A319/A320/A321
TECHNICAL TRAINING MANUAL

MECHANICS / ELECTRICS & AVIONICS COURSE

70 POWER PLANT (V2500-A5)

PART-

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70 POWER PLANT (V2500-A5)

■ UFD4200 TABLE OF CONTENTS Page

UFD4200

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70 - ENGINE - GENERAL

70-00-00 GENERAL

CONTENTS:

ENGINE - GENERAL

ENGINE CHARACTERISTICS

The Airbus A319/A320/A321 is powered by two IAE V2500-A5 turbofan engines.
These engines can produce a thrust ranging from 22000 LBS to 33000 LBS (9980 Kg to 14970 Kg) depending on the aircraft version set by the engine data programming plug.
IAE : International Aero Engines.

PYLON

The engines are attached to the lower surface of the wings by pylons.
The pylons provide an interface between the engine and the aircraft for electrics and fluids.

NACELLE

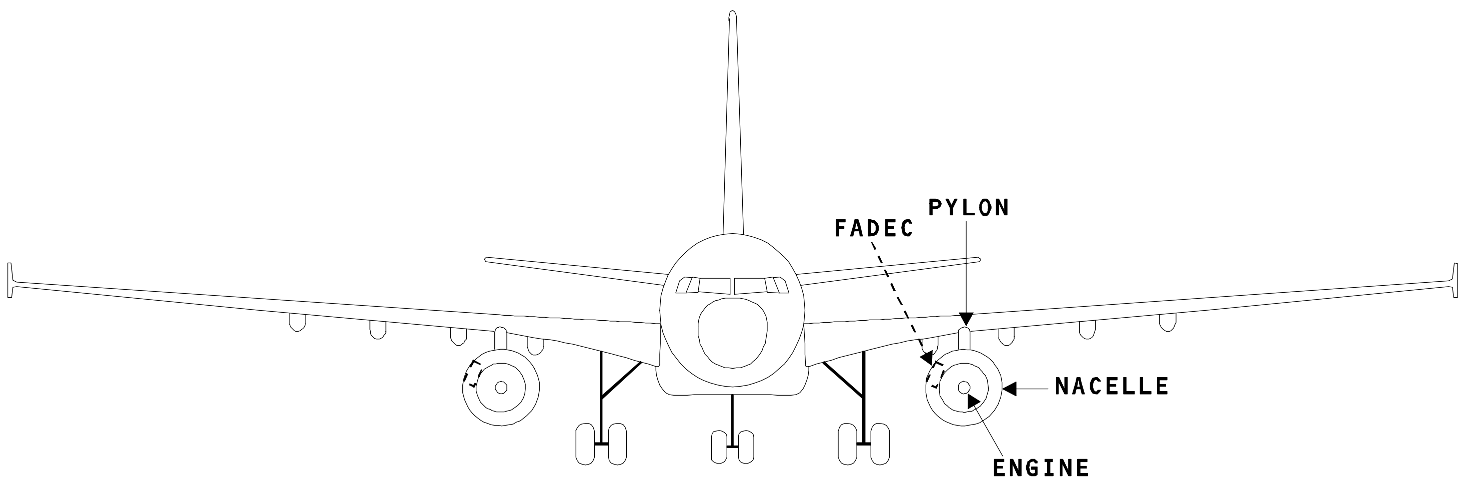
The engine is enclosed in a nacelle which provides aerodynamic airflow around the engine and ensures protection for the accessories.

ENGINE CONTROL

The engine includes a Full Authority Digital Engine Control (FADEC) which provides engine control, engine monitoring and help for maintenance and trouble shooting.

ENGINE DESIGNATION	THRUST RATING	AIRCRAFT TYPE
V2522-A5	22 000 LBS	A319-131
V2524-A5	23 500 LBS	A319-132
V2527-A5	26 500 LBS	A320-232
V2527E-A5	26 500 LBS	A320-233
V2527M-A5	26 500 LBS	A319-133
V2530-A5	30 000 LBS	A321-131
V2533-A5	33 000 LBS	A321-231

V2500-A5 ENGINE FAMILY FOR POWERING OF A319/A320/A321 FAMILY



GENERAL

UFD4200
TMU70IA02-P01 LEVEL 1

SELF EXAMINATION

How is the thrust rating defined on the V2500-A5 ?

A - By an engine data programming plug.
B - By a cockpit selection.
C - By FADEC control.

71 - POWER PLANT

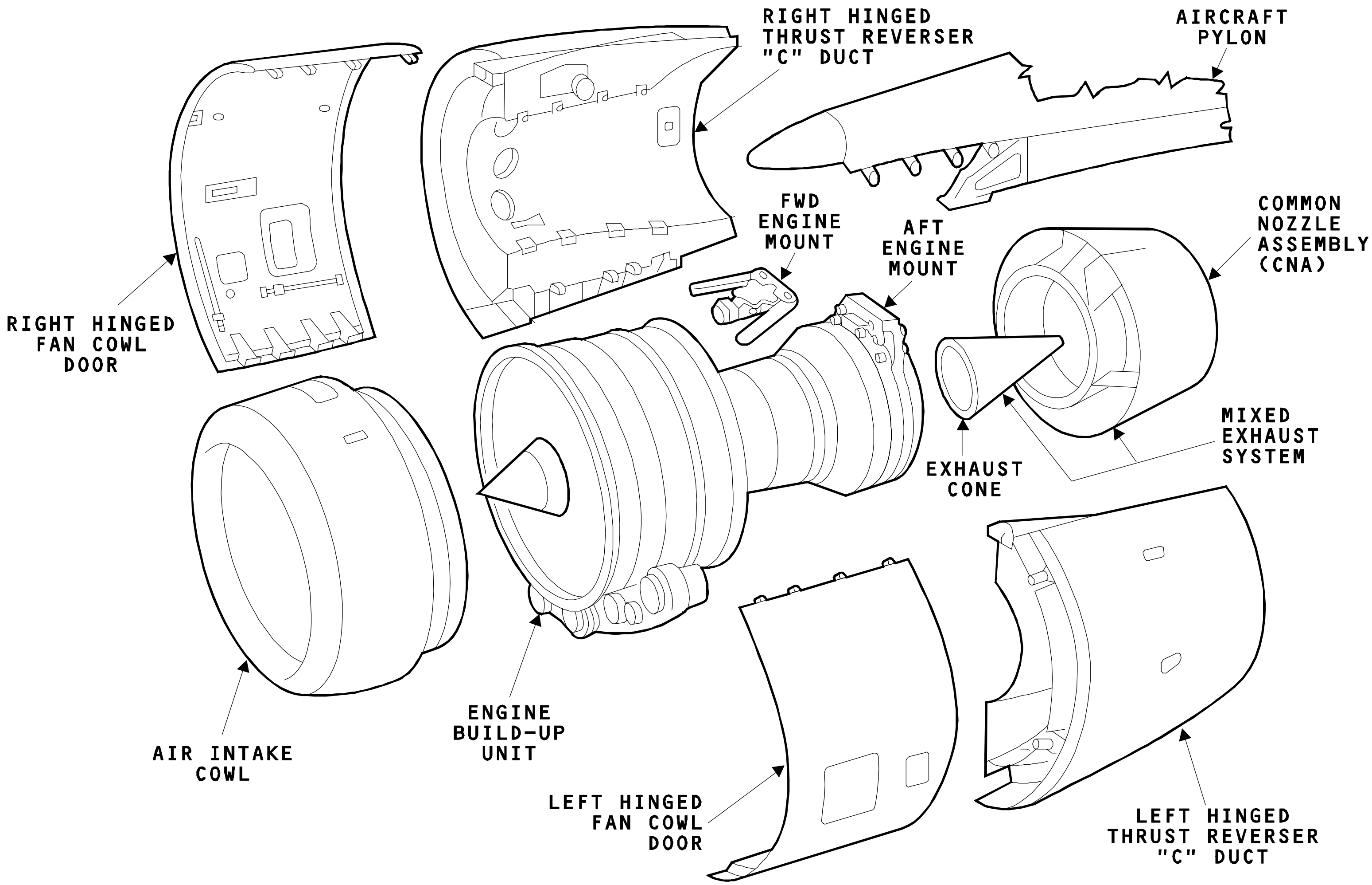
71-00-00 POWER PLANT INSTALLATION PRESENTATION

CONTENTS :

POWER PLANT INSTALLATION PRESENTATION

GENERAL

The mains items of the power plant installation are :
- Engine mounts,
- Engine build-up unit,
- Air intake cowl,
- Fan cowl doors,
- Thrust reverser "C" ducts,
- Exhaust.



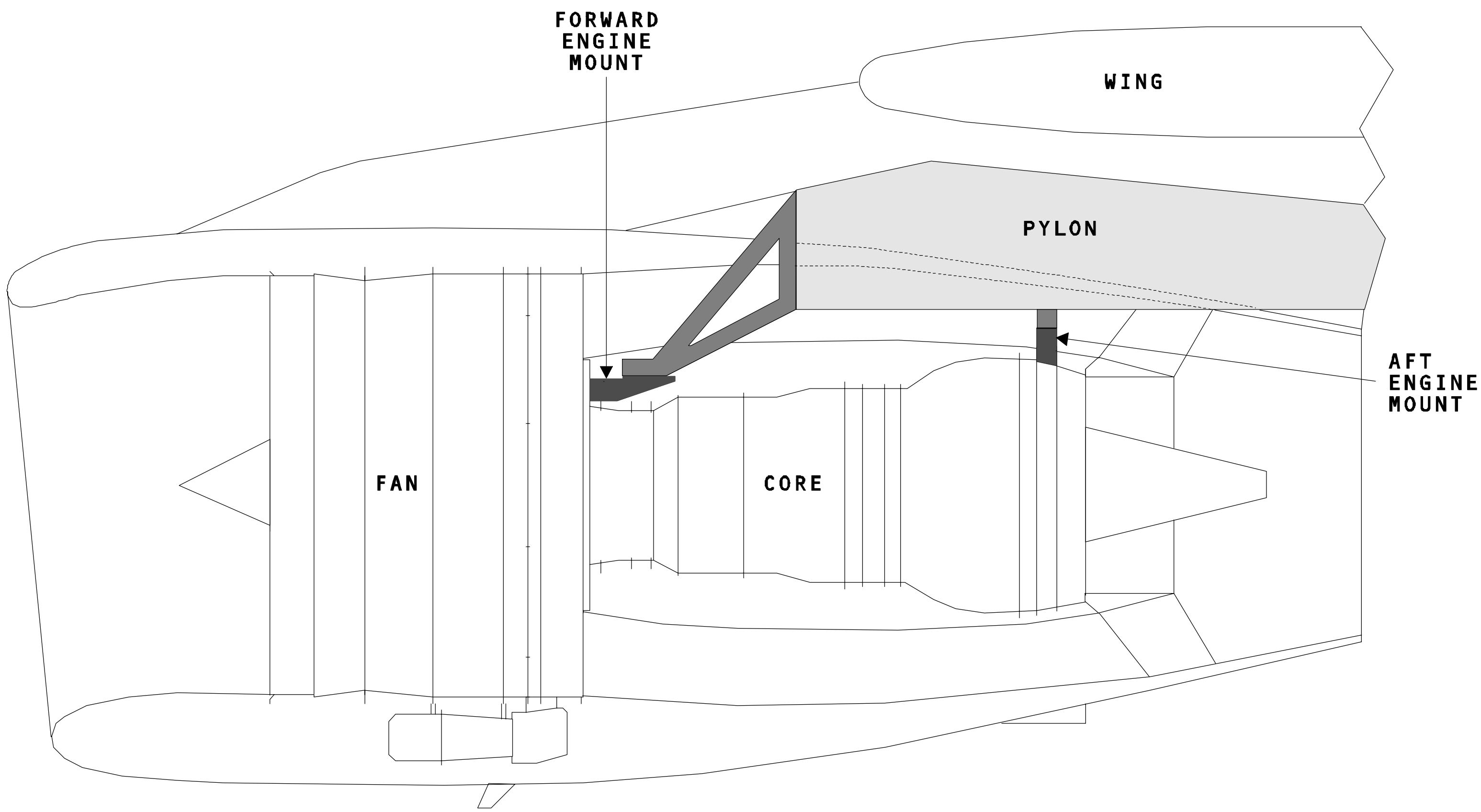
UFD4200
TMU71IA01-P01 LEVEL 1

POWER PLANT INSTALLATION PRESENTATION - GENERAL

POWER PLANT INSTALLATION PRESENTATION

ENGINE MOUNTS

The engine is attached to the pylon by two mounts.
The forward mount is the thrust mount.
The aft mount is the anti torque mount.
It allows engine thermal expansion.



UFD4200
TMU71IA01-P02 LEVEL 1

POWER PLANT INSTALLATION PRESENTATION - ENGINE MOUNTS

POWER PLANT INSTALLATION PRESENTATION

AIR INTAKE COWL

The air intake cowl is a fixed structure which ensures correct engine inlet airflow throughout the entire operating range.
The air inlet is anti-iced.

FAN COWL DOORS

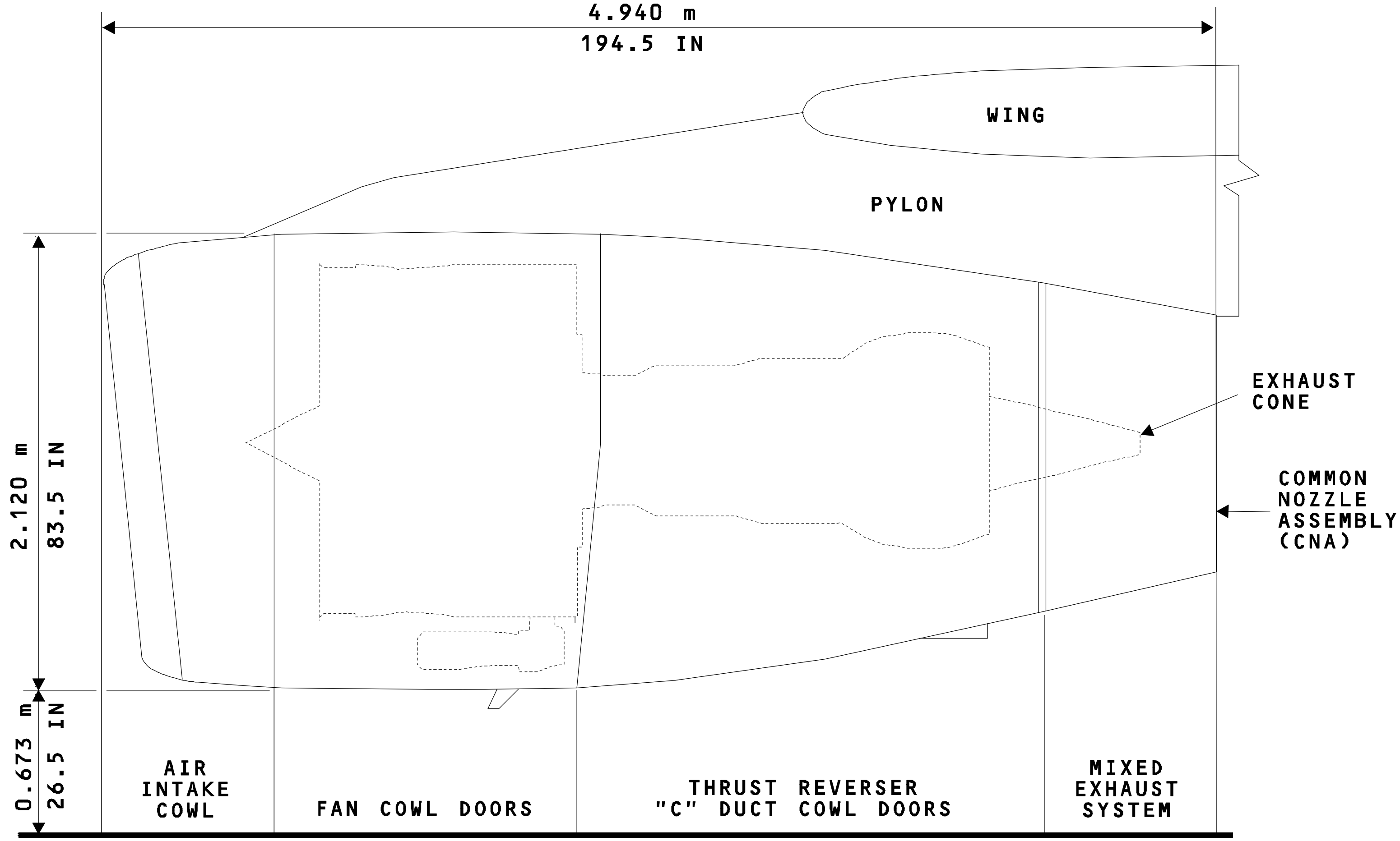
The fan cowl doors allow access to the fan case mounted accessories.
They are latched at their bottom center line and, when opened, they are held in position by two hold open rods.

THRUST REVERSER "C" DUCT COWL DOORS

The thrust reverser "C" ducts provide ducting for fan air exhaust.
The thrust reverser "C" ducts may be opened to get access to the core engine mounted accessories.
The thrust reverser "C" ducts are held open by hold open rods.
Due to their weight, the thrust reverser "C" ducts are opened by hydraulic actuators using a manual hand pump.

EXHAUST

The fixed mixed exhaust directs both the engine core exhaust and the fan air discharge rearward.
The mixed exhaust system composed of the common nozzle assembly and the exhaust cone.



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TMU71IA01-P03 LEVEL 1

POWER PLANT INSTALLATION PRESENTATION - COWLING

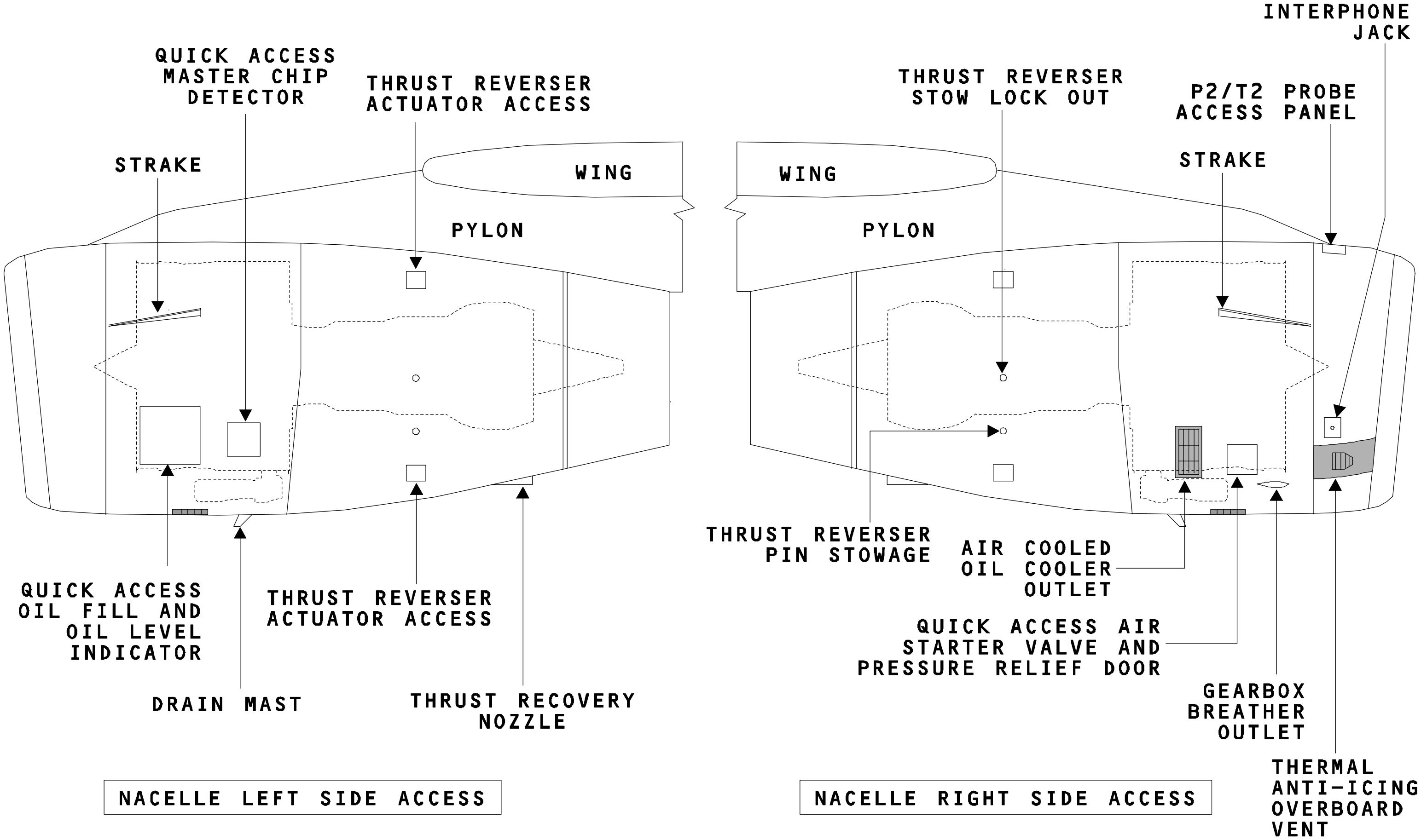
POWER PLANT INSTALLATION PRESENTATION

NACELLE LEFT SIDE ACCESS

For quick servicing, the nacelle is equipped with access panels and inspection doors.
On the fan cowl left side, an oil access door is provided for engine oil servicing and master chip detector inspection.

NACELLE RIGHT SIDE ACCESS

On the right side of the fan cowl, a starter valve access door is provided for manual override operation.
The air intake cowl right side is provided with an interphone jack.



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TMU71IA01-P04 LEVEL 1

POWER PLANT INSTALLATION PRESENTATION

SELF EXAMINATION

An oil access door is provided for servicing :

A - On the right side fan cowl door.
B - On the left side fan cowl door.
C - On the left side thrust reverser "C" duct door.

A starter valve access panel is provided for manual operation :

A - On the right side fan cowl door.
B - On the left side fan cowl door.
C - On the left side thrust reverser "C" duct door.

The exhaust directs rearward :

A - The fan air discharge.
B - The engine core exhaust.
C - Both the engine core exhaust and the fan air discharge.

71 - POWER PLANT

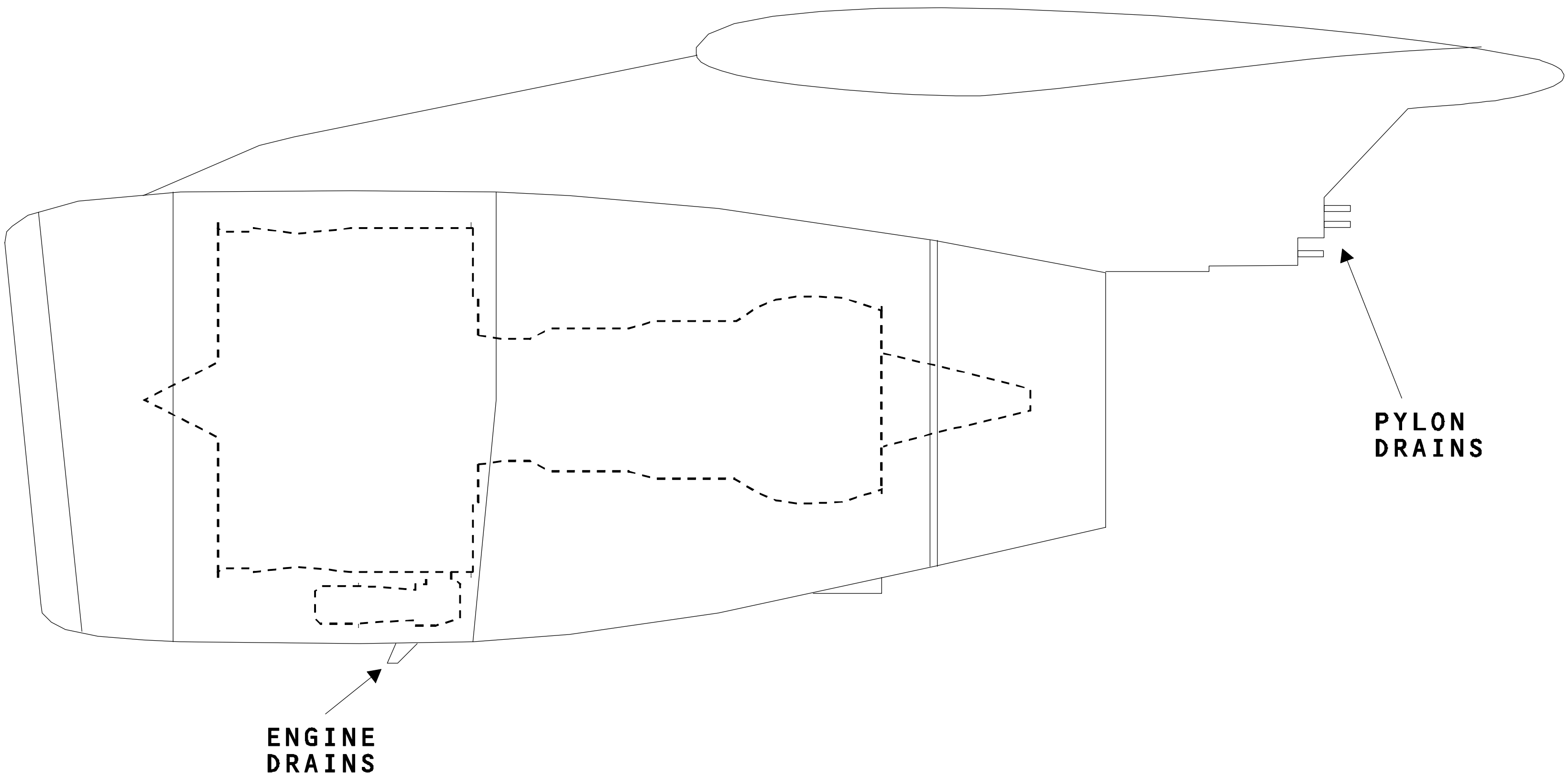
71-70-00 POWER PLANT DRAIN PRESENTATION

CONTENTS:

POWER PLANT DRAIN PRESENTATION

GENERAL

The power plant drain system collects fluids which can leak from the pylon, the engine accessories and drives.
The fluids collected from the power plant can be fuel, oil, hydraulic or water.
They are discharged overboard through the pylon drains and the engine drains.



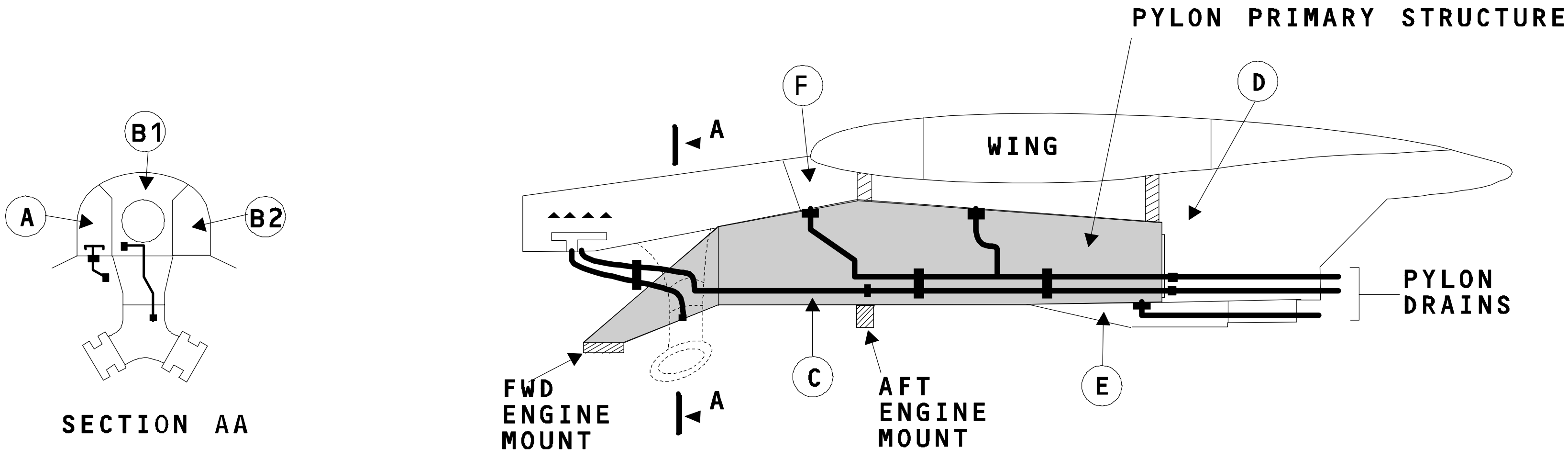
UFD4200
TMU71IB01-P01 LEVEL 1

POWER PLANT DRAIN PRESENTATION - GENERAL

POWER PLANT DRAIN PRESENTATION

PYLON DRAINS

The engine pylon is divided into 7 compartments; various systems are routed through these aeras.
Any leakage from fluid lines is drained overboard through separate lines in the rear of the pylon.



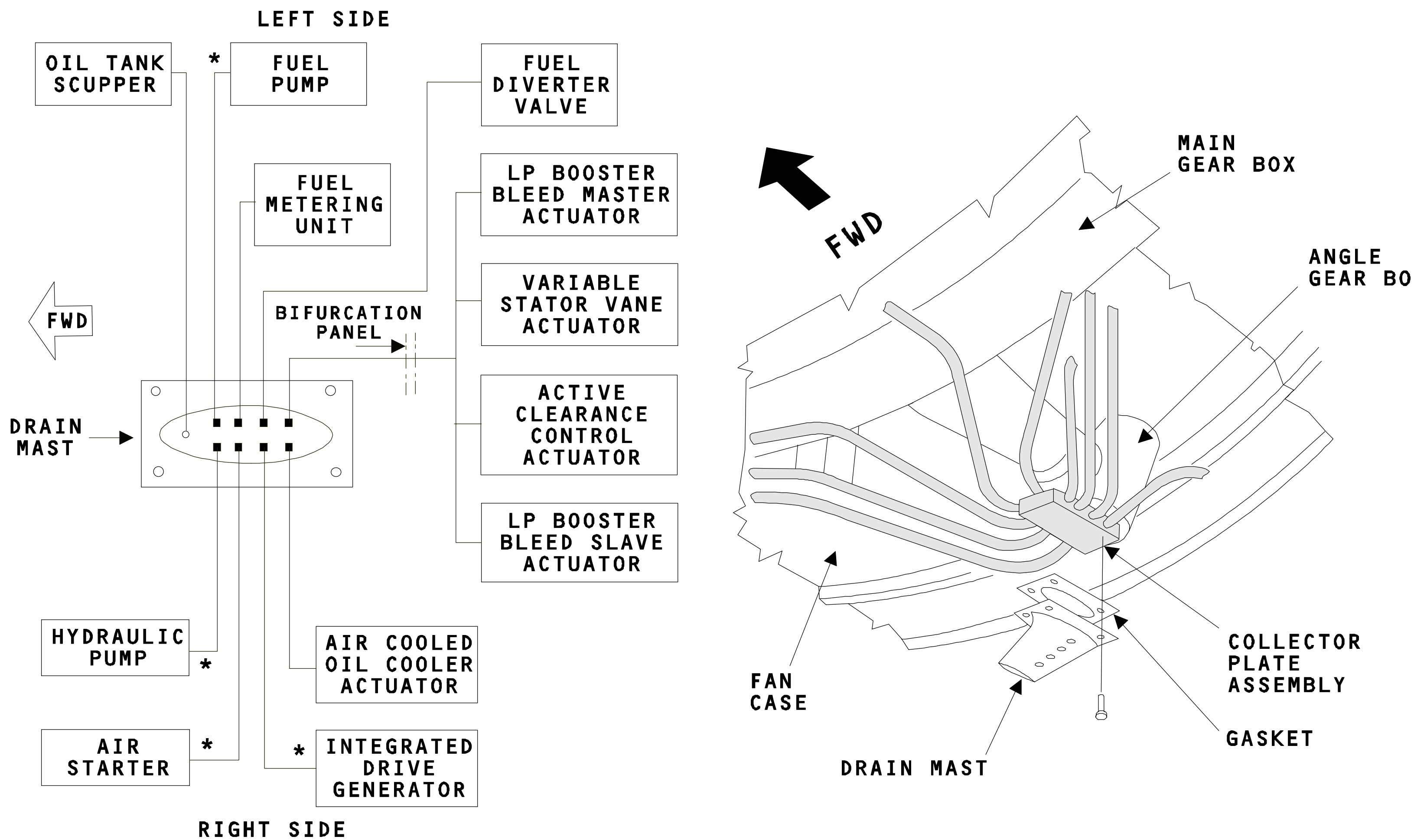
DESIGNATION	ZONE	SYSTEMS
Forward fairing	A B1 B2	Flammable fluids (Fuel,hydraulics) Bleed Air (Hi and Lo temperatures) Electrics
Pylon Box	C	Hydraulics without couplings Fire extenguisher bottles.
Rearward secondary structure	D	Hydraulics Limited electrics
Lower Fairing	E	None
Pylon to wing center fillets	F	Fuel (Zero-leakage couplings) Electrics Bleed Air (Low temperature)

POWER PLANT DRAIN PRESENTATION - PYLON DRAINS

POWER PLANT DRAIN PRESENTATION

ENGINE DRAINS

Fluid drained from the oil tank scupper, fuel diverter valve and gear box mounted accessories, is independently routed to the drain mast
The fuel drains from the core engine accessories, are routed through a separate drain line which passes through the bifurcation panel.



NOTE: CONNECTION * IS AT THE ACCESSORY MOUNTING PAD ONLY.

UFD4200

TMU71IB01-P03 LEVEL 1

POWER PLANT DRAIN PRESENTATION - ENGINE DRAINS

POWER PLANT DRAIN PRESENTATION

SELF EXAMINATION

Where are the drains located ?

A - At the rear part of the pylon.
B - At the bottom of the engine.
c - Both at the rear part of the pylon and at the bottom of the engine.

Which fluids can be discharged through the drain ?

A - Water, hydraulic and fuel.
B - Water and fuel.
C - Hydraulic and fuel.

71 - POWER PLANT

71-00-00 NACELLE D/O

CONTENTS :

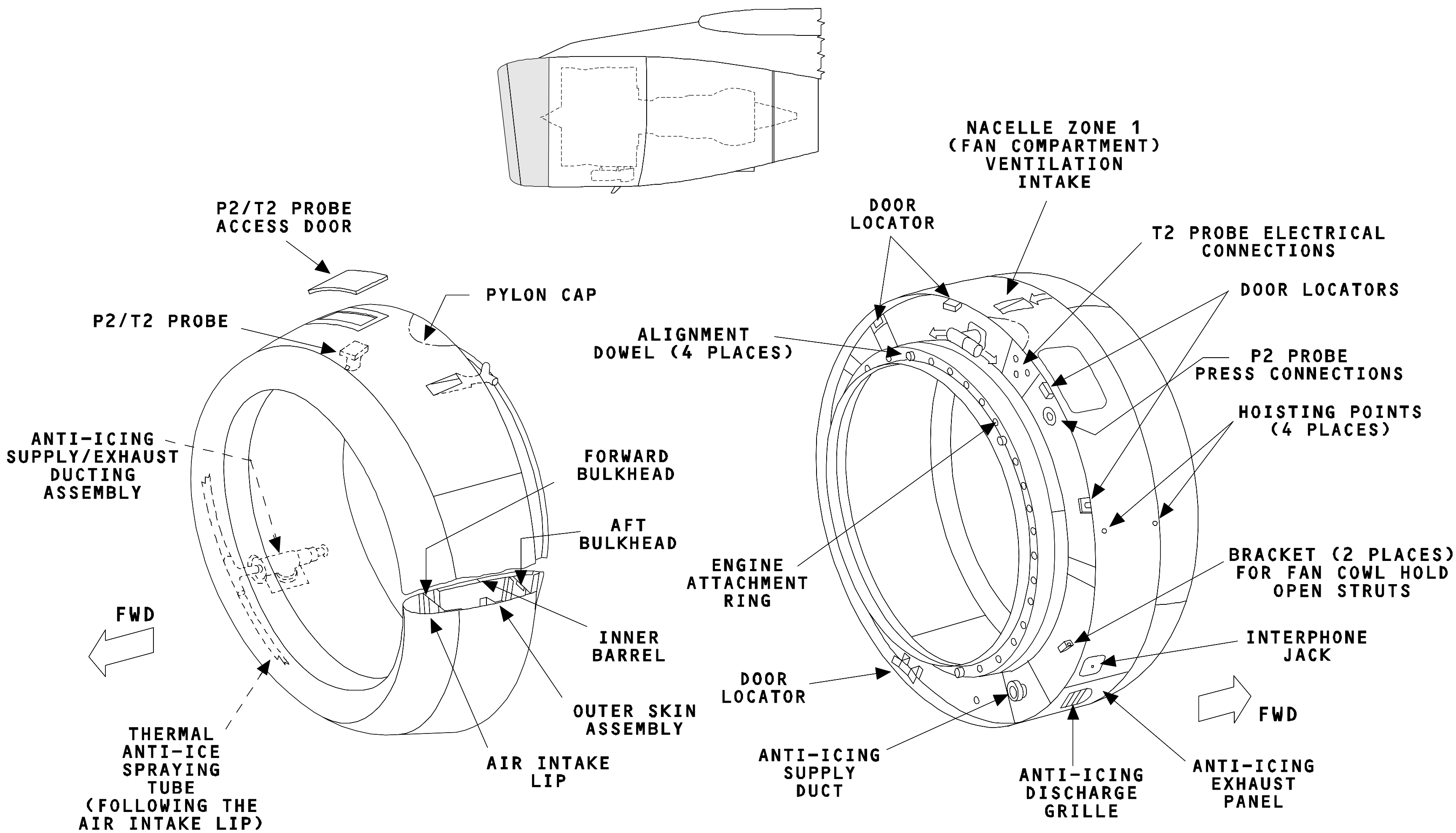
NACELLE D/O

AIR INTAKE COWL

The air intake cowl is bolted to the front of the fan case flange. It includes an anti-ice system, an interphone jack and a P2/T2 probe.
For removal and installation, the inlet cowl is provided with :

- 4 hoisting points,
- 36 identical attach fittings,
- 4 alignment dowels.

Weight : 238 lbs (108 kg).



UFD4200 TMU71IC01-P01 LEVEL 3

NACELLE D/O - AIR INTAKE COWL

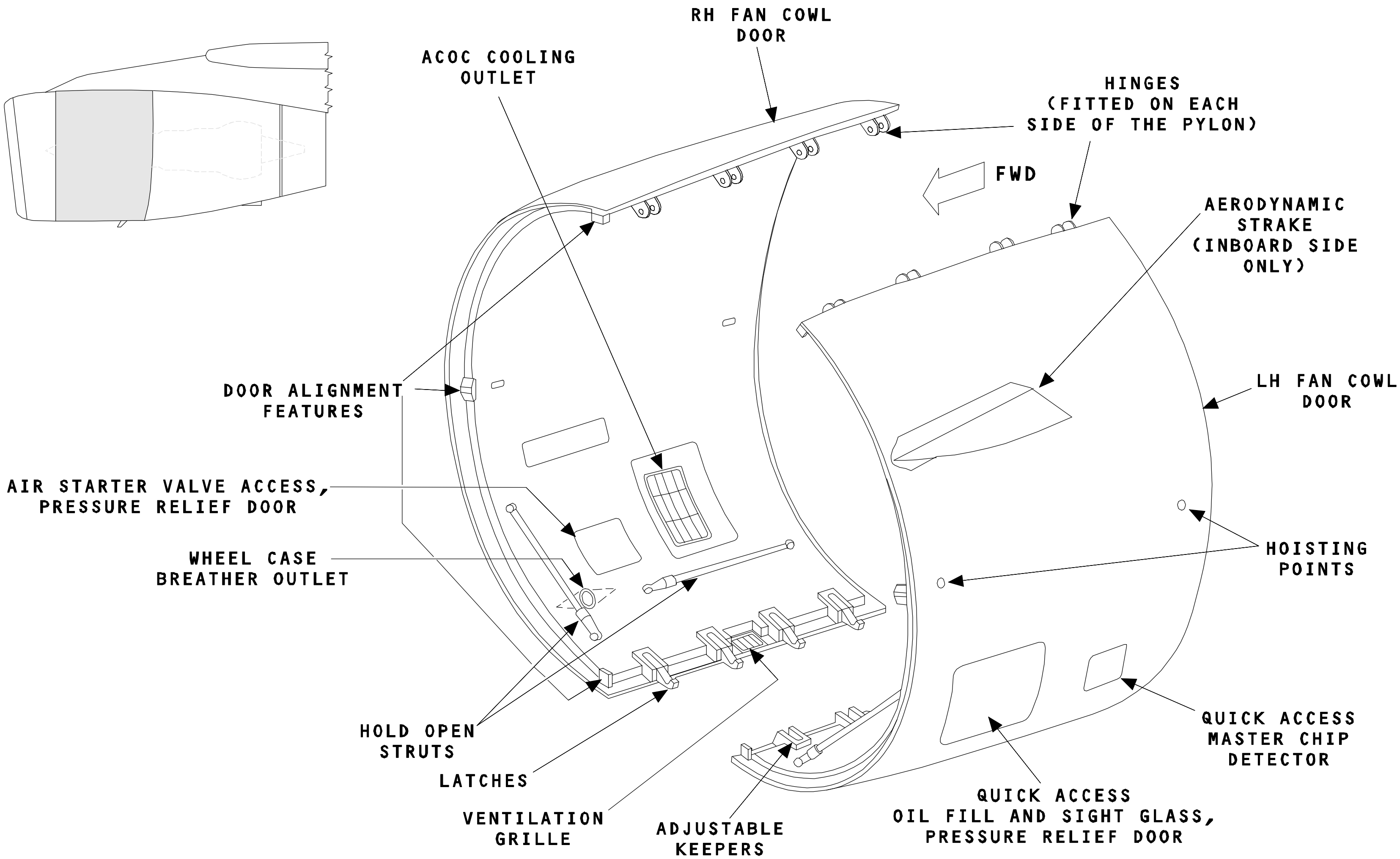
NACELLE D/O

FAN COWL DOORS (LH & RH)

There are two fan cowl doors to provide access to the fan case and gearbox mounted accessories.
Each door is supported by four hinges at the pylon.
The door assembly is latched along the bottom centerline with four latches.
Each door is provided with :

- 2 hoisting points, for removal and installation,
- 2 hold open struts, for opening.

Access doors are also provided for the start valve and the oil tank servicing.
Note that aerodynamic strakes are fitted on the inboard nacelle side.
LH door weight : 79 lbs (36kg)
RH door weight : 86 lbs (39kg).



NACELLE D/O - FAN COWL DOORS (LH & RH)

UFD4200
TMU71IC01-P02 LEVEL 3

NACELLE D/O

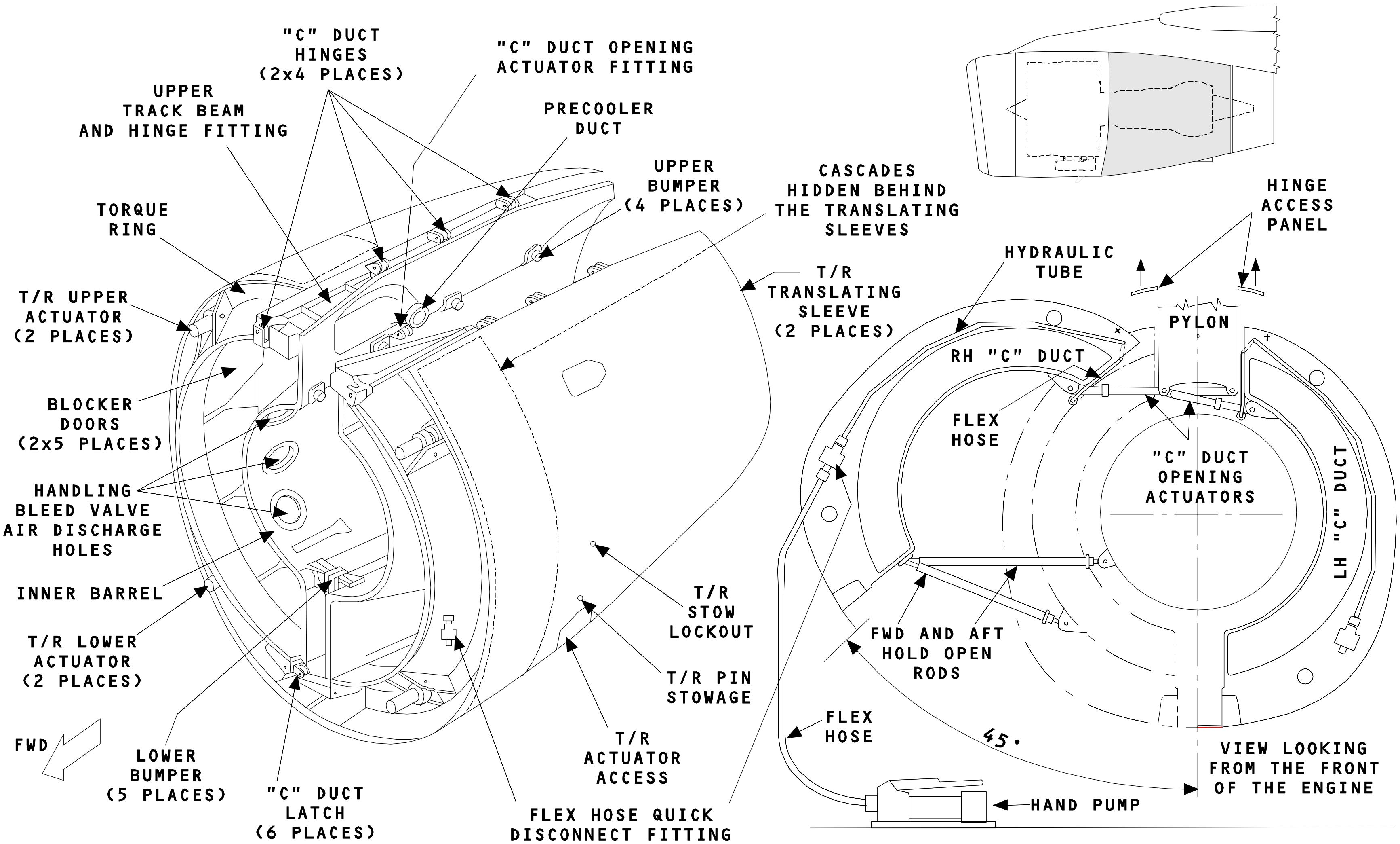
THRUST REVERSER "C" DUCTS

The thrust reverser "C" ducts are in two halves fitted with cascades, blocker doors and translating sleeves.
Each half is supported by four hinges at the pylon.
The halves assembly is latched along the bottom centerline with six latches.
LH door weight : 580 lbs (263 kg).
RH door weight : 574 lbs (260 kg).
Each half is provided with :

- 3 attachment points for handling,
- 1 opening actuator operated with a hand pump,
- 2 hold open rods for opening.

The latch assembly consists of :

- 1 forward bumper latch,
- 3 center latches, accessible through a hinged access panel,
- 1 aft twin latch.



NACELLE D/O - THRUST REVERSER "C" DUCTS

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TMU71IC01-P03 LEVEL 3

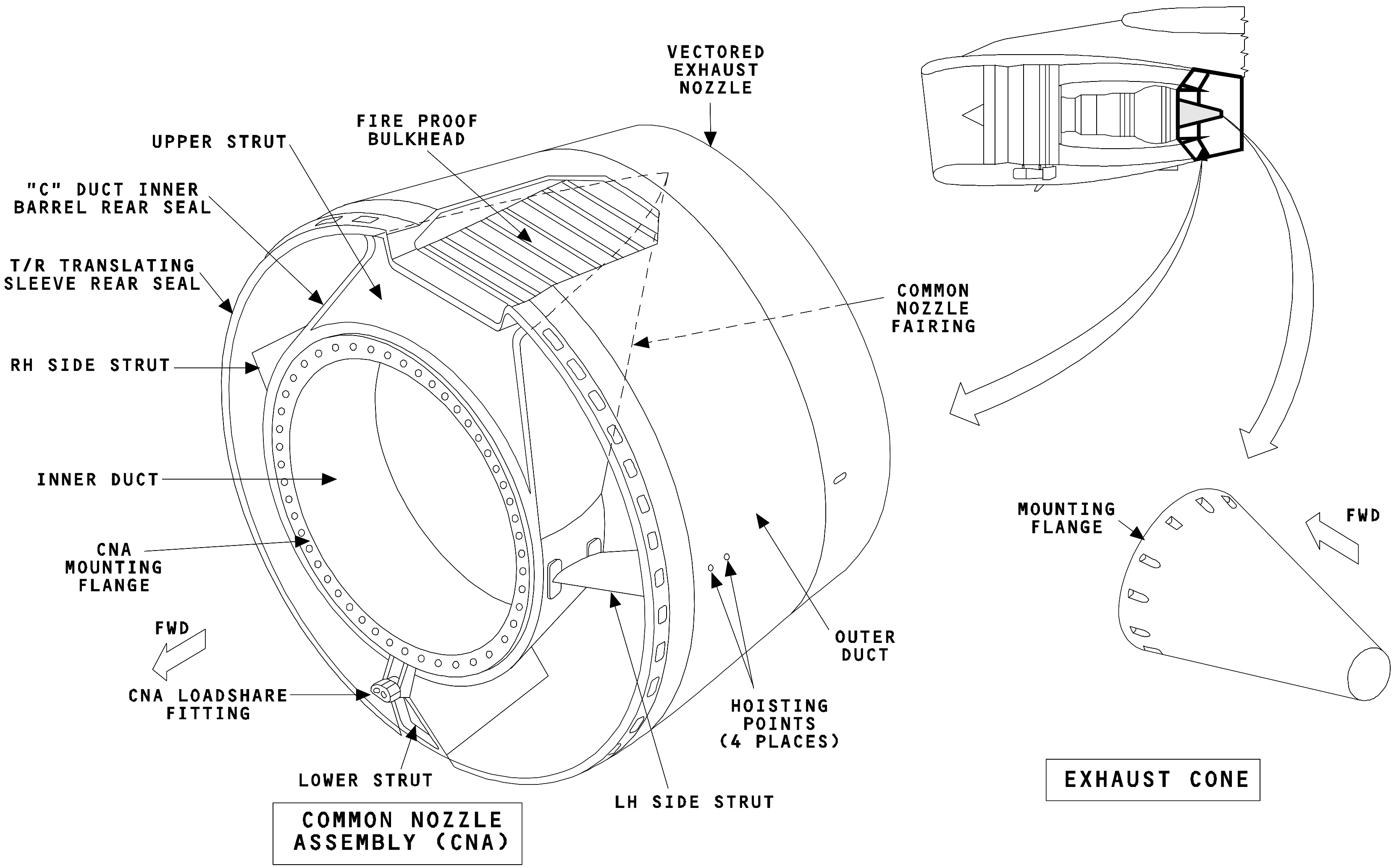
NACELLE D/O

COMMON NOZZLE ASSEMBLY

The Common Nozzle Assembly (CNA) mixes the exhaust gases from the secondary and primary airflows.
It is bolted to the rear flange of the turbine exhaust case.
The Common Nozzle Assembly is attached to the LP turbine frame by means of 56 bolts.
Weight : 181 lbs (82 kg).

EXHAUST CONE

The exhaust cone provides the inner contour of the common exhaust stream flow. It is attached to the inner flange of the turbine exhaust case.
The exhaust cone is bolted to the inner LP turbine frame by means of 13 bolts.
Weight : 10 lbs (4.5 kg).



NACELLE D/O - MIXED EXHAUST SYSTEM

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TMU71IC01-P04 LEVEL 3

NACELLE D/O

FORWARD MOUNT

The forward mount carries the engine thrust, vertical and side loads.
It is installed on the intermediate case, at the top center of the low pressure compressor, by means of the engine forward support shaft.
The forward mount is composed of 4 main parts :

- two thrust link assemblies,
- a beam assembly,
- a cross beam assembly,
- a support bearing assembly.

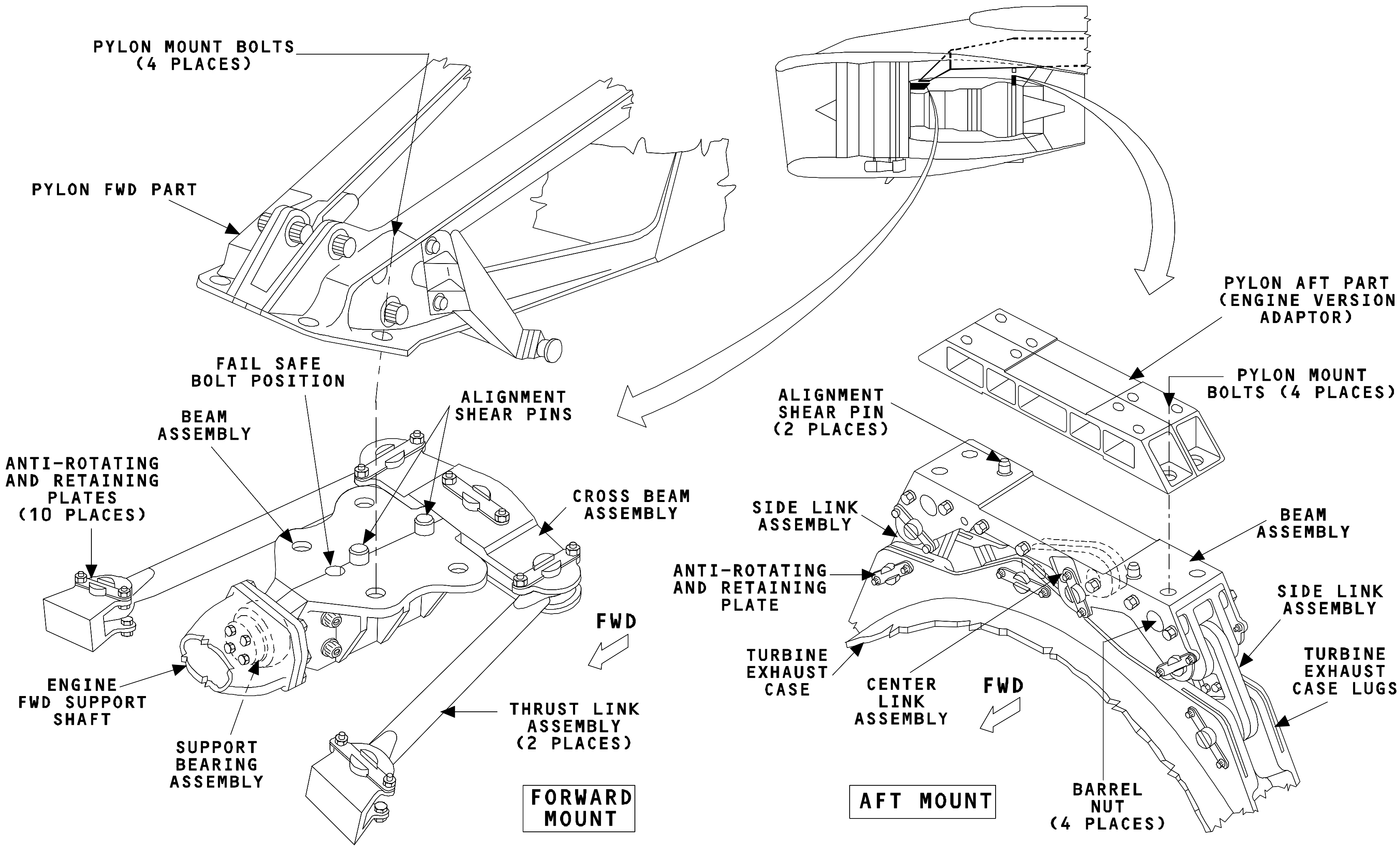
The Forward mount is made to be fail-safe.
It is linked to the pylon forward part with 4 bolts and self locking nuts.

AFT MOUNT

The aft mount carries the engine torque, vertical and side loads.
It is free in forward and aft directions to allow for engine thermal expansion.
It is installed on the turbine exhaust case lugs.
The aft mount is composed of 3 main parts :

- a beam assembly,
- two side link assemblies,
- a center link assembly.

The aft mount is made to be fail-safe.
It is linked to the pylon aft part with 4 bolts.



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TMU71IC01-P05 LEVEL 3

NACELLE D/O - ENGINE MOUNTS

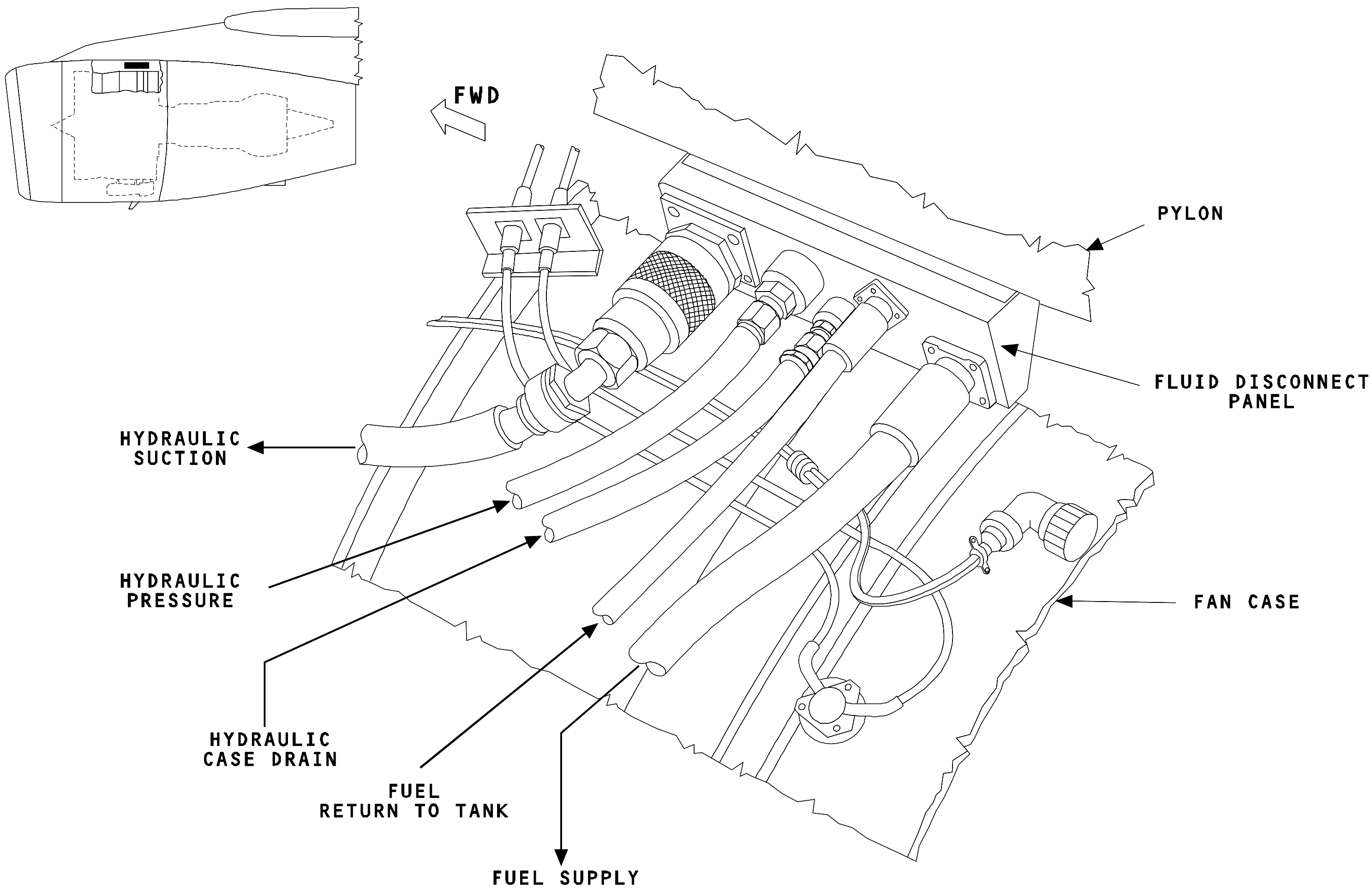
NACELLE D/O

FLUID DISCONNECT PANEL

The fluid disconnect panel provides the fluid connection between engine and pylon. It is located on the left hand side of the fan case upper part.
Fluid connection lines :

FUEL SYSTEM
- fuel supply,
- fuel return to tank,

HYDRAULIC SYSTEM
- hydraulic pump suction,
- hydraulic pump pressure delivery,
- hydraulic pump case drain.

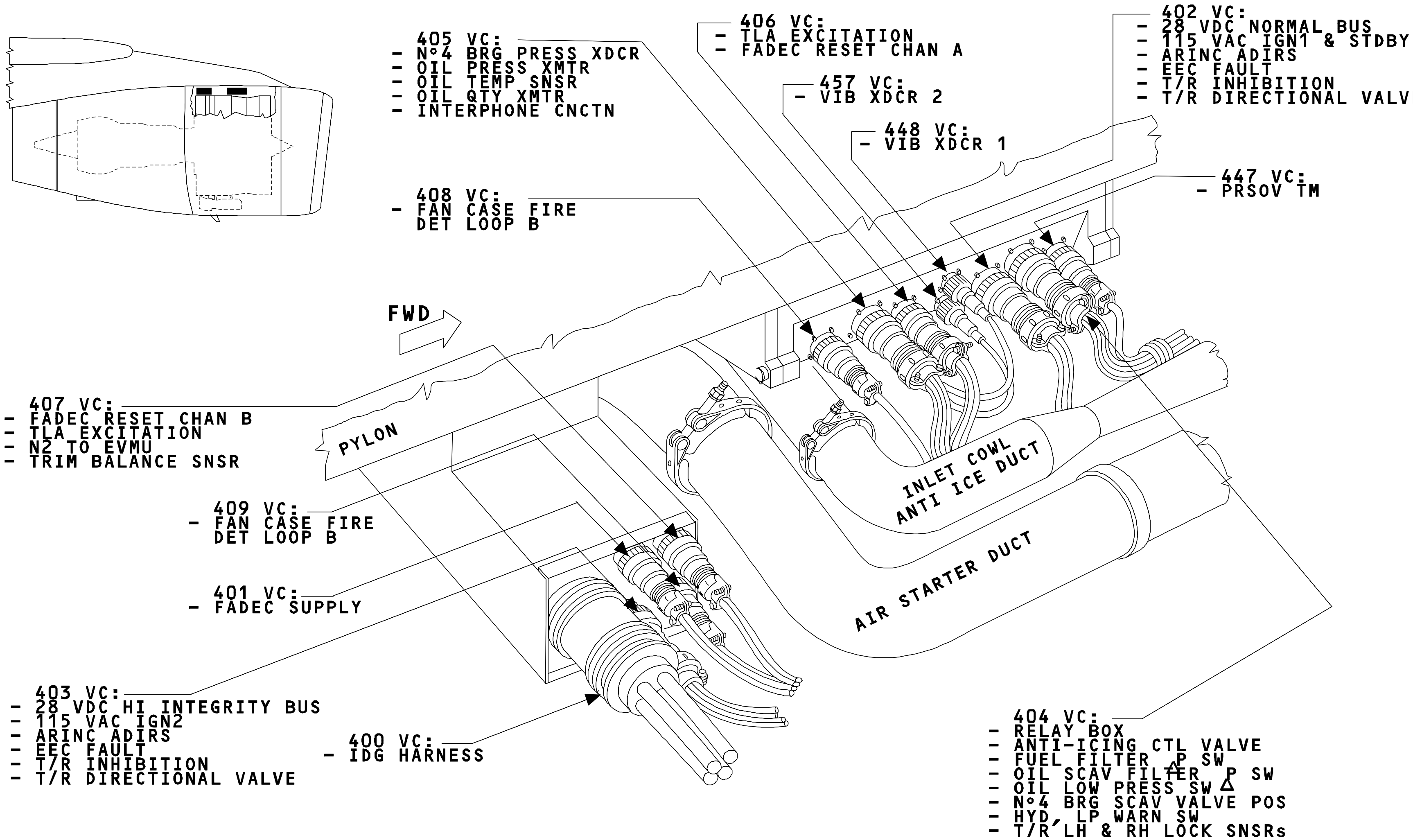


NACELLE D/O - FLUID DISCONNECT PANEL

NACELLE D/O

FAN ELECTRICAL CONNECTOR PANEL

The fan electrical connector panel provides the interface between the fan electrical harnesses and the pylon.
It is located on the right hand side of the fan case upper part.



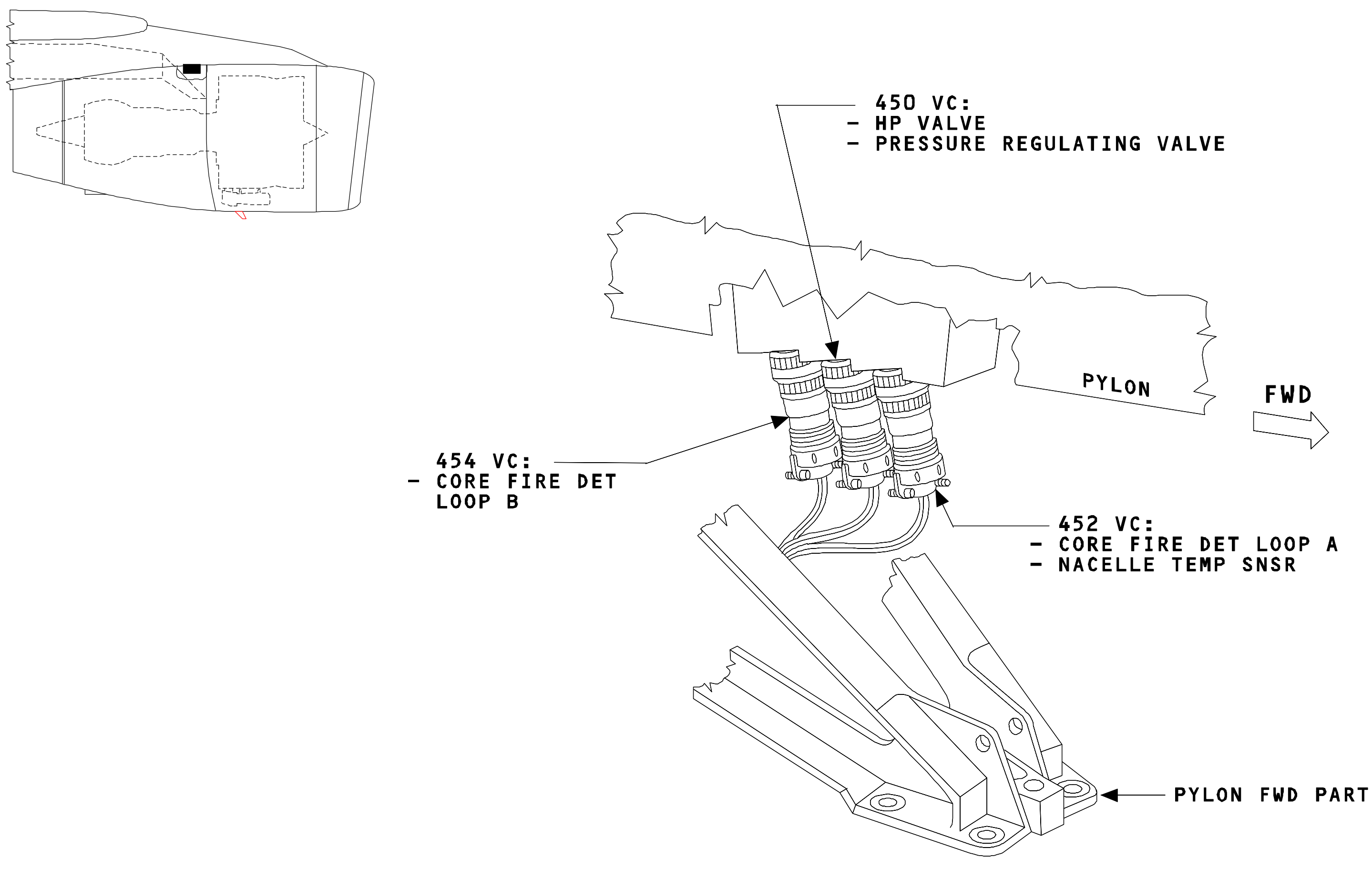
NACELLE D/O - FAN ELECTRICAL CONNECTOR PANEL

UFD4200
TMU71IC01-T07 LEVEL 3

NACELLE D/O

CORE ELECTRICAL JUNCTION BOX

The core electrical junction box provides the interface between the core electrical harnesses and the pylon.
It is located in the forward mount zone.



NACELLE D/O - CORE ELECTRICAL JUNCTION BOX

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71 - POWER PLANT

71-70-00 DRAIN COMPONENTS

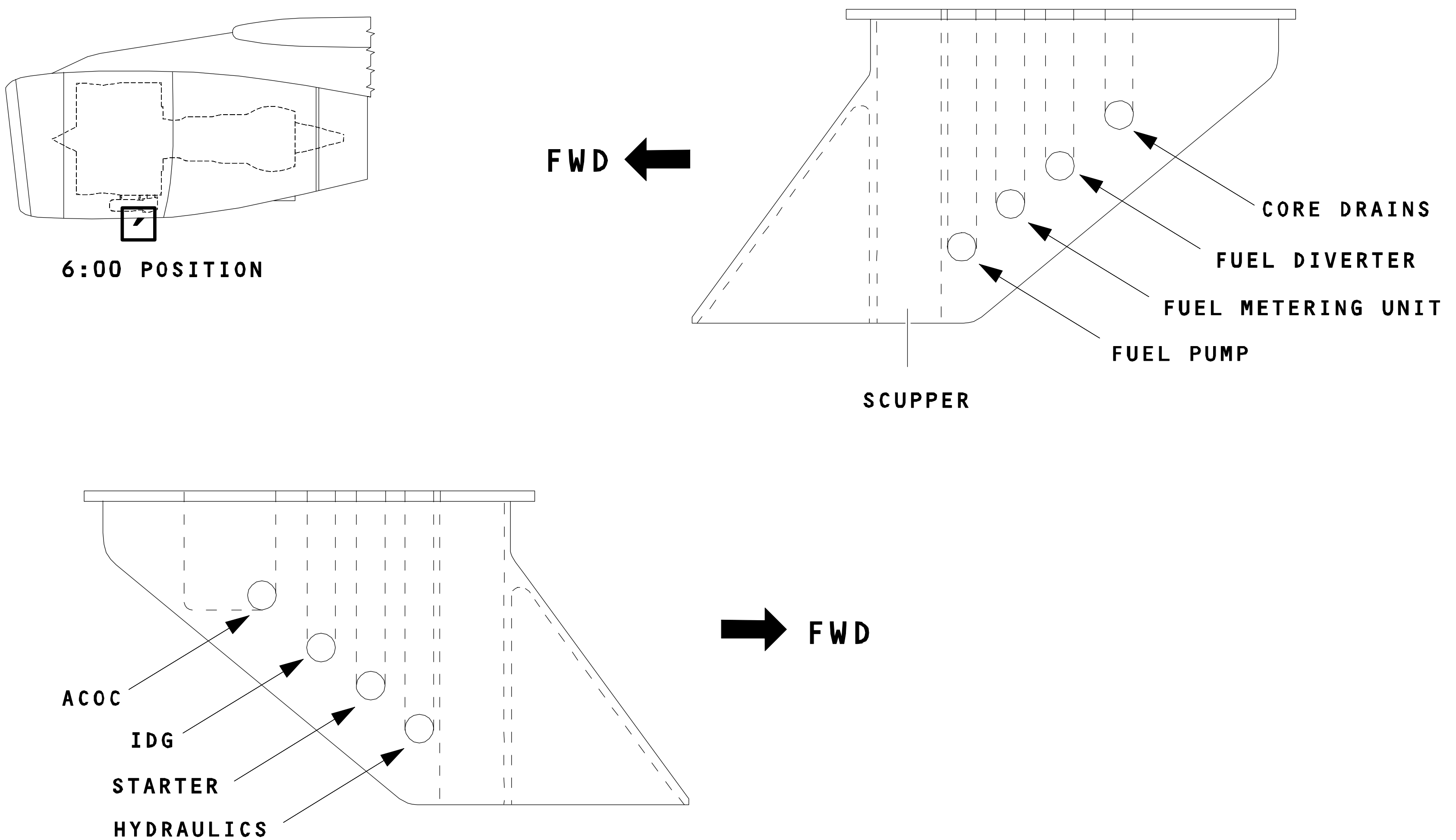
CONTENTS:

DRAIN COMPONENTS

DRAIN MAST

IDENTIFICATION
FIN:

LOCATION
ZONE: 437, 447



DRAIN COMPONENTS - DRAIN MAST

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72 - ENGINE

72-00-00 ENGINE PRESENTATION

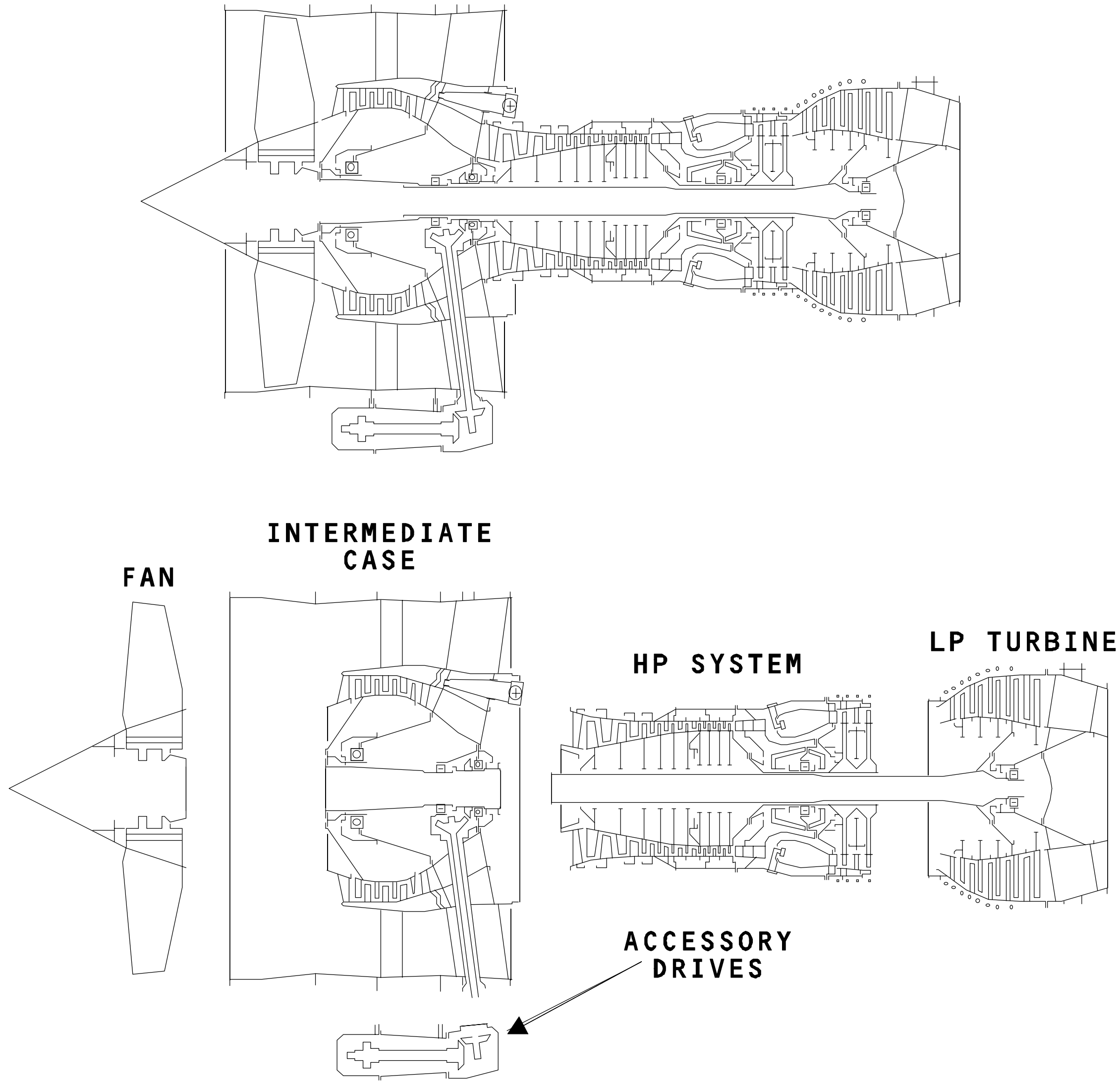
CONTENTS:

ENGINE PRESENTATION

MODULAR DESIGN

The IAE V2500-A5 comprises five primary modules which permit easy replacement at modular maintenance level.

Five primary modules :
- Fan,
- Intermediate case,
- HP system (including HP compressor, combustion chamber and HP turbine),
- LP turbine,
- Accessory Drives.



ENGINE PRESENTATION - MODULAR CONCEPTION

TMU72IA02-P01 LEVEL 1

UFD4200

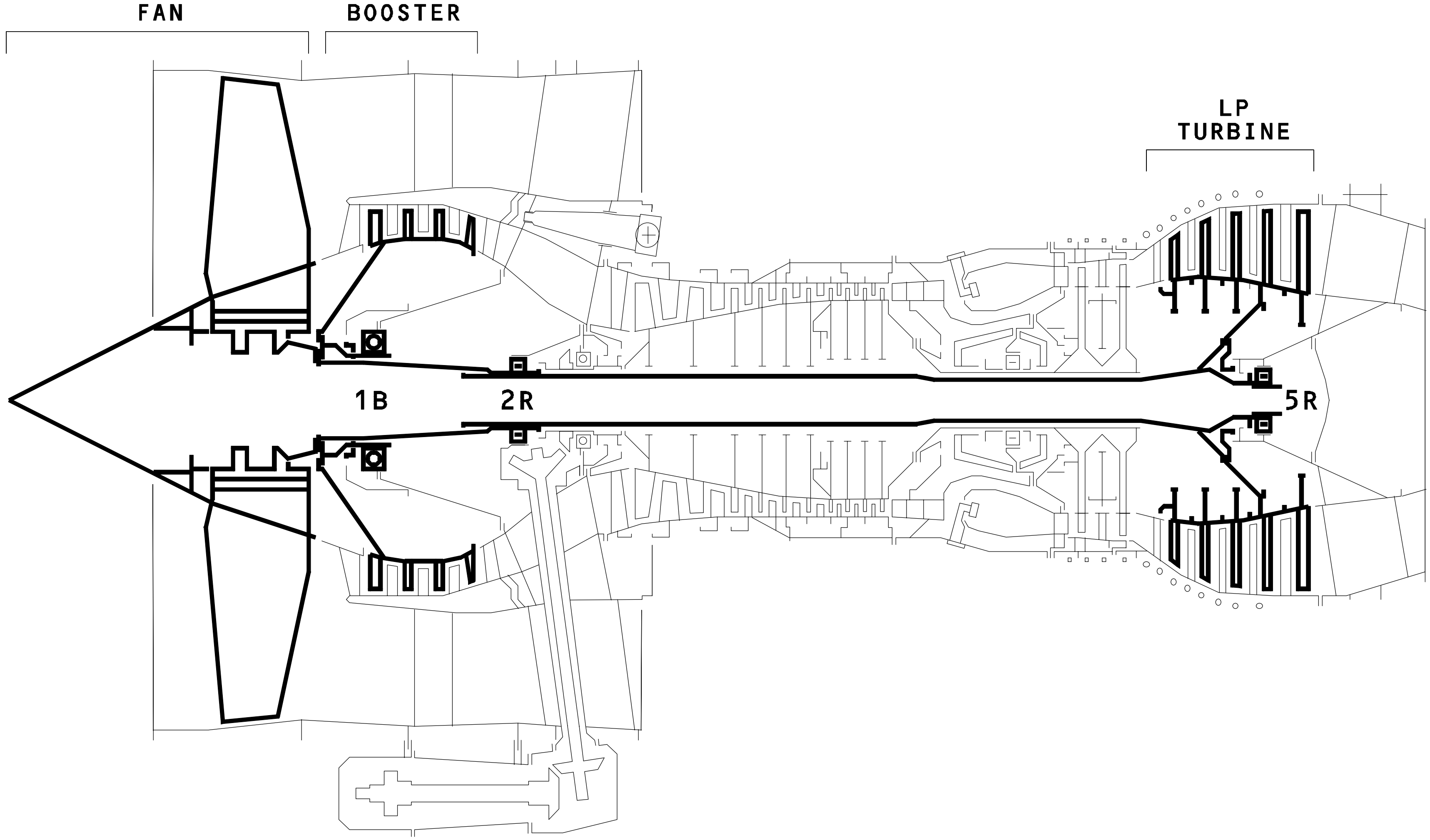
ENGINE PRESENTATION

LOW PRESSURE (LP) ROTOR

The Low Pressure or N1 rotor, supported by three bearings, consists of a fan and a four-stage compressor driven by a five stage turbine.

- Bearing 1B : thrust ball bearing,
- Bearing 2R : roller bearing,
- Bearing 5R : roller bearing.

LP ROTOR



ENGINE PRESENTATION - LP ROTOR

UFD4200
TMU72IA02-P02 LEVEL 1

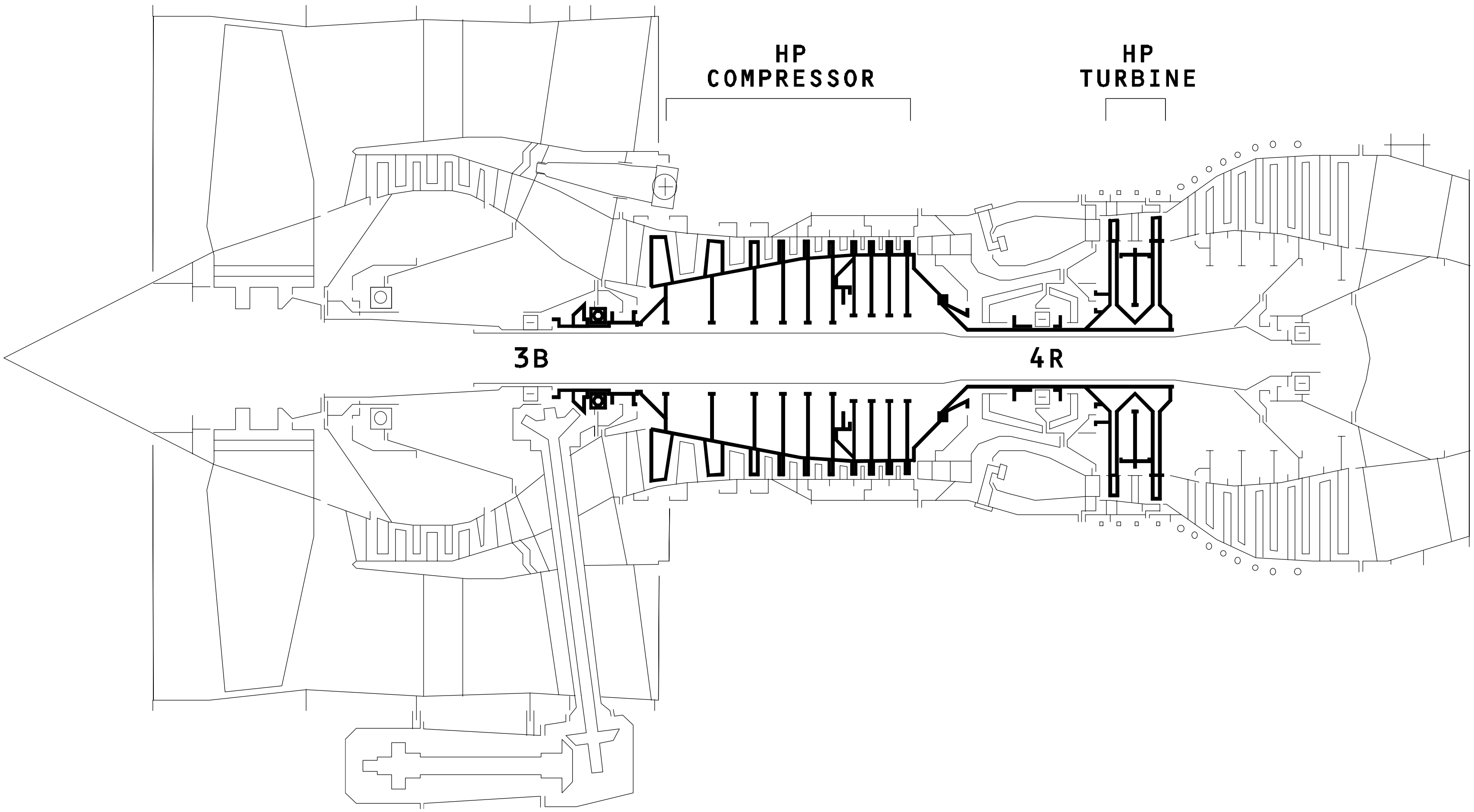
ENGINE PRESENTATION

HIGH PRESSURE (HP) ROTOR

The High Pressure or N2 rotor, supported by two bearings, consists of a ten-stage compressor driven by a two-stage turbine.

- Bearing 3B : thrust ball bearing,
- Bearing 4R : roller bearing.

HP ROTOR



ENGINE PRESENTATION - HP ROTOR

UFD4200
TMU72IA02-P03 LEVEL 1

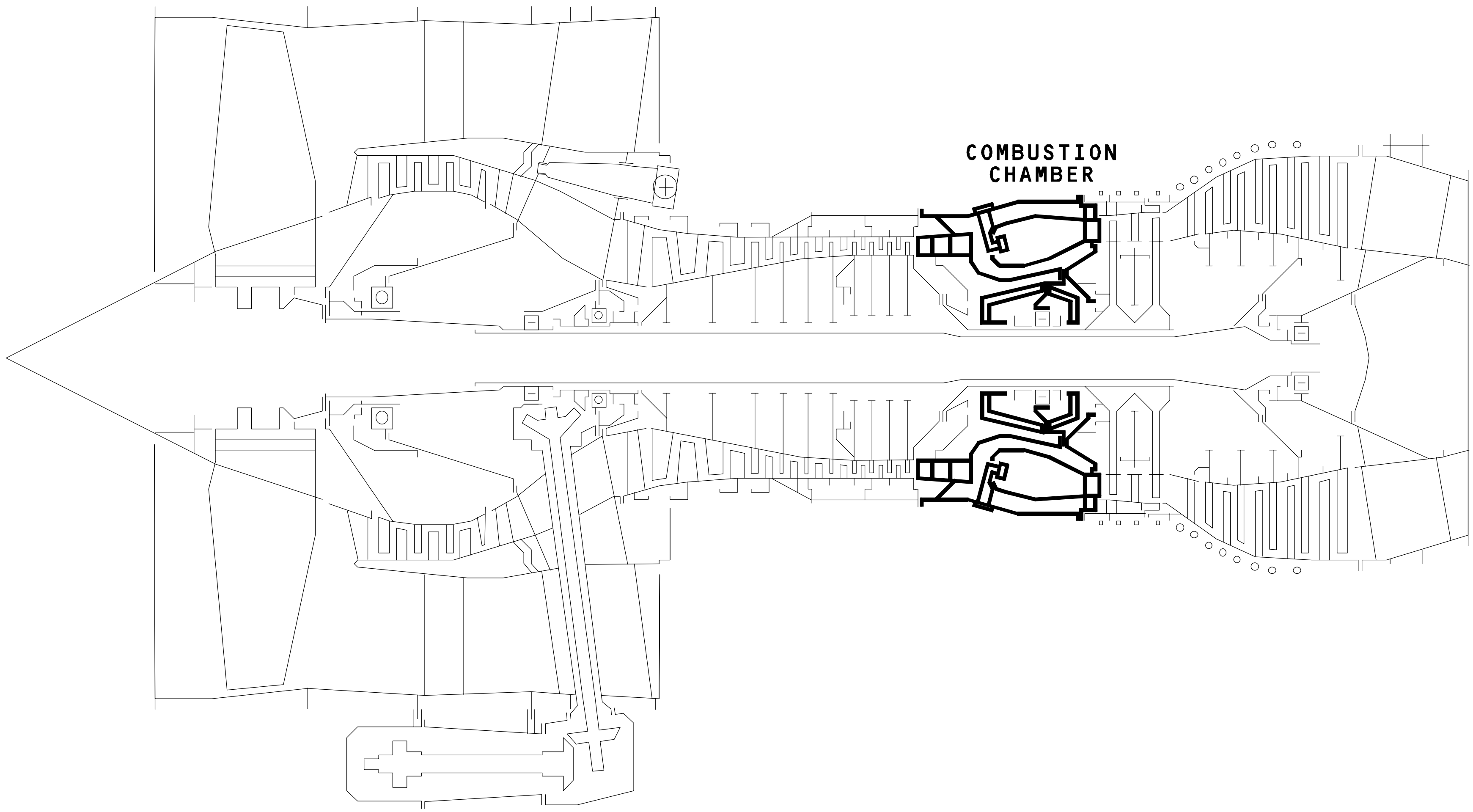
ENGINE PRESENTATION

COMBUSTION CHAMBER

The combustion chamber is located between the High Pressure compressor and the High Pressure turbine.

It is of the annular type and integrates the N°4 bearing support.

It has ports for twenty fuel nozzles and two igniter plugs.



ENGINE PRESENTATION - COMBUSTION CHAMBER

UFD4200
TMU72IA02-P04 LEVEL 1

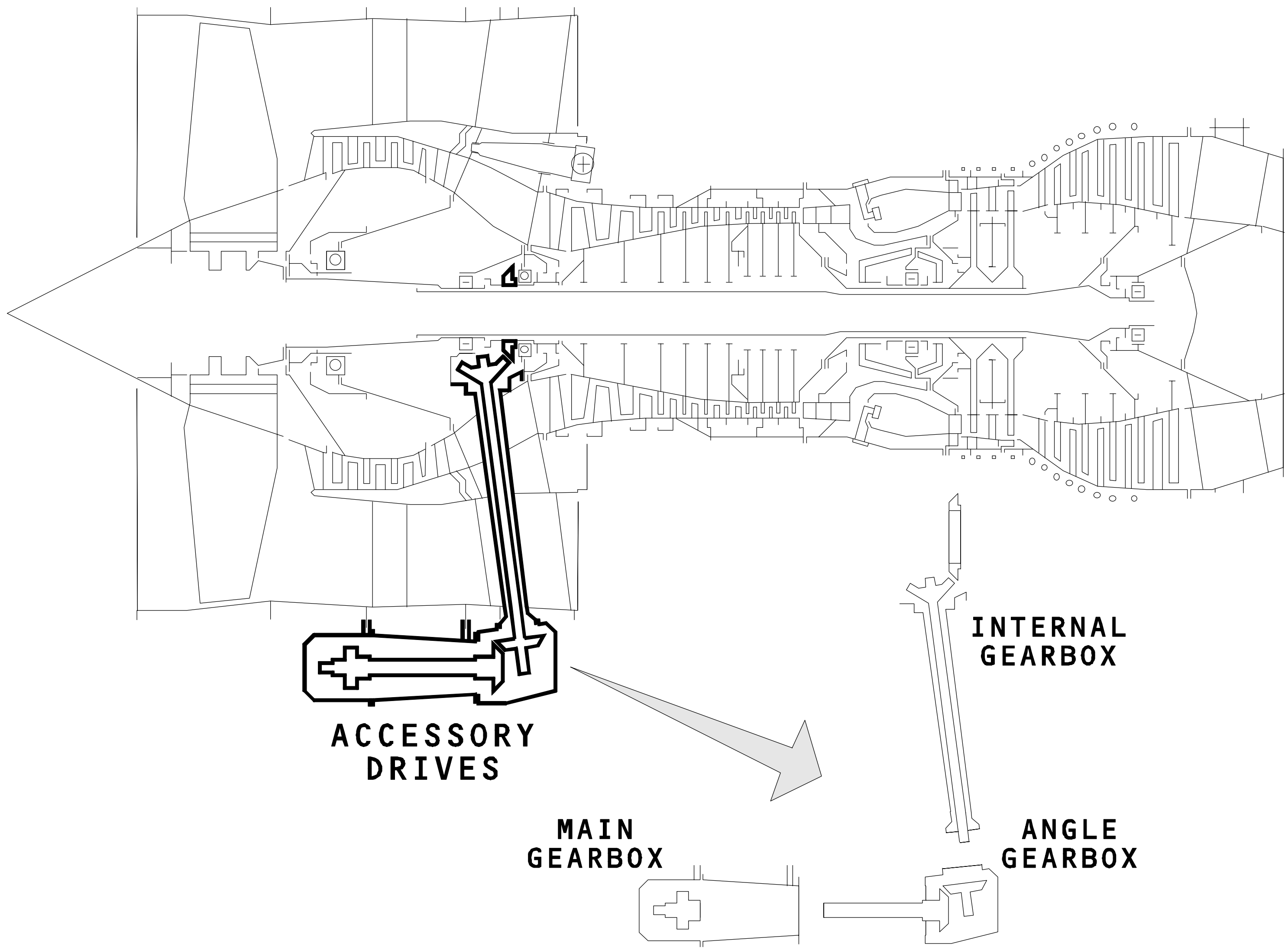
ENGINE PRESENTATION

ACCESSORY DRIVES (EXTERNAL GEARBOX)

The accessory drive or external gearbox is mounted on the fan casing lower part and supplies mechanical power to accessories.

It is composed of the angle gearbox and the main gearbox.

The main gearbox is driven by the HP or N2 rotor via the angle gearbox.



ENGINE PRESENTATION - ACCESSORY DRIVES

UFD4200

TMU72IA02-P05 LEVEL 1

ENGINE PRESENTATION

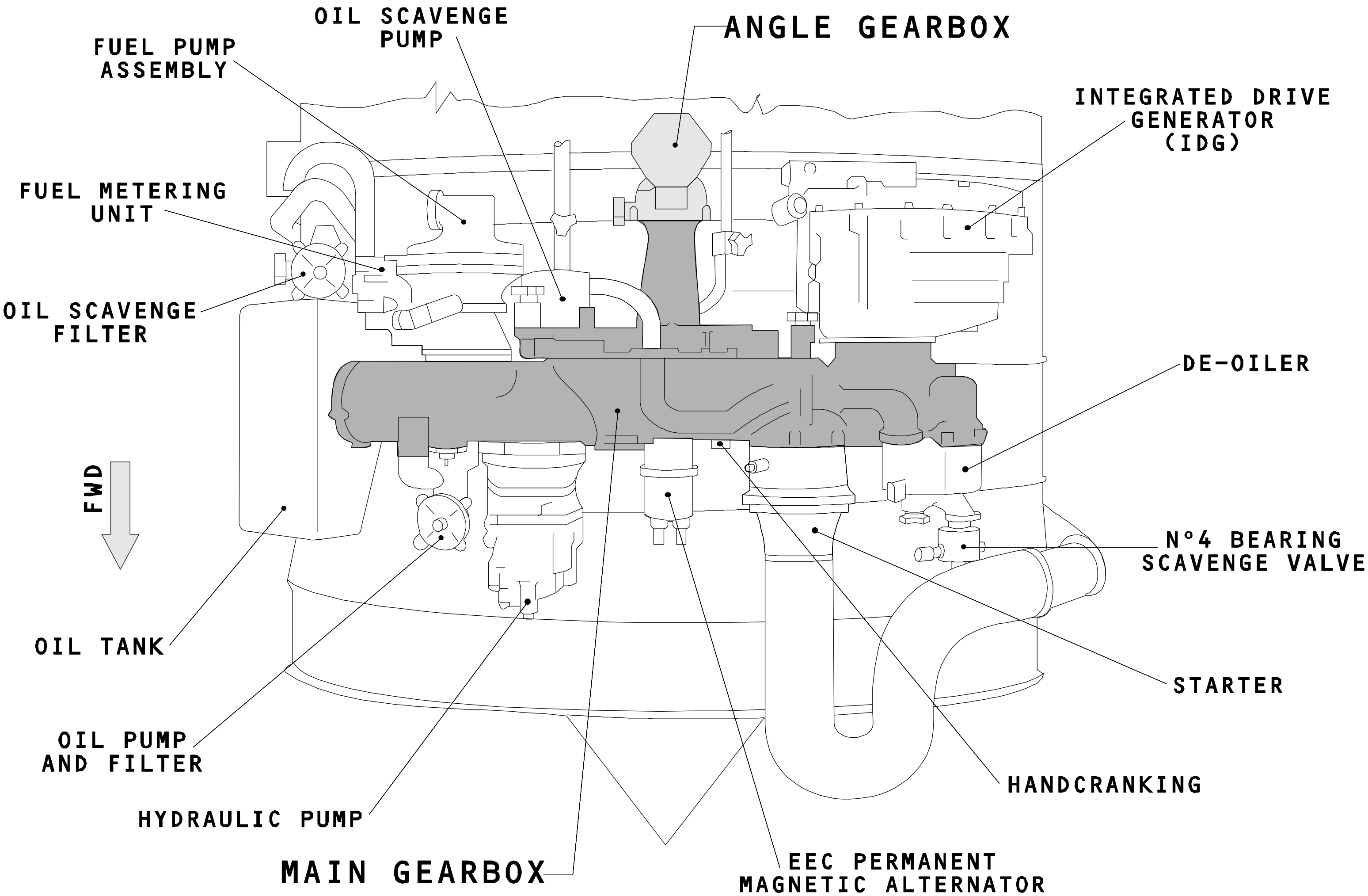
ACCESSORY LOCATION

The main gearbox is equipped with mounting pads to drive the accessories.

The main gearbox consists of a gear train that reduces and increases rotational speed to meet specific drive requirements of each accessory.

The Integrated Drive Generator (IDG), the hydraulic pump and the starter are installed using Quick Attach-Detach (QAD) system.

NOTE : a handcranking drive is provided on the front face.



UFD4200
TMU72IA02-P06 LEVEL 1

ENGINE PRESENTATION - ACCESSORY LOCATION

ENGINE PRESENTATION

AERODYNAMIC STATIONS AND STAGE NUMBERING

Here are the main aerodynamic stations corresponding to the pressure and temperature sensors installed on the engine :

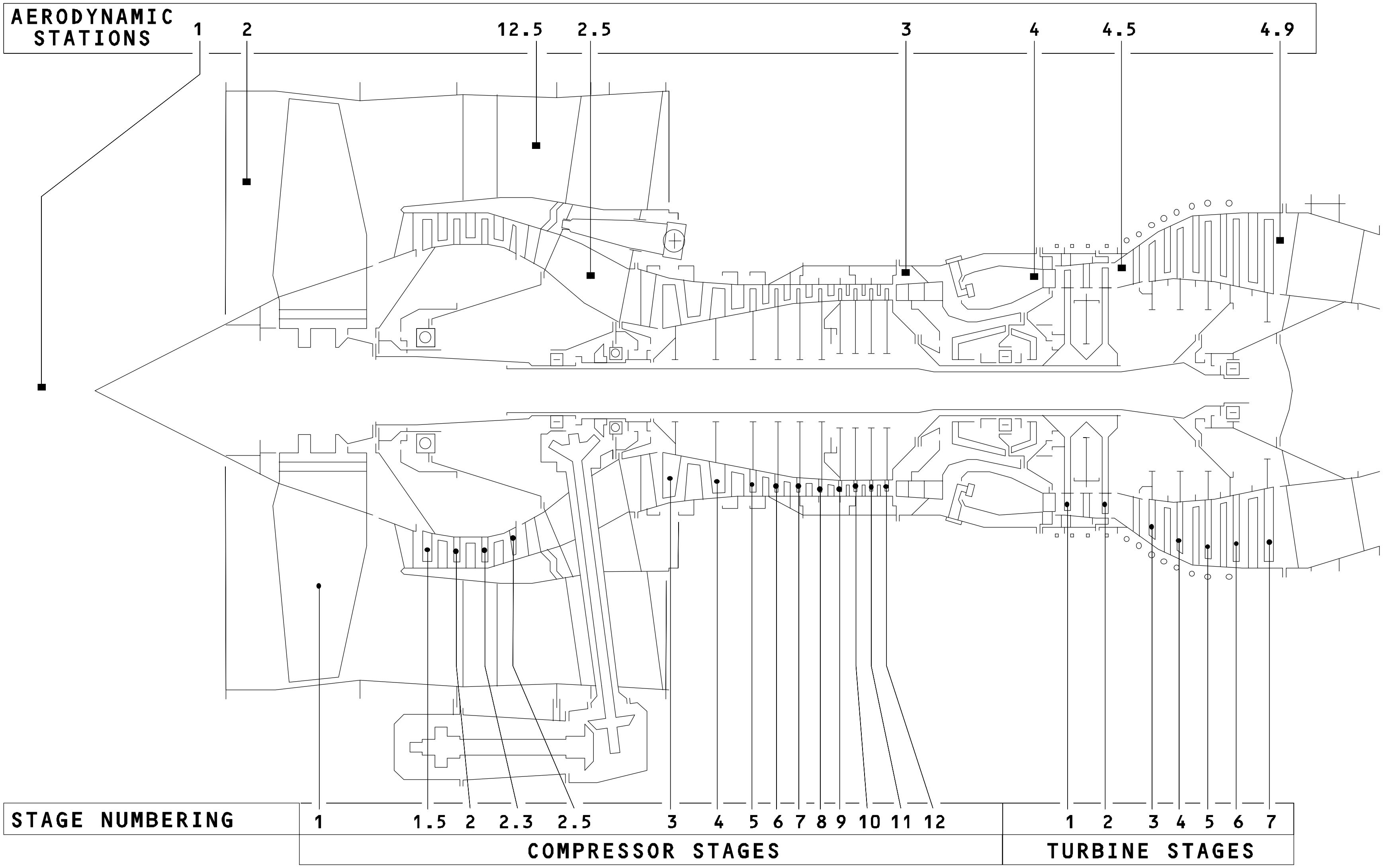
- STA 1 : Intake / Engine inlet interfaces,
- STA 2 : Fan inlet,
- STA 12.5 : Fan exit,
- STA 2.5 : LP compressor exit,
- STA 3 : HP compressor exit,
- STA 4 : Combustion section exit,
- STA 4.5 : HP turbine exit,
- STA 4.9 : LP turbine exit.

Here is the compressor stage numbering:

- Stage 1 : Fan,
- Stages 1.5 to 2.5 : Booster (LP compressor),
- Stages 3 to 12 : HP compressor.

Here is the turbine stage numbering:

- Stages 1 and 2 : HP turbine,
- Stages 3 to 7 : LP turbine.



ENGINE PRESENTATION - AERODYNAMIC STATIONS AND STAGE NUMBERING

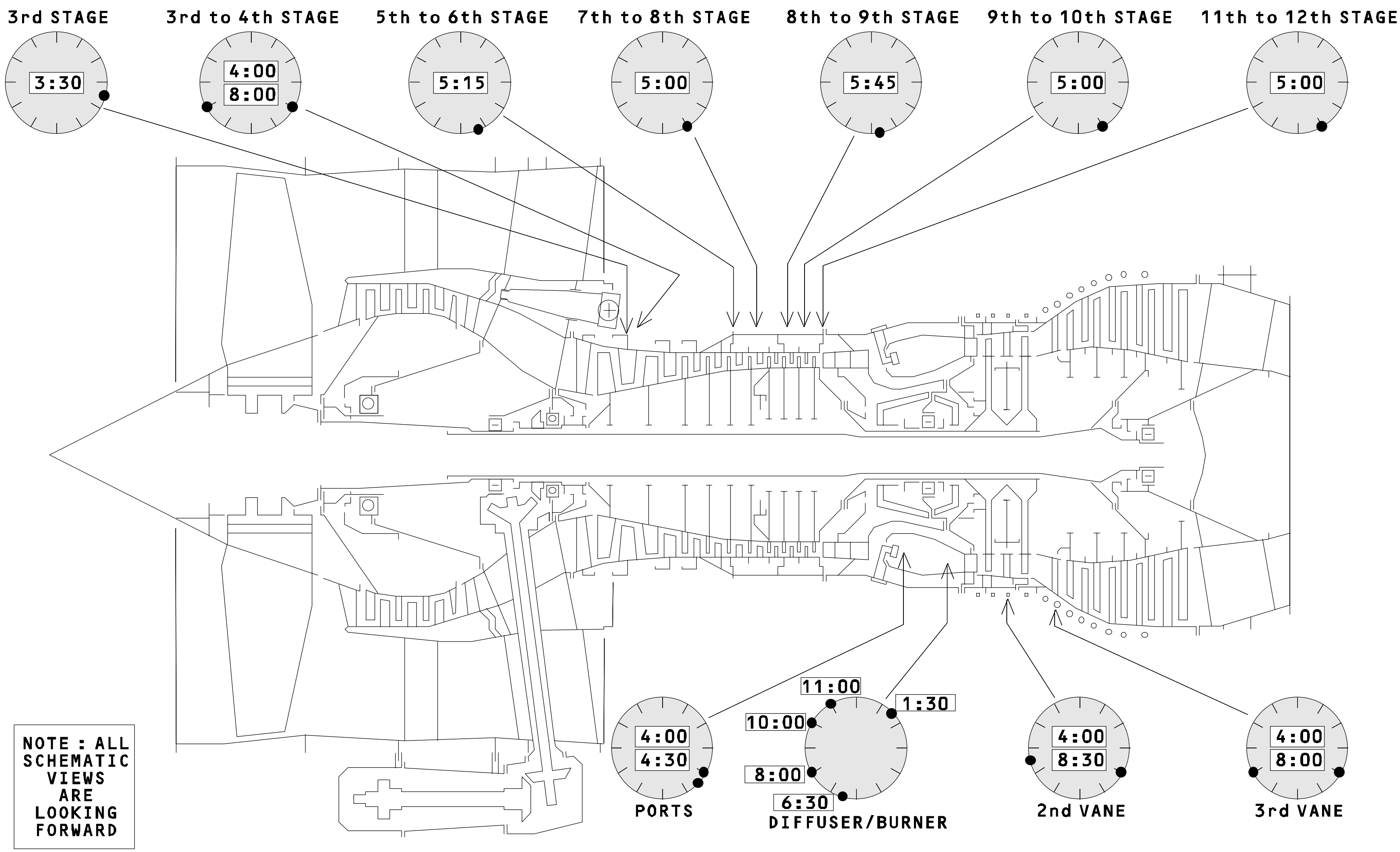
UFD4200

TMU72IA02-P07 LEVEL 1

ENGINE PRESENTATION

BORESCOPE PORTS

Several ports are provided on the engine for borescope inspection.



UFD4200

TMU72IA02-P08 LEVEL 1

ENGINE PRESENTATION - BORESCOPE PORTS

SELF EXAMINATION

How is the main gearbox driven ?

A - By the HP rotor,
B - By the LP rotor,
C - By the HP rotor via the angle gearbox.

The compressor stage N°12 is :

A - The 12th stage of the HP compressor,
B - The 10th stage of the HP compressor,
C - The 7th stage of the HP compressor.

What bearings support the HP rotor ?

A - N°3 and N°4,
B - N°3, N°4 and N°5,
C - N°2, N°3 and N°4.

73 - ENGINE FUEL AND CONTROL - FUEL

73-00-00 ENGINE FUEL SYSTEM D/O

CONTENTS:

ENGINE FUEL SYSTEM D/O

GENERAL

The engine fuel system is designed to provide fuel flow into the combustion chamber, servo fuel for actuation of the compressor airflow control and turbine clearance control systems and cooling for engine oil and IDG oil.

FUEL FEED

The fuel coming from the aircraft tanks supplies the LP fuel pump then provides engine oil cooling, through the Fuel Cooled Oil Cooler (FCOC).
It then passes through the filter before entering into the HP pump then into the Fuel Metering Unit (FMU).
A fuel differential pressure (ΔP) switch provides indication to the cockpit if the filter is clogged.
A fuel temperature sensor is installed at the fuel filter outlet for the Fuel Diverter and Return Valve operation (FD & RV).

METERED FUEL

The fuel from the fuel pump assembly passes through a fuel metering valve, an overspeed valve and a Pressure Raising and Shut-Off Valve (PRSOV) included in the Fuel Metering Unit (FMU).
The fuel flow is then routed to a Fuel Distribution Valve which supplies 20 nozzles through 10 manifolds.
The valves included in the FMU are controlled by the EEC through torque motors to ensure fuel metering, overspeed protection, pressure raising and shut-off functions.

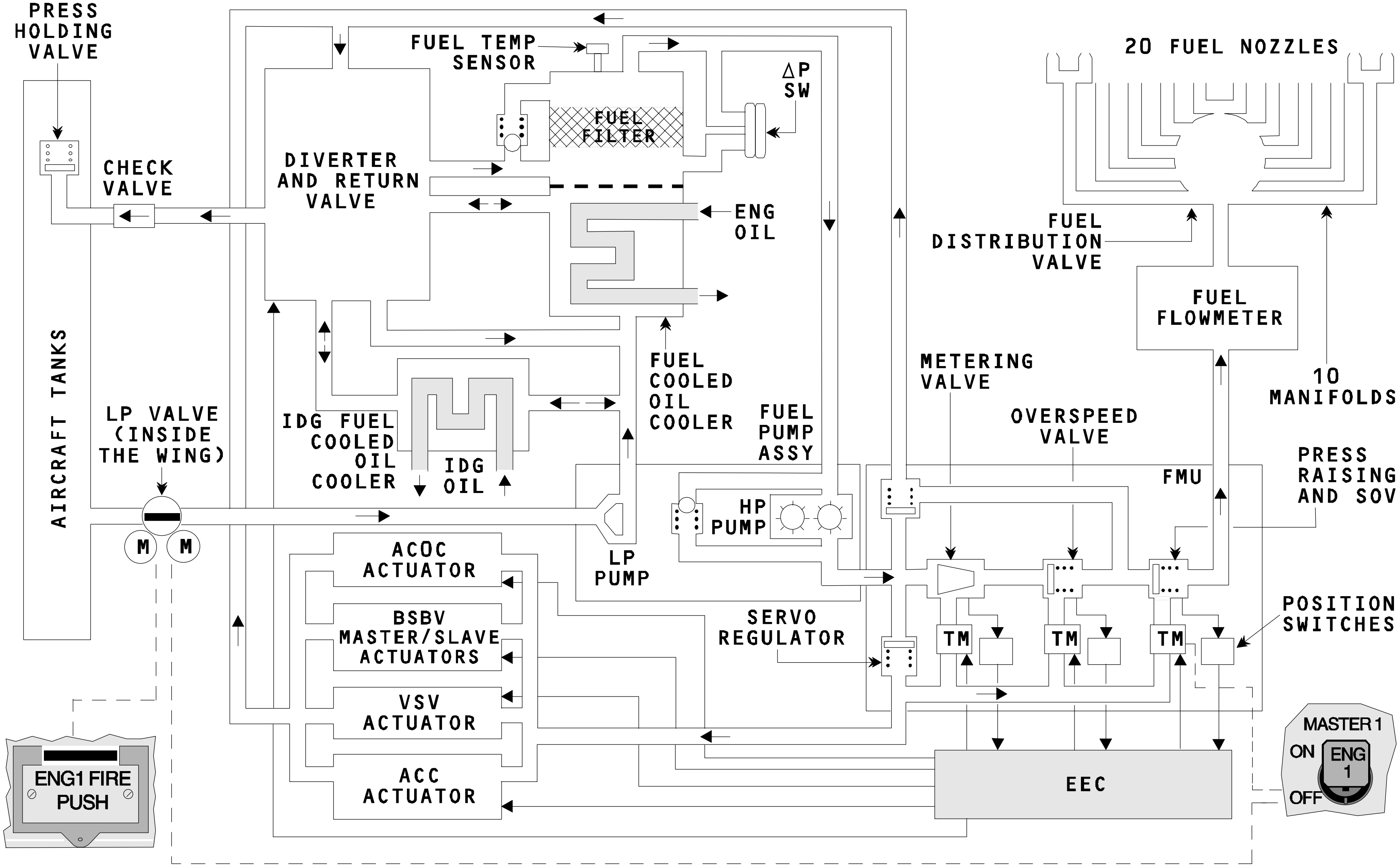
Note: The LP Shut-Off Valve and Pressure Raising and Shut-Off Valve (PRSOV) close when the ENG MASTER lever is set to OFF.
The PRSOV could be automatically closed by the ECC, during auto start only, to abort in case of an incident.

SERVO FUEL

In the Fuel Metering Unit (FMU), a servo regulator provides the high pressure fuel to :

- the FMU torque motor servo valves.
- the Air Cooled Oil Cooler (ACOC) actuator.
- the Booster Stage Bleed Valve (BSBV) actuators.
- the Variable Stator Vane (VSV) actuator.
- and the Active Clearance Control (ACC) actuator.

The servo regulator of the FMU regulates a fuel pressure to the compressor airflow control systems (BSBV and VSV) and the turbine Active Clearance Control system (ACC).



ENGINE FUEL SYSTEM D/O

TMU73IB01-P01 LEVEL 3

UFD4200

ENGINE FUEL SYSTEM DESCRIPTION

DIVERTED FUEL

Part of the fuel is used to provide adequate cooling of the engine oil and IDG oil, and to maintain engine fuel and oil temperatures within specified limits.
These functions are controlled through a Fuel Diverter and Return Valve which incorporates a module to permit fuel to be returned to the aircraft tanks under certain conditions.
The EEC processes the operation modes of the fuel diverter and return valve by software logic.
The logic is generated around the limiting temperatures of fuel and oil, to provide the Heat Management System (HMS).

EEC CONTROL

The Electronic Engine Control (EEC) controls the operation of the Fuel Metering Unit torque motor servo valves, the Fuel Diverter and Return Valve, the Air Cooled Oil Cooler (ACOC) actuator, the actuators of the Booster Stage Bleed Valve (BSBV), Variable Stator Vane (VSV) and Active Clearance Control (ACC) systems.
The EEC performs control functions and fault analysis required to regulate the fuel and to maintain the engine operation in all conditions.
In the event of loss of control functions on both channels, each servo valve and actuator has a fail safe position.

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SELF EXAMINATION

What directly provides the closure of the PR Shut-Off Valve ?

A - The FMU.
B - The EEC only.
C - The MASTER lever to OFF position.

Which valve ensures the adequate fuel flow ?

A - The fuel metering valve.
B - The Pressure Raising SOV.
C - The fuel distribution valve.

What controls the adequate cooling of the engine and IDG oils ?

A - The Fuel Cooled Oil Cooler.
B - The IDG oil cooler.
C - The Fuel Diverter and Return Valve.

73 - ENGINE FUEL AND CONTROL - FUEL

73-00-00 HEAT MANAGEMENT SYSTEM D/O

CONTENTS:

HEAT MANAGEMENT SYSTEM D/O

GENERAL

Heating and cooling of the fuel, engine oil and IDG oil is performed by the Fuel Cooled oil Cooler (FCOC), the Air Cooled Oil Cooler (ACOC) and the IDG Fuel Cooled Oil Cooler (IDG FCOC) under the control of the EEC.
The EEC acts, on the Heat Management System (HMS) through the Fuel Diverter and Return to tank Valve (FD & RV) and the Air Cooled Oil Cooler (ACOC) modulating valve.

ACOC MODULATING VALVE

Oil heated by the engine passes through the ACOC and then to the FCOC.
The ACOC modulating valve regulates a bleed part of fan airflow crossing the ACOC to maintain both oil and fuel temperatures within acceptable minimum and maximum limits.

FUEL DIVERTER AND RETURN TO TANK VALVE

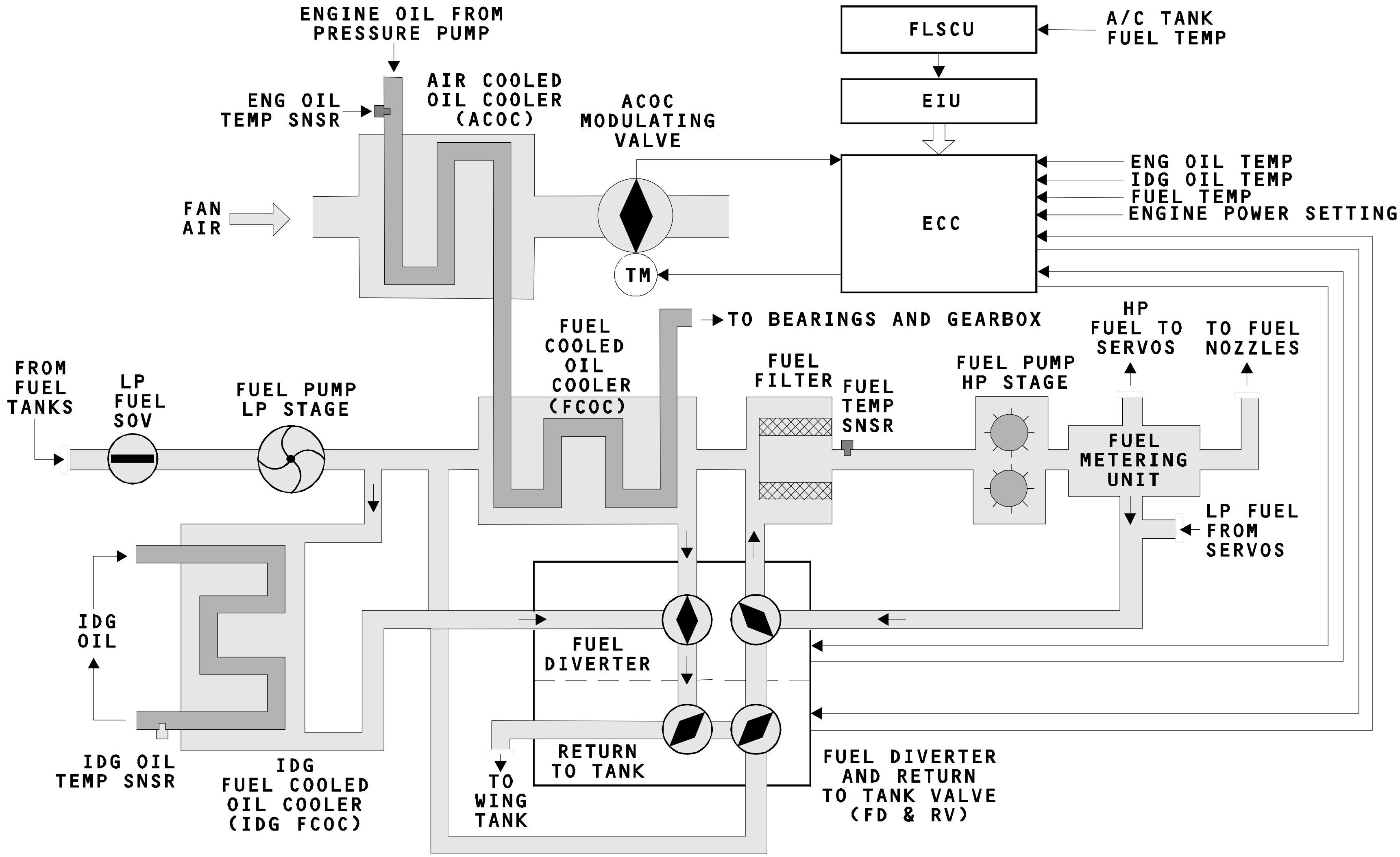
The Fuel Diverter Valve and the Return to tank Valve are enclosed in the same housing.
The FD & RV maintains fuel, engine oil and IDG oil temperatures within limits by minimizing ACOC cooling air usage
The two position diverter valve works by managing the fuel recirculation inside the engine fuel system.
The return to tank valve will divert a modulated proportion of the LP fuel back to aircraft tanks.

CONTROL

The EEC controls the HMS through 4 modes of operation taking into account 3 parameters of temperature :
- engine fuel
- engine oil
- IDG oil

The temperature of aircraft fuel tanks and the engine power setting are parameters used for inhibition of fuel return to aircraft tanks.

NOTE: The 4 modes of operation are modes 1, 3, 4 and 5.
- Modes 1 and 4 are return to tank modes,
- Modes 3 and 5 are no return to tank modes.



HEAT MANAGEMENT SYSTEM D/O

UFD4200
TMU73II01-P01 LEVEL 3

HEAT MANAGEMENT SYSTEM D/O

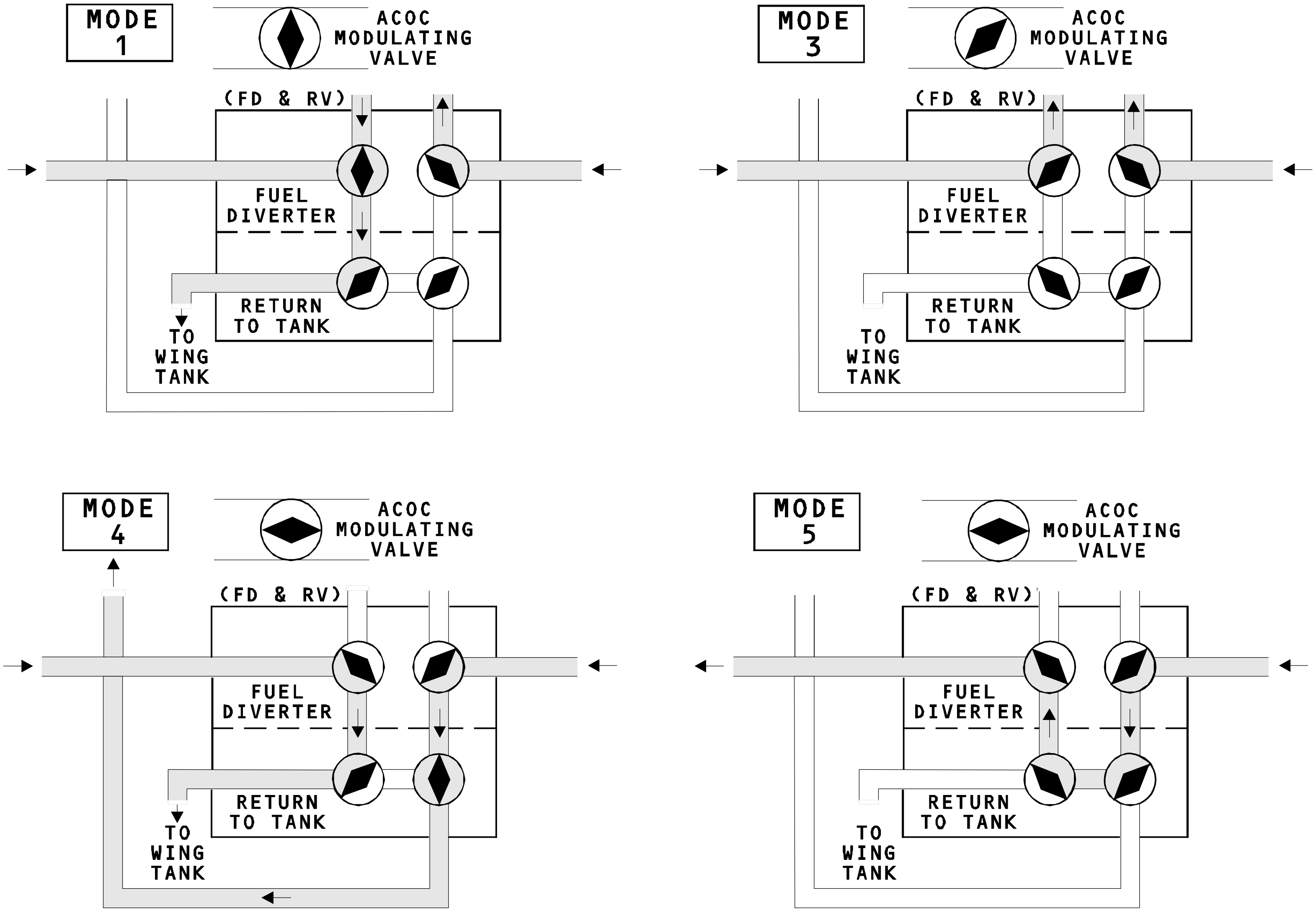
MODE 1
Normal return to tank mode.
When the engine is not at high power setting, some of the fuel is returned to the tank.
The heat is absorbed and dissipated within the tank.

