

# Bombardier Global Express - Auxiliary Power Unit

## INTRODUCTION

An Allied-Signal RE 220 gas turbine auxiliary power unit (APU) is installed in a fire resistant enclosure in the tail cone of the airplane behind the rear pressure bulkhead. The APU is installed outside the main engine rotor burst zone. This enhances airplane high altitude operation.

The APU provides bleed air for cabin cooling and heating through the Environmental Control System (ECS), main engine starting, and electrical power on the ground and in flight.

Under high demand load conditions, the APU electrical load takes priority over pneumatic load.

The main component of the APU electrical system is the Electronic Control Unit (FADEC), also known as the Full Authority Digital Engine Control (FADEC). The acronym FADEC will be used throughout this chapter in lieu of ECU. The APU FADEC interfaces with EICAS and the Central Aircraft Information Maintenance System (CAIMS), providing failure detection and isolation of faulty components.

Control of APU speed is automatic and monitoring of APU Exhaust Gas Temperature (EGT), speed, fuel and oil pressure is through the FADEC. The FADEC also records operating hours and start cycles.

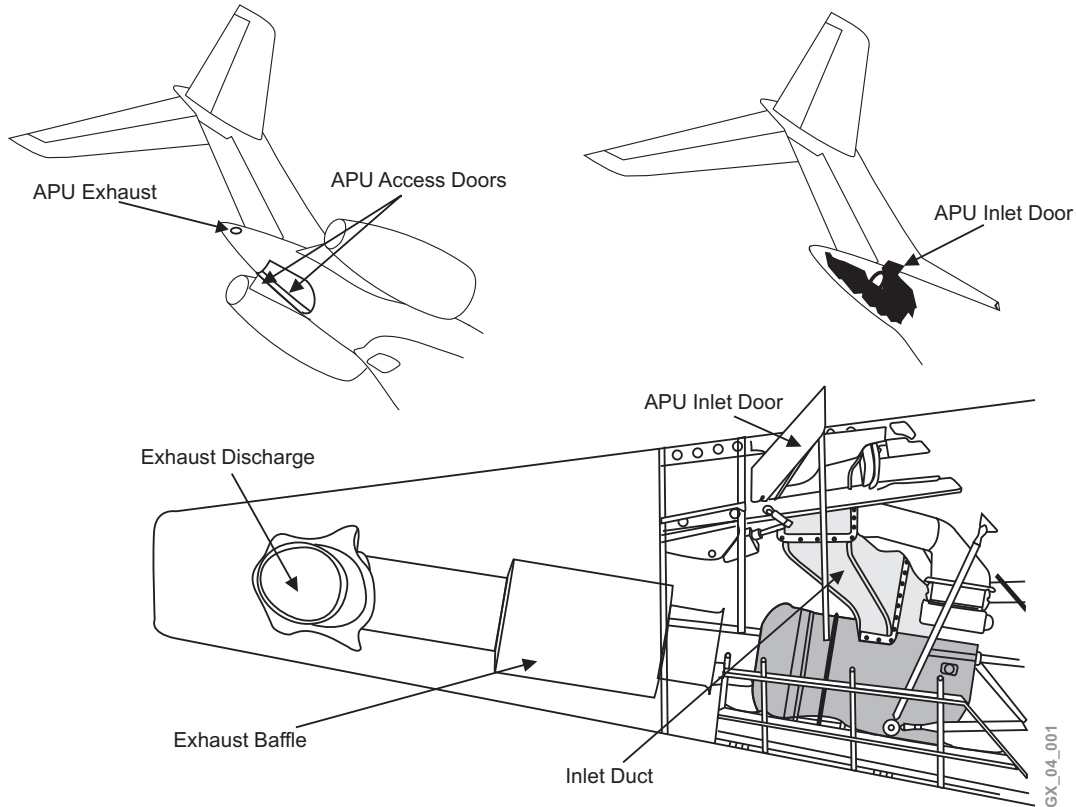
The engine speed for normal continuous steady state is displayed as 100% rpm. Overspeed protection is provided. The APU has automatic shutdown for abnormal ground and in-flight conditions.

APU start and run is initiated by a single switch, located on the APU control panel in the flight compartment. Operation of the APU electric and bleed system is performed at the ELECTRICAL and BLEED/AIR CONDITIONING ANTI-ICE panels respectively.

The APU is capable of operating up to 45,000 feet while supplying electrical power with operating limitations. The APU starting envelope is up to 37,000 feet. For other APU operating limitations, refer to AFM, Chapter 2, LIMITATIONS.

## DESCRIPTION

### APU LOCATION AND ACCESS



### APU COMPARTMENT

The APU is mounted in the tail cone by a multi-axis suspension rod system securing it in all axes.

The APU compartment is completely sealed from the atmosphere with the exception of the inlet door and exhaust duct. The APU compartment is isolated from the rest of the airplane for fire protection. The APU is designed for full rotor burst containment.

Cooling of the APU compartment is accomplished by an exhaust eductor system that draws airflow across the APU engine and the oil cooler. The airflow through the inlet splits in two sections. One section allows air to flow to the compressor, while the other section allows the air to flow through the oil cooler to provide cooling for the APU oil. The air flowing through the oil cooler then passes through the compartment to cool the APU and its mounted components. This air is then exhausted overboard.

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Access to the APU for inspection, maintenance and servicing is provided by two cowl doors located under the APU. These doors are to be kept closed during normal APU operation. However, they may be opened for APU inspection while the APU is running. In such case, to avoid an APU oil overtemperature, limit operation with the doors opened to a maximum of:

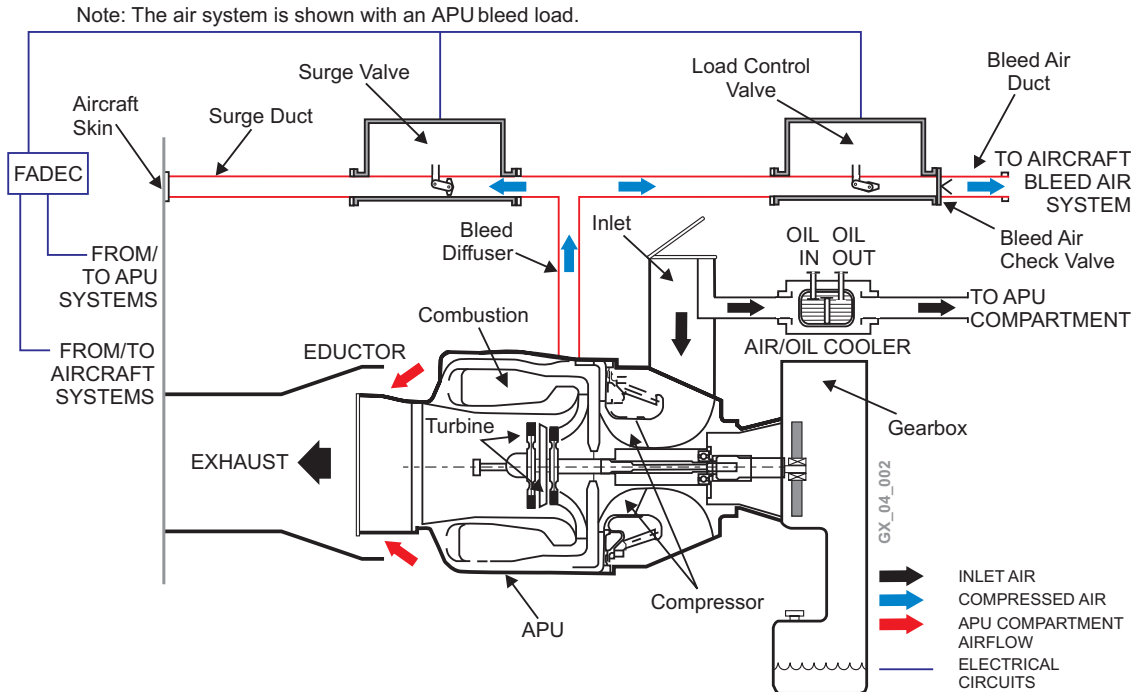
- 10 minutes with the APU unloaded (no bleeds, no electrics), and
- 5 minutes with the APU loaded (bleed air on and a maximum electrical load of 5 kVA)

### **APU ENGINE**

The APU engine consists of the following:

- Inlet Door - Variable position (0 to 47°). The door opening angle, controlled by the FADEC, is a function of weight-on-wheels, airplane MACH number and APU speed
- Compressor - Drives a single-stage centrifugal impeller. Delivers approximately 45 psi bleed pressure at normal operating speed
- Combustor - Contains 10 fuel nozzles and 2 igniters
- Turbine - Two-stage axial flow turbine which drives the gearbox
- Gearbox - Provides the sump for the lubrication system and mounting of component and accessories
- Exhaust - The flow across the APU and oil cooler is created by the eductor using the exhaust discharge velocity
- Monitor zones for fire/overheat/smoke events, FIDEEX system health and status

## SYSTEM SCHEMATIC



## LUBRICATION SYSTEM

The lubrication system incorporates an integral oil reservoir. The two main areas that are lubricated are the gearbox and turbine bearings.

