GENERAL

The Challenger 605 primarily uses 115-volt AC power, and also 28-volt DC electrical power.

Engine-driven integrated drive generators (IDGs) supply the primary source of AC electrical power. A generator mounted on the auxiliary power unit (APU) provides an alternate source of AC electrical power. In flight, if a total loss of AC power occurs, the air-driven generator (ADG) is deployed from the right side of the forward fuselage to provide an emergency source of AC electrical power.

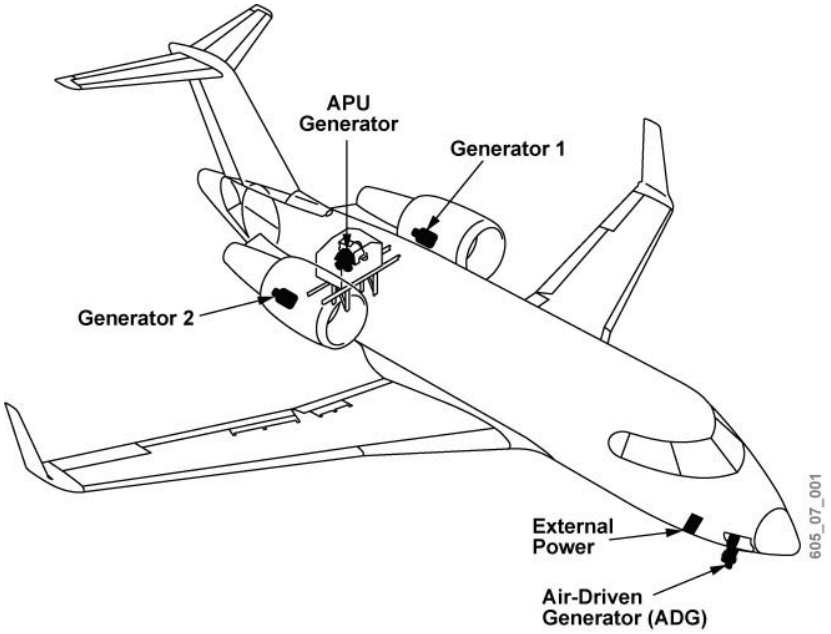
External AC electrical power is supplied through an electrical power receptacle, located on the right side of the forward fuselage.

Various aircraft systems and components require DC electrical power for operation. DC electrical power needs are primarily supplied by four transformer rectifier units (TRU) mounted in the nose compartment. The aircraft is equipped with two nickel-cadmium (NiCad) batteries that store and provide a source of DC electrical power for normal and emergency operations. The main battery is located in the nose section, the APU battery is in the aft equipment bay.

The aircraft is capable of accepting 28-volt DC external electrical power through a DC power receptacle, installed on the rear fuselage below the right engine.

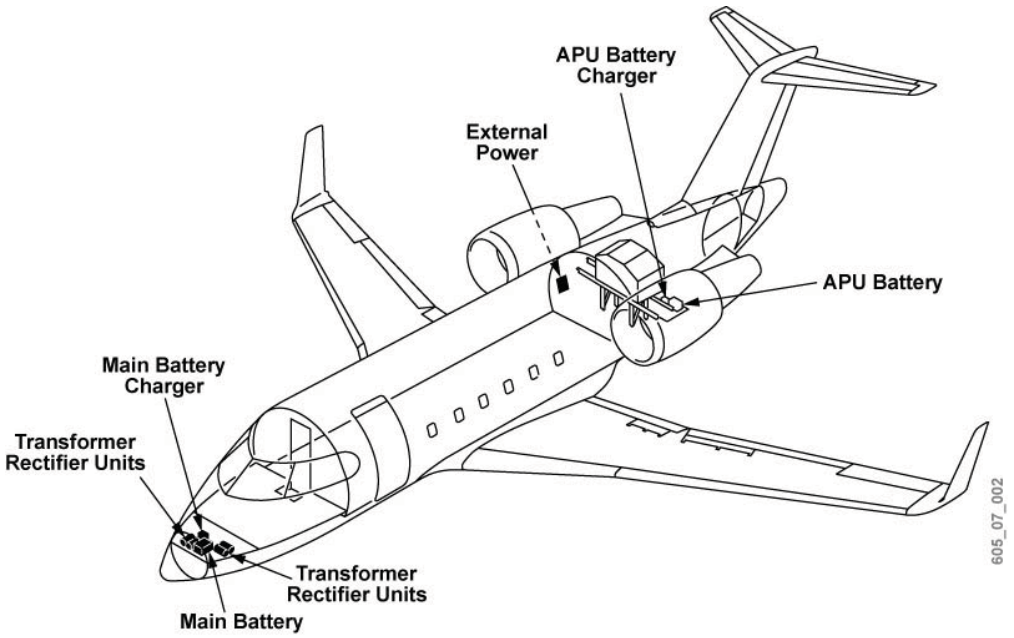
Five circuit breaker panels provide power distribution. Four circuit breaker panels are located in the flight compartment, and the fifth panel is in the aft equipment bay.

Control and operation are accomplished through the ELECTRICAL POWER panel, located on the left side of the overhead panel. AC and DC electrical system information is provided on the EICAS.



AC Electrical Power Sources
Figure 07–10–1

GENERAL (CONT'D)



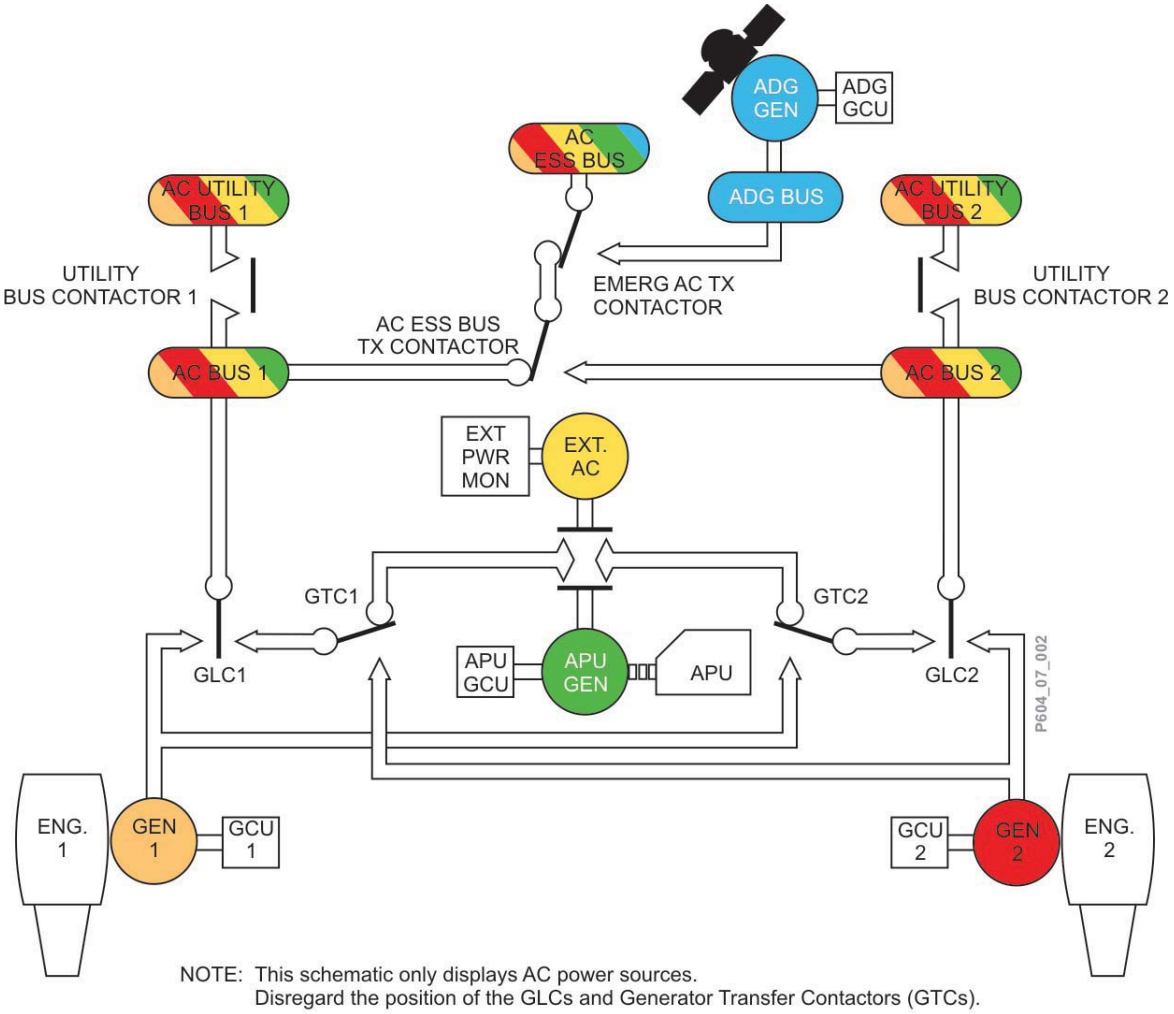
DC Electrical Power Sources
Figure 07–10–2

ALTERNATING CURRENT (AC) SYSTEM

Description

Three AC generators provide AC power for the aircraft electrical systems. Two engine-driven generators power all AC buses during normal operations. An APU generator provides a source of AC electrical power when the aircraft is on the ground with the engines off, and during flight if both engine-driven generators become inoperative.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)



AC Electrical System
Figure 07–10–3

Components and Operation

Integrated Drive Generators (IDGs)

Two engine-driven IDGs supply 115-volt AC, 400-Hz, three-phase electrical power to the AC buses. The IDG consists of two subcomponents, a constant speed drive and an electrical generator.

The generators are identified on the EICAS AC electrical synoptic page by the symbols GEN 1 and GEN 2 (see Figure 07–10–4). The nominal rating of each generator is 30 kilovolt-amperes (kVA) to an altitude of 35,000 feet MSL, then 25 kVA to 41,000 feet MSL. In the event of a single generator failure, the remaining generator is capable of supplying sufficient power for operation of the main systems.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)

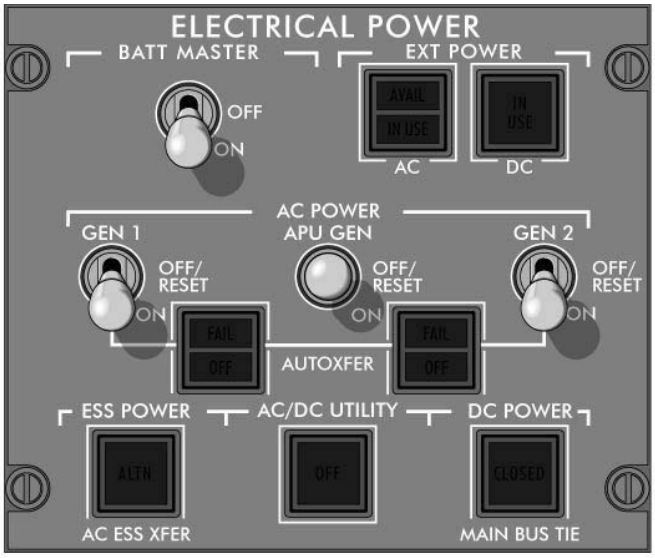
The generators are controlled by two-position GEN 1 or GEN 2 switches, located on the ELECTRICAL POWER panel. Selecting GEN 1 or GEN 2 switch to ON connects the respective generator to the main AC buses, provided they are operating normally. Selecting the switches to OFF/RESET will disconnect the respective generator from the main AC buses. The OFF/RESET position can also be used to reset the generator control circuit when a fault occurs.

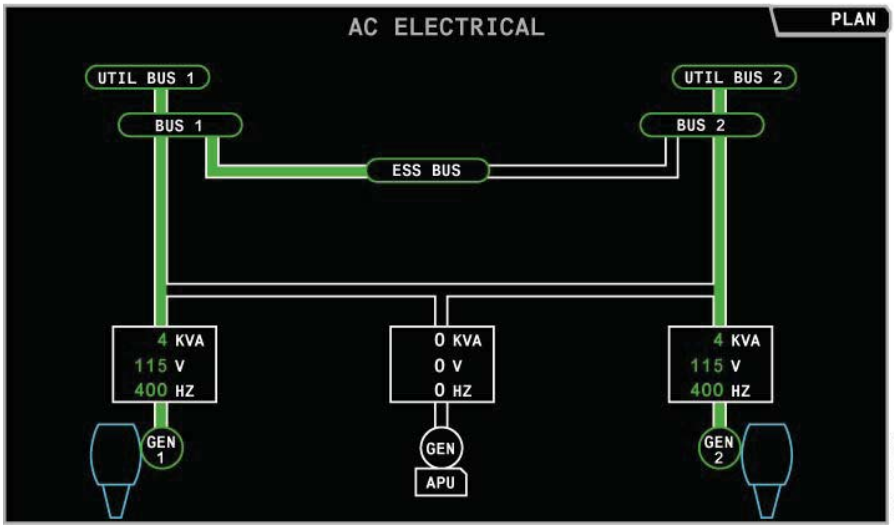
Generator Control Unit

Each IDG is controlled and monitored by its respective generator control unit (GCU). The GCUs provide protection and bus priority logic during normal and non-normal operations. The engine generator is tripped off and removed from the AC buses if any of the following conditions occur:

- Over- and undervoltage;
- Over- and underfrequency; or
- Generator and bus overcurrent.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)





GEN 1 and GEN 2 Power
Figure 07–10–4

APU Generator

The APU generator supplies 115-volt AC, 400-Hz, three-phase electrical power to the AC buses during ground operations with the engines off. The APU generator may also be used in flight as a backup power source to the AC buses following a failure of both engine generators. The APU generator is mounted on the APU generator adapter, and is driven at a constant speed, maintaining its frequency output at 400 Hz.

The APU generator is identified on the AC ELECTRICAL synoptic page by the symbol GEN above the APU icon (see Figure 07–10–5). The nominal rating of the APU generator is 30 kVA from sea level up to the APU's maximum operating altitude of 20,000 feet MSL.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)

The two-position APU GEN switch, located on the ELECTRICAL POWER panel, controls the APU generator. Selecting the APU GEN switch to ON connects the APU generator to the main AC buses, providing it is operating normally. Selecting the switch to OFF/RESET disconnects the APU generator from the main AC buses. The OFF/RESET position can also be used to reset the generator control circuit when a fault occurs.

NOTE

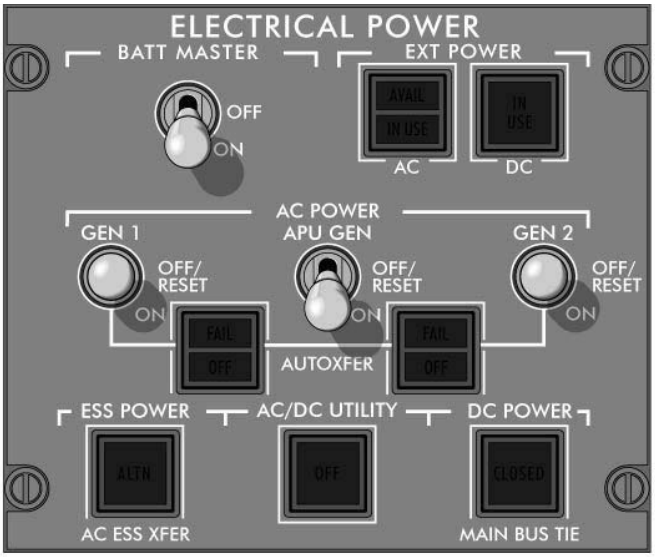
Use of the APU generator in flight is permitted when one main generator has failed or is off-line.

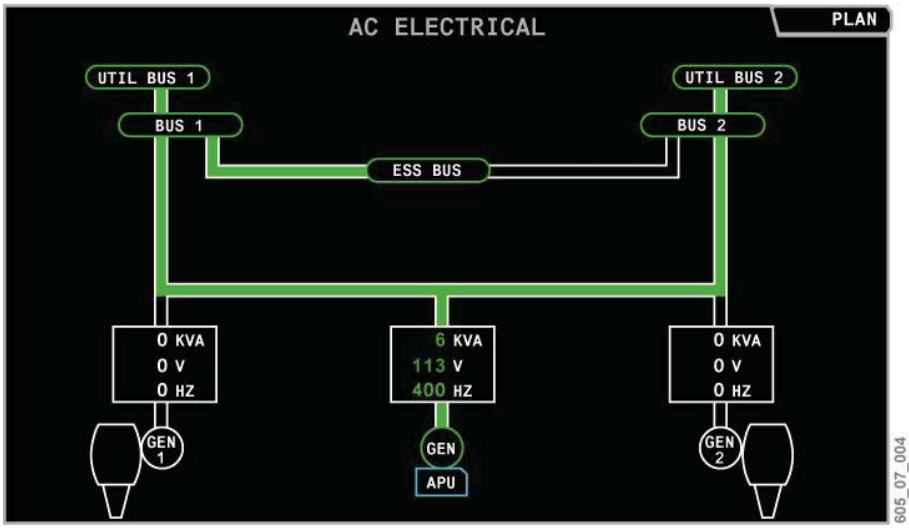
Generator Control Unit

The APU generator is controlled and monitored by the APU generator control unit (GCU). The APU GCU, in conjunction with the engine GCUs, provide protection and bus priority logic during normal and non-normal operations. The APU GENERATOR is tripped off and removed from the AC buses if any of the following conditions occur:

- Over- and undervoltage;
- Over- and underfrequency; or
- Generator and bus overcurrent.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)





APU Power
Figure 07–10–5

External AC Electrical Power

The aircraft is capable of being powered by an external AC power source when both engines and APU are off. External AC electrical power is connected at an external AC receptacle, located on the forward right side of the fuselage.

