DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-614

TO 31R2-2GRC-161

RADIO SET AN/GRC-10

RADIO TERMINAL SET AN/GRC-39

RADIO REPEATER SET AN/GRC-40

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

NOVEMBER 1954

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 550- and 250-volt plate and power supply circuits, or on the 230- or 115-volt a-c line connections

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES EXIST IN THE FOLLOWING UNITS:

Dynamotor-Power Supply DY–94/GRC–10
Radio Transmitter T–235/GRC–10
Radio Receiver R–125/GRC–10
Radio Set Control C–632/GRC–10

Do not touch the transmitting antenna connector when the equipment is in operation

TECHNICAL MANUAL
No. 11-614
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DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *19 November 1954*

RADIO SET AN/GRC-10
RADIO TERMINAL SET AN/GRC-39
RADIO REPEATER SET AN/GRC-40

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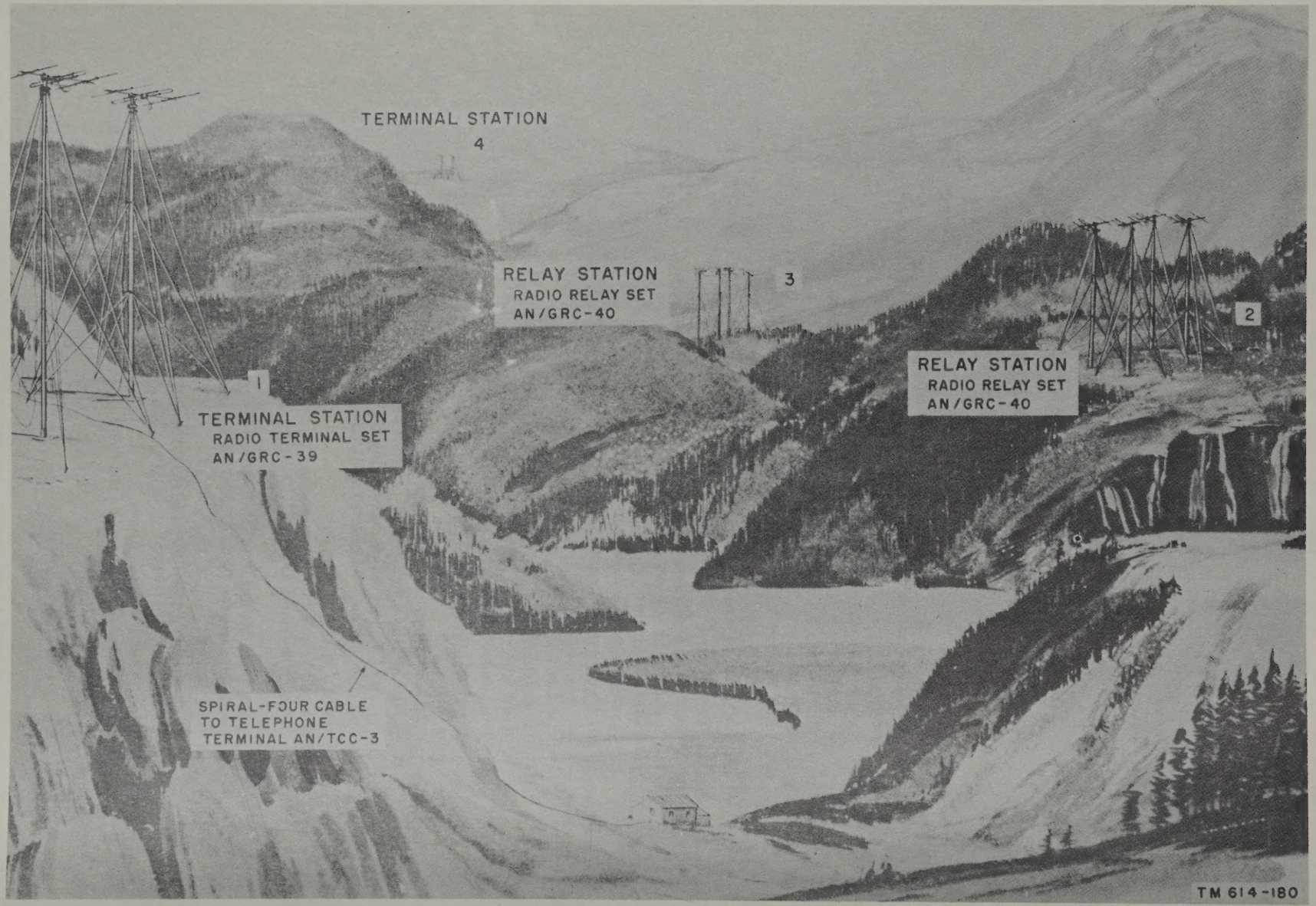


Figure 1. Complete radio relay system.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for the use of all concerned. It contains instructions necessary for the installation, operation, maintenance, and repair of Radio Set AN/GRC–10, Radio Terminal Set AN/GRC–39, and Radio Repeater Set AN/GRC–40.

b. The instructions cover the operation of Radio Set AN/GRC–10 as an ordinary radio set and as part of a single-channel radio-relay system. The instructions also cover the operation of the radio set as part of a multichannel radio terminal set (Radio Terminal Set AN/GRC–39) and as part of a multichannel radio relay set (Radio Repeater Set AN/GRC–40). Multichannel operation is used in connection with telephone equipment to complete a communication system composed of radio and telephone equipment. Figure 1 shows a complete radio relay system used to link two telephone terminals. Information is also given concerning the propagation characteristics of radio waves at the frequencies used by this equipment; these characteristics should be considered when installing and using the radio sets.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of material and equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5.

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. DA Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 53).

d. DA Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 54).

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use of Radio Set AN/GRC–10

a. Radio Set AN/GRC–10 is a combined frequency-modulated (f-m) transmitter, an f-m receiver, and a power supply, all interconnected through a control unit and mounted in an equipment rack (fig. 2). The frequency range of the radio set is 54.0 through 70.9 megacycles (mc). It may be mounted in various types of vehicles or used as a fixed field station.

b. Because, in most applications, it will be necessary for the transmitter and receiver to operate on different frequencies, two separate antennas are provided with the radio set. Two identical Yagi antennas (fig. 16) or one Yagi and one ground-plane antenna (fig. 8) may be constructed. Yagi antennas provide relatively strong transmission and reception in substantially one direction, and ground-plane antennas supply uniform, although lower, signal strength in all directions.

c. Two power outputs are available from the transmitter. A nominal power output of either 10 or 40 watts is selected by operating a switch on the front panel.

d. The power supplied to the radio set may be 115 or 230 volts alternating current (a-c) or 26 volts direct current (d-c). Provision is made in the control unit for using 26 volts d-c as a standby power source while operating on a-c. If the a-c

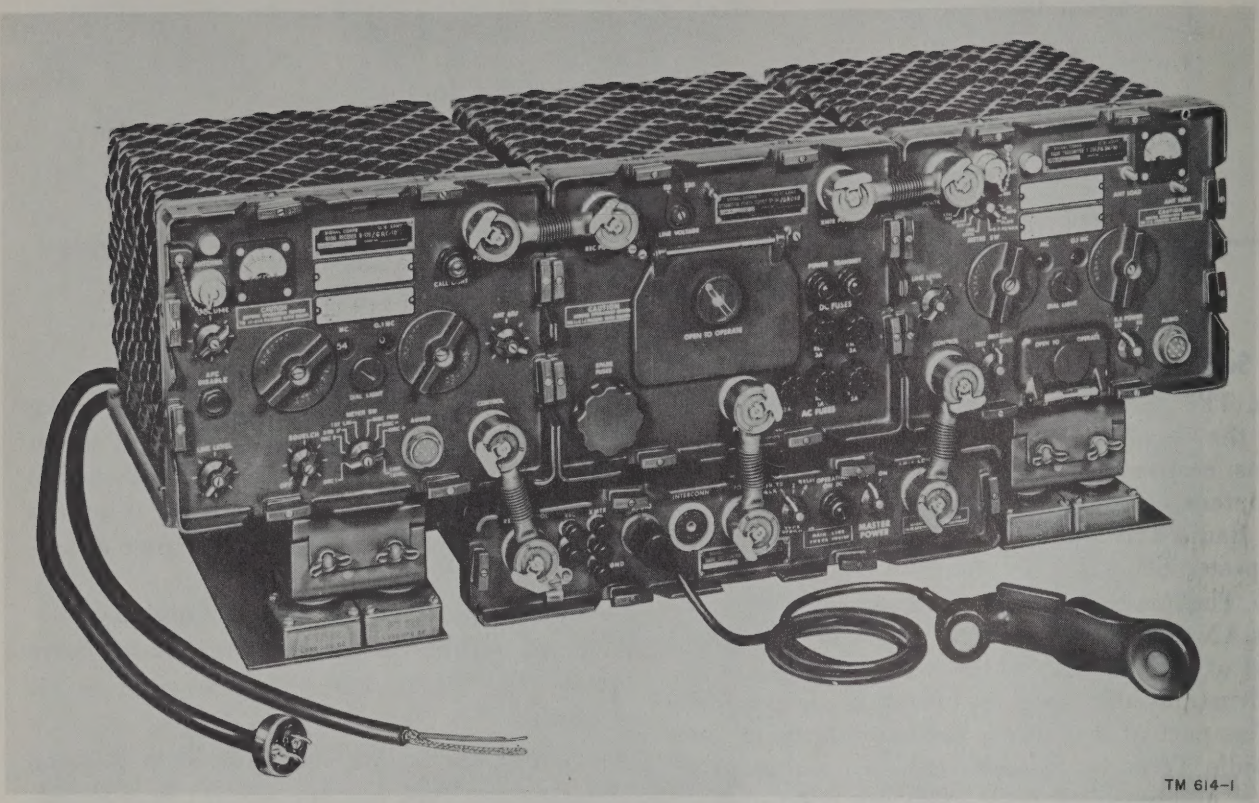


Figure 2. Radio Set AN/GRC–10, less antennas.

power fails, the d-c source is switched in automatically; the set will switch back to a-c operation when the a-c power is restored.

e. The radio set may be used for simple push-to-talk voice operation, or may be used as part of a multichannel system (par. 6). In the latter service, it is capable of handling up to five audio channels simultaneously. Figure 3 shows a block diagram of two Radio Sets AN/GRC–10 used in a simple point-to-point, single-channel, push-to-talk voice system. Two antennas are required at each station, one for the transmitter and one for the receiver. Normally the transmitters operate on different frequencies (F1 and F2 in figure 3),

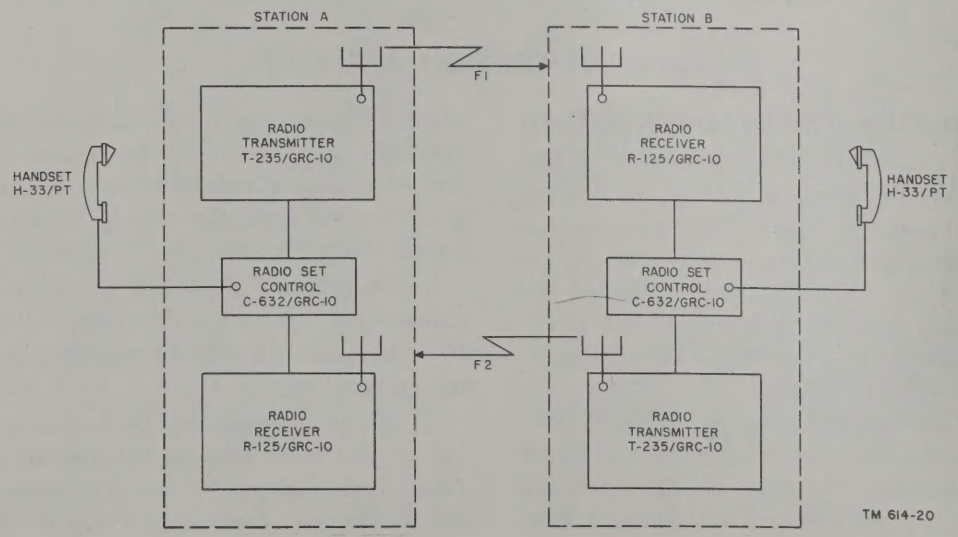


Figure 3. Radio Sets AN/GRC–10 as single push-to-talk field sets.

and thus permit break-in operation. Although this type of system is limited to one voice channel, it is suitable for point-to-point use. The radio sets may be mounted in vehicles or used at fixed locations.

4. Purpose and Use, Radio Repeater Set AN/GRC–40

a. Because the frequencies used by Radio Set AN/GRC–10 limit the transmitting range to approximately line-of-sight distances, one or more relay stations are used when the distance between terminal stations is outside the dependable transmitting range of the radio set. A relay station (Radio Repeater Set AN/GRC–40) consists of two Radio Sets AN/GRC–10 together with two Power Units PE–75, and the necessary connecting cords and junction boxes (fig. 4). Refer to the appendix for an exact list of the components. Figure 5 shows a block diagram of a single-channel system that uses two relay stations and two terminal stations. In such a system each transmitter normally operates on a different frequency, and thus permits break-in operation. Four antennas are required at each relay station (fig. 5). Although the terminal stations would usually be set for push-to-talk operation, the relay stations must be set for duplex operation; that is, they can receive and retransmit signals traveling in both directions at the same time. They are placed in duplex operation simply by setting a switch on the panel of each control unit. During duplex operation, the operator at any relay station may communicate in both directions at the same time.

b. The maximum number of relay stations that may be used will depend on the amount and nature of the signal traffic, the radio-frequency (r-f) noise at any receiving site, and the signal loss caused by terrain features. Normally the accumulated noise of the system will limit the number of relay stations to five.

5. Purpose and Use, Radio Terminal Set AN/GRC–39

a. Although Radio Set AN/GRC–10 may be used as a terminal station, Radio Terminal Set AN/GRC–39 (fig. 6) is usually supplied for that purpose. Radio Terminal Set AN/GRC–39 consists of one Radio Set AN/GRC–10, two Power Units PE–75, and the necessary connecting cords and junction boxes. Refer to the appendix for an exact list of the components.

b. When Radio Terminal Set AN/GRC–39 is connected to Telephone Terminal AN/TCC–3 and it associated equipment (figs. 6 and 7), multichannel operation may be obtained. Some of the possible signal combinations available are—

4 voice channels.
3 voice and 4 telegraph channels.
3 voice channels and 1 facsimile channel.
2 voice, 1 facsimile, and 4 telegraph channels.
2 voice and 8 telegraph channels.
1 voice and 12 telegraph channels.
1 voice, 1 facsimile, and 8 telegraph channels.
1 voice, 4 telegraph, and 2 facsimile channels.
I voice and 3 facsimile channels.

c. Figure 7 shows how wire equipment may be connected to the radio set or the terminal set; the radio equipment then forms a link between two telephone terminals. In this type of service, the terminal and relay stations must be set for duplex operation. The order wire channel at the telephone terminal becomes part of the radio order wire channel. Refer to paragraphs 125 through 130 for a description of the telephone and telegraph equipment with which the radio equipment covered by this manual may be used.

6. System Application

a. Anything that may be transmitted by a length of wire may be transmitted by this radio equipment; therefore it will normally be used with telephone terminal equipment as shown in figure 6. Such a system provides a rapid method of linking two or more telephone or telegraph terminals when time or terrain limitations prevent the laying of telephone wire. The spiral-four cable that connects telephone or telegraph terminal equipment to a terminal radio station may be up to 5 miles long.

b. In multichannel use, five audio channels are available, over which various combinations of signals may be distributed (par. 5*b*). The lowest-frequency channel (channel 1) is called the *order wire or narrow-band* (nb) channel. This channel normally is reserved as the system service channel; it permits all of the radio operators to communicate with each other, and thus is similar to a telephone party line. The frequency range of channel 1 is 250 through 3,500 cycles. The radio operators in the system are not able to communicate on the upper four audio channels, nor will they know the nature of the signals on these channels.



Figure 4. Radio Repeater Set AN/GRC-40, mounted in vehicle, including one antenna.

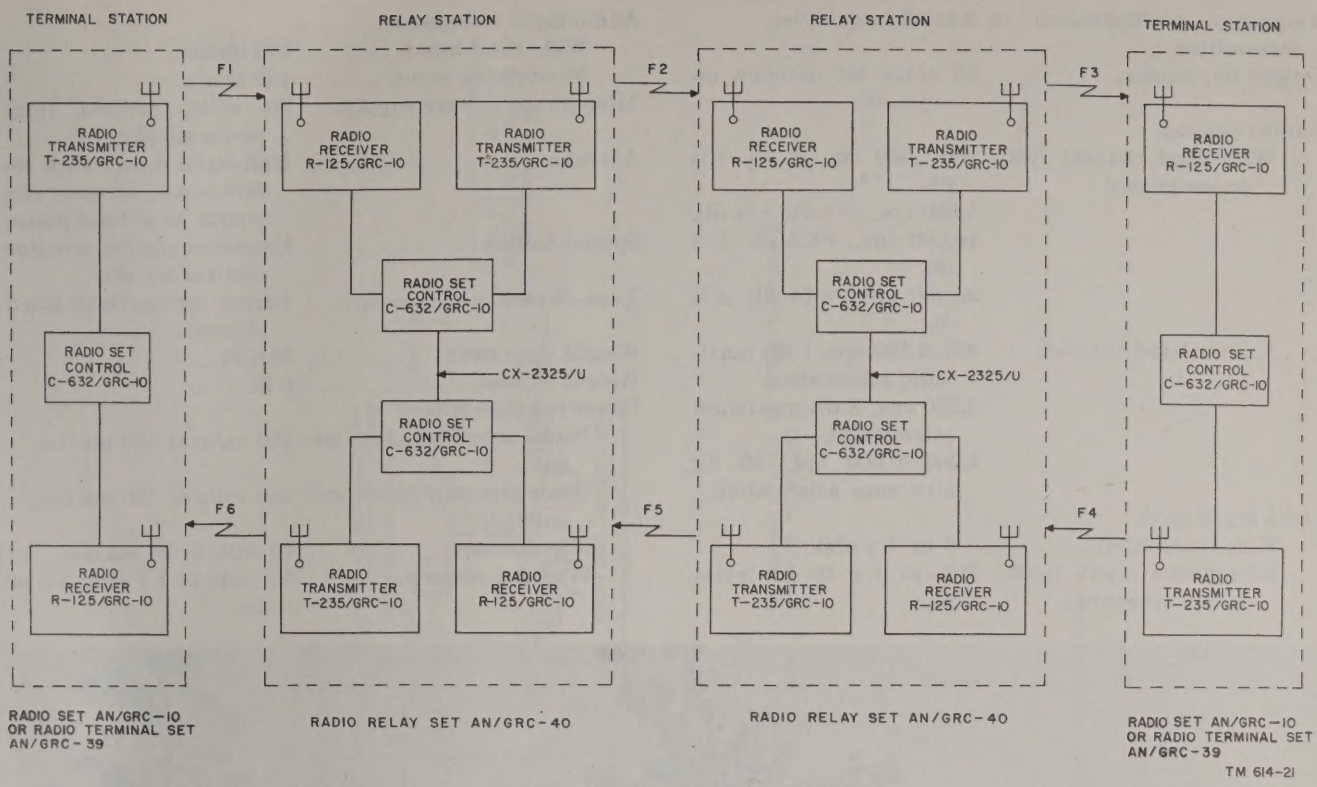


Figure 5. Single-channel radio relay system, block diagram.

c. It is possible to use several Radio Terminal Sets AN/GRC–39 at one location; each serves as a terminal station for a communications system. The essential precautions for such a setup are that the operating frequencies of the various transmitters and receivers be selected so that interference to the receivers from spurious radiations by the transmitters is at a minimum. Serious consideration must be given to the information in paragraphs 90 through 92.

d. Distances between stations will depend on various conditions, such as the terrain to be covered, the amount of r-f interference present, the type of signal traffic to be handled, and the degree of reliability required. Nominally, transmission at the frequencies used by these stations is confined to line-of-sight distances, although reliable communication is frequently obtained over distances greater than a true optical line of sight. When the exact nature of the terrain is known, maximum distances may be calculated (par. 36). When the terrain features are unfamiliar, some experimentation may be necessary in determining the proper location of a station.

e. Materials are provided to construct only one ground-plane antenna (fig. 8) with Radio Set AN/GRC–10 (par. 3*b*). Because Radio Terminal Set AN/GRC–39 and Radio Repeater Set AN/GRC–40 include a spare Radio Set AN/GRC–10, materials to construct another ground-plane antenna are supplied with them so that two ground-plane antennas may be used at relay or terminal stations.

7. Technical Characteristics of Radio Transmitter T–235/GRC–10

Frequency range	54 to 70.9 mc (170 channels spaced .1 mc apart).
Transmitter type	F-m, with afc.
Types of signals	Voice; multichannel telephone, telegraph, or facsimile; or a combination of these.
Distance range	HI power, 20–50 miles (line-of-sight path).
	LO power, 5–15 miles (line-of-sight path).
Type of modulation	F-m.
Maximum frequency deviation.	± 40 kc.
Number of tubes	16.
Power output	HI power, 40 watts.
	LO power, 10 watts.
Crystals, monitor receiver:	
Type	Crystal Holder HC–6/U.
Frequency range	37.85–53.85 mc (first h-f oscillator).
	12.95–13.85 mc (second h-f oscillator).

Frequency multiplication in transmitter.	2 at all frequencies.
Output impedance	50 ohms (at antenna receptacle).
Audio response:	
Wide-band channel (with pre-emphasis).	250-1,000 cps, 0 db ±½ db. 5,000 cps, +4 db ±½ db. 10,000 cps, +8.5 db ±½ db. 20,000 cps, +14 db ±½ db.
Narrow-band channel	250–2,500 cps, 1 db maximum attenuation. 3,200 cps, 3 db maximum attenuation. 4,200-20,000 cps, 40 db minimum attenuation.
Audio input level:	
Wide-band input	−9 to +3 dbm.
Microphone input (push-to-talk operation).	350 mv for 40 kc deviation.
Audio input impedance:	
Wide-band input	600 ohms.
Microphone input	150 ohms.
Microphone voltage supply	20 volts, derived from power supply.
Antenna	Half-wave dipole with reflector and director elements, or ground plane.
Special feature	Crystal-controlled monitor receiver for afc.
Type of cooling	Forced air (self-contained blower).
Weight (less case)	28½ lb.
Weight of case	6 lb.
Power requirements:	
Power amplifier plate circuit.	550 volts at 150 ma d-c.
Other plate and screen circuits.	250 volts at 120 ma d-c.
Microphone	20 volts at 25 ma d-c.
Filament circuits	26 volts at 1.7 amp a-c or d-c.



Figure 6. Radio Terminal Set AN/GRC–39 with telephone terminal equipment.

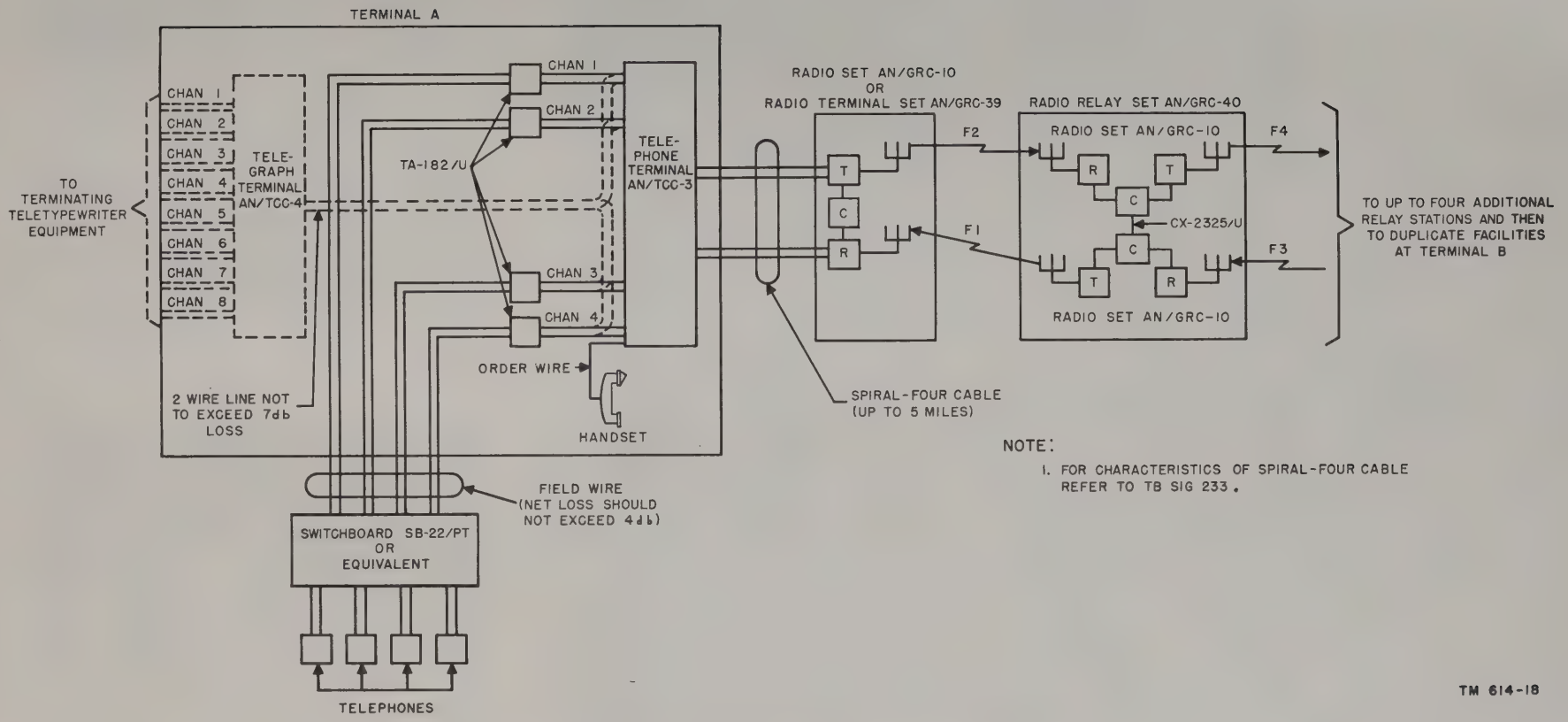


Figure 7. Radio sets in multichannel communication system.

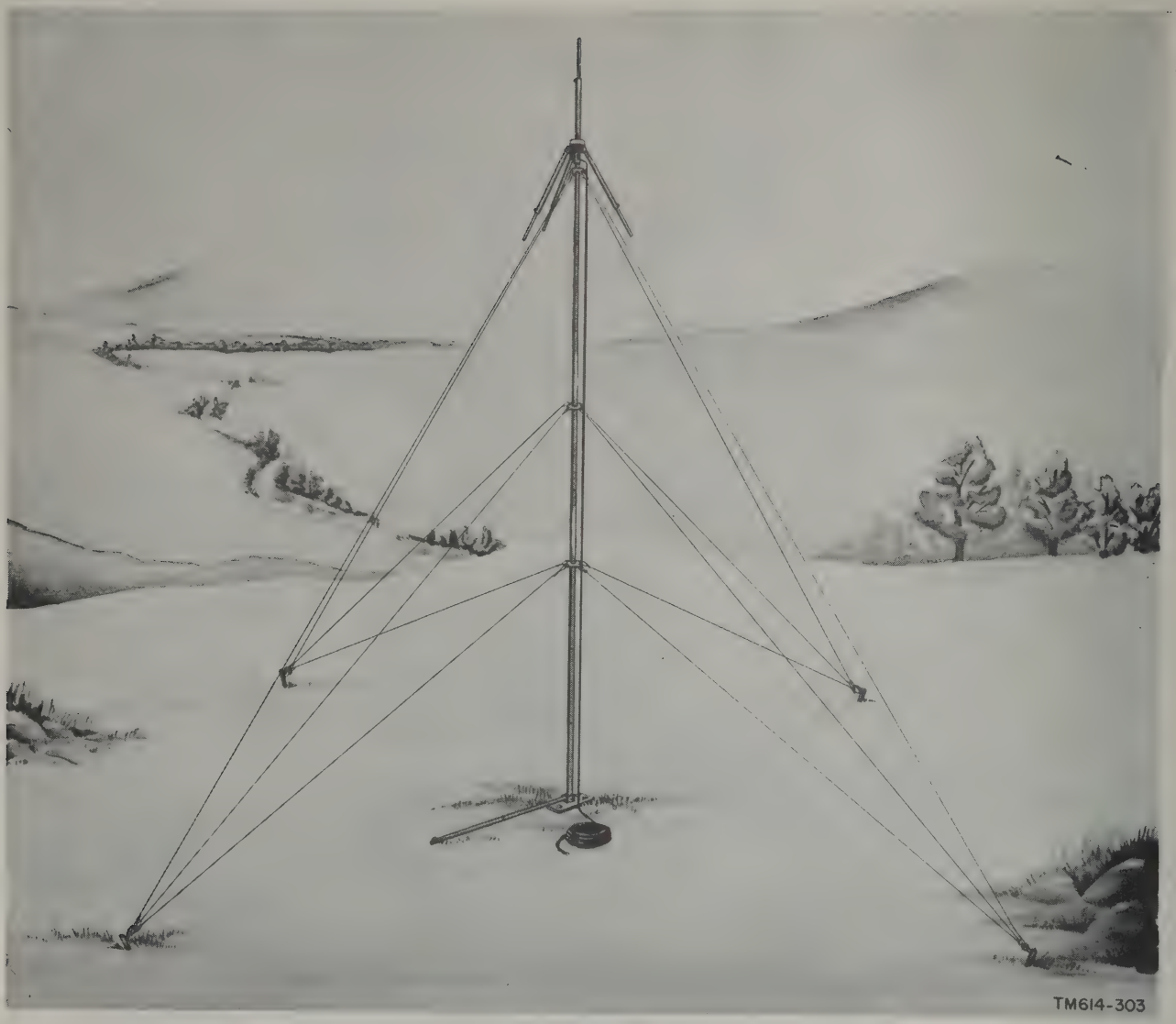


Figure 8. Ground-plane antenna.

8. Technical Characteristics of Radio Receiver R–125/GRC–10

Frequency range	54 to 70.9 mc (170 channels spaced .1 mc apart).
Receiver type	Double conversion superheterodyne.
Type of signal received	F-m (±40 kc maximum deviation).
Number of tubes	23.
Intermediate frequencies:	
Variable (2 stages)	15.15–16.05 mc.
Fixed (4 stages)	4.3 mc.
Frequency control	Crystal and afc.
Crystals:	
Type	Crystal Holder HC–6/U.
Frequency range	38.85–54.85 mc.
Output impedance:	
Wide-band output	600 ohms.
Narrow-band output	600 ohms for loudspeaker; 4 ohms for earphone of handset.
Output level (with 10 uv input; 40 kc deviation; 1,000 cps):	
Wide-band output	50 milliwatts.
Narrow-band output:	
Speaker	750 milliwatts.
Earphone of handset	30 milliwatts.
Audio response:	
Wide-band channel (with de-emphasis).	250–1,000 cps, 0 db ±½ db. 5,000 cps, −4 db ±½ db. 10,000 cps, −8.5 db ±½ db. 20,000 cps, −db ±½ db.

Audio response—Continued	
Narrow-band channel	250–2,500 cps, 1 db maximum attenuation. 3,200 cps, 3 db maximum attenuation. 4,200–20,000 cps, 40 db min attenuation.
Receiver sensitivity	.5 microvolt signal input for 10 db signal-plus-noise to noise ratio.
Squelch sensitivity	1 microvolt.
Selectivity	140 kc minimum at 3 db points. 420 kc maximum at 60 db points.
Antenna	Half-wave dipole with director and reflector elements, or ground plane.
Weight (less case)	25 lb.
Weight of case	6 lb.
Power requirements:	
Plate and screen circuits	200 volts at 100 ma d-c.
Filament circuits	26 volts at 1.3 amp a-c or d-c.

9. Technical Characteristics of Dynamotor-Power Supply DY–94/GRC–10

A-c rectification	Seven selenium rectifiers
D-c inversion	Two nonsynchronous vibrators: one for receiver 200-volt supply, one for transmitter 250-volt supply.
Dynamotor	Supplies 550 volts d-c for transmitter power amplifier plate when d-c power source is used.
Voltage regulation	Performed in receiver and transmitter.
Power input:	
115 volts or 230 volts, 50–65 cps a-c	292 watts.
or	
26 volts d-c	326 watts.
Type of cooling	Forced air (self-contained blower).
Power output:	
To transmitter	550 volts at 150 ma. 250 volts at 120 ma. 26 volts a-c or d-c at 1.7 amperes. 20 volts at 25 ma.
To receiver	200 volts at 100 ma. 26 volts a-c or d-c at 1.3 amp.
Weight (less case)	53½ lb.
Weight of case	6 lb.

10. Technical Characteristics of Radio Set Control C–632/GRC–10

Number of tubes	Two.
Power source	115 or 230 volts, 50–65 cps a-c; or 26 volts d-c.
Special features	Provision made for automatic use of d-c power when a-c power fails.
Weight (less case)	10 lbs.
Weight of case and power cables.	8 lbs.

11. Combined Receiver-transmitter Audio Response

Wide-band channel, 250–20,000 cps.	±1 db of 1 kc level, with maximum distortion of 1 percent.
Narrow-band channel, 250–3,500 cps.	±5 db of 1 kc level, with maximum distortion of 10 percent.

12. Technical Characteristics of Antenna Group OA–249/GRC–10

Characteristic impedance	52 ohms.
Frequency range	54 to 71 mc inclusive.
Weight	230 lb.
Antenna type	Yagi with ground-plane adapter.
Radiation pattern of Yagi antenna.	(par. 35c).

13. Nomenclature Assignments

a. A list of the nomenclature assignments for the radio sets covered by this technical manual is given below. A common usage name is indicated after each radio set.

Nomenclature	*Common name*
Radio Set AN/GRC–10	Radio set.
Radio Terminal Set AN/GRC–39	Terminal set.
Radio Repeater Set AN/GRC–40	Relay set.

b. A list of the nomenclature assignments for the components of Radio Set AN/GRC–10 is given below. A common usage name is indicated after each component.

Nomenclature	*Common name*
Radio Transmitter T–235/GRC–10	Transmitter.
Radio Receiver R–125/GRC–10	Receiver.
Dynamotor-Power Supply DY–94/GRC–10.	Power supply.
Radio Set Control C–632/GRC–10	Control unit.
Rf Cable Assembly CG–718/U (65 ft), Adapter Connector UG–643/U, and Rf Cable Assembly CG–718/U (35 ft).	Transmission line.
Special Purpose Cable Assembly CX–2324/U.	Component cable.
Special Purpose Cable Assembly CX–2325/U.	Interconnecting cable.
Antenna Group OA–249/GRC–10	Antenna group.
Antenna AS–620/GRC–10	Antenna array.
Mast AB–301/G	Mast.
Mast Section AB–300/G	Mast section.
Mast Base AB–318/U	Mast base.

Nomenclature	*Common name*
Guy Plate MX–1468/G	Guy plate.
Mast Adapter MX–1463/G	Mast adapter.
Electrical Equipment Rack MT–700/GRC–10.	Equipment rack.
Accessories Case CY–1097/GRC–10.	Accessories case.
Handset H–33/PT	Handset.
Dynamic Loudspeaker LS–166/U	Loudspeaker.

14. Packaging Data, Radio Set AN/GRC–10

a. When packed for shipment, the components of Radio Set AN/GRC–10 are placed in moisture-vaporproof containers and packed in four wooden crates. Shipping crates and typical packaging detail are shown in figures 9 through 12.

b. The following is a packaging data chart:

Number of crates	Height (in.)	Width (in.)	Depth (in.)	Volume (cu. ft.)	Unit weight (lb.)	Contents
1	12	18½	42½	7. 9	158	Transmitter, receiver, power supply, and running spares.
1	12¾	15¼	38⅜	6. 2	101. 25	Control unit with running spares, cable assemblies, accessories case, equipment rack, and technical manuals.
1	13⅜	14⅜	80	8. 9	134	Two antenna arrays, two transmission lines, accessories, and running spares.
1	11⅜	16¾	93	10. 0	216	Two sets of masts, two sets of guys, two sets of guy stakes, accessories, and spares.
					Total weight (lb.) 609.25	

15. Packaging Data, Radio Terminal Set AN/GRC–39

a. The radio terminal set includes two complete Radio Sets AN/GRC–10 (one of which is a spare), the packaging data for which is given in paragraph 14. Also included are two Power Units PE–75; refer to the appropriate technical manual for packaging data on these units.

b. Another crate is included with the radio terminal set. It contains the following:

1 Dynamic Loudspeaker LS–166/U.
1 Junction Box JB–110.
1 Junction Box J–85/G.
1 Telephone Cable Assembly CX–1521/U.
1 Cord CD–711.

The crate is: 20 inches high, 26 inches wide, and 48 inches deep and weighs 95 pounds.

16. Packaging Data, Radio Repeater Set, AN/GRC–40

The radio relay set is packed in the same manner as the radio terminal set (par. 15) with the following exceptions:

a. Three Radio Sets AN/GRC–10 are included (one of which is a spare).

b. The crate described in paragraph 15*b* does not contain a Telephone Cable Assembly CX–1512/U. Its dimensions remain the same; its weight is 90 pounds.

17. Components of Radio Set AN/GRC–10

Figures 13, 14, and 15 show the components of the radio set. A complete table of components is given in the appendix.

18. Components of Radio Terminal Set AN/GRC–39

A table of components of the radio terminal set is given in the appendix. The components supplied in addition to those that are part of Radio Set AN/GRC–10 are included in figure 6.

19. Components of Radio Repeater Set AN/GRC–40

A table of components of the radio relay set is given in the appendix. The components supplied in addition to those that are part of Radio Set AN/GRC–10 are included in figure 4.

20. Description of Radio Set AN/GRC–10

a. Radio Set AN/GRC–10 includes a transmitter, a receiver, a power supply, a control unit, a mounting rack, two suitable antenna systems, and interconnecting cables. Figure 13 shows the components of the radio set less the antennas; figure 16 shows the two antennas.

b. Transmitter T–235/GRC–10, Receiver R–125/GRC–10, Dynamotor-Power Supply DY–94/GRC–10, and Radio Set Control C–632/GRC–10

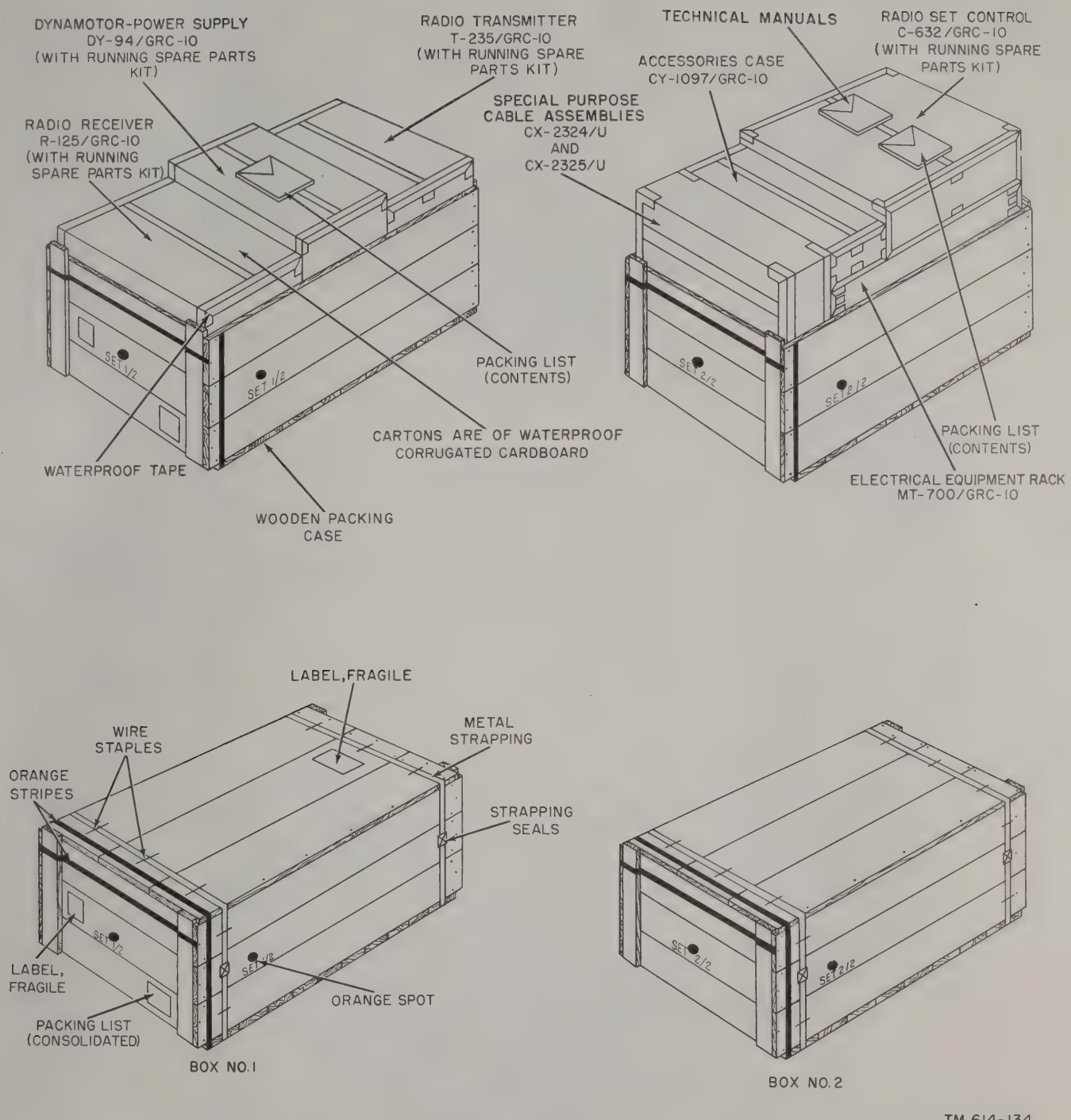


Figure 9. Radio Set AN/GRC–10 (less antenna group), packed for shipment.

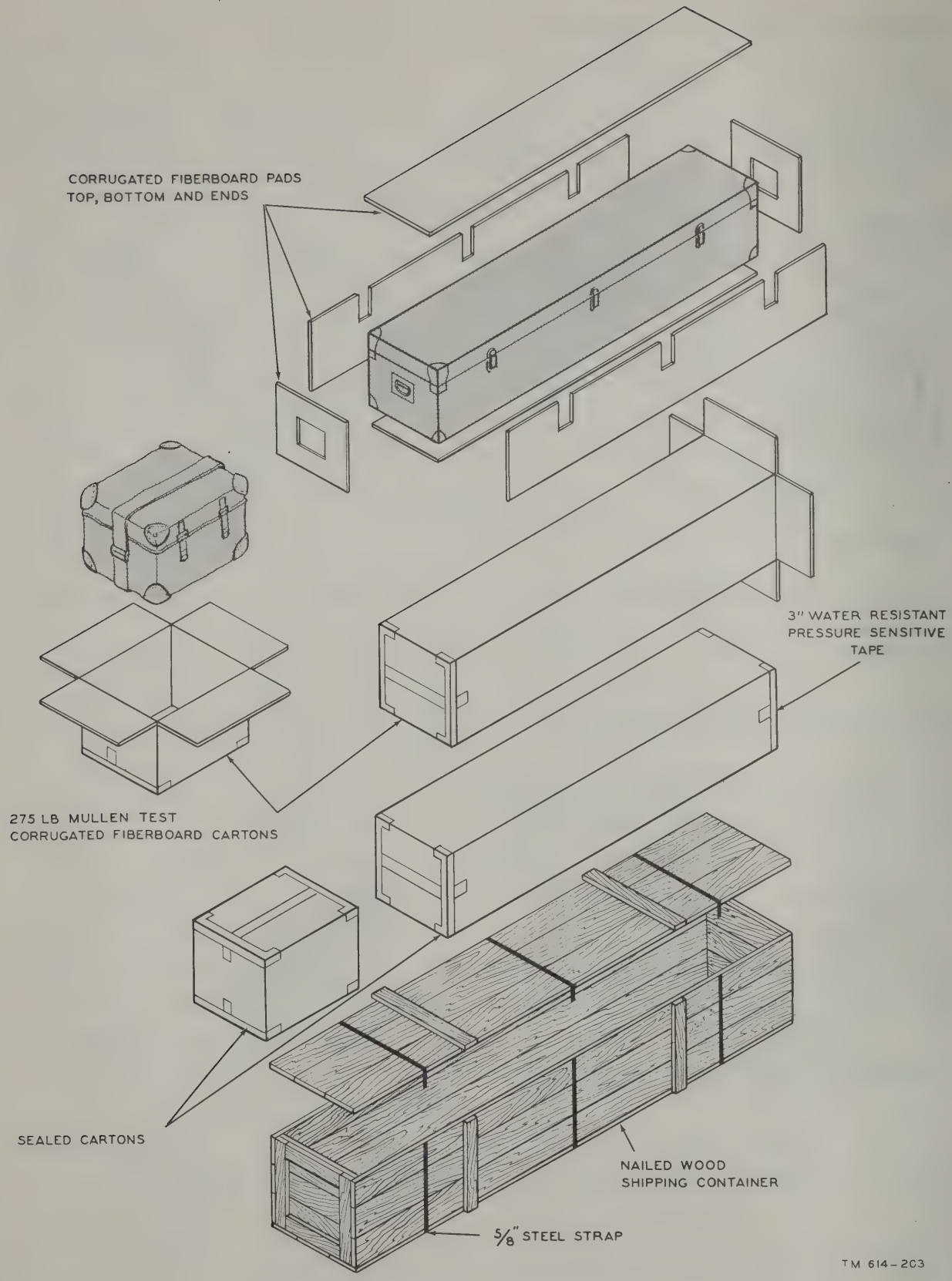


Figure 10. Antenna AS–620/GRC–10, packed for shipment.

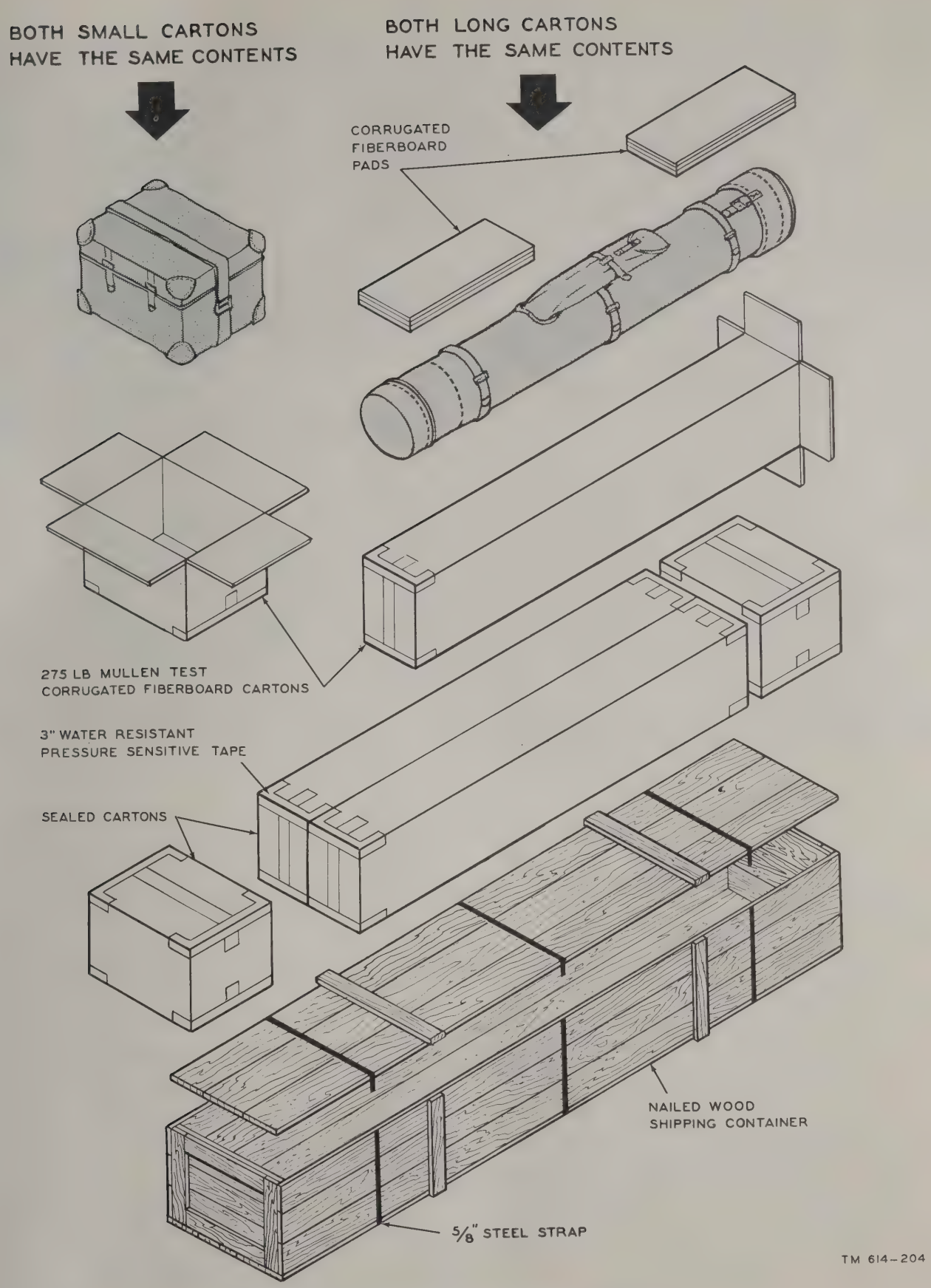


Figure 11. Mast AB-301/G, packed for shipment.

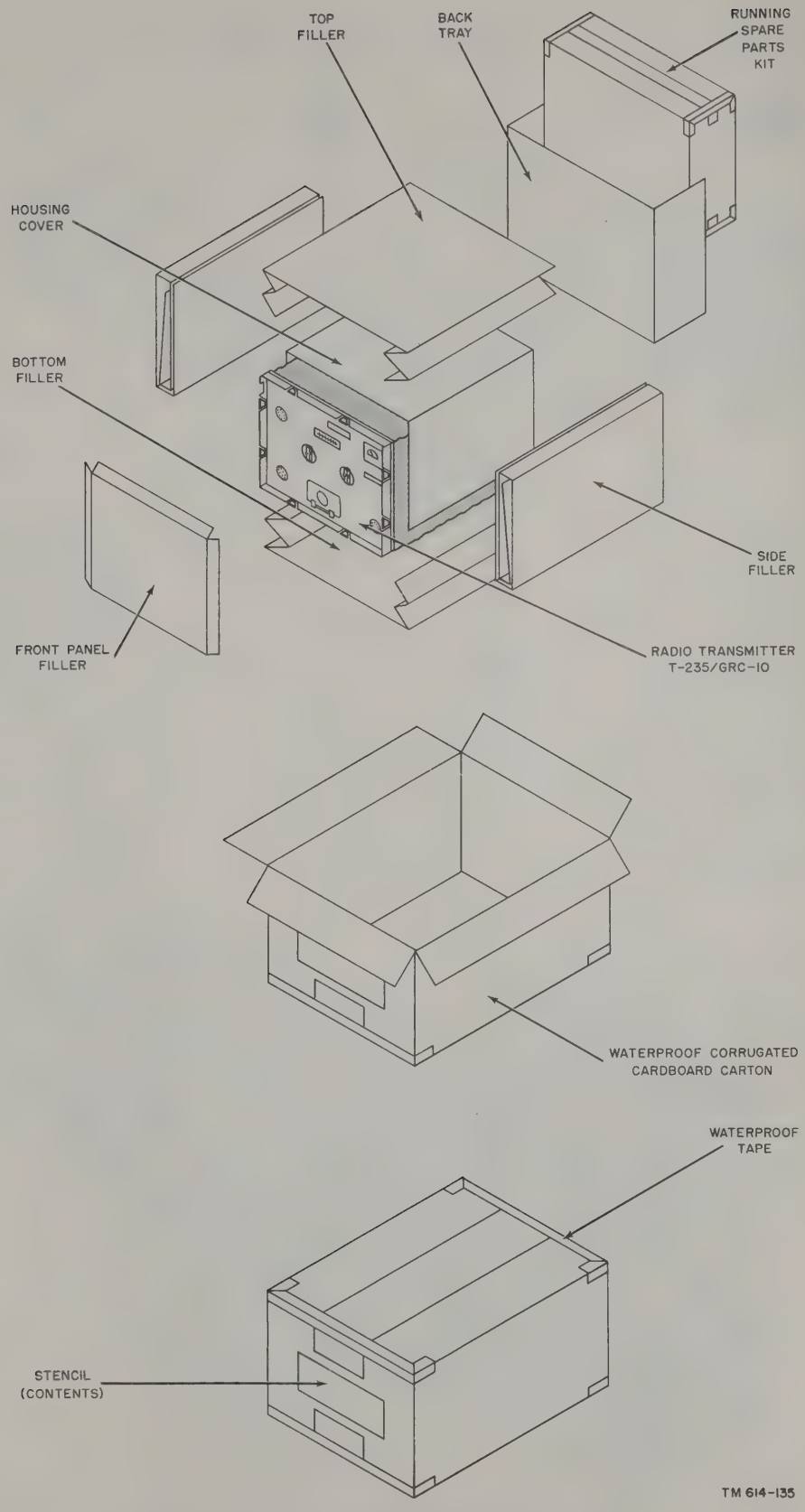


Figure 12. Typical packaging detail.

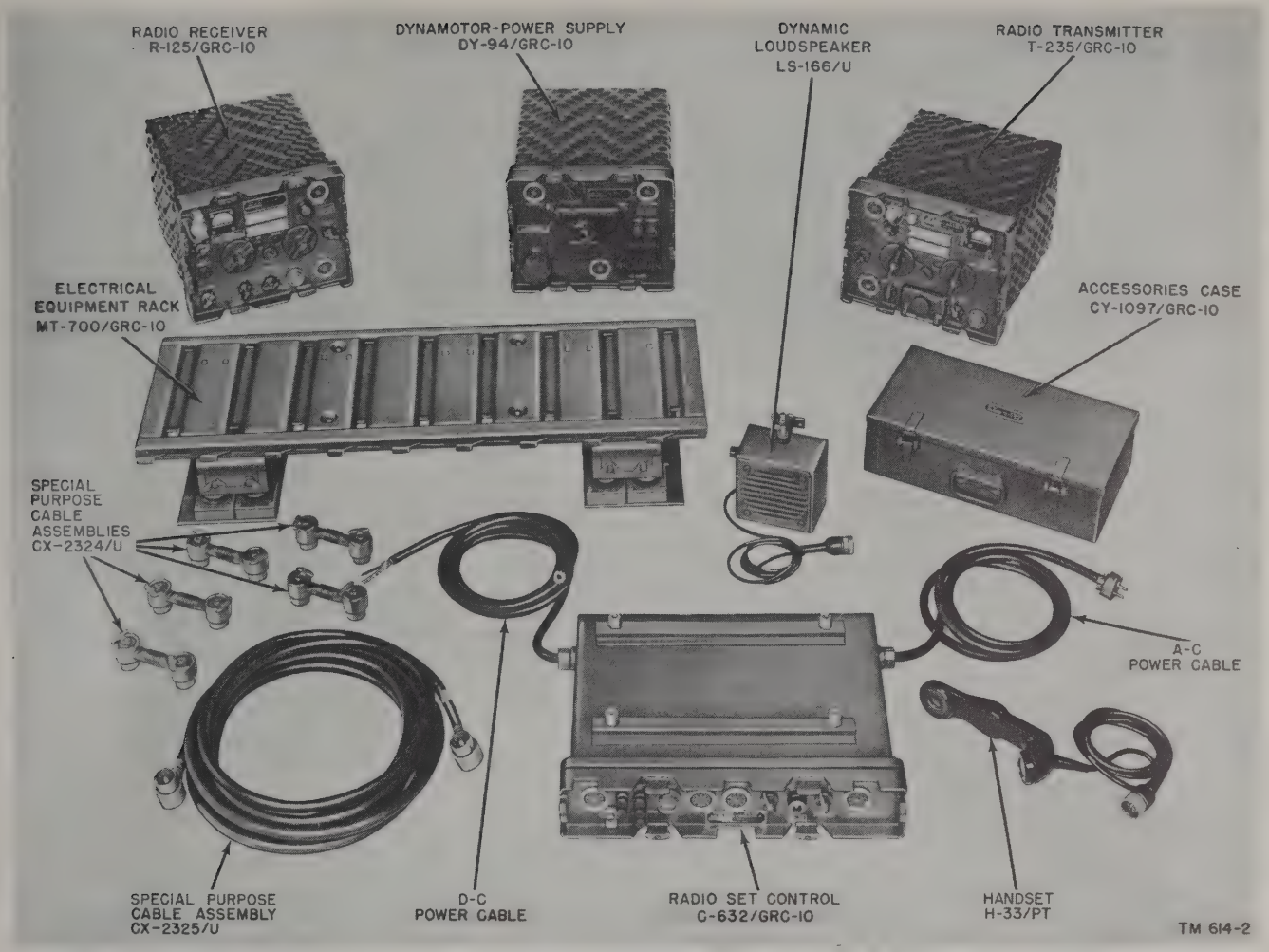


Figure 13. Components of Radio Set AN/GRC–10.

are secured to Electrical Equipment Rack MT–700/GRC–10. The equipment rack it fitted with shock-absorbing mounts to protect the radio set when it is installed in a vehicle. Power (a-c, d-c, or both) is connected through the control unit. Antenna connections are made directly to the front panels of the transmitter and receiver, each of which uses a separate antenna.

21. Radio Transmitter T–235/GRC–10

a. The transmitter consists of a panel-chassis assembly and a rigidized metal cabinet (fig. 17). Eight Dzus fasteners on the panel are used to secure the assembly in the cabinet, and thus form a waterproof seal. The bottom of the cabinet is fitted with channel rails which are used to secure the unit to the equipment rack. The operating controls, which are on the front panel, are protected from damage by the extended edge of the front panel. When the panel-chassis assembly is removed from the cabinet, all circuits are accessible from the top, sides, or bottom.

b. Two knobs are provided on the front panel for selecting the desired operating frequency, which is shown by two indicating dials mounted behind waterproof windows. One knob and dial combination changes the operating frequency of the transmitter in steps of 1 mc. the other combination changes the frequency in steps of .1 mc. All receptacles (including the antenna connector) for connecting the transmitter to other units of the radio set are mounted on the front panel.

c. A meter for indicating the operation of the transmitter at various test points is mounted on the front panel, together with a switch to select the est poin desired. Temperaures within the cabinet are maintained at a safe limit by a blower, which starts when the door at the lower part of the front panel is opened.

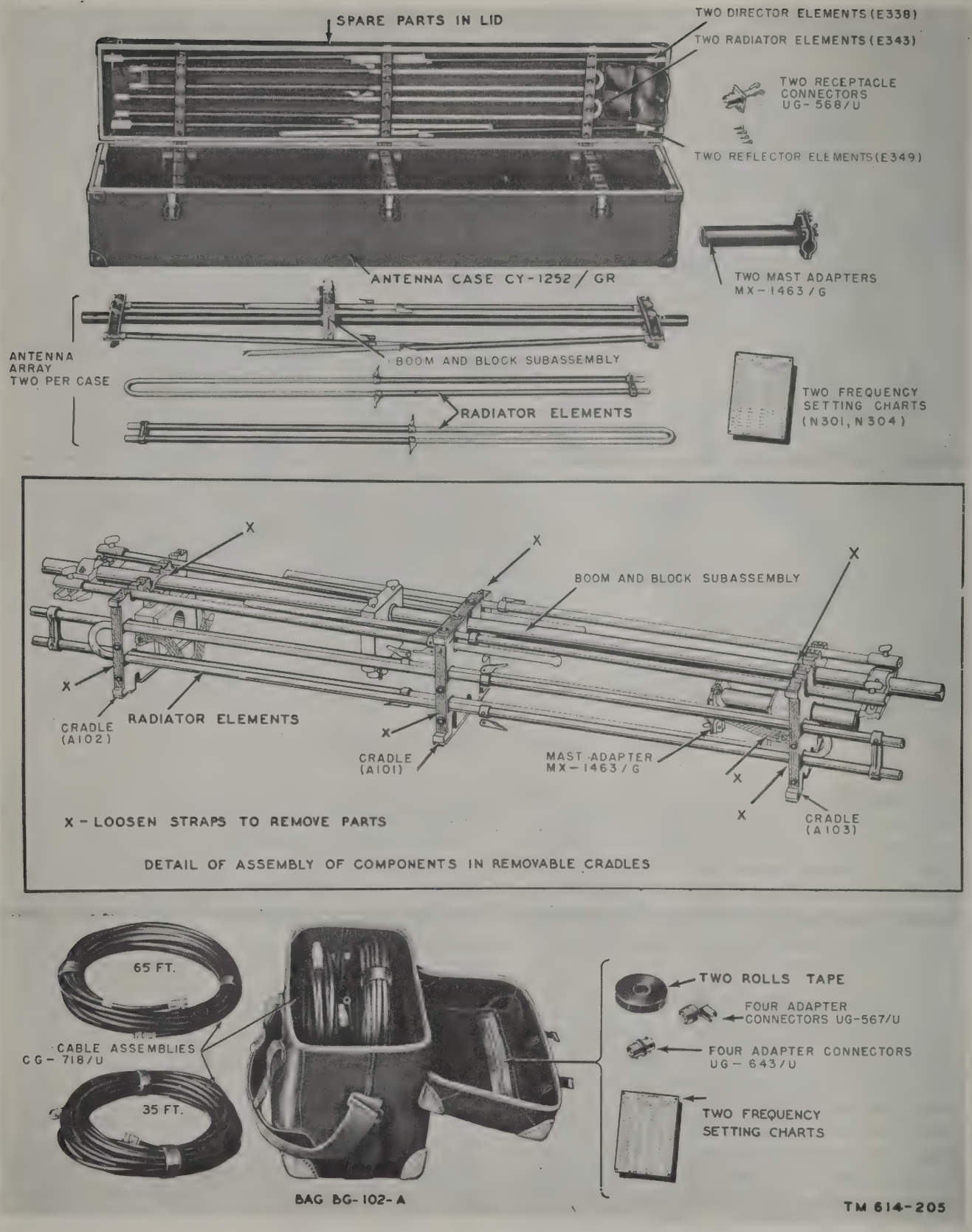


Figure 14. Two Antennas AS-620/GRC-10, components.



Figure 15. Two Masts AB–301/G, components.

22. Radio Receiver R–125/GRC–10

a. The receiver consists of a panel-chassis assembly and a rigidized metal cabinet (fig. 18). Eight Dzus fasteners on the panel are used to secure the assembly in the cabinet, and thus form a waterproof seal. The bottom of the cabinet is fitted with channel rails which are used to secure the unit to the equipment rack. The operating controls, which are on the front panel, are protected from damage by the extended edge of the front panel. When the panel-chassis assembly is removed from the cabinet, all circuits are accessible from the top, sides, or bottom.

b. Two knobs are provided on the front panel for selecting the desired operating frequency, which is shown by two indicating dials mounted behind waterproof windows. One knob and dial combination changes the operating frequency of the receiver in steps of 1 mc; the other combination changes the frequency in steps of .1 mc. All receptacles (including the antenna connector) for connecting the receiver to other units of the radio set are mounted on the front panel.

c. A meter for indicating the operation of the receiver at various test points is mounted on the front panel. Also included is a switch to select the test points desired.

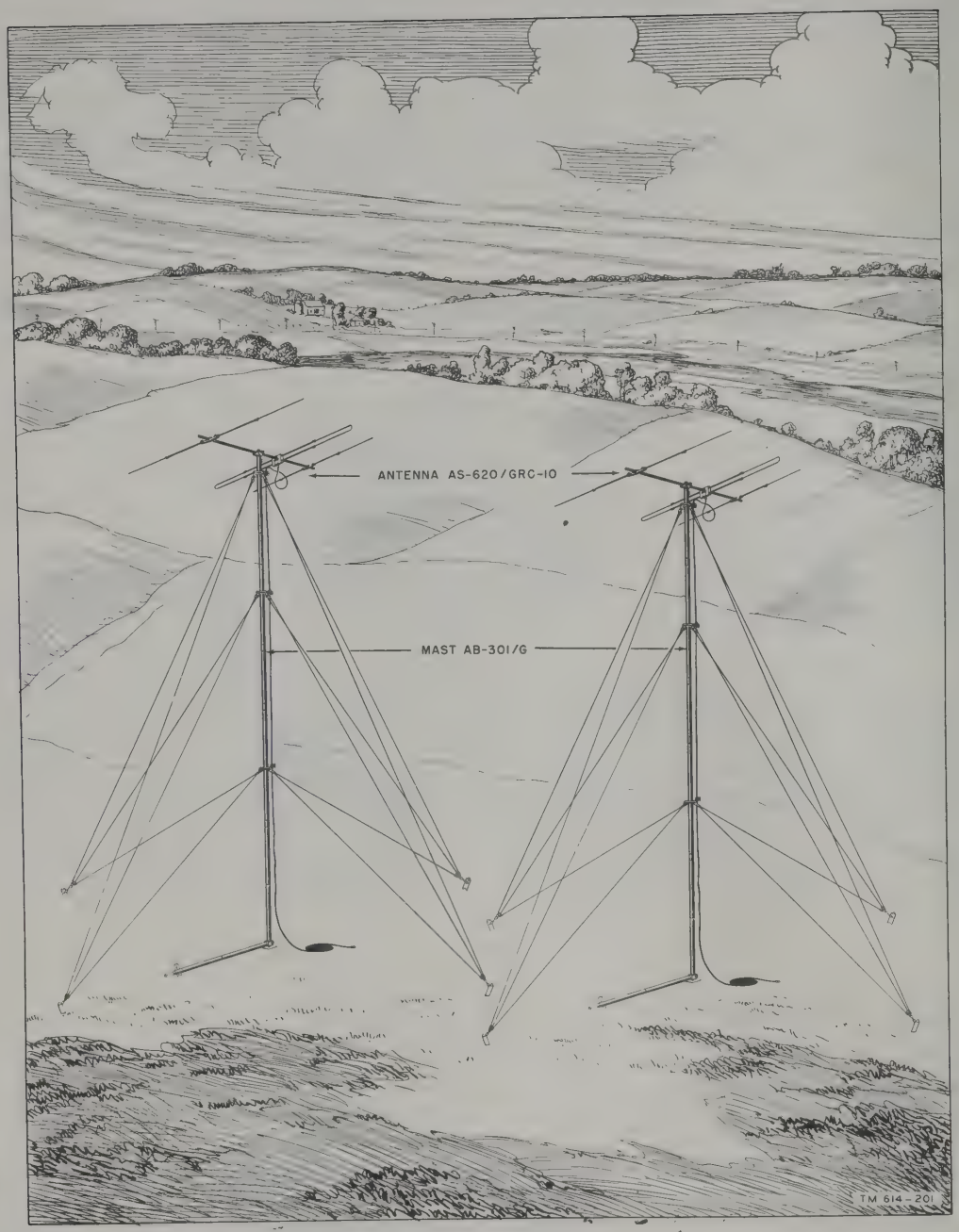


Figure 16. Antenna Group OA-249/GRC-10.

23. Dynamotor-Power Supply DY–94/GRC–10

a. The power supply (fig. 19) consists of two chassis (or decks) assembled to a front panel and mounted in a rigidized metal cabinet. Eight Dzus fasteners on the front panel are used to secure the assembly in the cabinet, and thus form a waterproof seal. The bottom of the cabinet is fitted with channel rails which are used to secure the unit to the equipment rack.

b. Receptacles for connecting the power supply to other units of the radio set are mounted on the front panel. The front panel also contains holders for most of the operating fuses, as well as a holder for spare fuses. In addition, a switch to permit a-c operation on either 115 or 230 volts is on the front panel.

c. Temperatures within the unit are maintained at a safe level by a blower, which starts when the door in the center of the front panel is opened. The power supply is built on two decks for compactness and to aid in maintenance. The lower deck is hinged on pins to allow it to swing away from the upper deck when maintenance is required.

d. Two pilot lights are mounted on the front panel. One light is labeled POWER; the other is labeled TRANSMIT.

24. Radio Set Control C–632/GRC–10

a. The control unit (fig. 20) is a panel-chassis assembly mounted in a metal cabinet. Six Dzus fasteners on the front panel are used to secure the assembly in the cabinet, and thus form a waterproof seal. The control unit is mounted to the bottom of the equipment rack with bolts and spacer nuts.

b. All connections to other units in the radio set are made on the front panel of the control unit. In addition, binding posts are provided for connecting spiral-four cable when the radio set is used with telephone terminal equipment. Other items on the front panel are a TYPE OF OPERATION switch and a MASTER POWER switch. All parts on the panel are protected from damage by the extended edge of the panel.

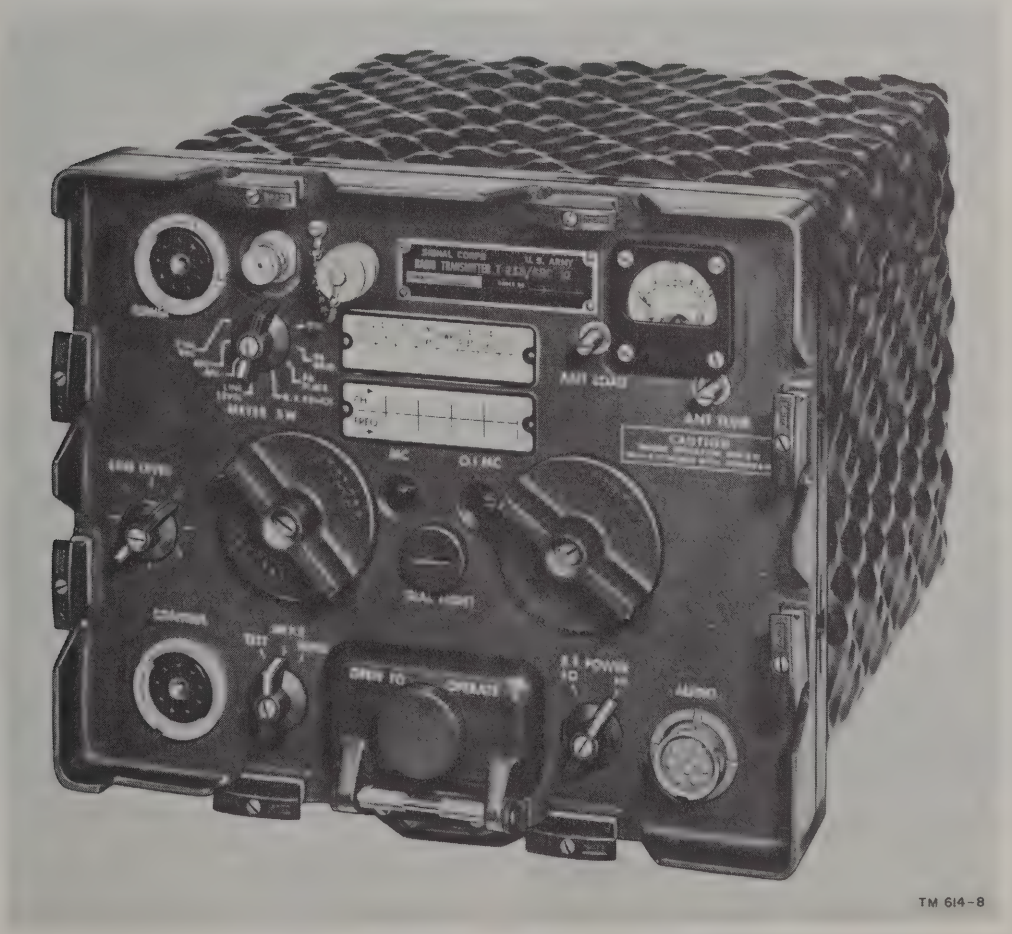


Figure 17. Radio Transmitter T–235/GRC–10.

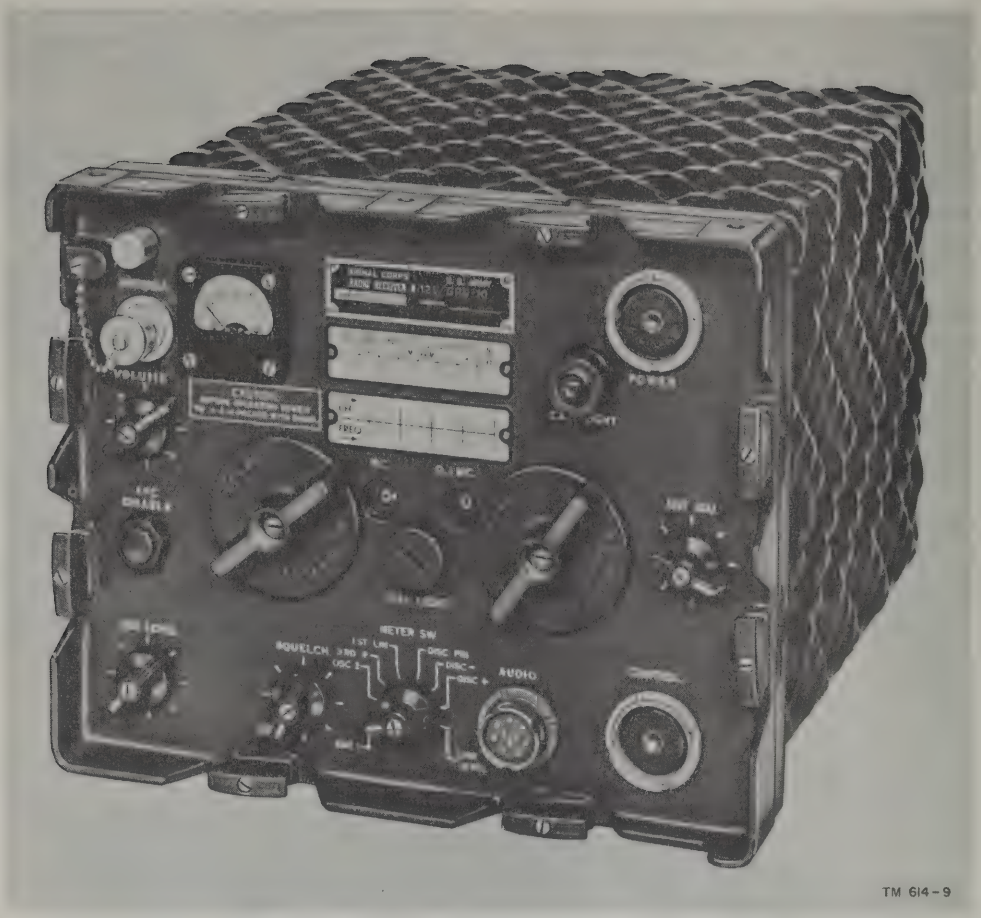


Figure 18. Radio Receiver R–125/GRC–10.

c. The power cables for the radio set are connected to the control unit. The d-c cable enters the cabinet near the rear at the left (facing the unit from the front), and the a-c cable enters the cabinet at the right side.

25. Electrical Equipment Rack MT–700/GRC–10

The electrical equipment rack (fig. 21) is stamped metal to endure rough usage. The receiver, transmitter, and dynamotor power supply are secured to the top of the rack by level-actuating locking devices. The case of the radio set control is bolted to the bottom of the electrical equipment rack. The rack is equipped with four shock mounts for installation in a vehicle.

26. Antenna Group OA–249/GRC–10

Antenna Group OA–249/GRC–10 is a pair of identical Yagi-type portable antennas for radio transmission and reception from 54 to 71 mc. One ground plane antenna can be constructed by using the ground plane adapter which is supplied with the antenna group. The equipment consists mainly of two Antennas AS–620/GRC–10 and two Masts AB–301/G (fig. 16).

a. Each Antenna AS–620/GRC–10 consists of an antenna array, mast adapter, transmission line, frequency setting chart, roll of tape, and running spares. The components for two antennas (fig. 14) are packaged in one wooden carrying case and one canvas carrying bag.

b. Mast AB–301/G components consist of mast sections, the mast base, the mast base plate, three guy plates, dacron guys, the gin pole cap, the hoisting rope assembly, the hammer, and running spares. The components for each mast (fig. 15) are packaged for storage or transport in one canvas carrying bag, resembling a golf bag, and one rectangular canvas carrying bag. One ground plane antenna adapter (fig. 22) is supplied with each antenna group. With the mast, antenna elements, and other accessories, it may be used to construct one ground plane antenna (fig. 8).

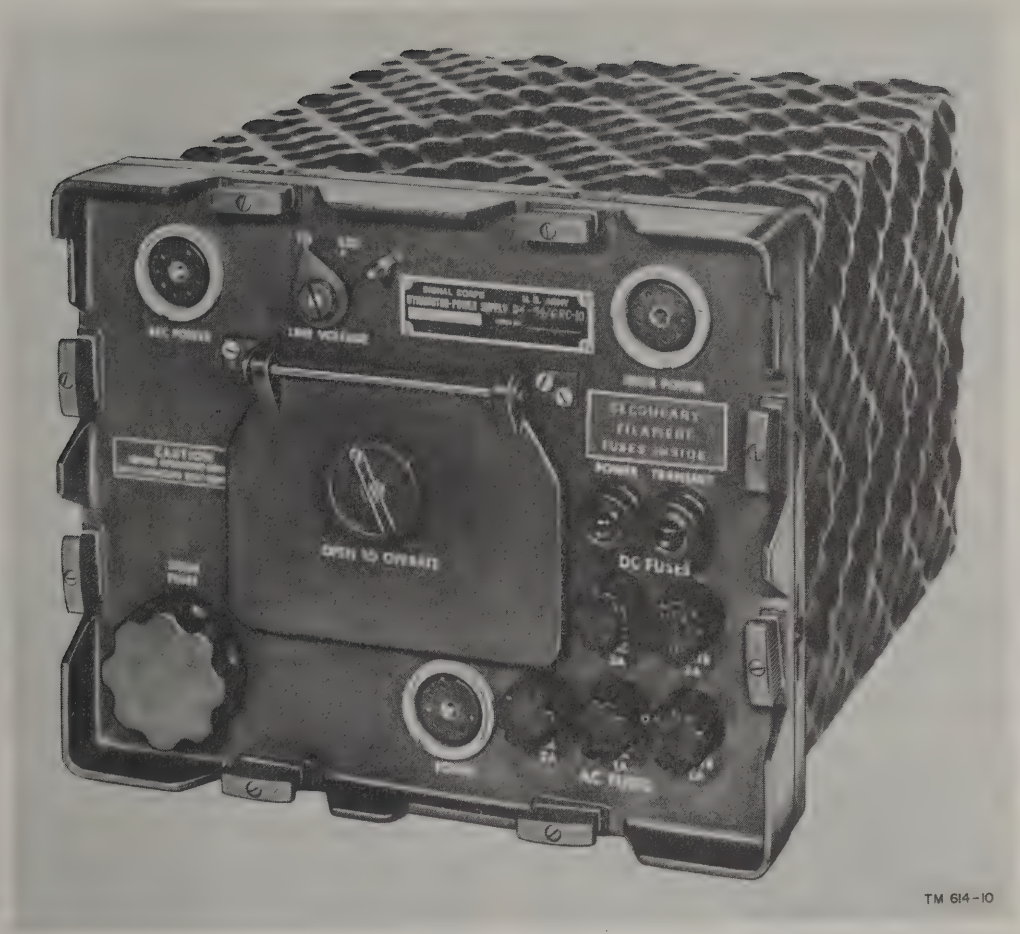


Figure 19. Dynamotor Power Supply DY-94/GRC-10.

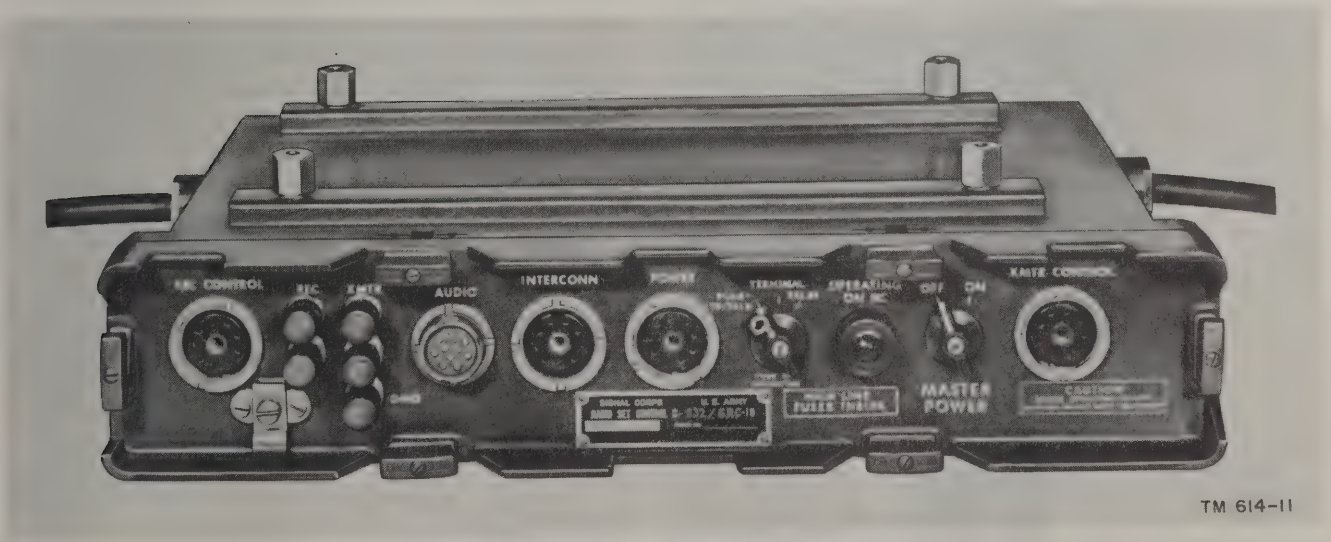


Figure 20. Radio Set Control C-632/GRC-10.

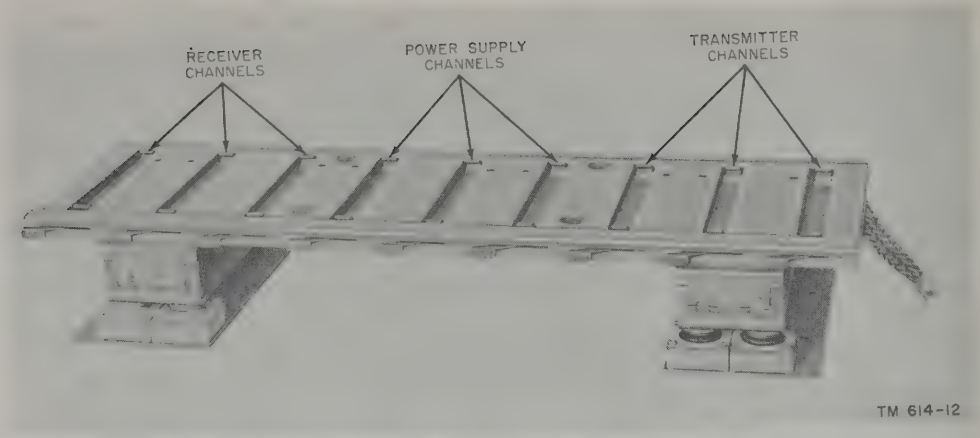


Figure 21. Electrical Equipment Rack MT–700/GRC–10.

27. Cables

A set of cables is supplied with Radio Set AN/GRC–10 for interconnecting the major components. The power cables are attached to the case of the control unit (fig. 2 and 13).

a. Special Purpose Cable Assemblies CX–2324/U. Five nine-contact cables are used to interconnect the receiver, transmitter, power supply, and control unit.

b. Special Purpose Cable Assembly CX–2325/U. This is a 20-foot, nine-contact cable used to interconnect two Radio Sets AN/GRC–10 during RELAY operation. The cable is connected between the INTERCONN jacks of the two control units.

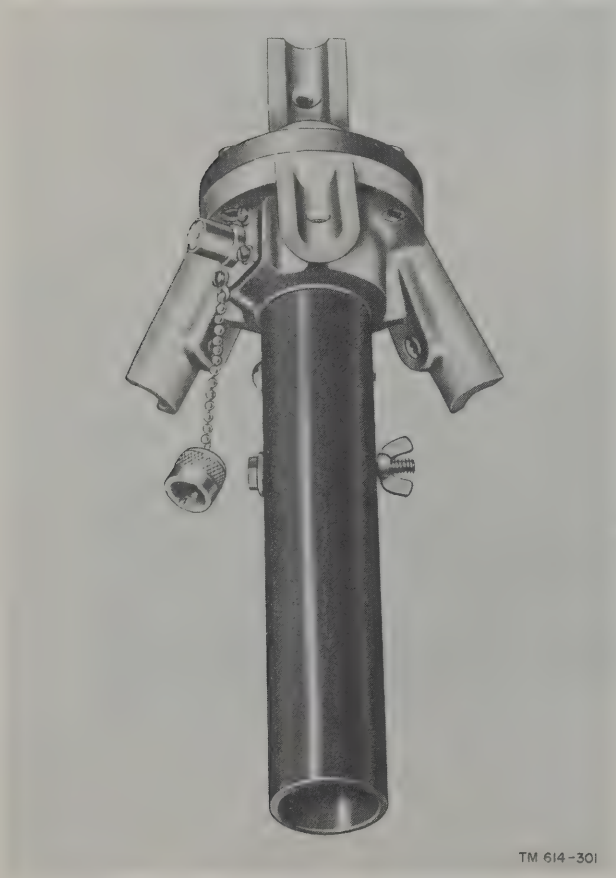


Figure 22. Ground plane adapter.

28. Minor Components

a. Handset H–33/PT. Handset H–33/PT (fig. 13) contains a microphone and earphone, used by the operator for all normal communications. The handset cable is terminated in a 10-contact plug that connects to the AUDIO jack on either the control unit or the transmitter.

b. Dynamic Loudspeaker LS–166/U. This is an auxiliary, 4-inch, permanent-magnet speaker (fig. 13). A 5-foot cord, terminated in a 10-pin plug, connects to the receiver AUDIO jack. A universal-type clamp is provided on the speaker case for mounting purposes.

c. Accessories Case CY–1097/GRC–10. The accessories case (fig. 13) is a metal box that is shipped with each radio set to store and protect spare parts such as tubes, lamps, fuses, etc. A foam rubber pad, inside the case, is provided with holes for the insertion of cartridge-type fuses.

29. Radio Terminal Set AN/GRC–39

(figs. 23 and 24)

a. General. Each radio terminal set cosists of the following:

2 Radio Sets AN/GRC–10, complete (one for use as spare).

2 Power Units PE–75.

1 Dynamic Loudspeaker LS–166/U.
1 Junction Box JB–110.
1 Junction Box J–85/G.
1 Telephone Cable Assembly CX–1512/U.
1 Cord CD–711.

b. Radio Set AN/GRC–10. The radio set is described in paragraphs 20 through 28. A table of components is given in the appendix.

c. Power Unit PE–75. The power unit (fig. 24) is a 2,500-watt, gasoline engine-driven, manual starting-type a-c generator. The engine speed is controlled automatically by a built-in governor. It generates a 120-volt, single-phase, 60-cycle current. Refer to TM 11–900 series packed with each unit for a detailed description and operating instructions.

d. Dynamic Loudspeaker LS–166/U. The loudspeaker is described in paragraph 28*b*.

e. Junction Box JB–110. The junction box (fig. 6) is used for connecting as many as 10 two-conductor power cords to a single power outlet. A 10-foot cord is furnished to connect the junction box to the power source. The radio sets, trouble lamps, shelter lights, etc., are plugged into the box.

f. Junction Box J–85/G. The junction box (fig. 24) is used to connect two power units to an extension cord or directly to the radio set. A switch on the top permits the selection of either power unit to be used. Two cords are provided, one for each power unit. Two outlet receptacles are furnished for connection to the radio set or to receive the plug of Cord CD–711.

g. Telephone Cable Assembly CX–1512/U. The cable assembly (fig. 6 and 13) is used to connect the radio terminal set to Telephone Terminal AN/TCC–3. It has a special plug on one end that mates with a receptacle on the front of the telephone equipment. The other end is connected to the spiral-four binding post on the front of the control unit of the radio terminal set.

h. Cord CD–711. The cord (fig. 24) is a 50-foot, two-conductor, rubber-jacketed cord with a twist-lock plug at one end and a receptacle at the other end. It is used to connect Junction Box J–85/G at the power units to Junction Box JB–110 at the radio set. The cord may be connected directly to a single power unit where only one is used.

30. Radio Repeater Set AN/GRC–10

(fig. 4)

a. General. Each radio relay set consists of the following:

3 Radio Sets AN/GRC–10, complete (one for use as spare).
2 Power Units PE–75.
1 Dynamic Loudspeaker LS–166/U.
1 Junction Box JB–110.
1 Junction Box J–85/G.
1 Cord CD–711.

b. Radio Set AN/GRC–10. Radio Set AN/GRC–10 is described in paragraphs 20 through 28; the other units are described in paragraph 29.

31. Running Spare Parts

Spare parts kits are supplied with each major component of the radio sets. The following list contains the full complement of running spares shipped with each Radio Set AN/GRC–10.

3 tubes, electron, type 5654/6AK5W
5 tubes, electron, type 6BH6
1 tube, electron, type 6AK6
2 tubes, electron, type 5726/6AL5W
4 tubes, electron, type 12AT7
2 tubes, electron, type 6BJ6
3 tubes, electron, type OA2
1 tube, electron, type 5686
2 tubes, electron, type 6CB6
2 tubes, electron, type 4X150D
2 lamps, GE #327 or equivalent
3 lamps, GE #313 or equivalent
2 vibrators
1 brush set—high voltage
1 brush set—low voltage
6 fuses, cartridge, 1 ampere
12 fuses, cartridge, 2 amperes
12 fuses, cartridge, 3 amperes
12 fuses, cartridge, 4 amperes
6 fuses, cartridge, 15 amperes
2 radiator elements
2 director elements (red)
2 reflector elements (blue)
2 adapter connectors UG–643/U
2 receptacle connectors UG–568/U
2 adapter connectors UG–567/U
2 frequency setting charts
2 guys MX–1469/G (52 ft)



Figure 23. Radio Terminal Set AN/GRC–39 with telephone terminal equipment, including one antenna.

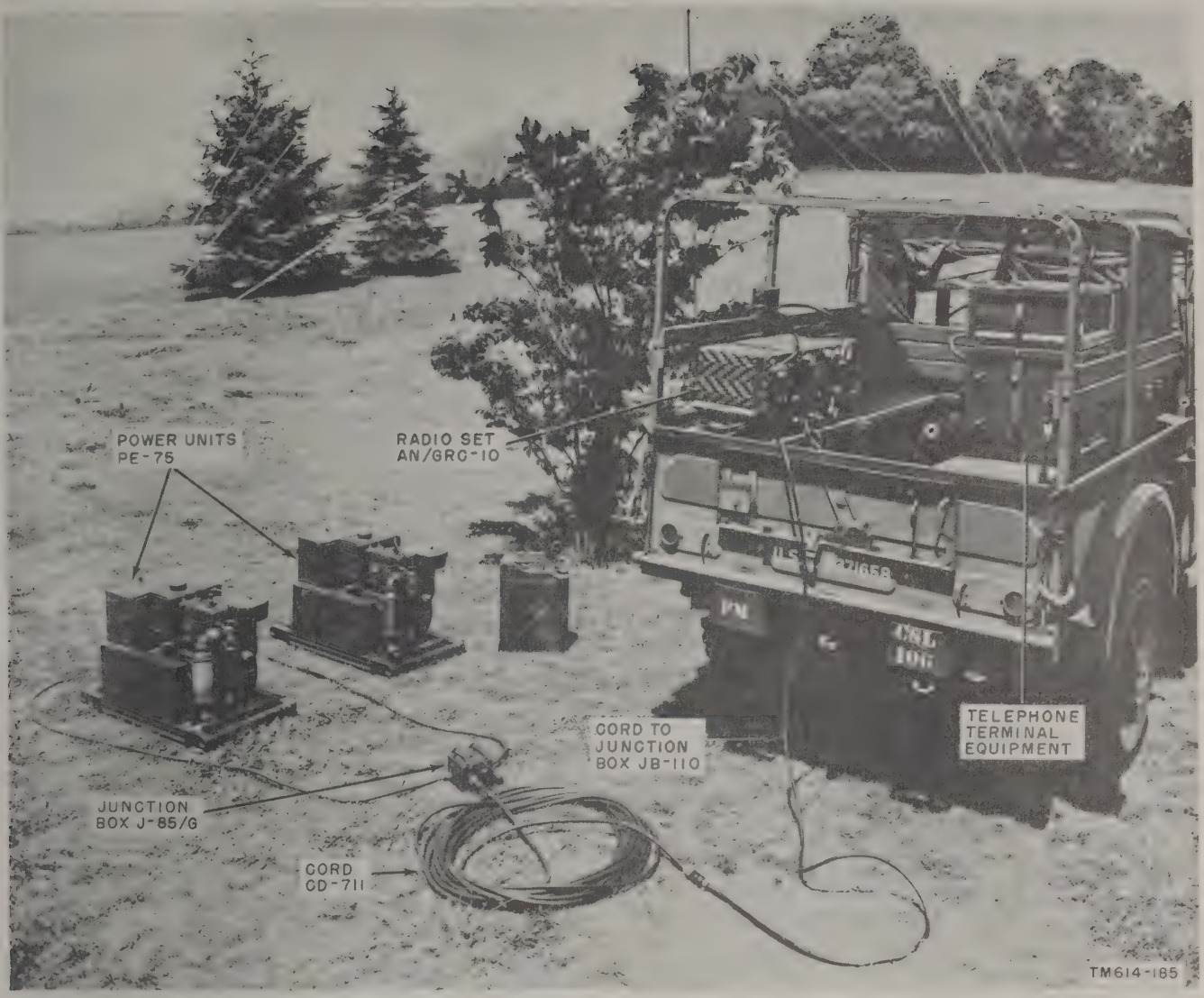


Figure 24. Radio Terminal Set AN/GRC–39, mounted in vehicle.

2 guys MX–1469/G (44 ft)
2 guys MX–1469/G (34 ft)
2 guy stakes GP–111/G
2 mast bases AB–318/U
2 guy plates MX–1468/G

32. Additional Equipment Required, Radio Set AN/GRC–10

a. Power Equipment. No power equipment is supplied with the radio set. Power requirements are given in paragraph 9. In vehicular installations, if a 26-volt, d-c source is used, be sure that the source is adequate to furnish the heavy power requirements of the radio set.

b. Vehicular Mounting. Equipment required to mount the radio set in a vehicle depends on the type of vehicle. Normally, the only additional equipment needed will be eight, suitable length, $\frac{5}{16}$-inch bolts with nuts and lock washers. These are used to secure the mounting rack in place.

33. Additional Equipment Required, Radio Repeater Set AN/GRC–40

Normally, no additional equipmetn is required with the radio relay set, except in vehicular installations where sixteen $\frac{5}{16}$-inch bolts of suitable length, with nuts and lock washers, are needed to secure the two mounting racks in place.

34. Additional Equipment Required, Radio Terminal Set AN/GRC–39

a. Spiral-four Cable. Telephone Cable Assembly CX–1512/U is supplied with the equipment to connect the telephone terminal equipment to the radio terminal set. Because this cable is only about 10 feet long, spiral-four cable of sufficient length should be provided if the radio terminal set is located more than 10 feet from the telephone equipment.

b. Vehicular Mounting. Mounting requirements are the same for vehicular mounting as for Radio Set AN/GRC–10 (par. 32*b*).

CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF RADIO SET AN/GRC–10, RADIO TERMINAL SET AN/GRC–39, AND RADIO REPEATER SET AN/GRC–40

35. Siting Radio Set AN/GRC–10

a. The best location for radio equipment depends on the tactical situation and local conditions, such as the following: The need to house the equipment where its shelter cannot be seen, the type of housing available, the terrain, and the need of messenger service. Signals from Radio Transmitter T–235/GRC–10 have a greater range if the antenna is high and clear of hills, buildings, cliffs, densely wooded areas, and other obstructions (fig. 25). Depressions, valleys, and other low places are poor locations for radio reception and transmission, because the surrounding high terrain absorbs r-f energy. Weak or otherwise undesirable signals may be expected if the set is operated under or close to steel bridges, underpasses, power lines, hospitals, or power units. If possible, choose a location on a hilltop or an elevation (fig. 26). Normally, transmission over water is better than over land. In ground installations, see that drainage is adequate to prevent flooding the shelter. If the equipment is part of a communications center, but is not to be installed within the center, locate the equipment nearby. Locate the antenna for line-of-sight communication with the distant station or stations.

b. The frequencies covered by the radio set (54.0 to 70.9 mc) are in the very-high-frequency (vhf) range. Radio waves at these frequencies tend to travel in straight lines, resulting in best operation when radio stations are located so that a line-of-sight path exists between them. Instructions for calculating line-of-sight paths are given in paragraph 36. When it is impossible to obtain a line-of-sight path, an operating test should be made to determine whether communication is possible. The features of the terrain may be such that the radio waves will be directed in an angular path.

(1) Frequently, large vertical objects will reflect radio waves. For this reason, when testing an obstructed path, try to orient the antennas over a wide angle. Although the antennas may be directed at an angle away from the distant station, a large object, a mountainside, for example, may reflect the waves at such an angle that they will be directed back toward the distant station.

(2) When a knife-edged obstacle, such as a sharply peaked mountain ridge, is located between radio stations, reliable vhf communications may be expected. One or more of these obstructions still may provide a path for dependable communication. In many cases, knife-edged obstacles produce signals that are considerably stronger and with less fading than signals that travel over smooth earth.

c. The radiation pattern of the Yagi antenna is shown in figure 27. The horizontal radiation pattern of the ground plane antenna is circular when the antenna is isolated in free space; that is, it radiates equally well in all directions. In actual practice, however, hill masses or other objects, such as buildings, frequently reflect the radiated waves and distort the otherwise circular pattern. These factors must be considered when planning the installation of the antenna group. The curvature of the earth limits the distance over which line-of-sight occurs. For example, with both the transmitting and receiving antennas located 40 feet above sea level, the maximum distance that can be spanned before the line-of-sight is obstructed by the curvature of the earth is roughly 18 miles. This is based on the assumption that the altitude of the intervening terrain is also at sea level. To obtain a line-of-sight path 50 miles

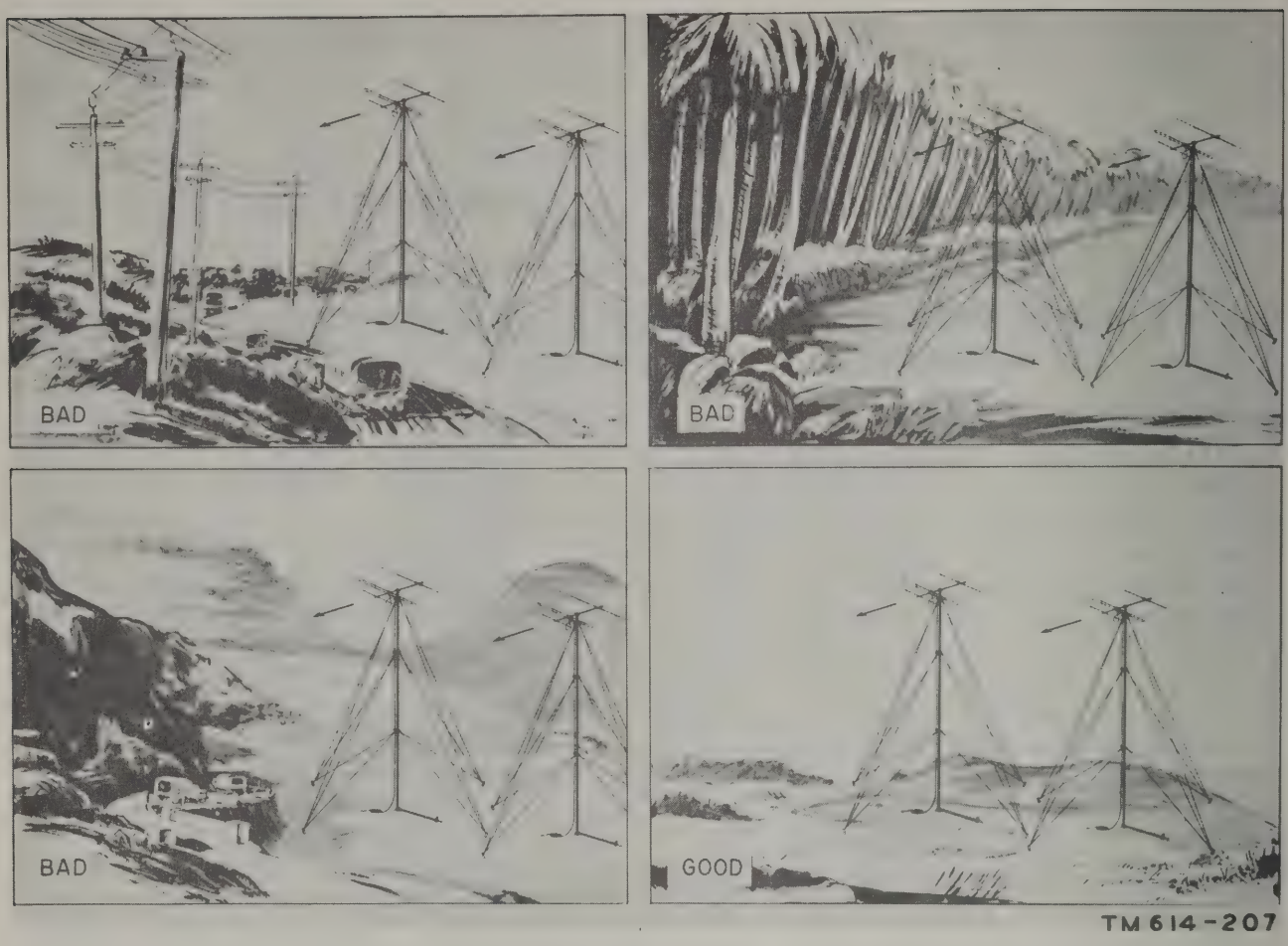


Figure 25. Siting antennas.

long, the height of both the antennas must be at least 312.5 feet above sea level and the altitude of the intervening terrain must be at sea level. To determine the maximum distance between two radio stations with the intervening terrain at sea level, the following formula is used:

$D=\sqrt{2A}+\sqrt{2B}$
where
D=distance in miles
A=height in feet of one antenna
B=height in feet of the other antenna

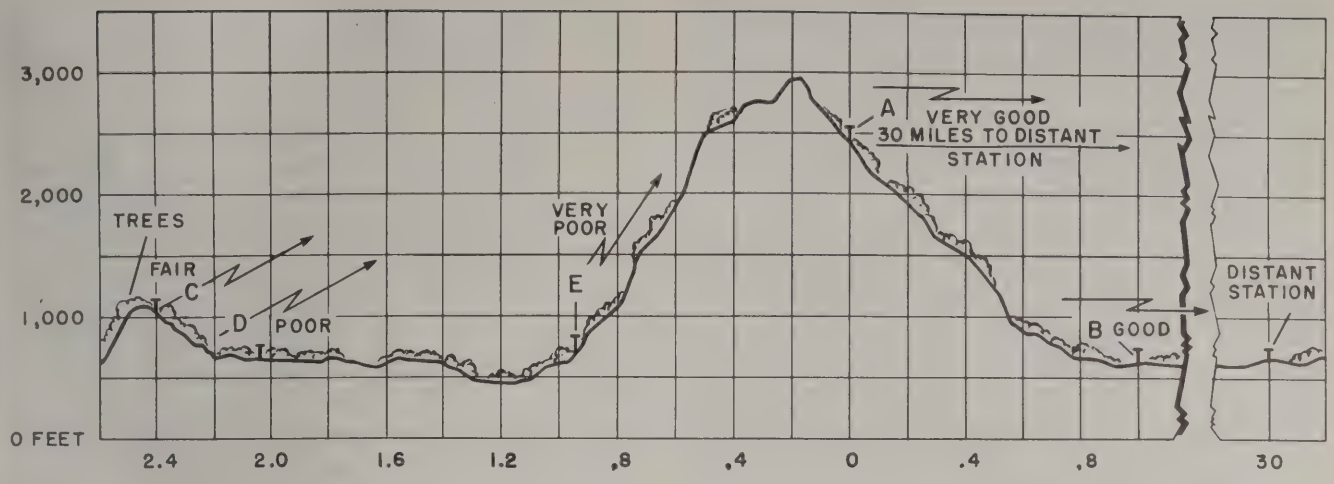
36. Plotting Profiles
(fig. 28)

A profile should be drawn before attempting an installation to determine whether a line-of-sight path exists. Figure 176 shows typical graphs similar to that shown in F, G, I, and J, figure 28, for plotting profiles from terrain maps. Either of the two types of graphs (figs. 28 and 176) may be used, depending on the elevations and distances between the two proposed sites. One graph (I and J, fig. 28) is used for elevations up to 5,000 feet and distances up to 125 miles. The other graph (F and G, fig. 28) will accommodate elevations up to 500 feet and distances up to 50 miles. To plot a profile, proceed as follows:

a. Determine from the terrain map the scales used for distances and elevation.

b. Draw a line on the terrain map between the two proposed sites (E and H, fig. 28). Measure the length of this line and convert it to the distance between the two points.

c. Determine the elevation at each site as indicated by the contour lines. Add the height of the antenna mast to this figure to arrive at the total elevation. For example, referring to path D (H, fig. 28), station N is 1,300 feet high. Adding antenna height, in this case 40 feet, brings the total elevation to 1,340 feet. This point is marked



RELATIVE SIGNAL STRENGTH	
LOCATION	PERCENT RELATIVE TO LOCATION A
A	100 (REFERENCE)
B	25
C	10
D	2
E	1

TM 2601-44

Figure 26. Antenna location in hilly areas.

