TM 11-5820-256-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DS, GS, AND DEPOT MAINTENANCE MANUAL

RADIO SET AN/GRC-26D

HEADQUARTERS, DEPARTMENT OF THE ARMY
FEBRUARY 1967

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the power supply circuits, the 115-volt ac line connections, or the 240-volt plate circuits in Receiver, Radio R–390(*)/URR. Turn off power when working on the transmitting antenna or the transmitting antenna terminals; high radiofrequency energy exists at these points.

DON'T TAKE CHANCES

EXTREMELY DANGEROUS VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Transmitter, Radio T–368(*)/URT	2,400 volts
Converter, Frequency Shift CV–116(*)/URR	620 volts

WARNING

VENTILATION

The shelter must be ventilated when occupied. Be sure to open the vents, window shutters, or door when the equipment is operated. Keep the shelter air intake vent closed during transportation. The truck exhaust stack is near the air intake vent and danger from carbon monoxide poisoning exists. When the vehicle is moving, adequate air circulation exists through the shelter windows.

TECHNICAL MANUAL
No. 11-5820-256-35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *8 February 1967*

Direct Support, General Support and Depot Maintenance Manual

RADIO SET AN/GRC-26D

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*This manual, together with TM 11-5820-256-10, 20 July 1961, and TM 11-5820-256-20, 5 January 1962, supersedes TM 11-264B, 7 May 1957, including C 1, 7 June 1957; C 2, 5 December 1957; C 3, 27 August 1959; C 4, 7 November 1960; and C 5, 6 November 1962.

CHAPTER 1

INTRODUCTION

1-1. Scope

a. This manual covers direct support, general support, and depot maintenance for Radio Set AN/GRC-26D. It includes instructions appropriate to direct and general support and depot categories for troubleshooting, testing, aligning, and repairing the equipment, replacing maintenance parts, and repairing specific maintenance parts for Modulator, Radio MD-239(*)/GR; Control, Radio Set C-1123/GRC; Control, Remote Switching C-1474/GRC; Switch Box SA-331/U; and Loudspeaker Assembly LS-206(*)/U. Detailed functions of these components are covered in the equipment functioning chapter. This manual also lists tools, materials, and test equipment required for direct and general support and depot maintenance.

b. Detailed information pertaining to functioning and direct support, general support, and depot maintenance of the remaining major components, such as Transmitter, Radio T-368(*)/URT; Radio Receiver R-390(*)/URR; and Converter, Frequency Shift CV-116(*)/URR, is contained in the applicable technical manuals listed in the appendix. Operating instructions and organizational maintenance for this equipment are contained in TM 11-5820-256-10 and TM 11-5820-256-20.

c. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting discrepancies and recommendations for improving this equipment publication. The form will be completed by the individual using the manual and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-MR-NMP-AD, Fort Monmouth, N.J., 07703.

Note. For other applicable forms and records, see TM 11-5820-256-10.

1-2. Index of Publications

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. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc.) and the latest changes to and revisions of each equipment publication.

1-3. Internal Differences in Models

Internal differences in models of the C-1123/GRC, C-1474/GRC, MD-239(*)/GR, and LS-206(*)/U are given below. For external and other internal differences, see TM 11-5820-256-10 and TM 11-5820-256-20. For differences in models of other components of the AN/GRC-26D, refer to their respective technical manuals (app. A).

Note. Component reference designations may vary between equipments procured on different orders; however, components are identical unless otherwise specified in *a*, *b*, or *c* below.

a. Control, Radio Set C-1123/GRC. On Order No. 25209-Phila-54, REC DX jacks J18 and J17 are series-connected. On other orders, the equivalent REC DX jacks are not connected in any way. Other wiring differences also exist between the units on Order No. 25209-Phila-54 and those on other orders. These, however, do not cause any differences in function, performance, or maintenance of the units.

b. Control, Remote Switching C-1474/GRC. Capacitor C201 is 2 microfarads (uf) in units on Order No. 25209-Phila-54. Equivalent capacitor C1 is 2 micromicrofarads (uuf) in units on Orders No. 28459-Phila-55, 21316-Phila-56, and 43056-Phila-56. Capacitor C1 is 2 uf on other units.

c. Modulators, Radio MD-239/GR and MD-239A/GR. All frequency-shift keying (fsk) modulators are functionally identical.

(1) Some circuit configurations and component values differ between the two models. These differences are shown on figures 5–16 and 5–18. Note that four terminal studs are provided as test points in the MD–239A/GR and are not provided in the MD–239/GR.

(2) The MD–239A/GR procured on Order No. 3219–Phila–59 differs from the MD–239A/GR procured on other orders as follows:

(*a*) Locking nuts are added to the adjustable screws on impedance networks Z1, Z2, Z3, and Z4.

(*b*) Some connecting wires, above the chassis on other orders, are laced into the cable harness on the bottom of the chassis (fig. 5–19).

d. Loudspeaker Assemblies LS–206/U and LS–206A/U. The transformers differ as indicated below:

(1) In the LS–206A/U, the primary winding is tapped to provide input impedances of 600, 4,000, and 8,000 ohms.

(2) In the LS–206/U, the primary winding is tapped to provide input impedances of 600 and 8,000 ohms.

Note. Only the 600-ohm input is used in the AN/GRC–26D.

CHAPTER 2

FUNCTIONING OF AN/GRC-26D

Section I. INTERUNIT FUNCTIONING

2-1. General

a. The purpose, operation, and interoperation of the various circuits (electrical, electronic, and mechanical) in the equipment, are explained in this chapter. Familiarity with the equipment, how it works, and why it works that way are valuable tools in troubleshooting the equipment rapidly and effectively.

b. This section describes the general characteristics of the antennas, used with the AN/GRC-26D, and the interunit transmitter keying and receiver disabling circuits. Block diagram analysis of the transmission paths in the AN/GRC-26D is covered in TM 11-5820-256-20. Detailed functioning of the minor components of the AN/GRC-26D is given in subsequent sections of this manual. The technical manuals containing detailed functioning of the major components of the radio set are listed in appendix A.

2-2. Antennas

a. Types and Characteristics.

(1) *Whip antenna.* Whip antennas receive and transmit equally well in all directions. The advantage of the whip antenna is its small space requirement, comparative ease in installation and removal, and mobile application. The distance over which satisfactory communication may be maintained, is less with a whip antenna than with the doublet antenna ((3) below).

(2) *Long-wire antenna.* The long-wire antenna is directional and affords satisfactory communications over long distances. Its radiation pattern is similar to that of the doublet antenna.

(3) *Doublet antenna.* A doublet antenna provides efficient termination of the antenna feeder by having two feeder leads connected to the center of the antenna to insure a balanced load for each lead. The doublet half-wave antenna is used in fixed or semifixed applications. It is directional and suitable for satisfactory communications over long distances in either direction perpendicular to the axis of the wire.

Note. For detailed information regarding the functioning of antennas and radiation patterns, refer to TM 11-486-6 and TM 11-666.

b. Space Diversity Reception.

(1) Space diversity reception is used to reduce the effects of fading radio signals. In high-speed radio teletypewriter operations, even short variations in signal strength have a marked effect on the accuracy of the message. Fading may be caused by a shift in the height of the ionosphere and multipath signal transmission, with the resulting out-of-phase recombination of the signal at the receiving antenna.

(2) A space diversity system is based on the probability that instantaneous fading will not occur everywhere at one time. If two receiving antennas are spaced several wavelengths apart, it is highly probable that a signal of sufficient strength will be received at one or the other. The space diversity system, to function efficiently, must consist of two receiving antennas, two receivers, and a converter which combines the output of the receivers.

2-3. Interunit Keying Circuits
(fig. 2-1)

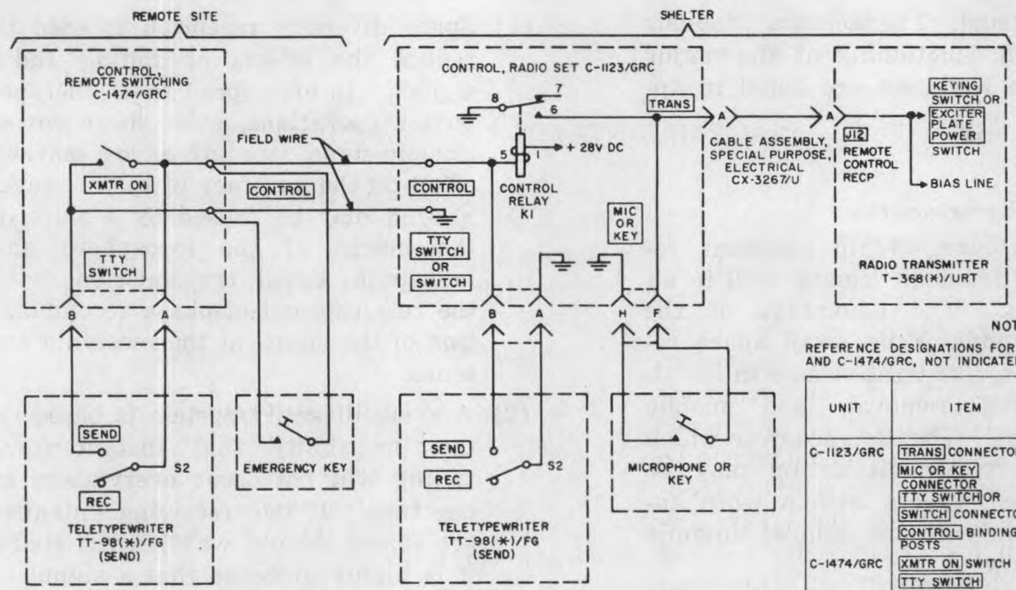
The transmitter is keyed by grounding the bias line in the transmitter (TM 11-809-35). The bias line may be grounded at the transmitter by placing the KEYING switch at CONTINUOUS or the EXCITER PLATE POWER switch to the *on* position. All the keying circuits, which are external to the transmitter, are in parallel with the transmitter switch. The methods used for external keying of the transmitter are explained in *a* through *d* below.

a. Within the shelter, the transmitter may be keyed by the send teletypewriter, microphone, or key. The microphone or key, as required, is connected to the MIC OR KEY jack of the C-1123/GRC. When the microphone or key contacts are closed, the transmitter bias line is grounded through pins H and F of the MIC OR KEY jack and pin A of the TRANS connector on the control unit, and pin A of remote control receptacle J12 on the transmitter.

b. The shelter send teletypewriter keys the transmitter when SEND-REC switch S2 is set to SEND. This action completes the circuit through the TTY SWITCH (SWITCH) connector to energize control relay K1 in the C-1123/GRC. Relay contacts 6 and 8 ground the bias line through pin A of the TRANS connector (*a* above) to key the transmitter.

c. The transmitter may be keyed from the remote site by the XMTR ON switch in the C-1474/GRC or teletypewriter SEND-REC switch S2. These switches are in parallel and connect to the CONTROL binding posts of the C-1474/GRC and C-1123/GRC. Closing either switch (SEND-REC switch to SEND or XMTR ON switch set to the *on* position) completes the circuit to energize control relay K1 in the control unit, and grounds the transmitter bias line through closed contacts 6 and 8 of relay K1 (*b* above).

d. Emergency continuous-wave (cw) keying can be accomplished at the remote site by connecting a key to the CONTROL binding posts on the remote control unit. Closing the key energizes control relay K1 of the control unit the same way as the XMTR ON switch in the remote control unit (*c* above).



NOTE:
REFERENCE DESIGNATIONS FOR THE ITEMS OF THE C-1123/GRC AND C-1474/GRC, NOT INDICATED, ARE LISTED BELOW:

UNIT	ITEM	REFERENCE DESIGNATION	
		ORDER NO. 25209-PHILA-54	OTHER ORDERS
C-1123/GRC	TRANS CONNECTOR	J22	J6
	MIC OR KEY CONNECTOR	J19	J8
	TTY SWITCH OR SWITCH CONNECTOR	J21	J2
	CONTROL BINDING POSTS	J24, J25	E1, E3
C-1474/GRC	XMTR ON SWITCH	S201	S1
	TTY SWITCH CONNECTOR	J208	J7
	CONTROL BINDING POSTS	J202, J207	E5, E6*

*ON ORDERS NO. 43056-PHILA-56 AND 3219-PP-59, THE CONTROL BINDING POSTS IN THE C-1474/GRC ARE DESIGNATED E2 AND E3.

TM5820-256-35-1

Figure 2-1. Interunit transmitter keying circuits, functional diagram.

2-4. Receiver Disabling Circuits
(fig. 2-2)

In one-way reversible operation of the AN/GRC-26D, the receivers are disabled during radiofrequency (rf) transmission. Three components are involved in receiver disabling: the transmitter, the control unit, and one or both receivers. Receiver disabling is provided by completing a path to ground for specific relay coils and circuits in the control unit and the receivers. Within the receivers, the antenna input circuits are grounded and, on three specific receiver functions, the audio signals are also grounded (TM 11-5820-357-35 and TM 11-5820-358-35).

a. When the transmitter is keyed, the transmitter bias line is grounded (para 2-3) and current from the relay control energizes the slow release relay. When the slow release relay in the transmitter operates, it grounds the receiver disabling line (TM 11-809-35). The ground is applied through pin J of remote control receptacle J12 in the transmitter, through Cable Assembly, Special Purpose, Electrical CX-3267/U, and pin J of the TRANS receptacle in the control unit. The ground is applied to terminal 5 of disabling relay K2 in the control unit, causing the relay to operate.

b. When disabling relay K2 in the control unit operates, ground is applied through pins B of connectors REC A and REC B and both Cable Assemblies, Special Purpose, Electrical CX-3268/U to terminals 9 of the BRK IN terminal boards in the receivers.

c. The application of ground to both receivers is identical. Only the general reaction of receiver A to the applied ground is described below. For detailed receiver functioning, refer to TM 11-5820-357-35 or TM 11-5820-358-35.

Note. The BREAK IN switch in the receiver must be at ON for the ground to have any effect.

(1) When the receiver BREAK IN switch is at ON and ground is applied, a circuit is completed through the winding of the receiver antenna relay. The relay operates and grounds the antenna input circuits of the receiver.

(2) When the receiver BREAK IN switch is at ON, the receiver FUNCTION switch is at AGC, MGC, or SQUELCH, and ground is applied ((1) above), the receiver break-in relay is placed in parallel with the receiver antenna relay. The operation of the receiver break-in relay grounds the audio output stage in the receiver.

Section II. BLOCK DIAGRAM ANALYSIS OF FSK-MODULATOR

2-5. General
(fig. 2-3)

a. The fsk-modulator shifts an injected 1.5- to 3.0-megacycle (mc) carrier signal from the transmitter master oscillator in accordance with signals from teletypewriter equipment. The incorporation of four different frequency shifts (850, 425, 212.5, and 106.25 cycles per second (cps)) permits the fsk-modulator to be used with the transmitters that double, quadruple, or double and quadruple the 1.5- to 3.0-mc signal to obtain operation in the desired band. When operating without frequency shift, the fsk-modulator circuits pass the 1.5- to 3.0-mc signal without modification.

b. The fsk-modulator functions as a double superheterodyne circuit that first increases the injected carrier signal frequency and adds the frequency shift, and then decreases the carrier signal to its original frequency but does not remove the shift. The output signal frequency of the fsk-modulator is the same as the input carrier signal frequency, except that the proper frequency shift has been included.

2-6. Block Diagram Analysis
(fig. 2-3)

Note. In the MD-239(*)/GR, the shift oscillator is V5, the intermediate-frequency (if.) amplifier is V2, the second mixer if V3, the fixed oscillator is V6, and the first amplifier is V4.

The keying input circuit switches the frequency of shift oscillator V2 to correspond to a mark or space signal from the teletypewriter. The signal from the shift oscillator (12 mc on mark, 12 mc minus frequency shift on space) is combined with the carrier signal (1.5 to 3

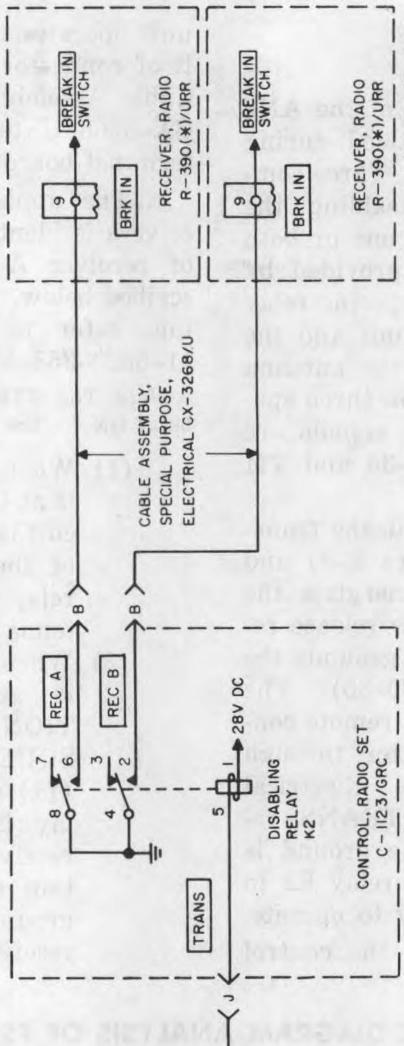


Figure 2–2. Receiver disabling circuits, functional diagram.

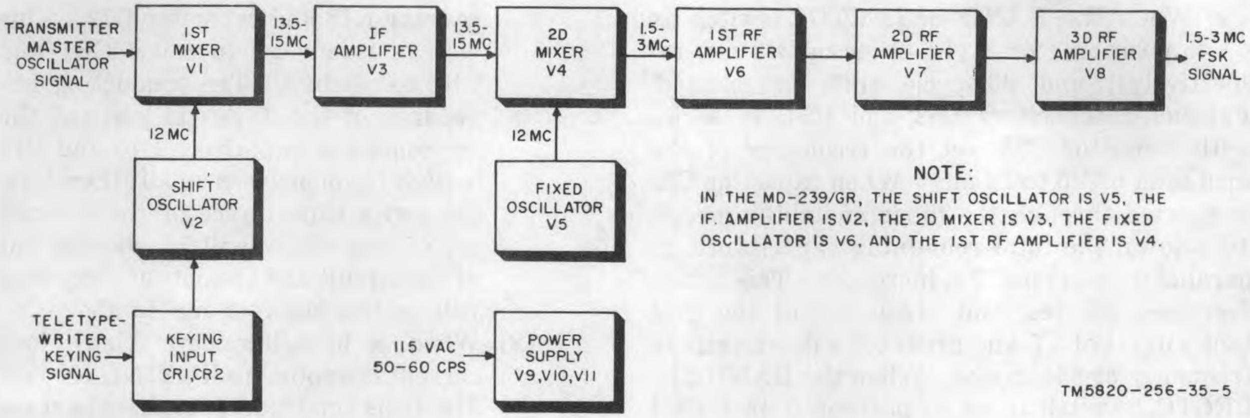


Figure 2-3. Fsk-modulator, block diagram.

mc) from the transmitter master oscillator, and the intermediate frequency produced in first mixer V1 (13.5–15 mc on mark, 13.5–15 mc minus frequency shift on space) is amplified by if. amplifier V3. Fixed oscillator V5 operates under the same temperature and circuit conditions as shift oscillator V2. Frequency drift caused by temperature variations in shift oscillator V2 is canceled by a similar drift in fixed oscillator V5 when the fixed oscillator signal is heterodyned with the signal from if. amplifier V3. The difference frequency from second mixer V4 (1.5–3mc on mark, 1.5–3 mc minus frequency shift on space) is selected and amplified by first, second, and third rf amplifiers V6, V7, and V8. The 3- to 5-volt output of third rf amplifier V8 (1.5–3 mc fsk signal) is used to drive the buffer stage of the transmitter. The power supply provides filament power, power to heat the crystal ovens, and plate voltages.

Section III. SCHEMATIC DIAGRAM ANALYSIS OF MODULATOR, RADIO MD-239/GR

2-7. Shift Oscillator V5
(fig. 5-16)

Shift oscillator V5 generates a 12-mc crystal-controlled signal. The oscillator is tuned by variable capacitors shunting the crystal. Additional capacitance is shunted across the crystal to provide the required frequency shift of the 12-mc signal. The addition of frequency-shifting capacitance is controlled through a diode switching network (*d* below). This circuit is a modified electron-coupled Colpitts oscillator.

a. Crystal Y1, 12-mc, is connected across the grid circuit of V5. It is contained in crystal oven HR1 and maintained at a temperature between 165° and 169° F. (74° and 76° C.). The shift frequency, which is 850 cps or less, is obtained by switching in additional capacitance. Resistor R29 is the grid resistor. Capacitors C26 and C27 form a voltage divider for feedback voltage to maintain oscillation. Coil L2 isolates the 12-mc signal voltage from ground while maintaining the cathode of V5 near direct-current (dc) ground potential. The screen grid is held at rf ground potential by capacitor C28. Resistor R30 is the screen grid voltage dropping resistor. The plate circuit of V5 is tuned by tank circuit Z3. Resistor R31 and capacitor C29 form a decoupling filter in the plate supply lead.

b. Four different sets of three capacitors each are used in conjunction with the four frequency shifts required. The setting of BAND SELECTOR switch S1 determines which set of capacitors will be used. The setting of switch S1 must correspond to the frequency setting of the transmitter BAND SELECTOR switch (TM 11-5820-256-10); therefore, the correct frequency shift is selected for the amount of multiplication required to obtain a resultant of 850-cycle shift in the transmitter (TM 11-809-35).

c. When the BAND SELECTOR switch is set to position 1 or 2 (1.5–2 mc or 2–3 mc, respectively), and 850-cycle shift is selected. Paralleled capacitors C53 and C54, in series with capacitor C55, set the frequency of the grid tank of V5 to 12 mc. When capacitor C55 is shorted through the diode switching circuit (*d* below), the total remaining capacitance, in parallel with crystal Y1, increases. This action decreases the resonant frequency of the grid tank circuit of V5 and produces a down shift in frequency of 850 cycles. When the BAND SELECTOR switch is set to position 3 or 4 (3–4 or 4–6 mc), a 425-cycle shift is selected. Paralleled capacitors C56 and C58, in series with capacitor C57, set the frequency of the grid tank of V5 to 12 mc. Shorting out series capacitor C57 through the switching circuit increases the total remaining capacitance in parallel with crystal Y1. This action decreases the resonant frequency of the grid tank circuit of V5 and produces a down shift in frequency of 425 cycles. When the BAND SELECTOR switch is set to position 5 or 6 (6–8 mc or 8–12 mc), a 212.5-cycle shift is selected. Capacitor C59 and paralleled capacitors C60 and C61 set the frequency of the grid tank of V5 to 12 mc. Shorting out capacitors C60 and C61, through the diode switching circuit, increases the capacitance and decreases the resonant frequency of the grid tank circuit of V5 and produces a down shift in frequency of 212.5 cycles. When the BAND SELECTOR switch is set to position 7 or 8 (12–16 mc or 16–20 mc), a 106.25-cycle shift is selected. Capacitor C62 and paralleled capacitors C63 and C64 set the frequency of the grid tank of V5 to 12 mc. Shorting out capacitors C63 and C64 through the diode switching circuit increases the capacitance and decreases the resonant frequency of the grid tank circuit of V5 and produces a down shift in frequency of 106.25 cycles.

d. Diodes CR1 and CR2 are used in the switching circuit. This circuit can be compared to an electronic switch and uses the cutoff and conducting characteristics of crystal diodes to switch capacitors into or out of a resonant tank circuit.

(1) When no current is applied to KEYING IN jack J14 (*space* condition), a positive voltage of approximately 7 volts is present at the junction of resistor R48 and capacitor C72. This voltage is enough to cause CR1 and CR2 to conduct. The conducting impedance of the diodes is low and the impedance of capacitors C70 and C71 to high frequencies is small; therefore, the series capacitance of the selected set of capacitors will be shorted out of the circuit and the output frequency will be less than 12 mc (*c* above).

(2) When a 60-milliampere (ma) loop current is applied to KEYING IN jack J14 (this condition prevails whenever a *mark* signal is transmitted, or when the teletypewriter is activated and in the standby condition), the positive voltage at the junction of resistors R46 and R47 is approximately 22 volts. This potential is greater than the potential at the junction of resistor R48 and capacitor C72. Diodes CR1 and CR2 are reverse-biased and will not conduct. The cutoff impedance of the diodes is high, the series capacitance will be included in the circuit, and the total capacitance of the tank circuit will be decreased and cause the shift oscillator frequency to return to 12 mc.

e. The output of V5 is coupled through capacitor C22 to the oscillator grid (pin 2) of first mixer V1.

2–8. First Mixer V1
(fig. 5–16)

The first mixer stage uses a type 6BA7 tube to mix the injected signal (1.5 to 3.0 mc) from the master oscillator in the transmitter with the signal from shift oscillator V5 (12 mc or 12 mc with frequency shift) (para 2–7). The output of V1 is applied through bandpass filter FL3 (which will pass only frequencies between 13.5 and 15 mc) to prevent the fundamental frequencies and the difference frequency from entering the following stages.

a. The injected signal at M.O. IN jack J4 is taken from the arm of input-level adjust potentiometer R2 and fed through anti-loading resistor R1 or R3 to input filter FL1 or FL2. The resistors are used to prevent the input filters from loading down the master oscillator in the transmitter. The selection of either FL1 or FL2 is determined by section 1 of BAND SELECTOR switch S1 in the fsk-modulator. If the injected frequency is between 1.5 and 2.0 mc, FL1 is used. This filter has an upper cutoff frequency above 2 mc and filters out all harmonics that might fall in the 2- to 3-mc band. If the injected frequency is between 2.0 and 3.0 mc, filter FL2 is used. This filter has a bandpass characteristic with the least attenuation between 2 and 3 mc. The signal output of the filter (filtered injected signal) is coupled into the signal injection grid (pin 7) of first mixer V1 through capacitor C1 across grid resistor R4. The output of V5 is fed into the oscillator grid (pin 2) of V1 through coupling capacitor C22 (para 2–7).

Note. The injected frequency from the master oscillator in the transmitter will fall into the 1.5- to 2.0-mc band or the 2- to 3-mc band for all settings of the BAND SELECTOR switch.

b. Resistor R5 is the grid resistor. Resistor R6 is the cathode-biasing resistor and capacitor C2 is the cathode rf bypass capacitor. Resistor R9 is the screen grid voltage dropping resistor and capacitor C3 is the screen grid bypass capacitor. Resistor R10 and capacitor C6 form a plate decoupling network. Tuned circuit Z1 is the plate load of the first mixer. Resistor R8 loads the tuned circuit to give it the broadband characteristics required to pass signals in the 13.5- to 15-mc band. The output voltage is fed through coupling capacitor C4 and into the impedance-matching network of R7 and R11. These resistors provide the proper impedance match for bandpass filter FL3. Filter FL3 is designed to pass only frequencies between 13.5 and 15 mc and to attenuate all other frequencies. The output of bandpass filter FL3 is applied through coupling capacitor C7 to if. amplifier V2.

2–9. If. Amplifier V2
(fig. 5–16)

If. amplifier V2 acts as a buffer between the first and second mixer stages.

a. The if. signal from bandpass filter FL3 is coupled to the grid of amplifier V2, a 6AH6 pentode-type tube, through capacitor C7. The output of V2 is developed across tuned circuit Z2 and is coupled to second mixer V3 through capacitor C12.

b. Self-bias is developed across cathode resistor R13. The cathode rf bypass capacitor is C8. The grid resistor is R12. Resistor R15 and capacitor C10 form the plate decoupling network. Screen grid voltage dropping resistor R14 and capacitor C9 form the screen grid decoupling network.

2–10. Fixed Oscillator V6
(fig. 5–16)

The fixed oscillator produces a signal that is identical in frequency with that of the frequency-shift oscillator without shift (12 mc). This frequency is mixed with the 13.5- to 15.0-mc frequency. The injected frequency is regained by combining the fixed oscillator frequency with that from if. amplifier V2 and extracting the difference.

a. Fixed oscillator V6 is similar to shift oscillator V5 (para 2–7), except that two capacitors are used in tuning the crystal circuit. Variable capacitor C33 and fixed capacitor C32 tune the grid of V6, controlled by crystal Y2. The output of V6 is applied through C13 to pin 2 of second mixer V3.

b. Circuit elements in this stage have the same functions as their counterparts in the shift oscillator (para 2–7).

2–11. Second Mixer V3
(fig. 5–16)

The second mixer combines the 13.51–1 to 15.0–mc if. signal, produced in the first mixer (para 2–8), with the 12-mc signal from the fixed oscillator (para 2–10). The difference frequency, which, either is identical with the injected signal frequency or is the injection signal frequency with the shift, is fed through low-pass filter FL4 to first rf amplifier V4.

a. The if. signal (13.5 to 15.0 mc) from if. amplifier V2 is applied to the signal injection grid (pin 7) of second mixer V3, a 6BA7 pentagrid converter-type tube, and is combined with the 12-mc oscillator signal that is applied to the oscillator grid (pin 2) of V3. The intermediate frequencies produced in V3 are developed across plate load resistor R21 and coupled through capacitor C14 to low-pass filter FL4.

b. Resistor R22 and capacitor C17 form the plate decoupling network. Self-bias is developed across resistor R19 and capacitor C15.

Resistor R18 is the grid resistor for the oscillator grid, and R17 is the grid resistor for the signal injection grid.

c. The output of second mixer V3 is applied to low-pass filter FL4, where the high frequencies are attenuated. The lower frequencies (1.5 to 3.0 mc) that are passed by the filter are coupled through capacitor C18 to the grid of first rf amplifier V4.

2-12. First, Second, and Third Rf Amplifiers V4, V7, and V8
(fig. 5-16)

The first, second, and third rf amplifiers increase the signal output of the second mixer to a 3- to 5-volt level, suitable for driving the second buffer stage of the transmitter.

a. The 1.5- to 3-mc frequency-shifted signal from second mixer V3 and low-pass filter FL4 is coupled through capacitor C18 to the grid of first rf amplifier V4, a 6AH6 pentode-type tube. The output is developed across plate load resistor R27 and inductance L1 and coupled to second rf amplifier V7 through capacitor C39.

b. Self-bias is developed across cathode resistor R24 and bypass capacitor C19. Resistor R26 and capacitor C21 form the plate decoupling network. Screen dropping resistor R25 and capacitor C16 form the screen grid decoupling network. The grid resistor is R23.

c. Component values of the second and third rf amplifiers are approximately the same as for the first rf amplifier described in *a* and *b* above; each similar component part serves the same function.

d. A 3.2-mc filter trap (K1) is inserted in the grid circut of second rf amplifier V7 whenever BAND SELECTOR switch S1 is set to position 1, 3, 5, or 7 (contact 2, 4, 6, or 8). The filter trap eliminates any unwanted harmonics of the basic 2- to 3-mc signal that might be amplified when the lower portion of the band is used.

e. The output of third rf amplifier V8 is coupled through capacitor C46 to the second buffer stage of the transmitter, and then through multiplier stages or direct to the intermediate amplifier stage of the transmitter, depending on the frequency selected (TM 11-809-35).

2-13. Power Supply for MD-239/6R
(fig. 5-16)

a. The power supply provides filament and plate voltage for the tubes and heater voltage for the crystal ovens. Transformer T1 supplies the alternating-current (ac) voltage for the filament and plate power. The dc voltage supply is developed by a full-wave rectifier circuit that uses a type 5R4WGA tube (V9). The filtering network is a capacitance-input type made up of capacitor C76, filter choke L6, and capacitor C75. The dc output is applied through limiting resistor R54 to voltage regulating tubes V10 (an OC3W-type 105-volt regulator) and V11 (an OD3W-type 150-volt regulator). Resistors R51 and R52 form a bleeder network. Resistor R53 and capacitor C74 function as an additional filter circuit in the unregulated B+ line. The plate and filament voltage lines pass through feedthrough capacitors, which bypass any stray radiofrequencies to ground.

b. Blower motor B1 is connected across the primary of T1. When POWER switch S2 is turned to ON, 115 volts ac is applied to the blower motor.

Section IV. SCHEMATIC DIAGRAM ANALYSIS OF MODULATOR, RADIO MD-239A/GR

2-14. Shift Oscillator V2
(fig. 5-18)

Shift oscillator V2 generates a 12-mc crystal-controlled signal. The oscillator is tuned by variable capacitors shuntng the crystal. Additional capacitance is shunted across the crystal to provide the required frequency shift of the 12-mc signal. The addition of frequency-shifting capacitance is controlled through a diode switching network (*d* below). This circuit is a modified electron-coupled Colpitts oscillator.

a. Crystal Y1, 12-mc, is connected across the grid circuit of V2. It is contained in crystal oven HR1 and maintained at a temperature between 165° and 169° F. (74° and 76° C.). The shift frequency, which is 850 cps or less, is obtained by switching in additional capacitance.

Resistor R13 is the grid resistor. Capacitors C8 and C10 form a voltage divider for feedback voltage to maintain oscillation. Coil 15 and resistor R14 isolate the 12-mc signal voltage from ground while maintaining the cathode of V5 near dc ground potential. The screen grid is held at rf ground potential by capacitor C12. Resistor R15 is the screen grid voltage dropping resistor. The plate circuit of V2 is tuned by tank circuit Z3. Resistor R16 and capacitor C13 form a decoupling filter in the plate supply lead.

b. Four different sets of three capacitors each are used in conjunction with the four frequency shifts required. The setting of BAND SELECTOR switch S1 determines which set of capacitors will be used. The setting of switch S1 must correspond to the frequency setting of the transmitter BAND SELECTOR switch (TM 11-5820-256-10); therefore, the correct frequency shift is selected for the amount of multiplication required to obtain a resultant of 850 cycles shift in the transmitter (TM 11-809-35).

c. When the BAND SELECTOR switch is in position 1 or 2 (1.5-2 mc or 2-3 mc), an 850-cycle shift is selected. Capacitor C9 determines the operating frequency of the oscillator. Capacitor C45 is in parallel with the circuit when diodes CR1 and CR2 are conductive; the ground return path for C45 is through the diode network input keying circuit (*d* below). The diode network switches C45 into or out of the V2 grid circuit. The addition of capacitance to the tuned circuit decreases its resonant frequency and produces the required frequency shift of 850 cycles.

d. Capacitors C47, C49, and C50 are used for the other positions of BAND SELECTOR switch S1 to shift the oscillator frequency down whenever a *space* signal (no current) is applied to the keying input of the fsk-modulator. The amount of shift depends on the position of BAND SELECTOR switch S1. The selected capacitor is electrically in the circuit only when crystal diodes CR1 and CR2 are conducting. With no current input, the impedance of the diodes is high and maintains an open circuit between the selected capacitor and ground. When current flows through the diodes, the impedance is greatly reduced, and a path to ground is provided for the selected capacitor. This condition places the capacitor in shunt with the crystal circuit of oscillator V2 and shifts the frequency. When the BAND SELECTOR switch is set to position 3 or 4 (3-4 or 4-6 mc), a 425-cycle shift is selected while C47 shunts the grid tank circuit. When the BAND SELECTOR switch is set to position 5 or 6 (6-8 mc or 8-12 mc), a 212.5-cycle shift is selected while C49 shunts the grid tank circuit. When the BAND SELECTOR switch is set to position 7 or 8 (12-16 mc or 16-20 mc), a 106.25-cycle shift is selected while C50 shunts the grid tank circuit.

e. Diodes CR1 and CR2 are series-connected. The cathode of CR1 is connected to ground through load resistor R52. The anode of CR2 is connected to ground. The junction of the diodes is connected to the capacitor to be grounded. When no 60-ma signal from the teletypewriter (space condition) is applied to TTY IN jack J12, the ac voltage produced by the crystal circuit of V2 causes the diodes to conduct and ground the selected capacitor (*c* above). This action shifts the operating frequency downward. When a 60-ma signal is applied (*mark* condition), the voltage developed across C52 prevents CR1 and CR2 from conducting. This action opens the groundpath for the additional capacitor and returns the frequency of the shift oscillator to 12 mc.

f. The output of V2 is coupled through capacitor C2 to the oscillator grid (pin 2) of first mixer V1.

g. Crystal oven HR1 maintains a constant operating temperature for crystal Y1. The temperature is controlled by coarse and fine thermostats.

2-15. First Mixer V1

(fig. 5-18)

The first mixer stage uses a type 6BA7 tube to mix the injected signal (1.5 to 3.0 mc) from the master oscillator in the transmitter with the signal from shift oscillator V2 (12 mc or 12 mc with frequency shift (para 2-14)). The output of V1 is applied through bandpass filter FL3 (which will pass only frequencies between 13.5 and 15 mc) to prevent the fundamental frequencies and the difference frequency from entering the following stages.

a. The injected signal at M.O. IN jack J1 is taken from the arm of input-level adjust potentiometer R1 and fed through antiloading resistor R3 or R4 to input filter FL2 or FL1. The resistors prevent the filters from loading down the master oscillator in the transmitter. The selection of either FL1 or FL2 is determined by section 2 of BAND SELECTOR switch S1. If the injected frequency is between 1.5 and 2.0 mc, FL1 is used. This filter has an upper cutoff frequency of about 2 mc, and filters out all harmonics which might fall in the 2- to 3-mc band. If the injected frequency is between 2.0 and 3.0 mc, filter FL2 is used. This filter has a bandpass characteristic with the least attenuation between 2 and 3 mc. The signal output of the selected filter is coupled into the signal injection grid (pin 7) of first mixer V1 through capacitor C1 and grid resistor R5. The output of V2 is fed into the oscillator grid (pin 2) of V1 through coupling capacitor C2 (para 2-14).

Note. The injected frequency from the master oscillator in the transmitter will fall into the 1.5- to 2.0-mc band or the 2- to 3-mc band for all settings of the BAND SELECTOR switch.

b. Resistor R6 is the grid load. Resistor R7 is the cathode-biasing resistor, and resistor C3 is the cathode rf bypass capacitor. Resistor R9 is the screen and voltage dropping resistor, and C4 is the screen grid bypass capacitor. Resistor R10 and capacitor C7 form a plate decoupling network. Tuned circuit Z1 is the plate load of the first mixer. Resistor R8 loads the tuned circuit to give it the broadband characteristics to pass signals in the 13.5- to 15-mc band. The output voltage is fed through coupling capacitor C6 and into impedance-matching network R11 and R12. These resistors provide the proper impedance match for bandpass filter FL3, which is designed to pass only those frequencies between 13.5 and 15.0 mc. The output of bandpass filter FL3 is applied through coupling capacitor C14 to if. amplifier V3.

2-16. If. Amplifier V3
(fig. 5-18)

If. amplifier V3 acts as a buffer between the first and second mixer stages.

a. The if. signal from bandpass filter FL3 is coupled to the grid of if. amplifier V3, a 6AH6 pentode-type tube, through capacitor C14. The output of V3 is developed across tuned circuit Z2 and is coupled to second mixer stage V4 through capacitor C19.

b. Self-bias is developed across cathode resistor R18. The cathode rf bypass capacitor is C15. The grid resistor is R17. Resistor R21 and capacitor C18 form the plate decoupling network. Screen grid voltage dropping resistor R19 and capacitor C16 form the screen grid decoupling network.

2-17. Fixed Oscillator V5
(fig. 5-18)

Fixed oscillator V5 produces a signal which is identical in frequency with that of the shift oscillator without shift (12 mc). This frequency is mixed with the 13.5- to 15.0-mc frequency from if. amplifier V3, and the difference is the injected frequency with or without shift.

a. Fixed oscillator V5 is similiar to shift oscillator V2, except that only one capacitor is used in tuning the crystal circuit. Variable capacitor C26 tunes the frequency of V5, controlled by crystal Y2. The output of V5 is applied through C20 to pin 2 of second mixer V4.

b. Circuit elements in the fixed oscillator stage have the same functions as their counterparts in the shift oscillator (para 2-14).

2-18. Second Mixer V4
(fig. 5-18)

The second mixer combines the 13.5- to 15.0-mc if. signal, produced in the first mixer (para 2-15), with the 12-mc signal from the fixed oscillator (para 2-17). The difference frequency, which is either identical with the injected signal frequency or is the injection signal frequency with the shift, is fed through low-pass filter FL4 to first rf amplifier V6.

a. The if. signal (13.5 to 15.0 mc) from if. amplifier V3 is applied to the signal injection grid (pin 7) of second mixer V4, a 6BA7 pentagrid converter-type tube, and is combined with the 12-mc oscillator signal that is applied to the oscillator grid (pin 2) of V4. The mixed frequencies produced in V4 are developed across plate load resistor R26 and coupled through capacitor C24 to low-pass filter FL4.

b. Resistor R27 and capacitor C23 form the plate decoupling network. Self-bias is developed across resistor R24. The cathode rf bypass capacitor is C22. Resistor R23 is the grid load resistor for the oscillator grid, and R22 is the grid load resistor for the signal injection grid.

c. The output of second mixer V4 is applied to low-pass filter FL4 where the high frequencies are attenuated. The desired frequencies (1.5- 3.0 mc) are passed by the filter and coupled through capacitor C31 to the grid of first rf amplifier V6.

2-19. First, Second, and Third Rf Amplifiers V6, V7, and V8
(fig. 5-18)

The first, second, and third rf amplifiers increase the signal output of the second mixer to a 3- to 5-volt level, suitable for driving the second buffer stage of the transmitter (TM 11-5820-256-20).

a. The 1.5- to 3-mc frequency-shifted signal output of low-pass filter FL4 is coupled through capacitor C31 to the grid of first rf amplifier V6, a 6AH6 pentode-type tube. The output is developed across plate load resistor R37 and inductance L1 and coupled through capacitor C35 to second rf amplifier V7.

b. Self-bias is developed across cathode resistor R33. The cathode bypass capacitor is C32. Resistor R36 and capacitor C34 form the plate decoupling network. Screen grid voltage dropping resistors R34 and R35 and capacitor C33 form the screen grid decoupling network. The grid resistor is R32.

c. Component values of the second and third rf amplifiers are approximately the same as for the first rf amplifier described in *a* and *b* above; each component part serves the same function.

d. A 3.2-mc filter trap (KFL1) is inserted in the grid circuit of third rf amplifier V8 whenever BAND SELECTOR switch S1 is set to position 1, 3, 5, or 7 (contact 3, 5, 7, or 9). The filter trap eliminates any unwanted harmonics of the basic 2- to 3-mc signal that might be amplified when the lower portion of the band is used.

e. The output of third rf amplifier V8 is coupled through capacitor C44 to the second buffer stage of the transmitter, and then through multiplier stages or direct to the intermediate amplifier stage of the transmitter, depending on the frequency selected (TM 11-809-35).

