TM 1-1520-238-T-6

TECHNICAL MANUAL

AVIATION UNIT AND INTERMEDIATE TROUBLESHOOTING MANUAL

FOR

ARMY MODEL AH-64A HELICOPTER (NSN 1520-01-106-9519) (EIC: RHA)

CHAPTER 9 ELECTRICAL SYSTEM

SUPERSEDURE NOTICE: **This manual supersedes TM 55-1520-238-T-2, dated 15 DECEMBER 1985, including all changes.**

DISTRIBUTION STATEMENT A: **Approved for public release; distribution is unlimited.**

HEADQUARTERS, DEPARTMENT OF THE ARMY
30 June 1992

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 30 June 1992

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898–5230. A reply will be furnished to you.

You may also send in your comments electronically to our e–mail address: 2028@redstone.army.mil or by fax 205–842–6546/DSN 788–6546. Instructions for sending an electronic 2028 may be found at the end of this manual immediately preceding the hard copy 2028.

OZONE DEPLETING CHEMICAL INFORMATION:
This document has been reviewed for the presence of Class I Ozone depleting chemicals. As of Change 7 dated 27 February 1998, all references to Class I Ozone depleting chemicals have been removed from this document by substitution with chemicals that do not cause atmospheric Ozone depletion.

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HOW TO USE THIS VOLUME

OVERVIEW

If you can't find information, you can't do the job. Learn how to use the Integrated Troubleshooting Manual System and this volume. Refer to TM 1-1520-238-T-2 for instructions on how to use the troubleshooting manual system and TM 1-1520-238-T-4 for instructions on how to use this volume.

USING AH-64A HELICOPTER EFFECTIVITY CODES

Helicopter effectivity codes designate differences between helicopters by helicopter serial numbers. These codes consist of three letters representing various helicopter serial number blocks. They are used throughout this volume as necessary to aid the helicopter troubleshooting effort.

The codes are used to designate serial number block differences as follows:

- When used within narrative text and fault isolation procedures (FIPs), effectivity codes appear within parentheses.

  For Example: Narrative text and FIPs (AAA)

- When used inside wiring interconnect diagrams, effectivity codes appear within triangular borders and are placed on the line which represents that particular helicopter's configuration.

  For Example: Wiring interconnect diagrams 

This volume uses these effectivity codes and corresponding helicopter serial numbers for reference.

To use the helicopter effectivity codes, note the helicopter serial number on the left side of the fuselage directly below the CPG window. Use this serial number to determine which procedure or path in a wiring interconnect diagram or FIP to use.

The effectivity codes and helicopter serial number blocks applicable to this volume are as follows:

Effectivity Code	Helicopter Serial No.
AAA	82-23355 thru 82-23365
AAB	82-23355 thru 83-23798
AAC	82-23355 thru 83-23814
AAD	85-25424 and subsequent
AAE	82-23355 thru 84-24231
AAF	84-24216 and subsequent
AAG	82-23355 thru 84-24289
AAH	82-23355 thru 85-25398
AAJ	85-25351 and subsequent
AAK	82-23355 thru 85-25488
AAL	88-0215 and subsequent

HOW TO USE THIS VOLUME (cont)

Effectivity Code	Helicopter Serial No.
AAM	85-25465 and subsequent
AAN	83-23787 thru 85-25415
AAP	82-23355 thru 88-0214
AAQ	82-23355 thru 84-24311
AAR	82-23355 thru 84-24239
AAS	84-24240 and subsequent
AAT	82-23355 thru 83-23804
AAU	83-23787 and subsequent
AAV	83-23805 and subsequent
AAW	83-23799 and subsequent
AAX	83-23799 thru 84-24245
AAY	83-23799 thru 85-25470
AAZ	83-23815 and subsequent
ABA	84-24200 and subsequent
ABB	84-24246 and subsequent
ABC	84-24290 and subsequent
ABD	82-23355 thru 85-25415
ABE	82-23355 thru 84-24295
ABF	84-24296 and subsequent
ABG	85-25399 and subsequent
ABH	82-23355 thru 84-24245
ABJ	85-25447 and subsequent
ABK	82-23355 thru 85-24446
ABL	82-23355 thru 89-0215
ABM	84-24290 thru 88-0199
ABN	89-0192 and subsequent
ABP	85-25471 and subsequent
ABQ	86-8940 and subsequent
ABR	82-23355 thru 84-24232
ABS	84-24233 and subsequent
ABT	82-23355 thru 83-23816
ABU	83-23817 thru 85-25415
ABV	84-24246 thru 85-25398
ABW	82-23355 thru 83-23795
ABX	83-23796 and subsequent