MODE 4
Mode selected when, in normal mode (MODE 1), there is a high engine fuel temperature.
In this mode the oil system is used to achieve a supplemental cooling of the fuel.
The ACOC modulating valve is fully open.

MODE 3
Engine at high power setting.
In this condition all the heat is absorbed by the burned fuel.
If however the fuel flow is too low to provide adequate cooling the ACOC valve could be modulated.

MODE 5
Mode selected when system condition demand as in MODE 3 but this is not permitted because IDG oil temperature is excessive or return to tank is not permissible due to the high return fuel temperature.
The ACOC valve is fully open.

NOTE: This is the fail safe mode of operation.



HEAT MANAGEMENT SYSTEM D/O

UFD4200
TMU73II01-P02 LEVEL 3

SELF EXAMINATION

What does the ACOC modulating valve regulate?

- A - The engine oil flowing through the ACOC.
- B - A bleed part of fan air crossing the ACOC.
- C - Both engine oil and a bleed part of fan air.

What does the Heat Management System heat and cool?

- A - Fuel, engine oil and IDG oil.
- B - Engine oil and IDG oil.
- C - Only engine oil.

The EEC controls the HMS with?

- A - The ACOC modulating valve and the FD & RV.
- B - The ACOC modulating valve, the FD & RV and the IDG FCOC.
- C - The FD & RV.

73 - ENGINE FUEL AND CONTROL - FUEL

73-00-00 ENGINE FUEL SYSTEM COMPONENTS

CONTENTS:

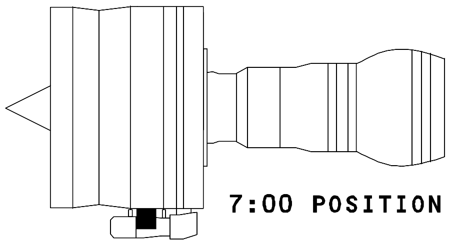
ENGINE FUEL SYSTEM COMPONENTS

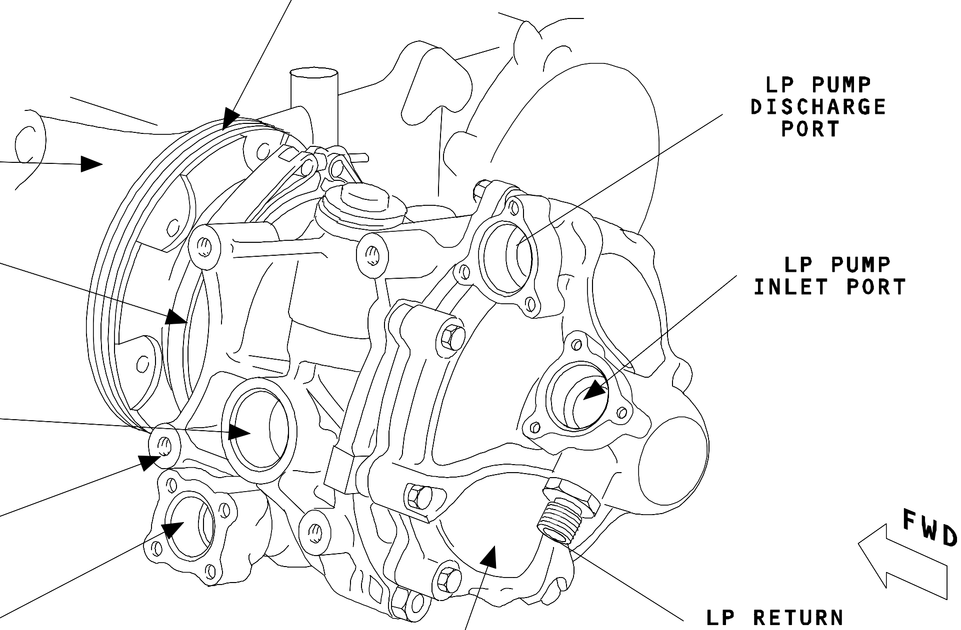
FUEL PUMP

IDENTIFICATION
FIN: 2001EM1, 2001EM2

LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
The LP pump stage is a shrouded radial flow centrifugal impeller.
The HP pump stage is a gear pump.
The HP pump stage has a relief valve that operates at 1365 PSI ΔP.





UFD4200

TMU73ID02-P01 LEVEL 3

ENGINE FUEL SYSTEM COMPONENTS - FUEL PUMP

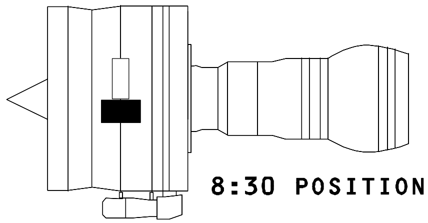
ENGINE FUEL SYSTEM COMPONENTS

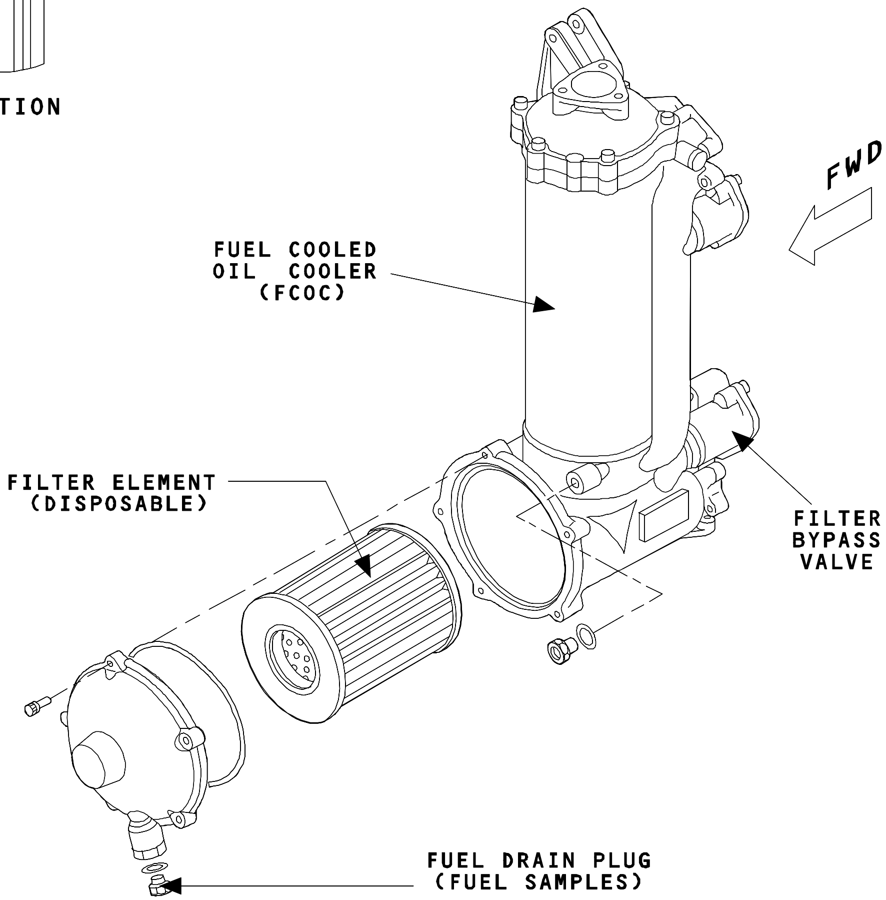
FUEL FILTER

IDENTIFICATION
FIN: 2000EM1, 2000EM2

LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
A 40 micron fuel filter provides the main filtration for the fuel system.
The filter bypass valve opens at 17 PSI ΔP.





TMU73ID02-P02 LEVEL 3

UFD4200

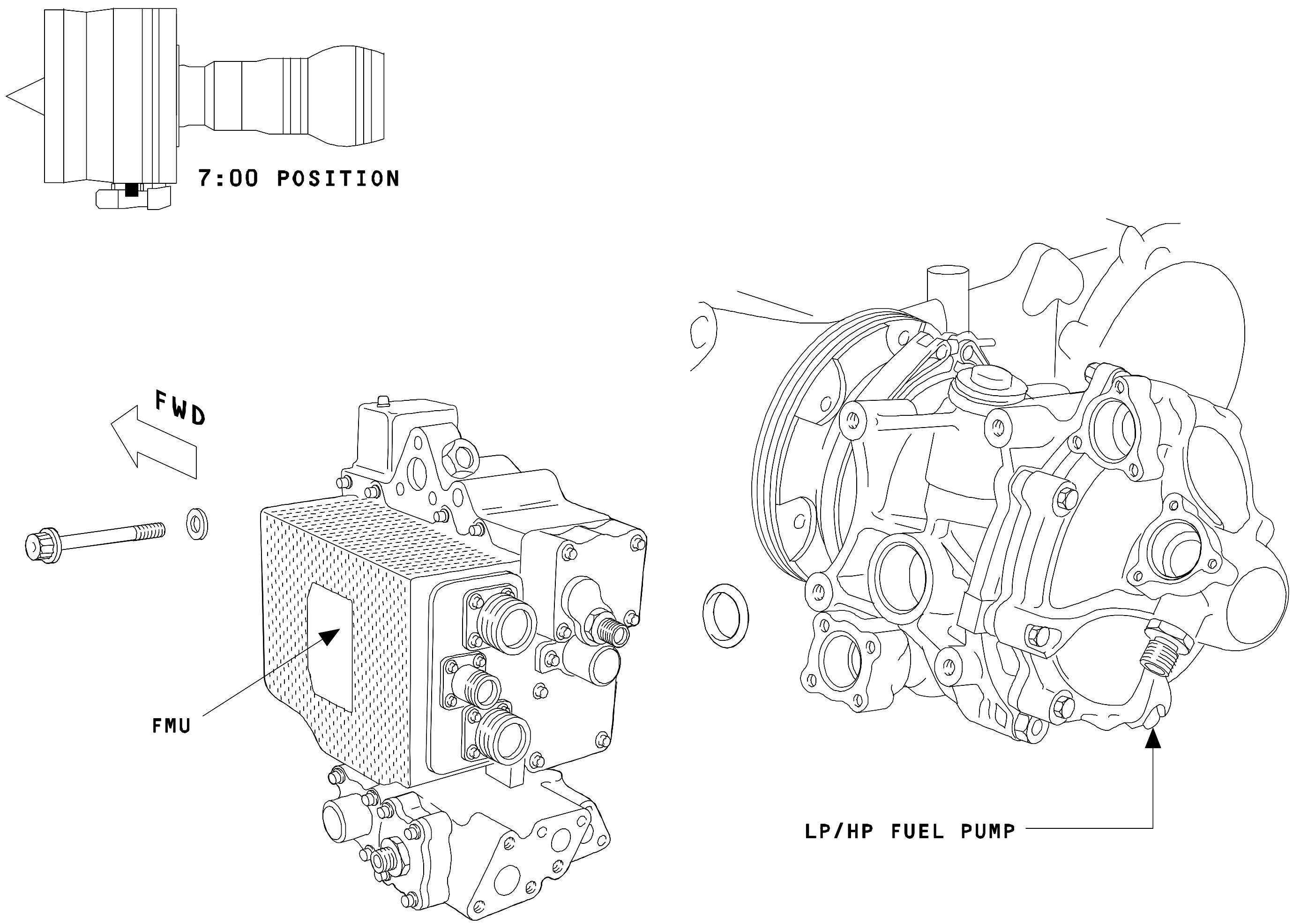
ENGINE FUEL SYSTEM COMPONENTS - FUEL FILTER

ENGINE FUEL SYSTEM COMPONENTS

FUEL METERING UNIT (FMU)

IDENTIFICATION
FIN: 4000KC

LOCATION
ZONE: 435, 445



ENGINE FUEL SYSTEM COMPONENTS - FUEL METERING UNIT (FMU)

UFD4200
TMU73ID02-P03 LEVEL 3

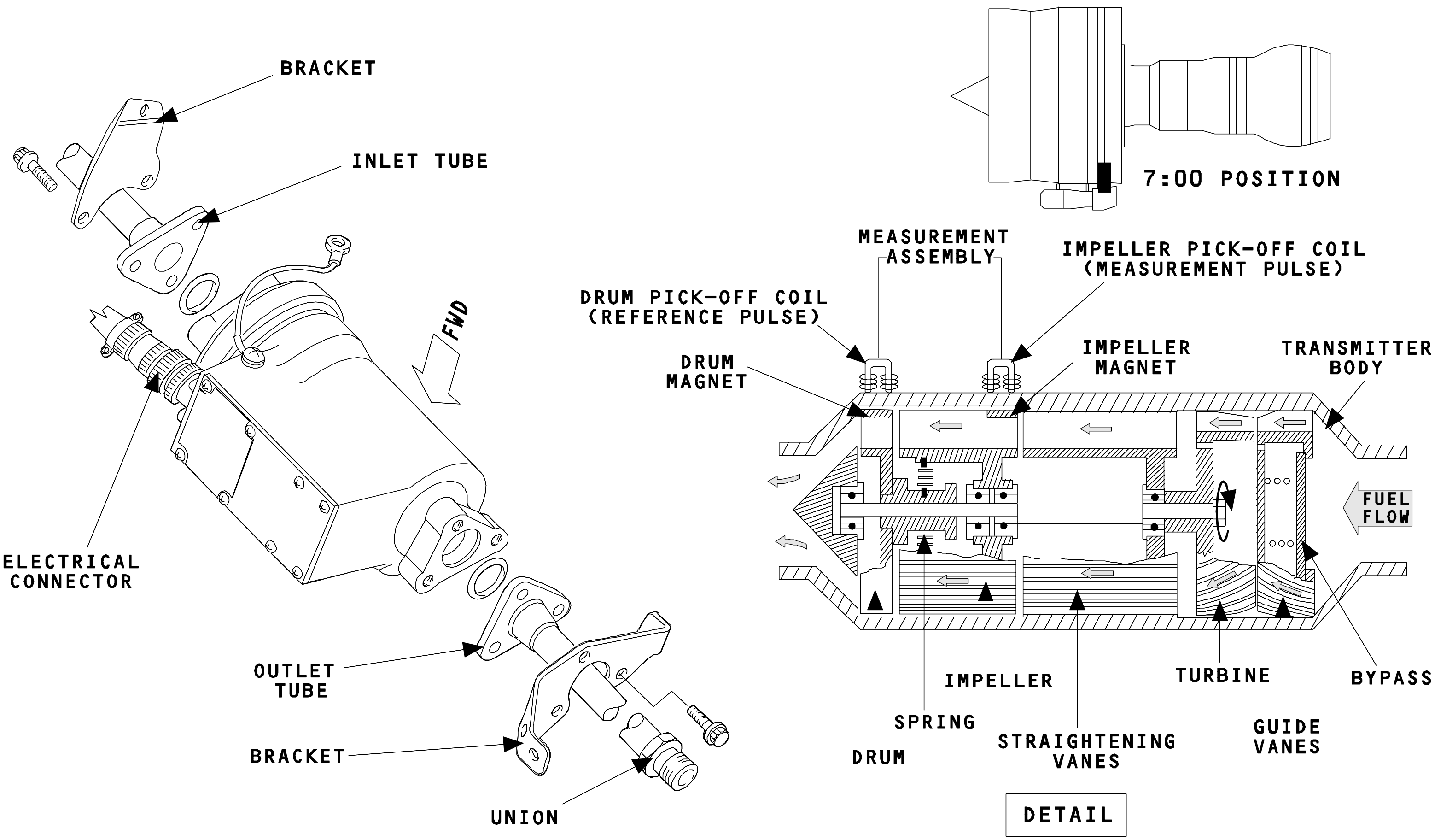
ENGINE FUEL SYSTEM COMPONENTS

FUEL FLOWMETER

IDENTIFICATION
FIN: 4010KS

LOCATION
ZONE: 435, 445

DETAIL
At high fuel flow rates, some fuel bypasses the turbine to prevent turbine overspeed.
The turbine drives the drum directly.
The impeller is driven by a spring.
In operation, the motion of the impeller is retarded because of the action of the spring.
The time difference between the reference pulse and the measurement pulse is proportional to the fuel mass flow and is used to calculate the fuel flow.



UFD4200 TMU73ID02-P04 LEVEL 3

ENGINE FUEL SYSTEM COMPONENTS - FUEL FLOWMETER

ENGINE FUEL SYSTEM COMPONENTS

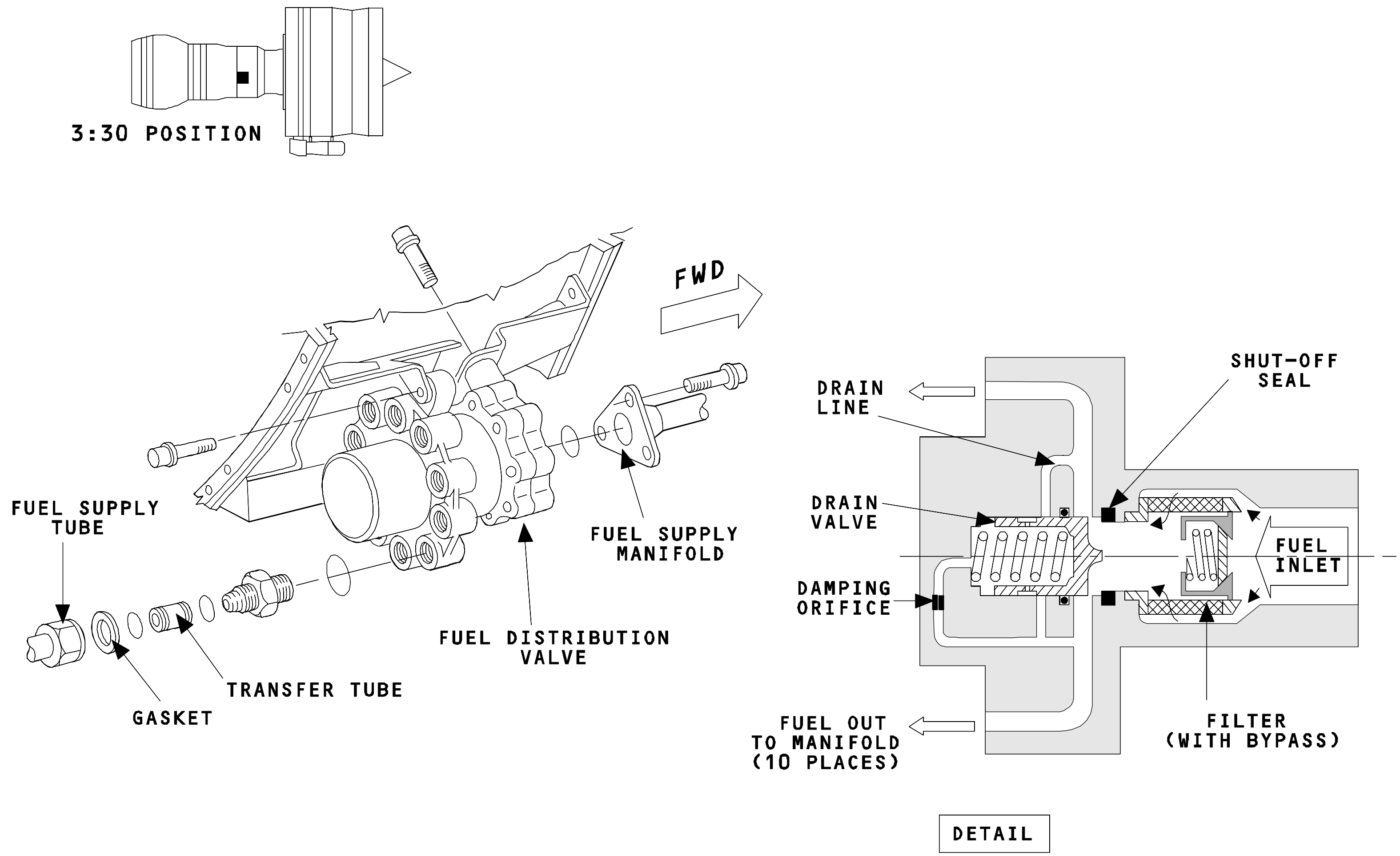
FUEL DISTRIBUTION VALVE

IDENTIFICATION
FIN: 2002EM

LOCATION
ZONE: 454, 464

COMPONENT DESCRIPTION
Each fuel supply tube feeds two fuel nozzles via a fuel distribution manifold.

DETAIL
The fuel distribution valve contains a 200 micron filter with a bypass valve.
At engine shutdown, the drain valve closes the fuel inlet and interconnects all ten fuel distribution manifolds.
This allows fuel to drain from eight manifolds into the engine, through the two lowest fuel nozzles.
The two fuel manifolds, which remain full, help supply fuel for the next engine start.



UFD4200

TMU73ID02-P05 LEVEL 3

ENGINE FUEL SYSTEM COMPONENTS - FUEL DISTRIBUTION VALVE

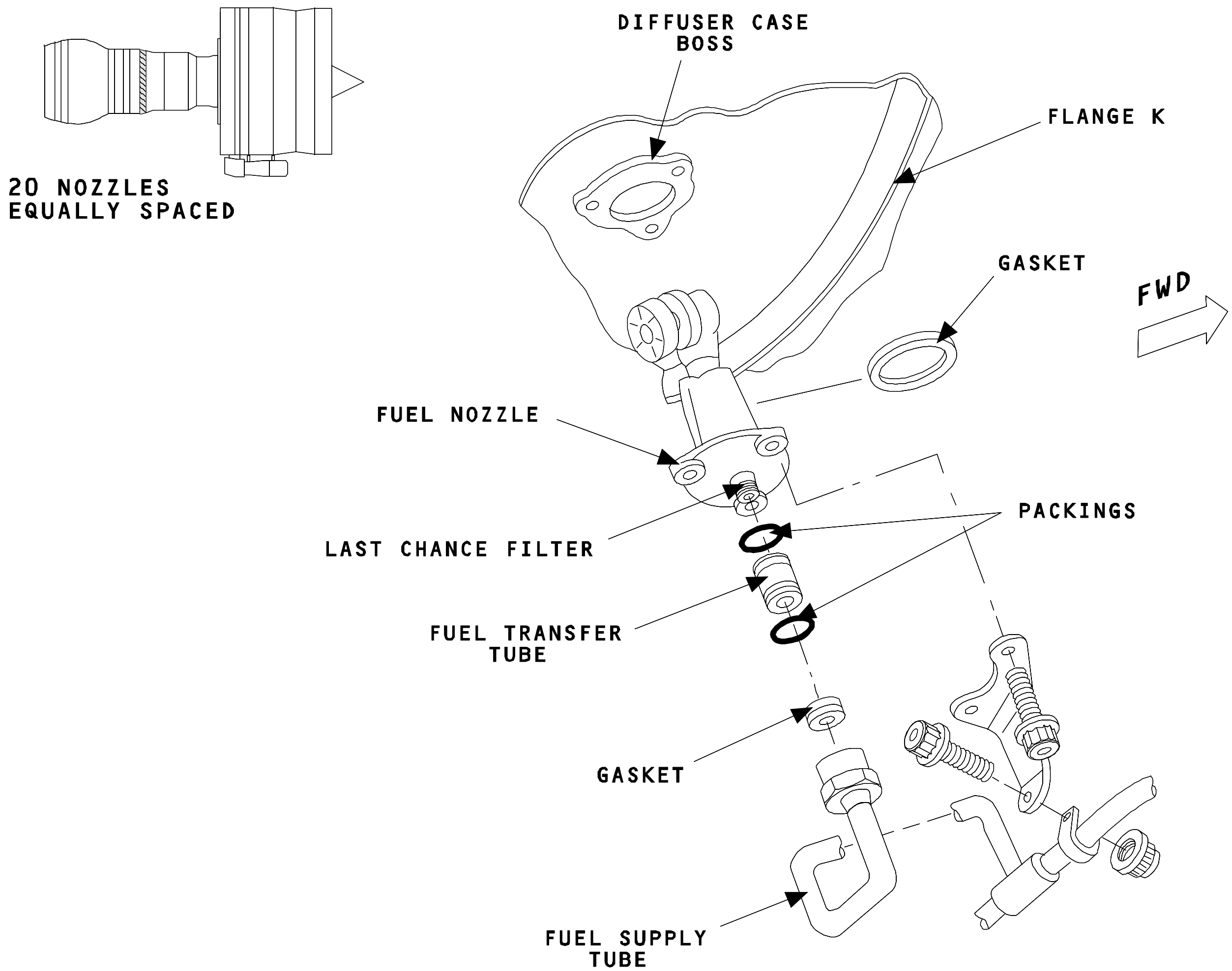
ENGINE FUEL SYSTEM COMPONENTS

FUEL NOZZLES

IDENTIFICATION
FIN: 2005EM

LOCATION
ZONE: 453, 454, 463, 464

COMPONENT DESCRIPTION
There are twenty fuel nozzles equally spaced around the diffuser case.



ENGINE FUEL SYSTEM COMPONENTS - FUEL NOZZLES

UFD4200

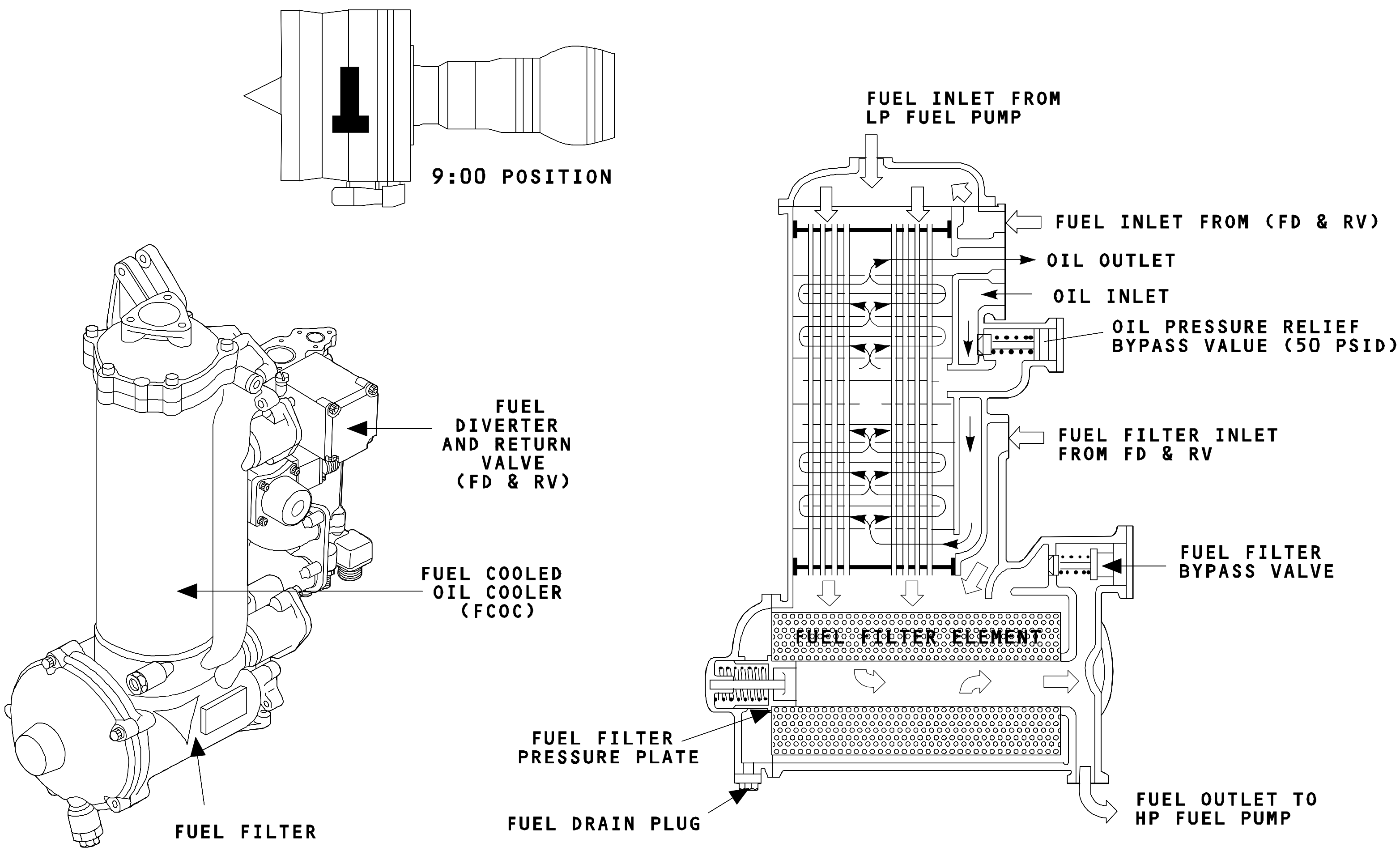
TMU73ID02-P06 LEVEL 3

ENGINE FUEL SYSTEM COMPONENTS

FUEL COOLED OIL COOLER (FCOC)

IDENTIFICATION
FIN: 6003EM

LOCATION
ZONE: 435, 445



UFD4200

TMU73ID02-P07 LEVEL 3

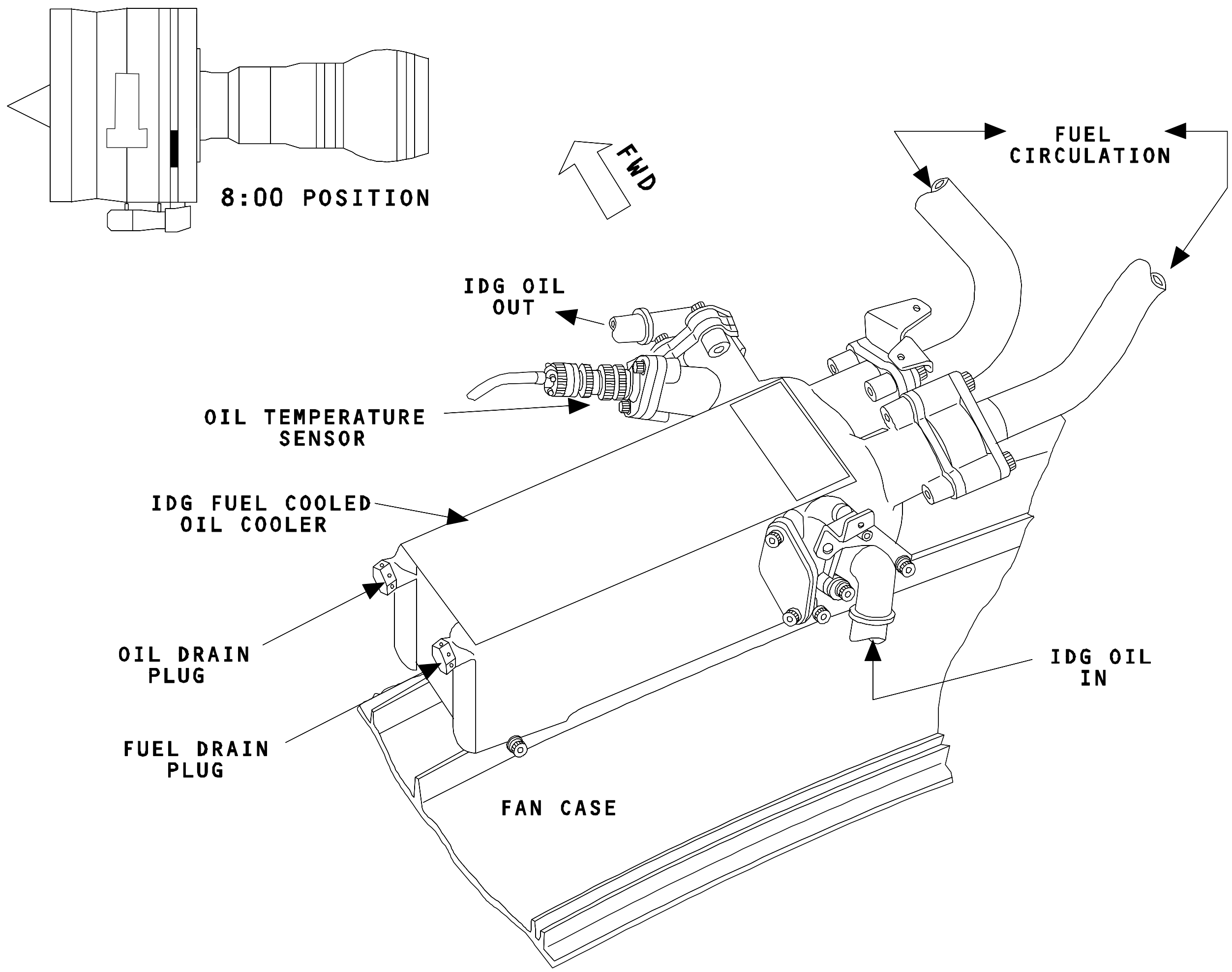
ENGINE FUEL SYSTEM COMPONENTS - FUEL COOLED OIL COOLER (FCOC)

ENGINE FUEL SYSTEM COMPONENTS

IDG FUEL COOLED OIL COOLER (IDG FCOC)

IDENTIFICATION
FIN:

LOCATION
ZONE: 435, 445



ENGINE FUEL SYSTEM COMPONENTS - IDG FUEL COOLED OIL COOLER (IDG FCOC)

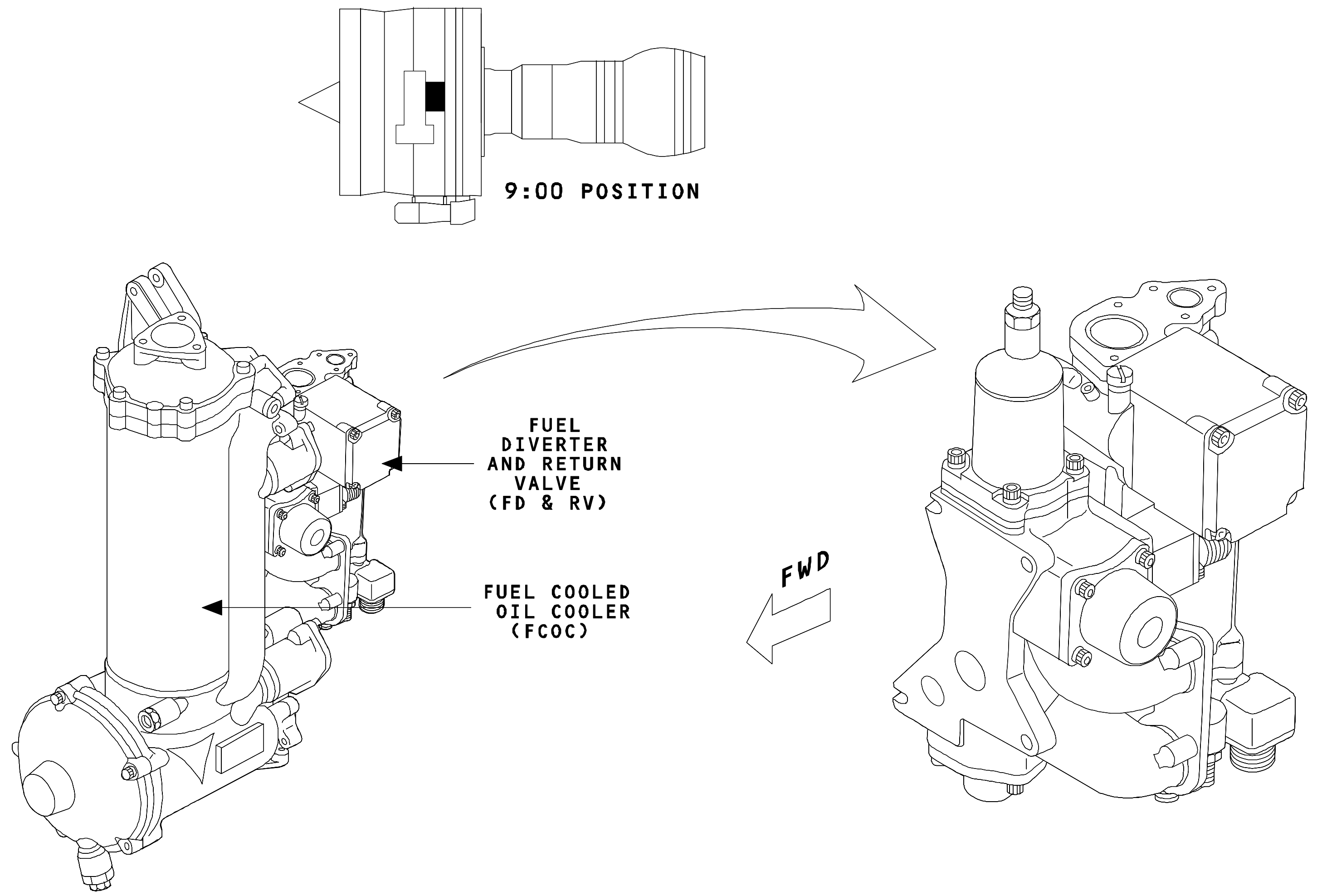
ENGINE FUEL SYSTEM COMPONENTS

FUEL DIVERTER AND RETURN VALVE (FD & RV)

IDENTIFICATION
FIN: 4018KS

LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
The fuel diverter and return valve must be attached to the fuel cooled oil cooler before installation on the engine.



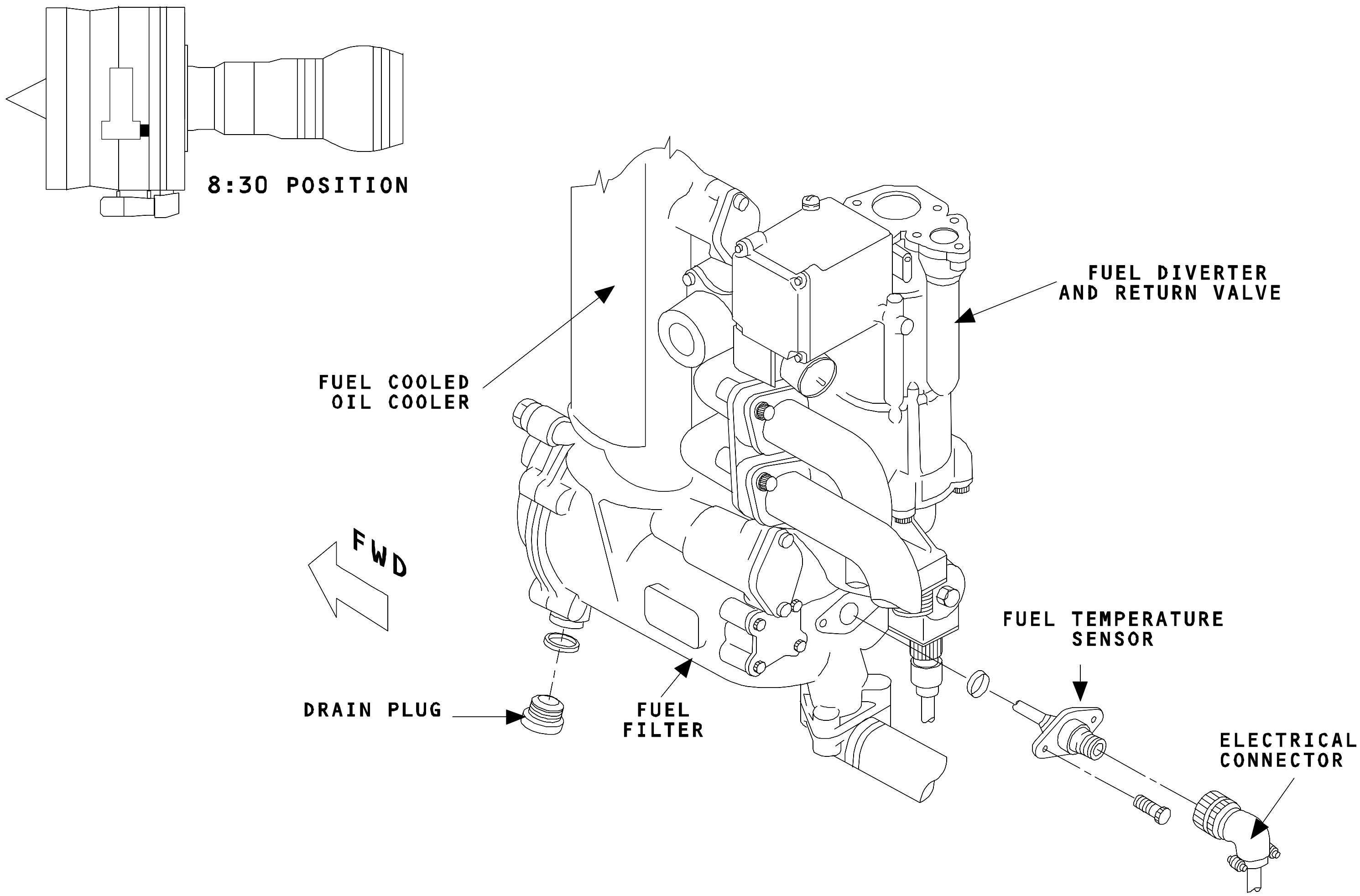
ENGINE FUEL SYSTEM COMPONENTS - FUEL DIVERTER AND RETURN VALVE (FD & RV)

ENGINE FUEL SYSTEM COMPONENTS

FUEL TEMPERATURE SENSOR

IDENTIFICATION
FIN: 4017KS

LOCATION
ZONE: 435, 445



UFD4200

TMU73ID02-P10 LEVEL 3

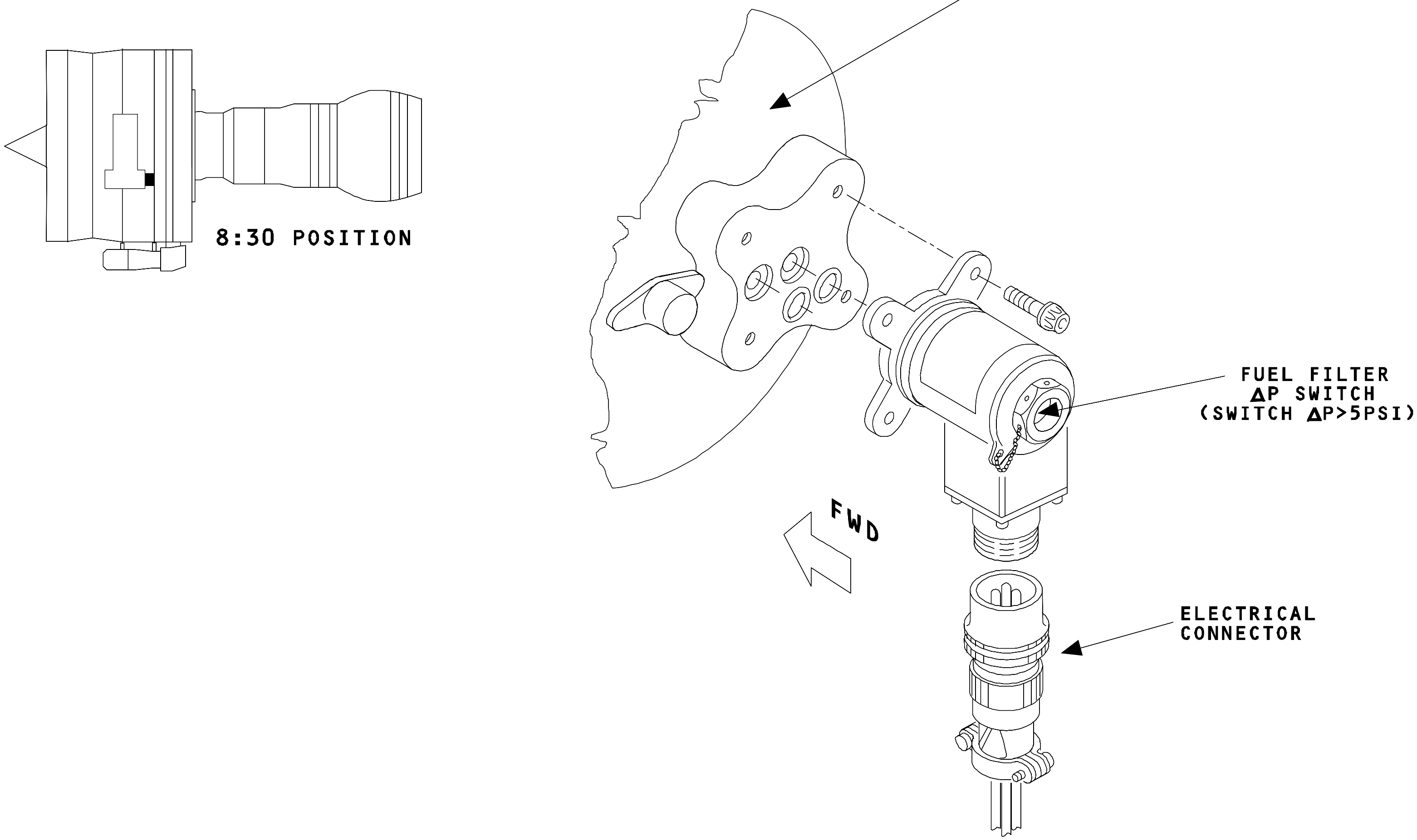
ENGINE FUEL SYSTEM COMPONENTS - FUEL TEMPERATURE SENSOR

ENGINE FUEL SYSTEM COMPONENTS

FUEL FILTER ΔP SWITCH

IDENTIFICATION
FIN: 4000EL

LOCATION
ZONE: 435, 445



ENGINE FUEL SYSTEM COMPONENTS - FUEL FILTER ΔP SWITCH

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73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-20-00 FADEC PRESENTATION

CONTENTS:

FADEC PRESENTATION

PURPOSE

The FADEC (Full Authority Digital Engine Control system) provides full range engine control throughout all flight and operational phases. It consists of a dual channel Electronic Engine Control (EEC) and its peripheral components and sensors.

FADEC FUNCTIONS

The FADEC provides the engine system regulation and scheduling to control the thrust and optimize the engine operation.
The FADEC provides:

- Power setting (EPR or N1 back-up mode),
- P2/T2 heating,
- Acceleration and deceleration times,
- Idle speed governing,
- Overspeed limits (N1 and N2),
- Fuel flow control,
- Variable Stator Vane system (VSV) control,
- Compressor handling bleed valves control,
- Booster Stage Bleed Valve system (BSBV) control,
- HP turbine cooling (stage 10 make-up air system),
- HP/LP Turbine Active Clearance Control (HP/LP TACC),
- Automatic and Manual engine starting,
- Thrust reverser CONTROL,
- Oil and fuel temperature management through the Heat Management System (HMS).

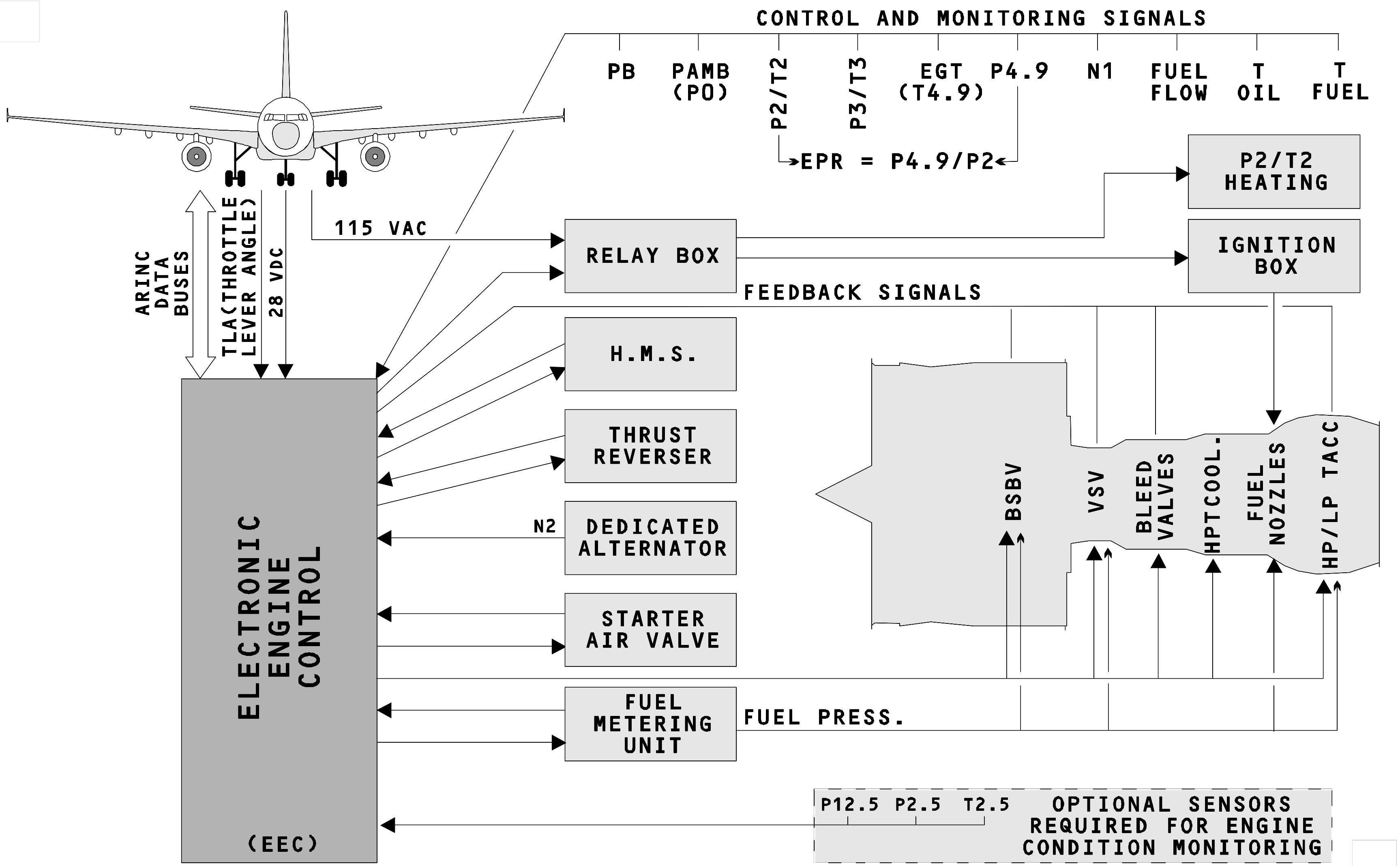
FADEC BENEFITS

The FADEC:

- saves weight and fuel by a full range control of the gas generator,
- reduces pilot workload and maintenance cost,
- allows the optimum adaptation of thrust rating schedules to the aircraft needs.

POWER SUPPLY

The FADEC system is self-powered by a dedicated Permanent Magnet Alternator (PMA) when N2 is greater than 10%.
The EEC is powered by the aircraft 28VDC electrical network for starting, as a backup and for testing with engine not running.
The 115 VAC is used for the power supply of ignition system and the P2/T2 probe heating.



FADEC PRESENTATION

UFD4200

TMU73IF01-P01 LEVEL 3

SELF EXAMINATION

What does the FADEC system consists of ?

A - One main frame computer for all engines.
B - The EEC and its peripherals, per engine.
C - A single EEC and its peripherals, for both engines.

73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-20-00 FADEC ARCHITECTURE

CONTENTS:

FADEC ARCHITECTURE

DUAL CHANNEL

The FADEC system is fully redundant and built around two independent control channels.
Dual inputs, dual outputs and automatic switch over from one channel to the other eliminate any dormant failure.
The Electronic Engine Control consists of two channels (A and B). Each channel can control the different components of the engine systems.
Channels A and B are permanently operational.
The channel in control manages the system.

DUAL INPUTS

All control inputs to the FADEC system are doubled. Only some secondary parameters used for monitoring and indicating are single.
To increase the fault tolerant design, the parameters are exchanged between the two control channels (inside the EEC) via the cross channel data link.

HARDWIRED INPUTS

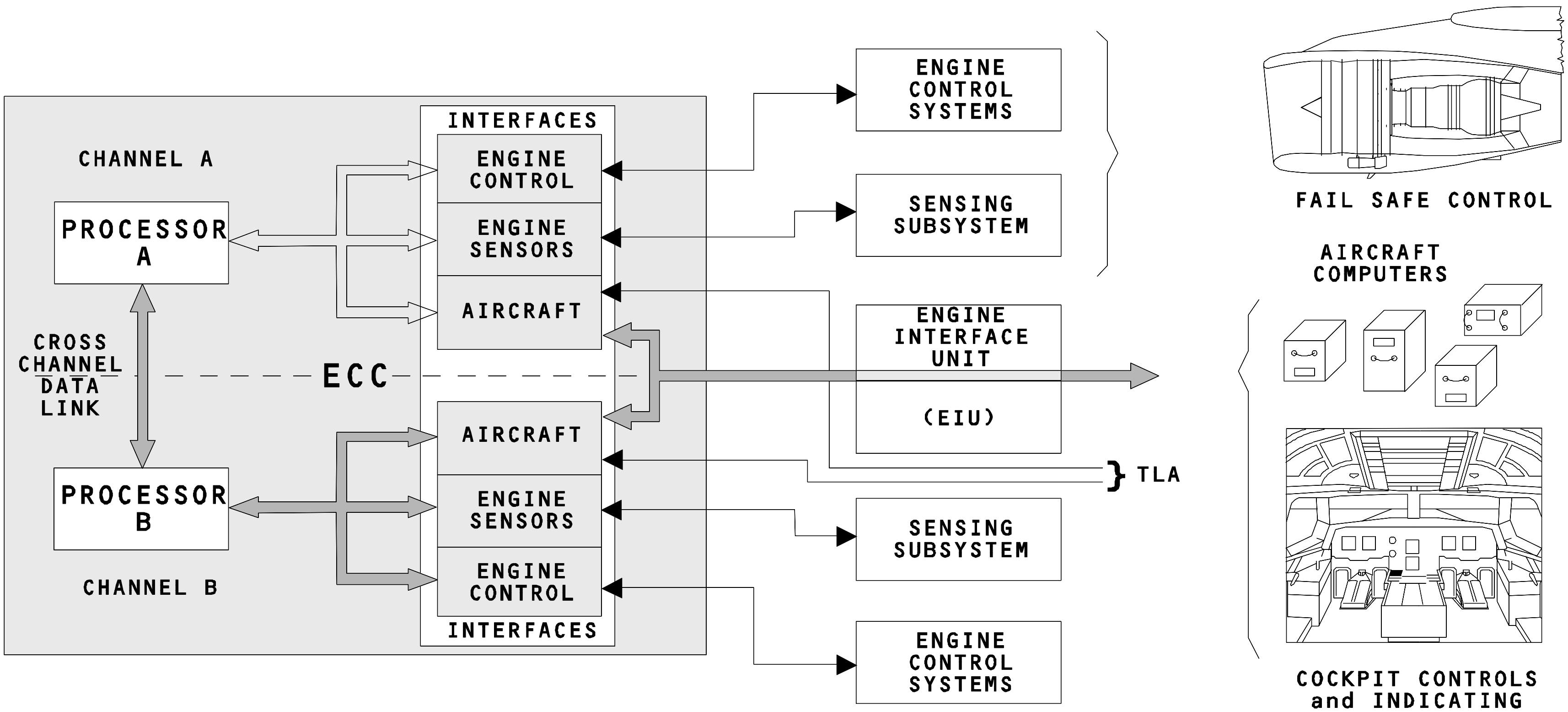
Most of the information exchanged between the aircraft and the EEC is transmitted over digital data buses, some signals over a single line.
In addition, some signals are hard-wired directly from the aircraft to the EEC.
The Thrust Lever Angle (TLA) signal is sent directly from throttle resolvers to the EEC.

DUAL OUTPUTS

All the EEC outputs are double, but only the channel in control supplies the engine control signals to the various receptors such as torque motors, solenoids. The other channel calculation is used for cross-checking.

BITE CAPABILITY

The EEC is equipped with a Built In Test Equipment (BITE) system which provides maintenance information and test capabilities via the MCDU.



UFD4200 TMU73IG01-P01 LEVEL 1

FADEC ARCHITECTURE

FAULT STRATEGY

Using the BITE system, the EEC can detect and isolate failures.
It also allows the EEC to switch engine control from the faulty channel to the healthy one.
Depending on the nature of the failure, the EEC will behave differently:

- SINGLE INPUT SIGNAL FAILURE : there is no channel changeover, the channel in control uses inputs from the other channel through the Cross Channel Data Link.
- DUAL INPUT SIGNAL FAILURE : in this case, the system runs on synthesized values of the healthiest channel.
- SINGLE OUTPUT SIGNAL FAILURE : there is an automatic switchover to the standby active channel.
- COMPLETE OUTPUT SIGNAL FAILURE : there is no longer any current to drive the torque motors or solenoids, the related component will go to the "fail-safe" position.

FAIL SAFE CONTROL

If a channel is faulty and the channel in control is unable to ensure one engine function, this control is moved to a fail-safe position.
Example : if the channel is faulty and the remaining channel in control is unable to control VSV position, the vanes are set to the fail-safe open position.

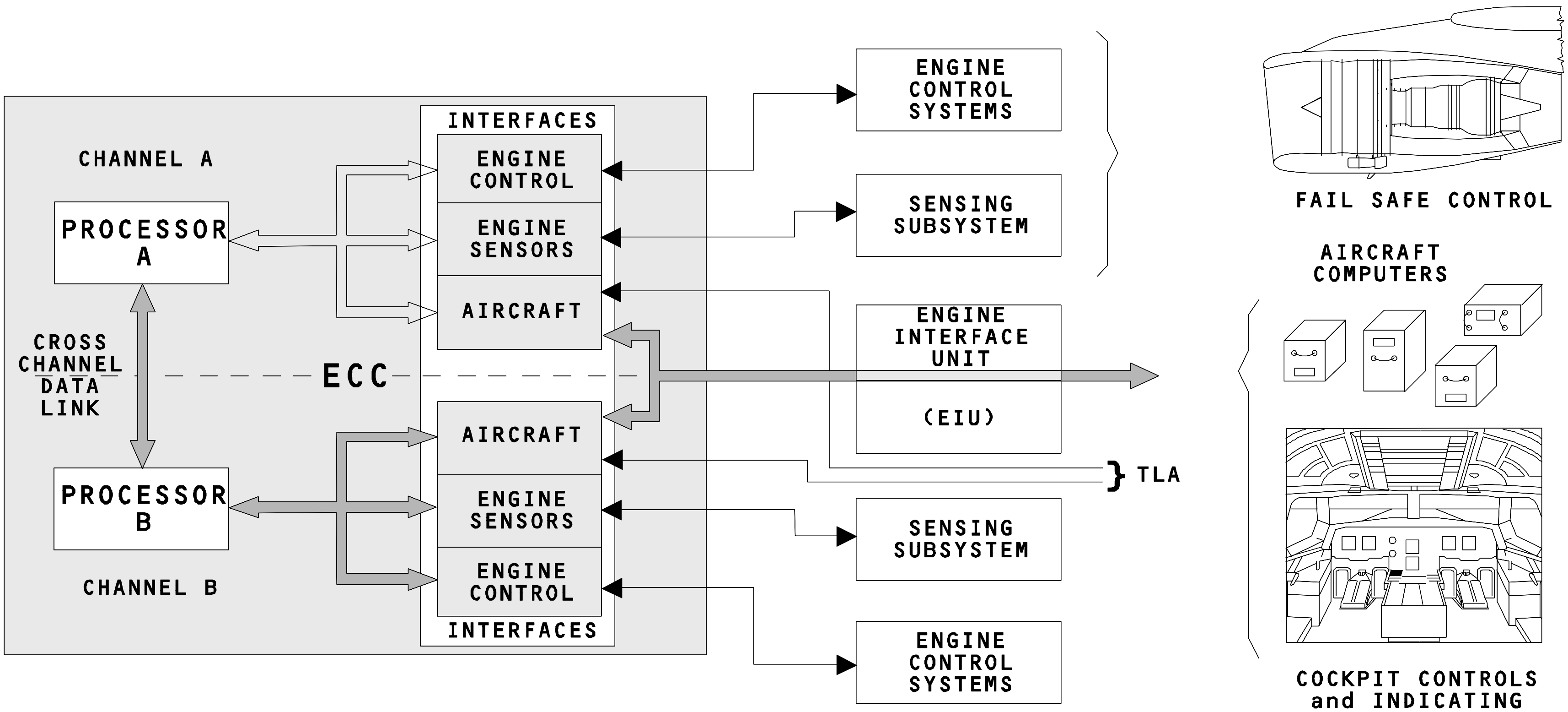
MAIN INTERFACES

To perform all its tasks, the EEC interfaces with aircraft computers, either directly or via the Engine Interface Unit (EIU), which is an interface concentrator between the aircraft systems and the FADEC system .
There is one EIU for each engine, located in the avionics bay.
The EEC receives inputs from :

- Landing Gear Control and Interface Unit(LGCIU),
- Air Data Inertial Reference Units (ADIRU),
- Flight Control Unit (FCU),
- Environmental Control System Computers (ECS),
- Centralized Fault Display Interface Unit (CFDIU),
- Cockpit engine controls including Throttle Lever Angle (TLA), fire and anti-ice systems.

The EEC sends outputs to :

- Bleed air Monitoring Computers (BMC),
- Electronic Control Box (ECB),
- Flight Warning Computers (FWC),
- Display Management Computers (DMC),
- Flight Management and Guidance Computers (FMGC),
- Centralized Fault Display Interface Unit (CFDIU),
- Data Management Unit (DMU) (optional).



FADEC ARCHITECTURE

UFD4200 TMU73IG01-P02 LEVEL 1

SELF EXAMINATION

In case of a single input loss, what happens ?

A - Switch over to the other channel.
B - Control goes to a fail-safe position.
C - The channel in control uses values from the other channel.

If both windings of a torque motor fail, what happens ?

A - Switch over to the other channel.
B - Control goes to a fail-safe position.
C - The channel in control supplies the winding of the other channel.

If one winding of a torque motor fails, what happens ?

A - Switch over to the other channel.
B - Control goes to a fail-safe position.
C - The channel in control supplies the winding of the other channel.

73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-20-00 FADEC PRINCIPLE

CONTENTS:

FADEC PRINCIPLE

GENERAL

The Full Authority Digital Engine Control system manages the engine thrust and optimizes the performance.

FADEC

The FADEC consists of the Electronic Engine Control and its peripheral components and sensors used for control and monitoring.
The Electronic Engine Control (EEC) is in relation with the other aircraft systems through the Engine Interface Unit (EIU).
The primary parameters (EPR, N1, N2, EGT, Fuel Flow) are sent directly by the EEC to the ECAM. The secondary parameters are sent to the ECAM through the EIU.

ENGINE INTERFACE UNIT (EIU)

Each Engine Interface Unit, located in the avionics bay, is an interface concentrator between the airframe and the corresponding FADEC located on the engine.
There is one EIU (Engine Interface Unit) for each engine.

POWER MANAGEMENT

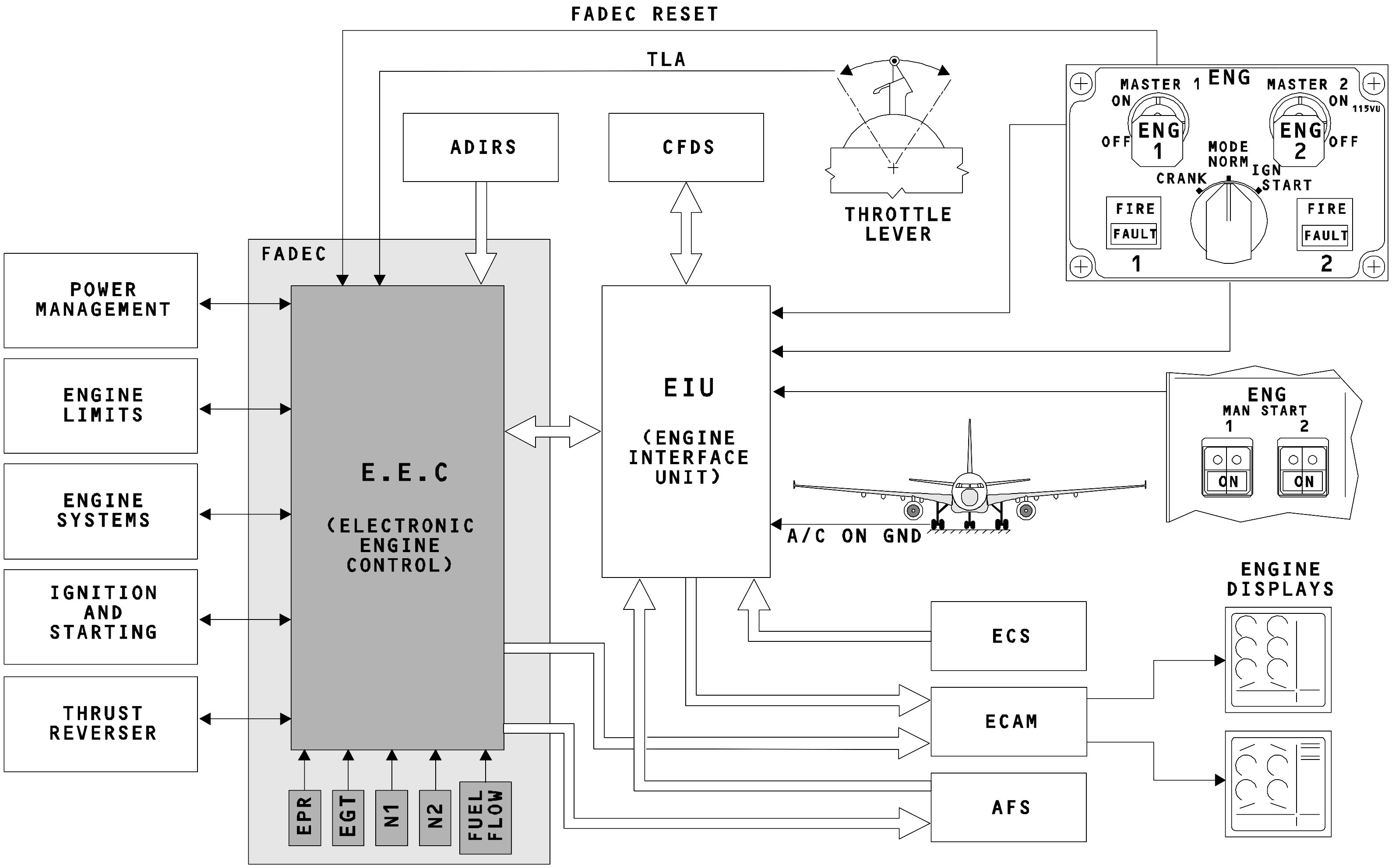
The FADEC provides automatic engine thrust control and thrust parameter limit computation.
The thrust is computed according to the Exhaust Pressure Ratio (EPR) (in normal mode) or N1 (in back-up mode). In fact, when the EPR mode is no longer operational the FADEC automatically reverts to the N1 alternate control mode.
The FADEC manages power according to two thrust modes:

- Manual mode depending on Throttle Lever Angle (TLA),
- autothrust mode depending on autothrust function generated by the AFS (Auto Flight System).

The FADEC also provides two idle mode selections:

- Approach idle,
- minimum idle.

Approach idle is obtained when the slats are extended.
Minimum idle can be modulated up to approach idle depending on air conditioning, engine anti-ice and wing anti-ice demands.



FADEC PRINCIPLE

FADEC PRINCIPLE

ENGINE LIMITS

The FADEC provides overspeed protection for N1 and N2, in order to prevent the engine from exceeding limits, and also monitors the Exhaust Gas Temperature (EGT) and Exhaust Pressure Ratio (EPR).

ENGINE SYSTEMS

The FADEC provides optimal engine operation by controlling the:

- Fuel Flow,
- Compressor Airflow and Turbine Clearance.

IGNITION AND STARTING

The FADEC controls the engine start sequence. It monitors EPR, N1, N2, and EGT parameters and can abort or recycle an engine start.
The FADEC controls the ignition and starting in automatic or manual mode when initiated from the ENGine start or ENGine MAN START panels.

THRUST REVERSER

The FADEC supervises the thrust reverser operation entirely.
In case of inadvertent deployment, the FADEC will command the automatic restowing sequence.
Note that during reverse operation the thrust is controlled as a function of N1.

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SELF EXAMINATION

What is the FADEC?

A - An engine control box.
B - The EEC and its peripheral sensors and components.
C - A throttle control unit.

Which of the following is controlled by the FADEC?

A - The EIU.
B - The Throttle Lever Angle.
C - The engine thrust rating.

How does the EEC send the engine parameters to the ECAM?

A - Directly.
B - Through the EIU.
C - Directly, for the primary parameters, and through the EIU for the secondary parameters.

73 - ENGINE FUEL AND CONTROL CONTROL (FADEC)

73-25-00 EEC INTERFACES

CONTENTS:

EEC INTERFACES

GENERAL

In order to provide a full range of engine control and monitoring, the EEC interfaces with the following sub systems:

- Air Data computers, which transmit air data for engine control,
- Engine Interface Unit (EIU), which concentrates aircraft signals and transmits them to the EEC,
- For cockpit indication and control, and autothrust control, the EEC sends signals to computers,
- Engine sensors and controls.

DIGITAL INPUTS

Inputs of each channel are isolated in order to prevent failure propagation. Each channel receives inputs for both the Air Data Inertial Reference Units (ADIRUs) and the Engine Interface Unit (EIU).
The EEC performs a fault detection on its input parameters by determining if they are valid. This check is made by applying a range of tests to each input.
Faults detected by the EEC are annunciated and recorded for maintenance or crew action, if required.
The ADIRUs send air data parameters to the EEC for engine control.
The EEC performs validation tests and selection logic between air data signals from the ADIRUs and the engine sensors.
ADIRU data is preferred over engine data.
The air data used to validate P0, TAT, PT, Mach for the power management and engine controls are :

- Total Air Temperature (TAT), TOTal PRESSure, Altitude (P0), Mach number, from the ADIRUs,
- P2, T2 and P0 from engine sensors.

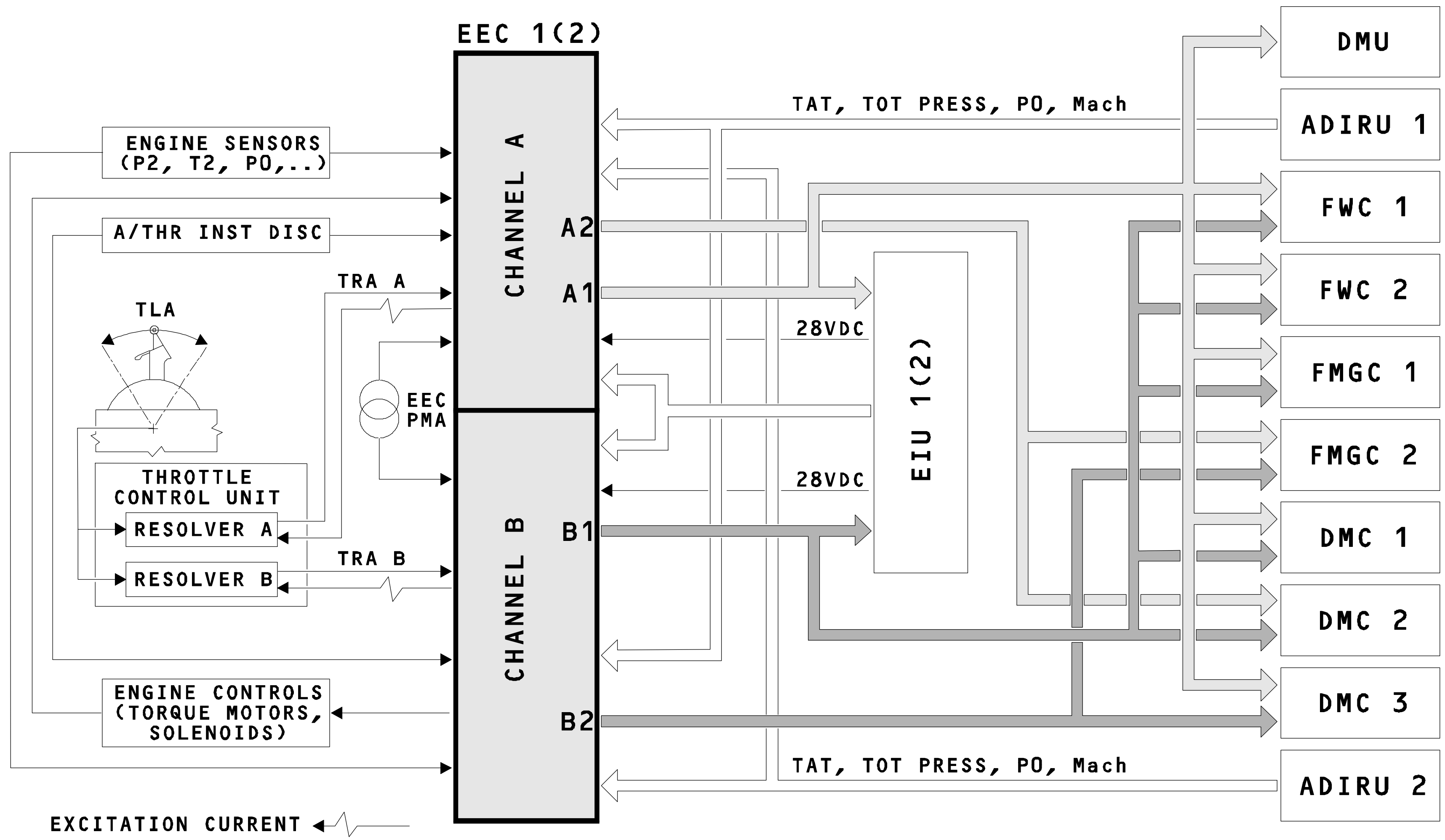
DIGITAL OUTPUTS

Each channel has 2 output ports and each bus has a separated line driver (A1, A2, B1, B2) in such a way that propagation of failures is prevented.
The EEC output buses provide :

- Engine control parameters,
- Engine condition monitoring parameters
- EEC status and fault indication,
- Engine rating parameters,
- FADEC system maintenance data.

The EEC transmits outputs continuously on all buses in normal operation, irrespective of whether the given channel is in active control or not.
The parameter values on the 2 output buses are normally identical as long as the cross channel data link is functioning.

NOTE : Channel switch over does not affect the output data of the EEC.



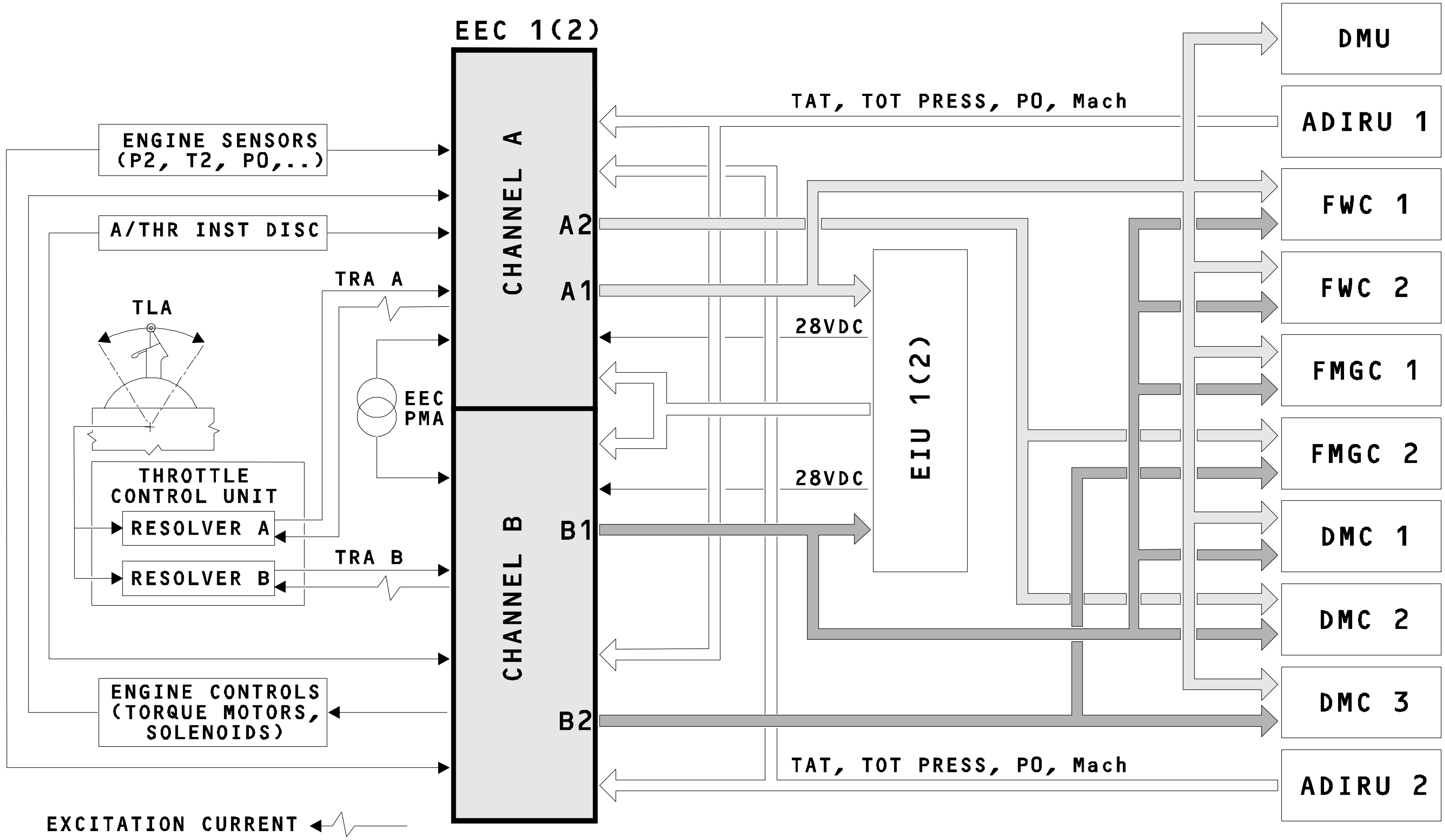
UFD4200
TMU73IJ03-P01 LEVEL 3

EEC INTERFACES

DISCRETE/ANALOG SIGNALS

The EEC receives the Throttle Resolver Angle (TRA) signal, the autothrust instinctive disconnect switch signals and engine sensor signals.
They are validated by the EEC. The EEC also sends signals to engine controls.
The resolvers of the Throttle Control Unit receive an excitation current from the EEC. The EEC checks the range limits, the rate limits and performs an interface fault detection test.

NOTE : 1 DEG TLA (Throttle Lever Angle) =>
1.9 DEG TRA (Throttle Resolver Angle)

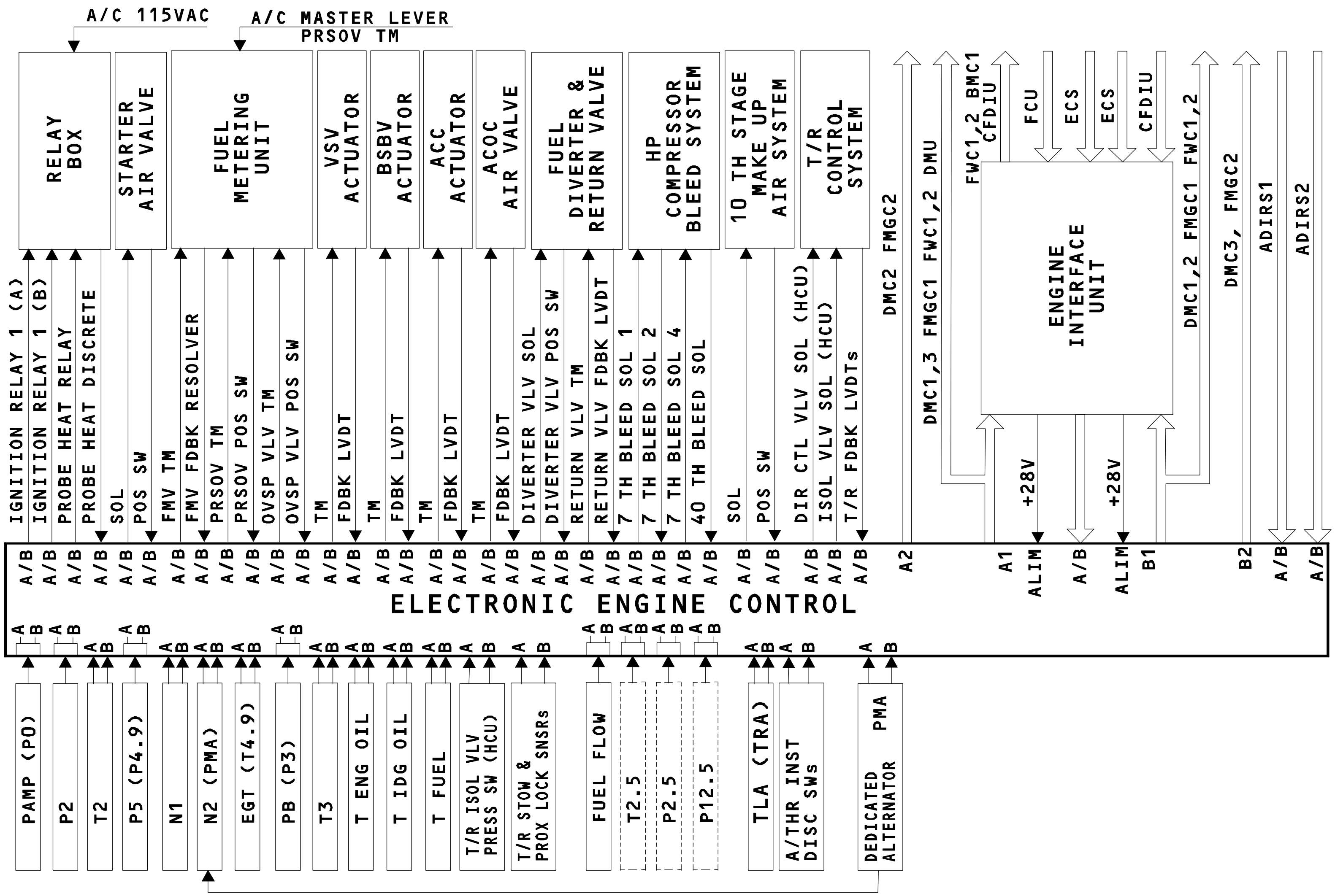


EEC INTERFACES

UFD4200

TMU73IJ03-P01 LEVEL 3

BLOCK DIAGRAM



EEC INTERFACES - BLOCK DIAGRAM

UFD4200
TMU73IJ03-P02 LEVEL 3

SELF EXAMINATION

What types of signals does the EEC send or receive ?
- A - Digital, discrete and analog.
- B - Digital and analog.
- C - Discrete and analog.

Where is the TRA directly sent to ?
- A - To the EIU.
- B - To the FMGC.
- C - To the EEC.

How do ADIRU 1 and 2 send signals to the EEC ?
- A - ADIRU 1 supplies channel A and ADIRU 2 supplies channel B.
- B - Both ADIRUs supply 2 channels.
- C - Only ADIRU 1 is used to supply the EEC.

73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-25-00 EIU INTERFACES

CONTENTS:

EIU INTERFACES

GENERAL

There are 2 Engine Interface Units (EIUs), one for each engine. The EIU is an interface concentrator between the aircraft and the FADEC system.
The main functions of the EIU are :

- To concentrate data from the cockpit panels
- To ensure the segregation of the 2 engines
- To provide the Electronic Engine Control (EEC) with an electrical power supply
- To give the necessary logic and information from the engine to the aircraft systems.

The EIU is composed of 5 main parts :

- Discrete and analog inputs,
- Digital inputs,
- Digital outputs,
- Discrete outputs,
- Power supply switching.

The EIU performs the following :

- Acquisition of information,
- Transmission of messages,
- Logics (Oil low pressure, APU boost...),
- Fault detection logic carried out by an internal BITE and transmission of the result to the CFDS.

INPUTS

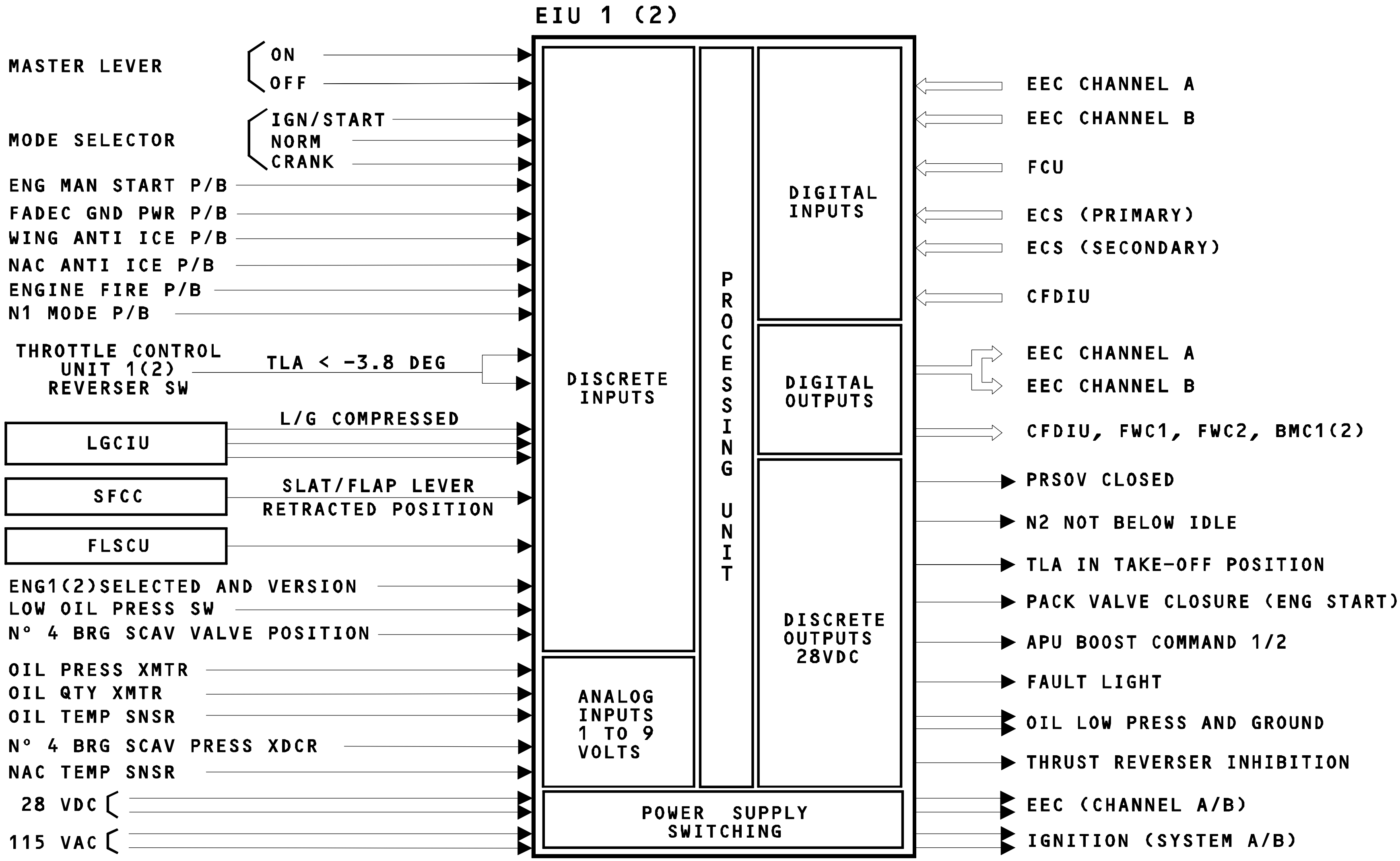
The EIU receives the following :

- Discrete signals which are of the ground/open circuit type,
- Analog inputs which are of differential type with a working range of 1 to 9 volts,
- Digital inputs on ARINC 429 lines.

OUTPUTS

The EIU sends the following :

- Digital output signals on ARINC 429 buses,
- Discrete signals which are of the 28 VDC/open circuit or ground/open circuit types.



EIU INTERFACES

UFD4200

TMU73IK03-P01 LEVEL 3

EIU INTERFACES

EEC INTERFACE

The EIU receives 2 ARINC 429 output data buses from EEC channels A and B and it uses data from the channel in control.
If some data is not available from the control channel, data from the other channel is used.
The EIU looks at particular engine data on the EEC digital data flow to interface this with other aircraft computers and with cockpit panels (control and monitoring).
The EIU sends information, coming from all aircraft computers which have to communicate with the EEC, through an output ARINC 429 data bus.
The EIU does not deal with ADIRU and thrust lever information as they communicate directly with the EEC.
NOTE: There is no data flow during the EIU internal test or initialization.

FMGS INTERFACE

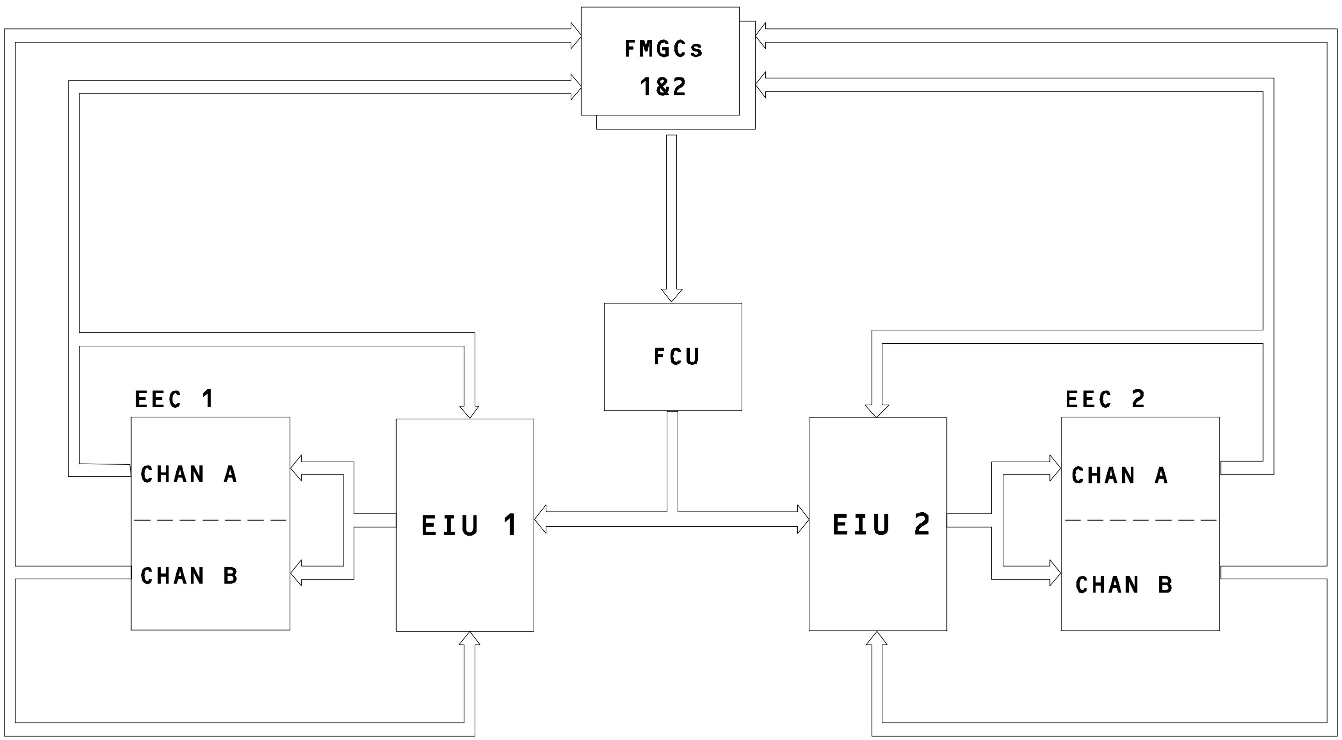
The Autothrust function is provided by the FMGS.
Therefore, the FMGS sends all command signals for engine power management via the FCU and both EIUs.
The FMGS assumes the following functions:

- computation of EPR target,
- selection of autothrust modes,
- alpha floor protection,
- flexible take-off,
- autothrust engagement.

The EEC directly sends specific feedback outputs to the FMGS without going through the EIU.
The EIU also receives this data but does not transmit it to FMGS.

The EEC feedback output data to FMGC is as follows:

- Thrust Resolver Angle (TLA),
- EPR command,
- EPR actual,
- EPR target (feedback),
- EPR limit (selected),
- EPR max,
- EPR reference throttle,
- thrust mode (selected),
- fuel flow,
- bleed configuration (feedback),
- engine rating modification,
- flexible temperature (feedback).



TMU73IK03-P02 LEVEL 3

UFD4200

EIU INTERFACES - FMGS INTERFACES

EIU INTERFACES

ECS INTERFACE

The EIU receives two input buses from the Environmental Control System (ECS) primary and secondary computers of the Zone Controller.
The ECS determines the various air bleed configurations according to logics of the air conditioning, wing anti-ice, nacelle anti-ice.
This information is transmitted by the EIU to the EEC to compute the bleed air demand required at the engine customer bleed ports.

ENGINE START CONTROL

The EIU receives and generates all starting signals from the cockpit engine panels.
Therefore engine starting is not possible in case of EIU failure.
The control panels provide the EIU with the following signals:

- Engine start mode selector position,
- Master lever position,
- Manual start pushbutton.

The EIU provides all starting signals to the EEC and to the engine start panel FAULT light.

CFDS INTERFACE

The CFDIU communicates with the BITE memory of the EIU and with the BITE memory of the EEC via the EIU.
The EIU interfaces with the CFIU to generate the EIU and the FADEC fault messages on the MCDU.
To access the FADEC menu function, the CFDS interrogates the EEC BITE memory through the EIU.

BMC INTERFACE

There is an interface between the EIU and the pneumatic system BMC for Engines 1 and 2.
During engine start, the EIU generates a ground signal for the BMC when the start valve moves away from the closed position.
On receipt of this ground signal, the BMC closes the pneumatic system Pressure Regulating Valve.

OTHER INTERFACES

The EIU also receives other signals from various aircraft systems for control and monitoring purposes.
The EIU also generates signals for various aircraft systems.

POWER SUPPLY

The EIU receives the following :

- 28VDC for its own power supply and for the FADEC power supply,
- 115 VAC for engine ignition system power supply.

NOTE: In case of EIU failure, the power supply for FADEC and ignition is preserved (fail safe position).

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SELF EXAMINATION

What happens in case of failure of the EIU?
- A - The TLA signal is no longer available.
- B - The engine goes to flight idle mode.
- C - The engine cannot be restarted from the engine start panel.

For the autothrust function, the EIU interfaces directly with :
- A - FMGC 1.
- B - FMGC 2.
- C - The FCU.

Which signals does the EIU send ?
- A - Digital signals only.
- B - Digital and discrete signals.
- C - Digital, discrete and analog signals.

73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-20-00 FADEC COMPONENTS

CONTENTS:

FADEC COMPONENTS

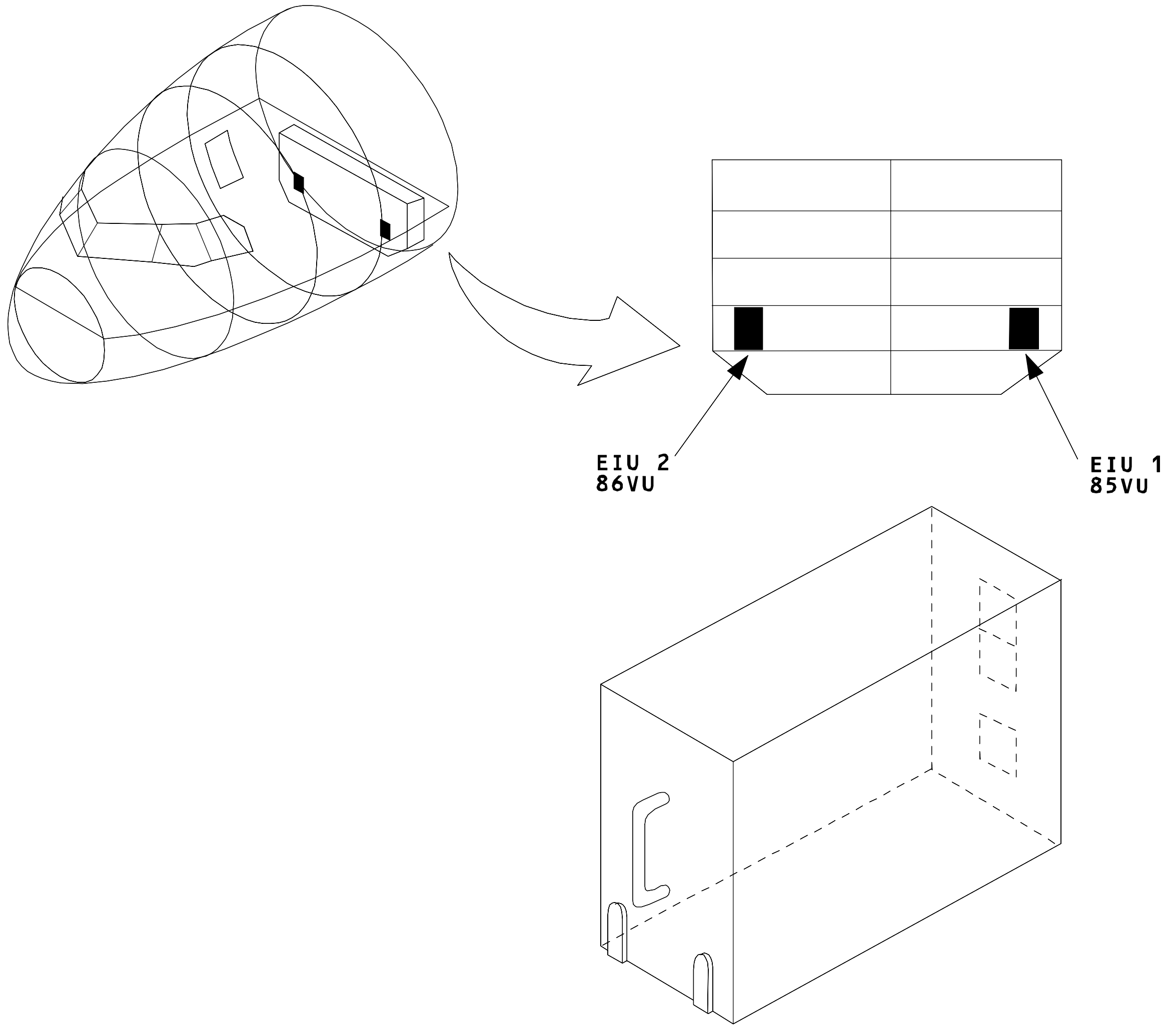
ENGINE INTERFACE UNIT (EIU)

IDENTIFICATION
FIN: 1KS1, 2KS2

LOCATION
ZONE: 127, 128

COMPONENT DESCRIPTION
Engine Interface Unit:

- EIU 1 for engine 1
- EIU 2 for engine 2



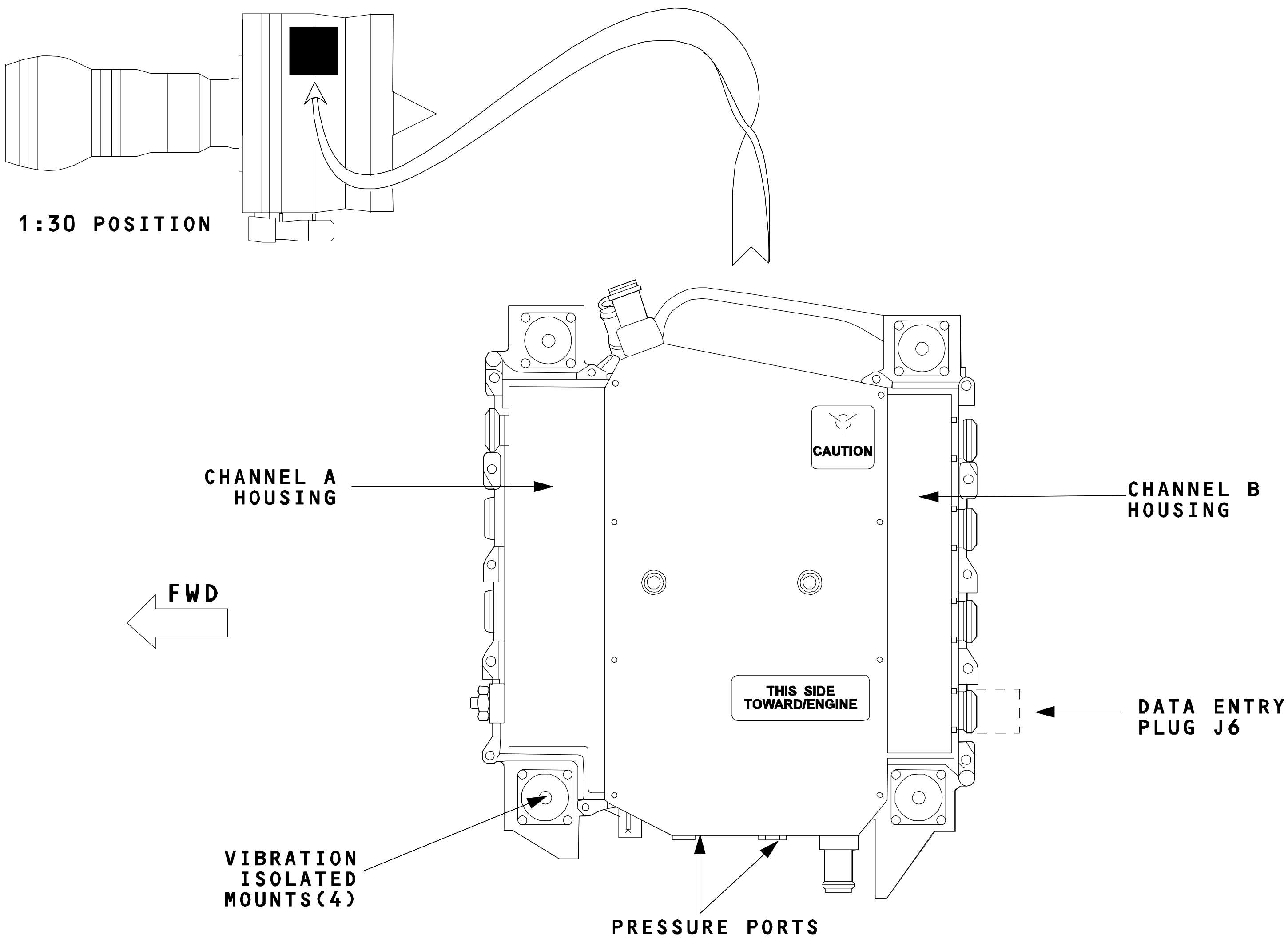
FADEC COMPONENTS - ENGINE INTERFACE UNIT (EIU)

FADEC COMPONENTS

ELECTRONIC ENGINE CONTROL (EEC)

IDENTIFICATION
FIN: 4000KS

LOCATION
ZONE: 436, 446



UFD4200

TMU73IN01-P02 LEVEL 3

FADEC COMPONENTS - ELECTRONIC ENGINE CONTROL (EEC)

FADEC COMPONENTS

ELECTRONIC ENGINE CONTROL (EEC) (Cont'd)

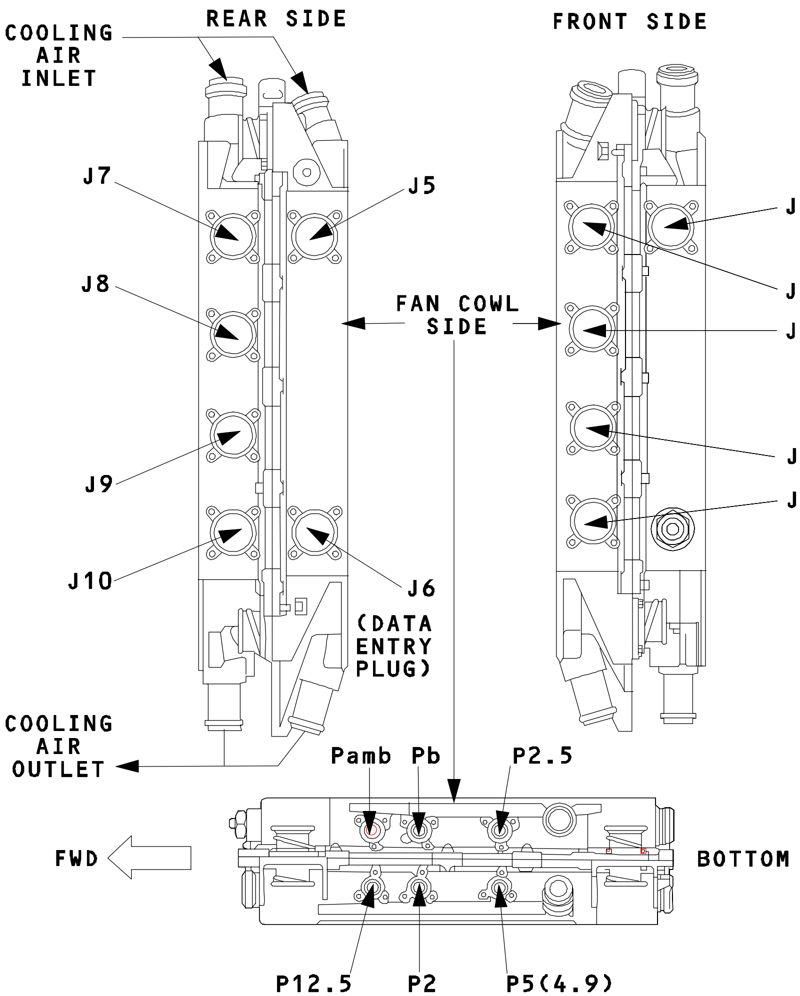
EEC HARNESS/PRESSURE CONNECTIONS

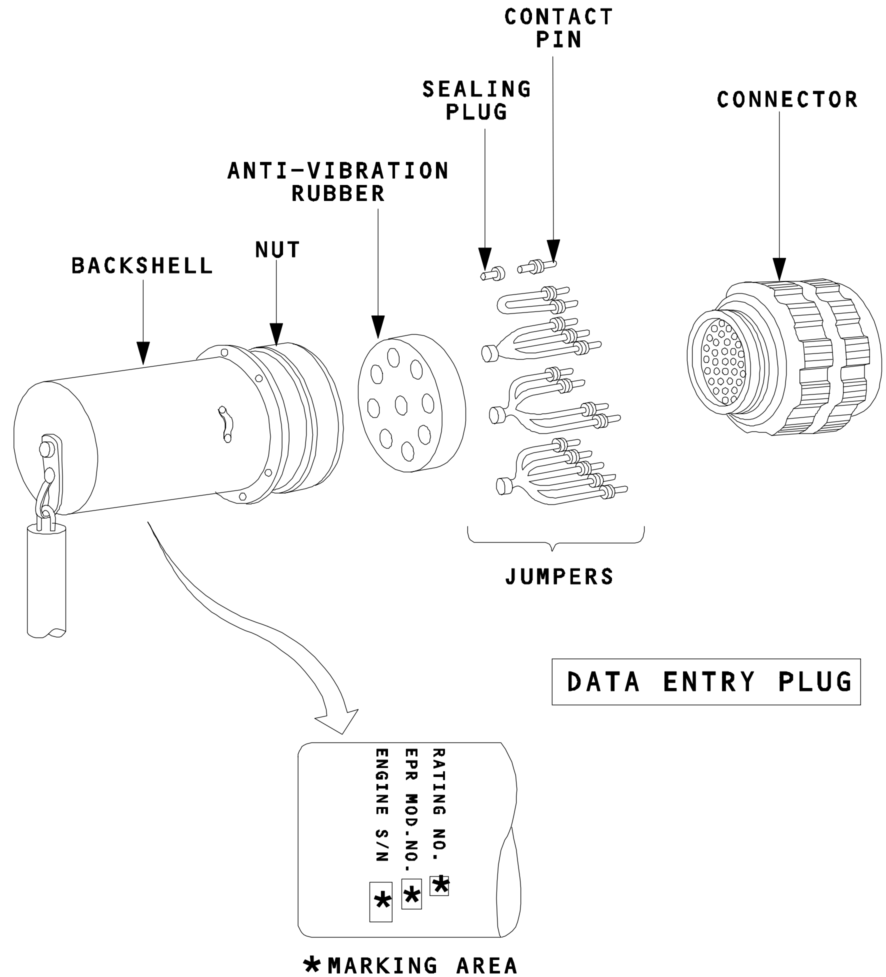
- Pamb - ambient air presssure - fan case sensor
- Pb - burner pressure (air pressure) P3/T3 probe used for monitoring (EEC)
- P2 - fan inlet pressure - P2/T2 probe
- P2.5 - booster stage outlet pressure
- P12.5 - fan outlet pressure - fan rake
- P2.5/P12.5 - Not a control parameter - used for monitoring (AIDS)
- P5 (P4.9) - L.P. Turbine exhaust pressure - P5 (P4.9) rake
- J1 to J11 - EEC Connectors

DATA ENTRY PLUG

NOTE: If the data inputs of the data entry plug J6 are lost, then an automatic reversion from EPR mode to unrated N1 mode occurs.

EEC HARNESS/PRESSURE CONNECTIONS





DATA ENTRY PLUG

TMU73IN01-P03 LEVEL 3

UFD4200

FADEC COMPONENTS - EEC - EEC HARNESS / PRESSURE CONNECTIONS / DATA ENTRY PLUG

FADEC COMPONENTS

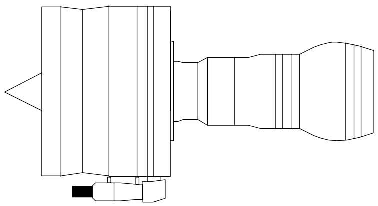
EEC DEDICATED GENERATOR

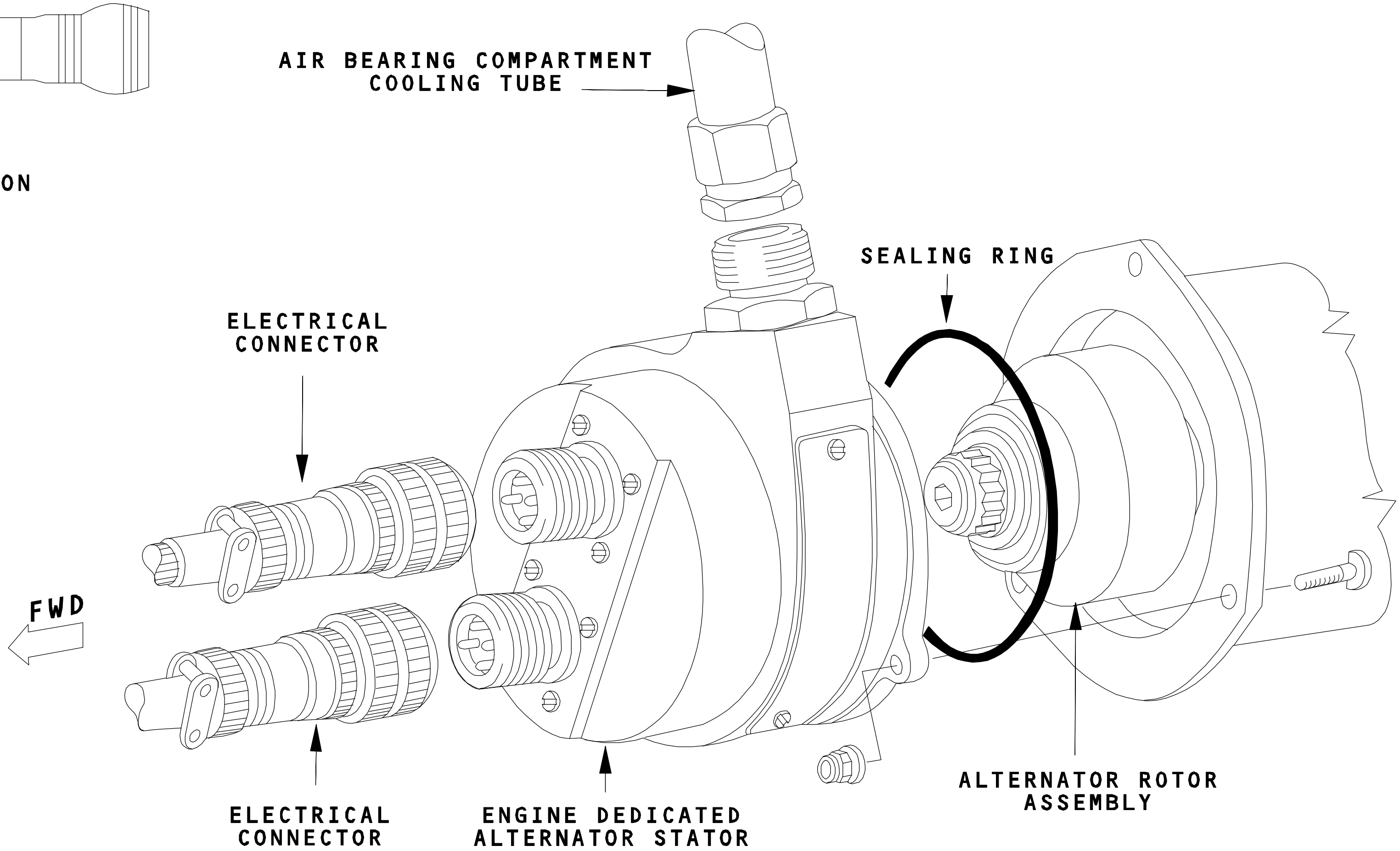
IDENTIFICATION
FIN: 4005EV

LOCATION
ZONE: 436, 446

COMPONENT DESCRIPTION

NOTE: The N2 speed signal is derived from the frequency output of the dedicated generator.





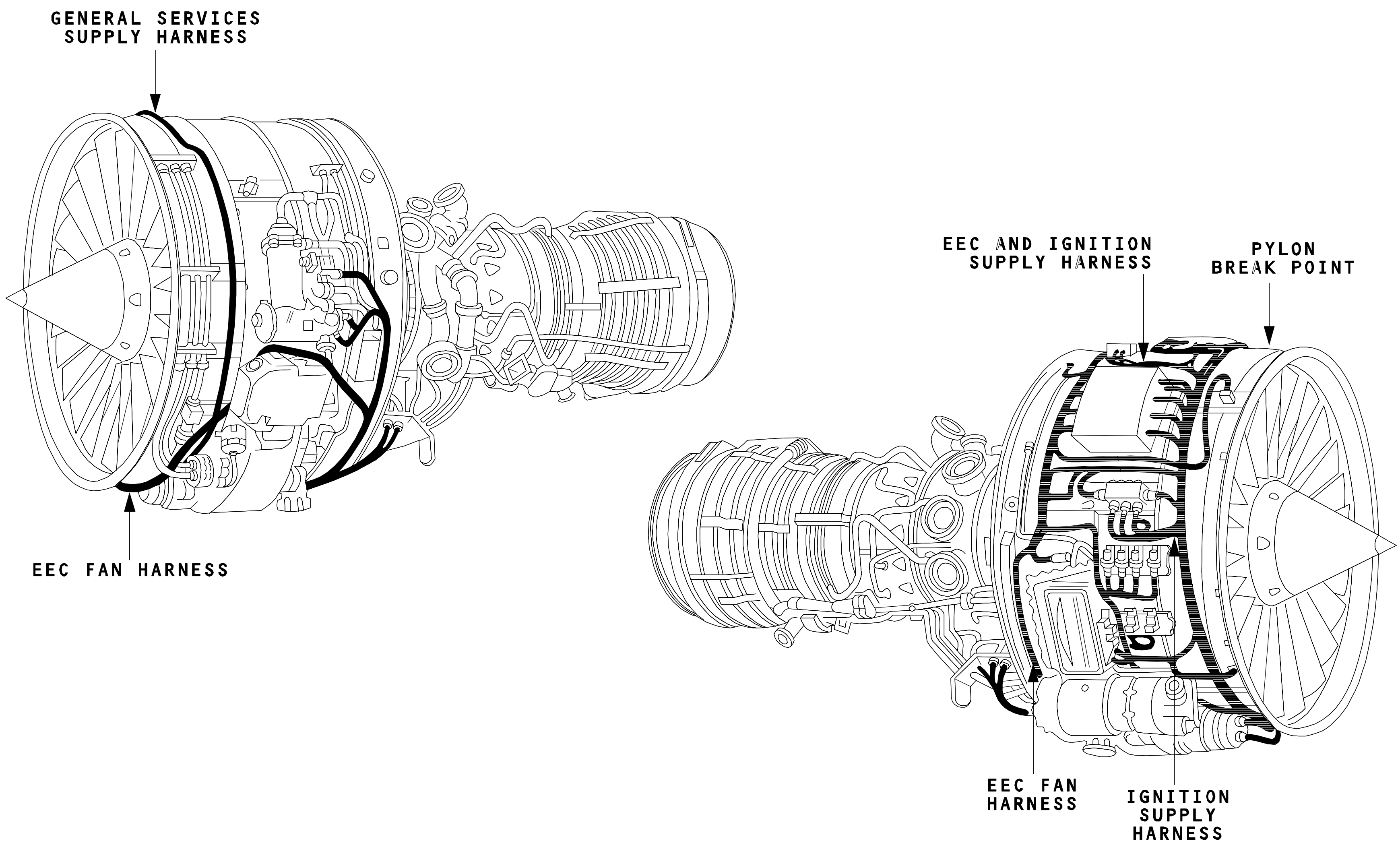
UFD4200

TMU73IN01-P04 LEVEL 3

FADEC COMPONENTS - EEC DEDICATED GENERATOR

FADEC COMPONENTS

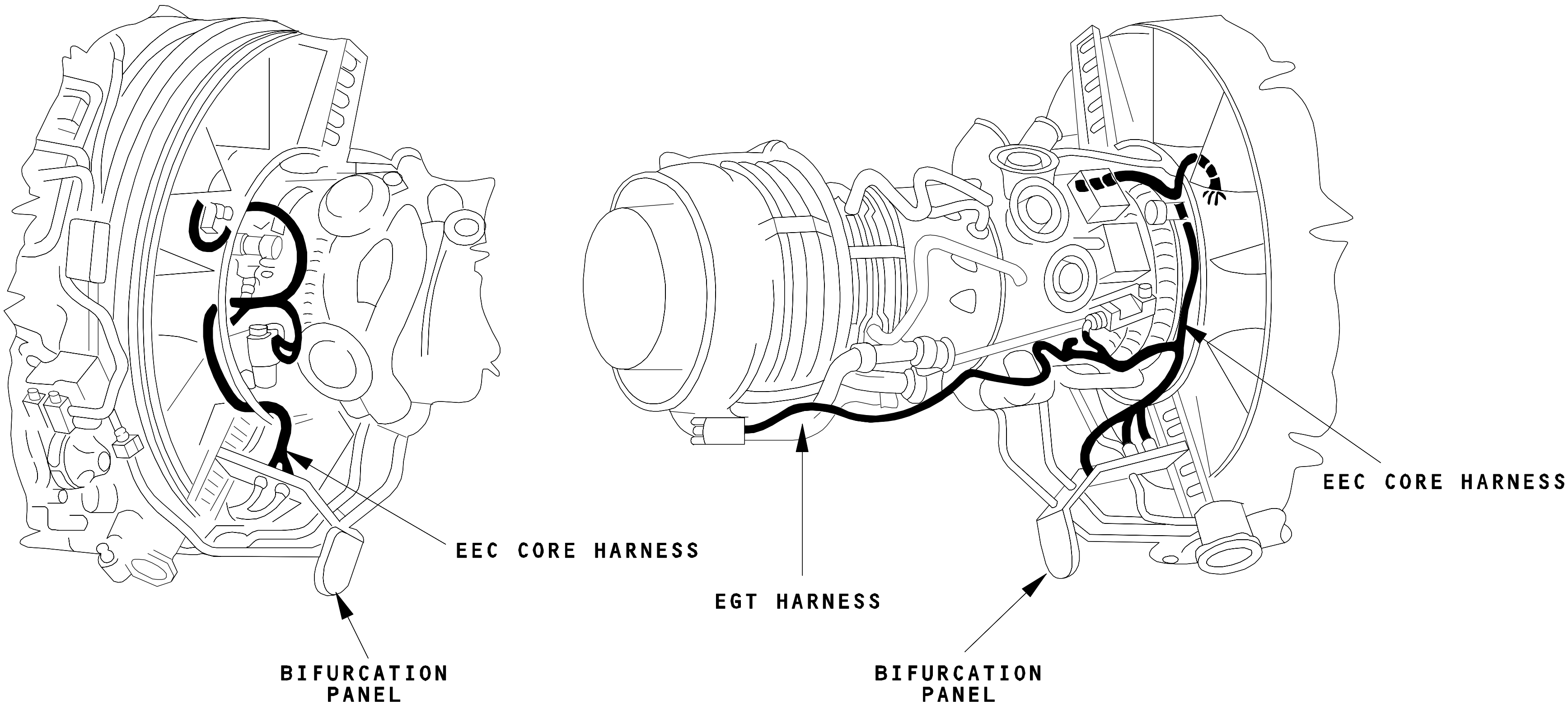
FAN ELEC HARNESSES



FADEC COMPONENTS - FAN ELEC HARNESSES

FADEC COMPONENTS

CORE ELEC HARNESSES



UFD4200
TMU73IN01-P06 LEVEL 3

FADEC COMPONENTS - CORE ELEC HARNESSES

FADEC COMPONENTS

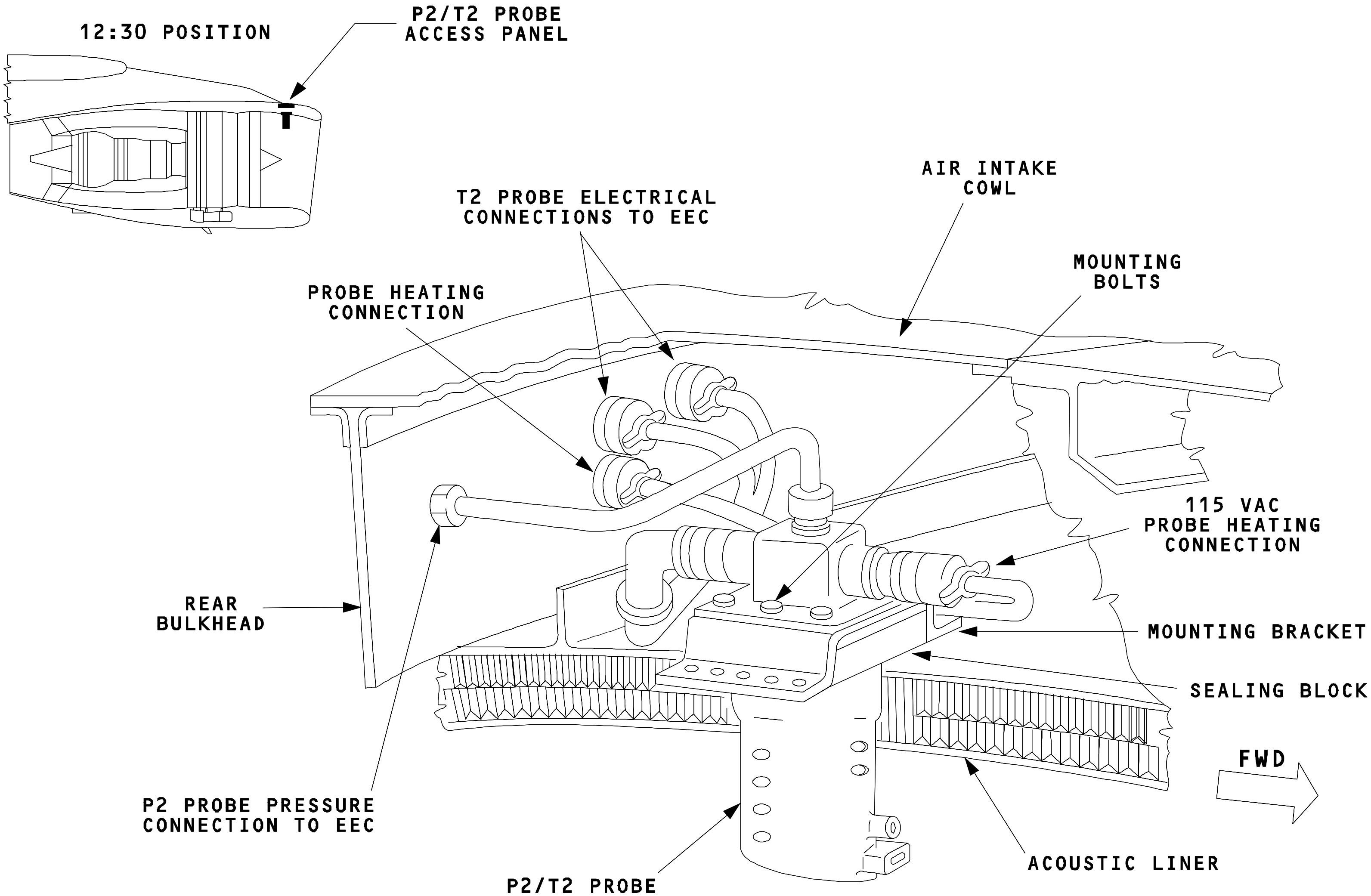
P2/T2 PROBE

IDENTIFICATION
FIN: 4014KS

LOCATION
ZONE: 433, 443

COMPONENT DESCRIPTION

NOTE: In case of loss of P2/T2 heating, an automatic reversion from EPR mode to unrated N1 mode occurs.