2-20. Power Supply for MD-239A/GR
(fig. 5-18)

a. The power supply provides filament voltage and plate voltage for the tubes, and heater voltage for the crystal ovens. Transformer T1 supplies the ac voltage for both the filament and the plate power. The dc voltage supply is developed by a full-wave rectifier circuit that uses a type 5R4WGA tube (V9). The filtering network is a capacitance-input type made up of capacitor C54, filter choke L4, and capacitor C55A and C55B. The dc output is applied through limiting resistor R53 to voltage regulating tubes V10 (an OD3W type 150-volt regulator) and V11 (an OC3W type 105-volt regulator). Resistor R53 and capacitor C56 also function as an additional filter circuit in the unregulated B+ line. Resistors R54 and R55 form a bleeder network. The plate and filament voltage lines pass through feedthrough capacitors, which bypass any stray radio-frequencies to ground.

b. Blower motor B1 is connected across the primary of T1. When POWER switch S2 is turned to ON, 115 volts ac is applied to the blower motor.

Section V. CONTROL, RADIO SET C-1123/GRC

2-21. General

The control unit functions as a control and interconnection center for the components of the radio set. The shelter component connections and the remote site connections to the control unit are shown in TM 11-5820-256-10.

a. Interconnections. The control unit provides facilities for interconnecting the following equipments:

(1) Microphone or key to the transmitter.

(2) Local teletypewriter equipment to the converter and fsk-modulator.

(3) Remote teletypewriter equipment (through the remote control unit) to

the converter and fsk-modulator.

(4) Receivers A and B to the local telephone, to the remote telephone (through the remote control unit), and to the transmitter.

(5) Local and remote telephones to the transmitter.

b. Switching. The control unit controls the switching and provides the following services:

(1) Local or remote teletypewriter operation.

(2) Keying the transmitter locally by push-to-talk switch or key.

(3) Modulating the transmitter with signals from the telephone line.

(4) Modulating the transmitter with received radio signals (radio relay operation).

(5) Monitoring radio reception by telephone at the local or remote site.

(6) Monitoring cw transmission through either receiver at the local site and by telephone at the remote site.

2-22. Control Capabilities
(figs. 5-13 and 5-14)

The signal and control paths (*a* through *h* below) describe the operation of the control unit. The power supply for the control unit is described in *i* below.

a. SIDETONE Switch. The SIDETONE switch controls the routing of a 1,000-cycle audio signal from terminal H of the TRANS connector to terminal D of either REC A (position 1) or REC B (position 3) to allow the operator to monitor the keying during cw operation. In the OFF position, no sidetone signal is applied to either receiver.

b. REMOTE TEL Switch. The REMOTE TEL switch controls the routing of voice signals between telephone sets. With the switch at REC A or REC B, voice signals from the LOCAL TEL connections, remote TEL connections, and the selected receiver will modulate the transmitter. The signal from the selected receiver will be heard at the telephone sets. All voice signals pass through the hybrid coil (para 2-23). In the LOCAL TEL position, the hybrid coil is switched out of the circuit and the LOCAL TEL and remote TEL terminals are connected together. Two-way telephone conversations may be conducted. The transmitter will not be modulated nor will received signals be heard in either telephone.

c. TELETYPE Switch. The TELETYPE switch routes teletypewriter signals to the proper units of the radio set for the different types of teletypewriter operation. Paths for the teletypewriter signals in the various switch positions are as follows:

(1) *NORMAL OW.* When the TELETYPE switch is set to NORMAL OW, one-way reversible operation from the shelter is selected. The path for the received signal is from the CONVERTER connector through contacts 12 and 8 on section 1 of S4 (fig. 5-14), or through contacts 11 and 7 on section 2 of S2 (fig. 5-13), contacts 3 and 4 of deenergized control relay K1, and red ONE WAY OR SEND DX jack to the send teletypewriter. The path for the received signal is interrupted by opening contacts 3 and 4 of control relay K1 when the relay is energized for transmission. The path for the transmitted signal is from send teletypewriter black ONE WAY OR SEND DX jack through the FS MOD connector to the fsk-modulator.

(2) *NORMAL DX.* When the TELETYPE switch is set to NORMAL DX, duplex operation from the shelter is selected. The path for the received signal is from the CONVERTER connector through contacts 12 and 9 on section 1 of S4 (fig. 5-14), or through contacts 11 and 8 on section 2 of S2 (fig. 5-13), and red REC DX jack to the shelter receive teletypewriter. The path for the transmitted signal is from send teletypewriter black ONE WAY OR SEND DX jack through the FS MOD connector to the fsk-modulator.

(3) *REMOTE OW.* When the TELETYPE switch is set to REMOTE OW, one-way reversible operation from the remote site is selected. The path for the received signal is from the CONVERTER connector through contacts 12 and 10 on section 1 of S4 (fig. 5-14), or through contacts 11 and 9 on section 2 of S2 (fig. 5-13), contacts

3 and 4 of deenergized control relay K1, and red ONE WAY OR SEND DX jack (either through the shorted contacts or through shelter send teletypewriter as monitor) through ONE WAY binding posts to the remote send teletypewriter. The path for the received signal is interrupted by energizing control relay K1 and opening contacts 3 and 4 whenever the transmitter is keyed. The path for the transmitted signal is from the remote send teletypewriter through ONE WAY binding posts, red ONE WAY OR SEND DX jacks, contacts 4 and 2 of energized control relay K1, black ONE WAY OR SEND DX jack, and the FS MOD connector to the fsk-modulator. The shelter send teletypewriter can monitor the remote transmission.

(4) *REMOTE DX.* When the TELETYPE switch is set to REMOTE DX, duplex operation from the remote site is selected. The path for the received signal is from the CONVERTER connector through contacts 12 and 11 on section 1 of S4 (fig. 5–14), or through contacts 11 and 10 on section 2 of S2 (fig. 5–13), red jack REC DX and REC DX binding posts to the remote receive teletypewriter. The path for the transmitted signal is the same as that for remote one-way reversible operation ((3) above).

d. Control Relay K1. The received teletypewriter signal path is completed or interrupted by the contacts of control relay K1, which also controls the interunit keying of the transmitter. The interunit keying circuit is explained in paragraph 2–3.

e. Disabling Relay K2. The receiver disabling circuits to both receivers are grounded when disabling relay K2 is energized. Refer to paragraph 2–4 for a detailed explanation of the receiver disabling circuits.

f. FS MOD Connector. Signals from the send teletypewriters are fed to the FS MOD connector for transmission to the fsk-modulator or SWITCH connector.

g. TTY SWITCH Connector. Teletypewriter control of control relay K1 is connected through the TTY SWITCH or SWITCH connector.

h. ON-OFF Switch. The power switch controls ac power to the control unit power supply circuit.

i. Power Supply. The power supply consists of a transformer (which has two primaries connected in parallel), bridge rectifier CR1, and a pi-type filter consisting of capacitor C1, resistor R1, a choke, capacitor C2, and bleeder resistor R2. The output voltage of this supply is approximately 28 volts dc with respect to ground. The neon indicator lamp lights when power is applied.

2–23. Hybrid Coil
(fig. 2–4)

The hybrid coil is an audio coupling transformer which allows modulation of the transmitter by either the local or remote telephone and also the incoming received signal. The REMOTE TEL switch of the control unit (figs. 5–13 and 5–14) determines which circuits are connected to the hybrid coil. The operation of these circuits in the various switch positions is explained in *a* and *c* below. Variations in reference designations for the components shown in figure 2–4 are given in *d* below.

a. When the REMOTE TEL switch is set to REC A, the components are connected as shown in figure 2–4. Terminals 1 and 2 of the hybrid coil are connected to the TRANS connector and the transmitter 600-ohm line input. Terminals 3 and 6 of the hybrid coil are connected to remote TEL binding posts. Terminals 7 and 9 of the hybrid coil are connected to LOCAL TEL binding posts. Terminals 11 and 12 of the hybrid coil are connected to the REC A connector and the audio output of receiver A. With these connections, the receiver A output can be heard at the local or the remote telephone. When the transmitter is keyed, speaking into the local or the remote telephone will modulate the transmitter. The signal from the receiver will also modulate the transmitter, and the radio set may be used as a radio relay station. To avoid retransmitting the received signal when relay operation is not desired, the receiver LINE GAIN control is set to 0. Radio relay operation is only possible in duplex operation. Resistors (300- and 620-ohm) and the HY-

BRID BAL control, placed across the remote and local telephone terminals, provide a constant impedance match for the 600-ohm line telephone circuits.

b. When the REMOTE TEL switch is at LOCAL TEL (figs. 5-13 and 5-14), the hybrid coil is bypassed. The local and remote telephones are direct-connected, allowing two-way voice communications between the local and remote sites without modulating the transmitter. Also, signals from receiver A or B cannot be monitored by either telephone nor can they modulate the transmitter.

c. When the REMOTE TEL switch is at REC B, terminals 11 and 12 of the hybrid coil (fig. 2-4) are disconnected from receiver A and connected through the REC B connector to receiver B. All functions discussed for receiver A now apply to receiver B (*a* above).

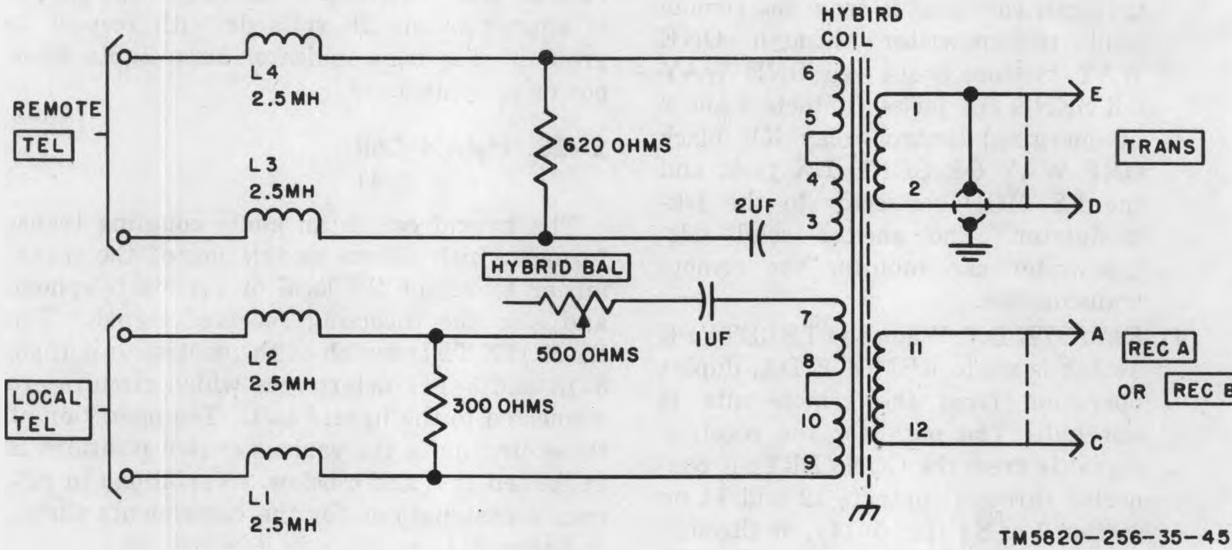


Figure 2-4. Control, Radio Set C-1123/GRC, hybrid coil, functional diagram.

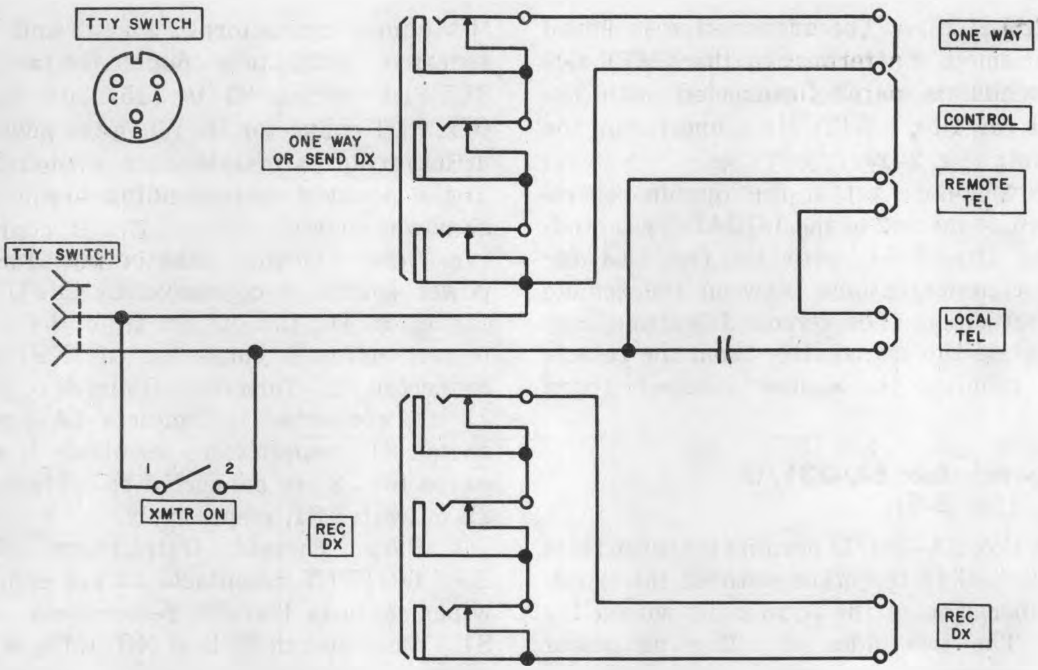
d. The chart below lists the differences in reference designations for the C-1123/GRC components shown in figure 2-4.

Component	C-1123/GRC, most units	C-1123/GRC, Order No. 25209-Phila-54
Remote TEL binding posts.	E2, E1	J23, J24
LOCAL TEL binding posts.	E7, E8	J14, J13
Resistor, 620-ohm	R4	R5
Resistor, 300-ohm	R5	R4
HYBRID BAL control (500 ohms).	R3	R1
Capacitor, 2-uf	C3	C4
Capacitor, 1-uf	C4	C3
Hybrid coil	T1	T2
TRANS connector	J6	J22
REC A connector	J4	J15
REC B connector	J5	J16

Section VI. MISCELLANEOUS COMPONENTS

2-24. Control, Remote Switching C-1474/GRC
(fig. 2-5)

a. The remote control unit provides facilities for operating the radio set from a remote location. When the remote control unit is connected to the control unit through the correspondingly marked binding posts on both units, corresponding jacks are placed in series. This permits duplex or one-way teletypewriter operation from the remote site, although controlled by the TELETYPE switch position at the control



NOTES:

1. THE CAPACITOR IS 2UUF ON ORDERS NO. 28459-PHILA-55, 21316-PHILA-56, AND 43056-PHILA-56; IT IS 2UF ON OTHER ORDERS.

2. ALL JACKS, BINDING POSTS, CONNECTORS, AND SWITCHES ARE IDENTICAL.

DIFFERENCES IN REFERENCE DESIGNATIONS ARE GIVEN IN THE CHART BELOW;

ITEM	ORDER NO. 25209-PHILA-54	ORDERS NO. 43056-PHILA-56 AND 3219-PP-59	OTHER ORDERS
TTY SWITCH CONNECTOR	J208	J7	J7
XMTR ON SWITCH	S201	S1	S1
ONE WAY OR SEND DX JACKS	J205, J204, J203	J6, J5, J4	J1, J2, J3
REC DX JACKS	J213, J214, J215	J3, J2, J1	J4, J5, J6
CAPACITOR	C201	C1	C1
ONE WAY BINDING POSTS	J201, J202	E1, E5	E1, E2
REMOTE TEL BINDING POSTS	J207, J206	E6, E2	E3, E4
LOCAL TEL BINDING POSTS	J209, J210	E4, E8	E6, E5
REC DX BINDING POSTS	J212, J211	E3, E7	E8, E7

TM5820-256-35-17

Figure 2-5. Control, Remote Switching C-1474/GRC, schematic diagram.

unit (para 2-22). The transmitter is keyed from the remote control unit by the XMTR ON switch, which is parallel-connected with the SWITCH (or TTY SWITCH) connector on the control unit (fig. 2-1).

b. The telephone set at the remote control unit, when connected to the LOCAL TEL binding posts (fig. 2-5), provides facilities for two-way communications between the remote and shelter sites. The remote telephone may also modulate the transmitter from the remote site and monitor the shelter receiver (para 2-23*a*).

2-25. Switch Box SA-331/U (fig. 2-6)

Switch Box SA-331/U permits transfer from one PU-286/G to the other without interrupting the operation of the equipment within the shelter. The two sides of either ac power source are connected through 115/230V AC 50-60 input connectors J1 and J2 and manually operated double-pole double-throw POWER SUPPLY switch S1 to 115/230V AC 50-60 OUTPUT connector J3. When the power source in use requires maintenance, switch S1 is set to the position corresponding to the operable ac power source.

a. Input Circuits. The output from one ac power source is connected to INPUT NO. 1 connector J1; the output from the second ac power source is connected to INPUT NO. 2 connector J2. Terminals B and E of connector J1 are connected to contacts 1A and 2A of switch S1, respectively; terminals B and E of connector J2 are connected to contacts 1B and 2B of switch S1, respectively.

b. Output Circuit. Output terminals B and E of OUTPUT receptacle J3 are connected to wiper contacts 1 and 2, respectively, of switch S1. When switch S1 is at NO. 1, the A contacts of both switch sections are connected to con-

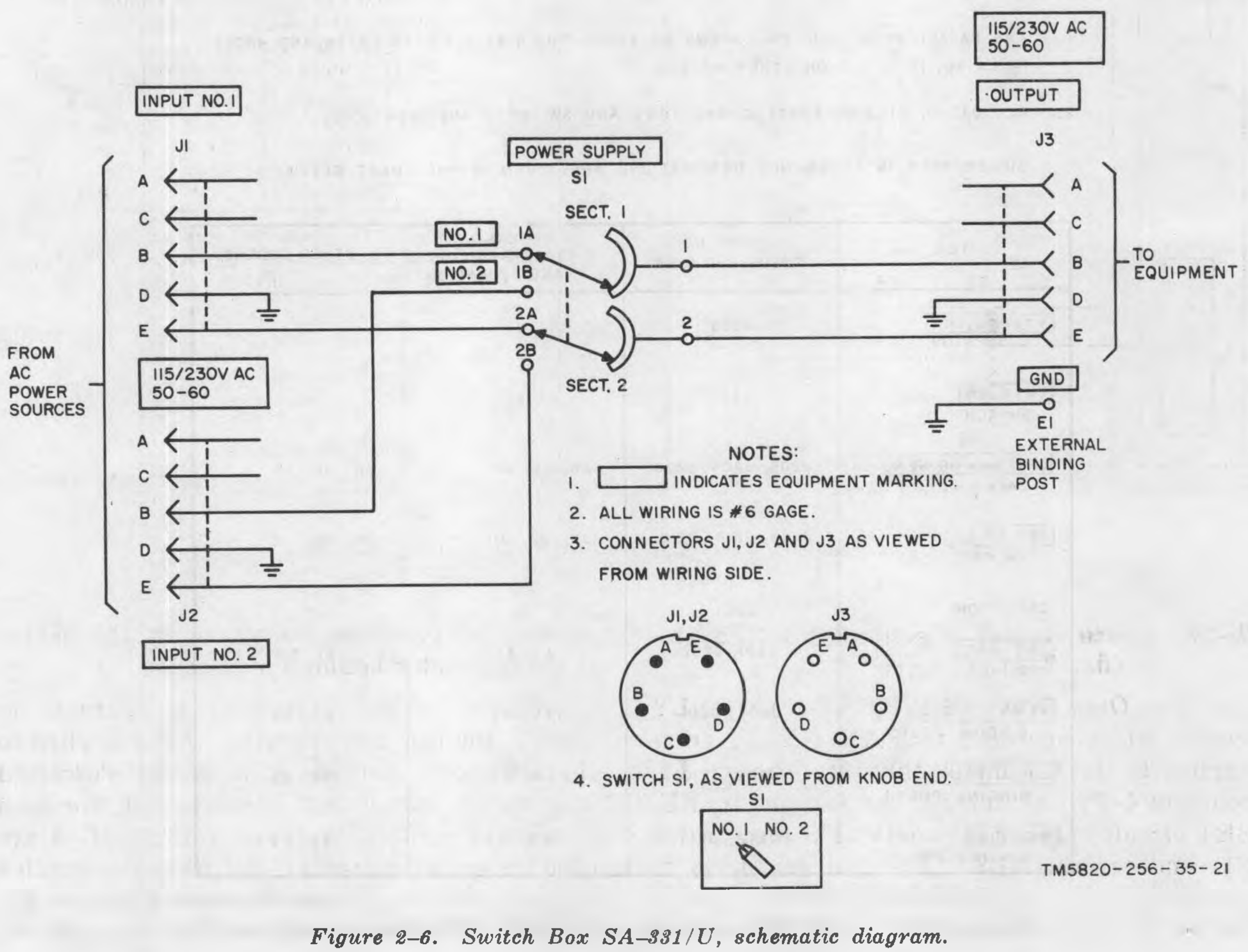


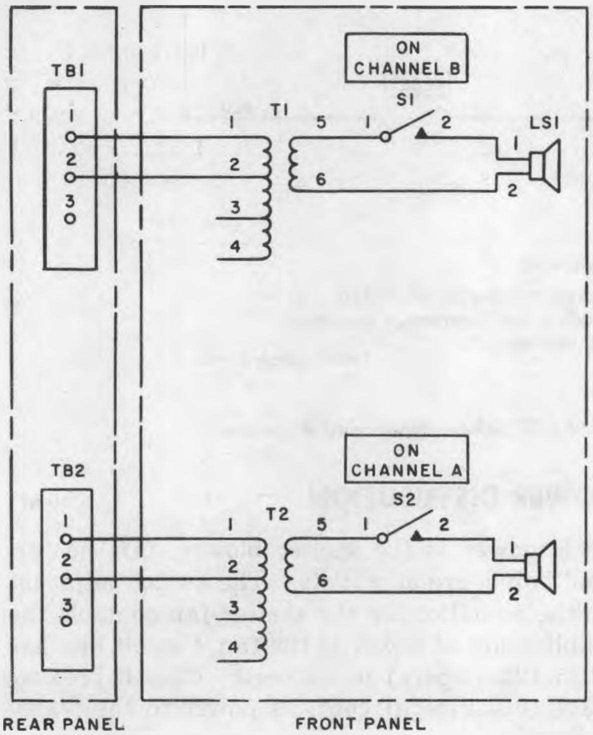
Figure 2-6. Switch Box SA-331/U, schematic diagram.

nector J3 to supply ac power to the equipment; when switch S1 is at NO. 2, the B contacts of both switch sections are connected to connector J3 to supply ac power to the equipments.

c. Ground Circuit. Terminals D of connectors J1, J2, and J3 are connected to GND binding post E1 to provide a common ground through the power cable between the ac power sources and the equipment within the shelter.

2-26. Loudspeaker Assembly LS-206(*)/U
(fig. 2-7)

The LS-206(*)/U consists of two completely independent loudspeaker circuits, each controlled by a separate on-off switch between the secondary of the matching transformer and the voice coil of the loudspeaker. When the CHANNEL A or CHANNEL B switch is at ON (up), audio signals from the associated receiver are heard from the loudspeaker. Each loudspeaker has a frequency range from 150- to 7,000-cps, and is rated at 2 watts. The 600-ohm tap of the transformer primary winding is used to match the output impedance of the R-390(*)/URR (TM 11-5820-357-10 and TM 11-5820-358-10).



NOTES:
1. THE LS-206A/U IS AS ILLUSTRATED. THE LS-206/U DIFFERS AS FOLLOWS:
   A-COMPONENT REFERENCE DESIGNATIONS ARE IN THE 100 SERIES; THUS THE TRANSFORMERS ARE DESIGNATED T101, AND T102, ETC.
   B-ONLY ONE TAP IS PROVIDED ON THE TRANSFORMER PRIMARY WINDING; THUS TERMINALS ARE NUMBERED 1 THROUGH 5.
2. TRANSFORMER TERMINAL IMPEDANCES (OHMS):

TERMINALS	WINDING	LS-206A/U	LS-206/U
1-2	PRIMARY	600 Z	600 Z
1-3	PRIMARY	4K Z	8K Z
1-4	PRIMARY	8K Z	N/A
4-5	SECONDARY	N/A	4 Z
5-6	SECONDARY	4 Z	N/A

3. ▭ INDICATES EQUIPMENT MAKING.
4. SWITCH AND LOUDSPEAKER TERMINAL DESIGNATIONS ARE ARBITRARILY ASSIGNED.

TM5820-256-35-57

Figure 2-7. Loudspeaker Assembly LS-206(*)/U, schematic-wiring diagram.

2-27. Space Heater, Electrical HD-375/U
(fig. 2-8)

a. Fan Only. When OFF-HEAT-FAN ONLY switch S1 is operated to FAN ONLY, ac is applied to the fan motor through terminal L1, contacts 4-1 of switch S1, the fan motor, RESET circuit breaker S2, contacts C-6 of switch S1, and terminal L2. The fan continues to operate until the OFF-HEAT-FAN ONLY switch is operated to OFF. RESET circuit breaker S2 provides protection for the heater if the fan motor becomes overloaded.

b. Heat. When switch S1 is operated to HEAT, the fan also operates. Ac is applied to the fan motor over the same circuit described in *a* above, except that contacts 3-1 are used instead of contacts 4-1 and contacts C-5 are used instead of contacts C-6. Ac is also applied to the heating element through terminal L1, contacts 4-2 of switch S1, the heating element, thermostat S3, RESET circuit breaker S2, contacts C-5 of the switch to terminal L2. Thermostat S3 opens the circuit through the heating element when the temperature reaches a predetermined level. The fan motor continues to operate when the thermostat opens the circuit through the heating element.

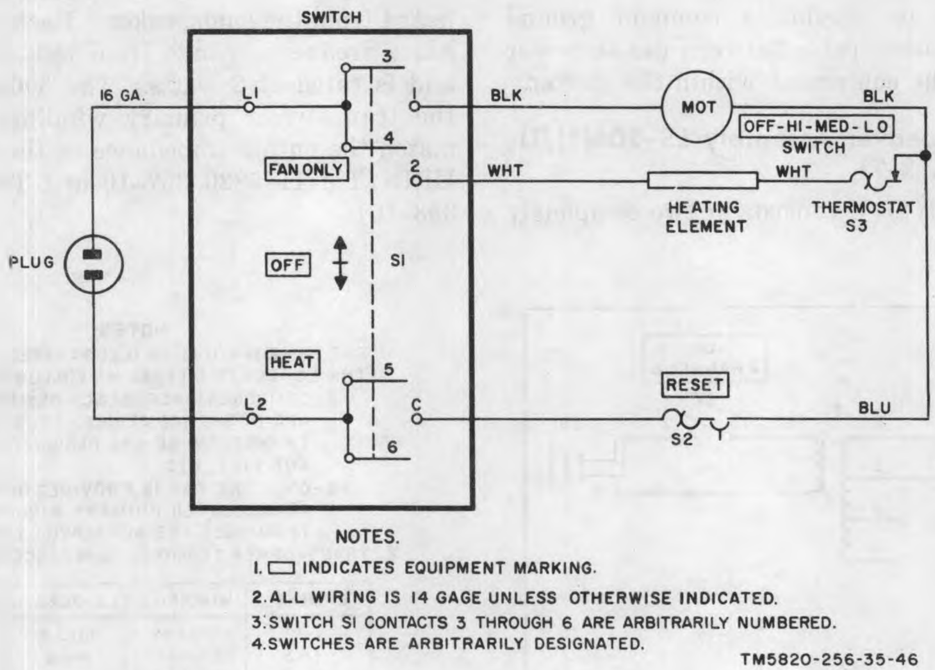


Figure 2-8. Space Heater, Electrical HD-375/U, schematic-wiring diagram.

Section VII. SHELTER AC POWER DISTRIBUTION

2-28. Primary Power
(fig. 2-9)

a. The ac power required for lighting, ventilation, heating, and operation of equipment within the shelter is supplied from the power unit or commercial source (TM 11-5820-256-10). Power is applied to the circuit breakers through the power input feedthrough receptacle on the shelter wall.

b. Primary ac power is applied to ganged 50-ampere main circuit breakers CB1 and CB2 for further circuit distribution. All power distribution within the shelter is made through conduit from the circuit breaker housing.

2-29. Secondary Power
(fig. 2-9)

a. Main Circuit No. 1. Main circuit breaker CB1 controls power to secondary circuits 3, 5, and 7. Circuit breaker CB3 (20-ampere) controls power to the shelter blower, fan, heater, and two spare ac outlets. The switch adjacent to the ac outlet for the shelter fan controls the application of power to the fan. Circuit breaker CB5 (20-ampere) is not used. Circuit breaker CB7 (30-ampere) controls power to the transmitter.

b. Main Circuit No. 2. Main circuit breaker CB2 controls power to secondary circuits 4, 6, and 8. Circuit breaker CB4 (20-ampere) controls power to the fsk-modulator, control unit, page printers, reperforator, equipment cabinet, and six spare ac outlets. Circuit breaker CB6 (15-ampere) is not used. Circuit breaker CB8 (15-ampere) controls power to the fluorescent lamps. Each lamp has an individual on-off switch, ballast, starter, and a capacitor for rf suppression.

Note. An outlet strip is provided within the CY-1807/G for distribution of ac power to the receivers, converter, and HD-223/G (TM 11-5820-256-10).

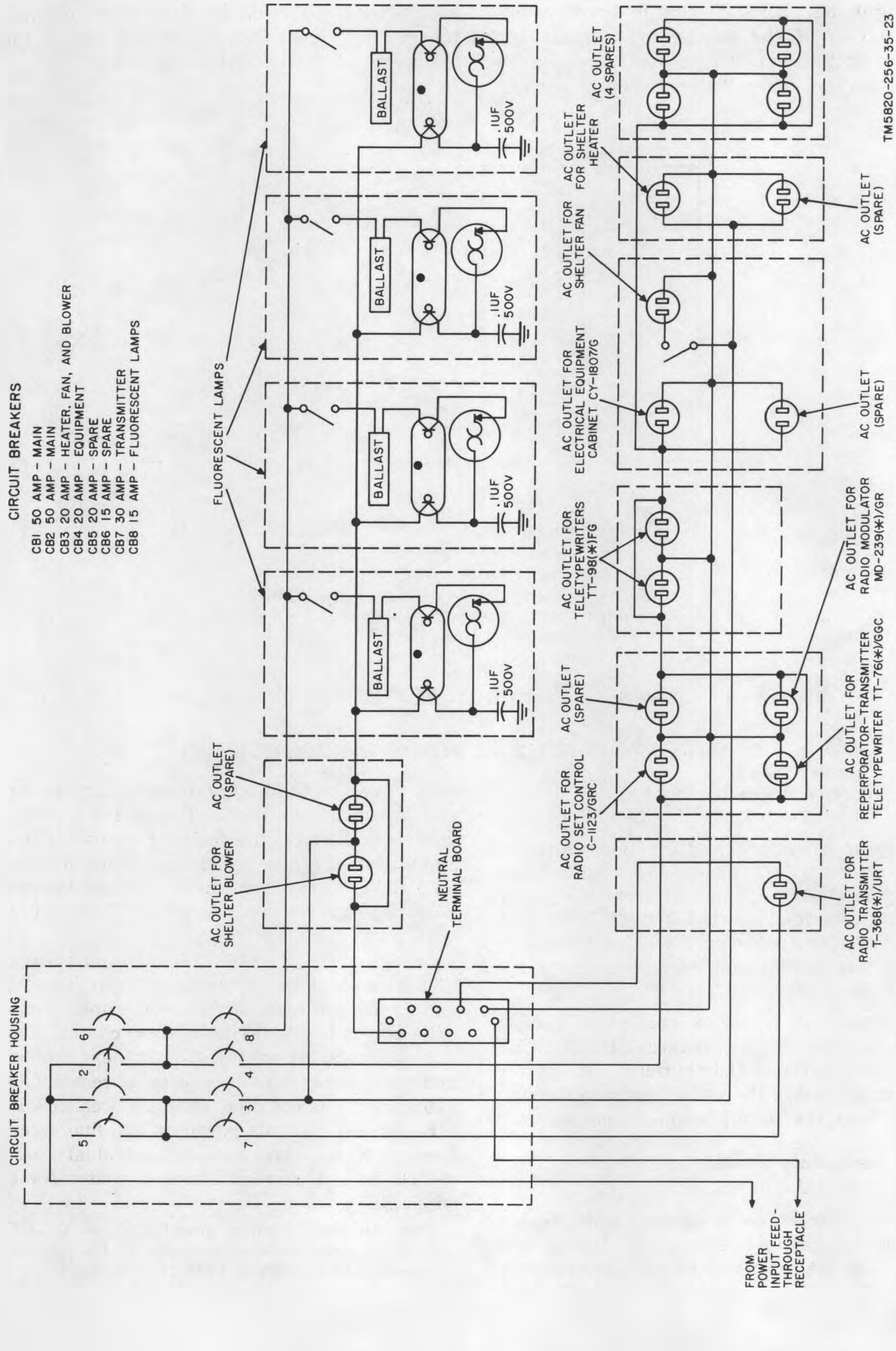


Figure 2–9. Shelter, ac power distribution.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE

Section I. TROUBLESHOOTING DATA

Warnings:

1. **Extremely high voltages are present in the transmitter that are dangerous to life. When servicing the transmitter, be sure that the back cover and the three decks are closed before applying plate power to the transmitter. The red PLATE POWER pilot lamp on the front panel of the transmitter indicates when the higher voltage is turned on. Do not rely upon the lamp entirely to indicate the absence of high voltage, since the lamp may be burned out. Also, do not rely entirely on protective electrical interlock switches.**

2. **Extremely high rf voltages are present at the antenna tuning unit, when the equipment is in operation. Be sure that the power is off, and use a shorting stick before changing parts and making repairs in the radio set. Always observe the warnings and cautions in the individual equipment technical manuals (app. A).**

3-1. General Instructions

a. Troubleshooting at the direct support maintenance category supplements and includes all the techniques outlined for organizational maintenance (TM 11-5820-256-20) and any other techniques that may be required to isolate a defective part. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at an organizational category are supplemented and extended by localizing and isolating techniques at the direct support category.

b. When trouble has been traced to a particular major component, refer to the technical manual covering the component (app. A) for detailed maintenance instructions. Follow the maintenance instructions given in the succeeding paragraphs for the fsk-modulator, control unit, and remote control unit.

3-2. Organization of Troubleshooting Procedures

a. To be effective, troubleshooting must be systematic. Generally, it is necessary to perform a *sequence* of operational checks, observations, and measurements before a defect will be revealed. If the proper sequence is used, the trouble will be traced first to a unit, and then to a portion of the unit, and finally to the defective part. The sequence of steps is commonly referred to as the sectionalization, localization, and isolation of trouble.

(1) *Sectionalization.* A defective radio set should first be sectionalized to a particular unit. Determine the defective unit through visual checks and observation of meter readings during operational procedures (TM 11-5820-256-20). Additional operational checks for the fsk-modulator are given in paragraph 3-7.

(2) *Localization.* When the defective unit has been determined ((1) above), localize the trouble to a particular portion of the unit. Use inspection and operational techniques first and, when necessary, use the specialized testing procedures as given in this manual and in the technical manuals for other components.

Caution: **Do not apply power to a radio set or one of its units unless the operational symptoms are known, and are of such nature as to eliminate the possibility of further damage when power is applied.**

(3) *Isolation.* After a trouble has been

isolated to a portion of a major component, such as a stage or a group of functionally related circuits, use visual inspection and voltage and resistance measurements to determine the defective part. Use resistor and capacitor color codes (figs. 5-11 and 5-12) to find the value of components. Use the voltage and resistance diagrams of the fsk-modulator (figs. 3-1 through 3-4) to find normal readings.

b. If the radio set is defective, operate the equipment in accordance with the equipment performance checklist (TM 11-5820-256-20). The checklist indicates the general location of trouble. Use the troubleshooting chart (para 3-5) with the checklist as an aid in locating the possible source of the defect. Detailed troubleshooting procedures of the major components can be obtained from the component technical manuals listed in the appendix A.

c. When Modulator, Radio MD-239(*)/GR; Control, Radio Set C-1123/GRC; or Control, Remote Switching C-1474/GRC is at fault, refer to paragraphs 3-6 through 3-13 for detailed troubleshooting procedures. Reference to the illustrations of the components listed in (1), (2), and (3) below will also aid in troubleshooting. Refer to the procedures given in paragraph 3-14 before making any repairs on the components. Procedures for repair of the shelter skin are given in paragraph 3-15. Refer to the illustrations listed in (4) below when troubleshooting of the miscellaneous components of the AN/GRC-26D is required.

(1) *Fsk-modulator.*

Figure No.	Caption
3-1	Modulator, Radio MD-239/GR, tube-socket voltage and resistance diagram.
3-2	Modulator, Radio MD-239/GR, terminal board voltage and resistance diagram.
3-3	Modulator, Radio MD-239A/GR, tube socket voltage and resistance diagram.
3-4	Modulator, Radio MD-239A/GR, terminal board voltage and resistance diagram.
3-5	Modulator, Radio MD-239/GR, top view, parts location.
3-6	Modulator, Radio MD-239/GR, left side view, parts location.
3-7	Modulator, Radio MD-239/GR, bottom view, parts location.
3-8	Modulator, Radio MD-239/GR, bottom-right oblique view, front section, parts location.
3-9	Modulator, Radio MD-239/GR, bottom-left oblique view, front section, parts location.
3-10	Modulator, Radio MD-239A/GR, top view, parts location.
3-11	Modulator, Radio MD-239A/GR, bottom view, capacitor, coil, tube socket, rectifier, and switch location.
3-12	Modulator, Radio MD-239A/GR, bottom view, resistor, terminal board, and connector location.
5-16	Modulator, Radio MD-239/GR, schematic diagram.
5-17	Modulator, Radio MD-239/GR, wiring diagram.
5-18	Modulator, Radio MD-239A/GR, schematic diagram.
5-19	Modulator, Radio MD-239A/GR, wiring diagram.

(2) *Control unit.*

Figure No.	Caption
3-13	Control, Radio Set C-1123/GRC, subchassis, parts location.
3-14	Control, Radio Set C-1123/GRC (most orders), bottom view, subchassis removed, parts location.
3-15	Control, Radio Set C-1123/GRC (Order No. 25209-Phila-54), bottom view, subchassis removed, parts location.
5-1	Control, Radio Set C-1123/GRC (most orders), main chassis wiring diagram.
5-2	Control, Radio Set C-1123/GRC (most orders), subchassis wiring diagram.
5-3	Control, Radio Set C-1123/GRC (Order No. 25209-Phila-54), subchassis wiring diagram.
5-15	Control, Radio Set C-1123/GRC (Order No. 25209-Phila-54), main chassis wiring diagram.
5-13	Control, Radio Set C-1123/GRC (Order No. 25209-Phila-54), schematic diagram.
5-14	Control, Radio Set C-1123/GRC (most orders), schematic diagram.

(3) *Remote control unit.*

Figure No.	Caption
2-5	Control, Remote Switching C-1474/GRC, schematic diagram.
3-16	Control, Remote Switching C-1474/GRC, parts location.
5-5	Control, Remote Switching C-1474/GRC (Orders No. 43056-Phila-56 and 3219-PP-59), wiring diagram.
5-6	Control, Remote Switching C-1474/GRC (some orders), wiring diagram.

(4) *Miscellaneous components.*

Figure No.	Caption
2-6	Switch Box SA-331/U, schematic diagram.
5-7	Switch Box SA-331/U, wiring diagram.
2-7	Loudspeaker Assembly LS-206(*)/U, schematic-wiring diagram.
2-8	Space Heater, Electrical HD-375/U, schematic-wiring diagram.
3-17	Space Heater, Electrical HD-375/U, parts location.
2-9	Shelter, ac power distribution.

3-3. Tools and Test Equipment Required

a. Tools. Tool Kit, Teletype Equipment Maintenance TE-50-B, Tool Equipment TE-111, and Tool Kit, Radar and Radio Repairman TK-87/U contain the tools necessary for troubleshooting the components of the AN/GRC-26D.

b. Test Equipment. The chart below lists test equipment (or equivalents) required for troubleshooting the AN/GRC-26D. Also listed are associated technical references.