Effectivity Code	Helicopter Serial No.
ABY	With T700-GE 701 engines
ABZ	With T700-GE 701C engines
ACA	82-23355 thru 88-0199
ACB	88-0200 and subsequent
ACC	82-23355 thru 83-23834
ACD	85-25416 and subsequent
ACE	82-23355 thru 86-9011
ACF	82-23355 thru 88-0284
ACG	89-0192 and subsequent
ACH	82-23355 thru 85-25423
ACJ	82-23355 thru 90-0290, 90-0292 thru 90-0301 (Before MWO 1-1520-238-50-07)
ACK	82–23355 thru 90–0290, 90–0292 thru 90–0301 (After MWO 1–1520–238–50–07) 90–0291, 90–0302 and subsequent
ACL	82-23355 thru 83-23814
ACM	83-23815 and subsequent
ACN	85-25471 thru 90-0448 (Before MWO 1-1520-238-50-37)
ACP	85–25471 thru 90–0448 (After MWO 1–1520–238–50–37) 90–0449 and subsequent
ACQ	82–23355 thru 90–0448 (Before MWO 1–1520–238–50–36)
ACR	82–23355 thru 90–0448 (After MWO 1–1520–238–50–36) 90–0449 and subsequent
ACS	82–23355 thru 90–0437
ACT	90–0438 and subsequent
ACU	82–23355 thru 90–0436
ACV	89–0192 thru 90–0434 with T700–GE–701C engines (Before MWO 1–1520–238–50–38)
ACW	89–0192 thru 90–0434 with T700–GE–701C engines (After MWO 1–1520–238–50–38) 90–0435 and subsequent with T700–GE–701C engines
ADA	Before MWO 1–1520–238–40
ADB	After MWO 1–1520–238–40
ADC	Before MWO 1–1520–238–50–49
ADD	After MWO 1–1520–238–50–49
ADP	After MWO 1–1520–238–50–50

USING THE ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX

The ECLC index will help you find electrical components and their connectors on the helicopter during troubleshooting. The ECLC is located at the beginning of the troubleshooting procedures of each chapter (when applicable). This index is a list of connectors and applicable wiring harnesses which are illustrated by component location. Component locations are shown from the helicopter's forward sections to its aft sections by horizontal and vertical grid numbers. Connectors are listed numerically in the **FROM COLUMN Connector Ref Des** columns of the index. Every connector is referenced to a grid area within the illustrations.

EXAMPLE OF ECLC INDEX

FROM COLUMN		TO COLUMN			
Connector Ref Des	**Component/ Harness**	**Connector Ref Des**	**Component/ Harness**	**Grid Area**	**Access**
P1	A76/W605	J1	A402	8B	PLT STATION
P402	W170	J402	W211	13E	R295 DOOR

Use the index to find connectors on the aircraft by first locating the connector reference designator number in the **FROM COLUMN Connector Ref Des** column of the index. Then, cross-reference the **FROM COLUMN Connector Ref Des** column with the following:

- **FROM COLUMN Component/Harness** column to locate the component or wire harness number.
- **TO COLUMN Connector Ref Des** column to locate the mating connector number.
- **TO COLUMN Component/Harness** column to locate the mating connector or wire harness number.
- **Grid Area** column to find the grid zone (within the illustration) depicting the location of the connector on the aircraft.
- **Access** column to find where access can be obtained (TM 55-1520-238-23).