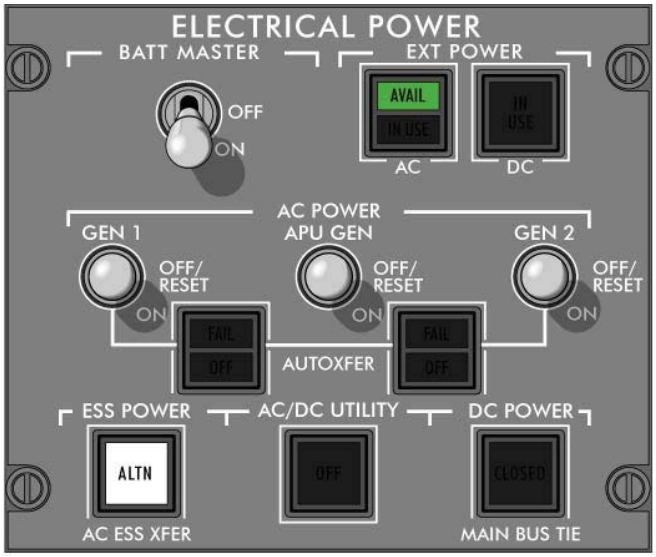
ALTERNATING CURRENT (AC) SYSTEM (CONT'D)

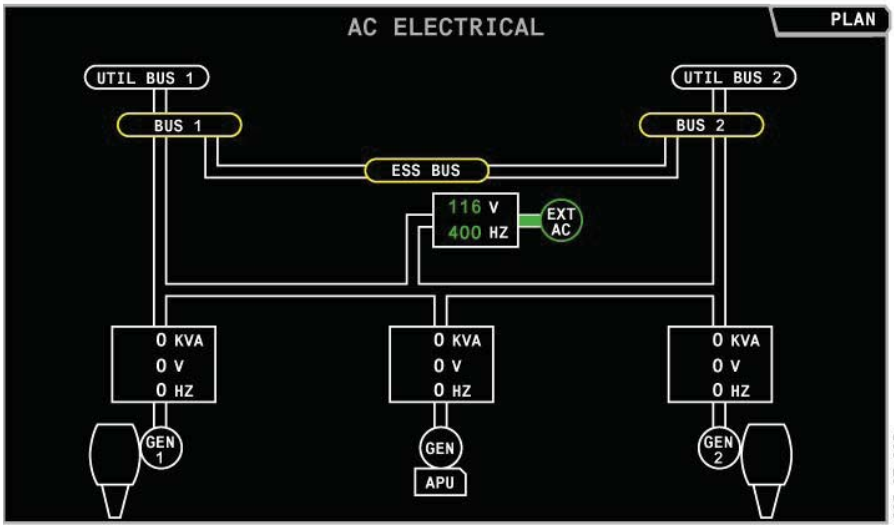
External AC Receptacle
Figure 07–10–6

Operation

External AC ground power is controlled by the EXT POWER switch/light, located on the ELECTRICAL POWER panel. When connected, the external AC ground power is checked by an external power monitor for proper voltage, frequency, and phase. When the external power is within limits, the green AVAIL annunciator on the EXT POWER switch/light illuminates.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)



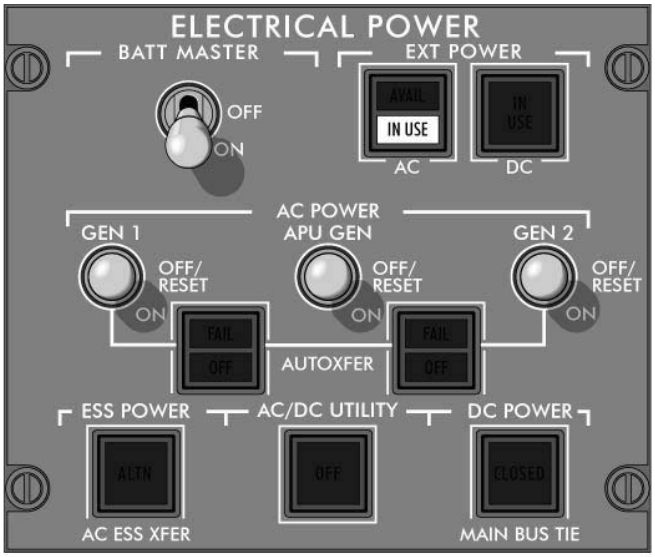


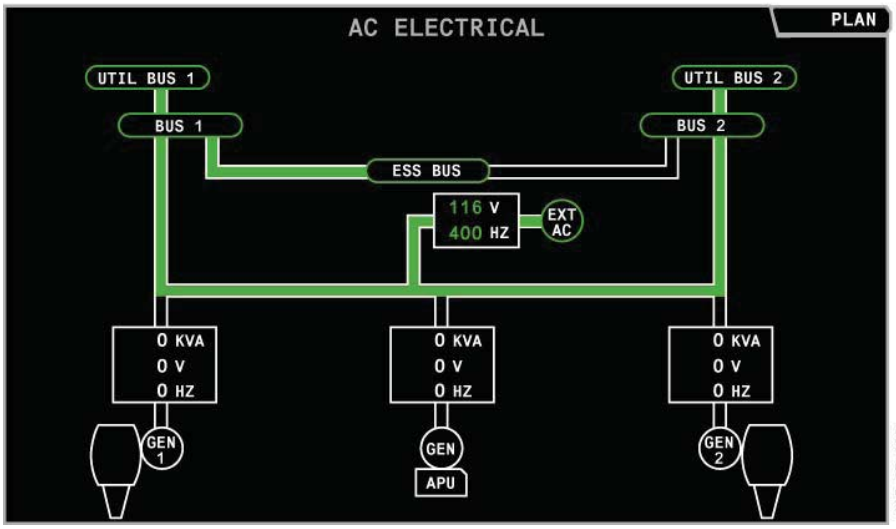
External AC Electrical Power Available
Figure 07–10–7

When the EXT POWER switch/light is pressed with the AVAIL annunciator illuminated, external AC electrical power is connected to the aircraft main AC buses via the auxiliary power/external power contactor. The IN USE annunciator then illuminates.

External AC ground power is identified on the AC ELECTRICAL synoptic page by the symbol EXT AC. This symbol appears only if external AC power is connected to the aircraft.

ALTERNATING CURRENT (AC) SYSTEM (CONT'D)





External AC Electrical Power In Use
Figure 07–10–8

AC ELECTRICAL POWER DISTRIBUTION

Description

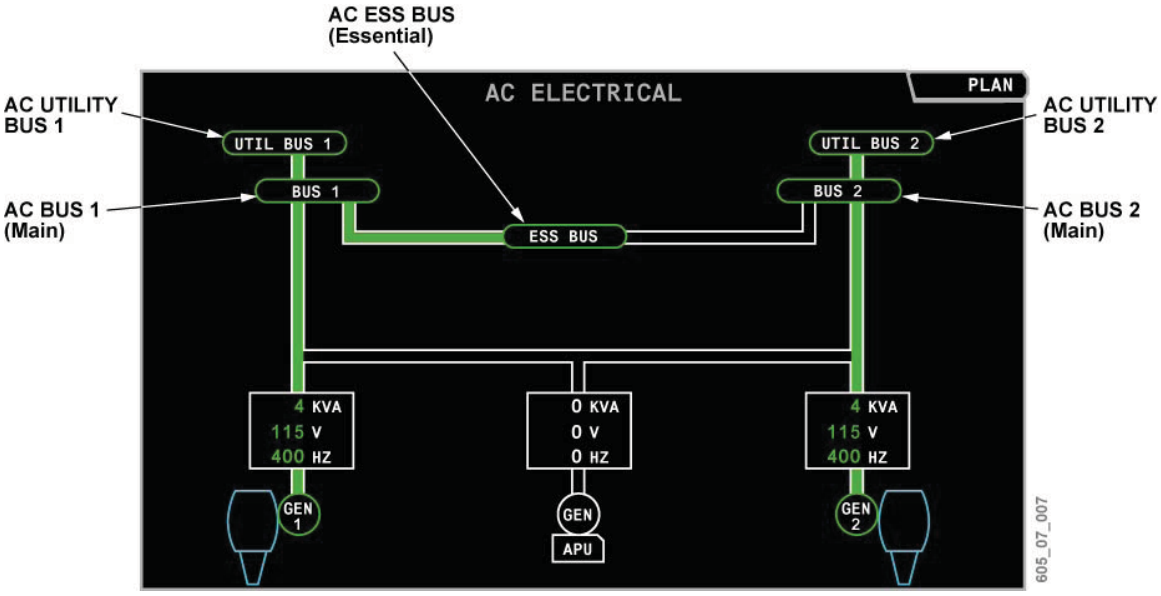
115-volt AC electrical power, from the aircraft generators and APU generator, is distributed to five AC buses through circuit breaker panels. Monitoring of system status is done using the AC ELECTRICAL synoptic page.

The aircraft AC bus system consists of the following five buses:

- AC BUS 1 (Main);
- AC BUS 2 (Main);
- AC ESS BUS (Essential);
- AC UTILITY BUS 1; and

AC ELECTRICAL POWER DISTRIBUTION (CONT'D)

- AC UTILITY BUS 2.



AC ELECTRICAL Synoptic Page
Figure 07–10–9

Components and Operation

AC BUS 1 and AC BUS 2

AC BUS 1 and AC BUS 2 are the main AC buses of the aircraft, and receive power from any of the three generators, or from external AC power. AC BUS 1 normally supplies power to the AC ESS BUS and AC UTIL BUS 1. AC BUS 2 normally powers AC UTIL BUS 2.

Bus Priority

AC BUS 1 and AC BUS 2 are protected by a bus priority logic, to ensure that the buses remain powered at all times. The generator control units (GCUs) determine the bus priority for AC BUS 1 and AC BUS 2 via the generator line contactors (GLCs) and generator transfer contactors (GTCs). The bus priority logic for AC BUS 1 and AC BUS 2 is as follows:

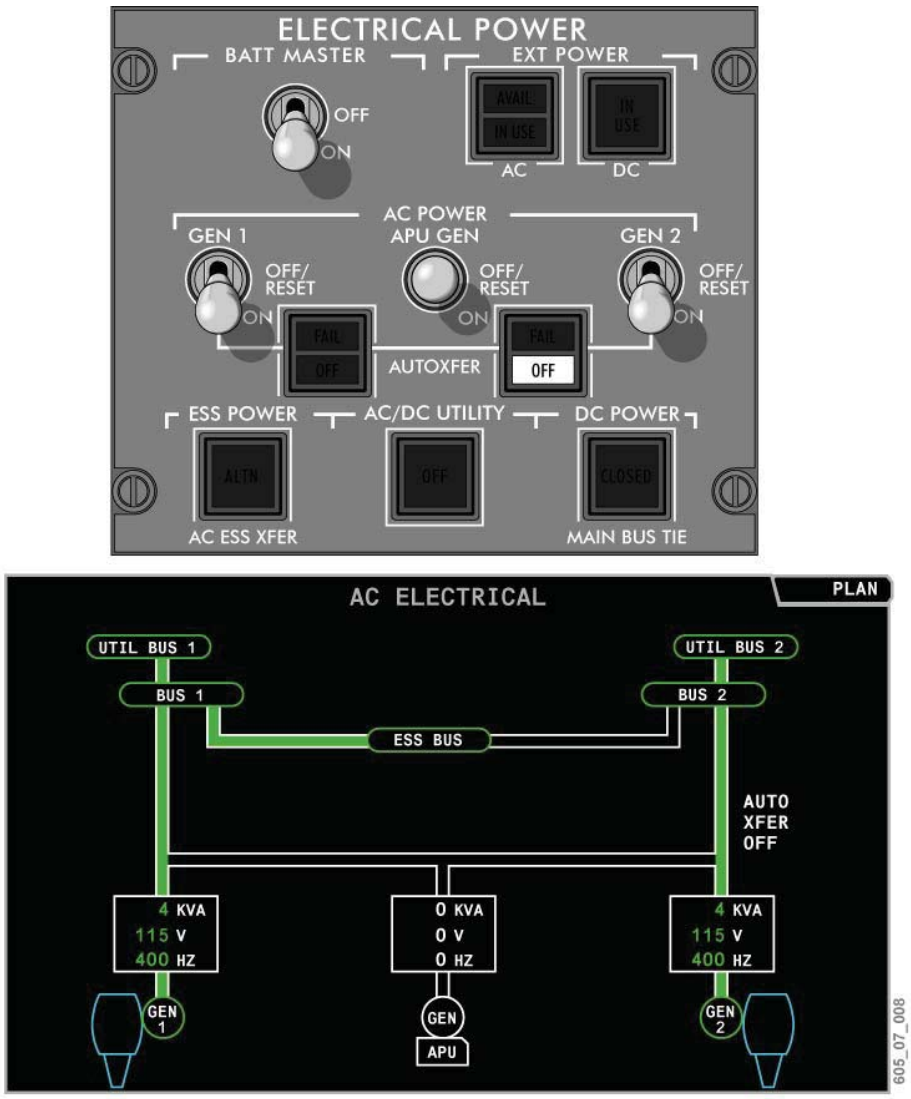
- On-side engine-driven generator (example: AC BUS 1 powered by GEN 1);
- APU generator;
- Cross-side engine-driven generator (example: AC BUS 1 powered by GEN 2); and
- External AC power.

According to the above priority logic, the GLCs and GTCs will automatically tie the main AC buses to any of the available AC power sources, to ensure that the main AC buses remain powered at all times.

AC ELECTRICAL POWER DISTRIBUTION (CONT'D)

AC BUS 1 (2) Automatic Transfer (AUTOXFER) Switch/Lights

The flight crew may manually inhibit the automatic bus transfer priority logic by pressing the appropriate AUTOXFER switch/light, located on the ELECTRICAL POWER panel. This prevents the corresponding AC BUS from being powered by any source except its on-side engine-driven generator. This may be used to isolate a main AC bus in the event of an electrical emergency (example: electrical smoke or fire). Selection of the AUTOXFER switch/light is indicated by illumination of the corresponding white OFF annunciator on the switch/light, and white AUTO XFER OFF icon on the AC electrical synoptic page.

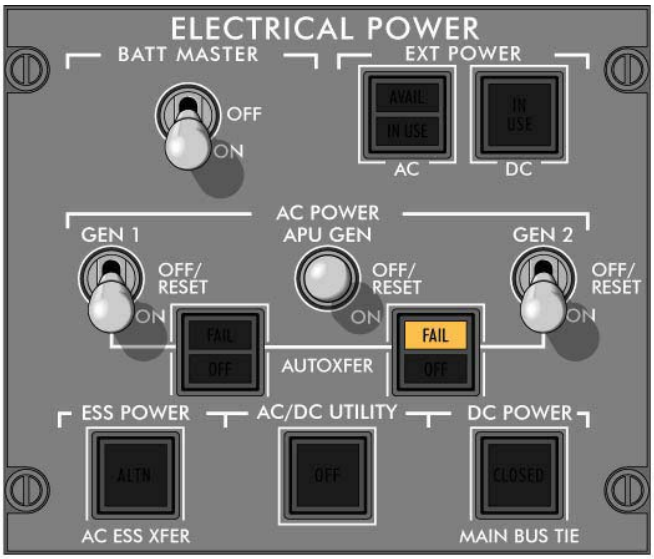


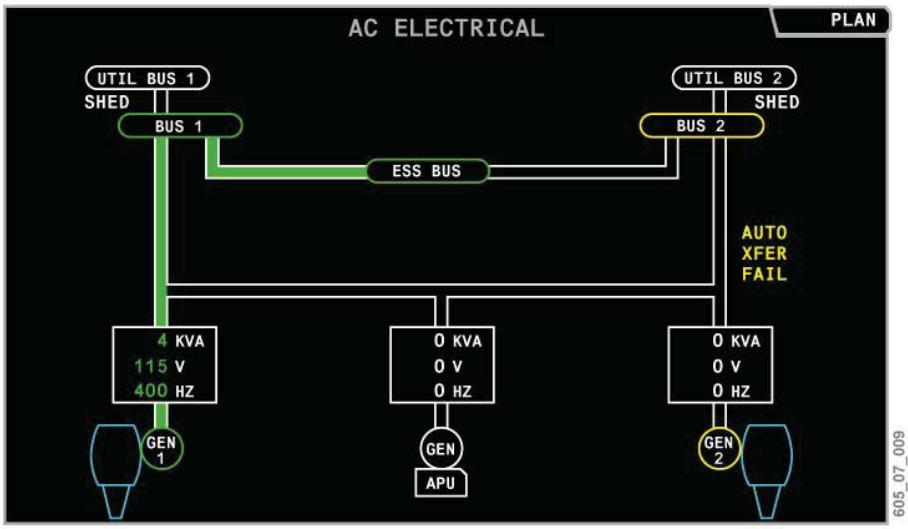
AC BUS 2 AUTOXFER SWITCHLIGHT SELECTED OFF

AC BUS Automatic Transfer
Figure 07–10–10

AC ELECTRICAL POWER DISTRIBUTION (CONT'D)

Should a bus fault or generator overcurrent condition occur on a main AC bus, the automatic bus transfer priority logic will be inhibited, isolating the fault from the remaining AC electrical system. This condition is indicated by the **AC 1 (2) AUTOXFER** caution EICAS message, illumination of the corresponding amber FAIL annunciator on the AUTOXFER switch/light, and the amber AUTO XFER FAIL icon on the AC ELECTRICAL synoptic page.





AC BUS 2 AUTOMATIC TRANSFER FAILURE

AC BUS Automatic Transfer Fail
Figure 07–10–11

AC ESS (Essential) Bus

The AC ESS BUS supplies power to the equipment essential for flight. It is normally powered by AC BUS 1, but may also be powered by AC BUS 2 or the ADG BUS. The AC ESS BUS supplies power to ESS TRU 1, which provides DC power to the DC ESS BUS and the BATT BUS.

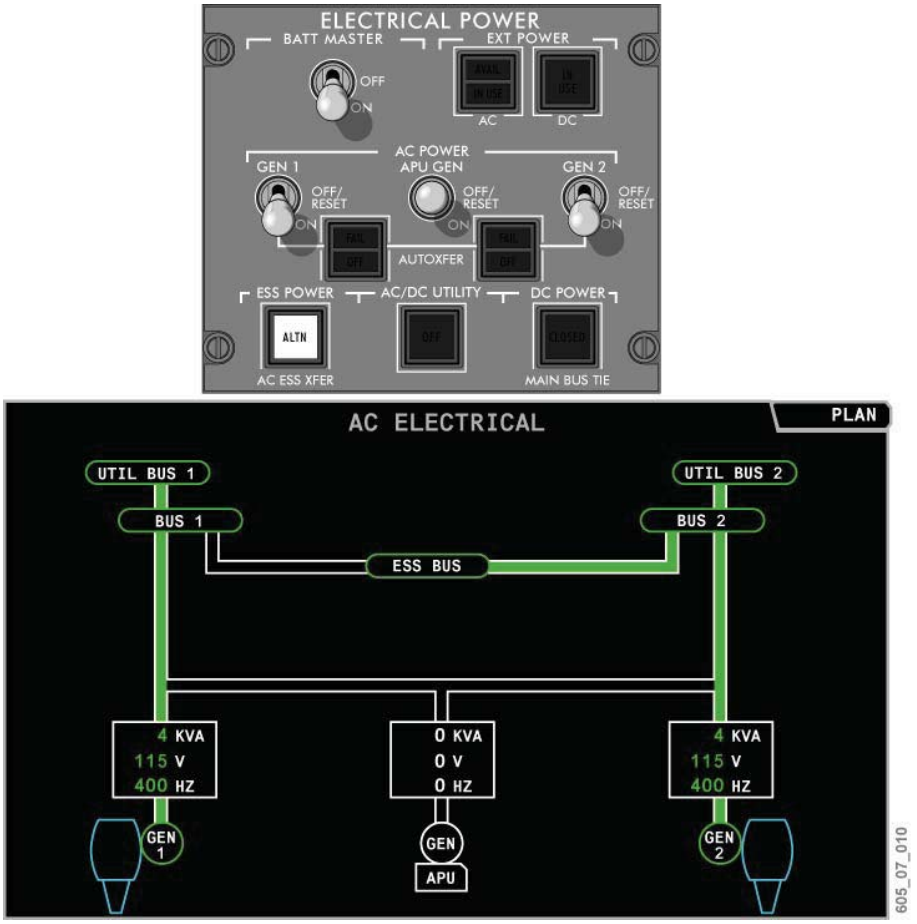
Refer to the ADG section in this chapter for information on the ADG BUS.