Test equipment	Technical reference
Electronic Equipment Maintenance Kit MK-288/URM.	TB SIG 319
Test Set, Teletypewriter Signal Distortion TS-2/TG.	TM 11-2208
Voltmeter, Meter ME-30A/U	TM 11-6625-320-12
Electronic Multimeter TS-505(*)/U.	TM 11-6625-239-12
Frequency Meter AN/URM-32 with Power Supply PP-1243/U.	TM 11-5120
Multimeter TS-352/U	TM 11-5527
R.F. Signal Generator AN/URM-25F.	TM 11-5551E
Test Set, Electron Tube TV-7/U.	TM 11-6625-274-12
Test Set TS-140/PCM	TM 11-6625-251-15

3-4. General Precautions

When servicing a component of the AN/GRC-26D, observe the following precautions:

a. When the fsk-modulator is removed from the top of the transmitter housing for servicing or testing, reconnect the ground strap to the transmitter and connect a suitable ground to the fsk-modulator from the main frame of the transmitter. This is a safety precaution and also prevents the occurrence of abnormal electrical effects caused by the absence of the ground connection.

b. Be sure all power is removed from the transmitter and from the component under test; also, be sure to carry out the capacitor shorting practice before contacting any of the wiring or parts that are connected to, or in the vicinity of, high voltage.

c. Observe all proper precautions to assure safety to personnel and equipment when making high-voltage and current measurements in the radio set. Disconnect all power and discharge capacitors (*b* above) before making any resistance measurements.

d. Before operating or testing any component, be sure that all cable and cord connections are correct, that there are no unnecessary connections, or that some of the required connections are not missing.

e. Careless or incorrect replacement of parts or repair can cause more damage and trouble than the original defect. Before unsoldering a part, note the position of the leads and parts involved. If the part (such as a transformer) has numerous connections, make notes and sketches of the original location and placement of parts and lead wires. This assures proper lead wire dress and parts locations to duplicate the original condition, and minimizes the possibility of wiring errors.

f. Before testing or troubleshooting, check the source voltages of the power supply circuits. Abnormal supply voltages often affect frequency and stability characteristics and the output or gain of the circuits.

3-5. Interunit Troubleshooting Chart

The following troubleshooting chart is supplied as an aid in locating trouble in the radio set. The chart lists symptoms which may be observed while operating the radio set and supplements the equipment performance checklist in TM 11-5820-256-20. For troubles other than those described below, refer to the individual component technical manuals and the troubleshooting chart for the fsk-modulator (para 3-9).

Item	Indication	Probable trouble	Corrective procedure
1	Power unit operating, but no power available at shelter.	Circuit breaker on panel of power unit defective.	Check circuit breaker on panel of power unit and replace.
		Circuit breakers CB1 and CB2 in shelter circuit breaker housing defective.	Check shelter circuit breakers CB1 and CB2 (fig. 2-9) and replace defective circuit breakers.
2	Shelter circuit breaker CB8 set to ON but fluorescent lamps do not light.	Defective circuit breaker	Check shelter circuit breaker CB8 (fig. 2-9) and replace.
		Defective lamp	Replace defective lamp.
		Defective starter	Replace defective starter.
		Defective on-off switch	Replace defective switch.
3	Blowers of Blower Assembly, Electrical HD-223/G not activated when power switch is set to ON.	No ac power to blower motors	Check shelter circuit breaker CB4 (fig. 2-9).
		Defective power switch	Replace defective power switch.
		Defective blower	Replace defective blower.
4	Blower motors actuated but pilot lamp does not light when power switch is set to ON.	Defective lamp socket	Check socket; replace if necessary.
		No power to indicator lamp	Check connections on HD-223/G terminal board.
5	Receiver (A or B) dial lamp lights, but no output in LS-206(*)/U.	ON CHANNEL A or ON CHANNEL B switch in LS-206(*)/U defective.	Check switch (fig. 2-7); replace if necessary.
		Defective speaker	Replace defective speaker (fig. 2-7).
6	Am. intelligence received but no fsk reception.	Control unit defective	Check control unit and repair (para 3-12).
		Remote control unit (if used) defective.	Check remote control unit and repair (para 3-13).
7	Teletypewriter does not print page copy during one-way reversible operation.	Relay K1 of control unit defective.	Replace relay, if defective.
		TELETYPE switch of control unit defective.	Set switch to NORMAL OW.
8	Teletypewriter does not print page copy during duplex operation.	TELETYPE switch of control unit defective.	Check switch; repair or replace if defective.
9	No rf signal output when transmitter is keyed.	Antenna changeover relay	Repair or replace relay, if defective.
		Fsk-modulator defective	Refer to paragraphs 3-6 through 3-10.
10	Rf signal radiated when KEYING switch of transmitter is set to CONTINUOUS; no signal radiated when handkey is pressed.	Defective control unit	Check control unit and repair (para 3-12).
11	Transmitter operation normal in cw mode, but carrier not modulated in am. mode.	Control relay K1 in control unit not operating.	Check relay K1 in control unit; replace if defective (para 4-2).
		Fsk-modulator defective	Refer to paragraphs 3-6 through 3-10.
12	No telephone communication between shelter and remote site.	Defective REMOTE TEL switch of control unit.	See that switch is set to LOCAL TEL. Check switch contacts, and replace if necessary.
		Remote control unit defective	Check remote control unit (para 3-13).
		Telephone defective	Refer to TM 11-337 or TM 11-2155.
13	No am. communication from remote site.	Defective REMOTE TEL switch of control unit.	See that switch is set to REC A or REC B. Check switch contacts, and replace if necessary.
		Hybrid coil of control unit defective.	Check hybrid coil and replace if defective (para 3-12).

Item	Indication	Probable trouble	Corrective procedure
14	No teletypewriter communication from remote site.	TELETYPE switch of control unit.	See that switch is set to REMOTE OW or REMOTE DX. Check switch, and replace if defective.

Section II. TROUBLESHOOTING MODULATOR, RADIO MD-239(*)/GR

3-6. General

Troubleshooting the fsk-modulator consists of an operational test (para 3-7) and a signal sampling test (para 3-8) to check the frequency-shift capabilities. If proper results are not obtained during these tests or other abnormalities are observed, refer to the troubleshooting chart (para 3-9) to isolate the possible source of trouble. Voltage and resistance checks (para 3-10) will further aid in determining the defective component.

3-7. Operational Test

Follow the instructions given in the equipment performance checklist (TM 11-5820-256-20). The output signal of the fsk-modulator is the same as the input signal, both in frequency and signal level, except for the frequency shift affected by the teletypewriter mark signals. Because frequency conversion is applied twice, and the signal is filtered and amplified, a failure of any stage in the fsk-modulator will have an effect on the output level or frequency of the fsk-modulator. Examine the effect of the frequency-shifting circuits in the fsk-modulator as follows:

a. Apply a signal from the master oscillator of the transmitter to the fsk-modulator, and tune the receiver to the same frequency.

b. Disconnect RF Cable Assembly CG-5300B/U from jack FSK on the transmitter and loosely couple this cable to the input jack RECEIVER.

c. With no 60-ma signal (equivalent of a space condition) applied to jack TTY IN or KEYING IN, monitor the output of the receiver. Listen to the beat note as the BAND SELECTOR switch of the fsk-modulator is advanced clockwise. A different beat note, decreasing in frequency, should be audible.

d. Apply a 60-ma signal to jack TTY IN or KEYING IN. (This should be the mark signal from the teletypewriter equipment.) No shift in frequency should occur, regardless of the position of the BAND SELECTOR switch.

3-8. Rf Signal Sampling

a. General. This procedure consists of sampling the rf signals in the fsk-modulator by coupling some of the rf signals from the individual tubes and receiving them on the R-390(*)/URR or a receiver with equal stability and frequency calibration accuracy.

b. Test Cable Fabrication. Prepare a short length of flexible and shielded wire or coaxial cable with a Connector, Adapter UG-573/U that will fit the whip antenna connector at the rear of the receiver. Trim approximately one-half or three-fourths of an inch of the outer jacket and braid from the other end of the shielded wire or coaxial cable. Solder this end to a miniature tube shield of the same size used on the fsk-modulator tubes. This tube shield is used to capacity-couple rf signals from the tube under test to the receiver. Slide a plastic or phenolic sleeve over the tube shield to prevent it from contacting adjacent parts in the modulator. Tape the test tube shield if a suitable insulating sleeve is not available.

c. Sampling Rf Signal. This test enables the repairman to determine whether or not each individual tube is producing a signal in its plate circuit. It also permits the repairman to obtain a *relative* indication of the signal amplitude and to measure the frequency of the signal within the dial calibration accuracy of a properly operating receiver. To sample the signal from the individual tube in the fsk-modulator, remove the individual tube shield and slip the test cable tube shield over the tube under test. Connect the UG-573/U at the end of the test cable to the whip antenna connector at the rear of the receiver. *Do not allow the bottom of the test tube shield (b above) to contact the chassis or anything other than the glass enve-*

lope of the tube under test. If the tube shield fits loosely, squeeze the tube shield to assure a snug fit. If the test cable tube shield contains a tube retaining spring, remove the spring so that the shield may be slipped over most of the glass envelope of the tube. The chart in *d* below indicates the frequency of the signal at the plate circuit of each tube for different positions of the BAND SELECTOR switch when no 60-ma signal (space condition) is applied to jack TTY IN or KEYING IN.

d. Signal Detection and Measurement. Use the receiver as a detector of the frequency-shift audio signal and tune in the signal indicated in the last column in the chart below as an ordinary radio signal. The frequency indicated on the frequency dial of the receiver should be within 300 cycles of that listed in the chart below for the tube under test. This method of testing quickly isolates the trouble to a particular stage. For example, if the rf input frequency applied to jack M.O. IN is 1.8 mc and the BAND SELECTOR switch is set to the 1.5–2 position, the frequency at the first mixer should be 13,799.15 kilocycles (kc). If the frequency tuned in on the receiver is 13,800 kc, the capacitors inserted in the frequency-shift network are suspected as being defective (open). If the signal cannot be detected on the receiver near 13,799.15 kc but a signal is present at 11,999.15 kc, the 1,800-kc signal from jack M.O. IN is not getting through to the input of the first mixer and defective components in the rf input signal path are indicated. If a signal is not present on the receiver at 13,799.15 kc but can be tuned in at 1,800 kc, the shift oscillator or associated circuits are probably at fault. Apply this procedure and analysis to the remaining stages in the fsk-modulator.

Stage under test	BAND SELECTOR switch setting (mc)	Frequency shift due to space condition (cps)	Frequency at stage under test (kc)
First mixer and if. amplifier	1.5–2 or 2–3	850	Rf input +11,999.15[a]
First mixer and if. amplifier	3–4 or 4–6	425	Rf input +11,999.575[a]
First mixer and if. amplifier	6–8 or 8–12	212	Rf input +11,999.788[a]
First mixer and if. amplifier	12–16 or 16–20	106	Rf input +11,999.894[a]
Shift oscillator	1.5–2 or 2–3	850	11,999.150
Shift oscillator	3–4 or 4–6	425	11,999.575
Shift oscillator	6–8 or 8–12	212	11,999.788
Shift oscillator	12–16 or 16–20	106	11,999.894
Second mixer and first, second, and third rf amplifiers.	1.5–2 or 2–3	850	Rf input[a] +11,999.15 minus 12,000
Second mixer and first, second, and third rf amplifiers.	3–4 or 4–6	425	Rf input[a] +11,999.575 minus 12,000
Second mixer and first, second, and third rf amplifiers.	6–8 or 8–12	212	Rf input[a] +11,999.788 minus 12,000
Second mixer and first, second, and third rf amplifiers.	12–16 or 16–20	106	Rf input[a] +11,999.894 minus 12,000
Fixed oscillator	12,000 kc under any conditions		

[a]Denotes rf input signal (1.5 to 3.0 mc) fed to jack M.O. IN of fsk-modulator.

3–9. Troubleshooting Chart

The following troubleshooting chart is supplied as an aid in locating troubles in the fsk-modulator. Refer to the schematic diagrams (figs. 5–16 and 5–18) for aid in troubleshooting the fsk-modulator. Parts locations are given on figures 3–5 through 3–12. Voltage and resistance checks are given in paragraph 3–10.

Note. Reference designations in parentheses pertain to the plain model of the fsk-modulator. All other reference designations pertain to the A model. Where a reference designation is not succeeded by one in parentheses, the designation applies to both models.

Item	Indication	Probable trouble	Procedure
1	POWER switch at ON. Indicator lamp does not light. Blower does not operate.	No ac to equipment	Check Cable Assembly, Power, Electrical CX-2491/U. Check seating of plug P14 (P16) in jack J14 (J16). Check fuse F1.
2	POWER switch at ON. Indicator lamp lights but blower motor does not operate.	No ac to blower B1	Check connection of jack J13 (J15) and plug P13 (P15). Check connections to blower motor.
3	POWER switch at ON. Blower operates but indicator lamp does not light.	Power transformer T1. Indicator lamp DS1 (I 1).	Check secondary of T1. Check indicator lamp DS1 (I 1).
4	No output with 1.5- to 2.0-mc input frequency; operates normally with a 2.0- to 3.0-mc input.	Resistor R4 (R1) Input filter FL1 BAND SELECTOR switch S1.	Check R4 (R1). Check input filter FL1. Check contacts of BAND SELECTOR switch S1, section 2 (section 1).
5	Normal output on all bands but no frequency shift during space signals.	Crystal diodes CR1 and CR2. BAND SELECTOR switch	Check diodes CR1 and CR2. Check sections 3 and 4 of BAND SELECTOR switch S1.
6	Output frequency shifted during mark signals.	Jack J12 (J14). Keying input circuit.	Check jack J12 (J14). Check resistor R52 (R46 and R47) and feedthrough capacitor C37 (C69).
7	Normal output with a 1.5- to 2.0-mc input signal; unstable operation (harmonics present) with 2.0- to 3.0-mc input signal.	3.2-mc trap KFL1 BAND SELECTOR switch Resistor R51 (R50)	Check trap KFL1 (3.2-mc filter trap). Check contacts of BAND SELECTOR switch S1, section 1. Check resistor R51 (R50). Check resistor R50 (no equivalent in A model) and feedthrough capacitor C64 (C73).
8	Unstable operation on all bands.	Crystals Y1 and Y2 Crystal ovens HR1 and HR2. CRYSTAL OVEN fuse F2 Shift oscillator and fixed oscillator. Voltage regulators V10 and V11.	Check crystals Y1 and Y2. Check crystal ovens HR1 and HR2. Check fuse F2. Check tubes V2 (V5) and V5 (V6). Check voltage regulators V10 and V11.

3-10. Voltage and Resistance Checks

Voltage and resistance diagrams for the MD-239/GR and MD-239A/GR are shown in figures 3-1 through 3-4, respectively. These drawings indicate the values that should be obtained at the tube-socket pins and terminal boards. If a value, as read on the multimeter, varies (outside of reasonable tolerance limits) from the value given in the diagram, note the amount of variance and use it to aid in determining which part is at fault. For instance, if a 100,000-ohm resistance reading is indicated at a given tube-socket pin on a diagram and the actual reading is 30,000 ohms on the meter, the circuit diagram should be examined for the presence of a resistor in the circuit under test that could, if defective, account for the incorrect reading. Such a resistor would then be suspected and should be checked. Another possibility would be that a capacitor has shorted out and is shunting a resistor. Refer to figures 5-11 and 5-12 for capacitor and resistor color codes.

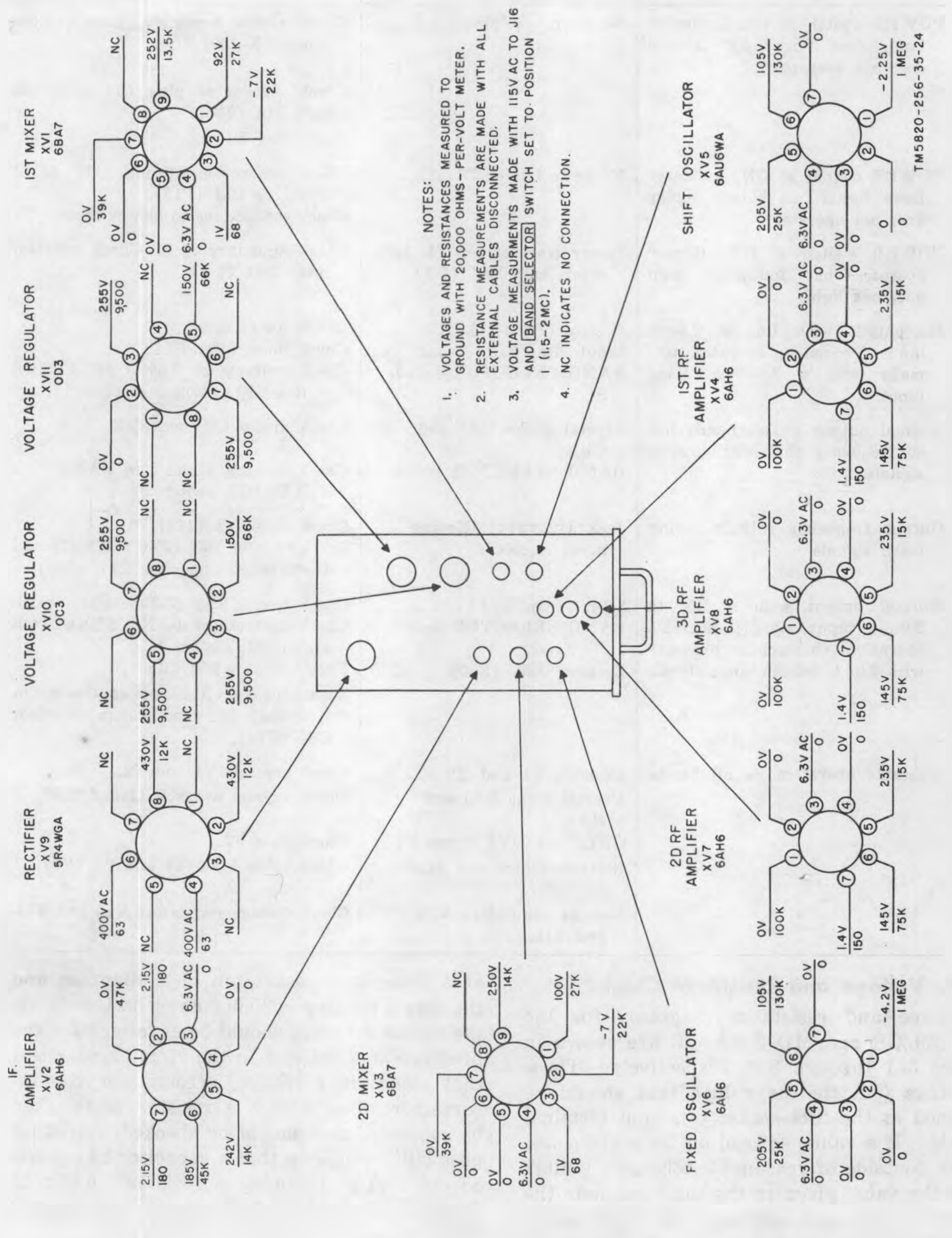


Figure 3-1. Modulator, Radio MD-239/GR, tube-socket voltage and resistance diagram.

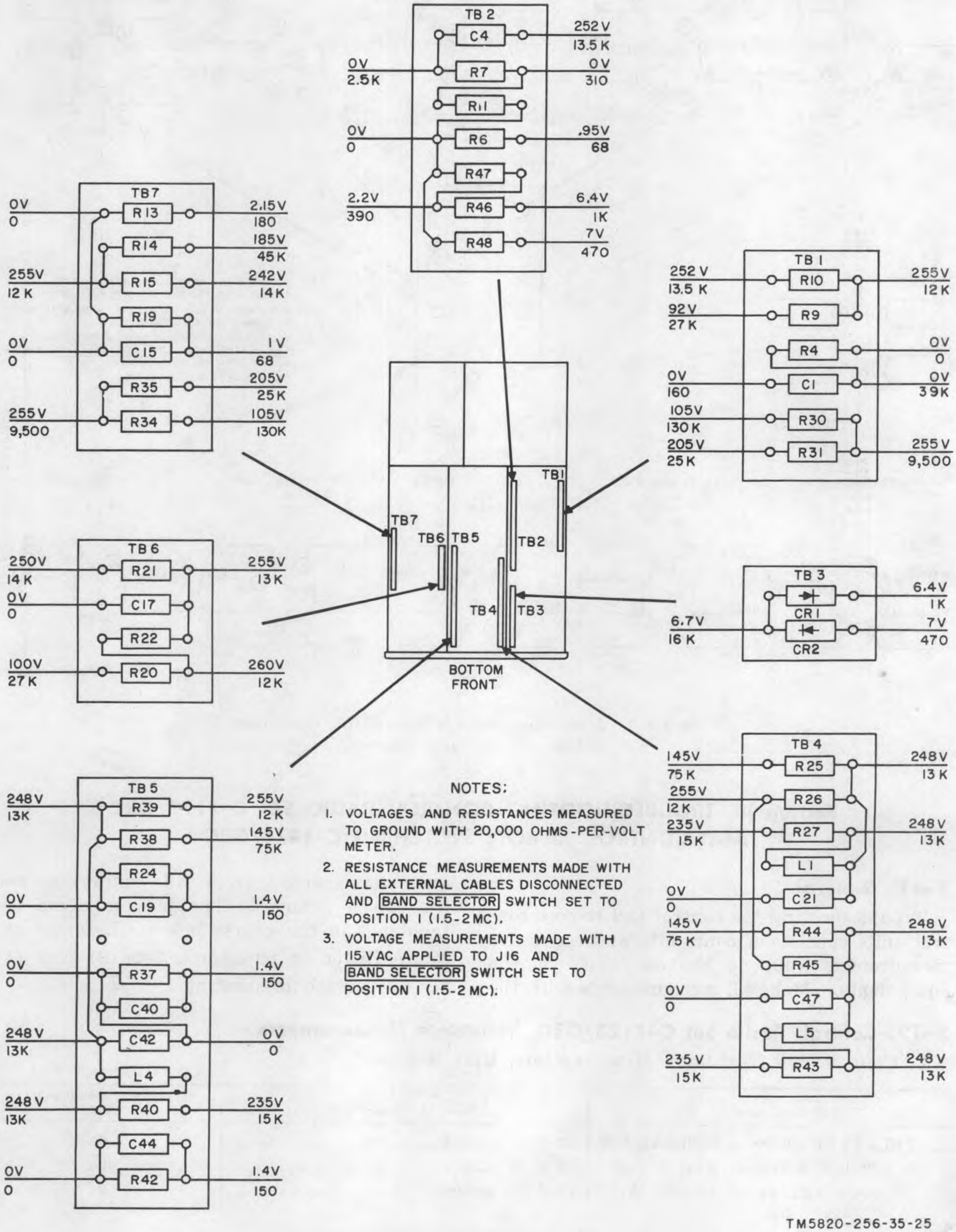


Figure 3-2. Modulator, Radio MD-239/GR, terminal board voltage and resistance diagram.

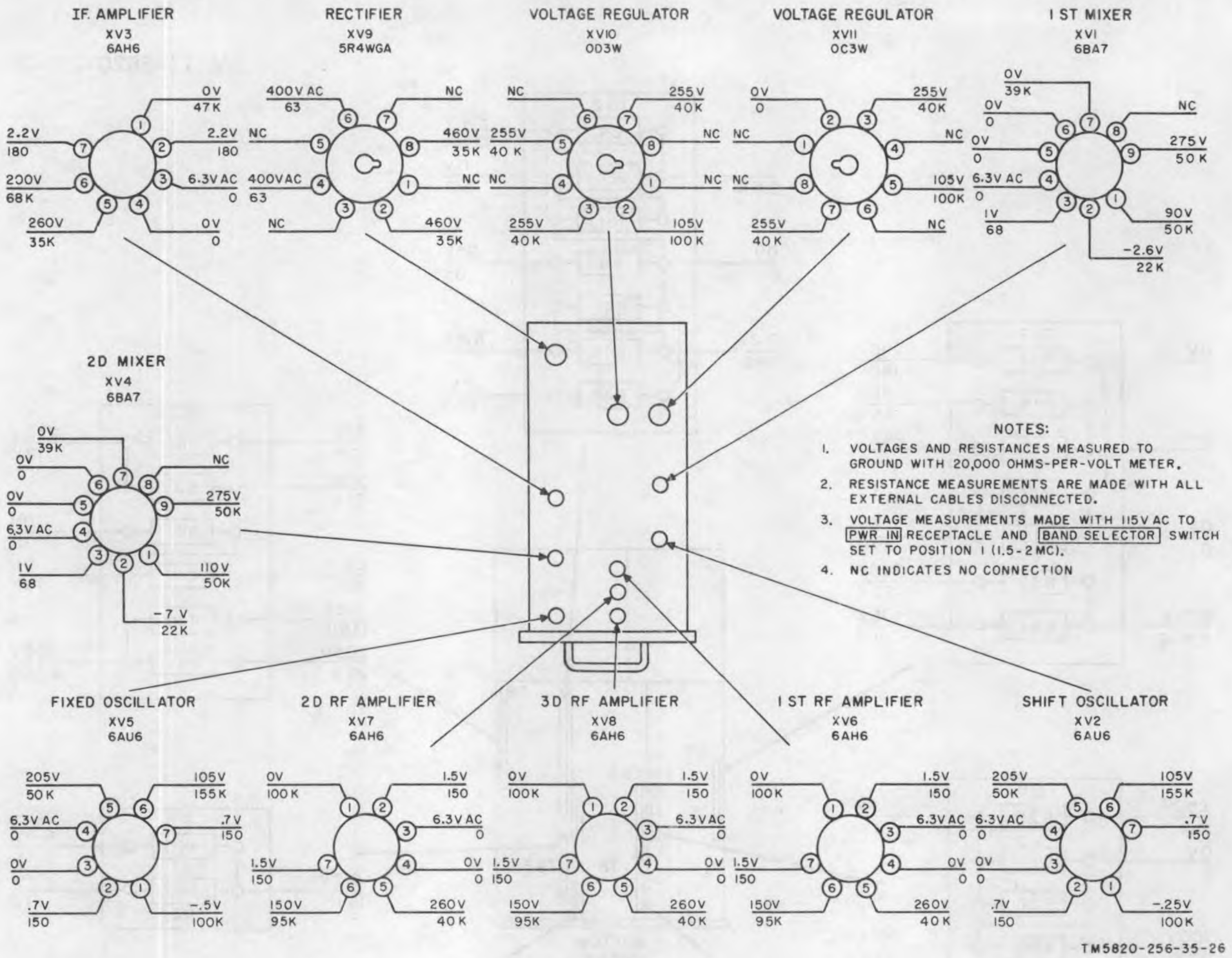


Figure 3-3. Modulator, Radio MD-239A/GR, tube-socket voltage and resistance diagram.

Section III. TROUBLESHOOTING CONTROL, RADIO SET C-1123/GRC AND CONTROL, REMOTE SWITCHING C-1474/GRC

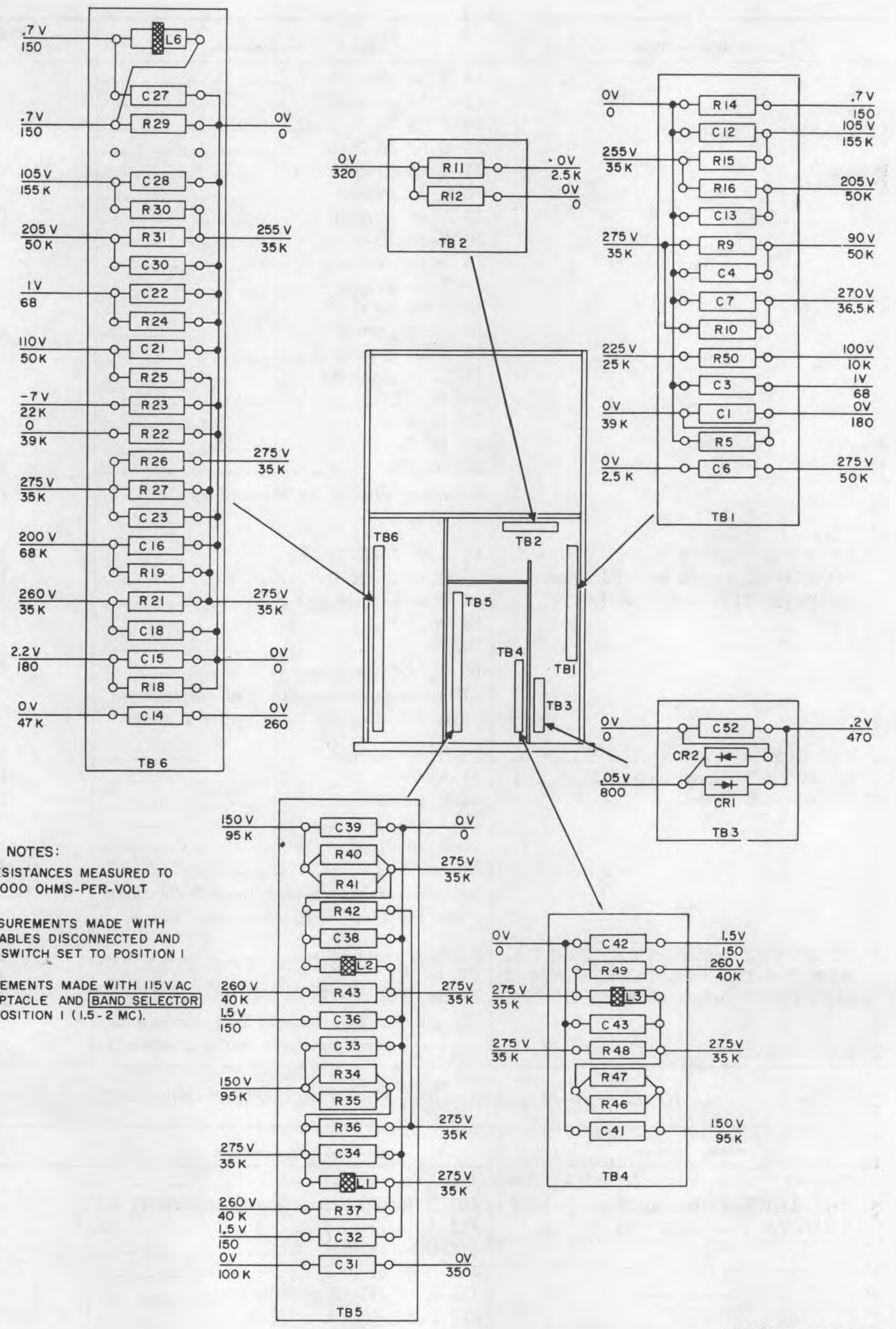
3-11. General

Troubleshooting the control and remote control units consists of continuity and resistance measurements due to the simplicity of the equipments. Make all measurements with the unit disconnected from all equipment and the cables removed. The measurements are tabulated in the charts below. Refer to the figures listed in paragraph 3-2*c*(2) and (3) for aids in troubleshooting.

3-12. Control, Radio Set C-1123/GRC, Resistance Measurements

a. Control Unit Resistance Measurements, Most Orders.

Switch position	Point of measurement	Normal indication (ohms)
1. TELETYPE switch at NORMAL OW, SIDETONE switch at REC A, and REMOTE TEL switch at REC A.	J2-A to ground	0
	J2-B to E1	40
	J3-A to ground	0



NOTES:

1. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
2. RESISTANCE MEASUREMENTS MADE WITH ALL EXTERNAL CABLES DISCONNECTED AND BAND SELECTOR SWITCH SET TO POSITION 1 (1.5-2 MC).
3. VOLTAGE MEASUREMENTS MADE WITH 115 V AC TO PWR IN RECEPTACLE AND BAND SELECTOR SWITCH SET TO POSITION 1 (1.5-2 MC).

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Figure 3-4. Modulator, Radio MD-239/GR, terminal board voltage and resistance diagram.

Switch position	Point of measurement	Normal indication (ohms)
	J3-B to ground	0
	J3-D to ground	0
	J4-A to J4-C	27
	J4-D to J6-H	0
	J4-E to ground	0
	J5-E to ground	0
	J6-A to ground	Infinity
	J6-A to J8-F	0
	J6-D to ground	27
	J6-E to ground	0
	J6-F to J8-C	0
	J6-J to ground	9,750
	J8-E to ground	0
	J8-H to ground	0
	E1 to E2	700
	E3 to E4	0
	E5 to E6	0
	E7 to E8	380
	All other pins of J2 through J8 to ground.	Infinity
2. TELETYPE switch at NORMAL DX, SIDETONE switch at OFF, and REMOTE TEL switch at LOCAL TEL.	J4-A to J4-C	Infinity
	J4-D to J6-H	Infinity
	J6-D to ground	Infinity
	E1 to E2	Infinity
	E2 to E8	80
	E7 to E8	Infinity
	All other measurements and indications are the same as listed under 1 above.	
3. TELETYPE switch at REMOTE OW, REMOTE TEL switch at RECB, and SIDETONE switch at REC B.	J3-D to ground	Infinity
	J4-A to J4-C	Infinity
	J4-D to J6-H	Infinity
	J5-A to J5-C	27
	J5-D to J6-H	0
	E3 to E4	Infinity
	All other measurements and indications are the same as listed under 1 above.	
4. TELETYPE switch at REMOTE DX, REMOTE TEL switch at REC A, and SIDETONE switch at REC A.	J3-D to ground	Infinity
	E3 to E4	Infinity
	E5 to E6	Infinity
	All other measurements and indications are the same as listed under 1 above.	

b. Control Unit Resistance Measurements, Order No. 25209-Phila-54.

Switch position	Point of measurement	Normal indication (ohms)
1. TELETYPE switch at NORMAL OW, SIDETONE switch at REC A, and REMOTE TEL switch at REC A.	J21-A to ground	0
	J21-B to J24	40
	J12-A to ground	0
	J12-B to ground	0
	J12-D to ground	0
	J15-A to J15-C	27
	J15-D to J22-H	0
	J15-E to ground	0
	J16-E to ground	0
	J22-A to ground	Infinity

Switch position	Point of measurement	Normal indication (ohms)
	J22–A to J19–F	0
	J22–D to ground	27
	J22–E to ground	0
	J22–F to J19–C	0
	J22–J to ground	4,800
	J19–E to ground	0
	J19–H to ground	0
	J23 to J24	700
	J25 to J26	0
	J8 to J9	0
	J13 to J14	380
	All other pins of J12, J15, J16, J19, J21, and J22 to ground.	Infinity
2. TELETYPE switch at NORMAL DX, SIDETONE switch at OFF, and REMOTE TEL switch at LOCAL TEL.	J15–A to J15–C	Infinity
	J15–D to J22–H	Infinity
	J22–D to ground	Infinity
	J23 to J24	Infinity
	J24 to ground	4,880
	J13 to J14	Infinity
	All other measurements and indications are the same as listed under 1 above.	
3. TELETYPE switch at REMOTE OW and REMOTE TEL switch at REC B.	J12–D to ground	Infinity
	J15–A to J15–C	Infinity
	J15–D to J22–H	Infinity

3–13. Control, Remote Switching C–1474/GRC, Resistance Measurements

Point of measurement			Normal indication (ohms)
Order No. 43056–Phila–56 and 3219–PP–59	Order No. 25209–Phila–54	Other orders	
		XMTR ON switch open:	
E1 to E5	J202 to J201	E1 to E2	0
E2 to E8	J206 to J209	E4 to E5	0
E7 to E3	J211 to J212	E7 to E8	0
E6 to TTY SWITCH connector J7–A.	J202 to TTY SWITCH connector J208–A.	E3 to TTY SWITCH connector J7–A	0
E7 to TTY SWITCH connector J7–B.	J207 to TTY SWITCH connector J208–B.	E7 to TTY SWITCH connector J7–B	0
		XMTR ON switch closed:	
TTY SWITCH connector J7–B to TTY SWITCH connector J7–A.	TTY SWITCH connector J208–B to TTY SWITCH connector J208–A.	TTY SWITCH connector J7–B to TTY SWITCH connector J7–A.	0
E5 to E6	J202 to J207	E2 to E3	0
E1 to E6	J201 to J207	E1 to E3	0
E4 to any jack or connector pin.	J210 to any jack or connector pin.	E6 to any jack or connector pin	Infinity

Section IV. REPAIRS

3-14. Replacement of Parts

All parts of the fsk-modulator, control unit, and remote control unit, can be reached easily and replaced without any special procedures. Pertinent information regarding the replacement of parts in these units is given below. Observe the precautions given in paragraph 3-4. Refer to the applicable technical manual (app. A) for additional information on removal and replacement techniques for the major components of the AN/GRC-26D.

a. Fsk-Modulator. Figures 3-5 through 3-9 show the location of all parts in the MD-239/GR; figures 3-10, 3-11, and 3-12 show the location of all parts in the MD-239A/GR. Filters FL1 through FL4 and impedance networks Z1 through Z4 each is replaced as a unit. Filter KFL1, 3.2-mc trap, crystal heaters HR1 and HR2 are also replaced as units. Refer to TM 11-5820-256-20 to replace crystal Y1 or Y2.

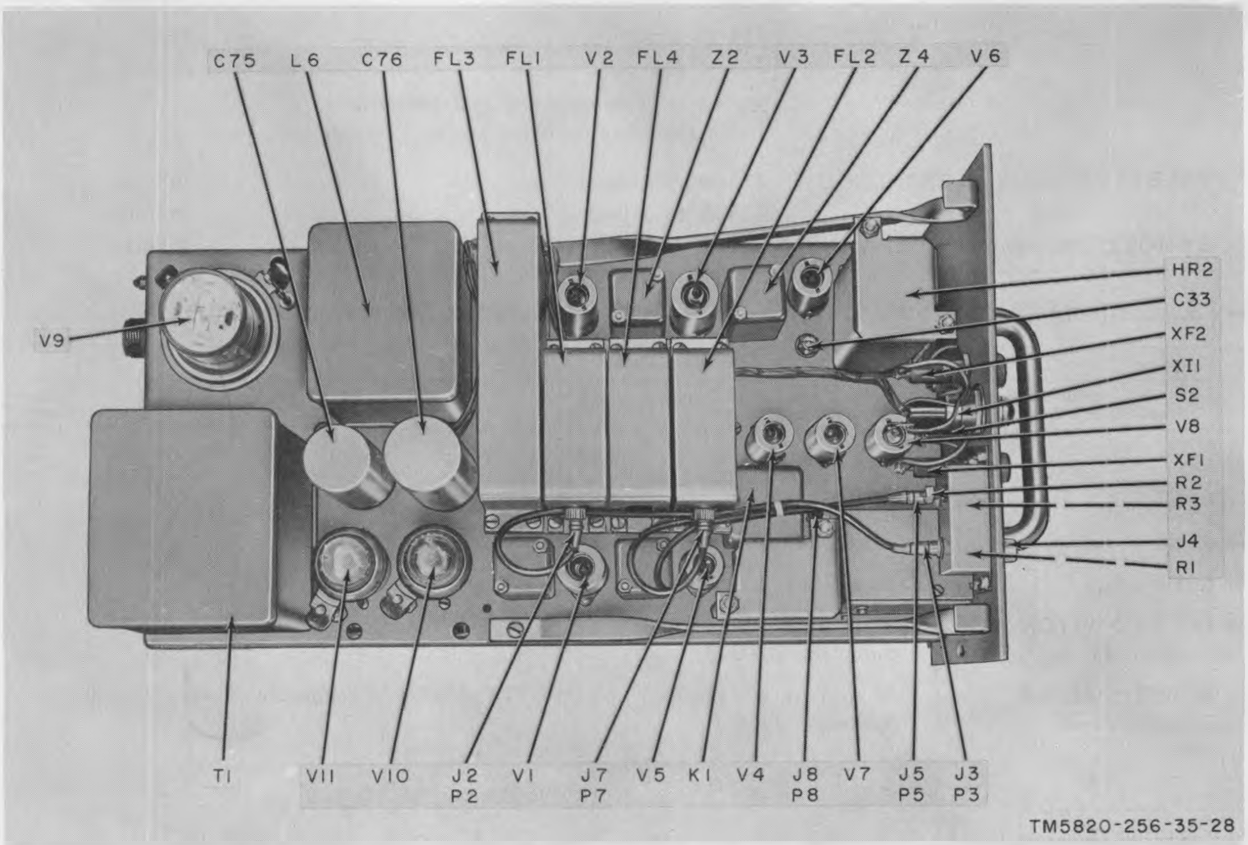


Figure 3-5. Modulator, Radio MD-239/GR, top view, parts location.

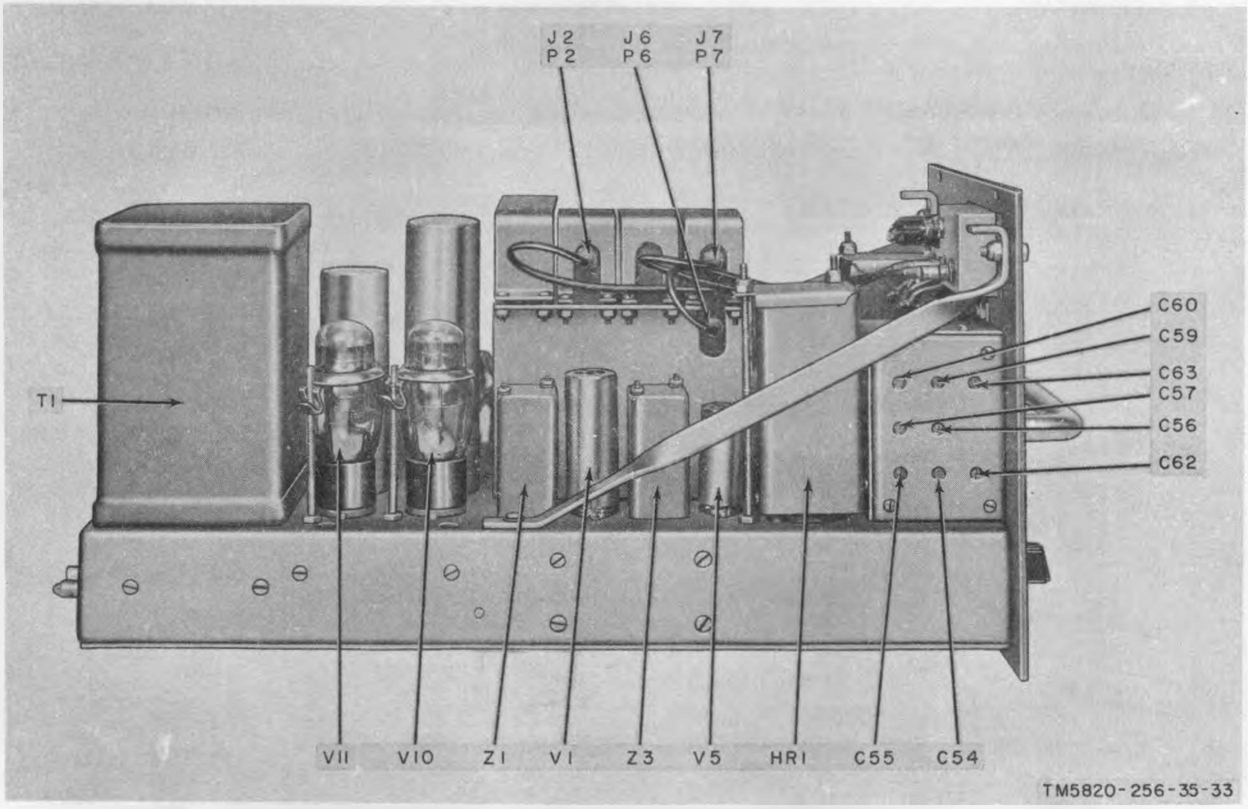


Figure 3-6. Modulator, Radio MD-239/GR, left side view, parts location.