UFD4200

TMU73IN01-P07 LEVEL 3

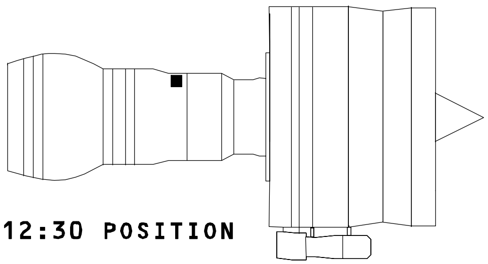
FADEC COMPONENTS - P2/T2 PROBE

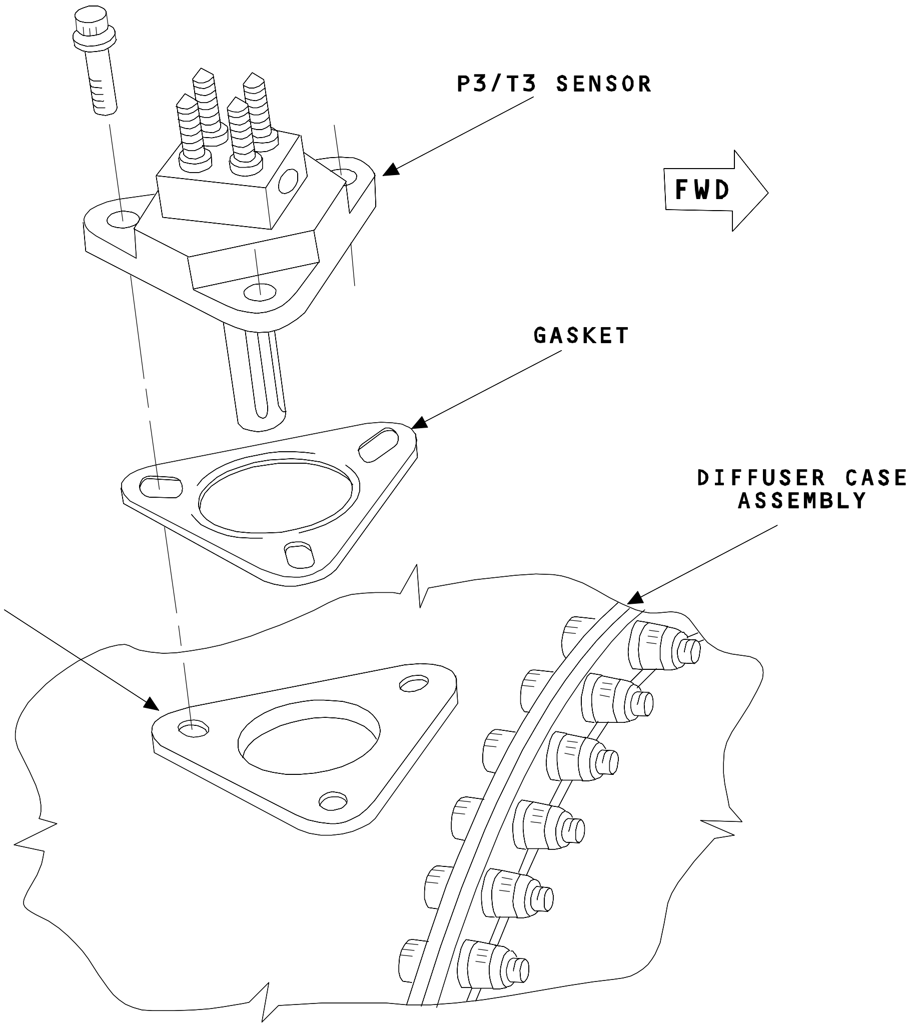
FADEC COMPONENTS

P3/T3 SENSOR

IDENTIFICATION
FIN: 2003EM

LOCATION
ZONE: 454, 464





UFD4200
TMU73IN01-P08 LEVEL 3

FADEC COMPONENTS - P3/T3 SENSOR

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73 - ENGINE FUEL AND CONTROL - CONTROL (FADEC)

73-20-00 EEC ELECTRICAL POWER SUPPLY CONTROL

CONTENTS:

EEC ELECTRICAL POWER SUPPLY CONTROL

GENERAL

The EEC is electrically supplied by:

- the aircraft network when N2 < 10% or when the dedicated generator has failed.
- the dedicated generator when N2 > 10%.

POWERING N2 < 10%

The EEC is supplied by the aircraft electrical power network when N2 is below 10%.
Each channel is independently supplied by the aircraft 28 volts through the EIU.
The aircraft 28VDC permits:

- automatic ground check of FADEC before engine running (FADEC GrouND PoWeR ON)
- engine starting (Master lever ON or mode selector on IGN or CRANK)
- powering the EEC while engine reaches 10% N2.

NOTE: EIU takes its power from the same bus bar as EEC.

POWERING N2 > 10%

As soon as the engine is running above 10% of N2, the dedicated generator directly supplies the EEC.
The dedicated generator supplies each channel with three-phase AC.
Two transformer rectifiers provide 28VDC power supply to channels A and B.

- Switching between the aircraft 28VDC supply and the dedicated generator power supplies is done automatically by the EEC.

AUTO DEPOWERING

The FADEC is automatically depowered on the ground, through the EIU, after engine shutdown.
EEC automatic depowering occurs on the ground:

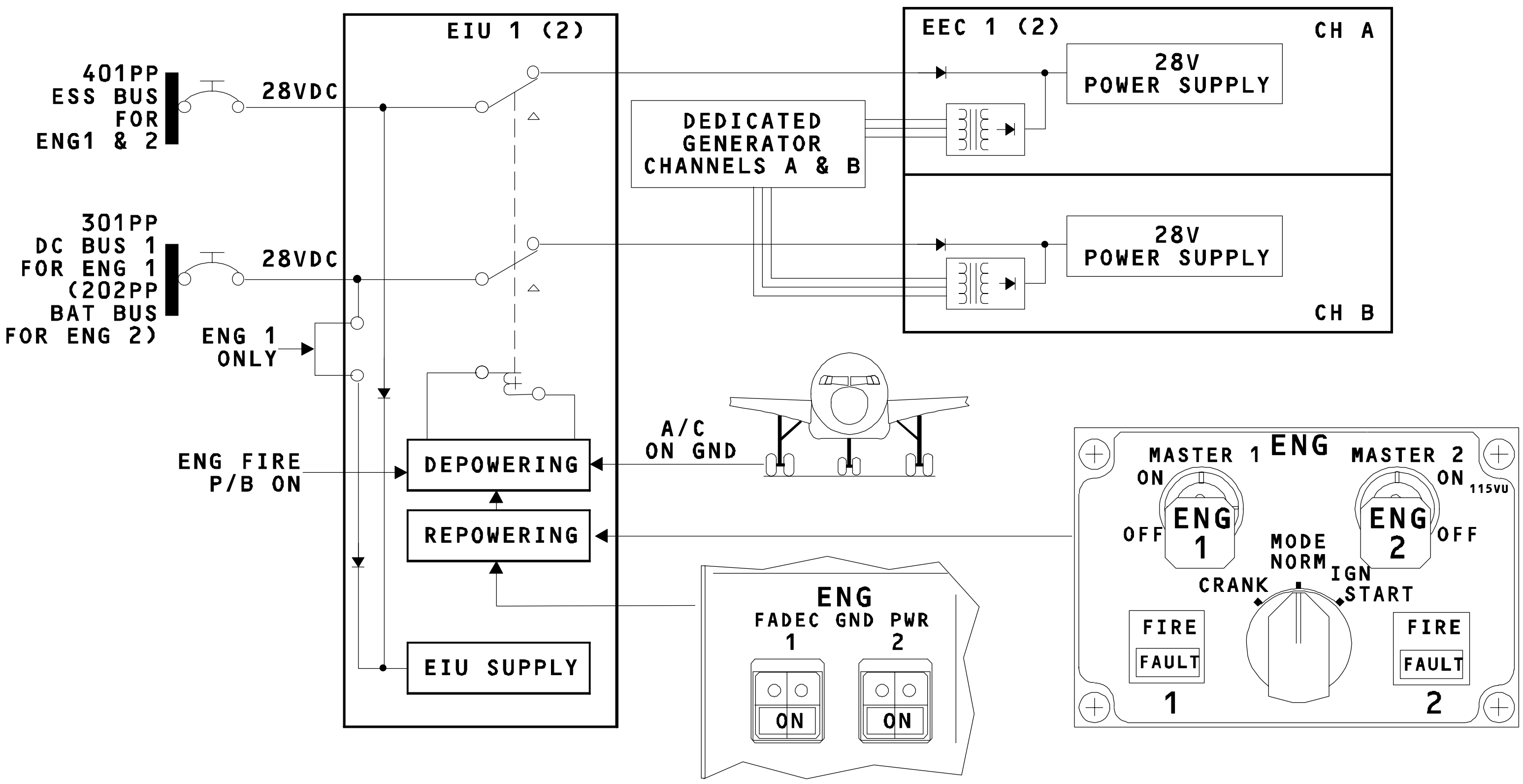
- 5 mn after aircraft power up.
- 5 mn after engine shut down.

NOTE: An action on the ENG FIRE pushbutton provides EEC power cut off from the aircraft network.

MANUAL REPOWERING

For maintenance purposes and MCDU engine tests, the Engine FADEC Ground Power Panel permits FADEC power supply to be restored on the ground with engines shut down.
When the corresponding ENG FADEC GND PWR pushbuttom is pressed ON the EEC recovers its power supply.

NOTE: The FADEC is also repowered as soon as the engine start selector is in IGN/START or CRANK position, or the master lever is selected ON.



EEC ELECTRICAL POWER SUPPLY CONTROL

UFD4200
TMU73I001-P01 LEVEL 3

SELF EXAMINATION

With aircraft on the ground, when is the EEC automatically depowered?

A - At aircraft power up.
B - As soon as engine is shut down.
C - 5 mn after engine shutdown.

What is the purpose of the ENG FADEC GND PWR panel?

A - To restore EEC power.
B - To restore EIU power.
C - To cut off EEC power.

When does the dedicated generator supply the EEC?

A - When N2 is above 10%.
B - When an engine is started.
C - Only if the Aircraft Electrical Power fails.

74 - IGNITION AND STARTING

74-00-00 IGNITION AND STARTING SYSTEM PRESENTATION

CONTENTS:

IGNITION AND STARTING SYSTEM PRESENTATION

GENERAL

The ignition system provides the electrical spark needed to start or continue engine combustion.
The ignition system is made up of two independent subsystems energized by a relay box.
Each subsystem includes an ignition exciter, a coaxial shield ignition lead and an igniter plug.

The pneumatic starting system drives the engine HP rotor at a speed high enough for a ground or in flight start to be initiated.
The start system is made up of the start valve and the starter.

CONTROL AND INDICATING

The EEC controls the ignition through the relay box and starting through the start valve, either in automatic or manual mode.
The operation of the start valve and of the ignition system is displayed on the ENGINE ECAM page.

AUTOMATIC START

During an automatic start, the EEC opens the start valve, then the ignition exciter is energized when the HP rotor speed is nominal.
The EEC provides full protection during the start sequence.
When the automatic start is completed, the EEC closes the start valve and cuts off the ignition.
In case of an incident during the automatic start the EEC aborts the start procedure.

MANUAL START

During a manual start, the start valve opens when the engine MANual START pushbutton is pressed in, then the ignition system is energized when the MASTER control lever is set to the ON position.

NOTE : there is no automatic shut down function in manual mode.

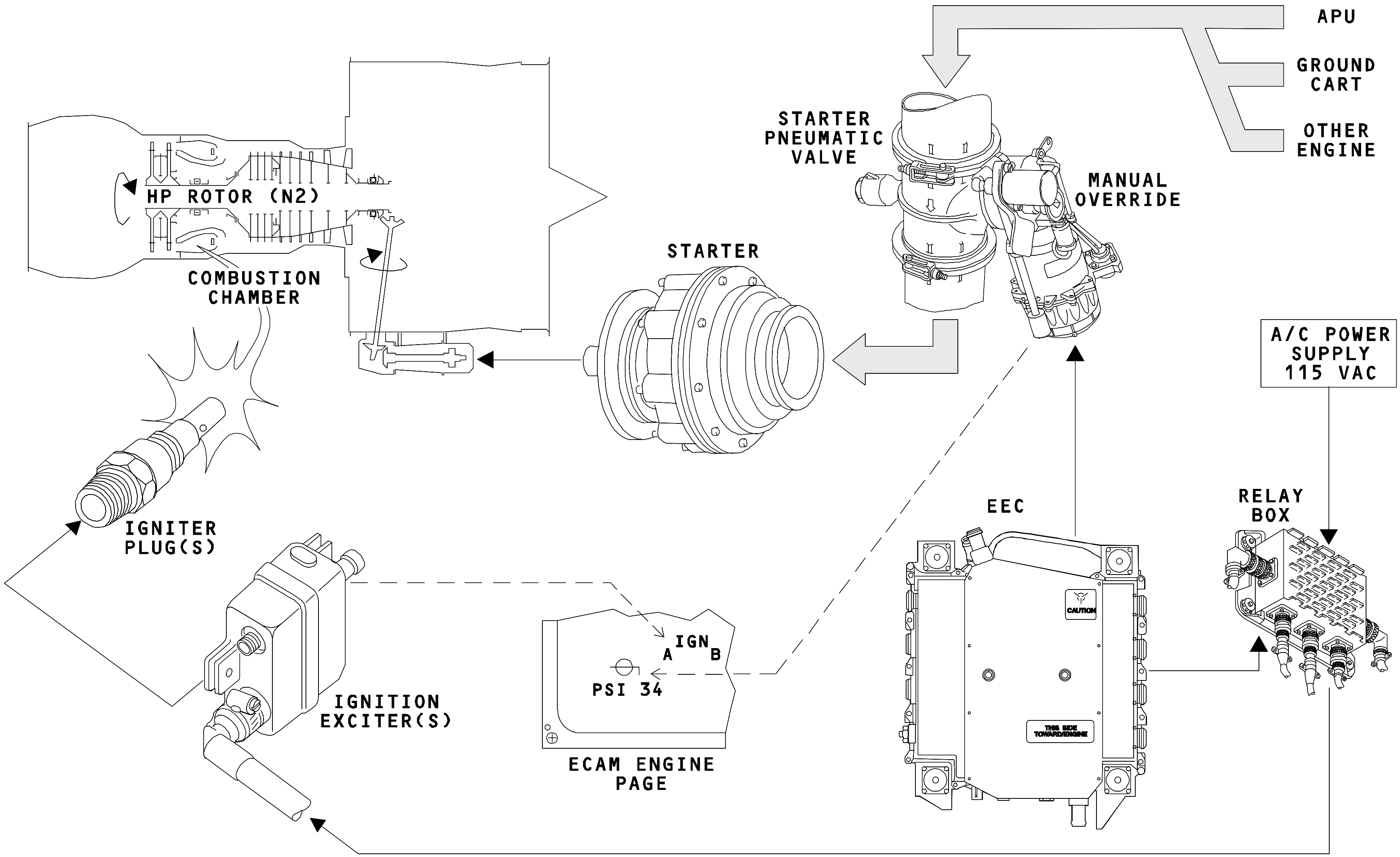
CRANKING

Engine motoring could be performed for dry cranking or wet cranking sequences.

NOTE : during cranking ignition is inhibited.

CONTINUOUS IGNITION

With engine running, continuous ignition can be selected via the EEC either manually using the rotary selector or automatically by the FADEC.



IGNITION AND STARTING SYSTEM PRESENTATION

IGNITION AND STARTING SYSTEM PRESENTATION

SAFETY PRECAUTIONS

Safety precautions have to be taken prior to working in this area.

Warning : the EEC and the relay box send 115 volts to the ignition boxes, which convert it and send high energy pulses through the ignition leads to the igniters plugs.

MAINTENANCE PRACTICES

To increase aircraft dispatch, the start valve is equipped with a manual override. For this manual operation, the mechanic has to be aware of the engine safety zones.

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SELF EXAMINATION

How does the starter operate ?

A - Electrically.
B - Pneumatically.
C - Hydraulically.

In which case can the EEC abort the start ?

A - Automatic start and manual start.
B - Automatic start only.
C - Wet motoring.

Of which type is the ignition system ?

A - Low voltage, low energy.
B - Low voltage, high energy.
C - High voltage, high energy.

74 - IGNITION AND STARTING

74-31-00 IGNITION AND STARTING SYSTEM D/O

CONTENTS:

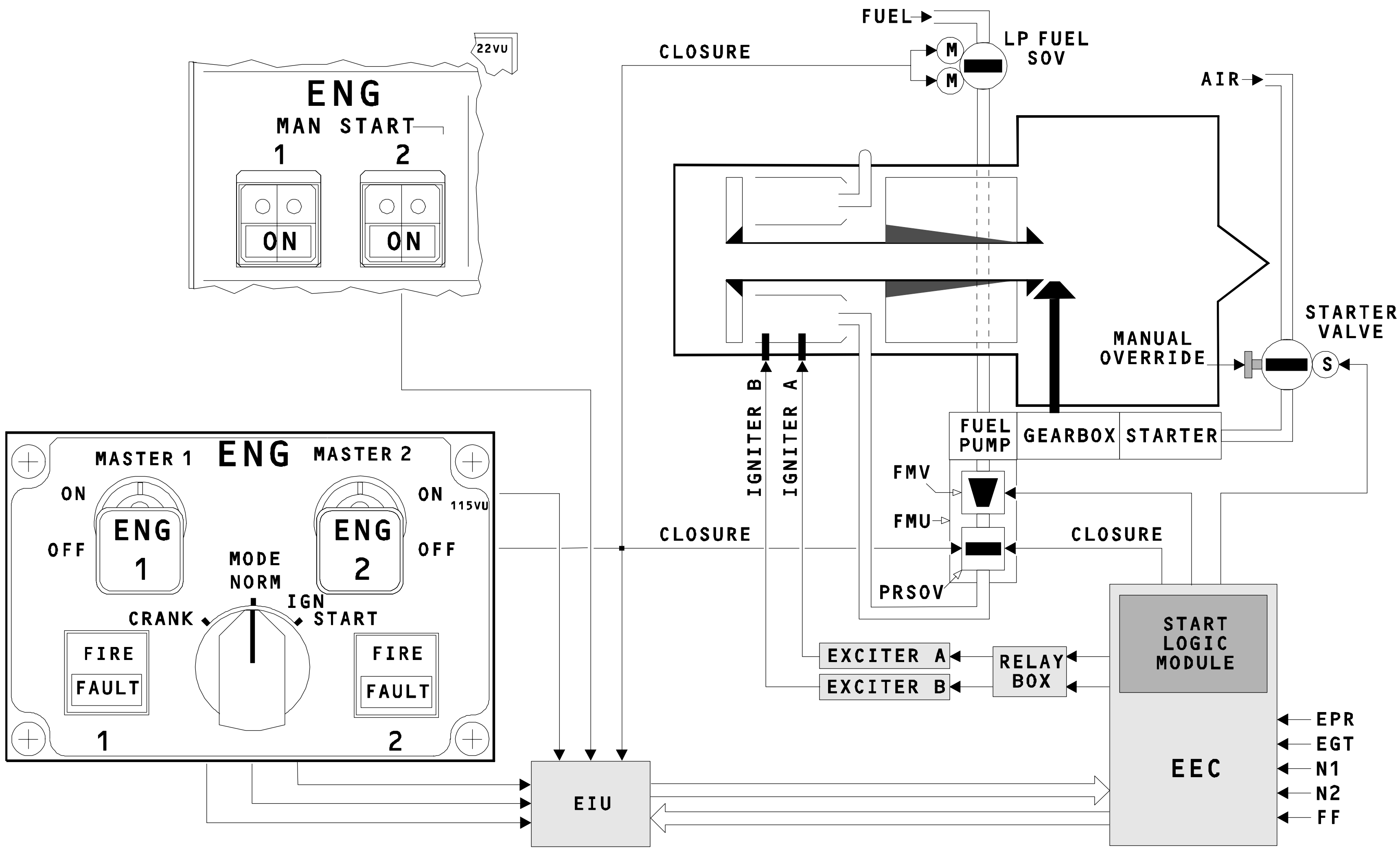
IGNITION AND STARTING SYSTEM D/O

GENERAL

The Electronic Engine Control (EEC) controls and monitors the start sequence either in automatic or manual mode.
The start sequence is aborted below 50% N2 in case of:

- starter valve failure
- ignition failure
- Pressure Raising Shut Off Valve (PRSOV) failure
- hot start
- hung start
- no N1 rotation.

The system consists of a starter valve, a pneumatic starter, a relay box, two ignition exciters and igniters A and B.
The starter valve is fitted with a manual override for mechanic operation on ground.



IGNITION AND STARTING SYSTEM D/O - GENERAL

UFD4200

TMU74IB02-P01 LEVEL 3

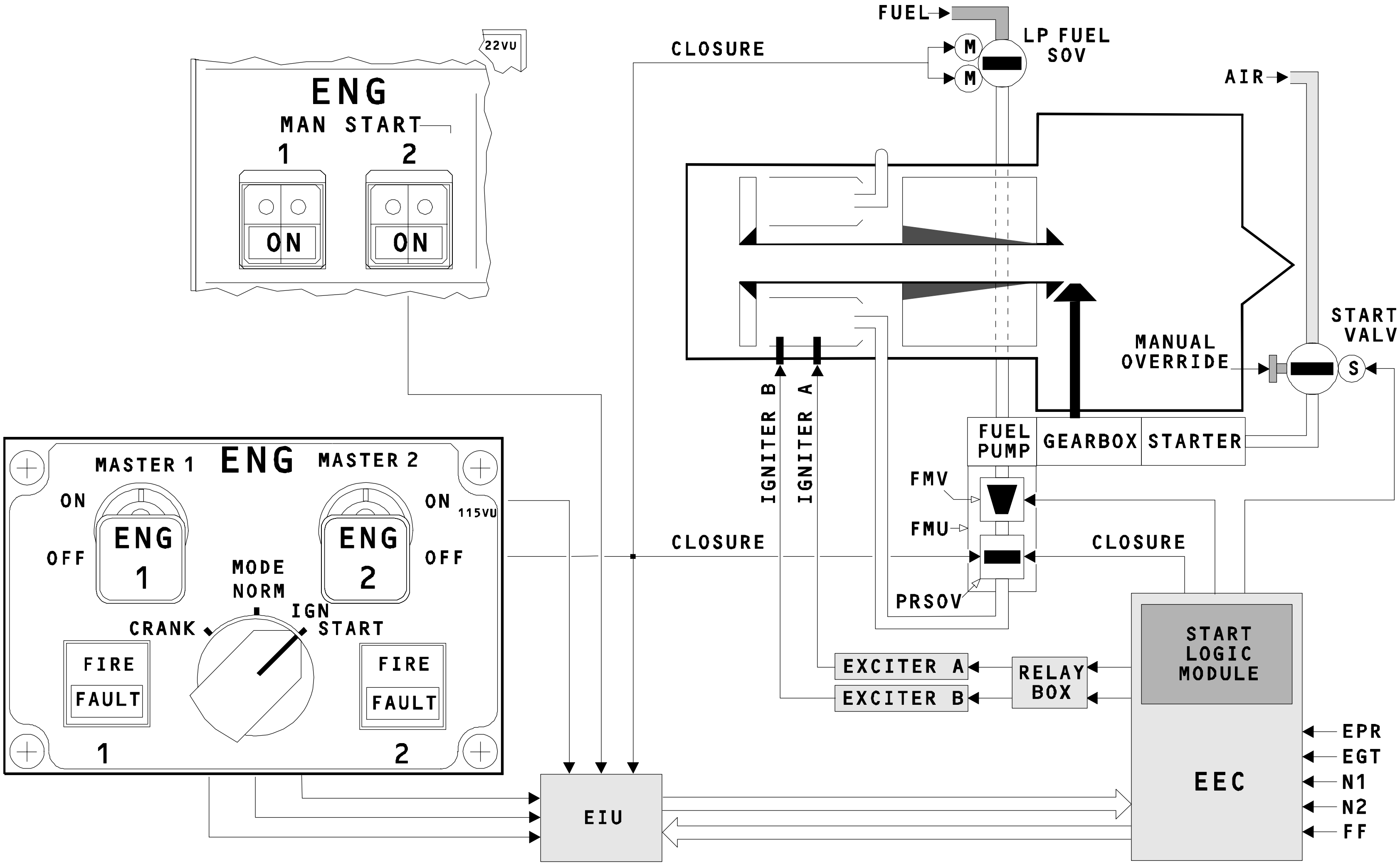
IGNITION AND STARTING SYSTEM D/O

AUTO START

Aircraft configuration:

- APU is running and APU bleed air is available.

When the MODE selector is set to IGN START, the EEC is armed for the start sequence.



IGNITION AND STARTING SYSTEM D/O - AUTO START

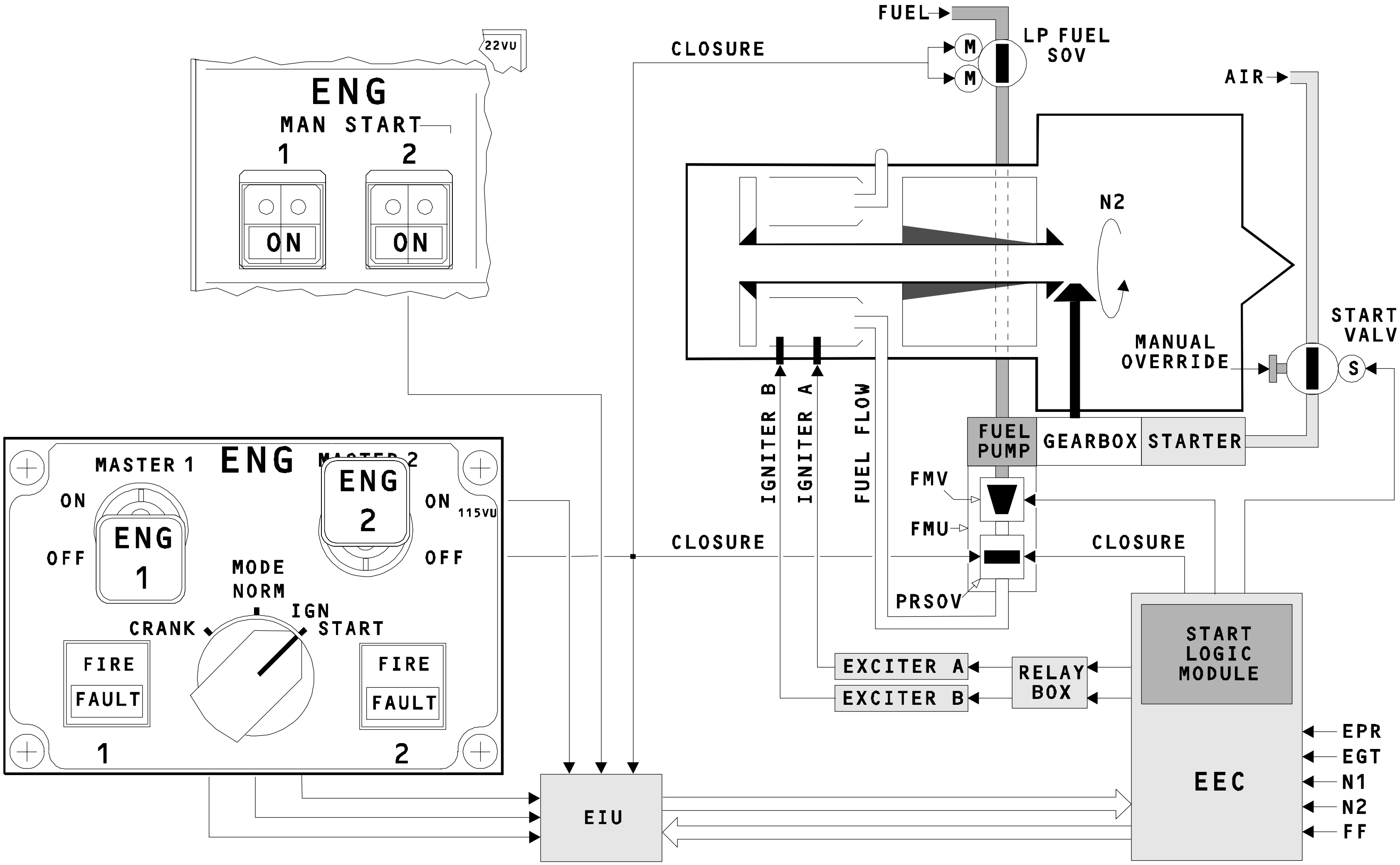
UFD4200
TMU74IB02-P02 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

AUTO START (Cont'd)

As soon as the MASTER lever is set to ON, the LP fuel Shut Off Valve opens and the EEC opens the starter valve.

- N2 increases
- the Pressure Raising and Shut Off Valve (PRSOV) solenoid is de-energized because the MASTER lever is ON.



UFD4200

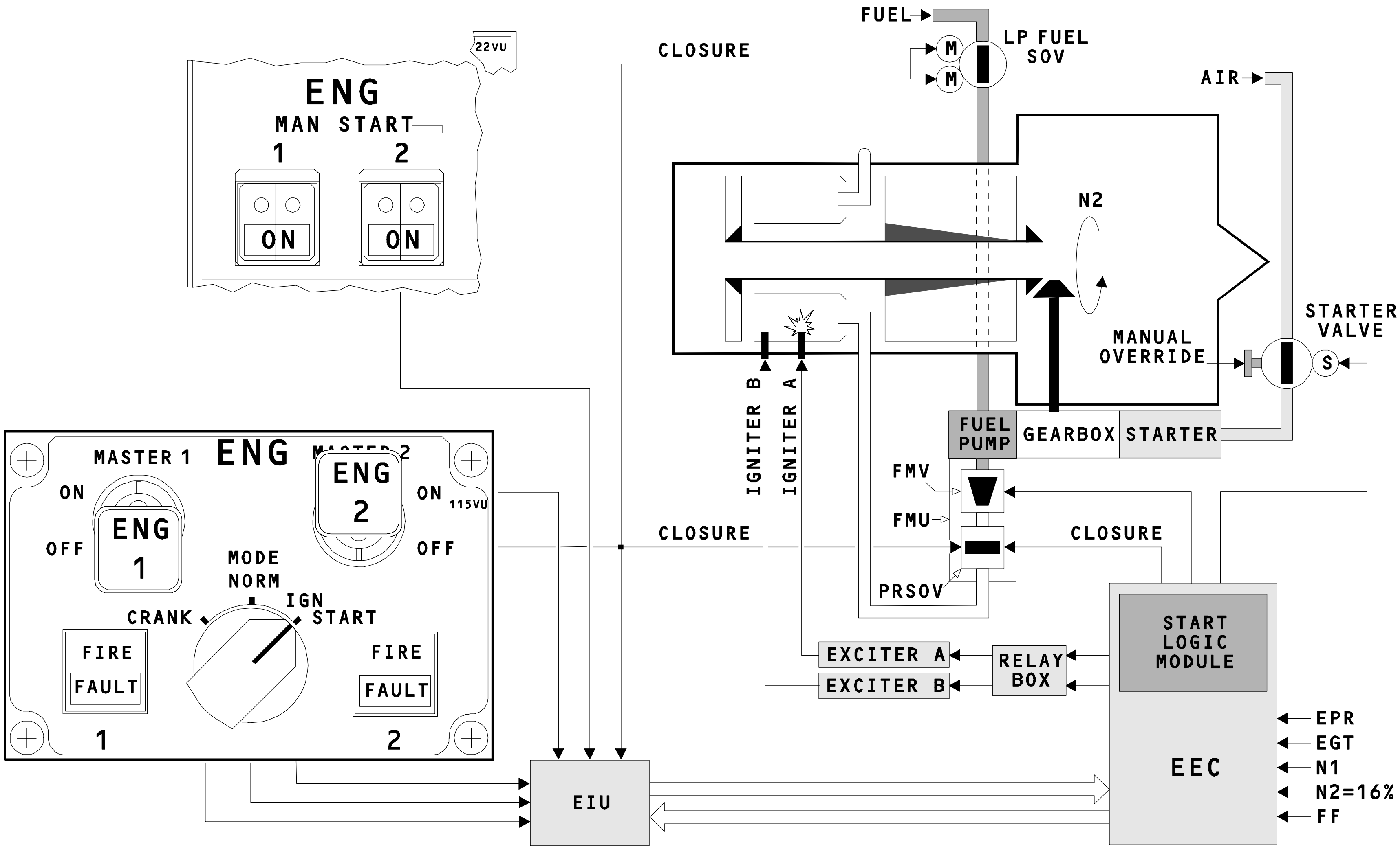
TMU74IB02-P03 LEVEL 3

IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

IGNITION AND STARTING SYSTEM D/O

AUTO START (Cont'd)

When N2 reaches 16%, the EEC provides ignition.
The igniter is automatically selected by the EEC.
At each start, the ignition selection will change.
At 16% of N2: the corresponding ignition system, chosen by the EEC, is displayed on the ENGINE page.



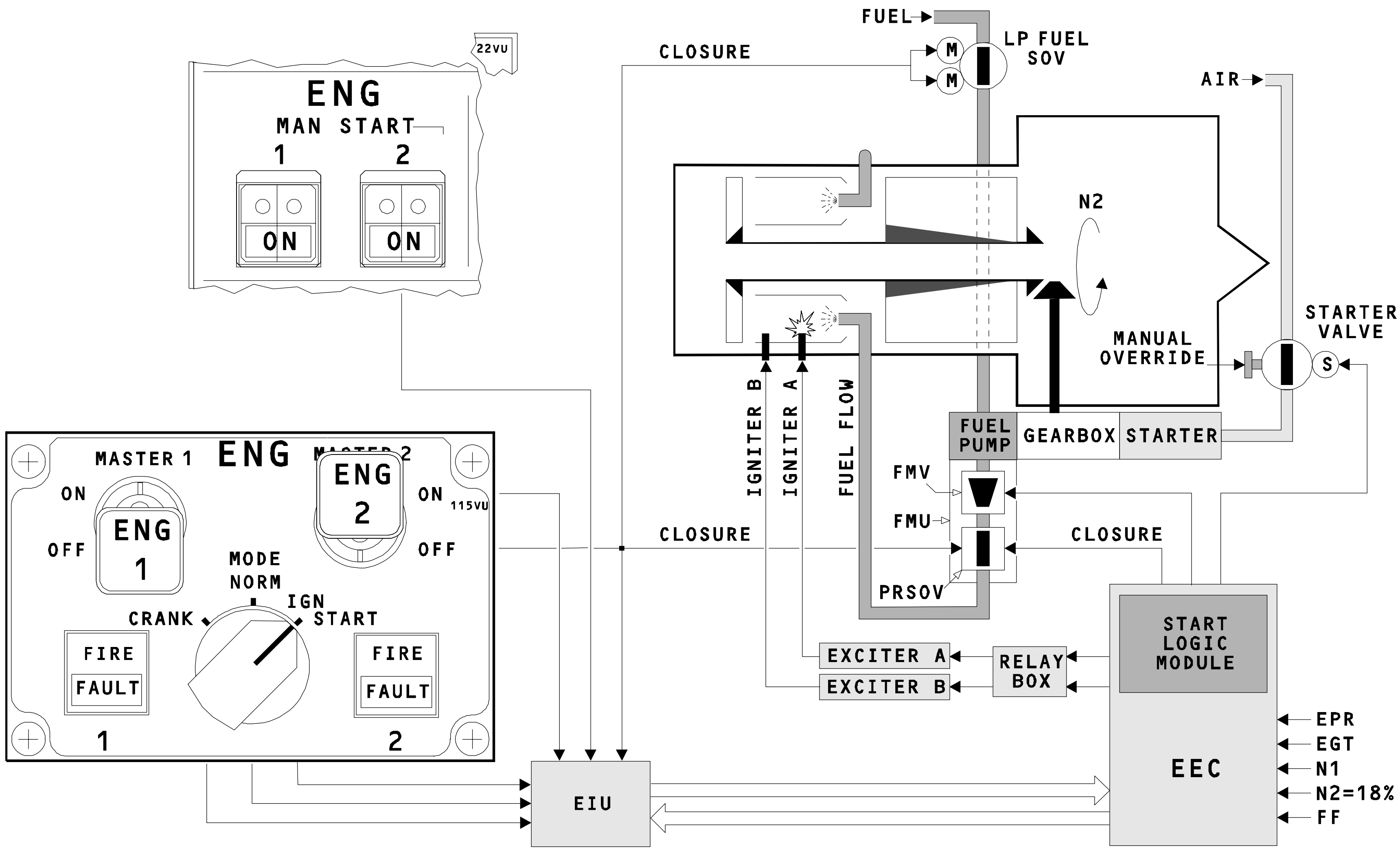
IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

UFD4200
TMU74IB02-P04 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

AUTO START (Cont'd)

When N2 reaches 18%, the EEC opens the Fuel Metering Valve (FMV) and the resulting fuel flow opens the Pressure Raising and Shut-Off Valve (PRSOV).
At 18% of N2: fuel flow begins.
In case of malfunction, the EEC automatically shuts down the engine and performs a dry motoring sequence.

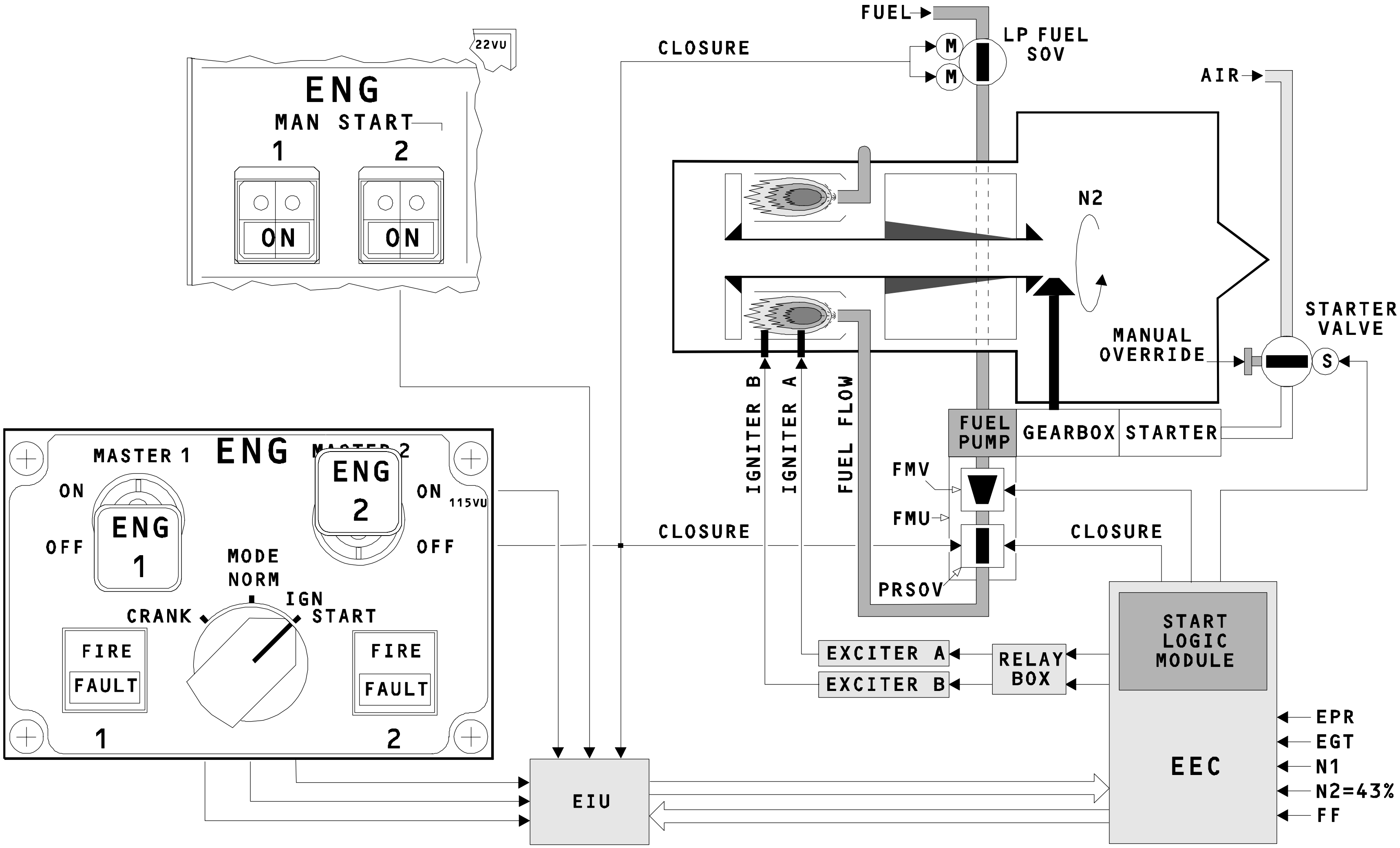


IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

IGNITION AND STARTING SYSTEM D/O

AUTO START (Cont'd)

When N2 reaches 43%, the EEC closes the starter valve and cuts off the ignition.



IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

IGNITION AND STARTING SYSTEM D/O

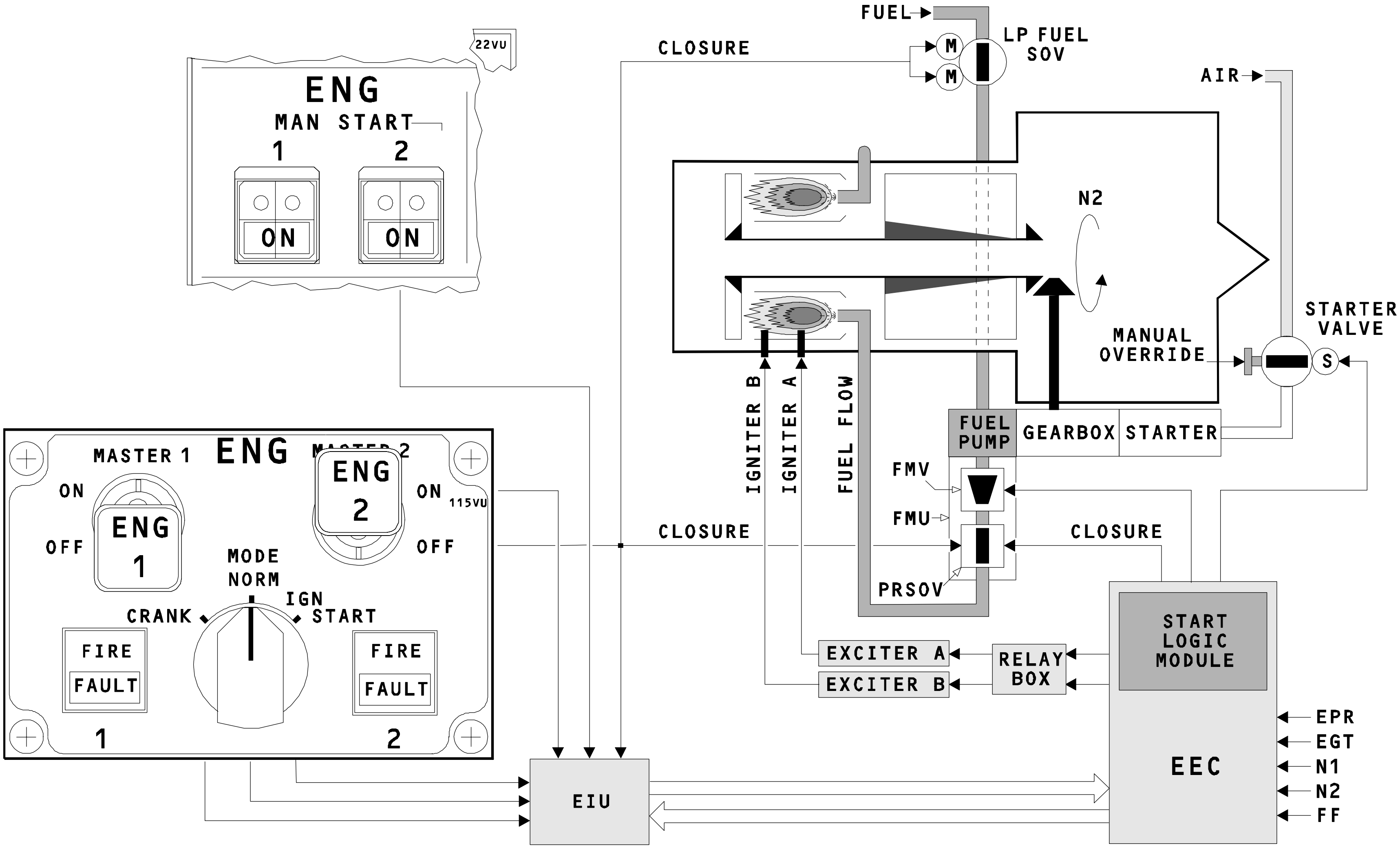
AUTO START (Cont'd)

Engine 2 is now stabilized at minimum idle.

NOTE: to start the second engine, you leave the MODE selector in the IGN START position, and set the MASTER lever 1 to ON.

After engine start the MODE Selector is set to NORM with engine running.

WARNING: if IGN START is reselected, the continuous relight function is initiated on the running engine(s).



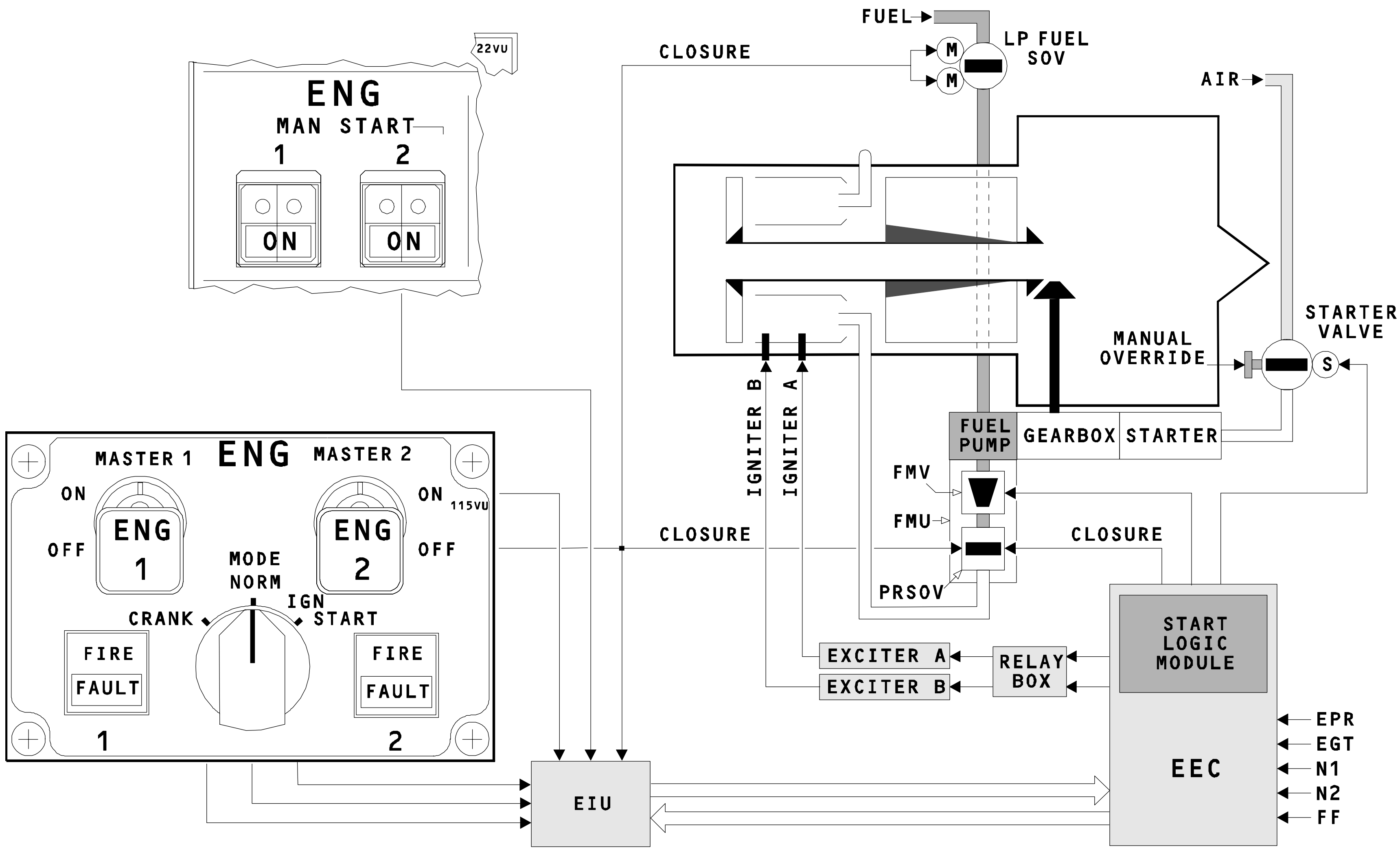
UFD4200
TMU74IB02-P07 LEVEL 3

IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

IGNITION AND STARTING SYSTEM D/O

AUTO START (Cont'd)

At any time, if the MASTER lever is set to OFF, the start sequence or engine operation is stopped because the MASTER lever directly energizes the PRSOV solenoid. With the MASTER lever to OFF, the LP and PR SOVs close.



IGNITION AND STARTING SYSTEM D/O - AUTO START (Cont'd)

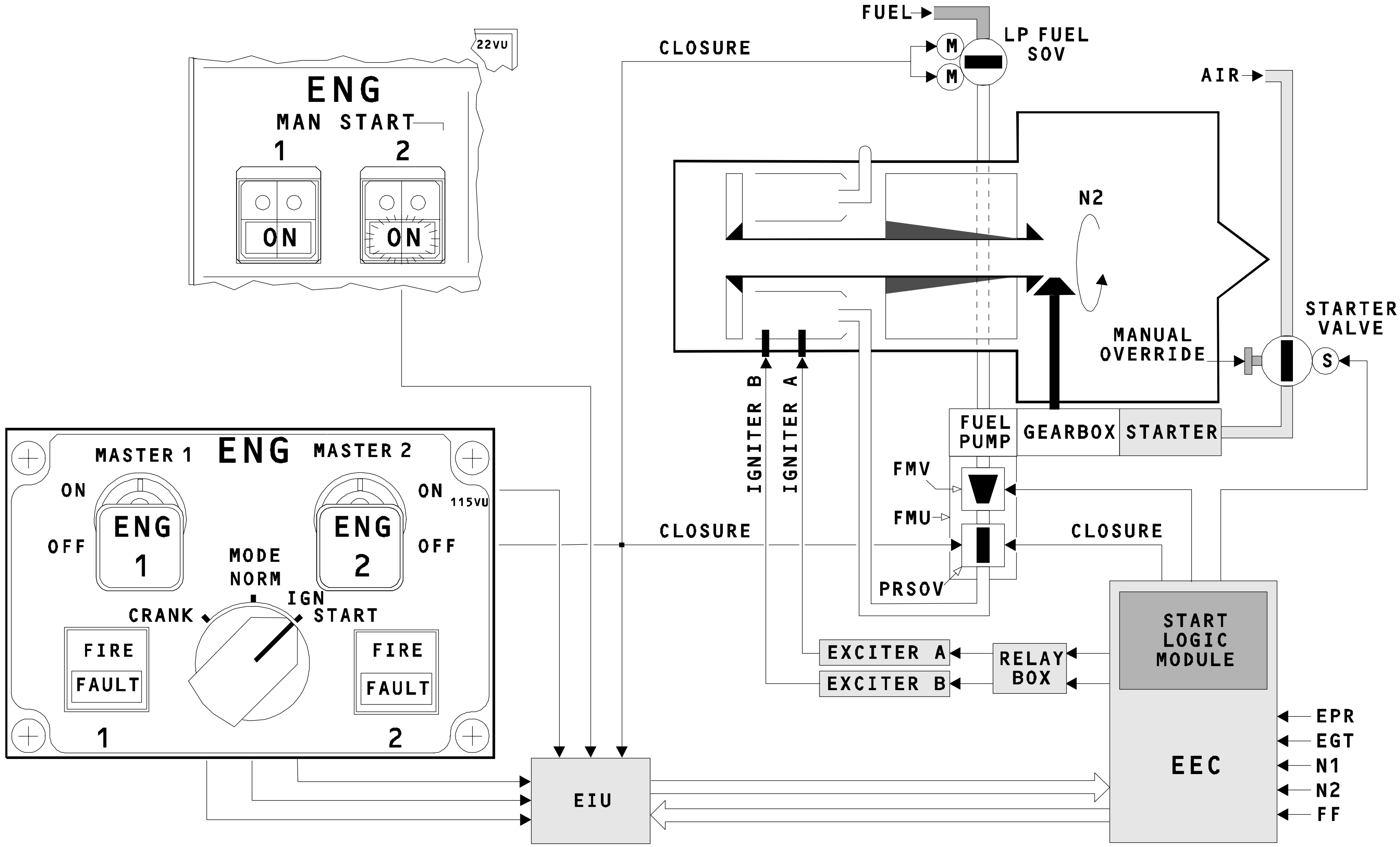
IGNITION AND STARTING SYSTEM D/O

MANUAL START

Aircraft configuration:

- APU is running and APU bleed air is available.

When the mode selector is set to IGN START, the Electronic Engine Control is armed for the start sequence.
Action on the engine MAN START pushbutton opens the starter valve, via the EEC.



IGNITION AND STARTING SYSTEM D/O - MANUAL START

UFD4200
TMU74IB02-P09 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

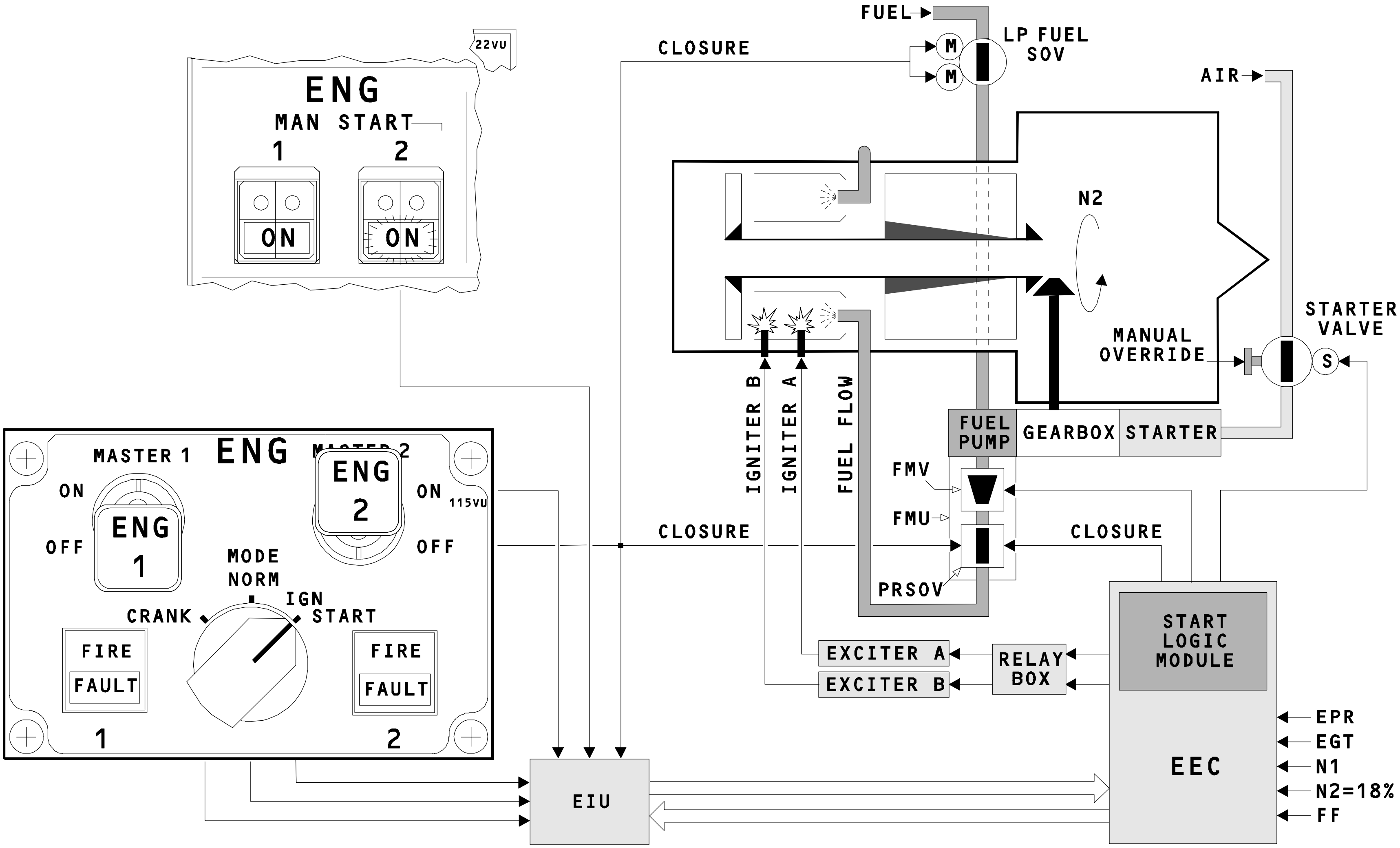
MANUAL START (Cont'd)

On the upper ECAM display, check N2 increasing and when it reaches 18%, set the MASTER lever to ON.

As soon as the MASTER lever is in the ON position, both ignition systems are energized, LP and PR Shut Off Valves open and the fuel flow increases.
At 18% of N2 with the MASTER lever ON:

- dual ignition and fuel flow.

The MAN START pushbutton stays latched and is normally left alone during the start sequence.



IGNITION AND STARTING SYSTEM D/O - MANUAL START (Cont'd)

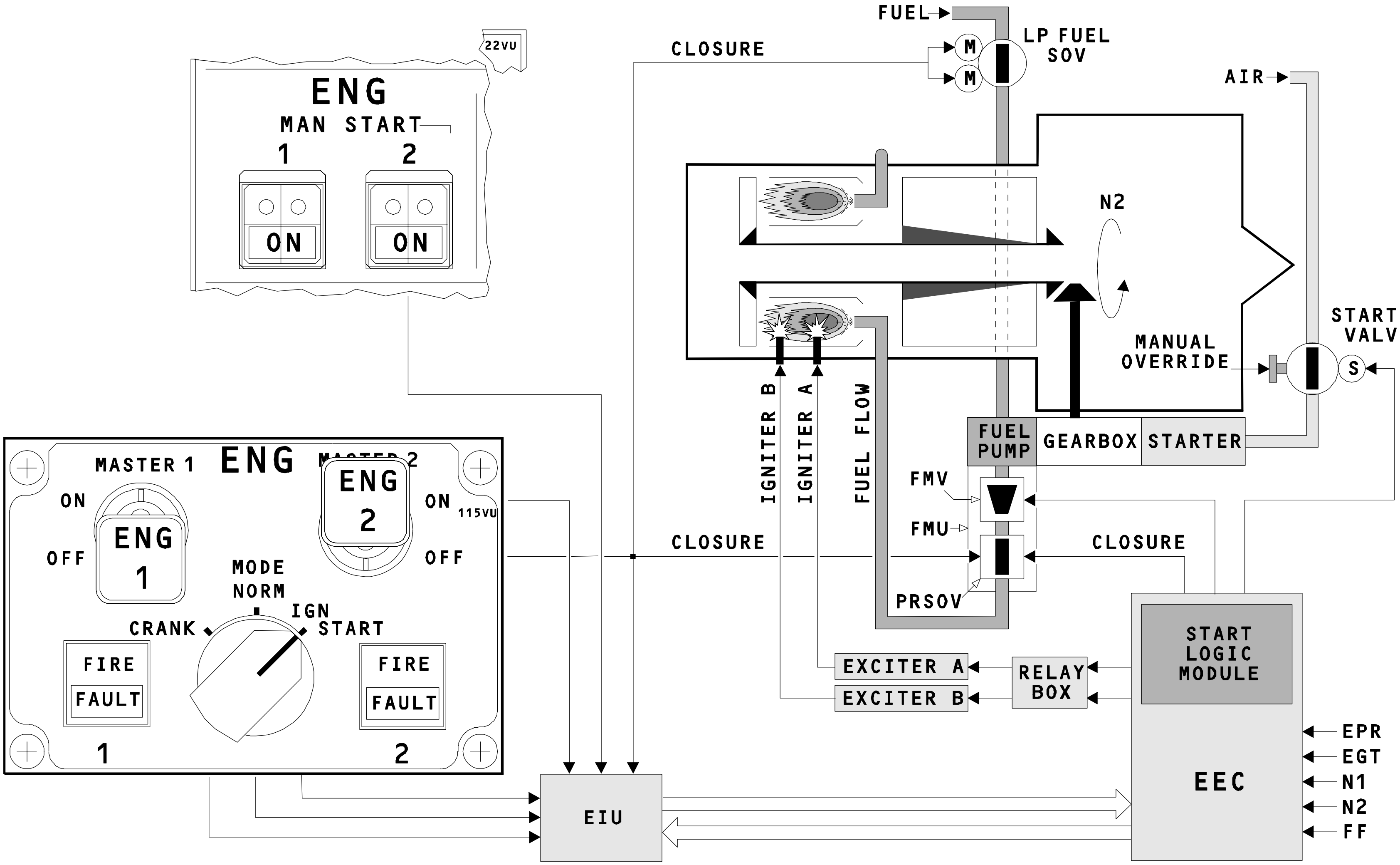
UFD4200
TMU74IB02-P10 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

MANUAL START (Cont'd)

Action of the MAN START pushbutton has no effect on the start sequence as long as the MASTER lever is set in the ON position.
The MAN START pushbutton is normally released at the end when the engine parameters are stabilized.
In case of malfunction, set the MASTER lever in the OFF position to abort the start.
Starting for up to 2 minutes maximum.

NOTE: there is no automatic shut down function in manual start.



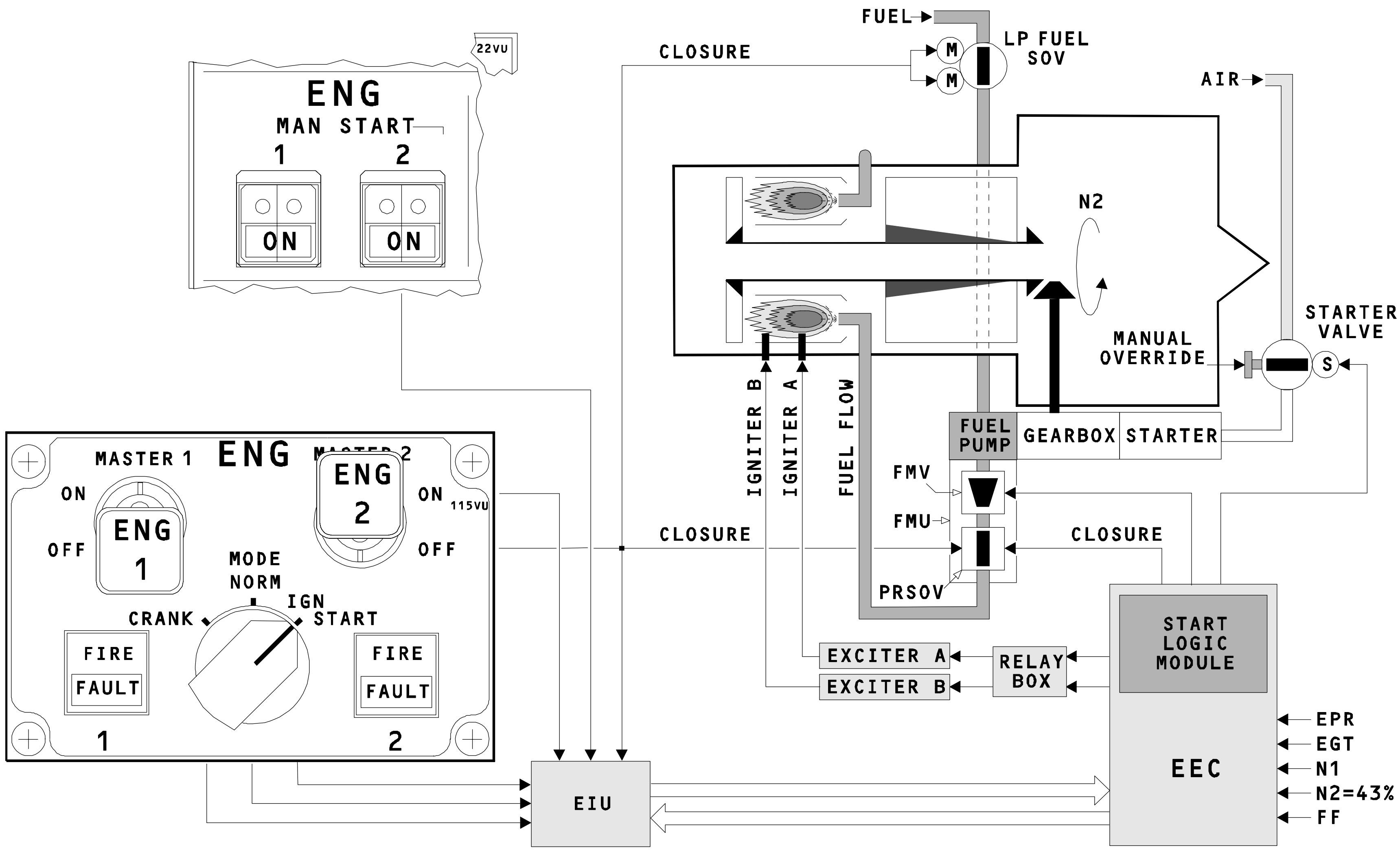
IGNITION AND STARTING SYSTEM D/O - MANUAL START (Cont'd)

UFD4200
TMU74IB02-P11 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

MANUAL START (Cont'd)

When N2 reaches 43%, the EEC closes the starter valve and cuts the ignition.



IGNITION AND STARTING SYSTEM D/O - MANUAL START (Cont'd)

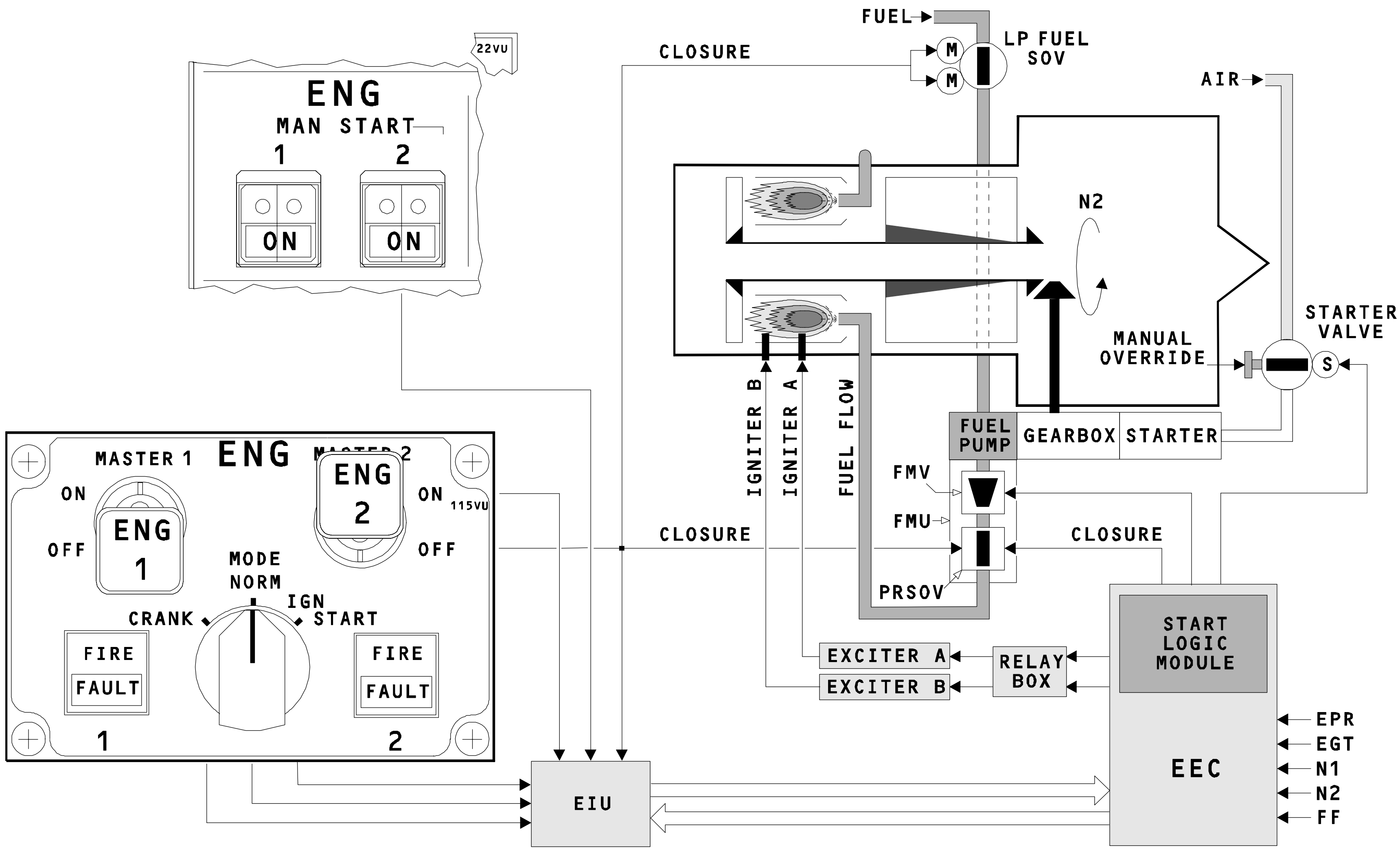
IGNITION AND STARTING SYSTEM D/O

MANUAL START (Cont'd)

Engine 2 is stabilized at minimum idle.

NOTE: to start the second engine, you leave the MODE selector in the IGN START position, set the MAN START pushbutton to ON; and then when N2 reaches 18% set the MASTER lever 1 to ON.

After engine start the MODE selector is set to NORM with engine running.
If IGN START is reselected, the continuous relight function is initiated on the running engine(s).



IGNITION AND STARTING SYSTEM D/O - MANUAL START (Cont'd)

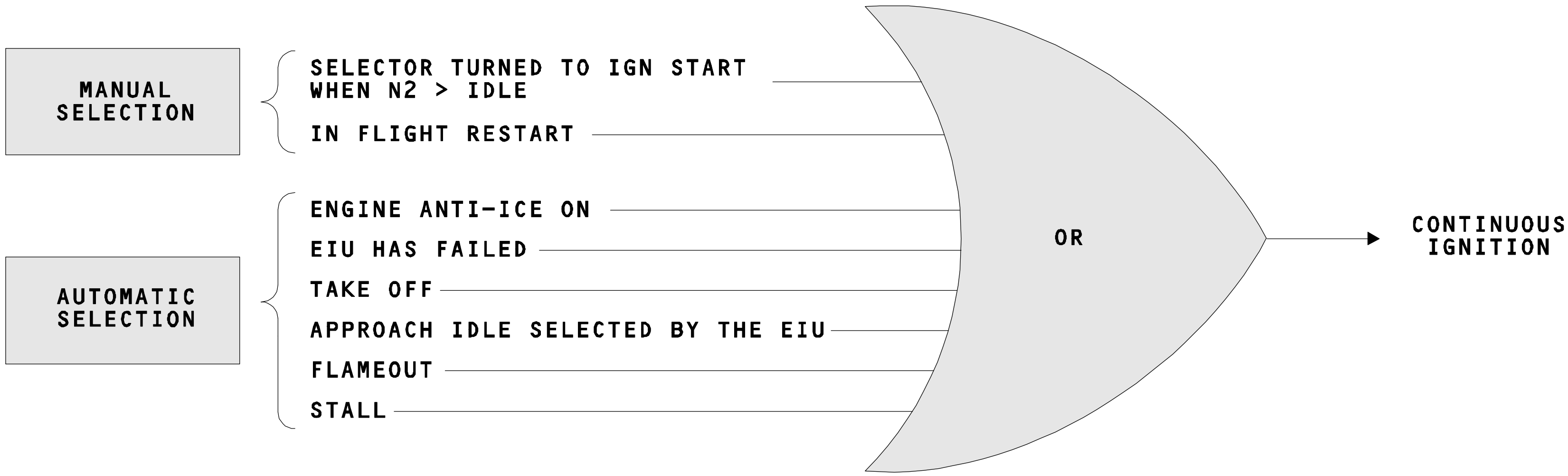
IGNITION AND STARTING SYSTEM D/O

CONTINUOUS RELIGHT

Aircraft configuration:

- APU is running and APU bleed air is available
- engine 2 running.

The continuous ignition is manually selected or automatically controlled by the EEC according to the following logic.



UFD4200

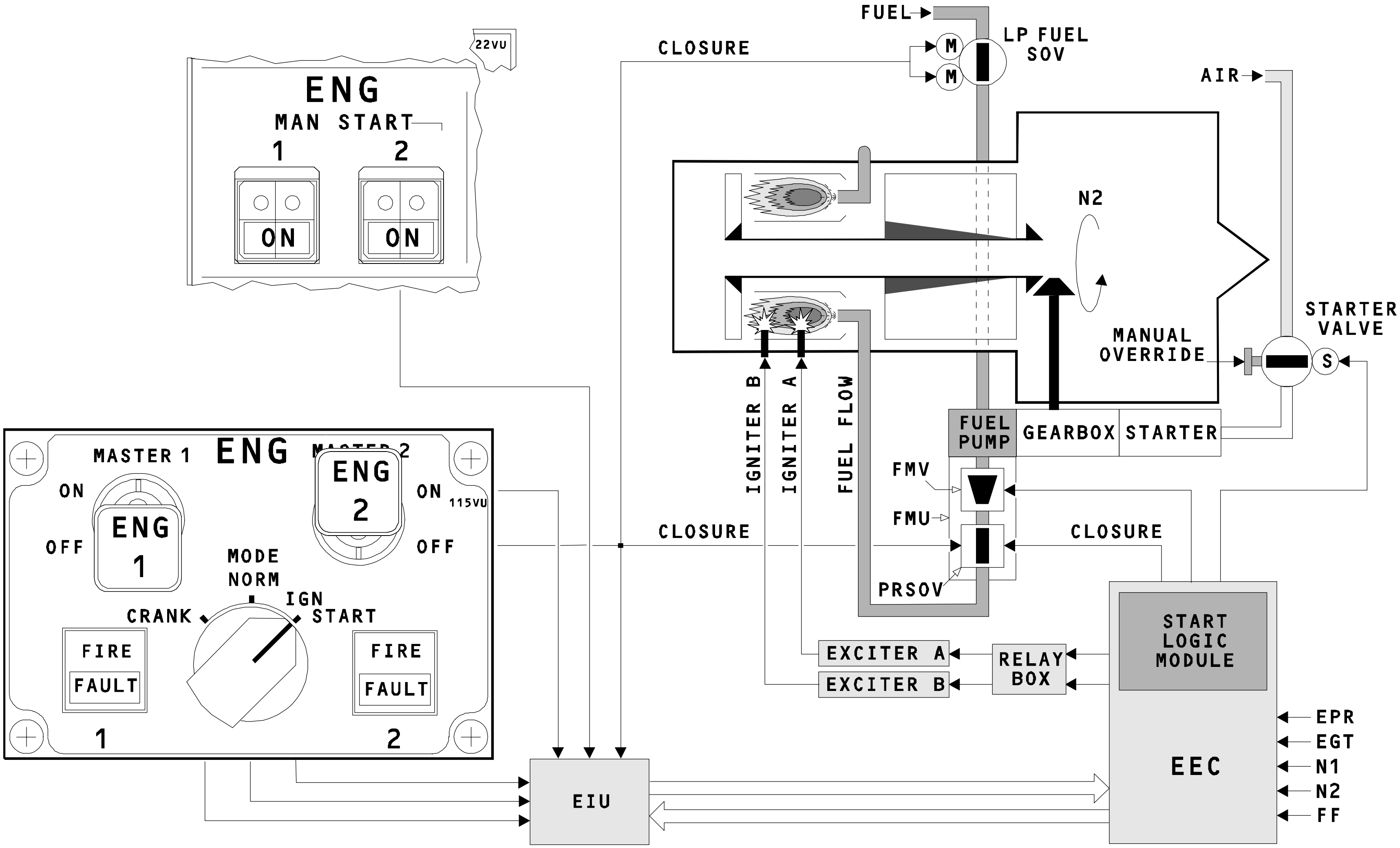
TMU74IB02-P14 LEVEL 3

IGNITION AND STARTING SYSTEM D/O - CONTINUOUS RELIGHT

IGNITION AND STARTING SYSTEM D/O

CONTINUOUS RELIGHT (Cont'd)

IF IGN START is reselected with an engine running, the corresponding EEC supplies the 2 igniters together, to provide continuous ignition.

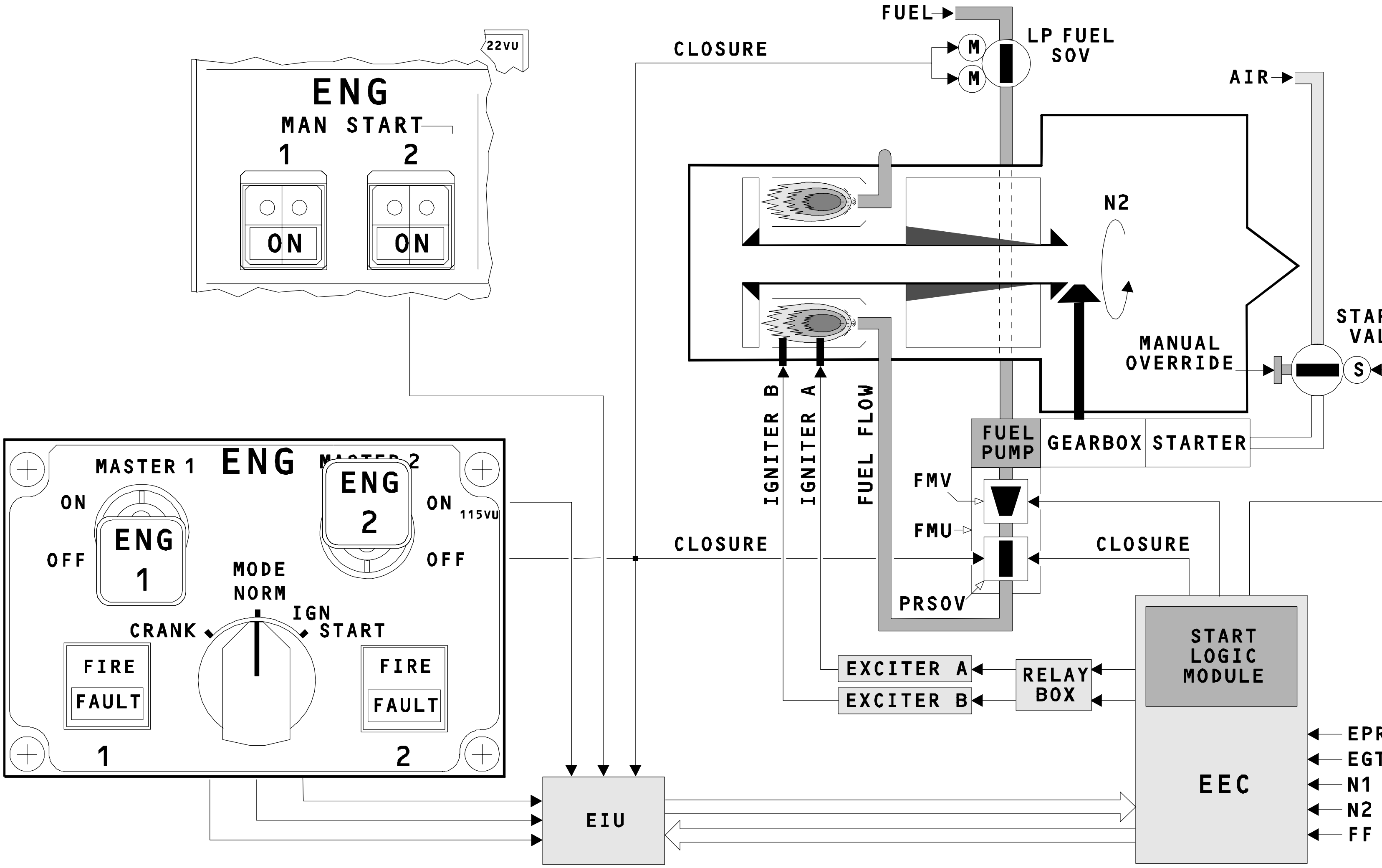


IGNITION AND STARTING SYSTEM D/O - CONTINUOUS RELIGHT (Cont'd)

IGNITION AND STARTING SYSTEM D/O

CONTINUOUS RELIGHT (Cont'd)

When NORM is restored, the continuous relight is cut off.



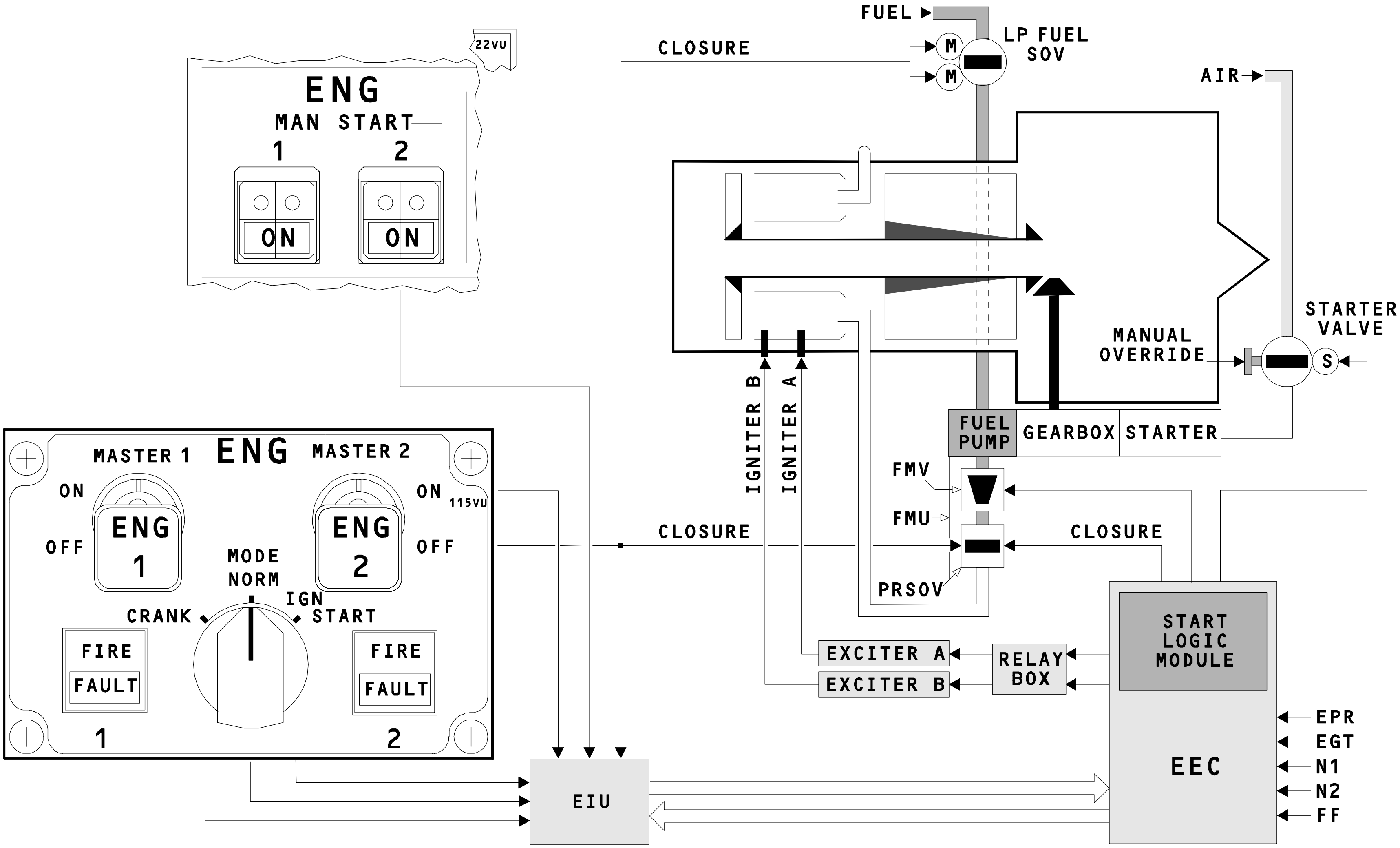
IGNITION AND STARTING SYSTEM D/O - CONTINUOUS RELIGHT (Cont'd)

UFD4200
TMU74IB02-P16 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

CONTINUOUS RELIGHT (Cont'd)

When the MASTER lever is set to OFF, the LP and PR Shut Off Valves close and the EEC functions are reset.
Engine 2 is shut down.



IGNITION AND STARTING SYSTEM D/O - CONTINUOUS RELIGHT (Cont'd)

UFD4200
TMU74IB02-P17 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

ENGINE CRANK

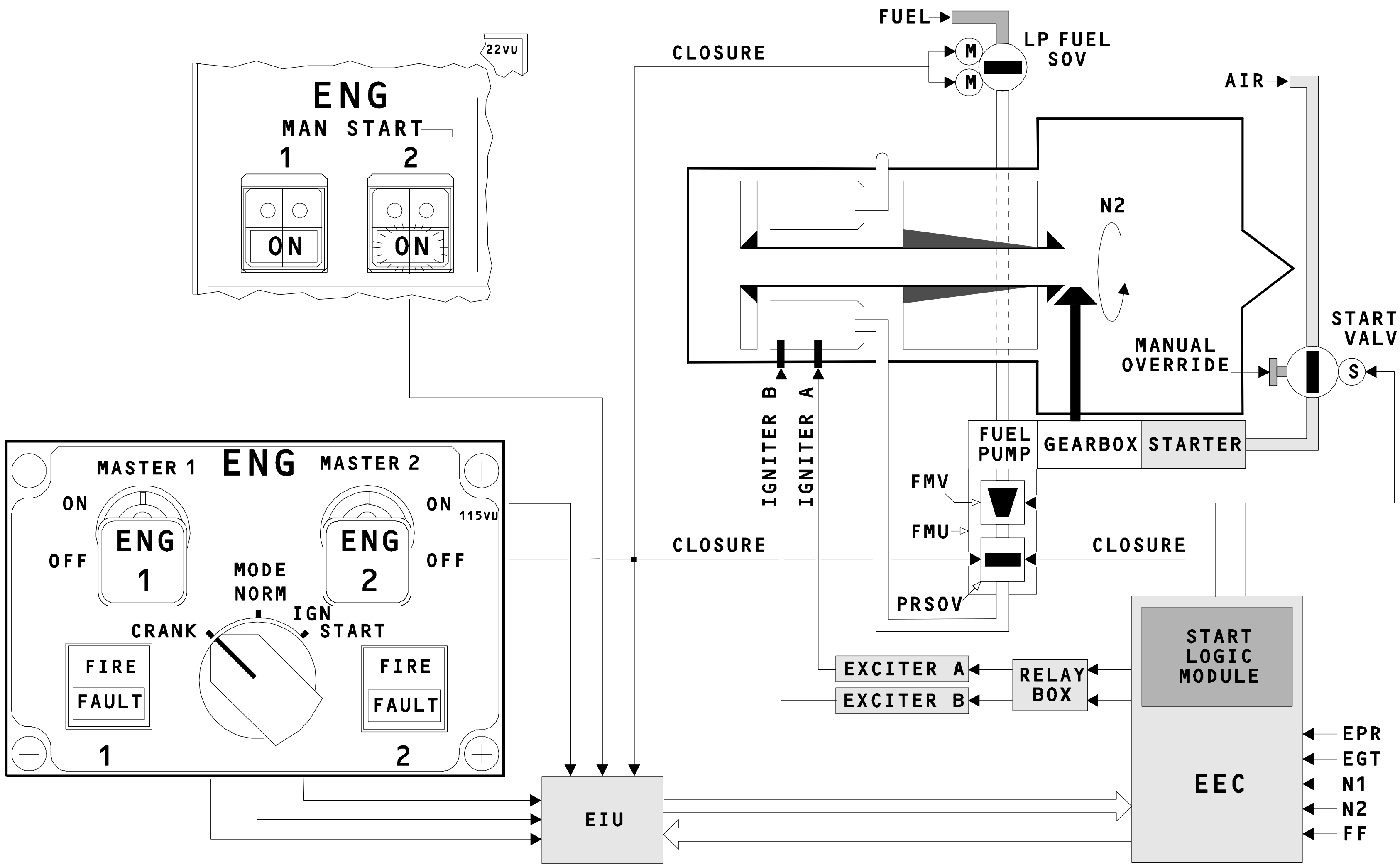
Aircraft configuration:

- APU is running and APU bleed air is available
- both engines are shut down.

When CRANK is selected on the ground, the ignition is inhibited.
Action on the engine MAN START pushbutton provides opening of the starter valve via the EEC.

During the crank sequence, the starter limitations should be observed. If the starter operation time is exceeded, a warning message is displayed on the ECAM, but there is no automatic abort.

Dry crank: - maximum of 3 consecutive cycles;
2 minutes on, 15 seconds off up 2 times and one minute on, then 30 minutes off for cooling
- or 4 continuous minutes on, then 30 minutes off for cooling.



IGNITION AND STARTING SYSTEM D/O - ENGINE CRANK

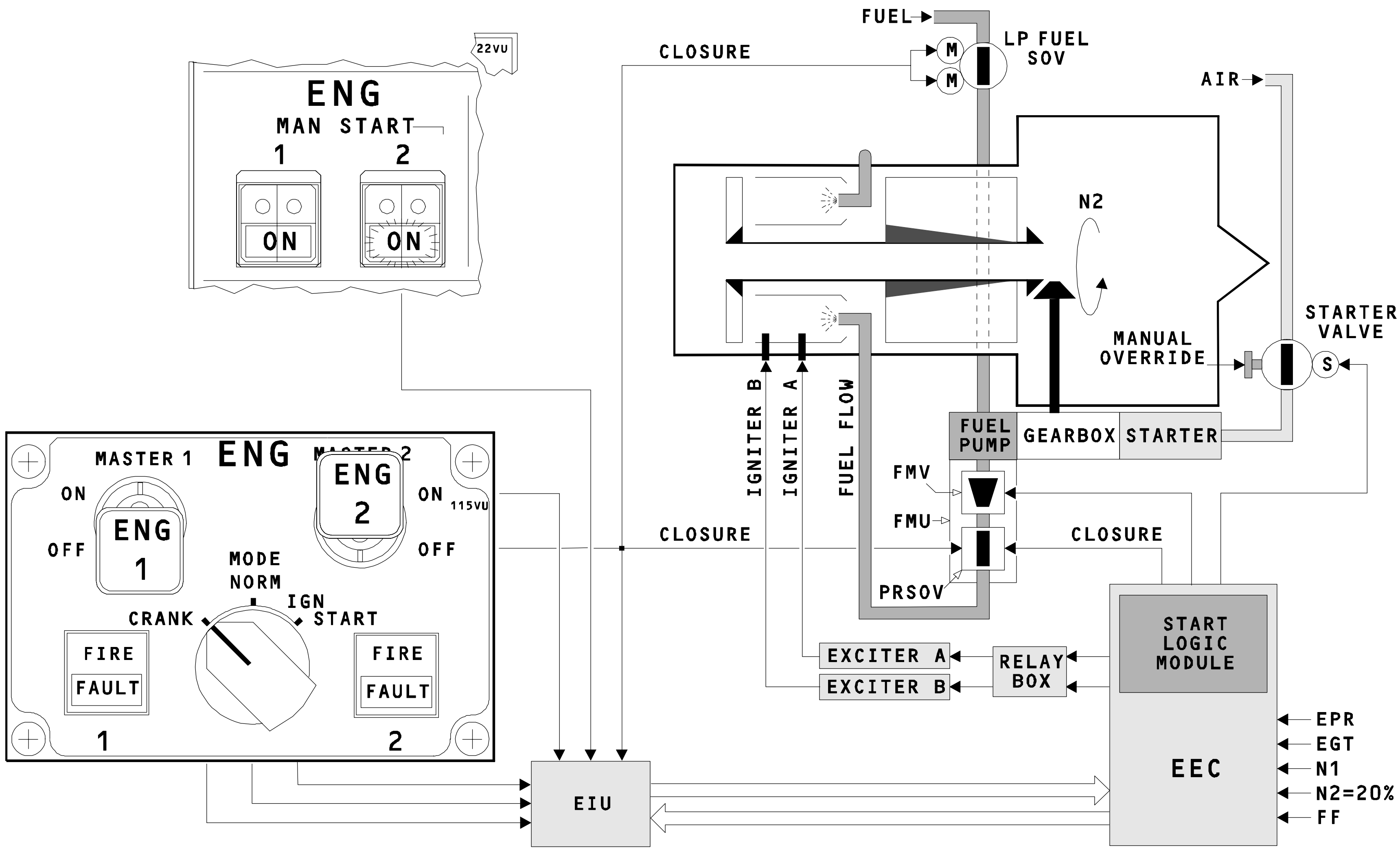
UFD4200
TMU74IB02-P18 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

ENGINE CRANK (Cont'd)

Wet crank: allow N2 to increase to 20% RPM before setting the master switch to ON.

When the MASTER lever is set in the ON position, the LP and PR Shut Off Valves open.



IGNITION AND STARTING SYSTEM D/O - ENGINE CRANK (Cont'd)

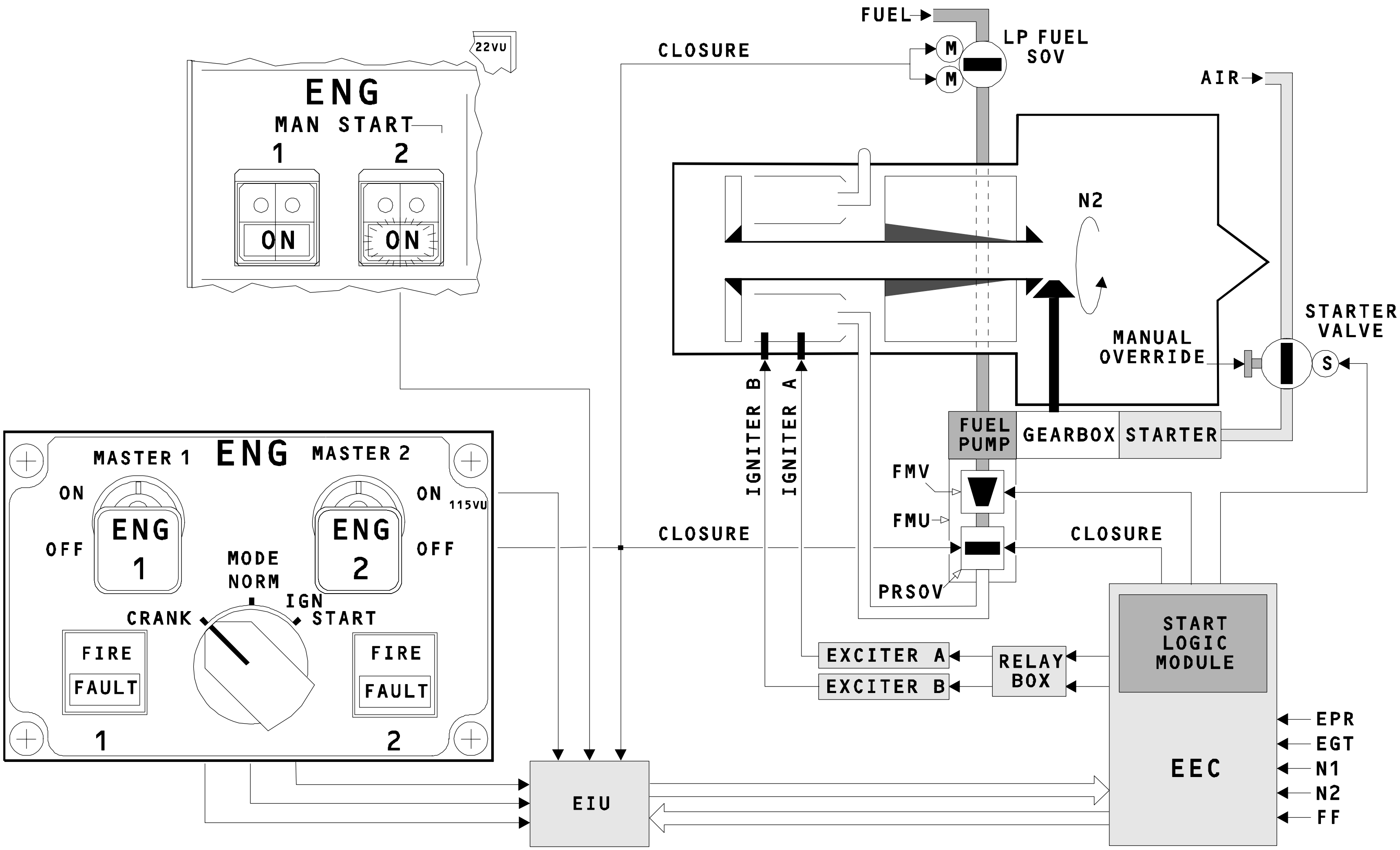
UFD4200

TMU74IB02-P19 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

ENGINE CRANK (Cont'd)

After wet cranking, the MASTER lever should be set to OFF, and dry cranking will continue to eliminate fuel vapors from the engine.
PRSOV is closed.
Continue to dry crank for at least 30 seconds.



IGNITION AND STARTING SYSTEM D/O - ENGINE CRANK (Cont'd)

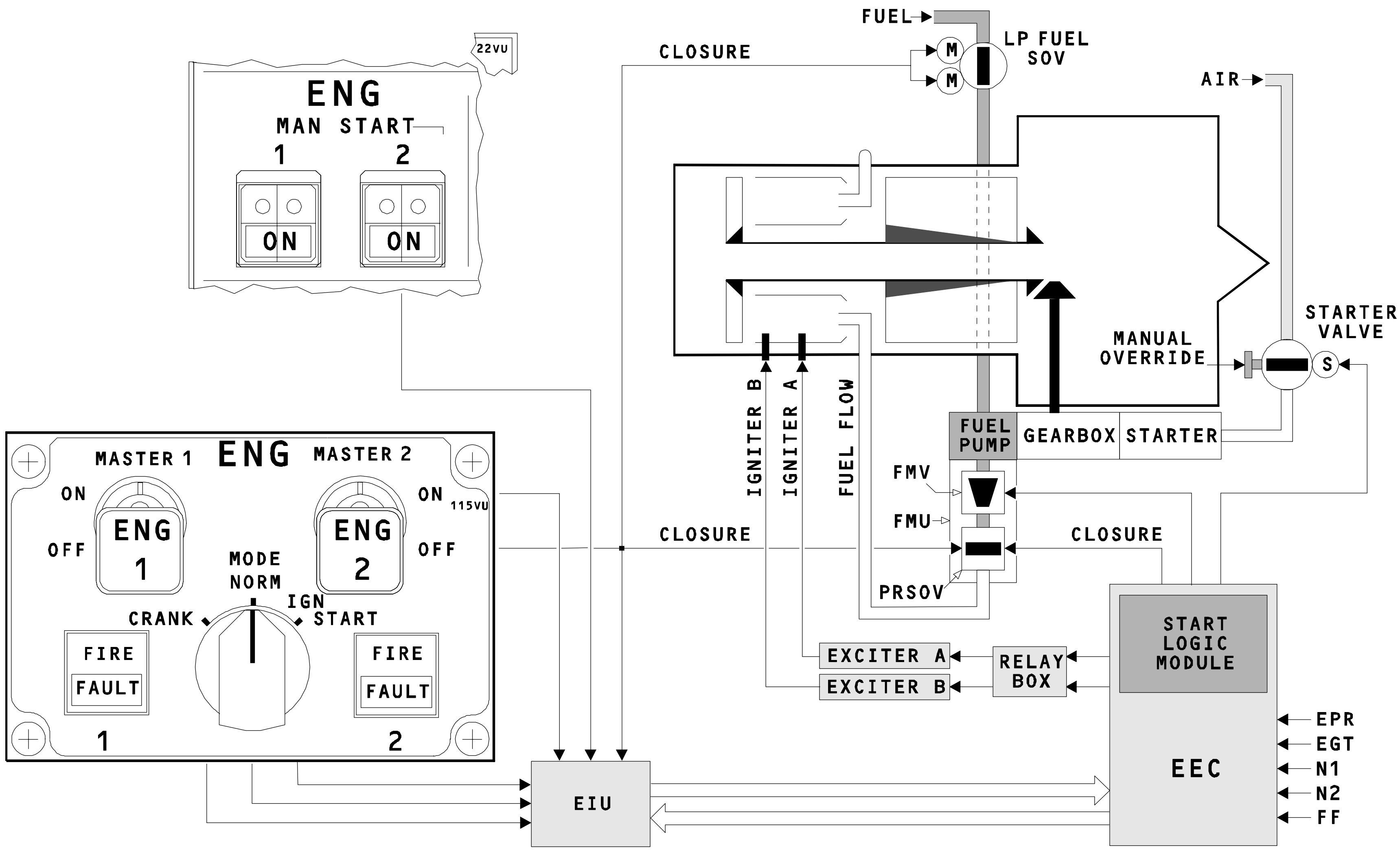
UFD4200
TMU74IB02-P20 LEVEL 3

IGNITION AND STARTING SYSTEM D/O

ENGINE CRANK (Cont'd)

When the MAN START pushbutton is released out, the starter valve closes and the engine shuts down.

To complete the crank sequence the MODE selector is set in the NORM position.



IGNITION AND STARTING SYSTEM D/O - ENGINE CRANK (Cont'd)

UFD4200
TMU74IB02-P21 LEVEL 3

SELF EXAMINATION

From where can igniters A and B be selected?
- A - The engine panel.
- B - The ECAM control panel.
- C - The EEC.

What causes an automatic continuous relight selection?
- A - IGN START selected.
- B - Flame-out detected.
- C - EEC failure.

What happens in manual mode when N2 reaches 43%?
- A - MAN START pushbutton ON light goes off.
- B - The EEC provides the ECAM with a message indicating that the start valve must be closed.
- C - The start valve automatically closes.

74 - IGNITION AND STARTING

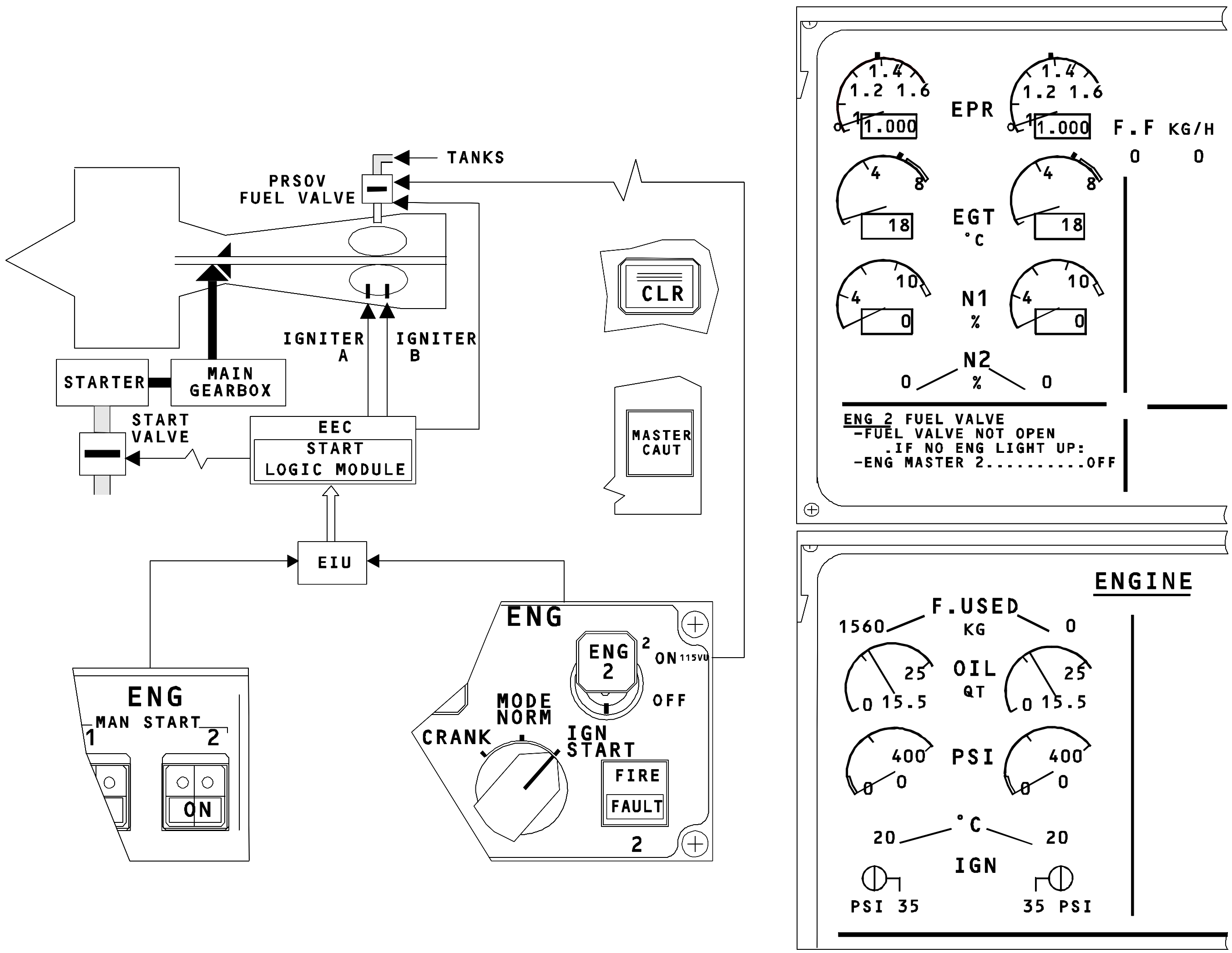
74-00-00 START FAILURES

CONTENTS:

START FAILURES

FUEL PRSOV NOT OPEN FAULT IN AUTOMATIC MODE

If the fuel Pressure Raising and Shut Off Valve does not open, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
In automatic mode, the FADEC automatically shuts down the engine.
Then the MASTER lever must be set to OFF.



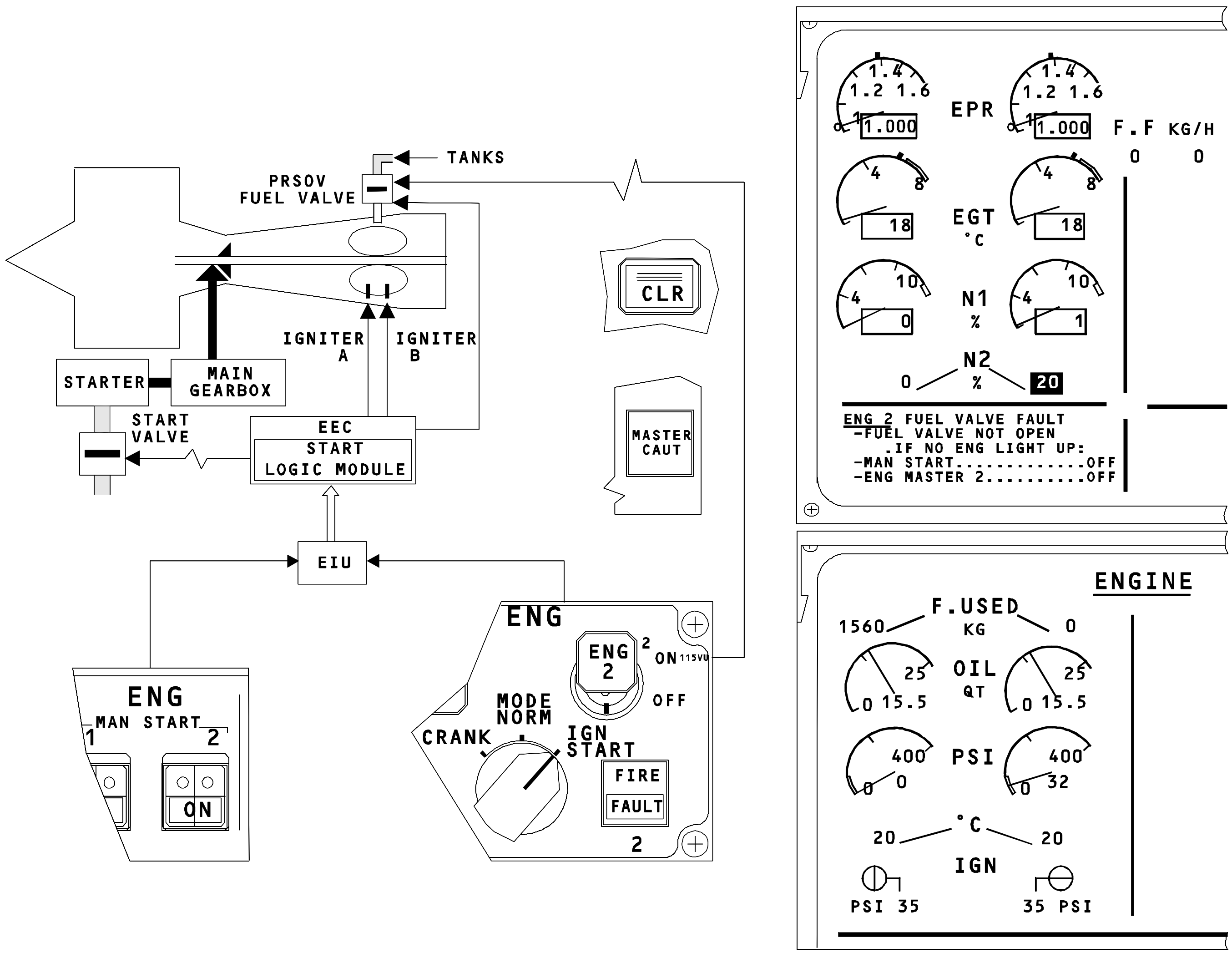
START FAILURES - FUEL PRSOV NOT OPEN FAULT IN AUTOMATIC MODE

UFD4200
TMU74IC04-P01 LEVEL 3

START FAILURES

FUEL PRSOV NOT OPEN FAULT IN MANUAL MODE

If the fuel Pressure Raising and Shut Off Valve does not open, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
In manual start, the FADEC does not abort the start.
You must perform the action necessary to shut down the engine.



START FAILURES - FUEL PRSOV NOT OPEN FAULT IN MANUAL MODE

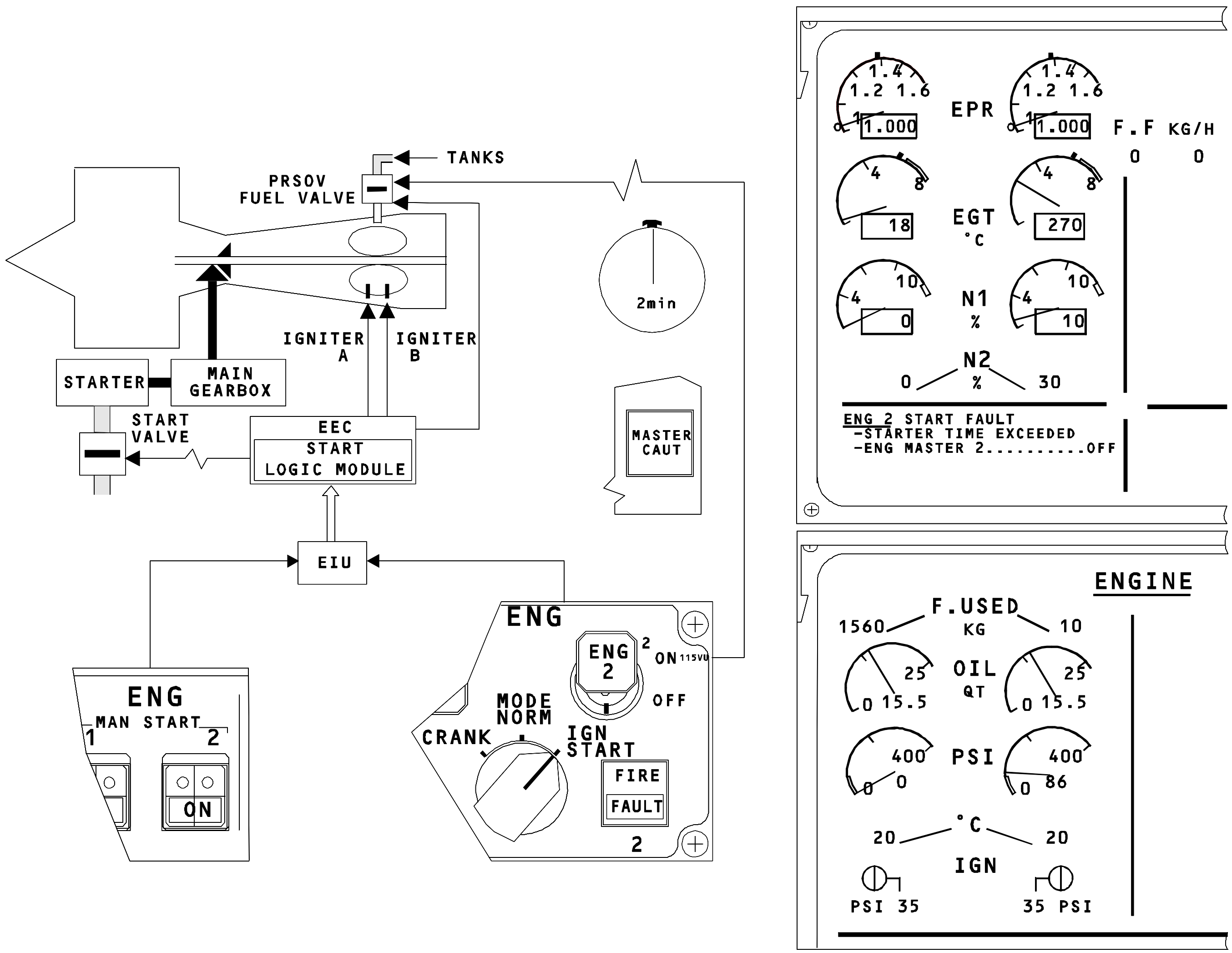
UFD4200
TMU74IC04-P02 LEVEL 3

START FAILURES

STARTER TIME EXCEEDED FAULT IN AUTOMATIC MODE

If the starter time limit is exceeded, an aural warning sounds.
The MASTER CAUT comes on.
An ECAM message appears.
In automatic mode, the FADEC automatically shuts down the engine.
Then the MASTER lever must be set to OFF.

CAUTION: Maximum starter time cycle: 2 minutes



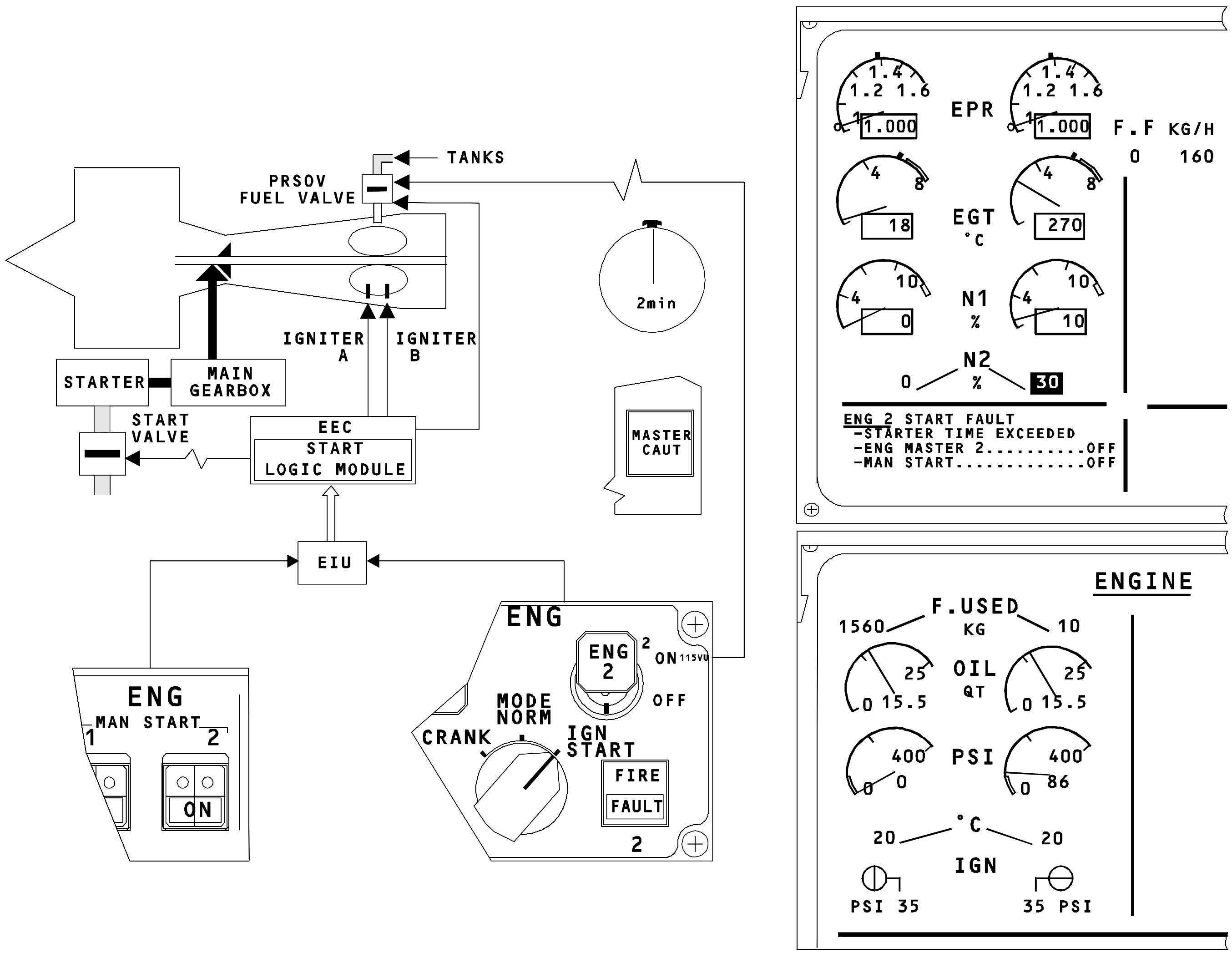
START FAILURES - STARTER TIME EXCEEDED FAULT IN AUTOMATIC MODE

START FAILURES

STARTER TIME EXCEEDED FAULT IN MANUAL MODE

If the starter time limit is exceeded, an aural warning sounds.
The MASTER CAUT comes on.
An ECAM message appears.
In manual start, the FADEC does not abort the start.
You must perform the action necessary to shut down the engine.

CAUTION: Maximum starter time cycle: 2 minutes.



START FAILURES - STARTER TIME EXCEEDED FAULT IN MANUAL MODE

START FAILURES

START VALVE NOT OPEN FAULT

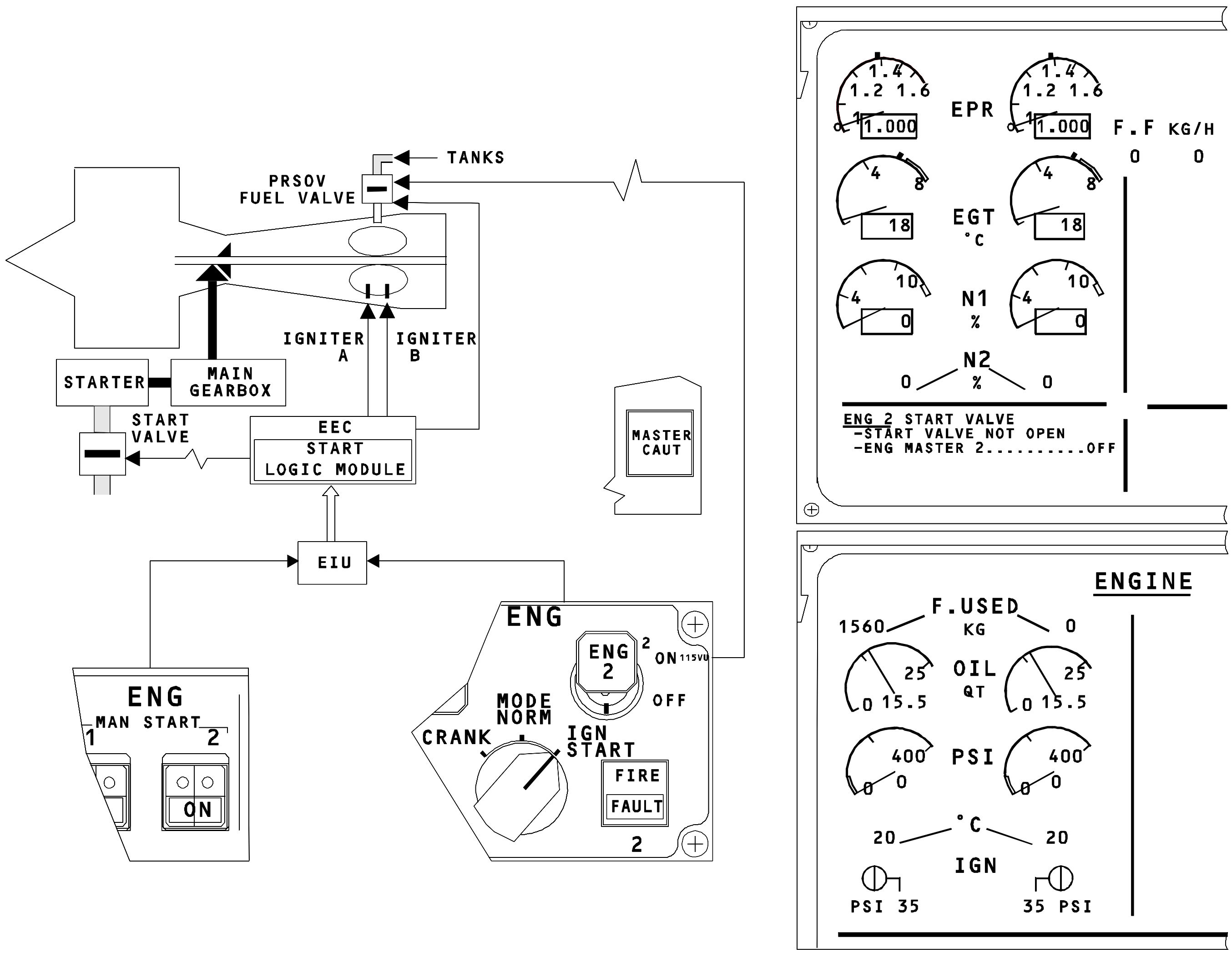
If the start valve does not open, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears. The FADEC aborts the start sequence.
Another start with a manual operation of the start valve will be performed.

