

**TECHNICAL MANUAL**

**DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL  
FLIGHT COORDINATION CENTRAL  
AN/TSC-61B  
(NSN 5895-01-057-3968)**

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**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**12 MARCH 1980**

**WARNINGS**  
**HIGH VOLTAGE**

Voltages in excess of 120/208 volts ac are used in this equipment. Be careful when working on the ac line connections. Serious injury or DEATH may result from contact with these terminals.

**POTENTIALLY DANGEROUS SOLVENT**

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

**CLEANING WITH COMPRESSED AIR**

To be usable for cleaning, the compressed air source must limit nozzle pressure to no more than 29 pounds per square inch gauge (PSIG). Goggles must be worn at all times while using compressed air.

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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 or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-procedures, please let us know. MQ, Fort Monmouth, NJ 07703.

A reply will be furnished direct to you.

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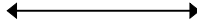
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CHAPTER 1  
INTRODUCTION

1-1. Scope

a. This manual contains instructions covering direct support and general support maintenance of Flight Coordination Central AN/TSC-61B (FCC). It covers the overall functioning of the equipment and describes procedures for troubleshooting, testing, aligning and repair of the FCC.

b. Operating instructions and organizational maintenance for the FCC are contained in TM 11-5895-469-12.

1-2. Indexes of Publications

a. *DA Pam 310-4*. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. *DA Pam 310-7*. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. *Reports of Maintenance and Unsatisfactory Equipment*. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

b. *Report of Packaging and Handling Deficiencies*. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DLAR 4145.8.

c. *Discrepancy In Shipment Report (DISREP) (SF 361)*. Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

1-4. Reporting Equipment Improvement Recommendations (EIR)

If your Flight Coordination Central AN/TSC-61B needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

1-5. Reference Designators for Flight Coordination Central AN/TSC-61 B

Unit number	Nomenclature
1	Shelter, Electrical Equipment S-594/TSC-61B.
2	Mast, Antenna AB-577/GRC.

Unit number	Nomenclature

3	Control, Intercommunication Set C-161 1D/AIC.
4	Tripod, Antenna AB-1256/GRC.
5	Headset-Microphone H-157/AIC.
6	Headset-Microphone H-157/AIC.
7	Receiver-Transmitter RT-1167/ARC-164.
8	Radio Set AN/ARC- S1A.
9	Radio Set AN/ARC-102.
9A	Control, Radio Set C-3940/ARC-94.
10	Radio Set AN/VRC-46.
11	Telephone Set TA-312/PT.
17	Generator, Ringing TA-248/TT.
18	Foot switch assembly.
19	Control Indicator C-8156/ARC.
20	Receiver-Transmitter RT-I 167/ARC- 164.
21	Radio Set AN/ARC-15A.
22	Radio Set AN/VRC-46.
23	Receiver-Transmitter RT-1167/ARC-164.
24	Radio Set AN/ARC-I 15A.
25	Radio Set AN/VRC-46.
26	Headset-Microphone H-157/AIC.
27	Foot switch assembly.
28	Headset-Microphone H-157/AIC.
29	Foot switch assembly.
30	Antenna Coupler CU-1658A/A.
31	Filter, Bandpass F-1463S.
32	Filter, Bandpass F-1463/TS.
33	Filter, Bandpass F-1463/TS.
34	Filter, bandpass (fm).
35	Filter, bandpass (fm).
36	Filter, bandpass (fm).
37	Filter, Bandpass F-1451/GRC.
38	Filter, Bandpass F-1451/GRC.
39	Filter, Bandpass F-1451/GRC.
41	Filter, lowpass (hi).
42	Clock, 8-day.
44	Antenna AS-3243/GRC.
45	Antenna AS-3244/TS.
46	Antenna AS-1729/VRC.
47	Antenna AS-1729/VRC.
48	Antenna AS-1729/VRC.
49	Antenna AT-IOI1/U.
51	Speech Security Equipment TSEC/KY-8.
52	Mounting MT-1029/VRC.
53	Mounting MT-1029/VRC.
54	Mounting MT-1029/VRC.
55	Case, Coupler CY-7658/GRC.
56	Headset-Microphone H-157/AIC.
57	Headset-Microphone H-157/AIC.
58	Headset-Microphone H-133/AIR.
1A41	Signal control box.
A1-A10	Radio Control Cards (I through 10).
A16	Buzzer-flasher card.
A17-A31	Telephone control cards (I through 15).
1A33	Power entrance box.
1 A34	Telephone entry panel.
1A35	AC power distribution.
1A36	AC line filter.
1A37	Power Supply PP-7442/G.
1A38	Power Supply PP-7442/G.
1A39	Control, Power Supply C-10419/TSC-61B.
1A40	DC power distribution.
1A42	Panel, Control Indicator C-10417/TS.

Unit number	Nomenclature
A1	Audio relay card.
A2	Headset-amplifier card.
A3	Microphone preamplifier card.
A4	Microphone amplifier card.
1A43	Panel, Control Indicator C-10417/TE.
A1-A4	Audio relay, headset-amplifier, microphone-preamplifier, and microphone amplifier cards.
1A44	Panel, Control Indicator C-10417/TS.
A1-A4	Audio relay, headset-amplifier, microphone-preamplifier, and microphone amplifier cards.
1A45	Panel, Control Indicator C-10418FrS.
1A46	Panel, Control Indicator C-10418T'S.
1A47	Panel, Control Indicator C-10418rm.
1A48	Speaker assembly.
1 A49	Speaker assembly.
1A52	Circulation fan.
1A53	Antenna entrance panel.
1A54	Amplifier Filter AM-6985IS.
A1	Preamplifier card.
A2	Amplifier card.

Unit number	Nomenclature
1A55	Blower.
1A57	Heater.
1A58	Thermostat.
1A59	Air conditioner.
1A60	Lamp assembly, fluorescent.
1A61	Lamp assembly, fluorescent.
1A62	Lamp assembly, fluorescent.
1A63	Lamp assembly, fluorescent.
1A64	Lamp assembly, fluorescent.
1A65	Lamp assembly, fluorescent.
1A66	Lamp assembly, fluorescent.
1A67	Lamp assembly, fluorescent.
1A68	Lamp assembly, fluorescent.
1A69	Lamp assembly, fluorescent.
1A70	Lamp assembly, incandescent.
1A71	Lamp assembly, incandescent.
1A72	Buzzer assembly.
1A73	Crypto junction box.
1A74	Speaker assembly.



## CHAPTER 2 FUNCTIONING OF EQUIPMENT

### Section I. BLOCK DIAGRAM ANALYSIS

#### 2-1. General

(fig. FO-2)

The FCC uses radio facilities to establish communications with aircraft and other ground installations such as FOC's. Telephone communication facilities are also available for ground communication. Ten radio sets (3 UHF band, 3 VHF band, 3 FM, and 1 HF) are used for reception and transmission. Aside from the telephone subsystem, the HF set provides long distance communication capability. Major components of the FCC, their subassemblies and functions, are discussed in paragraphs 2-2 through 2-6 and illustrated in the system block diagram (fig. FO-2).

#### 2-2. Radio Communication

(fig. FO-2)

Any one of the ten receiver-transmitters can be monitored or modulated individually or any combination of sets can be operated simultaneously. Control of the radio sets is exercised from any of the three operating positions. (Two designated *operator's*, the third designated *supervisor's*.) Each position is equipped with a radio-audio control panel containing 10 control switches. All three radio-audio panels are wired in parallel and each radio set can be operated from any of the positions. When the voice security system is used, however, fm radio set No. 3 (para 2-5) is not controlled by any of the radio-audio panels.

a. *Reception.* RF signals received at the various antennas are routed to the individual radio sets through the antenna entry panel. The signals are demodulated in the radio sets and, in all receivers are connected to the signal control box. Within the signal control box, audio is applied to a transistorized radio control card (para b below) and directly to each of the three radio-audio control panels. The switches on the radio-audio control panel (in MON or TALK position) pass the audio signal on to the audio control circuit where it is amplified and applied directly to the headset portion of Headset-Microphone H-157/U and (in positions 1 and 2 only) to the associated speaker.

b. *Signal lamp circuit.* The audio input in the signal control box is connected to a radio control card (para a above) as well as to the radio-audio control panels. Circuits in the signal control box act to ground the call lamps at each radio-audio control panel intermittently, causing the lamps to flash (e.g. all of the FM1 lamps). This indicates to the operator that someone is attempting to communicate with the FCC via the FM-1 channel.

c. *Transmission.* To transmit, the radio key switch associated with the flashing lamp is set in the TALK (up) position. This causes the call lamp to glow steadily and connects both incoming and outgoing audio circuits to

the respective portions of the headset-microphone. There are three methods of keying the transmitter. Pressing either the push-to-talk button on a headset-microphone cord, or the footswitch will key the transmitter. In addition, a KEY switch on the radio-audio control panel can either be set to a key position, (ON LOCK) or can be held in key position ON (MOM) to key the transmitter. Audio spoken into the microphone section of the headset-microphone is amplified by a preamplifier and amplifier in the panel to modulate the transmitter.

#### 2-3. Telephone Communication

(fig. FO-2)

Fifteen telephone line pairs can be accommodated in the FCC. Incoming ring signals are passed through the signal control box to each of three telephone control panels (one per position). With the key switch in the OFF position, the ring signal is passed back to the signal control box where the signal is applied to transistorized telephone control and buzzer-flasher control cards. These cards produce an intermittent ground to a call lamp at all the telephone control panels (producing a flashing visual signal) and, if the NIGHT ALARM switch is on, a ground circuit to a buzzer to produce an audible signal. When the telephone key switch is set to TALK (up), two-way audio conversation is possible. When the telephone key switch is held in the RING (down) position, ringer voltage (90 volts at 20 Hz) follows the audio path out to the telephone line panel and the remote phones.

#### 2-4. Operator Switch (A, A+ B)

There is one operator switch at each position (located on the radio-audio control panel). One position is normally associated with radio circuits and the headset-microphone with press-to-talk line; the other position is normally associated with telephone circuits and the other headset-microphone. When the operator switch on the radio audio control panel is set to position A, one operator can control the entire position, using radio and/or telephone. When, however, there is a great deal of both types of traffic, the switch can be set to A+B and two operators, one for radio and one for telephone, can man each position. Individual volume controls for radio and telephone are available at each station.

#### 2-5. Secure Voice System

(fig. FO-2)

The secure voice system is made up of radio set No. 3 (and its associated antenna), the TSEC/KY-8, the secure voice system junction box, an Intercommunication Set Control C- 1611 (D)/A1C (used as a headset amplifier and a microphone amplifier) mounted in the radio set control mounting rack, the KY-8 control indicator, and headset-

microphone. Switches on the control indicator provide for either encoded (or cipher) operation or for clear (un-coded) operation.

a. In secure voice operation (controlled by the KY-8 control indicator) the incoming audio signal from the receiver is decoded by the KY-8 and fed to the C-1611 (D)/A1C through the secure amplifier-filter. The decoded audio is also used to light the SECURITY CALL INDICATOR to alert the operator to the incoming call. To transmit on the voice security system, the operator presses the keying switch on the H-33C/AIC security headset-microphone and speaks into the microphone. The audio signals generated in the microphone are passed through the amplifier-filter, the amplifier in the C-1611 (D)/A1C, and back to the amplifier-filter for application to the KY-8 (for encoding). The encoded audio signals along with a keying ground (originating from the keying switch and applied through the amplifier-filter and the KY-8), are applied to the fm radio set No. 1 for transmission.

b. In unencoded operation, transmit and receive audio passes directly through the KY-8 without being encoded. Other components function as in coded operation.

## 2-6. Primary Power System

(fig. FO-2)

a. *General.* Provisions for generation and distribution of ac and dc power are incorporated in the

FCC. The system is comprised of a power trailer, an ac power distribution panel, a power supply control, two dc power supplies, and a dc power distribution box.

b. *AC Power.* The power trailer contains two identical engine generators which generate a 120/208-volt, 3-phase, 4-wire, 60 Hz output. Both engine generator outputs are fed to a transfer switch which allows selection of either output. The selected ac output is connected to the shelter power entrance panel using cable assembly W380 and W381. Connector J1 is wired to the ac power distribution panel. Circuit breakers in the ac power distribution panel control application of ac power to individual components of the system requiring same.

c. *DC Power.* Two dc power supplies and a power supply control are used in the dc power supply system. The 28 vdc output from each power supply is fed to the dc power control panel which contains circuitry for connecting the power supplies to the dc load. The load is divided into two branches: One branch (normally fed from power supply 1) supplies power to the signal control box, the UHF, VHF, and FM radios; the second branch (normally fed from power supply 2) supplies the HF radio and HF coupler. If one set should fail (or if for any reason only one power supply is used), the one power supply is automatically connected to the entire load.

## Section II. SCHEMATIC DIAGRAM ANALYSIS

### 2-7. Telephone Circuits

(fig. FO-3)

The 15 telephone circuits all operate identically. The only circuit differences lie in terminal pin and circuit card assignments. Telephone line 1 will be discussed in detail and with the exceptions noted, the discussion will apply to all circuits.

a. *Ring Circuit (incoming).* An external ring signal will cause the corresponding green call lamp on each control panel to flash. In addition, when ALARM switch S2 on the signal control box is set to on, the buzzer behind the map board will sound.

(1) The incoming ring signal of line 1 is passed through terminals of the telephone entrance panel (fig. FO-3) and out through terminals A and B of J1 (fig. FO-3) to A and B TEL connector J46 (fig. FO-5) of the signal control box. In the signal control box the lines pass terminals 136 and 144 of terminal block TB1 to terminals A and B of two connector jacks, J52 and J5 1. Cable W323 connects J51 with J1 of the telephone control panel at operator position 1. J1 of the telephone control panel at position 2 is connected to J5 of the position 1 telephone control panel. (In each control panel, J1 and J5 are connected in parallel.)

(2) In the telephone control panel (with the TALK-OFF-RING switch at OFF), the ring signal is passed through telephone key switch S1 (fig. FO-6) out through J2 to the signal control box. One "line in" connection is from A of J1 through contacts D2 and D1

of the top half of the switch and contacts C5 and C4 of the bottom half of the switch to terminal B of J2. The other "line in" connection is from B of J1 through contacts A2 and A1 of the top half of the switch and contacts C2 and C1 of the bottom half of the switch to A of J2. From J2, cable W322 of position 1 connects to J49 at the signal control box. J2 of the position 2 telephone control panel connects to J4 of the position 1 telephone control panel. 04 is in parallel with J2 in each panel.)

(3) In the signal control box (fig. FO-5) the ring signal from the telephone control panels is passed through terminals 61 and 69 of TB1 to the LINE IN terminals (N and E) of telephone control circuit card A17. (Each telephone line pair has an individual circuit card.) Application of the ring signal to the telephone circuit card (as explained in paragraph 2-9) has two effects. One is to permit an intermittent ground to be applied from terminal B of the telephone control circuit card through terminal 77 of TB1, terminal h of J49, to terminal h of J1 at each telephone control panel. This intermittent ground completes the lamp circuit of the associated call lamp, resulting in a flashing signal. The other effect is produced by input at terminal D which is connected to terminal B of the buzzer-flasher control circuit card. As described in paragraph 2-8, this produces a ground at terminal B of the

buzzer-flasher circuit card. This ground is connected through terminal 8 of TB2 to radio control AI and the buzzer. If the NIGHT ALARM switch (A41S2) is in the on position, 28 volts dc is completed through FI (2 amperes) in the signal control box and terminal board TB3 to J45 and the buzzer. Completing the ground causes the buzzer to operate until the TALK-OFF-RING switch is set to TALK (*b* below).

b. *Talk Circuit.* When the operator is alerted by either the flashing call lamp or the sound of the night alarm buzzer, the operator sets the TALK-OFF-RING switch to the TALK position and can initiate two-way conversation.

(1) *Audio-in Circuit.* Incoming audio from line pair 1 is applied through the L1 terminals and the signal control box to telephone control panel J1 terminals A and B as described for the incoming ring circuit in a(l) above (fig. FO-6). From terminal A of J1 the audio circuit is completed to terminals D2 and D1 of the top half of switch S1 and contacts C5 and C6 of the bottom half of the switch through the OPR, AUDIO switch, S16, to terminal B of J3. From terminal B of J1 the audio circuit is completed through contacts A2 and A1 of the top half of the switch, contacts C2 and C3 of the bottom half of the switch, and the other section of S16 to terminal A of J3. Terminal A of J2 connects to terminal 1 of impedance matching transformer T1 and terminal B of J2 connects to terminal 4 of T1. Audio output of T1 is

from terminals 11 and 6. The audio from terminal 6 of T1 is connected through resistor R7 on audio relay, AI card (fig. 2-1) and switch S12 (A+B position) to R4 and then to center terminal of telephone VOL control R12. If the A A+B switch on the radio control panel is in the A position, the telephone audio voltage from 6 of T1 is connected through resistor R7 and contacts C2 and C1 of S12 through contacts B1 and B2 to R3 and to center terminals of VOL control R11. From each of the VOL controls, audio voltage is applied to terminal 1 of the respective headset amplifier A2 circuit card. (For discussion purposes, the headset amplifier associated with the telephone VOL control is called A2-B and the headset amplifier associated with the radio VOL control is called A2-A.) In circuit card A2-A, the audio voltage is amplified; the output from terminal 6 is applied through TB1 to the headset portion of headset-microphone H-157. From A2-B terminal 2 of TB2 is used to connect through Cord CX-2555/U (modified) to the headset. From A2-A, terminal 2 of TB1 is used to connect through Cord CX-2556/U (modified) to the other headset. The individual VOL controls control the audio volume in the headsets. If audio voltage is applied to the A2-A headset amplifier (switch S1 in A position) the incoming audio will also be heard in the speaker/amplifier (operating positions 1 and 2 only).

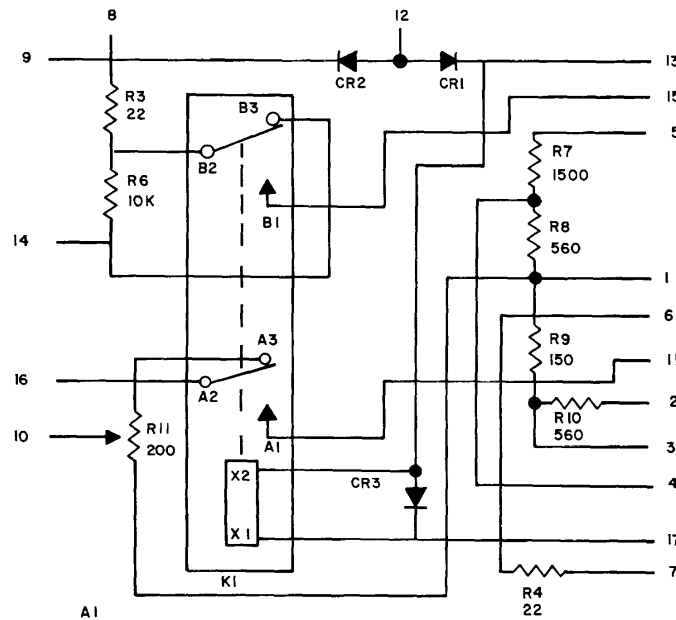


Figure 2-1. Audio relay circuit card, simplified schematic diagram.

(2) *Audio-out Circuit.* When the operator speaks into the microphone, audio voltage is applied through terminal 5 of TB2 (operator B position) or terminal 5 of TB1 (operator A position) to preamplifier card A3. The output of the preamplifier card is passed to the input of microphone card A4. From A4-B, (the card normally associated with telephone circuits), the output is applied through contacts C6 of S12 (A+B position) and resistor R10 to terminal 11 of transformer T1 (fig. FO-7). From A4-A (the board normally associated with radio circuits, but usable with telephone when switch S12 is set to A) the output is applied through terminal 16 of circuit card A1 audio relay, contacts A2 and A1 of energized relay K1, terminal 11 of circuit card A1, and contacts C4 and C5 of S12 (A position) through R10 to terminal 11 of transformer T1. From the output of the transformer T1 coil, terminals 4 and 1, outgoing audio voltage follows the audio-in path traced in (1) above to the party at the other end of the line. Relay K1 on circuit card A1 is energized as follows: Twenty-eight volts dc is applied through A1 fuse F1, terminal 17 of card A1 to the coil of K1. The other side of the coil (and the amplifier

control line of A4-A microphone amplifier, through diode CR1) is connected through terminal 13 of card A1 and contacts B1 and B2 of S12 (A position) to terminal D of J2 which in turn connects to D of J3 of the associated telephone control panel. In the telephone control panel, terminal D is completed through B9 and B8 of the key switch (TALK position) to ground. This allows the relay and the A4 microphone amplifiers to operate. In the A+B position of S12, the amplifier control line of A4-B is completed to D of J2 through contacts B3 and B2 of S12.

c. *Ring Circuit (Outgoing).* When it is desired to place a call, the operator presses the appropriate key switch on the telephone control panel. This connects the output of the TA-248A/PT ringer to the line terminals. Ninety volts ac at 20 Hz from the ringer is completed from J43 through terminals 11 and 12 of TB2 to terminals AA and y of J49. These connect to the same numbered terminals of J2 at each of the telephone control panels. One side of the ringer line connects through contacts A2 and A3 at the top half of the switch to an external line terminal. The other

side of the line connects through contacts D3 and D2 at the top half of the switch to the other half of the line pair. When the operator releases the switch, it returns to the OFF position, breaking the ring circuit.

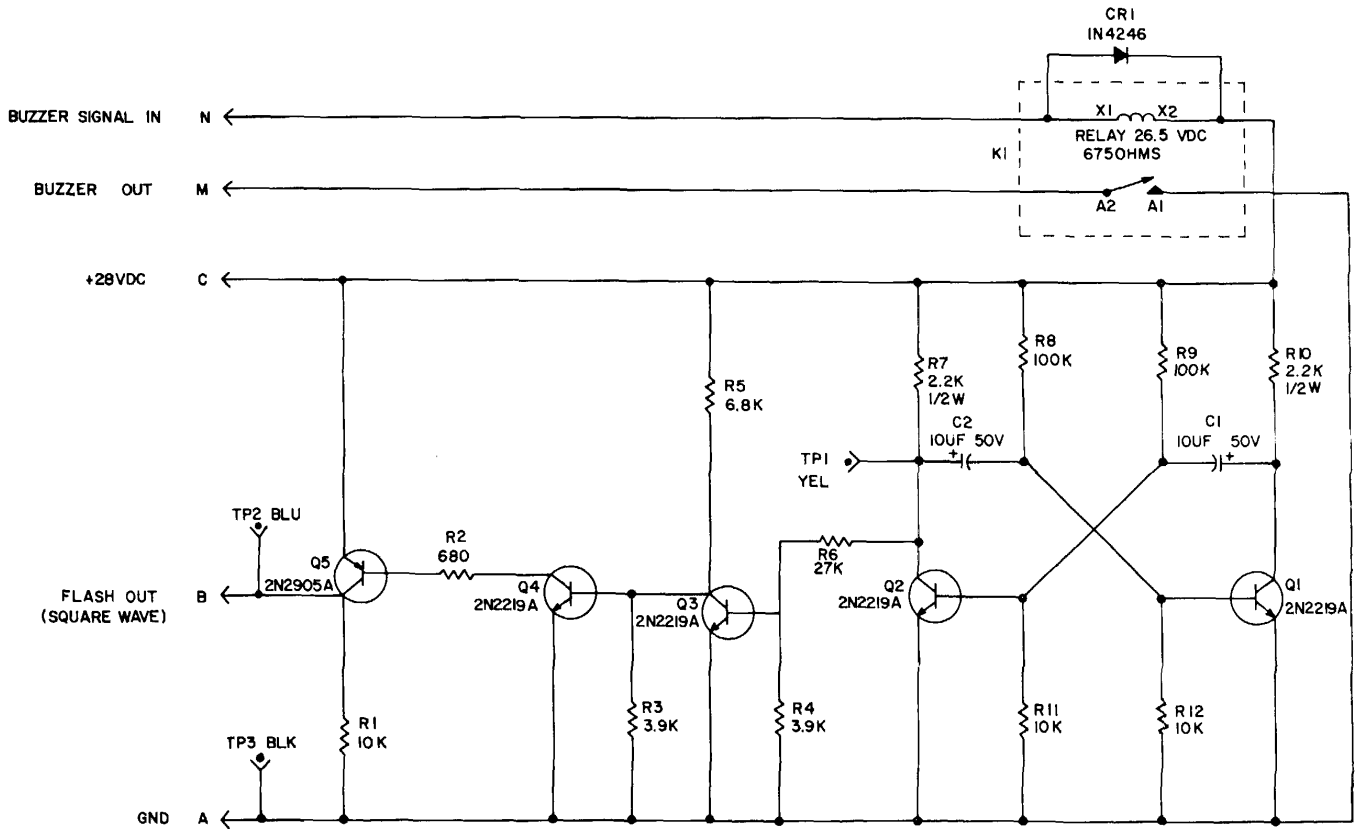
**NOTE**

The ringer is continuously at standby so long as its primary is connected to a convenience outlet. No other switching than completing the secondary circuit by a telephone key switch is required.

**2-8. Buzzer-Flasher Control Circuit Card**

(fig. 2-2)

The buzzer-flasher control circuit card is divided into two sections; one section utilizing Q1 through QS, provides a flasher signal for all radio control and telephone control circuit cards in the signal control box; the second section, comprised of K1 and diode CR1, controls operation of the night alarm buzzer.



UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS AND 1/4 WATT.

EL5UV002

Figure 2-2. Flasher/buzzer circuit card, simplified schematic diagram.

a. Transistors Q5, Q4 and Q3 serve to amplify the oscillatory signal produced by the common emitter multivibrator made up of Q1 and Q2. The output of transistor Q1 is coupled to the input transistor Q2 through the feedback capacitor C1, and the output of Q1 is coupled to the input of Q2 through the feedback capacitor C2. An increase in the collector current of Q1 causes a decrease in the collector voltage which, when coupled through capacitor C1 to the base of transistor Q2, causes a decrease in the collector current of Q2. The resultant increase of voltage at the collector of Q2, when coupled through capacitor C2 to the base of Q1, drives Q1 further. This regenerative process repeats, driving Q1 into saturation and Q2 into cutoff. Q2 is maintained at cutoff by C1 (which was previously charged to +28 volts through resistor R10) until C1 discharges through the parallel combination of R9 and R11 toward the collector supply potential. When the junction of C1 and R9 reaches a slight positive voltage, however, transistor Q2 begins to conduct and the regenerative process reverses. Q2 then reaches a saturation condition, Q1 is cutoff by the reverse bias applied to its base through C2, and the C2-R8-R12 junction starts charging toward + 28 volts.

b. The buzzer-in signal is a control voltage supplied from each telephone control circuit board in

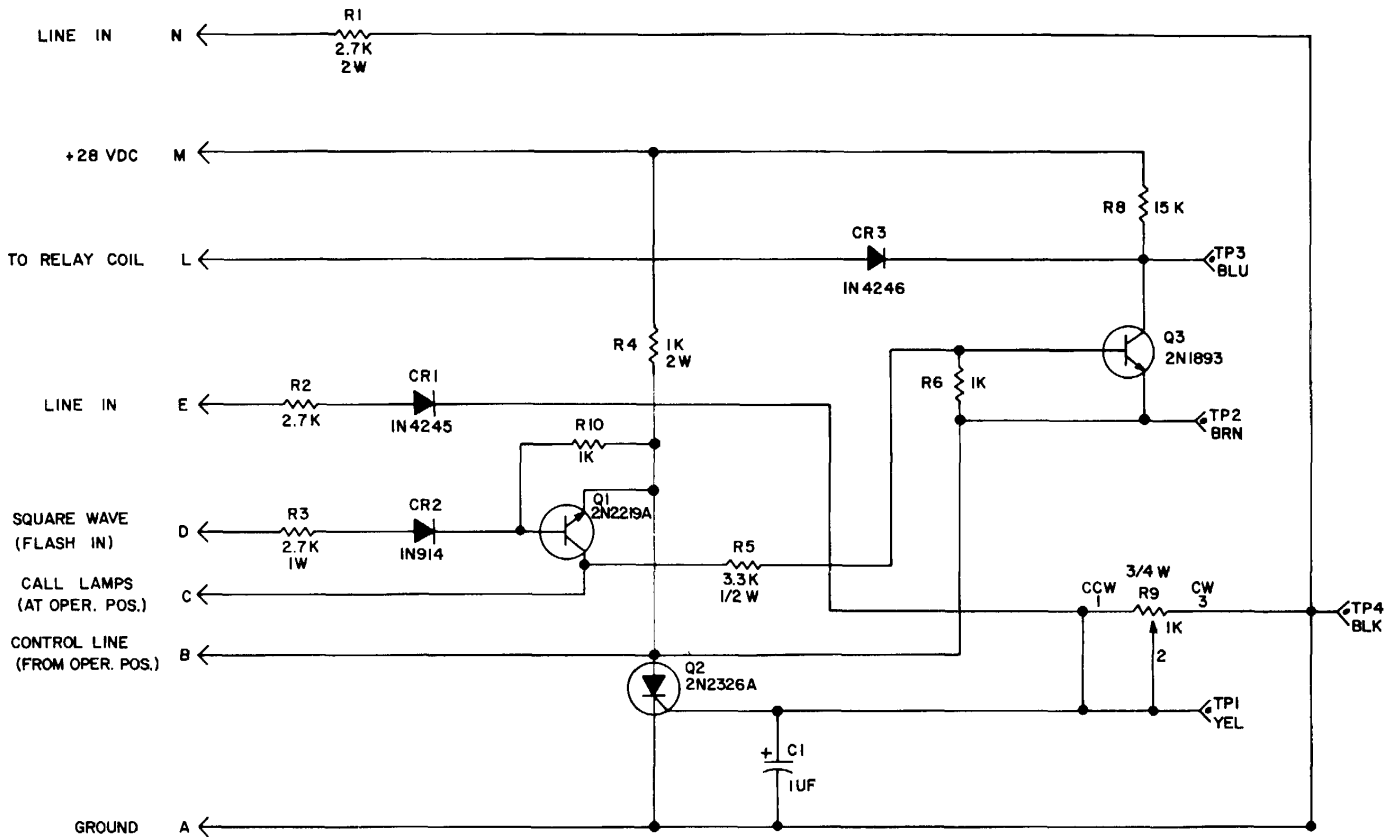
parallel. When the signal is received (low voltage), relay K1 energizes, causing a ground to appear at terminal M. The ground causes the buzzer to energize through the NIGHT ALARM on-off switch.

## **2-9. Telephone Control Circuit Card**

(fig. 2-3)

The telephone control circuit card serves to detect incoming ring and alert the operator by flashing the call lamp associated with the ringing line. For night alarm mode, a control signal is applied to the buzzer-flasher control circuit card.

a. Incoming ring voltage is applied to terminals N and E. Resistors R1 and R2 terminate the telephone line and form a load for the ring voltage (90 vac) which causes diode CR1 to conduct on positive alterations, forming positive going pulses across the parallel combination of R9 and C1. The positive going pulses are "felt" on the trigger electrode of silicon control rectifier (SCR) Q2, causing it to "fire" (conduct) and provide conducting paths for Q1 and Q3. Load resistor R4 provides + 28 vdc to the anode of Q2 to allow operation. The application of ground on the control line (applied when the operator puts the telephone key switch to talk) causes the SCR to revert to its nonconducting state.



UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS AND 1/4 WATT.

EL5UV003

Figure 2-3. Telephone control circuit card, simplified schematic diagram.



b. Transistor Q1 and Q3 are normally held cut off by the +28 vdc supplied to their emitters through R4. When Q2 "fires," the emitter voltage of Q1 and Q3 drops toward zero, and Q1 and Q2 turn on. The flash-in signal is connected through voltage divider network R3 and R10 to forward bias Q1. The collector of Q1 is connected to +28 vdc through the call lamp on the telephone control panel. The flash-in causes the call lamp to flash and applies a signal to Q3 through limiting resistor RS. Transistor Q3 develops the signal across collector load resistor R8 and applies it through isolation diode CR3 to terminal L, buzzer out, causing the buzzer to operate (para 2-8). When the operator places the key on switch in the TALK position to answer the call, a ground is placed on line C (call lamp) which cuts off Q3, stopping the buzzer operation.

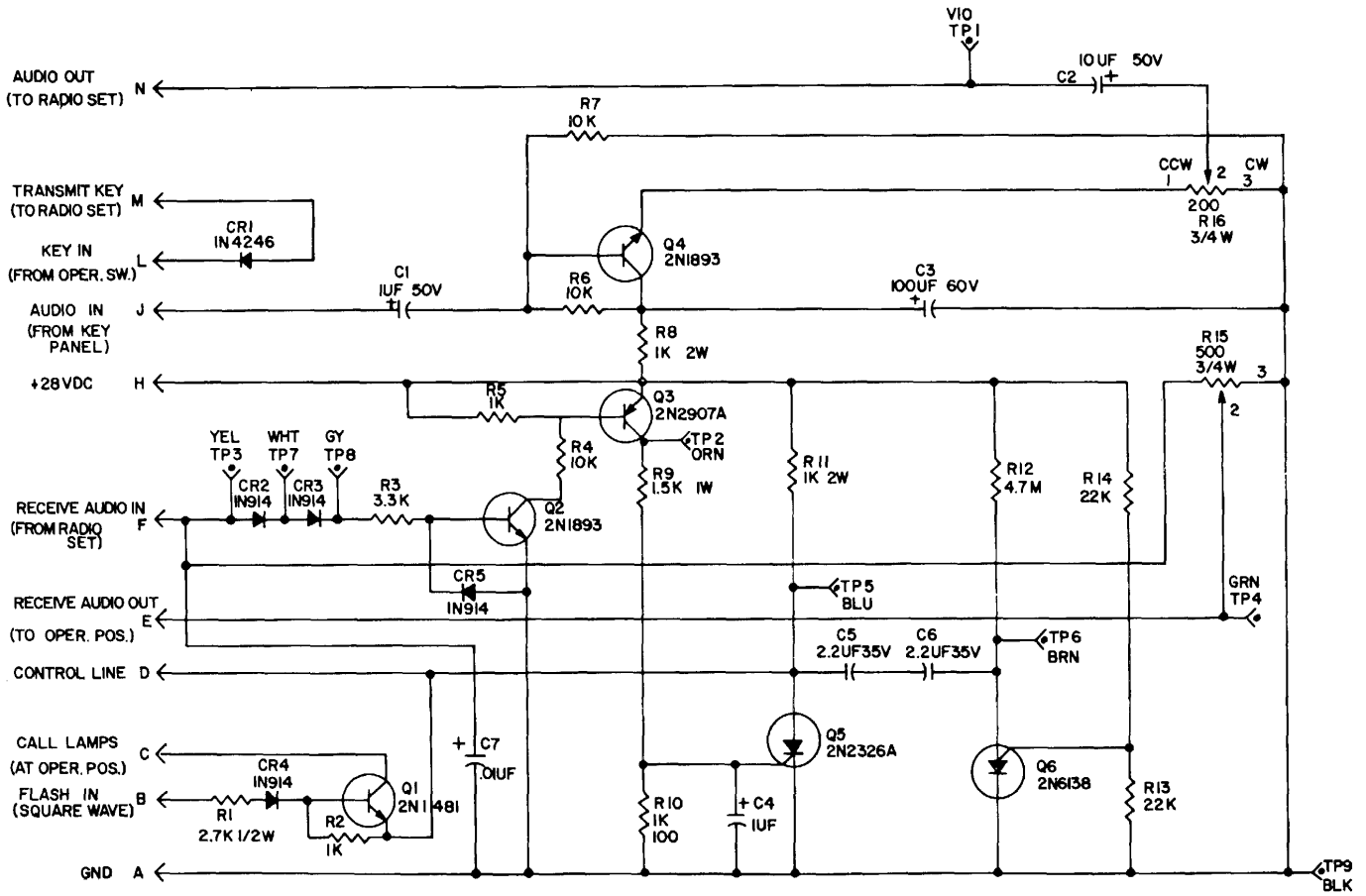
### 2-10. Radio Circuit

The 10 radio circuits (or 9 if radio set No. 3 is used with the voice security system (para 2-14)) all have identical key control circuits and have identical audio-in and audioout control circuits. The only circuit differences lie in terminal pin and control card numbers. Accordingly, the control and audio circuits of radio set No. 1 will be discussed in detail and, with the exceptions noted, will apply to all circuits.

a. *Call Lamp Circuit.* On the radio-audio control panel (fig. FO-7) there are 10 green call lamps, each

associated with one of the radio set control switches. Twenty-eight volts is applied through 1 ampere fuse FI but since the lamp is not grounded, it does not light. When, however, the lamp is pressed, contact is made between contacts 3 and 2 to ground. This determines, during non-operation, if the bulb is good or defective. If the key switch is set to TALK, contact is made from the call lamp through contacts B6 and B5 to ground. When an incoming audio signal is received (*b* below), operation of the radio control circuit card causes an intermittent ground to appear at contact D of J1. This causes the lamp to flash on and off, representing a call. This flashing will continue until either there is no audio input or the key switch is moved from OFF to TALK or MON.

b. *Receive Circuit.* An incoming signal at the UHF 1 antenna is fed to the receiver-transmitter, amplified, detected, and audio amplified. The audio voltage (together with the key line and microphone input lines) is connected through a 5-wire cable to the signal control box (fig. FO-5). A placard on the signal control box identifies and locates the connector for each of the radio sets. For all radios, the audio-in line is terminal A; the UHF 1 radio cable connects at J33. In the signal control box, the audio voltage is connected directly to terminals F and E of radio control circuit card connector XA1 (fig. 2-4).



UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS AND 1/4 WATT.

EL6UV004

Figure 2-4. Radio control circuit card, simplified schematic diagram.

(1) The audio voltage at terminal F is connected through R 15 direct to terminal E. (Detailed analysis of the radio control circuit card is presented in paragraph 2-11.) From terminal E, the audio is completed to terminal 8 of TB1. Terminal 8 connects to terminal A of connector jack, J47. The cable, labeled RADIO on the placard inside the signal control box cover, connects to J1 of the radioaudio control panel (fig. FO-7) at position 1. J1 of the radio-audio control panel at position 2 is connected to J3 of the position 1 radio-audio control panel. (In each radioaudio control panel, J1 and J3 are connected in parallel.) In the radio-audio control panel, the audio voltage is applied to terminal D2 of the top half of switch S1 (fig. FO-7). With S1 in the OFF position, terminal D2 makes contact with D3 through R1 to ground.

(2) The audio voltage at terminal F acts (para 2-11) to permit an intermittent ground potential to appear at terminal C of the radio control circuit card. The intermittent ground results from application of a flashing signal from the buzzer-flasher control card to terminal B of the radio control card (para 2-11). This intermittent ground is connected through terminal 53 of TB1. Output of terminal C is connected to terminal 32 of TB1 then to D of J47 to the call lamps associated with the UHF 1 radio set key switch, resulting in a flashing signal at each of the radio-audio control panels.

(3) When the operator responds to the call by setting the key switch to the TALK position, the call lamp remains lighted (a above), a transmit audio circuit is completed (c(2) below), and the received audio voltage ((1) above) is completed through contacts D2 and D1 of the top half of S1 to terminal 14 of AI audio relay of the radio-audio control panel (fig. FO-7). The audio voltage from terminal 14 is connected through R6 and R3 to terminal 8 of circuit card AI. The audio voltage from terminal 8 is connected to the arm of radio VOL control R11. From the VOL control, audio voltage is applied to terminal 1 of headset amplifier A2-A. In circuit card A2-A, the audio voltage is amplified; the output from terminal 6 is applied to the headset portion of headset microphone H-157 through terminal 2 of TB1 and CX-2556/U (modified) to the A operator's headset. Audio is also applied from the A2A, headset amplifier output to terminal E of J5 to the speaker/amplifier.

c. *Audio-Out Circuit.* To transmit audio-modulated signals, the transmitter must be keyed and audio voltage must be applied to the transmitter portion of the radio sets. Keying circuits will be discussed (below); this subparagraph will discuss the audio circuit from the microphone to the transmitter-in connection.

(1) When the operator at position A speaks into the microphone, audio voltage is applied through terminal 5 of TB1 to preamplifier board A3-A (terminal 2). The output of the preamplifier board (terminal 7) is passed to the input of microphone amplifier board A4-A (terminal 1). From A4-A, the amplified audio is

connected from terminal 4 to terminal 16 of printed circuit card A1, through contacts A2 and A3 of de-energized relay K1, to potentiometer R1 1. From the arm of R11, the circuit is completed through terminal 10 of printed circuit card A1 directly to terminal C6 of S1 of the radio-audio control panel. The other side of the amplified audio line is connected from terminal 5 of microphone amplifier A4-A to ground.

(2) Connector J1 of the position 1 radio-audio control panel connects to J47 at the signal control box. J1 of the position 3 radio-audio control panel connects to J3 of the position 2 radio-audio control panel. J1 of position 2 connects to J3 of the position 1 radio-audio control panel and, through that panel, out of J1 to J47 at the signal control box. J3, position 3 has no cable connection. In the signal control box (fig. FO-5), the microphone audio is connected from terminal E of J47 through terminal 40 of TB1 to terminal J of the radio control card. After the audio signal is processed in the radio control circuit card (para 2-11), the audio voltage is passed from terminal N of the circuit card to terminal C of J33 to the UHF 1 transmitter. The signal then modulates the rf output of the transmitter.

d. *Keying Circuit.* The radio sets are switched to the transmit condition by a grounding key line from the transmitter. For each of the radio sets, this key line is connected to the signal control box through connector terminal B of the individual radio set cable. Considering the UHF I key line, terminal L is connected to terminal M of radio control AI. Each radio control circuit card contains one diode in the key circuit. These diodes serve to isolate each of the key lines from the other to prevent keying more than one transmitter when one line is grounded. The key line is connected from terminal L of the radio control card through terminal 16 of TB1 to terminal B of jack J47. In the radio-audio control panel (fig. FO-3), terminal B is connected through switch S1 (TALK position), contacts C9 and C7 of the bottom section of the switch, to terminals C3 and C2. A connection at this point is made to KEY switch S11. Setting the switch to either ON position grounds the key line and keys the transmitter. The down position is springloaded, allowing for press-to-talk operation. Jack J3 of the radio-audio control panel is connected to J1 of the associated radio-audio control panel (fig. FO-6). There are two additional methods of grounding the key line (B of J1) in (or connected through) the radio-audio control panel.

(1) One connection is made through J4, contacts A and B, to the footswitch. Pressing the footswitch completes the ground circuit to the radio-audio control panel.

(2) The other possible key-line connection is made through terminal 4 of TB1. This line is connected through Cord CX-2556/U to microphone button S1 on the U-94/U. Pressing the button completes the circuit to terminal 1 of TB1 which is connected to ground.

**2-11. Radio Control Circuit Card**

(fig. 2-4)

The radio control circuit card contains circuits to alert the operator to incoming radio calls and provides a means for adjusting the received and transmitted audio for each individual radio set.

a. Radio audio signals are applied to terminals F and E to potentiometer R15, diodes CR2, CR3 and resistor R3. Diodes CR2 and CR3 rectify the incoming audio signals into positive going pulses which supply base drive to transistor Q2. Transistor Q2, forward biased by diode CR5, causes transistor Q3 to conduct, providing positive going pulses which causes SCR Q5 to "fire." When Q5 "fires " a conduction path is provided for transistor Q1 to operate which lights the call lamp. Resistor R1 supplies base bias current. When the operator is transmitting and transistor Q4 is conducting, SCR Q6 and resistors R12, R13, R14 (threshold switch) detect the increase in anode voltage and "fires" SCR Q6. Application of ground on control line (applied when the operator puts the radio line key switch to TALK (para 2-10d)) causes the SCR to revert to its non-conducting state.

b. Transmitter audio in is applied to line J and N and is coupled by capacitor C 1 to the base of transistor Q4 (emitter follower). The output of Q4 is taken across potentiometer R16, through coupling capacitor C2, to line N (transmit audio out). Resistor R6 supplies base bias current.

c. Audio from the receiver is applied to line F and A (ground) across potentiometer R15. Audio voltage from the wiper arm of RI 5 is connected directly to terminal E.

**2-12. Amplifier and Preamplifier Boards in the Radio-Audio Control Panel**

(fig. FO-9)

In the radio-audio control panel (fig. FO-7) there are two sets each of printed circuit cards: Headset amplifier A2, microphone preamplifier A3, and microphone amplifier A4. These boards have been taken directly from Control

b. The switching action of A switch and A + B switch are shown below.

S12 position	Circuit	Path	Effect
A	Audio out from 6 of T1.	Pin1, R11, R3, B2 & B1, C1 &C2, R7 to pin 6 of T1.	Telephone operation through A position headset.
A +B	Audio out from 6 of T1.	Pin 1, arm R12, R4, C3 &C2, R7 to pin 6 of T1.	Telephone operation through B position headset.
A	audio 11 to T1.	Pin4, A2, & A1, C4,& C5, R10 to pin 11 of T1. & B1 of S12, to ground side of K1. Ground also CR1 to pin 3 of A4A.	Telephone audio out from A microphone. Telephone operates thru radio microphone and Headset only
A +B	Telephone key line.	Ground through B9 & B8 (RING-OFF-TALK), through B3 & B4 of S12, to pin 3 of A4B.	Telephone operates through B microphone and headset only.

c. The radio key line is completed from ground (via footswitch, microphone button on the A headset microphone, or the KEY switch at the radio-audio control panel) to microphone amplifier A4A through diode CR4. It is unswitched. In secure voice operation (controlled by the KY-8 control indicator) the incoming audio signal from the receiver is decoded by the KY-8 for clear

Intercommunication Set C-1611 (D)/A1C. Twenty-eight volts is always applied to A4 through fuse F1. However, the microphone amplifier is only operative when its control line (terminal 3) is grounded. Figure FO-7 shows the grounding paths in both telephone operation and radio operation. The ground lines are discussed in detail in the telephone circuit functioning paragraph 2-7b(2) and the radio circuit functioning paragraph (2-10d) under the discussion of keying the transmitter. Diodes A1CR1 and A1CR2 (fig. 2-1) prevent (a) keying of the transmitter by setting a telephone key switch to TALK and (b) operation of telephone relay A 1K 1 by the act of keying the transmitter.

**2-13. Radio-Audio Control Panel Switching Circuits**

(fig. FO-3)

The radio-audio control panel contains microphone preamplifier and amplifier and headset amplifier circuits (para 2-12) for each of two positions (designated A and B) at each radio-audio control panel in the FCC. Under heavy traffic conditions, two operators, one for radio and one for telephone work at one position. Under light duty conditions, however, the A A+B switch can be set to A and one operator can control either radio or telephone communication. The switching actions of the A A+B switch and relays K on printed circuit board A1are summarized below.

a. Relay K1 is energized only when the RING-OFF-TALK switch is keyed and S12 is in the A position. This action opens the radio receive audio line (contacts B2 and B1 of K1) and the microphone output line (contacts A2 and A1 of K1) and no radio reception or transmission from this position is possible while the telephone line is keyed. Impedance matching transformer T1 connects the telephone audio in-and-out lines (terminals 4 and 1) to four lines in the radio-audio control panel. Audio in is from terminals 11 and 12, and audio out from the microphones connects to terminals 5 and 6.

(uncoded) operation.

d. Diodes CR2 and CR1 isolate the keying ground lines from each other to prevent keying interaction between the radio and telephone services.

e. Resistor R10 on printed circuit card A1 is across the

telephone output at all times. Resistor R7 on AI prevents shorting of the telephone line if the telephone VOL control is moved to extreme position.

#### **2-14. Secure Voice System Functioning**

(fig. FO-10)

The secure voice system uses fm radio set No. 3 and the receiver transmitter, but uses a TSEC/KY-8 to encode outgoing messages and decode incoming messages. A special control, Control Indicator C-8156/ARC is added to the circuit to control the KY-8. A special junction box interconnects the various units. The connections that other radio sets make to the signal control box and the three radio-audio control panels are present in the FCC but disconnected when the secure system is used.

a. *Received Audio Path.* The audio signal received by the RT-524/VRC and decoded by the TSEC/KY-8 appears at J3, pin A on the KY-8. From J3 pin A, the audio received signal follows the cabling to TB1-10 where it splits into two (2) paths.

(1) One path takes the signal to preamplifier board (A1 pin 1) where it is amplified to operate the call light circuit card (A2 pin 3). The call light card lights the SECURITY CALL INDICATOR next to the supervisor's console which gives a visual indication that a call is being received.

(2) The second path for the audio received signal is from TB1-10 to J1-30 on the C-1611(D)/A1C. The C-1611 (D)/A1C contains circuits which amplify the signal to the proper level to operate the headset. The amplified signal path is from J1-5 on the C-1611 (D)/A1C

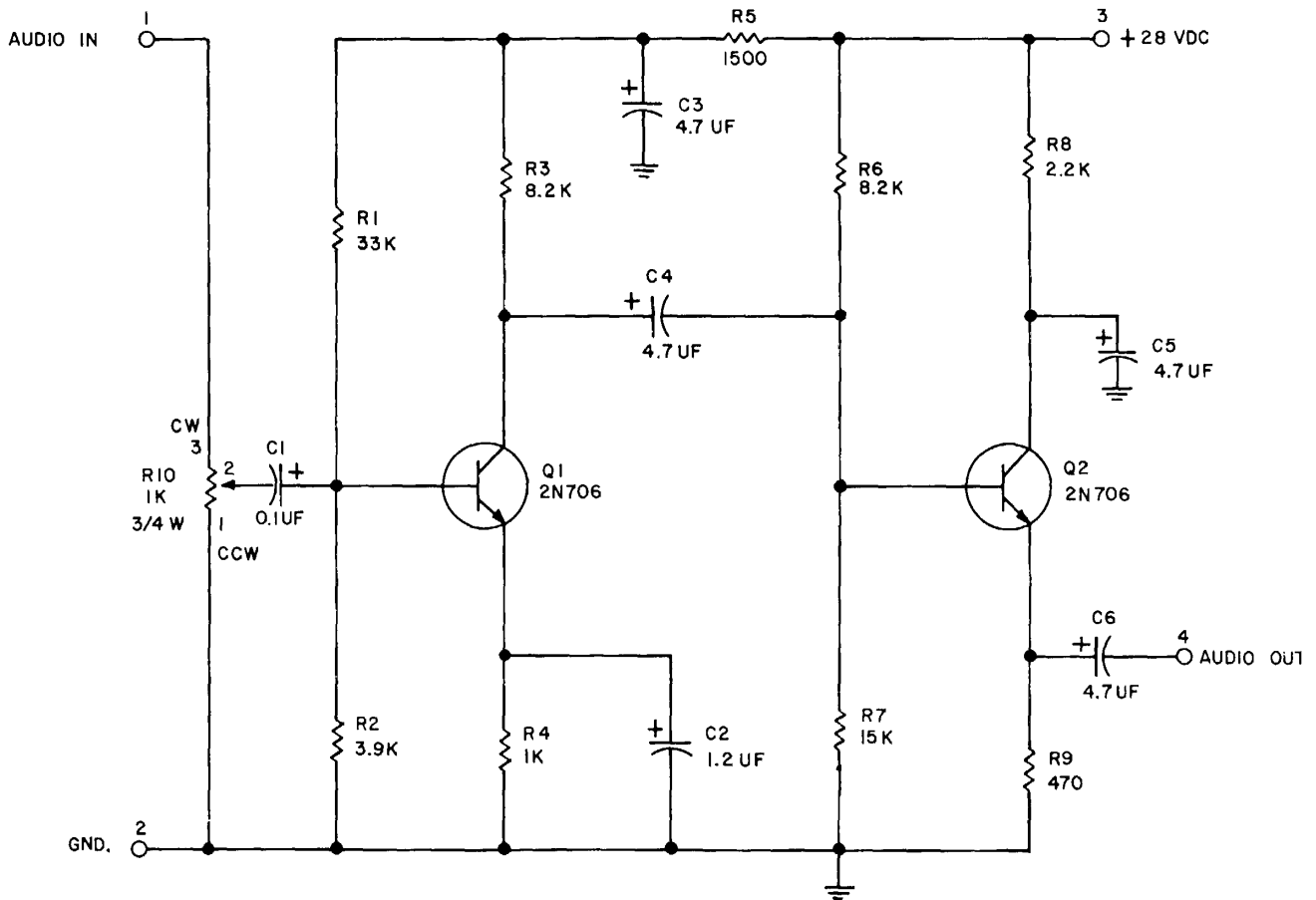
to TB1-3, to the white H-133C/A1C headset wire.

b. *Transmit Audio Path.* The transmit audio signal originates in the microphone of the H-133C/A1C and, through the red microphone wire, connects to TB 1-2 and to terminal 3 on the C-1611(D)/A1C. The C-1611 (D)/A1C contains an amplifier for amplifying the transmit audio signal for application to the KY-8. The path for the amplified transmit audio signal is from J1-24 on the C-1611 (D)/A1C to TB1-11, through resistors R1 and R2, to J3-C on the KY-8.

c. *Transmitter Keying.* The transmitter is keyed from press-to-talk SW1 on the CX-2556/U. When SW1 is closed, a ground originating in the C-1611 (D)/A1C (from J1-23, to TB1-4, to SW1) is connected from SW-1 across the yellow wire to TB1-7, to J1-15 and J1-17. The ground which goes to J1-17 is used to control the microphone amplifier (turns it on) through isolation diode CR1. The ground which goes to J1-15 is routed through the C-1611(D)/A1C to J1-33, to TB1-15, to J3-F on the KY-8 and keys the fm No. 2 transmitter.

#### **2-15. Amplifier Filter Circuit Analysis**

a. *Preamplifier Circuit Card* (fig. 2-5). The preamplifier card receives audio on terminal number 1. The signal (audio) is developed across potentiometer R10 and coupled to the base of transistor Q1 by capacitor C1. The amplified signal is taken from the collector of Q1 and coupled through C4 to the base of Q2. The signal from Q2 is taken across the emitter resistor and coupled to pin 4 by C6.



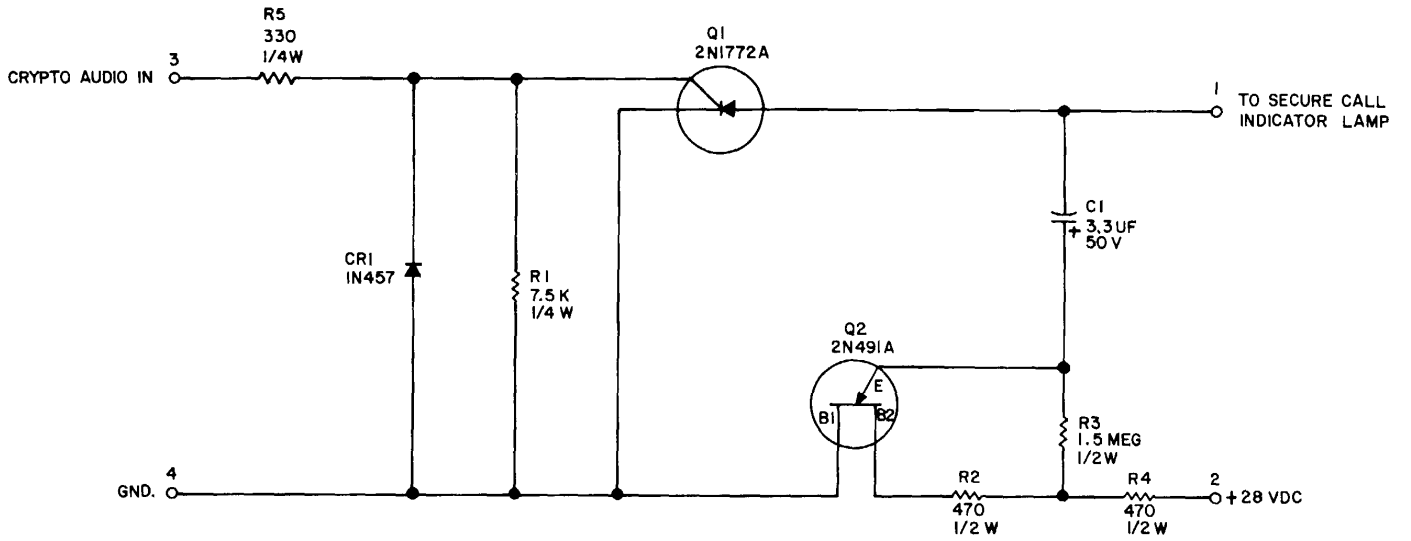
UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS AND 1/2 WATT.

EL5UV005

Figure 2-5. Preamplifier circuit card, simplified schematic diagram.

b. *Light Circuit Card* (fig. 2-6). The audio signal amplified by the preamplifier card (*a*, above) is applied to pin 3 of the light card. Negative-going audio signals are shorted to ground by CR1. Positive-going audio signals appearing across R1 causes SCR Q1 to "fire" and conduct from ground (pin 4) through the SECURITY CALL INDICATOR (connected to pin 1) to +28 vdc. This lights the lamp. Unjunction transistor Q2 is used to return Q1 to its non-conducting state when the audio

signal is removed. When Q1 fires, C1 charges through R2 and R3 towards + 28 vdc. After a time delay (depending on the values of resistances and capacitance), the emitter diode of Q2 becomes forward biased and Q2 "fires, " discharging C1 rapidly, thereby placing a large negative-going pulse on the anode of Q1. The negative pulse on the anode of Q1 switches it off, and the lamp extinguishes.



UNLESS OTHERWISE INDICATED,  
RESISTANCES ARE IN OHMS.

EL5UV006

Figure 2-6. Amplifier circuit card, simplified schematic diagram.



## 2-16. Antenna Coupler Case Circuit Analysis

(fig. FO-1)

a. The antenna coupler group (CY-7658/GRC and CU-1658A/U) for the hf radio set matches the impedance of the whip, long wire, or dipole antenna to the output impedance of the hf transmitter to within a vswr of 1.3:1. Coil switch S2 on the coupler case is set to the IN position when a whip antenna of 6 meters (18 feet) or less is attached to the antenna base. This allows load coil L4 to be automatically placed in series with the antenna when tuning below 4 MHz. The OUT position keeps the load coil out of the antenna circuit at all frequencies when the whip antenna is longer than 18 feet. A long wire antenna can also be attached to the whip antenna base using a long wire antenna adapter. Antenna output jack J2 is covered when not in use. When the handle on the coupler case is raised the jack is exposed and a 50-ohm antenna can be connected to the jack. When the handle is raised, load coil L4 and the antenna base are disconnected from the antenna circuit. Jacks J1 and J5 are located at the rear of the coupler case. Supply power and control signals are supplied to the antenna coupler group at jack J1. The rf signal (both transmit and receive) is connected to J5.

b. Much of the circuitry within the coupler case is concerned with inserting load coil L4 in series with the antenna under varying conditions. Energizing A4K1 inserts the load coil in the antenna circuit. When a whip antenna longer than 18 feet is attached to the antenna base, coil switch S2 is set to the OUT position. This keeps A4K1 deenergized and the load coil out of the antenna circuit for all frequencies (transmit or receive).

c. When a whip antenna 18 feet or shorter is connected to the antenna base, the coil switch is set to the IN position. When S2 is in this position, the load coil is connected as follows.

(1) It is removed from the antenna circuit while the antenna coupler is in the home position. (It is from this position that tuning starts and in this position that receive-only reception occurs.)

(2) It is removed from the antenna circuit when the antenna coupler is tuned to a frequency from 4 to 30 MHz.

(3) It is inserted in the antenna circuit when the antenna coupler is tuned to a frequency from 2 to 4 MHz.

d. As explained above, L4 may or may not be in the rf signal line when S2 is set to the IN position. The control of L4 is best explained by taking the system, of which the coupler case is a major component, step by step from standby through the various phases of operation. The basic tuning, operating, and homing sequences presented also apply when an antenna longer than 18 feet is used; however, the effect of the load coil control circuits do not apply when switch S2 is in the OUT position.

(1) When the hf radio set control unit is in standby, the antenna coupler is at home position, as

explained below.

(2) When the hf radio set control unit is turned to an operating mode, one of two conditions exists.

(a) The receiver-transmitter connected to J1 and J5 of the coupler case is set for receive-only operation and the +28 vdc is not available at J1-N of the coupler case and therefore A4K1 is not energized.

(b) The receiver-transmitter is set for low power or normal operation (enabling transmit or receive operation). In this case the +28 vdc is present at J1-N of the coupler case. However, since the coupler is at home position, the operate (P1-C) and tune (P1-J) lines are ungrounded by the coupler. This causes A2Q1 to conduct, grounding the base of A2Q2, cutting it off and keeping A4K1 deenergized. In either case, when at home position the load coil is out of the antenna circuit.

(3) To tune up for transmit operation, the receiver transmitter must be set for low power or normal operation. Momentary keying of one of the control units caused the receiver-transmitter to ground the key line (J1-P of the coupler case). The antenna coupler maintains this key line until completion of tuning. P1-H is grounded by the coupler which holds the rf being sent from the receiver transmitter to a comparatively low level during tuning. While the key line is grounded, the receiver-transmitter sends rf power to jack J2 of the coupler. Upon receiving this rf power, the coupler starts to tune up on the transmitted signal. The tune line (P1-J) is grounded by the coupler. This turns off A2Q1, removes its effect on A2Q2, and lights a tune light on the coupler. Band information circuits in the coupler ground the band Z(PI-N) or band Y(PI-P) line if the transmitted frequency is in one of their respective frequency ranges (4 to 8 or 8 to 30 MHz). If either is grounded, most of the + 28 vdc (from J1-N of the coupler case) is dropped across R3, VR2 does not break down, Q2 does not conduct, A4K1 remains deenergized, and load coil L4 is removed from the antenna circuit. However, if the frequency to which the coupler is tuning is between 2 and 4 MHz, P1-N and P1-P are ungrounded, VR2 breaks down, Q2 conducts energizing A4K1, and the load coil is placed in the antenna signal path. This tuning process continues until the antenna impedance matches the transmitter impedance within a vswr of 1.3:1. When this condition is reached, the key-line ground is removed, the receiver-transmitter stops sending rf power, the tune power line ground (P1-H) is removed, ground is removed from the tune line (P1-J), and the operate line (P1-C) becomes grounded. The operate line ground now keeps A2Q1 turned off, removing its effect on A2Q2 (as the tune line ground did during tuning). The tune light is out because tune ground is removed but now the operate line ground causes the operate light on the coupler to light. The state of the band Z or band Y lines was not affected by completion of tuning, so they still determine whether L4 is in the antenna circuit. The an-

tenna coupler group is now tuned for receive or transmit at the operating frequency of the system. The effect of changing to new frequency or of going to receive-only operation is described below.

(4) The antenna coupler is placed in the home position when a recycle pulse (a momentary ground) is received. A recycle pulse is received from the receiver transmitter when the following occurs:

(a) An operating frequency change is made.

(b) The receiver-transmitter is changed to receive-only operation.

(c) A control unit is initially switched from standby to an operating mode.

(d) A control unit is switched from an operating mode to standby.

(5) The recycle pulse is applied to J1-H of the coupler case. This ground is maintained by the antenna coupler until the home position has been reached. During the homing process, the ground is applied through A2CR6 to VR2 in the base circuit of Q2. Q2 is shut off and pin W of P1 of coupler is ungrounded. This is necessary to complete homing of the coupler. At this home position the rf signal path is essentially shorted through the coupler for receive-only operation. It is from this home position that the tuning process can be started again to enable operation in both the transmit and receive functions.

e. When the control unit is in an operating mode and the receiver-transmitter is not set for receiver-only operation, a key interlock voltage (+ 28 vdc) is supplied by the receiver-transmitter to J1-N of the coupler case. The + 28 vdc is supplied to P1-L of the antenna coupler. This voltage is normally supplied through the antenna coupler and back out to PI-S of the coupler case. The normal path is then through pins 4 and 6 of relay A2K2 and back out J1-S to the receiver-transmitter. The +28 vdc is then supplied to a power supply in the receiver-transmitter. Its presence at the power supply is necessary before keying the system turns on the high voltage required to produce the transmitted rf signal. Opening this key interlock voltage path (while transmitting) in the antenna coupler or coupler case will cause the high voltage and, hence, the transmitted rf signal to disappear. There are two times when this key interlock line is opened in the antenna coupler group.

(1) When the antenna coupler group is in the process of homing.

(2) When a fault occurs within the coupler, caused by the voltage or current of the transmitted of rf power being too long to complete tuning (longer than 8 to 10 seconds).

f. The key interlock line can be opened by the coupler case when an antenna is connected to 50-ohm output jack J2 rather than the antenna base. The transmitted rf signal is sampled and detected in circuit board A3. If the detected signal exceeds a preset threshold, the voltage drop across A2R7 causes the breakdown of A2VR3 which turns on Q3 and energizes

A2K2. The +28 vdc supplied from pin 4 to pin 7 of A2K2 keeps the relay energized. The + 28 vdc is removed from J1-S of the coupler case and the receiver-transmitter stops sending transmit power. Contact 3 of A2K2 is grounded, applying a ground on the fault line to the antenna coupler and the receiver transmitter. Grounding the fault line (whether done by the coupler case, as in this case, or by the coupler as in step above) causes both the tune and operate lamps on the coupler to light and also causes certain fault indications to take place in the receiver-transmitter and radio set control units. Q3 can be set back to the nonconducting state by homing the antenna coupler which removes the + 28 vdc from the winding of A2K2. This is done by a recycle pulse from the receive-transmitter.

g. There are two sources of operating power supplied to the antenna coupler group. These are 128-volt peak, 400 Hz square wave or 115 vac 400 Hz sine wave and +28 vdc. Both sources of operating power are supplied from the receiver-transmitter when it is set for normal or low power operation and for approximately 5 seconds after switching to receive-only operation. This allows time for the antenna coupler to reach home position. The 115 vac is applied to the antenna coupler at PI-D (ac ground) and P1-A (1.5 vac filtered). This 115 vac is used internally in the coupler to develop various operating ac and dc voltages, one of which is a +28 vdc partially filtered voltage. The +28 vdc is also taken off the key interlock line (from J1-N of the coupler case) through A2CR7 and into the antenna coupler group at P1-R. This is connected to the + 28 vdc partially filtered voltage inside the antenna coupler group as a pullup during low-voltage operation. The 400 Hz supply power (either 115 vac sine wave or 128-volt peak square wave) is used to drive the antenna coupler blower and the coupler case external air blower. This 400 Hz supply power is supplied to P1-D (ground) and P1-V (high) for driving the antenna coupler blower. The antenna coupler blower is turned on only when keyline ground is supplied to the coupler (which occurs during tune and transmit operation). The coupler case external air blower is turned on and off by thermal switch S1 in the coupler case.

## 2-17. AC Power Circuit Analysis

a. *General* The FCC is designed to operate from a 120/208-volt, 3-phase, 4-wire, 60 Hz power source. Two separate engine-driven generators are used for operation of the system. An ac power distribution system allows selection of one of the generators as the prime power source. This system also provides overload protection and controls distribution of the ac power. A schematic diagram of the ac power distribution system is provided in figure FO-12. Detailed information on the power trailer is contained in the manuals referenced in appendix A. The ac power distribution system consists of the power trailer, jacks located at the power entrance panel, interconnecting

power cables and the ac power distribution panel.

b. *AC Input Power.* The output of the ac power source (120/208 vac, 4-wire 60 Hz) is connected to the FCC at connector J1 in the power entrance box. Phases A, B, and C are connected to bus bars W1, W2 and W3 respectively; neutral is bus bar N. Connector J2 is used to connect ac to the air conditioner. A ground stud is used to connect the frame of the shelter facility to the ground rod driven into the earth. Circuit control and protection is provided by relay K1 and main circuit breaker CB1.

c. *AC Power Distribution Panel.* This panel provides an indication that power is applied to the FCC and allows the voltage and Frequency of each phase to be measured. Phases A, B, and C are connected to phase switch S1 which connects to parallel connected frequency meter (M2) and voltmeter (M1) for selective measurement of a phase. The other side of the meters is connected to neutral bus bar "N." DS8, DS9, and DS10 (phase voltage indicators) and DS7 (phase sequence indicator) will light when phase A-B-C are properly sequenced. Relay K1 (rated at 100 amps), will stay open if input power is out of phase sequence, and (DS7 will not light). A controlling coil which is an integral part of K1 having terminal designation X2-X1, will energize K1 when proper phase voltage is present from the output of phase sequence relay K2. Phase sequence indicator DS7 will light when proper phase sequence is present to input J1. Phase sequence relay assy K2 also contains a sensing network which taps directly off the input line voltage. The input phase voltage is monitored by the sensing network K2 for a difference in phase voltage of A-B-C. If proper generator voltage is present, relay contacts 4 and 5 of K2 will close providing B 0 to neutral to controlling coil (X2-X1) of K1. K1 will then close applying phase A-B-C to the line side of main circuit breaker CB1.

d. *AC Lights, Normal Operation.* During normal operation, blackout by-pass switch S1 is off, bypassing S6 door interlock. AC power is applied to the parallel connected switches S2 and S3 through CB4. DS4 will light when CB4 is on. The load side of S2 is connected to incandescent lights A70, A71 and A76. The load side of S3 is connected to fluorescent lights A60 through A69, and A77, A78.

e. *AC Light Black-Out Operation.* During black-out, bypass switch S1 is off (open). Door interlock (S6) is activated (closed) when the door is closed. AC power is applied to parallel connected switches S2 and S3.

f. *Air Conditioning Power.* Three phase 208 vac power is applied through four section 20 amp circuit breaker CB1 with the fourth section used as a no-voltage trip coil (NVT). The NVT provides protection to air conditioner unit in the event of overload of the FCC ac bus. The access to air conditioner circuit breaker is at power entrance box. Power entrance box A33 contains a full wave bridge CR1 to CR5 which provides an unfiltered dc to NVT under nominal load conditions. The rectifier circuit is protected by CB9 (DS12 light).

When under overload to FCC, ac power to the air conditioner will be disconnected.

g. *DC Power Supply No. 1 and No. 2.* The three-phase power is applied to dc power supply No. 1 and No. 2 through receptacle J1 and J2, which are mounted on the roadside wall. Circuit breakers CB2 and CB3 (rated at 30 amps), provide ac protection to J1 and J2. Light DS2 and DS3 indicate ac power is available when illuminated.

h. *Heater.* Single phase ac power is applied to multi-fuel heater through convenience receptacle J15 on the roadside wall.

i. *Convenience Outlets.* The load connected to the convenience outlets are distributed from two phases (W2 and W3). Circuit breaker CB6 (W3) provides ac power protection to receptacles J5, J6, J15, J12 and J11. Light DS6 will light when CB6 is on. Circuit breakers CB7 (W1) provides ac power protection to receptacles J13, J16, J14, J9, J10, J7 and J8. Light DS11 lights when CB7 is on.

j. *Blowers.* Receptacles for the fans are located on the front wall. Circuit breaker CB5 (rated at 15 amps) provides ac power protection to J4 and J3. Light DS5 lights when CB5 is on.

## 2-18. DC Power Circuit Analysis (fig. FO-13)

a. *General.* Two separate dc power supplies are furnished to provide the necessary 28-volt dc power for operation of the FCC. A dc power supply control allows automatic switching in case of failure, or selection of one of the dc power supplies as the prime power source. A dc power distribution panel controls distribution of the power output of the power supply to the various equipment within the FCC. The dc power distribution system consists of the two dc power supplies, power supply control, and the dc power distribution panel.

b. *DC Power Supply.* The 120/208-volt, 3-phase, 4-wire, 60 Hz power is applied to the dc power supplies direct from the ac power distribution panel. The output from the power supplies is controlled by the dc power supply control. Refer to TM 11-6130-368-34 for functioning of the dc power supplies.

c. *Power Supply Control.* Each of the dc power supplies has sufficient capacity to operate all of the equipments of the FCC. However, to ensure no interruption of dc power in the event of failure of one supply, the system is normally operated with switch S1 in the AUTO position. In this mode of operation, both power supplies are operative with power supply 1 feeding the signal and radio circuits and power supply 2 feeding the high-current drain hf radio. If either supply fails, the defective power supply is automatically dropped out of the circuit and the entire load is assumed by the remaining power supply.

(1) *Switch S1 in PS1 or PS2 position.* With switch S1 in the PS1 position, 28 volts dc is supplied through four paralleled sets of contacts on the right half of the switch, to the coil of relay K1 (contacts 6-5 and 2-3 on top and bottom of S1). Energizing relay K1 completes the 28-volt cir-

cuit directly to the signal and radio circuits and causes lamp DS1 to light. At the same time, the 28 volts is applied through contacts 11-12 of K1 and the contacts 13-14 of unenergized relay K2 to the coil of relay K3. Energizing relay K3 connects the output power of power supply 1 to the input circuits of the hf radio and to lamp DS4. When switch S1 is operated to the PS2 position, 28 volts dc is supplied through contacts 1-2 and 5-4 of S1 and the same actions take place with relays K2 and K3 energized and K1 de-energized.

(2) *Switch S1 in A UTO position.* With switch S1 in the AUTO position, both relay K1 and relay K2 are energized. Relay K1 is connected to power supply 1 through paralleled contacts 3-2 and A1-A2 of the top half of the switch and relay K2 is connected through paralleled contacts 5-4 and A1-A2 of the bottom half of the switch. Neither power supply applies power to the coil of relay K3 and the two outputs independently feed their share of the load. If either power supply should fail however, the coil of the associated relay will

de-energize, and the 28-volt circuit of the other power supply will be completed through the middle contacts of the de-energized relay to the coil of K3. When K3 operates, the output loads are connected together and the remaining power supply will supply all the required power. The indication of a failed power supply when switch S1 is in the AUTO position (other than meter readings on the front panel of the affected power supply), is the failure of DS1 or DS2 to light.

d. *DC Power Distribution Panel.* (The power supply output, after control by dc power supply control is fed to bus W1 (signal and radio) and W2 (HF bus) of the dc power distribution panel.) Voltmeter M1 monitors the dc voltage to the signal and radio bus or HF bus depending on the position of switch S1. Circuit breakers CB1 through CB12 control and protect the 28-volt dc output circuits to each radio set; corresponding indicator lights DS1 through DS12 show that power is being supplied to the individual circuit.