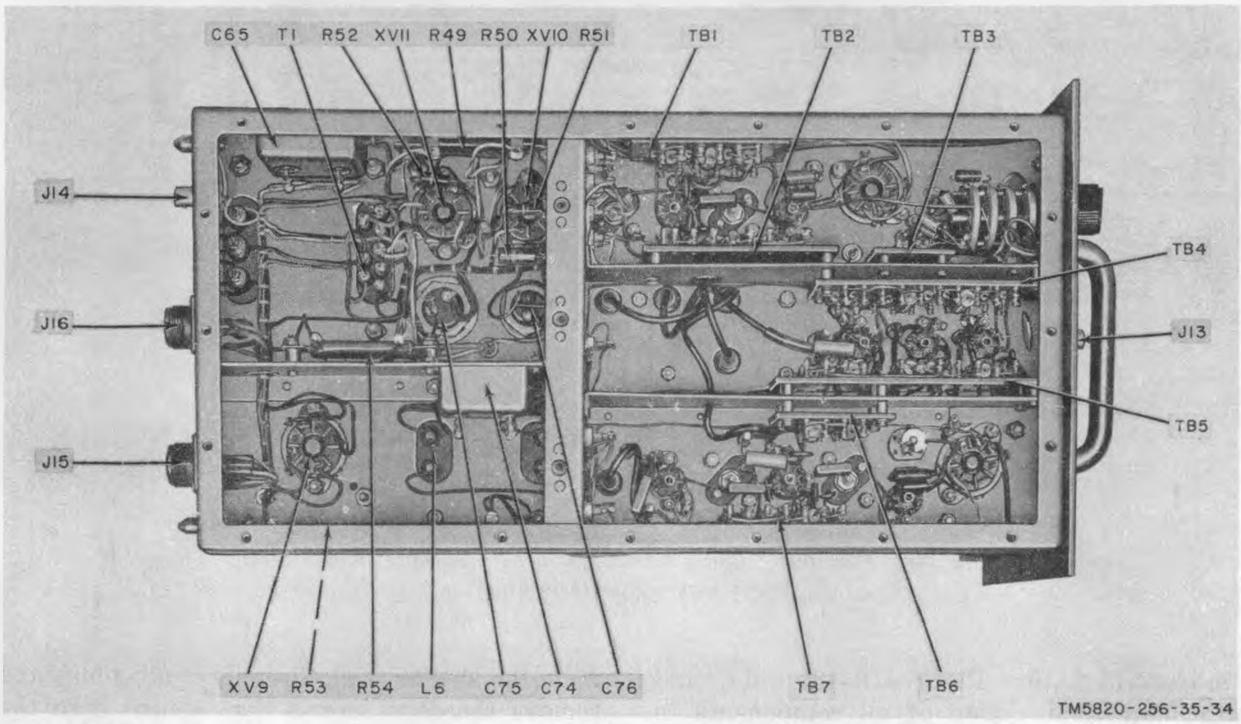


Figure 3-7. Modulator, Radio MD-239/GR, bottom view, parts location.

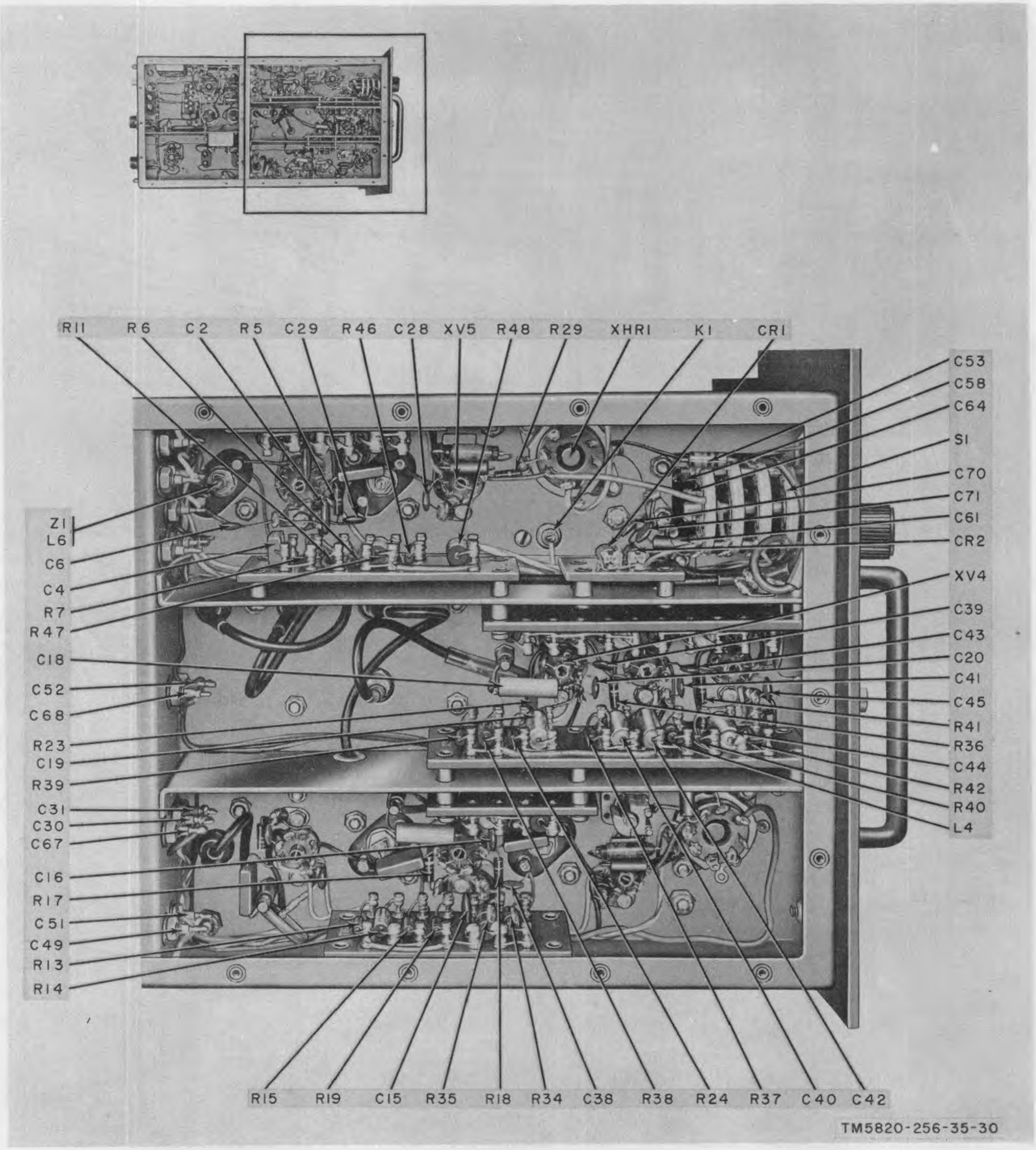


Figure 3-8. Modulator, Radio MD-239/GR, bottom-right oblique view, front section, parts location.

b. Control Unit. Figures 3-13, 3-14, and 3-15 show the location of all components in the control unit. To remove the control unit from the shelter wall, disconnect all cables and remove the four screws that secure it to the shelter wall. Remove the backplate by remov-

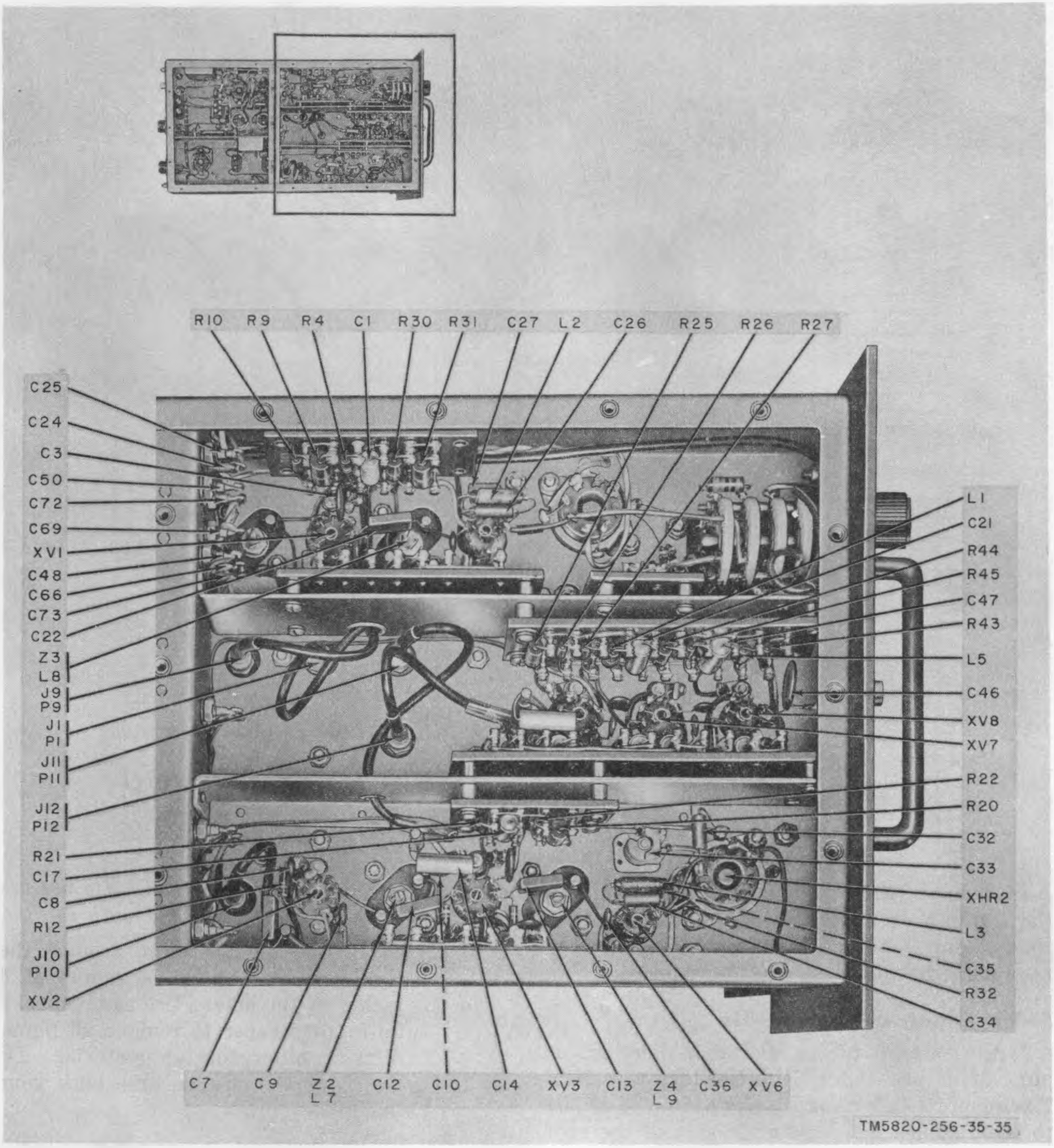


Figure 3-9. Modulator, Radio MD-239/GR, bottom-left oblique view, front section, parts location.

ing the four screws. Remove the subchassis by removing the four screws that secure it to the main chassis.

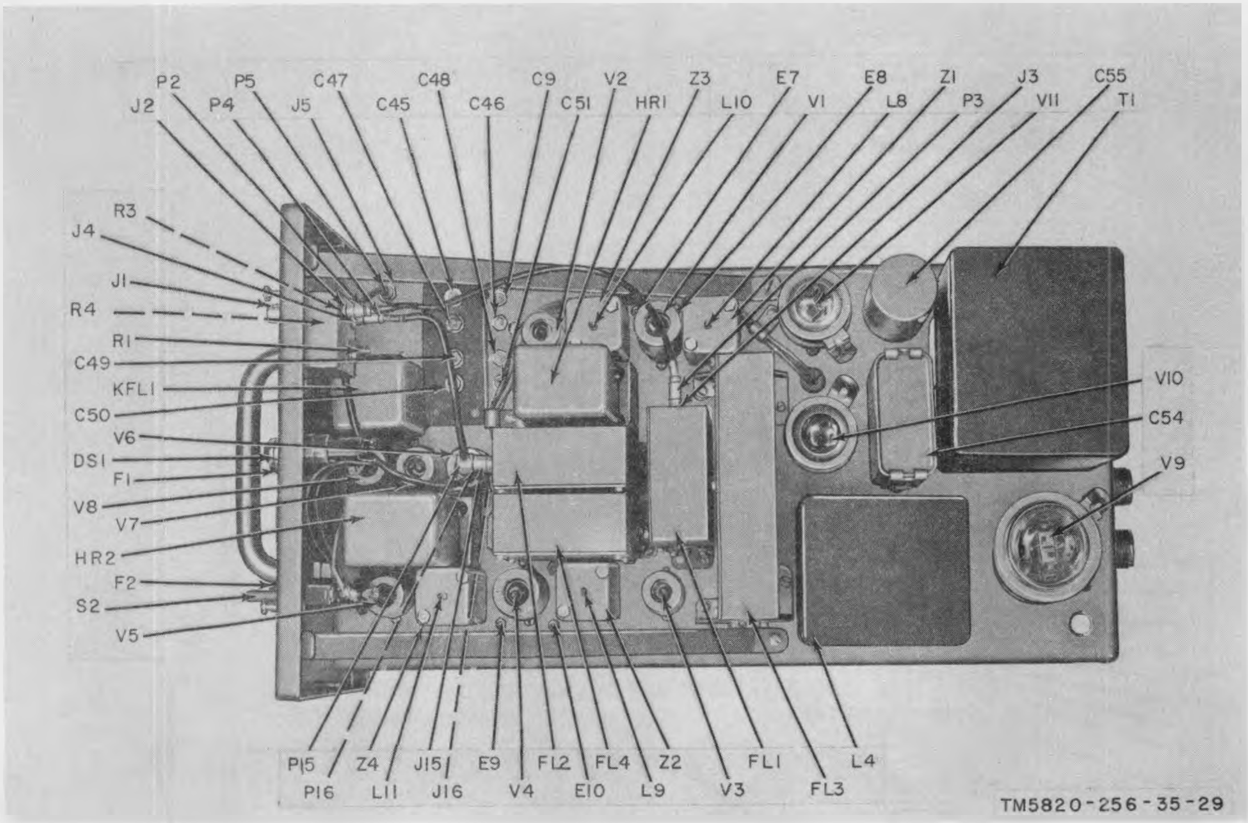


Figure 3-10. Modulator, Radio MD-239A/GR, top view, parts location.

c. Remote Control Unit. Figure 3-16 shows the location of all components of the remote control unit. To reach the parts, remove the rear panel by removing the four screws.

3-15. Repair of Shelter Skin

If the exterior of the shelter is damaged or punctured, use Patch Kit, Shelter, Electrical Equipment (Federal stock No. 5410-783-6250) to repair holes in the exterior skin of the roof or the sides of the shelter. Follow the procedures provided with the kit (TB SIG 354) and those given below to repair the shelter skin.

a. Preparation of Shelter Skin and Patch.

(1) Check the damaged area to determine if the insulation has been gouged out of the shelter wall. If necessary, fill the hole in the insulation with a clean noncombustible material. *Do not use the glass cloth provided with the kit.*

(2) Clean the shelter skin around the damaged area within a radius of 3 inches of the hole. Use sandpaper, a knife, or scraper to remove all paint, dirt, or other foreign material. Do *not* touch the cleaned area with your fingers.

(3) Cut a piece of glass cloth (patch) about 2 inches larger than the hole.

b. Mixing Adherent (Glue). The area to be covered determines the amount of adherent required; the surrounding temperature determines whether the cold weather promoter is required, and the amount required. Follow the procedures given below to mix the ingredients:

(1) Pour 3 ounces of resin into the mixing

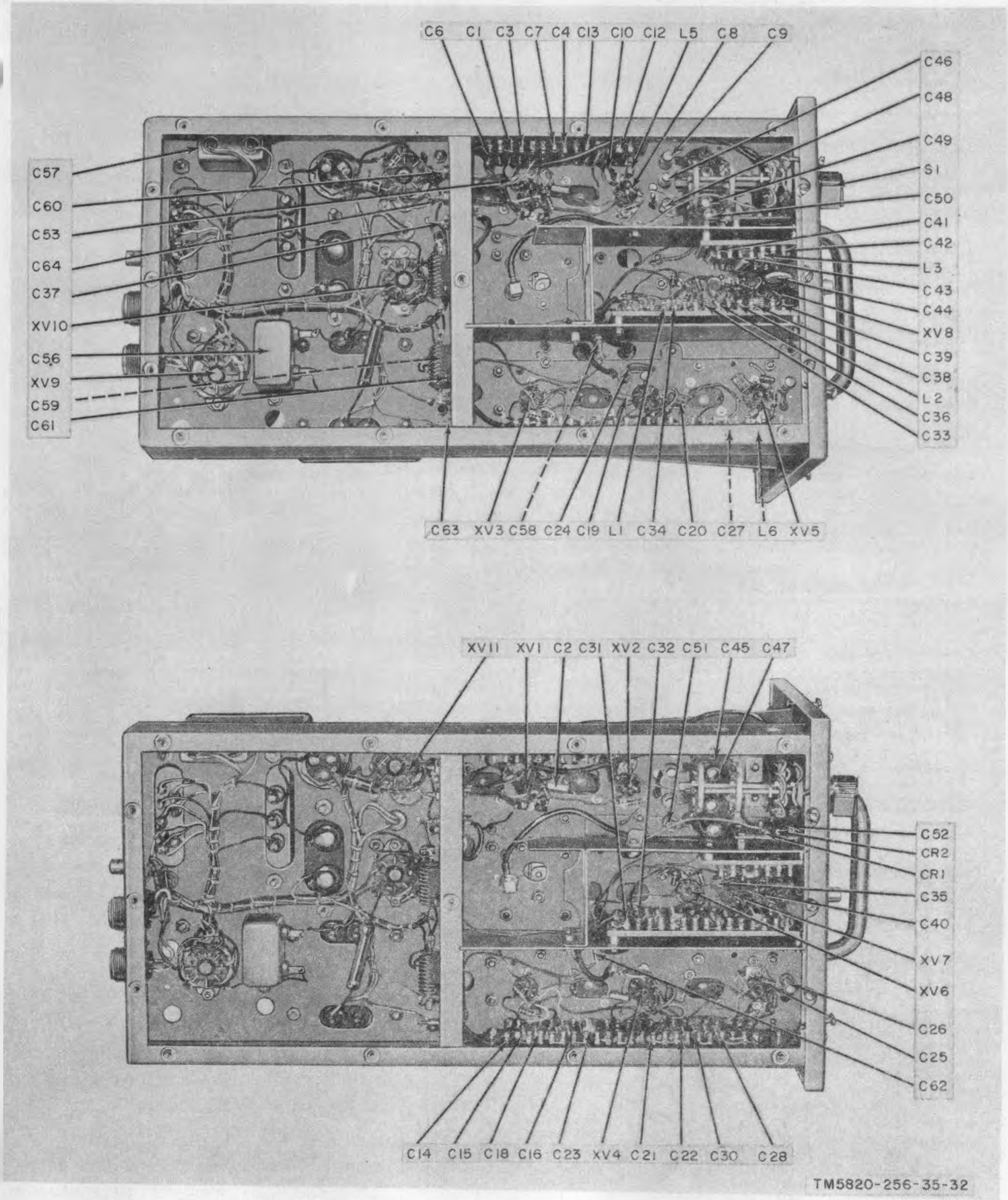


Figure 3-11. Modulator, Radio MD-239A/GR, bottom view, capacitor, coil, tube socket, rectifier, and switch location.

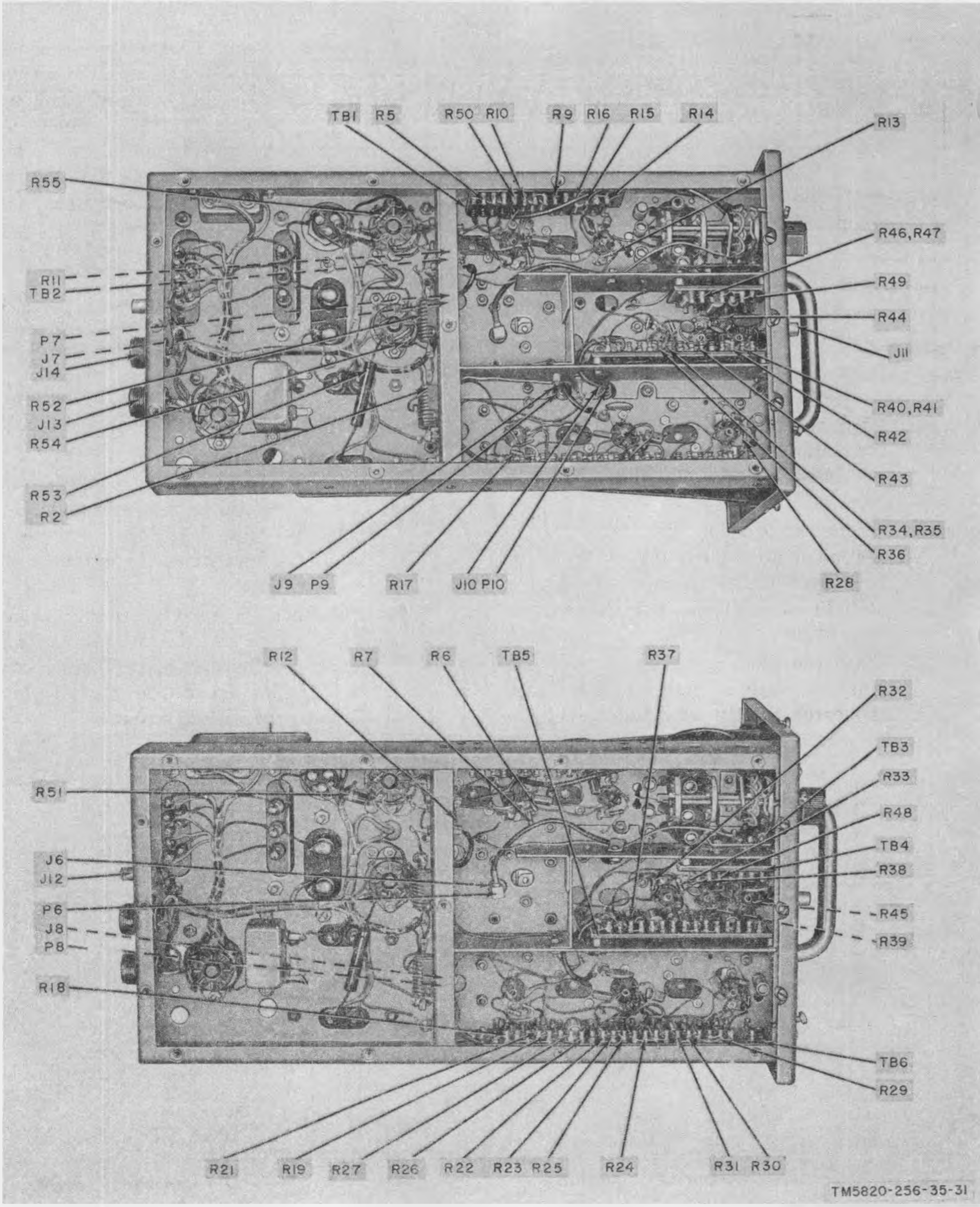


Figure 3-12. Modulator, Radio MD-239A/GR, bottom view, resistor, terminal board, and connector location.

cup for each square foot of area to be covered.

(2) Add the curing agent and cold weather promoter (if required) to the resin in the amounts shown in the chart below. These amounts are for 3 ounces of resin; increase the curing agent and cold weather promoter in proportion to the amount of resin required.

Temperature (°F.)	Curing agent No. 237 (eye dropper filled to redline)	Cold weather promoter (eye dropper filled to redline)
Above 55	1	None
20–55	1	½
Below 20	1	1

(3) Mix the ingredients thoroughly and then apply the mixture to the patch and shelter surface as indicated in *c* below.

c. Application of Mixture and Patch.

(1) Spread a liberal coating of the mixture over the surface of the entire area to be patched. Use the spatula or a brush.

(2) Place the glass cloth patch over the hole; be sure it is centered. Press the patch lightly with the spatula to be sure it is firmly embedded in the mixture.

(3) Spread a second liberal coating of the mixture over the patch. Work from the center of the patch toward the edges. Be sure the patch is completely covered. Check the edges of the patch to be sure they are flat and are firmly embedded in the mixture.

(4) Allow the patch to dry between 4 and 24 hours, depending on the drying conditions.

Note. To accelerate drying at low temperatures, heat the patch with warm, dry air or radiant heat. Do *not* use an open flame.

(5) After the patch is thoroughly dry, smooth the surface with sandpaper and paint it.

d. Cleaning Tools and Storing Components.

(1) Tightly recap the containers and store them in a cool, dry place. The shelf life of the ingredients is seriously affected by heat.

(2) Wait until the mixture is thoroughly dry and then flex the cup and spatula to remove the mixture. Discard the paintbrush. Store the spatula and the cup with the containers.

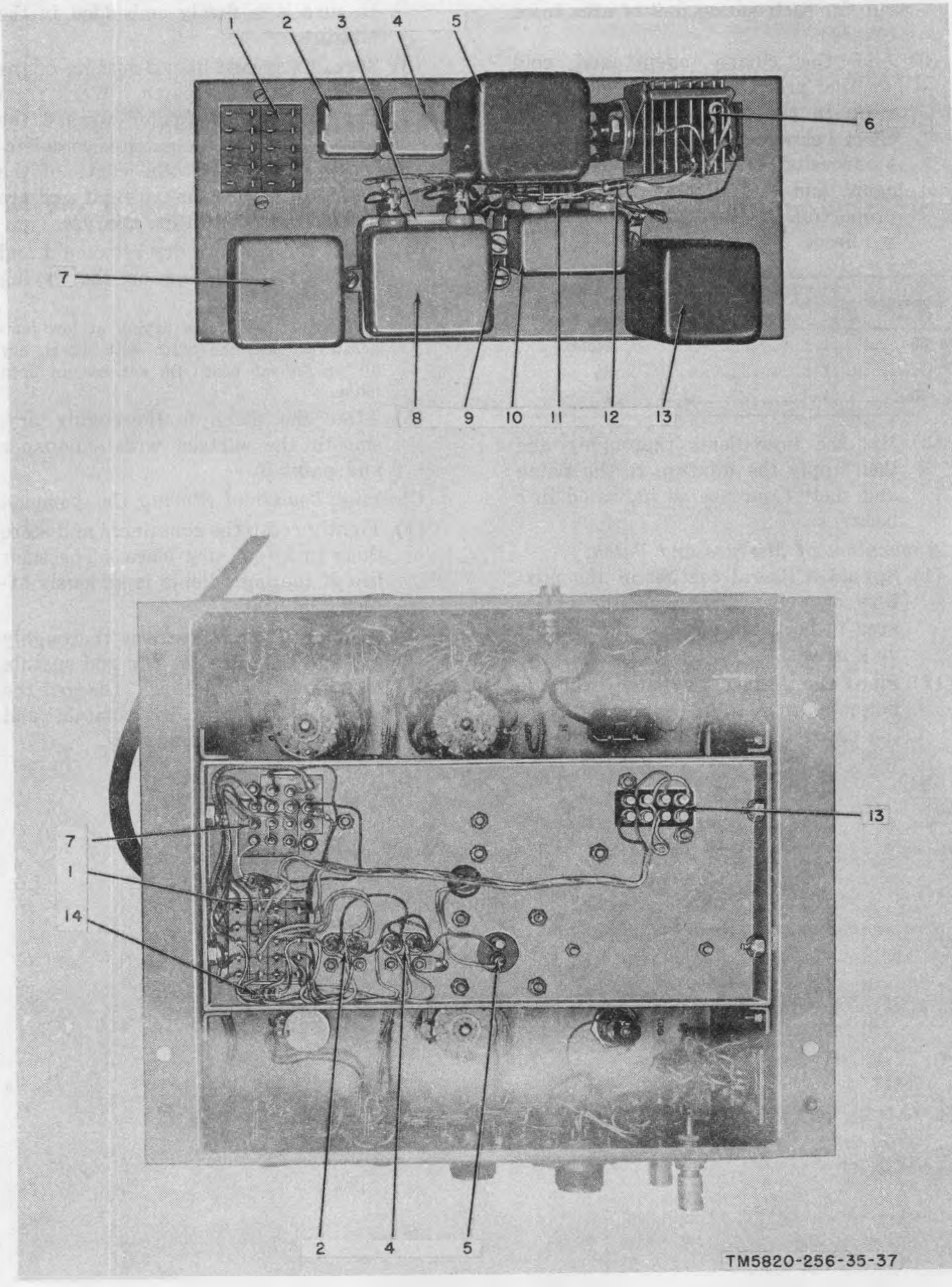


Figure 3-13. Control, Radio Set C-1123/GRC, subchassis, parts location.

Figure 3-13—Continued

Item	Order No. 25209-Phila-54	Other orders
1	P2	P1
2	K2	K1
3	C4	C3
4	K1	K2
5	L5	L5
6	CR1	CR1
7	T2	T1
8	C3	C4
9	C1	C2
10	C2	C1
11	R2	R2
12	R3	R1
13	T1	T2
14	Equivalent resistor (R5) to R4 on other orders not located on the subchassis.	R4

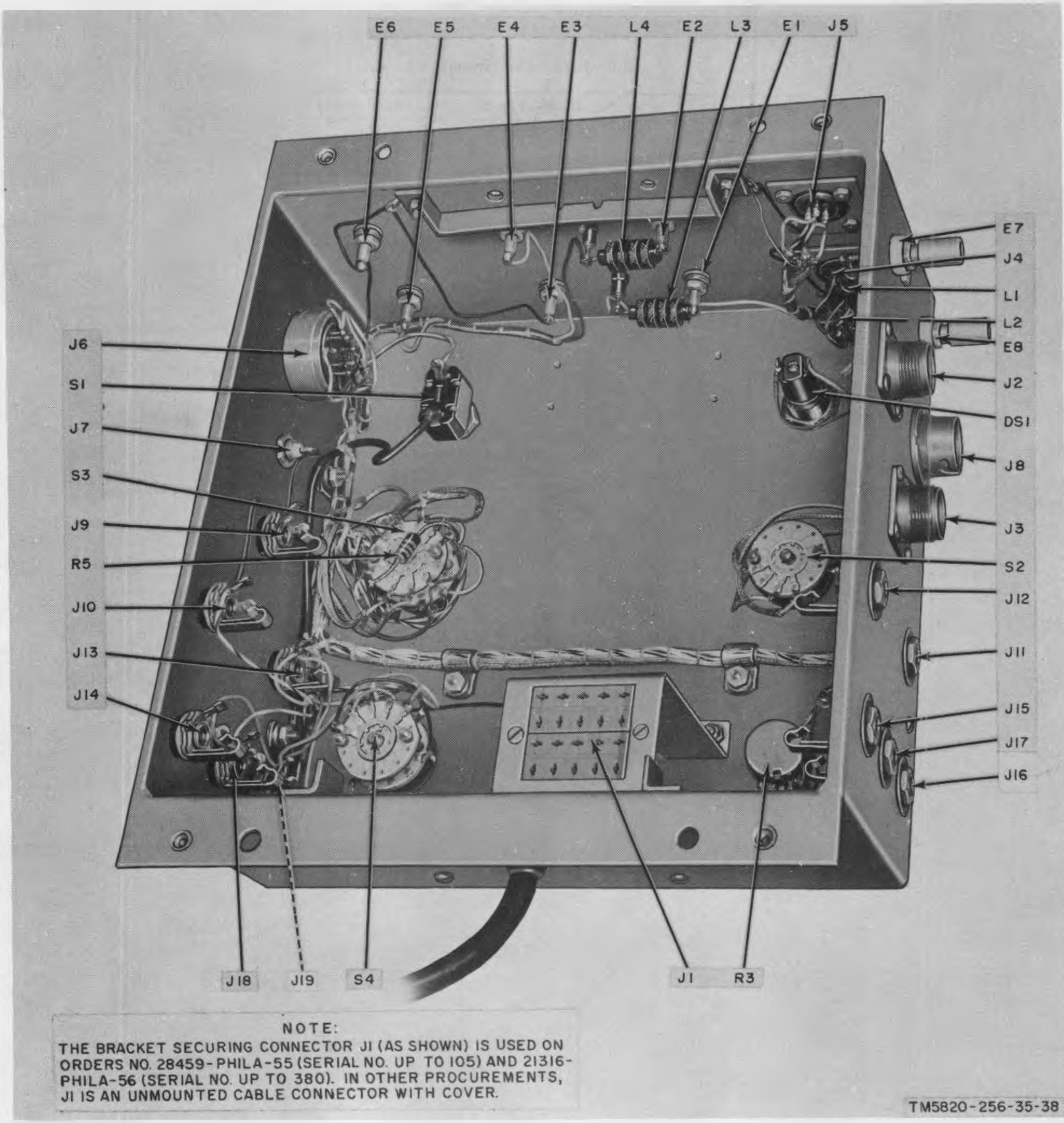


Figure 3-14. Control, Radio Set C-1123/GRC (most orders), bottom view, subchassis removed, parts location.

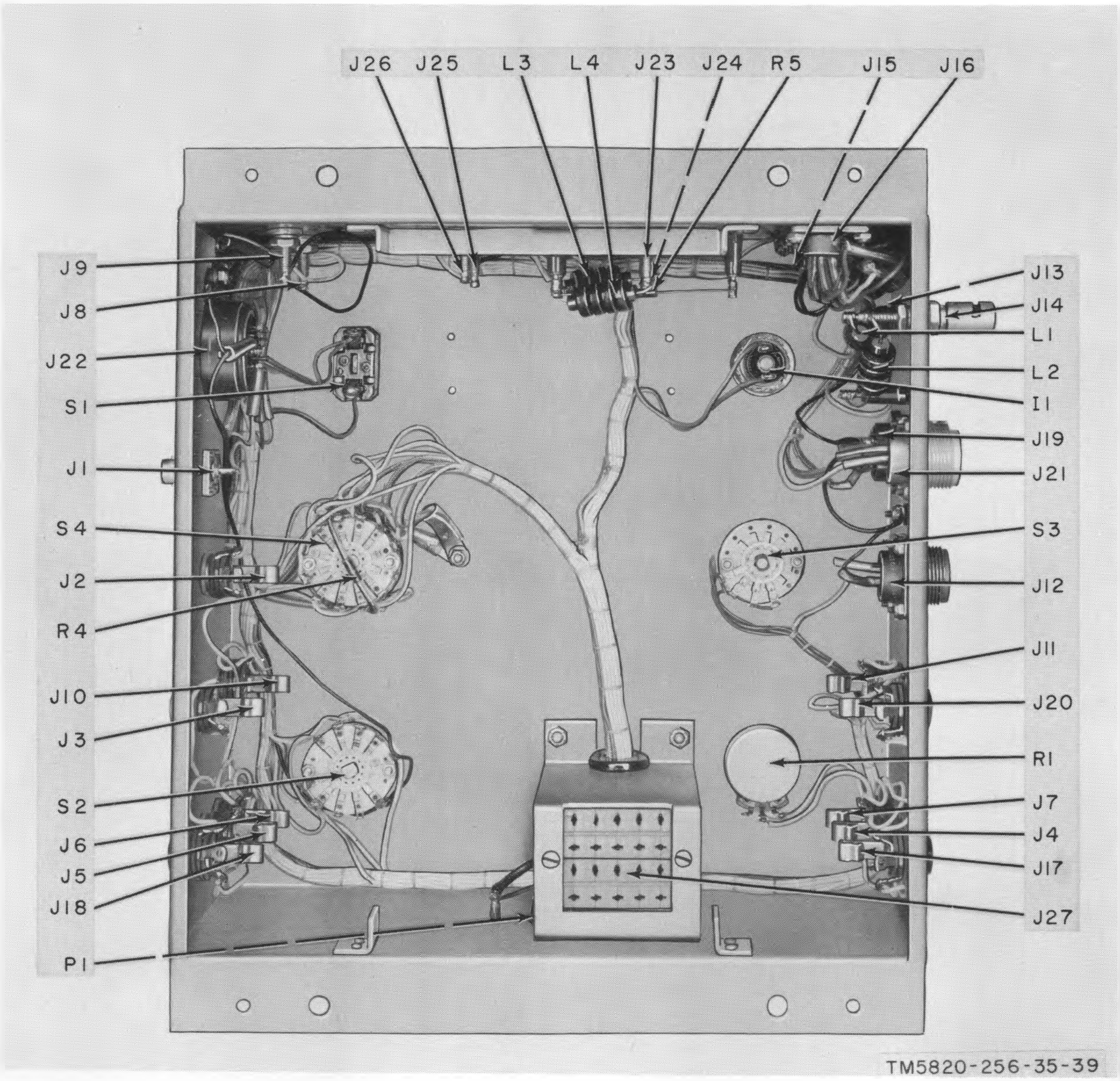
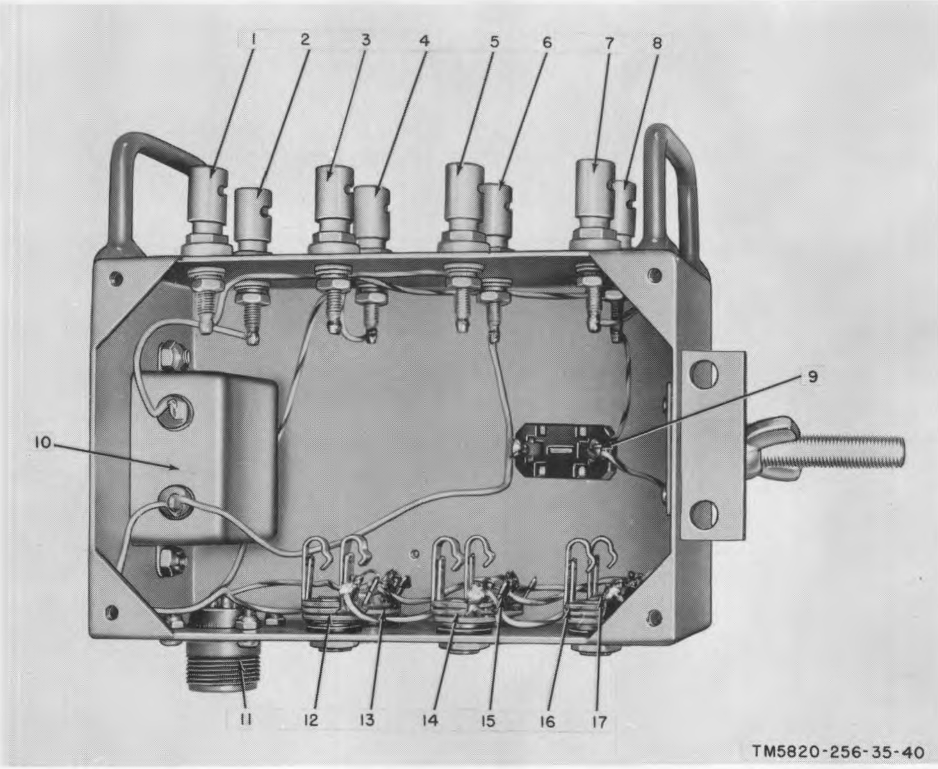


Figure 3–15. Control, Radio Set C–1123/GRC (Order No. 25209–Phila–54), bottom view, subchassis removed, parts location.



Item	Order No. 2509-Phila-54	Order No. 43056-Phila-56 and 3219-PP-59	Other orders
1	J210	E4	E6
2	J209	E8	E5
3	J212	E3	E8
4	J211	E7	E7
5	J207	E2	E4
6	J206	E6	E3
7	J202	E1	E1
8	J201	E5	E2
9	S201	S1	S1
10	C201	C1	C1
11	J208	J7	J7
12	J215	J1	J6
13	J205	J4	J3
14	J214	J2	J5
15	J204	J5	J2
16	J213	J3	J4
17	J203	J5	J1

Figure 3-16. Control, Remote Switching C-1474/GRC, parts location.

