THE POWER OF FLIGHT

TRAINING MANUAL

CFM56-5A

FAULT DETECTION & ANNUNCIATION

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TOC

FAULT DETECTION & ANNUNCIATION

THE POWER OF FLIGHT

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EFFECTIVITY
ALL CFM56-5A ENGINES FOR A319-A320

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LEXIS

A

A/C	AIRCRAFT
AC	ALTERNATING CURRENT
ACARS	AIRCRAFT COMMUNICATION ADRESSING and REPORTING SYSTEM
ACMS	AIRCRAFT CONDITION MONITORING SYSTEM
ACS	AIRCRAFT CONTROL SYSTEM
ADC	AIR DATA COMPUTER
ADEPT	AIRLINE DATA ENGINE PERFORMANCE TREND
ADIRS	AIR DATA AND INERTIAL REFERENCE SYSTEM
ADIRU	AIR DATA AND INERTIAL REFERENCE UNIT
AGB	ACCESSORY GEARBOX
AIDS	AIRCRAFT INTEGRATED DATA SYSTEM
ALF	AFT LOOKING FORWARD
ALT	ALTITUDE
ALTN	ALTERNATE
AMB	AMBIENT
AMM	AIRCRAFT MAINTENANCE MANUAL
AOG	AIRCRAFT ON GROUND
A/P	AIR PLANE
APU	AUXILIARY POWER UNIT
ARINC	AERONAUTICAL RADIO, INC. (SPECIFICATION)
ASM	AUTOTHROTTLE SERVO MECHANISM
A/T	AUTOTHROTTLE
ATA	AIR TRANSPORT ASSOCIATION
ATC	AUTOTHROTTLE COMPUTER
ATHR	AUTO THRUST
ATO	ABORTED TAKE OFF
AVM	AIRCRAFT VIBRATION MONITORING

B

BITE	BUILT IN TEST EQUIPMENT
BMC	BLEED MANAGEMENT COMPUTER
BPRV	BLEED PRESSURE REGULATING VALVE
BSI	BORESCOPE INSPECTION
BSV	BURNER STAGING VALVE (SAC)
BSV	BURNER SELECTION VALVE (DAC)
BVCS	BLEED VALVE CONTROL SOLENOID

C

C	CELSIUS or CENTIGRADE
CAS	CALIBRATED AIR SPEED
CBP	(HP) COMPRESSOR BLEED PRESSURE
CCDL	CROSS CHANNEL DATA LINK
CCFG	COMPACT CONSTANT FREQUENCY GENERATOR
CCU	COMPUTER CONTROL UNIT
CCW	COUNTER CLOCKWISE
CDP	(HP) COMPRESSOR DISCHARGE PRESSURE
CDS	COMMON DISPLAY SYSTEM
CDU	CONTROL DISPLAY UNIT
CFDIU	CENTRALIZED FAULT DISPLAY INTERFACE UNIT
CFDS	CENTRALIZED FAULT DISPLAY SYSTEM

CFMI	JOINT GE/SNECMA COMPANY (CFM INTERNATIONAL)
CG	CENTER OF GRAVITY
Ch A	channel A
Ch B	channel B
CHATV	CHANNEL ACTIVE
CIP(HP)	COMPRESSOR INLET PRESSURE
CIT(HP)	COMPRESSOR INLET TEMPERATURE
cm.g	CENTIMETER X GRAMS
CMC	CENTRALIZED MAINTENANCE COMPUTER
CMM	COMPONENT MAINTENANCE MANUAL
CMS	CENTRALIZED MAINTENANCE SYSTEM
CMS	CENTRAL MAINTENANCE SYSTEM
CODEP	HIGH TEMPERATURE COATING
CONT	CONTINUOUS
CPU	CENTRAL PROCESSING UNIT
CRT	CATHODE RAY TUBE
CSD	CONSTANT SPEED DRIVE
CSI	CYCLES SINCE INSTALLATION
CSN	CYCLES SINCE NEW
CTAI	COWL THERMAL ANTI-ICING
CTEC	CUSTOMER TECHNICAL EDUCATION CENTER
CTL	CONTROL
Cu.Ni.In	COPPER.NICKEL.INDIUM
CW	CLOCKWISE

D

DAC	DOUBLE ANNULAR COMBUSTOR
DAMV	DOUBLE ANNULAR MODULATED VALVE
DAR	DIGITAL ACMS RECORDER
DC	DIRECT CURRENT
DCU	DATA CONVERSION UNIT
DCV	DIRECTIONAL CONTROL VALVE BOEING
DEU	DISPLAY ELECTRONIC UNIT
DFCS	DIGITAL FLIGHT CONTROL SYSTEM
DFDAU	DIGITAL FLIGHT DATA ACQUISITION UNIT
DFDRS	DIGITAL FLIGHT DATA RECORDING SYSTEM
DISC	DISCRETE
DIU	DIGITAL INTERFACE UNIT
DMC	DISPLAY MANAGEMENT COMPUTER
DMD	DEMAND
DMS	DEBRIS MONITORING SYSTEM
DMU	DATA MANAGEMENT UNIT
DOD	DOMESTIC OBJECT DAMAGE
DPU	DIGITAL PROCESSING MODULE
DRT	DE-RATED TAKE-OFF

E

EAU	ENGINE ACCESSORY UNIT
EBU	ENGINE BUILDUP UNIT
ECA	ELECTRICAL CHASSIS ASSEMBLY
ECAM	ELECTRONIC CENTRALIZED AIRCRAFT MONITORING
ECS	ENVIRONMENTAL CONTROL SYSTEM
ECU	ELECTRONIC CONTROL UNIT
EE	ELECTRONIC EQUIPMENT
EEC	ELECTRONIC ENGINE CONTROL

EFH	ENGINE FLIGHT HOURS
EFIS	ELECTRONIC FLIGHT INSTRUMENT SYSTEM
EGT	EXHAUST GAS TEMPERATURE
EHSV	ELECTRO-HYDRAULIC SERVO VALVE
EICAS	ENGINE INDICATING AND CREW ALERTING SYSTEM
EIS	ELECTRONIC INSTRUMENT SYSTEM
EIU	ENGINE INTERFACE UNIT
EIVMU	ENGINE INTERFACE AND VIBRATION MONITORING UNIT
EMF	ELECTROMOTIVE FORCE
EMI	ELECTRO MAGNETIC INTERFERENCE
EMU	ENGINE MAINTENANCE UNIT
EPROM	ERASABLE PROGRAMMABLE READ ONLY MEMORY
(E)EPROM	(ELECTRICALLY) ERASABLE PROGRAMMABLE READ ONLY MEMORY
ESN	ENGINE SERIAL NUMBER
ETOPS	EXTENDED TWIN OPERATION SYSTEMS
EWD/SD	ENGINE WARNING DISPLAY / SYSTEM DISPLAY

F

F	FARENHEIT
FAA	FEDERAL AVIATION AGENCY
FADEC	FULL AUTHORITY DIGITAL ENGINE CONTROL
FAR	FUEL/AIR RATIO
FCC	FLIGHT CONTROL COMPUTER
FCU	FLIGHT CONTROL UNIT
FDAMS	FLIGHT DATA ACQUISITION & MANAGEMENT SYSTEM
FDIU	FLIGHT DATA INTERFACE UNIT
FDRS	FLIGHT DATA RECORDING SYSTEM
FDU	FIRE DETECTION UNIT
FEIM	FIELD ENGINEERING INVESTIGATION MEMO
FF	FUEL FLOW (see Wf) -7B
FFCCV	FAN FRAME/COMPRESSOR CASE VERTICAL (VIBRATION SENSOR)
FI	FLIGHT IDLE (F/I)
FIM	FAULT ISOLATION MANUAL
FIN	FUNCTIONAL ITEM NUMBER
FIT	FAN INLET TEMPERATURE
FLA	FORWARD LOOKING AFT
FLX TO	FLEXIBLE TAKE-OFF
FMC	FLIGHT MANAGEMENT COMPUTER
FMCS	FLIGHT MANAGEMENT COMPUTER SYSTEM
FMGC	FLIGHT MANAGEMENT AND GUIDANCE COMPUTER
FMGEC	FLIGHT MANAGEMENT AND GUIDANCE ENVELOPE COMPUTER
FMS	FLIGHT MANAGEMENT SYSTEM
FMV	FUEL METERING VALVE
FOD	FOREIGN OBJECT DAMAGE
FPA	FRONT PANEL ASSEMBLY
FPI	FLUORESCENT PENETRANT INSPECTION
FQIS	FUEL QUANTITY INDICATING SYSTEM

FRV	FUEL RETURN VALVE
FWC	FAULT WARNING COMPUTER
FWD	FORWARD

G

g.in	GRAM X INCHES
GE	GENERAL ELECTRIC
GEAE	GENERAL ELECTRIC AIRCRAFT ENGINES
GEM	GROUND-BASED ENGINE MONITORING
GI	GROUND IDLE (G/I)
GMM	GROUND MAINTENANCE MODE
GMT	GREENWICH MEAN TIME
GND	GROUND
GPH	GALLON PER HOUR
GPU	GROUND POWER UNIT
GSE	GROUND SUPPORT EQUIPMENT

H

HCF	HIGH CYCLE FATIGUE
HCU	HYDRAULIC CONTROL UNIT
HDS	HORIZONTAL DRIVE SHAFT
HMU	HYDROMECHANICAL UNIT
HP	HIGH PRESSURE
HPC	HIGH PRESSURE COMPRESSOR
HPCR	HIGH PRESSURE COMPRESSOR ROTOR
HPRV	HIGH PRESSURE REGULATING VALVE
HPSOV	HIGH PRESSURE SHUT-OFF VALVE
HPT	HIGH PRESSURE TURBINE
HPT(A)CC	HIGH PRESSURE TURBINE (ACTIVE) CLEARANCE CONTROL
HPTC	HIGH PRESSURE TURBINE CLEARANCE
HPTCCV	HIGH PRESSURE TURBINE CLEARANCE CONTROL VALVE
HPTN	HIGH PRESSURE TURBINE NOZZLE
HPTR	HIGH PRESSURE TURBINE ROTOR
Hz	HERTZ (CYCLES PER SECOND)

I

I/O	INPUT/OUTPUT
IAS	INDICATED AIR SPEED
ID	INSIDE DIAMETER
ID PLUG	IDENTIFICATION PLUG
IDG	INTEGRATED DRIVE GENERATOR
IFSD	IN FLIGHT SHUT DOWN
IGB	INLET GEARBOX
IGN	IGNITION
IGV	INLET GUIDE VANE
in.	INCH
IOM	INPUT OUTPUT MODULE
IPB	ILLUSTRATED PARTS BREAKDOWN
IPC	ILLUSTRATED PARTS CATALOG
IPCV	INTERMEDIATE PRESSURE CHECK VALVE
IPS	INCHES PER SECOND
IR	INFRA RED

K

°K	KELVIN
k	X 1000
KIAS	INDICATED AIR SPEED IN KNOTS
kV	KILOVOLTS

Kph	KILOGRAMS PER HOUR

L

L	LEFT
L/H	LEFT HAND
lbs.	POUNDS, WEIGHT
LCD	LIQUID CRYSTAL DISPLAY
LCF	LOW CYCLE FATIGUE
LE (L/E)	LEADING EDGE
LGCIU	LANDING GEAR CONTROL INTERFACE UNIT
LP	LOW PRESSURE
LPC	LOW PRESSURE COMPRESSOR
LPT	LOW PRESSURE TURBINE
LPT(A)CC	LOW PRESSURE TURBINE (ACTIVE) CLEARANCE CONTROL
LPTC	LOW PRESSURE TURBINE CLEARANCE
LPTN	LOW PRESSURE TURBINE NOZZLE
LPTR	LOW PRESSURE TURBINE ROTOR
LRU	LINE REPLACEABLE UNIT
LVDT	LINEAR VARIABLE DIFFERENTIAL TRANSFORMER

M

mA	MILLIAMPERES (CURRENT)
MCD	MAGNETIC CHIP DETECTOR
MCDU	MULTIPURPOSE CONTROL AND DISPLAY UNIT
MCL	MAXIMUM CLIMB
MCR	MAXIMUM CRUISE
MCT	MAXIMUM CONTINUOUS
MDDU	MULTIPURPOSE DISK DRIVE UNIT
MEC	MAIN ENGINE CONTROL
milsD.A.	Mils DOUBLE AMPLITUDE
mm.	MILLIMETERS
MMEL	MAIN MINIMUM EQUIPMENT LIST
MO	AIRCRAFT SPEED MACH NUMBER
MPA	MAXIMUM POWER ASSURANCE
MPH	MILES PER HOUR
MTBF	MEAN TIME BETWEEN FAILURES
MTBR	MEAN TIME BETWEEN REMOVALS
mV	MILLIVOLTS
Mvdc	MILLIVOLTS DIRECT CURRENT

N

N1 (NL)	LOW PRESSURE ROTOR ROTATIONAL SPEED
N1*	DESIRED N1
N1ACT	ACTUAL N1
N1CMD	COMMANDED N1
N1DMD	DEMANDED N1
N1K	CORRECTED FAN SPEED
N1TARGET	TARGETED FAN SPEED
N2 (NH)	HIGH PRESSURE ROTOR ROTATIONAL SPEED
N2*	DESIRED N2
N2ACT	ACTUAL N2
N2K	CORRECTED CORE SPEED
N/C	NORMALLY CLOSED
N/O	NORMALLY OPEN

NAC	NACELLE
NVM	NON VOLATILE MEMORY
O	
OAT	OUTSIDE AIR TEMPERATURE
OD	OUTLET DIAMETER
OGV	OUTLET GUIDE VANE
OSG	OVERSPEED GOVERNOR
OVBD	OVERBOARD
OVHT	OVERHEAT
P	
Pb	BYPASS PRESSURE
Pc	REGULATED SERVO PRESSURE
Pcr	CASE REGULATED PRESSURE
Pf	HEATED SERVO PRESSURE
P/T25	HP COMPRESSOR INLET TOTAL AIR PRESSURE/TEMPERATURE
P/N	PART NUMBER
P0	AMBIENT STATIC PRESSURE
P25	HP COMPRESSOR INLET TOTAL AIR TEMPERATURE
PCU	PRESSURE CONVERTER UNIT
PLA	POWER LEVER ANGLE
PMC	POWER MANAGEMENT CONTROL
PMUX	PROPULSION MULTIPLEXER
PPH	POUNDS PER HOUR
PRSOV	PRESSURE REGULATING SERVO VALVE
Ps	PUMP SUPPLY PRESSURE
PS12	FAN INLET STATIC AIR PRESSURE
PS13	FAN OUTLET STATIC AIR PRESSURE
PS3HP	COMPRESSOR DISCHARGE STATIC AIR PRESSURE (CDP)
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSID	POUNDS PER SQUARE INCH DIFFERENTIAL
psig	POUNDS PER SQUARE INCH GAGE
PSM	POWER SUPPLY MODULE
PSS	(ECU) PRESSURE SUB-SYSTEM
PSU	POWER SUPPLY UNIT
PT	TOTAL PRESSURE
PT2	FAN INLET TOTAL AIR PRESSURE (PRIMARY FLOW)
PT25	HPC TOTAL INLET PRESSURE
Q	
QAD	QUICK ATTACH DETACH
QEC	QUICK ENGINE CHANGE
QTY	QUANTITY
QWR	QUICK WINDMILL RELIGHT
R	
R/H	RIGHT HAND
RAC/SB	ROTOR ACTIVE CLEARANCE/START BLEED
RACC	ROTOR ACTIVE CLEARANCE CONTROL
RAM	RANDOM ACCESS MEMORY
RCC	REMOTE CHARGE CONVERTER
RDS	RADIAL DRIVE SHAFT

RPM	REVOLUTIONS PER MINUTE
RTD	RESISTIVE THERMAL DEVICE
RTO	REFUSED TAKE OFF
RTV	ROOM TEMPERATURE VULCANIZING (MATERIAL)
RVDT	ROTARY VARIABLE DIFFERENTIAL TRANSFORMER

S

S/N	SERIAL NUMBER
S/R	SERVICE REQUEST
S/V	SHOP VISIT
SAC	SINGLE ANNULAR COMBUSTOR
SAR	SMART ACMS RECORDER
SAV	STARTER AIR VALVE
SB	SERVICE BULLETIN
SCU	SIGNAL CONDITIONING UNIT
SDAC	SYSTEM DATA ACQUISITION CONCENTRATOR
SDI	SOURCE/DESTINATION IDENTIFIER (BITS) (CF ARINC SPEC)
SDU	SOLENOID DRIVER UNIT
SER	SERVICE EVALUATION REQUEST
SFC	SPECIFIC FUEL CONSUMPTION
SFCC	SLAT FLAP CONTROL COMPUTER
SG	SPECIFIC GRAVITY
SLS	SEA LEVEL STANDARD (CONDITIONS : 29.92 in.Hg / 59°F)
SLSD	SEA LEVEL STANDARD DAY (CONDITIONS : 29.92 in.Hg / 59°F)
SMM	STATUS MATRIX
SMP	SOFTWARE MANAGEMENT PLAN
SN	SERIAL NUMBER
SNECMA	SOCIETE NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION
SOL	SOLENOID
SOV	SHUT-OFF VALVE
STP	STANDARD TEMPERATURE AND PRESSURE
SVR	SHOP VISIT RATE
SW	SWITCH BOEING
SYS	SYSTEM

T

T oil	OIL TEMPERATURE
T/C	THERMOCOUPLE
T/E	TRAILING EDGE
T/O	TAKE OFF
T/R	THRUST REVERSER
T12	FAN INLET TOTAL AIR TEMPERATURE
T25	HP COMPRESSOR INLET AIR TEMPERATURE
T3	HP COMPRESSOR DISCHARGE AIR TEMPERATURE
T49.5	EXHAUST GAS TEMPERATURE
T5	LOW PRESSURE TURBINE DISCHARGE TOTAL AIR TEMPERATURE
TAI	THERMAL ANTI ICE
TAT	TOTAL AIR TEMPERATURE

TBC	THERMAL BARRIER COATING
TBD	TO BE DETERMINED
TBO	TIME BETWEEN OVERHAUL
TBV	TRANSIENT BLEED VALVE
TC(TCase)	HP TURBINE CASE TEMPERATURE
TCC	TURBINE CLEARANCE CONTROL
TCCV	TURBINE CLEARANCE CONTROL VALVE
TCJ	TEMPERATURE COLD JUNCTION
T/E	TRAILING EDGE
TECU	ELECTRONIC CONTROL UNIT INTERNAL TEMPERATURE
TEO	ENGINE OIL TEMPERATURE
TGB	TRANSFER GEARBOX
Ti	TITANIUM
TLA	THROTTLE LEVER ANGLE AIRBUS
TLA	THRUST LEVER ANGLE BOEING
TM	TORQUE MOTOR
TMC	TORQUE MOTOR CURRENT
T/O	TAKE OFF
TO/GA	TAKE OFF/GO AROUND
T/P	TEMPERATURE/PRESSURE SENSOR
TPU	TRANSIENT PROTECTION UNIT
TR	TRANSFORMER RECTIFIER
TRA	THROTTLE RESOLVER ANGLE AIRBUS
TRA	THRUST RESOLVER ANGLE BOEING
TRDV	THRUST REVERSER DIRECTIONAL VALVE
TRF	TURBINE REAR FRAME
TRPV	THRUST REVERSER PRESSURIZING VALVE
TSI	TIME SINCE INSTALLATION (HOURS)
TSN	TIME SINCE NEW (HOURS)
TTL	TRANSISTOR TRANSISTOR LOGIC

U

UER	UNSCHEDULED ENGINE REMOVAL
UTC	UNIVERSAL TIME CONSTANT

V

VAC	VOLTAGE, ALTERNATING CURRENT
VBV	VARIABLE BLEED VALVE
VDC	VOLTAGE, DIRECT CURRENT
VDT	VARIABLE DIFFERENTIAL TRANSFORMER
VIB	VIBRATION
VLV	VALVE
VRT	VARIABLE RESISTANCE TRANSDUCER
VSV	VARIABLE STATOR VANE

W

WDM	WATCHDOG MONITOR
Wf	WEIGHT OF FUEL OR FUEL FLOW
WFM	WEIGHT OF FUEL METERED
WOW	WEIGHT ON WHEELS
WTAI	WING THERMAL ANTI-ICING

IMPERIAL / METRIC CONVERSIONS

1 mile	= 1,609 km
1 ft	= 30,48 cm
1 in.	= 25,4 mm
1 mil.	= 25,4 µ
1 sq.in.	= 6,4516 cm^2
1 USG	= 3,785 l (dm^3)
1 cu.in.	= 16.39 cm^3
1 lb.	= 0.454 kg
1 psi.	= 6.890 kPa
°F	= 1.8 x °C + 32

METRIC / IMPERIAL CONVERSIONS

1 km	= 0.621 mile
1 m	= 3.281 ft. or 39.37 in.
1 cm	= 0.3937 in.
1 mm	= 39.37 mils.
1 m^2	= 10.76 sq. ft.
1 cm^2	= 0.155 sq.in.
1 m^3	= 35.31 cu. ft.
1 dm^3	= 0.264 USA gallon
1 cm^3	= 0.061 cu.in.
1 kg	= 2.205 lbs
1 Pa	= 1.45 10-4 psi.
1 kPa	= 0.145 psi
1 bar	= 14.5 psi
°C	= (°F - 32) /1.8

ARCHITECTURE

ENGINE CONTROL SYSTEM

System components.

The CFM56-5A engine incorporates a computer-based Full Authority Digital Engine Control (FADEC) system.

The engine control system is composed of the following elements :

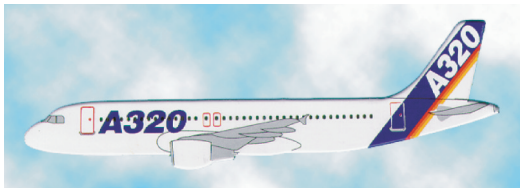
- Electronic Control Unit (ECU), containing two identical computers, designated channel A & B.
- Hydro-mechanical Unit (HMU), which converts electrical signals from the ECU into hydraulic pressures to drive the engine's valves and actuators.
- ECU alternator.
- Engine Identification plug (ID plug).
- Engine pressure, temperature and speed sensors.
- Variable Stator Vane (VSV) actuators.
- Variable Bleed Valve (VBV) actuators.
- High Pressure Turbine Clearance Control (HPTCC).
- Low Pressure Turbine Clearance Control (LPTCC).
- Transient Bleed Valve (TBV).
- Burner Staging Valve (BSV).
- Fuel Return Valve (FRV).
- Thrust Reverser (TR) control.
- Starter Air Valve (SAV).
- Ignition components / control system.

Electronic Control Unit (ECU).

The ECU is the prime component of the engine control system.

The ECU governs the engine in response to thrust command inputs from the airplane and provides information to the airplane for flight compartment indication, maintenance reporting and, optionally, engine condition monitoring.

Control system maintenance is assisted by extensive ECU internal software called Built-In-Test-Equipment (BITE), which monitors engine data and ECU status flags to detect engine failures.



CONTROL SIGNALS

T12 T25 T3 T49.5 TCASE TEO P0 Ps12 Ps3 N1 N2

FEEDBACK SIGNALS

ANALOG DISCRETE SIGNALS

115V 400Hz

28V

ARINC DATABUSES

ECU

FRV

VBV VSV TBV BSV HPT CCV LPT CCV

IGNITION

ALTERNATOR

FUEL HYDRO-MECHANICAL UNIT

FUEL FLOW Ps13 P25 T5

REVERSER SOLENOIDS + SWITCHES

STARTER AIR VALVE STARTER

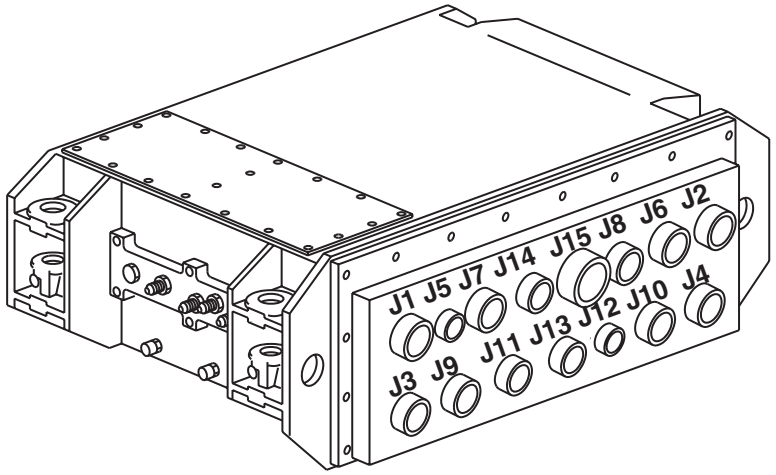
FADEC COMPONENTS

CTC-238-001-00

ECU INPUTS AND OUTPUTS.

Electrical interfaces.

The following chart is a summary of the ECU electrical interfaces to show which connectors interface with channel A and which interface with channel B.



CHANNEL A CONNECTOR (ODD)	CHANNEL B CONNECTOR (EVEN)	FUNCTION
J1	J2	A/C POWER (28V) AND IGNITER POWER (115V)
J3	J4	A/C INPUT/OUTPUT AND TLA
J5	J6	THRUST REVERSER
J7	J8	SOLENOIDS, TORQUE MOTORS, RESOLVERS, N2
J9	J10	ALTERNATOR, SAV, N1 AND T12
J11	J12	LVDT'S, RVDT'S, T25, BSV POSITION SWITCH
SHARED	J14	ENGINE IDENTIFICATION PLUG
J13	SHARED	WF METER, THERMOCOUPLES
J15	SHARED	TEST INTERFACE

ELECTRICAL CONNECTORS

ENGINE TESTS

ECU initialization.