**CHAPTER 3  
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS**

**Section I. GENERAL**

**WARNING**

During removal, disassembly, assembly, troubleshooting or repair of antennas, conform to all safety requirements of TB S1G 291. Injury or DEATH could result from failure to comply with safe practices.

**3-1. Scope of Direct Support Maintenance**

a. The direct support maintenance procedures in this manual supplement the procedures described in TM 11-5895-469-12. The systematic troubleshooting procedure originates with the operational and sectionalization checks performed at the operator and organizational maintenance level, but this procedure is carried to a higher maintenance level in this manual.

b. This chapter explains how to perform the maintenance activities authorized at direct support maintenance level. It includes:

- (1) Tools, test equipment and materials required (para 3-2).
- (2) Direct support system troubleshooting (sec II).
- (3) Direct support unit troubleshooting (sec III).
- (4) Removal and replacement (sec IV).
- (5) Direct support testing procedures (sec V).

**3-2. Tools, Test Equipment, and Materials Required**

a. *Tools.* The tools necessary for maintenance and repair of the aircraft control central are contained in the following tools kit.

<i>Item</i>	<i>Stock No.</i>
Tool Kit, Electronic Equipment TK-100/G.	5180-00-605-0079

b. *Test Equipment.* The test equipment required for direct support maintenance of the FCC is listed below. Associated technical manuals covering the test equipment are also referenced.

<i>Test equipment</i>	<i>Stock No.</i>	<i>Technical manual</i>
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Audio Oscillator AN/-URM-127.	6625-00-783-5965	TM 11-6625-683-15
Digital Readout, Electronic Counter AN/-USM-207A.	6625-00-044-3228	TM 11-6625-700-14-1
Multimeter AN/-USM-223.	6625-00-999-7465	TM 11-6625-654-14
Oscilloscope AN/-USM-281A.	6625-00-228-2201	TM 9-6625-2362-12
Ohmmeter ZM-21B/U.	6625-00-581-2466	TM 11-6625-298-14
Test Set, Radio Frequency Power AN/-URM-120.	6625-00-813-8430	TM 11-6625-446-15
Test Set, Semiconductor Device TS-1836/U.	6625-00-893-2628	TM 11-6625-539-15
Voltmeter, Electronic ME-30A/U.	6625-00-643-1670	TM 11-6625-320-12
General Purpose Dummy Load DA-75/U.	6625-00-117-1639	
Audio Output Meter TS-585B/U.	6625-00-244-0501	TM 11-5017
Generator, Pulse SG-1105/U.	6625-01-010-3524	
Audio Oscillator TS-421/U and TS-421A/U.	6625-00-435-2588	TM 11-6625-355-12
Analyzer, Distortion HP Models 331A and 332A.	6625-00-878-7290	TM 11-6625-1612-15
AC voltmeter ME459. 60 dB pad. Stopwatch. 92/94 test cable assembly (fig. 3-119). Audio input test cable assembly (fig. 3-120). Transmit test cable assembly (fig. 3-121). Telephone test cable assembly (fig. 3-122).	6625-00-229-0457	TM 11-6625-1538-15

**Section II. DIRECT SUPPORT SYSTEM TROUBLESHOOTING**

**3-3. General Instructions**

a. Troubleshooting at the direct support maintenance level involves procedures required to locate a defective unit by systematic analysis. This procedure begins with the operational and sectionalization checks performed at the operator and organizational level, and continues with the sectionalization techniques described in this chapter.

b. Sectionalization of the system carried out at the operator and organizational level in most instances (due to limitations in assigned maintenance functions and in

authorized test equipment) can only localize trouble to either a receiver and/or its monitoring circuitry, a transmitter and/or its control circuitry, or to one or more operator positions. However, sectionalization to isolate a malfunction to a definite component in a receiver or transmitter or at an operator position must be performed at the direct support level.

c. When it has been determined that a major unit of the system is malfunctioning, the defective unit can be removed and replaced by a spare unit. By this method, the

system may be returned to operational status while troubleshooting of the defective unit is being performed.

d. In normal usage, malfunctions of the system will be noted during daily operation as a failure of one or more transmitting and/or receiving channels or telephone circuits. Troubleshooting procedures to isolate the failure to a particular unit utilized in the defective channel(s) are detailed in the following paragraphs. Once a malfunction has been isolated to a particular unit, the unit troubleshooting procedure, section m, or the appropriate equipment technical manual will be utilized to locate the defective component. The importance of a visual inspection prior to a particular troubleshooting

procedure cannot be overemphasized at the direct support maintenance level.

**3-4. System Troubleshooting**

The troubleshooting chart (para 3-5), is a continuation of the organizational troubleshooting chart in TM 11-5895-469-12. The system troubleshooting chart reflects the additional maintenance capabilities and use of test equipment allocated to the direct support level. This chart assumes that all operator and organizational checks and corrective actions have been performed prior to referral to direct support maintenance personnel.

**3-5. System Troubleshooting Chart**

Item No.	Symptom	Probable Cause	Checks and Corrective Action
1	PHASE SEQUENCE INDICATOR on ac power distribution panel does not light.	Incorrect phasing of power source.	Refer to generator technical manual (app A).
2	AC VOLTS meter or FREQUENCY meter on ac power distribution panel has no reading or an incorrect reading	a. Generator output incorrect.  b. Faulty meter, switch S1, or power panel circuit.	a. Check for correct voltage and frequency reading at meters on power source. If incorrect, refer to higher level of maintenance. If correct, open CBI at the ac power distribution panel to remove power. b. Check continuity through monitor switch S1. If open or high-resistance is present, replace S1. If correct replace meter. (Refer to para 3-12.)
3	Associated indicator on ac power distribution panel does not light.	Defective circuit breaker.	Ensure 110 volts ac is present on both sides of CBI. If voltage is absent on both sides, check wiring from power entrance box to ac power distribution panel. If absent only on load side, replace CBI. If voltage is present on both sides check for 110 volts ac on both sides of applicable individual circuit breaker. If absent on load side replace circuit breaker. (Refer to para 3-12.)
4	DC VOLTS meter on dc power distribution panel has incorrect or no reading.	a. No ac power input to dc power supply. b. Defect in dc power supply or defective meter.	a. Same as above. b. Check for 28 volts dc across meter. If present, troubleshoot dc power supply and associated wiring (para 3-8).
5	Blowers do not operate.	No ac power or blower motor shorted or open.	Ensure 110 volts ac is present on both sides of CB1. If voltage is absent, check wiring from power distribution panel. If voltage is present on both sides, check for 110 volts ac on both sides, of BLOWERS circuit breaker. If absent on load side, replace circuit breaker. Refer to paragraph 3-13d.
6	Front panel dial indicator lamps on FM radio do not light.	<i>Radio communication</i> Defect in FM radio. Replace fm radio.	
7	POWER ON indicator on secure control does not light.	a. No input power or defect in secure control unit cabling. b. Defective secure control unit.	a. Check that circuit breaker on dc power distribution panel is set to ON. If correct 6. Replace control unit.
8	Panel lamps on HF control do not light.	a. No input power or defect in HF control unit cabling.  b. Defective control unit.	a. Check that HF radio circuit breaker on dc power distribution panel is set to ON. If correct, check cabling (para 3-20). 6. Replace control unit.
9	Front lamps on VHF or UHF radio do not light.	a. No input power or defect in cabling.  b. Defective radio.	a. Check that VHF or UHF circuit breaker on dc power distribution panel is set to ON. If correct check cabling (para 3-20). 6. Replace radio set.

Item No.	Symptom	Probable Cause	Checks and Corrective Action
10	Unable to key	<ul style="list-style-type: none"> <li>a Defective transmitter control circuit. operating position.</li> <li>b. Defect in signal control box or radio-audio control panel.</li> <li>c. Defective transmitter.</li> </ul>	<ul style="list-style-type: none"> <li>a. Interchange cable from faulty set with operable set at signal control box and key faulty set using operable set radio-audio control panel switch.</li> <li>b If faulty set can now be keyed, check keying circuit through the signal control box and radio-audio control panel (fig FO-7, FO-8).</li> <li>c. If faulty set cannot be keyed, check wiring to faulty receiver-transmitter unit. If wiring is satisfactory replace transmitter (or receiver-transmitter) unit.</li> </ul>
11	Unable to modulate a transmitter from the operating position.	<ul style="list-style-type: none"> <li>a. Defective transmitter audio circuit.</li> <li>B Defect in signal control box or radio-audio control panel.</li> <li>c. Defective cable assembly or transmitter.</li> </ul>	<ul style="list-style-type: none"> <li>a. If unable to modulate all transmitters, substitute microphone preamplifier and microphone amplifier in the radio-audio control panel.</li> <li>b. f unable to modulate any one transmitter, interchange cable from faulty set with operable set at signal control box and modulate faulty set using operable set radio-audio control panel switch. If faulty set can be modulated, check microphone audio circuit through radio-audio control panel and signal control box (fig. FO-7, FO-8).</li> <li>c. If faulty set cannot be modulated, check wiring to faulty receiver-transmitter unit. If wiring is satisfactory, replace transmitter (or receiver-transmitter). Refer to paragraph 3-14b.</li> </ul>
12	No receiver audio at the operating position,	Defective headset amplifier in radio-audio but radio call lamp lights.	
13	TUNE indicator on operator's console inoperative.	<ul style="list-style-type: none"> <li>a. Defect in HF radio.</li> <li>b. Defect in antenna coupler or wiring.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check for 28 volts dc at lamp with HF radio cycling. If not present, replace hf radio.</li> <li>B Check antenna coupler circuit (para 3-17).</li> </ul>
14	OPERATE indicator on radio operator's console inoperative.	<ul style="list-style-type: none"> <li>a. Defect in HF radio.</li> <li>b. Defect in antenna coupler or wiring</li> </ul>	<ul style="list-style-type: none"> <li>a. Check for 28 volts dc at lamp with HF radio not cycling. If not present, replace hf radio.</li> <li>.b Check antenna coupler circuit (para 3-17).</li> </ul>
15	No receiver audio at the operating position and radio call lamp does not light.	<ul style="list-style-type: none"> <li>a Defective receiver audio circuit.</li> <li>B Defect in signal control box or radio-audio control panel.</li> <li>c Defective cable assembly or defective receiver.</li> </ul>	<ul style="list-style-type: none"> <li>a. Interchange cable from faulty set with operable set at signal control box and check for received audio.</li> <li>b If audio is received, check audio circuit through signal control box and radio-audio control panel (fig. FO-7).</li> <li>c If audio cannot be received, check wiring to faulty receiver unit. If wiring is satisfactory, replace receiver (or receiver-transmitter).</li> </ul>
16	Receiver audio is present at all operating	<ul style="list-style-type: none"> <li>a. Defective radio control card. positions on one channel but radio call lamps do not light for the channel</li> <li>b Defective connector or wiring in the sig-</li> </ul>	<ul style="list-style-type: none"> <li>a Check radio control card assigned to the faulty channel (para 3-16b). Replace defective card.</li> <li>b. Check and repair connector or wiring (para 3-16c).</li> </ul>
17	Receiver audio is present at all operating positions on all channels but no radio call lamps light.	<ul style="list-style-type: none"> <li>a Defective buzzer flasher card.</li> <li>B Defective connectors or wiring in the signal control box.</li> </ul>	<ul style="list-style-type: none"> <li>a Check buzzer flasher card (para 3-16b). Replace defective card.</li> <li>b Check and repair connectors or wiring (para 3-16c).</li> </ul>
18	Receiver audio is present at all operating positions on one channel but radio call lamp at one operating position does not light.	<ul style="list-style-type: none"> <li>a. Defective wiring connector, or lampholder at the faulty radio-audio control panel.</li> <li>b Defective inter-unit cable between radio-audio control panel and signal control box.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check and repair radio-audio control panel (para 3-14b).</li> <li>b Check and repair cabling (para 3-14b).</li> </ul>

Item No.	Symptom	Probable Cause	Checks and Corrective Action
19	SECURE indicator does not light when a received signal is present.	<p>c Defective cable assembly or defective receiver.</p> <p>a. No 28-volt dc power.</p> <p>b. Defective circuit card A1 or A2 in amplifier filter.</p> <p>c. Defective amplifier-filter wiring.</p>	<p>c. If audio cannot be received, check wiring to faulty receiver unit. If wiring is satisfactory, replace receiver (or receiver-transmitter) unit.</p> <p>a Check power to circuit (para 3-7b).</p> <p>b. Check circuit card, replace defective card (para 3-7b)</p> <p>c. Check wiring; repair as needed (para 3-7b).</p>
20	Speaker ON-OFF switch does not effect speaker output.	Defective switch or speaker.	Check switch and speaker (para 3-19d).
21	Unable to tune receiver-transmitter from radio set control unit (hf) or at radio set (vhf and uhf).	a. Defective radio set control unit or radio set.	a Interchange radio control unit of faulty set with operable unit and attempt receiver-transmitter tuning with operable radio control unit. If receiver-transmitter tunes properly, replace faulty radio control unit.
22	No receiver audio at the operating position, but radio call lamp lights.	<p>b. Defective receiver-transmitter</p> <p>a Defective headset amplifier in radio-audio control panel.</p> <p>b. Defect in radio-audio control panel switch.</p>	<p>.b If receiver-transmitter does not tune, check wiring. If wiring is satisfactory, replace receiver-transmitter.</p> <p>a If audio from all receivers is absent, substitute headset amplifier in radio-audio control panel.</p> <p>b f audio from a single receiver is absent, check radio-audio control panel switch for faulty circuit (para 3-14b).</p>
23	Unable to ring on any telephone line at all telephone control panels.	<p><i>Telephone communication</i></p> <p>a Defective buzzer-flasher card.</p> <p>b. Defect in signal control box.</p>	<p>a Check buzzer-flasher card (para 3-16b). Replace defective card.</p> <p>B Check signal control box wiring (para 3-16a).</p>
24	Unable to ring on any telephone line at one telephone control panel.	Defect in telephone control panel.	Refer to paragraph 3-14c for unit telephone control panel.
25	Unable to talk on any telephone line at any telephone control panel.	<p>a No 28 volts dc.</p> <p>B Defect in telephone control panel, cabling or wiring.</p>	<p>a Check for 28 volts dc to panel (fig. FO-6).</p> <p>b. Check wiring (para 3-14c) and cabling (para 3-20).</p>
26	NIGHT BUZZER does not sound on incoming call with NIGHT switch in ON position.	<p>a Defective buzzer/flasher card or switch if problem occurs on all lines.</p> <p>b Defective telephone control card if problem occurs on one line.</p> <p>c Defective buzzer or wiring.</p>	<p>a Check switch and buzzer-flasher card (para 3-16b). Replace defective switch or card.</p> <p>b Check telephone control card (para 3-16b).</p> <p>c Check and repair buzzer or wiring (para 3-19g).</p>
27	Unable to talk on one telephone line from	Defective telephone circuit card.	Check telephone control card (para 3-16b). any telephone control panel.
28	Unable to talk on one or more telephone lines at one telephone control panel.	Defect in telephone control panel.	Refer to paragraph 3-14c for unit troubleshooting of telephone control panel
29	Unable to receive ring (call lamp) on one telephone line at any one of the telephone control panels.	a Defective telephone control circuit card.	a Check telephone control card assigned to the faulty line (para 3-16b). Replace defective card.
30	Unable to receive ring (call lamp) on all telephone lines at all telephone control panels.	<p>b Defective cabling or wiring in the signal control box.</p> <p>a. Defective buzzer-flasher card.</p> <p>B Defective cabling or wiring in the signal control box.</p>	<p>b Check and repair cabling or wiring (para 3-16c).</p> <p>a Check buzzer flasher card (para 3-16). Replace defective card.</p> <p>b Check and repair cabling or wiring (para 3-16c).</p>
31	Unable to receive ring (call lamp) on one telephone line at one telephone control panel.	<p>a Defective wiring, connector, or lampholder at the faulty telephone control panel.</p> <p>b Defective inter-unit cable between telephone control panel and signal control box.</p>	<p>a Check and repair telephone control panel (para 3-14c).</p> <p>b Check and repair cabling (para 3-20).</p>



**Section III. DIRECT SUPPORT UNIT TROUBLESHOOTING****3-6. General Instructions**

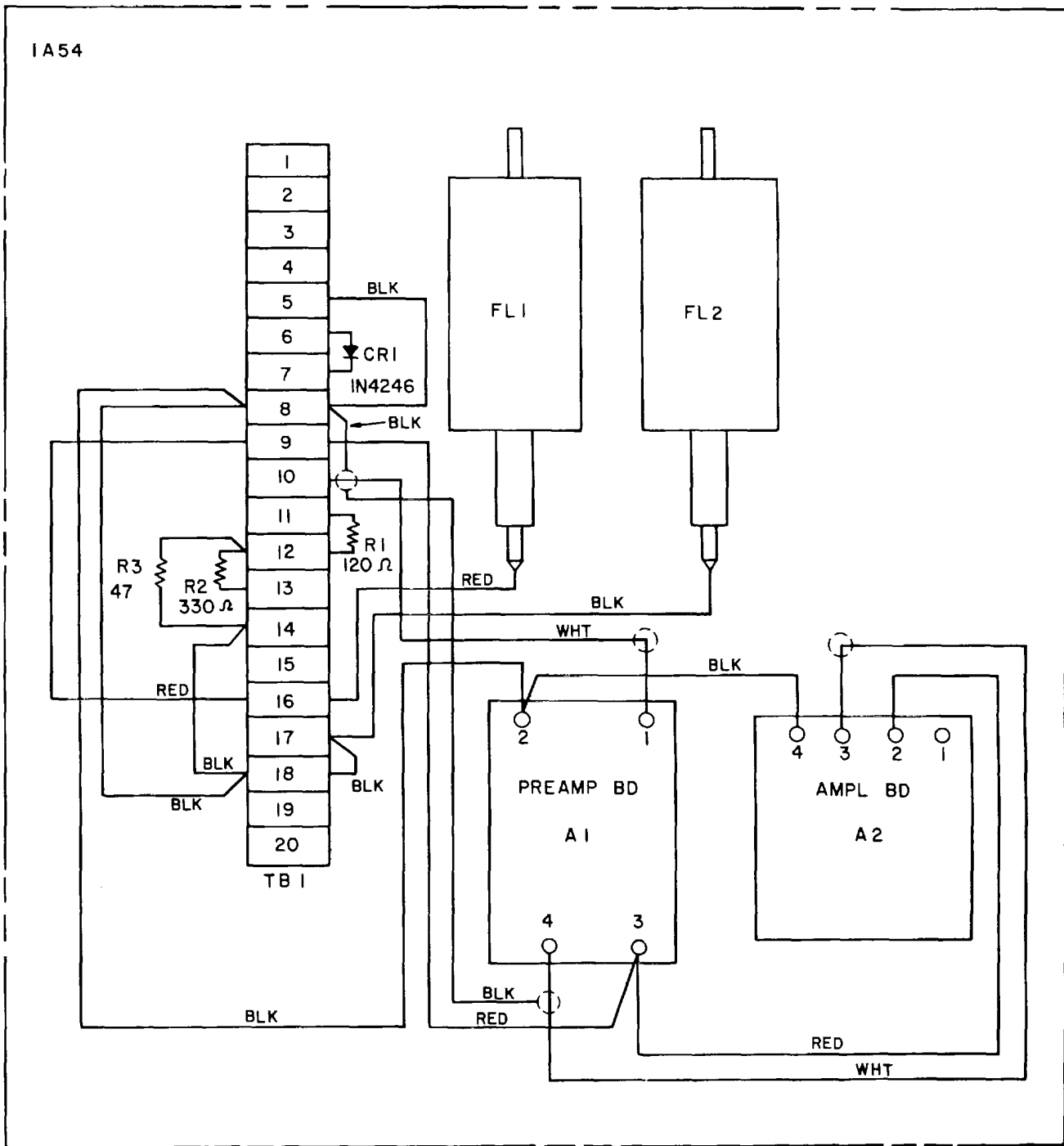
This section outlines direct support troubleshooting for units which make up the FCC. Generally, a troubleshooting procedure provides simple performance checks (to determine the specific trouble), adjustments, and other procedures necessary to return the defective unit to operation. Unless otherwise specified, the unit being checked is to be disconnected from the system. Maintenance procedures are furnished only for those units which are not covered in separate manuals. Component parts available to direct support maintenance personnel for equipment in the FCC are listed in TM 11-5895-469-34P.

**3-7. Amplifier Filter 1A54**

a. *General.* The secure amplifier filter serves as the inter-connection point between the secure control and KY-8 and as the inter-connection point for 28-volt dc

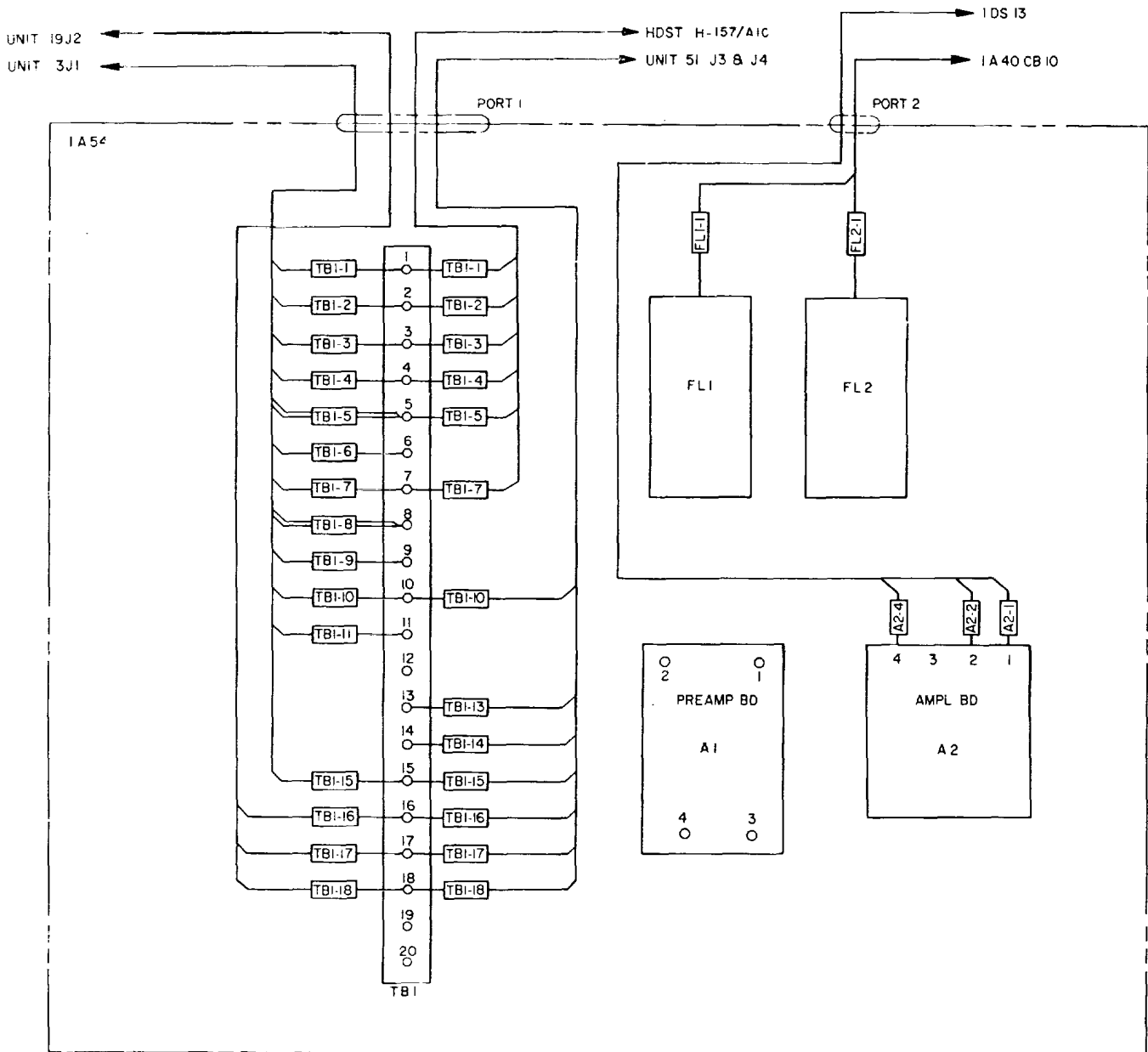
power to the secure equipment. It contains preamplifier circuit card A1 and amplifier circuit card A2 used with the SECURE CALL lamp. Since maintenance of the secure equipment will be accomplished by specially trained maintenance personnel, direct support maintenance will consist of isolation of a malfunction to a specific component of the amplifier filter when secure equipment maintenance personnel have isolated the malfunction to the unit. The amplifier filter is wall mounted; unit troubleshooting and repair may be accomplished without removal of the entire assembly.

b. *Troubleshooting Procedures.* Troubleshooting the amplifier filter consists of a visual check and voltage and resistance measurements necessary to isolate the cause of trouble to a specific component. A schematic diagram and wiring diagram of the unit are provided in figures 3-1 and 3-2.



EL5UV007

Figure 3-1. Amplifier filter, schematic diagram.



EL5UV008

Figure 3-2. Amplifier filter, wiring diagram.

(1) *Visual inspection.* Conduct a thorough inspection for any visible physical defects such as broken or frayed wiring, loose terminal board connections, and damage or discoloration of components parts.

(2) *Troubleshooting.* Troubleshooting the amplifier filter may be divided into five general functions: Preamplifier circuit card, amplifier circuit card, 28-volt power, transmitter keying, and transmit and receive audio. Procedures for troubleshooting each area are detailed in the following subparagraphs.

(a) *Preamplifier circuit card A and amplifier circuit card A2.* A defect in the secure call preamplifier or

amplifier circuit cards will be noted when audio is present at the secure control, but the SECURE CALL lamp is not lighted. Inputs to the preamplifier circuit card are receive audio and 28 volts dc. Check for 28 volts dc at TB1 terminals 9 and 16; pin 3 of A1 and pin 2 of A2. If 28 volts is present and SECURE CALL lamp has been eliminated as the source of trouble, isolate the problem to A1 or A2 by checking the voltage and resistance values shown in figure 3-1. Replace the faulty circuit card and forward to a higher level of maintenance.

(b) *DC power.* The 28-volt dc power is brought into the amplifier filter on terminal 16 of TB1 through filter FL1. Filter FL2 is tied to the ground side of the 28-volt source at terminal 17 of TB1. A shorted or open filter will cause a malfunction in the power circuitry and will be noted in improper operation of the secure call printed circuit card, KY-8, and secure control since TB1 is the interconnection point for the 28 volts to all these units. The 28 volts to the KY-8 is on terminals 16 and 17, and to the secure control on terminals 9 and 10. Terminals 9 and 16 are the positive side. If a short or open circuit is noted in the 28-volt circuit, disconnect the filter from TB1 and perform continuity checks to determine its condition. Any other defect in the 28-volt circuit will be traced to a component or cable assembly tied to the amplifier filter rather than the unit itself.

(c) *Transmit keying.* The transmit keying line is tied to TB1 terminal 1 which serves only as the tie point for cable assemblies W361 and W362. Any defect in this line other than a defective connection at terminal 1 would lie in circuitry external to the amplifier filter.

(d) *Transmit and receive audio.* A defect in either of these circuits which has been isolated to the amplifier filter may be readily traced to a defective diode or resistor. R1, R2, R3 and CR1 are all tied across TB1. Troubleshooting consists merely of removing one end of the component from the terminal board and performing resistance checks to isolate the defective component.

### 3-8. DC Power Supplies 1A37, 1A38

a. *General.* The two dc power supplies provide the power source to the radio sets through the dc power distribution panel (para 3-10). Malfunction of a power supply will be suspect if the applicable power supply fails to operate when activated at the power supply control panel (para 3-9).

b. *Troubleshooting Procedures.* Once a power supply has malfunctioned, it is necessary to isolate the problem to inter-unit wiring, to the power supply, or to the power supply itself. Visually inspect and check resistance and continuity, to isolate the malfunction to an individual component or wiring using the following illustrations, paragraphs, and literature:

- (1) DC power schematic diagram, see figure FO-13.
- (2) Inter-unit cables, see figure FO-15 and refer to paragraph 3-20.
- (3) Power supplies, refer to TM 11-6130-368-34.

### 3-9. Power Supply Control Panel 1A39

a. *General.* A defect in the power supply control panel will be suspected when power to the radio sets fails (not due to power supply para 3-8) or erratic operation is noted in switching between the power supplies. Troubleshooting of the unit consists of visual inspection of parts and electrical checks of the wiring and panel components.

b. *Troubleshooting Procedures.*

- (1) *Visual inspection.* Conduct a visual inspection of panel components to detect any obvious,

easily identified faults or loose connections. Repair any obvious defects and check operation prior to replacement.

(2) *Continuity check.* Refer to the schematic diagram of the power supply control panel (fig. FO-18) and check continuity of panel wiring, switches, connectors and other components.

### 3-10. DC Power Distribution Panel 1A40

a. *General.* The dc power distribution panel (fig. FO-13) is mounted to the wall and houses circuit breakers and indicating devices which are associated with the dc power distribution system. Malfunction of the dc power distribution panel will be suspect if the applicable radio set fails to operate when power has been turned on at its associated circuit breaker. Erratic or erroneous meter readings at a given radio set may also indicate a malfunction in the dc power distribution panel.

b. *Troubleshooting Procedures.* The first step in troubleshooting the dc power distribution panel is to isolate the inoperable component parts of the dc power distribution panel. Corrective action for component parts of the panel is limited to replacement of the defective component. A malfunction will be evidenced by failure to operate, or by erratic response of a component part. Troubleshooting will be accomplished as follows:

(1) *Visual inspection.* A thorough visual inspection of the unit is often possible to locate the source of trouble. Conduct a visual inspection to detect any overheating or other visible defects. Verify that all components are firmly connected to their respective terminals and or bus bar. Repair any obvious defects.

(2) *Voltage and resistance check.* Switch toggle switch S1 to SIG & RADIO BUS position; perform checks (a) through (d) below; then switch S1 to HF BUS and conduct the same checks.

(a) If voltmeter M1 does not indicate, first verify that PS1 and PS2 are functioning properly (para 3-8).

(b) If no malfunction exists in PS1 or PS2, proceed to (c) below.

(c) Turn switch S1 to the off position and make routine resistance measurements to locate the defective component. Replace the defective component with a new parts replacement.

(d) When a malfunction is isolated to M1 or S1, replace the defective meter or switch with a replacement part known to be operable.

### 3-11. AC Power Entrance Box 1A33

a. *General.* Troubleshooting of the ac power distribution system will serve to isolate a problem to a specific connector or the circuit breaker CB1 located in the ac power entrance box. Malfunctioning of the air conditioning power circuit may also be caused by the control rectifier circuit for the air conditioner circuit breaker.

b. *Troubleshooting.* Figure 3-3 is a wiring diagram of the ac power entrance box; also refer to the system ac

schematic (fig. FO-12). Troubleshooting will consist of visual inspection to locate any obvious physical of wiring defects prior to parts replacement of resistance and

continuity checks to confirm that a component is defective.

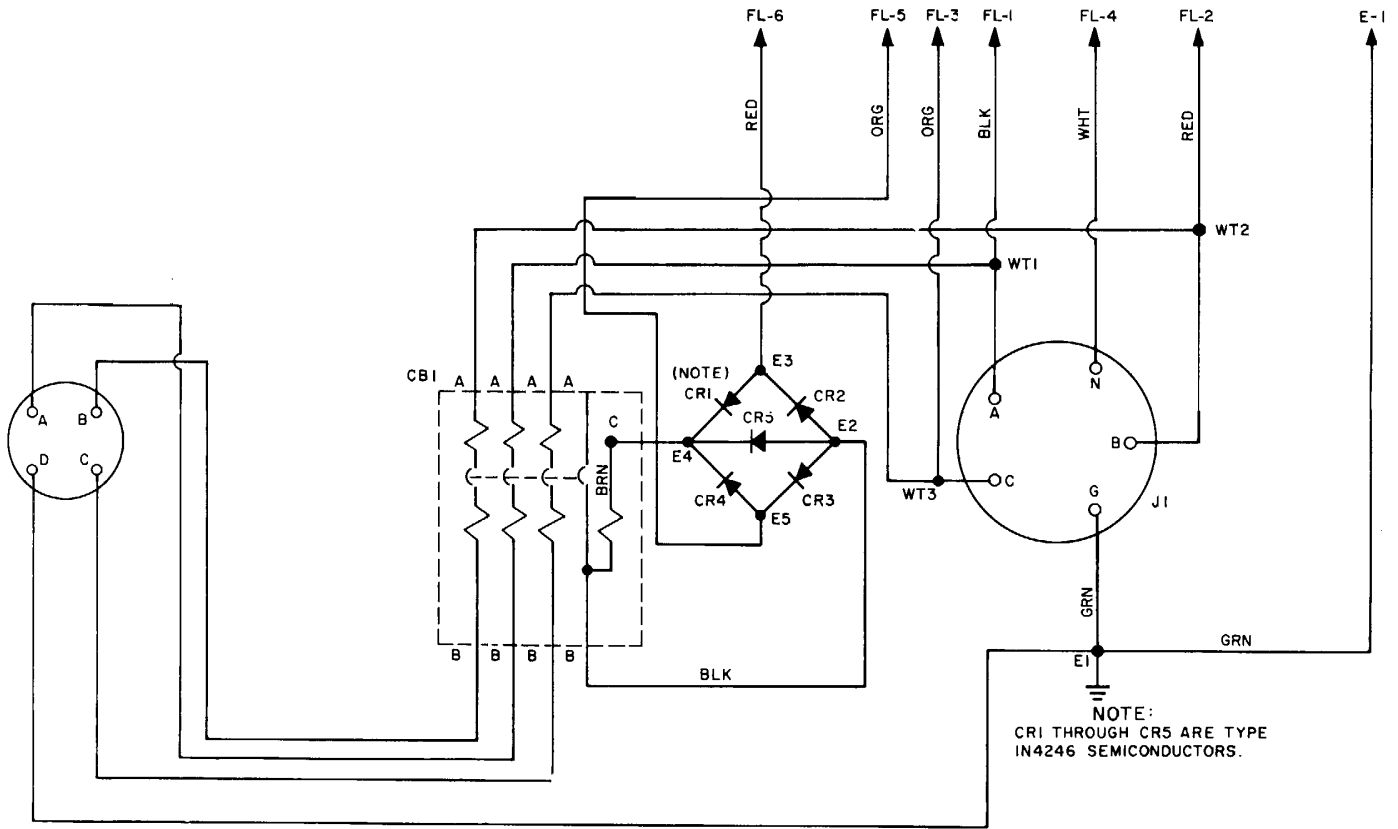


Figure 3-3. Power entrance box wiring diagram

EL5UV009

**3-12. AC Power Distribution Panel 1A35**

a. *General.* The ac power distribution panel is mounted on the wall and houses circuit breakers and indicating devices which are associated with the ac power distribution system. The system troubleshooting procedure will serve to isolate a defect to the ac power distribution panel and in most instances to a specific circuit breaker and/or indicating device. Checking the ac distribution system (fig. FO-12) between the distribution panel and another unit which indicates a malfunction may be necessary to isolate a power problem.

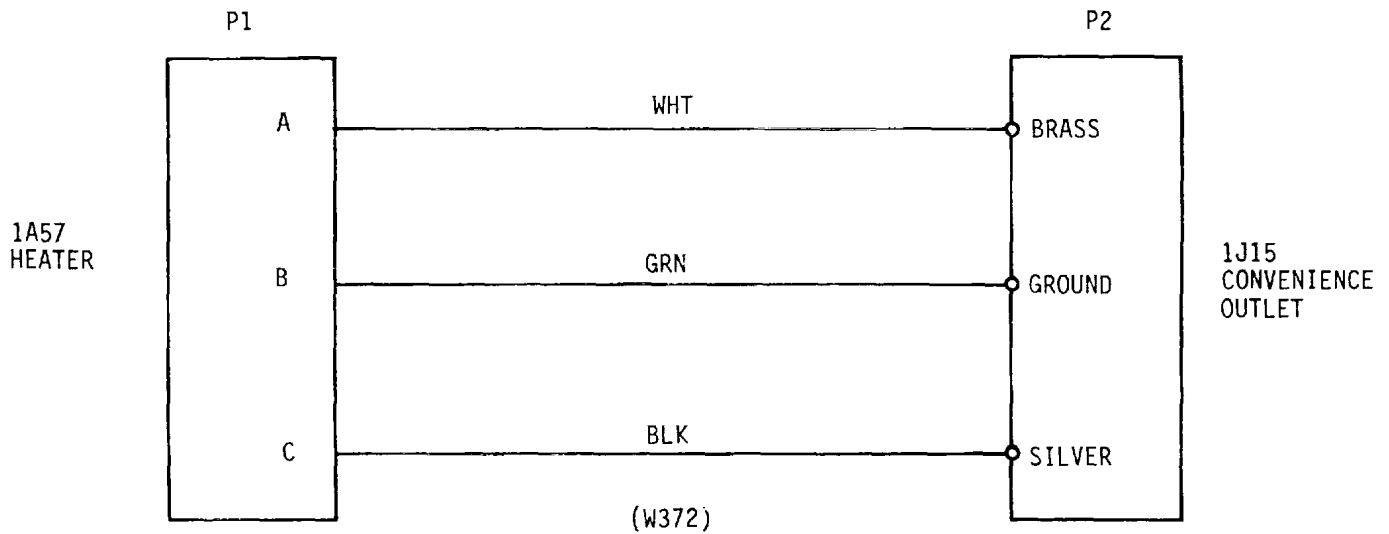
b. *Troubleshooting.* Figure FO-14 is a schematic diagram of the ac power distribution panel and figure 3-72 is a parts location diagram. All troubleshooting, maintenance, and repair will be possible without removal of the unit from the wall. Unit troubleshooting will consist only of a visual inspection to locate any obvious physical or wiring defects prior to parts replacement, or resistance and continuity checks to confirm a component is

defective.

**3-13. Environmental Control System**

a. *Air Conditioner.* Refer to appendix A for technical manuals covering maintenance of the air conditioner. Power loss to the unit can be caused by problems at the ac power distribution panel or system (para 3-12); power entrance box (para 3-11); or cable W103 (para 3-20). Refer to these paragraphs when troubleshooting the unit.

b. *Heater.* Refer to appendix A for technical manuals covering maintenance of the heater. Power loss to the unit can be caused by problems at the ac power distribution system or panel (para 3-12); heater wiring (fig. 3-4) or cabling W372 (para 3-20). Refer to these paragraphs and illustrations when troubleshooting the unit.



EL5UV010

Figure 3-4. Heater wiring diagram.

c. *Thermostat.* Malfunction of the thermostat can be caused by cabling to the unit (W373, para 3-20) or problems with the thermostat unit. The unit is not repairable and must be replaced when faulty.

d. *Blowers.* Two blowers are used with the FCC. Both blowers are powered from a 115-volt ac source (FO- 12). A BLOWERS circuit breaker (CBS) on the ac power distribution panel provides power to BLOWER convenience outlets (J3 and J4). Each convenience outlet has an associated ON-OFF switch (S4 and S5) which controls application of power to the blowers. Malfunction of the blowers will be readily noted by their failure to operate when power is applied.

(1) *Visual inspection.* Due to the sealed-bearing construction of the blowers, a visual inspection will consist of a check for overheating, noisy bearings, oil leakage, reduction of speed, or any obvious physical defect.. Replace any visible defective cable or wiring. Correct for looseness of guard or end bell housing

hardware, when applicable. If a visual inspection reveals a major malfunction as listed above, replace the blower with a replacement known to be operable.

(2) *Troubleshooting procedures.* Troubleshooting procedures are supplemented by inter-unit cable checks (para 3-20) and the system ac schematic (fig. FO-12). In troubleshooting the blowers, make the following voltage checks at the points listed below.

**NOTE**

Before making voltage measurements, check that blower switches are in the ON position. Also check that circuit breaker CB5 at the ac power distribution panel is in the ON position.

(a) Blower indicator lamp DS5 on the ac power

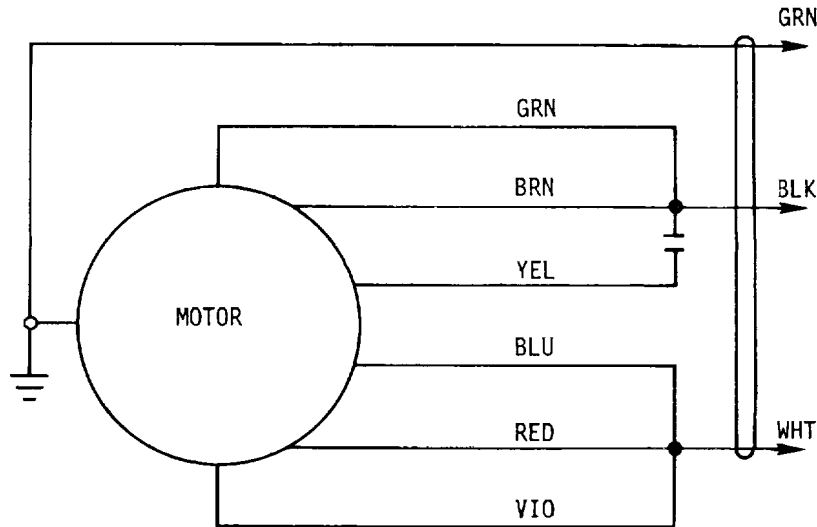
distribution panel should light. If it does not, proceed to (b) below.

(b) Measure 110 volts ac across both sides of circuit breaker CB5. If proper indication is not present, troubleshoot that portion of the ac circuitry. If the voltage is present only at the line side, replace the circuit breaker. If indication is proper proceed to (c) below.

(c) Measure 110 volts ac across both sides of switch (S4 and/or S5). If present, proceed to (4)

below. If present on one side of switch, replace the defective switch.

(d) Measure 110 volts ac at the exhaust blower receptacle. For the exhaust blower, if present troubleshoot motor wiring (fig. 3-5) and the ac power cord. If present, replace the blower motor. For the convenience fan, the entire unit is to be replaced when faulty.



MOTOR HOOK-UP FOR COUNTERCLOCKWISE ROTATION (110 VAC)

EL5UV011

Figure 3-5. Blower wiring diagram.

e. *Smoke and Fire Alarm.* Malfunction of this unit will be indicated when the power light on the front of the unit is not lighted. First check the indicator light; replace light (a spare is located inside the unit) if faulty. Next, check the 115-volt ac source at the ac convenience outlet; if a problem with the distribution system is indicated, refer to paragraph 3-12. When the problem is isolated to the alarm itself, the unit is to be replaced; it is not repairable.

f. *Clock.* Replace a clock which malfunctions.

**3-14. Operator's Console**

a. *General.* The operator's console is divided into two separate assemblies for troubleshooting purposes; the radio-audio control panel and the telephone control

panel. The system troubleshooting chart (para 3-5) contains necessary checks to isolate a defect in any of these assemblies. When a defect is suspected in one of these assemblies proceed as follows:

b. *Radio-Audio Control Panel (1A42, 1A43, 1A44).*

(1 *General.* One radio-audio control panel is located at each operating position. Generally, all components of the panels are repairable or replaceable at the direct support maintenance category. The radio-audio control panel is mounted to the console with four captive screws (fig. 3-6). Disconnect the inter-unit cabling, loosen the screws, and lift the panel carefully to provide access to the components.

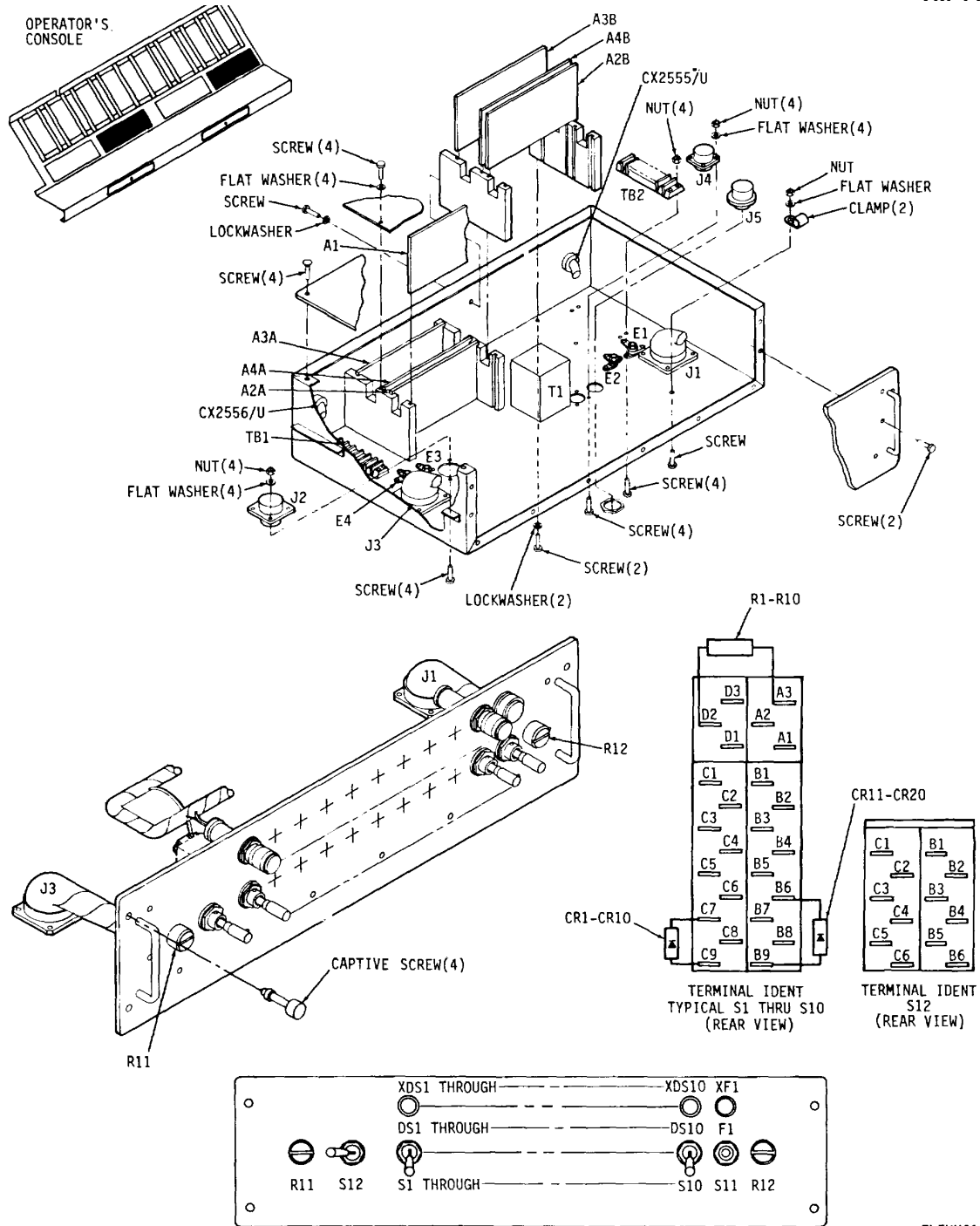


Figure 3-6. Radio-audio control panel, parts location.

EL5UV012

- (2) Troubleshooting procedures.
- (a) Troubleshooting the radio-audio control

panel consists of visual checks and resistance and voltage measurements which are necessary to isolate the cause of



trouble to a specific component. A schematic diagram of the equipment is provided in figure FO-7.

(b) For troubleshooting of the headset amplifier (A2) microphone, preamplifier (A3) or amplifier (A4) refer to figure FO-9 and TM 11-5831-201-35.

(c) Troubleshoot a suspected faulty audio relay card (A1) by conducting the checks indicated in subparagraph (5).

(3) *Visual check.*

(a) Lift the suspected unit free from the console to permit access to components and wiring.

(b) Carefully inspect all solder connections and cabling for damage or looseness. Replace any obviously damaged wiring and resolder any suspect connections.

(c) Verify that lamp sockets are firmly mounted and free of damage or corrosion.

(d) Repair any obvious defects.

(4) *Chassis wiring and harness checks.*

Refer to the schematic diagram (fig. FO-7) and accomplish the following checks.

(a) Set the AN/USM-223 RANGE switch to RX1 and perform the following point-to-point continuity checks. All readings must be 0.2 ohm or less.

*Measurement points*

J3-DD	E1
J3-EE	E3
J1-DD	E1
J1-EE	E3
J3-FF	F1-1
J3-GG	F1-1
J1-FF	F1-1
J1-GG	F1-1
J3-A	S1-A3
J1-A	S1-A3
J3-B	S1-C9
J1-B	S1-C9
J3-C	S1-B3
J1-C	S1-B3
J3-D	S1-B6
J1-D	S1-B6
J3-E	S1-CS
J1-E	S1-C5
J3-F	S2-A3
J1-F	S2-A3
J3-G	S2-C9
J1-G	S2-C9
J3-H	S2-B3
J1-H	S2-B3
J3-J	S2-B6
J1-J	S2-B6
J3-K	S2-CS
J1-K	S2-C5
J3-L	S3-A3
J1-L	S3-A3
J3-M	S3-C9
J1-M	S3-C9
J3-N	S3-B3
J1-N	S3-B3
J3-P	S3-B6
J1-P	S3-B6
J3-R	S3-CS

*Measurement points*

J1-R	S3-CS
J3-S	S4-A3
J1-S	S4-A3
J3-T	S4-C9
J1-T	S4-C9
J3-U	S4-B3
J1-U	S4-B3
J3-V	S4-B6
J1-V	S4-B6
J3-W	S4-C5
J1-W	S4-C5
J3-X	S5-A3
J1-X	S5-A3
J3-Y	S5-C9
J1-Y	S5-C9
J3-Z	S5-B3
J1-Z	S5-B3
J3-a	S5-B6
J1-a	S5-B6
J3-b	S5-C5
J1-b	S5-C5
J3-	S6-A3
J1-c	S6-A3
J3-d	S6-C9
J1-d	S6-C9
J3-e	S6-B3
J1-e	S6-B3
J3-f	S6-B6
J1-f	S6-B6
J3-g	S6-C5
J1-g	S6-C5
J3-h	S7-A3
J1-h	S7-A3
J3-i	S7-C9
J1-i	S7-C9
J3-j	S7-B3
J1-j	S7-B3
J3-k	S7-B6
J1-k	S7-B6
J3-m	S7-C5
J1-m	S7-C5
J3-n	S8-A3
J1-n	S8-A3
J3-p	S8-C9
J1-p	S8-C9
J3-q	S8-B3
J1-q	S8-B3
J3-r	S8-B6
J1-r	S8-B6
J3-s	S8-C5
J1-s	S8-CS
J3-t	S9-A3
J1-t	S9-A3
J3-u	S9-C9
J1-u	S9-C9
J3-v	S9-B3
J1-v	S9-B3
J3-w	S9-B6
J1-w	S9-B6
J3-x	S9-C5
J1-x	S9-CS
J3-y	S10-A3
J1-y	S10-A3
J3-z	S10-C9
J1-z	S10-C9
J3-AA	S10-B3
J1-AA	S10-B3
J3-BB	S10-B6

*Measurement points*

J1-BB S10-Bb  
 J3-CC S10-C5  
**J1-CC** S10-CS  
 E1 DS10-3  
 DS10-3 DS9-3  
 DS9-3 DS8-3  
 DS8-3 DS7-3  
 DS7-3 DS6-3  
 DS6-3 DS5-3  
 DS5-3 DS4-3  
 DS4-3 DS3-3  
 DS3-3 DS2-3  
 DS2-3 DS1-3  
 F1-2 DS10-1  
 DS10-1 DS9-1  
 DS9-1 DS8-1  
 DS8-1 DS7-1  
 DS7-1 DS6-1  
 DS6-1 DS5-1  
 DS5-1 DS4-1  
 DS4-1 DS3-1  
 DS3-1 DS2-1  
 DS2-1 DS1-1  
 DS10-1 DS10-B6  
 DS9-2 S9-B6  
 DS8-2 S8-B6  
 DS7-2 S7-B6  
 DS6-2 S6-B6  
 DS5-2 S5-B6  
 DS4-2 S4-B6  
 DS3-2 S3-B6  
 DS2-2 S2-B6  
 DS1-2 S1-B6  
 S1-B5 S2-B5  
 S2-B5 S3-B5  
 S3-B5 S4-B5  
 S4-B5 S5-B5  
 S5-B5 S6-B5  
 S6-B5 S7-B5  
 S7-B5 S8-B5  
 S8-B5 S9-B5  
 S9-B5 S10-B5  
 S10-B5 E-1  
 S1-D1 S2-D1  
 S2-D1 S3-D1  
 S3-D1 S4-D1  
 S4-D1 S5-D1  
 S5-D1 S6-D1  
 S6-D S7-D1  
 S7-D1 S8-D1  
 S8-D1 S9-D1  
 S9-D1 S10-D1  
 S1-C2 S2-C2  
 S2-C2 S3-C2  
 S3-C2 S4-C2  
 S4-C2 S5-C2  
 S5-C2 S6-C2  
 S6-C2 S7-C2  
 S7-C2 S8-C2  
 S8-C2 S9-C2  
 S9-C2 S10-C2  
 S1-C6 S2-C6  
 S2-C6 S3-C6  
 S3-C6 S4-C6  
 S4-C6 S5-C6  
 S5-C6 S6-C6

*Measurement points*

S6-C6 S7-C6  
 S7-C6 S8-C6  
 S8-C6 S9-C6  
 S9-C6 S10-C6

*Measuring points*

A1-1 E3 (W1)  
 A1-2 S12-C5 (W2)  
 Ferrule, W2 Ferrule 67 (, S12 (W3)  
 A1-3 T1-11 (W4)  
 Ferrule, W4 T1-12 (W5)  
 A1-4 T1-6 (W6)  
 Ferrule, W6 T1-5 (W7)  
 A1-5 S12-C2 (W8)  
 Ferrule, W8 Ferrule, W25 (W9)  
 A1-6 S12-C3 (W10)  
 Ferrule, W10 Ferrule, W8 (W11)  
 A1-7 R12-2 (W12)  
 Ferrule, W12 R12-1 (W13)  
 A1-8 R11-2 (W14)  
 Ferrule, W14 R11-1 (W15)  
 A1-9 S1-C2 (W16)  
 A1-10 S1-C6 (W17)  
 Ferrule, W17 S1-BS (W18)  
 A1-11 S12-C4 (W19)  
 Ferrule, W19 Ferrule, W2 (W20)  
 A1-12 A4A-3 (W21)  
 A1-13 S12-B1 (W22)  
 A1-14 S1-D1 (W23)  
 Ferrule, W23 S1-D3 (W24)  
 A1-15 S12-C1 (W25)  
 Ferrule, W25 E3 (W26)  
 A1-16 A4A-4 (W27)  
 Ferrule, W27 E4 (W28)  
 A1-17 A4B-8 (W29)  
 A2A-1 R11-3 (W30)  
 Ferrule, W30 c1 A2A A2A2 (W31)  
 Ferrule, W30 -, R11R1-1 (W32)  
 A2A-3 E4 (W33)  
 A2A-4 A4A-7 (W34)  
 A2A-S A4A-6 (W35)  
 A2A-6 TBI-2 (W36)  
 Ferrule, W36 12 A2A A2A-7 (W37)  
 Ferrule, W36 14 TB1 TB1-1 (w-8)  
 A3A-1 TB1-6 (W39A)  
 A3A-2 TB1-5 (W39B)  
 A3A-3 A4A-7 (W40)  
 A3A-4 A4A-2 (W41)  
 A3A-S E4 (W42)  
 A3A-6 E4 (W43)  
 A3A-7 A4A-1 (W44)  
 Ferrule, W44 E4 (W45)  
 A4A-5 E4 (W46)  
 A4A-8 F1-2 (W47)  
 A4A-9 E3 (W48)  
 A2B-1 R12-3 (W49)  
 Ferrule, W49A2B A2B-2 (WSO)  
 Ferrule, W49R12 R12-1 (W51)  
 A2B-3 EI (WS2)  
 A2B-4 A4B-7 (W53)  
 A2B-5 A4B-6 (W54)  
 A2B-6 TB2-2 (WS5)  
 Ferrule, W55A2B A2B-7 (W6)  
 Ferrule, WSS1 TB2 TB2-1 (W57)  
 A3B-1 TB2-6 (W58A)  
 A3B-2 TB2-S (W5BB)

Measuring points

Ferrule, W39	TB1-3	(W59)
A3B-3	A4B-7	(W60)
A3B-4	A4B-2	(W61)
A3B-5	E2	(W62)
A3B-6	E2	(W63)
A3B7	A4B-1	(W64)
Ferrule, W64	E2	(W65)
A4B-3	S12-B3	(W66)
A4B-4	S12-C6	(W67)
Ferrule, W67 Ca A4BA4B-5		(W68)
Ferrule, W67, S12	E4	(W69)
A4B-9	E1	(W70)
S11-I	E1	(W71)
S11-I	S11-3	(W72)
S11-2	S10-C2	(W73)
S11-2	TB1-4	(W74)
R11-I	E3	(W75)
TB2-1	E2	(W76)
TB1-3	E4	(W77)
Ferrule, W58	TB2-3	(W78)
TB2-3	E2	(W79)
R12-1	E2	(W80)
J2-A	T1-I	(W81A)
J2-B	T1-4	(W81B)
Ferrule, W81	T1-5	(W82)
T1-5	E2	(W83)
J2-C	A1-17	(W84)
J2-D	S12-B2	(W85)
J2-E	E3	(W86)
J4-B	E2	(W87)
J4-A	TB1-4	(W88)
TB1-1	E4	(W89)
J5-B	F1-2	(W90)
J5-E	TB1-2	(W91)
Ferrule, W91 67 J5	J5-A	(W92)
Ferrule, W916 TB1	TB1-1	(W93)

(b) Set all 10 radio key switches in the MON position; connect a 28-volt dc source positive lead to pin GG of J1 or J3 and move the negative to the following points

Connection points	Indication
J1/J3-D	DS1 lights
J1/J3-J	DS2 lights
J1/J3-P	DS3 lights
J1/J3-V	DS4 lights
J1/J3-a	DS5 lights
J1/J3-f	DS6 lights
Ji/J3-k	DS7 lights
J1/J3-r	DS8 lights
Ji/J3-w	DS9 lights
J1/J3-BB	DS10 lights

(c) Set all 10 radio key switches (S1 through S10) as indicated in the chart below.

Step	Switch position	Measurement point	Indication
1	TALK	J1/J3-C	J1/J3-DD
		J1/J3-H	Ji/J3-DD
		J1/J3-N	J1/J3-DD
		J1/J3-U	Ji/J3-DD
		J1/J3-Z	Ji/J3-DD
		J1/J3-e	Ji/J3-DD
		J1/J3-j	Ji/J3-DD
		J1/J3-q	J1/J3-DD
		J1/J3-v	J1/J3-DD
		J1/J3-A	J1/J3-F
		J1/J3-A	Ji/J3-L
		J1/J3-A	Ji/J3-S

J1/J3-A	J1/J3-X	20, 000 ohms
J1/J3-A	J1/J3c	20, 000 ohms
J1/J3-A	Ji/J3-ih	20, 000 ohms
J1/J3-A	Ji/J3-n	20, 000 ohms
J1/J3-A	J1/J3-t	20, 000 ohms
J1/J3-A	Ji/J3-y	20, 000 ohms
J1/J3-D	J1/J3-DD	Continuity
J1/J3-J	J1/J3-DD	Continuity
J1/J3-P	J1/J3-DD	Continuity
Ji/J3-V	J1/J3-DD	Continuity
J1/J3-a	J1/J3-DD	Continuity
J1/J3-f	J1/J3-DD	Continuity
J1/J3-k	J1/J3-DD	Continuity
J1/J3-r	J1/J3-DD	Continuity
J1/J3-w	J1/J3-DD	Continuity
Ji/J3-BB	J1/J3-DD	Continuity
Ji/J3-E	J1/J3-k	Continuity
J1/J3-E	Ji/J3-r	Continuity
J1/J3-E	J1/J3-w	Continuity
Ji/J3-E	J1/J3-b	Continuity
J1/J3-E	J1/J3-g	Continuity
J1/J3-E	Ji/J3-m	Continuity
J1/J3-E	Ji/J3-s	Continuity
Ji/J3-E	Ji/J3-x	Continuity
Ji/J3-E	J1/J3cc	Continuity
J1/J3-B	Ji/J3G	Continuity
J1/J3-B	Ji/J3-M	Continuity
Ji/J3-B	J1/J3-T	Continuity
J1/J3-B	Ji/J3-Y	Continuity
J1/J3-B	Ji/J3-d	Continuity
J1/J3-B	Ji/J3-i	Continuity
Ji/J3-B	J1/J3-p	Continuity
J1/J3-B	Ji/J3-u	Continuity
J1/J3-B	Ji/J3-z	Continuity
J1/J3-A	Ji/J3-F	20, 000 ohms
J1/J3-A	Ji/J3-1	20, 000 ohms
J1/J3-A	J1/J3-S	20, 000 ohms
Ji/J3-A	Ji/J3-X	20, 000 ohms
J1/J3-A	J1/J3-	20, 000 ohms
J1/J3-A	Ji/J3-h	20, 000 ohms
J1/J3-A	Ji/J3-n	20, 000 ohms
Ji/J3-A	J1/3-t	20, 000 ohms
J1/J3-A	J1/J3-y	20, 000 ohms
J1/J3-A	Ji/J3-DD	10, 000 ohms
J1/J3-F	Ji/J3-DD	10, 000 ohms
J1/J3-L	Ji/J3-DD	10, 000 ohms
J1/J3-S	Ji/J3-DD	10, 000 ohms
J1/J3-X	J1/J3-DD	10, 000 ohms
Ji/J3-n	J1/J3-DD	10, 000 ohms
J1/J3-t	Ji/J3-DD	10, 000 ohms
Ji/J3-y	Ji/J3-DD	10, 000 ohms

(a) Set switch S11 as indicated in the chart

below.

Step	Switch position	Measurement point	Indication
1	ON (LOCK)	TB1-4	J1/J3-DD
2	ON (MOM)	TB14	Ji/J3-DD
3	OFF	TB1-4	J1/J3-DD

(e) Set switch S12 as indicated in the chart

below.

Step	Switch position	Measurement point	Indication
1	"A"	J2-D	A1-13
		A1-15	A1-5
		A1- 1	A1-2
2	"A" & "B"	J2-D	A4B-3
		A1-S	A1-6
		A1-2	A4B4

(5) Resistance measurements, audio relay circuit card (fig. 2-1).

(a) Use the multimeter when performing measurements.

(b) With no power applied to relay K1, connect the multimeter across the following terminals of the audio relay circuit card and observe the measurements.

<i>Measurement point</i>	<i>Indicator</i>
Terminals 1 & 2	150 ohms ± 5%
Terminals 2 & 3	560 ohms ± 5%
Terminals 1 & 4	560 ohms ± 5%
Terminals 4 & 5	1500 ohms ± 5%
Terminals 6 & 7	22 ohms ± 5%
Terminals 8 & 14	22 ohms ± 5%
Terminals 1 & 16	200 ohms ± 5%

(c) Apply 28 volts dc to relay K1 by connecting the positive lead of a power source to terminal 17 and the negative lead to terminal 13 of the audio relay circuit card.

(d) Connect the multimeter across the following terminals of the audio relay circuit card and observe the measurements.

<i>Measurement point</i>	<i>Indication</i>
Terminals 8 & 15	22 ohms ± 5%
Terminals 14 & 15	10 kilohms ± 5%
Terminals 1116	Continuity

(e) Disconnect power source.

(f) Check variable resistor R11 by

connecting the multimeter across terminals 10 and 16 of the audio relay circuit card. Adjust R11 in a counterclockwise direction; the reading should be approximately zero ohms. Adjust R11 in a clockwise direction; reading should be 200 ohms ± 5%.

(g) Check diodes CR1 and CR2 by connecting the multimeter across the following terminals of the audio relay circuit card. Observing the polarity listed, note the reading for each point.

<i>Measurement point</i>	<i>Indication</i>
Positive lead to terminal 12; Negative lead to terminal 9.	Less than 750 ohms.
Positive lead to terminal 12; Negative lead to terminal 13.	Less than 750 ohms.
Positive lead to terminal 9; Negative lead to terminal 12;	Greater than 750 kilohms.
Positive lead to terminal 13, Negative lead to terminal 13;	Greater than 750 kilohms.

c. Telephone Control Panel (1A 45, 1A 46, J1A47).

(1) General. One telephone control panel is located at each operating position. Generally, all components of the panels are repairable or replaceable at the direct support level. The telephone control panel is mounted to the console with four captive screws (fig. 3-7). Disconnect the inter-unit cabling, loosen the screws, and lift the panel carefully to provide access to the components.

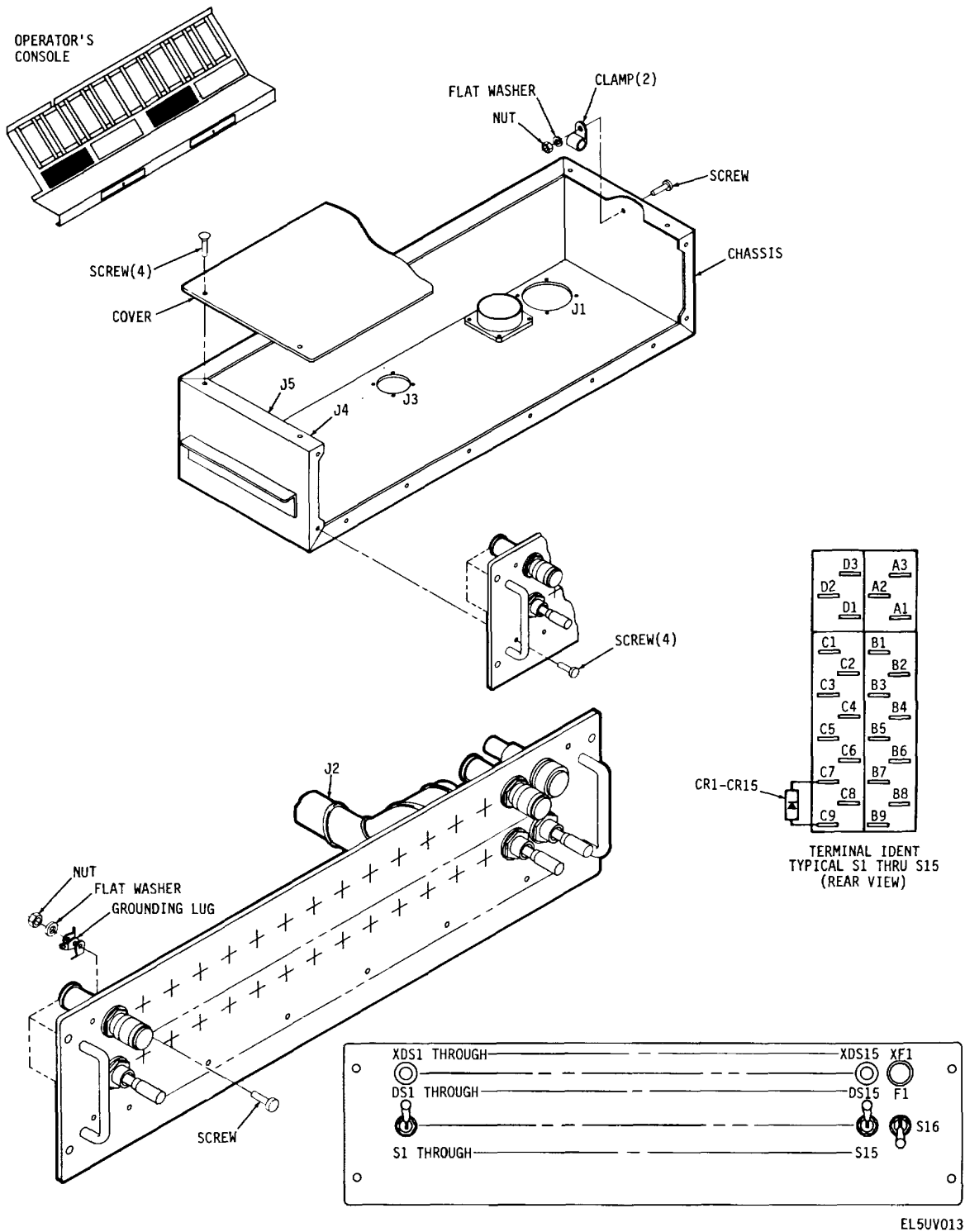


Figure 3-7. Telephone control panel, parts location.

(2) Troubleshooting procedures. Troubleshooting the telephone control panel consists of visual checks and resistance measurements necessary to isolate the cause of trouble to a specific component. A schematic diagram of the unit is provided in figure FO-6.

(3) Visual check.

(a) Lift the suspected unit free from the console to permit access to components and wiring.

(b) Carefully inspect all solder connections and cabling for damage or looseness. Replace any obviously damaged wiring and resolder any suspect connections.

(c) Verify that lamp sockets are firmly mounted and free damage or corrosion.

(d) Repair any obvious defects.

(4) Chassis wiring and harness checks. Refer to the schematic diagram (fig. FO-6) and accomplish the following checks.

(a) Set the multimeter RANGE switch to RX1 and perform point the following point-to-point checks. All readings must be 0.2 ohm or less.

