

12.23 (ATA 71) POWERPLANT

12.23.1 Introduction

The Dash 8-Q400 is powered by two Pratt & Whitney PW150A turboprop engines. Each engine drives a six bladed, constant speed, variable pitch, fully feathering Dowty R408 propeller through the engine gearbox. The powerplant develops 4,580 Shaft Horse Power (SHP) under normal take-off conditions. An automatic uptrim on a manual MTOP rating selection allows either engine, to develop a maximum take-off power of 5071 SHP, for a brief period of time, if an engine failure occurs during take-off.

12.23.2 General

The engine has a low pressure (first stage) axial compressor and a high pressure (second stage) centrifugal compressor, each attached to separate single stage turbines. A two-stage power turbine drives a third shaft to turn the propeller through a reduction gearbox. The high-pressure compressor also drives the accessory gearbox.

Two control levers for each engine, the power lever and the condition lever achieve engine control. The power levers control engine power through a Full Authority Digital Engine Control (FADEC) in the forward range, and propeller blade angle in the idle through reverse beta range. The condition levers, through a Propeller Electronic Controller (PEC) set propeller RPM in the forward thrust range, select engine power ratings, provide manual propeller feathering, and fuel on/off control for engine start and shutdown.

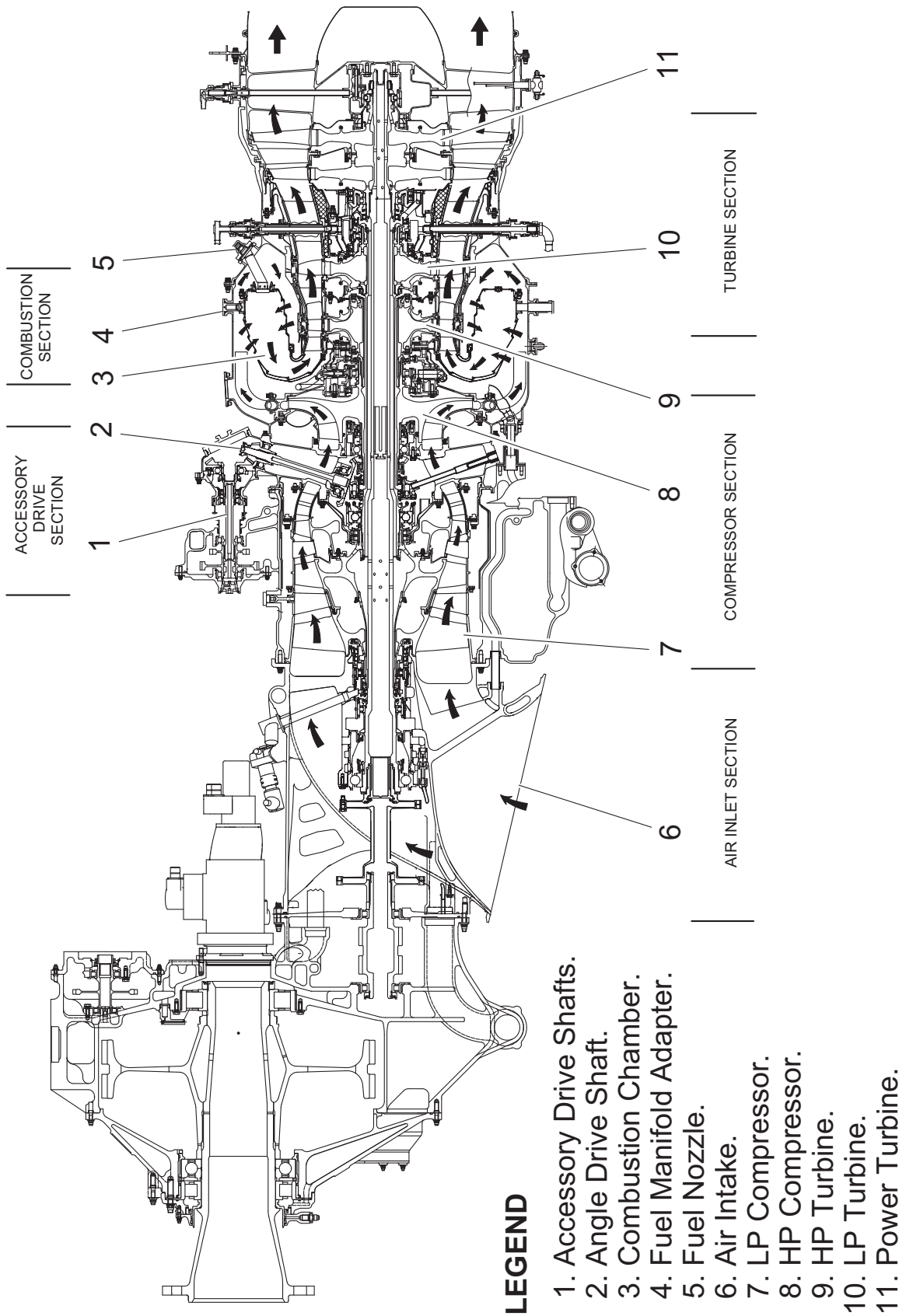


Figure 12.23-1 Engine Cross Section

12.23.3 Description - Powerplant

The PW 150A powerplant control system, consists of two control sub-systems:

- the engine control system
- the propeller control system

12.23.3.1 Engine Control System

General Air/Gas Flow

Air entering at the engine inlet is directed rearward and compressed (Figure 12.23-1). Two compressors carry out compression for combustion and bleed extraction purposes. Air is first ducted to the low-pressure (N_L) axial compressor and then to the high pressure (N_H) centrifugal compressor where it undergoes a second stage of compression. The compressed air then enters internal ducts, and is discharged into the combustion chamber where fuel is added and ignited. Gases exiting the combustion section initially impact onto a single stage N_H turbine. The turbine extracts energy from the flow, and drives a shaft directly connected to the N_H compressor. A gear drive attached to this compressor drives the accessory gearbox mounted on the top section of the turbo-machinery. Mounted behind the N_H turbine is a single stage N_L turbine, which also extracts gas energy. It drives a shaft connected directly to the N_L compressor. As the combustion gases continue to flow rearward they are directed towards the two-stage power turbine assembly. The power turbines turn as a single unit extracting the majority of gas energy remaining to rotate a shaft connected to the reduction gearbox at the front of the engine. Through the reduction gearbox, power is transmitted to the propeller. After leaving the power turbine, the gases vented through to the exhaust pipe where they are vented overboard.

12.23.3.2 Accessory Gear Box

An accessory gearbox mounted on top of the engine is driven by the high pressure compressor rotor N_H , and operates:

- Oil Pressure and Oil Scavenge Pumps
- High Pressure Fuel Pump
- Permanent Magnet Alternator (PMA)
- DC Starter / Generator

12.23.3.3 Bypass Door

Each engine nacelle intake incorporates a bypass door, which provides a means of preventing solids and precipitation from entering the engine intake. Door opening and closing is controlled by switchlights on the ICE PROTECTION panel.

The doors are selected open during flight whenever any of the following conditions are encountered:

- Icing Condition
- Heavy Precipitation
- Bird Activity
- Contaminated Runways

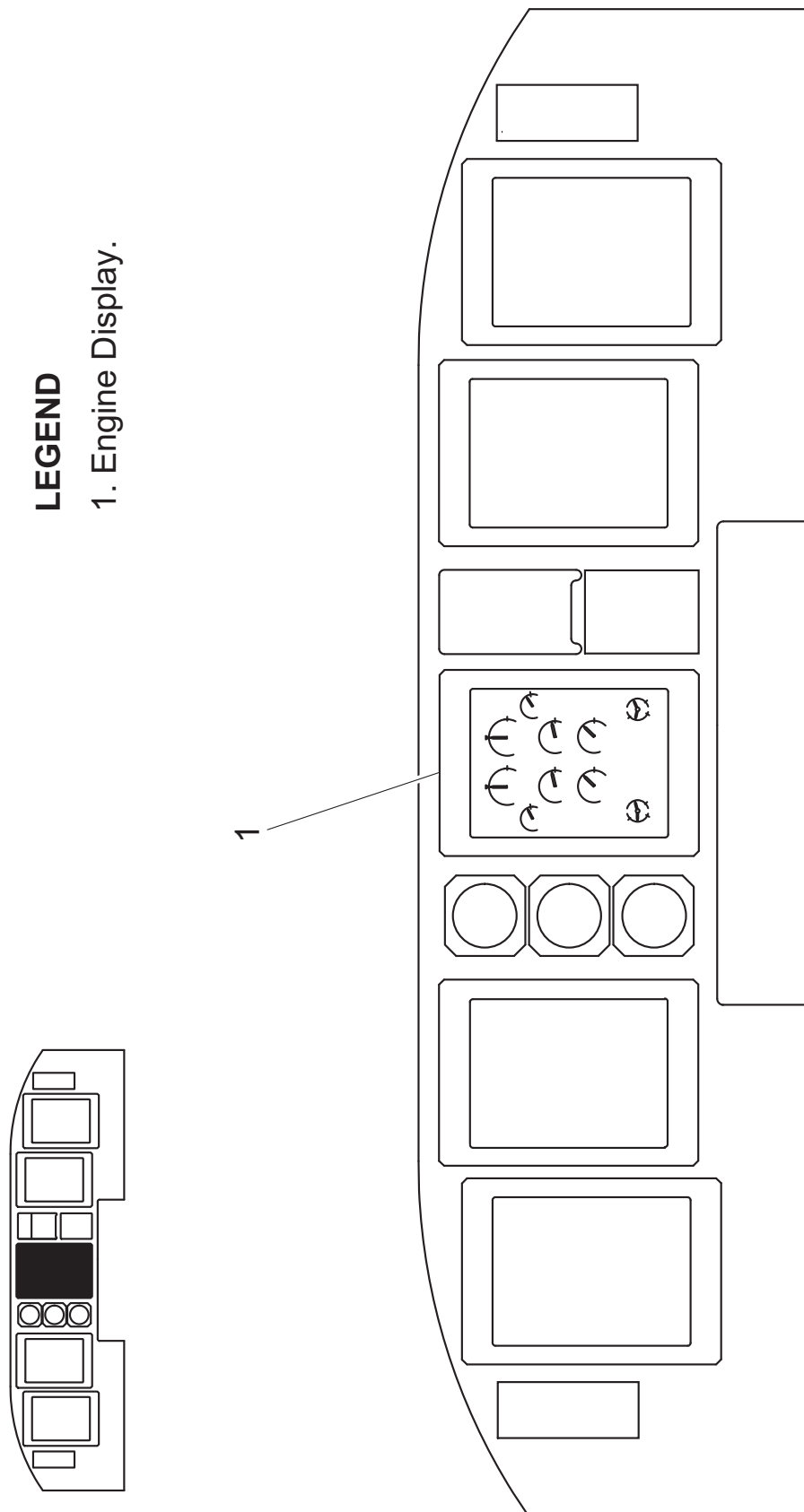


Figure 12.23-2 ED Location

12.23.4 Power Plant Indication

Engine operating information from the FADEC is transmitted to the Engine Display (ED) (Figure 12.23-2). The gauges provide indications in both analog and digital form, and include the following:

- TRQ Torque developed within the engine indicated as a percentage of the maximum.
- PROP Propeller speed indicated in RPM.
- N_H Indicates N_H turbine and compressor speed as a percentage of maximum speed.
- ITT Indicated Turbine Temperature shown in degrees Celsius.
- N_L Indicates N_L turbine and compressor speed as a percentage of maximum speed.
- FF Fuel Flow to the engine combustion section is shown in hundreds of kilogram per hour.

Dual split analog/digital oil temperature and pressure gauges display engine oil pressure and temperature. The oil temperature display is in degrees Celsius and oil pressure in psi.

12.23.5 Engine Shutdown

Normal

A normal shutdown is initiated by moving the Condition Lever to the FUEL OFF position. At this time the Engine System tests the NH overspeed (O/S) protection circuitry by using it to shutdown the engine.

12.23.5.1 Fire Handle Shutdown

The FMU has a dedicated fuel shutoff switch activated via the PULL FUEL/HYD OFF handles on the flight deck. This switch is energized (closed position) with aeroplane electrical power when the engine fire handle has been pulled.

12.23.6 Permanent Magnet Alternator

The primary source of electrical power for the engine control system is the engine mounted Permanent Magnet Alternator (PMA). The PMA has independent coils that provide electrical power to the individual channels of the FADEC when gas generator speed (N_H) is above 20% minimum. The aeroplane essential power busses provide alternate electrical power to the FADEC for engine starting and in the event of a PMA malfunction.

Dash8 - Q400 - Power Plant

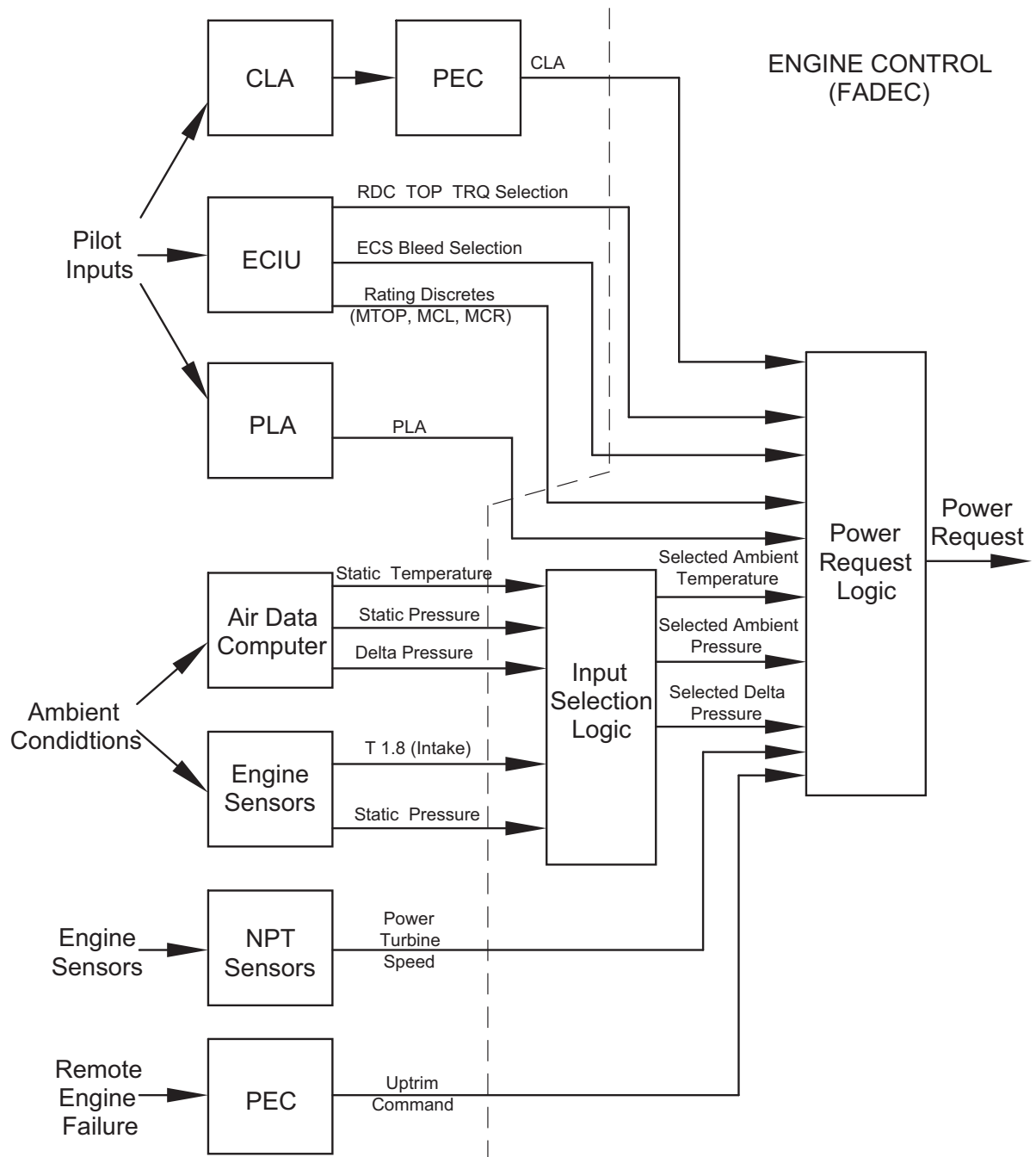


Figure 12.23-3 FADEC Schematic

12.23.7 Handling Bleed-Off Valves (HBOV)

The Handling Bleed-off Valves (HBOV) bleed engine air from the main gas path to provide increased surge margin for engine handling during starting, steady state and transient operation. The engine has two bleed off valves; one to bleed low pressure compressor inlet air (steady state operation) and the other to bleed high pressure compressor inlet air (transient operation).

The P2.2 bleed valve is used for controlling the LP compressor surge margin in steady-state. The P2.2 bleed valve is located after the second axial stage of the compressor. The valve is positioned to maximum bleed flow (100% open) during start, and then modulated in the closing direction during normal engine operation.

The P2.7 bleed valve is used primarily for controlling the LP compressor surge margin during transient operation. The P2.7 bleed valve is located at the entrance of the HP compressor. The FADEC commands this valve as an ON/OFF valve: fully open or close. The valve is commanded open when P2.2 bleed valve is fully open and more bleed air is required. The valve is also commanded open during rapid engine deceleration and reslam maneuvers.

12.23.8 Engine Sensors

The engine and control actuators are fitted with sensors to provide feedback signals to the FADEC for engine control, flight deck indication, engine health monitoring, and isolation of component failures.

The engine system has pressure sensors and switches to indicate the status of the engine fuel and oil systems. The Low Fuel Pressure, the Low Main Oil Pressure, and the Fuel Filter Bypass Pressure Switches each provide independent signals to the two FADEC channels. The Oil Pressure Sensor signal is routed directly to the engine display.

12.23.9 Power Management

The basic philosophy of the PW150A engine control is to “close loop on power”. The actual engine power is measured using the Torque/ N_{PT} sensors situated in the reduction gear box of the engine and compared to the requested power. The FADEC will attempt to eliminate the difference between the requested power (torque bug) and the actual power (torque gauge indication). The authority of the power loop is restricted by mechanical and operational limits on the gas generator speed.

12.23.10 Power Setting Logic

The power setting logic determines the requested power as a function of engine rating, pilot inputs (such as power lever position, ECS bleed selection, etc.), remote engine failure, and ambient conditions (Figure 12.23-3).

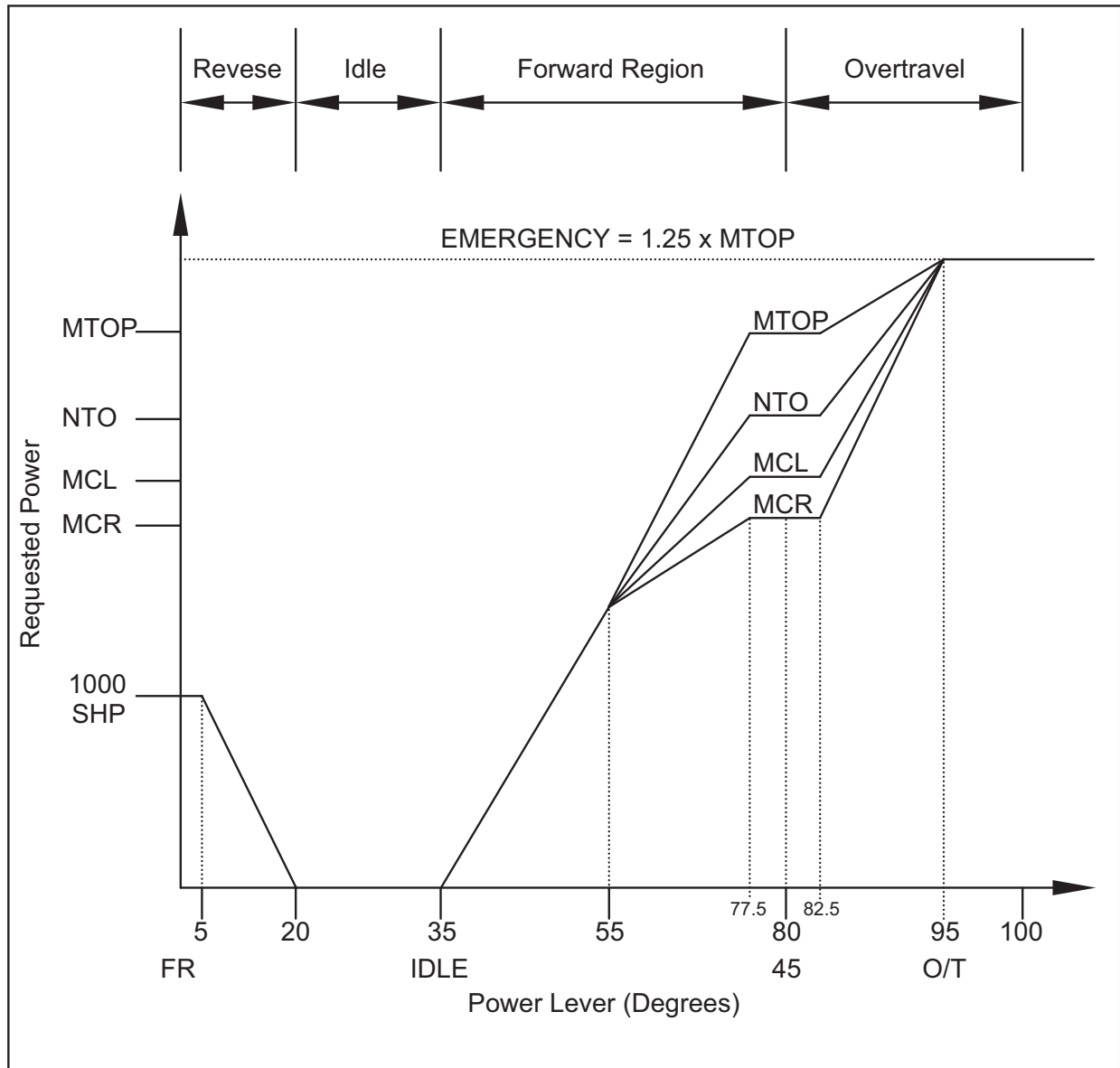


Figure 12.23-4 Power Requested vs. PLA

The power lever allows the pilot to modulate power request from Full Reverse to Rated Power (Figure 12.23-4). Ground handling is achieved at PLAs below FLIGHT IDLE. Above FLIGHT IDLE, the power request increases linearly with increasing PLA until the Rated Power detent.