If the engine is not running, the ECU becomes fully operational within a maximum of three seconds after application of airplane power, or an external reset.

If the core speed is greater than 10% N2, the ECU performs a short initialization and is fully functional in less than 750ms after application of airplane power.

Each ECU channel performs a reset initialization sequence in response to aircraft-generated resets, or at power-up.

An aircraft-commanded reset occurs when the master lever is toggled from ON to OFF.

During reset initialization, all RAM variables are initialized, except for a special reserved area. This area of RAM is not initialized as it is allocated to parameters critical to engine operation and which must maintain their values prior to the reset operation.

Built-In-Tests.

Built-In-Test-Equipment (BITE) monitors the system and memorizes failures.

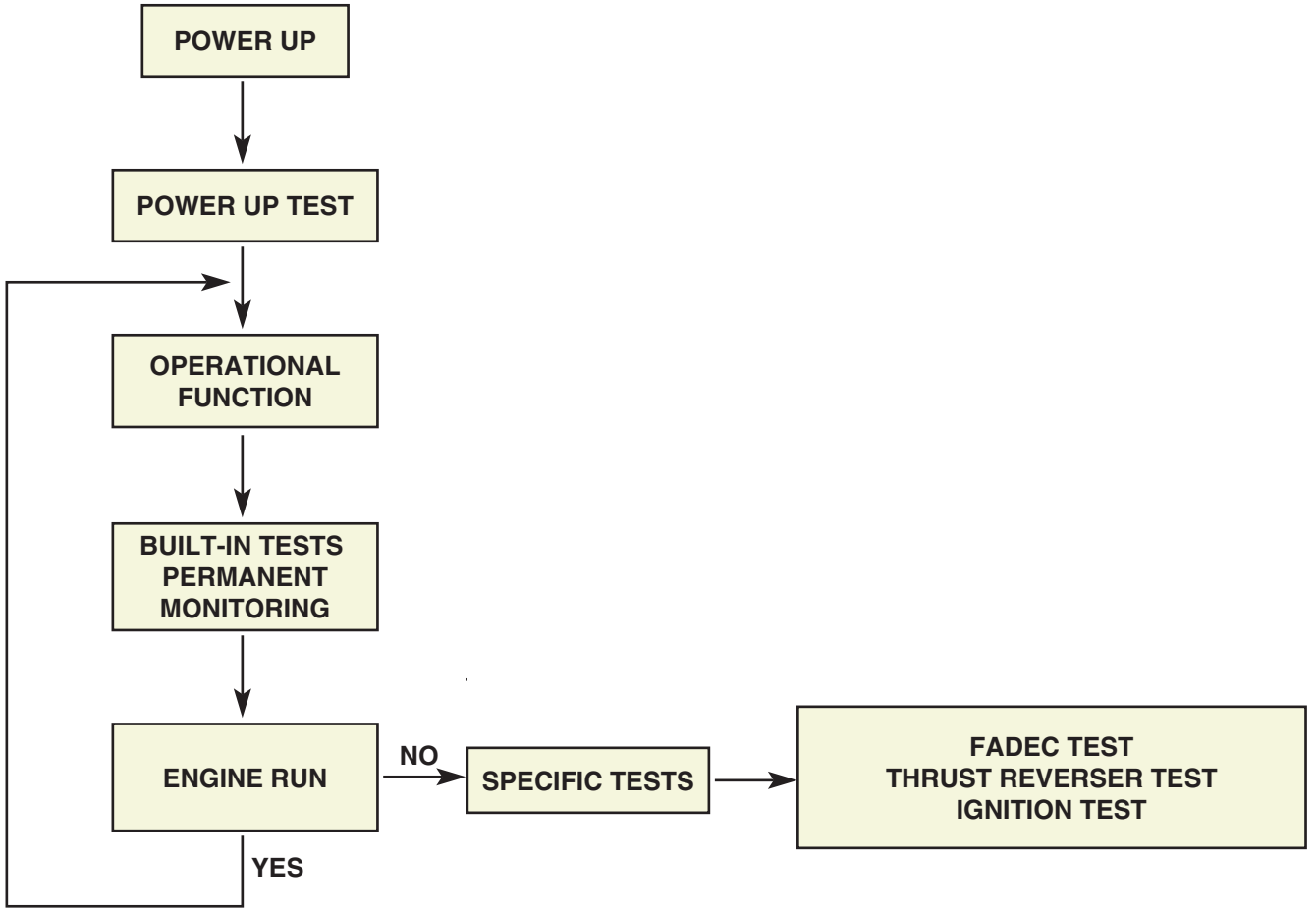
The BITE detects and isolates failures, or combinations of failures, in order to determine the health status of the channels and to transmit maintenance data to the aircraft.

There are two types of Built-In-Test : Initialization test and Periodic test.

The Initialization tests cover functions which cannot be continually tested without disturbing the ECU system operation. The typical tasks of an Initialization test are processor test, memories test and output driver disconnect tests.

The Periodic tests cover functions which can be continually tested. These tests are similar to the Initialization tests, but are run in background as time permits.

Specific tests are available to verify certain engine functions. These tests are the FADEC test (Non-motoring & motoring), ignition test and thrust reverser test.



TESTS

CTC-238-003-00

ENGINE CONTROL SYSTEM

Electronic Control Unit (ECU).

The ECU has two channels, A and B, and both channels are capable of controlling the engine.

The two channels are identical and permanently operational, but they operate independently from each other. Each channel has a full complement of sensors, interfaces to the engine and aircraft, central processor and output drivers.

As well as continuously checking and processing their own inputs, the channels compare each others data over a Cross Channel Data Link (CCDL), to ensure that there are no anomalies.

The two ECU channels operate their output drivers on an active/standby principle. Both channels always receive inputs and process them, but only the channel in control, called the Active channel, delivers control outputs (solenoids/torque motors). The other is called the Standby channel.

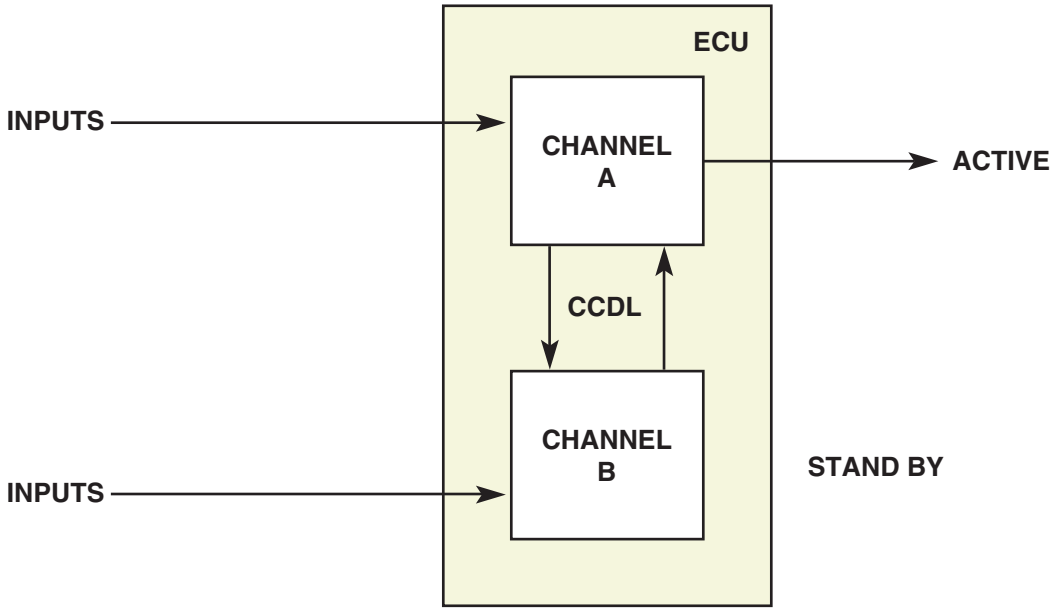
The purpose of the dual-redundant architecture is to minimize the effects of control system faults on the engine operation.

Channel selection and fault strategy.

Active and Standby channel selection is performed at ECU power-up and during operation.

Active and Standby selection is based upon the health of the channels and each channel determines its own health status. The healthiest is selected as the Active channel.

When both channels have an equal health status, active/standby channel selection alternates with every engine start, if N2 was greater than 11,000 RPM during the last run.



ECU DESIGN

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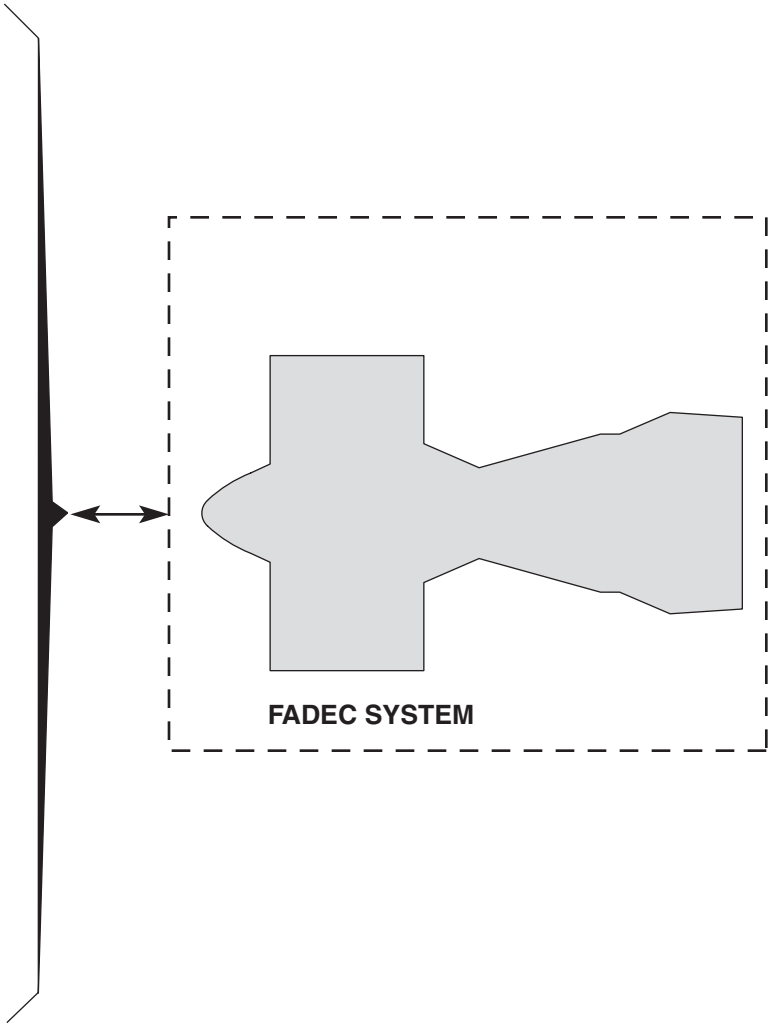
INTERFACES

FADEC INTERFACES

There are many aircraft computers and systems that interface directly, or indirectly with the engine FADEC system.

- Engine Interface Unit (EIU).
- Air Data & Inertial Reference System (ADIRS).
- Flight Management & Guidance Computer (FMGC).
- Flight Control Unit (FCU).
- Digital Flight Data Recording System (DFDRS).
- Centralized Fault Display Interface Unit (CFDIU).
- Engine Vibration Monitoring Unit (EVMU).
- Data Management Unit (DMU).
- Electronic Centralized Monitoring System (ECAM).
- Multipurpose Control & Display Unit (MCDU).
- System Data Acquisition Concentrator (SDAC).
- Flight Warning Computer (FWC).
- Display Management Computer (DMC).
- Slat Flap Control Computer (SFCC).
- Landing Gear Control Interface Unit (LGCIU).
- Environmental Control System (ECS).

- ENGINE INTERFACE UNIT (EIU)
- AIR DATA & INERTIAL REFERENCE SYSTEM (ADIRS)
- FLIGHT MANAGEMENT & GUIDANCE COMPUTER (FMGC)
- FLIGHT CONTROL UNIT (FCU)
- DIGITAL FLIGHT DATA RECORDING SYSTEM (DFDRS)
- CENTRALIZED FAULT DISPLAY INTERFACE UNIT (CFDIU)
- ENGINE VIBRATION MONITORING UNIT (EVMU)
- DATA MANAGEMENT UNIT (DMU)
- ELECTRONIC CENTRALIZED MONITORING SYSTEM (ECAM)
- MULTIPURPOSE CONTROL & DISPLAY UNIT (MCDU)
- SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)
- FLIGHT WARNING COMPUTER (FWC)
- DISPLAY MANAGEMENT COMPUTER (DMC)
- SLAT FLAP CONTROL COMPUTER (SFCC)
- LANDING GEAR CONTROL INTERFACE UNIT (LGCIU)
- ENVIRONMENTAL CONTROL SYSTEM (ECS)



AIRCRAFT - ENGINE INTERFACES

CTC-238-005-00

EFFECTIVITY

ALL CFM56-5A ENGINES FOR A319-A320

FADEC INTERFACES

Each ECU interfaces with the aircraft systems, through its corresponding EIU. Each EIU is an interface concentrator, which collects information to be used by the ECU from various aircraft systems and also sends information from the engines to the aircraft systems.

The EVMU receives analog signals from the engine speed and vibration sensors for vibration monitoring and recording.

The ECU entirely supervises the thrust reverser operation. In case of malfunction, the reverser doors are commanded stowed (LGCIU, HCU).

The ADIRS sends air data parameters to the ECU for power management and engine control.

The ECU manages power according to 2 thrust modes :

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

The FMGC computes the autothrust order and sends it to the ECU, via the FCU and EIU. The FCU is the interface for transmission of engine data from the FMGC to the EIU. Thrust limit computation is performed by the ECU, except if the alpha floor protection is activated.

The ECU provides idle mode selection :

- Approach idle, when flaps are extended (SFCC), or landing gear is down (LGCIU).
- Modulated idle, modulated up to approach idle, depending on oil temperature (IDG cooling), air conditioning and anti-ice demand (zone & pack controller).

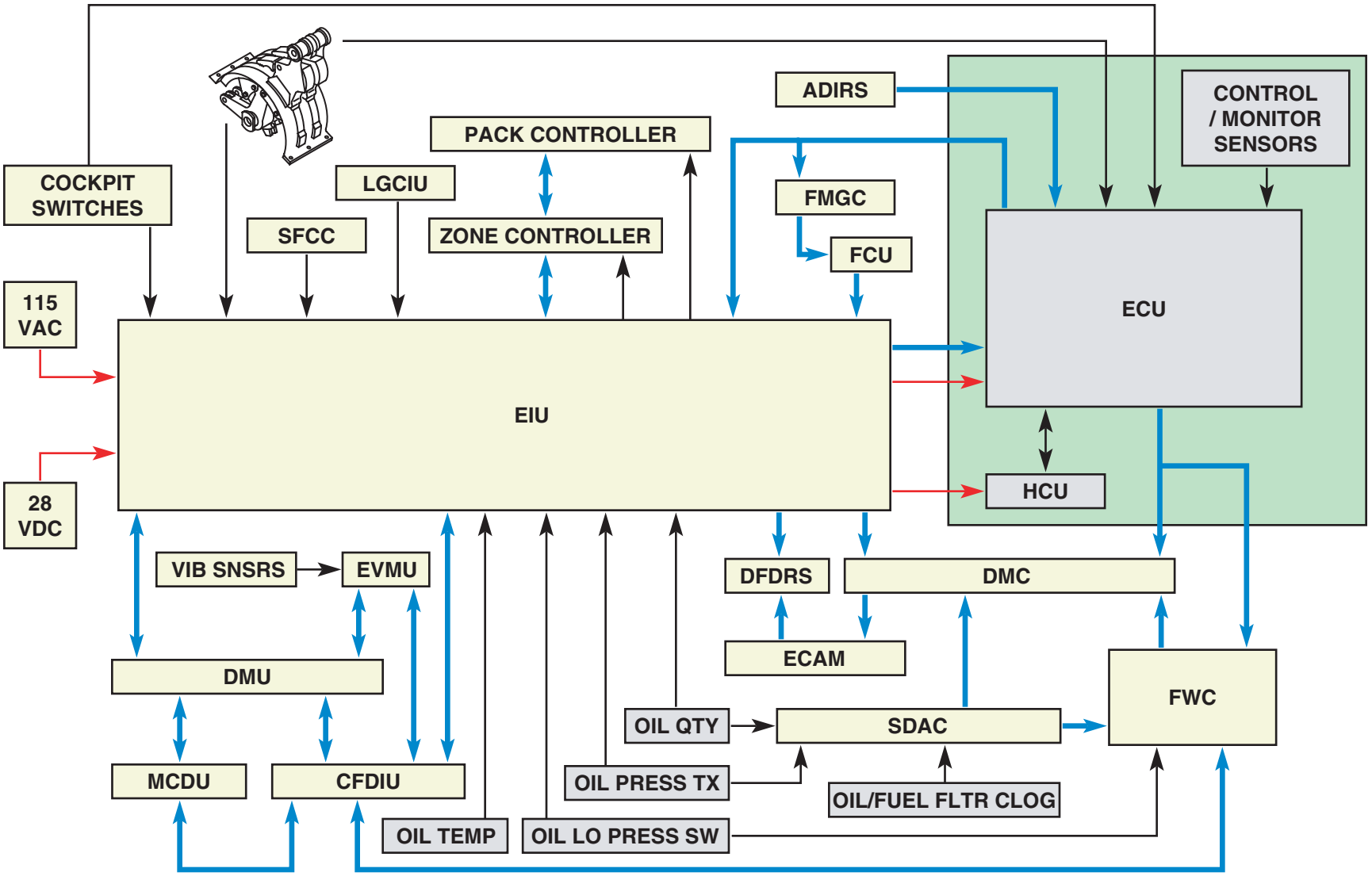
Primary parameters (N1, N2, EGT, Fuel Flow) are sent by the ECU directly to the ECAM, through the DMC. Secondary parameters are sent to the ECAM, through different aircraft computers (EIU, SDAC, FWC).

The DFDRS includes a Flight Data Interface Unit (FDIU) and a Flight Data Recorder (FDR). The FDIU collects various engine and A/C system parameters and processes them internally. The FDR stores data collected over the last 25 hours.

The DMU collects, stores and processes various A/C system data and generates condition reports.

The CFDIU memorizes warnings generated by the FWC and failure information produced by the BITE function integrated in the computers. Maintenance personnel can read out BITE memory information, through the MCDU's.

EFFECTIVITY
ALL CFM56-5A ENGINES FOR A319-A320



CTC-238-006-00

FADEC INTERFACES

FADEC INTERFACES

The FADEC system is closely integrated into the aircraft ECAM system to provide cockpit fault indication and warnings.

Propulsion system survey parameters are directly displayed on dedicated Engine Warning and System Displays.

Information contained on the ECU output buses includes:

- Engine rating parameter information.
- Parameters used for engine control.
- FADEC system maintenance data.
- Engine condition monitoring parameters.
- ECU status and fault information.
- Propulsion system status and fault information.

This data is sent to :

- The EIU for use in the aircraft systems logic and transmission to the DMU (AIDS).
- The FWC for fault warning messages.
- The DMC for parameter displays.

The ECAM monitors operational data in order to display warnings and system information. FADEC system data is processed by the SDAC's, FWC's and DMC's before being presented on the ECAM Engine Warning Display (EWD) and System Display (SD).

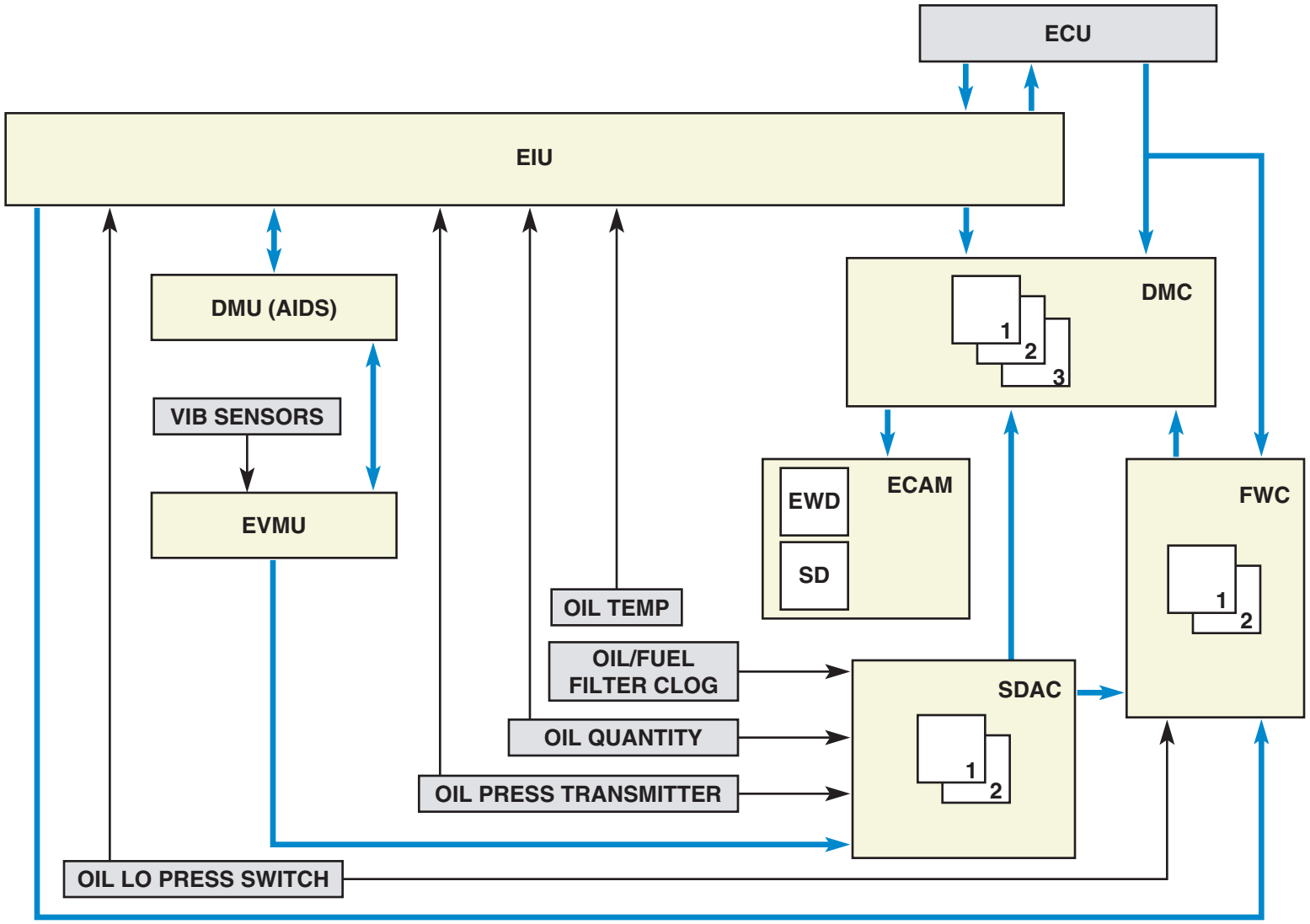
The EWD is dedicated to the primary engine parameters and engine warning messages. The SD is dedicated to the propulsion system parameters when the engine system page is called either automatically, or manually.

The SDAC's digitalize systems data and transmit it to the DMC's. The SDAC's receive systems information concerning amber cautions and transmit it to the FWC's.

The FWC's receive systems data concerning red warnings and memos, generate messages and activate attention getters. Both FWC's have the same engine monitoring capability.

The DMC's use outputs from the FWC's to display information on the lower part of the EWD.

The EVMU provides vibration information to the SDAC's for real time monitoring on the ECAM and to the DMU for condition monitoring.



ENGINE DATA DISPLAY PROCESSING

CTC-238-007-00

ON-BOARD MAINTENANCE SYSTEM

Acquisition of aircraft system data is performed by the Centralized Fault Display System (CFDS). This includes the ECAM to display warnings and system information, the DFDRS, which is an obligatory recording system, the CFDIU and the DMU, which is the main component of the Aircraft Integrated Data System (AIDS).

In each aircraft system computer, a BITE monitors the system and memorizes the failures. After failure detection, the BITE is able to identify the possible failed LRU's and give a 'snapshot' of the system environment when the failure occurred. All information necessary for maintenance and troubleshooting is memorized in NVM.

The ECU is able to distinguish between faults external and internal to the FADEC system. External faults are defined as those detected on aircraft interfaces not dedicated to the FADEC system. External functions include the ADIRU's, the EIU and aircraft power supplies. All other faults in the system (ECU, HMU, sensors, cables, components, etc..) are considered internal faults.

The main components of the CFDS are the CFDIU, which has a main channel and a standby channel, and the aircraft system BITES. The CFDIU continuously scans the buses from the aircraft systems and if a failure message from a system BITE is present on a bus, the CFDIU copies and stores it.