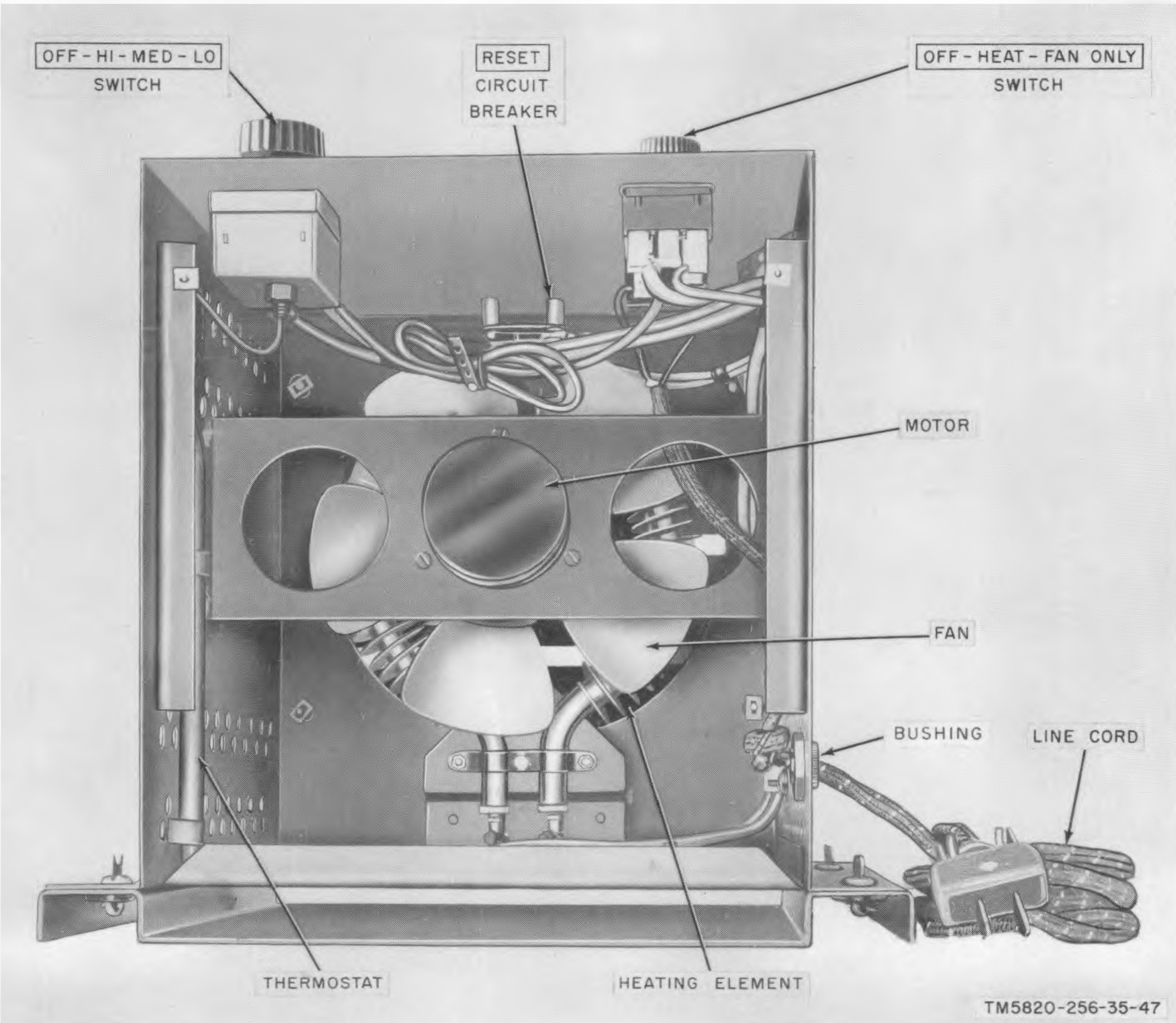


Figure 3-17. Space Heater, Electrical HD-375/U, parts location.

CHAPTER 4

GENERAL SUPPORT MAINTENANCE

Section I. ALIGNMENT AND ADJUSTMENT

4-1. General

a. Alignment procedures covering the MD-239/GR are given in paragraph 4-3; procedures covering the MD-239A/GR are given in paragraph 4-4. Adjustment of the fsk-modulator to provide sufficient transmitter drive is given in paragraph 4-5. Alignment and adjustment procedures for the other components of the AN/GRC-26D are given in the individual technical manuals (app. A).

b. Alignment and adjustment of the fsk-modulator is usually required under the following conditions:

(1) When component parts are replaced in the fixed or shift oscillator circuits.

(2) When component parts are replaced in the first mixer or if. amplifier circuits.

(3) When signals are weak and all checks fail to indicate a defective component.

c. Tools and test equipment allocated for general support maintenance of the AN/GRC-26D are listed in TM 11-5820-256-20. Test equipment required for aligning the fsk-modulator are given in paragraph 4-2.

4-2. Test Equipment Required for Alignment

The following test equipment is required for alignment:

a. Frequency Meter AN/USM-26.

b. Electronic Multimeter TS-505(*)/U.

c. Milliammeter, 0 to 100 ma.

d. Teletypewriter TT-98/FG or equivalent 60-ma mark signal source.

e. R. F. Signal Generator AN/URM-25F, or equivalent signal generator.

Note. Radio Transmitter T-368(*)/URT may be used in place of the AN/URM-25F to provide an input signal to the MD-239(*)/GR at jack M. O. IN.

4-3. Alignment Procedures, Modulator, Radio MD-239/GR

Remove the fsk-modulator from its case. Remove the bottom cover and connect the fsk-modulator as indicated in figure 4-1.

a. Preliminary Adjustments. With the power and excitation disconnected from the fsk-modulator, refer to A, figure 4-2 and preset capacitors C33, C54, C55, C56, C57, C59, C60, C62, and C63 to the center of their ranges (slot of C33 set parallel with chassis length and slots of C54, C55, C56, C57, C59, C60, C62, and C63 set in a vertical position).

b. Adjustment of Shift and Fixed Oscillator Plate Tanks Z3 and Z4. Apply power to the fsk-modulator and allow a minimum 15-minute warmup period. Perform the alignment procedure outlined below.

(1) Set the fsk-modulator BAND SELETOR switch to 1.5-2.

(2) Connect the TS-505(*)/U (arranged as a dc voltmeter) to pin 2 of tube V1 (fig. 3-1).

(3) Set the slug of Z3 (L8) (B, fig. 4-2) fully counterclockwise.

(4) Adjust the slug of Z3 (L8) clockwise until the TS-505(*)/U indicates −7 volts dc.

(5) Connect the TS-505/U to pin 2 of tube V3 (fig. 3-1).

(6) Set the slug of Z4 (L9) (B, fig. 4-2) fully counterclockwise.

(7) Adjust the slug of Z4 (L9) clockwise until the TS-505(*)/U indicates −7 volts dc.

c. Adjustment of If. Amplifier and First Mixer Plate Tanks Z2 and Z1.

(1) Apply power to the AN/URM-25F (fig. 4-1) and set the frequency to 2.7 mc and the output to 1 volt.

(2) Set the fsk-modulator BAND SELECTOR switch to 2–3.

(3) Connect the TS–505(*)/U (arranged as an ac voltmeter) to jack FSK OUT.

(4) Adjust the slug of plate tank Z2 (L7) (B, fig. 4–2) for maximum indication on the TS–505(*)/U.

(5) Set the AN/URM–25F to a frequency of 1.5 mc; maintain a 1-volt output level.

(6) Set the fsk-modulator BAND SELECTOR switch to 1.5–2.

(7) Adjust the slug of plate tank Z1 (L6) for a maximum indication on the TS–505(*)/U.

(8) Disconnect the AN/URM–25F from jack M. O. IN and the TS–505(*)/U from jack FSK OUT.

(9) Replace the bottom cover on the fsk-modulator.

d. Shift Adjustment. Adjust the four different shift frequencies as follows:

(1) Make a 2-turn loop at the end of the coaxial cable connected to the AN/USM–26.

(2) Remove the shield from tube V1 (fig. 3–5) and place the loop over first mixer tube V1.

(3) Set the fsk-modulator BAND SELECTOR switch to 3–4.

(4) Apply a 60-ma mark signal to jack KEYING IN (fig. 4–1).

(5) Observe and record the frequency indicated on the AN/USM–26.

(6) Remove the 60-ma mark signal.

(7) Refer to column 1 of the chart below and select the frequency closest to the frequency recorded in (5) above.

Note. This frequency should be close to 12 mc if the tuning capacitors are adjusted as given in *a* above.

Mark freq (mc)	BAND SELECTOR switch position			
	1.5–3	3–6	6–12	12–20
12.000300	11.999450	11.999875	12.000088	12.000194
12.000250	11.999400	11.999825	12.000038	12.000144
12.000200	11.999350	11.999775	11.999988	12.000094
12.000150	11.999300	11.999725	11.999938	12.000044
12.000100	11.999250	11.999675	11.999888	11.999994
12.000050	11.999200	11.999625	11.999838	11.999944
12.000000	11.999150	11.999575	11.999788	11.999894
11.999950	11.999100	11.999525	11.999738	11.999844
11.999900	11.999050	11.999475	11.999688	11.999794
11.999850	11.999000	11.999425	11.999638	11.999744
11.999800	11.998950	11.999375	11.999588	11.999694
11.999750	11.998900	11.999325	11.999538	11.999644
11.999700	11.998850	11.999275	11.999488	11.999594

(8) Set the fsk-modulator BAND SELECTOR switch to 1.5–2 and adjust capacitor C54 (A, fig. 4–2) for the frequency indicated in column 2 of the chart opposite the frequency selected ((7) above).

(9) Set the fsk-modulator BAND SELECTOR switch to 3–4 and adjust capacitor C56 for the frequency indicated in column 3 of the chart opposite the frequency selected ((7) above).

(10) Set the fsk-modulator BAND SELECTOR switch to 6–8 and adjust capacitor C59 for the frequency indicated in column 4 of the chart opposite the frequency selected ((7) above).

(11) Set the fsk-modulator BAND SELECTOR switch to 12–16 and adjust capacitor C62 for the frequency indicated in column 5 of the chart opposite the frequency selected ((7) above).

(12) Apply a 60-ma mark current signal to jack KEYING IN.

(13) Set the fsk-modulator BAND SELECTOR switch to 1.5–2 and adjust capacitor C55 for the frequency recorded in (5) above.

(14) Set the BAND SELECTOR switch to 3–4 and adjust capacitor C57 for the frequency recorded in (5) above.

(15) Set the BAND SELECTOR switch to 6–8 and adjust capacitor C60 for the frequency recorded in (5) above.

(16) Set the BAND SELECTOR switch to 12–16 and adjust capacitor C63 for the frequency recorded in (5) above.

e. Frequency Compensation. If the mark trimmer capacitors (*d*(13) through (16) above) will not adjust to the required frequency, proceed as follows:

(1) If the capacitors trim to maximum capacity (fully meshed) before tuning to the selected frequency, select a frequency higher than that recorded in *d*(5) above and repeat the alignment procedure (*d*(6) through (16) above).

(2) If the capacitors trim to minimum capacity (fully unmeshed) before tuning to the selected frequency, select a frequency lower than that recorded in *d*(5) above and repeat the alignment procedure (*d*(6) through (16) above).

f. Alignment of Fixed Oscillator V6. Align the fixed oscillator as follows:

(1) Adjust the frequency of the AN/URM–25F for 2 mc.

(2) Connect the AN/USM–26 to jack FSK OUT (fig. 4–1).

(3) Apply a 60-ma mark current to jack KEYING IN.

(4) Adjust trimmer capacitor C33 (A, fig. 4–2) until the AN/USM–26 indicates the same frequency as applied from the AN/URM–25F.

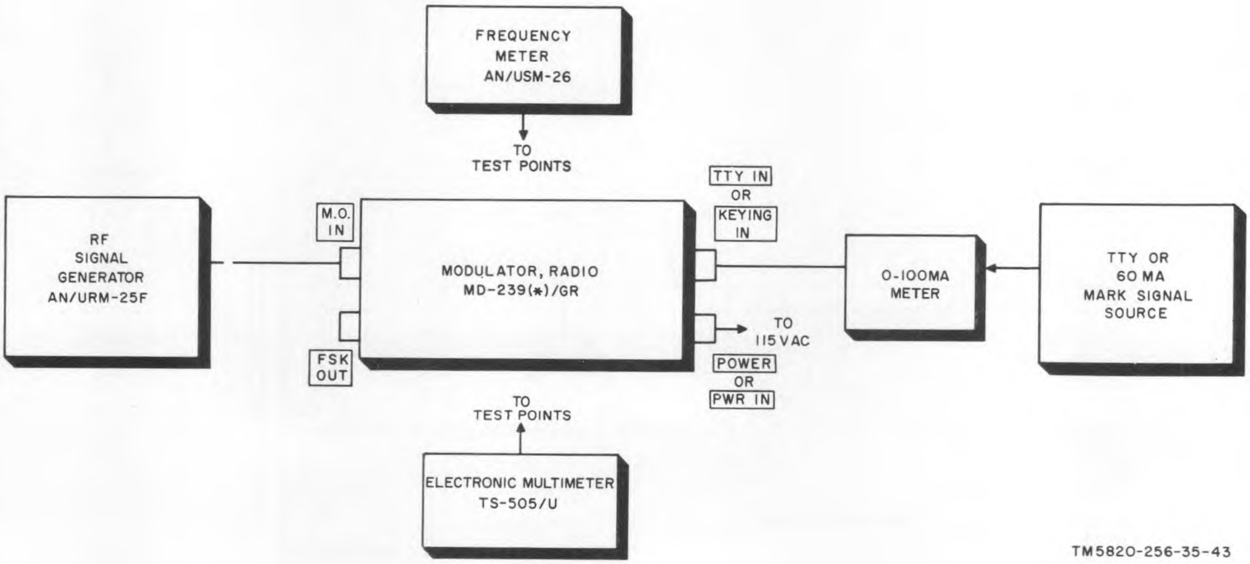


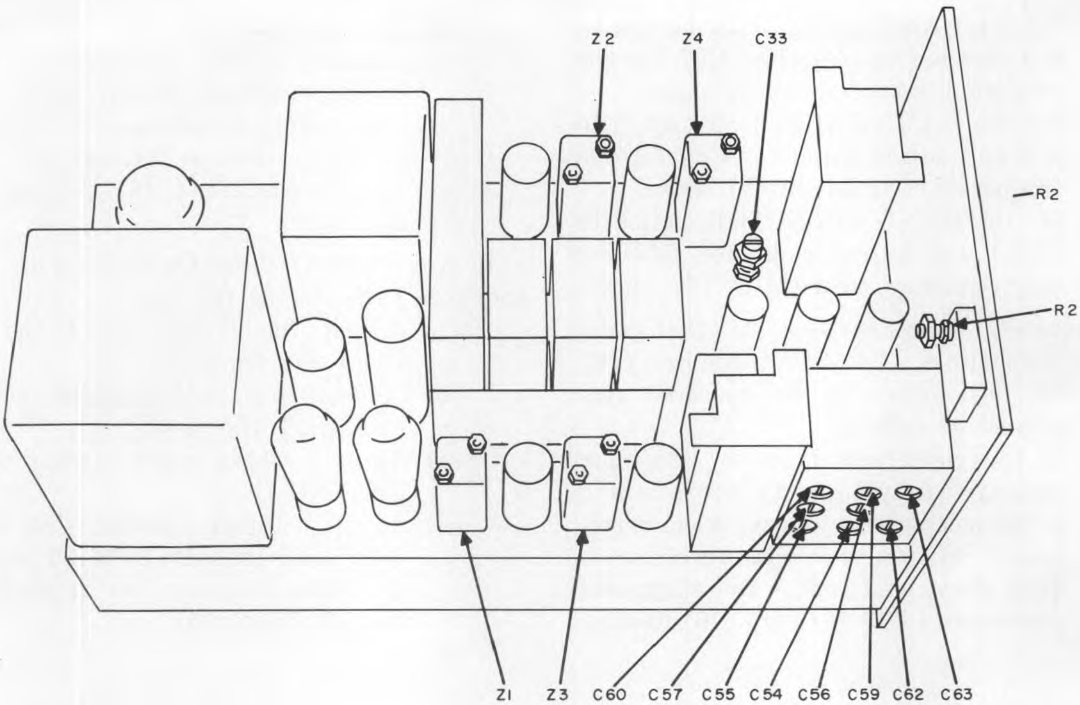
Figure 4–1. Modulator, Radio MD–239(*)/GR, alignment test setup.

4–4. Alignment Procedures, Modulator, Radio MD–239A/GR

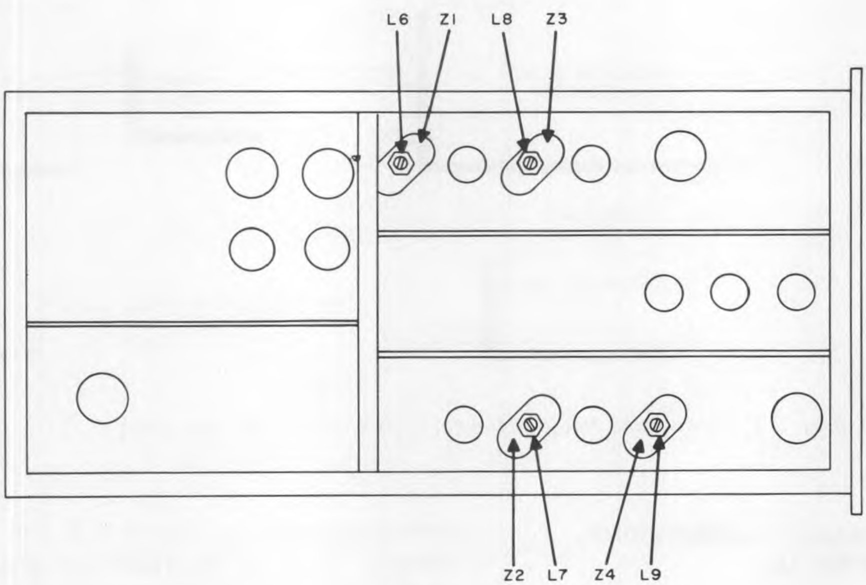
Remove the fsk-modulator from its case and connect the equipment as indicated in figure 4–1.

a. Preliminary Adjustments. With power and excitation disconnected from the fsk-modulator, refer to figure 4–3 and preset the controls listed in the following chart as indicated. To insure correct settings, turn all trimmer controls listed *fully counterclockwise* before setting to the indicated position.

Note. Modulator, Radio MD–239A/GR, procured on Order No. 3219–Phila–59, has locking nuts on trimmer



VIEW A



VIEW B

TM5820-256-35-44

Figure 4-2. Modulator, Radio MD-239/GR, alignment points.

controls Z1 through Z4 which must be loosened before the trimmer screws can be adjusted.

Trimmer or coil	Turns clockwise	Shaft exposed (inches)
C26	15	9/32
C45	9	½
C47	17	¼
C49	13	⅜
C50	10	7/16
C9	3	9/16
C46	8	15/32
C48	9	7/16
C51	14	5/16
L8 (Z1)		½[a]
L9 (Z2)		½[a]
L10 (Z3)	Fully counterclockwise	
L11 (Z4)	Fully counterclockwise	

[a]When determining the length of shaft exposed on the MD-239-A/GR, procured on Order No. 3219-Phila-59, disregard the width of the locking bushing and measure the length of the shaft exposed from top of the can.

b. Adjustment of Shift and Fixed Oscillator Plate Tanks Z3 and Z4. Apply power to the fsk-modulator and allow a minimum 15-minute warmup period. Perform the adjustment procedures outlined below.

Note. The tuning slugs of Z1 (L8) and Z2 (L9) require no further adjustment other than the initial settings (*a* above).

(1) Set the fsk-modulator BAND SELECTOR switch to 1.5–2.

(2) Connect the TS–505(*)/U (arranged as a dc voltmeter) to test point E7 (fig. 4–3).

(3) Adjust the slug of Z3 (L10) clockwise until the TS–505(*)/U indicates −7 volts dc.

Note. Be sure that the first −7-volt indication is obtained as approached from the initial extreme counterclockwise setting of the slug of L10 (*a* above).

(4) Connect the TS–505(*)/U to test point E9.

(5) Adjust the slug of Z4 (L11) clockwise until the TS–505(*)/U indicates −7 volts.

Note. On the MD–239A/GR, procured on Order No. 3219–Phila–59, secure the locking bushings on the tuning slug and recheck the adjustments ((1) through (5) above).

c. Alignment of Shift Oscillator Without Shift.

(1) Connect the AN/USM–26 to test point E8.

(2) Adjust trimmer capacitor C9 fully counterclockwise.

(3) Apply a 60-ma mark signal to jack TTY IN and observe the frequency indication on the AN/USM–26.

Note. The frequency indicated should be between 11,999.8 kc and 12,000.0 kc. If the frequency is not within the specified limits, replace crystal Y1 (TM 11–5820–256–20); select a crystal which will produce the proper frequency indication.

(4) Adjust trimmer capacitor C9 for the maximum attainable frequency indication and record this frequency.

(5) Calculate a frequency 50 cps *below* that recorded in (4) above and record this new frequency.

(6) Readjust trimmer capacitor C9 until the AN/USM–26 indicates the calculated frequency ((5) above).

(7) Set the fsk-modulator BAND SELECTOR switch to 3–4.

(8) Adjust trimmer capacitor C46 until the AN/USM–26 indicates the calculated frequency ((5) above).

(9) Set the fsk-modulator BAND SELECTOR switch to 6–8.

(10) Adjust trimmer capacitor C48 until the AN/USM–26 indicates the calculated frequency ((5) above).

(11) Set the fsk-modulator BAND SELECTOR switch to 12–16.

(12) Adjust trimmer capacitor C51 until the AN/USM–26 indicates the calculated frequency ((5) above).

d. Alignment of Fixed Oscillator.

(1) Connect the AN/URM–25F to jack M. O. IN. Apply power to the AN/URM–25F and adjust the frequency output of the AN/URM–25F for 1.5 mc at 1 volt.

(2) Connect the AN/USM–26 to test point E9.

(3) Apply a 60-ma mark signal to jack TTY IN.

(4) Adjust trimmer capacitor C26 until the AN/USM–26 indicates 12 mc.

Note. If it is impossible to obtain a frequency indication of 12 mc, replace crystal Y2 (TM 11–5820–256–20) and readjust trimmer capacitor C26 until the proper frequency indication is obtained.

(5) Set the BAND SELECTOR switch to 1.5-2.

(6) Connect the AN/USM-26 to test point E10. The frequency indication should be the same as the input frequency to jack M. O. IN (1.5 mc ((1) above)). Readjust trimmer capacitor C26 until the proper indication (1.5 mc) is obtained on the AN/USM-26.

e. Alignment for Frequency Shift.

(1) Remove the 60-ma mark signal from jack TTY IN.

(2) Adjust trimmer capacitor C45 until the AN/USM-26 frequency indication is exactly 850 cps below the input frequency of 1.5 mc (*d* above).

(3) Set the fsk-modulator BAND SELECTOR switch to 3-4.

(4) Adjust trimmer capacitor C47 until the AN/USM-26 frequency indication is exactly 425 cps below the input frequency of 1.5 mc.

(5) Set the fsk-modulator BAND SELECTOR switch to 6-8.

(6) Adjust trimmer capacitor C49 until the AN/USM-26 frequency indication

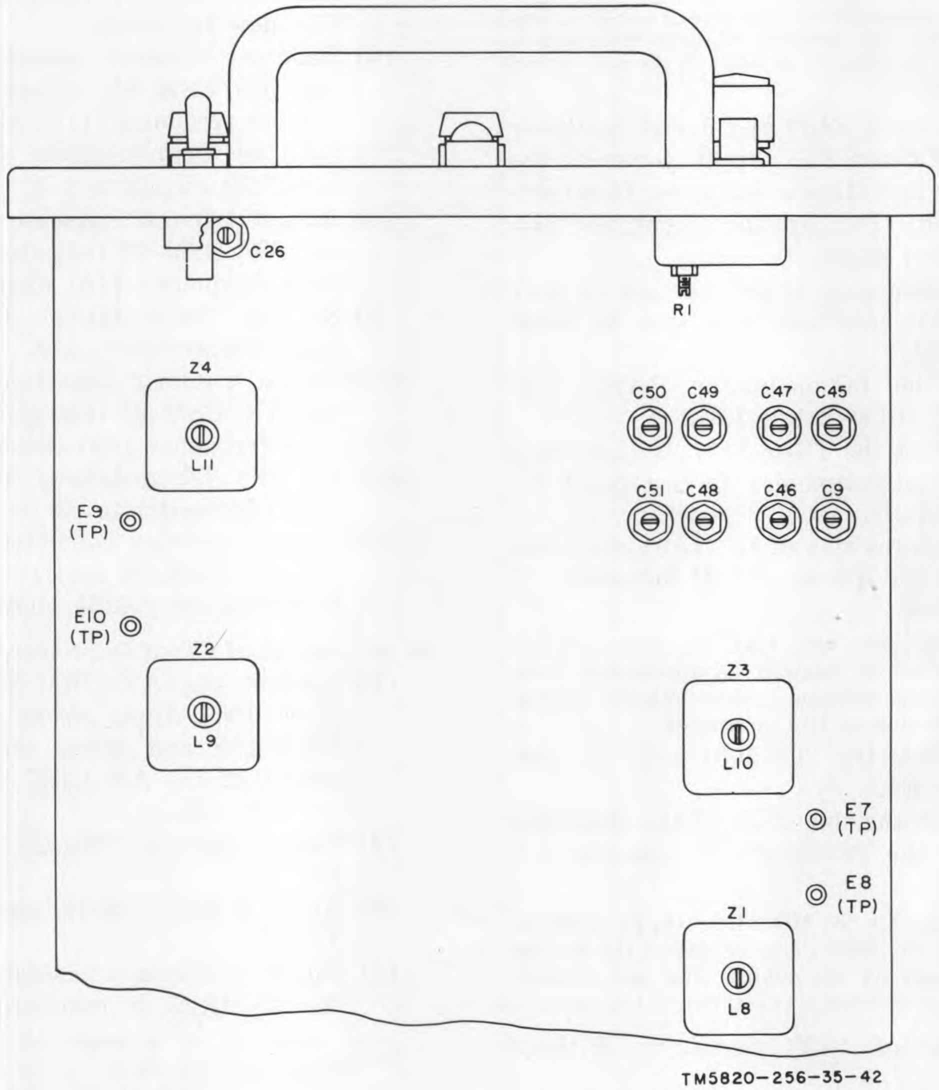


Figure 4-3. Modulator, Radio MD-239A/GR, alignment points.

4–11. Frequency-Shift Tolerance Test, Modulator, Radio MD–239(*)/GR

a. Equipment and Materials.

(1) Frequency Meter AN/USM–26.
(2) R.F. Signal Generator AN/URM–25F.
(3) Rectifier RA–87(*).
(4) Test Circuit (para 4–7*d*).
(5) Special test cable (para 4–8).
(6) Plug, Telephone PJ–055B.
(7) Fixed resistor, noninductive, 1,500 ohms ±10%, 2W.

b. Test Connections and Conditions. Remove cover from MD–239(*)/GR and turn input potentiometer R1 (MD–239/GR) or R2 (MD–239A/GR) fully clockwise. Connect the equipment as shown in figure 4–7. Do not insert the PJ–055B into J1 on test circuit. Place all power switches to either STANDBY or OFF. After equipment has been turned on, allow a minimum 15-minute warmup period.

c. Test Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*RA–87(*)* ON-OFF switch: ON *AN/URM–25F* POWER ON-OFF: ON SET RF OUTPUT: Fully counterclockwise. FUNCTION: CW BAND SWITCH: 1.5–3.8 TUNING: 2.0 MC MICROVOLTS: Fully clockwise (max). *AN/USM–26* DISPLAY TIME: Fully counterclockwise. POWER ON-STANDBY: ON 100KC STANDARD INT-EXT: INT FUNCTION SELECTOR: 10MC CHK FREQUENCY UNIT: 1 TIME UNIT: 100KC *MX–1637/U* MIXING FREQUENCY MCS: 0 GAIN: MIN	POWER: ON BAND SELECTOR: 1.5–2	*a.* Turn SET RF OUTPUT control on AN/URM–25F until meter reads on red arc of the scale. *b.* Observe frequency indicated on AN/USM–26. *c.* Place FUNCTION SELECTOR on AN/USM–26 to 100KC CHK, and observe frequency indication. *d.* Place FUNCTION SELECTOR on AN/USM–26 to FREQUENCY, and adjust GAIN CONTROL on MX–1637/U until tuning eye indicates minimum shadow.	*a.* None. *b.* AN/USM–26 indicates 10,000,000 cycles ±1. *c.* AN/USM–26 indicates 100,000 cycles ±1. *d.* None.
2	Same as above, except: *AN/USM–26* FUNCTION SELECTOR: FREQUENCY	Same as above.	*a.* Adjust resistor R1 on the test circuit until +60 milliamperes is indicated on meter. *b.* Note and record the frequency indicated on AN/USM–26. *c.* Place PJ–055B into J1 on the test circuit. Note and record frequency indicated on AN/USM–26. *d.* Place BAND SELECTOR switch on MD–239(*)/GR to 2–3. Note and record frequency indicated on AN/USM–26. *e.* Remove PJ–055B from J1 on test circuit. Note and record frequency indicated on AN/USM–26. *f.* Place BAND SELECTOR switch on MD–239(*)/GR to 3–4. Note and record frequency indicated on AN/USM–26. *g.* Place PJ–055B into J1 on test circuit. Note and record frequency indicated on AN/USM–26. *h.* Place BAND SELECTOR switch on MD–239(*)/GR to 4–6. Note and record frequency indicated on AN/USM–26. *i.* Remove PJ–055B from J1 on test circuit. Note and record frequency indicated on AN/USM–26. *j.* Place BAND SELECTOR switch on MD–239(*)/GR to 6–8. Note and record frequency indicated on AN/USM–26. *k.* Place PJ–055B into J1 on test circuit. Note and record frequency indicated on AN/USM–26. *l.* Place BAND SELECTOR switch on MD–239(*)/GR to 8–12. Note and record frequency indicated on AN/USM–26. *m.* Remove PJ–055B from J1 on test circuit. Note and record frequency indicated on AN/USM–26. *n.* Place BAND SELECTOR switch on MD–239(*)/GR to 12–16. Note and record frequency indicated on AN/USM–26. *o.* Place PJ–055B into J1 on test circuit. Note and record frequency indicated on AN/USM–26. *p.* Place BAND SELECTOR switch on MD–239(*)/GR to 16–20. Note and record frequency indicated on AN/USM–26. *q.* Remove PJ–055B from J1 on test circuit. Note and record frequency indicated on AN/USM–26.	*a.* None. *b.* None. *c.* Calculated difference frequency between that obtained in *b* and *c* is 850 cycles ±10. *d.* None. *e.* Calculated difference frequency between that obtained in *d* and *e* is 850 cycles ±10. *f.* None. *g.* Calculated difference frequency between that obtained in *f* and *g* is 425 cycles ±8. *h.* None. *i.* Calculated difference frequency between that obtained in *h* and *i* is 425 cycles ±8. *j.* None. *k.* Calculated difference frequency between that obtained in *j* and *k* is 212 cycles ±6. *l.* None. *m.* Calculated difference frequency between that obtained in *l* and *m* is 212 cycles ±6. *n.* None. *o.* Calculated difference frequency between that obtained in *n* and *o* is 106 cycles ±4. *p.* None. *q.* Calculated difference frequency between that obtained in *p* and *q* is 106 cycles ±4.

is exactly 212 cps below the input frequency of 1.5 mc.

(7) Set the fsk-modulator BAND SELECTOR switch to 12-16.

(8) Adjust trimmer capacitor C50 until the AN/USM-26 frequency indication is exactly 106 cps below the input frequency of 1.5 mc.

4-5. Adjustment of Fsk-Modulator Drive

The fsk-modulator must produce enough output to drive the transmitter without distortion. Check the fsk-modulator as follows:

a. Connect the fsk-modulator in the radio set and turn on the send teletypewriter, the transmitter, and the fsk-modulator.

b. Tune the transmitter to 1.5 mc and set the fsk-modulator BAND SELECTOR switch to 1.5-2.

c. Set the teletypewriter SEND-REC (LOCK) switch to SEND.

d. Set the transmitter EXCITATION METER SWITCH to PA GRID X2.

e. Key the transmitter with a test message.

f. The EXCITATION meter on the transmitter should indicate a minimum grid drive of 8 ma. If it does not, rotate gain control potentiometer R1 (fig. 4-3) or R2 (fig. 4-2) clockwise until it does.

g. Repeat this check with the transmitter tuned to the midband position and then at the high end of the band. Set the fsk-modulator BAND SELECTOR switch to correspond to the frequency setting of the transmitter.

Section II. GENERAL SUPPORT TESTING PROCEDURES

4-6. General

a. Testing procedures are prepared for use by Electronic Field Maintenance Shops and Electronic Service Organizations responsible for general support maintenance to determine the acceptability of repaired electronic equipment. These procedures set forth specific requirements that repaired electronic equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide for testing equipment repaired at direct support category, if the proper tools and test equipment are available. A summary of the performance standards is given in paragraph 4-20.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each test in sequence. Do not vary the sequence. For each step, perform all the actions required in the *Control settings* columns; then perform each specific test procedure and verify it against its performance standard.

4-7. Test Equipment and Other Equipment Required

All test equipment, tools, materials, and other equipment required to perform the testing procedures given in this section are listed in the following charts and are authorized under TA 11-17 and TA 11-100 (11-17) or TOE 11-158E and TA 11-101 (11-158) or are repair part items of the subject equipment authorized for stockage at general support categories.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical reference
Frequency Meter AN/USM-26	6625-692-6553	TM 11-5057
R. F. Signal Generator AN/URM-25F	6625-570-5719	TM 11-5551E
Multimeter ME-26(*)/U[a]	6625-542-6407	TM 11-6625-200-12
Rectifier RA-87(*)[b]	5815-230-7257	TM 11-5815-270-15
Signal Generator SG-71(*)/FCC[c]	6625-669-0255	TM 11-5088

[a]Indicates Multimeters ME-26A/U, ME-26B/U, and ME-26C/U.

[b]Indicates Rectifiers RA-87 and RA-87A.

[c]Indicates Signal Generators SG-71/FCC, SG-71A/FCC, and SG-71B/FCC.

b. Tools. The tools required are contained in the following tool equipments:

Tool	Federal stock No.
Tool Kit, Radio Repair TK-115/G	5180-856-1578
Tool Kit, Teletype Equipment Maintenance TE-50-B.	5180-356-4602
Tool Equipment TE-87-A	5180-448-7437
Tool Equipment TE-111	5180-408-1877

c. Other Equipment and Materials.

Item	Federal stock No.	Technical reference
Connector, Plug UG-88/U (2 ea)	5935-149-4066	
Cable, RF RG-58C/U[a] (10 ft)	6145-161-0909	
Cord Assembly, Electrical CX-3271/U	5995-752-2135	TM 11-5820-256-10
Plug, Telephone PJ-055B	5935-192-4760	
Resistor, fixed, 1,500 ohms ±10%, 2W[b]	5905-171-2072	
Clip, electrical alligator, red sleeve (2 ea)	5940-151-4043	
Clip, electrical alligator, black sleeve (2 ea)	5940-186-8933	
Test circuit (to be fabricated) (*d* below)		

[a]Two lengths of cable approximately 5 feet each.

[b]Any noninductive 1,500-ohm resistor will be satisfactory.

d. Test Circuit. A test circuit is required for the frequency-shift tolerance test. Use the following listed material or equivalent to build the test circuit and refer to figure 4-6 for the schematic diagram.

(1) Milliammeter, dc, center zero, 0-100-ma range, FSN 6625-196-6578.

(2) Resistor, variable, 0-5,000 ohms, 25 watts, FSN 5905-108-6308.

(3) Resistor, fixed, 1,000 ohms, 25 watts, FSN 5905-100-6855.

(4) Plug, male polarized.

(5) Jack, telephone, type JJ-089, normally closed, 2 conductor.

(6) Fuseholder, FSN 5920-285-0755.

(7) Fuse, 1/8 ampere, FSN 5920-356-2188.

4-8. Fabrication of Test Cable
(fig. 4-4)

Construct two special test cables to be used with the tests of Modulator, Radio MD-239(*)/GR (figs. 4-5 and 4-7).

a. To facilitate the proper attachment of the UG-88/U connector to the RG-58C/U cable (fig. 4-4), observe the following dimensions:

(1) Cut off rubber insulation 5/16 inch from end.

(2) Cut off cable dielectric 3/16 in from end.

b. Attach one alligator clip (with red sleeve) to the center conductor of each test cable, and the other alligator clip (with black sleeve) to the shield of each test cable.

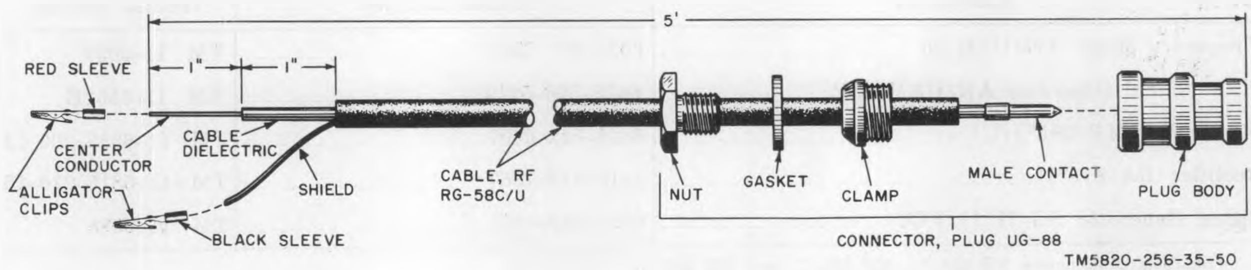


Figure 4-4. Fabrication of special test cable.

4–13. Control, Radio Set C–1123/GRC, Continuity Test

a. Test Equipment and Materials.

(1) Multimeter ME–26(*)/U.

(2) Telephone Plug PJ–055B.

b. Test Connections and Conditions. Do not connect power cord of C–1123/GRC to 115-volt, ac, 60-cps power source until instructed to do so in test procedure (*c* below). Connect the ME–26(*)/U to the power source. Ground referred to in the test procedure is chassis ground. Refer to figure 4–8 for the test points.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*ME–26(*)/U* FUNCTION: OHMS RANGE:RX1	Power switch: OFF SIDETONE: REC. A REMOTE TEL: REC. A TELETYPE: NORMAL OW	*a.* Connect ME–26(*)/U to points listed below and observe each meter indication. *From* — *To* (1) TTY SWITCH or SWITCH connector, pin A — Ground (2) CONVERTER connector, pin A — Ground (3) CONVERTER connector, pin B — Ground (4) CONVERTER connector, pin D — Ground (5) REC. A connector, pin D — TRANS connector, pin H (6) REC. A connector, pin E — Ground (7) REC. B connector, pin E — Ground (8) TRANS connector, pin A — MIC OR KEY connector, pin F (9) TRANS connector, pin E — Ground (10) TRANS connector, pin F — MIC OR KEY connector, pin C (11) MIC OR KEY connector, pin E — Ground (12) MIC OR KEY connector, pin H — Ground (13) ONE WAY-CONTROL binding post — ONE WAY binding post (14) REC. DX binding post — REC. DX binding post	*a.* ME–26(*)/U indicates 0 on OHMS (lower) scale.
			b. Place the RANGE switch on the ME–26(*)/U to RX10, and connect ME–26(*)/U from TTY SWITCH or SWITCH connector, pin B to TEL-CONTROL binding post.	*b.* ME–26(*)/U indicates approximately 4 on OHMS (lower) scale.
			c. Connect ME–26(*)/U from REC. A connector, pin A, to pin C.	*c.* ME–26(*)/U indicates approximately 2.7 on OHMS (lower) scale.
			d. Connect ME–26(*)/U from TRANS connector, pin D, to ground.	*d.* Same as *c* above.
			e. Place RANGE switch on ME–26(*)/U to RX100, and connect ME–26(*)/U from TRANS connector, pin J, to ground.	*e.* ME–26(*)/U indicates approximately 48 (or 100 on earlier model) on OHMS (lower) scale.
			f. Connect ME–26(*)/U from TEL binding post to TEL-CONTROL binding post.	*f.* ME–26(*)/U indicates approximately 7 on OHMS (lower) scale.
			g. Connect ME–26(*)/U from LOCAL TEL binding post to LOCAL TEL binding post.	*g.* ME–26(*)/U indicates approximately 3.8 on OHMS (lower) scale.
			h. Place RANGE switch on ME–26(*)/U to RX1M. Connect ME–26(*)/U from ground to all *other* pins of CONVERTER, REC. A, REC. B, MIC OR KEY, TTY SWITCH (SWITCH), and TRANS connectors while observing meter.	*h.* ME–26(*)/U indicates infinity.
2	*ME–26(*)/U* FUNCTION: OHMS RANGE: RX1M	Power switch: OFF SIDETONE: OFF REMOTE TEL: LOCAL TEL TELETYPE: NORMAL DX	*a.* Connect ME–26(*)/U to points listed below and observe each meter indication. *From* — *To* (1) REC. A connector, pin A — REC. A connector, pin C (2) REC. A connector, pin D — TRANS connector, pin H (3) TRANS connector, pin D — Ground (4) TEL binding post — TEL-CONTROL binding post (5) LOCAL TEL binding post — LOCAL TEL binding post	*a.* ME–26(*)/U indicates infinity.
			b. Place RANGE switch on ME–26(*)/U to RX100. Connect ME–26(*)/U from ground to TEL-CONTROL binding post.	*b.* ME–26(*)/U indicates approximately 4.8 (or 100 on earlier model) on OHMS (lower) scale.
3	Same as step 2	Power switch: OFF SIDETONE: REC. B REMOTE TEL: REC. B TELETYPE: REMOTE OW	*a.* Connect ME–26(*)/U to points listed below and observe each meter indication. *From* — *To* (1) REC. A connector, pin A — REC. A connector, pin C (2) REC. A connector, pin D — TRANS connector, pin H (3) ONE WAY-CONTROL binding post — ONE WAY binding post	*a.* ME–26(*)/U indicates infinity.
			b. Place RANGE switch on ME–26(*)/U to RX1. Connect ME–26(*)/U from REC. B connector, pin D, to TRANS connector, pin H.	*b.* ME–26(*)/U indicates 0 on OHMS (lower) scale.
			c. Connect ME–26(*)/U from REC. B connector, pin A, to pin C.	*c.* ME–26(*)/U indicates approximately 27 on OHMS (lower) scale.
4	Same as step 2	Power switch: OFF SIDETONE: REC. A REMOTE TEL: REC. A TELETYPE: REMOTE DX	Connect ME–26(*)/U to points listed below and observe each meter indication. *From* — *To* CONVERTER connector, pin D — Ground ONE WAY-CONTROL binding post — ONE WAY binding post REC DX binding post — REC DX binding post	ME–26(*)/U indicates infinity.
5	FUNCTION: OHMS RANGE: RX1	TELETYPE: NORMAL DX	*a.* Connect ME–26(*)/U from CONVERTER connector, pin D, to ground. Do not remove this connection.	*a.* ME–26(*)/U indicates 0 on OHMS (lower) scale.
			b. Insert PJ–055B into each of REC DX jacks in succession, observing ME–26(*)/U meter.	*b.* ME–26(*)/U indicates infinity with PJ–055B inserted into 4 of 6 REC DX jacks.
6	Same as step 5	Power switch: OFF	*a.* Ground pin J of TRANS connector to chassis.	*a.* None.
			b. Connect ME–26(*)/U from REC. A connector, pin B, to ground.	*b.* ME–26(*)/U indicates infinity.
			c. Connect C–1123/GRC power cord to 115-volt 60-cycle source and place power switch to ON.	*c.* ME–26(*)/U indicates 0 on OHMS (lower) scale.
			d. Connect ME–26(*)/U from REC. B connector, pin B, to ground.	*d.* Same as *c* above.
			e. Place power switch on C–1123/GRC to OFF and remove ground from pin J of TRANS connector.	*e.* None.
7	Same as step 5	TELETYPE: NORMAL OW Power switch: OFF	*a.* Ground pin B of TTY SWITCH or SWITCH connector to chassis.	*a.* None.
			b. Connect ME–26(*)/U from TRANS connector, pin A, to ground.	*b.* ME–26(*)/U indicates infinity.
			c. Place power switch on C–1123/GRC to ON.	*c.* ME–26(*)/U indicates 0 on OHMS (lower) scale.
			d. Connect ME–26(*)/U from center pin of FS MOD connector to ground.	*d.* Same as *c* above.
			e. Insert Telephone Plug PJ–055B into ONE WAY OR SEND DX jacks and TD jack in succession, observing ME–26(*)/U meter.	*e.* ME–26(*)/U indicates infinity with PJ–055B inserted.
			f. Place power switch on C–1123/GRC to OFF.	*f.* None.