Measurement Points

DS1-1	DS2-1
DS2-1	DS3-1
DS3-1	DS4-1
DS4-1	DS5-1
DS5-1	DS6-1
DS6-1	DS7-1
DS7-1	DS8-1
DS8-1	DS9-1
DS9-1	DS10-1
DS10-1	DS11-1
DS11-1	DS12-1
DS12-1	DS13-1
DS13-1	DS14-1
DS14-1	DS15-1
DS15-1	F1-2
DS1-3	DS2-3
DS2-3	DS3-3
DS3-3	DS4-3
DS4-3	DS5-3
DS5-3	DS6-3
DS6-3	DS7-3
DS7-3	DS8-3
DS8-3	DS9-3
DS9-3	DS10-3
DS10-3	DS 1-3
DS11-3	DS12-3
DS12-3	DS13-3
DS13-3	DS14-3
DS14-3	DS15-3
DS15-3	E1
DS1-2	S1-B3
DS2-2	S2-B3
DS3-2	S2-B3
DS4-2	S4-B3
DS5-2	S5-B3
DS6-2	S6-B3
DS7-2	S7-B3
DS8-2	S8-B3
DS9-2	S9-B3
DS10-2	S10-B3

DS11-2	S11-B3
DS12-2	S12-B3
DS13-2	S13-B3
DS14-2	S14-B3
DS15-2	S15-B3
S1-A3	S2-A3
S2-A3	S3-A3
S3-A3	S4-A3
S4-A3	S5-A3
S5-A3	S6-A3
S6-A3	S7-A3
S7-A3	S8-A3
S8-A3	S9-A 3
S9-A3	S10-A3
S10-A3	S11-A3
S11-A3	S12-A3
S12-A3	S13-A3
S13-A3	S14-A3
S14-A3	S15-A3
S1-B9	S2-B9
S2-B9	S3-B9
S3-B9	S4-B9
S4-B9	S5-B9
S5-B9	S6-B9
S6-B9	S7-B9
S7-B9	S8-B9
S8-B9	S9-B9
S9-B9	S10-B9
S10-B9	S11-B9
S11-B9	S12-B9
S12-B9	S13-B9
S13-B9	S14-B9
S14-B9	S15-B9
S1-C6	S2-C6
S2-6	S3-C6
S3-C6	S4-C6
S4-C6	S5-C6
S5-C6	S6-C6
S6-C6	S7-C6
S7-C6	S8-C6
S8-C6	S9-C6
S9-C6	S10-C6
S10-C6	S11 -C6
S11-C6	S12-C6
S12-C6	S13-C6
S13-C6	S14C6
S14-C6	S15-C6
S1-C3	S2-C3
S2-C3	S3-C3
S3-C3	S4-C3
S4-C3	S5-C3
S5-C3	S6-C3
S6-C3	S7-C3
S7-3	S8-C3
S8-C3	S9-C3
S9-C3	S10-C3
S10-C3	S11-C3
S 1-C3	S12-C3
S12-C3	S13-C3
S13-C3	S14-C3
S14-C3	S15-C3
S1-D3	S2-D3
S2-D3	S3-D3
S3-D3	S4-D3
S4-D3	S5-D3
SS-D3	S6-D3
S6D3	S7-D3
S7-D3	S8-D3

Measurement Points

S8-D3  
 S9-D3  
 S10-D3  
 S11-D3  
 S12-D3  
 S13-D3  
 S14-D3  
 S14-D3  
 E2  
 S1-B2  
 S2-B2  
 S3-B2  
 S4-B2  
 E-2  
 S6-B2  
 S7-B2  
 S8-B2  
 S9-B2  
 S10-B2  
 S11-B2  
 S12-B2  
 S13-B2  
 S14-B2  
 S15-B2  
 S15-C3  
 J1-AA  
 J1-BB  
 J5-AA  
 JS-BB  
 J1-CC  
 J1-DD  
 J5-CC  
 J5-DD  
 J4-CC  
 14-DD  
 J2-CC  
 J2-DD  
 J2-AA  
 J2-y  
 J4-AA  
 J4-y  
 J1-A  
 J5-A  
 J2-A  
 J4-A  
 J1-B  
 JS-B  
 J2-B  
 J4-B  
 J1-h  
 J5-h  
 J2-h  
 J4-h  
 J1-C  
 J5-C  
 J2-C  
 J4-C  
 J1-D  
 JS-D  
 J2-D  
 J4-D  
 J1-1  
 J5-1  
 J2-1  
 J4-T  
 J11-E

S9-D3  
 S10-D3  
 S11-D3  
 S12-D3  
 S13-D3  
 S14-D3  
 S15-D3  
 S1-B2  
 S2-B2  
 S3-B2  
 S4-B2  
 S5-B2  
 S6-B2  
 S7-B2  
 S8-B2  
 S9-B2  
 S10-B2  
 S11-B2  
 S12-B2  
 S13-B2  
 S14-B2  
 S15-B2  
 S16-B2  
 S16-5  
 F1-1  
 F1-1  
 F1-1  
 F1-1  
 E1  
 E1  
 E1  
 E1  
 E2  
 E2  
 E2  
 S1-A3  
 S1-D3  
 S1-A3  
 S1-D3  
 S1-D2  
 S1-D2  
 S1-C1  
 S1-C1  
 S1-A2  
 S1-A2  
 S1-C4  
 S1-C4  
 S1-B3  
 S1-B3  
 S1-B6  
 S1-B6  
 S2-D2  
 S2-D2  
 S2-C1  
 S2-C1  
 S2-A2  
 S2-A2  
 S2-C4  
 S2-C4  
 S2-C4  
 S2-B3  
 S2-B3  
 S2-B6  
 S2-B6  
 S3-D2

Measurement Points

15-E  
 J2-E  
 J4-E  
 J1-F  
 J5-F  
 J2-F  
 J4-F  
 J1-J  
 J5-J  
 J2-J  
 J4-J  
 J1-G  
 J5-G  
 J2-G  
 J4-G  
 J1-H  
 J5-H  
 J2-H  
 J4-H  
 J3-k  
 J5-k  
 J2-k  
 J4-k  
 J1-J  
 J5-J  
 J4-J  
 J1-K  
 J5-K  
 J2-K  
 J4-K  
 J1-m  
 J5-m  
 J2-m  
 J4-mn  
 J1-L  
 J5-L  
 J2-L  
 J4-L  
 J1-M  
 J5-M  
 J2-M  
 J4-M  
 J1-h  
 J5-h  
 J2-h  
 J4-h  
 J1-N  
 15-N  
 J2-N  
 J4-N  
 J1-P  
 J5-P  
 J2-P  
 J4-P  
 J1-p  
 J5-p  
 J2-p  
 J4-p  
 J5-R  
 J2-R  
 J4-R  
 J1-S  
 J5-S  
 J2-S  
 J4-S  
 J1-g  
 J5-

S3-D2  
 S3-C1  
 S3-C1  
 S3-A2  
 S3-A2  
 S3-C4  
 S3-C4  
 S3-B3  
 S3-B3  
 S3-B6  
 S3-B6  
 S4-D2  
 S4-D2  
 S4-C1  
 S4-C1  
 S4-A2  
 S4-A2  
 S4-C4  
 S4-C4  
 S4-B3  
 S4-B3  
 S4-B6  
 S4-B6  
 S5-D2  
 S5-D2  
 SS-C1  
 S5-A2  
 S5-A2  
 S5-C4  
 S5-C4  
 S5-B3  
 S5-B3  
 S5-B6  
 S5-B6  
 S6-D2  
 S6-D2  
 S6-C1  
 S6-C1  
 S6-A2  
 S6-A2  
 S6-C4  
 S6-C4  
 S6-B3  
 S6-B3  
 S6-B6  
 S6-B6  
 S7-D2  
 S7-D2  
 S7-C1  
 S7-C1  
 S7-A2  
 S7-A2  
 S7-C4  
 S7-C4  
 S7-B3  
 S7-B3  
 S7-B6  
 S7-B6  
 S8-D2  
 S8-C1  
 S8-C1  
 S8-A2  
 S8-A2  
 S8-C4  
 S8-C4  
 S8-B3  
 S8-B3

Measurement Points

J2-g S8-B6  
 J4-g S8-B6  
 J1-T S9-D2  
 JS5-T S9-D2  
 J2-T S9-C1  
 14-T S9-C1  
 J1-U S9-A2  
 J5-U S9-A2  
 J2-U S9-C4  
 J4-U S9-C4  
 J1-v S9-B3  
 J5-v S9-B3  
 J2-v S9-B6  
 J4-v S9-B6  
 J1-V S10-D2  
 JS-V S10-D2  
 J12-V S10-C1  
 J4-V S10-C1  
 J1-W S10-A2  
 J5-W S10-A2  
 J12-W S10-C4  
 J4-W S10-C4  
 J1-s S10-B3  
 J15-s S10-B3  
 J2-s S10-B6  
 J4-s S10-B6  
 J1-X SII-D2  
 15-X S1I-D2  
 J12-X S1I-C1  
 J4-X S1I-C1  
 J1-Y S11-A2  
 J5-Y S11-A2  
 J2-Y SII-C4  
 J4-Y SII-C4  
 J1-t SII-B3  
 J5-t S1 -B3  
 J2-t SII-B6  
 J4-t SII-B6  
 J1-z S12-D2  
 J5-z S12-D2  
 J2-z S12-C1  
 14-z S12-C1  
 J1-a S12-A2  
 J5-a S12-A2  
 J2-a S12-C4  
 J4-a S12-C4  
 J1-w S12-B3  
 J5-w S12-B3  
 J2-w S12-B6  
 J4-w S12-B6  
 J1-b S13-D2  
 J5-b S13-D2  
 J2-b S13-C1  
 J4-b S13-C1  
 J1-c S13-A2  
 J5-c S13-A2  
 12-c S13-C4  
 J4-c S13-C4  
 J1-v S13-B3  
 15-v S13-B3  
 J12-v S13-B6  
 J4-v S13-B6  
 J1-d S14-D2  
 J5-d S14-D2  
 J12-d S14-C1  
 14-d S14-C1

Measurement Points

11-e S14-A2  
 JS-e S14-A2  
 J2-e S14-C4  
 J4-e S14-C4  
 J1-w S14-B3  
 J15-w S14-B3  
 J2-w S14-B6  
 J4-w S15-D2  
 J5s- S15-D2  
 J2-f S15-C1  
 J4-T S15-C1  
 J1-g S15-A2  
 J5-g S15-A2  
 J2-g S15-C4  
 J4-g S15-C4  
 J1-x S15-B3  
 JS-x S15-B3  
 12-x S15-B6  
 J4-x S15-B6  
 13-D S15-B9  
 J3-A S16-6  
 J3-B S16-3  
 J3-C F1-2  
 J3-E E1  
 S1-B2 S1-B5  
 S1I-B5 S1-B8  
 S1-AI S1-C2  
 S1-DI S1-CS  
 S2-B2 S2-B5  
 S2-B5 S2-B8  
 S2-A1 S2-C2  
 S2-D1 S2-C5  
 S3-B2 S 3-BS  
 S3-BS S3-B8  
 S3-A1 S3-C2  
 S3-D1 S3-C5  
 S4-B2 S4-B5  
 S4-B5 S4-B8  
 S4-A1 A4-C2  
 S4-D1 S4-C5  
 SS-B2 S5-B5  
 S5-B5 Ss-B8  
 S5-A1 S5-C2  
 S5-D1 S5-C5  
 S6-B2 S 6-B5  
 S6-B5 S6-B8  
 S6-A1 S6-C2  
 S6-D1 S6-C5  
 S7-B2 S7-B5  
 S7-BS S7-B8  
 S7-A1 S7-C2  
 S7-D1 S7-CS  
 S8-B2 S8-BS  
 S8-BS S8-B8  
 S8-A1 S8-C2  
 S8-D1 S8-C5  
 S9-B2 S9-BS  
 S9-BS S9-B8  
 S9-A1 S9-C2  
 S9-D1 S9-C5  
 S10-B2 S10-B5  
 S10-B2 S10-B8  
 S10-A1 S10-C2  
 S10-D1 S10-C5  
 S11-B2 S11-B5  
 S11-B5 S11-B8



Measurement Points

S11-AL	S11-C2
S1 -D1	S11-C5
S12-B2	S12-B5
S12-B5	S12-B 8
S12-A1	S12-C2
S1 2-D1	S12-C5
S13-B2	S13-B5
S13-B5	S13-B8
S13-A1	S13-C2
S13-D1	S13-C5
S14-B2	S14-B5
S14-B5	S14-B8
S14-A1	S14-C2
S14-D1	S14-C5
S15-B2	S15-B5
S1-B5	S15-B8
S15-A1	S15-C2
S15-D1	S15-C5

(b) Set all 15 telephone key switches in the OFF position; connect a positive 28-volt dc source to pin AA of J1 or 35 and move the negative to the following points in turn.

Connection points	Indication
J1/J5-AA J1/J5-h	DS1 lights
J1/J5-AA J1/J5-1	DS2 lights
J1/J5-AA J1/J5-j	DS3 lights
J1/J5-AA J1/J5-k	DS4 lights
J1/J5-AA J1/J5-m	DS5 lights
J1/J5-AA J1/J5-n	DS6 lights
J1/J5-AA 1/JS5-p	DS7 lights
J1/J5-AA J1/J5h	DS8 lights
J1/J5-AA J1/J5-r	DS9 lights
J1/J5-AA J1/J5-s	DS10 lights
J1/J5-AA J1/J5-t	DS11lights
J1/J5-AA J1/J5-u	DS12 lights
J1/J5-AA J1/JS-v	DS13 lights
J1/J5-AA J1/J5-w	DS14 lights
J1/15-AA J1/J5-x	DS15 lights

d. Tuning Indicator Lights. Refer to figure FO-8 and paragraph 3-17 to troubleshoot malfunctions with the hf tuning lights.

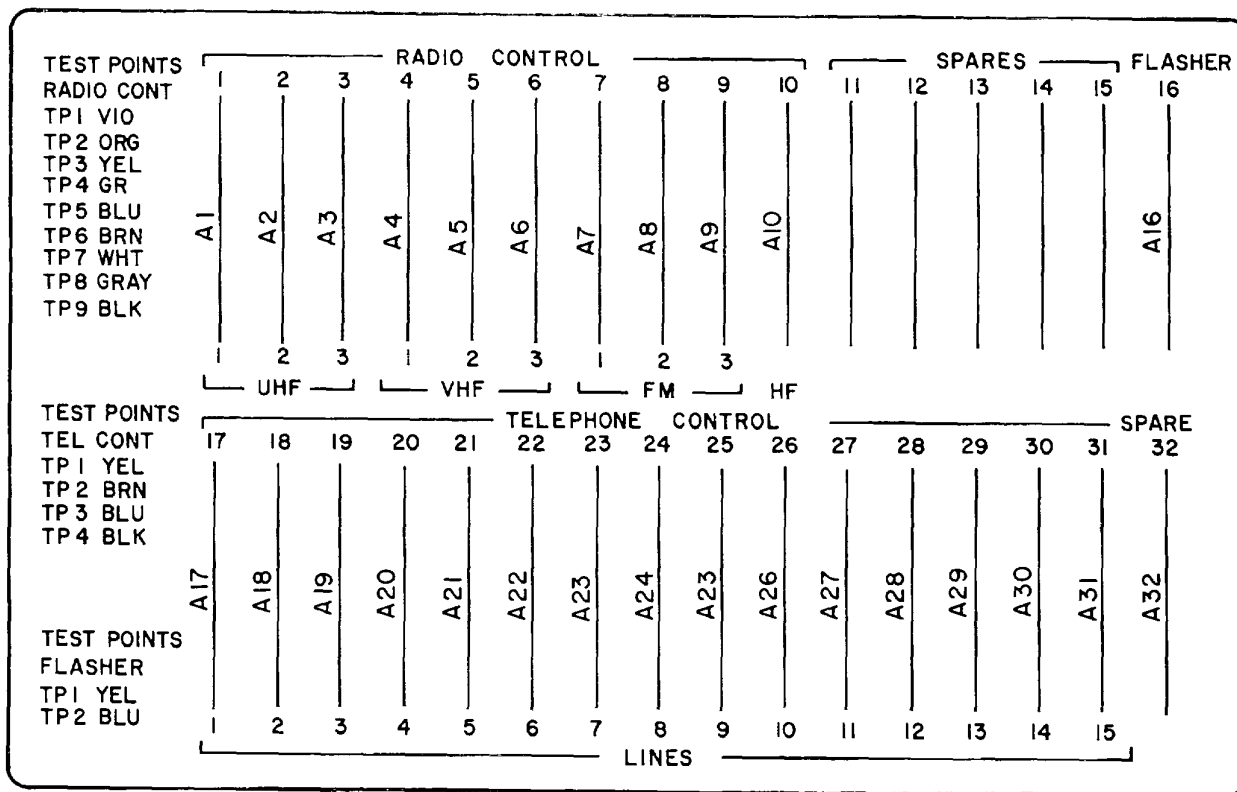
**3-15. Supervisor's Console**

The supervisor's console is divided into three assemblies for troubleshooting purposes; the radio-audio control panel, the telephone control panel and the KY-8 control. The system troubleshooting procedures contain necessary checks to isolate a defect to these assemblies. When a defect is suspected proceed as follows:

- a. Radio-Audio Control Panel. Refer to paragraph 3-14b for unit troubleshooting.
- b. Telephone Control Panel. Refer to paragraph 3-14c for unit troubleshooting.
- c. KY-8 Control. Refer to figure FO-10 and TM 11-5821-281-15 for troubleshooting.

**3-16. Signal Control Box A1A41**

a. General The signal control box (figs. FO-5, FO-7) is the interconnection unit between the radio sets, telephone lines, control circuit cards, and the operator control panels. Troubleshooting of the signal control box is divided into the following groups: (1) Radio control circuit cards A1 through A10; (2) Telephone control circuit cards A17 through A31; (3) Buzzer-flasher circuit card A16; and (4) Checking the wiring and components of the card nest. The system troubleshooting chart (para 3-5) localizes an operational malfunction to a probable faulty circuit card (figure 3-8). The following troubleshooting procedures further localize the system troubleshooting chart problems.



EL5UV014

Figure 3-8. Circuit card slot assignments, signal control box.

b. Circuit Card Assemblies.

(1) Radio control circuit card. A faulty radio control circuit card is indicated by symptoms identified in the system troubleshooting chart (para 3-5). Summarized, a radio control circuit card is suspect when the channel being checked has a malfunction in transmitter keying, audio reception, or lighting of the channel call lamp.

(2) Telephone control circuit card. A faulty telephone control circuit card is indicated by symptoms identified in the system troubleshooting chart. (para 3-5). Summarized, a telephone control circuit card is suspected when a telephone call lamp malfunctions at one line or the night alarm buzzer for the channel does not sound.

(3) Buzzer-flasher circuit card. A faulty buzzer-flasher circuit card is indicated from symptoms identified in the system troubleshooting chart (para 3-5). Summarized, a faulty buzzer-flasher card is suspected when the call lamp fails to flash on an incoming signal or the night buzzer does not sound when the night buzzer switch is ON.

(4) Visual inspection. Turn off the 28 vdc power from the signal control box and remove the suspected circuit card (fig. 3-8) using the card extractor. Inspect for any obvious physical defects such as discoloration of components due to excessive heat.

Inspect also for breaks in the printed wiring board etchings.

(5) Circuit card substitution. When a malfunction is noted in one of the radio or telephone circuits and identified to a circuit card, the quickest method of isolation is to substitute the suspected circuit card with one known to be good. If the malfunction is corrected by the substitution, route the faulty card to higher maintenance level for repair. If circuit card substitution does not correct the malfunction, the defect lies in the circuit card nest, wiring, or inter-unit cabling. Perform the checks in c below to isolate the defect.

(6) Circuit card repair. Troubleshooting and repair of circuit card assemblies is performed at special general support category shops. When a defect has been isolated to one of the circuit card assemblies, replace the defective circuit card and route the faulty card to higher maintenance level for troubleshooting and repair.

c. Signal Control Box Card Nest. Troubleshooting the signal control box card nest consists of visual checks and resistance and voltage measurements necessary to isolate the cause of trouble to a specific component.

(1) Visual check.

(a) Carefully inspect all solder connections, terminal board components, connections, and wiring for damage or looseness. Replace any obviously damaged

wiring and resolder any suspect connections.

(b) Inspect each circuit card assembly for proper fit.

(2) *Resistance and voltage checks.* Card nest failures will result in the same type of trouble indications as failed cards but will not be corrected by card replacement. After a circuit card has been eliminated as a possible source of the problem, conduct a continuity check between the connector pins and the connection points shown below. If the wiring and components of the signal control box do not indicate a problem, proceed to the inter-unit cabling (fig. FO-15) and other units to isolate the difficulty.

(3) *Continuity checks.* Set the multimeter RANGE switch to RX1 and perform the following point-to-point checks. All readings must be 0.2 ohm or less.

*Measurement points*

J45-A	TB1-41	(W1)
J45-C	E3	(W2)
J33-B	E1	(W3)
J33-D	E1	(W4)
134-B	E1	(W5)
J34-D	E1	(W6)
J35-B	E1	(W7)
J35-D	E1	(W8)
J36-B	E1	(W9)
J36-D	E1	(W10)
J37-B	E2	(W 1)
J37-D	E2	(W12)
J38-B	E2	(W13)
J38-D	E2	(W14)
J39-B	E2	(W15)
J39-D	E2	(W16)

**Measurement points**

J40-B	E2	(W17)
J40-D	E2	(W18)
J41-B	E3	(I9)
J41-D	E3	(W20)
J42-B	E3	(W21)
J42-D	E3	(W22)
S1-2	F2-2	(W23)
S1-5	F1-2	(W24)
S2-2	TBI-45	(W25)
J44-A	F1-1	(W26)
F1-1	F2-1	(W27)

**3-17. HF Antenna System**

a. *General* The high frequency antenna system consists of an AT-101 1/U antenna (32-foot whip); the hf antenna coupler, the hf coupler case, indicator lights, and interconnecting wiring and cables. Troubleshooting of the antenna system will be initiated by difficulties encountered in operation or tuning of the HF radio set, and subsequently isolated to the antenna system.

b. *HF Antenna Coupler.* Refer to TM11-5895-326-35.

c. *HF Coupler Case.* The coupler case provides the connecting circuitry between the antenna coupler and the HF radio and is also the mounting facility for the AT-1011/U antenna or the long-wire adapter. In addition to its interconnection function, it also allows for a load coil to be automatically placed in series with an antenna of 6 meters (18 ft) or less, when tuning below 4 MHz (out position of S-2). A schematic diagram (fig. FO-11) is furnished to troubleshoot circuits of the hf coupler case. Refer to the troubleshooting chart below for the hf coupler case.

Item No.	Malfunction	Probable Cause	Corrective Action
1	Blower inoperative-never comes on.	a. Thermal switch S1 open above 113° F. b. Capacitor A2C19 open.	Replace S1. Replace A2C19.
2	Blower runs continuously.	c. Windings of blower motor B1 open or shorted.	Replace B1.
3	High vswr operating below 4 MHz with an antenna 18 feet	Thermal switch S1 is shorted. a. Load CO1L switch S2 open. b. Transistor A2Q2 open. c. Zener diode A2VR2 open.	Replace S1. Replace S2. Replace A2Q2. Replace A2VR2.
4	High vswr operating above 4 18 feet MHz with an antenna	or less. d. Transistor A2Q1 collector to emitter shorted.	Replace A2Q1.
		e. Diode A2CR1 open.	Replace A2CRI.
		f. Diode A2CR2 open.	Replace A2CR2.
		g. Diode A4CR10 shorted.	Replace A4CR10.
5	No transmitted power out operating below 4 MHz with an	h. Relay A4K1 coil open.	Replace A4K1.
		a. Transistor A2Q2 collector to emitter shorted.	Replace A2Q2.
6	No transmitted power out regardless of frequency or an-antenna 18 feet or less. tenna length.	b. Diode A2CR5 open (operating in 4-8 MHz range or less and switch S2 in the 1N position. only).	Replace A2CRS.
		Load coil L4 open.	Replace L4.
6		a. Relay A4K1 contacts open.	Replace A4K1.
		b. Switch S3 open.	Replace S3.

e. *Tuning Indicator Lights.* An apparent malfunction of the TUNE, OPERATE, or FAULT light at the operator's console which is not traced to radio set or coupler problems may be caused by a faulty connector,

lampholder, or wiring. Refer to figure FO-8 and paragraph 3-20 and conduct continuity checks of the circuits between the antenna

coupler and the console lampholders.

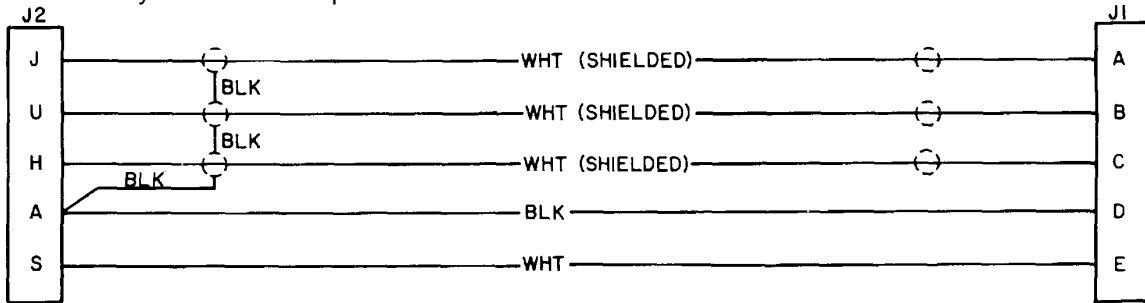
**3-18. Tunable Filters (VHF/UHF)**

These units are not repairable and are to be replaced when troubleshooting procedures indicate failure of a unit. Failure or marginal operation of a tunable filter will be indicated when transmitter tuning will not meet performance standards, and the problem is not isolated to the transmitter. When a filter is suspected, interchanging of cabling with a known good unit with a suspected unit will verify the need for replacement.

**3-19. Miscellaneous FCC Assemblies**

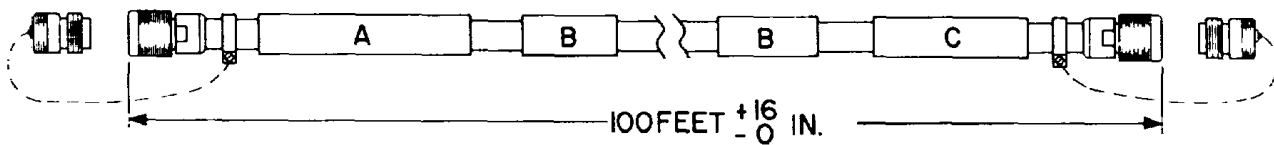
The following FCC repairable assemblies do not require special troubleshooting instructions; when system troubleshooting procedures indicate unit malfunction, refer to schematic diagrams which are referenced to isolate problems to a particular part.

a. *Secure Junction Box*. Refer to figure 3-9 to troubleshoot the secure junction box.



EL5UV015

Figure 3-9. Secure junction box, wiring diagram.



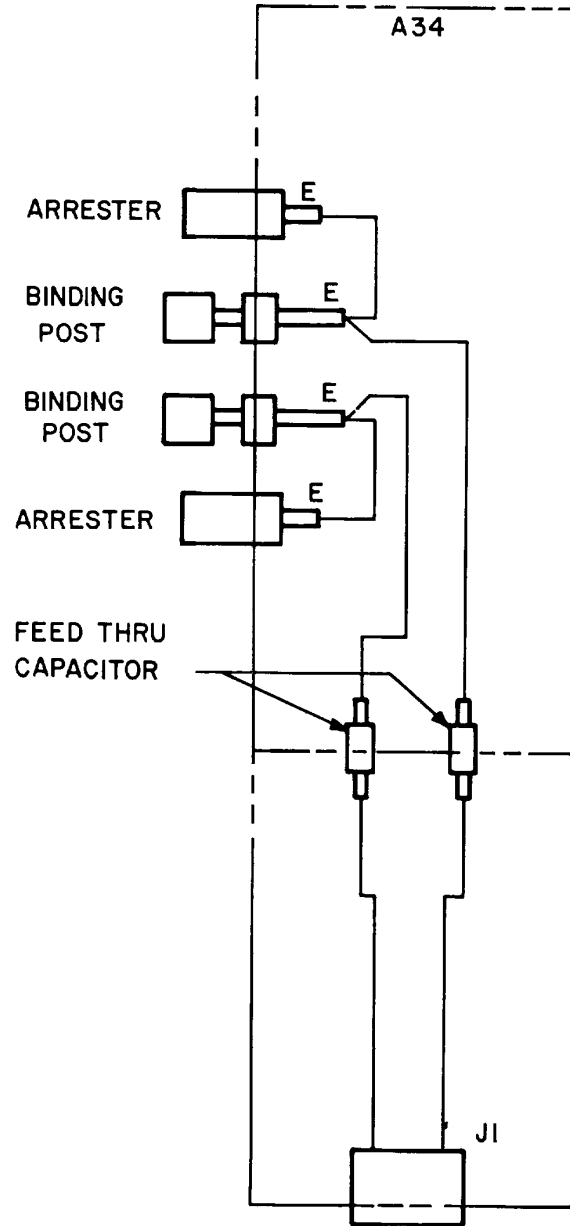
MARKING		
A	B	C
PI	W515	P2
ANT ENT UHF-2	80063 ASSY 882012	MAST AB-577 UVU-AS-3243/GRC L UHF-J3

EL5UV123

Figure 3-10. UVU antenna cable W515 (100 feet).

c. Telephone Entrance Panel. Refer to figure 3-11 and figure FO-3 to troubleshoot the telephone

entrance panel.



EL5UV017

Figure 3-11. Telephone entrance box, wiring diagram.

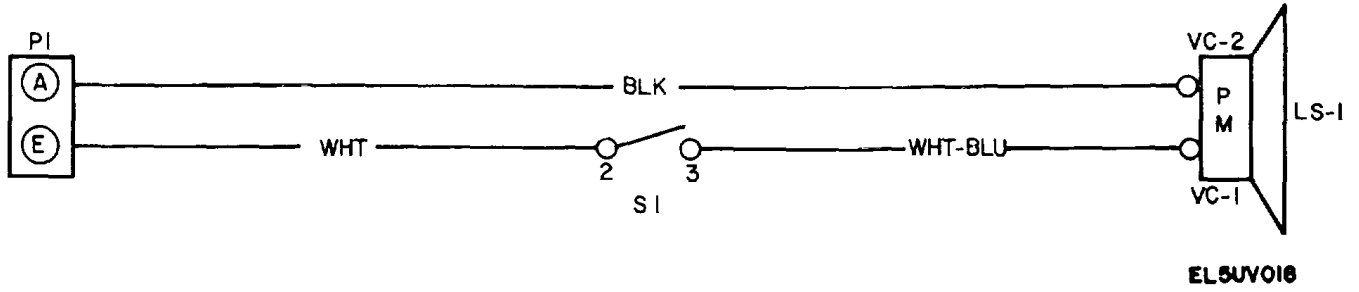


Figure 3-12. Loudspeaker wiring diagram

e. Footswitches. Refer to figures 3-13 and FO-7 to troubleshoot the footswitches.

to

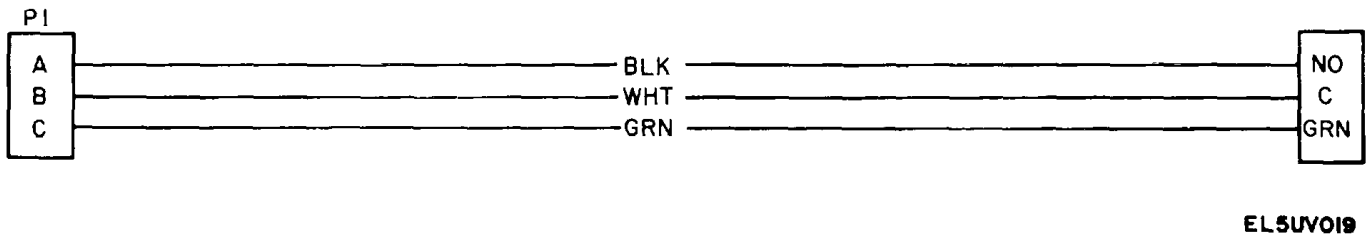
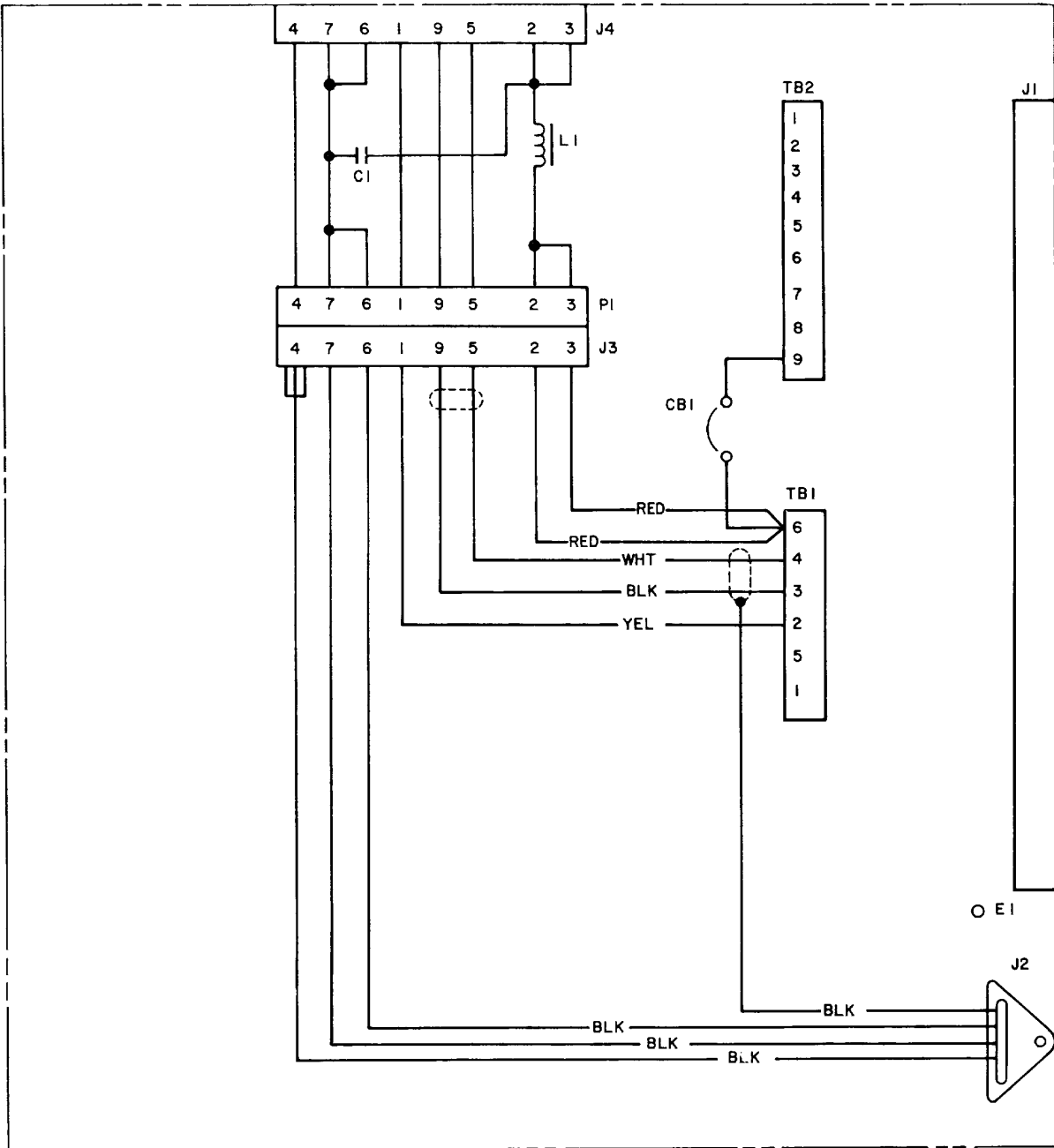


Figure 3-13. Footswitch wiring diagram.

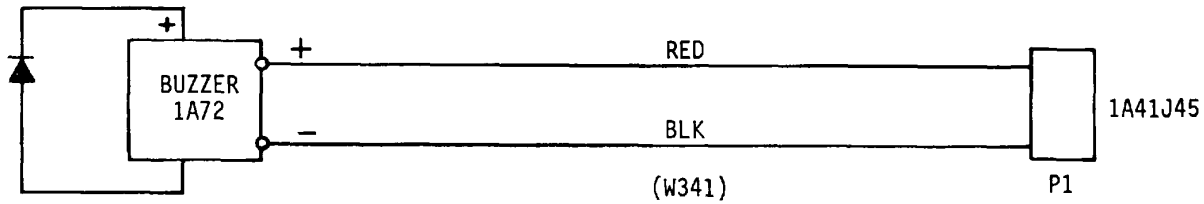
f. Mounting Tray for HF Radio. Refer to figures 3-14 and FO-8 to troubleshoot the mounting tray.



EL5UV020

Figure 3-14. Mounting tray wiring diagram.

g. Buzzer Box. Refer to figure 3-15 to troubleshoot the buzzer-box.



EL5UV021

Figure 3-15. Buzzer box wiring diagram.

h. Lighting System. Refer to figure FO-12 to troubleshooting the shelter lighting system.

**3-20. Cable Assemblies**

Two groups of cable assemblies are provided with the FCC. One group contains all external cabling, the other interior cabling. The interior cabling is fabricated in harnesses and installed within the shelter. TM 11-5895-469-12 contains an interconnection diagram for the external cabling. Figures FO-15 and FO-16 are the interconnection diagrams for all internal nonsecure and secure cabling.

a. RF Cable Assemblies. Refer to paragraph 3-34 for repair and replacement information.

b. Signal and Power Cables. For troubleshooting, repair, and replacement of signal and power cables, refer to figures FO-15 and FO-16 for cable identification, then refer to the listings below for the assembly and/or wiring diagram for the respective cable.

Cable assembly	Figure No.
W103 (SC-D-889445)	Air conditioner power 3-16
W104 (SC-D-881628)	Blower capacitor-plate 3-17
W201 (SC-D-881904)	Power supply 3-18
W202 (SC-D-881905)	Power supply 3-18
W202J2 (SC-D-934737)	DC power 3-19
W201J1 (SC-D-934736)	DC power 3-20
W203 (SC-D-881824)	DC power PS2 to A37 Single conductor
W204 (SC-D-881825)	DCpowerPS1 to A37 Single conductor
W207 (SC-D-889474)	DC power PS to A40 Single conductor
W208 (SC-D-889475)	DC power PS2 to A40 Single conductor
W301 (SC-D-881944)	UHF-1 Signal and power 3-21
W302 (SC-D-881945)	UHF-2 Signal and power 3-21
W303 (SC-D-881946)	UHF-3 Signal and power 3-21
W304 (SC-D-881955)	VHF-1 Signal and power 3-22
W305 (SC-D-881956)	VHF-2 Signal and power 3-22
W306 (SC-D-881957)	VHF-3 Signal and power 3-22
W307 (SC-D-881947)	FM-1 Signal 3-23
W307A (SC-D-881958)	FM-1 Power 3-24

W308 (SC-D-881948)	FM-2 Signal 3-23
W308A (SC-D-881959)	FM-2 Power 3-25
W309 (SC-D-881949)	FM-3 Signal 3-23
W309A (SC-D-881960)	FM-3 Power 3-26
W309B (SC-D-881381)	Crypto junction box FM-3 3-27
W310 (SC-D-881950)	ARC-102 3-28
W311 (SC-D-881951)	ARC-102 Transmit dc power 3-29
W312 (SC-D-881952)	ARC-102 Coupler 3-30
W315 (SC-D-881979)	Secure junction box 3-31
W320 (SC-D-889694)	DC power signal 3-32
W321 (SC-D-881985)	Radio signal control 3-33
W322 (SC-D-881986)	Signal control 3-34
W323 (SC-D-881987)	Key-Signal 3-35
W324 (SC-D-881988)	Radio-telephone 3-36
W325 (SC-D-881989)	Signal Control 3-33
W326 (SC-D-881990)	Telephone-key 3-34
W327 (SC-D-881991)	Telephone-key 3-35
W328 (SC-D-881992)	Rad-Tel control Pos-2 3-36
W329 (SC-D-881993)	Telephone-key 3-35
W330 (SC-D-881994)	Radio signal control 3-33
W331 (SC-D-881995)	Telephone-key 3-34
W337 (SC-D-889692)	Rad-Tel control Pos-3 3-36
W340 (SC-D-889820)	Signal-ringer 3-37
W341 (SC-D-889695)	Power buzzer 3-38
W350 (SC-D-881901)	Signal landline 3-39
W351 (SC-D-881902)	Signal landline 3-40
W352 (SC-D-881903)	Signal landline 3-41
W353 (SC-D-889829)	Landline signal box 3-42
W361 (SC-D-882000)	Secure junction box 3-43
W362 (SC-D-882001)	Secure junction box 3-44
W363 (SC-D-881964)	Secure junction box 3-45
W364 (SC-D-882003)	Secure junction box 3-46
W365 (SC-D-882004)	C-8156-TSEC/KY-8 3-47
W366 (SC-D-882002)	Secure junction box 3-48
W367 (SC-D-882005)	TSEC/KY-8 FM-3 3-49
W372 (SC-D-889690)	Heater power 3-50
W373 (SC-D-889691)	Thermostat 3-51
W376 (SC-D-881966)	TA248 ringer power 3-52
W380 (SC-D-889664)	AC power 3-53
W381 (SC-D-889665)	AC power stub 3-54
W413 (SC-D-881962)	FM-1 Control 3-55
W414 (SC-D-881963)	FM-2 Control 3-55
W415 (SC-D-881965)	FM-3 Control 3-55
W501 (SC-D-881918)	Coupler control & RF 3-56
W516 (SC-D-881908)	FM control 5 ft 3-57
W517 (SC-D-881906)	FM control 50 ft 3-57
W518 (SC-D-882014)	FM control 50 ft 3-55
W519 (SC-D-881907)	FM control 100 fl 3-57



**Cable assembly**

Cable assembly			Figure No.			
J1	(SC-D-934648)	Telephone entrance box	3-67	J48	(SC-D-881701)	Signal control box 3-60
J1	(SC-D-881777)	Telephone entrance box	3-67	J47	(SC-D-881700)	Signal control box 3-59
J2	(SC-D-881778)	Power entrance box	3-65	J49	(SC-D-881703)	Signal control box 3-61
		A/C	3-66	J50	(SC-D-881705)	Signal control box 3-62
J46	SC-D-881706)	Signal control box	3-58	J51	(SC-D-881704)	Signal control box 3-63
J47	SC-D-881700)	Signal control box	3-59	J52	(SC-D-881705)	Signal control box 3-64

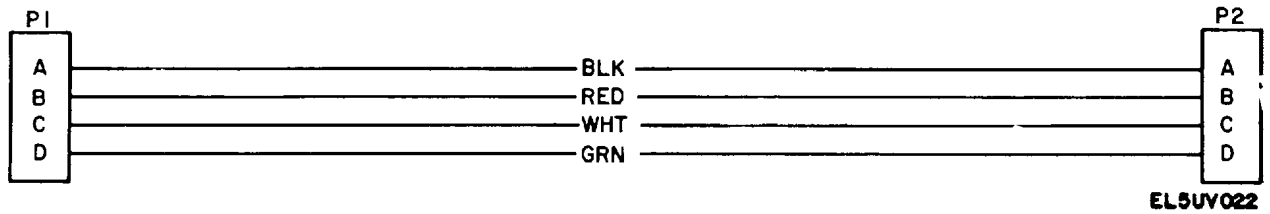


Figure 3-16. Air conditioner power cable W103, wiring diagram.

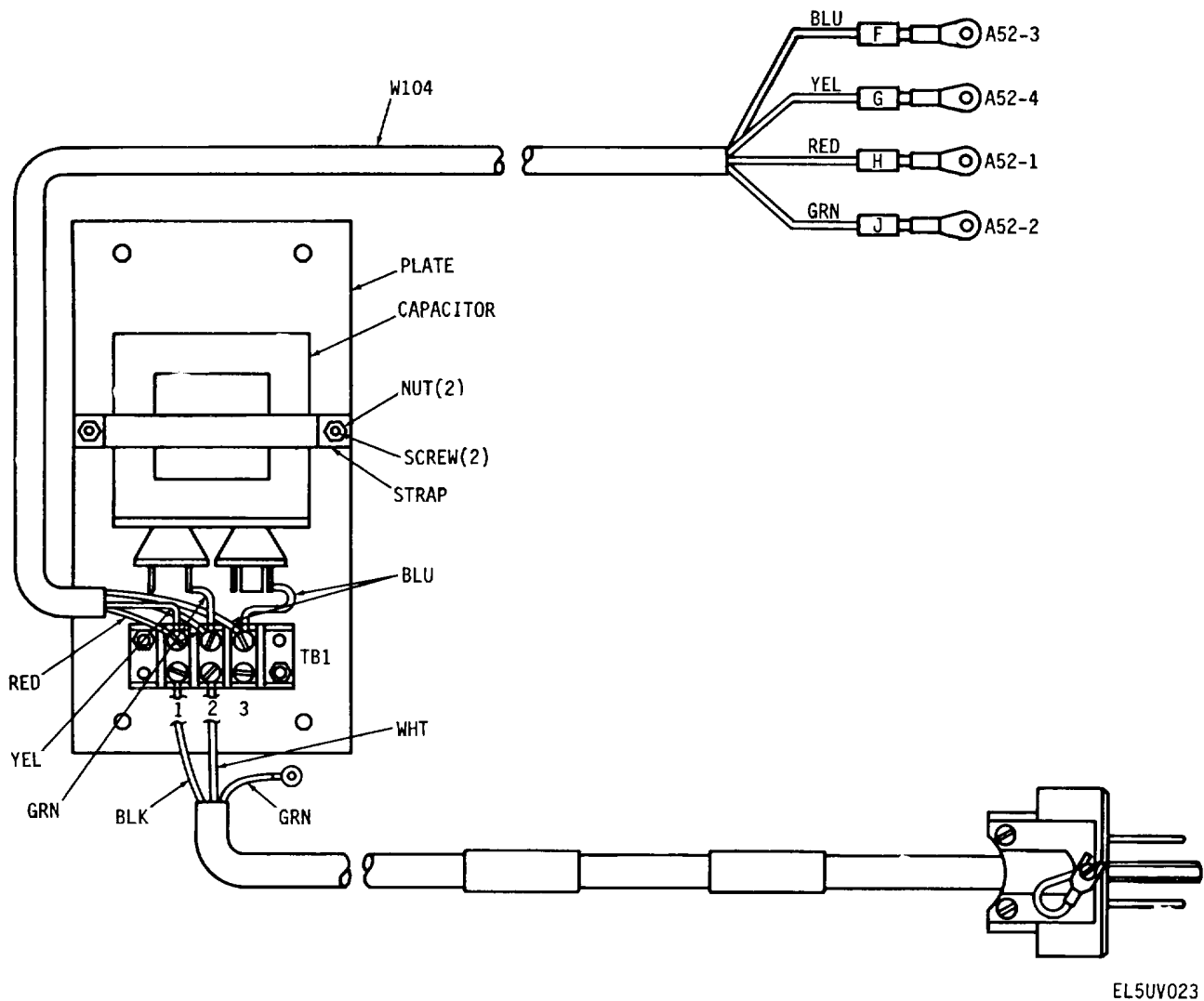
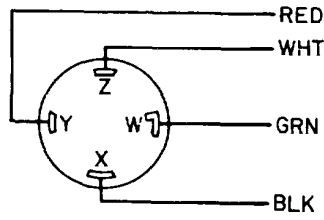
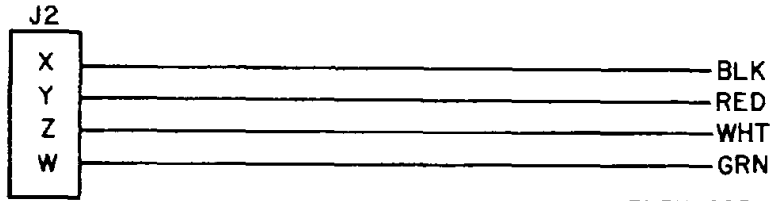


Figure 3-17. Capacitor and plate cable W104, wiring diagram.



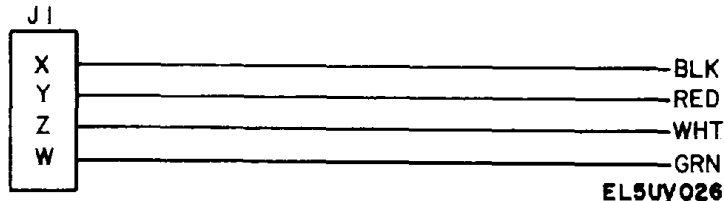
EL5UV024

Figure 3-18. DC power supply input cables W201, W202, wiring diagram.



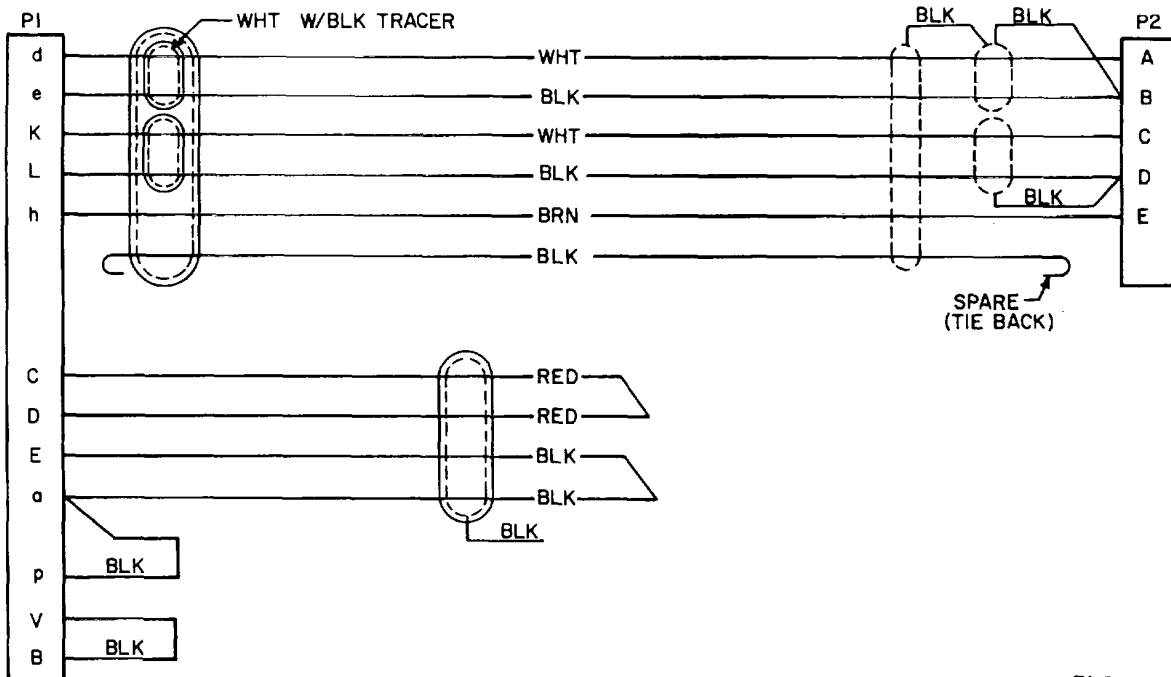
EL5UV025

Figure 3-19. DC power cable W20212, wiring diagram.



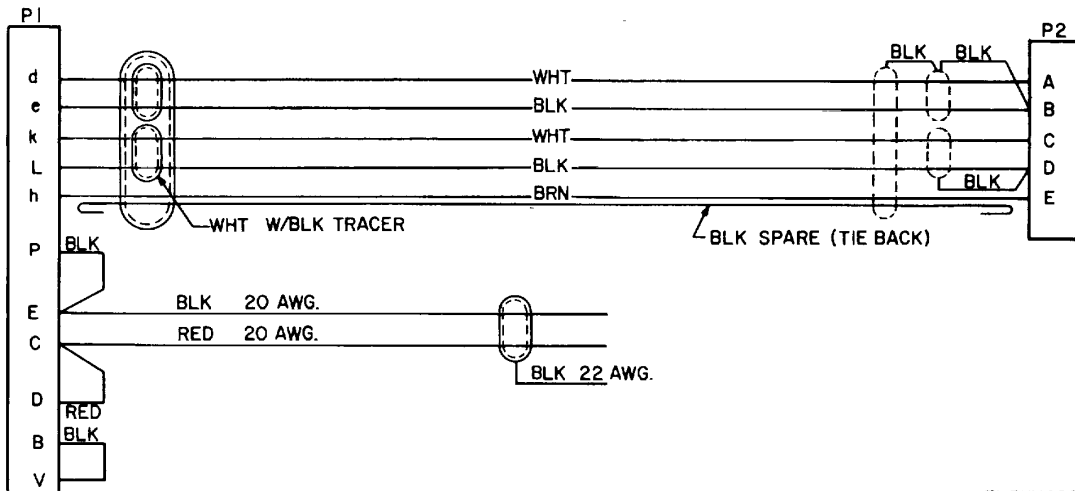
EL5UV026

Figure 3-20. DC power cable W201J1, wiring diagram.



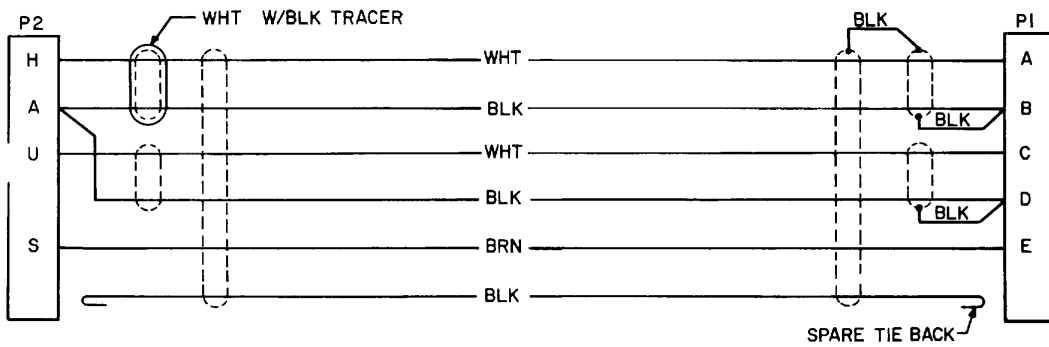
EL5UV027

Figure 3-21. UHF signal and power cables W301, W302, W303, wiring diagram.



EL5UV028

Figure 3-22. VHF signal and power cables W304, W305, W306, wiring diagram.



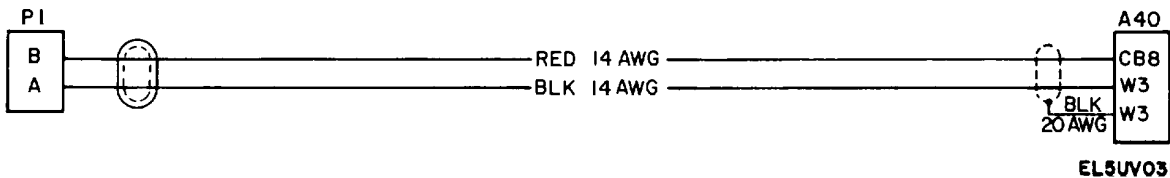
EL5UV029

Figure 3-23. FM signal cables W307, W308, W309, wiring diagram.



EL5UV030

Figure 3-24. Power FM-1 cable W307A, wiring diagram.



EL5UV031

Figure 3-25. FM-2 power cable W308A, wiring diagram.

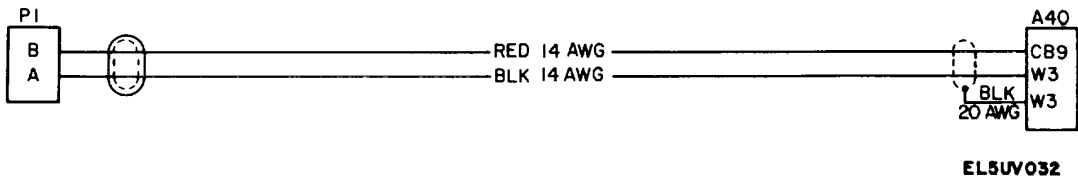


Figure 3-26. FM-3 power cable W309A, wiring diagram.

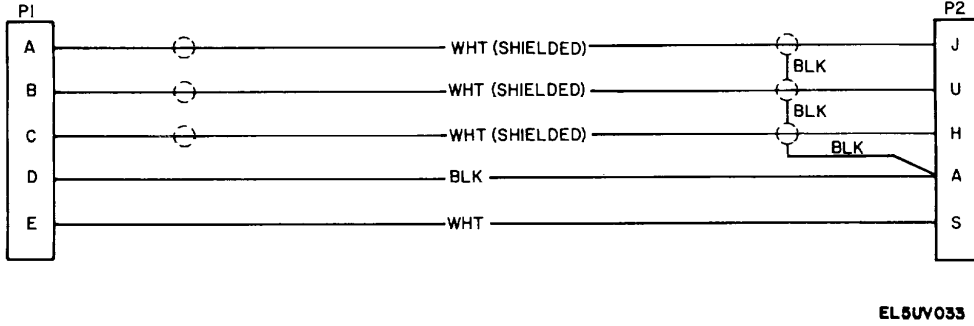
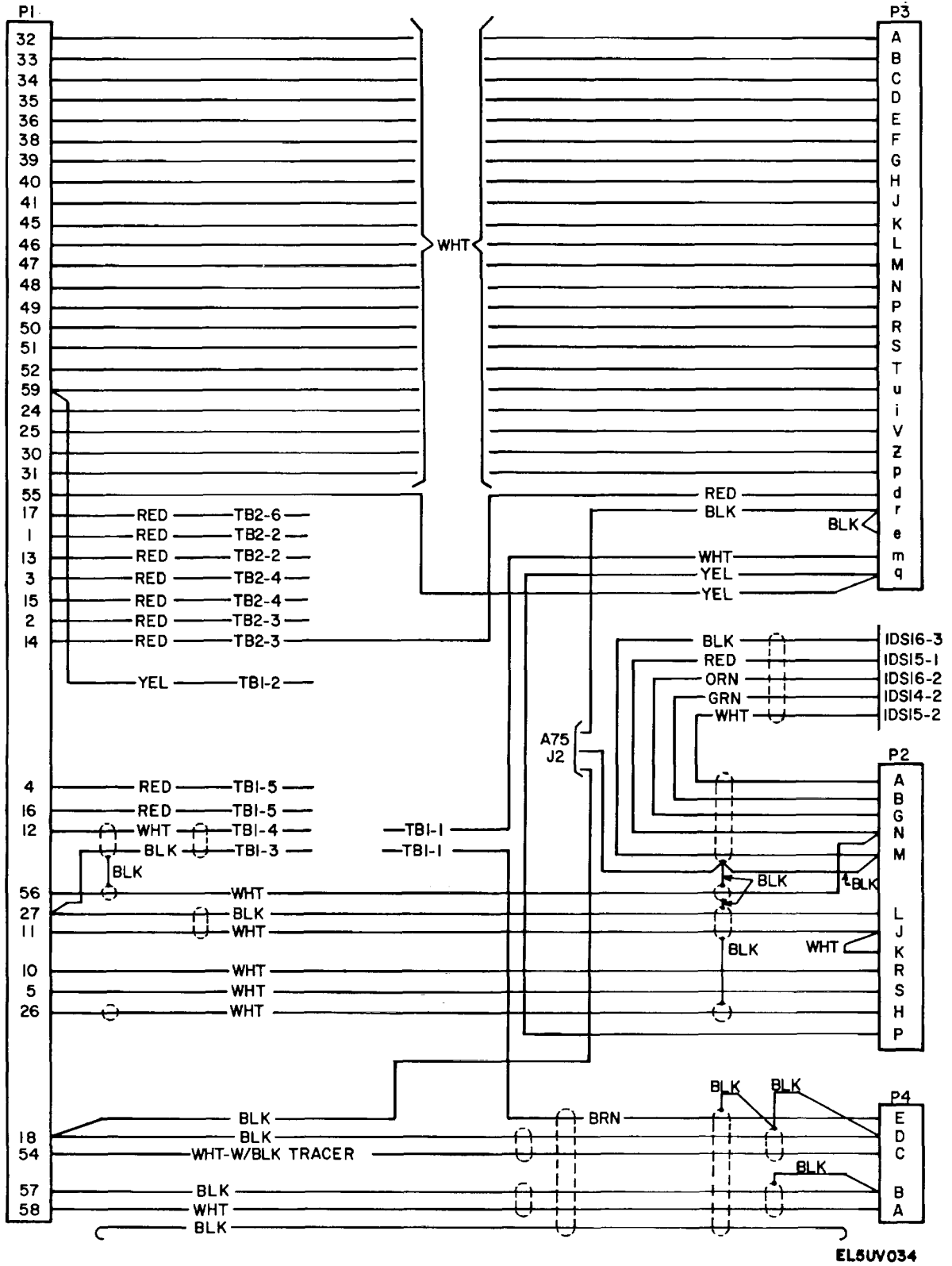
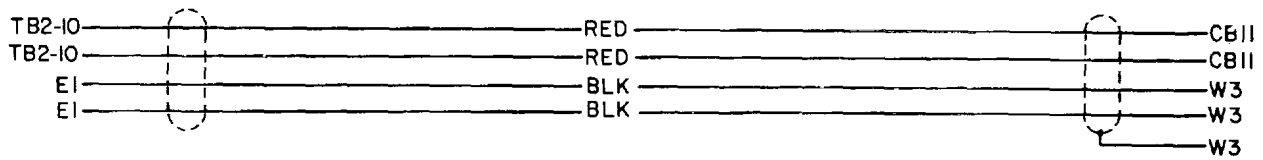


Figure 3-27. Secure junction box cable W309B, wiring diagram.



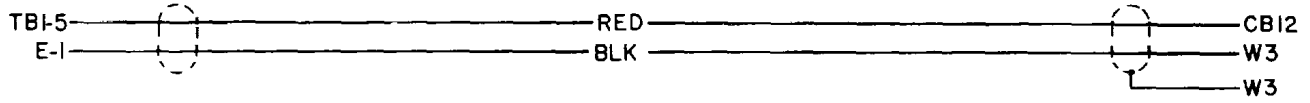
EL5UV034

Figure 3-28. HF radio cable W310, wiring diagram.



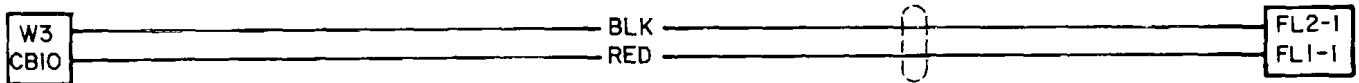
EL5UV035

Figure 3-29. DC power AN/ARC-102 transmit cable W311, wiring diagram.



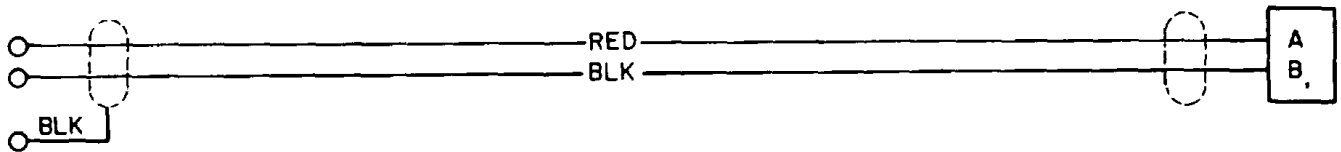
EL5UV036

Figure 3-30. Antenna coupler dc power cable W312, wiring diagram.



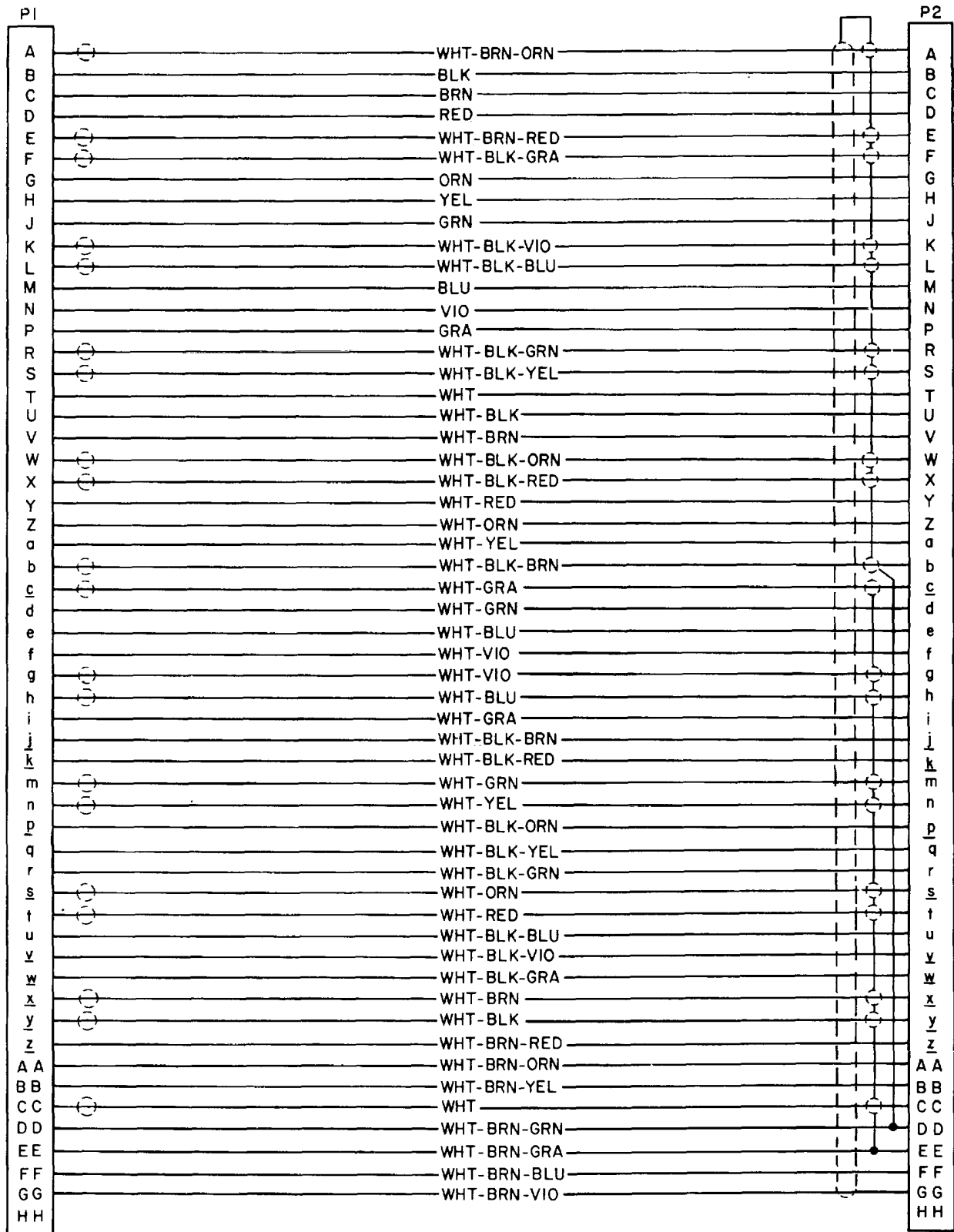
EL5UV037

Figure 3-31. Secure junction box cable W315, wiring diagram.



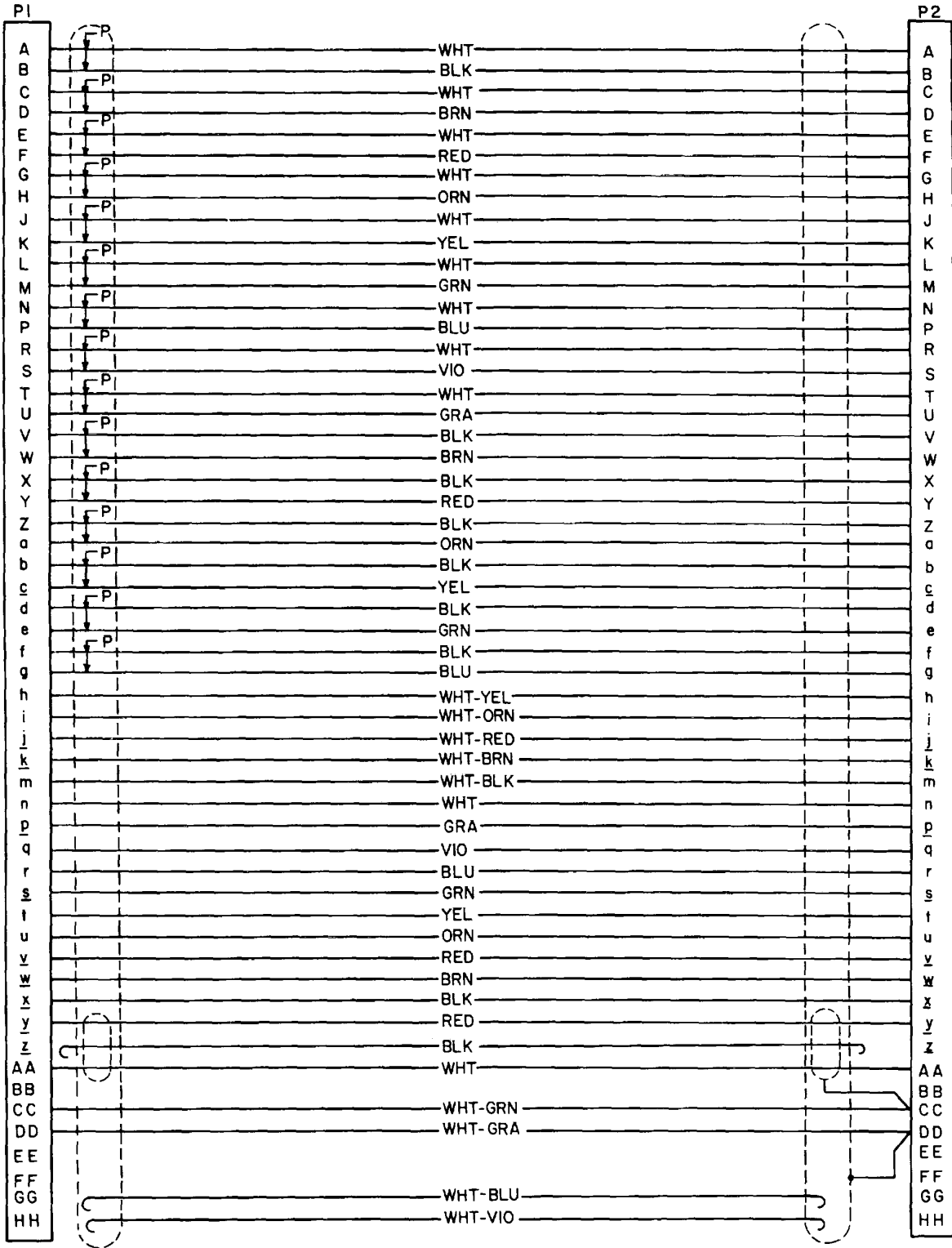
EL5UV038

Figure 3-32. DC power signal control box cable W320, wiring diagram.



EL5UV039

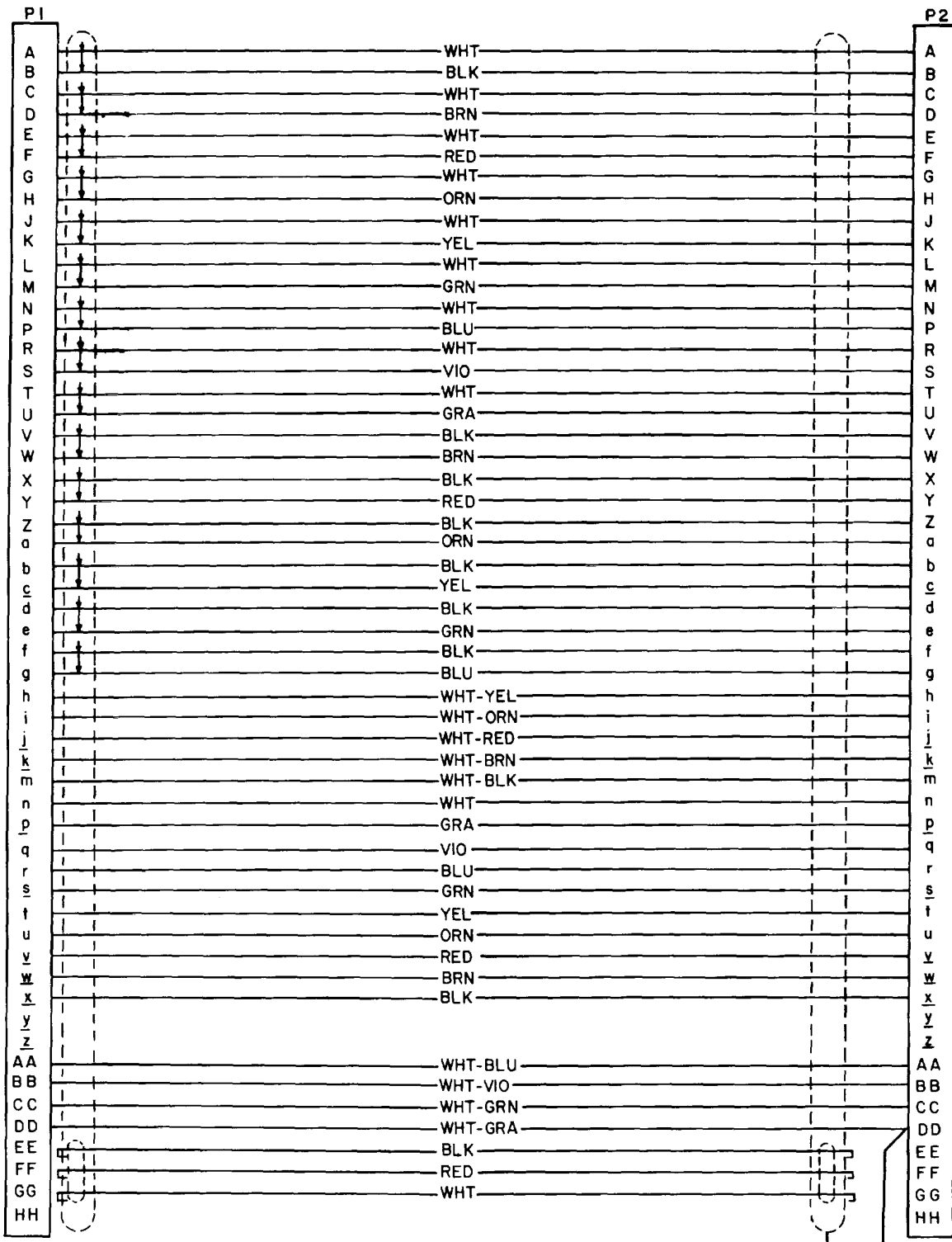
Figure 3-33. Radio signal control cable W321, W325, W330, wiring diagram.



EL5UV040

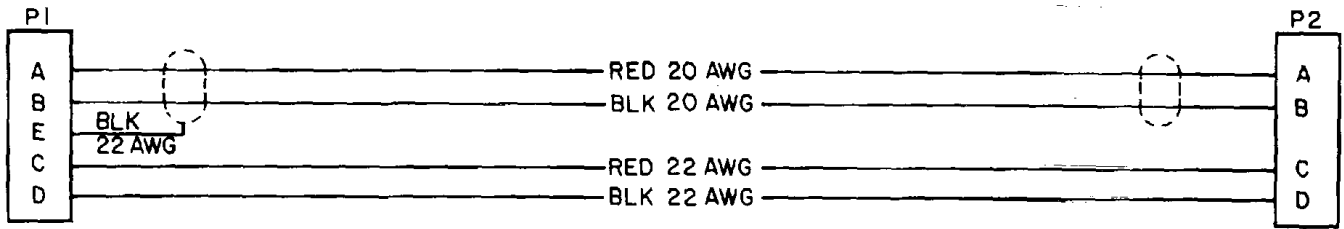
Figure 3-34. Telephone key cables W322, W326, W331, wiring diagram.





EL5UV041

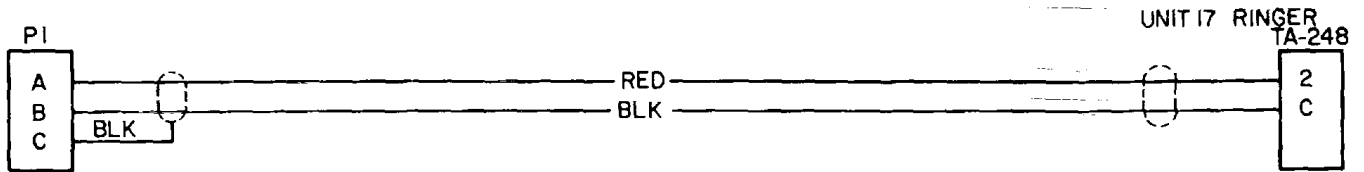
Figure 3-35. Telephone key cables W323, W327, W329, wiring diagram.



WIRING DIAGRAM

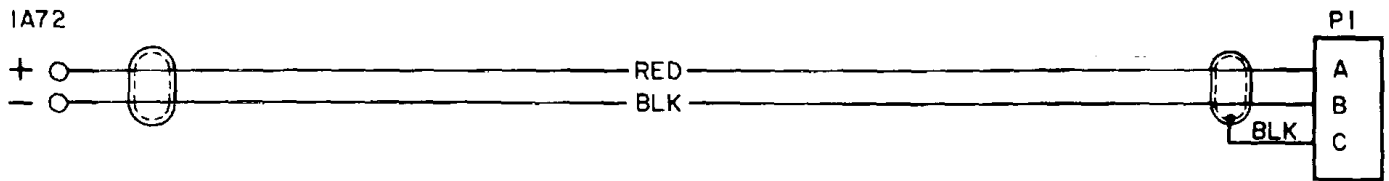
EL5UV042

Figure 3-36. Radio-telephone cables W324, W328, W337, wiring diagram.



