

ELECTRICAL

GENERAL

Electrical power is normally supplied by two 28-volt direct current (DC), 400-ampere, engine-driven starter/generators. A 24-volt, 44-ampere hour (or optional 43-ampere hour), nickel-cadmium battery is located in the tailcone compartment to supply power for starting and emergency requirements. A receptacle below the left engine pylon is provided for connection of an external power unit.

ALTERNATING CURRENT (AC) POWER

Alternating current (AC) is provided by two 250 VA static inverters that convert 28 volt DC into 115 and 26 volt, 400 Hz, AC power. The AC system is a dual split bus system in which the number one 115 and 26-volt AC buses, and the number two 115 and 26-volt buses are powered by the number one and number two inverters respectively (NORM position on the (INV 1/NORM/INV 2 AVIONIC POWER switch). If an inverter fails, the respective amber INVTR FAIL (1 or 2) annunciator will illuminate, and the pilot must select the remaining inverter to power the complete system, by selecting the inverter opposite to the one indicating failure (INV 1/NORM/INV 2 switch to the operating inverter).

DIRECT CURRENT (DC) POWER

The direct current (DC) power distribution system consists of the starter/generators, battery indicators, switches and bus networks. Normally, the left generator powers the left main DC bus and the right main DC bus receives power from the right generator. Both operate in parallel, but in the event either generator is off the line, the battery bus acts as a cross tie so that the remaining generator will power both main DC buses. The DC buses supply power for all DC functions except engine starting.

The avionics DC buses (and the 26-volt and 115-volt AC busses) are in two separate sections controlled by two power relays, so that the failure of one relay or the loss of one section of the bus will result in the loss of only approximately one-half the items of equipment on that particular bus. The circuit breakers in Figure 2-20 (Sheet 2) are coded to indicate the equipment items powered by each section of the main bus and its relay.

GENERATORS

A generator control unit provides starter regulation, overvoltage, feeder fault and ground fault protection for each generator. Three-position L and R generator switches are marked GEN, OFF and RESET. In the GEN position, generator control is automatic for regulation, protection and load bus connection. This is the normal switch position for battery starting and all flight modes. Placing the switch to OFF isolates the generator from its load bus. The momentary RESET position resets a generator that has been tripped as a result of an overvoltage, feeder fault or engine fire switch actuation.

Each starter/generator is capable of a 50 percent overload for two minutes. A single generator is capable of supporting the entire electrical system; however, if the optional Freon air conditioning system is installed and in operation, it must be shut down.

BATTERY

The battery is a secondary source of direct current (DC) power available to supply the distribution system prior to start, or in the event of generator failure. The three-position control switch is labeled BATT, OFF and EMER. Placing the switch to the BATT position closes the battery and emergency relays and powers the battery bus, emergency bus and both main DC buses. This position also enables external power to supply the entire system. In the OFF position, battery or external power is isolated from all but the hot battery bus.

The hot battery bus is energized any time the battery is installed or external power is connected. It powers the emergency exit lights, tailcone light, nose baggage compartment light and an aft baggage compartment light. A battery disconnect relay between the battery and ground is located below the battery.

During each engine start using external power, the battery disconnect relay will automatically open interrupting battery power to the hot battery bus. The relay will close automatically at the end of the start cycle.

The EMER (emergency) position of the battery switch will provide at least 30 minutes operation for selected instruments and systems. The following are powered from the emergency bus.

- LH & RH Fan Speed Inds.
- Cockpit Flood Lights
- COMM 1
- NAV 1
- DG1 and Standby HSI
- Voltmeter
- Standby Pitot-Static Heaters/standby altimeter vibrator
- Copilot's Audio Panel
- Pilot's Audio Panel *

* The pilot's audio panel is switched to the emergency bus when the battery switch is placed to EMER position.

Additionally, the standby gyro battery provides at least 30 minutes lighting for the following: dual fan tachometers, standby gyro indicator, standby HSI, and standby altimeter/airspeed indicator. In some cases, it may be prudent to select OFF on the unneeded systems, such as lighting and pitot-static heat in order to conserve battery life. The cockpit speakers will remain operational and selection of EMER COMM is not necessary.