For example, to locate connector P1 on the aircraft find connector P1 in the **FROM COLUMN Connector Ref Des** column, then refer to the **FROM COLUMN Component/Harness** column. This column shows that P1 is part of component/harness A76/W605. The **TO COLUMN Connector Ref Des** column shows that P1 connects to J1 on component A402 (**TO COLUMN Component/Harness** column). The **Grid Area** column indicates that P1 is depicted at illustration grid zone 8B, and that **Access** to the connector is obtained through the PLT STATION.

CHAPTER 9
ELECTRICAL SYSTEM

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SECTION I. Equipment Description and Data

9–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 9–1

a. **Characteristics.**

(1) The ac electrical power generation system generates and distributes ac electrical power required to operate the helicopter systems. AC electrical power is supplied to two transformer/rectifiers (T/R) which produce 28 VDC for systems requiring dc power. The dc electrical power generation system rectifies 3-phase, 115/200 VAC, 400 hertz (Hz) power to provide 28 VDC to the helicopter circuits requiring dc voltage. Major components of the system consist of two T/Rs and a dc bus tie contactor. The battery supplies dc voltage for APU starting and emergency operation in case of total electrical system failure. The external power system allows external ac electrical power application for systems operation and/or checkout. The ground service utility receptacle provides aircraft ac and dc power for lights, hand tools, etc.

b. **Capabilities and Features.**

(1) **AC Electrical Power**. AC electrical power generation **c**onsists of two identical and redundant electrical power systems. The system generates 3-phase, 115/200 VAC, 400 Hz ac power at 35 Kilo-Volt Amperes (KVA). Either system is capable of supplying all electrical power requirements. If either system malfunctions, automatic switching ensures continued electrical operation. The system is monitored internally and electrically shuts down if an overvoltage, undervoltage, underfrequency (on ground only), or an overcurrent fault is detected.

(2) **DC Electrical Power**. Each T/R is capable of providing 28 VDC at 250 amperes. DC electrical power generation maintains output voltage limits of 25 to 29 VDC at loads of 10 to 250 amperes. Each T/R provides its own forced air cooling and radio noise suppression. In the event of an over temperature condition, which is normally due to failure of the cooling fan, a thermal sensor is activated. The thermal sensor completes a circuit to light the appropriate **HOT RECT** indicator on the pilot caution/warning panel. The dc bus tie contactor connects the output of the T/R to the emergency dc bus, dc bus 1, dc bus 2, and dc bus 3. The contactor connects dc busses 1 and 2 in the event one T/R is not operating and prevents paralleling of the T/R outputs.

(3) **External Power.** The external power system supplies 3-phase, 115/200 VAC, 400 Hz ac power to aircraft ac distribution points. All major components are line replaceable units (LRUs). The system monitors input external power for over/under voltage, over/under frequency, and phase sequence. If a fault is detected, the system electrically disconnects external power.

(4) **Battery and Battery Relay.** The battery is connected to the emegency dc bus when the battery relay is energized by 18 VDC or greater. The battery supplies 24 VDC and contains 19 individual removable cells of 1.25 volts per cell.

(5) **Battery Charger.** The battery charger completely recharges a discharged battery within 2 hours. Charging is stopped if battery temperature rises above 122° ±5° F (50° ±3° C) and resumes charging when the temperature drops below 115° ±5° F (46° ±3° C). Battery charging is stopped if an open or short circuit occurs in the battery temperature transducer circuitry. Battery charging is stoped or inhibitted if the tenth cell voltage falls below or exceeds 45 to 60% of battery terminal voltage for more than 3 ±0.6 minutes. Battery charging is stopped when external power is applied to the helicopter to prevent buildup of explosive gases.