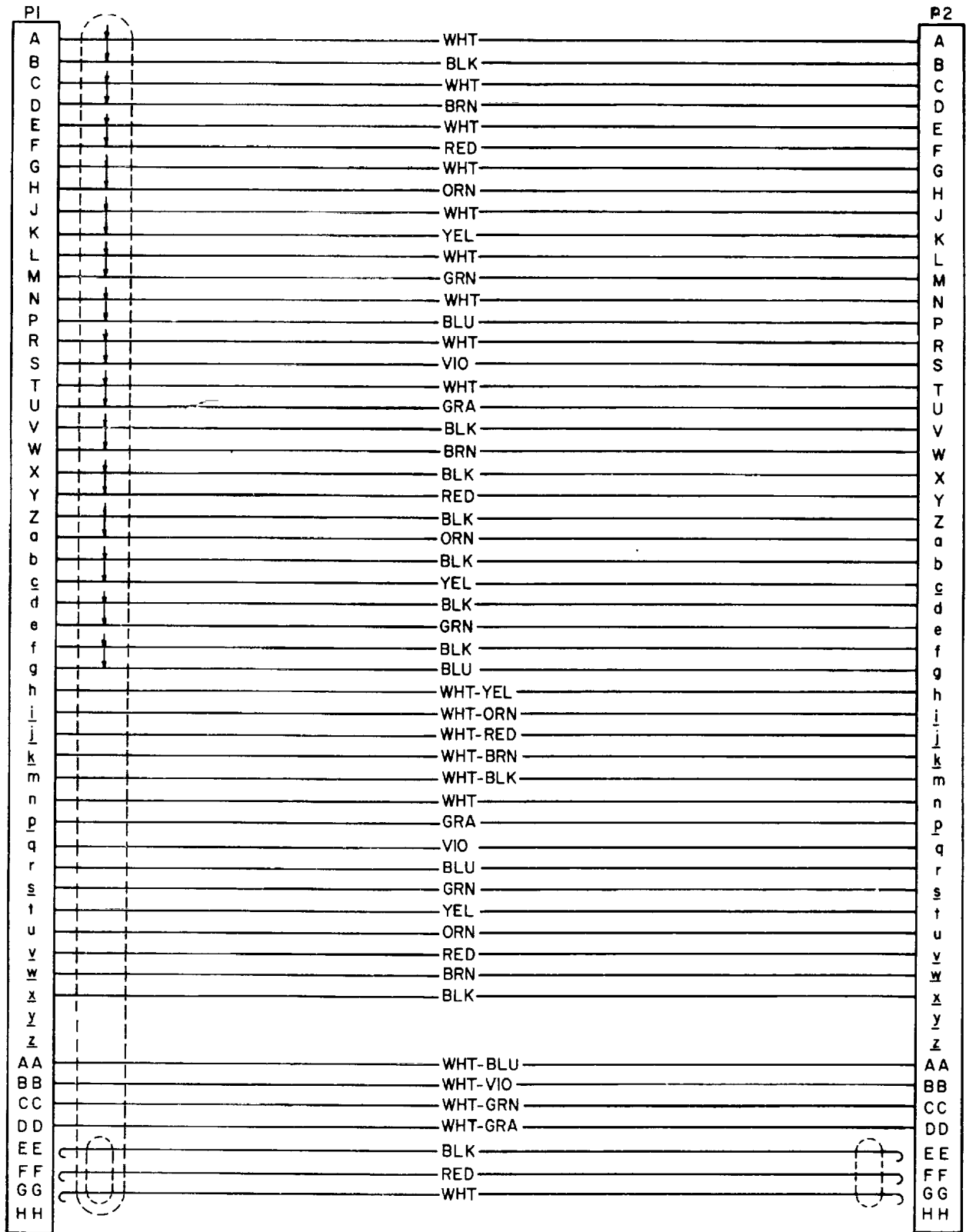
EL5UV043

Figure 3-37. Signal-ringer cable W340, wiring diagram.



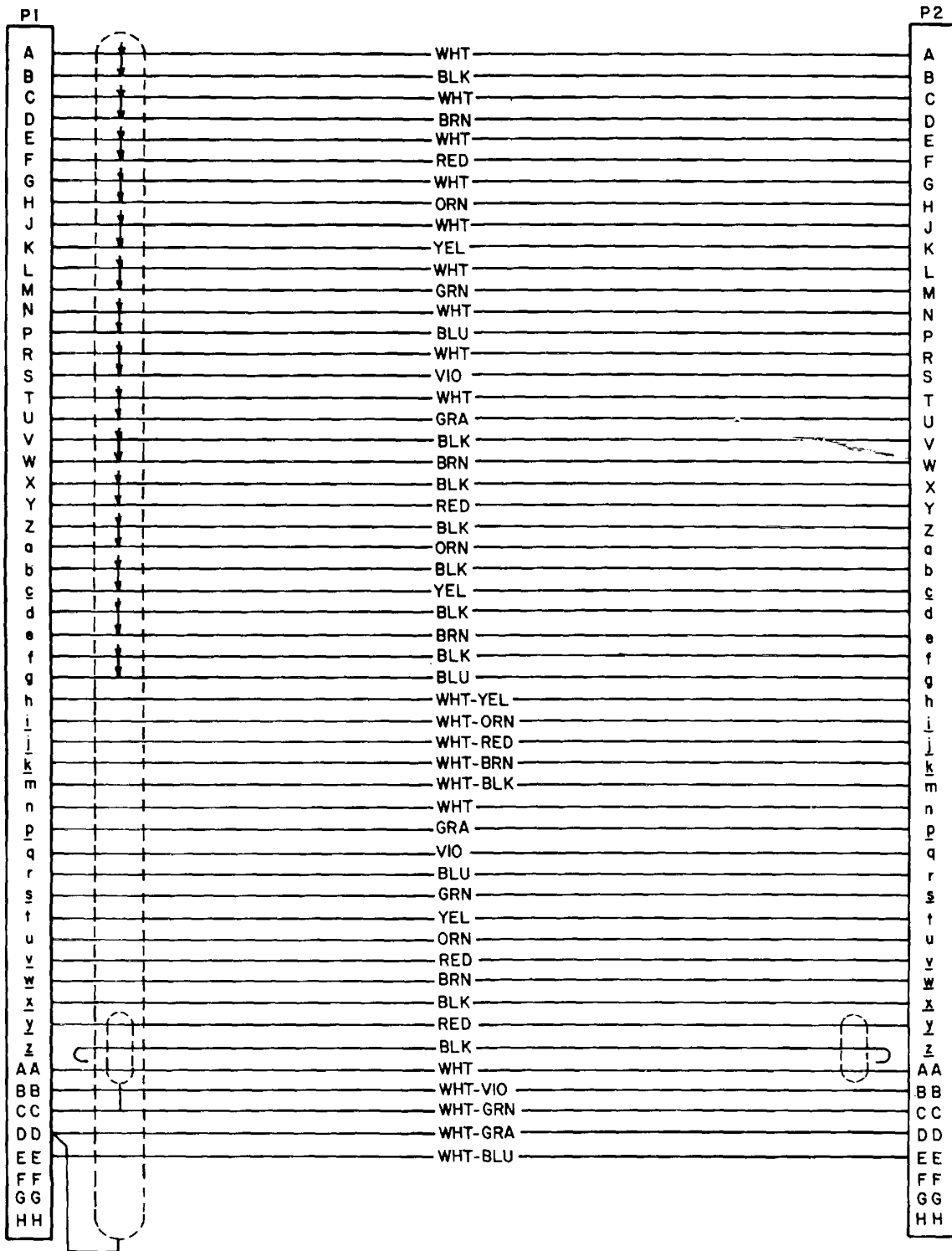
EL5UV044

Figure 3-38. Buzzer cable W341, wiring diagram.



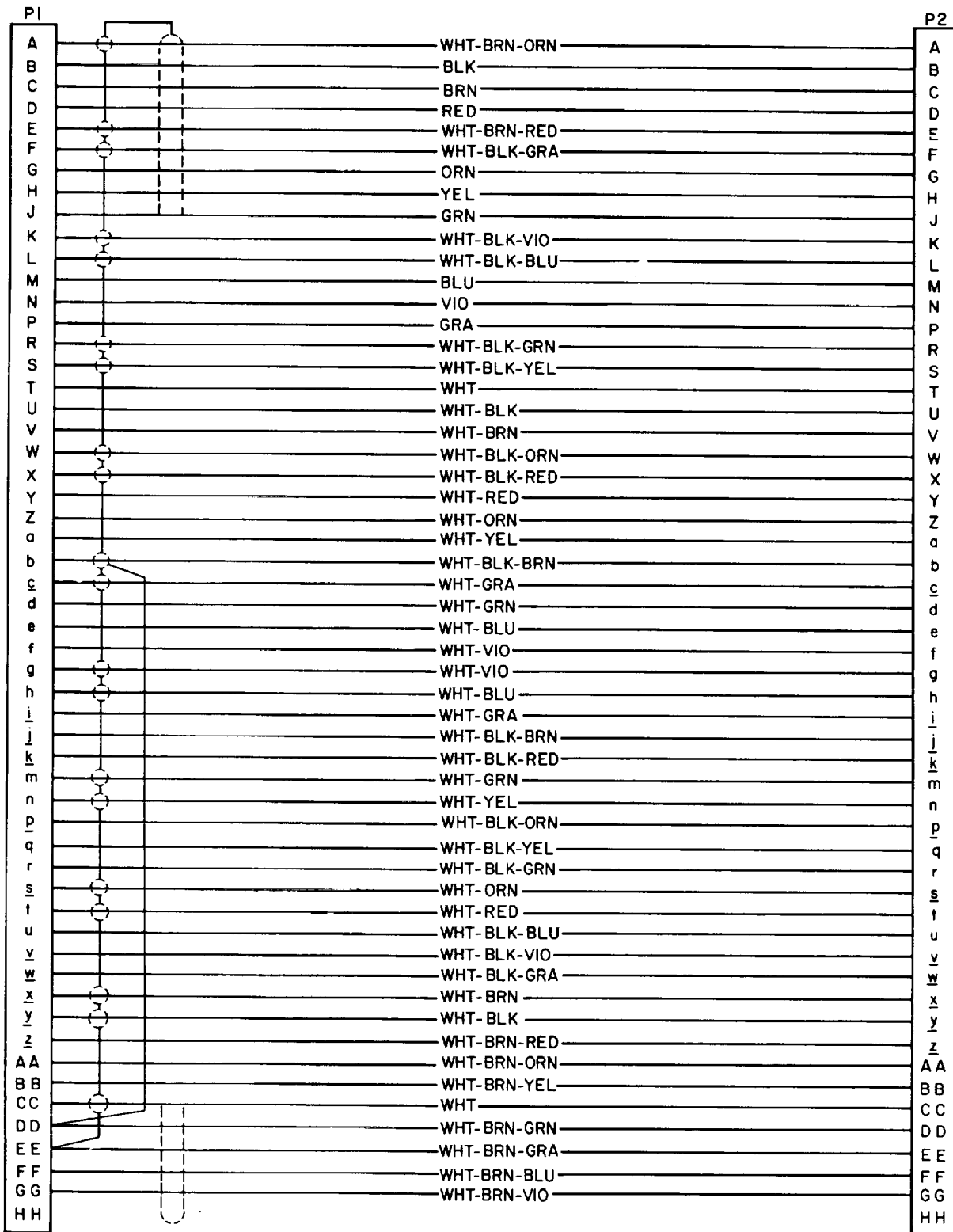
EL5UV045

Figure 3-39. Telephone entry panel cable W350, wiring diagram.



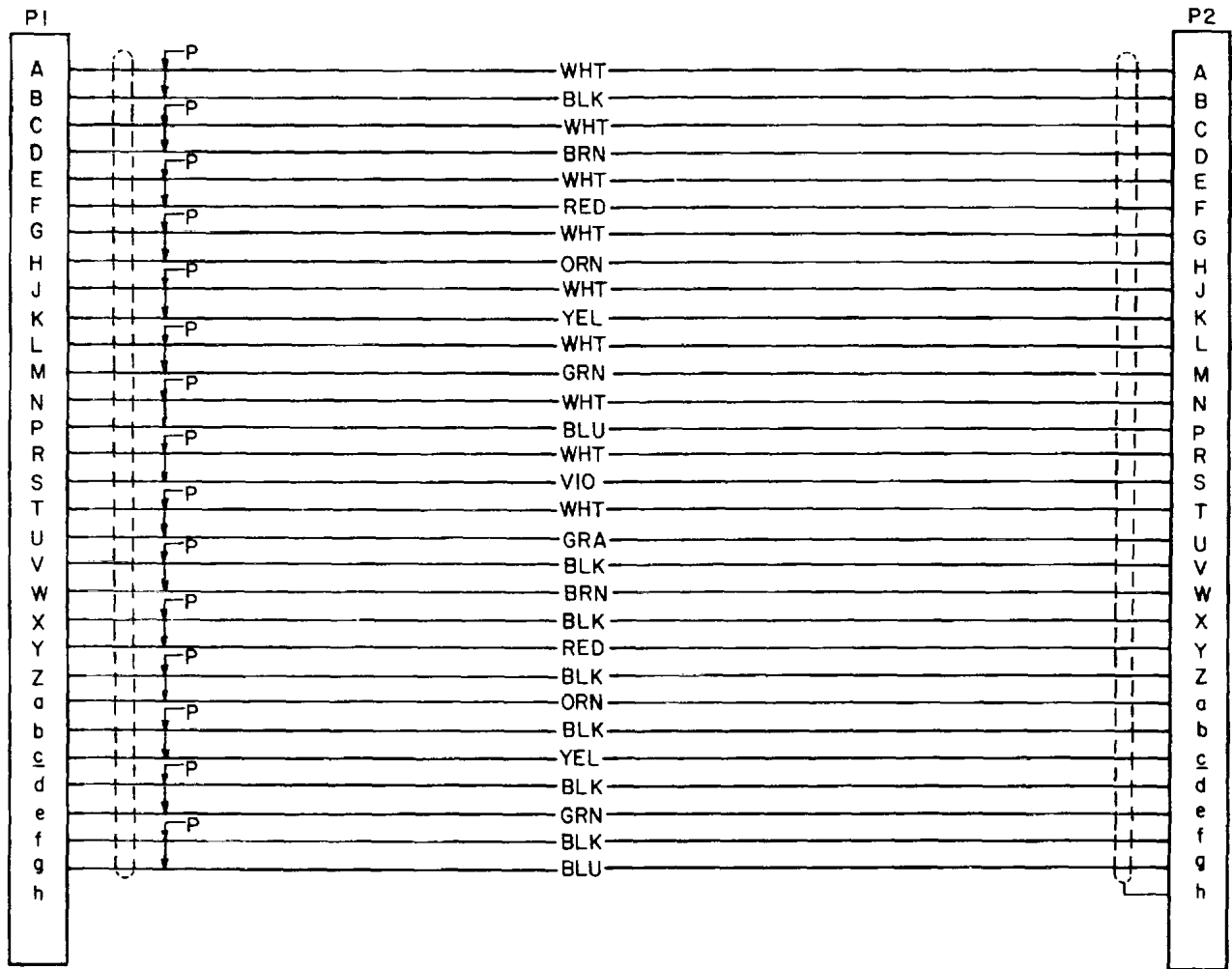
EL5UV046

Figure 3-40. Telephone entry panel cable W351, wiring diagram.



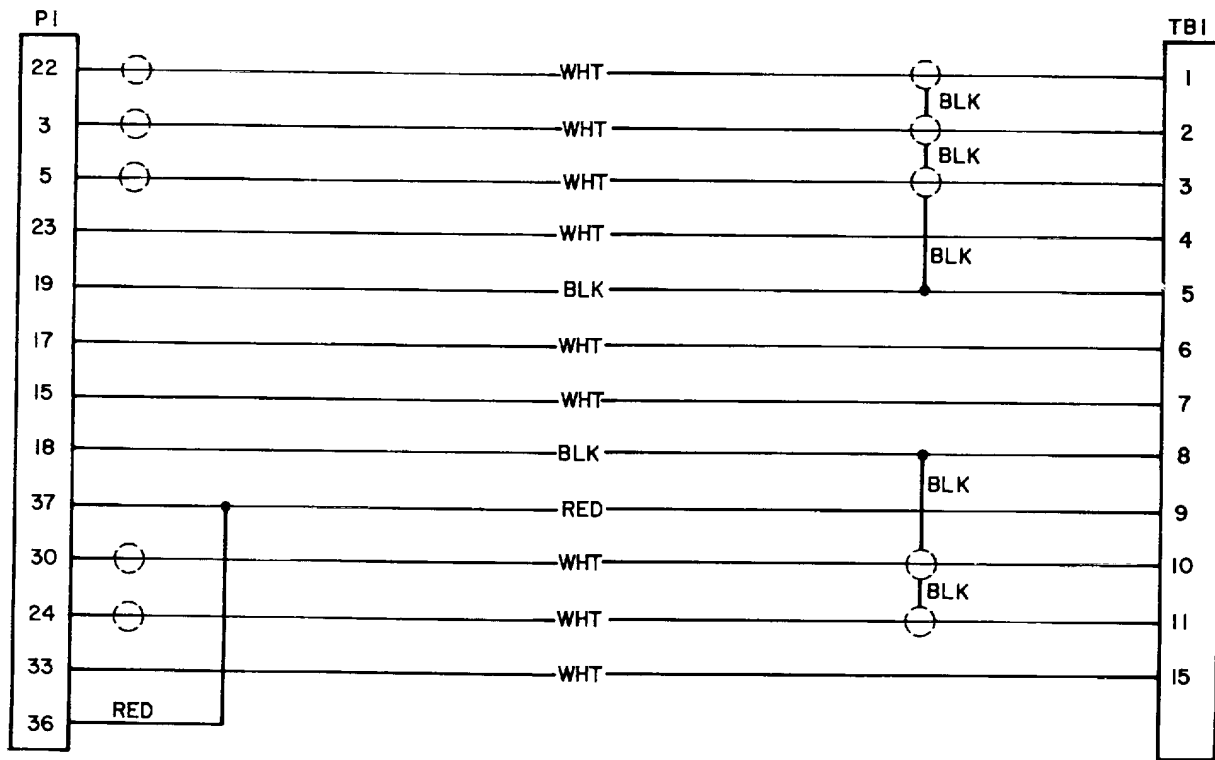
EL5UV047

Figure 3-41. Telephone entry panel cable W352, wiring diagram.



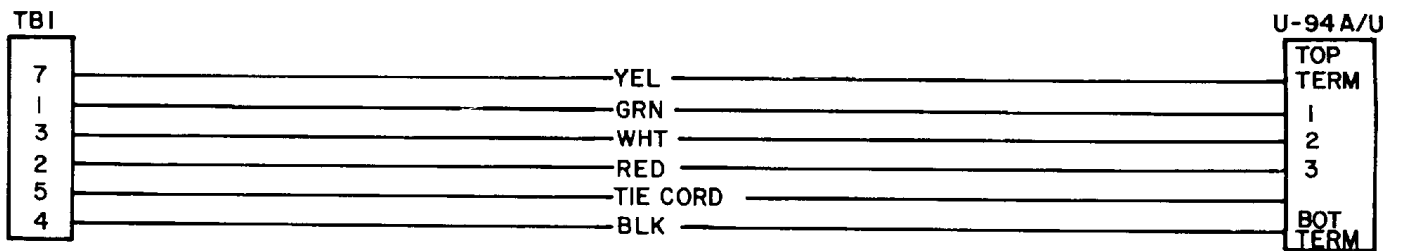
EL5UV048

Figure 3-42. Telephone entry panel cable W353, wiring diagram.



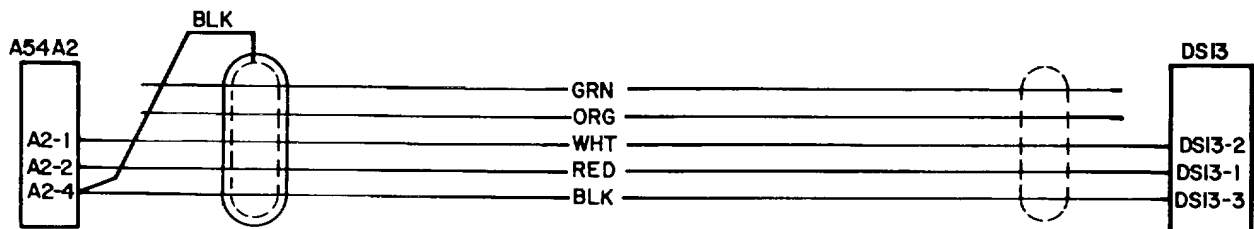
EL5UV049

Figure 3-43. Secure junction box cable W361, wiring diagram.



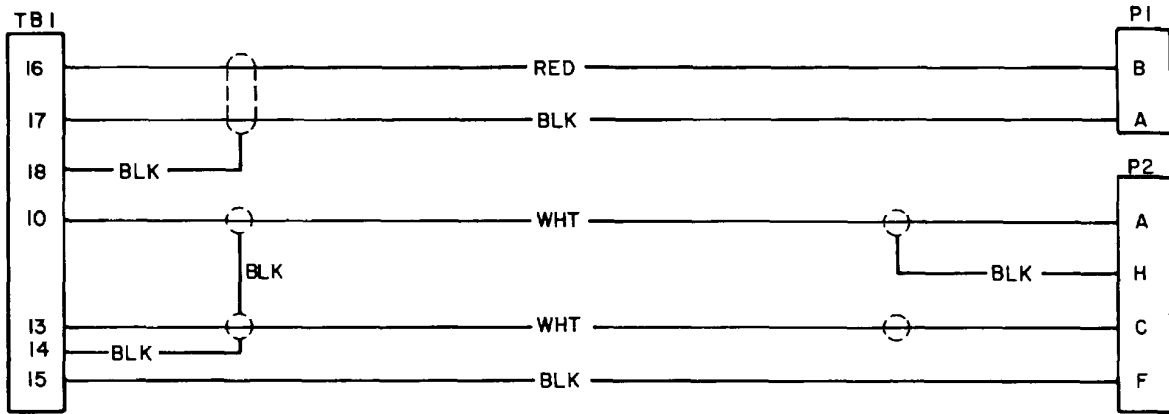
EL5UV060

Figure 3-44. Secure junction box cable W362, wiring diagram.



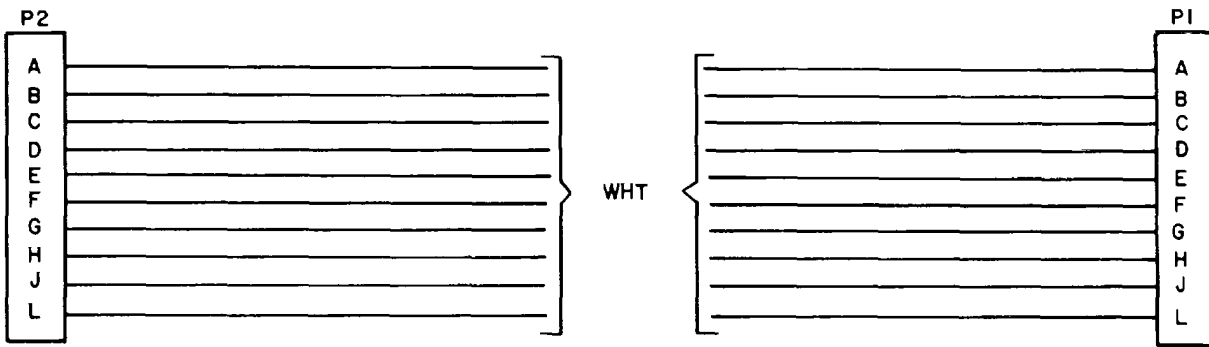
EL5UV081

Figure 3-45. Secure junction box cable W363, wiring diagram.



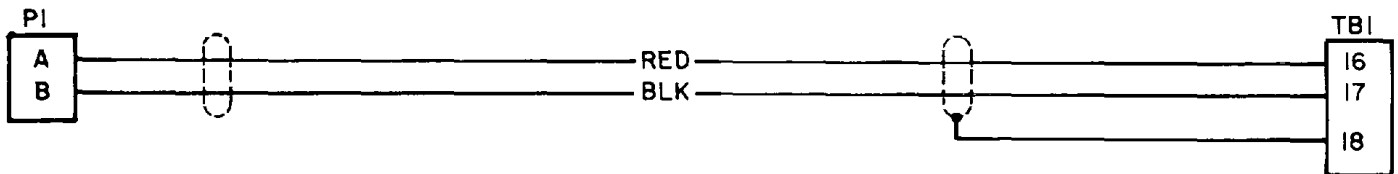
EL5UV052

Figure 3-46. Secure junction box cable W364, wiring diagram.



EL5UV053

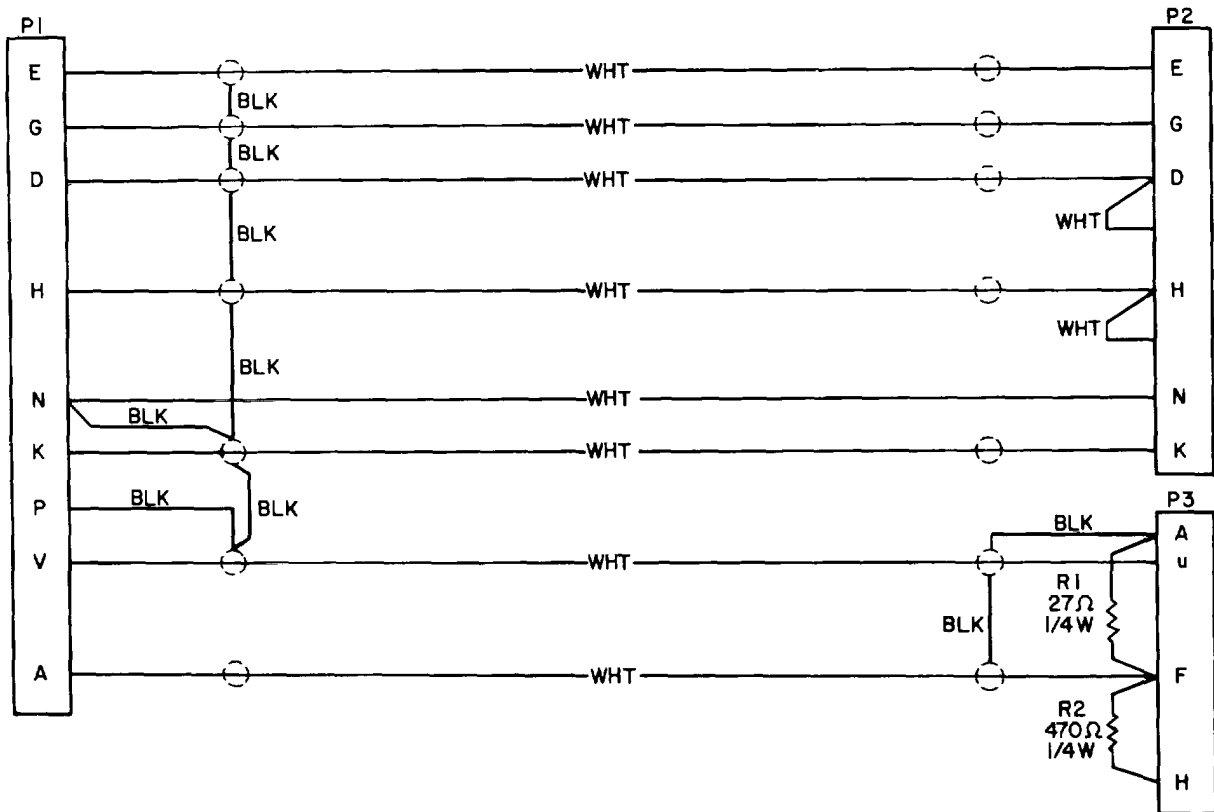
Figure 3-47. C8156/KY-8 cable W365, wiring diagram.



EL5UV054

Figure 3-48. Secure junction box cable W366, wiring diagram.

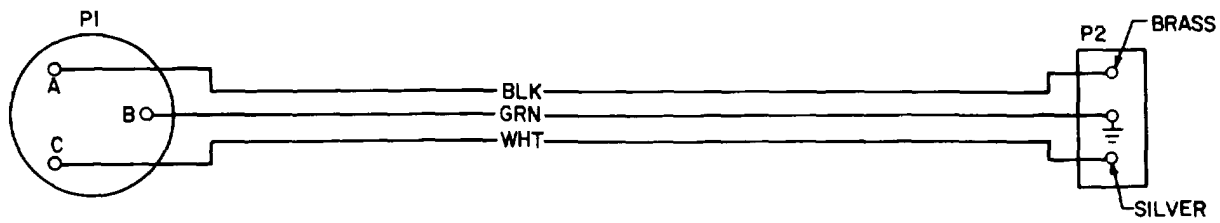




CONNECTION DIAGRAM

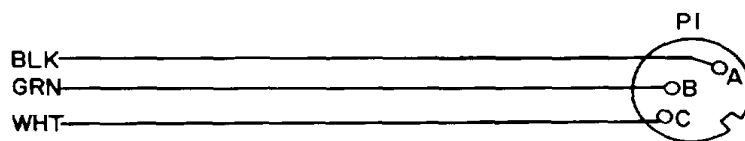
EL5UV055

Figure 3-49. KY-8/FM-3 cable W367, wiring diagram.



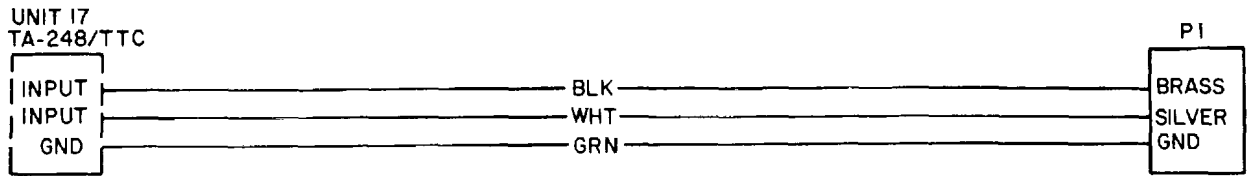
EL5UV056

Figure 3-50. Heater cable W372, wiring diagram.



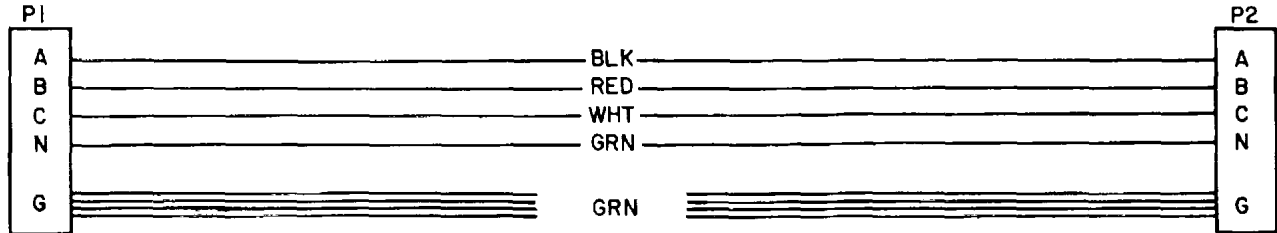
EL5UV057

Figure 3-51. Thermostat cable W373, wiring diagram.



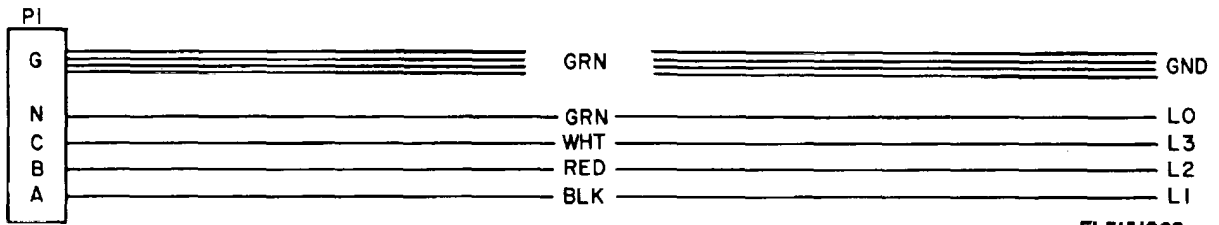
EL5UV058

Figure 3-52. TA-248/TT ringer power cable W376, wiring diagram.



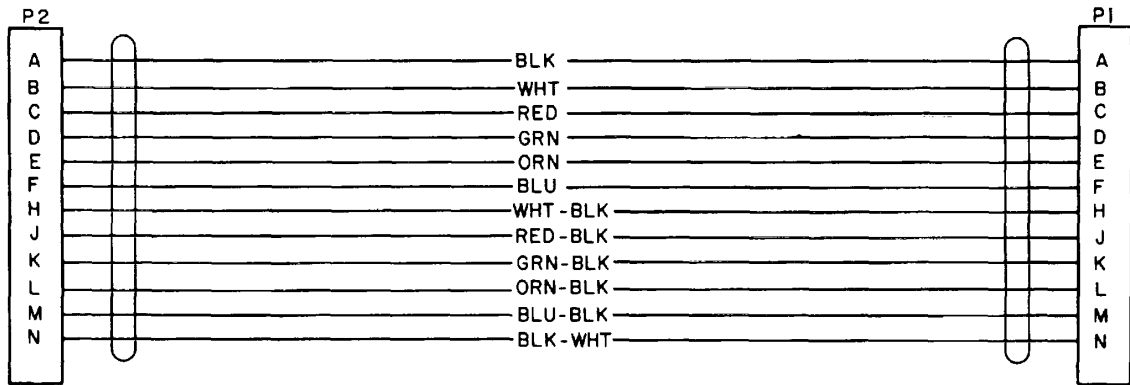
EL5UV059

Figure 3-53. AC power cable W380, wiring diagram.



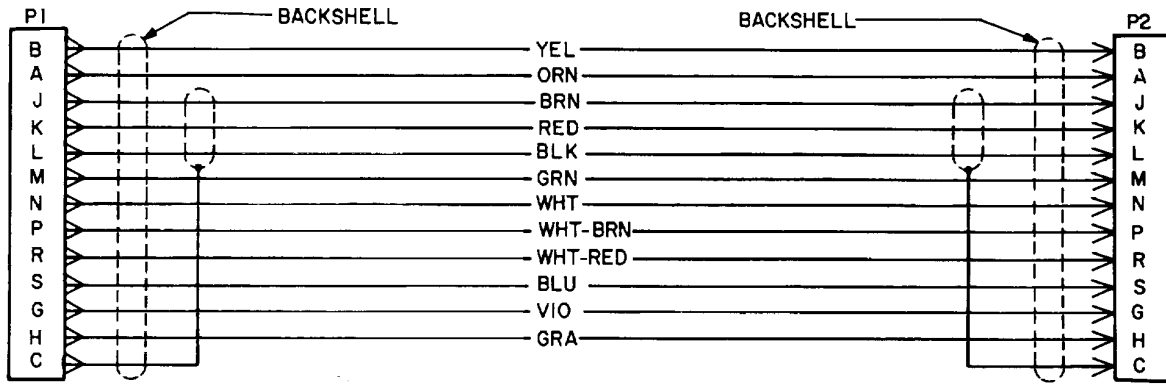
EL5UV060

Figure 3-54. AC power stub cable W381, wiring diagram.



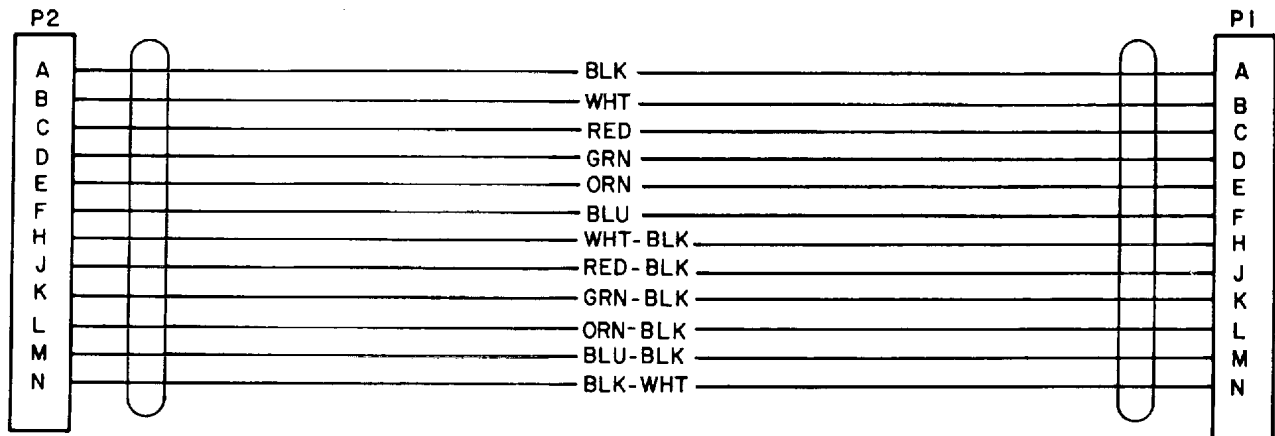
EL5UV061

Figure 3-55. FM control cables W413, W414, W415, W518, wiring diagram.



EL5UV062

Figure 3-56. HF antenna control and rf cable W501, wiring diagram.



EL5UV063

Figure 3-57. FM control cables W516, W517, W519, wiring diagram.

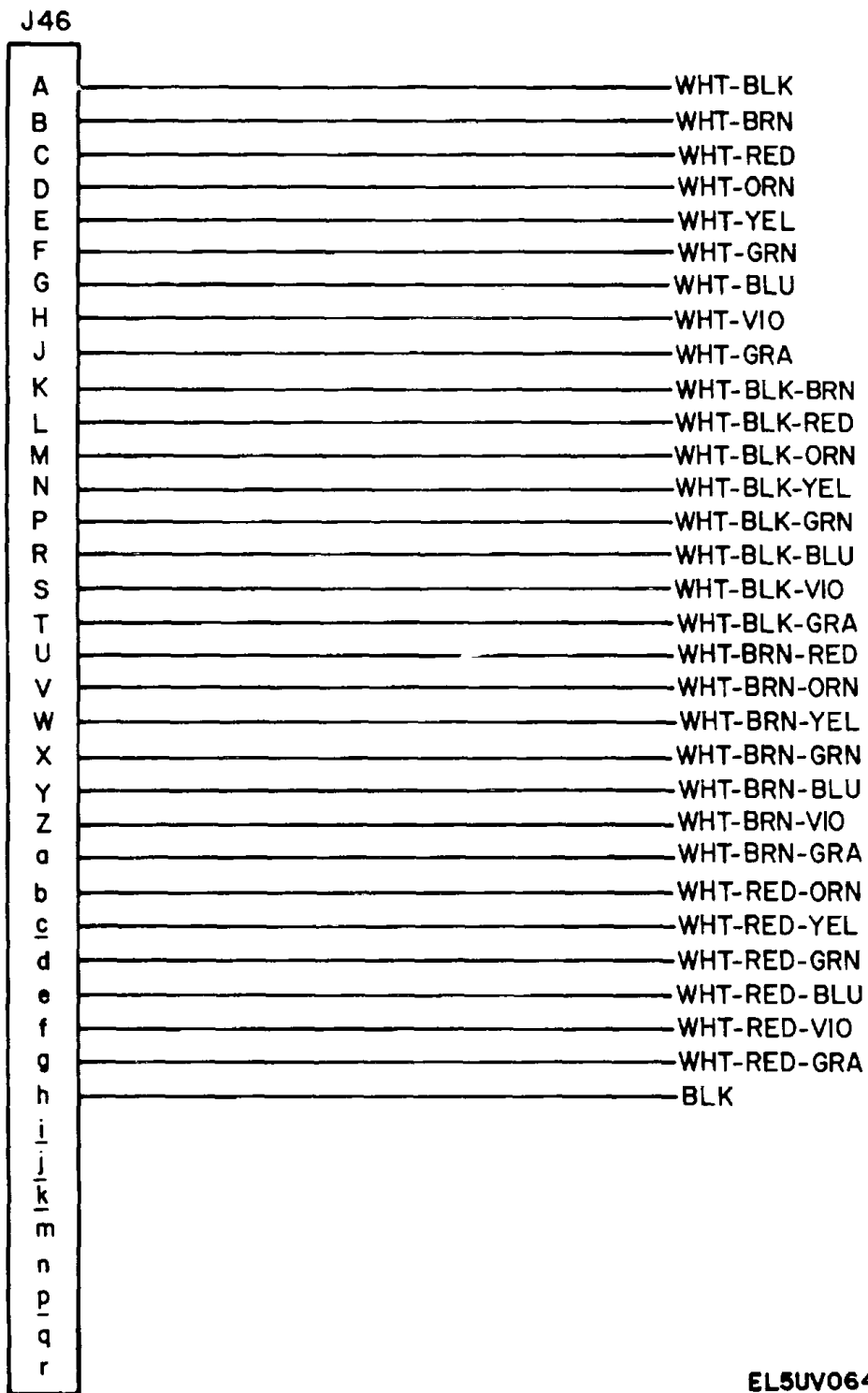


Figure 3-58. Signal control box cable J46, wiring diagram.

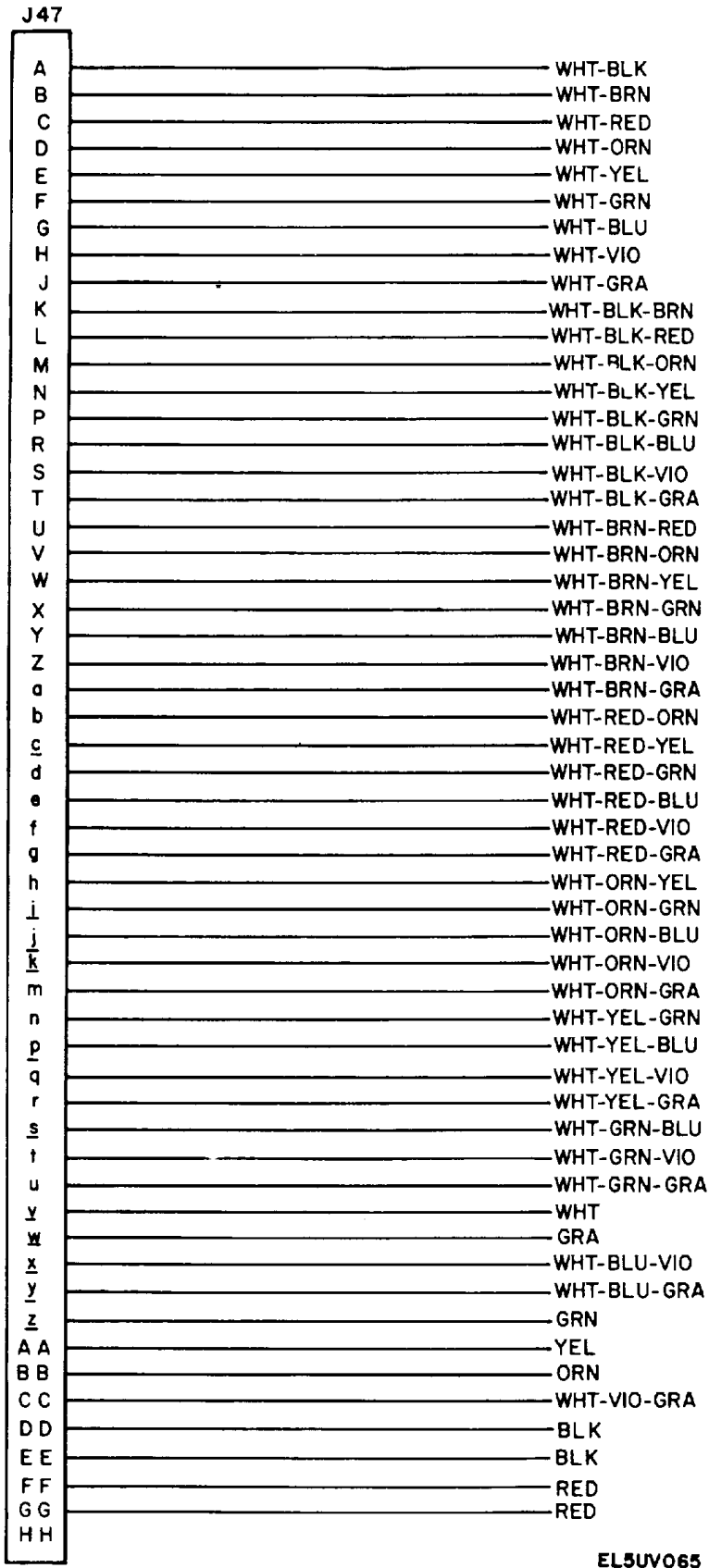


Figure 3-59. Signal control box cable J47, wiring diagram.

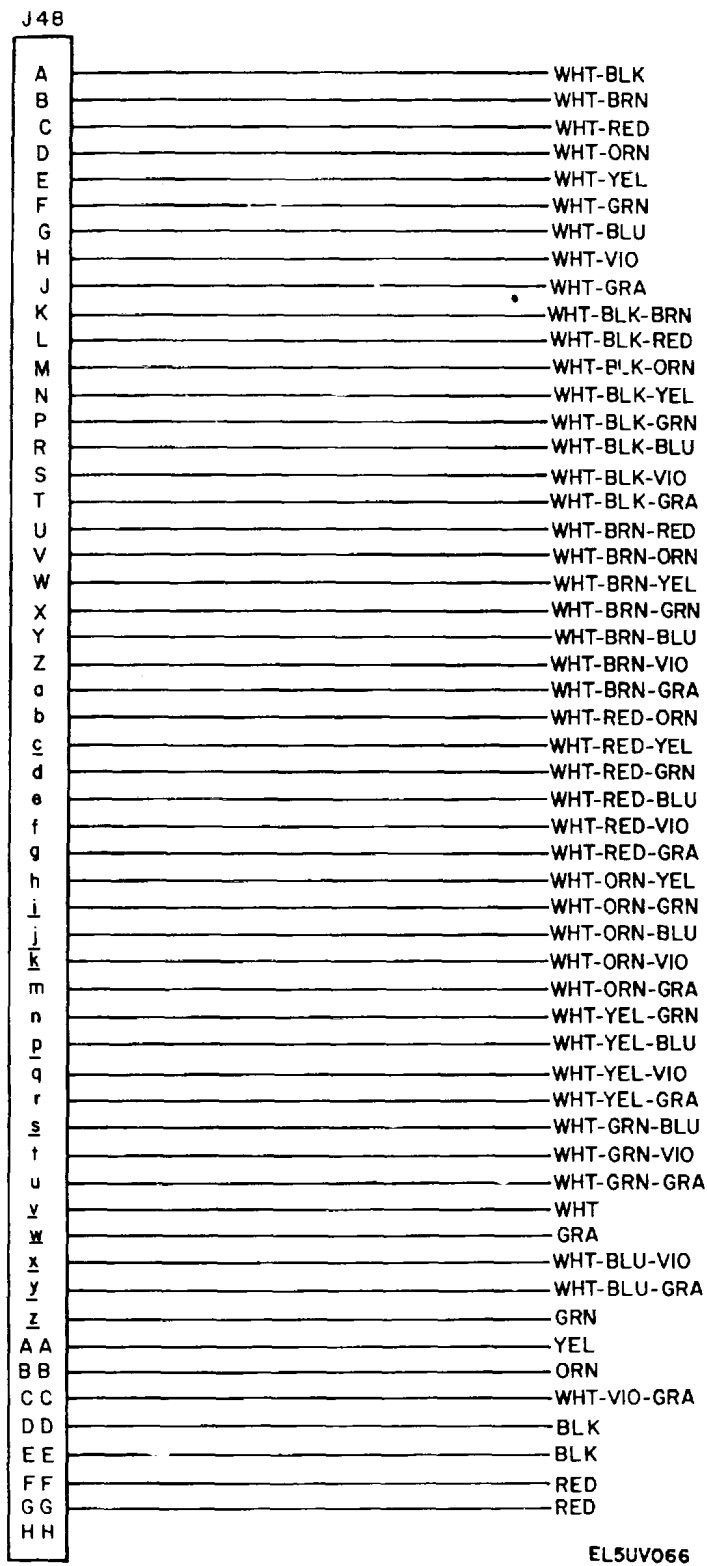


Figure 3-60. Signal control box cable J48, wiring diagram.

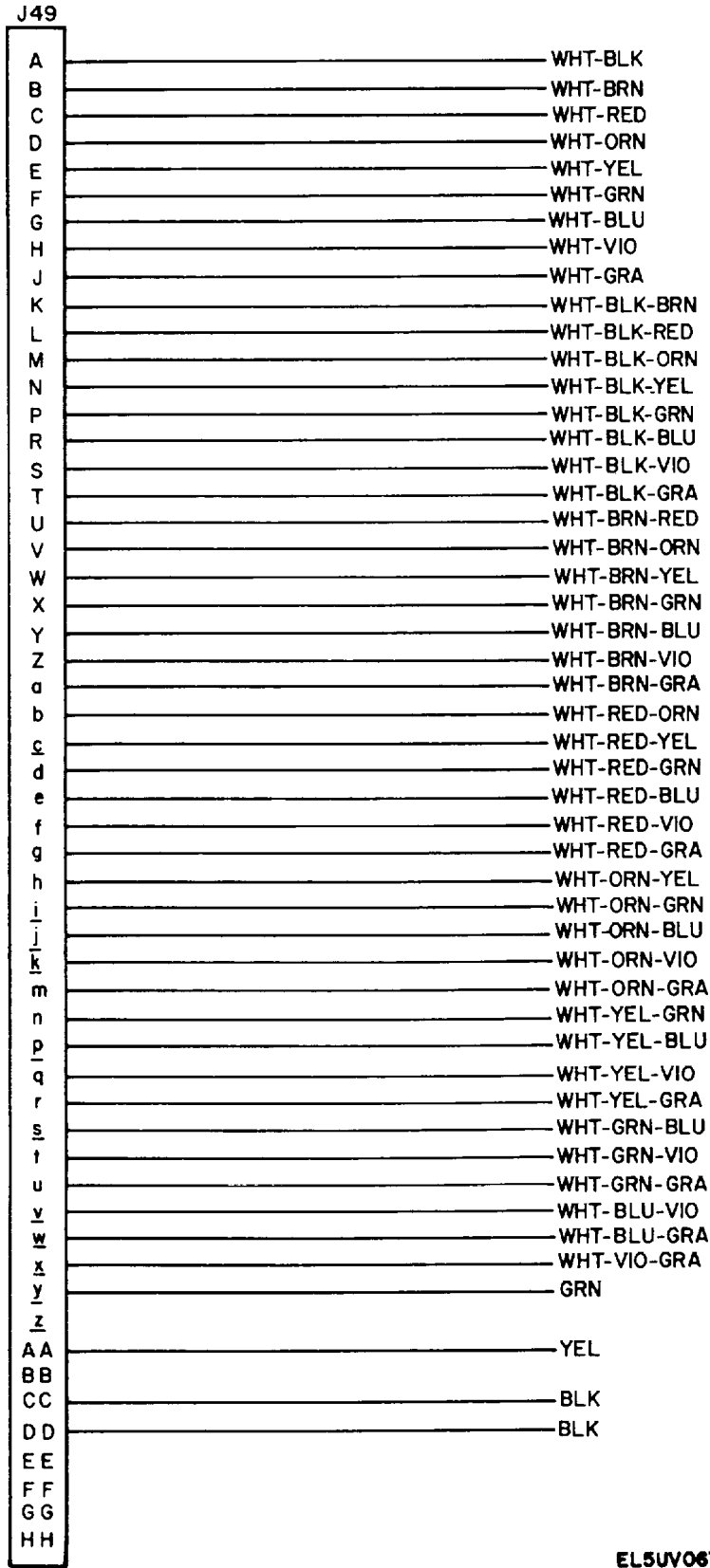
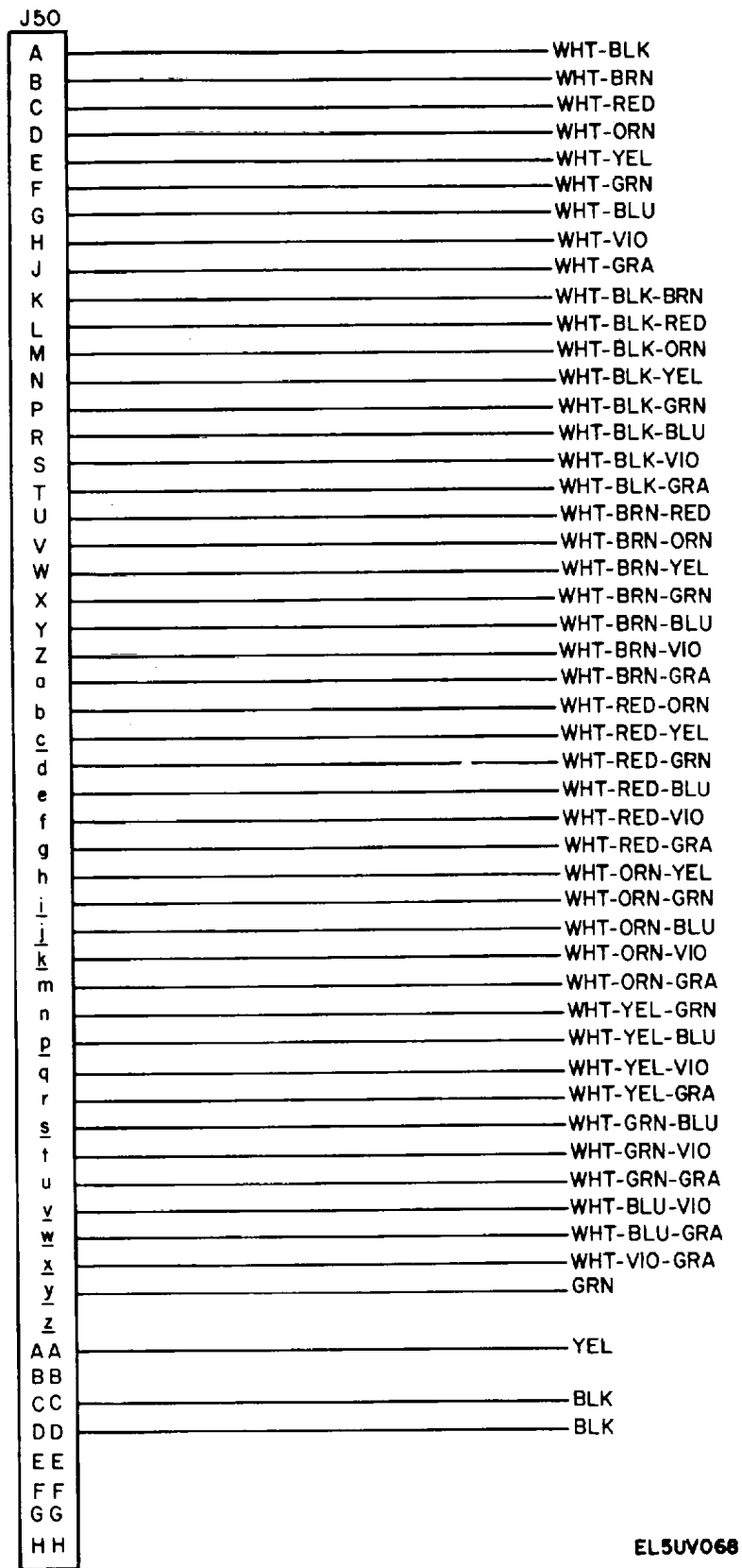


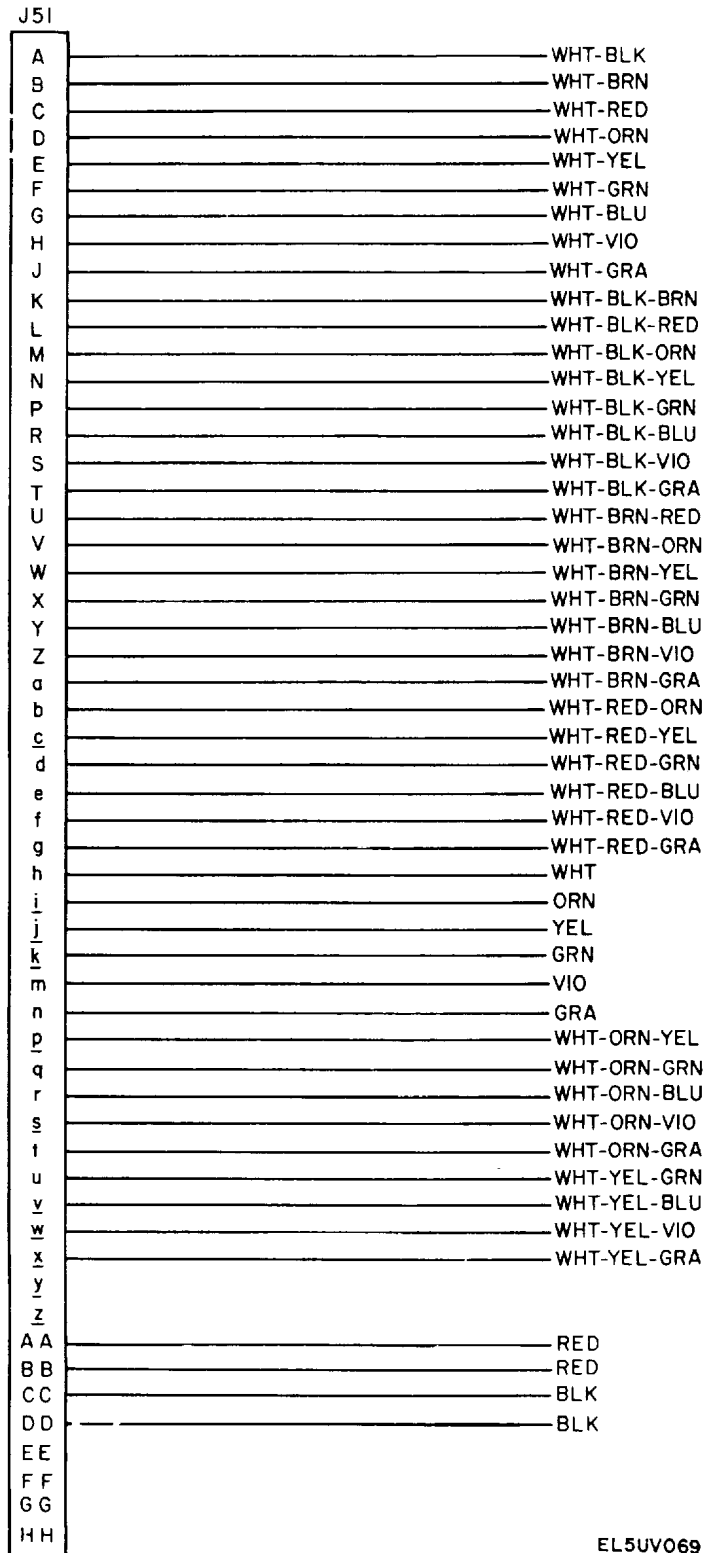
Figure 3-61. Signal control box cable J49, wiring diagram.



EL5UV068

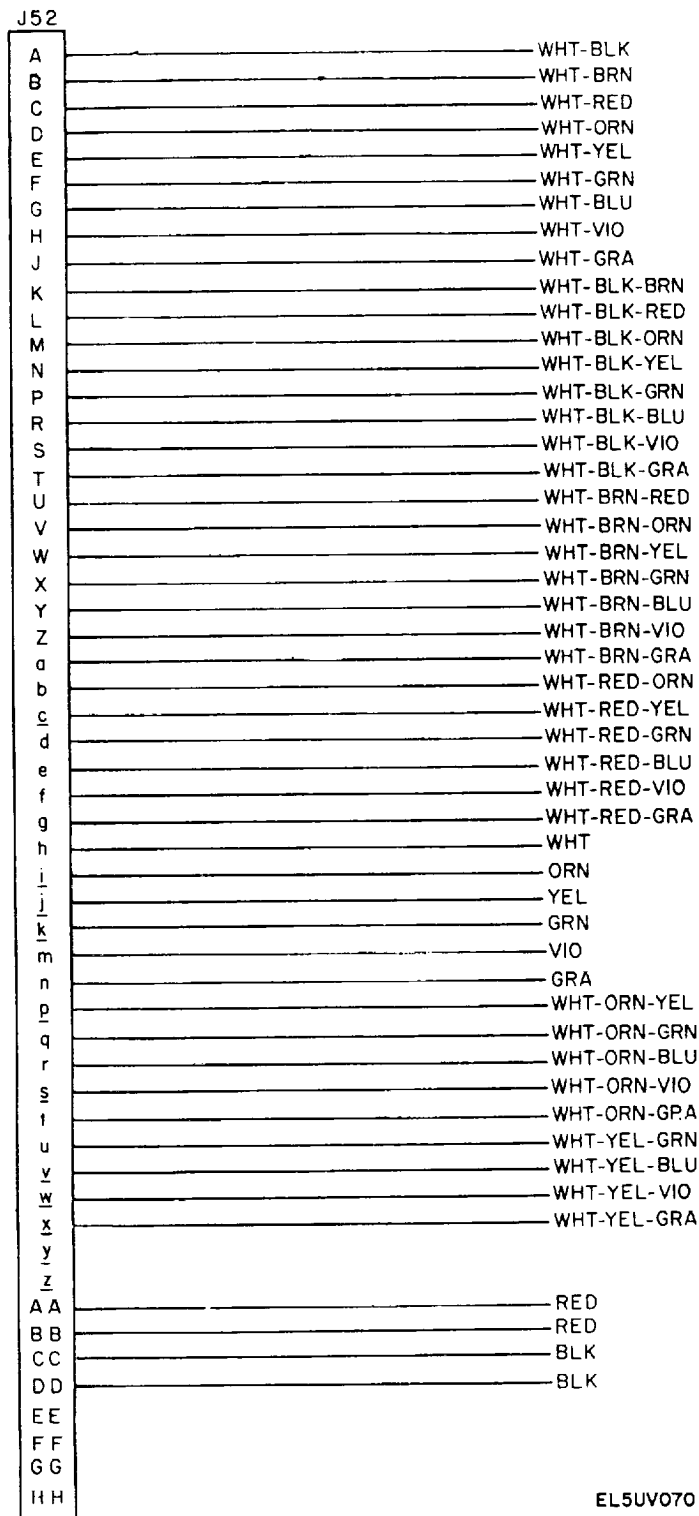
Figure 3-62. Signal control box cable J50, wiring diagram.





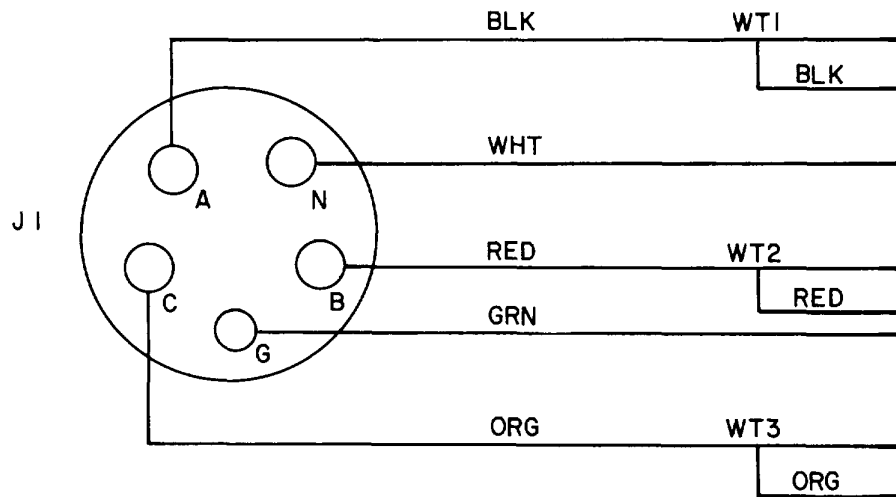
EL5UV069

Figure 3-63. Signal control box cable J1, wiring diagram.



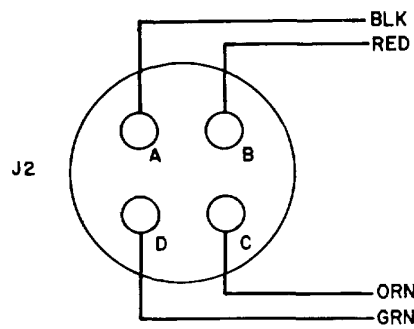
EL5UV070

Figure 3-64. Signal control box cable J52, wiring diagram.



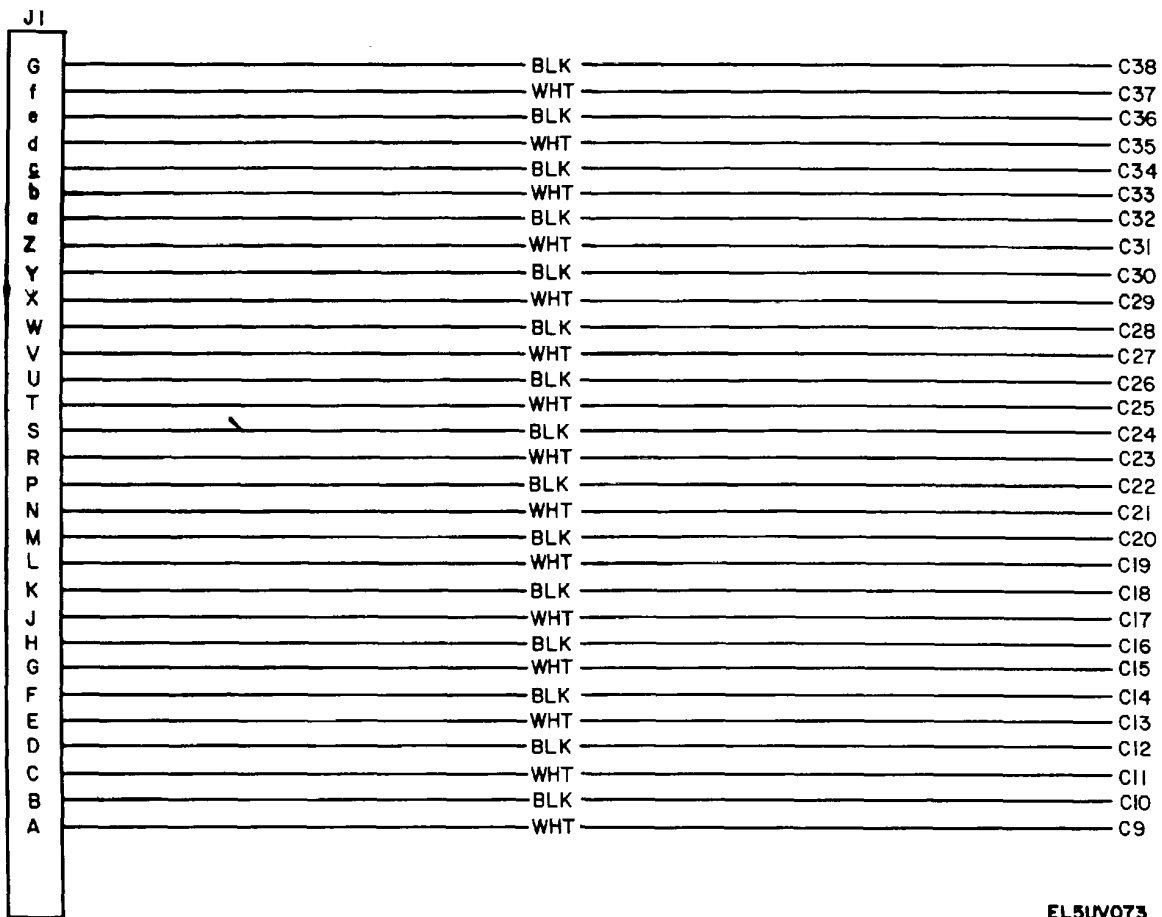
**EL5UV071**

Figure 3-65. Power entrance box cable J1, wiring diagram.



**EL5UV072**

Figure 3-66. Power entrance box air conditioner cable J2, wiring diagram.



EL5UV073

Figure 3-67. Telephone entrance box cable J1, wiring diagram

**Section IV. REMOVAL AND REPLACEMENT**

**3-21. General Instructions**

**WARNING**

Verify that all power is removed from a unit prior to removing or replacing parts.

a. When replacing parts in the various assemblies, observe the following general precautions and techniques. Before a part is unsoldered, note the connection pattern of each lead to that part, and identify each lead to be unsoldered. Tag each lead or draw a sketch of the wiring, noting the color coding and lead designation.

b. Where damaged or defective parts must be replaced, use only replacement parts known to be operable. The new part must be placed in the same mounting position as the one it replaces.

c. Before soldering, carefully clean the terminals and lead connections. Use sufficient heat to make a

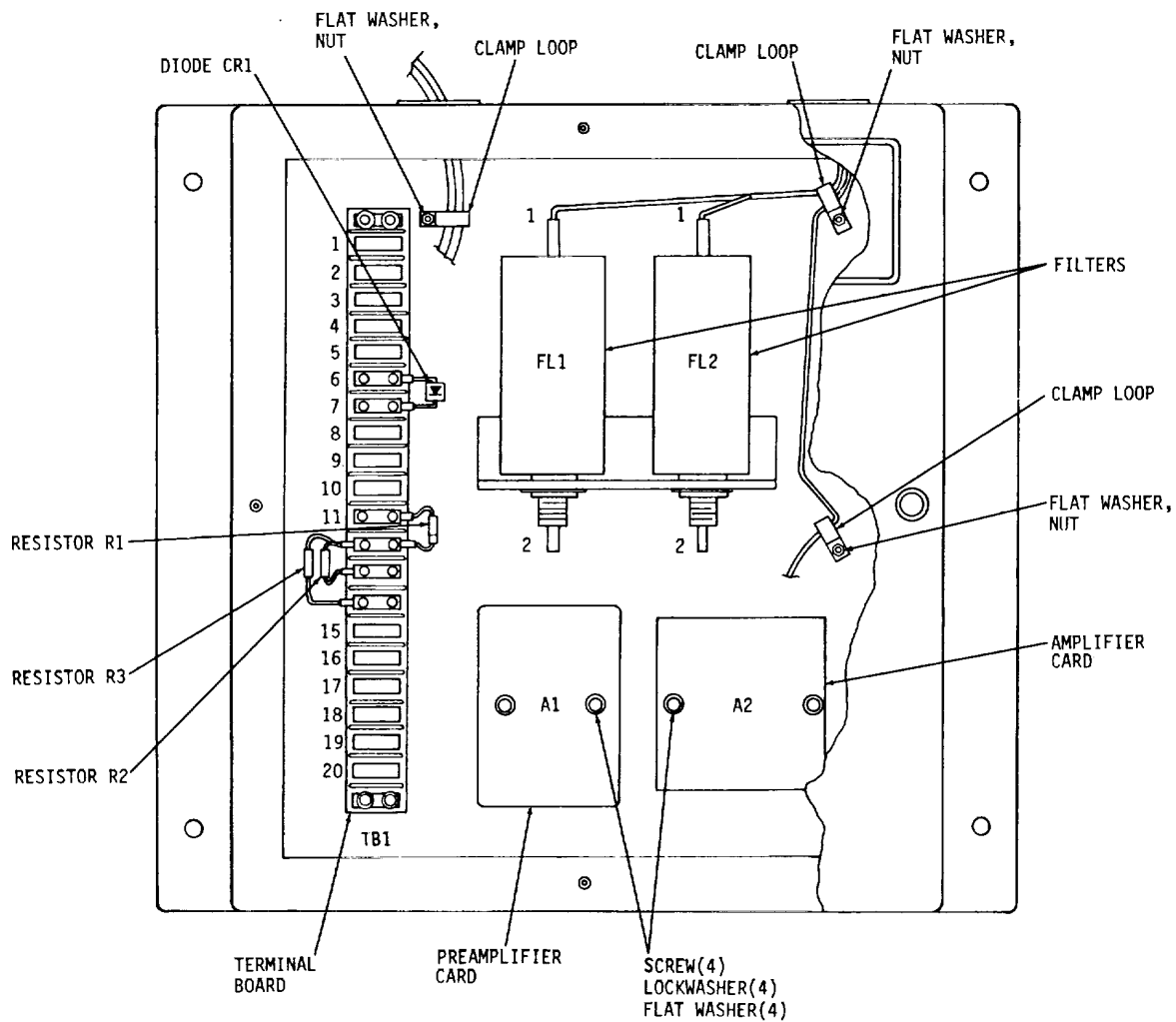
well-soldered connection. (A poorly soldered connection that causes faulty operation is difficult to locate.)

d. Do not permit excessive solder to drop into equipment during soldering operations.

e. After making a solder connection, allow the connection to cool. Grasp the applicable lead and exert a slight pressure to verify that a proper connection has been obtained.

**3-22. Amplifier Filter 1A54**

Figure 3-68 is a parts location illustration of the secure amplifier filter. All parts are readily accessible and no special tools or techniques are necessary when effecting replacement of parts. After parts replacement in the secure amplifier filter, performance of the secure equipment should be checked by the specially trained maintenance personnel responsible for maintenance of the secure equipment.



EL5UV074

Figure 3-68. Amplifier filter, parts location.

**3-23. DC Power Supply (1A37, 1A38)**

Refer to TM 11-6130-368-34 for troubleshooting information and parts replacement.

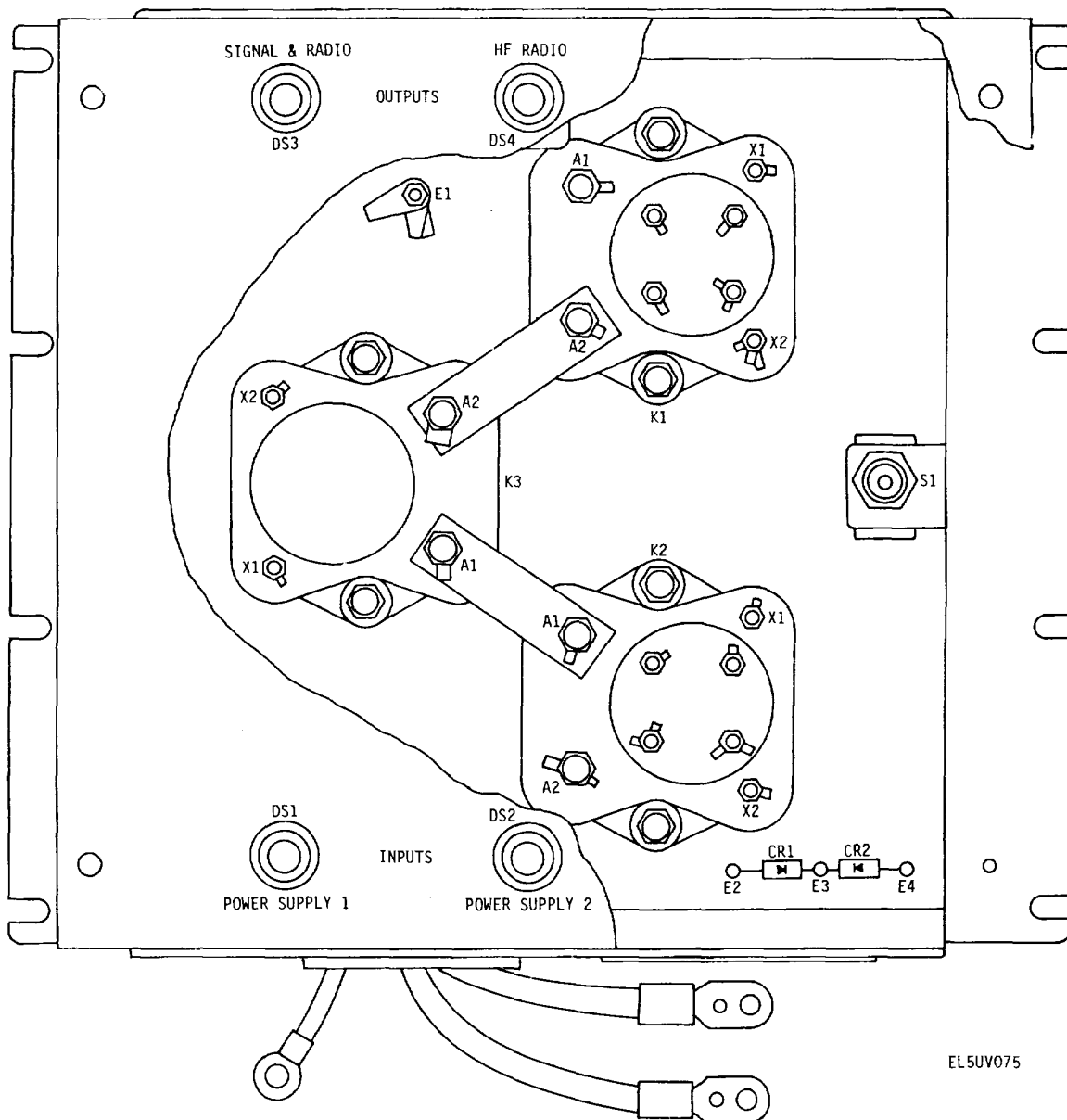
**3-24. Power Supply Control Panel 1A39**

**CAUTION**

Ensure that the DC POWER circuit breaker on the ac power distribution panel is set to OFF prior to parts

replacement.