The gearbox sump serves as a reservoir and can be filled through a fill cap. The APU can also be serviced using the airplane oil replenishment system, simplifying post flight maintenance actions.

The lubrication system consists of the following components:

- Oil filters - Lube and generator scavenge
- Oil temperature sensor - Sends an input to the FADEC for low and high oil temperature protection. When oil temperature increases to a high predetermined value for 10 seconds, the APU (on ground only) will shut down
- Low Oil Pressure (LOP) switch - When pressure drops below a predetermined PSIG after the APU has reached on-speed (not less than 99%) for 15 seconds, the APU (on ground only) will shut down automatically
- Oil cooler - Will bypass oil at a predetermined lower than normal operating temperature, and flow through the cooler when temperatures are greater than the normal operating range
- Magnetic Chip Collector (visual inspection) - Provides a visual indication of metal particles within the system

### **OIL PRESSURE**

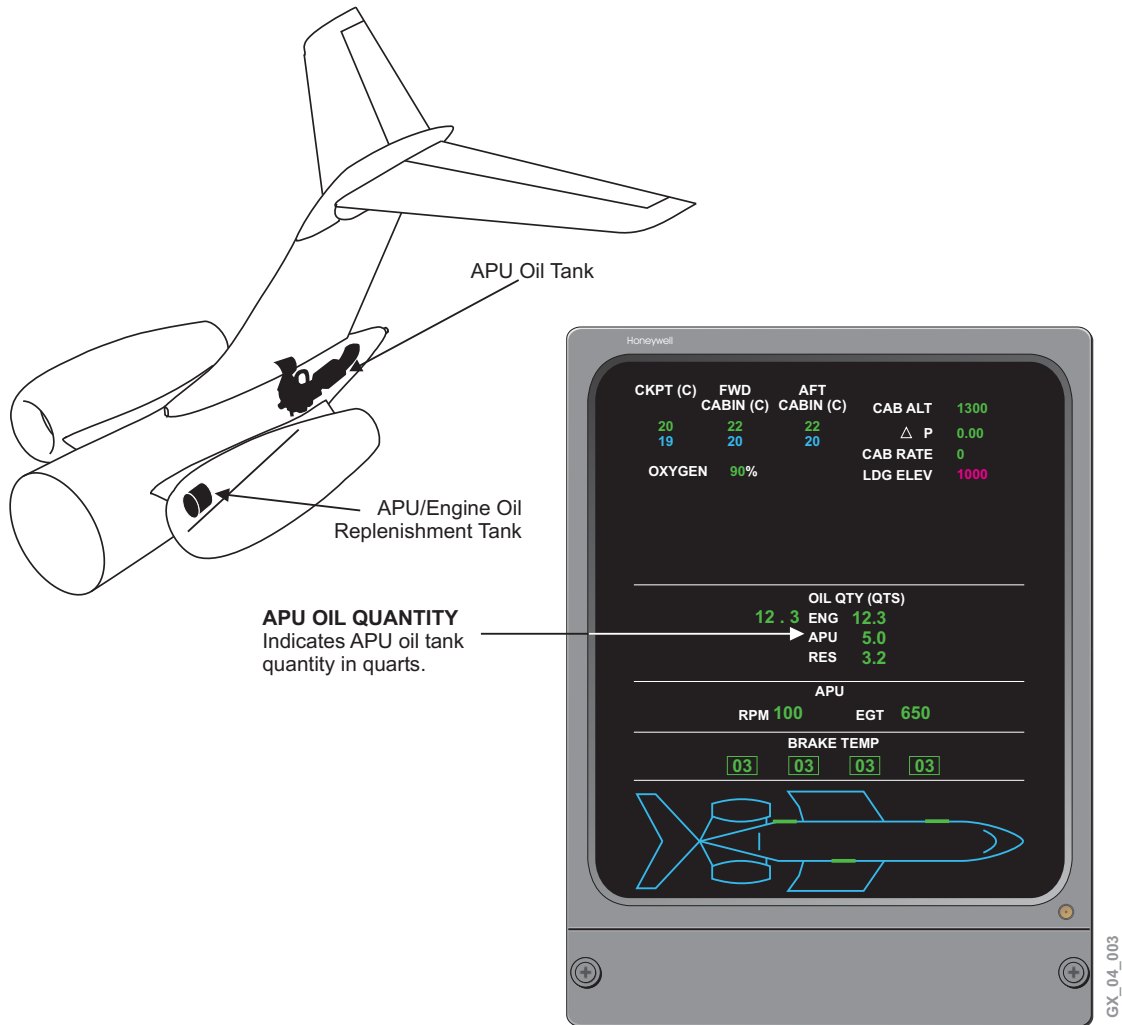
On the prestart BIT check, the LOP switch is monitored by the FADEC. During operation, if oil pressure decreases below a predetermined PSIG for approximately 15 seconds (on ground), automatic shut down will occur. An “**APU OIL LO PRESS**” message will be on for 15 seconds and will be replaced by a cyan “**APU SHUTDOWN**” advisory.

A low oil pressure condition in flight will not cause an APU protective shut down.

### **OIL REPLENISHMENT SYSTEM**

The oil replenishment tank volume contains 5.7 liters (6 US quarts). APU oil level is measured using a sensor which is located in the APU oil tank and provides quantity information on the EICAS STAT display. Electrical failure of this sensor will be detected during the BIT check and the indicated quantity will change from numerical value to amber dashes on EICAS. An “**APU OIL LO QTY**” advisory message will occur on EICAS (on ground) when the APU oil level reaches 3.5 U.S. quarts and the APU has not been operating for 15 minutes.

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An oil replenishment tank is located in the aft equipment bay and contains an electrical pump and sensor probe for quantity level. The oil replenishment (pressure filling) system is designed for ground use only and serves both main engines and APU. A three way electrical valve is incorporated in the replenishment system to allow transfer of oil to the system being topped up (either engine or APU).

### OIL REPLENISHMENT SYSTEM FILLING

The system can be operated using the battery or external electrical power. Oil level monitoring is required during servicing to verify that the system stops automatically when the full level is reached.

#### NOTE

To protect against overfilling due to system component failure, maintenance instructions must be followed according to the Airplane Maintenance Manual.

The oil filling system is operated through the oil replenishment panel located behind the pilot's seat in the flight compartment.

#### NOTE

1) A replenishment reservoir TANK LO light remaining on following panel power-up indicates that the oil replenishment tank is low. Under this condition refilling is inhibited until the reservoir is filled.

2) If a low oil replenishment condition occurs during a fill the system will shut down.

Oil is to be added to the APU when **APU OIL LO QTY** advisory message is on EICAS and the LO OIL for APU display is shown on the oil replenishment panel.

The switch legends on the oil replenishment panel can only be displayed when the SYSTEM ON switch is selected.

The APU may be replenished if:

- The APU has been shut down for a minimum of 15 minutes
- The APU oil reservoir is not already full
- Both engines are shut down and are not currently being replenished

## OIL REPLENISHMENT PANEL

### SYSTEM ON

Selecting the SYSTEM ON switch does the Following:

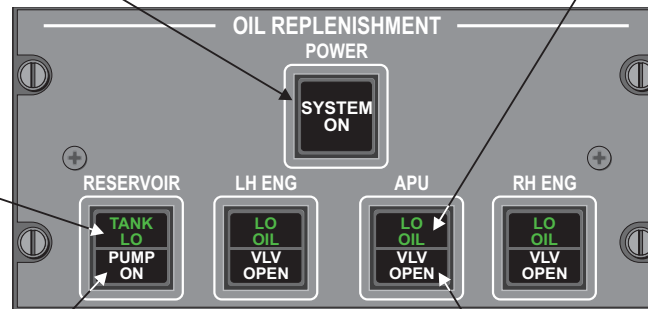
- The SYSTEM ON lamp will come on.
- A three second lamp test will be carried out on all annunciators.

### LO OIL (APU)

The LO OIL comes on to indicate that the APU is low in quantity and will remain on until the APU oil tank is replenished.