The battery temperature monitor gage provides a continuous indication of battery temperature from 0 to 180°F (-18° to +82°C).

Battery temperature should remain below 63°C (145°F). A battery temperature exceeding 63°C (145°F) is annunciated by a steady illumination of the red BATT O'TEMP light on the annunciator panel. A battery temperature exceeding 71°C (160°F) is shown by a flashing annunciator light.

The battery must be serviced per the Maintenance Manual when the battery temperature exceeds 63°C (145°F).

EXTERNAL POWER

External direct current (DC) power can be connected to the airplane through a receptacle located on the left side of the fuselage. When external power is connected, the external power relay energizes and connects the power source to the hot battery bus. Positioning the battery switch to BATT energizes the battery and emergency relays allowing external power to be connected to the entire DC system. Ground power requirements dictate a 28-volt unit, with a maximum capability of 1000 amperes current. If an adjustable power unit is used, it should be adjusted to provide a maximum of 1000 amperes. A ground power unit with a soft start capability is preferable. The battery should be disconnected if the airplane is to be on a ground power unit for a prolonged period of time.

CAUTION

CURRENT IN EXCESS OF 1000 AMPERES MAY DAMAGE THE STARTERS.

DIRECT CURRENT (DC) POWER INDICATORS

The indicators consist of two ammeters, a voltmeter and two amber generator failure lights (GEN OFF, L and R). The ammeters function as loadmeters indicating the load being carried by each generator.

The voltmeter is wired through the battery switch and will indicate the voltage of the hot battery bus any time the battery switch is in the BATT or EMER position. The voltmeter selector switch can be rotated to the LH or RH GEN positions to check generator voltage output. Since the voltmeter reads the highest voltage on the bus, an accurate check of one generator is obtained only with the opposite one off the line.

Should either generator fail, the associated power relay will open, removing the generator from the system and illuminating the appropriate L or R GEN OFF annunciator panel light. Should both generators fail, the master warning light will also illuminate. This is the only condition under which illumination of an amber annunciator light will trigger the master warning.

EMERGENCY BATTERY

Placing the battery switch in the EMER position opens the battery relay; the emergency bus relay will remain closed. This disconnects the main direct current (DC) busses and the battery bus from the battery and connects the battery directly to the emergency bus. With both generators off, all electrical equipment will be inoperative except COMM 1, NAV 1, the standby airspeed indicator/altimeter vibrator, the standby horizontal situation indicator (HSI), directional gyro number one, the N_1 tachometers, the standby pitot-static system heaters, the voltmeter and the cockpit floodlights, and the pilot's and copilot's audio amplifiers (the pilot's audio is switched to the emergency bus when the BATT switch is placed to EMER). Emergency lighting which will be available, in addition to the cockpit flood lights, are the instrument lights for the standby gyro, the N_1 /ITT indicators, the standby HSI, and the standby airspeed indicator/altimeter.

NOTE

The pilot should be aware that with both generators off the line and the battery switch in the EMER position some of the more important items such as annunciator lights, gear indicator lights, main pitot/static and angle-of-attack system heat, fire warning and fire bottle discharge will be inoperative.

Going to emergency (EMER) with either or both generators on the line will have no affect except that the battery will not charge. As long as at least one generator is on the line, turning off the battery switch will not cause any equipment on the emergency bus to cease functioning.

CIRCUIT BREAKERS

Push-to-reset, pull-off type circuit breakers with the amperage rating marked on each breaker, are installed in panels located on both sides of the cockpit. The panels are readily accessible to the flight crew during flight. Panel configurations may vary from airplane to airplane due to differences in installed equipment; therefore, the panels shown are typical installations.

Additional circuit breakers to which flight crew access is not essential, are located in the tailcone junction boxes.