Figure 3-69 is a parts location illustration of the dc power supply control panel. As shown in the illustration, all parts are readily accessible after removal of the front cover and no special tools or techniques are required for removal and replacement. Tag wiring when removing parts and check the wiring diagram (fig. FO-18) to assure correct installation.



EL5UV075

Figure 3-69. Power supply control, parts location.

**3-25. DC Power Distribution Panel 1A40**

a. *General.* Figure 3-70 is a parts location illustration of the dc power distribution panel. As shown in the illustration, all parts other than the circuit breakers and meters are readily accessible for replacement.

**CAUTION**

Ensure that the DC POWER circuit breaker on the ac power distribution panel is set to OFF prior to parts replacement.

b. *Circuit Breakers.* To remove individual circuit breakers, the panel which mounts the breakers must be

removed. Remove the four screws holding the panel and pull the panel down and forward from the box making sure not to put excess strain on the connecting leads. Remove leads from the defective breaker. Remove the breaker by removing the two screws which mount breaker switch handle through its panel cutout and secure to the panel with its two attaching screws. Reconnect the lead to the breaker. Replace the breaker mounting panel by replacing the four screws holding same to the box.

c. *Voltmeter M1*. To remove the voltmeter, detach the leads and remove three screws holding the meters to the panel. To install the meter insert it through the cutout in the panel and secure by attaching the three mounting

screws and connect meter leads.

d. *Toggle Switch 51*. To remove the toggle switch; unsolder the connections; remove the nut holding the switch to the panel and remove the switch.

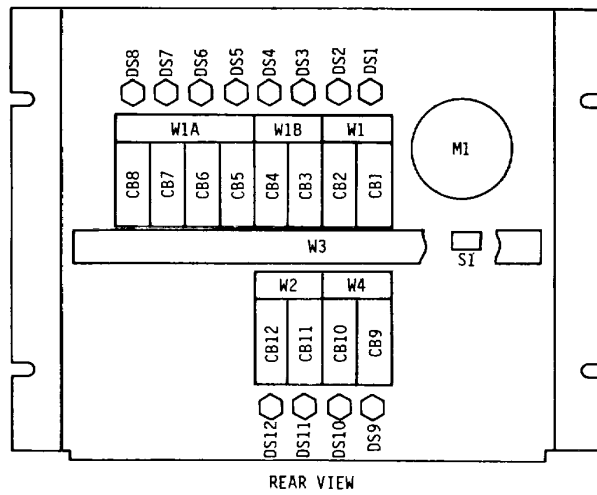
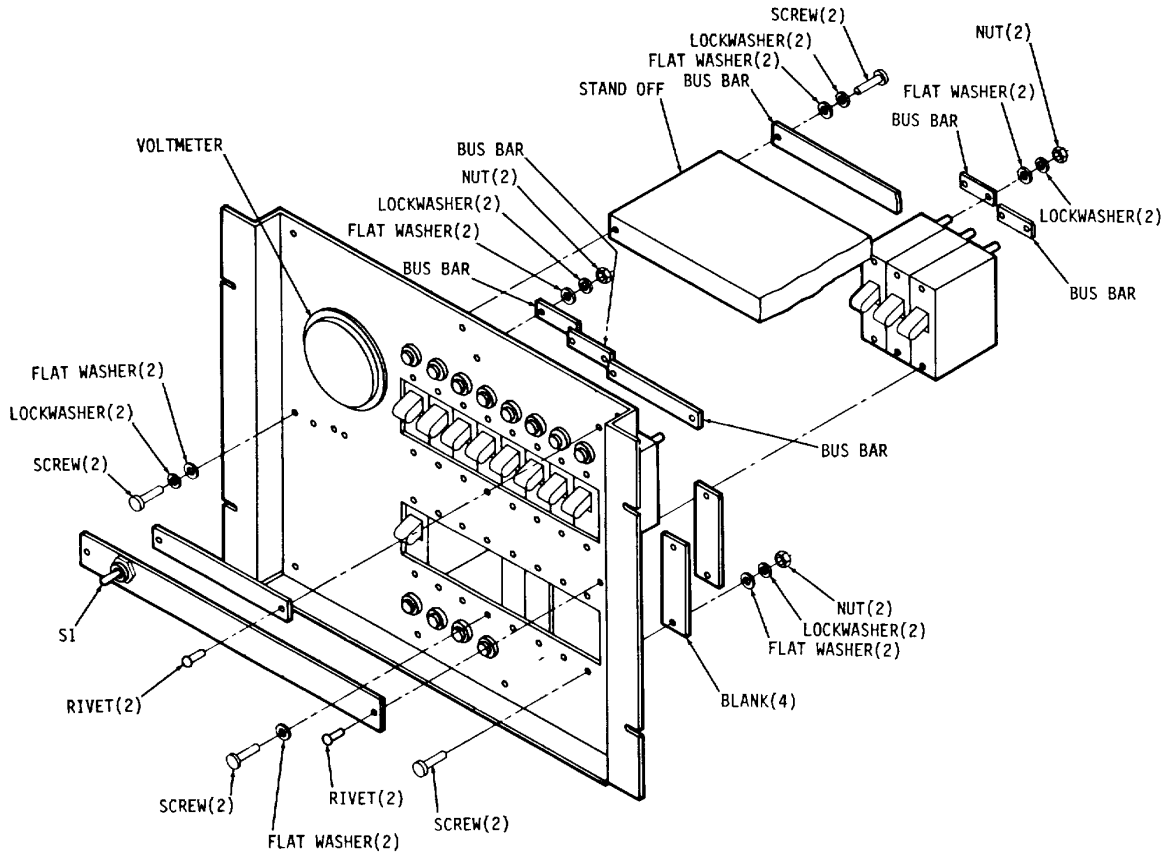


Figure 3-70. DC power distribution panel box, parts location.

EL5UV076



**3-26. AC Power Entrance Panel**

a. *General.* Figure 3-71 is a parts location illustration of the ac power entrance panel. As shown in the illustration, all parts are readily accessible for replacement after removing the rear cover.

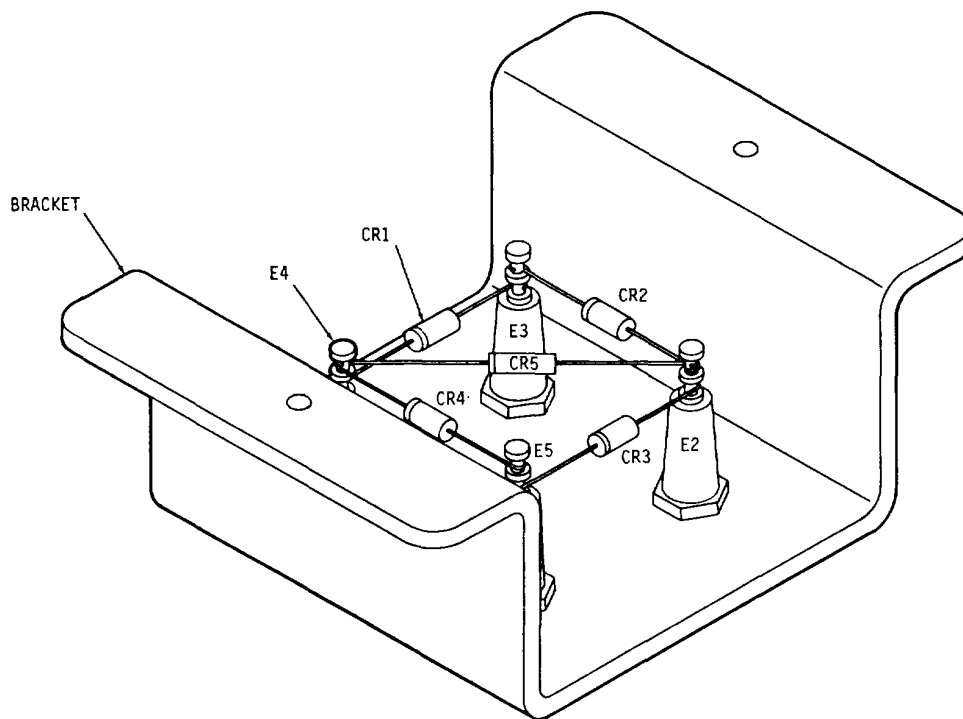
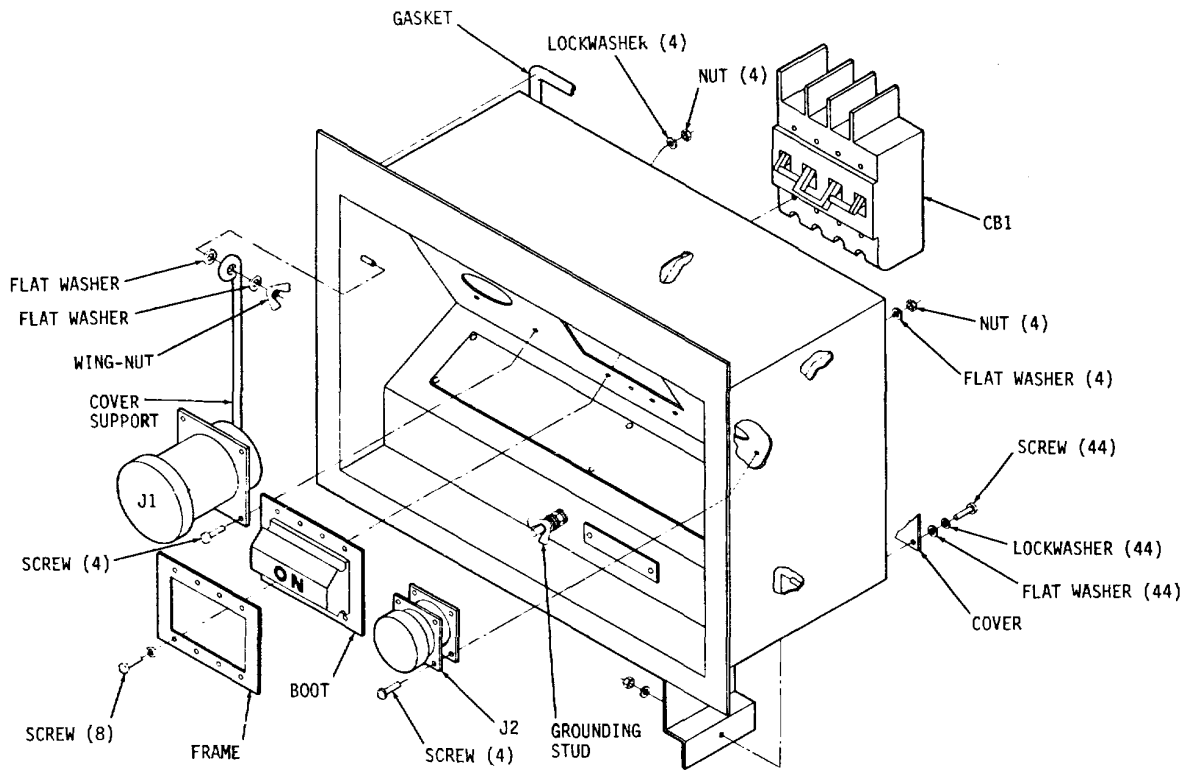
**CAUTION**

Ensure that the power transfer switch on the power trailer is set to the OFF position prior to parts replacement.

b. *Circuit Breaker CB1.* The circuit breaker is removed by disconnecting the wires and removing

attaching hardware from the front of the entrance panel. Tag wiring and check the wiring diagram figure 3-3 to assume correct installation.

c. *Rectifier Assembly.* To gain access to components of the rectifier circuit, remove the attaching hardware as shown in figure 3-71, and carefully lift the unit away from the side of the entrance panel. When replacing diodes, assure that polarity orientation is correct.



RECTIFIER ASSEMBLY  
(ROTATED VIEW)

EL5UV077

Figure 3-71. AC power entrance box, parts location.

**3-27. AC Power Distribution Panel**

a. *General.* Figure 3-72 is a parts location illustration of the ac power distribution panel. As shown in the illustration, all parts are readily accessible for replacement.

**CAUTION**

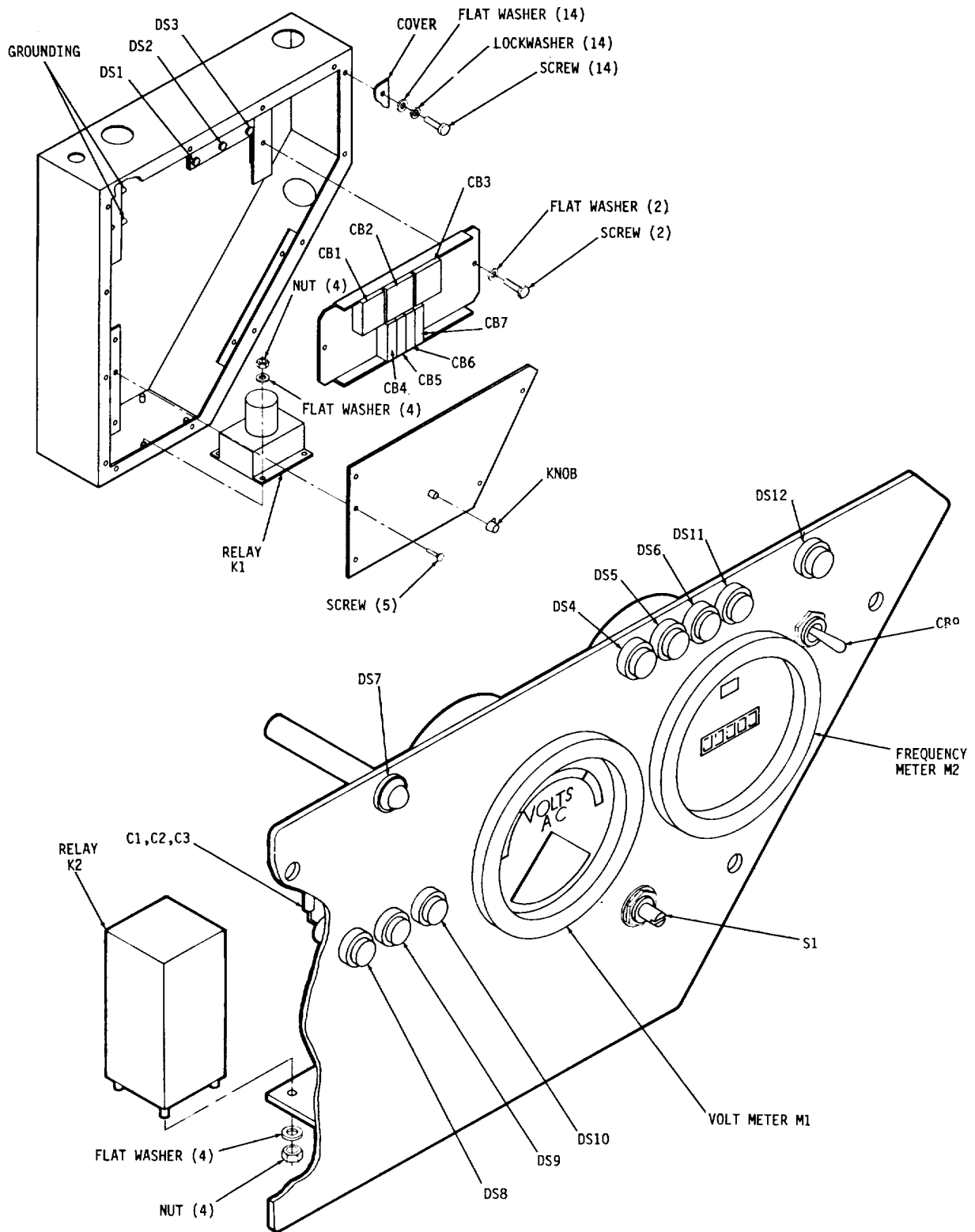
Ensure that the power transfer switch on the power trailer is set to the OFF position prior to parts replacement.

b. *Circuit Breakers.* The circuit breakers are removed by grasping the bottom portion and pulling outward and down. When the circuit breaker is free, its wires may be disconnected. To install the circuit breaker, connect the leads and (with the breaker in position at an angle) push upward and in until the top portion seats on the bus bar. Then push firmly in on the

bottom portion until the breaker is seated.

c. *Indicator Lamps.* The panel which mounts the eight indicator lamps may be removed by removing the two screws holding the panel. The mounting may then be positioned as necessary to remove the indicator lamps.

d. *Meters and Phase Sequence Indicator.* The two meters and the PHASE SEQUENCE INDICATOR are panel mounted. To effect replacement, remove the screws holding the panel. Sufficient play is provided in the wiring to position the panel as necessary to remove or replace either meter or the indicator. When repair or replacement has been accomplished, perform the starting procedure in TM 11-5895-469-12 and check for normal indications.



EL5UV078

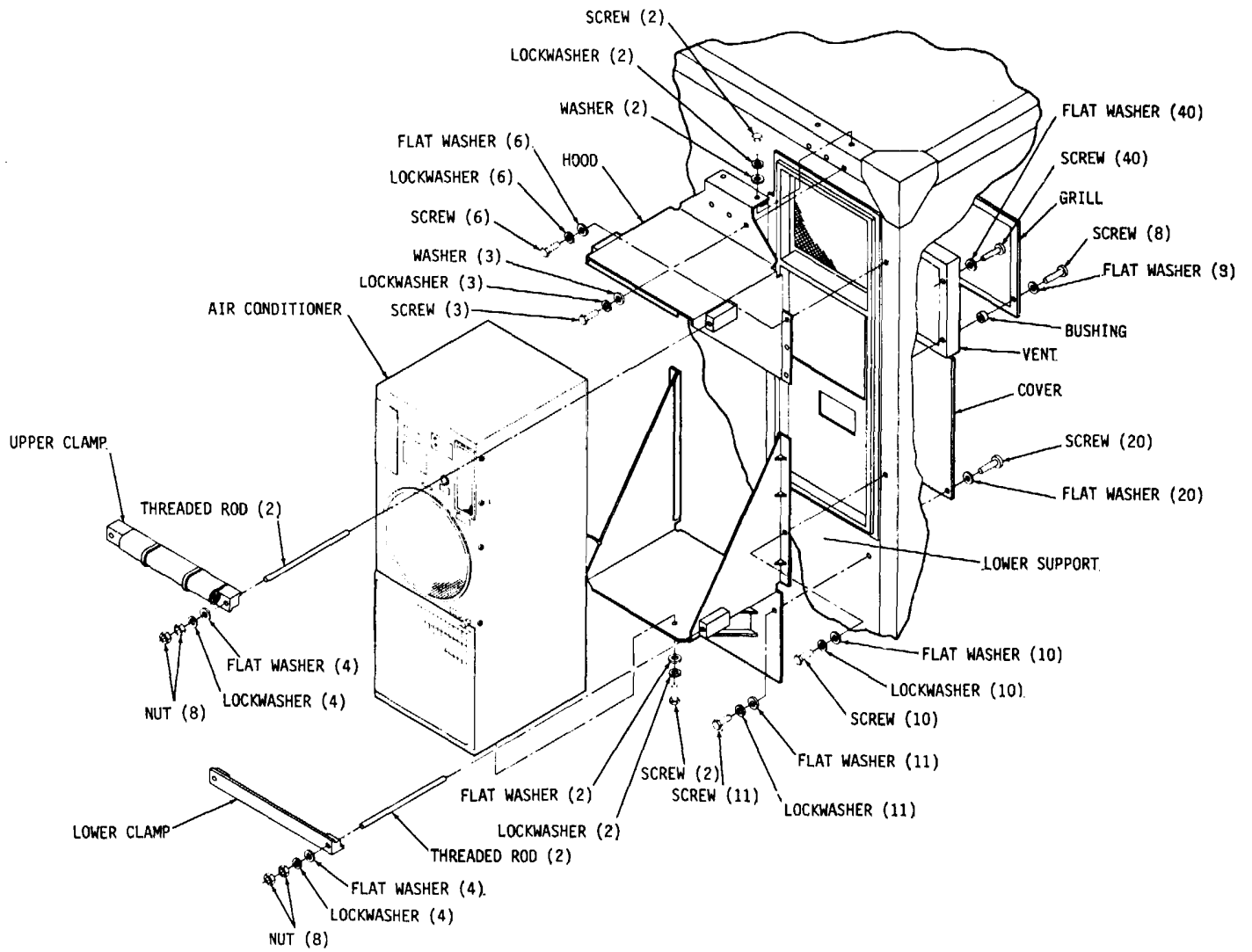
Figure 3-72. AC power distribution panel, parts location.

**3-28. Environmental Control System**

- a. *Air Conditioner*. Refer to figure 3-73 for the air conditioner installation and appendix A for repair of the air conditioner.
- b. *Heater*. Refer to figure 3-74 for the heater

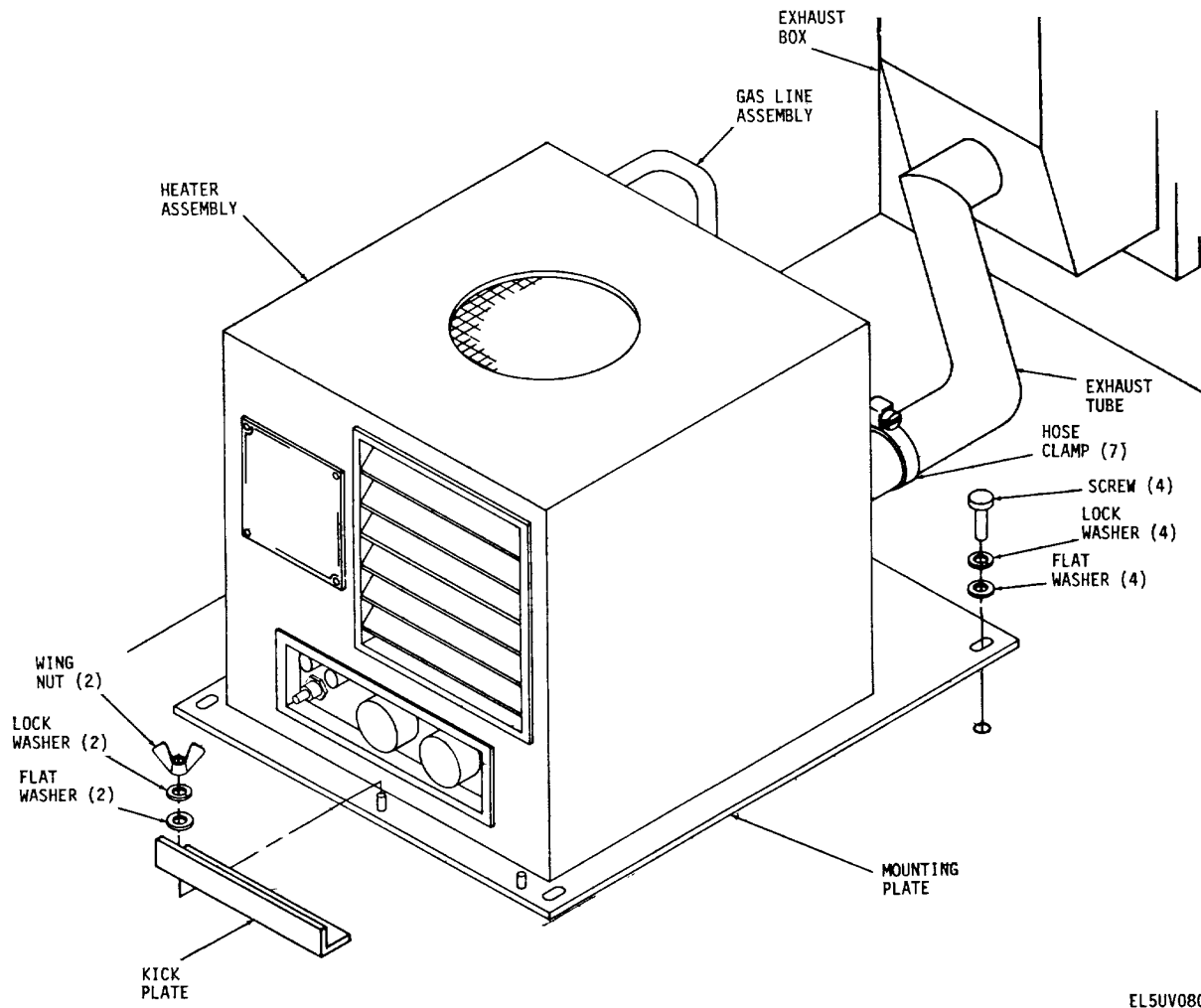
installation and appendix A for repair of the heater.

- c. *Exhaust Blower*. Refer to figures 3-75 and 3-76 for repair of the exhaust blower and motor.



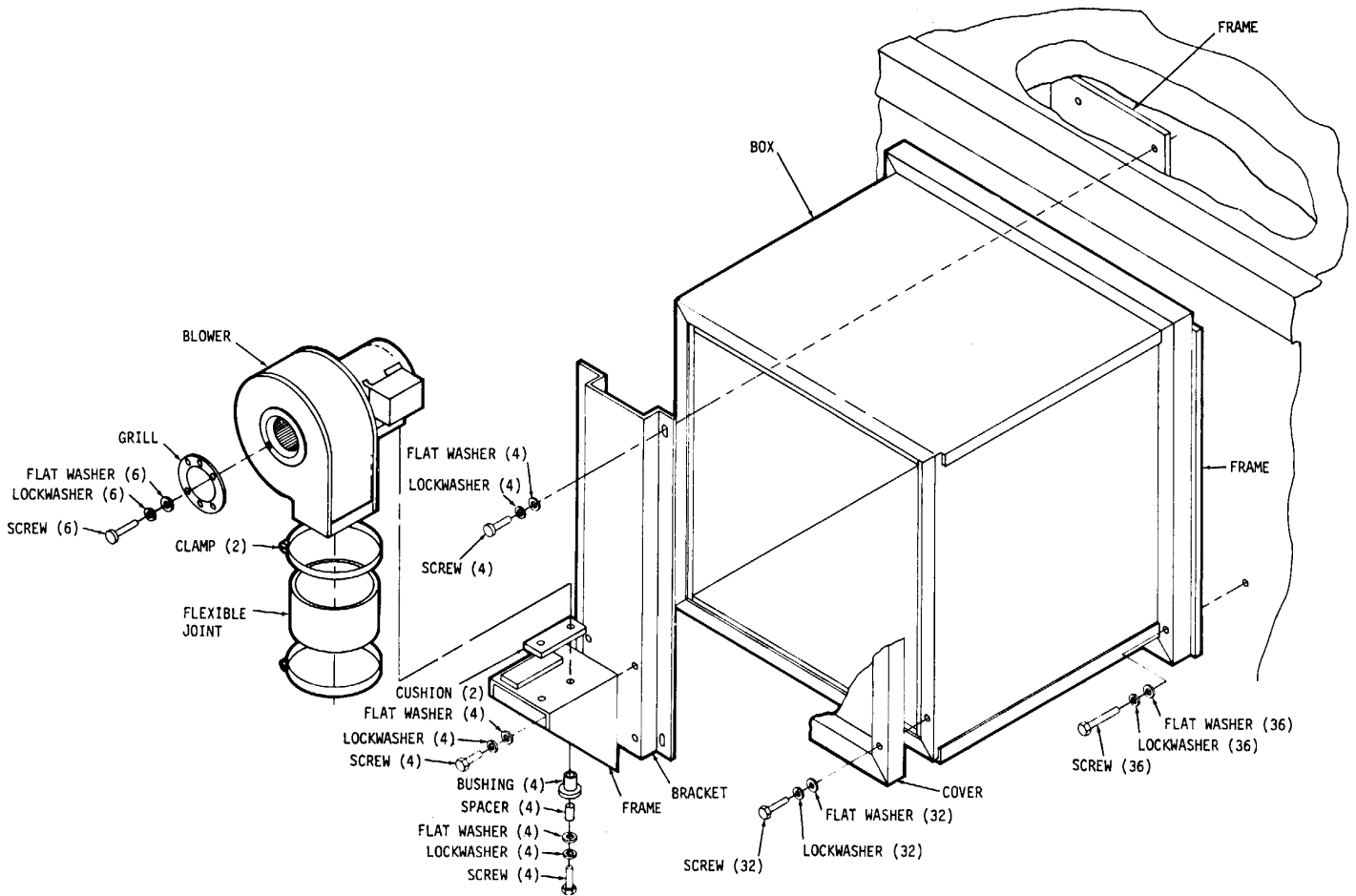
EL5UV079

Figure 3-73. Air conditioner installation, parts location.



EL5UV080

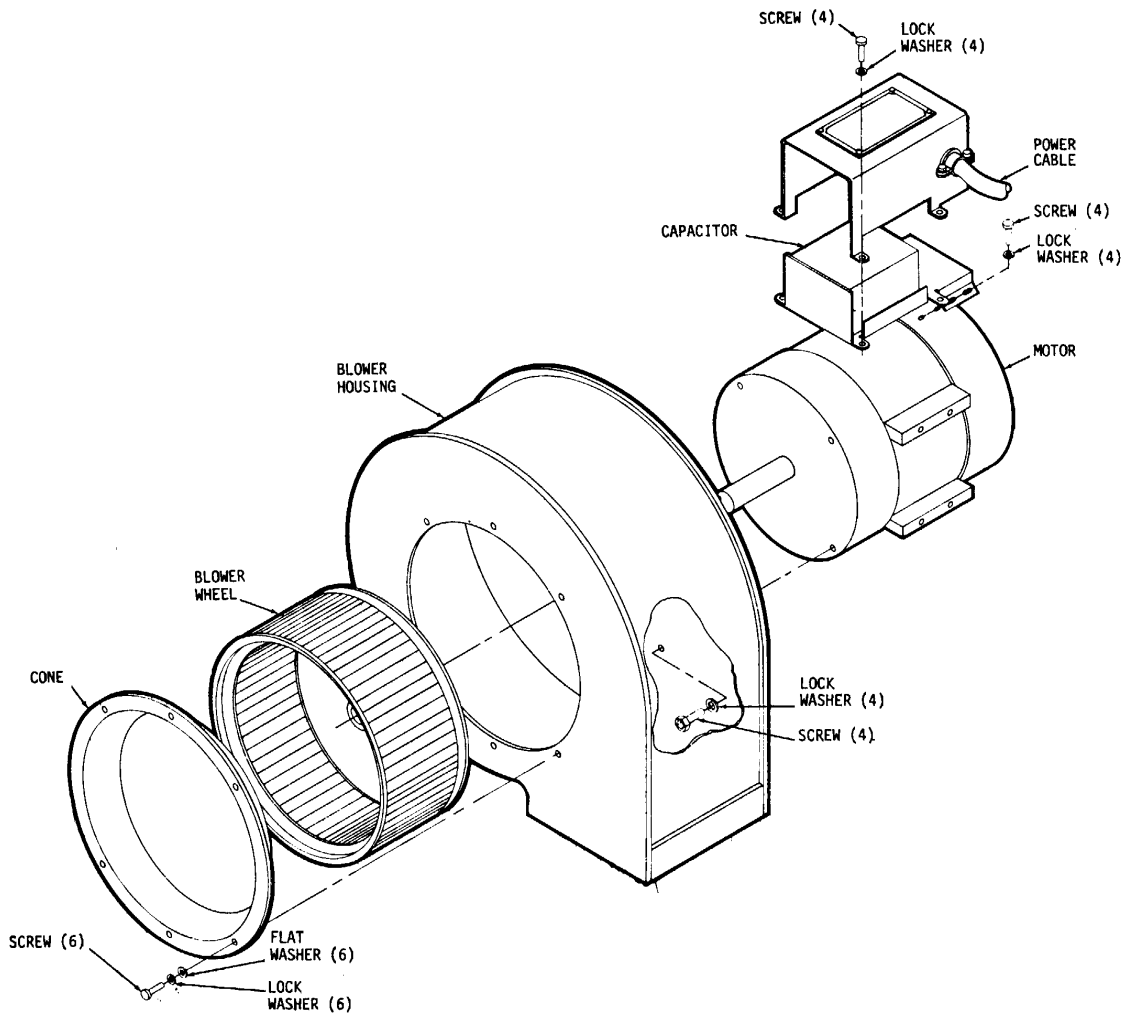
Figure 3-74. Heater installation, parts location.



EL5UV081

Figure 3-75. Exhaust blower installation, parts location.





FL5UV082

Figure 3-76. Exhaust blower motor, parts location.

**3-29. Operator's Console**

a. *General.* The operator's console houses two radio-audio control panels and two telephone control panels. Figures 3-5 and 3-6 illustrate the location of these panels. Before removing a control panel from the operator's console, disconnect the cabling from the control unit. After unscrewing the captive screws which hold the unit from the front panel, lift the unit out of the console with care to avoid damage to the control panel.

b. *Radio-Audio Control Panel.* Figure 3-6 is a parts location illustration of the radio-audio control panel. As shown in the illustration, all components are readily accessible and no special tools or techniques are required for removal and replacement. However, care should be exercised when replacing a radio key switch to ensure that the physical orientation of the new switch conforms to that of the defective switch. Also, wires connected to contacts on a defective switch must be carefully tagged prior to unsoldering to ensure that the wires will be soldered to the correct contacts on the new switch. Subsequent to replacing a defective component, repeat the applicable resistance and continuity checks in paragraph 3-14b(2) to verify that the unit operation is satisfactory for return to operation.

c. *Telephone Control Panel.* Figure 3-7 is a parts location illustration of the telephone control panel. As shown in the illustration, all components are readily accessible and no special tools or techniques are required for removal and replacement. However, care should be exercised when replacing a telephone key switch to ensure that the physical orientation of the new switch conforms to that of the defective switch. Also, wires connected to contacts on a defective switch must be carefully tagged prior to unsoldering to ensure that the wires will be soldered to the correct contacts on the new switch. Subsequent to replacing a defective component, repeat the applicable resistance and continuity checks in paragraph 3-14b(2) to verify that the unit operation is satisfactory for return to operation.

**3-30. Supervisor's Console**

a. *General.* The supervisor's console houses one radio-audio control panel and one telephone control panel. Before removing a control panel from the supervisor's console, disconnect the cabling from the

unit. After unscrewing the captive screws which hold the unit from the front panel, lift the unit out of the console with care to avoid damage to the control panel.

b. *Radio-Audio Control Panel.* Refer to paragraph 3-29 b.

c. *Telephone Control Panel* Refer to paragraph 3-29c 3-31. Signal Control Box Figure FO-19 is a parts location diagram of the connector positions, switches, and fuses for the signal control box with circuit cards removed. Repair of the signal control box consists of replacement or correction of wiring parts or connections. Refer to the following illustrations for repair of the signal control box wiring harnesses.

- a. Cable J46-see figure 3-58.
- b. Cable J47-see figure 3-59.
- c. Cable J48-see figure 3-60.
- d. Cable J49-see figure 3-61.
- e. Cable J50-see figure 3-62.
- f. Cable JS1--see figure 3-63.
- g. Cable J52-see figure 3-64.

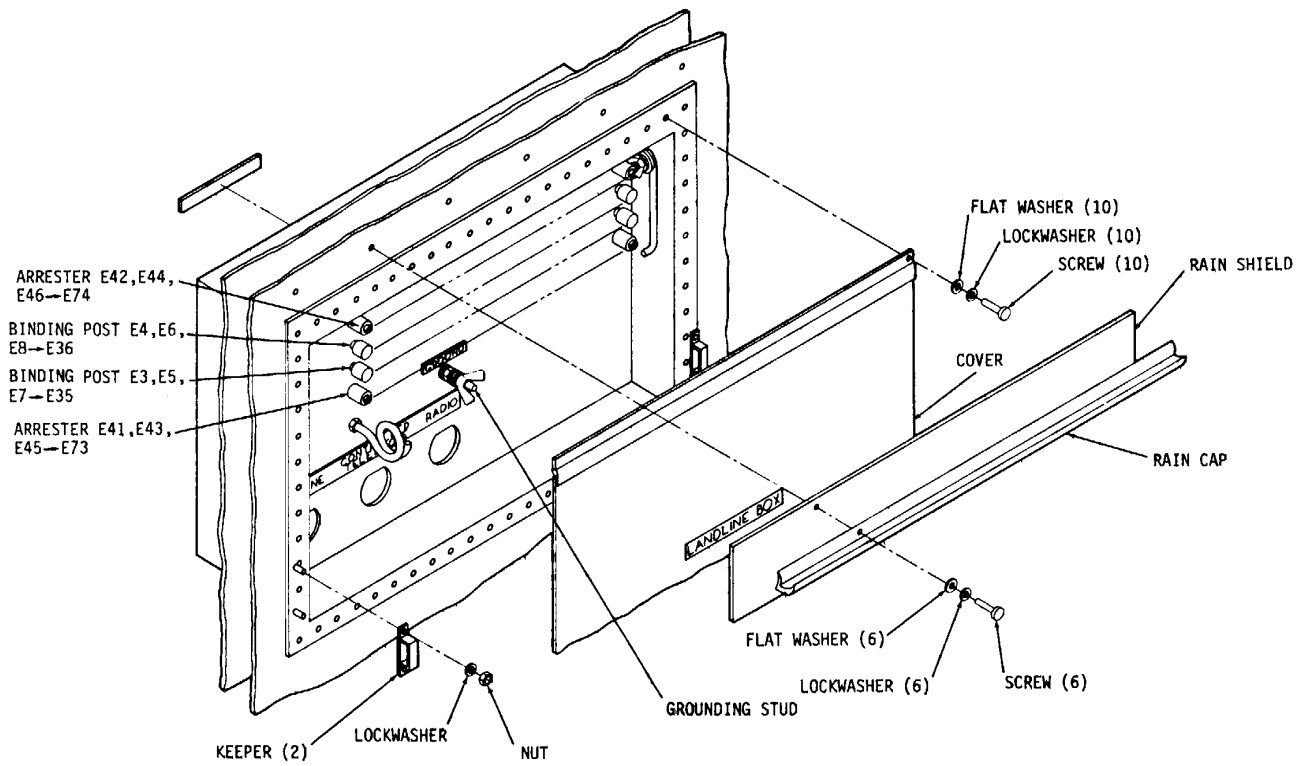
**3-32. HF Coupler Case**

Refer to paragraph 3-17 for troubleshooting and repair of the HF antenna coupler case.

**3-33. Replacement of Miscellaneous FCC Units**

The following FCC assemblies contain only interconnecting jacks, binding posts, connectors, and wiring. Parts replacement involves no special procedures, only observation of normal procedures during replacement. Refer to the parts illustrations listed below during parts replacement.

- a. *Telephone Entrance Panel.* Refer to figure 3-77.
- b. *Buzzer Box.* Refer to figure 3-78.
- c. *Speaker Assemblies.* Refer to figure 3-79.
- d. *Antenna Tripod.* Refer to figure 3-80.
- e. *UVU, Antenna.* Refer to figure FO-20.
- f. *VUV, Antenna.* Refer to figure FO-20.
- g. *Secure Junction Box.* Refer to figure 3-81.
- h. *Antenna Entrance Panel.* Refer to figure 3-82.
- i. *Filter Box Assembly.* Refer to figure 3-83.



EL5UV083

Figure 3-77. Telephone entrance panel, parts location.

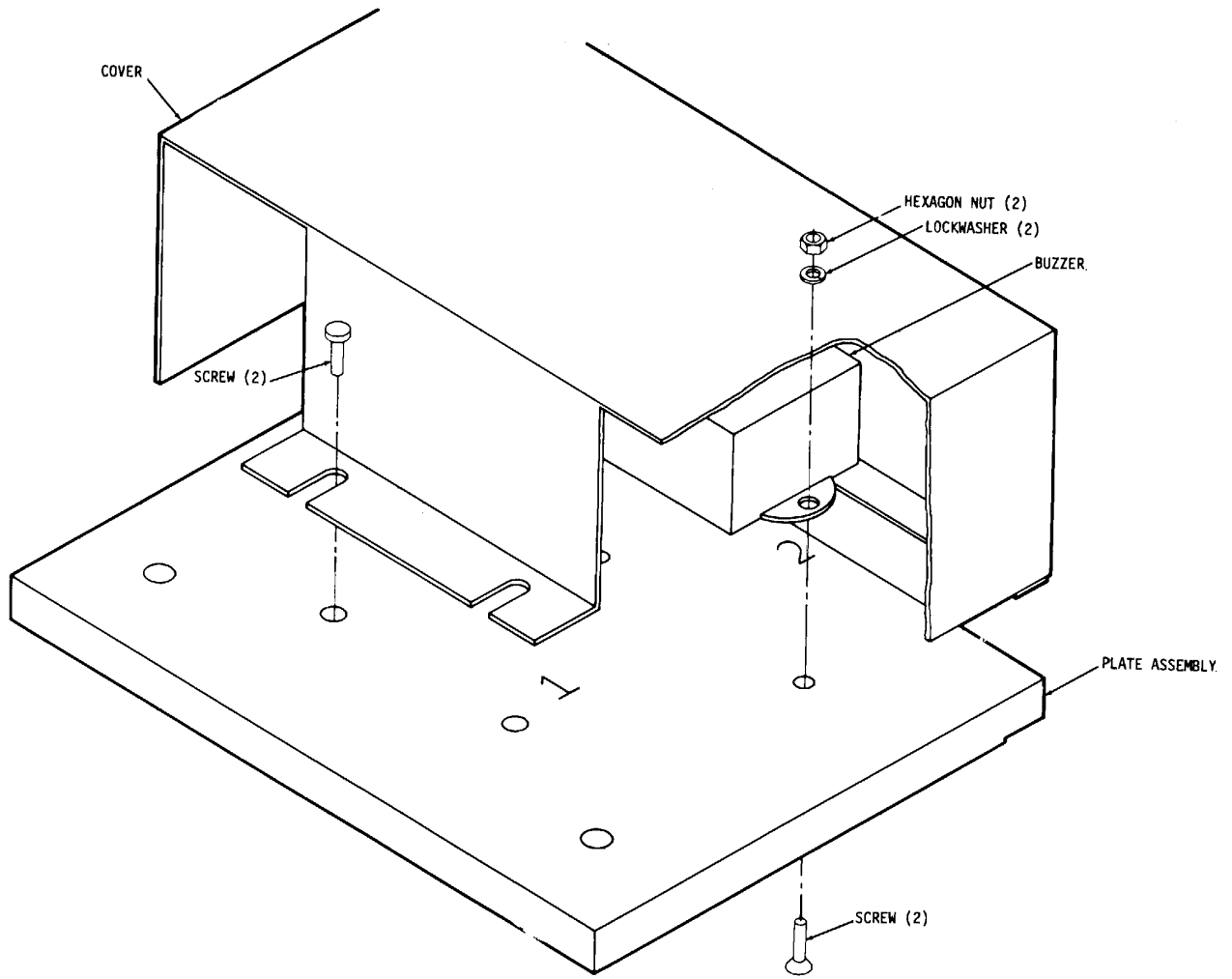


Figure 3-78. Buzzer box, parts location.

EL5UV084

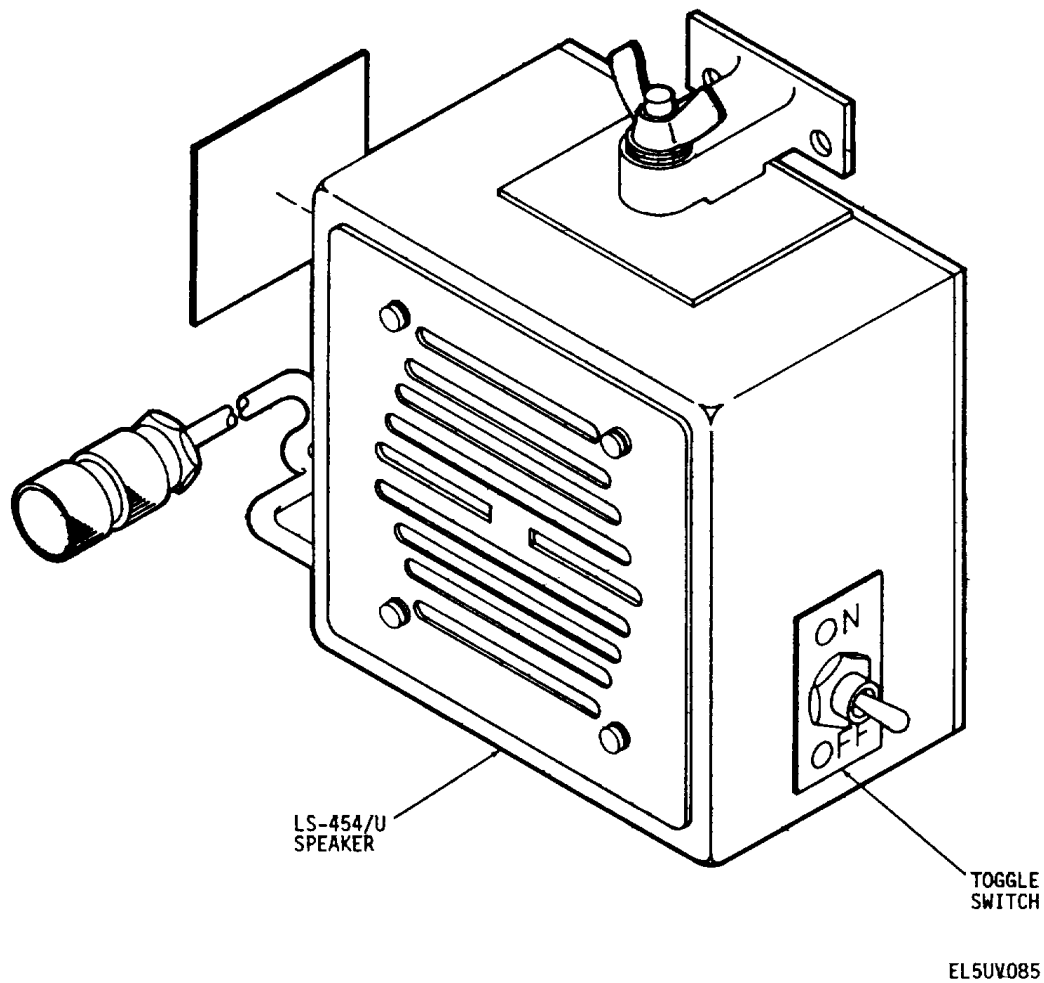


Figure 3-79. Loudspeakers, parts location.

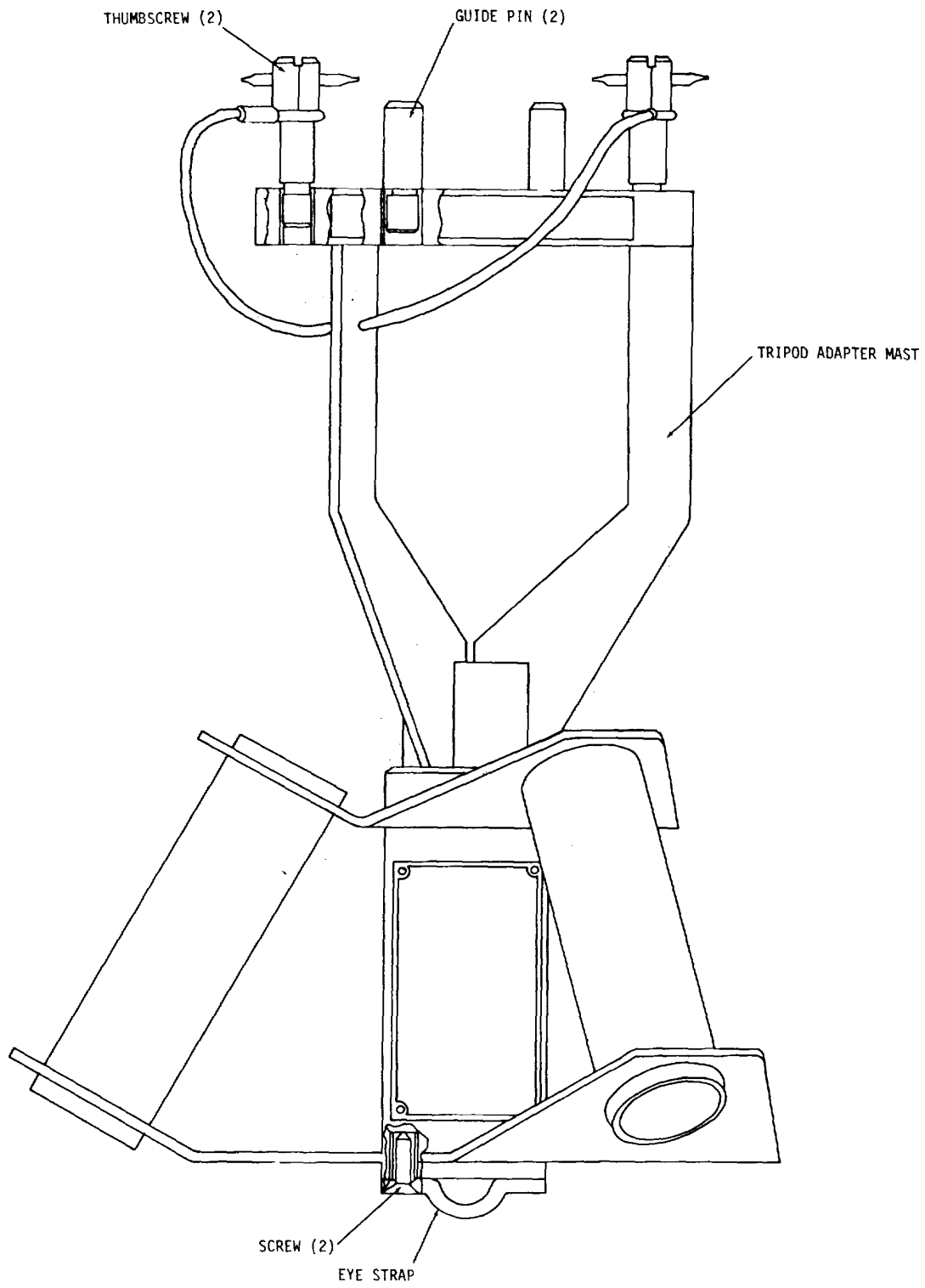


Figure 3-80. Antenna tripod, parts location.

EL5UV086

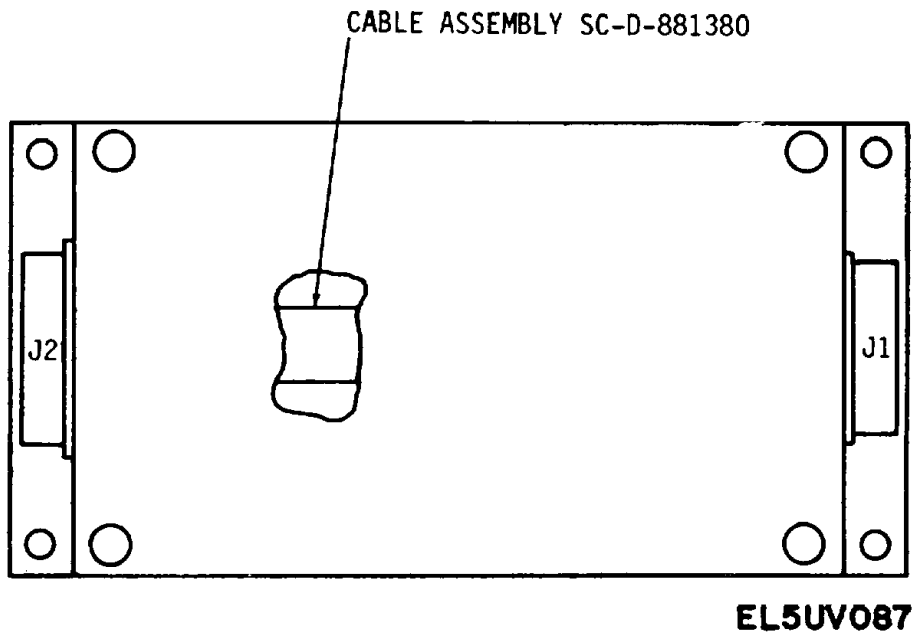


Figure 3-81. Secure junction box, parts location.

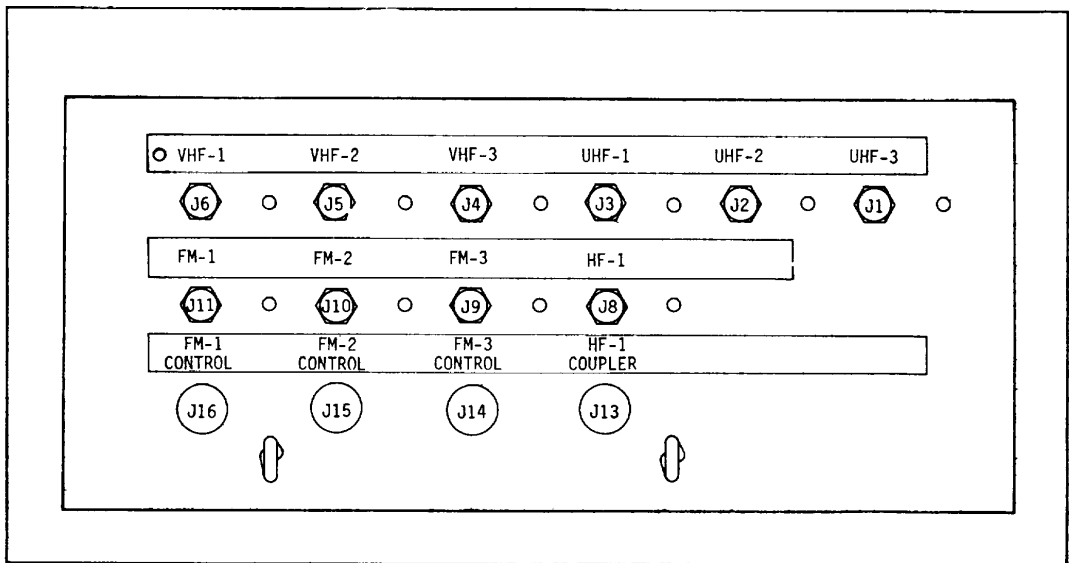


Figure 3-82. Antenna entrance panel, parts location.

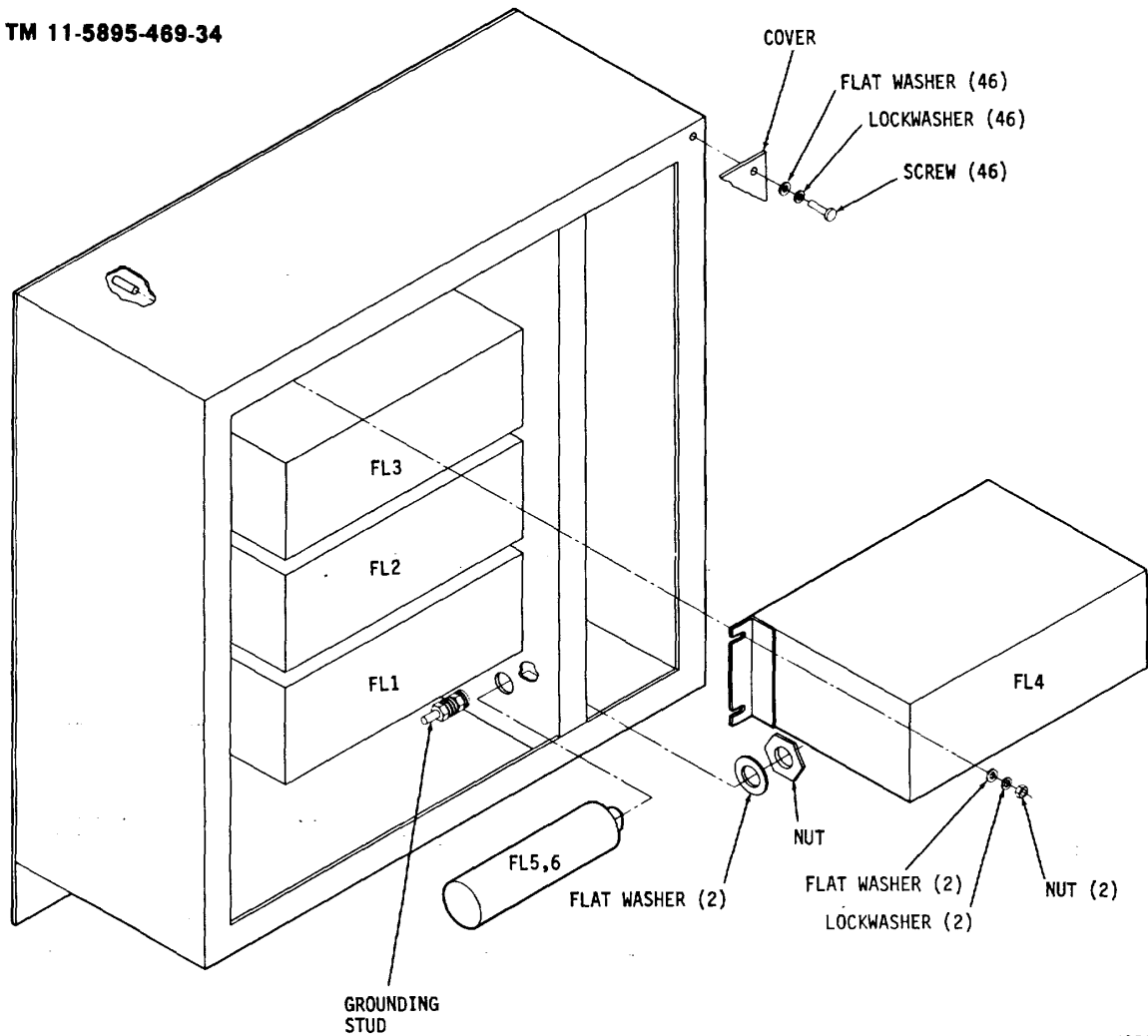


Figure 3-83. Filter box assembly, parts location.

F1 511V089

**3-34. Replacement and Fabrication of Cable Assemblies**

a. *Signal and Power Cables.* Use standard soldering techniques to fabricate replacement cables. Use the existing cable as a model and refer to paragraph 3-19 for wiring information. Connectors may be obtained through supply channels using the National stock numbers in TM 11-5895-469-34P (to be published).

b. *RF Cable Assemblies.* Refer to the following figures for repair or fabrication of replacement cables. Cables W401B, W402B, W407B, W408B, and W409B are critical in length. Make sure the replacement cable is the same length as the original.

**Cable Assembly**

			<i>Figure No.</i>
W401A	(SC-D-881919)	UHF-3 RF	3-84
W401B	(SC-D-881920)	UHF-3 RF	3-85
W402A	(SC-D-881921)	UHF-2 RF	3-86
W402B	(SC-D-881922)	UHF-2 RF	3-87
W403A	(SC-D-881923)	UHF-i RF	3-88
W403B	(SC-D-881924)	UHF-i RF	3-89

**Cable Assembly**

*Figure No.*

W404A	(SC-D-881925)	FM-1 RF	3-90
W404B	(SC-D-881926)	FM-1 RF	3-91
W405A	(SC-D-881927)	FM-2 RF	3-92
W405B	(SC-D-881928)	FM-2 RF	3-93
W406A	(SC-D-881929)	FM-3 RF	3-94
W406B	(SC-D-881930)	FM-3 RF	3-95
W407A	(SC-D-881931)	VHF-i RF	3-96
W407B	(SC-D-881932)	VHF-i RF	3-97
W408A	(SC-D-881933)	VHF-2 RF	3-98
W408B	(SC-D-881934)	VHF-2 RF	3-99
W409A	(SC-D-881935)	VHF-3 RF	3-100
W409B	(SC-D-881936)	VHF-3 RF	3-101
W411A	(SC-D-881939)	HF-1 RF	3-102
W411B	(SC-D-881940)	HF-1 RF	3-103
W501	(SC-D-881918)	HF-i antenna/control	3-104
W503	(SC-D-881917)	FM 5 ft	3-105
W504	(SC-D-881914)	FM antenna	3-106
W505	(SC-D-882013)	FM antenna	3-107
W506	(SC-D-881913)	FM antenna	3-108
W507	(SC-D-881915)	VUV antenna	3-109
W508	(SC-D-882007)	VUV antenna	3-110
W509	(SC-D-882008)	UVU antenna	3-111



**Cable Assembly**

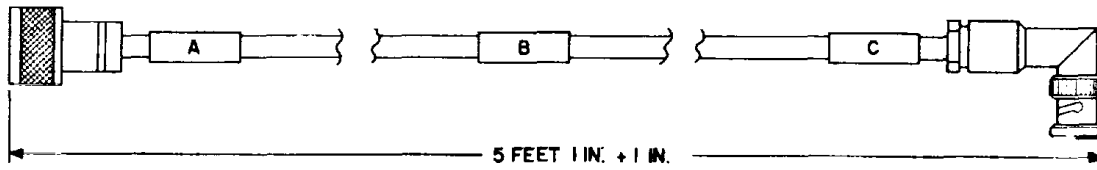
W510 (SC-D-881916)  
 W511 (SC-D-82009)  
 W512 S-D-882010)

UVU antenna  
 UVU 10 ft  
 UVU antenna

**Figure No.**  
 3-112  
 3-113  
 3-114

W513 (SC-D-881912)  
 W514 (SC-D-882011)  
 W515 (SC-D-882102)

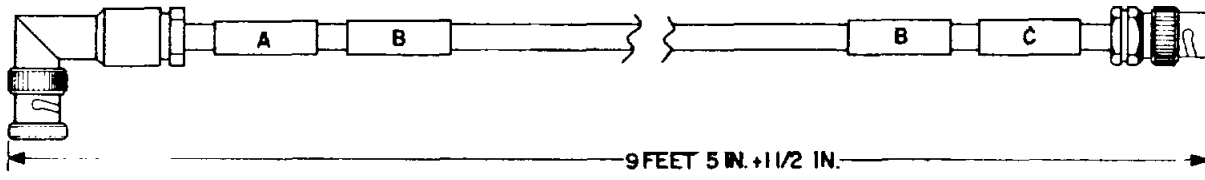
UVU antenna 3-115  
 UVU antenna 3-116  
 UVU 100 ft 3-10



MARKING		
A	B	C
PI	W401A	P2
(A53J1) ANT ENT	80063 ASSY 881919	(UNIT 31 ANT) UHF-FL

EL5UV090

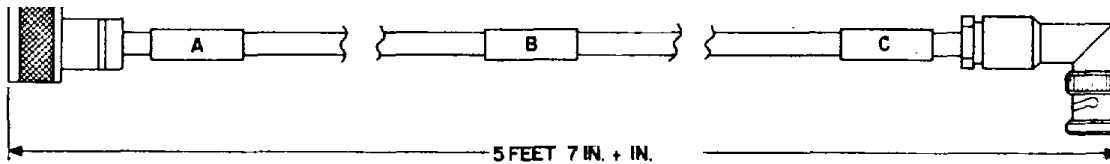
Figure 3-84. UHF-3 antenna cable W401A.



MARKING		
A	B	C
PI	W401B	P2
(UNIT 31 J5) UHF-FL	80063 ASSY 881920	(W401C PI OR UHF-3 ARC-164 J2)

EL5UV091

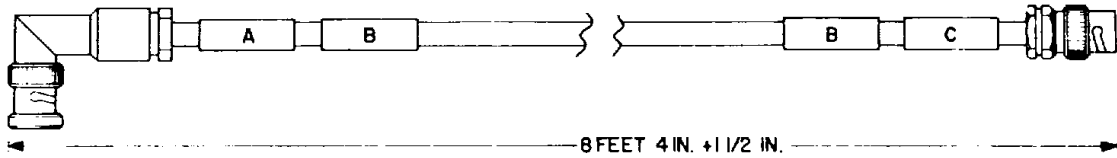
Figure 3-85. UHF-3 antenna cable W401B.



MARKING		
A	B	C
PI	W402A	P2
(A53J2) ANT ENT	80063 ASSY 881921	(UNIT 32 ANT) UHF-FL

EL5UV092

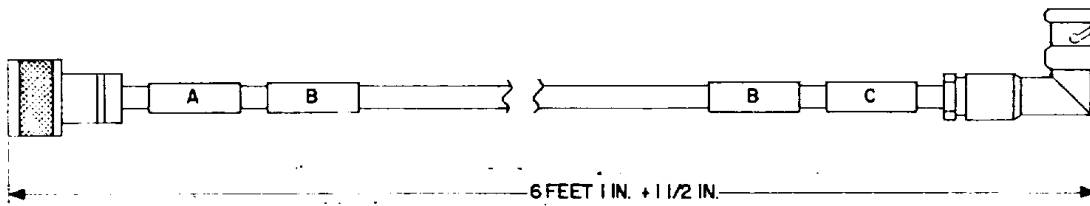
Figure 3-86. UHF-2 antenna cable W402A.



MARKING		
A	B	C
PI	W402B	P2
(UNIT 32 J5) UHF-FL	80063 ASSY 881922	(W402C PI OR UHF-2 ARC-164 J2)

EL5UV093

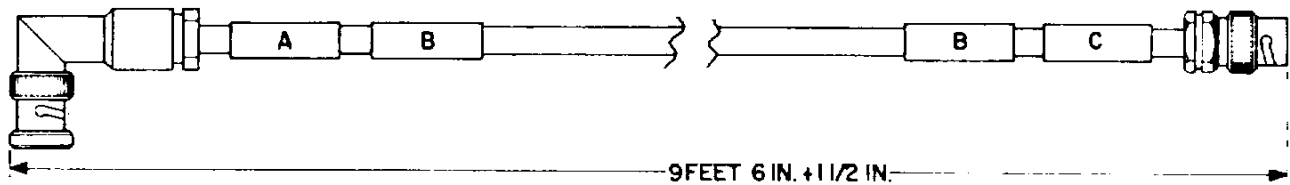
Figure 3-87. UHF-2 antenna cable W402B.



MARKING		
A	B	C
PI	W403A	P2
(A53J3) ANT ENT	80063 ASSY 881923	(UNIT 33 ANT) UHF-FL

EL5UV094

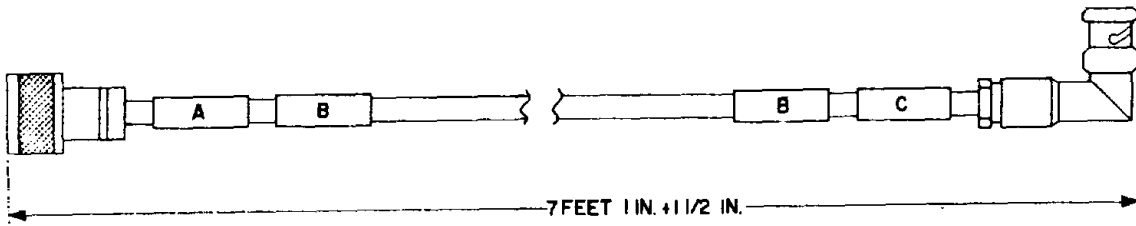
Figure 3-88. UHF-1 antenna cable W403A.



MARKING		
A	B	C
PI	W403B	P2
(UNIT 33 J5) UHF-FL	80063 ASSY 881924	(W403 C PI OR UHF-1 ARC-164 J2)

EL5UV095

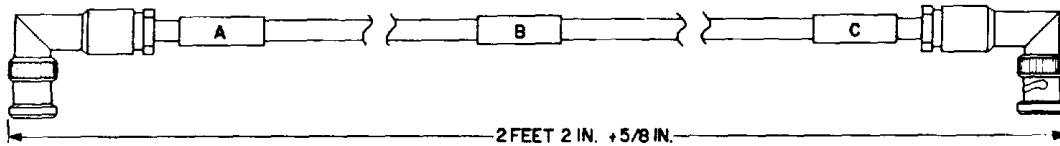
Figure 3-89. UHF-1 antenna cable W403B.



MARKING		
A	B	C
PI	W404A	P2
(A53J11) ANT ENT	80063 ASSY 881925	(UNIT 34 OUTPUT) FM-FL

EL5UV096

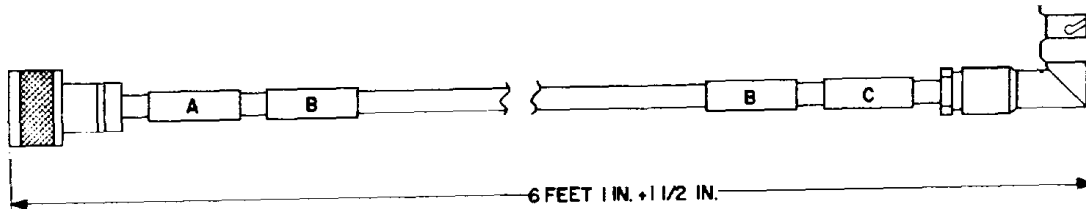
Figure 3-90. FM-1 antenna cable W404A.



MARKING		
A	B	C
PI	W404B	P2
(UNIT 34 INPUT) FM-FL	80063 ASSY 881926	(UNIT 10 ANT) FM-I

EL5UV097

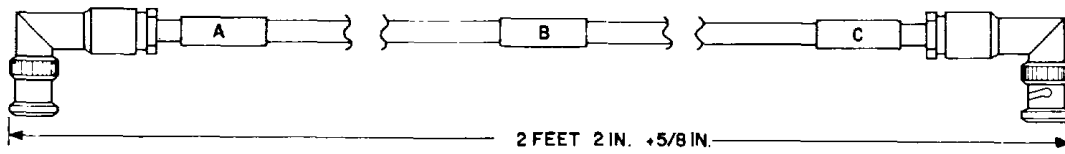
Figure 3-91. FM-1 antenna cable W404B.



MARKING		
A	B	C
PI	W405A	P2
(A53J10) ANT ENT	80063 ASSY 881927	(UNIT 35 OUTPUT) FM-FL

EL5UV098

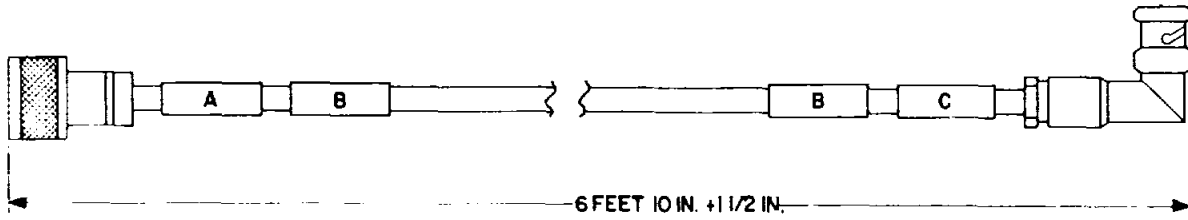
Figure 3-92. FM-2 antenna cable W405A.



MARKING		
A	B	C
PI	W405B	P2
(UNIT 35 INPUT) FM-FL	80063 ASSY 881928	(UNIT 22 ANT) FM-2

EL5UV099

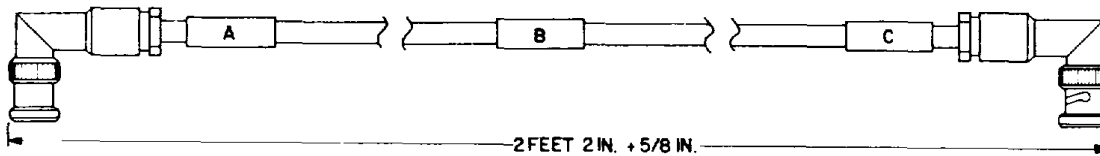
Figure 3-93. FM-2 antenna cable W405B.



MARKING		
A	B	C
PI	W406A	P2
(A53J9) ANT ENT	80063 ASSY 881929	(UNIT 36 OUTPUT) FM-FL

EL5UV100

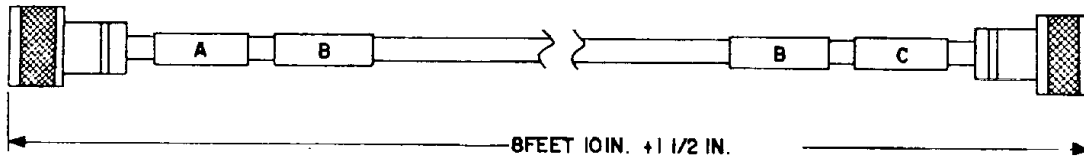
Figure 3-94. FM-3 antenna cable W406A.



MARKING		
A	B	C
PI	W406B	P2
(UNIT 36 INPUT) FM-FL	80063 ASSY 881930	(UNIT 25 ANT) FM-3

EL5UV101

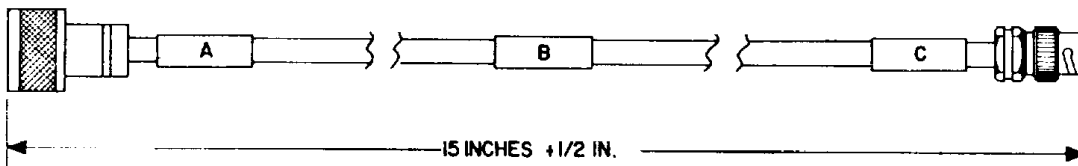
Figure 3-95. FM-3 antenna cable W406B.