### TANK LO

The reservoir TANK LO legend comes on to indicate that the reservoir is low in quantity.



### PUMP ON

The reservoir pump PUMP ON lamp will come on to indicate operation. The legend will remain on until the correct level of the system to be topped up is achieved.

### VLV OPEN (APU)

Selecting the switch will illuminate the VLV OPEN switch legend indicating valve operation. Oil will be pumped from the reservoir (through the valve) to the engine until full is achieved.

- The VLV OPEN and LO OIL switch legends will go out when the correct level is reached.

## OPERATION

The following procedure is to be used only as a guide to replenish the APU oil system. The Airplane Maintenance Manual takes precedence over all servicing procedures.

- Select the POWER switch (SYSTEM ON) on the oil replenishment panel
- Confirm that the LO OIL lamp (APU) on the replenishment panel corresponds to the condition indicated on EICAS i.e. **APU OIL LO QTY** advisory message and quantity in amber on STAT page
- Select the switch labeled APU on the replenishment panel
- Confirm that the PUMP ON (below RESERVOIR label) and VLV OPEN (below the APU label) legends are displayed
- Monitor the oil level on EICAS for both the APU and reservoir (example: if approximately one US quart is added to the APU, the oil replenishment tank level should have reduced by the same amount)
- When the APU oil tank is full, confirm that the PUMP ON legend goes out (indicating pump stoppage). Also confirm that the VLV OPEN legend goes out (indicating valve closure)
- Select the POWER switch, SYSTEM ON legend extinguishes. Record the amount of oil added and a carry-out a walk around for external leakage (oil overflow)



### **GRAVITY OIL FILL**

The APU oil sump can be filled through the gravity filler. The oil reservoir for the APU is an integral part of the accessory gearbox assembly and has a capacity of 5.25 US quarts. It is recommended to top up the reservoir when the STAT page indication shows 4.5 quarts. The gravity fill is designed for a “fill to spill” ease of servicing, and used only when the oil replenishment system does not function.

### **FUEL CONTROL AND INDICATION**

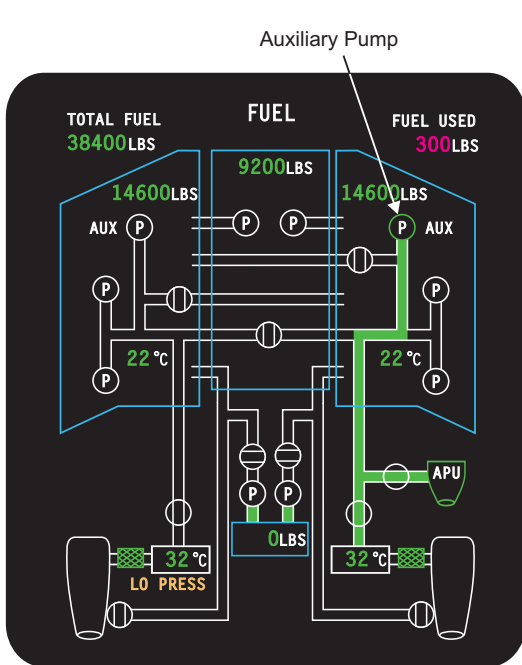
The fuel system is a fully automatic electronic control system. The fuel control unit provides metered fuel to 10 fuel injection nozzles regulated by signals received from the FADEC.

During start the fuel system provides the correct amount of fuel to support combustion and for smooth acceleration of the engine to full rated speed. Once on speed, fuel flow is modulated as necessary to meet the demands of varying pneumatic and electrical loads, while maintaining a constant speed.

### **AIRFRAME FUEL**

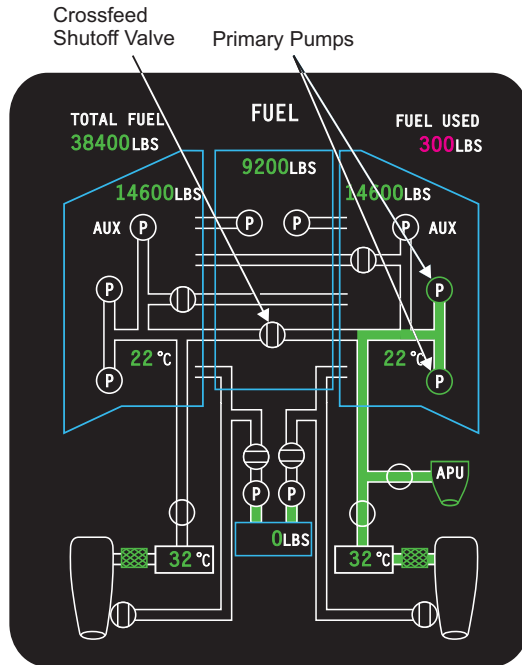
Fuel is normally supplied to the APU from the right engine feed line, or from the left engine feed line by opening the crossfeed shutoff valve. The examples below represent the APU operation with DC and AC power applications. Please refer to Chapter 11, FUEL SYSTEM for further information on the airframe fuel system operations.

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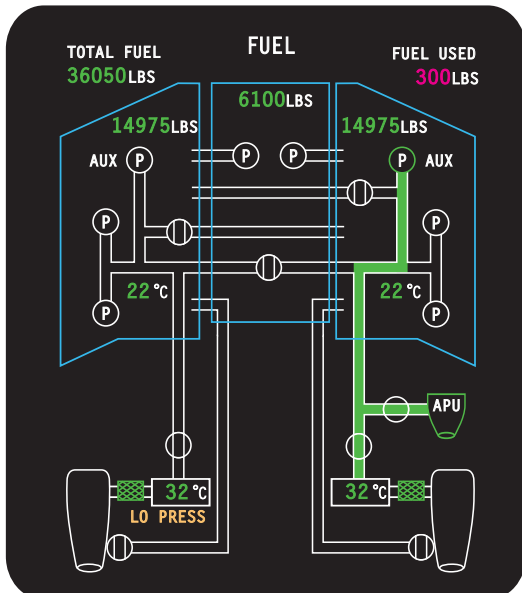
**APU starting and no main engines running:**  
The right AUX pump supplies the APU through the right engine feed line.



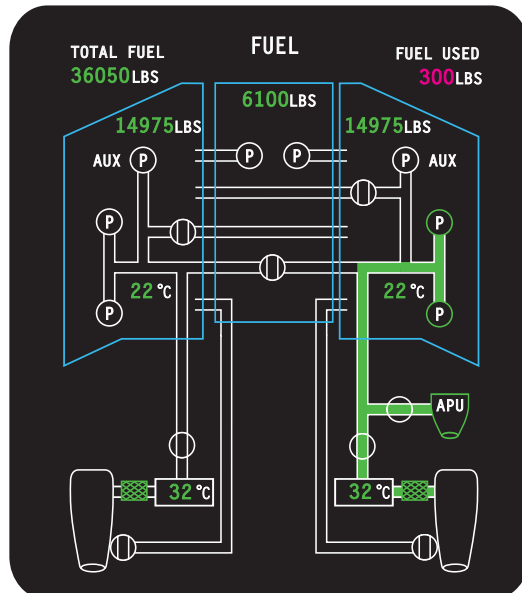
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**APU on-speed and no main engines running:**  
The right PRI pumps feed the APU through the right engine feed line.

Global 5000



Global 5000



Global 5000

GX\_04\_005

### **IGNITION**

The ignition system consists of a dual output ignition unit, two ignition leads and two igniter plugs. There are two cycles of operation: BURST for starting (at 5%) and MAINTENANCE for acceleration (duration of the start).

The ignition system is fully automatic and controlled by the FADEC. Ignition occurs at 5% APU rpm.

During APU ground operation (nonessential mode) ignition is terminated at 50% rpm. During flight (essential mode) ignition is terminated at 98% rpm.

Should a flameout occur during operation, ignition sequence will automatically start through the "Auto Relight" function of the FADEC.

### **START SYSTEM**

Operation of the starter is automatically controlled by the FADEC, through the APU control switch. Starter operation begins by selecting the START position on the APU control panel. At sea level, starter cutout occurs at 46%. At altitude, starter cutout may be as high as 60% to ensure a positive start.

The starter is capable of an immediate restart on roll down when APU rpm is at or below 7% rpm.

### **SPEED INDICATION**

Two speed sensors provide indicated speed for on-speed control and overspeed APU protection.

During operation, the FADEC monitors the input and should either sensor fail, there will be an **APU FAULT** advisory message displayed on EICAS.

A failure of either sensor will not cause an APU protective shut down to occur. However, a failure of both sensors will cause an APU protective shutdown both on ground and in the air.