(6) **Navigation Lights.** Navigation lights are arranged in the conventional configuration:

- Left side red.
- Right side green.
- Aft white.

(7) **Formation Lights.** Formation lights consist of four green lights. Light intensity is adjustable from dim to bright.

(8) **Anti-Collision Lights.** Anti-collision lights are day/night high-intensity strobe lights. The lights are omni directional and flash alternately at a rate of 35 times per minute.

(9) **Searchlight.** The searchlight is capable of extending up and down through an arc of 130° and rotating 360° left or right.

(10) **Maintenance Light.** The maintenance light can be attached at either of two points on the aircraft making it possible to perform maintenance in low visibility conditions anywhere on the aircraft.

(11) **Utility Light.** The pilot and CPG utility light is a standard hand-held light with a coil extension cord so that the light can be detached from its mount and shown around the cockpit. The light has built-in red and clear lenses. The pilot or CPG can select either lens at will.

(12) **Secondary Lights.** Secondary lights are standard 28 VDC aviation floodlight assemblies which provide emergency illumination of the pilot and CPG's instrument panels in case of instrument lighting failure.

(13) **Edge-Lights**. Edge-lights provide pilot and CPG station instrument and panel lighting as follows:

- Engine instruments.
- Flight instruments.
- All panel and console lighting.
- Caution/warning/advisory panels.
- All remote indicator lights.

(a) Control of the pilot and CPG edge-lights are divided into four channels:

- Channel 1 controls the lights on the right-hand instrument panels.
- Channel 2 controls the lights on the left-hand instrument panels.
- Channel 3 controls the lights on the pilot right-hand and center consoles and the CPG right-hand console.
- Channel 4 controls the lights on the left-hand consoles, circuit breaker panels, and collective stick grips.

(b) Pilot circuit breaker panel edge-lighting is controlled by a separate **ON/OFF** switch.

(14) **Circuit Protection.**

(a) Pilot station ac essential bus 1 circuit protection includes 31 circuit breakers on the pilot circuit breaker panel. These circuit breakers provide thermal protection for the ac essential bus 1 circuit.

(b) CPG station ac essential bus 1 circuit protection includes seven circuit breakers on CPG circuit breaker panel 1 and three circuit breakers on CPG circuit breaker panel 2. These circuit breakers provide thermal protection for the ac essential bus 1 circuits.

(c) Pilot station ac essential bus 2 circuit protection includes seven circuit breakers on the pilot aft circuit breaker panel. These circuit breakers provide thermal protection for the ac essential bus 2 circuits.

(d) CPG station ac essential bus 2 circuit protection includes four circuit breakers on CPG circuit breaker panel 1. These circuit breakers provide thermal protection for the ac essential bus 2 circuits.

(e) Pilot station dc essential bus 1 circuit protection includes six circuit breakers on the pilot aft circuit breaker panel. These circuit breakers provide thermal protection for the dc essential bus circuits.

(f) CPG station dc essential bus 1 circuit protection includes two circuit breakers on CPG circuit breaker panel 2. These circuit breakers provide thermal protection for the dc essential bus 1 circuits.

(g) Pilot station dc essential bus 2 circuit protection includes 10 circuit breakers on the pilot circuit breaker panel. These circuit breakers provide thermal protection for the dc essential bus 2 circuits.

(h) Pilot station dc essential bus 3 circuit protection includes 13 circuit breakers on the pilot circuit breaker panel. These circuit breakers provide thermal protection for the dc essential bus 3 circuits.

(i) CPG station dc essential bus 3 circuit protection includes 10 circuit breakers on CPG circuit breaker panel 1 and one circuit breaker on CPG circuit breaker panel 2. These circuit breakers provide thermal protection for the dc essential bus 3 circuits.

(j) Pilot station dc emergency bus circuit protection includes 36 circuit breakers on the pilot circuit breaker panel. These circuit breakers provide thermal protection for the dc emergency bus circuits.