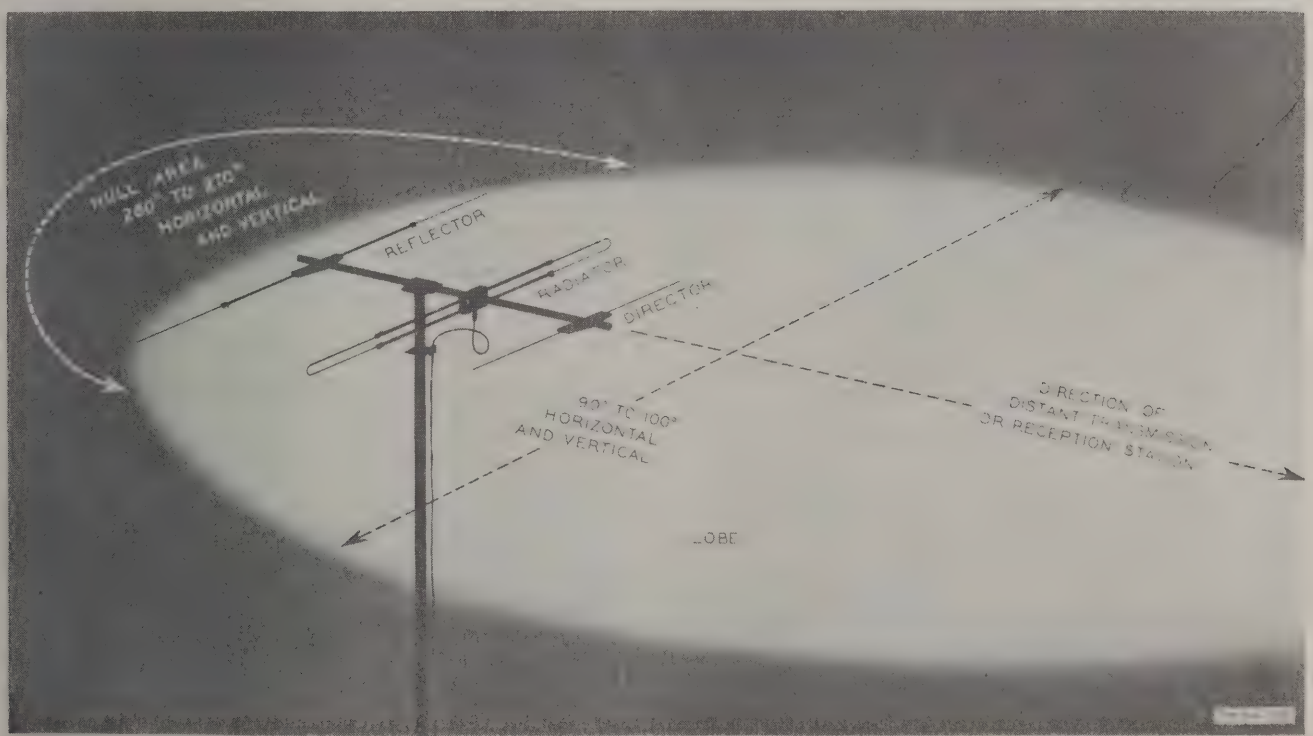


Figure 27. Antenna AS-620/GRC-10 radiation pattern.

off on the vertical scale of the graph above 0 mile (J, fig. 28). Station O has an indicated elevation of 909 feet. This height plus the antenna height of 40 foot gives a total elevation of 949 feet. This is plotted on the vertical scale (J, fig. 28) above the 16-mile point, because 16 miles is the distance between the two sites.

d. Draw a straight line between these two points, scan this line, and determine the point of lowest altitude. For example, on path D, this point is 949 feet; on path A (fig. 28) the lowest altitude is 10 feet (because of the curvature of the earth); and path B (G, fig. 28) is below the curvature of the earth, intercepting the line of sight.

e. Inspect the terrain map; note whether there are any points above the point of lowest altitude. If there are none, as on path D, line of sight exists and no further plotting is necessary.

f. If there are elevations above the point of lowest altitude as on path C, draw a complete profile. Follow the line drawn on the terrain map and pick out high and low points. Plot these points on the graph paper and join them. All points that project above the straight line on the graph (I, fig. 28) represent intervening terrain.

g. If there are intervening hills between the two proposed sites as in path C, or if the site line is below the curvature of the earth as in path B (C, fig. 28), poor communication may result. If there are no intervening hills as in paths A and D, good communication will be obtained.

h. If the proposed site is intended for a relay station, the transmission path to each relay or terminal station must be considered. A line of sight must exist in both directions.

i. If profile graph paper is not available, a profile may be plotted on any linear graph paper and then corrected for the curvature of the earth, as explained in (1) through (4) below:

(1) Determine from the terrain map the scales used for distances and elevations. Draw a line on the terrain map between the two proposed sites.

(2) Pick out high and low points along the line and plot these on the linear graph paper as a broken line curve as in the example in figure 29.

(3) Draw a straight broken line on the graph paper between terminal points A and B. This line represents the *apparent* line of sight.

(4) Correction must be made for the curvature of the earth to obtain a true picture of the line-of-sight path. A high or low point is selected which is as near as possible to the point halfway between the terminals, in this case R. Next, by means of the figures shown in the table below, the heights of all prominent points in both directions from this central point must be corrected (shown as solid line curve). For example, point P as shown in figure 29 is 6 miles from the reference point R. After correction, P becomes P^1, 24 feet lower than the original point. Some profile maps will indicate a line-of-sight path with the drawing uncorrected. With the correction, however, any intervening objects may be apparent.

Conversion of sea level elevations to line-of-sight elevations		Conversion of sea level elevations to line-of-sight elevations	
D (Miles from reference point)	Elevation correction (ft) (k=1)	D (Miles from reference point)	Elevation correction (ft) (k=1)
2	3	22	324
4	11	24	384
6	24	26	455
8	43	28	520
10	67	30	600
12	96	32	680
14	130	34	770
16	170	36	862
18	217		
20	266		

Note. The corrected elevation in feet equals $D^2/1.5k$ where k is the ratio of the effective radius of earth to the true radius of the earth and D is the distance in miles from the reference point. This formula does not correct the effect of refraction of the radio wave.

37. Noise and Interference

The range of vhf communications is inversely proportional to the amount of noise or interference at the receiver location; the more noise or interference present, the shorter the distance that can be spanned satisfactorily. The most objectional result of high noise level is reduced intelligibility in telephone circuits and errors in carrier telegraph circuits. Industrial plants that use electrical equipment, radio transmitters, power lines, motor vehicle ignition systems, and hospitals are sources of radio noises. Harmonic radiation from other transmitters may cause considerable interference. The prime requirement for good communications is a high signal-to-noise ratio.

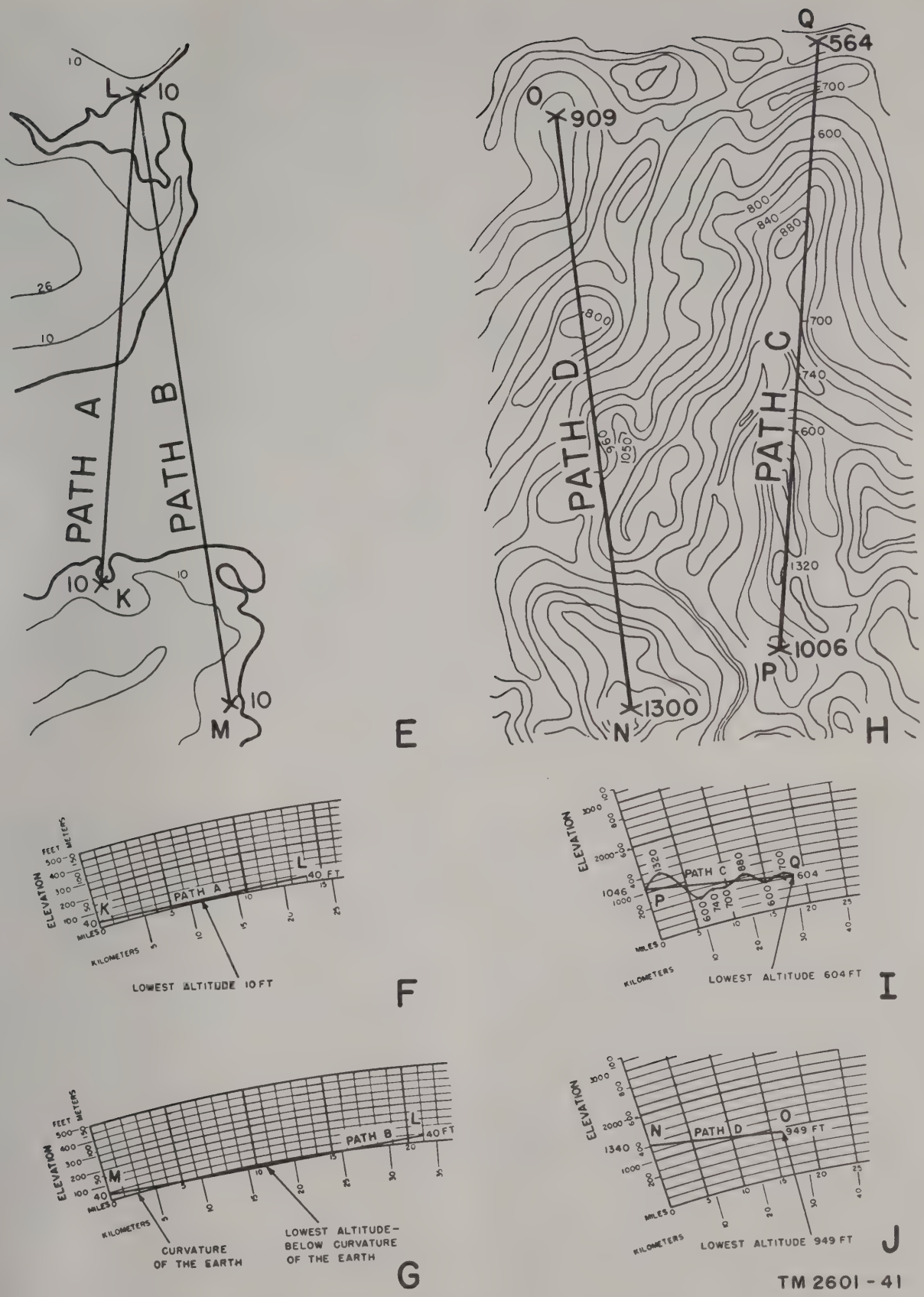


Figure 29. Plotting profiles nonlinear graph paper

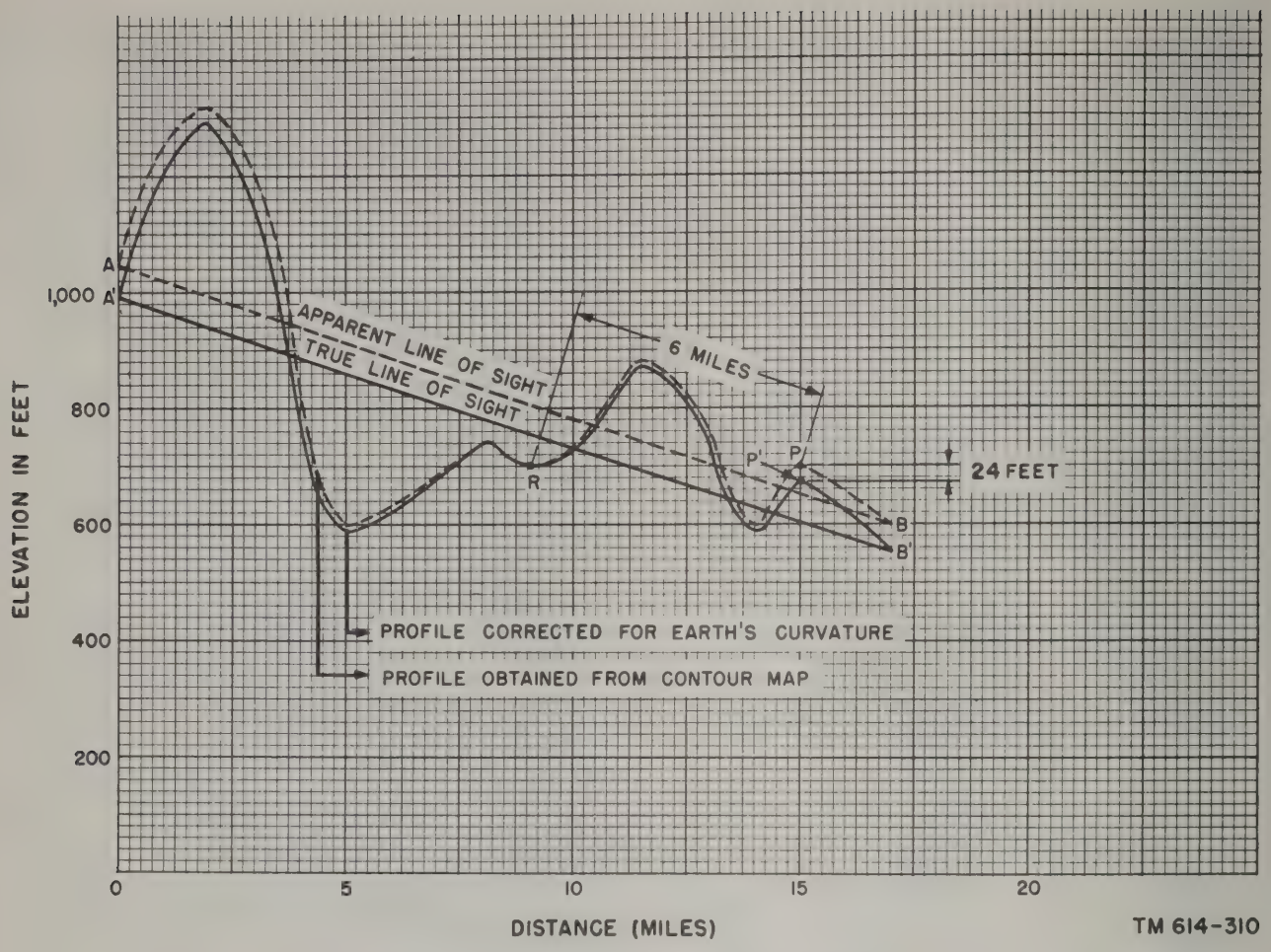


Figure 29. Plotting profiles on linear graph paper.

Caution: Set up the equipment away from all motor traffic and do not permit vehicles to come within 200 yards of the receiver antennas.

38. Siting Radio Terminal AN/GRC–39

a. All information given in paragraphs 35 through 37 on siting Radio Set AN/GRC–10 applies to the radio terminal set. The location of the set depends, to a certain extent, on the location of the telephone terminal equipment with which it will be used. The maximum of 5 miles of spiral-four cable that is permitted between the radio terminal set and the telephone terminal equipment should furnish sufficient latitude. When longer distances are required, the use of Telephone Repeater AN/TCC–5 will permit up to 25 miles more of spiral-four cable (par. 128).

b. Locate the power units as far from the radio terminal set as possible. When they are placed too close to the radio sets, the operator may be annoyed by the noise and exhaust fumes.

39. Siting Radio Repeater Set AN/GRC–40

a. All information given in paragraphs 35 through 37 on siting Radio Set AN/GRC–10 applies to the radio relay set. The situation is more complicated because, in relay operation, it is necessary to determine the suitability of two transmission paths instead of one. Inspect a terrain map for a location that seems usable; then draw lines from the chosen location to the sites of both stations with which communication is to be established. Plot profiles for both lines on the terrain map (par. 36). If both transmission paths do not provide line-of-sight communications, two solutions are possible:

(1) Select another location for the relay station and test it; use the terrain map and plotting profiles.

(2) Where two or more relay stations are to be used, it may be possible (and easier) to site the *next* relay station in a location

that will provide the required line-of-sight path without lengthy calculation. Familiarity with the terrain map and practice in using it for siting purposes will enable personnel to select suitable sites easily.

b. Locate the power units as far from the radio relay set as possible. When they are placed too close to the radio sets, the operator may be annoyed by the noise and exhaust fumes.

40. Shelter Requirements, Radio Set AN/GRC–10

a. Vehicular Installations. A wide variety of vehicles may be used for the installation of the radio set, if there is enough space to carry the antennas and power source. Figure 30 shows the dimensions of the equipment mounting rack, which may be bolted to a shelf or seat in the vehicle. Refer to the appendix for the dimensions and weights of the components of the radio set, other than those that are mounted on the equipment rack. Any type of cover that will keep the equipment protected from the weather is suitable.

b. Interior Installations. A small tent or hut that will protect the equipment from the weather and supply shelter for the operator is satisfactory. Although a bench or table should be provided on which to place the mounting rack, the handset, the loudspeaker, and other accessories, they may be put on dry ground. Be careful to keep all parts of the equipment free of dirt and sand. Provide enough lighting for day or night operation and maintenance. Be sure to provide space for any auxiliary equipment used and for spare parts that may be needed in an emergency.

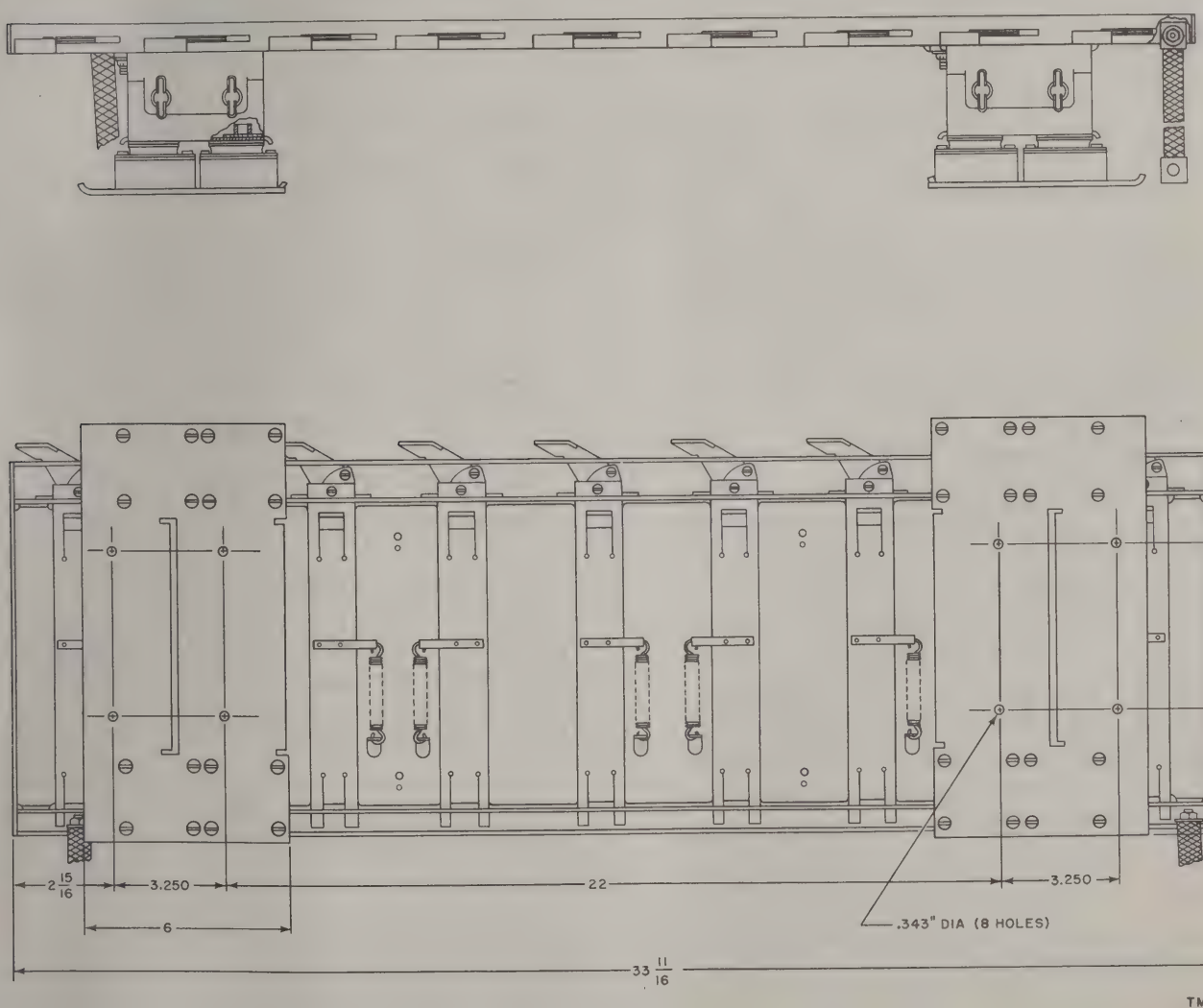


Figure 30. Electrical Equipment Rack MT–700/GRC–10, dimensions.

41. Shelter Requirements, Radio Terminal Set AN/GRC–39

a. Vehicular Installations. The information given in paragraph 40*a* for Radio Set AN/GRC–10 applies to the radio terminal set; however, consideration must be given to the larger amount of equipment, which adds to the space and weight-carrying requirements. Enough space should be available to mount the radio set, accessories, and spare radio set. The power units should be mounted so that they will be protected while the vehicle is in motion. At the same time, they should be capable of being unloaded at a site in a short time.

b. Interior Installations. The information given in paragraph 40*b* for Radio Set AN/GRC–10 applies to the radio terminal set, except that space should be provided for the spare radio set. Depending on the situation, the spare radio set should be mounted, ready for use, or its components should be placed at hand for rapid substitution in the radio set in an emergency.

42. Shelter Requirements, Radio Repeater Set AN/GRC–40

a. Vehicular Installations. The information given in paragraph 40*a* for Radio Set AN/GRC–10 applies to the radio relay set; however, consideration must be given to the larger amount of equipment, which adds to the space and weight-carrying requirements. Enough space should be available for mounting the two radio sets and their accessories, together with any auxiliary equipment used. The spare radio set should be readily accessible. The two power units should be mounted so that they will be protected while the vehicle is in motion. At the same time, they should be capable of being unloaded at a site in a short time.

b. Interior Installations. The information given in paragraph 40*b* for Radio Set AN/GRC–10 applies to the radio relay set, but because of the larger amount of equipment, more space is required for the radio relay set. Adequate mounting area is needed for two radio sets and their accessories. The spare radio set should be readily accessible; depending on the situation, it should be mounted ready for use, or its components should be placed at hand for rapid substitution in one of the radio sets in an emergency.

43. Arrangement of Antennas at Site

To choose the proper location for the antenna equipment, observe the following precautions:

a. The antennas should be placed as high as necessary to clear trees, buildings, or any other obstructions in the direction in which transmission or reception is desired.

b. The equipment should be set up so that no transmitting antenna at a site transmits directly towards a receiving antenna at the same site. The radio receiving antenna should be located at least 60 feet from the nearest transmitting antenna, with their null areas facing each other. Receiving antennas may be spaced 17 feet on centers from each other when their null areas face each other.

c. In special cases where transmission and reception are required from the site in question to two other points located along lines of transmission approximately 90° in respect to each other, advantage may be taken of the decoupling obtainable by placing antenna systems at exactly right angles to each other.

d. Although the relative placement of radio transmitting antennas in respect to each other cannot be rigidly expressed, the transmitting antennas should be separated by at least 35 feet on centers if their null areas face each other and if both antennas are supplied with approximately equal carrier power and are modulated equally. Some additional aid in troublesome cases may be obtained by increasing the carrier frequency difference between the two transmitters.

44. Unpacking New Equipment

Perform the steps outlined below when unpacking new equipment.

Note For used or reconditioned equipment, refer to paragraph 60.

a. Radio Set AN/GRC–10. Refer to figures 9 and 12 when unpacking the radio set. Note that each case contains more than one carton. Open each carton as follows:

(1) Place the packing container as near the operating position as convenient.

(2) Cut the metal straps with tin snips or large diagonal pliers. Fold back the straps from the top and one side.

(3) Remove the nails from the top and side with a nail puller. Remove the top and side. Do not attempt to pry off the top and side; the equipment may be damaged.

(4) Lift the waterproof cartons out of the packing case and open them by removing the waterproof tape that seals the top flaps.
(5) Remove the equipment from the cartons and place it on a work bench or near its final location.
(6) Inspect the equipment for damage possibly incurred during shipment.
(7) Check the contents of the packing case against the master packing slip.

b. Antenna Group OA–249/GRC–10. When unpacking the antenna group, refer to figures 10 and 11, and proceed as follows:

(1) Cut and remove the steel straps on the packing boxes.
(2) Remove the nails with a nail puller and take off the tops of the boxes. Do not attempt to pry off the top; the equipment may be damaged.
(3) Remove the cartons.
(4) Remove the spacers, carrying cases, and bags from the cartons.
(5) Remove the various parts from their containers and inspect them for damage possibly incurred during shipment.

Caution: In removing parts from their containers, keep all mating surfaces free of mud and sand.

(6) Before removing the antenna arrays and mast adapter, refer to figure 14. These parts are mounted on three cradles that must be lifted from the case to detach the parts. Replace the cradles in the case to avoid losing them.

c. Radio Terminal Set AN/GRC–39 and Radio Repeater Set AN/GRC–40. When unpacking radio relay and radio terminal sets, follow the instructions in *a* and *b* above for the radio sets and the extra accessories. Refer to the technical manual provided when unpacking the power units.

Section II. INSTALLATION OF ANTENNA GROUP OA–249/GRC–10

45. Arrangement of Components at Site

a. General. The components required for installing one complete antenna, as indicated in the appendix, will be contained in the following carrying case and carrying bags:

(1) Antenna array components are contained in the following:
1 Antenna Case CY–1252/GR.
1 Bag BG–102–A containing cable assemblies, etc.
(2) Mast components are contained in the following:
1 Mast Section Cover CW–294/U.
1 Bag BG–102–A containing guys, etc.

b. Arrangement of Components (fig. 31). The assembly of a complete antenna is performed more efficiently when the required components are placed at the antenna site in their containers as follows:

(1) Mark the spot selected for the mast base with a rock or other suitable marker.
(2) Place the antenna array components about 16 paces from the marker in the direction of the distant station and 3 paces to the left as shown in figure 31.
(3) Place the mast components about 11 paces from the marker in the direction of the distant station and 3 paces to the left.

46. Layout of Antenna Site
(fig. 32)

The layout of the antenna site consists of driving in place the mast base with mast base plate, establishing the location for the guy stakes, and driving them into the ground as follows:

a. Mast Base. Place the mast base plate on the spot marked for the location of the antenna, insert Mast Base AB–318/U (fig. 32) in the center hole of the mast base plate and drive it into the ground with Hammer HM–1.

b. Guy Stakes.

(1) Determine the location for Guy Stakes GP–111/G at 25 feet from the mast base by using the 25-foot rope assembly as a measure.
(2) Line up the rope with the distant station. At the end of the rope, drive guy stake No. 1 into the ground with the hook snap facing the mast base and the top of the stake angling away from the mast base at approximately 30° from the vertical position.
(3) Rotate the rope 180° around the mast base. Line it up with the distant station and drive guy stake No. 2 into the ground at the end of the rope.

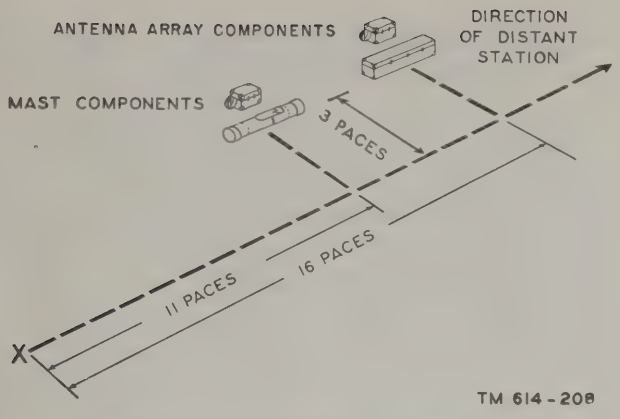


Figure 31. Components at antenna site.

(4) Drive guy stakes Nos. 3 and 4 into the ground equidistant from stakes Nos. 1 and 2 and at 25 feet from the mast base.

Note. The above layout of guy stake locations is for a comparatively level site. When the ground level slopes upward from the mast base, locate a guy stake closer to the mast base. When the ground slopes downward from the mast base, locate the guy stake farther from the mast base. The object is to balance the guying by arranging for approximately the same guying angle for all guys attached to a guy plate. In extreme cases it might be necessary to relocate one or more stakes after the mast is erected. This can be done by driving a spare stake in the newly selected spot and transferring the guys to it.

47. Assembly of Mast

Caution: When unpacking keep sand and mud from the ends of the mast sections.

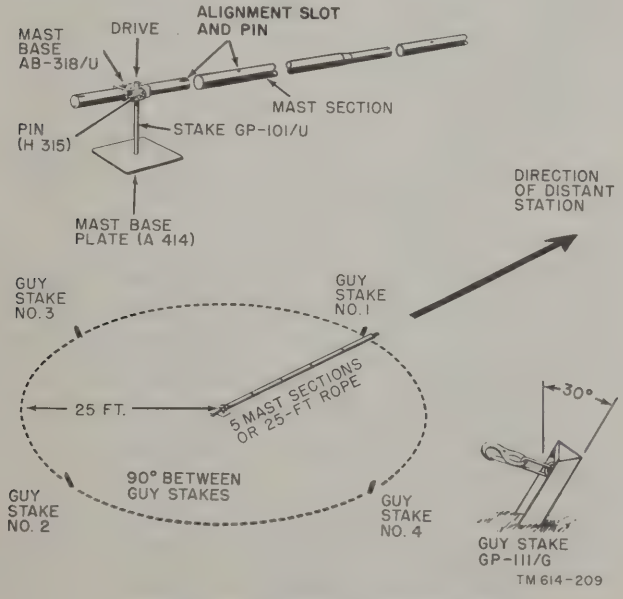


Figure 32. Layout of antenna site.

a. Mast. Assemble the mast as follows:

(1) Insert one mast section into the mast base by engaging the slot in the mast base holder with the pin in the large end of the mast section.
(2) Add two more mast sections in the same manner.
(3) Slip a guy plate over the small end of the third mast section.
(4) Add three more mast sections.
(5) Slip another guy plate over the small end of the sixth mast section.
(6) Add two more mast sections.
(7) Slip a third guy plate over the small end of the eighth mast section.

b. Guy Plates. To be sure that the transmission line will be properly attached, position the guy plates on the mast, with the strain relief clamps located as shown at A in figure 33.

c. Guys and Rope Assembly. All guys and the rope assembly are terminated on one end with a snap hook. Attach the snap hooks as follows:

(1) Attach four 52-foot guys to the top guy plate on the mast.
(2) Attach four 44-foot guys to the middle guy plate.
(3) Attach four 34-foot guys to the bottom guy plate.
(4) Attach the rope assembly and two spare guys to the gin pole cap as shown in B, figure 33 and in figure 34.

d. Pul-tite Guy Terminations (fig. 33). Note the operation of the Pul-tite terminations attached to the guys on the end opposite the snap hooks. Slack is taken up by pulling the knotted end of the guy. Tension is relieved on the guy by pulling out the spring-loaded chuck as illustrated in D, figure 33. Unroll the guys attached to the guy plates. Attach the chain on the Pul-tite terminations to the snap hooks on the guy stakes and gin pole cap (B and C, fig. 33) as follows:

Guys from—	Attach to—
Lower left holes of guy plates	Stake No. 3.
Upper right holes	Stake No. 4.
Lower right holes	Stake No. 1.
Upper left holes	Gin pole cap.

Note. Pull out the knotted end of the guys 4 feet from the Pul-tite.

e. Gin Pole. Assemble the gin pole and guy it as follows:

(1) Unwind the rope and gin pole guys (B, fig. 33).

(2) Insert the small end of a mast section through the center hole of the gin pole cap.

(3) Assemble a second mast section to the bottom of the first mast section and a third mast section to the bottom of the second.

(4) Raise the gin pole holder in the mast base to a vertical position and assemble the gin pole to it (fig. 34).

(5) Attach the left gin pole guy (B, fig. 33) to guy stake No. 3 and take up slack.

(6) Attach the right gin pole guy to guy stake No. 4 and take up slack.

f. Tension on Guys. Tension is applied to the guys by pulling the knotted end of the guy away from the Pul-tite guy terminal. The dacron guys will stretch more than ordinary rope but will return to normal length when the strain is removed.

(1) At guy stakes No. 3 and 4, simultaneously adjust the tension on each pair of gin pole guys and each pair of mast guys; leave the gin pole at an angle of 85° from the mast with the mast in line with the distant station.

(2) At guy stake No. 1, adjust the ends of the guys extending through the guy terminals to approximately the same lengths as at stakes No. 3 and 4.

(3) At the gin pole cap, adjust the tension on the mast guys until the end of the mast is bowed slightly upward; that is, the top gin pole guy should be tensioned more than the other guys.

48. Assembly of Antenna Array

a. General. Study the illustration of the boom and box subassembly in figures 35 and 36 to become familiar with the construction and nomenclature of its parts. The item numbers in figure 35 refer to the subparagraph numbers below.

(1) The boom is the large center tube equipped for attaching the antenna elements. Note that there is a hole at the midpoint for locating the mast adapter when asssembling it to the mast. Also note the graduations and locating holes at both ends of the tube for later adjustments.

(2) The junction box is fitted with Receptacle Connector UG–568/U for attaching the transmission line. It also has provisions for attaching the two folded dipole (radiator) elements. Note the thumbscrews provided for this purpose. The combination of the boom and junction box (without the antenna elements) is called the antenna support (E334).

(3) The red director element clamp (E308) is attached to the boom with thumbscrews.

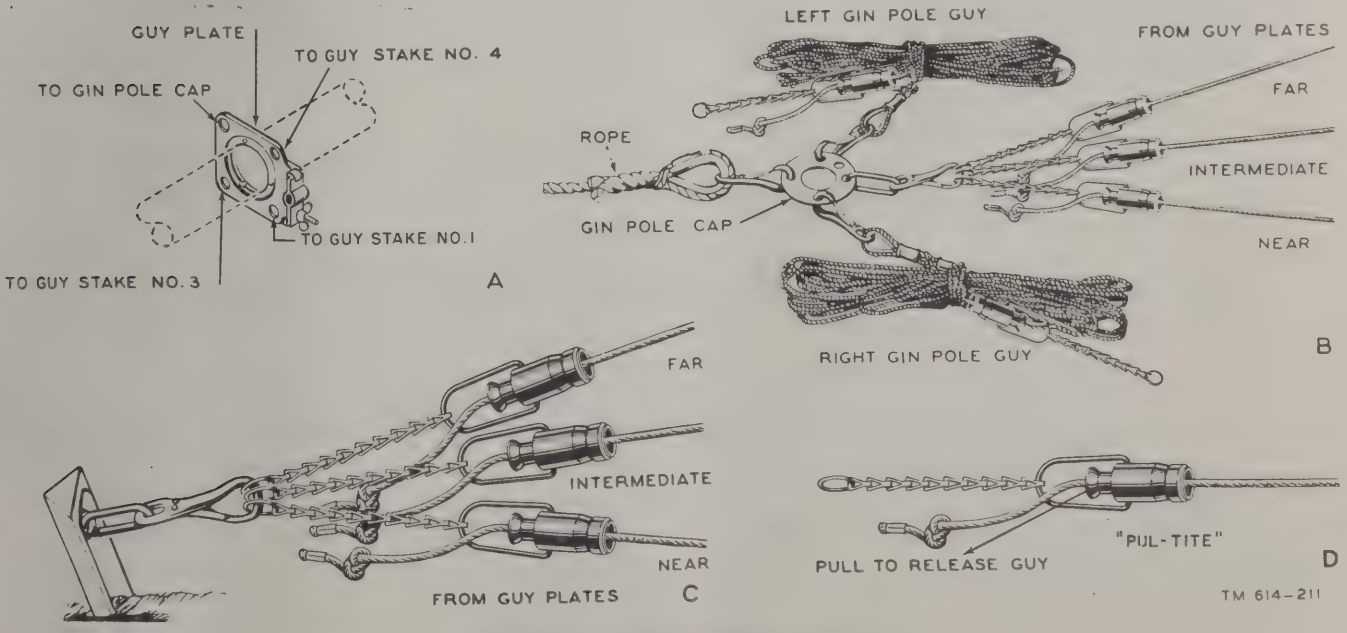


Figure 33. Mast assembly details.

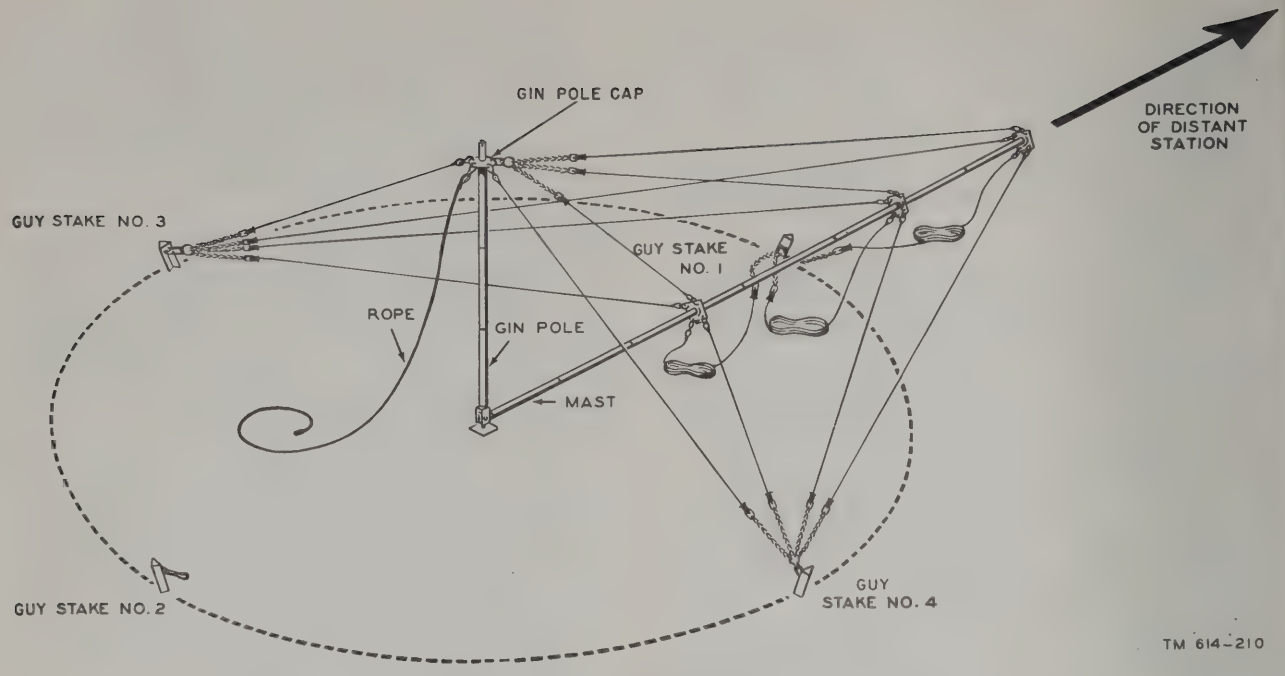


Figure 34. Mast assembled for erection.

(4) The two red director element assemblies are attached to the director element clamp with thumbscrews.
(5) The blue reflector element clamp (E307) is attached to the boom with thumbscrews.
(6) The two blue reflector element assemblies are attached to the reflector element clamp with thumbscrews.
(7) The electrical clamps are located on the antenna element assemblies for adjusting the length of the elements (par. 49).

b. Director and Reflector. Remove the boom and box subassembly from the case. Change the two director elements and the two reflector elements to the operating position by loosening the attaching thumbscrews sufficiently to swing the elements to right angles with the boom. Tighten the thumbscrews as shown in figure 37.

Caution: In removing parts from their containers keep all mating surfaces free of mud and sand.

c. Radiator. Assemble the folded dipole (radiator) elements to the terminal block. Loosen the

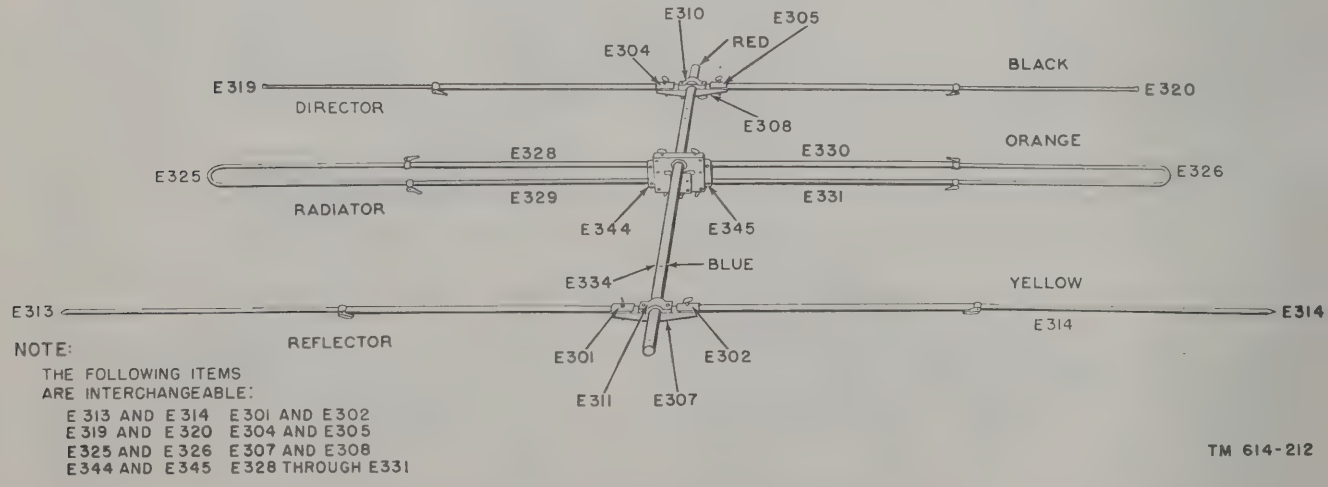


Figure 35. Antenna AS–620/GRC–10.

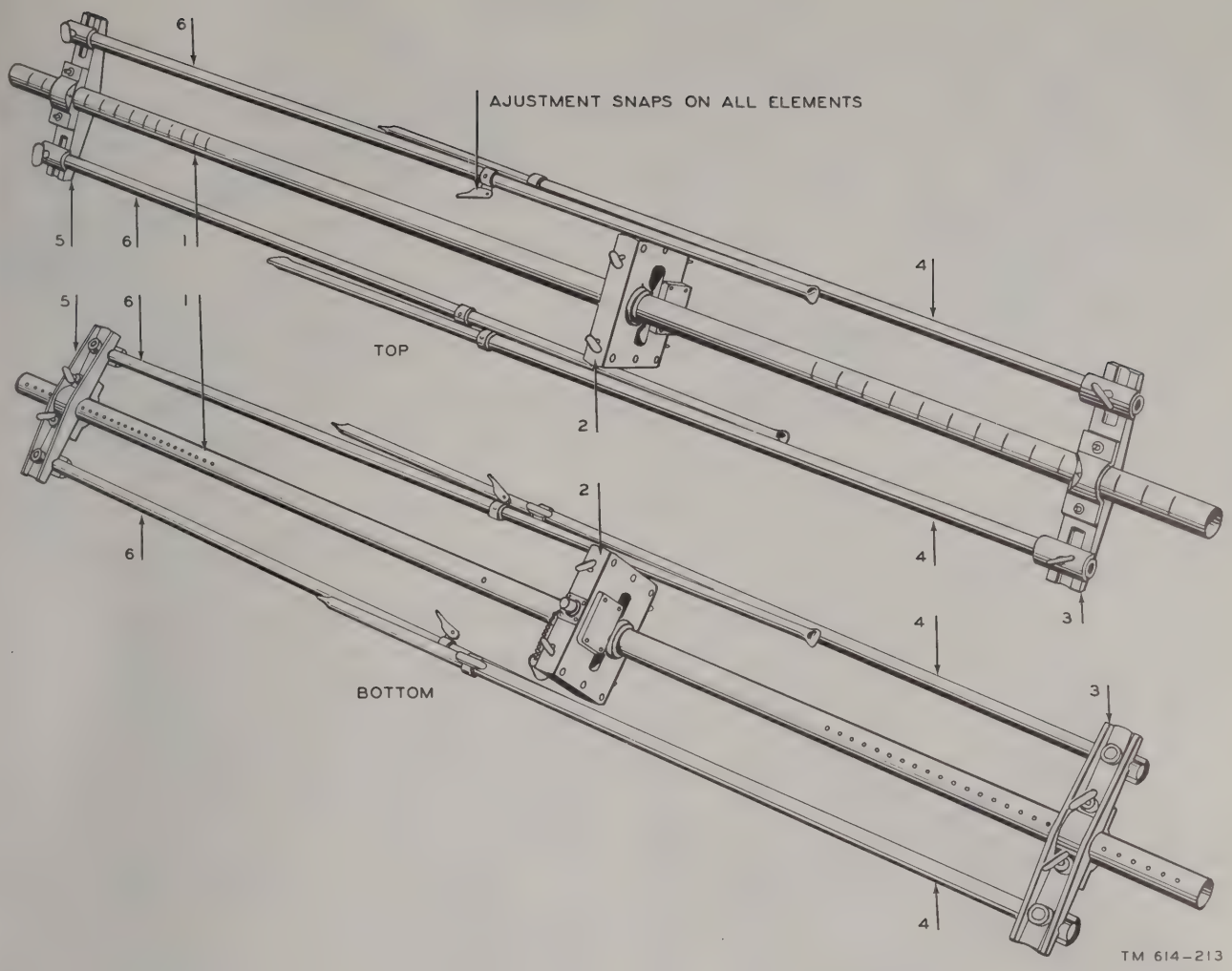


Figure 36. Boom and box assembly.

top and bottom thumbscrews (fig. 37), and insert the dipole element as far as possible in the holes. Hand-tighten the thumbscrews.

49. Frequency Adjustment of Antenna Elements

a. Color Code. Refer to figure 35 and to the frequency-setting chart in *e* below. Note that elements of the boom and box assembly are color-coded for rapid and accurate identification.

b. Adjustments. Note that the adjustments are listed on the frequency-setting chart in inches and that all graduations on the antenna array are in inches so that the adjustments can be made as indicated without the use of a rule or tape measure.

c. Element Lengths. Adjust the element lengths as indicated by the frequency-setting chart (*e* below) on the line with the required frequency. Do this by lifting up the adjusting snap and positioning the inner tube so that the correct reading lines up with the end of the tube sheath (fig. 38), then pressing down on the snap to secure the tube in position. Proceed as follows:

(1) Adjust the lengths of both reflector element assemblies as shown in column 2 of the frequency-setting chart. The adjusting snaps are color-coded yellow.

(2) Adjust the lengths of both radiator (folded dipole) element assemblies as shown in column 3. The adjusting snaps are color-coded orange.

(3) Adjust the lengths of both director element assemblies as shown in column 4. The adjusting snaps are color-coded black.

d. Boom Spacing. Adjust the boom spacing to the required setting (fig. 38). Do this by loosening the thumbscrews on the bottom side of the clamp, repositioning so that the arrow points to the required setting. The arrows on both the di-

rector and reflector clamps must point toward the mast adapter. *Be sure that the pin in the bottom casting is engaged in the locating hole on the bottom side of the boom. Tighten the two thumbscrews.* Adjust the boom spacing as follows:

(1) Adjust the boom spacing of the director element clamp (red) for the required frequency as indicated in column 5 of the frequency-setting chart.

(2) Adjust the boom spacing of the reflector element clamp (blue) according to column 6 of the frequency-setting chart.

e. Yagi Antenna Adjustments, Frequency-Setting Chart

Freq in mc/s	Element lengths in inches			Boom spacings in inches	
	Reflector (yellow)	Radiator (orange)	Director (black)	Director (red)	Reflector (blue)
54	58. 5	53	51. 5	22	33
55	57. 5	52	50. 5	21. 5	31. 5
56	56. 5	51	49. 5	21. 0	31. 5
57	55. 5	50	48. 5	20. 5	30. 5
58	54. 0	49	47. 5	20. 5	30. 5
59	53. 5	48. 5	47. 0	20. 0	30. 0
60	52. 5	47. 5	46. 5	19. 5	29. 0
61	52. 0	47. 0	46. 0	19. 5	29. 0
62	51. 0	46. 0	45. 5	19. 0	28. 5
63	50. 0	45. 0	44. 0	18. 5	27. 5
64	49. 5	44. 5	43. 5	18. 5	27. 5
65	48. 5	44. 0	43. 0	18. 0	27. 0
66	48. 0	43. 5	42. 5	18. 0	27. 0
67	47. 5	42. 5	41. 5	17. 5	26. 0
68	46. 5	42. 0	41. 0	17. 5	26. 0
69	46. 0	41. 5	40. 5	17. 0	25. 5
70	45. 5	41. 0	41. 0	17. 0	25. 5
71	45. 0	40. 5	39. 5	16. 5	25. 0

50. Assembly of Array to Mast (fig. 39)

a. Attach the mast adapter to the antenna array as follows:

(1) Loosen the wing nuts on the top of the mast adapter.

(2) Open the hinged top of the mast adapter and engage the pin in the mast adapter with the hole at the midpoint of the boom as shown in figure 39.

(3) Close the top of the mast adapter and secure it in place by the two spade bolts; hand-tighten the wing nuts.

b. Assemble the mast adapter to the mast (fig. 40) as follows:

(1) Loosen the wing nut on the body of the mast adapter.

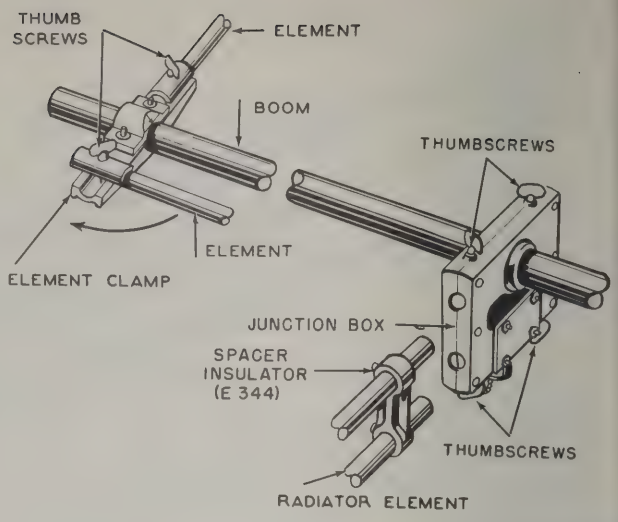


Figure 37. Antenna array assembly details.

(2) Insert the top of the mast into the mast adapter and be sure the bolt in the mast adapter engages in the slot in the mast section; hand-tighten the wing nut. When the mast is correctly inserted in the mast adapter, no part of the unpainted section of the mast section will show.

51. Assembly of Transmission Line to Antenna

The cable assemblies must be handled without kinking or bending. Do not step on or run vehicles over cable assemblies. All r-f connectors must be kept absolutely dry.

a. Assemble the transmission line by connecting the 65-foot RF Cable Assembly CG–718/U to the 35-foot RF Cable Assembly CG–718/U as shown in figure 40 as follows:

(1) Insert Adapter Connector UG–643/U into the coupling ring of the plug of one cable assembly with the bayonets of the adapter engaging in the bayonet slots of the plug coupling ring.

(2) Hold the adapter connector and turn the coupling ring clockwise until a clicking sound is heard.

(3) Pull on the adapter to be sure that it is securely attached.

(4) Attach the plug of the other cable assembly to the adapter connector in like manner.

b. Connect the transmission line to the junction box (fig. 40) as follows:

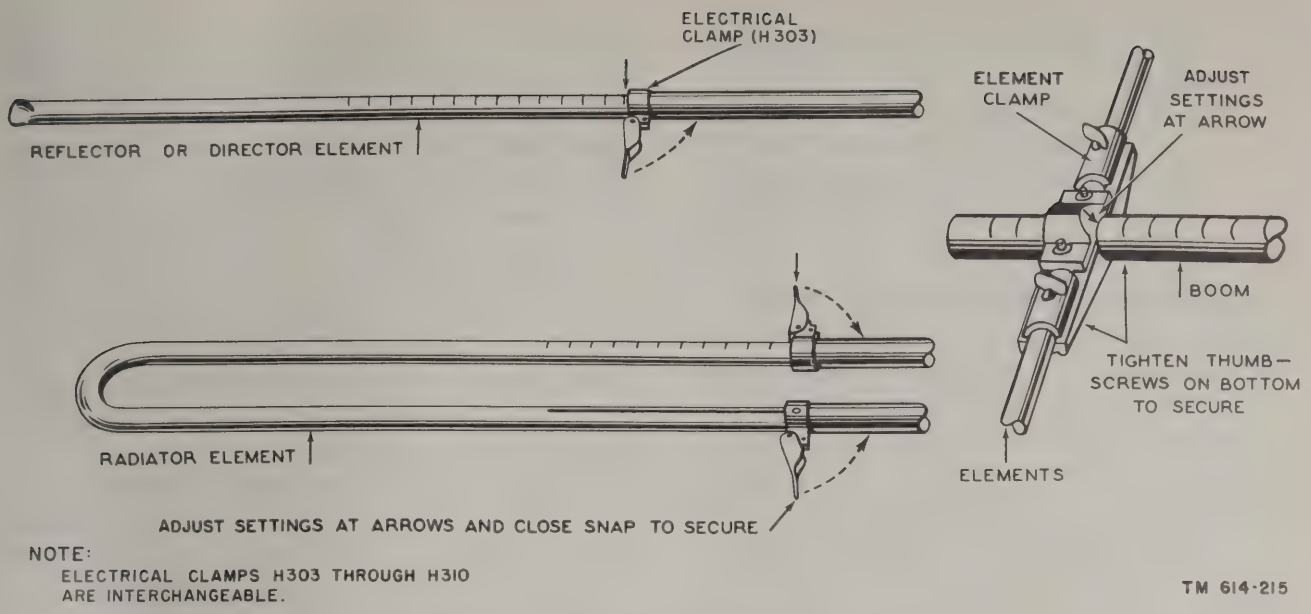


Figure 38. Antenna array adjustment details.

(1) Assemble one plug of the transmission line to the receptacle on the junction box with the bayonets of the receptacle engaging in the bayonet slots of the coupling ring as far as possible; turn the coupling ring clockwise until a clicking sound is heard.

(2) Pull on the transmission line to be sure that the plug and receptacle are securely attached.

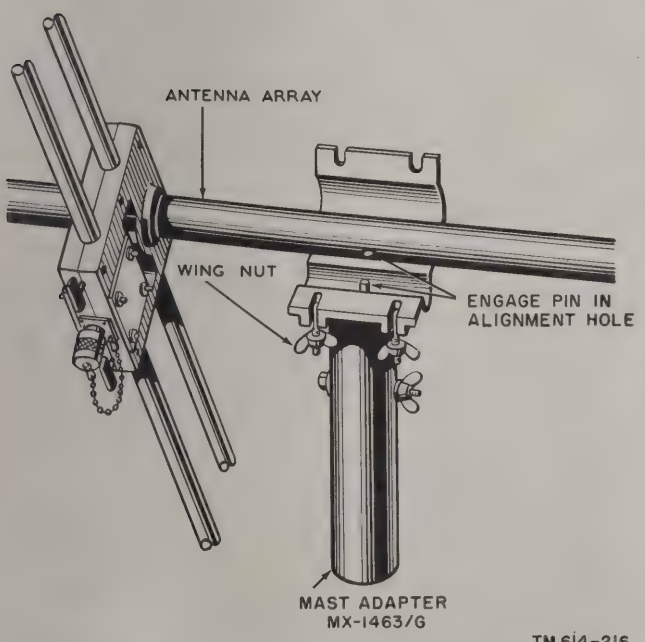


Figure 39. Antenna array and mast adapter, assembly detail.

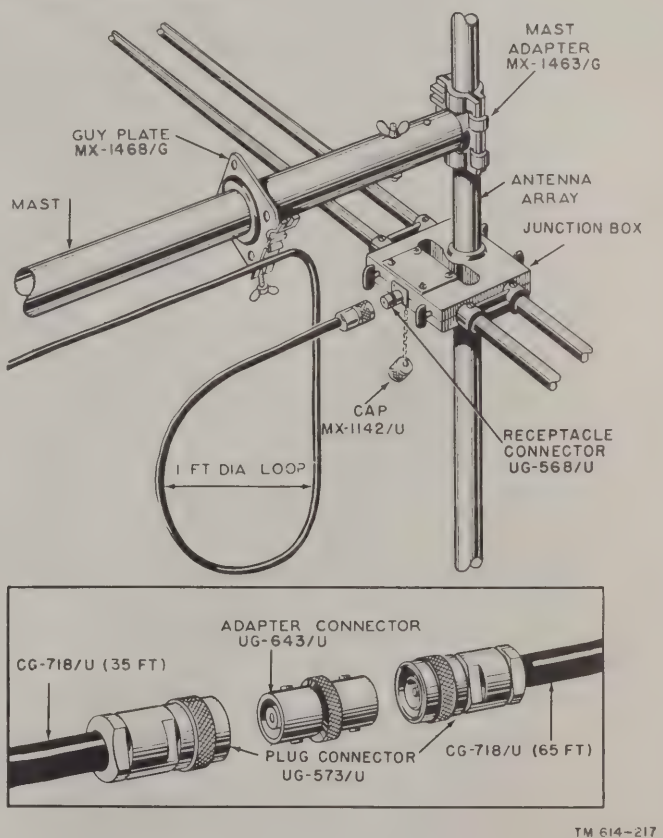


Figure 40. Antenna array, final assembly details.

c. Attach the transmission line to the mast as follows:

(1) Attach the transmission line to the strain relief mechanism of the top guy plate; allow sufficient slack to form a loop ap-

proximately 1 foot in diameter (fig. 40). Hand-tighten the wing nut on the strain relief.

(2) Attach the transmission line to the strain reliefs of the intermediate and lower guy plates by following the instructions in (1) above. No slack is required between the guy plates.

52. Assembly of Ground Plane Antenna

a. When assembling the ground plane antenna, check the table below to determine which elements are to be used. After this is determined, remove the required elements from the two Antennas AS–620/GRC–10 and install them on the ground plane adapter (fig. 41). Note that the radiator is the upright element; three ground plane elements are needed. Adjust the length of the elements as follows:

Frequency (mc)	Radiator length (in.)	Ground plane element length (in.)
54	53.0 Blue element	54.5 Blue element
55	52.0 Blue element	53.5 Blue element
56	51.5 Blue element	52.5 Blue element
57	50.5 Red element	51.5 Red element
58	49.5 Red element	50.5 Red element
59	48.5 Red element	49.5 Red element
60	48.0 Red element	49.0 Red element
61	47.0 Red element	48.0 Red element
62	46.5 Red element	47.5 Red element
63	45.5 Red element	46.5 Red element
64	45.0 Red element	46.0 Red element
65	44.0 Red element	45.0 Red element
66	43.5 Red element	44.5 Red element
67	43.0 Red element	44.0 Red element
68	42.0 Red element	43.0 Red element
69	41.5 Red element	42.5 Red element
70	41.0 Red element	42.0 Red element

b. Assemble the ground plane adapter to the mast (fig. 41) as follows:

(1) Loosen the wing nut on the body of the ground plane adapter.

(2) Insert the top of the mast into the ground plane adapter; be certain that the bolt in the mast adapter engages in the slot in the mast section. Hand-tighten the wing nut. When the mast is correctly inserted in the ground plane adapter, the unpainted portion of the mast section will not show.

53. Erection of Antenna

The antenna is raised and guyed by two men stationed as shown in figure 42, with man No. 1 at the rope attached to the gin pole and man No. 2 near the antenna array. Be certain that all guys are connected to the guy plates and guy stakes as shown in figure 42. In addition, the top mast guy on the gin pole should be tensioned, with the antenna array on the mast, so that the mast bows slightly upward during erection.

a. Raise the mast until the guys to guy stake No. 1 are taut as follows:

(1) *Man No. 1.* Pull on the rope until the gin pole is within reach; then force the gin pole toward the ground.

(2) *Man No. 2.* Assist Man No. 1 in raising the antenna. Push upward on the mast and work toward the mast base.

b. Guy the mast to guy stake No. 2 as follows:

(1) *Man No. 1.* Remain on the gin pole and force it toward the ground while Man No. 2 attaches the guys to stake No. 2.

(2) *Man No. 2.* Unsnap the mast guys from the gin pole cap, attach them to the snap hook linked to guy stake No. 2, and pull the knotted ends of the guys to take up slack. Remain at the stake for the next operation.

c. Apply tension to the mast guys so that the mast will be vertical as follows:

(1) *Man No. 1.* Go to guy stake No. 1 and apply tension to the guys that are attached to that stake while Man No. 2 does the same at guy stake No. 2.

(2) *Man No. 2.* Apply tension to the guys that are attached to guy stake No. 2.

(3) *Men Nos. 1 and 2.* Go to guy stakes Nos. 3 and 4 and apply tension to the attached guys simultaneously and remain at the guy stakes for the next operation.

(4) Men No. 1 and 2: Loosen the gin pole guys that are attached to guy stakes No. 3 and 4 and detach them from the guy stakes.

d. Place the unneeded components in guy Bag BG–102–A as follows:

(1) Remove the gin pole cap from the gin pole and detach the rope and guys.

(2) Place the removed guys and gin pole cap in guy Bag BG–102–A.

e. When high winds or icing conditions are anticipated, Antenna Mast AB–301/G may be made to withstand greater wind velocities and head loads than the regular installation by reducing the antenna height to 30 feet as follows:

(1) Locate Stakes GP–111/G 30 feet from the mast base instead of the recommended 25 feet. If extra MX–1469/G (44 ft.)

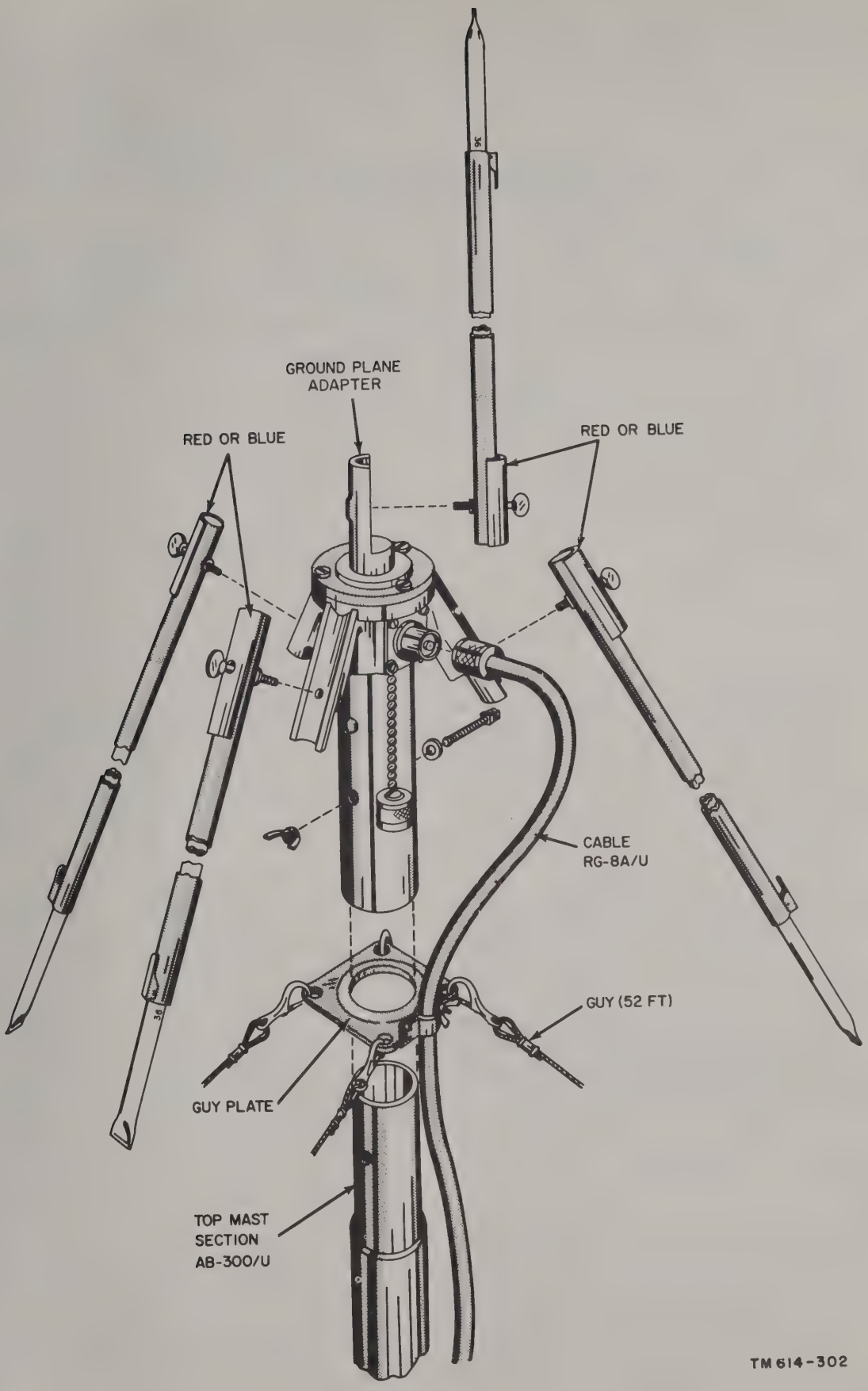


Figure 41. Ground plane adapter, assembly details.

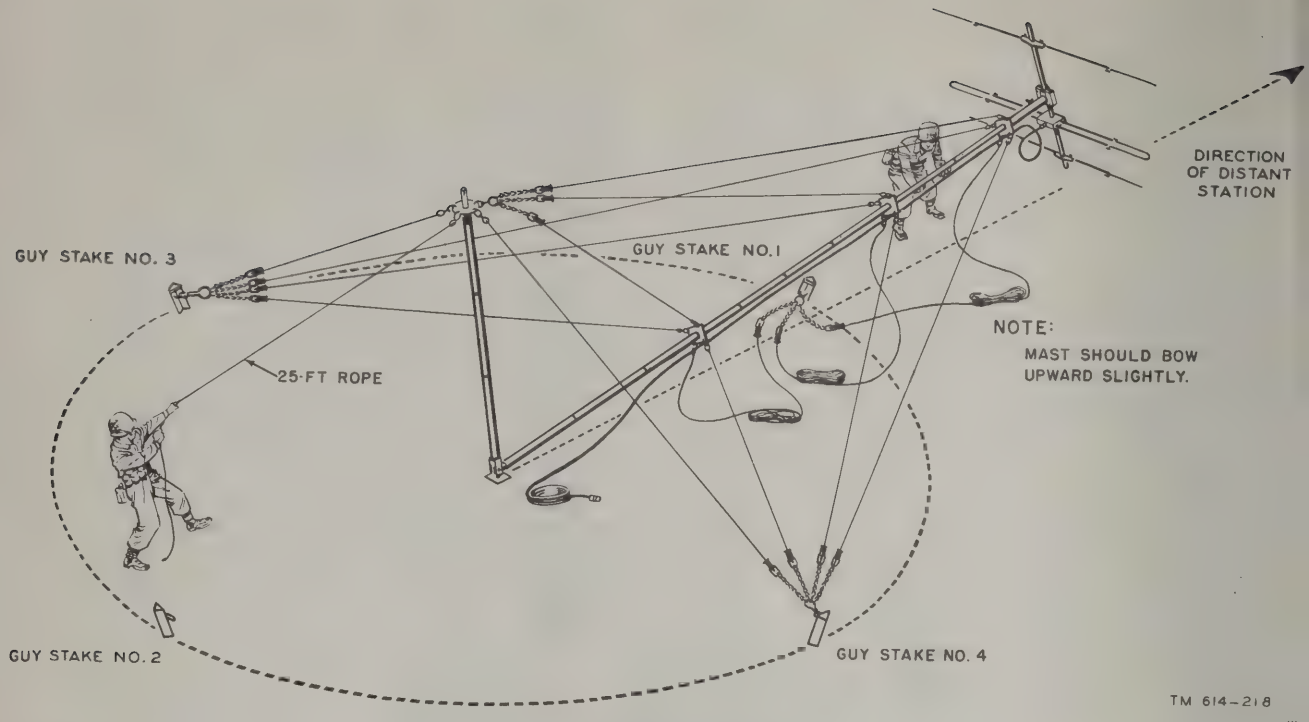


Figure 42. Raising antenna.

center guys are available and are used at the lower guy level instead of the 34-foot ones, the guying radius can be extended to 35 feet with an additional gain in mechanical reliability.

(2) Place a Guy Plate MX–1468/G at the end of the second, fourth, and sixth Mast Sections AB–300/G.

(3) Mount Mast Adapter MX–1463/G and the antenna array on the end of the sixth Mast Section AB–300/G. The antenna height will then be reduced from 40 feet to 30 feet.

(4) Stake GP–112/G may be requisitioned for use as a substitute for Stake GP–111/G in locations where coral, frozen ground, or hard pan types of underfooting are encountered.

54. Orientation of Antenna

(fig. 43)

Orient the antennas so that the director elements face in the direction of the distant station. The director elements are the straight sections of the antenna array that are attached to the half of the boom to which the junction box is attached. Rotate the antenna with the gin pole until it is in the desired position. Drive a spare stake beside the gin pole and lash the gin pole to it. This is

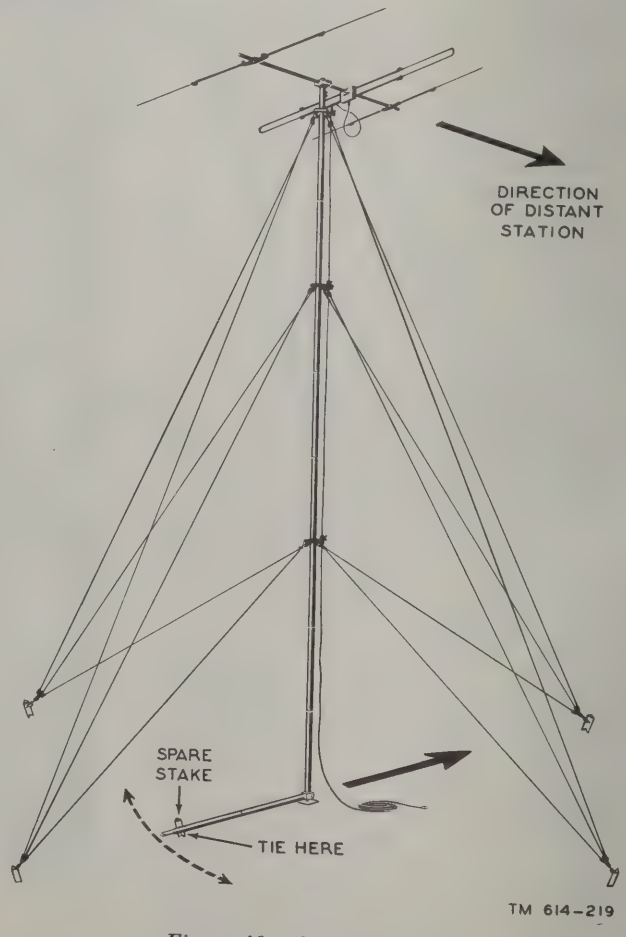


Figure 43. Orienting mast.

an approximate location; directions for final orientation of the antenna are given in paragraph 66.

Caution: When rotating the antenna over a wide angle, check the location of the slack in the transmission line under the antenna array. Turn the antenna in the direction that will not cause the transmission line to be pulled tight enough to be damaged.

Section III. INSTALLATION OF RADIO SET AN/GRC–10, RADIO TERMINAL SET AN/GRC–39, AND RADIO REPEATER SET AN/GRC–40

55. Checking Components

a. Remove all components from their cases by releasing the Dzus fasteners on the front panels and sliding the cases from the panel chassis assemblies. Inspect the inside and outside of each cabinet for dents and scratches. Inspect the panel and chassis of each component. Be sure that all tubes are in the correct sockets. Refer to figures 57, 58, and 59 for tube locations; refer to the list of tubes in (1) and (2) below for tube types. Be sure that all plug-in parts (capacitors, tubes, crystals, vibrators, and relays) are seated firmly in their sockets. Be sure that all crystals are of the proper frequency; refer to figures 132 and 141. Check the equipment for possible shipping damage, such as loose knobs, broken meter faces, broken wires, bent shafts, or damaged blower blades. At this time, be sure that the MASTER POWER switch on each control unit is OFF.

(1) The following tubes are used in Radio Transmitter T–235/GRC–10:

Circuit symbol	Type	Function
V201	6CB6	Modulator
V202	6CB6	Modulator
V203	5654/6AK5W	Master oscillator and doubler
V204	5686	Driver
V205	4X150D	Power amplifier
V206	12AT7	(A) Narrow-band amplifier (B) Ring test oscillator
V207	12AT7	(A) Meter amplifier (B) Meter rectifier
V208	OA2	Voltage regulator
V209	6BH6	First high-frequency oscillator
V210	6BH6	Second high-frequency oscillator
V211	12AT7	(A) First mixer (B) Second mixer
V212	6CB6	Intermediate-frequency amplifier
V213	6BJ6	Limiter
V214	5726/6AL5W	Dsicriminator
V215	6BH6	Automatic frequency control amplifier
V216	6BH6	Wide-band amplifier

(2) The folowing tubes are used in Radio Receiver R–125/GRC–10:

Circuit symbol	Type	Function
V1	5654/6AK5W	R-f amplifier
V2	5654/6AK5W	First mixer
V3	6BH6	First variable i-f amplifier
V4	6BH6	Second variable i-f amplifier
V5	6BH6	Second mixer
V6	6BH6	First fixed i-f amplifier
V7	6BH6	Second fixed i-f amplifier
V8	6BH6	Third fixed i-f amplifier
V9	6BH6	Fourth fixed i-f amplifier
V10	12AT7	First high-frequency oscillator
V11	6BH6	Second high-frequency oscillator
V12	6BH6	Automatic frequency control amplifier
V13	6BH6	First limiter
V14	6BJ6	Second limiter
V15	5726/6AL5W	Discriminator
V16	OA2	Voltage regulator
V17	12AT7	(A) Meter amplifier (B) Meter rectifier
V18	6BH6	Noise amplifier
V19	5726/6AL5W	Noise rectifier
V20	12AT7	Squelch
V21	5654/6AK5W	Wide-band audio amplifier
V22	12AT7	Narrow-band audio amplifier
V23	6AK6	Narrow-band audio output

(3) The control unit uses two type OA2 tubes (V401 and V402) as voltage limiters.

b. Check all fuses for condition and value. The value and location of each fuse in the equipment is listed below:

Fuse	Value (amp.)	Location
F301	3	Front panel, power supply. Designated as XMTR 3A.
F302	3	Front panel, power supply. Designated as REC 3A.
F303	2	Front panel, power supply. Designated as FIL 2A.
F304	1	Front panel, power supply. Designated as REC 1A.

Fuse	Value (amp.)	Location
F305	2	Front panel, power supply. Designated as XMTR 2A.
F306	4	Swing-out chassis (bottom) of power supply.
F307	3	Swing-out chassis (bottom) of power supply.
F401	4	Rear of chassis, control unit.
F402	4	Rear of chassis, control unit.
F403	15	Rear of chassis, control unit.

Caution: To avoid damage to the components, do not use any fuse rated other than that specified.

c. Inspect all interconnecting cables. Look for kinks and bends. Be sure they are not frayed or cut and that all connectors are firmly attached.

d. Check the power units, where supplied, as described in the technical manual furnished with them.

56. Mounting Components

a. General. After a good site has been chosen, and the equipment has been thoroughly checked, the components should be mounted to Electrical Equipment Rack MT–700/GRC–10 as shown in figure 2.

b. Mounting Control Unit. This component should be mounted first. Slide the four case-mounting nuts (provided in the hardware kit) into the channels at the top of the control unit case until they line up with the holes; screw the spacer screws into the case-mounting nuts. (Use lock washers between spacer screws and case.) Loosen the four wing fasteners at the front of the mounting rack (fig. 44), and swing back the mounting table. Place the control unit between the mounting supports; bring the power cables out through the sides of the mounting rack. Swing the mounting table down and secure it to the supports by tightening the wing fasteners. Line up the control unit case so that the spacer screws are under the holes in the mounting table. Bolt the control unit to the mounting table; use the cap screws and lock washers.

c. Mounting Receiver, Transmitter, and Power Supply.

(1) *Receiver.* See that all locking levers (fig. 44) are unlocked, to the left. Place the receiver so that the rails on the bottom of the case rest in the first and third left-hand channels of the mounting table. Move the three extreme left-hand locking levers to the right, thus locking the receiver to the electrical equipment rack.

(2) *Power supply.* Following the same procedure as above; place and lock the power supply next to the receiver.

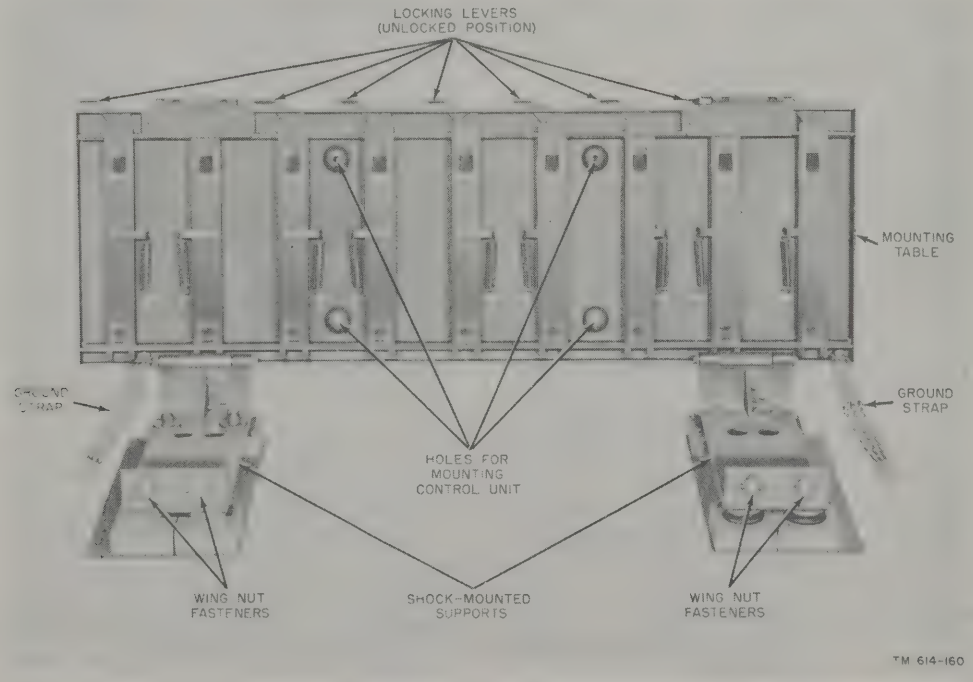


Figure 44. Electrical Equipment Rack MT–700/GRC–10, open view.

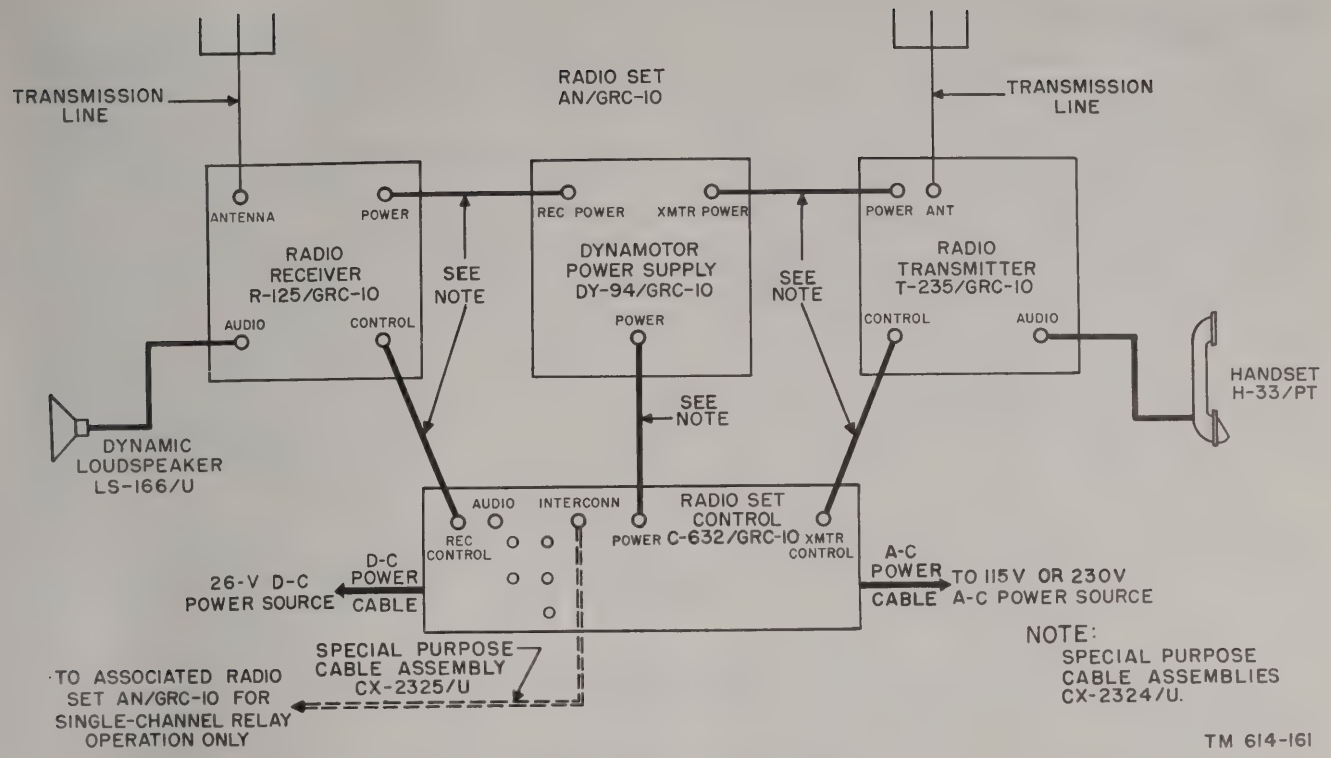


Figure 45. Radio Set AN/GRC–10, cording diagram.

(3) *Transmitter.* Place and lock the transmitter next to the power supply. The set should then appear, except for cable connections and accessories, as shown in figure 2.

57. Connections for Radio Set AN/GRC–10

Refer to figures 2 and 45 when making connections.

Caution: Be sure that the MASTER POWER switch on the control unit is in the OFF position before making any connections.

a. Major Components. Use the set of five component cables to connect the receiver, transmitter, and power supply to the control unit, and to connect the power supply to the receiver and to the transmitter.

(1) Press the connectors on the ends of the cables firmly into the sockets on the units.

(2) Tighten the screw by turning the wing nut hand-tight.

b. Antennas. Remove the caps from the antenna jacks on the receiver and transmitter front panels; place them on the dummy jacks. Connect the transmission lines from the receiving and transmitting antennas to their respective packs. These are bayonet connectors; turn the connectors on the transmission line until the pins slide into the slots. Press in firmly and twist clockwise until they lock.

c. Audio. Connect the loudspeaker to the AUDIO jack of the receiver. Connect the handset to the jack of either the control unit or the transmitter. The connectors on the loudspeaker and handset cables will mate with their jacks in only one position. While pushing them lightly against the jacks, keep turning them until they slip into the jacks; then turn clockwise until they lock.

d. Power. Plug the connector at the end of the a-c power cable into a source of 115 volts or 230 volts a-c, 50 to 65 cycles. Connect the d-c power cable to a 26-volt d-c source, if one is available. Connect the center conductor of the d-c cable to the positive side; connect the outside conductor (shield) to the negative side.

Caution: Be sure that the position of the LINE VOLTAGE switch corresponds to the voltage of the a-c power source.

e. Interconnections. To use two radio sets as a relay station, attach the connectors at each end of the interconnecting cable to the INTERCONN jacks on the two control units. These connectors are the same as those on the component cables. Attach them in the manner described in *a* above.

58. Connections for Radio Terminal Set AN/GRC–39

a. Make the connections for Radio Set AN/GRC–10 according to the information in paragraph 57. Connect the power units and their accessories as shown in figure 46. The set is now connected for single-channel operation.

b. For multichannel operation, connect the telephone terminal equipment to the control unit as shown in figure 46. Connect the wires at the end of Telephone Cable Assembly CX–1512/U to the binding posts on the control unit as follows:

(1) Connect the pair of colored wires to the XMTR binding posts.

(2) Connect the white wires to the REC binding posts.

(3) Connect the shield of the cable to the GND binding post.

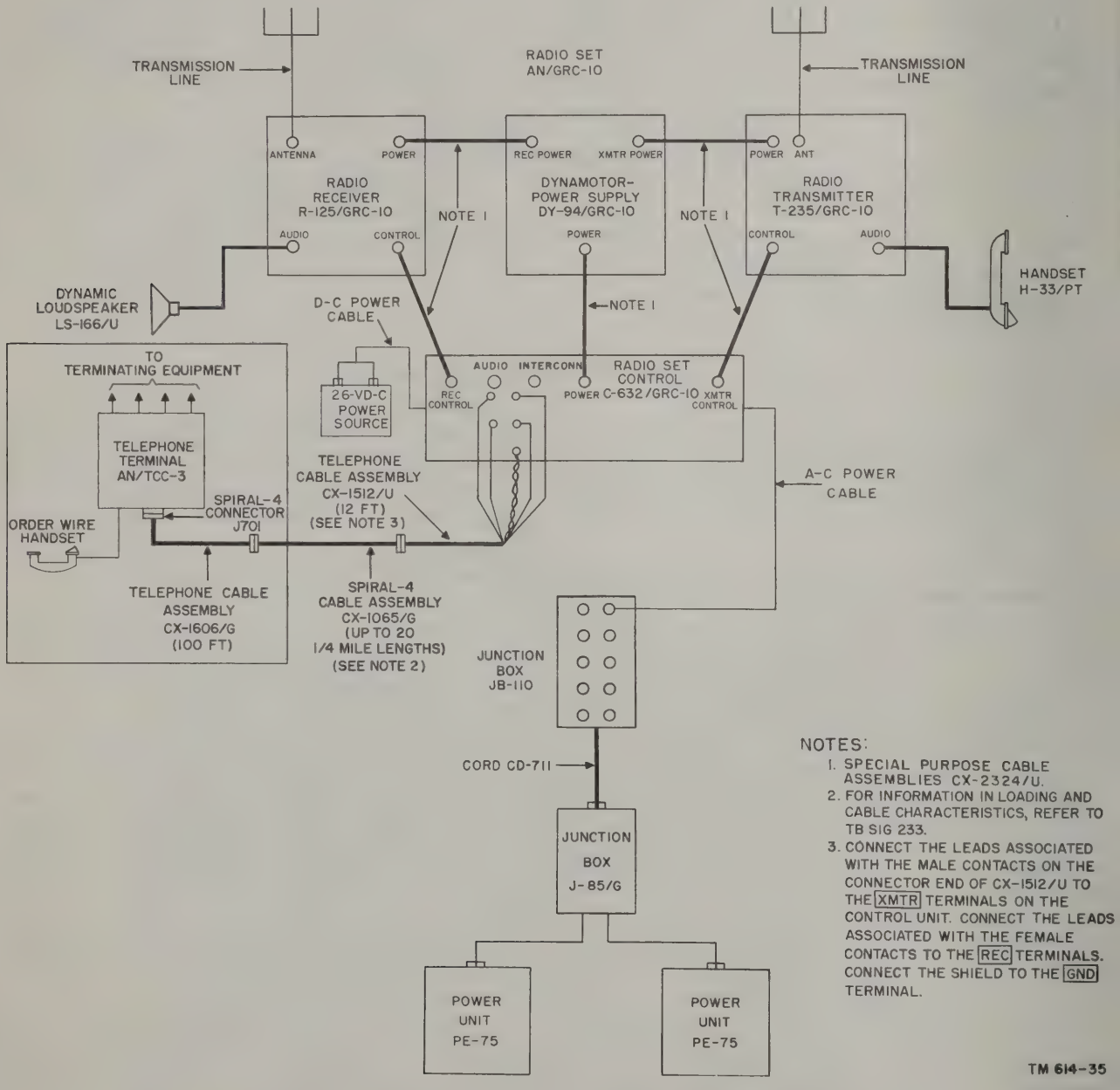


Figure 46. Radio Terminal Set AN/GRC–39, cording diagram.

c. If a spiral-four cable longer than the 12-foot telephone cable assembly is needed, use additional lengths of spiral-four cable as required (fig. 46).

59. Connections for Radio Repeater Set AN/GRC–40

(fig. 47)

a. Make the connections for each Radio Set AN/GRC–10 according to the information in paragraph 57. Connect the power units and their accessories as shown in figure 47. Attach the connectors at each end of the interconnecting cable to the INTERCONN jacks on the two control units.

b. If required, connect the extra loudspeaker to the AUDIO jack of the receiver not used for the first loudspeaker.

60. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 44 for uncrating and unpacking the equipment. Check all parts as described in paragraph 55.

b. Check the used or reconditioned equipment for tags or other indications that pertain to changes in the wiring of the equipment. If any changes in wiring have been made, note them in this manual, preferably on the schematic diagram.

c. Check the operating controls for ease of operation; check especially the frequency-setting controls. If lubrication is required, refer to the lubrication instructions in paragraphs 106, 107, and 108.

d. Perform the installation and connection procedures (where applicable) given in paragraphs 45 through 59.

Section IV. INITIAL ADJUSTMENT OF EQUIPMENT

Note. Personnel who perform the procedures described in this section should be familiar with the use of controls and instruments and with the operating procedures described in chapter 3.

61. Extent of Initial Adjustments

The procedures outlined in paragraphs 62 through 68 must be performed before the radio set can be used for the routine operations described in chapter 3. Whenever the assigned operating frequencies are changed, the transmitter and receiver tuning procedures must be repeated. Although the procedures refer specifically to Radio Set AN/GRC–10, they apply equally to Radio Terminal Set AN/GRC–39 and Radio Repeater Set AN/GRC–40, because Radio Set AN/GRC–10 is a basic part of the other equipment.

62. Preliminary Adjustment of Radio Transmitter T–235/GRC–10

Caution: Voltages dangerous to human life are present on the plate lead of the power amplifier tube and in the power supply circuits. Do not touch these parts while the equipment is operating. When the operating frequency of the transmitter has been determined (par. 91), the transmitter must be tuned for that frequency. Before the tuning procedure can be carried out, take the following preliminary steps.

a. Check for proper mating of all front panel connecting plugs.

b. Set the TEST-MIKE-RING switch to the MIKE position.

c. Set the LINE LEVEL, ANT TUNE, and ANT LOAD controls at their midway positions.

d. Set the METER SW to the R. F. POWER position.

e. Set the R. F. POWER switch to the HI position.

f. Open the blower door by turning the knob counterclockwise.

g. Set the MC and 0.1 MC selectors to the desired operating frequency.

63. Preliminary Adjustment of Radio Receiver R–125/GRC–10

Before the receiver can be operated, the operating frequency must be determined (par. 91) and the receiver tuned to that frequency. However, before tuning the receiver, carry out the following preliminary steps:

a. Check for proper mating of all front panel connecting plugs.

b. Set the LINE LEVEL, VOLUME, and ANT ADJ controls at their midway positions.

c. Turn the SQUELCH control to the OFF position.

d. Set the METER SW to the 3RD IF position.

e. Set the MC and 0.1 MC selectors to the desired operating frequency.

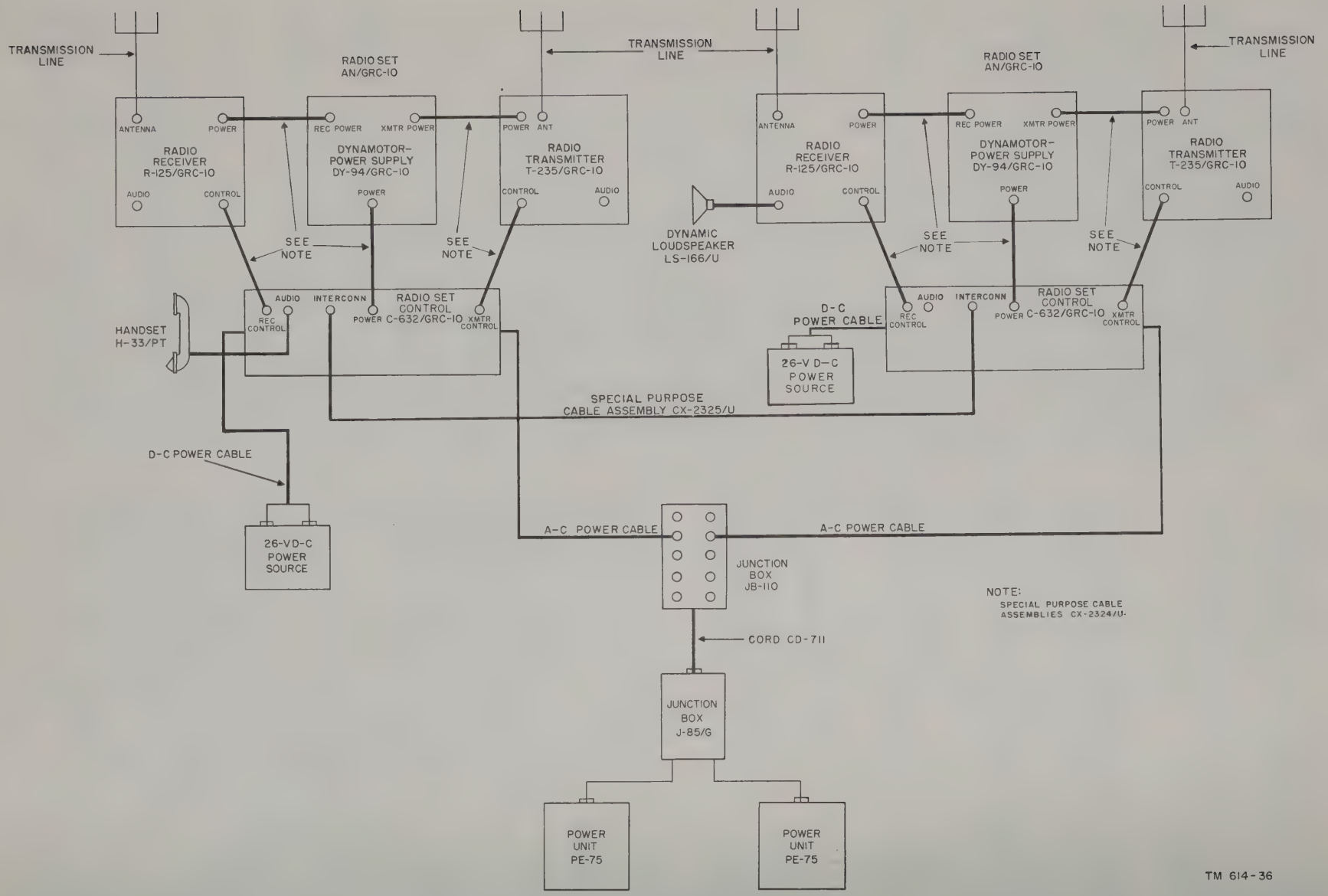


Figure 47. Radio Repeater Set AN/GRC-40, coraing diagram.

64. Preliminary Adjustment of Dynamotor-Power Supply DY–94/GRC–10

a. Check for proper mating of all front panel connecting plugs.

b. Check all front panel a-c and d-c fuses and be sure that the value of the fuse corresponds to the value indicated on the front panel.

c. Set the LINE VOLTAGE switch to the 115 position when operating from a 115-volt a-c power source, and to the 230 position when operating from a 230-volt power source.

d. Turn the knob on the blower door counterclockwise until the door opens. Raise the door as far as it will go. Press it until the hairpin-shaped spring on the knob engages the hang-up stud mounted on the front panel near the name plate.

65. Preliminary Adjustment of Radio Set Control C–632/GRC–10

a. Check for proper mating of all front panel connecting plugs.

b. Set the TYPE OF OPERATION switch to the PUSH-TO-TALK position.

66. Tuning Radio Set AN/GRC–10

If during the following procedure an abnormal result is obtained, refer to paragraph 115.

Caution: Before turning on the equipment, be sure that the TYPE OF OPERATION switch is in the PUSH-TO-TALK position.

a. Turn the MASTER POWER switch on the control unit to ON; the POWER lamp on the power supply will glow.

b. Allow the tubes to heat for at least 30 seconds; then turn the TYPE OF OPERATION switch to TERMINAL. This will key the transmitter; the TRANSMIT lamp on the power supply will glow.

c. Check to be sure that the METER SW on the transmitter is in the R. F. POWER position.

d. Adjust the transmitter ANT TUNE control (a screwdriver adjustment) for maximum deflection on the transmitter meter.

e. Turn the METER SW on the transmitter to the PA PLATE position.

f. Adjust the transmitter ANT LOAD control (a screwdriver adjustment) for an increase in the meter reading. Continue to adjust for an increase in plate current, but do not permit a reading of more than 150 milliamperes (ma).

Note. Although the highest number on the meter scale is 100, that figure represents 200 ma; therefore a reading of 75 on the scale represents 150 ma.

g. Set the METER SW on the transmitter at the R. F. POWER position.

h. Check the setting of the transmitter ANT TUNE control for a maximum deflection on the meter.

i. Repeat the steps in *c* through *h* above until it is certain that the ANT TUNE control is adjusted to produce a maximum deflection of R. F POWER on the transmitter meter, and that the ANT LOAD control is adjusted to produce 150 ma PA PLATE current.

j. Set the transmitter METER SW at LINE LEVEL and set the TEST-MIKE-RING switch at TEST.

k. Adjust the LINE LEVEL control on the transmitter for a reading of zero db on the meter.

l. Set the TEST-MIKE-RING switch at MIKE. Call the adjacent station by pressing the switch on the handset and speaking clearly into the handset. Ask the operator to transmit a TEST signal. If it is difficult to hear the test tone from the station, turn the LINE LEVEL and VOLUME controls clockwise.

m. Check the orientation of the receiving antenna. While the adjacent station is transmitting a TEST signal, slowly rotate the antenna (par. 54) for a maximum deflection of the meter on the receiver. (The METER SW on the receiver should be set at 3RD IF.) If the deflection of the meter is too small, turn the METER SW on the receiver to the 1ST LIM position.

Note. Ground-plane antennas do not require orientation; their radiation pattern is uniform in all directions.

n. While checking for the best direction for the receiving antenna, adjust the ANT ADJ control on the receiver for maximum deflection of the meter. Usualy two men will be required: one to rotate the antenna, and the other (at the receiver) to adjust the ANT ADJ control and to watch the meter on the receiver.

o. After the antenna has been oriented for best signal strength, as indicated by the highest possible reading on the receiver meter, lash the gin pole as described in paragraph 54. Make a final check of the ANT ADJ control.

Note. If, at the beginning of the receiver adjustment, it was necessary to set the METER SW to the 1ST LIM position, it probably will be necessary to turn the METER SW to 3D IF as the adjustment proceeds and the signal becomes stronger. When it is at the 1ST LIM position, the meter will not deflect properly on strong signals.

p. With the adjacent station still sending a TEST signal, turn the METER SW on the re-

ceiver to the LINE LEVEL position. Adjust the LINE LEVEL control on the receiver for a zero db reading on the meter. Adjust the receiver VOLUME control for a comfortable listening level.

q. Ask the operator of the adjacent station to stop transmitting.

r. Turn the SQUELCH control on the receiver clockwise from the OFF position; the CALL LIGHT will glow. Continue turning the SQUELCH control clockwise; stop turning immediately when the CALL LIGHT goes out. This position of the control is the threshold point. Be sure that no signal is being received when the foregoing adjustment is made.

s. Ask the operator of the distant station to turn his transmitter on and off a few times while his TEST-MIKE-RING switch is in the MIKE position. Each time his transmitter is keyed, the CALL LIGHT on the receiver should go on, and it should go out when the transmitter goes off. If this does not happen, readjust the SQUELCH control slightly.

t. Check the orientation of the transmitting antenna. Ask the operator of the adjacent station to turn his receiver METER SW to 3D IF and watch the meter. Turn the TEST-MIKE-RING switch to TEST. Rotate the transmitting antenna carefully (par. 54) until the adjacent-station operator reports maximum indication on his receiver meter. Lash the gin pole as described in paragraph 54.

67. Tuning Radio Terminal Set AN/GRC–39

Tune the radio terminal set according to the instructions in paragraph 66. After all adjustments have been made, set the TYPE OF OPERATION switch at the TERMINAL position.

68. Tuning Radio Repeater Set AN/GRC–40

Disconnect the interconnecting cable that is between the INTERCONN jacks on the control units. Tune each Radio Set AN/GRC–10 according to the instructions in paragraph 66. When orienting the antennas and when making the SQUELCH control adjustments, be sure that the proper adjacent station is contacted for each radio set. After all adjustments have been made, set the TYPE OF OPERATION switch at the RELAY position. Reconnect the interconnecting cable.

CHAPTER 3

OPERATION

Section I. CONTROLS AND INSTRUMENTS

Note. This section locates, illustrates, and describes the use of the various controls and instruments that are provided for the proper operation of the equipment.

69. General

Haphazard operation or improper settings of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in paragraphs 74 through 86.

70. Radio Transmitter T–235/GRC–10, Controls

(fig. 48)

The following table lists the controls of the radio transmitter and indicates their function:

Control	Function
MC control	Selects and indicates the desired carrier frequency of the transmitter in 1-mc steps.
0.1 MC control	Selects and indicates the desired carrier frequency of the transmitter in 100-kc steps.
TEST-MIKE-RING switch (S202).	
TEST	Applies a 1,000-cycle audio note to the wide-band audio input, which is used for adjusting the LINE LEVEL control.
MIKE	Feeds the audio from the handset to the modulators and to the input of the narrow-band audio amplifier.
RING	Applies a 1,600-cycle audio note to the modulator tubes and the input of the narrow-band audio amplifier. Used for attracting the attention of operators for order wire communication.
LINE LEVEL control (R201).	Varies the strength of the audio applied to the modulators. This control is adjusted for a 0-db meter reading when the TEST-MIKE-RING switch is in the TEST position.
R. F. POWER switch (S201).	Selects HI or LO power operation of the transmitter.
METER SW switch (S203).	
OSC	Measures the grid leak bias at the master oscillator stage. Normal reading is 2 volts. Full scale deflection is 10 volts.
PA GRID	Measures the grid voltage at the power amplifier. A reading of 50–95 volts indicates that the driver is supplying excitation voltage to the power amplifier stage. Full scale deflection is 100 volts.
PA PLATE	Indicates the amount of plate current in the power amplifier stage. Full scale deflection is 200 ma.
R. F. POWER	A relative indication of the r-f power radiated by the antenna. Full scale deflection is 100 watts.
LINE LEVEL	Indicates the level of wide-band audio applied to the transmitter from the telephone terminal equipment. Use db scale.
AFC	A zero reading indicates that the afc circuit is operating properly. A meter deflection indicates that the afc is not operating or that the master oscillator has drifted more than 150 kc above the center frequency of the carrier. Full scale deflection is 20 volts.

Control	Function
METER SW switch (S 203)—Continued	
AFC+	A zero reading indicates that the afc circuit is operating properly. A meter deflection indicates that the afc is not operating or that the master oscillator has drifted more than 150 kc below the center frequency of the carrier. Full scale deflection is 20 volts.
XTAL OSC	Indicates grid voltage at the first hf oscillator (1 volt). Full scale deflection is 10 volts.
ANT LOAD control (L207).	With the METER SW set to the PA PLATE position, this control is adjusted for 150-milliampere deflection. Full scale deflection is 200 ma.
ANT TUNE control (C228).	With the METER SW set to the R. F. POWER position, this control is adjusted for maximum deflection.
Blower door (OPEN TO OPERATE).	Opens air passages and starts blower motor.