### **TEMPERATURE INDICATION**

The EGT system consists of a single temperature sensing unit with two probes. The probes provide redundant signals to the FADEC for fuel schedule trim, turbine temperature monitoring, and Load Control Valve modulation. The APU is protected from overtemperature during acceleration by protective features incorporated in the FADEC.

Loss of one probe will not affect APU operation.

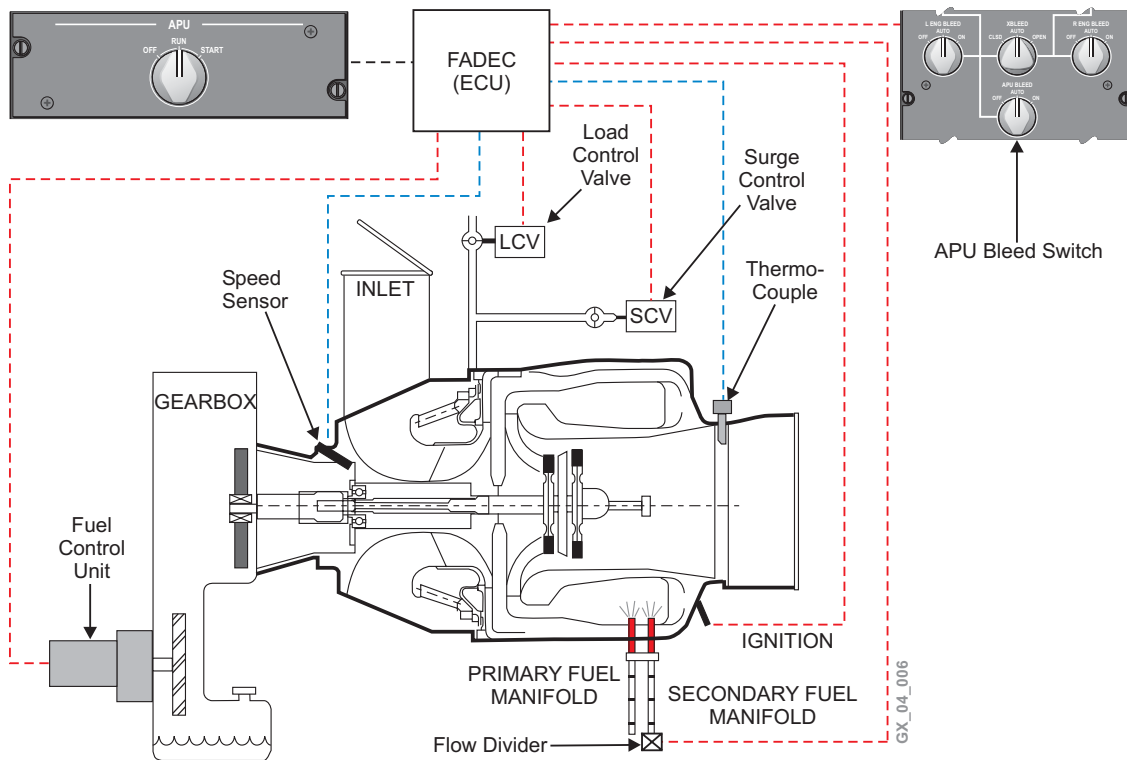
In the nonessential (ground) mode, failure of both probes will cause the FADEC to shut down the APU and inhibit start.

In the essential (flight) mode, failure of both probes will not cause a shut down. Instead the FADEC reverts to a preset temperature signal (260°C) to allow pneumatic loading and normal operation of electrical power. Because of the loss of EGT control, the APU should be shutdown unless required for another contingency (refer to QRH).

## HOURMETER/CYCLE COUNTER

An hourmeter/cycle counter is powered on at 95% rpm and records the amount of running hours and start cycles of the APU. It is deactivated when APU shutdown is initiated.

## FADEC COMPONENT CONTROL SCHEMATIC



## CONTROL SYSTEM

The APU electrical control system consists of two major sections: FADEC and electrical accessories. The FADEC is designed to execute precise control of the APU. Programming within the FADEC controls the APU through all modes and operating conditions. The FADEC monitors EGT, rpm, oil temperature and pressure, and provides output signals for information on EICAS. The electrical accessories are used, in conjunction with the FADEC, to perform the sensing and control functions required to safely and reliably start and monitor the APU.

### PNEUMATIC

The pneumatic bleed load system consists of the Load Control Valve (LCV) connected to the bleed ducting and normally modulated by the FADEC. The LCV can either be controlled automatically by the bleed management control system (AUTO selection), or manually by the APU BLEED switch (ON selection) on the BLEED/AIR COND/ ANTI-ICE panel.

The LCV will not open when manually selected ON if:

- Anti-ice is active
- The left engine pressure regulating valve is manually opened
- The right engine pressure regulating valve and the crossbleed valve are manually opened

If the left and right PRV and crossbleed valve are in to AUTO position, a manual ON selection of the APU LCV will result in the BMC reconfiguring all the values to accommodate pilot selection.

A Surge Control Valve (SCV) works as a “waste gate” to protect the APU compressor from a potential to Surge (stall). The solenoid valve assembly (which allows pneumatic air to open the SCV) is energized only when:

- The APU generator is providing electrical power and
- The APU LCV is CLOSED (i.e APU not supplying any bleed air to the ECS) and
- Atmosphere pressure of 7 psia is sensed (at and above 16,375’ during ISA conditions)

The exhaust of the APU SCV is located on the left side of the fuselage, aft of the left engine pylon. The operation of the SCV is transparent to the pilot.

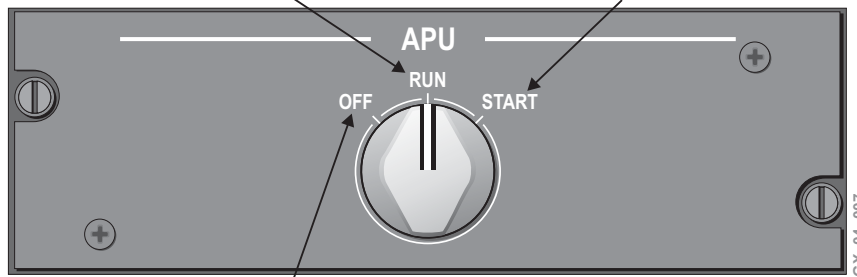
## APU CONTROL PANEL

### RUN

- Initiates the APU prestart BIT.
- On ground, commands the inlet door to full open.
- In flight, commands the inlet door to open to either 10° (0.85 MACH) or 20° (0.40 MACH)
- Activates the flight compartment displays (oil quantity, speed and RPM).
- Starts the fuel pump.

### START

- Spring-loaded to RUN
- Fuel and ignition on at 5%.
- Starter disengage at approximately 50% RPM.
- Ground - ignition off at 50% RPM.
- In-flight - ignition off at 98% RPM.
- Accelerates at 100% RPM.



**OFF** (APU enters a 60 second unloaded, i.e. bleed and AC loads removed, cooldown period).

- RPM decreases to 70% RPM for 60 seconds (below 20,000 ft.) or remains at 100% above (20,000 ft.).
- After 60 seconds the RPM will continue to decrease and fuel will stop at this time.
- Below 25% RPM the inlet door closes.
- Below 5% RPM the EICAS displays and indications are removed.

## START SEQUENCE

The APU requires 28 VDC to start. APU start is automatic following switch selections of RUN and START on the APU control panel.

The start sequence is initiated by selecting the APU control switch to RUN:

- **APU IN BITE** (on ground only) advisory message comes on
- APU rpm and EGT indications appear on the EICAS STAT page
- APU inlet door opens (on ground)
- APU fuel SOV is commanded open and right DC auxiliary fuel pump is energized
- **APU IN BITE** (on ground) advisory message goes out (approximately 10 seconds)

Select the APU control switch to START position (spring-loaded from START to RUN) for greater than one second and note the following:

- In flight, the **APU IN BITE** message would now annunciate momentarily
- At approximately 5 percent rpm, fuel and ignition occur
- Between 46 and 60 percent the starter disengages, and
- RPM accelerates to 100 percent
- For ground starts, ignition is deactivated at 50 percent. In flight, ignition is deactivated at 98 percent

### NOTE

At 99% rpm plus 2 seconds, the APU is ready to load electrically. At 99% rpm plus 60 seconds on ground, the APU is ready to load pneumatically, if the prestart EGT < 149°C. At 99% rpm plus 2 seconds on ground, the APU is ready to load pneumatically, if the prestart EGT ≥ 149°C. At 99% rpm plus 2 seconds in flight, the APU is ready to load pneumatically.