MARKING		
A	B	C
PI	W407A	P2
(A53 J6) ANT ENT	80063 ASSY 881931	(UNIT 37 OUTPUT) VHF-FL

EL5UV102

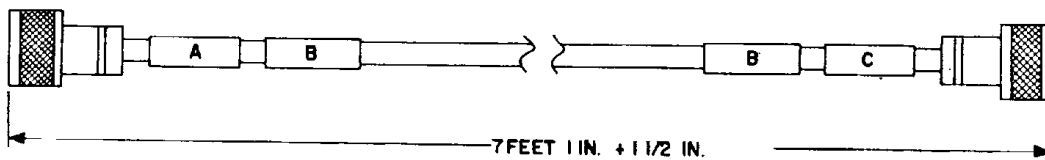
Figure 3-96. VHF-1 antenna cable W407A.



MARKING		
A	B	C
PI	W407B	P2
(UNIT 37 INPUT) VHF-FL	80063 ASSY 881932	(UNIT 8 J2) VHF-I

EL5UV103

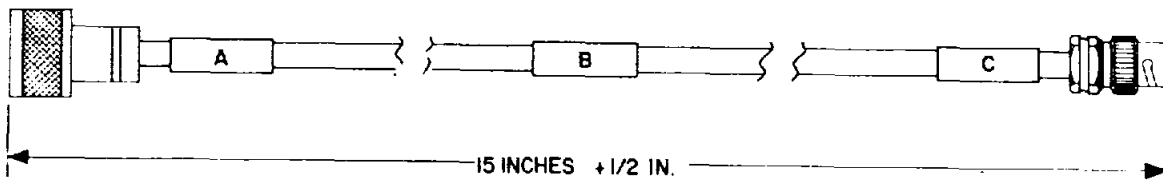
Figure 3-97. VHF-1 antenna cable W407B.



MARKING		
A	B	C
PI	W408A	P2
(A53 J5) ANT ENT	80063 ASSY 881933	(UNIT 38 OUTPUT) VHF-FL

EL5UV104

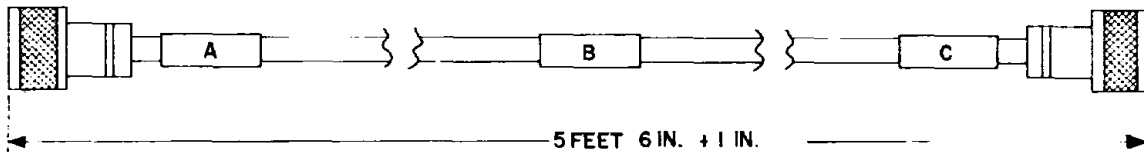
Figure 3-98. VHF-2 antenna cable W408A.



MARKING		
A	B	C
PI	W408B	P2
(UNIT 38 INPUT) VHF-FL	80063 ASSY 881934	(UNIT 21 J2) VHF-2

EL5UVI05

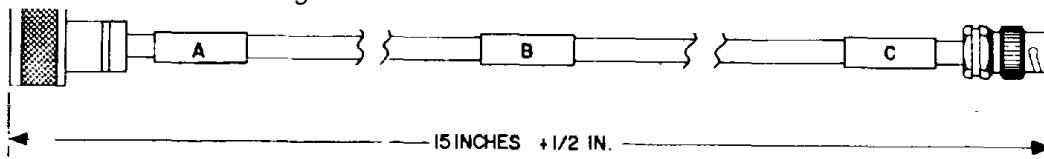
Figure 3-99. VHF-2 antenna cable W408B.



MARKING		
A	B	C
PI	W409A	P2
(A53 J4) ANT ENT	80063 ASSY 881935	(UNIT 39 OUTPUT) VHF-FL

EL5UVI06

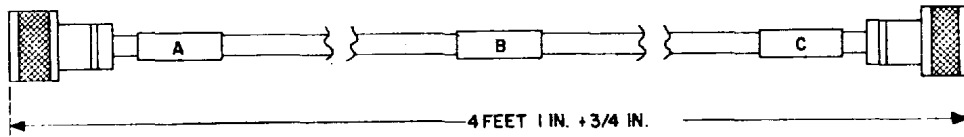
Figure 3-100. VHF-3 antenna cable W409A.



MARKING		
A	B	C
PI	W409B	P2
(UNIT 39 INPUT) VHF-FL	80063 ASSY 881936	(UNIT 24 J2) VHF-3

EL5UVI07

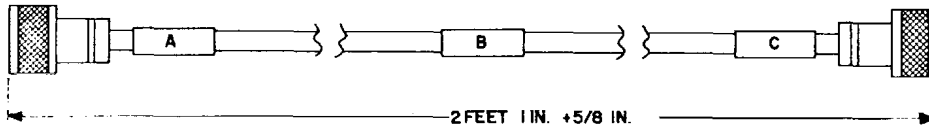
Figure 3-101. VHF-3 antenna cable W409B.



MARKING		
A	B	C
PI	W411A	P2
(A53 J8) ANT ENT	80063 ASSY 881939	(UNIT 4I OUTPUT) HF-FL

EL5UV108

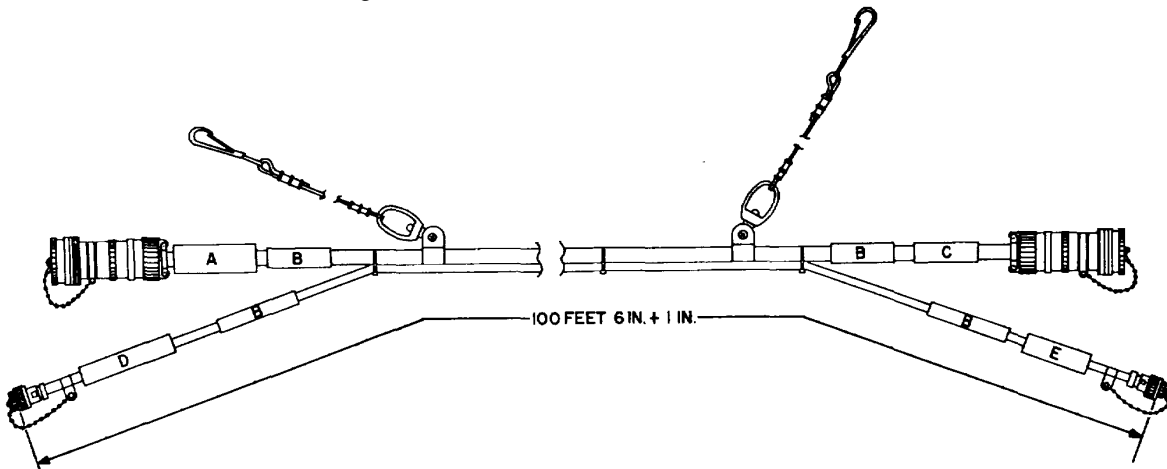
Figure 3-102. HF-1 antenna cable W411A.



MARKING		
A	B	C
PI	W411B	P2
(UNIT 4I INPUT) HF-FL	80063 ASSY 881940	(UNIT 9 ANT) HF-I

EL5UV109

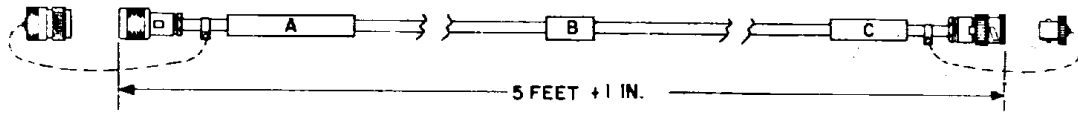
Figure 3-103. HF-1 antenna cable W411B.



MARKING				
A	B	C	D	E
PI	W501	P2	P3	P4
(UNIT I ANT ENT HF COUPLER)	80063 ASSY 881918 100 FEET	(HF COUPLER JI)	(UNIT I ANT ENT HF ANTENNA)	(HF ANTENNA J5)

EL5UV110

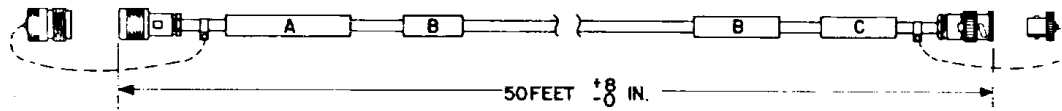
Figure 3-104. HF-1 antenna cable W501.



MARKING		
A	B	C
PI	W503	P2
ANT ENT FM-1	80063 ASSY 881917	SHELTER FM-AS-1729 J1

EL5UV111

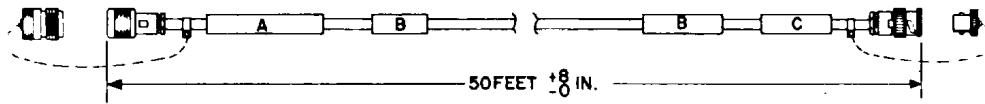
Figure 3-105. FM antenna cable W503, (5 feet).



MARKING		
A	B	C
PI	W504	P2
ANT ENT FM-2	80063 ASSY 881914	FM-AS-1729 (TRIPOD) J1

EL5UV112

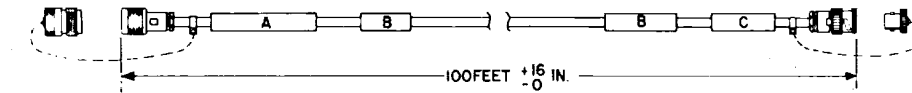
Figure 3-106. FM antenna cable W504, (50 feet).



MARKING		
A	B	C
PI	W505	P2
ANT ENT FM-3	80063 ASSY 882013	FM-AS-1729 (TRIPOD) J1

EL5UV113

Figure 3-107. FM antenna cable W505, (50 feet).

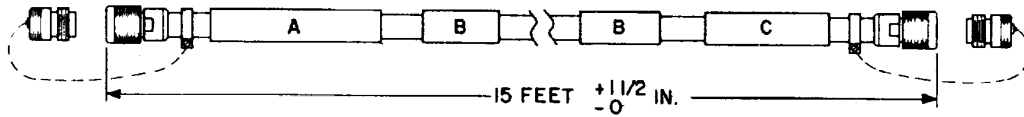


MARKING		
A	B	C
PI	W506	P2
ANT ENT FM-3	80063 ASSY 881913	ANT MAST AB-577 FM-AS-1729 J1

EL5UV114

Figure 3-108. VUV antenna cable W506, (100 feet).

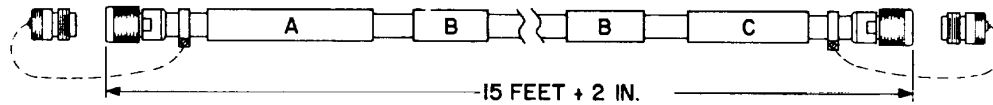




MARKING		
A	B	C
PI	W507	P2
ANT ENT VHF-2	80063 ASSY 881915	VUV-AS-3244/TS LVHF-J3

EL5UV115

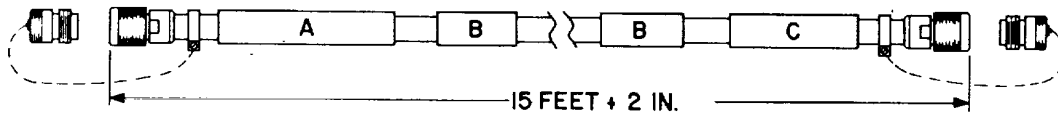
Figure 3-109. VUV antenna cable W507, (15 feet).



MARKING		
A	B	C
PI	W508	P2
ANT ENT VHF-3	80063 ASSY 882007	VUV-AS-3244/TS UVHF-J2

EL5UV116

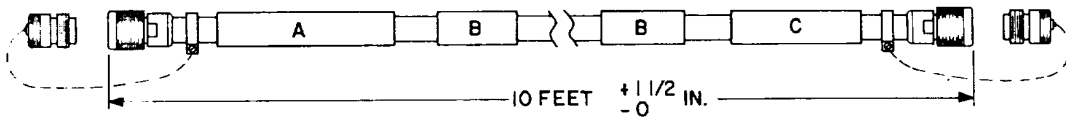
Figure 3-110. UVU antenna cable W508, (15 feet).



MARKING		
A	B	C
PI	W509	P2
ANT ENT UHF-3	80063 ASSY 882008	VUV-AS-3244/TS CUHF-J1

EL5UV117

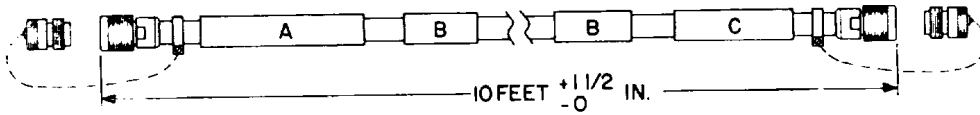
Figure 3-111. UVU antenna cable W509, (15 feet).



MARKING		
A	B	C
PI	W510	P2
ANT ENT VHF-1	80063 ASSY 881916	UVU-AS-3243/GRC VHF-J2

EL5UV118

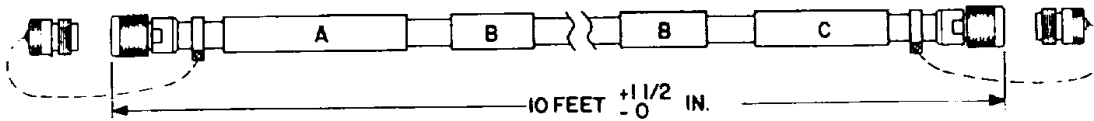
Figure 3-112. UVU antenna cable W510, (10 feet).



MARKING		
A	B	C
PI	W511	P2
ANT ENT UHF-1	80063 ASSY 882009	UVU-AS-3243/GRC UUHF-J1

EL5UV119

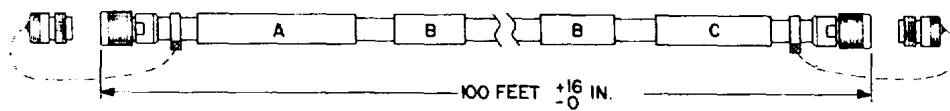
Figure 3-113. UVU antenna cable W511, (10 feet).



MARKING		
A	B	C
PI	W512	P2
ANT ENT UHF-2	80063 ASSY 882010	UVU-AS-3243/GRC L UHF-J3

EL5UV120

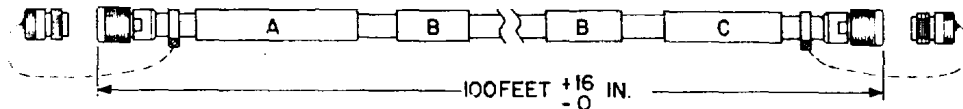
Figure 3-114. UVU antenna cable W512, (10 feet).



MARKING		
A	B	C
PI	W513	P2
ANT ENT VHF-I	80063 ASSY 881912	MAST AB 577 UVU-AS-3243/GRC VHF-J2

EL5UVI21

Figure 3-115. UVU antenna cable W513, (100 feet).



MARKING		
A	B	C
PI	W514	P2
ANT ENT UHF-I	80063 ASSY 882011	MAST AB-577 UVU-AS-3243/GRC U UHF-J1

EL5UVI22

Figure 3-116. UVU antenna cable W514, (100 feet).

**3-35. Audio System Adjustments**

Adjustment of the transmit and receive audio circuits may be required during maintenance operations. For the transmit audio, R- 11, located on the audio relay board in each radio key panel, must be set for a 0.7 vrms output, and R-16, located on each radio control board in the signal control box, must be set to provide the proper audio level required for the associated radio set. For proper functioning of the receive audio circuit, R-15 on each radio control board must be set to provide an output of 2.5 vrms. To make these adjustments the following procedures shall be used:

a. *Transmit Audio.*

(1) Adjustment of transmit audio level for each radio key panel.

(a) Apply power to the system signal control system.

(b) Set all selector switches on the radio key panel being adjusted to TALK.

(c) Set all selector switches on the outer two panels to OFF.

(d) Set the A A+B switch to A.

(e) Apply the standard microphone input signal (0.6 Millivolts rms) Ca 1000 Hz to the microphone input of the panel being adjusted.

(1) Connect an ac voltmeter across terminal 10 (high) and 1 (common) on PC board A1.

(g) Adjust R11 for a meter reading of 0.7 vrms.

(h) Repeat for each of the two remaining radio key panels.

(2) Adjustment of transmit audio level for each radio.

(a) After completing the radio key panel adjustment, leave the standard microphone input signal connected.

(b) Switch all radio selector switches to OFF, except for the radio circuit being adjusted. That switch should remain in TALK position.

(c) Connect an rf dummy load to the radio set antenna circuit associated with the circuit being adjusted.

(d) Apply power to the radio.

(e) Connect an ac voltmeter between TP1 (HIGH) and TP9 (COMMON) on the radio control board being adjusted.

(f) Key transmitter circuit and adjust R-16 (200-ohm variable resistor) for a meter reading indicated:

1. AN/ARC-164-0.6 vrms.
2. AN/ARC-115-0.39 vrms.
3. AN/VRC-46 (RT-524)-0.11 vrms.

(3) For the AN/ARC-102 the following special

procedures must be used.

(a) Adjust the frequency of the microphone input signal to 2000 Hz.

(b) Connect an oscilloscope through a suitable attenuator to the RF output of the AN/ARC-102.

(c) Key transmitter and adjust R16 (200 ohm variable resistor) on the radio control circuit card for a maximum modulation pattern on the oscilloscope (approx. 0.14 vrms between TP1 and TP9).

b. *Receive Audio-Adjustment of Each Receiver Output Level.*

(1) Connect an RF signal generator to the antenna connector on the radio set of the circuit being adjusted.

(2) Connect an 8-ohm resistor to the headset jack at the radio-audio panel under test and set selector switches on all radio-audio panels to MON. Apply the signals indicated below:

(a) AN/ARC-164-1, 000 microvolts modulated 90% at 1,000 Hz.

(b) AN/ARC-115-1, 000 microvolts modulated 30% at 1,000 Hz.

(c) AN/ARC- 11 A-1, 000 microvolts modulated 90% at 1,000 Hz.

(d) AN/VRC-46-10 microvolts f 10 kHz deviation at 1,000 Hz.

(e) AN/ARC-102-1, 000 microvolts modulated 30% at 1,000 Hz.

(3) Adjust the audio controls on all radio sets for maximum output except for the AN/ARC- 115. Connect an oscilloscope to TP3 and TP9 of each radio control circuit card and turn down the volume control of each radio under test until no clipping is observed on the oscilloscope. When adjusting the AN/ARC-115A turn the volume control to maximum and check for clipping. Adjust volume control accordingly.

(4) Connect the ac voltmeter between TP4 (HIGH) and TP9 (GROUND) on the radio control card and adjust R15 (200-ohm variable resistor) for a reading of 2.5 vrms.

### 3-36. Security Call Indicator Flasher Circuit Sensitivity Adjustment

#### NOTE

This adjustment is only applicable when fm radio set No. 3 is connected for voice security operation.

## Section V. DIRECT SUPPORT TESTING PROCEDURES

### 3-38. General Instruction

This section contains tests for use by direct support organizations. These procedures set forth specific requirements that repaired equipment must meet before being returned to the using organization. The testing procedures may also be used as a guide for the testing of equipment that has been repaired at direct support.

Perform the following test, and adjustment if necessary, whenever the fm radio set No. 3 radio control board circuit card or the receiver-transmitter is replaced.

a. Adjust potentiometer R10 (fig. 2-5) on preamplifier board AI in the Amplifier Filter AM-6989/TS fully counter-clockwise (minimum sensitivity).

b. Connect the output of the rf signal generator (fm) through the 6 dB pad to the antenna connector of radio set FM3.

c. Set the rf signal generator frequency to match that of the receiver-transmitter. Apply a 1000 gv signal, with a deviation of 8 kHz, to the receiver-transmitter through the 6 dB pad.

d. At the Amplifier Filter AM-6989/TS box, adjust variable resistor R10 clockwise until the SECURITY CALL INDICATOR starts to flash.

e. After the lamp begins to flash, increase the sensitivity by turning R10 an additional four or five turns clockwise.

### 3-37 Telephone Call Lamp Flasher Light Circuit Adjustment

Perform the following test, and adjustment if necessary, whenever a telephone control circuit card is replaced.

a. At the telephone entrance panel, after removing any external wires, connect a pair of jumper wires from any of the telephone circuits to the terminals of the telephone line to be adjusted. As an example, assume that telephone control circuit card A26 (telephone line 10) has been replaced and that telephone line 9 is jumpered to telephone line 10.

b. At the signal control box set potentiometer R9 (fig. 2-3) on telephone control circuit card A25 fully clockwise (minimum sensitivity).

c. At the operator's console, check to see that telephone key switches (line 10) on all three telephone control panels are set to OFF. Hold any telephone key switch 9 to the RING position.

d. Adjust R9 on telephone control circuit card A26 counterclockwise until telephone call lamp 10 starts to flash.

e. After the lamps begin to flash (lamp 10 on all three telephone panels), increase the circuit sensitivity by turning R9 an additional four or five turns counterclockwise.

### 3-39. Testing Procedures

The test procedures included in this section cover those direct support repairable units which are subject to separate testing, and an operational test of the FCC facilities; these are:

a. Amplifier-Filter 1A54.

b. Signal control box 1A36.

- c. Radio-audio control panel 1A42, 1A43, 1A44.
- d. Flight coordination central AN/ISC-61B.

**3-40. Amplifier Filter 1A54**

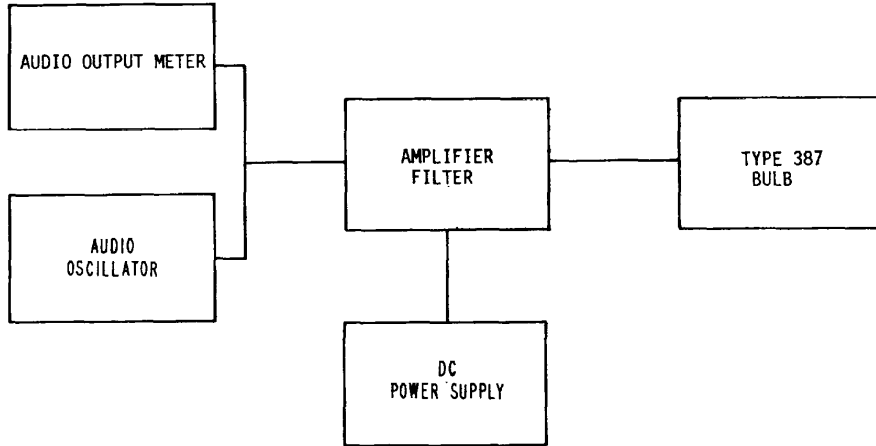
a. *Test Equipment and Material.*

- (1) DC power supply.
- (2) Multimeter AN/USM-223.
- (3) Audio Output Meter TS-585B/U.

(4) Audio Oscillator AN/URM-127.

(5) Socket and Bulb Type MS25237-387.

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 3-117 and detailed in paragraphs c and d, below. The amplifier filter is not to be connected to other units of the FCC during these tests.



EL5UV124

Figure 3-117. Amplifier-filter test setup.

c. Continuity Tests.

Step No.	Test procedure	Performance standard
1.	Connect the AN/USM-223 across the following terminals of TB1 and observe readings:	None.
2.	5 to 8.	Continuity.
3.	8 to 18.	Continuity.
4.	9 to 16.	Continuity.
5.	1 to 12.	120 ohms ±5%.
6.	12 to 13.	330 ohms ± 5%.
7.	12 to 14.	47 ohms ± 5%.
8.	14 to 18.	Continuity.
9.	17 to 18.	Continuity.
10.	Connect one lead of the AN/USM-223 to the input of FL1; connect the second lead to terminal 16 of TB1.	Continuity.
11.	Connect one lead of the AN/USM-223 to the input of FL2; connect the second lead to terminal 17 of TB1.	Continuity.
12.	Connect one lead of the AN/USM-223 to the following pins of preamplifier circuit card A1; connect the second lead to the following terminals of TBI and observe readings:	Continuity.
13.	Pin 1 to terminal 10.	Continuity.
14.	Pin 2 to terminal 8.	Continuity.
15.	Pin 3 to terminal 9.	Continuity.
16.	Connect one lead of the AN/USM-223 to the following pins of preamplifier circuit card A1; connect the second lead to following pins of amplifier circuit card A2 and observe readings:	None.
17.	A1 pin 4 to A2 pin 3.	Continuity.
18.	A1 pin 3 to A2 pin 2.	Continuity.
19.	A1 pin 2 to A2 pin 4.	Continuity.

Step No.	Test procedure	Performance standard
20.	Connect the AN/USM-223 across the following terminals of TB1, observing the polarity listed below and note the readings: Positive lead to terminal 6; negative lead to terminal 7. Positive lead to terminal 7; negative lead to terminal 6.	None.
21.		Less than 750 ohms.
22.		Greater than 750 ohms.

*d. Operational Test.*

Step No.	Test procedure	Performance standard
1.	Connect the positive lead of power supply to input of FL1; connect the negative lead to the input of FL2. Adjust the input impedance of the audio output meter for 600 ohms and connect the unit between terminals 10 (input) and 8 (ground.) Connect the output of audio oscillator to terminals 10 and 8 of TB1; set the unit for 100 milliwatts at 1000 Hz. Connect the type MS25237-387 bulb to terminal 1 and 2 of circuit Card A2. Turn on the power supply and adjust for 28 volts dc t5%. Observe the bulb when the audio oscillator is set at 100. Remove the audio oscillator signal from terminals 10 and 8 of TB1 and observe the time delay for extinguishing the light.	None.
2.		None
3.		None.
4.		None.
5.		None.
6.		The bulb should light.
7.		The bulb should extinguish after a delay of 2 to 7 seconds.

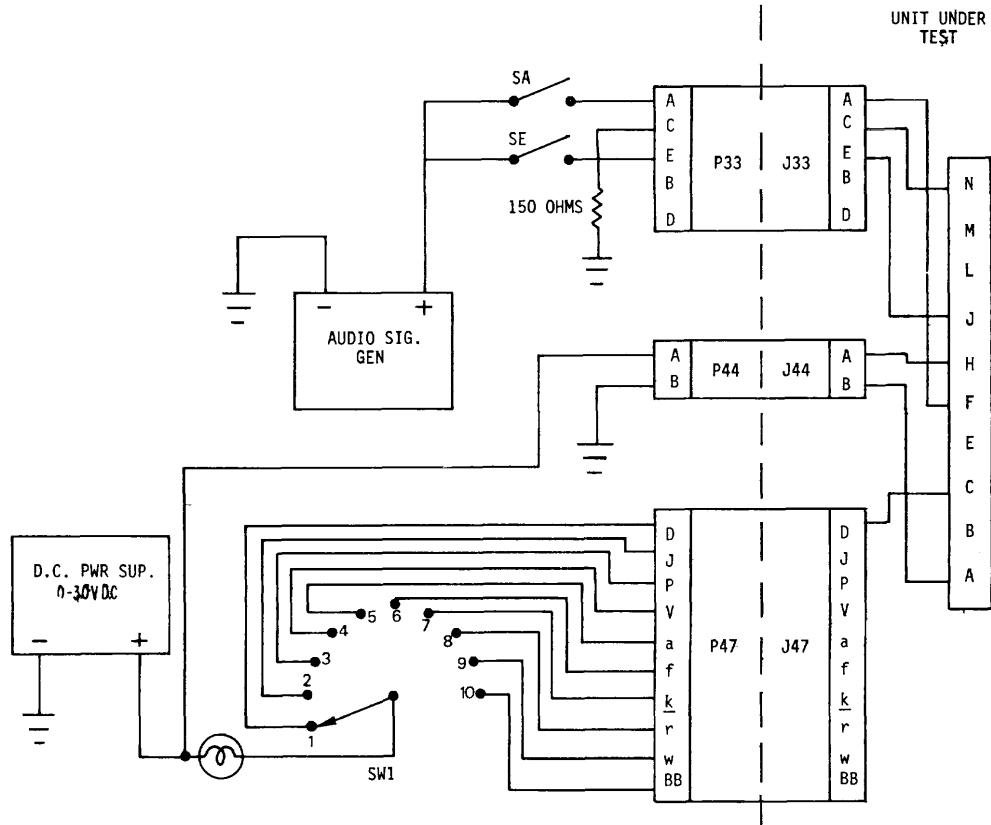
- (6) Socket and bulb type MS25237-387.
- (7) Stopwatch.

**3-41. Signal Control Box 1A36**

*a. Test Equipment and Material.*

- (1) DC power supply.
- (2) Audio oscillator AN/URM-127.
- (3) Rotary switch SW1, 10 position.
- (4) Toggle switch SA.
- (5) Toggle switch SB.

*b. Test Connections and Conditions.* Connect the equipment as shown in figure 3-118. The signal control box is not to be connected to other units of the FCC during the test and is to be complete with all tested circuit cards installed. Refer to figure FO-17 for wiring references.



EL5UV125

Figure 3-118.

c. Electrical Performance Test.

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-118.	None.
2.	Close switch S2 on the unit under test; ensure that fuses are installed; jumper test points TP3 and TP8 on radio-audio circuit card No. 1.	None.
3.	Place selector switch SW1 in position 1 and adjust the power supply to 28 vdc. Close switch SA and apply an audio oscillator signal at frequencies of 300 and 600 Hz between pins A and F. Increase the audio input signal until the lamp starts to flash.	The audio input voltage required to start the lamp flashing shall be no more than 1.0 vrms.
4.	Measure the duration of continued lamp flashing from the time of removal of the audio input signal.	The duration of lamp flashing shall be $6.5 \pm 2.5$ seconds.
5.	Reapply the audio signal and decrease the audio input to 0.1 vrms below the turn on threshold	Several tests may have to be performed to insure accurate timing measurements. The turn off voltage should be less than 0.1 vrms below the threshold voltage.
6.	Repeat 3 through 5 above with an audio signal of 6,000 Hz.	Refer to 3 through 5 above.
7.	An audio input signal of 0.7 vrms at a frequency of 1000 Hz shall be applied between TB1-40 and ground.	The output voltage measured between TP9 and TP1 (radio circuit card) shall be greater than 0.5 vrms.
8.	Maintaining an audio signal of 0.7 vrms, vary the input frequencies from 300 to 6000 Hz and measure the input voltages between	The frequency response shall not be more than + and -3 db relative to 1000 Hz in 7 above.

Step No.	Test procedure	Performance standard
9.	TP9 and TP1 at frequencies of 300, 600, 1000, 3000 and 6000 Hz. Repeat 8 above measuring the total harmonic distortion of output voltage between TP9 and TP1 at the frequencies of 8 above.	The total harmonic distortion shall be less than 5%.
10.	Repeat 5 through 9 above, placing selector switch in the appropriate positions (2-10) and reconnecting P33 connector to connector P34 through P42. Connect audio input signal to points TB1-39, TB1-38, etc., to TB1-33 and TB1-80 and 79.	Refer to 3 through 9 above.
11.	Adjust the power supply to 24 vdc. Apply a 20 Hz, ringing signal between TBI-61 and TBI-69. Connect a lamp load between TB1-110 and the positive pin of the power supply the Increase the ringing signal amplitude to obtain turn on of the lamp and relay loads. Measure the voltages between pins 61 and 69 of TB1, TB1-110 and ground, and TP3 and - ground (telephone control circuit card).	Observe readings as follows: TB1-61 and 69, less than 22 vrms. TB1-60 and 68, less than 22 vrms. TB1-59 and 67, less than 22 vrms. TB1-58 and 66, less than 22 vrms. TB1-57 and 65, less than 22 vrms. TB1-110 and GND, less than 4 vdc. TB1-118 and GND, less than 4 vdc. TB1-126 and GND, less than 4 vdc. TB1-109 and GND, less than 4 vdc. TB1-117 and GND, less than 4 vdc. TB1-88 and 96, less than 22 vrms. TB1-87 and 95, less than 22 vrms. TB1-86 and 94, less than 22 vrms. TB1-85 and 93, less than 22 vrms. TB1-84 and 92, less than 22 vrms. TB1-125 and GND, less than 4 vdc TB1-108 and GND, less than 4 vdc. TB1-116 and GND, less than 4 vdc TB1-124 and GND, less than 4 vdc. TB1-107 and GND, less than 4 vdc. TB1-83 and 91, less than 22 vrms. TB1-82 and 90, less than 22 vrms. TB1-81 and 89, less than 22 rms. TB1-112 and 120, less than 22 vrms. TB1-111 and 119, less than 22 vrms. TB1-115 and GND, less than 4 vdc. TB2-123 and GND, less than 4 vdc. TB1-106 and GND, less than 4 vdc. TB1-114 and GND, less than 4 vdc. TB1-122 and GND, less than 4 vdc. TP3 and GND, less than 4 vdc. TP3 and GND, less than 4 vdc. TP3 and GND, less than 4 vdc. TP3 and GND, less than 4 vdc. TP3 and GND, less than 4 vdc. Refer to 10 above.
12.	Repeat 10 above, applying the ringing signal to points TB1-60 and 68, TB1-59 and 67, through TB1-111 and 119 and TB1-118 through TB1-122 (figure FO-17).	None.
13.	Reconnect the power supply output (24 vdc) to pins 42 (+) and 50(-) of TB1.	None.
14.	Measure pulse output amplitude, pulse repetition rate and pulse duty cycle at pin TB2-8 and ground.	Pulse output amplitude shall not be less than 22 vdc. Pulse repetition rate shall be 3 ± 2 pps. Pulse duty cycle shall be 50 ± 20%.

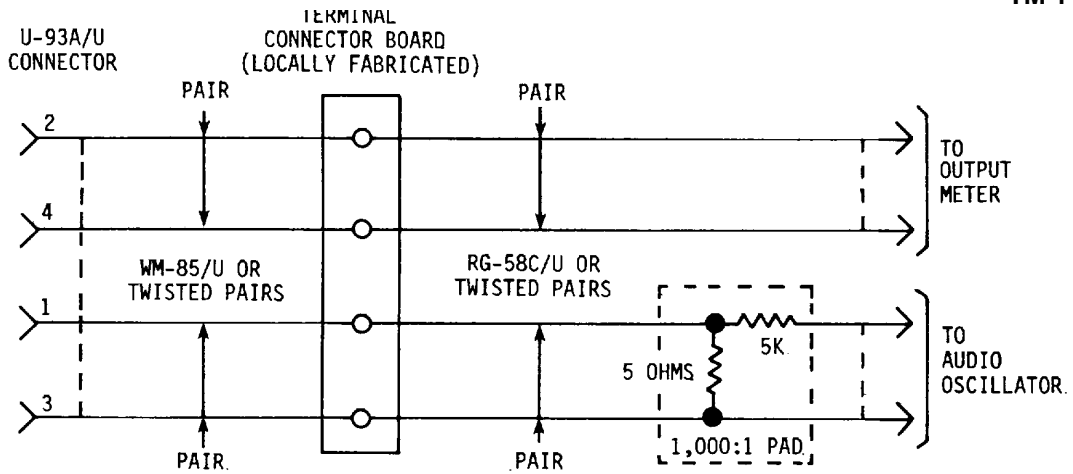
**3-42. Radio-Audio Control Panel 1A42, 1 A43, 1 A44**

*a. Test Equipment and Material*

- (1) Audio Oscillator AN/URM-127.
- (2) Voltmeter, Electronic ME-30A/U.
- (3) Audio Output Meter TS-585B/U.
- (4) Analyzer, Distortion AN/USM-259.
- (5) Power supply.
- (6) Test Set, Radio Frequency Power AN/URM-1 20.
- (7) 92/94 test cable assembly (fig. 3-119).
- (8) Audio input test cable assembly (fig. 3-

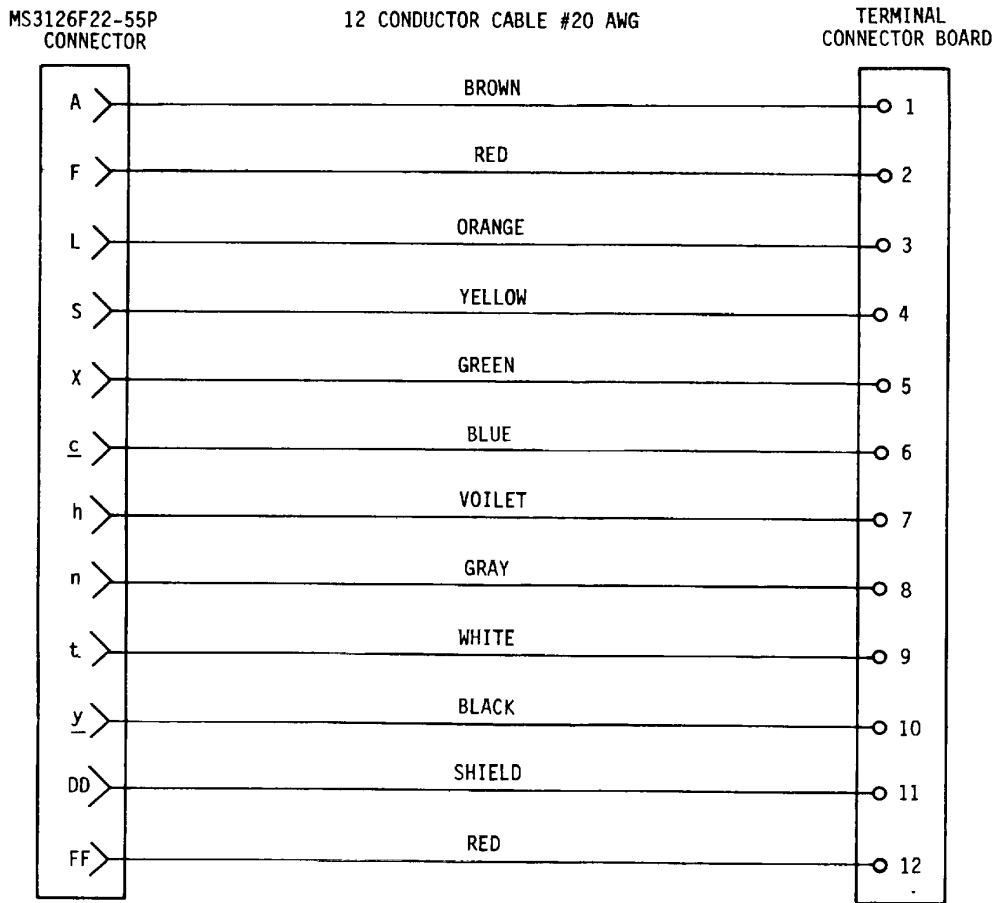
- 120).
- (9) Transmit test cable assembly (fig. 3-121).
- 122).
- (10) Telephone test cable assembly (fig. 3-122).
- b. Test Connections and Conditions.* Fig. 3-123 through 3-126 show the test equipment connections for the test procedures covered in paragraphs c through e below. The special cabling (fig. 3-119 through 3-122) requires fabrication prior to test setup. The radio-audio control panel is not to be connected to other units of the FCC during these tests.





EL5UV126

Figure 3-119. 92194 test cable assembly.



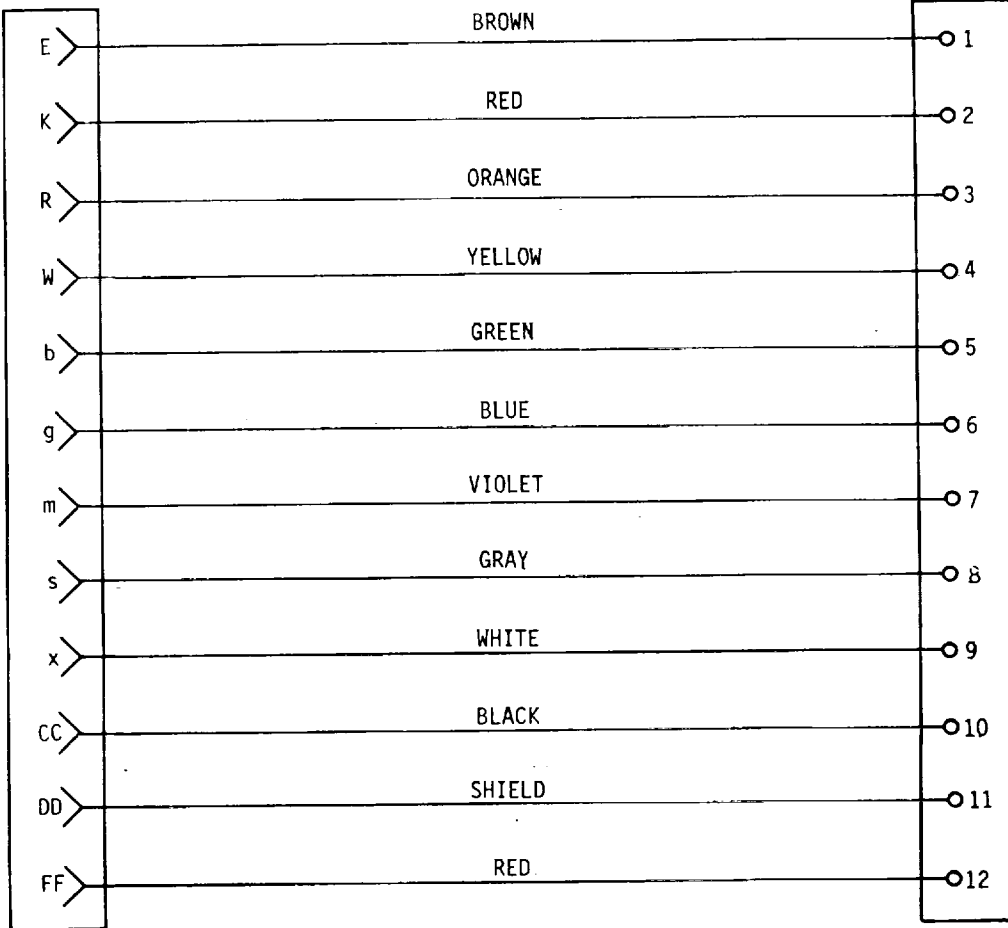
EL5UV127

Figure 3-120. Audio input test cable assembly.

MS3126F22-55P  
CONNECTOR

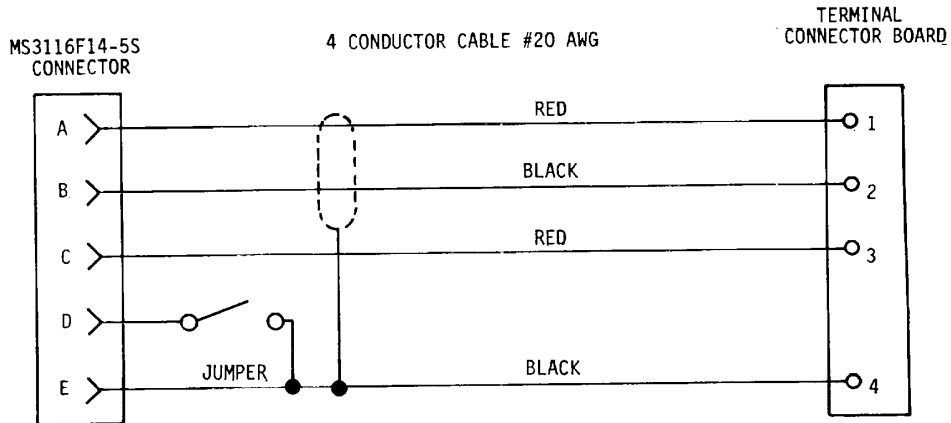
12 CONDUCTOR CABLE #20 AWG

TERMINAL  
CONNECTOR BOARD.



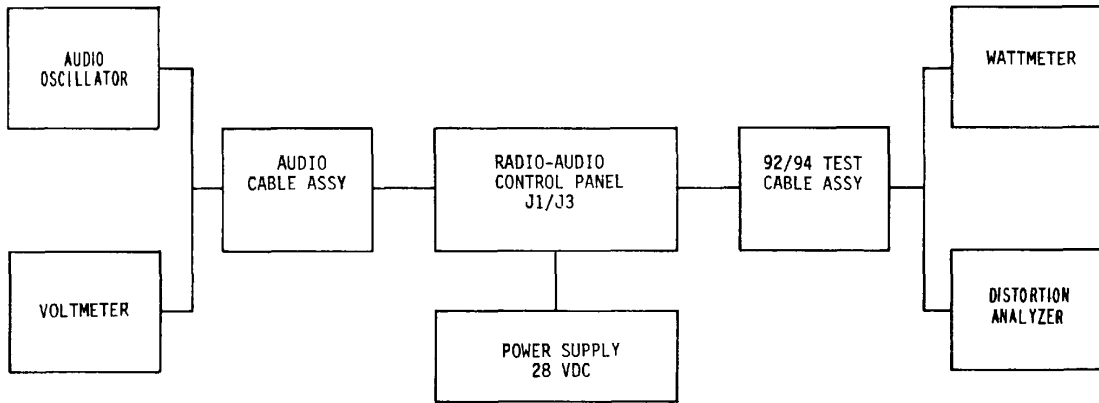
EL5UV128

Figure 3-121. Transmit test cable assembly.



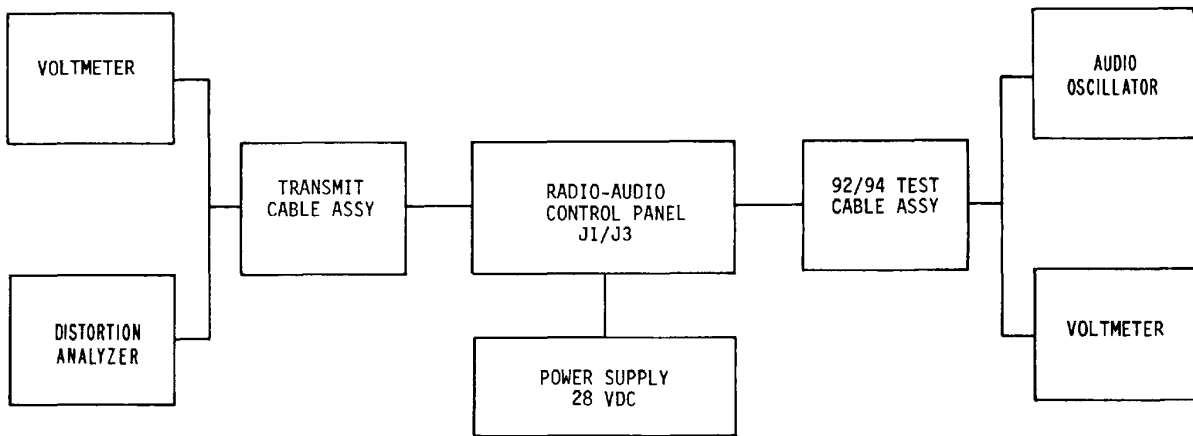
EL5UV129

Figure 3-122. Telephone test cable assembly.



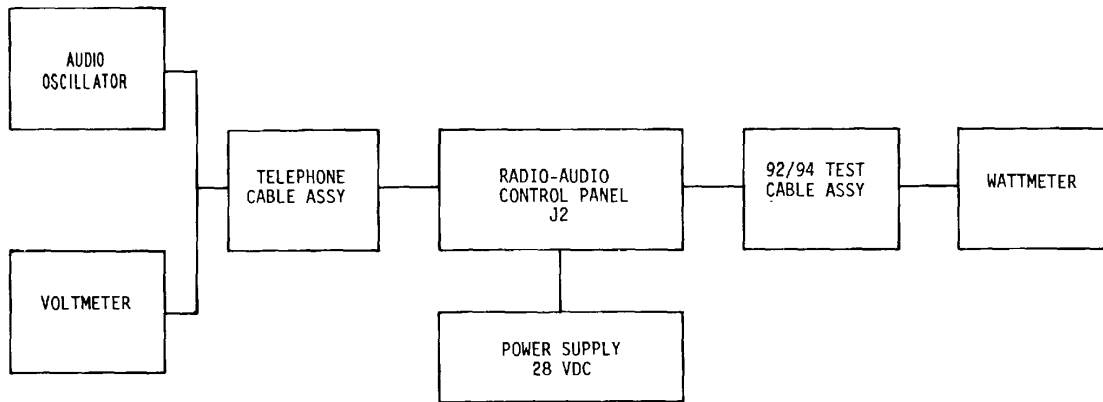
EL5UV130

Figure 3-123. Radio-audio output power and distortion test setup.



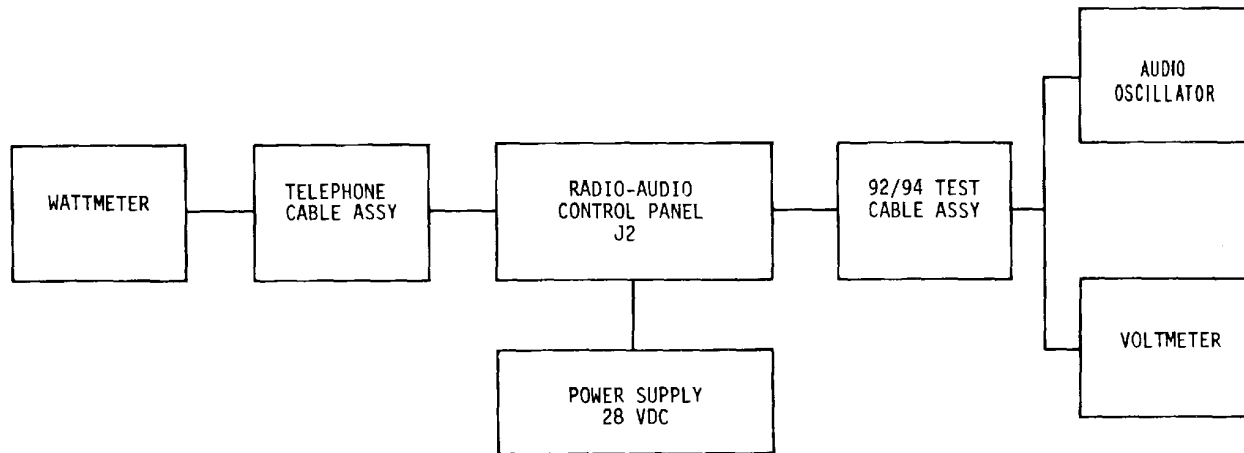
EL5UV131

Figure 3-124. Voltage gain, frequency response, and distortion test setup.



EL5UV132

Figure 3-125. Receive audio output power test setup.



EL5UV133

Figure 3-126. Transmit audio output power test setup.

c. Receiver Circuits Radio-Audio Output Power Test:

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-123.	None.
2.	Place switch S12 in A position on the radio-audio control panel.	None.
3.	Adjust the input impedance of the TS-585B/U for 8 ohms and connect the unit between headset terminals 2 and 4 of Connector U-94/U 92/94 test cable (fig. 3-119).	None.
4.	Apply 28 vdc: 0.5 to J1 utilizing audio input test cable (fig. 3-120). Positive lead to pin FF and negative lead to pin DD.	None.
5.	Apply a 2.5 vrms audio signal from the audio oscillator at frequencies of 300 and 6000 Hz between pins A and DD of connector J1 utilizing audio input test cable (fig. 3-120). S1 through S10 are in the MON position.	None.
6.	Adjust volume control A for maximum output and record radio audio output power.	With an input voltage of 2.5 vrms at a frequency between 300 and the 6000 Hz the headset power output shall be at least 180 milliwatts when terminated in an 8-ohm impedance load.

Step No.	Test procedure	Performance standard
7.	Repeat steps and connecting audio oscillator between the following pins of connector J1: F and DD. L and DD. S and DD. X and DD. C and DD. H and DD. N and DD. T and DD. Y and DD.	Refer to 6 above.

*d. Receiver Circuits; Radio-Audio Output Distortion Test:*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-123.	None.
2.	Place switch S12 in A position on the radio audio control panel.	None.
3.	Connect an 8 ohm ± 5 percent resistance load between headset terminals 2 and 4 of Connector U-94/U utilizing 92/4 test cable (fig. 3-119).	None.
4.	Connect the input of distortion analyzer across the 8-ohm load.	None.
5.	Apply a 2.5 vrms audio signal from the audio oscillator at frequencies of 300 and 6000 Hz between pins A and DD of connector J1, utilizing special audio test cable (fig. 3-120). 51 through 512 are in the MON position.	None.
6.	Record the headset distortion at 300 and 6000 Hz.	With an input voltage of 2.5 vrms at a frequency between 300 and 6000 Hz, the total harmonic distortion measured at the headset output termination shall be less than 7% at 300 Hz and 5% at 6000 Hz. The output shall be terminated in an 8-ohm impedance load and set for 100 milliwatts with volume control A on radio-audio control panel.
7.	Repeat steps 5 and 6 connecting the audio oscillator between the following pins of connector J1: F and DD. L and DD. S and DD. X and DD. c and DD. h and DD. n and DD. t and DD. y and DD.	Refer to 6 above.

*e. Transmit Circuits; Voltage Gain Test:*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-124.	None.
2.	Place switch S12 in A position on the radio-audio control panel.	None.
3.	Connect a 150 ohm ± 5 percent resistance load between pins E and DD of J-1, utilizing transmit test cable (fig. 3-121).	None.
4.	Apply 28 vdc ±0.5 to J1 utilizing transmit test cable (fig. 3-121). Positive lead to pin FF and negative lead to pin DD.	None.
5.	Apply a 0.6 millivolt rmnns audio signal at 1000 Hz between microphone terminals 1 and 3 of Connector U-94/U, cable 92/94 (fig. 3-119).	None.
6.	Place key switch (S1 1) to key ON position.	None.
7.	Place switch S1 in TALK position and adjust R11 on A1 board for maximum output. The output voltage will be measured across the 150-ohm load.	With a microphone input voltage of 0.6 mvrms at a frequency of 1000 Hz and the output terminated in a 150-ohm resistance, the output voltage shall exceed 2.0 vrms.
S.	Repeat steps 4 through 7 of the above procedure with switches S2 through S10, respectively, connecting the 150-ohm load and meter across the following pins of connector J1: K and DD. R and DD. W and DD. b and D	Refer to 7 above.

Step No.	Test procedure	Performance standard
	g and DD. m and DD. s and DD. x and DD. CC and DD Adjust R1 on AI board for 7 vrms across the 150-ohm load and observe readings.	

*f. Transmit Circuits; Frequency Response Test:*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-124.	None.
2.	Place switch S12 in A position on the radio audio control panel.	None.
3.	Connect A 150 ohm i 5 percent resistance load between pins E and DD of connector J1, utilizing transmit test cable (fig. 3-121).	None.
4.	Apply a 0.6 millivolt rms audio signal over a range of 300 to 600 Hz between microphone terminals 1 and 3 of Connector U-94/U, utilizing 92/94 test cable (fig. 3-119).	None.
5.	Place key switch S1 I to key ON position.	None.
6.	Place switch S1 in TALK position and measure the voltage across the 150-ohm load at frequencies of 300, and 600, 1000, 3000 and 6000 Hz.	The frequency response at frequencies between 300 and 6000 Hz shall be not more than +1, -3 dB relative to 1000 Hz.
7.	Repeat steps 4 through 6 of the above procedure with switches S2 through S10, respectively, connecting the 150-ohm load and meter across the following pins of connector J1: K and DD. R and DD. W and DD. b and DD. g and DD. m and DD. s and DD. x and DD. CC and DD.	Refer to 6 above.

*g. Transmit Circuits; Distortion Test:*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-124.	None.
2.	Place switch S12 in A position on the radio-audio control panel.	None.
3.	Connect a 150-ohm :t 5 percent resistance load between pins E and DD of connector J1, utilizing transmit test cable (fig. 3-121).	None.
4.	Apply a 0.6 millivolt rms audio signal over a range of 300 to 6000None. Hz between microphone terminals 1 and 3 of Connector U-94/U, utilizing 92/94 test cable (fig. 3-119).	None.
5.	Connect the input of the distortion analyzer across the 150-ohm	None.
6.	Place key switch S11 to key ON position.	None.
7.	Place switch S1 in TALK position, and measure the total harmonic distortion across the 150-ohm load at frequencies of 300, 600 1000, 3000, and 6000 Hz.	The total harmonic distortion measured at the audio output terminations shall be less than 10%. The output shall be terminated in a 150-ohm resistance load.
8.	Repeat steps 4 through 7 of the above procedure with switches S2 through S10, respectively, connecting the 150-ohm load and distortion analyzers across the following pins of connector J1: K and DD. R and DD. W and DD. b and DD. g and DD. m and DD. s and DD. x and DD. CC and DD.	Refer to 7 above.

*h. Telephone Circuits; Receiver Audio Output Power Test:*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 3-125.	None.
2.	Place switch S12 in A position on the radio audio control panel.	None.
3.	Adjust the input impedance of TS-585B/U for 8 ohms and connect the unit between headset terminals 2 and 4 of Connector U-92/U, utilizing 92/94 test cable (fig. 3-119).	None.
4.	Apply a 0.8 vrms audio signal from the audio oscillator at frequencies of 300 and 3200 Hz between pins A and B of J2, utilizing telephone test cable (fig. 3-122).	None.
5.	Apply 28 vdc :0.5 to J2 utilizing telephone test cable (fig. 3-122). Positive lead to pin C and negative lead to pin E.	None.
6.	Adjust VOL control B for maximum output and observe readings.	With an input voltage of 0.8 vrms at a frequency between 300 and 3200 Hz, the headset power output shall be at least 100 milliwatts terminated
7.	Disconnect the audio output meter and 92/94 test cable from Connector U-92/U	an 8-ohm impedance load. None.
8.	Connect the wattmeter and 92/94 test cable to Connector U-94/U.	None.
9.	Place switch S12 in A position on the radio audio control panel.	None.
10.	Place tel key switch on test cable to ON position.	None.
11.	Repeat procedure for A position and observe readings.	Refer to 6 above.

in

*i. Telephone Circuits; Transmit Audio Output Power Test*

Step No.	Test procedure	Performance standard
1.	Connect the equipment as in figure 3-126.	None.
2.	Place switch S12 in A position on the radio audio control panel.	None.
3.	Adjust the input impedance of TS-585B/U for 500 ohms and connect the unit between pins A and B of J2, utilizing the telephone test cable (fig. 3-122).	None.
4.	Apply a 0.6 millivolt rms audio signal at 1000 Hz between microphone terminals 1 and 3 of Connector U-94/U, utilizing 92/94 test cable (fig. 3-119).	None.
5.	Place telephone key switch on test cable at ON position.	None.
6.	Observe audio power output.	With an input voltage of 0.6 millivolt rms at a frequency between 300 and 3200 Hz, the telephone output power shall be at least 0.5 milliwatts terminated in a 500-ohm
7.	Disconnect audio signal and 92/94 test cable from Connector U-94/U	load. None.
8.	Connect audio signal and 92/94 test cable to Connector U-94/U.	None.
9.	Place switch S12 in A+B position on the radio-audio control panel.	None.
10.	Repeat procedure for A+B position and observe readings.	Refer to 6 above.

impedance

**3-43. System Performance Tests**

a. *Test Equipment and Material.* During the FCC operational test, a remote radio site will be required having a complement of radios compatible with those in the AN/TSC-61B. Selection of radio frequencies for this test shall be such that at least six megahertz separation is maintained between adjacent channels and that the frequency selected shall not be a direct harmonic of the lower band test frequencies. Prior to this test, the performance test procedures for the radio and telephone equipments will have been conducted and the equipment shall function within the limits as specified.

b. *Test Connections and Conditions.* Each of the various communications and power equipment of the FCC are to be checked as part of the overall systems test in order to determine acceptability of a repaired system. When testing of an individual set or subsystem is being conducted, all other equipment in FCC shall be operating normally. Radio and telephone communication equipment not being tested during a selected test procedure shall be in monitor mode with volume at normal operating levels; air conditioners, blowers, power units, and other ancillary equipment shall be operating normally. All equipment shall be permitted sufficient warm up time to achieve normal operating temperature.

Step No.	Test procedure	Performance standard
1.	Test Setup Procedures. a. Before connecting input power to shelter, place all circuit breakers to the OFF position.	a. None.

Step No.	Test procedure	Performance standard
lights	<p>b. Connect power cables and apply main power by placing main circuit breaker to the ON position.</p> <p>c. Apply power to equipment and components by placing appropriate circuit breakers to the ON position.</p> <p>d. Place A A+B switch on each radio key panel in A+B position.</p> <p>e. Adjust each radio set to its assigned frequency.</p> <p>f. Arrange to communicate with remote station. One frequency should be assigned as a standby or guard channel so that communication will not be lost.</p> <p>g. Progressively place each radio key in MON position and adjust for squelch condition with no signal and volume level with signal.</p> <p>h. On all telephone key panels, place key switches in OFF position</p>	<p>b. None</p> <p>c. None.</p> <p>d. None.</p> <p>e. None.</p> <p>f. None.</p> <p>g. None.</p> <p>h. Observe that all radio and telephone key</p>
2.	<p>and OPR AUDIO switch in ON position.</p> <p>Radio Key Panel Test Procedure</p> <p>a. Depress each key light test lamp.</p> <p>b. Starting with the first key (UHF-1) on the extreme left side of key panel # 1, use the following sequence</p> <p>c. Place the key in TALK position.</p> <p>d. Key transmitter and communicate with remote station. Place key in MON position to receive. Check for signal level, distortion, and interference.</p> <p>e. Observe indicator lights.</p>	<p>are extinguished with no incoming signals.</p> <p>a. The lamp shall light.</p> <p>b. None.</p> <p>c. None.</p> <p>d. Signal level, distortion, and interference shall be acceptable</p> <p>e. No other light except the one over the</p>
selected	<p>f. When it is established that undistorted operation is achieved with no undesirable effects and communication is satisfactory, place the key in OFF position.</p> <p>g. Repeat c through f above for each remaining key (UHF-2, UHF-3, etc.).</p> <p>h. Place A A+B switch in A position.</p> <p>i. Repeat c through g above.</p> <p>j. Finally, repeat c through j above for each remaining radio key panel.</p>	<p>key is lighted during receiving and transmitting periods</p> <p>f. None.</p> <p>g. Refer to c through above.</p> <p>h. None.</p> <p>i. Refer to c through g above.</p> <p>j. Refer to c through j.</p>
3.	<p>Telephone Key Panel Test Procedure.</p> <p>a. Set A A+B switch on all radio key panels to A+B position.</p> <p>b. Depress each key light to test lamp.</p> <p>c. Starting with the first key (line # 1) on the extreme left side of key panel # 1, use the following sequence:</p> <p>d. Connect a TA-312/PT field telephone to line at the telephone entrance panel.</p> <p>e. Ring line # 1 from TA-312/PT and check flashing light above key # 1 of all telephone key panels</p> <p>f. Place key in TALK position. Check for steady light above key # 1 of all key panels and establish voice communication with TA-312/PT operator to verify that correct indications have been received.</p> <p>g. Observe voice communication level.</p>	<p>a. None.</p> <p>b. The lamp shall light.</p> <p>c. None.</p> <p>e. Key light shall flash.</p> <p>f. Key light shall remain steady.</p>
is of	<p>telephone loudness and undistorted.</p> <p>h. Place key to RING position and check ringing of TA-312/PT by returning key to TALK position.</p> <p>i. Repeat d through h above for each remaining key (line # 2, # 3, etc).</p> <p>j. Place A A+B switch in A position.</p> <p>k. Repeat d through i above</p> <p>l. Finally, repeat d through k above for each remaining telephone key panel.</p>	<p>g. Determine that voice communication level normal</p> <p>h. Establish communication with TA-312/PT operator for ring verification.</p> <p>i. Refer to through h above.</p> <p>j. None.</p> <p>k. Refer to d through i above.</p> <p>j. Refer to d through k above.</p>
4.	<p>Signal Control Box Operational Test.</p> <p>a. Place the alarm buzzer switch in ON position.</p> <p>b. Perform the FCC operational test.</p>	<p>a. None.</p> <p>b. Observe that the buzzer activates when a</p>
key		<p>lamp flashes during an incoming signal.</p>



## CHAPTER 4 GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

### Section I. GENERAL

#### 4-1. Scope of General Support Maintenance

These procedures supplement direct support maintenance procedures for those assemblies designated for repair at general support level.

#### 4-2. Items for Repair

The information in this chapter provides troubleshooting, repair, and testing procedures for the following circuit cards:

- a. Buzzer-flasher circuit card 1A41A16.
- b. Radio control circuit cards 1A41A1 through (3) Resistor 100-ohm, 30 w.
- c. Telephone control circuit cards 1A41A17 through dA41A31.
- d. Preamplifier circuit card IA54A1.
- e. Amplifier circuit card 1A54A2.

#### 4-3. Test Equipment and Materials Required

- a. *Test Equipment.*
  - (1) Power supply.

#### 4-4. Troubleshooting Data

The following data should be used as required:

- a. *Simplified Schematic Diagrams (figs. 2-3 through 2-6).* These diagrams are simple and easy to read. They can be found in chapter 2.
- b. *Parts Location Illustrations figs. 4-6 through 4-10).* These figures can be used to locate parts mentioned in troubleshooting charts.
- c. *Resistor and Capacitor Color Code Diagrams (fig. FO-1).* This diagram will help to find the values of capacitors and resistors. Ratings and tolerances are also set forth in the diagram.
- d. *Complete Schematic Diagrams figs. FO-3 through FO-17).* These figures can be used to find faults related to the circuit cards when installed in the FCC.
- e. *Voltage Measurements.* This information is given in the operational test charts (para 4-10d, 4-11d, 4-12d, 4-13d, and 4-14d). Also refer to the simplified schematic diagrams (figs. 2-2 through 2-6).

#### 4-5. General Precautions

**Observe the following precautions:**

- a. Do not overtighten screws.
- b. Always replace lockwashers.
- c. Before a part is unsoldered, note and tag the leads.
- d. Do not damage other leads by pushing or pulling them.
- e. Do not use a large soldering iron.
- f. Do not allow solder to fall onto circuit card components.

- (2) Multimeter AN/USM-223.
- (3) Audio Oscillator AN/URM-127.
- (4) Generator, Pulse SG-1105/U.
- (5) Audio Oscillator TS-421C/U.
- (6) Test Set, Radio Frequency Power AN/URM-120.
- (7) Oscilloscope AN/USM-281A.

#### b. *Materials.*

- (1) Resistor 12-ohm, 56 w.
- (2) Resistor 25-ohm, 75 w.
- (3) Resistor 10-ohm, 30 w.
- (4) Resistor 150-ohm  $\pm 5\%$ .
- (5) Resistor 300-ohm  $\pm 5\%$ .
- (6) Resistor 3000-ohm  $\pm 5\%$ .
- (7) Resistor 600-ohm  $\pm 5\%$ .
- (8) Socket and bulb type MS25237-387.

### Section II. TROUBLESHOOTING

- g. Make well soldered joints.
- h. Do not disturb adjustment settings.

#### 4-6. Parts Substitution

- a. Do not substitute parts indiscriminately. Substitute only when trouble has been isolated to a specific stage.
- b. When an *open* capacitor is suspected, connect a good capacitor of equal value across the capacitor in question. Check the operation of the component.
- c. When all other possibilities of trouble are ruled out, substitute a good part for the one which is suspected of being defective.

#### 4-7. Intermittents

- a. If the operation of a component is intermittently faulty, the trouble may be difficult to locate when the component is functioning normally. Such troubles can often be found by lightly tapping each part in the suspected stage or portion of the component with an insulated rod while watching test equipment indications. Lightly tap all of the parts including transistors and wiring. If the test equipment indications remain normal, repeat the tapping process at adjoining stages until the normal indications change.

- b. Intermittent operation can be caused by loose connections, broken wires, or parts with internal defects. Observe test equipment for erratic behavior which could indicate this problem.

#### 4-8. Transistor Troubleshooting

When troubleshooting, observe the following:

a. When measuring voltages, use sleeving to insulate the test probe except for the extreme tip.

b. Check the open circuit voltage across the ohmmeter test leads. Do not use the ohmmeter if the open circuit voltage exceeds 1.5 volt. Do not use the RX1 scale when testing low power transistors.

c. Any change in the output circuit of one transistor amplifier stage can affect all preceding stages.

d. Common-emitter transistor amplifiers have a 180-degree phase shift between input and output voltages. However, there will be no phase shift if the base is shorted to the collector.

e. The dc base voltage should be slightly higher than the emitter voltage during normal operation of a common-emitter transistor amplifier. However, an open circuit between the base and the emitter will result in the emitter voltage approximating ground potential and a base voltage considerably greater than normal.

f. An unusually high dc collector voltage can be caused by:

- (1) An open emitter circuit.
- (2) An open collector circuit.
- (3) A short between base and emitter.
- (4) An open circuit between base and emitter.

g. An unusually low dc collector voltage indicates a short circuit across the output impedance or between:

- (1) Collector and ground.
- (2) Collector and emitter.
- (3) Collector and base.

h. When checking the base-to-emitter resistance of NPN transistors, the ohmmeter ground must be connected to the emitter lead. The resistance indicated on the RX1 scale should be greater than 10 ohms, but less than 50 ohms. However, when meter leads are reversed, the emitter-to-base resistance should be several thousand times greater.

i. When unsoldering transistor leads, use long-nosed pliers as a heat sink.

#### 4-9. Isolating Trouble

Circuit cards removed from the FCC because of operational malfunctions identified at organizational or direct support maintenance level should first be examined to determine repair action needed. The isolation process to be used in determining a faulty part(s) depends mainly on the condition of the circuit card to be repaired.

a. When visual inspection indicates that a particular part may be at fault; a simple check of the part, appropriate replacement action followed by an operational test should be used as the most expedient method.

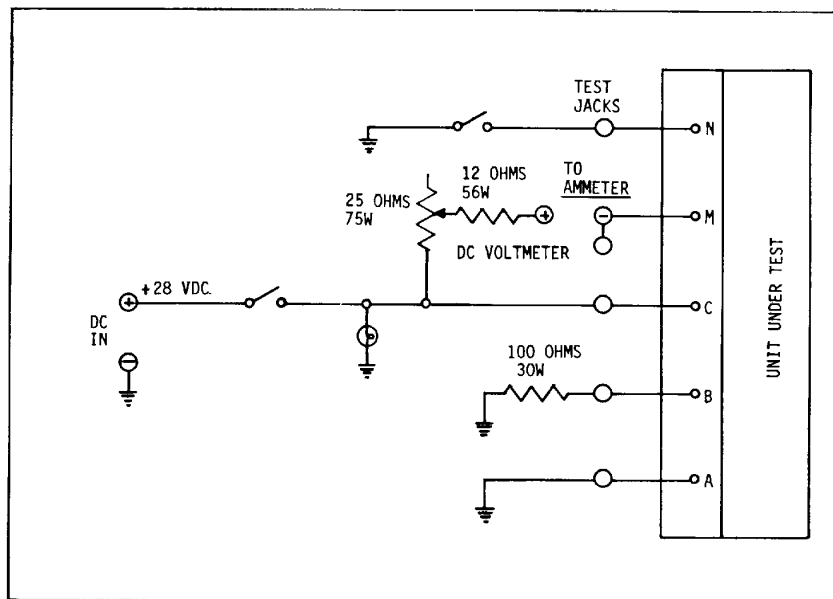
b. When visual inspection does not isolate the problem to a possible faulty part, it may be advisable to first conduct the operational tests to first determine that the card is actually at fault; or second to aid in identifying the malfunctioning circuit and part.

#### 4-10. Buzzer-Flasher Circuit Card A16

a. *Troubleshooting Procedure.* Troubleshooting the buzzer-flasher circuit card will consist of a visual inspection, resistance measurements, and operational test.

b. *Visual Inspection.* Inspect the buzzer-flasher circuit card for any obvious defects such as overheating of component parts and for breaks or openings in the printed wiring board etching.

c. *Resistance Measurements (fig. 2-2).* With Multimeter AN/USM-223, measure the resistance value of all resistances. Replace components if they are not within the specified tolerance. Measure transistor resistances between base to emitter and base to collector. If not within the specified tolerance, replace the transistor. Measure the forward and reverse resistance of diodes by reversing the AN/USM-223 probes. An acceptable reading of 10:1 should be indicated. Replace if out of tolerance.



EL5UV136

Figure 4-1. Buzzer-flasher circuit card test setup.

d. Operational Tests for Buzzer-Flasher Card.

Step No.	Test procedure	Performance standard
1.	<p>Pulse Output Voltage Test.</p> <p>a. Connect the equipment as shown in figure 4-1.</p> <p>b. Apply 24 vdc to the circuit card under test.</p> <p>c. Measure the pulse amplitude, pulse repetition rate, and pulse duty cycle between pins A and B using the oscilloscope.</p> <p>d. Apply 20 vdc to the circuit card under test.</p> <p>e. Repeat c of the above procedure.</p> <p>f. Apply 30 vdc to the circuit card under test.</p> <p>g. Repeat c of the above procedure.</p> <p>h. Disconnect dc voltage from circuit.</p>	<p>a. None.</p> <p>b. None.</p> <p>c. The pulse output voltage shall measure 3 ± 2 pulses per sec-and at a duty cycle of 50 ± 20 percent. The voltage amplitude shall be not than 2 volts less than the supply voltage.</p> <p>d. None.</p> <p>e. Refer to c above.</p> <p>f. None.</p> <p>g. Refer to c above.</p>
2.	<p>Relay Coil Resistance Test.</p> <p>a. Place the positive lead of the multimeter on pin C and negative</p> <p>b. Measure the relay coil resistance across the pin C and pin N with the multimeter.</p>	<p>a. None.</p> <p>b. The dc resistance of the relay coil shall be ohms plus or minus 10 percent.</p>
3.	<p>Relay Contact Voltage Test.</p> <p>a. Connect the equipment as shown in figure 4-1.</p> <p>b. Set the current scale on the multimeter for a reading greater than 1 ampere dc ±5%.</p> <p>c. Turn on relay switch and 28 vdc. Vary the relay load control to obtain a current reading of 1 ampere dc -5%.</p> <p>d. Measure the voltage between pins M and A.</p>	<p>a. None.</p> <p>b. None.</p> <p>c. None.</p> <p>d. The voltage drop measured across the relay contacts, when conducting a current of 1 ampere ±5%, shall be less than 2 vdc.</p>

4-11. Radio Control Circuit Cards A1 Through A10

a. *Troubleshooting Procedure.* Troubleshooting the radio control card will consist of a visual inspection, resistance measurements, and operational test.

