

EMBRAER 135/145



Auxiliary Power Unit

GENERAL

The APU is a source of pneumatic and electrical power to be used either simultaneously with or independent of aircraft sources, while on the ground or in flight. Basically, it is a constant-speed gas turbine engine, consisting of a single-stage centrifugal compressor, a reverse-flow annular combustion chamber, and a single-stage radial turbine.

The airplane may be equipped with two APU models: T-62T-40C11 or T-62T-40C14. The Model T-62T-40C11 APU is controlled by the Electronic Sequence Unit (ESU), while the Model T-62T-40C14 APU is controlled by the Full Authority Digital Electronic Control (FADEC). Both control systems provide automatic, full-authority, fuel scheduling from start to full load operation, under all ambient conditions and operating modes. In addition, the ESU (or FADEC) automatically controls the APU to shut down should certain failures or events occur during start or operation.

An automatic APU shutdown may occur either on the ground or in flight, and takes place under the following conditions:

On the ground:

- fire
- overtemperature
- overspeed
- underspeed
- failure to start
- failure to accelerate
- failure to light
- loss of speed data
- external short
- loss of ESU (or FADEC) signal
- ESU (or FADEC) failure
- bleed valve opening
- low oil pressure
- high oil temperature
- oil pressure switch short
- loss of EGT.

NOTE: In the event of fire, a 10 second delay is allowed before an automatic APU shutdown is initiated.

In flight:

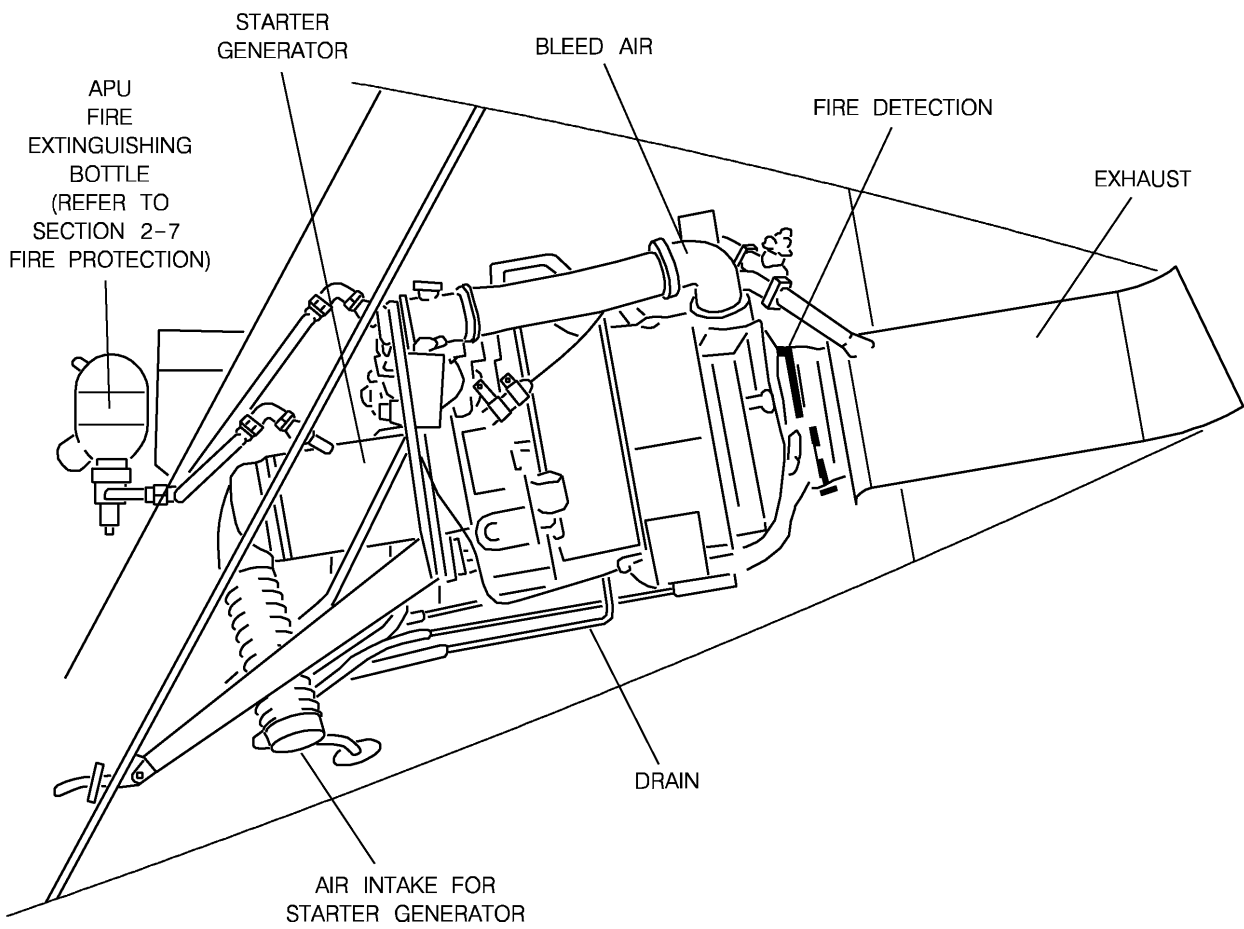
- overspeed
- underspeed
- failure to start
- failure to accelerate
- failure to light
- loss of speed data
- external short
- loss of ESU (or FADEC) signal
- ESU (or FADEC) failure.