Moving the power lever in the overtravel region (above the Rated Power detent position) results in an increase in requested power of up to 125% of the maximum take-off rating and an increase in the engine software limits. In this region, the propeller control system will automatically set propeller speed to 1020 rpm.

Rating selection occurs concurrently with propeller speed selection when the pilot moves the condition lever to the detent positions:

Condition Lever Position	Standard Rating
1020 RPM	Normal Take-off (NTOP)
900 RPM	Maximum Climb (MCL)
850 RPM	Maximum Cruise (MCR)
Start/Feather	Normal Take-off (NTOP)
Shutdown	None

For all condition lever positions, the Rated Power is achieved when PLA is in the Rating detent.

The pilot may select alternate combination of propeller speed and engine power rating by using the MTOP, MCL, and MCR Rating Discretes in the flight compartment. These discretes, which are transmitted to the FADEC, override the rating nominally selected as a function of condition lever position under certain conditions.

When the MTOP discrete is activated by the pilot, the Maximum Take-off (MTOP) Rating is selected by the FADEC anytime the condition lever is in the 1020 RPM position. The MTOP rating is defined as the maximum available power certified for take-off operation. (Note that NTOP is normally selected by the FADEC when the condition lever is in the 1020 RPM position.)

When the condition lever is in the 900 RPM position and the MCR discrete is selected, the MCL rating normally associated with this propeller speed is overridden by the MCR rating. Since the MCL rating discrete is a momentary switch, a subsequent movement of the condition lever will base engine rating selection on the new condition lever position. Alternatively, the MCL rating can be recovered at the same condition lever position by selecting the MCL discrete.

Selection of MCL at the condition lever position of 850 rpm is also possible using the MCL rating discrete (also a momentary switch). This rating selection is similar to that described for the MCR selection at 900 RPM position.

12.23.11 ECS Bleed Selection

The FADEC discriminates between single and dual engine ECS bleed by using the following logic: dual engine level is used unless the power rating is MTOP (via Uptrim only) or ECS is selected OFF on the failed engine (info available from ECIU) then it reverts to single engine ECS bleed.

The ECS Bleed Selection is also used by the FADEC to distinguish between the Maximum Take-off Power Rating and the Maximum Continuous Power Rating (MCP).

12.23.12 Power Derate

Prior to take-off, the power may be reduced for take-off in the NTOP rating using the power derate function. To decrement (or derate) the requested power, the pilot presses the DEC discrete with the condition lever at the 1020 RPM position (NTOP rating) and the power lever below the rated power detent. Selection of the DEC discrete, which is a momentary switch, decreases the NTO requested power in steps of 2% to a limit of 10%. The selection of the Power Derate RESET discrete at any time resets the derate to 0%.

The Power Derate function cannot be activated while in the MTOP or MCP rating. If an Uptrim is commanded from the remote powerplant, the requested derate will apply to the MTOP requested power.

12.23.13 Auto Take-OFF Power Contr Syst. (ATPCS)

During an engine take-off, an Automatic take-off Power Control System (ATPCS) augments the power of the engine, without pilot intervention, in response to a loss of power of the opposite engine. This function is also referred to as "Uptrim". The working engine's FADEC will respond to the Uptrim signal from the failed engines PEC/AF unit by changing engine rating from NTOP to MTOP.

The working ATPCS is armed when both PLAs are "high" and local torque engine is "high". If an engine fails (i.e. engine torque is "low") an Uptrim signal is commanded by the failed engine PEC to the working engine FADEC. The working engines power is increased 10%.

An Uptrim condition is indicated to the pilot by:

- the UPTRIM indication on the ED
- a change in the engine rating from NTOP to MTOP
- a change in the torque bug from NTOP to MTOP

12.23.14 Mechanical and Thermal Power Limitation

The engine power limit logic is selected as being the lowest value between the mechanical power limit and the thermodynamic power limit for the selected rating.

The thermodynamic power limit is set as a function of the rating selected, ambient temperature, aeroplane altitude and speed, ECS bleed air extraction and power turbine shaft speed.

12.23.14.1 NPT Underspeed Governing

The N_{PT} Underspeed Governing is used to limit the propeller speed to a minimum propeller speed of 660 RPM in the air and on the ground. The control system then closes loop on propeller speed and determines the gas generator speed to set the required N_{PT} . Thrust is then controlled through the minimum blade angle schedule in the PEC which gives a direct relationship between the power lever position and the propeller blade angle.

12.23.14.2 N_{PT} Overspeed Governing

The NPT Overspeed Control Limit in the FADEC prevents the power turbine speed from exceeding 115% (1173 RPM). The FADEC signals the Fuel Metering Unit to reduce fuel flow, lowering propeller RPM.

12.23.14.3 Torque Limiting

The Torque Limiting Logic in the FADEC prevents engine torque from exceeding a given threshold which is function of PLA and ambient conditions. Generally torque is limited to 35% in reverse, 106% in the forward power range, and 125% in the overtravel range.

However, during such events as caused by a spurious feathering of the propeller at high power, the transient overtorque can exceed this steady state threshold. The FADEC uses anticipation in this control loop to rapidly reduce N_H to prevent overtorque in exceedance of 135%.

12.23.14.4 N_H Overspeed Protection

The PW150A Powerplant has an independent overspeed (O/S) protection circuitry (dual channel) built into the FADEC which has the capability to cut off the fuel flow through the Fuel Shutoff Solenoid. Independent N_H signals (from the FADEC) are used by the O/S circuitry. A fuel shutoff command is issued when the measured frequency of the N_H input signals exceed a pre-programmed threshold value of 108%. The O/S Protection circuitry is exercised on normal shut-downs by the FADEC.

12.23.14.5 Fault Classification

The FADEC accommodates and annunciates detected faults depending on their effect on the system. The FADEC classifies a new fault into one of three (3) fault classes:

- CRITICAL
- CAUTIONARY
- ADVISORY

12.23.14.6 Critical Faults

A critical fault is defined as a detected fault which results in either:

- stabilizing the engine at Flight Idle or Ground Idle (DISC) depending on the airspeed/WOW, or
- an engine shutdown (commanded by the control system).

In both cases the FADEC automatically accommodates as per a critical fault without the pilot moving the PLA or the CLA. The FADEC turns on the #1 or #2 ENG FADEC FAIL warning light.

12.23.14.7 Cautionary Fault

A cautionary fault is defined as a detected fault which results in either:

- Asymmetric power levers may be required to obtain symmetric power/thrust.
- Rapid power levers movement may cause engine surge.

In both cases the FADEC turns on the #1 or #2 ENG FADEC caution light.

12.23.14.8 Advisory Fault

An advisory fault is defined as a detected fault which is automatically accommodated and is not classified as a critical or cautionary fault. The FADEC transmits the advisory fault codes to the Engine Monitoring Unit (EMU) and to the Engine Display.

12.24 (ATA 73) ENGINE FUEL SYSTEM AND CONTROL

12.24.1 General

The Fuel Metering Unit (FMU) (Figure 12.24-1) controls the fuel flow supplied to the engine based on demand, from the Full Authority Digital Electronic Control (FADEC). The FADEC calculates the amount of fuel to supply based on power request and various engine sensory inputs like NH, NL, NP, torque and ambient conditions. The fuel pump delivers pressurized fuel to the FMU. It is driven by the engine gas generator spool through an accessory gear box. Excess fuel delivered by the fuel pump to the FMU is returned back to the pump inlet and to the airframe fuel tanks as motive flow to drive the main and scavenge ejector pumps.

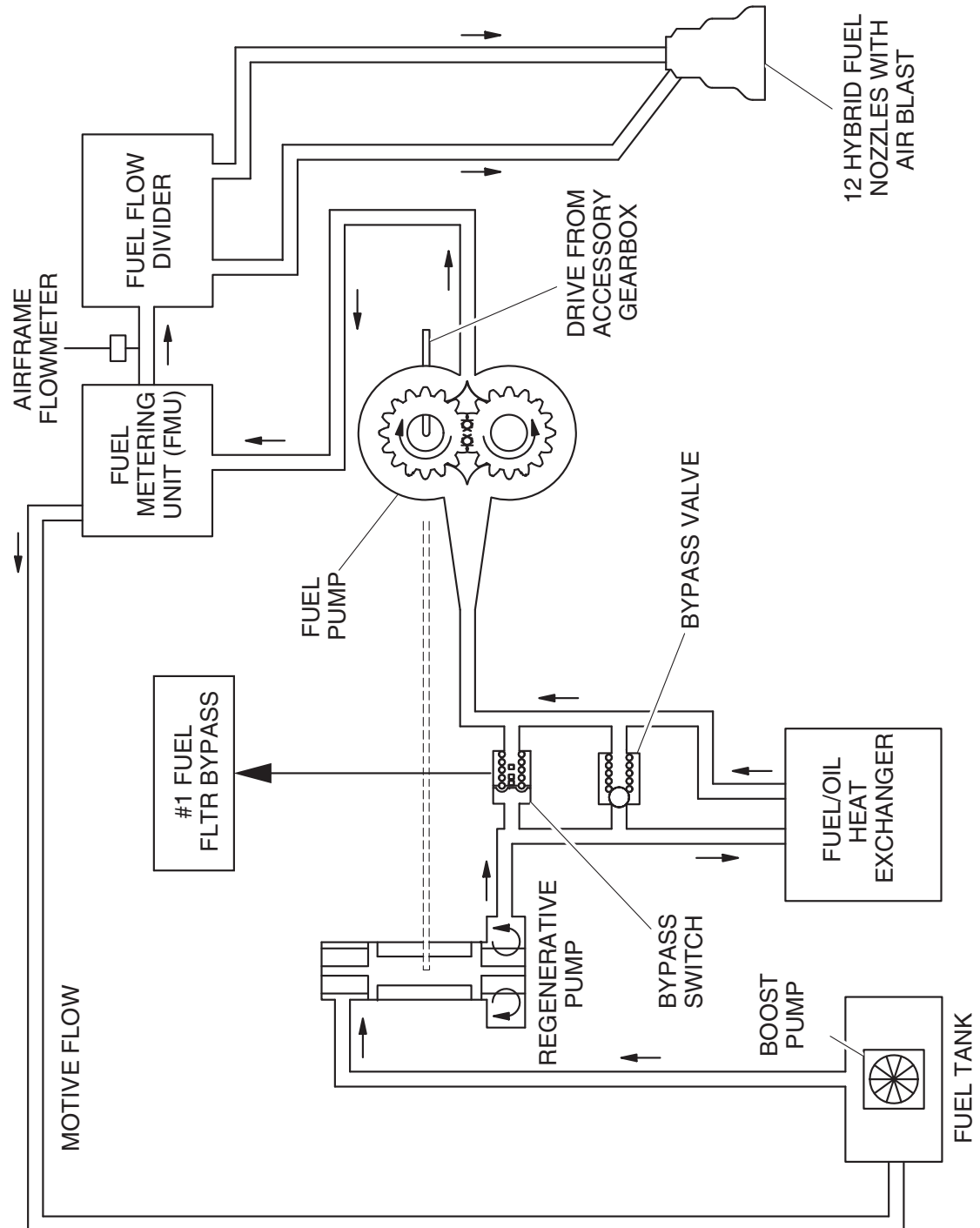
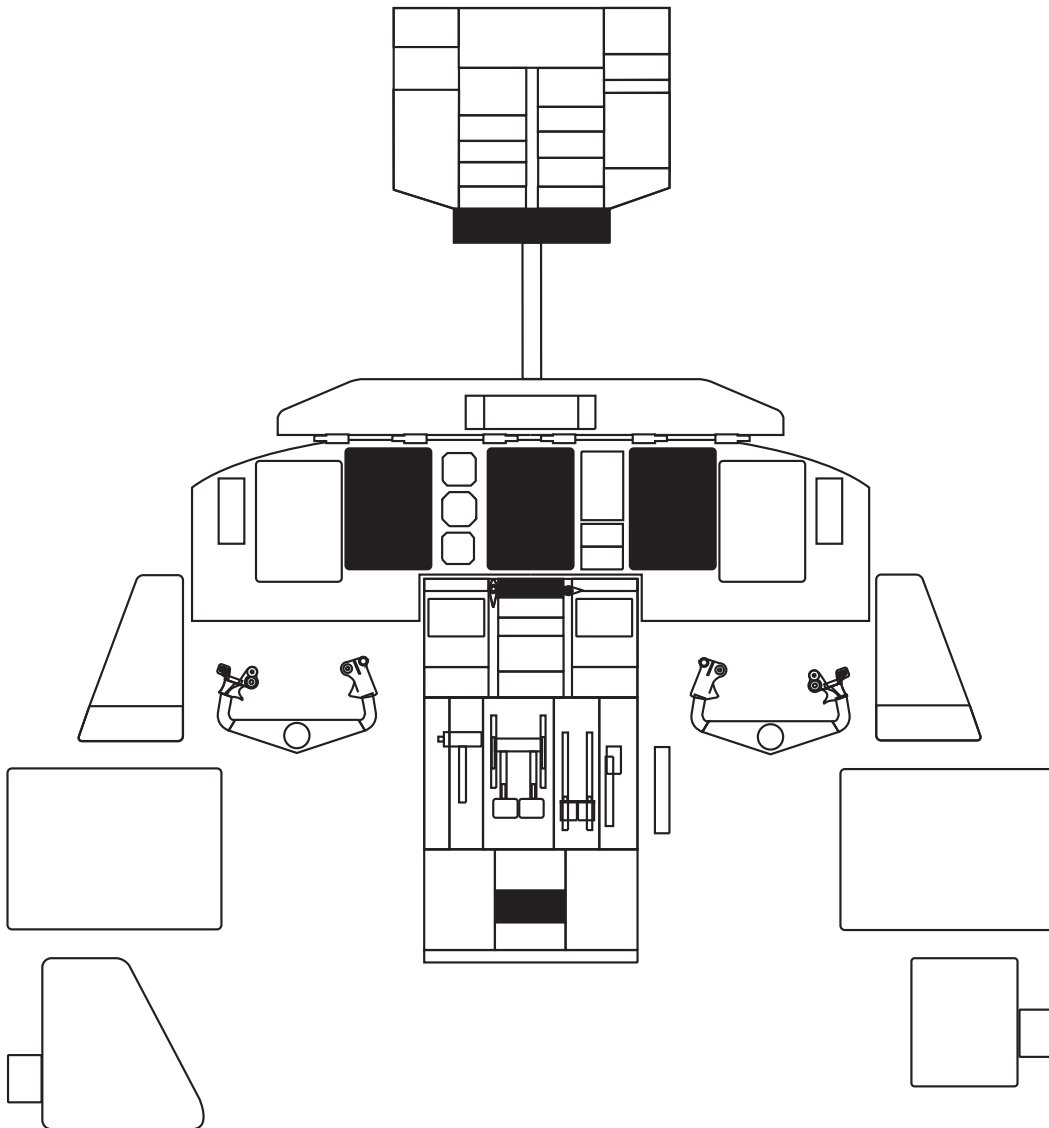


Figure 12.24-1 Engine Fuel Schematic

12.24.2 Controls and Indications - Engine Fuel



Dash8 - Q400 - Power Plant

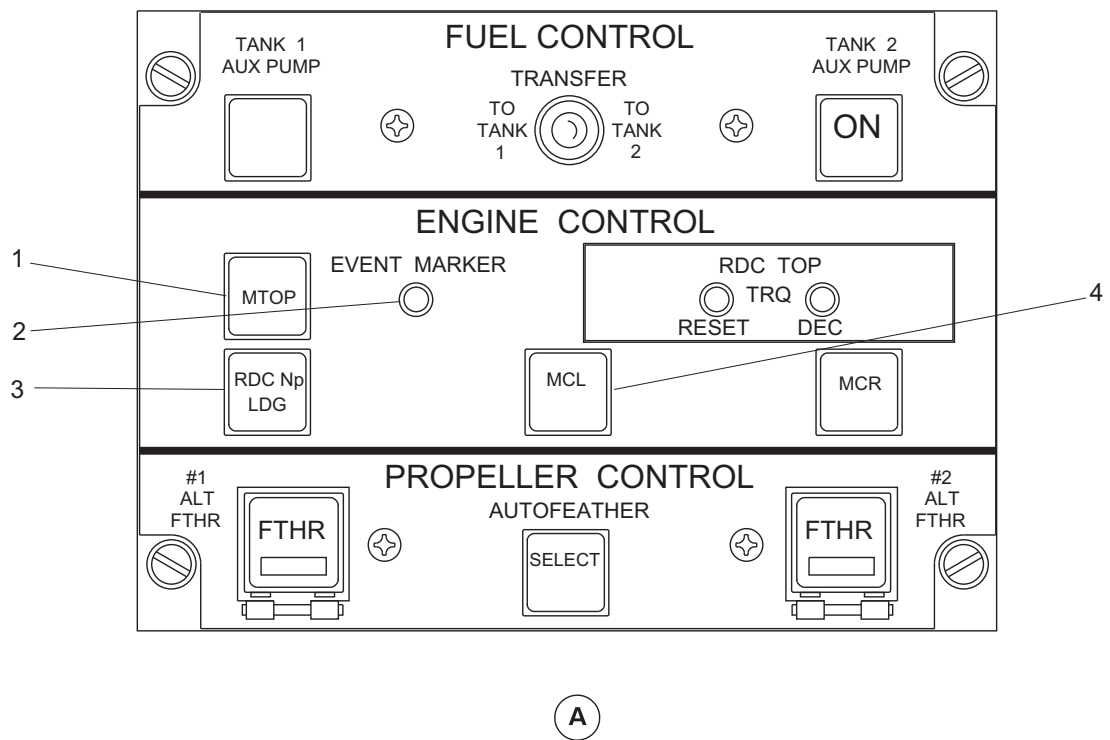
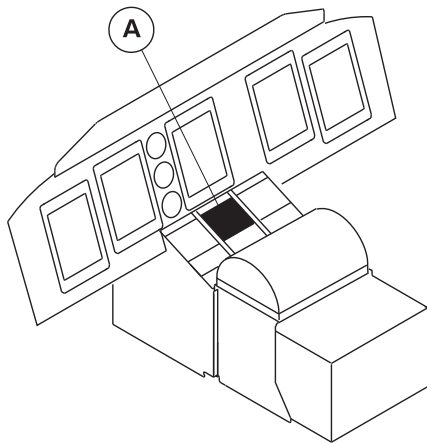


Figure 12.24-2 Engine Control Panel (1 of 2)

ENGINE CONTROL PANEL CALLOUTS

1. MTOP PUSHBUTTON (alternate action)

PUSH - enables maximum take-off power rating (MTOP) with condition levers at MAX/1020

- changes ED rating annunciation to MTOP with BLEEDS set to OFF or ON/MIN
- changes ED rating annunciation to MCP with BLEEDS set to ON/NORM or MAX

2. EVENT MARKER

PUSH - places a “bookmark” in the Engine Monitoring System (EMS)

- stores a data snapshot and a data trace in the EMS for 2 minutes leading up to the event and 1 minute following the event

3. RDC N_P LDG PUSHBUTTON (momentary action)

PUSH - enables a reduced propeller speed for landing

- Configuration for reduced N_P for landing:
 - power levers between FLIGHT IDLE and approx. 50% RATING
 - with condition lever in the MIN/850 position, push the RDC N_P LDG pushbutton

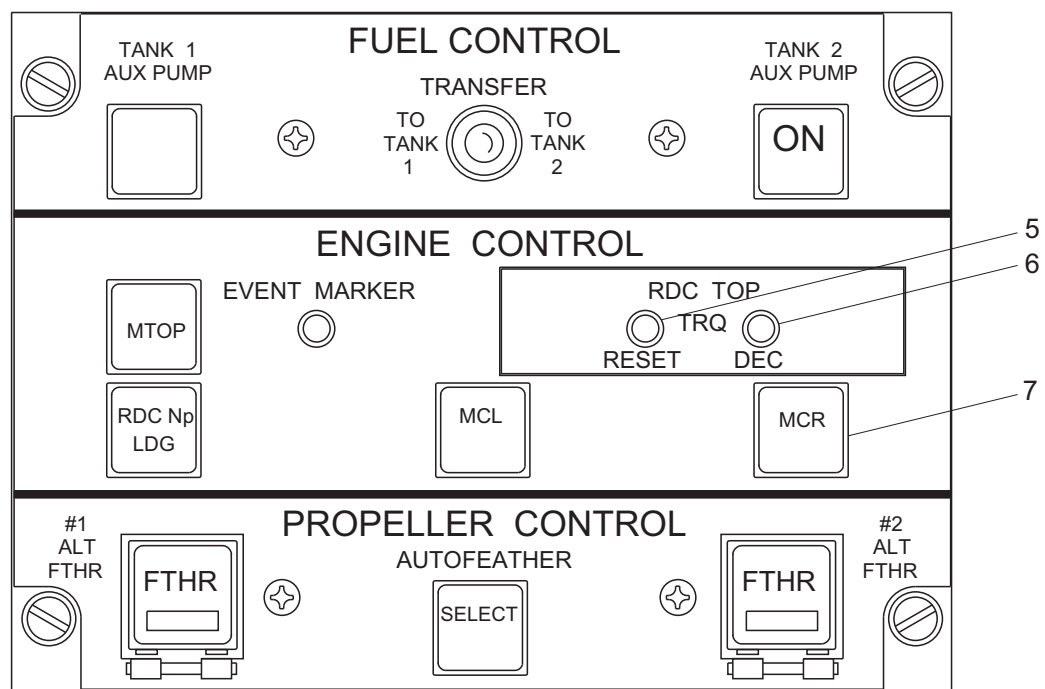
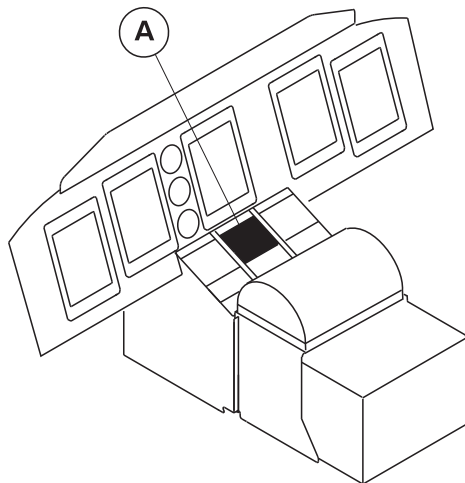
NOTE: Reduced N_P Landing mode will be cancelled if condition levers are not set to MAX/1020 within 15 seconds of selecting RDC N_P LDG switch.