DIRECT CURRENT ELECTRICAL SYSTEM SCHEMATIC

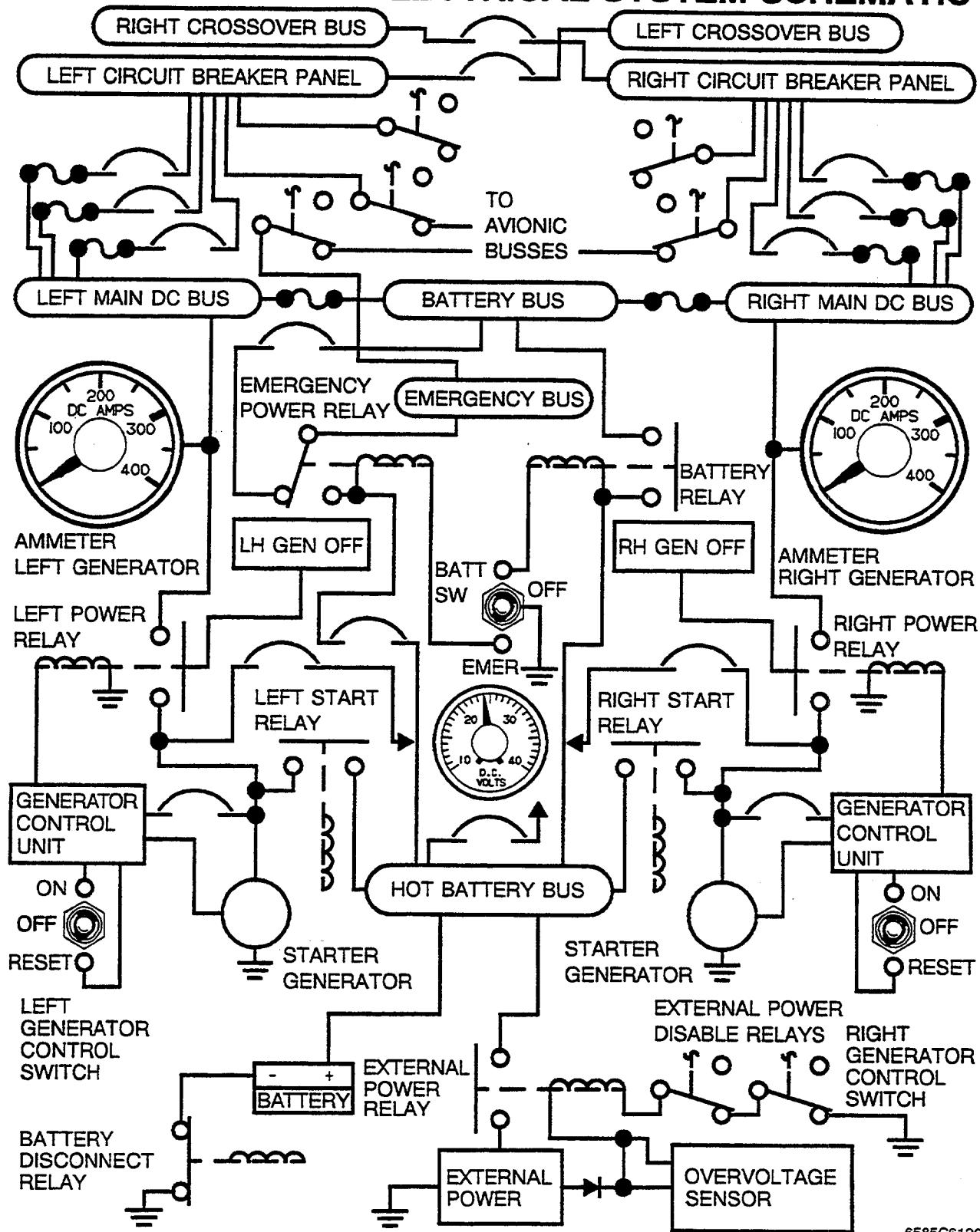


Figure 2-18

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ENGINE STARTING

Depressing either engine start button closes the respective start relay and provides DC power to the engine starter. Power to close the solenoid start relays and energize ignition comes from the battery bus requiring the battery switch to be in the BATT position. Automatic ignition sequencing takes place with both engine ignition switches in the NORM position.