The APU compartment is located in the airplane's tailcone, isolated by a titanium firewall. On the left side of the APU compartment, an inspection door allows access and inspection of the APU's components.

The APU starter-generator shaft drives an air-cooling fan. Air is drawn through an NACA air inlet located on the left side of the tailcone. APU draining is ducted to the airplane skin on the right side of the tailcone.

Control switches, alarms, and emergency shutdown means are provided on the cockpit overhead panel.

The normal APU indications and caution/warning messages are presented on the EICAS.



APU INSTALLATION

CONTROL SYSTEM

The APU control systems include the electrical, fuel, ignition, lubrication, and pneumatic systems.

On the Model T-62T-40C11 APU, the electrical control system consists of the Electronic Sequence Unit (ESU) and electric accessories. On the Model T-62T-40C14 APU, the electrical control system consists of the Full-Authority Digital Electronic Control (FADEC). Both control systems incorporate the APU starting system, control logic, and failure indication. Electric accessories provide ESU (or FADEC) inputs and execute output commands.

Electrical power for the APU control is fed from two bus bars. For airplanes Pre-Mod. SB 145-49-0012, one of these buses is supplied by the APU starter-generator itself, and the other is supplied by the airplane electrical system. This arrangement is provided to ensure that a loss of the airplane electrical power during the APU operation will not cause the APU shutdown.

For airplanes Post-Mod. SB 145-49-0012 or with an equivalent modification factory-incorporated, the APU control system is electrically fed by "ESS DC BUS" and "CENTRAL DC BUS" as the secondary source (instead of the APU generator). This modification improves the quality of power supply to ESU or the FADEC, but the APU will shut down if all generators and batteries are turned off.