AC ELECTRICAL POWER DISTRIBUTION (CONT'D)

AC ESS Bus Transfer

If a loss of power on AC BUS 1 is sensed, the AC ESS BUS is automatically transferred to AC BUS 2. When an automatic transfer to AC BUS 2 occurs, the AC ESS XFER switch/light located on the ELECTRICAL POWER panel illuminates and the **AC ESS ALTN** status EICAS message appears.

If the automatic transfer fails to occur, the AC ESS BUS can be manually transferred to AC BUS 2 by pressing the AC ESS XFER switch/light.



AC Essential Bus on Alternate Source
Figure 07–10–12

AC Utility Buses

AC UTILITY BUS 1 and 2 receive power from AC BUS 1 and 2 respectively. The AC utility buses supply AC power to nonessential cabin equipment.

Utility Bus Shedding

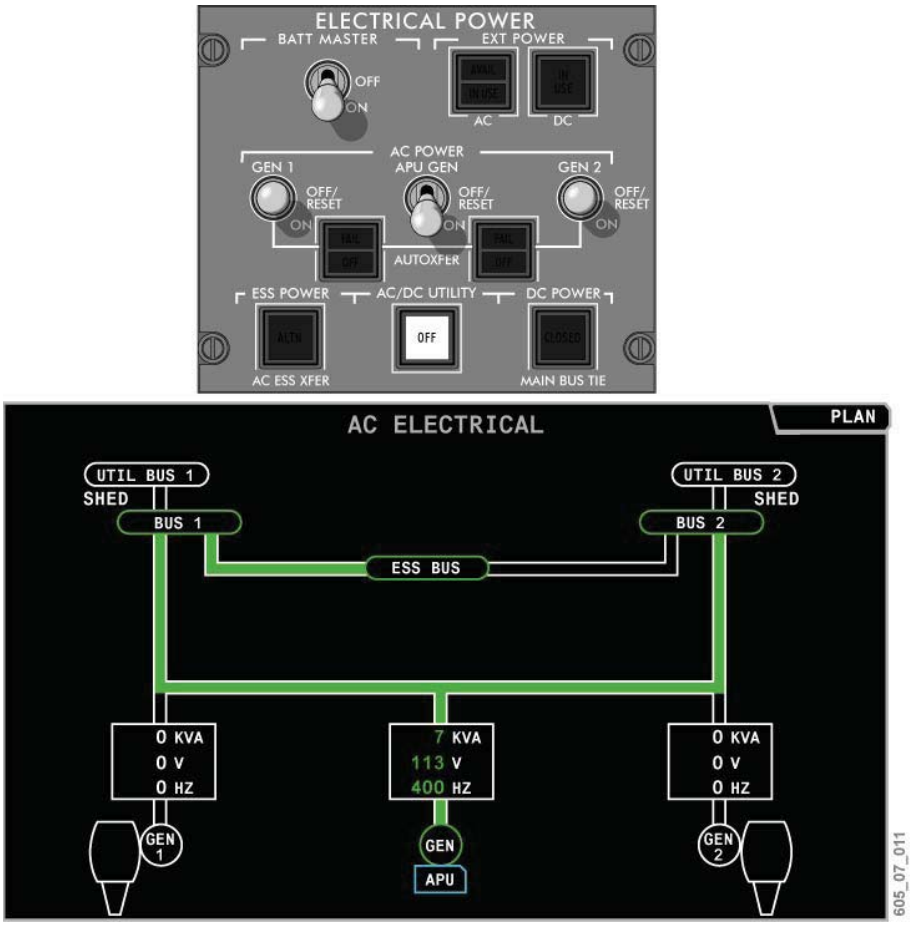
During single-generator operation in flight, AC UTILITY BUS 1 and 2 are automatically load shed, to reduce the electrical load on the remaining generator.

During ground operations, AC UTILITY BUS 1 and 2 are load shed when a single generator (or external AC power only) is supplying AC power, and the flaps are not retracted.

AC ELECTRICAL POWER DISTRIBUTION (CONT'D)

Manual load shedding of utility buses can be accomplished by pressing the AC UTILITY switch/light on the ELECTRICAL POWER panel.

Load shedding is indicated by the illumination of the AC UTILITY switch/light and the respective bus SHED icons on the AC ELECTRICAL synoptic page.



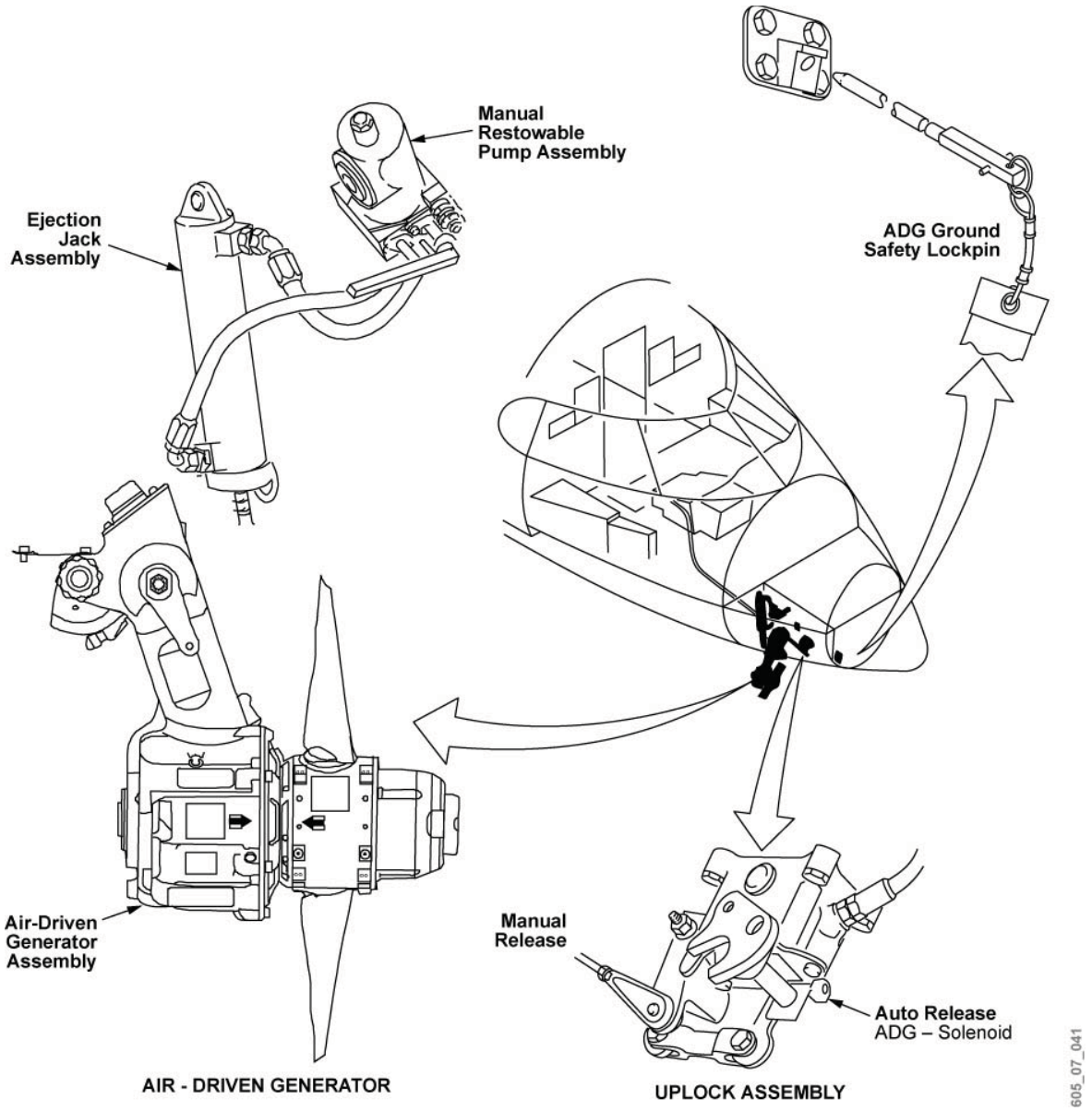
AC Utility Bus Shedding
Figure 07–10–13

AIR-DRIVEN GENERATOR (ADG)

Description

The ADG provides 115-volt, 400-Hz, 15-kVA power to the AC ESS BUS and 3B hydraulic pump, in the event of a complete loss of AC power in flight. The ADG is located in the forward right fuselage beside the nose gear, and is deployed automatically or manually. Once deployed, the ADG can only be restowed when the aircraft is on the ground.

AIR-DRIVEN GENERATOR (ADG) (CONT'D)



Air-Driven Generator
Figure 07–10–14

Components and Operation

Air-Driven Generator

The ADG consists of an AC generator mounted on a pivoted support leg, and a variable-pitch two-bladed propeller that turns in the airstream. The constant speed of the ADG is achieved by using a counterweight system to control the propeller pitch angle. This ADG is commonly referred to as the “dry ADG”.

AIR-DRIVEN GENERATOR (ADG) (CONT'D)

An internal heating element is installed around the circumference of the stator, to protect against condensation or frost which may form when a cold soaked ADG enters a hot, high humidity environment.

ADG Generator Control Unit

The ADG generator is controlled and monitored by the ADG generator control unit (GCU). The ADG GCU provides the following functions:

- Monitors and controls ADG voltage output;
- Protects against overvoltage, overfrequency and underfrequency to the ADG BUS; and
- Provides a signal to the ADG auto deploy control unit, to energize the HYD PUMP 3B transfer contactor, emergency AC transfer contactor, and emergency DC transfer contactor when the ADG voltage and frequency are within limits.

ADG AUTO DEPLOY CONTROL Unit

Located on the lower center pedestal, the ADG AUTO DEPLOY CONTROL unit controls the automatic deployment of the ADG.

Automatic deployment of the ADG occurs when:

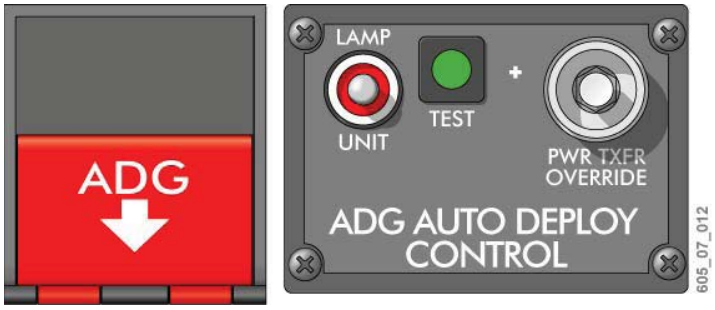
- Both AC BUS 1 and AC BUS 2 become unpowered; and
- The aircraft is in flight.

Another ADG deployment prerequisite is that one of the three main generators must be on line prior to both AC main buses going off. This prevents the ADG from deploying during ground maintenance tests, with external power being connected and disconnected with the aircraft on jacks.

The red **EMER PWR ONLY** warning EICAS message indicates loss of all normal electrical power, and ADG deployment.

When the ADG unit is fully extended, the two-blade propeller is unlocked and rotates in the airstream. Once the ADG voltage and frequency are within normal limits, the AUTO DEPLOY CONTROL unit energizes the appropriate transfer contactors, and allows the ADG to provide power to the AC ESS BUS and to hydraulic pump 3B via the ADG BUS.

The ADG AUTO DEPLOY CONTROL unit sends a signal to release the solenoid of the ADG uplock mechanism.



ADG Manual Deploy Handle and ADG AUTO DEPLOY CONTROL Panel
Figure 07–10–15

AIR-DRIVEN GENERATOR (ADG) (CONT'D)

ADG Manual Deploy Handle

In the event of an auto-deploy failure, the ADG can be manually deployed using the ADG manual deploy handle, located on the lower center pedestal. Pulling the handle manually releases the uplock, allowing the ADG to deploy. In addition, the emergency AC transfer contactor and emergency DC transfer contactor are energized immediately.

In the event the ADG fails, operating the ADG manual deploy handle enables the DC ESS BUS to be supplied by the BATT BUS through the emergency DC transfer contactor.

NOTE

If the ADG is not operating properly and the airplane is on battery power only, then all electrical power may be lost after 30 minutes.

Hydraulic pump 3B will be inoperative when on battery power.

Manual deployment of the ADG handle is also required for landing, when the ADG is the only source of AC electrical power. This ensures that the DC ESS BUS remains powered by the BATT BUS throughout the landing rollout, when the ADG is no longer capable of generating AC power.

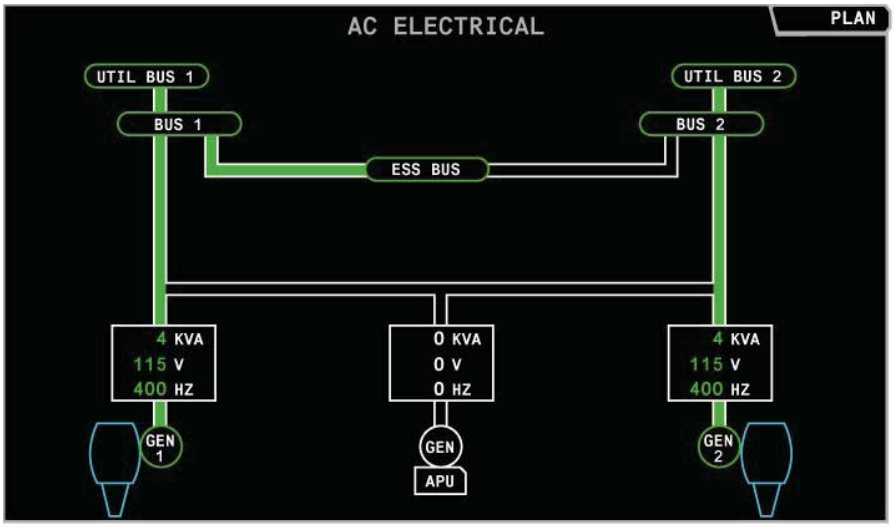
ADG LAMP/UNIT Switch

The ADG auto deploy control unit may be tested using the two-position ADG LAMP/UNIT switch, located on the ADG AUTO DEPLOY CONTROL panel.

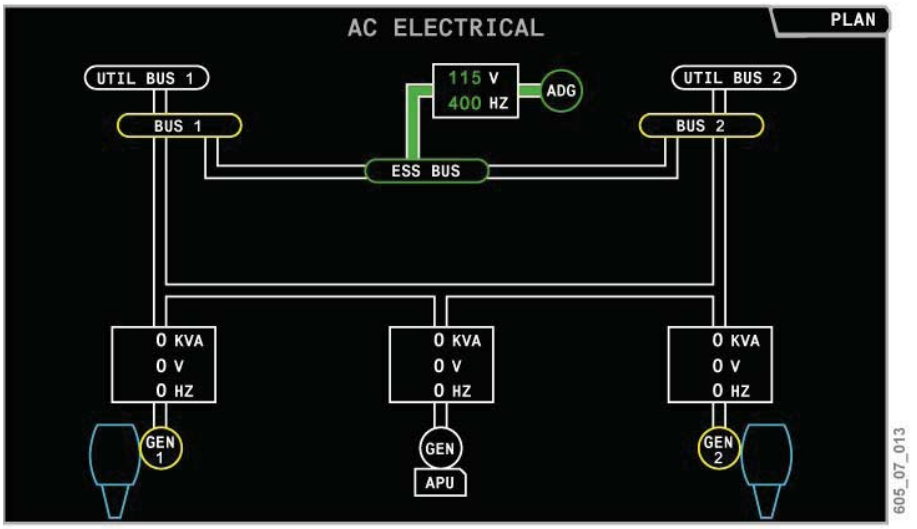
Selecting the switch to the UNIT position tests the continuity of the uplock circuit, the three transfer contactors, and the ADG AUTO DEPLOY CONTROL unit internal logic circuitry. Both engine generators must be operating, and AC BUS 1 and AC BUS 2 must be powered, to ensure a proper test.

Selecting the switch to the LAMP position checks the serviceability of the green TEST lamp only.

AIR-DRIVEN GENERATOR (ADG) (CONT'D)



1. NORMAL OPERATION



2. EMER PWR ONLY – ADG DEPLOYED

ADG Operation
Figure 07–10–16

AIR-DRIVEN GENERATOR (ADG) (CONT'D)

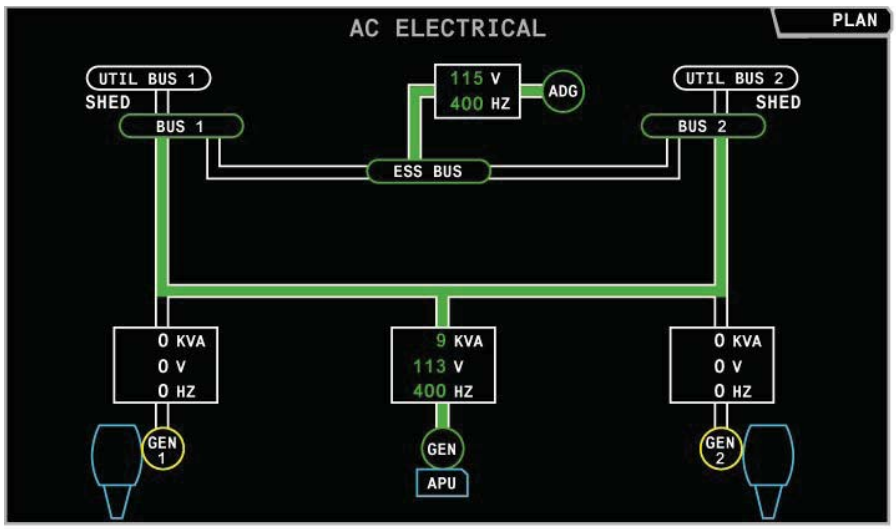
PWR TXFR OVERRIDE

With the ADG deployed, it may be possible to restore normal AC electrical power by resetting an engine-driven generator, or by using the APU generator. If AC electrical power is restored, the PWR TXFR OVERRIDE switch should be selected, to reset the three transfer contactors and regain normal AC distribution. This returns the AC ESS BUS to AC BUS 1, and the 3B hydraulic pump to normal operation.