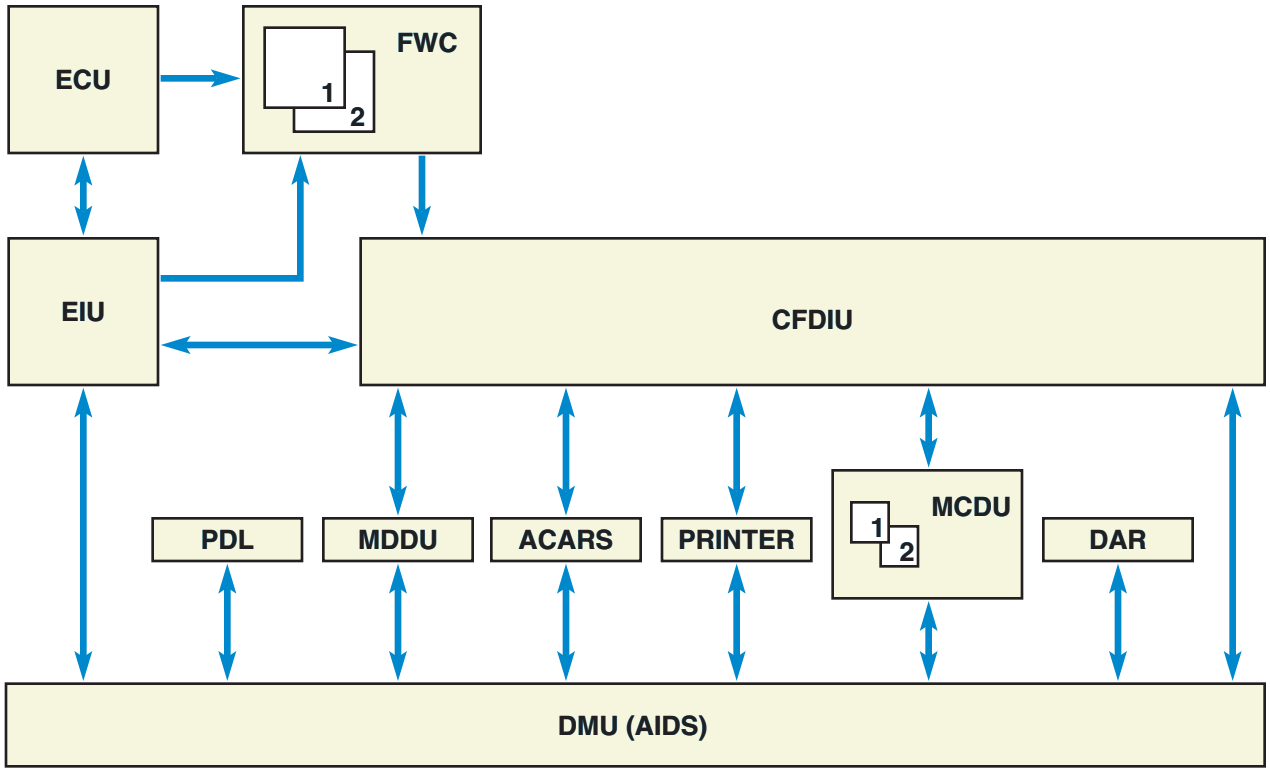
The CFDIU also stores the ECAM messages generated by the FWC's and acts as an interface for some class 2 failures, transmitted by the DMU, and used for the ECAM maintenance status.

The aircraft systems are divided into types 1, 2 and 3, depending on their capabilities and connection to the CFDIU. Most systems are type 1 and these can memorize failures which have occurred in the last 64 flights. The engine (FADEC) is a type 1 system.

The MCDU is the operators interface with the CFDIU.

The DMU records significant operational parameters in order to monitor the engines, the aircraft performance and to analyze specific aircraft problems. A Portable Data Loader (PDL) can be connected to the DMU for up and down loading. An optional Digital AIDS Recorder (DAR) enables data to be stored on a replaceable cassette.

Most reports may be printed and data can also be transmitted to the ground, manually or automatically, through the ACARS. Data may also be loaded into the maintenance computers, through the Multi-purpose Disk Drive unit (MDDU).



ON-BOARD MAINTENANCE

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ECU SIGNALS

EFFECTIVITY

ALL CFM56-5A ENGINES FOR A319-A320

ECU INPUTS

Each ECU channel receives critical engine signal inputs from separate sources.

Dual inputs :

LVDT/RVDT and resolver :
- VSV, VBV, TBV, LPTC, HPTC, FMV.

Valve position switches :
- SAV, FRV, BSV, HPSOV.

PS12.
PS3.
P0.
T25.
T12.
T3.
TEO.
TECU.
N1 and N2 signals.

Dual power :

Engine alternator.

When the signal is less critical, only one source sends a signal, which is connected to both channels.

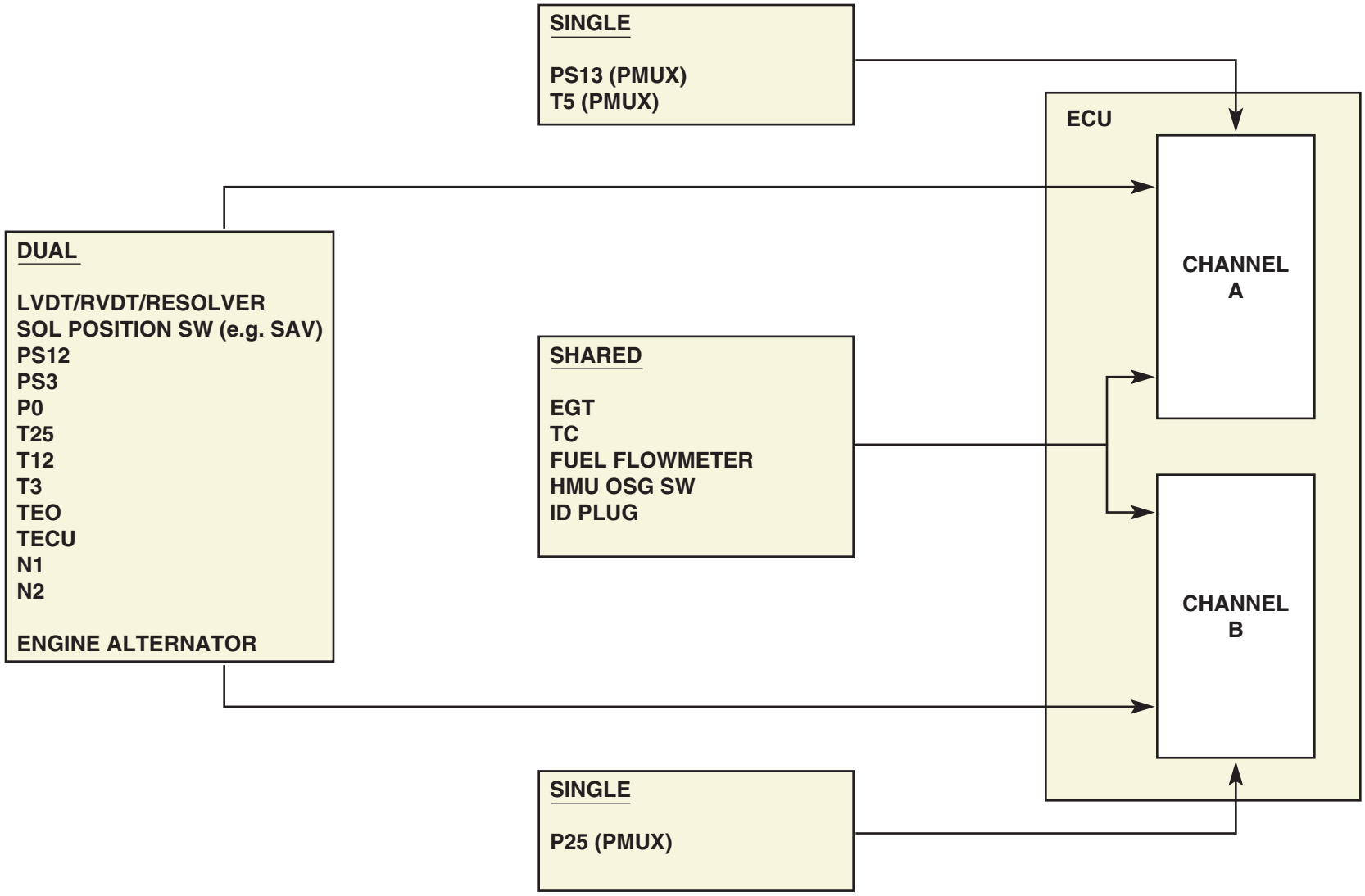
Shared inputs :

EGT.
T Case.
Fuel flowmeter.
HMU OSG switch.
ID plug inputs.

Non-critical control inputs are only sent to one channel.

Single inputs :

PS13 to channel A (PMUX option).
T5 to channel A (PMUX option).
P25 to channel B (PMUX option).



ENGINE INPUTS TO THE ECU

CTC-238-009-00

AIRCRAFT TO ECU INPUTS

The aircraft provides the electrical power supplies for the ECU and also the ignition system.

The aircraft normal and emergency buses supply the ECU with 28Vdc, through the EIU.

The 115Vac, 400Hz supply to each of the ignition exciters is routed from the aircraft, through the EIU and then the ECU, where it is switched on and off to control the operation of the exciters.

The ARINC429 databuses and some aircraft discretes are wired to the engine as simplex connections and split into duplex connections on the engine. The actual split is implemented within the ECU.

The aircraft provides the ECU with :

- Altitude.
- Total Air Temperature (TAT).
- Total Air Pressure (Pt).
- Mach number (M0).

From the ADC's, via ARINC429 serial databuses.

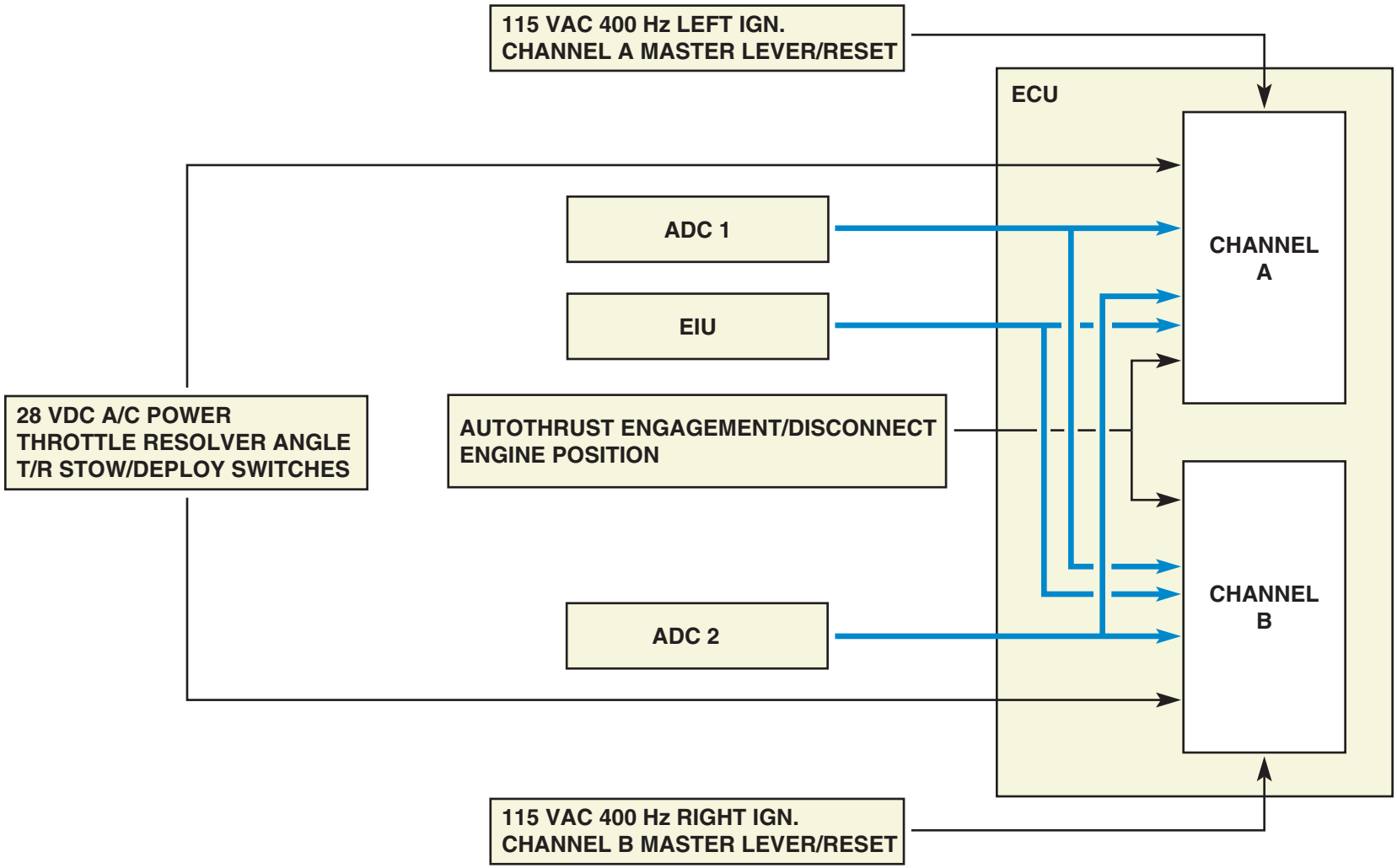
- General aircraft data.
- Idle setting data.
- Engine starting data.
- Autothrust function data.
- Maintenance function data.

From the EIU, via an ARINC429 serial databus.

- Throttle lever position in terms of electrical resolver angle. The resolver is mechanically linked to the throttle levers in the cockpit.

Selected hardwired discrete signals.

- Engine position discretes, which are used by the ECU to assign the SDI on ARINC outputs.
- Autothrust engagement and disconnect.
- Master lever reset.



AIRCRAFT INPUTS TO THE ECU

CTC-238-010-00

ECU OUTPUTS

Each ECU channel has 2 independent ARINC429 serial databuses, which interface with the aircraft. There are no differences in the bus outputs, but data which is specific to a channel, such as fault and maintenance data, may differ from channel to channel. Sensor values that are output by the two separate ECU channels will also be slightly different, but within signal tolerance requirements.

Cockpit indication data is output to the aircraft to keep the flight crew informed of the operational status of system components and FADEC system controlled engine parameters.

Maintenance data is output, via the ARINC429 buses to the aircraft maintenance computer. This data provides information to help the ground crew identify system faults and isolate the faults to the correct LRU, or system interface.

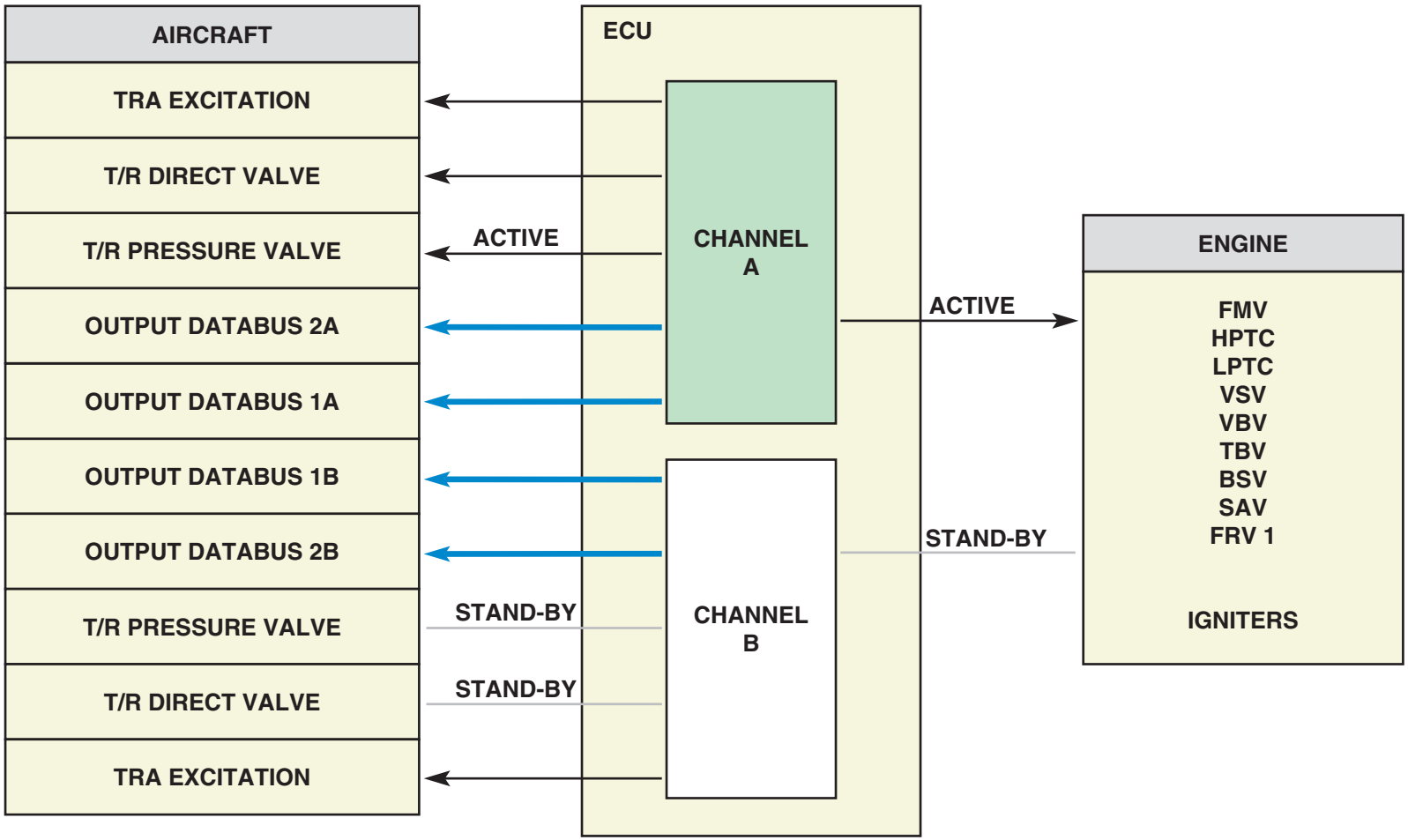
Engine condition monitoring parameters are output to the aircraft, via the ARINC buses, as digital equivalents of all sensor inputs to the ECU.

Channels A and B deliver constant outputs, irrespective of which channel is in control. Channel switch-over does not affect the output data of the ECU, except for the status indication for the channel in control, items specific to the channel in control and whatever faults caused the switch-over.

Both ECU channels are able to control torque motor and solenoid output loads, but only the active channel supplies control outputs during normal operation and the standby outputs are not used.

The ECU turns the two engine igniters on, or off, using relay-controlled switches, internal to the ECU.

Each channel of the ECU also provides excitation voltages for the throttle control system resolvers.



ECU OUTPUTS

CTC-238-011-00

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FAULT DETECTION

EFFECTIVITY

ALL CFM56-5A ENGINES FOR A319-A320

FAULT DETECTION

Signal processing.

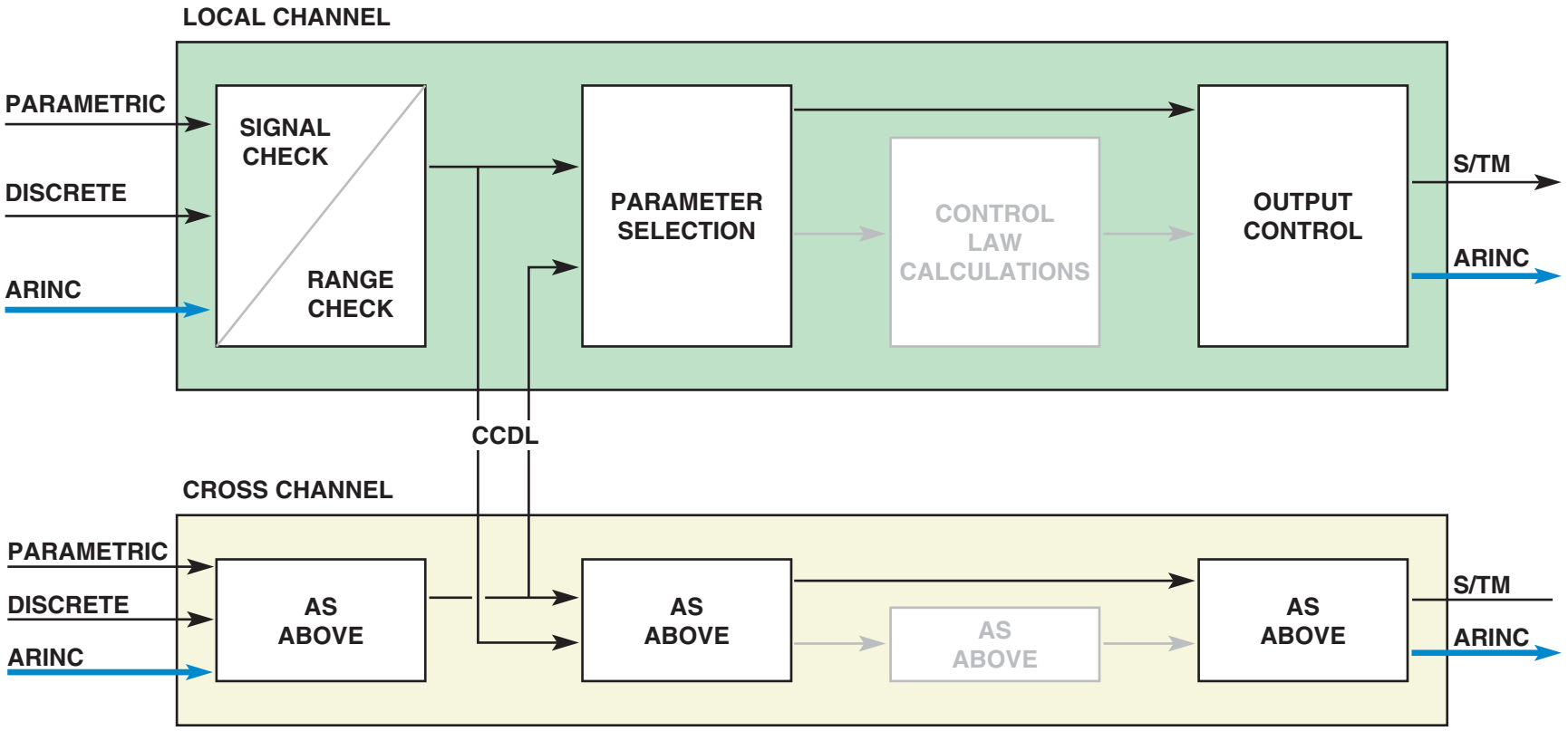
Within the ECU, the various inputs from sensors, switches and the aircraft pass through several stages of checks before the values received are finally selected to be used in the control law calculations.

Both ECU channels validate their inputs, process the data and check their outputs identically.

After they have been converted to a digital format, the parametric/discrete values and the ARINC datawords must first pass through a signal and range check logic.

The values are then compared across the CCDL before being selected for control low calculations. The control laws are entirely managed by the ECU software and will not be described here as they have no impact on fault detection.

After the values have been calculated and processed in the control law logic, they pass through to the output stage for transmission to engine, or aircraft systems.



SIGNAL PROCESSING

CTC-23-012-00

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WARNING INDICATIONS

WARNING INDICATIONS

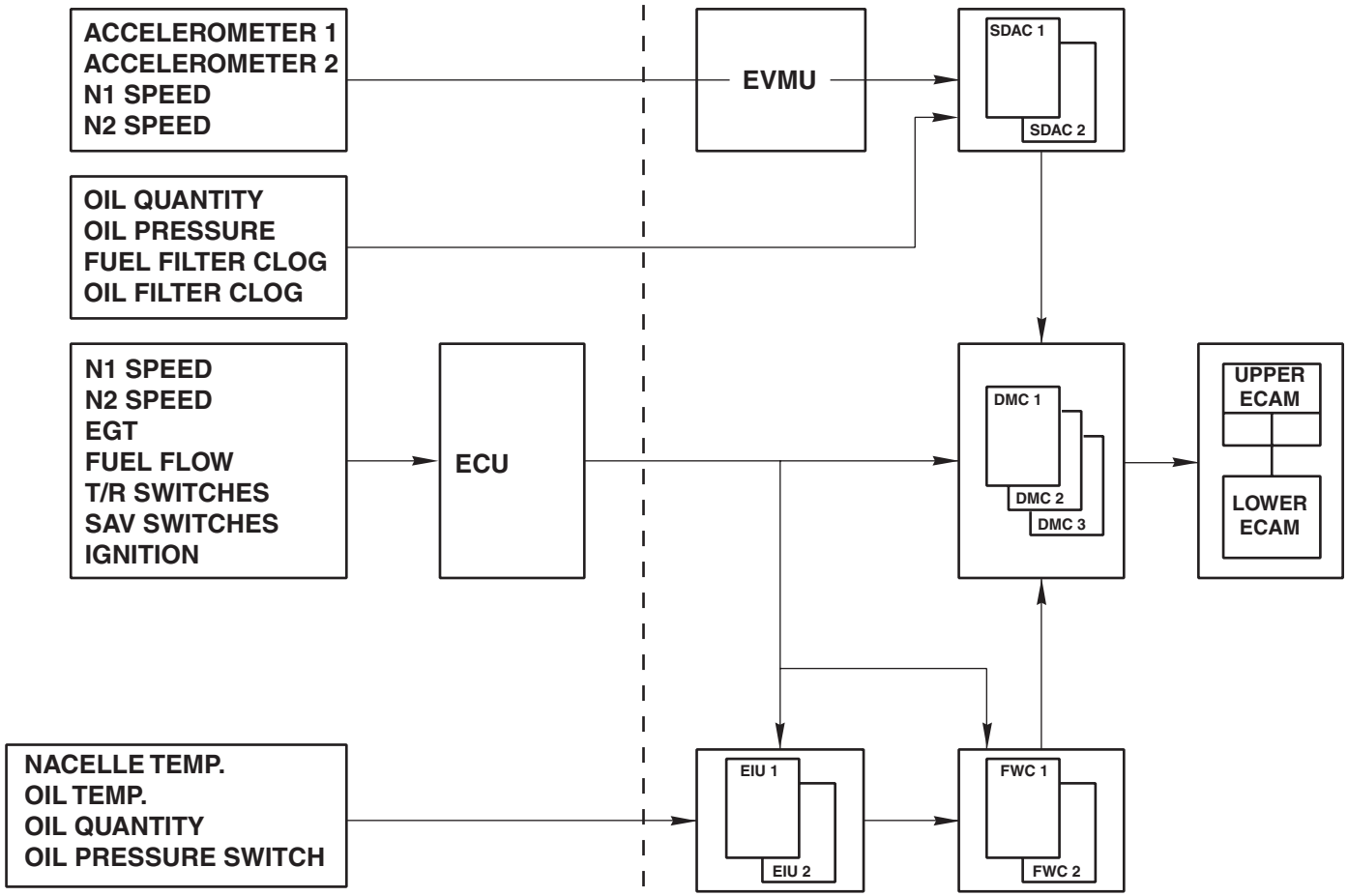
Depending on the data transmitted from the engine, messages are generated on the :

- Upper ECAM : Engine Warning Display (EWD).
- Lower ECAM : Systems Display (SD).
- Master caution, or warning.
- Audible chimes and oral warnings.