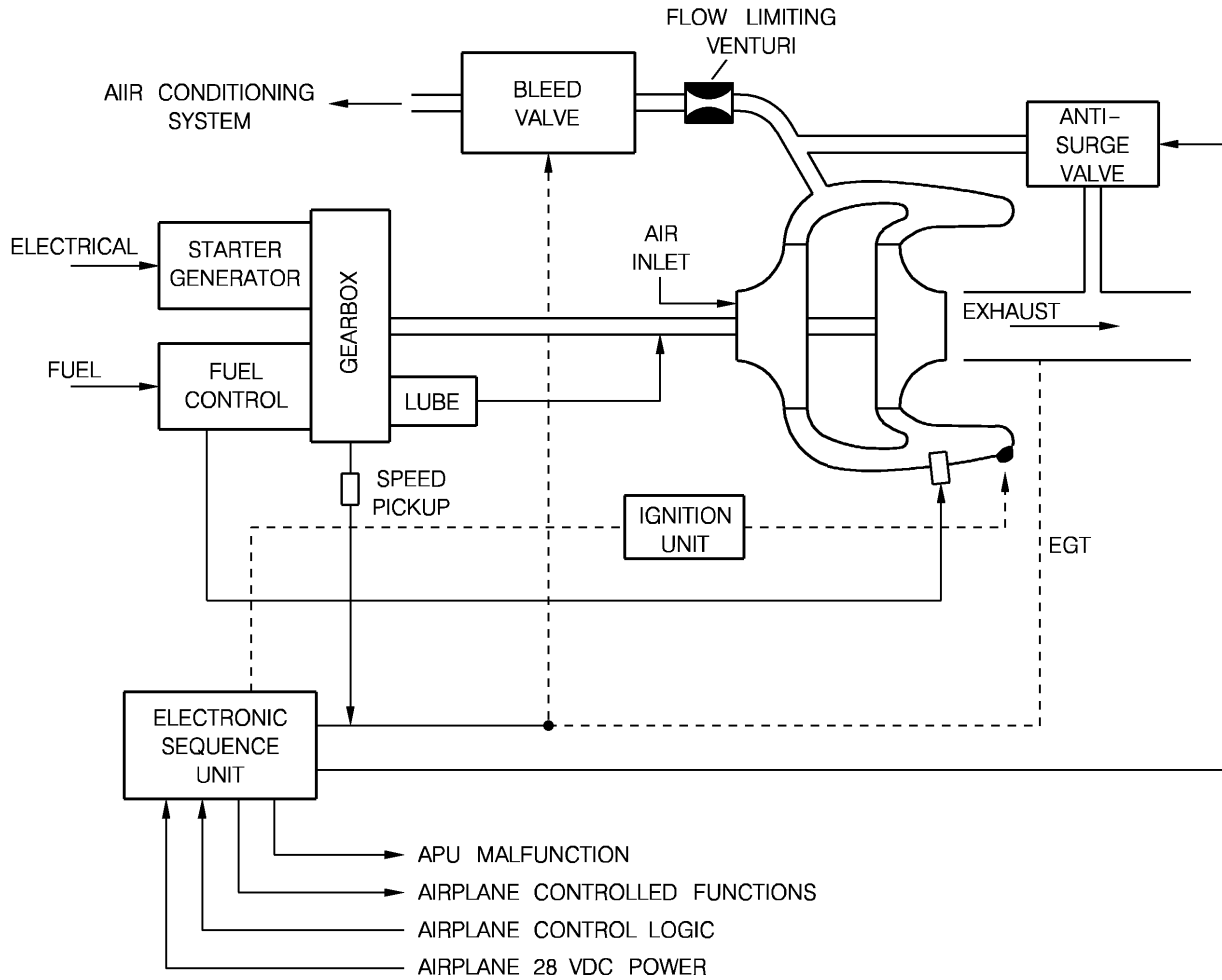
The fuel system is composed of the fuel pump, fuel solenoid valves (Start, Main, and Maximum), acceleration control, purge valve, fuel nozzles, fuel filter, and manifold. Acceleration control provides fuel in accordance with a preprogrammed schedule. Fuel from the right wing tank is normally used to supply the APU. Alternatively, fuel from the left wing tank may be used by means of the crossfeed valve.

NOTE: the fuel system for the Model T-62T-40C14 APU does not include a start fuel solenoid valve.