4-9. Physical Test and Inspection, Modulator, Radio MD-239(*)/GR

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. None.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	Controls may be in any position.	*a.* Check BAND SELECTOR switch and POWER switch for smooth operation, free of binding throughout their respective limits of travel.	*a.* All controls operate freely without binding, are properly indexed, and have positive detent action.
			b. Inspect connectors, fuses, pilot lamp, and cover plate for damage, missing parts, or incorrect fuse ratings. Inspect case, front and rear, for missing screws, nuts or bolts.	*b.* None of the listed items are missing or damaged, nor are the fuses of an incorrect rating.
			c. Inspect front, rear, top, and bottom for physical damage (dents, punctures, or bent areas).	*c.* There are no dents, punctures, or bent areas.
			d. Inspect modulator for condition of finish and panel markings. *Note.* Touchup painting is recommended instead of refinishing, whenever practicable. Screwheads, receptacles, and carrying handles will not be painted or polished with abrasives.	*d.* Surfaces intended to be painted do not show bare metal (TM 9-213). Panel markings are legible.

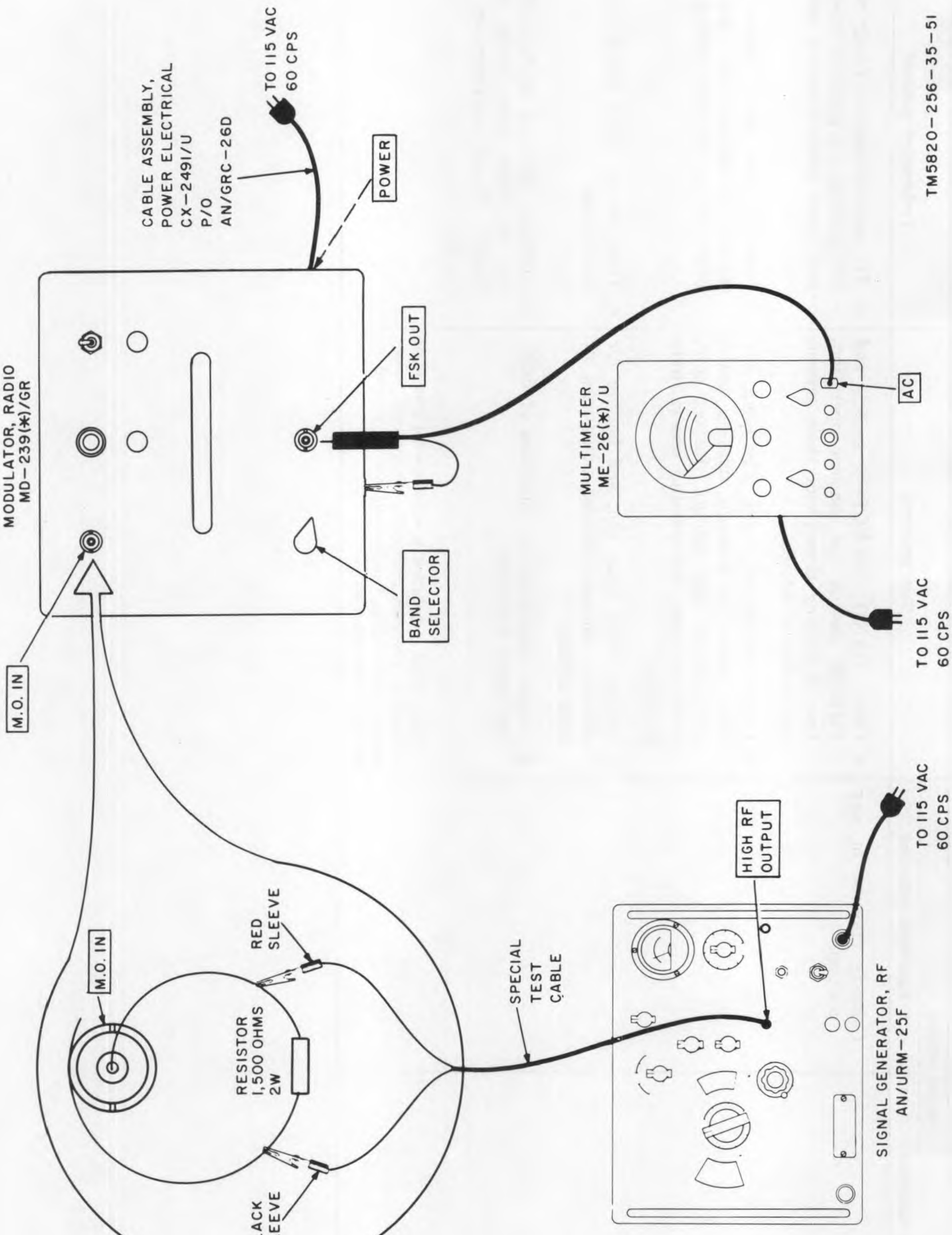


Figure 4-5. Modulator, Radio MD-239(*)/GR, output volts versus frequency, test setup.

4-10. Output Volts Versus Frequency Test, Modulator, Radio MD-239(*)/GR

a. Test Equipment and Materials.

(1) R. F. Signal Generator AN/URM-25F.
(2) Multimeter ME-26(*)/U.
(3) Special test cable (para 4-8).
(4) Fixed resistor, noninductive, 1,500 ohms ±10%, 2W.

b. Test Connections and Conditions. Remove the cover from Modulator, Radio MD-239(*)/GR and turn input potentiometer R1 (MD-239/GR) or R2 (MD-239A/GR) maximum clockwise. Connect the equipment as shown in figure 4-5. Allow a minimum 15-minute warmup period after the equipment has been turned on, as outlined in the test procedure.

c. Test Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME-26(*)/U:* FUNCTION: AC RANGE: 10V *AN/URM-25F:* POWER ON-OFF: ON SET RF OUTPUT: fully counterclockwise. FUNCTION: CW BAND SWITCH: 1.5-3.8 TUNING: 1.5 MC MICROVOLTS: fully clockwise (max).	POWER: ON BAND SELECTOR: 1.5-2	*a.* Turn SET RF OUTPUT control on AN/URM-25F until meter reads in red arc of the scale. *b.* Observe ME-26(*)/U indication on 0-10-volt ac scale. Place RANGE switch to lower scale if necessary. *c.* Adjust TUNING control on AN/URM-25F to 2.0 mc. Readjust SET RF OUTPUT control until meter reads in red arc of the scale. *d.* Observe ME-26(*)/U indication on 0-10-volt ac scale. Place RANGE switch to a lower scale if necessary. *e.* Place BAND SELECTOR switch on ME-239(*)/GR to 2-3. Observe ME-26(*)/U indication on 0-10-volt ac scale. Place RANGE switch to a lower scale if necessary. *f.* Adjust TUNING control on AN/URM-25F to 3.0 mc. Readjust SET RF OUTPUT control until meter reads on red arc of the scale. *g.* Observe ME-26(*)/U indication on 0-10-volt ac scale. Place RANGE switch to a lower scale if necessary.	*a.* None. *b.* ME-26(*)/U indicates a minimum of 1.9 volts. *c.* None. *d.* ME-26(*)/U indicates a minimum of 1.9 volts. *e.* ME-26(*)/U indicates a minimum of 1.76 volts. *f.* None. *g.* ME-26(*)/U indicates a minimum of 1.62 volts.

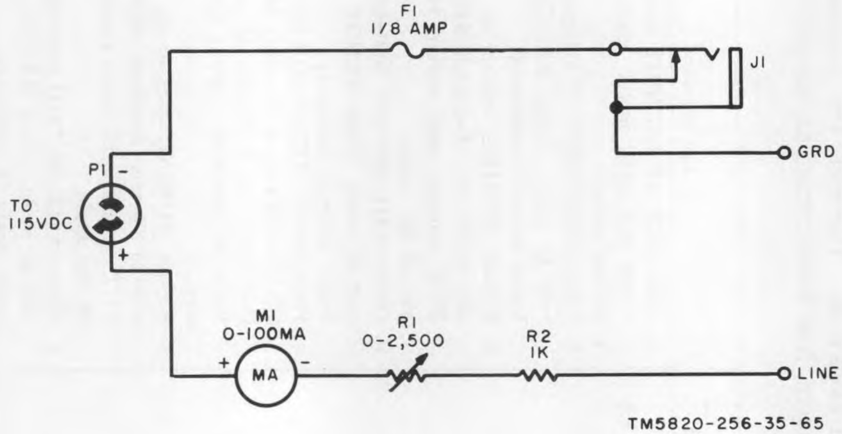


Figure 4-6. Test circuit, schematic diagram.

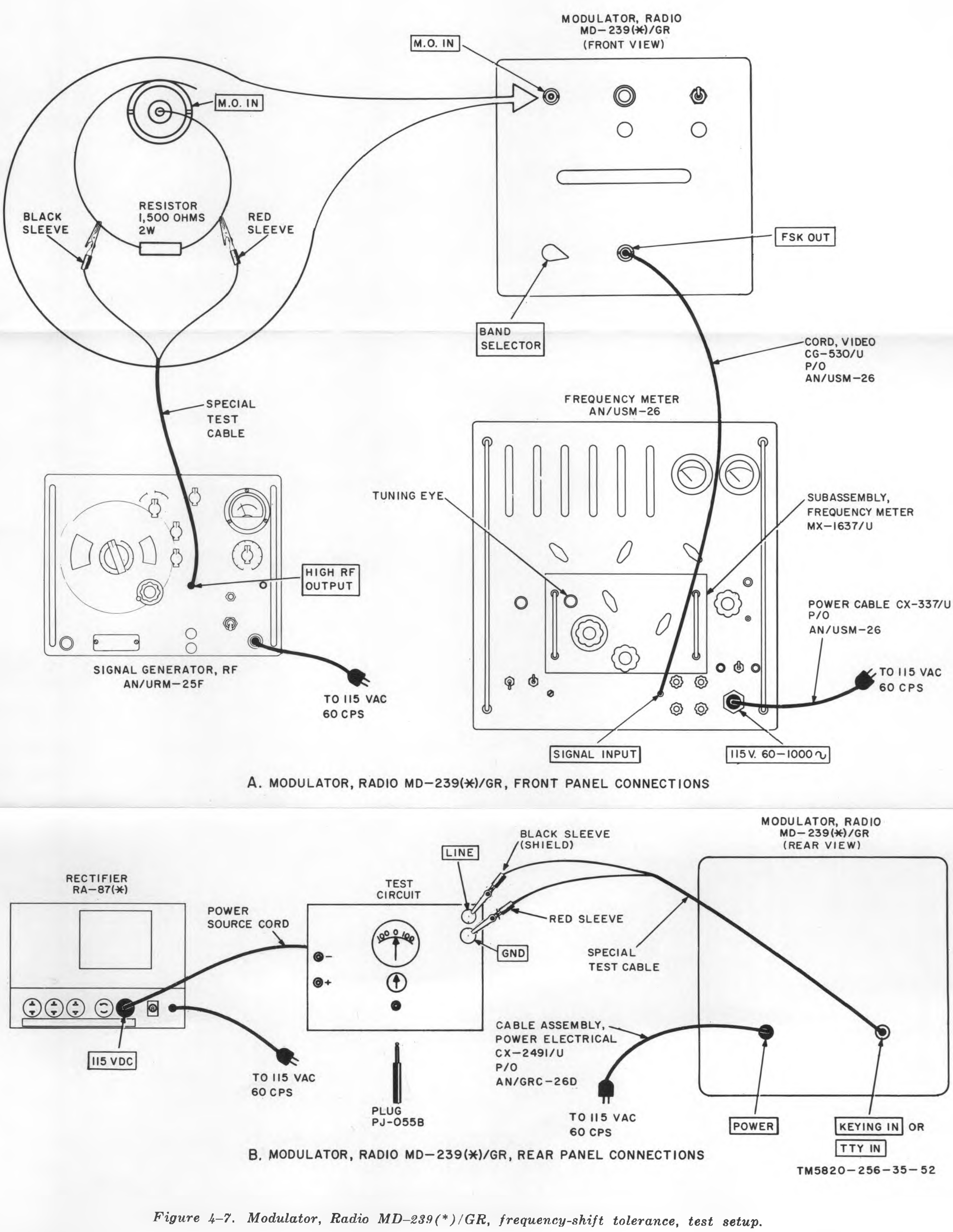


Figure 4-7. Modulator, Radio MD-239(*)/GR, frequency-shift tolerance, test setup.

4-12. Physical Test and Inspection, Control, Radio Set C-1123/GRC

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. None.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	Controls may be in any position.	*a.* Check power, SIDETONE, REMOTE TEL, and TELETYPE switches for smooth operation, free of binding throughout their respective limits of travel. *b.* Inspect pilot lamp, cover plate, and all connectors for damage or missing parts. Inspect case, front and rear, for missing screws, nuts, or bolts. *c.* Inspect front, rear, top, and bottom for physical damage (dents, punctures, or bent areas). *d.* Inspect for condition of finish and panel markings. *Note.* Touchup painting is recommended instead of refinishing whenever practicable. Screwheads and receptacles will not be painted or polished with abrasives.	*a.* All controls operate freely without binding, are properly indexed, and have positive dentent action. *b.* None of the listed items are missing or damaged. *c.* There are no dents, punctures, or bent areas. *d.* Surfaces intended to be painted do not show bare metal (TM 9-213). Panel markings are legible.

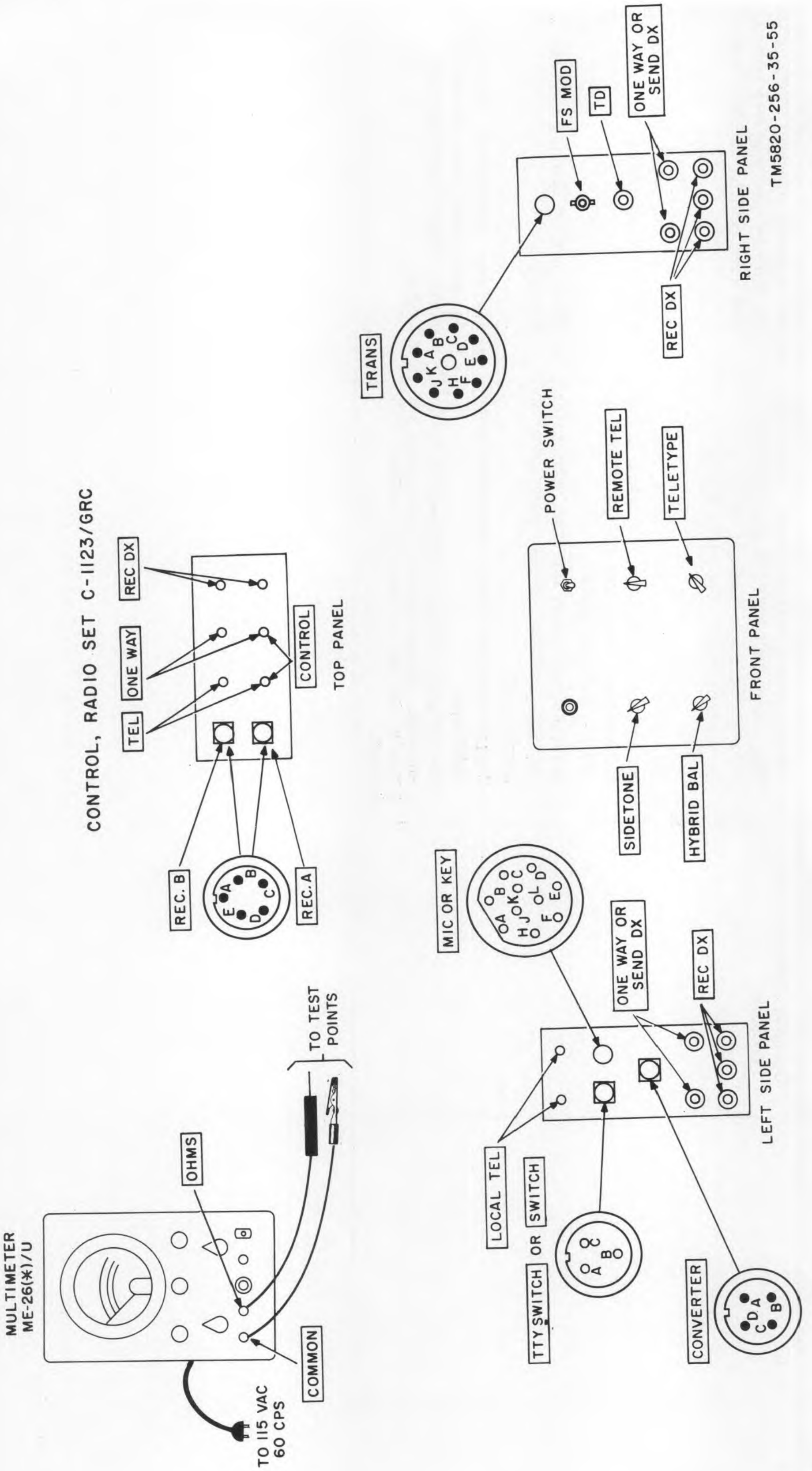


Figure 4-8. Control, Radio Set C-1123/GRC, test setup.

4-14. Physical Test and Inspection, Control, Remote Switching C-1474/GRC

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. None.

c. Test Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None	None	*a.* Check XMTR ON switch for proper operation.	*a.* Control operates freely, is properly indexed, and has positive action.
			b. Inspect cover plate, all connectors, and jacks for damage and missing parts.	*b.* None of the listed items are missing or damaged.
			c. Inspect front, rear, top, and bottom for physical damage (dents, punctures, or bent areas).	*c.* There are no dents, punctures, or bent areas.
			d. Inspect remote control unit for condition of finish and panel markings. *Note.* Touchup painting is recommended instead of refinishing whenever practicable. Screwheads, connector, and receptacles will not be painted or polished with abrasives.	*d.* Surfaces intended to be painted should not show bare metal (TM 9-213). Panel markings should be legible.

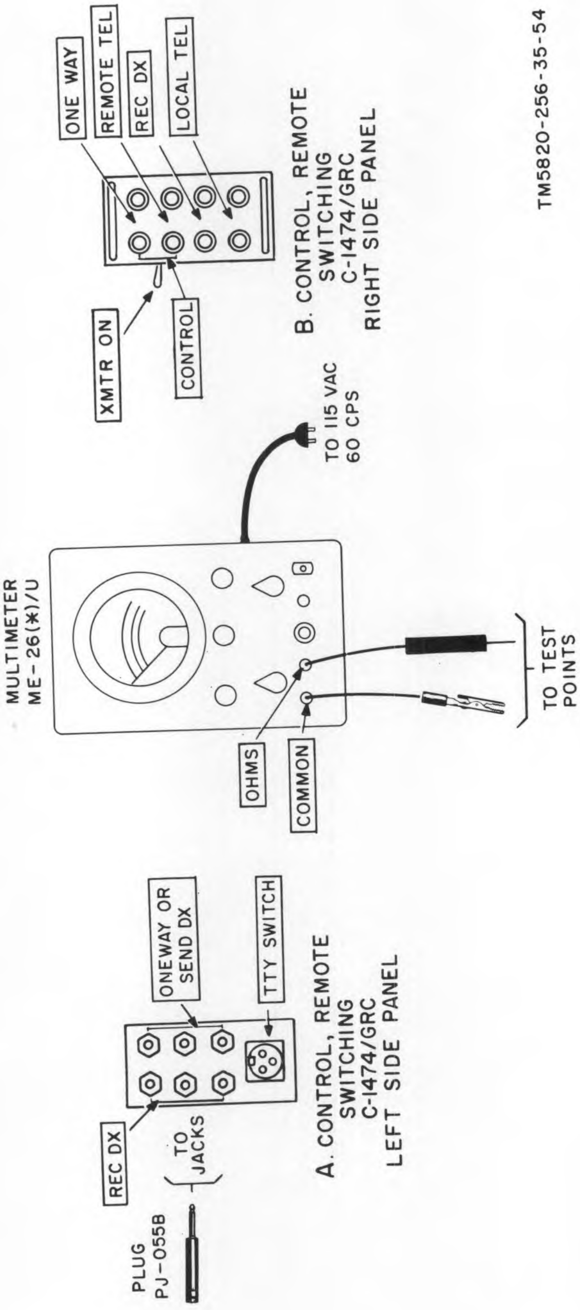


Figure 4-9. Control, Remote Switching C-1474/GRC, test setup.

4–15. Control, Remote Switching C–1474/GRC, Continuity Test

a. Test Equipment and Materials.

(1) Multimeter ME–26(*)/U.

(2) Plug, Telephone PJ–055B.

b. Test Connections and Conditions. No cables are connected to the equipment under test. Refer to figure 4–9 for the test points.

c. Test Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*ME–26(*)/U* FUNCTION: OHMS RANGE: RX1	XMTR ON switch: down (off) position (H)	*a.* Connect ME–26(*)/U between the ONE WAY binding posts, and observe meter indication.	*a.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.
			b. Insert the PJ–055B into ONE WAY OR SEND DX jacks in succession and observe the meter indication after each operation.	*b.* ME–26(*)/U indicates infinity when PJ–055B is inserted.
			c. Connect ME–26(*)/U between the REC. DX binding posts and observe meter indication.	*c.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.
			d. Insert the PJ–055B into REC. DX jacks in succession and observe the meter indication after each operation.	*d.* ME–26(*)/U indicates infinity when PJ–055B is inserted.
			e. Connect ME–26(*)/U to the points listed below and observe meter indications: *From* — *To* (1) TTY SWITCH connector, pin A — ONE WAY CONTROL binding post (2) TTY SWITCH connector, pin B — REMOTE TEL CONTROL binding post	*e.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.
			f. Connect ME–26(*)/U from REMOTE TEL. binding post to each LOCAL TEL. binding post.	*f.* ME–26(*)/U indicates 0 on the OHMS(lower) scale in one instance and infinity in the other.
			g. Place RANGE switch on ME–26(*)/U to RX1M position. Connect ME–26(*)/U from TTY SWITCH connectors, pin B, to each LOCAL TEL. binding post, and observe meter indication. Reverse meter leads if necessary to get indication.	*g.* ME–26(*)/U meter pointer deflects first to left and then gradually moves to the right for one LOCAL TEL. binding post on some models; ME–26(*)/U meter indicates infinity for both LOCAL TEL. binding posts on other models.
			h. Connect ME–26(*)/U from TTY SWITCH connector, pin A, to TTY SWITCH connector, pin B, and observe meter indication.	*h.* ME–26(*)/U indicates infinity.
			i. With ME–26(*)/U connected as in *h* above, place RANGE switch to RX1 and place the XMTR ON switch to the up (on) position. Observe meter indication.	*i.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.

4-16. Physical Test and Inspection, Switch Box SA-331/U

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. No cables are connected to equipment under test.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	Control may be in either position.	*a.* Check power supply switch for smooth operation, free of binding throughout its limits of travel.	*a.* Control operates freely without binding, is properly indexed, and has positive detent action.
			b. Inspect all connectors, connector covers, and web carrying strap for damage. Inspect case,' front and rear, for missing screws, nuts, or bolts.	*b.* None of the listed items are missing or damaged.
			c. Inspect front, rear, top, and bottom for physical damage (dents, punctures, or bent areas).	*c.* There are no dents, punctures, or bent areas.
			d. Inspect switchbox for condition of finish and panel markings. *Note.* Touchup painting is recommended instead of refinishing whenever practicable. Screwheads, receptacles, and ground binding post will not be painted or polished with abrasives.	*d.* Surfaces intended to be painted do not show bare metal (TM 9-213). Panel markings are legible.

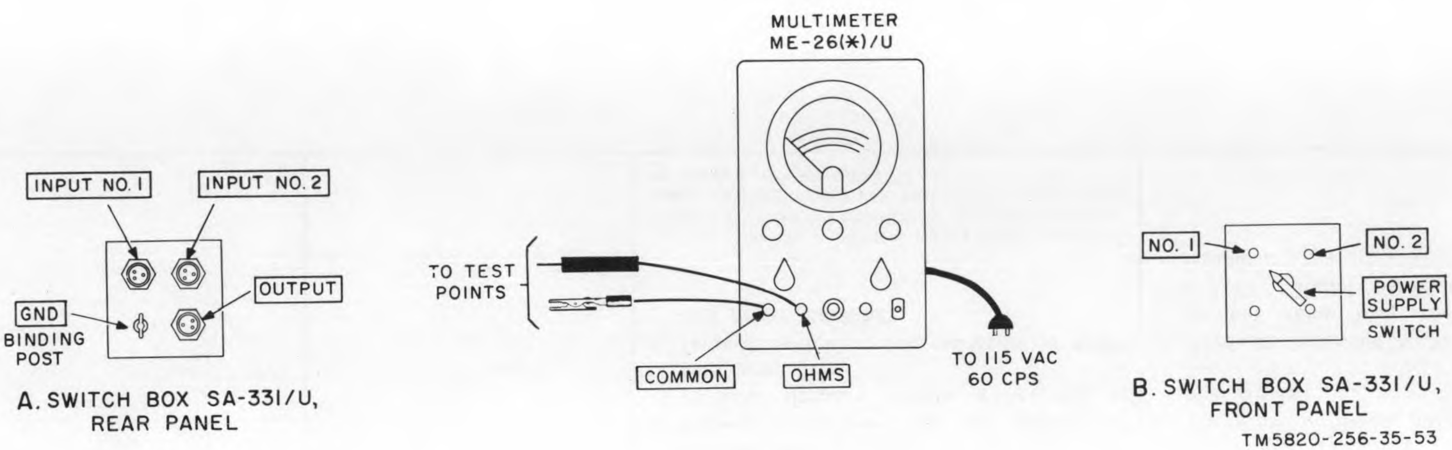


Figure 4–10. Switch Box SA–331/U, test setup.

4–17. Switch Box SA–331/U, Continuity Test

a. Test Equipment and Materials. Multimeter ME–26(*)/U.

b. Test Connections and Conditions. No power or cables are connected to equipment under test. Refer to figure 4–10 for test points.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*ME–26(*)/U* FUNCTION: OHMS RANGE: RX1	POWER SUPPLY: NO. 1	*a.* Connect ME–26(*)/U to the points listed below and observe meter indications: *From* — *To* (1) INPUT NO. 1 connector, pin B. — OUTPUT connector, pin B. (2) INPUT No. 1 connector, pin D. — INPUT NO. 2 connector, pin D. (3) INPUT NO. 1 connector, pin D. — GND binding post. (4) INPUT NO. 1 connector, pin D. — OUTPUT connector, pin D. (5) INPUT NO. 1 connector, pin E. — OUTPUT connector, pin E.	*a.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.
			b. Place the RANGE switch to RXIM, connect ME–26(*)/U to the points listed below, and observe meter indications: *From* — *To* (1) INPUT NO. 2 connector, pin B. — OUTPUT connector, pin B. (2) INPUT NO. 2 connector, pin E. — OUTPUT connector, pin E.	*b.* ME–26(*)/U indicates **infinity.**
2	Same as step 1	POWER SUPPLY: NO. 2	*a.* Connect ME–26(*)/U to the points listed below and observe meter indications: *From* — *To* (1) INPUT NO. 2 connector, pin B. — OUTPUT connector, pin B. (2) INPUT NO. 2 connector, pin E. — OUTPUT connector, pin E.	*a.* ME–26(*)/U indicates 0 on the OHMS (lower) scale.
			b. Place the RANGE switch to RXLM, connect ME–26(*)/U to the points listed below, and observe meter indications: *From* — *To* (1) INPUT NO. 1 connector, pin B. — OUTPUT connector, pin B. (2) INPUT NO. 1 connector, pin E. — OUTPUT connector, pin E.	*b.* ME–26(*)/U indicates **infinity.**

4–18. Physical Test and Inspection, Loudspeaker Assembly LS–206(*)/U

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. None.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	Switches may be in any position.	*a.* Check CHANNEL A and CHANNEL B switches for smooth operation.	*a.* Switches operate freely without binding, are properly indexed, and have positive dent action.
			b. Check entire unit for physical damage including acoustical fabric.	*b.* Physical damage is not such that the unit may be termed unserviceable.
			c. Inspect unit for condition of finish, nameplate, and panel markings. *Note.* Touchup painting is recommended instead of refinishing whenever practicable. Screwheads and terminals will not be painted or polished with abrasives.	*c.* Surfaces intended to be painted do not show bare metal (TM 9–213). Nameplate and panel markings are legible.

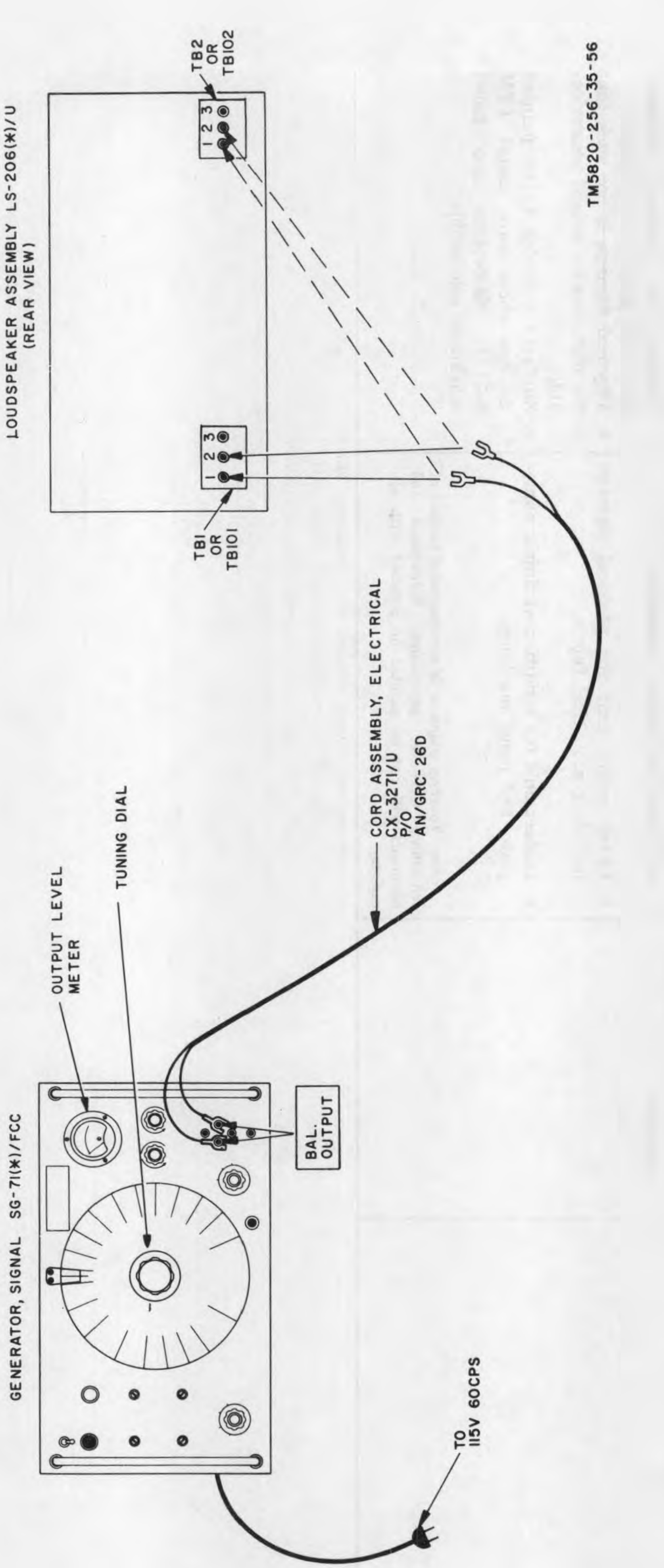


Figure 4–11. Loudspeaker Assembly LS–206(*)/U, test setup.

4-19. Loudspeaker Assembly LS-206(*)/U, Loudspeaker Response Test

a. Test Equipment and Materials.

(1) Signal Generator SG-71(*)/FCC.

(2) Cord Assembly, Electrical CX-3271/U (part of AN/GRC-26D).

b. Test Connections and Conditions. Connect the equipment as indicated in figure 4-11; connect the CX-3271/U to TB1 or TB101.

c. Test procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*SG-71(*)/FCC* RANGE: X10 Tuning dial: 100 MOD BAL. -BAL.-UNBAL.: BAL. FINE AMPLITUDE: Fully counterclockwise. COARSE AMPLITUDE: Fully counterclockwise. Power switch: ON	ON CHANNEL A: off ON CHANNEL B: off	*a.* Rotate SG-71(*)/FCC COARSE AMPLITUDE control clockwise until OUTPUT LEVEL meter indicates 34 on the 0 to 50 (lower) scale. *b.* Place LS-206(*)/U ON CHANNEL B switch to ON, and listen to loudspeaker tone. *c.* Maintain the SG-71(*)/FCC output at 34 volts, and slowly sweep the SG-71(*)/FCC output frequency from 150 cycles to 7,000 cycles by rotating the tuning dial in conjuction with the appropriate setting of the RANGE control. Listen to loudspeaker tone. *d.* Place LS-206(*)/U ON CHANNEL B switch off.	*a.* None. *b.* No evidence of cone rattle or scraping of the voice coil. *c.* Same as *b* above. *d.* None.
2	Same as step 1	Same as step 1	*a.* Connect equipment to TB2 or TB102 as indicated in figure 4-11. *b.* Repeat step 1*a*. *c.* Place LS-206(*)/U ON CHANNEL A switch to ON, and listen to loudspeaker tone. *d.* Repeat step 1*c*.	*a.* None. *b.* None. *c.* No evidence of cone rattle or scraping of the voice coil. *d.* Same as 1*c* above.

4-20. Summary of Performance Standards

a. Modulator, Radio MD-239(*)/GR.

1. OUTPUT VOLTS VERSUS FREQUENCY TEST		Performance standard	Test data
BAND SELECTOR switch position	Input frequency (mc) /volt ac	Output volts ac (minimum)	
1.5-2	1.5/0.73	1.64	
1.5-2	2.0/0.64	1.9	
2-3	2.0/0.64	1.76	
2-3	3.0/0.5	1.62	

2. FREQUENCY-SHIFT TOLERANCE TEST BAND SELECTOR switch position	Mark frequency minus space frequency (cps)
1.5-2	850 ±10
2-3	850 ±10
3-4	425 ±8
4-6	425 ±8
6-8	212 ±6
8-12	212 ±6
12-16	106 ±4
16-20	106 ±4

b. Control, Radio Set C-1123/GRC. Performance standards of continuity checks are given in paragraph 4-12*c*.

c. Control, Remote Switching C-1474/GRC. Performance standards of continuity checks are given in paragraph 4-14*c*.

d. Switch Box SA-331/U. Performance standards of continuity checks are given in paragraph 4-16*c*.

e. Loudspeaker Assembly LS-206(*)/U.

LOUDSPEAKER RESPONSE TEST (Input: 150 to 7,000 cps at 34 volts)	Performance standard	Test data
a. Channel A	No cone rattling or voice coil scraping in loudspeaker.	
b. Channel B	No cone rattling or voice coil scraping in loudspeaker.	

CHAPTER 5

DEPOT OVERHAUL STANDARDS FOR MODULATORS, RADIO MD—239/GR AND MD—239A/GR

5–1. Scope and Applicability of Depot Overhaul Standards

The tests outlined in this chapter are designed to measure the performance capability of a repaired fsk-modulator. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation, equivalent to that of new equipment.

5–2. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355–1, TB SIG 355–2, and TB SIG 355–3 form a part of the requirements for testing this equipment.

b. Technical Publications. The following technical publications are applicable to this equipment:

Title	Number	Date
Operator's Manual: Radio Set AN/GRC–26D	TM 11–5820–256–10	20 July 1961
Organizational Maintenance Manual: Radio Set AN/GRC–26D	TM 11–5820–256–20	5 January 1962

c. Modification Work Orders. Perform all applicable modification work orders pertaining to this equipment before making the tests specified. DA Pam 310–4 lists all available modification work orders.

5–3. Test Facilities Required

The following equipments, or suitable equivalents, will be employed in determining compliance with the requirements of this specific standard.

a. Test Equipment.

Equipment	Federal stock No.	Quantity required	Applicable literature
Signal Generator SG–479/G (p/o AN/GRM–50).	6625–819–0472	1	TM 11–6625–573–15
Frequency Meter AN/USM–26	6625–692–5023	1	TM 11–5057
Multimeter TS–352/U	6625–242–5023	1	TM 11–5527
Multimeter ME–26A/U	6625–542–6407	2	TM 11–6625–200–12 TM 11–6625–200–35
Distortion Test Set TS–383/GG	6625–222–1714	1	TM 112217
Oscilloscope AN/USM–50A	6625–668–4676	1	TM 11–5129
Teletypewriter Test Set TS–1060A/GG.	6625–542–6106	1	TM 11–6625–207–10 TM 11–6625–207–20 TM 11–6625–207–35

b. Additional Equipment.

Equipment	Federal stock No.	Quantity required	Applicable literature
Dummy load[a] (consists of):		1	
Choke, 43 uh:	5950–393–1477	1	
Resistor, composition, 22 ohms 1 w.	5905–279–1738	1	

b. Additional Equipment—(Continued)

Equipment	Federal stock No.	Quantity required	Applicable literature
Resistor, composition, 18 ohms, 1 w.	5905-279-1740	1	
Resistor, composition, 68 ohms, 1 w.	5905-279-1733	1	
Resistor, composition, 51 ohms, 1 w.	5905-279-2544	1	
Switch, single pole, double throw.	5930-180-2540	1	
Switch, single pole, double throw	5930-180-2540	2	
Switch, single pole, single throw	5930-188-1055	1	
Power supply, variable, 0-115v, 60 ma, dc.		1	
Radio Receiver R-390/URR	5820-503-1242	1	TM 11-5820-357-10; -20; -35
or			
Radio Receiver R-390A/URR	5820-538-7555	1	TM 11-5820-358-10; -20; -35
Frequency Shift Converter CV-116/URR, CV-116A/URR, CV-116B/URR, or CV-116C/URR.	5815-503-2600	1	TM 11-2241

[a]Construct dummy load as shown in figure 3-12.

5-4. General Test Requirements

All tests should be conducted under the following conditions, unless otherwise specified.

a. Tests should be made after a warmup period of 15 minutes.

b. Power supply input should be 115 volts ±1, single phase, 60 cycles.

5-5. Specific Tests

a. Output Level, Frequency Tolerance, and Frequency Shift.

Note. In the unlettered model of the MD-239/GR, the connections are as shown in figure 5-9. On the A model, KEYING IN is changed to jack TTY IN.

(1) Connect the fsk-modulator into the test circuit shown in figure 5-9. Set the dummy load switch D (fig. 5-8) to MOD.

(2) Adjust input potentiometer R1 (MD-239/GR) or R2 (MD-239A/GR) for maximum gain (clockwise).

(3) Adjust the SG-479/G (signal generator) for an output of 1 volt (as measured on the ME2-6A/U) at each frequency listed in the chart in (4) below, column 2.

(4) Measure and record the output voltage for each band switch position and corresponding signal generator frequency given in columns 1 and 2 in the chart below.

Band switch position (mc)	Signal generator frequency (mc)	Maximum frequency tolerance (cps)	Frequency-shift limits (cps)
Column 1	Column 2	Column 3	Column 4
1.5-2.0	1.5	±45	820-880
2.0-3.0	3.0	±90	820-880
3.0-4.0	1.5	±45	410-440
4.0-6.0	3.0	±90	410-440
6.0-8.0	1.5	±45	204-220
8.0-12.0	3.0	±90	204-220
12.0-16.0	1.5	±45	102-110
16.0-20.0	2.5	±90	102-110

(5) In each case, the output voltage should be at least 1 volt as indicated on the ME-26A/U.

(6) Close switch C and adjust the dc power supply as measured on the TS-352/U.

(7) For each band switch position given in the chart ((4) above), measure the frequency of the signal generator and the frequency of the fsk-modulator output on Frequency Meter AN/USM-26. Do this by operating switches A and B from 1 and 2 in rapid succession.