These messages are used to run the engine under normal conditions throughout the operating range, or to provide warning messages to the crew and maintenance personnel.

The aircraft computers that impact the engine are :

- 2 System Data Acquisition Concentrators (SDAC).
- 3 Display Monitoring Computers (DMC).
- 2 Flight Warning Computers (FWC).
- 2 Engine Interface Units (EIU).
- 1 Engine Vibration Monitoring Unit (EVMU).



ENGINE INDICATING SYSTEM

CTC-238-013-00

WARNING INDICATIONS

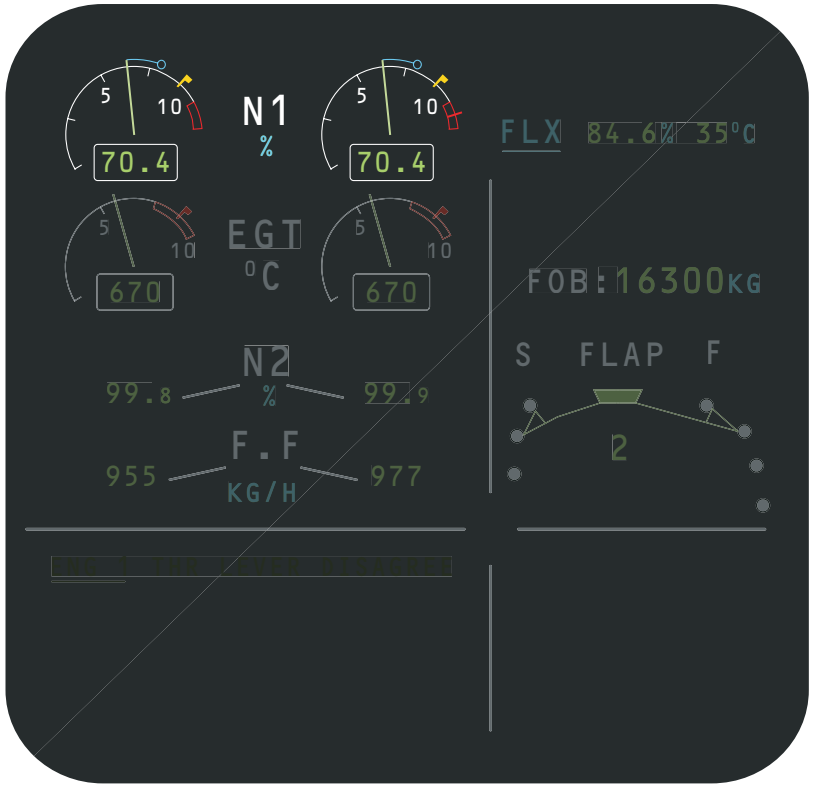
Upper display - N1 indications.

The N1 needle and N1 digital indication are normally green. The needle pulses amber when the actual N1 is above the N1 Max.

Both needle and digital indication pulse red when the actual N1 is above the N1 red line (104%). After an exceedance, a red mark appears at the maximum value achieved. It disappears after a new engine start on ground, of after maintenance action through the MCDU.

If N1 is degraded (N1 dual sensor failure), the last digit of the digital display is amber and dashed.

A blue arc symbolizes the difference between the N1 command and the actual N1. This is not displayed if the A/THR is off.



REDLINE : 104%

N1 INDICATIONS

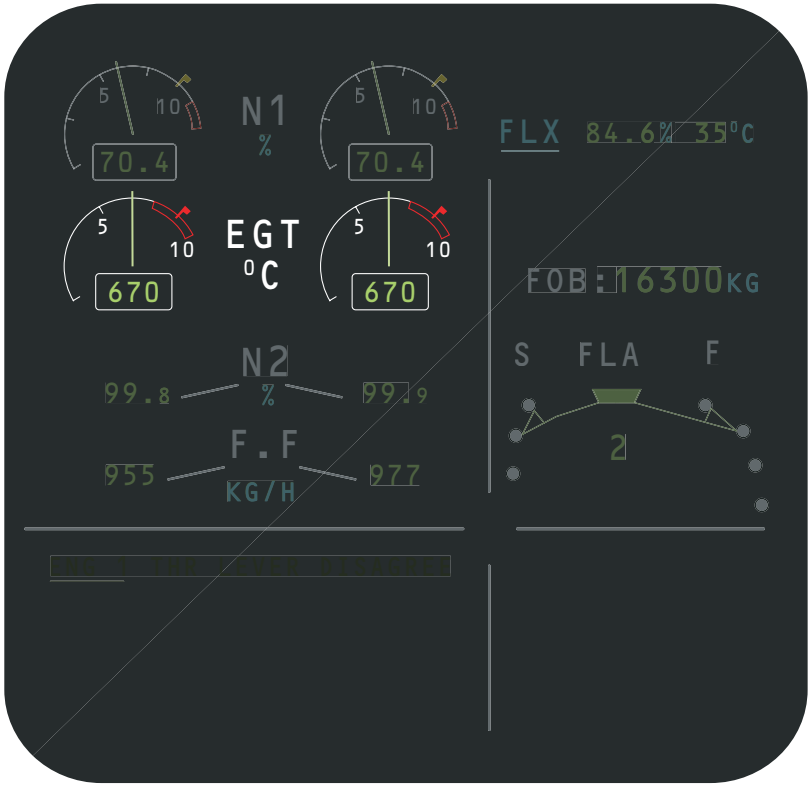
WARNING INDICATIONS

Upper display - EGT indications.

The actual EGT indications are normally green

The index pulses amber above 915°C (or above 725°C during the start sequence). The index and the numerical value pulse red above 950°C.

If 950°C is exceeded, a red mark appears at the maximum value achieved. It disappears after a new take off, or after maintenance action through the MCDU.



AMBER LINE : 725˚C DURING START

AMBER LINE : 915˚C AFTER START

RED LINE : 950˚C

EGT INDICATIONS

WARNING INDICATIONS

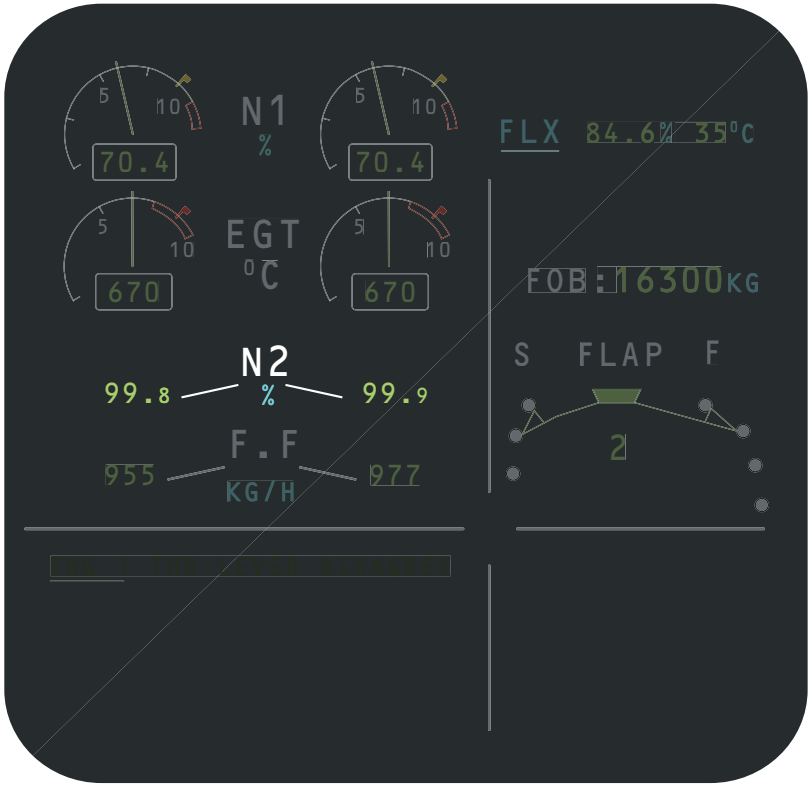
Upper display - N2 indications.

The HP rotor speed digital indication is normally green.

During the start sequence, the indication is green on a grey background.

When N2 is above 105%, the indication becomes red and a red + appears next to the digital indication. It disappears after a new take off, or after a maintenance action through the MCDU.

If the N2 value is degraded (N2 dual sensor failure), the last digit is amber and dashed.



RED LINE : 105%

N2 INDICATIONS

WARNING INDICATIONS

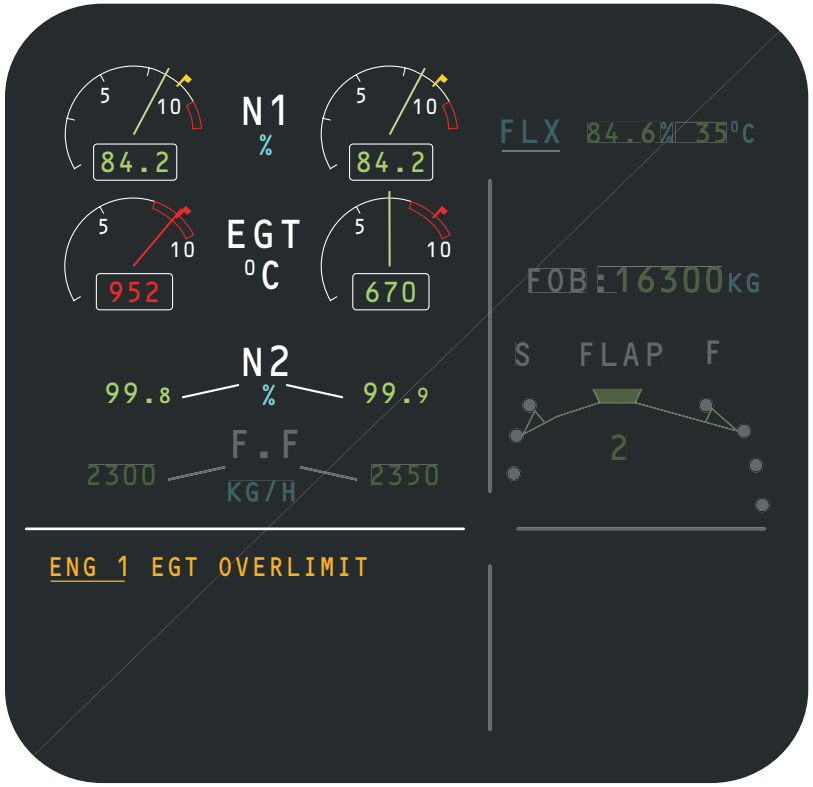
EGT N1 or N2 overlimit.

This warning appears when there are primary parameter limit exceedances.

The over limit for :
- EGT is 950°C.
- N1 is 104%.
- N2 105%.

The master caution comes on and the aural warning (single chime) sounds.

The indication is shown in red and the failure message appears in amber on the upper ECAM display.



THIS WARNING APPEARS WHEN EGT EXCEEDS 950°C.
THE OVERLIMIT FOR :
- **N1 IS 104% AND CORRESPONDING MESSAGE IS "ENG1 (2) N1 OVERLIMIT".**
- **N2 IS 105% AND THE CORRESPONDING MESSAGE IS "ENG1 (2) N2 OVERLIMIT".**

EGT, N1 OR N2 OVERLIMIT

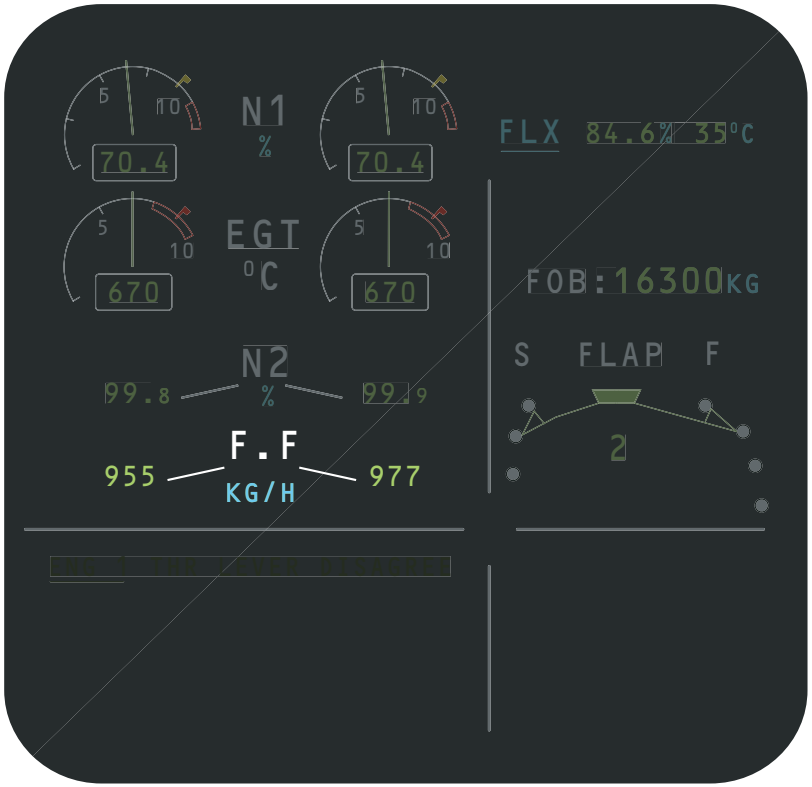
WARNING INDICATIONS

Upper display - Fuel flow indications.

The fuel flow indications are displayed in green.

In case of invalid fuel flow information, the digital indication is replaced by two amber crosses.

This lack of valid data happens when the ECU power is off. This is the case on the ground, five minutes after the last engine shut down.



FUEL FLOW INDICATIONS

WARNING INDICATIONS

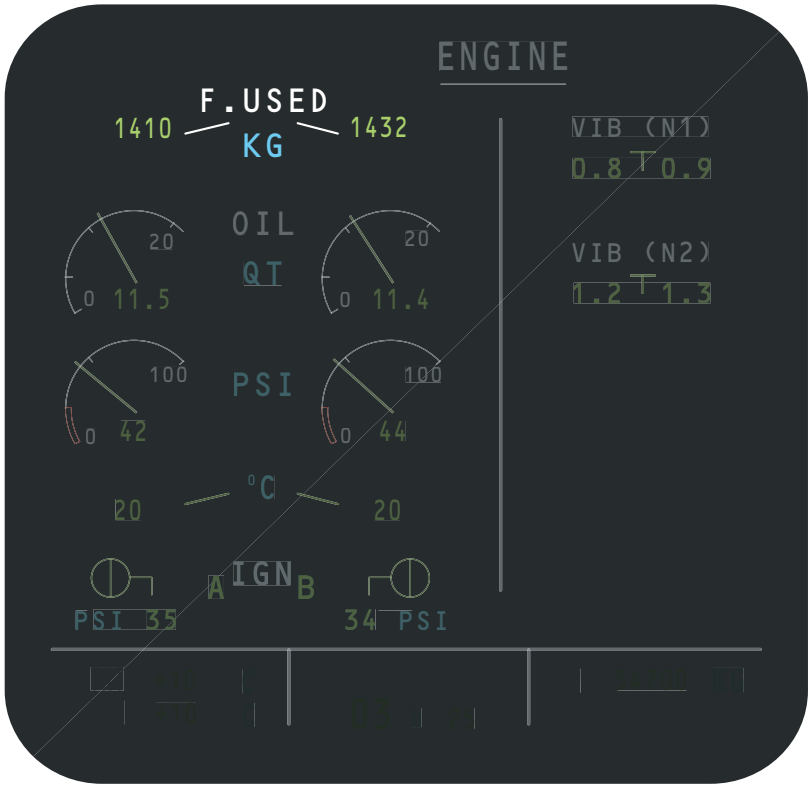
Lower display - Fuel used indications.

The fuel used value, computed by the ECU, is displayed in green.

It is reset at the next engine start (Master switch ON) on ground.

It is frozen at its last value at engine shut down until the next engine start.

The two last digits are dashed if the fuel used indication is inaccurate due to a loss of fuel flow information for more than 1 minute.



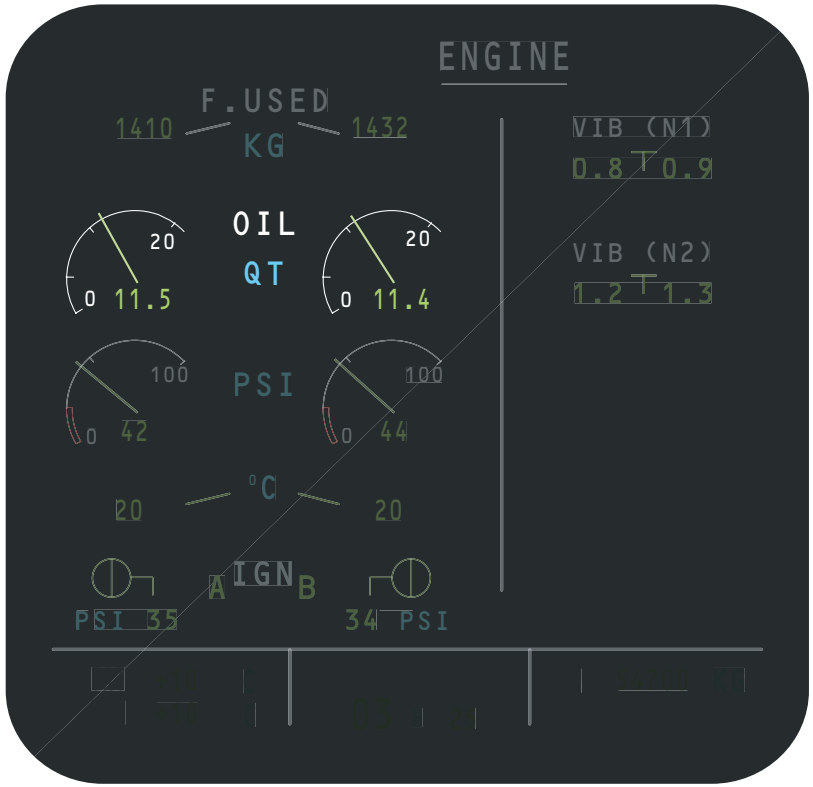
FUEL USED INDICATIONS

WARNING INDICATIONS

Lower display - Oil quantity indications.

The needle and the digital indication are normally green.

The indication pulses below 3 quarts decreasing, or 5 quarts increasing.



NORMAL INDICATION PULSES IF :

- BELOW 3 QUARTS DECREASING.

- BELOW 5 QUARTS INCREASING.

OIL QUANTITY INDICATIONS

WARNING INDICATIONS

Lower display - Oil pressure indications.

The needle and digital indication are normally in green.

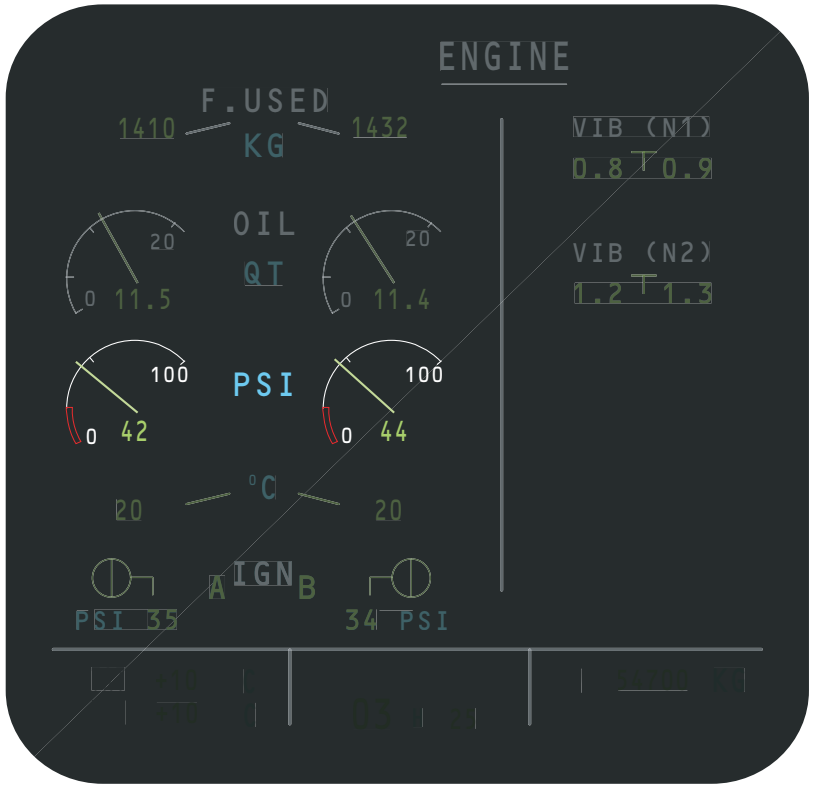
The normal indication pulses if :

- the oil pressure exceeds 90 psi and will continue to pulse until the pressure drops below 85 psi.

- the oil pressure drops below 16 psi and will continue to pulse until the pressure exceeds 20 psi.

The indication is red associated with an ECAM warning if the oil pressure drops below 13 psi.

In case of oil low pressure warning, the master warning flashes and the aural warning (continuous chime) sounds. The failure message is shown in red on the upper ECAM display.



INDICATION PULSES IF :

- PRESSURE EXCEEDS 90 PSI. WILL CONTINUE TO PULSE UNTIL PRESSURE DROPS BELOW 85 PSI.

- PRESSURE DROPS BELOW 16 PSI. WILL CONTINUE TO PULSE UNTIL PRESSURE EXCEEDS 20 PSI.

INDICATION RED IF PRESSURE DROPS BELOW 13 PSI.

OIL PRESSURE INDICATIONS

WARNING INDICATIONS

Lower display - Oil temperature indications.

The oil temperature indication is normally green.

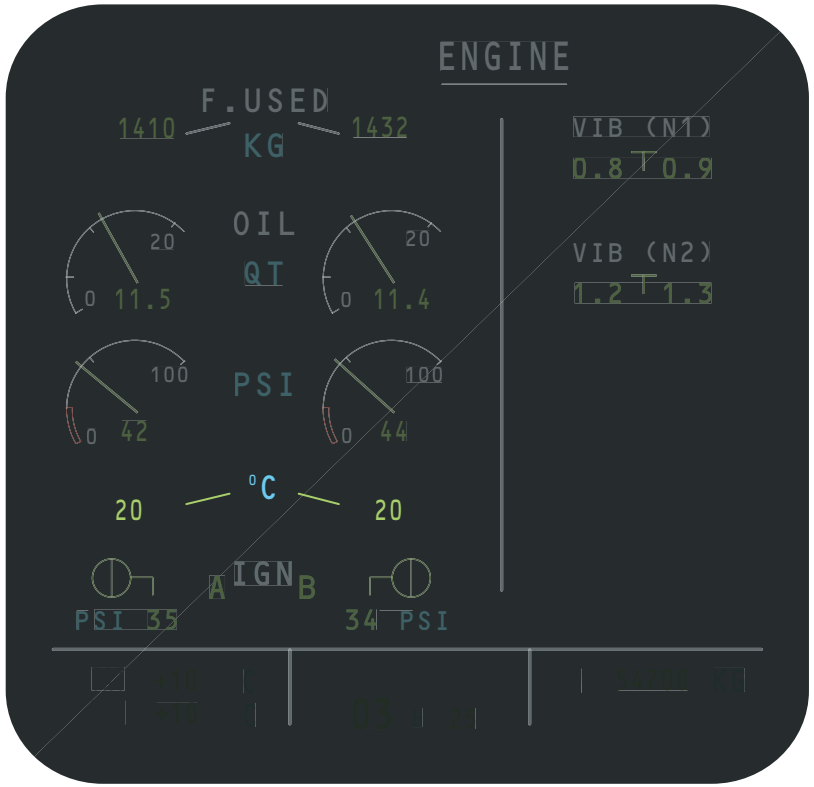
The indication pulses above 140°C increasing and continues to pulse until the temperature drops below 135°C.

The indication becomes amber associated, with an ECAM warning, if the temperature exceeds :

- 140°C for more than 15 minutes,

or

- 155°C without delay.



INDICATION PULSES ABOVE 140˚C INCREASING, WILL CONTINUE TO PULSE UNTIL TEMPERATURE DROPS BELOW 135˚C.

INDICATION AMBER IF TEMPERATURE EXCEEDS :

- 140˚C FOR MORE THAN 15 MINUTES.

OR

- 155˚C WITHOUT DELAY.

OIL TEMPERATURE INDICATIONS

WARNING INDICATIONS

Lower display - Ignition indications.

IGN is displayed in white during the start sequence.

