

# **DASSAULT FALCON 900EX EASY SYSTEMS SUMMARY**



## **Auxiliary Power Unit**

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**Do not use it for flight!**

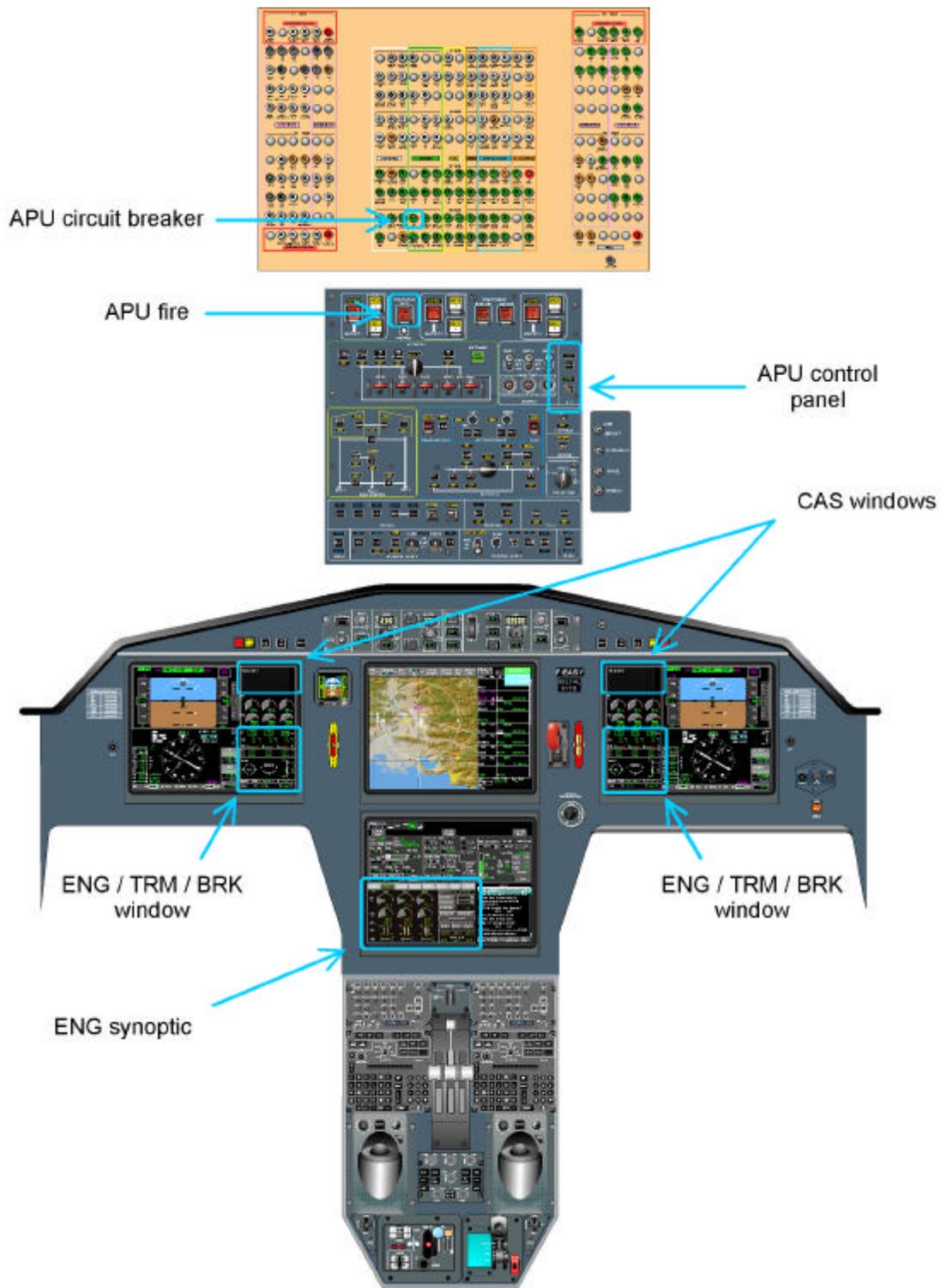
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## Falcon 900EX Easy [Auxiliary Power Unit Summary]

### INTRODUCTION

The Auxiliary Power Unit (APU) allows the Falcon 900EX EASy airplane to be self-supported (providing electrical power and bleed air) during ground operations especially at remote locations where ground servicing equipment may not be compatible or available.