### APU DOOR POSITIONING

The APU door is positioned as a function of WOW, Mach number, and APU speed. When RUN is selected on the APU control panel and the airplane is on ground, the APU door is commanded to the full open position (47°).

### DOOR OPERATION

The APU inlet door is located on the upper right fuselage area. It is electrically actuated and is scheduled opened by the FADEC. The door will be commanded to full open for start and on-speed condition for ground operation. In flight prior to start, the inlet door will be positioned according to Mach number until the APU reaches 20% speed and then will begin to gradually open until the door has reached the full open position.

The inlet door will be commanded to the closed position by the FADEC when the speed drops below 25% on shut down.

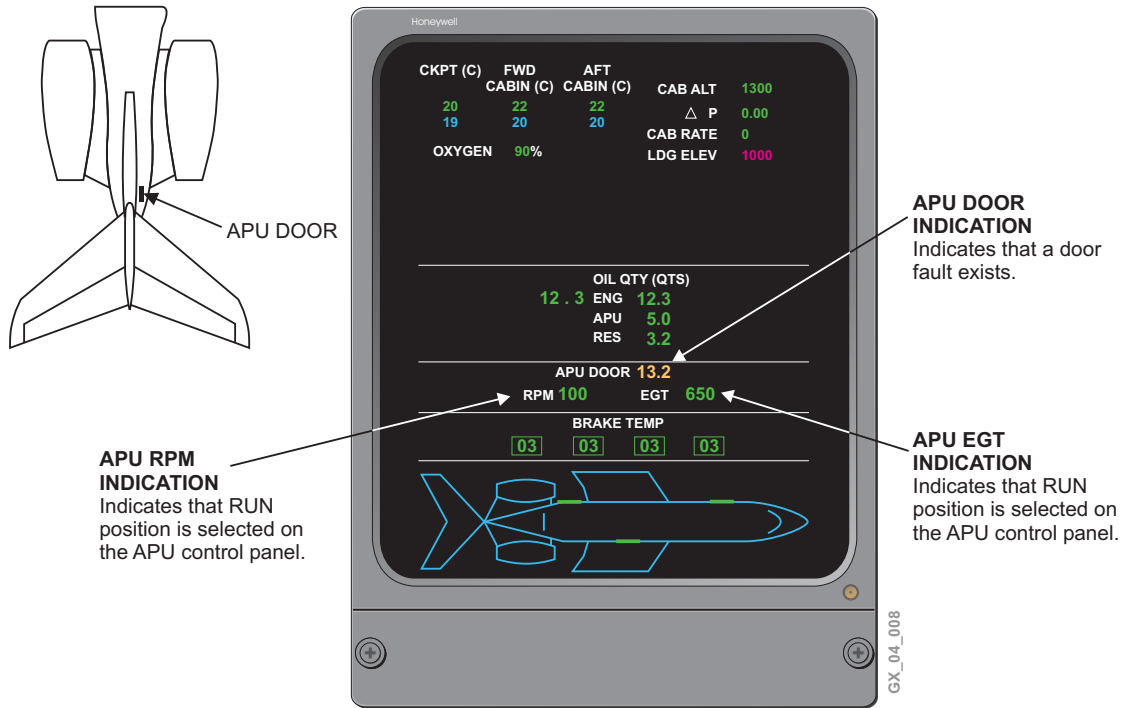
A fully opened door will cause profile drag and affect performance (refer to AFM Chapter 6, PERFORMANCE).

### EICAS DISPLAY

#### DOOR INDICATION

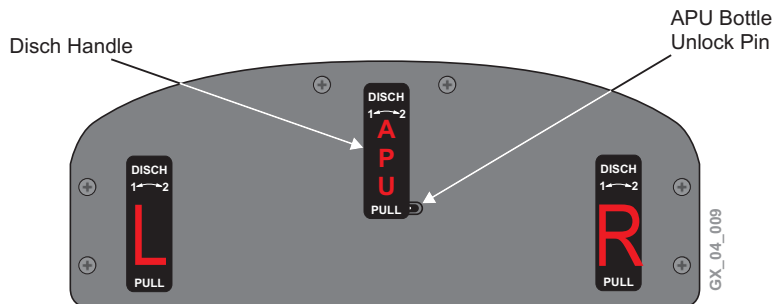
The APU door position is normally NOT displayed on the EICAS STAT page. It is only indicated when there is a door fault and will appear in conjunction with an **APU DOOR FAIL** caution message. When a door fault is sensed by the FADEC an amber numerical readout in degrees will be displayed.

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## APU FIRE PROTECTION

When the APU DISCH fire handle is pulled, the FADEC initiates an immediate APU shut down (with no cooldown period) and sends a signal to display the APU SHUTDOWN advisory message. When the pulled APU fire handle is then turned, the first fire extinguishing bottle is discharged. If necessary, the second fire bottle can be discharged by displacing the APU bottle unlock pin, and turning the fire handle in the opposite direction (this is a two-handed operation).





Although there are protective shutdown features for the APU (see “Protective Shutdowns” on page 6-20), there is no automatic discharging of the fire agent in the event of a fire. The APU must not be left unattended for ground operation. Refer to FIRE PROTECTION chapter 9 in this manual for information on APU fire protection system.

### **WARNING**

**THE APU MUST NOT BE LEFT UNATTENDED DURING GROUND OPERATIONS.**

#### **APU LOADING**

The FADEC controls the ready to load signals, one for electrical loading and one for pneumatic loading. Electrical loading is activated 2 seconds after the APU speed reaches 99%. If the APU drops below 95%, electrical loading is no longer available (on ground and in flight).

On the ground, pneumatic loading is available 60 seconds after the APU reaches 99% if the APU pre-start EGT was  $< 149^{\circ}\text{C}$ . If the APU prestart EGT was  $\geq 149^{\circ}\text{C}$ , pneumatic loading is available on the ground 2 seconds after the APU reaches 99%.

In flight, pneumatic loading is available 2 seconds after the APU reaches 99%, regardless of the pre-start EGT. Bleed air extraction is limited to 30,000 feet.

The APU LCV is opened upon receiving a bleed air request from the airplane bleed management control system or if the APU BLEED switch on the BLEED/AIR COND/ ANTI-ICE panel is selected. Open and closed positions of the control valve are determined by the status of weight-on-wheels, main engine starting, and environmental control system signals. The bleed and load management systems are responsible to ensure that the bleed air request is activated only when another source of bleed air is not commanded. Example: L engine bleed valve open and/or the R engine bleed valve open and crossfeed valve open, the LCV will remain closed to prevent damage to the APU.

The normal position for the APU Bleed switch is AUTO. The AUTO position automatically integrates control of the APU LCV. The manual ON position will command the LCV to open as selected, but only if allowed by the FADEC (to guarantee APU self-preservation). The manual OFF position will command the LCV to close as selected.

#### **APU SHUTDOWN**

When the “OFF” position on the APU control panel is selected, the FADEC controls the shut down sequence. The ready-to-load signals are cancelled, commanding the LCV closed and the generator is tripped off line. During cooldown, the APU speed is gradually lowered to 70 percent rpm over 60 seconds below 20,000 feet or remains at 100 percent rpm for 60 seconds above 20,000 feet.

### NOTE

If the APU RUN switch is selected to RUN prior to completion of the 60 second cooldown period, the APU returns to 100 percent and continues normal operation.

After cooldown is completed, the APU FADEC shuts down the APU. When the speed drops below 25 percent the inlet door is closed, APU operating hours and fault information are stored in the FADEC. APU indications are removed from EICAS when the rpm drops below 5 percent.

If the BATT MASTER switch is selected OFF with no AC power on (i.e. APU GEN, VFGs, Ext AC) or if either the APU shutoff switches (External Services Panel or APU compartment) are selected the APU FADEC will cancel the cooldown period and initiates an immediate shutdown.

### APU RPM AND EGT INDICATIONS

For normal operations, two APU parameters (rpm and EGT) are displayed on the status page when the RUN position is selected on the APU control panel. With the APU switch selected to OFF the display remains active until APU speed drops below 5 percent, and the APU door is closed. The numerical readouts change to red when their limit values are exceeded (AFM, Chapter 2, LIMITATIONS).