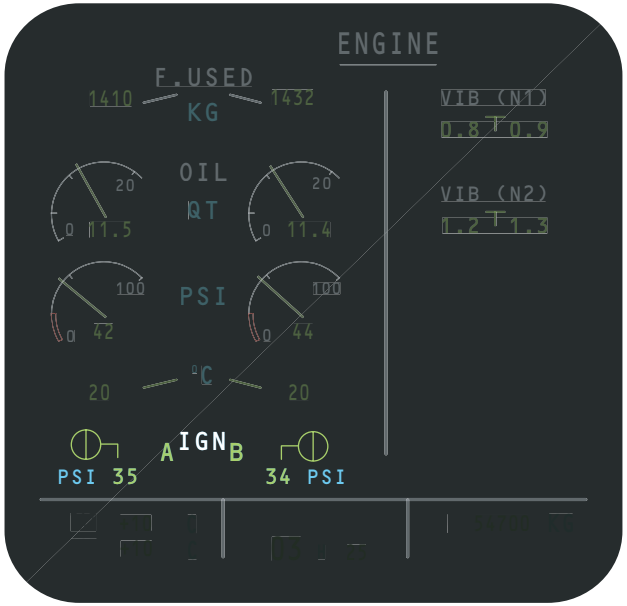
The selected ignitors ‘A’, or ‘B’, or ‘AB’ are displayed in green when supplied during start, or continuous relight.

The start valve position is green and displayed only during the start sequence.

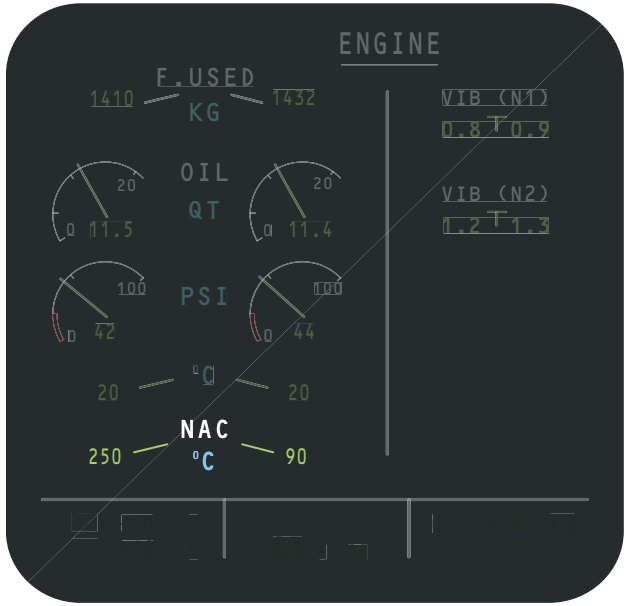
The bleed pressure, upstream of the precooler, is displayed normally in green. It becomes amber below 21 psi with N2 greater than 10%, or in the case of overpressure. It is displayed only during the start sequence.

Lower display - Nacelle temperature indications.

This indication is displayed, except during the start sequence, when the nacelle temperature is above 240°C (advisory threshold).



BLEED PRESSURE BECOMES AMBER BELOW 21 PSI WITH N2 GREATER THAN 10%.



INDICATION DISPLAYED (EXCEPT DURING START) WHEN NAC TEMP EXCEEDS 240˚C.

IGNITION AND NACELLE TEMP INDICATIONS

WARNING INDICATIONS

Lower display - Vibration indications.

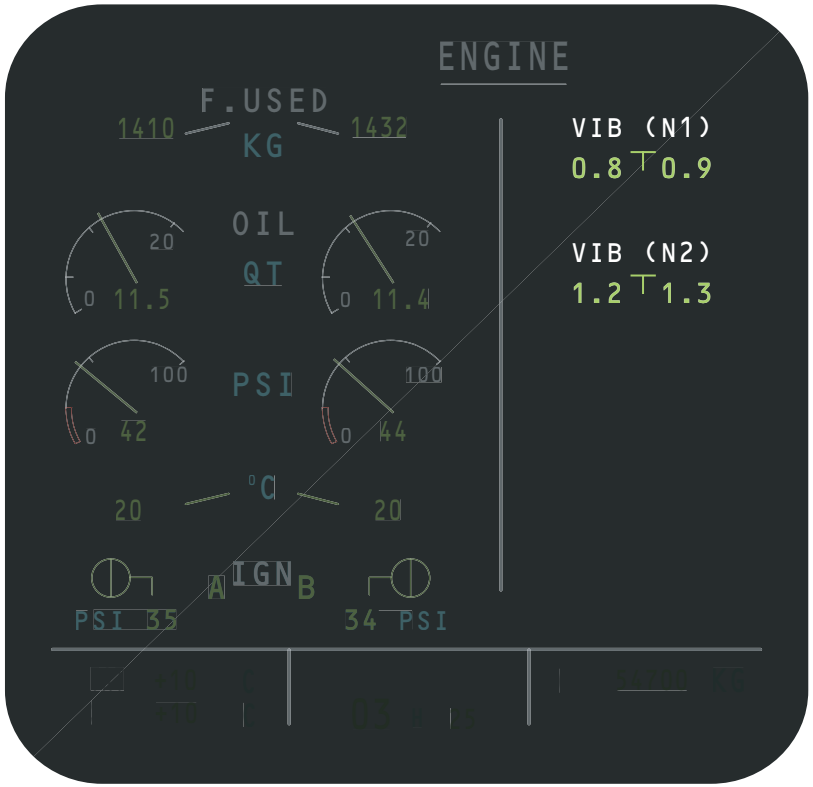
Vibration tracking is theoretically done in Mils for the LP (N1) rotor and IPS for the HP (N2) rotor.

In order to avoid two different types of unit indication being provided to the crew, the two values are transformed and displayed in cockpit units.

The LP rotor indication is green and pulses above 6 units.

The HP rotor indication is green and pulses above 4.2 units.

If an indication is not available, the corresponding indication is replaced by 2 amber crosses.



N1 INDICATION PULSES ABOVE 6 UNITS.

N2 INDICATION PULSES ABOVE 4.2 UNITS.

NOTE : IF INDICATION UNAVAILABLE, THE CORRESPONDING INDICATION IS REPLACED BY 2 AMBER CROSSES.

VIBRATION INDICATIONS

WARNING INDICATIONS

Lower display - Filter clog indications.

Oil.

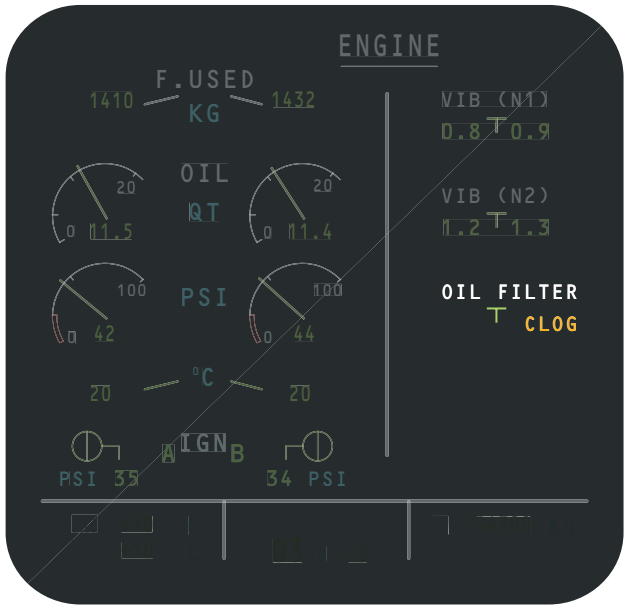
The oil filter clog message appears in amber in case of excessive pressure loss (25.5 psid) across the oil main filter.

When the pressure loss in the oil filter drops below 22 psid, the caution disappears.

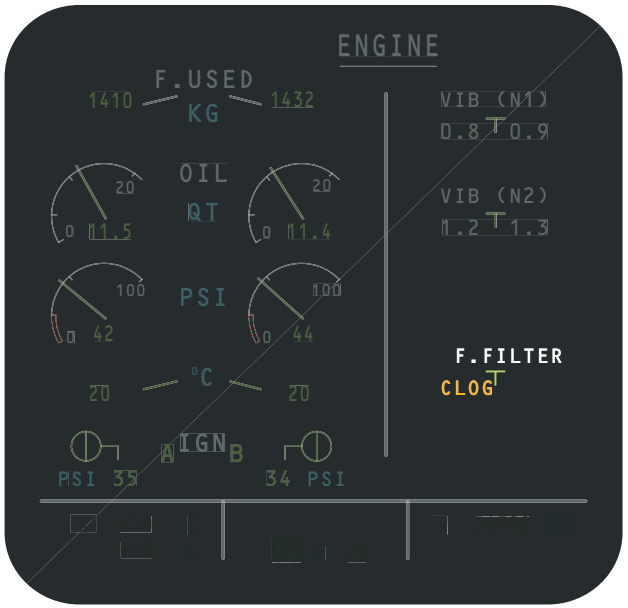
Fuel.

The fuel filter clog message appears in amber in case of excessive pressure loss (11.5 psid) across the fuel filter.

When the pressure loss in the filter drops below 8.5 psid, the pressure switch is de-energized and the caution goes off.



MESSASE APPEARS IF PRESSURE LOSS ACROSS OIL MAIN FILTER EXCEEDS 25.5 PSID.



MESSASE APPEARS IF PRESSURE LOSS ACROSS FUEL FILTER EXCEEDS 11.5 PSID.

FILTER CLOG INDICATIONS

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MESSAGE INTERROGATION

CENTRALIZED FAULT DISPLAY SYSTEM & AIRCRAFT INTEGRATED DATA SYSTEM.

The MCDU menu is displayed by selecting the appropriate key on the keypad. The menu provides access to various systems, including the Centralized Fault Display System (CFDS) and, if installed, the Aircraft Integrated Data System (AIDS).

The CFDS enables maintenance personnel to perform system operational tests, functional checks and readout of BITE memory information, through the MCDU. The CFDS enables memorization and display of fault messages and ECAM warnings and also enables BITE interrogation and system tests.

The CFDS operates in 2 modes : Normal and Menu.

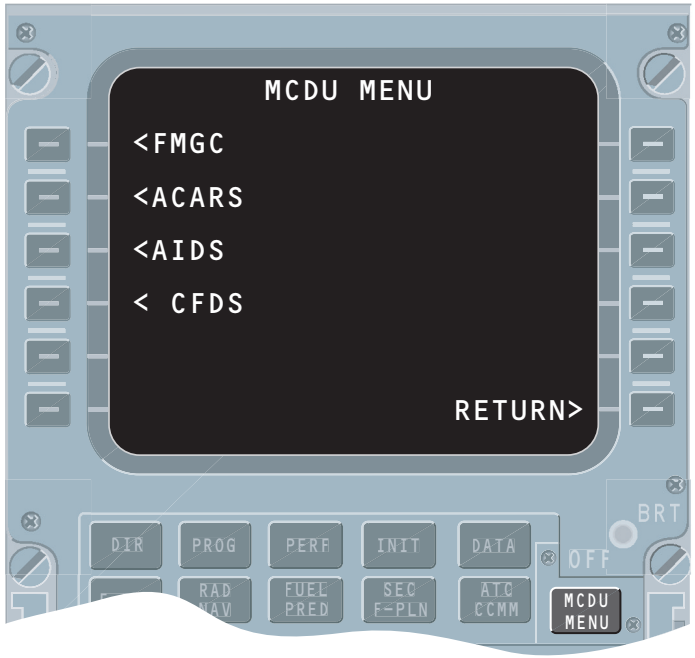
- Normal mode : The CFDS records fault messages.
- Menu mode : The CFDS allows the operator to obtain troubleshooting data from the systems and initiate self tests. This mode is available on ground only.

Most CFDS reports can be printed on board, or transmitted to the ground, manually or automatically, through the ACARS, if installed, or dumped on the MDDU floppy disk, if installed.

The AIDS enables the data stored and processed in the Data Management Unit (DMU) to be read in the form of printed reports. A report is a set of data related to a specific event (e.g. Limit exceedance of engine parameters).

The reports can also be sent to the ground through the ACARS, if installed, or dumped on the MDDU floppy disk, if installed.

The AIDS also enables the operator to view, in real time, the values of aircraft and engine parameters and also the labels transmitted on the ARINC buses.


MCDU MENU
<FMGC
<ACARS
<AIDS
< CFDS
RETURN>
DIR
PROG
PERF
INIT
DATA
BRT
OFF
RAD NAV
FUEL PRED
SEC F-PLN
ATC COMM
MCDU MENU

MCDU MENU

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CENTRALIZED FAULT DISPLAY SYSTEM

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). FAULT CLASSIFICATION - AIRCRAFT.

Failures are classified by the aircraft according to three classes : Class 1, 2 and 3.

Class 1 failures.

Class 1 failures may have operational consequences on the current flight, or on subsequent ones. These failures are normally displayed in real time on the upper ECAM warning display. In some cases, the FWC applies inhibitions and failures are displayed in delayed time during critical flight phases when crew disruptions are not desired.

Class 1 failure warning messages are displayed in 3 levels, according to their severity and the required crew corrective action. Warning messages may also be associated with specific sounds.

- Display level 3 : Red warning. This corresponds to an emergency situation and the crew will have to take immediate corrective actions.
- Display level 2 : Amber caution. This corresponds to an abnormal situation and corrective action is not immediately required.
- Display level 1 : Caution. This level corresponds to an alert situation and the affected system must be monitored by the crew.

Class 2 failures.

Class 2 failures have no immediate operational consequences on the current flight, or on subsequent ones, but should be repaired when the aircraft is back at its main base (first opportunity). They are indicated to the crew by means of an STS indication, pulsing after the 2nd engine shutdown, on ground. They can be displayed, on request, on the ECAM status page under the MAINTENANCE title.

Class 3 failures.

Class 3 failures have no operational consequences on the current flight, or on subsequent ones. They are not presented to the flight crew, either in flight, or on ground. They are only available for maintenance crews, on manual request, through the MCDU.

Advisory mode.

The value of some critical system parameters is monitored by an Advisory mode. When the value drifts from its normal range, the corresponding System page is displayed automatically and the affected parameter pulses. An Advisory may, or may not, lead to a failure.

FAILURE	CLASS 1	CLASS 2	CLASS 3
INDICATION TO THE FLIGHT CREW	MESSAGE DISPLAYED IN FLIGHT - WARNING, CAUTION ON EWD - FLAGS - LOCAL WARNINGS	STATUS LIGHT FLASHING AT THE END OF THE FLIGHT	NO INDICATION TO THE FLIGHT CREW
DISPATCH CONSEQUENCES	MEL ENTRY : "GO", "GO IF" OR "NO GO"	MEL PREAMBLE : "GO"	MEL NOT APPLICABLE
MAINTENANCE INFORMATION	HAVE TO BE REPORTED BY THE PILOTS IN THE LOG BOOK. FAILURES INDICATED AT THE END OF EACH FLIGHT LEG. MEL ENTRY REQUIRED		PRESENTED ON REQUEST, WHEN NEEDED. NO FIXED TIME FOR CORRECTION

AIRCRAFT FAULT CLASS ASSIGNMENTS

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). MAINTENANCE MENU.

From the MCDU menu, selecting CFDS will display the first page of two maintenance menu pages. The first page provides access to :

- **The Last Leg Report** : This displays up to 40 failures (Class 1 & 2), which occurred during the last flight.

- **Last Leg ECAM Report** : This report displays a list of ECAM warning messages sent to the CFDIU, by the FWC's. It can store up to 40 warnings, which occurred during the last flight.

- **Previous Legs Report** : At each new flight leg, the contents of the last leg report are transferred to the Previous Legs Report. It can store up to 200 failures recorded over the last 63 flights.

- **Avionics Status** : This presents a list of the systems currently affected by a failure. The information is permanently updated.

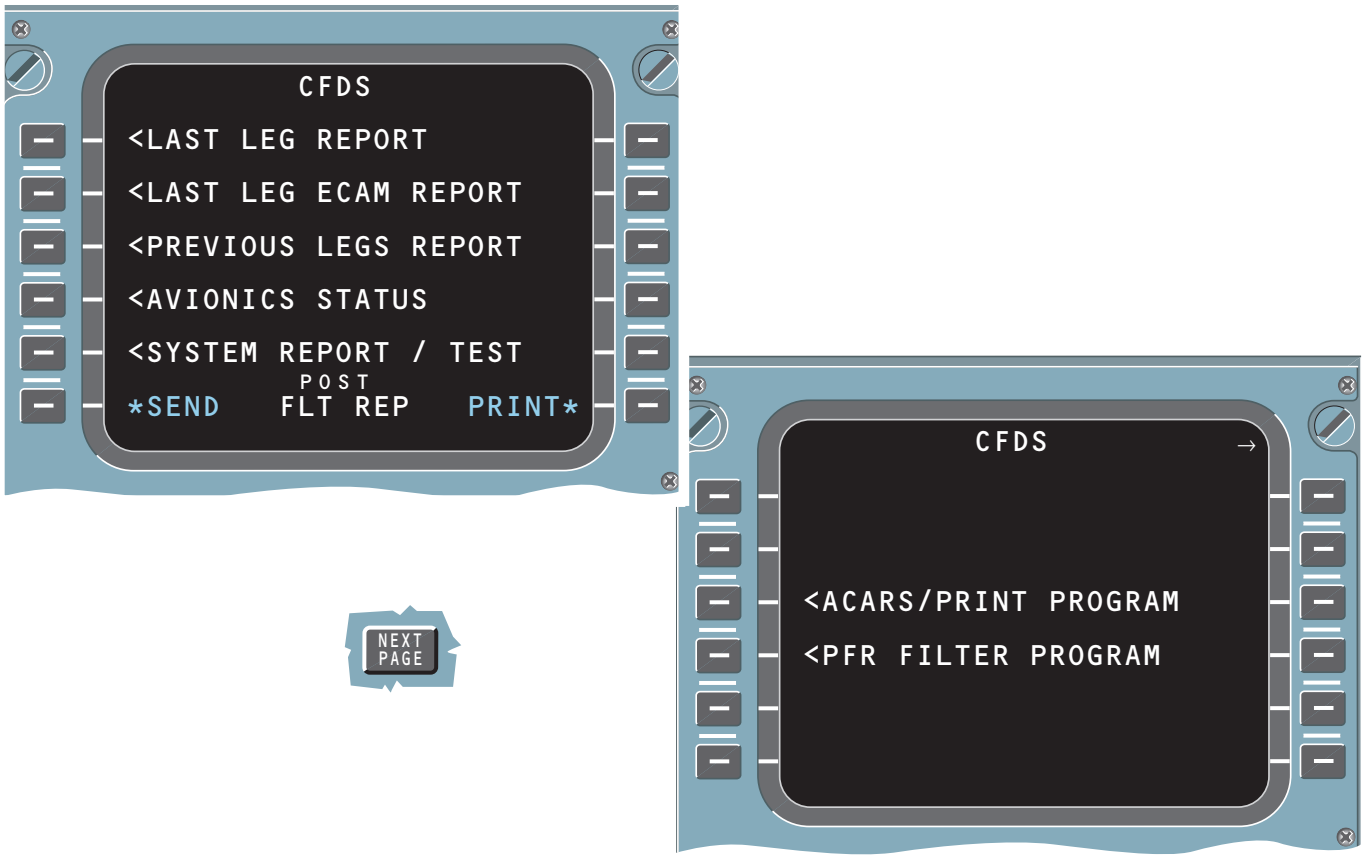
- **System Report/Test** : This presents a list of all the systems connected to the CFDIU.

- **Post Flight Report** : This is the sum of the Last Leg Report and the Last Leg ECAM Report. It is only available on the printer.

The second page of the maintenance menu provides access to:

- **ACARS/Print Program** : This selection provides access to a menu in order to program automatic transmission, or print-out of the Post Flight Report at the end of the flight, or failures and warnings in real time.

- **PFR Filter Program** : The purpose of this function is to improve the operational use of the Post Flight Report by filtering all spurious, or unjustified failures, or messages.



THE MAINTENANCE MENU

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). THE SYSTEM REPORT/TEST.

This function is available only on ground. Selection of the System Report/Test provides access to a list of all the systems connected to the CFDIU.

The System Report/Test function allows interactive dialogue between the MCDU and one system computer.

The systems are displayed in ATA chapter order and the list is displayed on 2 pages, which can be accessed using the NEXT PAGE key.

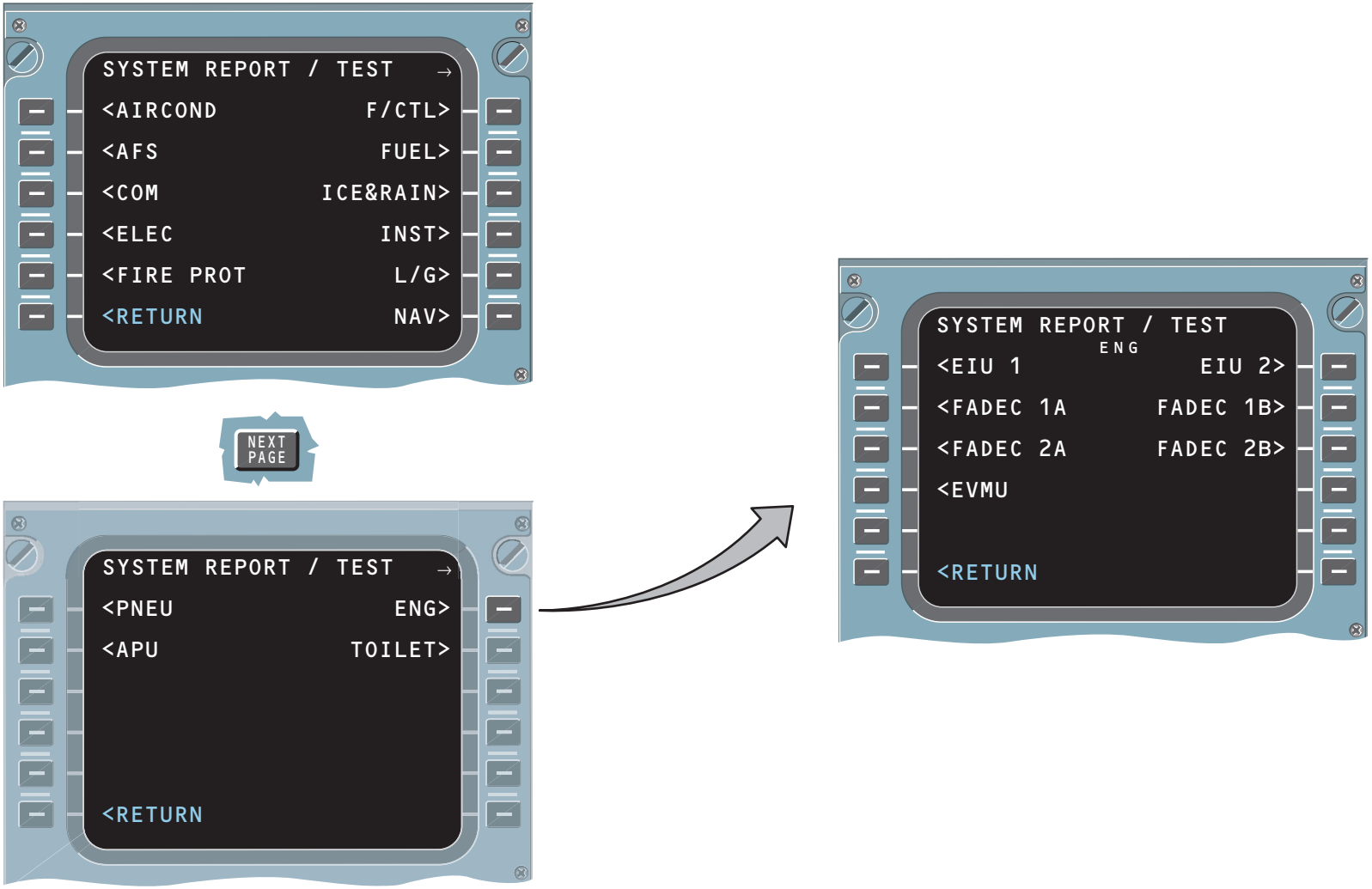
Selecting ENG on page 2 of the System Report/Test will display a menu for engine related systems.

- **EIU 1 & EIU 2** : allows access to the main menus for Engine Interface Units 1 & 2.

- **FADEC 1A & FADEC 1B** : allows access to the main menus for ECU 1 channels A & B.

- **FADEC 2A & FADEC 2B** : allows access to the main menus for ECU 2 channels A & B.

- **EVMU** : allows access to the main menu for the Engine Vibration Monitoring Unit. This menu has 2 pages.



SYSTEM REPORT/TEST

CTC-238-029-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). THE ENGINE INTERFACE UNIT (EIU).

The Engine Interface Unit (EIU) is an interface concentrator between the FADEC system and the aircraft systems. There is one EIU for each engine.

Each EIU main menu provides access to :

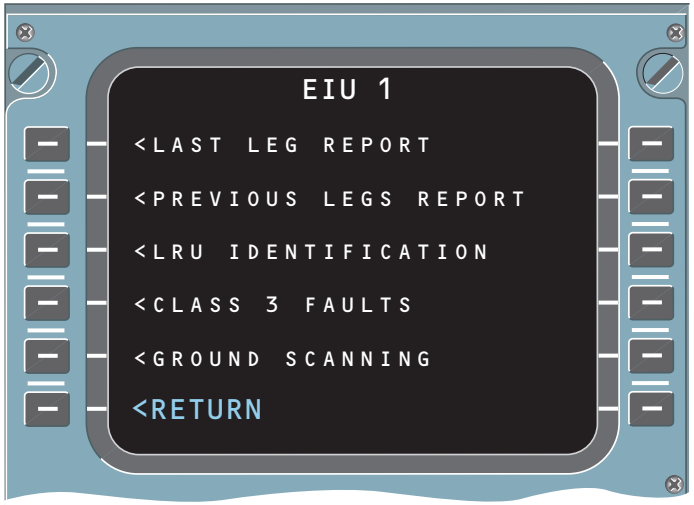
- **Last leg report** : Presents any internal, or external EIU failures, which occurred during the last flight.