- ED indicates REDUCED N_P LANDING
- advance condition lever to MAX/1020; N_P will remain at 850 RPM
- a Power Lever angle of 65 degrees or greater will cancel the RDC N_P selection
- RDC N_P mode can be cancelled by pushing the RDC N_P LDG button again

4. MCL PUSHBUTTON (momentary action)

PUSH - changes the engine rating associated with the MIN/850 CLA to maximum climb rating (MCL) 900 RPM.

Dash8 - Q400 - Power Plant



A

Figure 12.24-3 Engine Control Panel (2 of 2)

ENGINE CONTROL PANEL CALLOUTS (cont'd)

5. RDC TOP TRQ RESET PUSHBUTTON (momentary action)

PUSH - resets normal take-off power

6. RDC TOP TRQ DEC PUSHBUTTON (momentary action)

PUSH - reduces NTOP requested power in steps of 2% to a limit of 10%

- cannot be activated while in MTOP or MCP rating

7. MCR PUSHBUTTON (momentary action)

PUSH - changes the engine rating associated with the 900 CLA to maximum cruise rating (MCR) 850 RPM

Dash8 - Q400 - Power Plant

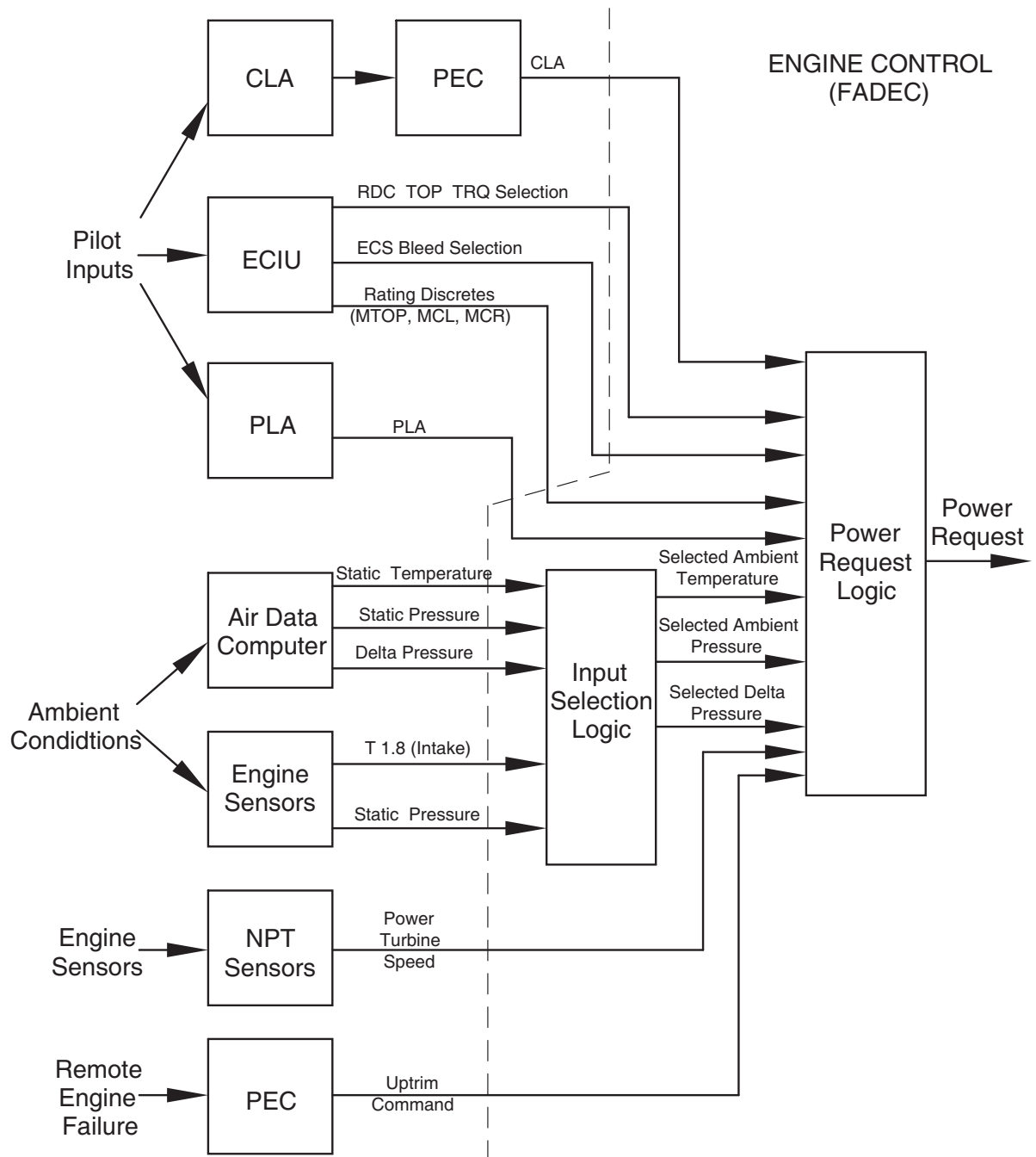


Figure 12.24-4 FADEC Schematic

Dash8 - Q400 - Power Plant

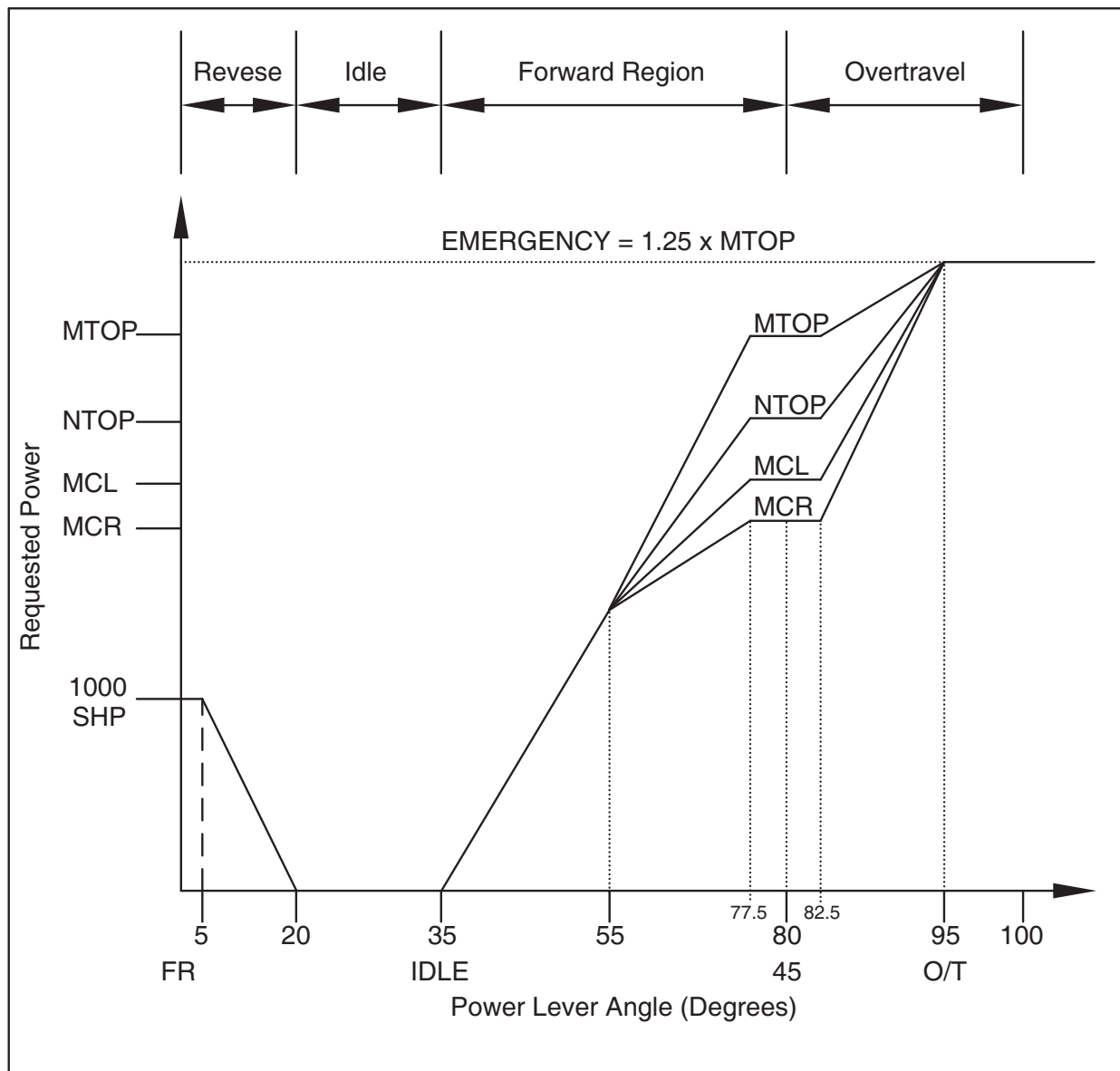


Figure 12.24-5 Power Requested vs. PLA

Dash8 - Q400 - Power Plant

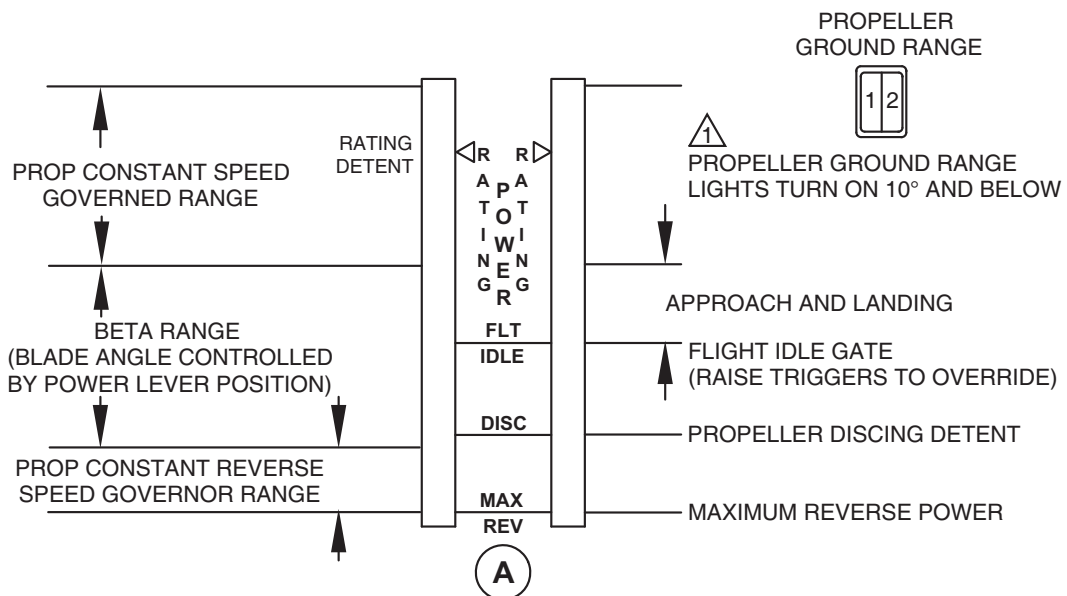
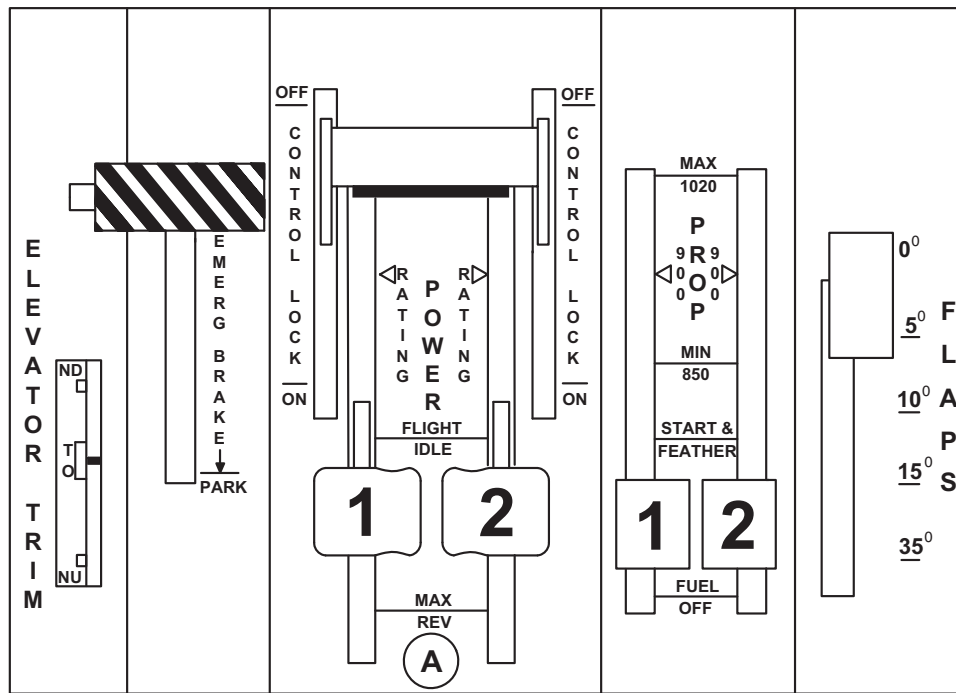


Figure 12.24-6 Power Lever Positions

ENGINE DISPLAY CALLOUTS (cont'd)

11. ENGINE RATING MODE ANNUNCIATION (green)

- indicates selected engine rating mode
- rating mode is a function several inputs:

Rating Display	Condition Lever	Bleed Selection	MTOP Pushbutton (or UPTRIM)
NTOP	1020	- any -	OFF
MTOP	1020	MIN/OFF or ON/MIN	ON
MCP	1020	ON/NORM or MAX	ON

Rating Display	Condition Lever	MCL Selection	MCR Selection
MCL	900	OFF	OFF
MCL	850	ON	OFF
MCR	900	OFF	ON
MCR	850	OFF	OFF

- RDC TOP will be displayed when in NTOP or MTOP and reduced take-off power is selected with RDC TOP switch on ENGINE Control panel
- when data is not valid, 4 white dashes are displayed

12. TORQUE BUG DIGITAL VALUE (cyan)

- torque bug digits are always displayed in cyan excepted when they are replaced by white dashes as the parameter is no longer valid
- indicates from 0 to 199% in 1% increments

13. BLEED STATUS ANNUNCIATION

- appears just below the engine rating mode of each engine when:
 - MTOP or NTOP engine mode is set by the Fadec and,
 - BLEED ON and MIN, NORM or MAX is selected on by the crew
- the word BLEED is displayed as follows:

Bleed Display	Bleed Selection	Rating Display
Bleed (W)	MIN	NTOP
Bleed (W)	MIN	MTOP
Bleed (Y)	NOMR or MAX	NTOP
- blank -	NORM or MAX	MCP *

w = white
y = yellow

* **NOTE:** Bleed selection of NORM or MAX with NTOP engine rating will set the rating to MCP.

- nothing is displayed when the bleed air is selected OFF

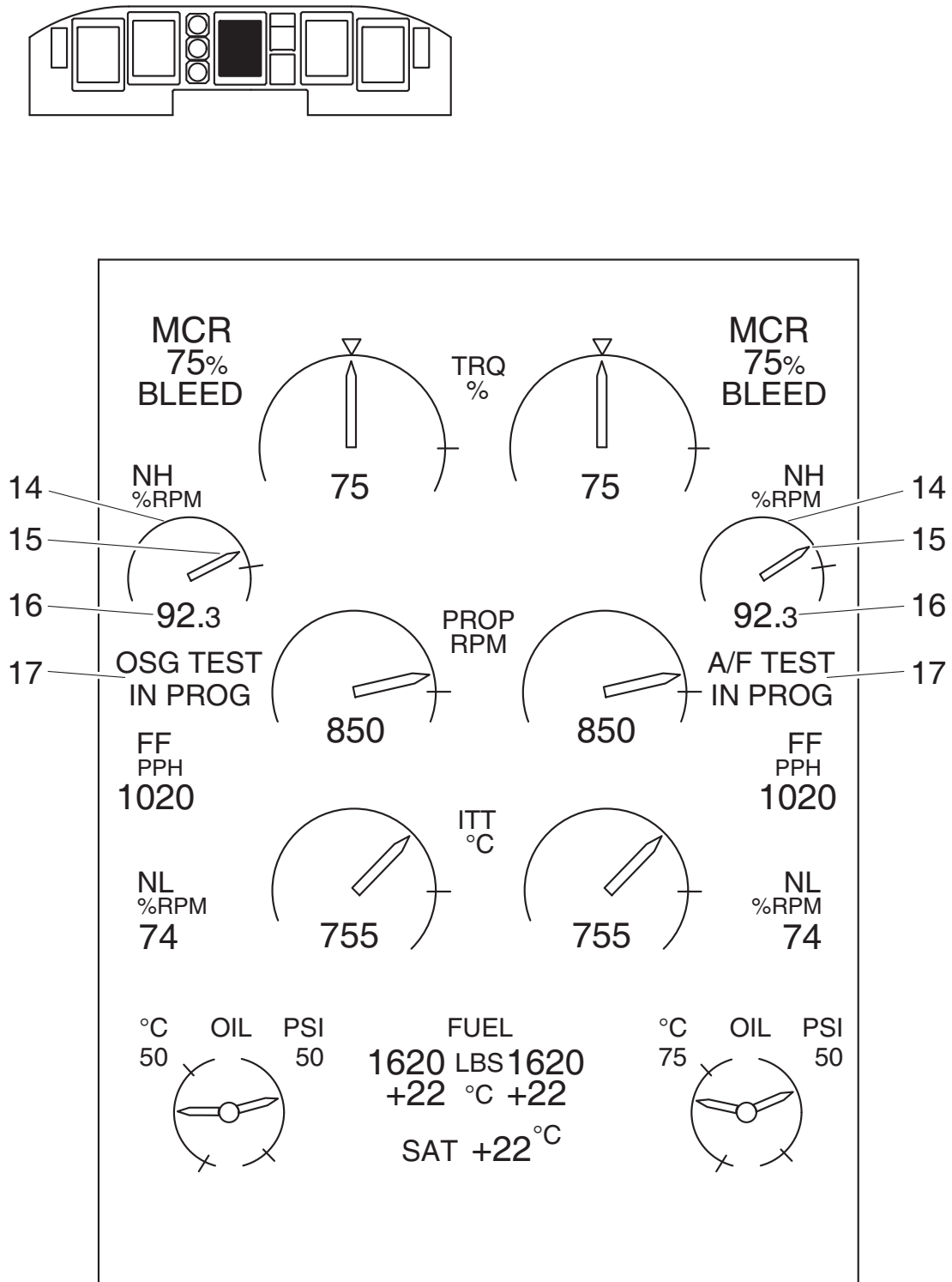


Figure 12.27-7 Engine Display (5 of 9)

MULTI FUNCTION DISPLAY (MFD) FUEL PAGE CALLOUTS

1. AUXILIARY FUEL PUMPS SWITCH ANNUNCIATOR

OFF segment (white text surrounded by a white box)

- the respective TANK 1 or TANK 2 AUX PUMP switchlight is not in the depressed position

ON segment (reverse video, black text on green background)

- the respective TANK 1 or TANK 2 AUX PUMP switchlight is in the depressed position
- white dashes replace the text (without a box), when no data is available

2. DIGITAL DISPLAY OF FUEL TANK TEMPERATURE

(digital value and TANK segment in white, °C segment in blue)

- indicates temperature in left collector bay with a $\pm$ sign
- if using JET B/JP-4 and TANK temperature is more than 35°, maximum altitude is 20,000 ft
- indicates from -99 to +99 in 1° increments
- digits are replaced by white dashes when the data is not valid

3. ANALOG DISPLAY OF FUEL QUANTITY

- gives an analog readout of fuel quantity in the left and right tanks

QTY segment (white)

KGx1000 segment (cyan)

Scale and digit segments (white)

- scale marks and digits are removed when the parameter is not valid

Pointer segment (white) - normal

Pointer segment (yellow) - during an imbalance condition

- removed when the parameter is not valid

4. TANK AUXILIARY PUMP PRESSURE STATUS INDICATOR

Circle segment (white outline with black fill) - low or no pressure

Circle segment (white outline with green fill) - normal pressure

5. DIGITAL DISPLAY OF TOTAL FUEL QUANTITY

(digital value and TOTAL FUEL in white, KG segment in blue)