### EMERGENCY SHUTDOWN

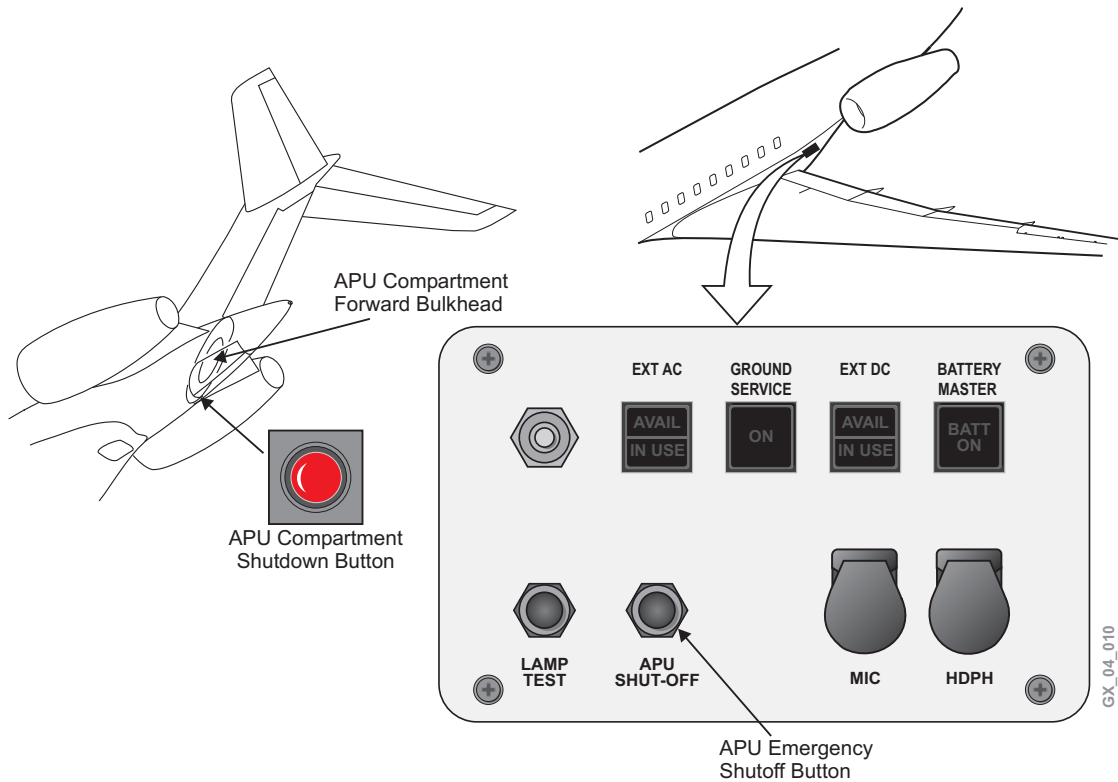
The following methods are considered non-normal shutdown procedures, but may be used in an emergency situation. Actioning any or all of these procedures will result in shutdown.

### NOTE

Carrying out any of the following shutdown procedures will cancel the "cooldown" mode and shutdown will occur immediately.

- BATT MASTER switch selected to OFF with no AC power on
- APU DISCH handle pulled
- APU SHUTOFF button on the external services panel pushed in momentarily and released, or
- APU compartment SHUT DOWN button, located inside the APU compartment (on the forward bulkhead) pushed in momentarily and released

## EXTERNAL SERVICES PANEL



## RESTART AFTER EMERGENCY SHUTDOWN

In order to restart the APU following an emergency shutdown procedure, two conditions have to be met:

- The BATT MASTER switch has to be in the ON position
- The switch on the APU control panel must be placed to the OFF position before moving it to the momentary START position (to reset the FADEC start logic)

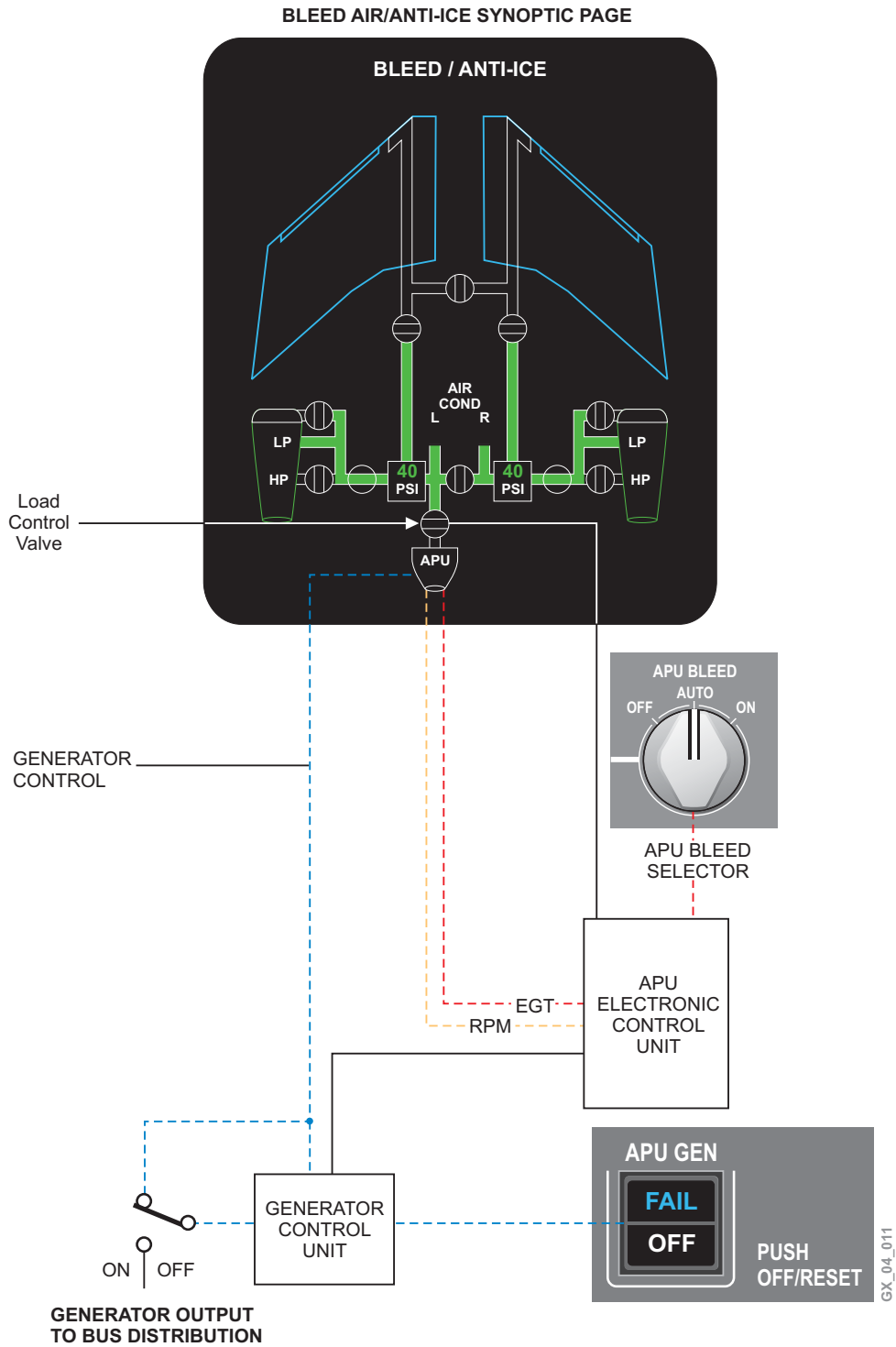
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### PROTECTIVE SHUTDOWNS

The FADEC will automatically shut down the APU when any of the following are detected:

SHUTDOWN CONDITIONS	GROUND	FLIGHT
NOTE: An <b>X</b> in one or both columns indicate when shutdown can or will occur.		
<b>FADEC Failure:</b> Internal failure.	x	x
<b>Inlet Door:</b> Not in commanded position.	x	x
<b>Loss Of Overspeed Protection:</b> Loss of any combination of speed sensors, FADEC overspeed circuitry or fuel solenoid that results in a loss of both overspeed systems.	x	x
<b>Overspeed:</b> APU speed greater than 106 percent.	x	x
<b>Loss Of Speed:</b> Loss of both APU speed signals.	x	x
<b>Fire:</b> Fire signal received by APU FADEC.	x	
<b>DC Loss:</b> Loss of DC power to the FADEC.	x	x
<b>Slow Start:</b> No crank, slow start, no acceleration, no flame or fall back (starter cutout and subsequent drop below 25 percent)	x	x
<b>High Oil temperature:</b> Oil temperature limit exceeded.	x	
<b>Low Oil Pressure:</b> Low oil pressure condition detected.	x	
<b>LOP Switch Fail:</b> Low oil pressure switch failed.	x	
<b>Loss Of Both EGT Sensors:</b> Failure of both EGT thermocouples.	x	
<b>Reverse Flow:</b> APU inlet temperature exceeded.	x	
<b>Underspeed:</b> APU drops below 80 percent.	x	x
<b>Overtemperature:</b> EGT exceeds scheduled limits.	x	

SYSTEM OVERVIEW SCHEMATIC



## ELECTRICAL POWER AND DISTRIBUTION

The electrical control of the APU consists of electrical sensing, starting and ignition, and the electronic control system through the FADEC.