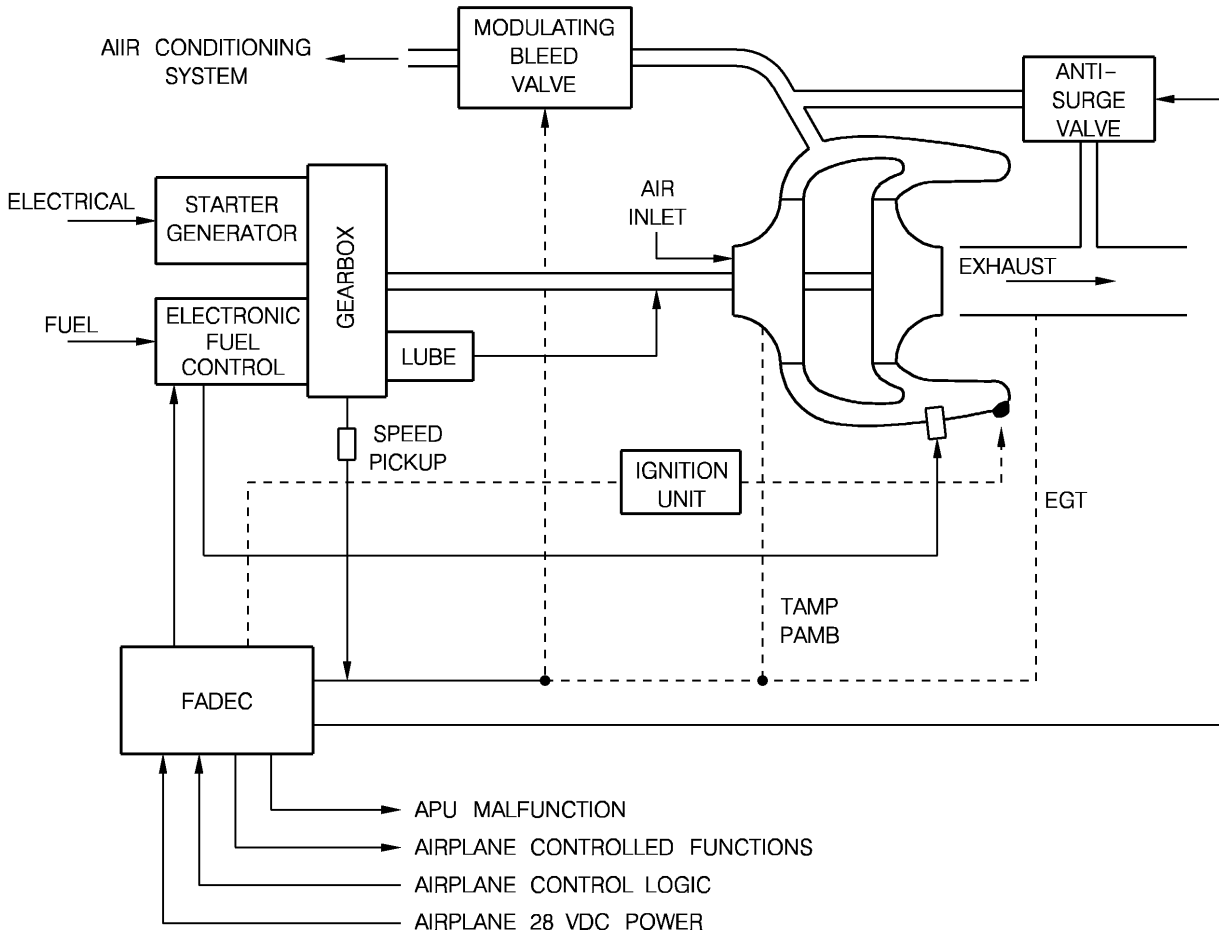
The ignition system provides the electrical power necessary during the APU starting sequence. It consists of an exciter, igniter plugs, and wiring.

The APU has a self-contained lubrication system totally integrated into the accessory gearbox. In addition to lubrication functions, the system provides the required oil cooling, with no need for an external heat exchanger. A thermostat, installed in the oil tank, sends a signal to the EICAS in case the oil temperature exceeds 166°C (331°F).

The pneumatic control system consists of a flow limiting venturi (for APU Model T-62T-40C11 only), a bleed valve, and an anti-surge valve. The flow limiting venturi maintains the bleed flow below a set value, depending on air conditioning system requirements and atmospheric conditions, thus maintaining the EGT within acceptable levels. The anti-surge valve is controlled by the ESU (or FADEC), which monitors the signal from the APU bleed valve, the Air Turbine Starter (ATS) valve, and the Environmental Control System (ECS) valve.



APU MODEL T-62T-40C11 SCHEMATIC



APU MODEL T-62T-40C14 SCHEMATIC

APU STARTING/OPERATION

The APU starting cycle is initiated when the APU Master knob, located on the APU control panel, is moved to the ON position. At this moment, an EGT valid value is shown on the EICAS. On the Model T-62T-40C14 APU, at this time, the fuel shutoff valve is energized to open. When the Master switch is momentarily set to START, DC power is applied to the starter-generator, which will drive the APU compressor up to a speed high enough to obtain sufficient airflow for combustion.