71. Radio Receiver R–125/GRC–10, Controls

(fig. 49)

The following table lists the controls of the radio receiver and indicates their function:

Control	Function
MC control	Selects and indicates the desired carrier frequency of the receiver in 1-mc steps.
0.1 MC control	Selects and indicates the desired carrier frequency of the receiver in 100-kc steps.
VOLUME control (R122).	Varies the input to the narrow-band amplifier, and thus provides the desired signal level to the speaker or handset.
LINE LEVEL control (R114).	Varies the input to the wide-band amplifier, and thus provides the desired signal level to the telephone equipment or to the transmitter during retransmission.
METER SW switch (S5).	
OSC 1	Indicates grid current of first h-f oscillator (normally 10–40 μa). Full scale deflection is 100 μa.
OSC 2	Indicates grid current of second h-f oscillator (normally 15–50 μa). Full scale deflection is 100 μa.
3D IF	Indicates relative signal strength at the grid of the third i-f stage. Full scale deflection is 100 μa.
1ST LIM	Indiates relative signal strength at the grid of the first limiter stage. Full scale deflection is 100 μa.
DISC PRI	Indicates relative signal strength at the primary of the discriminator transformer. Full scale deflection is 100 μa.
DISC−	A zero reading indicates that the afc circuit is operating properly. A meter deflection indicates that the afc circuit is defective or that the receiver has drifted more than 400 kc above the center frequency of the carrier. Full scale deflection is 20 volts.
DISC +	A zero reading indicates that the afc circuit is operating properly. A meter deflection indicates that the afc circuit is defective or that the receiver has drifted more than 400 kc below the center frequency of the carrier. Full scale deflection is 20 volts.
LINE LEVEL	Indicates the output level of the wide-band audio amplifier. With the transmitter operating at the same frequency as the receiver, and with the TEST-MIKE-RING switch in the TEST position, the receiver LINE LEVEL control is adjusted to give a zero db reading. Use db scale.
SQUEICH control (R101).	Suppresses background and other noise during no input signal conditions. In the OFF position there is no noise suppression.
ANT ADJ control (C3).	Matches the receiver input impedance to the impedance of the antenna cable.
CALL LIGHT (I3)	During squelch control opertion, the CALL LIGHT is on when a signal is being received.
AFC DISABLE switch (S3).	Momentarily disables afc circuit when required.

72. Dynamotor-Power Supply DY–94/GRC–10, Controls

(fig. 50)

The following table lists the controls of the power supply and indicates their function:

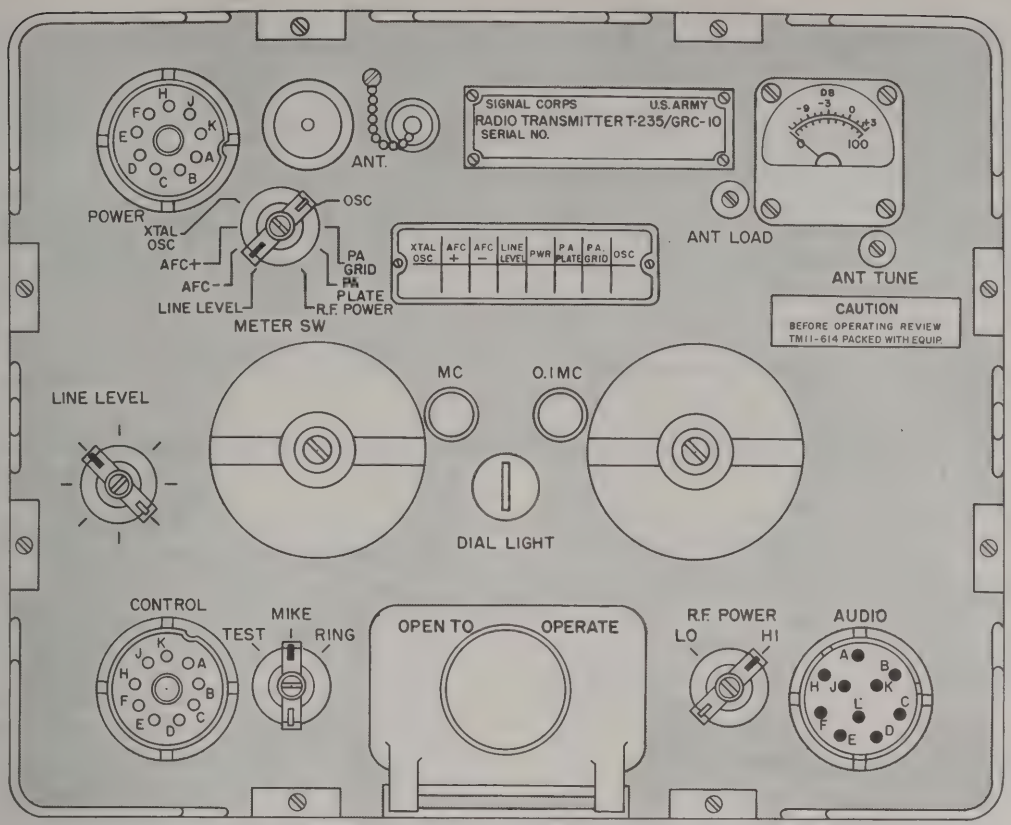


Figure 48. Radio Transmitter T–235/GRC–10, front panel.

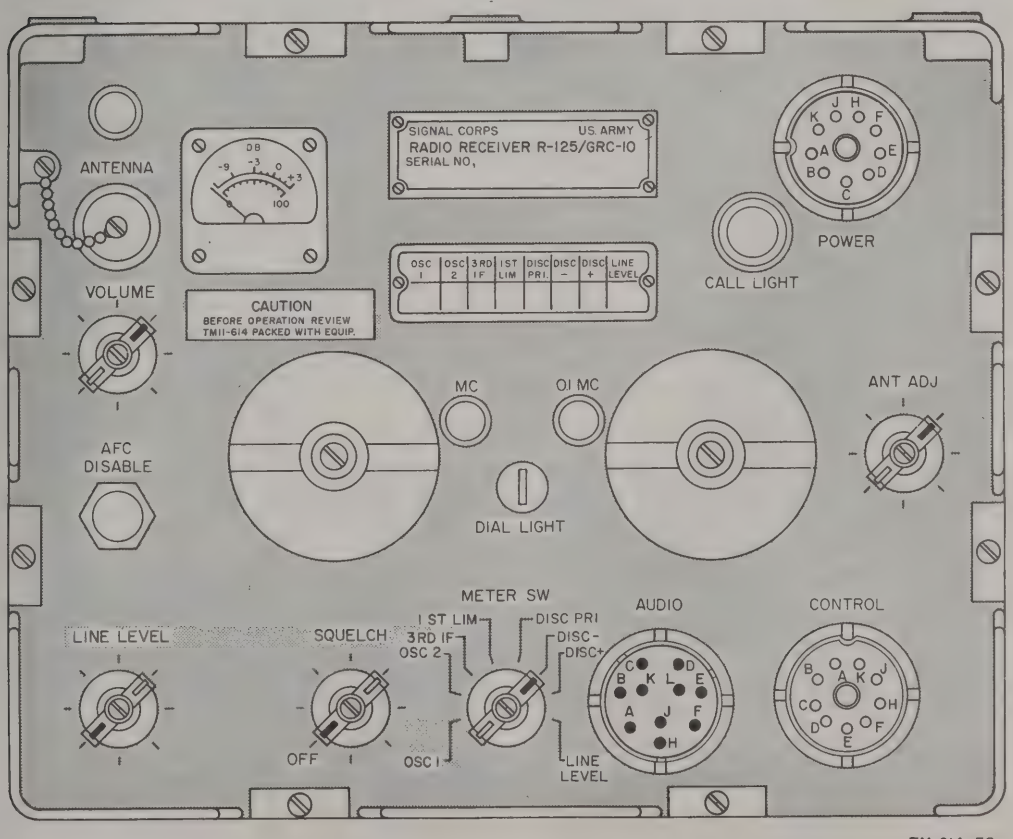


Figure 49. Radio Receiver R–125/GRC–10, front panel.

Control	Function
LINE VOLTAGE switch (S301).	Selects the proper circuits in the power supply for operation from a 115- or 230-volt power source.
POWER light (I 301)	Glows when power is applied to the radio set.
TRANSMIT light (I 302).	Glows when the transmitter is keyed.
DC FUSES:	
REC 3A (F302)	Protects the vibrator of the receiver B supply circuit.
XMTR 3A (F301)	Protects the vibrator of the transmitter B supply circuit.
AC FUSES:	
FIL 2A (F303)	Protects the a-c input circuit of the filament transformer.
REC 1A (F304)	Protects the a-c input circuit of the receiver B supply circuit.
XMTR 2A (F305)	Protects the a-c input circuit of the transmitter B supply circuit.
SPARE FUSES	Contains spare fuses.

Control	Function
Blower door (open to operate).	Opens air passages and starts blower motor.

73. Radio Set Control C–632/GRC–10, Controls

(fig. 51)

Control	Function
MASTER POWER switch (S402).	Applies 115/230 volts a-c or 26 volts d-c to the radio set.
TYPE OF OPERATION switch (S401).	Selects the type of operation desired for the radio set: PUSH-TO-TALK, TERMINAL, or RELAY.
OPERATING ON DC light (I 401).	Pilot lamp glows when the equipment automatically switches to d-c operation as a result of an a-c power failure, or when only a d-c power source is used.

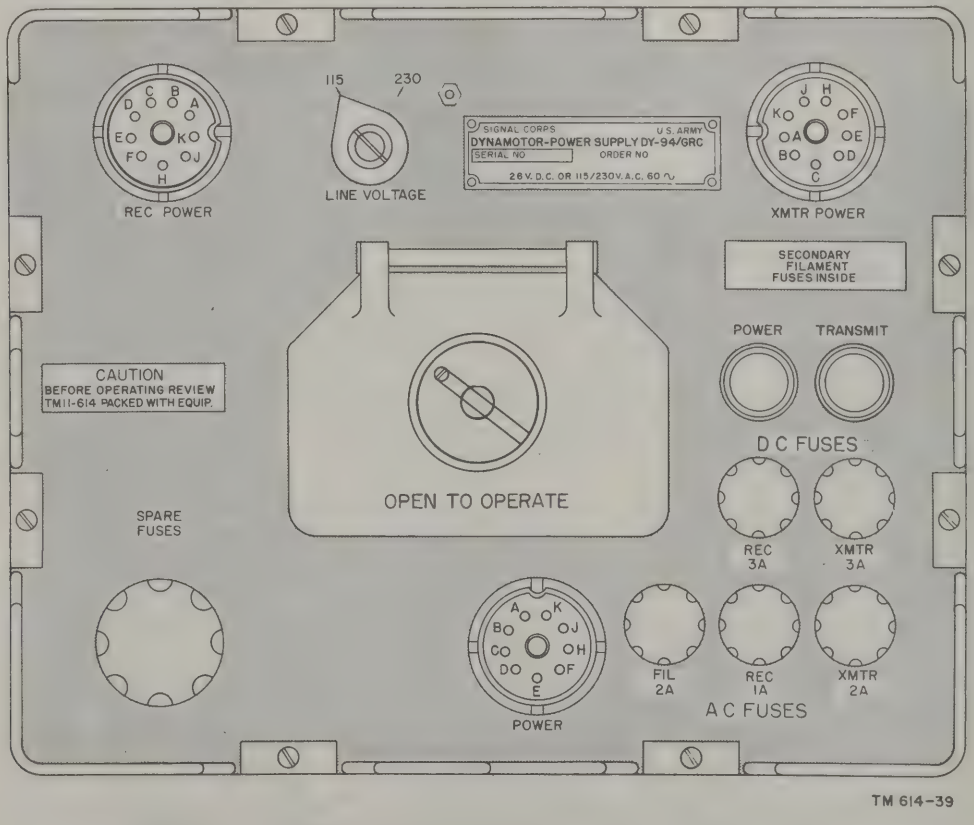


Figure 50. Dynamotor-Power Supply DY–94/GRC–10, front panel.

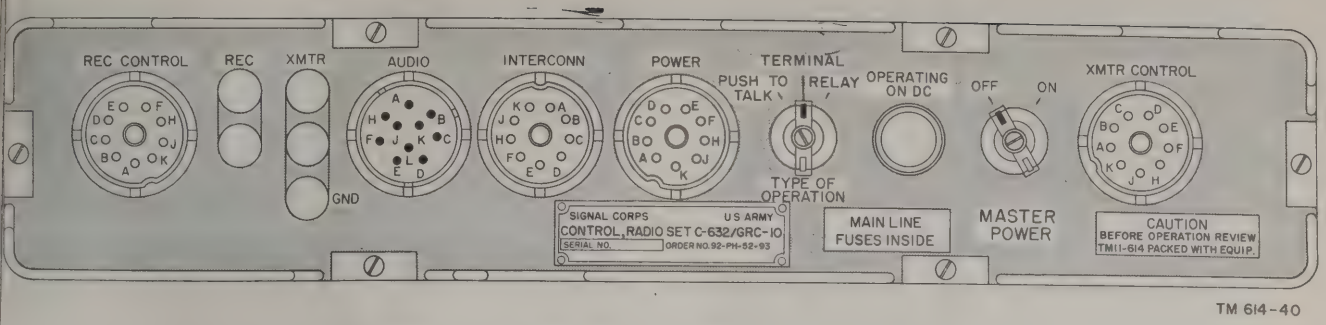


Figure 51. Radio Set Control C–632/GRC–10, front panel.

Section II. OPERATION UNDER USUAL CONDITIONS

74. Modes of Operation

a. General. The radio sets, terminal sets, and relay sets may be operated locally or remotely. After they have been adjusted for the type of operation desired, remote operation is available through the use of Control Group AN/GRA–6 (par. 130). To operate the equipment for any particular mode of operation, perform the procedures listed below. The information referred to in (1) through (5) below is given later in this section.

(1) Preliminary starting procedure (par. 75 through 77).
(2) Starting procedure (par. 78 through 80).
(3) Tuning procedure (par. 81 through 83).
(4) Procedure for the desired mode of operation (*e* below).
(5) Stopping procedure (par. 84 through 86).

b. Radio Set AN/GRC–10. Possible modes of operation for the radio set are—

(1) Single-channel push-to-talk field set.
(2) Single-channel radio relay set.
(3) Multichannel terminal radio set.
(4) Multichannel radio relay set.

c. Radio Terminal Set AN/GRC–39. Possible modes of operation for the radio terminal set are—

(1) Single-channel push-to-talk field radio set.
(2) Multichannel radio terminal set.

d. Radio Repeater Set AN/GRC–40. Possible modes of operation for the radio relay set are—

(1) Single-channel radio relay set.
(2) Multichannel radio relay set.
(3) As a substitute for Radio Set AN/GRC–10 (*b* above), and as a substitute for Radio Terminal Set AN/GRC–39 (*c* above).

e. Procedures for Modes of Operation. Selection of the desired mode of operation is included in the tuning procedures given in paragraphs 81*r*, 82, and 83. Because the radio sets, the terminal sets, and the relay sets are interchangeable to a certain extent, a summary of the procedures is given below:

Mode of operation	Set TYPE OF OPERATION switch at
Single-channel push-to-talk	PUSH-TO-TALK.
Single-channel radio relay	RELAY.
Multichannel radio terminal	TERMINAL.
Multichannel radio relay	RELAY.

Caution: Always be sure that the TYPE OF OPERATION switch is in the PUSH-TO-TALK position before turning on the power. Allow at least a 30-second warm-up period before turning the switch to TERMINAL or RELAY. Be sure to return the switch to PUSH-TO-TALK before turning off the power.

75. Preliminary Starting Procedure, Radio Set AN/GRC–10

Perform the preliminary operations listed below before starting the equipment as described in paragraph 78. It is assumed that the equipment has been adjusted as described in paragraph 61 through 68 of this manual.

a. Control (fig. 51).

(1) Set the MASTER POWER switch to OFF.
(2) Set the TYPE OF OPERATION switch to PUSH-TO-TALK.

b. Transmitter (fig. 48).

(1) Set the METER SW to R. F. POWER.

(2) Set ANT LOAD and ANT TUNE (screwdriver controls) to their midpoints.
(3) Set the MC and 0.1 MC controls to the desired operating frequency.
(4) Set the TEST-MIKE-RING switch to MIKE.
(5) Set the R. F. POWER switch to HI.
(6) Open the blower door (marked OPEN TO OPERATE) by turning the knob counterclockwise.

c. Receiver (fig. 49).
(1) Set the VOLUME and LINE LEVEL controls to their midpoints.
(2) Set the MC and 0.1 MC controls to the desired operating frequency.
(3) Set the ANT ADJ control to its midpoint.
(4) Set the SQUELCH control to OFF.
(5) Set the METER SW to 3D IF.

d. Power Supply (fig. 50).
(1) Set the LINE VOLTAGE control to agree with the voltage of the ac power source being used.
(2) Open the blower door (marked OPEN TO OPERATE) and swing it up until the spring in the knob engages with the stud on the front panel near the name plate.

76. Preliminary Starting Procedure, Radio Terminal Set AN/GRC–39

a. Perform the preliminary operations given in paragraph 75 to the Radio Set AN/GRC–10.

b. Perform the preliminary operations to the power units as described in the technical manual provided with them.

77. Preliminary Starting Procedure, Radio Repeater Set AN/GRC–40

a. Perform the preliminary operations given in paragraph 75 to each of the two Radio Sets AN/GRC–10.

b. Perform the preliminary operations to the power units as described in the technical manual provided with them.

78. Starting Procedure, Radio Set AN/GRC–10

If an abnormal indication is obtained during the starting procedure, refer to the equipment performance check list (par. 115) for corrective measures. With the controls set as outlined in the preliminary starting procedure, perform the steps described in *a* and *b* below.

Caution: Before turning on the equipment, be sure that the TYPE OF OPERATION switch on the control unit is in the PUSH-TO-TALK position.

a. Turn the MASTER POWER switch on the control unit to ON. The POWER lamp on the power supply will glow. If no a-c power is applied to the radio set, the OPERATING ON D-C lamp on the control unit will glow.

b. After at least a 30-second warm-up period, turn the TYPE OF OPERATION switch on the control unit to TERMINAL. This will key the transmitter; the TRANSMIT lamp on the power supply will glow.

79. Starting Procedure, Radio Terminal Set AN/GRC–39

a. Start the power units according to the instructions in the technical manual furnished with them.

b. Start the radio set according to the instructions in paragraph 78.

80. Starting Procedure, Radio Repeater Set AN/GRC–40

a. Start the power units according to the instructions in the technical manual furnished with them.

b. Start each radio set according to the instructions in paragraph 78, except set the TYPE OF OPERATION switch at RELAY after the warm-up period.

81. Tuning Procedure, Radio Set AN/GRC–10

Note. If an abnormal result is obtained during the following procedure, refer to paragraph 115.

With the controls set as outlined in the preliminary starting procedure, perform the steps described in *a* through *r* below.

a. Turn the MASTER POWER switch on the control unit to ON; the POWER lamp on the power supply will glow.

b. Allow the tubes to heat for at least 30 seconds, and then turn the TYPE OF OPERATION switch to TERMINAL. This will key the transmitter; the TRANSMIT lamp on the power supply will glow.

c. Check to be sure that the METER SW on the transmitter is in the R. F. POWER position.

d. Adjust the transmitter ANT TUNE control (a screwdriver adjustment) for maximum deflection on the transmitter meter.

e. Turn the METER SW on the transmitter to the PA PLATE position.

f. Adjust the transmitter ANT LOAD control (a screwdriver adjustment) for an increase in the meter reading. Continue to adjust for an increase in plate current, but do not permit a reading of more than 150 ma.

Note. Although the highest number on the meter scale is 100, that figure represents 200 ma; therefore a reading of 75 on the scale represents 150 ma.

g. Set the METER SW on the transmitter at the R. F. POWER position.

h. Check the setting of the transmitter ANT TUNE control for a maximum deflection on the meter.

i. Repeat the steps in *c* through *h* above until it is certain that the ANT TUNE control is adjusted to produce a maximum deflection of R. F. POWER on the transmitter meter, and that the ANT LOAD control is adjusted to produce 150 ma PA PLATE current.

j. Set the transmitter METER SW at LINE LEVEL, and set the TEST-MIKE-RING switch at TEST.

k. Adjust the LINE LEVEL control on the transmitter for a reading of 0 db on the meter.

l. Set the TEST-MIKE-RING switch at MIKE. Call the adjacent station by pressing the switch on the handset, and speaking clearly into the handset. Ask the operator to transmit a TEST signal. If it is difficult to hear the test tone from the station, turn the LINE LEVEL and VOLUME controls on the receiver clockwise.

m. While the adjacent station is sending a TEST signal, adjust the ANT ADJ control on the receiver for maximum deflection of the meter. (Be sure the METER SW on the receiver is in the 3D IF position.) If the received signal is too weak to give a satisfactory deflection of the meter, turn the METER SW on the receiver to the 1ST LIM position. Return it to 3D IF as the signal becomes stronger.

n. With the adjacent station still sending a TEST signal, turn the METER SW on the receiver to the LINE LEVEL position. Adjust the LINE LEVEL control on the receiver for a 0-db reading on the meter. Adjust the receiver VOLUME control for a comfortable listening level.

o. Ask the operator of the adjacent station to stop transmitting.

p. Turn the SQUELCH control on the receiver clockwise from the OFF position; the CALL LIGHT will glow. Continue to turn the SQUELCH control clockwise, and stop turning it immediately when the CALL LIGHT goes out. This position of the control is the threshold point. Be sure that no signal is being received when the foregoing adjustment is made.

q. Ask the operator of the adjacent station to turn his transmitter on and off a few times while his TEST-MIKE-RING switch is in the MIKE position. Each time his transmitter is keyed, the CALL LIGHT on the receiver should go on; it should go out when his transmitter goes off. If this does not happen, readjust the SQUELCH control slightly.

r. The radio set is now ready for operation. Set the TYPE OF OPERATION switch at the proper position for the type of operation desired: PUSH-TO-TALK, TERMINAL, or RELAY. For normal operation, the TEST-MIKE-RING switch must be in the MIKE position.

82. Tuning Procedure, Radio Terminal Set AN/GRC–39

Tune the radio terminal set according to the instructions in paragraph 81. After all adjustments have been made, set the TYPE OF OPERATION switch at the TERMINAL position.

83. Tuning Procedure, Radio Repeater Set AN/GRC–40

Disconnect the interconnecting cable that is between the INTERCONN jacks on the two control units. Tune each Radio Set AN/GRC–10 according to the instructions in paragraph 81. When making the SQUELCH control adjustments, be sure that the proper adjacent station is contacted for each radio set. After all adjustments have been made, set the TYPE OF OPERATION switch at the RELAY position. Reconnect the interconnecting cable.

84. Stopping Procedure, Radio Set AN/GRC–10

a. Turn the TYPE OF OPERATION switch on the control unit to the PUSH-TO-TALK position.

b. Turn the MASTER POWER switch on the control unit to the OFF position.

85. Stopping Procedure, Radio Terminal Set AN/GRC–39

a. Turn the TYPE OF OPERATION switches on both control units to the PUSH-TO-TALK positions.

b. Turn the MASTER POWER switches on both control units to the OFF position.

c. Stop the power units according to the instructions in the technical manual provided with them.

86. Stopping Procedure, Radio Repeater Set AN/GRC–40

a. Turn the TYPE OF OPERATION switch on the control unit to the PUSH-TO-TALK position.

b. Turn the MASTER POWER switch on the control unit to the OFF position.

c. Stop the power units according to the instructions in the technical manual provided with them.

Section III. SYSTEM OPERATION

87. Single-Channel System Operation

a. General. The procedure for setting up a single-channel (radio without telephone terminal equipment) communication system will depend on the type of service for which the system is to be used. When no relay stations are used in a single-channel system, PUSH-TO-TALK operation may be used. In this type of operation, the transmitter is on the air only when the switch on the handset is pressed; communication may be carried on in only one direction at a time (simplex operation). To communicate in both directions simultaneously (duplex operation), set the TYPE OF OPERATION switch at TERMINAL. When one or more relay stations are used, set all TYPE OF OPERATION switches at the relay stations at RELAY; set the TYPE OF OPERATION switches at the terminal stations to TERMINAL.

b. Audio-Level Adjustments. After a single-channel communication system has been installed, the operator at each station should make contact with each adjacent station. All stations must be in contact with their adjacent stations before an audio-level line-up of the system can be started. The chart below shows the procedure to be followed when performing a system line-up. It is based on a system (fig. 52) that use two terminal stations (A and B) and four relay stations (1, 2, 3, and 4). Note that a single-channel system will not use the telephone terminal equipment shown by broken lines in figure 52. The procedure given in the chart may be adjusted to apply to a system which uses from one to five relay stations.

Note. During the following procedure, the operators may talk freely to each other simply by using the handset. Press the switch on the handset while speaking; release it while listening.

Step No.	Operator at station	Action.
1	Terminal A	TYPE OF OPERATION switch to TERMINAL.
	Terminal B.	
	All relay stations.	TYPE OF OPERATION switch to RELAY.
2	Terminal A	Inform relay 1 that a system line-up is to follow.
3	Relay 1	When informed by terminal A that a system line-up will follow, tell relay 2.
4	Relay 2	When informed by relay 1 that a system line-up will follow, tell relay 3.
5	Relay 3	When informed by relay 2 that a system line-up will follow, tell relay 4.
6	Relay 4	When informed by relay 3 that a system line-up will follow, tell terminal B.
7	Terminal B	When informed by relay 4 that a system line-up will follow, acknowledge to relay 4.
8	Relay 4	When acknowledgment is received from terminal B, pass it on to relay 3.
9	Relay 3	When acknowledgment is received from relay 4, pass it on to relay 2.
10	Relay 2	When acknowledgment is received from relay 3, pass it on to relay 1.
11	Relay 1	When acknowledgment is received from relay 2, pass it on to terminal A.
12	Terminal B	TEST-MIKE-RING switch to MIKE; stand by.
	All relay stations.	
13	Terminal A	Leave TEST-MIKE-RING switch at TEST for 5 minutes.

Step No.	Operator at station	Action
14	Relay 1	When test tone is heard from terminal A, adjust LINE LEVEL control on receiver A for 0-db reading on meter. When finished, tell relay 2 to go ahead.
15	Relay 2	When told by relay 1 to go ahead, adjust LINE LEVEL control on receiver A for 0-db reading on meter. When finished, tell relay 3 to go ahead.
16	Relay 3	When told by relay 2 to go ahead, adjust LINE LEVEL control on receiver A for 0-db reading on meter. When finished, tell relay 4 to go ahead.
17	Relay 4	When told by relay 3 to go ahead, adjust LINE LEVEL control on receiver A for 0-db reading on receiver A. When finished, tell terminal B to go ahead.
18	Terminal B	When told by relay 4 to go ahead, adjust LINE LEVEL control on receiver for 0-db reading on meter. Stand by until terminal A turns off TEST tone.
19	Terminal A	After 5-minute period (step 13) turn TEST-MIKE-RING switch to MIKE.
20	Terminal B	When terminal A turns off TEST tone, turn TEST-MIKE-RING switch to TEST. Leave it there for 5 minutes.
21	Relay 4	When test tone from terminal B is heard, adjust LINE LEVEL control on receiver B for 0-db reading on meter. When finished, tell relay 3 to go ahead.
22	Relay 3	When told by relay 4 to go ahead, adjust LINE LEVEL control on receiver B for 0-db reading on meter. When finished, tell relay 2 to go ahead.
23	Relay 2	When told by relay 3 to go ahead, adjust LINE LEVEL control on receiver B for 0-db reading on meter. When finished, tell relay 1 to go ahead.
24	Relay 1	When told by relay 2 to go ahead, adjust LINE LEVEL control on receiver B for 0-db reading on meter. When finished, tell terminal A to go ahead.
25	Terminal A	When told by relay 1 to go ahead, adjust LINE LEVEL control on receiver for 0-db reading on meter.
26	Terminal B	After 5-minute period (step 20) turn TEST-MIKE-RING to MIKE.
27	Terminal A	After terminal B turns off TEST tone, announce to all stations in system that system line-up has been completed.

c. Line-up Check. In a single-channel system (radio without telephone equipment), maintaining the proper line level is not as important as in a multichannel system (radio with telephone equipment). The level, however, should be adjusted as described in *b* above, and thus it becomes unnecessary to re-establish this level by a station which is not actually at fault.

(1) When the single-channel system is properly adjusted, an operator at either terminal station, talking in a normal tone of voice into his handset, will cause a deflection on the front panel meter (LINE LEVEL position) on every receiver along the line of communication. A reading of +3 db results during high level audio peaks.

(2) The audio level should be checked at least twice a day by observing the amount of meter swing for ordinary conversation from terminal to terminal.

(3) The audio-level line-up should be re-established at least once each day as explained in this paragraph.

d. Stopping Procedure. When closing down of the system is anticipated, each relay station should monitor closely so that relay stations are not shut down prematurely. After terminals A and B have cleared all the communication for the

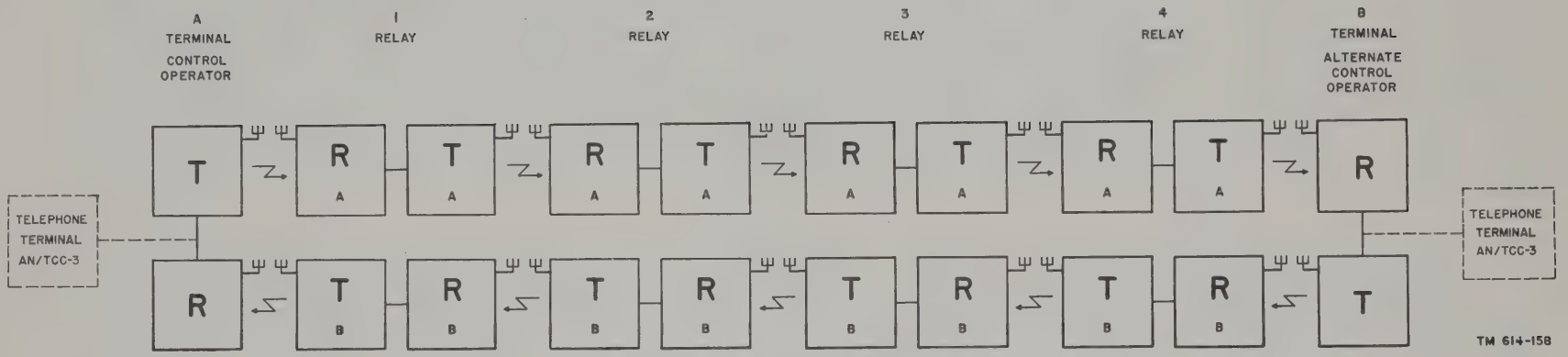


Figure 52. System line-up.

day or for the intended period of time, they should announce the fact and have it acknowledged by each relay station. When it is determined that every operator in the system is ready to shut down and that equipment at each station is still in proper working order, the shut-down signal is given by the controlling terminal station. The controlling terminal station should be the first to close down after having definitely established the time of reopening the circuit. All stations turn off equipment in the following manner:

(1) Set the TYPE OF OPERATION switch on the control unit to the PUSH-TO-TALK position.

(2) Turn the MASTER POWER switch to OFF.

88. Multichannel System Operation

a. Figure 52 shows a block diagram of a complete four-channel (plus order wire channel) radio-relay communication system.

(1) The radio requirements for this system are two Radio Terminal Sets AN/GRC–39 and one or more (up to a max. of 5) Radio Repeater Sets AN/GRC–40. Telephone Terminals AN/TCC–3 and associated telegraph and telephone equipment constitute a part of the complete communications system and are included at the radio terminal stations.

(2) Radio transmitter T (fig. 52) of Radio Terminal Set AN/GRC–39 at terminal station A receives the signal from Telephone Terminal AN/TCC–3. This signal represents all the communications that originate at the telephone equipment. It is passed through four relay stations along the path indicated by arrows to the radio and telephone terminal equipment at terminal station B. In the same manner, all communication from terminal B is transmitted through relay equipment back to terminal A.

b. It is very important that radio equipment in a multichannel communication system be adjusted to maintain the proper audio levels. Under normal operating circumstances, all the communications that originate at terminal A leave Telephone Terminal AN/TCC–3 at an audio level that corresponds to 0 dbm for each channel in use.

c. Any radio set in the system which is not adjusted or maintained properly will cause improper audio levels or excessive noise all along the line of communication. The proper procedure for lining up a system must be adhered to if satisfactory operation of the system is to be expected.

d. The procedure for a multichannel system line-up is similar to that of a single-channel system; the only exception is that the operators at terminals A and B must establish contact with operators at the telephone equipment. This is accomplished after the proper pairs of wires from Telephone Cable Assembly CX–1512/U are connected to the corresponding binding posts on the control unit front panel (fig. 46). The system line-up is now conducted in the same manner as described in paragraph 87.

e. In a multichannel system, maintaining the proper audio-level setting throughout is of prime importance. A check of the line level adjustment at each station should be made daily, preferably at the same time a check is made of Telephone Terminal AN/TCC–3. The line levels also should be checked in the following instances:

(1) When a transmitter or receiver in the system has been replaced.

(2) Whenever a component part has been repaired or replaced in any transmitter or receiver in the system.

(3) Whenever the operating frequency of any radio set in the system has been changed.

(4) Whenever unsatisfactory or impaired operation of the system is indicated.

89. System Control

Note. The information contained in this paragraph is a suggested method of system operation; it can be used if other instructions are not issued by the proper authorities.

a. In a multichannel radio-relay system, the operator at terminal A (fig. 52) is designated as the *System Control Operator.* At the opposite terminal, B, the operator is designated as the *Alternate System Control Operator.* The system control operator is responsible for the satisfactory operation of the system. Any changes or adjustments except those of an emergency nature must be referred to the system control operator for clearance. Among the duties performed by the system control operator are—

(1) Scheduling of periodic line-up checks.

(2) Taking action on reports of trouble.

(3) Making decisions regarding changes which may affect service over the system.

b. When an emergency occurs which disables the system control station, the alternate system control operator assumes full responsibility of the system. The alternate control station exercises all the functions of the control station in such cases.

90. Mutual Interference Problems

a. During operation, considerable interference will be produced in the receivers of the various radio sets covered by this manual unless certain precautions are taken. The principal cause of such interference will be the radio sets themselves (mutual interference). The frequencies to be used to reduce this condition to a minimum are listed in the frequency assignment chart described in paragraph 91. Other information on interference problems is contained in TM 11–486, Electrical Communication Systems Engineering, chapter 6, section VI.

b. In addition to the frequency assignment problems which are common to all radio sets, the radio sets covered by this manual have other frequency assignment limitations. This condition exists because of spurious radiations from the transmitters and spurious responses in the receivers. The term *spurious radiation* refers to signals radiated from the transmitter which are other than the fundamental or carrier frequency. While these spurious radiations are weaker than the fundamental or carrier frequency, they are strong enough to cause interference in nearby receivers which may be tuned to a frequency that corresponds with one of the spurious radiations of the transmitter.

c. When Radio Receiver R–125/GRC–10 is tuned to any one of the channels between 54.0 and 70.9 mc, it will respond to a signal on this frequency; however, the receiver also will respond to strong signals above and below the frequency to which it is tuned. The response of the receiver to these undesired frequencies is called *spurious response.*

d. It is possible for the oscillators in a superheterodyne receiver to radiate unwanted signals which can cause interference. This condition is known as receiver radiation; however, in Radio Receiver R–125/GRC–10, the unwanted radiation from the oscillators is very weak and is seldom the cause of interference.

e. There are various ways in which mutual interference can occur. They are as follows:

(1) Transmitter fundamental radiation to receiver fundamental response.
(2) Transmitter spurious radiation to receiver fundamental response.
(3) Transmitter fundamental radiation to receiver spurious response.
(4) Transmitter spurious radiation to receiver spurious response.
(5) Receiver radiation to receiver fundamental response.

f. When a receiver is situated close to a transmitter, the frequency separation usually should be greater than 300 kc, since transmitter spurious radiations which are close to the receiver tuned frequency may cause interference.

g. The precaution of keeping the receiver frequency separated at least 300 kc from the transmitter frequency does not mean that it is impossible to use less separation. Combinations of transmitter and receiver frequencies (with less than 300-kc separation) can be used even though the transmitter and the receiver are operated very close to each other. These useful combinations are somewhat unpredictable since they depend upon both the carrier level and the frequency at which the receiver is operating. Unless time is available for finding the usable combinations, it is best to keep the receiver and transmitter frequencies separated as much as possible.

h. Radio Transmitter T–235/GRC–10 uses a frequency multiplication of two times the master oscillator frequency. This multiplication causes spurious frequencies to be radiated above and below the fundamental at intervals equal to the oscillator frequency. Many of these spurious radiations are too weak to cause interference, but some are strong enough to interfere with normal reception by receivers located at the same installation. This interference can be avoided by proper selection of operating frequencies.

i. Spurious response of the receiver to the transmitter fundamental frequency is unusual. An exception would be when several radio sets are operated at one location and the desired signal is weak.

(1) When the receiver is tuned to a particular frequency, most of the spurious responses which cause trouble do not occur at the exact transmitter frequency. Since the minimum channel separation of the radio set is 300 kc, the probability of interference caused by the receiver spurious response to the transmitter

fundamental frequency is lowered considerably because most of the receiver spurious response will occur at frequencies between the 300-kc separation.

(2) For installations of not more than two transmitters and two receivers, where the received signal is above saturation of the limiters (60 or more on the meter scale of Radio Receiver R–125/GRC–10, METER SW in 1ST LIM position), it is unlikely that spurious radiation from any transmitter will interfere with the receiver.

j. Response of the receiver to the transmitter spurious radiation is unusual. An exception would be when several radio sets are operated at one location and the desired signal is weak. In a communication system where one or two transmitters and receivers are operated with the antennas located at least 60 feet apart and with the receivers operating with saturated limiters, no interference of this type will be encountered.

k. In Radio Receiver R–125/GRC–10, the first and second high-frequency (h-f) oscillators may originate spurious radiations from the receiver case and the antenna system. The magnitude of these radiations is so low that they will not normally cause interference unless the receivers are removed from the cases in which they normally operate, or are operated side by side.

91. Selection of Operating Frequencies

The mutual interference chart (fig. 175) has been prepared to speed the selection of frequencies that will permit operation without harmonic interference.

a. The scales are indicated along the edges of the chart. Solid squares indicate an undesirable amount of interference; squares containing an X indicate a borderline condition. Selection of frequencies shown by solid squares is not recommended. Selection of frequencies in the borderline condition may give satisfactory results; however, they are recommended only in cases of necessity.

b. Observe the following rules when selecting operating frequencies:

(1) See that the frequencies of any two transmitters operating in the same location are separated by at least 300 kc, and that the difference frequencies of the transmitters are not 4.3, 3.2, or 15 to 16 mc.

(2) See that the frequencies of any two receivers operating in the same location are separated by at least 300 kc.

(3) See that the frequencies of transmitters and receivers operating in the same location are separated by at least 1 mc to minimize the effects of receiver desensitization.

(4) Operate the transmitters and receivers at opposite ends of the band, if possible.

(5) Do not repeat frequencies anywhere in one complete relay circuit.

(6) Use the mutual interference chart (fig. 175) to determine interference free channels for all transmitters and receivers in the same location. Refer to figure 5 to determine from the mutual interference chart that F_2 and F_6 do not interfere with F_1 and F_5. Follow this same procedure for each station.

92. Methods of Reducing Interference

a. A transmitter causing interference in nearby receivers can be located by turning the r-f carrier on and off or by modulating the transmitter. A check of the receiver meter or loudspeaker then will reveal the offending transmitter. In some cases, where there are several transmitters in operation, the interference may be caused by a single transmitter. It is possible for two or more signals of the transmitters to mix in the r-f section of a receiver and cause interference. This can happen even though one of the transmitters does not cause any interference. The probability of this condition occurring is rare; it is likely to happen only where several radio sets are in simultaneous operation near each other. To check for this condition, turn the r-f carrier of each of the transmitters off and on until the two offending transmitters can be isolated.

b. In some cases, the interference does not show as a modulated signal but as an increase in background noise. Sometimes, this noise can be heard in the speaker of the receiver and can be related to the source of interference. At other times, this noise occurs at higher audio frequencies which are filtered out in audio circuits and cannot be heard in the loudspeaker circuit of the receiver. The latter condition is particularly troublesome in multichannel systems because the noise will fall into one of the upper channels. The method for locating this type of interference is much the same as for other types; that is, observing the

meter readings on the receiver, while turning the suspected transmitters on and off.

c. Observe the following precautions to minimize interference at locations where two or more radio sets are in operation:

(1) Keep the radio sets separated by a minimum of 1 foot.

(2) Keep the antenna lead-in cables of each radio set separated. Do not coil the excess antenna cables of several equipments together.

(3) If more than one system terminates at one location, consider using vertical polarization in one or more of the systems. Two systems, one vertically polarized and the other horizontally polarized, will have less mutual interference than two horizontally polarized systems. Vertical polarization of Yagi antennas requires that the antenna arrays in one system be mounted at right angles to their normal positions. To do this, it is necessary to drill a new alinement hole in the boom (fig. 39) to engage the pin in the mast adapter. Drill it at right angles to the existing hole. Mount the antenna array so that the elements will be parallel with the tube of the mast adapter, and complete the antenna installation in the usual way. Bear in mind that ground plane antennas provide vertically polarized signals. When vertical polarization is used, the antenna of the receiver picking up the signals must be vertically polarized also.

d. The stronger the desired signal, as compared to the spurious radiations, the less will be the noticeable interference. It is always desirable to operate the receivers above the saturation point of the first limiter or at least to the 60 mark on the meter of Radio Receiver R–125/GRC–10 when the METER–SW is in the 1ST LIM position.

e. The location of the transmitting and receiving antennas at any one site often is responsible far various types of mutual interference. In general, the interference problem is maximum when the transmitting antenna and the receiving antenna are directed toward each other (front to front), and it is minimum when they are pointing in the same direction and located side by side. The spurious radiations may originate from the antenna array, antenna feed line, transmitter case, or hookup cables. They may be picked up by the antenna array of the receiving antenna or, if the array offers high attenuation, they may be picked up by the receiver lead-in cable or by the receiver itself. The radiation from the side of the transmitting antenna is very small at the frequency for which it is adjusted compared to the forward or rear radiation. Likewise, the response from the side of the receiving antenna is very low compared to the response from the front or the rear. The transmitting and receiving antennas should be placed side by side and separated as far as permitted by the transmission lines and the terrain. At a relay station, the two transmitting antennas and the two receiving antennas should, if possible, be in a single line perpendicular to the direction of communication.

93. Antijamming Procedures

a. In an effort to prevent radio communication, an enemy frequently will attempt to jam radio receivers by transmitting a series of signals that will tend to make unintelligible the information being handled by the system. Usually, the effect of jamming will be noticed first by the operators at the telephone terminal equipment in a multichannel system, although the radio operators, if they are monitoring their radio sets, will recognize jamming signals immediately.

b. When it is recognized that a receiver is being jammed, report it promptly to a superior officer. Do not stop operating under any conditions. Follow the procedure below, if possible, until some degree of read-through is established.

(1) Turn the ANT ADJ control on the receiver until the desired signal comes through best.

(2) Vary the SQUELCH control until best reception results. It may be necessary to turn the SQUELCH control to OFF.

(3) Turn up the VOLUME control to determine whether the desired signal may be read through the interference. If this does not help, turn it down to a comfortable level.

(4) Change the receiving antenna length, height, and direction. This may prove effective, especially at the higher frequencies.

(5) If the jamming is complete, and no read-through can be obtained by the above pro-

cedures, request a change in frequency and call sign.

(6) If enemy jamming is so thorough and effective that communication is impossible, report this fact to a superior officer and use some other means of getting the message through. Continue to operate; this will keep the enemy uncertain as to the success of the jamming. The enemy jamming equipment will be tied down to what seems to be an active operating frequency.

94. Summary of Operating Practices

a. Types of Operation. When no relay stations are used in a single-channel voice communication system, PUSH-TO-TALK operation is satisfactory for communication in one direction at a time. This type of operation conserves power, because the transmitter is keyed only when the handset switch is pressed.

(1) In TERMINAL operation, the transmitter is keyed continuously; it is possible to transmit and receive simultaneously. This type of operation is to be used at a terminal station that is operated in connection with telephone terminal equipment.

(2) In RELAY operation, the output of the receiver is connected to the input of the transmitter, causing automatic retransmission of signals picked up by the receiving antenna. When the two control units of a relay station are connected between the INTERCONN jacks, the handset is connected to both radio sets. When the operator presses the switch on the handset and speaks, his voice modulates both transmitters.

b. Order Wire Channel. It is over this channel that the radio operators talk to each other. In a multichannel system, the operators at the telephone terminal are also included in the order wire channel. It should be noted that an operator will not be heard unless he presses the switch on the handset while talking. To attract the attention of the other operators in the system, the RING position of the TEST-MIKE-RING switch is provided. When the switch is at RING, a 1,600-cycle tone is heard at every speaker and handset. The switch must be returned to MIKE before speaking.

c. Line-Level Adjustments. Although receiver line-level setup is not important in single-channel operation, it is strongly recommended that it be carried out for *all* types of operation. This practice is of great value in determining a defective receiver in a system as well as insurance that a system will be set up with a minimum of time and trouble. The maintenance of accurate line-level adjustment is extremely important in multichannel operation.

d. Starting and Stopping. Be sure never to turn the MASTER POWER switch to ON unless the TYPE OF OPERATION switch is at PUSH-TO-TALK. It is equally important that the switch be in the same position before turning the MASTER POWER switch to OFF.

e. R.F. POWER. When communicating with adjacent stations, the LO position of the R.F. POWER switch should be tried. If satisfactory reception is reported by the adjacent stations, use the LO position; otherwise use the HI position. When LO power is used, less interference is caused in other radio stations and the possibility of interception by an enemy is reduced.

f. SQUELCH Control. Use of the SQUELCH control will depend on the type of operation in use and the signal strength of the adjacent station. The purpose of the control is to quiet the output of the receiver when no carrier is being received. In a system where the transmitter of the adjacent station is keyed continuously and its signal is strong enough, it is likely that the SQUELCH control may be left in the OFF position. In the case of intermittent operation of the adjacent station, the control may be used; however, be careful in its adjustment to be sure that the carrier of the adjacent station will unsquelch the receiver promptly.

g. AFC DISABLE. When changing the frequency setting of the receiver, press the AFC DISABLE switch on the receiver and hold it for a moment. The automatic frequency control circuits then will be ready to operate on the new frequency.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

95. General

The operation of the radio sets may be difficult in regions where extreme cold, heat, humidity, moisture, sand conditions, etc., prevail. In the following paragraphs, instructions are given on procedures for minimizing the effect of these unusual operating conditions.

96. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Keep the equipment warm and dry. If it is not in a heated inclosure, construct an insulated box. If resistor heaters are supplied, keep them turned on, provided the power supply is not overloaded. If this method is impracticable, turn the equipment on occasionally; be sure that the TYPE OF OPERATION switch is in the PUSH-TO-TALK position.

b. Heavy coatings of frost will gather on the microphone of the handset in extremely cold weather when it is used in the open air or in an unheated room. Moisture will form on the cap and will affect transmitter modulation. Plastic covers have been designed to protect this type of microphone; use them when available.

c. When equipment which has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. This condition also arises when equipment warms up during the day after exposure during a cold night. When the equipment has reached room temperature, dry it thoroughly.

97. Operation in Tropical Climates

a. When operated in tropical climates, radio equipment may be installed in tents, huts or, when necessary, in underground dugouts. When equipment is installed below ground or when it is set up in swampy areas, it will be subjected to moisture conditions more acute than normal. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the surrounding air. To minimize this condition, place lighted electric bulbs under the radio set.

b. The fungiproofing on all items must remain unbroken.

98. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the moving parts of radio equipment, such as motors and power units. The ideal preventive precaution is to house the equipment in a dustproof shelter; however, since such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent their flapping in the wind.

c. Never tie power cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (pars. 102–105). Pay particular attention to the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. TOOLS AND EQUIPMENT

99. General

The tools, parts, supplies, and test equipment necessary to perform organizational maintenance are authorized by appropriate publications. Additional tools are supplied with the radio set (par. 101).

100. Tools and Materials Required for Radio Set AN/GRC–10

The following tools and materials are not furnished as part of the radio set. They are required for organizational maintenance.

a. Tools.

1 Tool Equipment TE–41.

b. Materials.

Cheesecloth, bleached, lint-free.[1]

Carbon tetrachloride.[1]

Paper, sand, flint, No. 000.[1]

Solvent, Dry Cleaning (SD) (Fed spec No. P–S–661a).

Brush.

[1] Part of Tool Equipment TE–41.

101. Special Tools Supplied

a. Alinement tools, suitable for high-frequency adjustments, are necessary for tuning various stages of the transmitter and receiver. All types supplied have minimum high-frequency loss characteristics. If emergency alinement tools are used, they should contain as little metal as possible. The transmitter and receiver each contain a #6 and #8 Allen wrench (held to the interior wall of the component by two clips) and two alinement tools held by fuse-type holders.

b. Two tube pullers, one for seven-pin miniature tubes and one for nine-pin tubes, are supplied in Accessories Case CY–1097/GRC–10. Frequently, when removing and replacing miniature tubes the pins become slightly bent. Tube pin straighteners for seven- and nine-pin tubes are supplied in the accesories case.

c. Four spanner wrenches are supplied; three are face type and one is a hook type. The face-type wrenches are for removing and installing the antenna input receptacles, the interconnecting cable plugs, and the audio input receptacles. The hook-type wrench is used to adjust the frequency-selector gear train.

Section II. PREVENTIVE MAINTENANCE SERVICES

102. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring (see AR 750–5).

103. General Preventive Maintenance Techniques

a. Use No. 000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning. If the dry cloth or brush will not remove the dirt, use one of the following techniques, as applicable:

(1) When cleaning electrical contacts, use a cloth or brush moistened with carbon tet-

rachloride; when the contacts are clean, wipe them dry with a *dry* cloth.

Caution: Repeated contact with carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Be sure to provide adequate ventilation.

(2) When cleaning surfaces that perform no electrical function, use a cloth or brush moistened with solvent (SD); after cleaning, wipe the parts dry with a *dry* cloth.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result. Do not use compressed air in the vicinity of speaker cones or meter movements.

Caution: When using compressed air, always direct the first blast of the air line toward the floor to clear condensed moisture from the line.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

104. Use of Preventive Maintenance Forms

a. The decision concerning the items on DA Forms 11–238 and 11–239 (figs. 53 and 54) that are to be applied to this equipment is a tactical decision to be made, in the case of first echelon maintenance, by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items on figures 53 and 54 are partially or totally applicable to Radio Set AN/GRC–10. References in the ITEM column are to paragraphs that contain additional detailed information.

105. Performing Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Exterior Items.

(1) Check for completeness and satisfactory condition of the radio set. The components of the radio sets are listed in the appendix and are illustrated in figures 4, 6, 13, 14, and 15.

(2) Check suitability of location and installation for normal operation (pars. 45–60).

(3) Clean dirt and moisture from handsets, jacks, plugs, and the panels of the components.

(4) Inspect the seating of lamps, fuses, and all connectors (figs. 2, 48, 49, 50, 51, and 57).

(5) Inspect all controls for binding, scraping, excessive looseness, misalinement, and positive action (pars. 69–73).

(6) Check for normal operation (par. 115).

(7) Clean and tighten the exterior of the components, the equipment rack, the shock mounts, the coaxial transmission lines, and all cable connections (figs. 2, 4, 6, 13, 14, and 41).

(8) Inspect cases, mountings, antennas, masts, and other exposed metal surfaces for rust, corrosion, and moisture (figs. 14 and 15).

(9) Inspect all cords, interconnecting cables, and shock mounts for cuts, breaks, fraying, deterioration, kinks, and strain (figs. 2, 4, 6, and 41).

(10) Inspect antennas for bent mast sections, corrosion, loose fit, and damaged elements (pars. 45–54).

(11) Inspect Bags BG–102–A, Mast Section Covers CW–294/U, and technical manuals TM 11–614 for tears, mildew, or fraying (figs. 14 and 15).

(12) Inspect for looseness of switches, knobs, connectors, jacks, blowers, and pilot light assemblies (figs. 2, and 48–51).

(13) Inspect storage batteries (where used) for dirt, loose terminals, electrolyte level, specific gravity, and damaged cases.

(14) Clean air filters, brass name plates, and dial and meter windows (figs. 48–51).

(15) Inspect meters for damaged glass (figs. 48 and 49).

(16) Inspect shelters and covers for adequacy of weatherproofing (pars. 40–42).

(17) Check antenna guy wires for proper tension (par. 53).

(18) Check terminal box covers for cracks, leaks, damaged gaskets, dirt, and grease (figs. 4, 6, 23, and 24).

Caution: Disconnect all power from the radio set before performing the following operations. Upon completion,

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR.105 a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR.105 a (2)							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR.105 a (3)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR.105 a (4)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR.105 a (5)							
6	CHECK FOR NORMAL OPERATION. PAR.105 a (6)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR.105 a (7)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR.105 a (13)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR.105 a (8)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR.105 a (14)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR.105 a (9)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR.105 a (15)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR.105 a (10)		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR.105 a (16)	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. PAR.105 a (11)		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR.105 a (17)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR.105 a (12)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE. PAR.105 a (18)	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-238 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 614-44

Figure 53. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR.105a(1)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR.105a(2)	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR.105a(3)	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR.105a(4)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR.105a(5)	
6	CHECK FOR NORMAL OPERATION. PAR.105a(6)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR.105a(7)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR.105a(8)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR.105a(9)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR 105a(10)	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. PAR.105a(11)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR.105a(12)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR.105a(13)	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR.105a(14)	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR.105a(15)	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR.105a(16)	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR.105a(17)	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE. PAR.105a(18)	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR.105b(1)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR.105b(2)	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR.105b(3)	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR.105b(4)	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR.105b(5)	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR.105b(6)	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR.105b(7)	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR. PAR.105b(8)	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR.105b(9)	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR.105b(10)	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS. PAR.105b(11)	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS. PAR.105b(12)	
37	MOISTURE AND FUNGIPROOF. PAR.105b(13)	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA FORM 1 MAY 51 11-239 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE. c6—16—54382-1

TM 614-45

Figure 54. DA Form 11-239.

reconnect the power and check for satisfactory operation of the set.

Interior Items.

(1) Inspect electron tubes for loose envelopes and loose cap connectors. Inspect tube sockets for cracks and insufficient socket spring tension. Carefully clean dust and dirt from the tubes. Check emission of receiver-type tubes.

(2) Inspect fixed capacitors for leaks, bulges, and discoloration (figs. 57–59).

(3) Inspect variable capacitors for dirt, moisture, misalinement of plates, and loose mountings (fig. 58).

(4) Inspect resistors, bushings, and insulators for cracks, chipping, blistering, discoloration, and moisture (figs. 122, 129, 134, 135, 143, 144, 145, and 147).

(5) Inspect terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts (figs. 57, 122, 127, 129, 134, and 145).

(6) Clean and tighten switches, terminal blocks, blowers, and interiors of chassis and cabinets not readily accessible (figs. 122, 127, 128, 130, 131, 135, 142, 143, 144, and 146).

(7) Lubricate equipment according to instructions given in paragraphs 106 through 108.

(8) Inspect the dynamotor for brush wear, spring tension, arching, and pitting of commutator (fig. 160).

(9) Clean and tighten connections and mountings for transformers, chokes, and variable resistors (figs. 122–135, and 142).

(10) Inspect transformers, chokes, and variable resistors for overheating and oil leakage (figs. 122–135, and 142).

(11) Inspect storage batteries (where used) for shorts and dead cells.

(12) Inspect for worn or loose parts.

(13) Check adequacy of moistureproofing and fungiproofing treatment (pars. 109 and 110).

Section III. LUBRICATION

106. General Lubricating Instructions

a. Do not use excessive amounts of oil or grease, and do not allow electrical connections to become greasy.

b. Be sure that lubricants and points to be lubricated are free of sand, dirt, or grit; abrasives are the chief cause of wear and often cause breakdown of dynamotors and gear assemblies. Before lubrication, clean all surfaces with a lint-free cloth dampened with solvent (SD).

107. Lubrication Requirements

a. Approximately once a month, clean the exposed bearing surfaces of switch detents, switch mechanisms, and fasteners; sparingly apply oil, lubricating, preservative, special (PL Special). Remove excess oil to prevent possible improper operation of other parts, especially switch contacts.

b. Lubricate the differential gear mechanisms of the receiver and transmitter once every 6 months (fig. 55). With the component removed from the case, open the top of the gear assembly. Wipe clean all exposed gear surfaces with a lint-free cloth moistened with solvent (SD); then wipe with a dry cloth. Lubricate by applying grease to the gear teeth. Rotate the gear assembly until a light coating of Grease, Aircraft and Instruments (GL), is spread evenly over the gears. Wipe away excess grease from the face of the gears. This grease contains a rust and corrosion inhibitor. It may be used in regions where temperatures range from −70° to +160° F.

c. The power supply dynamotor is lubricated with enough grease for 300 hours of operation. Under conditions of continuous operation, lubrication will be necessary again after 300 hours of use. If the equipment is used for a short time each day, lubrication is required every 6 months. Refer to figure 56, and lubricate as follows:

(1) Disconnect the A+, B+, and ground leads as shown in figure 124.

(2) Loosen the four corner mounting screws (fig. 124) and remove the dynamotor from the power supply.

(3) Disconnect terminal board TB303 from the mounting plate.

(4) Remove the mounting strap and the two screws which attach the dynamotor to the mounting plate.

(5) Remove the end covers (par. 193).

(6) Remove the impeller, the bearing plates, and the bearing plate gaskets.

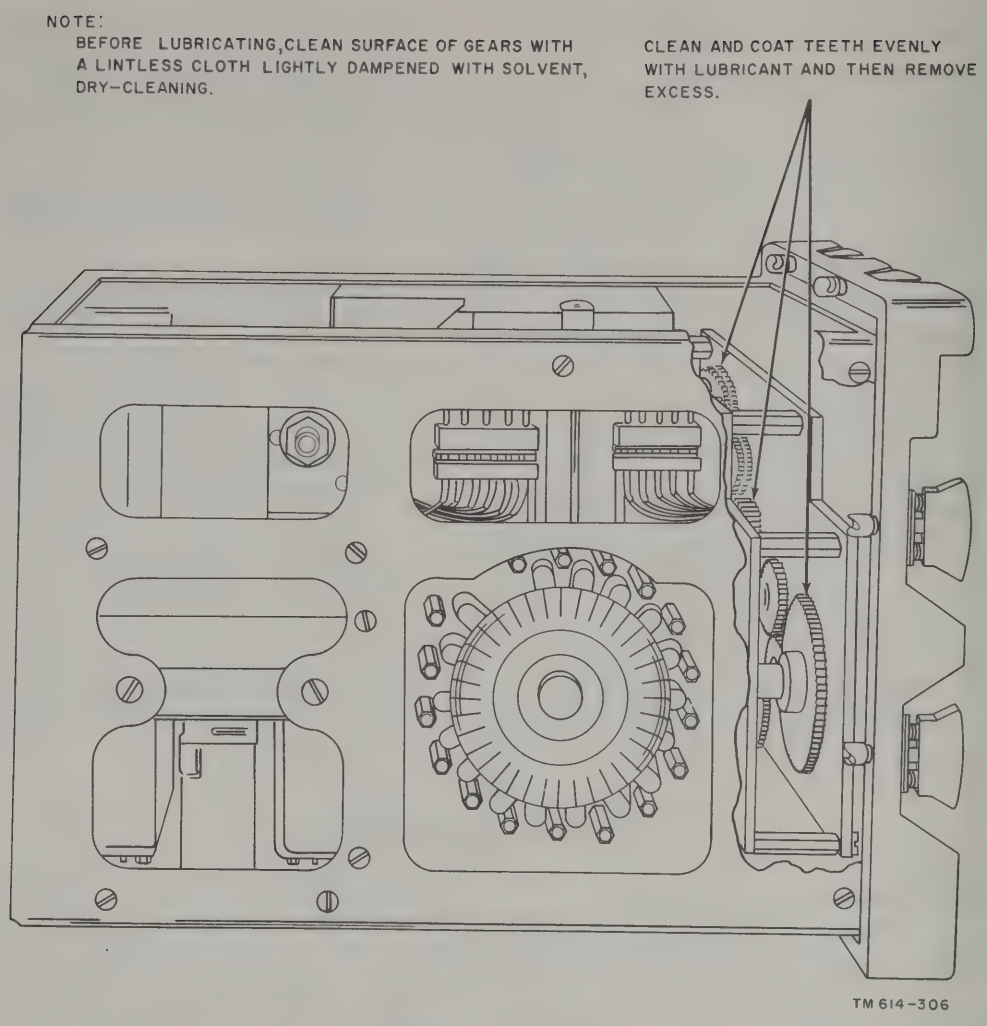


Figure 55. Lubrication of differential gear train.

(7) Apply sufficient grease (GL) to cover ball retainers.

(8) Replace parts and mount the dynamotor to the power supply chassis.

d. When it becomes necessary to change the type of lubricant because of operation in an arctic or desert region, wash out the old lubricant with solvent (SD); dry thoroughly and lubricate with proper grease. Do not disassemble the dynamotor when changing the lubricant.

108. Lubrication Under Unusual Conditions

a. Arctic Regions. Lubricants which are satisfactory at moderate temperatures stiffen and solidify at subzero temperatures; as a result, moving parts bind and become inoperative. When preparing the equipment for low-temperature operation, be sure that lubricants used for moderate temperatures are completely removed. Even small amounts of such lubricants, if allowed to remain, may impair the operation of moving parts. Be sure to use lubricants specified for low-temperature operation. The grease used on the gear drive mechanism and dynamotor should not congeal at temperatures of −40° F.

b. Tropical Regions. High temperatures and moisture due to rain, condensation, etc., may cause lubricants which are normally satisfactory to flow from moving parts and other surfaces. Hinges, fasteners, and other moving parts will be damaged or destroyed by rust and corrosion. Loss of grease on bearing surfaces results in added friction and overheating and causes permanent damage to the bearings. Inspect the equipment daily and lubricate as required to insure efficient operation; use lubricants suitable for high temperatures.

c. Desert Regions. Dust and sand infiltration of the equipment causes grit in the lubricants and

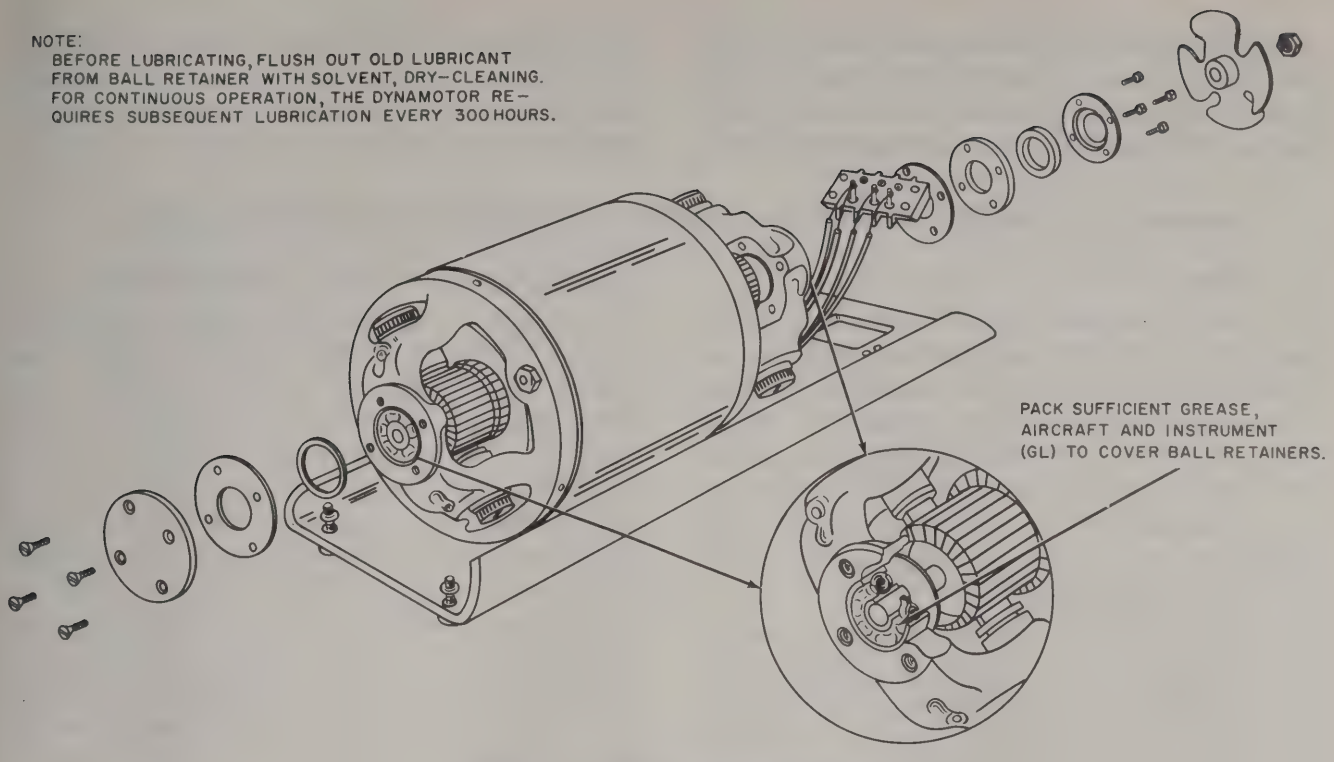


Figure 56. Lubrication of dynamotor.

will seriously impair and damage the moving parts of the set. Hot, dry temperatures cause the lubricants to flow from the moving parts, and conditions similar to those described in *b* above will result. Use lubricants suitable for high temperatures. Inspect and clean the equipment daily.

Section IV. WEATHERPROOFING

109. Weatherproofing Procedures and Precautions

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and in TB SIG 72. The equipment is given the moistureproofing and fungiproofing treatment at the factory; it is necessary to repeat the treatment only when parts are replaced or repaired.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66 and in TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

e. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold and heat. Refer to paragraphs 106 through 108 for detailed instructions.

110. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up the bared surfaces. Use No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the cases and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section V. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

111. General

a. The troubleshooting and repairs that can be performed at the organizational maintenance level (operators and repairmen) are necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, broken cables, etc.

b. The paragraphs which follow in this section help in determining which of the components, such as the receiver or transmitter, is at fault and in localizing the fault in that component to the defective stage or part, such as a tube or a fuse. Complete trouble localization procedures and necessary follow-up repairs are described in chapter 7.

112. Visual Inspection

a. Failure of this equipment to operate properly usually will be caused by one or more of the following faults:

(1) Improperly connected battery cable.
(2) Worn, broken, or disconnected cords or plugs.
(3) Burned-out fuses.
(4) Defective spiral-four cable.
(5) Relay contacts burned because of overloads.
(6) Wires broken because of excessive vibration.
(7) Defective tubes.
(8) Defective (dirty or cracked) crystals.

b. When failure is encountered and the cause is not immediately apparent, check as many of the items above as is practicable before starting a detailed examination of the components of the radio set. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

c. Visually inspect the antenna system for obvious defects.

113. System Sectionalization of Trouble

a. General. Chapter 1 contains an explanation of the applications of Radio Set AN/GRC–10 as part of Radio Terminal Set AN/GRC–39 or as part of Radio Repeater Set AN/GRC–40. Under these applications, the radio sets function as a radio link in a wire communications network. Should breakdown occur at one station, a complete system break results and telephone communication is impaired. This paragraph outlines a fast, efficient procedure for operators and repairmen to follow in returning the equipment to satisfactory operation, thereby restoring system communication. System sectionalization consists of tracing the fault to the radio station responsible for the abnormal operation.

b. System Control Operator. The system control station (par. 89) is responsible for proper operation of both telephone and radio equipments. When trouble occurs, the operator at this station is notified by the operator at the telephone equipment, by order wire communication or by hand-carried message. If this is impossible, the alternate system control station should be notified. The operator at the system control station or the alternate control station supervises all necessary repair procedures.

c. System Break. An r-f carrier break is immediately indicated to operators when receiver call lights go off. For example, if transmitter T (fig. 52) of terminal station A is not transmitting a signal, the call lights at receivers A of relay stations No. 1, 2, 3, 4, and the receiver R of terminal B will not be on. When an r-f carrier break occurs, the operator at relay station No. 1 may call the control operator (via the order wire channel) and inform him of a carrier break. The same procedure is followed regardless of which transmitter in the system loses its carrier. If transmitter B of relay station No. 4 becomes defective, the call lights of receivers B at relay stations No. 3, 2, 1, and receiver R of terminal A will not light. The operator at relay station No. 3 may call the operator at relay station No. 4 (via the order wire) and inform him of a carrier break. When a system

break occurs, other than r-f carrier type, operators may not use the order wire channel until instructed to do so by the control operator. All stations set up their equipment in the following manner (fig. 52).

(1) *Control Operator at Terminal Station A.* Establish communication with the operator of the associated telephone equipment. If communication is not possible, check the spiral-four cable connections at the control unit. Check the transmitter and the receiver by using the equipment performance check list (par. 115). If a defective component is found, replace it with one from the spare radio set and return the system to normal operation. If no trouble exists at the terminal station, attempt to contact each relay station along the system until the defective station is located. If unable to contact any of the relay stations, allow enough time (aprx. 30 min.) for minor repairs or component substitution.

(2) *Operator at Relay Station No. 1.* Wait for order wire communication from the system control operator. If receiver A at the relay station is inoperative or suspected of being inoperative, tune receiver B to the same frequency as receiver A. To insure reliable communication with the control terminal, the antennas of receiver A and receiver B must be interchanged. In the same manner, it may be necessary for the control operator to tune his receiver to the frequency of transmitter A at the relay station if transmitter B at the relay station is defective. Upon establishing contact with relay station No. 1, the control operator instructs the operator at relay station No. 1 to check the equipment by using the equipment performance check list (par. 115). If no trouble exists at relay station No. 1, return the radio set to the normal retransmission setup.

(3) *Operator at Relay Station No. 2.* Wait for order wire communication from the system control operator. If receiver A at relay station No. 2 is inoperative or suspected of being inoperative, tune receiver B to the same frequency as receiver A. To insure reliable communication with the control terminal through relay station No. 1, the antennas of receiver A and receiver B must be interchanged. In the same manner, it may be necessary for the operator at relay station No. 1 to tune receiver B to the frequency of transmitter A of relay station No. 2. The system control operator follows the same procedure as for relay station No. 1. The control operator repeats the process of calling each station in succession until an open circuit is located. This will isolate the particular station in trouble.

(4) *All stations contacted.* If contact is made with all station operators along the system and an open circuit still exists, the system control operator instructs operators at all stations to substitute spare radio sets. (Operators at relay stations will substitute a spare for radio set A; if an open circuit still exists, the spare will be substituted for radio set B.)

(5) *Repair.* With the system returned to normal operation, a more thorough check of the replaced equipment will indicate the defective component. If the trouble is of a nature that cannot be repaired by the operator or organizational repairman, the component should be sent to a higher echelon for repair. If the defective component is found and the trouble may be corrected by the repairman, the system control operator should be notified of the action taken.

114. Sectionalizing Trouble to Major Component

a. General. Sectionalizing trouble to a major component consists of tracing the fault to the component or circuit responsible for the abnormal operation of the radio set. Localization, described in paragraphs 117 through 124 and in chapter 7, means tracing the fault to the particular defective part. With certain applications of the radio set, it is essential to maintain continuous operation. When equipment breakdown occurs, the operator or repairman must return the set to normal operation in a minimum amount of time.

b. Checking Components. Observe the performance of the radio equipment during normal operation. Keep a record of meter readings in the spaces provided on the front panels of the

transmitters and receivers. Abnormal meter readings often will sectionalize a fault to the transmitter, receiver, power supply, or control unit when breakdown occurs. See the equipment performance check list (par. 115) for normal operating indications. If only one component is inoperative, check the cables connected to it; check the connectors at the ends of the cables and check the jacks with which they mate. If all cables and connectors are good, the fault is probably within the component; replace the suspected component with one known to be good. If the trouble is cleared, the component removed is faulty and requires troubleshooting.

c. Use of Troubleshooting Information. In locating a defective component and, where necessary, troubleshooting it, use the information given in paragraphs 115 through 124.

(1) *Equipment performance check list.* In most cases of trouble, operating the equipment according to the steps in the equipment performance check list (par. 115) will show which component is faulty. When troubleshooting the component is necessary, use the information in paragraphs 117 through 124.

(2) *Voltage and resistance charts.* When a fault cannot be traced to a particular component by use of the equipment performance check list, make voltage and resistance checks as described in paragraph 116. When troubleshooting the component is necessary, use the information in paragraphs 117 through 124.

(3) *Trouble-shooting charts.* The information in paragraphs 117 through 124 will help to find trouble within a component that may be corrected by the use of running spare parts. If the fault cannot be cleared in this manner, further troubleshooting (ch. 7) will be required.

115. Sectionalizing Trouble to Component by Using Equipment Performance Check List

a. General. The equipment performance check list (*f* below) will help the operator to determine whether Radio Set AN/GRC–10 is functioning properly. The check list gives the item to be checked, the conditions under which the item is to be checked, the normal indications and tolerances of correct operation, and the components the operator must check. Items 1 through 18 are preparatory and should be checked before operating the equipment, items 19 through 36 when starting, and items 37 and 38 when stopping the equipment. Items 19 through 35 on the check list should be checked at least once during each operating period (at least four times a day during continuous operation).

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it consists of an action that must be taken to check the indications given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. In the case of meter readings, the allowable tolerance of the readings is given. When the meter indicates within the specified limits, the indications are considered normal. If the indications are not normal, the operator should check the indicated component.

d. Component to be Checked. The components listed are those most likely to be defective when normal indications are not obtained, and on which trouble shooting will be necessary. Spare components are provided with Radio Terminal Set AN/GRC–39 and with Radio Repeater Set AN/GRC–40. To maintain communication with these equipments, it is only necessary to replace a defective component with a spare. When no spares are available and the tactical situation requires the maintenance of communication, use the troubleshooting procedures given in paragraphs 117 through 124. When certain types of troubles occur, the use of the equipment performance check list may not provide a definite indication of a defective component; in such cases, perform the voltage and resistance measurements given in paragraph 116. In all cases of trouble, be sure that all cables and their connectors are not defective; always remember that the first things to suspect are the component cables, the power cables, the transmission lines, the handset and loudspeaker cables, the interconnecting cables, and all connectors associated with them.

e. Frequency of Checking. Items 1 through 35 must be checked each time equipment is put into operation.

f. Equipment Performance Check List.

	Item No.	Item	Action or condition	Normal indications	Component to be checked
PREPARATORY	1	Control unit MASTER POWER switch.	Set to OFF position.		
		TYPE OF OPERATION switch.	Set to PUSH-TO-TALK position.		
	2	Control unit front panel plugs.	Tighten connection plugs with wing-blade fasteners.		
	3	Power supply LINE VOLTAGE switch.	Set to 115 when operating from a 115-v a-c power source, and to 230 when operating from a 230-v a-c power source.		
	4	Power supply blower door.	Turn blower dook locking screw counterclockwise until door opens. Door remains open during operation. Door locks open with stud fastener.		
	5	Power supply front panel plugs.	Tighten connection plugs with wing-blade fasteners.		
	6	Transmitter LINE LEVEL control.	Set to center position.		
	7	Transmitter TEST-MIKE-RING control.	Set to MIKE position.		
	8	Transmitter R. F. POWER switch.	Set to HI position.		
	9	Transmitter ANT LOAD control.	Set to center position.		
	10	Transmitter ANT TUNE control.			
	11	Transmitter blower door.	Turn blower door locking screw counterclockwise until spring-loaded door opens. Door remains open during operation.		
	12	Transmitter front panel plugs.	Tighten connection plugs with wing-blade fasteners.		
	13	Receiver LINE LEVEL control.	Set to center position.		
	14	Receiver SQUELCH control.	Rotate to OFF position.		
	15	Receiver VOLUME control.	Set to center position.		
	16	Receiver ANT ADJ.	Set to center position.		
	17	Receiver AFC DISABLE switch.	Spring-loaded; relaxed position off.		
	18	Receiver front panel plugs.	Tighten connection plugs with wing-blade fasteners.		

	Item No.	Item	Action or condition	Normal indications	Component to be checked
START	19	Control unit MASTER POWER switch.	Turn to ON position	POWER pilot lamp will glow.	Power supply.
				Blower motors will begin to operate.	Power supply.
				Either a signal or a rushing noise will be heard at handset.	Receiver.
				If operating from a 26-v source, the OPERATING ON DC lamp will glow.	Control unit.
	20	Control unit TYPE OF OPERATION switch.	After allowing a 30-second warm-up period, turn TYPE OF OPERATION switch to TERMINAL position.	TRANSMIT pilot lamp on power supply glows and transmitter is keyed.	Power supply.
	21	Transmitter METER SW.	Set to OSC position	Meter indicates 2 v. (10 v is full scale deflection.)	Transmitter.
	22	Transmitter METER SW.	Set to XTAL OSC position.	Meter indicates 1 v. (10 v is full scale deflection.)	Transmitter.
	23	Transmitter METER SW.	Set to PA GRID position	Meter indicates between 50 v and 95.v (100 v is full scale deflection.)	Transmitter.
	24	Transmitter METER SW.	Set to PA PLATE position.	Meter indicates 135 to 150 ma. (200 ma is full scale deflection.)	Transmitter.
	25	Transmitter METER SW and TEST-MIKE-RING switch.	Set METER SW to LINE LEVEL position and TEST-MIKE-RING switch to TEST position.	Adjust LINE LEVEL control until panel meter indicates 0 db.	Transmitter.
				Audio note heard at handset.	Receiver.
	26	Transmitter METER SW.	Set to AFC+ and then to AFC−.	Meter indicates 0 in both positions.	Trasmitter.
	27	Transmitter METER SW.	Set to R. F. POWER position. Adjust ANT TUNE control.	A peak occurs on meter at one setting of control. Adjust for maximum deflection.	Transmitter.
	28	Transmitter METER SW.	Set to PA PLATE position.	A peak occurs on meter at one setting of control. Adjust for maximum deflection.	Transmitter.
	29	Receiver METER SW	Set to OSC 1 position	Meter indicates between 10 and 40 microamperes.	Check V10, V11, or V12.
	30	Receiver METER SW	Set to OSC 2 position	Meter indicates between 15 and 50 microamperes.	Check V11.
	31	Receiver METER SW and transmitter TEST-MIKE-RING switch.	Set receiver METER SW to LINE LEVEL position and TEST-MIKE-RING switch to TEST position. Set the receiver frequency to the operating frequency of the transmitter.	Adjust LINE LEVEL control until the receiver panel meter indicates 0 db. Return TEST-MIKE-RING switch to MIKE position.	Receiver.
	32	Receiver METER SW	Set to DISC− and then to DISC+.	Meter indicates zero in both positions.	Receiver.

	Item No.	Item	Action or condition	Normal indications	Component to be checked
START	33	Receiver METER SW and ANT ADJ control.	Set to 3RD IF and turn ANT ADJ control.	Adjust for maximum reading.	Receiver.
	34	Receiver METER SW---	Set to 1ST LIM--------	Meter indicates between 0 and 60 microamperes.	Receiver.
	35	Receiver SQUELCH control.	No signal heard at handset. Turn control fully clockwise.	Turn control counterclockwise; as threshold point is approached, signal is heard at handset.	Receiver.
	36	Handset H–33/PT-------	Disconnect handset from control unit. Attach to AUDIO plug of receiver.	Signal is heard at handset.	Component cable; receiver CONTROL.
			Disconnect handset from receiver and attach to AUDIO plug of transmitter.	Signal is heard at handset.	Component cable; transmitter CONTROL.
STOP	37	Control unit TYPE OF OPERATION switch.	Turn to PUSH-TO TALK position.	TRANSMIT pilot light goes out.	
	38	Control unit MASTER POWER switch.	Turn to OFF position----	POWER pilot light goes out.	

116. Voltage and Resistance Charts

a. General. If difficulty arises in locating a defective component, perform the voltage and resistance measurements given in the charts below. An abnormal reading indicates a defective component. When making resistance measurements, remove the five component cables and measure from the outer rim of each jack to the desired pin. For voltage measurements, leave the cables in place; remove the four-slot retainer ring with the spanner wrench provided, and remove the wing-blade fastener from the back of each plug. The soldered connections of each plug will be exposed. Attach the negative lead of the voltmeter to the outer rim of the plug and measure the voltage at the desired pin with the positive lead. Where the charts indicate a negative voltage, reverse the meter leads. Measure resistances with the radio set turned off; measure voltages with the radio set turned on.

b. Voltage Measurements. Before making voltage measurements, set the radio set controls at the following positions: On the control unit, set the MASTER POWER switch at ON and set the TYPE OF OPERATION switch at TERMINAL. On the power supply, set the LINE VOLTAGE switch at 115 or 230, depending on the power source. On the transmitter, set the R. F. POWER switch at HI, set the TEST-MIKE-RING switch at MIKE, set the METER SW to LINE LEVEL, and set the LINE LEVEL control to minimum. On the receiver, leave the ANT ADJ control at any position, set the METER SW at LINE LEVEL, set the SQUELCH control at OFF, and set the VOLUME and LINE LEVEL controls at their midway positions.

c. Resistance Measurements. Before making resistance measurements, set the radio set controls at the following positions: On the control unit, set the MASTER POWER switch at OFF and set the TYPE OF OPERATION switch at TERMINAL. On the power supply, set the LINE VOLTAGE switch to 115. On the transmitter, set the R. F. POWER switch at HI, set the TEST-MIKE-RING switch to MIKE, set the METER SW at LINE LEVEL, and set the LINE LEVEL control at about midpoint. On the receiver, leave the ANT ADJ control at any position, set the METER SW at LINE LEVEL, set the SQUELCH control at OFF, and set the VOLUME and LINE LEVEL controls at their midway positions.

d. Power Supply XMTR POWER Jack.

Pin No.	Voltage	Resistance (ohms)
A	+540 v d-c	200K.
B	+245 v d-c	100.
C	−17 v d-c	1,250.
From D to E	115 v a-c	Infinite.
F	26.4 v a-c or +24 v d-c (depending on input).	1.5.
H	26.4 v a-c or +24 v d-c (depending on input).	1.5.
J	0	Infinite.
K	0	0.

e. Power Supply REC POWER Jack.

Pin No.	Voltage	Resistance (ohms)
A	+195 v d-c	100K.
B	NC (no connection)	
C	NC	
D	NC	
E	NC	
F	26.4 v a-c or +24 v d-c (depending on input).	1.5.
H	26.4 v a-c or +24 v d-c (depending on input).	1.5.
J	0	0.
K	0	0.

f. Receiver POWER Jack.

Pin No.	Voltage	Resistance (ohms)
A	+195 v d-c	20K.
B	NC	
C	NC	
D	NC	
E	NC	
F	26.4 v a-c or +24 v d-c (depending on input).	100.
H	26.4 v a-c or +24 v d-c (depending on input).	3. 5.
J	0	0.
K	0	0.

g. Receiver CONTROL Jack.

Pin No.	Voltage	Resistance (ohms)
A	0	Infinite.
B	0	3.4.
C	0	250K.
D	0	2.5.
E	0	8,500.
F	0	20.
H	0	0.
J	0	19.
K	0	Infinite.

h. Receiver AUDIO Jack.

Pin No.	Voltage	Resistance (ohms)
A	0	3.4.
B	0	Infinite.
C	NC	
D	NC	
E	NC	
F	NC	
H	NC	
J	NC	
K	0	Infinite.
L	0	35.

i. Power Supply POWER Jack.

Pin No.	Voltage	Resistance (ohms)
A	0 or +24 v d-c [a]	400.
B	0 or +24 v c-d [a]	400.
C	0	9K.
D	24 v d-c	9K.
E	0	0.
F	0	0.
H	0 or +24 v d-c [a]	125.
From J to K	115 v or 230 v a-c (depending on supply).	Infinite.

[a] A reading obtained during d-c operation only.

j. Transmitter POWER Jack (R. F. POWER Switch in HI Position).

Pin No.	Voltage	Resistance (ohms)
A	+540 v d-c	Infinite.
B	+245 v d-c	200K.
C	−17 v d-c	1,100.
D	0	Infinite.
E	0	Infinite.
From D to E	115 v a-c	400.
F	26.4 v a-c or 24 v d-c (depending on input).	54.
H	26.4 v a-c or 24 v d-c (depending on input).	2.4.
J	NC	
K	0	0.

k. Transmitter CONTROL Jack.

Pin No.	Voltage	Resistance (ohms)
A	−6 v d-c	560.
B	0	Infinite.
C	0	Infinite.
D	0	2, 200.
E	0	12.
F	0	210.
H	0	0.
J	0	220.
K	0	Infinite.

l. Transmitter AUDIO Jack.

Pin No.	Voltage	Resistance (ohms)
A	0	Infinite.
B	0	0.
C	—6 v d-c	560.
D	NC	
E	0	0.
F	0	Infinite.
H	0	0.
J	NC	
K	NC	
L	NC	

m. Control Unit XMTR CONTROL Jack.

Pin No.	Voltage	Resistance (ohms)
A	—6 v d-c	Infinite.
B	0	1 meg.
C	0	Infinite.
D	0	Infinite.
E	0	Infinite.
F	0	Infinite.
H	0	0.
J	0	Infinite.
K	0	Infinite.

n. Control Unit POWER Jack.

Pin No.	Voltage	Resistance (ohms)
A	0 or +24 v d-c [a]	Infinite.
B	0 or +24 v d-c [a]	Infinite.
C	0	5 meg.
D	+24 v d-c	5 meg.
E	0	0.
F	0	0.
H	0	Infinite.
J [b]	0	Infinite.
K [b]	0	Infinite.

[a] A reading obtained during d-c operation only.
[b] 115/230 v a-c between pins J and K.

o. Control Unit INTERCONN Jack.

Pin No.	Voltage	Resistance (ohms)
A	NC	
B	−6 v d-c	Infinite.
C	+24 v d-c	5 meg.
D	NC	
E	0	0.
F	0	8 meg.
H	NC	
J	0	Infinite.
K	NC	

p. Control Unit REC CONTROL Jack.

Pin No.	Voltage	Resistance (ohms)
A	0	Infinite.
B	0	Infinite.
C	0	Infinite.
D	0	Infinite.
E	0	Infinite.
F	0	Infinite.
H	0	0.
J	0	Infinite.
K	0	0.

q. Control Unit AUDIO Jack.

Pin No.	Voltage	Resistance (ohms)
A	0	Infinite.
B	0	0.
C	−6 v d-c	Infinite.
D	NC	
E	0	0.
F	0	5 meg.
H	0	0.
J	0	Infinite (with control unit disconnected from d-c supply).
K	0	Infinite.

117. Localizing Trouble to Component Part

a. General. The charts in paragraphs 118 through 123 list procedures for the replacement of parts for which running spares are provided. Running spares for each unit are listed in paragraph 31. The procedures described will be necessary in localizing trouble to a particular component part.

b. Chassis Removal. Replacement of plug-in items (except most fuses) requires the removal of the waterproof cases which house the chassis of the various components. To remove the chassis of the transmitter, receiver, power supply, or control unit, perform the following steps:

(1) Remove all external connections from the component.
(2) Remove the component from the electrical equipment rack (par. 56).
(3) Loosen the fasteners.
(4) Slide the panel and chassis assembly out of the case. Be careful not to damage any wiring or parts while removing or handling the assembly.

(5) Use the 20-foot interconnecting cable in place of the short component cable for applying power to the transmitter or receiver when the component is removed from the case.

118. Dynamotor-Power Supply DY–94/GRC–10

a. Fuses. One of the most common forms of operational failure is burned-out fuses. Because of the unstable output of mobile power units, many current surges result. Check fuses immediately upon observing an inoperative radio set. Remove the panel-mounted fuses by unscrewing the fuse caps which serve also as fuse extractors. Spare fuses are provided in the front panel compartment marked SPARE FUSES. To gain access to the spares, unscrew the large cover plate and select the desired fuse.

b. Troubleshooting Chart for Dynamotor-Power Supply DY–94/GRC–10.

Symptom	Probable trouble	Corrective measures
1. Transmitter inoperative on a-c or d-c operation. POWER indicator lamp does not light.	Fuse F306 blown	Replace 4-amp fuse.
2. Receiver inoperative on a-c or d-c operation. POWER indicator lamp lights.	Fuse F307 blown	Replace 3-amp fuse.
3. During d-c operation, REC 3A fuse F302 burns out.	Vibrator G302 (sticking or shorted contacts).	Replace vibrator G302 and then replace REC 3A fuse.
4. During d-c operation, XMTR 3A fuse F301 burns out.	Vibrator G301 (sticking or shorted contacts).	Replace vibrator G301 and then replace XMTR 3A fuse.
5. Receiver inoperative on a-c operation; transmitter operates; POWER indicator lamp lights.	Fuse F304, REC 1A	Replace REC 1A fuse.
6. Transmitter inoperative on a-c operation; receiver operates; POWER indicator lamp lights.	Fuse F305, XMTR 2A	Replace XMTR 2A fuse.

119. Replacing Dynamotor Brushes

Excessive brush wear is a common cause of dynamotor failure. To replace brushes in the dynamotor, use the following procedure.

a. Remove Dynamotor-Power Supply DY–94/GRC–10 from the electrical equipment rack; use the reverse procedure outlined in paragraph 56.

b. Remove the panel and chassis assembly from the case by turning the eight fasteners counterclockwise and sliding the component out of its case.

c. Remove the leads connected to terminal board TB303 (fig. 124).

d. Remove the four dynamotor assembly mounting screws (fig. 124).

e. Remove the end covers (4 and 5, fig. 160) by removing the cover screws (1, fig. 160).

f. Remove the brush and cap assemblies (14 and 16, fig. 160). Turn the caps counterclockwise with the fingers; if a screw driver is necessary, be careful not to crack or chip the cap.

g. Inspect the brushes and replace if worn or damaged.

h. Replace the dynamotor; use the reverse procedure outlined in *a* through *f* above.

120. Radio Set Control C–632/GRC–10 (fig. 57)

a. Removal. The panel and chassis assembly of the control unit has a safety interlock plug at the rear of the chassis. When the control unit is removed, power to the radio set is automatically cut off. The fuses of the control unit are not accessible from the front panel and can be changed only with the component removed from its case.

b. Troubleshooting Chart for Radio Set Control C-632/GCR-10.

Symptom	Probable trouble	Corrective measures
1. Radio set changes to d-c operation. OPERATING ON D-C pilot lamp lights.	Defective fuses F401 and/or F402.	Replace 4-amp fuse.
	Defective tubes V401 and/or V402.	Replace tube(s).
2. Radio set fails to operate from d-c source	Defective fuse F403	Replace 15-amp fuse.

121. Radio Transmitter T–235/GRC–10

(fig. 58)

a. Modulator Bias Control. If V201 and/or V202 is replaced, modulator bias control R294 (a screw-driver control located on the rear panel of the transmitter) must be readjusted as follows:

(1) Set the TEST-MIKE-RING switch at TEST.
(2) Set the METER SW to LINE LEVEL.
(3) Adjust the LINE LEVEL control for approximately zero db.
(4) Adjust the modulator bias control for a maximum reading on the meter.

b. Troubleshooting Chart for Radio Transmitter T–235/GCR–10.

Symptom	Probable trouble	Corrective measures
1. No output from transmitter: Abnormal meter reading in PA POWER or PA PLATE position.	Defective V205	Replace tube. If V205 is replaced, it may be necessary to realign the power amplifier stage to obtain maximum power output. The procedure is given in paragraph 200*i*.
LINE LEVEL control cannot be set for proper reading.	Defective V201, V202, and/or V216.	Replace tube(s).
Abnormal meter reading in OSC position	Defective V203	Replace tube.
Abnormal meter reading in PA GRID position.	Defective V204	Replace tube.
2. Transmitter drift, abnormal meter readings in XTAL OSC position.	Defective V209	Replace tube.
3. No audio note heard at handset when TEST-MIKE-RING switch is in the TEST or RING position.	Defective V206	Replace tube.
4. Meter indicates zero for any setting of LINE LEVEL control although transmitter operation normal.	Defective V207, V210, V211, V212, V213, and/or V214.	Replace tube(s).
5. No output from transmitter. All meter readings abnormal.	Defective voltage regulator V208	Replace tube.
6. Transmitter modulated by test ring oscillator from RING position only.	Defective V216	Replace tube.
7. Panel meter readings abnormal in AFC+ and AFC— positions of METER SW.	Defective V215	Replace tube.

122. Transmitter Air Filter Cleaning or Replacement

a. Remove Radio Transmitter T–235/GRC–10 from the electrical equipment rack by reversing the procedure outlined in paragraph 56.

b. To remove the panel and chassis assembly from the case, turn the fasteners counterclockwise and slide the component out of the case.

c. Follow the detailed instructions lettered on the filter housing.

d. Replace the filter and the component by reversing the procedure outlined in *a* through *c* above.

123. Troubleshooting Chart for Radio Receiver R–125/GRC–10

(fig. 59)

Symptom	Probable trouble	Corrective measures
1. No output from receiver:		
Abnormal meter reading in 3RD IF, 1ST LIM, and DISC PRI positions.	Defective V1, V2, V3, V4, V5, V6, V7, and/or V8.	Replace tubes.
Abnormal meter reading in 1ST LIM and DISC PRI positions.	Defective V9	Replace tube.
Abnormal meter reading in OSC 1 position	Defective V10	Replace tube.
Abnormal meter reading in OSC 2 position	Defective V11	Replace tube.
Abnormal meter readings in DISC+, DISC−, and LINE LEVEL positions.	Defective V15	Replace tube.
Meter readings normal; no audio output	Defective V21, V22, and/or V23	Replace tubes.
2. Receiver drifts off frequency	Defective V12	Replace tube.
3. Squelch fails to operate	Defective V18, V19, and/or V20	Replace tubes.
4. No output from receiver; all readings abnormal	Defective voltage regulator tube V16.	Replace tube.

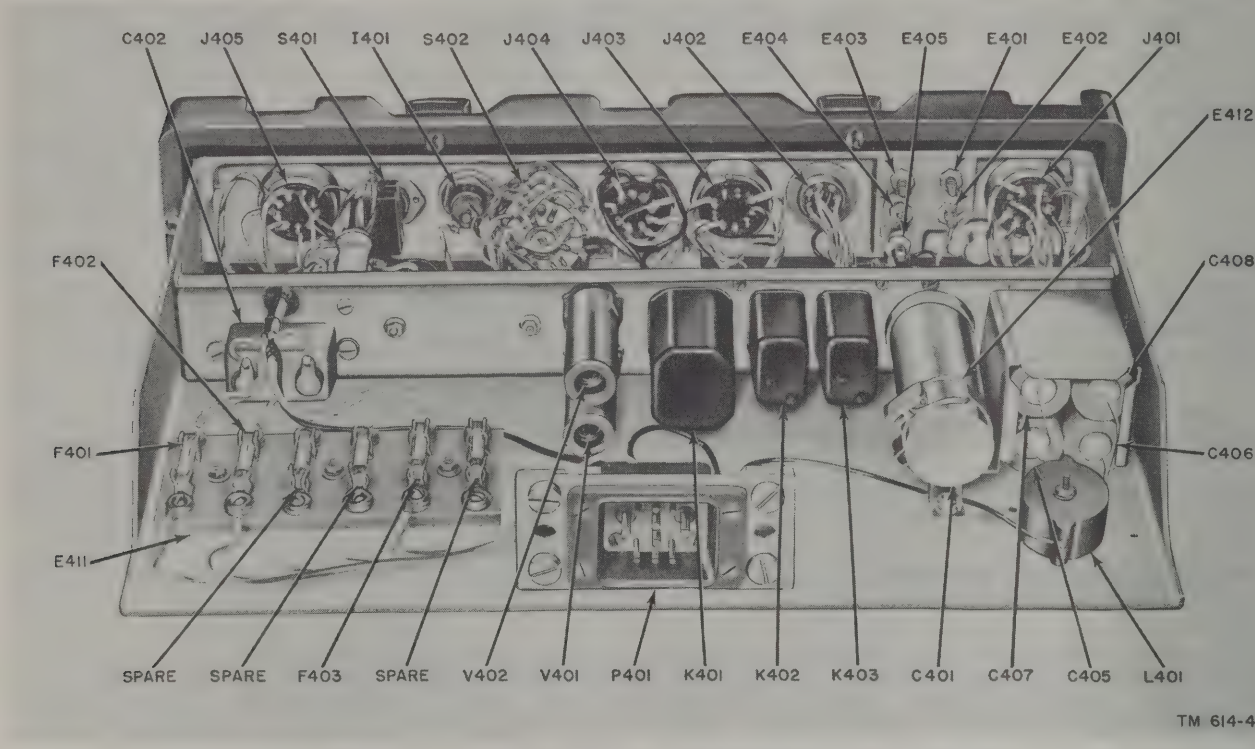


Figure 57. Radio Set Control C–632/GRC–10, part location.

124. Filament Circuits

The filament circuits of both the receiver and the transmitter are connected in series-parallel arrangements. For this reason, if the filament of one tube opens, the filaments of tubes on the same series string will not light. When power is applied, the filament strings composed entirely of good tubes will light, but the entire filament string containing one or more open filaments will not light. Refer to figure 8 or 109.

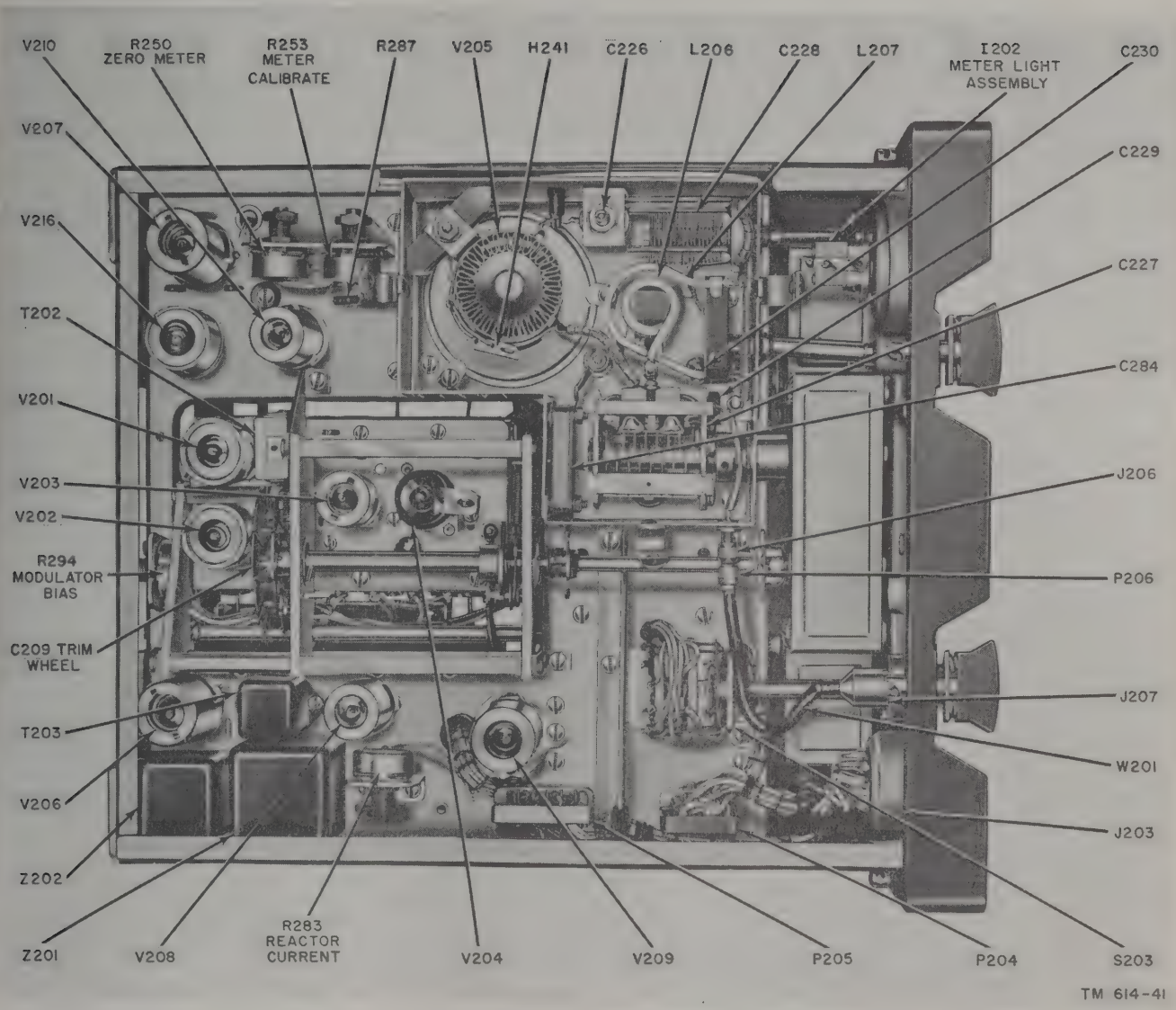


Figure 58. Radio Transmitter T–235/GRC–10, tube location.

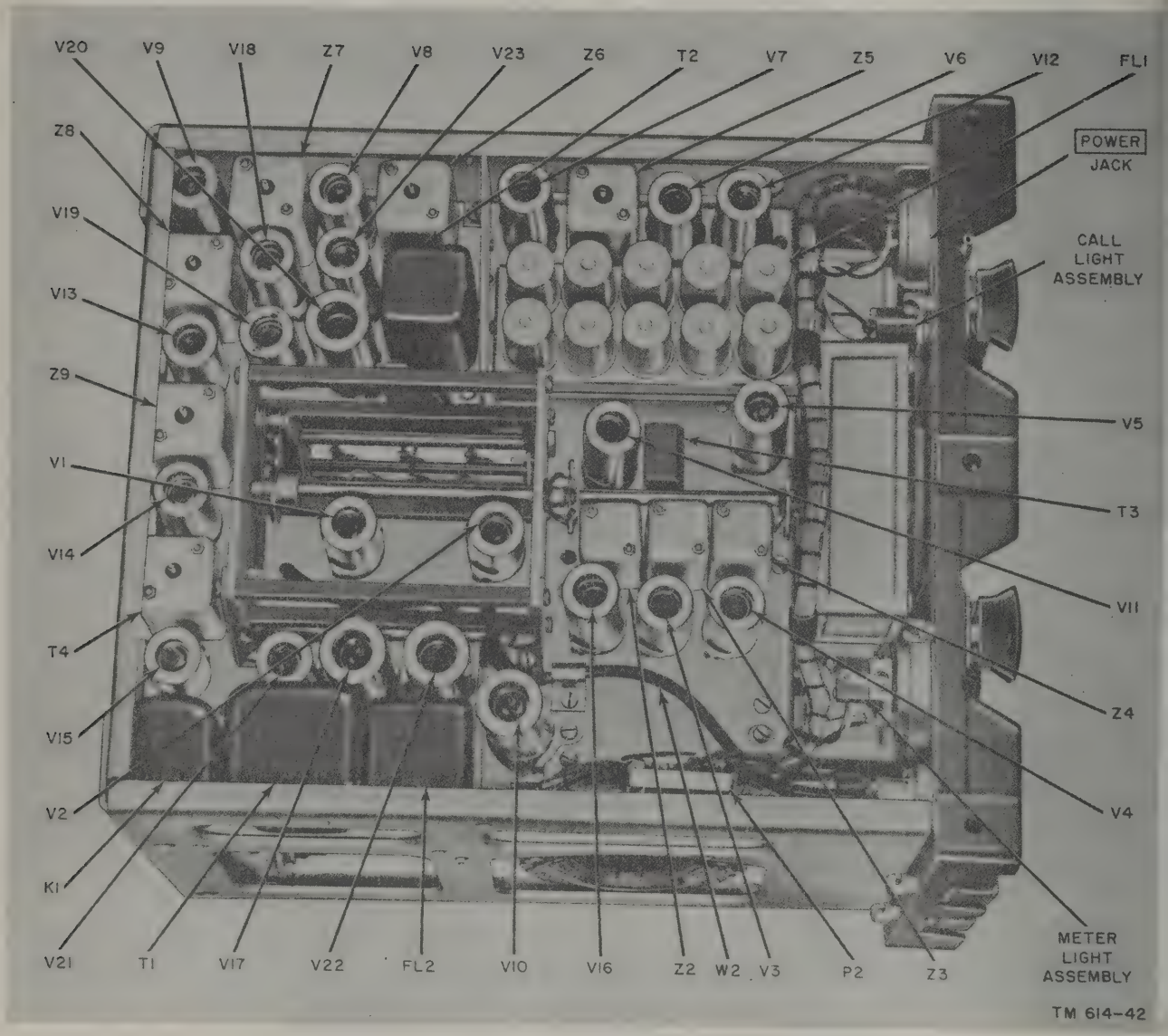


Figure 59. Radio Receiver R-125/GRC-10, tube location.

CHAPTER 5

AUXILIARY EQUIPMENT

125. General

Auxiliary equipment is considered to be any unit or units that will extend the usefulness of the radio sets. Telephone and telegraph terminal equipment, as well as a remote control group that will permit operation of the radio sets from a distance up to 2 miles, is described in this chapter.