(8) Compare the two frequencies obtained. For each band switch position, the two frequencies should not differ more than the amount given in column 3 in the chart in (4) above.

(9) Set switches A and B to position 2.

(10) For each band switch position given in the chart, measure the frequency of the fsk-modulator output with switch C closed and opened in rapid succession.

(11) Compare the two frequencies obtained for each case. For each band switch position, the two frequencies should not differ by more than the amount given in column 4 in the chart in (4) above.

b. Teletypewriter Bias Distortion and Keying Transit Response.

(1) Connect the TS-1060A/GG to the TS-383/GG and measure the bias distortion even though the bias distortion of the TS-383/GG is set to zero. Any distortion indicated will be used as a reference ((7) below).

(2) Connect the fsk-modulator into the test circuit shown in figure 5-10. Set dummy load switch D (fig. 5-5) to REC.

(3) Start the standard message on the TS-383/GG with the bias distortion set at zero and the gears set for 60 words per minute (wpm).

(4) Set the signal generator to 1.5 mc and 1-volt output.

(5) Set the BAND SELECTOR switch on the fsk-modulator to the 3.0-4.0 mc position.

(6) Set the TS-1060A/GG for proper operation as outlined in TM 11-6625-207-10, and note the percentage of distortion.

(7) Subtract the percentage of distortion noted in (1) above from that noted in (6) above.

(8) The difference should be less than 5 percent.

(9) Repeat the procedures given in (1) through (8) above with the TS-383/GG set for 100 wpm.

(10) The percent of distortion should be less than 5 percent.

(11) Connect the vertical deflection plates of Oscilloscope AN/USM-50 across the input to the TS-1060A/GG.

(12) Set the letter R on the TS-383/GG with the bias distortion set at zero and the gears set for 100 wpm.

(13) Adjust the AN/USM-50A for proper operation and observe the waveform on the screen. No overshooting or rounding of the pulses should be observed.

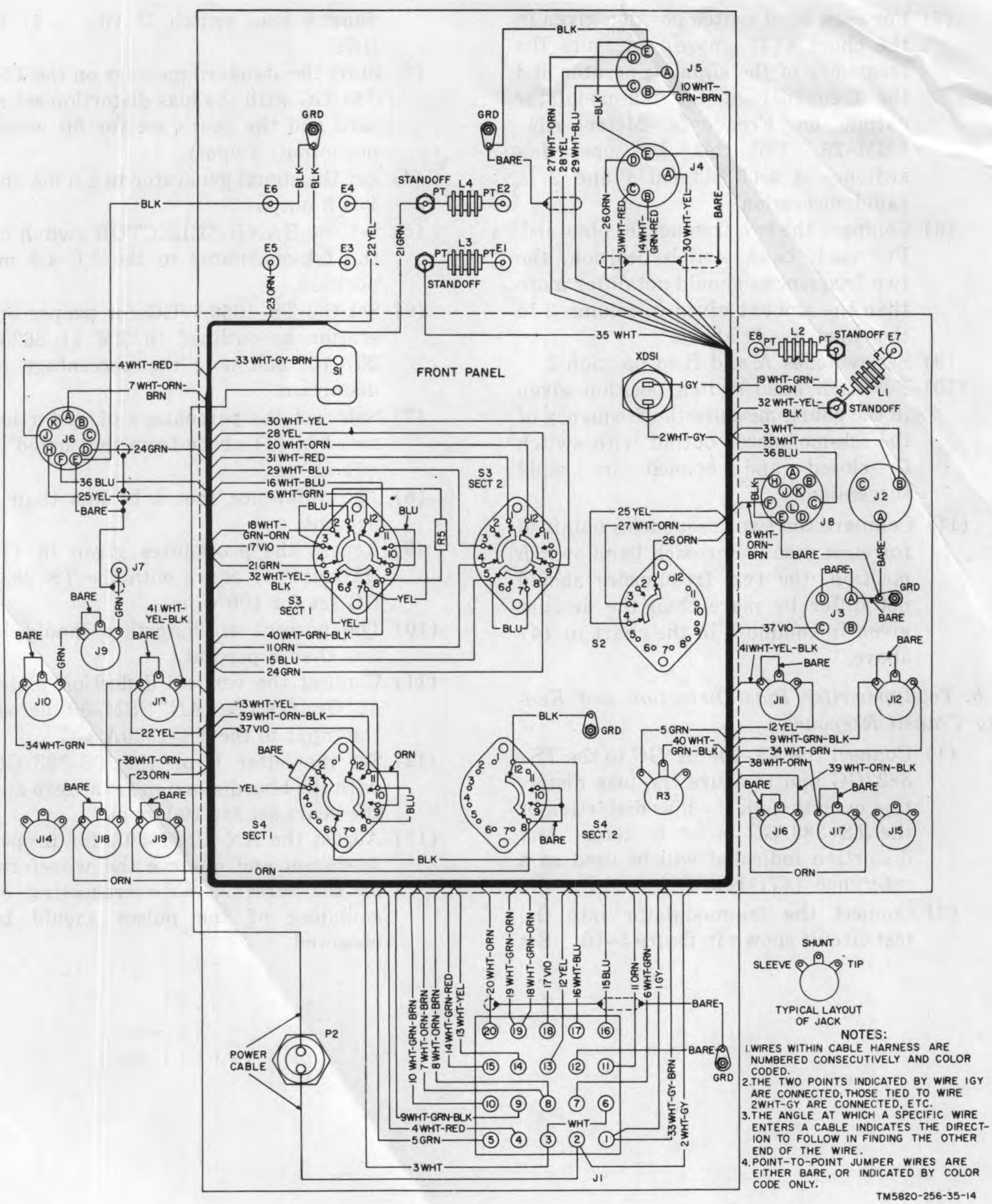


Figure 5-1. Control, Radio Set C-1123/GRC, most orders, main chassis wiring diagram.

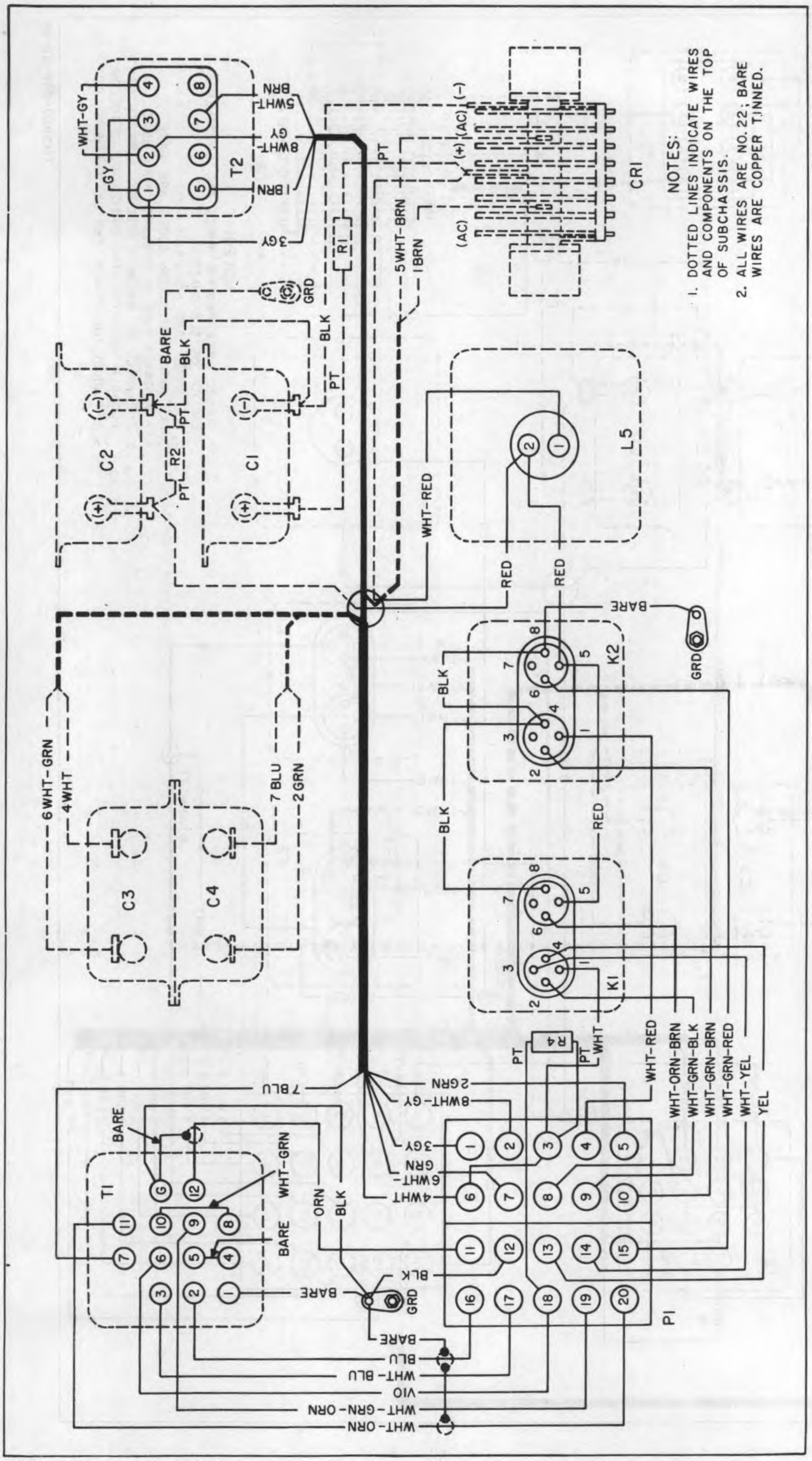
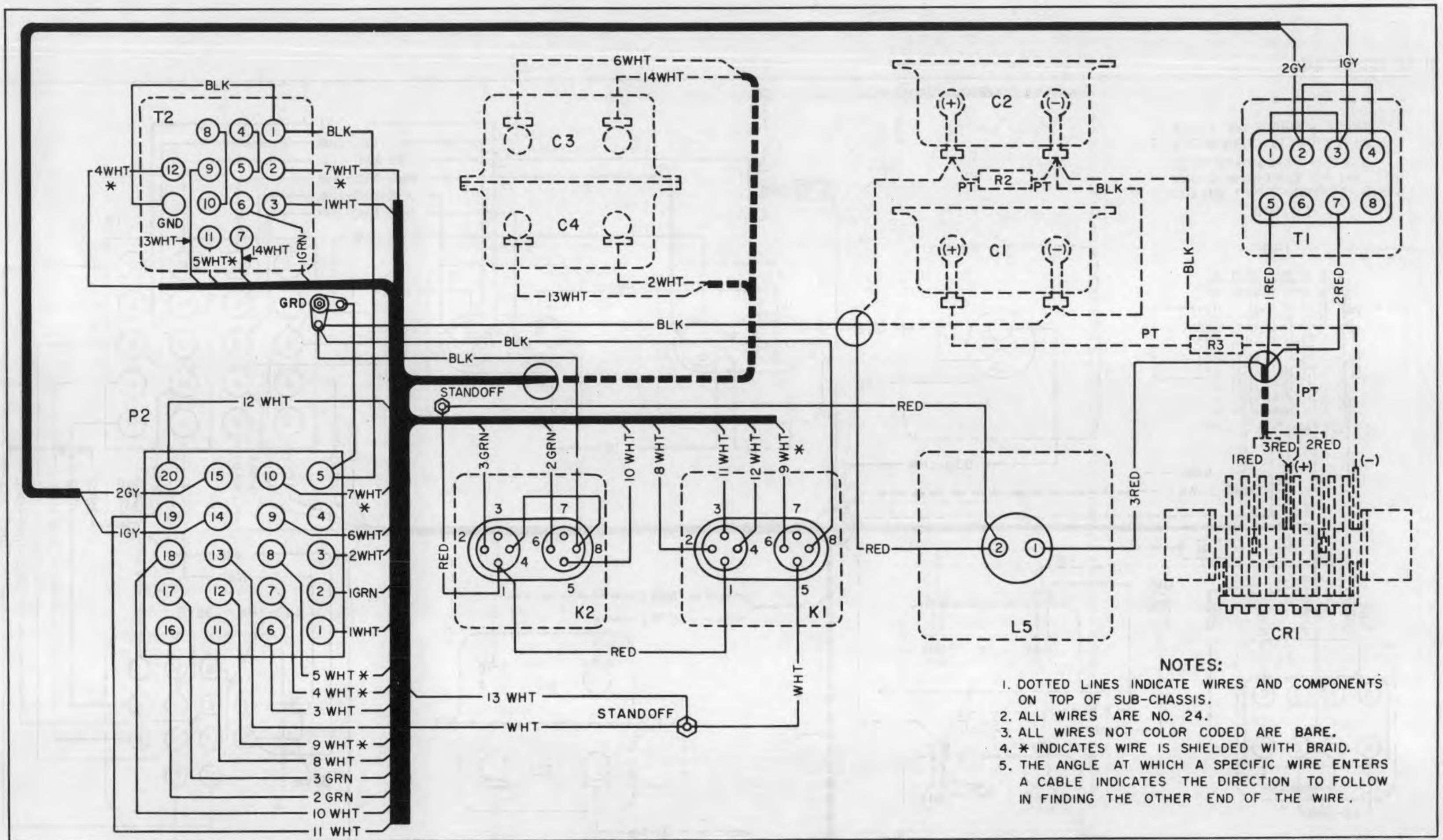


Figure 5–2. Control, Radio Set C–1123/GRC, most orders, subchassis wiring diagram.



TM5820-256-35-16

Figure 5–3. Control, Radio Set C–1123/GRC, Order No. 25209–Phila–54, subchassis wiring diagram.

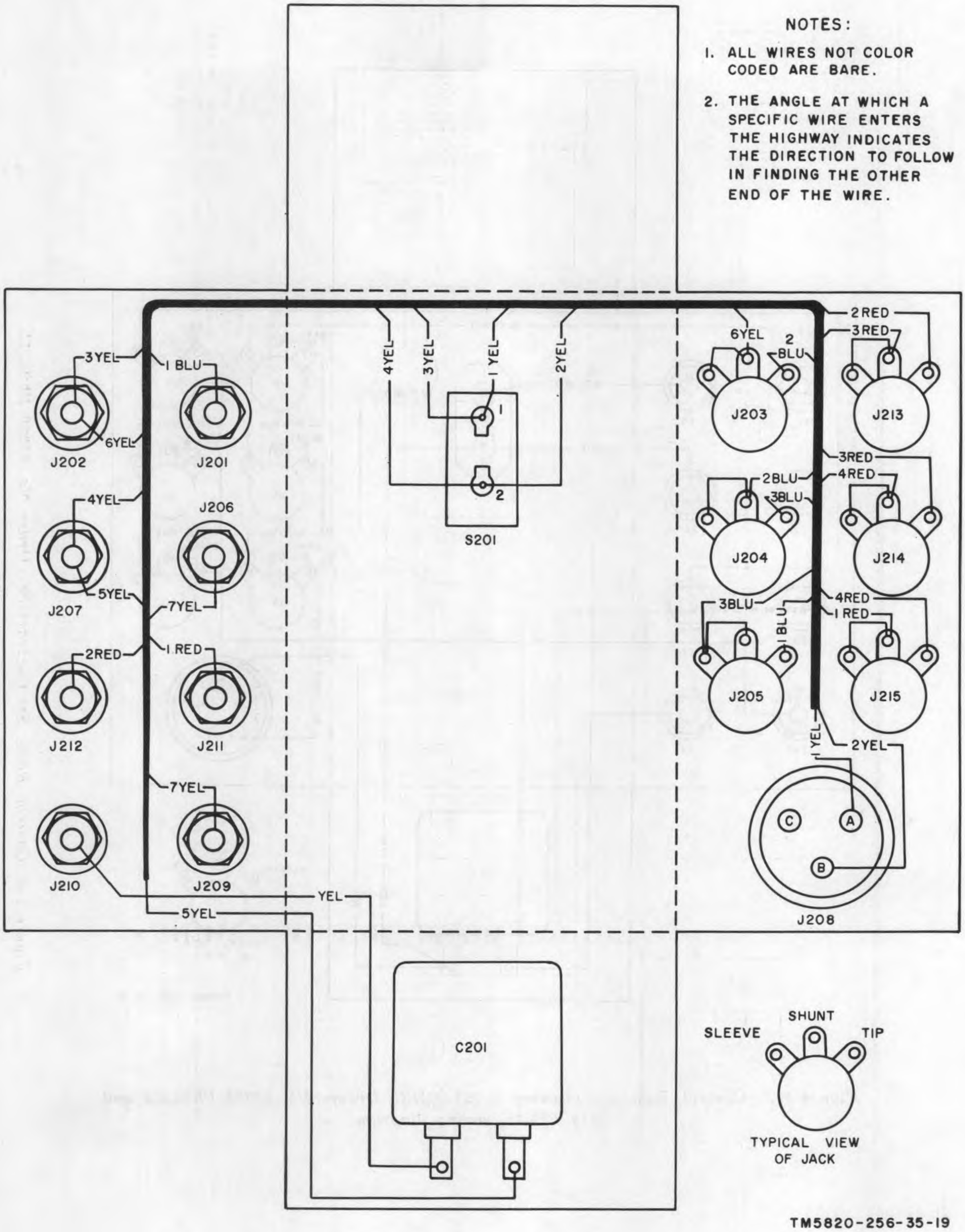


Figure 5-4. Control, Remote Switching C-1474/GRC, Order No. 25209-Phila-54, wiring diagram.

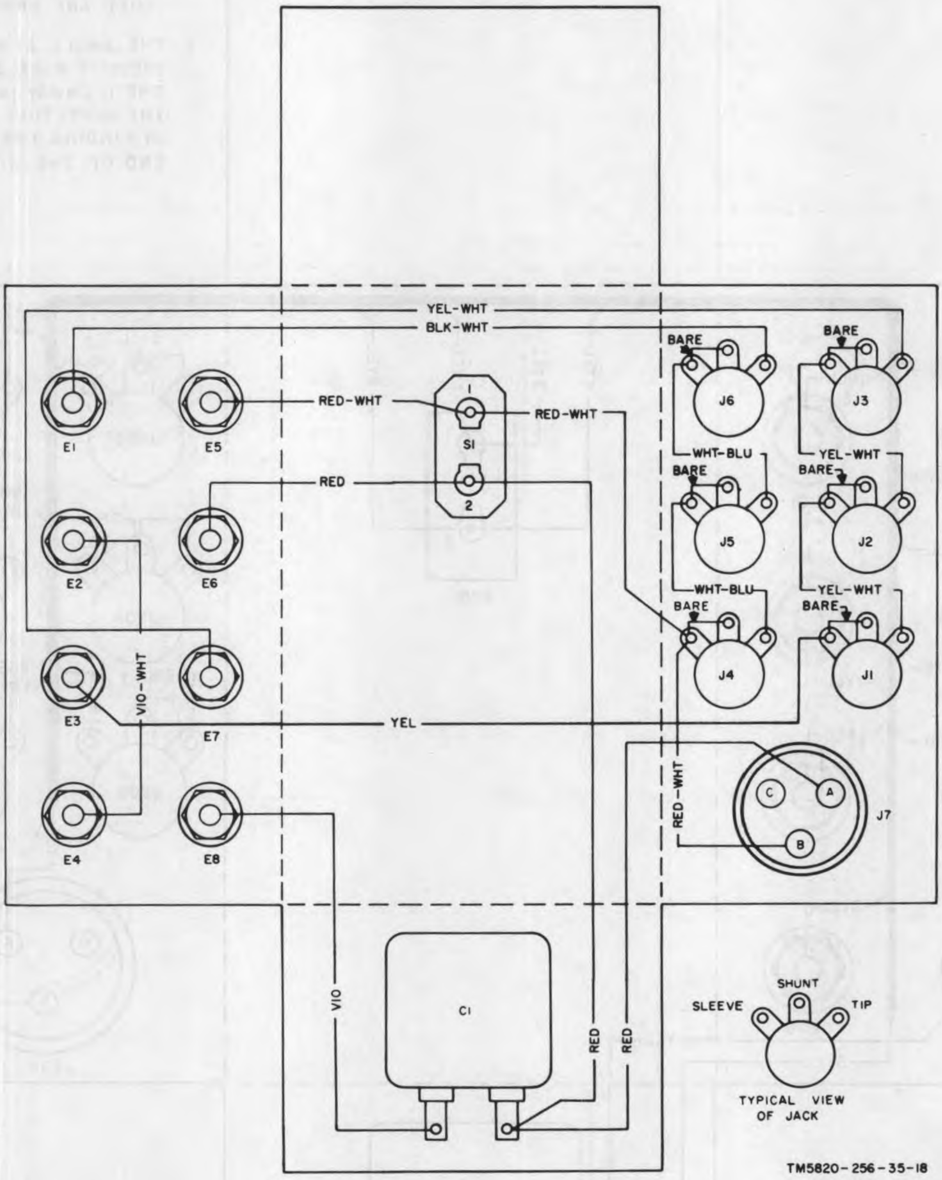


Figure 5-5. Control, Remote Switching C-1474/GRC, Orders No. 43056-Phila-56 and 3219-PP-59, wiring diagram.

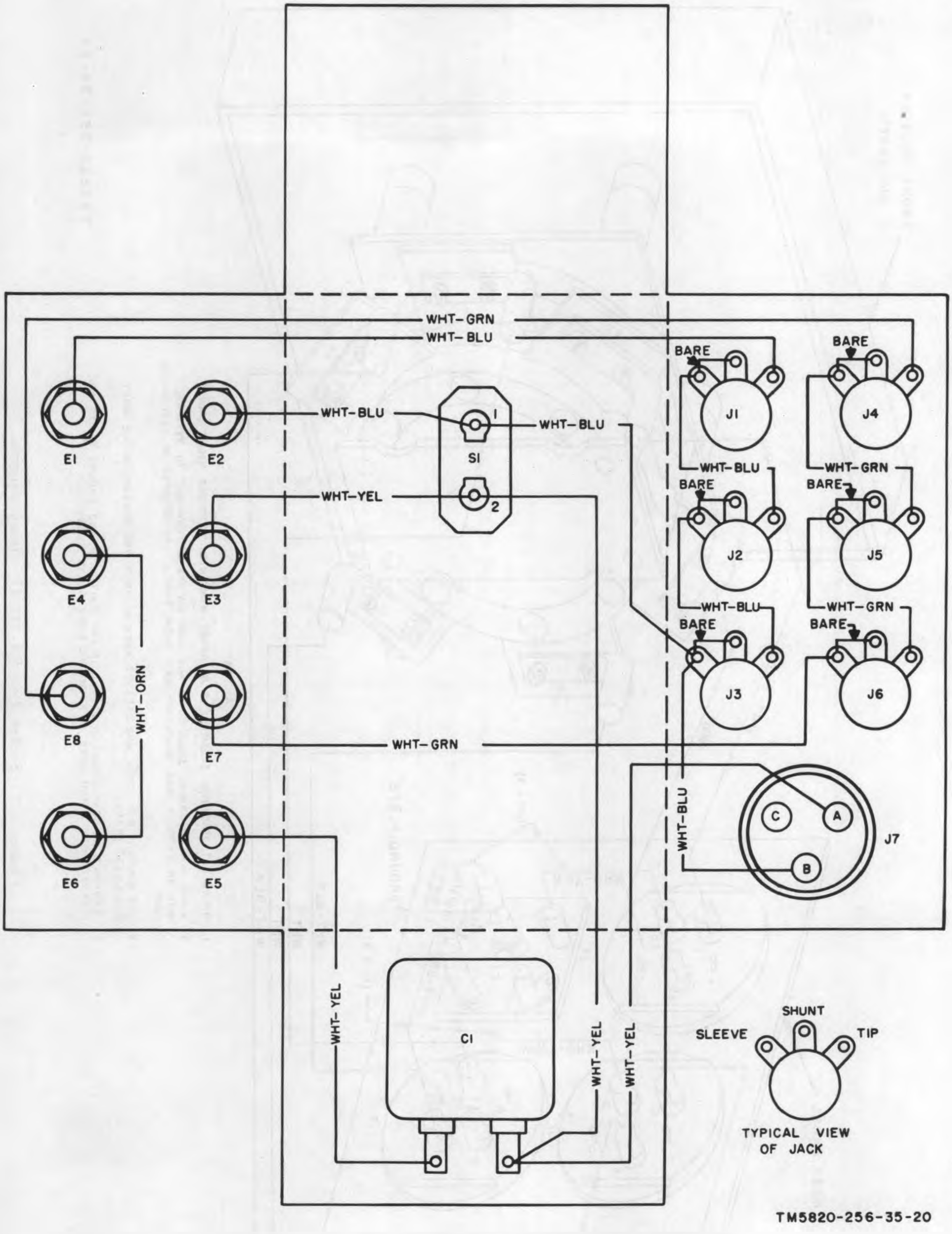
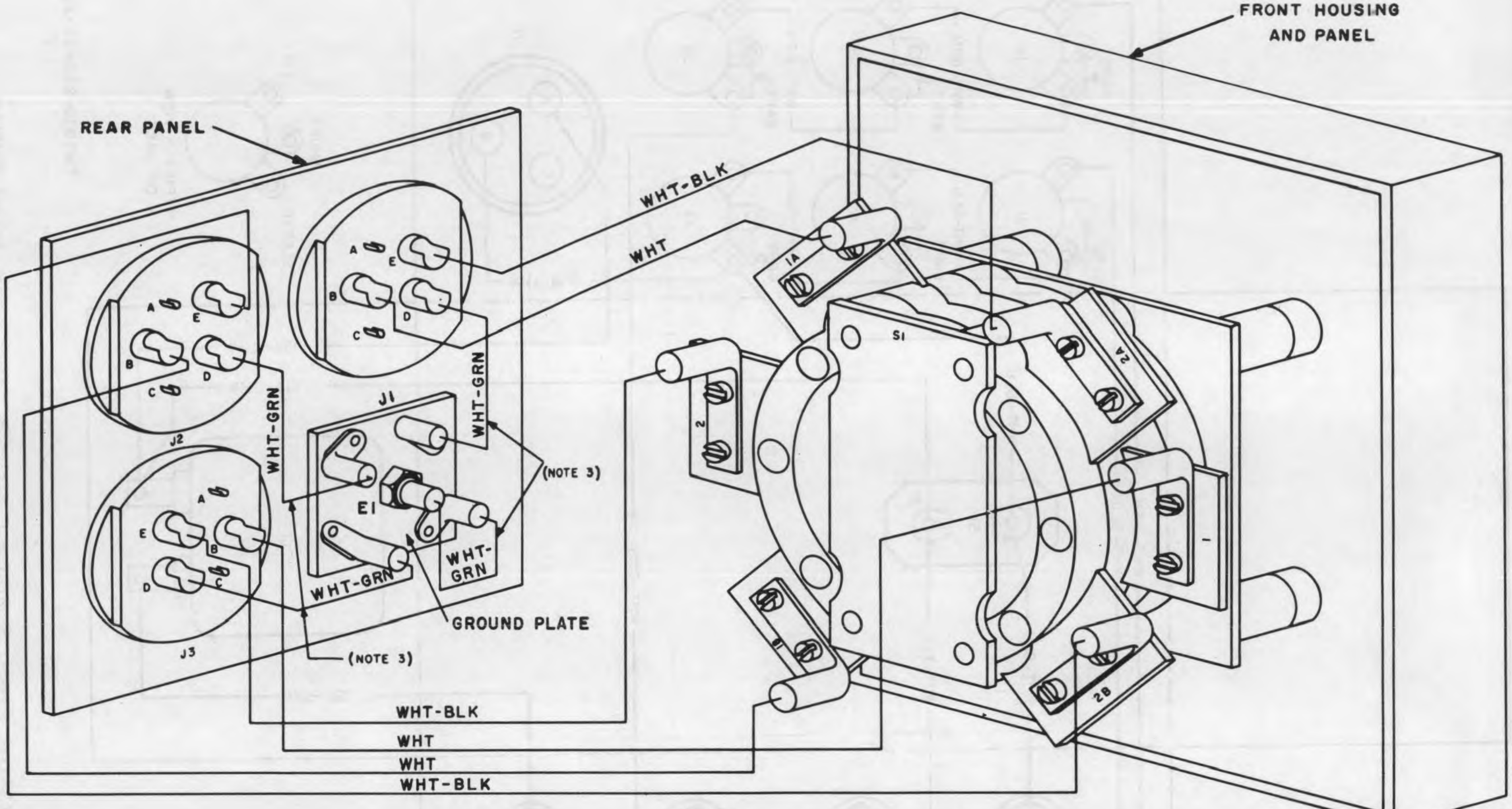


Figure 5-6. Control, Remote Switching C-1474/GRC, some orders, wiring diagram.



NOTES:

1. WIRING NOT OTHERWISE SPECIFIED IS 6 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
2. WIRING NOT OTHERWISE SPECIFIED IS RUN DIRECTLY FROM TERMINAL TO TERMINAL WITH AN EXTRA 2 INCH SLACK INCLUDED WHEN PANELS ARE MOUNTED IN ASSOCIATED CASE.
3. THIS WIRING IS RUN LOOSE AND DRESSED BACK AGAINST THE CHASSIS IN THE MOST CONVENIENT MANNER.
4. TERMINALS ON CONNECTORS J1, J2, AND J3, AND SWITCH S1, AND GROUND PLATE ARE SLEEVED WITH 1 INCH LONG IMPREGNATED FIBRE GLASS SLEEVING.

TM5820-256-35-22

Figure 5-7. Switch Box SA-331/U, wiring diagram.

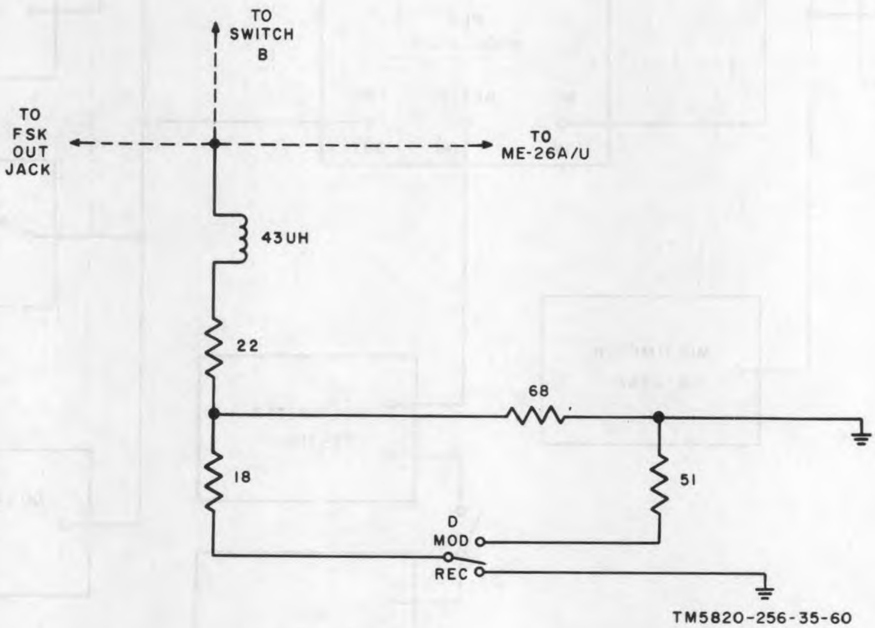


Figure 5-8. Dummy load, schematic diagram.

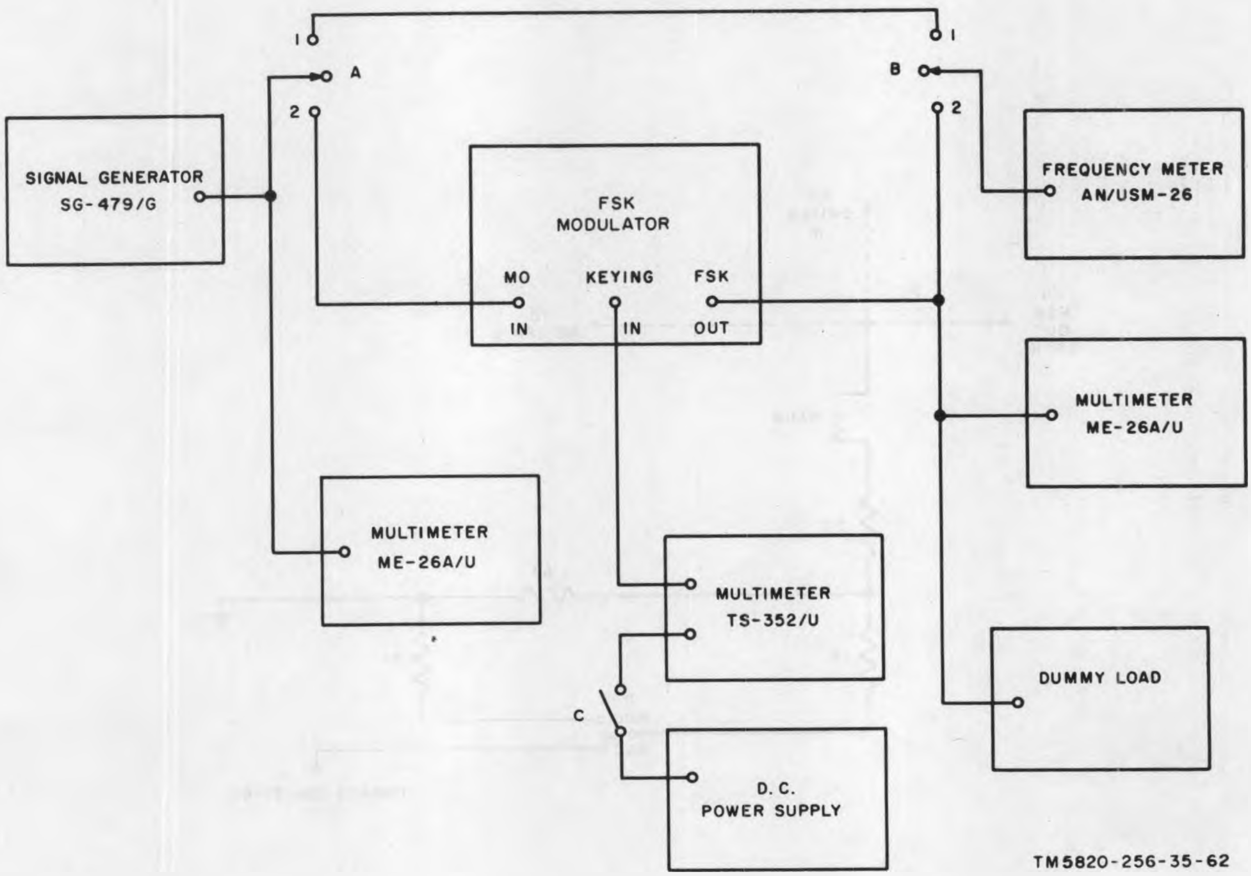


Figure 5-9. Test setup for output level, frequency tolerance, and frequency shift tests.

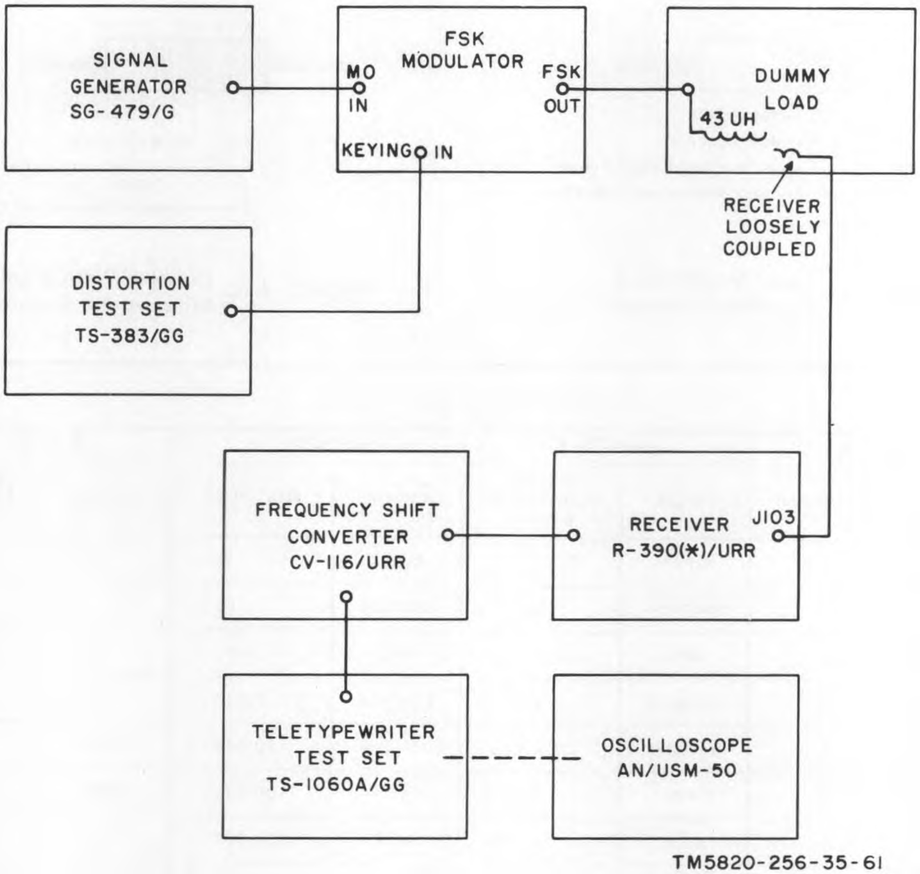
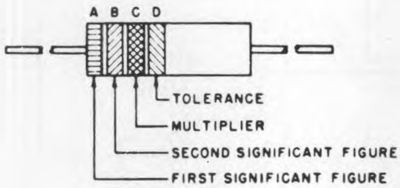


Figure 5-10. Test setup for teletypewriter bias distortion and keying transit response.

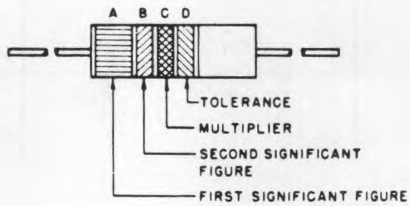
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



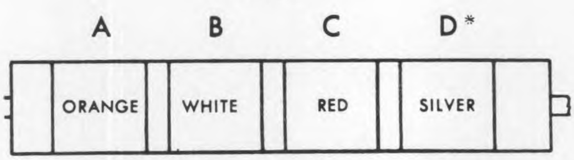
BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
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	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

BAND

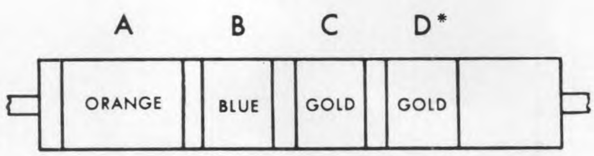


3 9 X100 ± 10%

NOMINAL RESISTANCE 3,900 Ohms

RESISTANCE TOLERANCE ± 10 percent

BAND



3 6 X0.1 ± 5%

3.6 Ohms

± 5 percent

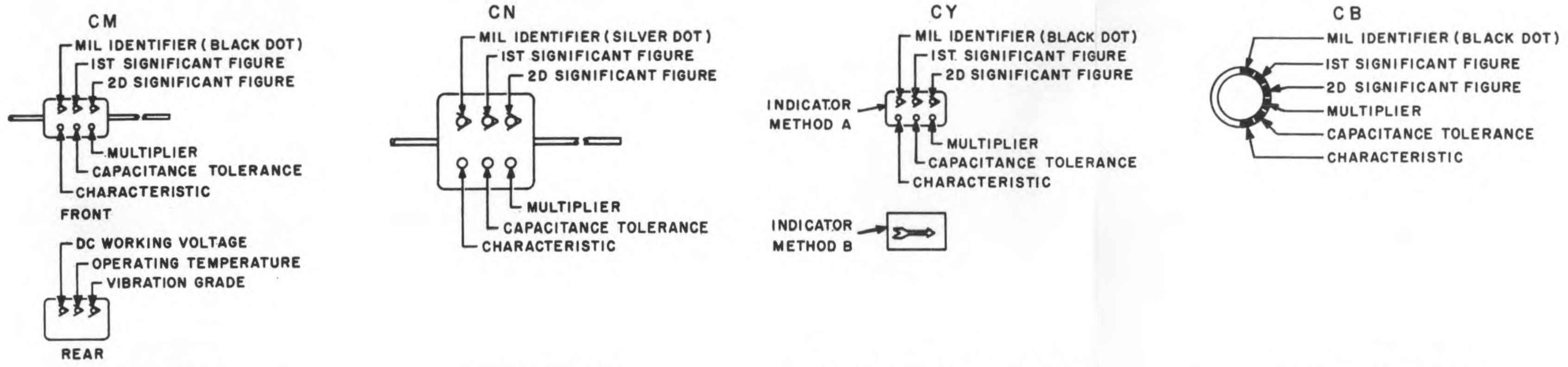
STD-R2

*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

Figure 5-11. Color code marking for MIL STD resistors.