Application of the START VALVE MANUAL OPERATION procedure:
Advise the ground crew to prepare for a start valve manual operation.
Check that the corresponding pneumatic sources are connected.

- If opposite engine running:
  . X BLEED.........ON
- If APU available:
  . APU BLEED.......ON

Perform an automatic start.
When the ground crew member is ready, order " START ENGINE 1 or 2":

- ENG MODE selector.........IGN
- MASTER lever..............ON
- When the MASTER lever is set to ON, order the ground crew to open the start valve.
  - START VALVE.............ORDER OPENING
- When N2 reaches 43%, order the ground crew to close the start valve.
  - START VALVE.............ORDER CLOSURE.
- Continue with the normal procedure.



START FAILURES - START VALVE NOT OPEN FAULT

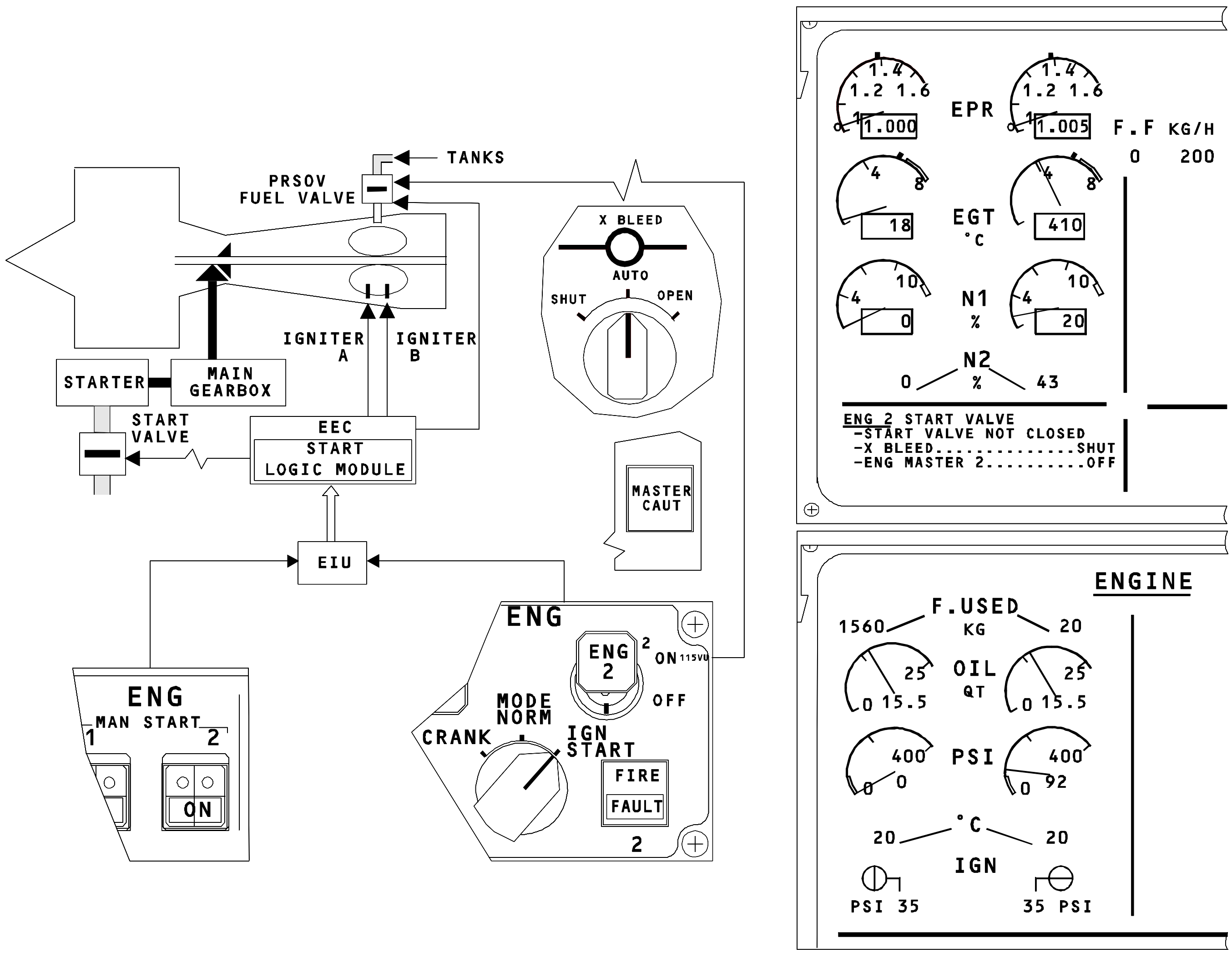
START FAILURES

START VALVE NOT CLOSED FAULT

At 43% of N2, the FADEC sends a signal to close the start valve.
If the start valve does not close, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.

Application of the START VALVE NOT CLOSED procedure
- Remove all bleed sources supplying the faulty start valve:
  - APU BLEED (if ENG 1 affected)....OFF
  - X BLEED..........................SHUT
  - ENG MASTER.......................OFF

No restart is allowed, a maintenance action is required.

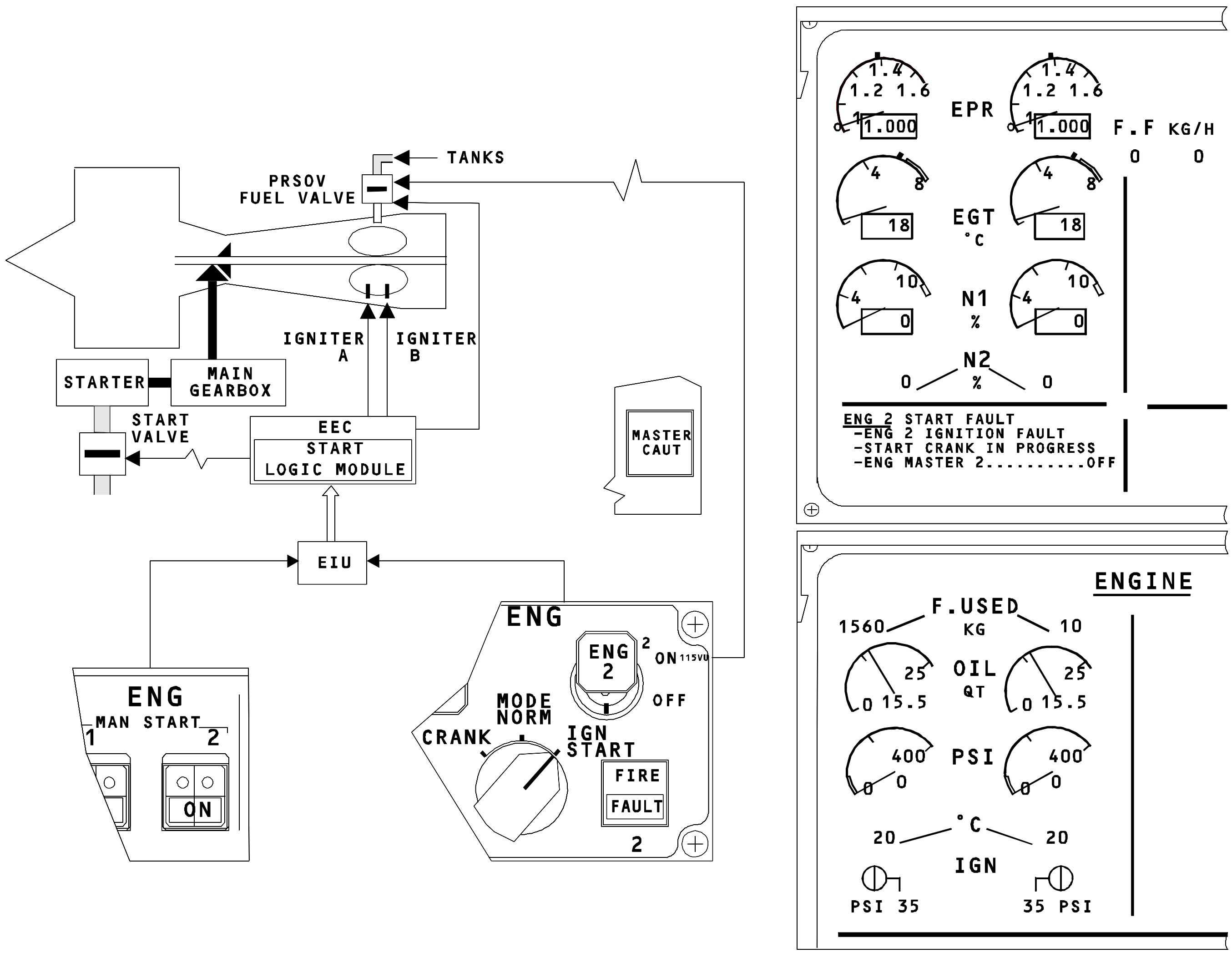


START FAILURES – START VALVE NOT CLOSED FAULT

START FAILURES

IGNITION FAULT IN AUTOMATIC MODE

If an ignition fault occurs, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
The FADEC cuts the fuel supply and automatically ventilates the engine.
The FADEC then closes the start valve and de-energizes the igniters.
Then the MASTER lever must be set to OFF.

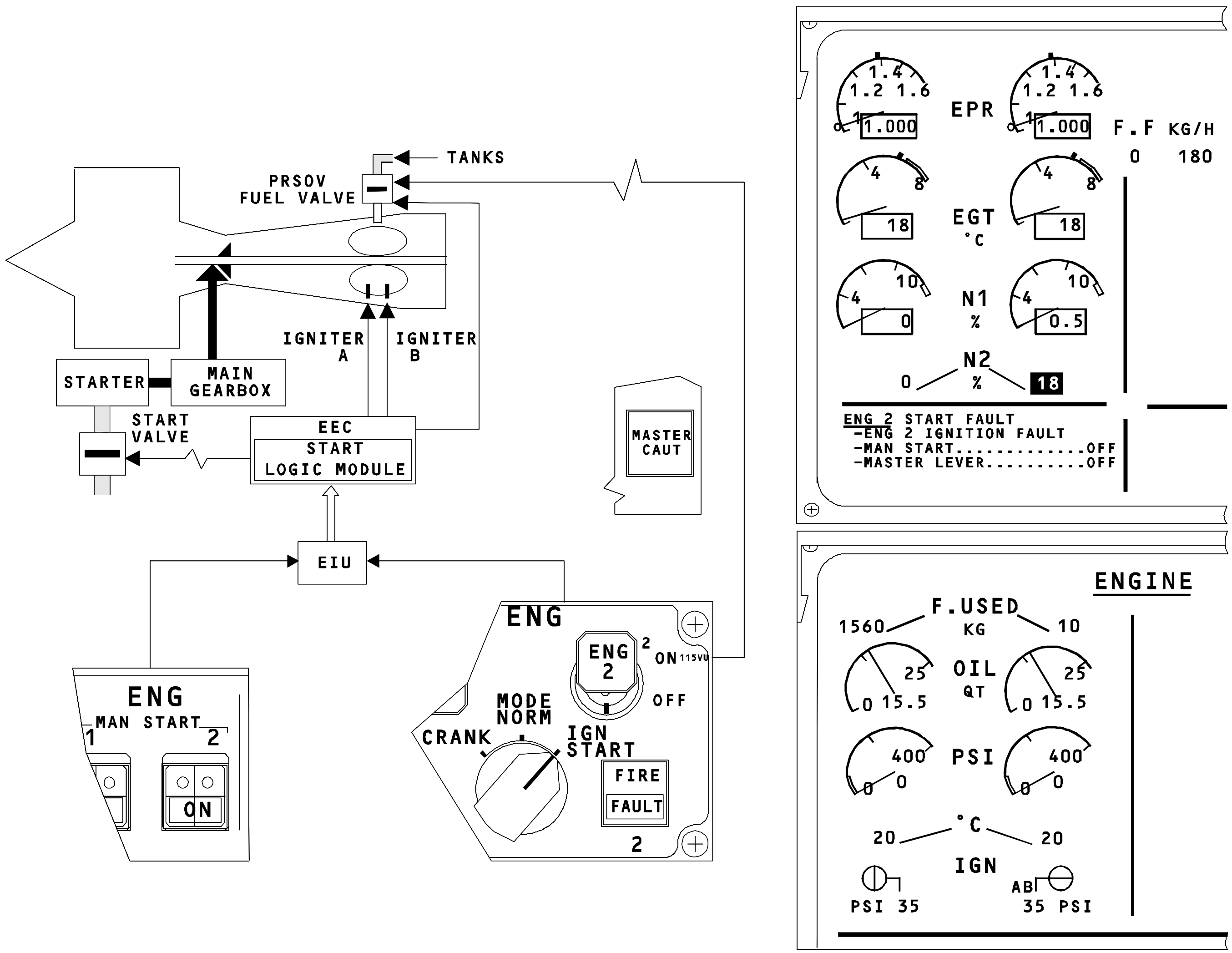


START FAILURES - IGNITION FAULT IN AUTOMATIC MODE

START FAILURES

IGNITION FAULT IN MANUAL MODE

If an ignition fault occurs, an aural warning sounds.
The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
In manual start, the FADEC does not abort the start.
You must perform the action necessary to shut down the engine.



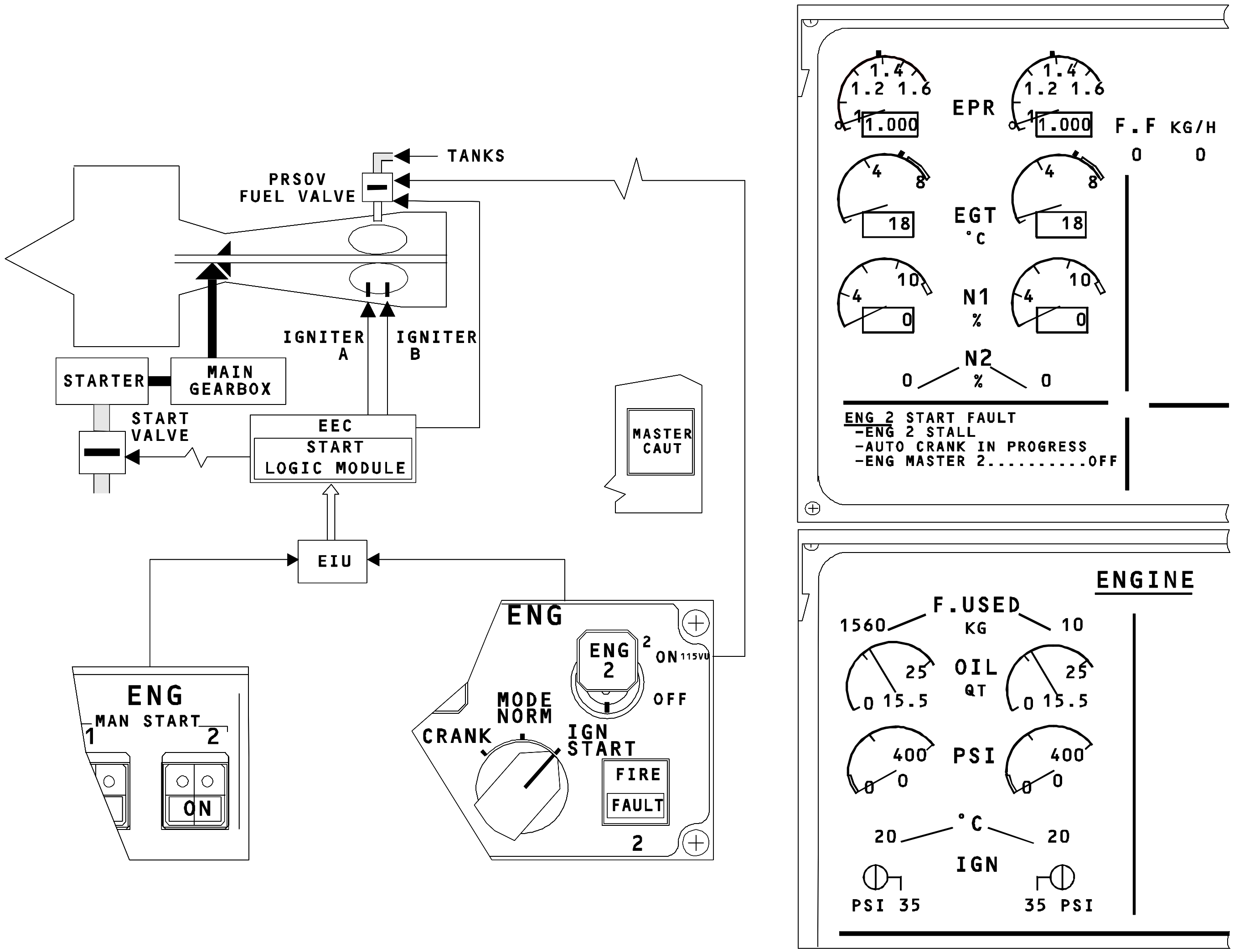
START FAILURES - IGNITION FAULT IN MANUAL MODE

UFD4200
TMU74IC04-P08 LEVEL 3

START FAILURES

EGT OVERLIMIT AND STALL FAULT IN AUTOMATIC MODE

In case of detected stall or EGT overlimit, the FADEC auto start control or the flight crew actions are identical.
When a stall or an EGT overlimit is detected, an aural warning sounds, the MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
The FADEC shuts off the fuel and ventilates the engine.
After the auto cranking, the FADEC aborts the start sequence.
Then the MASTER lever must be set to OFF.

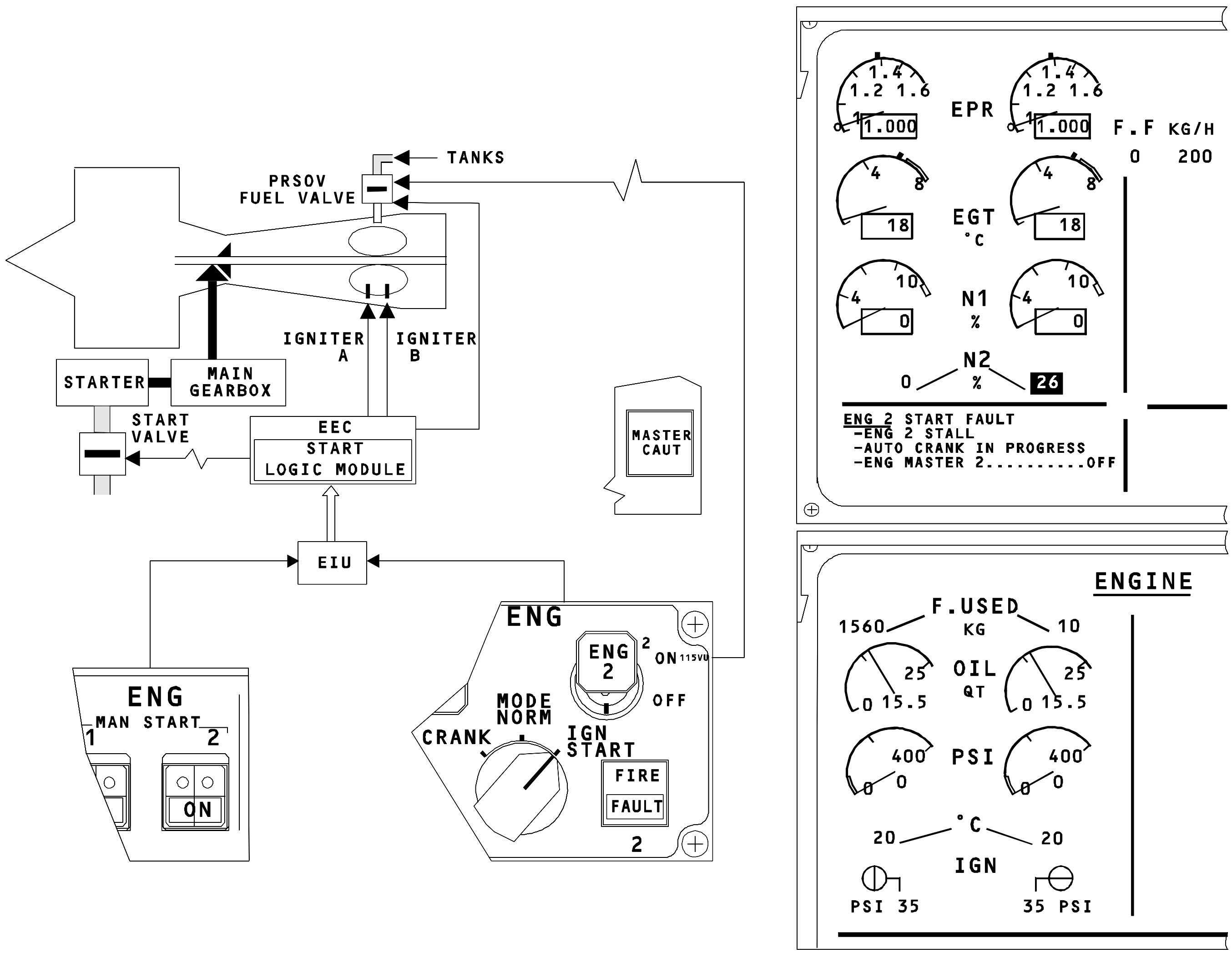


START FAILURES - EGT OVERLIMIT AND STALL FAULT IN AUTOMATIC MODE

START FAILURES

EGT OVERLIMIT AND STALL FAULT IN MANUAL MODE

During the start, if EGT exceeds the average value expected for a given N2, an aural warning sounds. The MASTER CAUT and the engine FAULT light come on.
An ECAM message appears.
In manual start, the FADEC does not abort the start. You must perform the action necessary to shut down the engine.



START FAILURES - EGT OVERLIMIT AND STALL FAULT IN MANUAL MODE

UFD4200
TMU74IC04-P10 LEVEL 3

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74 - IGNITION AND STARTING

74-00-00 IGNITION AND STARTING COMPONENTS

CONTENTS:

IGNITION AND STARTING COMPONENTS

SAFETY PRECAUTIONS

WARNING: Do not touch the ignition system components for at least one minute after the ignition power supply is switched off. The electrical discharge of the high energy unit is dangerous and can kill.

WARNING: Make sure that the ignition boxes are de-energized before working on the ignition system.
The voltage output can be dangerous. Do not touch the electrical contacts, the ignition boxes can still contain an electrical charge when they are not energized.

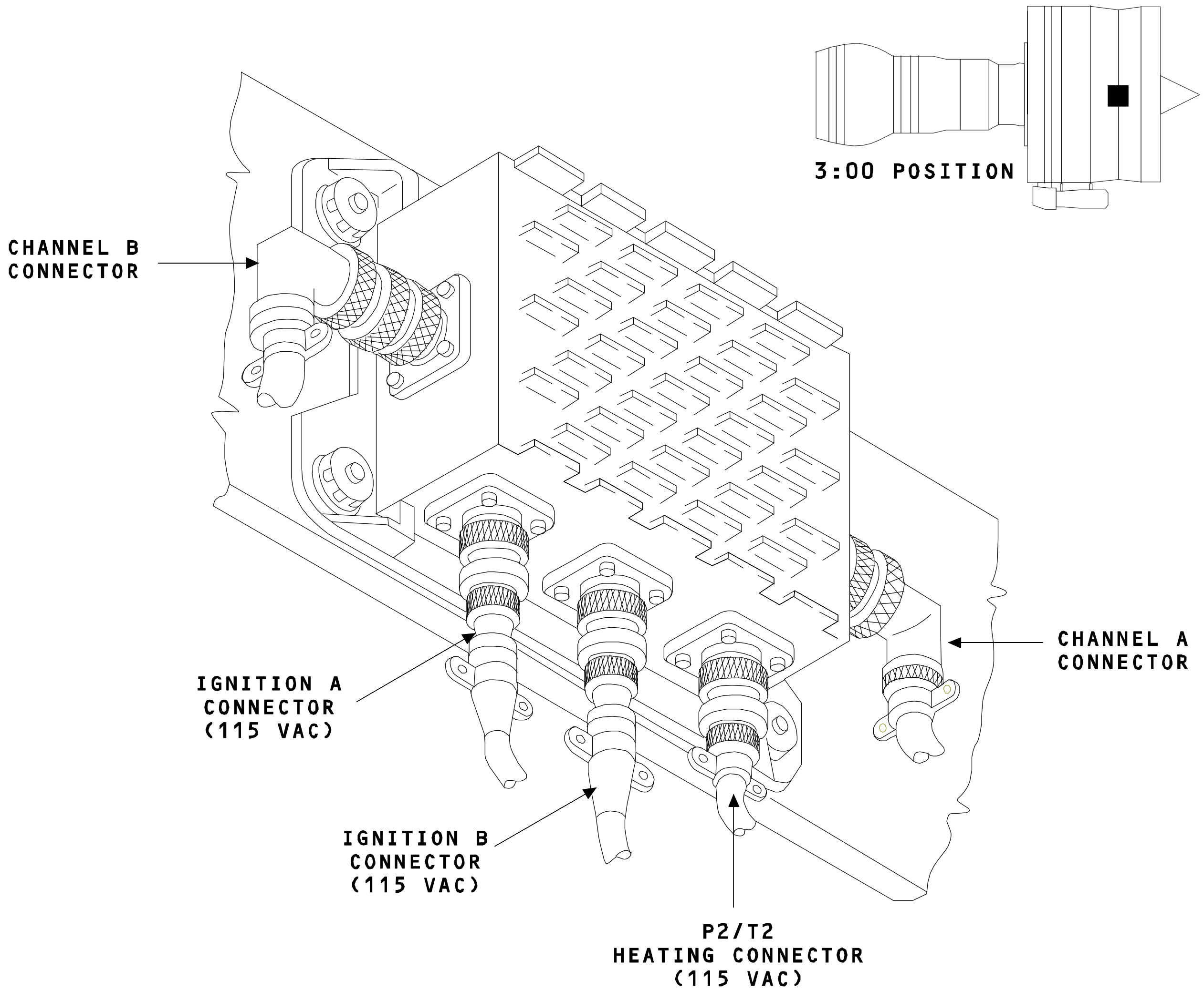
WARNING: Make sure that the EIU C/Bs are not pulled to avoid continuous ignition on the associated engine.

WARNING: During the start valve manual override operation, remain in the safety zones while the engine is operating.
There is sufficient suction to kill or cause serious injury to persons by pulling them suddenly into or against the air intake. The high temperature, velocity and overpressure in the exhaust gas wake is also very dangerous.

RELAY BOX

IDENTIFICATION
FIN: 4100KS

LOCATION
ZONE: 436, 446



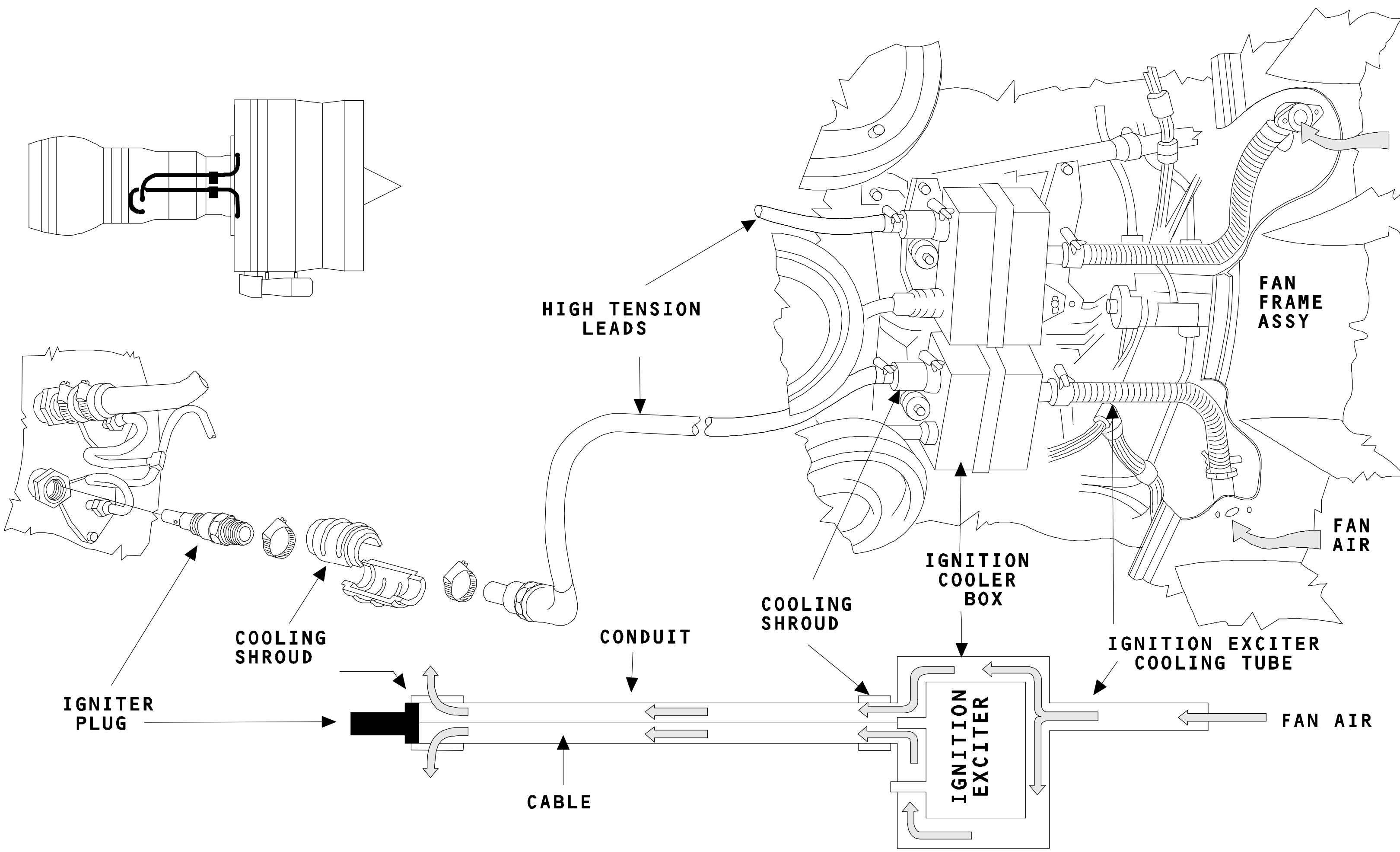
IGNITION AND STARTING COMPONENTS - RELAY BOX

UFD4200
TMU74ID01-P01 LEVEL 3

IGNITION AND STARTING COMPONENTS

IGNITION COOLING SYSTEM

COMPONENT DESCRIPTION
The high tension leads are cooled along the engine core by fan air.
The cooling air is taken on the fan frame assembly and discharged at the igniter plug location.



TMU74ID01-P02 LEVEL 3

UFD4200

IGNITION AND STARTING COMPONENTS - IGNITION COOLING SYSTEM

IGNITION AND STARTING COMPONENTS

IGNITION EXCITERS

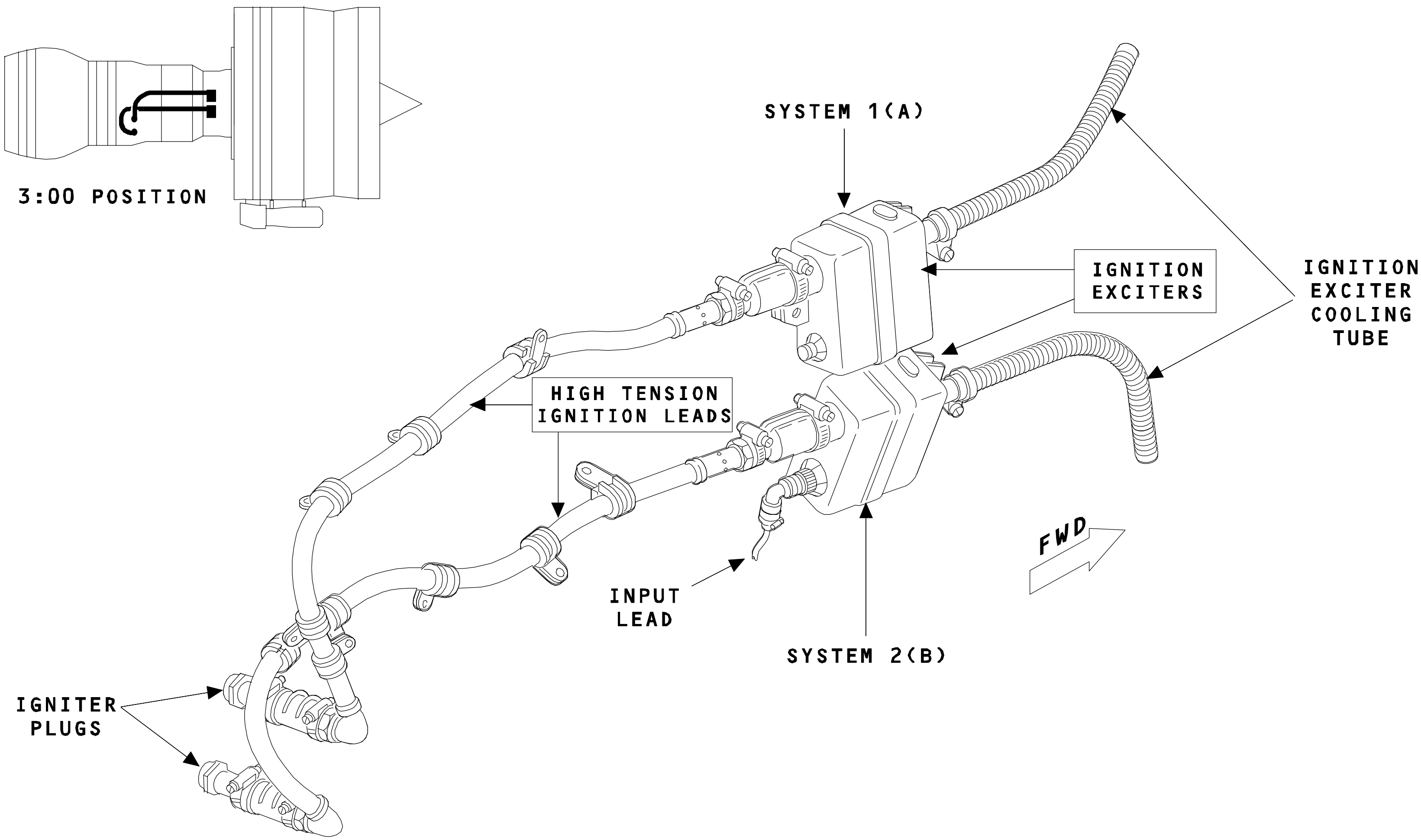
IDENTIFICATION
FIN: 4000JH1, 4000JH2

LOCATION
ZONE: 454, 464

IGNITION LEADS

IDENTIFICATION
FIN: 4002JH1, 4002JH2

LOCATION
ZONE: 454, 464



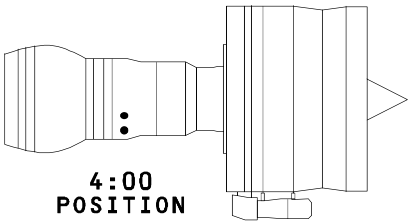
IGNITION AND STARTING COMPONENTS - IGNITION EXCITERS / IGNITION LEADS

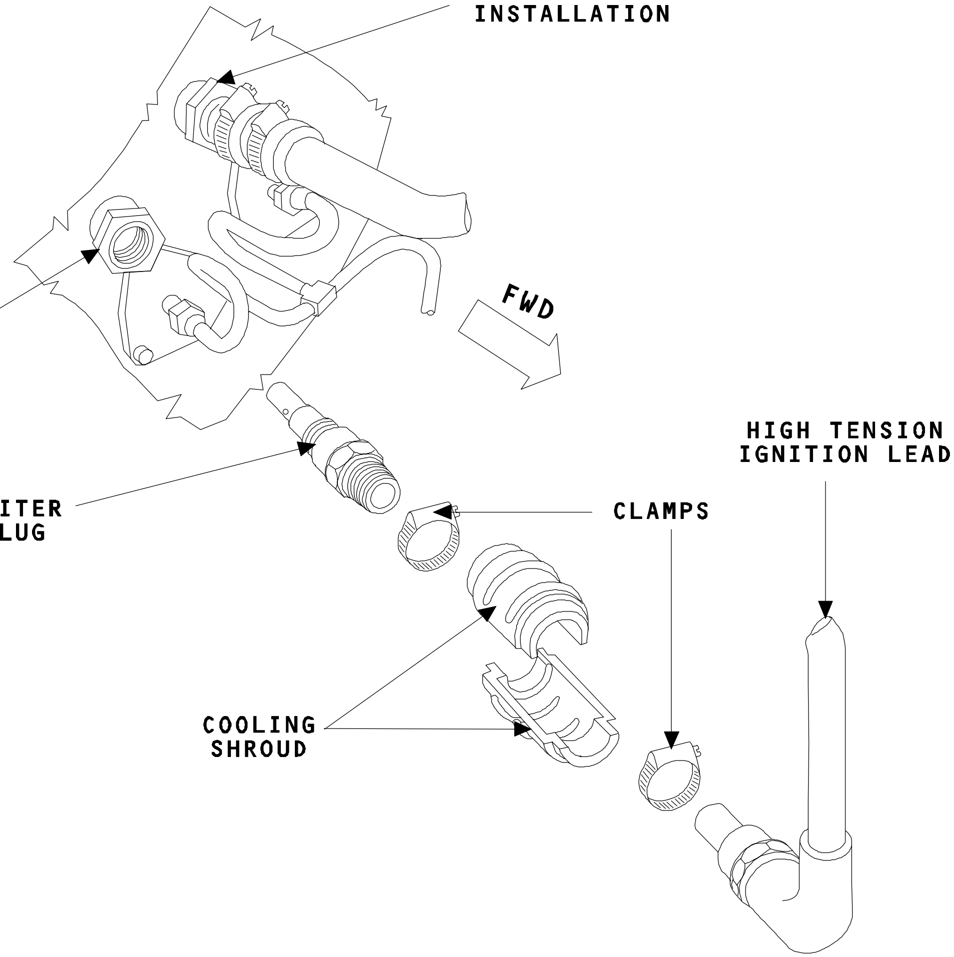
IGNITION AND STARTING COMPONENTS

IGNITER PLUGS

IDENTIFICATION
FIN: 4001JH1, 4001JH2

LOCATION
ZONE: 454, 464





IGNITION AND STARTING COMPONENTS - IGNITERS

IGNITION AND STARTING COMPONENTS

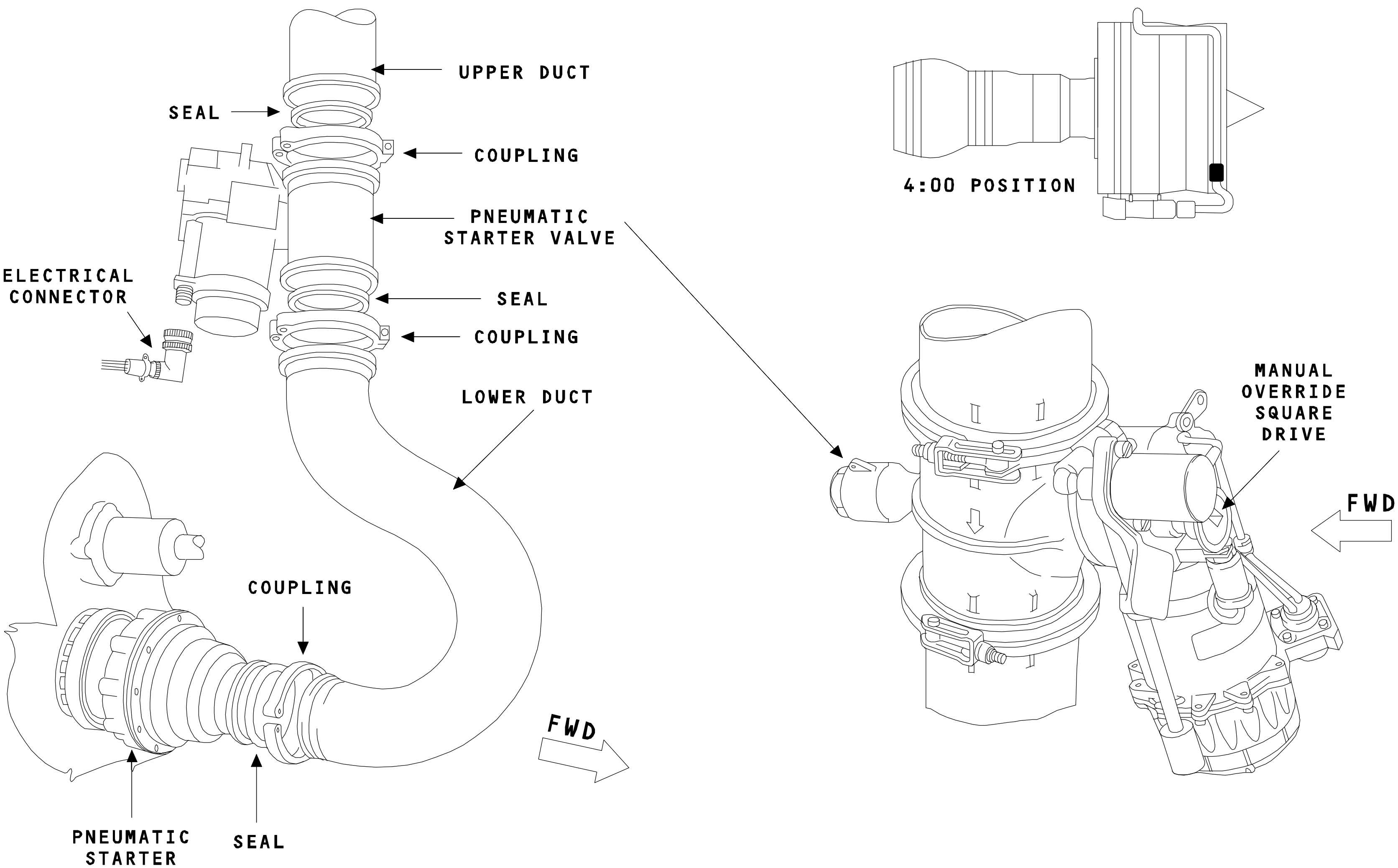
STARTER VALVE

IDENTIFICATION
FIN: 4005KS

LOCATION
ZONE: 436, 446

MANUAL OVERRIDE
The start valve can be manually opened/closed by using a 0.375 in square drive.
An access panel is provided on the RH fan cowl door for quick access.

NOTE: Never operate the start valve without pneumatic pressure to avoid damaging seals.



IGNITION AND STARTING COMPONENTS - STARTER VALVE

UFD4200
TMU74ID01-P05 LEVEL 3

IGNITION AND STARTING COMPONENTS

AIR STARTER

IDENTIFICATION
FIN: 8KA

LOCATION
ZONE: 438, 448

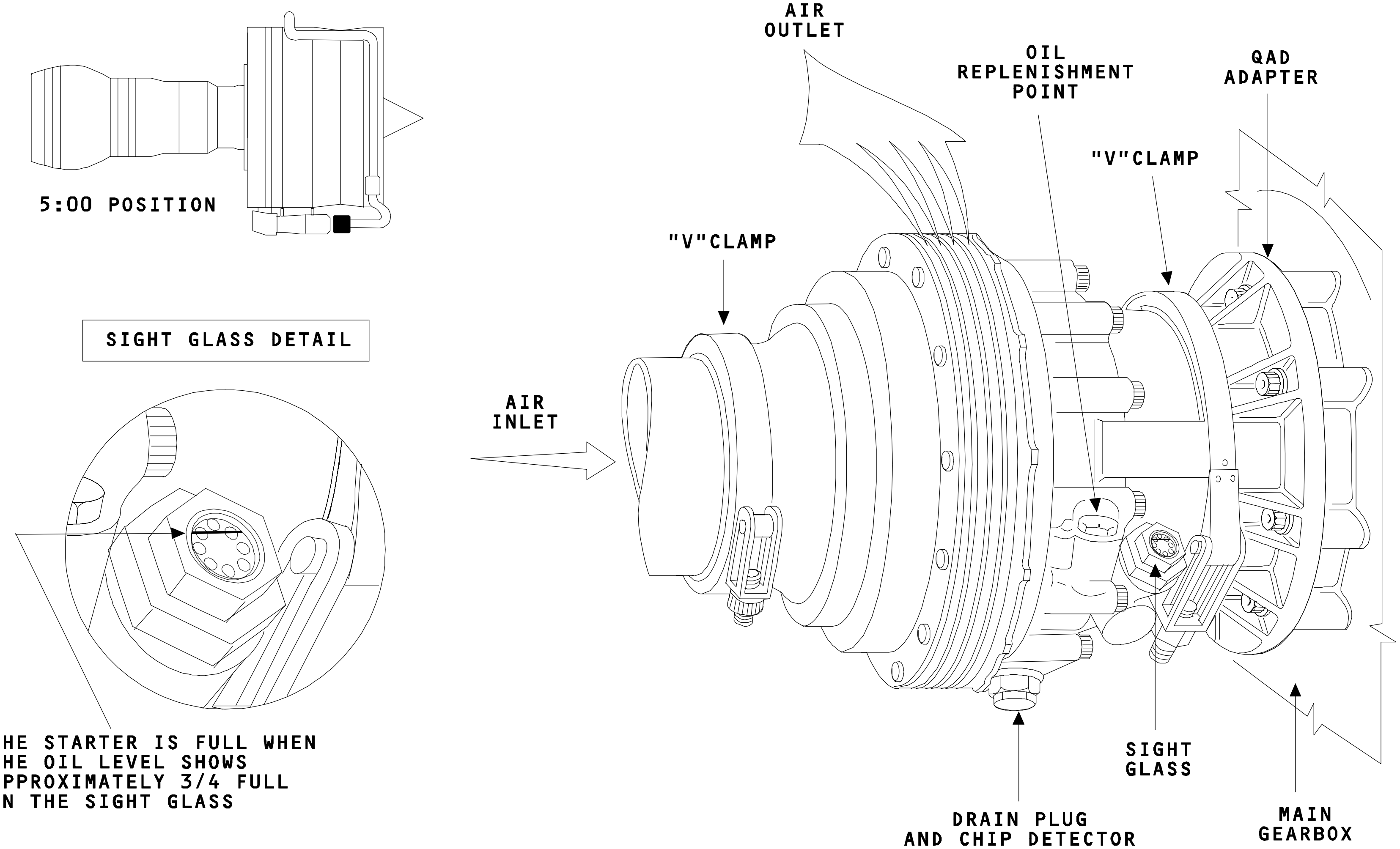
COMPONENT DESCRIPTION

STARTER LIMITS:

- 3 consecutive cycles, each of a maximum duration of 2 mn.
- wait for N2 to drop to 0% RPM between two cycles.
  or
- 1 continuous cycle of 4 mn.
  After the above cycles wait for 30 mn to allow the starter to cool before attempting another engine start.

MAXIMUM RE-ENGAGEMENT SPEED:

- N2 10% on ground
- N2 18% in flight.



UFD4200

TMU74ID01-P06 LEVEL 3

IGNITION AND STARTING COMPONENTS - AIR STARTER

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75 - AIR

75-00-00 AIR SYSTEM PRESENTATION

CONTENTS:

AIR SYSTEM PRESENTATION

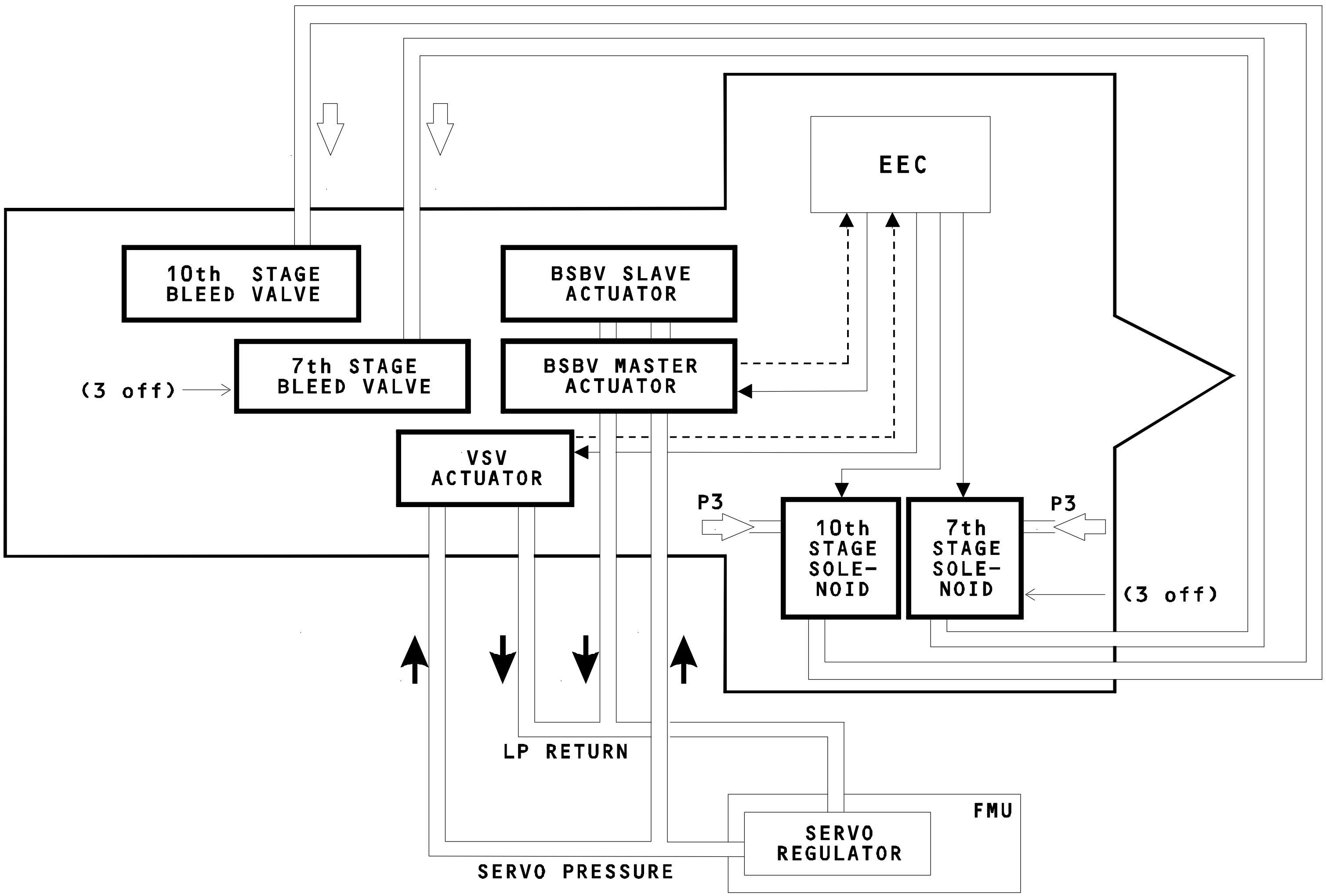
GENERAL

The engine air system ensures the control of the compressor airflow and turbine clearances.
The system also deals with the cooling and pressurizing airflows.

COMPRESSOR AIRFLOW CONTROL

The compressor airflow control is provided by a Booster Stage Bleed Valve system, a Variable Stator Vane system and additional bleed valves at the 7th and 10th stages of the HP compressor.
All these systems are controlled by the Electronic Engine Control (EEC).

The Booster Stage Bleed Valve (BSBV) system permits booster compressor airflow discharge into the fan airstream to ensure that the booster compressor output matches the HP compressor requirements at low engine speed and decceleration.
The Variable Stator Vane (VSV) system directs the airflow into the HP compressor 4 initial stages to prevent blade stall and engine surge.
Four bleed valves, three for the 7th stage and one for the 10th stage of the HP compressor, complete the compressor airflow control.



AIR SYSTEM PRESENTATION

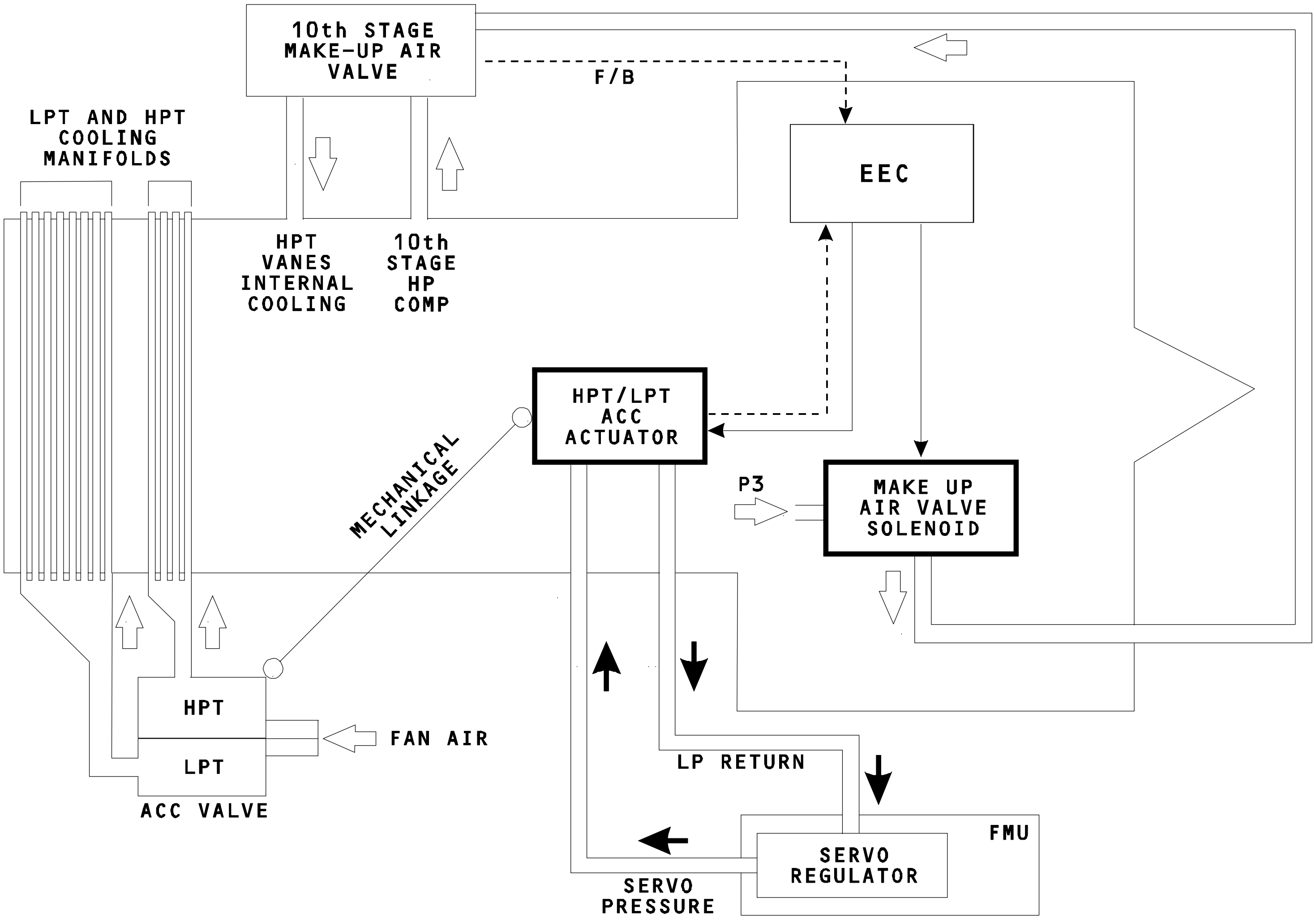
AIR SYSTEM PRESENTATION

TURBINE CLEARANCE CONTROL AND TURBINE COOLING

The EEC controls the actuation of an Active Clearance Control (ACC) valve for the HP and LP turbine active clearance control and a 10th stage make-up air valve for supplementary internal cooling of the turbines.

The Active Clearance Control (ACC) system ensures the blade tip clearances of the turbines for better performance.
The EEC controls a dual ACC valve which discharges fan air through manifolds to cool the surfaces of the HP and LP turbine cases during climb and cruise power operations.

The make-up air valve supplies supplemental air, from the HP compressor 10th stage, to cool the 2nd stage vanes, hubs and both disks of the HP turbine.
During cruise, the valve is closed.



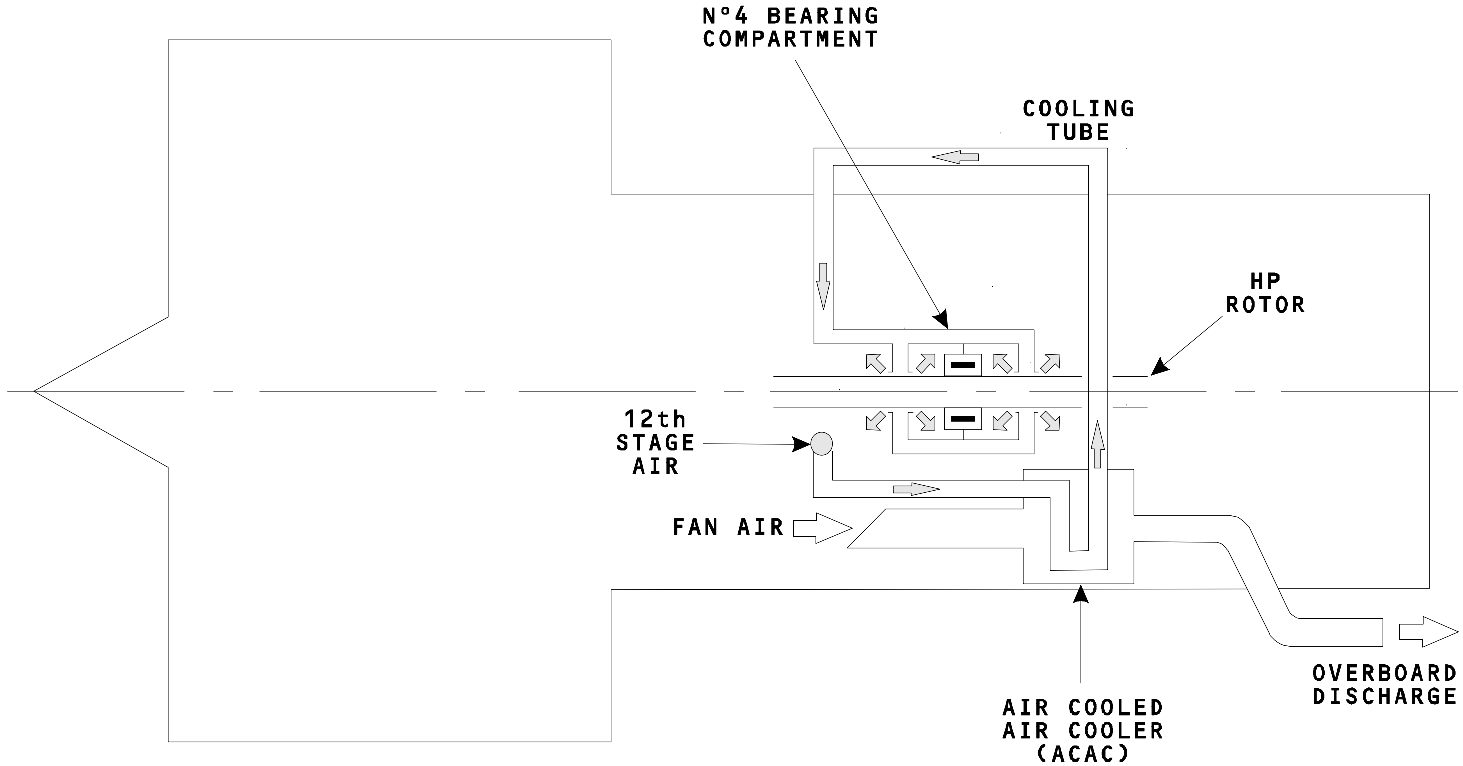
AIR SYSTEM PRESENTATION - TURBINE CLEARANCE CONTROL AND TURBINE COOLING

UFD4200
TMU75IA02-P02 LEVEL 3

AIR SYSTEM PRESENTATION

N°4 BEARING COMPARTMENT COOLING

The number 4 bearing compartment is cooled by 12th stage air of the HP compressor. An external line carries this air through an Air Cooled Air Cooler before entering into the N° 4 bearing compartment.
The Air Cooled Air Cooler (ACAC) cools the 12th stage air of the HP compressor with fan air before going into the N°4 bearing compartment.
The fan air is then discharged overboard.



AIR SYSTEM PRESENTATION - N° 4 BEARING COMPARTMENT COOLING

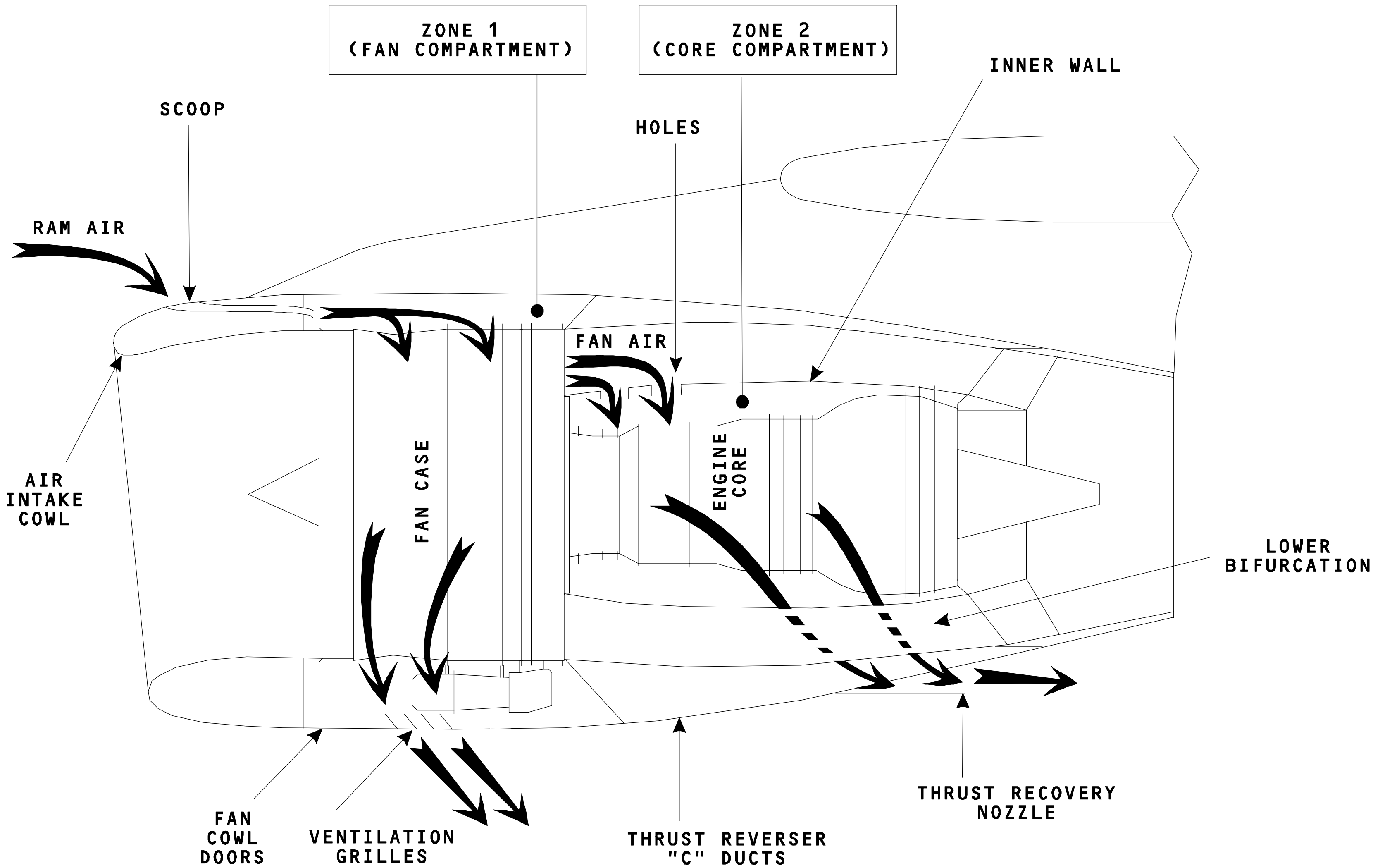
AIR SYSTEM PRESENTATION

FAN AND CORE VENTILATION ZONES

The fan case and engine core compartments, which form the nacelle, are ventilated to provide airflow around the engine during its operation.

ZONE 1: The fan case and accessories are cooled by air taken in by a scoop on the upper side of the air intake cowl. The air is then vented overboard through two ventilation grilles at the bottom of each fan cowl door.

ZONE 2: Core compartment ventilation is provided by fan air through holes in the inner wall of the thrust reverser "C" ducts. The air circulates into the core compartment and flows through the lower bifurcation of the thrust reverser "C" ducts, then exits through the thrust recovery nozzle.



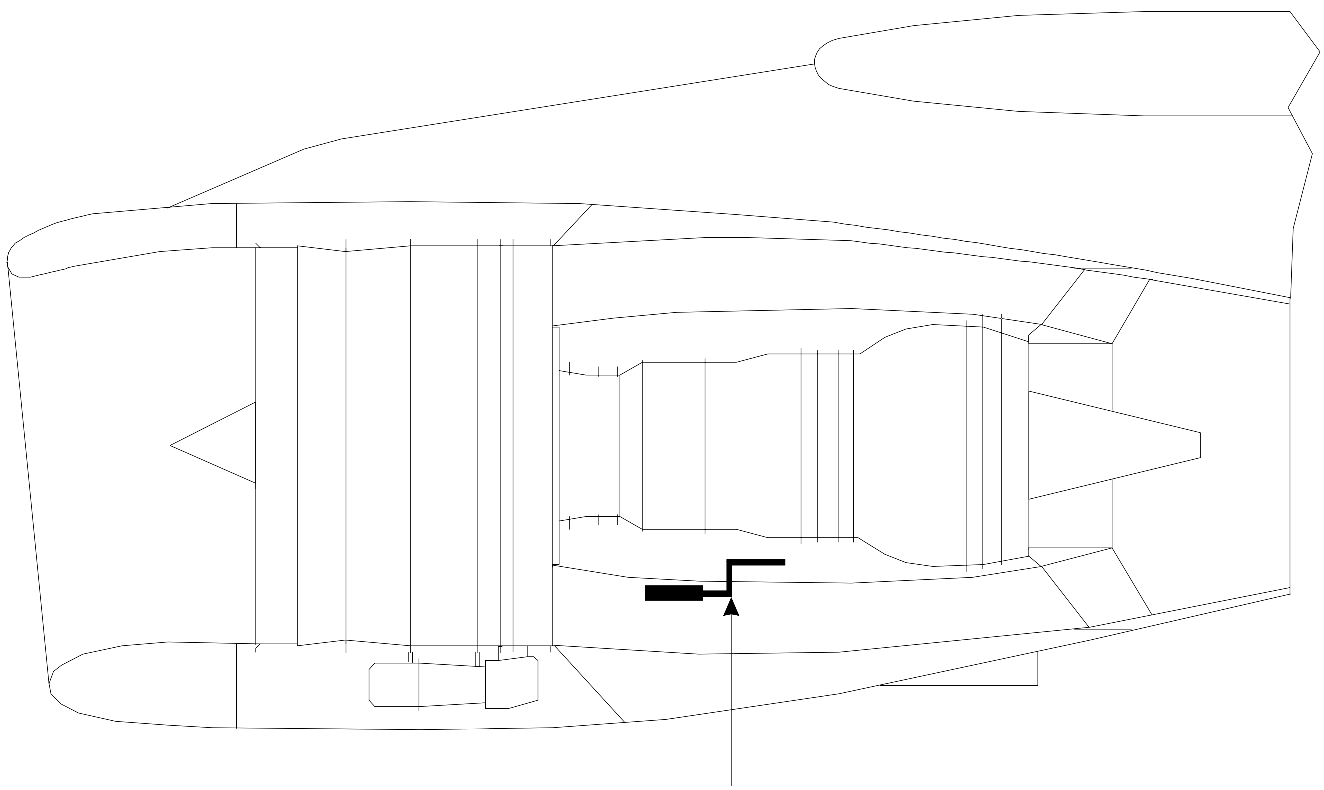
AIR SYSTEM PRESENTATION - FAN AND CORE VENTILATION ZONES

UFD4200 TMU75IA02-P04 LEVEL 3

AIR SYSTEM PRESENTATION

NACELLE TEMPERATURE

The nacelle temperature is monitored by a temperature probe installed in the ventilated core compartment. The nacelle temperature sensor provides indication to the ECAM lower display.



UFD4200
TMU75IA02-P05 LEVEL 3

AIR SYSTEM PRESENTATION - NACELLE TEMPERATURE

SELF EXAMINATION

Which of the following controls the Booster Stage Bleed Valve?
A - The BSBV master actuator.
B - The FMU.
C - The EEC.

What provides the HP Turbine vane internal cooling?
A - The HPT/LPT ACC valve.
B - The 10th stage make-up air valve.
C - The 10th stage handling bleed valve.

Where is air taken from to cool N° 4 bearing compartment?
A - 7th stage.
B - 10th stage.
C - 12th stage.

75 - AIR

75-00-00 AIR SYSTEM COMPONENTS

CONTENTS:

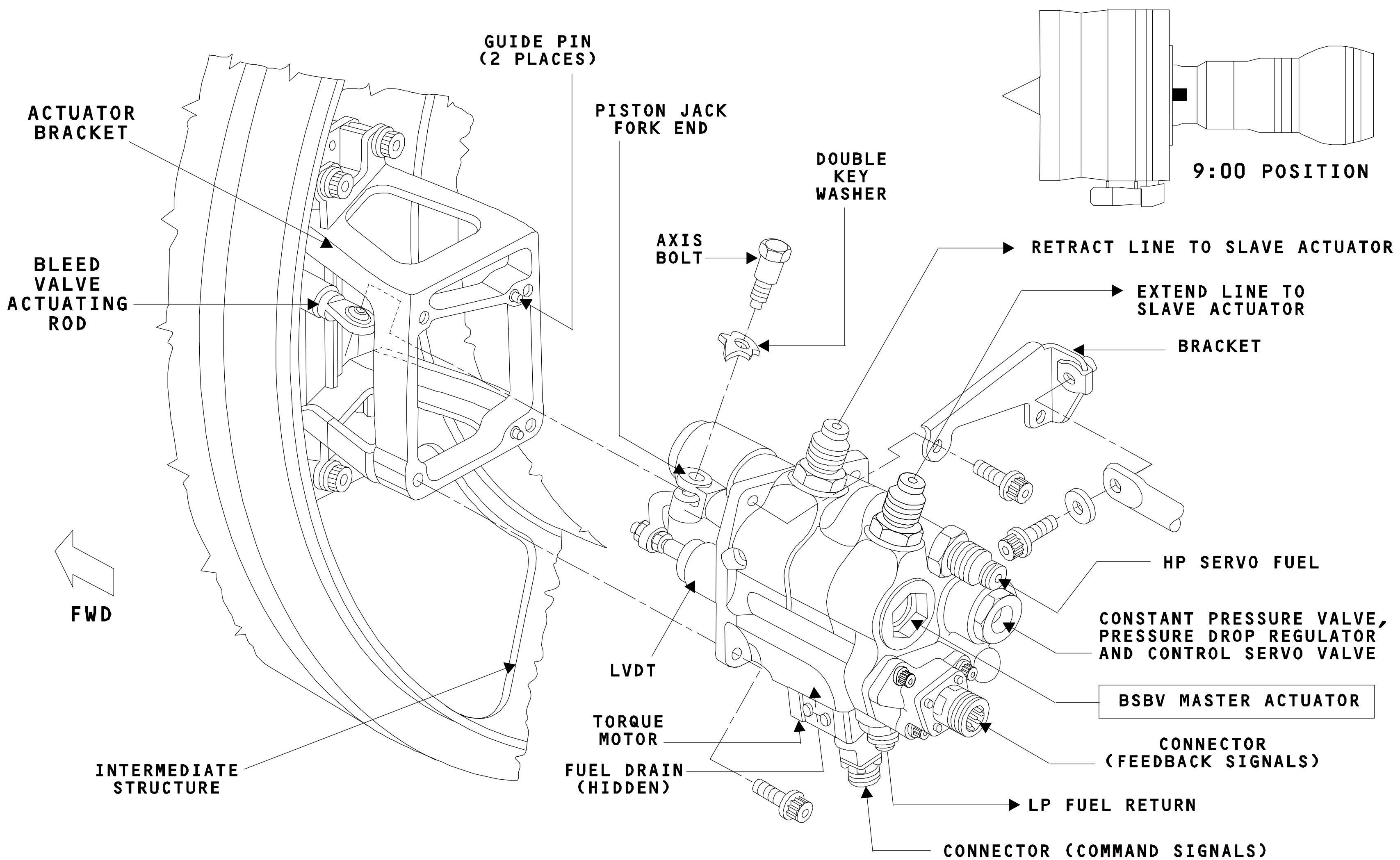
AIR SYSTEM COMPONENTS

BSBV MASTER ACTUATOR

IDENTIFICATION
FIN: 4021KS

LOCATION
ZONE: 451AL, 461AL

COMPONENT DESCRIPTION
Note that no adjustment is required after replacement of the BSBV master actuator.



UFD4200

TMU75IG02-P01 LEVEL 3

AIR SYSTEM COMPONENTS - BOOSTER STAGE BLEED VALVE MASTER ACTUATOR

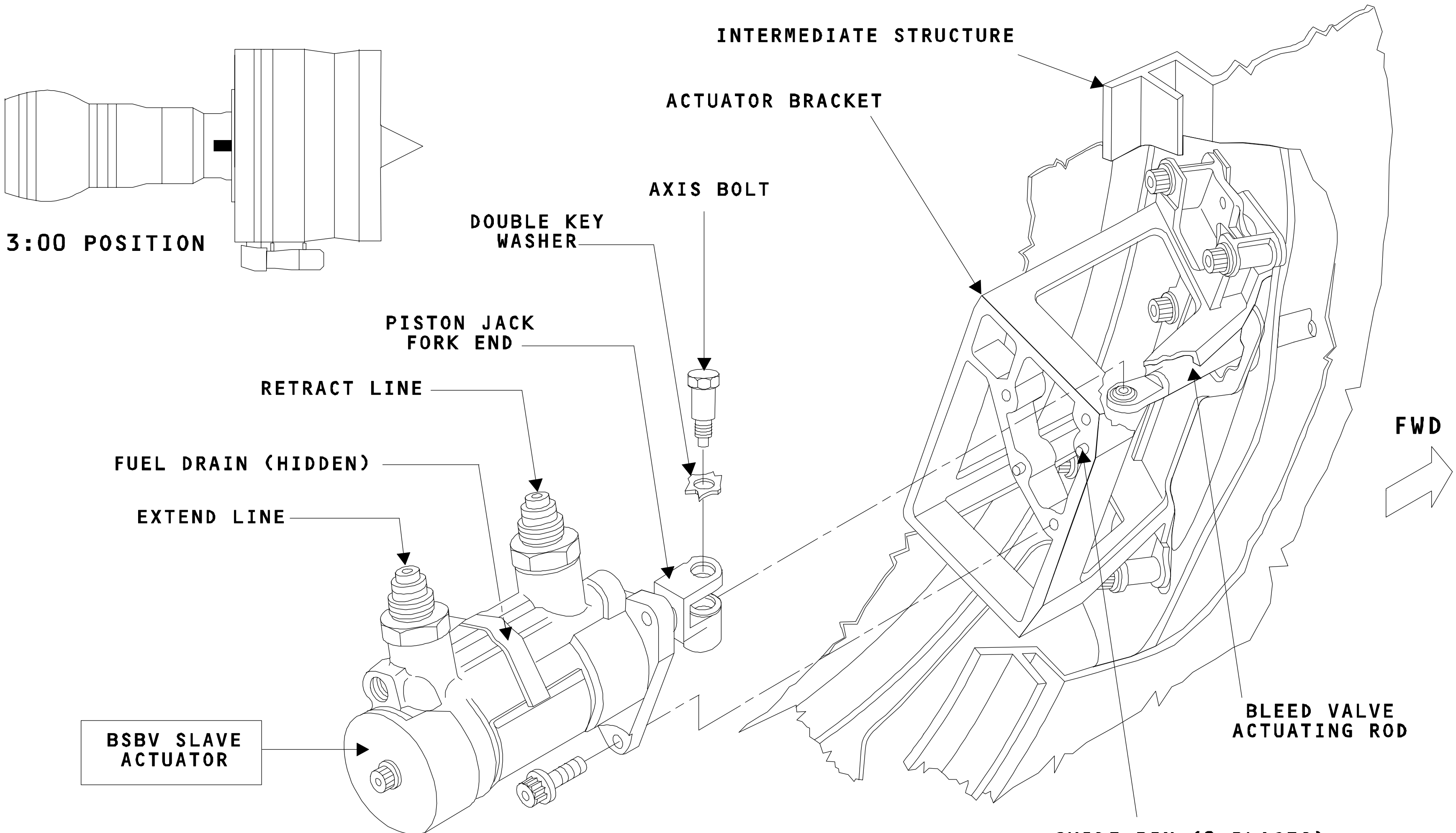
AIR SYSTEM COMPONENTS

BSBV SLAVE ACTUATOR

IDENTIFICATION
FIN: 4021KS

LOCATION
ZONE: 452AR, 462AR

COMPONENT DESCRIPTION
Note that no adjustment is required after replacement of the BSBV slave actuator.



UFD4200

TMU75IG02-P02 LEVEL 3

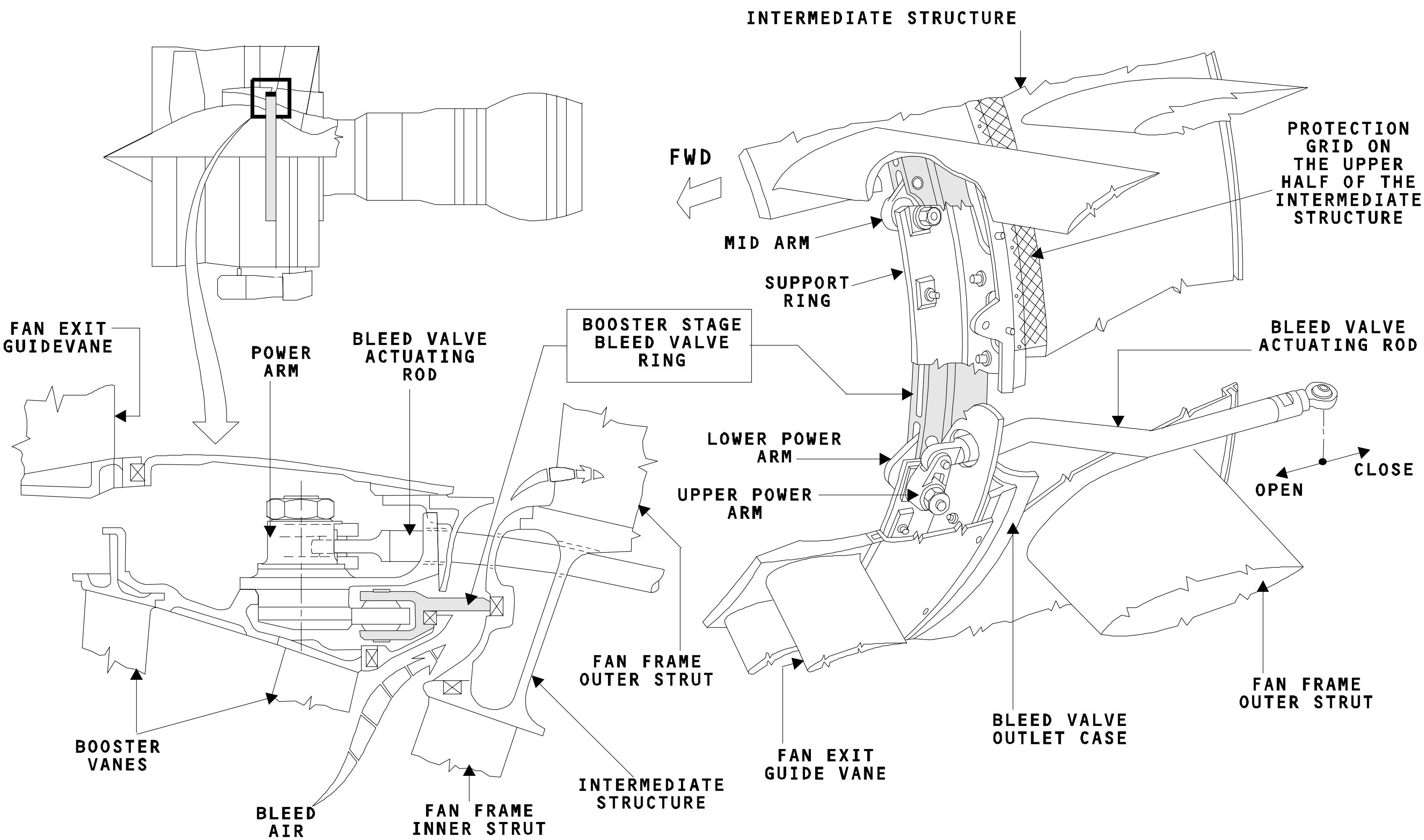
AIR SYSTEM COMPONENTS - BOOSTER STAGE BLEED VALVE SLAVE ACTUATOR

AIR SYSTEM COMPONENTS

BOOSTER STAGE BLEED VALVE RING

IDENTIFICATION
FIN:

LOCATION
ZONE: 451AL, 452AR, 461AL, 462AR



UFD4200

TMU75IG02-P03 LEVEL 3

AIR SYSTEM COMPONENTS - BOOSTER STAGE BLEED VALVE RING

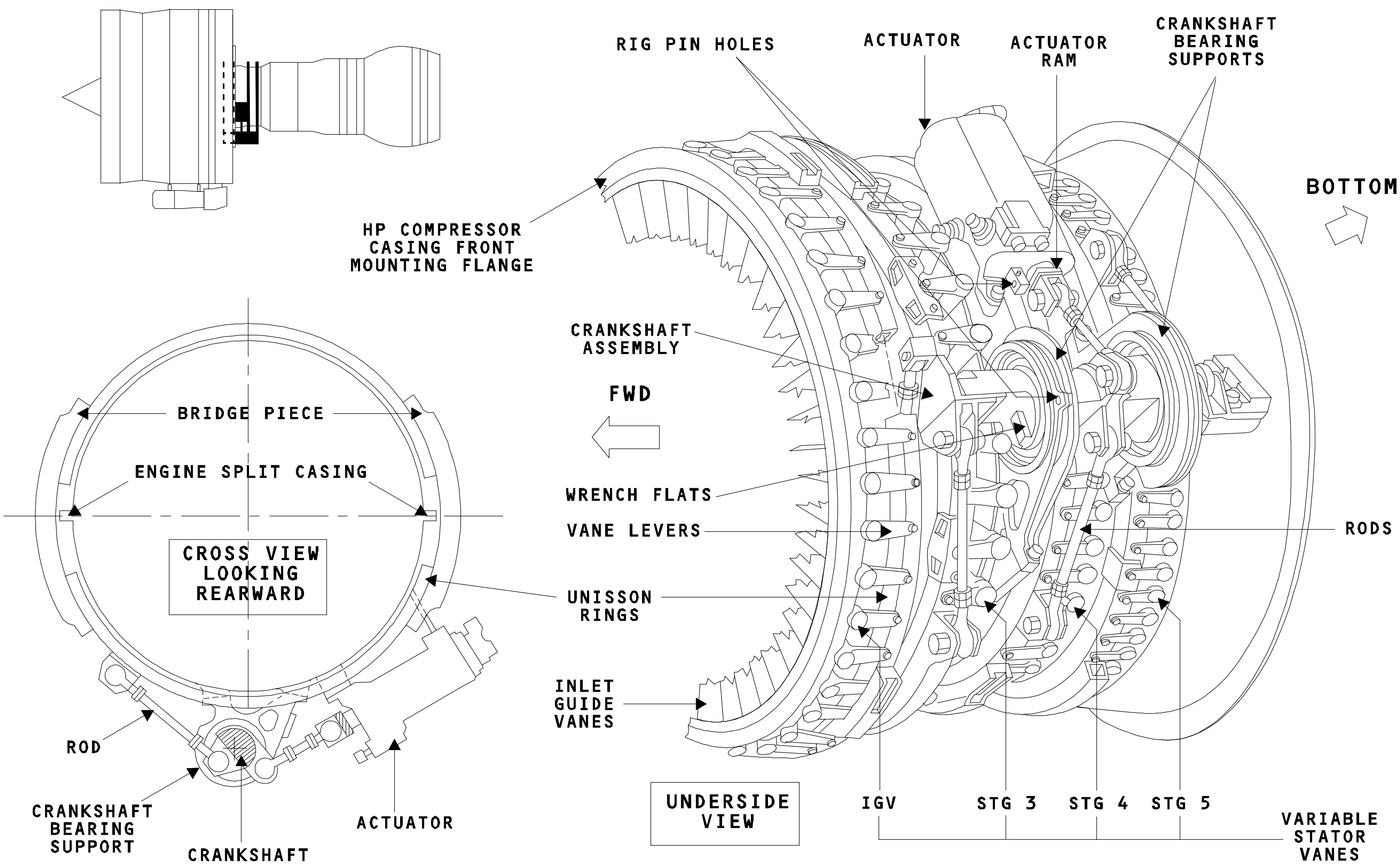
AIR SYSTEM COMPONENTS

VSV SYSTEM

IDENTIFICATION
FIN:

LOCATION
ZONE: 451AL, 452AR, 461AL, 462AR

COMPONENT DESCRIPTION
Rig-pin positions are provided for the actuator ram retracted and VSV crank assembly high speed positions.



AIR SYSTEM COMPONENTS - VSV SYSTEM

AIR SYSTEM COMPONENTS

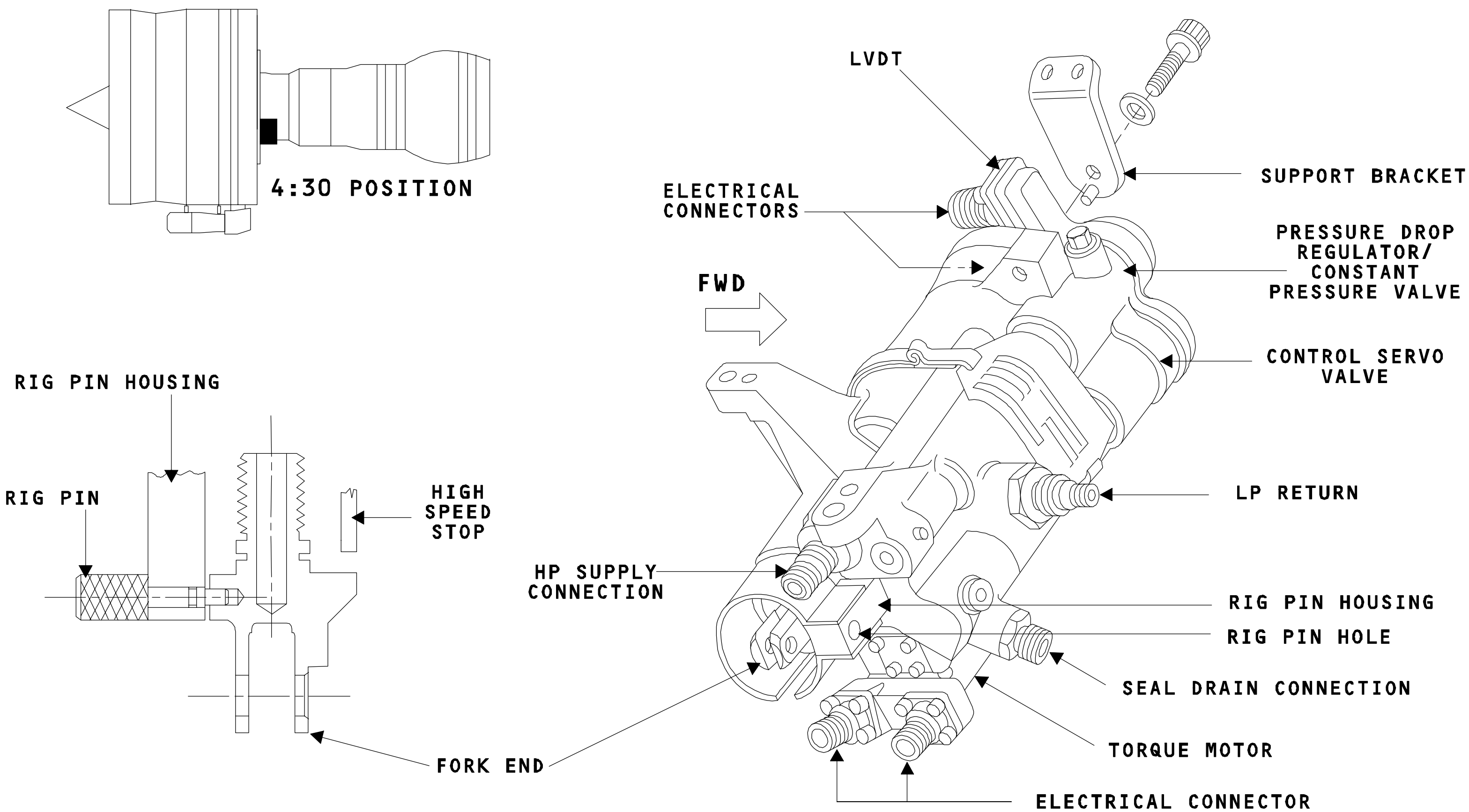
VSV ACTUATOR

IDENTIFICATION
FIN: 4022KS

LOCATION
ZONE: 451AL, 461AL

COMPONENT DESCRIPTION

CAUTION: Before disconnecting the actuator, the VSV crank assembly must be rig-pinned in the high speed (ram retracted) position.
Before installing the VSV actuator, ensure that, with the ram retracted, the fork end is against the actuator high speed stop and the rig-pin can be freely inserted.



AIR SYSTEM COMPONENTS - VARIABLE STATOR VANE ACTUATOR

AIR SYSTEM COMPONENTS

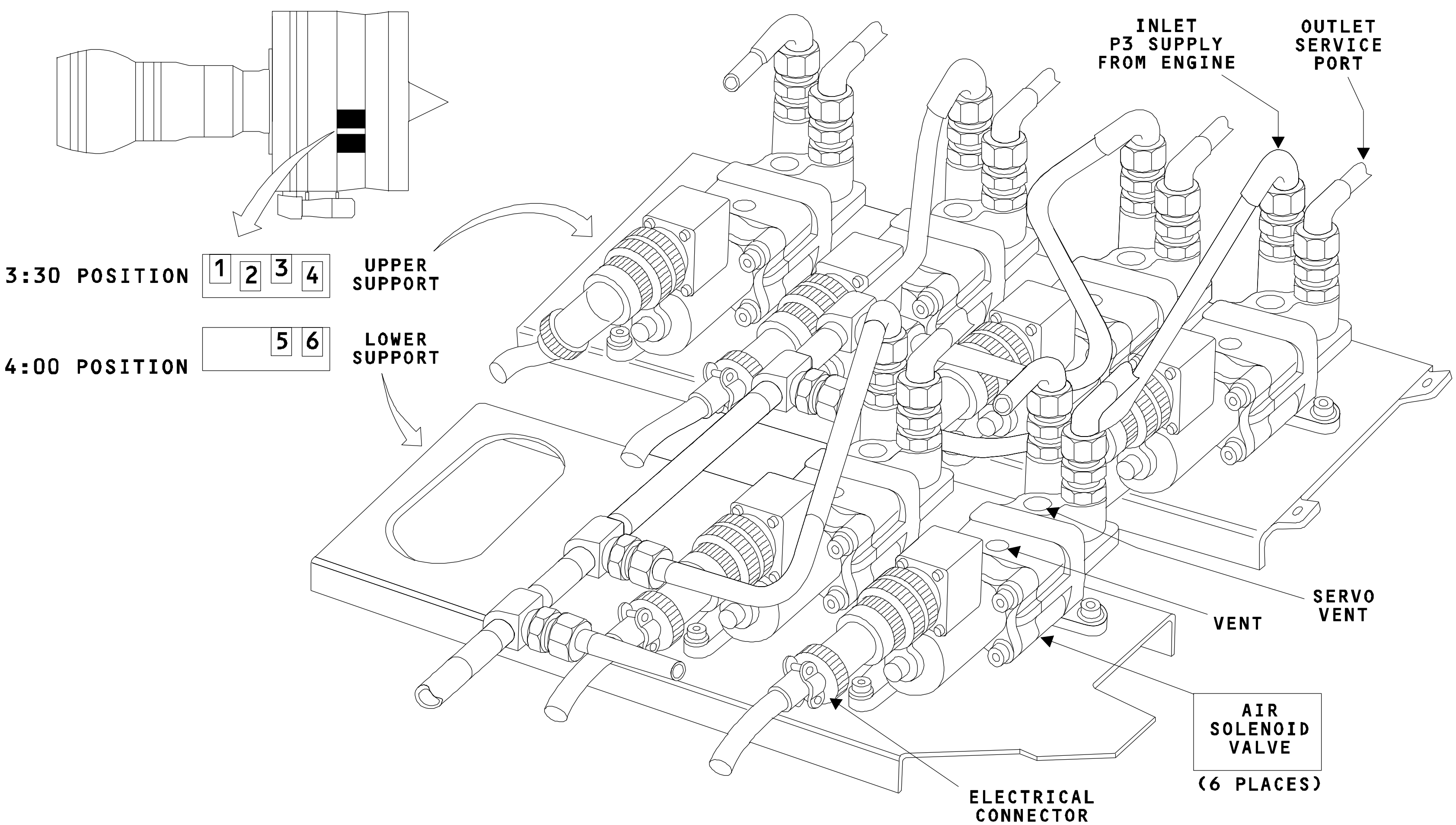
AIR SOLENOID VALVES

IDENTIFICATION
FIN: 7th stage: 4020KS1, 4020KS2, 4020KS3.
10th stage: 4023KS.
Stage 10 make-up air: 4028 KS

LOCATION
ZONE: 438AR, 448AR

COMPONENT DESCRIPTION
Solenoid valve identification:

1. Pneumatic system HP bleed Valve closure solenoid.
2. 7th stage bleed solenoid valve A.
3. 7th stage bleed solenoid valve B
4. 7th stage bleed solenoid valve C.
5. 10th stage bleed solenoid valve.
6. Stage 10 make-up air solenoid valve.



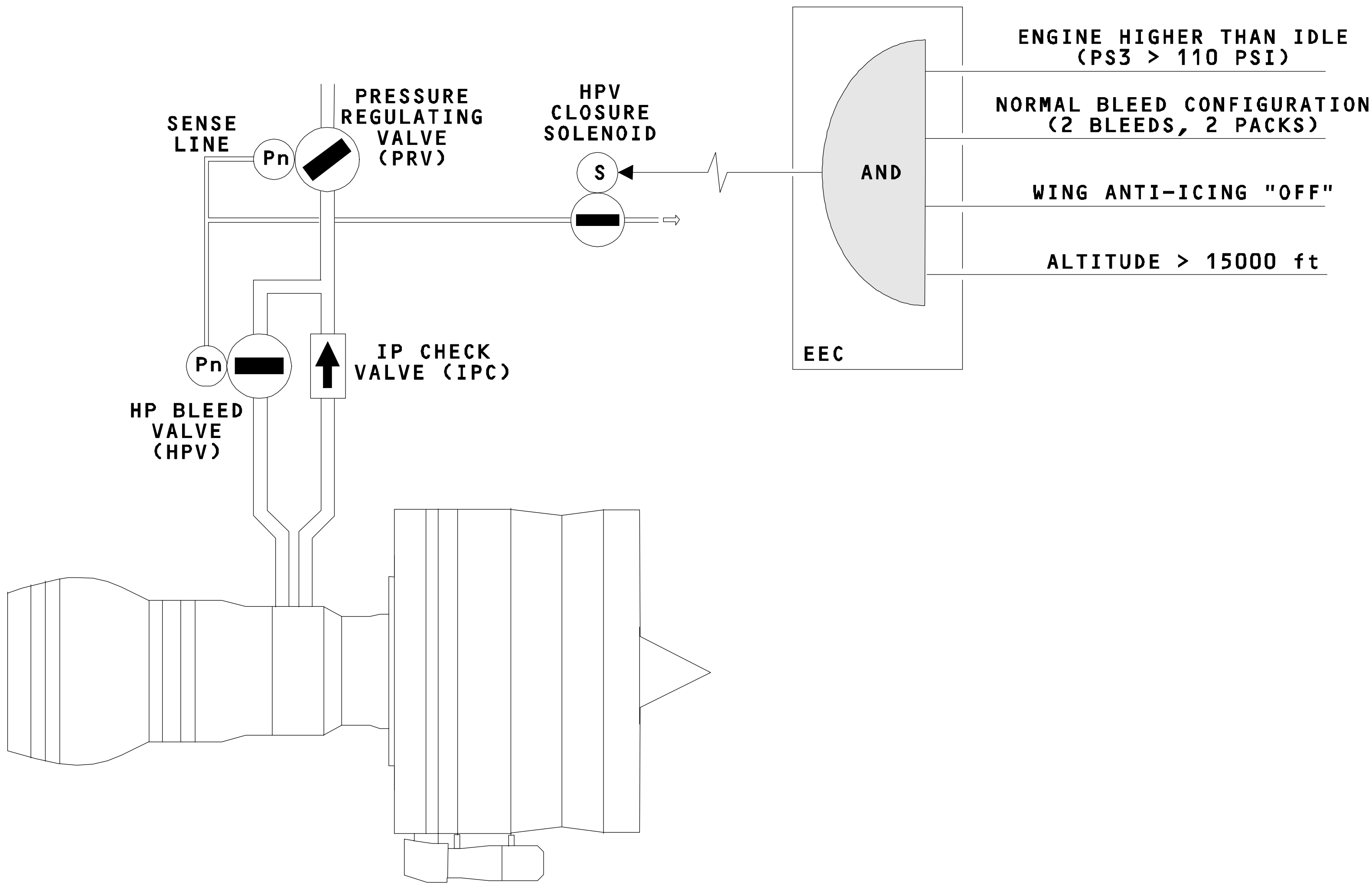
AIR SYSTEM COMPONENTS - AIR SOLENOID VALVES

UFD4200
TMU75IG02-P06 LEVEL 3

AIR SYSTEM COMPONENTS

AIR SOLENOID VALVES (cont'd)

HPV CLOSURE CONTROL SOLENOID
When the solenoid is energized (normal engine bleed configuration), the sense line is vented to ambient. This causes the High Pressure bleed Valve (HPV) closure.
When one of the four conditions is no longer met, the solenoid is de-energized and the opening of the HPV is no longer inhibited.



AIR SYSTEM COMPONENTS - AIR SOLENOID VALVES

UFD4200
TMU75IG02-P07 LEVEL 3

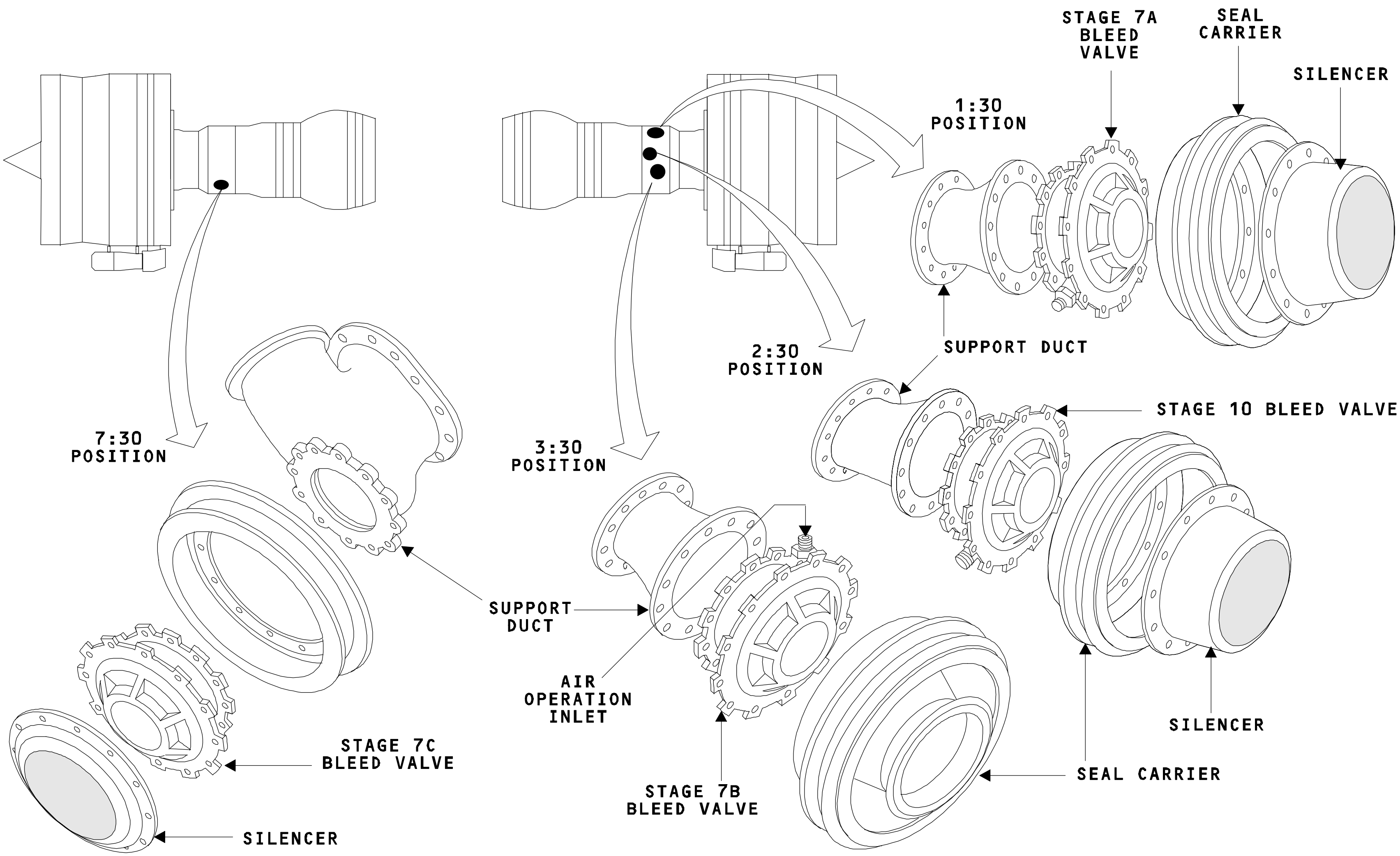
AIR SYSTEM COMPONENTS

HANDLING BLEED VALVES

IDENTIFICATION
FIN: 7th stage: 4000JM1, 4000JM2, 4000JM3.
10th stage: 4001JM.

LOCATION
ZONE: 451AL, 452AR, 461AL, 462AR

COMPONENT DESCRIPTION
The 7A and 7C bleed valves are transient valves and are fitted with silencers.
The 7B valve is a steady state valve and does not have a silencer.
The stage 10 bleed valve is a steady state valve but is fitted with a silencer.
Each 7th stage valve bleeds 5% of the compressor airflow.
The 10th stage valve bleeds 9.7% of the compressor airflow.



UFD4200
TMU75IG02-P08 LEVEL 3

AIR SYSTEM COMPONENTS - COMPRESSOR HANDLING BLEED VALVES

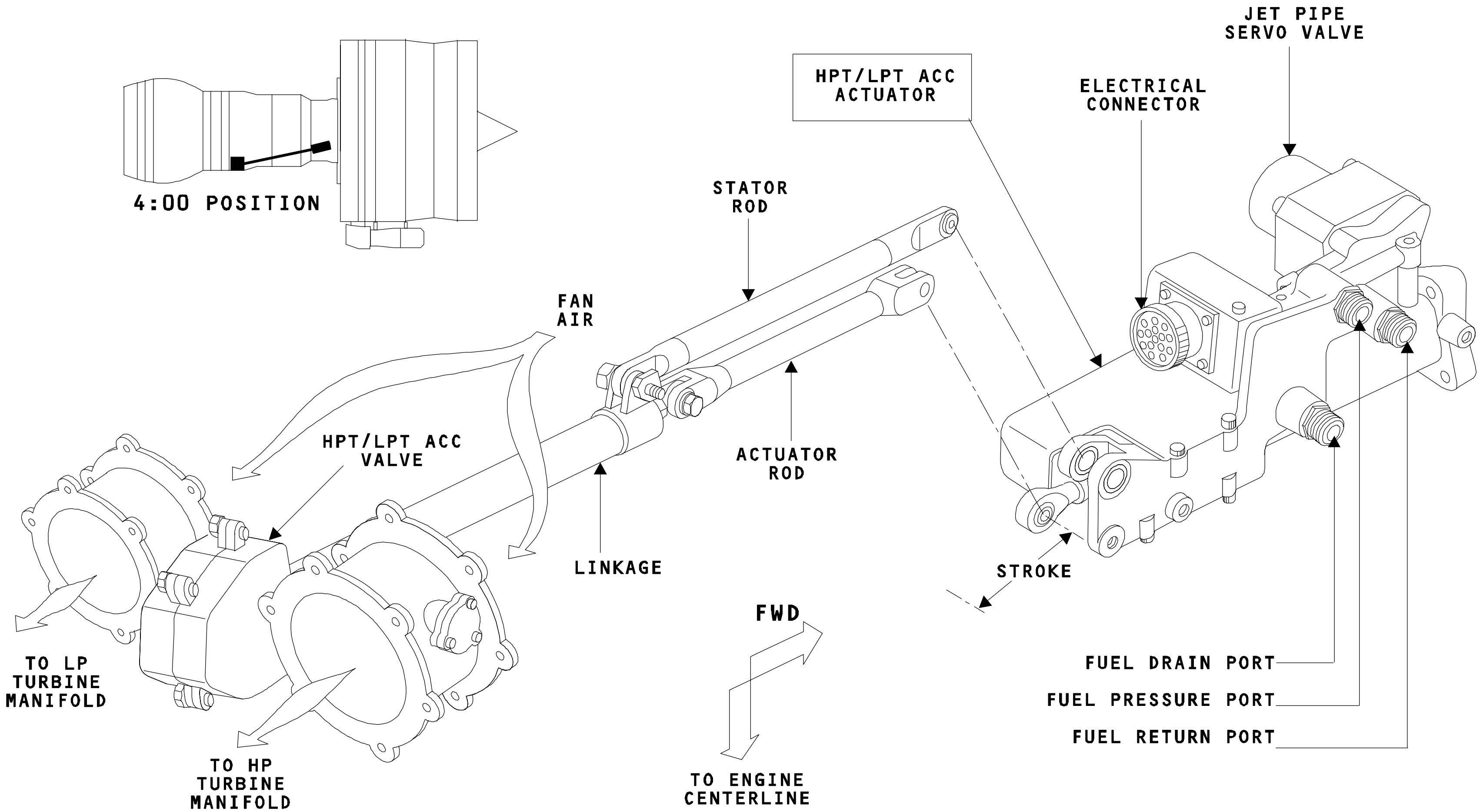
AIR SYSTEM COMPONENTS

HPT/LPT ACC ACTUATOR

IDENTIFICATION
FIN: 4027KS.

LOCATION
ZONE: 452AR, 462AR

COMPONENT DESCRIPTION
Note that no adjustment is required after replacement of either the actuator or the valve.



UFD4200
TMU75IG02-P09 LEVEL 3

AIR SYSTEM COMPONENTS - HPT/LPT ACTIVE CLEARANCE CONTROL ACTUATOR

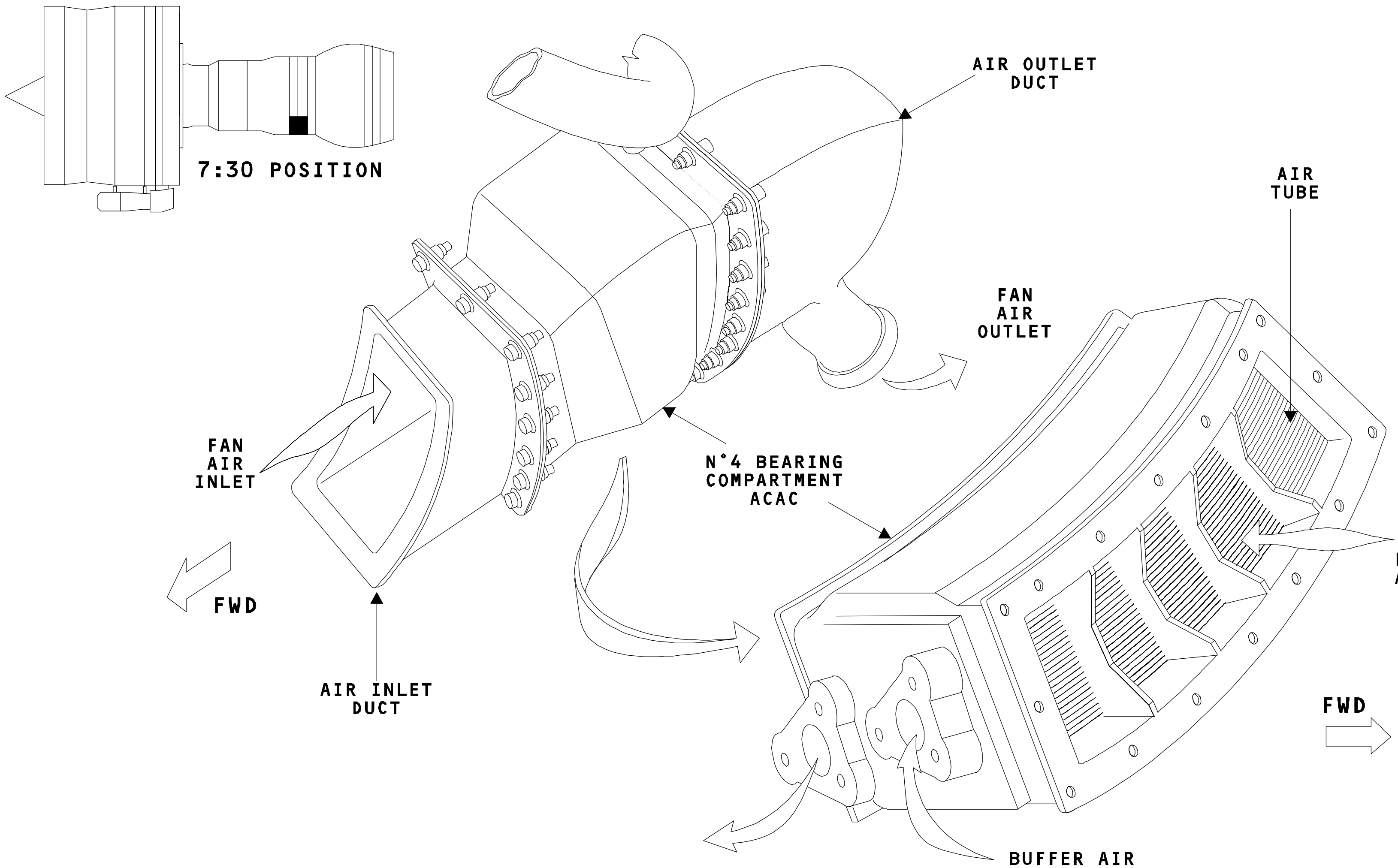
AIR SYSTEM COMPONENTS

N°4 BEARING COMPARTMENT ACAC

IDENTIFICATION
FIN:

LOCATION
ZONE: 451AL, 452AR, 461AL, 462AR

COMPONENT DESCRIPTION
The 12th stage bleed air that is cooled by the ACAC and flows through the cooling jacket of the N°4 bearing compartment is called buffer air.



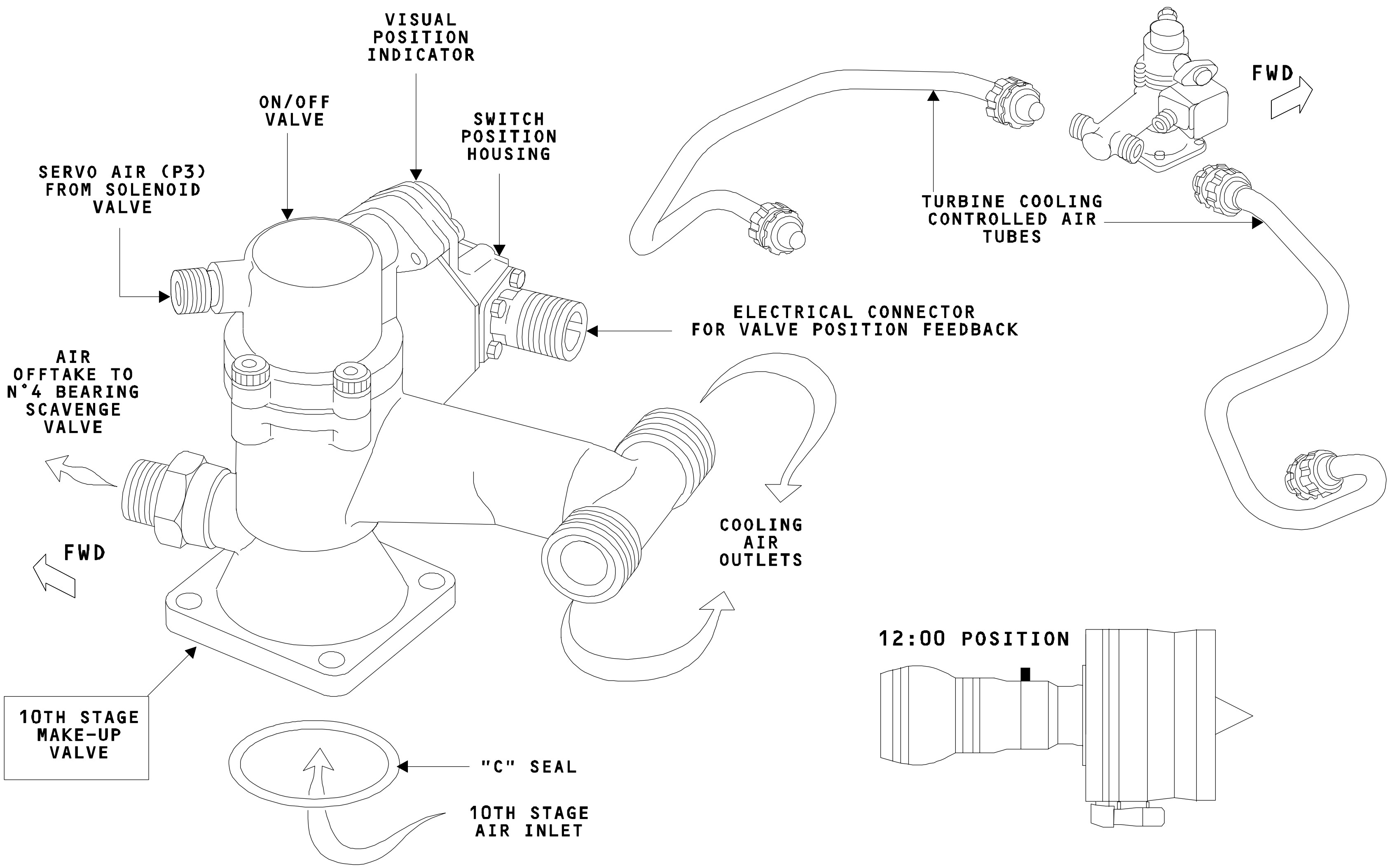
AIR SYSTEM COMPONENTS - N°4 BEARING COMPARTMENT AIR COOLED AIR COOLER

AIR SYSTEM COMPONENTS

10th STAGE MAKE-UP AIR VALVE

IDENTIFICATION
FIN: 4025KS

LOCATION
ZONE: 451AL, 461AL



AIR SYSTEM COMPONENTS - 10TH STAGE MAKE-UP AIR VALVE

TMU75IG02-P11 LEVEL 3
UFD4200

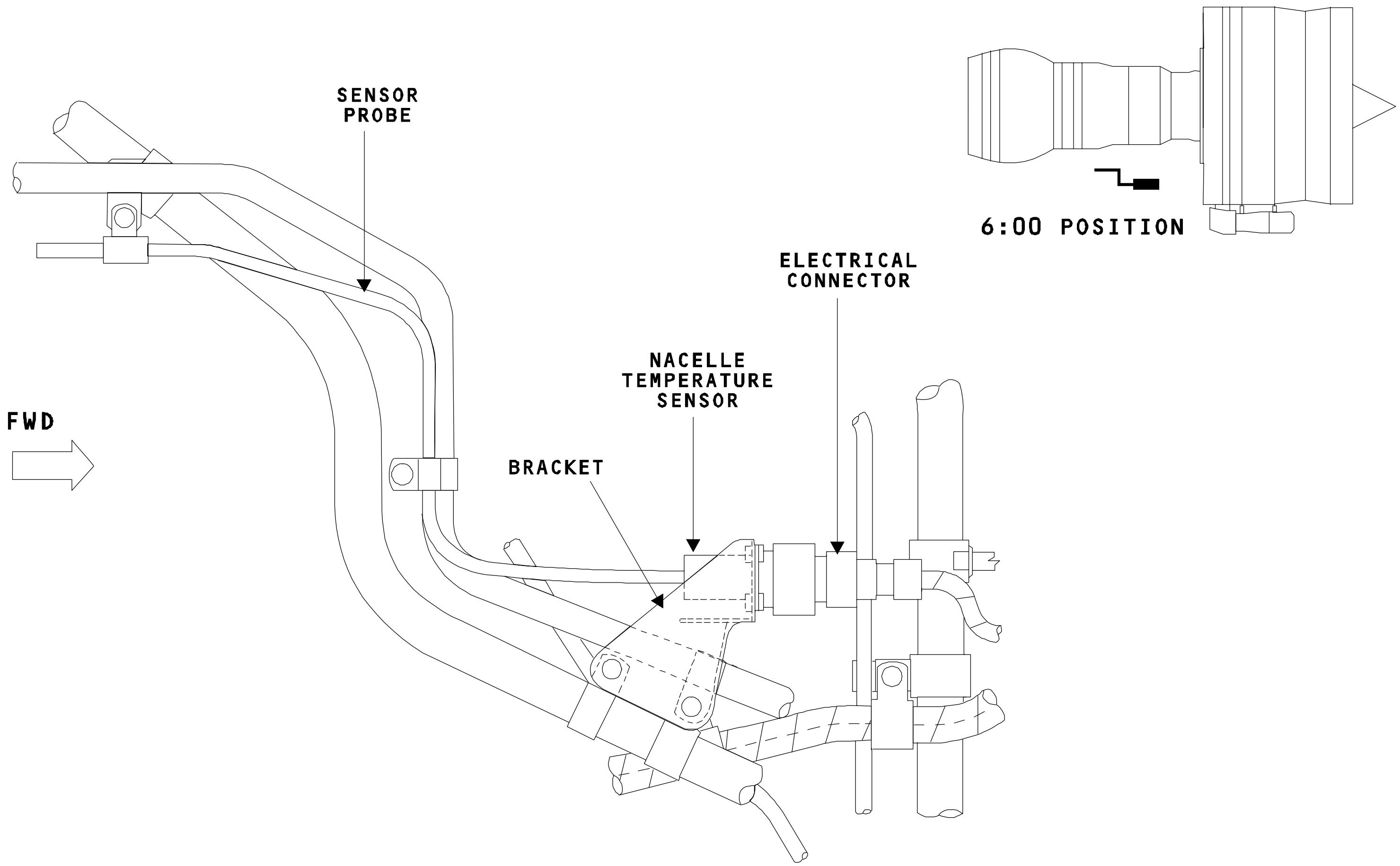
AIR SYSTEM COMPONENTS

NACELLE TEMPERATURE SENSOR

IDENTIFICATION
FIN: 4008KS

LOCATION
ZONE: 454, 464

COMPONENT DESCRIPTION
The nacelle temperature sensor has a measurement range of -54°C to 330°C (-65,2°F to 626°F).
The signal is fed to the EIU which transforms the information to digital form.
The EIU transmits the data to the ECAM system.



UFD4200

TMU75IG02-P12 LEVEL 3

AIR SYSTEM COMPONENTS - NACELLE TEMPERATURE SENSOR

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76 - ENGINE CONTROLS

76-00-00 ENGINE CONTROLS AND INDICATING PRESENTATION

CONTENTS:

ENGINE CONTROLS AND INDICATING PRESENTATION

GENERAL

The engine controls are located on the overhead panel and on the center pedestal.
The indications are given on the ECAM displays.

THROTTLE LEVERS

The throttle levers are installed on the center pedestal.
The throttle lever positions are transmitted by electrical signals to the FADEC systems.
Each throttle lever is fitted with a reverse thrust latching lever and an auto-thrust instinctive disconnect pushbutton.

The throttle quadrant is graduated from 0 to 45°. Idle is at 0°, the lever is moved in forward sector for thrust and in the aft sector for reverse thrust.
The throttle lever has three detents marked CL (Climb), FLX/MCT (FLeXiBle take-off or Maximun Continuous Thrust), TOGA (Take-Off, Go-Around).
In the aft sector, the throttle lever also has a detent at the beginning of the REVerse zone and a stop marked FULL (FULL reverse) at the end of this zone.
Note that MCT position is also used for Flexible Take-Off, which is a reduced power setting.

In manual thrust control mode the throttle lever acts exactly like a throttle on traditional aircraft. So thrust increases as you move the lever regardless of the detents.

In autothrust control mode, the EPR is commanded by the EEC according to the thrust target demand from the FMGC.
The throttle levers are used as a limit mode selector device. In automatic thrust, the throttle levers do not move.