126. Telephone Terminal AN/TCC–3

a. Telephone Terminal AN/TCC–3 (fig. 60) is used to provide four channels of telephone communication over a spiral-four cable system or over a radio link. An order wire channel also is provided. The length of spiral-four cable between the telephone terminal and the radio sets may be up to 5 miles without Telephone Repeater AN/TCC–5 (fig. 62); with the repeater, the range may be increased to 30 miles. For complete information, refer to TM 11–2142.

b. Telephone Terminal AN/TCC–3 also may provide special service uses for the transmission and reception of wide-band signals, such as high-speed facsimile or data transmission. During the wide-band special service uses, the four channels for telephone communication cannot be used. Any channel of the telephone terminal may be used as the transmission facility for voice-frequency telegraph signals, such as those produced by Telegraph Terminal AN/TCC–4 (fig. 61).

c. Telephone Terminal AN/TCC–3 will not accept 20-cps ringing signals. Voice-frequency equipment using 20-cps ringing signals may be connected on the loop side of the AN/TCC–3 if a signal converter, such as Telegraph-Telephone Signal Converter TA–182/U (fig. 63), is inserted in the circuit between the AN/TCC–3 and the voice-frequency loop equipment. The TA–182/U must be arranged for telephone operation. A separate TA–182/U must be inserted in each AN/TCC–3 channel loop terminated in equipment using 20-cps ringing signals. Each loop may be operated on either a two- or four-wire basis. The order wire of the telephone terminal is equipped with the proper ringing circuits (1,600 cps) to permit signaling between terminals and repeaters.

127. Telegraph Terminal AN/TCC–4

a. Telegraph Terminal AN/TCC–4 (fig. 61) provides high-speed carrier telegraph communications within the voice-frequency band of 300 to 3,100 cps. It consists of two Telegraph Modem Assemblies TH–15/T, two Telegraph Terminal Groups TH–13/T, and one Telegraph Modem TH–14/T. Eight duplex telegraph channels may be obtained for operation over two- or four-wire circuits. Telegraph Terminal AN/TCC–4 may be used in point-to-point systems, trunk circuit systems, telegraph-through-carrier telephone channel systems, and telegraph-through-radio link systems. Sixteen duplex telegraph channels may be obtained by interconnecting two Telegraph Terminals AN/TCC–4 as a single carrier telegraph terminal for operation over a four-wire circuit.

b. Telegraph Terminal AN/TCC–4 can be adapted for various uses by different combinations of the three basic units mentioned in *a* above. A telegraph terminal is obtained by stacking a number of the basic units in one or more vertical stacks. Interconnections between the equipment units are made from the front panels by means of cables and connectors provided for this purpose.

c. Telegraph Terminal AN/TCC–4 can operate over one channel of Telegraph Terminal AN/TCC–3. The line side of each telegraph terminal is connected to the drop side of the channel of the telephone terminal selected for use in telegraph transmission. The connection between the telegraph terminal and the telephone channel may be made on either a two- or four-wire basis. The four-wire arrangement is normally used. The remaining channels of the telephone system are used for normal speech transmission.

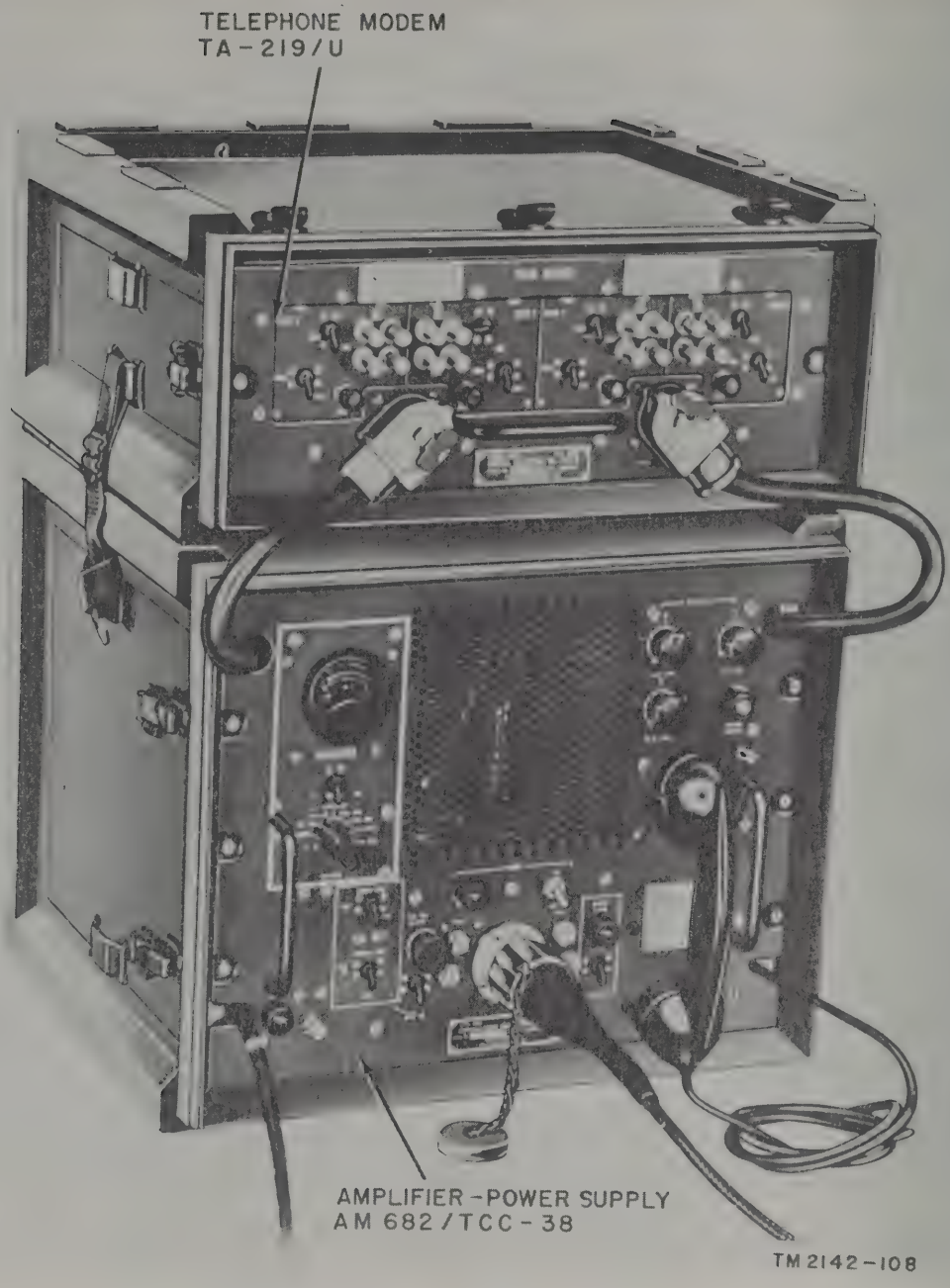


Figure 60. Telephone Terminal AN/TCC-3.

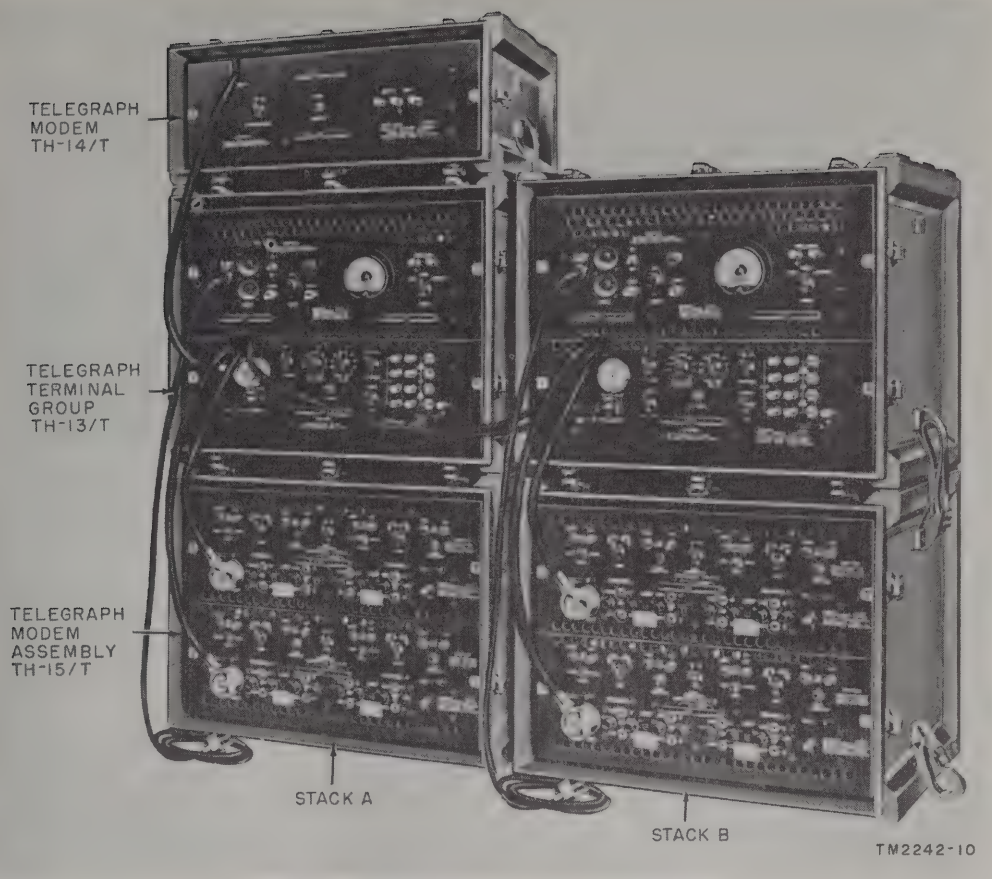


Figure 61. Telegraph Terminal AN/TCC-4.

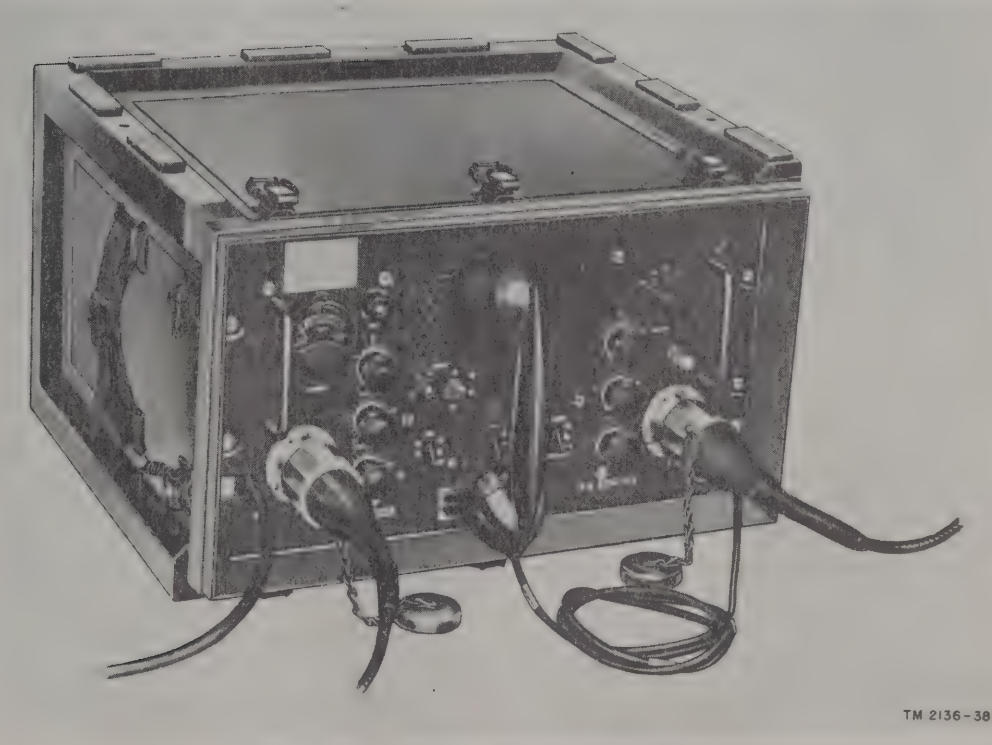


Figure 62. Telephone Repeater AN/TCC-5.

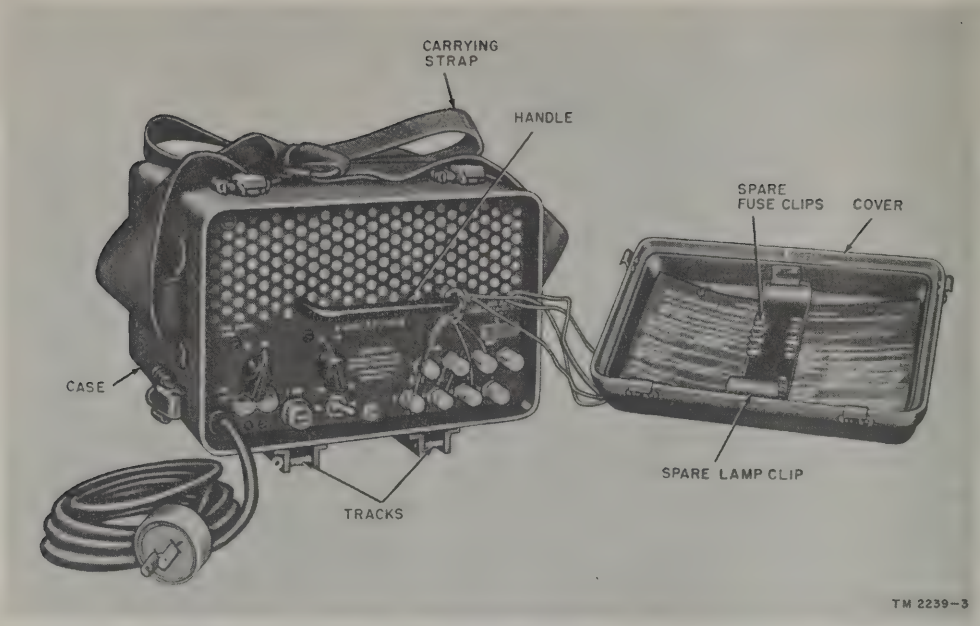


Figure 63. Telegraph-Telephone Signal Converter TA–182/U.

d. Telegraph Terminals AN/TCC–4 also can operate while using Radio Set AN/GRC–10 or Radio Terminal Set AN/GRC–39 as the interconnecting facility. In this case, the four-wire transmitting path of the terminal is connected to the input of the radio transmitter. The four-wire receiving path of the terminal is connected to the radio receiver output. For complete information on the telegraph terminal, refer to the applicable literature.

128. Telephone Repeater AN/TCC–5

a. Telephone Repeater AN/TCC–5 (fig. 62) is a four-wire carrier telephone repeater; it provides equalization and amplification in both directions of transmission. Its purpose is to extend the length of a four-channel carrier telephone system or single wide-band system that uses Telephone Terminal AN/TCC–3. The extension obtained is about 25 miles for each repeater used, with a maximum system length of approximately 100 miles.

b. Topographical or other considerations may indicate the need for the telephone repeater in conjunction with Radio Set AN/GRC–10 or Radio Terminal Set AN/GRC–39. Provision is made in the repeater for ringing, monitoring, and talking over the order wire to a distant telephone terminal or another repeater in the system and for measuring test signals from either of the two distant terminals in the carrier system.

c. When the telephone repeater is used, not more than 5 miles of cable should be between the repeater and the radio set. The cable between the repeater and the telephone terminal may be up to 25 miles long. For complete information, refer to TM 11–2136, Telephone Repeater AN/TCC–5.

129. Telegraph-Telephone Signal Converter TA–182/U

a. Telegraph-Telephone Signal Converter TA–182/U (fig. 63) provides a means of signaling in circuits which will not pass 20-cps ringing signals because of line or equipment characteristics.

b. In telegraph circuits, the unit converts 20-cps ringing signals to 1,255-cps ringing signals and 1,225-cps ringing signals to 20-cps ringing signals. In telephone circuits, the unit converts 20-cps ringing signals to 1,600-cps ringing signals and 1,600-cps ringing signals to 20-cps ringing signals. For complete information, refer to TM 11–2137.

130. Remote Control Equipment

All radio sets covered by this manual may be remotely operated from a distance up to 2 miles by using Control Group AN/GRA–6 (fig. 64). Local Control C–434/GRC of the control group is plugged into the AUDIO jack normally occupied by the handset. Remote Control C–433/GRC is connected to the local control by a pair of telephone wires. The control group may be used for all types of operation: push-to-talk, terminal, and relay. For complete information, on the remote control group, refer to TM 11–5038.

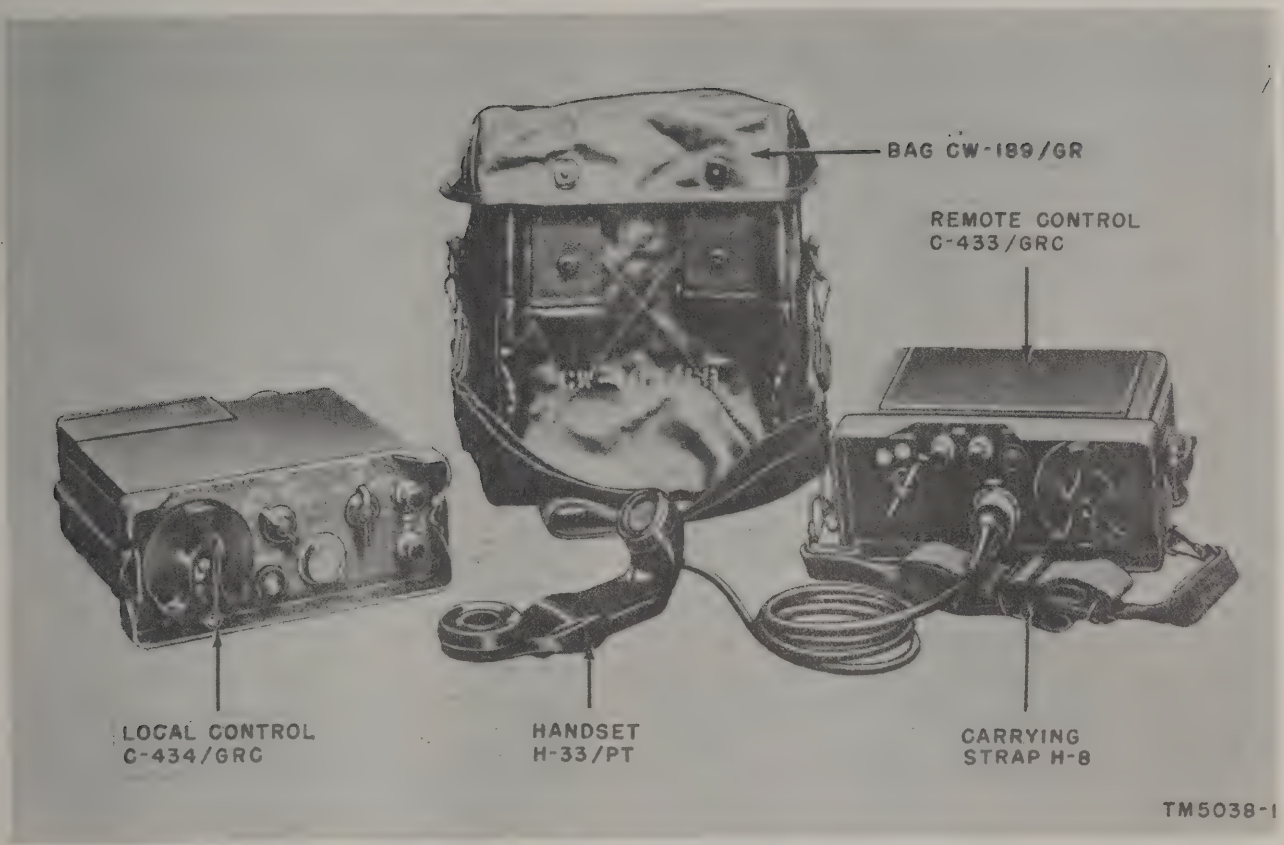


Figure 64. Control Group AN/GRA–6.

CHAPTER 6

THEORY

Section I. THEORY OF RADIO TRANSMITTER T–235/GRC–10

131. Differences in Transmitters

Because of changes in design, certain differences exist between the schematic diagrams and photographs in this section and some of the actual transmitters. The same statement is true concerning the voltage and resistance charts (figs. 139 and 169) and the complete schematic diagram of the transmitter (fig. 164). The table below shows the units that differ from the foregoing figures, and what the differences are. *Note that this table applies only to transmitters manufactured under Order No. 92–Phila–52.* The order number appears on the front-panel name plate of the transmitter, following the serial number.

Reference symbol	Serial numbers	Differences
C224	1 through 300	0.01 μf.
C291	1 through 230	0.01 μf, mounted outside T204 assembly.
C292	1 through 150	0.02 μf, single section.
R226	1 through 307	8,200 ohms, fixed.
R232	308 through 329	8,200 ohms.
R249	1 through 230	1 megohm.
R251	1 through 230	22K.
R252	1 through 230	120K.
R287	1 through 325	1,800 ohms.
R296	1 through 16	Not used.
R297	1 through 16	Not used.
R298	1 through 16	Not used.
R299	1 through 16	Not used.
R901	1 through 16	Not used.
R902	1 through 230	Not used.
R903	1 through 230	Not used.
T203	1 through 230	Not sealed type. Pin 1 is pin 3. Pin 2 is pin 1. Pin 3 is pin 2. Pin 6 is not separated.
V210 and V216	1 through 150	Pins 3 are connected to C237.
V201	1 through 150	Pins 3 and 4 are interchanged. Pin 4 is connected to ground.

132. Block Diagram

(fig. 65)

Radio Transmitter T–235/GRC–10 is a medium-power (40-watt) f-m transmitter, operating within a frequency range of 54.0 to 70.9 mc. The types of transmission possible are single-channel or multichannel telephone, telegraph, teletypewriter, and facsimile.

a. The fundamental frequency, developed in the tank circuit of the master oscillator (a modified Colpitts), is within the frequency range of 27 to 35.45 mc. The plate circuit of V203 is tuned to twice the oscillator frequency, resulting in an output frequency of 54 to 70.9 mc. The signal is amplified by driver V204 to provide a sufficiently large excitation voltage to the grid of power amplifier V205. The power amplifier, a tetrode, is tuned to the frequency of the driver. With maximum screen grid voltage on V205, the output of this class C operated power amplifier stage is 40

watts. When the transmitter is operating over a short range (usually 15 miles or less), a decreased power output of 10 watts can be used. Placing the front-panel R. F. POWER switch in the LO position reduces the screen supply voltage, thereby reducing the output of the transmitter.

b. A portion of the signal appearing at the plate of the driver is coupled to the input of the monitor receiver. The monitor receiver, incorporated as part of the transmitter, stabilizes the transmitter output by comparing the carrier frequency with crystal-controlled oscillators. The signal from the monitor receiver is fed to an afc tube (V215), which changes the inductance of the master oscillator tank circuit when a shift in frequency occurs.

c. The modulator stage (V201 and V202 operated in parallel) converts audio signals into a varying reactance, which is applied to the tank circuit of the master oscillator. Applying a varying reactance across the tank circuit of the master oscillator changes its frequency to a value above and below the initial value. Because the reactance applied across the tank changes in accordance with the applied audio voltages, the master oscillator frequency is modulated at the same audio rate.

d. Three sources of audio signals are applied to the modulator, two directly and one through wide-band (wb) amplifier V216.

(1) The wide-band audio input is supplied by telephone equipment for terminal station operation or by an associated receiver for retransmission.

(2) The microphone input from the handset is used by the operator for order wire communication with the operators at associated equipment. The microphone signal is applied to the transmitter circuit at the modulators, and to the receiver through the transmitter narrow-band amplifier. The TEST-MIKE-RING switch must be in the MIKE position.

(3) To attract the attention of other operators in the system, a 1,600-cycle note is transmitted over the order wire channel. Ring test oscillator V206B develops the 1,600 ring note and applies it to the grids of the modulators as well as to the narrow-band amplifier. The TEST-MIKE-RING switch must be in the RING position. The ring test oscillator also develops a 1,000-cycle test note that is applied to the input of the wide-band amplifier when the TEST-MIKE-RING switch is in the TEST position. This test note is used to set the LINE LEVEL control on the transmitter.

e. A metering circuit checks specific stages throughout the transmitter. Although used primarily for making adjustments and for periodic operational checks, it is an important maintenance aid for localizing trouble in a defective transmitter. Figure 65 indicates the various stages that can be checked by the meter.

f. Turning the MC and 0.1 MC selectors changes the operating frequency of the transmitter. Figure 66 is a block diagram showing the stages affected when the transmitter is tuned. Turning the MC selector tunes the circuits of the master oscillator-doubler, driver, power amplifier, and first high-frequency oscillator. Turning the 0.1 MC selector tunes the master oscillator-doubler, driver, power amplifier, and second high-frequency oscillator tuned circuit.

133. Master Oscillator-Doubler

a. The initial carrier frequency of the transmitter is developed by a modified Colpitts oscillator, V203. Figure 67 is a simplied drawing of the oscillator tank circuit and frequency controlling elements. The components from point A to ground (L202, C206, C207, and C209) comprise one leg of the tank, principally inductive, and C211 and C213, point B to ground, make up the capacitive leg. The tank resonates at frequencies from 27.00 to 35.45 mc. Coil L202 and capacitor C209 vary the oscillator frequency in .05-mc steps. The powdered iron core slug of L202 and capacitor C209 are controlled from the front panel of the transmitter by the differential gear mechanism. Feedback, necessary to sustain oscillations, is supplied by the voltage developed across C213 between point C and ground. L203 prevents the r-f voltage across C213 from being shorted to ground. Capacitor C207 has a negative temperature coefficient to compensate for temperature variations.

b. The Colpitts oscillator has excellent frequency stability; however, this frequency is not as stable as is required for satisfactory operation. The oscillator must be controlled by crystal oscillators to keep the drift to an acceptable minimum. Stabilization of the carrier frequency is a function of the monitor receiver. The carrier frequency is compared with crystal-controlled oscil-

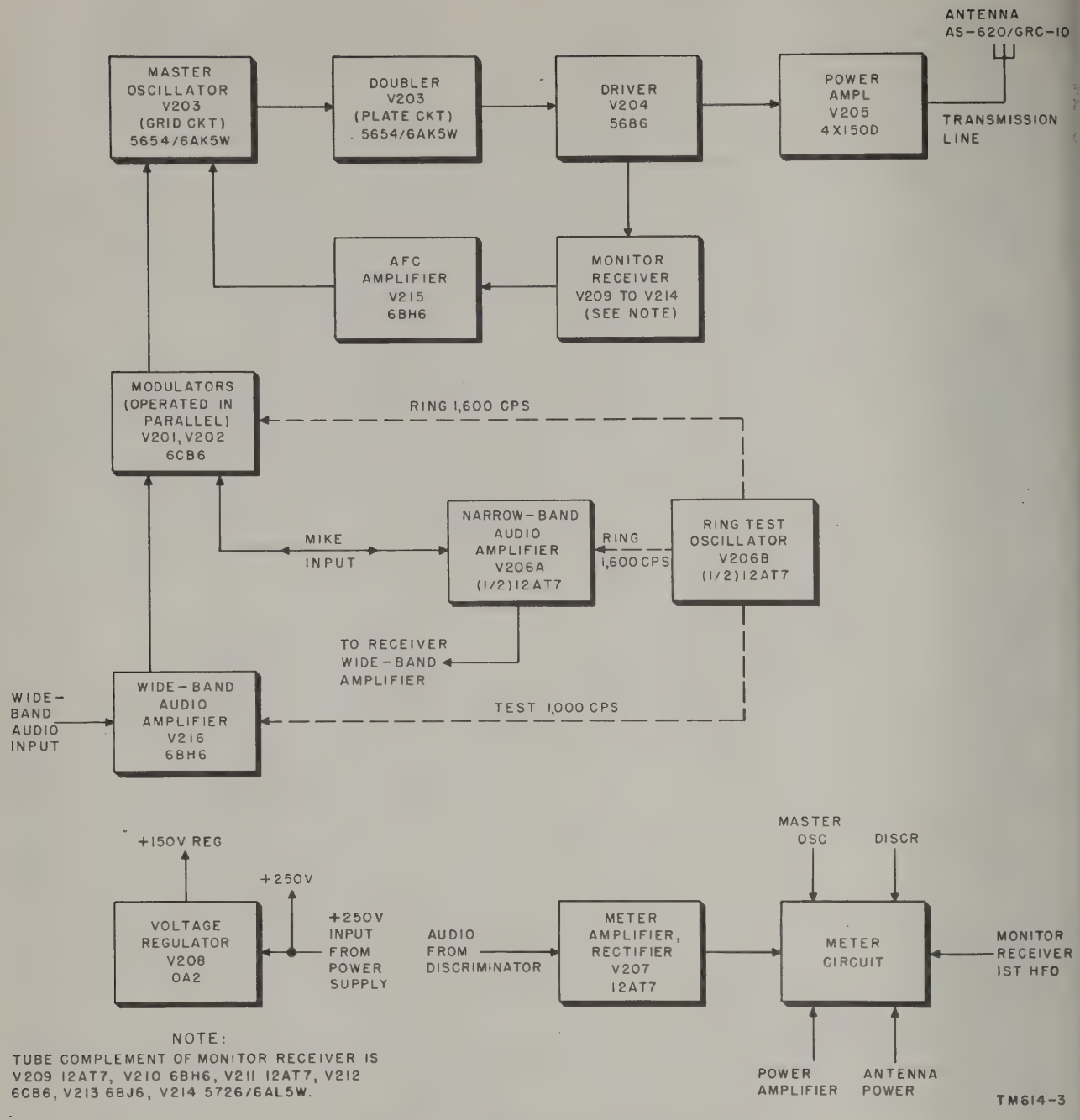


Figure 65. Transmitter block diagram.

lators in the monitor receiver. When a frequency drift occurs, a d-c voltage appears at the output of the receiver discriminator stage. The d-c voltage is positive or negative in respect to ground, depending on whether the drift is above or below the desired frequency. This voltage varies the bias of automatic frequency control amplifier V215, and thus controls current flow at the plate. In series with the plate circuit of the afc amplifier is R285 and the primary winding of saturable reactor T202 (fig. 68). The secondary winding of T202, in series with C212, parallels tank circuit capacitor C213. Any change in current through the primary of T202 causes a change in the inductance of the secondary. This inductance change will cause a shift in the frequency of the master oscillator. For example, if the carrier frequency of the transmitter drifts to 10 kc below the desired

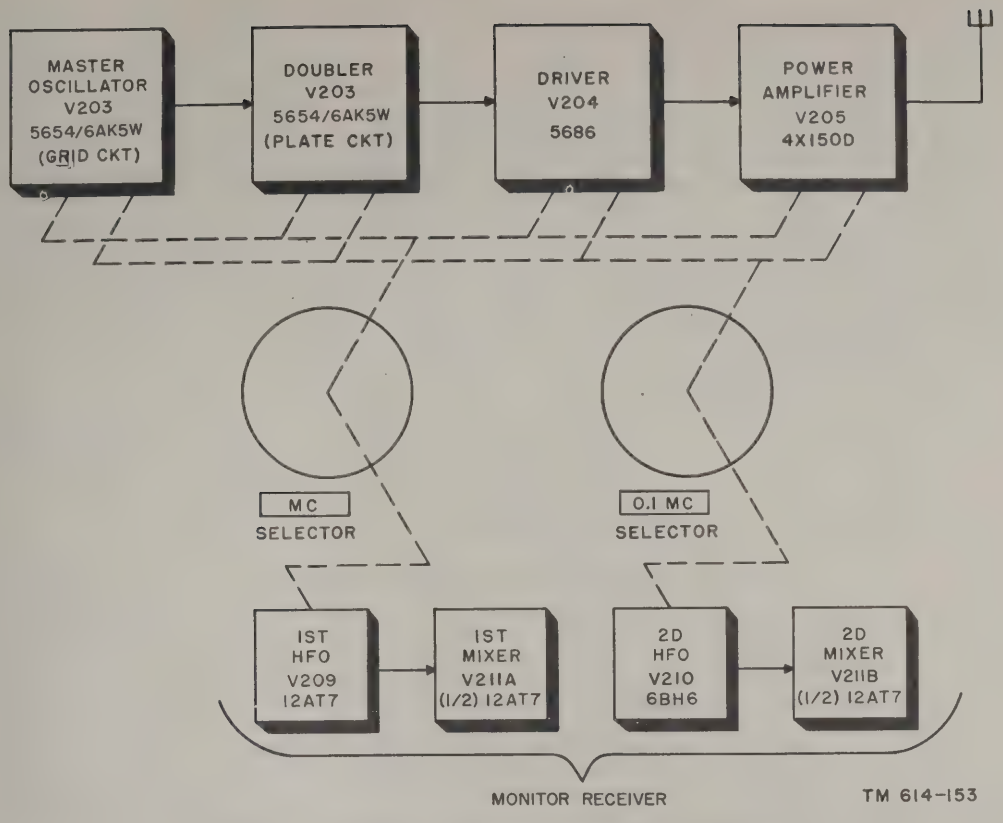


Figure 66. Control circuits, transmitter gear train.

operating frequency, the afc amplifier stage, through the saturable reactor, increases the frequency of the master oscillator 5 kc to compensate for the drift.

c. The components providing grid leak bias for V203 are R216, R217, and C210. During the positive peaks of the input signal, current flows in the grid circuit, charging C210. Because of the relatively long time constant of the resistance-capacitance (RC) circuit involved, C210 discharges only slightly through R216 and R217 during the remaining part of each cycle. Capacitor C210, therefore, presents a d-c voltage (negative side toward the grid) which is in series with the r-f input voltage. A meter circuit is connected to the junction between the two grid leak resistors. If the stage is not oscillating, no grid bias voltage will be present, resulting in a zero reading on the

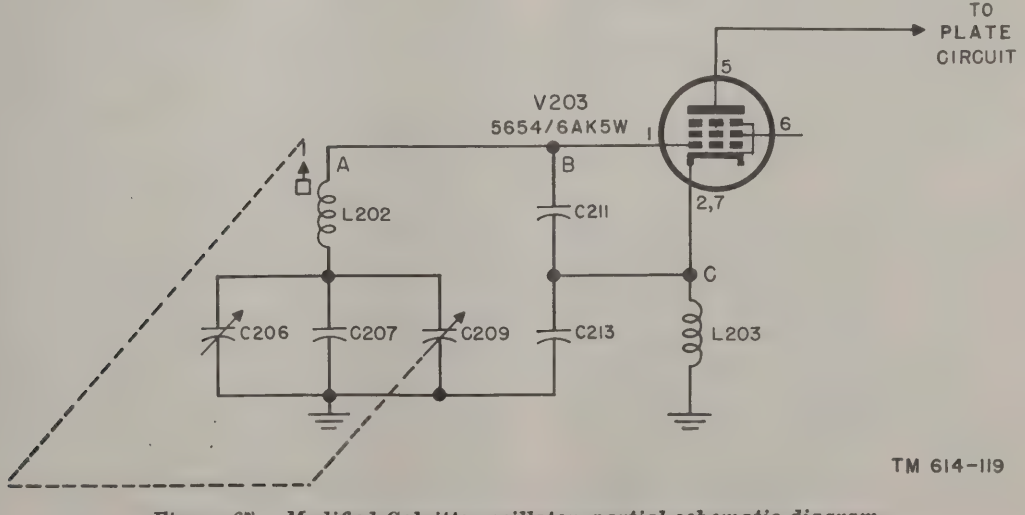


Figure 67. Modified Colpitts oscillator, partial schematic diagram.

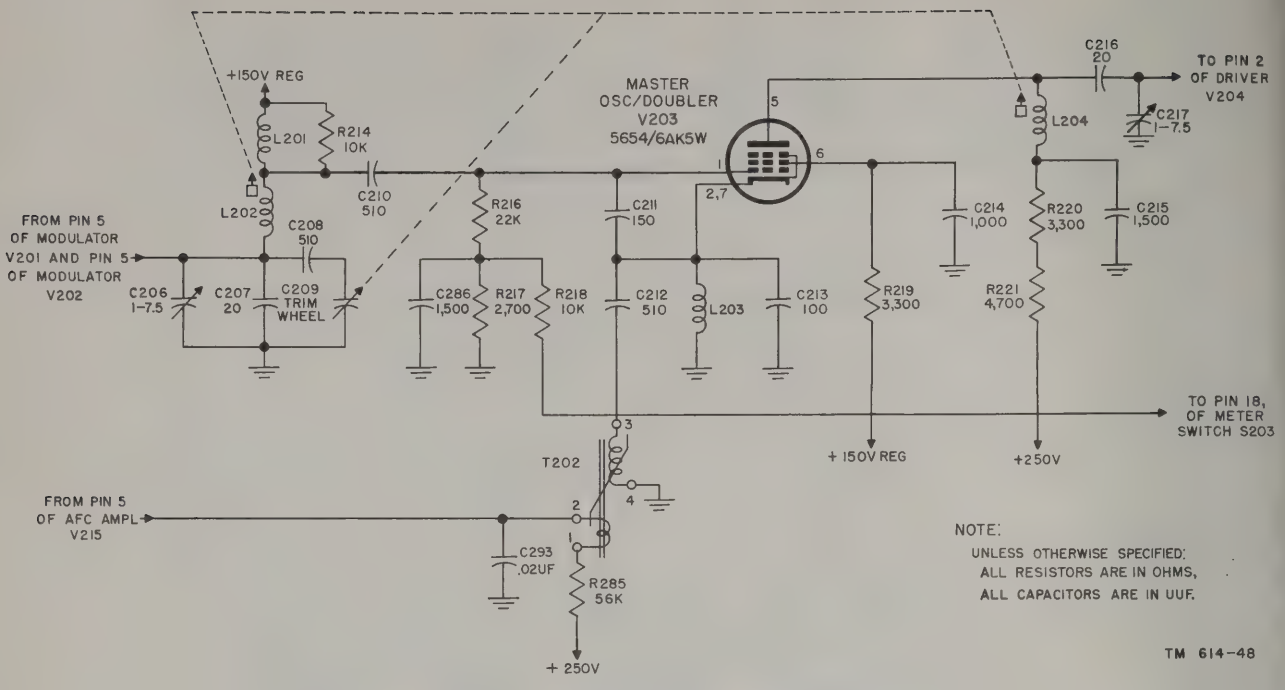


Figure 68. Master oscillator-doubler, schematic diagram.

meter. An isolating network (R218 and C286) couples the meter circuit to the control grid.

d. The plate circuit of V203 acts as a doubler, with L204 (including its distributed capacitance and the stray capacitance of the circuit) tuned to twice the frequency of the master oscillator. Coil L204 is tunable from 54.0 to 70.9 mc in 0.1-mc steps by means of the MC and 0.1 MC selectors. Plate voltage is supplied by a 250-volt source through R220 and R221. The r-f component is decoupled from the power supply by C215. Because oscillator stability is of prime importance, a regulated 150 volts is applied to the screen grid of V203 through R219; the screen grid is bypassed by C214. The signal is applied to the grid of driver V204, through capacitor C216.

134. Driver

(fig. 69)

a. Driver stage V204 amplifies the signal from the doubler to provide a sufficiently large excitation voltage for the power amplifier. The driver also acts as a buffer by isolating the master oscillator from the power amplifier. The output of the doubler circuit is coupled to the grid of the driver through C216. This capacitor and resistor R223 provide grid leak bias for the tube; during positive peaks of the input signal, the control grid draws current, thereby charging C216. The discharge of the capacitor through grid resistor R223 during negative peaks is sufficiently slow to maintain a voltage across the capacitor that is in series with the applied signal.

b. A plate tank circuit, consisting of L205 and its distributed capacity, is tuned to the carrier frequency 54.0 to 70.9 mc. The tuning of this circuit is controlled by the MC and 0.1 MC selectors on the front panel of the transmitter. The inductance of L205 is changed by varying the position of the core within the coil, resulting in a changed frequency. Replacing tubes, changing the position of leads when servicing, etc., may also cause the frequency of the tank circuit to change. Trimmer capacitors C221 and C217 are provided to compensate for any variations.

c. Plate voltage is applied to the driver through resistor R225 and L205. Capacitor C222 decouples the plate circuit from the power supply. Voltage from the 250-volt source is applied to the screen grid of V204 through resistor R224; the screen grid is bypassed by C289. Capacitor C219 neutralizes the effect of the plate-to-grid interelectrode capacity of V204, eliminating the possibility of self-oscillation within the stage.

d. An external test point is provided for measuring voltage at the grid of the driver. R222 and

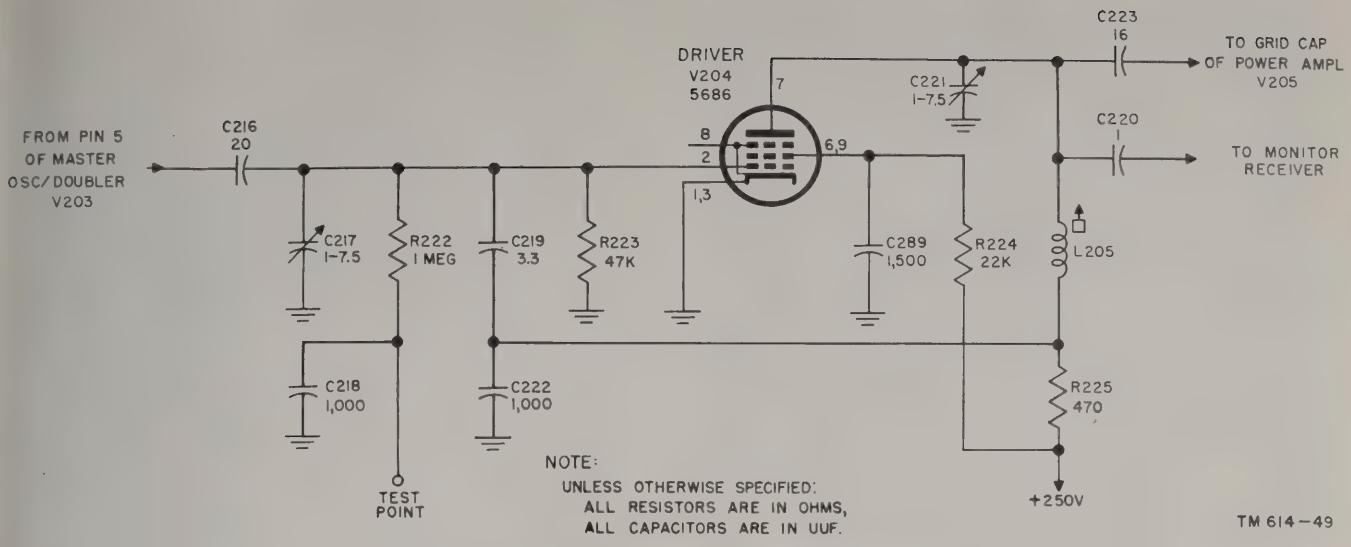


Figure 69. Driver, functional schematic diagram.

C218 act as an isolating network, preventing the meter from loading the grid circuit. The signal voltage developed across L205 is coupled to the power amplifier through C223. A portion of this output is also coupled by capacitor C220 to the first mixer of the monitor receiver.

135. Power Amplifier

a. Figure 70 is a functional schematic of power amplifier stage V205. The output tube, a type 4X150D, is capable of delivering up to 200 watts of power output. Because the transmitter is intended primarily for continuous operation, the power amplifier circuit is designed to deliver only 40 watts. This reduced rating insures less heat dissipation and thus longer life of the tube. The plate tank circuit of the tube consists of L206 and C227; the tuning of C227 is controlled by the differential gear mechanism. Trimmer capacitor C226 permits compensation for changes in distributed capacity resulting from tube changes, repositioning of leads, or other similar factors encountered in maintenance. The 550-volt power source is applied to the plate through R258 and L248 (an r-f choke). Capacitor C284 decouples the r-f component of the plate current from the power supply. A fixed bias of −20 volts is applied to resistor R227 from the power supply through pin 5 of chassis plug J204. This bias voltage is fed to the transmitter through pin C of POWER connector J203. In series with the fixed bias is a grid leak bias produced by coupling capacitor C223, PA GRID CONTROL resistor R226 and resistor R227. The combination of these two bias voltages prevents the tube from conducting except during positive peaks of the input signal. Should any

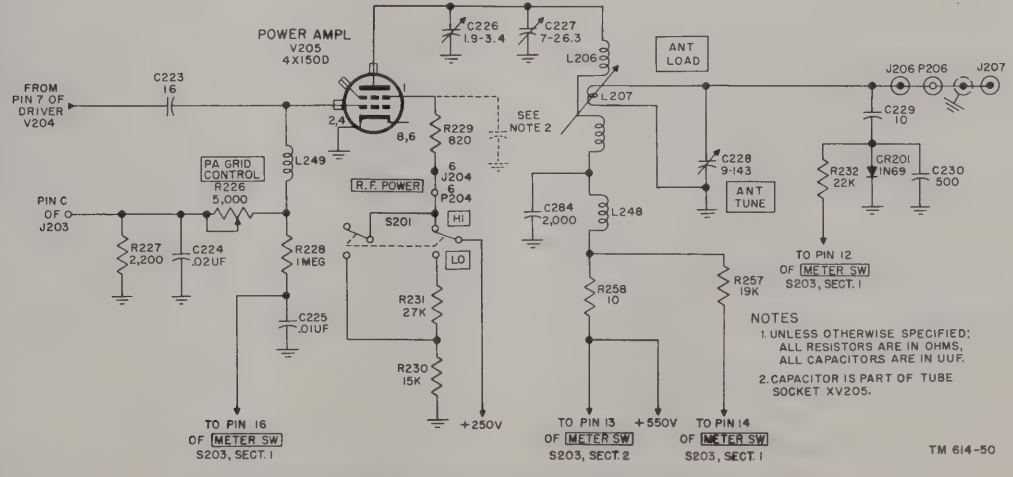


Figure 70. Power amplifier, schematic diagram.

of the preceding stages of the transmitter cease to function, the grid leak bias would be removed; however the fixed bias would prevent any damage to the tube caused by excessive conduction. Capacitor C224 and choke coil L249 decouple r-f from the control grid to the power source.

b. Coil L206 inductively couples the power amplifier output to antenna coil L207. The degree of coupling between these two coils is adjusted with the front panel control marked ANT LOAD. Antenna coil L207 and variable capacitor C228 form a resonant circuit, which can be tuned to the transmitter output frequency by a screw driver adjustment on the front panel marked ANT TUNE. The signal continues to the antenna through antenna jacks J206 and J207.

c. Radio Transmitter T–235/GRC–10. offers two values of power output. Either a full 40 watts or a reduced output of 10 watts is selected with the front panel switch marked R. F. POWER. When this switch is in the HI position, the screen grid of V205 is connected to 250 volts through resistor R229, pin 6 of chassis jack J204, pin 6 of chassis plug P204, and switch S201. When the switch is in the LO position, a voltage divider, consisting of R230 and R231, reduces the voltage supplied to the screen. It is used in the LO position when operating over a range of 15 miles or less. Bypassing of the screen grid circuit is done by a 2,750-$\mu\mu$f capacitor, incorporated as part of tube socket XV205.

d. The power amplifier and antenna circuit are connected to meter switch S203 at three points.

(1) The value of the r-f signal voltage applied to the control grid of V205 is measured when the METER SW is in the PA GRID position. A lower than normal reading indicates that the driver is not supplying sufficient excitation voltage to the power amplifier. Isolating resistor R228 and capacitor C225 decouple the meter from the control grid circuit.

(2) When the METER SW is in the PA PLATE position, the meter is connected across R258 and thus measures the plate current of the power amplifier tube. A zero reading generally indicates loss of plate voltage on V205. Resistor R257 limits the current flow through the meter.

(3) In the R. F. POWER position of the METER SW, a measure of the relative power transferred to the antenna is obtained. Capacitor C229 couples a portion of the output signal to the meter circuit. This voltage is rectified by a germanium crystal diode, CR201, and filtered by capacitor C230. The circuit continues through isolating resistor R232 to the meter circuit. This reading is not an absolute measure of the transmitted power, as changes in the standing wave ratio of the antenna will change the reading.

e. To prevent damage to the power amplifier because of excessive heat dissipation at the plate of the tube, forced-air cooling is provided. A blower housed within the transmitter chassis draws air in through a vent located on the front panel. The air is passed through the openings of the tube socket, around the plate, and finally expelled through another vent on the front panel. The plate of V205 consists of a metal sheet, providing a large conducting surface. This insures a rapid radiation of heat and enables the tube to operate at lower and safer temperatures. The blower motor operates from 115 volts a-c.

136. Monitor Receiver
(fig. 71)

The primary purpose of the monitor receiver is to stabilize the transmitter carrier frequency. Master oscillator V203 incorporates a modified Colpitts oscillator (par. 133). Because the equipment design considerations required true frequency modulation, a crystal-type master oscillator could not be used. The monitor receiver effects crystal control through afc of the master oscillator. A portion of the modulated carrier is coupled from the driver to first mixer V211A of the monitor re-

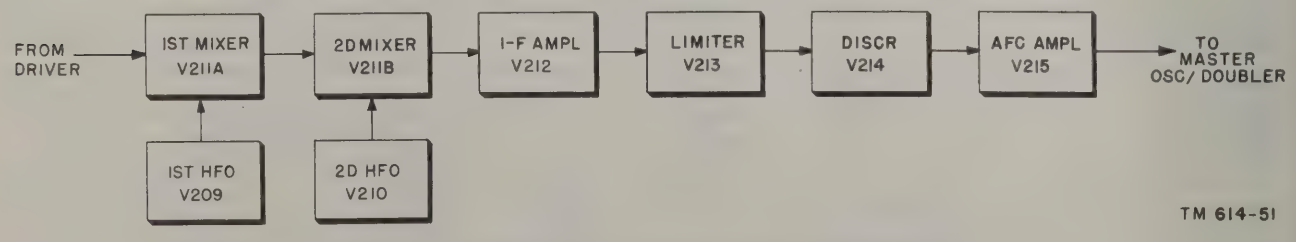


Figure 71. Transmitter monitor receiver, block diagram.

ceiver (fig. 71). Here the signal beats with the output of first high-frequency oscillator V209 and then is applied to second mixer V211B. The signal is mixed with the output of second high-frequency oscillator, V210. Both oscillators are crystal-type circuits. The original modulated carrier frequency signal has now been heterodyned down to the i-f of the monitor receiver, 3.2 mc, and is applied to i-f amplifier V212. The signal continues through limiter stage V213 to discriminator, V214. Any audio variations present at the grid of the afc amplifier will be filtered, leaving a d-c potential. If the transmitter carrier has not shifted from the center frequency, the d-c potential present will be zero. If a shift has occurred, a positive or negative voltage, depending on the direction of the shift, is applied to the grid of afc amplifier V215. The primary winding of a saturable reactor, T202, is connected in the plate circuit of V215 while the secondary parallels a portion of the master oscillator tank circuit. Any change in the plate current of V215 results in a change in the inductance of the secondary. Varying this inductance varies the frequency of the master oscillator.

a. First High-Frequency Oscillator (fig. 72). The first high-frequency oscillator is composed of both sections of V209 operating within a frequency range of 37.85 to 53.85 mc. Oscillator V209 is a modified tuned crystal oscillator using two sources of feedback to overcome an extra loss incurred because a low resistance is used across the crystal. Switch S204, section 1, selects any one of 17 slug-tuned coils consisting of L210 through L226 for the plate circuit of V209B. Capacitors C255 and C256 are across L255 and L256 respectively so that resonance may be obtained at the two lowest operating frequencies. Sections 2 and 3 of switch S204 select any one of 17 crystal and coil combinations of Y201 through Y217 and L227 through L243 for the grid circuit of V209B. Capacitor C260 has a negative temperature coefficient to compensate for changes in capacity of the tank circuit resulting from changes in temperature.

(1) The plate tank of V209B (a frequency resonator of opposite phase to the grid) is coupled through C257 to the high impedance grid of cathode follower control tube V209A. Part of the output voltage appears across its cathode resistor (R263) and is used as one source of feedback to maintain oscillations. Resistors R263 and R264 and capacitor C261 supply positive feedback to the cathode of V209B. At the grid (pin 2), which is near ground potential, the voltages appear across the crystal, and the other feed-back loop is completed through the grid-to-plate capacity of V209B.

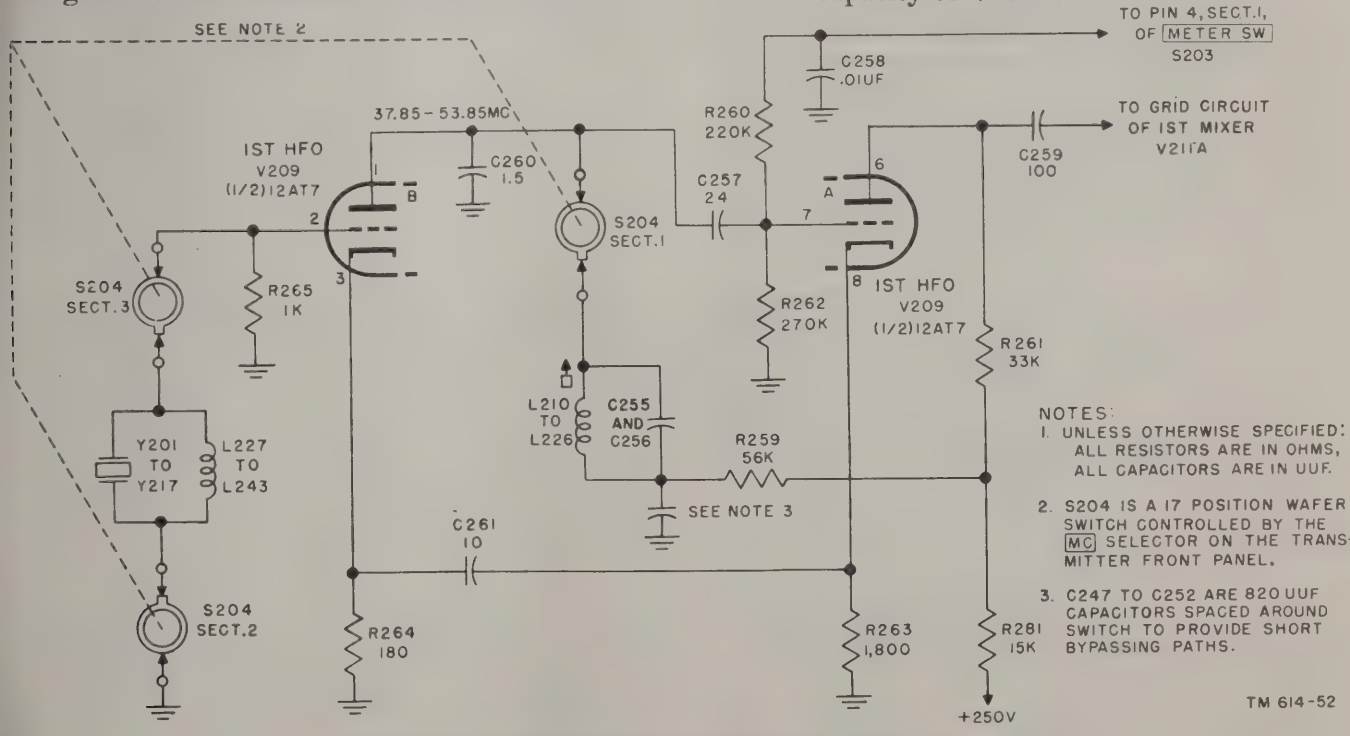


Figure 72. First high-frequency oscillator, monitor receiver

(2) Crystal neutralizing chokes L227 through L243 are of values that cause resonance with the switch S204 capacitance and the crystal holder capacitance. The resonant frequency is below the lowest frequency to which the plate tank circuit can be tuned with its slug. Grid resistor R265 parallels each choke to obtain smoother control of oscillation over the tuning adjustment range.

(3) Voltage from the 250-volt source is applied to the plate of V209B through R259 and the inductance of the plate tank circuit, and to the plate of V209A through R261 and R281. The voltage developed across grid resistor R262 is applied to the meter circuit. An isolating network, consisting of R260 and C258, couples the signal to pin 4, section 1, of METER SW S203. The output of the first high-frequency oscillator is coupled to the first mixer through C259 and C265 (fig. 73).

b. First Mixer (fig. 73)

(1) First mixer V211A combines the 37.85- to 53.85-mc signal from the first high-frequency oscillator with the 54.0- to 70.9-mc signal from the output of the driver and produces a new frequency which is applied to second mixer V211B. The two input signals are applied to the grid of V211A through C265. This capacitor, along with R268, provides grid leak bias for the stage. The plate tank circuit, consisting of L245 and C266, offers a maximum impedance to frequencies between 16.15 and 17.15 mc. When the sum and difference frequencies, produced by heterodyning the two input signals, appear at the plate of V211A, only signals within the frequency range of 16.15 and 17.05 mc will be coupled to the second mixer through C269.

(2) Voltage from the 250-volt source is applied to the plate of V211A through R269 and L245. The circuit is decoupled from the power source through C267.

c. Second High-frequency Oscillator and Second Mixer (fig. 74).

(1) Second high-frequency oscillator V210 is the equivalent of a crystal-controlled, grounded plate Colpitts oscillator. The initial frequency is determined by 1 of 10 crystals, Y218 through Y227, selected by S205. Excitation is provided by the voltage developed across capacitors C262 and C263. The output of the oscillator (12.95 to 13.85 mc) is developed across L244 and coupled to the second mixer through C264 and C268. The second high-frequency oscillator is a pentode connected as a triode, with the plate and screen externally tied together. The 250-volt source is applied to the plate and screen through R267. The r-f component is decoupled by capacitor C285. Resistor R266 provides grid leak bias.

(2) The upper half of figure 74 is a drawing of second mixer V211B of the monitor receiver. Performing the same function as the first mixer, the second mixer combines two signals, 12.95 to 13.85 mc and 16.15 to 17.05 mc, at the grid and provides

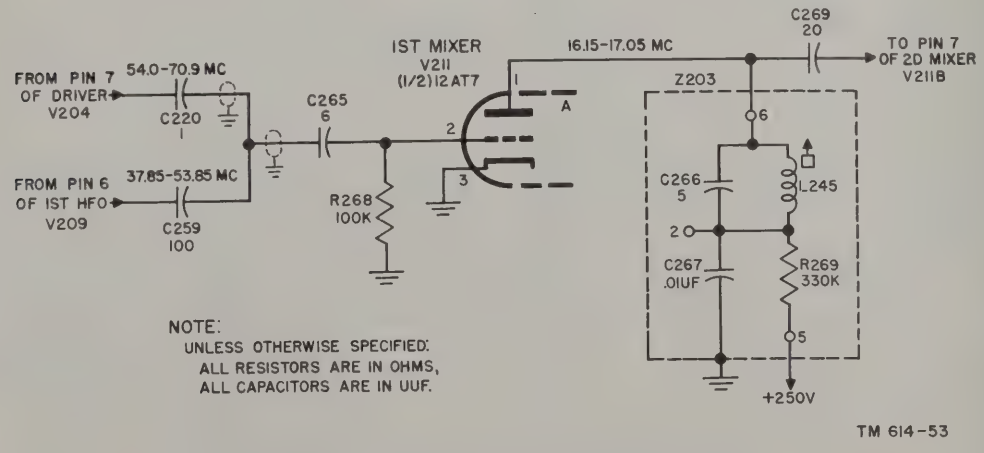


Figure 73. First mixer, monitor receiver.

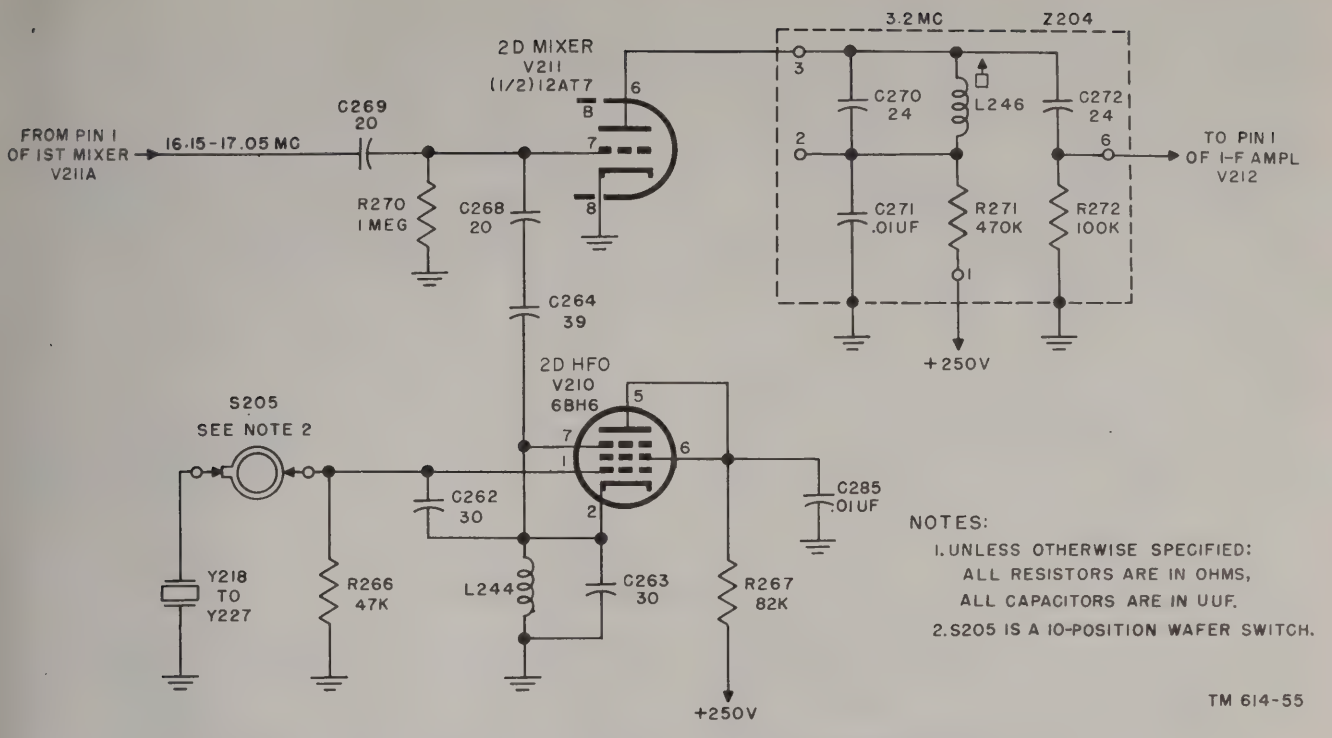


Figure 74. Second high-frequency oscillator and second mixer, monitor receiver.

sum and difference frequencies at the plate. Capacitor C269 couples the output of the first mixer to the grid of V211B; capacitors C264 and C268 couple the output of the second high-frequency oscillator to V211B. The three capacitors, with R270, provide grid leak bias for the stage. Four frequencies always appear at the plate of V211B: the sum, the difference, and the two original frequencies. The difference frequency will always be 3.2 mc (the i-f of the monitor receiver). The 3.2-mc frequency is selected and the others are rejected by the plate tank circuit consisting of L246 and C270. The power source of 250 volts is applied to the plate through R271 and L246. Capacitor C271 decouples the r-f component in the plate circuit from the power supply. The signal is coupled to i-f amplifier V212 through C272 and across R272.

d. I-f Amplifier (fig. 75). The 3.2-mc signal from the plate of V211B is applied to the grid of i-f amplifier V212. One stage of i-f amplification is used, since only a small signal is necessary to operate the afc amplifier and metering circuits.

(1) The 250-volt source is applied to the plate of V212 through R274 and L247 while C275 decouples the r-f component of the plate current from the power source. The plate tank circuit, consisting of C274 and L247, is tuned to 3.2 mc. Screen voltage is supplied through R273. Capacitor C273 is the screen grid bypass capacitor.

(2) I-f amplifier V212 uses grid leak bias supplied by C272 and R272. The output signal is fed to limiter stage V213 through coupling capacitor C276 and across R275.

e. Limiter (fig. 76). The limiter stage removes amplitude modulation from the input signal. This process cuts off (or limits) noises that amplitude-modulate the carrier frequency. Limiting of the positive portion of the input signal is provided by plate saturation, since the plate is operated at a low voltage. The negative portion of the signal is limited because a relatively small negative grid voltage is required to cut off the tube.

(1) A 3.2-mc signal is applied to the grid of V213. Amplified and limited through the tube, the signal continues to the plate tank circuit consisting of C278 and the primary of T204, also tuned to 3.2 mc.

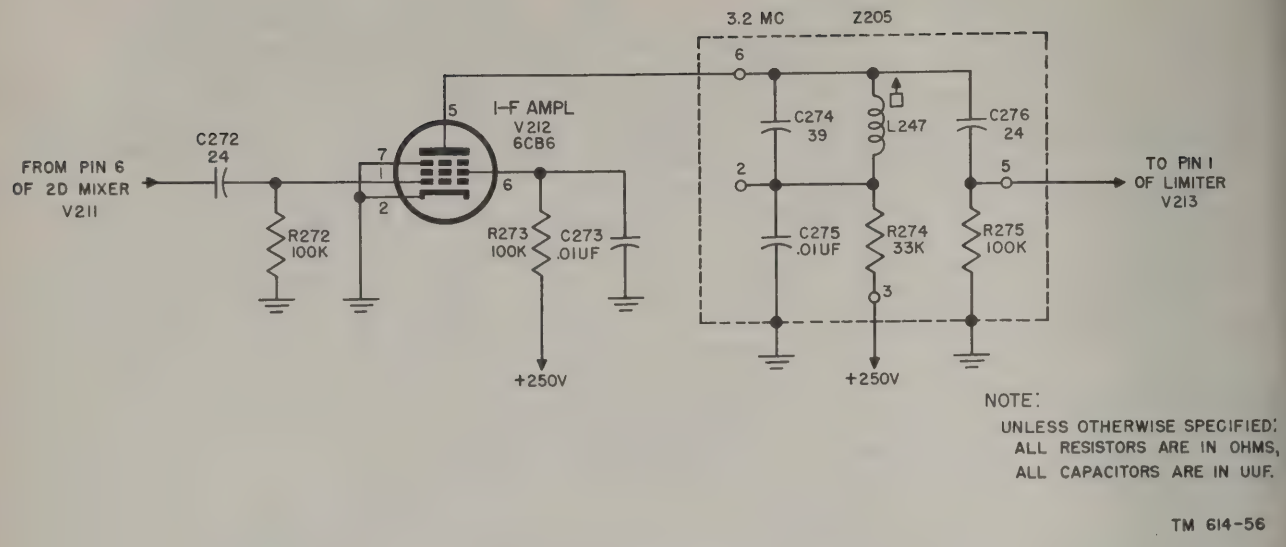


Figure 75. I-f amplifier, monitor receiver.

(2) A 150-volt regulated power source supplies the plate voltage of V213 through R276 and the primary of T204. Capacitor C291 is the decoupling capacitor. The same regulated power source supplies the screen voltage through R282; the r-f component is bypassed by C277. Grid leak bias is supplied by C276 and R275.

f. Discriminator (fig. 76). The discriminator consists of transformer T204, two diode rectifiers V214A and V214B, and associated resistors and capacitors. It converts the f-m output of the limiter to audio-frequency voltages. The f-m signal from the limiter has a center frequency of 3.2 mc and varies above and below this frequency at the rate of the audio signal by which it is modulated. In addition, because the carrier frequency has a tendency to drift, the discriminator stage acts to change this shift in frequency into a positive or negative d-c voltage, depending on the direction in which the carrier has drifted from the center frequency.

(1) The output of limiter V213 is applied to the discriminator at two points. One is by direct connection from the plate of V213 to the junction of C280 and C281. The other is by inductive coupling from the primary of T204 to the secondary. The voltages (E_1) applied to the two rectifiers, V214A and V214B, through C280 and C281 are equal to each other and are in phase with the signal at the plate of V213.

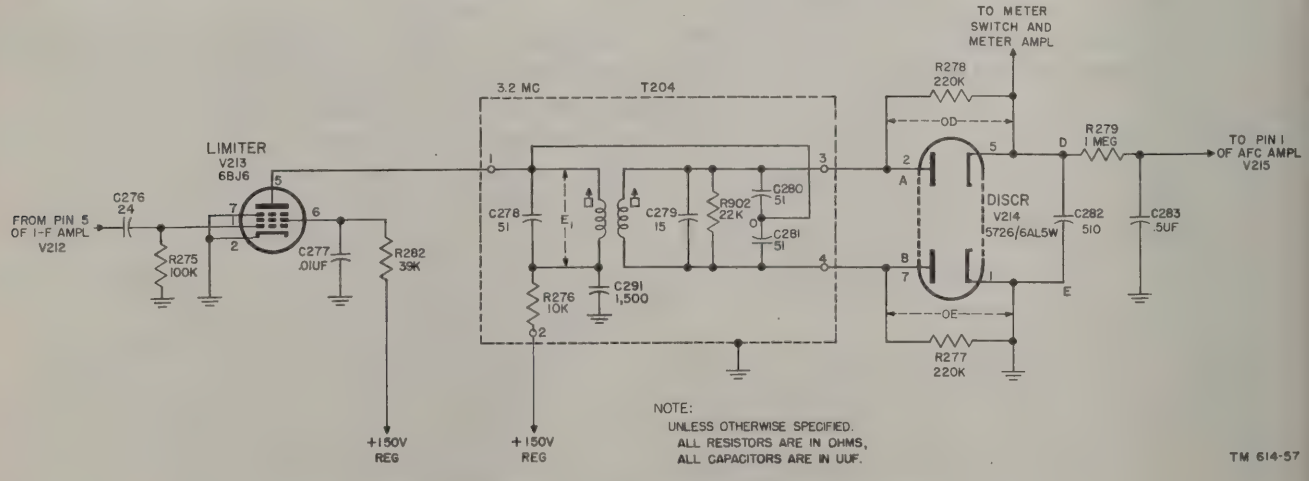


Figure 76. Limiter and discriminator, monitor receiver.

(2) Because the primary and secondary of T204 are tuned to 3.2 mc, the impedance of the circuit at that frequency is resistive. No reactive component is imparted to the signal voltage by the capacitors and inductance of T204. The voltages OB and OC (A, fig. 77) are inductively applied, 180° out of phase with each other, to rectifiers V214A and V214B. However, each is 90° out of phase with the voltage applied to the junction of C280 and C281, indicated as OE_1. At resonance, the resultant voltages, OD and OE, appearing across rectifier load resistors R278 and R277 are equal in magnitude and opposite in polarity. The net voltage appearing at the output of the discriminator is zero.

(3) When the carrier deviates from the center frequency, the tuned circuits of T204 are no longer resistive and impart a reactive component to the voltage applied to the rectifiers. The component of voltage OE_1 applied to the rectifiers by direct connection remains unchanged with respect to the voltage at the plate of V213. The 90° phase relationship between the two components of voltage OB to OE_1 and OC to OE_1 no longer holds. The amount of change in phase at the two rectifiers is the same but in opposite directions. The resultant voltages OD and OE applied across the rectifiers are no longer equal and opposite in polarity. A net voltage (other than zero) is therefore developed at D, figure 76. For frequencies above resonance, the tuned circuits show an inductive reactance, and the inductively coupled component of voltage is shifted in phase in the leading direction. The larger resultant voltage, OD, is then applied to V214A, the output voltage across R278 is larger than that across R277, and the net output voltage at the discriminator is positive at D (B, fig. 77). For frequencies below resonance, the tuned circuits show a capacitive reactance, the inductively coupled voltage is shifted in phase in the lagging direction, and resultant voltage OE is applied across V214B (C, fig. 77). The rectified voltage across R277 is larger than that across R278, and the net voltage at D is negative. A typical response curve of the discriminator is shown in D, figure 77.

(4) Since the frequency shift above and below the resonant frequency for a modulated signal occurs at the audio frequency rate, the changes in voltage across rectifier load resistors R277 and R278 occur at the same rate. A portion of the resultant alternating voltage developed across

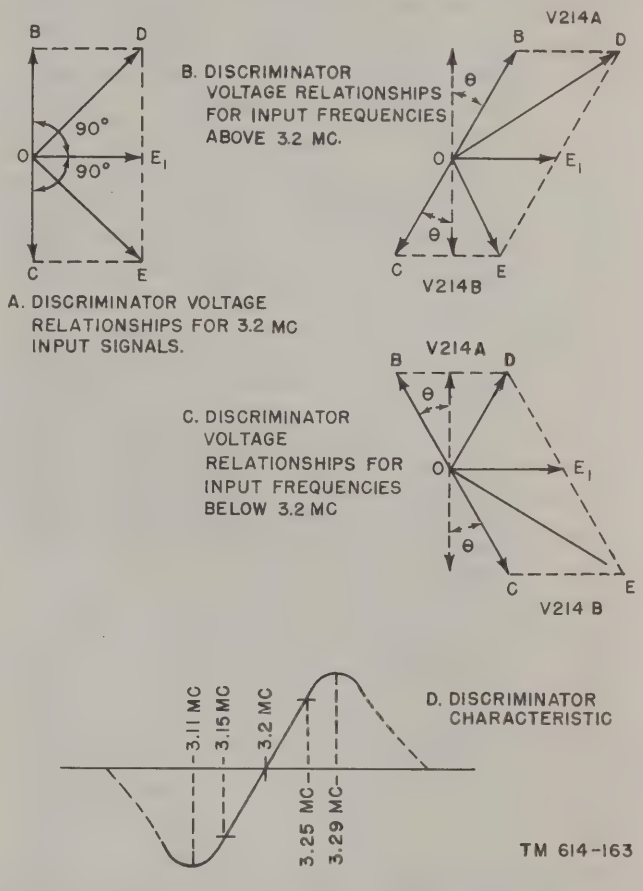


Figure 77. Vector diagrams of monitor receiver discriminator.

load capacitor C282 is delivered to the metering stage and represents the audio frequencies originally applied at the transmitter modulator stage. The audio frequencies, undesirable at the afc stage, are filtered by the network composed of R279 and C283.

(5) An important point to be noted about the discriminator is that, for proper operation, the circuit must be balanced for both signal voltages and d-c currents. Signal balance is obtained by adjusting the inductances of the coils in the tuned circuits to be exactly equal to each other.

Similarly, capacitors C280 and C281 are equal to each other. D-c balance is obtained by making the two load resistors, R277 and H278, equal. For a properly adjusted and operating discriminator circuit, the front panel meter should read zero in the AFC+ and AFC− positions when a 3.2-mc signal of 2 volts is applied to the grid of V213. Normally, when one of the fixed components of the discriminator, such as capacitor C280 or C281 or resistor R277 or R278, becomes defective, balance in the discriminator is lost. Unbalance which is not caused by a defective component may be restored by adjusting the powdered iron cores of discriminator transformer T204. Resistor R209 lowers the Q of the secondary of T204, providing flat frequency response.

(6) When the i-f signal is below the center frequency, the voltage at V214B exceeds that at V214A and the voltage across R277 exceeds that across R278. This causes the d-c output of the discriminator to appear negative. The amount of d-c voltage depends upon the amount of shift off frequency.

(7) When the i-f signal applied to the discriminator is above the center frequency, the voltage at V214A exceeds that at V214B and the d-c output across R278 exceeds that across R277. This causes the d-c output to appear positive. The amount of d-c voltage depends on the amount of shift off frequency.

(8) Since the frequency of the i-f signal varies at an audio rate, the d-c output of the discriminator varies at the same rate. In normal f-m receivers, the audio from the discriminator stage is amplified and fed to a loudspeaker. In the monitor receiver, however, the audio is filtered out; the remaining d-c voltage is used to operate an afc circuit. If the transmitter carrier is on frequency, the d-c from the discriminator will be zero; if below frequency, the d-c will be negative; if above frequency, the d-c will be positive. This voltage is applied directly to the grid of afc amplifier V215. The METER SW is connected to the discriminator circuit to permit the meter to indicate a positive or negative d-c output. In addition, the meter will indicate the amplitude of the audio output, which is relative to the audio input to the modulator stage. The meter reading of the audio output is used in setting the LINE LEVEL control.

g. Afc Amplifier and Saturable Reactor (fig. 78). Afc amplifier V215 controls the frequency of the master oscillator. When the transmitter carrier has shifted from the desired operating frequency, it becomes necessary to return the carrier to center frequency. The plate current of the afc amplifier, through the saturable reactor, changes the master oscillator frequency equal to the amount it has shifted, effectively stabilizing the transmitter frequency at all times. If, however, a frequency-controlling component of the master oscillator becomes defective and causes a frequency shift of more than 150 kc, the afc will be unable to return the transmitter to the correct frequency.

(1) The filtered audio output of the monitor receiver is applied to the grid of V215. If the transmitter carrier is at center frequency, the d-c potential at the grid of V215 will be the bias developed by R283. This bias remains constant, resulting in a constant current flow in the plate circuit. If the transmitter carrier shifts above the center frenquency, the bias of V215 will become less negative, causing more current to flow through the plate circuit. If the carrier shifts below center frequency, the bias will become more negative, causing less current to flow in the plate circuit. The 250-volt source is supplied to the plate through R285 and the primary of T202 (saturable reactor).

(2) The primary of the saturable reactor is wound on one leg of a rectangular ferrite core. The secondary is wound on the other leg. The magnitude of current flowing through the primary determines the amount of saturation of the core. Changing the plate current in the primary varies the saturation of the core, which in turn changes the inductance of the secondary winding. If the current flowing through the primary remains constant, there is no change in core saturation and consequently the inductance of the secondary remains constant. Capacitor C293 bypasses any audio-frequency

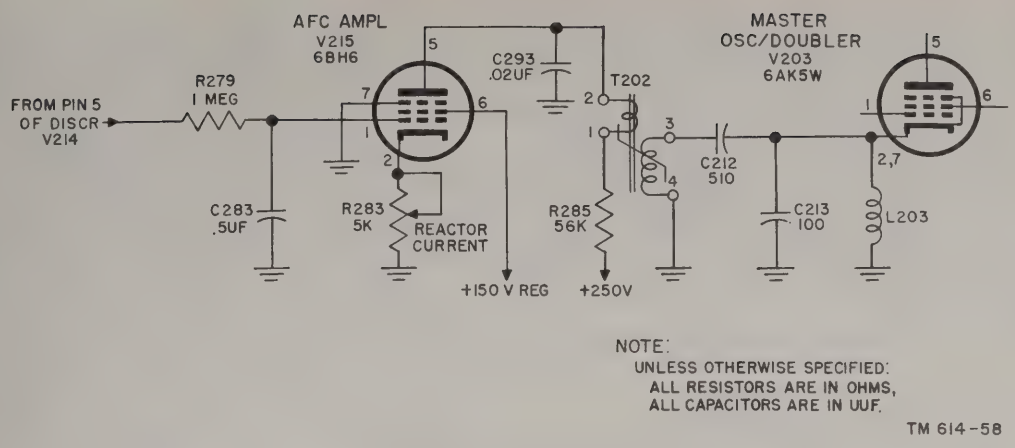


Figure 78. Afc amplifier and saturable reactor, monitor receiver.

ripple present at the plate circuit of V215. In series with the saturable reactor secondary, is C212. This series circuit parallels C213 which is part of the master oscillator tank circuit. The total series-parallel arrangement appears as one capacitance in the tank circuit. Changing the value of this capacitance will change the operating frequency of the oscillator.

(3) Summarizing the sequence of events that takes place when the master oscillator drifts off frequency, the afc action is as follows: Assuming first that the oscillator drifts above its required frequency, the discriminator secondary acts as an inductance. This helps the discriminator tube to develop a positive potential in its output circuit. The positive voltage is applied to the control grid of the afc tube, increasing plate current through the saturable reactor to reduce its inductance. This in turn reduces the inductance in the secondary which is in one leg of the master oscillator tank circuit. Less inductance in series with the capacitance of C212 makes this leg more capacitive and thus lowers the frequency back to normal. The reverse action will take place if the oscillator drifts below resonance.

137. Modulator

(fig. 79)

a. The carrier frequency of Radio Transmitter T–235/GRC–10 is developed in the master oscillator-doubler stage. To effect the transmission of audio intelligence, modulation of this carrier is necessary. When not modulated, the carrier is at the center frequency. The modulator stage shifts the carrier above and below the center frequency in proportion to the amplitude of the modulating signal. Figure 79 shows a portion of the master oscillator tank circuit where the initial frequency is developed. Note that the output of the modulator is connected to the junction of L202 and C206. The inductance of L202 is one of the frequency-determining factors of the tank circuit. Paralleling L202 with additional inductance or capacitance will change the frequency of the tank. The reactive current that flows in the plate circuit of the modulator results in an inductive reactance that varies in accordance with the audio signal applied to the grid circuit.

b. The two modulator tubes, V201 and V202, are operated in parallel to provide a high degree of efficiency. The cathode bias network for both tubes is made up of R213, R294, C203, and C204. Variable resistor R294, the modulator bias control, provides the correct bias for minimum distortion. Because of variations in tube characteristics, this control must be readjusted when the modulator tubes are replaced. (For readjustment procedure, see paragraph 121*a*.) The wide-band audio and microphone inputs are fed to the grids through isolating resistor R210.

c. A portion of the r-f carrier, developed in the tank circuit of the master oscillator, is applied between the plates and the grids of V201 and V202 through an RC network consisting of R212 and C202. The input capacity of V201 and V202 is in series with this network and the master oscillator tank. The resistance of R212 is large compared to the reactance of the input capacity of the tubes, so that the r-f current through the series

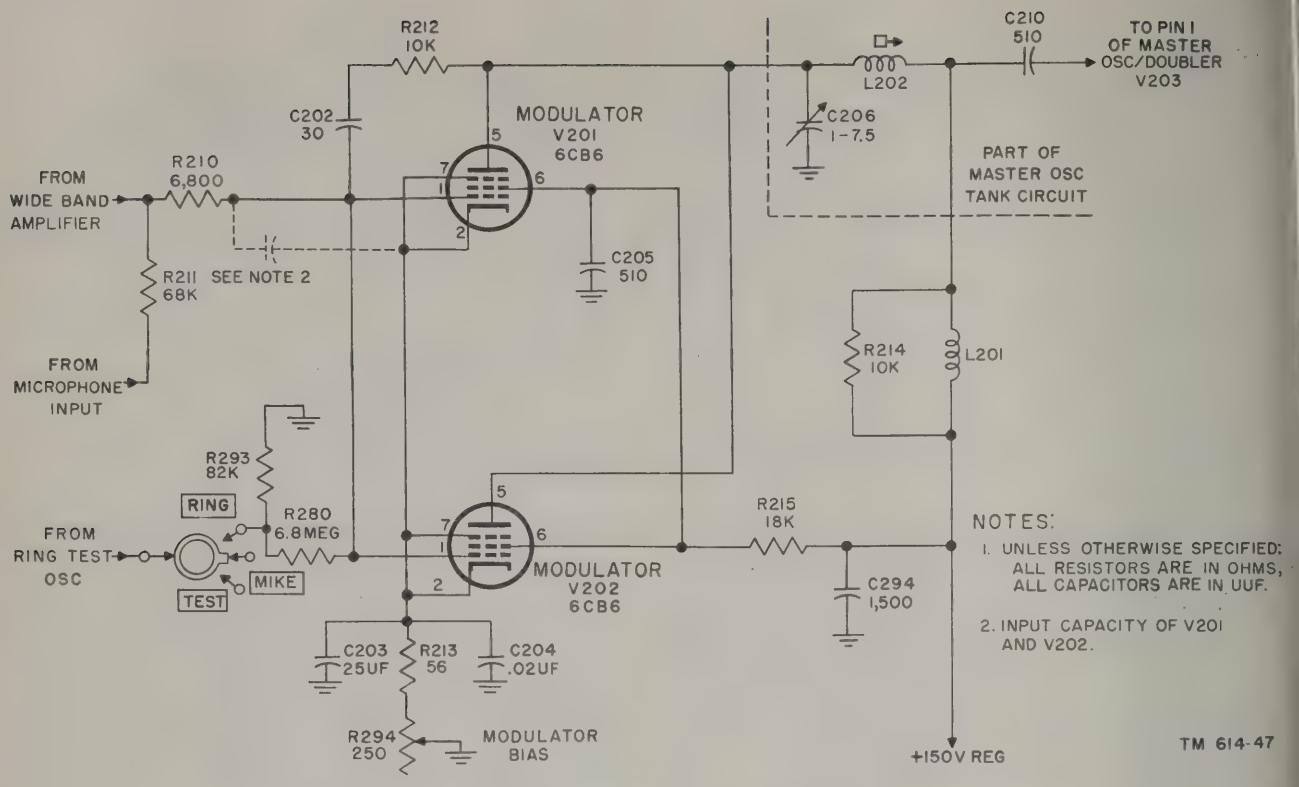


Figure 79. Modulator, schematic diagram.

circuit will be practically in phase with the voltage appearing at the tank circuit. However, the voltage across the tube input capacity will lag the current by 90°. The current in the plate circuit of V201 and V202 is in phase with the grid voltage and consequently is 90° behind the current through the input capacity, or 90° behind the voltage of the r-f tank. The lagging plate current passes through L202, giving the same effect as an additional inductance added in parallel with L202. The reactive current through L202 varies in accordance with the grid voltage of V201 and V202; therefore, the master oscillator frequency changes in proportion to the applied audio signal.

d. The d-c plate voltage is blocked from the grids of V201 and V202 by capacitor C202. Voltage from a 150-volt regulated power source supplies screen voltage through R215 while C205 provides a short bypassing path at the screen grid of each tube. The d-c for the plates is supplied through r-f choke L201 and coil L202 in the master oscillator tank circuit. Capacitor C294 decouples the modulator stage from the power source.

138. Audio Circuits

Three separate sources of audio feed the modulator tubes of the transmitter, the wide-band input, the microphone input, and the test ring oscillator (audio note) input. During TERMINAL operation, it is necessary to couple these audio signals not only to the transmitter modulator but also to the receiver audio circuits. In TERMINAL operation, the audio is fed through the receiver to the associated telephone terminal equipment.

a. Wide-Band Amplifier (fig. 80). The wide-band audio input is applied to pins J and F of transmitter CONTROL jack J202. In TERMINAL operation, the input is from the telephone terminal equipment through a 600-ohm line. For retransmission (RELAY operation), the wide-band audio output of the associated receiver is connected directly to the wide-band input of the transmitter. The signal continues to the LINE LEVEL control through sections 4 and 5 of TEST-MIKE-RING switch S202. The LINE LEVEL control is an H-pad attenuator consisting of a network of resistors, R201, R202, R203, R205, and R206, designed to maintain a constant 600-ohm input and output impedance for any setting of the control. Resistors R288 and R289 provide impedance matching to the output of the LINE LEVEL control. The signal continues to the control grid of wide-band amplifier V216

through capacitor C201. Resistor R208, connected from the control grid of V216 to the junction of R207 and R290, provides a high input impedance to the wide-band audio signals.

(1) The 250-volt source is applied to the plate through resistors R204 and R292. Capacitor C297 decouples the power source from the plate circuit. A regulated 150 volts supplies the screen voltage through R291. The audio component is decoupled by C299. The output of the wide-band amplifier is coupled through C295 to the junction of R209 and R210. This isolating network prevents the wide-band amplifier circuit and the microphone circuit from loading the modulator stage.

(2) To complete order wire communication, a portion of the wide-band signal from the LINE LEVEL control is fed to the receiver narrow-band audio circuits.

b. Pre-emphasis. Deviation in the f-m transmitter is the same for a given amplitude regardless of the frequency of the modulating signal. Certain amounts of noise and distortion are superimposed on the carrier upon radiation of the signal. The distortion increases more on the high end of the audio-frequency band to give a low signal-to-noise ratio. To overcome this loss, the high frequencies at the transmitter are made stronger; this process is called pre-emphasis. The reverse process is then performed by the receiver to return the amplitude of the high frequencies to their original value; this process is called de-emphasis. The combination of pre-emphasis and de-emphasis provides a more uniform signal-to-noise ratio throughout the audio-frequency range. Although the wide-band amplifier provides a gain in signal voltage, its primary purpose is to provide pre-emphasis of the wide-band audio-frequency input. There are three reasons why R208 is connected to the junction of R207 and R290, as follows:

(1) Because bias is the d-c voltage between the control grid and cathode. R208 is returned to R207 and R290 for the correct bias level. If R208 were returned to ground, the bias developed would almost cut off the tube and cause distortion of the audio signal. Resistor R207 produces the correct amount of voltage and, because R208 is returned to the negative end of R207, the voltage between the control grid and cathode is the proper bias level for distortionless amplification.

(2) The input voltage is less on the low frequencies than on the high frequencies because of the arrangement of resistors R208, R207, R290, and capacitor C298. The input signal voltage is divided across R208 and R290 on the low frequencies; the reactance of capacitor C298 is much greater than that of R208 and R290 com-

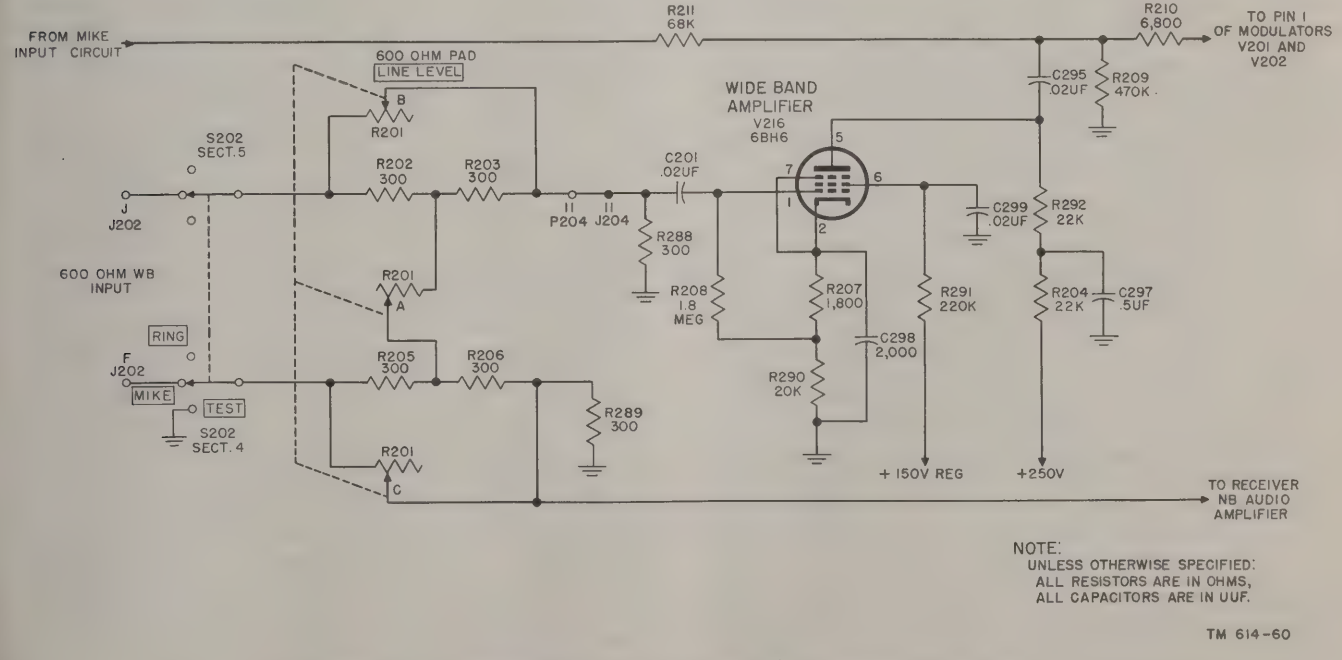


Figure 80. Transmitter wide-band amplifier, schematic diagram.

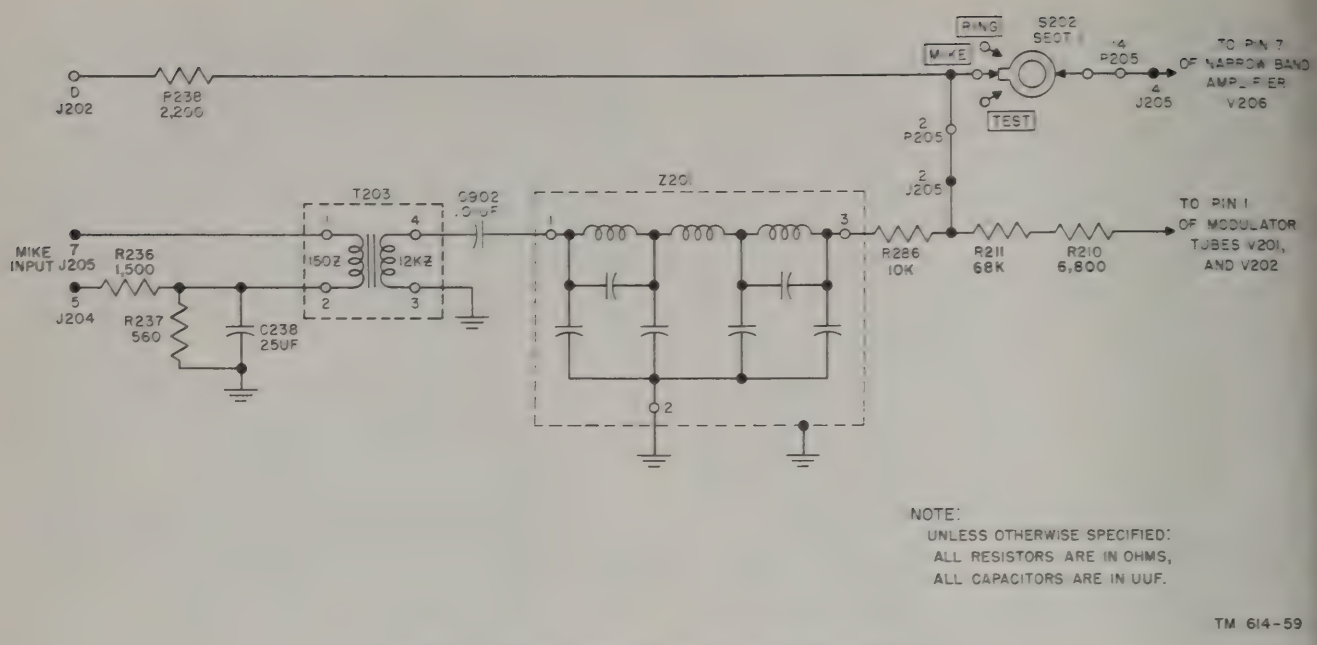


Figure 81. Microphone input, schematic diagram.

bined in series. At the high frequencies, the signal is across R208 and R207 because the reactance of C298 now is very small and can be neglected. Thus the input voltage of the high frequencies is greater than that of the low frequency because the high frequencies are not divided.

(3) Degeneration takes place across R207 on the low frequencies, because the variations in cathode current are in opposite polarity to the signal polarity across input resistor R208. The sum of the voltages lowers the effective input signal voltage. On the high frequencies, C298 has a very low impedance because the reactance of a capacitor decreases as the frequency increases; therefore, no signal voltage is developed across R207 to cause degeneration. Thus, decreasing the degeneration at the high frequencies gives a greater output voltage at these frequencies.

(4) The pre-emphasis circuit causes differences in deviation of the transmitter signal in the range of ±8 kc at 1,000 cycles to ±40 kc at 20,000 cycles.

c. Microphone Input (fig. 81). The microphone input to the modulators is obtained from a handset connected to the front panel of the control unit or to the front panel of the transmitter. A voltage divider, consisting of R236 and R237, supplies a negative 2-volt excitation voltage for the microphone of the handset. This voltage is applied from the power supply when the push-to-talk button is pressed. Capacitor C238 bypasses the divider for audio frequencies. The primary impedance of T203 matches the impedance of the handset, and the secondary matches the impedance of audio filter Z201. The signal from the secondary of the transformer is coupled through C902 to the audio filter where any audio signals above 3,500 cps are filtered. This is necessary to maintain the audio signal within the frequency limits of the order wire channel (250 to 3,500 cps). From Z201, the signal is fed to the grid circuits of the modulator tubes through isolating resistors R210, R211, and R286. The signal is also fed to pin 7 of narrow-band amplifier V206 through pins 2 of J205 and P205, section 1 of switch S202, and through pins 14 of P205 and J205. The wide-band audio input is preset by the LINE LEVEL control and the ring test oscillator. Since the microphone audio is fed directly to the modulator stage, resistor R238 is connected in series with R286 across the output of Z201 to prevent overmodulation. One end of the resistor is connected to the junction of R286 and R211 and the other to pin D of CONTROL jack J202. At the control unit, the

TYPE OF OPERATION switch grounds the resistor for TERMINAL or RELAY operation, attenuating the audio voltage to the desired amount. In PUSH-TO-TALK operation, the microphone modulates the transmitter a full 40 kc.

d. Narrow-Band Amplifier and Ring Test Oscillator (fig. 82). One half of V206 provides one stage of amplification for audio signals that are coupled to the receiver while the other half is used as the ring test oscillator. Inputs to the narrow-band amplifier are from the handset connected to the transmitter or control unit AUDIO plug, or from the output of ring test oscillator V206B. Section 1 of a five-section wafer switch (S202) selects an input in two positions and disables the amplifier in a third.

(1) With switch S202 in the MIKE position, the audio from the handset is coupled through section 1 of the switch to the grid of V206A. The amplified signal continues through R243 and C239 to pins 9 of J205 and P205 and ultimately to the receiver audio circuits.

(2) With switch S202 in the RING position, a 1,600-cycle audio note, generated by ring test oscillator V206B, is applied to the grid of V206A. Three capacitors and an inductor (housed within Z202) in conjunction with resistors R284, R295, and V206B make up the basic audio oscillator. The signal at the junction of R284 and R295 (in the grid circuit of ring test oscillator V206B) is applied to the narrow-band audio amplifier through R245. The audio note is also fed across R293 to the control grids of modulator tubes V201 and V202 through section 3 of S202 and R280.

(3) With switch S202 in the TEST position, the narrow-band amplifier is disabled by

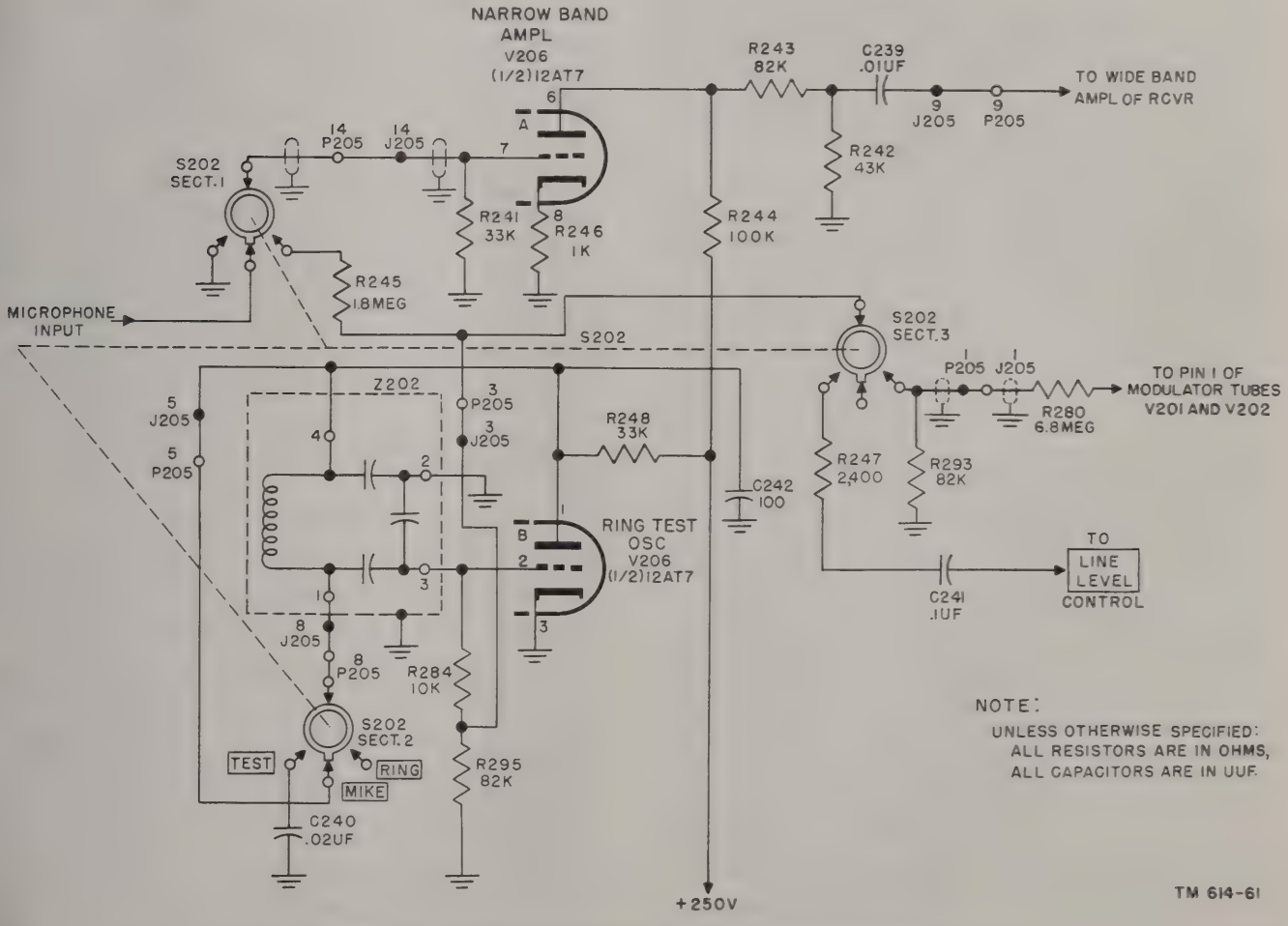


Figure 82. Ring test oscillator and narrow-band amplifier.

grounding the grid at section 1. Capacitor C240 is switched into the audio oscillator circuit at section 2, changing the frequency to 1,000 cycles. The audio note is fed through section 3 of S202, R247, and C241 from the grid circuit of V206B to the LINE LEVEL control. This signal is used for adjusting the control for the proper level of audio input to the modulator stage.

(4) When S202 is returned to the MIKE position, the ring test oscillator is disabled by shorting out the coil of Z202 at section 2.

139. Meter Circuits

(fig. 83)

The meter circuit enables the operator to check the performance of various circuits within the transmitter and to adjust the LINE LEVEL control for the proper amount of input signal to the modulators. In addition, it serves as an aid in localizing troubles to sections or stages of the transmitter during erratic operation. The complete circuit, consisting of meter amplifier V207A, meter rectifier V207B, two-deck, eight-position switch S203, and front panel meter M201, provides the following functions:

a. With S202 in the TEST position, a 1,000-cycle note is fed through the LINE LEVEL control to the transmitter circuit. A portion of the carrier, modulated by the audio note, is coupled from the plate of the driver stage to the input of the monitor receiver. Discriminator tube V214 demodulates the carrier, and the original 1,000-cycle audio note is fed to the grid of V207A through R255 and C244 (fig. 83). Plate voltage of 250-volts is applied to the plate of V207A through plate load resistor R251. Capacitor C243 couples the amplified signal to the cathode of meter rectifier V207B. With the plate and grid of V207B externally tied together, the tube operates as a diode rectifier. The rectified output returns to ground through switch S203 and ammeter M201 when S203 is in the LINE LEVEL position. With the TEST-MIKE-RING switch in the TEST position, the LINE LEVEL control is adjusted to obtain a 0-db reading on the panel meter. Potentiometer R250, a screwdriver adjustment, compensates for the contact potential of meter rectifier V207B. METER ADJUST resistor R253 allows adjustment of the current through the meter. Resistor R287 limits the current through the control. The panel meter has two scales. One scale measures voltage and current and the other indicates magnitude in terms of decibels. A full scale deflection occurs when a current of 100 ua is passed through the meter. The usable db range is from −9 db to +3 db.

b. With the METER SW in the XTAL OSC position, pin 4 of S203, section 1, is connected to the grid (pin 7) of the first high-frequency oscillator in the monitor receiver. A resistor and capacitor isolating network, R 260 and C258, prevents the meter circuit from affecting the operation of the oscillator (fig. 72).

c. During normal operation of the transmitter, the meter will read zero in either the AFC+ or AFC− position. However, should a component in the transmitter become defective and cause the center frequency of the carrier to shift more than 150 kc above or below the desired operating frequency, a reading will be observed. The signal from the discriminator is coupled through R255 to the junction of R254 and C245 where any r-f components are bypassed by C245. Paragraph 136*f* describes how a positive or negative voltage appears at the output of the discriminator when the center frequency of the carrier has shifted off frequency. When the transmitter is operating on frequency, the resultant d-c potential across R254 is zero, consequently a zero reading is shown on the meter with S203 in either the AFC+ or AFC− positions. When a carrier shift occurs, a reading is obtained which is proportional to the shift.

d. With METER SW S203 in the R. F. POWER position, a relative indication of the power radiated by the antenna is obtained. The meter reading is not an absolute measure of transmitted power, because changes in the standing wave ratio of the antenna will change the reading. A filter network, R232 and C230 (fig. 70), couples a rectified portion of the signal from the antenna to pin 12, section 1, of METER SW S203.

e. With the METER SW in the PA PLATE position, the meter and R257 parallel R258, a 10-ohm resistor in the power amplifier plate circuit (fig. 70). The resistance of R257 is large as com-

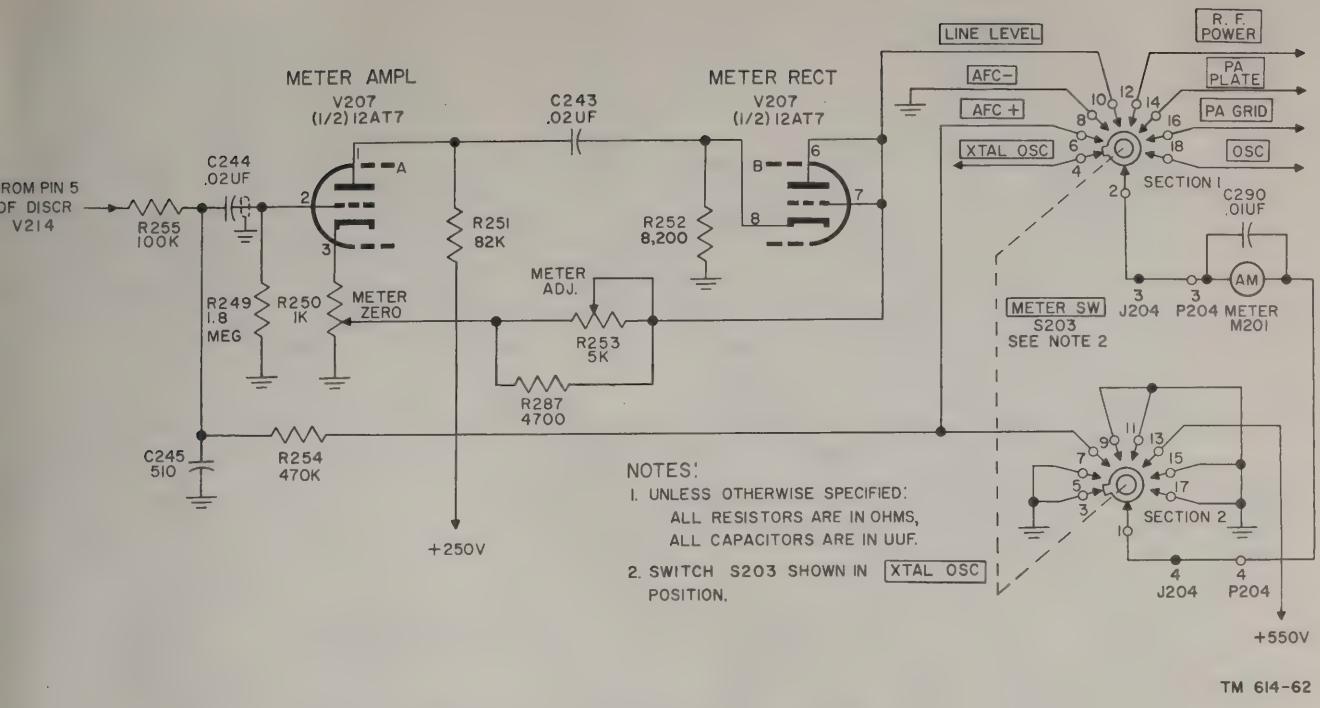


Figure 83. Transmitter metering circuit.

pared to 10 ohms, resulting in only a small portion of current flow through the meter. Assuming a full scale deflection of 200 milliamperes, the meter reads 150 milliamperes during normal operation.

f. With the METER SW in the PA GRID position, pin 16 of S203 connects to the power amplifier grid through an RC isolating network composed of R228 and C225 (fig. 70). A meter reading between 50 and 95 volts is obtained when the driver applies excitation voltage to the power amplifier.

g. With the METER SW in the OSC position, a reading of 1.5 volts indicates satisfactory operation of the master oscillator. An isolating network composed of R218, and C286 (fig. 68) couples a portion of the grid leak bias voltage to pin 18 of switch S203, section 1.