# Falcon 900EX Easy [Auxiliary Power Unit Summary]



**FLIGHT DECK OVERVIEW**

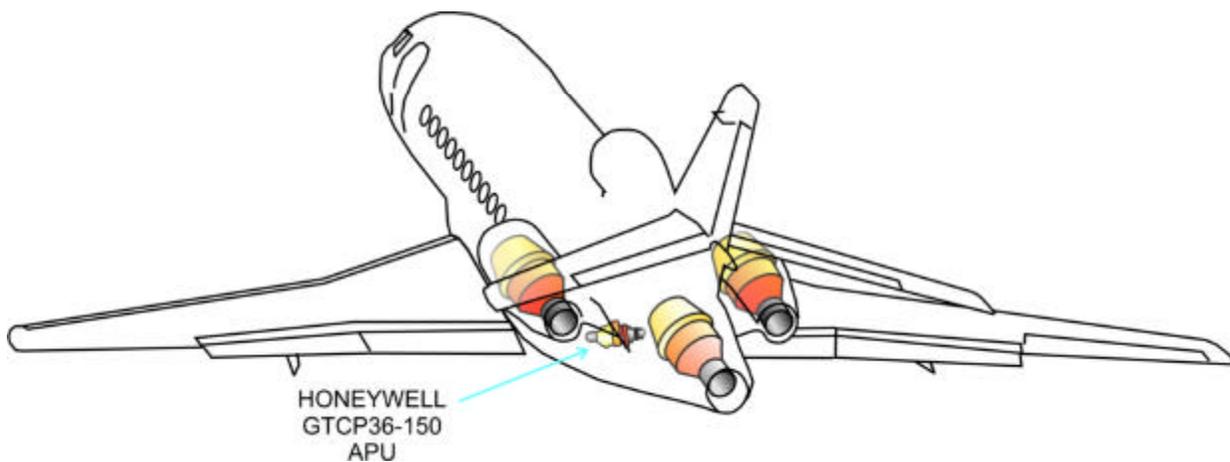
## Falcon 900EX Easy [Auxiliary Power Unit Summary]

### SOURCES

The APU sources are independent of all installed airplane systems except for the electrical power source used during starting and fuel supply from the airplane fuel tanks.

ELECTRICAL POWER	FUEL
APU starting requires electrical power provided either: <ul style="list-style-type: none"><li>- by the batteries through the starting bus</li><li>- by a Ground Power Unit</li></ul>	Fuel is supplied by the No 2 engine fuel feed line  ➤ Refer to CODDE1 / Chapter 02 / ATA 28

### APU LOCATION



APU LOCATION

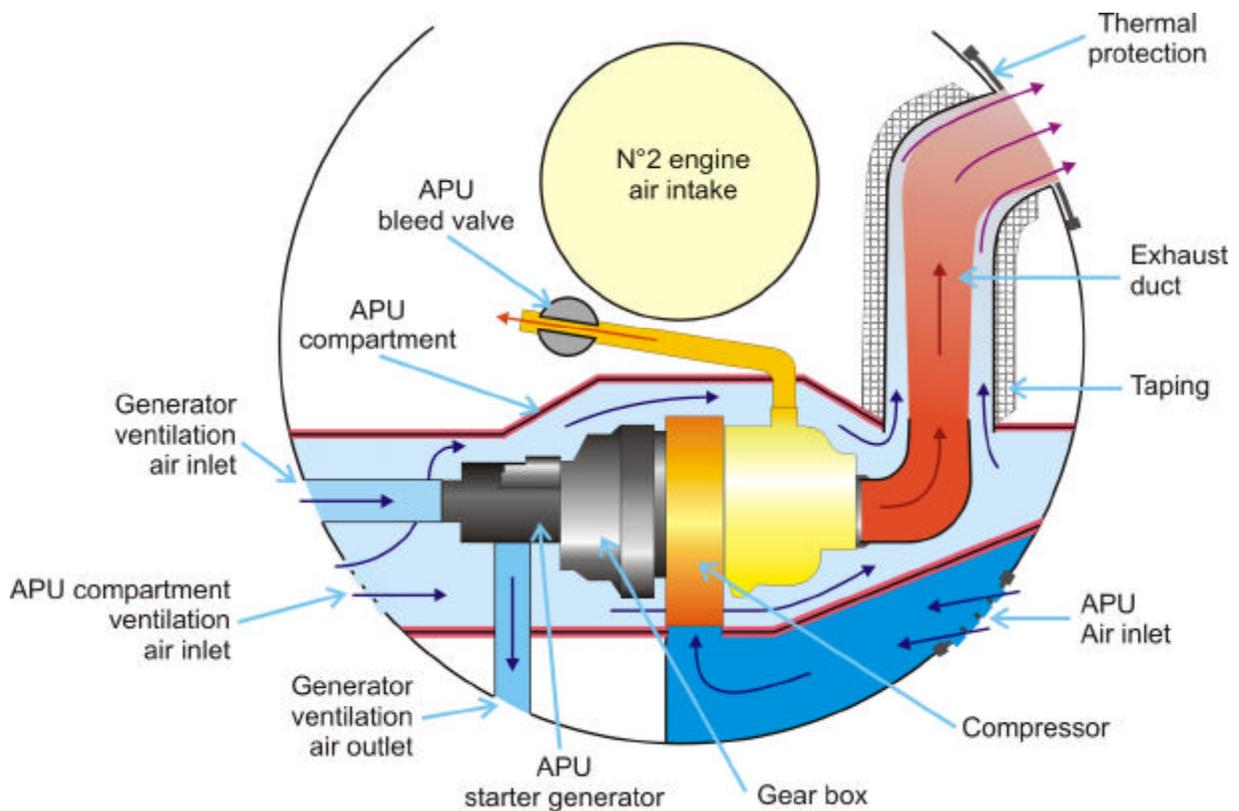
## Falcon 900EX Easy [Auxiliary Power Unit Summary]