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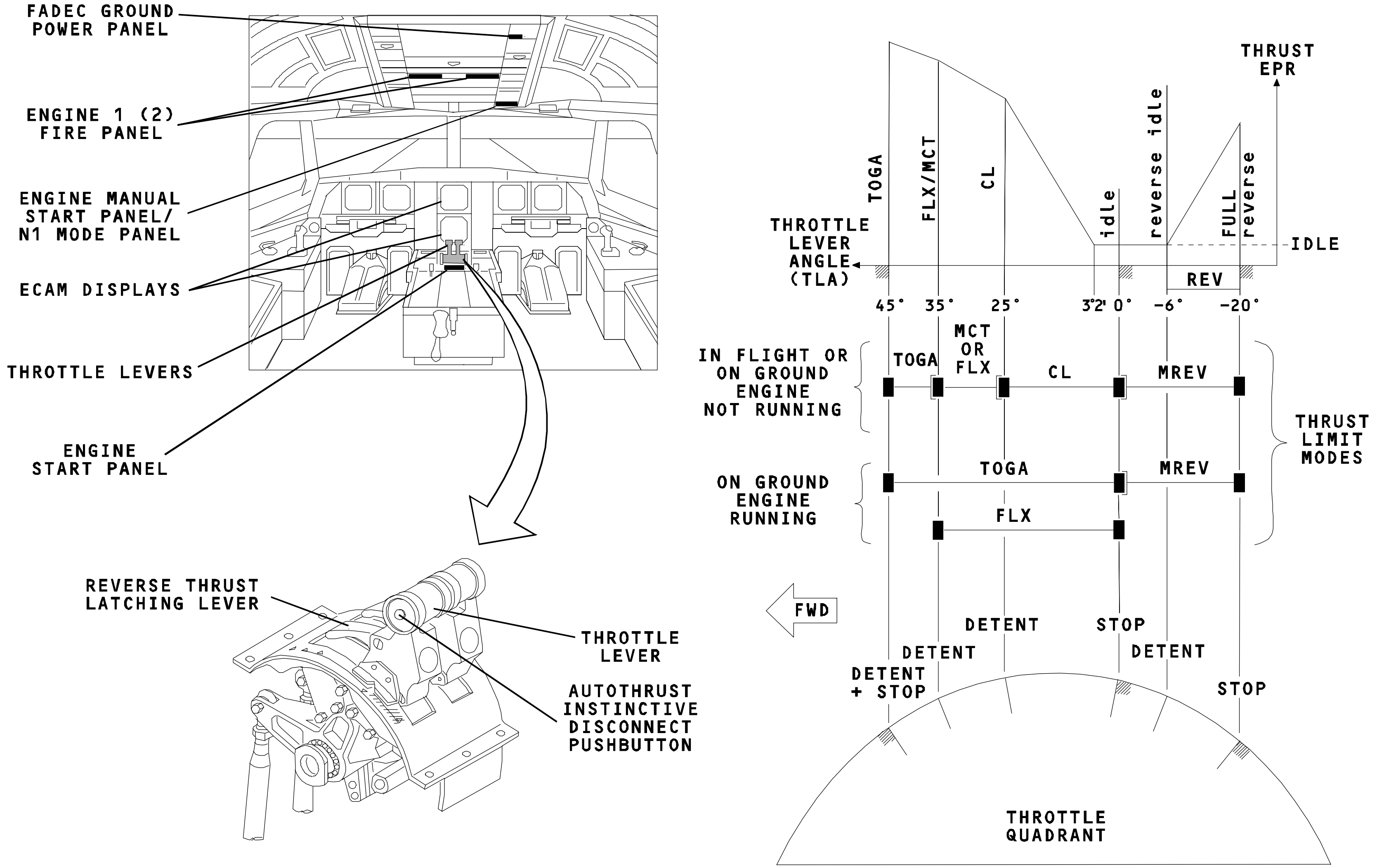


ENGINE CONTROLS AND INDICATING PRESENTATION

UFD4200

TMU76IA04-P01 LEVEL 1

ENGINE CONTROLS AND INDICATING PRESENTATION

ENGINE START PANEL

On the center pedestal the ENGine start panel is provided to control the engine start sequences.
Two ENG MASTER switches with two positions, "ON" or "OFF", are provided to open or close the ENG 1(2) High Pressure (HP)fuel shut-off valve and command and reset the FADEC functions.
The rotary selector initiates either a START sequence or a CRANK sequence.
The start sequence is carried out, in automatic mode, when the ENGine MASTER switch is set to "ON" with the "IGN START" selected.
After the start or crank sequence, the selector is set back to the MODE NORMal position.
The red FIRE indicator light is activated in case of fire detected and the amber indicator FAULT light is activated in case of aborted start.

ENGINE MANUAL START PANEL

The ENGine MANual START panel has two guarded push buttons to operate the corresponding start valves in the manual start mode or during an engine cranking.

N1 MODE PANEL

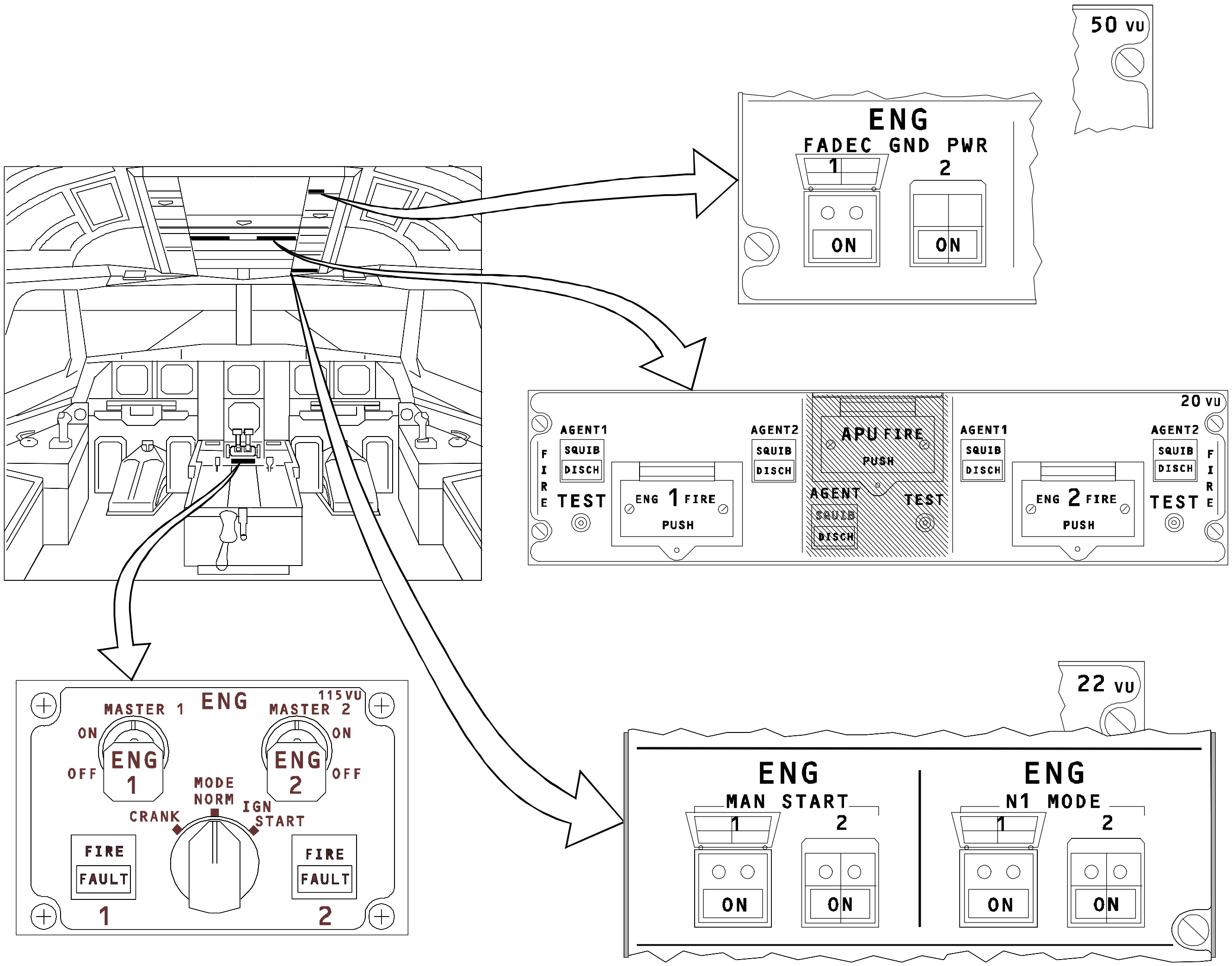
In case of EPR control mode failure, two guarded pushbuttons are provided near the ENG MAN START panel to manually select N1 mode on both engines.

FADEC GROUND POWER PANEL

The FADEC is normally supplied with power by a dedicated generator driven by the gearbox, when the engine is running.
At engine shut-down, the FADEC is still supplied from the aircraft network during 5 minutes.
After the 5 minutes the FADEC is automatically de-powered and can be re-powered for maintenance purposes by using the FADEC GND PWR pushbutton.

ENGINE 1 (2) FIRE PANEL

When the engine fire pushbutton is released out, for isolation purposes, the low pressure (LP) fuel shut-off valve is closed, and the Engine Interface Unit cuts off the aircraft electrical supply to the FADEC system.



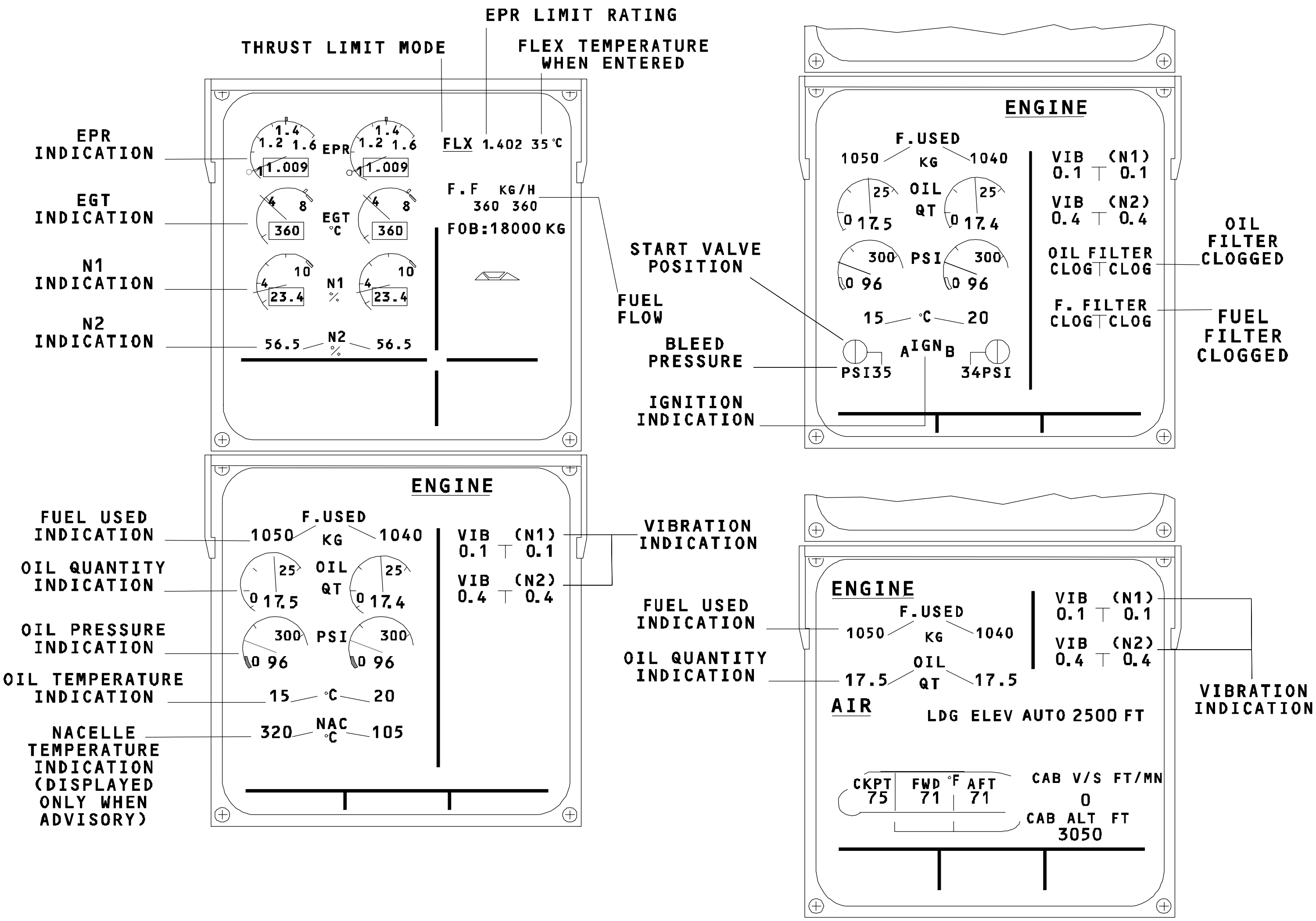
ENGINE CONTROLS AND INDICATING PRESENTATION

UFD4200
TMU76IA04-P02 LEVEL 1

ENGINE CONTROLS AND INDICATING PRESENTATION

INDICATING

The engine primary parameters are permanently displayed on the ECAM upper display.
The screen shows the various indications and their arrangement.
The secondary parameters are displayed on the ENGine page of the ECAM lower display.
In case of pressure loss across the fuel filter or the main scavenge oil filter, some additional indications appear.
During the starting sequence, nacelle temperature is no longer displayed; start valve position, selected ignitor and bleed pressure indications appear.
Fuel used, oil quantity and vibration indications are also displayed on the ECAM cruise page.



ENGINE CONTROLS AND INDICATING PRESENTATION

UFD4200
TMU76IA04-P03 LEVEL 1

SELF EXAMINATION

Where are the engine controls located ?

- A - On the overhead panel.
- B - On the overhead panel and the center pedestal.
- C - On the center pedestal.

Where are the engine primary parameters permanently displayed ?

- A - On the ECAM upper display.
- B - On the ECAM lower display.
- C - On both ECAM displays.

What is the purpose of the ENGINE MASTER SWITCH ?

- A - To open or close the HP fuel Shut-Off Valve.
- B - To command and reset the FADEC functions.
- C - Both to open or close the HP fuel Shut-Off Valve and to command and reset the FADEC functions.

76 - ENGINE CONTROLS

76-10-00 ENGINE THRUST CONTROL ARCHITECTURE

CONTENTS:

THRUST CONTROL ARCHITECTURE

SYSTEM PHILOSOPHY

The thrust control includes the same functions as a conventional aircraft : manual thrust setting, thrust limit selection, autothrust function.

MANUAL THRUST

In manual mode, the Electronic Engine Control (EEC) computes a thrust corresponding to the throttle lever position.
The EEC controls the fuel metering in such a way that computed fuel flow leads to a desired thrust.

THRUST LIMIT SELECTION

A thrust limit is selected when the throttle lever is in a corresponding detent. The mode and its limit value are displayed on the Engine and Warning Display.
When the throttle lever is between two detents, the limit value displayed corresponds to the upper detent, but the engine thrust limit corresponds to the actual throttle lever position.

THRUST LIMIT MODE

The different thrust limit modes are as follows :

- IDLE
- CLimb (CL)
- FLeXible take off or Max Continuous Thrust (FLX/MCT)
- There is a mechanical stop for Take Off/Go Around (TOGA).

AUTOTHRUST FUNCTION

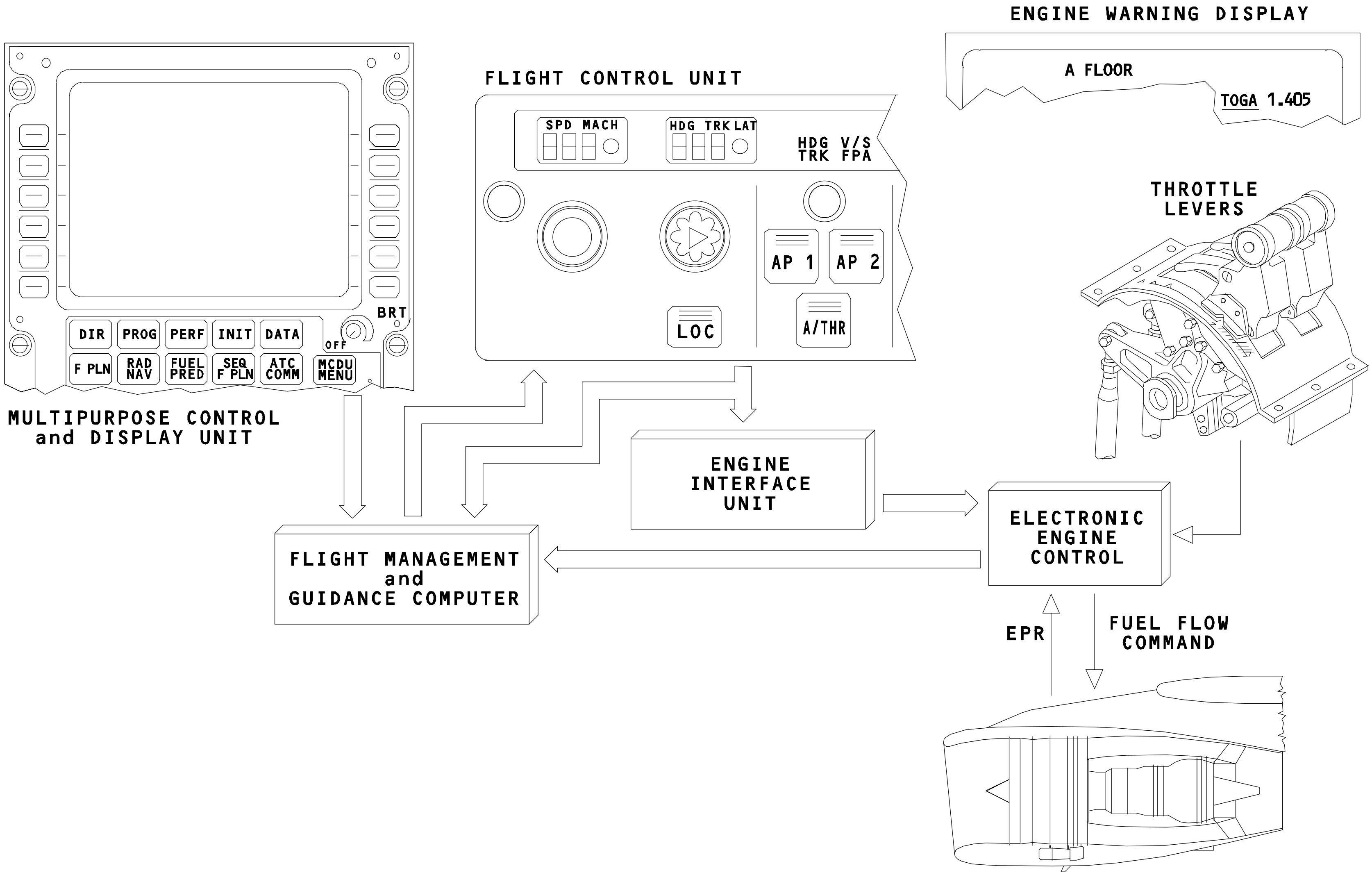
The Flight Management and Guidance Computer (FMGC) computes the thrust according to the data inserted into the MCDU, the Flight Control Unit (FCU) and also the engine parameters from the Electronic Engine Control.
The thrust computation is sent to the EEC via the FCU and the EIU.

AUTOTHRUST ACTIVE

In flight, the autothrust function is ensured when the autothrust is engaged and active.
Autothrust engaged, Auto/THRust P/B comes on green.
Autothrust active : normally, in flight, the throttle levers should be in the CLimb detent.

ALPHA FLOOR

When an alpha floor condition is detected, the Flight Management Guidance Computer sends a signal to the Electronic Engine Control to drive the engine to take off thrust (TOGA) regardless of throttle lever position, autothrust engaged or not.



ENGINE THRUST CONTROL ARCHITECTURE

UFD4200
TMU76IB01-P01 LEVEL 1

SELF EXAMINATION

Which computer controls the engine thrust, either in manual mode or autothrust mode?

A - FMGC.
B - FCU.
C - EEC.

What is the normal cruise detent point?

A - TOGA.
B - FLX/MCT.
C - CL.

When the throttle lever is between two detent points what position corresponds to the thrust limit?

A - The upper detent point
B - The lower detent point.
C - The actual throttle lever position.

76 - ENGINE CONTROLS

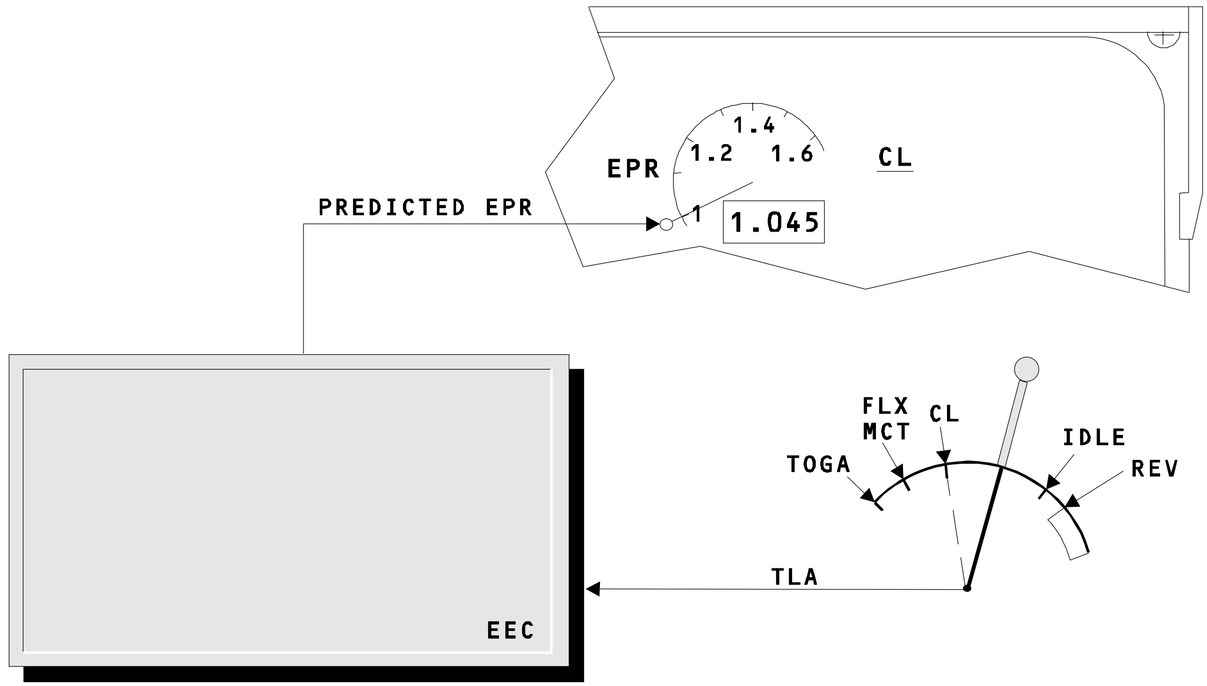
76-10-00 ENGINE THRUST MANAGEMENT

CONTENTS:

ENGINE THRUST MANAGEMENT

BASIC INFORMATION

PREDICTED EPR
The predicted EPR is indicated by a white circle on the EPR indicator and corresponds to the value determined by the Throttle Lever Angle (TLA).



ENGINE THRUST MANAGEMENT - BASIC INFORMATION - PREDICTED EPR

ENGINE THRUST MANAGEMENT

BASIC INFORMATION (CONT'D)

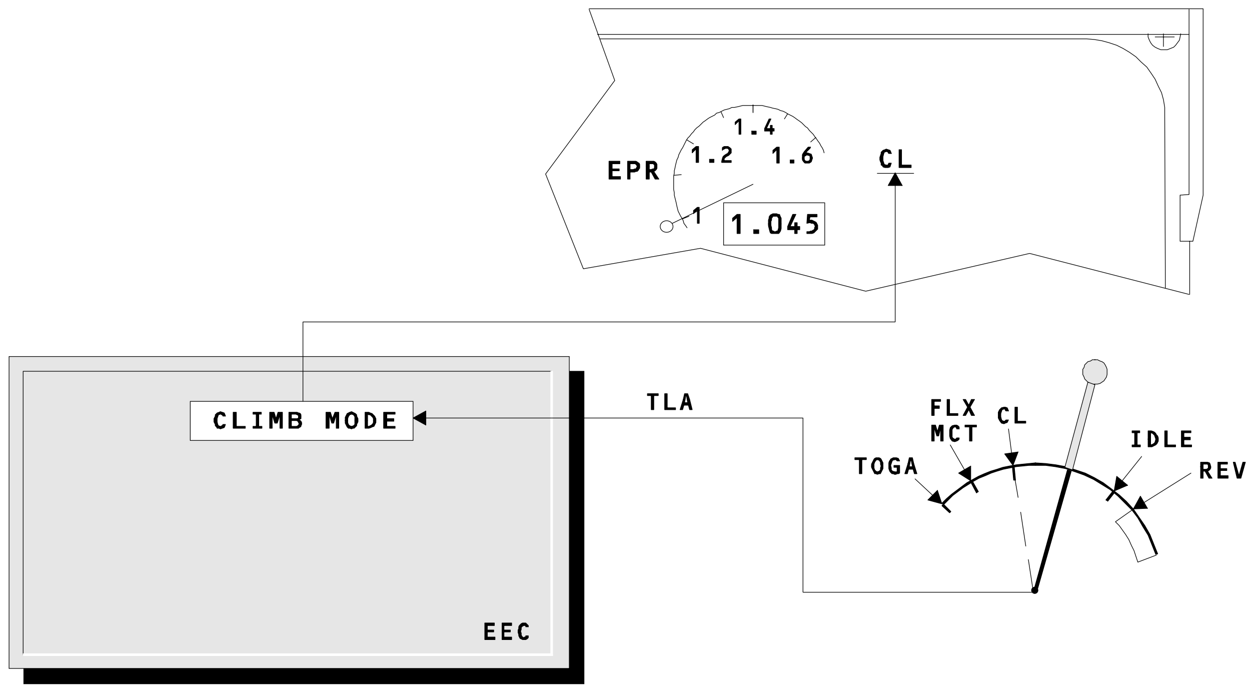
THRUST LIMIT MODES

The throttle levers are used as thrust limit mode selectors. Depending on the throttle lever position, a thrust limit mode is selected and appears on the upper ECAM display.

If the throttle levers are set between two detent points, the upper detent will determine the thrust limit mode.

Thrust limit modes:

- CL: CLimb
- FLX: FLeXible take off
- MCT: Maximum Continuous Thrust
- TOGA: Take Off/Go Around.



UFD4200

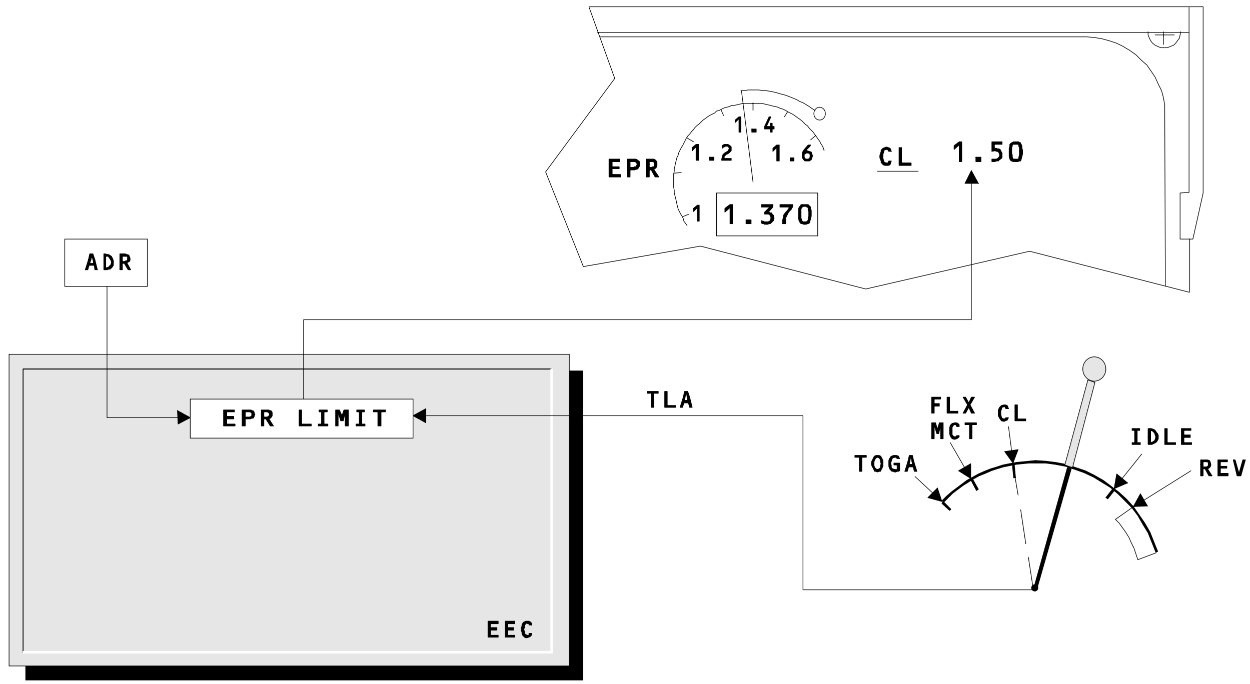
TMU76IC01-P02 LEVEL 3

ENGINE THRUST MANAGEMENT - BASIC INFORMATION (CONT'D) - THRUST LIMIT MODES

ENGINE THRUST MANAGEMENT

BASIC INFORMATION (CONT'D)

EPR LIMIT
For each thrust limit mode selection, an EPR limit is computed according to the Air Data and appears on the upper ECAM display beside the thrust limit mode indication.



UFD4200

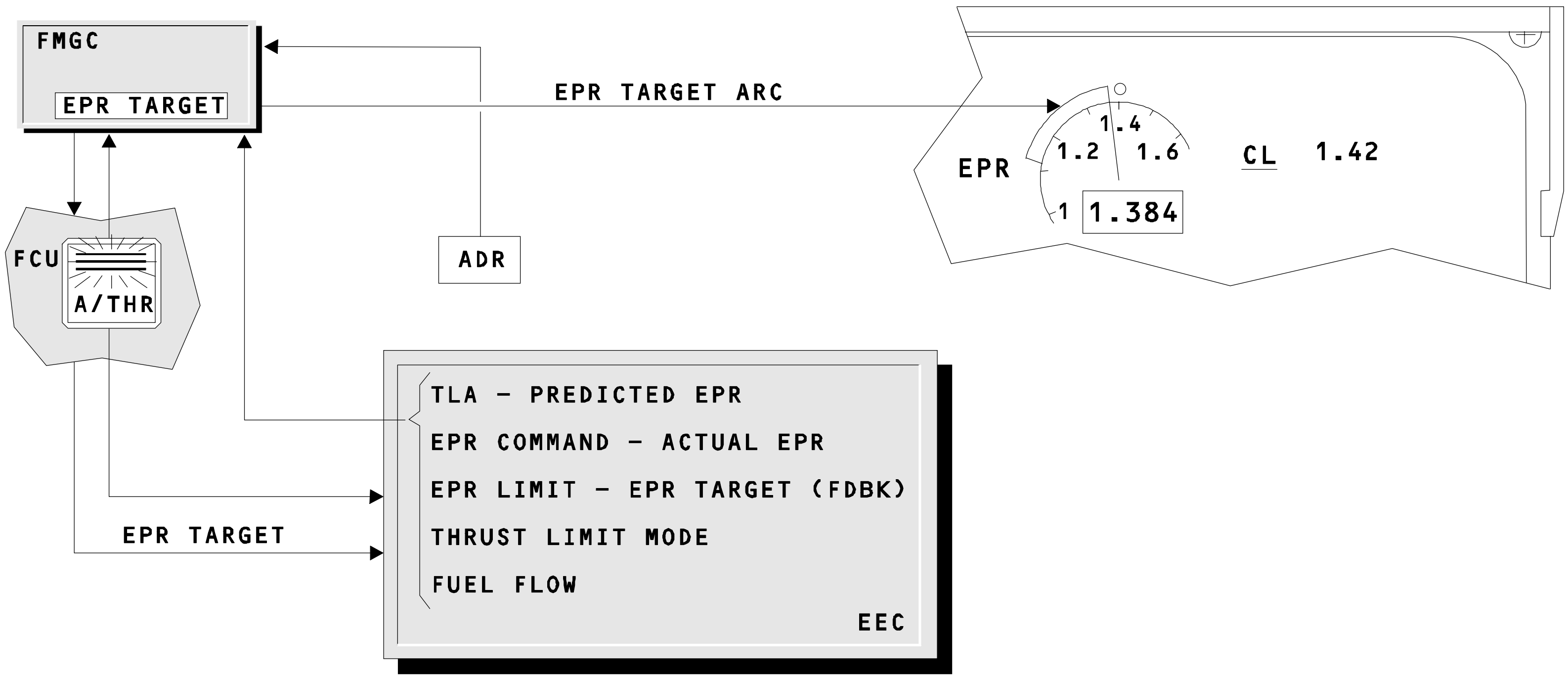
TMU76IC01-P03 LEVEL 3

ENGINE THRUST MANAGEMENT - BASIC INFORMATION (CONT'D) - EPR LIMIT

ENGINE THRUST MANAGEMENT

BASIC INFORMATION (CONT'D)

EPR TARGET
For its autothrust function, the Flight Management and Guidance System computes an EPR target according to Air Data and engine parameters and sends it to the Electronic Engine Control (EEC).



UFD4200 TMU76IC01-P04 LEVEL 3

ENGINE THRUST MANAGEMENT - BASIC INFORMATION (CONT'D) - EPR TARGET

ENGINE THRUST MANAGEMENT

BASIC INFORMATION (CONT'D)

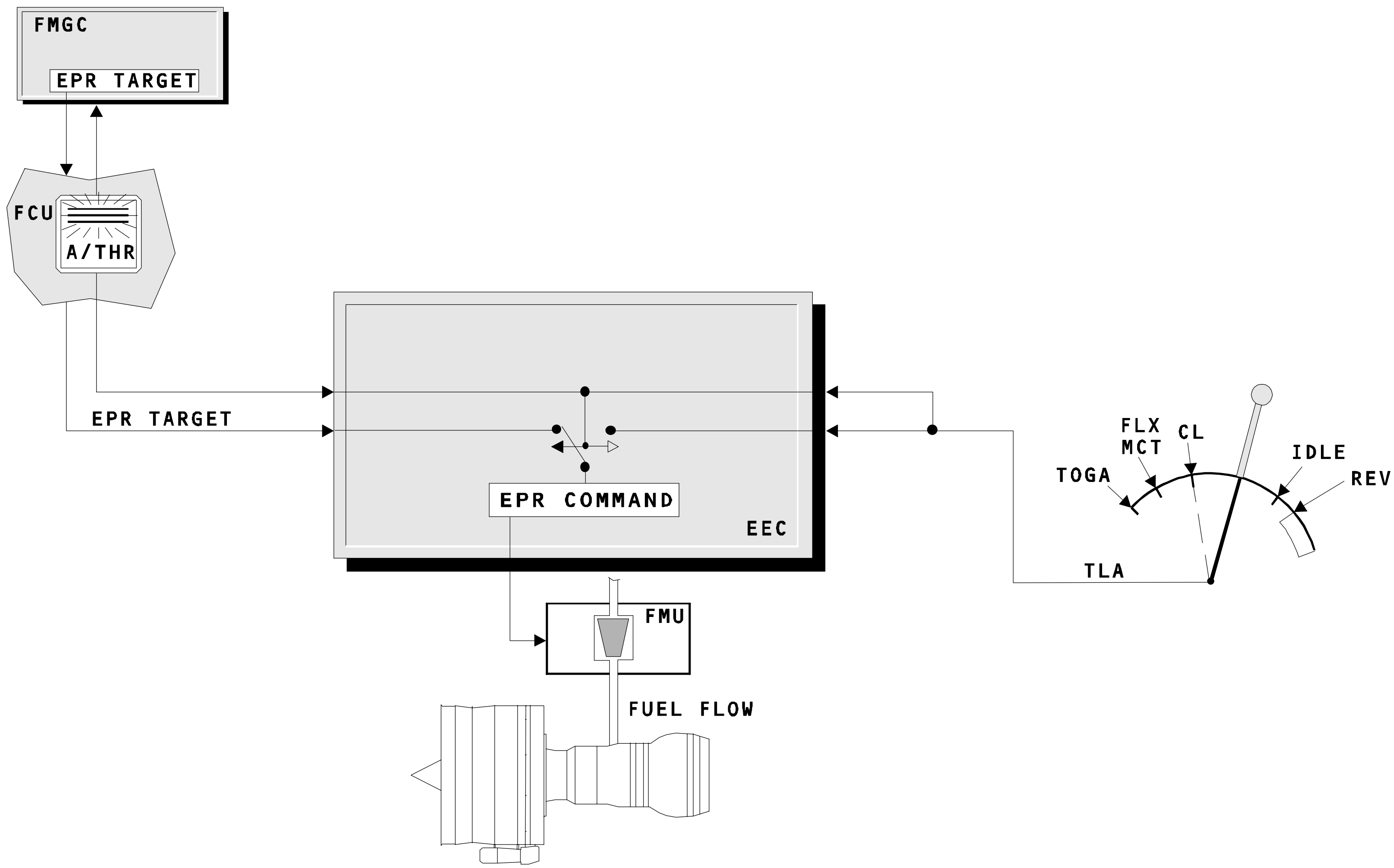
EPR COMMAND

The EPR command, used to regulate the fuel flow, is the FMGC EPR target when the autothrust function is active.

When the autothrust function is not active, the EPR command is the EPR corresponding to the Throttle Lever Angle (TLA).

EPR command is:

- EPR target
- or EPR corresponding to TLA.



UFD4200 TMU76IC01-P05 LEVEL 3

ENGINE THRUST MANAGEMENT - BASIC INFORMATION (CONT'D) - EPR COMMAND

ENGINE THRUST MANAGEMENT

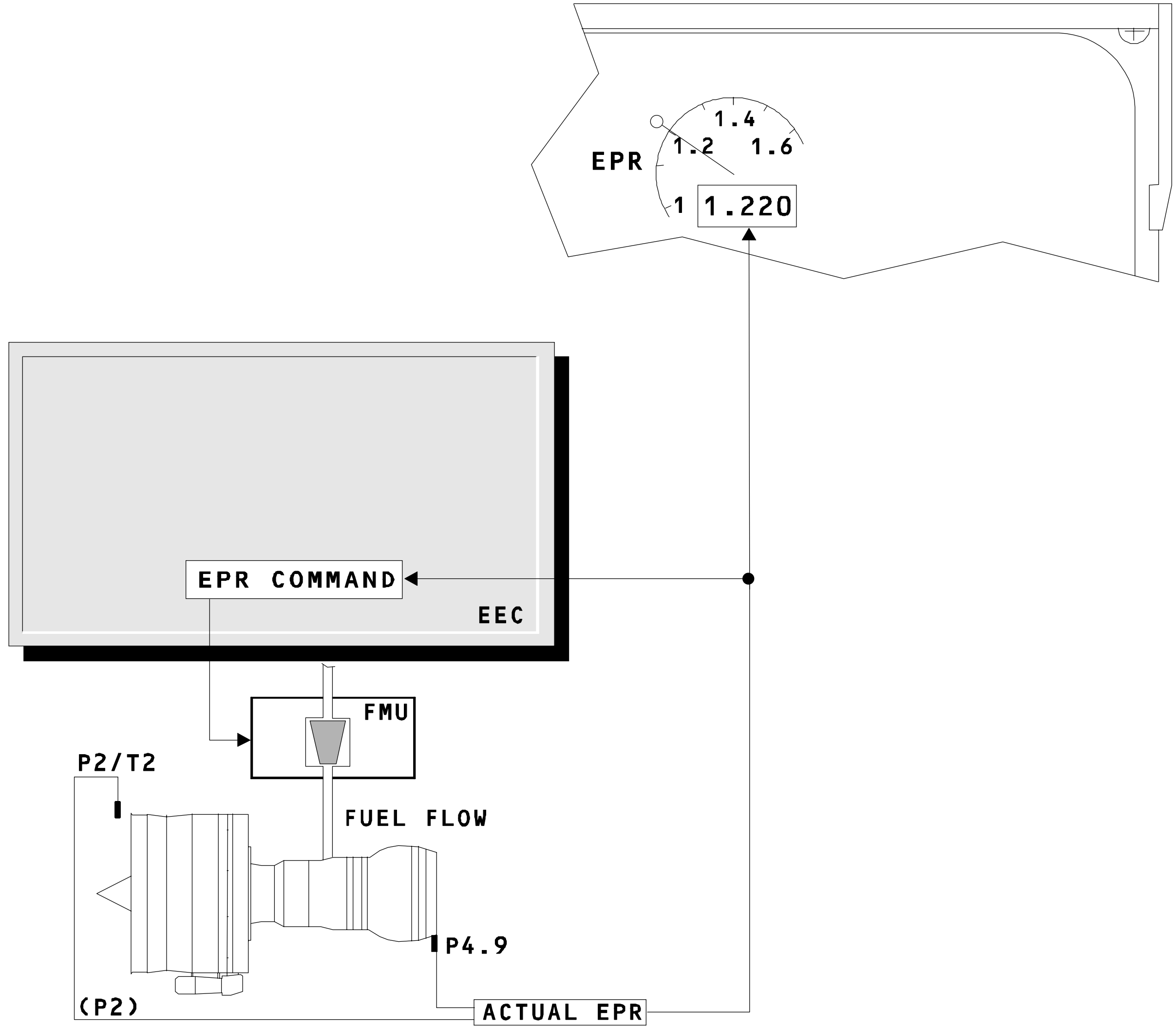
BASIC INFORMATION (CONT'D)

ACTUAL EPR

The actual EPR is the actual value given by the ratio of the LP turbine exhaust pressure (P4.9) to the engine inlet pressure (P2).

The actual EPR is displayed in green on the EPR indicator.

The actual EPR signal is also compared to the EPR command.



ENGINE THRUST MANAGEMENT - BASIC INFORMATION (CONT'D) - ACTUAL EPR

ENGINE THRUST MANAGEMENT

AUTOTHRUST CONTROL MODE

The autothrust function is engaged when the Autothrust (A/THR) pushbutton is on.
A/THR engages:

- When the A/THR pushbutton is pressed in.
- At take-off power application.

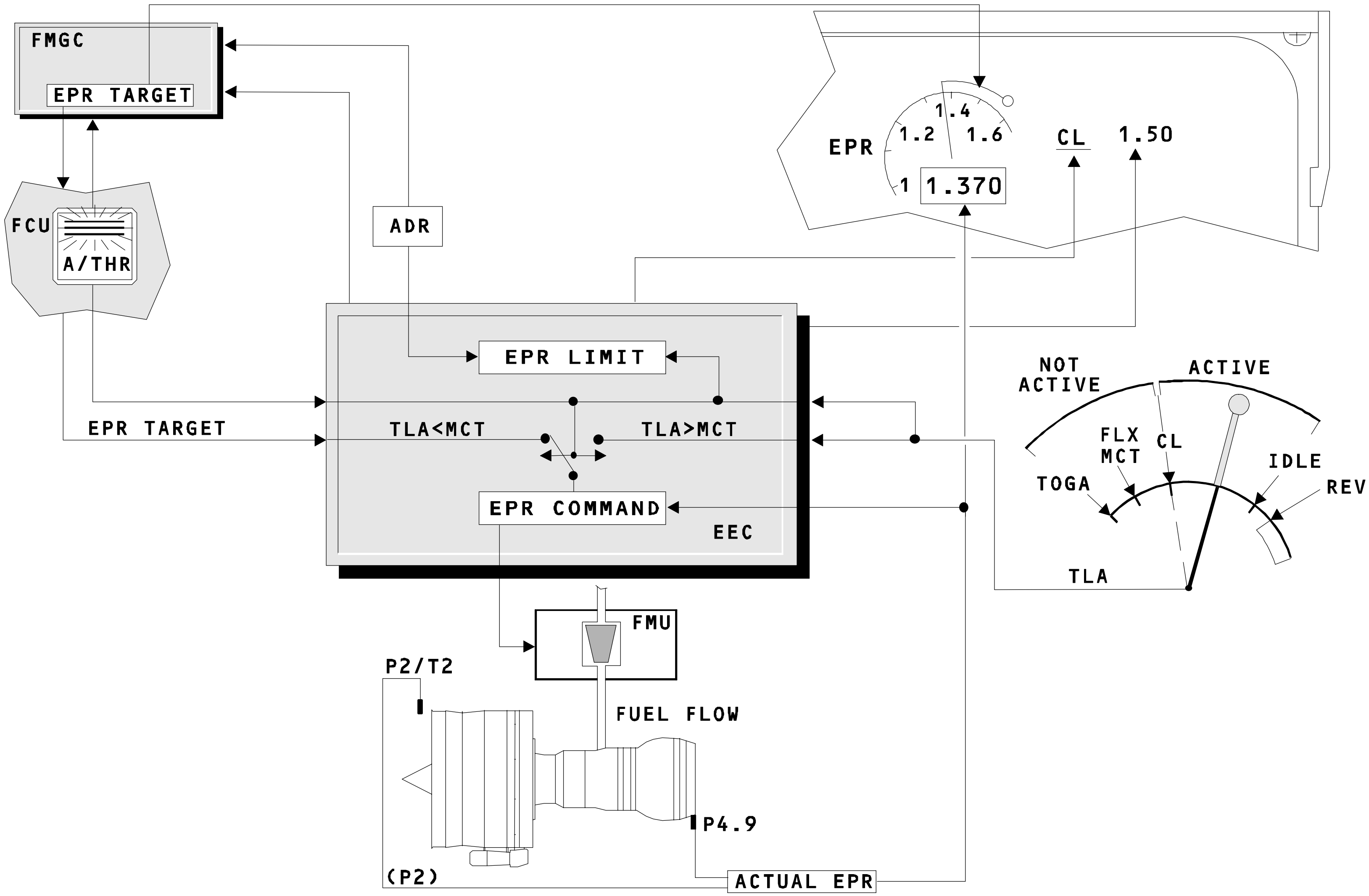
AUTOTHRUST ACTIVE
When engaged, the autothrust function comes active when the throttle Levers are set to CLimb detent after take off.
The EPR command is the FMGC EPR target.

A/THR function is active when the throttle levers are set between IDLE and CL (including CL) with 2 engines running.

NOTE: The A/THR active range is extended to MCT in the case of single engine operation.

When the throttle levers are set between two detent points, the EPR command is limited by the throttle lever position.

NOTE : In alpha floor condition the A/THR function becomes active automatically.
The EPR target is TOGA.



ENGINE THRUST MANAGEMENT - AUTOTHRUST CONTROL MODE - AUTOTHRUST ACTIVE

ENGINE THRUST MANAGEMENT

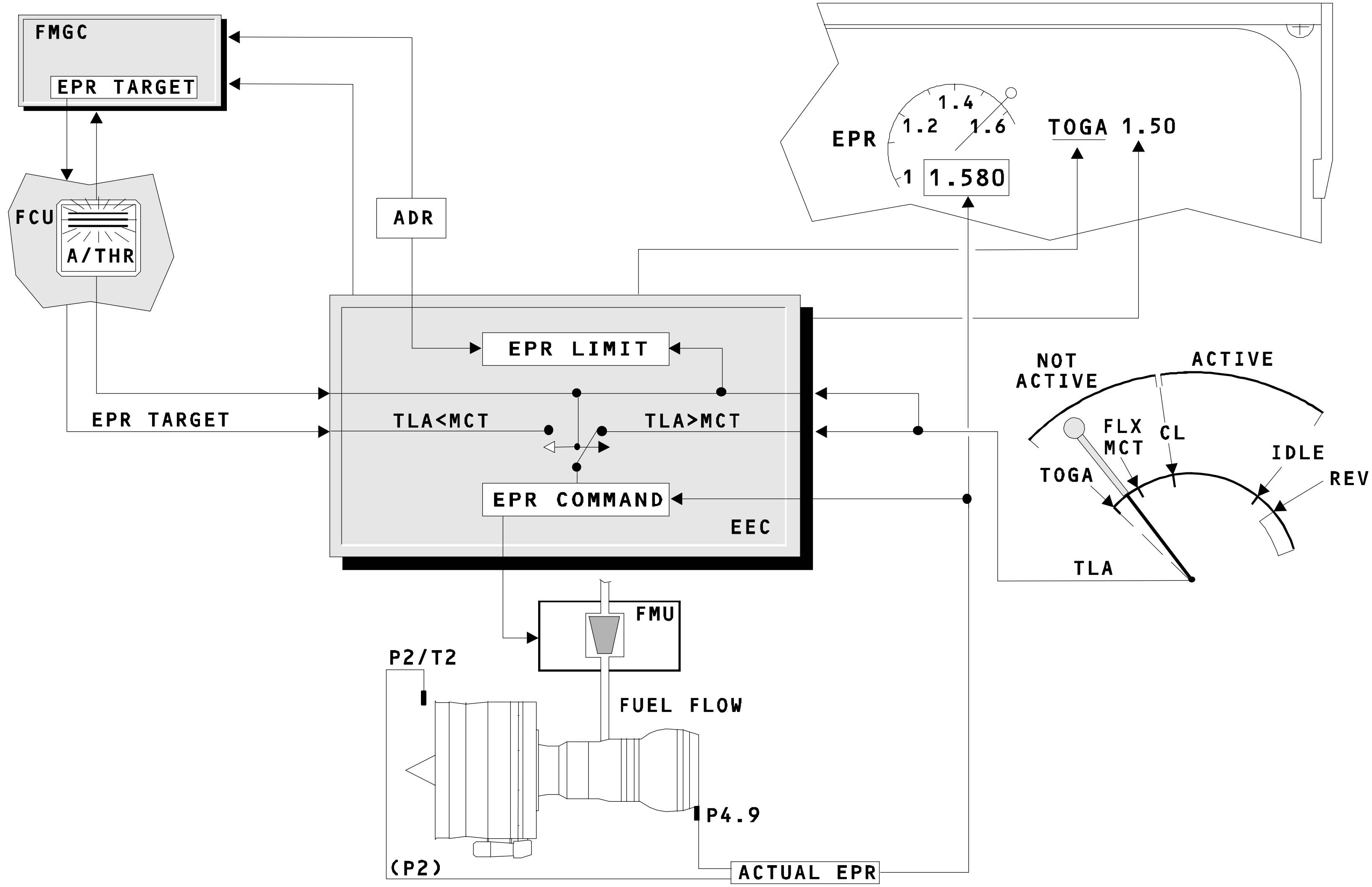
AUTOTHRUST CONTROL MODE (CONT'D)

AUTOTHRUST NOT ACTIVE

When engaged, the autothrust function becomes inactive when the throttle Levers are set above CLimb with 2 engines running.
The EPR command corresponds to the TLA.

NOTE: A/THR function is not active above MCT in case of single engine operation.

The A/THR function is disengaged when the throttle levers are set at IDLE stop.

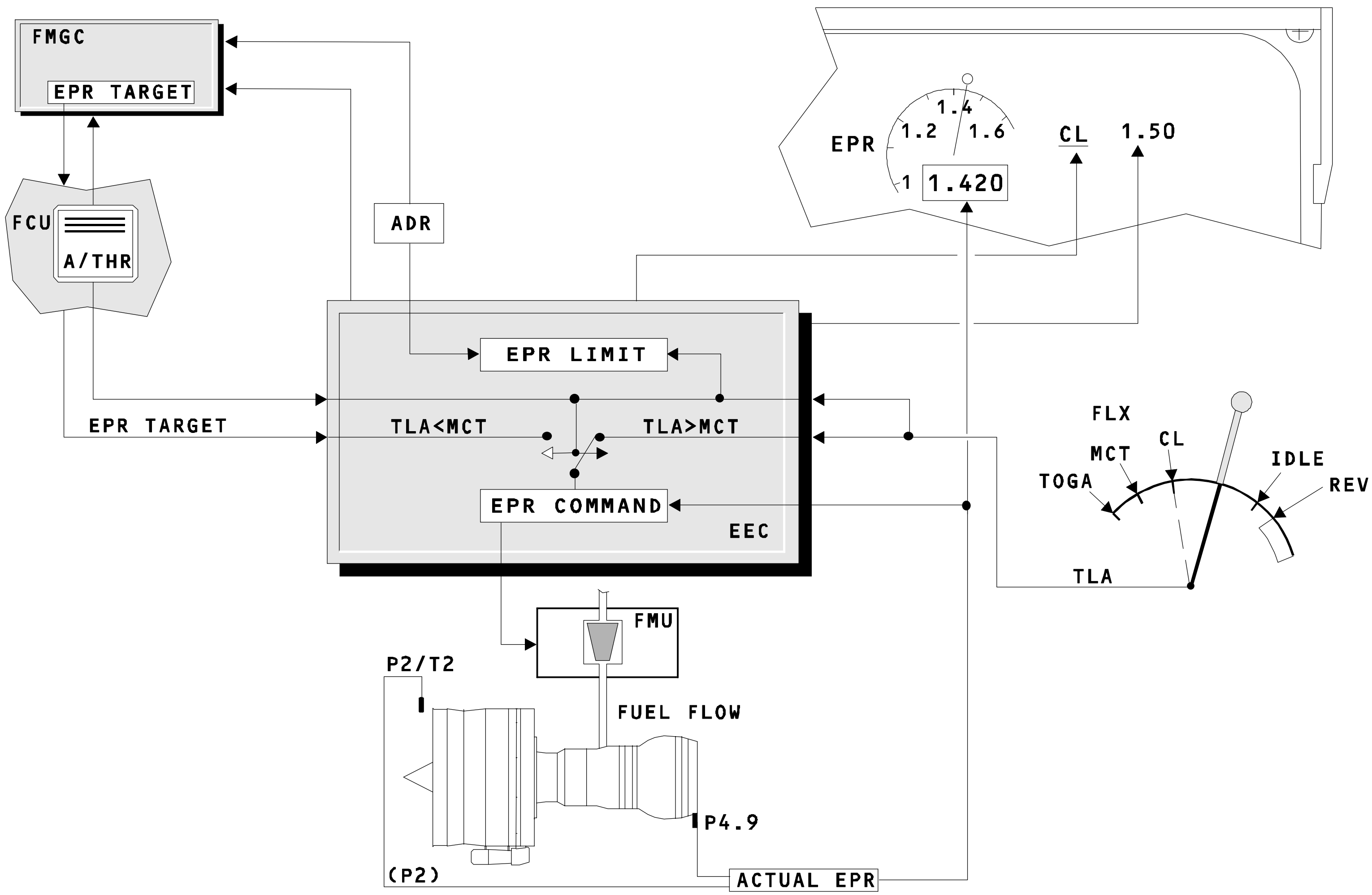


ENGINE THRUST MANAGEMENT - AUTOTHRUST CONTROL MODE (CONT'D) - AUTOTHRUST NOT ACTIVE

ENGINE THRUST MANAGEMENT

MANUAL CONTROL MODE

When the autothrust function is not engaged, the Electronic Engine Control processes the EPR command signal according to the Throttle Lever Angle (TLA).
Manual mode: A/THR not engaged.



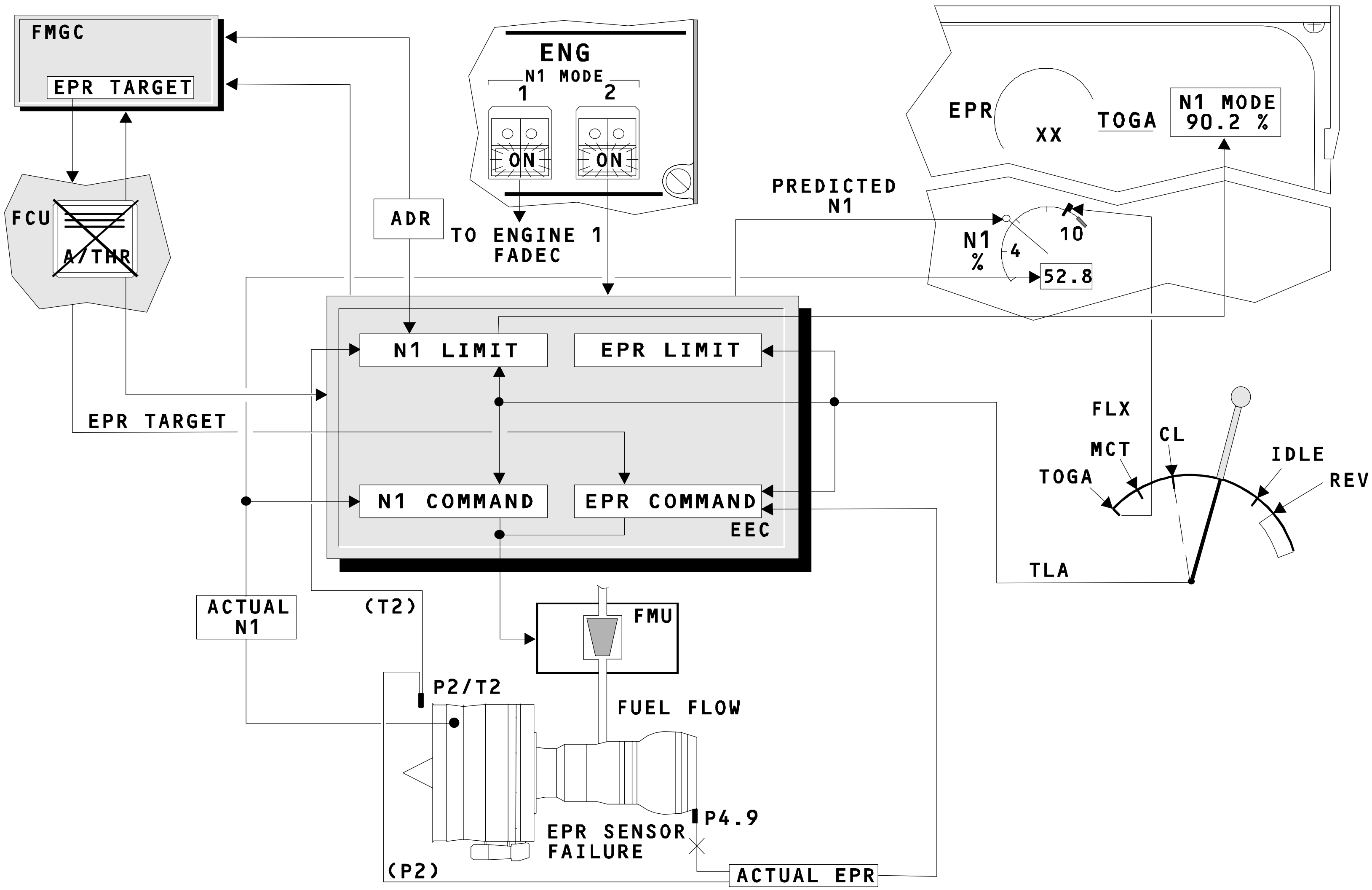
ENGINE THRUST MANAGEMENT - MANUAL CONTROL MODE

ENGINE THRUST MANAGEMENT

BACK-UP N1 MODE

RATED N1 MODE
In case of EPR sensor failure (P2 or P4.9), the Electronic Engine Control (EEC) automatically reverts to the rated N1 mode. On the ECAM, the EPR indicator is crossed amber.
The EEC uses TLA, Air Data Reference (ADR) and T2.
T2 is used in N1 rated mode to limit the engine thrust.
To select N1 mode on both engines, the ENG N1 MODE pushbuttons must be pressed in.

NOTE: The autothrust function is not available in N1 mode.
When the N1 MODE pushbuttons are pressed in, the ON lights come on and a signal is sent to their corresponding FADEC system to confirm or to force the N1 MODE selection.
On the ECAM, the EPR indicator is crossed amber and the N1 MODE limit is displayed instead of the EPR limit.
On the N1 indicator, the predicted N1 (white circle) replaces the predicted EPR and an amber index appears to indicate the take-off N1 limit.



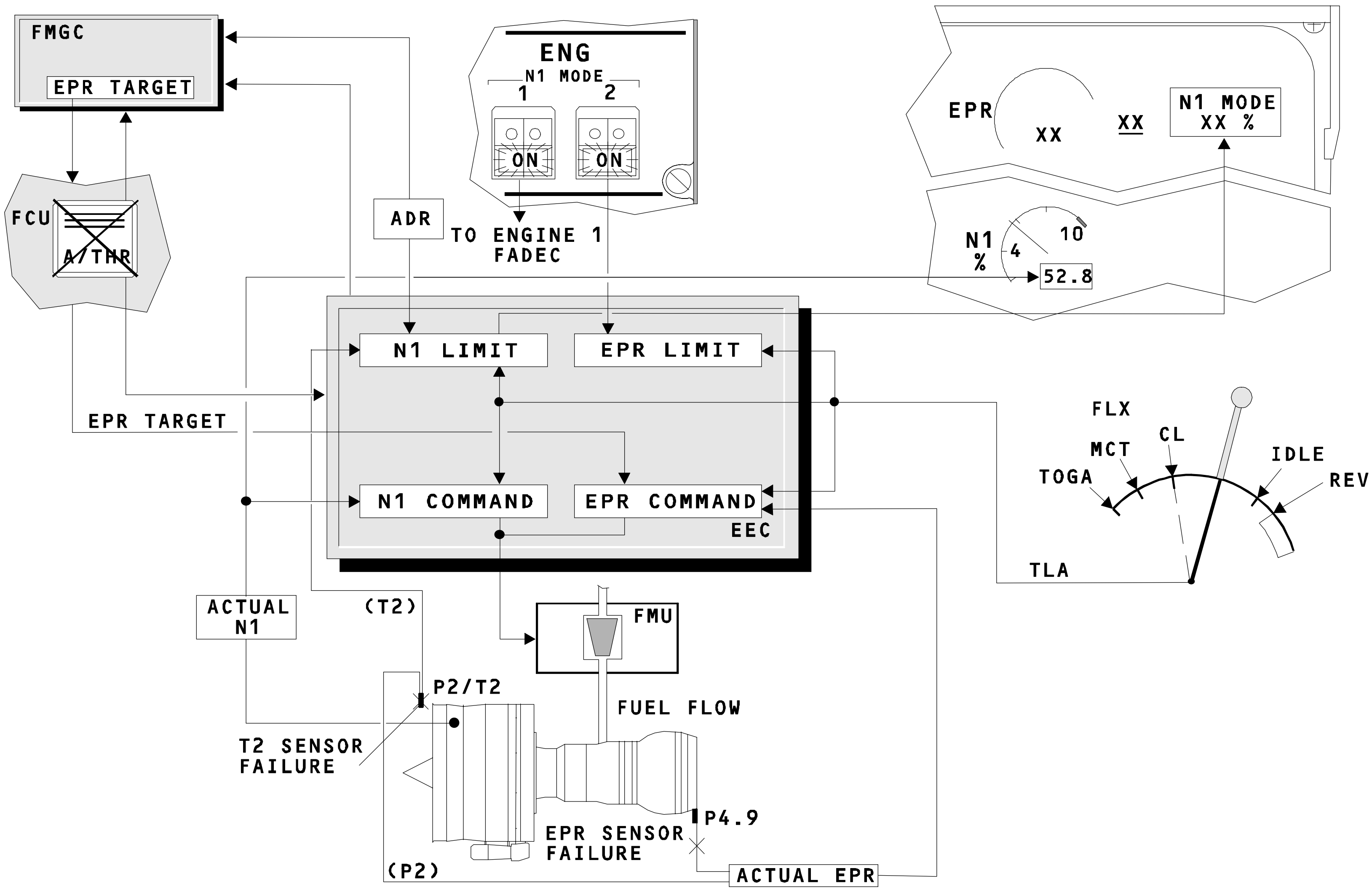
ENGINE THRUST MANAGEMENT - BACK-UP N1 MODE - RATED N1 MODE

UFD4200
TMU76IC01-P10 LEVEL 3

ENGINE THRUST MANAGEMENT

BACK-UP N1 MODE (CONT'D)

UNRATED N1 MODE
T2 is no longer available, the EEC reverts from the EPR mode to the unrated N1 mode.
In this case the N1 limitation is no longer computed.
The N1 command is directly related to the Throttle Lever Angle (TLA).
Note that in unrated N1 mode, there is no longer an engine protection against overboost (ex: Go -Around).



ENGINE THRUST MANAGEMENT - BACK-UP N1 MODE (CONT'D) - UNRATED N1 MODE

UFD4200
TMU76IC01-P11 LEVEL 3

SELF EXAMINATION

In flight with the throttle lever between two detent points what defines the EPR rating limit?

A - The throttle lever position.
B - The upper detent point position.
C - The lower detent point position.

With the autothrust function active and the throttle lever between two detent points, what limits the upper EPR command?

A - The Throttle Lever Angle (TLA).
B - The EPR limit.
C - The EPR target.

What does the FMGC compute?

A - The EPR limit.
B - The EPR command.
C - The EPR target.

What happens in case of EPR sensor failure?

A - The EEC reverts to a manual N1 mode.
B - The EEC reverts to a rated N1 mode.
C - The EEC reverts to an unrated N1 mode.

76 - ENGINE CONTROLS

76-00-00 ENGINE PRESSURE RAISING AND SHUT-OFF VALVE (PRSOV) CONTROL

CONTENTS:

ENGINE PRESSURE RAISING AND SHUT-OFF VALVE (PRSOV) CONTROL

GENERAL

The Pressure Raising and Shut-Off Valve (PRSOV) can be controlled from the cockpit through the MASTER lever or by the EEC during engine start.

ENGINE MASTER LEVER OPENING COMMAND

During the start sequence, the EEC controls the opening of the Fuel Metering Valve which causes the Pressure Raising and Shut-Off Valve to open, provided its latching torque motor is de-energized.
When the MASTER lever is set to ON, the PRSOV will only open if fuel pressure from the Fuel Metering Valve is available.

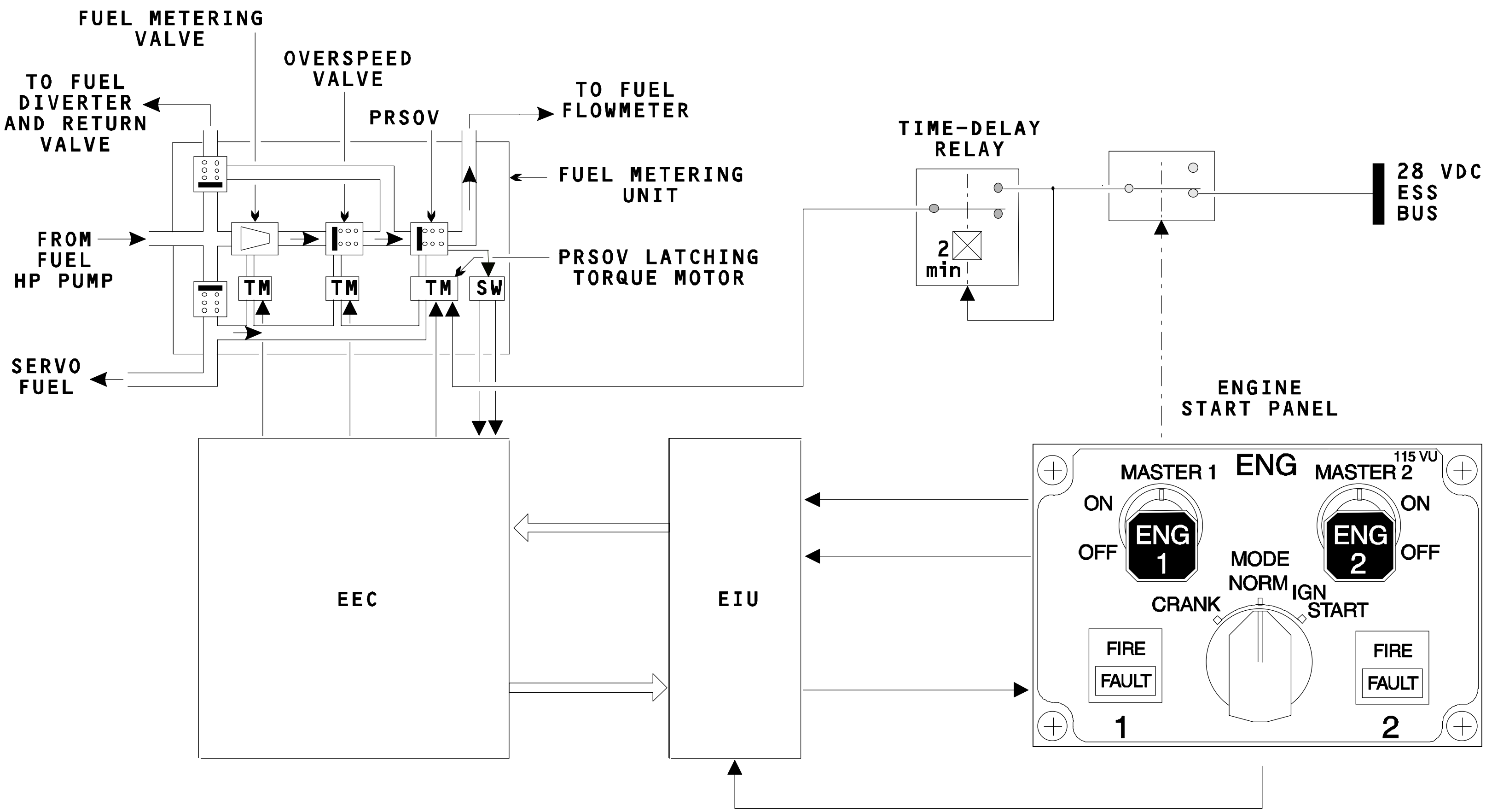
NOTE : During engine start in automatic mode, the EEC can close the PRSOV to abort the start sequence up to 50% N2

ENGINE MASTER LEVER CLOSURE COMMAND

The closure of the Pressure Raising and Shut-Off Valve is controlled directly from the MASTER lever, when it is set at the OFF position it energizes the latching torque motor which closes the valve.
A time-delay relay automatically de-energizes the PRSOV latching torque motor 2 minutes after engine shutdown
This device avoids damage due to high temperature induced by a long time power supply on ground.

MONITORING

The Pressure Raising and Shut-Off Valve is monitored by two microswitches which send signals to the EEC and then to the EIU.
In case of disagreement between control and position, an ECAM warning is triggered and the FAULT light comes on.



ENGINE PRESSURE RAISING AND SHUT-OFF VALVE (PRSOV) CONTROL

SELF EXAMINATION

How is the fuel PRSOV controlled ?
- A - De-energized open.
- B - Energized open.
- C - To close when it receives a signal from the EEC.

How is the PRSOV closure command sent ?
- A - Directly from the MASTER lever.
- B - From the MASTER lever via the EEC.
- C - From the MASTER lever via the EIU and the EEC.

Which condition is required to open the PRSOV ?
- A - Fuel pressure from the fuel metering valve available.
- B - Latching torque motor de-energized.
- C - Both fuel pressure from the fuel metering available and latching torque motor de-energized.

76 - ENGINE CONTROLS

76-00-00 ENGINE LP FUEL SHUT-OFF VALVE CONTROL

CONTENTS:

ENGINE LP FUEL SHUT-OFF VALVE CONTROL

GENERAL

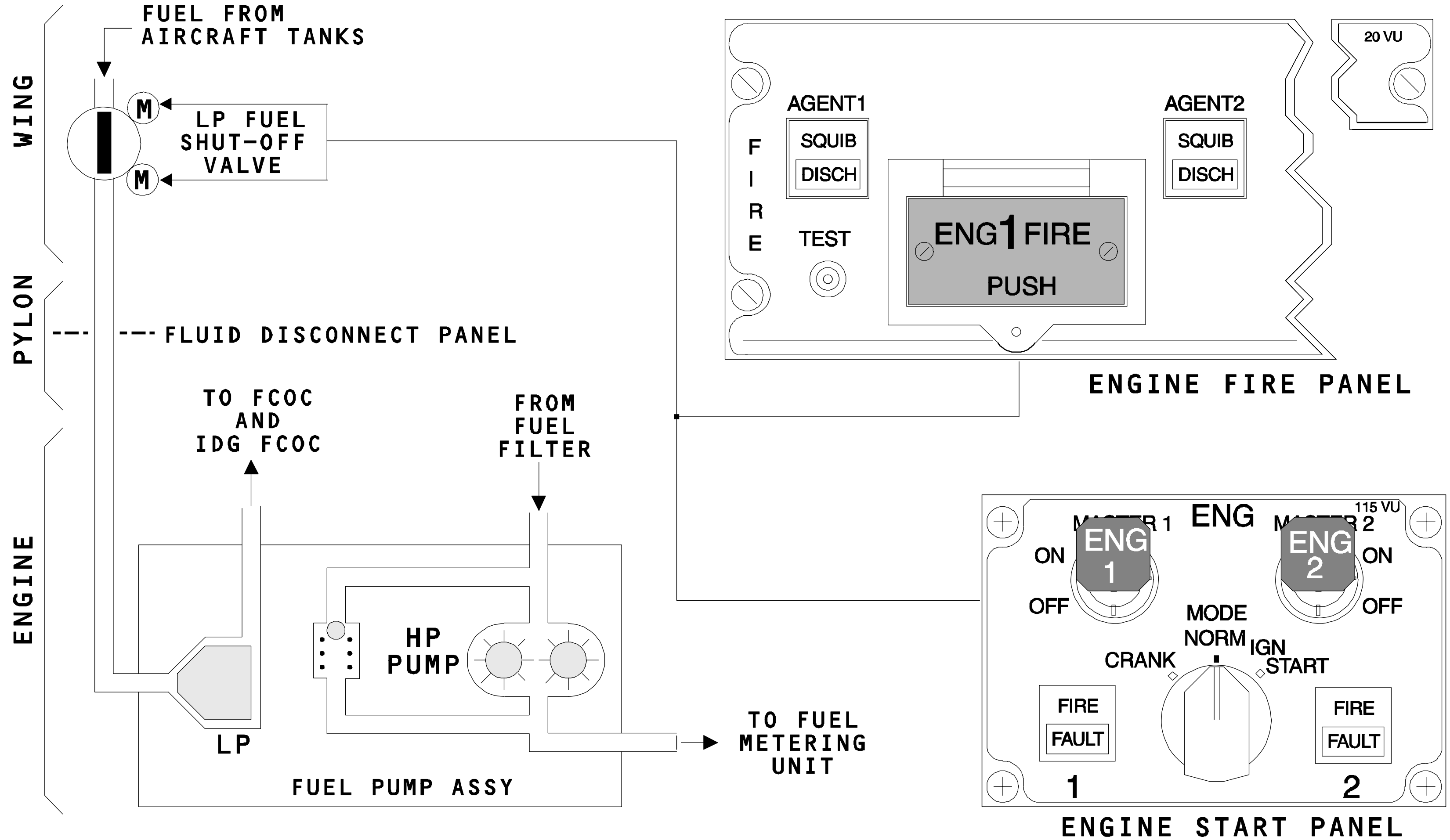
The LP fuel shut-off valve operation is controlled from the engine fire panel or from the engine start panel.

ENGINE MASTER LEVER CONTROL

When the MASTER lever is set to OFF, both electrical motors drive the LP shut-off valve to the closed position.

ENGINE FIRE PUSHBUTTON COMMAND

When the ENG FIRE pushbutton is released out, both electrical motors drive the LP shut-off valve to the closed position.



ENGINE LP FUEL SHUT-OFF VALVE CONTROL

UFD4200
TMU76IE01-P01 LEVEL 3

SELF EXAMINATION

How is the engine LP fuel shut off valve controlled ?

A - By the Engine fire pushbutton.
B - Automatically when a fire is detected.
C - By the MASTER lever or by the Engine fire Pusbutton.

How is the engine LP fuel shut-off valve actuated ?

A - By two electrical motors.
B - By a dual solenoide.
C - Hydraulically by servofuel.

76 - ENGINE CONTROLS

76-00-00 ENGINE CONTROLS COMPONENTS

CONTENTS:

ENGINE CONTROLS COMPONENTS

THROTTLE LEVER(S)

IDENTIFICATION
FIN:

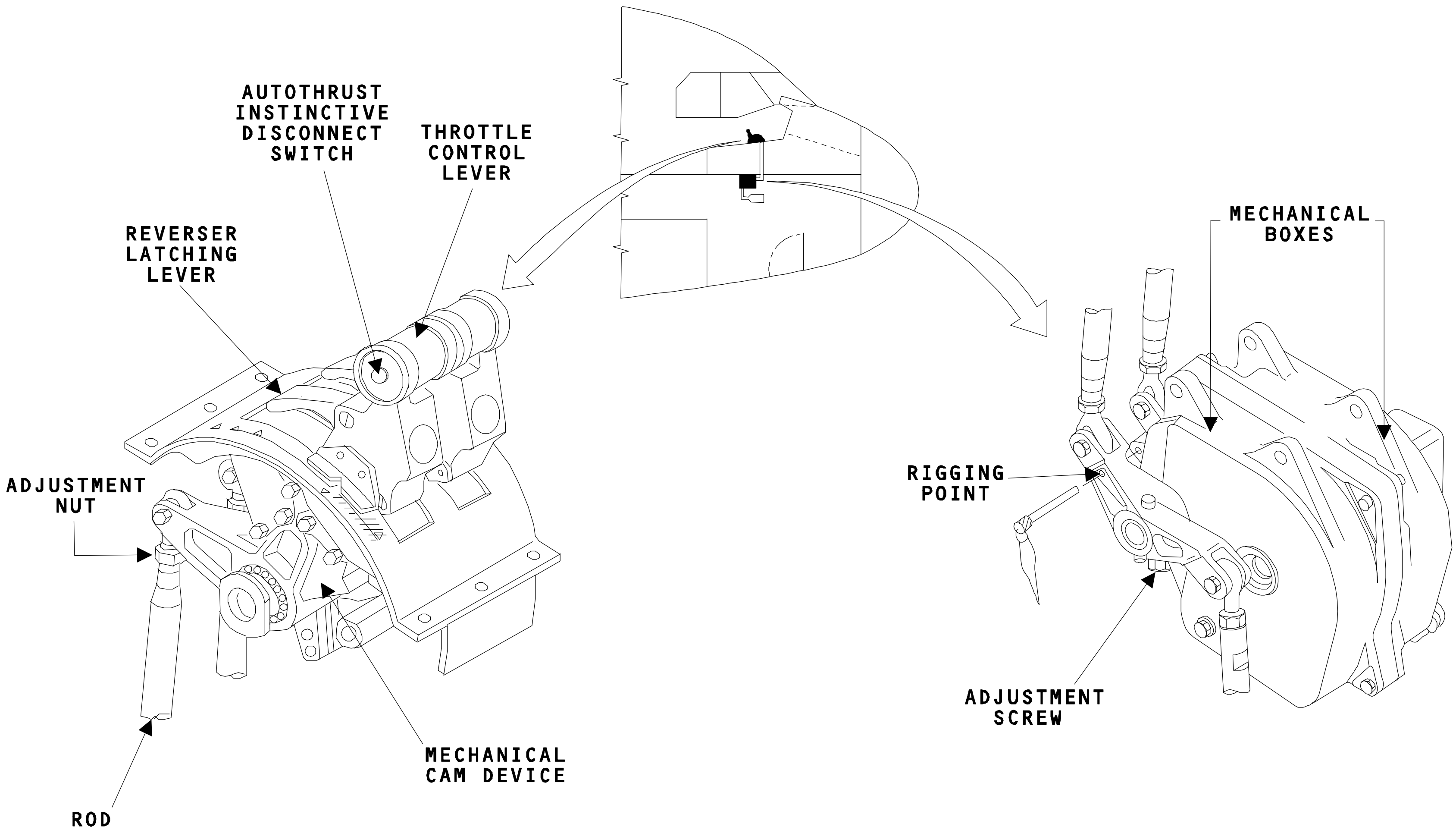
LOCATION
ZONE: 210

MECHANICAL BOX(ES)

IDENTIFICATION
FIN:

LOCATION
ZONE: 120

COMPONENT DESCRIPTION
An adjustment screw is provided at the lower part of each mechanical box to adjust the artificial feel.



THROTTLE LEVER(S)

MECHANICAL BOX(ES)

ENGINE CONTROLS COMPONENTS - THROTTLE LEVER(S) / MECHANICAL BOX(ES)

ENGINE CONTROLS COMPONENTS

THROTTLE CONTROL UNIT(S)

IDENTIFICATION
FIN: 8KS1, 8KS2

LOCATION
ZONE: 120

COMPONENT DESCRIPTION
2 units (one per engine)
Each unit consists of:

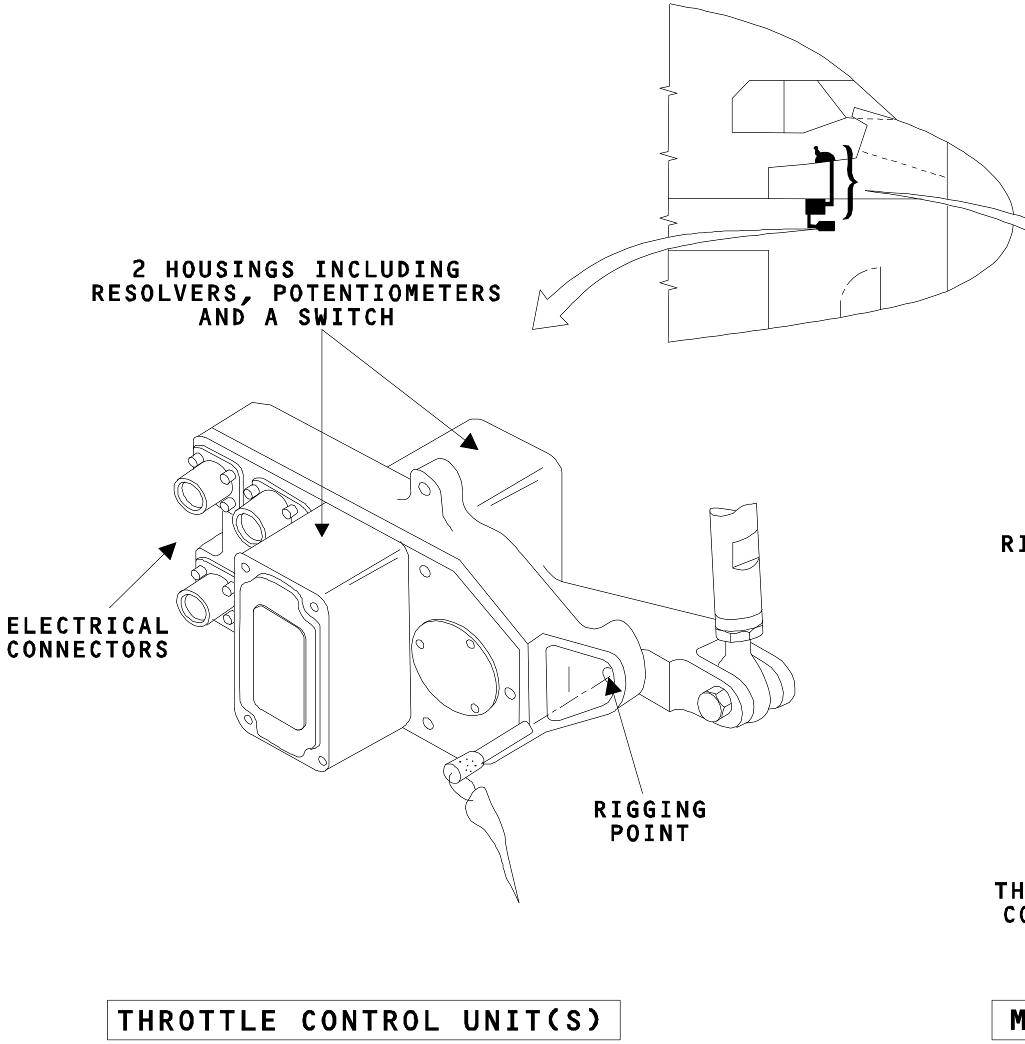
- 2 resolvers, one per ECU channel.
  The relationship between the Throttle Lever Angle (TLA) and the Throttle Resolver Angle (TRA) is linear.
  1 DEG TLA corresponds to 1.9 DEG TRA.

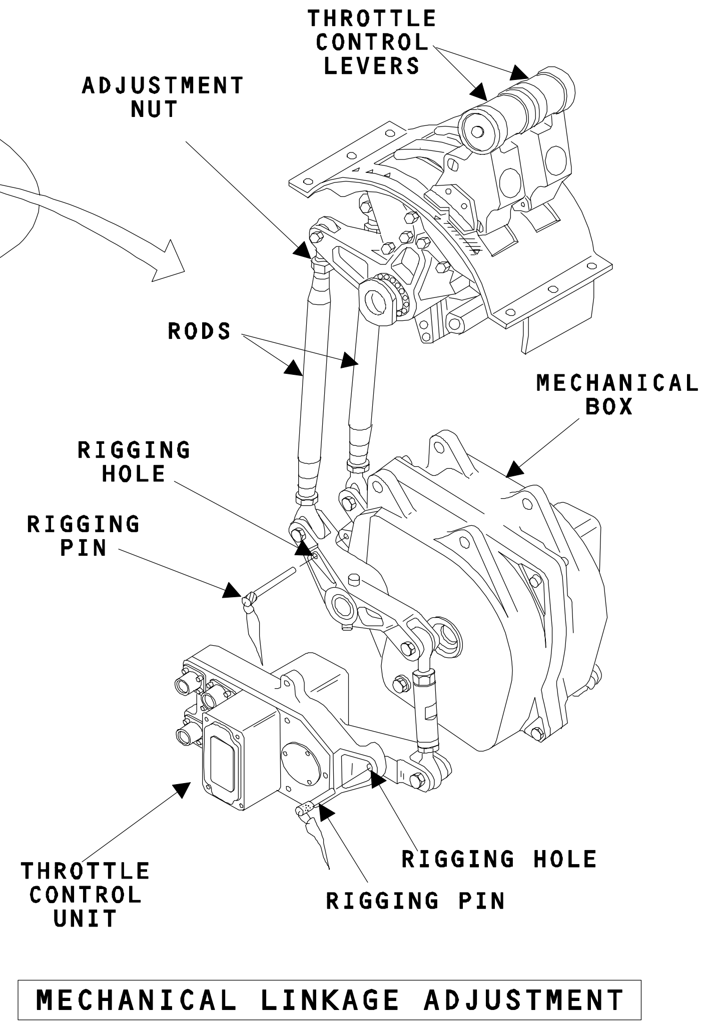
- 6 potentiometers fitted three by three and electrically connected in pairs. Only two pairs are in service, they send signals to the Spoiler Elevator Computers (SECs) used for the ground spoiler extension function and the third defence line of the thrust reverser.

- 1 microswitch dedicated to the EIU and used for the thrust reverser control logic.

MECHANICAL LINKAGE ADJUSTMENT

COMPONENT DESCRIPTION
To perform this task the throttle levers must be set to idle position.
Recommendation:
Do not apply force to push in or pull out the rigging pins in the rigging holes.
If the rigging pins are difficult to push in, you must adjust the rods until they go in easily.





ENGINE CONTROLS COMPONENTS - THROTTLE CONTROL UNIT(S) / MECHANICAL LINKAGE ADJUSTMENT

ENGINE CONTROLS COMPONENTS

PRESSURE RAISING AND SHUT OFF VALVE

IDENTIFICATION
FIN: 4000KC

LOCATION
ZONE: 435, 445

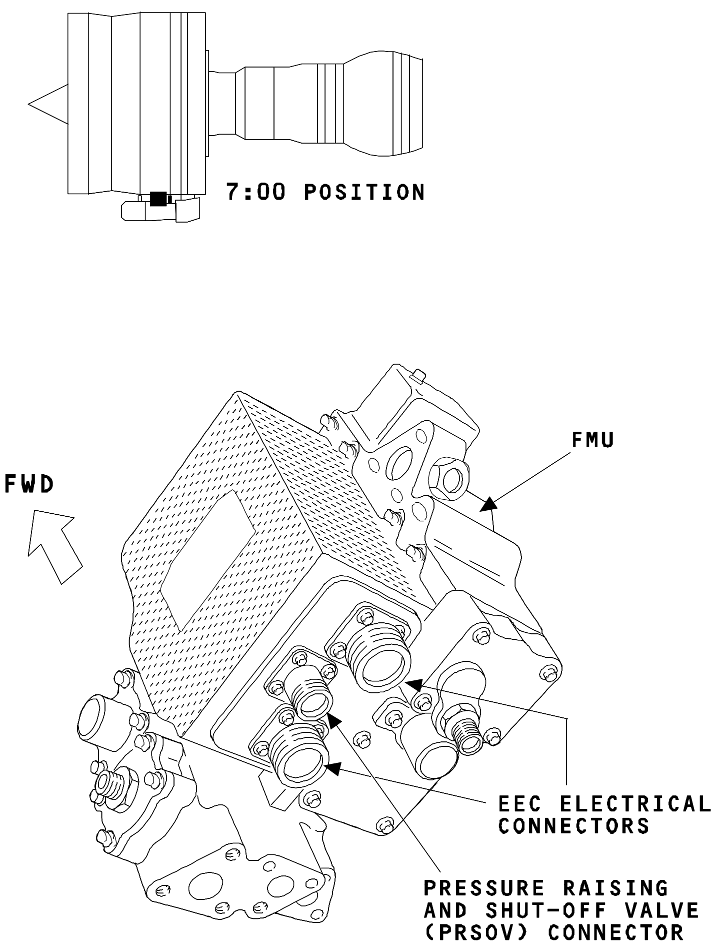
COMPONENT DESCRIPTION
Its primary function is to isolate fuel supply to the fuel spray nozzles. It opens during engine start when fuel pressure is high enough for FMU control.

NOTE: It is not a Line Replaceable unit. You must change the Fuel Metering Unit (FMU).

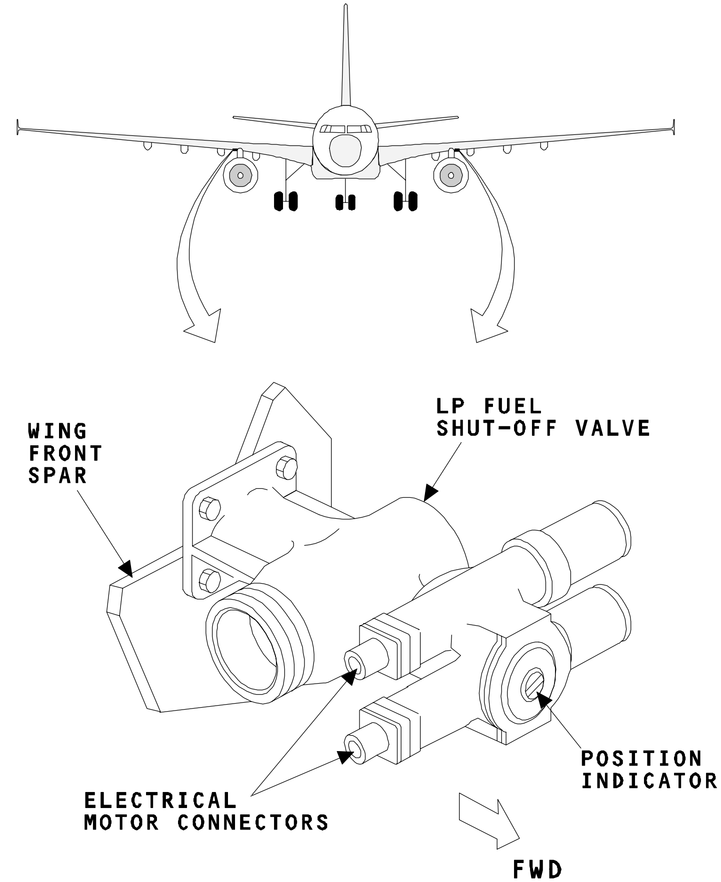
LP FUEL SHUT OFF VALVE

IDENTIFICATION
FIN: 9QG, 10QG

LOCATION
ZONE: 522, 622



PRESSURE RAISING AND SHUT-OFF VALVE



LP FUEL SHUT-OFF VALVE

ENGINE CONTROLS COMPONENTS - PRESSURE RAISING AND SHUT OFF VALVE / LP FUEL SHUT OFF VALVE

UFD4200
TMU76IF03-P03 LEVEL 3

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77 - ENGINE INDICATING

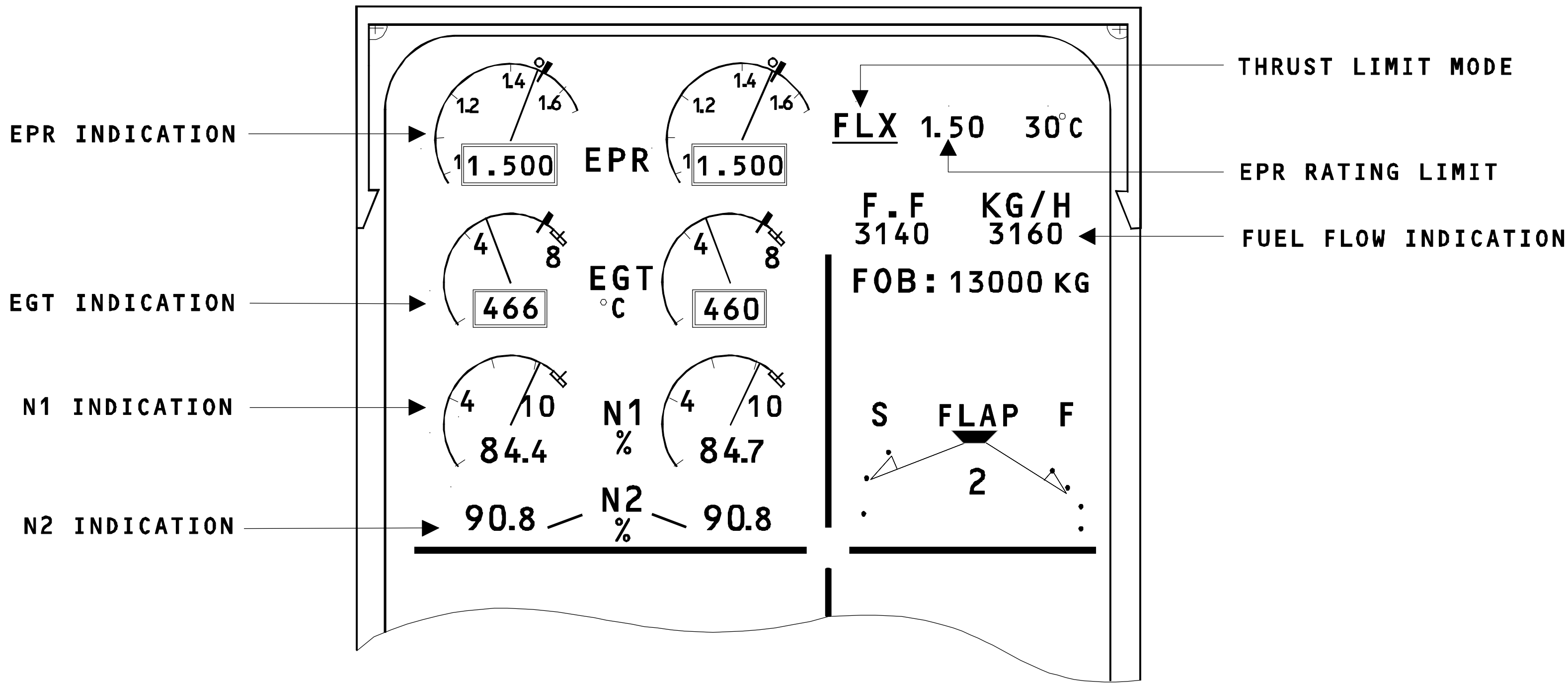
77-00-00 ECAM PAGE DESCRIPTION

CONTENTS :

ECAM PAGE DESCRIPTION

UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY)

The engine primary parameters are permanently displayed on the ECAM upper display called ENGINE/WARNING DISPLAY (EWD).



UFD4200 TMU77IA04-P01 LEVEL 3

ECAM PAGE DESCRIPTION - UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY)

ECAM PAGE DESCRIPTION

UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY) (Cont'd)

EPR (Exhaust Pressure Ratio) INDICATION

1 - ACTUAL EPR:
Normally green.
Amber if EPR exceeds EPR limit value.

2 - EPR MAX:
Thick amber index.
It is the limit value of EPR corresponding to the full forward position of the throttle lever.

3 - EPR THROTTLE LEVER ANGLE (TLA):
White circle.
It corresponds to the throttle lever position (predicted EPR).

4 - TRANSIENT EPR:
Blue arc.
From actual EPR pointer to EPR command value, it is only displayed with auto thrust engaged.

5 - IDLE INDICATION:
Flashing in green for 10 seconds then steady.
It is displayed in flight when both engines operate at idle.
This message appears between the two EPR indications.

6 - REVERSE INDICATION:
Appears amber when one thrust reverser sleeve is unstowed or unlocked.
It changes to green when the sleeves are fully deployed.

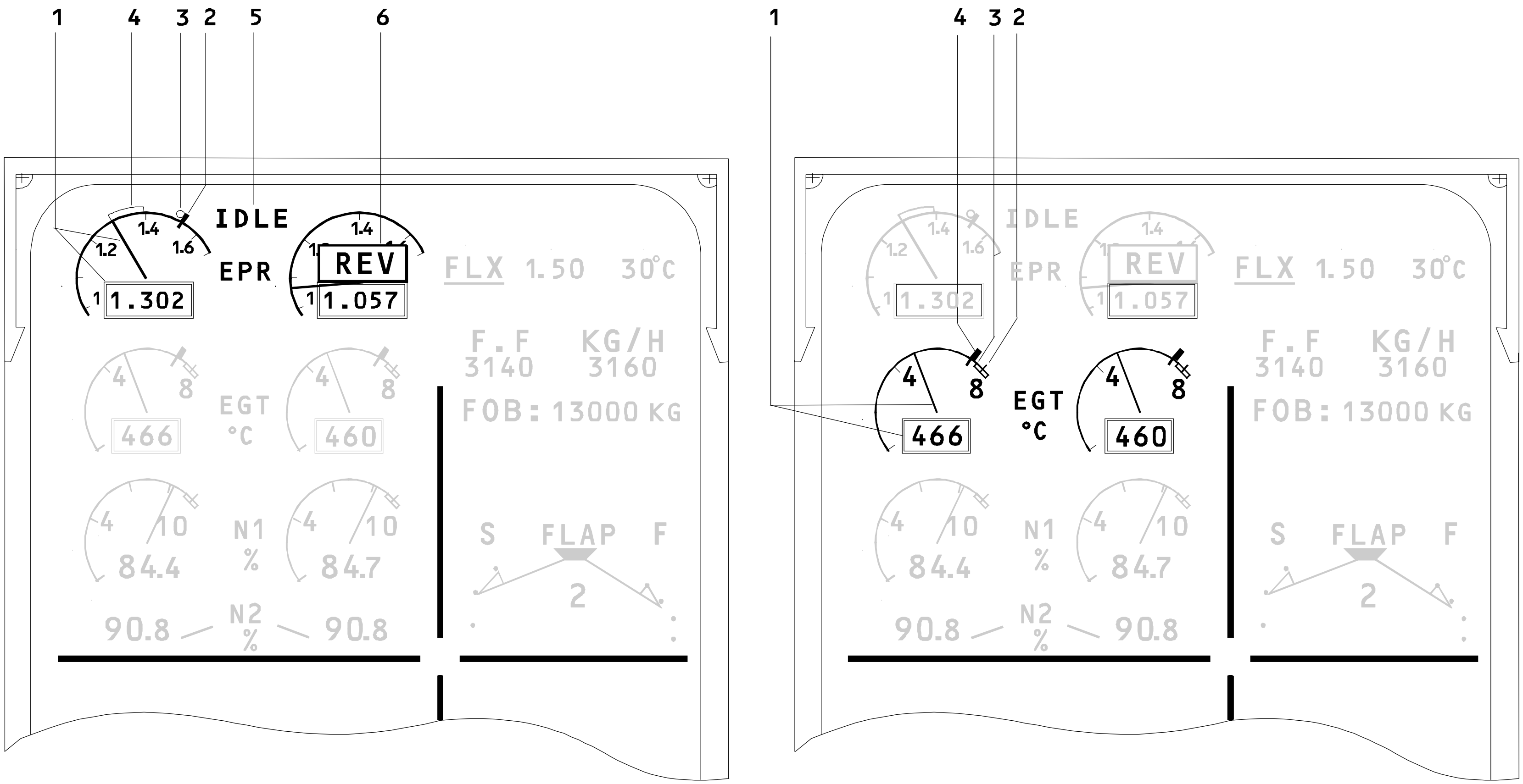
EGT INDICATION

1 - ACTUAL EGT:
Normally green.
When the EGT exceeds 610°C the numeric value remains green and the pointer pulses amber.
The values pulse red when EGT exceeds EGT red line.

2 - EGT OVERTEMPERATURE:
Red mark.
If EGT exceeds the MAX PERMISSIBLE EGT, a red mark appears at the max value achieved.
It will disappear after a new take off or a maintenance action through the MCDU.

3 - MAX PERMISSIBLE EGT:
Red line (at beginning of the red arc).
The EGT red line is:
- 635°C for the A320 and A319,
- 650°C for the A321.
During the starting sequence an EGT red line value is 590°C.

4 - MAX EGT:
Thick amber index at 610°C.
It is not displayed during the start sequence.



UFD4200
TMU77IA04-P02 LEVEL 3

ECAM PAGE DESCRIPTION - UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY)

ECAM PAGE DESCRIPTION

UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY) (Cont'd)

LP ROTOR SPEED (N1) INDICATION

1 - ACTUAL N1:
Normally green.
Pulses red if N1 exceeds 100%.
Pulses amber when N1 exceeds N1 rating limit, in N1 mode.

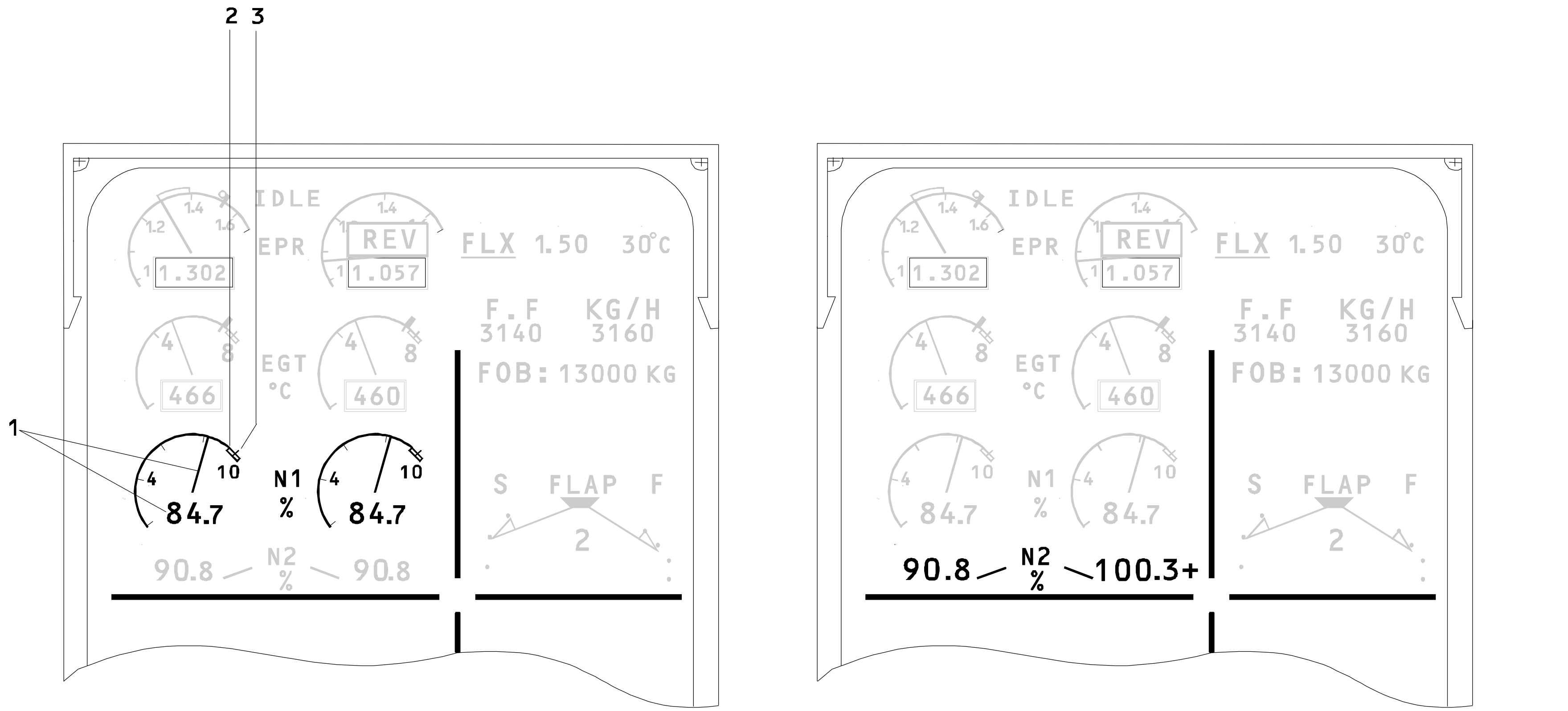
2 - MAX PERMISSIBLE N1:
Red line (at the beginning of the red arc).
Corresponds to 100% of N1.

3 - N1 OVERSPEED:
If 100% is exceeded, a red mark appears and remains at the max value achieved.
It will disappear after a new take off or after a maintenance action through the MCDU.

NOTE: The N1 mode is used as back-up in case of EPR sensor failure and normally used in the thrust reverse operation to manage the engine power.

HP ROTOR SPEED (N2) INDICATION

- The HP rotor speed digital indication is normally green. It becomes red when N2 exceeds 100%.
- When N2 exceeds 100%, a red cross appears next to the digital value. It will disappear after a new take off or maintenance action through the MCDU.
- It is hightlighted and boxed in grey during the start sequence.



UFD4200
TMU77IA04-P03 LEVEL 3

ECAM PAGE DESCRIPTION - UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY)

ECAM PAGE DESCRIPTION

UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY) (Cont'd)

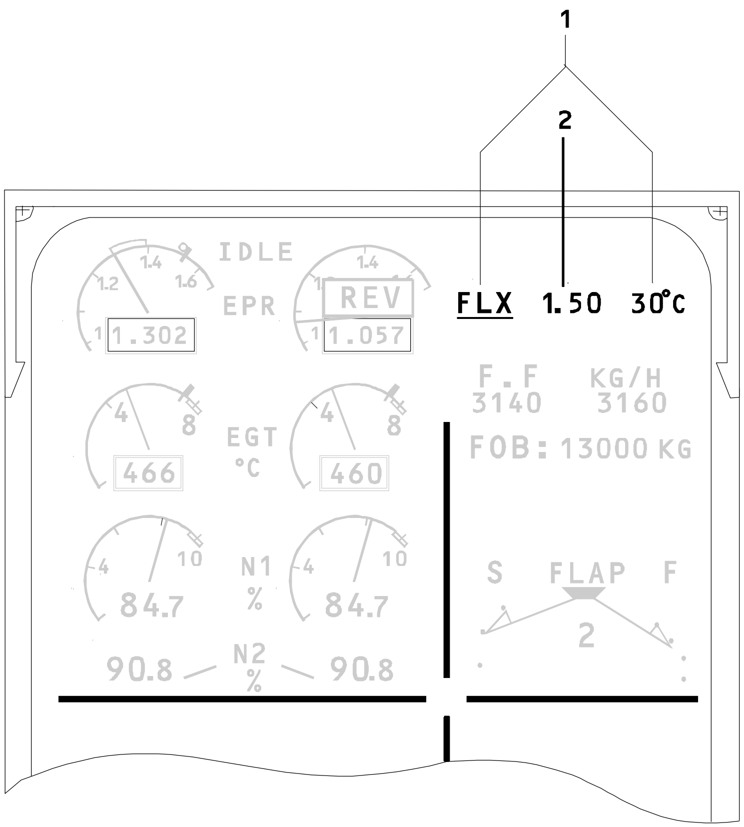
THRUST LIMIT MODE AND EPR RATING LIMIT

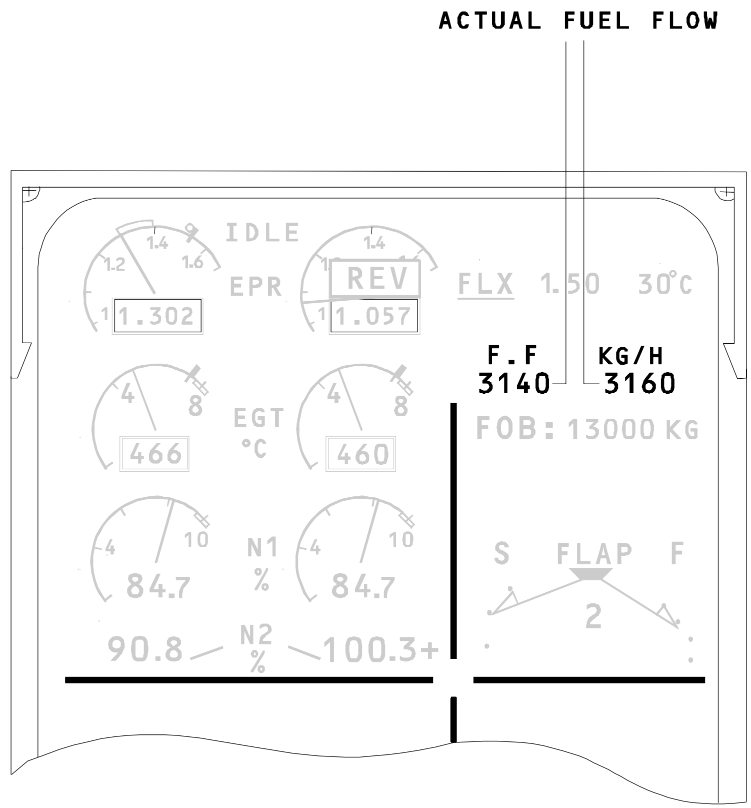
1 - THRUST LIMIT MODE:
TOGA, FLX, MCT, CL and MREV, displayed in blue, are the modes selected by the throttle lever.
The lever which is the most advanced is taken into account.
If FLX mode is selected, the flexible take off temperature selected through the MCDUs, is displayed in blue.

2 - EPR RATING LIMIT:
Displayed in green.
- In flight, or on ground with engines stopped, this limit corresponds to the most advanced throttle lever position.
- With engines running, on ground, whatever the lever position, this limit corresponds to the TOGA thrust limit.
- With engines running, on ground, if FLX mode is selected, FLX EPR is displayed whatever the throttle lever position between IDLE and FLX/MCT.

FUEL FLOW INDICATION

ACTUAL FUEL FLOW:
Displayed in green.



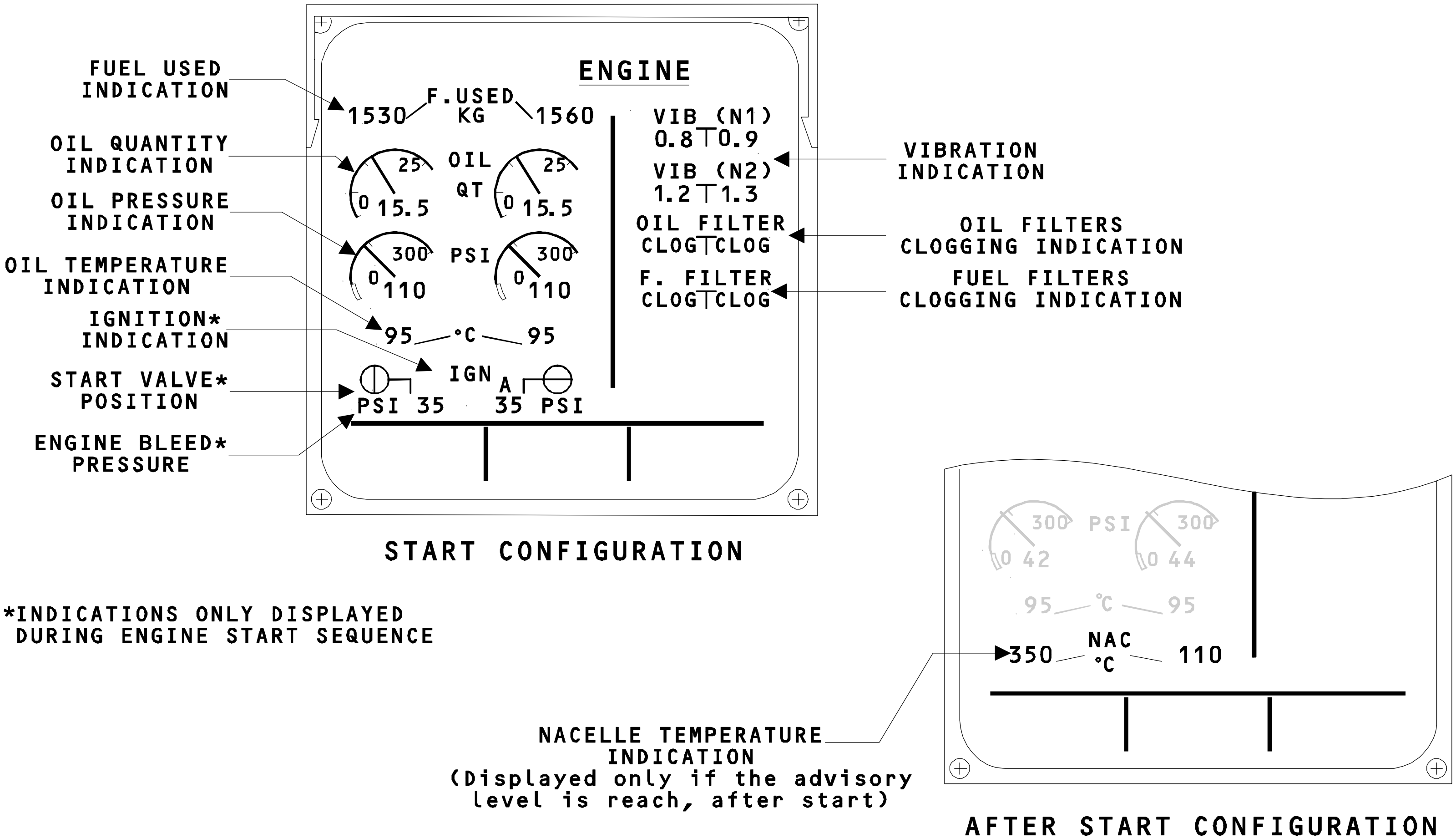


ECAM PAGE DESCRIPTION - UPPER DISPLAY : EWD (ENGINE/WARNING DISPLAY)

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

The secondary parameters are displayed via the ENGINE page on the ECAM lower display called System Display (SD). The ENGINE page is selected manually or automatically.



TMU771A04-P05 LEVEL 3

UFD4200

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

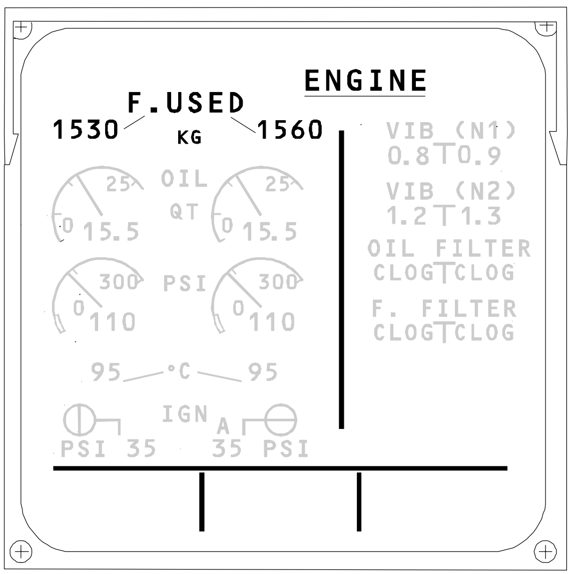
FUEL USED INDICATION

The fuel used value computed by the FADEC is displayed in green.
It is reset at engine starting (master switch ON) on ground.
It is frozen at its last value at engine shut down until next engine start.
The two last digits are dashed if the fuel used indication is inaccurate due to the loss of fuel flow for more than 1 minute.

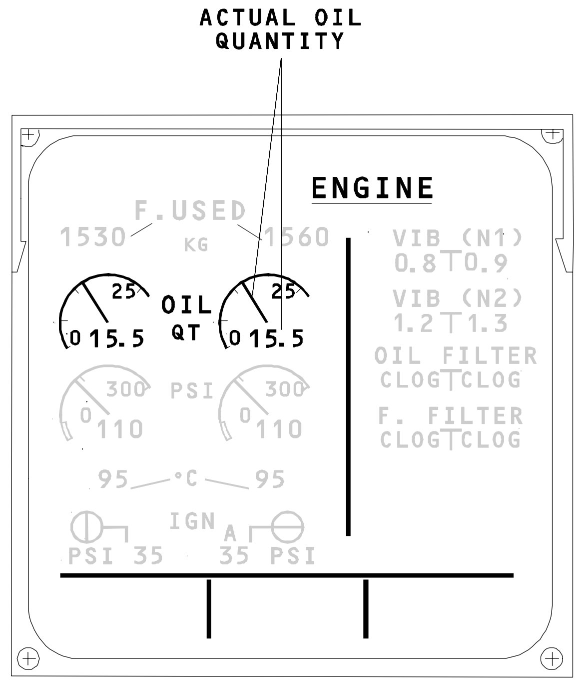
OIL QUANTITY INDICATION

The needle and the digital indication are normally green.
The indication pulses when the advisory level is reached.
Advisory level:

- at 5 quarts (quantity decreasing)
- cancelled at 7 quarts (quantity increasing).



START CONFIGURATION



START CONFIGURATION

UFD4200

TMU77IA04-P06 LEVEL 3

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

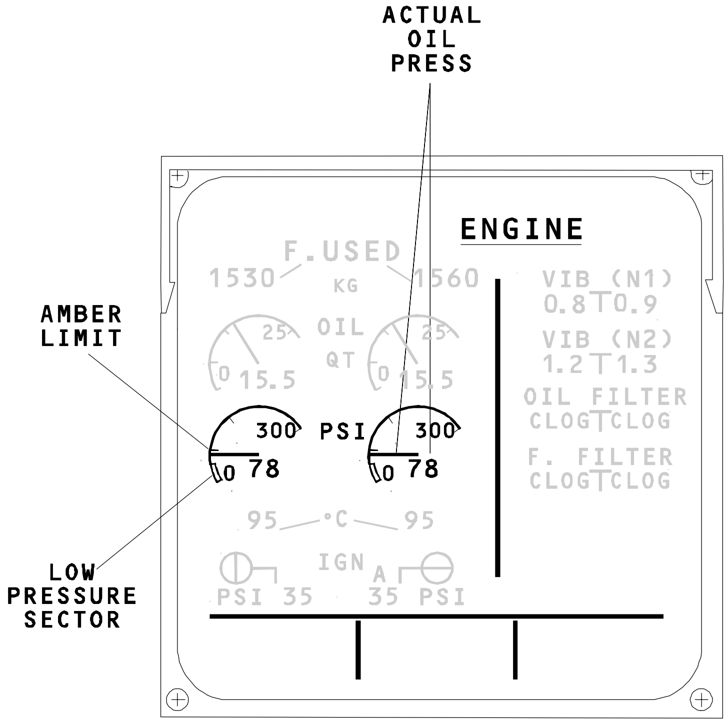
OIL PRESSURE INDICATION

The needle and the digital indication are normally green.
The digital indication pulses if oil pressure exceeds 390 PSI (increasing) or 385 PSI (decreasing).
The needle and the digital indication become amber below 80 PSI down to 60 PSI, then red below 60 PSI.

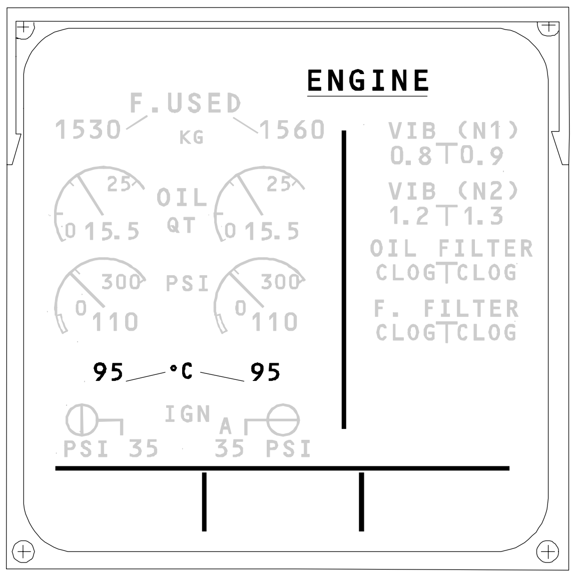
OIL TEMPERATURE INDICATION

Normally green.
The indication pulses above 156°C (increasing) or 150°C (decreasing).
The indication becomes amber associated with ECAM warning if temperature:

- exceeds 156°C for more than 15 minutes or 165°C without delay
- is below -10°C.



START CONFIGURATION



START CONFIGURATION

UFD4200

TMU77IA04-P07 LEVEL 3

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

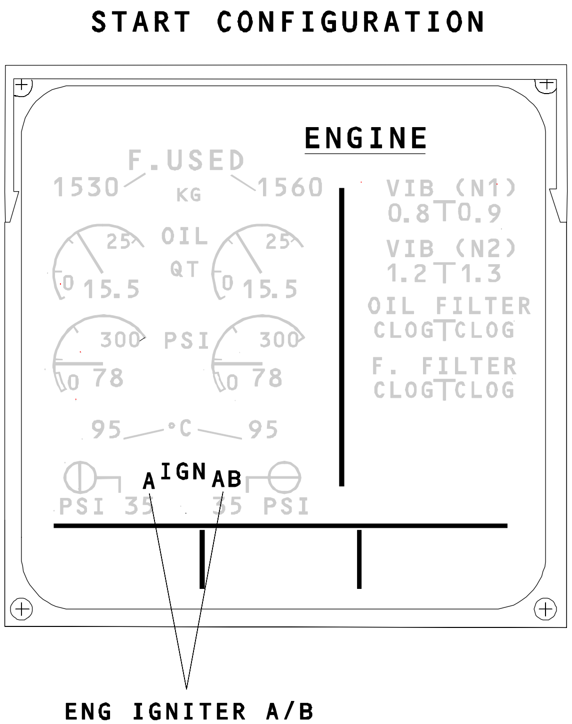
IGNITION INDICATION

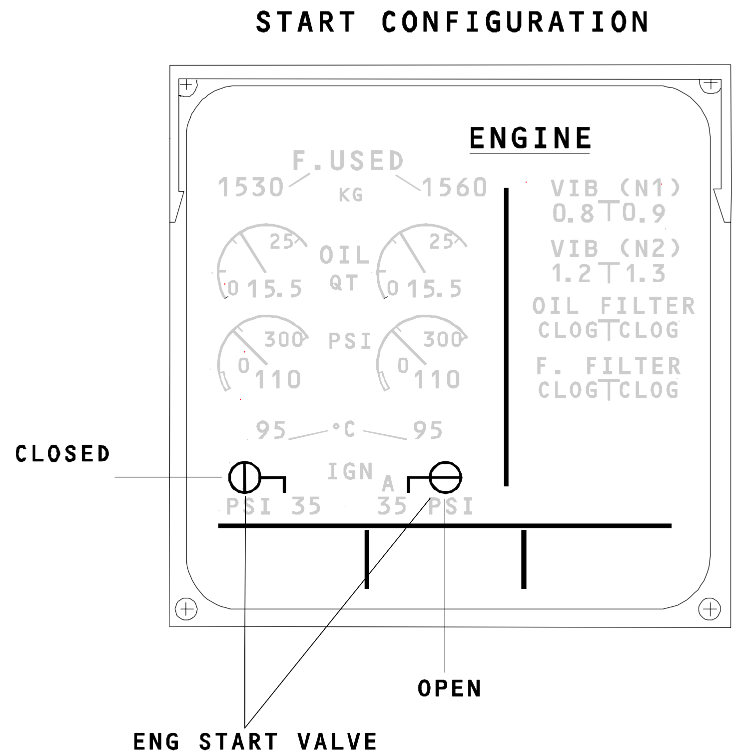
The ignition indications are only displayed during the start sequence.
IGN is displayed in white.
The selected ignitors are displayed in green when supplied.

- "A" or "B" in automatic mode
- "AB" in manual mode or continuous relight.

START VALVE POSITION

The start valves are only displayed during start sequence.





ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

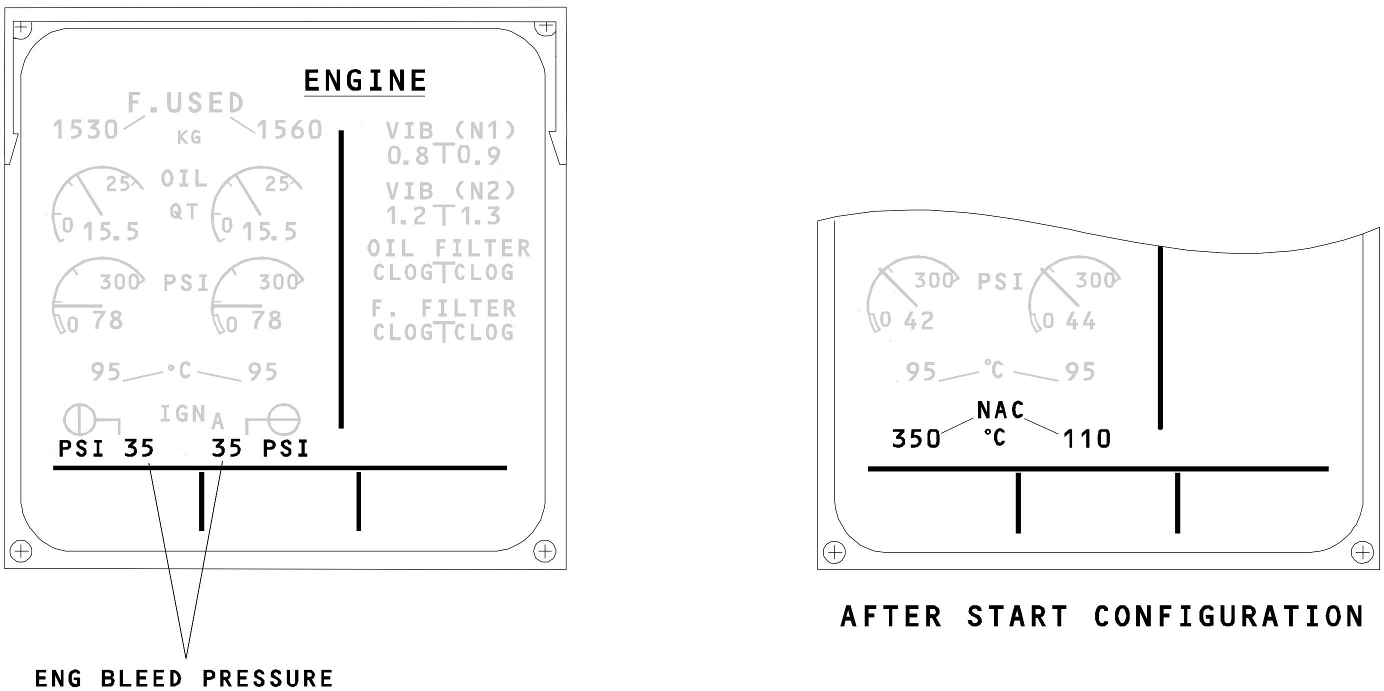
ENGINE BLEED PRESSURE

The bleed pressure, upstream of the precooler, is only displayed during the start sequence, normally in green. It becomes amber in case of overpressure or if the pressure is below 21 PSI with the start valve not closed.

NACELLE TEMPERATURE INDICATION

The nacelle temperature indication is displayed pulsing green when above 320°C (advisory threshold). This indication is displayed if the system is not in engine starting mode and one of the two temperatures reaches the advisory threshold.

START CONFIGURATION



AFTER START CONFIGURATION

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

TMU77IA04-P09 LEVEL 3

UFD4200

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

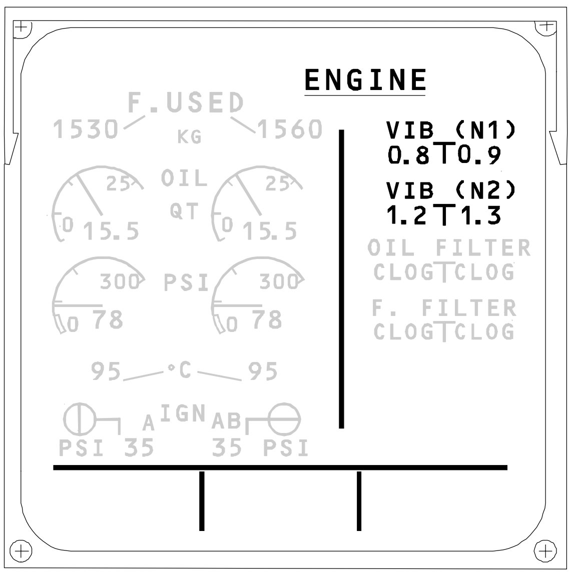
VIBRATION INDICATION

The LP and HP rotors (N1 and N2) indications are pulsing green at 5.0.

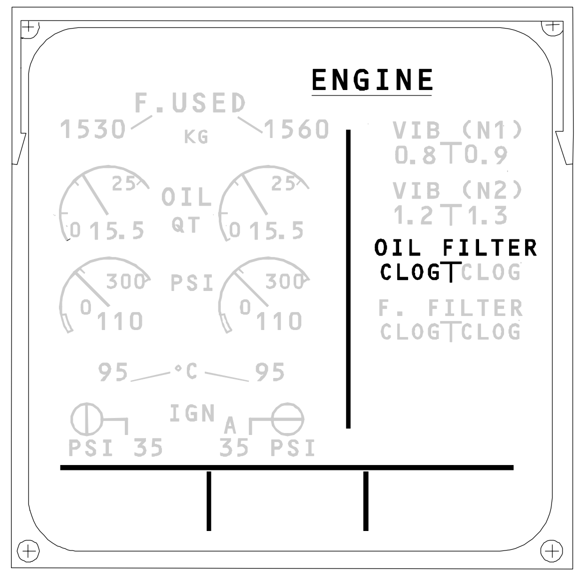
NOTE: The advisory threshold may be modified by an MCDU procedure at the level of vibration reached during the last flight.

OIL FILTER CLOG INDICATION

CLOG message appears in amber, associated with an ECAM message, when the differential pressure accross the scavenge oil filter is excessive.



START CONFIGURATION



START CONFIGURATION

UFD4200
TMU77IA04-P10 LEVEL 3

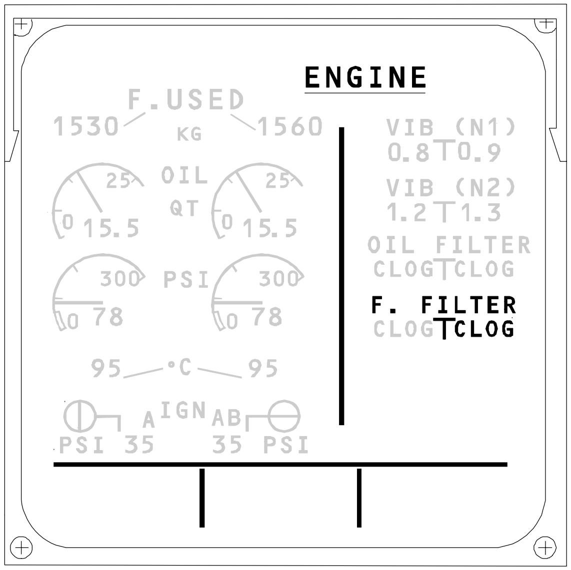
ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE (Cont'd)

FUEL FILTER CLOG INDICATION

CLOG message appears in amber, associated with an ECAM message, only when the differential pressure across the fuel filter is excessive.



START CONFIGURATION

UFD4200 TMU77IA04-P11 LEVEL 3

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - ENGINE PAGE

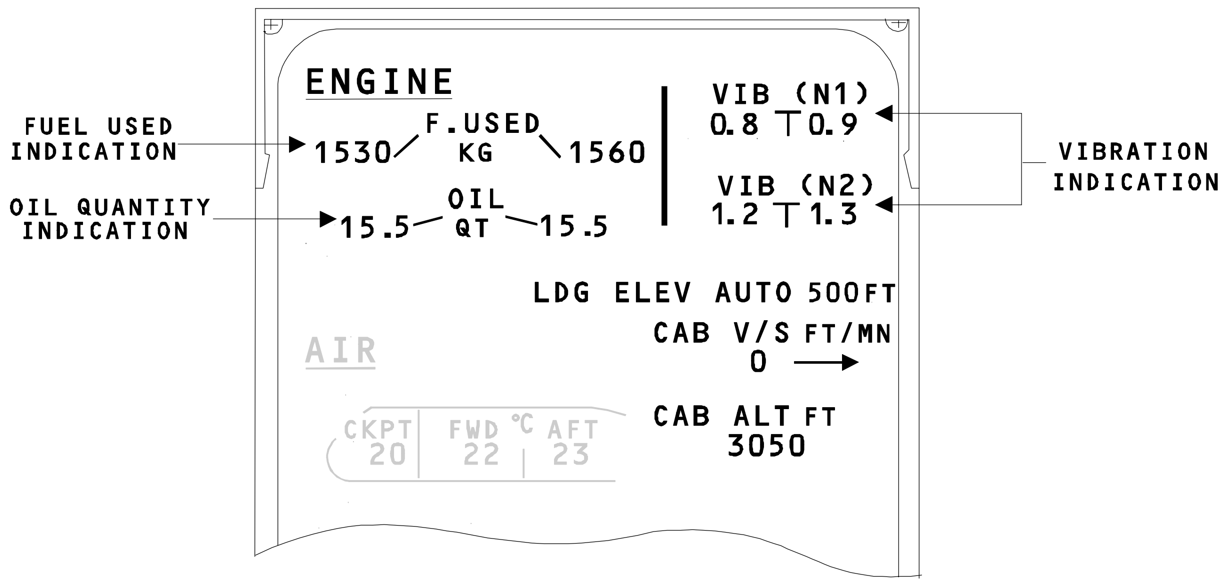
ECAM PAGE DESCRIPTION

LOWER DISPLAY : SD (SYSTEM DISPLAY) - CRUISE PAGE

The CRUISE page is automatically selected and replaces the ENGINE page when the following conditions are met:

- flight phase 6 (or cruise phase),
- slats and flaps retracted,
- no take off power.

The cruise page is automatically replaced by the WHEEL page below 800 ft.
FUEL USED and VIBRATION indications of the ENGINE page are displayed with the same characteristics. For the OIL QUANTITY indication only a digital indication is displayed which pulses with the same advisory threshold.



UFD4200
TMU77IA04-P12 LEVEL 3

ECAM PAGE DESCRIPTION - LOWER DISPLAY : SD (SYSTEM DISPLAY) - CRUISE PAGE

SELF EXAMINATION

The Engine primary parameters are displayed:

A - On the ECAM upper display.
B - On the ECAM lower display.
C - On both ECAM displays.

The Engine page is selected:

A - Manually or automatically depending on flight phases.
B - Manually only.
C - Automatically only according to flight phases.

The Engine vibration indications are displayed:

A - On the ENGINE/WARNING DISPLAY.
B - On the ENGINE page.
C - On the ENGINE page and the CRUISE page.

77 - ENGINE INDICATING

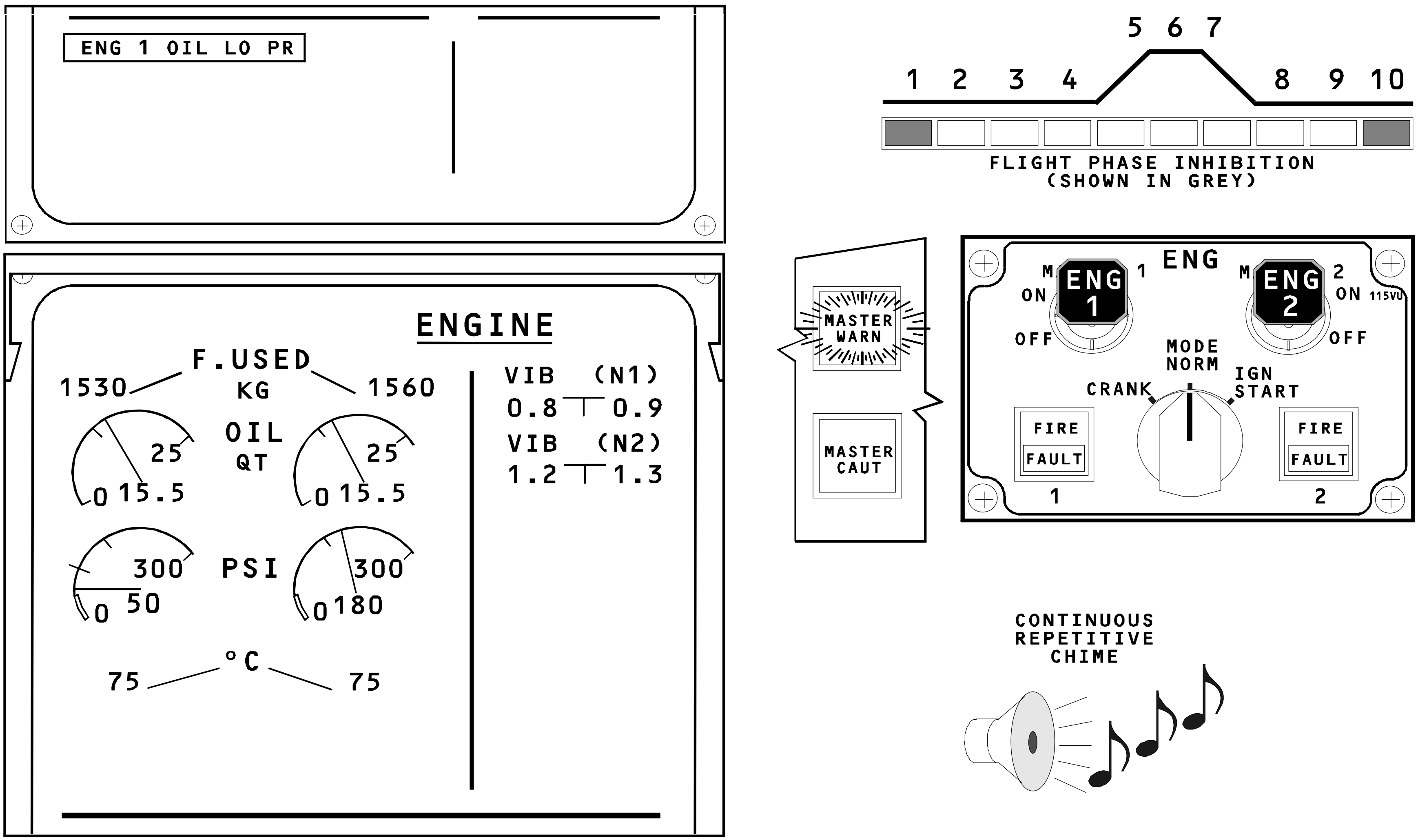
77-00-00 ENGINE WARNINGS

CONTENTS:

ENGINE WARNINGS

OIL LOW PRESSURE

In case of OIL LOw PRessure, the MASTER WARNing flashes and the aural warning sounds (continous repetitive chime).
The failure is shown red on the ECAM upper display.
This warning appears when the oil pressure is lower than 60 PSI.

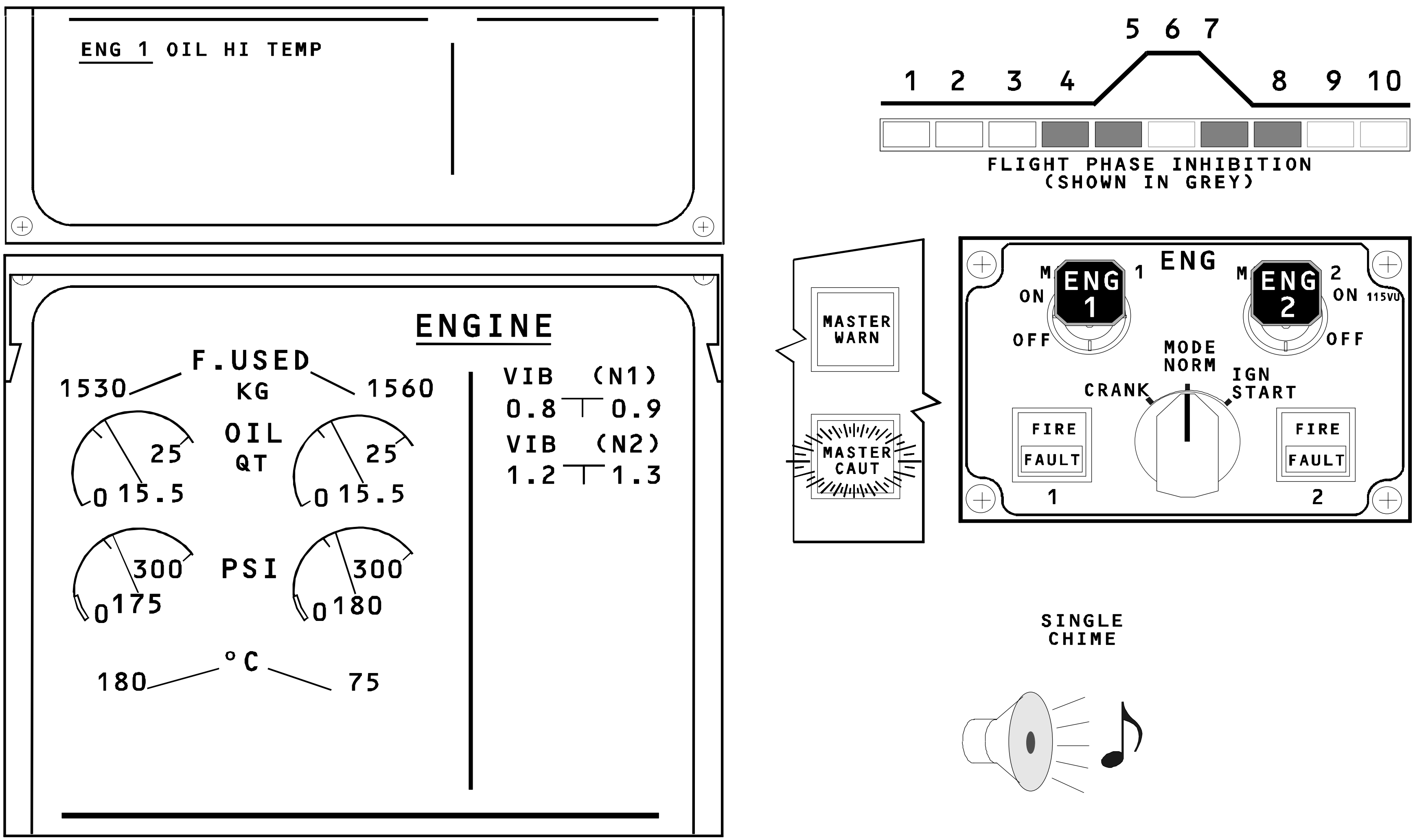


ENGINE WARNINGS - OIL LOW PRESSURE

ENGINE WARNINGS

OIL HIGH TEMPERATURE

In case of OIL HIgh TEMPerature, the MASTER CAUTion comes on and the aural warning sounds (single chime). The failure is shown amber on the ECAM upper display. Firstly the oil temperature indication flashes green when the temperature is higher or equal to 156°C and the warning appears amber when the engine oil temperature is between 156°C and 165°C for more than 15 mn, or if the oil temperature is greater than 165°C.



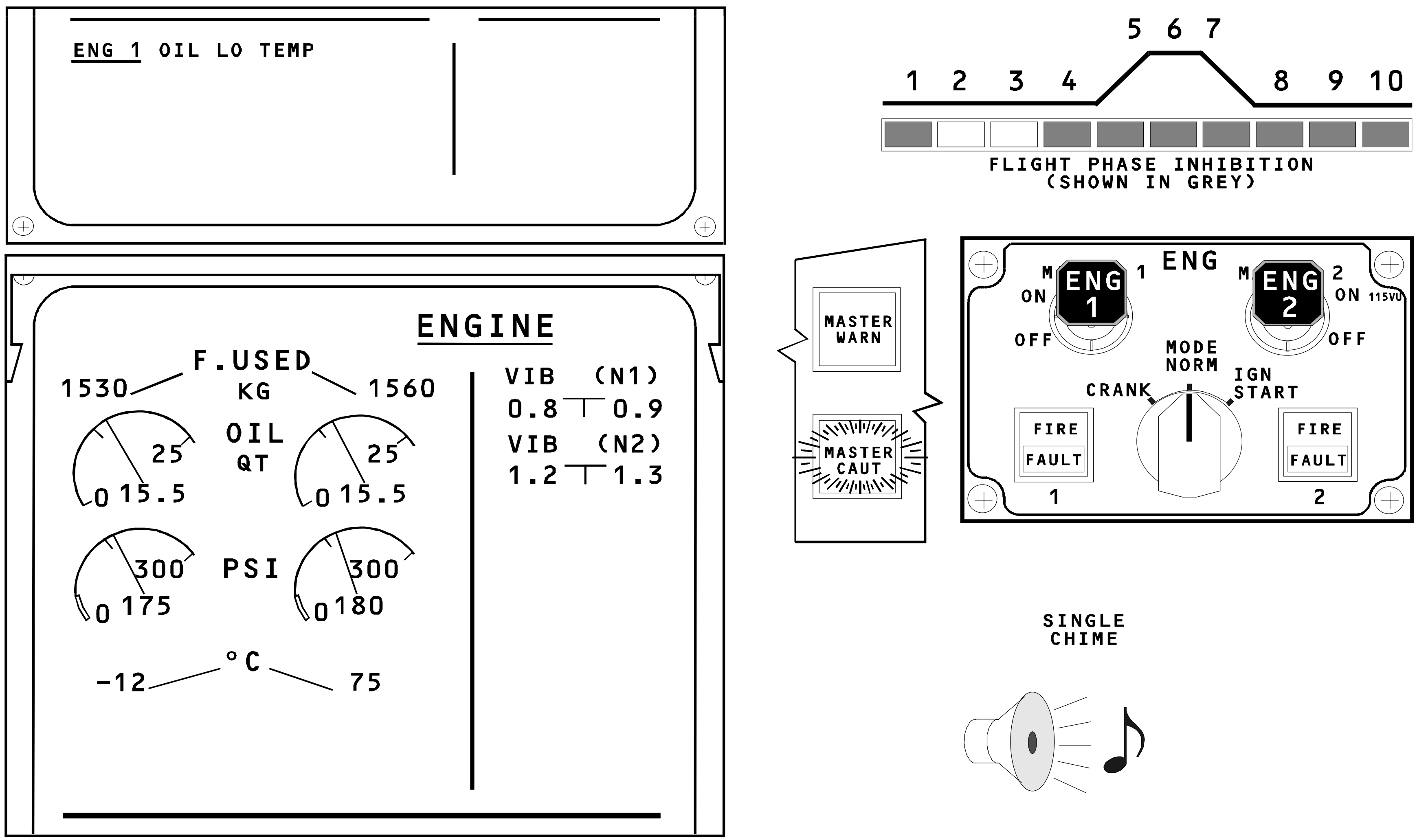
ENGINE WARNINGS - OIL HIGH TEMPERATURE

UFD4200
TMU77IB04-P02 LEVEL 3

ENGINE WARNINGS

OIL LOW TEMPERATURE

In case of OIL LOw TEMPerature, the MASTER CAUTion comes on and the aural warning sounds (single chime).
The value of the corresponding parameter is displayed amber on the ECAM page.
This warning appears when the oil temperature is below -10°C or below 50°C for take off.



ENGINE WARNINGS - OIL LOW TEMPERATURE

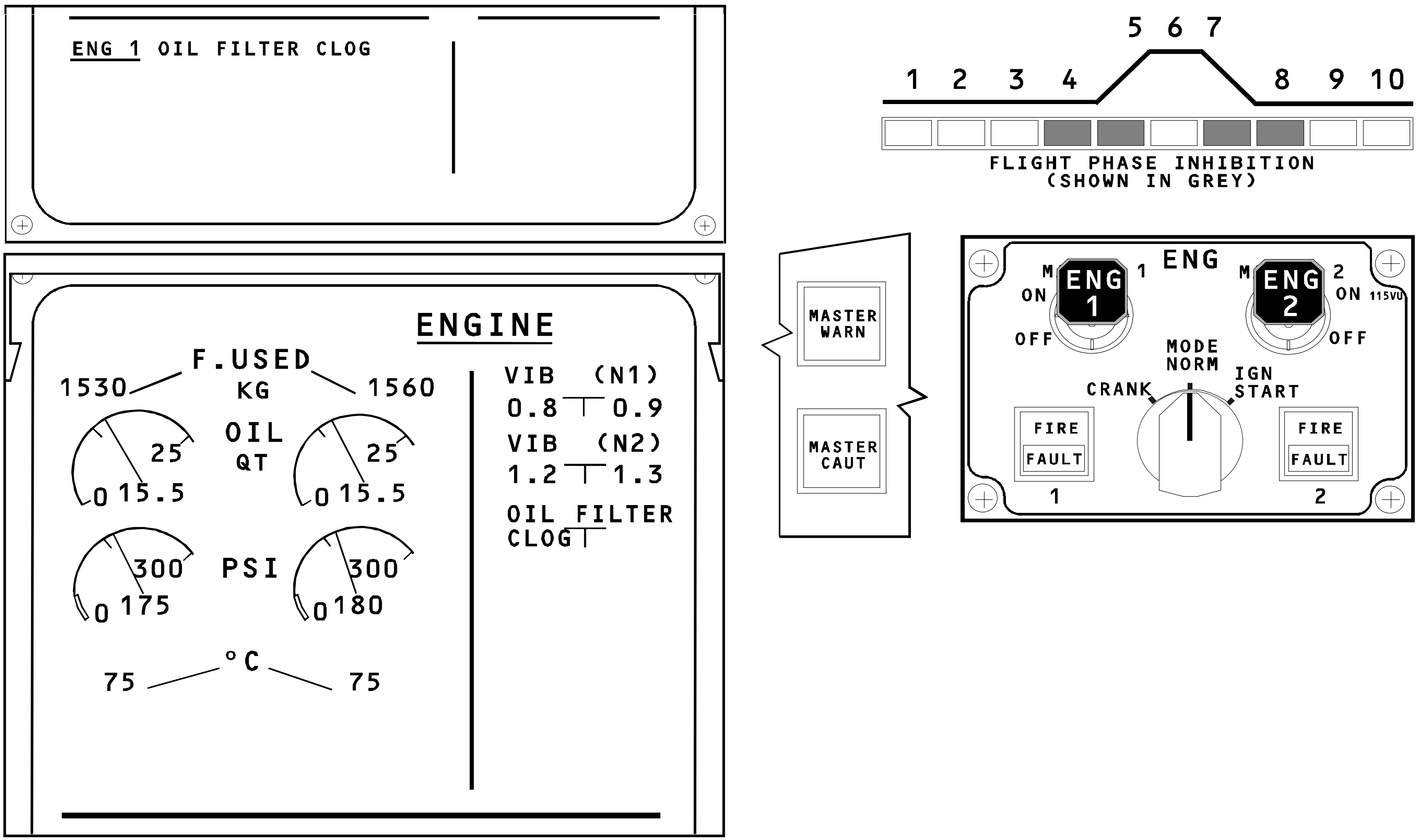
TMU77IB04-P03 LEVEL 3

UFD4200

ENGINE WARNINGS

OIL FILTER CLOGGED

In case of OIL FILTER CLOGged, the failure is shown amber on the ECAM displays.
This warning appears when the pressure loss across the main scavenge oil filter is excessive (Differential pressure greater than 12 PSI).

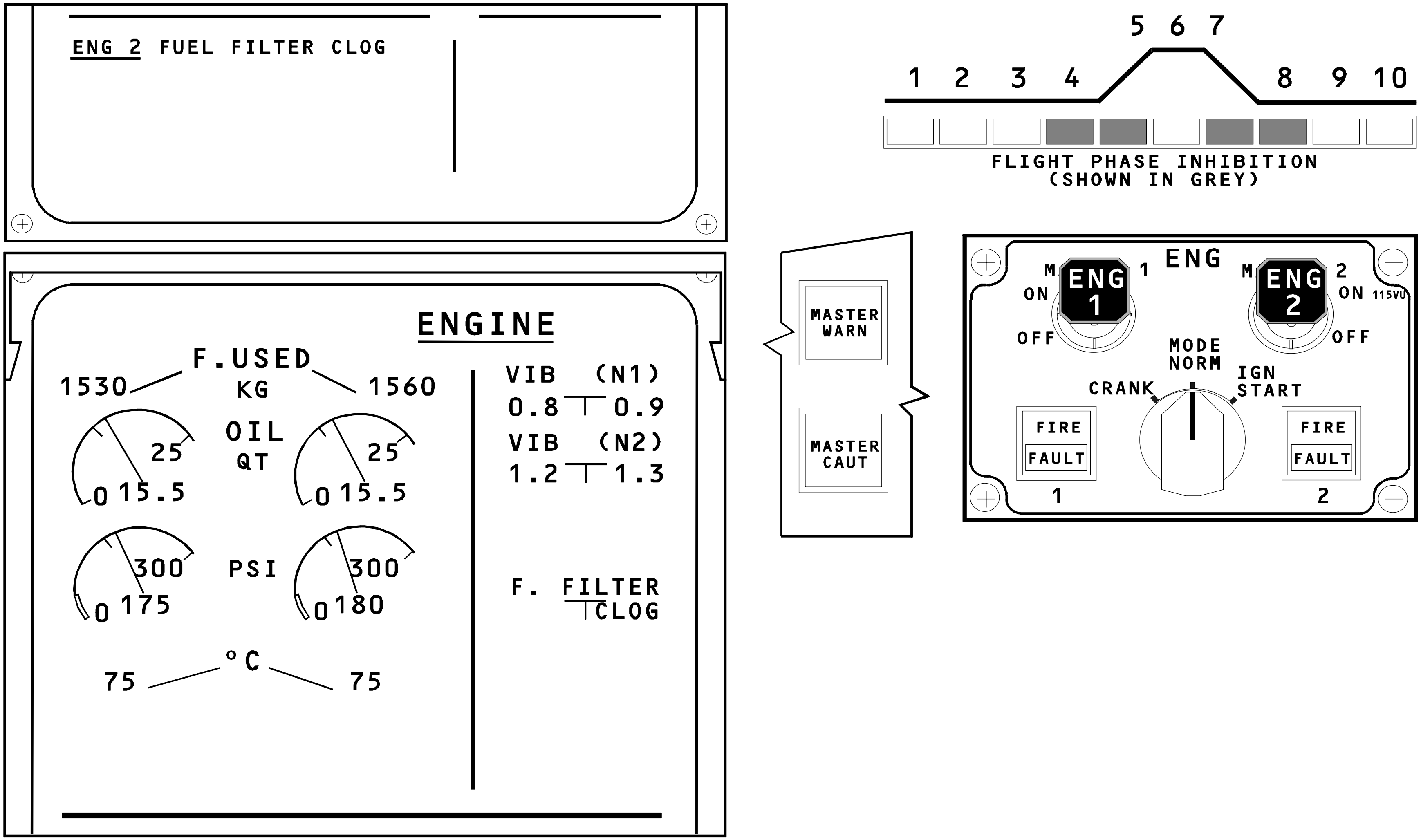


ENGINE WARNINGS - OIL FILTER CLOGGED

ENGINE WARNINGS

FUEL FILTER CLOGGED

In case of FUEL FILTER CLOGged, the failure is shown amber on the ECAM displays.
This warning appears when the pressure loss across the fuel filter is excessive (Differential pressure greater than 5 PSI).

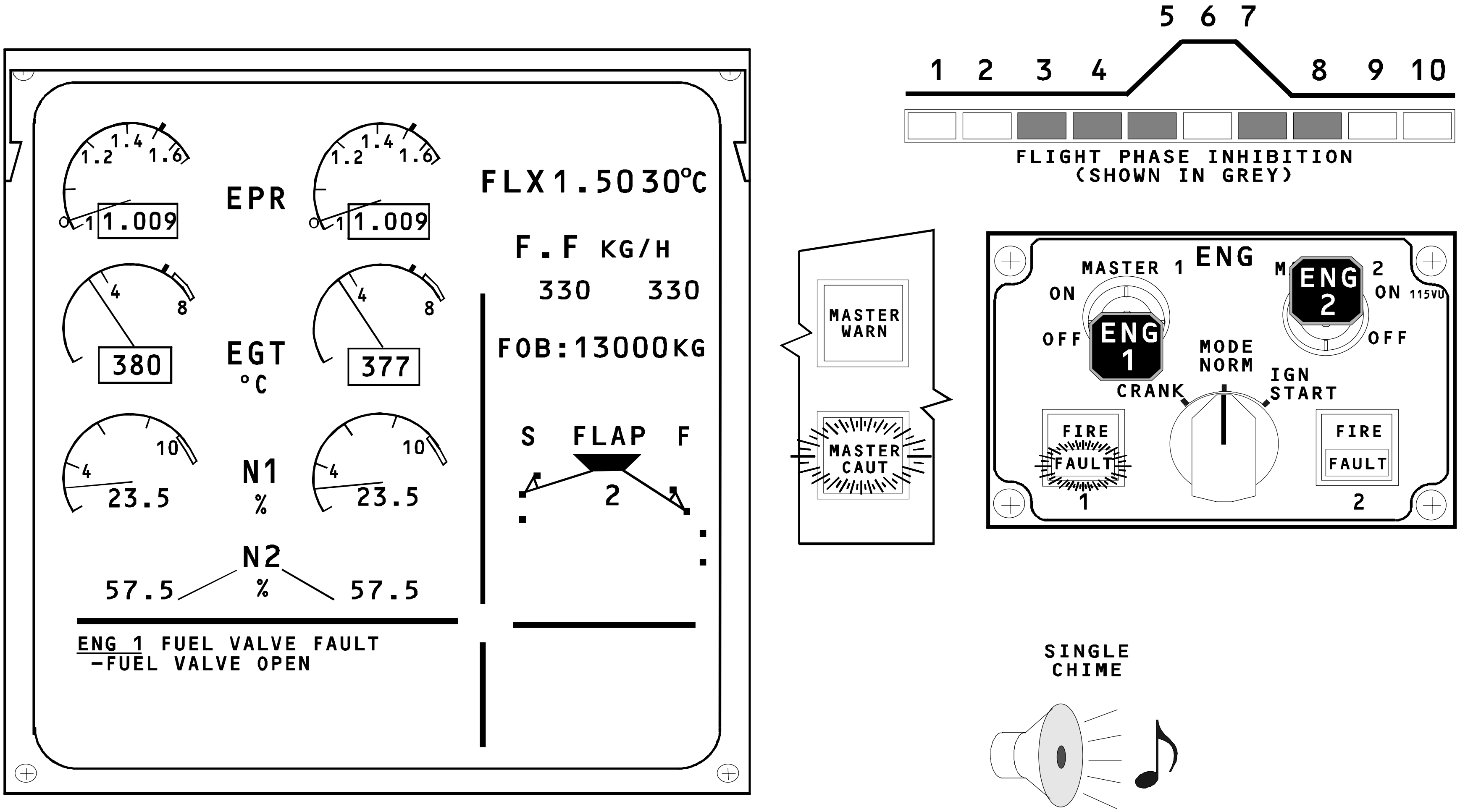


ENGINE WARNINGS - FUEL FILTER CLOGGED

ENGINE WARNINGS

FUEL VALVE (PRSOV) FAULT

In case of fuel valve fault, the MASTER CAUTion and the corresponding engine panel FAULT light come on and the aural warning sounds (single chime).
This warning appears when the fuel valve (PRSOV) fails open or closed or in case of fuel valve switch position failure.



ENGINE WARNINGS - FUEL VALVE (PRSOV) FAULT

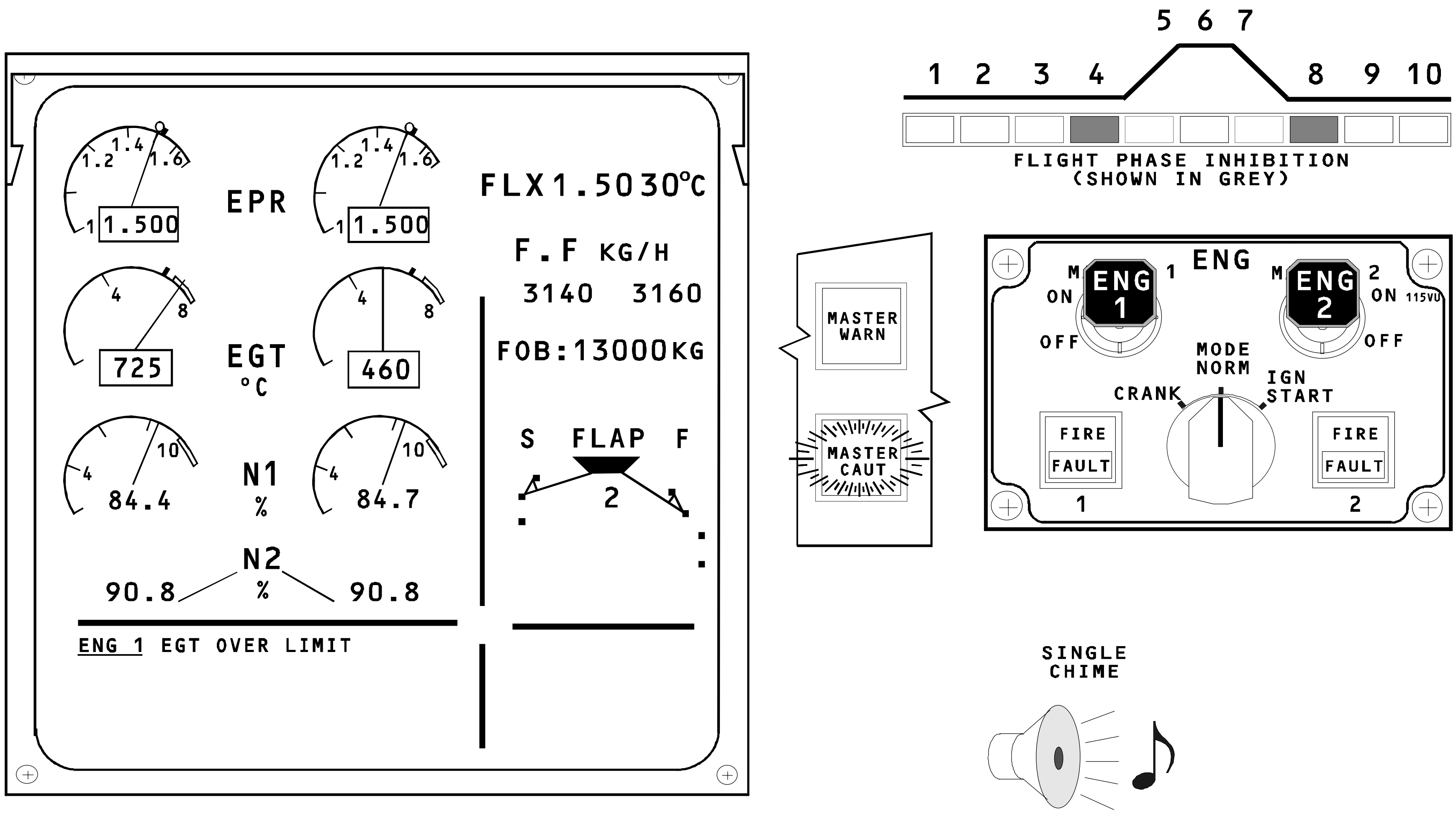
UFD4200
TMU771B04-P06 LEVEL 3

ENGINE WARNINGS

N1 OR N2 OR EGT OVER LIMIT

In case of N1, N2 or EGT OVER LIMIT, the MASTER CAUTion comes on and the aural warning sounds (single chime).
The failure message appears amber on the ECAM upper display.
The failure indications appear in the following cases:

- N1 ≥ 100% : flashes red.
- N2 > 100% : steady red.
- EGT ≥ 610°C : flashes amber.
- EGT ≥ 635°C : flashes red (A319/A320).
- EGT ≥ 650°C : flashes red (A321).

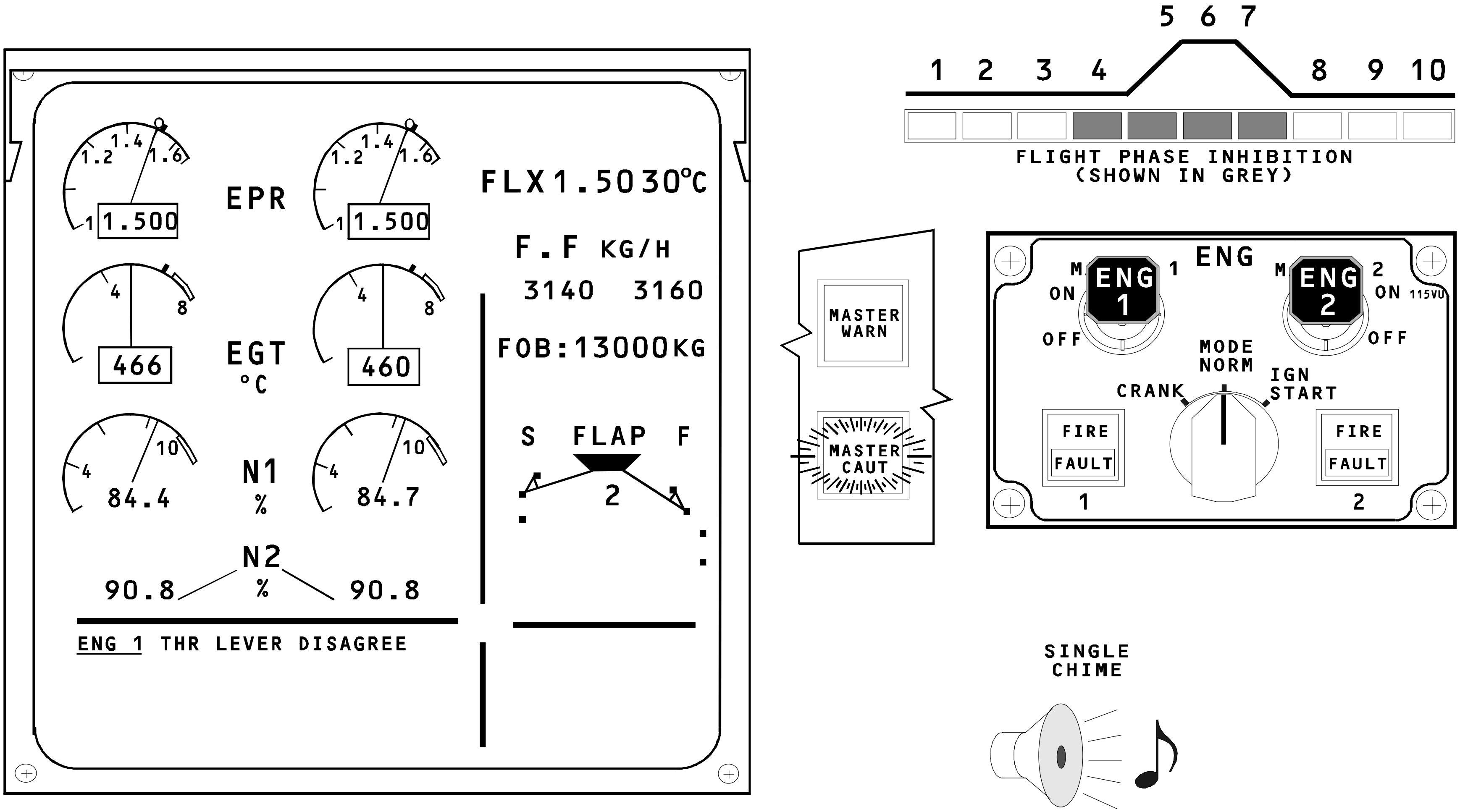


ENGINE WARNINGS - N1 OR N2 OR EGT OVER LIMIT

ENGINE WARNINGS

THROTTLE LEVER DISAGREEMENT ON GROUND

In case of THRottle LEVER DISAGREEment, the MASTER CAUTion comes on and the aural warning sounds (single chime).
The failure is shown amber on the ECAM upper display.
This warning appears when there is a disagreement between both resolvers of a throttle lever.



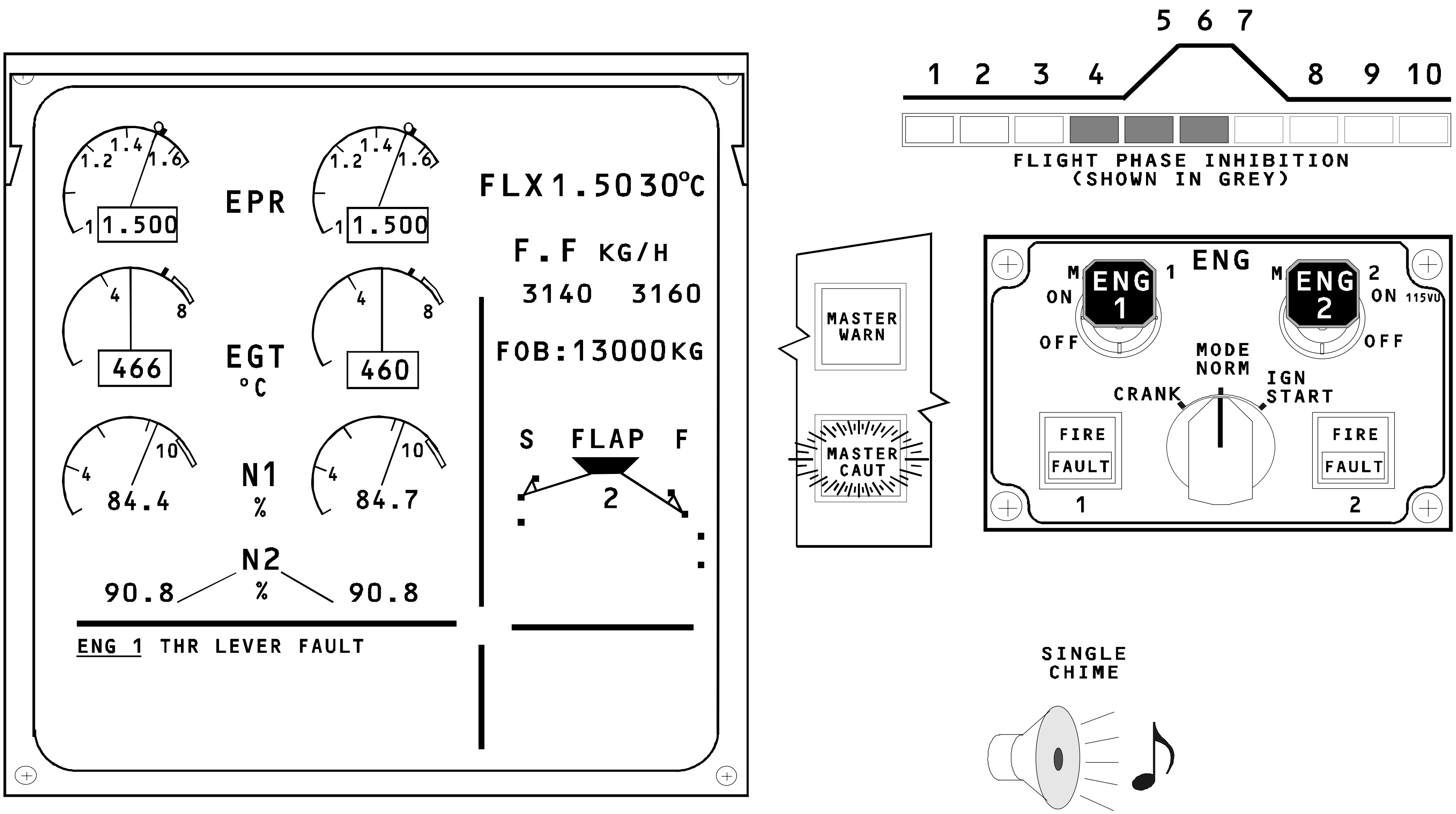
ENGINE WARNINGS - THROTTLE LEVER DISAGREEMENT ON GROUND

UFD4200
TMU77IB04-P08 LEVEL 3

ENGINE WARNINGS

TLA FAULT ON GROUND

In case of Throttle Lever Angle fault, the MASTER CAUTion comes on and the aural warning sounds (single chime).
The failure is shown amber on the ECAM upper display.
This warning appears when both resolvers on one throttle lever are faulty.



ENGINE WARNINGS - TLA FAULT ON GROUND

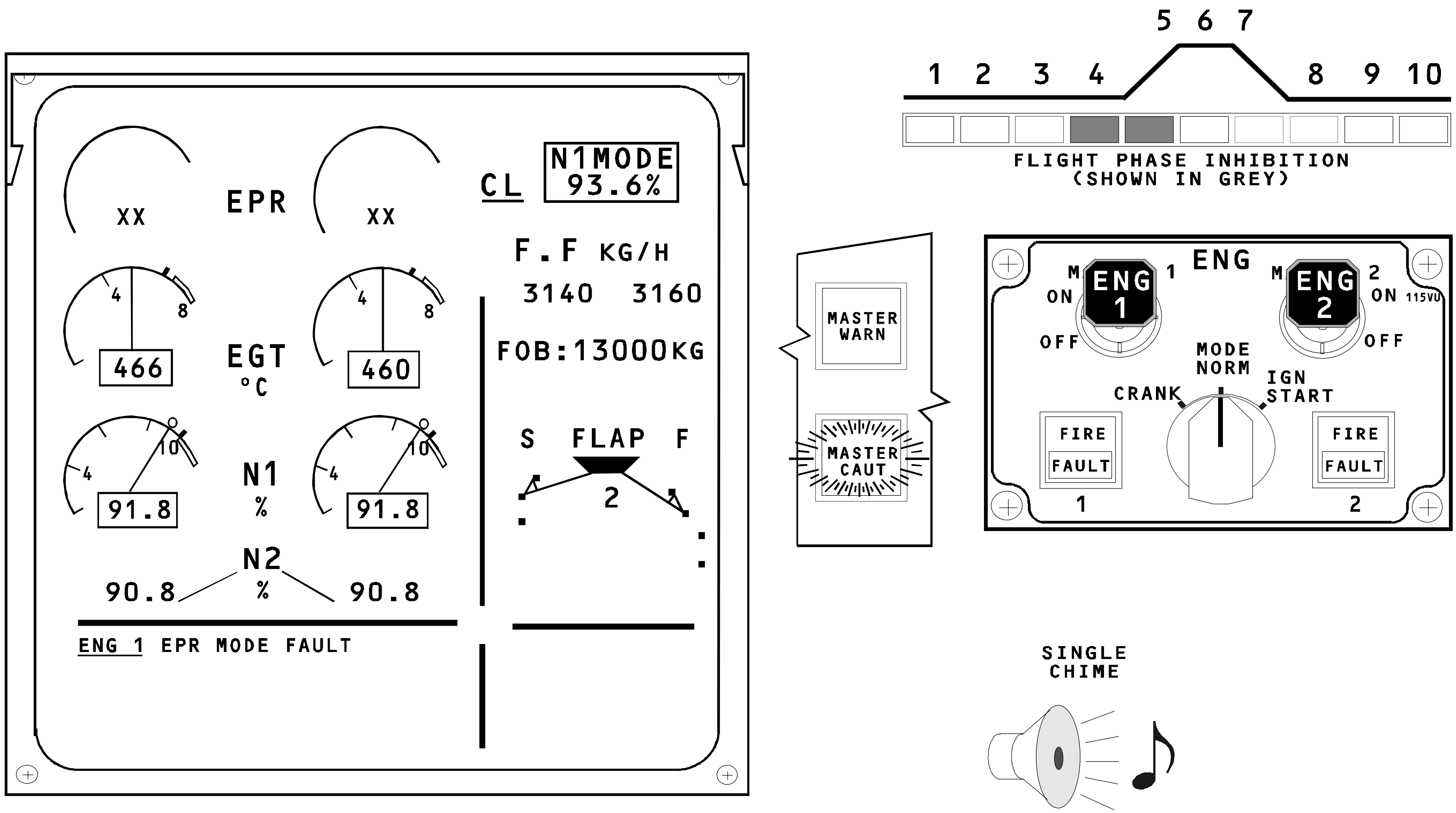
TMU77IB04-P09 LEVEL 3
UFD4200

ENGINE WARNINGS

EPR MODE FAULT

In case of EPR MODE FAULT, the MASTER CAUTion comes on and the aural warning sounds (Single chime).
The EPR indication is no longer available.
This warning appears when the FADEC is unable to sense or calculate EPR.
The engine automatically reverts to N1 MODE.
Selection of the N1 MODE pushbuttons on the overhead panel will display:

- The N1 MODE window
- The throttle lever reference (white circle) and N1 max limit (amber index) on the N1 indicator.



ENGINE WARNINGS - EPR MODE FAULT

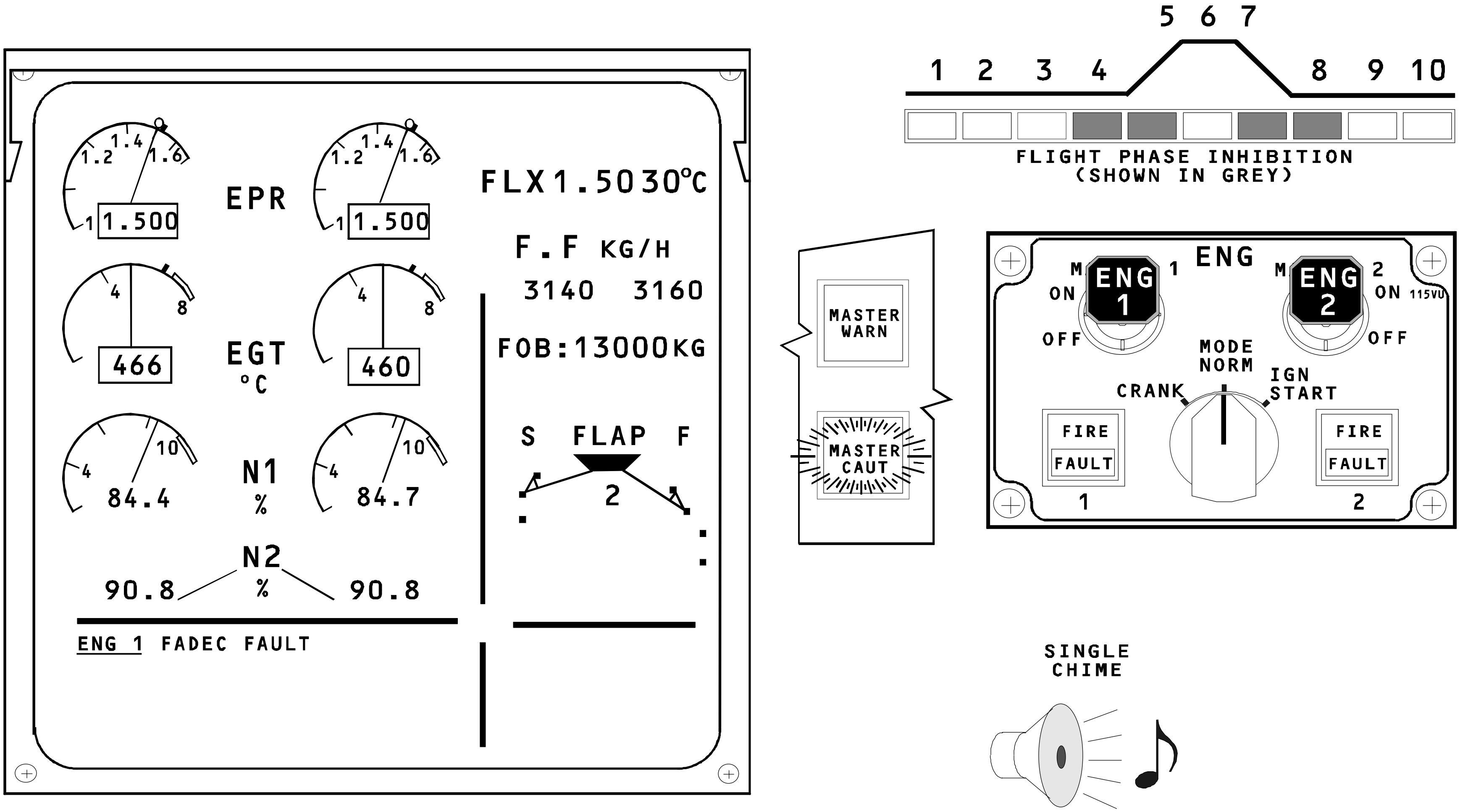
TMU77IB04-P10 LEVEL 3

UFD4200

ENGINE WARNING

FADEC FAULT

In case of FADEC FAULT, the MASTER CAUTion comes on and the aural warning sounds (single chime).
The failure is shown amber on the ECAM upper display.
This warning appears when both EEC channels are faulty.



ENGINE WARNINGS - FADEC FAULT

TMU77IB04-P11 LEVEL 3

UFD4200

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77 - ENGINE INDICATING

77-30-00 ENGINE VIBRATION MONITORING D/O

CONTENTS:

ENGINE VIBRATION MONITORING D/O

GENERAL

This system provides the vibration monitoring for both engines.

DUAL ACCELEROMETER

A dual accelerometer is installed on each engine.
It provides the analog signals of N1 and N2 vibration frequencies.
Only one sensor (A or B) of the dual accelerometer is used at a time and during one flight. It is automatically selected by the Engine Vibration Monitoring Unit (EVMU) at each flight, the second is in back-up mode in case of failure.
These accelerometers are also used for fan trim balance.

NOTE: In case of sensor failure, the transfer to the second sensor is carried out on the ground through the MCDU.

ENGINE VIBRATION MONITORING UNIT (EVMU)

An Engine Vibration Monitoring Unit (EVMU) monitors the N1 and N2 vibration levels of both engines.
The EVMU determines for each engine, the N1 and N2 vibration levels by analysing:

- N1 and N2 speeds
- Dual accelerometer frequency signals

The EVMU also computes the position and amplitude of the unbalance and is capable of on board fan trim balancing.

VIBRATION INDICATION

The N1 and N2 vibrations of the left and right engines are displayed on the engine and cruise pages.
The maximum value that can be displayed is of 10 units.

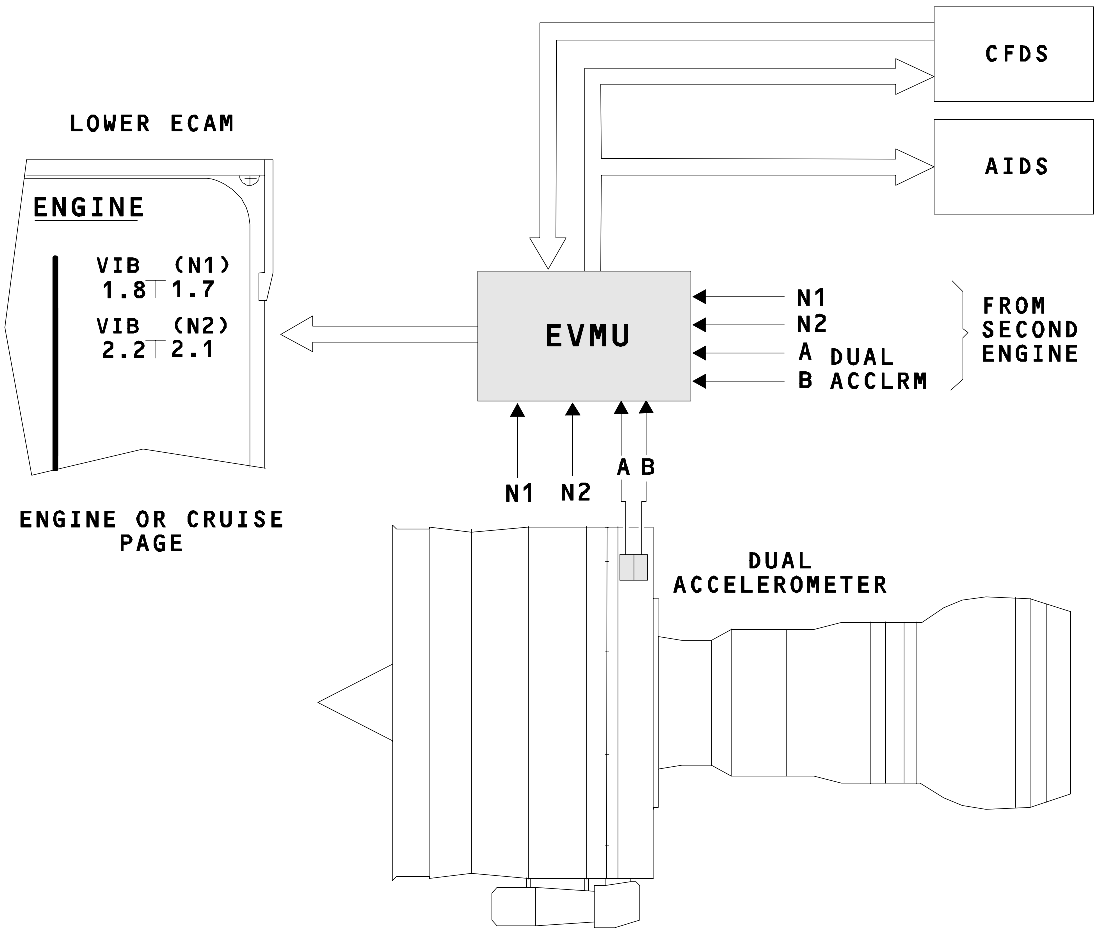
- 1 unit for N1 rotor corresponds to 0.3 IPS.
- 1 unit for N2 rotor corresponds to 0.3 IPS.

(IPS = Inch Per Second)

INTERFACES

The EVMU interfaces with the ECAM, with the Centralized Fault Display System (CFDS) and the Aircraft Integrated Data System (AIDS).
CFDS interface: Maintenance fault messages and vibration data analysis.
AIDS interface: Performance data reports.

NOTE: There is no interface with the EEC.



ENGINE VIBRATION MONITORING D/O

SELF EXAMINATION

Which systems interface with the EVMU?

A - ECAM - CFDS - AIDS.
B - ECAM - CFDS - FADEC.
C - CFDS - AIDS - ACARS.

How is the selection of the accelerometer sensors provided?

A - The EEC selects the sensor to be used.
B - The EVMU selects automatically a sensor for each flight.
C - The MCDU is used to select the sensor to be used for the next flight.

Where is the Engine Vibration displayed?

A - On the upper ECAM.
B - On the cruise page.
C - Both on the Engine and cruise pages.

77 - ENGINE INDICATION

77-00-00 PRIMARY PARAMETERS AND VIBRATION COMPONENTS

CONTENTS:

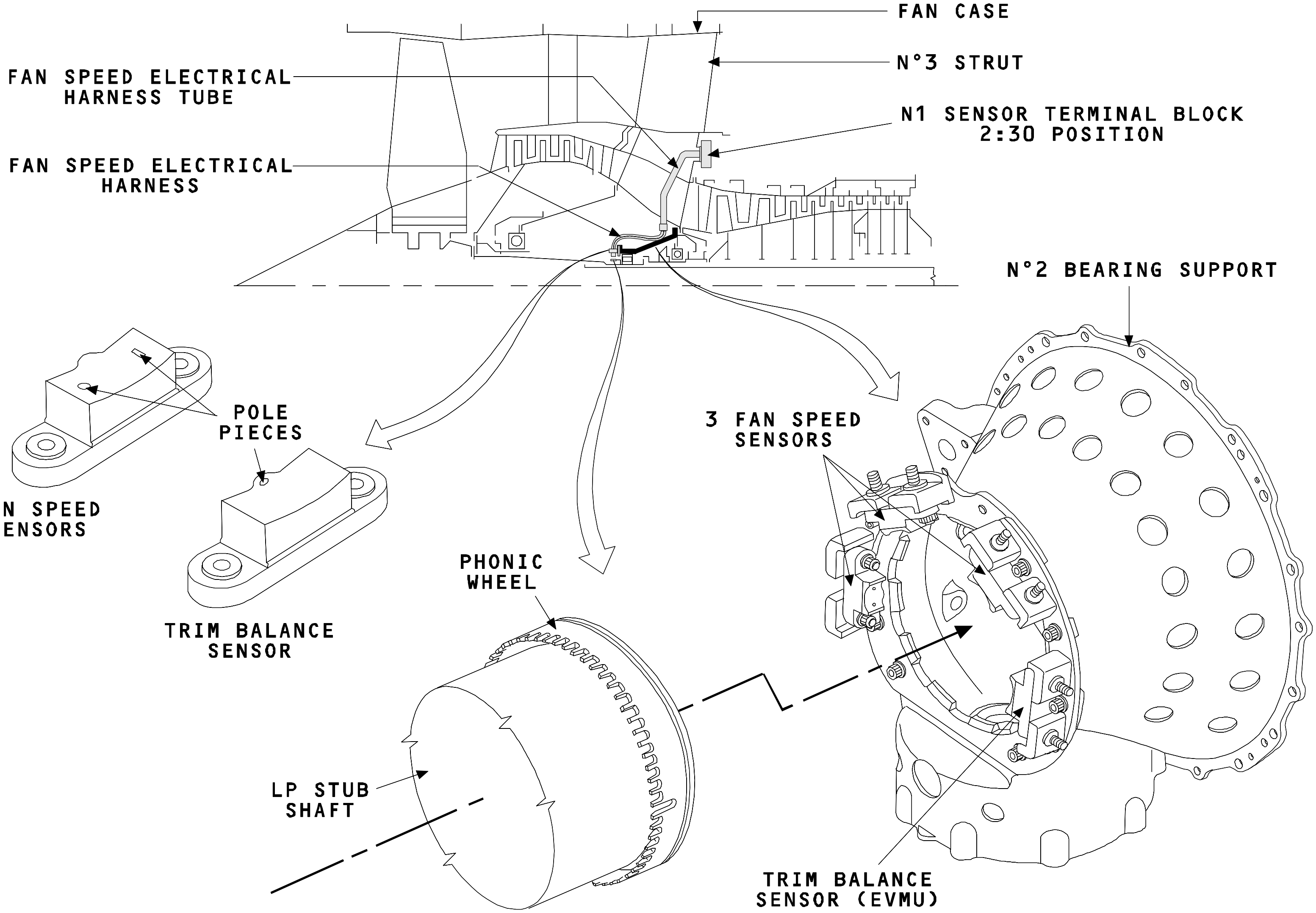
PRIMARY PARAMETERS AND VIBRATION COMPONENTS

CAUTIONS: For removal operations:
- Warning notices must be put to tell not to start engine 1 (2) and not to set ENGine/FADEC GRouND PoWeR 1 (2) pushbutton to ON.
- Make sure that engine 1 (2) has been shut down for at least 5 minutes.

N1 SENSORS

IDENTIFICATION
FIN: 4013KS1, 4013KS2, 4013KS3

LOCATION
ZONE: 436, 446



PRIMARY PARAMETERS AND VIBRATION COMPONENTS - N1 SENSORS

PRIMARY PARAMETERS AND VIBRATION COMPONENTS

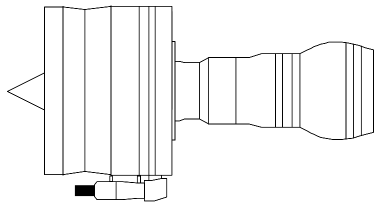
DEDICATED GENERATOR (N2)

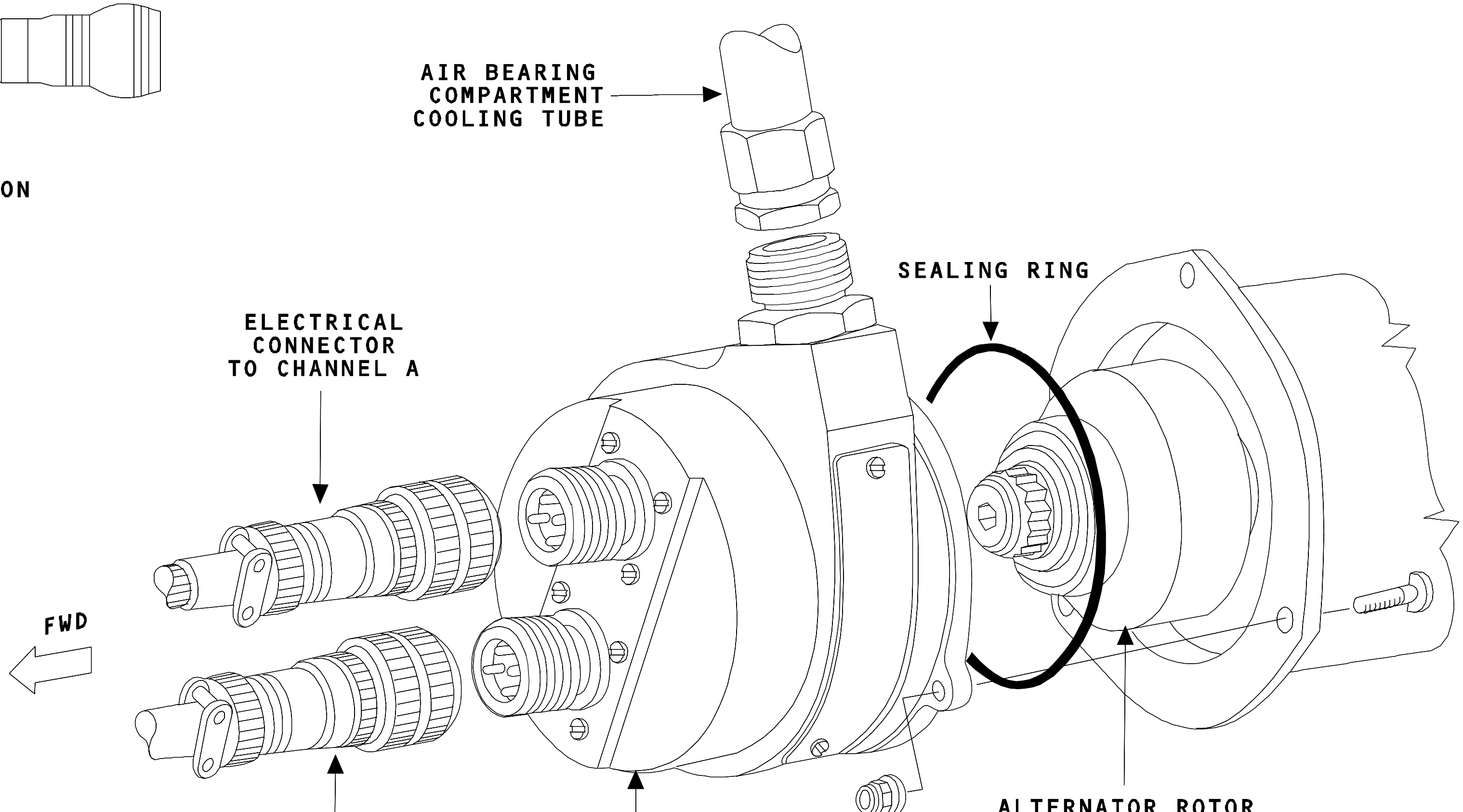
IDENTIFICATION
FIN: 4005EV

LOCATION
ZONE: 436, 446

COMPONENT DESCRIPTION

NOTE: The N2 speed signal is derived from the frequency output of the dedicated generator.





UFD4200

TMU77IE02-P02 LEVEL 3

PRIMARY PARAMETERS AND VIBRATION COMPONENTS - DEDICATED GENERATOR (N2)

PRIMARY PARAMETERS AND VIBRATION COMPONENTS

EPR

P2/T2 PROBE

IDENTIFICATION
FIN: 4014KS

LOCATION
ZONE: 433, 443

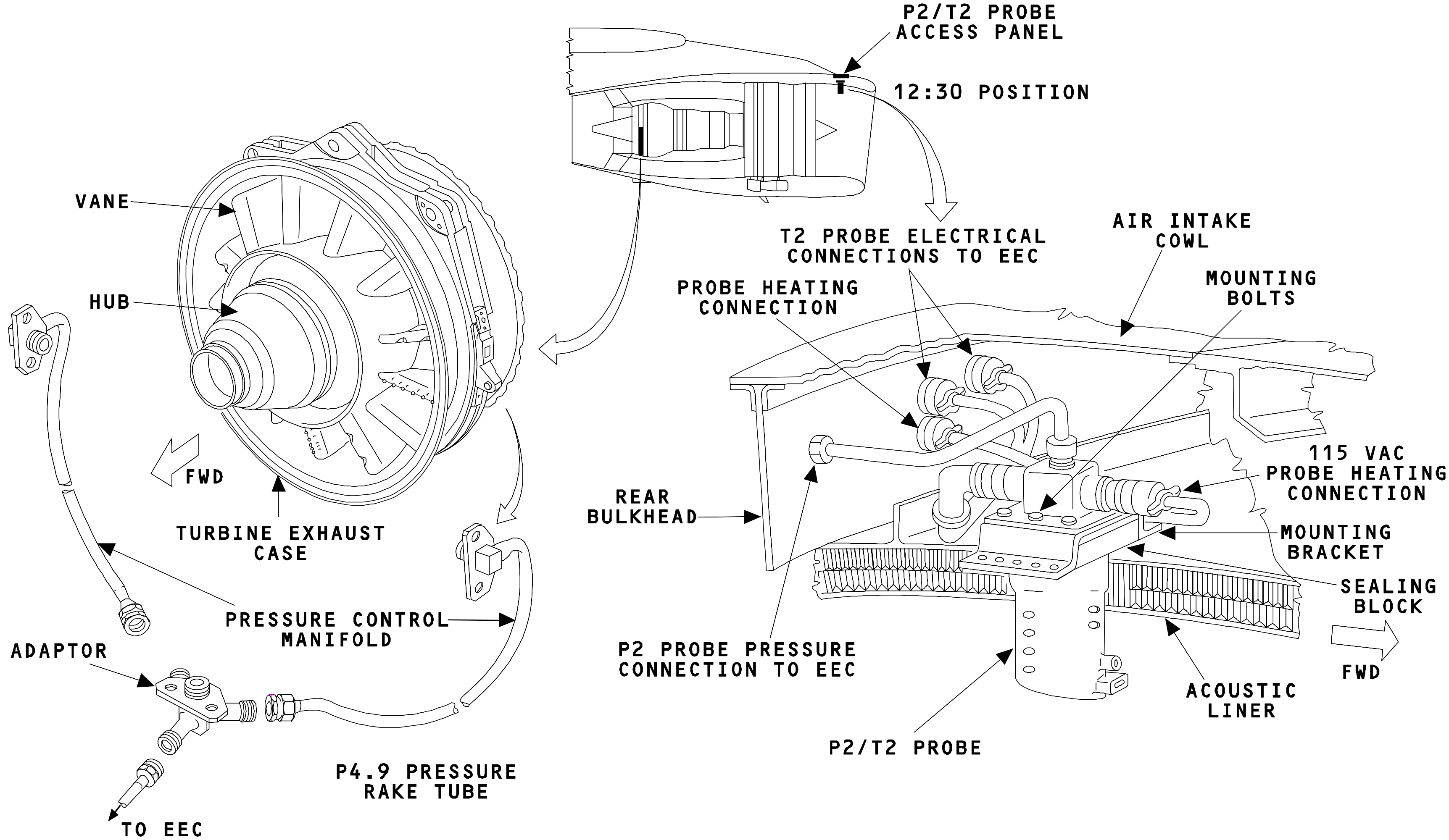
COMPONENT DESCRIPTION

NOTE: In case of loss of P2/T2 heating, an automatic reversion from EPR mode to unrated N1 mode occurs.

P4.9 SENSORS

IDENTIFICATION
FIN: 2004EM1, 2004EM2, 2004EM3

LOCATION
ZONE: 453, 454, 463, 464



UFD4200 TMU77IE02-P03 LEVEL 3

PRIMARY PARAMETERS AND VIBRATION COMPONENTS - EPR

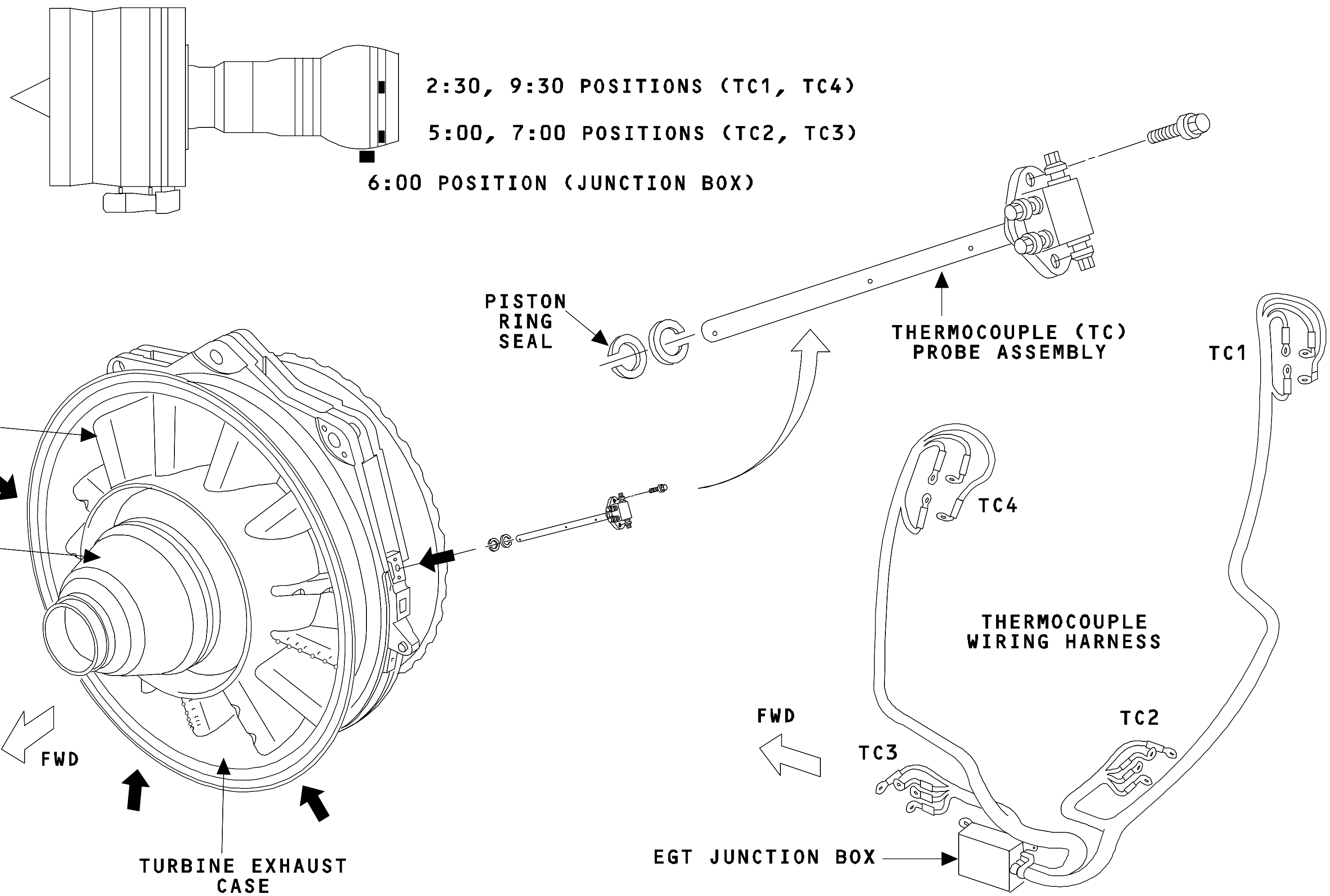
PRIMARY PARAMETERS AND VIBRATION COMPONENTS

EGT THERMOCOUPLES

IDENTIFICATION
FIN: 4012KS1, 4012KS2, 4012KS3, 4012KS4

LOCATION
ZONE: 453, 454, 463, 464

COMPONENT DESCRIPTION
EGT thermocouples with Chromel/Alumel materials.



PRIMARY PARAMETERS AND VIBRATION COMPONENTS - EGT THEMOCOUPLES

PRIMARY PARAMETERS AND VIBRATION COMPONENTS

ENGINE VIBRATION MONITORING UNIT (EVMU)

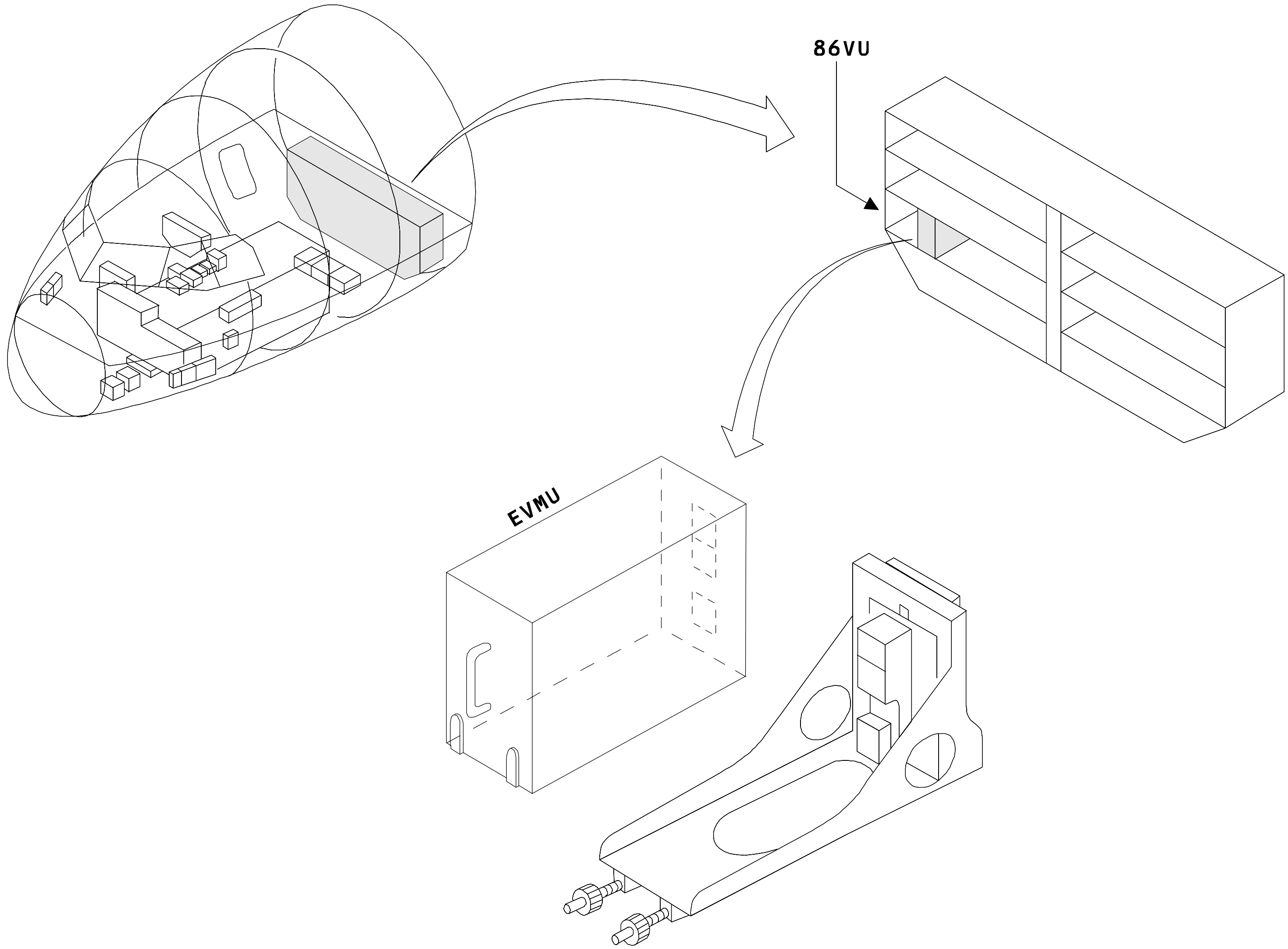
IDENTIFICATION
FIN: 2EV

LOCATION
ZONE: 128

COMPONENT DESCRIPTION
The Engine Vibration Monitoring Unit (EVMU) is located in the avionics compartement shelf 86VU.
The EVMU is composed of:

- 1 power supply module,
- 2 channel modules,
- 1 balancing module,
- 1 data processing module.

These modules are removable parts and are repairable sub-assemblies.



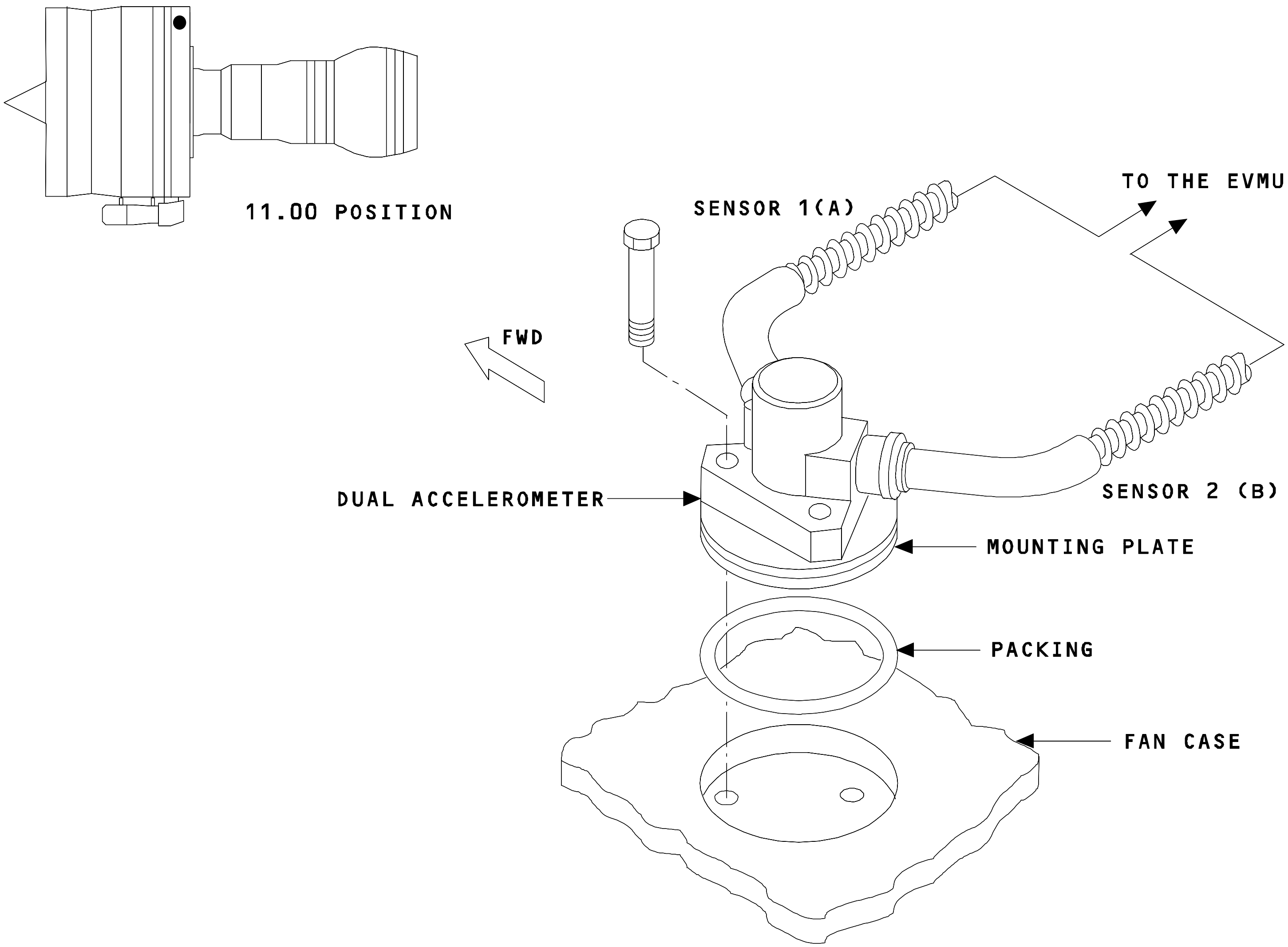
PRIMARY PARAMETERS AND VIBRATION COMPONENTS - ENGINE VIBRAION MONITORING UNIT (EVMU)

PRIMARY PARAMETERS AND VIBRATION COMPONENTS

VIBRATION TRANSDUCER

IDENTIFICATION
FIN: 4004EV1

LOCATION
ZONE: 435, 445



PRIMARY PARAMETERS AND VIBRATION COMPONENTS - VIBRATION TRANSDUCER

UFD4200
TMU77IE02-P06 LEVEL 3

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78 - EXHAUST

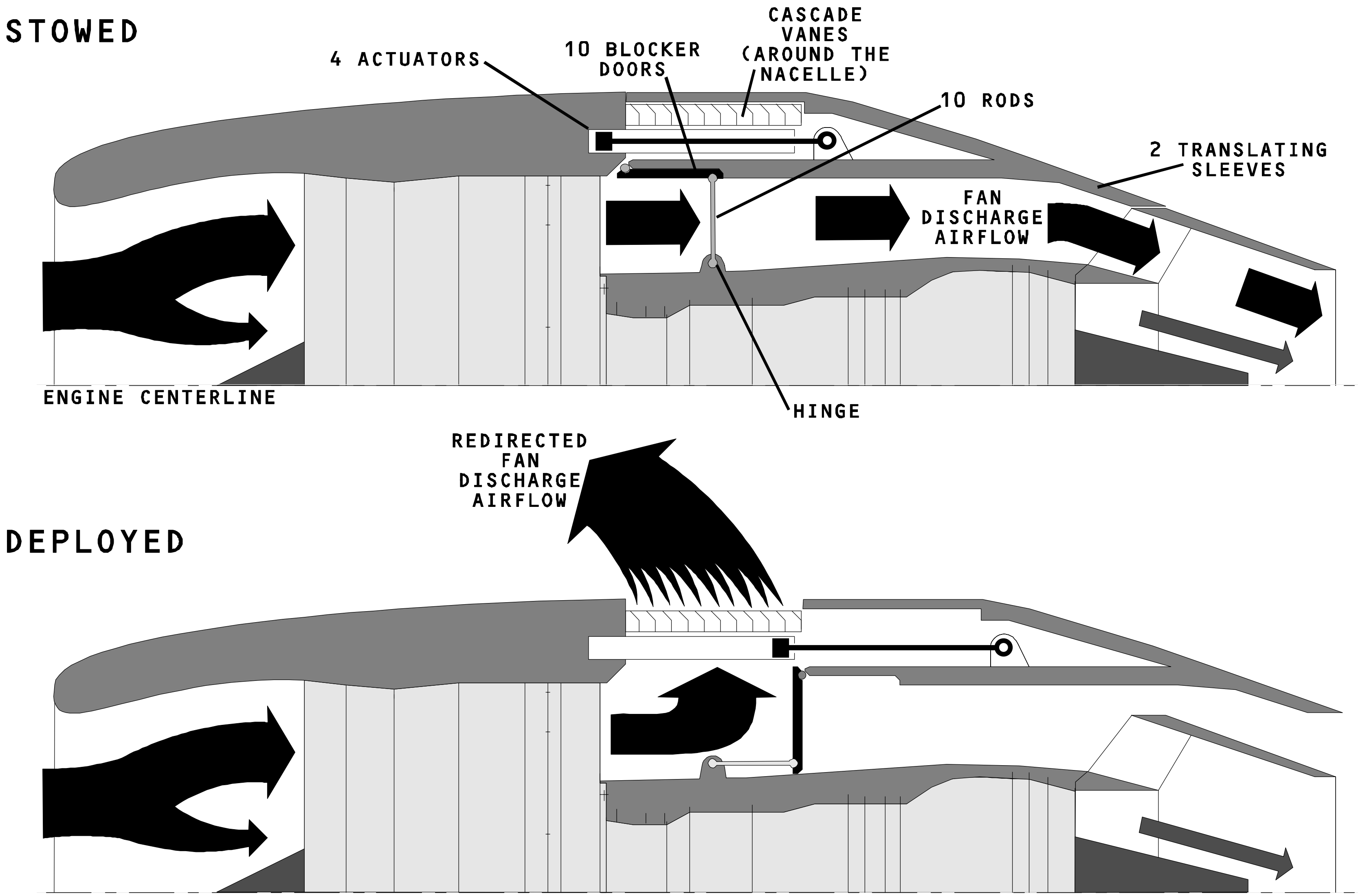
78-30-00 THRUST REVERSER SYSTEM PRESENTATION

CONTENTS:

THRUST REVERSER SYSTEM PRESENTATION

REVERSER DESIGN

The thrust reverser system is of the aerodynamic blockage type.
It consists of two translating sleeves, blocker doors and cascade vanes to redirect fan discharge airflow.
The thrust reverser system is designed for use on the ground only to reduce aircraft landing roll.



THRUST REVERSER SYSTEM PRESENTATION - REVERSER DESIGN

HYDRAULIC SUPPLY

The thrust reverser system is hydraulically actuated utilizing the aircraft hydraulic pressure from the corresponding engine.
The thrust reverser system is isolated from the hydraulic supply by a Shut Off Valve.

ACTUATION

Each translating sleeve is operated by two hydraulic actuators.
The actuators receive fluid from the Hydraulic Control Unit (HCU) which is controlled by the Electronic Engine Control (EEC).

When the deploy sequence is commanded the pressure in the lower actuators releases the locks as the four actuator pistons move rearward to deploy the reverser.
The actuators are linked together by a synchronizing system.

REVERSER CONTROL

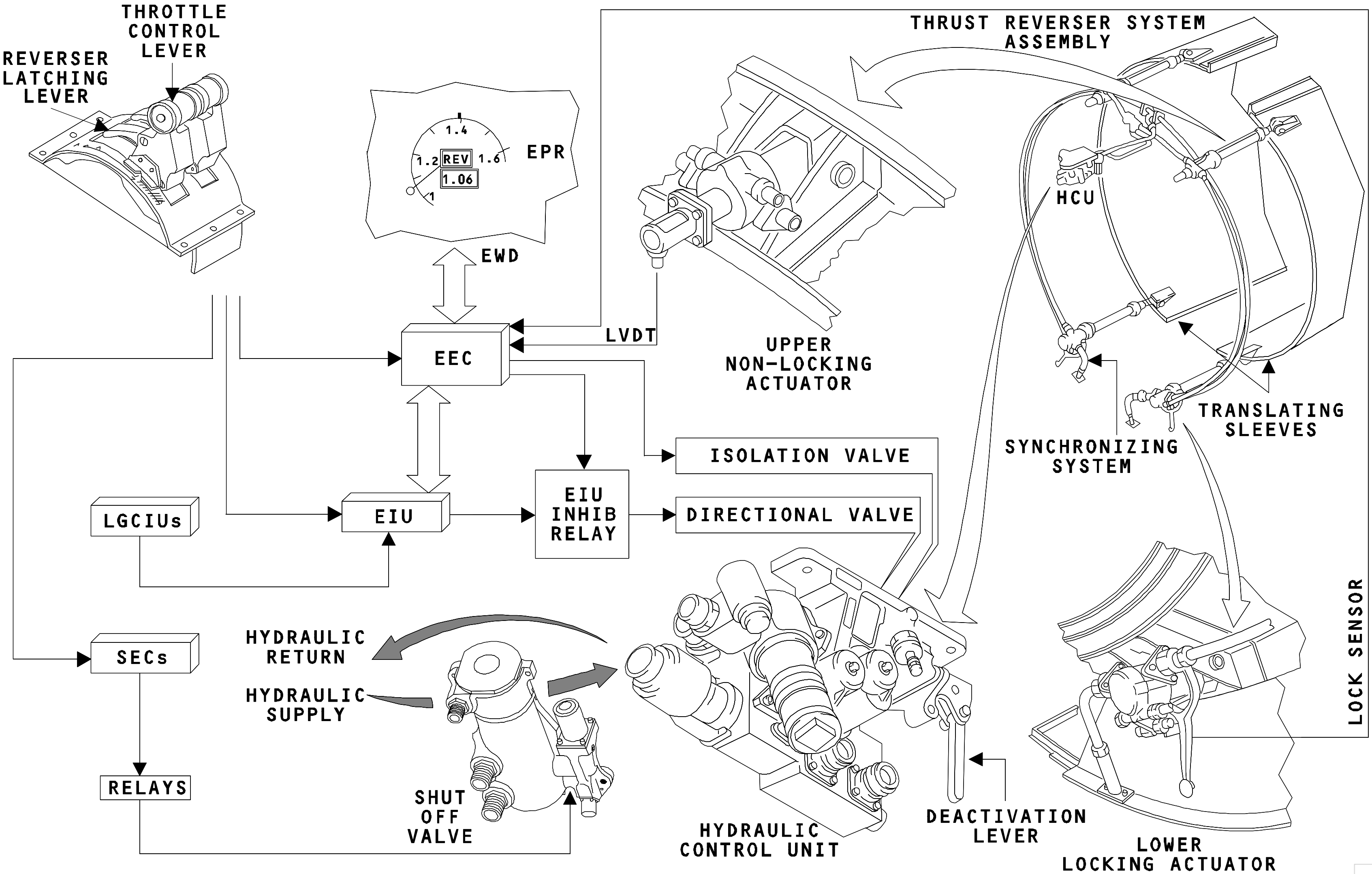
Basically the thrust reverser system is controlled through the EEC from the two reverser latching levers located on the throttle control levers.
The Hydraulic Control Unit has an isolation valve and a directional valve to select deploy or stow mode.
The directional valve is operated to deploy only.

For third defence line purposes, the Spoiler Elevator Computers (SECs) have previously opened the Shut Off Valve and the hydraulic pressure is supplied to the HCU.

Then, the EIU permits reverser deployment by energization of the inhibition relay, so the directional valve can be open by the EEC.
To command the thrust reverser, the EEC needs an "aircraft on ground" signal supplied by the Landing Gear Control and Interface Units (LGCIUs).

REVERSER INDICATING

The actual state of the thrust reverser is shown on the upper ECAM (REV indication appears in the middle of the EPR dial).
The signals come from the lock sensor and the Linear Variable Differential Transducer (LVDT).



THRUST REVERSER SYSTEM PRESENTATION

UFD4200
TMU78IA03-P02 LEVEL 1

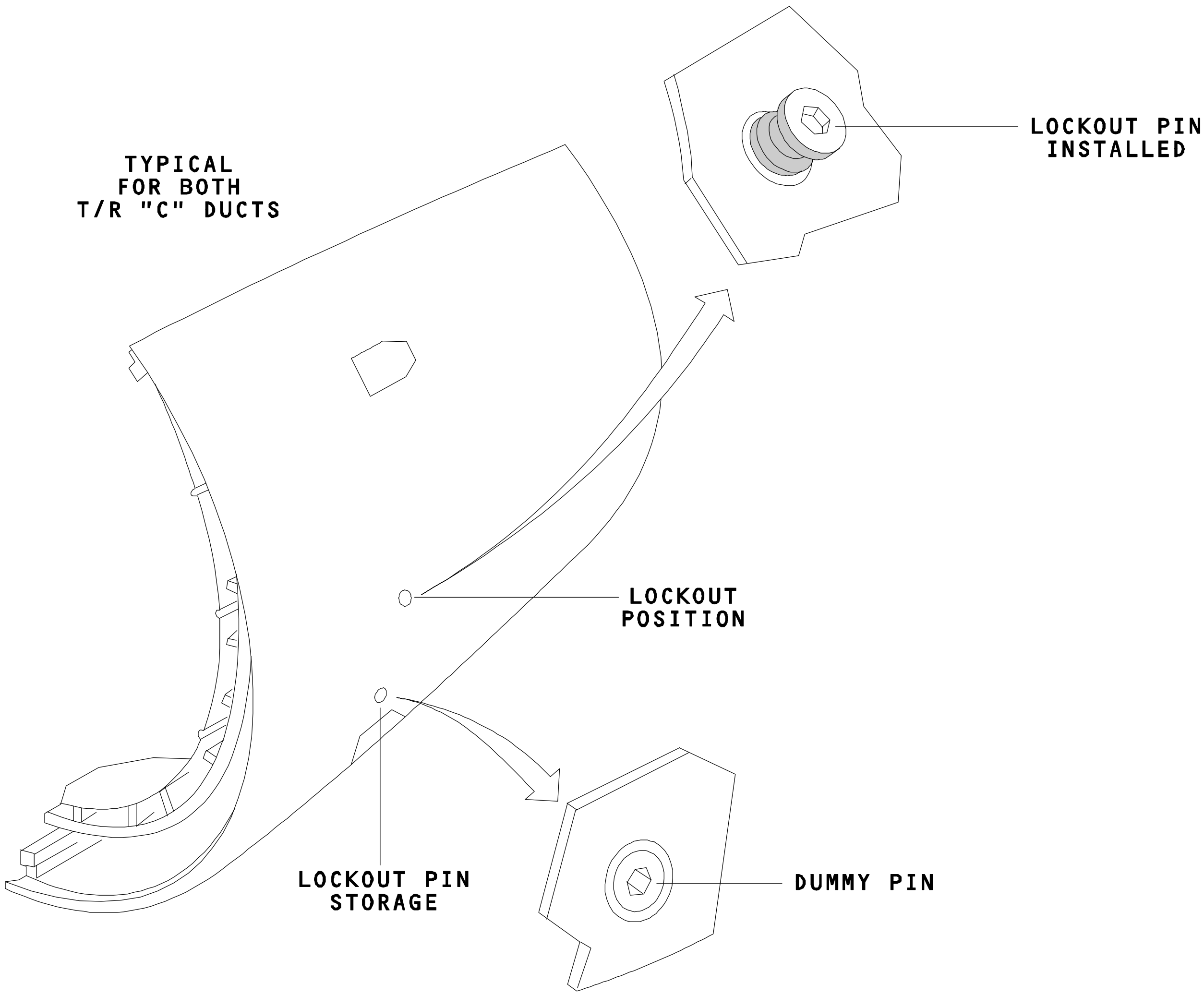
THRUST REVERSER SYSTEM PRESENTATION

MAINTENANCE PRACTICES

To help trouble shooting, a reverser test can be performed through the MCDU.
For maintenance purposes or to increase aircraft dispatch, the Hydraulic Control Unit is fitted with a manual deactivation lever to inhibit the thrust reverser system.

In case of a thrust reverser inoperative, lockout pins stored on the translating sleeves have to be installed to complete the deactivation procedure.

WARNING:
The thrust reverser system should be inhibited using the HCU deactivation lever before working on the system or on the engine.
The system must be deactivated in order to prevent the thrust reverser from operating accidentally and cause serious injuries to personnel and/or damage to the reverser.



THRUST REVERSER SYSTEM PRESENTATION

SELF EXAMINATION

When is it possible to operate the thrust reverser system?

A - On ground only,
B - On ground and in flight,
C - In flight only.

How is the thrust reverser actuated?

A - Electrically,
B - Hydraulically,
C - Pneumatically.

How is the directional valve controlled?

A - Directly by the reverser lever,
B - By the reverser lever through the EEC and EIU,
C - By the reverser lever through the EEC.

78 - EXHAUST - THRUST REVERSER

78-30-00 THRUST REVERSER MANAGEMENT

CONTENTS:

THRUST REVERSER MANAGEMENT

GENERAL

The thrust reverser system is controlled independently for each engine by the associated FADEC system.

THRUST REVERSER ACTUATION

The hydraulic power required for the actuators is supplied by the normal aircraft hydraulic system:
- green system for engine 1
- yellow system for engine 2.

A Shut Off Valve (SOV) located upstream of the Hydraulic Control Unit (HCU) achieves an independent locking system.

Each channel of the EEC controls and monitors solenoid valves included in the HCU which provides the deployment and stowage of two translating sleeves.

Internal locks in the lower actuators are hydraulically operated. The operation of the actuators is synchronised by flexible drive shafts inside the deploy hydraulic lines (synchronizing system).

The HCU includes an isolation valve, a pressure switch and a directional valve which is controlled through the inhibition relay.

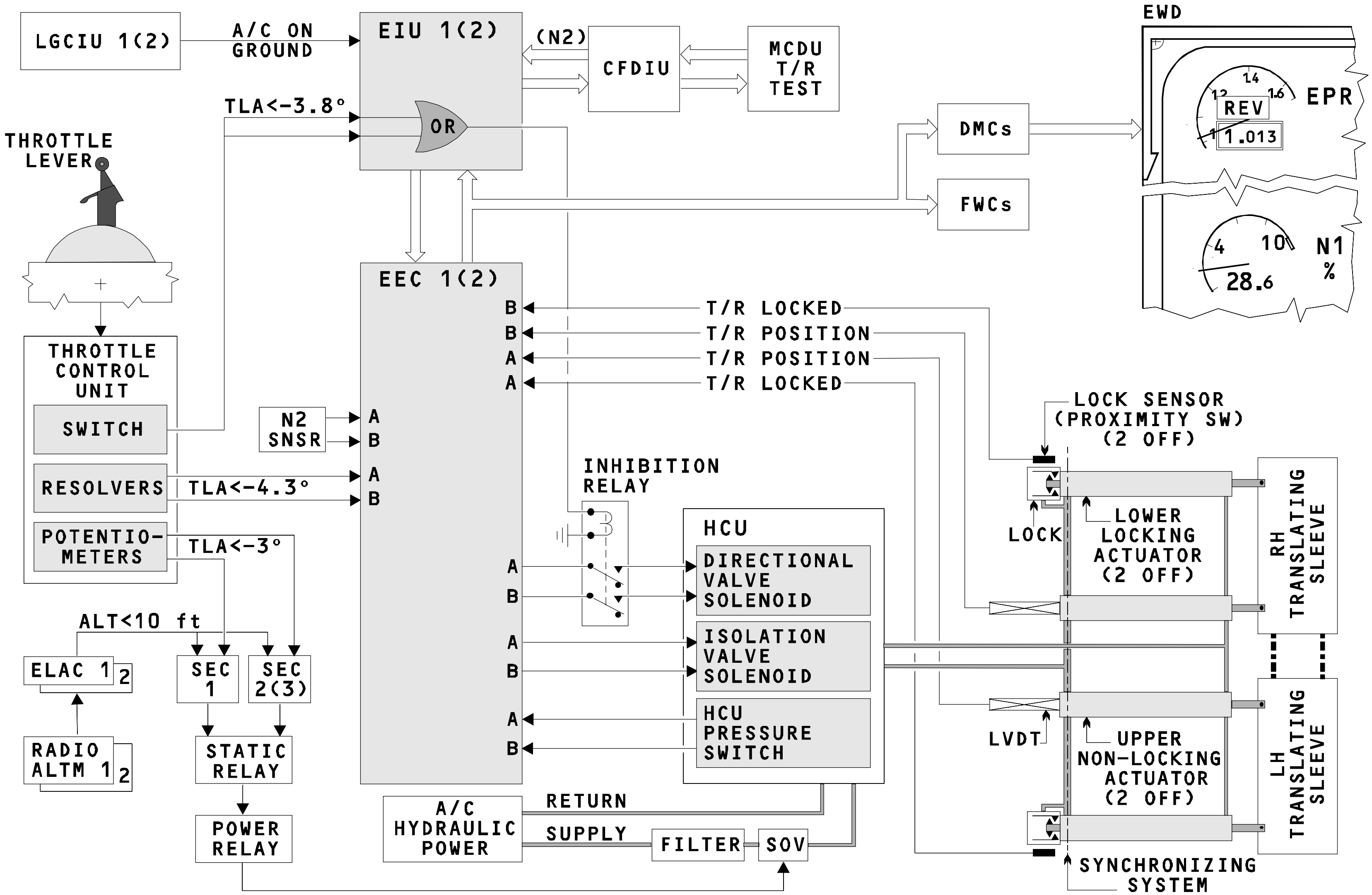
THRUST REVERSER CONTROL

When the reverse thrust is selected in the cockpit, the following sequence occurs :

- When the potentiometers detect a Throttle Lever Angle (TLA) lower than -3°, the SOV opens if the altitude is less than 10 feet and if high forward thrust (TLA <30°) is not selected on opposite engine. Then the HCU is supplied hydraulically.
The SOV is controlled energized open by the Spoiler Elevator Computers (SECs) through the static and power relays.

- When the switch of the throttle control unit detects a TLA lower than -3.8°, the EIU energizes the inhibition relay.

- When the aircraft is on ground with engine running (N2 condition) and the resolvers detecting a TLA lower than -4.3° the EEC controls the thrust reverser operation through the HCU.
The lock sensors and the Linear Variable Differential Transducers (LVDTs) are used to monitor the thrust reverser position and for EEC control.



THRUST REVERSER MANAGEMENT

UFD4200
TMU78IC03-P01 LEVEL 3

THRUST REVERSER MANAGEMENT

THRUST REVERSER INDICATION

The thrust reverser operating sequences are displayed in the cockpit on the Engine/ Warning Display (EWD).

An amber REVerse indication appears when the translating sleeves are in transit and then becomes green when the sleeves are deployed.
The reverse thrust is monitored through N1 indication dial.

CFDS INTERFACE

The Centralized Fault Display System (CFDS) interfaces with the EIU to provide thrust reverser fault diagnostics.

For maintenance purposes, a thrust reverser test can be performed through the MCDU menus.
In this case the Centralized Fault Display Unit (CFDIU) simulates an engine running (N2 condition) to permit the thrust reverser deployment.

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SELF EXAMINATION

What is the logic of the reverse operation?

A - TLA position and aircraft on ground only.
B - TLA position, aircraft on ground and Reverse indication green.
C - TLA position, aircraft on ground, engine running (N2 condition) and both SECs and EIU signals.

Reverser system actuation is provided by two solenoid valves which are energized by the:

A - Electronic Engine Control (EEC).
B - Engine Interface Unit (EIU).
C - Throttle Control Unit.

What does the CFDIU simulate during the MCDU reverse test?

A - The TLA.
B - The ground logic.
C - The N2 condition.

78 - EXHAUST - THRUST REVERSER

78-30-00 THRUST REVERSER SYSTEM D/O

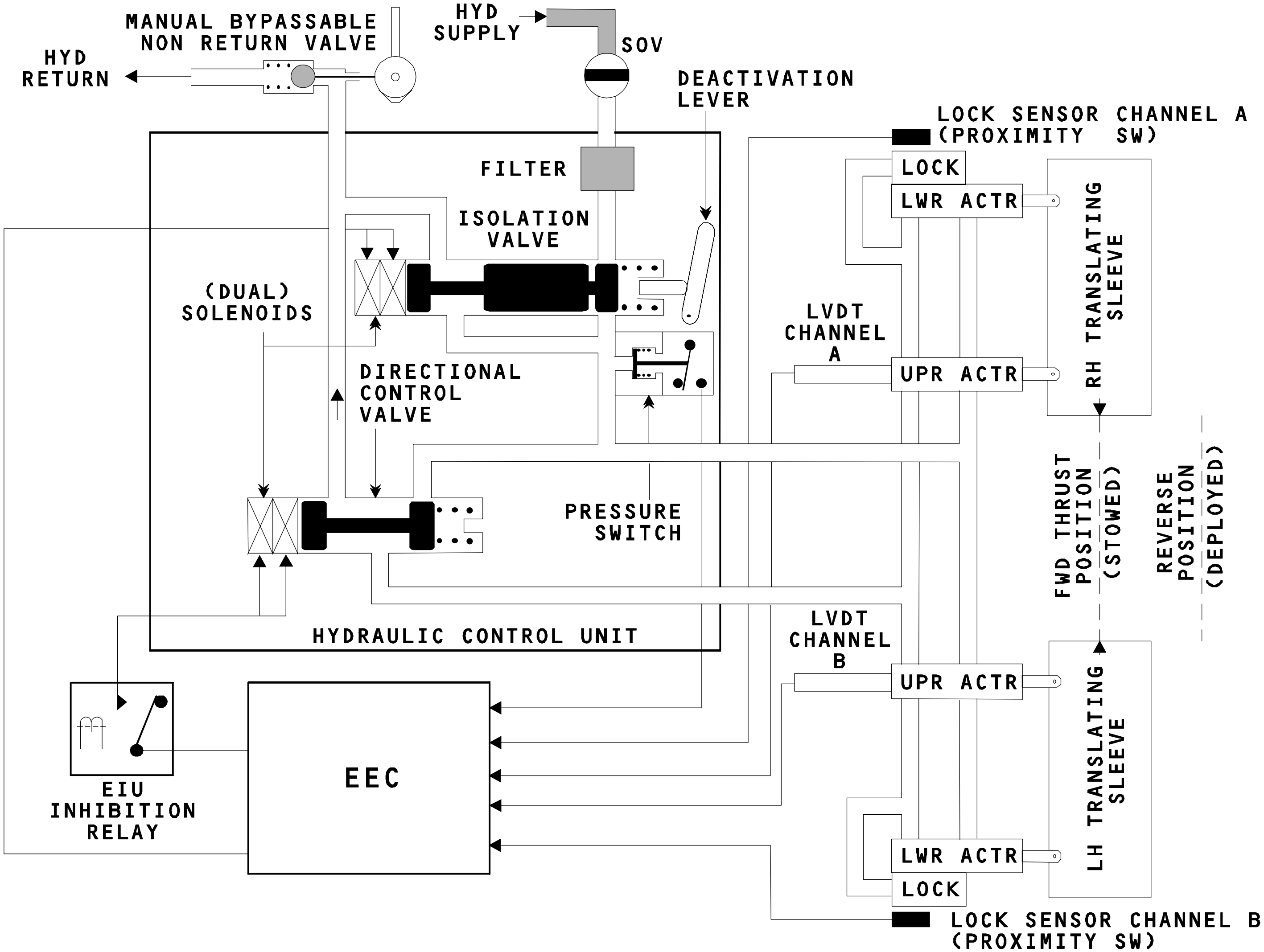
CONTENTS:

THRUST REVERSER SYSTEM D/O

INITIAL CONDITIONS

Hydraulic pressure is available upstream of the Shut Off Valve (SOV) to isolate the Hydraulic Control Unit. Inside the Hydraulic Control Unit, the isolation valve is in the closed position. The control solenoids are de-energized.
The directional control valve is in the "stow" position. The control solenoids are de-energized.
The thrust reverser is maintained in the forward thrust position by mechanical locks which are an integral part of the lower actuators.
The actuators are not yet pressurized.
Hydraulic supply:

- yellow system for ENG 2
- green system for ENG 1.



THRUST REVERSER SYSTEM D/O - INITIAL CONDITIONS

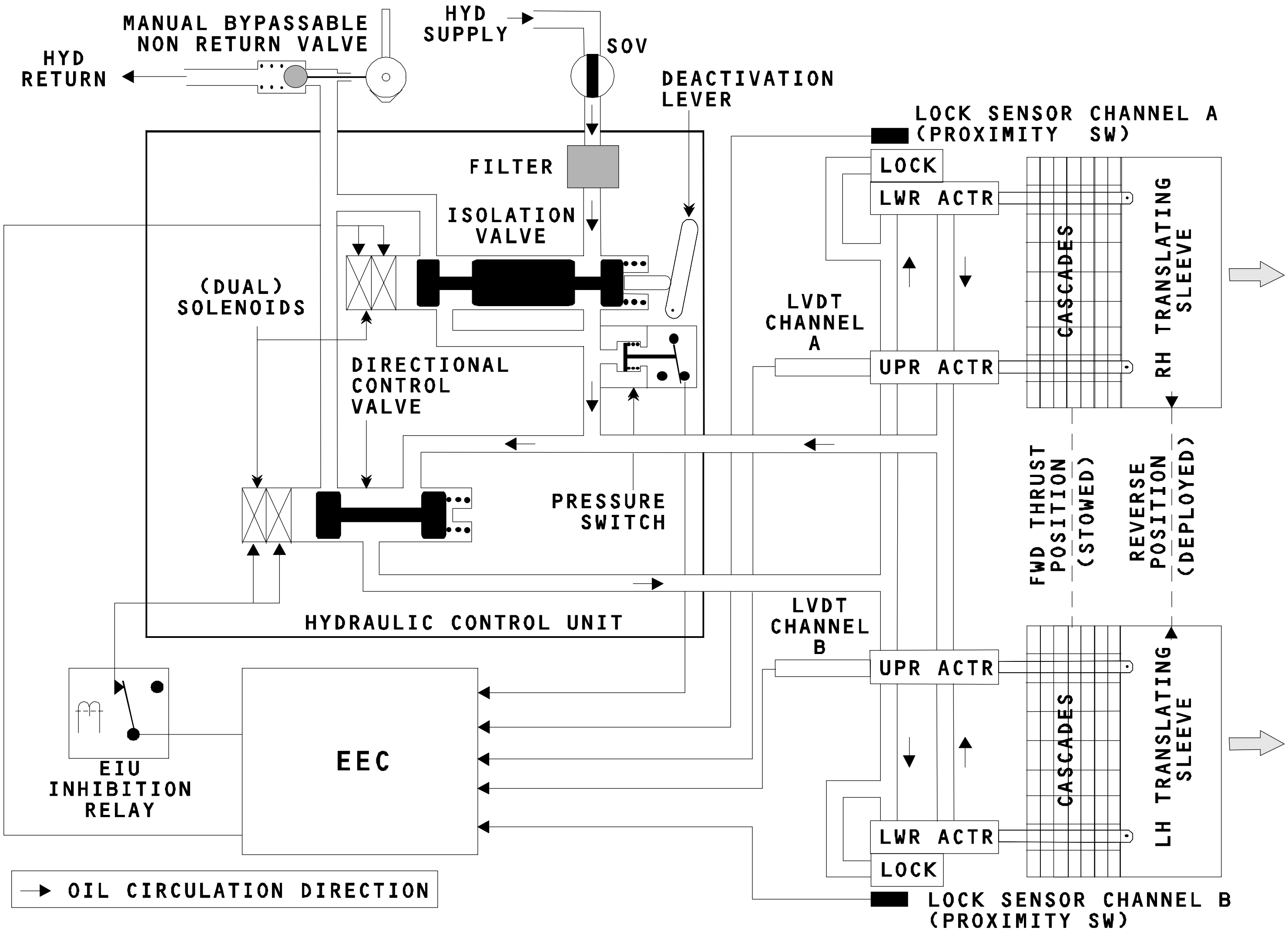
UFD4200
TMU78IB03-P01 LEVEL 3

THRUST REVERSER SYSTEM D/O

DEPLOY SEQUENCE

The selection of reverse thrust will provide signals to open the SOV independently following the third defence line logic and through the EEC, to energize the isolation valve so that it moves to the open position.
The EEC then energizes the directional valve through the inhibition relay so that it moves to the deploy position.
The pressure switch provides signals to the EEC to indicate that the hydraulic pressure downstream of the isolation valve is sufficient.
Hydraulic pressure is then applied on both sides of the actuators but, due to differential piston areas, the actuators will extend to move the translating sleeves to the deploy position.
Tine locks within the lower actuators are hydraulically released before translating sleeve movement occurs.

NOTE: The signal from the EEC to the directional control valve is routed via an inhibition relay which is closed by the Engine Interface Unit (EIU).



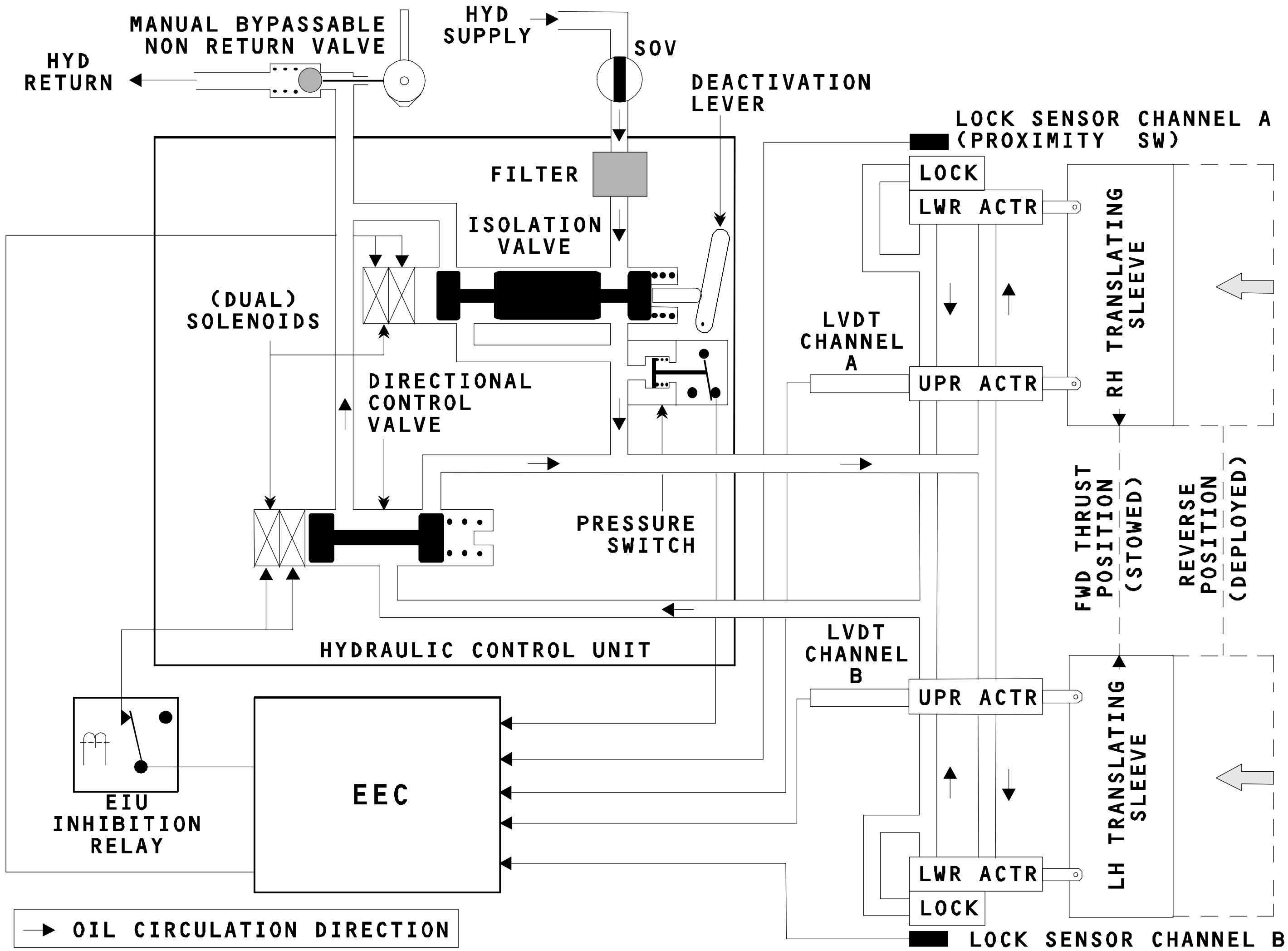
THRUST REVERSER SYSTEM D/O - DEPLOY SEQUENCE

UFD4200
TMU78IB03-P02 LEVEL 3

THRUST REVERSER SYSTEM D/O

STOW SEQUENCE

Selection of forward thrust will de-energize the directional control valve, through the EEC, to allow the valve to move to the stow position.
The isolation valve remains energized providing hydraulic pressure to the stow side of the actuators.
The extend side of the actuators is opened via the directional control valve to the hydraulic return.
The EEC will de-energize the isolation valve 5 seconds after the translating sleeves reach the fully stowed position to ensure full lock engagement.
Then the SOV is independently closed following the third defence line logic.