(k) CPG station dc emergency bus circuit protection includes five circuit breakers on CPG circuit breaker panel 1. These circuit breakers provide thermal protection for the dc emergency bus circuits.

(l) Pilot station dc ground circuit protection includes two circuit breakers on the pilot circuit breaker panel. These circuit breakers provide thermal protection for the dc ground circuit protection system.

(m) CPG station dc ground circuit protection includes five circuit breakers on CPG circuit breaker panel 1. These circuit breakers provide thermal protection for the dc ground circuit protection system.

(n) The pilot circuit breaker edge-light panels provide edge-lighting for the pilot forward, center, and aft circuit breaker panels. The panels are controlled through multi-channel dimming controller channel 4.

(o) The CPG circuit breaker edge-light panels provide edge-lighting for CPG circuit breaker panels 1 and 2. The panels are controlled through channel 4 of the multi-channel dimming controller.

9–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 9–1

(15) **Caution/Warning.**

(a) The pilot and CPG caution/warning system accepts discrete fault signals and alerts the pilot and CPG to hazardous conditions by lighting caution and/or warning indicators in the instrument panel. When a fault signal is received, the caution or warning indicator is lighted and flashes at 2 Hz while the **MASTER CAUTION** indicator on the master caution/warning panel simultaneously flashes at 5 Hz. Pressing the **MASTER CAUTION** indicator acknowledges the fault and turns the **MASTER CAUTION** indicator off which causes the caution or warning indicator to remain steady–on. When the fault condition is removed, the indicator turns off.

(b) The audio warning system provides audible hazard warning signals to the pilot and CPG headsets. Audio warning signals are generated when the following conditions occur:

- Engine out.
- Rotor low.
- Stabilator failure.

(16) **Squat Switch System.** The squat switch, a magnetic proximity switch located in the left–hand forward avionics bay (FAB), is mounted to the airframe and the target is mounted on the main landing gear (MLG). When the helicopter is on the ground the switch acts as a safety device for some systems while enabling fault detection capabilities for other systems.

9–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS 9–2

a. **AC Electrical Power Generation System.** The ac electrical power generation system (fig. 9–1) consists of two identical ac generators, two generator control units (GCUs), and two ac contactors.

(1) **AC Generators 1 and 2.** Two ac generators, located in the main transmission bay, are mounted on and driven by the accessory section of the main transmission. Each ac generator is capable of producing all ac electrical power required by the aircraft. Two quick disconnect receptacles and four terminal studs are mounted on each generator for power and control connections. Each ac generator is self–excited, brushless, air–cooled with pre–lubricated bearings and is rated at 115/200 VAC, 400 Hz 35 KVA. Each ac generator weighs approximately 45 lbs.

b. **GCUs 1 and 2.** Two GCUs, located in the electrical power distribution box, control and protect the ac generators. Each GCU is a solid state LRU with a single quick disconnect receptacle which consists of five major circuits, two printed wiring boards, three hermetically sealed relays, and a base assembly enclosed in a metal case.

c. **Generator Contactors K1 and K2.** Two generator contactors, located behind the pilot in the electrical power distribution box, control connections between the ac generators and ac buses 1 and 2. Each generator contactor is a solid state LRU with nine terminal studs and one quick disconnect receptacle on the front face for power and control connections.