A white light in each starter button indicates power on the contacts of the respective start relay. The starter operation is terminated when the speed sensor in the generator control unit removes power from the start relay at approximately 39 percent N_2 RPM. The automatic start sequence can be terminated at any time by pushing the cockpit STARTER DISENGAGE switch located between the start buttons which will open the start relay and halt the start sequence. During engine start, when the generator output exceeds battery voltage and/or is in parallel with the other generator (within 40 amperes), the starter/generator reverts to generator operation. The power relay closes and supplies power to the respective DC bus. Current will then flow from either main DC bus through the battery bus, battery relay and hot battery bus, providing battery charging.

The airplane is equipped with a cross start capability which utilizes the generator of an operating engine to assist starting the second. This is accomplished by both start relays closing when the second start is initiated routing power through the hot battery bus to the other engine. On all cross starts, the operating engine should be set at 52 to 53 percent N_2 to ensure proper torque on the generator shaft. Cross generator start capability is disabled with weight off the left main gear squat switch in order to prevent cross starts in flight.

Starts being made on external power may be accomplished with the generator switches in either the ON or OFF position; however, it is recommended that they be turned OFF during the start. If the generator switch is placed in the ON position the generator control unit will automatically initiate the generator mode after engine start. If the generator switch is placed in the OFF position, the generator mode will be initiated by manually placing the generator switch to the ON position. External power is automatically disconnected when either generator is supplying power to the bus. In order to start the second engine by auxiliary power unit, the generator supplying voltage to the bus must be disconnected by placing the generator switch to the OFF position.

An overvoltage protection system is provided during use of an auxiliary power unit. The control unit monitors the external power unit voltage and will deenergize the external power relay if the voltage rises above 32.5 volts. During an engine start using the external power unit, a voltage signal is applied to the control unit. If the output of the power cart exceeds 32.5 volts the control unit will deenergize the external power relay and terminate the start. External power cannot be reapplied to the airplane until the voltage has been interrupted after the start termination. Simply reducing the voltage to below 32.5 volts will not enable the external power to be reapplied.

For battery starts and under all normal flight conditions, the generators are left in the GEN position.