140. Filament Circuits
(fig. 84)

A 26-volt a-c or d-c voltage (depending on the power source) is applied to the transmitter at pin H of POWER connector J203. The unit incorporates 6-, 12-, and 26-volt filament tubes in a series-parallel arrangement. All dual filament 12-volt tubes are wired with the filament of one half paralleling the filament of the other half. Wired in this manner, each tube requires 6 volts for operation. There are four parallel branches making up the filament supply.

a. The first parallel branch of the filament circuit contains V206, V209, V204, and V203 in series, requiring a total voltage of 24 volts. Resistor R234 parallels the filaments of V206 and V209 in series, limiting the current through the filaments. Capacitors C231, C232, C287, and C288 bypass and r-f voltage present in the circuit. Resistor R233 parallels the filament of V203, limiting the current through the filament.

b. The filaments of V211, V212, V214, and V213 paralleled by V215 make up the second 24-volt series branch. Capacitors C233, C234, and C235 bypass r-f voltages to ground. R-f chokes L208 and L209, located in the monitor receiver subchassis, suppress r-f induced in the long filament wires leading to and from the monitor receiver.

c. The third branch of the filament circuit consists of V210 and V216 in parallel, connected in series with V207, V202, and V201. R-f voltages are bypassed by C236 and C237.

d. Power amplifier tube V205 has a 26-volt filament and represents the fourth and final branch of the series-parallel filament circuit.

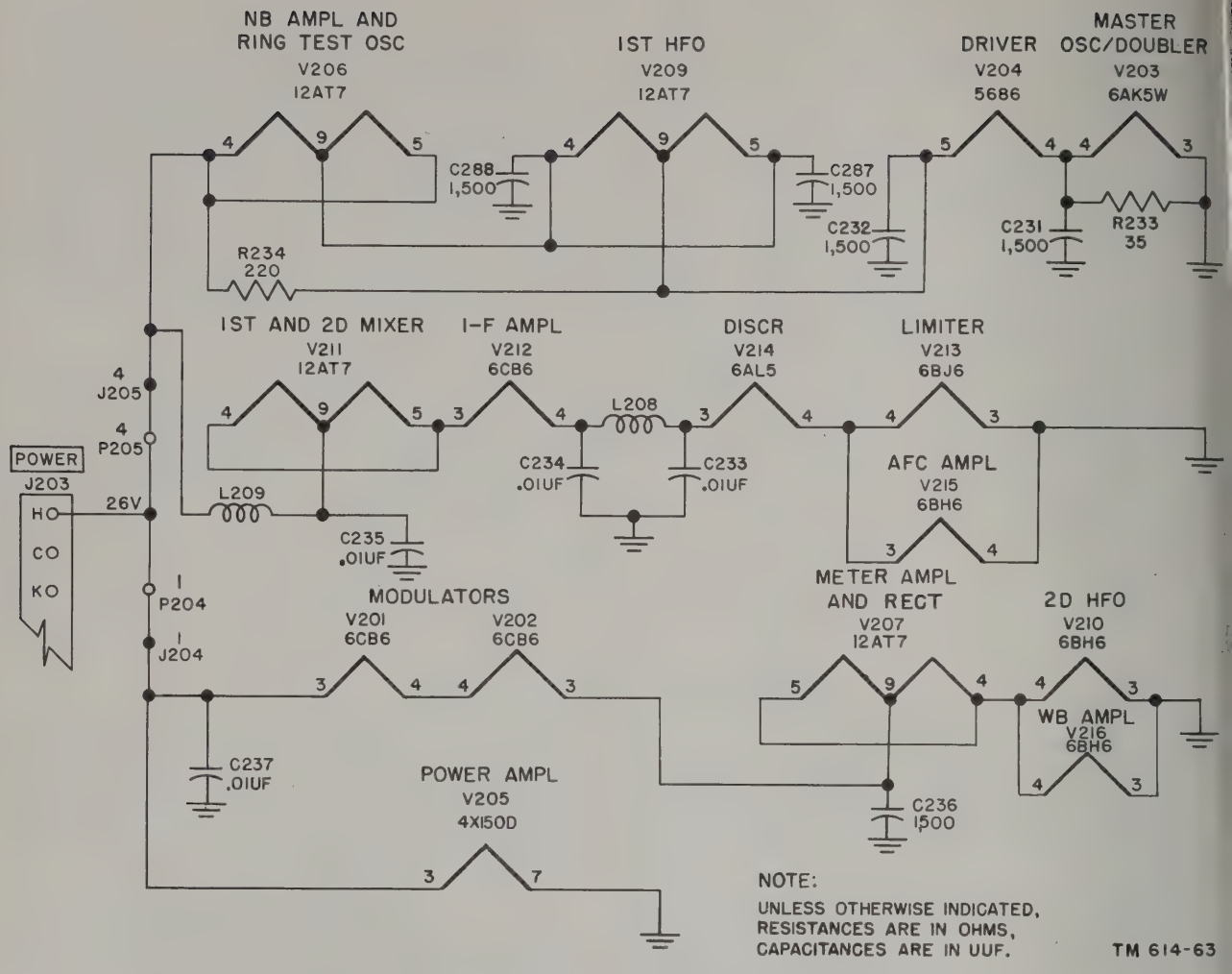


Figure 84. Transmitter filament supply, schematic diagram.

141. Transmitter B+ Distribution

a. Figure 85 shows the B+ distribution in Radio Transmitter T–235/GRC–10. The positive side of a 250-volt power source, originating at the power supply, is connected to the transmitter at terminal B of J203. Capacitor C292 decouples the power supply from the transmitter r-f circuits. The 250 volts supplies screen voltage for V205, plate voltage for V203, V206, V207, V209, V211, V215, and V216, and plate and screen voltage for V204, V210, and V212. The R. F. POWER switch S201 serves a dual purpose. In the LO position, the switch places the voltage divider R230 and R231 in series with the normal screen voltage dropping resistor (R229), lowering the screen voltage on power amplifier tube V205. This condition limits the plate current to a value that will not harm the tube during tuning or adjustment. It also reduces the r-f power output of the transmitter from 40 watts in the HI position to approximately 10 watts in the LO position. Low power operation should be used whenever these equipments are operated close together or placed advantageously enough to give reliable communication with a 10-watt output.

b. The plate of voltage regulator V208 is connected to the 250-volt source through R256. The output, a regulated 150 volts, supplies screen voltage for V215, V216, and V203 and plate and screen voltages for V201, V202, and V213.

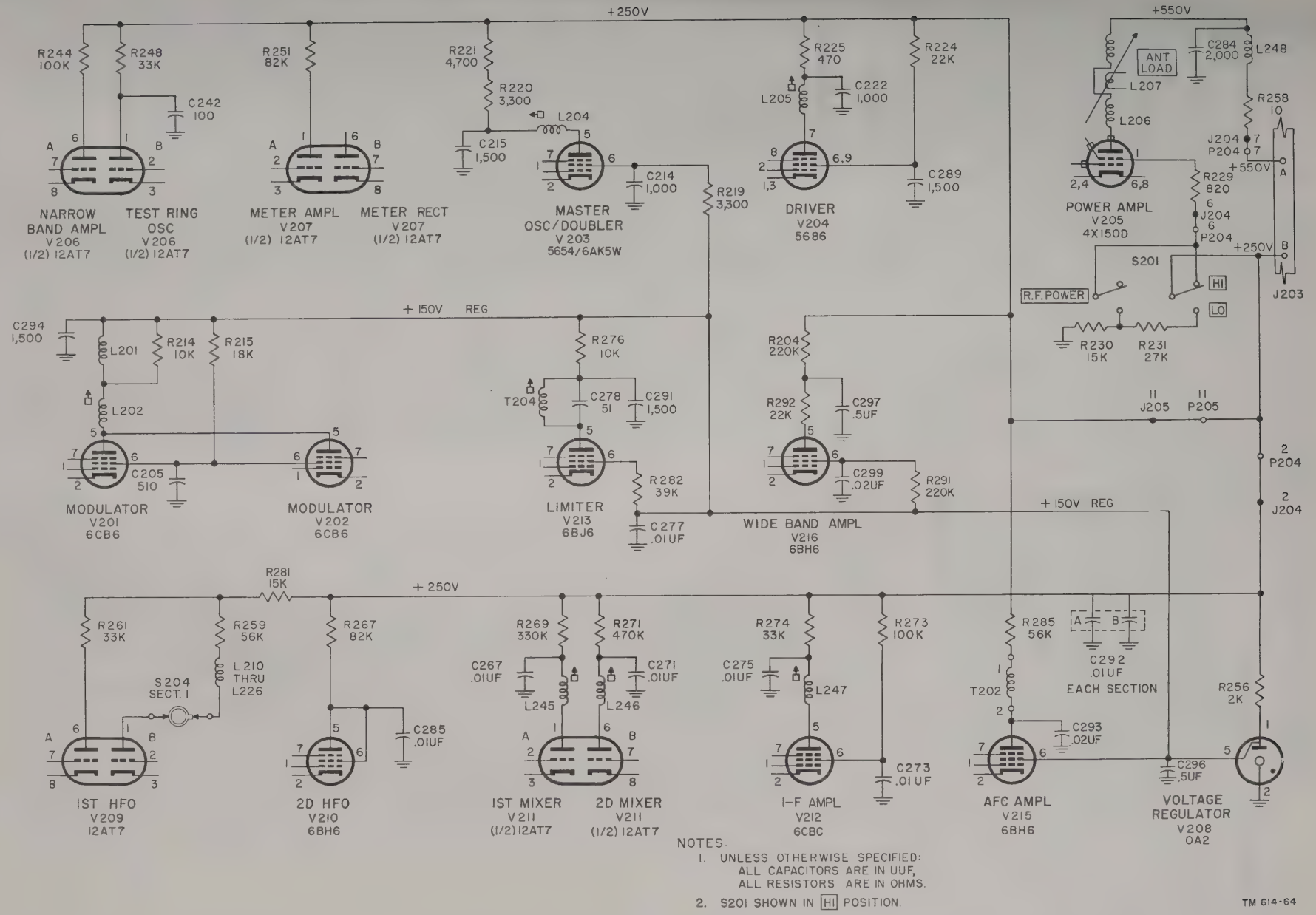


Figure 85. Transmitter B+ distribution.

142. Differences in Receivers

Because of changes in design, certain differences exist between the schematic diagrams in this section and some of the actual receivers. The same statement is true concerning the voltage and resistance chart (fig. 170), the front-panel diagram (fig. 168), and the complete schematic diagram of the receiver (fig. 165). The table below shows the units that differ from the above figures and what the differences are. *Note that this table applies only to receivers manufactured under Order No. 92-Phila-52.* The order number appears on the front-panel nameplate of the receiver following the serial number.

Reference symbol	Serial numbers	Differences
C52	51 through 224	1,500 μμf.
C93	51 through 224	1,500 μμf.
C113	1 through 350	51 μμf.
C116	1 through 350	15 μμf.
C122	After 50	Not used.
C165	After 150	Not used.
C166	After 50	Not used.
C167	1 through 50	Not used.
C168	1 through 50	Not used.
C169	1 through 50	Not used.
C170	1 through 300	Not used.
R64	1 through 530	470 ohms.
R81	1 through 424	22K.
R82	1 through 530	22K.
R83	1 through 424	12K.
R102	1 through 530	180K.
R104	1 through 350	220K.
R111	1 through 350	560K.
R113	1 through 424	470K.
R117	1 through 50	250K.
R133	After 50	Not used; R122 is connected to ground.
R136	1 through 16	Not used.
R137	1 through 16	Not used.
R138	1 through 16	Not used.
R139	1 through 16	Not used.
R140	1 through 16	Not used.
R141	After 50	Not used.
R142	1 through 50	Not used.
R143	1 through 150	Not used.

143. Block Diagram
(fig. 86)

a. Radio Receiver R–125/GRC–10 is a double conversion superheterodyne receiver designed to receive f-m signals in the frequency range of 54.0 to 70.9 mc, with a maximum deviation of ±40 kc. The signal received at Antenna AS–620/GRC–10 is fed through the antenna cable assembly to tuned r-f amplifier V1. The output of first high-frequency oscillator V10 heterodynes with the output of the r-f amplifier in first mixer stage V2, producing sum and difference frequencies. First and second variable i-f amplifiers V3 and V4 are tuned to the difference frequency from V2. The signal is then fed to second mixer V5 where it combines with the output of the second high-frequency oscillator to produce a fixed i-f frequency of 4.3 mc. The signal continues through four stages of i-f amplification, V6, V7, V8, and V9, and then through limiting amplifiers V13 and V14. The output of the second limiter is applied to discriminator stage V15.

b. The audio output from the discriminator is fed to wide-band audio amplifier V21. The signal continues from the wide-band audio amplifier to telephone terminal lines during terminal operation, or to the input of an associated transmitter during relay operation. Also applied to the wide-band audio amplifier is the output from the narrow-band audio amplifier of the transmitter. The output of the wide-band audio amplifier is coupled to narrow-band audio amplifier V22A and ultimately to narrow-band audio output V23. Also applied to V22A is the signal from narrow-band audio amplifier V22B whose input is from the transmitter 600-ohm wide-band input.

c. The discriminator output is also applied to afc amplifier V12 which, in turn, controls the frequency of second high-frequency oscillator V11. Should the receiver drift off frequency, the afc amplifier changes the frequency of the second high-frequency oscillator to compensate for the drift. The output of V15 is also fed to the squelch control circuit, consisting of noise amplifier V18, noise rectifier V19, and squelch tube V20. The squelch control circuit grounds the wide-band audio input during *no signal* conditions and ungrounds this input during *signal* conditions.

d. The metering circuit is connected by isolating networks to various stages throughout the receiver. The stages that can be checked by the meter are shown in figure 86.

e. The second limiter, the second high-frequency oscillator, and the afc amplifier require a stable power source for proper operation. These stages

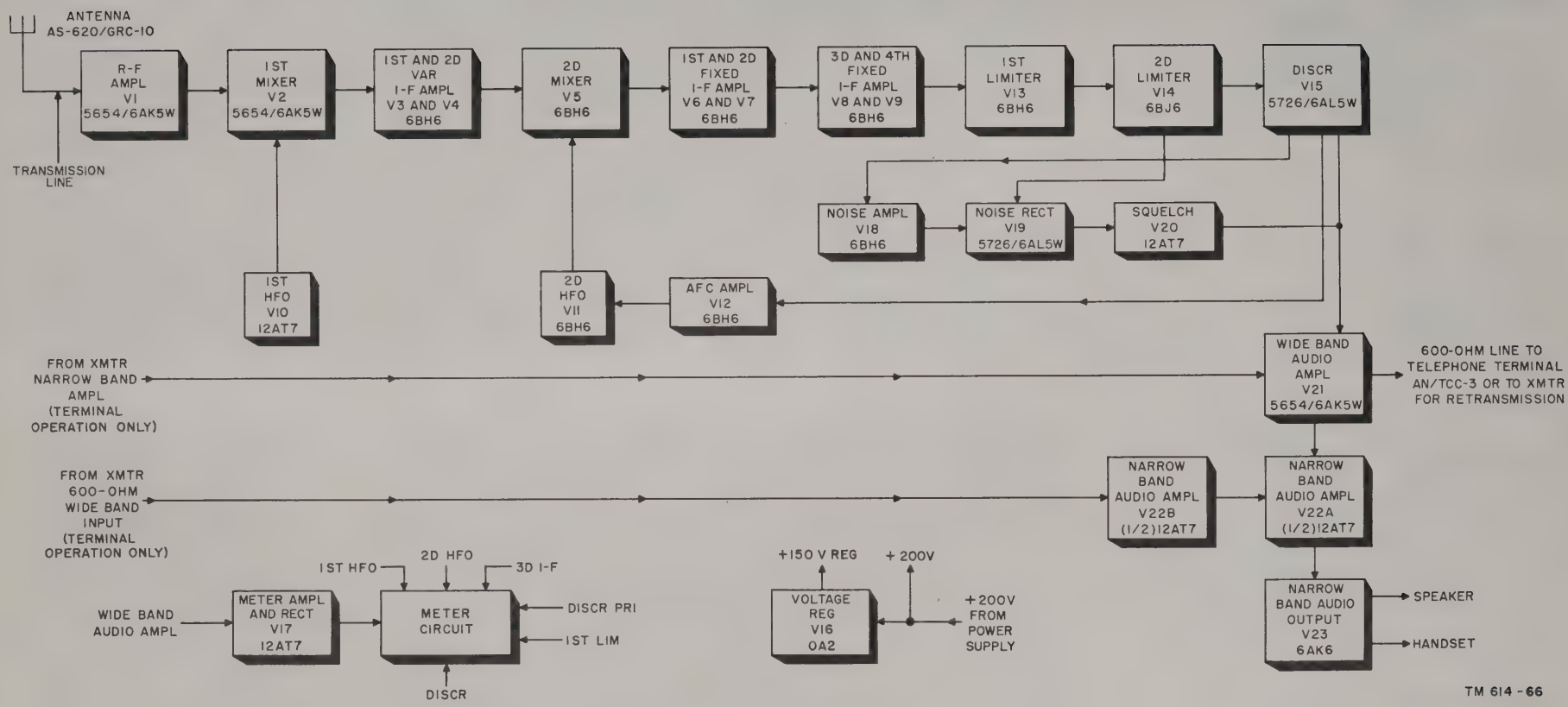


Figure 86. Receiver, block diagram.

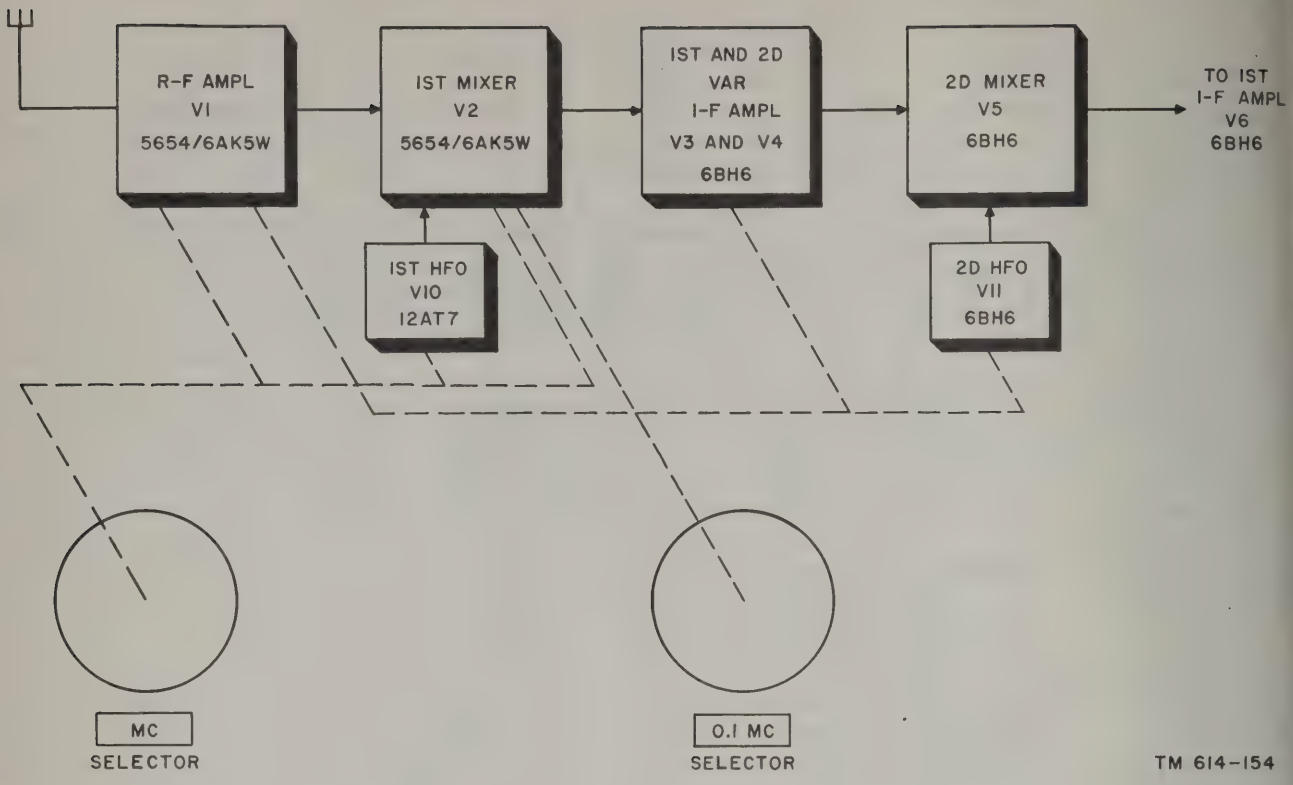


Figure 87. Control circuits, receiver gear train.

are supplied with 150 volts from voltage regulator V16. The audio output is available at either a handset or a standby speaker, connected to the proper AUDIO jacks on the radio set.

f. Turning the MC and 0.1 MC selectors automatically selects the operating frequency of the receiver and adjusts all necessary circuits. Figure 87 is a block diagram showing the circuits affected when the receiver is tuned. Turning the MC selector tunes the circuits of the r-f amplifier, the first mixer, and the first high-frequency oscillator. Turning the 0.1 MC selector tunes the circuits of the r-f amplifier, the first mixer, the first and second variable i-f amplifiers, and the second high-frequency oscillator.

144. R-f Amplifier

(fig. 88)

a. R-f amplifier V1 uses a sharp cutoff pentode. To match the low impedance of the antenna (50 ohms) to the high impedance of the control grid input circuit, the received signal is applied to the junction of C1 and C2. Resistor R1 provides a leakage path to ground for any accumulated charge on the antenna. Both the input and output circuits of the r-f amplifier are tuned by the differential gear mechanism located on the front panel of the receiver. Fine tuning of the control grid input circuit is done by the ANT ADJ control C3. Grid leak bias is supplied by capacitor C4 and resistor R2.

b. The plate tank circuit, composed of C8 and L2, is paralleled by resistor R4. This resistor lowers the plate load impedance, thus broadening the response of the stage. At low operating frequencies, the slug tuning of L2 has the most effect on the circuit. However, at higher operating frequencies, the effect of L2 decreases, requiring compensation which is supplied by capacitor C5. A 200-volt power source supplies the plate of V1 through R5 and L2, and the screen through R3. The r-f voltage at the plate and screen is decoupled from the power supply by choke L4 and bypass capacitors C6, C7, and C11. The signal is coupled to first mixer V2 through C10.

145. First High-Frequency Oscillator

Figure 89 is a simplified schematic of the first high-frequency oscillator. V10 is a modified tuned-plate crystal oscillator. Switch S1, section 3, selects any one of 17 capacitor and coil combinations of L31 through L47 and C69 and C70 for the plate load of V10A. Sections 1 and 2 select any one of 17 crystal and coil combinations of Y1

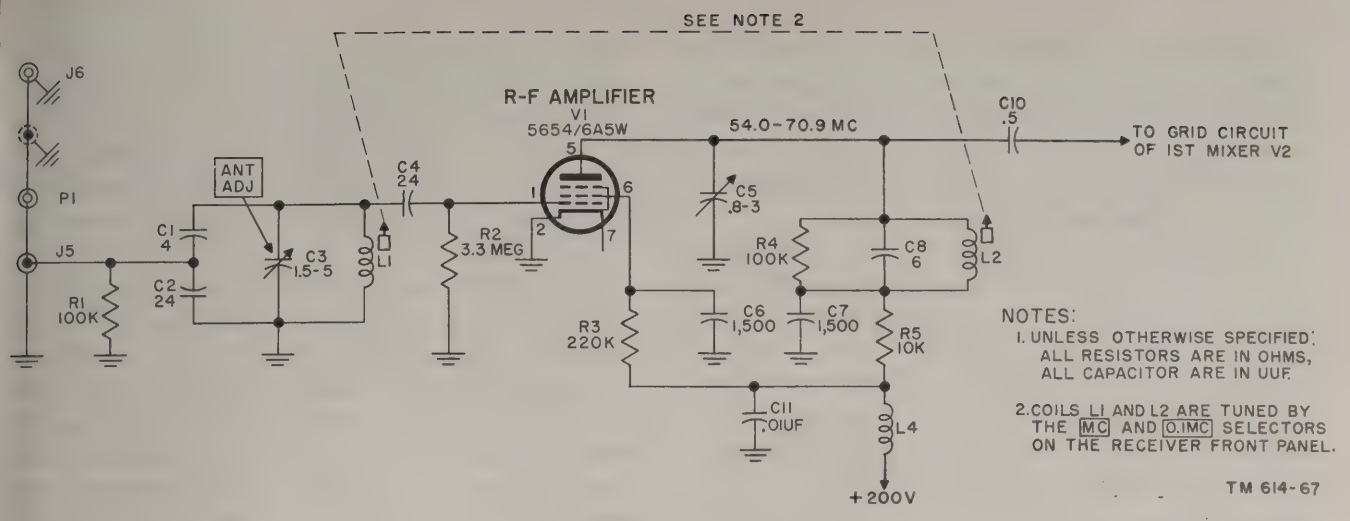


Figure 88. R-f amplifier, receiver.

through Y17 and L14 through L30 for the grid circuit of V10A.

a. The plate tank of V10A (a frequency resonator of opposite phase to the grid) is coupled through C64 to the high impedance grid circuit of cathode follower control tube V10B. Part of the signal voltage applied to this tube appears at the cathode. Capacitor C62 has a negative temperature coefficient to compensate for changes in the capacity of the tank circuit resulting from changes in temperature. Resistors R51, R50, and capacitor C63 supply positive feedback to the cathode of V10A. At the grid (pin 2), which is near ground potential, the voltages appear across the crystal. The feed-back loop is completed through the grid-to-plate capacity of V10A.

b. Crystal neutralizing chokes L14 to L30 are of values that cause resonance with switch S1 and

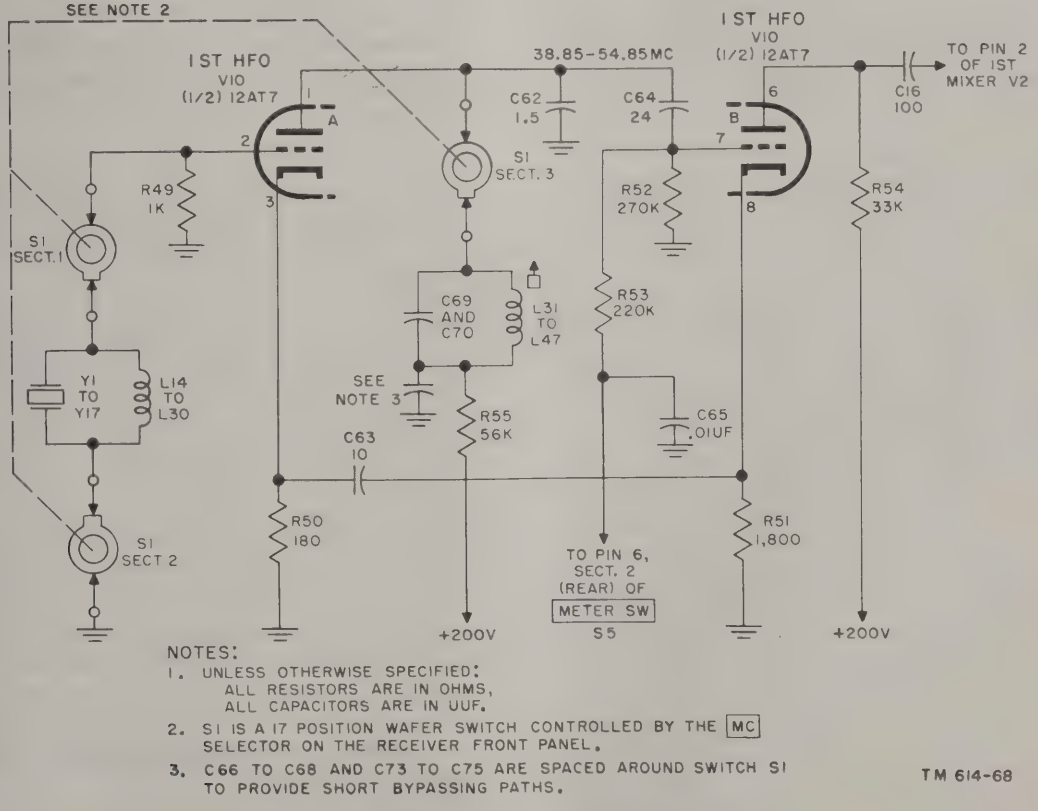


Figure 89. First high-frequency oscillator.

crystal holder capacitance; this resonant frequency, however, is below the lowest frequency to which the plate tank circuit can be tuned with the tuning slug. Grid resistor R49 parallels each choke to obtain smoother control of oscillation over the tuning adjustment range.

c. Plate voltage is applied to V10A through R55 and the inductance of the plate tank circuit, and to V10B through R54. An isolating network, consisting of R53 and C65, couples the d-c voltage developed across grid resistor R52 to pin 6, section 2, of METER SW S5. The output of the first high-frequency oscillator is coupled through C16 to the cathode of first mixer V2.

146. First Mixer

(fig. 90)

The purpose of first mixer V2 is to combine the 38.85- to 54.85-mc signal from the first high-frequency oscillator with the 54.0- to 70.9-mc signal from the r-f amplifier to produce an i-f of 15.15 to 16.05 mc.

a. A resonant circuit, L3, C13, and C12, is tuned to the desired signal by moving the slug of L3 with the MC and 0.1 MC selectors. At resonance, the circuit offers maximum impedance to ground, coupling the signal to the control grid of V2 through C10 and C15. The output of the first high-frequency oscillator is coupled to the cathode of V2 through C16. A sum frequency of 92.85 to 125.75 mc and a difference frequency of 15.15 to 16.05 mc appears at the plate of V2. The plate tank circuit consisting of C20 and L5 is tuned to the difference frequency of 15.15 to 16.05 mc by the 0.1 MC selector. Resistor R10 lowers the Q of the tank circuit; this broadens the response of the stage. R7 provides a d-c return to ground for the grid of V2.

b. Voltage from the power supply is applied to the plate of V2 through R10, R11, and L5 and to the screen through R9. Capacitors C18, C19, and C21 decouple the r-f from the power source. Resistor R8 and C17 develop the required bias to make mixing possible by V2. An isolating network, consisting of R6 and C14, provides a test point for the grid circuit. The first mixer output is fed to the first variable i-f amplifier V3 through C22.

147. First and Second Variable I-f Amplifiers

(fig. 91)

a. The 15.15- to 16.05-mc output signal from the first mixer is coupled through C22 to the control grid of first variable i-f amplifier V3. The plate tank circuit is composed of C26 and L6. The amplified signal is coupled from the plate of V3 to the grid of second variable i-f amplifier V4. The circuits of both stages are identical. To make use of the maximum number of operating r-f channels, while maintaining a crystal-controlled oscillator, the first and second i-f amplifiers must be made variable. For example, if the receiver is tuned to

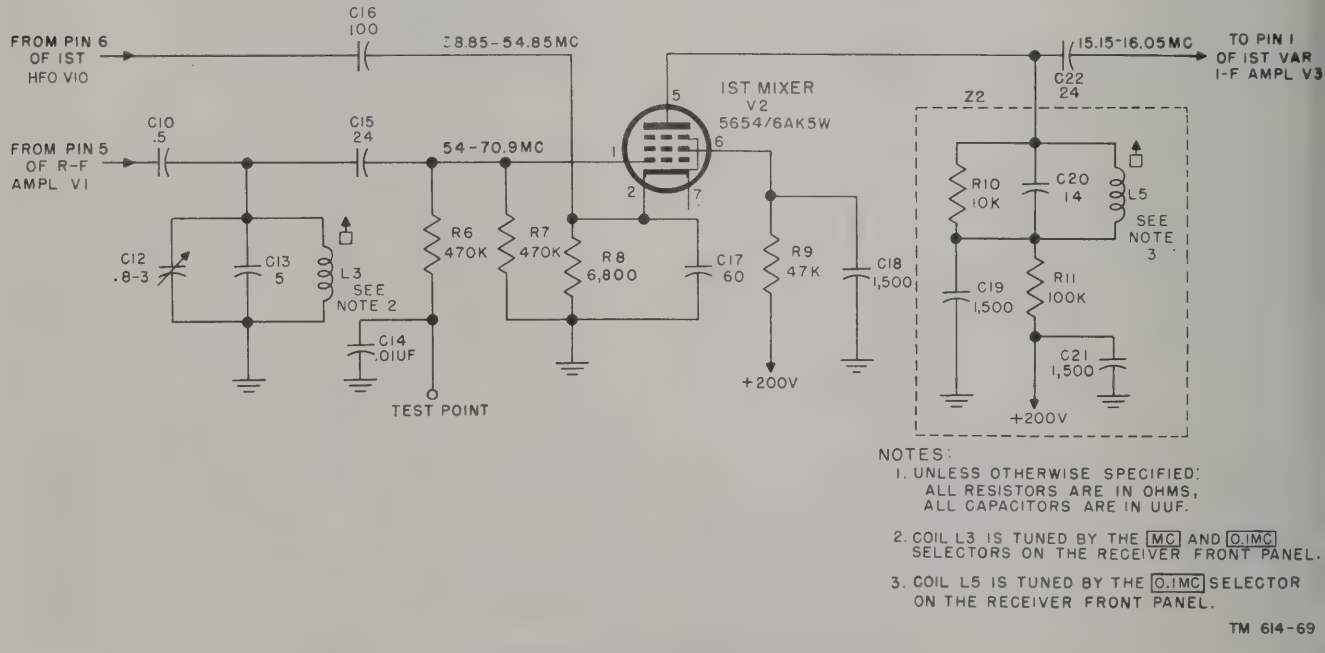


Figure 90. First mixer, receiver.

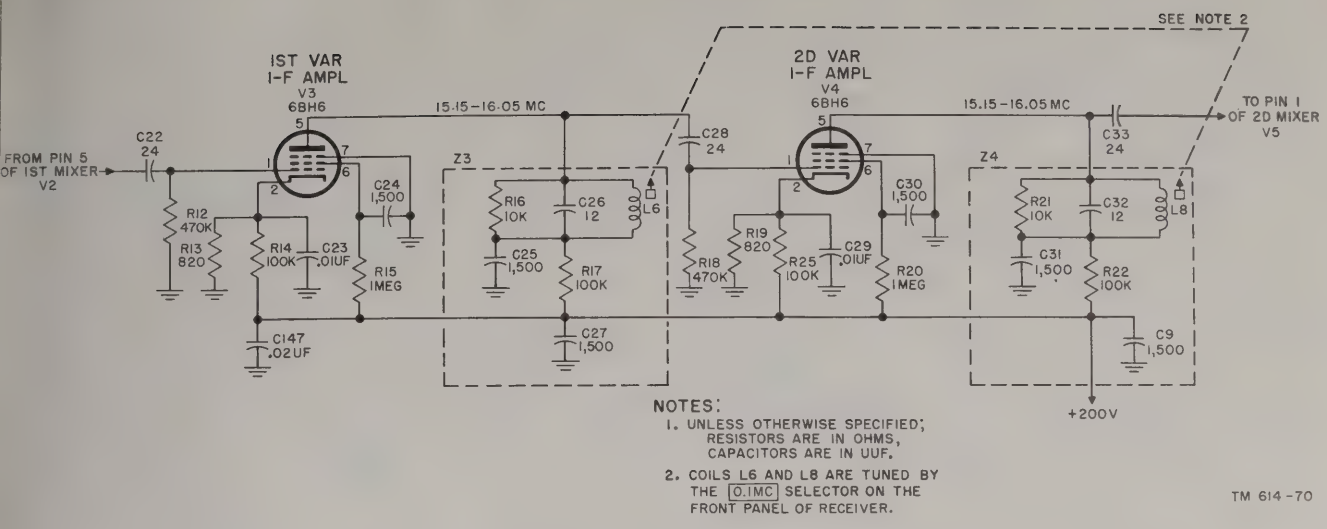


Figure 91. First and second variable i-f amplifiers.

54.0 mc, the frequency of the first high-frequency oscillator is 38.85 mc, and the variable i-f is 15.15 mc. If the receiver is tuned to 54.6 mc, the frequency of the first high-frequency oscillator remains the same, but the variable i-f changes to 15.75 mc. The tuned plate tank circuits of V3 and V4 (L6 and L8) are tuned by the 0.1 MC selector at the front panel of the receiver. Coils L6 and L8 resonate with capacitors C26 and C32 respectively. Resistors R16 and R21 reduce the plate load impedance of each circuit, resulting in a broad band pass for each stage.

b. A voltage divider, R13 and R14, and bypass capacitor C23, provide a fixed bias for V3. The stage is also operated with grid leak bias (provided by R12 and C22) during strong input signal conditions. Voltage is applied to the screen through R15 and its decoupled by C24. Plate voltage is applied from the same power source through R16, R17, and L6. Bypass capacitors C25, C9, C30, C31, C27, and C147 prevent any r-f voltage from returning to the power supply through the B+ line. The 15.15- to 16.05-mc signal is coupled to the grid of second variable i-f amplifier V4 through capacitor C28. The function of each capacitor, resistor, and coil of the second variable i-f amplifier is identical to the corresponding part in the first variable i-f amplifier. After passing through the second i-f amplifier, the signal is coupled to the grid of second mixer V5 through C33.

148. Second High-Frequency Oscillator

a. The second high-frequency oscillator, a modified ultraudion, produces an output frequency within the range of 19.45 to 20.35 mc. This frequency beats with the input signal at second mixer V5 to produce a fixed i-f of 4.3 mc. Figure 92 shows a schematic diagram of second high-frequency, V11. Positive feedback, necessary to sustain oscillations, is developed across the total input capacity of the tube. The main frequency-determining components are the combined inductance of L7 and L58 and the combined capacity of C79 and C49. Changing the frequency of this series resonant leg is done by switching any one of 10 coils (L48 to L57) into the tuned circuit. The added inductance changes the over-all inductance, thus changing the resonant frequency. Capacitor C80 will affect the over-all oscillator frequency only slightly. For this reason, the saturable reactor circuit is placed in parallel with C80. The afc control tube V12, through the saturable reactor, keeps the receiver on frequency. If the receiver has shifted off frequency or if the received signal is off frequency, the afc tube will cause the inductance of T3 to change. This inductive change combined with the capacitance of C81 parallels C80 and results in a shift of frequency of the second high-frequency oscillator.

b. When the stage is oscillating, grid leak bias is supplied by C80 and R56. A decoupling network, consisting of R57 and C77, couples a portion of the bias voltage to the metering circuit. With the METER SW in the OSC 2 position, a meter reading indicates that the stage is oscillating.

c. Voltage is applied to the plate through R58 and to the screen through R60. Bypass capacitors C76 and C78 decouple the r-f components of the plate and screen circuits from the power supply.

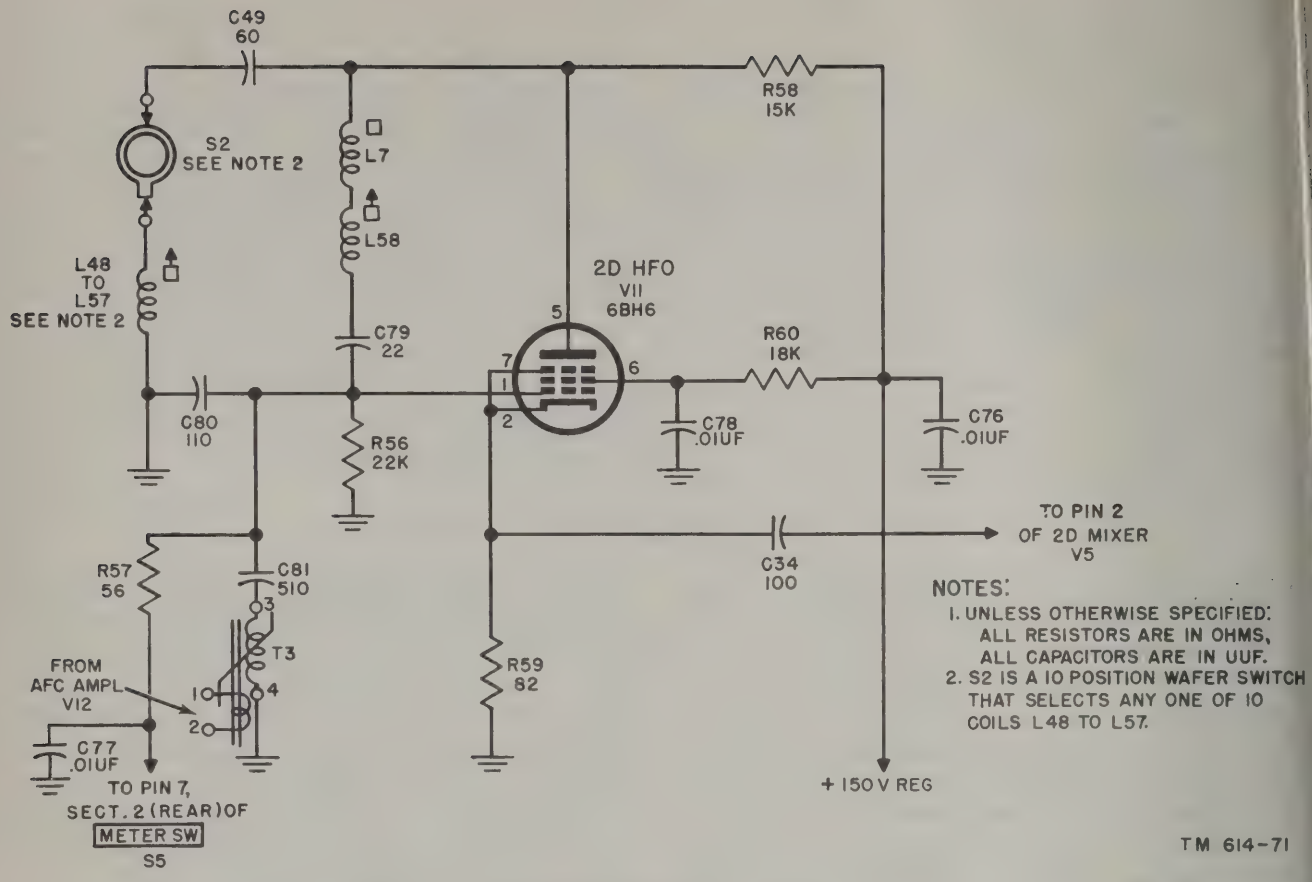


Figure 92. Second high-frequency oscillator, receiver.

The output of the second high-frequency oscillator is taken from across R59 and is coupled to the cathode of second mixer V5 through C34.

149. Second Mixer

(fig. 93)

a. The purpose of second mixer V5 is to combine the output of the second high-frequency oscillator (19.45 to 20.35 mc) with the output of the second variable i-f amplifier (15.15 to 16.05 mc) to produce a fixed i-f of 4.3 mc. The second high-frequency oscillator output is fed to the cathode of the second mixer, and the second variable i-f amplifier output is fed to the control grid. A series of sum frequencies and a difference frequency of 4.3 mc (in addition to the original input frequencies) appear at the plate. A band-pass filter accepts those frequencies near 4.3 mc and greatly attenuates all other frequencies.

b. The stage uses a combination of grid leak bias, supplied by C33 and R23, and cathode bias, supplied by R24. To eliminate loading the second high-frequency oscillator, its output is applied to the cathode of V5 through a voltage divider consisting of C34 and C35. Voltage is applied to the plate through R27 and to the screen through R26. Capacitors C36 and C152 decouple the r-f at the plate and screen circuits from the power source. The signal from the second variable i-f amplifier is coupled to the control grid of V5 through C33. The 4.3-mc output from the second mixer is fed through C37 to the band-pass filter.

150. Band-Pass Filter and First Fixed I-f Amplifier

(fig. 94)

a. Band-pass filter FL1 determines, to a major degree, the selectivity of the receiver. The filter is pretuned and factory-sealed and cannot be retuned or repaired. A defective unit *must* be replaced completely. Frequencies that are below 3.85 and above 4.75 mc will be greatly attenuated; frequencies in the region of 4.3 mc will be attenuated to not less than 25 percent of the voltage across the input of the filter. The bandwidth at 3db attenuation is approximately 180 kc, and at 60 db attenuation, less than 430 kc. The output of

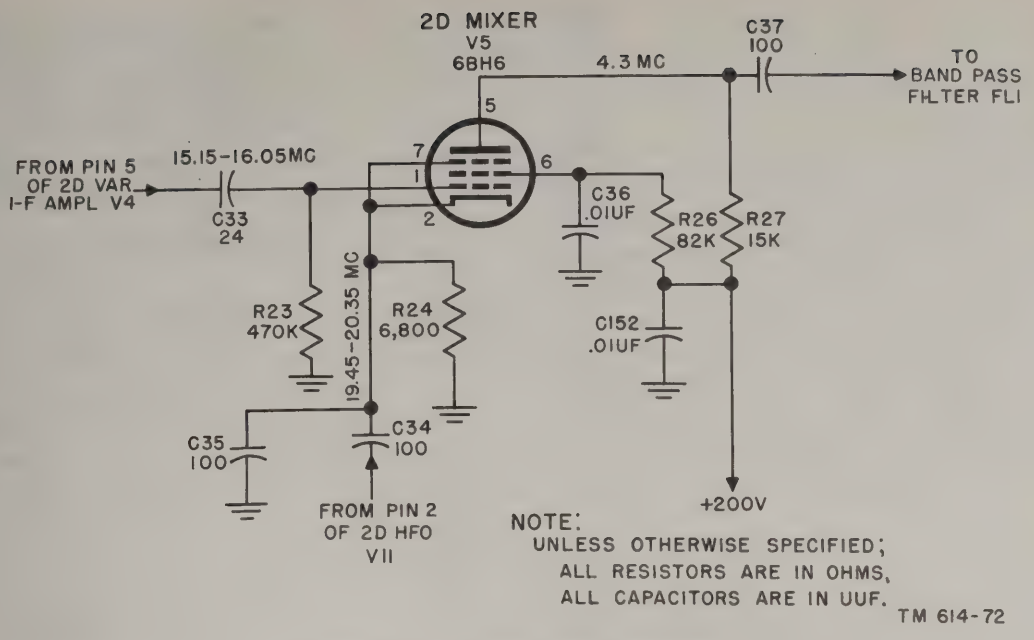


Figure 93. Second mixer, receiver.

the band-pass filter is directly coupled to the grid of V6.

b. Because the filter introduces a loss, and because of broad band-pass requirements, four stages of fixed i-f amplification are used. The first fixed i-f uses sharp cutoff pentode V6. To maintain selectivity, R28 matches the output impedance of FL1. The stage is operated with self bias supplied by R29 and C38. The plate tank circuit of Z5 is tuned to 4.3 mc by L9 and C41. A broader bandwidth is attained by lowering the Q of the tank circuit with parallel damping resistor R31. Voltage is applied to the plate through R32, R31, and L9, and to the screen through R30. Capacitors C40, C42, C39, and C157 decouple the plate and screen circuits from the power source. Capacitor C39 provides an r-f bypass at the screen. The signal from the first fixed i-f amplifier is coupled through C43 to the grid of second fixed i-f amplifier, V7.

151. Second and Third Fixed I-f Amplifiers (figs. 95 and 96)

a. Second and third fixed i-f amplifiers V7 and V8 use sharp cutoff pentodes. The plate tank circuits are tuned to 4.3 mc by C48 and L11, and by C56 and L12. The function and operation of the

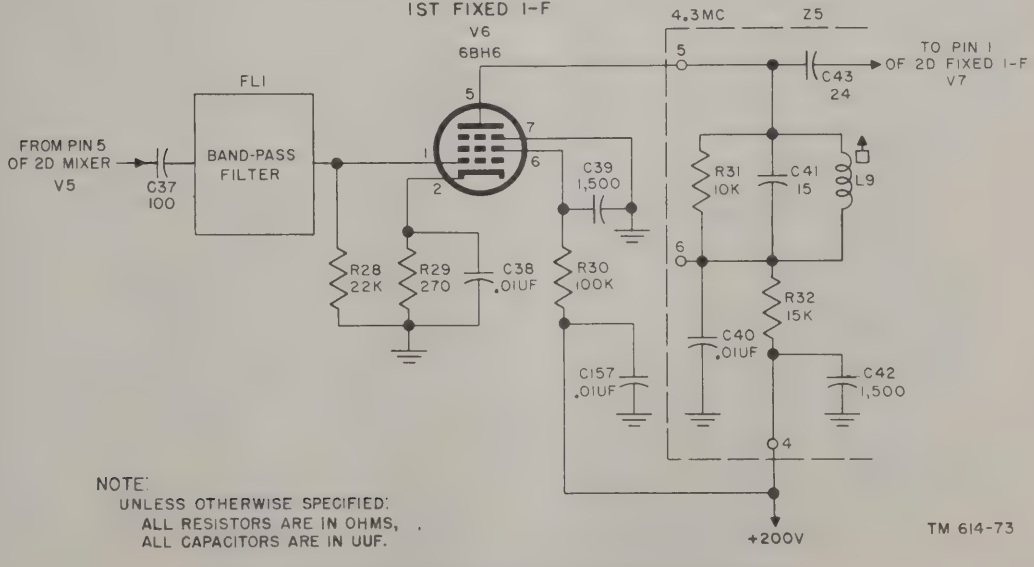


Figure 94. Band-pass filter and first fixed i-f amplifier.

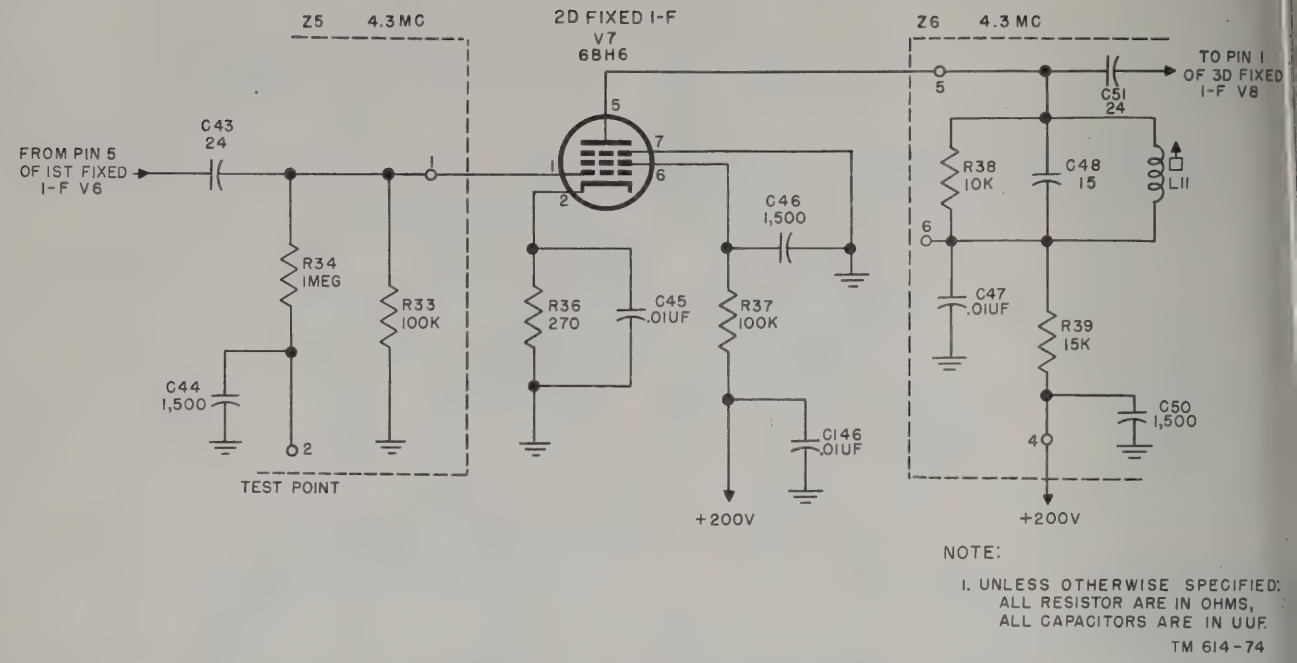


Figure 95. Second fixed i-f amplier, receiver.

two stages are identical; those component parts which have the same function in each stage have the same values. Because of the broad band-pass requirements of the receiver, resistors R38 and R44 are connected in parallel with the plate tank circuits, thus lowering the Q of the tank circuits and broadening the response of the two stages. Cathode bias is supplied by R36 and R42. Capacitors C45 and C53 reduce degeneration. Capacitors C43, C51, and C58 couple the signal between stages. Resistors R33 and R40 provide d-c paths between the control grids and ground. Resistors R37 and R43 are screen dropping resistors. R39 and R45 are plate decoupling resistors. C46 and C54 are screen bypass capacitors. Capacitors C47, C50, C146, C55, C57, and C95 decouple the r-f from the power source in the plate and screen circuits of V7 and V8.

b. At the control grid circuit of the second fixed i-f amplifier, R34 and C44 isolate the test point of

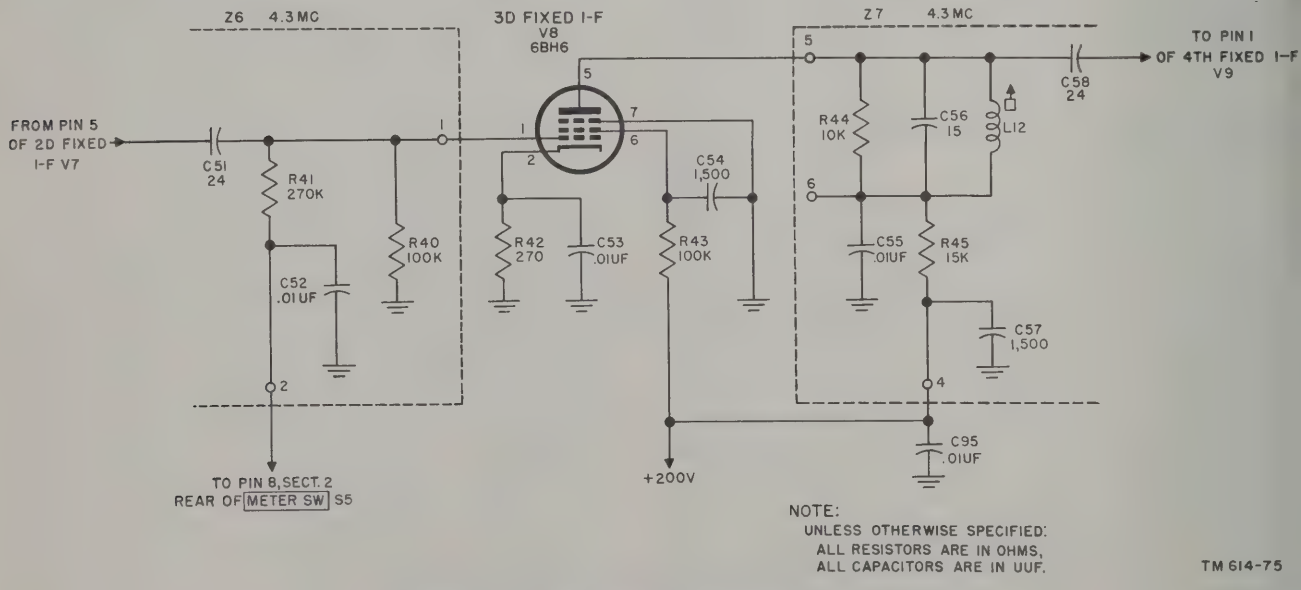


Figure 96. Third fixed i-f amplifier, receiver.

Z5. The primary use of this test point is to aid in alining the receiver. It can be used, however, for trouble shooting. When the METER SW S5 is at the 3RD IF position, the rectified grid voltage of V8 is applied to the metering circuit through the isolating network formed by R41 and C52.

152. Fourth Fixed I-f Amplifier

(fig. 97)

The fourth fixed i-f amplifier uses sharp cutoff pentode V9. The circuit design is the same as that of the second and third fixed i-f amplifiers, except for the type of bias that is used. Resistor R46 and capacitor C58 develop grid leak bias when a signal is applied. Because of the type of bias used, the stage will act as a limiter on strong signals. The output of V9 is coupled to the grid of the first limiter through C92.

153. First Limiter

(fig. 98)

a. First limiter V13 removes any amplitude modulation that is acquired by the carrier wave during transmission and reception. When the input signal to V13 is above a definite threshold level, the limiter output is substantially independent of the input. Grid leak bias, supplied by R73 and C92, maintains a negative potential on the grid during input signal conditions. Additional limiting results from operating the plate and screen at reduced voltages. The positive peaks are clipped when grid current flows; the negative peaks are clipped when the tube is driven beyond cutoff.

b. The plate load of the first limiter is a resonant circuit (tuned to 4.3 mc) composed of L61 and C98, and shunted by R76 to provide the necessary bandwidth. Voltage is applied to the plate through R77, R76, and L61, and to the screen through R75. The 4.3-mc r-f is decoupled from the power source by C97 and C99. C96 is the screen bypass capacitor. A portion of the grid voltage at V13 is coupled to pin 9, section 2, of METER SW S5, through an isolating network that consists of R72 and C93. The output of the first limiter is coupled to the grid of V14 through capacitor C100.

154. Second Limiter

(fig. 99)

a. Second limiter V14 provides additional amplification and amplitude limiting of the 4.3-mc signal. Its operation is similar to that of the first limiter, differing mainly in that the output is fed to double-tuned discriminator transformer T4. The output of V13 is applied to the grid of V14 through coupling capacitor C100. During positive peaks of the input signal, the grid draws current and causes a bias voltage to be developed across C100. The plate load of the second limiter is a resonant circuit (tuned to 4.3 mc), composed of C39 and the primary of T4, shunted by R81 to provide the necessary bandwidth. A regulated 150

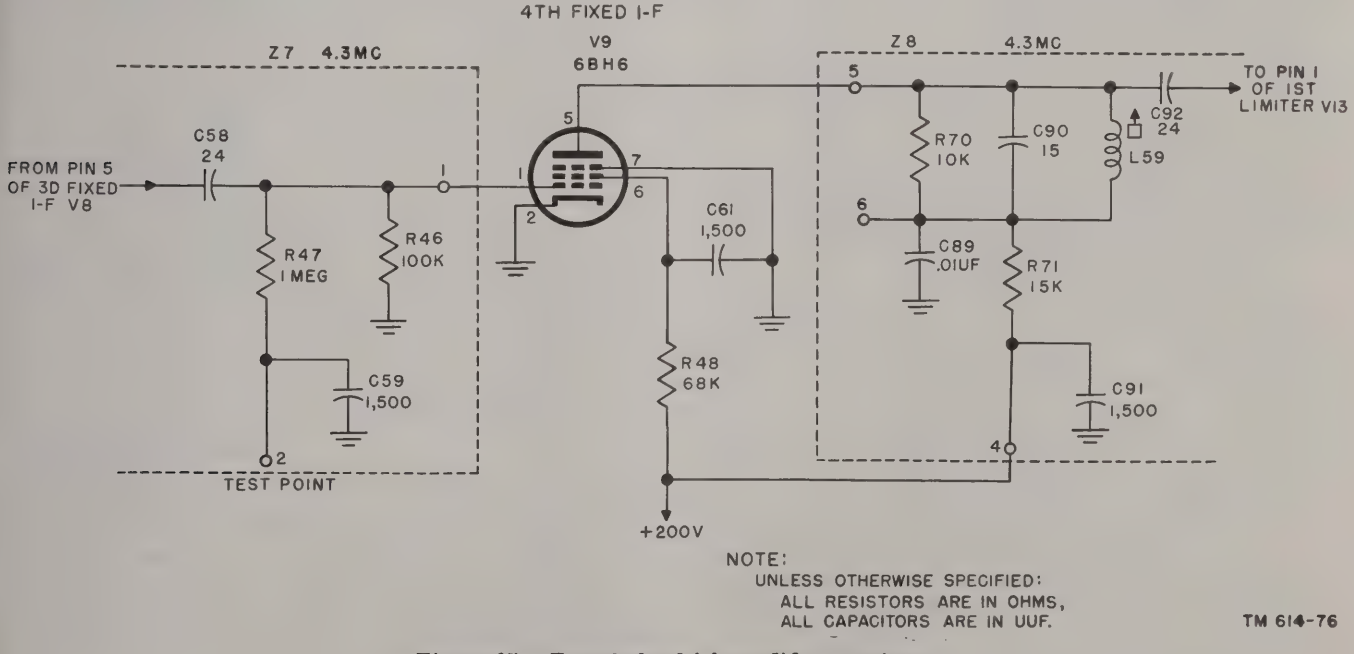


Figure 97. Fourth fixed i-f amplifier, receiver.

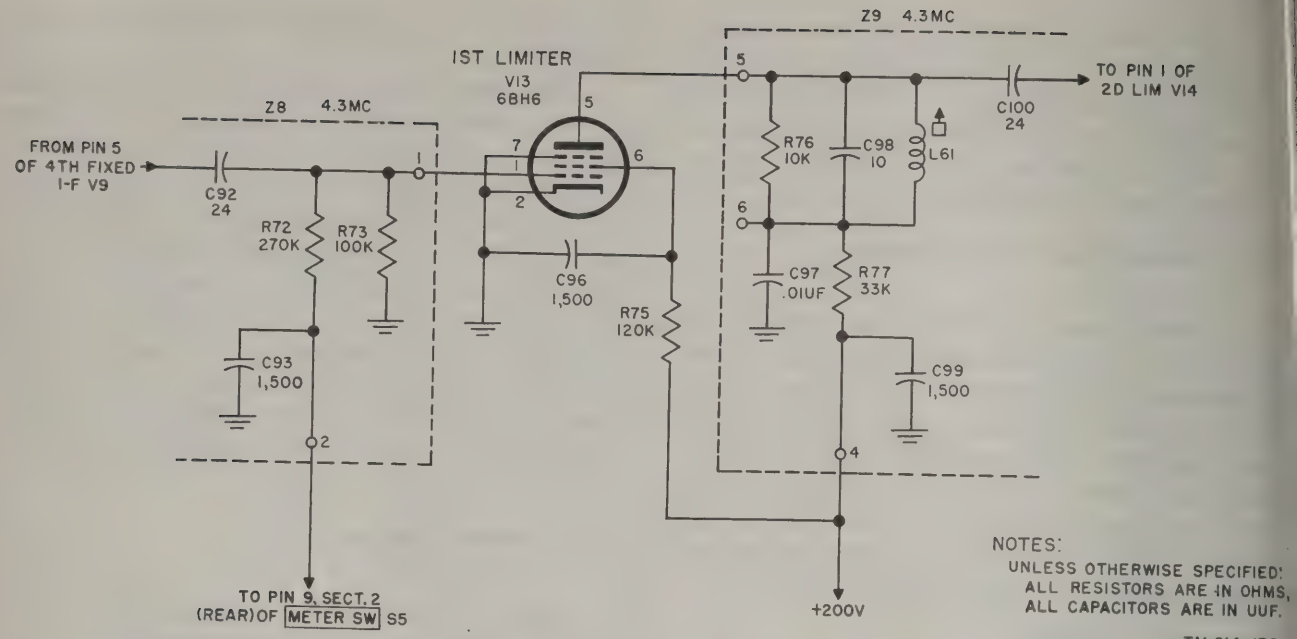


Figure 98. First limiter, receiver.

volts is applied to the screen through R80; the screen is bypassed by C102. Voltage is applied to the plate through R82, R81, and the primary of T4. Capacitors C103 and C170 decouple the r-f component in the plate circuit from the power source.

b. A portion of the grid voltage is coupled to a test point (pin 2 of Z9) through an isolating network that consists of R78 and C101. A portion of the grid voltage is also coupled to the squelch circuit through R74 and C121. (Refer to par. 156 for squelch circuit operation.)

155. Discriminator

(fig. 100)

a. The discriminator circuit converts the r-f variations of the input signal into audio frequency variations, which are used for the output of the receiver and for the afc and squelch circuits.

b. The output of second limiter V14 is coupled to the discriminator at two points. One is by direct coupling from the plate of V14 to the junction of C105 and C106. The other is by inductive coupling from the tuned primary of T4 to the tuned secondary.

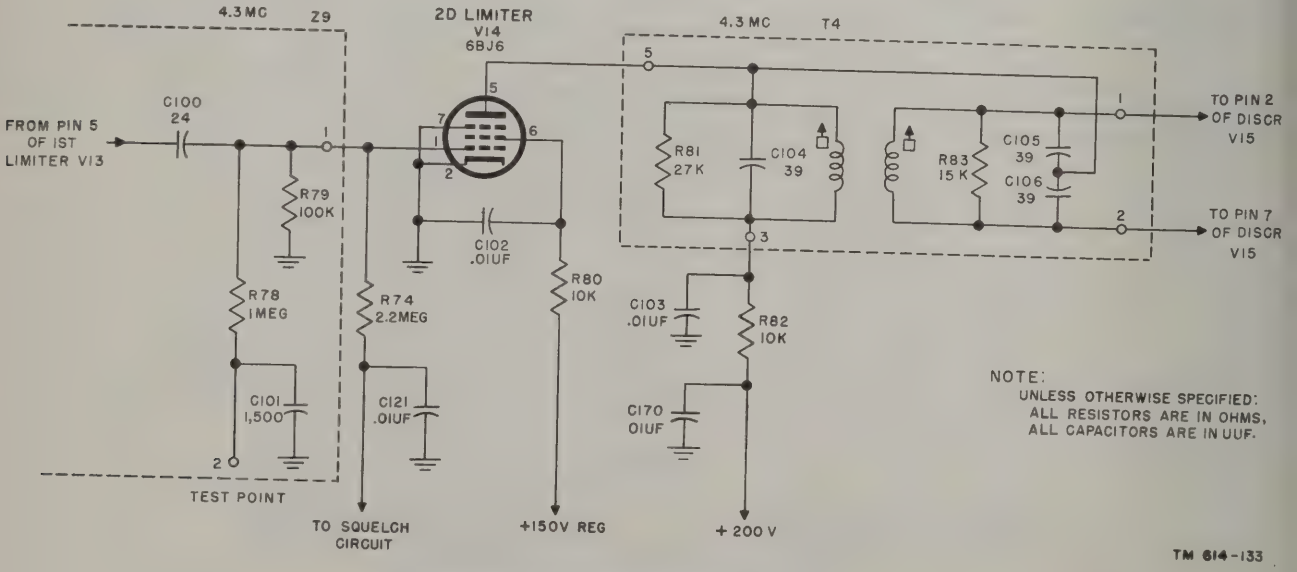


Figure 99. Second limiter, receiver.

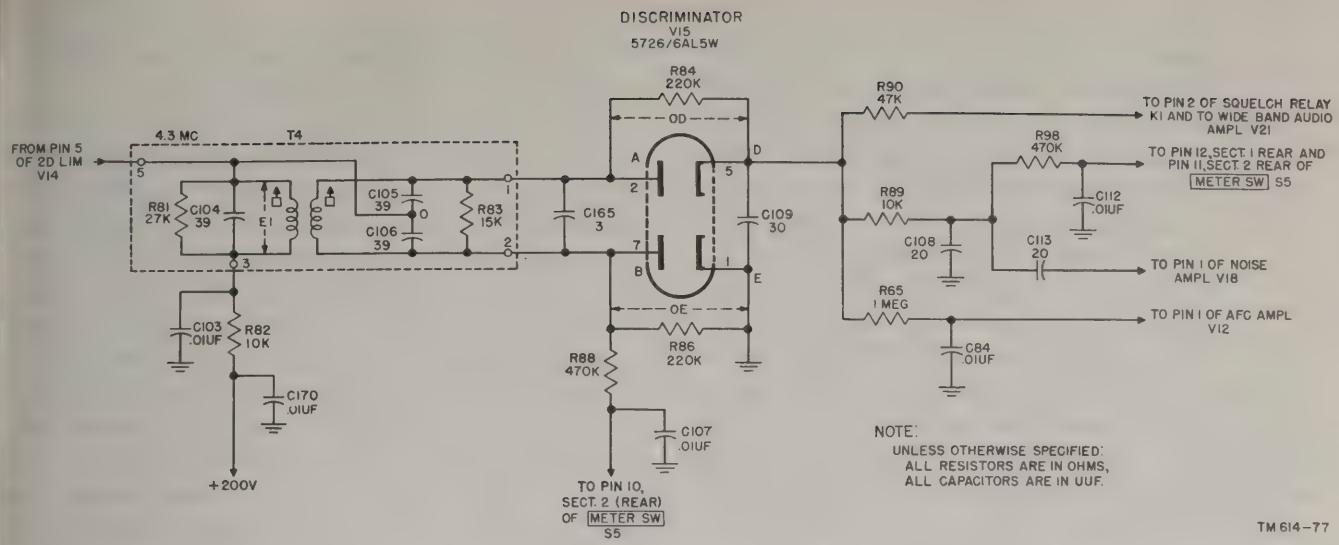


Figure 100. Discriminator, receiver.

c. The operation of the discriminator in the receiver is the same as that in the monitor receiver of the transmitter. Refer to paragraph 136*f* for a discussion of the theory of operation of the discriminator in the transmitter. In the receiver, C165 has been added to the circuit; C165, having a negative temperature coefficient, maintains circuit balance during temperature changes. Figure 100 shows the discriminator circuit; figure 101 is the vector diagrams of the operation.

d. The discriminator outputs are as follows:

(1) The audio frequencies at the output of the discriminator are applied through isolating resistor R90 to pin 2 of squelch relay K1 and to wide band amplifier V21. During input signal conditions, the audio passes directly to V21. During squelch operation (no input signal), pin 2 of K1 is grounded, thus cutting off all background noise.

(2) A portion of the audio signal is coupled through R89 and C113 to pin 1 of noise amplifier V18. During no input signal conditions, noises (generally stronger at the high end of the audio spectrum) are amplified by V18. Capacitor C108 decouples the discriminator stage for r-f voltages.

(3) A portion of the audio signal is also fed to pin 12, section 1, rear, and pin 11, section 2, rear, of METER SW S5. The time constant of R98 and C112 is such that audio frequencies are filtered, leaving only the d-c component of the audio signal. If the received signals at the discriminator are at 4.3 mc, the resultant d-c output is zero. If their center frequency is below 4.3 mc, the d-c voltage is negative, and if it is above 4.3 mc, it is positive.

(4) Resistor R65 couples a portion of the signal to the grid of afc amplifier V12. A

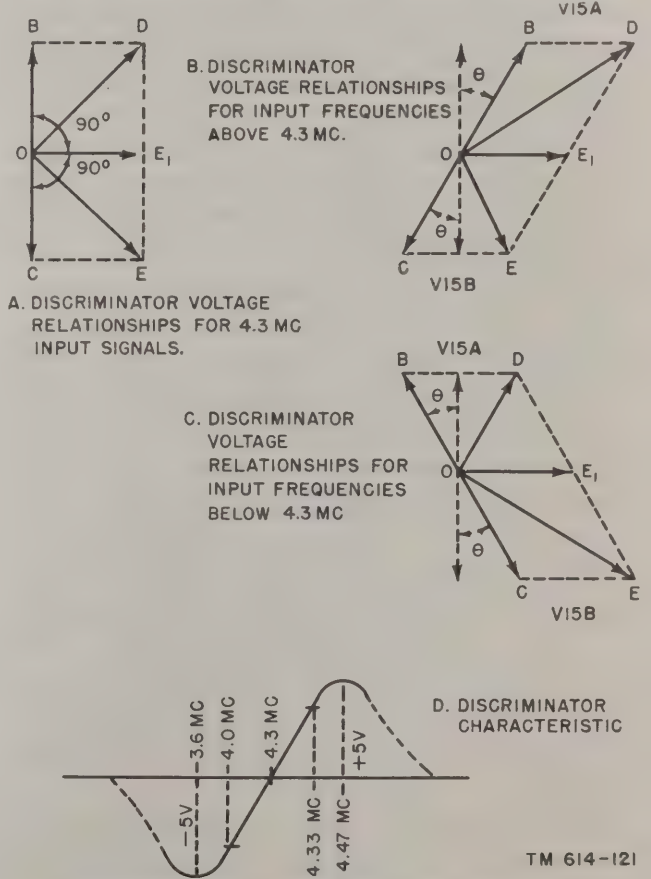


Figure 101. Vector diagrams, discriminator.

resultant d-c remains, because capacitor C84 bypasses audio variations to ground.

(5) The rectified i-f signal, which is present at pin 7 of V15B, is coupled to the meter circuit through isolating resistor R88. A maximum reading on the panel meter indicates that the primary circuit is tuned to resonance (4.3 mc). The signal is coupled from the secondary circuit to pin 10, section 2, rear, of METER SW S5.

e. Resistors R81 and R83, placed in parallel with the primary and secondary circuits of the discriminator transformer, lower the Q of the tank circuits, thus broadening the frequency response of the circuit.

156. Squelch

a. General. Limiters in f-m receivers clip the carrier envelope, thus removing amplitude modulation that developed as a result of noise and interference. The limiter grid voltage increases in the negative direction as the strength of the signal increases. The limiter grid voltage is then an indication of the r-f signal strength and may be used in a control circuit to turn the receiver output circuits *on* only when a predetermined signal strength is reached. The squelch circuit (fig. 102) uses this feature to eliminate noise at the output when no signal is being received.

b. Noise Amplifier. When no modulated r-f carrier signal is being received, the output of an unsquelched f-m receiver generally consists of a *rushing* or *background* noise that is caused by thermal agitation and external electrical disturbances. This noise is fed from the discriminator through a frequency selective network, C113, C108, R89, and R99, to the grid of noise amplifier V18. Audio frequencies are attenuated, but the higher noise frequencies are passed. B+ is applied to the plate through R104 and to the screen through R103. The screen is bypassed by C115. A voltage divider network that consists of R100, R101, and R102 provides cathode bias for the noise amplifier stage; C114 prevents degeneration. Because SQUELCH control R101 varies the cathode bias of the noise amplifier, it varies the tube gain. The output of V18 is coupled to noise rectifier V19 through capacitor C116.

c. Noise Rectifier. Figure 102 shows duo-diode V19 connected as a voltage doubler circuit. The rectified noise voltage from V19 appears across resistor R105. Voltage fluctuations and high-frequency noise are bypassed by C117.

d. Second Limiter Input. A negative voltage from the second limiter grid circuit is fed through R74 and R106 to one plate (pin 2) of V19. The algebraic sum of the positive noise voltage and the negative limiter voltage appears at the junction of R105 and R108, forming a bias voltage for squelch tube V20A. The normal squelch-closed threshold voltage will be approximately 0±.5 volt. Resistor R108 and capacitor C119 form a time-delay circuit to smooth out rapid noise voltage fluctuations. Resistors R106 and R107 comprise a voltage divider that decreases the negative limiter voltage applied to the noise rectifier. Capacitors C121 and C118 decouple the r-f at the limiter from the squelch circuit.

e. Squelch. Because the grid voltage of V20A is either zero or positive, the tube conducts and causes a drop in plate voltage. The plate is directly coupled to the grid of V20B. When the plate voltage of V20A is decreasing, V20B is biased beyond cutoff, no plate current flows, and relay K1 de-energizes. Contacts 2 and 3 of K1 close and ground the output of the discriminator (when S6 is in the *on* position); this results in no signal being applied to the wide-band audio amplifier circuit.

(1) When an r-f signal is received, the grid current of limiter V14 increases. This makes the limiter grid voltage (applied to R105 and R108) more negative. At the same time, noise voltage decreases and results in less positive voltage from the noise rectifier. As the algebraic sum voltage becomes more negative, canceling out the positive noise voltage, squelch tube V20A is cut off. The resulting decrease in plate current returns the bias of V20B to normal, and plate current flows. The flow of current through the solenoid of K1 energizes the relay, ungrounds the discriminator output, and permits the signal to be heard at the loudspeaker.

(2) The positive side of a 200-volt source is connected to the plate of V20A and the grid of V20B through R110 and R111. The cathode of V20B is biased by the voltage divider, which is composed of R109 and R110. The plate of V20B is connected to the positive side of the 200-volt source through the coil of relay K1.

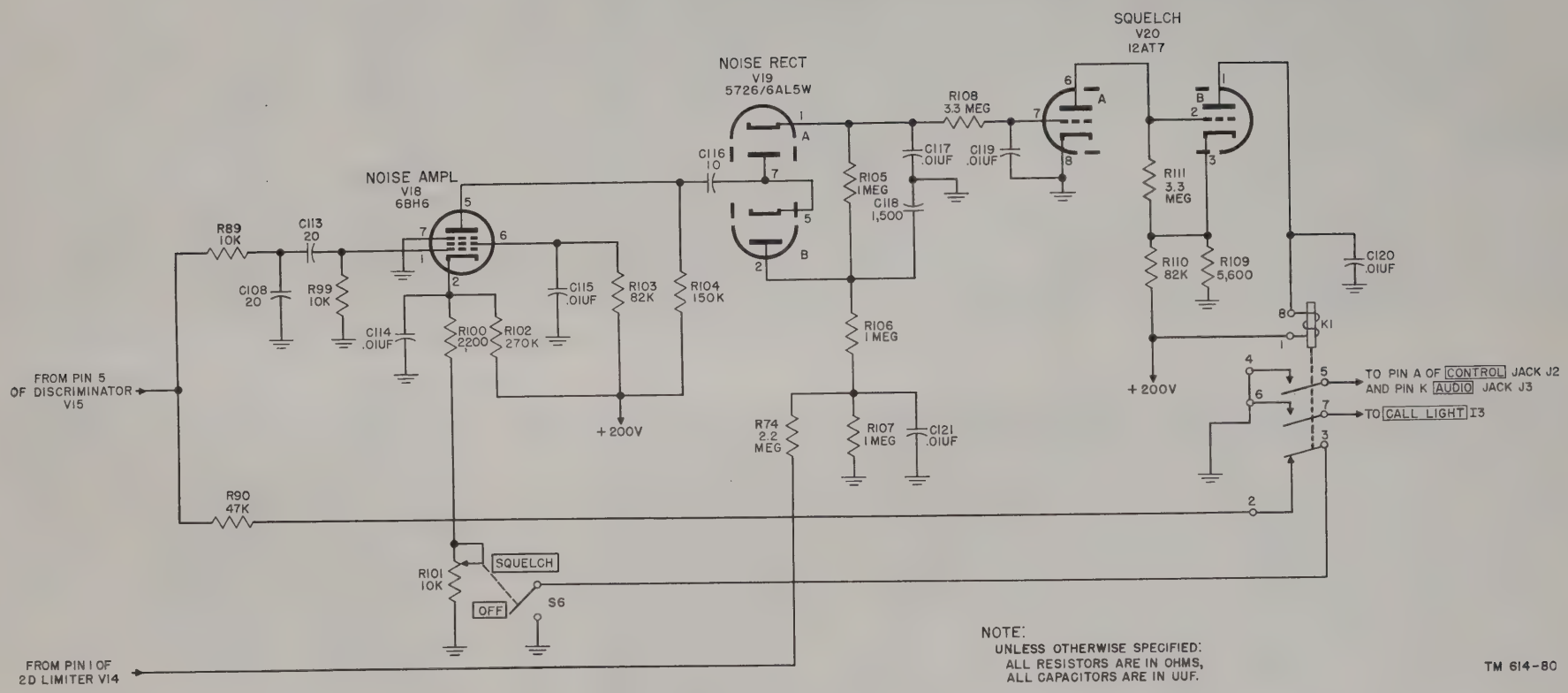


Figure 102. Squelch circuit, receiver.

(3) When relay K1 is in the energized position, contacts 2 and 3 are open and the discriminator output is fed to the wide-band audio input. At the same time, contacts 7 and 6 are closed to complete the circuit that turns the CALL LIGHT on. Contacts 4 and 5 are closed, and ground terminal A of CONTROL jack J2 and terminal K of AUDIO jack J3. During PUSH-TO-TALK operation, terminal K of control unit AUDIO jack J402 is also grounded. When no r-f signal is being received, relay K1 is de-energized and the CALL LIGHT goes out.

f. Threshold. The setting of SQUELCH control R101 determines the input r-f signal strength that is required to open the squelch. When no signal is being received, the output of the discriminator consists mainly of background noise. The SQUELCH control setting at a point where the receiver is just *squelched* is called the *threshold* point. A higher setting will block the reception of weak signals because the limiter grid draws only a small amount of current.

157. Audio Circuits

a. General. Because the radio set can be applied to three distinct types of operation, the arrangement of the audio circuits will vary with each type. Figure 103 is a simplified block diagram that shows the audio signal paths for the various types of operation. The three main circuits, selected by TYPE OF OPERATION switch S401 on the control unit are:

(1) PUSH-TO-TALK.

(2) TERMINAL.

(3) RELAY.

b. Push-To-Talk. The radio set operates as an ordinary receiver-transmitter, capable of communicating with equipment that operates on the same frequency, when the TYPE OF OPERATION switch on the control unit is in the PUSH-TO-TALK position. The output from the discriminator is fed through wide-band audio amplifier V21 to narrow-band audio amplifier V22A. The signal continues through low-pass audio filter FL2, which attenuates frequencies above 3,500 cycles, to narrow-band audio output stage V23. The loudspeaker and the handset are provided with 600-ohm and 4-ohm outputs, respectively.

c. Terminal. When the radio set is used as part of a Radio Terminal Set AN/GRC–39, the TYPE OF OPERATION switch is set to the TERMINAL position. Under these conditions, the output from the discriminator and the output from the narrow-band audio amplifier of the transmitter are applied to the input of wide-band audio amplifier V21. The signal is coupled through a high-pass filter network, which attenuates frequencies below 250 cycles, to the Telephone Terminal AN/TCC–3. The signal is also coupled to the input of the narrow-band audio circuit and follows the same path as in PUSH-TO-TALK operation. The output of V22B is also fed to the narrow-band audio grid circuit. This stage amplifies the signal from the wide-band input of the transmitter.

d. Relay. With the TYPE OF OPERATION switch in the RELAY position, the radio set is operated as part of Radio Repeater Set AN/GRC–40. The audio from the discriminator is fed

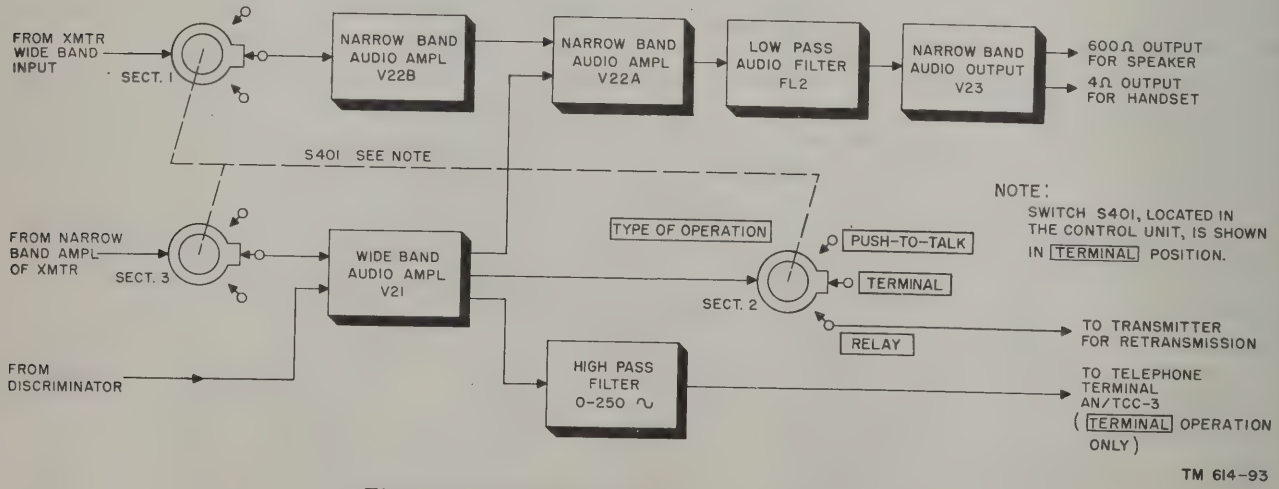


Figure 103. Receiver audio circuits, block diagram.

through wide-band audio amplifier V21 to the associated transmitter input circuit, for retransmission. The signal is also coupled to the narrow-band audio amplifier circuit and follows the same path as in PUSH-TO-TALK operation.

158. Wide-Band Amplifier

a. Figure 104 is a functional schematic diagram of the wide-band audio amplifier. V21 is a sharp cutoff pentode. This stage provides broad-band amplification that uses an RC feed-back network. The output of the discriminator is fed to the LINE LEVEL control through R90. The narrow-band output from the transmitter is coupled to the receiver at pin C of CONTROL jack J2. This narrow-band signal is developed across R116 and applied to the grid of V21 through isolating resistor R115. LINE LEVEL control R112 adjusts the magnitude of the signal from the discriminator, which is applied to the grid through R114. Cathode bias is supplied by R119, which is paralleled by C123 to prevent degeneration. Resistor R118 provides a d-c path to ground for the grid of V21. Distortion is kept within .5 per cent in the 250–20,000-cps band by balanced transformer T1 and the inverse feed-back network, which consists of C122, C166, R117, and R141, in sets with serial numbers 1 through 50. In sets with serial numbers 51 and above, the feed-back network is made up of C168, C169, R117, and R142.

b. The output signal of V21 is fed to four individual circuits. The center-tapped secondary of transformer T1 has a total impedance of 600 ohms. When the radio set operates as a relay station, this output is coupled to the 600-ohm input of an associated transmitter. During terminal station operation, the impedance of T1 matches that of the spiral-four telephone line. The signal is applied to the VOLUME control (fig. 105) through R121 and then to the narrow-band amplifier circuit. A portion of the signal is coupled to the meter circuit through C110. The meter indicates the audio level at the output of V21. Increasing the LINE LEVEL control increases the db reading on the meter. The positive side of the 200-volt power source is applied through the primary of T1 to the plate, and through R120 to the screen. Capacitor C124 decouples the screen from the power source. In radio sets with serial numbers 1 through 50, capacitors C122 and C166 and resistor R141 have been added to compensate for a resonant peak at the high end of the audio response curve.

c. During squelch operation, the input to the wide-band amplifier is grounded, and bypasses all audio. When a signal is present and squelch relay K1 is energized, the input to V21 is ungrounded, and permits audio signals to pass through the audio amplifier stages.

159. Narrow-Band Amplifiers
(fig. 105)

Although the entire wide-band signal is applied to the narrow-band amplifiers, no attempt is made to preserve the broad bandwidth of the signal. Narrow-band amplifiers V22A and V22B amplify the signals in the order wire channel, 250 to 3,500 cycles. During TERMINAL operation, the five-

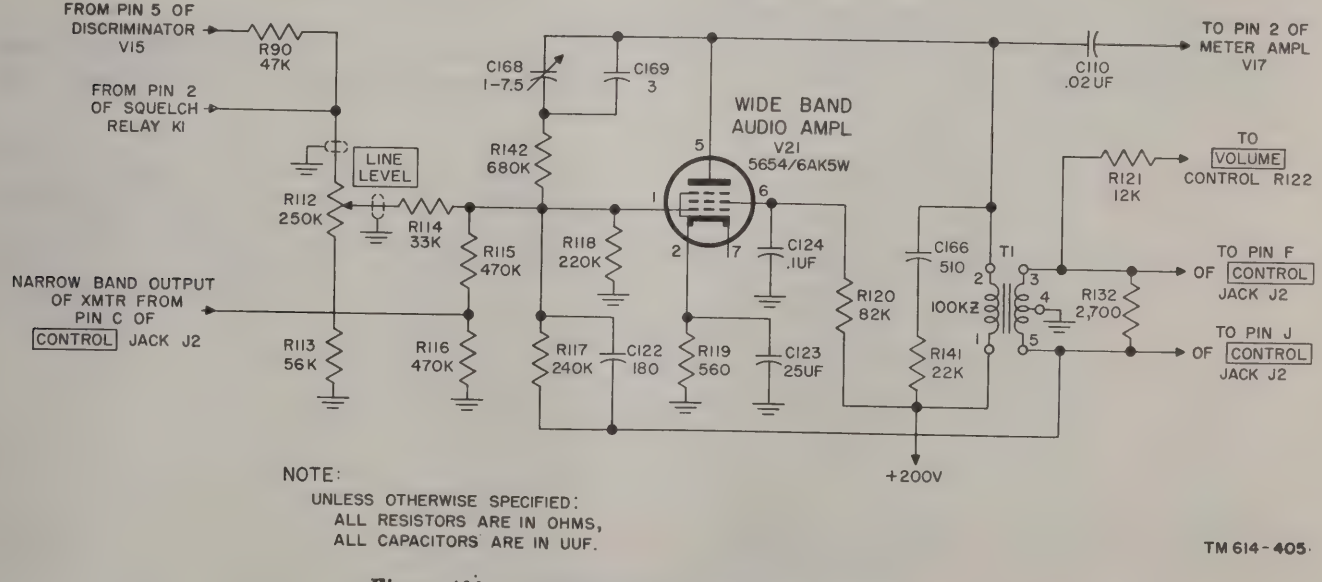


Figure 104. Wide-band audio amplifier, receiver.

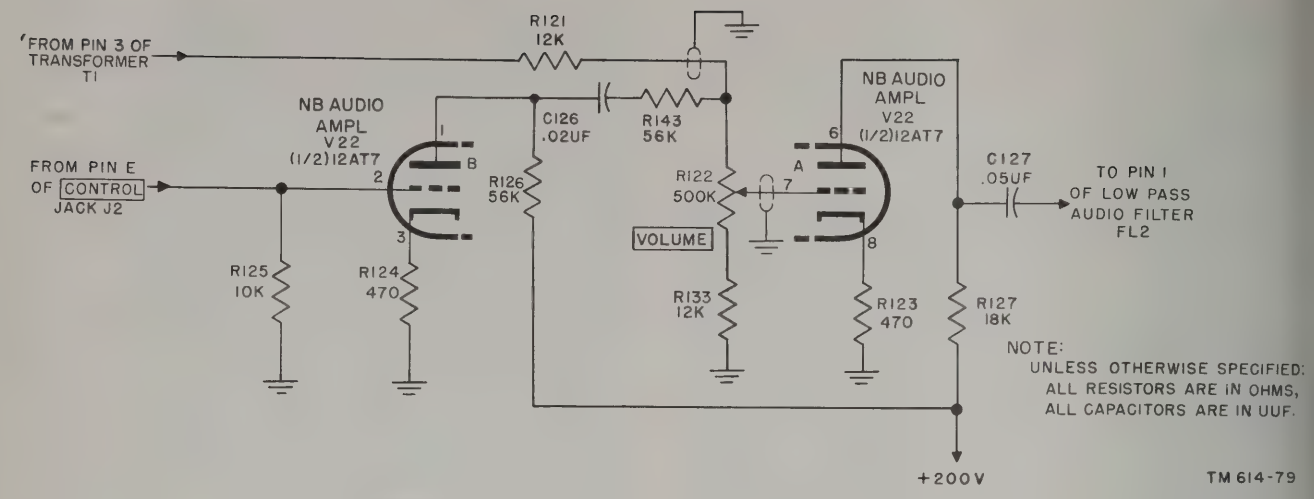


Figure 105. Narrow-band audio amplifiers, receiver.

channel input signal to the transmitter is coupled through the control unit to the receiver and mixed with the receiver wide-band signal. All audio voltages are amplified by V22A and fed to a low-pass filter that rejects channels 2, 3, 4, and 5, passing only channel 1 (order wire).

a. The output from V21 is coupled to the grid circuit of V22A through R121. The transmitter wide-band audio signal is coupled through the control unit to pin E of CONTROL jack J2 on the receiver, and fed directly to triode amplifier V22B. C126 couples the amplified audio to V22A. Isolating resistor R121 permits mixing of the two audio signals, the initial input and the output of V22B, without one circuit causing a loading effect on the other. VOLUME control R122 varies the input to V22A, thus varying the audio output at the speaker and handset. The signal from the plate of V22A is coupled to pin 1 of low-pass audio filter FL2, through C127.

b. The amplifiers, two triodes of a 12AT7 tube, are operated with self bias, which is supplied by R123 and R124, respectively. Because the purpose of the two narrow-band amplifiers is primarily isolation in preference to amplification, the two cathode resistors R123 and R124 are unbypassed. A tube-type circuit, rather than a resistor network, provides the isolation of receiver signals from the transmitter. Unbypassed cathodes supply negative feedback, thus reducing distortion. Resistor R125 is the grid return resistor for V22B. The positive side of the 200-volt supply is applied to the plate of V22B through R126 and to the plate of V22A, through R127.

160. Low-Pass Filter and Narrow-Band Audio Output

(fig. 106)

a. Low-pass audio filter FL2 greatly attenuates all frequencies above 3,500 cps and passes audio

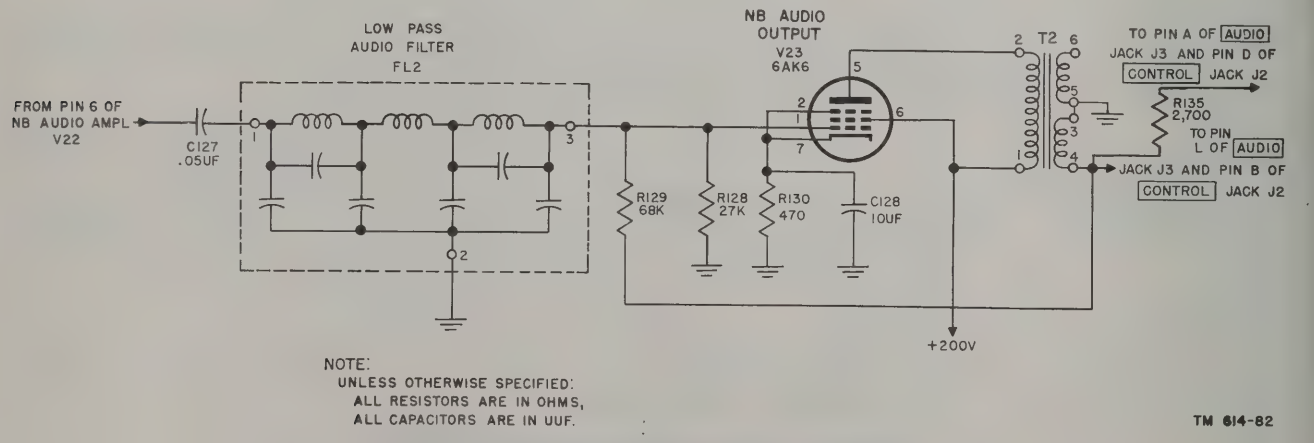


Figure 106. Narrow-band audio output, receiver.

frequencies within 250 to 3,500 cps to the grid of narrow-band audio output tube V23. The amplified order wire signals drive the primary of output transformer T2. The 600-ohm secondary of T2 operates the loudspeaker. The same secondary, through R135, operates the earpiece in the handset.

b. The signal from the plate (pin 6) of V22A is coupled to pin 1 of FL2 through C127. The output of the low-pass filter (pin 3) is fed directly to the grid of V23. Plate voltage is supplied through the primary of output transformer T2 from the 200-volt B supply. Self bias is provided by R130, which is paralleled by C128 to prevent degeneration. Voltage divider resistors R128 and R129 couple a portion of the signal from pin 4 of the output transformer to the grid of V23. The negative feedback that is supplied by the divider reduces the distortion of the stage. This feed-back circuit prevents the handset from being overdriven. Without this circuit, readjustment of the VOLUME control would be necessary each time the speaker is connected or disconnected. The output from pin 4 of T2 is fed through R135 to pin A of AUDIO jack J3 and pin D of CONTROL jack J2. The 600-ohm output from pin 4 is directly connected to pin L of AUDIO jack J3 and pin B of CONTROL jack J2.

161. Automatic Frequency Control

(fig. 107)

Afc amplifier V12 and its associated circuits control the frequency drift of the second high-frequency oscillator. When the receiver tuning shifts from the desired center frequency, the afc amplifier, through saturable reactor T3, changes the frequency of the second high-frequency oscillator inversely proportional to the amount the tuning has shifted, effectively maintaining the receiver on frequency.

a. The heart of the control system is the saturable reactor. The primary of T3 is wound on one leg of a rectangular ferrite core. The secondary is wound on the other leg. The inductance of the secondary varies in accordance with the d-c through the primary. If the current that flows through the primary remains constant, there is no change in core saturation, and, consequently, no change of inductance of the secondary. Paragraph 136*f* describes the presence of a d-c component at the output of the discriminator and how a carrier shift from the center frequency determines the polarity and value of this d-c. The audio voltage from pin 5 of discriminator V15 is filtered by R65, C84, and C151. Resistor R65 and capacitor C151 provide a large enough time constant to filter out any rapid changes in the resultant d-c that is applied to the grid of V12. This condition prevents overcompensation, thus eliminating a *hunting* effect of the afc circuit.

b. Assuming that the carrier in the receiver is at center frequency, the resultant d-c at the grid of V12 is zero. Plate current remains constant, and causes a constant current to flow through the primary of saturable reactor T3. The secondary

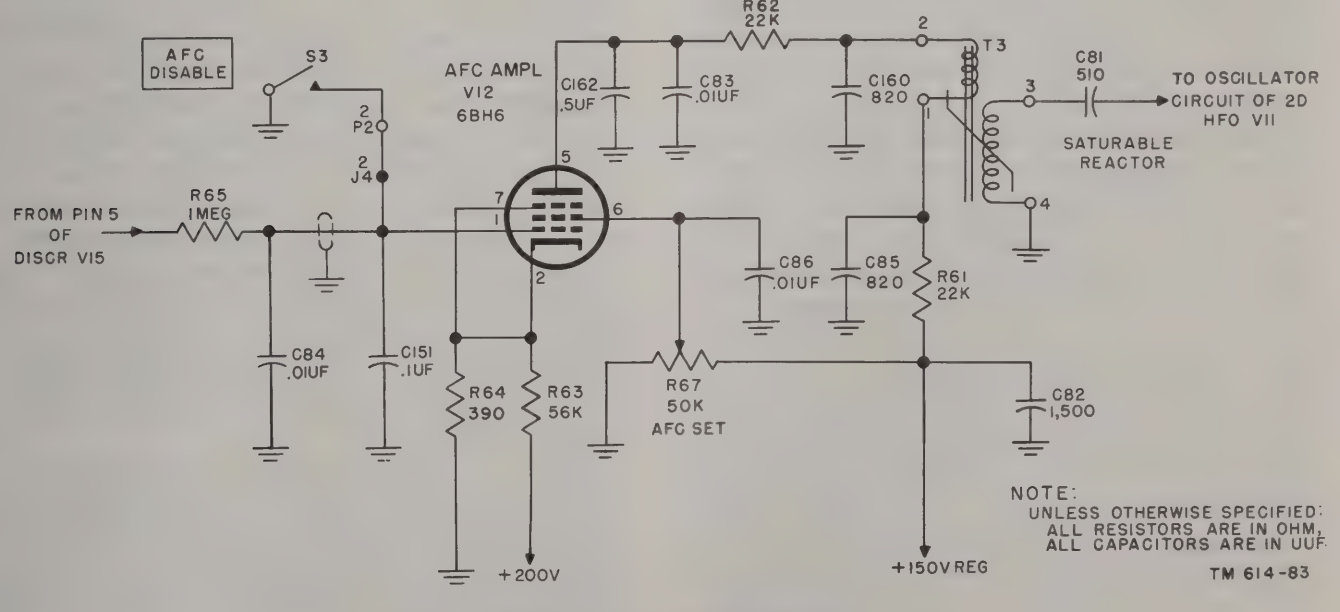


Figure 107. Afc circuit, receiver.

circuit of T3 is one of the frequency determining components in the oscillator circuit of second high-frequency oscillator V11. The constant current in the primary results in a constant value of inductance in the secondary of T3. Plate voltage for the afc amplifier tube is applied from a 150-volt regulated power source through R61, the primary of T3, and R62. When AFC SET control R67, in the screen circuit of V12, is adjusted to cause 1 ma of plate current to flow, the secondary of T3 provides the proper parallel inductance for center frequency operation. Resistor R62 and capacitor C83 provide additional filtering of rapid d-c variations at the plate of V12. Capacitors C160, C85, C82, C162, and C86 decouple audio frequency signals that are present in the circuit.

c. If the carrier shifts above center frequency, a resultant positive d-c voltage appears at the grid of V12. An increase in grid voltage causes a proportional increase in d-c through the primary of T3, and lowers the inductance of the secondary. The decreased inductance in series with C81 effectively increases the capacity across C80, which in turn lowers the operating frequency of the second high-frequency oscillator and returns the carrier to center frequency. Conversely, a negative voltage at the grid of V12 causes less plate current to flow, and increases the T3 secondary inductance, resulting in a higher operating frequency of the second high-frequency oscillator.

d. Fixed bias for the afc amplifier is supplied to the cathode through a voltage divider network R63 and R64, which is connected to the 200-volt power source. Because the afc circuit compensates for frequency drifts up to 400 kc, and because of the large time constant of R65 and C151, it is possible for the receiver to *hold* on an adjacent frequency when switching from one channel to another. Correction is provided by AFC DISABLE switch S3 on the front panel of the receiver. Pressing the spring-loaded button switch discharges capacitors C151 and C84, and allows normal afc action when the switch is released.