On the Model T-62T-40C11 APU, at approximately 3% rotor speed on the ground (or 0% in flight), the ESU supplies power to the ignition unit as well as power to open the Start Fuel Solenoid Valve, allowing fuel to flow to the combustion chamber. At 14% rotor speed, the Main Fuel Solenoid Valve is energized. The APU continues accelerating up to the 70% rotor speed, when the ESU commands starter disengagement and Start Fuel Solenoid Valve and ignition deenergization.

On the Model T-62T-40C14 APU, at approximately 3% rotor speed on the ground (or 0% in flight), the FADEC supplies power to the ignition unit as well as power to open the Main Fuel Solenoid Valve, allowing fuel flow to the combustion chamber. The APU continues accelerating and, when rotor speed exceeds 50%, the FADEC de-energizes the starter and at 70% rotor speed the FADEC de-energizes the ignition exciter.

The APU acceleration continues by the APU's own means and, 7 seconds after having reached 95% rotor speed, the Maximum Fuel Solenoid Valve is energized and the ESU (or FADEC) circuits allow electrical and pneumatic power extraction through the starter-generator and the bleed valve.

If a failure in the control system occurs, associated with an APU overspeed, the Model T-62T-40C11 APU will automatically shutdown after the rotating parts reach 108% speed, while the Model T-62T-40C14 APU will automatically shutdown after the rotating parts reach 104% speed.

The APU is shut down by pressing the APU Stop Button or by setting the Master switch to the OFF position. Normal shutdown of the APU should be accomplished by pushing the STOP switch on the cockpit APU control panel. On APU Model T-62T-40C11, a signal is sent to the ESU in order to simulate an overspeed condition, which, aside shutting the APU down, allows the ESU overspeed protection testing. On APU Model T-62T-40C14, a stop request signal is sent to the FADEC in order to execute the APU shutdown procedure; the FADEC overspeed protection is tested during the FADEC power-up.

NOTE: The APU FUEL SHUTOFF BUTTON when pressed, also shuts the APU down by closing shutoff valve of the APU fuel feed-line.

EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	APU FAIL	APU has been automatically shut down.
	APU OIL LO PRESS	Oil pressure is below 6 psi.
	APU OIL HI TEMP	Oil temperature is above 166°C (331°F).

CONTROLS AND INDICATORS

APU CONTROL PANEL

1 - APU MASTER KNOB

OFF - Deenergizes the ESU (or FADEC), closes the APU fuel shutoff valve, turns off APU indications and alarms whenever APU RPM is below 10%, and commands APU shutdown.

ON - Energizes the ESU (or FADEC), commands the fuel shutoff valve to open, enables indication and alarms on the EICAS and allows the APU to keep running after starting.

START (momentary position) - Initiates start cycle.

2 - APU STOP BUTTON

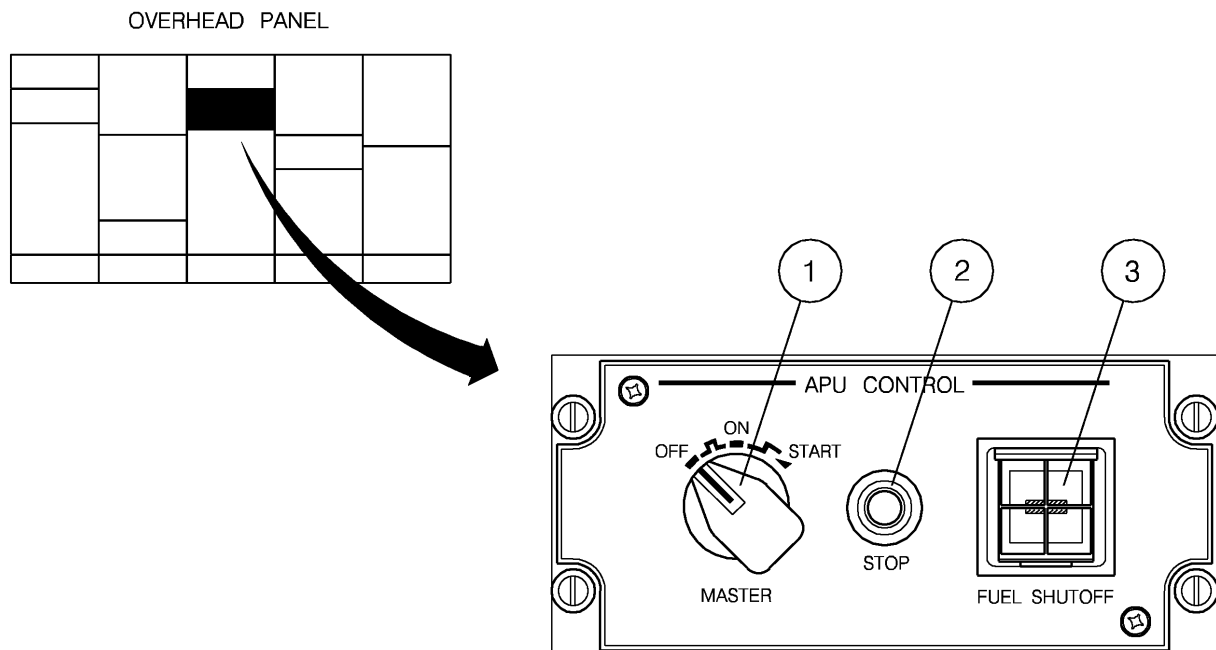
– Shuts the APU down.