ALTERNATING CURRENT ELECTRICAL SCHEMATIC

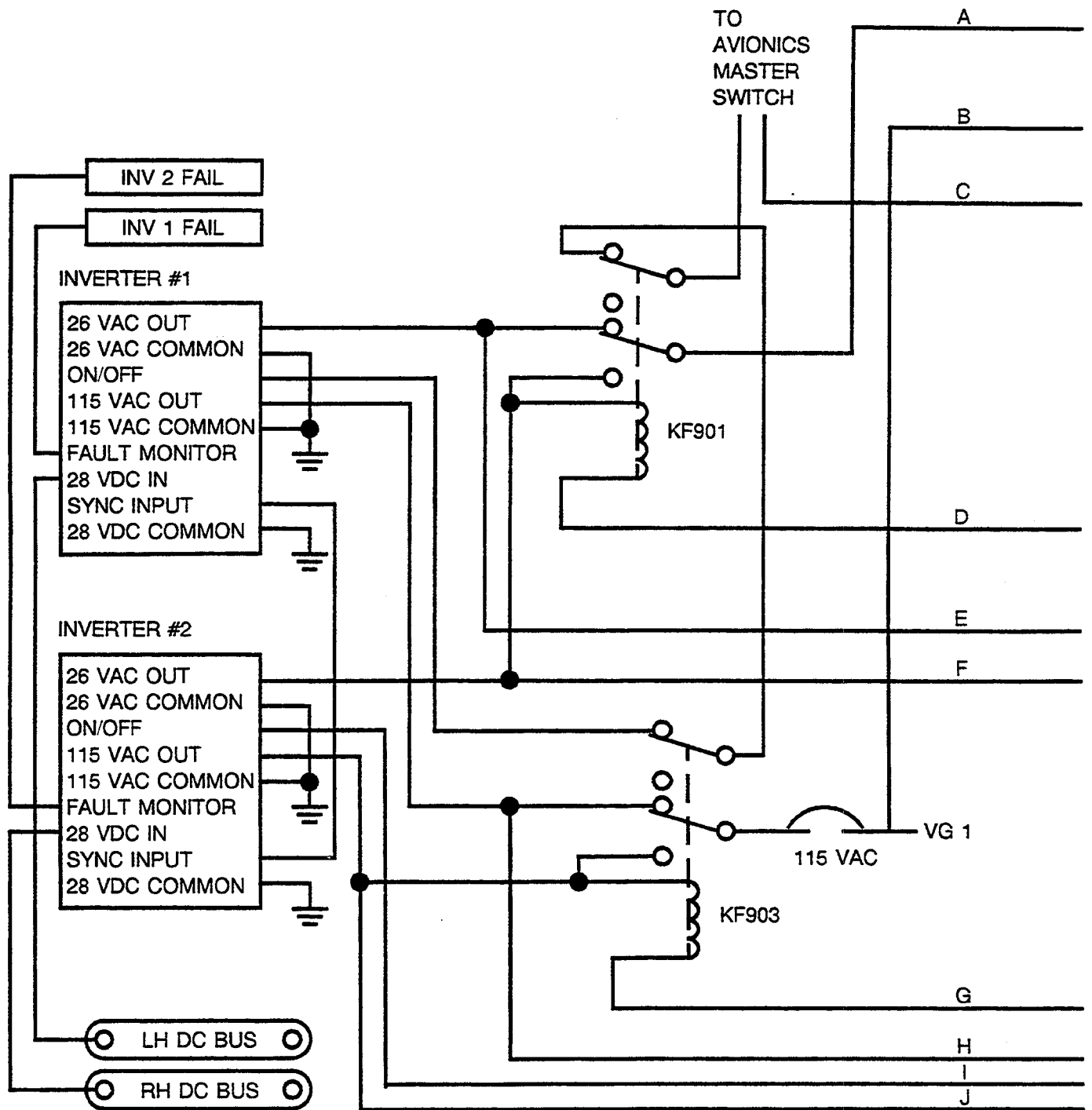


Figure 2-19 (Sheet 1 of 2)