THRUST REVERSER SYSTEM D/O - STOW SEQUENCE

UFD4200

TMU78IB03-P03 LEVEL 3

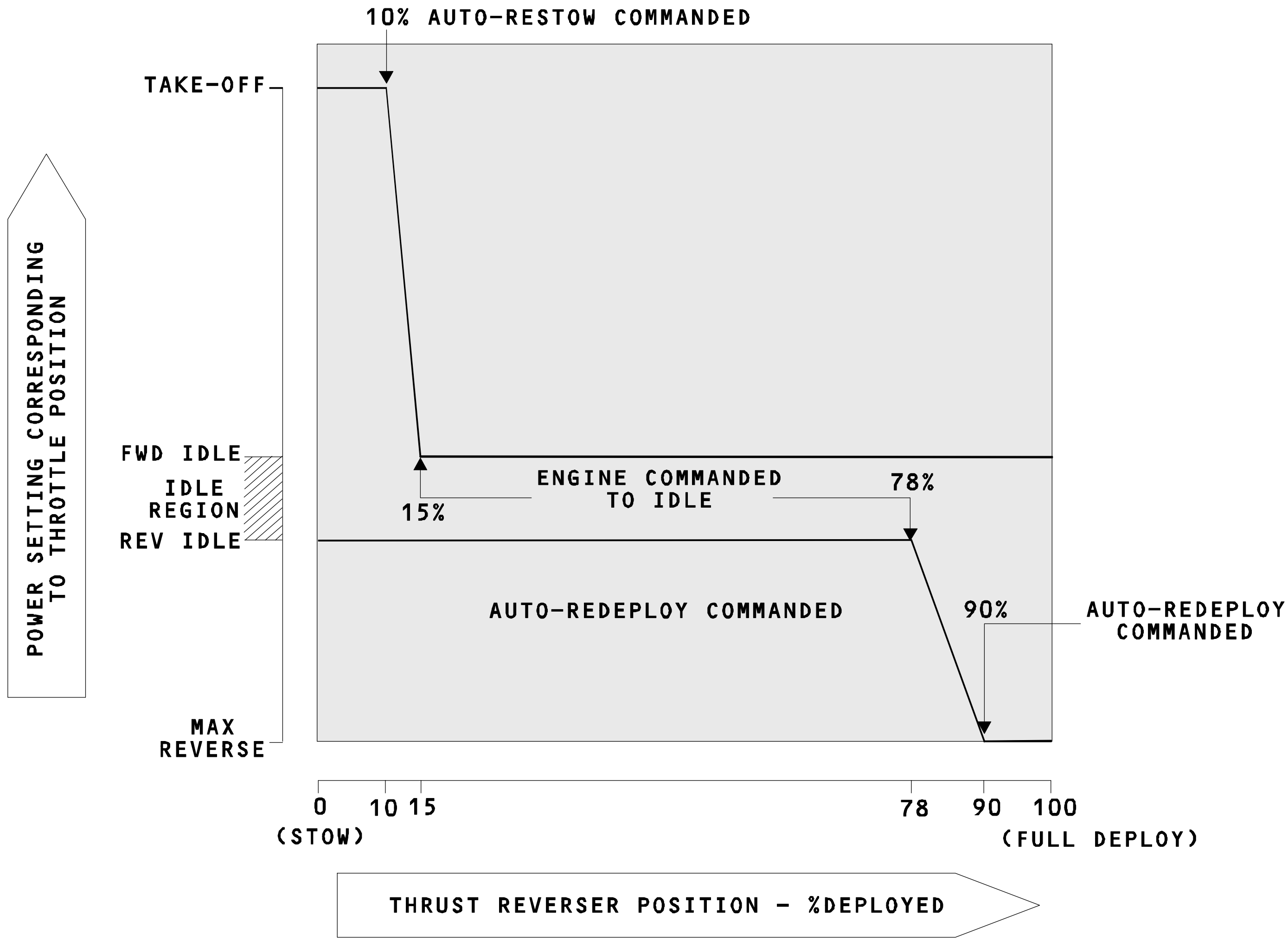
THRUST REVERSER SYSTEM D/O

COMMAND LIMITATION

If the LVDTs sense an uncommanded movement of the thrust reverser from the stowed or deployed position, the EEC commands an automatic stowage or deployment.

AUTO-RESTOW
In forward thrust, if the EEC detects any uncommanded movement greater than 10% from stow, it commands an auto-restow of the thrust reverser.
Following auto-restow, the isolation valve in the HCU remains energized for the rest of the flight.
In forward thrust, if the EEC detects any uncommanded movement greater than 15% from stow, it commands engine idle power.

AUTO-REDEPLOY
In reverse thrust, if the EEC detects any uncommanded movement greater than 10% from full deploy, it commands an auto-redeploy of the thrust reverser.
When auto-redeploy is initiated to counteract inadvertant stow, the EEC will command the isolation valve to close and maintain it closed until forward thrust has been reselected.
The air aerodynamic load on the translating sleeves will normally be sufficient to redeploy the thrust reverser.
In reverse thrust, if the EEC detects any uncommanded movement greater than 22% from full deploy, it commands engine idle power.



THRUST REVERSER SYSTEM D/O - COMMAND LIMITATION

UFD4200
TMU78IB03-P04 LEVEL 3

SELF-EXAMINATION

What is the position and power state of the directional control valve for normal flight?

A - Stow position - solenoid energized.
B - Stow position - solenoid de-energized.
C - Neutral position - solenoid de-energized.

How is the thrust reverser movement sensed?

A - By the hydraulic pressure switch.
B - By proximity switches.
C - By LVDTs on the upper actuators.

What is the purpose of the auto-restow system?

A - To restow the thrust reverser immediately after detection of any uncommanded movement.
B - To restow the thrust reverser after detection of any uncommanded movement of at least 10% of travel.
C - To automatically restow the thrust reverser on cancellation of a deploy command.

78 - EXHAUST - THRUST REVERSER

78-30-00 THRUST REVERSER COMPONENTS

CONTENTS:

THRUST REVERSER COMPONENTS

SAFETY PRECAUTIONS

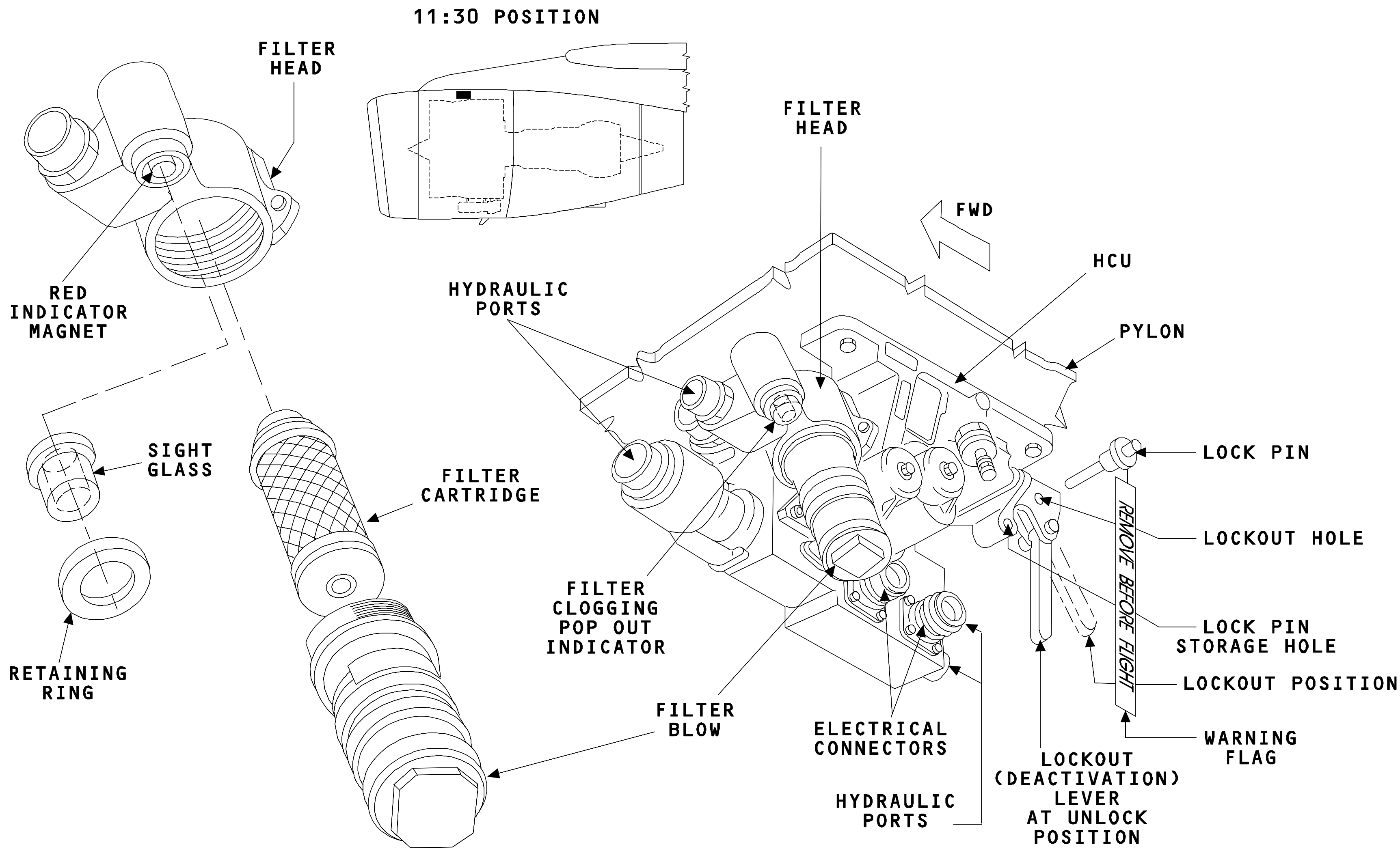
WARNING
Before working on the thrust reverser the system should be deactivated using the lockout (deactivation) lever of the Hydraulic Control Unit .

CAUTION
If not, the thrust reverser can accidentally operate and cause serious injuries to personnel and/or damage to the reverser.
In the cockpit, make sure that the thrust levers are in the idle position and place a warning notice stating not to select reverse.

HYDRAULIC CONTROL UNIT (HCU)

IDENTIFICATION
FIN: 4101KS1, 4101KS2

LOCATION
ZONE: 435, 445



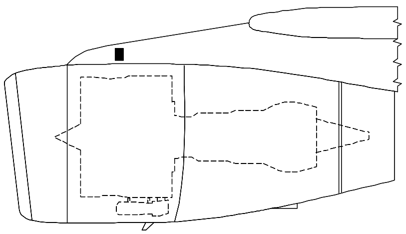
THRUST REVERSER COMPONENTS - HYDRAULIC CONTROL UNIT (HCU)

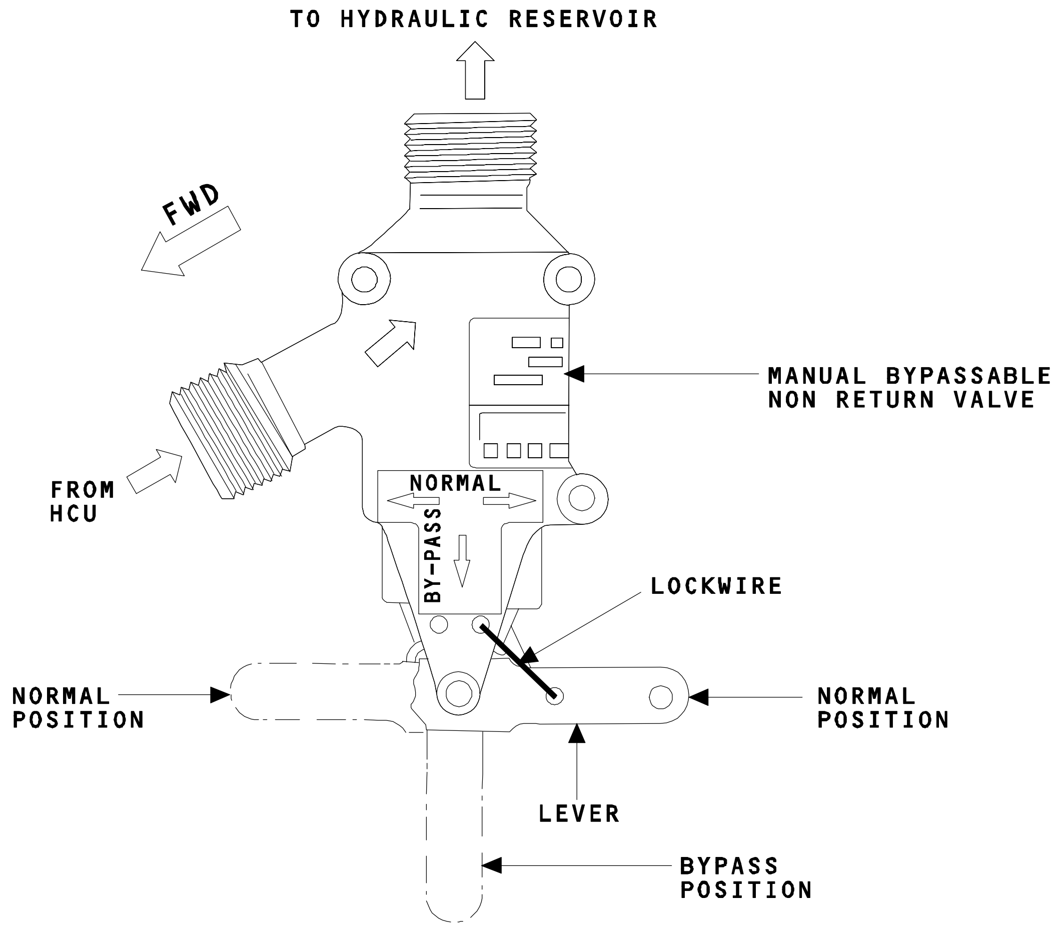
THRUST REVERSER COMPONENTS

MANUAL BYPASSABLE NON RETURN VALVE

IDENTIFICATION
FIN:

LOCATION
ZONE: 415, 425





UFD4200

TMU78ID03-P02 LEVEL 3

THRUST REVERSER COMPONENTS - MANUAL BYPASSABLE NON RETURN VALVE

THRUST REVERSER COMPONENTS

UPPER ACTUATOR

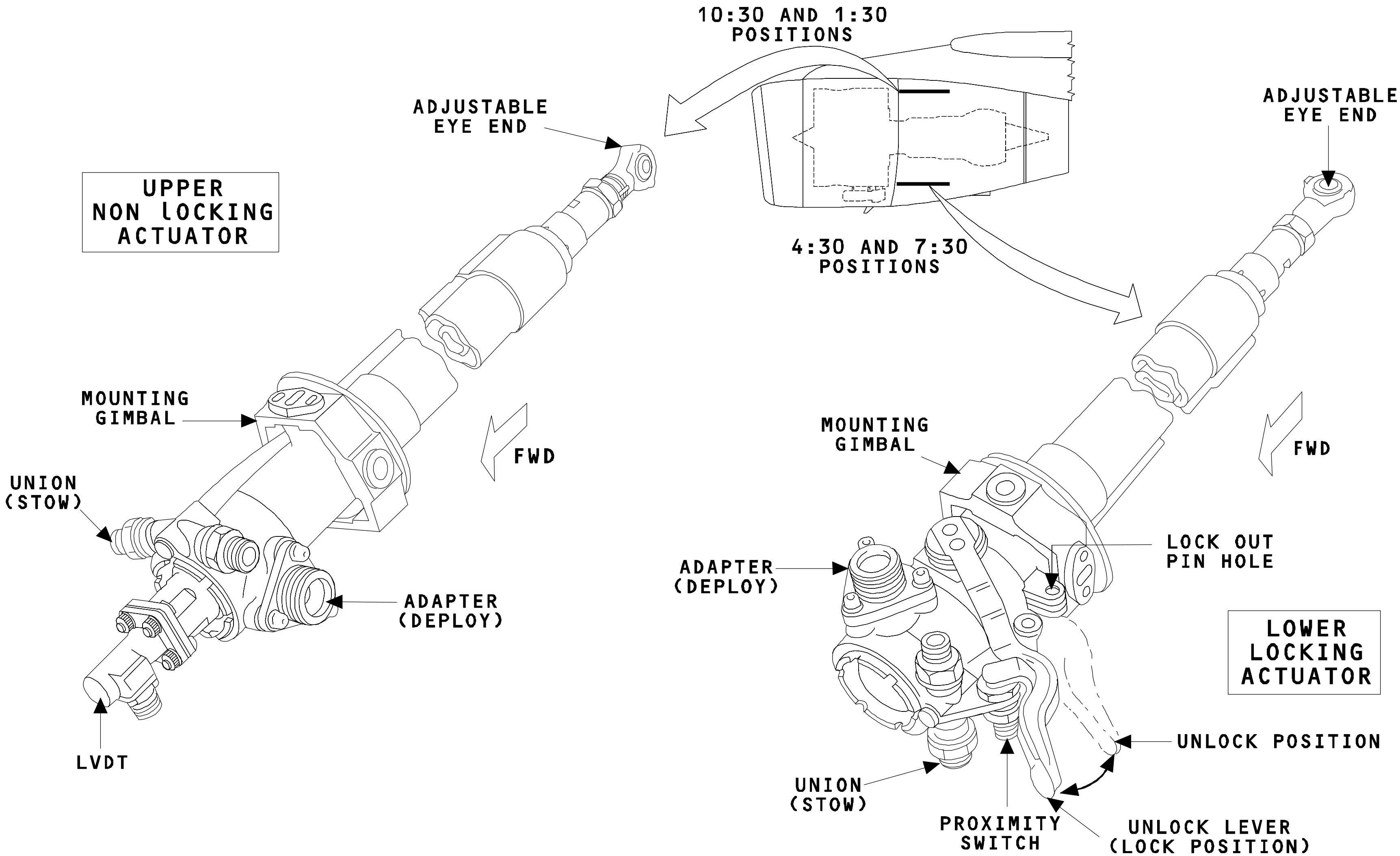
IDENTIFICATION
FIN: 3001KM1, 3001KM4

LOCATION
ZONE: 453, 454, 463, 464

LOWER ACTUATOR

IDENTIFICATION
FIN: 3001KM2, 3001KM3

LOCATION
ZONE: 453, 454, 463, 464



UFD4200

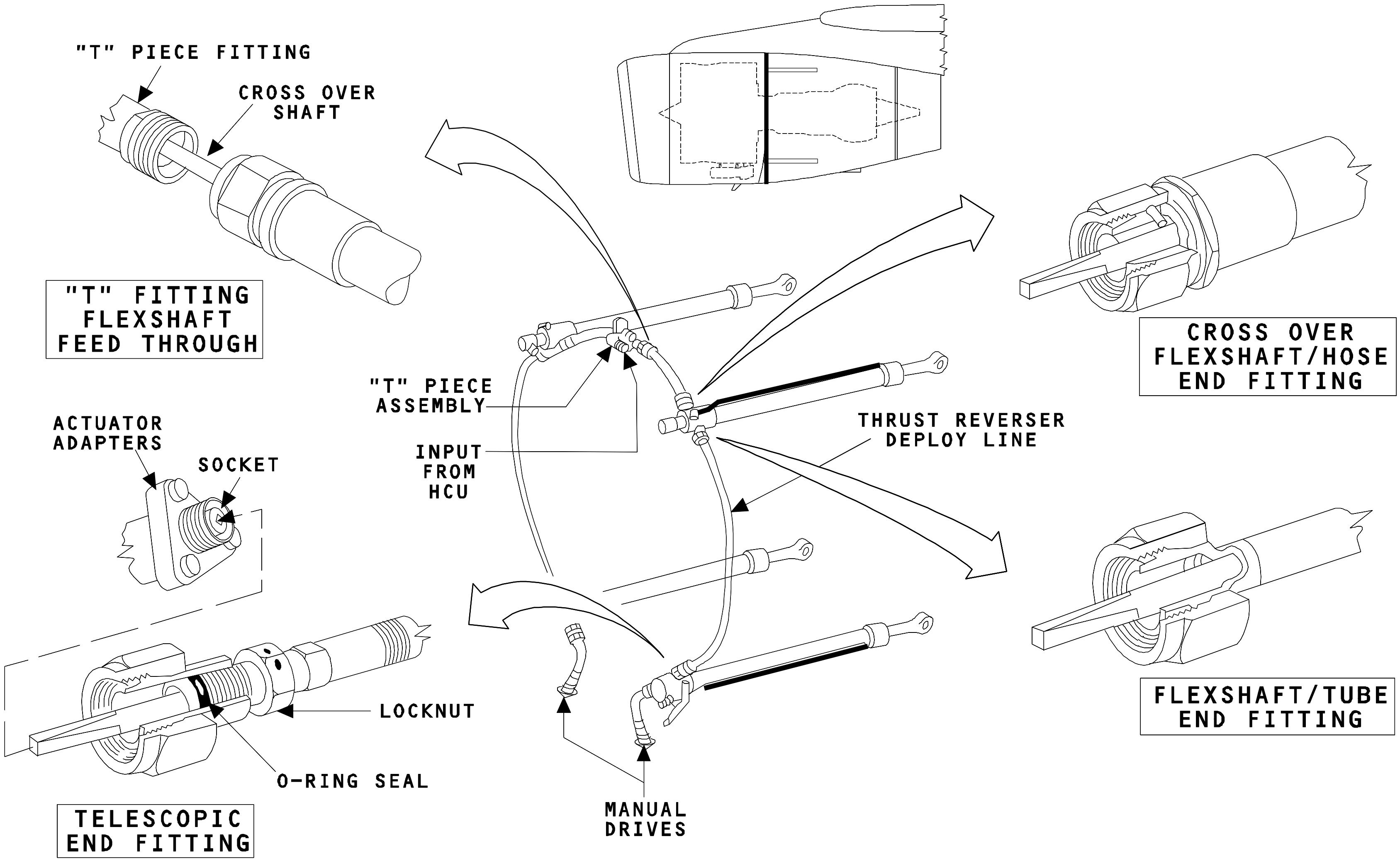
TMU78ID03-P03 LEVEL 3

THRUST REVERSER COMPONENTS - UPPER ACTUATOR / LOWER ACTUATOR

THRUST REVERSER COMPONENTS

SYNCHRONIZING SYSTEM

NOTE: The hoses and the tubes of the T/R deploy line are used both for hydraulic ducting and flexible shaft housing.



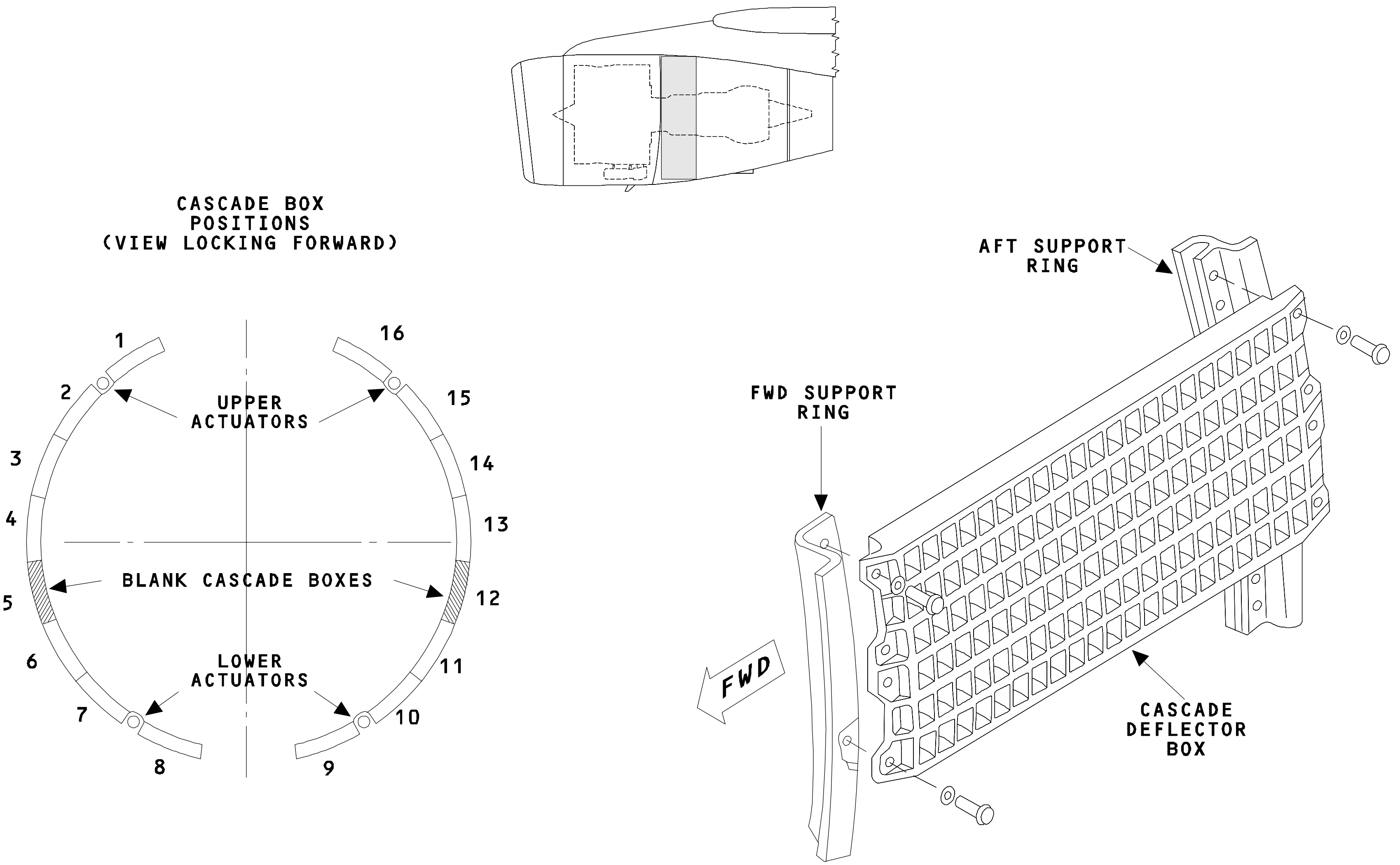
UFD4200

TMU78ID03-P04 LEVEL 3

THRUST REVERSER COMPONENTS - SYNCHRONIZING SYSTEM

THRUST REVERSER COMPONENTS

CASCADES



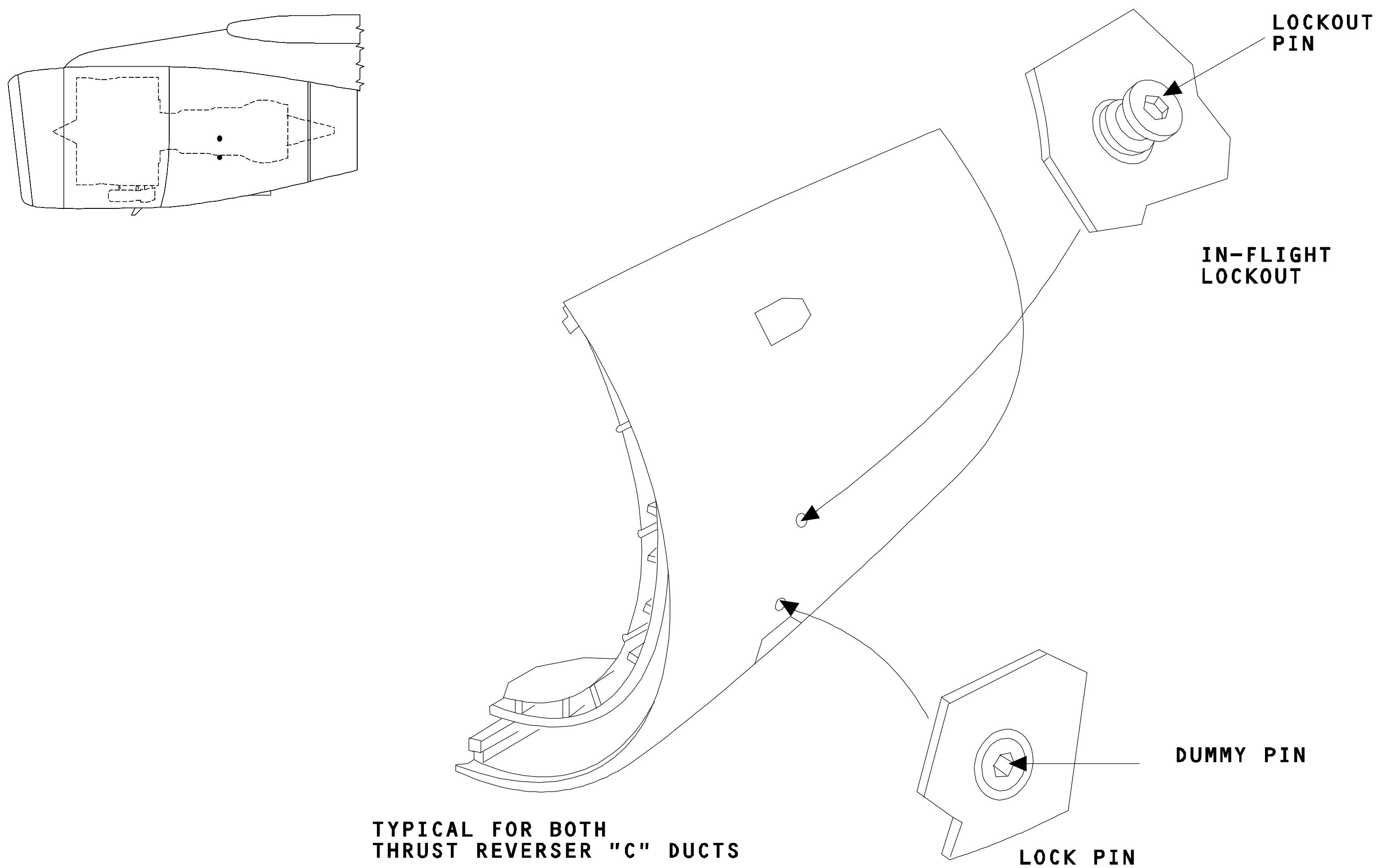
THRUST REVERSER COMPONENTS - CASCADES

UFD4200
TMU78ID03-P05 LEVEL 3

THRUST REVERSER COMPONENTS

LOCKOUT PINS

REMARK: One thrust reverser system may be inoperative provided the inoperative reverser is deactivated and secured (locked-out) in the stowed position, and no operations or procedures requiring their use are to be performed.



THRUST REVERSER COMPONENTS - LOCKOUT PINS

UFD4200
TMU78ID03-P06 LEVEL 3

THRUST REVERSER COMPONENTS

SHUT OFF VALVE

IDENTIFICATION
FIN: 50EG1, 50EG2

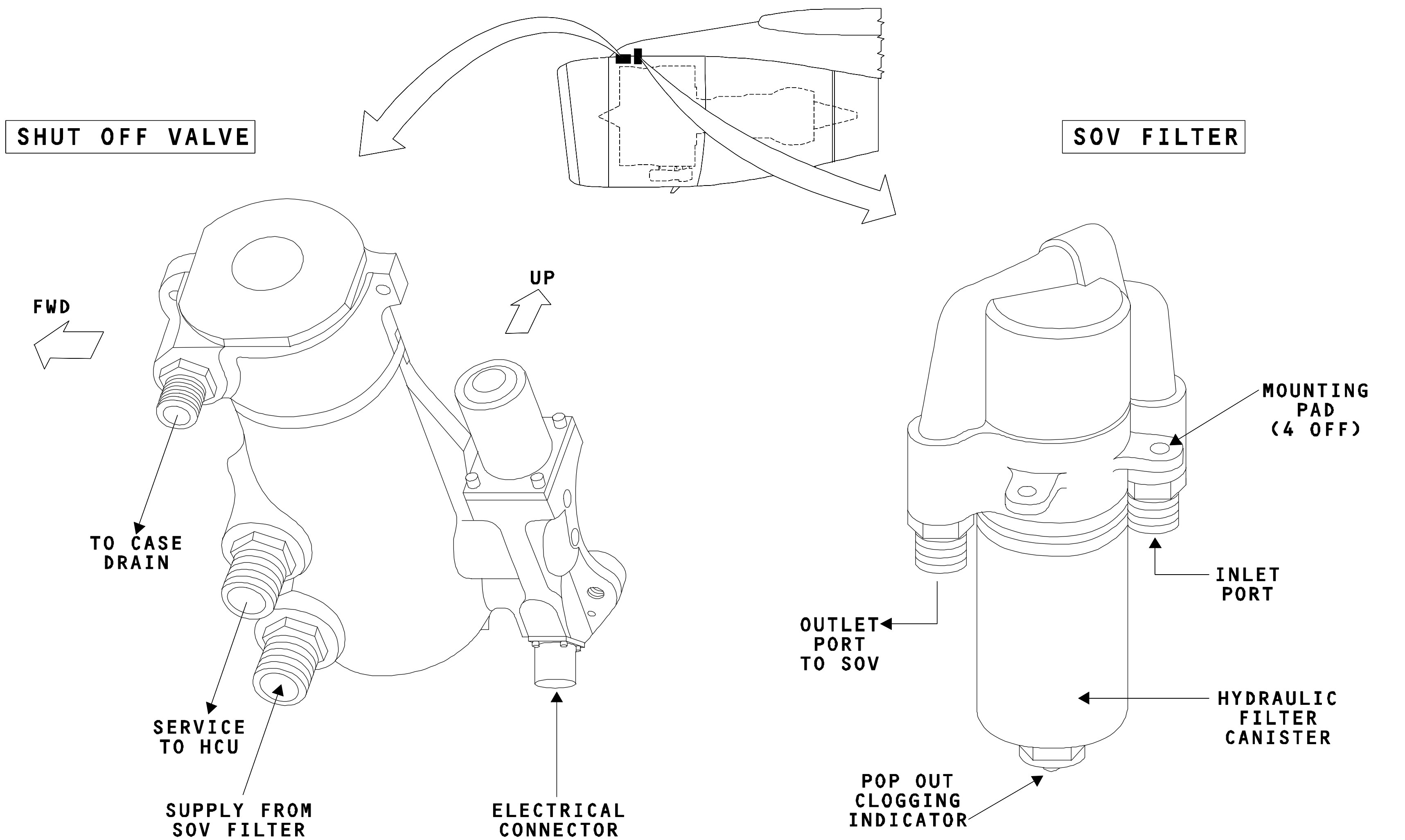
LOCATION
ZONE: 410, 420

SOV FILTER

IDENTIFICATION
FIN: 3455KM1, 3455KM2

LOCATION
ZONE: 410, 420

COMPONENT DESCRIPTION
The SOV filter assembly is fitted under the pylon floor. It contains a check valve to permit the removal of the canister and the change of filter element with a minimum of spillage.



THRUST REVERSER COMPONENTS - SHUT OFF VALVE - SOV FILTER

UFD4200
TMU78ID03-P07 LEVEL 3

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79 - OIL

79-00-00 OIL SYSTEM D/O

CONTENTS:

ENGINE OIL SYSTEM D/O

GENERAL

The engine oil system includes 3 circuits :
- a supply circuit,
- a scavenge circuit,
- a vent circuit.

The oil system lubricates and cools the bearings in the 3 bearing compartments. It also lubricates bearings and gears in the Angle Gearbox and Main Gearbox.
Oil cooling is controlled by a dedicated Heat Management System (HMS) which ensures that engine oil, IDG oil and fuel temperatures are maintained within limits.
The oil system is a dry sump full flow type system.
The single pressure pump is independent of the 6 scavenge pumps (standard gear type).
They are mounted on the Main Gear Box.
The major components of the oil system are : oil tank, pressure and scavenge pumps, Fuel Cooled Oil Cooler (FCOC) and Air Cooled Oil Cooler (ACOC).
Other components are a pressure filter included in the pressure pump, a scavenge filter, a de-oiler, a scavenge valve, chip detectors and sensors.

OIL SUPPLY CIRCUIT

The oil from the tank passes through the pressure pump and pressure filter to lubricate the bearing compartments and also the gearboxes.
Between the supply line and the N°4 BRG scavenge line, an oil low pressure switch and an oil pressure transmitter are provided for indication and monitoring. The oil tank content is measured through an oil quantity transmitter.

Note the installation of an oil temperature sensor for the Heat Management System (HMS).
There is no pressure regulator, so the oil pressure varies with N2. A pressure relief valve is provided to limit the pressure during cold starts.
The cold start pressure relief valve opens at 450 PSI.

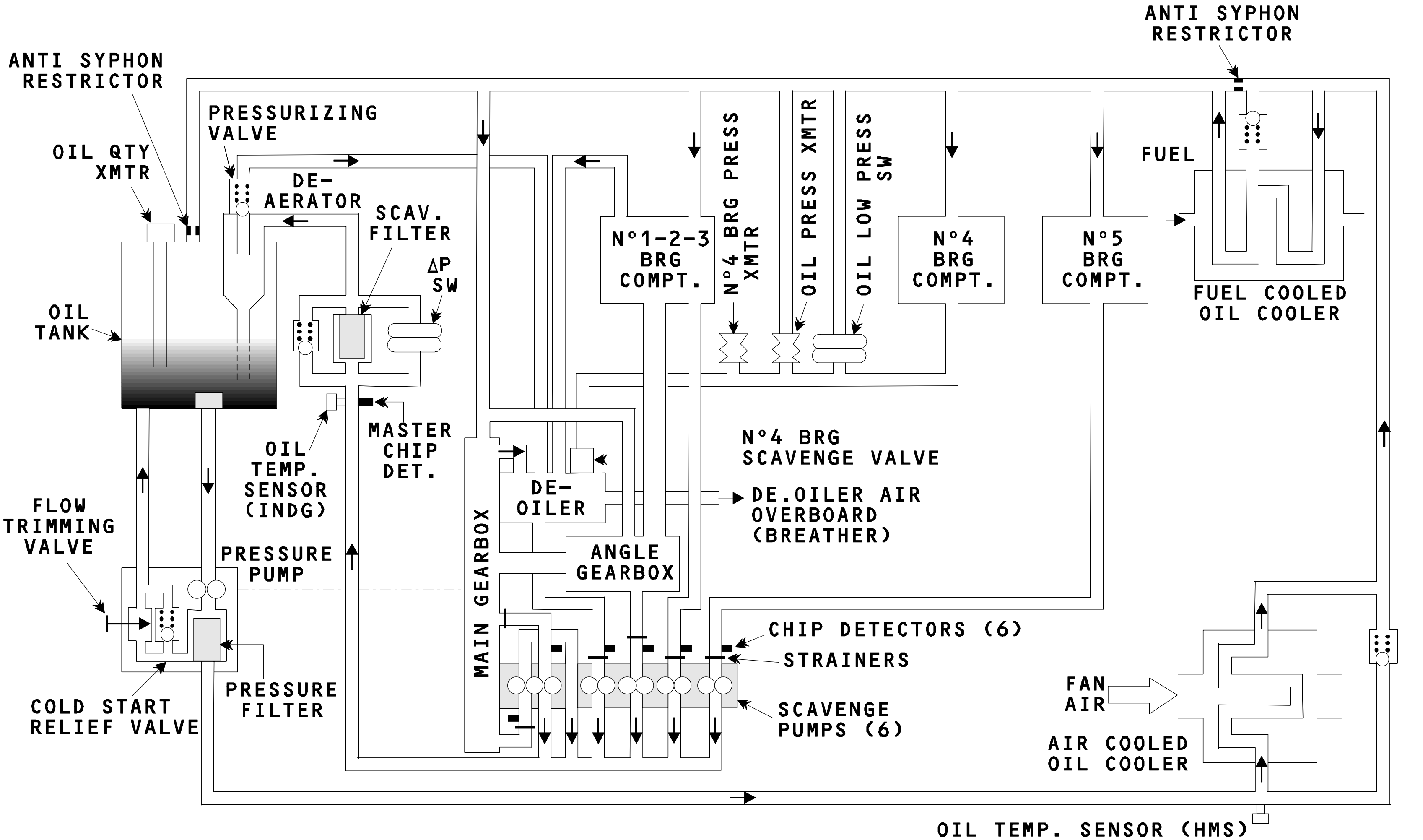
NOTE: The anti-syphon system prevents the syphoning of the oil from the tank to the gearboxes when the engine is static.

OIL SCAVENGE CIRCUIT

Six scavenge pumps suck the oil from bearing compartments, and gearboxes.
The pumps then return this oil to the tank through the scavenge filter.
The main scavenge line is provided with:
- a Master Chip Detector for inspection,
- an oil temperature sensor for indication,
- an oil differential pressure (ΔP) switch for monitoring and warning to the cockpit when the scavenge filter is clogged.

If the scavenge filter becomes clogged a differential pressure switch sends a signal to the ECAM and eventually the by-pass will open.
The ECAM is activated when ΔP is greater than 12 PSI.
The by-pass valve opens at 20 PSI.

NOTE: The scavenge line of the N° 4 bearing compartment is controlled by the N° 4 bearing scavenge valve.
Each scavenge line is equipped with a strainer and a magnetic Chip Detector to protect the pumps.



OIL SYSTEM D/O

UFD4200

TMU79IB01-P01 LEVEL 3

ENGINE OIL SYSTEM D/O

VENT CIRCUIT

Air drawn in with the scavenge oil is separated in the tank by a de-aerator and is vented to a de-oiler.
The N°4 bearing scavenge line is connected to the de-oiler through the scavenge valve.
The de-oiler separates the oil still in the air and discharges this air overboard.
Oil and air from the N°4 bearing compartment is scavenged through a common line. A pressure transducer, installed on this line, monitors the N°4 bearing scavenge pressure.
The N°4 bearing scavenge valve maintains the compartment differential pressure to ensure adequate sealing.

N°4 BEARING SCAVENGE VALVE

The N°4 bearing scavenge valve maintains N°4 bearing compartment seal differential pressure by controlling the venting of the de-oiler compartment air/oil mixture.
It is a pneumatically operated two position valve which uses stage 10 compressor air pressure as servo air.
The valve is fully open at low engine speeds and closed to minimum flow position at high engine speeds.

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SELF EXAMINATION

What happens if the oil scavenge filter is clogged?

- A - Oil filter clog warning is activated in the cockpit.
- B - A visual clogging indicator on the filter becomes red.
- C - Oil low press switch closes.

What protects the scavenge pumps from metallic particles?

- A - A Master Chip Detector.
- B - The scavenge filter.
- C - Six magnetic Chip Detectors with strainers.

Which of the following is not directly scavenged?

- A - 1, 2, 3, Bearing compartment.
- B - No 4 Bearing compartment.
- C - No 5 Bearing compartment.

79 - OIL

79-00-00 OIL SYSTEM COMPONENTS

CONTENTS:

OIL SYSTEM COMPONENTS

SAFETY PRECAUTIONS

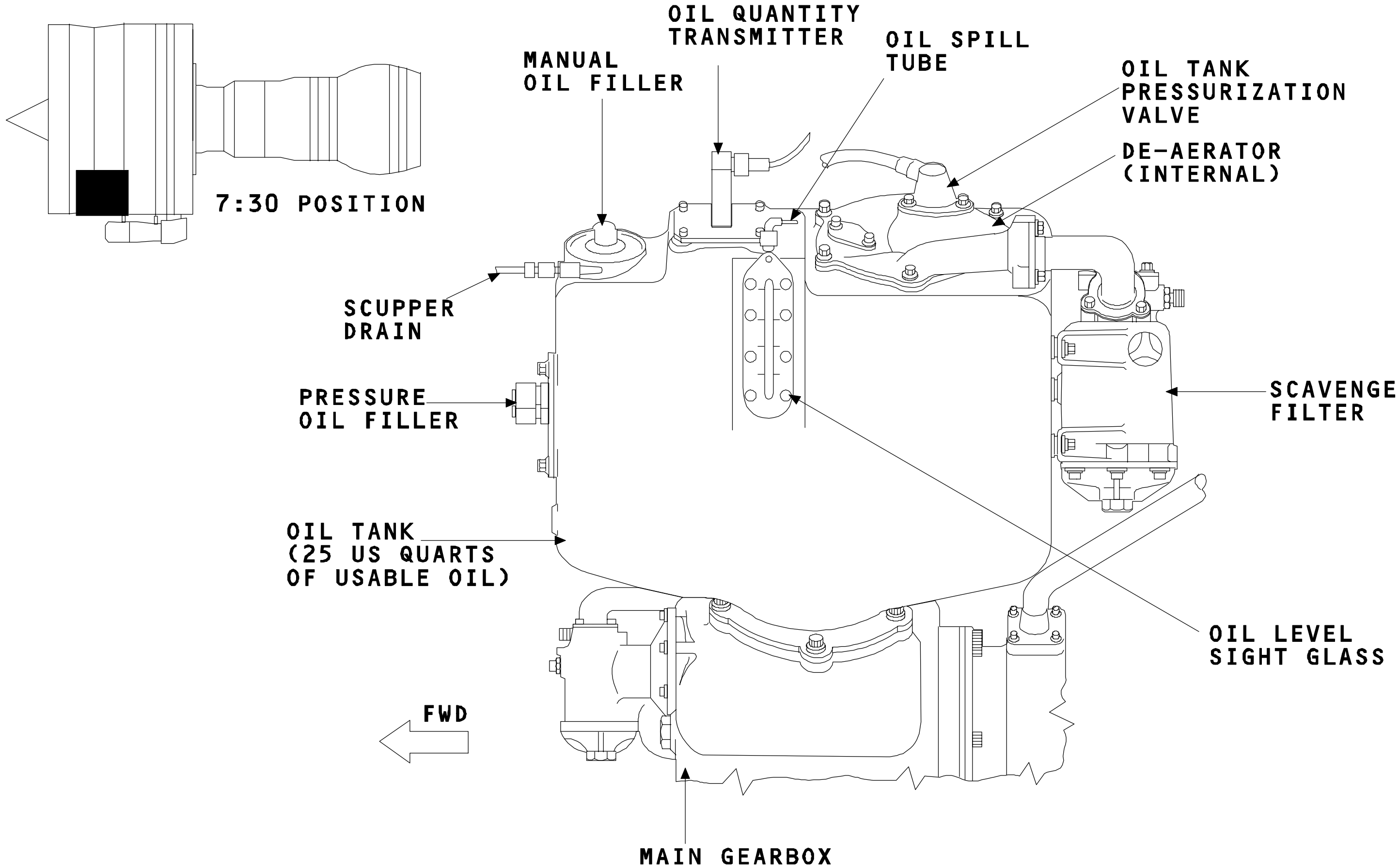
WARNING: Hot oil can cause deep burns.
Avoid any contact with oil splashes when performing maintenance.

WARNING: Wait a minimum of 5 minutes after engine shutdown before removing the oil tank filler cap.
The oil tank is pressurized during engine operation and it takes time for the pressure to drop.
If the oil tank cap is removed before the pressure decreases, hot oil may gush out of the oil tank and could cause severe burns.

OIL TANK

IDENTIFICATION
FIN: 6000EM

LOCATION
ZONE: 435, 445



OIL SYSTEM COMPONENTS - OIL TANK

OIL SYSTEM COMPONENTS

OIL PRESSURE PUMP

IDENTIFICATION
FIN: 6004EM

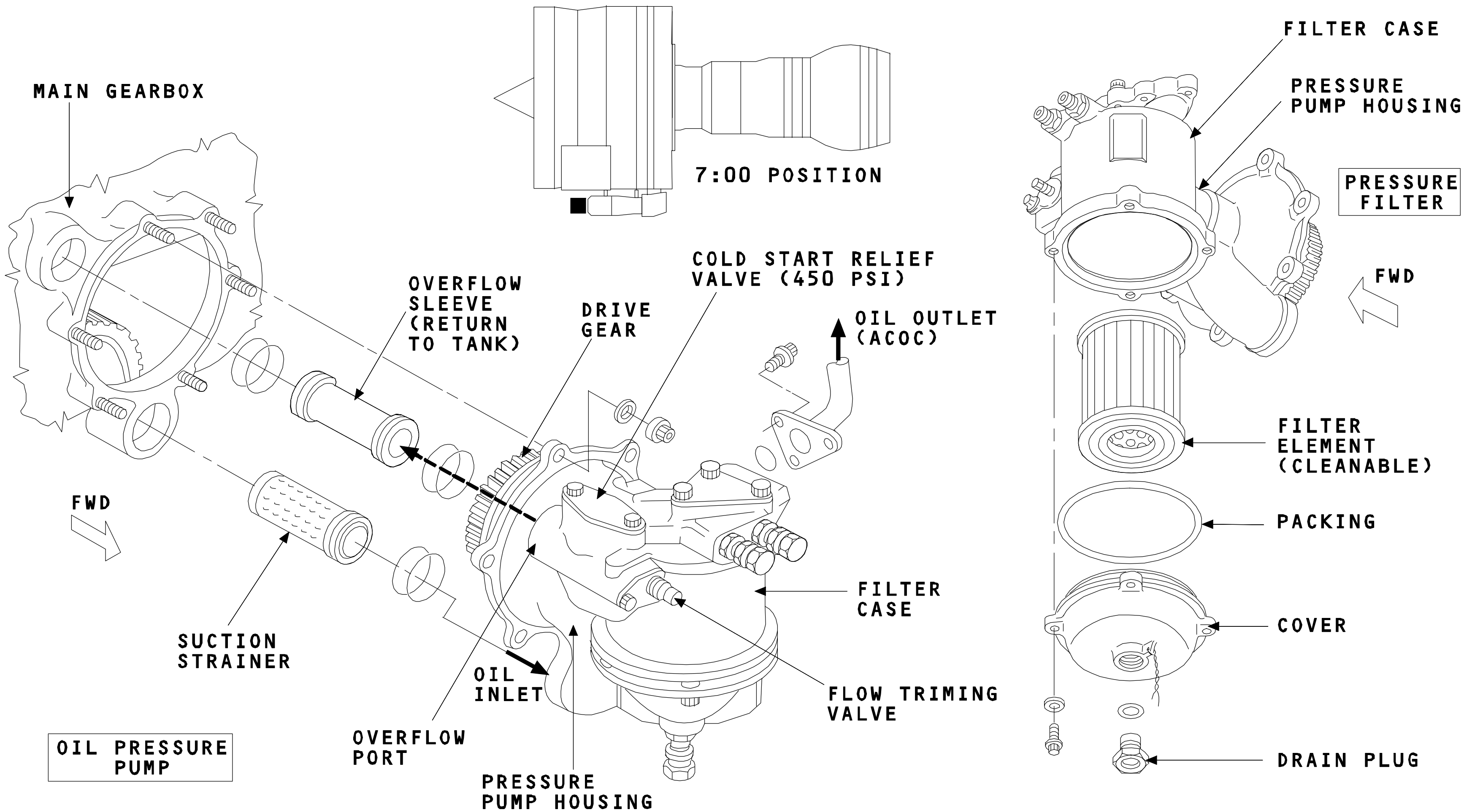
LOCATION
ZONE: 435, 445

PRESSURE FILTER

IDENTIFICATION
FIN: 6005EM (Filter Element)

LOCATION
ZONE: 435, 445

NOTE: There is no warning indication in case of filter clogging.



UFD4200
TMU79IC01-P02 LEVEL 3

OIL SYSTEM COMPONENTS - OIL PRESSURE PUMP / PRESSURE FILTER

OIL SYSTEM COMPONENTS

SCAVENGE PUMPS

IDENTIFICATION
FIN:

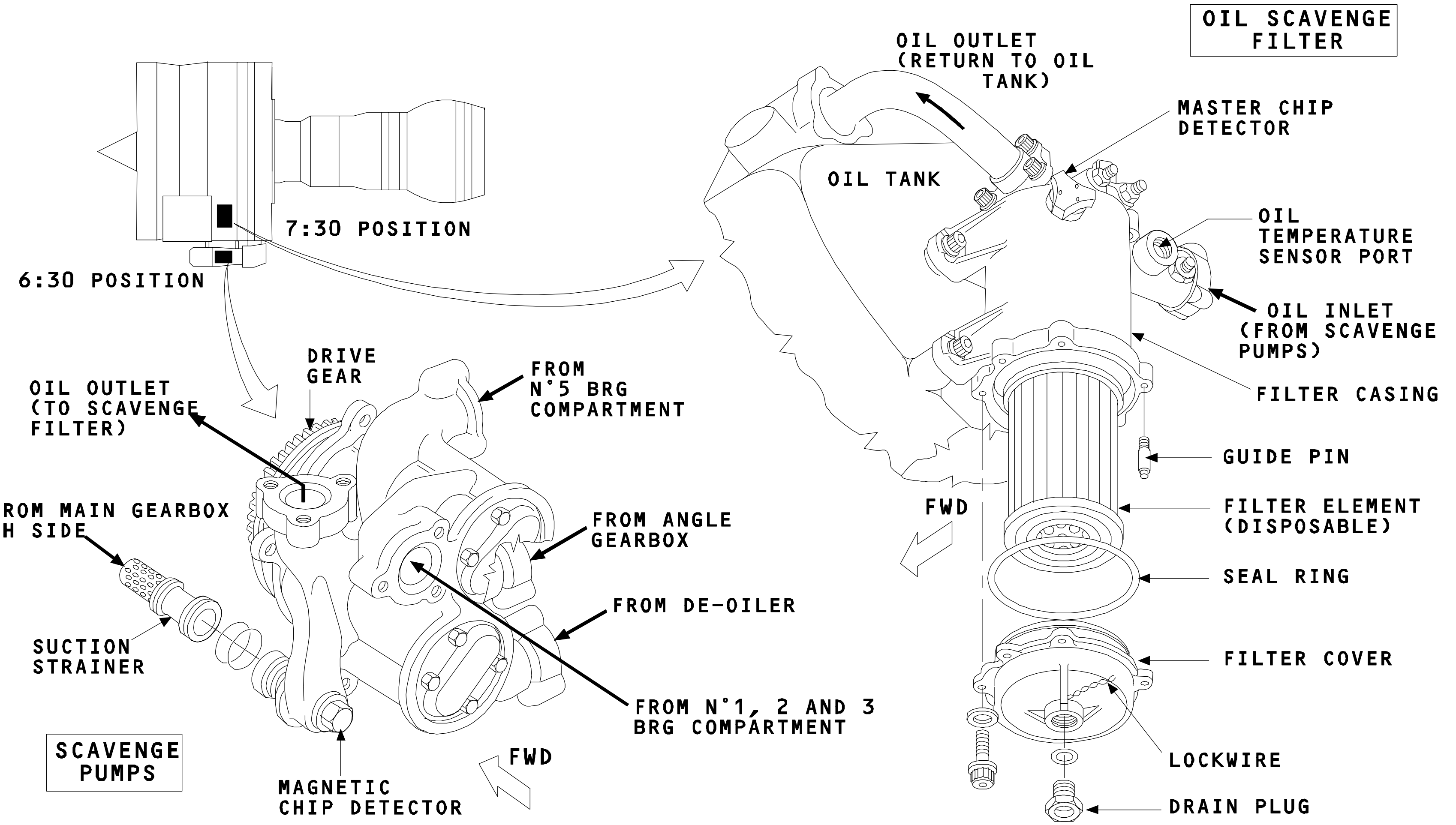
LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
One dual and 4 single scavenge pumps are housed in a single unit.

OIL SCAVENGE FILTER

IDENTIFICATION
FIN: 6001EM (Filter Element)

LOCATION
ZONE: 435, 445



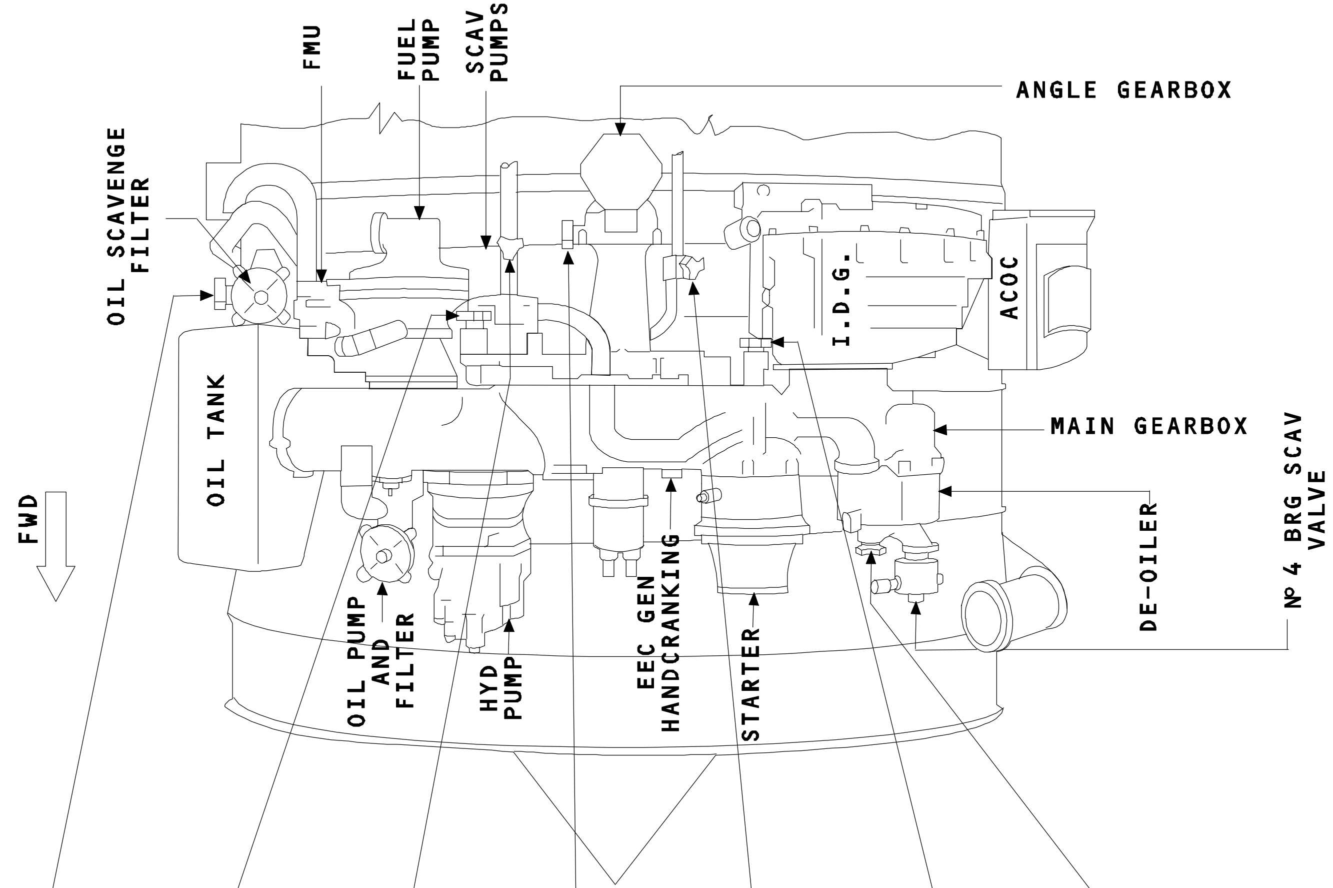
UFD4200

TMU79IC01-P03 LEVEL 3

OIL SYSTEM COMPONENTS - SCAVENGE PUMPS / OIL SCAVENGE FILTER

OIL SYSTEM COMPONENTS

CHIP DETECTOR LOCATION



MASTER CHIP DETECTOR	MAIN GEARBOX LH CHIP DETECTOR	Nº 1,2 AND 3 BRG SCAVENGE CHIP DET.	ANGLE GEAR BOX SCAV. CHIP DETECTOR	Nº 5 BRG SCAVENGE CHIP DETECTOR	MAIN GEARBOX RH CHIP DETECTOR	DE-OILER CHIP DETECTOR

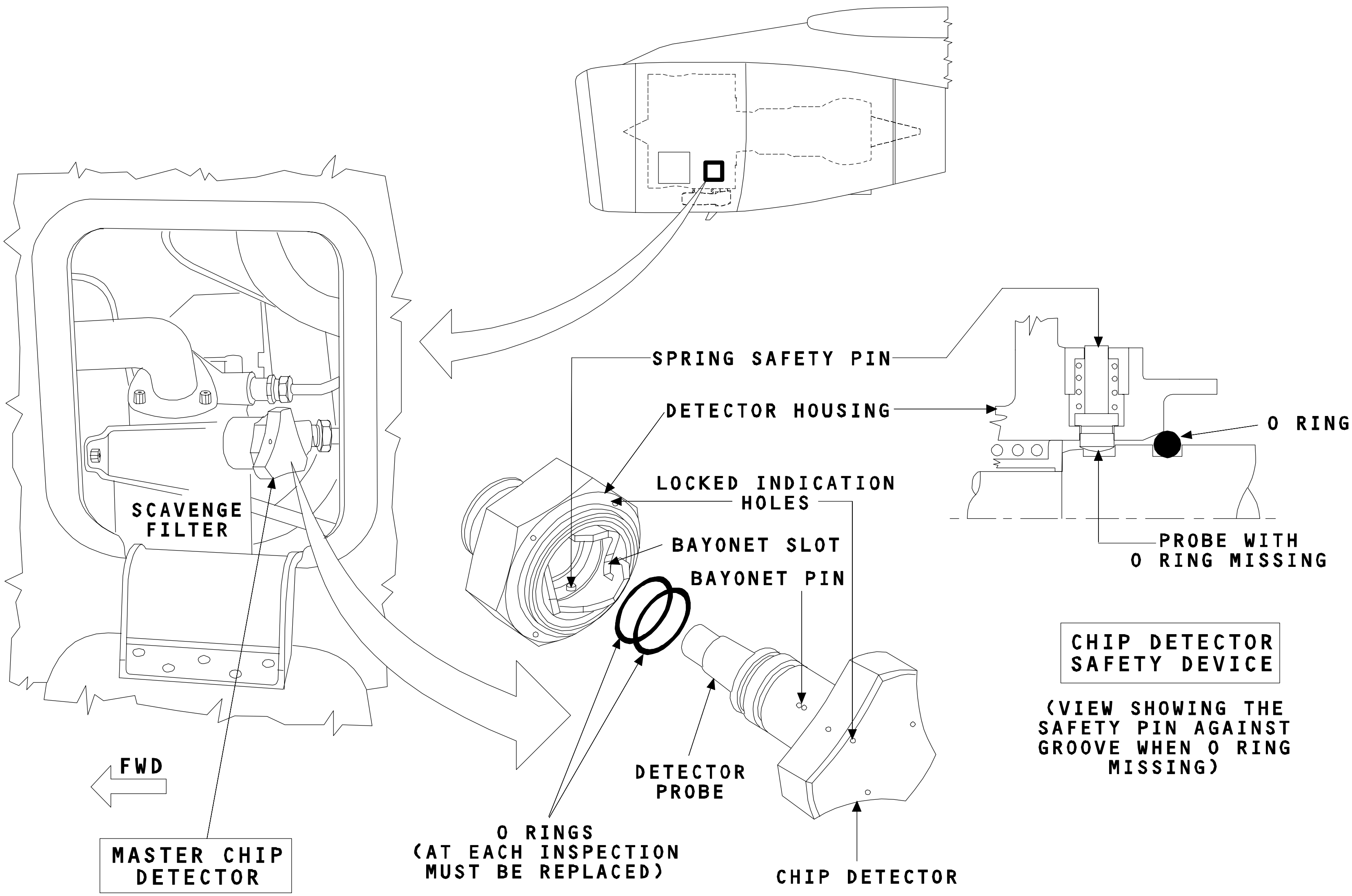
OIL SYSTEM COMPONENTS - CHIP DETECTOR LOCATION

UFD4200
TMU79IC01-P04 LEVEL 3

OIL SYSTEM COMPONENTS

MASTER CHIP DETECTOR

CHIP DETECTOR SAFETY DEVICE



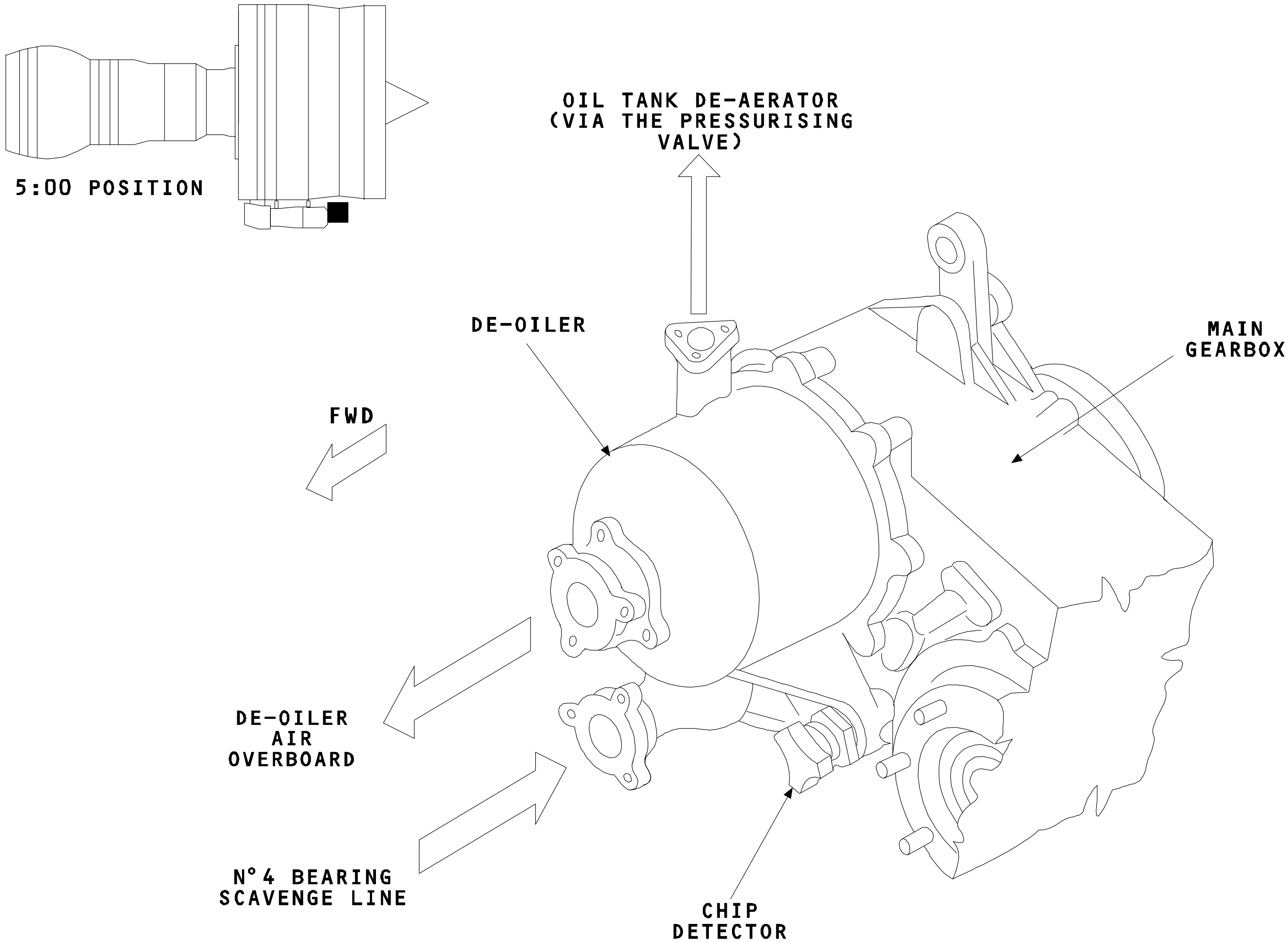
OIL SYSTEM COMPONENTS - MASTER CHIP DETECTOR / CHIP DETECTOR SAFETY DEVICE

OIL SYSTEM COMPONENTS

DE-OILER

IDENTIFICATION
FIN:

LOCATION
ZONE: 436, 446



OIL SYSTEM COMPONENTS - DE-OILER

UFD4200
TMU79IC01-P06 LEVEL 3

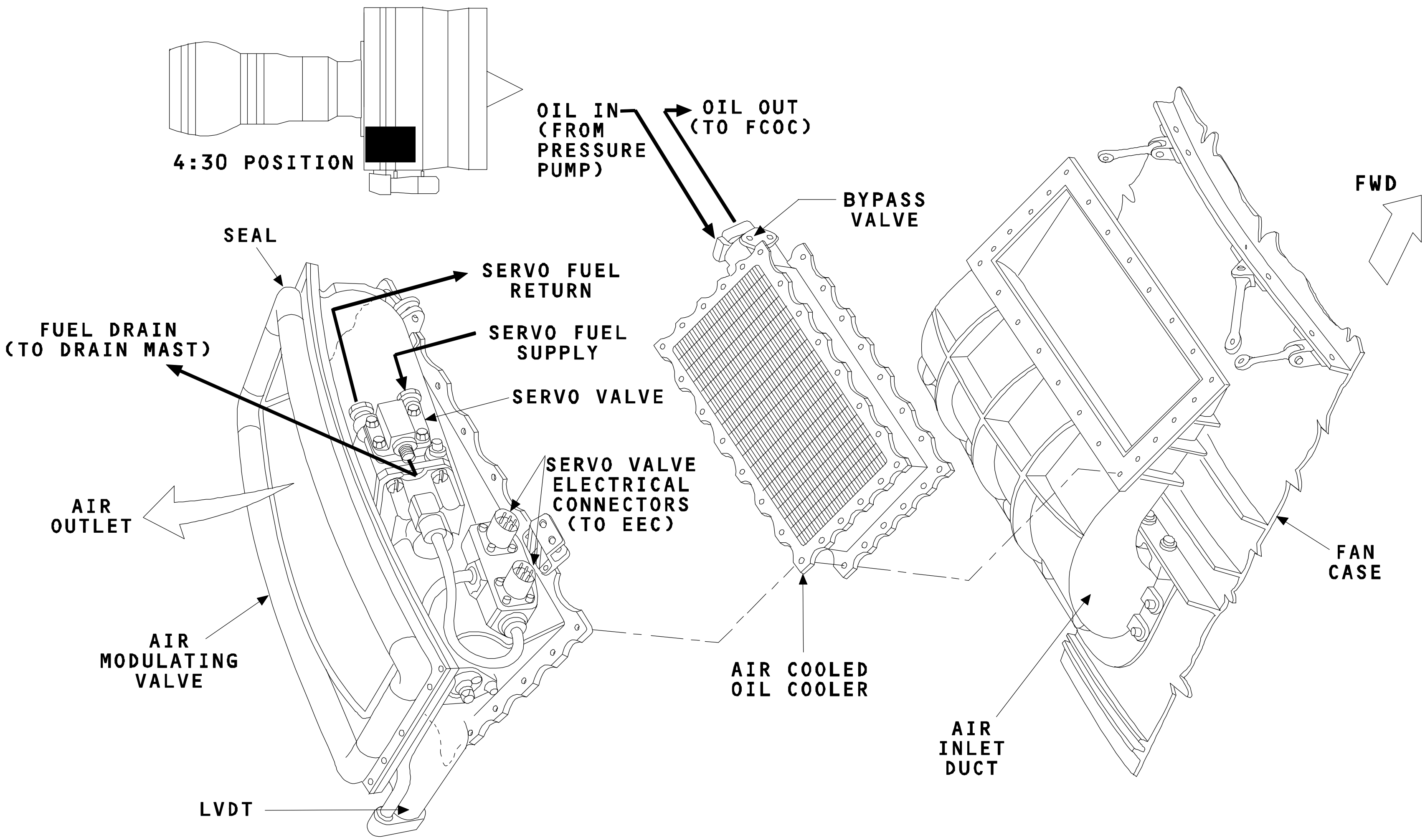
OIL SYSTEM COMPONENTS

AIR COOLED OIL COOLER (ACOC)

IDENTIFICATION
FIN: 6002EM

LOCATION
ZONE: 436, 446

NOTE: The ACOC is equipped with a bypass valve which operates when the differential pressure is greater than 50 PSI.



OIL SYSTEM COMPONENTS - AIR COOLED OIL COOLER

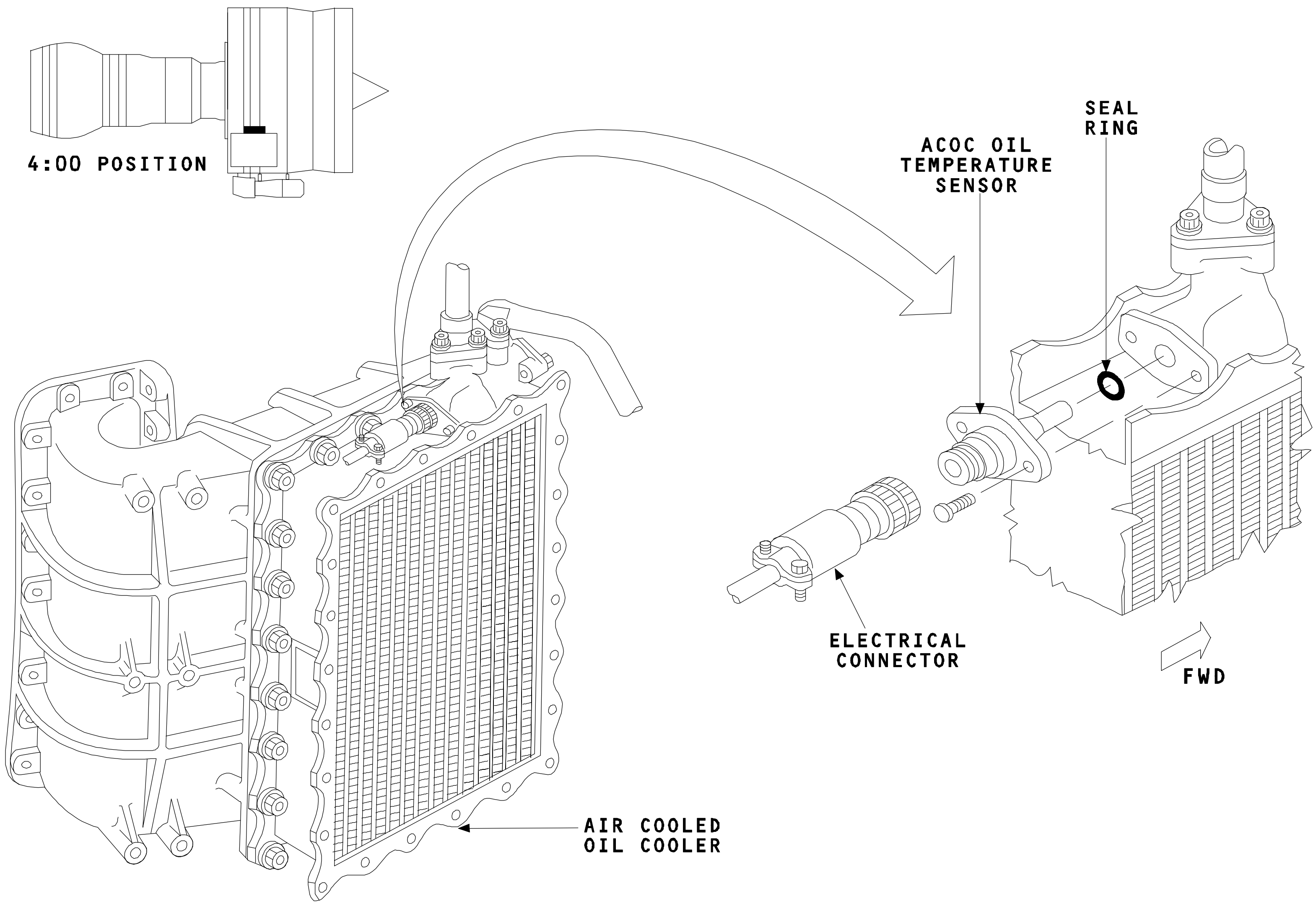
OIL SYSTEM COMPONENTS

AIR COOLED OIL COOLER (ACOC) TEMPERATURE SENSOR

IDENTIFICATION
FIN: 4016KS

LOCATION
ZONE: 436, 446

NOTE: The ACOC temperature sensor signal is sent to the Heat Management System, via the FADEC, for the ACOC air modulating valve operation.



OIL SYSTEM COMPONENTS - ACOC TEMPERATURE SENSOR

UFD4200
TMU79IC01-P08 LEVEL 3

OIL SYSTEM COMPONENTS

OIL QUANTITY TRANSMITTER

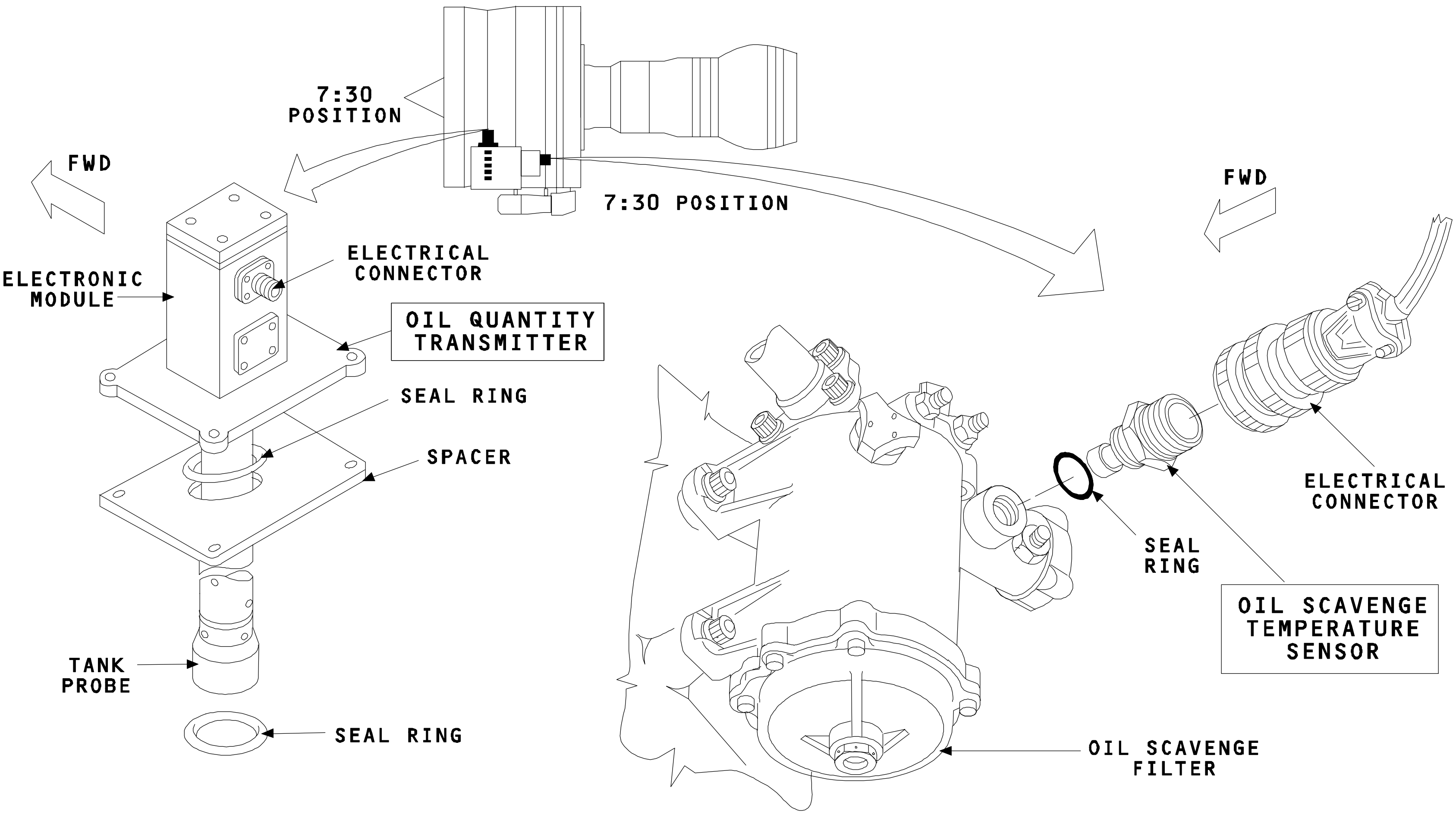
IDENTIFICATION
FIN: 4002EN

LOCATION
ZONE: 435, 445

OIL SCAVENGE TEMPERATURE SENSOR

IDENTIFICATION
FIN: 4004EN

LOCATION
ZONE: 435, 445



UFD4200

TMU79IC01-P09 LEVEL 3

OIL SYSTEM COMPONENTS - OIL QUANTITY TRANSMITTER / OIL SCAVENGE TEMPERATURE SENSOR

OIL SYSTEM COMPONENTS

OIL PRESSURE TRANSMITTER

IDENTIFICATION
FIN: 4003EN

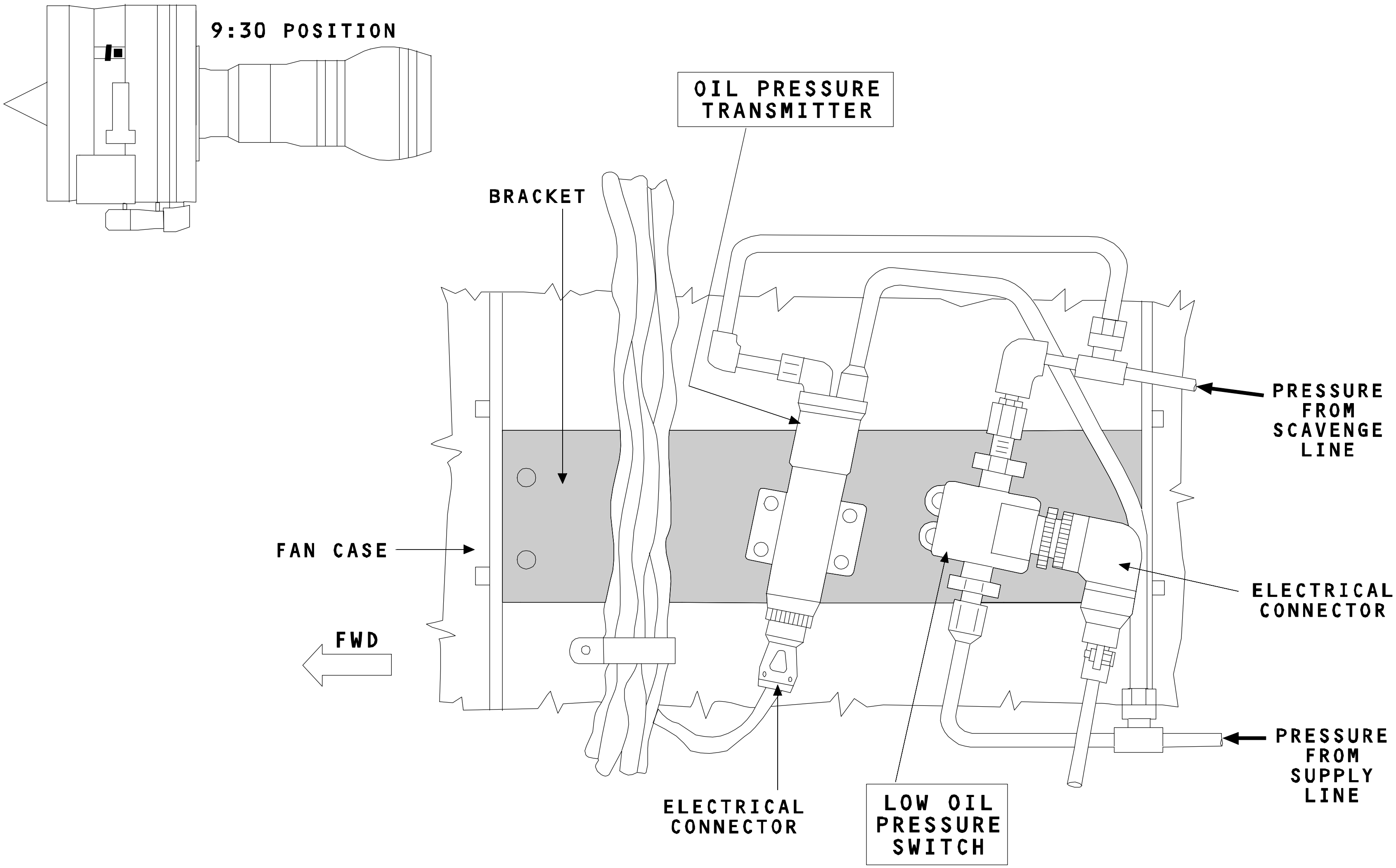
LOCATION
ZONE: 435, 445

OIL LOW PRESSURE SWITCH

IDENTIFICATION
FIN: 4000EN

LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
The oil low pressure switch triggers a warning when the pressure drops below 60 PSI.
The oil low pressure switch has the same shape as the scavenge filter ΔP switch.



UFD4200

TMU79IC01-P10 LEVEL 3

OIL SYSTEM COMPONENTS - OIL PRESSURE TRANSMITTER / LOW OIL PRESSURE SWITCH

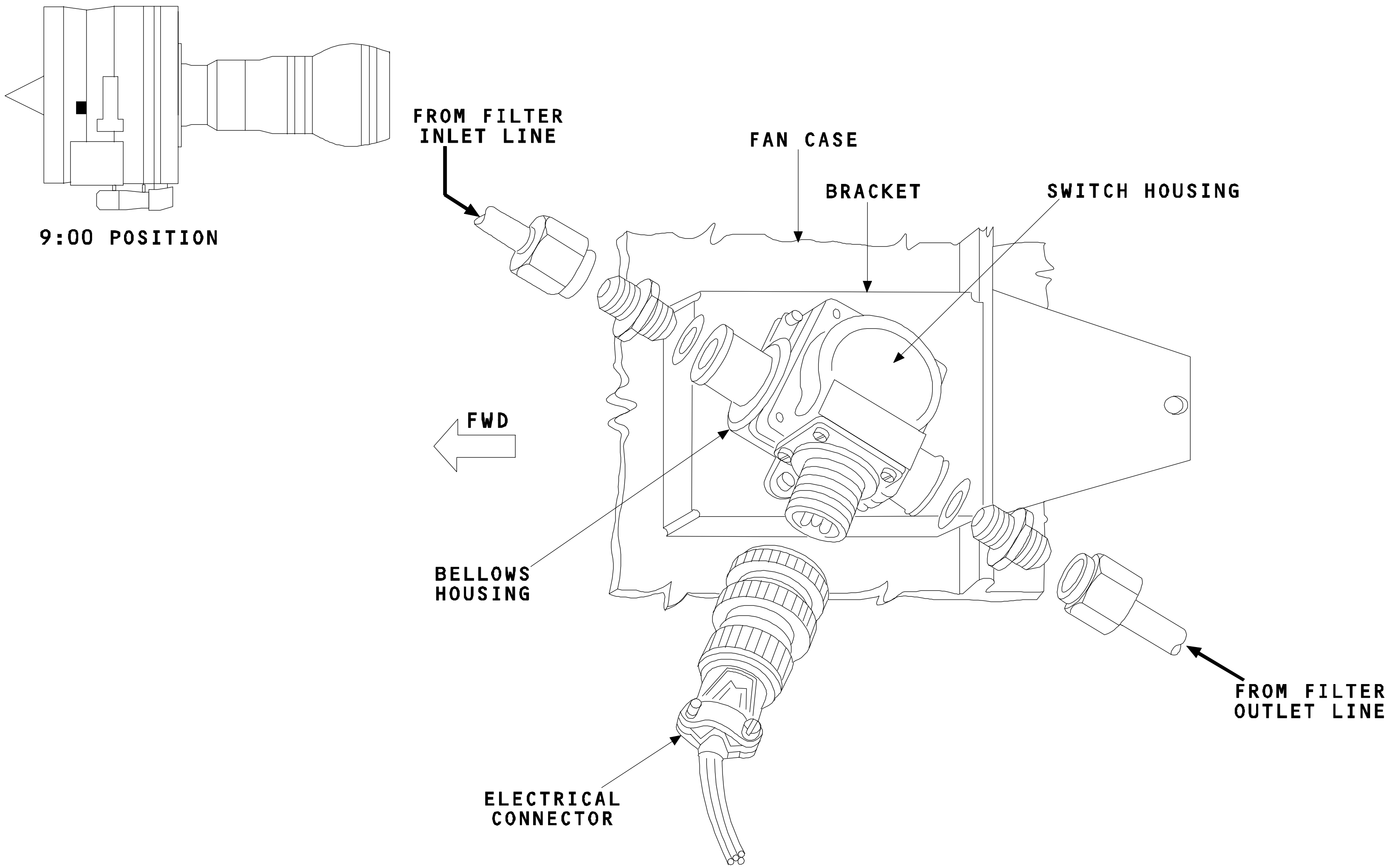
OIL SYSTEM COMPONENTS

SCAVENGE FILTER DIFFERENTIAL PRESSURE SWITCH

IDENTIFICATION
FIN: 4001EN

LOCATION
ZONE: 435, 445

COMPONENT DESCRIPTION
The scavenge filter differential pressure (ΔP) switch triggers a warning when the differential pressure reaches 12 PSI.
The scavenge filter ΔP switch has the same shape as the oil pressure transmitter.



OIL SYSTEM COMPONENTS - SCAVENGE FILTER DIFFERENTIAL PRESSURE SWITCH

OIL SYSTEM COMPONENTS

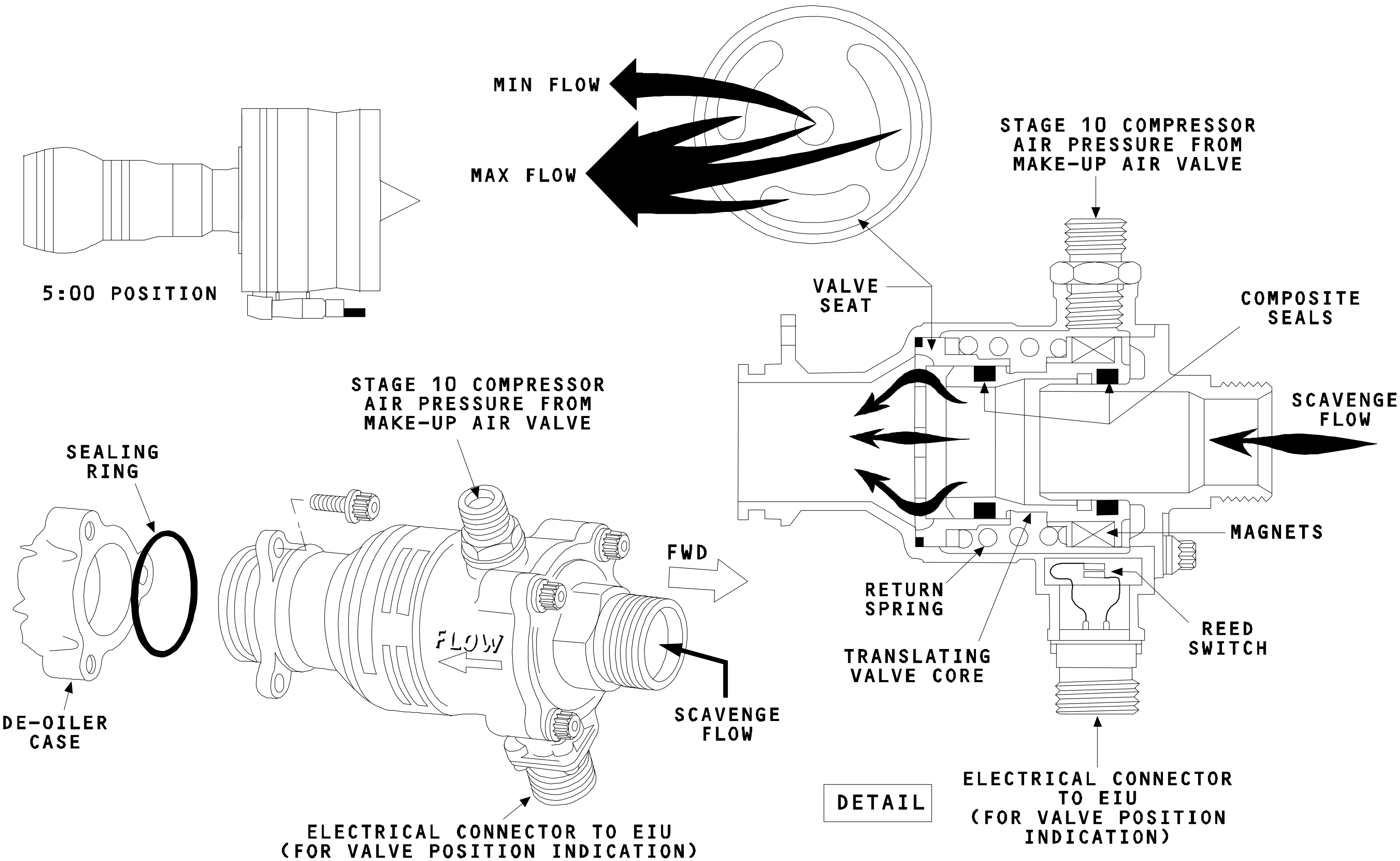
N°4 BEARING COMPARTMENT SCAVENGE VALVE

IDENTIFICATION
FIN:

LOCATION
ZONE: 436, 446

COMPONENT DESCRIPTION - DETAIL

- The valve is fully open when stage 10 air pressure is less than 150 PSI.
- The valve moves to the minimum flow position when stage 10 air pressure is more than 200 PSI.



UFD4200

TMU79IC01-P12 LEVEL 3

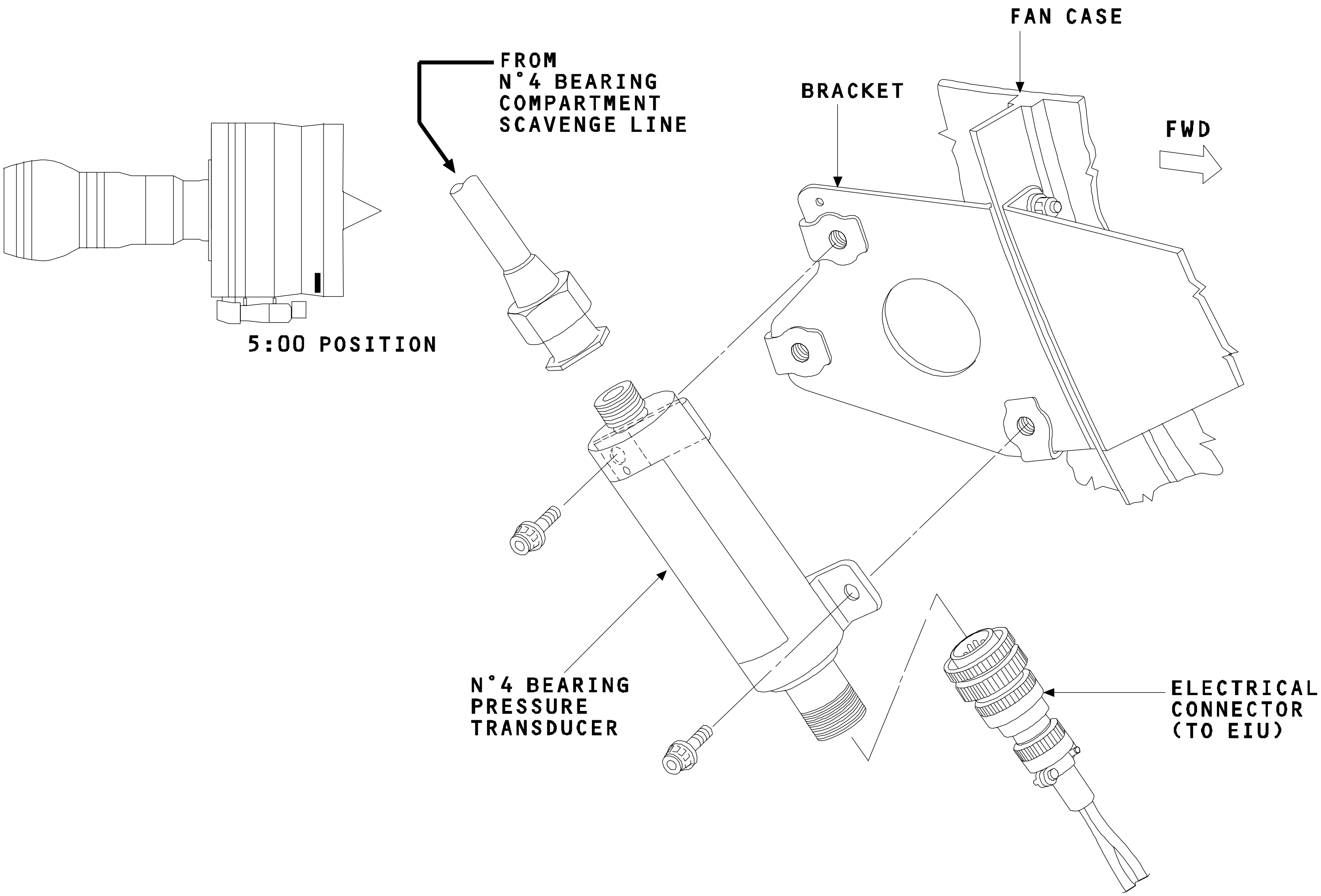
OIL SYSTEM COMPONENTS - N°4 BEARING COMPARTMENT SCAVENGE VALVE

OIL SYSTEM COMPONENTS

N°4 BEARING COMPARTMENT PRESSURE TRANSDUCER

IDENTIFICATION
FIN: 4005EN

LOCATION
ZONE: 436, 446



UFD4200 TMU79IC01-P13 LEVEL 3

OIL SYSTEM COMPONENTS - N°4 BEARING COMPARTMENT PRESSURE TRANSDUCER

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70 - MAINTENANCE PRACTICES

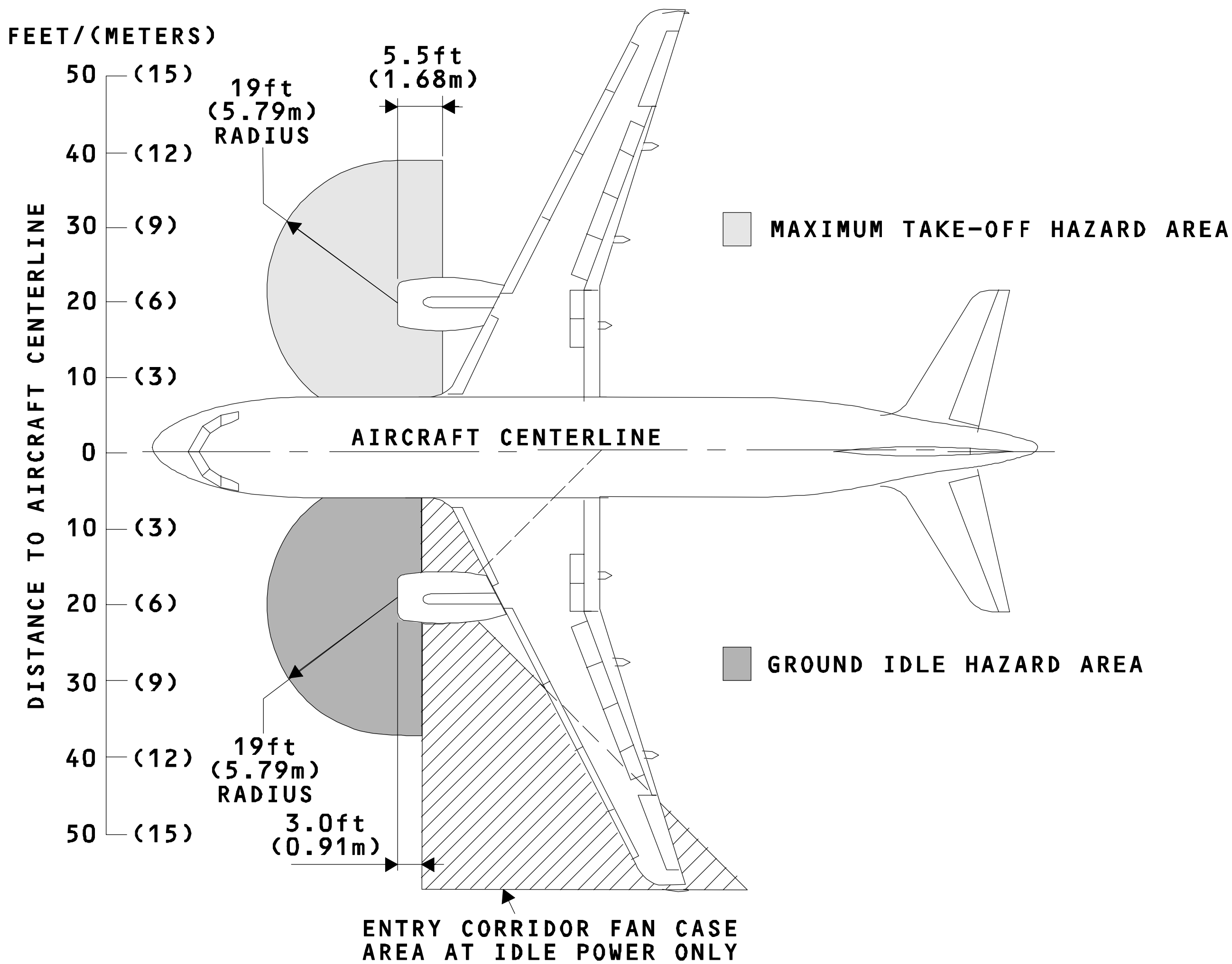
70-10-00 SAFETY ZONES

CONTENTS:

SAFETY ZONES

INLET SUCTION HAZARD AREAS

During run up operations, extreme care should be exercised when operating the engines.
Refer to the diagram showing the inlet suction hazard areas for the conditions at idle and take-off thrust.



SAFETY ZONES - INLET SUCTION HAZARD AREAS

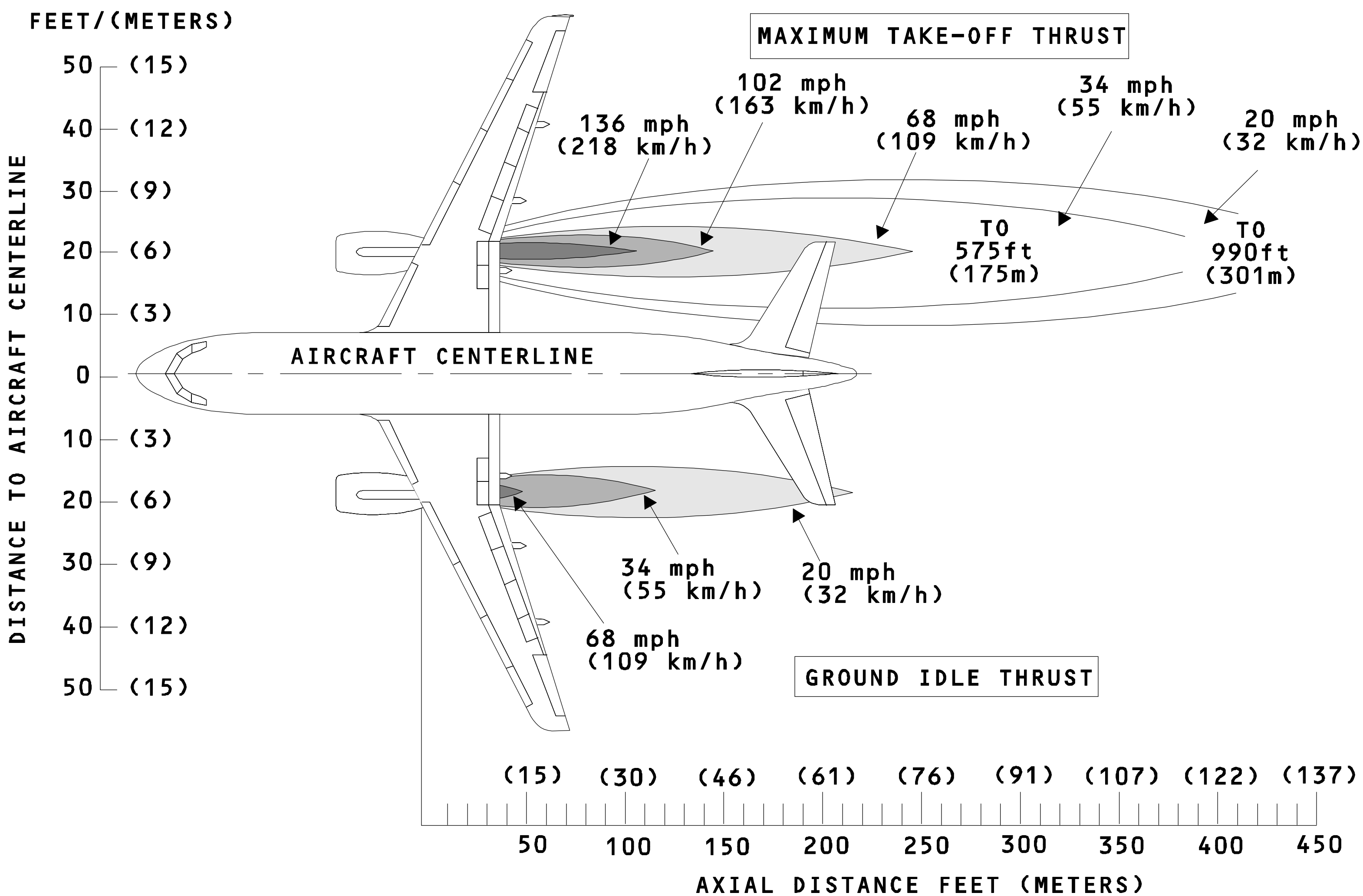
SAFETY ZONES

JET WAKE HAZARD AREAS

During run up operations, extreme care should be exercised when operating the engines.
Refer to the diagram showing the jet wake hazard areas for the conditions at idle and take-off thrust.

NOISE DANGER AREAS

Ear protection must be worn by all persons working near the engine while it operates.
Loud noise from the engine can cause temporary or permanent damage to the ears.



SAFETY ZONES - JET WAKE HAZARD AREAS

UFD4200

TMU70IB01-P02 LEVEL 2

SELF EXAMINATION

Which condition is sufficient to close the entry corridor ?

A - Engine running.
B - Engine running above 80% of N2.
C - Engine running above minimum idle.

With the engine running, what is dangerous.

A - The inlet suction.
B - The inlet suction and the jet wake.
C - The inlet suction, the jet wake and the noise.

70 - MAINTENANCE PRACTICES

70-00-00 OPENING AND CLOSING OF ENGINE COWL DOORS

CONTENTS:

OPENING AND CLOSING OF ENGINE COWL DOORS

FAN COWL MAINTENANCE PRACTICES

OPENING OF THE FAN COWL DOORS

WARNING: Do not open the fan cowl doors if the wind speed is more than 60 mph (96 km/h).

WARNING: Be careful if you open the fan cowl doors if the wind speed is more than 30 mph (48 km/h). Injury or damage to the engine can occur if the wind moves the fan cowl doors.

WARNING: Make sure that the hold open rods of the fan cowl doors are in the extended position and are attached correctly. If not, the cowl doors can close accidently.

A. On panel 115VU:
- Put a warning notice to tell persons not to start engine 1 (2).
- Make sure that engine 1 (2) has been shut down for at least 5 minutes and the corresponding ENGine MASTER lever is in OFF position.

B. On panel 50VU:
- Make sure that the ENGine FADEC GrouND PoWeR pushbutton ON light is extinguished.
- Install a warning notice.

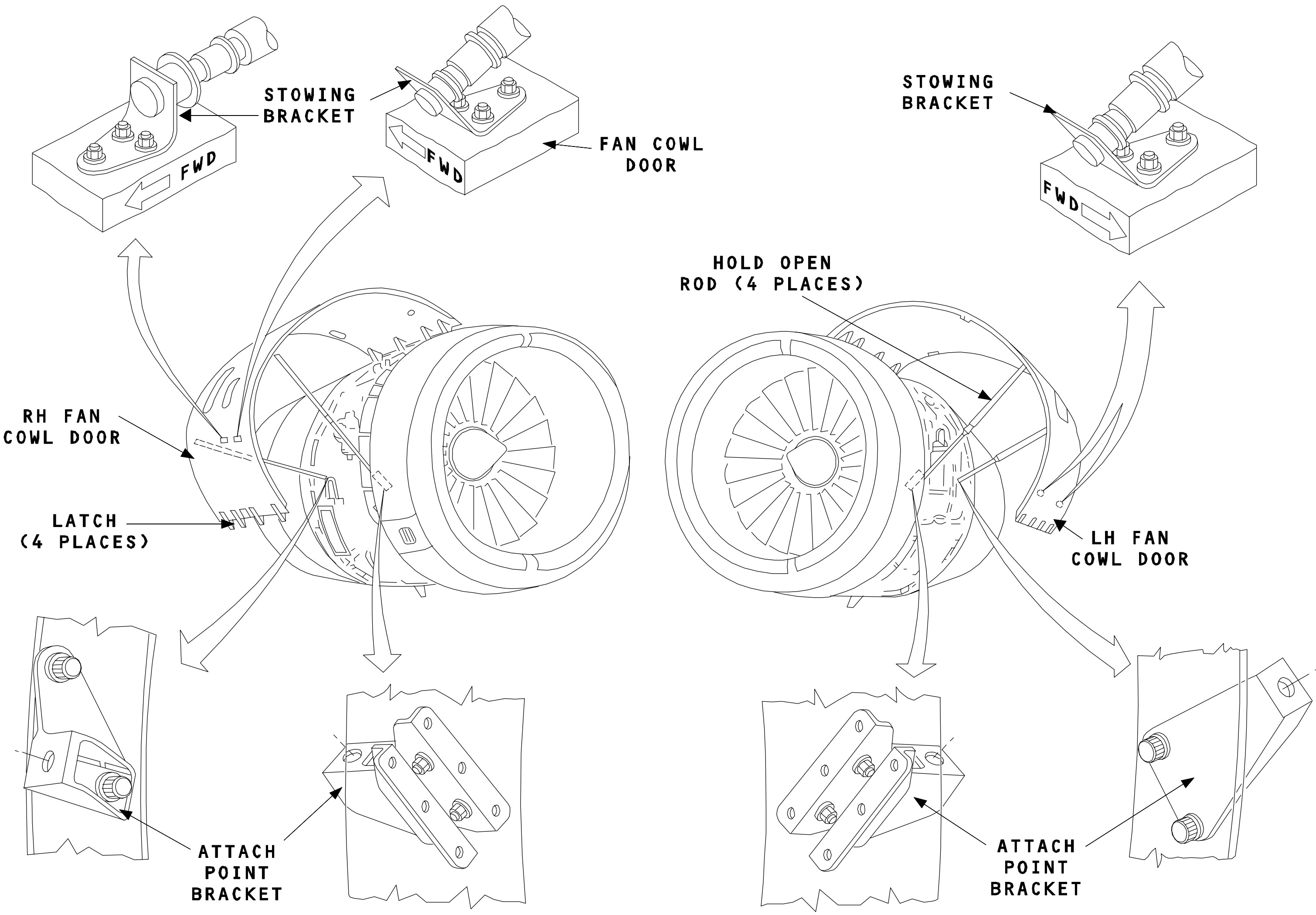
C. Unlock the four latches in sequence from the front of the cowl to the rear.
- For each latch, push the snap to release the latch.

D. Manually lift and support the door at lower edge.
E. Release the front hold open rod from its stowing bracket on the cowl door and attach the hold open rod to its attach point bracket on the fan case.
F. Open the door sufficiently to engage the rod.
G. The rear hold open rod is then extended and attached to its support on the fan case.
H. Repeat the sequence for the other fan cowl door.

CLOSING OF THE FAN COWL DOORS

CAUTION: Make sure that the engine area is clear of tools and equipment before closing the fan cowl doors.

A. Make sure that the aircraft is in the same configuration as for the opening task.
B. Hold the cowl door.
C. Disengage the hold open rods from their attach point brackets and store them on their stowing brakets on the fan cowl door.
D. Lower the door.
E. Repeat the same task for the second door.
F. Push the doors together and lock the latches then check that the latches are correctly engaged.
G. Remove the warning notices in the cockpit.



OPENING AND CLOSING OF ENGINE COWL DOORS - FAN COWL DOOR OPENING/CLOSING

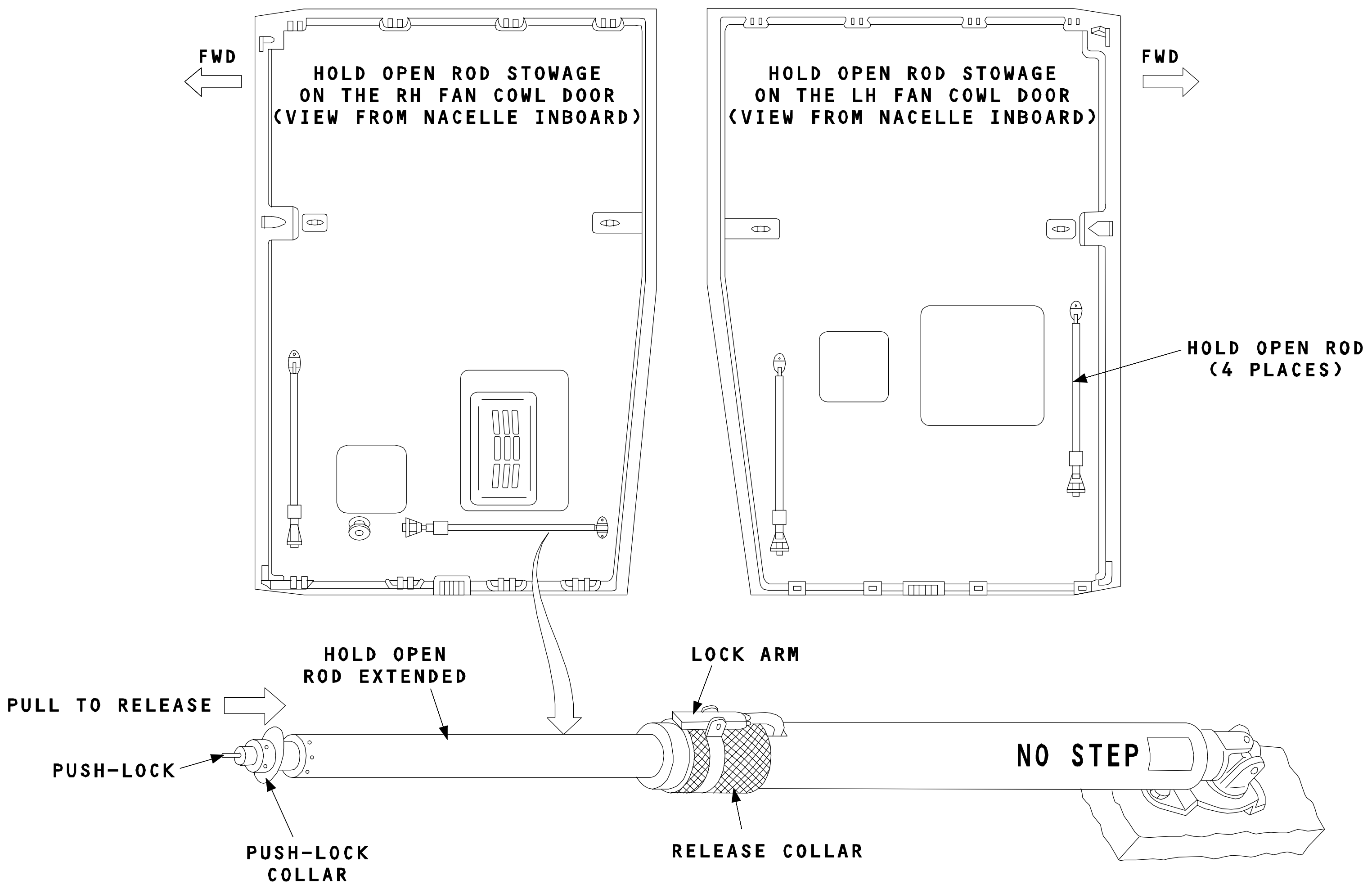
UFD4200

TMU70IC01-P01 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS

FAN COWL MAINTENANCE PRACTICES (Cont'd)

FAN COWL DOOR HOLD OPEN RODS



UFD4200

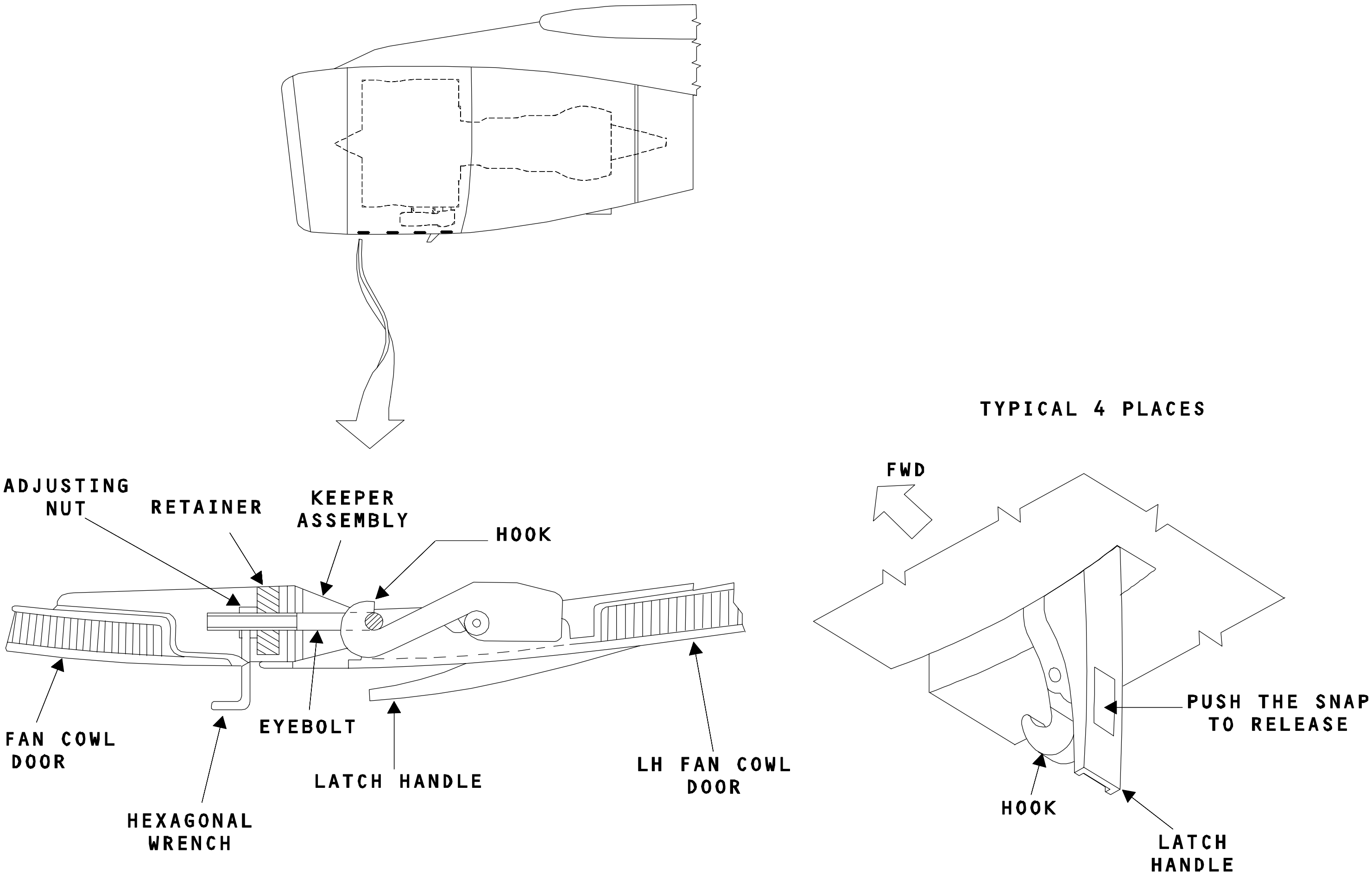
TMU70IC01-P02 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS - FAN COWL DOOR HOLD OPEN RODS

OPENING AND CLOSING OF ENGINE COWL DOORS

FAN COWL MAINTENANCE PRACTICES (Cont'd)

FAN COWL DOOR LATCHES



UFD4200

TMU70IC01-P03 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS - FAN COWL DOOR LATCHES

OPENING AND CLOSING OF ENGINE COWL DOORS

THRUST REVERSER "C" DUCT MAINTENANCE PRACTICES

OPENING OF THE THRUST REVERSER "C" DUCTS

CAUTION: Do not open the inboard thrust reverser "C" duct if the wing leading edge slats are extended. Damage to the thrust reverser, wing leading edge slats and wing can occur.

A. On panel 115VU:
- Put a warning notice to tell persons not to start engine 1 (2).
- Make sure that engine 1 (2) has been shut down for at least 5 minutes and the corresponding ENGine MASTER lever is in the OFF position.

B. On panel 50VU:
- Make sure that the ENGine FADEC GrouND PoWeR pushbutton ON light is extinguished.
- Install a warning notice.

C. On panel 114VU:
- Put a warning notice to tell persons not to use slats.

D. Open the fan cowl doors.

E. Put an access platform in position.

F. Deactivate the thrust reverser Hydraulic Control Unit.

G. Open the latch access panel.

H. Adjust the thrust reverser "C" duct take-up device.

I. Engage the take-up device on its attach fitting, on the other thrust reverser "C" duct.

J. Turn the adjustment nut with a wrench to pull the two thrust reverser "C" ducts closer together.
This relieves the tension on the thrust reverser "C" duct latches.

K. Unlock the thrust reverser "C" duct latches.

WARNING: Make sure that the take-up device is correctly engaged before you release the latches. Failure to do so can cause the latches to open fast and cause injury to persons.

Release the latches at all positions:
- Aft (Translating sleeve double latch)
- Center (Bifurcation latches)
- Forward.

L. Loosen the take-up device and store it on its stowage bracket.

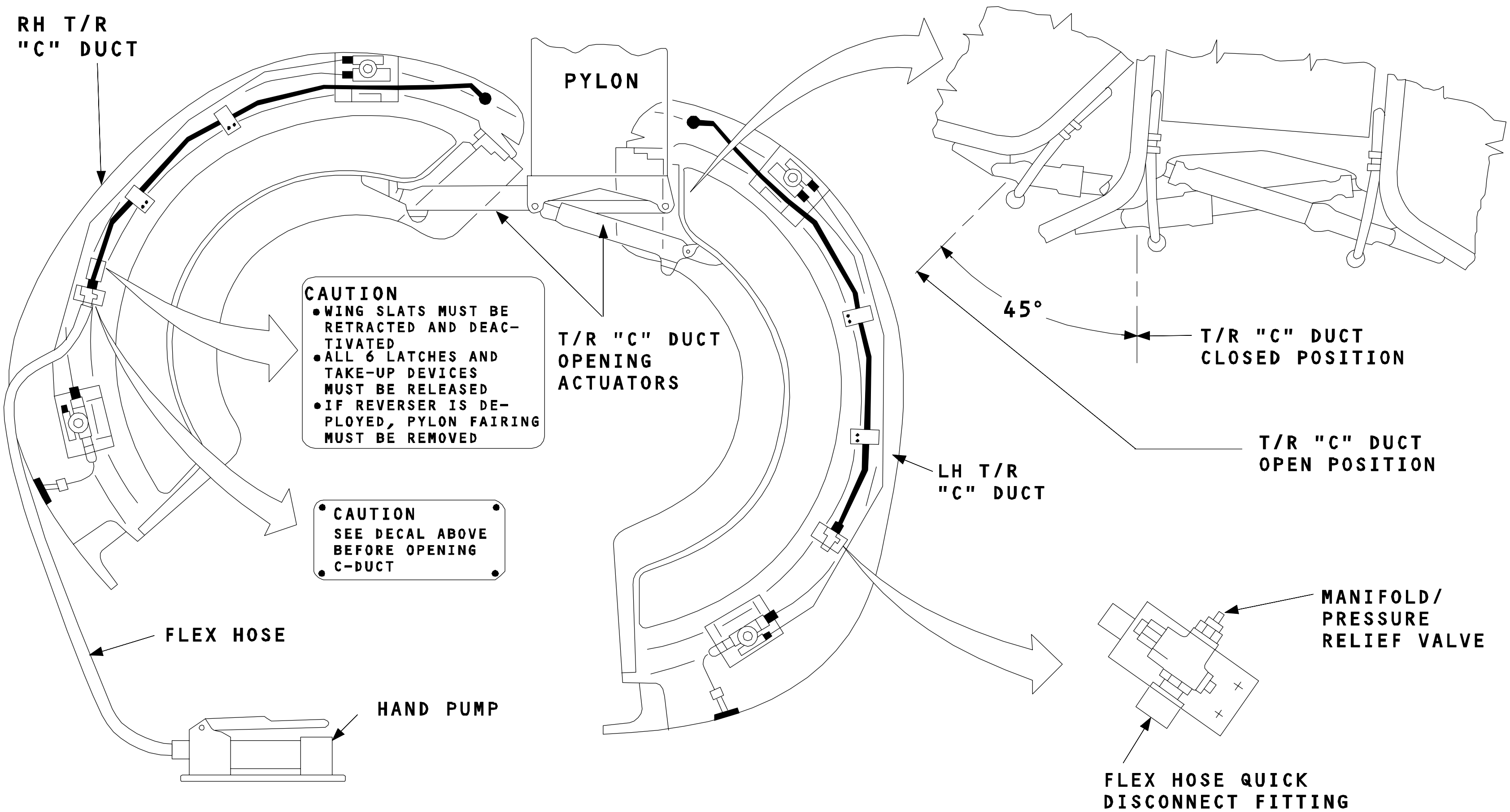
M. Connect the hydraulic hand pump and open the thrust reverser "C" duct.
- Remove the dust cover from the quick disconnect and attach the hand pump hose to the thrust reverser "C" duct opening actuator manifold.
- Make sure that the hand pump hose is correctly connected.
- Operate the hand pump until the thrust reverser "C" duct is fully open.