APU electrical power may be used in flight or on ground. Electrical power is extracted from the APU in the form of horsepower that drives the APU generator, and may be used to feed the airplane electrical power system.

Under high electrical load demands, the APU's electrical load takes priority over pneumatic load demands.

The APU generator load limit is 40 kVA.

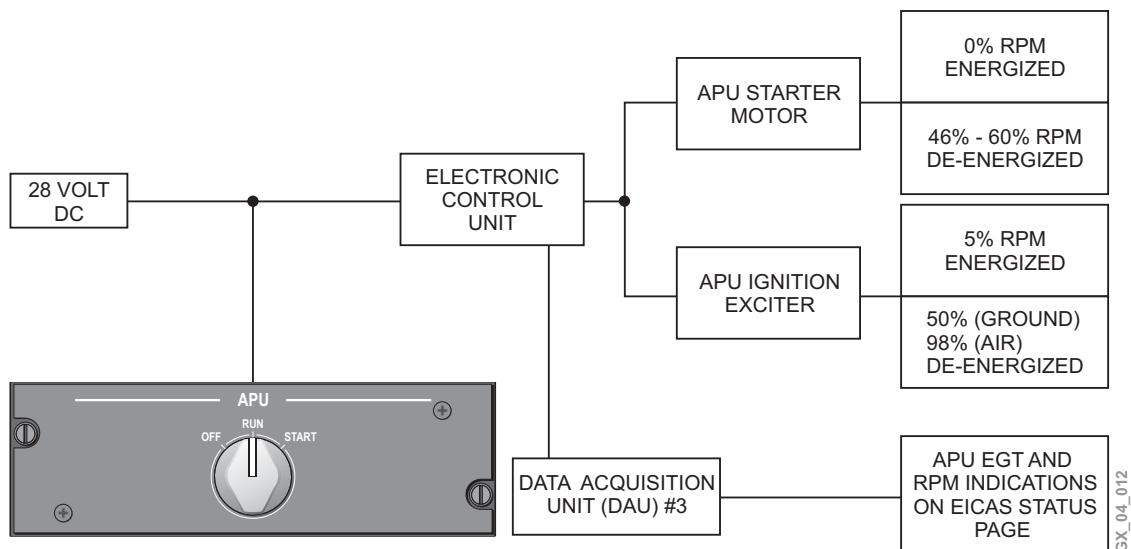
For operations above 37,000 feet, if the APU is powering a bus, the associated hydraulic pump must be selected off (due to the heavy load of the pump).

The FADEC is mounted remotely from the APU in a compact enclosure located in the aft equipment bay.

The FADEC is powered up when the BATT MASTER switch is selected ON. The BATT MASTER switch powers the airplane BATTERY BUS, which provides electrical power to the FADEC.

The FADEC uses the APU acceleration rate to calculate when to de-energize the starter motor and the ignition exciter. The values shown (START CONTROL SCHEMATIC below) are the maximum speeds at which the starter motor and the ignition exciter are permitted to operate.

## START CONTROL SCHEMATIC



## **Bombardier Global Express - Auxiliary Power Unit**

The FADEC control outputs include fuel metering, arming and regulation of the LCV and control of the SCV. It also performs protective shutdowns when the APU is not within allowable operating limits.

A BITE capability of the FADEC tests components for serviceability and initiates the start sequence. It also enables reliable fault isolation within the system.

### **FADEC INPUTS AND OUTPUTS**

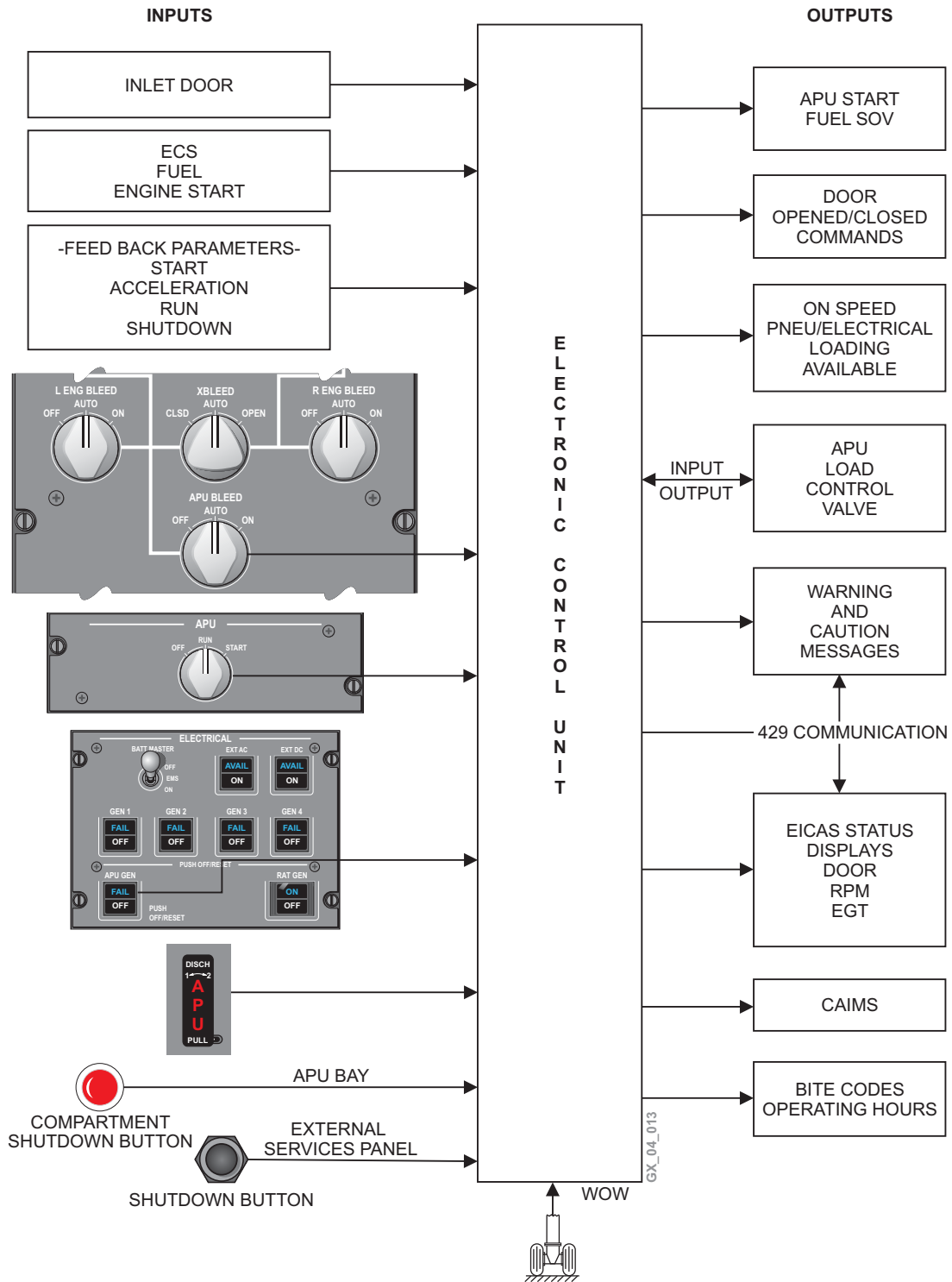
The following are input signals received by the FADEC:

- 28 VDC power, supplied by the DC BATTERY BUS (the AVIONICS BATTERY DIRECT BUS is used as a backup)
- Environmental Control System, fuel and engine start
- Inlet door position
- Feedback of all applicable parameters during start, acceleration, run and shut down
- Fuel, bleed/air conditioning, anti-icing, engine start and electrical control panels
- APU FIRE DISCH handle, APU SHUTOFF (external services panel and APU bay), and WOW status

The following are outputs generated by the FADEC:

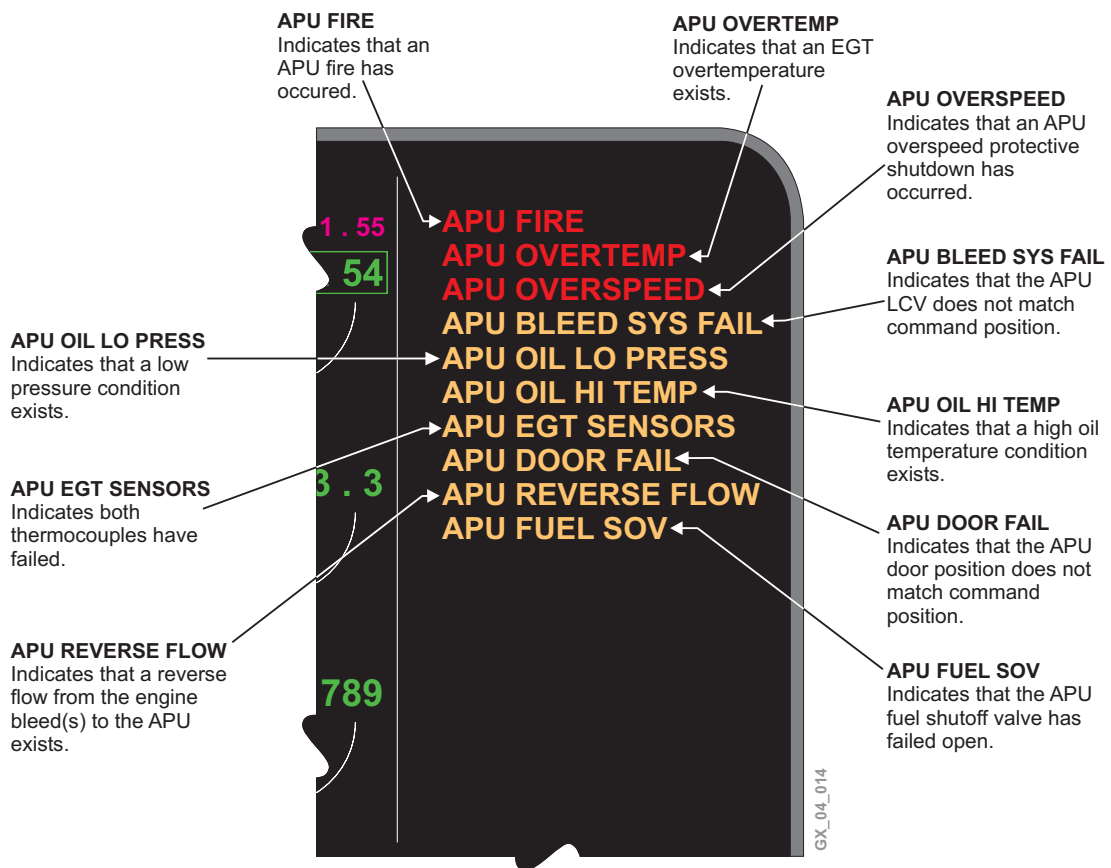
- APU start and fuel feed shutoff
- Door opening and closing operations
- On speed loading of pneumatics and electrics
- ARINC 429 Communication signals to EICAS
- Interface with CAIMS

FADEC SCHEMATIC





EICAS MESSAGES



**EICAS MESSAGES (Cont)**

**APU OIL LO QTY**  
Indicates that the APU oil level has reached 3.5 quarts (2 quarts low).

**APU BLEED DISABLED**  
Indicates that the LCV command has been received, and either:  
• The inlet pressure is less than 3.3 psia (35,000 ft).  
• The 60 second warm-up period (on ground only) is in progress.

**Note:**  
The Airplane Flight Manual limits the use of APU bleed extraction to 30,000 ft.

**APU FAULT**  
Indicates a failure in one of the following:  
•single speed sensor,  
•EGT thermocouple,  
•fuel solenoid (failed to Close),  
•fuel/oil filters in impending bypass,  
•low oil pressure switch has failed (in flight).

**APU BLEED OFF**  
Indicates that the APU BLEED switch is in the OFF position, and the load control valve is closed.

**APU FADEC FAIL**  
Indicates that no data is received by the DAU.

**APU NOT AVAILABLE**  
Indicates that when START or RUN is selected, checks/testing is in progress.

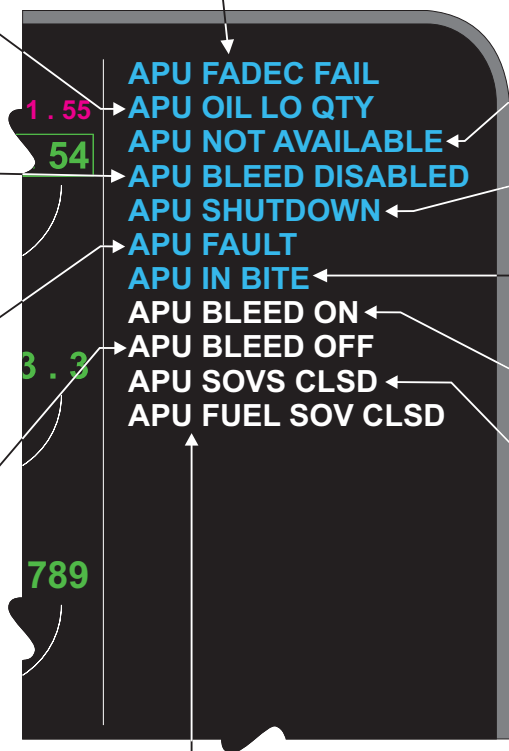
**APU SHUTDOWN**  
Indicates that an APU protective shut down has occurred, other than an overspeed or overtemperature.

**APU IN BITE**  
Indicates that RUN is selected and the prestart BITE is in progress.

**APU BLEED ON**  
Indicates that the APU BLEED switch is in the ON position, and the load control valve is open.

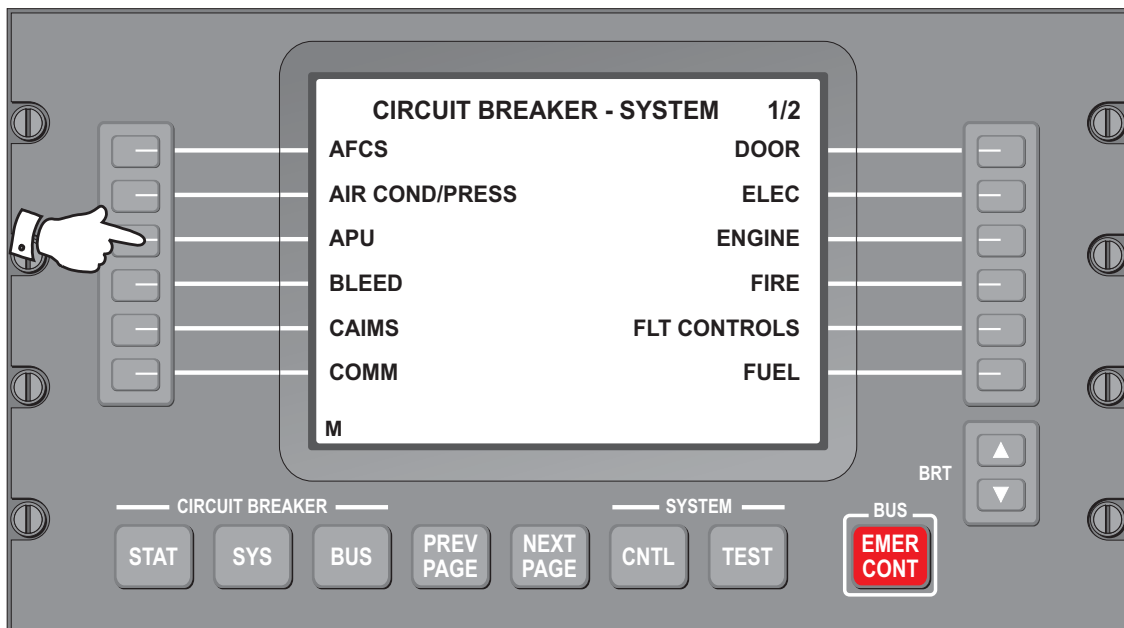
**APU SOVS CLSD**  
Indicates that both fuel and bleed air shutoff valves are closed.

**APU FUEL SOV CLSD**  
Indicates that the APU fuel shutoff valve is closed.



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EMS CIRCUIT PROTECTION



CB - APU SYSTEM				1/1
APU DOOR	APU BATT	ASCA	IN	
APU FADEC PWR 1	BATT		IN	
APU FADEC PWR 2	AV BATT	DCPC	IN	
APU OIL HEAT	AC 4		IN	
APU START	BATT		IN	
APU START CONTACT	APU BATT	ASCA	IN	
M				

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