- **Previous legs report** : Any internal, or external EIU failures, which occurred during the previous 64 flights are displayed in this report.

- **LRU identification** : Presents the EIU serial number.

- **Class 3 faults** : This report presents any class 3 failure messages that appeared during previous flights.

- **Ground scanning** : This presents any internal, or external failures which are present when a ground scanning request is made. This report is established by forcing operation of the BITE into normal mode (same BITE operation as in flight).



EIU MAIN MENU

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). ENGINE SYSTEMS - ECU.

Data retrieval.

The ECU interfaces with the CFDIU over ARINC429 databuses, through the EIU, for all fault reporting and maintenance operations.

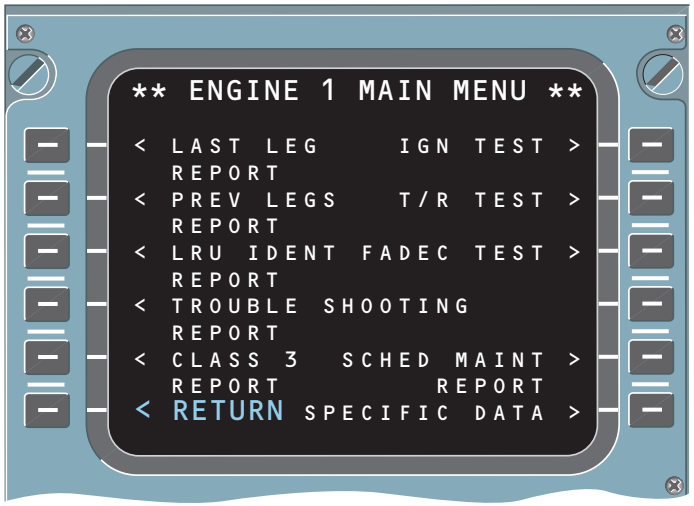
When using the MCDU to interrogate the Last Leg Report, the data displayed is retrieved from the CFDIU memory.

When using the MCDU to interrogate the System Report/ Test- FADEC 1 A/B & FADEC 2 A/B, the data displayed is retrieved from the respective ECU memory.

ECU Menu.

The ECU main menu provides access to various sub-menus :

- Last leg report (leg 00).
- Previous legs report (legs 01 - 63).
- LRU identification report.
- Troubleshooting report.
- Class 3 report.
- Ignition tests.
- Thrust reverser tests.
- FADEC test (motoring / non-motoring).
- Scheduled maintenance report.
- Specific data (PWR setting max values).



ECU MAIN MENU

CTC-238-031-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). ENGINE SYSTEMS - ECU.

ECU fault class assignments.

The ECU automatically determines the criticality level of the fault, or combination of faults to establish the dispatch state of the control/indication system, to comply with the engine and aircraft safety objectives.
The ECU assigns different fault classes to those of the aircraft. The ECU fault classes are :

- Class 1 'NO GO'.
- Class 2 ' TIME LIMITED'.
- Class 3 'UNLIMITED'.
- Class SM (Scheduled Maintenance) 'LONG TIME'.

Class 1 NO GO faults.

This condition does not satisfy dispatch criteria and should be corrected prior to aircraft dispatch. However, there may be possible maintenance, or operational procedures that allow dispatch with the fault(s) and the maintenance manual refers to these particular cases.

Class 2 TIME LIMITED faults.

These conditions are system faults that have no immediate direct impact on the loss of thrust control and satisfy the engine and aircraft safety objectives during the time limitation. The aircraft can be dispatched with these faults, but they should be cleared at an interval that is not greater than the time limitation specified in the Aircraft Maintenance Manual.

Class 3 UNLIMITED faults.

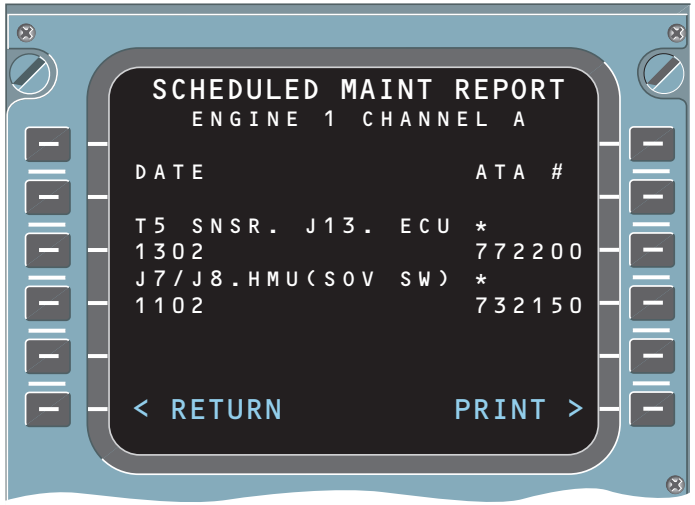
These faults have 'UNLIMITED' conditions and do not have any impact on the dispatch of the aircraft. They may remain unrepaired during the entire aircraft life.

Class SM LONG TIME faults.

These faults are 'time limited' conditions and may be hidden from the flight crews up to the next 'A' check. 'LONG TIME', or Scheduled Maintenance (SM) conditions are system faults that have an indirect impact on the loss of thrust control and the aircraft can be dispatched with these faults. All long time faults must be cleared at an interval that is no longer than the 'A' check maintenance interval.

Note : The ECU may re-evaluate a particular fault and change its priority to a higher class level depending on the health state of the 2 ECU channels.

For example, if there is a Class 2 fault set on the active channel and the standby channel becomes inoperative or,
the same fault is set on both active and standby channels, the ECU will re-evaluate the situation and change the fault level to a Class 1 condition.



CLASS 1 NO GO.

CONDITION DOES NOT SATISFY DISPATCH CRITERIA.
SHOULD BE CORRECTED PRIOR TO AIRCRAFT DISPATCH.

CLASS 2 TIME LIMITED.

AIRCRAFT CAN BE DISPATCHED, BUT SHOULD BE CORRECTED BEFORE TIME LIMITS SPECIFIED IN AIRCRAFT MAINTENANCE MANUAL.

CLASS SM LONG TIME.

TIME LIMITED CONDITION.
MUST BE CORRECTED AT NEXT A CHECK.

CLASS 3 UNLIMITED.

MAY REMAIN UNREPAIRED DURING THE ENTIRE AIRCRAFT LIFE.

ECU FAULT CLASS ASSIGNMENTS

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

ECU BITE memory structure & fault storage.

Internal and external class 1, 2, 3 and SM faults data isolated during Normal Mode operation is stored in BITE memory and the entire contents can be retrieved by shop maintenance test equipment.

The BITE memory structure is divided into five zones and each zone is treated as a circular buffer. The oldest data is overwritten by incoming data. Data from one zone will not be stored in another zone. Class 1 and 2 fault data is divided between zones 1 and 2.

Zone 1 : NVM - Contains failure identification of the 12 most recent class 1, or 2 isolated faults that occurred during the previous 64 flights. This zone contains the fault number, flight leg (0-63) and number of fault occurrences (up to 4).

Zone 2 : NVM - Contains snapshot data corresponding to the 12 class 1 and 2 faults stored in zone 1.

Zone 3 : Reserved RAM - contains failure identification of the 12 most recent class 1, 2, 3, or SM isolated faults that occurred during the ECU test, or thrust reverser test. This zone contains the fault number, flight leg (0), number of occurrences (up to 4), the GMT and date data.

Zone 4 : NVM - Contains information required for troubleshooting the ECU, while in the repair shop. The data is only accessible in the repair shop and display of this information on the aircraft is inhibited.

Zone 5 : NVM - Contains failure identification of the 12 most recent class 3 and class SM isolated faults that occurred during the previous 64 flights. This zone contains the fault number, flight leg (0-63), number of fault occurrences (up to 4), the GMT and date data.

Note : This zone is shared between class 3 and class SM faults. The sum total of faults saved in the zone is 12, therefore, if there are several SM faults, less than 12 class 3 faults can be reported.

ZONE 1 : NVM (FAULT IDENTIFICATION).

12 MOST RECENT CLASS 1, OR 2 ISOLATED FAULTS DETECTED DURING THE PREVIOUS 64 FLIGHTS.

FAULT NUMBER. FLIGHT LEG (0-63). NUMBER OF OCCURRENCES (UP TO 4).

ZONE 2 : NVM (ADDITIONAL FAULT DATA).

SNAPSHOT DATA CORRESPONDING TO THE 12 MOST RECENT CLASS 1, OR 2 ISOLATED FAULTS DETECTED DURING THE PREVIOUS 64 FLIGHTS AND STORED IN ZONE 1.

ZONE 3 : RESERVED RAM (FAULT IDENTIFICATION).

12 MOST RECENT CLASS 1, 2, 3, OR SM ISOLATED FAULTS DETECTED DURING THE ECU TEST, OR THRUST REVERSER TEST

FAULT NUMBER. FLIGHT LEG (0) NUMBER OF OCCURRENCES (UP TO 4).

TIME AND DATE DATA.

ZONE 4 : NVM (SHOP DATA).

INFORMATION REQUIRED FOR TROUBLESHOOTING THE ECU AND ONLY ACCESSIBLE IN THE REPAIR SHOP.

ZONE 5 : NVM (CLASS 3 & SM FAULTS).

12 MOST RECENT CLASS 3 AND SM ISOLATED FAULTS DETECTED DURING THE PREVIOUS 64 FLIGHTS.

FAULT NUMBER. FLIGHT LEG (0-63) NUMBER OF OCCURRENCES (UP TO 4).

TIME AND DATE DATA.

ECU BITE MEMORY STRUCTURE

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Aircraft status - ECU memory.

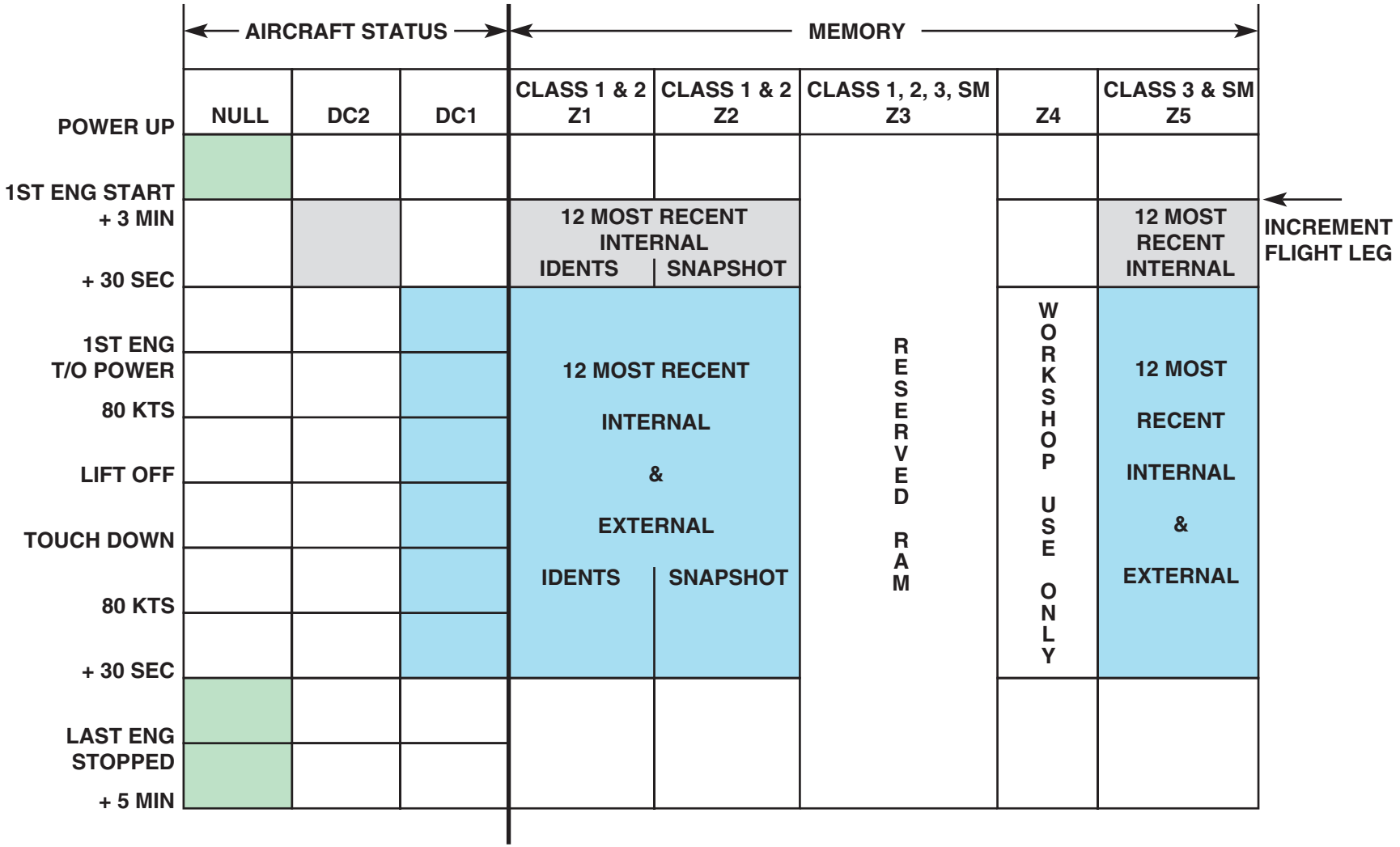
Storage of internal and external fault data in BITE memory is a function of aircraft status.

NULL : No data is stored.

DC2 : Data for all internal faults only will be stored in appropriate areas.

DC1 : Data for all internal and external faults will be stored in appropriate areas.

Flight leg counting and storage processing is done at the start of the flight at the NULL to DC2 transition. The current flight leg (or, last leg if on ground) is identified by 00 on the menu mode display. The previous flight legs increment from 01 to 63.



A/C STATUS - ECU MEMORY FAULT STORAGE

CTC-238-034-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

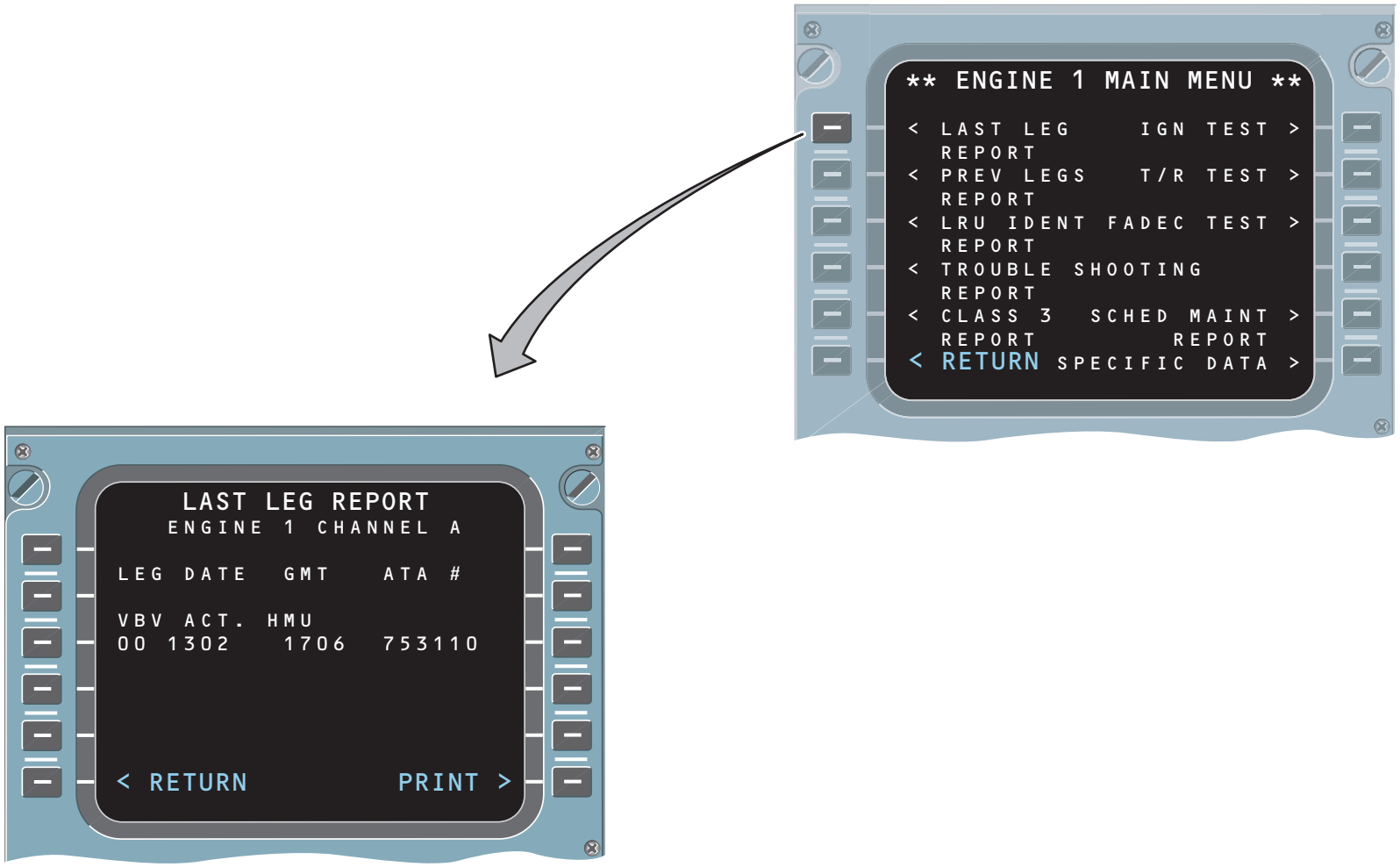
Last leg report (Leg 00).

The last leg report format (class 1 and 2 faults only) contains the identity of each faulty LRU, the flight leg (always 00), the date and time at which the fault occurred and the ATA reference number.

A maximum of three faults are displayed per page and the faults are displayed in chronological order with the oldest fault first.

If no faults were recorded during the last flight, a 'NO FAULTS RECORDED' message is displayed.

When there is an NVM failure, the ECU will display a 'DATA NOT RETRIEVABLE' message.



LAST LEG REPORT (00)

CTC-238-035-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

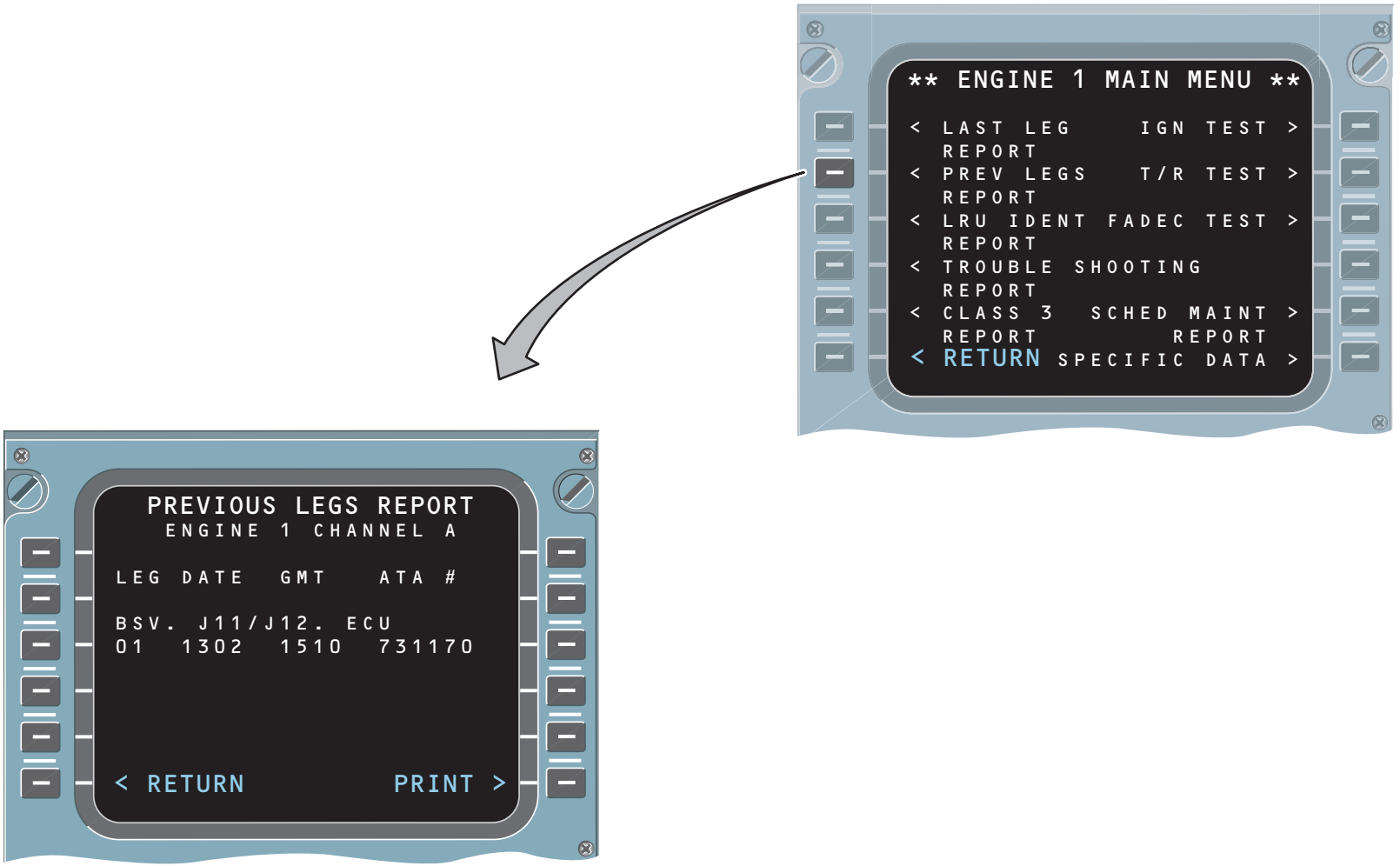
Previous legs report (Legs 01 to 63).

The previous legs report format (class 1 and 2 faults only) is the same as the last leg report, except that for each fault, the flight leg number at which the fault occurred is added.

Flight leg numbers are displayed in reverse chronological order with the most recent flight leg first and the faults within each leg are displayed in chronological order with the oldest fault first.

If no faults were recorded during previous flights, a 'NO FAULTS RECORDED' message is displayed.

When there is an NVM failure, the ECU will display a 'DATA NOT RETRIEVABLE' message.



PREVIOUS LEGS REPORT (01-63)

CTC-238-036-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

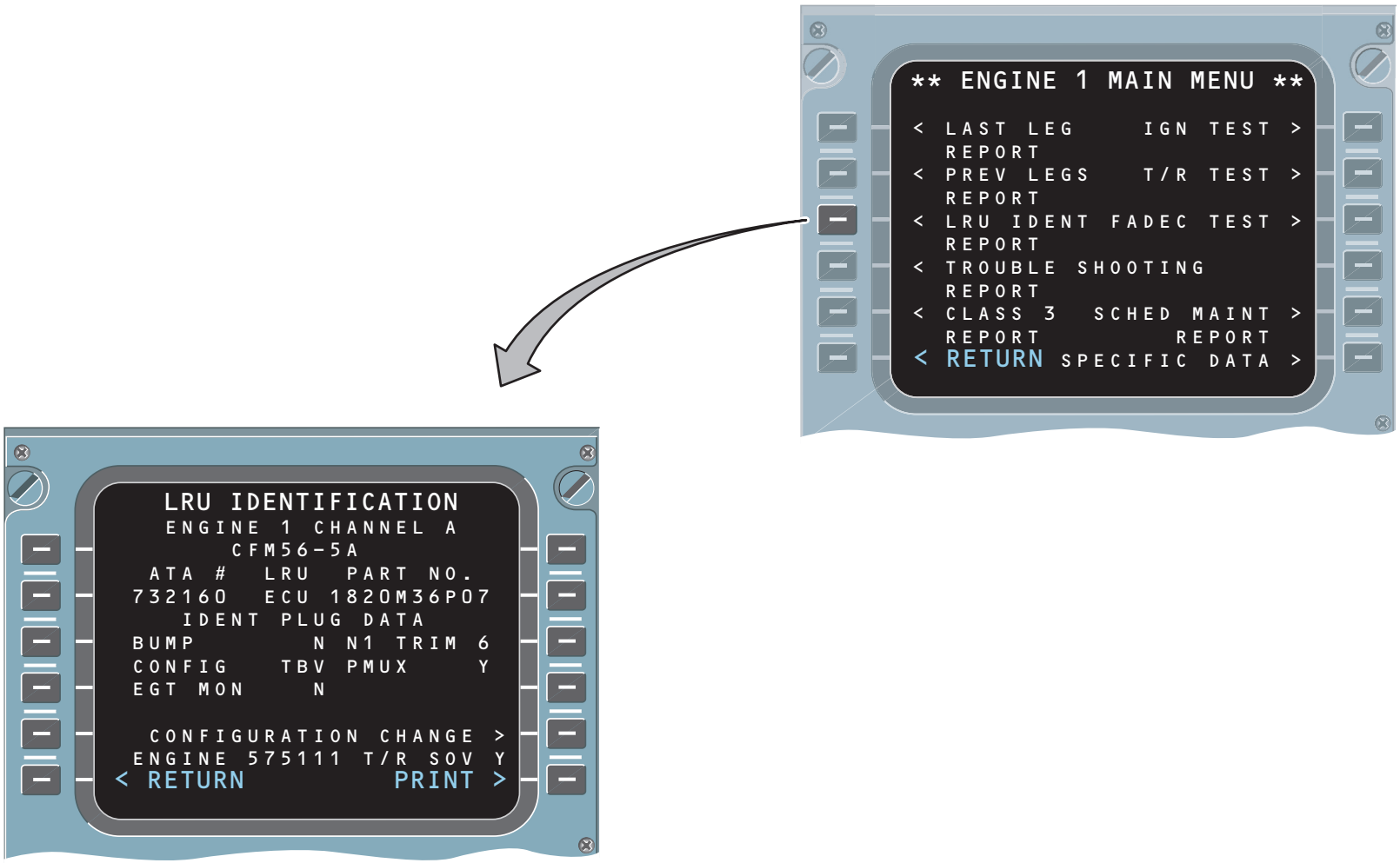
LRU identification.