### INTRODUCTION

The Falcon 900EX EASy incorporates an APU model GTCP36-150 (F) manufactured by HONEYWELL. The unit is transversely mounted in the rear section of the fuselage under the No 2 engine area and is enclosed within a carbon / titanium fireproof container. The APU is certified for ground operation only and a control circuit is wired through the landing gear ground proximity switches to prevent operation in flight.

### DESCRIPTION

The APU consists of an air intake, located in the middle of the unit, a centrifugal compressor and its discharge port for bleed air, a combustion chamber, a single stage turbine, an exhaust duct and an accessory section. The accessories include the APU fuel control unit, the fuel pump, the oil pump and the starter-generator.



APU LAYOUT

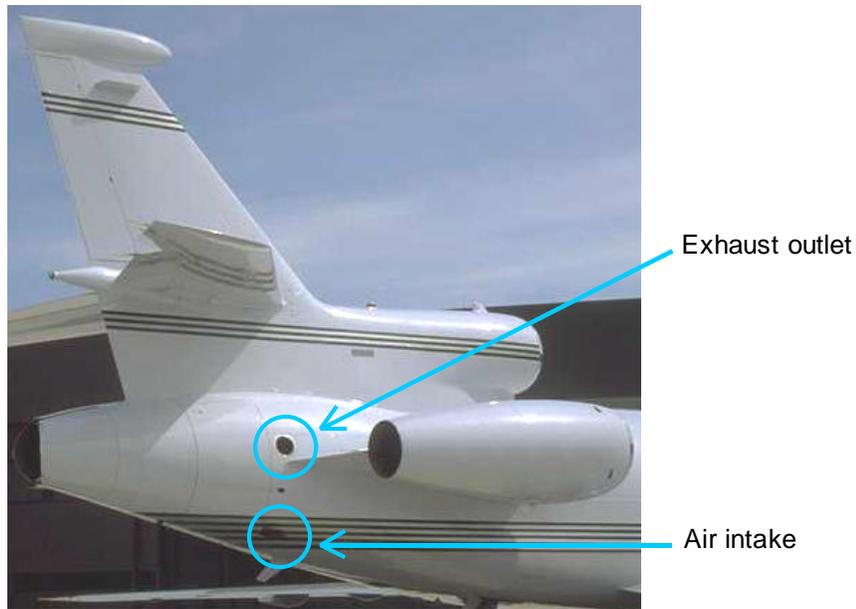
## Falcon 900EX Easy [Auxiliary Power Unit Summary]

Air inlets are located on the right and left hand side of the aft fuselage and are screened to prevent entry of foreign material.

On the right hand side is the inlet for the APU engine.

On the left hand side is the inlet for APU shroud for cooling and exhaust gases dilution.

The exhaust outlet is located on the upper right hand side of the aft fuselage.



### EXHAUST OUTLET AND AIR INTAKE INLET

The hot bleed air necessary for air conditioning is tapped downstream from the compressor.

### OPERATING PRINCIPLE

The starter-generator first drives the APU.

Once APU speed has reached 10% N1, the fuel induction begins and ignition is turned on. At 50% N1, energy extracted from exhaust gases is sufficient to drive the compressor and the starter operation is terminated.