- total fuel quantity given in KG
- indicates from 0 to 15000 in 5 KG increments
- digits are replaced by white dashes when the data is not valid

Dash8 - Q400 - Power Plant

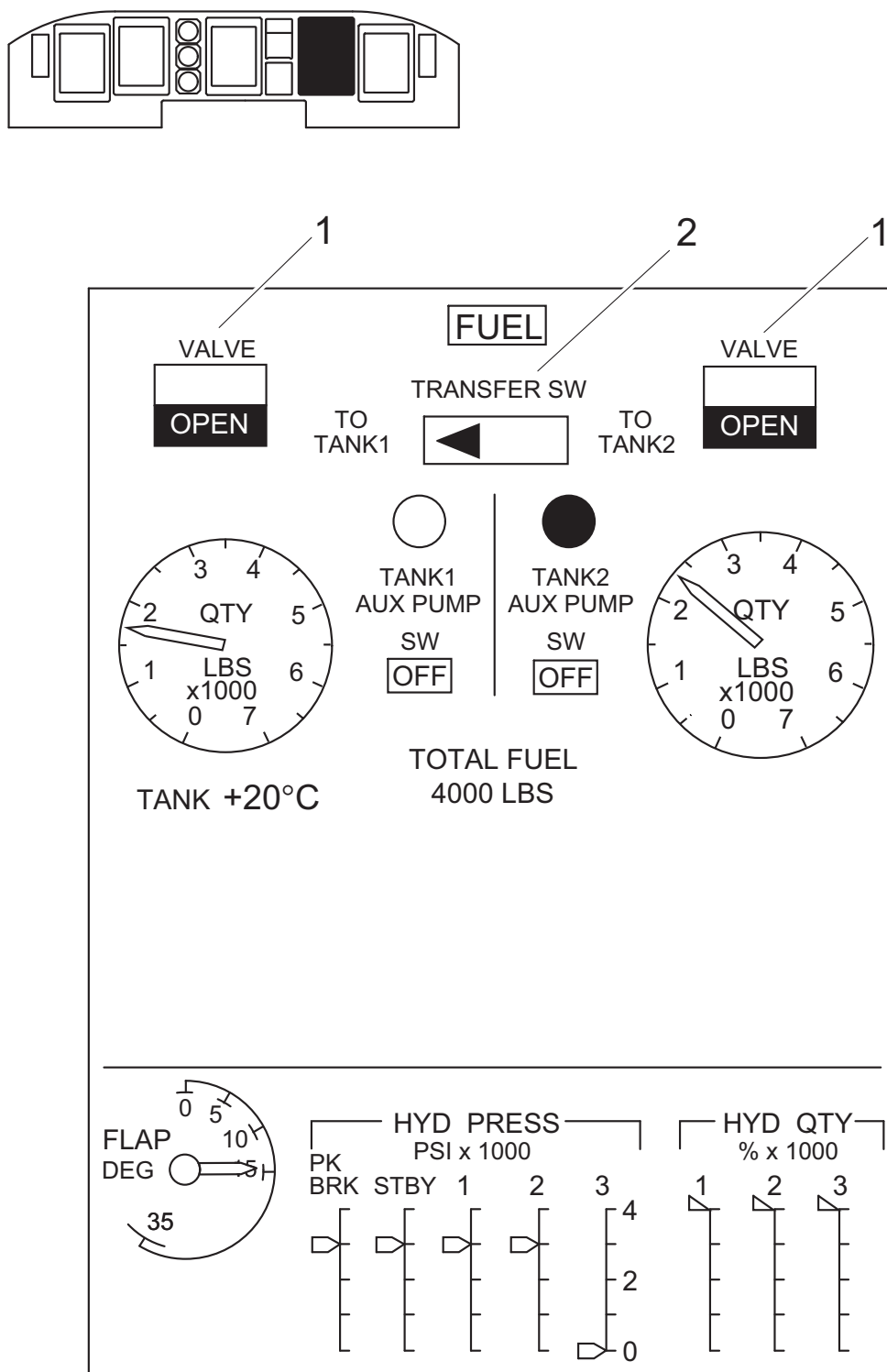


Figure 12.24-85 MFD Fuel Page - Transfer Indication

MULTI FUNCTION DISPLAY (MFD) FUEL PAGE CALLOUTS

1. FUEL SHUT-OFF VALVE ANNUNCIATOR

- indicates shut-off valve state in response to a crew transfer request

VALVE segment (white)

CLOSED segment (white in upper white outline rectangle)

- indicates fuel transfer valve is closed

OPEN segment (reverse video, black text on green in lower rectangle)

- indicates fuel transfer valve is open
- when the valve is neither fully closed nor fully open (typical case during valve transition), nothing is displayed
- three white dashes are displayed instead of the CLOSED and OPEN indication when no data is available

2. FUEL TRANSFER SWITCH INDICATION

- indicates the position of the FUEL TRANSFER switch on the FUEL CONTROL panel

TRANSFER SW segment (white)

TO TANK 1 and **TO TANK 2** segment (white)

Triangle segment (white in white outline rectangle)

- pointing towards the left indicates that a transfer is active from right to left
- pointing towards the right indicates that a transfer is active from left to right
- in case of inconsistency (transfer fault towards both sides), both triangles are displayed as the data is received
- three white dashes are displayed when no data is available

OFF segment (white in white outline rectangle)

- indicates no fuel transfer is requested

12.25 (ATA 74) ENGINE IGNITION SYSTEM

12.25.1 General

Each engine incorporates an ignition system consisting of one exciter dual channel unit and two ignitor plugs in the combustion chamber. The system is activated and deactivated automatically by the engine FADEC during the start sequence.

In addition to controlling the ignitors during starting, the FADEC can determine that the engine has suffered a flameout on a surge. The FADEC activates the ignition circuitry for both ignitors as soon as the flameout on a surge has been detected and will cancel it when the engine has recovered.

12.26 (ATA 76) ENGINE CONTROLS

12.26.1 General

Powerplant operation is managed by power levers and condition levers mounted on the center console in the flight deck.

Dash8 - Q400 - Power Plant

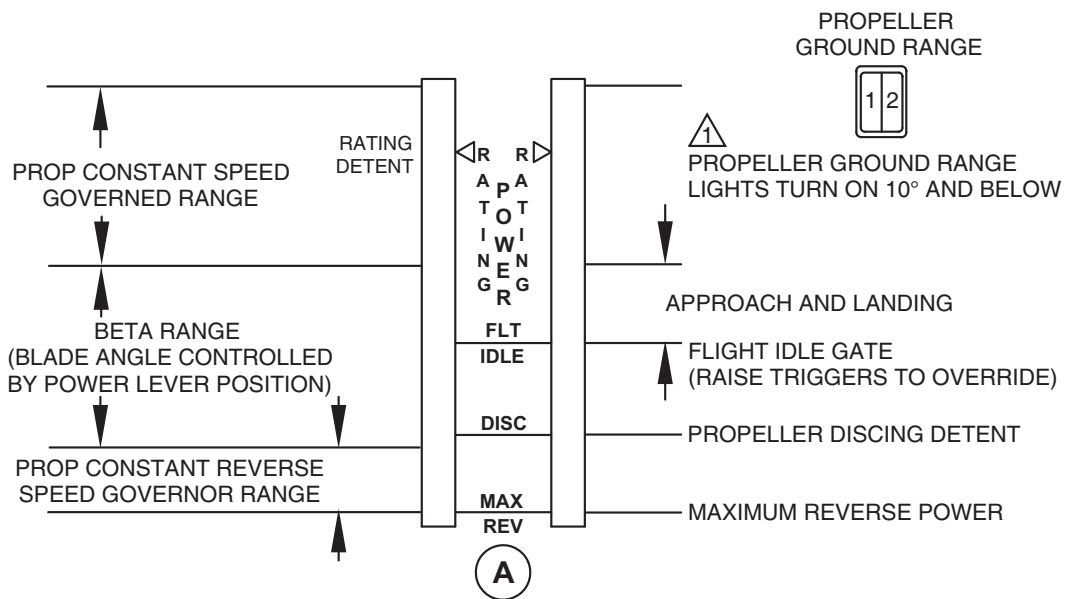
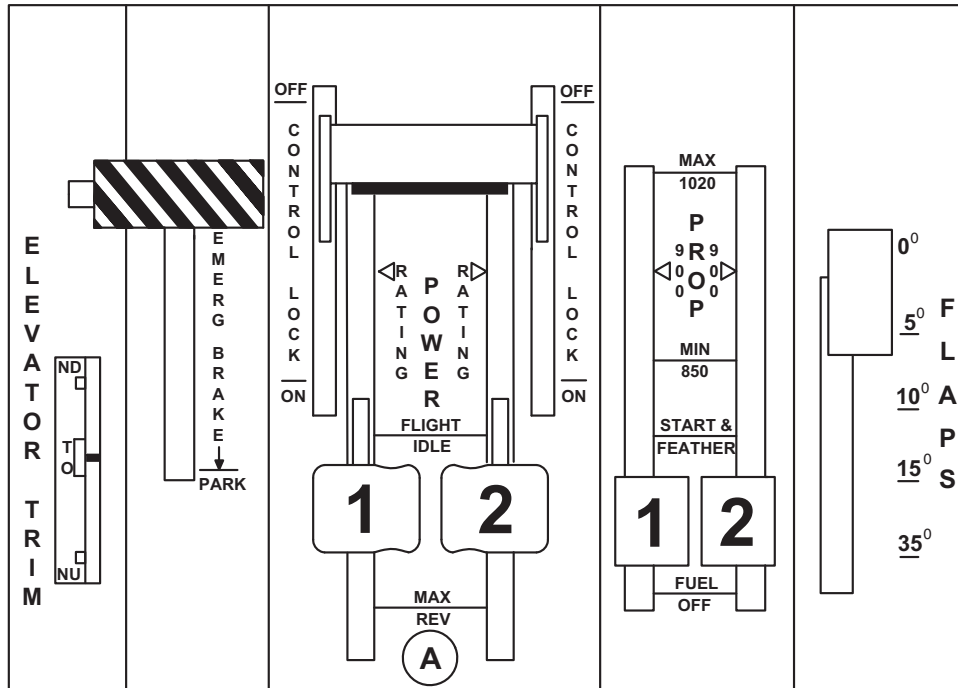


Figure 12.26-1 Power Lever Positions

12.26.2 Power Levers

The two power levers (Figure 12.26-1), marked 1 and 2, control engine power in the forward power range and propeller speed and propeller blade angle in the idle through reverse Beta range.

The power lever system is used to initiate power demand through the Full Authority Digital Electronic Control (FADEC) to meter fuel to the engine in the forward and reverse ranges. The power lever system also initiates control signals to the Propeller Electronic Control (PEC) to control propeller blade angles in the beta range.

Power Levers Select:

- Power for Flight
- Flight Idle (FLT IDLE)
- DISC
- Reverse (MAX REV)

The FADEC receives the power lever position signal by means of a dual channel RVDT installed in each lever. Discrete positional signals are also transmitted from microswitches mounted on the power lever quadrant to the PEC.

Power lever movement between FLIGHT IDLE and RATING results in the FADEC modulating the power proportionally between flight idle power and the selected rated power.

The gate is overridden by raising gate release triggers below the handgrips, allowing the power lever to be moved further aft.

NOTE: A Beta warning horn will sound if the gate is raised in flight.

Further power lever movement aft moves the blades into reverse until the power levers reach MAX REV. Between DISC and MAX REV, fuel flow and power output is increased.

Dash8 - Q400 - Power Plant

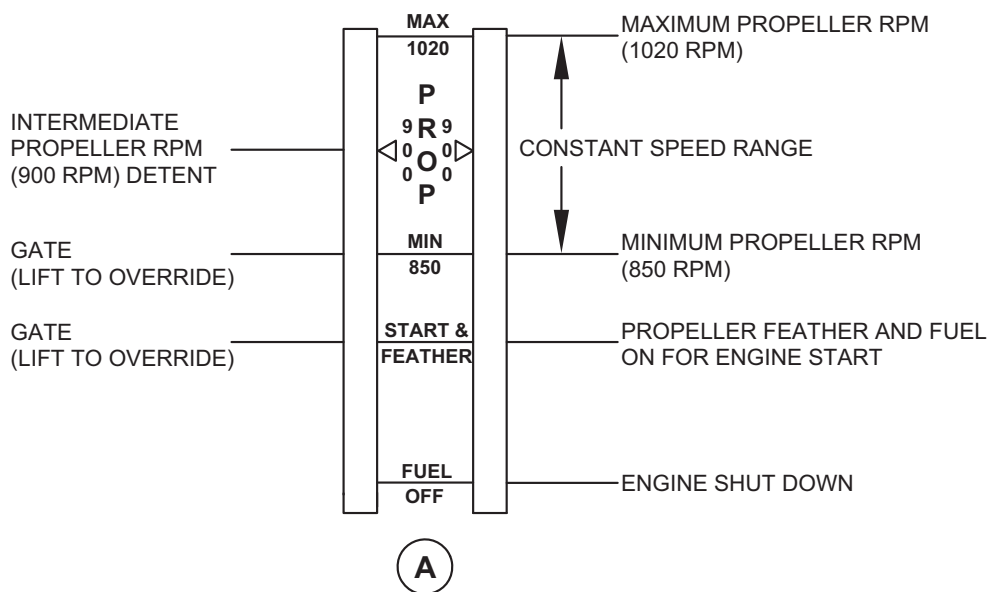
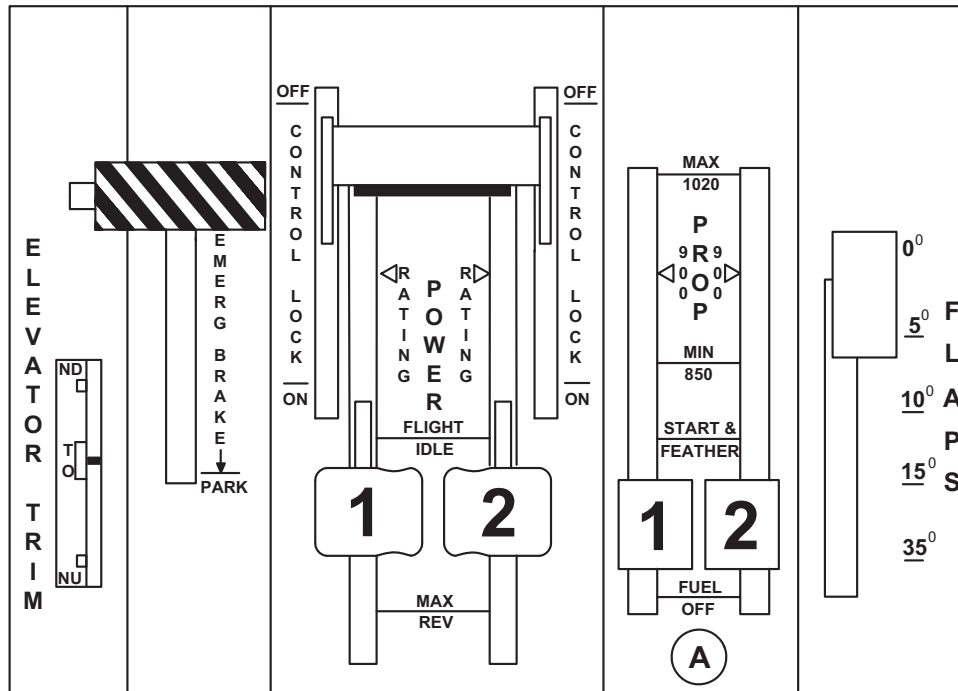


Figure 12.26-2 Condition Lever Positions

12.26.3 Condition Levers

Two condition levers (Figure 12.26-2), to the right of the power levers, marked 1 and 2 are used to set:

- Maximum Propeller RPM (MAX)
- Intermediate Propeller RPM (900)
- Minimum Propeller RPM (MIN)
- Propeller Feather & Fuel On (Start & Feather)
- Engine Ratings
- Engine Shutdown (FUEL OFF)

The PEC receives the condition levers position signal by means of a dual channel RVDT installed in each lever. Two discrete shutdown signals are also transmitted from microswitches mounted on the condition lever quadrant to the FADEC

While in constant speed range, three discrete governing speeds can be selected: 1020 RPM, 900 RPM and 850 RPM. Each of the selected speeds also sets a default engine rating: NTOP at 1020, MCL at 900 and MCR at 850.

On the ground with power levers at FLT IDLE, and a CLA between MIN and MAX inclusive, the propeller speed maintained by the FADEC at 660 RPM. This is known as prop underspeed governing. In the START & FEATHER position the propeller is feathered. Moving the lever to FUEL OFF closes microswitches connected to the FADEC and results in the FADEC commanding an engine shut down, by cutting off the fuel. Lift gates prevent unintentional movement of the lever from MIN/850 to START & FEATHER and from START & FEATHER to FUEL OFF.

If CLA is inadvertently selected to START/FEATHER during flight and then reselected to speed governing with engine power at cruise or higher, then the reaction of the propeller electronic control (PEC) is to activate the Automatic Underspeed Protection Circuit (AUPC) function.

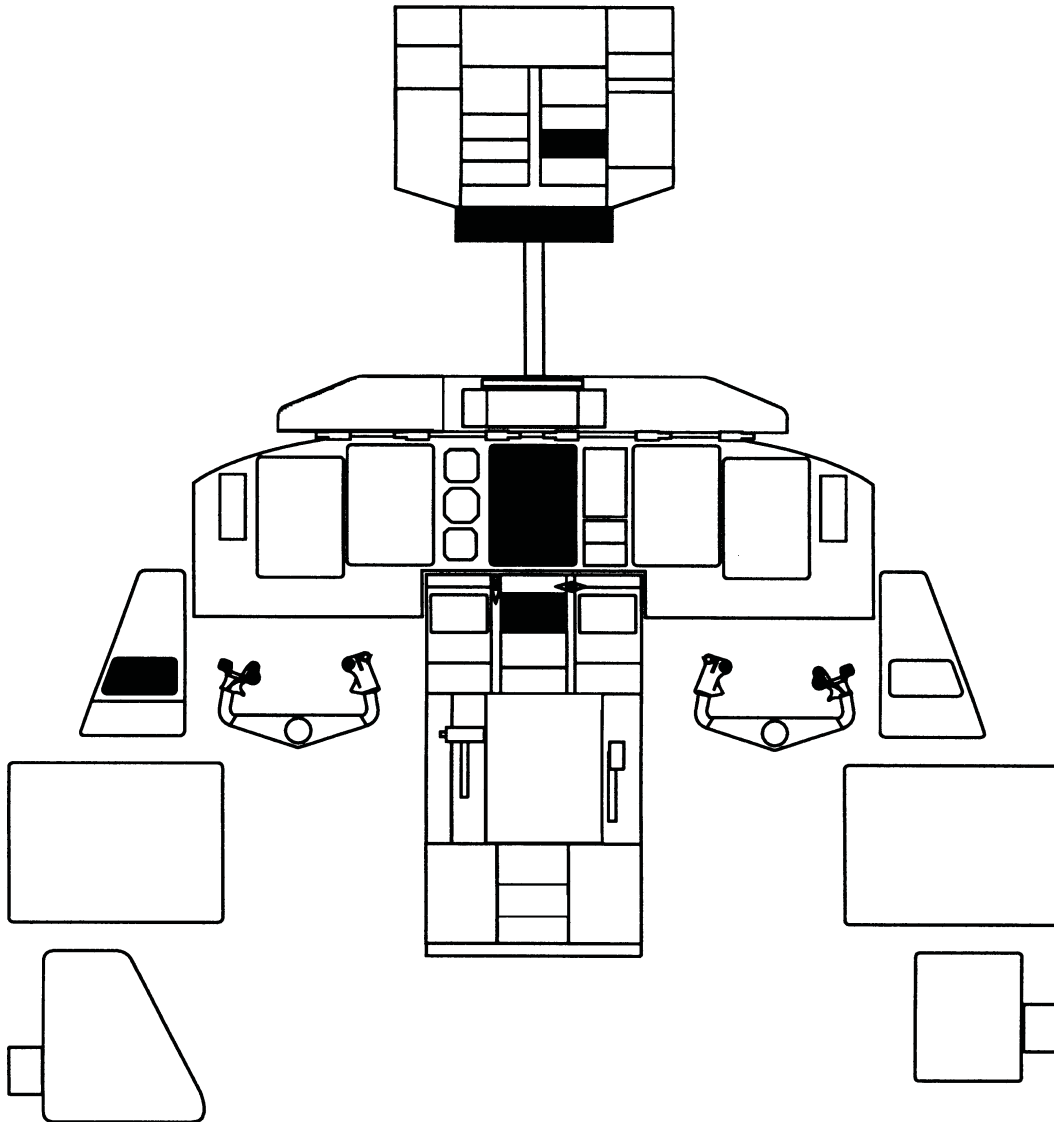
This function disables PEC Speed Governing and Beta Control, and provides an unmodulated drive fine signal to the pitch control unit (PCU). The propeller pitch decreases and speed increases until speed control by the overspeed governor (OSG) is achieved at about 1070 rpm. This is a latched condition, the PEC Caution light will illuminate and propeller speed will remain at this value unless the propeller is feathered, or until the blade angle reaches the fine pitch stop during landing.

The OM-B (QRH) procedure for in-flight propeller unfeathering requires as first action to retarded the power lever flight idle, this avoids activation of the AUPC, and normal control functions will be maintained.

12.26.4 Full Authority Digital Electronic Control Unit

The Full Authority Digital Electronic Control (FADEC) is a dual-channel microprocessor-based controller that controls the engine fuel flow based on various inputs from the aeroplane, engine, and propeller control system. The FADEC also controls two bleed valves on the engine for surge avoidance during normal steady state and transient operation.