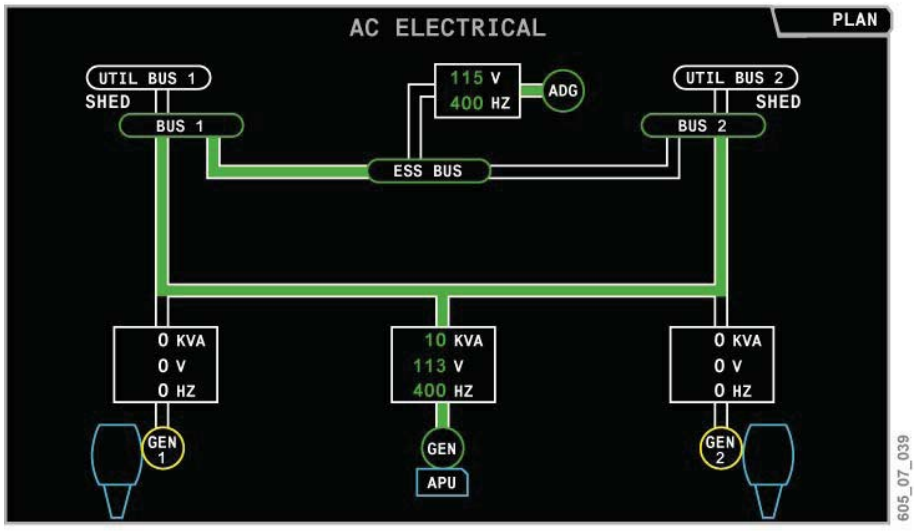
NOTE

The ADG manual deploy handle must be stowed to allow the transfer contactors to reset.

AIR-DRIVEN GENERATOR (ADG) (CONT'D)



3. APU GEN SELECTED ON



4. PWR TXFR OVERRIDE PRESSED

ADG Operation
Figure 07–10–17

DC ELECTRICAL POWER SYSTEM

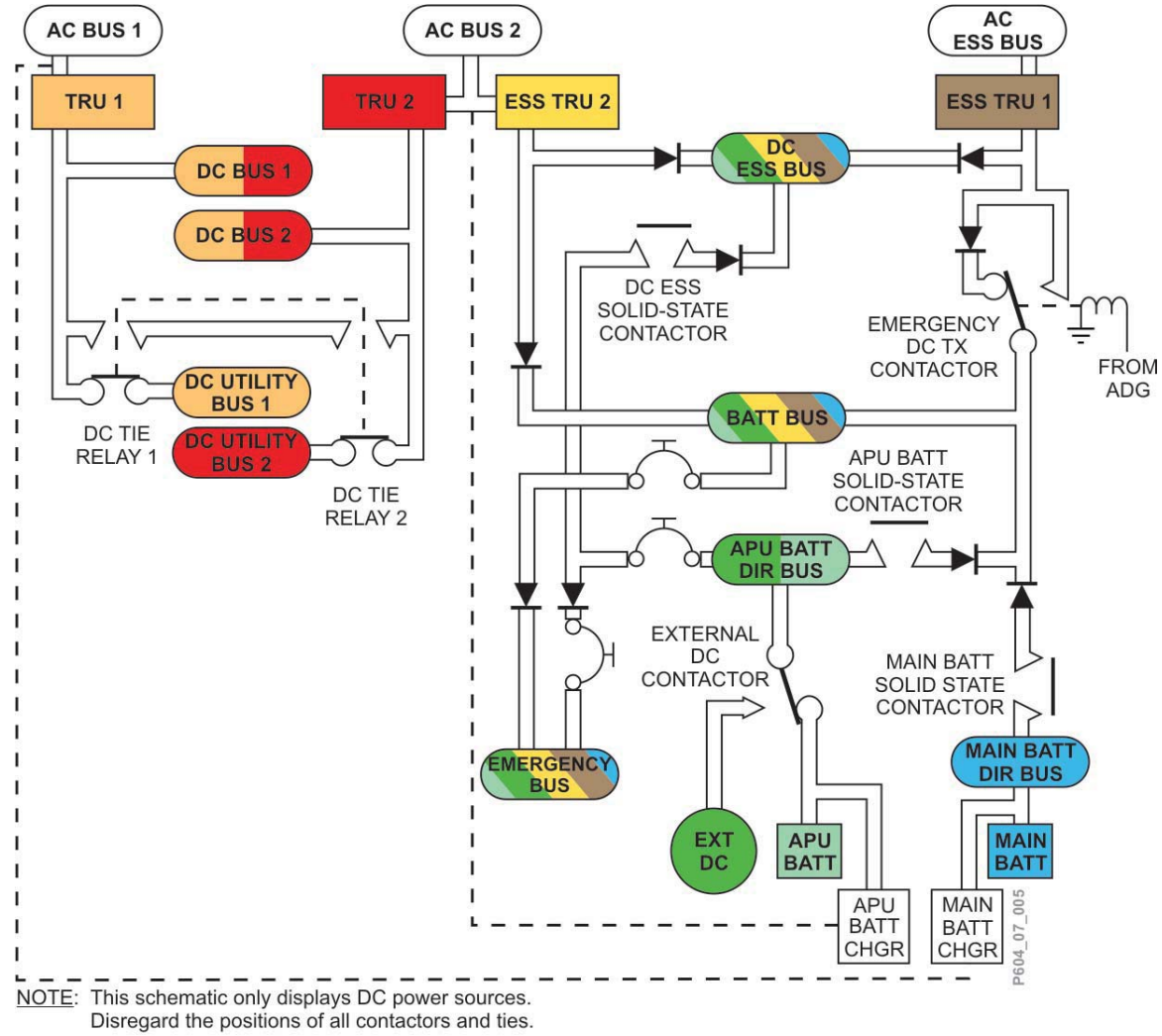
Description

Four transformer-rectifier units (TRUs), two NiCad batteries, and an external DC power receptacle supply direct current (DC) power to the DC buses. The TRUs carry the majority of the DC electrical loads, and the batteries provide emergency power in-flight and allow the APU to be started on the ground.

DC power is distributed to the DC buses directly from the TRUs or batteries, and from various contactors which provide alternate sources of power.

DC ELECTRICAL POWER SYSTEM (CONT'D)

Electrical power is supplied to the buses through the circuit breaker panels.



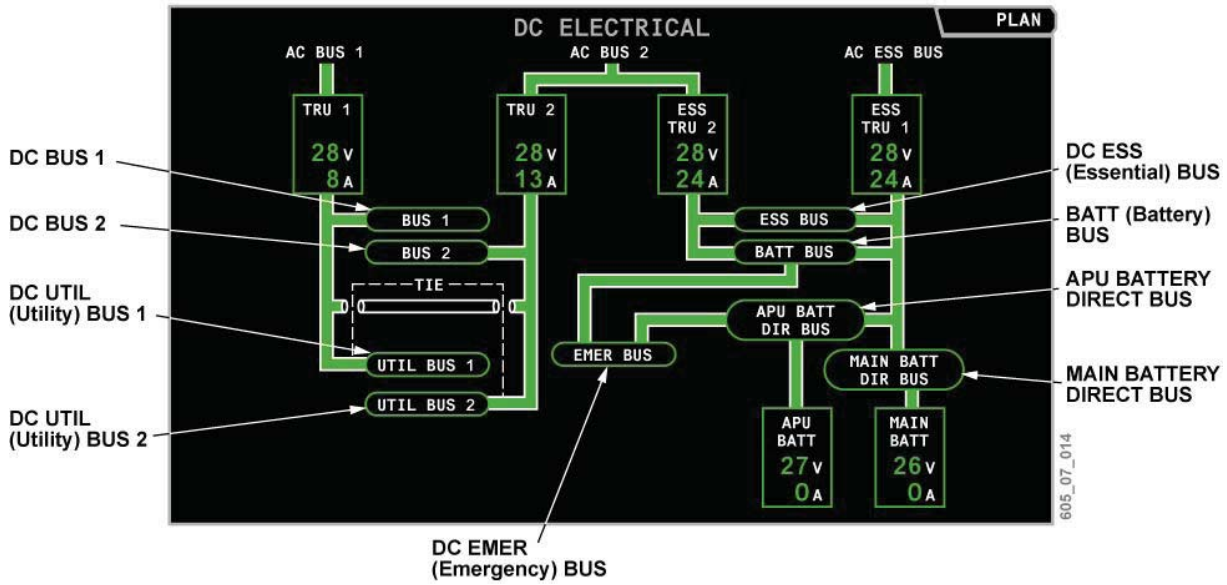
NOTE: This schematic only displays DC power sources. Disregard the positions of all contactors and ties.

DC System Schematic
Figure 07–10–18

Monitoring of system status is done using the DC ELECTRICAL synoptic page. The aircraft DC bus system consists of the following nine buses:

- DC BUS 1;
- DC BUS 2;
- DC ESS (Essential) BUS;
- DC EMER (Emergency) BUS;
- BATT (Battery) BUS;
- DC UTIL (Utility) BUS 1;
- DC UTIL (Utility) BUS 2;
- MAIN BATTERY DIRECT BUS; and
- APU BATTERY DIRECT BUS.

DC ELECTRICAL POWER SYSTEM (CONT'D)



DC ELECTRICAL Synoptic Page
Figure 07–10–19

Components and Operation

Transformer-Rectifier Units (TRUs)

The normal sources of 28-volt DC electrical power for the DC system are the four TRUs. Each TRU converts 115-volt AC to 28-volt DC, and supplies it to its respective DC buses. Each TRU is rated at 100 amps.

The four TRUs are identified as:

- TRU 1;
- TRU 2;
- ESS (Essential) TRU 1; and
- ESS (Essential) TRU 2.

The TRUs supply the following buses:

- TRU 1 normally supplies DC BUS 1 and DC UTIL BUS 1;
- TRU 2 normally supplies DC BUS 2 and DC UTIL BUS 2;
- ESS TRU 1 normally supplies DC ESS BUS and DC BATT BUS; and
- ESS TRU 2 normally supplies DC ESS BUS and DC BATT BUS.

DC ELECTRICAL POWER SYSTEM (CONT'D)

TRU Power Distribution System

The TRU power distribution system supplies the following buses:

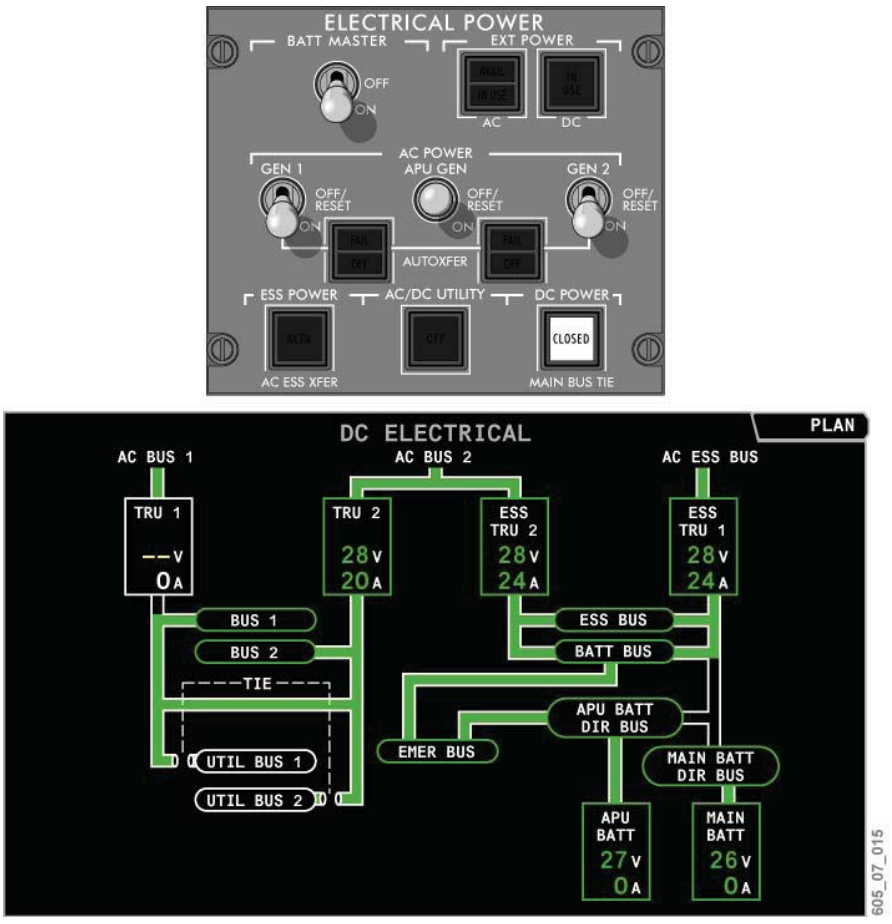
DC BUS 1 and DC BUS 2

DC BUS 1 is supplied by TRU 1, and DC BUS 2 is supplied by TRU 2. If either TRU fails, both buses can be supplied by either TRU by selecting the MAIN BUS TIE switch/light on the ELECTRICAL POWER panel.

DC UTIL BUS 1 and DC UTIL BUS 2

The DC UTIL buses supply power to nonessential cabin equipment. TRU 1 and TRU 2 power DC UTILITY BUS 1 and 2 respectively.

Whenever the MAIN BUS TIE switch/light is selected following a TRU 1 or 2 failure, the DC UTIL buses are load shed to reduce the DC electrical load.



TRU 1 Failed and MAIN BUS TIE Closed
Figure 07–10–20

DC ELECTRICAL POWER SYSTEM (CONT'D)

DC ESS BUS

The DC ESS BUS powers equipment essential for safe flight and, therefore, may be supplied by numerous DC sources to ensure redundancy of its power supply. Normally, ESS TRU 1 and ESS TRU 2 power the DC ESS BUS. In the event of a single ESS TRU failure, either ESS TRU is capable of sustaining the DC ESS BUS load. Should both ESS TRUs fail with the aircraft in flight, the APU BATT DIR BUS, through the DC ESS solid-state contactor, will power the DC ESS BUS.

During ADG operation, the AC ESS BUS powers ESS TRU 1, which in turn powers the DC ESS BUS. The DC ESS BUS can also be powered by the APU and main batteries, through the emergency DC transfer contactor. Refer to the ADG section of this chapter for additional information.

BATT BUS

The BATT BUS powers equipment essential for safe flight, and may be supplied by several DC sources to ensure redundancy. Normally, ESS TRU 1 and ESS TRU 2 power the BATT BUS when the main AC buses are powered. If the ESS TRUs are not operating (no AC power or ESS TRU failures), the BATT BUS will be powered by the APU BATT DIR BUS and MAIN BATT DIR BUS, provided the BATT MASTER switch is selected ON.

The BATT MASTER switch, located on the ELECTRICAL POWER panel, controls the APU BATT and MAIN BATT contactors to supply the BATT BUS, as described above.

The BATT BUS also supplies the DC EMER BUS.

Battery Power Distribution System

The battery power distribution system represents a small portion of the aircraft's total DC load. The batteries primarily provide the energy needed to start the APU, which can then be used to supply AC power to the aircraft. The batteries also supply emergency DC power in-flight, should all AC power be lost and the ADG become inoperative.

Two rechargeable nickel-cadmium (NiCad) batteries are installed in the aircraft. The main battery is a 24-volt, 17-amp/hour battery located in the nose section. The APU battery is a 24-volt, 43-amp/hour battery, installed in the aft equipment bay.

The batteries supply DC electrical power to the following buses:

- MAIN BATT DIR BUS;
- APU BATT DIR BUS;
- DC EMER BUS; and
- BATT BUS.

Battery Charging

The main battery charger and APU battery charger are in a charging configuration at all times, when the applicable main AC buses are powered.

- AC BUS 1 for main battery charger
- AC BUS 2 for APU battery charger

The battery chargers operate automatically in various modes, based on battery temperatures. Should a battery or battery charger fault be detected, the respective battery charger will shut down. A **MAIN (APU) BATT CHGR FAIL** status EICAS message will appear, and the CHGR OFF icon will be displayed on the DC ELECTRICAL synoptic page, indicating a failure.

DC ELECTRICAL POWER SYSTEM (CONT'D)

MAIN and APU BATT DIR Buses

These DC buses are continuously powered from the associated battery, regardless of the BATT MASTER switch position. The main battery is connected to the MAIN BATT DIR BUS, and the APU battery is connected to the APU BATT DIR BUS. These buses provide power to the aircraft systems which primarily relate to ground service operation (refueling, service lights, etc.) The APU BATT DIR BUS also supplies the DC EMER BUS.

DC Emergency Bus

The DC EMER BUS provides power to the engine and APU fire extinguishers, and the fuel and hydraulic shutoff valves. The bus is connected to the APU BATT DIR BUS and the BATT BUS, and is continuously powered.

External DC Electrical Power

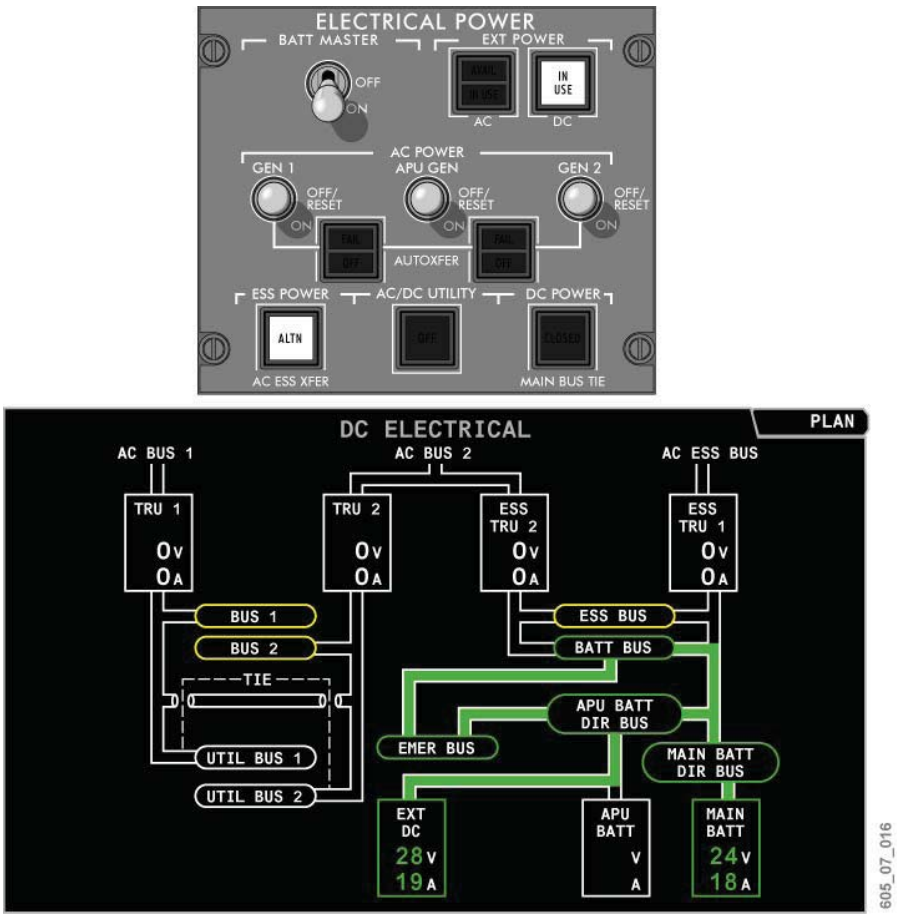
External DC ground power may be used to start the APU, if the APU battery charge is low. The external DC receptacle is located at the rear of the aircraft, near the right engine pylon.