The LRU identification page provides information on engine configuration.

The page displays :

- ECU ATA number
- ECU part number
- Engine rating
- Bump availability
- N1 Trim (0 - 7)
- PMUX inhibited status
- EGT monitoring status
- Engine configuration (RACSB valve, or TBV valve)
- TR SOV status
- Engine serial number

A menu selection is also provided to change the engine serial number if the ECU is moved from one engine to another and also to change the TRSOV installation status.



LRU IDENTIFICATION

CTC-238-037-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

LRU identification - S/N & TRSOV status change.

If the ECU has been changed, or moved to another engine, the engine serial number may be changed through the MCDU. The S/N must correspond to that engraved on the Engine Dataplate, riveted on the fan frame.

When 'CONFIGURATION CHANGE' is selected from the LRU identification page, a sub-menu appears that allows the operator to select either engine S/N change, or TRSOV status change.

If the operator selects 'ENGINE S/N CHANGE', a new sub-menu is displayed that allows the operator to enter six digits from the keypad. When the new S/N has been entered, the operator presses the corresponding line select key and a new screen appears informing the operator that the S/N entry has been accepted.

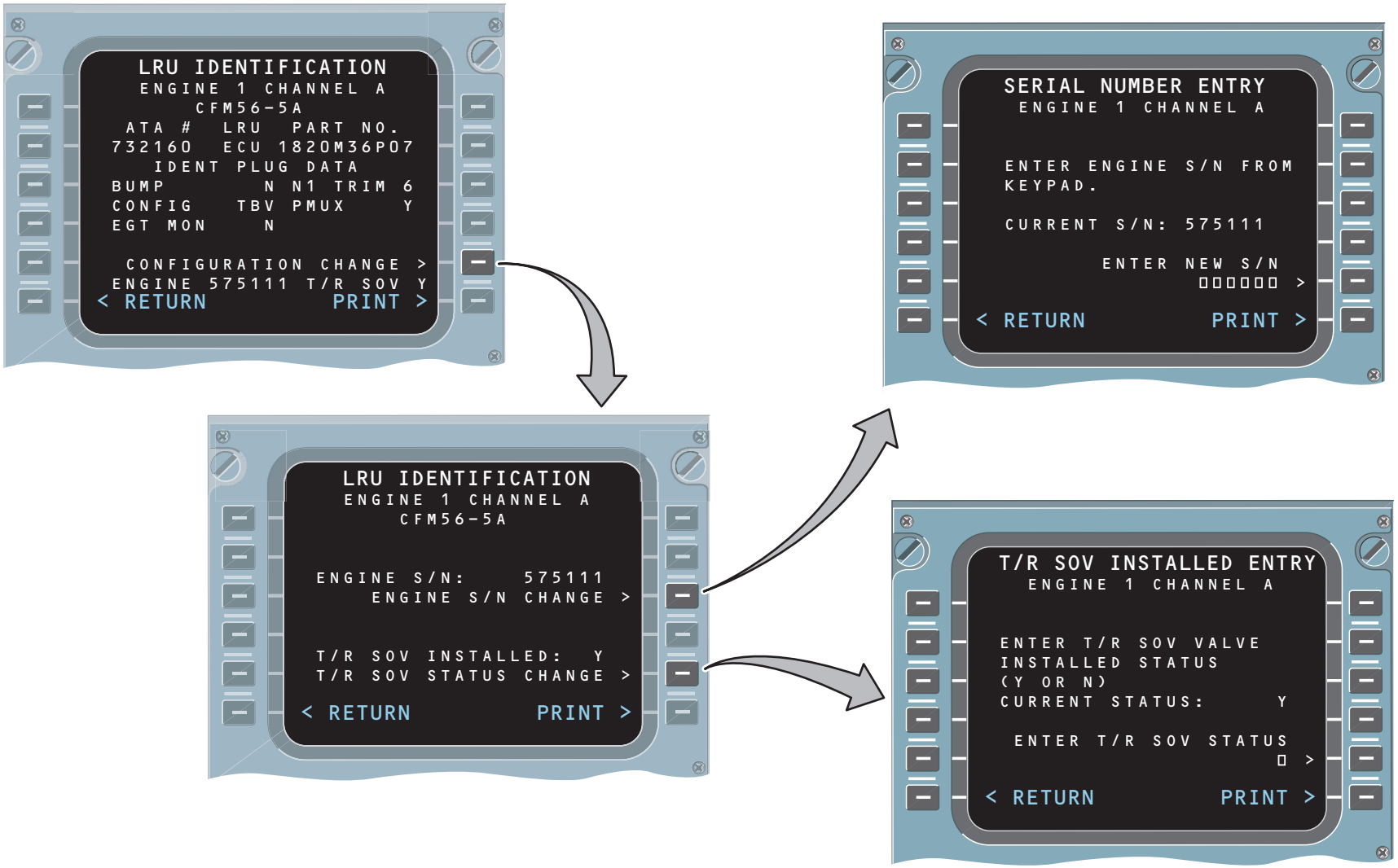
If the number was wrongly entered (incorrect number of digits, or a letter accidentally keyed), a different screen will be displayed informing the operator that a mistake was made and allowing the correct number to be re-entered. Once the correct number has been entered, the ECU stores it in both channels. The LRU identification menu will then display the new S/N.

If the operator selects 'T/R SOV STATUS CHANGE', a new sub-menu is displayed that allows the operator to change the status. The current status is displayed and the operator can key 'Y', or 'N' using the keypad.

When the new status has been entered, the operator presses the corresponding line select key and a new screen appears informing the operator that the new status has been accepted.

If the entry was incorrect (any character other than 'Y', or 'N'), a different screen will be displayed informing the operator that a mistake was made and allowing the correct status to be re-entered.

Once the correct status has been entered, the ECU stores it in both channels. The LRU identification menu will then display the new status.



S/N AND TRSOV STATUS CHANGE

CTC-238-038-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Troubleshooting report.

This report provides a snapshot of certain parameters recorded at the time the fault first appeared and is used as an aid in troubleshooting.

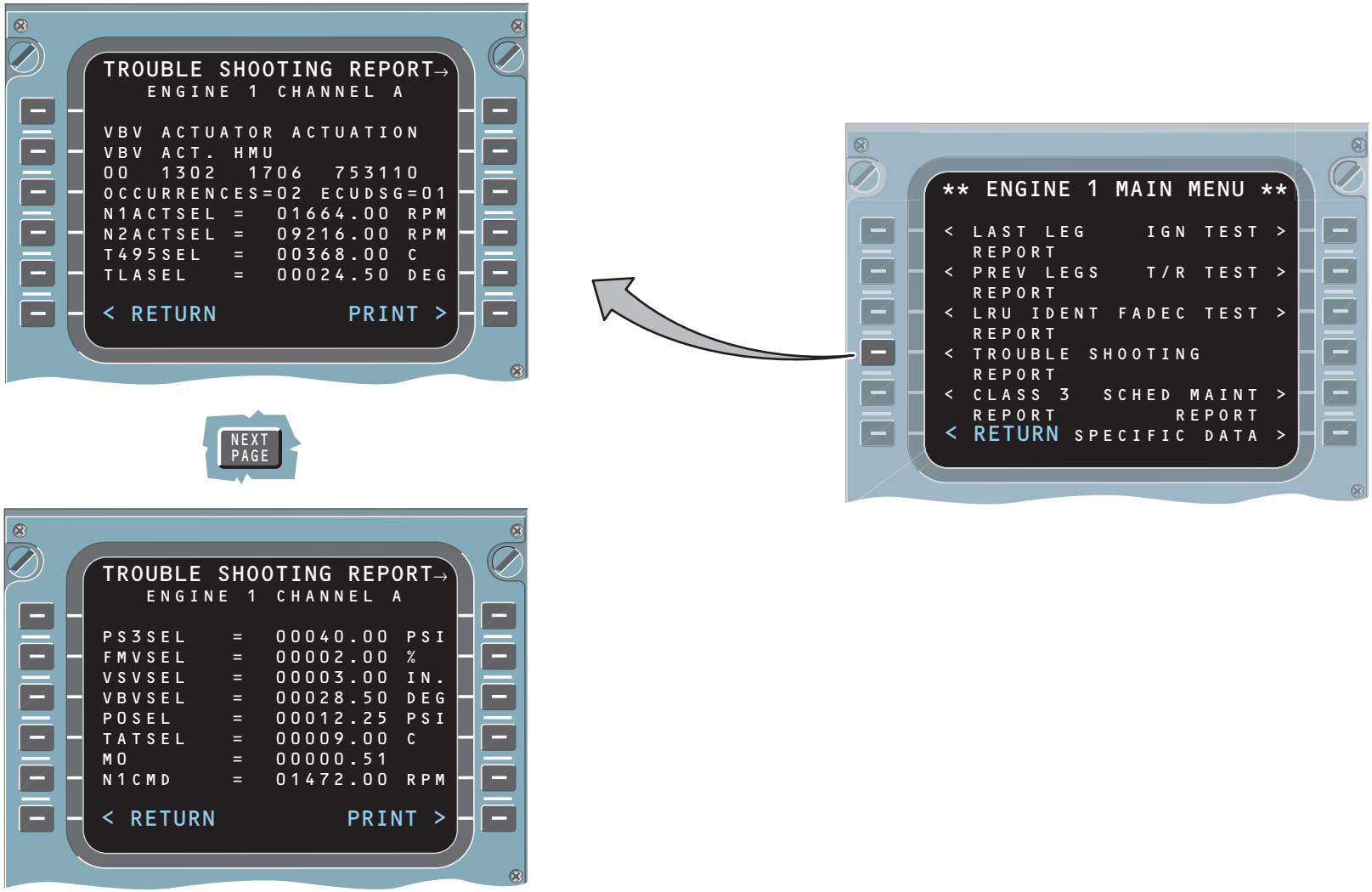
Each report has 2 pages and data for a maximum of 12 class 1 & 2 faults recorded over the last 64 flight legs may be displayed.

Troubleshooting data is displayed in reverse chronological order, i.e. last event first.

The display shows the fault message and the normal mode message, followed by the flight leg number, date, time, and ATA number.

The number of occurrences (1 to 4) and the ECU designation are shown followed by the values of selected parameters.

If no troubleshooting data is available, a 'NO FAULTS RECORDED' message is displayed.



TROUBLESHOOTING REPORT

CTC-238-039-00

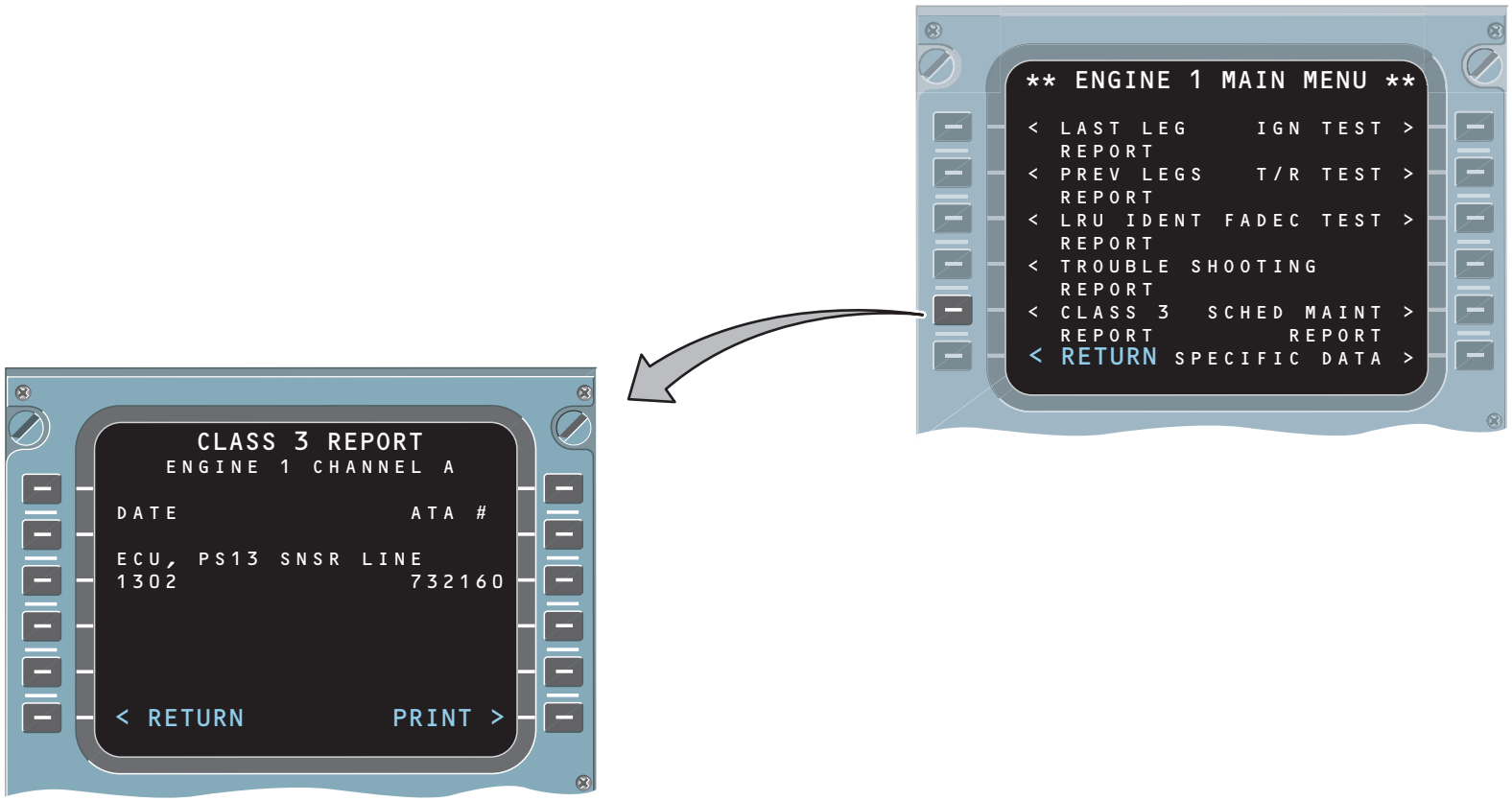
CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Class 3 report.

The Class 3 report has the same format as the ‘Last leg report’, except that there is no flight leg, or date information.

Troubleshooting data is not available for class 3 faults.

If no class 3 faults have been recorded during the last 64 flights, a ‘NO FAULTS RECORDED’ message is displayed.



CLASS 3 REPORT

CTC-238-040-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

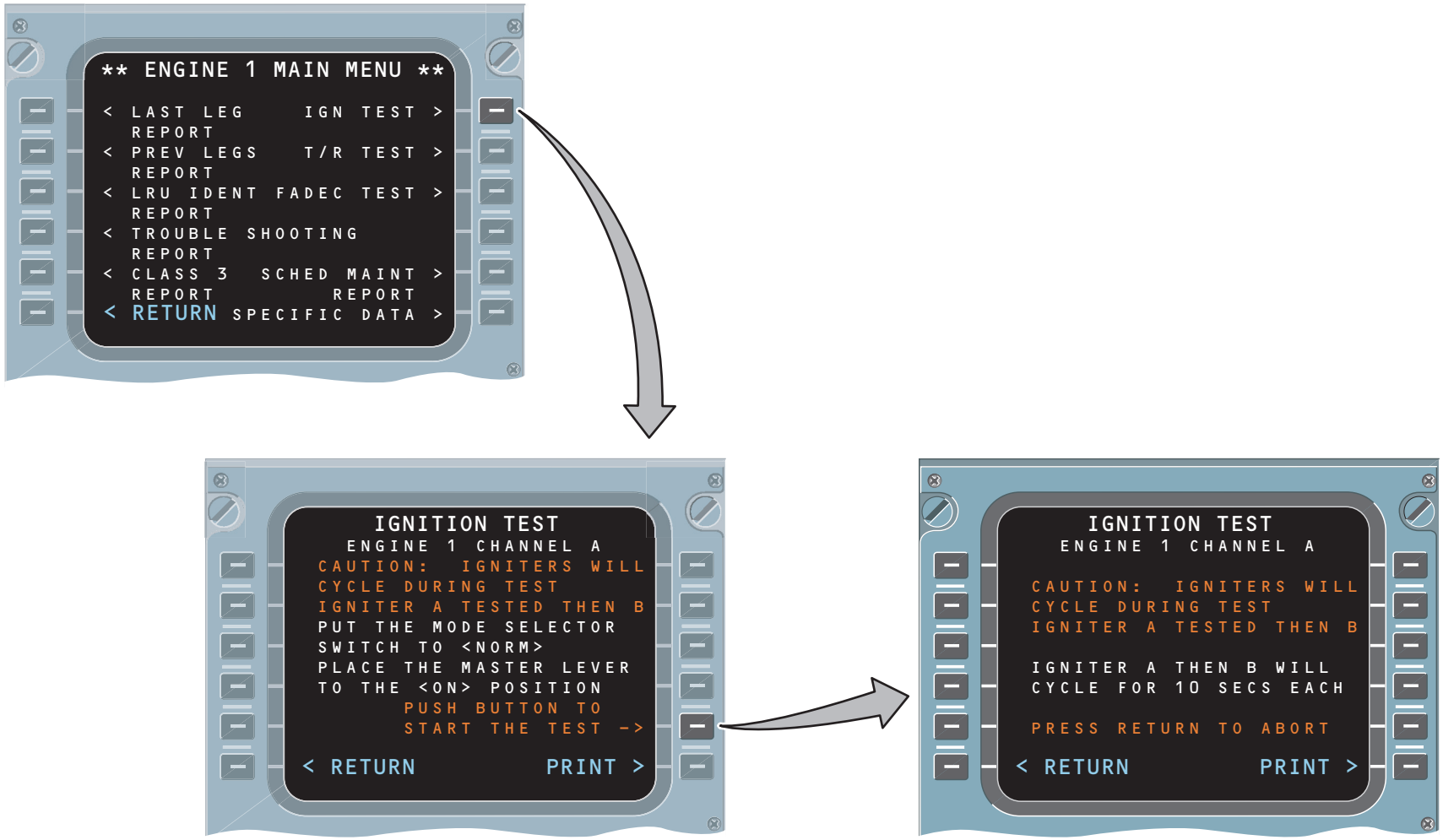
Ignition test.

The ignition test consists of cycling ignitor A for 10 seconds, waiting 2 seconds, then cycling ignitor B for 10 seconds.

Selecting 'IGN TEST' from the main menu will display a screen with initial aircraft setup conditions. The operator is prompted to place the mode selector switch to the 'NORM' position and place the master lever to 'ON'. The operator must then press the appropriate line select key to start the test.

While the test is active, a page is displayed warning the operator the ignitors are cycling and that pressing the 'RETURN' key will abort the test.

Upon completion of the test, a test 'close up' screen is displayed to ensure that the function is exited with the master lever returned to the 'OFF' position.



IGNITION TEST

CTC-238-041-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Thrust reverser test.

During this test, hydraulic pressure must be available for supply to the thrust reverser system. By moving the throttle in the reverse and forward regions, the T/R will deploy and stow under controlled conditions.

Thrust reverser position switch faults, pressurizing valve and directional valve solenoid electrical checks, aircraft inhibition switch failures and pressurizing valve position faults are announced, if detected.

Only thrust reverser system faults are announced during the test and the general FADEC test may be selected to determine if any other faults are present.

Selecting 'T/R TEST' from the main menu will display a screen with initial setup conditions and caution information. The operator must press the appropriate line select key to start the test.

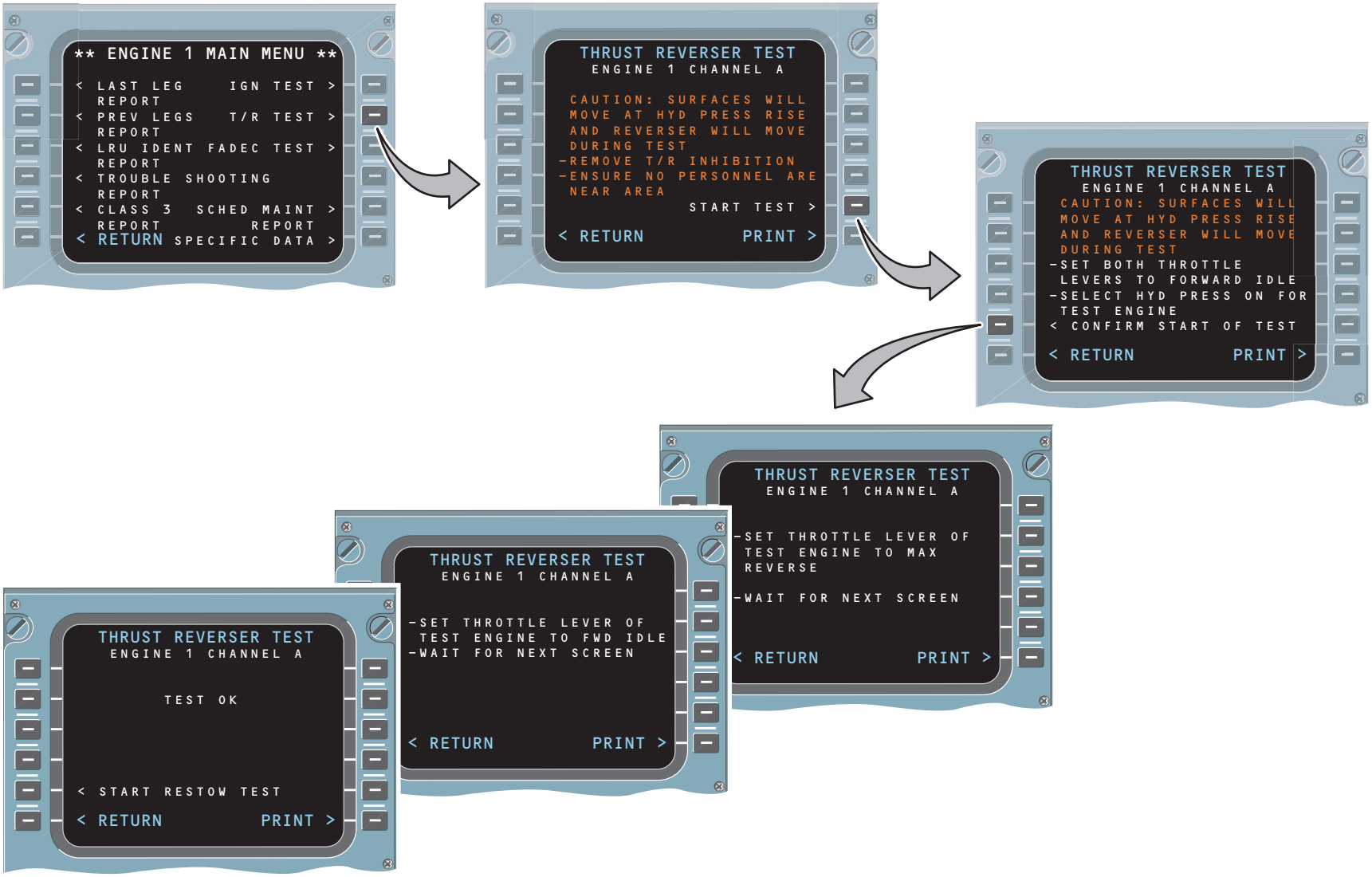
Selecting 'START TEST' displays another screen with more caution information and setup conditions. The operator must confirm the start of the test by pressing the appropriate line select key.

If the TRSOV is not installed, a screen is displayed to ask the operator to set the throttle lever to max reverse and this screen is displayed until a timer times out, or the T/R is fully deployed.

If the TRSOV is installed, a 'PERFORMING TR SHUTOFF VALVE TEST' screen is displayed, which times out after about 8 seconds. The next display asks the operator to set the throttle lever to max reverse and this screen is displayed until a timer times out, or the T/R is fully deployed.

The next display asks the operator to set the throttle lever to fwd idle and, when the doors are fully stowed, the test results screen is displayed.

If no faults were found, a 'TEST OK' message is displayed and the operator is also given the opportunity of performing a restow test. This checks for possible restrictions in the hydraulic return lines from the HCU. To the operator, the test is identical to the previous test. There is no limit to the number of times the operator may perform the restow test.



CTC-238-042-00

THRUST REVERSER TEST

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

FADEC test.

The FADEC test is divided into two parts. If starter air is available at the beginning of the test, a motoring test is performed. Otherwise, a non-motoring test is performed.

The non-motoring test will complete automatically in about two minutes. After the operator has pressed the line select key to start the test, a screen appears prompting the operator to place the mode selector switch to 'NORM' and the master lever to 'ON'. When the conditions are met, a 'TEST ACTIVE' screen is displayed.