162. Meter Switching Circuits

The meter circuit of Radio Receiver R–125/GRC–10 consists of: meter amplifier V17A; meter rectifier V17B; two-deck, three-wafer, 12-position switch S5; and ammeter M1. The circuit enables the operator to check the performance of various stages within the receiver. When the radio set is operated as a terminal station, audio channels 2, 3, 4, and 5 cannot be demodulated at the receiver; therefore, the output level that feeds the telephone terminal equipment is adjusted with the LINE LEVEL control and the metering circuit. The metering stage also aids in localizing troubles to components, sections, or circuits of the receiver during erratic operation. The meter consists of two scales, one calibrated from −9 db to +3 db, and the other calibrated from 0 to 100 for d-c voltage and current readings. Figure 108 is a functional schematic of the meter circuit.

a. Oscillator 1. With the METER SW set to the OSC 1 position, the signal from the first high-frequency oscillator is coupled through an isolating network to pin 6, section 2, rear, of S5. The signal continues from pin 2 of S5 to pin 7 of J4, pin 7 of P2 and to one side of microammeter M1. Because of changes in grid voltage of the first high-frequency oscillator for each of 17 different operating frequencies, the meter will indicate a different reading for each frequency. Any value between 10 and 40 microamperes indicates satisfactory operation. The circuit is completed to ground from the meter through pin 8 of P2, pin 8 of J4, and pins 2 and 6 of S5, section 1, rear.

b. Oscillator 2. With the METER SW in the OSC 2 position, the signal from the second high-frequency oscillator is coupled through an isolating network to switch S5, pin 7, section 2, rear. The signal continues through the meter, and follows the same path as in the OSC 1 position. A reading between 15 and 50 microamperes indicates normal operation of the second high-frequency oscillator.

c. Third Fixed I-f. With the METER SW set to the 3RD I-F position, the meter gives a relative indication of the amplitude of the received signal, which is proportional to the grid voltage at third fixed i-f amplifier V8. The grid voltage is coupled to pin 8 of S5, section 2, rear. A minimum reading of 10 microamperes indicates satisfactory operation of the previous stages. No maximum can be stated because strong input signals to the receiver will cause an increased grid leak bias at the third fixed i-f. The meter circuit continues through the same path to ground as in the OSC 1 position.

d. First Limiter. With the METER SW set to the 1ST LIM position, the signal from the grid of first limiter V13 is coupled through an RC isolating network to pin 9 of S5, section 2, rear. The meter circuit reads the value of grid bias, which

is directly dependent on the strength of the input signal to the receiver. A zero reading is observed during no signal conditions, but a deflection up to 60 microamperes is possible during strong input signal conditions.

e. Discriminator Primary. With the METER SW set to the DISC PRI position, a meter reading, which is relative to the signal strength in the primary of the discriminator transformer is obtained. However, because of the high gain ahead of this point, the meter will also read with no signal being received. Therefore, this meter position can be used only for adjusting the primary slug with a 4.3-mc signal and not as an indication of signal strength at the antenna jack. An RC isolating network couples the signal from pin 7 of V15 to pin 10 of S5, section 2, rear. The circuit through the meter to ground follows the same path as in the OSC 1 position.

f. Discriminator Zero. The DISC + and DISC − positions of the METER SW indicate to the operator if the received signals are at the center frequency of the desired carrier. During operation, if the receiver frequency drifts, the amount and direction of shift can be detected by switching the METER SW back and forth from the DISC + to DISC − positions. When the receiver is operating *on frequency*, a zero reading is observed. If the frequency drifts above the center frequency, a meter reading, which is relative to the amount of shift, will be indicated in the DISC + position. If the frequency shifts below the center frequency, a similar reading is obtained in the DISC − position.

(1) With the METER SW in the DISC− position, the resultant d-c from the discriminator is applied to pin 11 of S5, section 2, rear. The signal continues through the meter circuit to ground at pin 11 of S5, section 1, rear.

(2) With the METER SW in the DISC+ position, the resultant d-c is applied at pin 12 of S5, section 1, rear, through the meter circuit, and to ground through pins 2 and 12, of S5, section 2, rear.

163. Line Level Meter Circuits

a. The signal that is picked up by the receiver is coupled from the plate of V21 through C110 to the grid of meter amplifier V17A. One triode section of a 12AT7 acts as a cathode follower, and couples the signal to meter rectifier V17B. With the plate and grid of V17B externally tied together, the tube functions as a diode rectifier. The rectified output, a d-c voltage that represents the audio that is applied to the receiver wide-band amplifier, is fed to the meter at pin 1 of S5, section 2, rear. The circuit continues to ground through pin 1 of S5, section 1, rear.

b. With a 1,000-cycle TEST signal being received, the LINE LEVEL control is adjusted for a meter reading of zero db. Under these conditions, the wide-band receiver output that feeds the telephone equipment at a terminal station, will be a 1,000-cycle audio note at zero dbm.

c. When the METER SW is in the LINE LEVEL position, pins 4 and 5 of S5, section 2, front, complete the cathode circuit of V17A to ground. Potentiometer R95, *Line Level Meter Zero*, compensates for the contact potential of rectifier V17B. The current through meter M1 is adjusted with *Line Level Meter Calib* control R97. The 200-volt supply is applied directly to the plate of V17A. A high input impedance is provided by grid resistor R92 and cathode resistor R94. The signal is developed across R94 and coupled to the rectifier circuit through C111.

164. Filament Circuit

(fig. 109)

Radio Set A/GRC–10 can operate from three source voltages: 230 or 115 volts a-c, or 26 volts d-c. The receiver uses 6- and 12-volt tubes in a series-parallel arrangement, with 26 volts across the six parallel branches. During a-c operation (230 or 115 volts), the 26 volts required for the filaments is obtained from filament transformer T302. When the radio set is operating on 26 volts d-c, the source voltage is applied directly to the filament circuit.

a. The first parallel branch of the filament circuit (fig. 109), has two 6-volt tubes, V18 and V23, paralleled by 12-volt tube V20, all in series with V19 and V15. Capacitors C129, C130, and C153 decouple any r-f and audio frequency variations of the individual stages from the power source. Choke L64 blocks the r-f of the discriminator from the filament of V19.

b. The second parallel branch consists of the 12-volt filament of V22 in series with the 6-volt filaments of tubes V13 and V14. Capacitors C131,

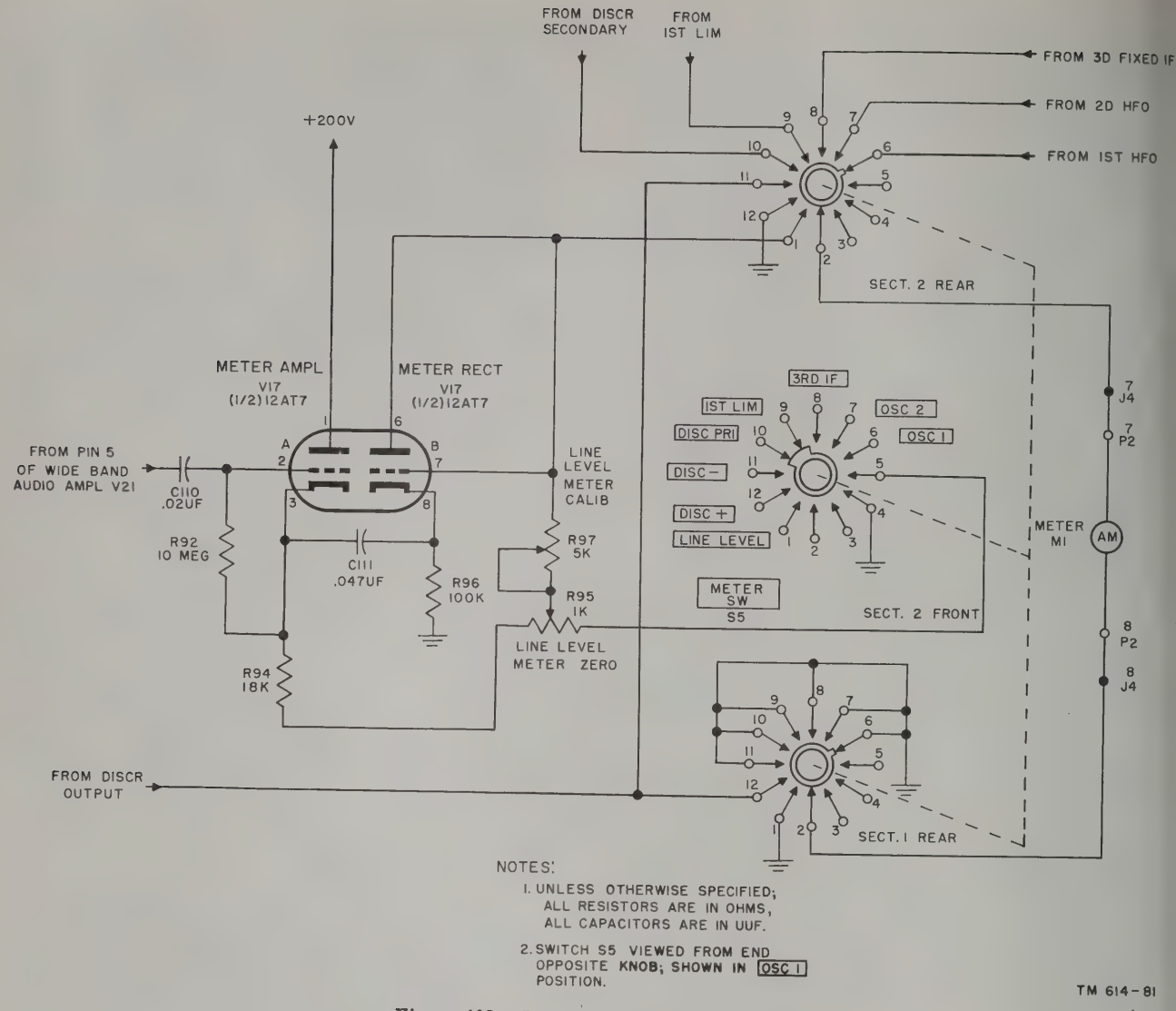


Figure 108. Receiver metering circuit.

C167, and C132 provide r-f bypassing; choke L65 blocks the r-f between the two limiter stages.

c. The third parallel branch of the filament circuit consists of four 6-volt filaments in series, V1, V2, V3, and V21. The first variable i-f filament draws less current than the others in series with it, and necessitates the use of parallel resistor R131. Capacitors C133, C134, C135, C136, C145, C154, and chokes L66, L67, and L68 provide decoupling and blocking of r-f and audio frequencies, and reduce any effects of interaction between stages.

d. The fourth parallel branch consists of the 12-volt filament of V10, in series with the two 6-volt filaments of V11 and V12. Three capacitors, C155, C156, and C159, decouple the power source from any r-f voltages that are present at the individual stages.

e. The fifth branch consists of V4, V5, and V17 in series. Capacitors C163, C164, and C150 provide sufficient decoupling from the power source.

f. The final parallel branch of the filament circuit consists of four 6-volt filaments in series, V6, V7, V8, and V9. Capacitor and choke networks, similar to those previously described, provide decoupling and r-f blocking.

165. Receiver B+ Distribution
(fig. 172)

a. The positive side of a 200-volt d-c source that originates at the power supply is fed to the receiver at pin A of POWER connector J1. This

B+ voltage, which continues through pin 13 of P2 and pin 13 of J4, is applied to the plate and screen circuits within the receiver. Figure 172 shows the relative position of each tube in relation to the power source, pin A of POWER connector J1.

b. The plate of voltage regulator V16 connects to +200 volts through the parallel combination of resistors R87 and R134. The regulated 150 volts output supplies plate and screen voltage to those stages where fluctuations could appreciably affect receiver operation. The plates and screen grids of V11 (second high-frequency oscillator) and V12 (afc amplifier), and the screen of V14 (second limiter) are tied to the regulated 150 volts through their respective circuits.

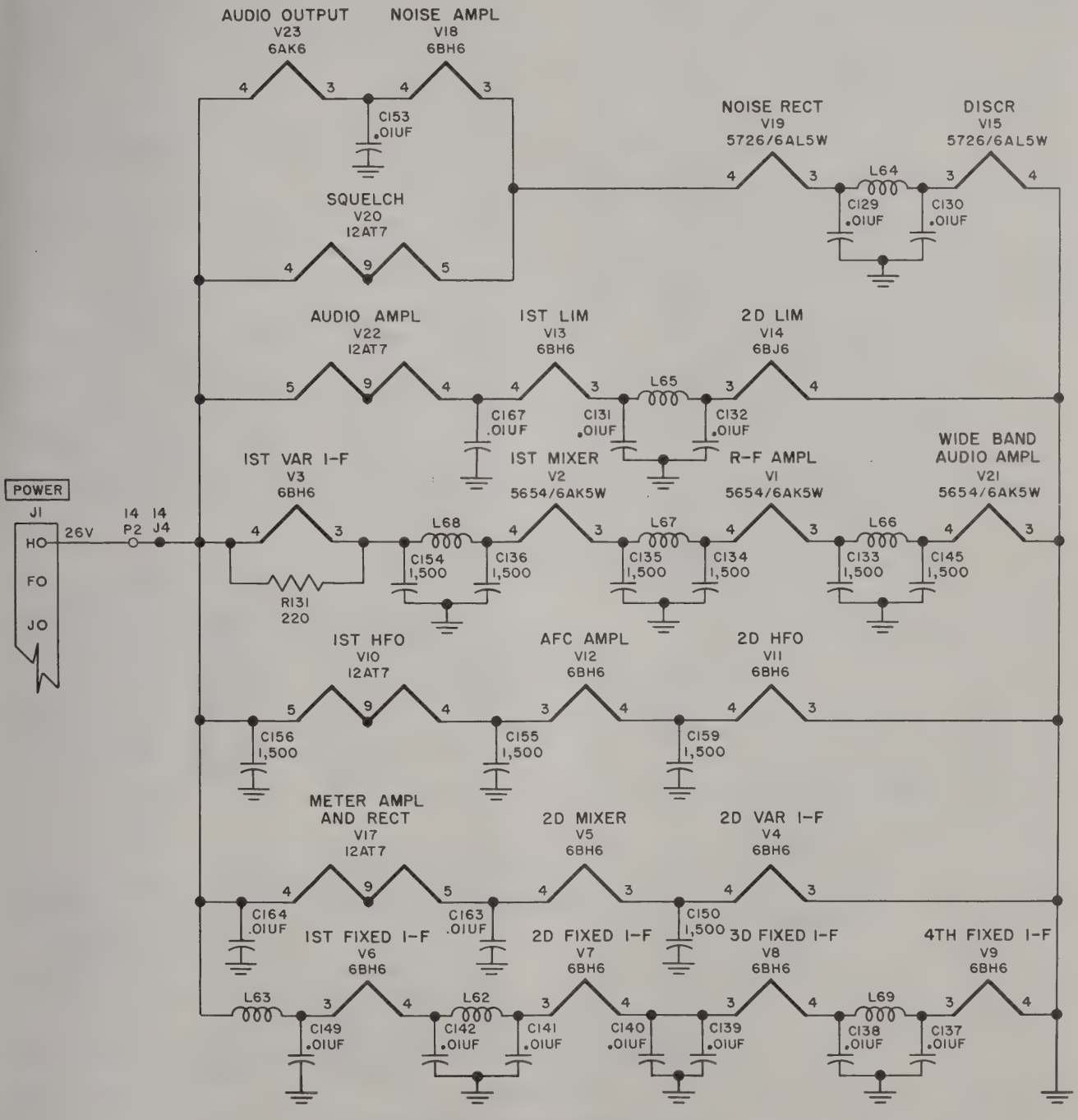


Figure 109. Receiver filament circuit.

166. Block Diagram
(fig. 110)

Dynamotor-Power Supply DY–94/GRC–10 provides operating voltages for Radio Set AN/WRC–10. The power supply operates from 115 volts or 230 volts a-c, 50–65 cps, or from 26 volts d-c. In place of diode vacuum tubes, the component uses selenium rectifiers in both bridge- and doubler-type circuits; this provides longer, cooler operation. A blower, housed within the power supply, keeps the interior at a safe operating temperature when the surrounding temperature is below 150° F. Power drain during a-c operation is 225 watts and during d-c operation is 335 watts. Because of the high current drain when operating from a d-c source, the equipment should be connected to either 115 volts or 230 volts a-c whenever possible, with a 26-volt battery connected as a *standby* power source. If the a-c source fails, a series of relay operations automatically changes the equipment to battery operation.

a. Power Input. The power source voltage is applied through cables at the rear of Radio Set Control C–632/GRC–10. From the control unit, the a-c voltage is fed to the power supply through pins K and J of POWER conector J301. The 26-volt d-c input, although not applied until an a-c power failure occurs, is fed to the power supply through pins A and F of POWER connector J301.

b. LINE VOLTAGE Switch. Transformers T301, T302, and T303 have dual primary windings, each rated for 115 volts a-c. The two primaries of each transformer are placed in parallel with each other by LINE VOLTAGE switch S301 during 115-volt operation. When the equipment is operated from a 230-volt a-c power source, S301 switches the two primaries in series with each other. The operator should determine the type of source voltage before turning on the equipment because an incorect setting of the LINE VOLTAGE switch will cause either blowing of line fuses or possible damage to the equipment.

c. Transmitter Power Circuits. One secondary winding of transformer T303 supplies a stepped-up a-c voltage to selenium rectifier CR304. This voltage is rectified by CR304, filtered by capacitor C303 and choke L305, and fed as a +550-volt supply to pin A of XMTR POWER jack J303. This voltage is used to supply the plate of the power amplifier in the transmitter. Another secondary winding of T303 supplies an a-c voltage for the

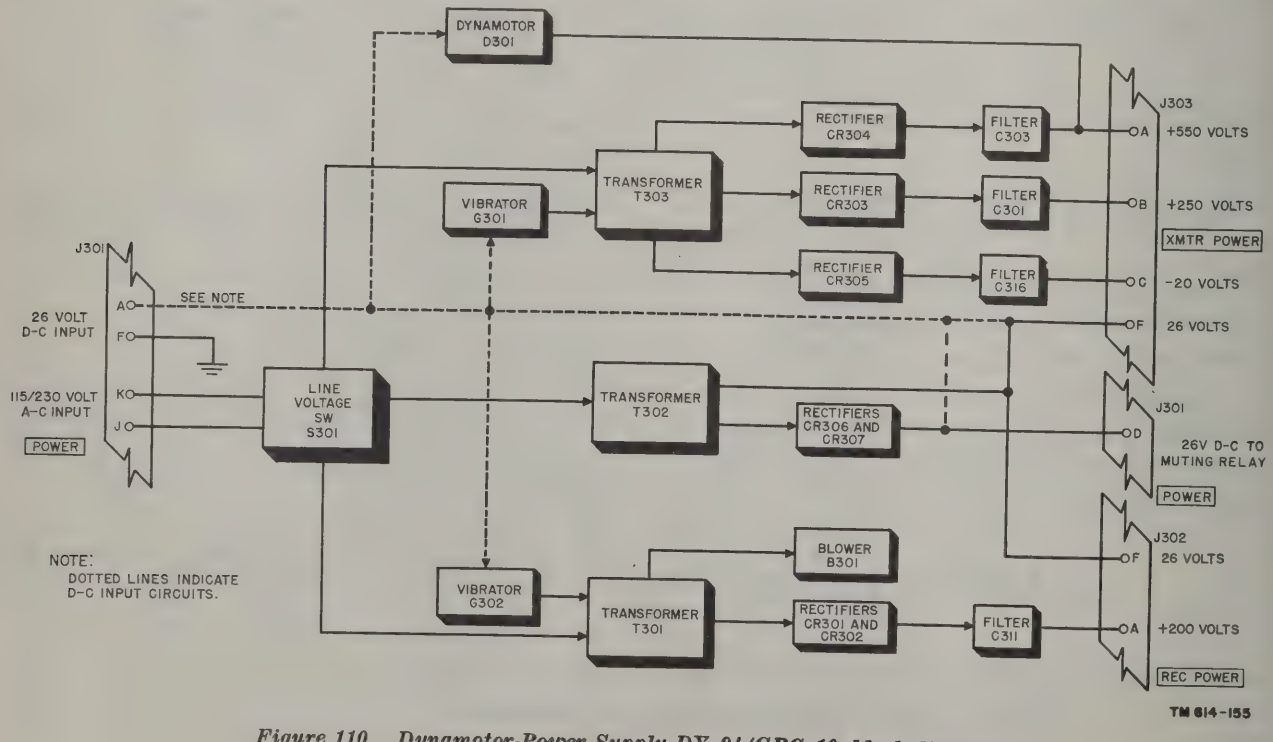


Figure 110. Dynamotor-Power Supply DY–94/GRC–10, block diagram.

+250-volt circuit. The a-c voltage is rectified by selenium rectifier CR 303, filtered by C301, L303, and L304, and fed as a +250-volt supply to pin B of XMTR POWER jack J303. A third secondary winding of T303 is connected to rectifier CR305. The output of this rectifier, filtered by C316, is 20 volts, used as a bias voltage for the power amplifier stage and as a d-c voltage for the microphone of the handset. The negative side of this voltage is fed to the transmitter through pin C of XMTR POWER jack J303.

d. Receiver Power Circuits. The secondary of transformer T301 applies a stepped-up a-c voltage to rectifiers CR301 and CR302. The rectified output is filtered by C311 and L302 and then is fed to pin A of REC POWER jack J302.

e. Filament Supply. Filament transformer T302 steps down the input voltage of 115 or 230 volts a–c to an output voltage of 26 volts a-c. One secondary supplies filament voltage to pin F of XMTR POWER jack J303 and the other to pin F of REC POWER jack J302. The 26 volts a-c is also rectified by CR306 and CR307 and used to energize the push-to-talk relay.

f. D-c Operation. When the a-c power source fails, Radio Set Control C–632/GRC–10 automatically applies 26 volts d-c to pins A and B of POWER jack J301. From this jack the voltage is fed to vibrators G301 and G302, and to the filament circuits of the transmitter and receiver at pins F of J302 and J303. The 26 volts d-c is also fed to dynamotor D301, the output of which is applied to pin A of J303. Transformers T301 and T303 each have a primary winding that is rated for 26 volts, and are fed by vibrators G301 and G302. T301 and T303 transform the pulses at the primary to an a-c voltage at the secondary. The secondary circuits function in the same manner as for a-c operation.

167. A-c Input

Figure 111 is a functional schematic diagram of the input circuit to the power supply. The use of dual primary windings for transformers T301, A302, and T303, each rated for 115 volts, permits operation of the equipment from either a 115- or a 230-volt a-c power source. With LINE VOLTAGE switch S301 in the 230 position, the two primaries of each transformer are in series, and provide an input rating for each transformer of 230 volts a-c. With the switch in the 115 position, the two primaries are in parallel, and provide a total input rating of 115 volts a-c. The source voltage is applied at pins J and K of POWER jack J301.

a. 115-Volt Operation. Pin J is connected directly to terminals 7 and 9 of T301, terminals 1 and 3 of T302, and terminals 8 and 10 of T303.

(1) Pin K of POWER jack J301 is connected to terminals 6 and 8 of T301 through the circuit that consists of fuse F304, pins 10 of J304 and P304, terminals 6 and 7 of relay K301, pins 3 of P304 and J304, and terminals 32 and 33 of LINE VOLTAGE switch S301.

(2) Pin K is connected to terminals 2 and 4 of filament transformer T302 through fuse F303, and terminals 22 and 23 of switch S301.

(3) The circuit between terminals 9 and 11 of T303 and pin K of POWER jack 301 is completed through fuse F305, pins 8 of J304 and P304, terminals 8 and 13 of relay K301, pins 11 of P305 and J305, and terminals 12 and 13 of switch S301.

(4) During a-c operation, relay K301 is in a de-energized position, and is energized only during d-c operation.

b. 230-Volt Operation. With LINE VOLTAGE switch S301 set to the 230 position, the input from pin J of J301 is applied to terminal 9 of T301, terminal 1 of T302, and terminal 8 of T303. Switch S301 places the dual primaries in series with each other for 230-volt operation.

(1) The circuit from terminal 6 of T301 follows the same path through the swing-out deck and fuse F304 as for 115-volt operation.

(2) The filament transformer circuit is completed from terminal 4 of T302 through fuse F303 to pin K of POWER jack J301.

(3) The circuit from power transformer T303 continues from terminal 11 through the same path as for 115-volt operation.

168. D-c Input

(fig. 112)

During an a-c power failure, the control unit automatically applies the 26 volts d-c (standby battery) to the input of the power supply at POWER jack J301. The positive side is connected to pins A, B, and H. Because the negative side of the battery is grounded, pins E and F of jack J301, which are also grounded, complete the d-c circuit. The voltage is applied to vibrators

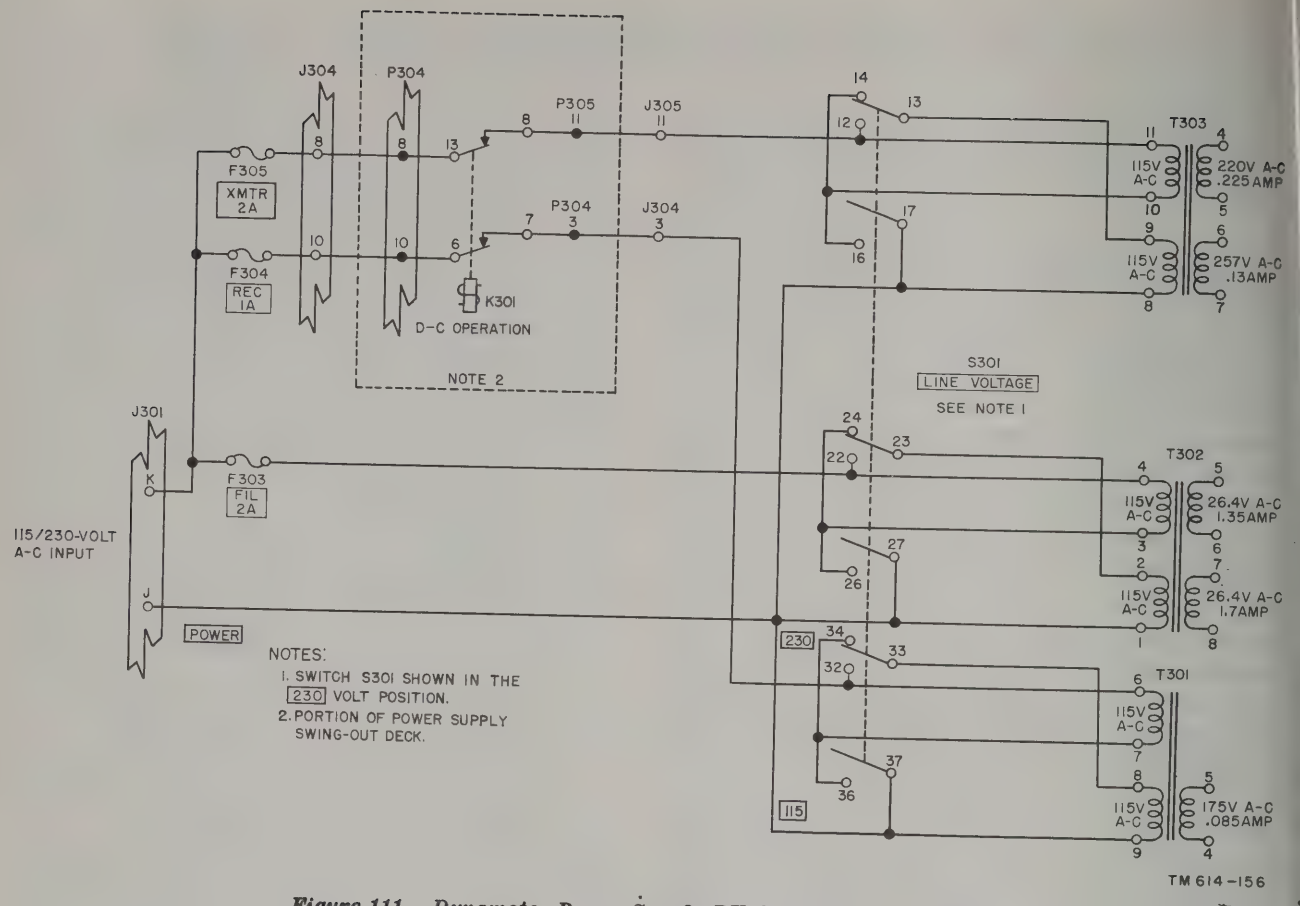


Figure 111. Dynamotor-Power Supply DY-94/GRC-10, a-c input.

G301 and G302, to the filament circuits of the receiver and transmitter, and to the dynamotor.

a. D-c Relays. The 26 volts from pin H of POWER connector J301 is fed through pins 10 of J305 and P305 and through the solenoid of relay K301 to ground. The 26 volts from pins A and B of J301 is fed through pins 13 of J304 and P304, through solenoid of relay K302 to ground. During d-c operation, current that flows through the solenoids energizes the relays, completes the vibrator circuit, and applies filament power to the receiver and transmitter.

b. Vibrator G301. Vibrator G301, connected as nonsynchronous type, operates at 95 cps and changes the 26 volts d-c to a-c. At the instant terminals 9 and 14 of relay K301 close, electrons flow from ground through the relay contacts, through pins 14 of P305 and J305 to terminal 3 of G301. The circuit continues through the coil and the reed to terminal 6, through parallel resistors R301 and R309 and fuse F301, back to the power source at pin A of J301. At this instant, the magnetic field that is created by the vibrator coil attracts the reed toward it, and closes the circuit between terminals 1 and 2. A pulse of d-c flows through one-half of the primary (terminals 1 and 2) of transformer T303. The expanding and collapsing magnetic field produced by the pulse induces a half cycle of a-c in the secondaries. When the vibrating reed swings toward the coil, the circuit that causes current flow through the coil is broken. The magnetic field collapses, the spring action swings the vibrating reed in the other direction, and the circuit between terminals 4 and 5 is closed. A pulse of d-c passes through the other half (terminals 2 and 3) of T303 of the opposite polarity from the first, and results in a complete a-c cycle at the secondaries. The vibrating reed returns to the position where the circuit through the coil is completed once again, and results in a duplication of the first cycle. Thus the current through the driving coil is interrupted by periodic open circuiting. As the reed vibrates, electrons flow alternately through vibrator contacts 1 and 5 that are connected to the primary of T303, constituting an a-c which induces a stepped-up a-c voltage in the two secondary windings (6 and 7 and 4 and 5). Resistor R302 limits the cur-

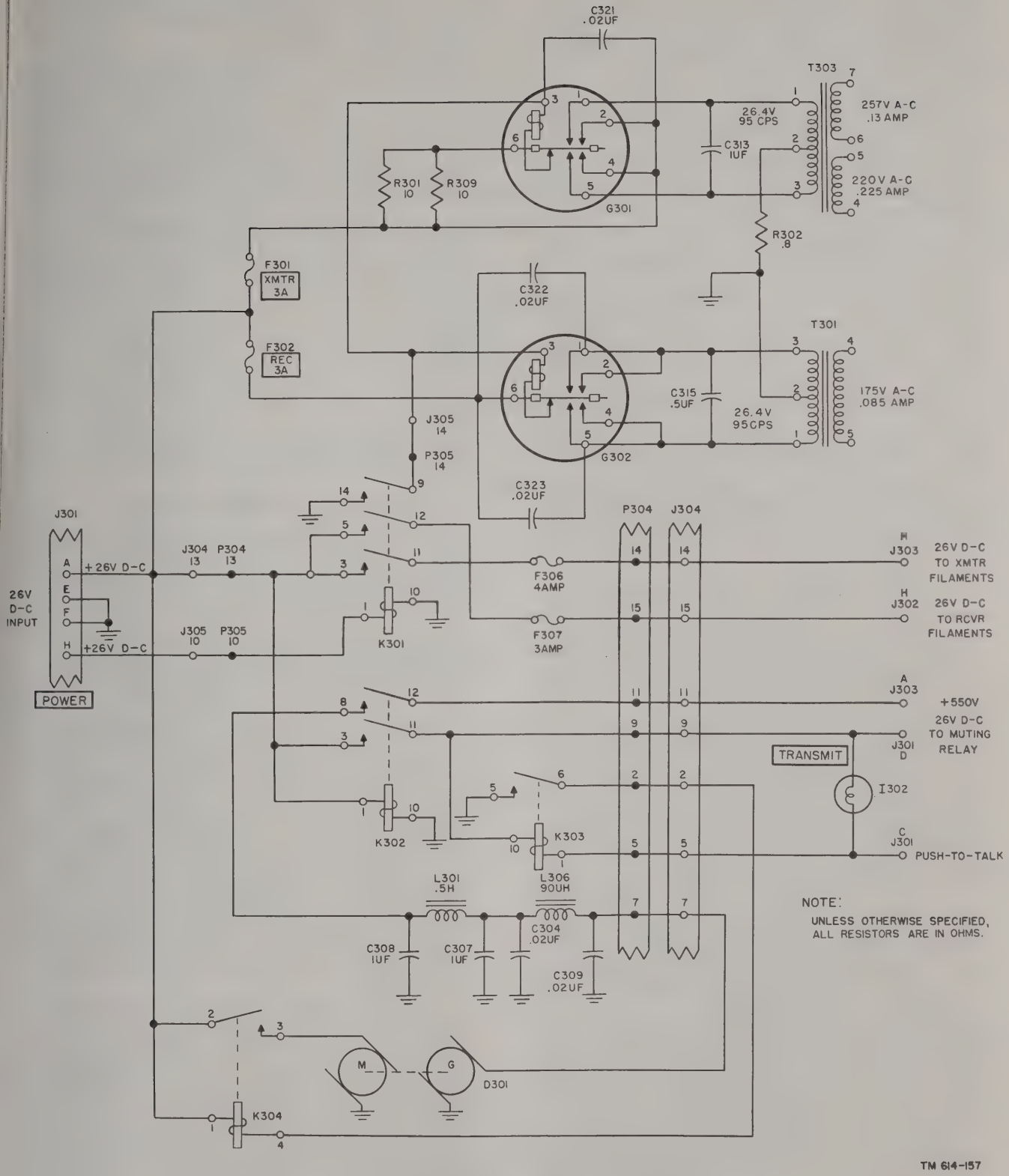


Figure 112. Dynamotor-Power Supply DY-94/GRC-10, d-c input.

rent through the primary of T303; buffer capacitor C313 reduces arcing, thereby preventing damage to the vibrator contacts. Capacitor C321, connected between terminal 3 and terminals 2 and 3 of the vibrator, prevents arcing.

c. Vibrator G302. This vibrator is the same type as G301. With transformer T301, it produces a-c voltage from the 26-volt d-c source. The positive side of the 26-volt d-c source is connected through fuse F302 to terminal 6 of the vibrator. Because the vibrating reed is connected to terminal 6, it completes the circuit alternately to terminals 1 and 2, which are connected together, and to terminals 4 and 5, which are also connected together. The result is that when the reed contacts terminals 1 and 2, current flows through half of the primary of T301, between terminals 2 and 3. When the reed contacts terminals 4 and 5 of the vibrator, current flows through the other half of T301, between terminals 2 and 1. An a-c voltage appears across the secondary of T301, between terminals 4 and 5. Capacitors C315 and C322 reduce arcing of the vibrator contacts.

d. Filament Supply.

(1) The positive side of the 26 volts d-c for the transmitter filament circuit appears at pin H of J303. The electrons flow from ground, through the filament circuit, through pins 14 of J304 and P304, through fuse F306, and through contacts 11 and 3 of relay K301 to the power source, through pins 13 of P304 and J304.

(2) The electrons flow from the filaments of the receiver through pin H of J302, pins 15 of J304 and P304 and through F307, and continue through contacts 12 and 5 of relay K301 to the positive side power source, through pins 13 of P304 and J304.

e. Push-To-Talk. During PUSH-TO-TALK operation, pressing the button on the handset grounds pin C of J301 and completes the push-to-talk circuit. During TERMINAL or RELAY operation, pin C is grounded automatically within the control unit. When the circuit is energized (grounding pin C), electrons flow through pins 5 of J304 and P304, through the solenoid of relay K303 (terminals 1 and 10) and to the power source, through contacts 11 and 3 of relay K302. The 26-volts d-c is supplied to the muting relay at pin D of J301, through pins 9 of J304 and P304, and contacts 11 and 3 of relay K302. Electrons flow through TRANSMIT indicator I302 when pin C of J301 is grounded.

f. Dynamotor. Energizing push-to-talk relay K303 closes contacts 5 and 6, and completes the d-c circuit through the solenoid of relay K304 (terminals 4 and 1). Energized relay K304 closes contacts 2 and 3, and applies 26 volts d-c to dynamotor D301. The dynamotor is a combination motor and generator which changes the 26-volt input to a 550-volt d-c output. The positive side of the output from D301 is connected through pins 7 of J304 and P304, to a filter network that consists of C304, C307, C308, C309, L301, and L306. This network filters out variations in the d-c output of the dynamotor. The circuit continues through contacts 8 and 12 of energized relay K302, through pins 11 of P304 and J304, to pin A of XMTR POWER jack J303.

169. Transmitter B Supply Circuits

Figure 113 is a schematic diagram of the rectifier and filter network which supplies B voltages to the transmitter at XMTR POWER jack J303.

a. The a-c voltage from pins 4 and 5 of T303 is applied to bridge rectifier CR303 through pins 4 and 9 of J305, 4 and 9 of P305, and through contacts 2 and 11 of push-to-talk relay K303. CR303 provides full-wave rectification and feeds pulsating d-c to the filter network that consists of L303, L304, C301, and C302A. R307 is a bleeder resistor across the d-c output. The positive side of the filtered d-c is applied through contacts 7 and 8 of push-to-talk relay K303, through pins 1 of P304 and J304 to terminal B of XMTR POWER jack J303. The negative side is grounded. The 250 volts supplies plate and screen voltages for the various stages in the transmitter, except the power amplifier.

b. The a-c voltage from pins 6 and 7 of T303 is applied to bridge rectifier CR304 through pins 6 and 8 of J305 and pins 6 and 8 of P305, through contacts 4 and 5 of de-energized relay K302 and contacts 3 and 4 of push-to-talk relay K303. The d-c output voltage of the circuit is connected in series with the output from CR303. The negative end is connected to the junction between L303 and L304 through contacts 6 and 7 of relay K302. The pulsating d-c output of CR304 is fed to a filter

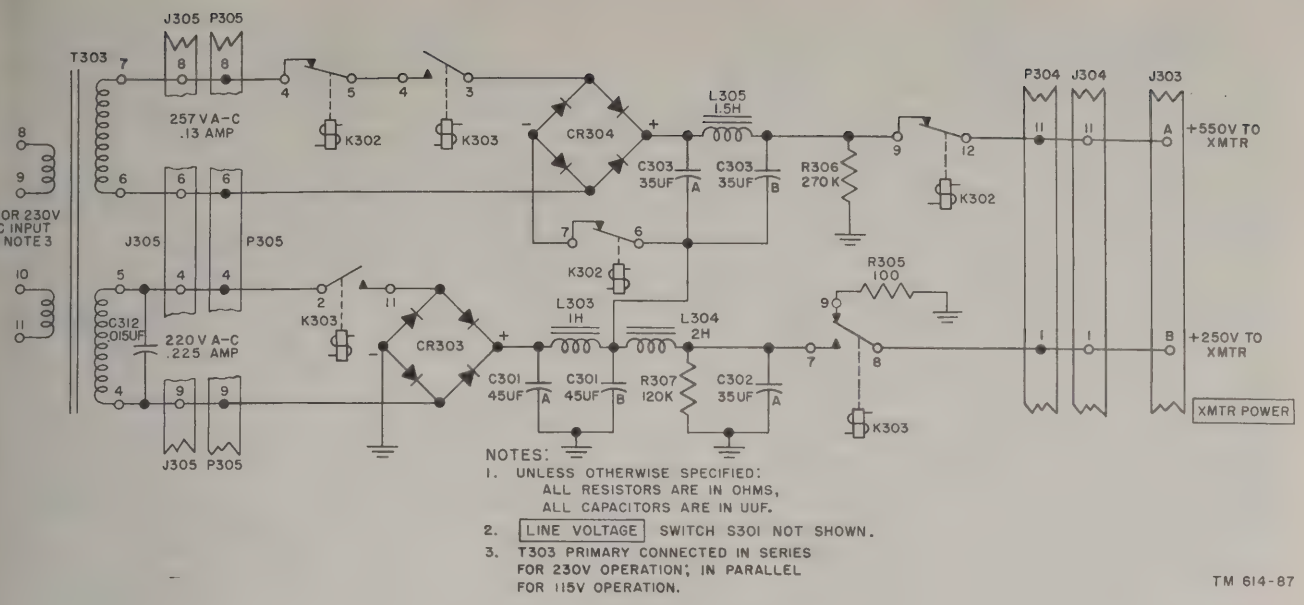


Figure 113. Transmitter B supply circuits.

network that consists of C303 and L305. R306 is a bleeder resistor across the d-c output. The output of the filter (+550 volts) is applied to terminal A of J303 through contacts 9 and 12 of K302 and through pins 11 of P304 and J304. Within the transmitter the +550 volts is used as plate voltage for the type 4X150D power amplifier tube.

c. Relay K302 remains in a de-energized position during a-c operation; it energizes only during d-c operation. Relay K303 remains de-energized until the transmitter is keyed. The transmitter is keyed by pressing the button on the handset during PUSH-TO-TALK operation, or by setting the TYPE OF OPERATION switch to the TERMINAL or RELAY position. Capacitor C312 reduces arcing at the contacts of relay K303 (2 and 11) and protects the selenium rectifiers from surges of current. Resistor R305 provides a discharge path to ground for plate and screen circuits when the transmitter is not keyed.

170. Receiver B Supply Circuits

The lower portion of figure 114 shows a simplified schematic diagram of the circuit that supplies B voltage to the receiver. The stepped-up a-c at the secondary of T301, terminals 4 and 5, is applied to bridge rectifier CR301 through terminals 4 and 12 of J304, and terminals 4 and 12 of P304. The full-wave rectified output is filtered by C311 and L302 and applied to terminal A of J302 to supply 200 volts to the receiver plate and screen circuits. Buffer capacitor C306 prevents arcing of the vibrator contacts and damage to the bridge rectifier that results from surges of current during d-c operation. Resistor R308 functions as a bleeder for the 200-volt supply.

171. Filament Supply Circuits

(fig. 114)

The voltage at the primary of T302 induces 26-volt a-c at the secondaries (terminals 5–6 and 7–8). One side of the receiver filament voltage is fed through pins 15 of J305 and P305, contacts 4 and 12 of K301, and through a 3-ampere fuse, F307, to terminal H of J302. One side of the transmitter filament supply is fed through pins 13 of J305 and P305, contacts 2 and 11 of K301 and, through a 4-ampere fuse, F306 to terminal H of J303. The other side of each filament voltage is grounded.

a. Connected to the 26-volt a-c line at terminal 8 of T302 are selenium rectifiers CR306 and CR307. The two rectifiers, in parallel, provide half-wave rectification. The 26-volt pulsating d-c output is filtered by capacitor C302B. When terminal C of J301 is grounded, electrons flow through the solenoid of K303, energizing the push-to-talk relay. Grounding terminal C also causes electron flow through the solenoid of the muting relay located in the control unit.

b. In parallel with the solenoid of K303 is the TRANSMIT pilot lamp, I302, which glows when the relay is energized.

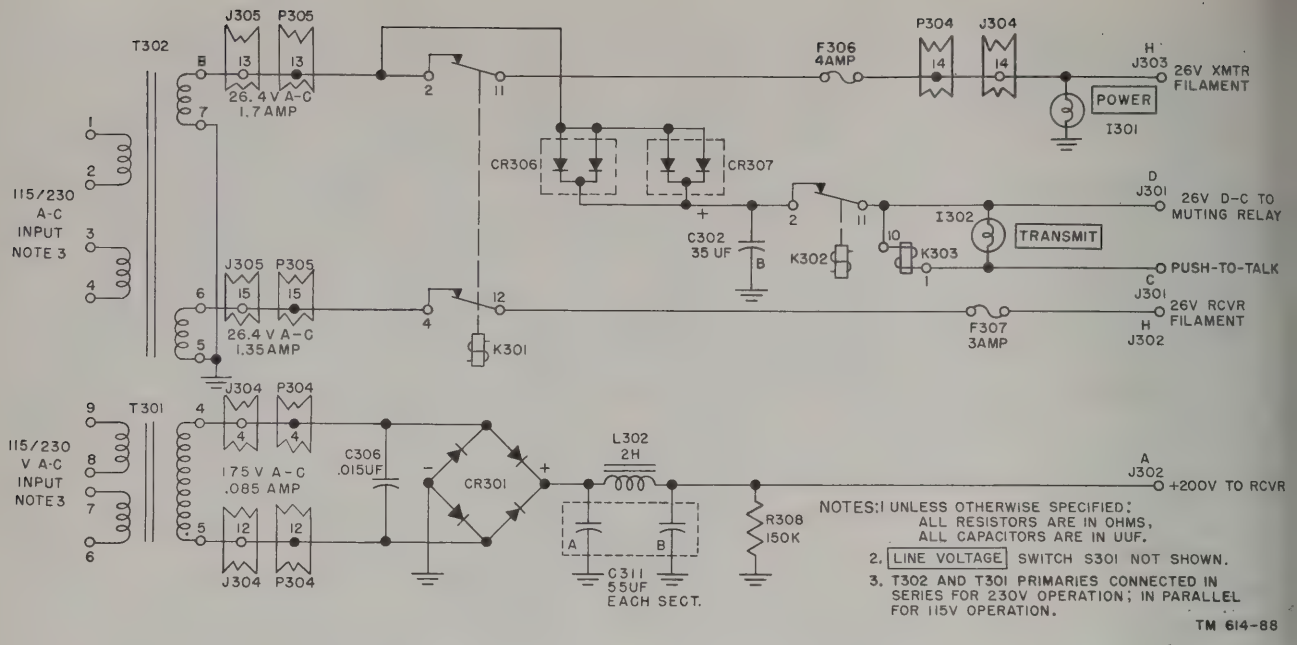


Figure 114. Receiver B supply and filament supply circuits.

c. Current flows through the POWER indicator lamp I301, in parallel with one secondary of T302, when primary power is applied to filament transformer T302.

172. Blower

During a-c operation, the blower, B301, operates from 115 volts a-c (fig. 166). The cool air, drawn in through a vent of the front panel, circulates around the selenium rectifiers and is expelled through another vent. With the blower connected across one primary of T301, terminals 8 and 9, the voltage across it will be 115 volts a-c, regardless of the power source voltage. During d-c operation, the pulsating d-c across the primary of T301, (terminals 1, 2, and 3) induces 115 volts in the a-c primary (terminals 8 and 9). Effectively, the primary becomes a secondary during d-c operation. To accommodate the a-c line voltage or the vibrator output, the blower operates satisfactorily from 50 to 95 cycles a-c.

173. Negative 20-Volt Supply (fig. 166)

a. A negative 20-volt d-c is used at the transmitter to provide fixed bias for the power amplifier stage and to provide a d-c voltage for the microphone of the handset. Selenium rectifier CR305 is connected across terminals 1 and 3 of T303, through pins 3 and 5 of J305 and pins 3 and 5 of P305. During d-c operation, the pulses from the output of G301 are rectified by CR305. During a-c operation this primary (terminals 1, 2, and 3) becomes a secondary with 26-volt a-c induced. CR305 provides full-wave rectification of the applied a-c.

b. The pulsating component of the rectified voltage is filtered by a dual capacitor, C316A and C316B. The −20 volts is fed to terminal C of XMTR POWER jack J303 through pins 6 of P304 and J304. Capacitors C305 and C310 and choke coil L307 filter hash produced by vibrator G301. R304 is a current limiting resistor.

Section IV. THEORY OF RADIO SET CONTROL C–632/GRC–10

174. Differences Between Control Units

Because of changes in design, certain differences exist between the schematic diagrams in this section and some of the actual control units. The table below shows the units that differ from the diagrams, and what the differences are. *Note that this table applies only to control units manufactured under Order No. 92-Phila-52.* The order number appears on the front panel name plate of the control unit following the serial number.

Ref symbol	Serial numbers	Differences
S401	1 through 20--	Terminal 8, section 2, not grounded.
S401	1 through 50--	Terminal 11, section 1, not connected to terminal 5, section 3.

175. General

Radio Set Control C–632/GRC–10 provides switching connections for the input power, selects the desired type of operation, and provides wideband input and output connections for associated telephone equipment used during TERMINAL operation. The unit is mounted to the underside of Electrical Equipment Rack MT–700/GRC–10 by four cap screws. A special feature of the control unit is the automatic switchover from a-c to d-c operation during an a-c power source failure. A complete schematic diagram is given in figure 119.

176. Input Circuits

Figure 115 is a functional schematic diagram of Radio Set Control C–632/GRC–10 input circuits. The input power plug, P401, mounted at the rear of the panel and chassis assembly, mates with J406, mounted at the rear of the control unit case. The a-c input cable enters the left side of the case and the d-c input cable enters the right side. The 115- or 230-volt a-c is applied to terminals 5 and 7 of P401, and the 26-volt d-c to terminals 4 and 6 (negative to 4, positive to 6). Protection for the component parts of the control unit is provided by 4-ampere line fuses F401 and F402 during a-c operation and fuse F403 during d-c operation.

a. During normal a-c operation, with either 115 or 230 volts applied to the input, relay K402 is energized to complete the circuit and to connect the a-c voltage to terminals J and K of POWER jack J404. The connections are made through contacts 4 and 5 and through contacts 6 and 7 of a-c power relay K402, respectively. Failure of the a-c power supply results in automatic switchover to d-c because, when K402 is not energized. the positive side of the d-c circuit is completed through contacts 2 and 3 of relay K402. These contacts are closed when the relay is not energized.

(1) The plate of voltage regulator tube V401 and the cathode of voltage regulator tube V402 are connected to one side of the a-c input through half of MASTER POWER switch S402. The cathode of V401 and the plate of V402 are connected to the other side of the a-c input through resistor R402. Rectifier CR401, a full-wave bridge rectifier, is connected in parallel with the two voltage regulator tubes. During 115-volt operation, V401 and V402 have no effect in the circuit, because they require about 150 volts before they conduct. The input voltage, therefore, is applied to rectifier CR401 through resistor R402. The rectified output of CR401 flows through the coil of relay K402, limited by resistor R404.

(2) When 230-volt a-c is applied to the input, V401 and V402 conduct alternately, each conducting on ½ of each cycle. With R402, the voltage regulating tubes form a voltage divider. Because CR401 is connected in parallel with the two tubes, the voltage that appears across the tubes is applied to the rectifier. The rectifier and relay K402 operate satisfactorily on a-c voltages, applied to the rectifier, between 110 and 150.

b. When power relay K402 is not energized (failure of the a-c power supply or failure of fuses F401 and F402) the positive side of the d-c input circuit is completed through R401, the coil of d-c power relay K401, contacts 2 and 3 of a-c power relay K402, and half of MASTER POWER switch S402. Thus, d-c power relay K401 is energized, closing its contacts 2 and 3 and completing the circuit between the positive side of the d-c power source and terminals A, B, and H of POWER jack J404. Fuse F403 in the positive lead protects the parts in the d-c circuit of the control unit from damage resulting from shorts or surges. Capacitors C401 and C402 protect the windings of relays K401 and K402, respectively, from surges of voltage that occur at the moment when power is disconnected.

c. Pilot lamp, I401, OPERATING ON DC, connected between contact 2 of K401 and ground, indicates when the set is operating from a d-c power source.

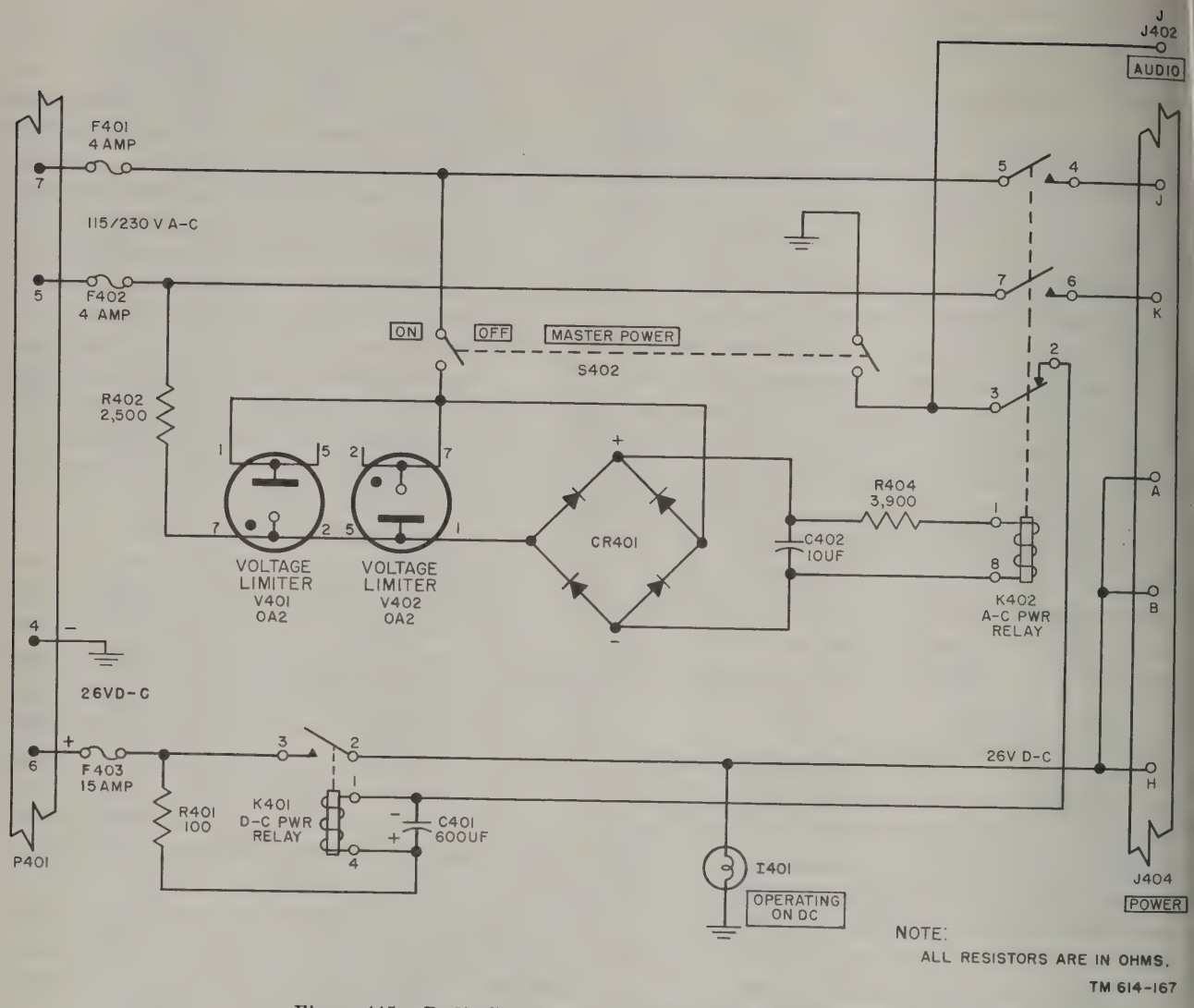


Figure 115. Radio Set Control C–632/GRC–10, input circuit.

177. Push-to-Talk Operation
(fig. 116)

a. With the TYPE OF OPERATION switch, S401 set to the PUSH-TO-TALK position, the radio set operates as a single channel transmitter and receiver capable of operating both simplex and duplex. The power supply provides 26-volt d-c to terminal D of POWER jack J404. This voltage is used to energize the speaker muting relay, K403. Grounding terminal B of XMTR CONTROL jack J405, terminal F of AUDIO jack J402, or terminal C of J404 causes electrons to flow from ground through the solenoid of K403 and current limiting resistor R405 to the positive side of the 26-volt d-c source. Electrons also flow through contacts 7 and 8 of S401, section 3, to the power supply, energizing the TRANSMIT indicator lamp and the push-to-talk relay. These circuits are generally energized by pressing the push-to-talk button on Handset H–33/PT, connected to the AUDIO jack of the transmitter (J202) or control unit (J402). Note that the transmitter cannot be keyed when the handset is connected to receiver AUDIO jack J3. Capacitor C404 eliminates the inductive kick of relay K403. The handset connected to the receiver AUDIO jack will be muted when the transmitter is keyed from either of the other two AUDIO jacks.

b. With relay K403 energized, the speaker circuit of the receiver, terminal K of J401, is ungrounded by the open contacts 2 and 3. The audio output of the receiver can be heard at the earpiece of the handset but not at the speaker. Releasing

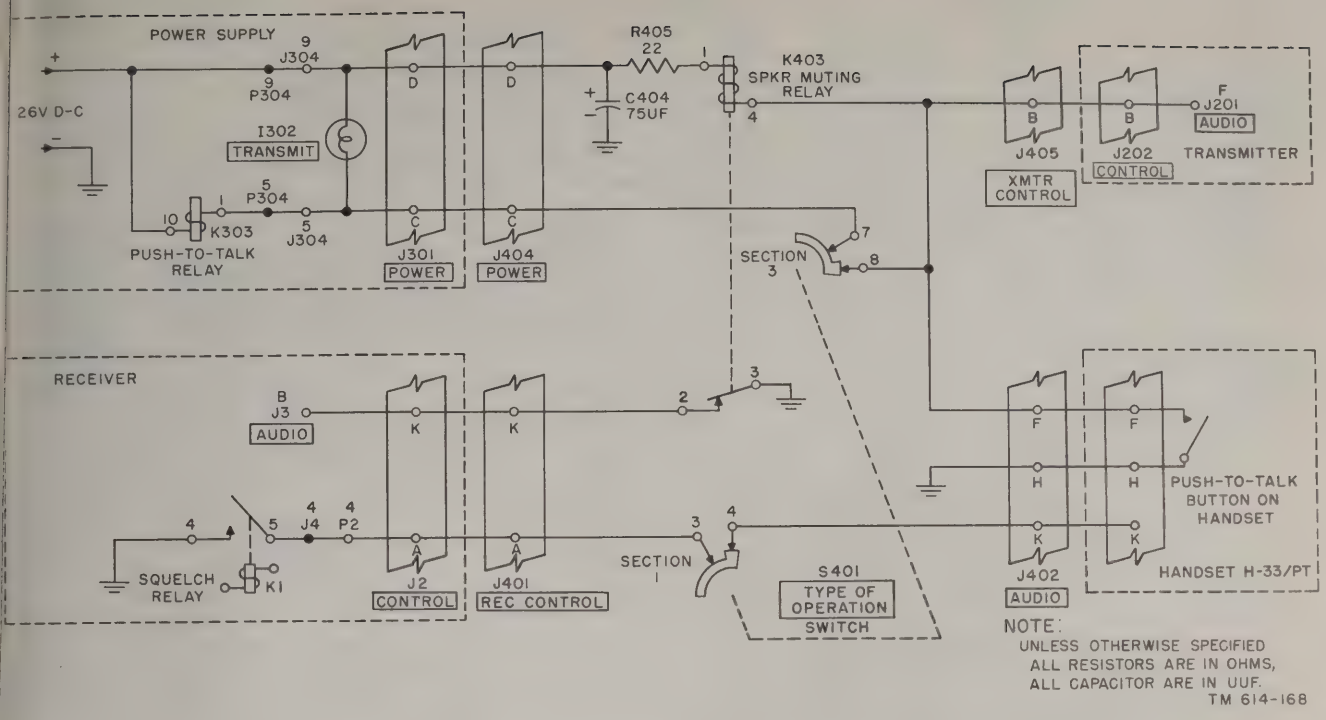


Figure 116. Push-to-talk operation, functional schematic diagram.

the button on the handset de-energizes the relay; the circuit is grounded and received signals will be heard at the speaker. The audio output of the receiver can be heard at the earpiece of the handset no matter which AUDIO jack on the radio set is used.

c. During squelch operation of the receiver, a ground is provided from terminal A of J401 through contacts 3 and 4 of S401, section I, to terminal K of J402.

d. During push-to-talk operation, resistor R406 (fig. 119) loads the narrow-band circuit, thus eliminating a response dip at 330 cycles. This resistor is connected between pins 2 and 4 of S401, section 2.

178. Terminal Operation

(fig. 117)

With the TYPE OF OPERATION switch, S401, set to the TERMINAL position, the radio set can be used as an end station of a radio relay network for multichannel telephone operation or single channel radio communication.

a. The wide-band audio output of the receiver appears at terminals F and J of REC CONTROL jack J401. The signal is fed to telephone terminal jacks, REC (E401 and E402), on the front panel of the control unit through a high pass filter network. The signals from E401 and E402 are fed to associated telephone equipment through spiral-four cable. The high pass network, which consists of C405, C406, C407, C408, and L401, sharply attenuates signals below 250 cycles.

b. The wide-band signals *from* the telephone equipment are applied to the radio set at XMTR jacks E403 and E404 at the control unit and routed to the transmitter at terminals J and F of XMTR CONTROL jack J405. A portion of this signal is fed back through the control unit to terminal E of J405, through contacts 7 and 9 of S401, section 1, to the receiver at terminal E of J401.

c. A portion of the narrow-band microphone signal of the transmitter is coupled to terminal C of J405, through contacts 3 and 5 of S401, section 3, to terminal C of REC CONTROL jack J401. In the receiver, the signal is applied to the input of the wide band amplifier.

d. To prevent the microphone output from deviating the carrier beyond 8 kc, resistor R238 is placed in parallel with the secondary of the microphone transformer, attenuating the signal. Grounding terminal D of J405 through contacts 11 and 1 of S401, section 3, places this resistor in the circuit.

e. The transmitter is keyed when the TYPE OF OPERATION switch is set to the TERMINAL position. The keying occurs when terminal C of POWER connector J404 is grounded through contacts 7 and 9 of S401, section 3.

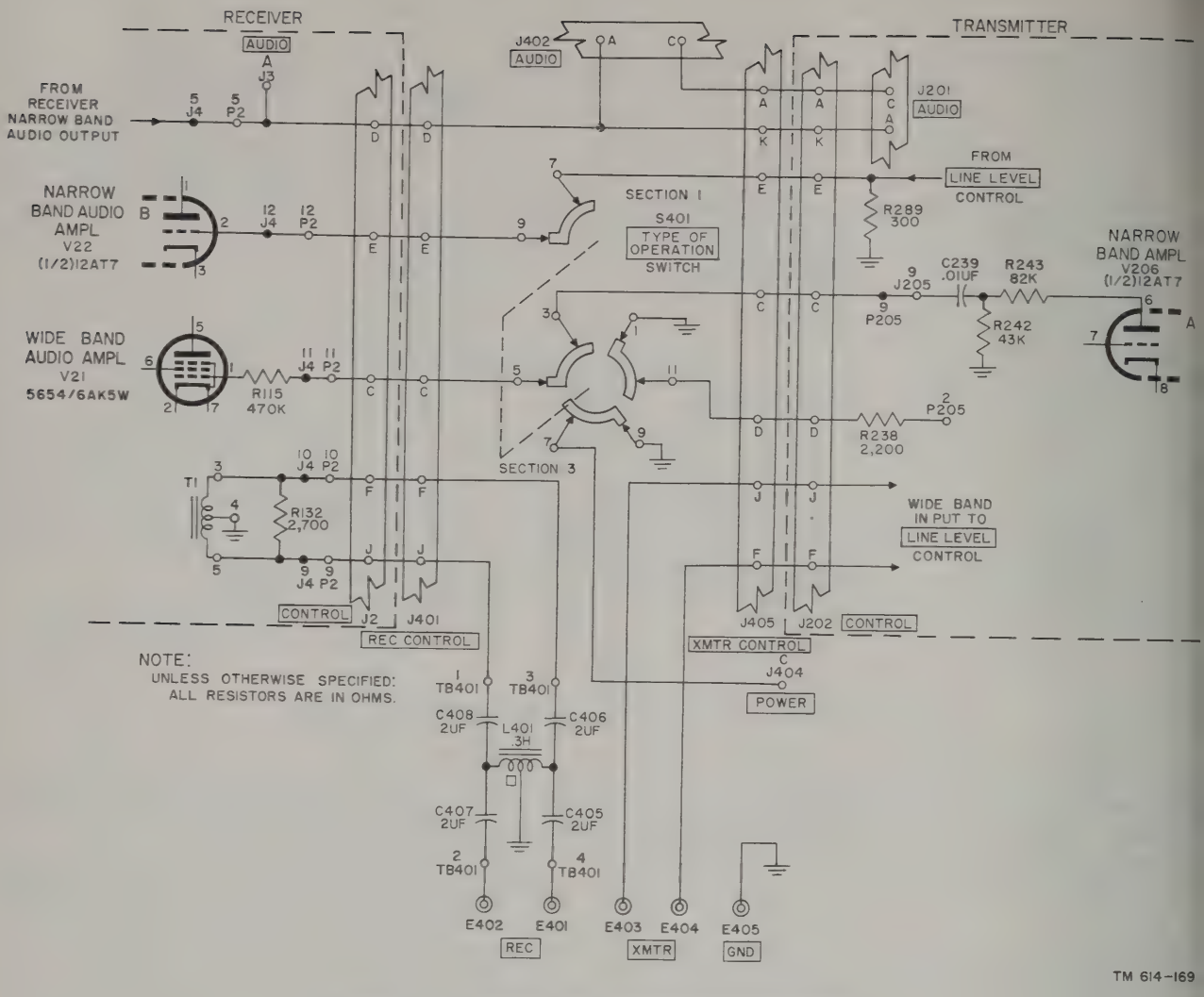


Figure 117. Terminal operation, schematic diagram.

f. The audio output of the receiver is coupled from terminal D of REC CONTROL jack J401 to terminal A of control unit AUDIO jack J402. The audio is also fed to terminal K of XMTR CONTROL jack J405 where it is connected to the AUDIO jack on the transmitter.

179. Relay Operation

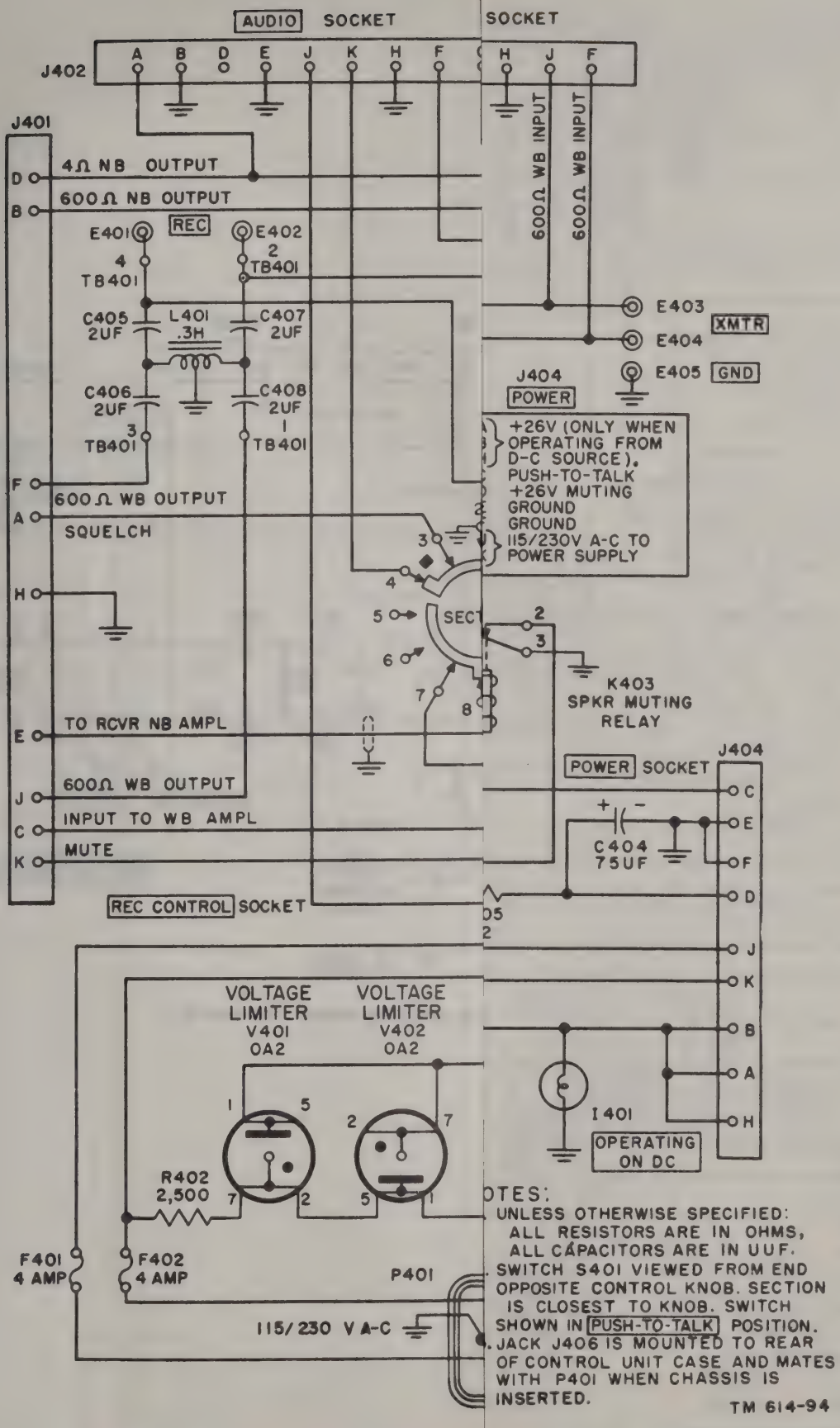
(fig. 118)

With the TYPE OF OPERATION switch set to the RELAY position, the radio set can be used as a radio relay station in a single channel or multichannel communication network.

a. The wide-band output from the receiver is fed to terminals F and J of the REC CONTROL jack J401. The signal continues through a low pass filter, which consists of C405, C406, C407, C408, and L401, through contacts 2 and 11 and contacts 7 and 10 of S401, section 2, to terminals F and J of XMTR CONTROL jack J405. From J405 the signal continues to the wide-band input of the transmitter.

b. The ungrounded side of the 600-ohm speaker output of the receiver is coupled from terminal B of REC CONTROL jack J401 to terminal J of INTERCONN jack J403. The audio output for the handset is coupled from terminal D of REC CONTROL jack J401 to terminal A of the control unit AUDIO jack J402 and to terminal K of XMTR CONTROL jack J405. It is finally connected to terminal A of the AUDIO jack of the transmitter.

c. During relay operation two radio sets are in operation, one for each circuit direction. Special Purposes Cable Assembly CX–2325/U interconnects the two radio sets at the INTERCONN jacks J403. The speaker muting relay supply voltages are connected together at each terminal



NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. SWITCH S401 VIEWED FROM END OPPOSITE CONTROL KNOB. SECTION IS CLOSEST TO KNOB. SWITCH SHOWN IN PUSH-TO-TALK POSITION.
3. JACK J406 IS MOUNTED TO REAR OF CONTROL UNIT CASE AND MATES WITH P401 WHEN CHASSIS IS INSERTED.

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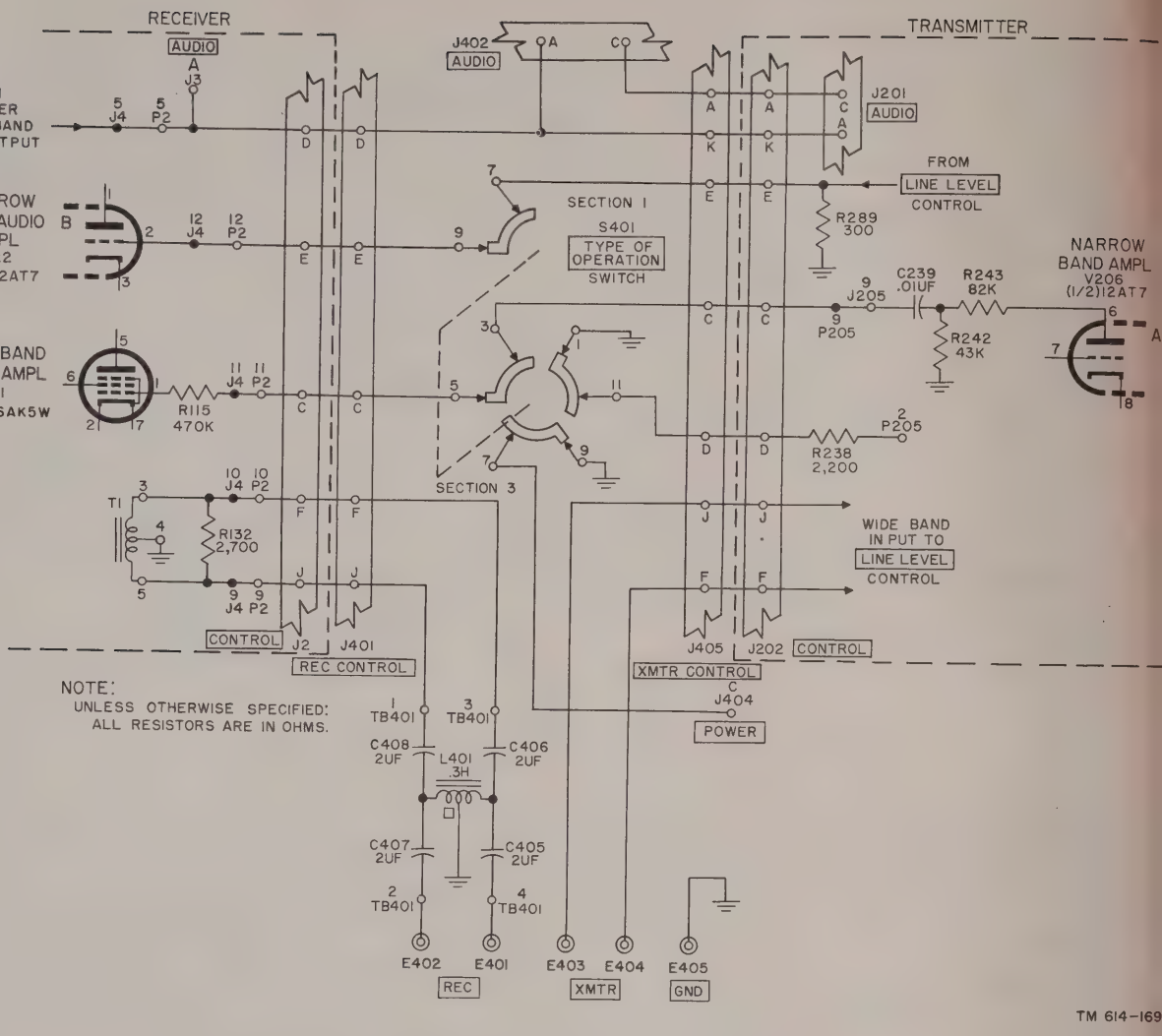


Figure 117. Terminal operation, schematic diagram.

f. The audio output of the receiver is coupled from terminal D of REC CONTROL jack J401 to terminal A of control unit AUDIO jack J402. The audio is also fed to terminal K of XMTR CONTROL jack J405 where it is connected to the AUDIO jack on the transmitter.

179. Relay Operation

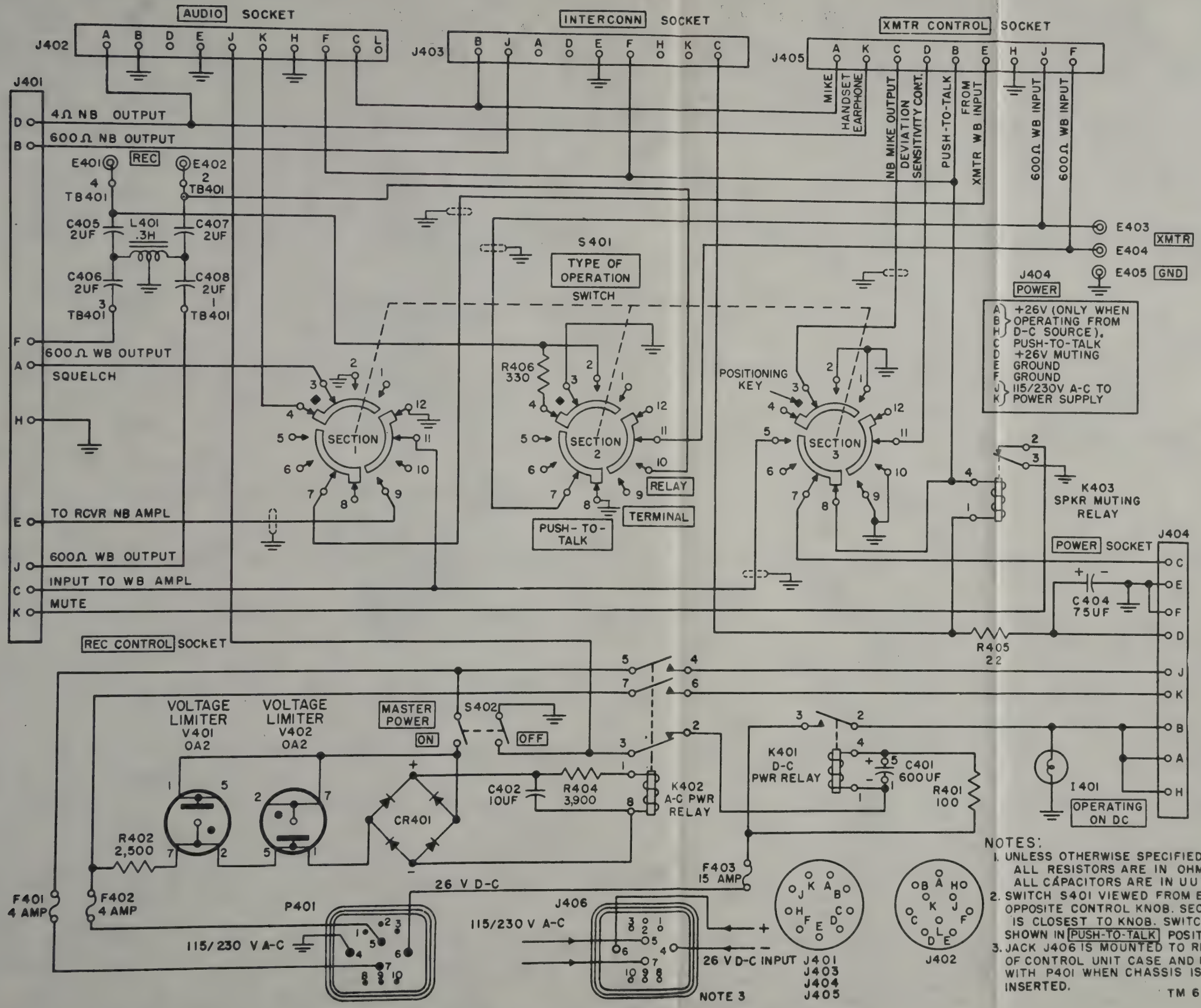
(fig. 118)

With the TYPE OF OPERATION switch set to the RELAY position, the radio set can be used as a radio relay station in a single channel or multichannel communication network.

a. The wide-band output from the receiver is fed to terminals F and J of the REC CONTROL jack J401. The signal continues through a low pass filter, which consists of C405, C406, C407, C408, and L401, through contacts 2 and 11 and contacts 7 and 10 of S401, section 2, to terminals F and J of XMTR CONTROL jack J405. From J405 the signal continues to the wide-band input of the transmitter.

b. The ungrounded side of the 600-ohm speaker output of the receiver is coupled from terminal B of REC CONTROL jack J401 to terminal J of INTERCONN jack J403. The audio output for the handset is coupled from terminal D of REC CONTROL jack J401 to terminal A of the control unit AUDIO jack J402 and to terminal K of XMTR CONTROL jack J405. It is finally connected to terminal A of the AUDIO jack of the transmitter.

c. During relay operation two radio sets are in operation, one for each circuit direction. Special Purposes Cable Assembly CX–2325/U interconnects the two radio sets at the INTERCONN jacks J403. The speaker muting relay supply voltages are connected together at each terminal



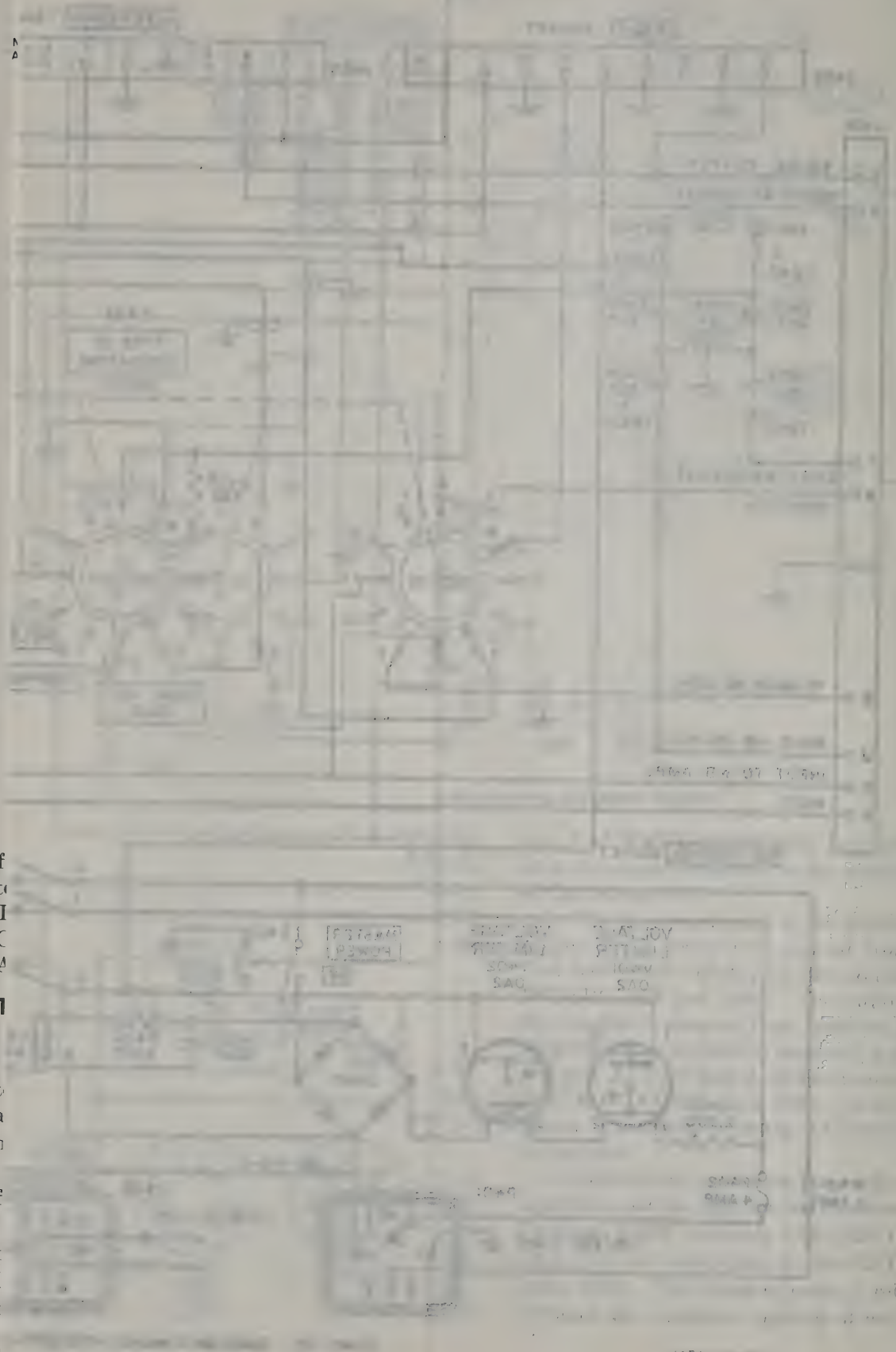
NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. SWITCH S401 VIEWED FROM END OPPOSITE CONTROL KNOB. SECTION IS CLOSEST TO KNOB. SWITCH SHOWN IN PUSH-TO-TALK POSITION.
3. JACK J406 IS MOUNTED TO REAR OF CONTROL UNIT CASE AND MATES WITH P401 WHEN CHASSIS IS INSERTED.

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Figure 119. Radio Set Control C-632/GRC-10, complete schematic diagram.

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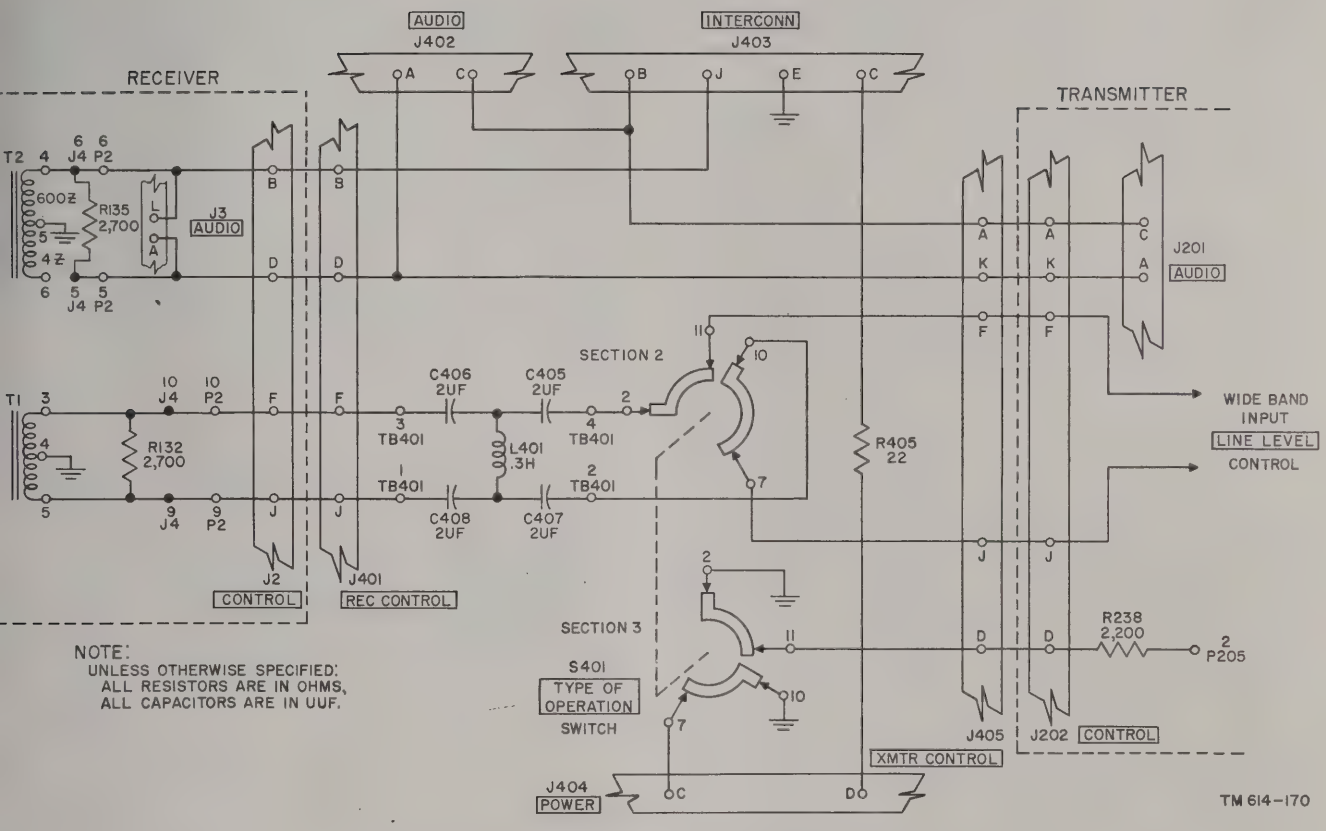


Figure 118. Relay operation, schematic diagram.

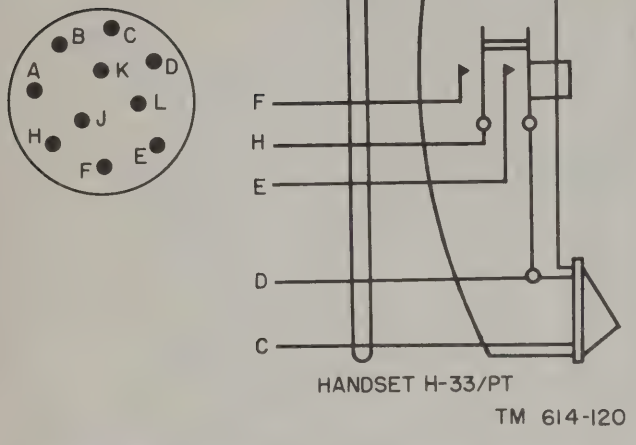


Figure 120. Handset H–33/PT, schematic diagram.

C of jacks J403, preventing relay chatter and the possibility of static voltage conditions energizing either relay.

d. To provide modulation of both transmitters from either radio set, the handset microphone circuits are interconnected at terminal B of J403. Terminal C of control unit AUDIO jack J402 supplies signals from the handset microphone to terminal A of XMTR CONTROL jack J405 and to the other radio set through the INTERCONN jack.

e. To prevent the handset microphone output from deviating the carrier beyond 8 kc, resistor R238 is placed in parallel with the secondary of the microphone transformer, attenuating the signal. Grounding terminal D of XMTR CONTROL jack J405 through contacts 11 and 2 of S401, section 3, places this resistor in the circuit.

f. The transmitter is automatically keyed when the TYPE OF OPERATION switch is set to the RELAY position. Keying occurs when terminal C of the POWER connector J404 is grounded through contacts 7 and 10 of S401, section 3.

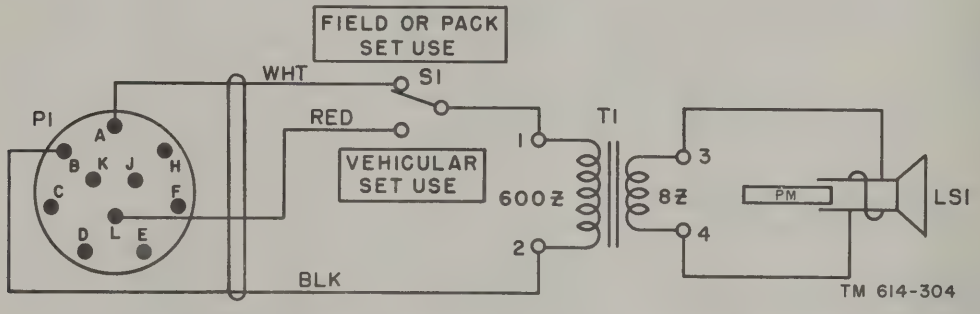


Figure 121. Dynamic Loudspeaker LS–166/U, schematic diagram.

CHAPTER 7

FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and the skill of the repairman.

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning: When servicing the radio set, be extremely careful because of the high voltages exposed. Always disconnect the power sources before opening any of the components. Be sure to discharge the filter capacitors in the dynamotor power supply before attempting to do any work on it.

180. Extent of Instructions

Troubleshooting at a field maintenance level includes all the techniques outlined for organizational maintenance (ch. 4) and any other techniques that may be required to isolate a defective part. The field maintenance instructions are not complete in themselves, but supplement the instructions described in chapter 4. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at an organizational level (pars. 112–124), must be completed by means of localizing and isolating techniques described in paragraphs 182 through 187.

181. Troubleshooting Techniques

a. General. To be effective, troubleshooting must be systematic. It is seldom possible to observe a trouble symptom and diagnose the cause immediately. Generally, it will be necessary to perform a sequence of operational checks, observations, and measurements before a fault will be revealed. If the proper sequence is employed, the trouble will be traced first to a unit, then to a portion of a unit, and finally to a defective part. The sequence of steps is referred to commonly as the sectionalization, localization, and isolation of trouble.

b. Sectionalization. The first aim when troubleshooting is to sectionalize the trouble to a unit of the radio set. Determine the defective unit through visual checks or operational procedures (pars. 111–124).

c. Localization. After the defective unit is determined, make additional checks and measurements to localize the trouble to a portion of the unit. As in the case of sectionalization, use inspection, short circuit checks, and operational techniques (pars. 111–124) first, and use the specialized testing procedures of paragraphs 182 through 187 when necessary.

Caution: Do not apply power to a set or unit unless the operational symptoms are known, and are such as to avoid further damage when power is applied. If the symptom is not known, or indicates the possible existence of short circuits, make short-circuit checks (par. 184) before applying power.

d. Isolation. After trouble has been localized to a portion of a unit, for example, to a stage or a group of functionally related circuits, use visual inspection, voltage measurements, and resistance measurements to determine the defective part. Data and procedures for isolating defective parts are detailed in paragraphs 182 through 187.

e. Intermittent Troubles. During all tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set.

Section II. COMPONENT TROUBLESHOOTING

182. Troubleshooting Setup

After a component has been found to be defective, it will frequently be necessary to operate the component out of its case and on a bench. The most satisfactory method is to substitute specially prepared cables for the component cables, so that

the component, while connected to the remaining components of the radio set, may be placed in any required position for inspection or measurement. At the most, two such cables will be needed. Using spare 9-pin connectors, make up the cables by using #20 or larger wire about 5 feet long. Connect corresponding pins together; A to A, B to B, etc. When spare interconnecting cables are available, use them for this purpose.

a. Dynamotor-Power Supply DY–94/GRC–10, used with the radio set in normal operating installations, is the most convenient power source for use in bench tests of the transmitter and receiver. If it is available, connect the power supply to the POWER jack on the component with one of the long cables, and connect the control unit to the CONTROL jack on the component with the other long cable.

b. If Dynamotor-Power Supply DY–94/GRC–10 is not available, use an equivalent power source capable of supplying the voltages and currents listed below. Use one of the long cables with a connector on one end, to be plugged into the proper POWER jack.

(1) For the transmitter, connect to POWER jack J203:
Pin A, +550 volts at 150 ma d-c.
Pin B, +250 volts at 120 ma d-c.
Pin C, −20 volts at 25 ma d-c.
Pins F and H, one side of 26-volt a-c or d-c at 1.7 amperes.
(If d-c is used, connect the positive side to these pins.) Pin K, other sides of all above voltages (ground).

(2) For the receiver, connect to POWER jack J1:
Pin A, +200 volts at 100 ma d-c.
Pins F and H, one side of 26-volt a-c or d-c at 1.3 amperes.
Pins J and K, other sides of above voltages (ground).

(3) Use a long cable to connect the component under test to the control unit.

183. Localizing and Isolating Troubles

a. General. Procedures are outlined in the charts below for localizing troubles in each component. In some cases, the trouble will be isolated immediately to a component part; in other cases, the trouble will be localized to a stage or section. Further checking according to the instructions in the righ-hand column will isolate the faulty component part.

b. Troubleshooting Data. The material supplied in this manual will help in the rapid location of faults. Consult the troubleshooting data listed below.

Caution: When using the trouble-shooting data in this manual, be sure to use it with paragraphs 131, 142, and 174. These paragraphs list the differences between transmitters, receivers, and control units, respectively. Changes in design to improve operation of the equipment resulted in differences between some of the equipments.

(1) *Differences in voltage and resistance measurements.* Voltage and resistance measurements on some radio sets will differ from those shown in the voltage and resistance charts in this manual because of design changes. These differences are listed below.

Fig. No.	Location of measurement	Early sets		Later sets	
		Serial numbers	Measurement	Serial numbers	Measurement
169	Pin 3, V201	1–150	0V/0	151 & above	**26V/2.5
169	Pin 4, V201; Pin 4, V202	1–150	**7V/2.5	151 & above	**20.3V/4.1
169	Pins 4 & 5, V207; Pin 4, V210; Pin 4, V216.	1–150	**20.3V/4.1	151 & above	7V**/2.5
169	Pin 3, V210; Pin 3, V216	1–150	**26V/2.5	151 & above	0V/0
169	Pin 2, V207	1–230	*−2V/1 meg	231 & above	*−2V/1.8 meg
169	Pin 1, V207	1–230	178V/240k	231 & above	120V/290k
169	Pin 8, V207	1–230	32.5V/120k	231 & above	4.2V/8,200
169	Control grid, V205	1–300	*−56V/9k	301 & above	*−56V/5,000
170	Pin 6, V20, Pin 3 TB2	1–350	*23V/600k	351 & above	*13.5V/3.3 meg
170	Pin 5, V18	1–350	185V/235k	351 & above	185V/164k
170	Pin 2, V12	1–530	*2.5V/470	531 & above	*1.8V/390
170	Pin 5, V14	1–530	80V/36k	531 & above	138V/24k

(2) *Radio Receiver R–125/GRC–10.*

r. No.	Fig. No.	Description
	59	Radio Receiver R–125/GRC–10, tube location.
	86	Radio Receiver R–125/GRC–10, block diagram.
	87	Control circuits, receiver gear train.
	109	Receiver filament supply.
	120	Handset H–33/PT, schematic diagram.
	121	Dynamic Loudspeaker LS–166/U, schematic diagram.
	140	Receiver, bottom view.
	141	Receiver, right side view of chassis.
	142	Receiver, rear view.
	143	Receiver, section A shown in figure 140.
	144	Receiver, section B shown in figure 140.
	145	Receiver, section C shown in figure 140.
	146	Receiver, section D shown in figure 140.
	147	Receiver, section E shown in figure 140.
	148	Receiver, 10-frequency oscillator.
	149	Receiver, 17-frequency oscillator.
	150	Receiver, r-f slug rack.
	154	Receiver gear train, over-all view.
	155	Gear train, tool marking.
	156	Gear train, front plate removal.
	157	Receiver gear train, subassemblies.
	159	Gear train, spring loading planetary gear.
	172	Receiver B+ distribution.
	165	Radio Receiver R–125/GRC–10, schematic diagram.
	174	Receiver gear train, exploded view.
	170	Voltage and resistance charts, receiver.
	168	Receiver front panel assembly.
114	------	Sectionalizing trouble to a major component of Radio Set AN/GRC–10.
115	------	Troubleshooting by using equipment performance check list.
184	------	Checking key circuits for shorts.
185	------	Troubleshooting charts.
186	------	Signal substitution.
187	------	Stage gain chart.
204	------	Final tests.

(3) *Radio Transmitter T–235/GRC–10.*

ar. No.	Fig. No.	Description
	58	Radio Transmitter T–235/GRC–10, tube location.
	65	Radio Transmitter T–235/GRC–10, block diagram.
	66	Control circuits, transmitter gear train.
	72	Transmitter monitor receiver, block diagram.
	84	Transmitter filament supply circuit.
	85	Transmitter B+ distribution.
	128	Transmitter, bottom view with blower.
	129	Transmitter, bottom view without blower, showing resistors and capacitors.
	130	Transmitter, bottom view without blower.
	131	Transmitter, right side view.
	132	Transmitter, left side view.
	133	Transmitter, monitor receiver, top view.
	134	Transmitter, monitor receiver, bottom view.
	135	Transmitter, 10-frequency oscillator.
	136	Transmitter, 17-frequency oscillator.
	137	Transmitter, r-f slug rack, over-all view.
	138	Transmitter, r-f slug rack, bottom view.
	139	Voltage and resistance charts, monitor receiver.
	155	Gear train, tool marking.
	156	Gear train, front plate removal.
	158	Transmitter gear train, subassemblies.
	159	Gear train, spring loading planetary gear.
	164	Radio Transmitter T–235/GRC–10, schematic diagram.
	173	Transmitter gear train, exploded view.
	169	Voltage and resistance charts, transmitter main chassis.
	167	Transmitter front panel assembly.
114	------	Sectionalizing trouble to a major component of Radio Set AN/GRC–10.
115	------	Troubleshooting by using equipment performance check list.
184	------	Checking key circuits for shorts.
185	------	Troubleshooting charts.
204	------	Final tests.

(4) *Dynamotor-Power Supply DY–94/GRC–10.*

Par. No.	Fig. No.	Description
	110	Dynamotor-Power Supply DY–94/GRC–10, block diagram.
	113	Transmitter B supply, power supply.
	114	Receiver B supply and filament supply circuits.
	124	Power supply, top view of main chassis.
	125	Power supply, bottom view of main chassis.
	126	Power supply, top view of lower (swinging) deck.
	127	Power supply, bottom view of lower (swinging) deck.
	160	Dynamotor, exploded view.
	166	Dynamotor-Power Supply DY–94/GRC–10, schematic diagram.
	171	Voltage and resistance charts, power supply.
114	------	Sectionalizing trouble to a major component of Radio Set AN/GRC–10.
115	------	Troubleshooting by using equipment performance check list.
184	------	Checking key circuits for shorts.
185	------	Troubleshooting charts.
204	------	Final tests.

(5) *Radio Set Control C–632/GRC–10.*

Par. No.	Fig. No.	Description
	57	Radio Set Control C–632/GRC–10, part location.
	119	Radio Set Control C–632/GRC–10, schematic diagram.
	122	Control unit, top view.
	123	Voltage and resistance charts, control unit.
114	------	Sectionalizing trouble to a major component of Radio Set AN/GRC–10.
115	------	Troubleshooting by using equipment performance check list.
184	------	Checking key circuits for shorts.
185	------	Troubleshooting charts.

c. Test Equipment Required. The test equipment required for trouble shooting Radio Set AN/GRC–10 is listed below. A common usage name is indicated after each component.

Nomenclature	*Common name*
Multimeter TS–352/U	Multimeter
Electronic Multimeter TS–505/U	Vtvm
Electronic Multimeter ME–6A/U	Vtvm
Tube Tester TV–2/U	Tube tester
Electron Tube Test Set TV–7/U	Tube tester
RF Signal Generator Set AN/URM–48	Signal generator
Audio Oscillator TS–382A/U	Audio oscillator
Radio Frequency Wattmeter TS–118/AP	Radio frequency watt meter
Panoramic Indicator IP–173/U	Panoramic indicator
Output Meter TS–585/U	Output meter
Spectrum Analyzer TS–723/U	Spectrum analyzer
Frequency Meter Set SCR–211–( )	Frequency meter
Frequency Meter TS–174/U	Frequency meter

184. Checking Key Circuits for Shorts

Shorts or near shorts (resistance considerably lower than normal) in the B+, filament, or bias circuits will often cause damage to the power supply if power is applied. The following measurements should be made, and any indicated defects should be corrected before attempting to put the equipment in operation. These measurements are all made to ground with the individual components disconnected. A defect is indicated by a measurement which differs appreciably from the specified value.

a. Radio Receiver R–125/GRC–10.

Point	Normal reading (ohms)	Aid in localizing abnormal readings
J1, pin A	20K	Figure 172.
J1, pin F	80	Figure 165.
J1, pin H	20	Figure 109.

b. Radio Transmitter T–235/GRC–10.

Point	Normal reading (ohms)	Aid in localizing abnormal readings
J203, pin A	Infinity	Figure 85.
J203, pin B	200K in HI position 40K in LO position	Figure 85.
J203, pin C	1,100	Figure 81.
J203, pin H	2.4	Figure 84.

185. Troubleshooting Charts

a. General. These charts are given to aid in rapidly localizing and isolating defects in any of the components of Radio Set An/GRC–10. The charts not not apply to the complete radio set; they can be used only after the defect has been sectionalized to one of the components as described in paragraph 114. These voltage and resistance charts may be used to aid in isolating the defective part after locating the defective stage. Also refer to the data given in paragraph 183*b*. The voltage and resistance charts referred to are:

Figure No.	Component
123	Control unit.
139	Monitor receiver, transmitter.
169	Main chassis, transmitter.
170	Receiver.
171	Dynamotor-power supply.

Caution: Some of the corrective measures listed in the charts refer to making voltage, resistance, or continuity checks. Be sure the power is on for voltage measurements, and off for resistance or continuity checks.

b. Radio Set Control C–532/GRC–10, Troubleshooting Chart. Use figures 57 and 122 for locating the component parts.

Symptom	Probable trouble	Correction
. Radio set operates on 26 v d-c although a-c voltage is present at P401.	F401 and/or F402 open	Check with ohmmeter; replace if necessary.
	V401 or V402 defective	Replace.
	CR401 defective	Measure forward to reverse resistance ratio between all groups of two contacts. Replace if necessary.
	K402 defective	Refer to *i*(1) below.
	C402 defective	Check with ohmmeter; replace if necessary.
2. No d-c supplied to power supply when a-c source is not present.	F403 open	Remove and check with ohmmeter; replace if necessary.
	K402 contacts defective	Check for continuity between pins 2 and 3, K402, with ohmmeter. Replace relay if reading is greater than 0 ohm.
	K401 defective	Refer to *i*(2) below.
	C401 defective	Check with ohmmeter; replace if necessary.
3. Speaker does not mute when transmitter is keyed in push-to-talk operation.	K403 defective	Check for continuity between pins 1 and 4, K403, with ohmmeter. Replace relay if reading is infinite. Check for continuity between pins 2 and 3. Replace relay if reading is greater than 0 ohm.
	C404 defective	Check with ohmmeter; replace if necessary.