12.27 (ATA 77) Engine Indications



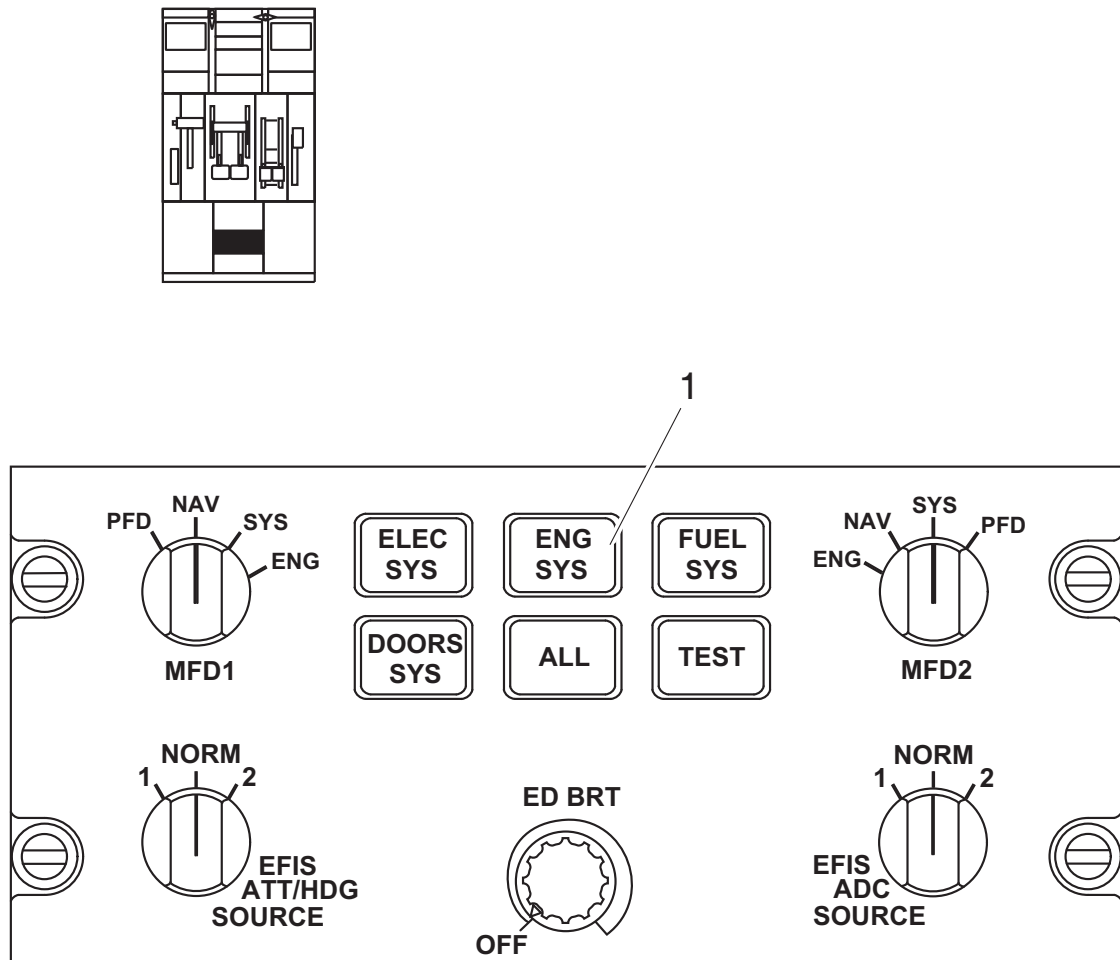


Figure 12.27-1 Engine and System Integrated Displays Control Panel (ESCP)

ESCP Callouts Pertaining to powerplant Items

1. ENG SYS PUSHBUTTON (momentary action)

- PUSH** - provides a display of the engine system page on the MFD (upper area) with MFD 1 or MFD 2 set at SYS
- there is no action with another push

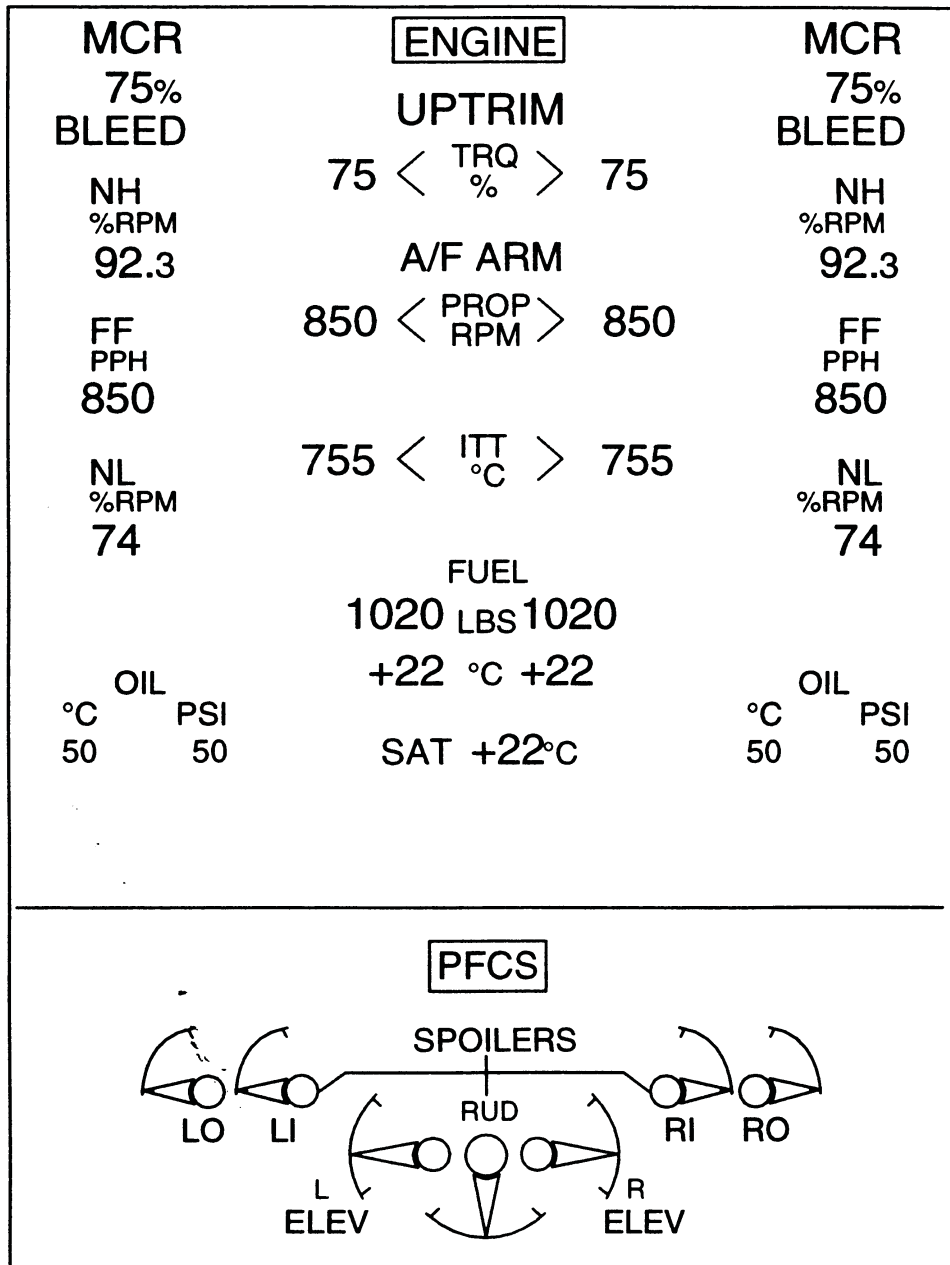
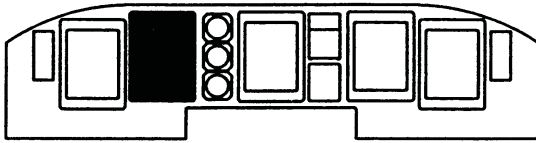


Figure 12.27-2 MFD1 ENG Page

Dash8 - Q400 - Power Plant

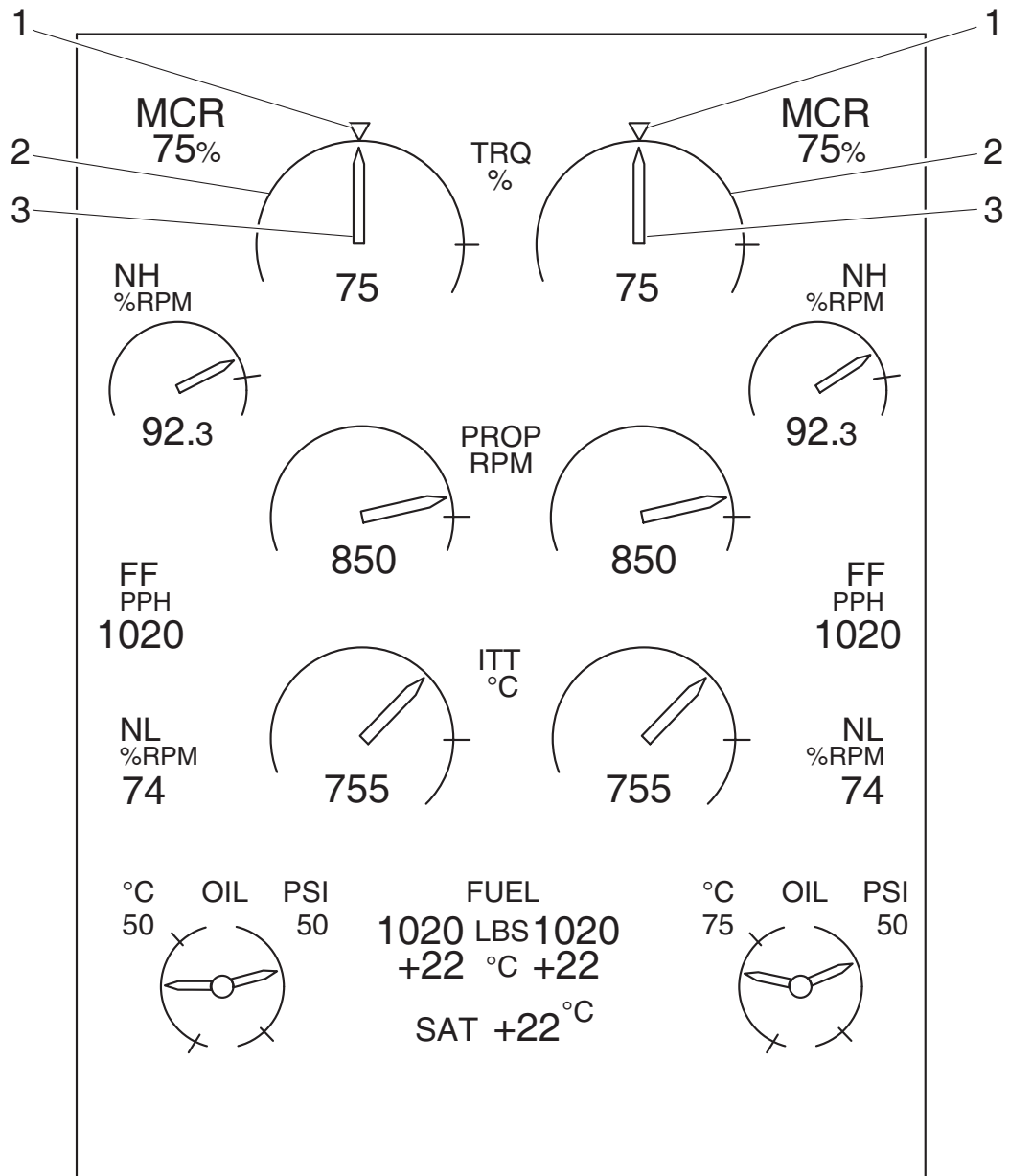
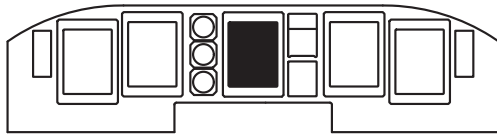


Figure 12.27-3 Engine Display (1 of 9)

ENGINE DISPLAY CALLOUTS

1. TORQUE BUG (cyan)

- indicates the torque commanded by FADEC
- it is removed when the actual torque or the torque bug parameter is no longer valid
- removed from view with condition lever at START/FEATHER or FUELOFF

2. TORQUE DIAL SCALE (TRQ white, % cyan)

- it is the scale along which the analog torque value can be read
- the numerical value is available on the digital readout just below the dial
- the scale is composed of 4 different colored arcs:
 - green arc (normal operating)
 - yellow arc (caution range)
 - red radial (maximum)
 - white arc (max needle travel)
- the scale is always presented
- it automatically reverts to a totally white arc when the parameter is no longer valid

3. TORQUE NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line
- when entering the yellow arc, a confirmation time of 3 seconds is incorporated in order to prevent any spurious yellow color change during transient operations
- at the end of the white arc, the needle will be parked at the maximum value, but the numerical value will still be available on the digital display
- the needle is removed when the parameter is no longer valid

Dash8 - Q400 - Power Plant

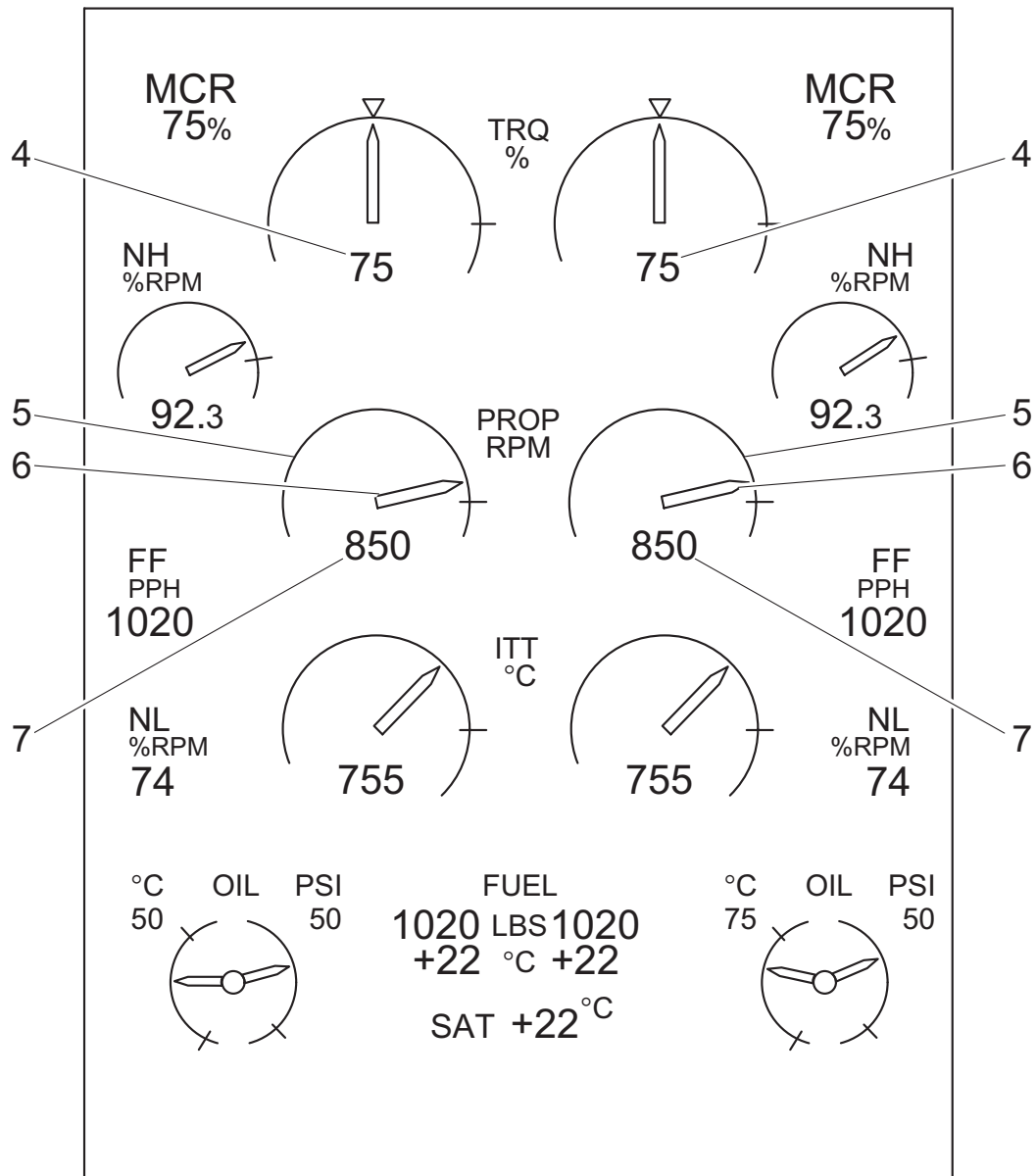
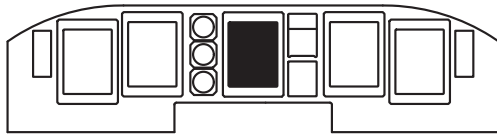


Figure 12.27-4 Engine Display (2 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

4. TORQUE DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from 0 to 199% in 1% increments
- they are replaced by white dashes when the parameter is no longer valid

5. PROPELLER RPM (N_P) DIAL SCALE (PROP white, RPM cyan)

- it is the scale along which the analog propeller speed value can be read
- the scale is composed of 6 different colored arcs:
 - white arc (min needle travel)
 - green arc (normal operating)
 - yellow arc (caution range)
 - red radial (maximum)
 - white arc (max needle travel)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

6. N_P NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line when entering the yellow arc, a confirmation time of 3 seconds is incorporated in order to prevent any spurious yellow color change during transient operations
- the needle is suppressed when the parameter is no longer valid

7. N_P DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from 0 to 1990 RPM in 10 RPM increments
- they are replaced by white dashes when the parameter is no longer valid

Dash8 - Q400 - Power Plant

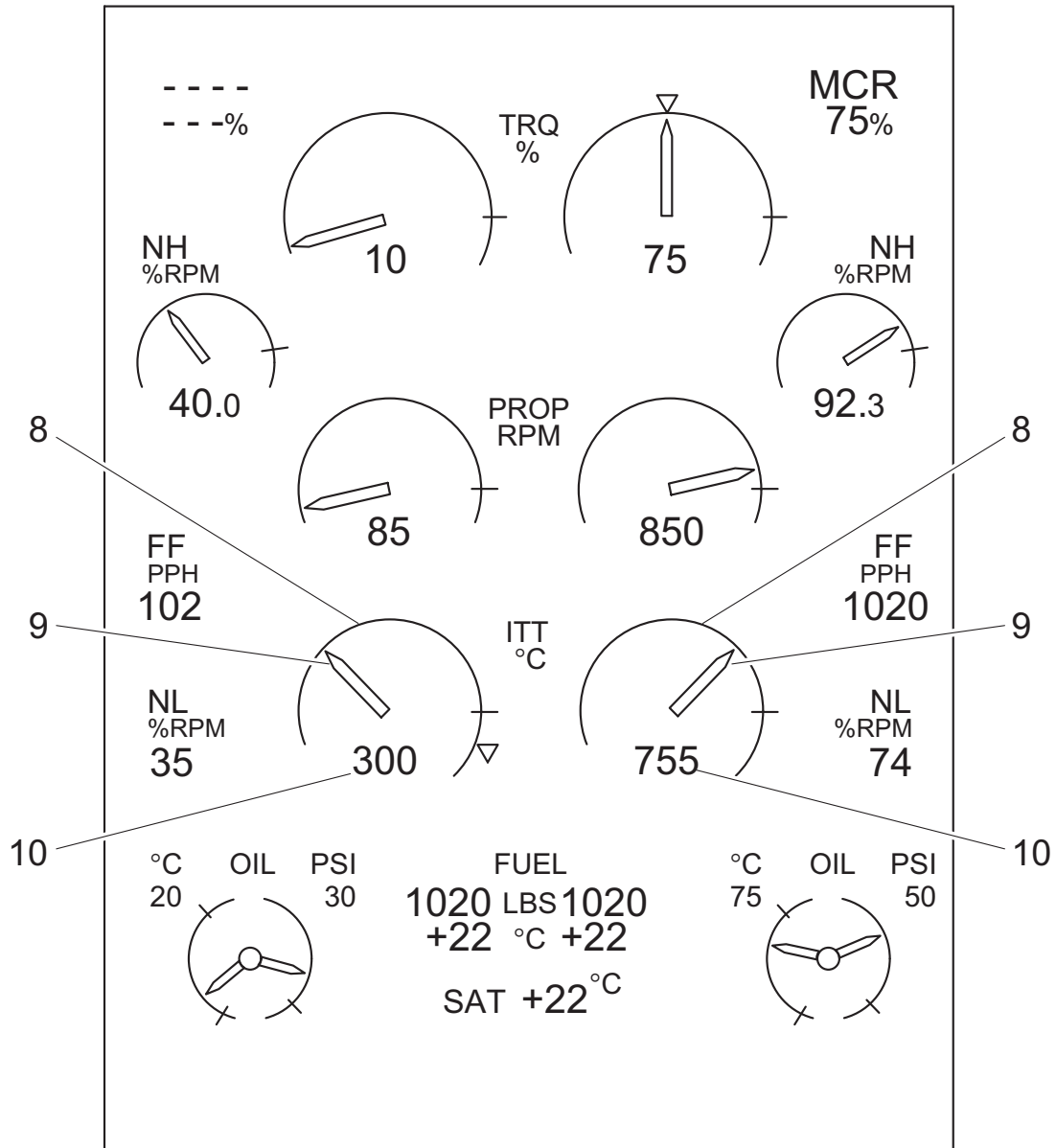
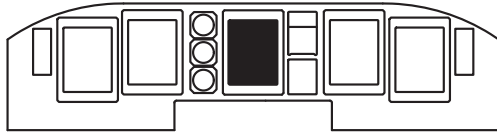