When the APU reaches 97% N1, ignition is terminated. The generator is automatically connected to the RH bus and, if APU BLEED AIR is selected, bleed air is available for air conditioning.

APU continues to accelerate to approximately 101.6% before being stabilized to 100% N1. The stabilized T5 temperature may vary depending on the taking or not of hot air for air conditioning and on the ambient air temperature. The engine then operates on a cycle of continuous induction, compression, combustion and exhaust at a constant N1.

When the APU generator is on line, left and right main buses are powered (through the bus tie selector), batteries 1 and 2 are charging and starting bus and battery bus are also powered by the APU.

If the start relay fails to open, the **STARTER APU** CAS message appears.

In case of failure during APU generator connection, the **APU GEN** CAS message appears.

## APU SYSTEMS

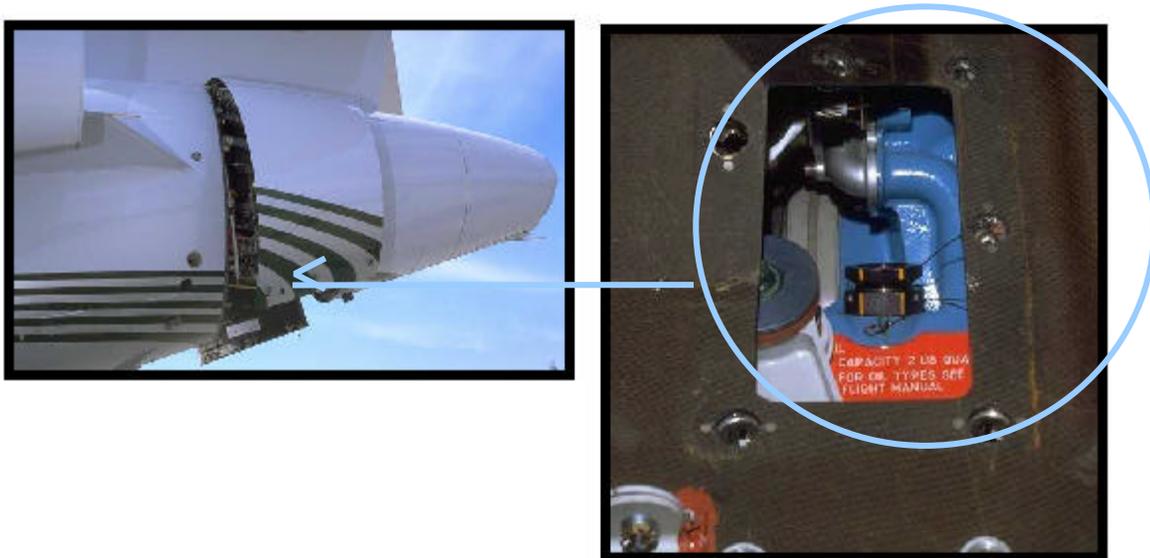
### OIL SYSTEM

The oil system provides cooling and lubrication of the main rotor bearings and accessory gearbox.

A switch, located downstream from the oil system, indicates when oil pressure decreases below 31 psi.

If APU is running and oil pressure drops below 31 psi, the APU is automatically shut down after 10 sec and the **APU OIL** CAS message appears.

A thermostat, inside the oil sump, controls oil temperature. If oil temperature exceeds 141°C, the APU is automatically shut down and the **APU OIL** CAS message appears.



APU OIL FILLER PORT

### FUEL SYSTEM

Fuel is supplied to the APU by the No 2 engine fuel feed line through the fuel supply shut-off valve. The APU fuel system features a bypass filter and a high pressure gear pump. A solenoid shut-off valve permits the system to command APU shut-off in case of failure detected by the APU Electronic Control Unit (ECU).

The fuel flow is controlled by the ECU for the different phases and loads of APU operation.

### **IGNITION SYSTEM**

The APU incorporates a high-energy ignition system consisting of an exciter box, high-tension cable, and a single igniter plug in the combustion chamber.

The ignition system is entirely controlled by the APU ECU. The ignition is started at 10% N1 and continues until N1 reaches 97%. Upon reaching 97% of N1, a signal from the ECU terminates the ignition.

### **APU ELECTRONIC CONTROL UNIT (ECU)**

The ECU is located in the mechanic servicing compartment.

It provides for automatic management of APU performance and safeties during starting, operation and shutdown phases. APU operation is monitored through N1 signal generated by a magnetic sensor mounted on the accessory gearbox and a temperature signal (T5) generated by the single thermocouple probe installed in the APU exhaust duct.