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ALTERNATING CURRENT ELECTRICAL SCHEMATIC

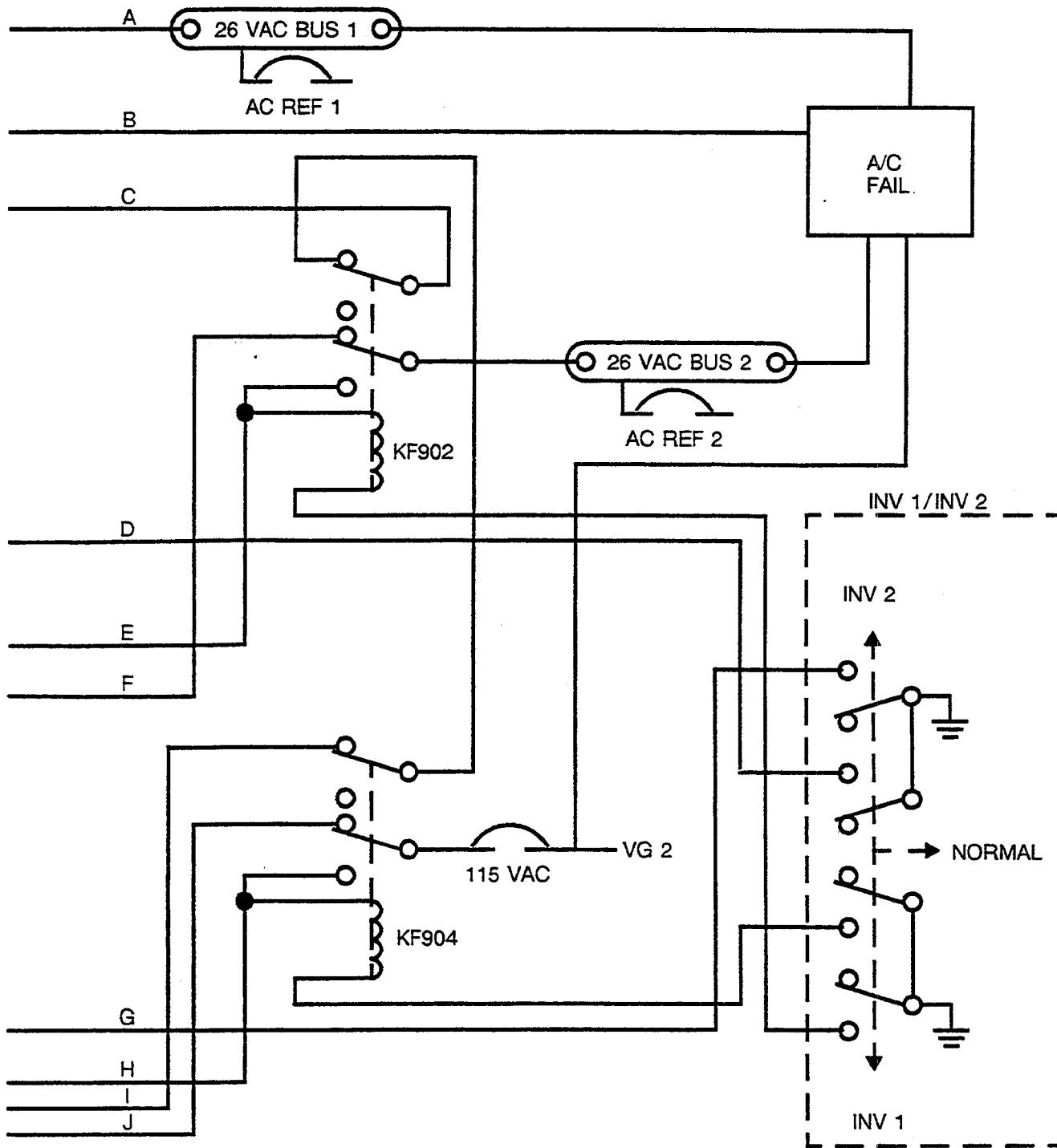


Figure 2-19 (Sheet 2 of 2)

6577C7006 (R)

ALTERNATING CURRENT (AC) POWER

The AC power distribution system consists of a 2-position AVIONIC POWER switch (ON/OFF), a 3-position INV 1/NORM/INV 2 switch (both on the left meter panel), two 26 VAC/115 VAC, 400 Hz static inverters, four AC buses (two 26-volt and two 115-volt) and two annunciator panel lights. Each inverter converts 28 volts DC into AC power, with a maximum output of 250 VA each. Both AC and DC power to the avionics equipment is controlled by the AVIONIC POWER ON/OFF switch, which serves as an avionics master switch. The AC system functions normally with the left AVIONICS POWER switch in the NORM position; in this position the number 1 inverter powers the number one 26 VAC bus and the number one 115 VAC bus, and the number two inverter powers the respective number two AC busses. In the case of the failure of an inverter, the pilot must select the opposite inverter by positioning the switch to INV 1 or INV 2, which will result in the remaining (selected) inverter powering both busses.