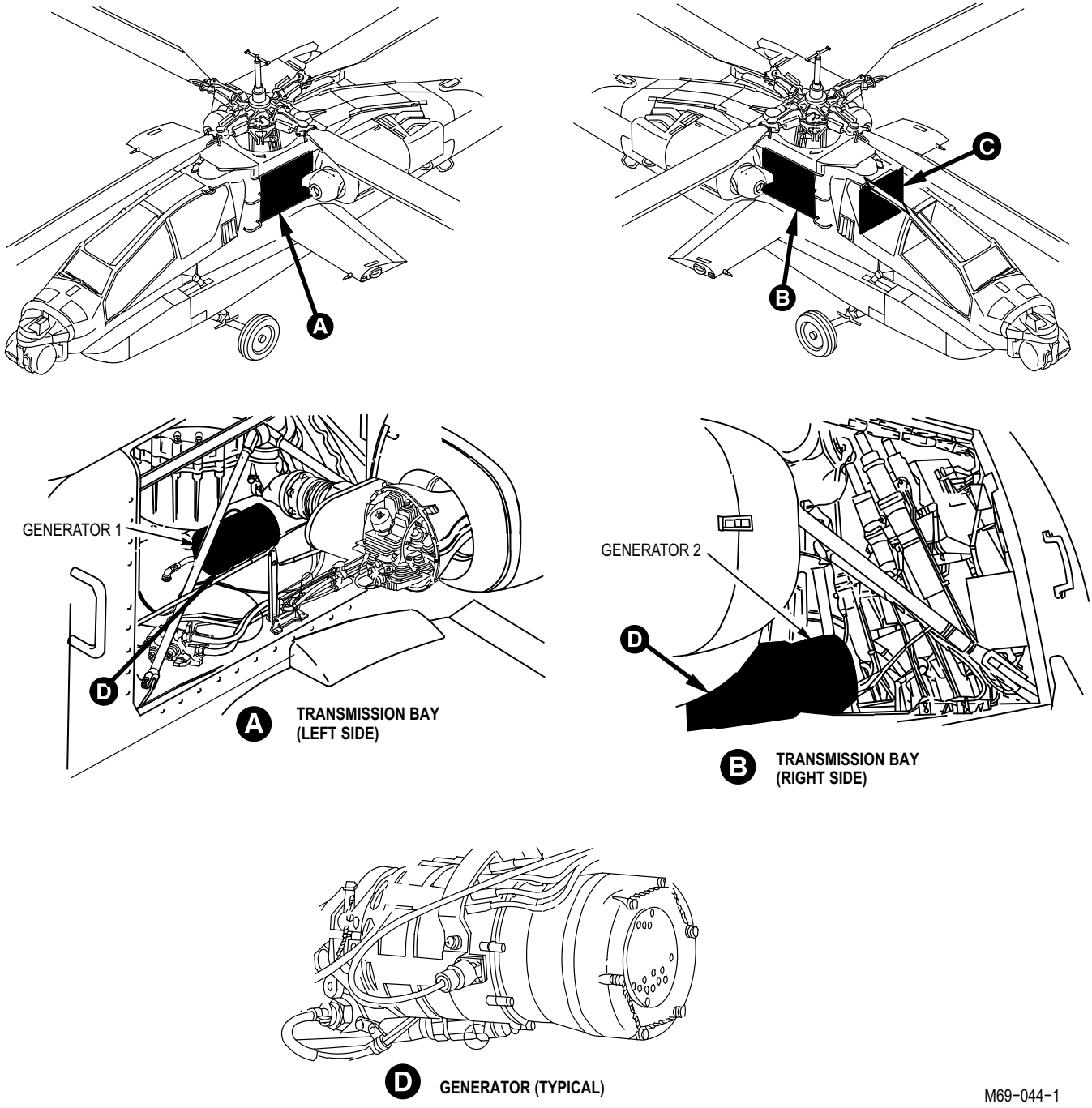

Figure 9–1. AC Electrical Power Generation System Major Components Location (Sheet 1 of 2)