The speed governing loop continuously monitors N1 and modulates fuel flow (timed-acceleration during starting of the engine or control during self-sustaining operation).

The temperature loop is not active during APU starting or normal operation unless exhaust duct temperature exceeds the maximum operating value.

## **DISTRIBUTION**

### **APU GENERATOR**

The APU starter-generator is the same as the engines.

It is rated at 28.5 V / 300 A and is regulated by an associated Generator Control Unit (GCU) mounted in the rear compartment.

It is capable of powering the entire DC electrical system in addition to charging batteries and engine start assistance.

➤ *For more information, refer to CODDE 1 / Chapter 02 / ATA 24.*

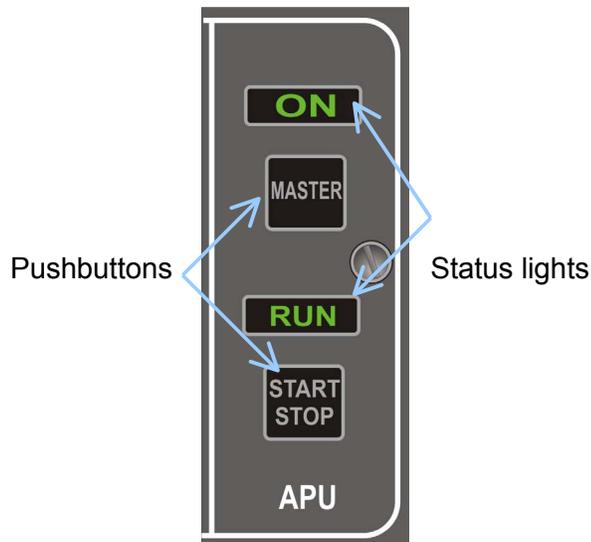
### **BLEED AIR**

The APU bleed air is driven through a BLEED AIR valve to the pneumatic system.

When used for air conditioning, the APU ECU controls the valve to obtain the desired temperature.

➤ *For more information, refer to CODDE 1 / Chapter 02 / ATA 21.*

**CONTROL**



**APU CONTROL PANEL**

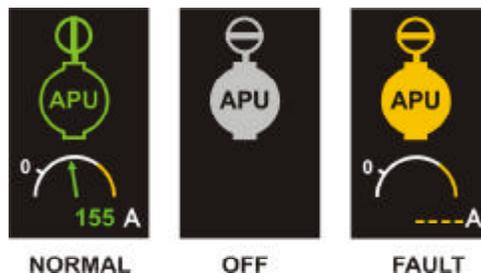
CONTROL	FUNCTION	TO ACTIVATE		SYNOPTIC
		TO DEACTIVATE		
	<ul style="list-style-type: none"> <li>- powers the APU if the ON light is off (APU not running and not powered)</li> <li>- deactivates the APU if the ON light only is on (APU only powered and not running)</li> <li>- abnormal APU stop</li> </ul>	push to power before start-up  push to deactivate or stop APU  ON flashing	  	Empty windows  N1 and EGT values (ENG synoptic and ENG window of PDU)
	<ul style="list-style-type: none"> <li>- initiates APU starting sequence when the ON light only is on</li> <li>- initiates APU shutdown when both ON and RUN lights are on (APU running)</li> </ul>	push to start  push to stop	  	

**INDICATION**

As the APU supplies electrical power to the airplane, APU electrical indications can be displayed in the ELEC synoptic. This page indicates APU generator status and the corresponding ammeter measurement.



**ELEC SYNOPTIC, APU RUNNING**

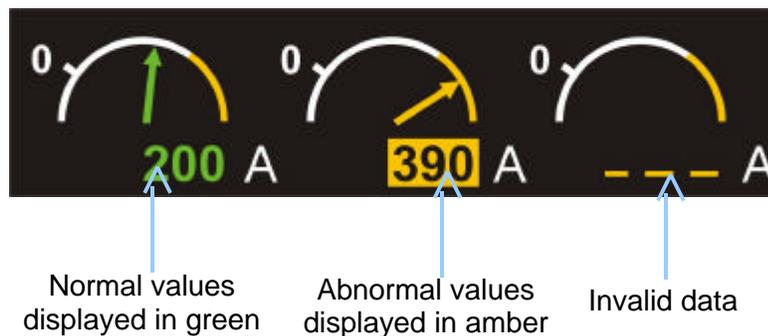


**APU GENERATOR SYMBOL**

The APU generator status can be:

- on line (green outlined synoptic), or
- disconnected (gray outlined synoptic), or
- failed (amber outlined synoptic).