External DC Receptacle
Figure 07–10–21

When connected, external DC ground power automatically supplies the APU BATT DIR BUS through the external DC contactor, and the BATT BUS when the BATT MASTER switch is selected ON. The DC EXTERNAL POWER white IN USE light, on the ELECTRICAL POWER panel, illuminates whenever DC external power is connected.

External DC ground power is identified on the DC electrical synoptic page by the symbol EXT DC. This symbol appears only if DC external power is connected to the aircraft.

DC ELECTRICAL POWER SYSTEM (CONT'D)



External DC Power Connected
Figure 07–10–22

Circuit Breakers

Description

Electrical power distribution is accomplished through five circuit breaker panels. Four circuit breaker panels are installed in the flight deck, and the fifth panel is in the aft equipment bay. They are identified as follows:

- Circuit breaker panel 1 (CBP–1);
- Circuit breaker panel 2 (CBP–2);
- Circuit breaker panel 3 (CBP–3);
- Circuit breaker panel 4 (CBP–4); and
- Circuit breaker panel 5 (CBP–5).

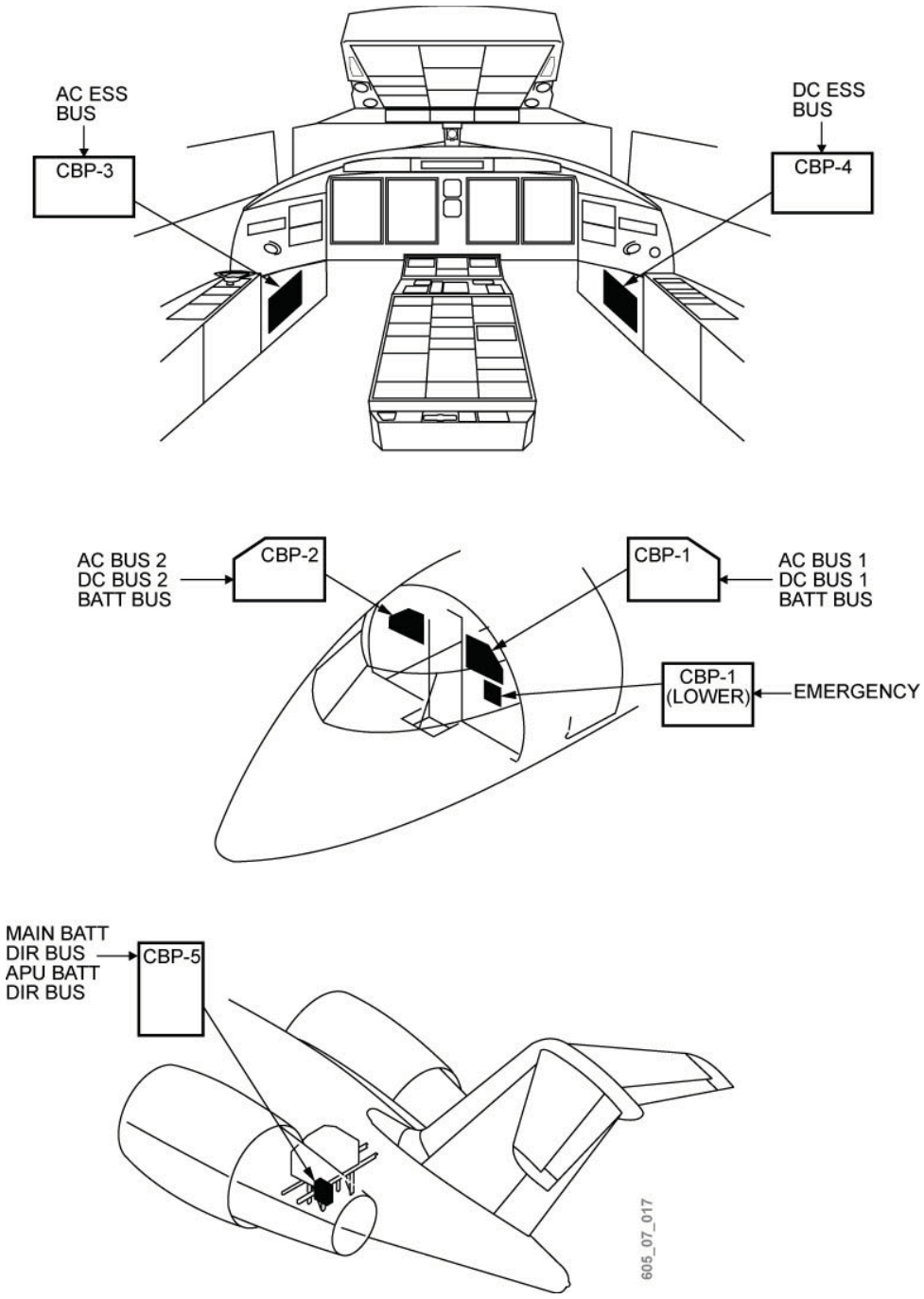
DC ELECTRICAL POWER SYSTEM (CONT'D)

Electrical equipment protection is provided by conventional thermal circuit breakers. When a circuit breaker is tripped, a white collar is exposed. Depending on airplane completion specification, circuit breakers may also be located in other parts of the airplane. Should a circuit breaker trip while the airplane is in flight, the circuit breaker should be allowed to cool for as long as possible before resetting.

NOTE

Do not attempt more than one reset of a circuit breaker.

DC ELECTRICAL POWER SYSTEM (CONT'D)



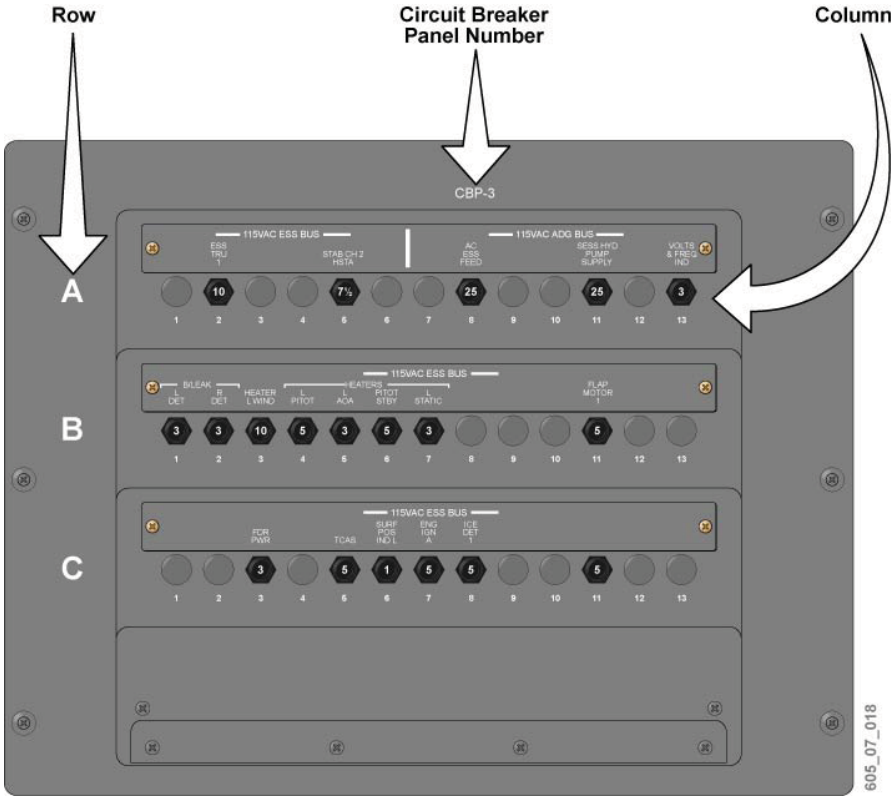
Circuit Breaker Panels (CBPs)
Figure 07–10–23

DC ELECTRICAL POWER SYSTEM (CONT'D)

Circuit Breaker Grid System

A circuit breaker can be located, when called for in a procedure, by using the grid reference on the circuit breaker panel.

For example, the “VOLTS & FREQ IND” circuit breaker location is identified as (3A13), and therefore found on panel CBP–3, row A, column 13.



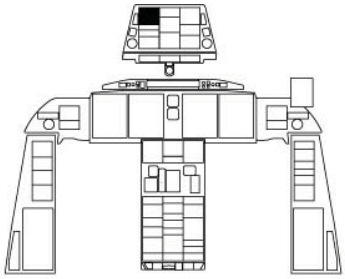
Circuit Breaker Grid System
Figure 07–10–24

CONTROLS AND INDICATORS

The overhead ELECTRICAL POWER panel and the air-driven generator (ADG) panel provide the system controls. The AC ELECTRICAL and DC ELECTRICAL synoptic pages provide a pictorial representation of system status. The EICAS pages provide system caution and advisory messages respectively. Circuit breaker panel (CBP) diagrams are also located in this section.

CONTROLS AND INDICATORS (CONT'D)

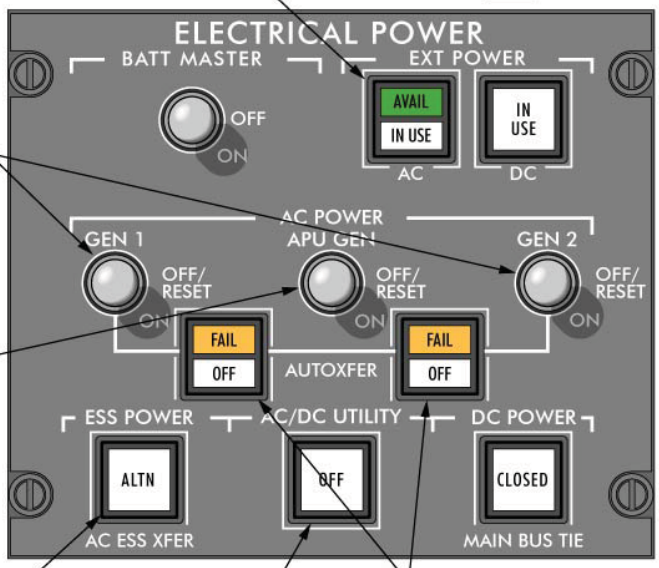
AC Electrical Power



External AC Power Switch/Light (alternate-action)
Connects external AC power to appropriate main AC BUS(s) when the AVAIL light is illuminated.
AVAIL Light
Illuminated – Indicates that external AC power is connected and operating within limits.
IN USE Light
Illuminated – Indicates external AC power is connected and supplying the appropriate main AC BUS(s).

GEN 1 (2) Switch
ON – Connects applicable generator to appropriate main AC BUS(s) provided it is operating normally.
OFF/RESET
- Disconnects applicable generator from main AC BUS(s)
- Resets generator control circuit

APU GEN Switch
ON – Connects APU generator to appropriate main AC BUS(s) provided it is operating normally.
OFF/RESET
- Disconnects APU generator from main AC BUS(s).
- Resets generator control circuit.



AC ESS XFER Switch/Light (alternate-action)
Manually transfers source of power for AC ESS BUS from AC BUS 1 to AC BUS 2.
ALTN Light
Illuminated – Indicates AC ESS BUS is being supplied from AC BUS 2.

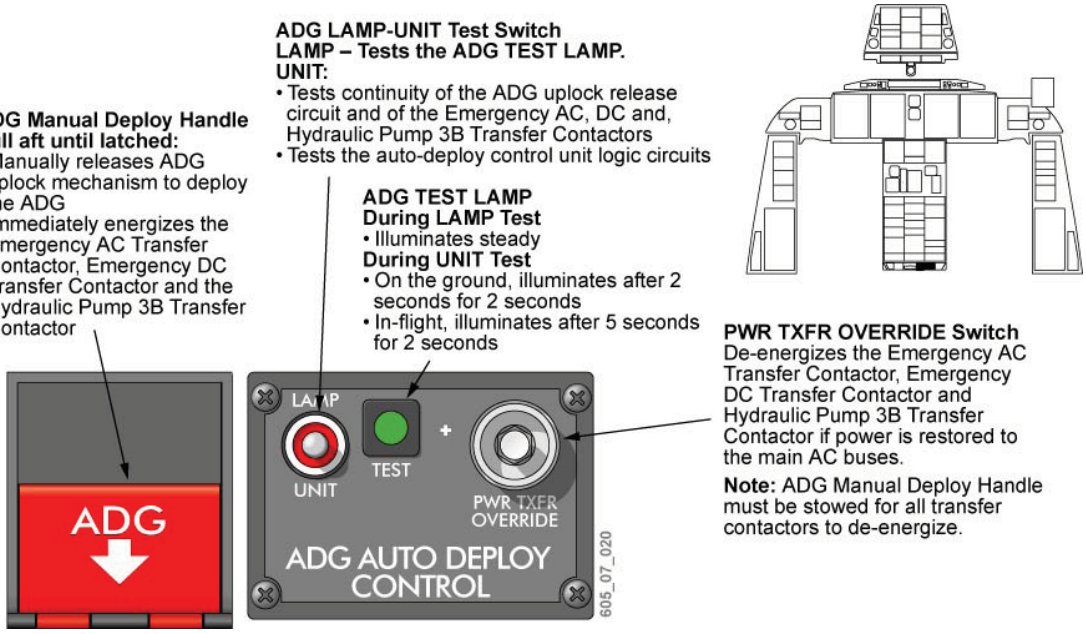
AC/DC UTILITY Switch/Light
Manually shed AC UTILITY BUS 1 and 2.
Illuminated – Indicates AC UTILITY buses 1 and 2 have been load shed.

AC AUTOXFER Switch/Lights (alternate-action)
Disables automatic bus tie operation for corresponding main AC BUS (left AC BUS 1, right AC BUS 2).
OFF Light
Illuminated – Indicates automatic bus tie operation has been manually disabled.
FAIL Light
Illuminated – Indicates automatic bus tie operation has been automatically disabled due to a bus fault or generator overcurrent condition.

ELECTRICAL POWER Panel
Figure 07–10–25

CONTROLS AND INDICATORS (CONT'D)

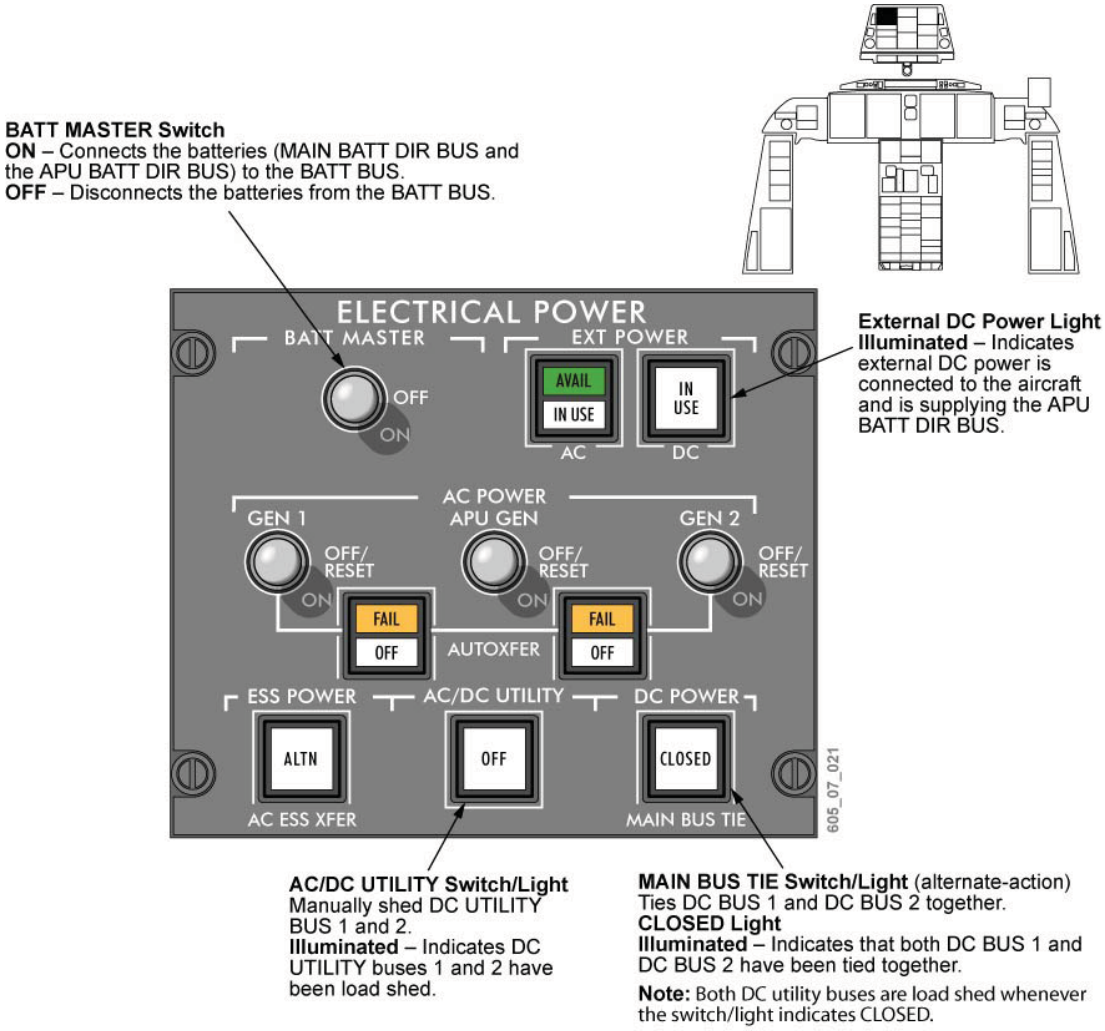
Air-Driven Generator (ADG)



Air-Driven Generator (ADG)
Figure 07–10–26

CONTROLS AND INDICATORS (CONT'D)