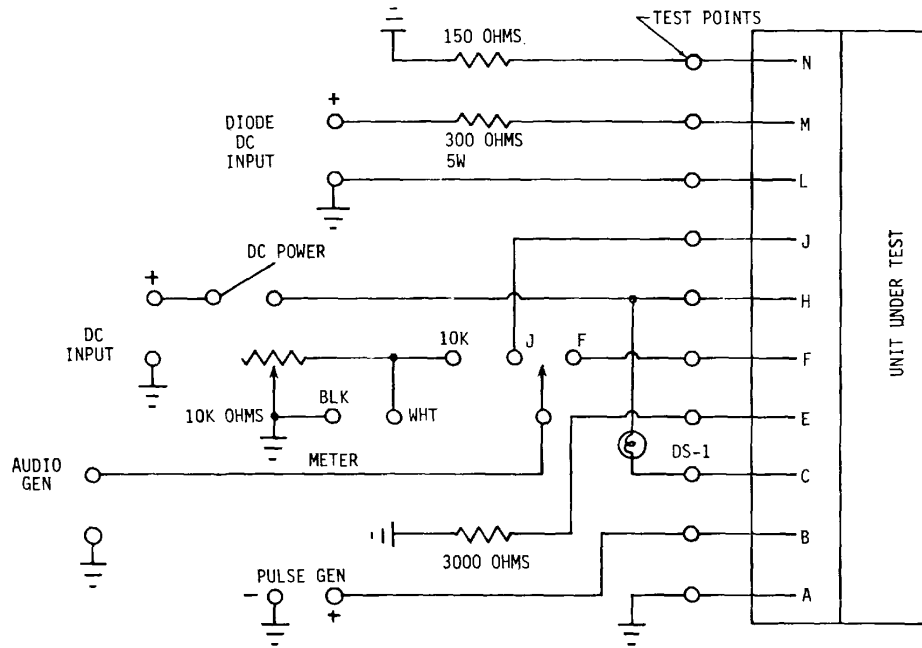
b. *Visual Inspection.* Inspect the radio control circuit card for any obvious defects such as overheating

of component parts and for breaks or openings in the printed wiring board etching.

c. *Resistance Measurements (fig. 2-4).* With Multimeter AN/USM-223, measure the resistance value of all resistances. Replace if not within the specified

tolerance. Measure transistor resistances between base to emitter and base to collector. If not within the specified tolerance, replace the transistor. Measure the

forward and reverse resistance of diodes by reversing the AN/USM-223 probes. An acceptable reading of 10:1 should be indicated. Replace if out of tolerance.



EL50V137

Figure 4-2. Radio control circuit card test setup.

d. Operational Tests for Radio Control Card.

Step No.	Test procedure	Performance standard
1.	<p>Receiver Circuit Input Impedance Test</p> <p>a. Connect the equipment as shown in figure 4-2.</p> <p>b. Prior to applying a supply voltage and connecting the audio input signal, measure the dc resistance between pins A and F. Potentiometer RIS shall be adjusted to obtain minimum input impedance. Reverse connections for assurance of minimal resistance.</p>	<p>a. None.</p> <p>b. The dc resistance of the audio input circuit shall be a minimum i5% resistance load.</p>
2.	<p>Receive Circuit Output Impedance Test.</p> <p>a. Connect the equipment as shown in figure 4-2.</p> <p>b. Prior to applying a supply voltage and connecting the audio input signal, measure the dc resistance between pins A and E. Adjust potentiometer R15 fully clockwise and counterclockwise and observe readings. Reverse connections and repeat measurements for assurance of minimum resistance.</p>	<p>a. None.</p> <p>b. The dc resistance of the audio output circuit shall be variable between zero and not less than 375 ohms when the output is terminated in a 3000-ohm i5% resistance load.</p>
3.	<p>Receive Circuit Lamp Turn on Threshold Test.</p> <p>a. Connect the equipment as shown in figure 4-2.</p> <p>b. Connect the pulse generator to the test setup. Connect 24 vdc to the test setup. Adjust the pulse generator voltage to 2 volts below the supply voltage (22 vdc). Select a pulse repetition rate of 5 pulses per second at a duty cycle of 75 i5%.</p> <p>c. Place a jumper between TP3 and TP8 on the circuit card.</p> <p>d. Place the audio generator select switch to position F on the test setup. Apply an audio signal at frequencies of 300 and 6000 Hz. more than 1.0 vrms at frequencies between 300 and 6000 Hz.</p>	<p>a. None.</p> <p>b. None.</p> <p>c. None.</p> <p>d. The lamp shall turn on when the audio input voltage is not</p>

Step No.	Test procedure	Performance standard
4.	<p>Increase the audio input signal until the lamp starts to flash. Measure the voltage between pins A and C with an oscilloscope.</p>	<p>The voltage measured between the lamp load Terminations when the lamp circuit is energized shall be less than 4 vdc.</p>
	<p>e. Apply 20 vdc to the circuit card under test. f: Repeat b, c, and above at 20 vdc supply. g. Apply 30 vdc to the circuit card under test. h. Repeat b, c, and d above at 30 vdc supply.</p>	<p>e. None. f. Refer to b, c, and d above. g. Refer to b, c, and d above. h. Refer to b, c, and above.</p>
	<p>Receive Circuit Lamp Turn Off Threshold and Turn Off Relay. a. Connect the equipment as shown in figure 4-2. b. Connect the pulse generator to the test setup. Supply 24 vdc to the test setup. Adjust the pulse generator voltage to 2 volts below the supply voltage (22 vdc). Apply an audio input signal of 1 vrms and 300 Hz between pins A and F to start the lamp flashing. Measure the duration of continued lamp flashing from the time of removal of the audio input signal. c. Apply 20 vdc to the circuit card under test. d. Repeat b above at 20 vdc supply. e. Apply 30 vdc to the circuit card under test. f. Repeat b above at 30 vdc supply.</p>	<p>a. None. b. The lamp load shall turn off between 6.5 :2.5 seconds after the audio input voltage has decreased to less than 0.1 vrms below the threshold voltage obtained in 3dabove.  c. None. d. Refer to b above. e. None. f. Refer to b above.</p>
5.	<p>Transmit Circuit Key Line Test. a. Connect the equipment as shown in figure 4-2. b. Connect a power supply between pins M and L with positive polarity at M. With the power supply at 30 vdc +5%, measure the voltage between pins M and L. c. Reverse the connections to M and L and measure the leakage current.</p>	<p>a. None. b. The voltage measured between the key line terminations when conducting 100 milliamperes5% shall not exceed 1 volt. c. The leakage current measured in the key line, terminations when a voltage of 30 vdc <u>+5%</u> not exceed 100 micro amperes.</p>
6.	<p>Transmit Circuit Input Impedance Test. a. Connect the equipment as shown in figure 4-2. b. Connect an audio signal having an impedance of 600 ohms : 5% to the test setup. Place audio generator switch to position J on the test setup. c. Adjust the audio signal to 0.7 vrms at frequency of 1000 Hz The output potentiometer R16 on the card shall be adjusted to yield the maximum output at pin N (use an oscilloscope). d. Place the audio selector switch to the 10K position. Adjust the external potentiometer to obtain a voltage of 0.7 vrms. Measure the resistance of the potentiometer load.</p>	<p>a. None. b. None.  .c. None.  d. The input impedance shall be at least 2200 ohms measured at a frequency of 1000 Hz.</p>
7.	<p>Transmit Circuit Voltage Gain, Frequency Response, and Distortion Test. a. Connect the equipment as shown in figure 4-2. b. Place the audio generator select switch to position J on the test setup. Connect an audio input signal of 0.7 vrms at 1000 Hz to test setup. c. Adjust potentiometer R16 for maximum output. Measure the output voltage between pins N and A.  d. Vary the audio input signal (maintaining a level of 0.7 vnms) over a range of frequencies between 300 and 6000 Hz. Measure the output voltage between pins N and A at frequencies of 300, 600, 1000, 3000 and 6000 Hz. Adjust R16 to yield maximum output for this test. e. Repeat procedure d above and measure distortion.</p>	<p>a. None b. None.  c. With an input voltage of 0.7 vrms at a frequency of 1000 Hz, and the output terminated in a 150-ohm resistance load, the output voltage shall exceed 0.5 vrms. d. The frequency response at frequencies between 300 and 6000 Hz shall be not more than + 1 - 3 dB relative to 1000 Hz output. The output shall be terminated in a 150-ohm resistance load. e. The total harmonic distortion measured at</p>
audio		<p>output terminations shall be less than 5%. The output shall be terminated in a 150-ohm</p>
resistance		<p>load. f. None. g. Refer to b through e above. h. None. i. Refer to b through above.</p>
	<p>f Apply 20 vdc to the circuit card under test. g. Repeat b through e above. h. Apply 30 vdc to the circuit card under test. i. Repeat b through above.</p>	

**4-12. Telephone Control Circuit Cards A17 Through A31**

a. *Troubleshooting Procedure.* Troubleshooting the telephone control circuit card will consist of a visual inspection, resistance measurements, and operational test.

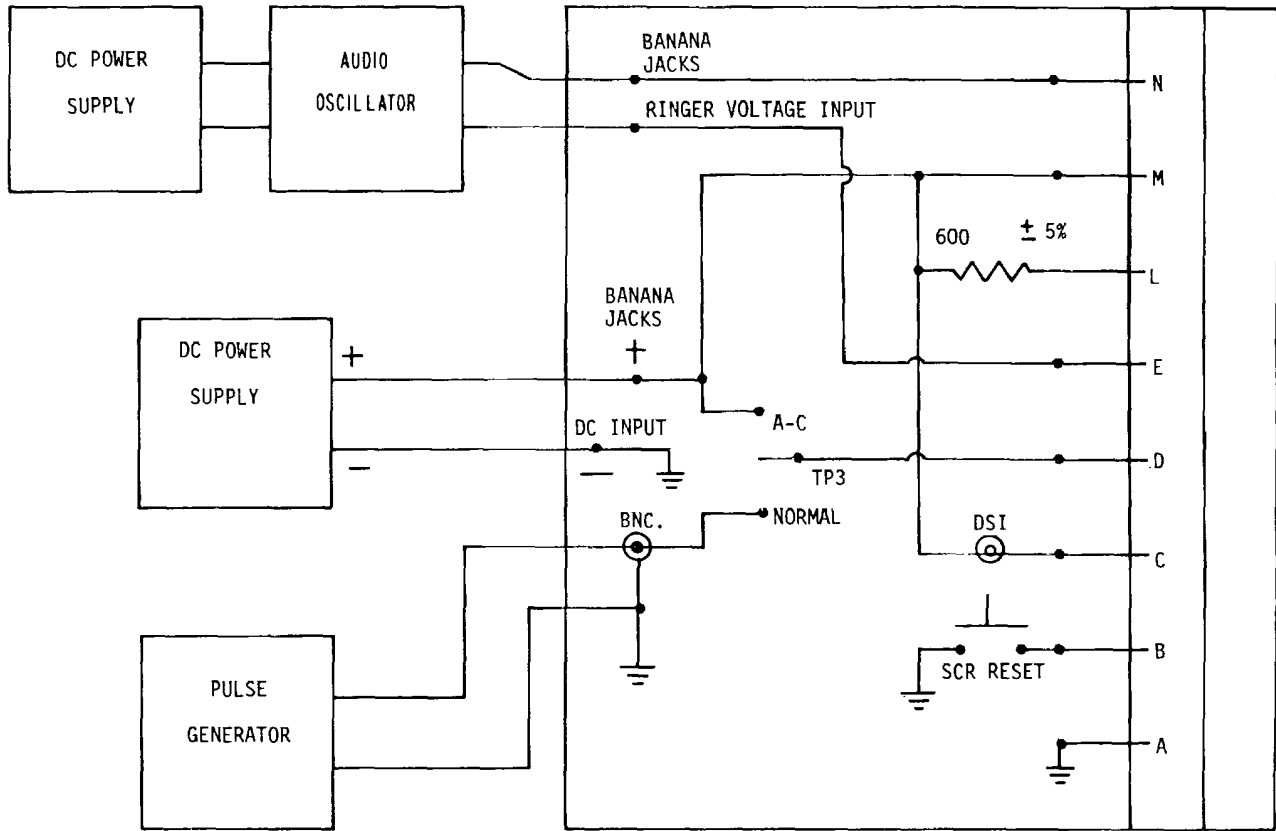
b. *Visual Inspection.* Inspect the telephone control circuit card for any obvious defects such as overheating

of component parts and for breaks or openings in the printed wiring board etching.

c. *Resistance Measurements (fig. 2-3).* With Multimeter AN/USM-223, measure the resistance value of all resistances. Replace components if they are not with-

in the specified tolerance. Measure transistor resistances between base to emitter and base to collector. If not within the specified tolerance, replace the transistor. Measure the forward and reverse

resistance of diodes by reversing the AN/USM-223 probes. An acceptable reading of 10:1 should be indicated. Replace if out of tolerance.



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Figure 4-3. Telephone control circuit card test setup.

d. Operational Tests for Telephone Control Card.

Step No.	Test procedure	Performance standard
1.	<p>Input Impedance Test.</p> <p>a. Connect the probes of the multimeter between pins E and N of the circuit card.</p> <p>b. Measure the dc resistance; reverse the connections and observe the second reading.</p>	<p>a. None.</p> <p>b. The lowest dc resistance of the ringing input circuit shall not be less than 5400 ohms; the higher reading shall approach infinity.</p>
2.	<p>Turn On Threshold Test.</p> <p>a. Connect the equipment as shown in figure 4-3.</p> <p>b. Connect a pulse generator having a current rating of at least 1 ampere to the test setup.</p> <p>c. Apply a supply voltage of 24.0 vdc.</p> <p>d. Adjust the pulse generator voltage to 2 volts below the supply voltage. Select a pulse repetition rate of 5 pulses per second at a duty cycle of 75 : 5%.</p> <p>e. Apply a 20 Hz ringing signal to the test setup; monitor the ringer voltage on pins E and N.</p> <p>f. Increase the ringing signal to turn on the lamp.</p> <p>g. Continue to increase the ringing signal to 110 vrms f 5% and sustain for 30 seconds. Decrease the ringing signal to zero volts and momentarily press the SCR reset switch on the test setup. Slowly increase the ringer signal until the lamp turns on. Monitor the input signal on pins E and N</p>	<p>a. None.</p> <p>b. None.</p> <p>c. None.</p> <p>d. None.</p> <p>e. None.</p> <p>f. Lamp will flash on and off.</p> <p>g. If the turn on voltage is less than 20 vrms, proceed to h below. If the turn on voltage is above-20 vrms, proceed to i below.</p>

Step No.	Test procedure	Performance standard
3.	<p>h. Set the ringer signal to 19 vrms. Turn R9 on the circuit card clockwise while momentarily pressing and releasing the SCR reset switch until the lamp remains out in the release position. Increase the ringer signal voltage to 20 vrms.</p> <p>i. Set the ringer signal voltage to 20 vrms. Turn R9 counterclockwise while depressing and releasing the SCR reset switch until the lamp stays on.</p> <p>j. Increase the ringing signal voltage to 22 vrms. Place the pulse generator switch to the C&amp;A position on the test setup. Measure the voltage between pins C and A.</p> <p>k. Place the generator switch in the TP3 position on the test setup and measure the voltage between pins TP3 and A.</p> <p>l. Apply a supply voltage of 20.0 vdc and perform d through k above.</p> <p>m. Apply a supply voltage of 30.0 vdc and perform d through k above.</p> <p>Turn Off Threshold Test.</p> <p>a. Repeat a through e of step 1 above.</p> <p>b. Slowly increase the ringing signal voltage to the level required to turn on the lamp. Slowly decrease the ringing signal voltage approximately 90-98% of tur on voltage while momentarily pressing and releasing the SCR reset switch to turn off the lamp.</p>	<p>h. The lamp should go on; proceed to below.</p> <p>i. None.</p> <p>j. The voltage measured between lamp termination (pin C) and ground shall be less than 4 vdc.</p> <p>k. The voltage measured between TP3 and ground (when an externally connected relay is energized) shall be less than 4 vdc.</p> <p>l. Refer to d through k above.</p> <p>m. Refer to d through k above.</p> <p>a. Refer to a through e of step 1 above.</p> <p>b. The turn off voltage shall be slightly below the turn on voltage,</p>

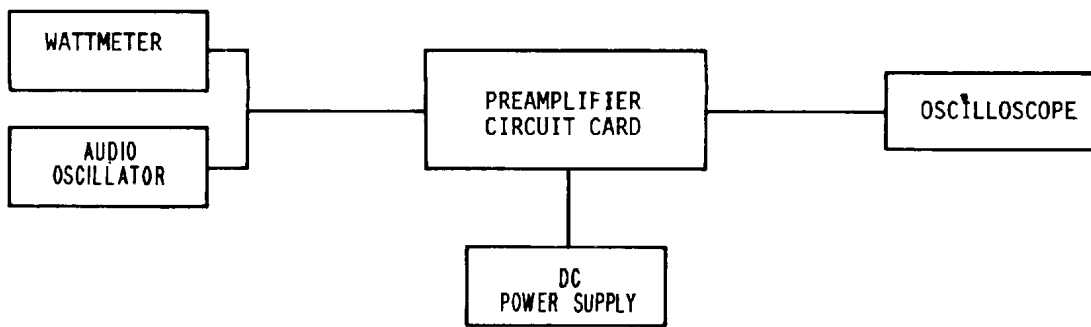
**4-13. Preampifier Circuit Card 1A54A1**

a. *Troubleshooting Procedure.* Troubleshooting the preamplifier card will consist of a visual inspection, resistance measurements, and operational test.

b. *Visual Inspection.* Inspect the preamplifier circuit card for any obvious defects such as overheating of component parts and for breaks or openings in the printed wiring board etching.

c. *Resistance Measurements (fig. 2-5).* With Multimeter AN/USM-223, measure the resistance value

of all resistances. Replace components if they are not within the specified tolerance. Measure transistor resistance between base to emitter and base to collector. If not within the specified tolerance, replace the transistor. Measure the forward and reverse resistance of diodes by reversing the AN/USM-223 probes. An acceptable reading of 10:1 should be indicated. Replace if out of tolerance.



EL5UV139

Figure 4-4. Preampifier circuit card test setup.

d. Operational Test for Preamplifier Card.

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 4-4.	None.
2.	Connect the output of the audio oscillator to terminals 1 (Cinput) and 2 (ground).	None.
3.	Connect the oscilloscope to the positive end of capacitor C1.	None.
4.	Connect the positive lead of the power supply to terminal 3 and the negative lead to terminal 2.	None.
5.	Turn on the power supply and adjust for 28 volts ±5%.	None.
6.	Set the audio generator for 7.5 vac at 1000 Hz.	None.

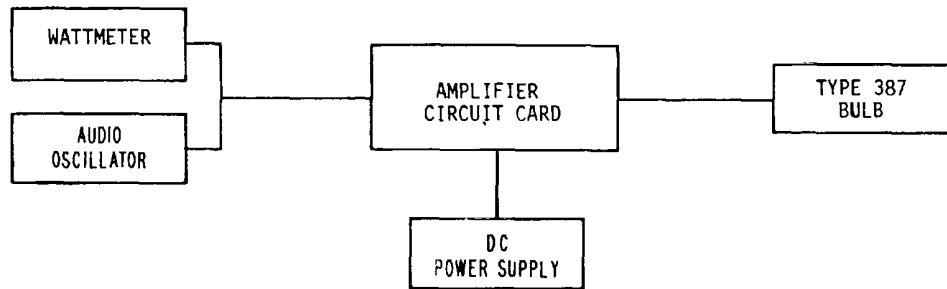
Step No.	Test procedure	Performance standard
7.	Adjust R10 for 50 millivolts peak-to-peak measured on the oscilloscope.	None.
8. peak	Move the oscilloscope to pin 4 (output).	A signal should be observed with a peak-to-peak of at least 500 millivolts.

**4-14. Amplifier Circuit Card 1A54A2**

a. *Troubleshooting Procedure.* Troubleshooting the amplifier circuit card will consist of a visual inspection, resistance measurements, and operational test.

b. *Visual Inspection.* Inspect the amplifier circuit card for any obvious defects such as overheating of component parts and for breaks or openings in the printed wiring board etching.

c. *Resistance Measurements (fig. 2-6).* With Multimeter AN/USM-223, measure the resistance value of all resistances. Replace if not within the specified tolerance. Measure transistor resistances between base to emitter and base to collector. If not within the specified tolerance, replace the transistor. Measure the forward and reverse resistance of diodes by reversing the AN/USM-223 probes. An acceptable reading of 10:1 should be indicated. Replace if out of tolerance.



EL5UV140

Figure 4-5. Amplifier circuit card test setup.

d. Operational Tests for Amplifier Card.

Step No.	Test procedure	Performance standard
1.	Connect the equipment as shown in figure 4-5.	None.
2.	Connect the MS25237-387 bulb across pins 1 and 2 of the circuit Card.	None.
3.	Connect the positive lead of the power supply to terminal 2 and the negative to terminal 4.	None.
4.	Adjust the input impedance of the audio output meter for 600 ohms and connect the unit between terminals 3 and 4 (4 is ground).	None.
5.	Connect the output of the audio oscillator to terminals 3 and 4 and set for 11 vac at 1000 Hz.	None.
6. the	Turn on the power supply and adjust the output for 28 volts $\pm$ 5%.	with the audio oscillator set for 11 vac output, bulb should light.
7. 7	Remove the audio signal from the circuit card and observe the time required for the test bulb to extinguish.	The bulb should extinguish after a delay of 2 to seconds.

**Section III. REMOVAL AND REPLACEMENT**

**4-15. General**

General support repair includes removal and replacement of all active and passive electronic components necessary to return a defective circuit card assembly to normal operation. As illustrated in figures 4-6 through 4-10, parts are easily accessible for replacement. No special techniques are required. The following general procedures should be followed when replacing defective components.

**CAUTION**

Verify that all power is removed from an assembly before removing or repairing.

a. Identical or equivalent components should be used for replacing defective components. Equivalent components should conform to both the electrical and physical properties of the original component since the construction of the assemblies does not provide space for mount-



ing larger components than those used initially.

b. Physical orientation of the new component should conform to that of the replaced component.

c. When it is necessary to replace a part with several leads, sketch the lead connections or tag the leads before unsoldering. This will aid in replacement.

d. Use proper heat sink techniques when soldering to leads on solid state devices to prevent damage to the new components.

e. When replacing parts which are soldered directly in the eyelets on the printed circuit boards, apply heat to the back side of the board, both when removing and replacing components. Apply heat sparingly to prevent damage to the new component and to other components and conductive paths on the printed circuit

board.

f. When repairing breaks in conductive strips on printed circuit boards, thoroughly clean and dry the area to be repaired. Solder a short length of tinned copper wire of small diameter across the break. After soldering, remove any excess resin and coat the repaired area with a high quality electrical varnish or lacquer.

#### **4-16. Buzzer-Flasher Circuit Card A16**

(fig. 4-6)

All component parts on the buzzer-flasher circuit card are readily accessible. No special tools or techniques are required for removal and replacement. Observe the general procedures detailed in paragraph 4-15 during repair, removal, and replacement.

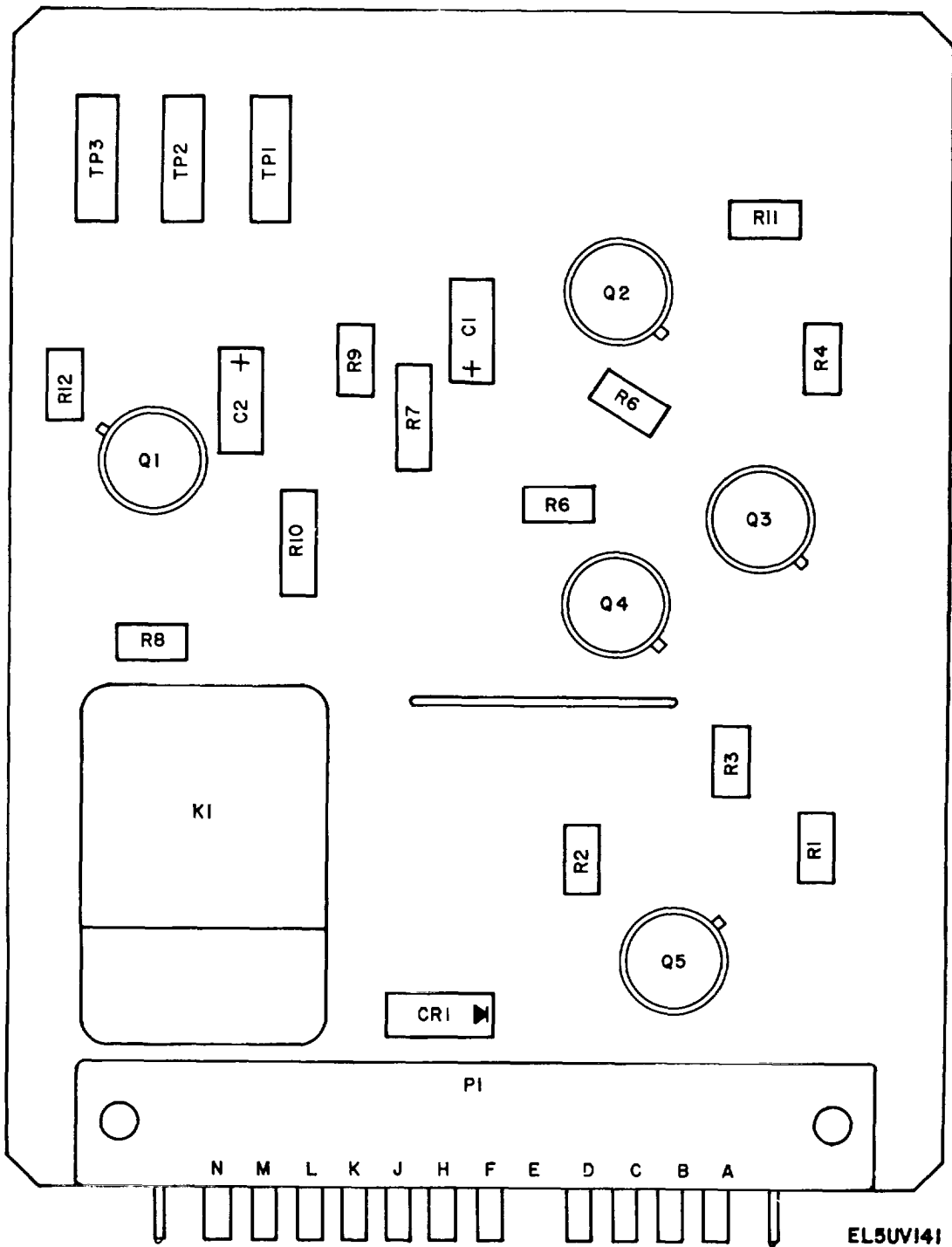


Figure 4-6. Buzzer-flasher circuit card, parts location.

**4-17. Radio Control Circuit Cards A1**  
Through AI O  
(fig. 4-7)

All component parts on the radio control circuit card are

readily accessible. No special tools or techniques are required for removal and replacement. Observe the general procedures detailed in paragraph 4-15 during repair, removal, and replacement.

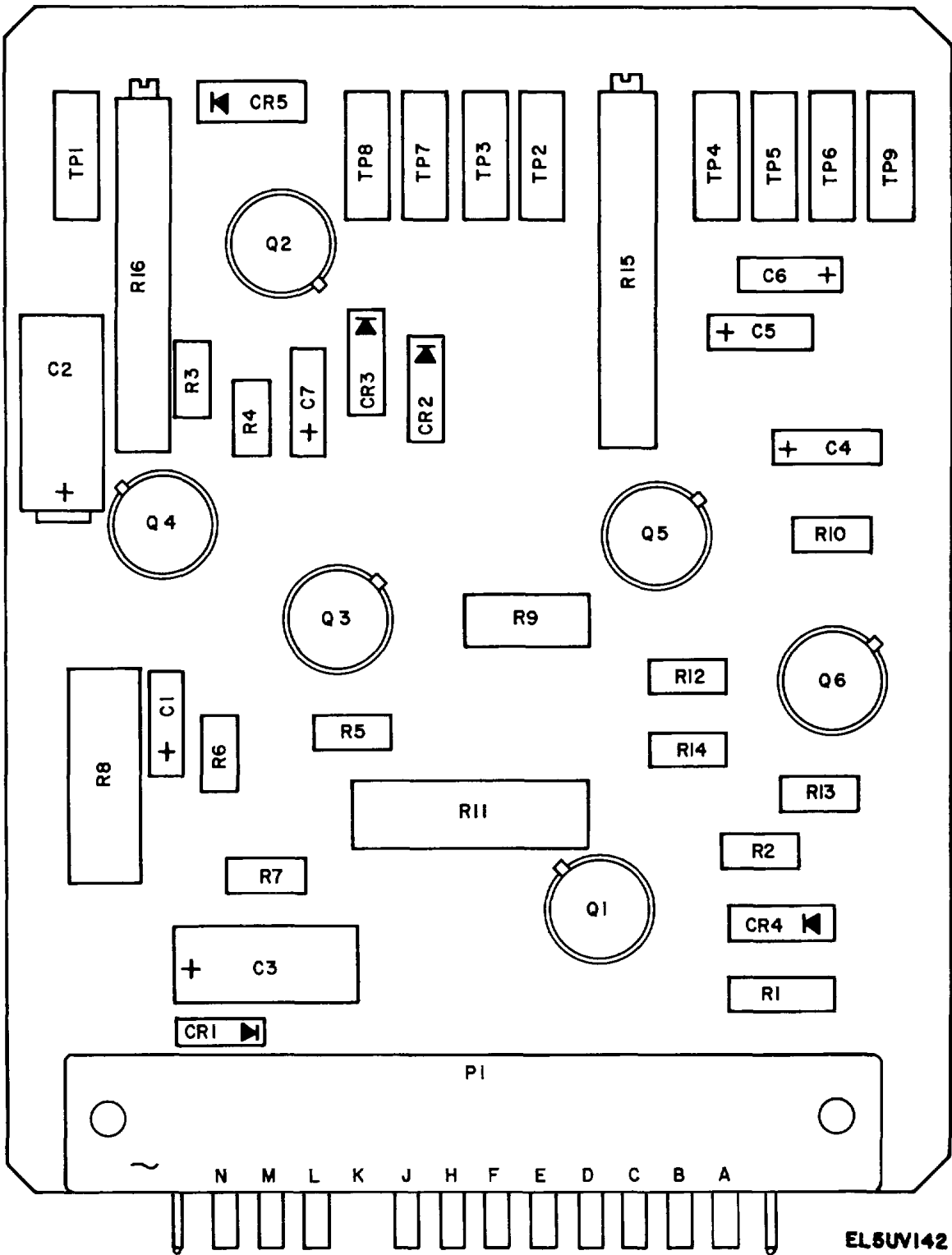
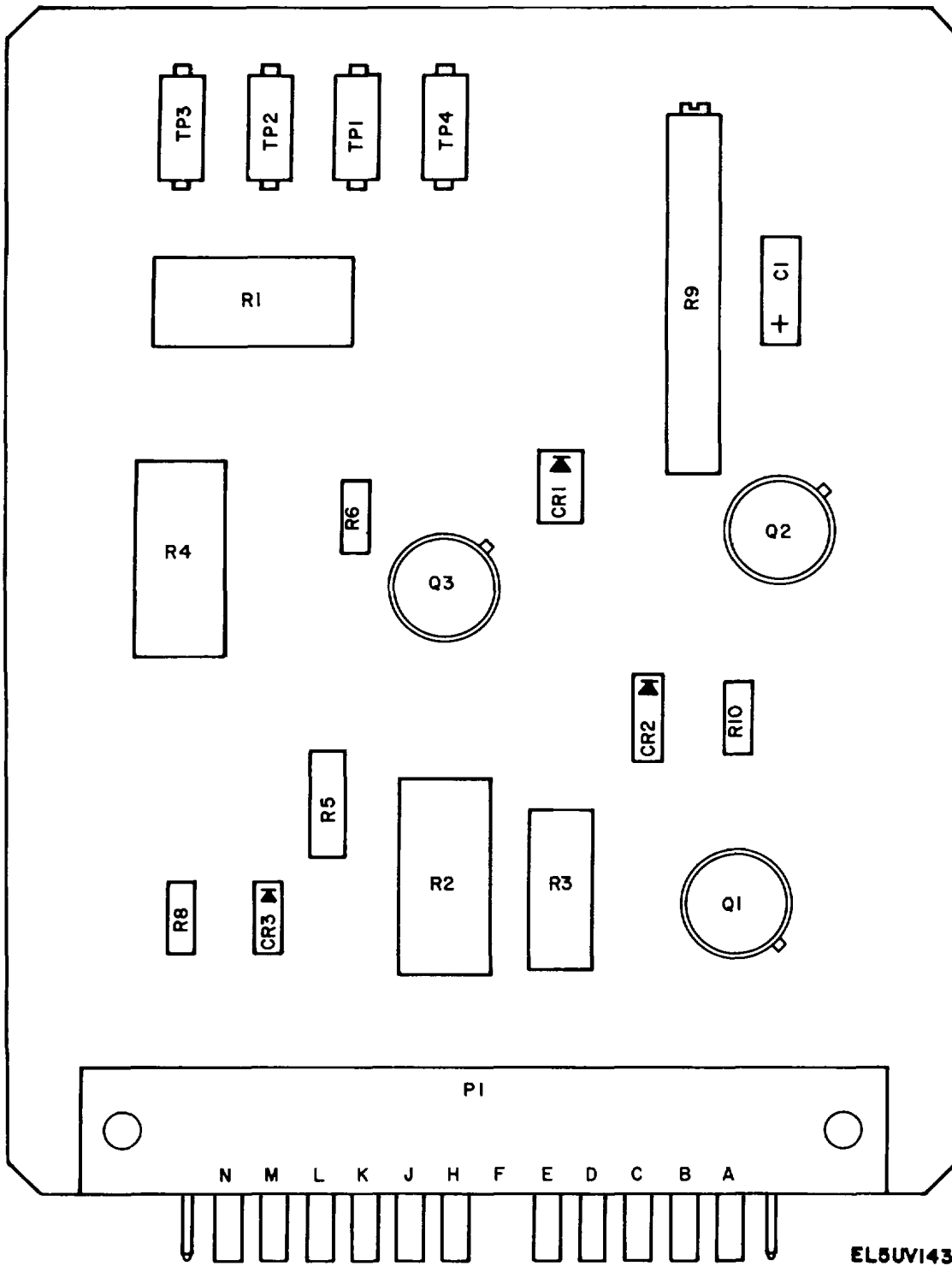


Figure 4-7. Radio control circuit card, parts location.

**4-18. Telephone Control Circuit Cards A17 Through A31 (fig. 4-8)**

All component parts on the telephone control circuit card

are readily accessible. No special tools or techniques are required for removal and replacement. Observe the general procedures detailed in paragraph 4-15 during repair, removal, and replacement.



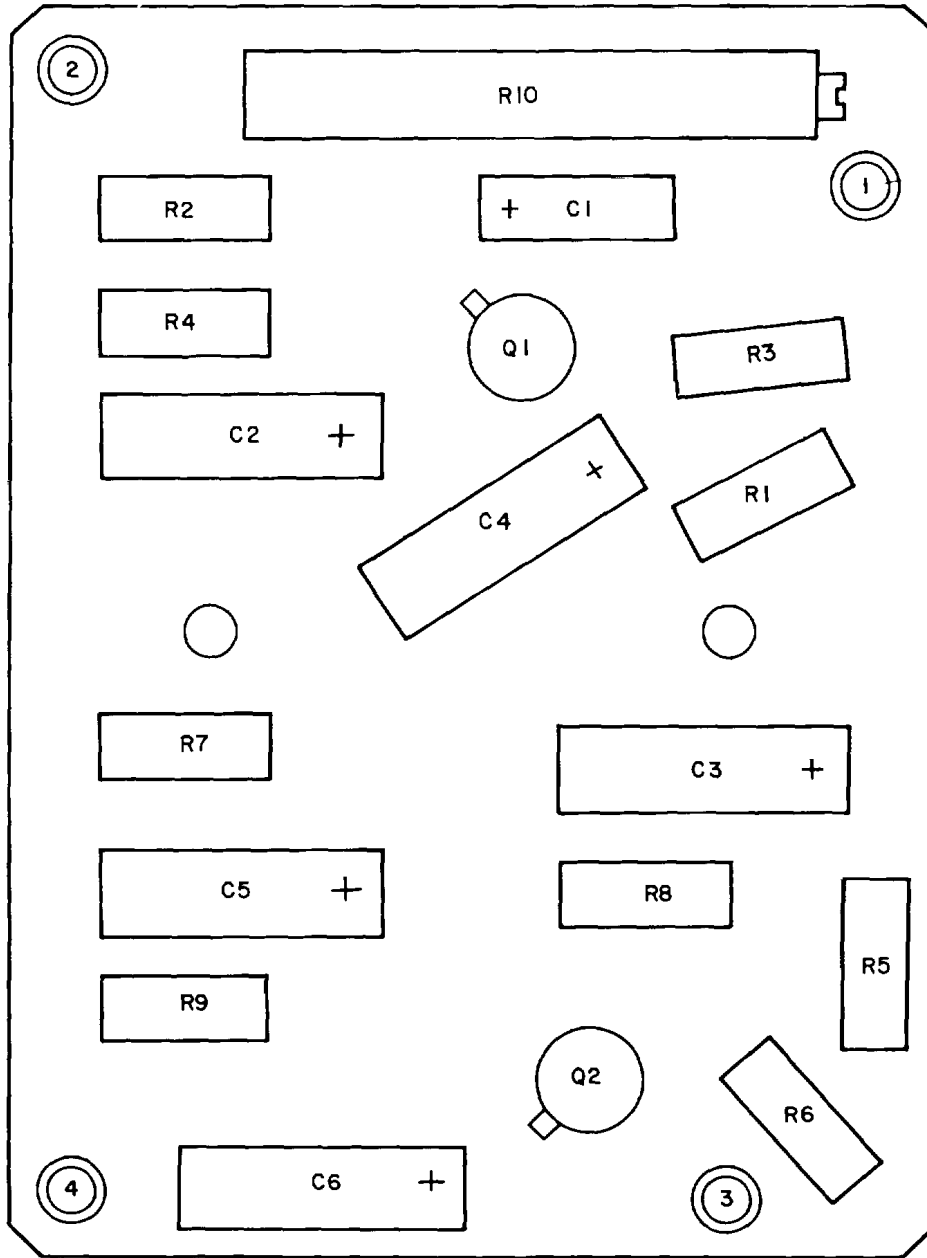
EL5UV143

Figure 4-8. Telephone control circuit card, parts location.

**4-19. Preamplifier Circuit Card 1 A54A1 (fig. 4-9)**

All component parts on the preamplifier circuit card are readily accessible. No special tools or techniques are

required for removal and replacement. Observe the general, procedures detailed in paragraph 4-15 during repair, removal, and replacement.



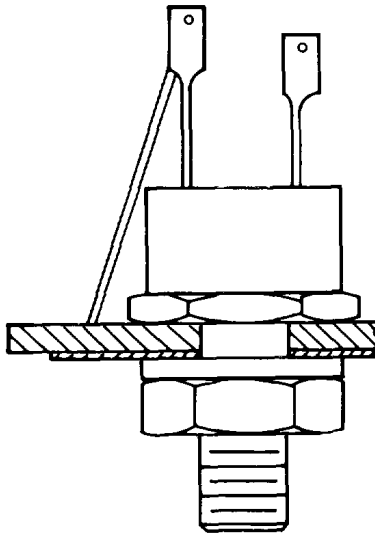
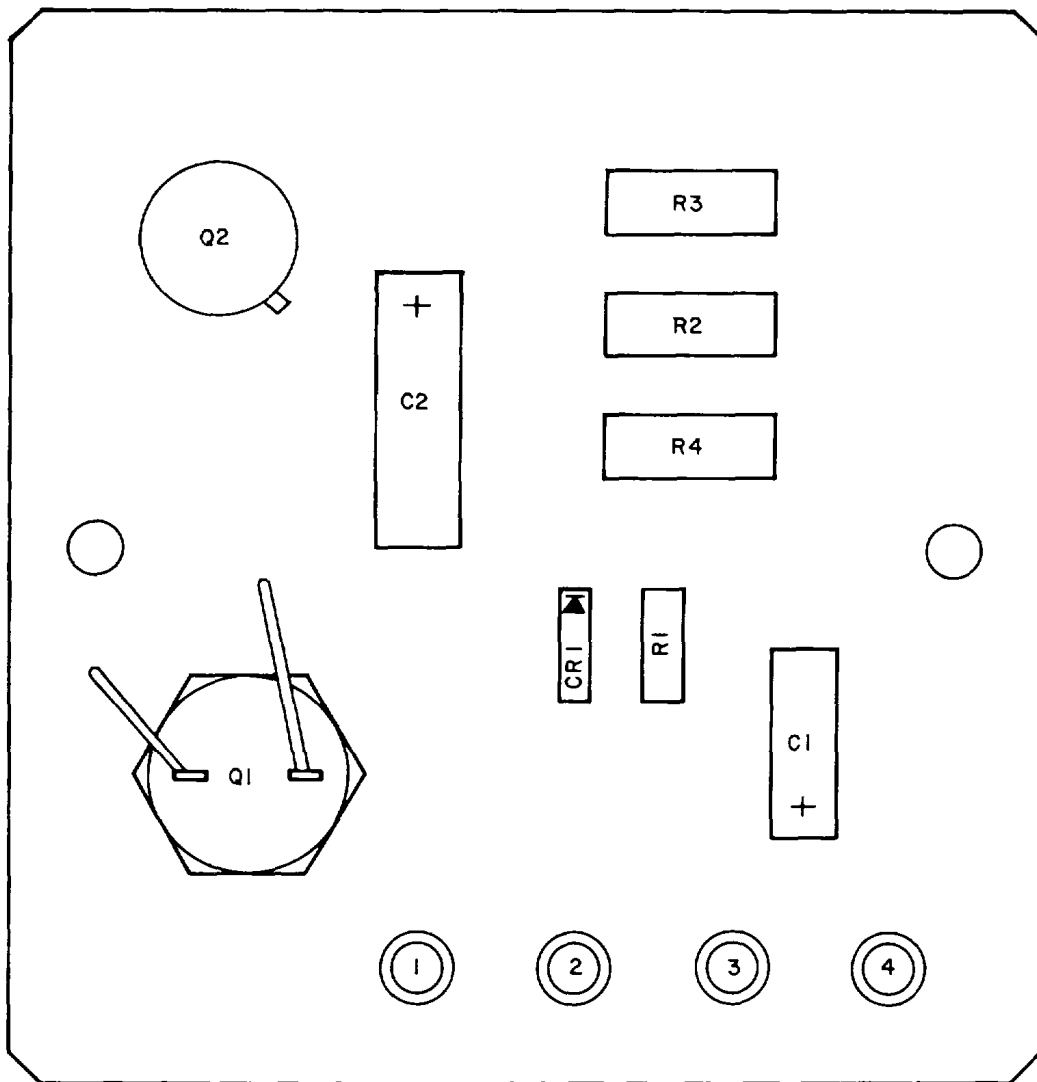
EL5UV144

Figure 4-9. Preamplifier circuit card, parts location.

**4-20. Amplifier Circuit Card 1 A54A2  
(fig. 4-10)**

All component parts on the amplifier circuit card are readily accessible. No special tools or techniques are

required for removal and replacement. Observe the general procedures detailed in paragraph 4-15 during repair-, removal, and replacement.



EL5UV145

Figure 4-10. Amplifier circuit card, parts location.

**APPENDIX A  
REFERENCES**

---

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7 SB 11-573	US Army Equipment Index of Modification Work Orders. Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TB SIG 291	Safety Measures to be Observed When Installing and Using Whip Antennas, Field-Type Masts, Towers and Antennas and Metal Poles that are used with Communications, Radar and Direction Finder Equipment.
TM 5-4120-222-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual: Air Conditioner Compact Vertical 208 V, 3 phase, 18, 000 BTUH Cooling, 12, 000 BTUH Heating (Trane models); 50/60 Hz (Model CE20VAL6) (NSN 4120-00-973-4589) and 400 Hz (Model CE20VAL4) (NSN 4120-00-858-5795).
TM 5-4520-232-14	Operator's, Organizational, Direct Support, and General Support Maintenance Manual (Including Repair Parts and Special Tools List): Heater, Space, Multifuel W/Blower; 15, 000 BTU/HR, 120 V, 60 Hz, 3.5 Amp (Hunter Model UH-48, Type 1) (FSN 4520-709-9222).
TM 5-6115-365-15	Operator, Organizational, Direct Support, General Support and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Generator Sets, Gasoline and Diesel Engine Driven, Trailer Mounted, PU-236A/G, PU-236/G (NSN 6115-00-393-1709), PU-236B/G (6115-00-738-6334) PU-253A/U, PU-253/U (6115-00-697-2402), PU-304C/MPQ-4 (6115-00-056-8421) PU-332/G (6115-00-577-8471), PU-332A/G (6115-00-738-8336), PU-375A/G, PU-375/G (6115-00-753-2231), PU-375B/G (6115-00-931-6789), PU-401/M (6115-00-823-2217), PU-402/M (6115-00-722-3760), PU-406/M (6115-00-738-6342), PU-409/M (6115-00-702-3343), PU-409A/M (6115-00-733-6338), PU-495/G (6115-00-823-2218), PU-551/G (6115-00-889-1307), PU-564A/G (6115-00-728-6341), PU-564B/G (6115-00-179-2789), PU-617/M (6115-00-738-6335), PU-618/M (6115-00-738-6337), PU-619/M (6115-00-738-6339), PU-620/M (6115-00-738-6340), PU-625/G (6115-00-873-3915), PU-628/G (6115-00-087-0873), PU-629/G (6115-00-937-5555), PU-631/G (6115-00-059-5172), PU-656/G (6115-00-939-3296), PU-650B/G (6115-00-258-1622) and PU-656/G (6115-00-989-3296).
TM 11-5805-201-12	Operator's and Organizational Maintenance Manual: Telephone Set TA-312/PT (NSN 5805-00-543-0012).
TM 11-5805-201-20P	Organizational Maintenance Repair Parts and Special Tools Lists for Telephone Set TA-312/PT (NSN 5805-00-543-0012).
TM 11-5805-298-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Generator, Ringing, Static, TA-248/TT and TA-248A-TT (NSN 5805-00-503-1482).
TM 11-5820-401-12	Operator's and Organizational Maintenance Manual (Including Repair Parts and Special Tools Lists): Radio Set AN/VRC-12 (NSN 5820-00-223-7412), AN/VRC-43 (5820-00-223-7415), AN/VRC-44 (5820-00-223-7417), AN/VRC-45 (5820-00-223-7418), AN/VRC-46 (5820-00-223-7433), AN/VRC-47 (5820-00-223-7434), AN/VRC-48 (5820-00-223-7435), AN/VRC-49 (5820-00-223-7437), AN/VRC-54 (5820-00-223-7567), AN/VRC-55 (5820-00-402-2265); Mounting MT-1029/VRC (5820-00-893-1323) and MT-1898/VRC (5820-00-893-1324); Antenna AT-912/VRC (5820-00-897-6357); Control, Frequency Selector C-2746/VRC (5820-00-892-3343) and Control, Radio Set C-2299/VRC (5820-00-892-3340).
TM 11-5820-538-12	Operator's and Organizational Maintenance Manual: Mast AB-577/GRC (NSN 5820-00-892-3862) and Extension Kit Mast MK-806/GRC (5895-00-691-2344).

TM 11-5821-260-20	Organizational Maintenance Manual, Radio Set AN/ARC-115.
TM 11-5821-260-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Radio Set AN/ARC-1 15 (FSN 5821-935-5072).
TM 11-5821-248-12	Operator's and Organizational Maintenance Manual: Radio Set AN/ARC-102 (NSN 5821-00-050-8255).
TM 11-5821-248-20P	Organizational Repair Parts and Special Tool List: Radio Set AN/ARC-102 (NSN 5821-00-050-8255).
TM 11-5821-311-12	Operator's and Organizational Maintenance Manual for Receiver-Transmitter, Radio RT-1167/ARC-164(V) (NSN 5821-00-138-7990).
TM 11-5821-311 -20P	Organizational Maintenance Repair Parts and Special Tools List for Receiver-Transmitter RT-1167/ARC-164 (NSN 5821-00-138-7990).
TM 11-5831-201-20	Organizational Maintenance Manual: Control Intercommunication Set, C-161 1D/AIC and Discriminator, Discrete Signal MD-736/A.
TM 11-5985-262-15	Operator's Organizational, Direct Support, General Support and Depot Maintenance Manual: Antenna AS-1729/VRC (NSN 5985-00-985-9024).
TM 11-5985-326-20	Organizational Maintenance Manual: Coupler, Antenna CU-1658/A and CU- 1669/GRC.
TM 38-750	The Army Maintenance Management System CrAMMS).
TM 11-5821-281-15*	KY-8 Control, Instruction Manual, Control Indicator C-8156/ARC.

\*This manual is not available through AG publication channels but may be obtained by writing to Commander, CERCOM, ATTN: DRSEL-ME-MQ, Fort Mnnmouth, NJ 07703.

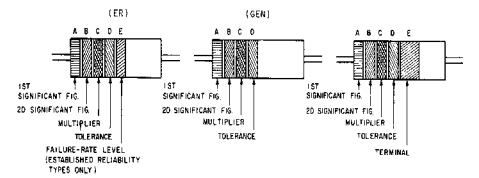


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**Index-2**



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS

COLOR CODE MARKING FOR FILM-TYPE RESISTORS

TABLE 1  
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS

BAND A	BAND B	BAND C	BAND D	BAND E	TERM.
COLOR	FIRST SIGNIFICANT FIGURE	SECOND SIGNIFICANT FIGURE	COLOR	RESISTANCE TOLERANCE (PERCENT)	FAILURE RATE LEVEL
BLACK	0	BLACK	0	BLACK	1
BROWN	1	BROWN	1	BROWN	10
RED	2	RED	2	RED	100
ORANGE	3	ORANGE	3	ORANGE	1,000
YELLOW	4	YELLOW	4	YELLOW	10,000
GREEN	5	GREEN	5	GREEN	100,000
BLUE	6	BLUE	6	BLUE	1,000,000
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7	RED	± 2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY)
GRAY	8	GRAY	8	SILVER	0.01
WHITE	9	WHITE	9	GOLD	0.1

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)

BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE

BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)

BAND D — THE RESISTANCE TOLERANCE.

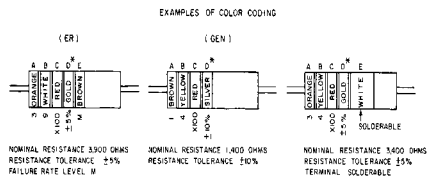
BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS) ON FILM RESISTORS THIS BAND SHALL BE APPROXIMATELY 1/10 TIMES THE WIDTH OF OTHER BANDS AND INDICATES TYPE OF TERMINAL.

RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS (THESE ARE NOT COLOR CODES)

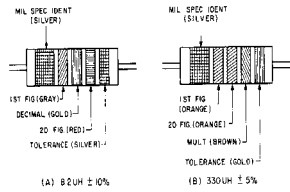
SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR OMIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

DR7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED. IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.



A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN 8.2UH CHOKES IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

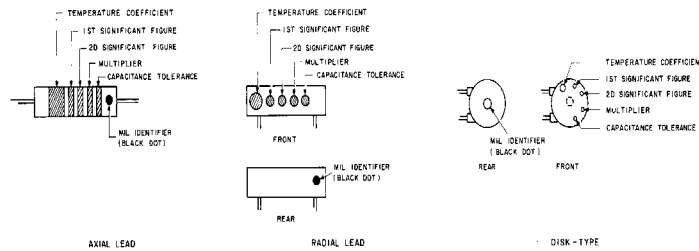
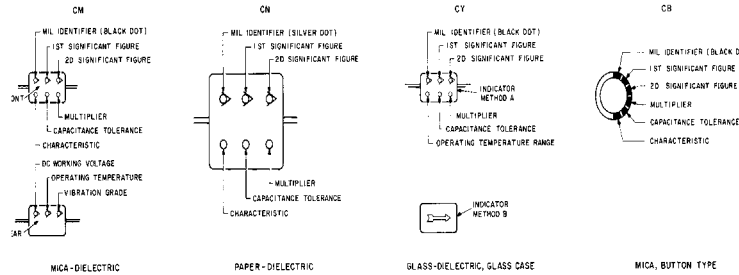
TABLE 2  
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE		20	
SILVER		10	
GOLD	DECIMAL POINT	5	

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKES COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB



C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

TABLE 3 - FOR USE WITH STYLES CM, CN, CY AND CB

COLOR	MIL ID	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE				CHARACTERISTIC		DC WORKING VOLTAGE	OPERATING TEMPERATURE RANGE	VIBRATION GRADE	
					CM	CN	CY	CB	CM	CB				
BLACK	00	0	0											
BROWN	1	1	1	10										
RED	2	2	2	100	25%	22%	22%	C						
ORANGE	3	3	3	1,000										
YELLOW	4	4	4	10,000										
GREEN	5	5	5											
BLUE	6	6	6											
PURPLE (VIOLET)	7	7	7											
GRAY	8	8	8											
WHITE	9	9	9											
GOLD														
SILVER	CN				0.01	20%	10%	20%	20%					

TABLE 4 - TEMPERATURE COMPENSATING, STYLE CC

COLOR	TEMPERATURE COEFFICIENT	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE		MIL CAPACITANCES (10 UHF OR LESS)
					OVER 10 UHF	10 UHF OR LESS	
BLACK	0	0	0	1			2.0 UHF
BROWN	-30	1	1	10	± 1%		
RED	-80	2	2	100	± 2%		+0.25 UHF
ORANGE	-100	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		± 5%		2.0 UHF
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	± 10%		
GOLD	+100			0.1			± 1.0 UHF
SILVER				0.01			

- THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UHF.
- LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-250, MIL-C-11272B, AND MIL-C-10350C RESPECTIVELY.
- LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
- TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
- OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

Figure FO-1. Resistor and capacitor color code chart.

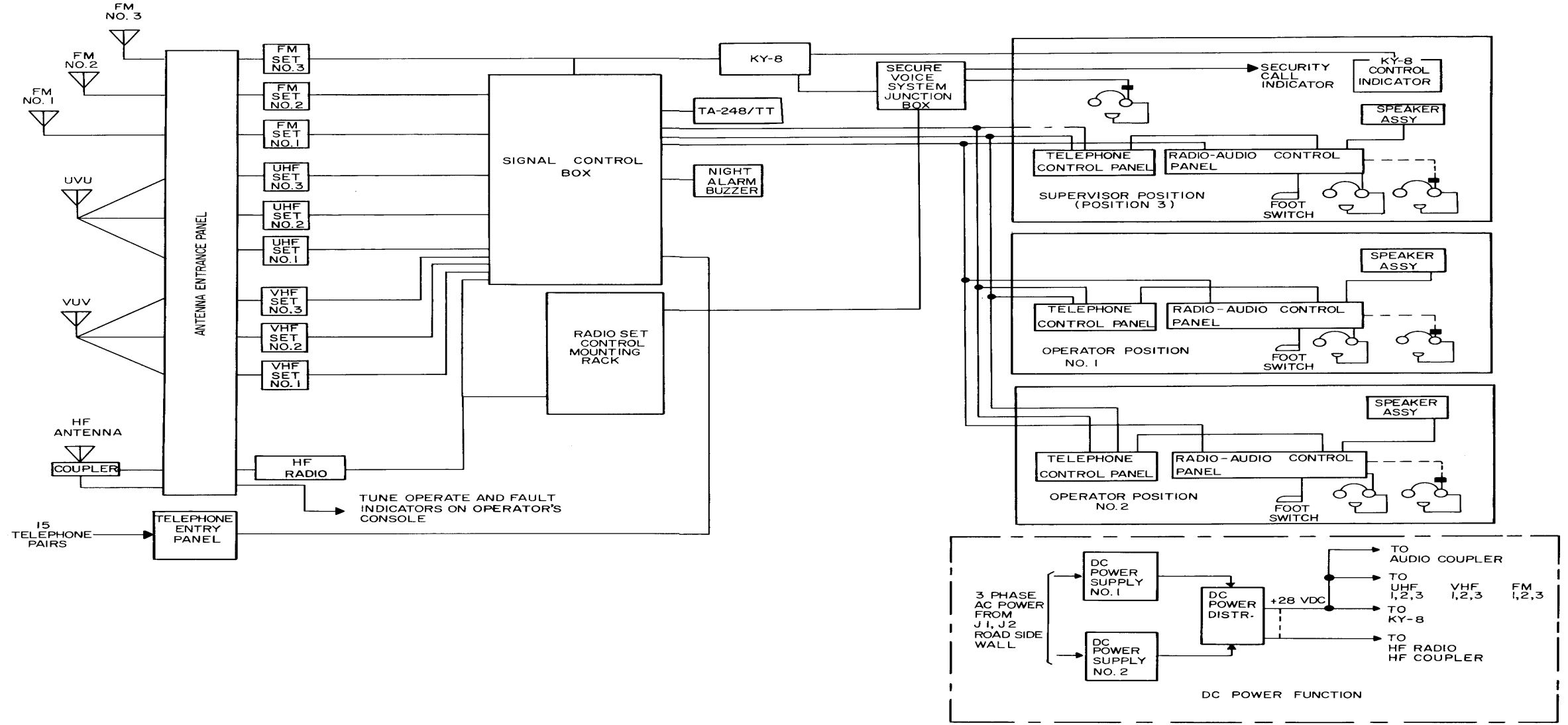
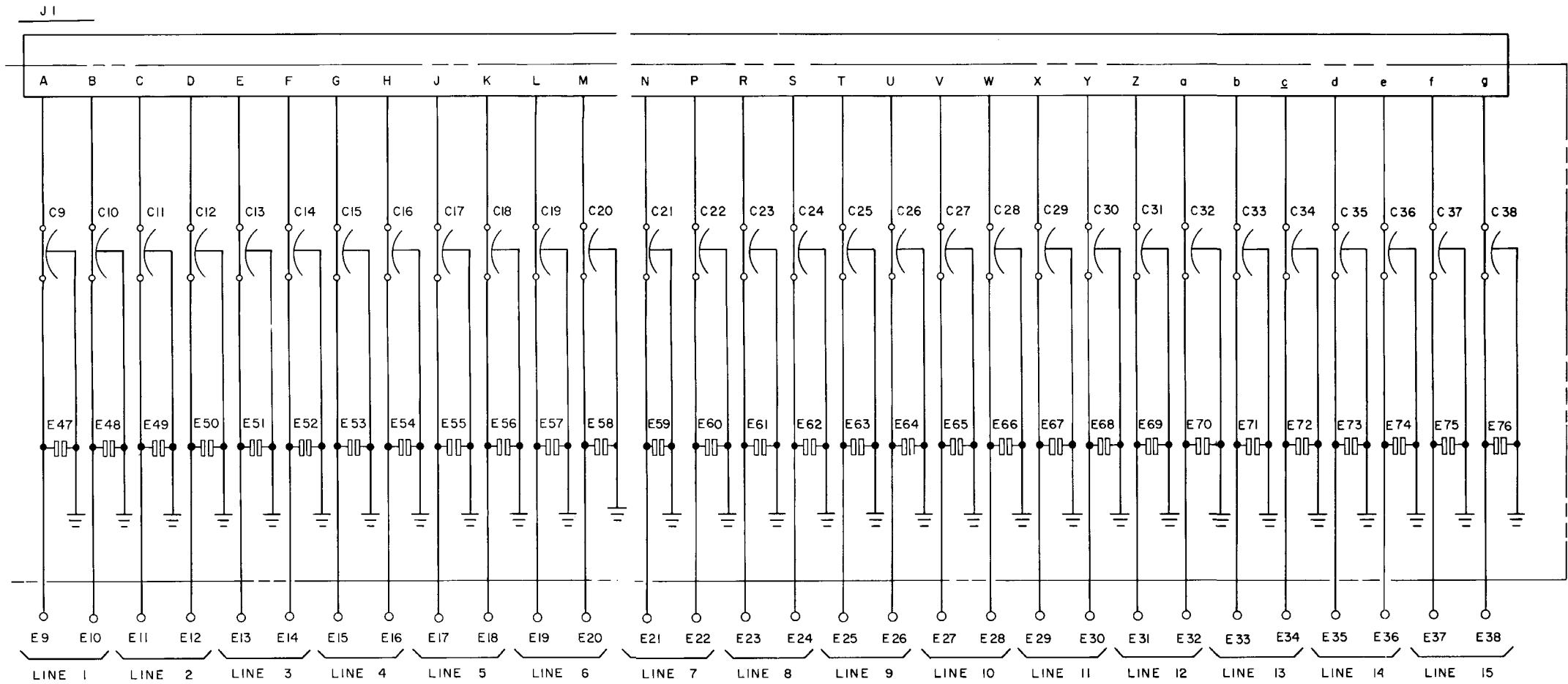
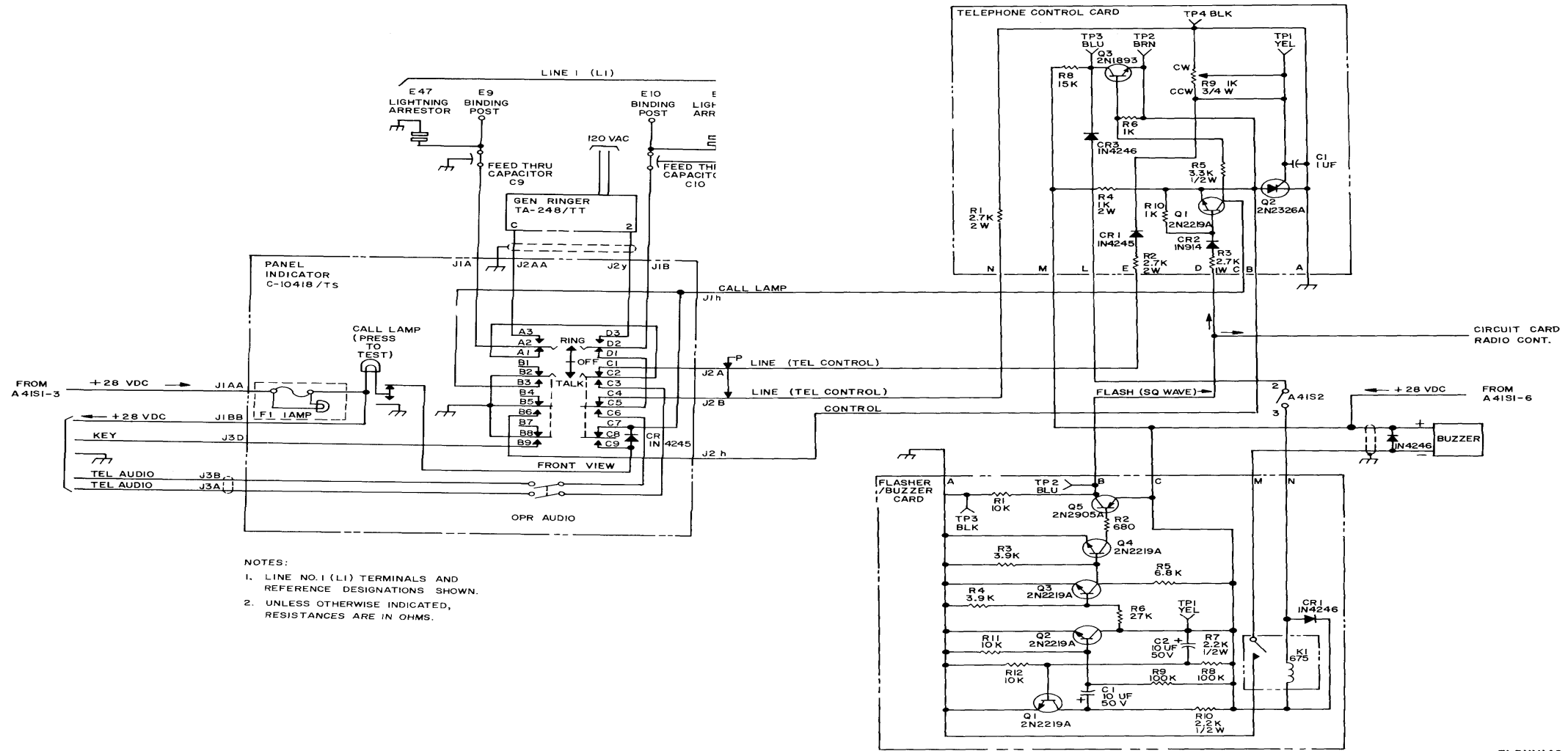


Figure FO-2. ANITSC-61B block diagram.



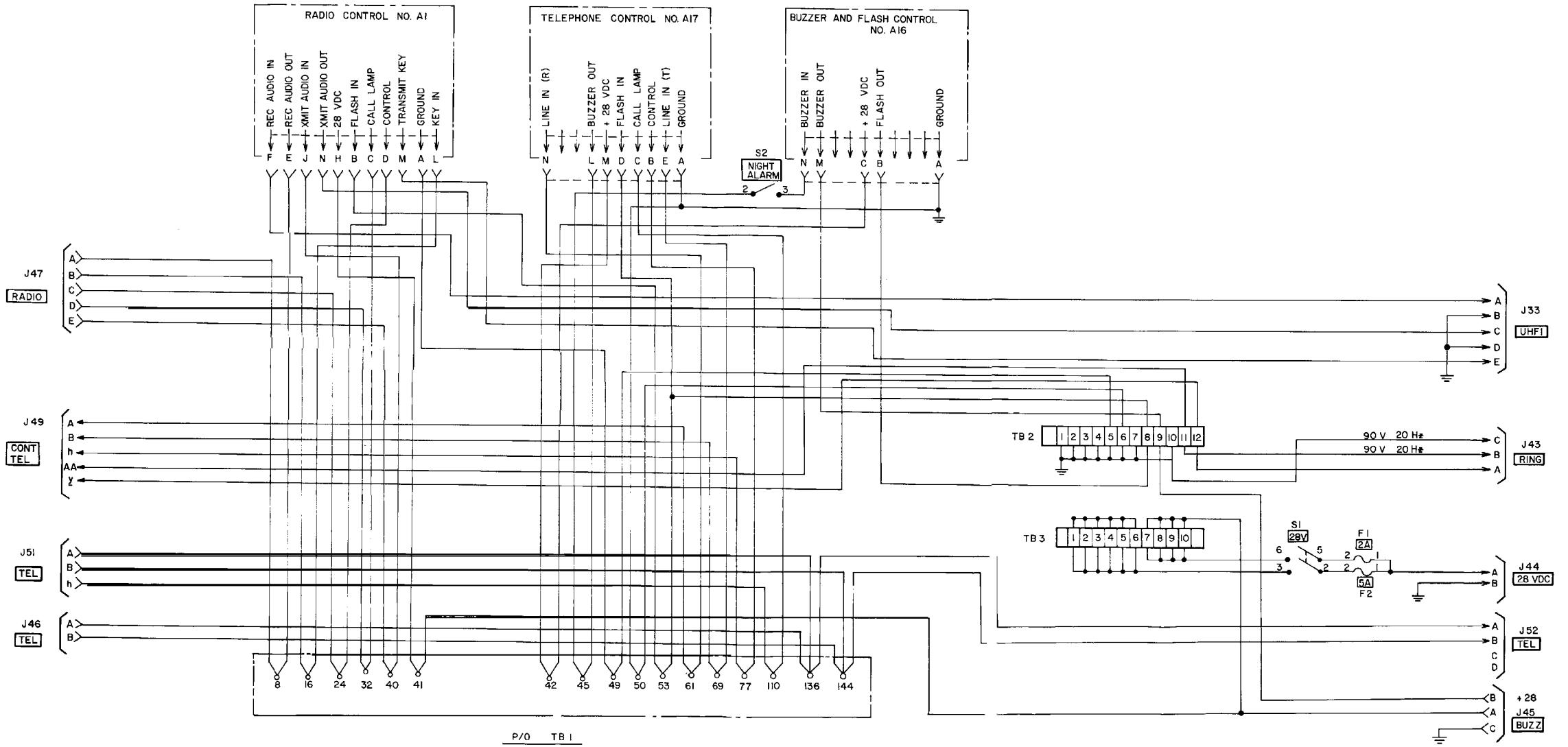
EL5UVI47

Figure FO-3. Telephone entrance panel, schematic diagram.



EL5UVI48

Figure FO-4. Telephone control, schematic diagram.

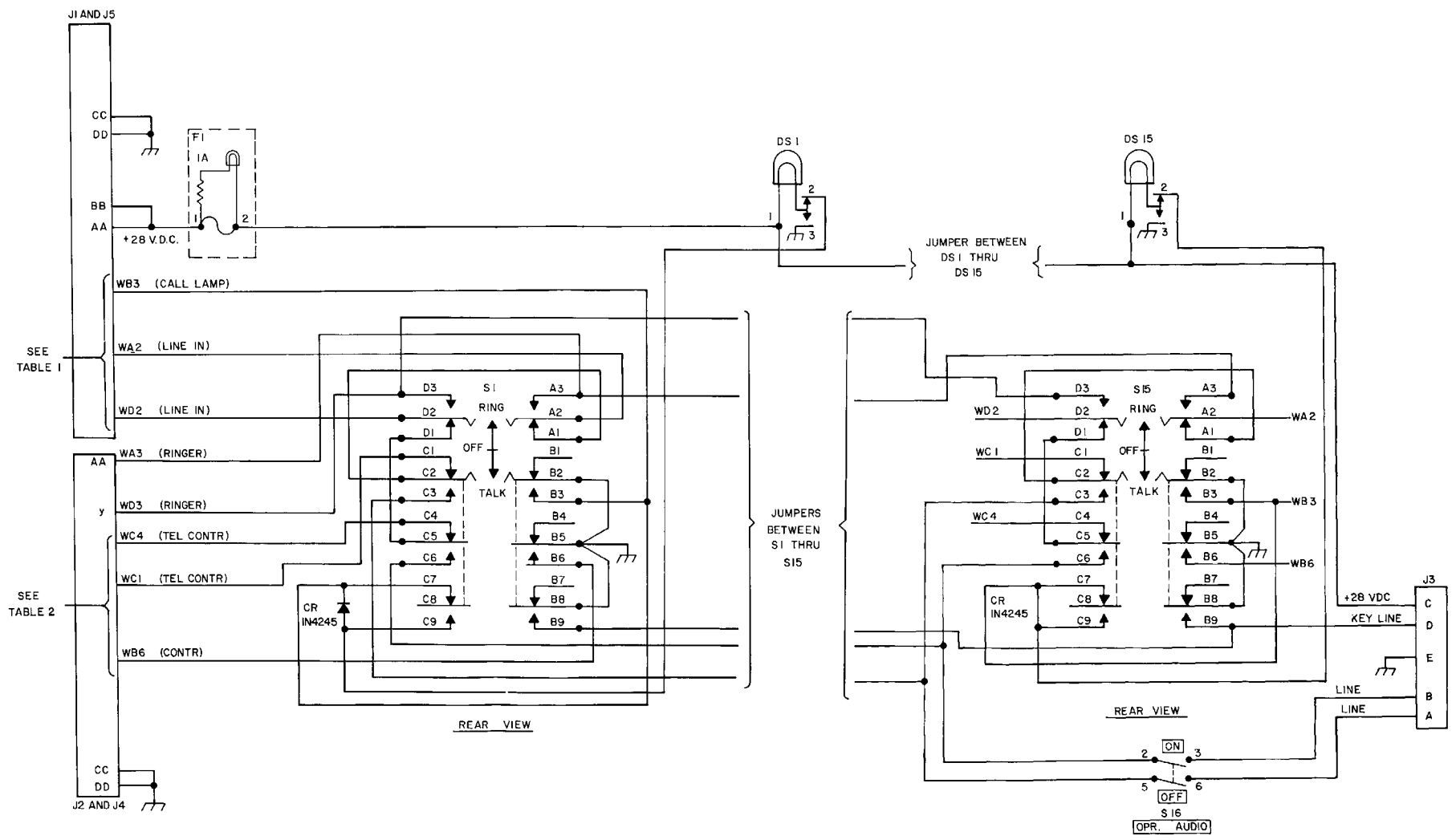


EL5UVI49

Figure FO-5. Signal control box, simplified schematic diagram.

TABLE NO. 1				
J1 AND J5 SOCKET CONNECTIONS				
TEL LINE PAIR	SWITCH	WIRE		
		WD2	WA2	WB3
1	S1	A	B	h
2	S2	C	D	i
3	S3	E	F	j
4	S4	G	H	k
5	S5	J	K	m
6	S6	L	M	n
7	S7	N	P	p
8	S8	R	S	q
9	S9	T	U	r
10	S10	V	W	s
11	S11	X	Y	t
12	S12	Z	a	u
13	S13	b	c	v
14	S14	d	e	w
15	S15	f	g	x

TABLE NO. 2				
J2 AND J4 PIN CONNECTIONS				
TEL LINE PAIR	SWITCH	WIRE		
		WC 1	WC 4	WB 6
1	S1	A	B	h
2	S2	C	D	i
3	S3	E	F	j
4	S4	G	H	k
5	S5	J	K	m
6	S6	L	M	n
7	S7	N	P	p
8	S8	R	S	q
9	S9	T	U	r
10	S10	V	W	s
11	S11	X	Y	t
12	S12	Z	a	u
13	S13	b	c	v
14	S14	d	e	w
15	S15	f	g	x



EL5UVI50

Figure FO-6. Telephone control panel, signal schematic diagram.