The ammeter indicates normal operating values or abnormal values using the following rules.



**AMMETER INDICATIONS**

## Falcon 900EX Easy [Auxiliary Power Unit Summary]

For the APU generator, the analog ammeter and digital readout are only displayed when the airplane is on the ground with APU running. The range of the scale is amber above 300 A.

APU engine parameters are displayed at the bottom of the ENG - TRM - BRK window and at the top right hand corner of the ENG Synoptic. N1 (%) and T5 (°C) are displayed as digital readouts. T5 indication turns amber when T5 is above 679°C.



ENG SYNOPTIC



LOWER ENG-TRM-BRK WINDOW

## Falcon 900EX Easy [Auxiliary Power Unit Summary]

In the TEST synoptic, APU OIL status can be obtained.

The system indicates:

- if APU oil level is valid: **LEVEL OK**
- if APU oil level is too low: **ADD APU OIL**,
- if the oil data is invalid: **TEST FAIL**.

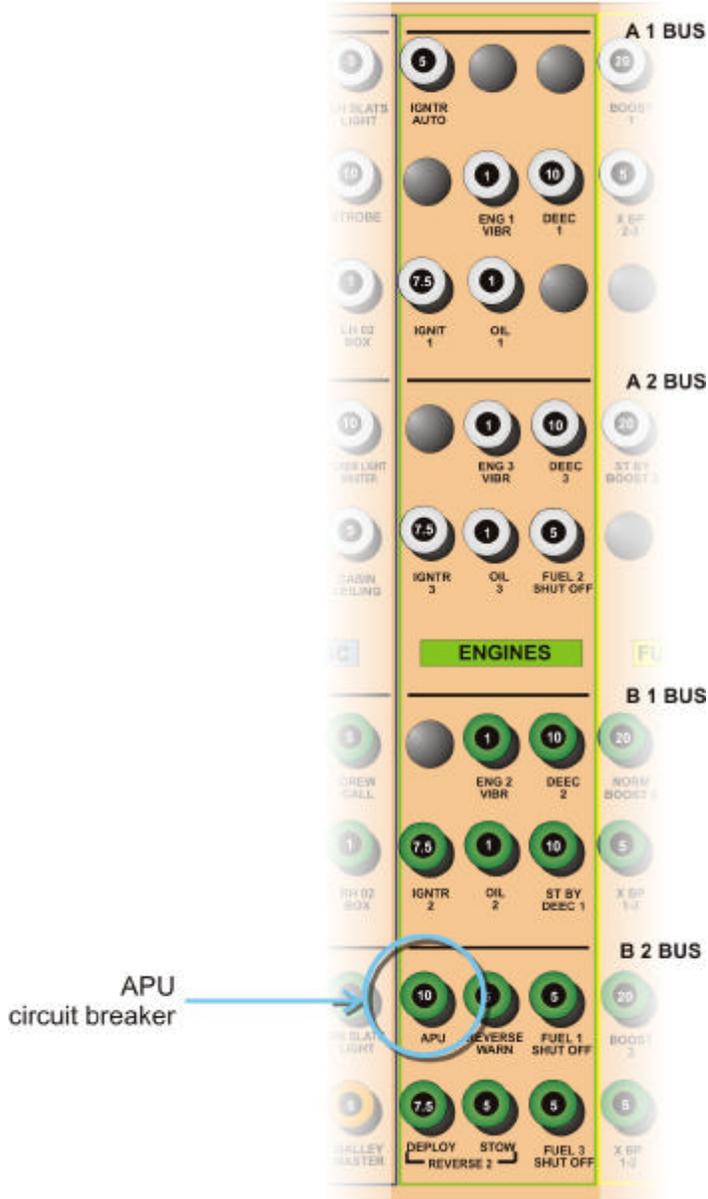
STAT	ENG	ELEC	FUEL	HYD	ECS	BLD	TEST
				DOOR TEST		DOOR RST	
MAU/DU BAT				STALL 1		STALL 2	
HORIZ BAT				WX RADAR			
AUX BAT				CVR1		HUD DATA	
RAD ALT 1						EGPWS	
RAD ALT 2				LIGHTS		TCAS	
APU OIL				CLEAR FAULT		CAS ENABLE	LEVEL OK

**TEST SYNOPTIC**

An hourmeter located in the mechanic-servicing compartment, records APU operating time. It automatically begins to record as soon as the APU N1 reaches 97% N1.