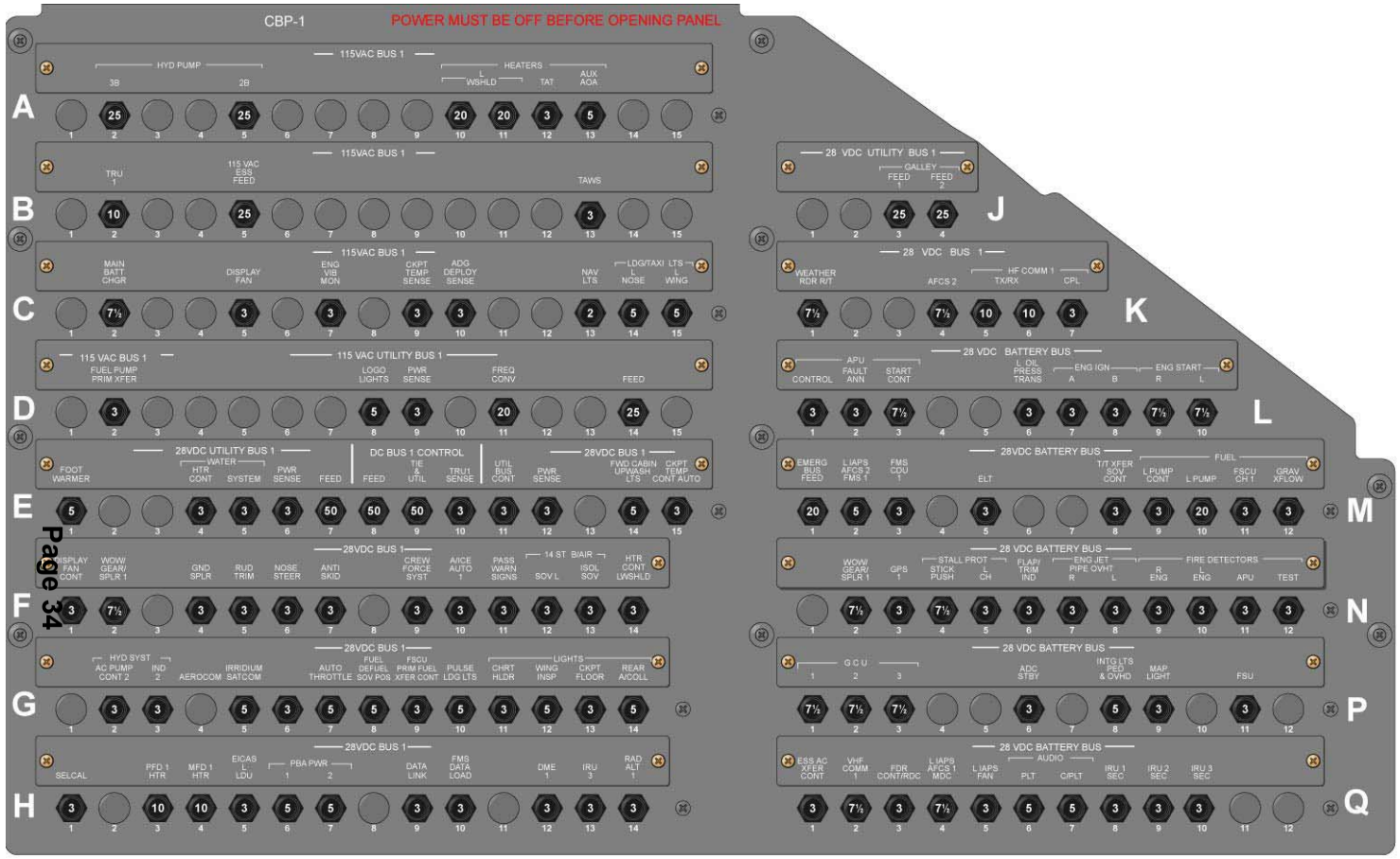
DC Electrical Power



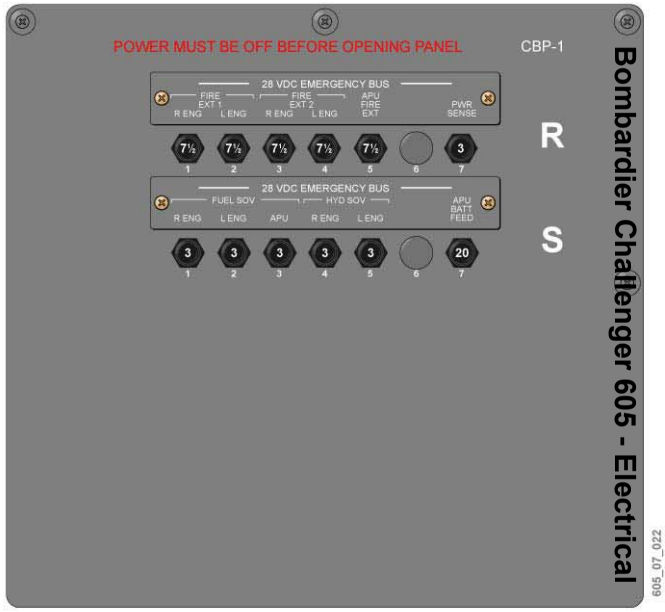
ELECTRICAL POWER Panel
Figure 07–10–27

Circuit Breaker Panels

CONTROLS AND INDICATORS (CONT'D)



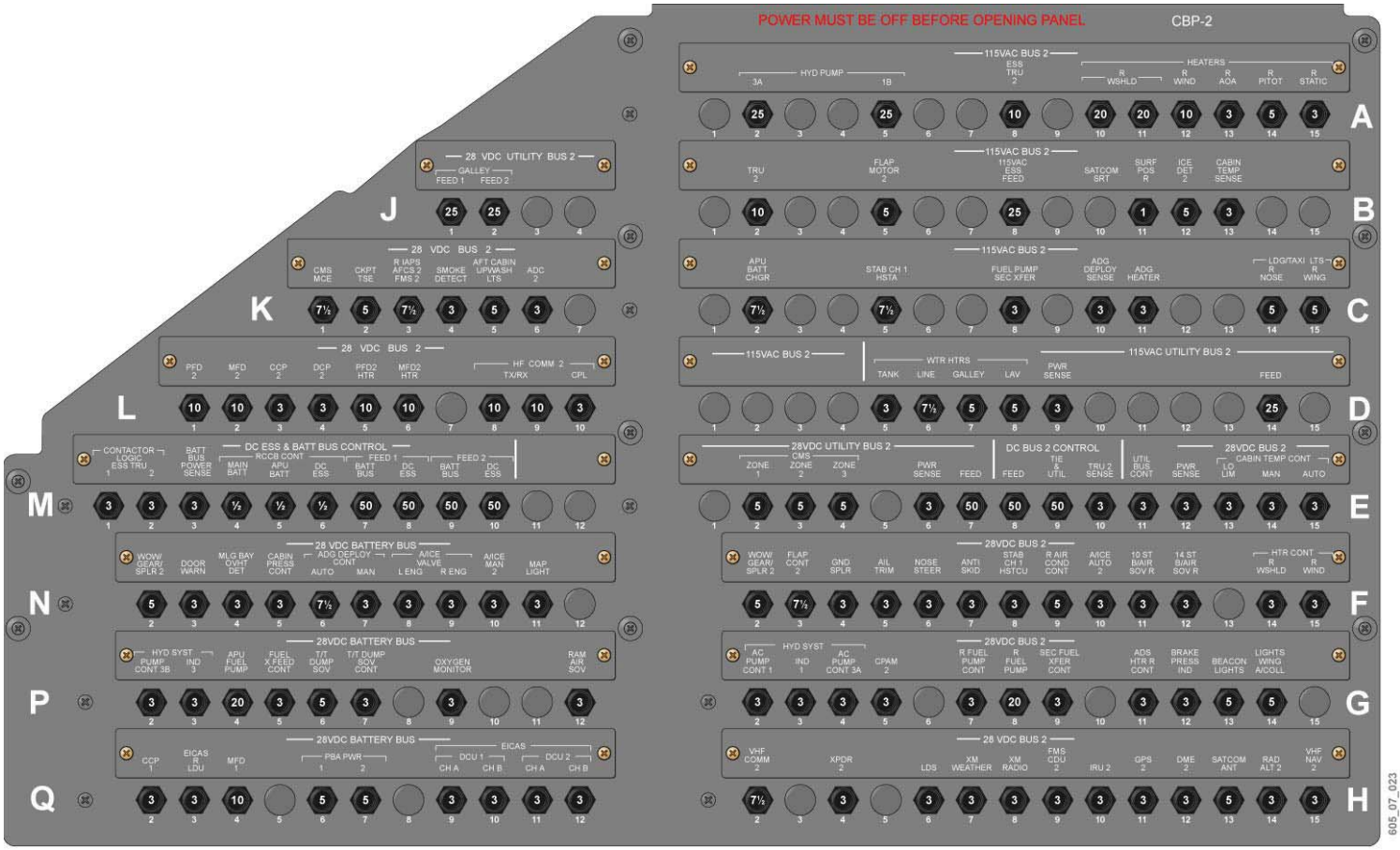
CIRCUIT BREAKER PANEL CBP - 1



CIRCUIT BREAKER PANEL CBP - 1 (LOWER)

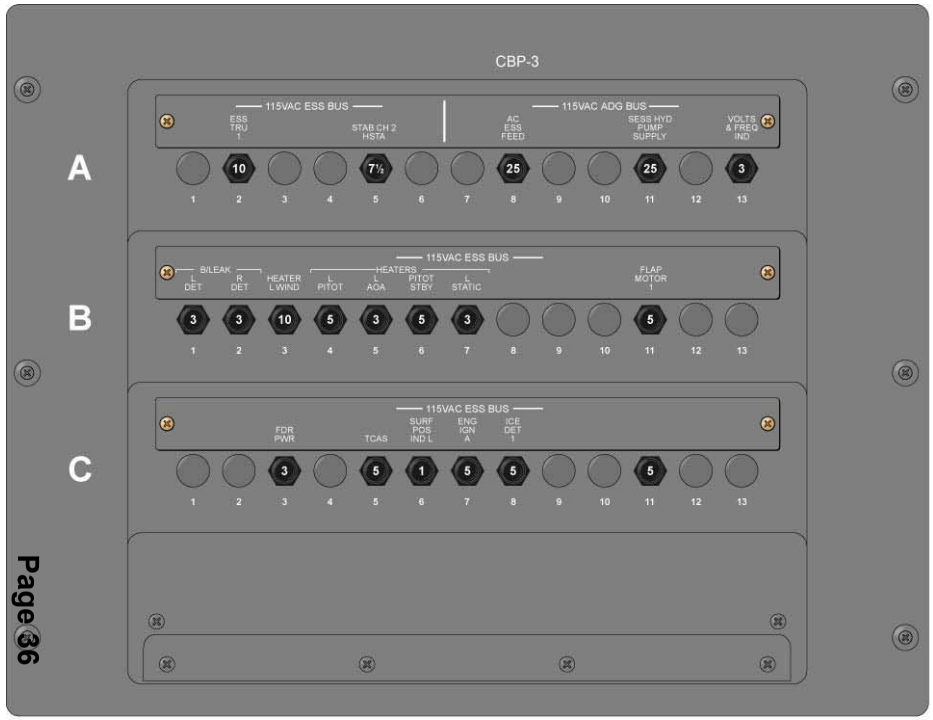
Circuit Breaker Panel 1
Figure 07–10–28

CONTROLS AND INDICATORS (CONT'D)

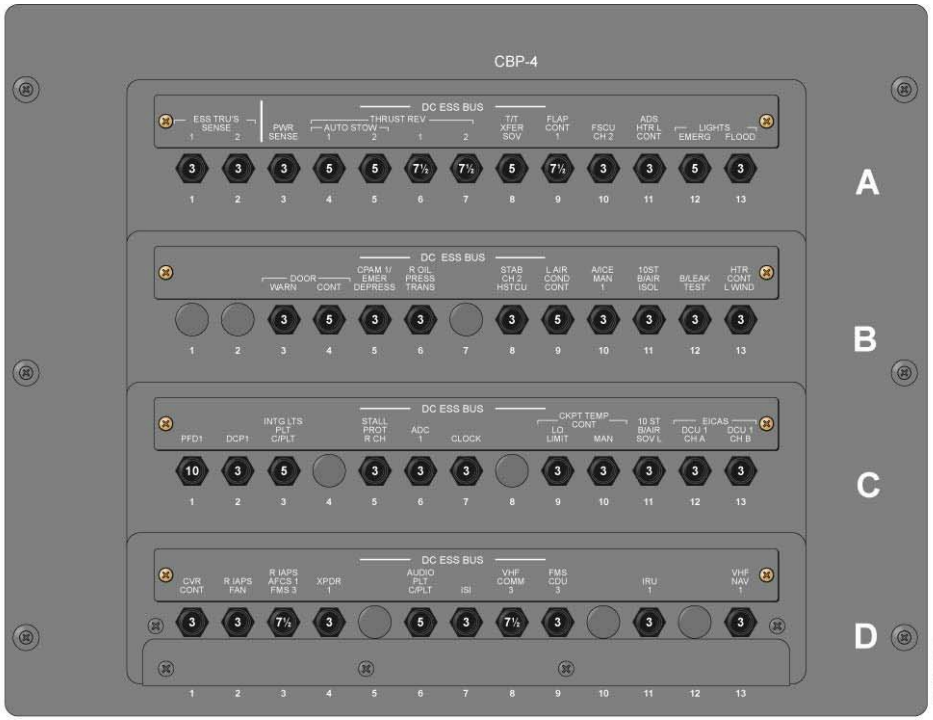


CIRCUIT BREAKER PANEL CBP - 2

Circuit Breaker Panel 2
Figure 07–10–29



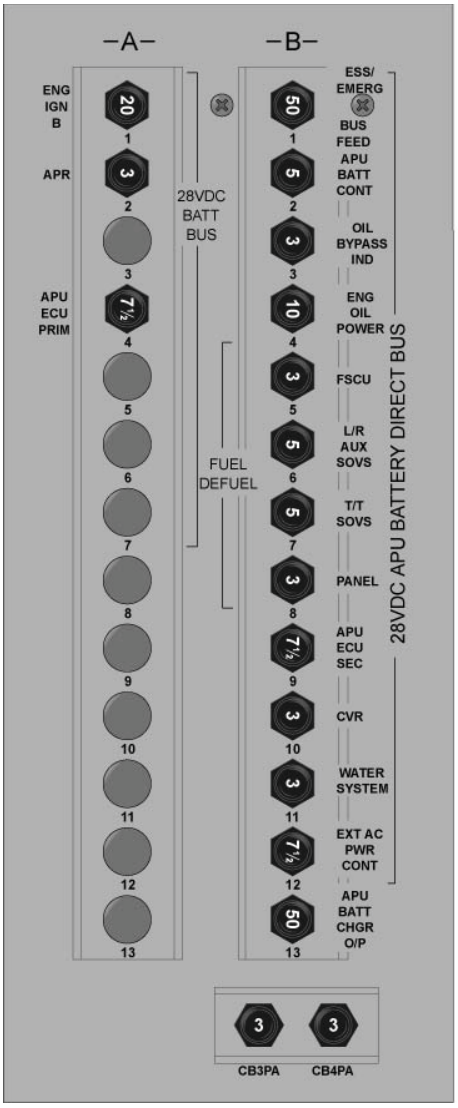
CIRCUIT BREAKER PANEL CBP-3



CIRCUIT BREAKER PANEL CBP-4

Circuit Breaker Panels 3 & 4
Figure 07–10–30

CONTROLS AND INDICATORS (CONT'D)

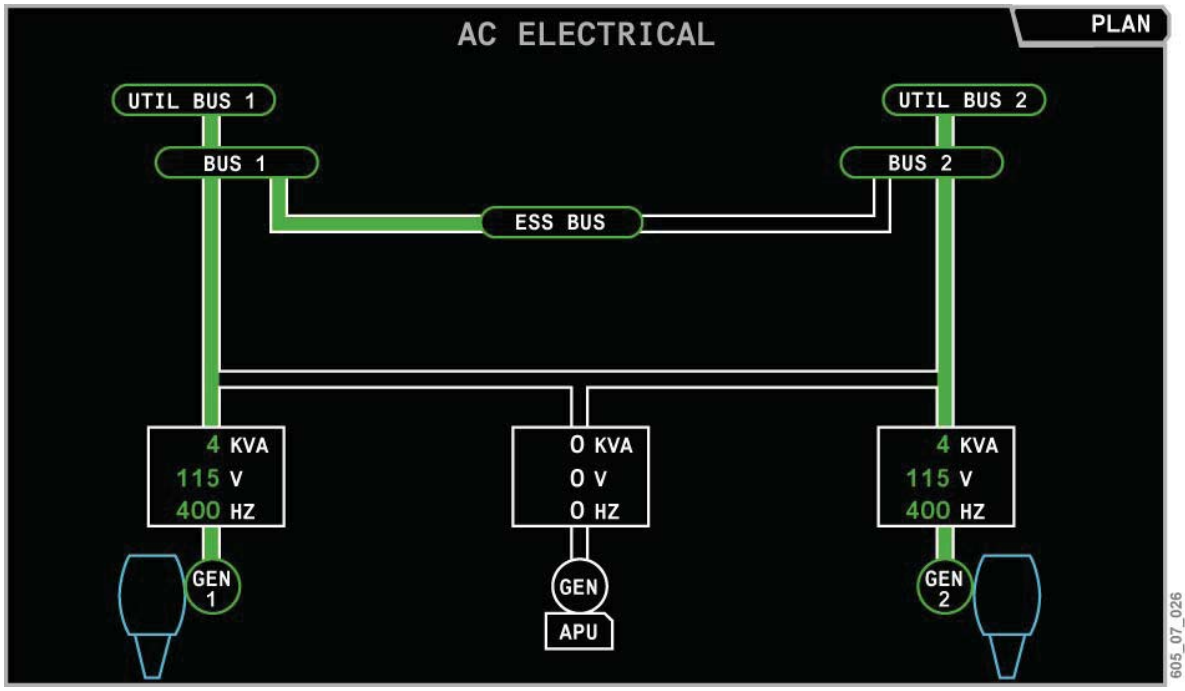


Circuit Breaker Panel 5
Figure 07–10–31

CONTROLS AND INDICATORS (CONT'D)

EICAS Synoptic Pages

AC Synoptic Page



AC Synoptic Page Colour Coding – Integrated Drive Generators
Figure 07–10–32

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
Engine Outline		Engine off
		Engine running and ready to load
		Invalid data
Generator 1, 2 Outline		Generator on-line
		Generator off with engine running
		Both respective generator and engine are off
		Invalid data
Generator 1, 2 Flow Lines		Normal operating power
		No power
Generator 1, 2 Load Readout	4 KVA	Generator is loaded
	36 KVA	Generator is overloaded
	0 KVA	Generator is not on-line
	17 KVA	Invalid data
	- - KVA	Invalid data or outside display range
Generator 1, 2 Voltage Readout	115 V	Voltage between 100 and 125 VAC
	94 V	Voltage less than 100 VAC or more than 125 VAC
	- - - V	Invalid data
Generator 1, 2 Frequency Readout	400 HZ	Frequency between 375 and 425 Hz
	429 HZ	Frequency less than 375 Hz or more than 425 Hz
	- - - HZ	Invalid data