NOTE: APU EICAS indications remain operational.

3 - APU FUEL SHUTOFF BUTTON (guarded)

– Cuts off fuel to the APU.

– A striped bar illuminates inside the button to indicate that it is pressed.



APU CONTROL PANEL

EICAS INDICATIONS

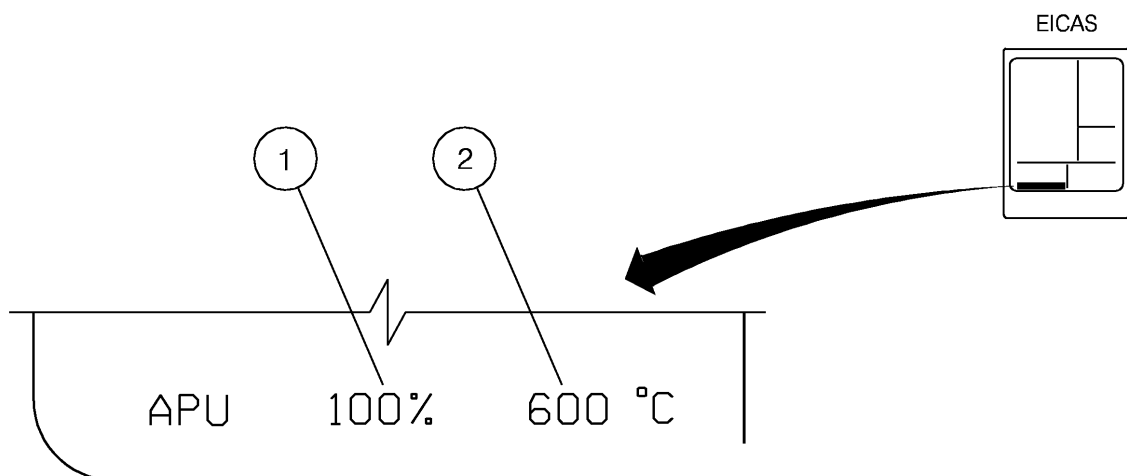
1- APU RPM INDICATION

- Ranges from 0 to 120% speed.
- Green from 96 to 104%.
- Amber and boxed from 0 to 95% and from 105 to 110%.
- Red and boxed above 110%.

2- APU EGT INDICATION

- NORMAL OPERATION
 - Ranges from -54 to 927°C.
 - Green from -54 to 680°C.
 - Amber and boxed from 681 to 717°C.
 - Red and boxed above 717°C.
- START SEQUENCE
 - Ranges from -54 to 927°C.
 - Green from -54 to 838°C.
 - Amber and boxed from 839 to 884°C.
 - Red and boxed above 884°C.

NOTE: After APU shutdown, the RPM and EGT indications are replaced by APU OFF inscription, provided the APU Master Knob is set to OFF position and APU speed is below 10%.



EICAS INDICATIONS