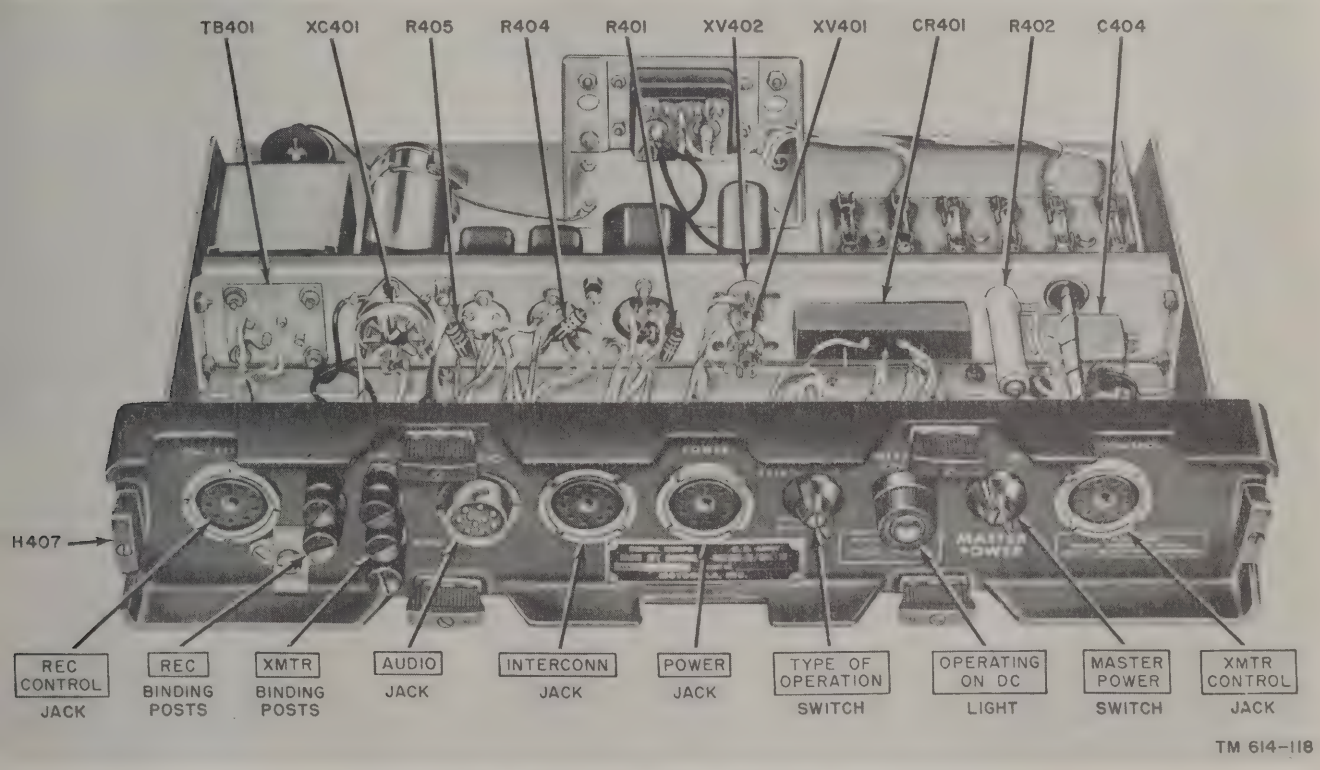
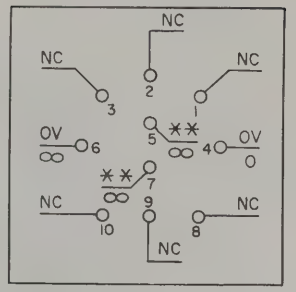


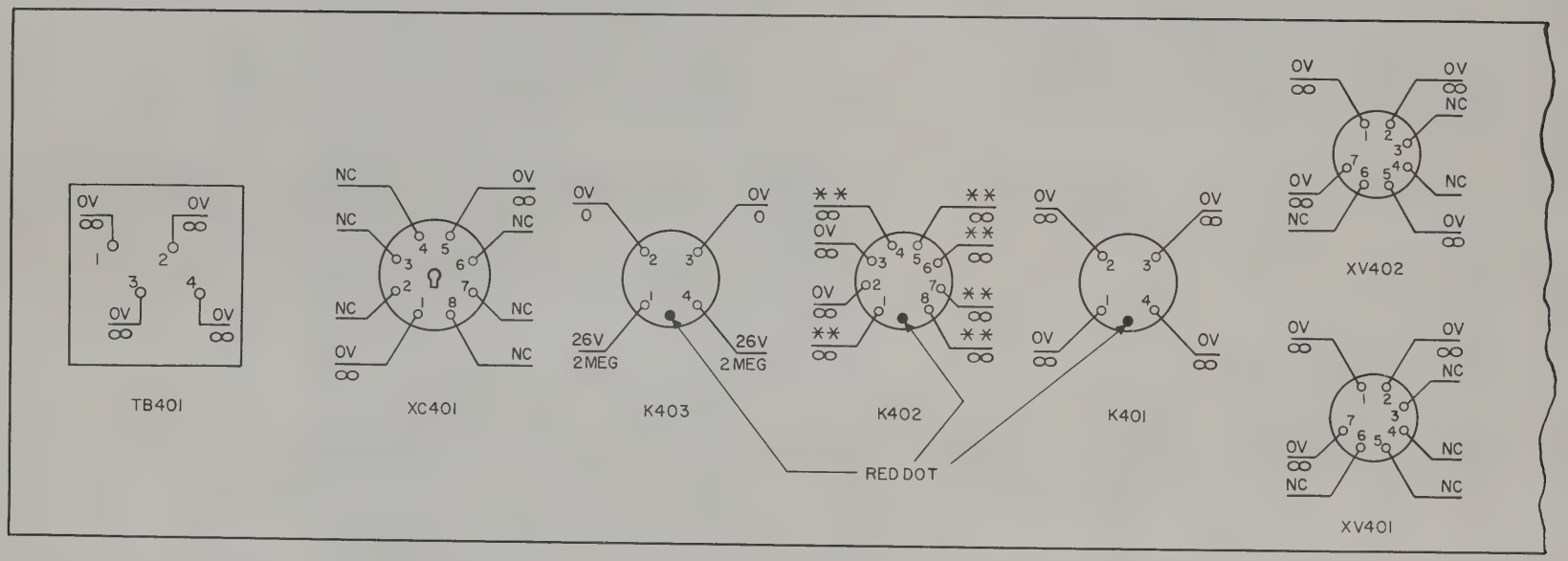
Figure 122. Control unit, top view

P401
VIEWED FROM REAR



POINT TO POINT MEASUREMENTS

MEASURED AT			VOLTAGE
PART	FROM	TO	
P401	5	7	* 115
K402	5	7	* 115
K402	4	6	* 115
K402	1	8	75



NOTES:

1. ALL VOLTAGE MEASUREMENTS MADE WITH THE FRONT PANEL CONTROLS SET AS FOLLOWS: MASTER POWER – ON, TYPE OF OPERATION – PUSH-TO-TALK.
2. RESISTANCE MEASUREMENTS ARE IN OHMS, AND WERE MADE WITH THE CONTROL UNIT DISCONNECTED FROM ALL OTHER COMPONENTS AND THE POWER SOURCE, WITH FRONT PANEL CONTROLS SET AS FOLLOWS: MASTER POWER – OFF, TYPE OF OPERATION – PUSH-TO-TALK.
3. ALL RESISTANCE MEASUREMENTS MADE WITH C401 REMOVED FROM SOCKET.
4. VOLTAGE MEASUREMENTS MADE WITH A 20,000 OHMS-PER-VOLT METER AND ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED. * INDICATES A-C VOLTAGE.
5. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND UNLESS OTHERWISE SPECIFIED. ** INDICATES MEASUREMENTS GIVEN IN THE TABLE.
6. ALL VOLTAGE MEASUREMENTS MADE WITH THE CONTROL UNIT CONNECTED TO A 115V, 60 CYCLE A-C SOURCE OF PRIMARY POWER; NO D-C SOURCE.

TM 614-123

Figure 123. Voltage and resistance measurements, control unit.

c. Dynamotor-Power Supply DY–94/GRC–10. The troubleshooting chart for the power supply is divided into three groups of symptoms; those that may occur on a-c operation, d-c operation, and on both a-c and d-c operation. When a defect occurs in the power supply, check to see whether the defect is present on a-c, on d-c, or on both types of operation. Use figures 124 through 127 for locating component parts; use figure 171 for voltage and resistance measurements.

Warning: Arc-overs in selenium rectifiers cause the release of poisonous fumes and the deposit of poisonous selenium compounds. If arc-overs occur, avoid inhaling the poisonous fumes. Ventilate the unit and do not handle the damaged rectifier until it has cooled. Avoid direct skin contact with the damaged part.

d. Dynamotor-Power Supply DY–94/GRC–10, Troubleshooting Chart.

(1) *A-c and d-c operation* (figs. 124–127).

Symptom	Probable trouble	Correction
Zero or low voltage at pin A or B, J303.	K303 coil defective	Check for continuity between pins 1 and 10 with ohmmeter. Replace relay if reading is infinity.
	T303 or C312 defective	Check with ohmmeter. Replace if necessary.
No. d-c voltage at pin A, J302	C311A, C311B, or C306 shorted; L302 or T301 winding open.	Check with ohmmeter; replace if necessary.
Voltage at pin A, J302 much lower than 200 v d-c.	C311A or C311B leaky or CR301 or CR302 defective.	Check with ohmmeter; replace if necessary.
Zero or less than −20 v d-c at pin C, J303.	C310, C305, C313, C316A, C316B, L307, R304, CR305, or winding in T303 defective.	Check with ohmmeter; replace if necessary.
Blower does not operate	B301 defective	Check continuity of windings with ohmmeter; replace if necessary.

(2) *A-c operation only.*

Symptom	Probable trouble	Correction
No +550 v d-c at pin A, J303. Voltage at pin B, J303, normal.	K302 contacts defective	Check for continuity between pins 9 and 12 with ohmmeter. Replace relay if reading is greater than zero.
	Same as above	Check for continuity between pins 6 and 7 with ohmmeter. Replace relay if reading is greater than zero.
	L305 open	Check with ohmmeter; replace if necessary.
. Voltage at pin A, J303, much lower than 550 v d-c (voltage at pin B, J303, normal.	K303 contacts defective	Refer to *i*(3) below.
	K302 contacts defective	Check for continuity between pins 4 and 5 with ohmmeter. Replace relay if reading is greater than zero.
	T303 winding open, or C303A or C303B shorted.	Check with ohmmeter; replace if necessary.
	CR304 defective	Check with ohmmeter; replace if necessary.
. No voltage at pin B, J303. Voltage at pin A, J303, 550 v d-c or higher.	K303 contacts defective	Refer to *i*(4) below.
	L304 open	Check with ohmmeter; replace if necessary.
. No voltage at pin B, J303. Voltage at pin A, J303, low.	C301A, C301B, C302A, C312, L303, CR303, or T303 winding defective.	Check with ohmmeter; replace if necessary.
	K303 contacts defective	Refer to *i*(5) below.
. No voltage at pin A or B or J303	K301 contacts defective	Check for continuity between pins 8 and 13 with ohmmeter. Replace relay if reading is greater than zero.
	K303 coil open	Check for continuity between pins 1 and 10 with ohmmeter. Replace relay if reading is infinite.

Symptom	Probable trouble	Correction
6. Voltage below normal at both pins A and B, J303.	C301A, C301B, or C302A leaky	Check with ohmmeter; replace if necessary.
	CR303 defective	Check with ohmmeter; replace if necessary.
7. No a-c filament voltage at pin H, J303. POWER indicator does not light.	F306 or T302 winding open	Check with ohmmeter; replace if necessary.
	K301 defective	Check for continuity between pins 2 and 11 with ohmmeter. Replace relay if reading is greater than zero.
8. No a-c filament voltage at pin H, J302.	F307 or T302 winding open	Check with ohmmeter; replace if necessary.
	K301 contacts defective	Check for continuity between pins 4 and 12 with ohmmeter. Replace relay if reading is greater than zero.
9. No muting relay voltage (normally 26 v d-c) at pin D, J301. Transmitter will not key.	K302 contacts defective	Check for continuity between pins 2 and 11 with ohmmeter. Replace relay if reading is greater than zero.
	C302B shorted	Check with ohmmeter; replace if necessary.
	CR306 and/or CR307 defective	Check with ohmmeter; replace if necessary.

(3) *D-c operation only.*

Symptom	Probable trouble	Correction
1. No +550 v d-c at pin A, J303. Voltage at pin B, J303, normal.	C304, C307, C308, C309, L301, or L306 defective.	Check with ohmmeter; replace if necessary.
	K302 contacts defective	Refer to *i*(6) below.
	Dynamotor brushes defective	Check for excessive wear; replace if necessary.
	Dynamotor defective	Replace.
	K303 contacts or K304 defective	Refer to *i*(8) below.
2. No voltage at pins A or B, J303	K302 coil defective	Check for continuity between pins 1 and 10. If reading is infinite, replace relay.
	K303 coil defective	Check for continuity between pins 1 and 10. If reading is infinite, replace relay.
3. No voltage at pin B, J303. Voltage at pin A, J308, normal.	K303 contacts defective	Refer to *i*(4) and (5) below.
	C301A, C301B, C302, C313, C321, C312, L303, L304, CR303, or T303 winding defective.	Check with ohmmeter; replace if necessary.
	Vibrator G301 defective	Check by substitution; replace if necessary.
4. No voltage at pin A, J302	C315, C322, or C323 defective	Check with ohmmeter; replace if necessary.
	Vibrator G302 defective	Check by substitution; replace if necessary.
	T301 winding defective	Check continuity between pins 1, 2, and 3, T301. If reading is infinite, replace transformer.
5. No voltage at pin B, J303, pin A, J302, or pin C, J303 (both vibrators inoperative).	K301 contacts defective	Refer to *i*(7) below.
6. No filament voltage at pin H, J303, or pin H, J302.	K301 coil defective	Check for continuity between pins 1 and 10 with ohmmeter. Replace relay if reading is infinite.

Symptom	Probable trouble	Correction
7. F301 opens repeatedly	Vibrator G301 defective	Check by substitution; replace if necessary.
	C312 or C313 shorted	Check with ohmmeter; replace if necessary.
8. F302 opens repeatedly	Vibrator G302 defective	Check by substitution; replace if necessary.
	C322, C323, or C315 shorted	Check with ohmmeter; replace if necessary.

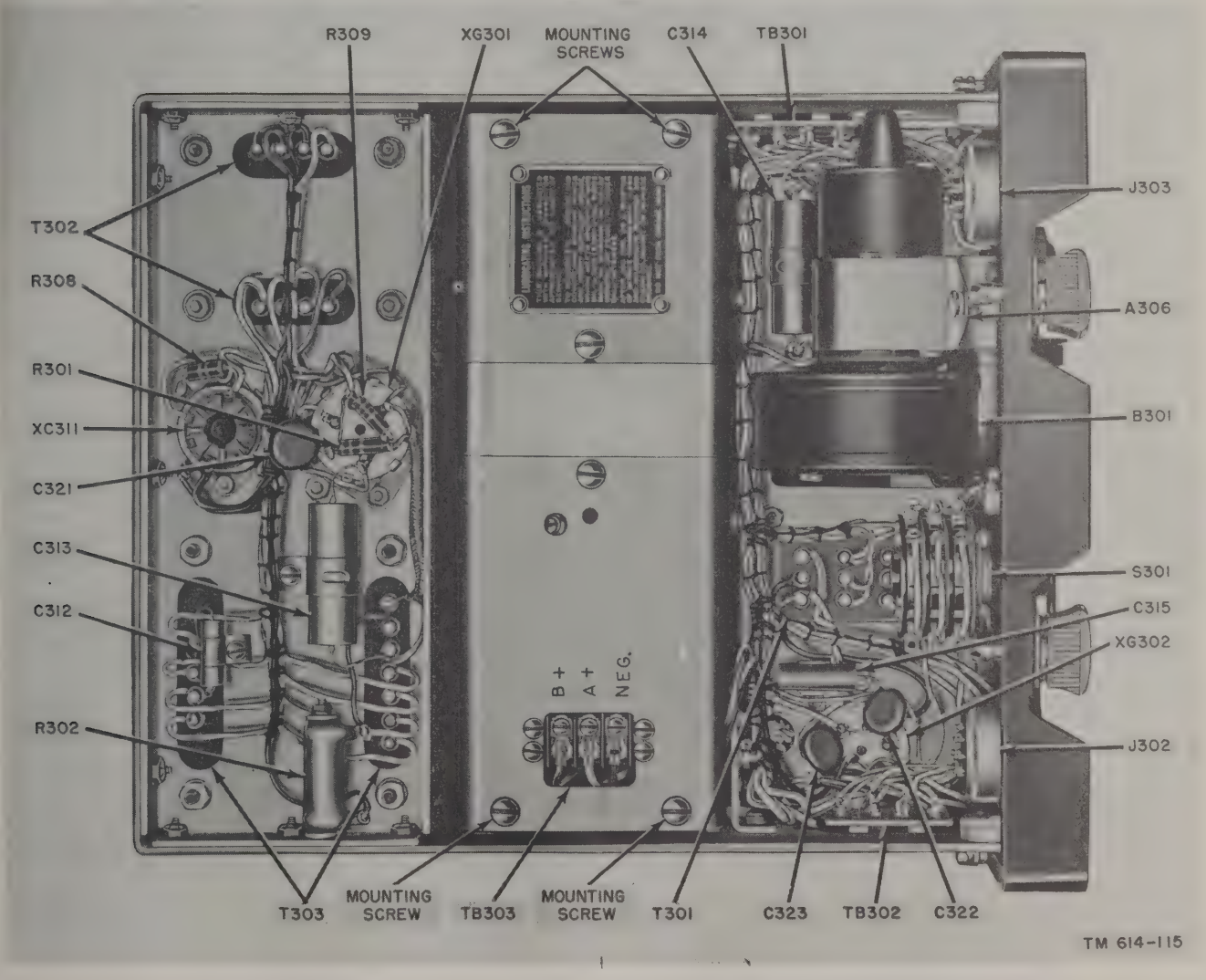


Figure 124. Power supply, top view of main chassis.

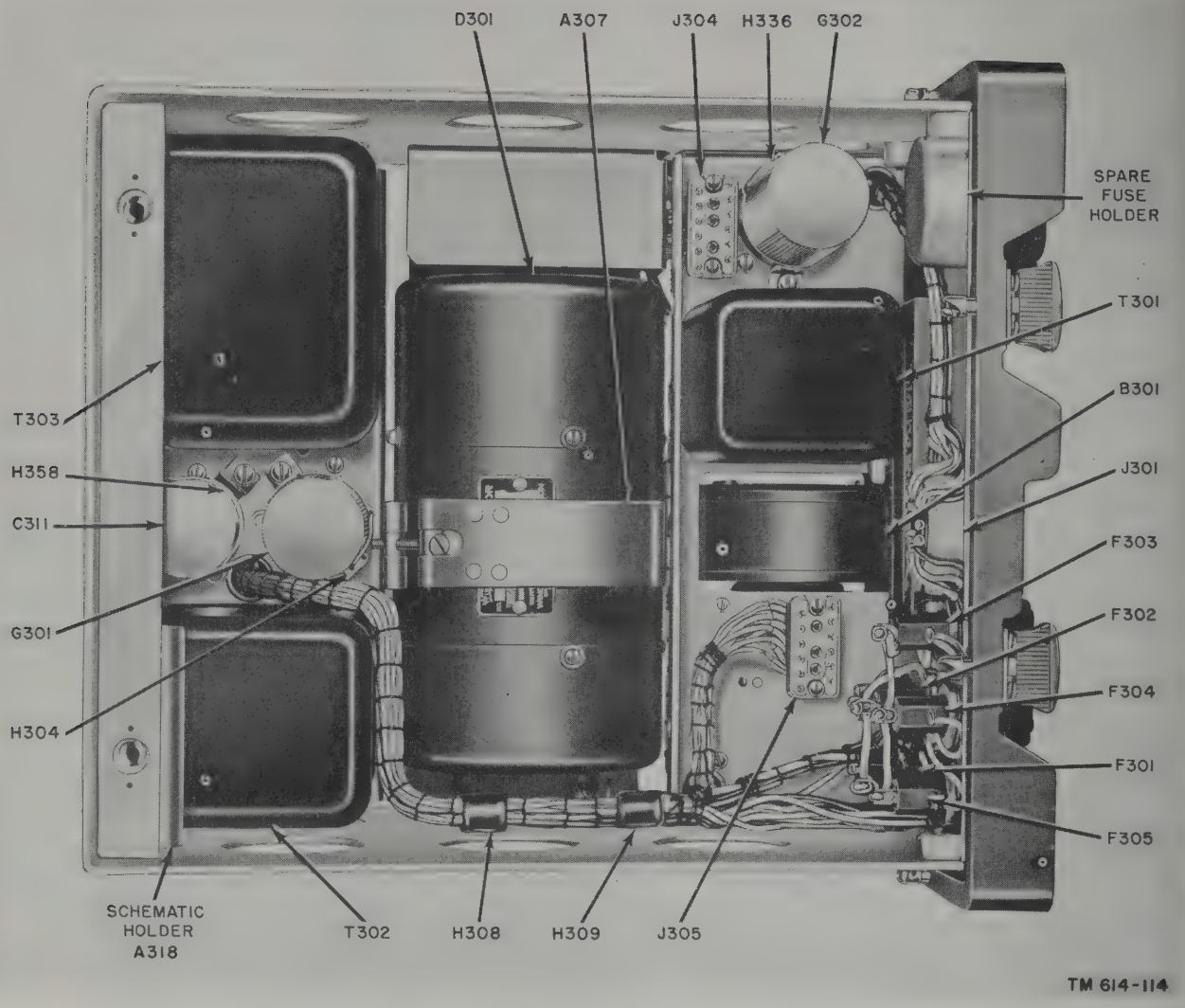


Figure 125. Power supply, bottom view of main chassis.

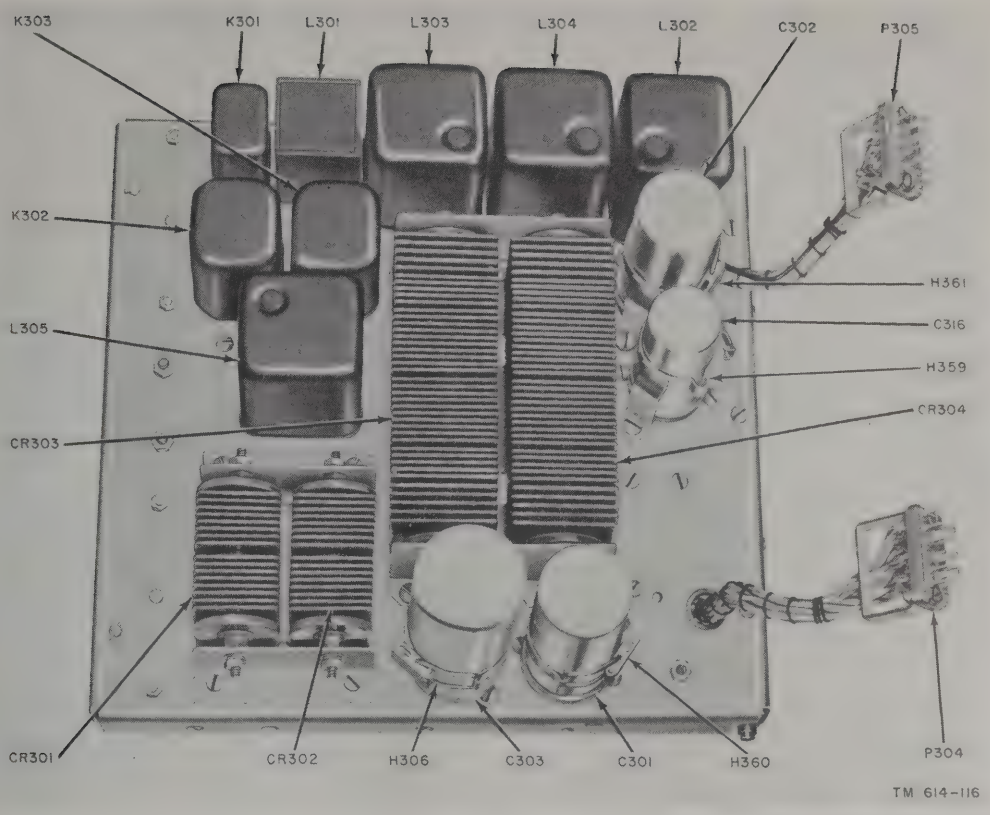


Figure 126. Power supply, top view of lower (swinging) deck.

e. Radio Transmitter T–235/GRC–10. Troubles in the transmitter may be rapidly localized by proper use of the metering circuit provided. Switch S203 connects the meter to various points in the circuit so that operation at these points can be checked merely by operating a front panel control. Also, a test point (fig. 137) on the r-f slug rack indicates the performance of the master oscillator/doubler; check this test point with a vtvm. For troubles that appear as low power output, or no output, start checking from the antenna and work back through the circuit toward the master oscillator/doubler. For troubles that cause the transmitter to operate off frequency (afc circuit inoperative), start checking at the afc amplifier and work back through the monitor receiver. Use figures 58 and 128 through 138 for locating component parts; use figures 139 and 169 for voltage and resistance measurements.

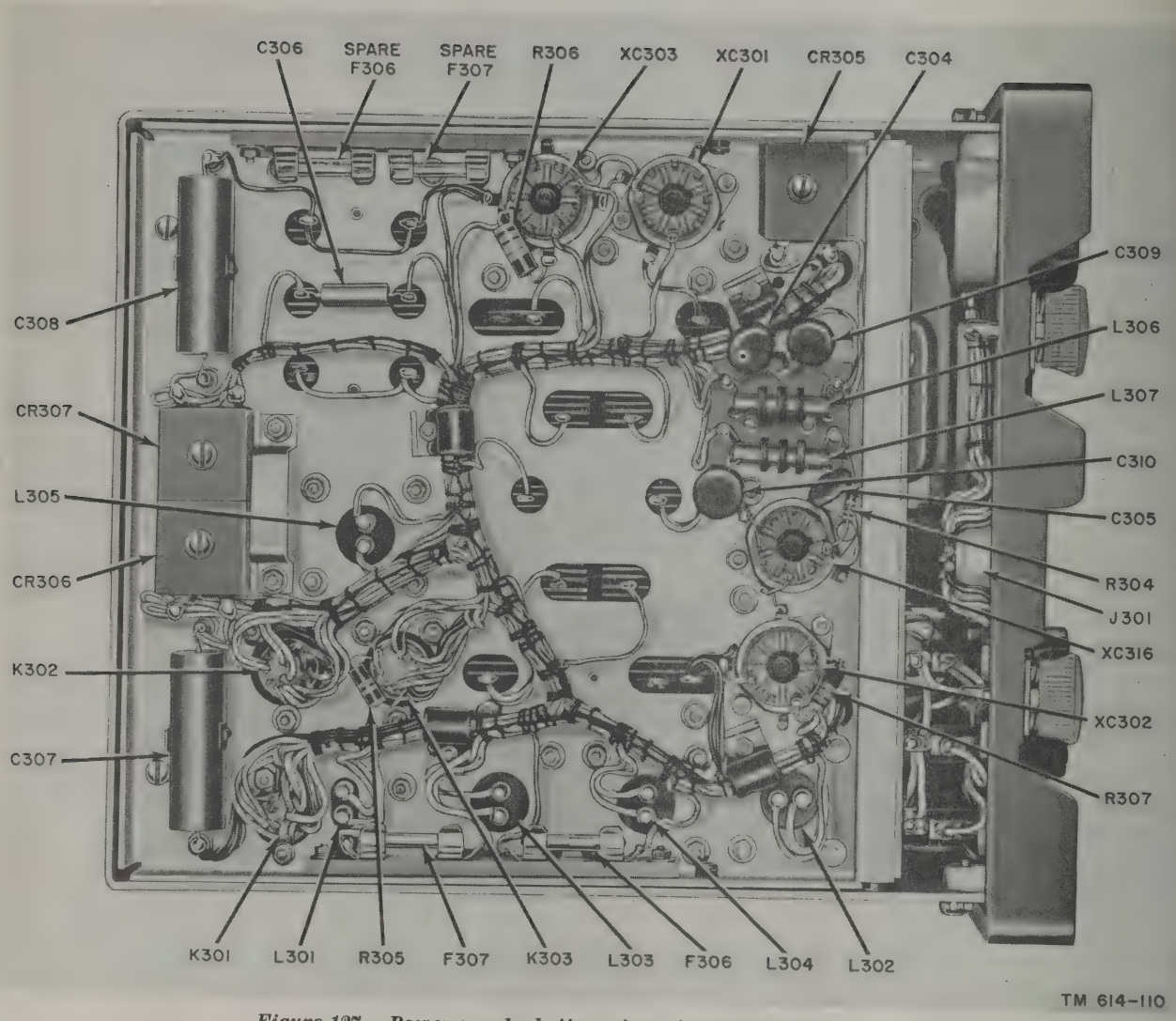


Figure 127. Power supply, bottom view of lower (swinging) deck.

f. Radio Transmitter T–235/GRC–10, Troubleshooting Chart.

Symptom	Probable trouble	Correction
1. Entire transmitter fails to operate.	Trouble exists in filament of B+ voltage circuits.	Check voltage and resistance measurements at POWER jack, J203 (par. 114).
2. Transmitter operates off frequency. No afc action. Meter indication present on AFC— or AFC+.	Trouble exists in monitor receiver.	Check for operation of first and second hf oscillator; check tubes V209 through V215; check voltage and resistance measurements of V209 through V215.
3. No modulation.	Trouble exists in modulator circuits.	Check V201 and V202; check voltage and resistance measurements of V201 and V202.
4. Frequency not deviating required amount for given audio input.	Modulator tube or tubes defective.	Check V201 and V202; replace if defective.
5. No modulation with S202 in RING or TEST position. Operation in MIKE position normal.	Trouble exists in ring test oscillator circuit, V206B.	Check V206; check Z202; check voltage and resistance measurements of V206B.
6. No modulation with S202 in MIKE or TEST position. Operation normal with S202 in RING position.	Trouble exists in wide-band amplifier circuit.	Check V216; check voltage and resistance measurements of V216.
7. No reading with meter at the LINE LEVEL position. Transmitter operation normal as indicated by a receiver. All other meter readings normal.	Trouble exists in the meter circuit.	Check V207; check voltage and resistance measurements of V207.
8. No indication on meter with S203 in XTAL OSC position on one frequency only.	Trouble exists in 17-crystal oscillator circuit.	Check crystal in use on frequency at which trouble exists.
9. Same as above, except trouble exists on all frequencies.	Trouble exists in 17-crystal oscillator circuit.	Check V209; check voltage and resistance measurements on V209.
10. Zero or low R. F. POWER indicated by meter. PA GRID indication normal.	Trouble exists in power amplifier stage or antenna coupling circuit.	Check V205; check voltage and resistance measurements at V205.
11. Low indication with METER SW in PA GRID position. OSC indication normal; voltage at driver test point normal.	Trouble exists in driver circuit.	Check V204; check voltage and resistance measurements at V204.
12. No OSC indication.	Trouble exists in master oscillator doubler stage.	Check V203; check voltage and resistance measurements at V203.

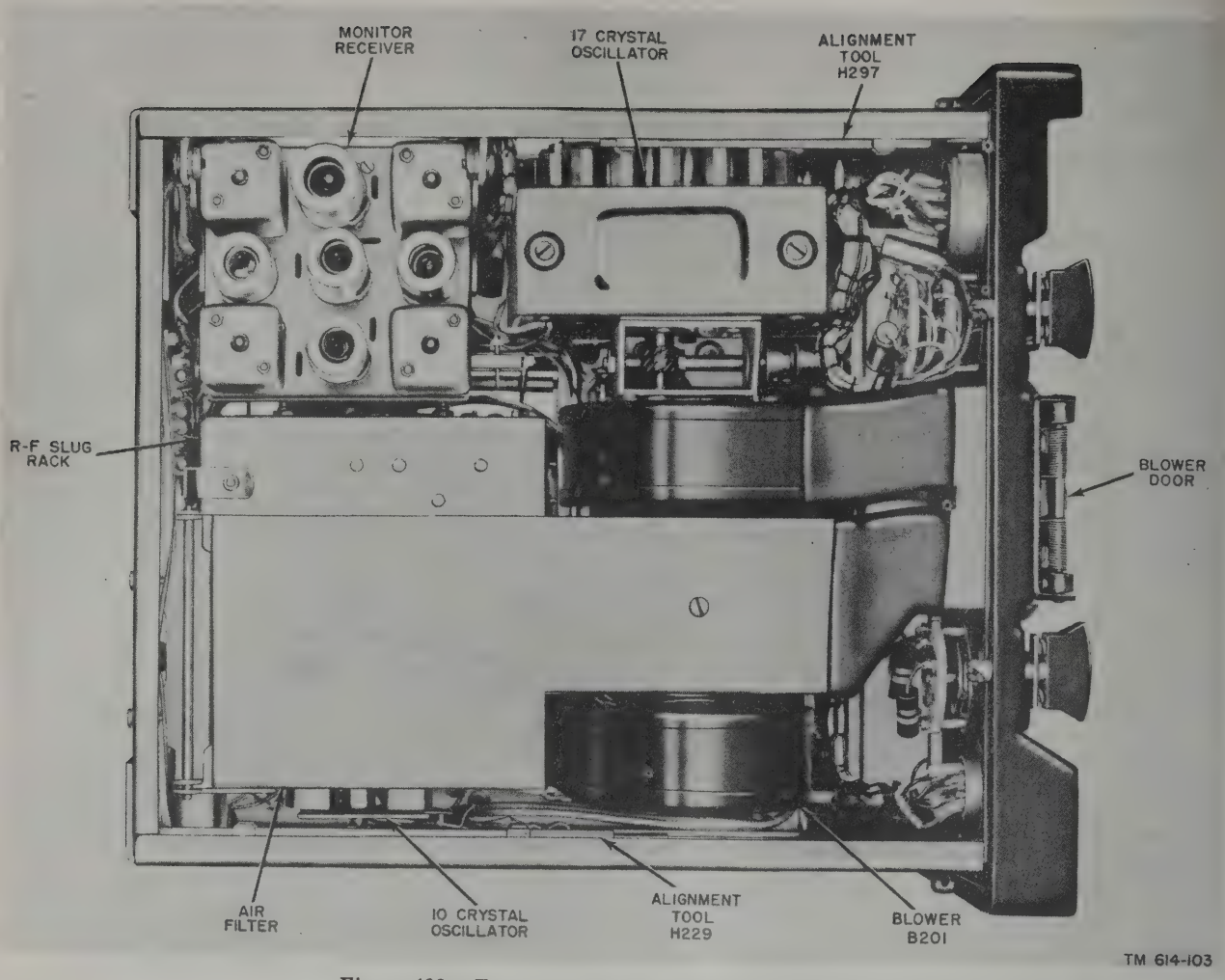


Figure 128. Transmitter, bottom view with blower.

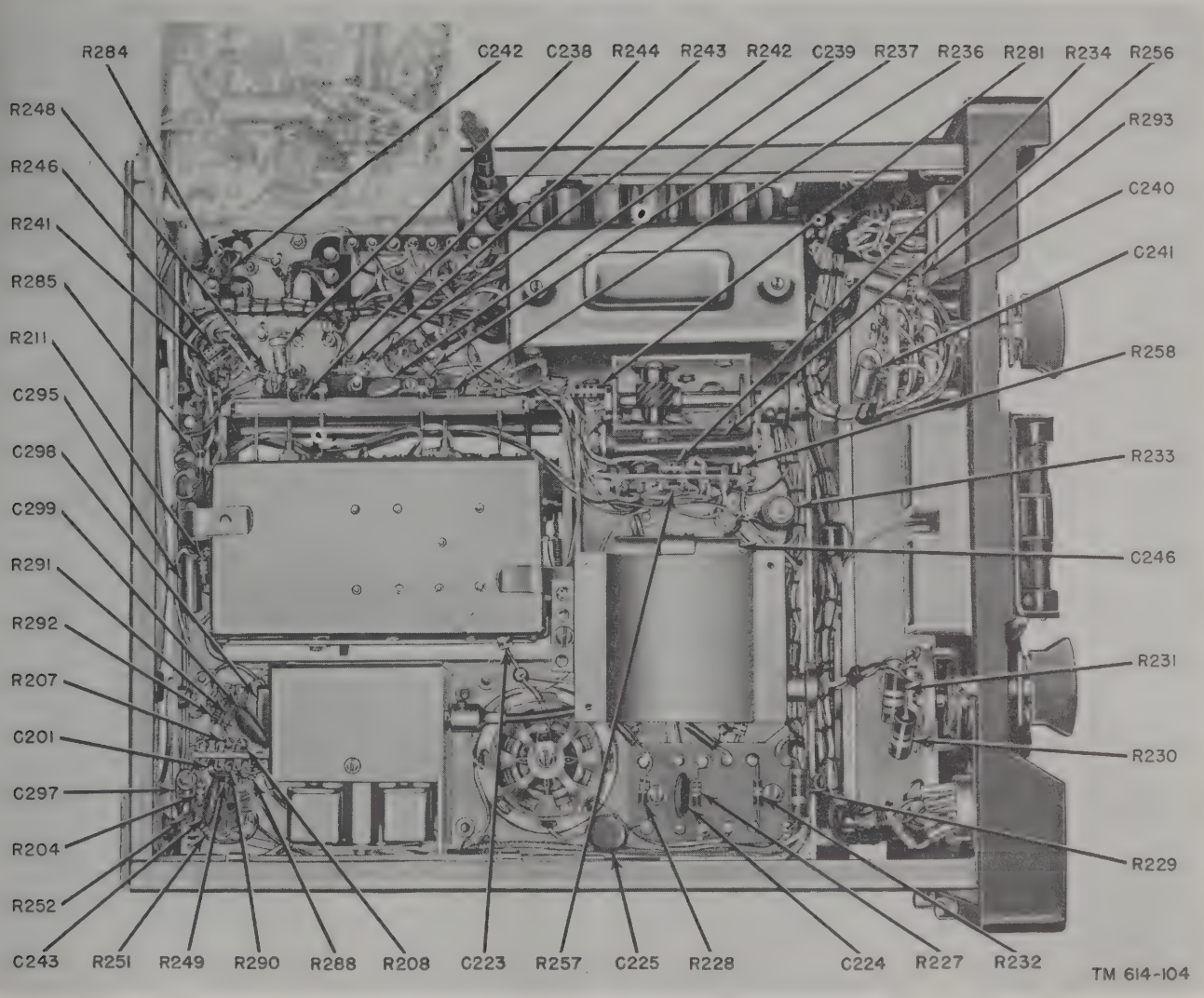


Figure 129. Transmitter, bottom view without blower, showing resistors and capacitors.

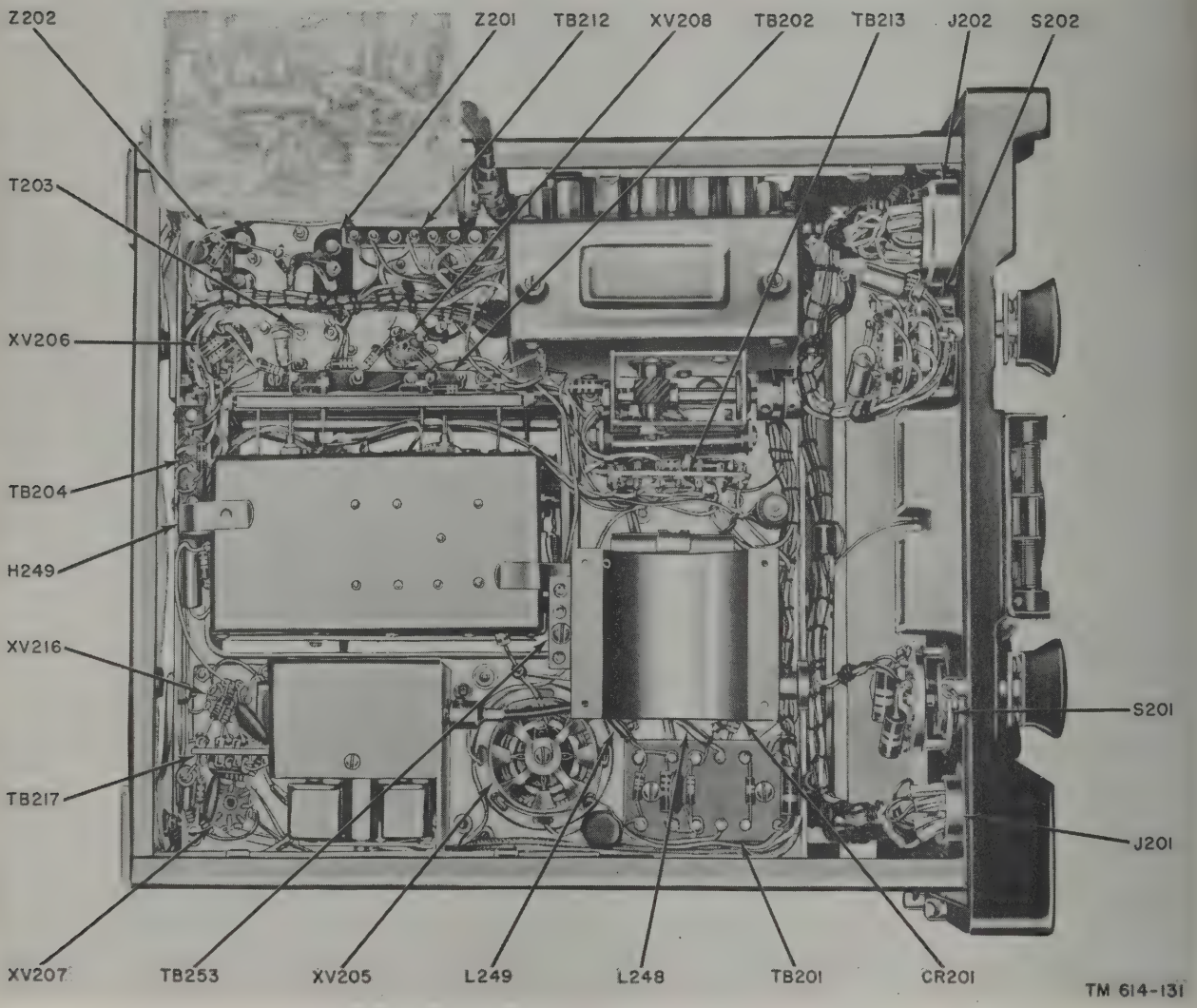


Figure 130. Transmitter, bottom view without blower.

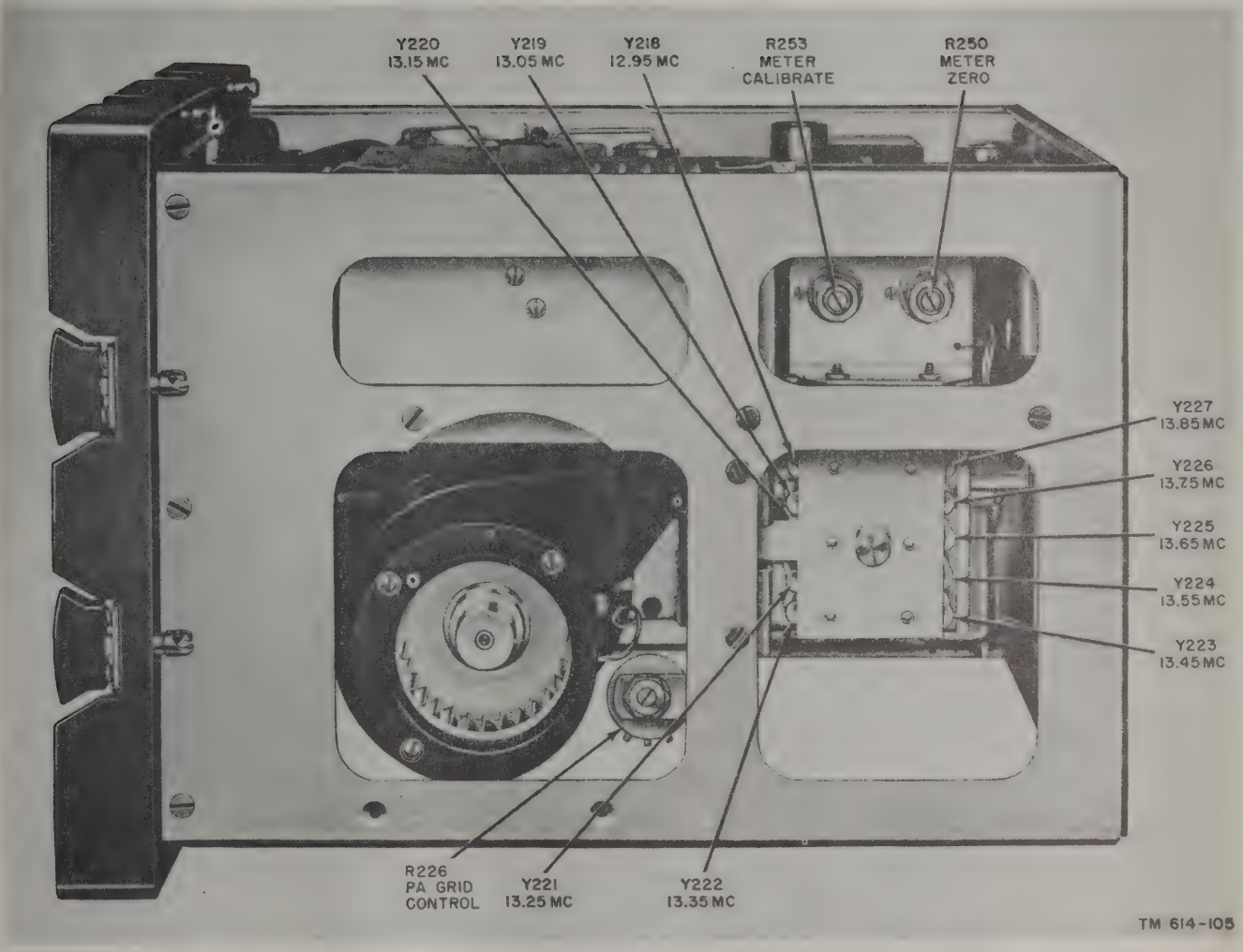


Figure 131. Transmitter, right side view.

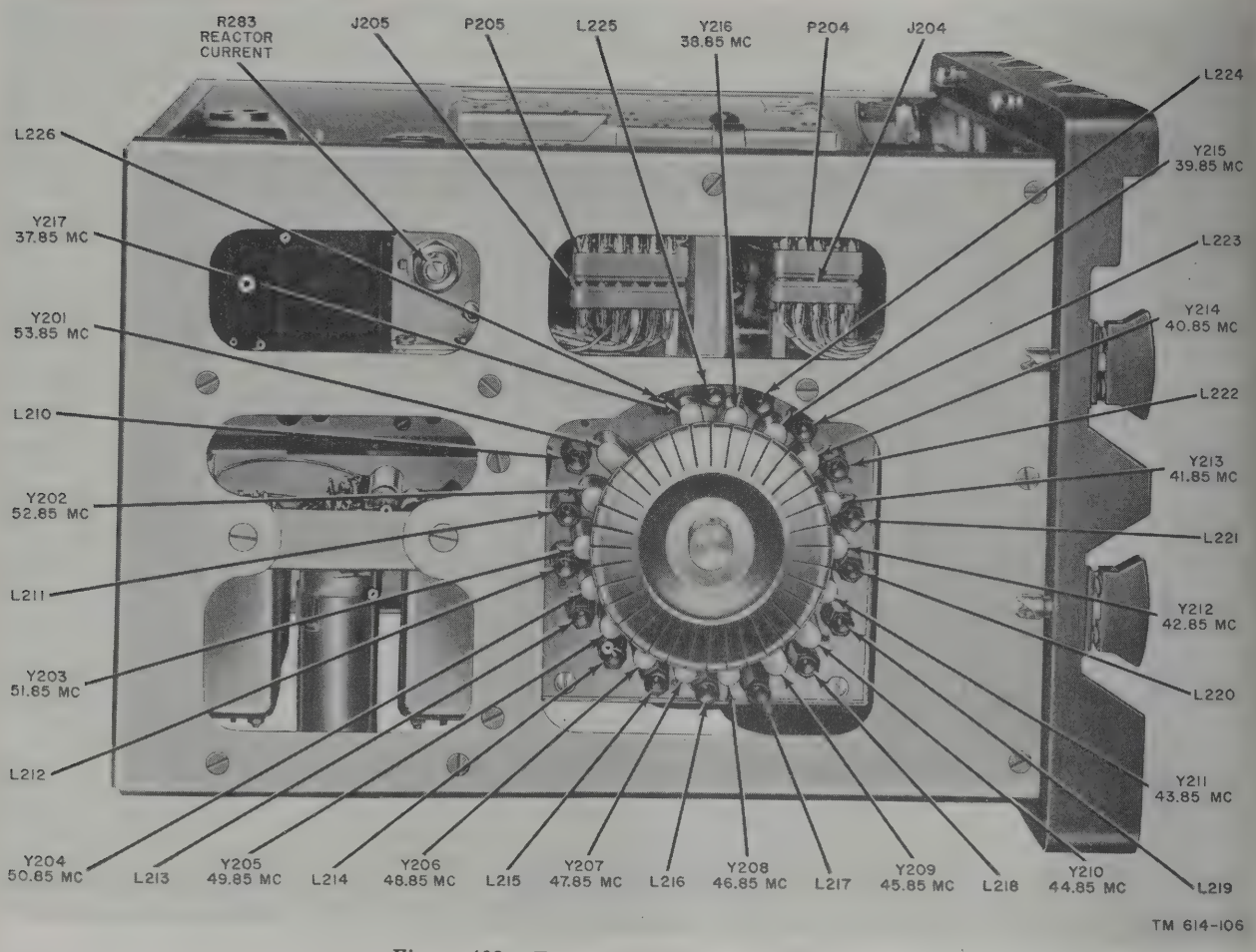


Figure 132. Transmitter, left side view.

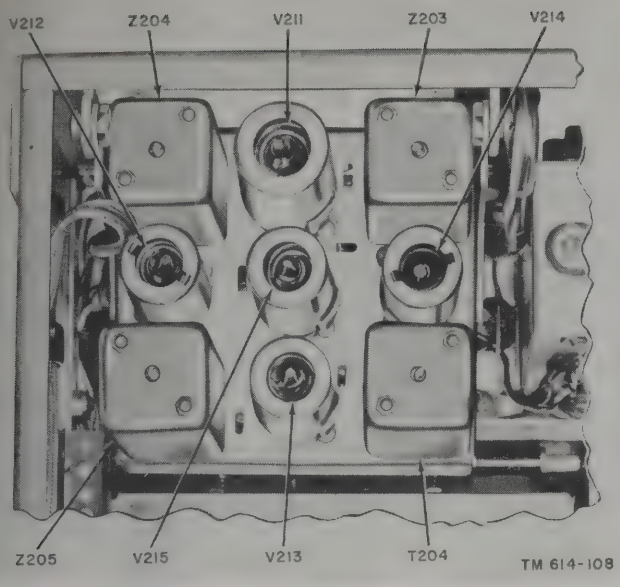


Figure 133. Transmitter monitor receiver, top view.

g. Receiver. Troubles in the receiver may be localized rapidly by proper use of the metering circuit provided, or by making voltage measurements at the test points provided. METER SW S5 connects the meter to various points in the circuit so that operation at these points can be checked by operating the front panel control.

(1) In the trouble-shooting chart below, when checking voltages at the test points on Z1 or Z5, or when checking the 3RD IF meter indication, inject an unmodulated .02-volt signal at the ANT jack. The indications should be as follows:

Test point of Z1	—.12 volt
Test point of Z5	—1.28 volts
Meter reading in 3RD IF position	55 ua

(2) When checking voltages at all other points in the trouble-shooting chart, use a normal incoming air signal. If one is not available, inject a 10-microvolt signal, modulated by 1-kc, 40-kc deviation. The indications should be as follows:

Test point of Z7	—1.1 volts
Meter reading in 1ST LIM position	60 ua
Test point Z9	—14 volts
Meter reading in DISC PRI position	60 ua
Meter reading in LINE LEVEL position	100 ua

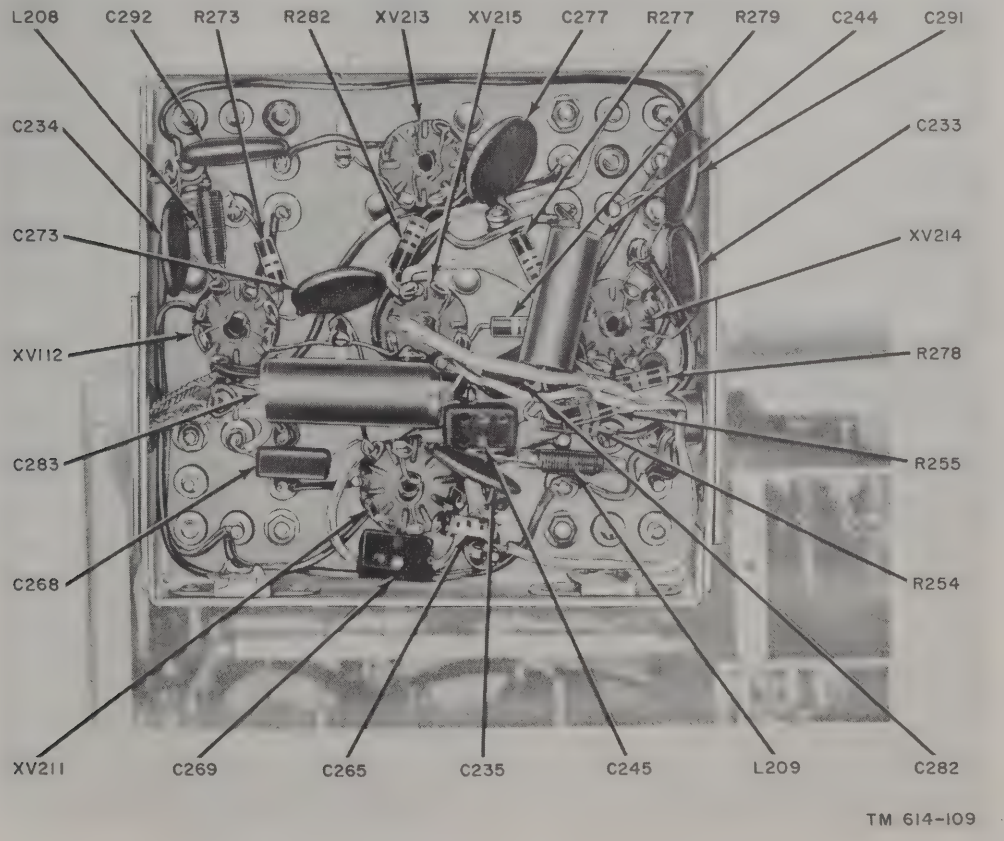


Figure 134. Transmitter monitor receiver, bottom view.

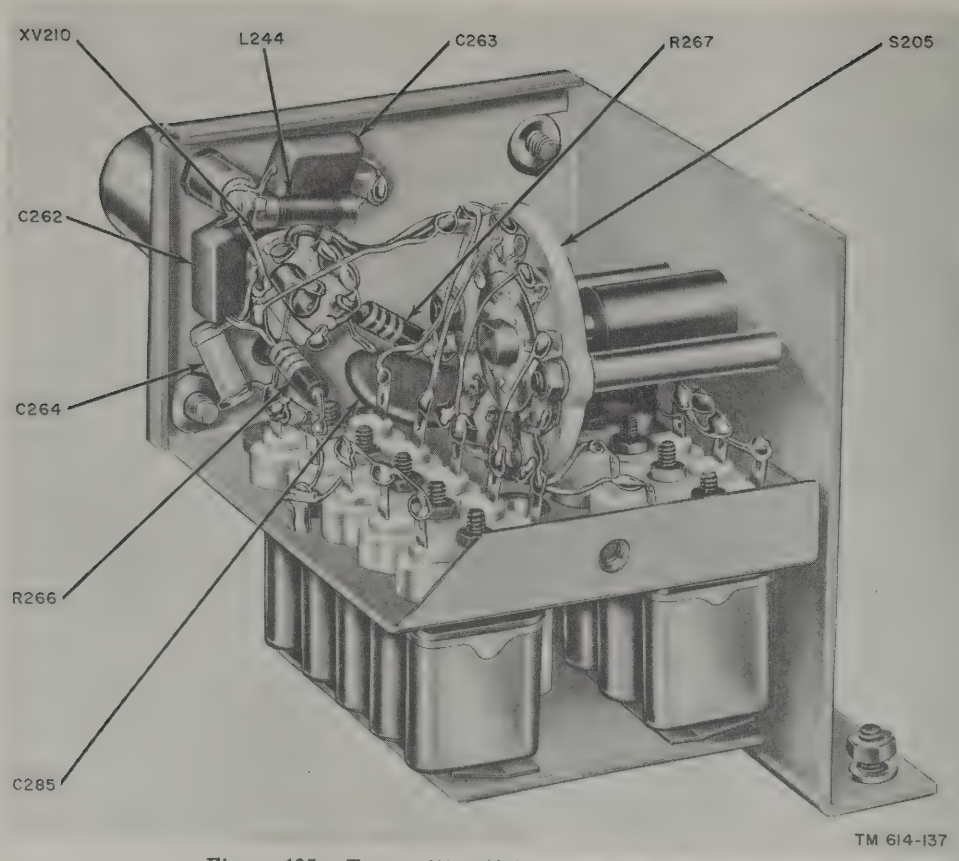


Figure 135. Transmitter 10-frequency oscillator.

(3) Use RF Signal Generator Set AN/URM–48 to simulate the incoming signal. Connect the signal generator output lead to the ANT jack on the receiver and make a common ground connection.

(4) Trouble shooting by use of the front panel meter must begin at the antenna end of the receiver, since a trouble near the antenna would cause most of the meter readings to be abnormal. The sequence of meter positions on the front panel is OSC 1, OSC 2, 3RD IF, 1ST LIM, DISC PRI, DISC−, DISC+, and LINE LEVEL. Take readings in that order. To use the following chart, take the meter readings in their proper order, and be sure that all readings prior to the one listed in the symptom column are normal unless otherwise specified. After the defect has been localized to a particular section of the receiver, refer to the signal substitution paragraphs to locate the defective stage; then use voltage and resistance measurements to isolate the defective part. Use figures 59 and 140 through 150 to identify the sections and parts of the receiver; use figure 170 for voltage and resistance measurements.

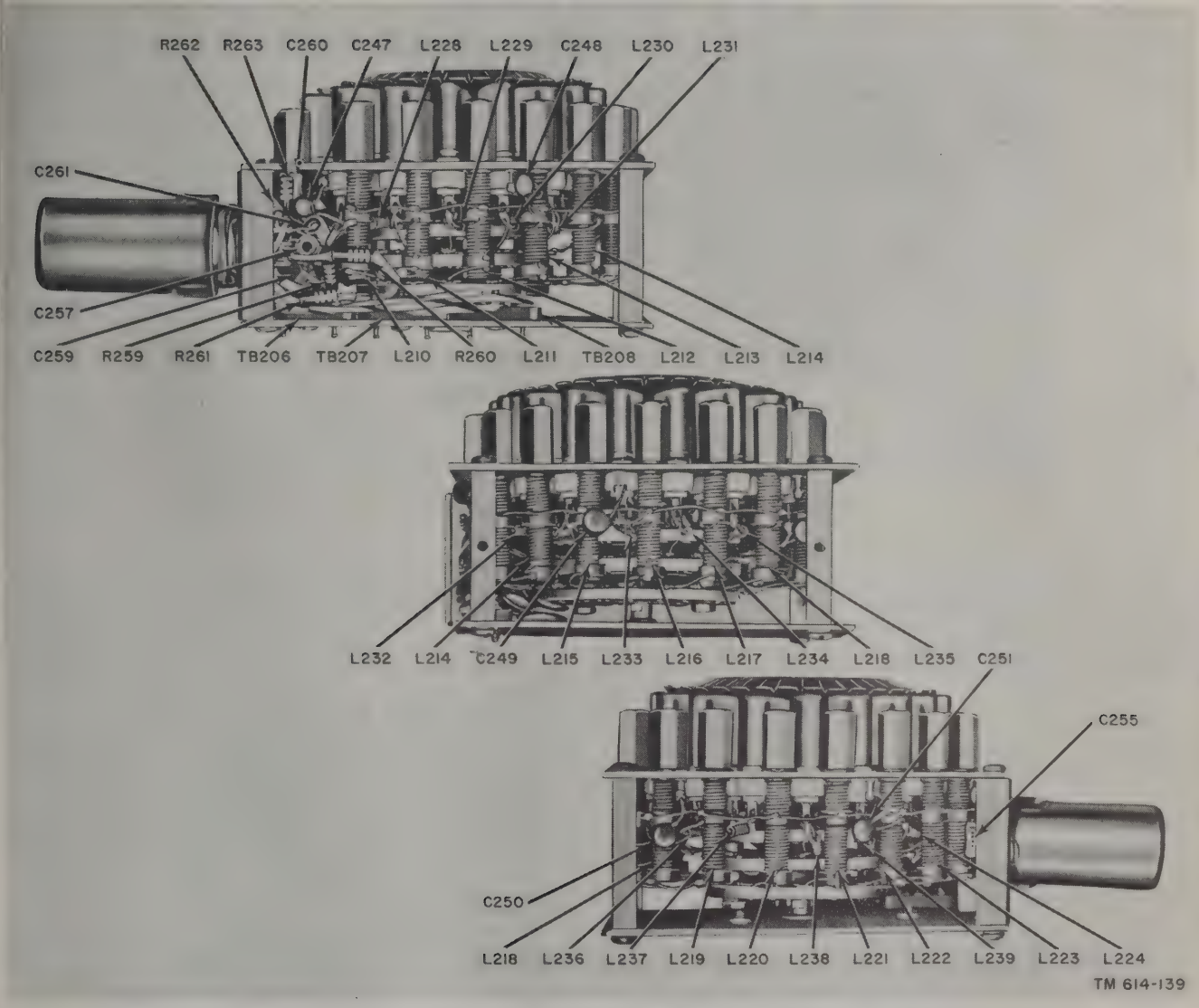


Figure 136. Transmitter 17-frequency oscillator.

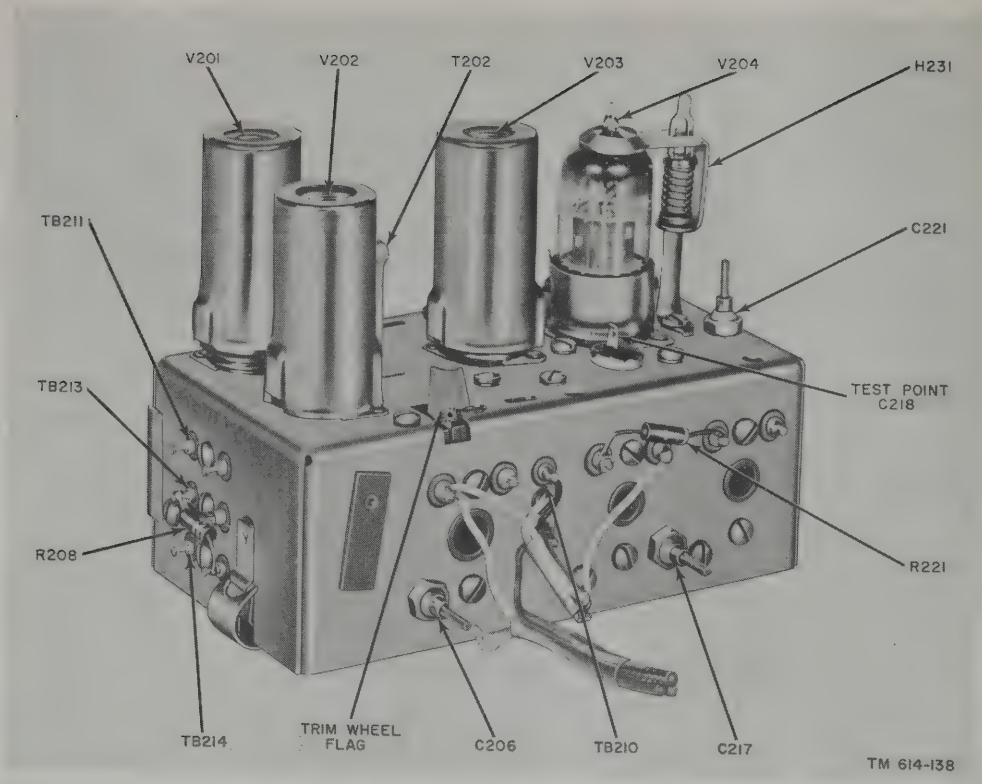


Figure 137. Transmitter r-f slug rack, over-all view.

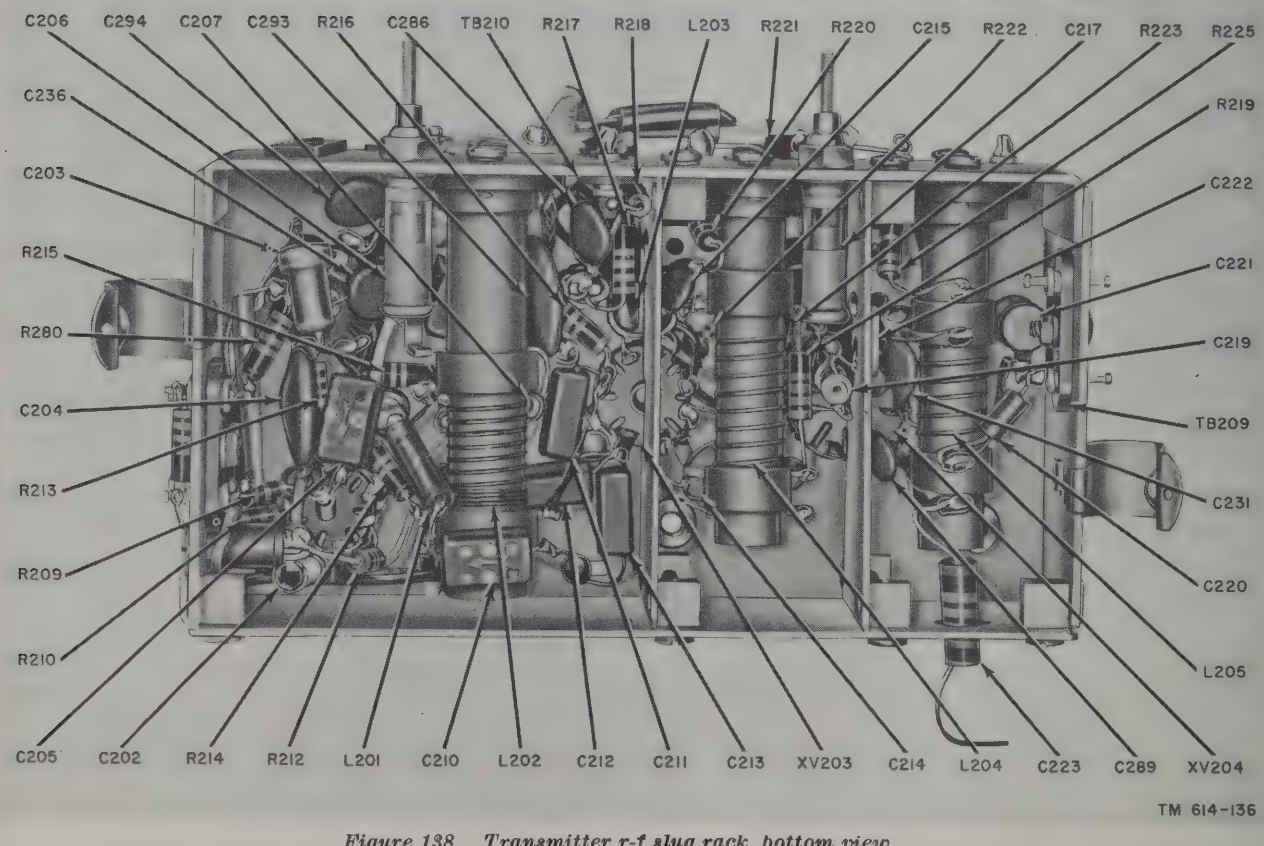
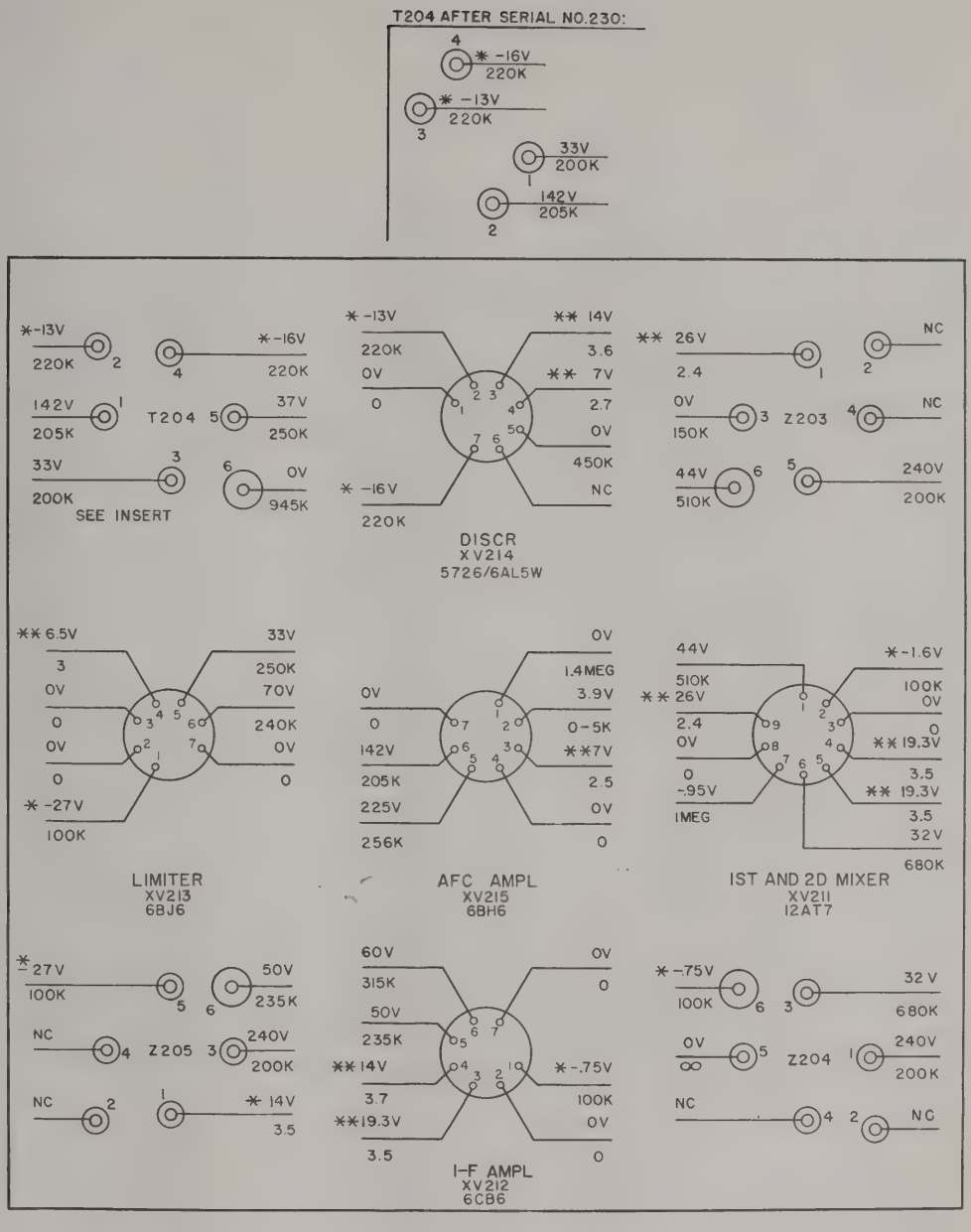


Figure 138. Transmitter r-f slug rack, bottom view.



NOTES:

1. ALL VOLTAGE MEASUREMENTS TAKEN WITH A 20,000 OHMS-PER-VOLT METER UNLESS OTHERWISE SPECIFIED. * INDICATES READING TAKEN WITH A VTVM.

2. ALL VOLTAGE MEASUREMENTS ARE D-C UNLESS OTHERWISE SPECIFIED. ** INDICATES READING WHICH ARE A-C WHEN THE PRIMARY POWER SOURCE IS A-C, AND D-C WHEN THE PRIMARY POWER SOURCE IS D-C.

3. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND. ALL RESISTANCE MEASUREMENTS MADE WITH TRANSMITTER DISCONNECTED FROM ALL OTHER COMPONENTS, WITH R F POWER SWITCH AT HI.

4. ALL RESISTANCE MEASUREMENTS ARE IN OHMS.

TM 614-125

Figure 139. Voltage and resistance charts, monitor receiver.

h. Radio Receiver R–125/GRC–10, Troubleshooting Chart.

Symptom	Probable trouble	Correction
1. No indication on meter in OSC 1 position (all frequencies).	Trouble exists in first h-f oscillator circuit.	Check V10; check voltage and resistance measurements at V10.
2. No indication on meter in OSC 1 position (one frequency only).	One of crystals Y1 through Y17 or S1 defective.	Check crystal by substitution; use ohmmeter to check continuity through S1.
3. No indication on meter in OSC 2 position (all frequencies).	Trouble exists in second h-f oscillator circuit.	Check V11.; check voltage and resistance measurements at V11.
4. No indication on meter in OSC 2 position (one frequency only).	One of coils L48 through L57 or S2 defective.	Check continuity with ohmmeter.
5. Zero volt at test point on Z1	Trouble exists in r-f amplifier V1 circuit or in antenna.	Use signal substitution (par. 186) to determine point at which trouble exists. Then use voltage and resistance measurements to localize defective component part.
6. Voltage normal at test point on Z1 but no voltage at test point on Z5 (pin 2).	Trouble exists between input circuit of first mixer and input of second fixed i-f.	Check for proper operation of both h-f oscillators. If both oscillators are operating properly, use signal substitution to localize defective stage (par. 186). Check tube in defective stage, and if necessary, use voltage and resistance measurements to isolate defective component part.
7. Voltage normal at test point on Z5 (pin 2), but no reading on meter in 3RD IF position.	Trouble exists in second fixed i-f circuit.	Check V7; check voltage and resistance measurements at V7 and Z6.
8. Normal indication on meter in 3RD IF position, but no voltage at test point on Z7 (pin 2).	Trouble exists in third fixed i-f circuit.	Check V8; check voltage and resistance measurements.
9. Voltage normal at test point on Z7 (pin 2), but no indication on meter in 1ST LIM position.	Trouble exists in fourth fixed i-f circuit.	Check V9; check voltage and resistance measurements.
10. Normal indication on meter in 1ST LIM position, but 0 volt at test point on Z9 (pin 2).	Trouble exists in first limiter circuit	Check V13; check voltage and resistance measurements.
11. Voltage normal at test point on Z9 (pin 2), but no indication in DISC PRI meter position.	Trouble exists in second limiter or discriminator circuits.	Check V14 and V15; check voltage and resistance measurements at V14 and V15 tube sockets and T4.
12. Reading normal with S1 in DISC PRI position, but no reading in LINE LEVEL.	Trouble exists in wide-band audio amplifier circuit.	Check V21; check voltage and resistance measurements at V21.
	Trouble exists in meter amplifier and/or meter rectifier circuits.	Check V17; check voltage and resistance measurements at V17.
13. Reading normal with S1 in LINE LEVEL position. Wide band output normal, but no output from narrow band circuit.	Trouble exists in narrow-band audio amplifier V22 or in narrow band audio output V23 circuit.	Check V22 and V23; if necessary, use signal substitution method to locate defective stage. Check voltage and resistance measurements to isolate defective component part.
14. No squelch position	Trouble exists in squelch circuit	Check V18, V19, and V20; check voltage and resistance measurements at V18, V19, and V20.
15. No reading with METER SW at LINE LEVEL. Receiver operation normal. All other meter readings normal.	Trouble exists in meter amplifier or meter rectifier circuit.	Check V17; check voltage and resistance measurements at V17.
16. Low sensitivity	Gain of one or more stages low, but receiver still operative. Defective tube or component part.	Refer to stage gain charts (par. 187) and check gain of each stage to locate defective stage. Check tube; check voltage and resistance measurements to isolate defective part.
	Misalinement	Aline according to par. 197.

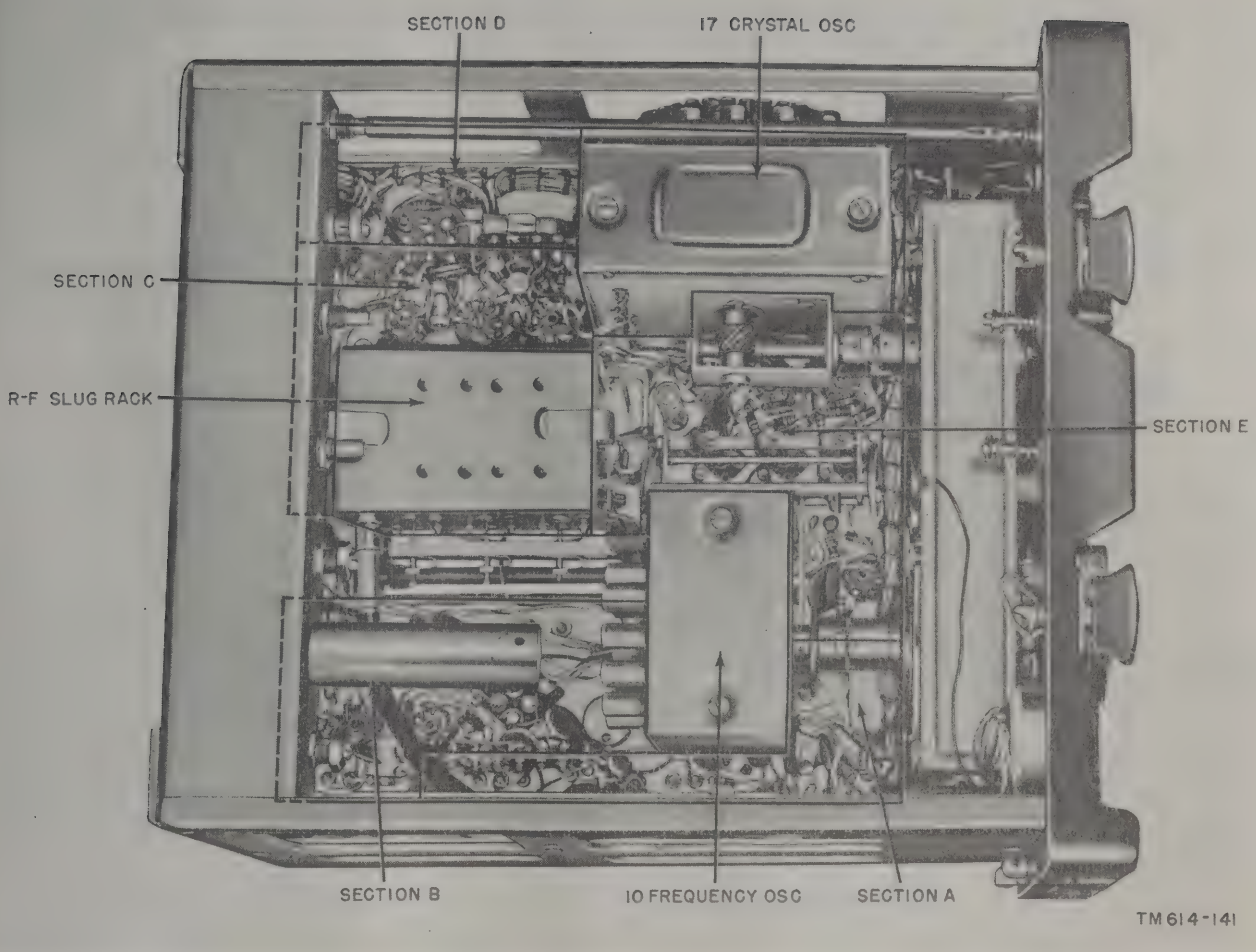


Figure 140. Receiver, bottom view.

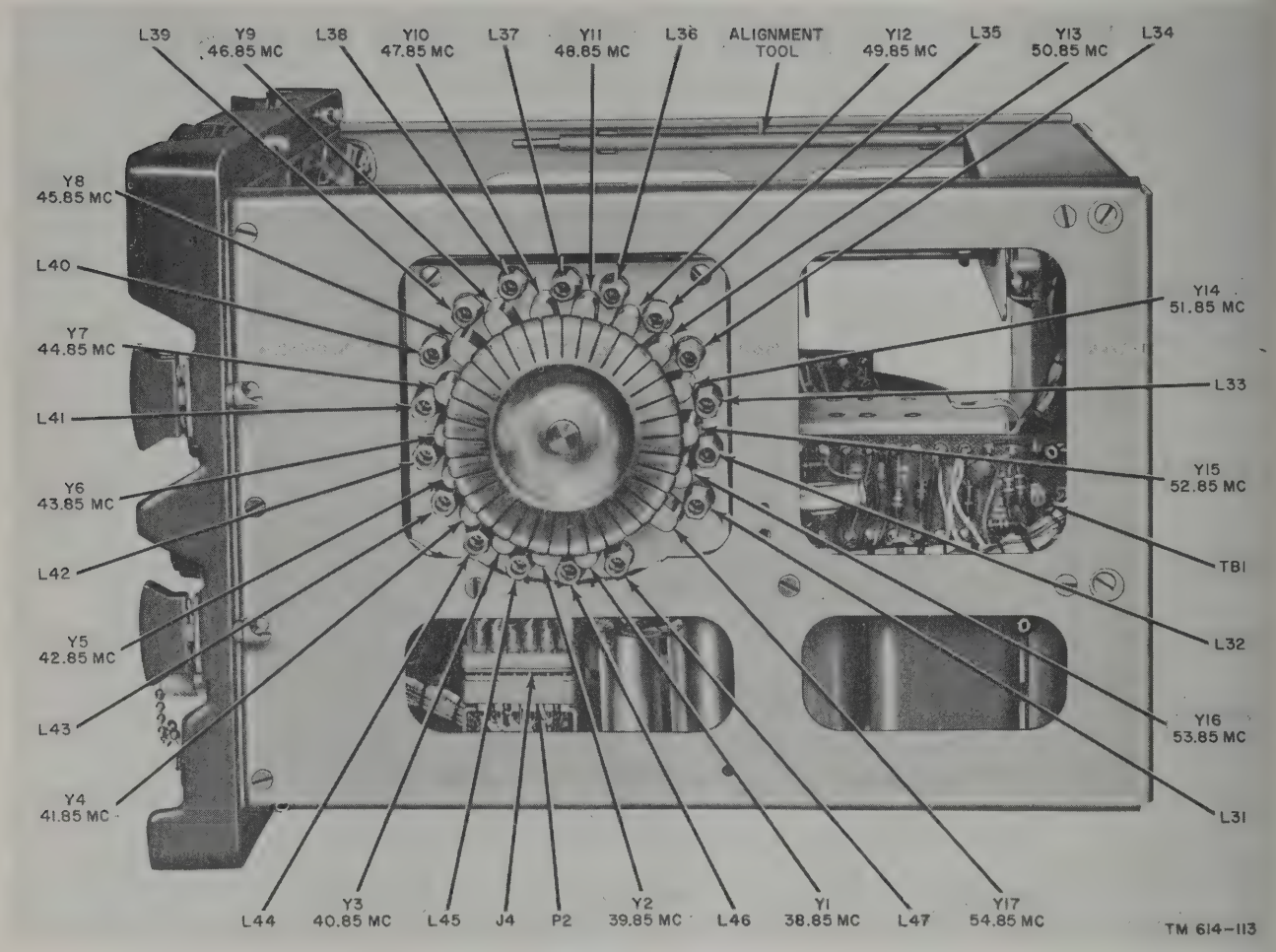


Figure 141. Receiver, right side view of chassis.

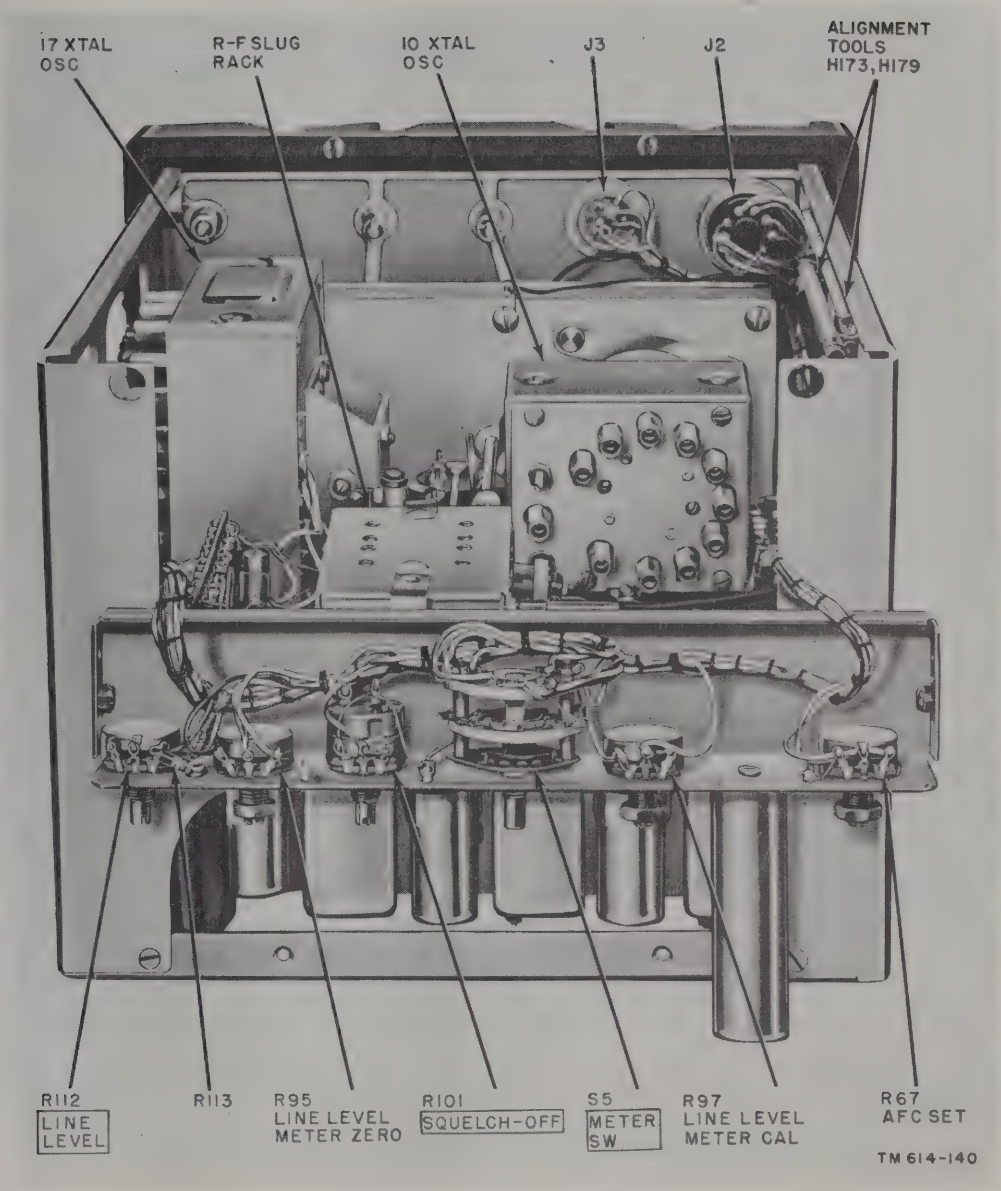


Figure 142. Receiver, rear view.

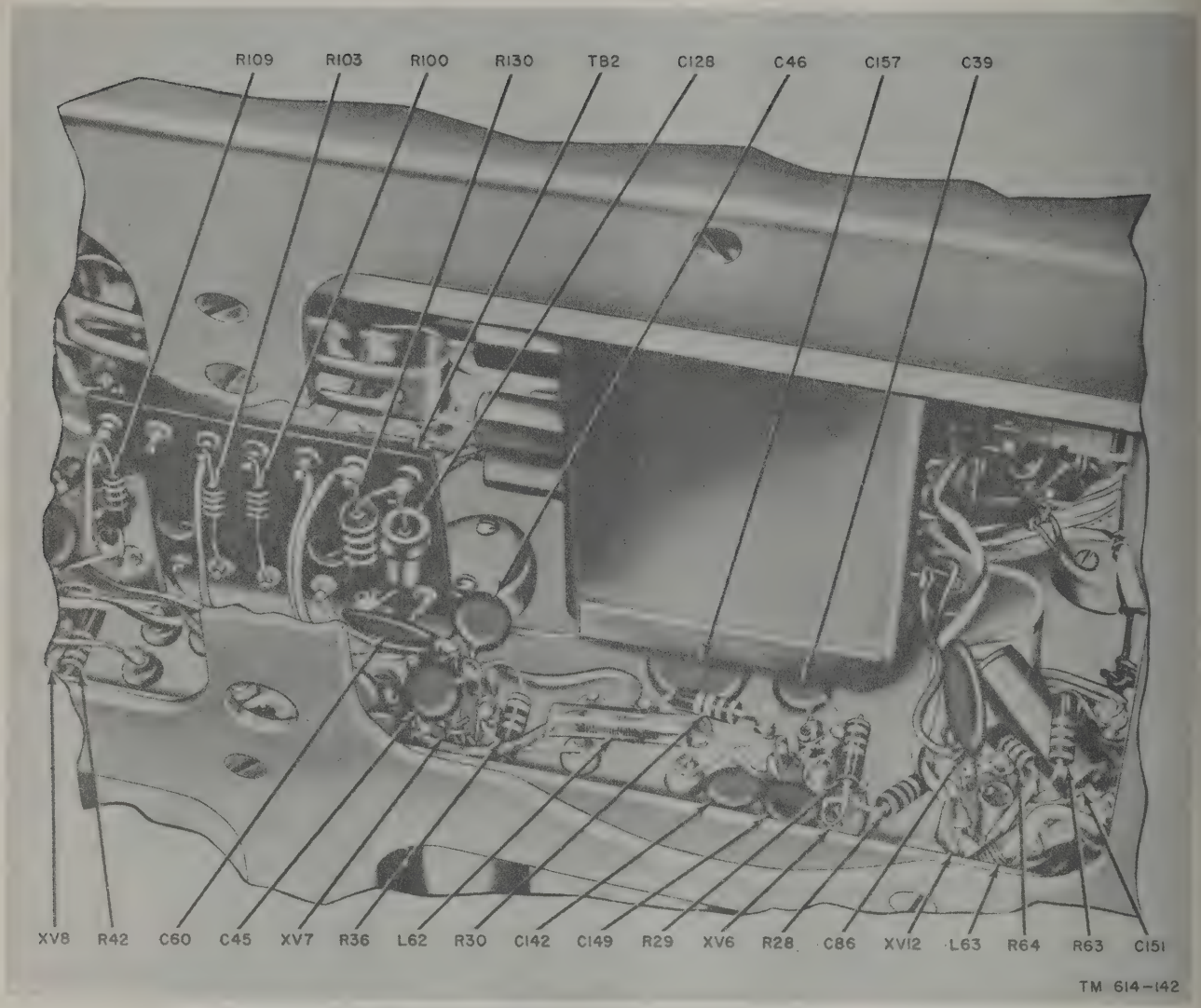


Figure 143. Receiver, bottom view, section A shown in figure 140.

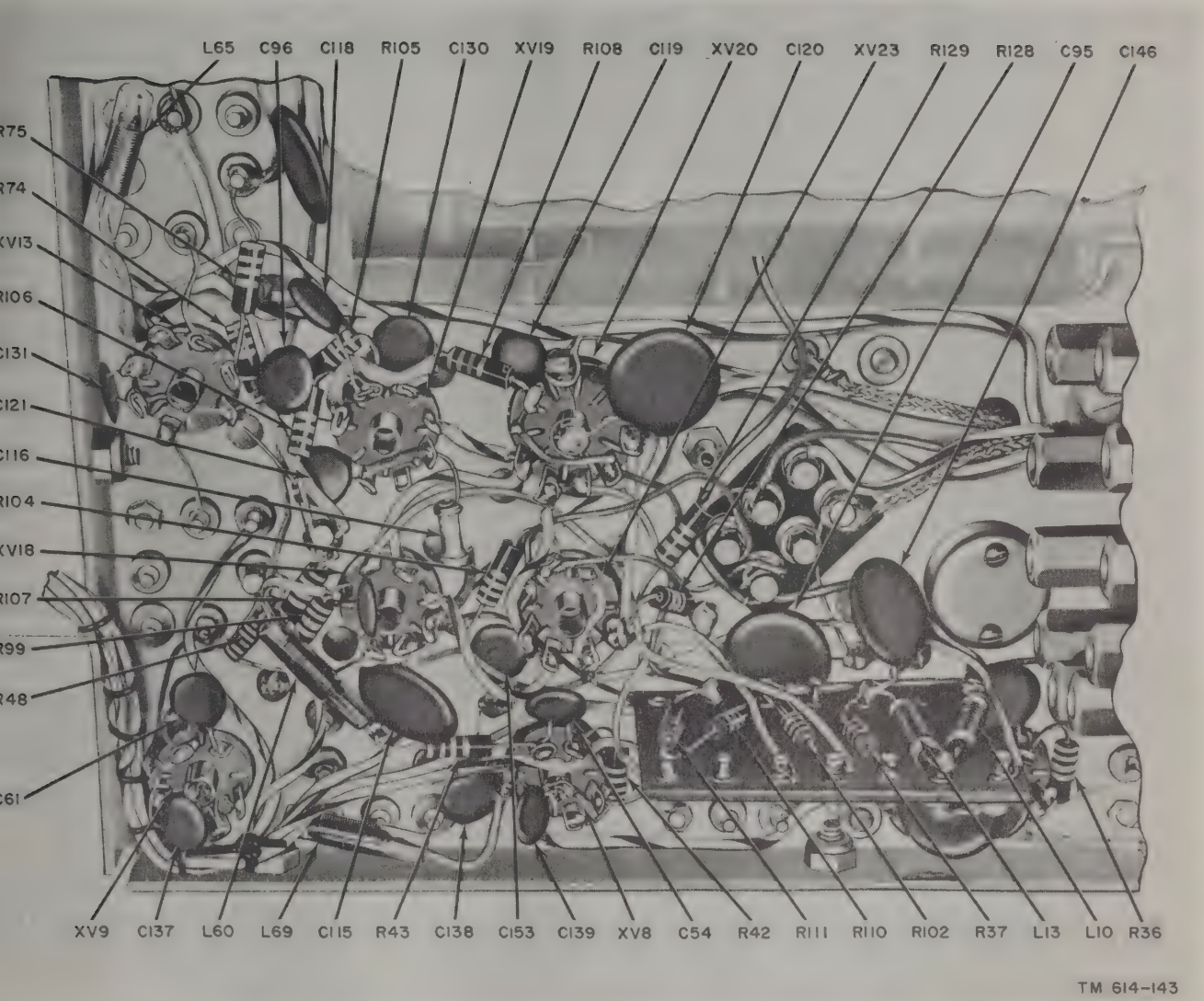


Figure 144. Receiver, section B shown in figure 140.

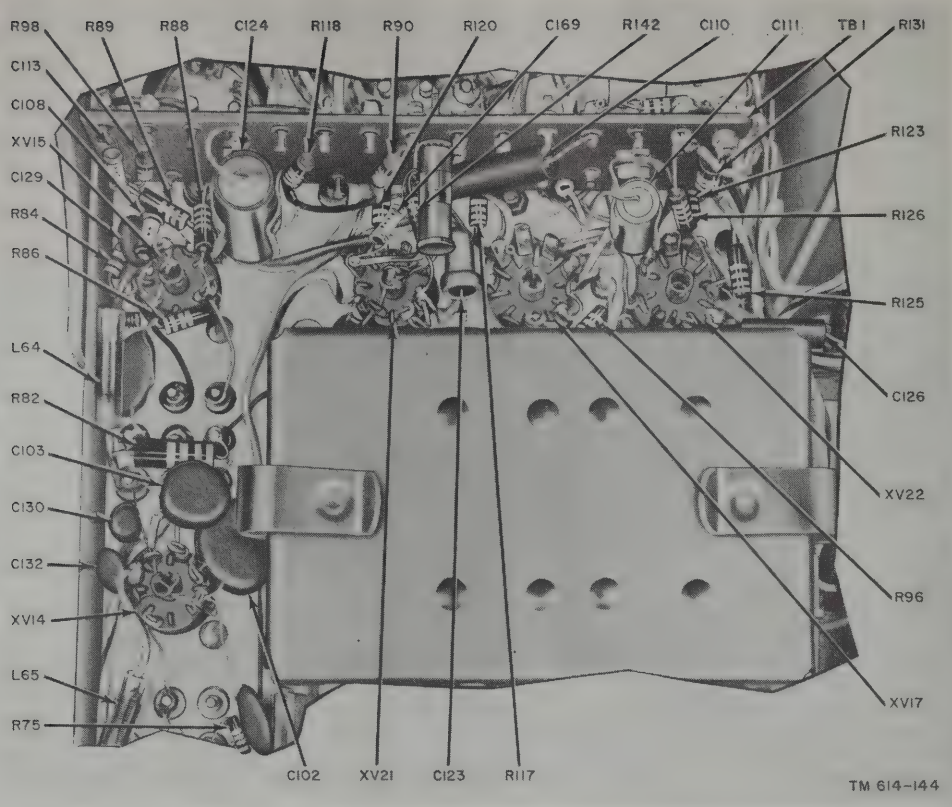


Figure 145. Receiver, section C shown in figure 140.

i. Detailed Explanations.

(1) Check continuity of K402 coil by measuring with an ohmmeter between pins 1 and 8. If this reading is infinity, replace the relay. Check K402 contacts by measuring the a-c voltage between pins 5 and 7. This should be the source voltage, 115 or 230 volts. Then measure the a-c voltage between pins 4 and 6. If the two readings are not the same, replace the relay.

(2) Check continuity of K401 coil by measuring with an ohmmeter between pins 1 and 4. If this reading is infinity, replace the relay. Check K401 contacts by measuring the d-c potential from pin 3 to ground (26 volts). Then measure from pin 2 to ground (26 volts). If the two readings are not the same, replace the relay.

(3) To check K303 contacts, measure the a-c potential from pin 6, T303, to pin 4, K303, and then measure from pin 6, T303, to pin 3, K303. If the two readings are not the same, replace the relay.

(4) To check K303 contacts, measure the positive d-c potential from pin 7 to ground, and then measure from pin 8 to ground. If the same potential is not present at both points, replace the relay.

(5) To check K303 contacts, measure the a-c potential from pin 4, T303, to pin 2, K303, and from pin 4, T303, to pin 11, K303. If the same potential is not present at both points, replace the relay.

(6) To check K302 contacts, measure the d-c voltage from pin 8 to ground, and then measure from pin 12 to ground. If the two readings are not the same replace the relay.

(7) To check K301 contacts, temporarily ground pin 9. If the vibrators begin operation when pin 9 is grounded, K301 contacts 14 to 9 are defective; replace the relay.

(8) Check continuity of K304 coil by measuring between pins 1 and 4 with an ohmmeter. If reading is infinity, replace the relay. Check K304 contacts by measuring the voltage from pin 2 to ground, and then measure from pin to ground. If the two readings are not the same, replace

the relay. Check K303 contacts by temporarily grounding pin 6; if K304 energizes, K303 contacts 5 and 6 are defective; replace the relay.

j. Transmitter and Receiver Filament Circuits. One very common source of tube failure is open filaments. Since the filaments of the tubes in this equipment are in series-parallel arrangement, an open filament can cause several other tubes to be inoperative. When trouble occurs in either the receiver or transmitter, look at the tubes to see if all of them are lighted. If one or more tubes are not lighted, refer to the filament circuit functional diagrams, figure 109 for the receiver and figure 84 for the transmitter, to see which tubes are in that series-parallel circuit. Check continuity of the filament of each tube with an ohmmeter, removing only one tube at a time; replace it with a new one if necessary or replace the original before another tube is removed. Figures 84 and 109 show that there are a number of bypass capacitors in the filament circuits. If one of these capacitors becomes shorted, there would be an overload on the tube or tubes between that point and the power source, and the other tubes in that series circuit would be inoperative. This condition may cause some of the tubes to be lighted more brightly than normal, while the rest of the series string would not be lighted at all. The overload may be great enough to open one or more filaments. Use the voltage and resistance charts of figures 139, 169, and 170 to isolate troubles of this nature.

186. Signal Substitution

a. General.

(1) Signal substitution requires a source of audio and radio frequencies. RF Signal Generator Set AN/URM–48 is suitable for r-f; Audio Oscillator TS–382A/U is suitable for a-f.

(2) In addition, a handset or permanent magnet loudspeaker such as Handset H–33/PT or Dynamic Loudspeaker LS–166/U, respectively, is necessary.

(3) A multimeter and tube tester are also needed to isolate the defective part after the faulty stage has been indicated by signal substitution. Suitable equip-

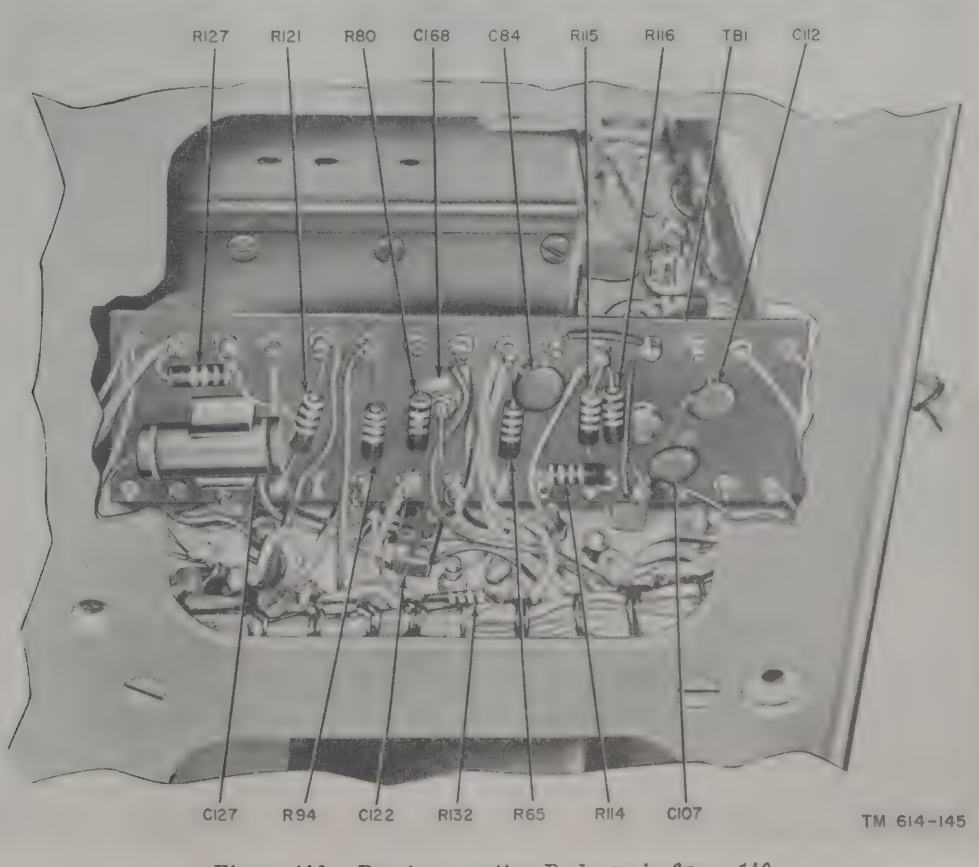


Figure 146. Receiver, section D shown in figure 140.

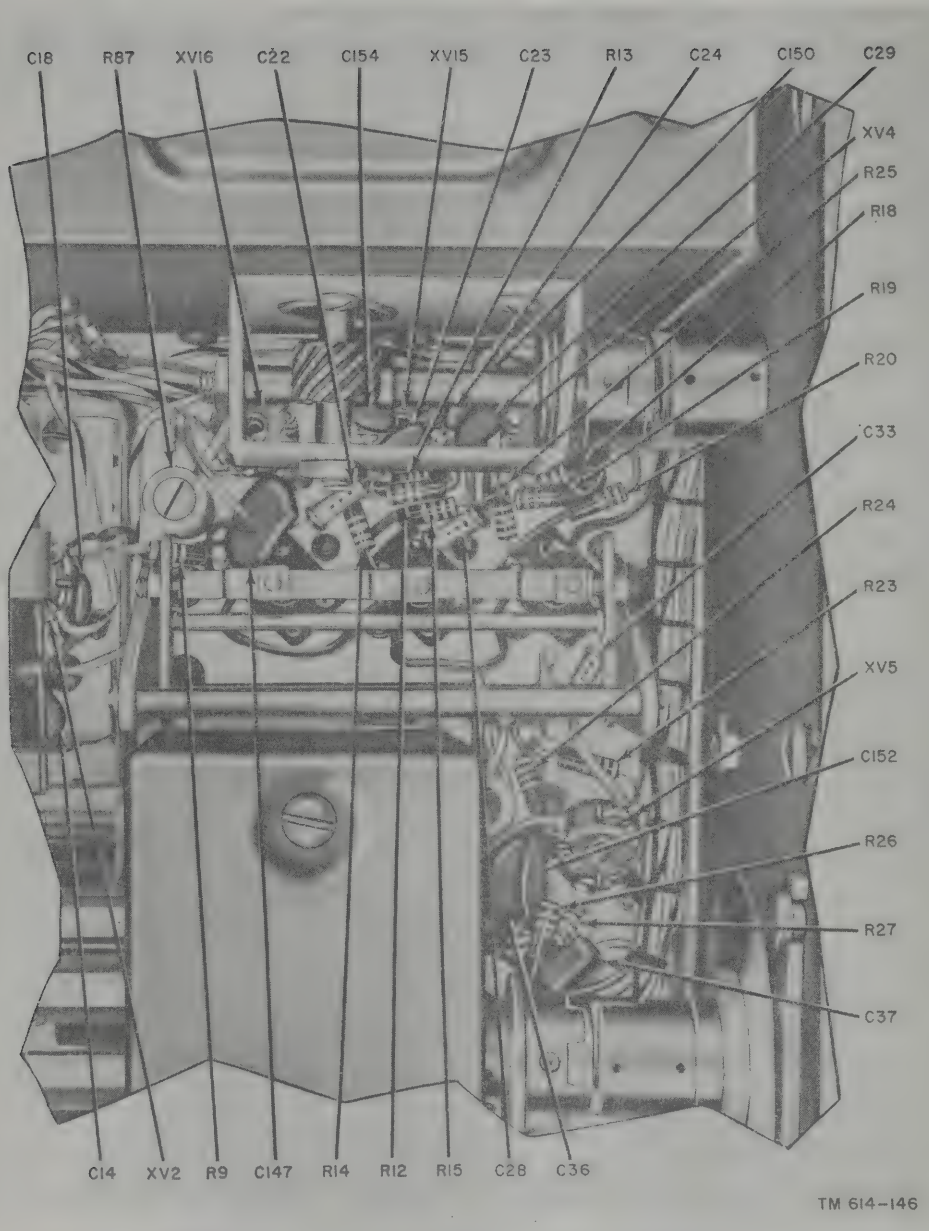


Figure 147. Receiver, section E shown in figure 140.