## CIRCUIT BREAKERS

APU ECU circuit protection is provided by a conventional trip-free circuit breaker located above the overhead panel.



APU CIRCUIT BREAKERS PANEL

### APU ECU PROTECTIONS

The APU Electronic Control Unit incorporates comprehensive protection, which automatically shuts down the unit when any of the following conditions is met:

- over-speed (primary) –  $110 \pm 1\%$  (tested using stop pushbutton),
- N1 magnetic sensor open circuit,
- T5 over-temperature (T5 greater than  $870^{\circ}\text{C}$  for more than 10 sec during normal operation ; T5 between  $870^{\circ}\text{C}$  and  $985^{\circ}\text{C}$  for more than 10 sec or T5 above  $985^{\circ}\text{C}$  during starting),
- T5 open circuit,
- low oil pressure (pressure below 31 psi and N1 above 97% N1),
- high oil temperature (oil temperature in the sump above  $141^{\circ}\text{C}$ ),
- over-current in APU electrical components,
- faulty APU generator excitation,
- all battery and engine generator switches off,
- power micro-cuts in excess of 50 milliseconds,
- take-off with APU operating,
- APU fire,
- Environmental Control Unit (ECU) overheat.

### STARTING SEQUENCE

The APU can be started using either the airplane batteries or an external ground power unit. The battery start is the usual operating mode. GPU start assist is detailed in the ABNORMAL OPERATION sub-section.

Prior to starting the APU, the oil level must be checked as well as the security area. The bus tie must be closed (BUS TIED light on) or APU does not start.

Pushing the APU MASTER pushbutton turns the ON light on (steady green). The APU ECU is powered. If bus is not tied, the ON light is flashing green.

Pushing the START / STOP pushbutton initiates the automatic start sequence and automatically starts the stand-by No 2 booster pump. The RUN light then illuminates for approximately 5 sec to indicate that the command is taken into account (steady green). It extinguishes during APU starting (about 20 sec). When APU start is successful (generator on line), it illuminates again and remains illuminated until the APU is stopped.

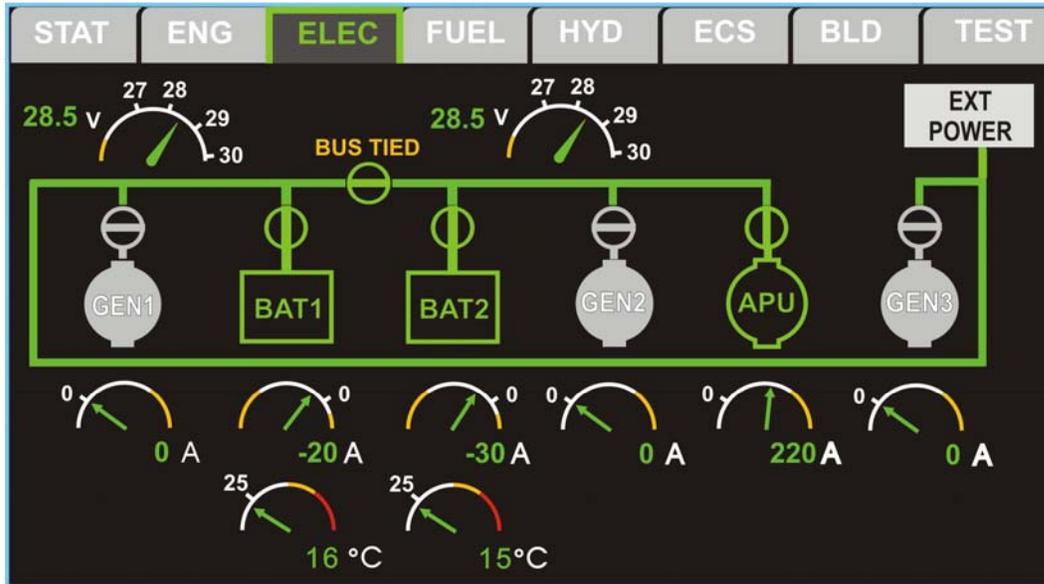
As long as the RUN light remains illuminated, the starting sequence is successful. The engine parameters can be monitored on the ENG - TRM - BRK window. N1 and T5 can be checked while increasing up to approximately 101% for N1 and 985°C for T5. The electrical parameters can be checked in the ELEC synoptic before connecting equipment.

The following examples show controls and indications displayed to the pilots during normal ground operation of the APU.