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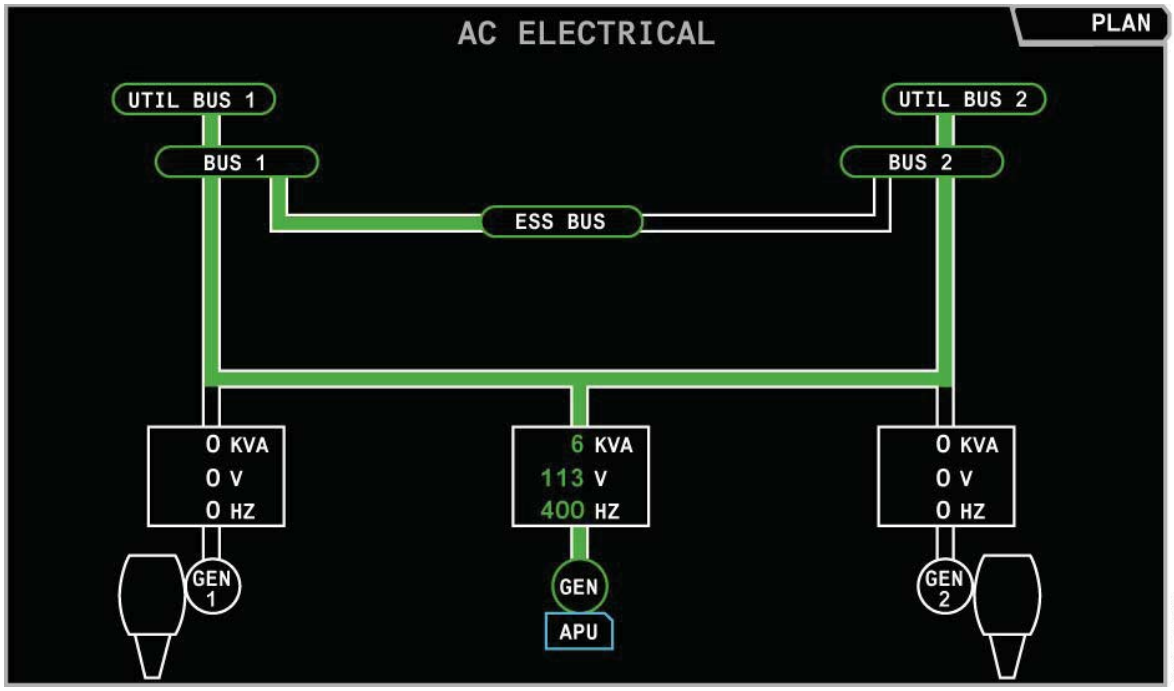
AC Synoptic Page Colour Coding – Integrated Drive Generators
Figure 07–10–33

CONTROLS AND INDICATORS (CONT'D)



AC Synoptic Page Colour Coding – APU Generator
Figure 07–10–34

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
APU Outline	APU	APU off
	APU	APU running and ready to load
	APU	Invalid data
APU Generator Outline	GEN	Generator on-line
	GEN	Generator off with APU running
	GEN	Both respective generator and APU are off
	GEN	Invalid data
APU Generator Output Flow Line		Normal operating power
		No power
APU Generator Load Readout	6 KVA	Generator is loaded
	36 KVA	Generator is overloaded
	0 KVA	Generator is not on-line
	17 KVA	Invalid data
	- - KVA	Invalid data or outside display range
APU Generator Voltage Readout	113 V	Voltage between 100 and 125 VAC
	94 V	Voltage less than 100 VAC or more than 125 VAC
	- - - V	Invalid data
APU Generator Frequency Readout	400 HZ	Frequency between 375 and 425 Hz
	429 HZ	Frequency less than 375 Hz or more than 425 Hz
	- - - HZ	Invalid data

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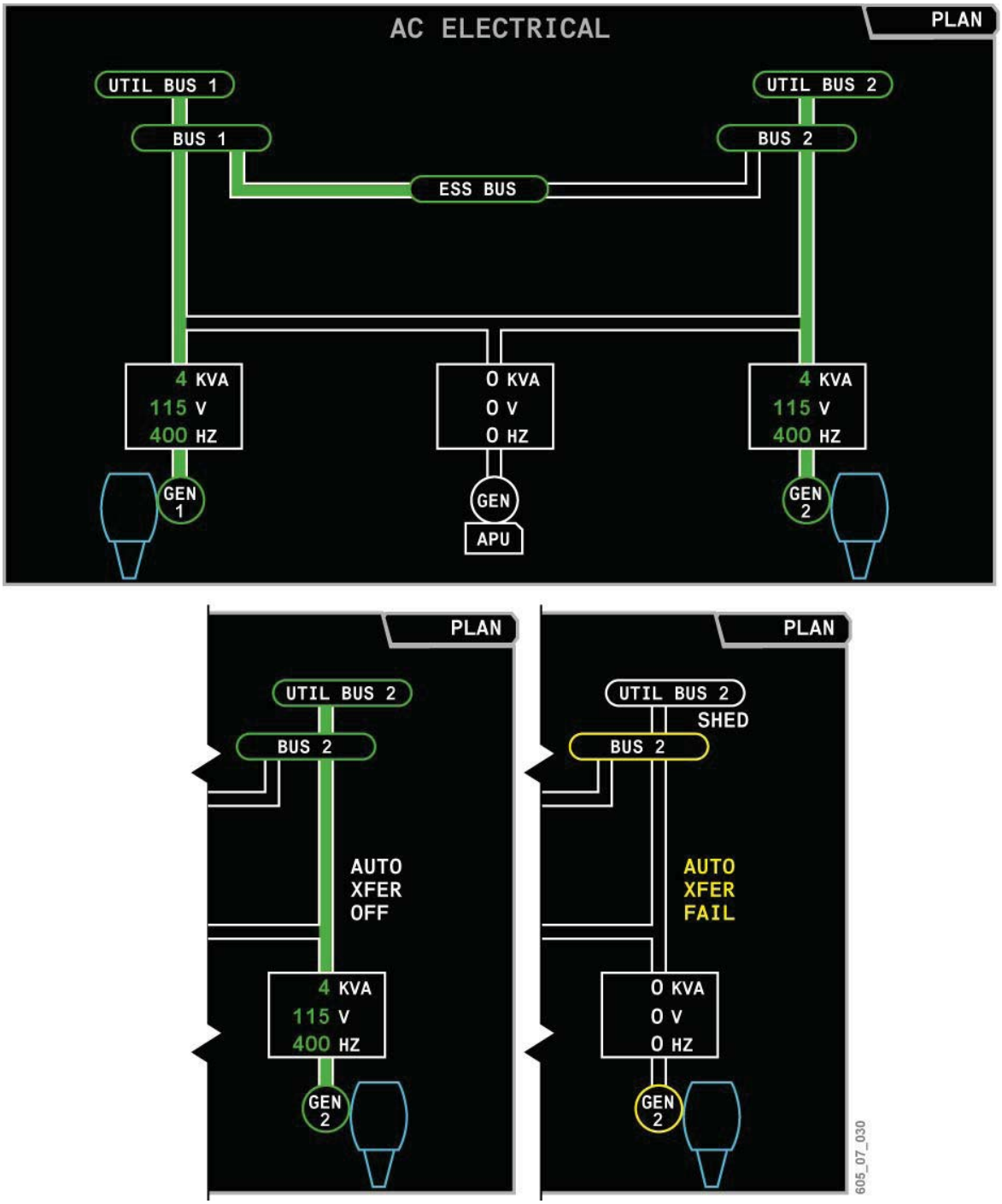
AC Synoptic Page Colour Coding – APU Generator
Figure 07–10–35

CONTROLS AND INDICATORS (CONT'D)



AC Synoptic Page Colour Coding – AC Electrical Power Distribution
Figure 07–10–36

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
AC BUS 1, 2 Outline	BUS 1 BUS 2	Bus powered
	BUS 1 BUS 2	Bus not powered
	BUS 1 BUS 2	Invalid data or data outside display range
ESS BUS Outline	ESS BUS	Bus powered
	ESS BUS	Bus inoperative
	ESS BUS	Invalid data
UTIL BUS 1, 2 Outline	UTIL BUS 1 UTIL BUS 2	Bus powered voltage greater than 90 V
	UTIL BUS 1 UTIL BUS 2	Bus not powered (shed) voltage equal to or less than 90 V
	UTIL BUS 1 UTIL BUS 2	Invalid data or data outside display range
AUTO XFER OFF Icon	AUTO XFER OFF	Displayed when AUTO XFER switch/light is manually selected (auto transfer manually inhibited)
AUTO XFER FAIL Icon	AUTO XFER FAIL	Indicates that the corresponding automatic bus transfer has failed
SHED Icon	SHED	Displayed when AC UTIL BUS 1 and 2 are load shed

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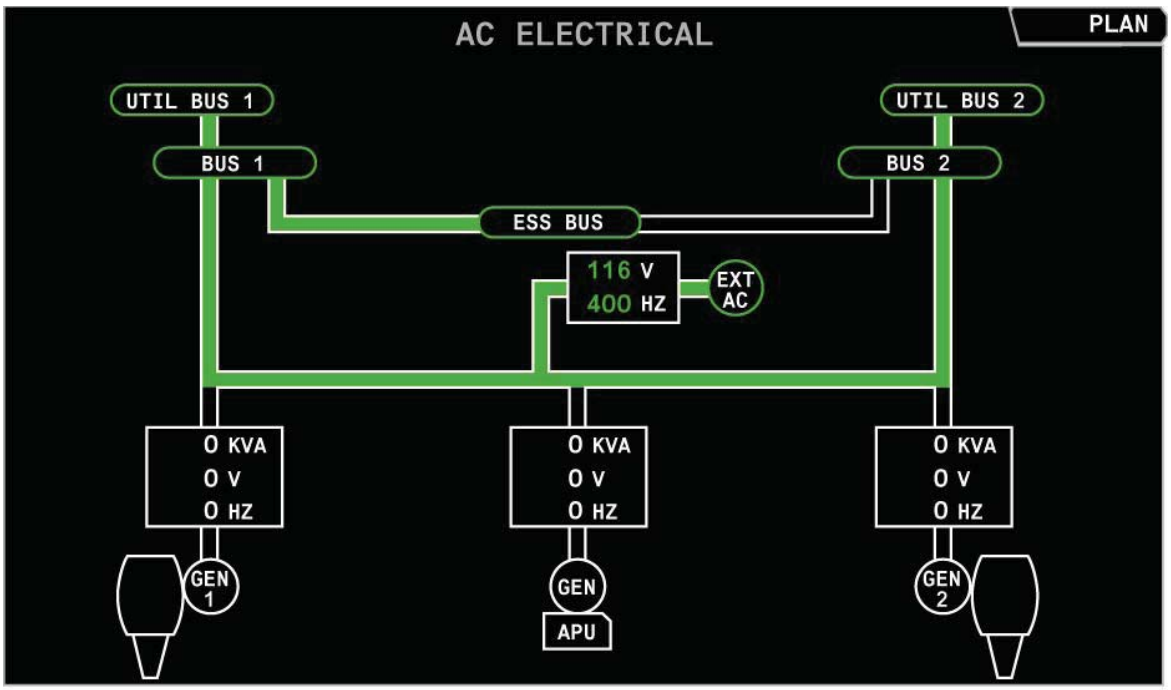
AC Synoptic Page Colour Coding – AC Electrical Power Distribution
Figure 07–10–37

CONTROLS AND INDICATORS (CONT'D)



Description	Symbol	Condition
External AC Outline	EXT AC	External AC power equal to or less than 10 VAC, or external power equal to or less than 50 Hz
	EXT AC	Displayed when external AC power is connected (voltage greater than 10 VAC and frequency greater than 50 Hz)
External AC Input Outline	EXT AC	External AC power is available
External AC Voltage Readout	116 V	Voltage between 106 and 124 VAC
	102 V	Voltage less than 106 VAC or more than 124 VAC
	- - - V	Invalid data or outside display range
External AC Frequency Readout	400 HZ	Frequency between 370 and 430 Hz
	365 HZ	Frequency less than 370 Hz or more than 430 Hz
	- - - HZ	Invalid data or outside display range
External AC Output Line		Normal external AC power
	||	No external AC power

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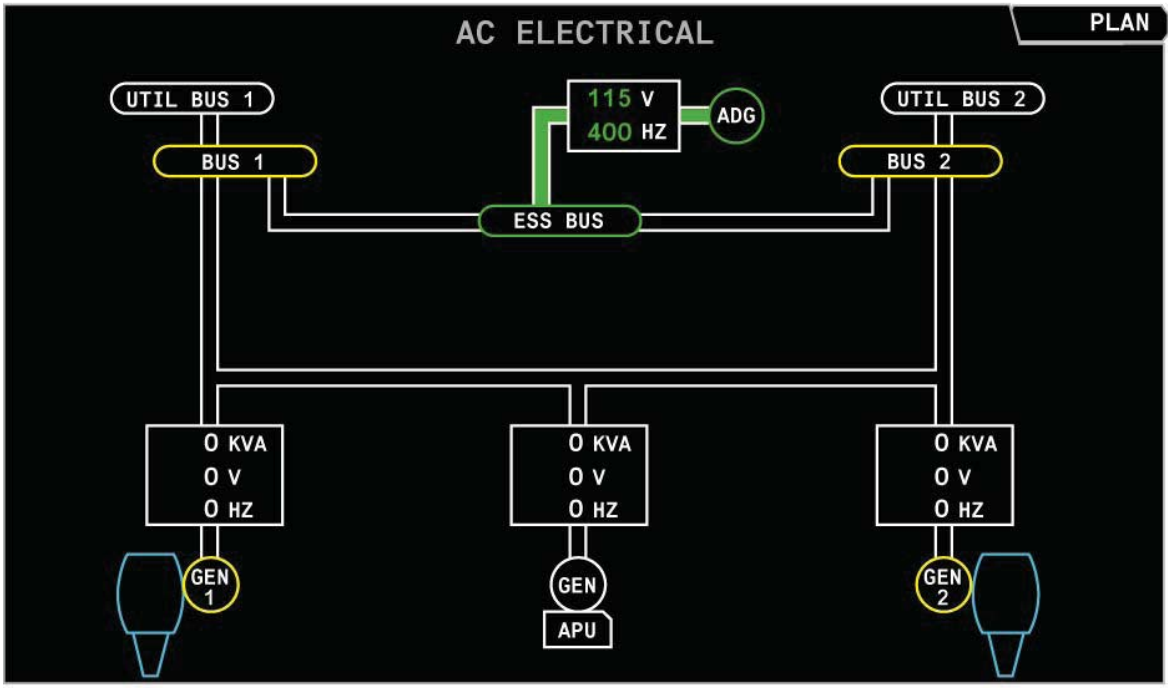
AC Synoptic Page Colour Coding – External AC Electrical Power
Figure 07–10–38

CONTROLS AND INDICATORS (CONT'D)



Description	Symbol	Condition
ADG Outline	ADG	Displayed when ADG AC power is greater than 10 VAC and frequency greater than 50 Hz
	ADG	ADG voltage equal to or less than 10 VAC, or ADG frequency is equal to or less than 50 Hz
	ADG	Data outside valid parameters or invalid data
ADG Input Outline	ADG	ADG power not available
	ADG	ADG power is in use
ADG Voltage Readout	115 V	Voltage between 108 and 130 VAC
	100 V	Voltage less than 108 VAC or more than 130 VAC
	- - - V	ADG voltage invalid or outside display range
ADG Frequency Readout	400 HZ	Frequency between 360 and 440 Hz
	435 HZ	Frequency less than 360 Hz or more than 440 Hz
	- - - HZ	Invalid data or outside display range

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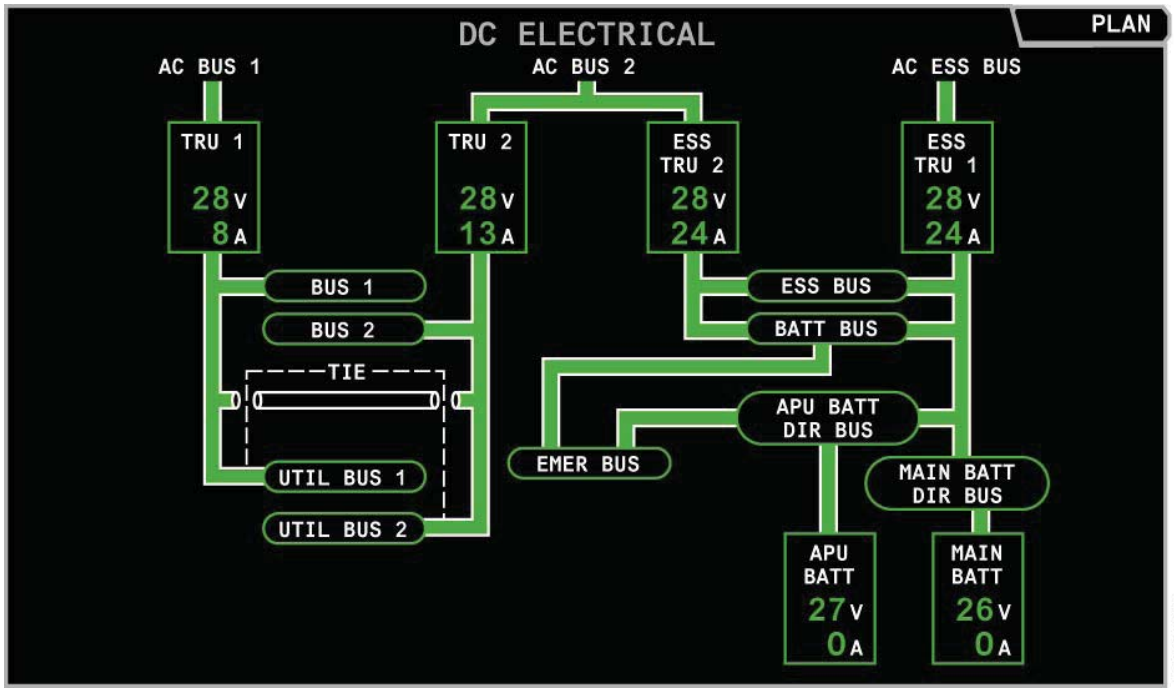
AC Synoptic Page Colour Coding – Air-Driven Generator
Figure 07–10–39