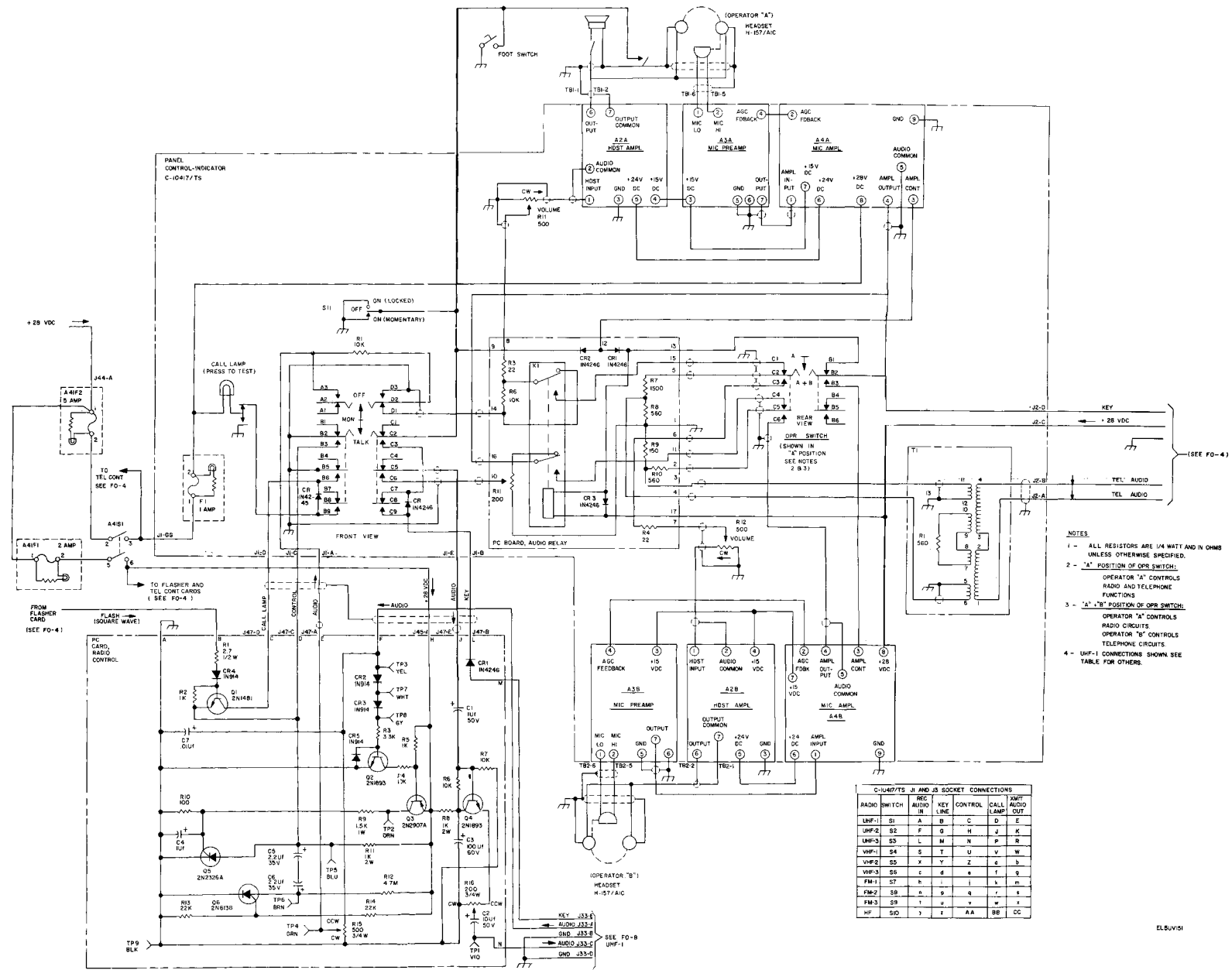


Figure FO-7. Radio-audio control panel, schematic diagram.

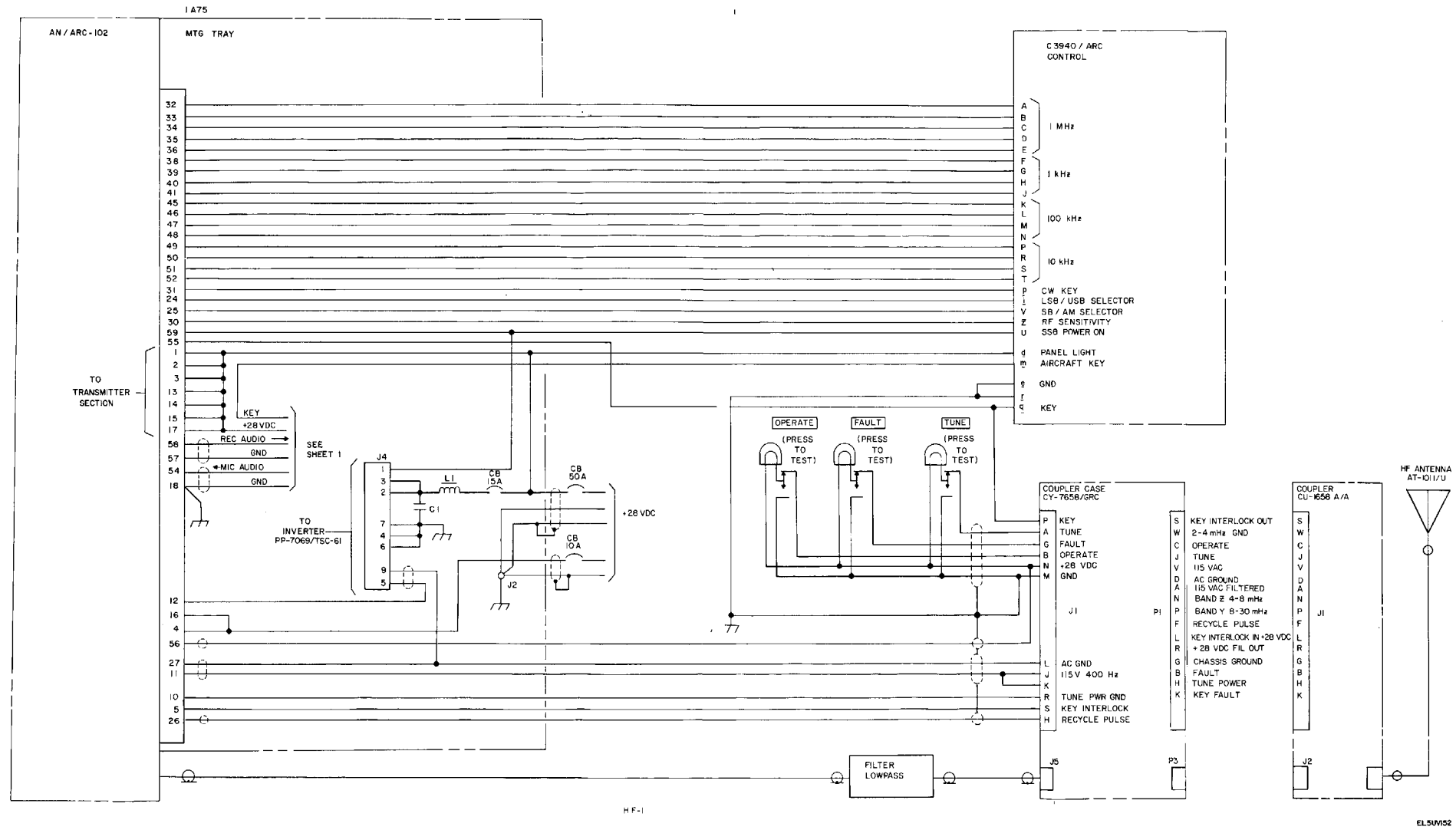


Figure FO-8. Radio-audio control, VHF, UHF, FM, and HF, schematic diagram (sheet 1 of 2).

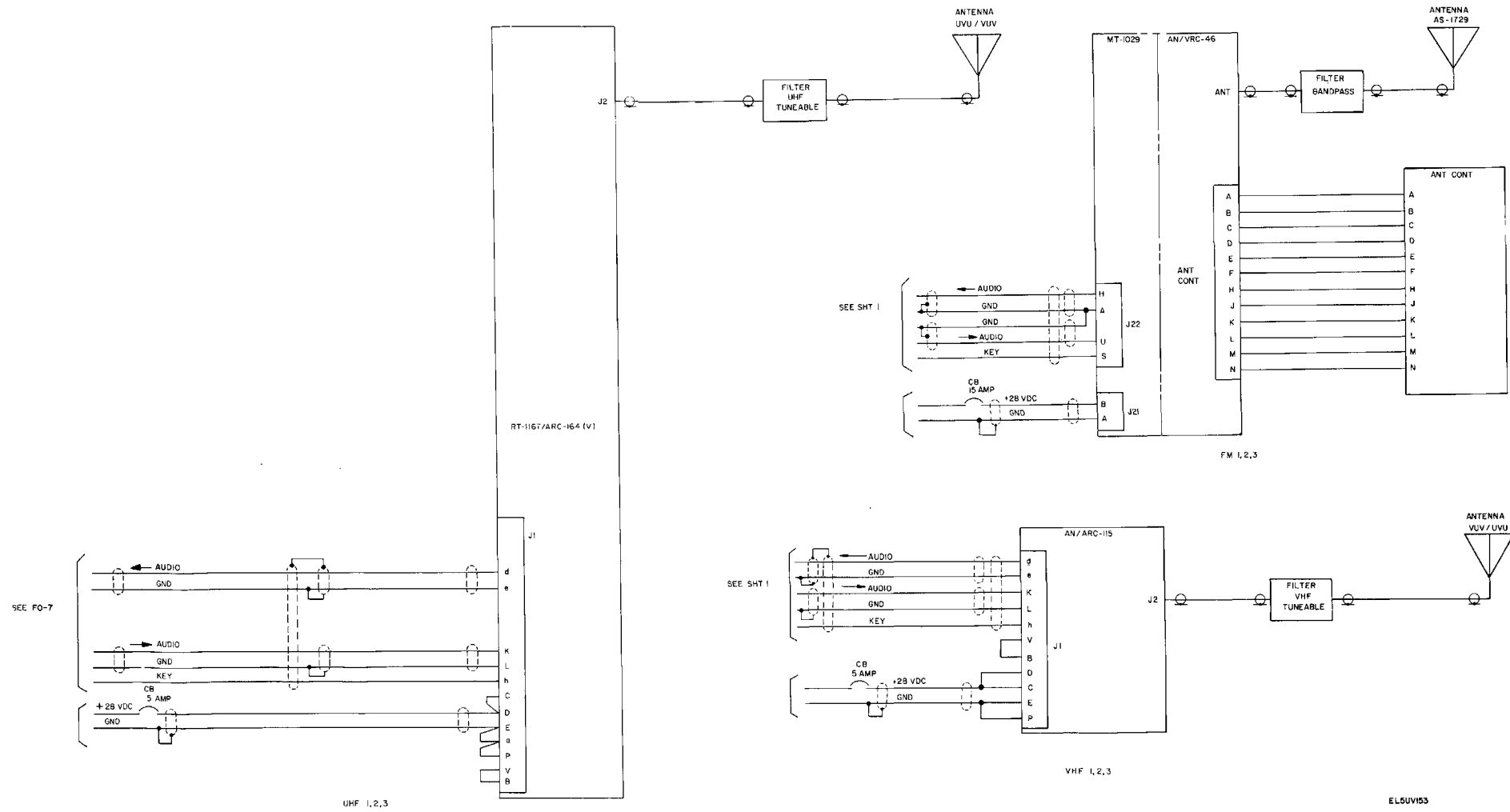


Figure FO-8. Radio-audio control, VHF, UHF, FM and HF, schematic diagram (sheet 2 of 2).

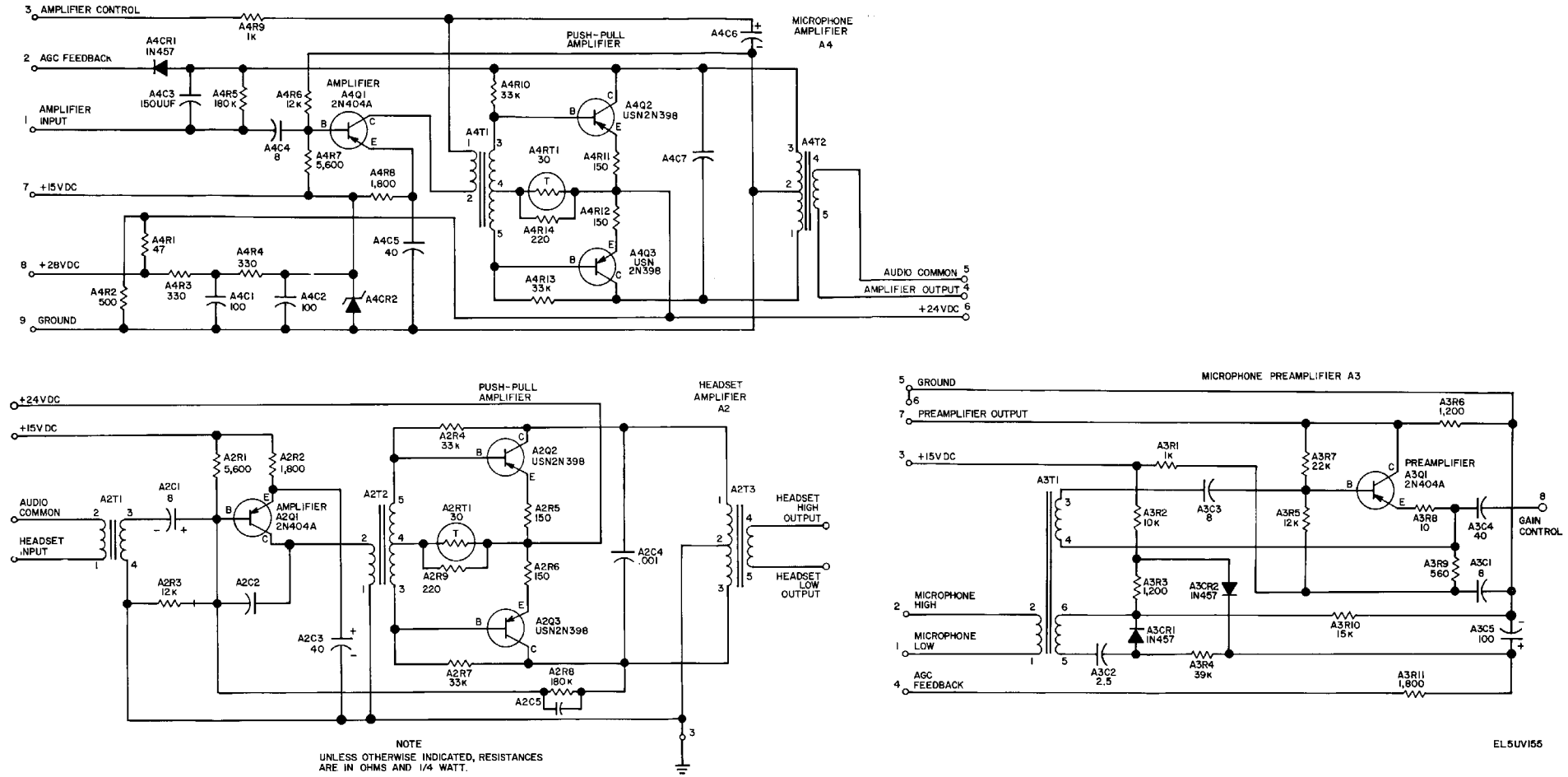


Figure FO-9. Microphone preamplifier, headset amplifier, microphone amplifier; simplified schematic diagram.

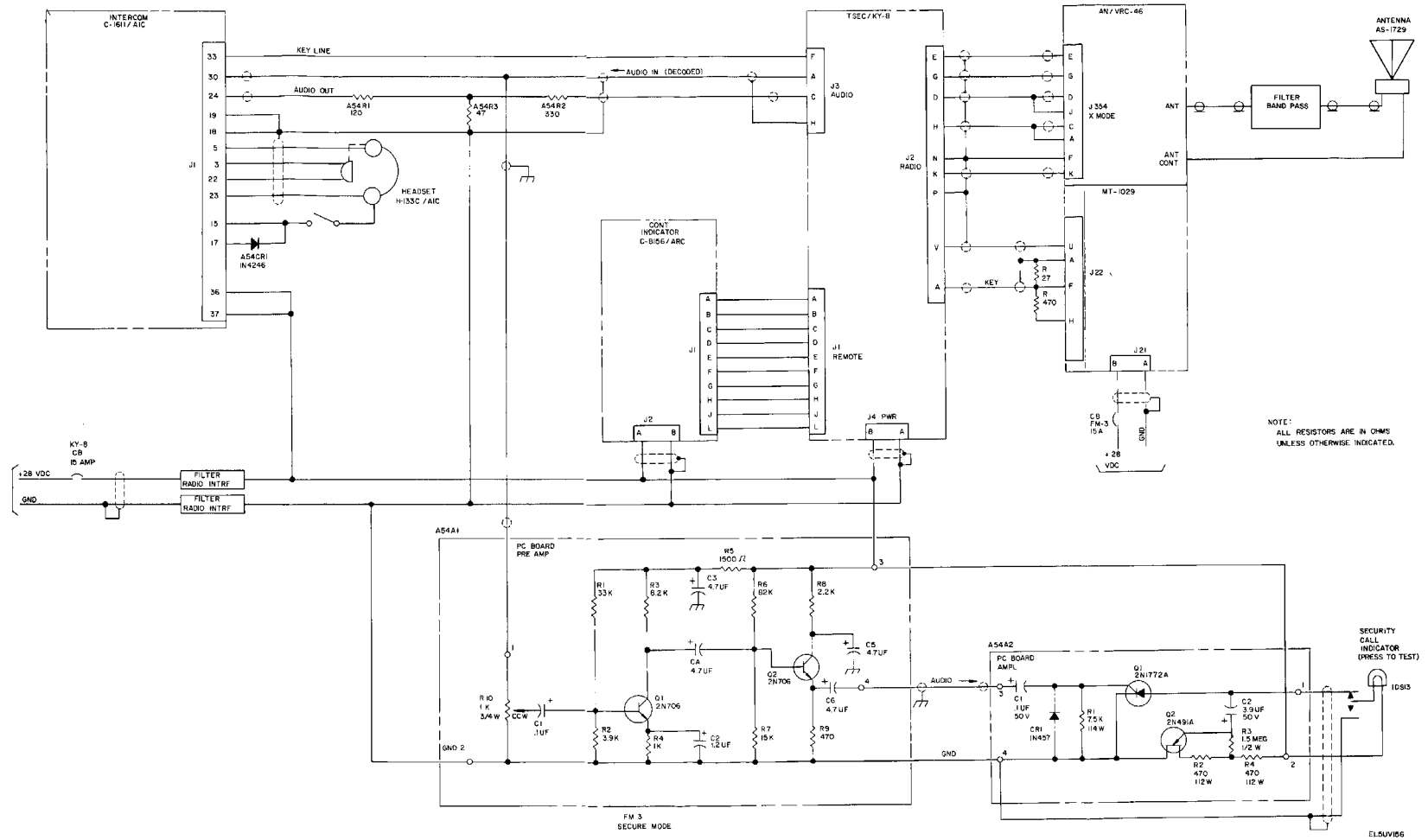
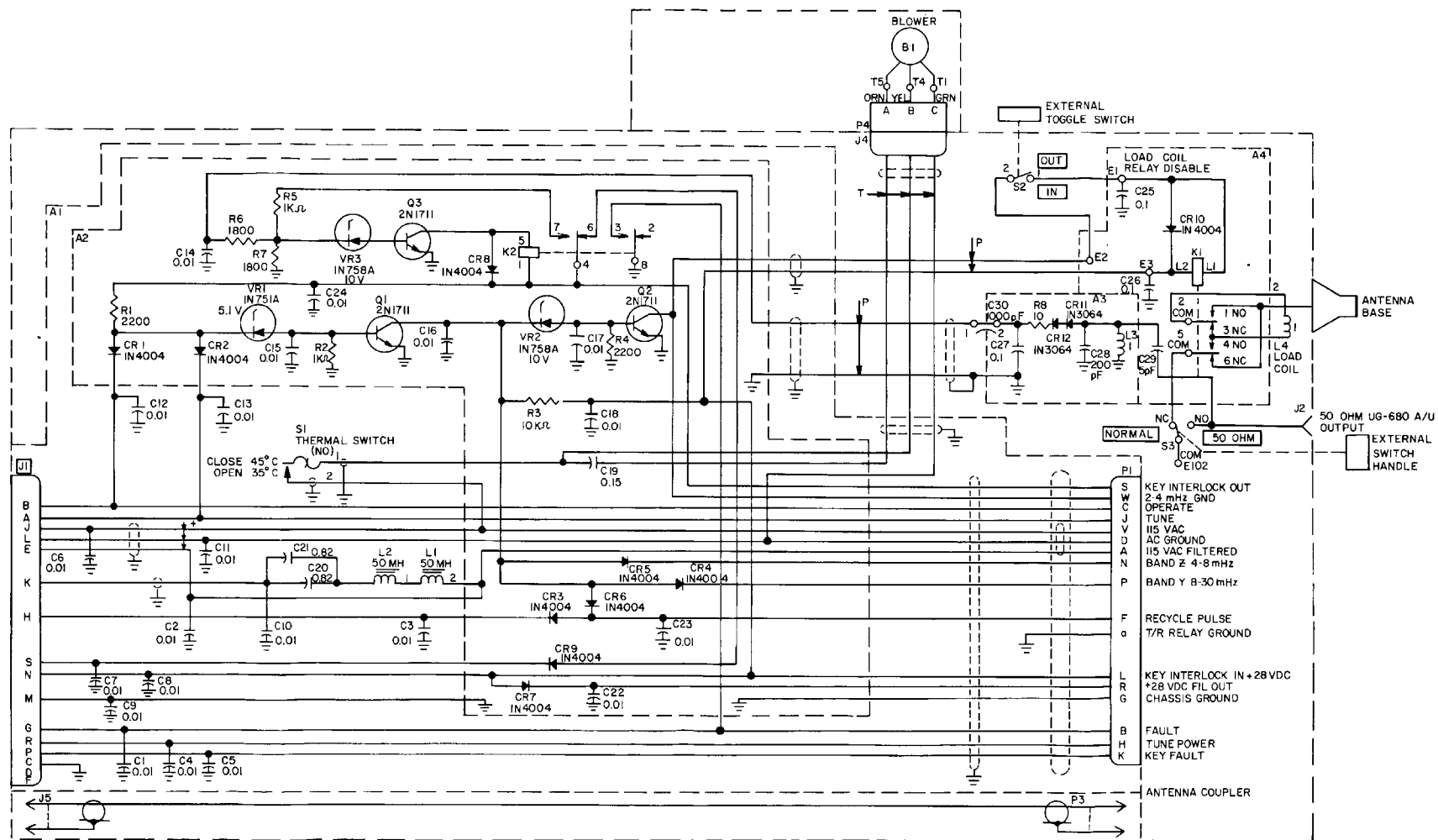
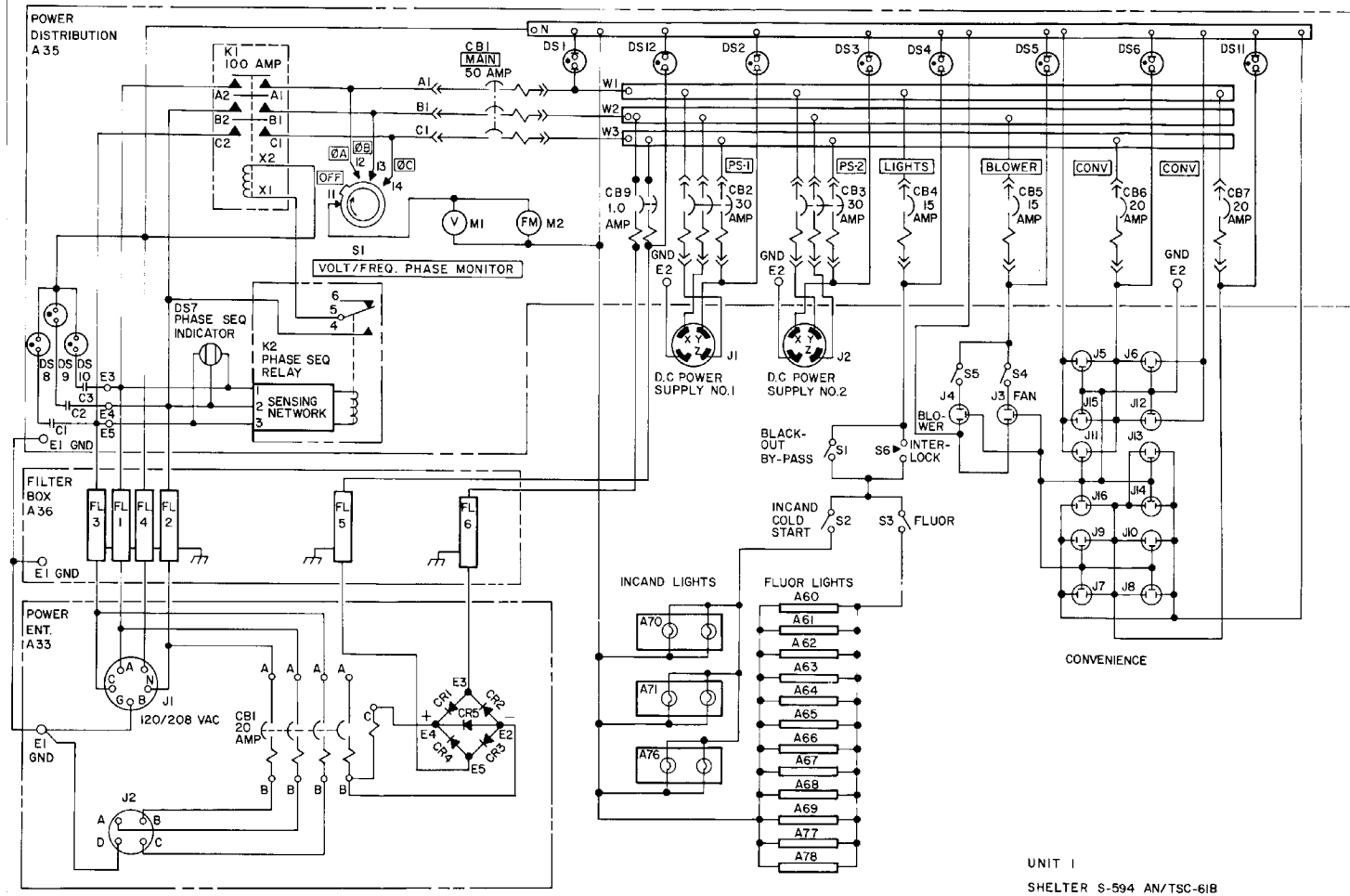


Figure FO-10. FM-3 secure communications, schematic diagram.



EL5UV157

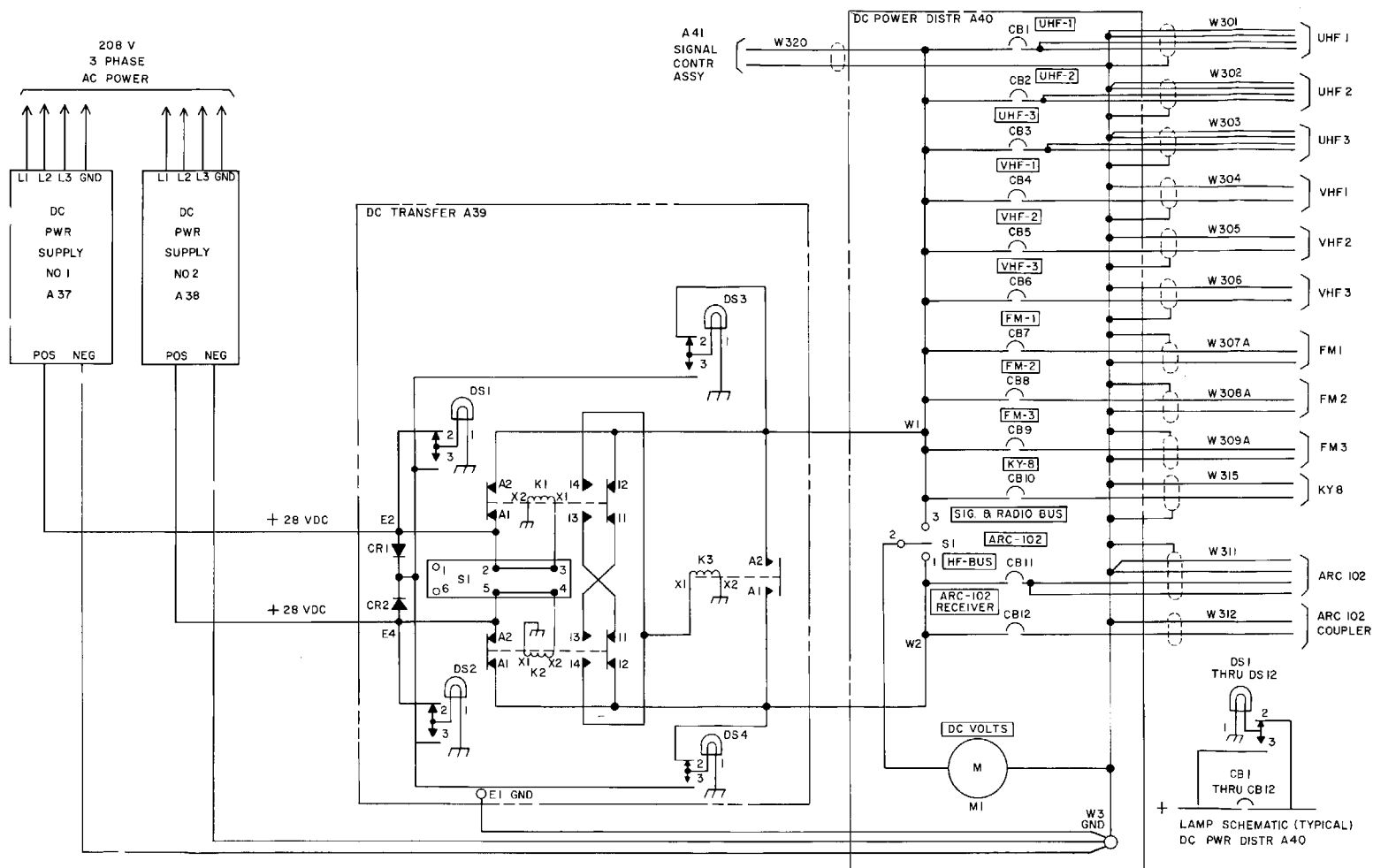
Figure FO-11. Coupler case, schematic diagram.



UNIT I  
SHELTER S-594 AN/TSC-61B

EL5UVI58

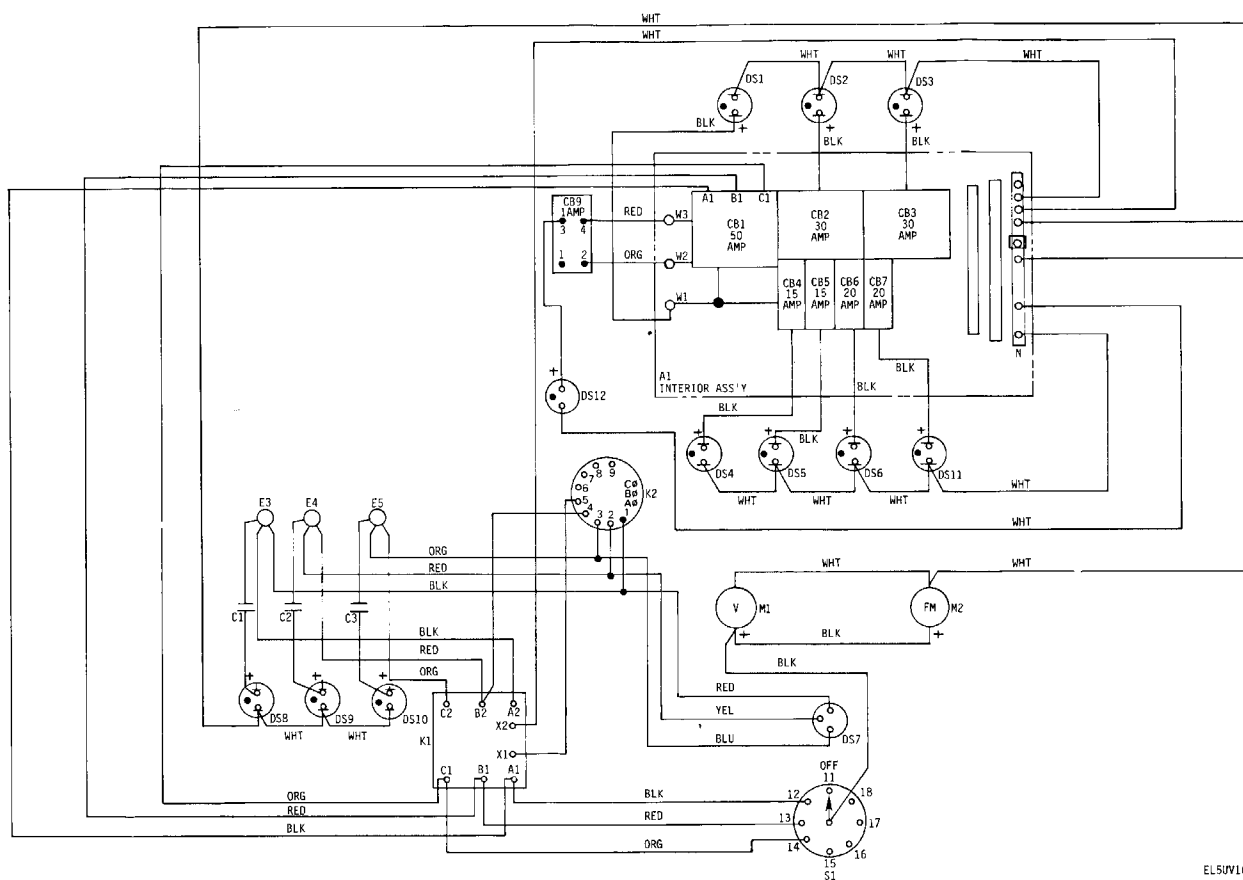
Figure FO-12. AC power, schematic diagram.



- NOTES:
1. S1 SHOWN IN AUTO
  2. S1 IN PSI POSITION.
  3. S2 IN PS2 POSITION.

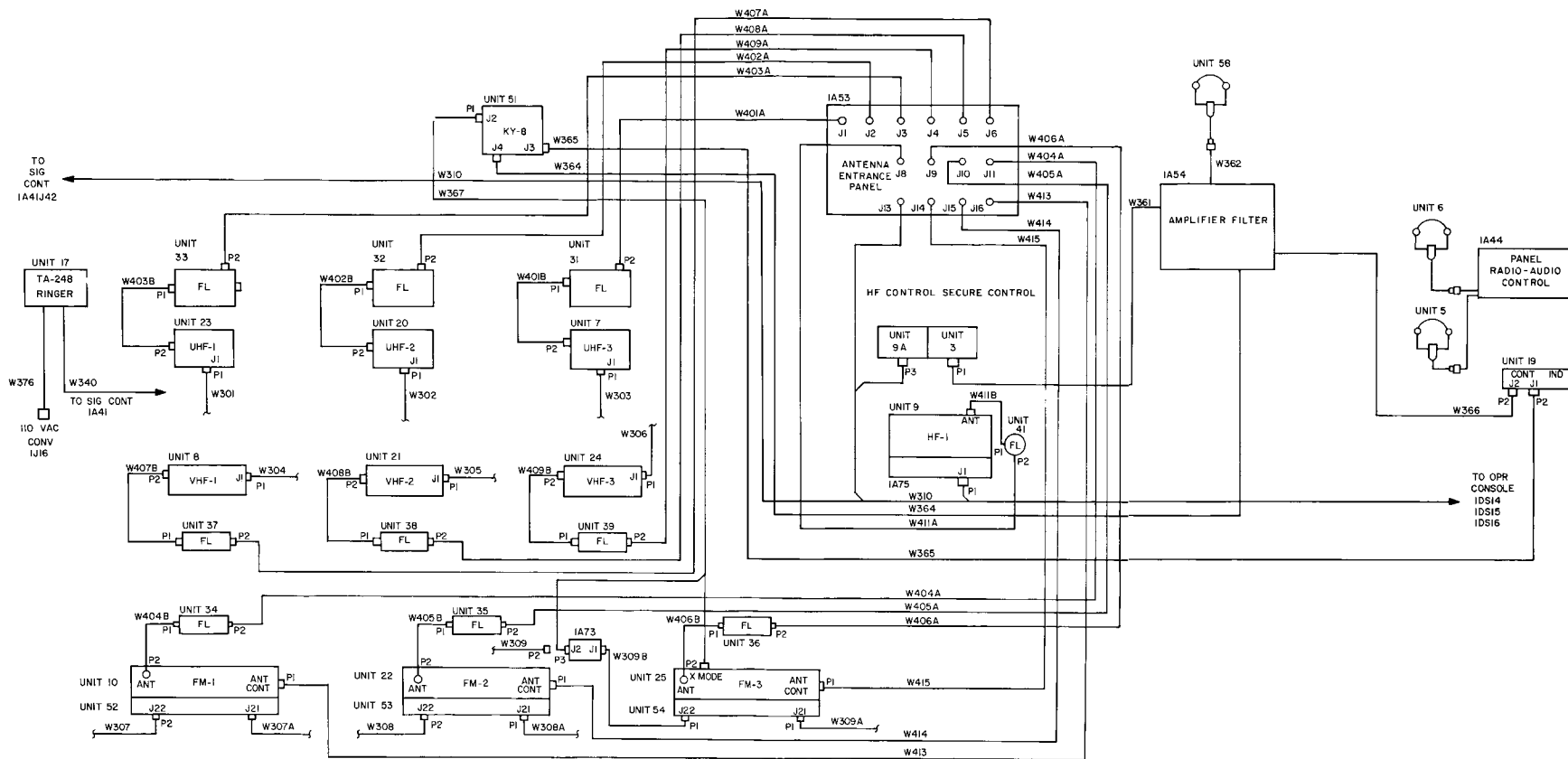
Figure FO-13. DC power, schematic diagram.





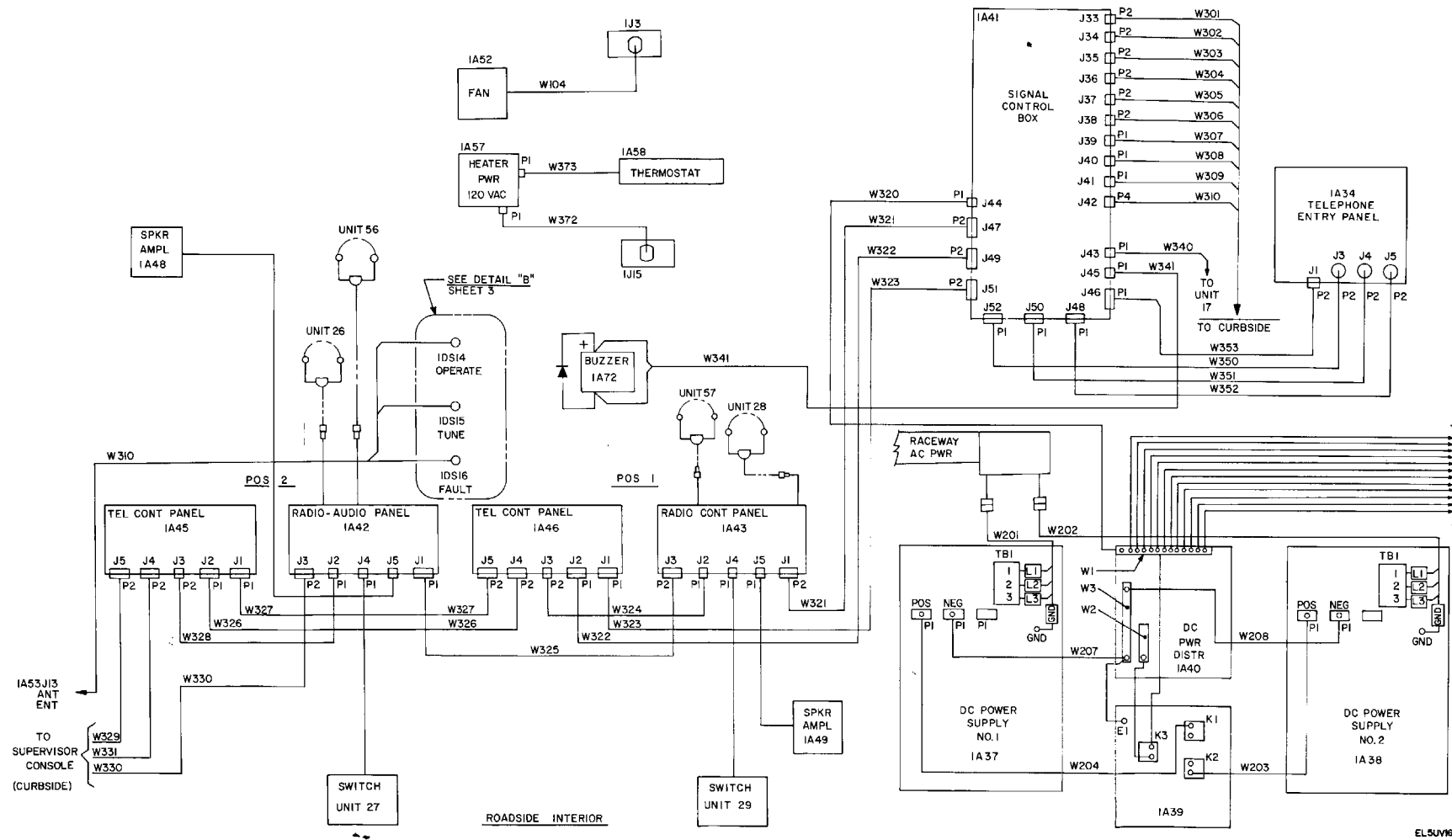
EL50V160

Figure FO-14. AC power distribution panel, schematic diagram.



ELSUVI61

Figure FO-15. Connection diagram, inter-unit cables



ELSUV64

Figure FO-16. Connection diagram, inter-assembly cables (sheet 1 of 3).

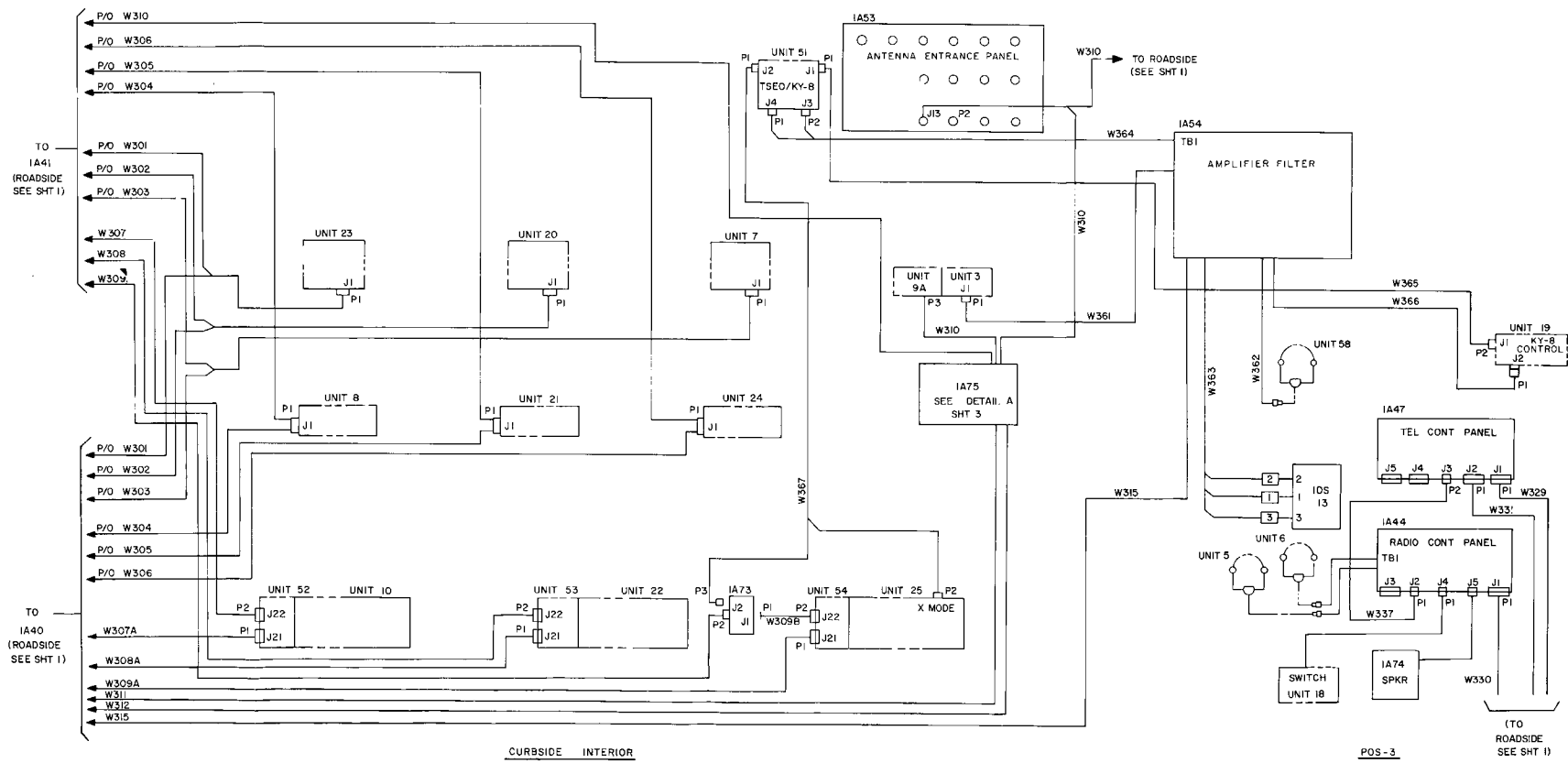


Figure FO-16. Connection diagram, inter-assembly cables (sheet 2 of 3).

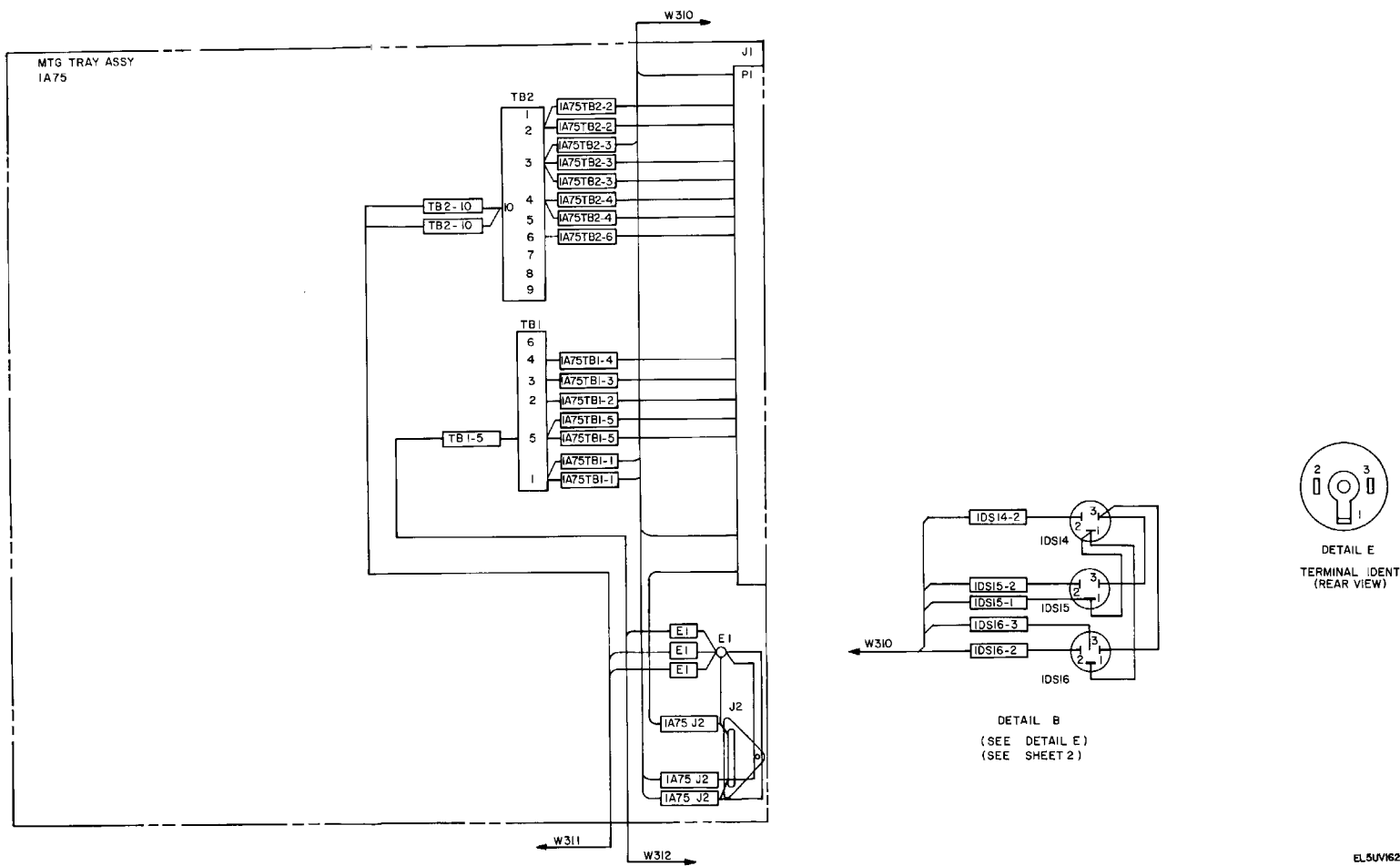
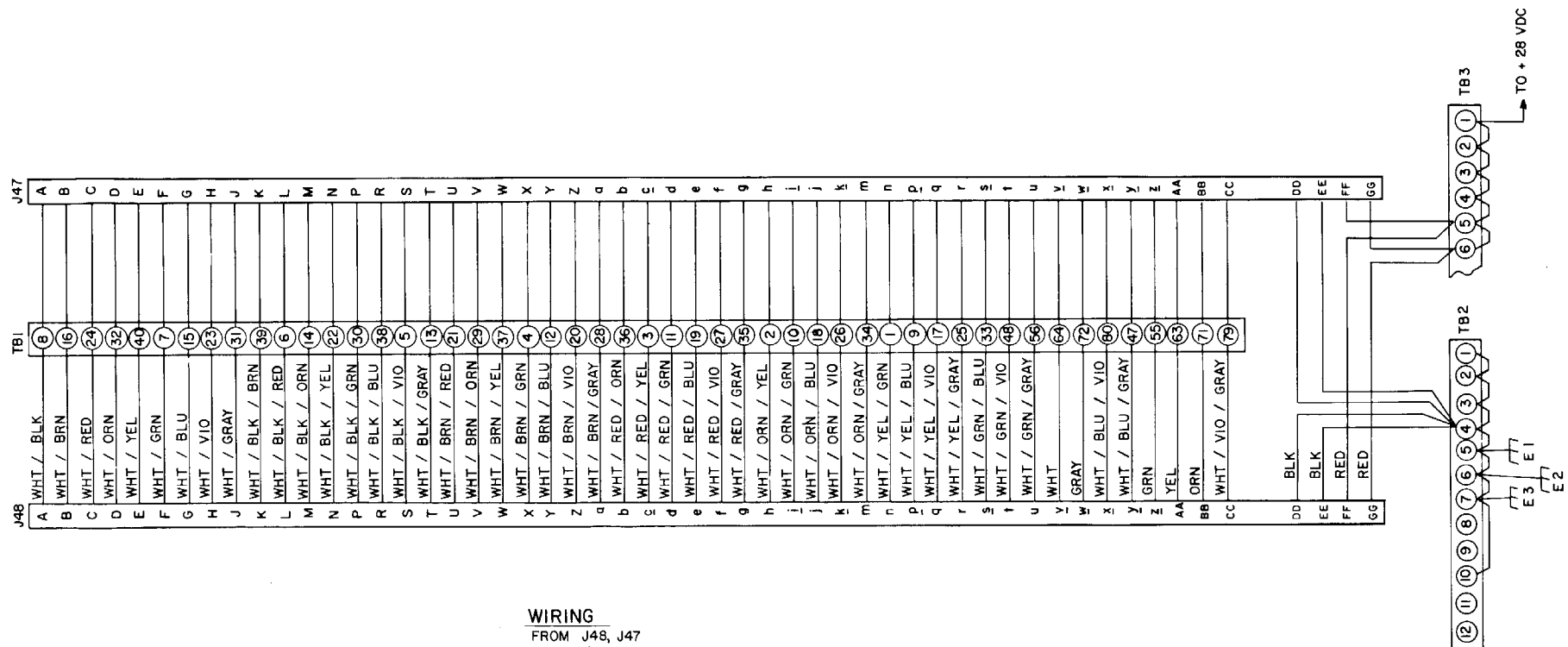


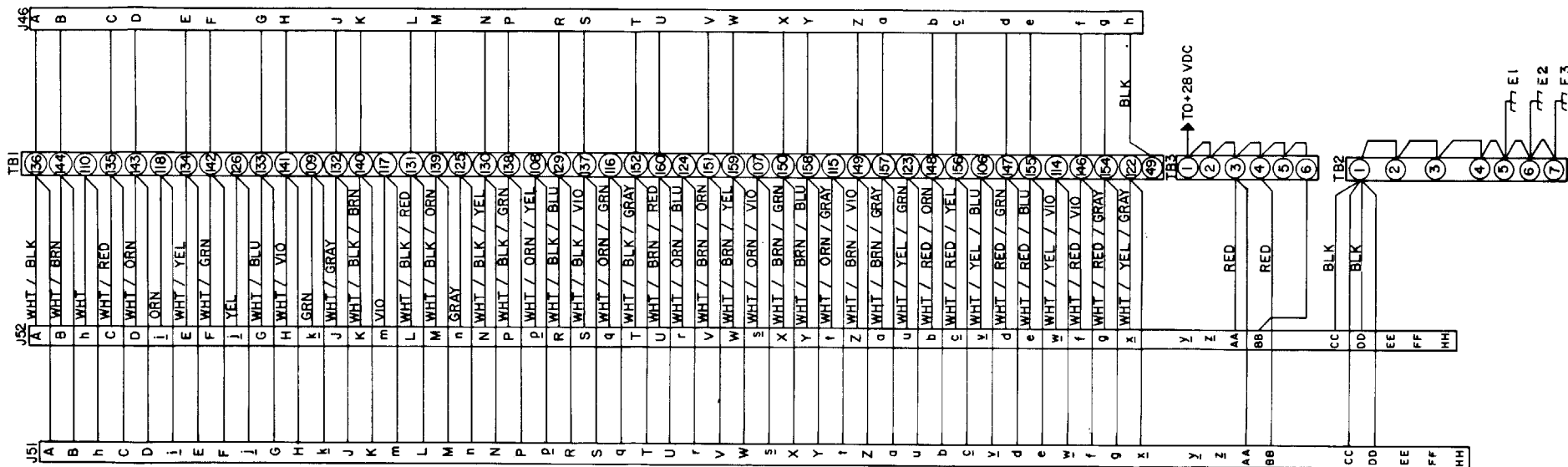
Figure FO-16. Connection diagram, inter-assembly cables (sheet 3 of 3).



**WIRING**  
 FROM J48, J47  
 TO TB1, TB2, TB3

EL5UVI66

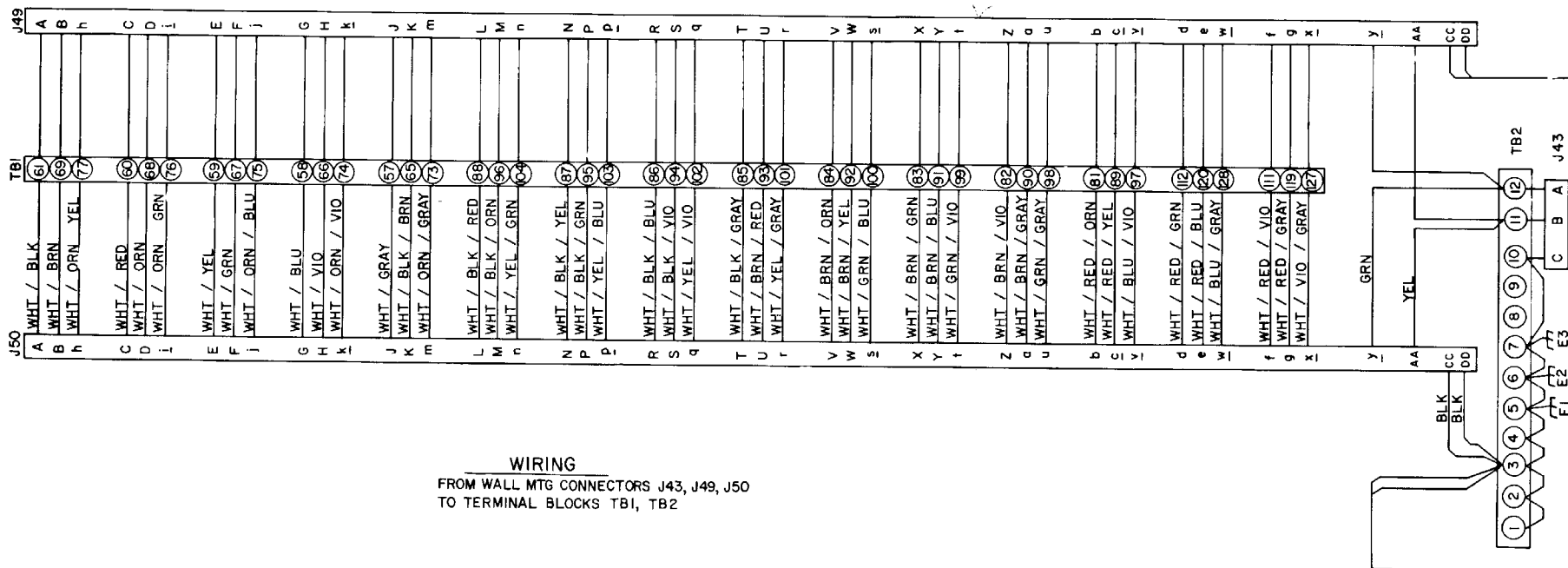
Figure FO-17. Signal control box, wiring diagram (sheet 1 of 4).



WIRING  
FROM J51, J52, J46  
TO TB1, TB2, TB3

EL5UV167

Figure FO-17. Signal control box, wiring diagram (sheet 2 of 4).



V168

Figure FO-17. Signal control box, wiring diagram (sheet 3 of 4).



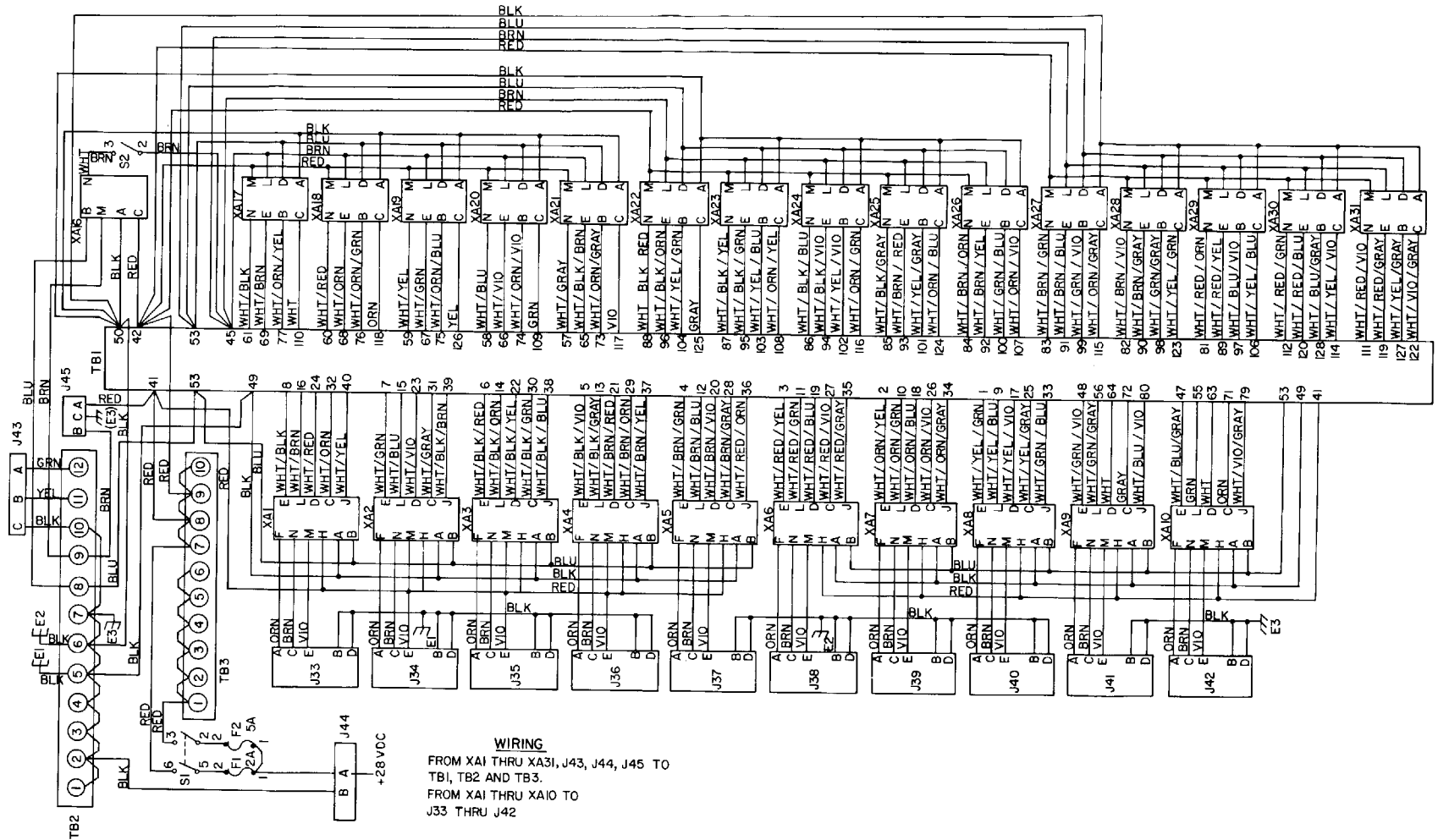
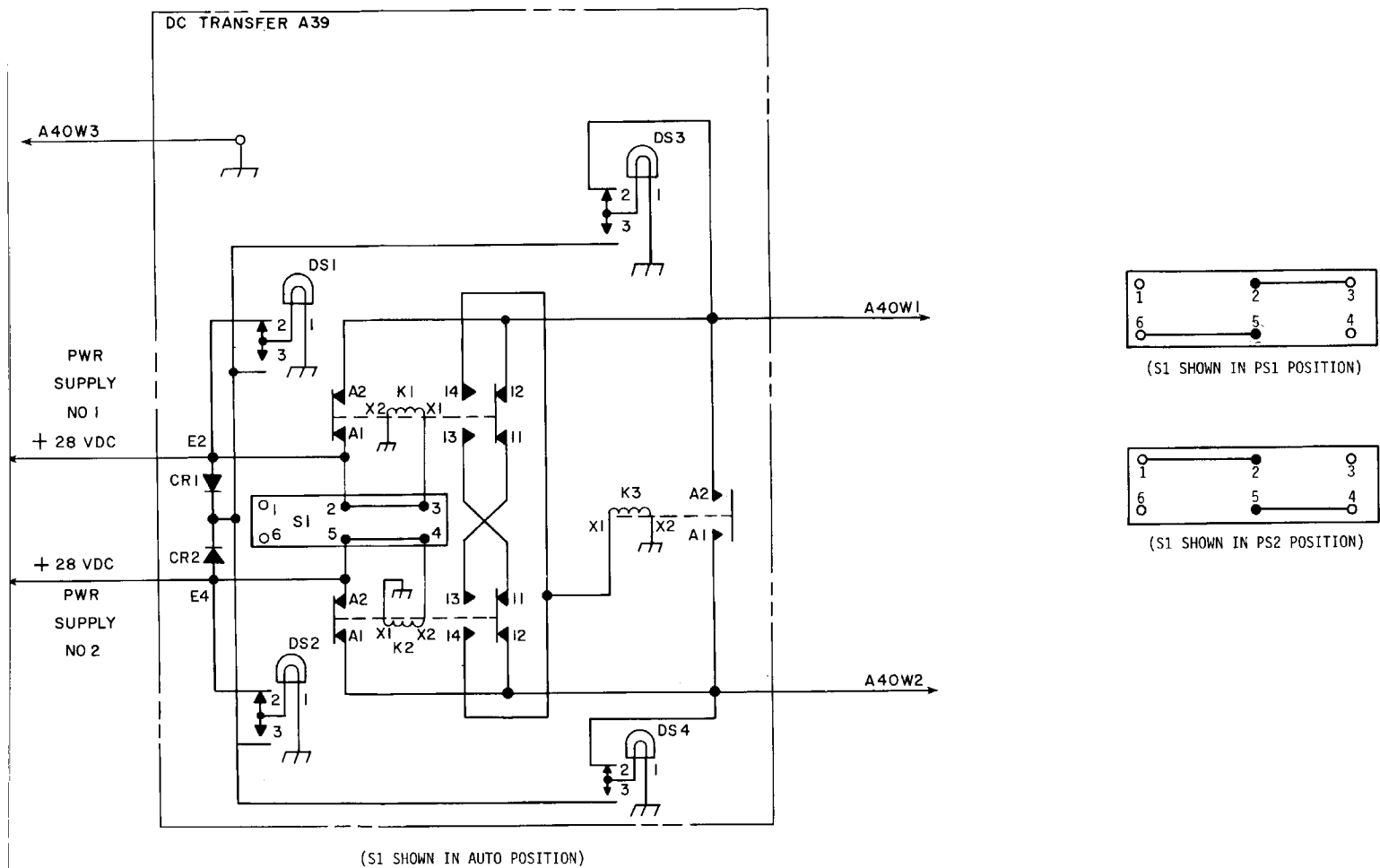
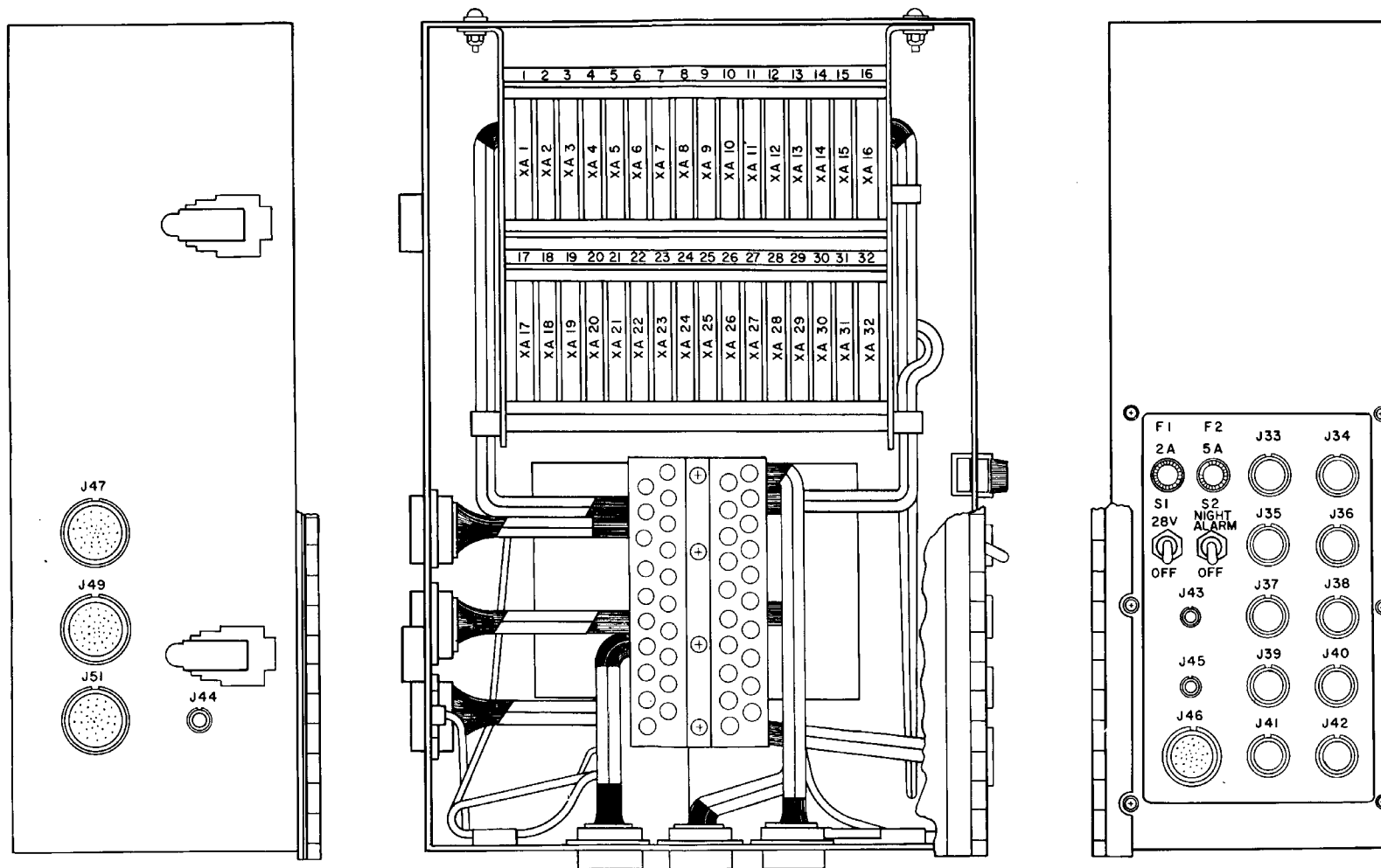


Figure FO-17. Signal control box, wiring diagram (sheet 4 of 4).



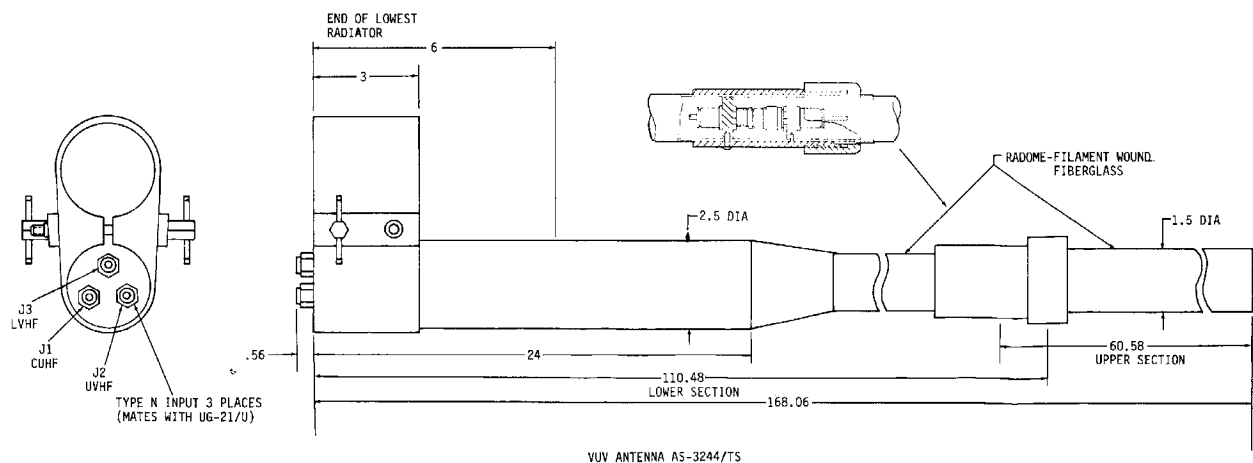
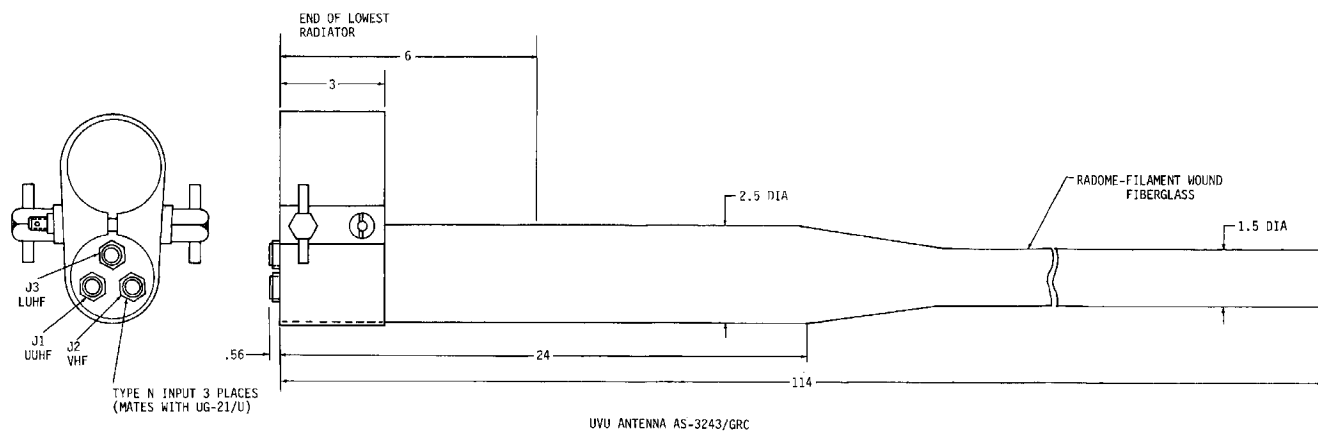
ELSUV170

Figure FO-18. Power supply control panel, schematic diagram.



EL5UV 71

Figure FO-19. Signal control box, parts location.



EL50V1712

Figure FO-20. UVU, VUV antennas, parts location.

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USACC (2)  
HISA (Ft Monmouth) (21)  
Armies (1)  
USASIGS (10)  
Svc Colleges (1)  
Ft Richardson (CERCOM Ofc) (1)  
Ft Carson (5)  
Ft Gillem (10)

WSMR (1)  
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Army Dep (1) except:  
LBAD (10)  
SAAD (30)  
TOAD (14)  
SHAD (3)  
USA Dep (1)  
Sig Sec Dep (1)  
Units org under fol TOE:  
29-134 (1)  
29-136 (1)  
29-207 (2)  
29-610 (2)

NG: None

USAR: None

For explanation of abbreviations used see AR 310-50.

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