When the test is complete, a display reports that a non-motoring test was performed and prompts the operator to either press a key to display the test results, or return to the main menu.

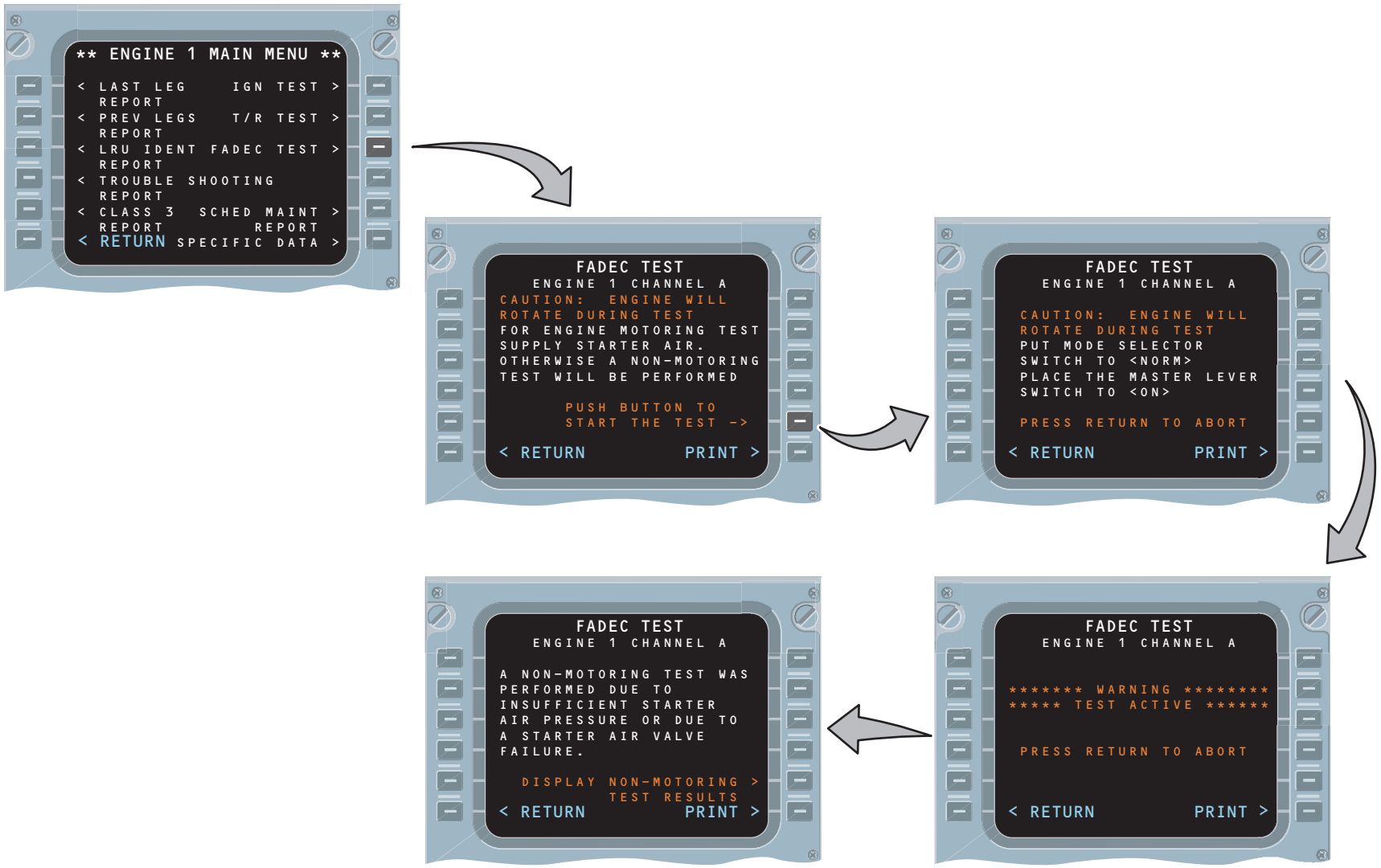
If a fault is detected, the fault report page contains the identity of the 3 most likely failed LRU's for the fault. A maximum of 3 faults per page are displayed with a maximum of 12 faults recorded.

If starter air is supplied, the engine is dry cranked and the various actuators and valves (except FMV, HPSOV and FRV valves) are commanded to move to certain positions. The test will complete automatically in less than one minute.

As in the non-motoring test, after the operator has pressed the line select key to start the test, a screen appears prompting the operator to place the mode selector switch to 'NORM' and the master lever to 'ON'. When the conditions are met, a 'TEST ACTIVE' screen is displayed.

If the test is positive, a 'NO FAULTS RECORDED' message is displayed.

Before exiting either the non-motoring, or motoring tests, a 'TEST COMPLETE' screen is displayed that prompts the operator to place the master lever to the 'OFF' position.



FADEC TEST

CTC-238-043-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

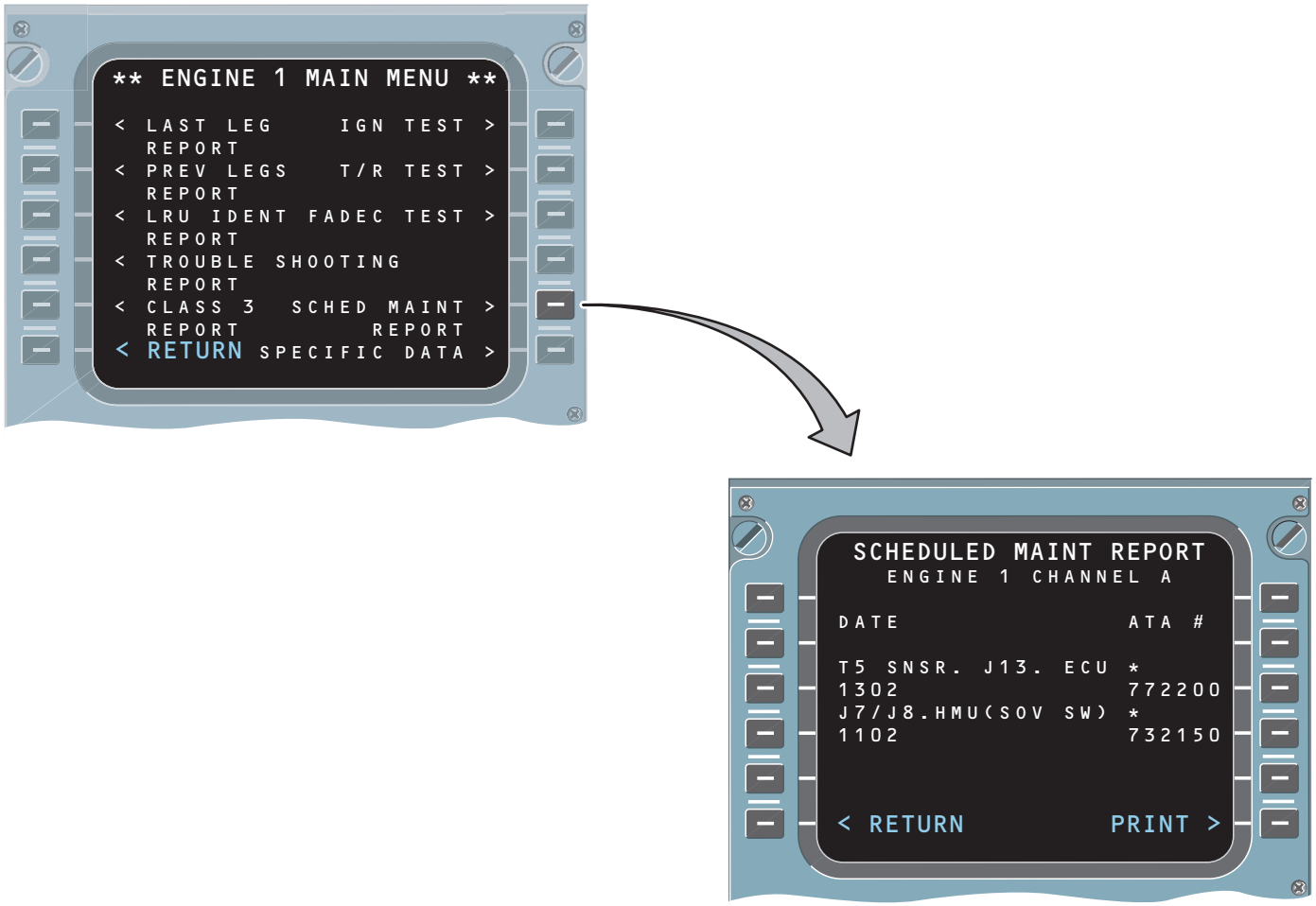
Scheduled maintenance report.

The report format is the same as the 'Last leg report', except that there is no flight leg or data information.

When no SM faults are recorded during the last 64 flight legs, a 'NO FAULTS RECORDED' message is displayed.

Troubleshooting data is not available for scheduled maintenance faults.

Note : Some (not all) single channel SM faults may be upgraded by the ECU to class 2, or even class 1, if they become dual channel faults.



SCHEDULED MAINTENANCE REPORT

CTC-238-044-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Specific data.

The specific data report is a sub-menu that currently has only one selection available :

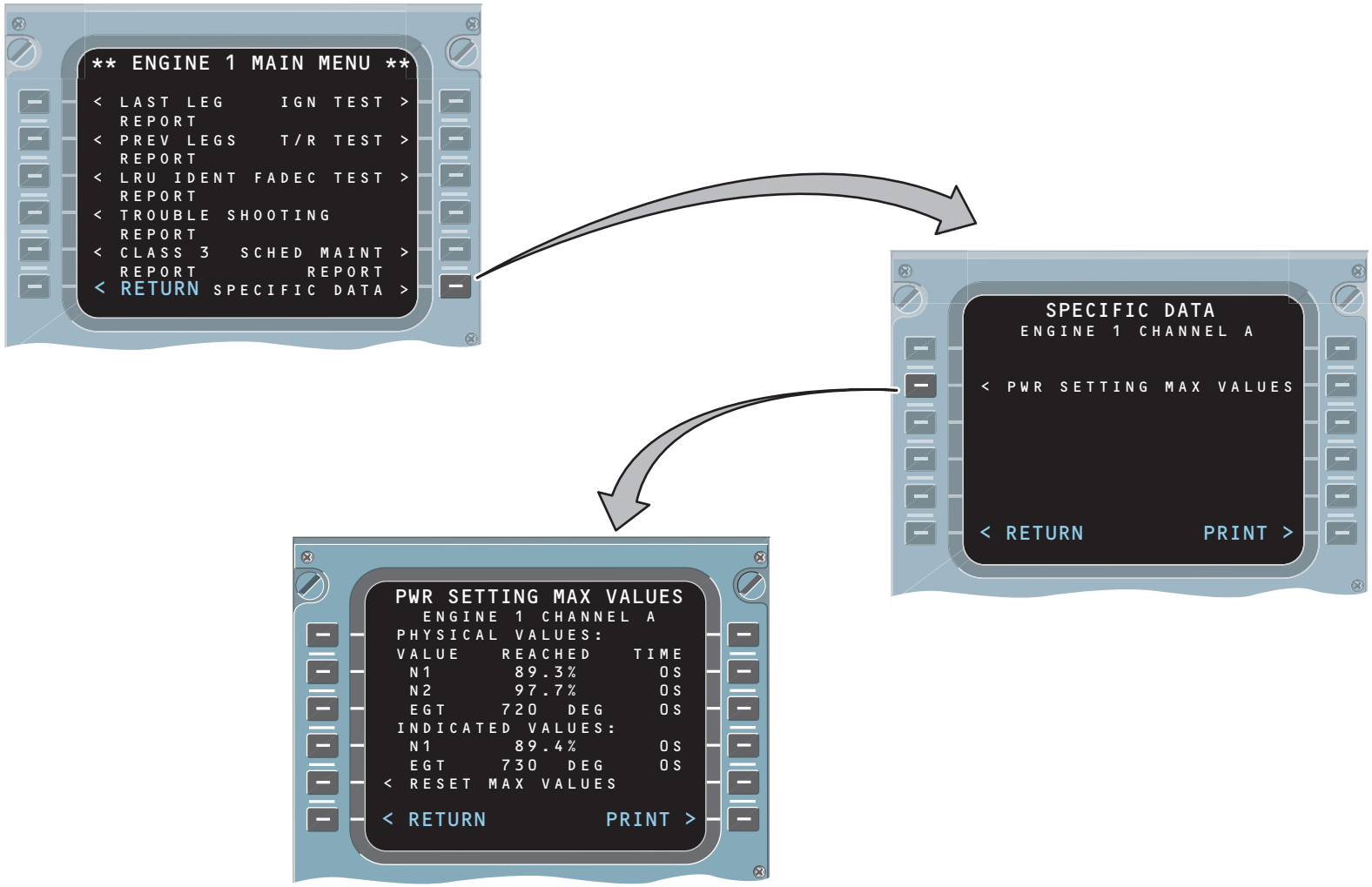
PWR SETTING MAX VALUES

This displays the maximum values of N1, N2 and EGT reached the last time the engine was operated. The time, in seconds, logged at these maximum values is also displayed.

Both indicated and physical N1 and EGT values are displayed. There is no separate indicated value for N2.

These maximum values and the duration of any limit exceedance are reset during engine ground start, or they may be reset by an option in menu mode.

When the reset option is selected by the operator, a confirmation screen is displayed. If the operator presses the line select key to confirm, then the reset values (all zeros) are displayed.



SPECIFIC DATA

CTC-238-045-00

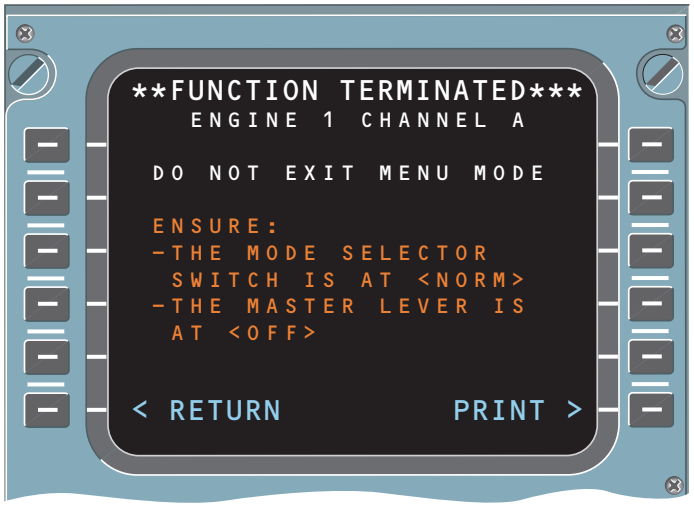
CENTRALIZED FAULT DISPLAY SYSTEM (CFDS).
ENGINE SYSTEMS - ECU.

Function terminated report.

If the cockpit rotary selector is turned to 'IGN/START', at any time, menu mode will terminate the current function and display the function terminated report screen.

If the master lever is set to 'ON', (except during the ignition test, or FADEC test), menu mode will also terminate the current function and display the function terminated report screen.

The purpose is to prompt the operator to return cockpit switches to safe positions. The page is displayed until the operator does so and then, when the return key is pressed, the screen displays the main menu.



FUNCTION TERMINATED REPORT

CTC-238-046-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). ENGINE SYSTEMS - EVMU.

Engine vibration measurement consists of :
- 2 transducers (piezo-electric accelerometers).
- an Engine Vibration Monitoring Unit (EVMU).
- 2 vibration indications.

The No1 bearing vibration sensor permanently monitors vibrations from the No1 bearing. It also senses vibrations in the LPT and HPT shafts. This sensor is also used for trim balance operations.

The Turbine Rear Frame (TRF) vibration sensor is used in conjunction with the No1 bearing vibration sensor to monitor and, if necessary, reduce engine vibration levels using the trim balance procedure.

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

The EVMU does not interface directly with the ECU.

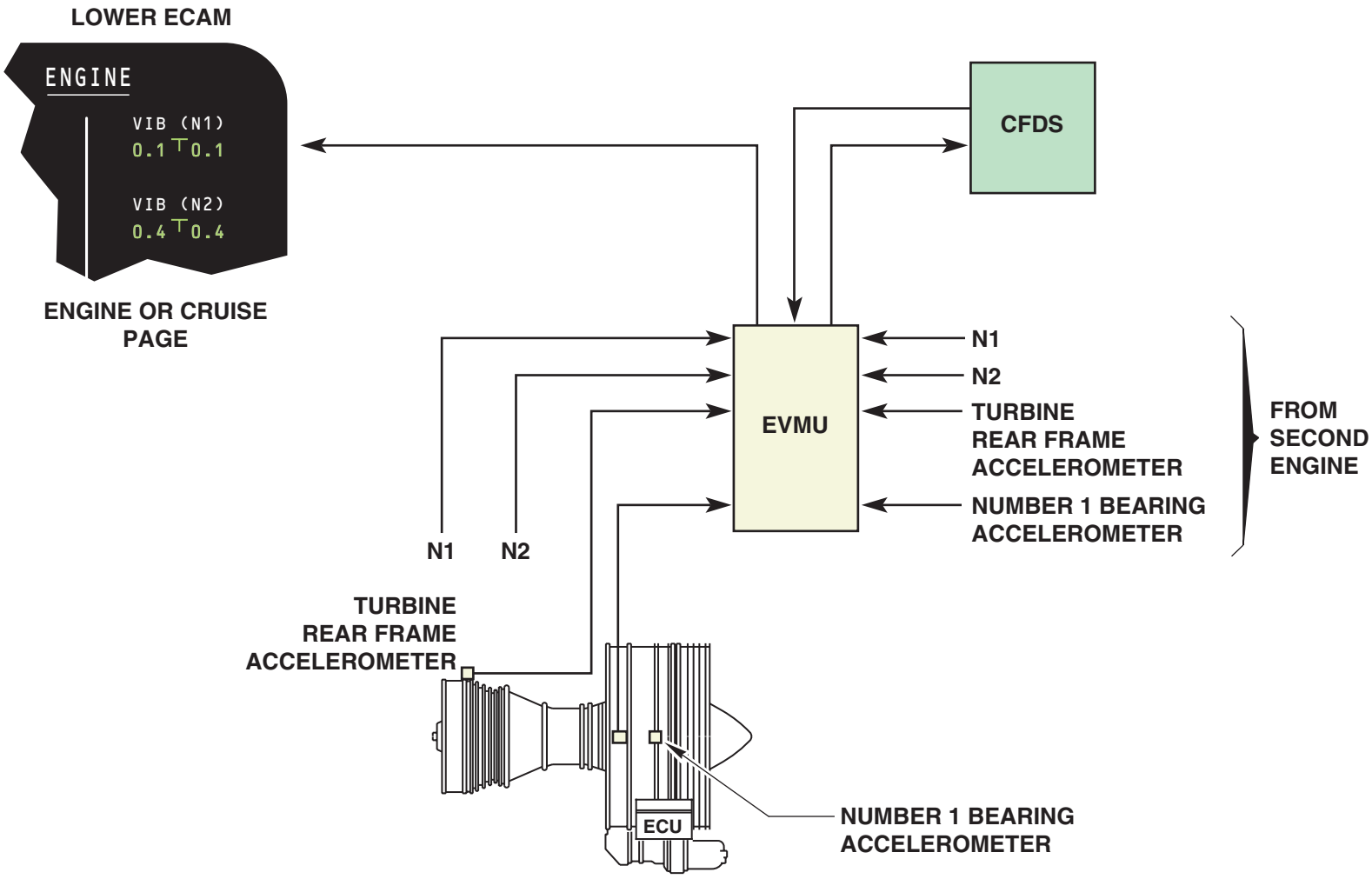
The EVMU receives analog signals from the 4 engine accelerometers (2 per engine) and the N1 and N2 speed sensors of each engine.

The EVMU interfaces with the CFDS, through ARINC429 databuses, for maintenance fault messages and vibration data analysis.

The EVMU also sends signals to SDAC1, SDAC2 and the DMU over ARINC429 databuses.

The ECAM receives information via SDAC1 and SDAC 2. The vibration indications are displayed in green on the lower ECAM display, in the engine and cruise pages.

The maximum value that can be displayed is 10 units.
- 10 units for the N1 rotor corresponds to 10 MILS (MILS = Milli-Inch).
- 10 units for the N2 rotor corresponds to 4 IPS (IPS = Inch per second).



ENGINE SYSTEMS - EVMU

CTC-238-047-00

CENTRALIZED FAULT DISPLAY SYSTEM (CFDS). ENGINE SYSTEMS - EVMU.

The EVMU main menu is on 2 pages and provides access to various sub-menus.

The first page provides access to :

- **Last leg report** : Internal and external class 1 & 2 faults recorded during the last flight leg.

- **Previous legs report** : Internal and external class 1 & 2 faults recorded during the previous 63 flight legs, excluding the last flight.

- **LRU identification** : Provides part and serial number information.

- **Class 3 failures** : Provides a list of LRU's detected faulty during a ground test. Only the last 3 detected failures are displayed.

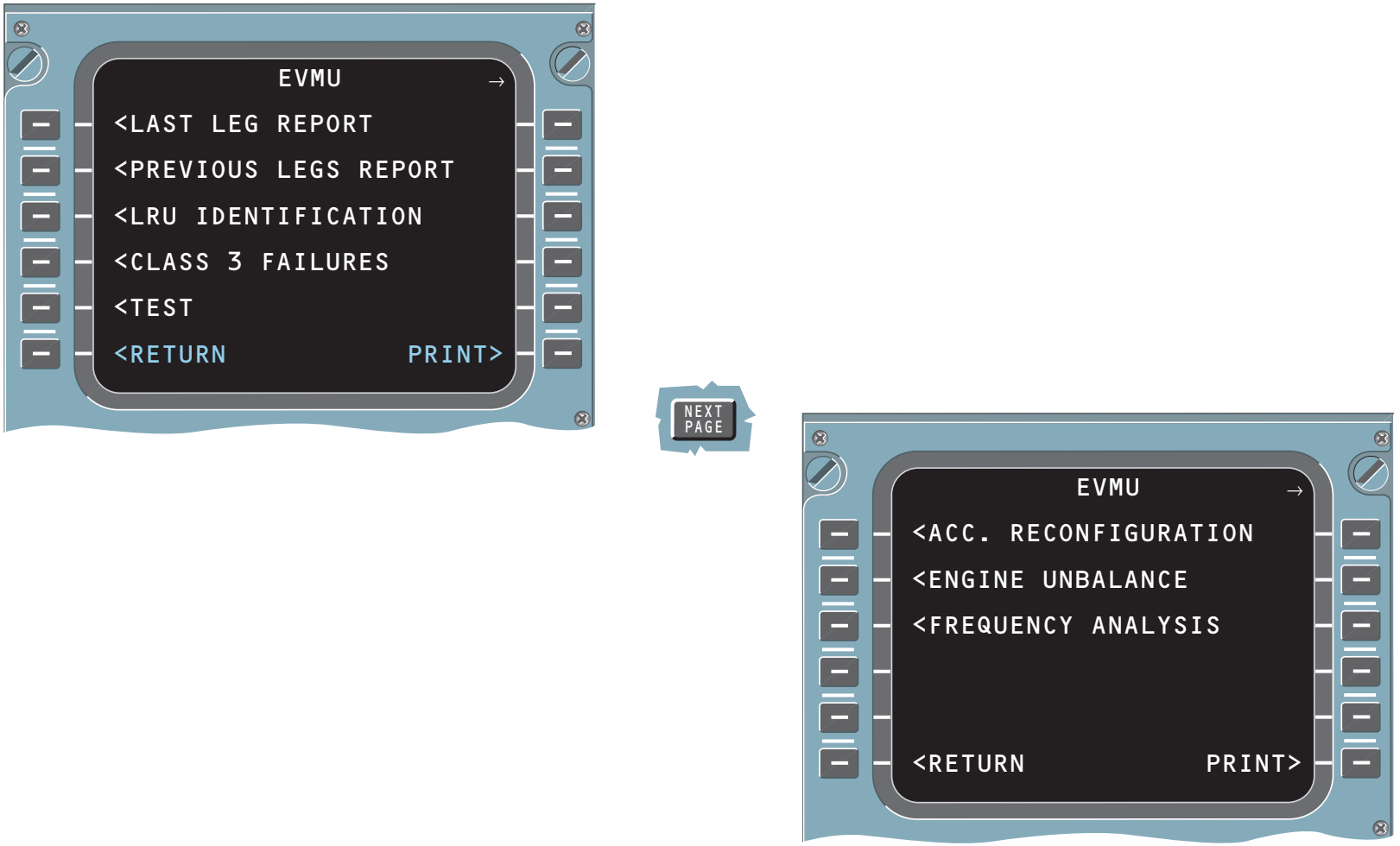
- **Test** : Allows user to initiate a complete check of the EVM system and view the results.

The second page provides access to :

- **Acc. reconfiguration** : Allows selection of the accelerometer (Fan No1 bearing, or TRF) to be used for the next flight. The EVMU also indicates which accelerometer is in operation.

- **Engine unbalance** : Allows selection, per engine, of 5 different engine speeds (from 50% to 100% N1) at which unbalance data will be stored. Unbalance data acquired during the previous command can be read and trim balancing (one shot, or vectorial method) for both engines with both accelerometers can be performed.

- **Frequency analysis** : With this menu, the operator can set aquisition conditions for an in-flight frequency analysis. This menu also provides lines for comments (up to 3) that the operator considers necessary for the frequency analysis printout that will be made after the next flight.



EVMU MAIN MENU

CTC-238-048-00

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