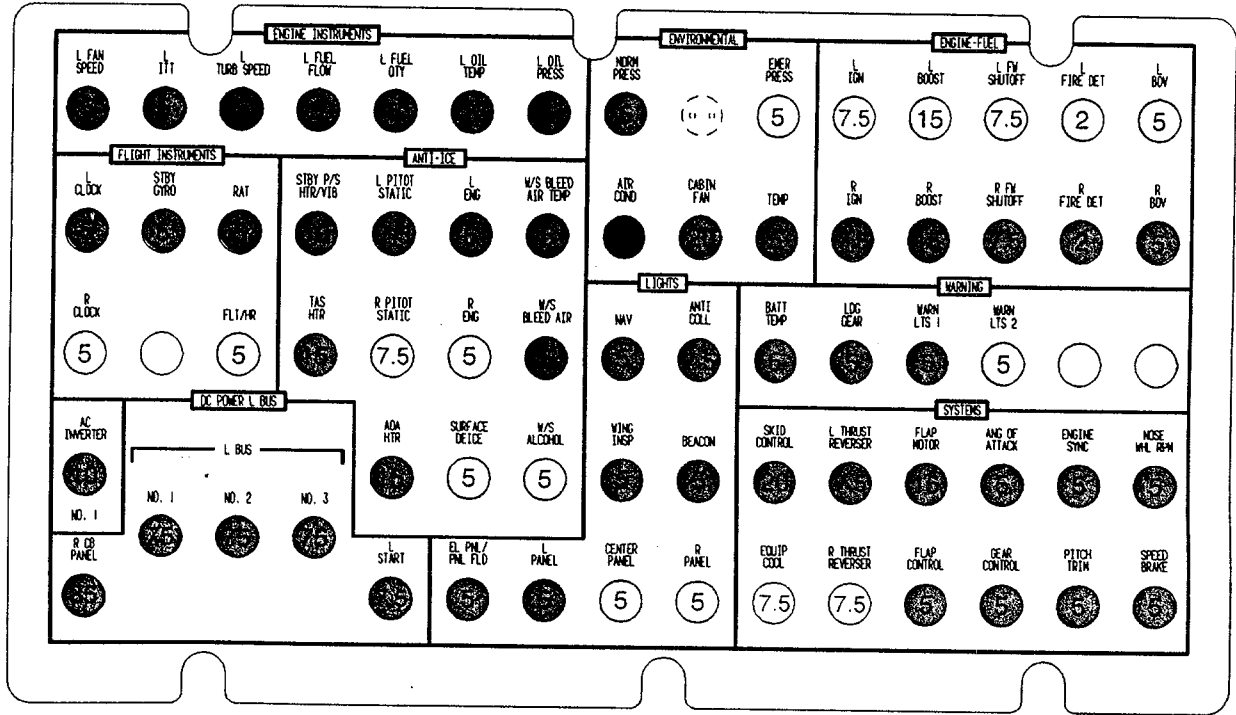
The AC system powers avionics and navigation equipment. Equipment on the number one 26-volt AC (VAC) bus includes: NAV 1 (AC REF 1 circuit breaker), vertical gyro number one (VG 1), and the optional flight data recorder (FDR). The number one 115 VAC bus powers the pilot's vertical gyro (VG 1). The number two 26 VAC bus powers NAV 2 (AC REF 2), the pilot's directional gyro (DG REF 1), the standby horizontal situation indicator (HSI), the weather radar, and the optional traffic warning and collision avoidance system (TCAS). The number two 115 VAC bus provides power for the number two (copilot's) vertical gyro. When the battery switch is placed to EMER position AC power for the standby HSI is provided by an internal static inverter in the pilot's C-14D directional gyro. In this case the DG static inverter also provides its own AC power.

In the event of failure of one inverter the respective amber INVTR FAIL (1 or 2) light and the MASTER CAUTION will flash. Selecting the opposite inverter will correct the AC power failure situation by switching the busses having the failed inverter to the remaining (opposite) inverter, which will then power all four AC busses, thereby cancelling the failure light. Resetting the MASTER CAUTION will not cancel the INVTR FAIL light unless the failure situation has been cleared. One inverter provides adequate power for the AC system; however, both inverters must be operational for takeoff. An operational check of both inverters, according to the procedure stated in Section Four of this manual, must be accomplished before takeoff.

In the unlikely event of a dual inverter failure the amber INVRTR FAIL 1 and 2 annunciator lights, the red AC FAIL warning light, the MASTER CAUTION, and the MASTER WARNING lights will flash. In this case the pilots DG and the standby HSI can be used for heading reference; the NAV bearing pointers will be inoperative.