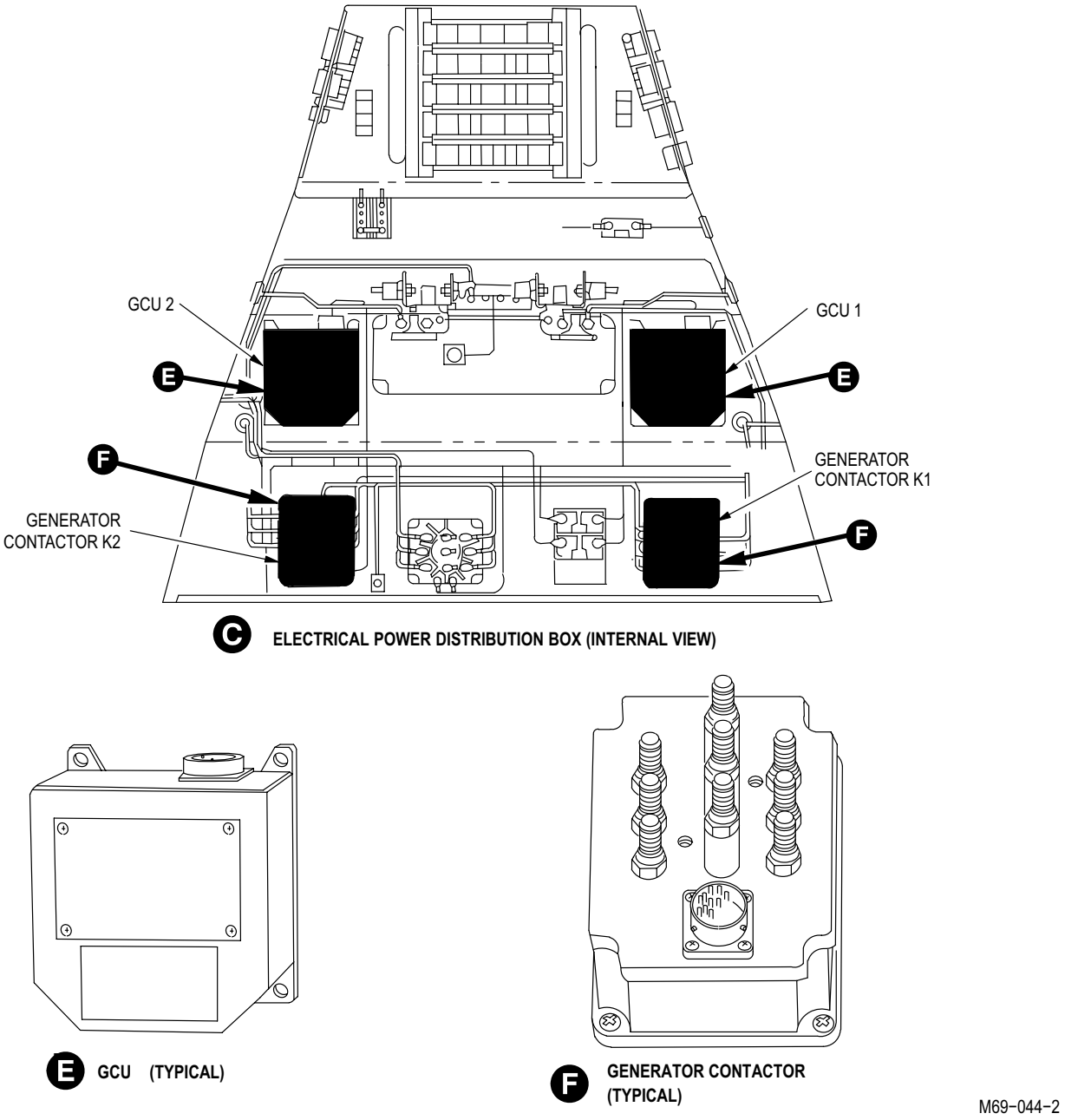

Figure 9–1. AC Electrical Power Generation System Major Components Location (Sheet 2 of 2)

d. **DC Electrical Power Generation System**. The dc electrical power generation system (fig. 9–2) consists of T/R 1 and 2, and a dc bus tie contactor.

(1) **T/R.** T/R 1 is mounted in the forward left side of the main transmission bay. T/R 2 is mounted in the forward right side of the main transmission bay. Each T/R is a solid state LRU containing one electrical connector and two terminal studs for power and control connections.