Figure 12.27-5 Engine Display (3 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

8. ITT DIAL SCALE (ITT white, °C cyan)

- it is the scale along which the analog ITT value can be read
- the scale is composed of 4 different colored arcs:
 - white arc (min needle travel)
 - green arc (normal operating)
 - red radial (maximum)
 - white arc (max needle travel)
- a red triangle is positioned along the second white arc to indicate the maximum transient limit during engine start (920°C). The red triangle is only visible during engine start phase, plus 30s after engine start is finished
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

9. ITT NEEDLE

- the needle is normally white and will turn red depending on the engine phase:
 - if in engine start phase, it will turn red when the maximum transient red limit is exceeded,
 - if outside the engine start phase, it will turn red as soon as the red line is exceeded
- the needle is suppressed when the parameter is no longer valid

10. ITT DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from -99 to 1999°C in 1°C increments
- they are replaced by white dashes when the parameter is no longer valid

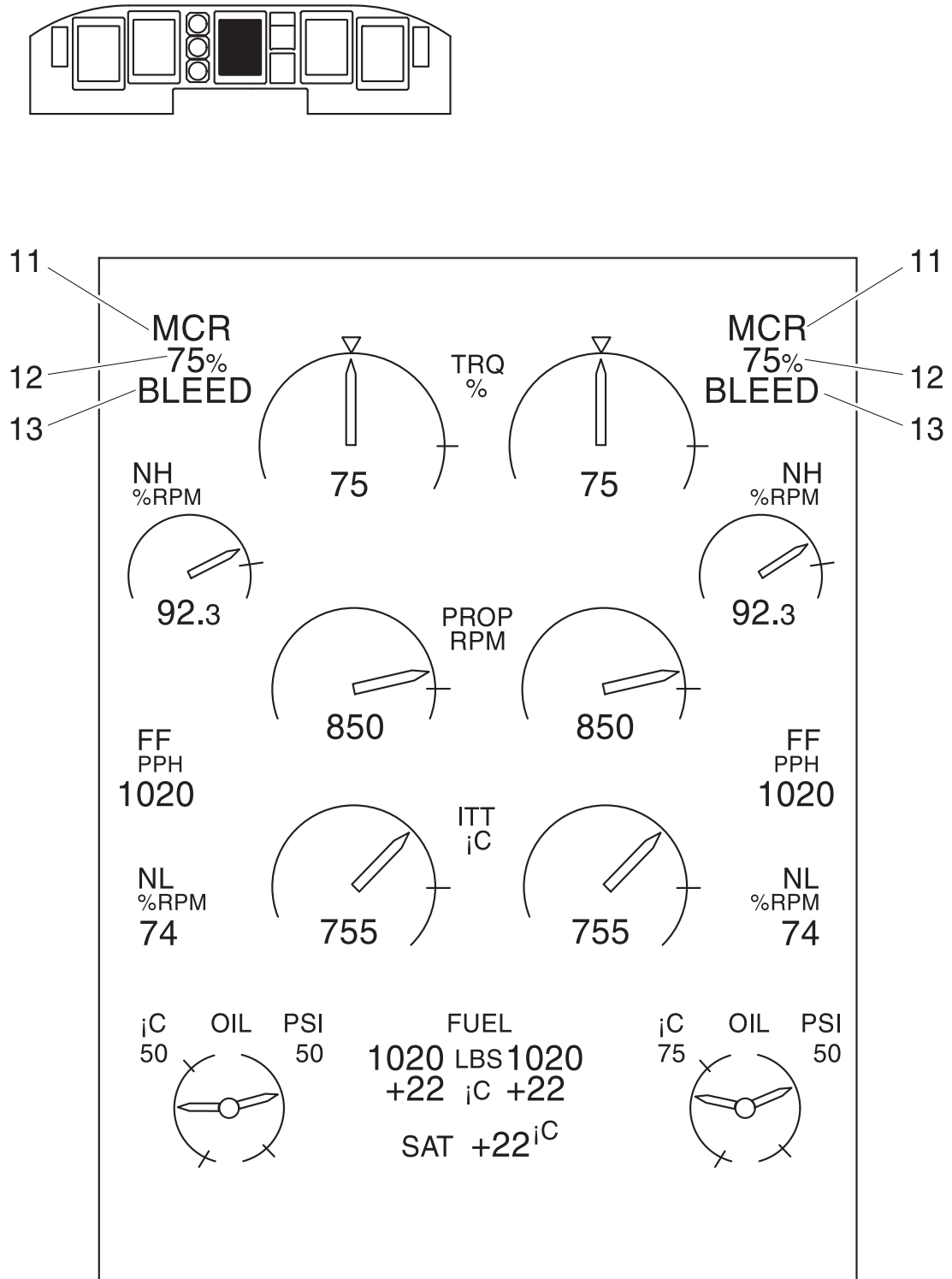


Figure 12.27-6 Engine Display (4 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

11. ENGINE RATING MODE ANNUNCIATION (green)

- indicates selected engine rating mode
- rating mode is a function several inputs:

Rating Display	Condition Lever	Bleed Selection	MTOP Pushbutton (or UPTRIM)
NTOP	1020	- any -	OFF
MTOP	1020	MIN/OFF or ON/MIN	ON
MCP	1020	ON/NORM or MAX	ON

Rating Display	Condition Lever	MCL Selection	MCR Selection
MCL	900	OFF	OFF
MCL	850	ON	OFF
MCR	900	OFF	ON
MCR	850	OFF	OFF

- RDC TOP will be displayed when in NTOP or MTOP and reduced take-off power is selected with RDC TOP switch on ENGINE Control panel
- when data is not valid, 4 white dashes are displayed

12. TORQUE BUG DIGITAL VALUE (cyan)

- torque bug digits are always displayed in cyan excepted when they are replaced by white dashes as the parameter is no longer valid
- indicates from 0 to 199% in 1% increments

13. BLEED STATUS ANNUNCIATION

- appears just below the engine rating mode of each engine when:
 - MTOP or NTOP engine mode is set by the Fadec and,
 - BLEED ON and MIN, NORM or MAX is selected on by the crew
- the word BLEED is displayed as follows:

Bleed Display	Bleed Selection	Rating Display
Bleed (W)	MIN	NTOP
Bleed (W)	MIN	MTOP
Bleed (Y)	NOMR or MAX	NTOP
- blank -	NORM or MAX	MCP *

w = white
y = yellow

* **NOTE:** Bleed selection of NORM or MAX with NTOP engine rating will set the rating to MCP.

- nothing is displayed when the bleed air is selected OFF

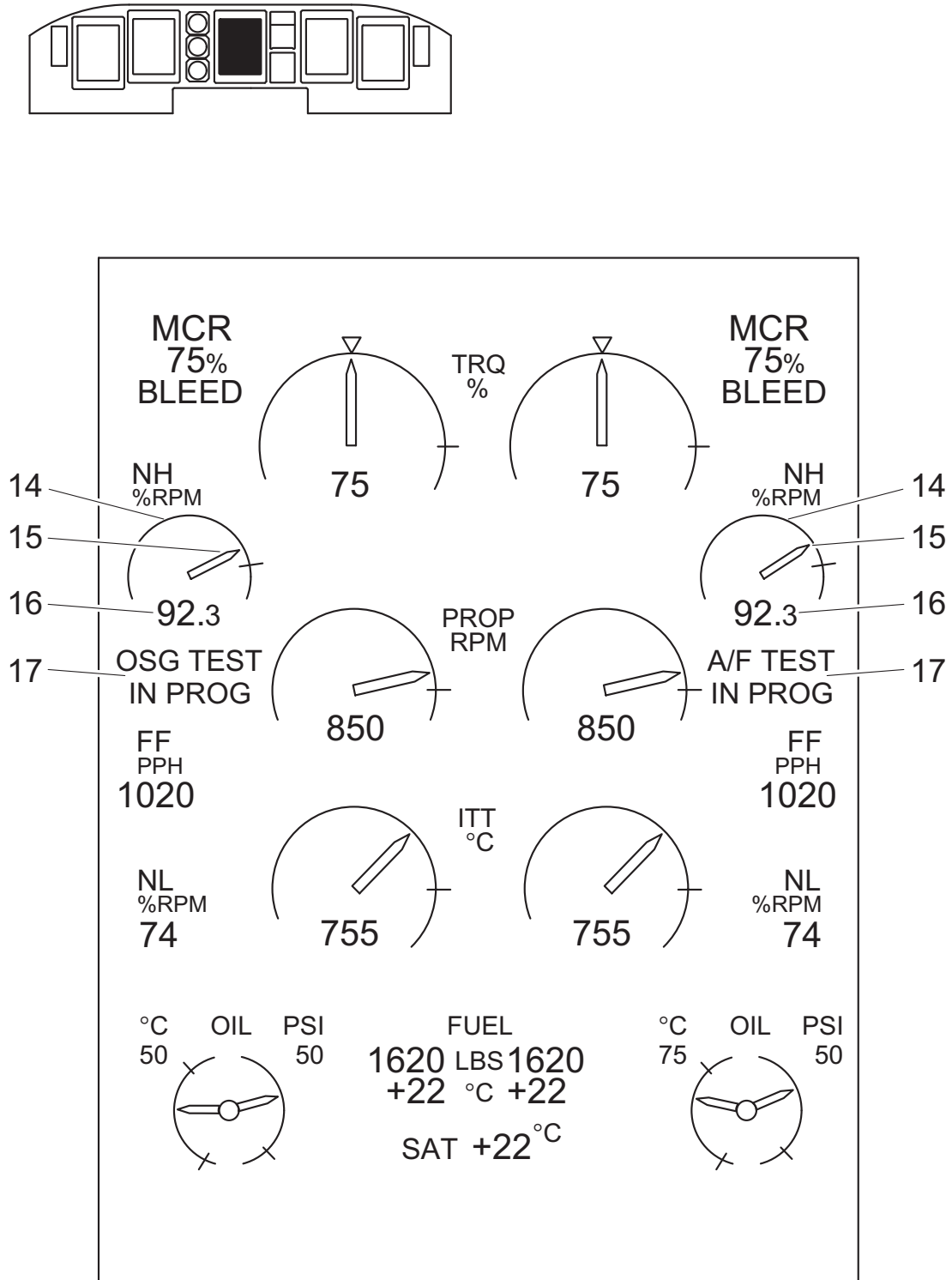


Figure 12.27-7 Engine Display (5 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

14. N_H DIAL SCALE (N_H white, %rpm cyan)

- it is the scale along which the analog N_H value can be read
- the scale is composed of 4 different colored arcs:
 - white arc (min needle travel)
 - green arc (normal operating)
 - red radial (maximum)
 - white arc (max needle travel)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

15. N_H NEEDLE

- the needle is normally white and will turn red as soon as the red line is exceeded
- the needle is removed when the parameter is no longer valid

16. DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from 0 to 199.9% in 0.1% increments
- they are replaced by white dashes when the parameter is no longer valid

17. OSG AND AUTOFEATHER TEST ANNUNCIATION

- indicates the status of the prop overspeed governor or autofeather test
- as soon as the test is launched the OSG TEST or A/F TEST (white) message appears followed by the following messages:
 - IN PROG in white, or
 - ABORT or FAILED in yellow, or
 - PASSED in green, depending on the status of the test
- nothing is displayed when the test conditions are removed or when no valid data are received

Dash8 - Q400 - Power Plant

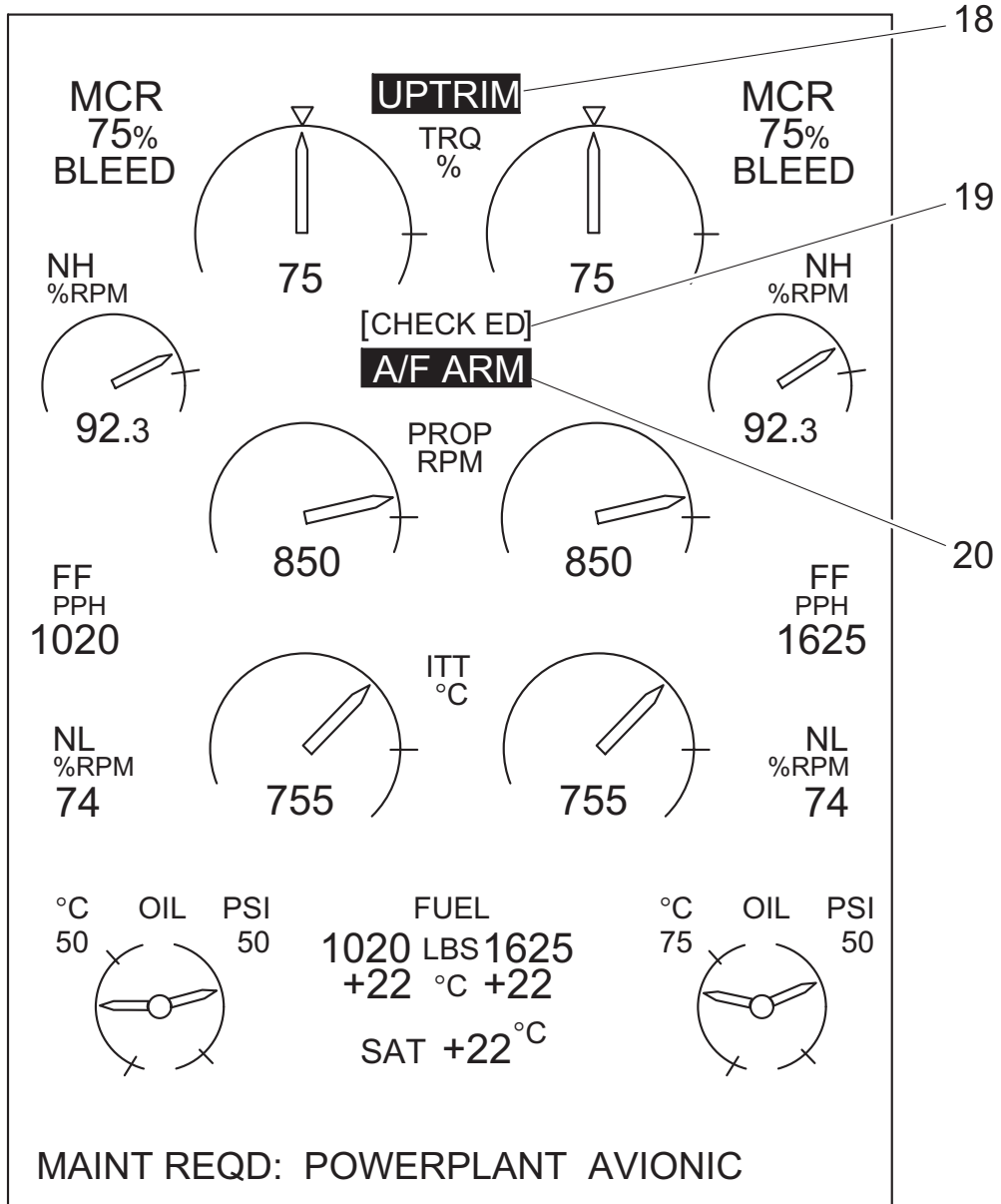
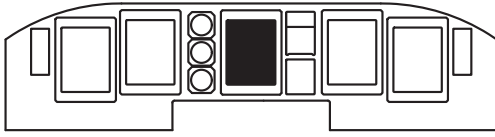


Figure 12.27-8 Engine Display (6 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

18. UPTRIM ANNUNCIATION (white)

- displayed as soon as the increased uptrim power is request from the Fadec (MTOP engine mode is set by the FADEC).
- MTOP is displayed by the rating annunciator if RDC TOP is not selected, else RDC TOP will remain
- the message is presented in reverse video for the first 5 seconds of display to annunciate the status change
- otherwise or if the data is invalid, nothing will be shown

19. CHECK ED ANNUNCIATION (yellow)

- message CHECK ED appears flashing during the first 5 seconds then steady
- the message indicates that a display discrepancy on one or more of the critical engine parameters (TRQ, N_H, N_P, ITT) has been detected by one of the adjacent MFDs

20. A/F STATUS ANNUNCIATION (white)

- the A/F SELECT message is displayed as soon as the pilot pushes the AUTOFEATHER pushbutton on the PROPELLER CONTROL panel
- the A/F ARM message is displayed at the same location when the autofeather system of both propellers are armed
- the A/F ARM message is presented in reverse video during the first 2 seconds of display
- nothing will be shown if the data is invalid

Dash8 - Q400 - Power Plant

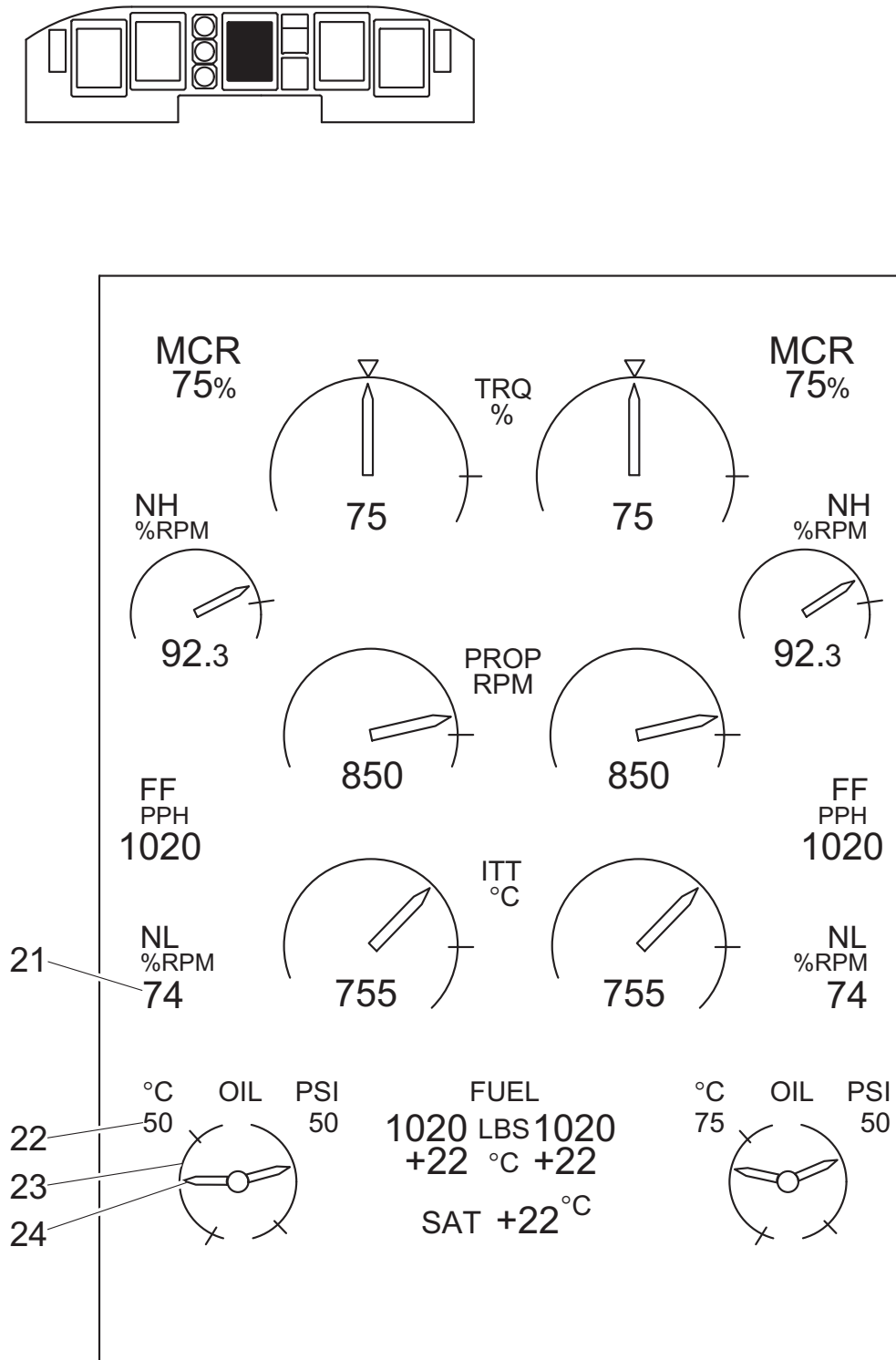


Figure 12.27-9 Engine Display (7 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

21. N_L DIGITAL VALUE (N_L white, %RPM cyan)

- digits are displayed in the following colors:
 - white (normal operating)
 - red (over limit)
- indicates from 0 to 199% in 1% increments
- they are replaced by white dashes when the parameter is no longer valid

22. OIL TEMPERATURE DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from -99 to 199°C in 1°C increments
- they are replaced by white dashes when the parameter is no longer valid

23. OIL TEMPERATURE DIAL SCALE (OIL white, °C cyan)

- it is the scale along which the analog oil temperature value can be read
- the scale is composed of 7 different colored arcs:
 - white arc (min needle travel)
 - red radial (minimum starting)
 - yellow arc (caution)
 - green arc (normal operating)
 - yellow arc (caution)
 - red radial (maximum)
 - white arc (max needle travel)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

24. OIL TEMPERATURE NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line. Transitioning from green to yellow arc when a conformation time of 1 second is incorporated in the display logic
- the needle is removed when the parameter is no longer valid