N. Install the hold open rods in position to hold the thrust reverser "C" duct.

O. Unload the hand pump.
- Make sure that the thrust reverser "C" duct is held correctly.

P. Disconnect the hand pump hose and put the dust cover on the quick disconnect.

Q. Open the second thrust reverser "C" duct in the same way.



UFD4200

TMU70IC01-P04 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS - T/R "C" DUCT OPENING/CLOSING

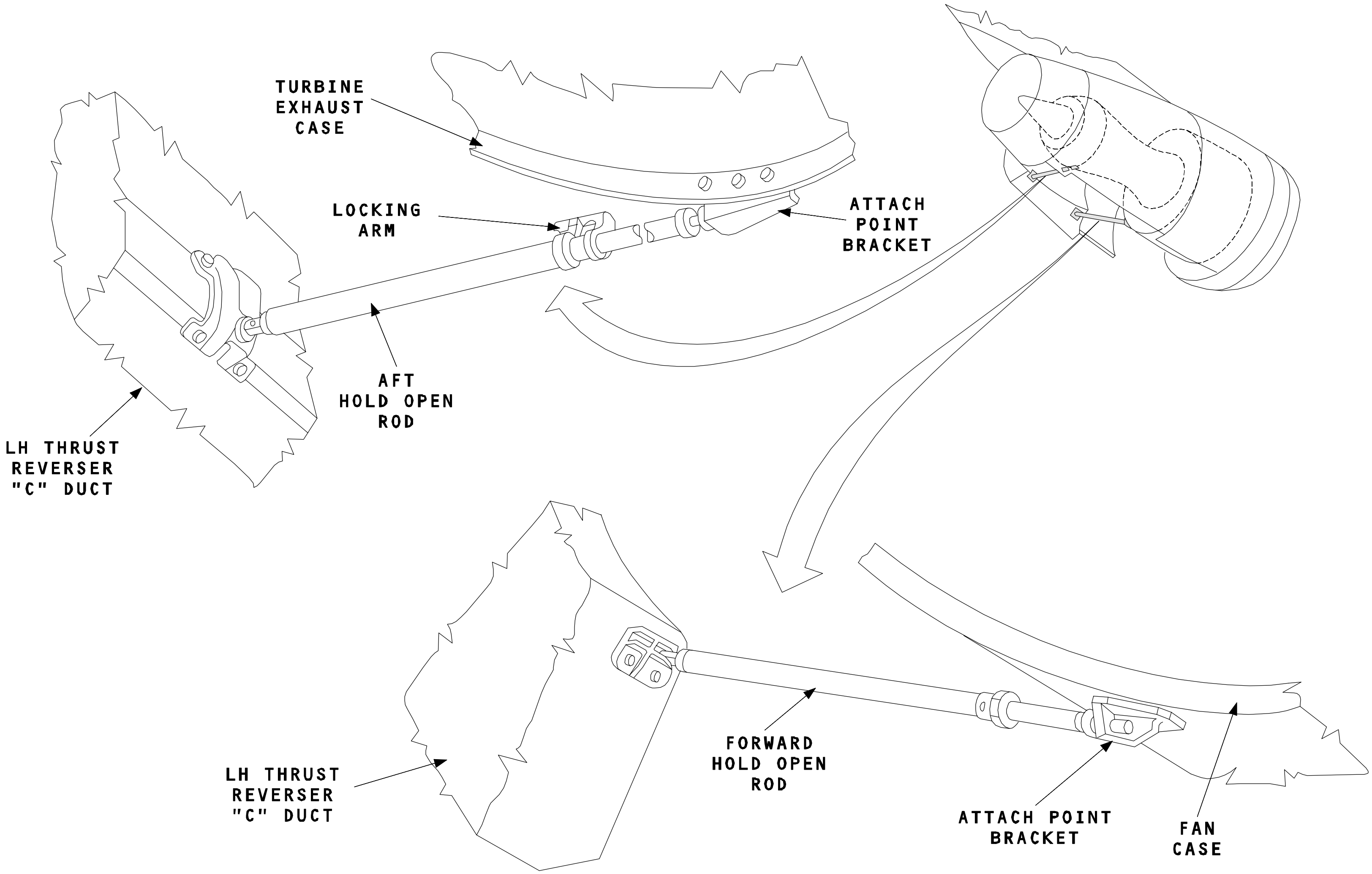
OPENING AND CLOSING OF ENGINE COWL DOORS

<u>THRUST REVERSER "C" DUCT MAINTENANCE PRACTICES (Cont'd)</u>

CLOSING OF THE THRUST REVERSER "C" DUCT

<u>CAUTION:</u> Make sure that the thrust reverser area is clear of tools and equipment before closing the "C" duct.

A. Make sure that the aircraft is in the same configuration as for the opening task.
B. Connect and operate the hand pump until the hold open rods are unloaded from the weight of the thrust reverser "C" duct.
C. Disengage the hold open rods and store them on their storage brackets on the thrust reverser "C" duct.
D. Slowly open the hand pump valve and let the thrust reverser "C" duct close.
E. Disconnect and remove the hand pump.
F. Close the second thrust reverser "C" duct in the same way.
G. Adjust the take-up device and engage it in its attach fitting on the other thrust reverser "C" duct.
H. Turn the body of the take-up device with a wrench to pull the two thrust reverser "C" duct closer together.
I. Lock the thrust reverser "C" duct latches and make sure that they are correctly engaged.
J. Release the take-up device and put it back on its storage bracket.
K. Close the latch access panel.
L. Reactivate the thrust reverser hydraulic control unit.
M. Close the fan cowl doors.
N. Remove the warning notices from panels 115VU and 50VU and from the slats control lever on panel 114VU.



UFD4200
TMU70IC01-P05 LEVEL 3

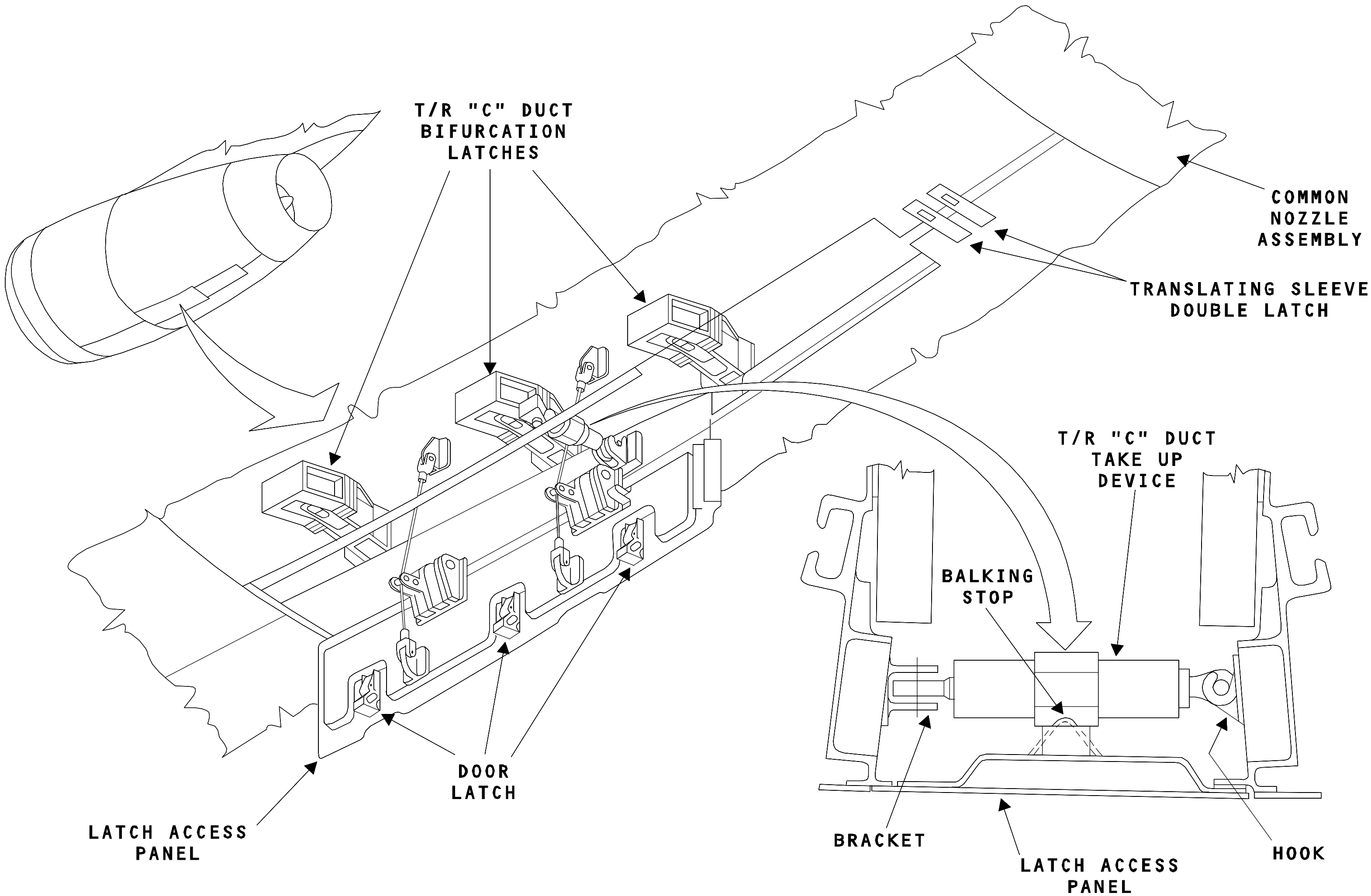
OPENING AND CLOSING OF ENGINE COWL DOORS - T/R "C" DUCT HOLD OPEN RODS

OPENING AND CLOSING OF ENGINE COWL DOORS

THRUST REVERSER "C" DUCT MAINTENANCE PRACTICES (Cont'd)

THRUST REVERSER "C" DUCT LATCH ACCESS PANEL

- BIFURCATION LATCHES
- TAKE-UP DEVICE
- LATCH ACCESS PANEL



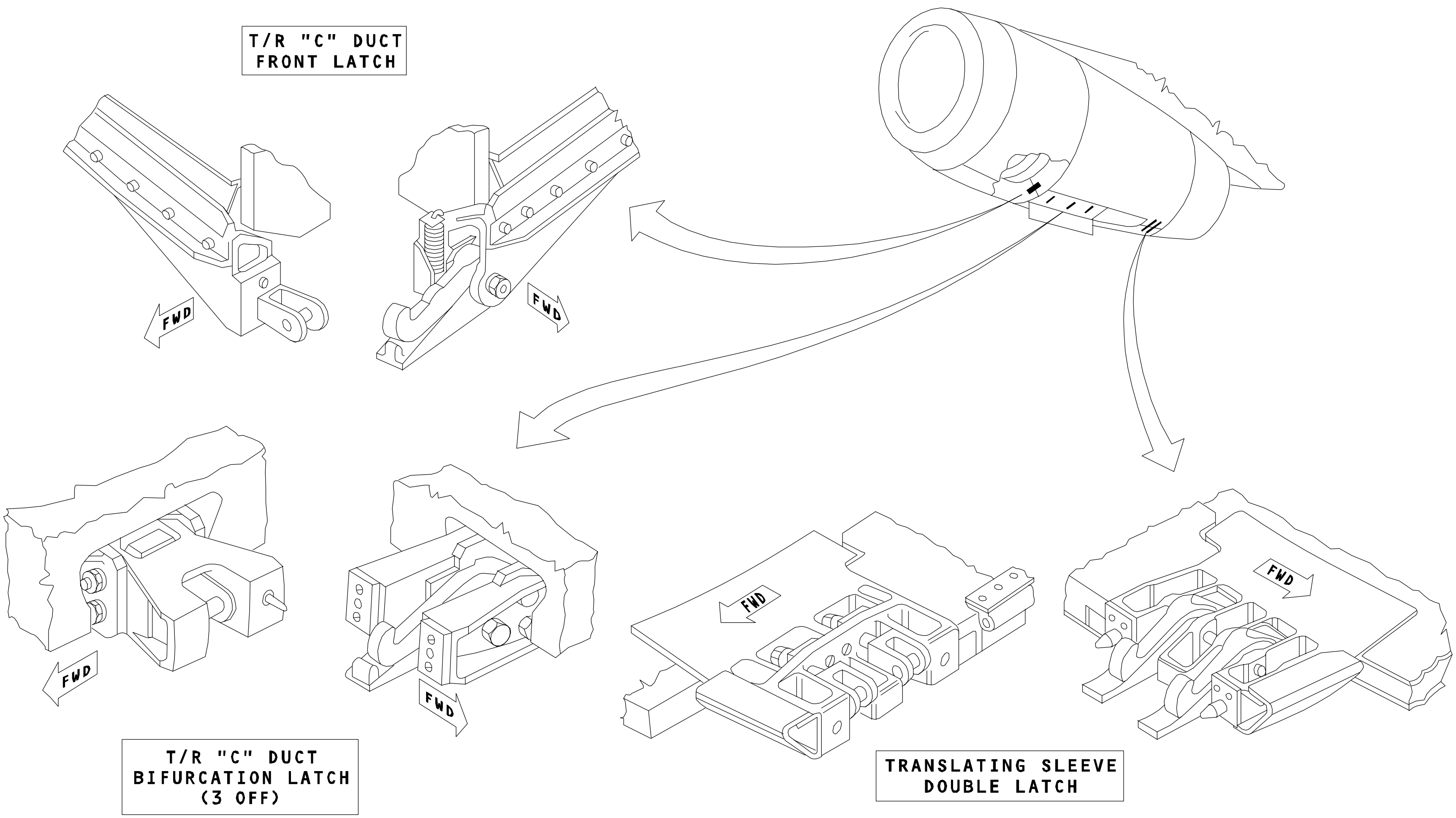
OPENING AND CLOSING OF ENGINE COWL DOORS - T/R "C" DUCT LATCH ACCESS PANEL

UFD4200
TMU70IC01-P06 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS

THRUST REVERSER "C" DUCT MAINTENANCE PRACTICES (Cont'd)

THRUST REVERSER "C" DUCT LATCHES



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TMU70IC01-P07 LEVEL 3

OPENING AND CLOSING OF ENGINE COWL DOORS - T/R "C" DUCT LATCHES

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70 - MAINTENANCE PRACTICES

70-00-00 THRUST REVERSER DE-ACTIVATION AND LOCKOUT

CONTENTS:

THRUST REVERSER DE-ACTIVATION AND LOCKOUT

THRUST REVERSER DE-ACTIVATION

WARNING: The thrust reverser system should be de-activated using the Hydraulic Control Unit (HCU) lever, before working on the system or on the engine.
If not the thrust reverser can accidently operate and cause serious injuries to personnel and/or damage to the reverser.

However de-activation and lockout procedures are applied in order to release an aircraft with a thrust reverser system that does not operate.

A. On panel 115VU:
- Make sure the ENGine MASTER lever is in the OFF position
- Place a warning notice to tell persons not to start engine 1 (2).

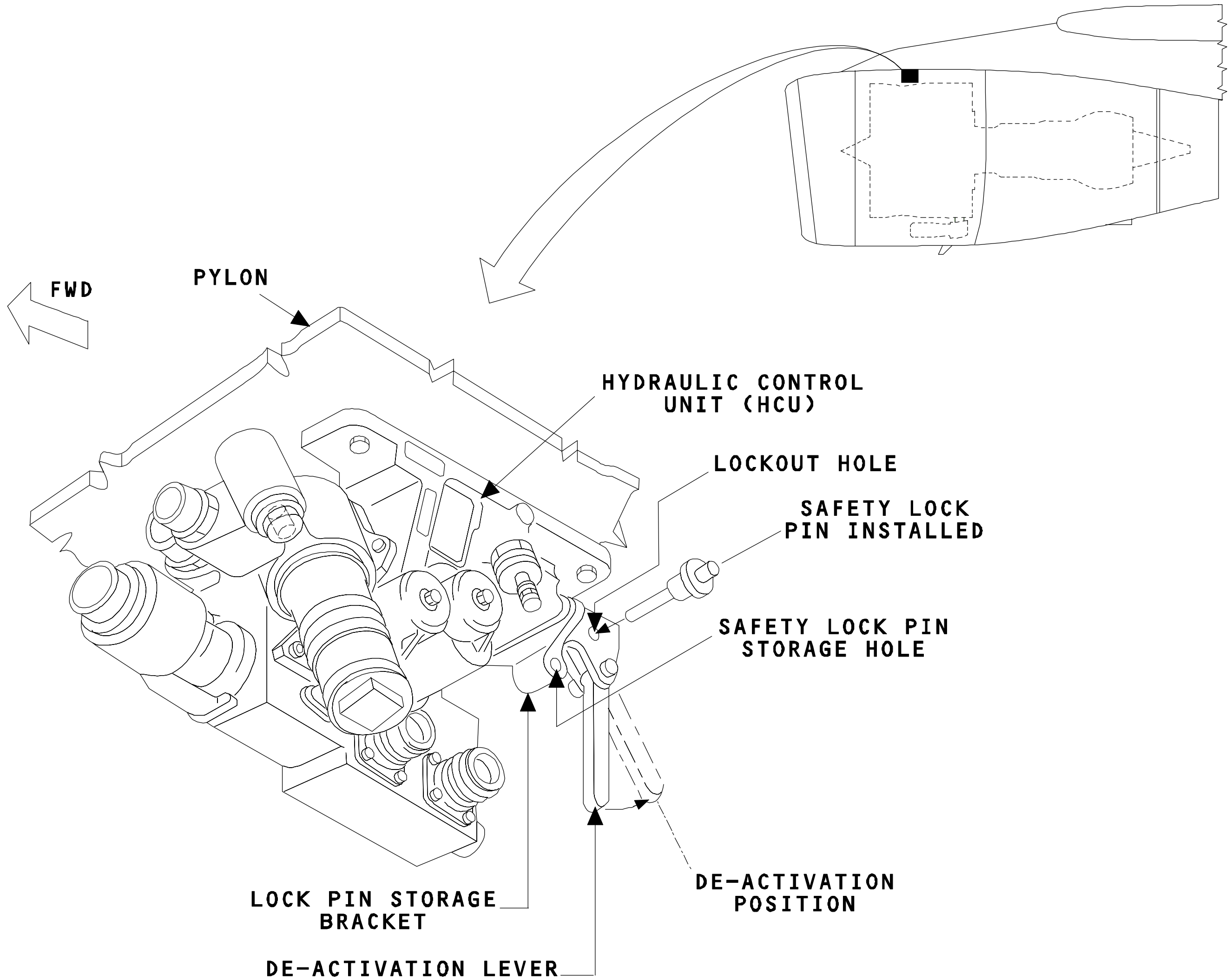
B. Make sure that engine 1 (2) has been shutdown for at least 5 minutes.

C. On panel 50VU:
- Make sure that the ON light of the ENGine FADEC GrouND PoWeR 1 (2) pushbutton is off
- Place a warning notice.

D. Open the left fan cowl door.

E. Put an access platform in position.

F. De-activate the thrust reverser through the Hydraulic Control Unit (HCU).
- Make the thrust reverser unserviceable by pushing the HCU lever to the de-activation position.
- Hold the HCU lever in the de-activation position by installing the safety lock pin (stored on the HCU).



THRUST REVERSER DE-ACTIVATION AND LOCKOUT - THRUST REVERSER DE-ACTIVATION

THRUST REVERSER DE-ACTIVATION AND LOCKOUT

THRUST REVERSER LOCKOUT

A. De-activate the thrust reverser.

NOTE: Make sure that the thrust reverser translating sleeves are in the retracted (stowed) position. If necessary, manually retract the translating sleeves.

B. Lock the left and the right translating sleeves by using the lock pins.

- For each translating sleeve:
  1. Remove the dummy pin from the upper lock-pin receptacle.
  2. Remove the thrust reverser lockout pin from the lower lock-pin receptacle and install it in the upper lock-pin receptacle.
  3. Install the dummy pin in the lower lock-pin receptacle (storage).

NOTE: The thrust reverser lockout pin has a red head which extends above the surface of the translating sleeve when it is installed in the lockout position.

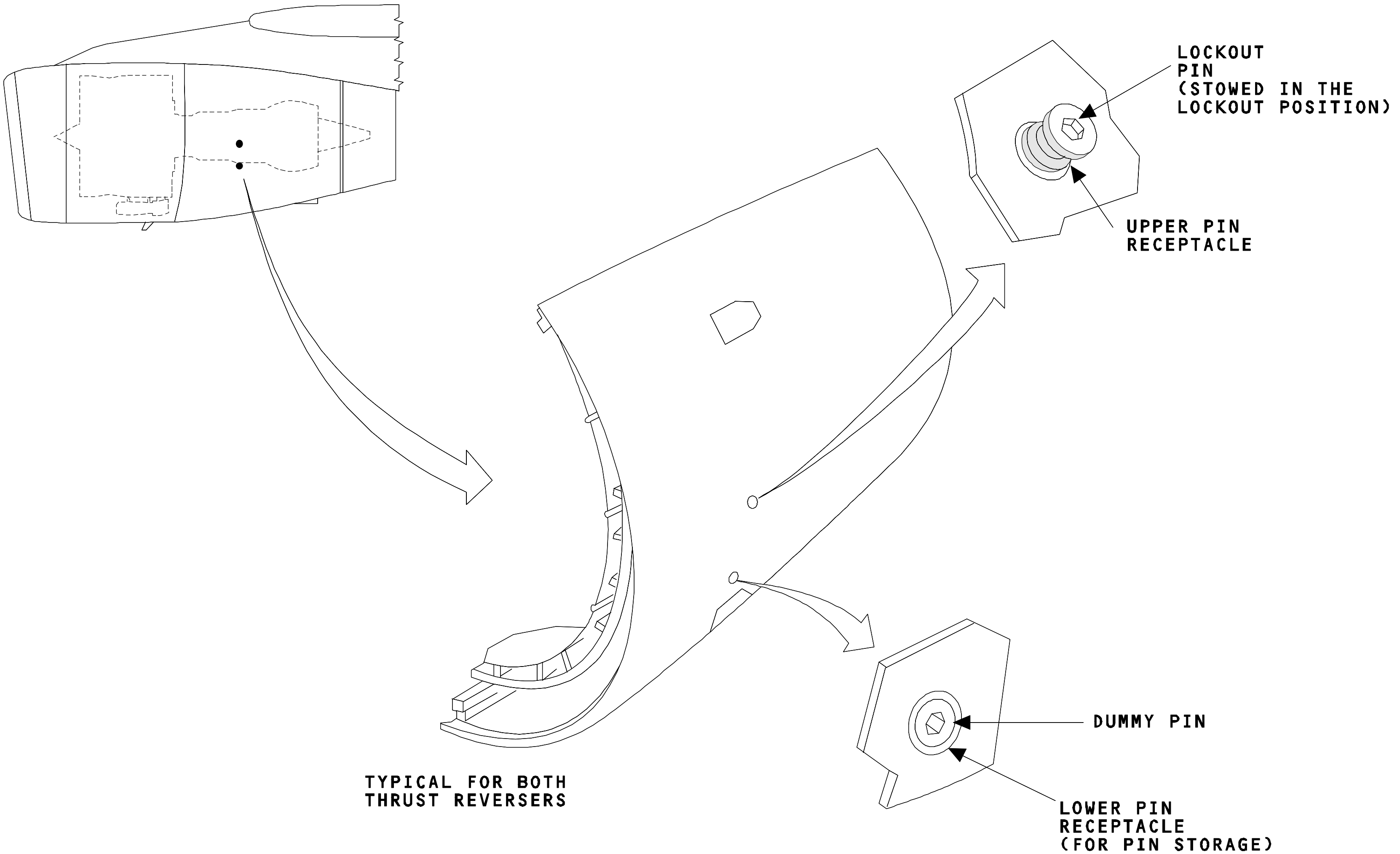
C. Make sure that the work area is clean and clear of tools and other items.

D. Remove the access platform.

E. Close the left fan cowl door.

F. Remove the warning notices from panels 115VU and 50VU.

G. In the cockpit, place a warning notice indicating that the reverser is inoperative.



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TMU70ID01-P02 LEVEL 2

THRUST REVERSER DE-ACTIVATION AND LOCKOUT - THRUST REVERSER LOCKOUT

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70 - MAINTENANCE PRACTICES

70-00-00 MANUAL OPERATION OF THE THRUST REVERSER TRANSLATING SLEEVES

CONTENTS:

MANUAL OPERATION OF THE THRUST REVERSER TRANSLATING SLEEVES

PRECAUTIONS

CAUTION: Do not extend and stow the translating sleeves with the thrust reverser "C" ducts open.
Damage to the translating sleeves, synchronizing system and the hinge access panels could occur. Do not use power tools in the manual drive sockets.

MANUAL DEPLOYMENT PROCEDURE

WARNING: The thrust reverser system should be deactivated using the Hydraulic Control Unit (HCU) lever, before working on the system or on the engine.
If not the thrust reverser can accidently operate and cause serious injuries to personnel and/or damage to the reverser.

A. On panel 115VU:
- Make sure the ENGine MASTER lever is in the OFF position
- Place a warning notice to tell persons not to start engine 1 (2).

B. Make sure that engine 1 (2) has been shutdown for at least 5 minutes.

C. On panel 50VU:
- Make sure that the ON light of the ENGine FADEC GrouND PoWeR 1 (2) pushbutton is off.
- Place a warning notice.

D. Open the fan cowl doors.

E. Put an access platform in position and gain access to the HCU.

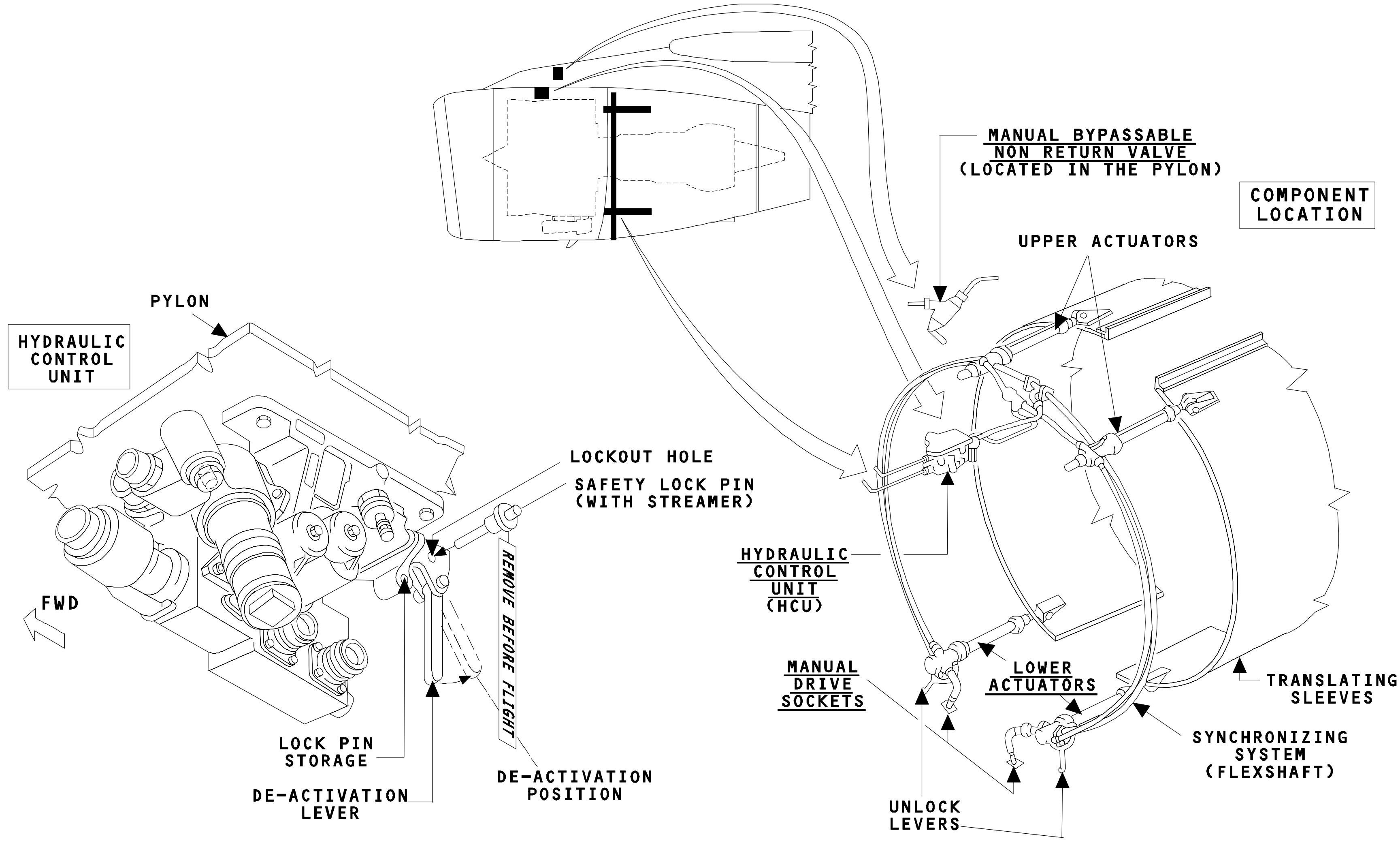
F. De-activate the thrust reverser.
- Make the thrust reverser unserviceable by pushing the HCU lever to the deactivation position.
- Hold the HCU lever in the de-activation position by installing the lock pin with streamer.

G. Gain access to the manual bypassable non return valve located in the pylon area and move its lever to the bypass position.

H. Move the unlock levers of both thrust reverser lower actuators to the unlocked position.

I. Using the manual drive socket, manually deploy the translating sleeves.
Fluid necessary to prevent hydraulic cavitation is provided by the manual bypassable non return valve.
- Insert a 3/8 inch square speed wrench in the manual drive of one translating sleeve.
- Turn it to extend the translating sleeves.

NOTE: Both translating sleeves move together due to the synchronising system.



MANUAL OPERATION OF THE THRUST REVERSER SLEEVES

UFD4200

TMU70IE01-P01 LEVEL 3

MANUAL OPERATION OF THE THRUST REVERSER TRANSLATING SLEEVES

MANUAL STOWAGE PROCEDURE

NOTE: Make sure that the aircraft is in the same configuration as for the manual deploying task.

A. Using the manual drive socket, manually stow the translating sleeves.

- Insert a 3/8 in square speed wrench in to the manual drive of one translating sleeve.
- Turn it to retract the translating sleeves.

B. When the translating sleeves reach their fully stowed position, make sure that the lower actuator is correctly engaged in the locked position.

C. Move the manual bypassable non return valve lever to its normal position.

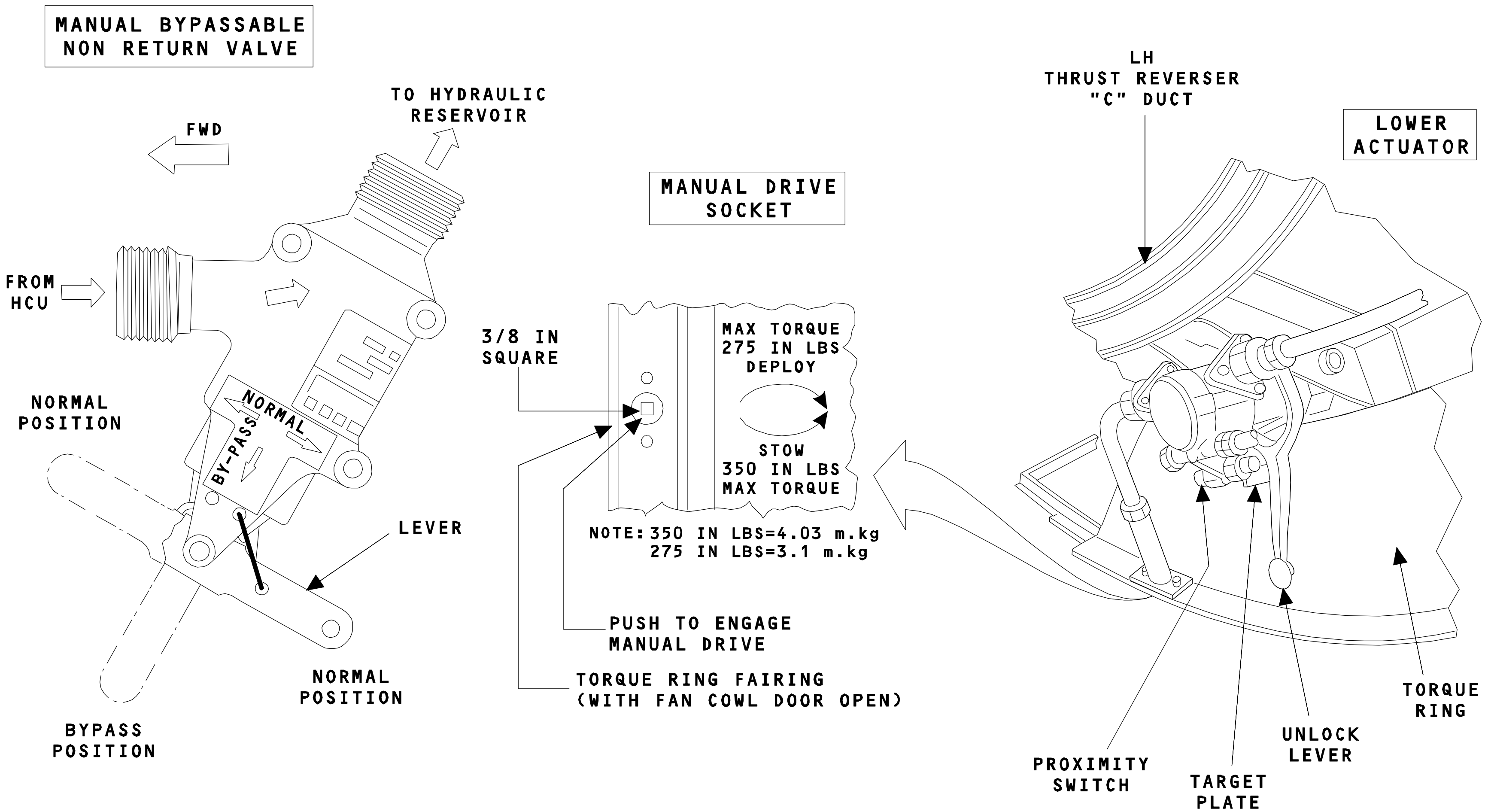
D. Re-activate the thrust reverser system using the HCU lever.

E. Make sure that the work area is clean and clear of tools and other items.

F. Remove the access platform.

G. Close the fan cowl doors.

H. Remove the warning notices from panels 115VU and 50VU.



UFD4200 TMU70IE01-P02 LEVEL 3

MANUAL OPERATION OF THE THRUST REVERSER SLEEVES

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70 - MAINTENANCE PRACTICES

70-00-00 ENGINE REMOVAL AND INSTALLATION

CONTENTS:

ENGINE REMOVAL AND INSTALLATION

PRECAUTIONS

WARNING: Make sure that you have the correct fire fighting equipment available before you start any task on the fuel system.

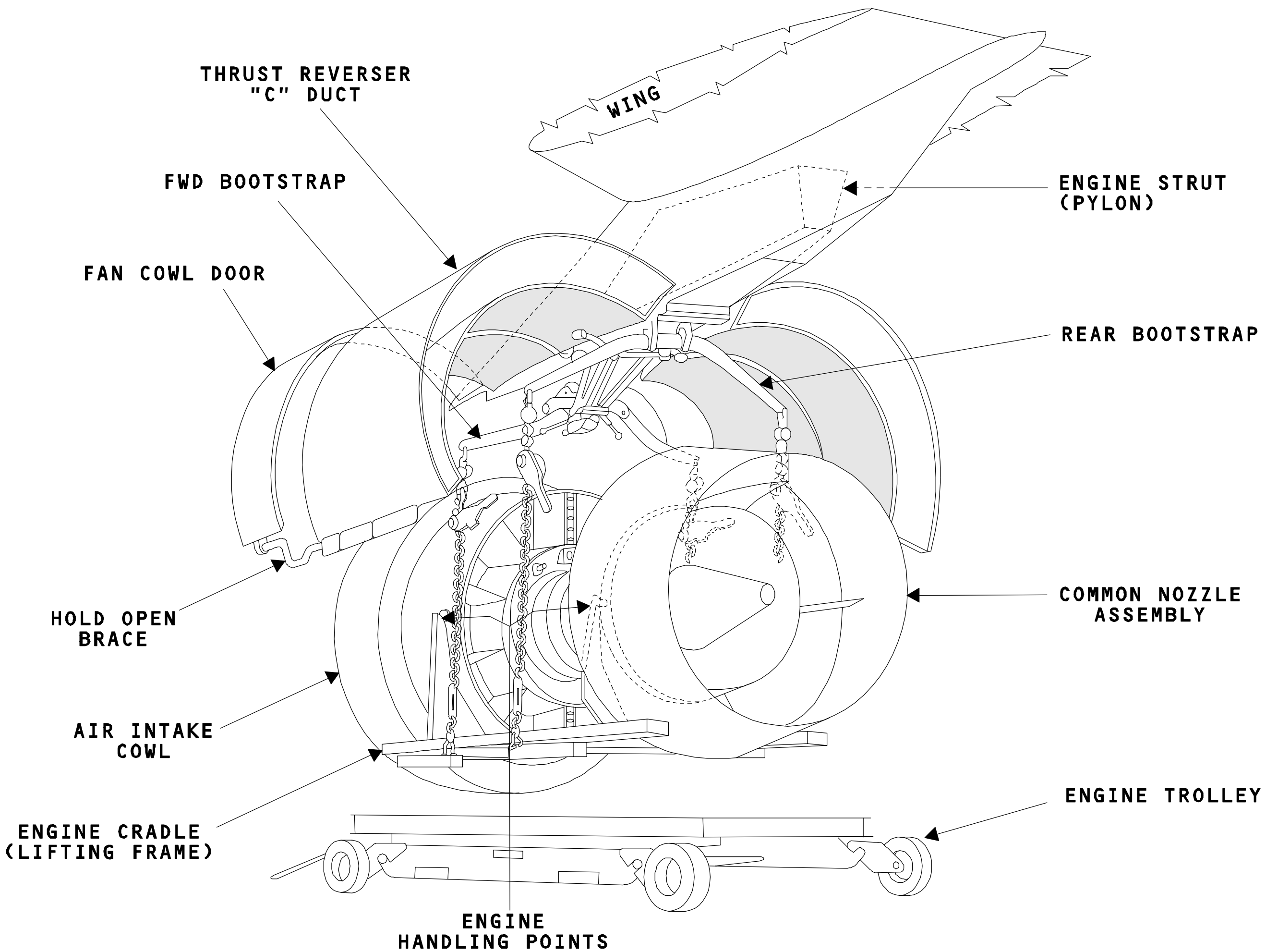
WARNING: Make sure that the landing gear safety-locks and the wheel chocks are in position.

WARNING: Put the safety devices and the warning notices in position before you start any task on or near:
- the flight controls
- the flight control surfaces
- the landing gear and the associated doors
- or any component that moves.

WARNING: Make sure that all the circuits in maintenance are isolated before you supply electrical power to the aircraft.

ENGINE REMOVAL MAIN MAINTENANCE TASK DESIGNATION

Here are listed the main tasks for engine removal.
For more information please see the procedures described in the Aircraft Maintenance Manual ATA 70-00.
A) On the engine start panel make sure that the ENGine MASTER levers are in the OFF position and put a warning notice to tell persons not to start the engine.
B) Make sure that the engine has been shut down for at least 5 minutes.
C) On the ENGine FADEC GrouND PoWeR panel make sure that the ON light is off and install a warning notice.
D) On the pneumatic/air conditioning panel make sure that the AIR BLEED pushbutton ON light is off and put a warning notice in place.
E) Put a warning notice on the HP ground connector to tell persons not to pressurize the pneumatic system.
F) Open and safety the circuit breakers concerning Engine Fire Detection, Engine Fire Extinguishing, Engine FADEC, Engine Ignition, Anti-ice system, Electrical GCU, Yellow Hydraulic Electrical Pump and Hydraulic Power.
G) Depressurize the hydraulic reservoirs (Green for Eng 1/Yellow for Eng 2).
H) Open the fan cowl doors.
I) Gain access to the Hydraulic Control Unit and deactivate the thrust reverser.
J) Open the thrust reverser "C" ducts.
K) Put access platforms in position.
L) Install cowl hold open braces and the adjustable struts to support the fan and the thrust reverser cowl doors.
M) Drain the fuel remaining in the engine and the pylon fuel hose by draining at the fuel filter level.
N) Remove these components from the right side of the engine:
- 1) Disconnect the electrical connectors at the Fan electrical connector panel.
- 2) Disconnect the electrical connectors at the core electrical junction box.
- 3) Remove the coupling and disconnect the upper starter duct from the pylon duct.
- 4) Remove the coupling and disconnect the Thermal Anti-Ice (T.A.I) duct located on the fan case close to the pylon.



ENGINE REMOVAL AND INSTALLATION - ENGINE REMOVAL

ENGINE REMOVAL AND INSTALLATION

ENGINE REMOVAL MAIN MAINTENANCE TASK DESIGNATION (Cont'd)

O) Remove these components from the left side of the engine:

- 1) Disconnect the thrust reverser harness connectors from the Hydraulic Control Unit.
- 2) Remove the couplings and disconnect the T.A.I located near the forward mount.
- 3) Remove the coupling and disconnect the cabin air duct.
- 4) Disconnect the hydraulic and fuel tubes from the fluid disconnect panel.
- 5) Disconnect the thermostat and Pressure Regulating Valve sensor tubes located forward of the pylon.
- 6) On engine 1 only, disconnect the hydraulic reservoir pressurizing tube from the union located at 11 o'clock on the combustor case.

P) Install caps on all openings and connectors.

Q) Loosen the forward engine mount bolts. Each bolt is tightened again to the maximun force an operator using a standard wrench can apply.

R) Install the bootstrap system:

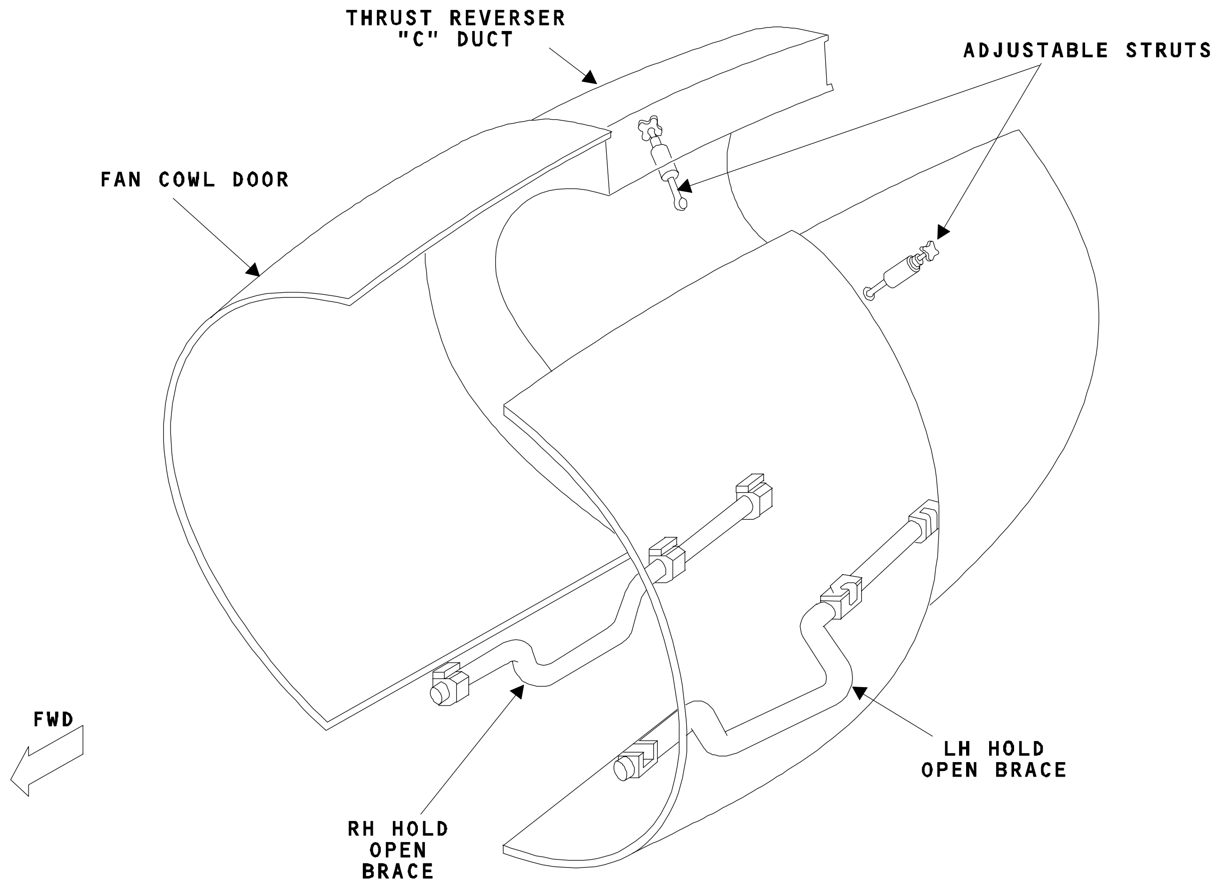
- 1) Install the center hinge clamp of the forward bootstrap on the forward mount pyramid and attach the left and right hinge arms here.
- 2) Attach the rear beam of the bootstrap equipment on the lower part of the pylon.
- 3) Install the dynamometers and the chain pulley blocks.

S) Install the front fixtures and rear supports on the left and right engine handling points located on the fan case and LP turbine frame.

T) Install the engine trolley:

- 1) Put the engine trolley and cradle in position below the engine.
- 2) Attach the chain hooks to the engine cradle.
- 3) Remove the pins which attach the engine cradle to the engine trolley.
- 4) Raise the engine cradle to the engine, using the four chain pulley blocks.
- 5) When the cradle reaches the engine, secure the front fixtures and rear supports with the cradle.

U) Remove the engine.



UFD4200

TMU70IF01-P02 LEVEL 3

ENGINE REMOVAL AND INSTALLATION - HOLD OPEN BRACES AND ADJUSTABLE STRUTS

ENGINE REMOVAL AND INSTALLATION

ENGINE REMOVAL MAIN MAINTENANCE TASK DESIGNATION (Cont'd)

ENGINE REMOVAL PROCEDURE:

WARNING: Death or serious injury may result if the power plant falls on personnel. Make sure that all personnel are away from the aircraft when the power plant is removed.

A) Disconnect the forward engine mount.
B) Disconnect the aft engine mount.
C) Make sure that no lines or unions remain connected to the pylon.
D) Lower the assembly, using the four chain pulley blocks at the same time, taking care to keep the pylon and engine mount mating faces parallel, so that the locating pins, of the engine mounts, can be easily disengaged.

NOTE: Avoid any dynamic effect during descent.

E) First put first the aft section of the engine cradle on the trolley, then the forward section.
F) Lock the engine cradle to the trolley using all pins.
G) Remove the four chain pulley blocks and dynamo- meters.
H) Remove the forward and then the rear bootstrap equipment.
I) Move the engine away from the pylon, making sure that nothing catches.

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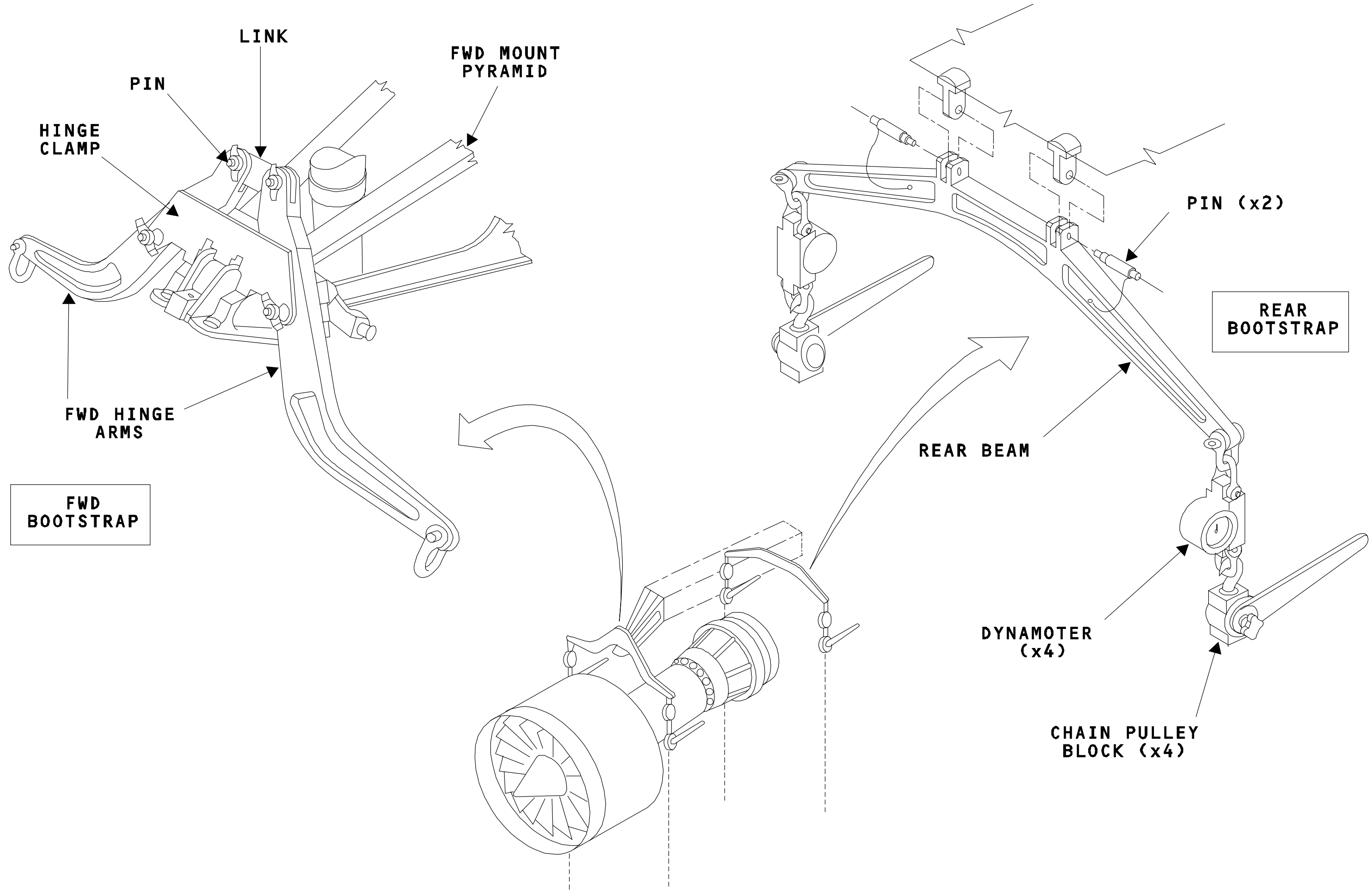
ENGINE REMOVAL AND INSTALLATION

BOOTSTRAP EQUIPMENT

The bootstrap system consists of:

- A forward hinge clamp and left and right forward arms which form the forward bootstrap equipment.
- A rear beam which forms the rear bootstrap equipment.

Four chain pulley blocks and dynamometers complete the equipment.
To support the fan and thrust reverser cowl doors during engine removal and installation, special hold open braces and adjustable struts are installed. This enables the engine to be changed under the wing without removing the fan cowl doors and the thrust reverser "C" ducts.



ENGINE REMOVAL AND INSTALLATION - BOOTSTRAP EQUIPMENT

UFD4200
TMU70IF01-P04 LEVEL 3

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70 - MAINTENANCE PRACTICES

70-00-00 MAINTENANCE OPERATIONS

CONTENTS:

MAINTENANCE OPERATIONS

FAN COWL DOORS - REMOVAL/INSTALLATION

WARNING: DO NOT OPEN THE FAN COWL DOOR(S) WHEN THE WIND SPEED IS 60 MPH (96KPH) OR MORE. INJURY AND/OR DAMAGE TO THE ENGINE CAN OCCUR IF THE WIND MOVES THE FAN COWL DOOR(S).

REMOVAL

1. Job Set-Up
A. On panel 115 VU, put a warning notice to tell persons not to start engine 1(2), and ensure that engine 1(2) has been shut down for at least 5 minutes.
B. On panel 50 VU, make sure that the ON light of the ENGine FADEC GrouND PoWeR pushbutton is off and install a warning notice.
C. Put the access platform in position.
D. Remove the caps from the fan cowl sling points.
E. Attach the sling to the hoist and to the lower fan cowl.

2. Procedure
A. Open the fan cowl door.
B. Remove the hinge bolts.
C. Remove and carry-up the fan cowl door onto the fan cowl work-stand.
D. Remove the sling.
E. Install the caps in the fan cowl door.

INSTALLATION

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
B. Remove the caps from the fan cowl door sling points.
C. Attach the sling to the hoist and to the fan cowl door.
D. Remove the fan cowl door from the fan cowl work-stand with the sling and the hoist.
E. Clean the fan cowl hinges and the pylon hinges with a lint free cloth made moist with cleaning fluid.
F. Examine the fan cowl hinges and the pylon hinges and make sure that they are not damaged.

2. Procedure
A. Install the fan cowl door.
B. Install the hinge bolts.
C. Lower the fan cowl door and remove the sling.
D. Make sure that the fan cowl latches are aligned.
E. Install the caps on the fan cowl door sling points.

3. Close-Up
A. Make sure that the work area is clean and clear of tools and other items.
B. Close the fan cowl door
C. Remove the access platform.
D. Remove the warning notice from the cockpit.

MAINTENANCE OPERATIONS

THRUST REVERSER "C" DUCTS - REMOVAL/INSTALLATION

WARNING: DO NOT GET HYDRAULIC FLUID ON YOUR SKIN, IN YOUR MOUTH OR IN YOUR EYES. HYDRAULIC FLUID IS POISONOUS AND CAN GO THROUGH YOUR SKIN AND INTO YOUR BODY. FLUSH HYDRAULIC FLUID FROM YOUR MOUTH OR YOUR EYES AND GET MEDICAL AID.

WARNING: BE CAREFUL DURING THE REMOVAL OR INSTALLATION OF THE THRUST REVERSER "C" DUCT, IT WEIGHS 580LBS (263KG).

CAUTION: DO NOT OPEN OR REMOVE THE THRUST REVERSER "C" DUCTS IF THE WING LEADING EDGE SLATS ARE EXTENDED. THIS WILL CAUSE DAMAGE TO THE THRUST REVERSER, THE WING LEADING EDGE SLATS AND THE WING.

REMOVAL

1. Job Set-up
A. On panel 115VU, put a warning notice to tell persons not to start the engine.
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Open the fan cowl door
E. De-activate the thrust reverser Hydraulic Control Unit (HCU).
F. Remove the thrust reverser pylon fairing if the thrust reverser is deployed.
G. Remove the hinge access panel.
H. Attach the Thrust Reverser (T/R) sling.
I. Open the T/R "C" duct latches.
J. With the T/R sling and hoist, open the T/R "C" duct as a door and support its weight.

2. Procedure
A. Disconnect the pylon wire harness electrical connector from the receptacle at the top of the T/R "C" duct.
B. Disconnect the hydraulic hoses from the thrust reverser upper actuator.
C. Put the applicable caps on all the openings.
D. Disconnect the opening actuator.
E. Slowly lower the T/R "C" duct to 30 cm (12 inches) from the closed position.
F. Remove the hinge bolts from No 1, 2 and 3 hinge positions, and the hinge bolt and sleeve from the N°4 hinge position .
G. Remove the T/R "C" duct.
H. Put the T/R "C" duct on the dolly.
I. Remove the thrust reverser sling from the T/R "C" duct.

MAINTENANCE OPERATIONS

THRUST REVERSER "C" DUCTS - REMOVAL/INSTALLATION (Cont'd)

INSTALLATION

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
2. Preparation for installation
A. Remove the applicable caps.
B. Attach the T/R sling.
C. Remove the tie-down strap and lift the T/R "C" duct from the dolly.

3. Procedure
A. Install the T/R "C" duct and secure hinge bolts Nos 1, 2, 3 and 4.
B. Remove the T/R sling from the upper hoist point on the T/R "C" duct and keep the other two sling points attached.
C. Open the T/R "C" duct with the hoist.
D. Attach the T/R "C" duct opening actuator.

WARNING: MAKE SURE THAT THE HYDRAULIC HAND PUMP HOSE IS CORRECTLY CONNECTED TO THE T/R "C" DUCT OPENING ACTUATOR, IF NOT THE T/R "C" DUCT CAN CLOSE QUICKLY AND CAUSE INJURY TO PERSONS BETWEEN THE T/R "C" DUCT AND THE ENGINE.

E. Connect the electrical connector from pylon to the T/R "C" duct electrical receptacle.
F. Connect the retract hydraulic hose and the extend hydraulic hose/flexshaft assembly to the thrust reverser upper actuator.
G. Bleed the air from the T/R "C" duct opening system.

WARNING: MAKE SURE THAT ALL THE TRAPPED AIR IS BLED FROM THE SYSTEM, IF NOT TRAPPED AIR WILL CAUSE AN IRREGULAR CLOSE RATE OF THE THRUST REVERSER "C" DUCT.

4. Close-Up
A. Make sure that the T/R "C" duct is closed correctly.
B. Remove the T/R sling from the T/R "C" duct.
C. Install the hinge access panel with the 11 screws.
D. Install the T/R pylon fairing, if it has been removed, and activate the T/R Hydraulic Control Unit (HCU).
E. Remove the warning notices and close the fan cowl door.

MAINTENANCE OPERATIONS

COMMON NOZZLE ASSEMBLY - REMOVAL/INSTALLATION

REMOVAL

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Open the fan cowl door and the thrust reverser "C" ducts.
F. Put the access platform in position.
G. Install the equipment support.

2. Procedure
A. Remove the common nozzle assembly.

INSTALLATION

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.

2. Procedure
A. Install the common nozzle assembly.
B. Remove the equipment support,
C. Torque the bolts in sequence.

3. Close-Up
A. Make sure that the work area is clean and clear of tools and other items.
B. Remove the access platform.
C. Close the thrust reverser "C" ducts and the fan cowl doors.
D. Remove the warning notices.

MAINTENANCE OPERATIONS

AIR INTAKE COWL - REMOVAL/INSTALLATION

REMOVAL

WARNING: BE CAREFUL DURING THE REMOVAL OF THE AIR INTAKE COWL, IT WEIGHS 238LBS (108KG).

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2) and make sure that engine 1(2) has been shut down for at least 5 minutes.
B. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
C. Open the fan cowl doors.
D. Put the equipment support in position.
E. Attach the sling to the hoist and to the air intake cowl.

2. Procedure
A. Remove the coupling at the anti-ice duct connection and discard the seal.
B. Disconnect the four electrical connectors from the air intake cowl aft bulkhead.
C. Disconnect the P2/T2 tube connection from the air intake cowl aft bulkhead.
D. Remove the air intake cowl and move it forward, lower and safety it on the air intake cowl transit case/work-stand.
E. Put caps on all openings and electrical connectors.
F. Remove the sling from the air intake cowl.
G. Put the fan case cover on the fan case.

INSTALLATION

WARNING: BE CAREFUL DURING THE INSTALLATION OF THE AIR INTAKE COWL, IT WEIGHS 238LBS (108KG).

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
B. Remove the fan case cover.
C. Attach the sling to the hoist and to the air intake cowl.
D. Remove the caps from the openings and electrical connectors.
E. Use a lint free cloth, made moist with cleaning fluid to clean the parts to install.

WARNING: DO NOT GET THE CLEANING FLUID ON YOUR SKIN, IN YOUR EYES OR IN YOUR MOUTH, THE CLEANING FLUID IS POISONOUS. FLUSH CLEANING FLUID FROM YOUR EYES, MOUTH OR SKIN WITH WATER. USE ONLY IN AN AREA OPEN TO THE AIR.

F. Examine the front flange of the engine fan case and the rear flange of the air intake cowl for damage.

2. Procedure
A. Remove the air intake cowl from the air intake cowl transit-case/work-stand and install it.
B. Remove the sling.
C. Connect the anti-ice duct.
D. Connect the P2/T2 tube.
E. Connect the four electrical connectors.

MAINTENANCE OPERATIONS

AIR INTAKE COWL - REMOVAL/INSTALLATION (Cont'd)

3. Close-Up
A. Make sure that the work area is clean and clear of tools and other items.
B. Close the fan cowl doors.
C. Remove the equipment support, access platform, warning notices and the air intake cowl transitcase/work-stand.

4. Test
A. Perform an operational test and a leak test of the engine air intake ice protection system.
B. Perform an operational test of the FADEC.

MAINTENANCE OPERATIONS

FAN BLADE - REMOVAL/INSTALLATION

REMOVAL

CAUTION: DO NOT LET TOOLS, PARTS OR UNWANTED MATERIALS FALL ON THE AIR INTAKE COWL SURFACE WHEN YOU USE THE WORKMAT. TO PREVENT THIS, SEAL THE EDGES OF THE WORKMAT WITH TAPE BEFORE YOU USE IT.

CAUTION: BE CAREFUL DURING THE REMOVAL OF THE FRONT BLADE RETAINING RING AND THE STAGE 1 FAN BLADE, THEY EACH WEIGH APPROXIMATELY 10LBS (4.5KG).

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pusbutton is off and install a warning notice.
D. Put the access platform and the workmat in position.

2. Procedure
A. Remove the inlet cone.

CAUTION: DO NOT PUT ANY TOOLS OR PARTS THAT ARE REMOVED IN THE STAGE 1 FAN DISK INNER SURFACE.
B. Remove the front blade retaining ring.
C. Remove the stage 1 fan blade and the annulus fillers and put it into the blade storage container.

INSTALLATION

WARNING: DO NOT LET ENGINE OIL STAY ON YOUR SKIN A LONG TIME, IT IS POISONOUS AND CAN GO THROUGH YOUR SKIN AND INTO YOUR BODY.

CAUTION: BE CAREFUL DURING THE INSTALLATION OF THE FRONT BLADE RETAINING RING AND THE STAGE 1 FAN BLADE, THEY EACH WEIGH APPROXIMATELY 10LBS (4.5KG).

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
B. Make sure that there is no damage on the different elements to install.

3. Procedure
A. Install the stage 1 fan blade.
B. Install the front blade retaining ring.
C. Install the annulus fillers to the front blade retaining ring attachment bolts.
D. Install the inlet cone.

4. Close-Up
A. Remove the workmat and the access platform from the air intake cowl.
B. Make sure that the work area is clean and clear of tools and other items and remove warning notices.

5. Test
A. Perform a balance and vibration check.

MAINTENANCE OPERATIONS

FAN MODULE - REMOVAL/INSTALLATION

REMOVAL

WARNING: BE CAREFUL DURING THE REMOVAL OF THE FAN MODULE, IT WEIGHS APPROXIMATELY 395LBS (179KG).

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Put the access platform in position to gain access to the engine for the removal of the fan module.
E. Open the fan cowl doors to remove the air intake cowl.
F. Close the previously opened fan cowl doors.

2. Procedure
A. Remove the inlet cone.
B. Install the hub protector.

WARNING: PUT APPROVED GLOVES ON YOUR HANDS BEFORE YOU HOLD THE FAN BLADES. THE LEADING EDGES OF THE FAN BLADES CAN CAUSE INJURY TO YOUR HANDS.

CAUTION: DO NOT TOUCH THE STAGE 1 FAN DISK WITH TOOLS WHEN YOU LOOSEN OR REMOVE THE CURVIC COUPLING BOLTS.

CAUTION: THERE ARE TWENTY FOUR CURVIC COUPLING BOLTS WHICH ATTACH THE FAN MODULE TO THE LP COMPRESSOR/ INTERMEDIATE CASE MODULE. DURING REMOVAL OF THE FAN MODULE, KEEP THREE OF THE BOLTS IN POSITION UNTIL AFTER THE INSTALLATION OF THE SUPPORT AND SLINGING TOOLS. OBSERVE THE CORRECT UNTORQUE PROCEDURE AND PLACE THE HUB PROTECTOR.

C. Untorque the curvic coupling bolts 1/4 turn.
D. Remove 3 bolts 120° apart and replace with alignment pins.
E. Keep 3 bolts adjacent to the alignment pins and remove the other 18 bolts.
F. Remove the hub protector.
G. Install the support and slinging tools

WARNING: BE CAREFUL DURING THE ASSEMBLY OF THE CANTILEVER SLING AND THE SLING ADAPTER, THE SLING WEIGHS 165LBS (75KG) AND THE ADAPTER WEIGHS 74LBS (34KG).

H. Remove the remaining curvic coupling bolts.
I. Remove the fan module from the engine.
J. Install the protective cover on the curvic teeth of the stage 1 fan disk of the fan module and safety it with bolts and washers.
K. Install the fan module on the storage stand.

CAUTION: MAKE SURE THAT THE QUICK RELEASE PIN IS INSTALLED IN THE INNER HOLES IN THE CANTILEVER SLING BRACKET BEFORE MOVING THE FAN MODULE/SLINGING ASSEMBLY.

CAUTION: PUT TWO PERSONS ON EACH SIDE OF THE FAN MODULE BEFORE MOVING THE FAN MODULE/SLINGING TOOL ASSEMBLY.

MAINTENANCE OPERATIONS

FAN MODULE - REMOVAL/INSTALLATION (Cont'd)

L. Remove the slinging tools from the fan module.
M. Install a clamp on the front hub of the stage 1 fan disk and safety with a wing nut on the storage stand
N. Install the protection cover on the LP compressor fan case.

WARNING: DO NOT GET ENGINE OIL ON YOUR SKIN FOR A LONG TIME, THE OIL IS POISONOUS AND CAN GO THROUGH YOUR SKIN AND INTO YOUR BODY.

INSTALLATION

WARNING: BE CAREFUL DURING THE INSTALLATION OF THE FAN MODULE, IT WEIGHS APPROXIMATELY 395LBS (179 KG).

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
2. Preparation for installation
A. Remove the wing nut and the clamp from stage 1 fan disk on the storage stand.
B. Install the slinging tools on the fan module.

WARNING: BE CAREFUL DURING THE INSTALLATION OF THE CANTILEVER SLING AND THE SLING ADAPTER, THE SLING WEIGHS 165LBS (75KG) AND THE ADAPTER 74 LBS (34KG).

C. Remove the fan module from the storage stand.

WARNING: PUT APPROVED GLOVES ON YOUR HANDS BEFORE YOU HOLD THE FAN BLADES. THE LEADING EDGES OF THE FAN BLADES CAN CAUSE INJURY TO YOUR HANDS.

CAUTION: PUT TWO PERSONS ON EACH SIDE OF THE FAN MODULE BEFORE MOVING THE FAN MODULE/SLING TOOL ASSEMBLY.

CAUTION: MAKE SURE THAT THE QUICK RELEASE PIN IS INSTALLED IN THE INNER HOLES IN THE CANTILEVER SLING BRACKET BEFORE MOVING THE FAN MODULE/SLINGING TOOL ASSEMBLY.

D. Remove the protection cover from the LP compressor fan case.
E. Remove the retaining protector from the stub shaft.
F. Clean the two halves of the curvic coupling
G. Examine the curvic coupling and other parts for damage.

3. Procedure
A. Install the alignment pins.

CAUTION: DO NOT TOUCH THE STAGE 1 FAN DISK WITH TOOLS WHEN YOU INSTALL OR TIGHTEN THE CURVIC COUPLING BOLTS.

B. Ensure the fan module correlation marks are correctly aligned.
C. Install the fan module on the engine and secure with 4 bolts.
D. Remove the support and slinging tools.
E. Remove the alignment pins.
F. Install the hub protector.

MAINTENANCE OPERATIONS

FAN MODULE - REMOVAL/INSTALLATION (Cont'd)

G. Install the remaining 20 curvic coupling bolts.
H. Torque load the curvic coupling bolts in sequence.

CAUTION: DO NOT USE A POWER WRENCH TO TIGHTEN THE BOLTS.
THE USE OF A POWER WRENCH CAN CAUSE DAMAGE TO THE BOLTS.

CAUTION: WHEN YOU TORQUE THE CURVIC COUPLING BOLTS, IT IS IMPORTANT THAT THE TORQUE VALUE IS ON THE INCREASE.
A NEW BOLT MUST BE INSTALLED IF THE TORQUE VALUE IS CONSTANT OR DECREASES.

I. Remove the hub protector.
J. Install the inlet cone.

4. Close-Up
A. Open the fan cowl doors to Install the air intake cowl and close them.
B. Remove the access platform and the warning notices.

5. Test
A. Perform a vibration survey during the next engine ground run.

MAINTENANCE OPERATIONS

ENGINE BORESCOPE - INSPECTION/CHECK

Here are listed the main tasks of the engine borescope inspection. For more information please see the procedures described in the Airbus Maintenance Manual ATA 72-00.

NOTE: The borescope inspection requires skill and competence.

1. Job Set-Up

A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Open the fan cowl doors and the thrust reverser "C" duct.
E. Install the access platform and prepare the borescope equipment.

2. Procedures

INSPECTION OF THE STAGE 1.5 AND 2.5 LP COMPRESSOR BLADES

A. Put the guide tube and the borescope probe in position to examine the stage 1.5 blades.

CAUTION: BE CAREFUL DURING INSTALLATION AND REMOVAL OF THE GUIDE TUBE NOT TO CAUSE DAMAGE TO THE OUTER OR INNER OUTLET GUIDE VANES.

B. Examine the front surface of each stage 1.5 LP compressor blade for damage.
C. Remove the borescope probe and the guide tube.
D. Put the guide tube and the borescope probe in position to examine the stage 2.5 LP compressor blades.
E. Examine the rear surface of each stage 2.5 LP compressor blade for damage.
F. Remove the borescope probe and the guide tube.

INSPECTION OF THE HP COMPRESSOR

A. Remove the borescope access port covers for the stages of the compressor you want to examine.
B. Install the rotator kit on the cranking pad near the starter for manual drive of the HP rotor.
C. Install the borescope probe.
D. Examine each HP compressor blade for damage.
E. Remove the borescope probe and the rotator kit used to turn the HP rotor.
F. Clean the access port mating faces.

WARNING: IF YOU GET FLUID ON YOUR SKIN OR IN YOUR EYES, FLUSH IT AWAY WITH CLEAN WATER AND GET MEDICAL AID.

G. Install the borescope access port covers.

MAINTENANCE OPERATIONS

ENGINE BORESCOPE - INSPECTION/CHECK (Cont'd)

INSPECTION OF THE COMBUSTION CHAMBER AND HPT FIRST STAGE VANES

CAUTION: THE LIMITS WHICH FOLLOW ARE APPLICABLE ON A CONTINUE IN SERVICE BASIS ONLY. EACH LIMIT IS BASED ON WHAT THE STRUCTURE OF THE VANE MUST BE AND DOES NOT INDICATE THAT THERE WILL NOT BE DETERIORATION OF THE ENGINE PERFORMANCE, STABILITY, OPERATING LIMITS OR PART REPAIRABILITY.

A. Get access to the combustion chamber and the HPT 1st stage vanes through five borescope ports and the two igniter ports.
B. Examine the combustion chamber, fuel injectors and the first stage vanes for damage.
C. Close the borescope and igniter ports.

INSPECTION OF THE STAGE 1 HPT BLADES

A. Install the rotator kit on the gearbox crank pad for manual drive of the HP rotor.
B. Prepare the borescope equipment for inspection.
C. Get access to the stage 1 HPT blades through the igniter port.

CAUTION: MAKE SURE THAT THE BORESCOPE TIP IS NOT IN THE PATH OF THE STAGE 1 HPT BLADES BEFORE ROTATING THE ENGINE.

D. Examine the blades for damage.
E. Get access to the stage 1 HPT blades through the HP turbine borescope ports.
F. Close the borescope and the igniter ports.
G. Remove the rotator kit from the gearbox crank pad.

INSPECTION OF THE STAGE 2 HPT BLADES

A. Install the rotator kit on the gearbox crank pad.
B. Prepare the borescope equipment for inspection.
C. Get access to the stage 2 HPT blades through the HP turbine borescope ports

WARNING: MAKE SURE THAT THE BLANKING PLUG IS SUFFICIENTLY COOL BEFORE REMOVAL, THE TEMPERATURE STAYS HIGH FOR A SHORT TIME AFTER ENGINE SHUTDOWN.

D. Examine the stage 2 HPT blades for damage.
E. Close the borescope inspection ports and remove the rotator kit from gearbox crank pad.

INSPECTION OF THE STAGE 3 LP1 TURBINE

A. Prepare the borescope equipment for inspection.
B. Remove the LP turbine borescope port covers.
C. Examine the stage 3 turbine blades and shrouds for damage.
D. Close the borescope ports of the LP turbine when the inspection is completed.
E. Install the borescope port covers.

3. Close-Up

A. Make sure that the work area is clean and clear of tools and other items.
B. Remove the access platforms.
C. Close the fan cowl doors and the thrust reverser "C" duct.
D. Remove the warning notices.

MAINTENANCE OPERATIONS

AIR STARTER - REMOVAL/INSTALLATION

WARNING: DO NOT LET ENGINE OIL STAY ON YOUR SKIN FOR A LONG TIME, THE OIL IS POISONOUS AND CAN GO THROUGH YOUR SKIN AND INTO YOUR BODY.

WARNING: BE CAREFUL DURING REMOVAL OR INSTALLATION OF THE STARTER, IT WEIGHS 33LBS (15KG).

REMOVAL

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Open the fan cowl door.

2. Procedure
A. Remove the lower air duct from the starter.
B. Remove the starter.
C. Install caps on all openings.

INSTALLATION

CAUTION: DURING INSTALLATION OF THE AIR DUCT, DO NOT PUT MORE STRESS THAN IS NECESSARY ON THE DUCT.

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.
B. Make sure that the replacement starter is not damaged.

2. Preparation for installation
A. Remove caps from all openings.
B. Lubricate the new sealing ring with engine oil and install it on the starter drive shaft.
C. Make sure that the adapter mating flange is not damaged.

3. Procedure
A. Install the starter in the adapter housing.
B. Install the lower duct.
C. Add engine oil to the starter.

4. Preparation for test.
A. Make sure that the work area is clean and clear of tools and other items.
B. Close the fan cowl doors.

5. Test
A. Perform an engine ground run to make sure that the engine starter system operates.
B. Perform a leak check of the engine starter system after the first ground run.

6. Close-Up
A. Remove the warning notices.

MAINTENANCE OPERATIONS

IDG - REMOVAL/INSTALLATION

WARNING: BE CAREFUL DURING THE REMOVAL OR THE INSTALLATION OF THE IDG, IT WEIGHS 124LBS (60KG).

WARNING: DO NOT LET ENGINE OIL ON YOU SKIN FOR A LONG TIME, THE OIL IS POISONOUS AND CAN GO THROUGH YOU SKIN AND INTO YOUR BODY.

CAUTION: DO NOT LET ENGINE OIL FALL ON THE ENGINE, UNWANTED OIL MUST BE REMOVED IMMEDIATELY.THE OIL CAN CAUSE DAMAGE TO THE SURFACE PROTECTION AND TO SOME PARTS.

WARNING: DO NOT TOUCH THE FUEL OR OIL SYSTEM COMPONENTS FOR A SHORT TIME AFTER THE ENGINE SHUT DOWN, THE ENGINE COMPONENTS STAY HOT FOR SOME TIME AND CAUSE INJURY.

REMOVAL

1. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start the engines.
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pusbutton is off and install a warning notice.
D. Open the fan cowl doors.
E. Drain the oil from the IDG.

2. Procedure

A. Disconnect the electrical connections.
B. Put the clean container, minimum capacity 2 US gallons below the oil tubes.
C. Disconnect the oil tubes.
D. Remove the transferrable parts.
E. Remove the IDG and install it on an IDG removal/installation dolly.

CAUTION: HELP THE IDG OUT IN A STRAIGHT LINE, THE INPUT SHAFT CAN CATCH AND CAUSE DAMAGE TO THE INPUT SEAL.

CAUTION: DO NOT USE EXTERNAL PARTS OR TOOLS TO PULL THE IDG FROM THE GEARBOX, THEY CAN CAUSE DAMAGE.

F. Remove the clean container.
G. Put applicable covers/caps/plugs on all exposed openings and electrical connections.

INSTALLATION

1. Job Set-Up
A. Make sure that the aircraft is in the same configuration as for the removal task.

2. Preparation of the replacement IDG
A. Remove all the applicable covers/caps/plugs from the openings and the electrical connectors.
B. Use a lint free cloth, made moist with cleaning fluid to clean the overflow drain valve and the charging valve.
C. Examine the valves for damage and install them.

MAINTENANCE OPERATIONS

IDG - REMOVAL/INSTALLATION (Cont'd)

3. Preparation for installation
A. Clean the IDG mounting pad.
B. Make sure that the mounting pad is not damaged.
C. Install the IDG removal/installation dolly on an applicable hoist and to the IDG.

4. Procedure
A. Install the IDG, make sure that the OPEN marks on the QAD coupling are aligned.

CAUTION: DO NOT APPLY SIDE LOADS WHICH COULD BEND THE SPLINED DRIVE SHAFT DURING THE INSTALLATION OF THE IDG. A BENT SPLINED DRIVE SHAFT WILL PREVENT CORRECT INSTALLATION OF THE IDG AND DAMAGE IT IN OPERATION.

CAUTION: MAKE SURE THAT YOU NOT DAMAGE THE INPUT SEAL DURING THE INSTALLATION OF THE IDG.

B. Attach the QAD coupling.
C. Use a lint free cloth, made moist with cleaning fluid to clean the banjo couplings and make sure that they are not damaged.
D. Install the banjo couplings.
E. Remove the IDG removal/installation dolly from the IDG and the hoist.

CAUTION: MAKE SURE THAT THE TUBES ARE NOT STRESSED, THIS CAN CAUSE DAMAGE.

F. Connect the IDG oil cooling tubes.
G. Connect the electrical connectors to the IDG.

CAUTION: THE SQUARE WASHERS MUST BE INSTALLED BETWEEN THE PHASE CABLES AND THE TERMINAL BLOCK ON THE IDG TO PREVENT THE TERMINAL BLOCK BECOMING HOT AND CAUSING DAMAGE TO THE IDG.

H. Connect the output cables at the terminal block
I. Install the cover to the terminal block.

5. Preparation for test
A. Remove the warning notice from the cockpit.
B. Fill the IDG with oil.

6. Close-Up
A. Make sure that the work area is clean and clear of tools and other items.
B. Close the fan cowl doors.

7. Test
A. Perform an oil leak test, leaks are not permitted.
B. Perform an operational test, check the IDG output values.

MAINTENANCE OPERATIONS

IDG - SERVICING

WARNING: DO NOT TOUCH THE IDG SYSTEM COMPONENTS FOR A SHORT TIME AFTER THE ENGINE IS SHUTDOWN. THE ENGINE COMPONENTS STAY HOT FOR SOME TIME AND CAN CAUSE INJURY.

WARNING: DO NOT LET ENGINE OIL STAY ON YOUR SKIN FOR A LONG TIME, THE OIL IS POISONOUS AND CAN GO THROUGH YOUR SKIN AND INTO YOUR BODY.

WARNING: YOU MUST PUT THE DRAIN HOSE INTO A CONTAINER BEFORE YOU CONNECT THE DRAIN HOSE TO THE OVERFLOW DRAIN VALVE. MAKE SURE THAT THE DRAIN HOSE HANGS DOWN VERTICALLY AND THE END OF THE HOSE IS ABOVE THE OIL LEVEL IN THE CONTAINER. WHEN YOU CONNECT THE DRAIN HOSE TO THE IDG, YOU RELEASE THE OIL PRESSURE AND OIL WILL SPRAY FROM THE DRAIN HOSE.

CAUTION: DO NOT LET ENGINE OIL FALL ON THE ENGINE, UNWANTED OIL MUST BE REMOVED IMMEDIATELY. THE OIL CAN CAUSE DAMAGE TO THE SURFACE PROTECTION AND TO SOME PARTS.

CAUTION: THE DRAIN HOSE MUST BE CONNECTED TO LET THE OIL IN THE IDG DRAIN TO THE CORRECT LEVEL. THE IDG CAN BECOME TOO HOT IF IT CONTAINS TOO MUCH OIL.

CAUTION: DO NOT OPERATE THE IDG WITHOUT SUFFICIENT OR WITH TOO MUCH OIL, THIS WILL CAUSE DAMAGE TO THE IDG.

CAUTION: WHEN YOU SERVICE THE IDG OIL SYSTEM, DO NOT MIX TYPES OR BRANDS OF OIL.

SERVICING OF THE IDG OIL SYSTEM

1. Reason for the Job
A. To make a check of the IDG oil level.
B. To give instructions for filling or draining the IDG oil system to obtain a correct IDG oil level.

2. Job Set-Up
A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shut down for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pushbutton is off and install a warning notice.
D. Open the fan cowl door.

3. Procedure
A. Check of the IDG oil level.
1. Check that the oil level in the IDG sight glass is in the green band (5 minutes after engine shut down).

MAINTENANCE OPERATIONS

IDG - SERVICING (Cont'd)

B. Prepare the IDG for servicing.

WARNING: YOU MUST PUT THE DRAIN HOSE ON THE OVERFLOW DRAIN VALVE BEFORE YOU REMOVE THE CASE DRAIN PLUG.THE INSTALLATION OF THE DRAIN HOSE RELEASES THE PRESSURE IN THE IDG OIL SYSTEM.

1. Add oil to the IDG if the level is under the green band.
2. Drain oil from the IDG if the level is above the green band.

C. Remove the support equipment.

4. Close-Up

A. Make sure that the work area is clear and clean of tools and other items.
B. Close the fan cowl door.
C. Remove the warning notices.

5. Test

A. Perform a leak test of the IDG oil system, leaks are not permitted.
B. Perform an operational test of the IDG system during the next engine ground run.

WARNING: YOU MUST PUT THE DRAIN HOSE ONTO THE OVERFLOW DRAIN VALVE BEFORE YOU REMOVE THE CASE DRAIN PLUG.THE INSTALLATION OF THE DRAIN HOSE RELEASES THE PRESSURE IN THE IDG OIL SYSTEM.

CAUTION: LET THE TEMPERATURE OF THE IDG DECREASE TO 120°F (48,8°C) OR LESS BEFORE YOU DRAIN THE OIL. DRAINING/FILLING OF THE IDG OIL SYSTEM

1. Job Set-Up

A. On panel 115VU, put a warning notice to tell persons not to start engine 1(2).
B. Make sure that engine 1(2) has been shutdown for at least 5 minutes.
C. On panel 50VU, make sure that the ON light of the ENG FADEC GND PWR pusbutton is off and install a warning notice.
D. Open the fan cowl door.

2. Procedure

A. Prepare to drain the IDG oil system.

1. Drain the IDG oil system.
2. Put a warning notice on the engine to tell persons that the IDG does not contain oil.
3. Remove the drain hose.

B. Prepare to fill the IDG oil system to the correct oil level.

1. Connect the drain hose to the overflow drain valve.
2. Pump filtered engine oil into the IDG until a minimum of 2 US pints (0.94 l) have drained from the drain hose. The oil level must be in the green band.
3. Remove the drain hose and the pressure fill service unit.

3. Preparation for Test

A. Make sure that the work area is clean and clear of tools and other items.
B. Close the fan cowl door.
C. Remove the warning notices.

MAINTENANCE OPERATIONS

IDG - SERVICING (Cont'd)

4. Test

A. Perform a one minute ground run (dry crank) of the engine that has the new IDG installed.

NOTE: This procedure is to let the air escape from the IDG oil system and to let the oil flow around the system.

B. Make sure that the IDG oil level is correct (in the green band), if not start the draining or the filling procedure again.

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73 - MAINTENANCE PRACTICES SPECIFIC PAGES

73-00-00 CFDS SPECIFIC PAGE PRESENTATION / EIU & FADEC

CONTENTS:

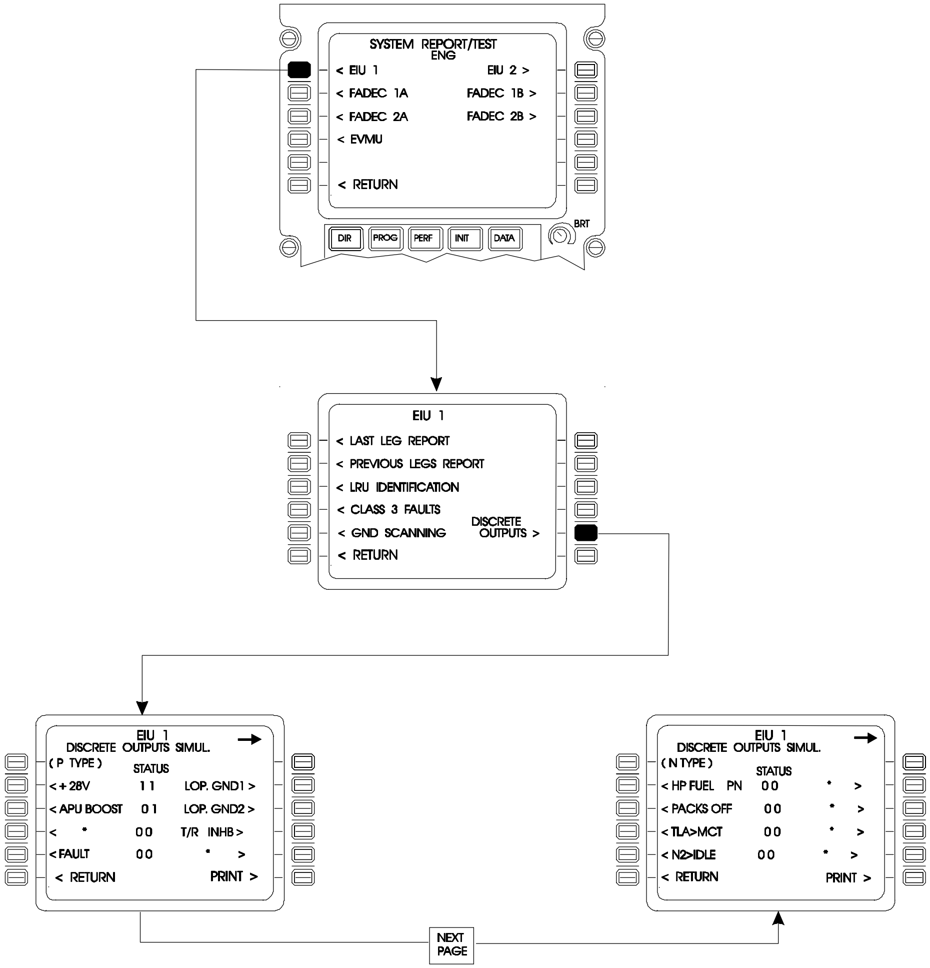
CFDS SPECIFIC PAGE PRESENTATION

The purpose of this module is to present the CFDS specific pages relative to the EIU and the FADEC.
The engine SYSTEM REPORT/TEST menu gives access to the different computers of the engine:
for engine interfaces: EIU1, EIU2
for FADEC systems:
EEC1 (FADEC 1 CHANNEL A), (FADEC 1 CHANNEL B)
EEC2 (FADEC 2 CHANNEL A), (FADEC 2 CHANNEL B)

EIU

This page shows the menu of the Engine Interface Unit, EIU 1.
The EIU 1(2) is a type 1 system. The EIU 1(2) menu is available in CFDS back up mode.

DISCRETE OUTPUTS SIMUL.
The purpose of this menu is to simulate EIU discrete outputs by setting their status to 0 or 1. The discrete outputs are listed on two pages, one for the positive type and one for the negative type.
The first page displays the positive type signals: 28 volts DC circuits.
The second page displays the negative type signals: ground circuits.



CFDS SPECIFIC PAGE PRESENTATION - EIU

UFD4200
TMU70IG04-P01 LEVEL 3

CFDS SPECIFIC PAGE PRESENTATION

FADEC

This page shows the menu of the Full Authority Digital Engine Control, FADEC 1A.
The FADEC is a type 1 system.
The FADEC 1(2)A(B) menu is available in CFDS back up mode.

Note: To get access to the SYSTEM REPORT/TEST of FADEC 1(2)A(B), the ENG FADEC 1(2) GND PWR pushbutton switch must be set to ON when the FADEC is automatically de-energized:
- 5 minutes after engine shutdown or
- 5 minutes after aircraft power up.

SCHEDULED MAINT REPORT
This scheduled maintenance report informs the operator about:
- the preview possible "A" check maintenance action,
- the fault to be cleared at "A" check,
- the new fault which will appear at "A" check.

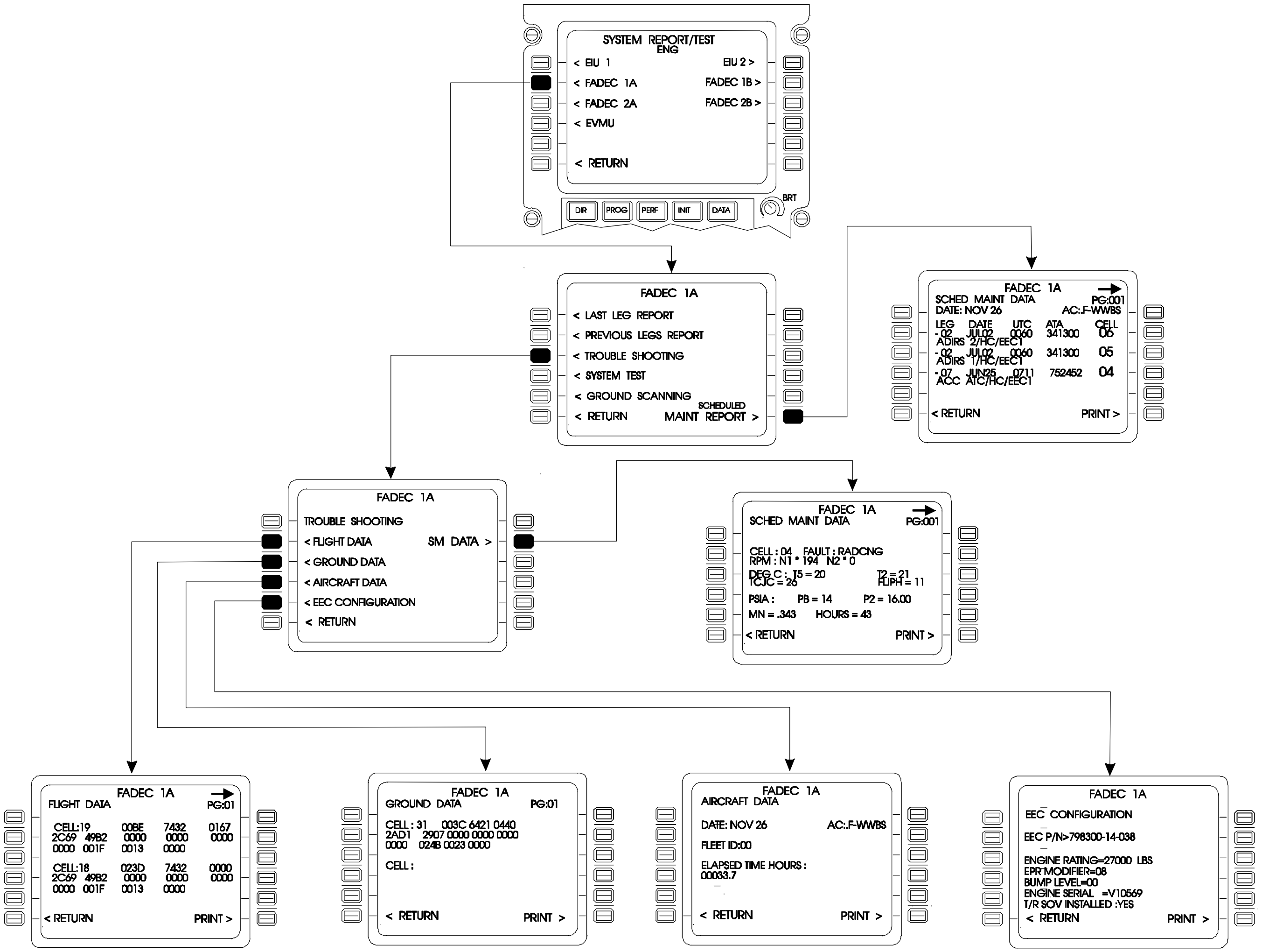
TROUBLE SHOOTING
The trouble shooting menu is used as an additional trouble shooting procedure to identify the faulty components through flight or ground data.
This page gives access to trouble shooting FLIGHT and GROUND DATA plus to the AIRCRAFT primary DATA and EEC Part Number.

FLIGHT DATA
This page gives fault data which occurred during last flights. It is stored in memory cells and displayed in hexadecimal words.
The flight cells are numbered from 1 to 30.
The highest cell numbers correspond to the last failures stored.
For each cell the last two digits of the first word is used for additional trouble shooting (refer to the TSM 70).

Note: These cells are also indicated in the LAST LEG and the PREVIOUS LEGS REPORTS of the FADEC with their associated clear language fault messages.

GROUND DATA
This page gives fault data which occurred on the ground. It is stored in memory cells and displayed in hexadecimal words.
The ground cells are numbered from 31 to 33.
For each cell the last two digits of the first word is used for additional trouble shooting (refer to the TSM 70).

Note: These cells are also indicated in the LAST LEG and the PREVIOUS LEGS REPORTS of the FADEC with their associated clear language fault messages.



CFDS SPECIFIC PAGE PRESENTATION - FADEC

UFD4200

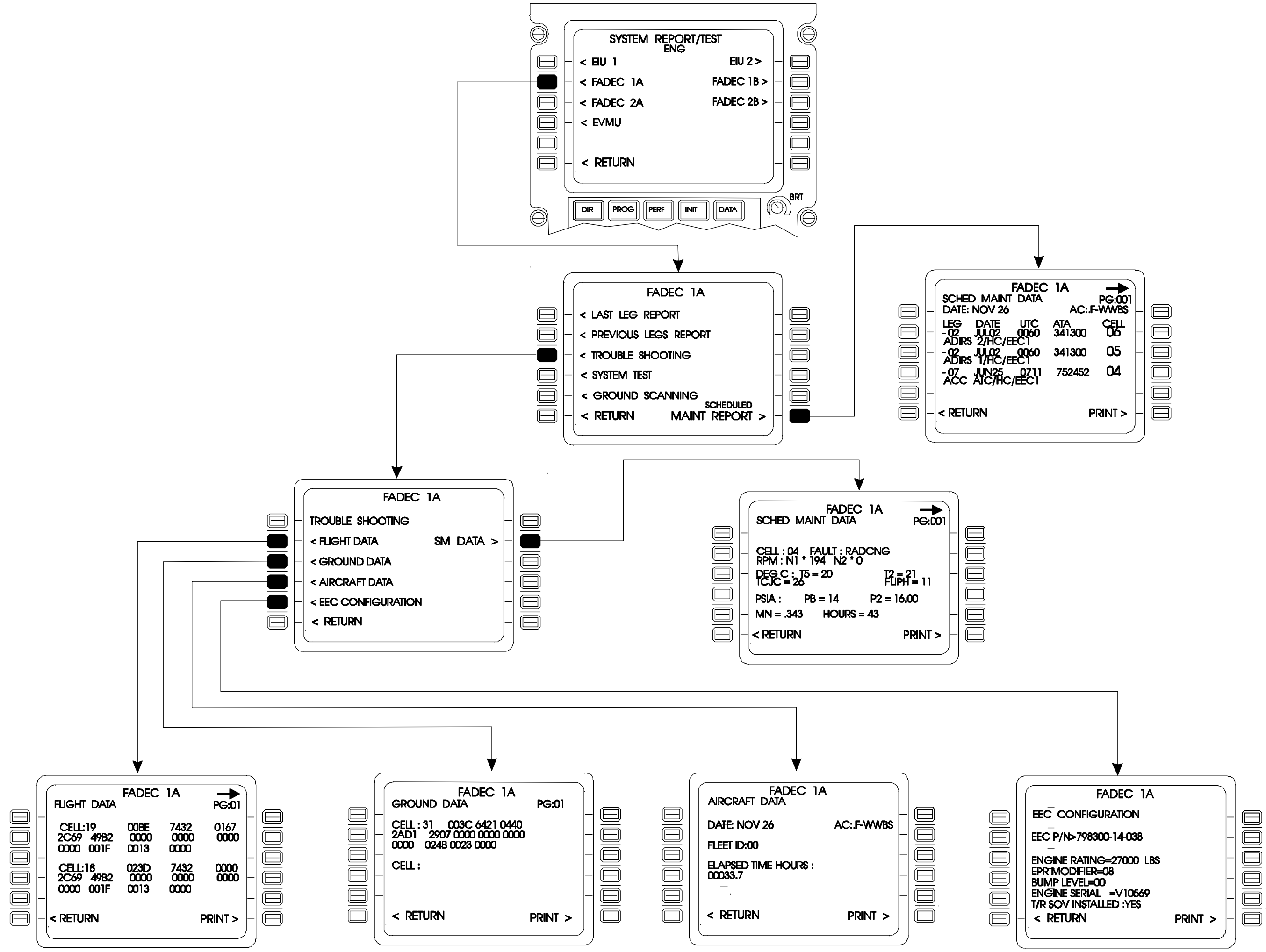
TMU70IG04-P02 LEVEL 3

AIRCRAFT DATA

This page shows information about the aircraft and fleet identification, elapsed time, hours of engine operation.

EEC CONFIGURATION

This page shows information about the EEC part number.

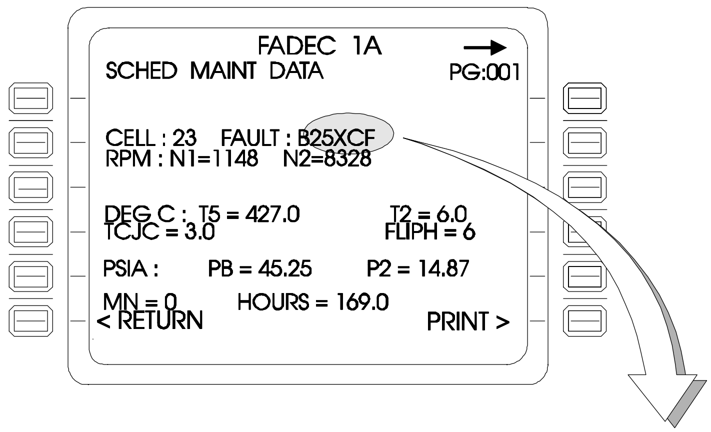


UFD4200
TMU70IG04-P03 LEVEL 3

CFDS SPECIFIC PAGE PRESENTATION - FADEC

SM DATA

This page permits the operator to link the IAE V2500 achronym message to a clear language message in order to perform the trouble shooting.



V2500 A1/A5 FAULT DATA

(Sorted by CLM and A5 Acronym)

CLEAR LANGUAGE MESSAGE	ATA	ACRONYM	FAULT DEFINITION
2.5 BLD ACT/HC/EEC?	753100	B25WAF	2.5 BLEED TORQUE MOTOR FAILURE
2.5 BLD ACT/HC/EEC?	753100	B25XCF	2.5 BLEED CROSSCHECK FAILED
7TH BLD A SOL/HC/EEC?	753251	B7AWAF	B7A SOLENOID WRAPAROUND FAILURE

CFDS SPECIFIC PAGE PRESENTATION - FADEC

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77 - MAINTENANCE PRACTICES SPECIFIC PAGES

77-00-00 CFDS SPECIFIC PAGES PRESENTATION / EVMU

CONTENTS:

CFDS SPECIFIC PAGE PRESENTATION

The purpose of this module is to present the CFDS specific pages relative to the EVMU.

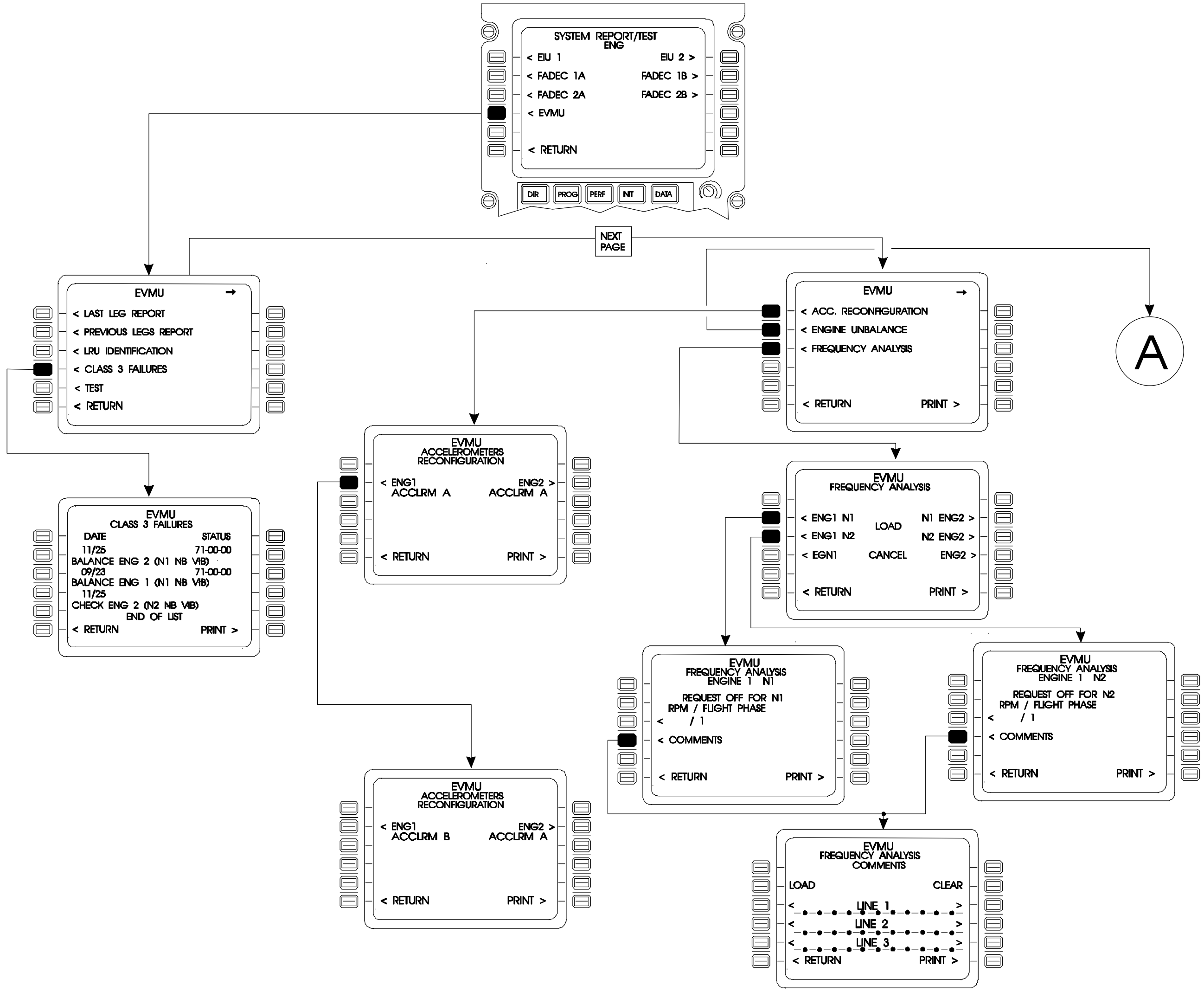
EVMU

The Engine Vibration Monitoring Unit (EVMU) menu consists of two pages. The engine SYSTEM REPORT/TEST menu gives access to the EVMU computer for vibration indications.

CLASS 3 FAILURES
This page displays all the class 3 failures stored during the previous flights with a maximum of 3 failures per page.

ACC. RECONFIGURATION
This menu page indicates which vibration accelerometer is used for both engines at the present time.
This page enables the operator to select which accelerometer will be available. If accelerometer A is declared faulty, the message "ENG 1 ACCLRM 4004 EV(A) DEFECT" is displayed and the previous configuration is conserved.
The next selection after ACCLRM A is ACCLRM B for accelerometer B. If accelerometer B is declared faulty, the message "ENG 1 ACCLRM 4004 EV(B) DEFECT" is displayed and the previous configuration is conserved.

FREQUENCY ANALYSIS
This menu allows the acquisitions to be acquired/ loaded or cancelled.
This page allows the operator to program a frequency analysis acquisition for the next flight, through the LOAD function. An action on CANCEL line key replots this screen to indicate that the cancel function is taken into account.
This page enables the operator to program speed and flight phase on which frequency data would be recorded.
This page enables the operator to write any comments about the analysis.



CFDS SPECIFIC PAGE PRESENTATION - EVMU

UFD4200

TMU70II05-P01 LEVEL 3

ENGINE UNBALANCE
This menu page is used to acquire and read engine unbalance data and enables fan balacing to be performed.

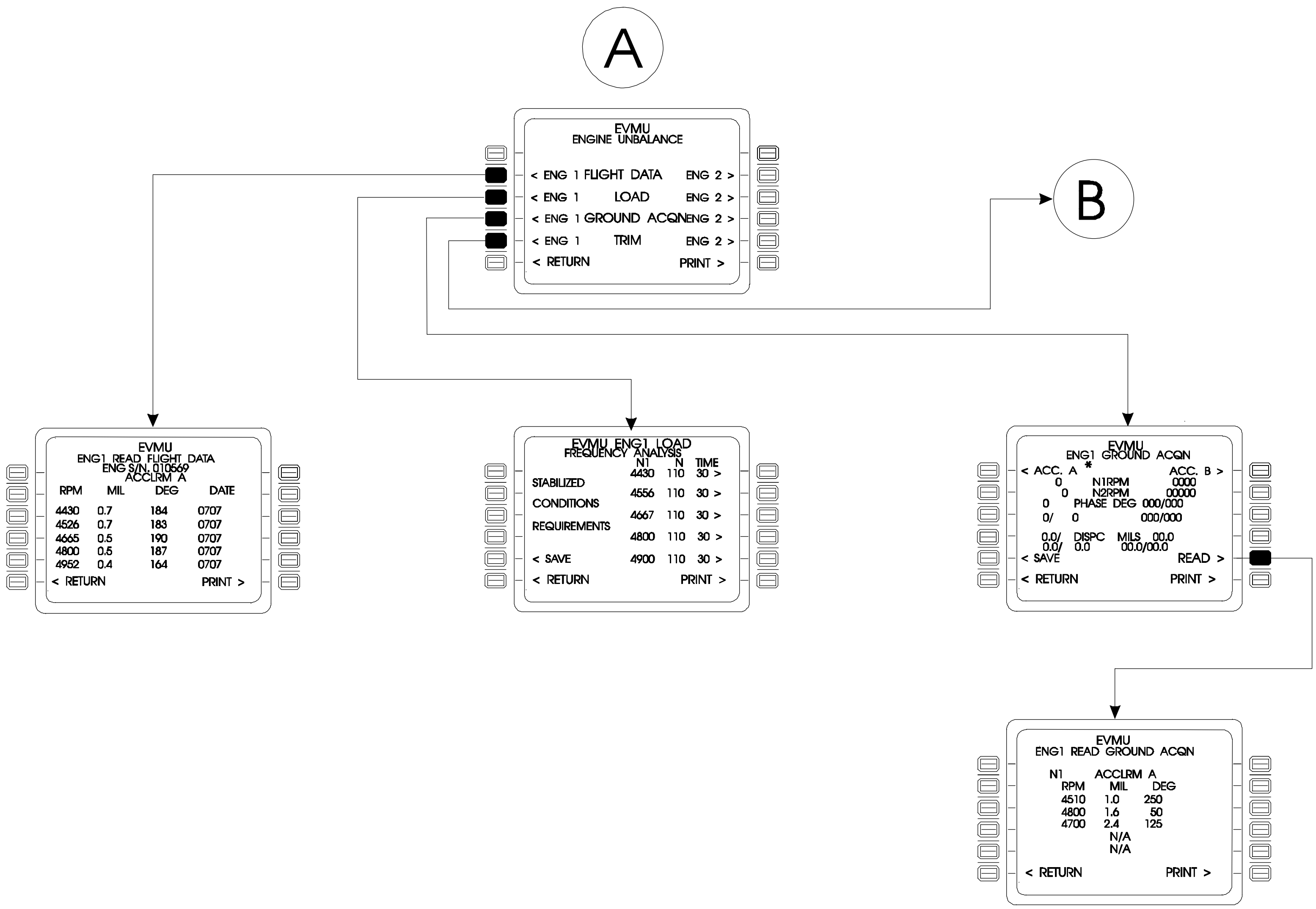
ENG1 FLIGHT DATA
This page shows the fan unbalance data stored during the last flight acquisition. This data has been recorded through the load function. Fan balance data is indicated for 5 N1 speeds. The displacement, the phase and the date are indicated for each N1 speed. The page also indicates the engine serial number and the accelerometer in function.

ENG1 LOAD
This function allows the operator to preprogram the fan unbalance data acquisition which will be automatically performed during the next flight. The N1 speed, the N1 speed range and the acquisition time are required to record the data acquisition. The SAVE key records data for the next flight which is available on the FLIGHT DATA page.

ENG1 GROUND ACQN
This function enables fan trim balancing data to be obtained on the ground during engine run-up. The parameters are displayed in real time and refreshed every 5 seconds. The SAVE key can record 5 data acquisitions displayed in real time.

Note: The "*" symbol indicates which accelerometer is used to acquire data.

The displayed parameters have been recorded through the SAVE function. N/A indication means that the data acquisition is still not recorded.



CFDS SPECIFIC PAGE PRESENTATION - EVMU

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TMU70II05-P02 LEVEL 3

ENG1 TRIM

This menu offers the operator two trim balance methods:

- the one shot trim balance method needs a set of data and generic coefficient.
- the trial weight trim balance method needs two sets of data.

Note: Set of data is the association of vibration parameters and the current weight configuration.

ONE SHOT TRIM BALANCE

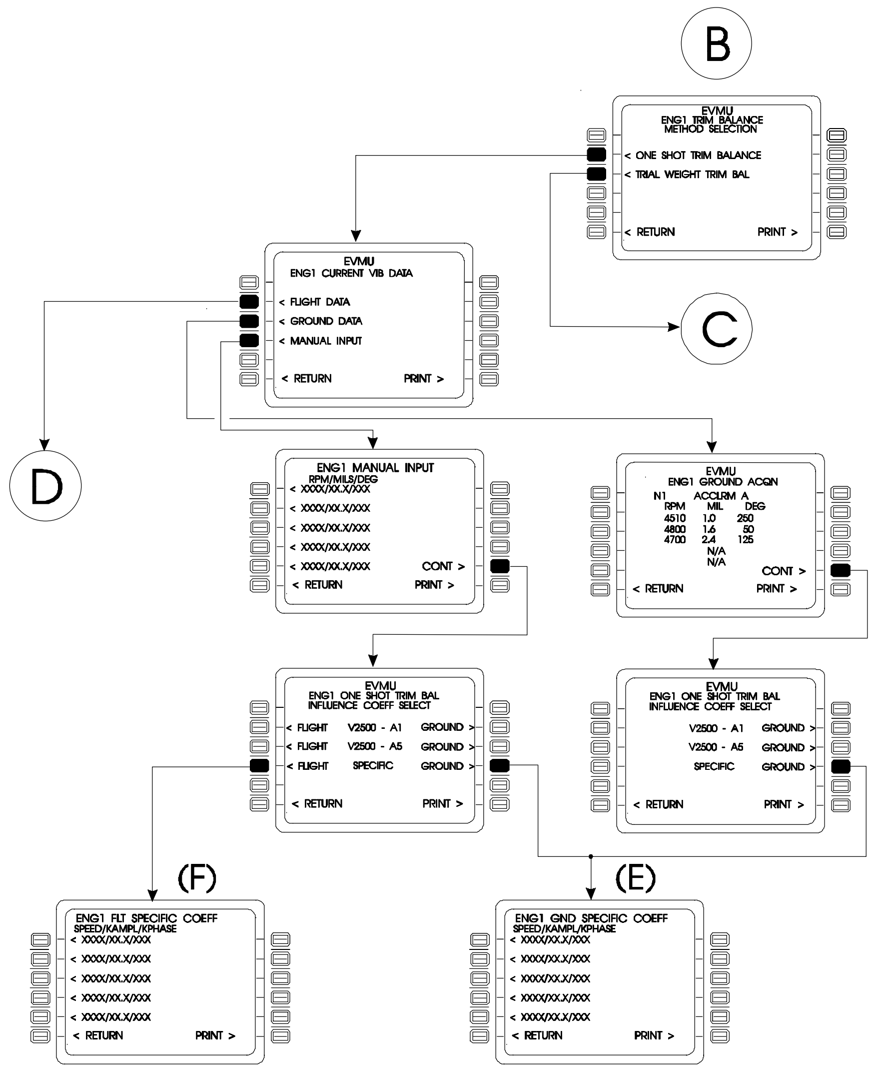
This menu is used for reading data recorded during the last acquisition or inserted manually.
This method is more simple than the trial method, Nevertheless it cannot resolve a few unbalance cases and the trial method has to be performed.
This menu enables the operator to select the flight or ground recorded data, or the manual data inputs.

GROUND DATA

The displayed parameters have been recorded through the SAVE function. N/A indication means that the data acquisition is still not recorded.
With the one shot trim balance method, the operator cannot directly use the unbalance data. He needs a corrector coefficient to convert unbalance data in to weights.
This page (E) enables the operator to insert the ground coefficient for a given engine defined by the airline.

MANUAL INPUT

This menu enables the operator to manually enter specific vibration data.
With the one shot trim balance method, the operator cannot directly use the unbalance data. He needs a corrector coefficient to convert unbalance data in to weights.
These pages (E) and (F) enable the operator to insert the ground or flight coefficient for a given engine defined by the airline.



CFDS SPECIFIC PAGE PRESENTATION - FADEC

TMU70II05-P03 LEVEL 3
UFD4200

FLIGHT DATA

This data has been recorded through the load function. Fan unbalance data is indicated for 5 N1 speeds. The displacement, the phase and the date are indicated for each N1 speed.

This page shows the fan unbalance data stored during the last flight acquisition and confirms the data acquisitions have been made.

With the one shot trim balance method, the operator cannot directly use the unbalance data. He needs a corrector coefficient to convert unbalance data in to weights (G).

This page (H) enables the operator to insert the flight coefficient for a given engine defined by the airline.

This menu (I) forces the operator to verify if the engine weight configuration, on the two flanges, is identical to the weight configuration recorded in the EVMU.

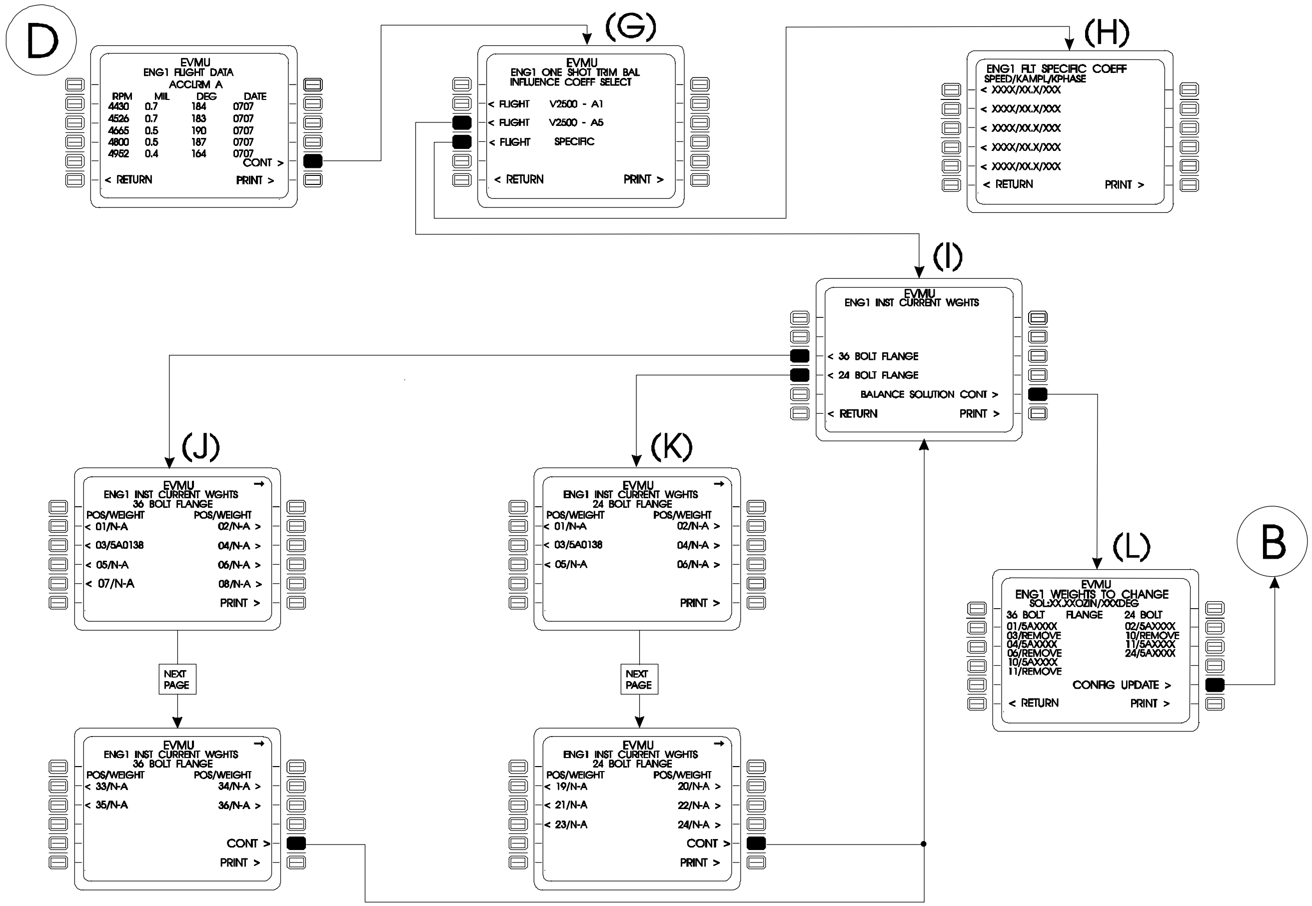
This page (J) enables the operator to check if all weight configurations fitted on the engine are correctly recorded on the EVMU. In the opposite case, the operator has to record the correct data on the EVMU.

Note: The operator has to check 5 pages on this flange.

This page (K) enables the operator to check if all weight configurations fitted on the engine are correctly recorded on the EVMU. In the opposite case, the operator has to record the correct data on the EVMU.

Note: The operator has to check 4 pages on this flange.

This page (L) gives the operator the solution to perform the fan trim unbalance on both flanges. It also enables the operator to update the new fan trim unbalance data configuration selecting the CONFIG UPDATE key.



CFDS SPECIFIC PAGE PRESENTATION - FADEC

UFD4200
TMU70II05-P04 LEVEL 3

TRIAL WEIGHT TRIM BALANCE

This menu is used when the one shot trim balance method is not feasible.
This page gives access to two sets of data :

- the previous data which is data from the last trim balance.
- the current data which has been recorded during the last flight or during the last ground acquisistion.

The trial method is more complicated but it can resolve all unbalance cases.

PREVIOUS DATA

The previous vibration data is automatically recorded by the BALANCE SOLUTION CONT line key but manual input data can be entered through the different line keys.
This page (M) enables the operator to review and, if necessary, to correct the bolt configuration present on the engine before the last one shot trim balancing.

CURRENT DATA

This menu allows the operator to review the data to be used for the fan trim balancing or to enter data manually.

FLIGHT DATA

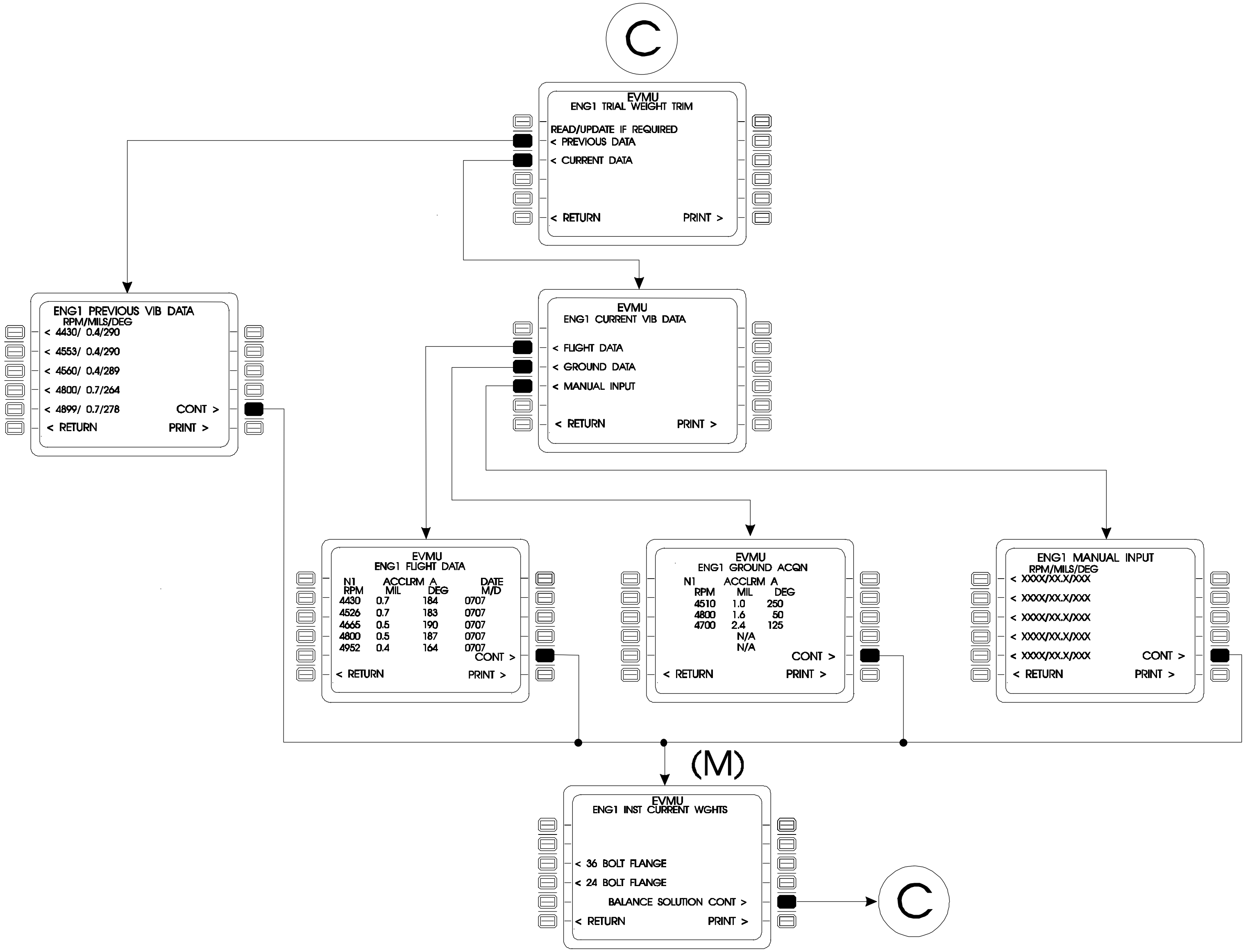
This data has been recorded through the load function. Fan unbalance data is indicated for 5 N1 speeds. The displacement, the phase and the date are indicated for each N1 speed.
This page shows the fan unbalance data stored during the last flight acquisition and confirms that the data acquisitions have been made.

GROUNG DATA

The displayed parameters have been acquired during ground run using the "ground acquisition" menu. Only the five last sets of data are stored.

MANUAL DATA

This menu enables the operator to manually enter specific vibration data.



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TMU70II05-P06 LEVEL 3

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