APU CONTROL PANEL

# Falcon 900EX Easy [Auxiliary Power Unit Summary]



ELEC SYNOPSIS



LOWER ENG-TRM-BRK WINDOW



ENG SYNOPSIS

## Falcon 900EX Easy [Auxiliary Power Unit Summary]

### SHUTDOWN

The APU incorporates an automatic and manual shutdown. The automatic shutdown system is controlled by the APU ECU and corresponds to the abnormal conditions detailed in the SYSTEM PROTECTION sub section.

Pushing the START / STOP pushbutton closes the APU fuel shut-off valve. The APU START / STOP RUN light flashes for 2 sec then extinguishes.

Pushing the APU MASTER pushbutton, while ON light is steady green, stops electrical power to the APU ECU. The ON light then extinguishes.

### NOTE

When the APU is shut down by the STOP pushbutton, or if automatic shut-down occurs, the APU cannot be restarted unless the MASTER pushbutton is momentarily unlatched and latched again (pushed twice).

### LIMITATIONS

The APU is certified for ground use only. Operation of the APU is not authorized without supervision.

Maximum N1 speed:  $110 \pm 1\%$ .

Exhaust gas temperature limit (T5):

- starting (below 50% N1):
  - o T5 below 988°,
  - o between 870°C and 985°C maximum, less than 10 sec
- stabilized: 679°C.

### NOTE

The duration of operation on amber range (679°C to 732°C) must be as short as possible.

Maximum generator output:

- transient: 350 A, less than 60 sec,
- stabilized: 300 A.

### APU START WITH GPU ASSIST

Prior to initiating the APU start cycle, the GPU must be plugged in and operating.

When the EXT POWER pushbutton is pushed and illuminated, the following occurs:

- batteries No1 and 2 are isolated, even from the battery bus,
- the battery bus, the starting bus and the right and left main buses are powered by the GPU (main buses are automatically tied),
- all generators are inhibited, including APU generator.

Pushing APU MASTER pushbutton powers the APU ECU, opens APU fuel supply valve and illuminates the ON light.

Pushing APU START / STOP pushbutton initiates the starting sequence. This sequence is the same as the battery starting sequence until the engine reaches 97% N1.

At 97% N1, with EXT POWER selected, the APU generator is not connected. GPU generator continues to power the distribution system, inhibiting all generators.

Since the engine speed is above 97% N1, APU bleed air is available for the air conditioning system.

### APU STARTING SEQUENCE FAILED

If the APU fails to start when the START / STOP pushbutton is used, the RUN light does not illuminate and the ON light of the MASTER pushbutton flashes.

### APU NORMAL SHUTDOWN FAILED

If the APU fails to shut down when the START / STOP pushbutton is pushed, an alternate method is also available.

Pushing the APU MASTER pushbutton turns off the ON light, closes the APU fuel shut-off valve and cuts off power from the APU ECU causing the APU fuel shut-off valve to close.

### NOTE

This condition should be written up as a maintenance follow-up action. This problem may be associated with the ECU automatic shutdown logic.

### APU BLEED AIR VALVE NOT CLOSED AT TAKE OFF

If the APU bleed air valve is not closed at take-off, the **BLEED APU** CAS message appears.

Pushing the APU pushbutton of the BLEED AIR panel closes the valve and removes the message from the CAS window.

➤ For more information, refer to CODDE 1 / Chapter 02 / ATA 36.

### APU FIRE

The fire warning activates the warning horn, causes the illumination of the corresponding:

- guarded  pushbutton on the overhead control panel, and
- displays the **FIRE APU** CAS message.

Pressing the  pushbutton automatically shuts down the APU, closes the APU fuel shut-off valve and discharges the corresponding extinguisher cylinder.

➤ For more information, refer to CODDE 1 / Chapter 02 / ATA 26.

### CAS MESSAGES

CAS MESSAGE	DEFINITION
<b>FIRE APU</b>	Fire detected in APU compartment
<b>APU FIRE DETEC FAIL</b>	Failure of APU fire detector
<b>APU GEN</b>	APU generator not connected with APU running
<b>APU OIL</b>	Low oil pressure or high oil temperature
<b>BLEED APU</b>	On ground, bleed air valve not closed with (Throttle lever > 54° and APU control set to Auto) or APU control set to Off
<b>STARTER APU</b>	APU ON and starter still active
<b>APU GEN FAIL</b>	On ground, failure of electrical contactor
<b>APU OIL FAIL</b>	On ground, failure of APU oil and temperature switch