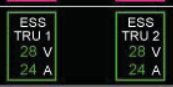
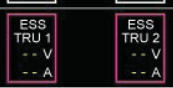
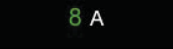
CONTROLS AND INDICATORS (CONT'D)

DC Synoptic Page



DC Synoptic Page – TRU Power Distribution System
Figure 07–10–40

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
AC BUS to TRU Flow Lines		Respective AC BUS is powering TRU
		No AC power to TRU
TRU 1 and TRU 2 Outline		TRU voltage is 18 VDC or greater, and average load greater than 3.7 amps
		TRU voltage is less than 18 VDC or average load less than 3.7 amps with DC main bus tie selected
		Invalid data
Essential TRU 1 and TRU 2 Outline		TRU voltage is 18 VDC or greater and load is greater than 3 amps
		TRU voltage is less than 18 VDC or load is less than 3.7 amps
		Invalid data
TRU Voltage Readouts		Voltage is between 22 and 29 VDC
		Voltage is less than 22 VDC or more than 29 VDC
		Invalid data or outside display range
TRU Load Readouts		Load is between 3 and 99 amps
		Load is less than 3.7 amps
		Invalid data or outside display range

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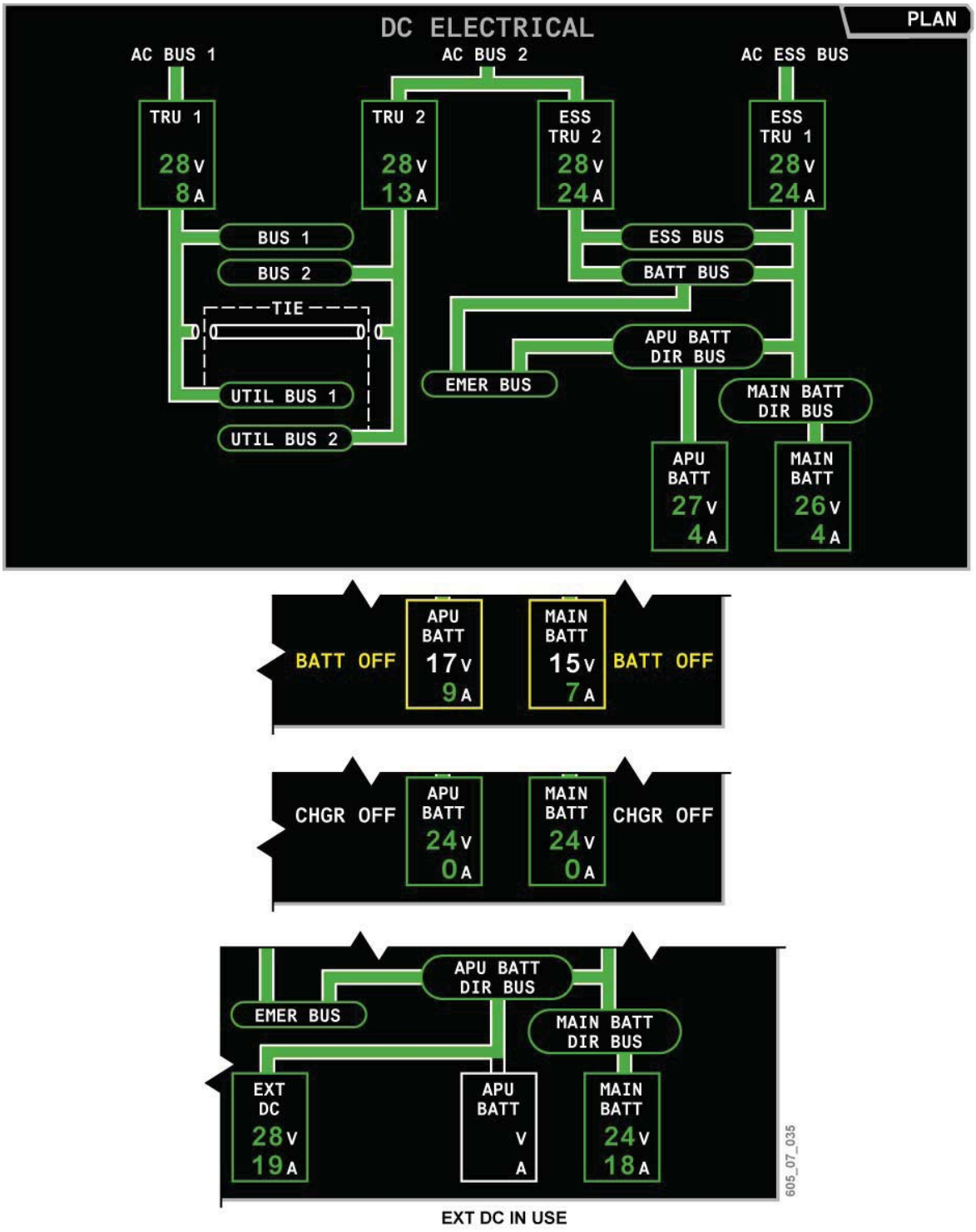
DC Synoptic Page – TRU Power Distribution System
Figure 07–10–41

CONTROLS AND INDICATORS (CONT'D)



DC Synoptic Page – Battery Power Distribution System
Figure 07–10–42

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
MAIN Battery Outline	MAIN BATT 26 V 0 A	Battery voltage is equal to or greater than 18 VDC
	MAIN BATT 15 V 7 A	Battery voltage is less than 18 VDC
	MAIN BATT - - V - - A	Invalid data or value less than 0 VDC or greater than 40 VDC
	BATT OFF	Main battery is less than 18 VDC
	CHGR OFF	Main battery is not charging or Main charger has failed
APU Battery Outline	APU BATT 27 V 0 A	Battery voltage is equal to or greater than 18 VDC and EXT DC is not in use
	APU BATT 17 V 9 A	Battery voltage is less than 18 VDC and EXT DC is not in use
	APU BATT V A	EXT DC is in use **Note:** APU BATT voltage and amperage go blank
	APU BATT - - V - - A	Invalid data or value less than 0 VDC or greater than 40 VDC
	BATT OFF	APU battery is less than 18 VDC
	CHGR OFF	APU battery is not charging or APU charger has failed
EXT DC Outline	EXT DC 28 V 19 A	External DC connected and APU battery voltage is equal or greater than 18 VDC
	EXT DC 16 V 5 A	External DC connected and APU battery voltage is less than 18 VDC
MAIN and APU Battery Voltage Readouts	26 V	Voltage is between 18 and 32 VDC inclusive
	10 V	Voltage is less than 18 VDC or greater than 32 VDC
	- - V	Invalid data
MAIN and APU Battery Load Readouts	8 A	Battery is equal or greater than 12 VDC or load is greater than 0 amps
	0 A	Battery is less than 12 VDC and load is 0 amps
	- - A	Invalid data
EXT DC Voltage Readout	24 V	EXT DC connected and APU battery voltage is between 18 and 32 VDC inclusive
	15 V	EXT DC connected and APU battery voltage less than 18 VDC or greater than 32 VDC
EXT DC Load Readout	5 A	EXT DC connected
	- - A	Invalid data

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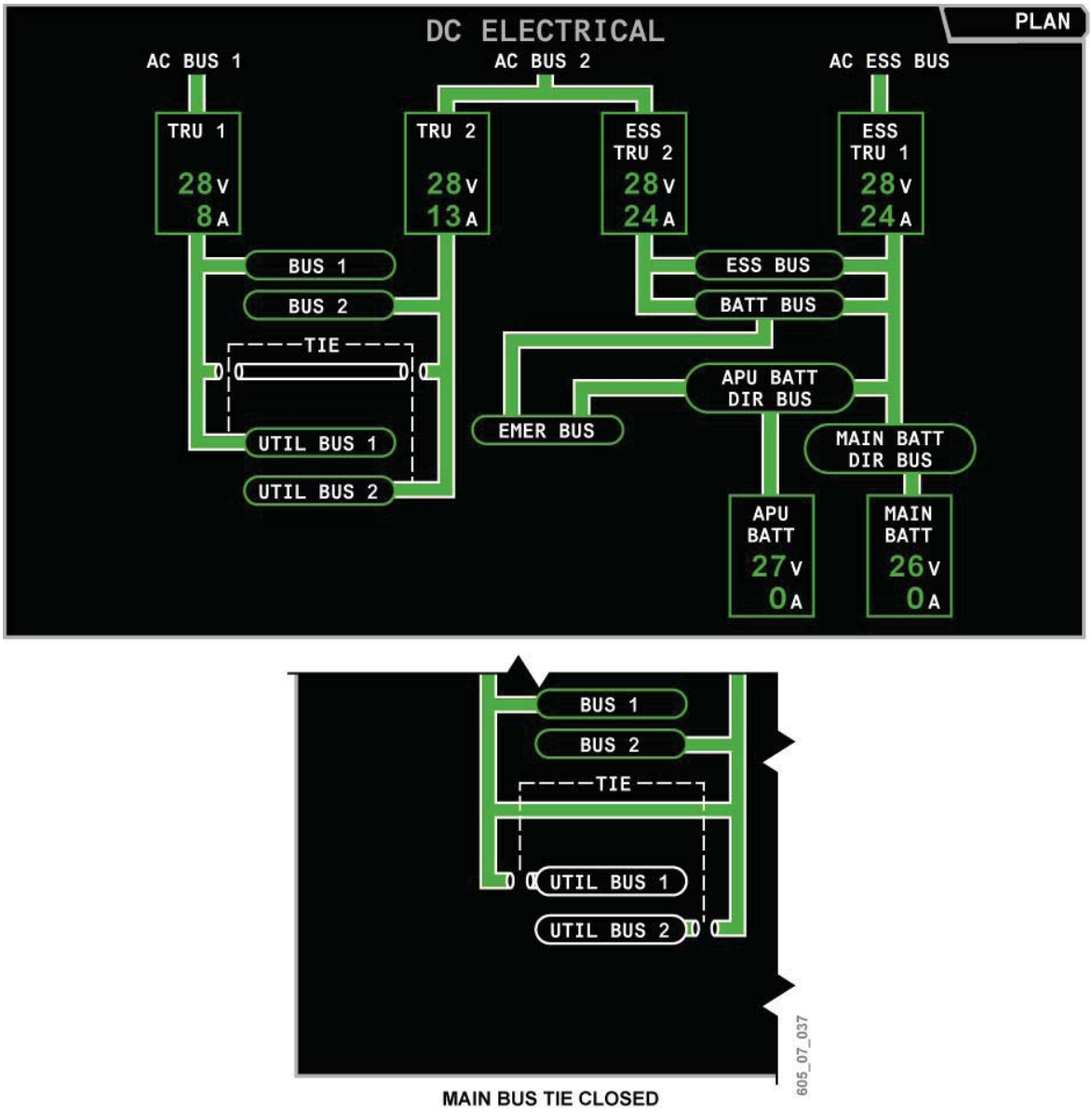
DC Synoptic Page – Battery Power Distribution System
Figure 07–10–43

CONTROLS AND INDICATORS (CONT'D)



DC Synoptic Page – DC Electrical Power Distribution
Figure 07–10–44

CONTROLS AND INDICATORS (CONT'D)

Description	Symbol	Condition
Bus Input Flow Lines		Respective TRU/battery is on-line and output is 18 VDC or greater
		Respective TRU/battery is on-line and output is less than 18 VDC or no supply is being provided to respective bus
DC BUS 1, 2 Outline	BUS 1 BUS 2	Bus powered
	BUS 1 BUS 2	Bus not powered
	BUS 1 BUS 2	Invalid data
UTIL BUS 1, 2 Outline	UTIL BUS 1 UTIL BUS 2	Bus powered
	UTIL BUS 1 UTIL BUS 2	Bus not powered
	UTIL BUS 1 UTIL BUS 2	Invalid data
ESS BUS, EMER BUS and BATT BUS Outline	EMER BUS ESS BUS BATT BUS	Bus powered
	EMER BUS ESS BUS BATT BUS	Bus not powered
	EMER BUS ESS BUS BATT BUS	Invalid data
APU BATT DIR BUS Outline	APU BATT DIR BUS	APU battery voltage is greater than or equal to 18 VDC
	APU BATT DIR BUS	APU battery voltage is less than 18 VDC
	APU BATT DIR BUS	Invalid data
MAIN BATT DIR BUS Outline	MAIN BATT DIR BUS	Main battery voltage is greater than or equal to 18 VDC and BATT MASTER switch ON
	MAIN BATT DIR BUS	Main battery voltage is less than 18 VDC and BATT MASTER switch ON
	MAIN BATT DIR BUS	Invalid data

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EICAS MESSAGES

MESSAGE	MEANING	AURAL WARNING (IF ANY)
EMER POWER ONLY	ADG is supplying the AC essential bus, and no power is available from AC BUS 1 or 2.	WARNING Triple Chime
AC 1 AUTOXFER	Respective automatic AC bus tie function has been inhibited because of an overcurrent condition on the respective AC bus.	
AC 2 AUTOXFER		
AC BUS 1	Respective AC bus is unpowered.	
AC BUS 2		
AC ESS BUS	AC essential bus is unpowered.	
APU BATTERY OFF	APU battery is not available.	
APU GEN OFF	APU generator is off-line with the APU running.	
APU GEN OVLD	Load current on any phase of APU GEN exceeds 100 Amp.	
BATTERY BUS	Battery bus is unpowered.	
DC BUS 1	Respective DC bus is unpowered.	
DC BUS 2		
DC EMER BUS	DC emergency bus is unpowered.	
DC ESS BUS	DC essential bus is unpowered.	
GEN 1 OFF	Respective generator is OFF.	
GEN 2 OFF		
GEN 1 OVLD	Load current on any phase of GEN 1 exceeds 100 Amp.	
GEN 2 OVLD	Load current on any phase of GEN 2 exceeds 100 Amp.	
MAIN BATTERY OFF	Main battery is not available.	
AC ESS ALTN	AC essential bus is powered by AC BUS 2.	
APU BATT CHGR FAIL	APU battery is not charging, or APU battery charger has failed.	
ESS TRU 1 FAIL	Respective essential transformer-rectifier unit output is less than 18 VDC.	
ESS TRU 2 FAIL		
MAIN BATT CHGR FAIL	Main battery is not charging, or main battery charger has failed.	

POWER SUPPLY AND CIRCUIT BREAKER SUMMARY

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
AC Power	Emergency Power and Control	ADG AUTO	MAIN BATT DIRECT	6	B5	
		ESS HYD PUMP SUPPLY	AC ADG BUS	3	A11	
		ADG MAN	MAIN BATT DIRECT	6	B4	
		ADG DEPLOY CONT AUTO	DC BATT	2	N6	
		ADG DEPLOY CONT MAN	DC BATT	2	N7	
		ADG DEPLOY SENSE	AC BUS 1	1	C10	
		ADG DEPLOY SENSE	AC BUS 2	2	C10	
		ADG HEATER	AC BUS 2	2	C11	
		AC ESS FEED	AC ADG BUS	3	A8	
		VOLTS & FREQ IND	AC ADG BUS	3	A13	
	AC Distribution	FREQ CONV	AC BUS 1	1	D11	
		115VAC ESS FEED	AC BUS 1	1	B5	
		115VAC ESS FEED	AC BUS 2	6	A4	
		AC ESS PWR CONT	DC MAIN BATT DIRECT	5	A12	
		ESS AC XFER BATT BUS CONT	DC BATT	1	Q1	
	Control and Protection	GCU 1	DC BATT	1	P1	
		GCU 2	DC BATT	1	P2	
		GCU 3	DC BATT	1	P3	
		UTIL BUS CONT	DC BUS 1	1	E11	
		UTIL BUS CONT	DC BUS 2	2	E11	
		EXT AC PWR CONT	DC APU BATT DIRECT	5	B12	

POWER SUPPLY AND CIRCUIT BREAKER SUMMARY (CONT'D)

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
DC Power	Distribution	PWR SENSE	DC UTILITY BUS 1	1	E6	
		UTILITY BUS 1 FEED	DC UTILITY BUS 1	1	E7	
		FEED	DC BUS 1 CONTROL	1	E8	
		TIE & UTIL	DC BUS 1 CONTROL	2	E9	
		PWR SENSE	DC BUS 1	1	E12	
		PWR SENSE	DC EMERGENCY	1	R7	
		FEED	DC EMERGENCY	1	S7	
		EMERG BUS FEED	DC BATT	1	M1	
		UTILITY BUS PWR SENSE 2	DC UTILITY BUS 2	2	E6	
		FEED	DC UTILITY BUS 2	2	E7	
		FEED	DC BUS 2 CONTROL	2	E8	
		TIE & UTIL	DC BUS 2 CONTROL	2	E9	
		DC BUS 2 PWR SENSE	DC BUS 2	2	E12	
		BATT BUS POWER SENSE	DC ESS	2	M3	
		RCCB CONT DC ESS	DC ESS	2	M6	
		FEED 1 BATT BUS	W35PA	2	M7	
		FEED 1 DC ESS	W35PA	2	M8	
		FEED 2 BATT BUS	W36PA	2	M9	
		FEED 2 DC ESS	W36PA	2	M10	
		PWR SENSE	DC ESS	4	A3	
		ESS/EMER BUS FEED	DC APU BATT DIRECT	5	B1	

POWER SUPPLY AND CIRCUIT BREAKER SUMMARY (CONT'D)

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
DC Power	Transformer Rectifier Units	TRU 1	AC BUS 1	1	B2	
		TRU 1 SENSE	DC BUS 1 CONTROL	1	E10	
		TRU 2	AC BUS 2	2	B2	
		TRU 2 SENSE	DC BUS 2 CONTROL	2	E10	
		ESS TRU 1	AC ESS	3	A2	
		ESS TRU SENSE 1	DC ESS	4	A1	
		ESS TRU 2	AC BUS 2	2	A8	
		ESS TRU SENSE 2	DC ESS	4	A2	
		CONTACTOR LOGIC ESS 1	BATT BUS	2	M1	
		CONTACTOR LOGIC ESS 2	BATT BUS	2	M2	
Batteries	APU Battery	APU BATT CONT	DC APU BATT DIRECT	5	B2	
		APU BATT CHGR O/P	DC APU BATT DIRECT	5	B13	
		RCCB CONT APU BATT	DC ESS AND BATT BUS CONTROL	2	M5	
		APU BATT CHGR	AC BUS 2	2	C2	
	Main Battery	MAIN BATT PWR SENSE REF	BATT DIRECT	6	A2	
		MAIN BATT PWR SENSE	BATT DIRECT	6	A1	
		MAIN BATT PWR O/P	BATT DIRECT	6	A2	
		RCCB CONT MAIN BATT	DC ESS AND BATT BUS CONTROL	2	M4	
		MAIN BATT CHGR O/P	AC BUS 1	1	C2	