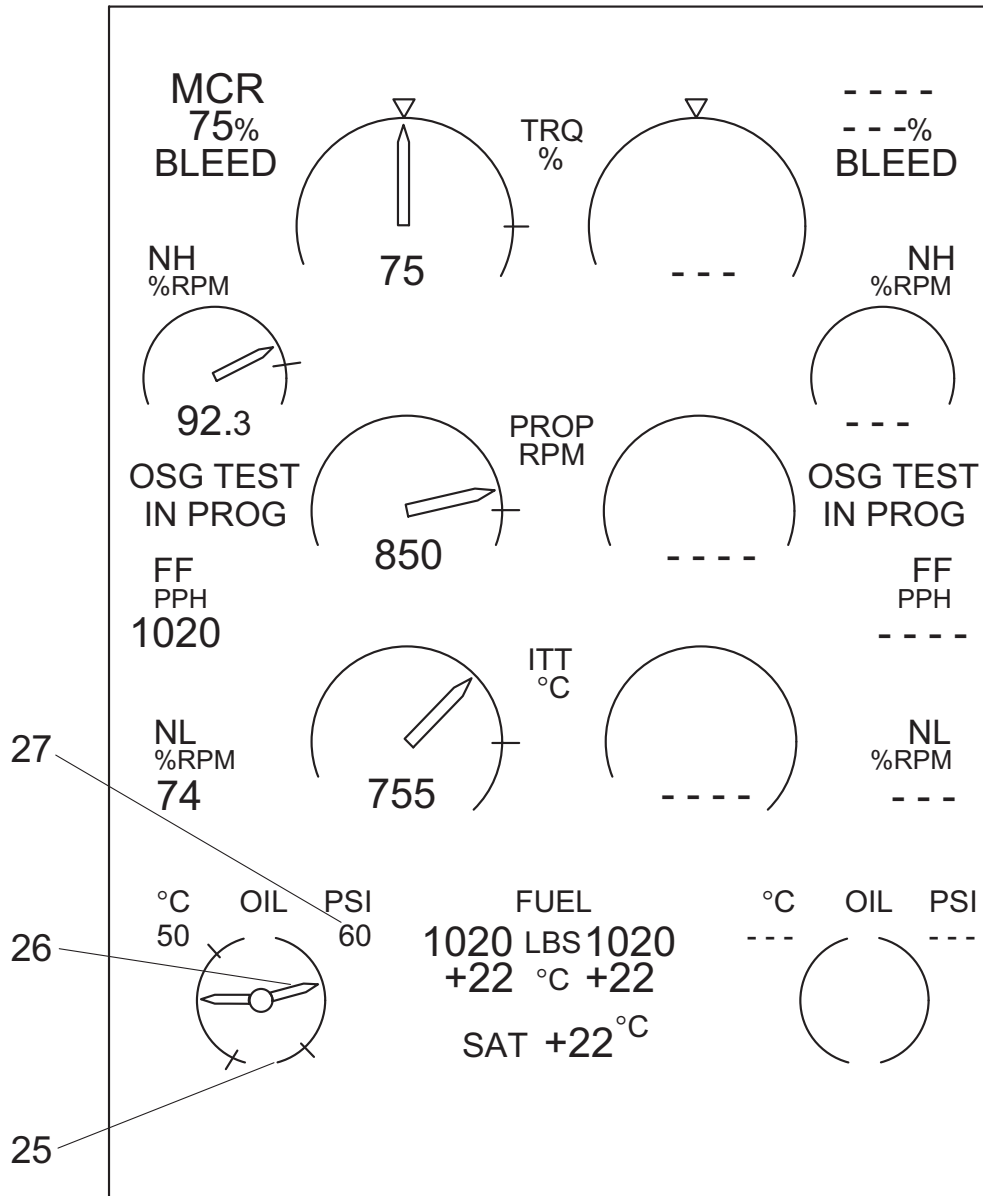
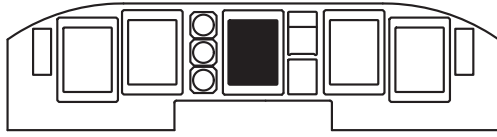


Figure 12.27-10 Engine Display (8 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

25. OIL PRESSURE DIGITAL VALUE

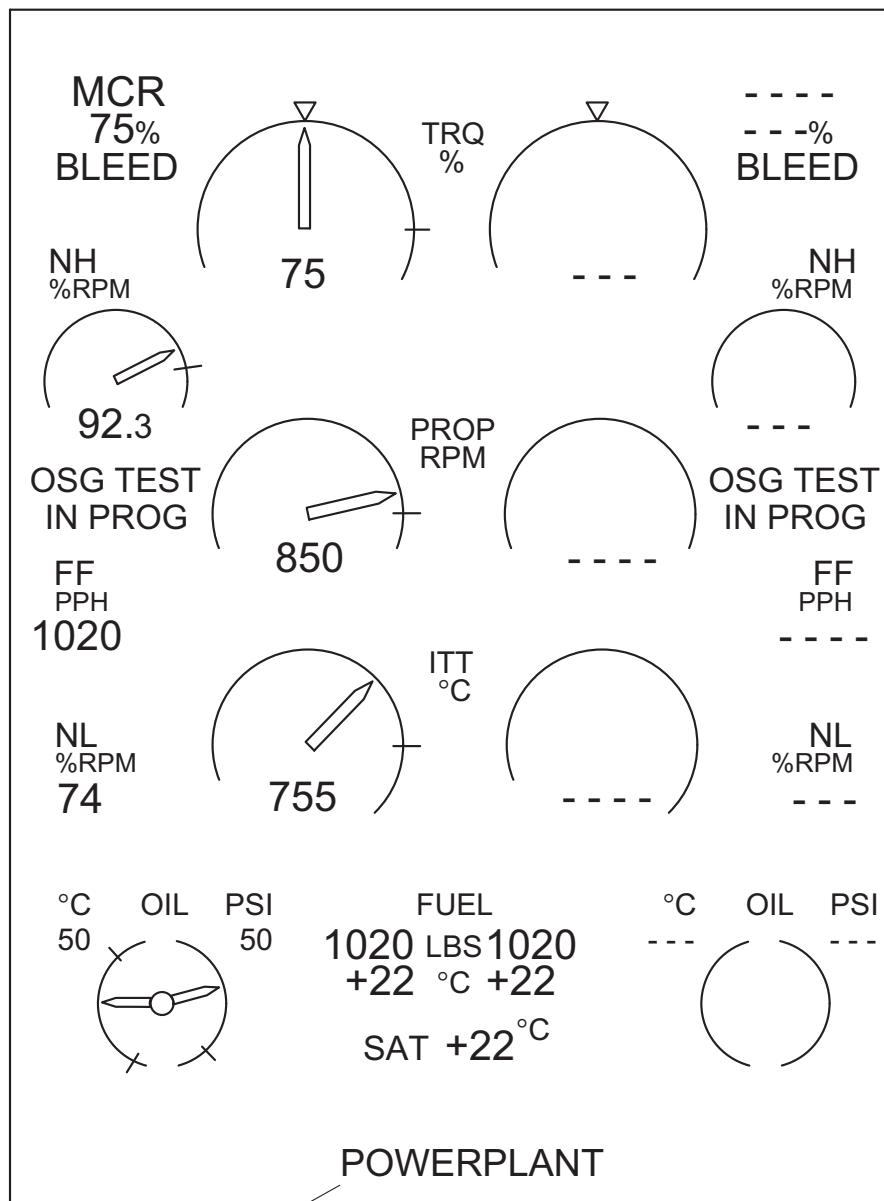
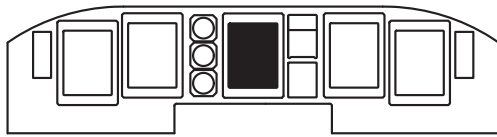
- digits follow the same color changes as the needle
- indicates from 0 to 299 PSI in 1 PSI increments
- they are replaced by white dashes when the parameter is no longer valid

26. OIL PRESSURE NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line. Transitioning from green to yellow arc when a confirmation time of 1 second is incorporated in the display logic
- the needle is removed when the parameter is no longer valid

27. OIL PRESSURE DIAL SCALE (oil white, PSI cyan)

- it is the scale along which the analog oil pressure value can be read
- the scale is composed of 5 different colored arcs:
 - white arc (min needle travel)
 - red radial (minimum)
 - yellow arc (caution)
 - green arc (normal operating)
 - yellow arc (caution)
- #1 or #2 ENG OIL PRESS warning light comes on 44 to 50 PSI
- there are 3 scale factors, one when oil pressure is below 40 PSI, the second one for intermediate values and the third one above 80 PSI (This is done so that the normal operating range is expanded and positioned between 2 and 3 o'clock as on existing series aeroplanes)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid



28

Figure 12.27-11 Engine Display (9 of 9)

ENGINE DISPLAY CALLOUTS (cont'd)

28. POWERPLANT MESSAGES (white)

- following messages are clarified in decreasing priority level. The message with the highest priority appears on the center bottom line

POWERPLANT message - appears when FADEC 1 or FADEC 2 annunciates "No Dispatch"

- the message is originated from the FADEC itself or from the Propeller Electronic Controller (PEC) via the FADEC

FADEC x/DU message (x = 1 or 2 of S if both are concerned) - appears when one FADEC channel transmission (channel A or B) is detected and confirmed failed for more than 10 seconds by the active Engine Display

Dash8 - Q400 - Power Plant

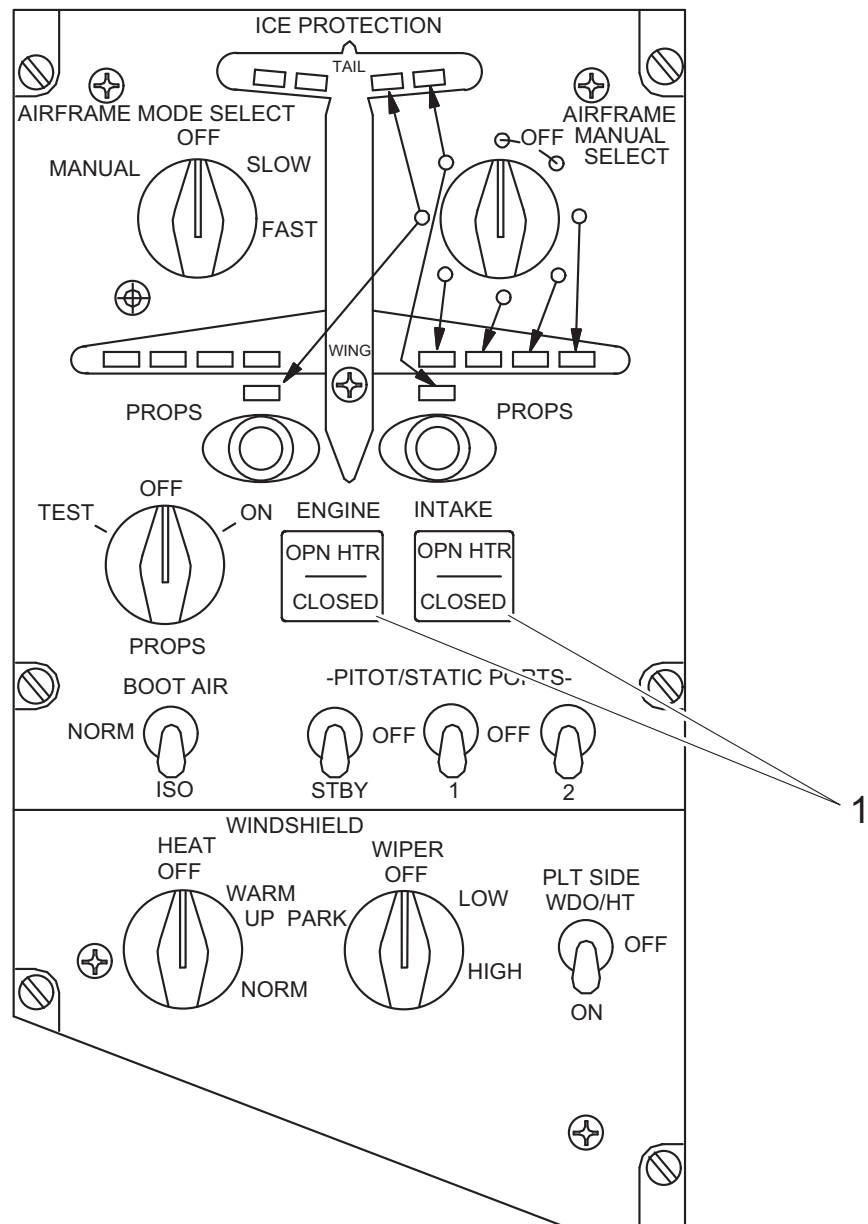
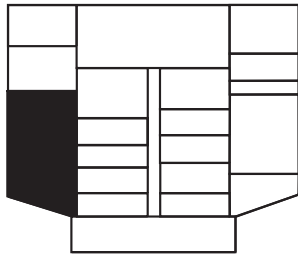


Figure 12.27-12 Engine Intake Door Switchlights

ICE PROTECTION PANEL CALLOUTS PERTAINING TO ENG

1. ENGINE INTAKE SWITCHLIGHT (alternate action)

PUSH - OPN segment (amber)

- bypass door open

HTR - segment (amber)

- switchlight pushed
- OPN segment (amber)
- SAT less than +10°C on ground or less than +5°C in flight
- engines running (sensed by oil pressure minimum 47 ±3 PSI or higher)
- main or back up engine intake adapter heater energized (AC variable frequency power available)

PUSH - CLOSED segment (green)

- bypass door closed
- engine intake adapter heater off

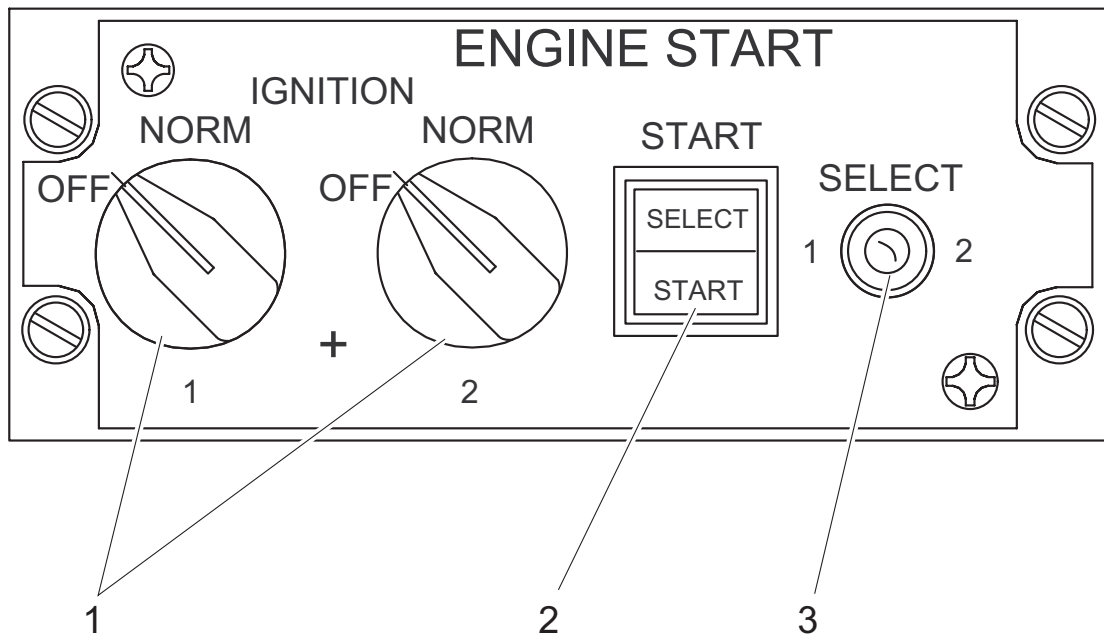
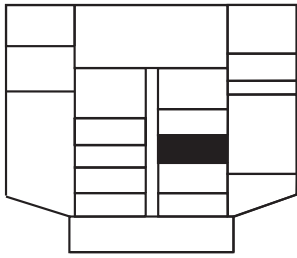


Figure 12.27-13 Engine Start Control Panel

ENGINE START CONTROL PANEL CALLOUTS

1. IGNITION CONTROL SWITCH (two position)

- controls ignition for related engine

OFF - the FADEC disables ignition regardless of ground or flight status

- required for dry engine motoring

NORM - FADEC activates ignition during engine starts (ground or flight starts)

- FADEC commands both ignitors on during flameout and surge accommodation

2. ENGINE START SWITCHLIGHT (momentary action)

SELECT segment (amber)

- indicates start control circuitry of selected engine has armed

PUSH - START segment (amber)

- indicates engine start has been initialized

3. ENGINE START SELECT SWITCH

(three-position toggle, spring loaded to center, magnetically latched in No. 1 or No. 2 position)

1 - arms start control circuits for #1 engine

- observe SELECT (amber) in engine START switchlight

2 - arms start control circuit for #2 engine

- observe SELECT (amber) in engine START switchlight

SWITCH unlatches when engine N_H reaches 50% on START.

Dash8 - Q400 - Power Plant

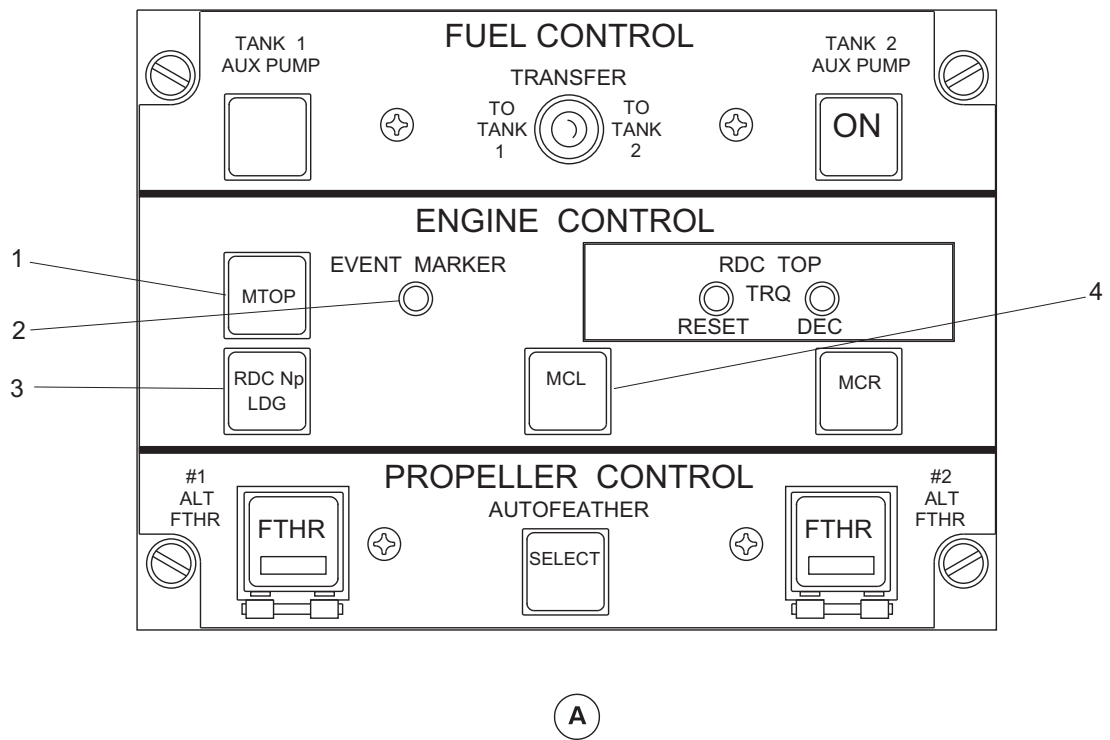
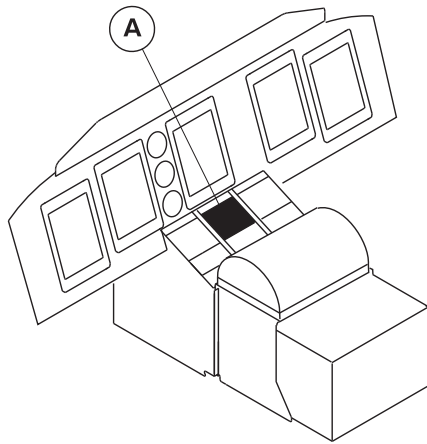


Figure 12.27-14 Engine Control Panel (1 of 2)

ENGINE CONTROL PANEL CALLOUTS

1. MTOP PUSHBUTTON (alternate action)

PUSH - enables maximum take-off power rating (MTOP) with condition levers at MAX/1020

- changes ED rating annunciation to MTOP with BLEEDS set to OFF or ON/MIN
- changes ED rating annunciation to MCP with BLEEDS set to ON/NORM or MAX

2. EVENT MARKER

PUSH - places a “bookmark” in the Engine Monitoring System (EMS)

- stores a data snapshot and a data trace in the EMS for 2 minutes leading up to the event and 1 minute following the event

3. RDC N_P LDG PUSHBUTTON (momentary action)

PUSH - enables a reduced propeller speed for landing

- Configuration for reduced N_P for landing:
- power levers between FLIGHT IDLE and approx. 50% RATING
- with condition lever in the MIN/850 position, push the RDC N_P LDG pushbutton

NOTE: Reduced N_P Landing mode will be cancelled if condition levers are not set to MAX/1020 within 15 seconds of selecting RDC N_P LDG switch.

- ED indicates REDUCED N_P LANDING
- advance condition lever to MAX/1020; N_P will remain at 850 RPM
- a Power Lever angle of 65 degrees or greater will cancel the RDC N_P selection
- RDC N_P mode can be cancelled by pushing the RDC N_P LDG button again

4. MCL PUSHBUTTON (momentary action)

PUSH - changes the MCR engine rating associated with the MIN/850 CLA to maximum climb rating (MCL).