AC inverter protection is provided by two 10-amp circuit breakers (AC INVERTER NO.1, left circuit breaker panel and AC INVERTER No. 2, right circuit breaker panel). Since the circuit breakers are located between the DC bus and the inverters which can power the respective AC bus, the AC bus cannot receive power if the circuit breaker is disengaged. It is possible that a disengaged circuit breaker was caused by a bus short; therefore, re-engagement should be carefully considered before an attempt is made. System damage could possibly result.

LEFT CIRCUIT BREAKER PANEL




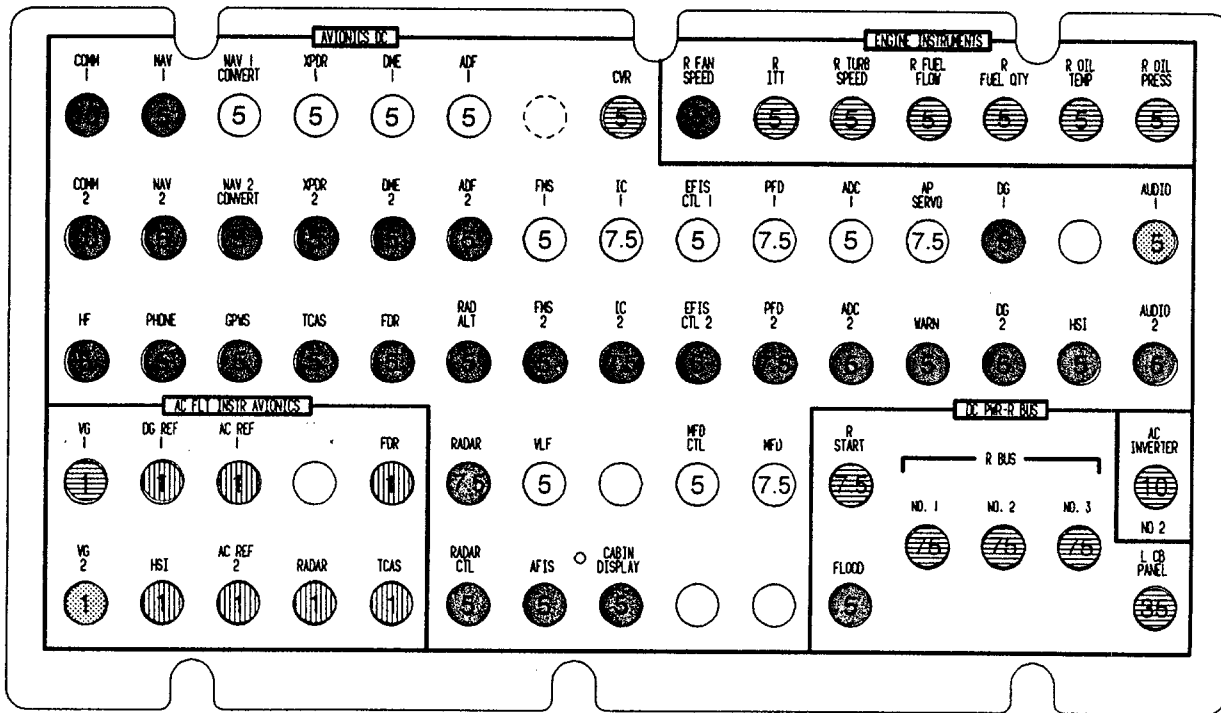
-  LEFT MAIN DC BUS
-  PLUG BUTTON
-  RIGHT MAIN DC BUS
-  EMERGENCY DC BUS

Figure 2-20. Circuit Breaker Panels (Sheet 1 of 2)

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RIGHT CIRCUIT BREAKER PANEL



DC POWER

- EMERGENCY DC BUS
- RIGHT AVIONICS BUS #1 - SWITCHES TO EMERGENCY DC BUS WHEN BATT SWITCH TO EMER
- RIGHT AVIONICS BUS #1
- RIGHT AVIONICS BUS #2
- RIGHT MAIN DC BUS

AC POWER

- 26 VAC BUS #1
- 26 VAC BUS #2
- 115 VAC BUS #1
- 115 VAC BUS #2

Figure 2-20. Circuit Breaker Panels (Sheet 2 of 2)

9912472-2