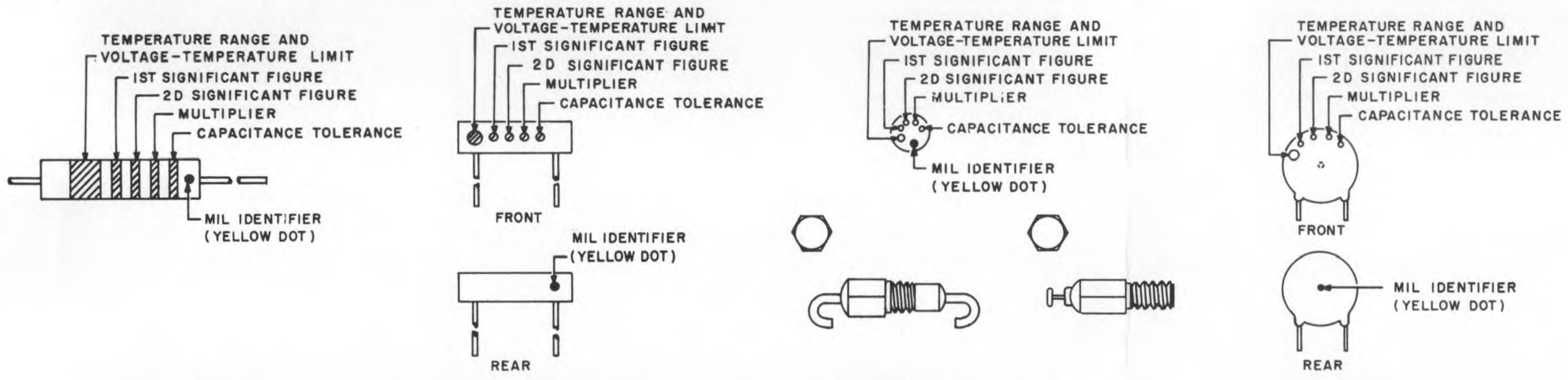
COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



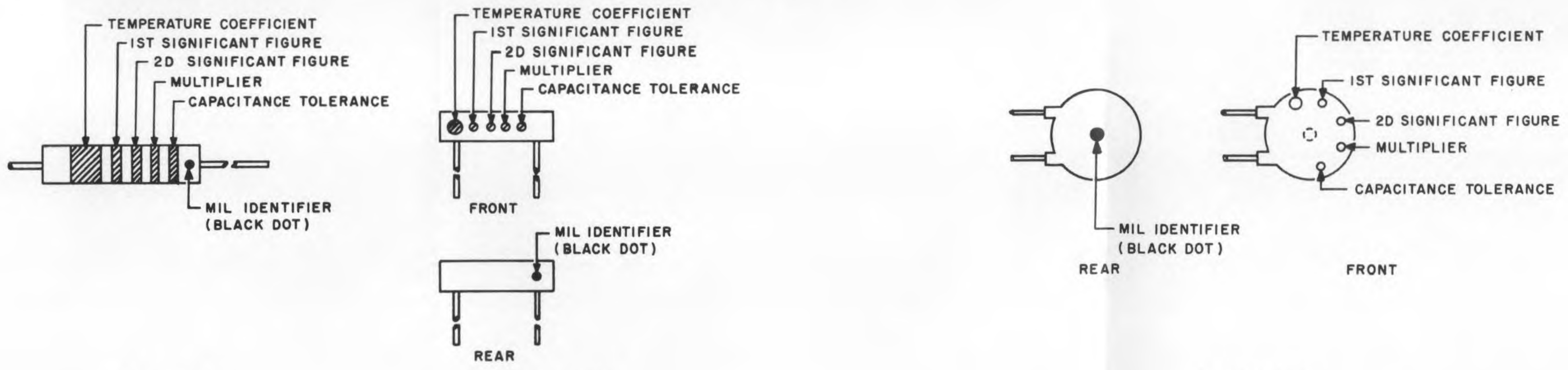
MICA-DIELECTRIC PAPER-DIELECTRIC GLASS-DIELECTRIC, GLASS CASE MICA, BUTTON TYPE

GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD RADIAL LEAD FEED-THROUGH STAND-OFF DISK-TYPE

GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



AXIAL LEAD RADIAL LEAD DISK-TYPE

COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

Figure 5–12. Color code marking for MIL STD capacitors.

Army-Ft Monmouth,NJ-MON 524-61

APPENDIX A
REFERENCES

Following is a list of applicable references available to direct support, general support, and depot maintenance personnel of Radio Set AN/GRC-26D.

AR 380-5	Safeguarding Defense Information.
OA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TA 11-17	Signal Field Maintenance Shops.
TA 11-100 (11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TA 11-101 (11-158)	Allowances of Signal Corps Expendable Supplies for Signal Depot Company.
TB SIG 272	Microphones M-29A/U and M-29B/U.
TB SIG 286	Headset H-113/U.
TB SIG 319	Electronic Equipment Maintenance Kit MK-288/URM.
TB SIG 354	Maintenance and Repair Procedures for S-141/G-, S-144/G-, S-280/G-, and S-318/G-Type Shelters.
TM 9-213	Painting Instructions for Field Use.
TM 11-337	Telephone Sets TA-43/PT and TA-263/PT.
TM 11-486-6	Electrical Communication Systems Engineering: Radio.
TM 11-666	Antennas and Radio Propagation.
TM 11-809-35	DS, GS, and Depot Maintenance Manual: Radio Transmitters T-368/URT, T-368A/URT, T-368B/URT, T-368C/URT, T-368D/URT, and T-368E/URT; Antenna Tuning Unit BC-939-B; Radio Frequency Tuner TN-339/GR; and Standing Wave Ratio-Power Meter ME-165/G.
TM 11-2155	Telephone Set TA-312/PT.
TM 11-2208	Test Sets TS-2/TG, TS-2A/TG, TS-2B/TG, and TS-2C/TG (Teletypewriter Signal Distortion).
TM 11-2217	Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG.
TM 11-2241	Frequency Shift Converters CV-116/URR, CV-116A/URR, CV-116B/URR, and CV-116C/URR.
TM 11-3895-201-13P	Operator, Organizational, and Field (Third Echelon) Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Axles RL-27-B, RL-27-C, and RL-27-D.

TM 11-4140-200-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Blower Assembly, Electrical HD-223/G.
TM 11-5057	Frequency Meter AN/USM-26.
TM 11-5088	Generators, Signal SG-71/FCC, SG-71A/FCC, and SG-71B/FCC.
TM 11-5094	Frequency Meters AN/URM-79 and AN/URM-82.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.
TM 11-5120	Frequency Meters AN/URM-32 and AN/URM-32A and Power Supply PP-1243/U.
TM 11-5129	Oscilloscopes AN/USM-50A, B, and C.
TM 11-5410-200-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Shelters, S-56/G, S-56A/G, and S-56B/G.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5551E	R.F. Signal Generator AN/URM-25F.
TM 11-5805-201-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Telephone Set TA-312/PT.
TM 11-5805-256-35P	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Telephone Set TA-43/PT.
TM 11-5805-257-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Generators, Ringing, Hand G-42/PT and G-42A/PT.
TM 11-5815-200-35	DS, GS, and Depot Maintenance Manual: Teletypewriter Sets AN/FGC-20, AN/FGC-20X, AN/FGC-21, AN/FGC-64, AN/FGC-66, AN/FGC-67, AN/FGC-67X, and AN/UGC-4, AN/UGC-29, AN/UGC-29X, and Teleprinter TT-259/FG.
TM 11-5815-200-35P/1	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Teletypewriter Set AN/FGC-20.
TM 11-5815-200-35P/2	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Teletypewriter Sets AN/FGC-20X and AN/UGC-4.
TM 11-5815-200-35P/3	Field and Depot Maintenance Repair Parts and Special Tool Lists: Teletypewriter Set AN/FGC-21.
TM 11-5815-200-35P/4	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Teletypewriter Set AN/FGC-66.
TM 11-5815-200-35P/5	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Teleprinter TT-259/FG.
TM 11-5815-221-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Frequency Shift Converters CV-116/URR, CV-116A/URR, CV-116G/URR, and CV-116C/URR.
TM 11-5815-238-12	Organizational Maintenance Manual Including Repair Parts and Special Tool Lists: Teletypewriter Sets AN/GGC-3 and AN/GGC-3A and Teletypewriter, Reperforator-Transmitters TT-76/GGC, TT-76A/GGC, TT-76B/GGC, and TT-76C/GGC.

TM 11-5815-238-35P	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Teletypewriter Sets AN/GGC-3 and AN/GGC-3A, Reperforator-Transmitters, Teletypewriter TT-76/GGC, TT-76A/GGC, TT-76B/GGC, and TT-76C/GGC.
TM 11-5815-270-15	Organizational, DS, GS, and Depot Maintenance Manual: Rectifiers RA-87 and RA-87A.
TM 11-5820-251-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Masts AB-155/U, AB-155A/U, and AB-155B/U.
TM 11-5820-256-10	Operator's Manual: Radio Set AN/GRC-26D.
TM 11-5820-256-20	Organizational Maintenance Manual: Radio Set AN/GRC-26D.
TM 11-5820-256-20P	Organizational Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Radio Set AN/GRC-26D.
TM 11-5820-256-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Radio Set AN/GRC-26D.
TM 11-5820-257-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Antenna Tuning Units BC-939-A, and BC-939-B and Tuner, Radio Frequency TN-339/GR.
TM 11-5820-321-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Modulators, Radio MD-239/GR and MD-239A/GR.
TM 11-5820-357-10	Operator's Manual: Radio Receiver R-390/URR.
TM 11-5820-357-35	Field and Depot Maintenance Manual: Radio Receiver R-390/URR.
TM 11-5820-357-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Receiver, Radio R-390/URR.
TM 11-5820-358-10	Operator's Manual: Radio Receiver R-390A/URR.
TM 11-5820-358-35	Field and Depot Maintenance Manual: Radio Receiver R-390A/URR.
TM 11-5820-358-35P	DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Receiver, Radio R-390A/URR.
TM 11-5930-201-15P	Operator, Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Switch Box SA-331/U.
TM 11-5665-201-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists for Loudspeaker Assemblies LS-206/U and LS-206A/U.
TM 11-5965-224-15P	Operator, Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Handsets H-60/PT and H-165/U.
TM 11-5965-231-15P	Operator, Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Headset, Electrical H-113/U.
TM 11-5965-263-12P	Operator and Organizational Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Microphones M-29/U, M-29A/U, and M-29B/U.

TM 11-6115-202-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Generator Set, Gasoline Engine PU-286/G and Power Unit PE-197.
TM 11-6115-223-15P	Operator, Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Generator Set, Gasoline Engine, Trailer Mounted PU-294/G.
TM 11-6625-200-12	Organizational Maintenance Manual: Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
TM 11-6625-202-10	Operator's Manual: Test Sets I-181, I-181A, and I-181B, and Relay Test Set TS-1775/U.
TM 11-6625-207-10	Operator's Manual: Teletypewriter Test Set TS-1060/GG, TS-1060A/GG, and TS-1060B/GG.
TM 11-6625-573-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual: Signal Generator AN/GRM-50.
TOE 11-158E	Signal Depot Company.
TM 11-6625-218-12	Organizational Maintenance Manual: Frequency Meter AN/TSM-16.
TM 11-6625-239-12	Operator's and Organizational Maintenance Manual: Electronic Multimeters TS-505A/U and TS-505B/U, and Multimeters TS-505C/U and TS-505D/U.
TM 11-6625-251-15	Organizational, DS, GS, and Depot Maintenance Manual: Test Set TS-140/PCM, Signal Generator SG-15/PCM and SG-15A/PCM, and Decibel Meter ME-22/PCM and ME-22A/PCM.
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-316-12	Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-320-12	Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-333-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Standing Wave Ratio-Power Meter ME-165/G.

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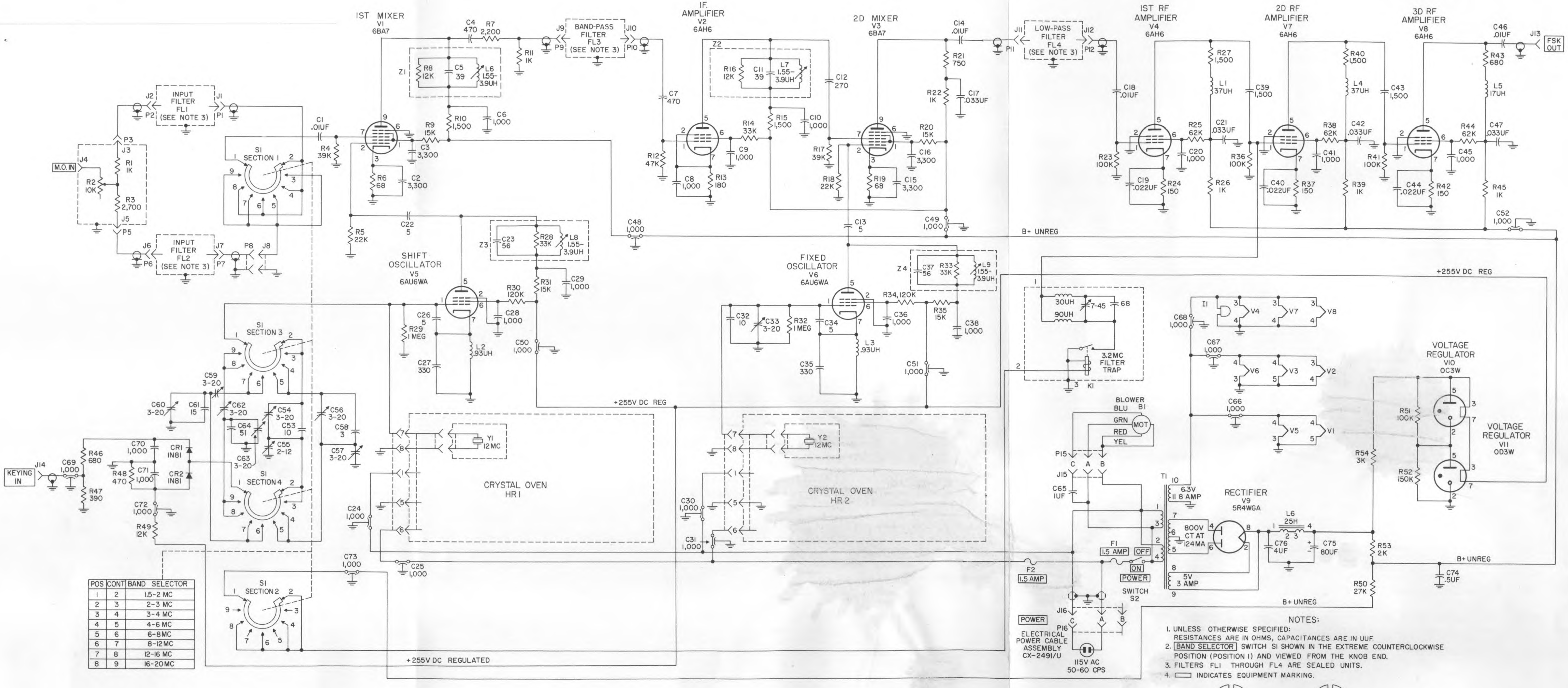
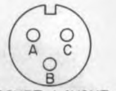


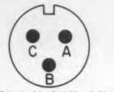
POS	CONT	BAND SELECTOR
1	2	1.5-2 MC
2	3	2-3 MC
3	4	3-4 MC
4	5	4-6 MC
5	6	6-8 MC
6	7	8-12 MC
7	8	12-16 MC
8	9	16-20 MC

NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
2. BAND SELECTOR SWITCH S1 SHOWN IN THE EXTREME COUNTERCLOCKWISE POSITION (POSITION 1) AND VIEWED FROM THE KNOB END.
3. FILTERS FL1 THROUGH FL4 ARE SEALED UNITS.
4. ▭ INDICATES EQUIPMENT MARKING.



SOCKET LAYOUT OF J15 AND P16



PIN LAYOUT OF P15 AND J16

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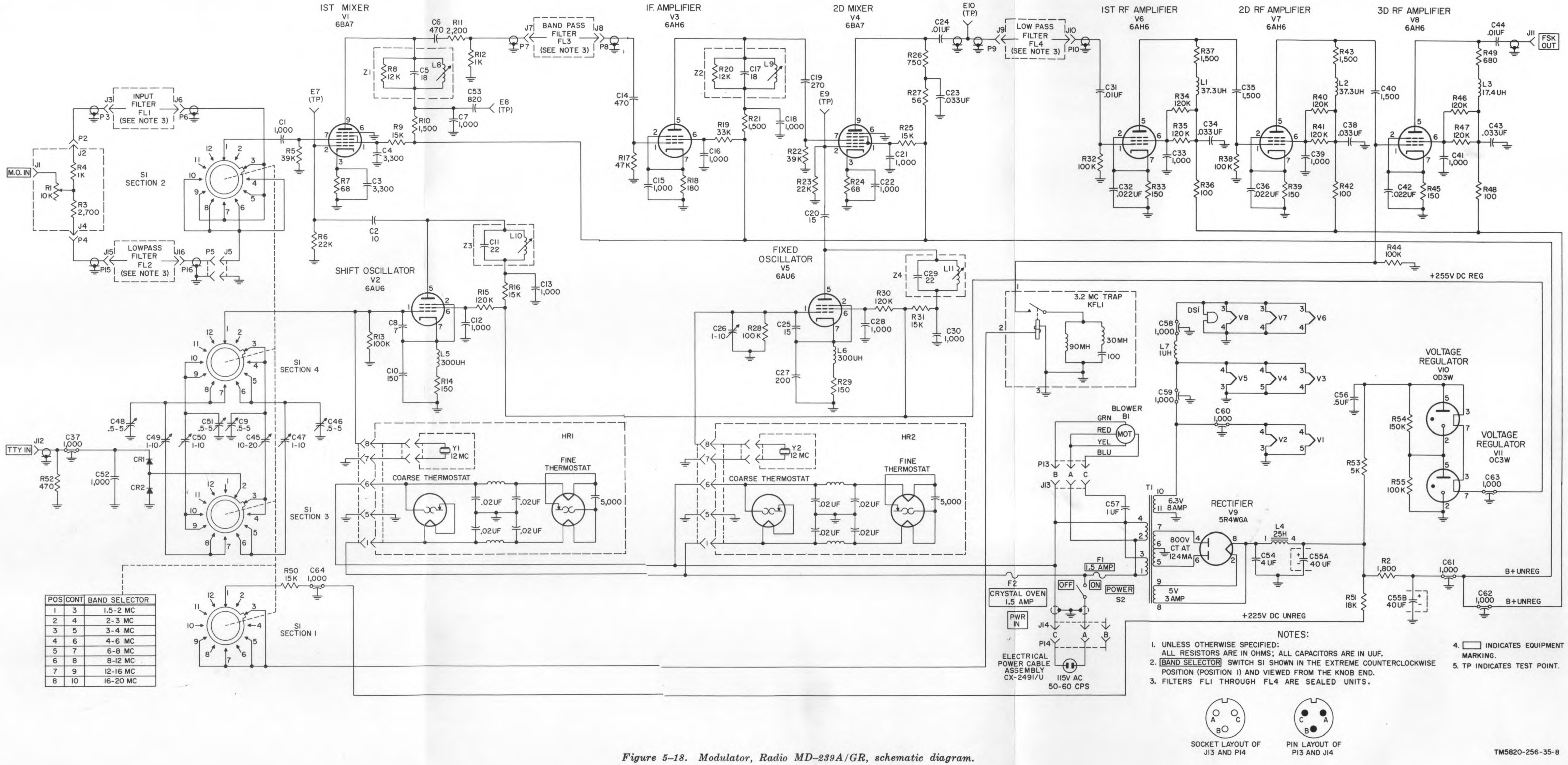
Figure 5–16. Modulator, Radio MD–239/GR, schematic diagram.



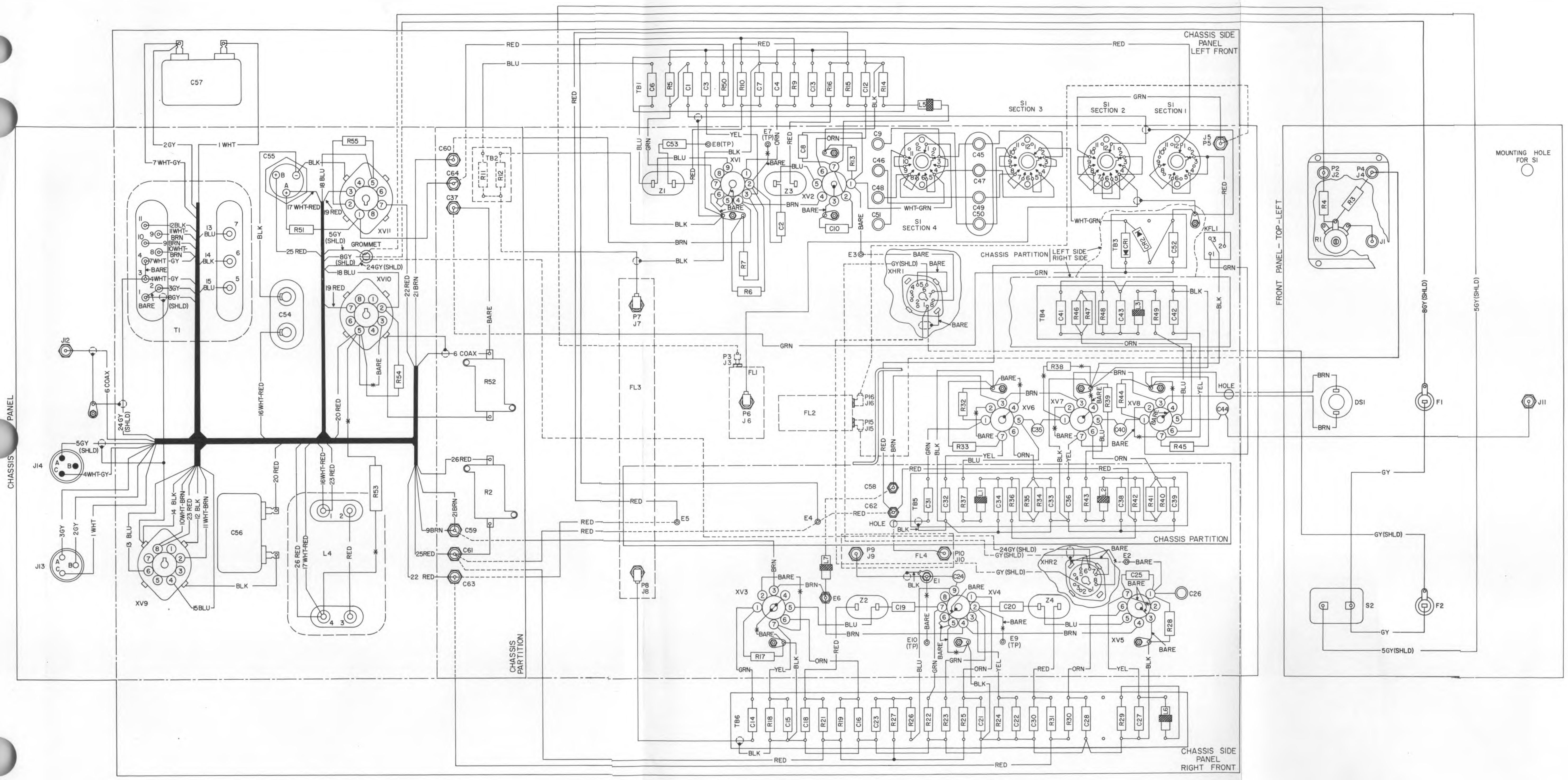
POS	CONT	BAND SELECTOR
1	3	1.5-2 MC
2	4	2-3 MC
3	5	3-4 MC
4	6	4-6 MC
5	7	6-8 MC
6	8	8-12 MC
7	9	12-16 MC
8	10	16-20 MC

NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS; ALL CAPACITORS ARE IN UUF.
2. BAND SELECTOR SWITCH S1 SHOWN IN THE EXTREME COUNTERCLOCKWISE POSITION (POSITION 1) AND VIEWED FROM THE KNOB END.
3. FILTERS FL1 THROUGH FL4 ARE SEALED UNITS.
4. ▭ INDICATES EQUIPMENT MARKING.
5. TP INDICATES TEST POINT.

Figure 5–18. Modulator, Radio MD–239A/GR, schematic diagram.

TM5820-256-35-8



NOTES:

1. WIRES WITHIN CABLE HARNESS ARE NUMBERED CONSECUTIVELY AND COLOR CODED.
2. THE TWO POINTS INDICATED BY WIRE 1 WHT ARE CONNECTED, THOSE TIED TO WIRE 2 GY ARE CONNECTED, ETC.
3. THE ANGLE AT WHICH A SPECIFIC WIRE ENTERS A CABLE INDICATES THE DIRECTION TO FOLLOW IN FINDING THE OTHER END OF THE WIRE.
4. POINT-TO-POINT JUMPER WIRES ARE EITHER BARE, OR INDICATED BY COLOR CODE ONLY.
5. * INDICATES WIRES COVERED WITH SLEEVING.
6. ALL POINTS SHOWN ARE CHASSIS GROUND.
7. ON MODULATOR, RADIO MD-239A/GR PROCURED ON ORDER NO. 3219-PHILA-59, THE INDICATED CABLE IS EXTENDED TO INCLUDE THE FOLLOWING WIRES:

   A- THE THREE SHIELDED WIRES DESIGNATED 5GY, 8GY, AND 24GY FROM THE ORIGINAL CABLE BREAKOUT (NEAR THE GROMMET BETWEEN XV10 AND XV11) TO A POINT NEAR THEIR TERMINATIONS.

   B- THE SHIELDED JUMPER FROM PIN 6 OF XHR1 TO PIN 6 OF XHR2. THE WIRE DESIGNATION IS CHANGED FROM GY (SHLD) TO 27GY (SHLD).

   C- THE SHIELDED JUMPER FROM PIN 1 OF XHR1 TO PIN 1 OF XHR2. THE WIRE DESIGNATION IS CHANGED FROM GY (SHLD) TO 28GY (SHLD)

   D- THE SHIELDED WIRE FROM F2. THE WIRE DESIGNATION IS CHANGED FROM GY (SHLD) TO 29GY (SHLD).

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Figure 5-19. Modulator, Radio MD-239A/GR, wiring diagram.

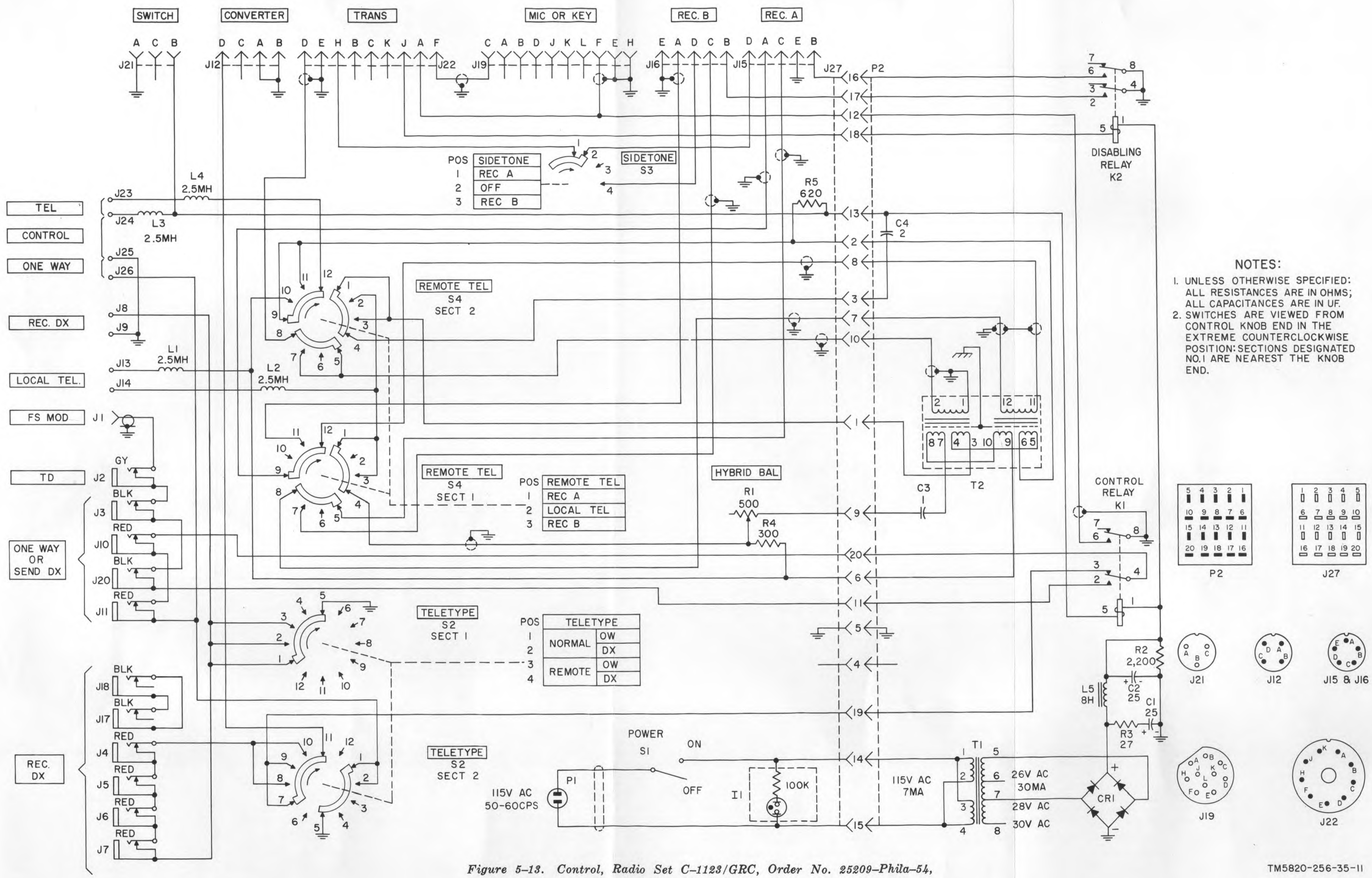

Figure 5-13. Control, Radio Set C-1123/GRC, Order No. 25209-Phila-54, schematic diagram.

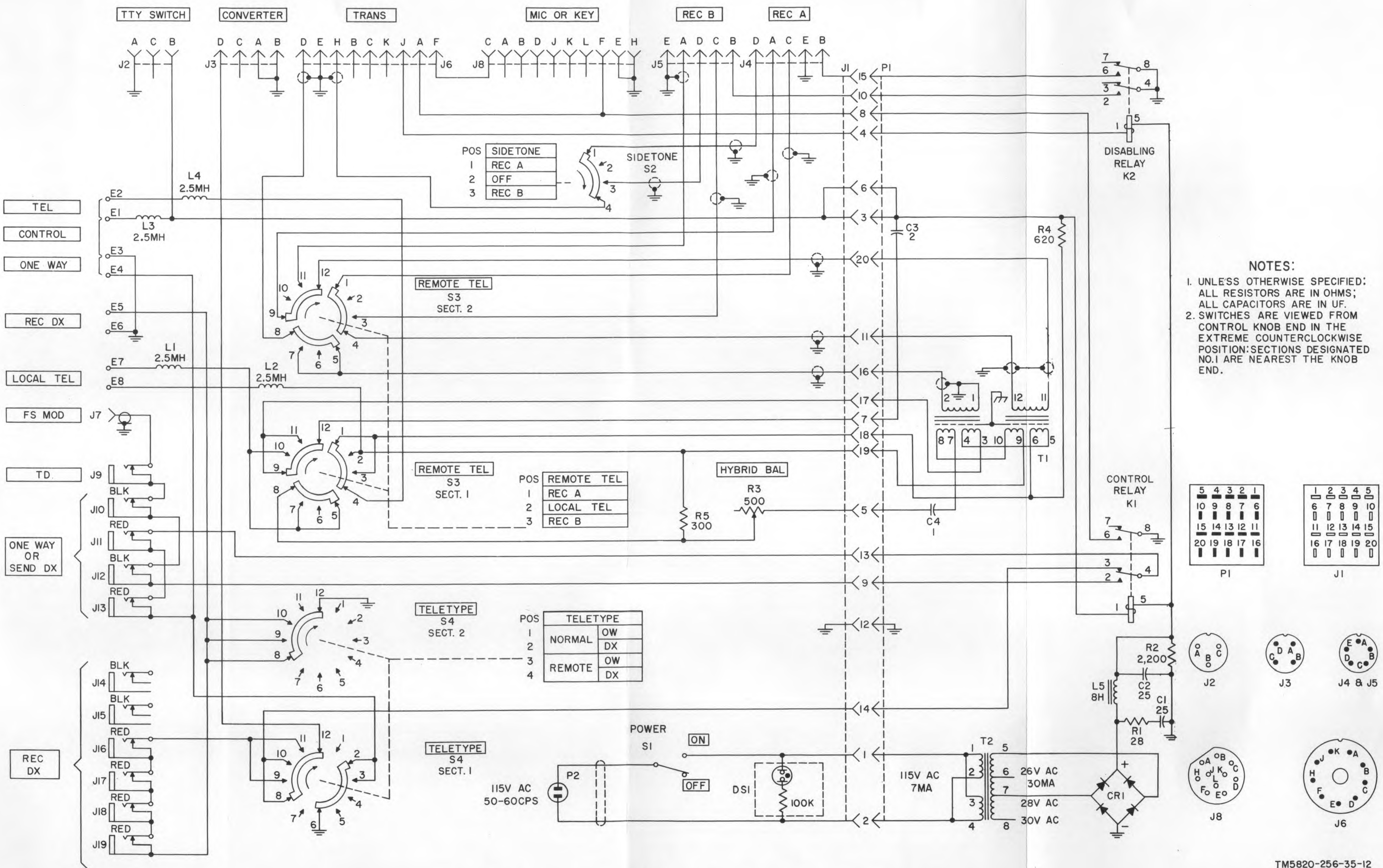

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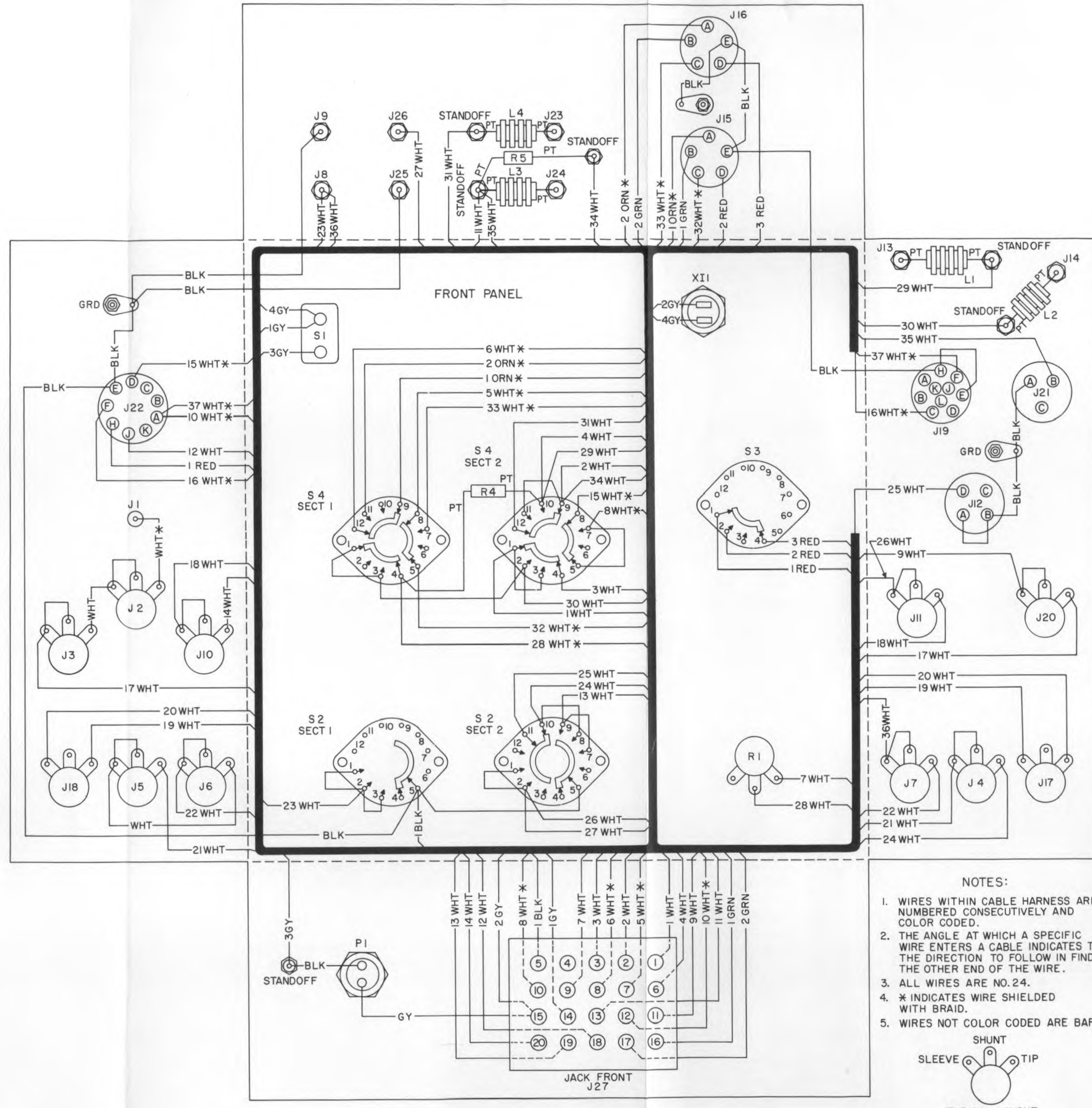
Figure 5-14. Control, Radio Set C-1123/GRC, most orders, schematic diagram.

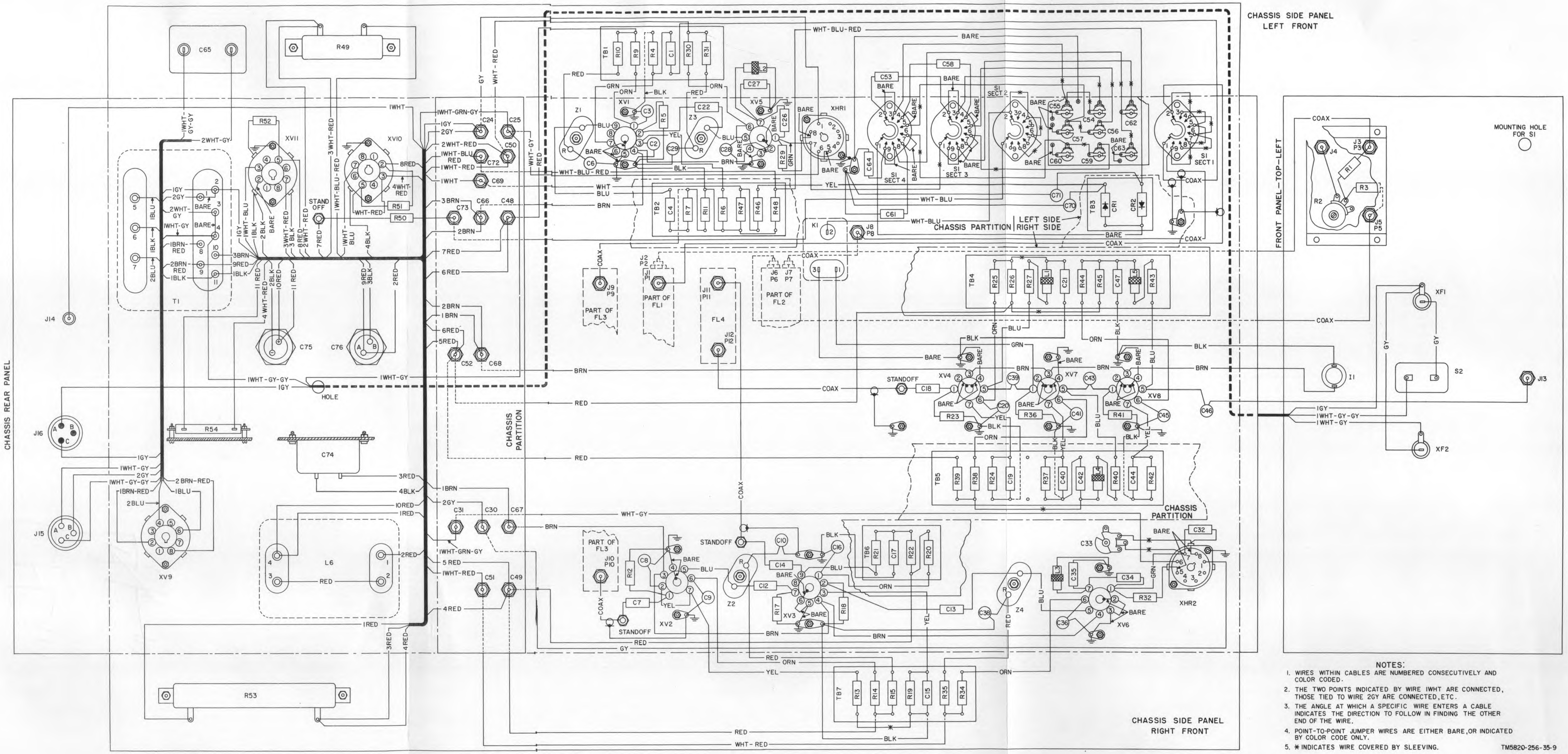


NOTES:

1. WIRES WITHIN CABLE HARNESS ARE NUMBERED CONSECUTIVELY AND COLOR CODED.
2. THE ANGLE AT WHICH A SPECIFIC WIRE ENTERS A CABLE INDICATES THE THE DIRECTION TO FOLLOW IN FINDING THE OTHER END OF THE WIRE.
3. ALL WIRES ARE NO.24.
4. * INDICATES WIRE SHIELDED WITH BRAID.
5. WIRES NOT COLOR CODED ARE BARE.

TM5820-256-35-13

Figure 5-15. Control, Radio Set C-1123/GRC, Order No. 25209-Phila-54, main chassis wiring diagram.



NOTES:

1. WIRES WITHIN CABLES ARE NUMBERED CONSECUTIVELY AND COLOR CODED.
2. THE TWO POINTS INDICATED BY WIRE IWHT ARE CONNECTED, THOSE TIED TO WIRE 2GY ARE CONNECTED, ETC.
3. THE ANGLE AT WHICH A SPECIFIC WIRE ENTERS A CABLE INDICATES THE DIRECTION TO FOLLOW IN FINDING THE OTHER END OF THE WIRE.
4. POINT-TO-POINT JUMPER WIRES ARE EITHER BARE, OR INDICATED BY COLOR CODE ONLY.
5. * INDICATES WIRE COVERED BY SLEEVING.

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Figure 5-17. Modulator, Radio MD-239/GR, wiring diagram.

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