Dash8 - Q400 - Power Plant

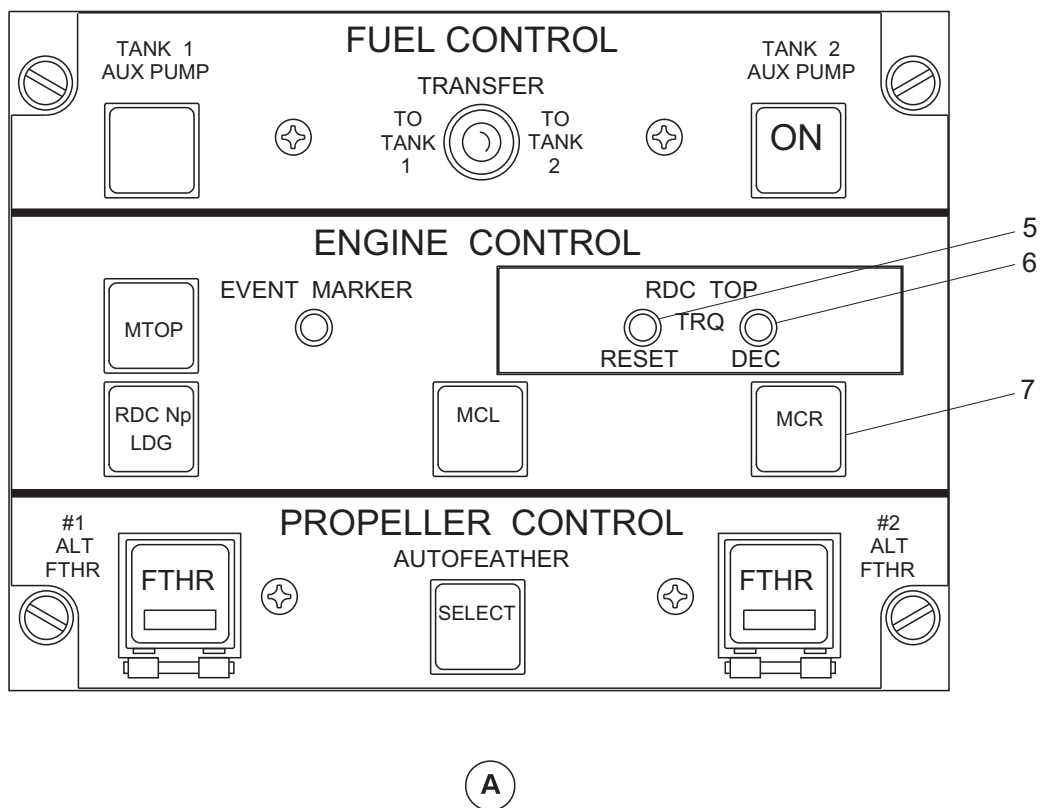
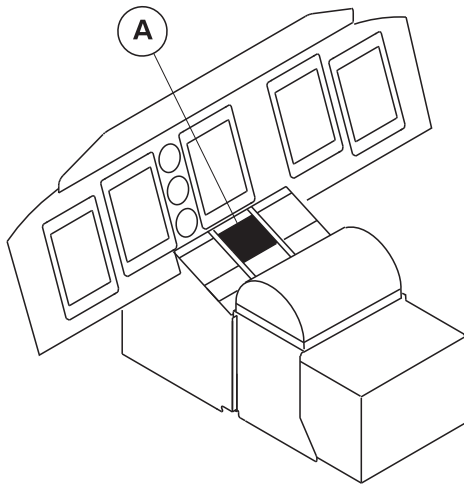


Figure 12.27-15 Engine Control Panel (2 of 2)

ENGINE CONTROL PANEL CALLOUTS (cont'd)

5. RDC TOP TRQ RESET PUSHBUTTON (momentary action)

PUSH - resets normal take-off power

- can be used at any time

6. RDC TOP TRQ DEC PUSHBUTTON (momentary action)

PUSH - reduces NTO requested power in steps of 1.8% TRQ to a limit of 9% TRQ

- can be activated only in NTO rating and with power levers below the RATING detent

7. MCR PUSHBUTTON (MOMENTARY ACTION)

PUSH - changes the MCL engine rating associated with the 900 CLA to maximum cruise rating (MCR)

12.28 (ATA 79) ENGINE OIL

The engine oil system provides lubrication of the engine bearings and gearboxes, and supplies oil for propeller operation. The integral oil tank in the engine (approx. 6 US gallons total capacity) has a sight gauge to check oil quantity.

NOTE: Oil quantity on the sight gauge must be checked within 15 - 30 minutes following engine shutdown.

Oil temperature is controlled by the AIR COOLED OILCOOLER (ACOC) which has an internal thermal by pass valve, and by the ACOC flap door which controls the air flow through the cooler. Flap door position is controlled based on oil temperature using an electrical actuator. The low oil pressure switch for each engine turns on a No. 1 ENG OIL PRESS or No. 2 ENG OIL PRESS warning light when oil pressure drops below 47 ± 3 psid.

12.28.1 Remote Oil Level Indication

A remote oil level indication system is installed as an option on the DASH 8-Q400. The system will give notification to the flight crew when the oil level is approximately 10 flying hours or less of engine oil (based on nominal oil consumption).

NOTE: Indication is available with the engines shutdown.

The oil level indication system cockpit display consists of two green lights (one for each engine), a test lamp switch, and a system status interrogation switch. The control panel is located on the pilot's forward side console. A description of the oil level indication is as follows: indication is given only when the system interrogation switch is selected to ON.

Condition	Cockpit Display
Oil level OK	Steady green light
Oil level low	No light
No valid reading	Flashing green light

"No light" indicates that a physical oil level check should be accomplished in accordance with the Aircraft Maintenance Manual within 10 flying hours from the last previous successful remote oil level check, or that the oil level should be maintained in accordance with the requirements of the Aircraft Maintenance Program.

The standard engine oil filler cap/dipstick is replaced with an oil filler cap/sensor assembly. The Sight Gauge and Low Level Gauge is still available to facilitate manual visual oil level checks.

A discrete signal is sent from the sensor to the FADEC. This information is transmitted to the EMU which performs the required logic, verification, and monitoring of the required conditions for determining the Oil Level Status.

Dash8 - Q400 - Power Plant

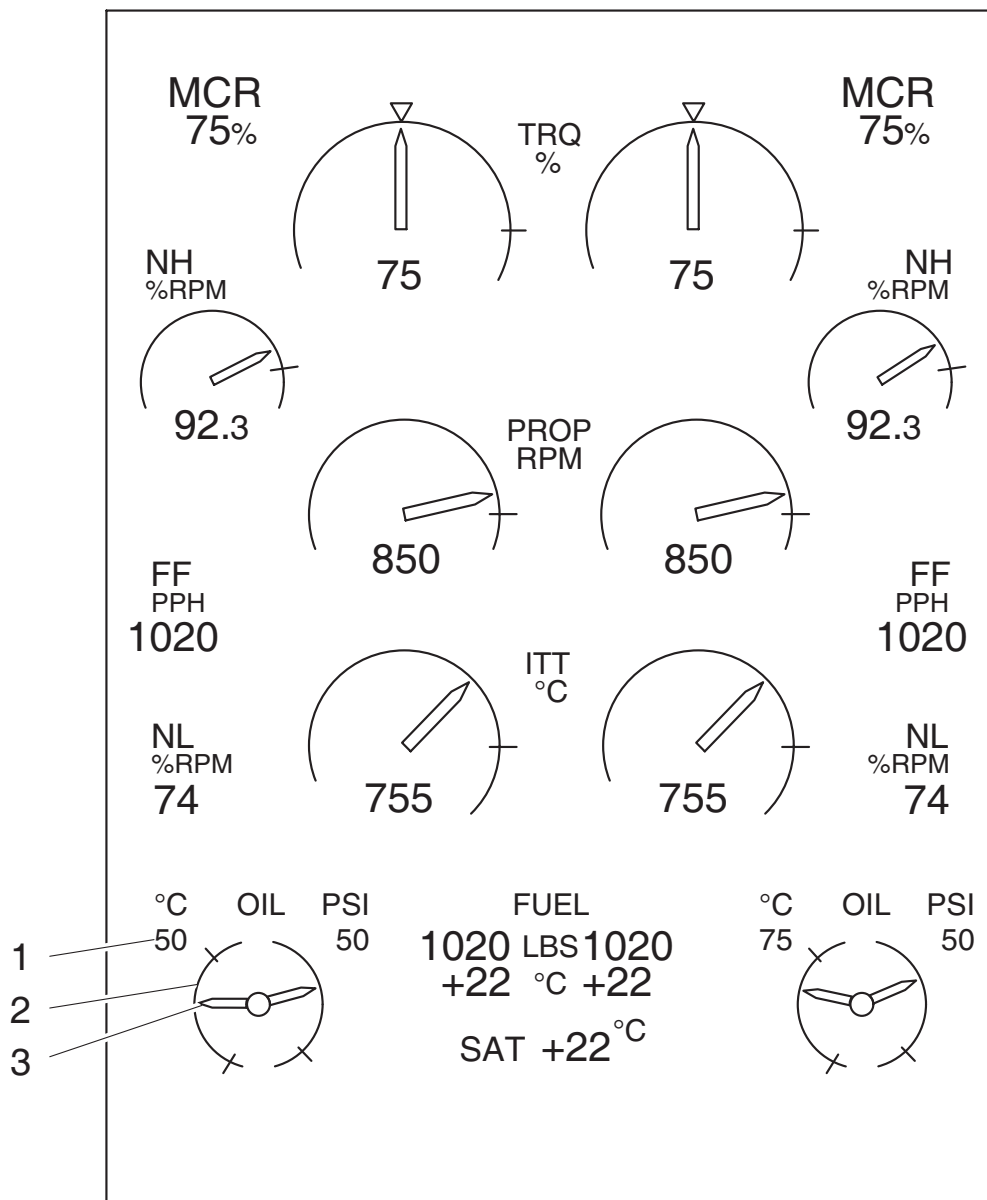
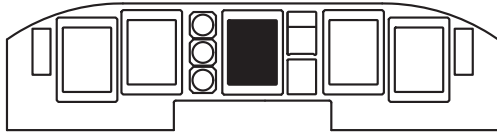


Figure 12.28-1 Engine Display (1 of 2)

ENGINE DISPLAY CALLOUTS

1. OIL TEMPERATURE DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from -99 to 199°C
- they are replaced by white dashes when the parameter is no longer valid

2. OIL TEMPERATURE DIAL SCALE (OIL white, °C, cyan)

- it is the scale along which can be read the analog oil temperature value
- the scale is composed of 7 different colored arcs:
 - white arc (under limit)
 - red radial (minimum)
 - yellow arc (caution)
 - green arc (normal operating)
 - yellow arc (caution)
 - red radial (maximum)
 - white arc (over limit)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

3. OIL TEMPERATURE NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line
- the needle is removed when the parameter is no longer valid

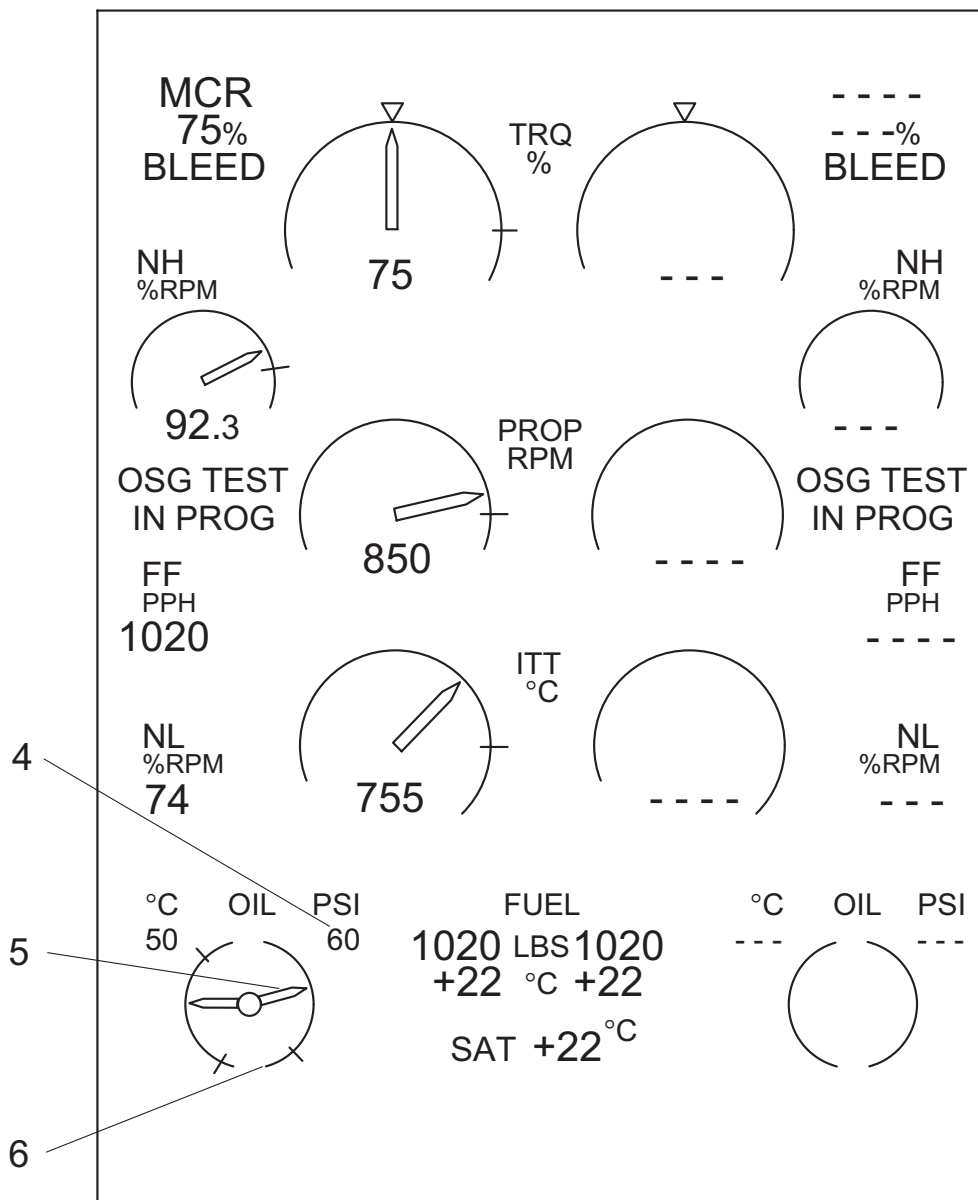
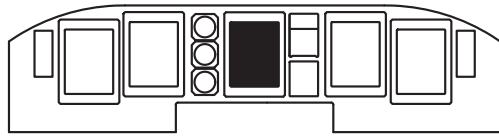


Figure 12.28-2 Engine Display (2 of 2)

ENGINE DISPLAY CALLOUTS (cont'd)

4. OIL PRESSURE DIGITAL VALUE

- digits follow the same color changes as the needle
- indicates from 0 to 299 PSI
- they are replaced by white dashes when the parameter is no longer valid

5. OIL PRESSURE NEEDLE

- the needle is normally white and will turn yellow or red when respectively entering the yellow arc or exceeding the red line

6. OIL PRESSURE DIAL SCALE (OIL white, PSI cyan)

- it is the scale along which can be read the analog oil pressure value
- the scale is composed of 5 different colored arcs:
 - white arc (under limit)
 - red radial (minimum)
 - yellow arc (caution)
 - green arc (normal operating)
 - yellow arc (caution)
- #1 or #2 ENG OIL PRESS warning light comes on 40 to 44 PSI
- there are 3 scale factors, one when oil pressure is below 40 PSI, the second for one for intermediate values and the third one above 80 PSI (this is done so that the normal operating range is expanded and positioned between 2 and 3 o'clock as on the existing series A/C)
- the scale is always presented
- it automatically reverts to a white arc when the parameter is no longer valid

NOTE: The oil pressure scale does not appear until oil pressure is sensed during engine start.

12.29 (ATA 80) ENGINE START SYSTEM

12.29.1 Ground Start

Engine starting is accomplished using the STARTER/GENERATOR in conjunction with the ignition and fuel control systems. The STARTER/GENERATOR rotates the High Pressure (N_H) compressor through the accessory gearbox, to develop the necessary airflow and engine RPM before fuel is introduced. The start system is armed by selecting the engine to be started on the ENGINE START panel and turned on using the switch. The start sequence is initiated by pressing the START switchlight and selecting the condition lever to the START & FEATHER position at the first indication of N_H .

Once the start has been initiated, the FADEC controls the starting sequence in the following manner:

- The FADEC must be in a START state for the FADEC to command the FMU (Fuel Metering Unit) to initiate fuel flow. This is achieved by moving the CL toward Start/Feather position.
- If the CL is momentarily retarded during its movement to the Start/Feather position, the effect is that the FADEC is dropping out of a START state into a SHUTDOWN state. The FADEC can only transition into the START state again after transitioning through the OFF state (for which a criteria is N_H dropping below 5%).
- The requirement of the FADEC START logic to initiate from the OFF state only, was implemented to prevent the engine from relighting following a shutdown. This could occur by inadvertently moving the CL above FUEL OFF prior to the N_H spooling down. This logic loop is only in effect when the aircraft is on the ground.
- When the STARTER/GENERATOR has increased N_H speed to 8%, the FADEC commands ignition on and schedules fuel flow as a function of N_H , ambient temperature and ambient pressure.
- Only one of the two ignitors is turned on (this is to identify any failures in the dual channel ignition system). If the engine does not light-off within 8 seconds of fuel flow being selected on, the FADEC turns on both ignitors, and starts a count towards logging a fault against the faulty ignition. Light-off is defined as an increase of 20°C in ITT.
- When N_H is greater than 50%, the ignitor(s) is automatically turned off.
- The FADEC controls engine run-up to the requested N_H speed or power.

During ground starts, to ensure that the engine start does not cause overtemperature, the FADEC has active ITT limiting to reduce the fuel flow if required (below the standard start schedule).

In addition, the FADEC will automatically abort the start, and shutdown the engine if any one of the following conditions occur:

- if the engine does not light within 16 seconds of fuel flow being selected on,
- the ITT limit of 920°C is exceeded;
- N_H does not reach 50% within 70 seconds (i.e. hung or slow start).

As the start circuit is terminated the SELECT switch is automatically released to the center position and the START caption of the start switchlight goes out.

12.29.2 Inflight Start

Inflight starts are similar to ground starts except for the following:

- Both ignitors are commanded on during the start,
- the auto abort features are disabled,
- the FADEC does not actively limit ITT.

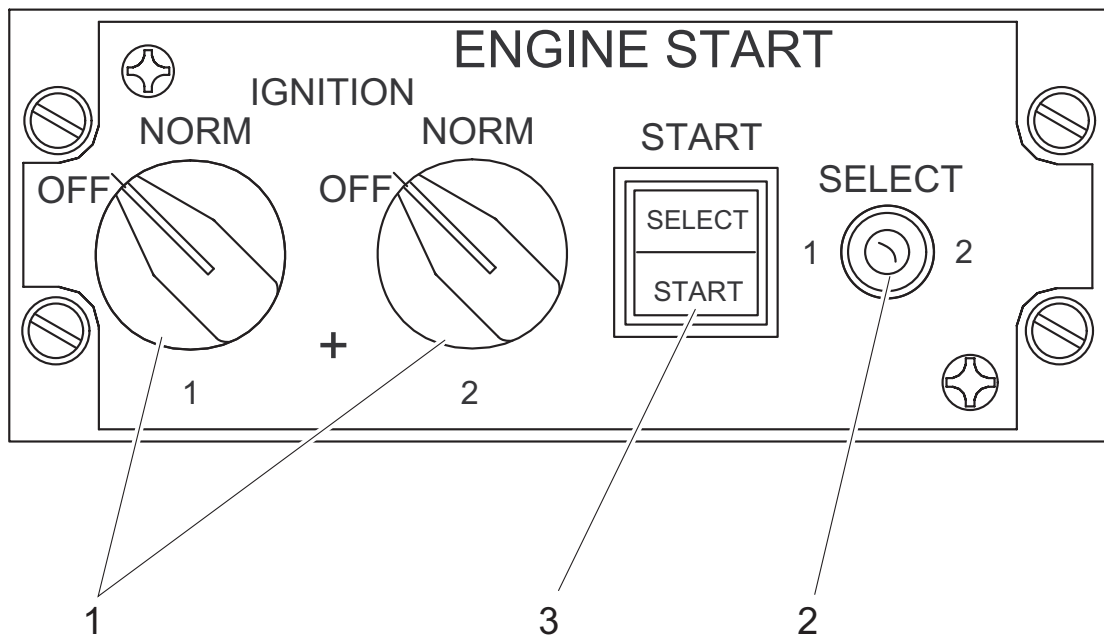
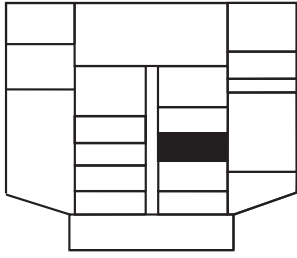


Figure 12.29-1 Engine Start Control Panel

ENGINE START CONTROL PANEL CALLOUTS

1. IGNITION CONTROL SWITCH (two position)

- controls ignition for related engine

OFF - the FADEC disables ignition regardless of ground or flight status

- required for dry engine motoring

NORM - FADEC activates ignition during engine starts (ground or flight starts)

- FADEC commands both ignitors on during flameout and surge accommodation

2. ENGINE START SELECT SWITCH

(three position toggle, spring loaded to center, magnetically latched in No. 1 or No. 2 position)

1 - arms start control circuits for #1 engine

- observe SELECT (amber) in engine START switchlight

2 - arms start control circuits for #2 engine

- observe SELECT (amber) in engine START switchlight

3. ENGINE START SWITCHLIGHT (momentary action)

SELECT segment (amber)

- indicates start control circuitry of selected engine has armed

PUSH - START segment (amber)

- indicates engine start has been initialized