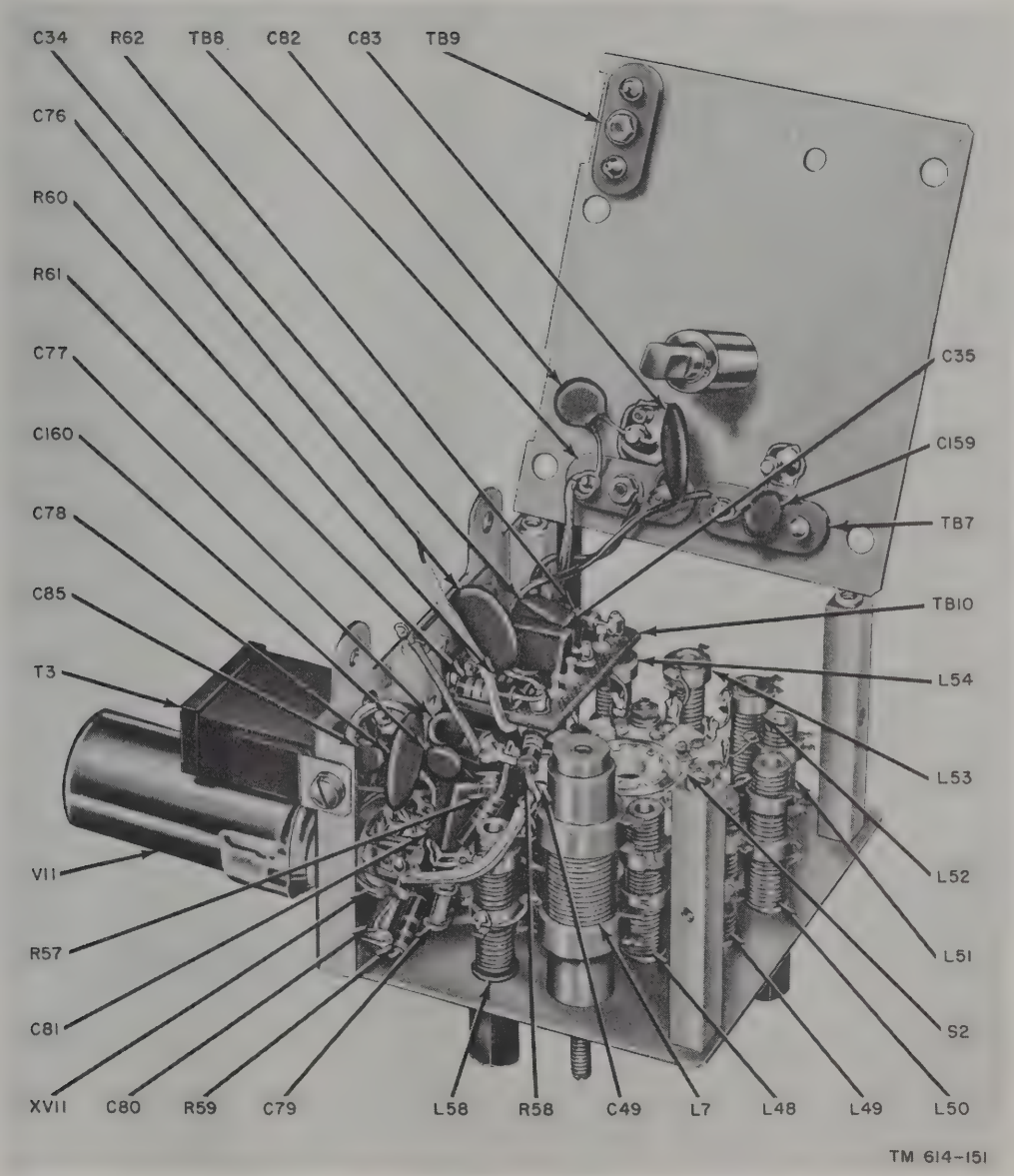


Figure 148. Receiver, 10-frequency oscillator.

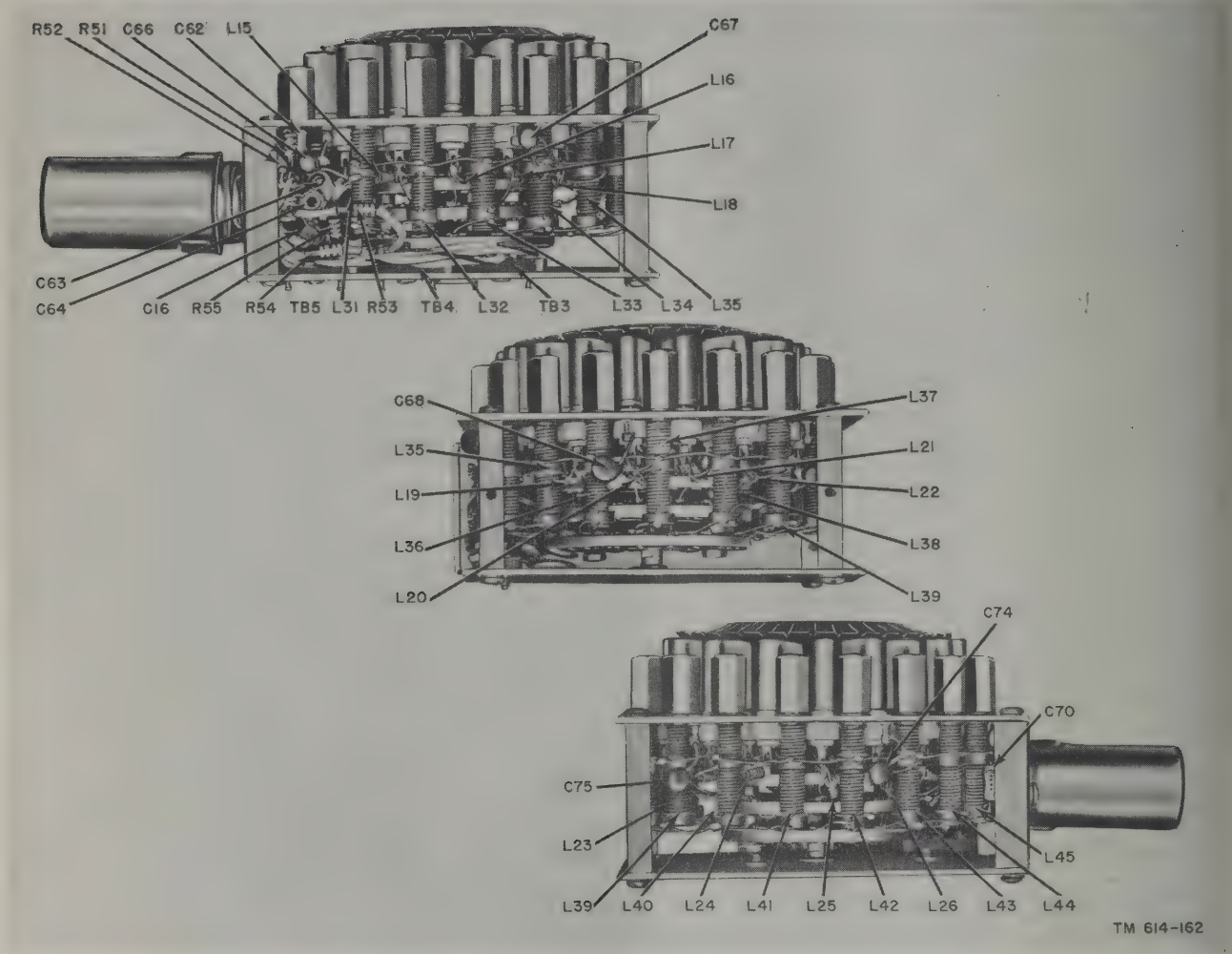


Figure 149. Receiver, 17-frequency oscillator.

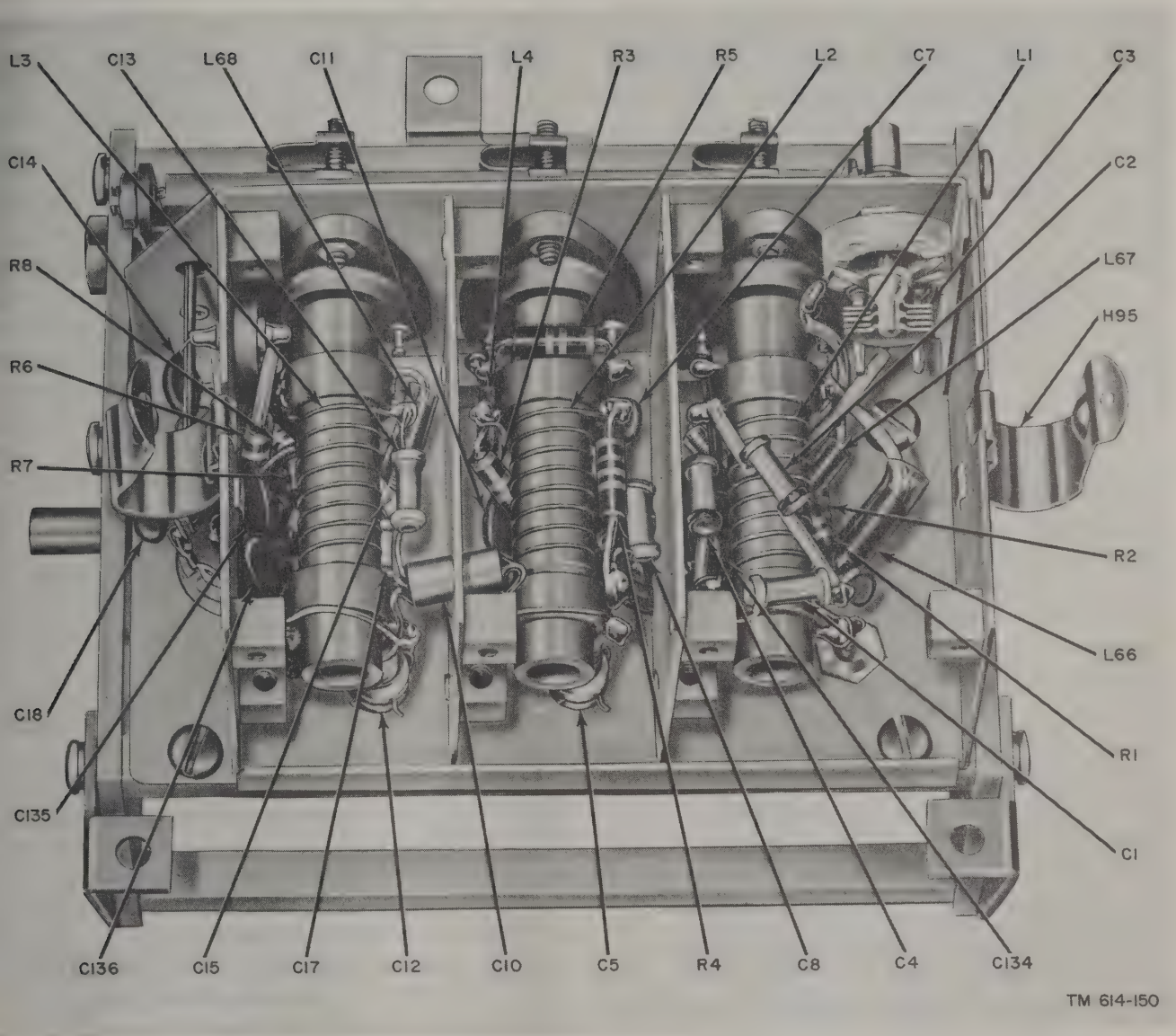


Figure 150. Receiver, r-f slug rack.

ments are Multimeter TS–352/U or Electronic Multimeter ME–6A/U, and Tube Tester TV–2/U or Electron Tube Test Set TV–7/U.

Note. Since a tube tester cannot simulate the actual operating conditions of a tube, its indications cannot be completely relied upon. If there is any doubt, a more positive check of a tube can be made by substituting one known to be good.

(4) In the tests indicated in paragraph 186*b*, *c*, *d*, and *e* below, ground one side of the signal generator to the receiver chassis and connect the other side through a capacitor to the receiver point as directed.

(5) Note the volume, and listen for serious distortion from the loudspeaker or handset at the various points in the signal substitution procedure. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. When practicable, compare the output with a receiver known to be in good condition.

(6) Check the wiring and soldering in each stage during the procedure.

Caution: Do not damage the wiring by pushing it back and forth during inspection. Be careful not to damage the receiver in any other way.

(7) When trouble is localized to a given stage, first test the tube; then measure the voltage; finally measure the resistance at the tube socket of that stage. *Be sure power is off when measuring resistance.*

(8) Trouble in a circuit or stage may not cause changes in voltage and resistance measurements at the tube socket. The instructions included in this paragraph are merely a guide and should suggest other procedures, such as resistance measurements on individual parts.

(9) Misalinement of one or more stages of the receiver will cause reduced output. Misalinement of the high-frequency oscillator may cause no output. If a stage has been found to be defective and the voltage and resistance checks are normal, check the alinement. Refer to the alinement procedure in paragraphs 196 through 201.

(10) Remove only one tube at a time when testing. Check the tube type to be sure that it is in the proper socket. Test the tube, and, if it is not defective, return it to the socket before removing another tube.

(11) Be sure to complete each step before proceeding to the next step. Isolate and repair any trouble located before going further.

Warning: Be extremely careful because of the high voltages exposed when servicing the set.

b. A-F Tests.

(1) Set the signal generator (Audio Oscillator TS–382A/U) frequency to 1 kc and adjust the output to maximum. Use the same frequency for all a-f tests, but lower the output of the signal generator as progress is made back through the audio circuits. Set the VOLUME control completely clockwise and turn the SQUELCH control to OFF. The squelch circuit test is given in paragraph 204*o*. Use a .05-μf capacitor in series with the signal generator lead.

(2) Apply the signal generator output to pin 5, V23. If the output of the signal generator is sufficient, a low signal will be heard. If the signal is not heard, check continuity of T2, both primary and secondary, and check the wiring to the speaker and handset jack.

(3) Apply the signal generator output to pin 1, V23. There should be a noticeable increase in volume as compared with the previous test. Turn the output of the signal generator down if the volume is excessive. If there is no signal, or low volume, check V23. If V23 tests good, check plate and screen grid voltages.

(4) Apply the signal generator output to pin 6, V22. If the volume is greatly reduced from that of the preceding test, check C127 and FL2.

(5) Apply the signal generator output to pin 7, V22. If there is no increase in volume as compared with the previous test, or if the audio signal is not heard at all, check V22. If V22 tests good, check the plate voltage. Be sure the VOLUME control is completely clockwise.

(6) Apply the signal generator output to pin 1, V22. If the volume is greatly reduced as compared to the preceding test, check C126 and R143.

(7) Apply the signal generator output to pin 2, V22. There should be a noticeable increase in volume as compared with the preceding test. Turn down the output of the signal generator if the volume is excessive. If there is no signal, or the volume is low, check V22. If V22 checks good, check the plate voltage.

(8) Apply the signal generator output to pin 5, V21. A decrease in volume from that of the preceding test will be noticed. If necessary, increase the signal generator output. If no signal is heard, check the VOLUME control, R122; check T1, C166, R141, R121, and R132. When a signal is present, check R122 by rotating the control knob slowly counterclockwise to the mechanical limit, and then clockwise to the other mechanical limit while listening closely to the signal. If the decrease and increase in volume are erratic or noisy, replace the control.

(9) Apply the signal generator output to pin 1, V21. An increase in volume over that of the preceding test should be noticed. If there is no signal, or if the volume is low, check V21. If V21 checks good, check the plate and screen grid voltages of V21.

c. Fixed I-f Amplifier and Limiter Tests.

(1) Adjust Signal Generator TS–497/URR to a frequency of 4.3 mc. Place a 100-$\mu\mu$f capacitor in series with the ungrounded lead. Use Electronic Multimeter TS–505/U as an indicating device inserted in the circuit between pin 5 of V15 and ground.

(2) Apply the signal generator output to pin 1, V14. With the output of the signal generator set at maximum, a zero reading on the multimeter should be observed. Increase the frequency of the signal generator to 4.325 mc and record the reading on the multimeter. Decrease the frequency of the signal generator to 4.275 mc. If no readings are observed at either of the frequencies, check V14 and V15. If both tubes check satisfactorily, check voltage and resistance readings at V14 and V15 sockets.

(3) Apply the signal generator output to pin 5, V13. Again set the signal generator frequency at 4.325 mc and then at 4.275 mc. If there are no meter readings or if they are less than those of the preceding test, Check Z9.

(4) Apply the signal generator output to pin 1, V13. Set the signal generator frequency at 4.325 mc and then at 4.275 mc. The meter readings should be the same or greater than those of the preceding stage. If there are no readings, or if they are less than those of the preceding stage, check V13. If the tube checks good, check the voltage and resistance readings at V13 socket.

(5) Apply the signal generator output to pin 5, V9, in the same manner as described in (4) above. If abnormal meter readings are observed as described in (4) above, check Z8.

(6) Apply the signal generator output to pin 1, V9, in the same manner as described in (4) above. If abnormal meter readings are observed, check V9. If the tube checks good, check the voltage and resistance measurements at V9 socket.

(7) Apply the signal generator output to pin 5, V8, in the same manner as described in (4) above. If the meter readings are abnormal, check Z7.

(8) Apply the signal generator output to pin 1, V8, in the same manner as described in (4) above. If there are no meter readings, or the readings are less than those of the preceding stage, check V8. If the tube checks good, check the voltage and resistance measurements at V8 socket.

(9) Apply the signal generator output to pin 5, V7, in the same manner as described in (4) above. If an abnormal meter reading is observed, check Z6.

(10) Apply the signal generator output to pin 1, V7, in the same manner as described in (4) above. If abnormal meter readings are observed, check V7. If the tube checks good, check the voltage and resistance measurements at V7 socket.

(11) Apply the signal generator output to pin 5, V7, in the same manner described in (4) above. If abnormal meter readings are observed, check Z5.

(12) Apply the signal generator output to pin 1, V6, in the same manner as described in (4) above. If there are no meter readings, or if the readings are less than those of the preceding stage, check V6. If the tube checks good, check the voltage and resistance measurements at V6 socket.

(13) Apply the signal generator output to pin 5, V5, in the same manner as described in (4) above. If abnormal meter readings are observed, check FL1 and C37.

d. Variable I-f Amplifier Tests.

(1) Tune the receiver to 68.1 mc. At this frequency, the variable i-f is 15.25 mc; set the frequency of Signal Generator TS–497/URR to 15.25 mc. Place a 100-$\mu\mu$f capacitor in series with the ungrounded lead of the signal generator. Insert Electronic Multimeter TS–505/U in the receiver circuit between pin 5 of V15 and ground. Check the operation of the second high-frequency oscillator by rotating the METER SW to OSC 2. This oscillator must be operating properly for these tests to be effective.

(2) Apply the signal generator output to pin 1, V5. With the signal generator set at 15.25 mc the meter reading should be zero. Change the frequency of the signal generator to 15.00 mc and then to 15.50 mc; record the meter readings. If no readings are observed, check V5. If the tube checks good, check voltage and resistance readings at V5 socket.

(3) Apply the signal generator output to pin 5, V4, changing the frequencies as described in (2) above. If no meter readings are observed, or if the readings are less than those of the preceding tests, check Z4 and C33.

(4) Apply the signal generator output to pin 1, V4, changing the frequencies in the same manner described in (2) above. If no meter readings are observed, or if the readings are less than those of the preceding stage, check V4. If the tube checks good, check voltage and resistance measurements at V4 socket.

(5) Apply the signal generator output to pin 5, V3, changing the frequencies in the same manner as described in (2) above. If no meter readings are observed, or if the readings are less than those of the preceding test, check Z3 and C28.

(6) Apply the signal generator output to pin 1, V3, changing the frequencies in the same manner as described in (2) above. If no meter readings are observed, or if the readings are less than those of the preceding test, check V3. If the tube checks good, check the voltage and resistance measurements at V3 socket.

(7) Apply the signal generator output to pin 5, V2, changing the frequencies in the same manner as described in (2) above. If no meter readings are observed, or if the readings are less than those of the preceding test, check Z2 and C22.

e. R-F Amplifier Tests.

(1) Adjust RF Signal Generator Set AN/URM–48 to the frequency indicated on the front panel of the receiver. Adjust the signal generator so that it is modulated by a 1-kc audio signal with a deviation of 25 kc. Use a 100-uuf capacitor in series with the ungrounded signal generator lead. Check for proper operation of the first h-f oscillator by rotating the METER SW to OSC 1. This oscillator must be operating properly for these tests to be effective.

(2) Apply the signal generator output to pin 1, V2. Adjust the signal generator output until an audio note is heard in the handset or loudspeaker. If the signal is not heard, check V2. If the tube checks good, check the voltage and resistance measurements at V2 socket.

(3) Apply the signal generator output to pin 5, V1. If the volume is greatly reduced from that of the preceding stage, check for continuity of L2 and L3. Check C10 and C15.

(4) Apply the signal generator output to pin 1, V1. At this point it may be necessary to increase the output of the signal generator to hear the audio note, because the signal generator may load the input cir-

cuit of the r-f amplifier. If no signal is heard, or the volume is reduced greatly from that of the preceding test, check V1. If V1 checks good, make voltage and resistance measurements at the socket of V1.

(5) Apply the signal generator output to the ANTENNA jack. If no signal is heard, or if the volume is reduced greatly from that of the preceding test, check R1 and R2; check C1, C2, C3, and C4.

187. Stage Gain Chart

a. General. The stage gain chart given in this paragraph is primarily intended to aid in localizing the defect when low sensitivity is encountered. The chart lists the amount of input required for a specified output. The amount of signal required to produce a specified output is given as an approximate value, since this value will vary from one receiver to another even with normally operating equipment. However, an appreciable deviation from the value given in the chart indicates a defect. After the defect has been localized to a stage, refer to the voltage and resistance charts for aid in isolating the defective component part.

b. Procedure. Set the frequency selectors to 62.0 mc. Connect the applicable signal generator between the point indicated and ground. Suitable equipment is listed in paragraph 183*c*. Use a capacitor in series with the ungrounded lead; .05 μf for the audio generator, and 100 $\mu\mu$f for the r-f generator. Connect Output Meter TS–585/U from the point indicated to ground for the audio stages and connect a vtvm so it reads negative voltage from the point indicated to ground for the i-f and r-f stages. The r-f signal generator output is calibrated, but an a-c vtvm must be used to measure the output of the audio generator. When using the chart, always adjust the signal generator output to obtain the specified indication on the vtvm or the output meter. Compare the amount of signal generator output with the nominal value listed in the chart. If there is an appreciable difference, a defect is indicated.

c. Discriminator Test. Using the frequency meter, set the signal generator to 4.3 mc, and apply the output to pin 1, V14. Connect the vtvm to the junction of R98 and C112 (figs. 145 and 146). Set the signal generator output to 2,000 mv. The meter will indicate 0 volt if T4 is properly alined. The front panel meter of the receiver will also read zero when the METER SW is set to either the DISC+ or DISC− positions. Change the frequency of the signal generator to 4.34 mc. The nominal vtvm indication is −3.1 volts. Change the frequency of the signal generator to 4.26 mc. The nominal vtvm indication is +3.1 volts.

Signal			Output	
Freq.	Applied to—	Nominal value	Measured at—	Amount
1 kc	Pin 1, V23	7.9 v	Pin 4, T2	750 mw
1 kc	Pin 7, V22	1.7 v	Pin 4, T2	750 mw
1 kc	Pin 2, V22	0.075 v	Pin 4, T2	750 mw
1 kc	Pin 1, V21	0.09 v	Pin 4, T2	750 mw
4.3 mc	Pin 1, V13	1,575 mv	Pin 2, Z9	−15 v
4.3 mc	Pin 1, V9	78 mv	Pin 2, Z9	−15 v
4.3 mc	Pin 1, V8	6.3 mv	Pin 2, Z9	−15 v
4.3 mc	Pin 1, V7	485 uv	Pin 2, Z9	−15 v
4.3 mc	Pin 1, V6	31 uv	Pin 2, Z9	−15 v
4.3 mc	Pin 1, V5	43 uv	Pin 2, Z9	−15 v
15.15 mc	Pin 1, V4	165 uv	Pin 2, Z9	−15 v
15.15 mc	Pin 1, V3	60 uv	Pin 2, Z9	−15 v
15.15 mc	Pin 1, V2	45 uv	Pin 2, Z9	−15 v
62 mc	ANT jack	3.9 uv	Pin 2, Z9	−15 v

Section III. REPAIRS

188. General Precautions

Observe the following precautions when servicing the equipment. Careless replacement of parts often creates new faults.

a. If a part to be removed has a number of connections, tag or mark each connection or make a drawing of the part and connections so that the replacement part will be connected correctly.

b. Be careful not to damage other leads or parts by pushing or pulling them.

c. Avoid the use of excessive solder. Short circuits may be caused. If a drop of solder should fall into the component, remove it immediately. It may be forgotten and cause trouble.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints. A poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced in r-f or i-f circuits, it must be placed exactly as the original part was

placed. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground used in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit.

189. Replacement of Parts

a. Most of the component parts in Radio Set AN/GRC–10 are readily accessible and can be replaced. On the transmitter chassis, the blower must be removed to gain access to the component parts below it. To remove the blower, remove the four screws from the bracket which holds the blower in place. Lift the bracket off, then lift the blower from the mount. If complete removal of the blower is necessary, unsolder the three wires at the terminal board. For most repairs, the blower can be set aside while making part replacements.

b. When removing a part having more than two or three connecting wires, always tag or mark the leads in some way to avoid misconnection when replacing the part.

c. If any component of the antenna group becomes defective, it should be replaced by a new component. The new components are installed in the same manner as in the installation of the antenna system except Receptacle Connector UG–568/U, which is supplied as a spare. Receptacle Connector UG–568/U is replaced on the junction box of the boom and box subassembly (fig. 151) as follows:

(1) Remove the cover plate screws, cover plate, and gasket.
(2) Remove the terminal screws.
(3) Detach the receptacle gasket and cap by removing the receptacle screws.
(4) Install the spare Receptacle Connector UG–568/U by reversing the procedure outlined in (1) through (3) above.

d. The only item of the antenna group which can be readily repaired is Cable Assembly CG–718/U. Plug Connector UG–573/U is assembled to the RG–8A/U coaxial cable (fig. 152) by the following procedure:

(1) Cut the end of the coaxial cable evenly.
(2) Place the nut and gasket on the cable and remove the outer jacket 9/32 inch as shown in A, figure 152. *Do not nick the braid.*
(3) Comb and fan out the braid; remove the cable dielectric, exposing the center conductor 5/32 inch as shown in B, figure 152. *Do not nick the center conductor.*
(4) Pull the braid wires forward, taper them and assemble the clamp as shown in C, figure 152. *Be sure the clamp is butted against the end of the cable dielectric.*
(5) Fold back the braid wires, trim to the proper length, and form them over the clamp as shown in D, figure 152. When performed correctly, the required dimension will be as shown.
(6) Solder the contact to the center conductor.
(7) Insert the cable and parts into the plug body as shown in E, figure 152 and tighten the nut. *Be sure the sharp ridge of the clamp is properly seated in the gasket groove.* When assembled correctly, the end of the contact will be flush with the insulator.

e. When checking solder connections or replacing parts in Special Purpose Cable Assembly CX–2324/U, refer to figure 153 and the following assembly and disassembly instructions.

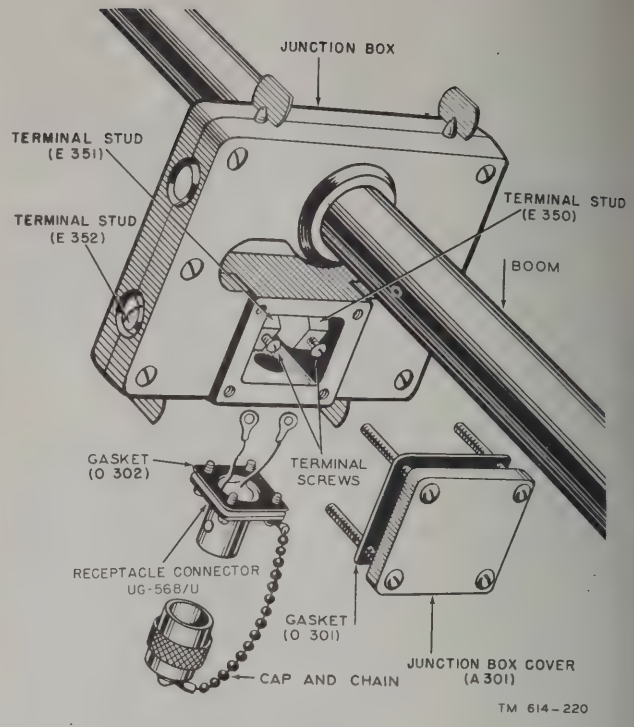


Figure 151. Replacing Receptacle Connector UG–568/U.

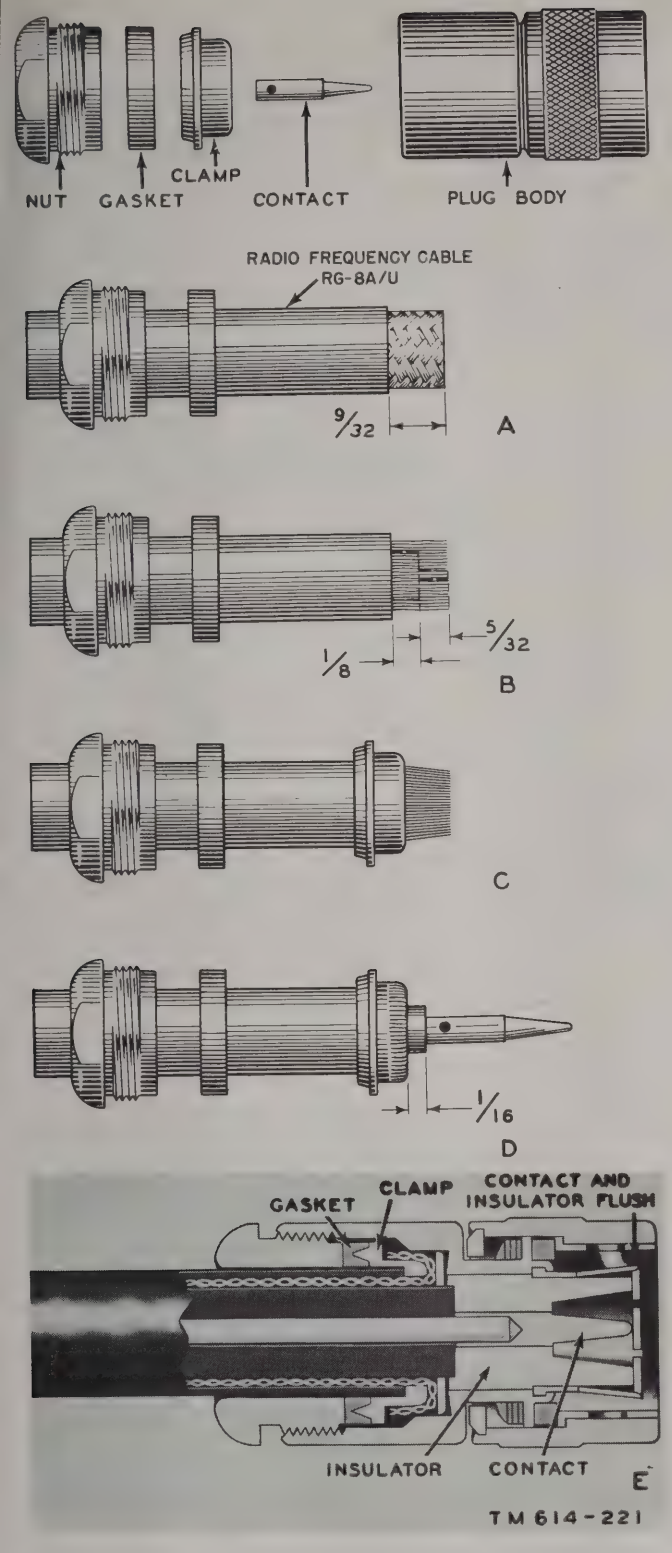


Figure 152. Repairing RF Cable Assembly CG–718/U.

(1) Use a spanner wrench and remove the spanner nuts by turning the wrench counterclockwise.

(2) Remove the thumbscrew and plug shell cap.

(3) Remove the retaining ring.

(4) To remove electrical connector insert, unsolder all connected wires.

(5) Replace defective or worn parts. To reassemble, reverse the procedure outlined in (1) through (4) above.

f. When replacing worn or damaged parts of Special Purpose Cable Assembly CX–2325/U, follow the same procedure outlined in *e* above.

Caution: When replacing thumbscrew and plug shell cap, make certain the part is replaced as shown in figure 153; improper replacement will cut and short out connected wires.

190. Gear Train, Assembly and Disassembly Instructions

a. General. Figure 154 shows an over-all view of the receiver gear train as removed from the component. The transmitter gear train appears identical to the receiver gear train, the only exceptions being the addition of two subassemblies and the positioning of the couplings. The assembly and disassembly instructions outlined in this paragraph apply to both the receiver and transmitter gear trains. Part designations are shown by numbers and a letter. The number indicates the part while the letter indicates the subassembly. Paragraph 190*f* lists a cross-reference chart showing part designations, reference symbols (where assigned) and manufacturer's part numbers. Before proceeding with the disassembly, fold out figures 173 and 174 at the rear of this manual.

b. Disassembly.

(1) Set the MC and 0.1 MC selectors to 54.0 (both controls completely counterclockwise).

(2) Secure the adjusting tool to shaft 37P as shown in figure 155. (A cone-pointed setscrew of the adjusting tool mates with a coned depression in the shaft.)

(3) Use a soft lead pencil and place a marker on rear plate 62R (fig. 155). Remove the adjusting tool.

(4) Use a drift pin and a ball peen hammer and remove roll pins 82C and 82D (fig. 154).

(5) Remove dial face assemblies 67C, 69C, and 67D, 68D by sliding off shafts 35N and 8J (fig. 154).

(6) Remove top and bottom dust covers 45 and 53 after removing screws from each side (fig. 154).

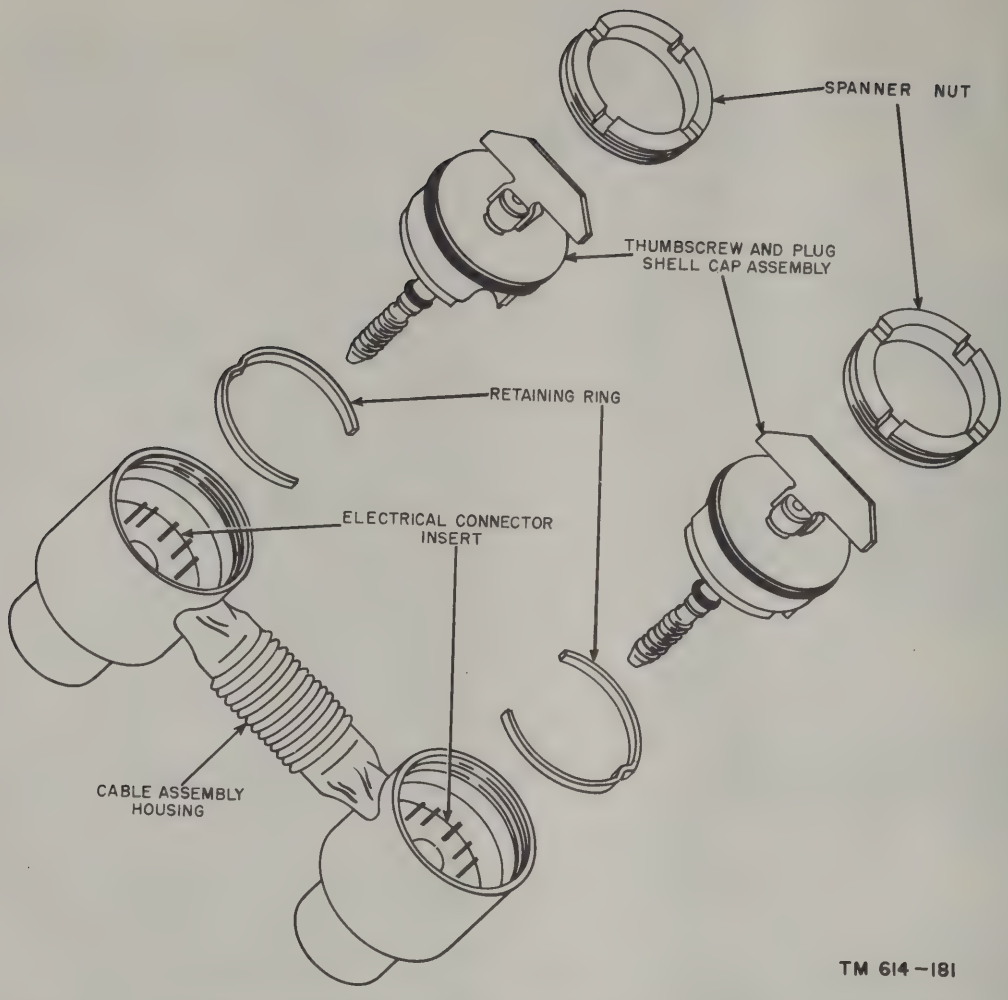


Figure 153. Repairing Special-Purpose Cable Assemblies CX-2324/U and CX-2325/U.

(7) Remove detent spring 28F and the sleeve, 29F, around it. Remove detent spring 28E (fig. 155 and 173).

(8) Remove detent arms 49E and 49F (fig. 173).

(9) Use a drift pin and a ball peen hammer and remove roll pins 81A and 81B from couplings 76A and 90B, at the rear of the assembly. Slide the couplings off shafts 35N and 8J (fig. 174).

(10) With a soft lead pencil, mark the position of detent hub 47G with respect to shaft 8J (fig. 155).

(11) Use a drift pin and a ball peen hammer and remove roll pin 83G and slide the detent assembly from the shaft 8J (fig. 174).

(12) Insert one of the roll pins, removed previously, into the meshed holes of spring-loaded gears 39P and 40P to maintain the spring loading. In the transmitter, gears 85S and 86S are also spring-loaded. Insert a roll pin in the holes provided (fig. 173).

(13) Remove four bolts 58H from front panel plate 33H (fig. 155).

(14) Remove front plate 33H by placing both thumbs on the protruding shafts (fig. 156) and lifting gently.

(15) Lift out subassemblies, J, K, L, M, N, and P (in the transmitter S and T also) (fig. 157 and 158).

(16) Remove spacer posts 7R (fig. 156).

(17) Remove tru-arc clamp 42K, spring washer 5K, and slide idler gear 27K from pinion 34H (fig. 157).

(18) Remove tru-arc clamp 42L, spring washer 5L, and slide idler gear 27L from pinion 34H (fig. 157).

c. Replacement of Subassemblies. If the reason for disassembly of the gear mechanism is erratic operation, the defective gear or gears will now be apparent. If one gear of a subassembly is defective, replace the entire subassembly. Replacement of only the defective gear requires redrilling of associated pinned parts. If shaft 8J, hubs 67D, or 47G are defective, disregard the following assembly instructions and proceed with instructions given in *e* below.

d. Assembly.

(1) Replace all subassemblies in their positions, excluding subassembly L. Make certain that ball bearings are seated properly and packed with grease (fig. 157).

(*a*) Before replacing the planetary gear assembly J, gear 10J must be spring-loaded (fig. 159).

(*b*) Hold gear 16J between thumb and middle finger of left hand (fig. 159).

(*c*) Spring-load gear 10J with right hand (fig. 159).

(*d*) Slide gear 16J forward and lock 10J in spring-loaded position (fig. 159).

(*e*) Remove adjusting tool (fig. 159).

(2) Replace spacer posts 7R (fig. 156).

(3) Replace front plate 33H (fig. 156). Hold gear train at eye level and seat each subassembly into position. When all gears are properly engaged and seated, hold the front and rear plate together firmly while replacing machine screws and lock washers 58H and 59H.

Caution: Do not force down the front panel. If the front plate does not snap into place readily, the subassembly gears are not seated properly.

(4) Replace detent gear and hub assembly G, referring to marker on hub for proper positioning (fig. 155).

(5) Remove pins from spring-loaded gears (fig. 156).

(6) Replace detent arms and springs 28E, 49E, 28F, and 49F (fig. 155 and 174).

(7) Replace idler gear 27L but do not replace spring washer 5L and tru-arc clamp 42L (fig. 157).

(8) Rotate both controls counterclockwise and replace dial assemblies C and D (fig. 154).

(9) Remove idler gear 27L and adjust MC dial to read 54 (fig. 157).

(10) Replace gear 27L, spring washer 5L and tru-arc clamp 42L (fig. 157).

(11) Loosen hex nut 3P and set screw 54P until gear assembly P disengages from subassembly M (fig. 174).

(12) Attach adjusting tool as shown in figure 155. Rotate gear until marking on the front plate lines up with the right side of the tool (fig. 155).

(13) Re-engage assembly P and tighten down set screw 54P. Lock in place with hex nut 3P (fig. 154).

(14) Replace coupling assemblies A and B (fig. 174).

(15) Replace dust covers 45 and 53 (fig. 154).

e. Assembly (Secondary). If shaft 8J, hubs 67D, or 47G are replaced, drill holes in shaft corresponding to locking pin positions. Proceed with assembly instructions outlined in *d* above.

f. Cross-Reference Chart. The chart below shows a comparison of the numerical designation used as references on the various illustrations, the manufacturer's part numbers, and the reference symbols. In the illustrations, the numbers are followed by a letter to designate the subassembly to which the numbered part belongs.

Part designation	Manufacturer's part number	Reference symbol
1	343A481	A 290
2	303A430	
3	302A273	
4	304A294	
5	304A287	H276, H277, H117
6	343B488	A 43
7	343B486	A 42
8	347A220	
9	341A573	
10	344B164	
11	342K454	
12	342K456	H206
13	364B951	
14	344A180	
15	343B483	
16	344A176	
17	3S115172	
18	344B163	O 33
19	344B167	
20	344H166	
21	344A173	O 54
22	364B939	
23	3S115338	
24	332K101	
25	322K156	

Part designation	Manufacturer's part number	Reference symbol
26	344A189	O 237, O 238
27	344A183	O 235, O 236, O 29
28	341A577	O 218, O 219, H127
29	337A234	
30	364C962	
31	346A245	
32	346B247	
33	364C933	
34	946B243	
35	347B214	O 206, O 27, A 45
36	344A177	O 206, O 28, O 27
37	347A218	
38	341A575	
39	344A175	
40	344A174	
41	342K455	
42	342K453	
43	343A469	
44	322K159	A 269, A 270, H120
45	315B754	A 203, A 49, O 39
46	364A938	A 204, A 53
47	343A485	A 204, A 53
48	364B948	A 204, A 53
49	345B154	A 44, A 288, O 39
50	346A249	
51	343A481	
52	343A480	
53	315C752	A 286, A 48, O 39
54	303A430	
55	3S11580	
56	3S114954	
57	4S115938	
58	3S118505	
59	4S115362	
60	343K482	A 261
61	347B216	
62	364C937	
63	344A178	
64	344A179	
65	304A286	H116
66	343A490	
67	343A484	
68	344B111	A 40, H232
69	344B112	A 41, H263
70	303A425	
71	346B251	
72	322K102	
73	322K157	H119
74	364C957	
75	346B257	
76	358A309	
77	341B223	
78	322A110	
79	364B982	
80	358A306	
81	322K158	
82	322K158	
83	322K158	A 219, A 252
84	347A225	
85	344A187	
86	344A188	
87	341A576	H115
88	344B192	
89	347A223	
90	358A310	
91	364C962	
92	364C961	
93	322K158	

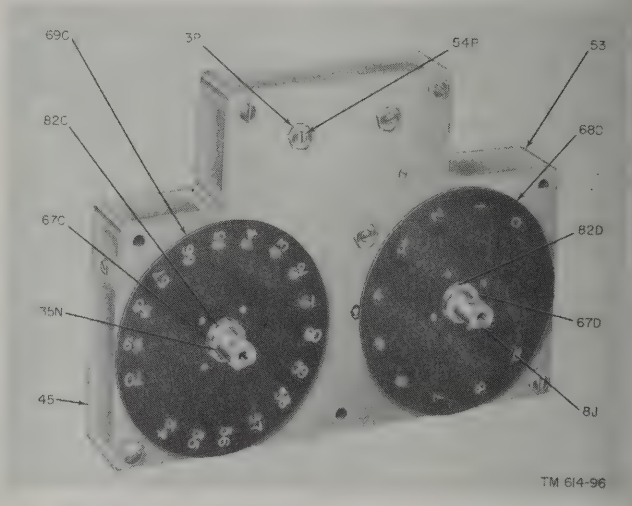


Figure 154. - Receiver gear train, over-all view.

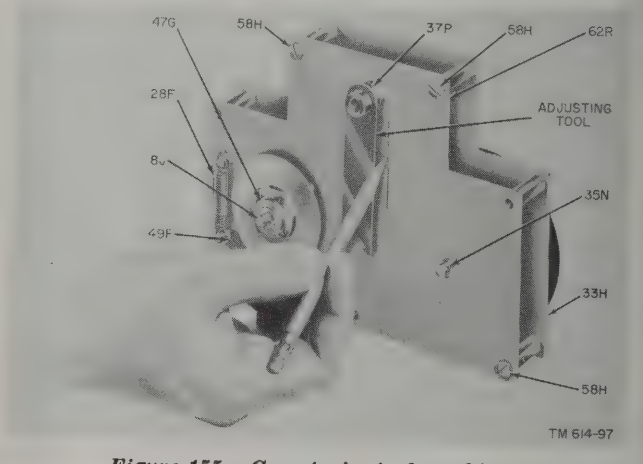


Figure 155. Gear train, tool marking.

191. Receiver Front Panel Removal and Replacement

a. Receiver Front Panel Removal. The front panel and the chassis are two separate assemblies which may be joined or separated quickly and easily. Figure 168 is a schematic drawing of the receiver front panel. In this illustration, the values of component parts and wire colors are

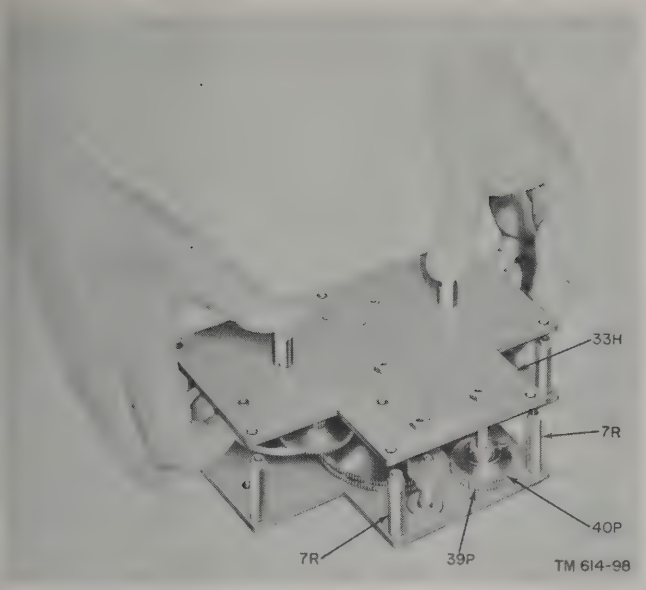


Figure 156. Gear train, front plate removal.

shown. This feature provides greater ease in servicing. To remove the front panel, proceed as follows:

(1) Remove the receiver from the case. Position it so that the front panel faces upwards. Set the frequency selectors to 54.0 mc (fig. 18).

(2) Remove the three rods that connect the front panel knobs to the controls mounted on the subchassis located at the rear of the chassis wrap-around. Disconnect P2 and J4; disconnect P1 and J5 (fig. 140).

(3) Loosen the Allen set screws on the coupling between the gear mechanism and the r-f rack *at the gear mechanism end* of the coupling (fig. 155).

(4) Loosen the Allen set screw located on the coupling on the C3 end of the flexible

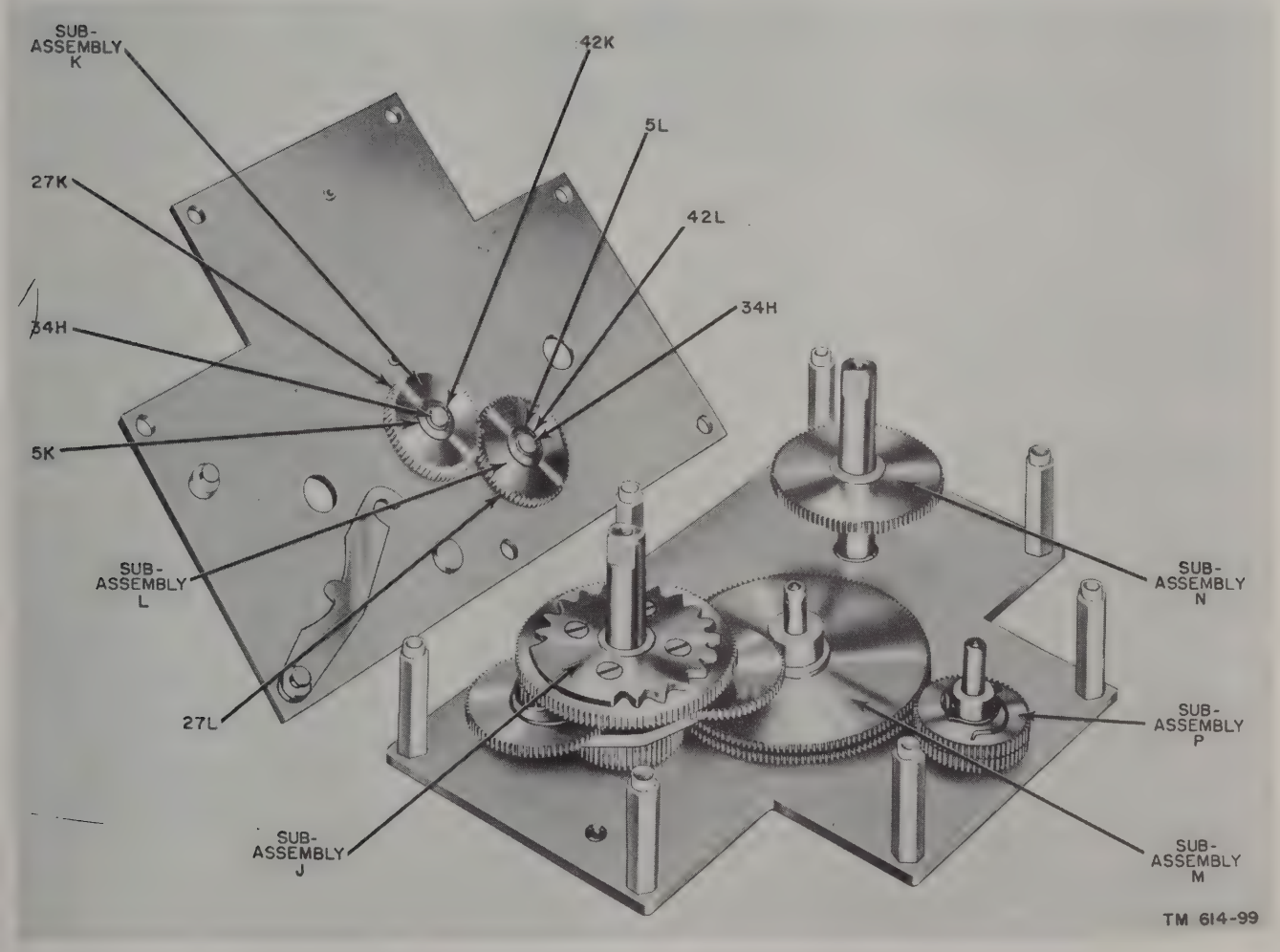


Figure 157. Receiver gear train, subassemblies.

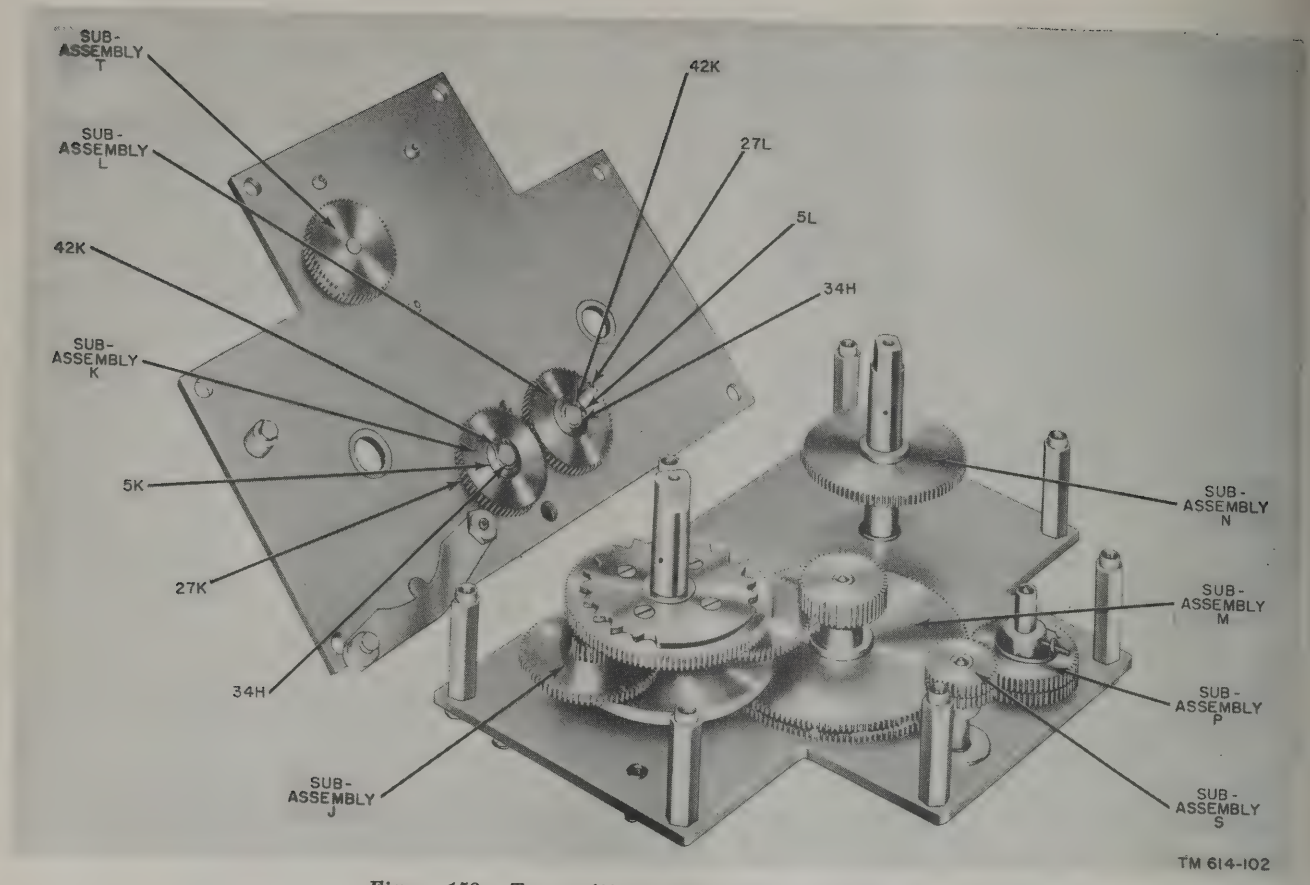


Figure 158. Transmitter gear train, subassemblies.

shaft which couples C3 to the front panel ANT ADJ control. Remove the flexible shaft coupling from the shaft of C3. Remove the clamp that holds the flexible shaft housing to the wrap-around (fig. 155).

(5) Remove the six screws that hold the front panel and the chassis wrap-around together. Lift the front panel clear of the chassis (fig. 141).

b. Receiver Front Panel Replacement. To reconnect the receiver and front panel assemblies, proceed as follows:

(1) Set the 10-frequency oscillator switch, S2, so that the rotary wiper arm is at the first position clockwise from the stationary wiper contact. Set the part of the coupling which is connected to the shaft of the 10-frequency oscillator switch so that the notches are perpendicular to the chassis, with the outside notch nearest the 17-crystal oscillator.

(2) Set the 17-crystal switch, S1, so that the rotary wiper arm of the switch is at the first position clockwise from the stationary wiper contact (fig. 149). Remove the crystal hold-down spring to expose the viewing hole through which the proper position of the rotary wiper arm can be seen. Set the coupling, connected to the shaft of the 17-crystal oscillator

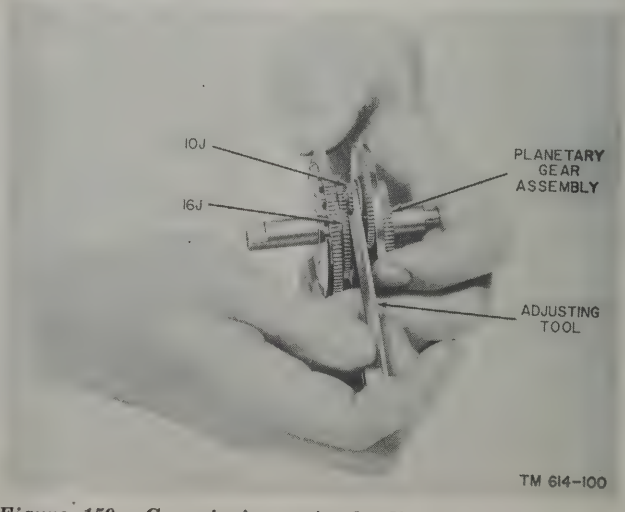


Figure 159. Gear train, spring-loading planetary gear.

switch, so that the notches are perpendicular to the chassis, with the outside notch on the side nearest the 17-crystal oscillator assembly.

(3) Turn the frequency selectors to 54.0 mc, and set the front panel assembly in place. Be sure the coupling arm of the front panel knob is properly engaged with the pin in the VOLUME control shaft, and that the r-f slug rack flexible coupling is mated with the shaft on the gear mechanism before inserting the screws. After all couplings have been properly engaged, insert the six screws and tighten them (fig. 141).

(4) The r-f slug rack flexible coupling has two Allen set screws at each end. One of the set screws on the gear mechanism end of the flexible coupling is cone pointed to mate with a cone-shaped recess in the gear mechanism shaft. This allows removal and replacement of the front panel assembly without realinement being necessary because the r-f slug rack can be recoupled to the exact point from which it was removed. However, if the Allen set screws on the r-f slug rack end of the flexible coupling are loosened, realinement is necessary.

(5) If no changes or adjustments have been made on the r-f slug rack, recouple it to the front panel simply by setting the cone-pointed set screw over the cone-shaped recess in the gear mechanism shaft, and tighten the set screw. Tighten the other set screw in the flexible coupling. Realinement should not be necessary. If the flexible coupling has been loosened at the r-f slug rack end for any reason, realinement will be necessary, and the procedure for coupling to the front panel is given in (6) below.

(6) Loosen the two set screws at the slug rack end of the flexible shaft. Secure the flexible shaft to the gear mechanism shaft by tightening the cone-pointed set screw into the cone-pointed recess of the gear mechanism shaft. Rotate the r-f slug rack shaft and cam assembly so that the cam rests on the roller approximately one-sixteenth of an inch from the high point of the cam. Tighten the set screw at the r-f slug rack end of the flexible coupling. Rotate the frequency selectors until the remaining two set screws are accessible, and tighten them.

(7) Replace the flexible coupling which connects C3 to the front panel knob, ANT ADJ. Replace the clamp which bolts on the wrap-around to hold the coupling.

(8) Connect P1 to J5, connect P2 to J4. Replace the three control rods which connect the rear subchassis to the front panel knobs.

192. Transmitter Front Panel Removal and Replacement

a. Transmitter Front Panel Removal. The front panel and the chassis are two separate assemblies which may be quickly and easily joined or separated. Figure 167 is a schematic drawing of the transmitter front panel. In this illustration the values of component parts and wire colors are shown. This feature provides greater ease in servicing. To remove the front panel, proceed as follows:

(1) Remove the transmitter from the case. Position it so that the front panel faces upwards. Set the frequency selectors to 54.0 mc (fig. 17).

(2) Remove P206. Remove P205 and P204 from J205 and J204, respectively (fig. 132).

(3) Loosen the Allen set screw on the coupling between the gear mechanism and the r-f slug rack at the gear mechanism end of the coupling (fig. 58).

(4) Remove the flexible coupling from the shaft of the 10-crystal oscillator switch S205.

(5) Remove the six screws which hold the front panel and the chassis wrap-around together. Lift the front panel clear of the chassis (fig. 131 and 132).

b. Transmitter Front Panel Replacement. To reconnect the transmitter and front panel assembly, proceed as follows:

(1) Set the 10-crystal oscillator switch, S205, so that the rotary wiper arm is at the first position clockwise from the stationary wiper contact (fig. 135).

(2) Set the 17-crystal oscillator switch, S204, so that the rotary wiper arm of the switch is at the first position clockwise from the

stationary wiper contact. Remove the crystal hold-down spring to expose the viewing hole through which the proper position of the rotary wiper arm can be seen. Set the coupling, connected to the shaft of the 17-crystal oscillator switch, so that the notches are perpendicular to the chassis, with the outside notch on the side nearest the 17-crystal oscillator assembly (fig. 136).

(3) With the frequency selectors set to 54.0 mc, set the front panel assembly in place. The couplings for the ANT TUNE, ANT LOAD, and the METER SW must be guided into position as the front panel is lowered into place (fig. 58). After checking to see that couplings are properly engaged, insert the six screws through the wrap-around, and tighten them (figs. 131 and 132).

(4) The r-f slug rack flexible coupling has two Allen set screws at each end. One of the set screws on the gear mechanism end of the flexible coupling is cone-pointed to mate with a cone-shaped recess in the gear mechanism shaft. This allows removal and replacement of the front panel assembly without realinement being necessary because the r-f slug rack can be recoupled to the exact point from which it was removed. However, if the Allen set screws on the r-f slug rack end of the flexible coupling are loosened, realinement is necessary.

(5) If no changes or adjustments have been made on the r-f slug rack, recouple it to the front panel simply by setting the cone-pointed set screw over the cone-shaped recess in the gear mechanism shaft, and tightening the set screw. Tighten the other set screw in the flexible coupling. Realinement should not be necessary. If the flexible coupling has been loosened at the r-f slug rack end for any reason, realinement will be necessary. The procedure for coupling to the front panel is given in (6) below.

(6) Tighten the cone-pointed Allen set screw into the cone-shaped recess in the gear mechanism shaft. Tighten the other Allen set screw at the gear mechanism end of the flexible coupling. Loosen both set screws in the flexible coupling at the r-f slug rack end. Set the frequency selectors to 70.9 mc. Rotate the slug rack shaft in the direction that brings the slugs out (fig. 54) until the cam rider is between $\frac{1}{16}$ and $\frac{1}{32}$ inch from the extreme mechanical limits. Tighten both Allen set screws in the flexible coupling.

(7) Replace the flexible coupling on the shaft of the 10-frequency oscillator switch, S205. Connect P205 to J205, P204 to J204, and P206 to J206 (fig. 58).

193. Dynamotor Assembly and Disassembly Instructions

a. Figure 160 is an exploded view of the main subassemblies of dynamotor D301. Because of the special design and construction of this dynamotor, it is not advisable to disassemble and perform re-

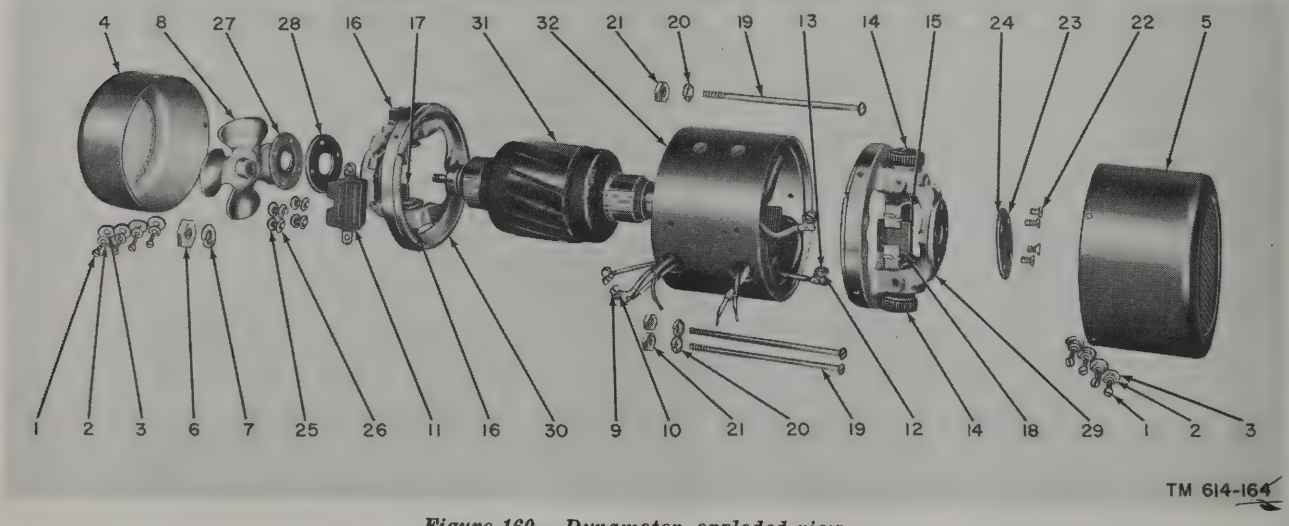


Figure 160. Dynamotor, exploded view.

pairs in the field. All repairs or maintenance other than routine brush replacement should be made at the depot where special test equipment and tools are available; however, when disassembly is required, use the following procedure:

(1) Remove eight vent cover screws and washers 1, 2, and 3.
(2) Remove end cover assemblies 4 and 5.
(3) Remove nut and washer assembly 6 and 7. (It may be necessary to place one finger on the armature to keep it from rotating while loosening nut 6.)
(4) Remove fan assembly 8.
(5) To remove capacitor and lug assembly 11, remove screws and washers 9 and 10.
(6) Remove screws and washers 12 and 13.
(7) Remove brush holder caps 14.
(8) Remove low voltage brush assemblies 15.
(9) Remove brush holder caps 16.
(10) Remove high voltage brush assemblies 17.
(11) Remove machine screws 19, lock washers 20, and hex nuts 21.
(12) Remove bearing plate cover screws 22.
(13) Remove bearing plate 23 and bearing plate gasket 24.
(14) Remove bearing plate screws and washers 25 and 26.
(15) Remove bearing plate and gasket 27 and 28.
(16) Remove the low voltage leads and bracket assembly 29.
(17) Remove the high voltage leads and bracket assembly 30.
(18) Slide armature and bearing assembly 31 out of field shell and coil assembly 32.

b. Reassemble the unit by reversing the disassembly procedure.

c. The cross-reference chart (for fig. 60) applies only to power supplies manufactured under Order No. 92-Phila-52.

Symbol	Manufacturer's part No.	Symbol	Manufacturer's part No.
1	7179	17	A-5864
2	7098	18	A-7012
3	5648	19	A-6754
4	B25151	20	5996
5	B25152	21	5649
6	7185	22	7181
7	7183	23	A-6948
8	A-5853	24	A-5039
9	7182	25	7096
10	5993	26	5648
11	A-7018	27	A-7176
12	7182	28	A-5039
13	5993	29	B-6742
14	A-5635	30	B-6743
15	A-6752	31	B-6741
16	A-5065	32	B-25156

194. Disassembly and Lubrication of Equipment at Field Maintenance Level

Complete instructions for necessary lubrication are given in paragraphs 106 through 108.

195. Refinishing

Instructions for refinishing badly marred panels are given in TM 9-2851.

Section IV. RADIO RECEIVER R-125/GRC-10 ALINEMENT

196. Test Equipment

a. Signal Generator. The signal generator must cover the range from 4.3 mc to 70 mc and have an output impedence of 50 ohms. The output must be calibrated. The dial accuracy is not important because a frequency meter must be used to set the frequency. Signal Generator TS-497/URR may be used for the lower frequencies, and RF Signal Generator Set AN/URM-48 for frequencies over 54 mc.

b. Frequency Meter. A frequency meter is required to set the signal generator to the exact frequency desired. Any type which will cover a range from 4.3 mc to 70 mc is suitable; for example, Frequency Meter Set SCR-211-( ) (for the lower frequencies) and Frequency Meter TS-174/U.

c. Vacuum Tube Voltmeter. The vacuum tube voltmeter must be capable of reading low d-c voltages, and must have an input impedance of 10 megohms or greater. Electronic Multimeter TS-505/U is suitable.

d. Alinement Tool. Special alinement tools are required. These tools are supplied with the receiver. They are fastened to the chassis wraparound by clips. Figure 142 shows the location of the tools.

197. Receiver Alinement Procedure

a. Preparatory. Remove the receiver from the case. Check to see that the front panel assembly is connected properly to the receiver chassis. Complete instructions for connecting, as well as disconnecting the front panel assembly and the receiver chassis are given in paragraph 191.

b. Conditions for Alinement. For best results, the equipment should be set up on a metal-topped bench located in a grounded screen room. All the equipment should be bonded to the bench. In many cases, however, a screen room and a metal-topped bench are not available. If the receiver must be alined without them, be sure that there is a good ground connection between the receiver and the test equipment. Connect the receiver to the power supply by means of the interconnecting cable. It is not necessary to connect the receiver to the control unit. Allow approximately one-half hour for the equipment to warm up before starting the alinement procedure.

c. Fixed I-f and Discriminator Alinement. Set the signal generator to 4.3 mc, using the frequency meter for accuracy. Use a 100 $\mu\mu$f capacitor in series with the signal generator lead, and do not modulate the signal.

(1) Set the output of the signal generator to approximately 100,000 microvolts and apply it to pin 1, V6. Place the vtvm d-c probe on the test point on Z5. Set the vtvm to the lowest d-c scale on negative volts. Adjust Z5 for a maximum indication on the vtvm. Use one of the alinement tools provided with the receiver.

(2) Move the vtvm probe to the test point on Z6. Reduce the signal generator output until the minimum usable indication is shown on the meter. This is necessary to prevent saturation and possible misalinement. Adjust Z6 for a maximum indication on the vtvm.

(3) Follow the procedure given in (2) above and adjust Z7, Z8, and Z9.

(4) Move the vtvm probe to the junction of R88 and C107. Make sure that the METER SW is not in the DISC+ or DISC− positions. This point is located on TB1, bottom row of terminals, third terminal from the rear of the chassis. Increase the output of the signal generator to approximately 100,000 uv. Adjust T4 (fig. 45) primary for a maximum indication on the vtvm. After the peak is obtained, turn the primary slug counterclockwise one complete turn.

(5) Move the vtvm probe to the junction of R98 and C112. Make sure that the METER SW is not in the DISC+ or DISC− positions. This point is located on TB1, top row of terminals, second terminal from rear of chassis. Adjust T4 secondary for a zero indication on the vtvm. Check this setting by turning the vtvm from negative volts to positive volts to make certain there is no difference in the zero indication.

d. Second High-Frequency Oscillator Alinement. The frequency meter must be used to set the frequency of the oscillator. To apply a portion of the oscillator output to the frequency meter, remove the shield from V11. Wrap two or three turns of wire around V11, and connect the wire to the frequency meter. Disable the afc circuit by making a connection from pin 1, V12, to ground, or by pressing the AFC DISABLE switch on the front panel. With the vtvm probe connected to pin 6, V12, adjust the AFC SET potentiometer, R67, until +98 volts is indicated on the meter. This adjustment sets the current flow through the saturable reactor, T3, primary to the required 1 ma.

(1) Set the 0.1 MC frequency to 9. Turn coil L48 slug in a counterclockwise direction until it is completely out; then turn the slug five or six turns clockwise. Do not attempt to adjust L7; it is not tunable. Adjust L58 slug until the oscillator is at 20.35 mc as indicated by the frequency meter.

(2) Set the 0.1 MC frequency selector to 0. Adjust L57 slug until the oscillator is operating at 19.45 mc as indicated by the frequency meter. If adjusting L57 will not tune the oscillator to 19.45 mc, readjust L58 so that the oscillator can be made to operate at 19.45 mc by adjusting L57. Then set the 0.1 MC frequency selector to 9 and set the oscillator frequency at 20.35

mc by readjusting L48. Do not proceed any further until the oscillator is operating at 19.45 mc with the 0.1 MC selector in the 0 position, and 20.35 mc when the 0.1 MC selector is in the 9 position.

(3) Set the 0.1 MC frequency selector to 5. Set the oscillator at 19.94 mc by adjusting L52.

(4) The following table lists the oscillator frequency and the coil slug to adjust for each position of the 0.1 MC frequency selector switch. Do not attempt to use this chart until steps indicated in (1), (2), and (3) above have been satisfactorily completed. Then follow the procedure given in (3), substituting the information given in the chart for each position of the 0.1 MC selector switch.

0.1 MC selector	Frequency	Coil
0	19.45 mc	L57
1	19.55 mc	L56
2	19.65 mc	L55
3	19.75 mc	L54
4	19.85 mc	L53
5	19.95 mc	L52
6	20.05 mc	L51
7	20.15 mc	L50
8	20.25 mc	L49
9	20.35 mc	L48

(5) After all the coils have been adjusted, set the 0.1 MC selector to 0 and check the frequency of the oscillator. Check the oscillator frequency at each position of the 0.1 MC selector and make any necessary readjustments.

e. Variable I-f Alinement. Set the signal generator to 16.05 mc, using the frequency meter for accuracy. Use a 100 $\mu\mu$f capacitor in series with the signal generator output lead, and do not modulate the signal.

(1) Place the voltmeter d-c probe on the test point on Z8. Make certain panel test meter switch is off 1ST LIM position. Apply the signal generator output to pin 7, V2. Adjust the signal generator for enough output to provide an indication on the vtvm. Adjust Z4, Z3, and Z2 slugs (on rocker arm assembly) for a maximum indication on the vtvm.

(2) Set the 0.1 MC selector to 0. Swing the signal generator frequency approximately 50 kc above and below 15.15 mc. The indication on the meter should rise to a maximum, then decrease as the frequency of the signal generator is varied. If the variable i-f is tracking properly, this maximum will occur at 15.15 mc, $\pm$25 kc.

(3) If the preceding test indicates improper tracking, Z4, Z3, and Z2 must be readjusted at a frequency near the center of the range. The following table lists the proper frequency for each position of the 0.1 MC selector switch. The variable i-f is properly aligned when it is tuned to within $\pm$25 kc of the frequency indicated in the table for each of the positions of the 0.1 MC selector.

0.1 MC position	Variable i-f frequency	0.1 MC position	Variable i-f frequency
0	15.15 mc	5	15.65 mc
1	15.25 mc	6	15.75 mc
2	15.35 mc	7	15.85 mc
3	15.45 mc	8	15.95 mc
4	15.55 mc	9	16.05 mc

f. First High-Frequency Oscillator Alinement. The frequency meter must be used to set the frequency of the oscillator. To apply a portion of the oscillator output to the frequency meter, remove the shield from V10. Wrap two or three turns of wire around V10 and connect the wire to the frequency meter.

(1) Set the MC frequency selector to 54.0. Set the frequency meter to 38.85 mc. Adjust L47 until the frequency meter indicates that the oscillator is operating at 38.85 mc.

(2) The following table lists the oscillator operating frequency and the coil slug which must be adjusted for each position of the MC selector. Follow the procedure given in (1), substituting the information given in the table below for

that in (1), and adjust each position of the MC selector.

MC selector	Oscillator frequency (mc)	Coil	MC selector	Oscillator frequency (mc)	Coil
54	38. 85	L47	63	47. 85	L38
55	39. 85	L46	64	48. 85	L37
56	40. 85	L45	65	49. 85	L36
57	41. 85	L44	66	50. 85	L35
58	42. 85	L43	67	51. 85	L34
59	43. 85	L42	68	52. 05	L33
60	44. 85	L41	69	53. 85	L32
61	45. 85	L40	70	54. 85	L31
62	46. 85	L39			

Note. If necessary, the first high-frequency oscillator may be alined by adjusting the individual coil slugs for a maximum indication on the front panel meter at each of the MC positions of the selector. However, this may result in as much as a 3-kc error on each position, and therefore this method should not be used unless the equipment necessary for the complete procedure is not available.

g. R-F Slug Rack Alinement. Use the frequency meter when setting the signal generator to any particular frequency. Use a 50-ohm coaxial cable to connect the signal generator to the receiver antenna jack.

(1) Set the MC selector to 70 and the 0.1 MC selector to 9. Make a connection from pin 7, V2, to ground. Set the signal generator to exactly 70.9 mc, and set the output to 50,000 uv with no modulation. Place the vtvm d-c probe on the terminal marked *metering*. Adjust the three slugs (L1, L2, L3) on the slug rack assembly to protrude approximately one-sixteenth of an inch from the end of the coil form. Adjust the front panel ANT ADJ, C5, and C12 for a maximum negative voltage indication on the vtvm with each adjustment.

(2) Set the MC selector to 62 and the 0.1 MC selector to 0. Set the signal generator to exactly 62 mc, keeping the output constant throughout the slug rack alinement procedure. Adjust slugs of L1, L2, and L3 for a maximum negative voltage indication on the vtvm with each adjustment.

(3) Repeat the procedure given in (1) above. Then repeat the procedure in (2) above. Continue alternating between the procedures of (1) and (2) above until no further adjustments are necessary for a maximum negative voltage indication at 70.9 mc or 62.0 mc.

(4) Set the frequency selectors to 54.0 mc. Set the signal generator to the frequency at which the maximum negative voltage is indicated on the meter. Measure this frequency with the frequency meter. If adjustment of the front panel ANT ADJ will not bring the maximum indication to within ±25 kc of 54.0 mc, the slug rack is not tracking properly.

(5) If the preceding test shows that the slug rack is not tracking properly, readjust the ANT ADJ, C5, and C12 for a maximum indication on the vtvm with the signal generator and the frequency selectors set at 54.0 mc.

(6) Set the frequency selectors and the signal generator to exactly 70.9 mc. Adjust the ANT ADJ, C5, and C12 for a maximum negative voltage indication.

(7) Set the frequency selectors and the signal generator to exactly 54 mc. Adjust slugs L1, L2, and L3 for a maximum indication on the vtvm.

(8) Repeat the procedure given in (6) above. Then repeat the procedure given in (7) above; continue alternating between these procedures until no further adjustments are necessary for a maximum negative indication on the vtvm at 54.0 and 70.9 mc. (If necessary, the ANT ADJ may be used at either the high or low end of the band.)

(9) When the procedure given in (8) above is completed, proper tracking of the r-f slug rack is indicated. Check the mid-range tracking by setting the frequency of the signal generator above and below 62 mc until the point of maximum indication on the meter is found. This should occur at 62.0 mc, ±25 kc for proper tracking.

198. Receiver Wide-Band Amplifier Alinement

The following alinement information does not apply to receivers with serial numbers 1 through 50. The alinement should not be made except in

cases where component parts in the wide-band amplifier have been replaced and there are definite indications that the stage is not producing the proper de-emphasis.

a. Tune the receiver to 62 mc. Connect Output Meter TS–585/U to terminals J and H of CONTROL jack J2. Adjust the signal generator for 10-uv output at 62 mc, modulated by 1,000 cycles with 8-kc deviation. Couple the generator lead to the receiver dummy antenna lead. Adjust the LINE LEVEL control for a 0-dbm indication of the output meter.

b. Increase the signal generator modulating frequency to 10,000 cycles. Adjust C168 (on TB1 between resistors R65 and R80) for an output meter reading of −10.5 dbm.

c. Return the signal generator modulating frequency to 1,000 cycles. If the output meter does not read 0 dbm, repeat the procedure given in *a* and *b* above.

Section V. RADIO TRANSMITTER T–235/GRC–10 ALINEMENT

199. Test Equipment

a. Signal Generator. The signal generator must cover the range from 3.2 mc to 16.5 mc. The output must be calibrated. The dial accuracy is not important since a frequency meter must be used to set the frequency. Signal Generator TS–497/URR is suitable.

b. Frequency Meter. A frequency meter is required to set the signal generator to the exact frequency desired. Any type which will cover a range from 3.2 mc to 70.9 mc may be used, for example Frequency Meter Set SCR–211–( ) (for the lower frequencies) and Frequency Meter TS–174/U.

c. Vacuum Tube Voltmeter. The vacuum tube voltmeter must be capable of reading low d-c voltages, and must have an input impedance of 10 megohms or greater. Electronic Multimeter TS–505/U is suitable.

d. Alinement Tools. Special alinement tools are required. These tools are supplied with the transmitter. They are fastened to the chassis wrap-around by clips. Figure 128 shows the location of the tools.

e. Wattmeter. The wattmeter must be of the type that will respond to frequencies from 54 to 70.9 mc, with an input impedance of 50 ohms. Radio Frequency Wattmeter TS–118/AP is suitable.

f. Deviation Indicator. Some type of deviation indicator must be used in the meter calibration procedure. Panoramic Indicator IP–173/U is suitable; however, if a panoramic indicator is not available, Radio Receiver R–125/GRC–10 may be used if it is properly calibrated by means of an accurately calibrated signal generator.

g. Audio Oscillator. An audio oscillator is required to provide a modulating signal for the transmitter. The audio oscillator must be capable of providing a 1-kc signal with a variable output level. Audio Oscillator TS–382A/U is suitable.

200. Transmitter Alinement Procedure

a. Preparatory. Remove the transmitter from the case. Check to see that the front panel assembly is properly connected to the transmitter chassis. Complete instructions for connecting, and disconnecting the front panel assembly and the receiver chassis are given in paragraph 192.

b. Conditions for Alinement. For best results, the equipment should be set up on a metal-topped bench located in a grounded screen room. All the equipment should be bonded to the bench. In many cases, however, a screen room and a metal-topped bench are not available. If the receiver must be alined without them, be sure that there is a good ground connection between the transmitter and the test equipment. Connect the transmitter to the power supply by the interconnecting cable. It is not necessary to connect the transmitter to the control unit. Allow approximatly one-half of an hour for the equipment to warm up before starting the alinement procedure.

c. Control Settings. Set the TEST-MIKE-RING switch to MIKE, set the R. F. POWER switch to LO, and connect the wattmeter to the ANT jack.

d. AFC SET Adjustment. The current in the primary of the saturable reactor, T202, must be set at 1 ma with zero volts on the control grid of V215. Since the resistance of the saturable reactor primary is 3,000 ohms, a voltage drop of 3 volts across the primary indicates a current flow of 1 ma. Make a connection from pin 1, V215 to ground. Connect the positive voltmeter lead to

the terminal on TB204 which is closest to the center of the chassis, and connect the negative voltmeter lead to the next terminal. These terminals on TB204 are electrically the same as the primary terminals of T202, but are more accessible. Adjust R283 for a meter reading of 3 volts. Tighten the locknut on R283 to maintain the setting. Do not remove the connection from pin 1, V215, to ground until the entire alinement procedure is completed.

e. Monitor Receiver Alinement. Use the frequency meter to set the signal generator to 3.2 mc. Disable the oscillators to keep interference at a minimum by removing V204. The master oscillator and the 17-crystal oscillator will be inoperative, because the filaments of the two oscillators are in series with V204. Turn the 0.1 MC selector to 0 and pull out the 12.95 mc crystal to disable the 10-crystal oscillator.

(1) Apply the signal generator output to pin 1, V213. Place the vtvm d-c probe on pin 7, V214. Adjust T204 primary (the adjustment on T204 which is located on the tube side of the chassis) for a maximum negative indication.

(2) Move the vtvm d-c probe to pin 5, V214. Adjust T204 secondary (the adjustment on T204 which is located on the wiring side of the chassis) for a zero voltage indication with the vtvm on the lowest scale.

(3) Repeat the procedures in (1) and (2) above until no further adjustment is necessary. When this occurs again, repeat the procedure in (2) above. Be sure that the indication obtained is exactly 0 volts. This is very important, because the accuracy of the transmitter frequency depends on the adjustment of T204 secondary.

(4) Apply the signal generator output to pin 1, V212. Place the vtvm d-c probe on pin 1, V213. Adjust Z205 slug for a maximum indication on the vtvm. Keep the output of the signal generator just high enough for a usable indication on the vtvm. If the signal generator output is excessive, V212 may be overdriven and improper alinement will occur.

(5) Apply the signal generator output to pin 7 of V211. Place the vtvm d-c probe on pin 1 of V212. Adjust Z204 slug for a maximum indication on the vtvm.

(6) Use the frequency meter to set the signal generator to 16.5 mc. Apply the signal generator output to pin 2 of V211. Place the vtvm d-c probe on pin 7 of V211. Adjust Z203 slug for a maximum indication on the vtvm. Replace V204.

(7) When the preceding instructions have been completed satisfactorily, the monitor receiver is alined. Realinement should not be necessary unless V213 or V214 has been replaced, and in that case, only the procedures in (1), (2), and (3) above need be completed.

f. First High-Frequency Oscillator Alinement. The frequency meter must be used to set the frequency of the oscillator. To apply a portion of the oscillator output to the frequency meter, remove the shield from V209. Wrap two or three turns of wire around V209 and connect the other end of the wire to the frequency meter.

(1) Set the frequency selectors to 54.0. Set the frequency meter to 37.85 mc. Adjust L226 slug until the oscillator is operating at 37.85 mc, as indicated by the frequency meter.

(2) The following table lists the oscillator operating frequency and the coil slug which must be adjusted for each position of the MC selector. Follow the procedure in (1) above, substituting the information given in the table below for that given in (1) above, and adjust at each position of the MC selector.

MC selector	Oscillator frequency	Coil	MC selector	Oscillator frequency	Coil
54.0	37. 85	L226	63.0	46. 85	L217
55.0	38. 85	L225	64.0	47. 85	L216
56.0	39. 85	L224	65.0	48. 85	L215
57.0	40. 85	L223	66.0	49. 85	L214
58.0	41. 85	L222	67.0	50. 85	L213
59.0	42. 85	L221	68.0	51. 85	L212
60.0	43. 85	L220	69.0	52. 85	L211
61.0	44. 85	L219	70.0	53. 85	L210
62.0	45. 85	L218			

Note. If necessary, the first high-frequency oscillator may be alined by adjusting the individual coil slugs for a maximum indication on the front panel meter at each of the MC positions of the selector. This may result in as much as a 3-kc error on each position, therefore this method should not be used unless the equipment necessary for the complete procedure is not available.

g. Master Oscillator-Doubler Alinement. Check the mechanical setting of the trim wheel. With the front panel selectors set to 56.0 mc, the flat segment of the trim wheel should coincide with the flag protruding from the chassis under the trim wheel. All the trim wheel segments should be parallel. Connect the oscillator output to the frequency meter by inserting the end of a length of wire inside the shield of V203. Connect the other end of the wire to the frequency meter.

(1) Set the frequency selectors to 70.9 mc. Withdraw L202 slug to the extreme *out* position. Adjust C206 until the oscillator is operating at 35.45 mc as indicated by the frequency meter.

(2) Set the frequency selectors to 56.0 mc. Adjust L202 until the oscillator is operating at 28 mc as indicated by the frequency meter.

(3) Set the frequency selectors to 54.0 mc. Adjust the trim wheel segment which coincides with the flag protruding from the chassis until the oscillator is operating at 27 mc as indicated by the frequency meter.

(4) Set the frequency selectors to 56.0 mc. The oscillator should be operating at 28 mc as indicated by the frequency meter. However, if an adjustment is necessary, adjust the trim wheel segment which coincides with the flag protruding from the chassis until the oscillator is operating at 28 mc.

(5) The following chart lists the frequency selector positions to be adjusted along with the oscillator frequency for each adjustment. Set the selectors to each position in the order listed. Adjust the trim wheel segment which coincides with the flag protruding from the chassis until the oscillator is operating at the frequency given in the table, as indicated by the frequency meter.

Frequency selector (mc)	Oscillator frequency (mc)	Frequency selector (mc)	Oscillator frequency (mc
58. 0	29. 00	66. 0	33. 00
60. 0	30. 00	68. 0	34. 00
62. 0	31. 00	70. 0	35. 00
64. 0	32. 00	70. 9	35. 45

(6) Remove the wire from V203. If the procedure given has been followed carefully, the tracking error should be less than 5 kc.

(7) Connect the vtvm between C218 test point and ground. Set the frequency selectors to 56.0 mc. Adjust L204 for a maximum negative indication on the vtvm.

(8) Set the frequency selectors to 70.0 mc. Adjust C217 for a maximum negative indication on the vtvm.

(9) Repeat the procedures given in (7) and (8) above until no further adjustments are required to produce a maximum negative indication on the vtvm at 70.0 mc and 56.0 mc.

h. Driver Alinement.

(1) Set the frequency selectors to 70.0 mc. Set the front panel METER SW to PA GRID. Adjust C221 for a maximum indication on the meter.

(2) Set the frequency selectors to 56.0 mc. Adjust L205 for a maximum indication on the meter.

(3) Repeat the procedures given in (1) and (2) above until no further adjustments are required to produce a maximum indication on the meter.

i. Power Amplifier.

(1) Set the frequency selectors to 62.0 mc; connect the wattmeter to the ANT jack. Set C226 for approximately half the maximum capacity.

(2) Adjust ANT TUNE for maximum power ouput, and ANT LOAD for a plate current of 150 ma.

(3) Loosen the Allen set screw located in the gear mechanism half of the coupling which provides mechanical coupling from the differential gear mechanism to C227. Adjust C227 by turning the coupling (gear train shaft stationary) until minimum plate current is indicated by the front panel meter. Connect the coupling to the gear mechanism shaft again by tightening the Allen set screw.

(4) This step applies only to sets with serial numbers 308 and above. With the R. F. POWER switch at LO, and the frequency selectors at 54.0, adjust the PA GRID CONTROL R226 (located on the right side of the transmitter chassis just

behind the blower) so that the voltage drop across screen resistor R229 is approximately 2 volts.

(5) Set R. F. POWER to HI.

(6) Check the power output at every second MC position across the entire frequency range either by measuring the voltage across a 50-ohm dummy load or by using Radio Frequency Wattmeter TS–118/AP. If 40 watts cannot be obtained by slight adjustments of ANT TUNE and ANT LOAD, adjust C227 by bending the slotted tabs on the rotor. Proper tracking may be attained in this manner.

201. Transmitter Meter Adjustment

a. Set the frequency selectors to 62.5 mc. Connect the audio oscillator to pins F and J on transmitter CONTROL jack. Set the vtvm to the a-c range, and connect it so that it measures the output of the audio oscillator. Adjust the output of the audio oscillator to .77 volts.

b. Adjust ANT TUNE and ANT LOAD for maximum power output. Set the METER SW to LINE LEVEL. Set the LINE LEVEL control for 8-kc deviation as measured with Panoramic Indicator IP–173/U.

c. Set the METER ADJUST control (R253) for a 0-db indication on the front panel meter.

d. Remove the audio oscillator leads from the CONTROL jack. Set METER ZERO control (R250) for a zero indication on the front panel meter.

e. Repeat the procedures given in *c* and *d* above. The audio oscillator must be connected for *c*, and disconnected for *d*. Continue alternating between the two until no further adjustment is necessary.

Section VI. FINAL TESTING

202. General

This section is intended as a guide to be used in determining the quality of a repaired Radio Set AN/GRC–10. The minimum test requirements outlined in paragraph 204 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

203. Test Equipment

The test equipment in the following list is necessary to complete the final testing. However, if the particular type mentioned is not available, an equivalent may be used. When using a substitute, be sure that the characteristics such as input or output impedance, frequency range, and accuracy are the same.

RF Signal Generator Set AN/URM–48
Audio Oscillator TS–382A/U
Spectrum Analyzer TS–723/U
Electronic Multimeter TS–505/U with 600-ohm load resistor

204. Final Test Procedure

Follow the steps in the order given. In some cases, the test equipment setup is not changed from the end of one test to the beginning of the next. Connect the test equipment as shown in figure 161. The antenna is merely a short length of wire attached to the antenna jack. In addition to the equipment shown in figure 161, connect the r-f signal generator to the receiver antenna.

a. Receiver LINE LEVEL Control. Set both the r-f signal generator and the receiver to 54.0 mc. Modulate the signal generator with a 1-kc audio signal, with a deviation of 8 kc. Set the receiver LINE LEVEL control for an output of zero dbm. Disconnect the r-f signal generator.

b. Transmitter LINE LEVEL Control. Set the transmitter frequency to 54.0 mc. Adjust the audio input to the transmitter to zero dbm. Set the transmitter LINE LEVEL control for zero dbm output from the receiver.

c. Preemphasis and Deemphasis. Keeping the audio input to the transmitter constant at zero dbm, set the audio signal generator to each of the following frequencies: 250; 1,000; 5,000; 10,000; and 20,000 cps. At each frequency setting, proper operation is indicated by a receiver output of 0 $\pm$1 dbm. To check the receiver and transmitter separately, proceed as follows:

(1) *Deemphasis.* Connect the r-f signal generator to the receiver antenna. Set both the receiver and the signal generator to 54.0 mc. Turn the TYPE OF OPERATION switch to PUSH-TO-TALK. Keeping the deviation (8 kc) constant, modulate the signal generator with each of the frequencies listed in the following

table. Proper operation is indicated if the output of the receiver corresponds to the listings in the following chart.

Modulating frequency (cps)	Receiver output (dbm)	Modulating frequency (cps)	Receiver output (dbm)
250	0 ± ½	10, 000	−8. 5 ± ½
1, 000	0 ± ½	20, 000	−14 ± ½
5, 000	−4 ± ½		

(2) *Preemphasis.* A receiver with known deemphasis characteristics must be used to check the transmitter preemphasis. The test made is similar to the radio set test described in *c* above, but the amount of deemphasis must be calculated. Subtract the amount of deemphasis (previously determined) from the receiver output. For example, at 10 kc, the deemphasis is −8.5 dbm. Modulating the transmitter with a 10 kc signal produces a receiver output of +.5 dbm. Subtracting −8.5 gives +9. Thus the preemphasis at 10 kc is +9 dbm. The limits are the same as for deemphasis, except that the output is +dbm instead of −dbm.

Note. When a negative number is being subtracted from any number, change the sign of the subtrahend and add.

d. Linearity. With the test equipment connected as in figure 161, set the audio signal generator to 1 kc, with 0 dbm input to the transmitter. Increase the input to the transmitter to +14 dbm. For proper operation, the receiver output must be plus 14 ±1 dbm.

e. Noise. The equipment remains set as for the preceding test (+14 dbm input to transmitter). The transmitter is deviating 40 kc. Refer to the distortion analyzer technical manual for the proper procedure to measure relative output levels. Set up the distortion analyzer on the receiver output level with the transmitter deviating 40 kc. Remove the signal generator leads at the transmitter input. The transmitter is no longer being modulated. Measure the noise level of the receiver with the unmodulated transmitter carrier still being received. For proper operation, the noise level must be at least 50 db down. Connect the audio signal generator to the transmitter input.

f. Transmitter Modulation Sensitivity. Turn the transmitter LINE LEVEL control completely clockwise. Decrease the amount of audio input to the transmitter until the receiver output is zero dbm. For proper operation, the transmitter input must be −8 dbm or less. Reset the LINE LEVEL control as directed in paragraph 204*b*.

Note. A value of −9, −10, is less than −8 dbm.

g. Transmitter Power Output. Check the power output at every position of the MC frequency selector across the entire band. For proper operation, the power output must be not less than 40 watts at all frequencies. The power amplifier plate current must not exceed 150 ma at 40-watt output.

h. Transmitter Meter Accuracy. With the transmitter audio input adjusted for zero dbm output from the receiver, turn the transmitter METER SW to LINE LEVEL. For proper operation, the reading on the transmitter front panel meter must be 0, ±1 dbm.

i. Transmitter 17-Crystal Oscillator. Set the transmitter METER SW to the OSC position. The meter should indicate approximately 1.5 v. (See par. 139 for instructions on the front panel meter.) Check the meter reading for each position of the MC frequency selector. For proper operation, the meter indication should be approximately 1.5 v across the entire band.

j. Transmitter Afc. Disconnect the audio signal generator from the transmitter input. Set the frequency selectors to 54.0 mc. Measure the transmitter frequency with the frequency meter. Ground pin 1 of V215. Raise the transmitter frequency 100 kc by means of the oscillator slug. Remove the ground from pin 1, V215. For proper operation, the transmitter must return to within 3 kc of the original frequency. Ground pin 1 of V215. By means of the oscillator slug, set the transmitter frequency 100 kc below the original frequency. Remove the ground from pin 1 of V215. For proper operation, the transmitter must return to within 3 kc of the original frequency. Reconnect the audio signal generator to the transmitter input.

k. Transmitter TEST-MIKE-RING Switch.

(1) Set the audio signal generator to 1 kc, and adjust the input to the transmitter to .175 v. Set the TYPE OF OPERATION switch to the TERMINAL position. The TEST-MIKE-RING switch should be in the MIKE position. Meas-

ure the deviation. For proper operation, the deviation must not exceed 9 kc.

(2) Repeat the procedure in (1) with the TYPE OF OPERATION switch in the PUSH-TO-TALK position. For proper operation, the deviation must not exceed 8 kc.

(3) Turn the TEST-MIKE-RING switch to the RING position, and measure the deviation. For proper operation, the deviation must be 8 kc, ±1 kc. Measure the frequency of the audio signal heard in the receiver with the TEST-MIKE-RING switch in the RING position. For proper operation, this signal should be 1,600 cps ±10 cps.

(4) Turn the TEST-MIKE-RING switch to the TEST position, and measure the deviation. For proper operation, the deviation must be 8 kc, ±1 kc. Set the TYPE OF OPERATION switch to PUSH-TO-TALK so that the transmitter will not be keyed during the following receiver tests.

l. Receiver I-f Bandwidth. Connect the output of the r-f signal generator through a 50-ohm coaxial cable to the receiver ANT jack. Disable the afc by pressing the AFC DISABLE switch, or by connecting pin 1, V215, to ground. Set the signal generator and the receiver to 54.0 mc. With the signal generator turned off, set the distortion analyzer db meter to zero db on the noise level. Turn the signal generator on (no modulation), and adjust the output for a −20-db indication on the meter. The input is now set for 20-db quieting. Increase the output of the signal generator by 3 db. (To increase the signal generator output 3 db, set it to 1.4 times the original output voltage.) Lower the signal generator frequency until 20-db quieting is again indicated in the output. Raise the signal generator frequency until 20-db quieting is again indicated in the output. For proper operation, the difference between the upper and lower frequencies at which 20-db quieting exists must not be less than 140 kc. Repeat the above procedure, increasing the signal generator output by 60 db. (A 60-db increase is 1,000 times the original voltage.) For proper operation, the difference between the upper and lower frequencies at which 20-db quieting exists must not be more than 420 kc.

m. Receiver Output Levels.

(1) *Wide-band output.* With the signal generator connected to the receiver as in the preceding test, set both to 54.0 mc. Set the signal generator for 10-uv output, modulated with a 1 kc signal, with a deviation of 40 kc. For proper operation, the receiver output must be at least 17 dbm with the LINE LEVEL fully clockwise.

(2) *Narrow-band speaker output.* The signal generator remains set as it was for the preceding test. Connect the handset plug to the control unit AUDIO jack. Connect the output meter across a 600-ohm load between ground and pin L of the receiver AUDIO jack. For proper operation, an output of at least 21.2 volts must be indicated on the meter.

(3) *Narrow-band handset output.* Do not change the settings of the signal generator. Connect the loudspeaker to the receiver AUDIO jack. Disconnect the handset, and connect the meter across a load resistance of 125 ohms between ground and pin A of the control unit AUDIO jack. For proper operation, an output of at least 6.1 volts must be indicated on the meter. Remove the loudspeaker. For proper operation, the output level must not increase more than 10 db.

n. Sensitivity. Set both the signal generator and the receiver frequencies to 54 mc. Turn SQUELCH control to OFF. The output meter remains connected as in the preceding test. Set the signal generator modulation to 1 kc, with 40-kc deviation, and set the output to approximately .1 uv. Turn the modulation off, and check the difference in output level. If the difference in receiver output between modulation on and off conditions is less than 10 db, increase the signal generator output slightly. Again, turn the modulation off and check the difference between the receiver output levels. Continue this procedure until the difference between modulation on and off levels is 10 db. For proper operation, this condition should occur with a signal generator output of .50 uv or less. Repeat this procedure at 62.5, and 70.9 mc.

o. Squelch Sensitivity.

(1) *Maximum.* With the setup of the previous test, turn the signal generator out-

put to zero. Turn the SQUELCH control completely counterclockwise, then turn clockwise and stop when the CALL LIGHT goes off and the noise is indicated by the output meter. Slowly increase the signal generator output until the CALL LIGHT goes on. For proper operation, the amount of signal required to operate the squelch must not exceed the amount of signal required to produce a 10-db difference between the output levels with and without modulation as directed in *n* above.

(2) *Minimum.* Set the signal generator output to zero. Turn the SQUELCH control completely clockwise. Slowly increase the signal generator output until the CALL LIGHT goes on. For proper operation, the signal required to operate the squelch must not be less than 1 uv, nor more than 10 uv.

p. AFC. Turn the SQUELCH control to OFF. Set the signal generator output to 10 uv. Turn the signal generator off frequency approximately 60 kc. Press the AFC DISABLE switch and measure the d-c voltage at pin 5, V15, with a vtvm. Release the AFC DISABLE switch and again measure the d-c voltage at pin 5, V15. For proper operation, the ratio of the two voltage measurements must not be less than 10 to 1.

q. Wide-Band Distortion.

(1) *Receiver.* Connect the distortion analyzer to the receiver output on the control unit. Set both the receiver and signal generator frequencies to 54.0 mc. Adjust the signal generator for 50-uv output, modulated by a 1-kc audio signal with a deviation of 40 kc. Measure the distortion with a distortion analyzer. (If necessary, refer to the distortion analyzer technical manual for instruction.) For proper operation, the distortion must be less than .8 percent.

Note. If distortion is too high, changing the wide-band audio amplifier tube, V21, may lower it.

(2) *Radio set.* Connect the equipment as shown in figure 161. Adjust the audio signal generator for an output of +14 dbm, at a frequency of 1 kc. Measure the distortion of the receiver output. For proper operation, the distortion must be less than 1 percent.

r. Narrow-Band Distortion.

(1) *Receiver.* Follow the procedure given in *q*(1) above, but connect the distortion analyzer between ground and pin L, of the receiver AUDIO jack. For proper operation, the distortion must be less than 6 percent.

(2) *Radio set.* Follow the procedure given in *q*(2) above, but connect the distortion analyzer between ground and pin L of the receiver AUDIO jack. For proper operation, the distortion must be less than 10 percent.

s. Narrow-Band Frequency Response. The equipment remains set as indicated in *r*(2) above, except for the transmitter audio input. Connect a 150-ohm resistor across the output of the signal generator, and connect an a-c vtvm across the resistor. Apply the signal generator output between ground and pin A of the transmitter CONTROL jack. Set the audio signal generator frequency to 1 kc, and set the output to 1 volt. Set up the output meter in this range, then check the output with the audio generator set to 120; 250; 400; 2,500; and 3,500 cps, keeping the input to the transmitter constant at 1 volt. For proper op-

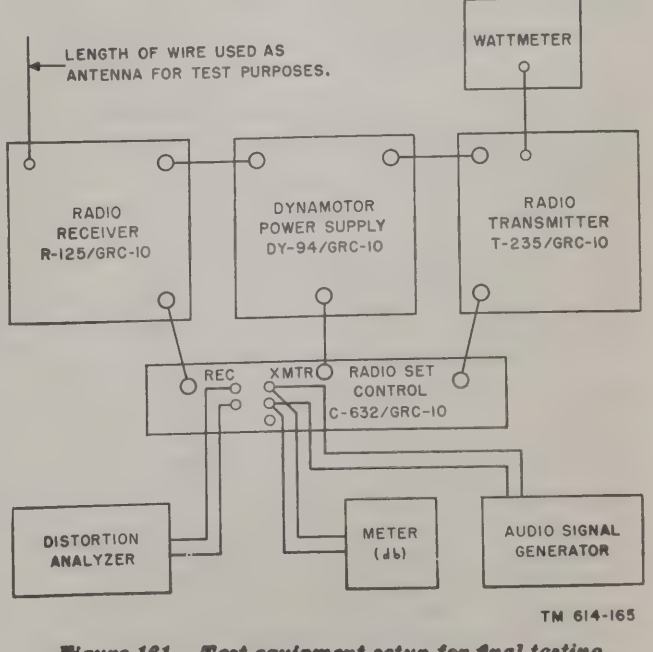


Figure 161. Test equipment setup for final testing.

eration, the output level for all frequencies must be within ±5 db of the 1 kc reference level.

t. Power Supply Final Test. For proper operation, the output voltages must be within the specified tolerance of the values given. The measurements must be taken under load conditions, with the power supply operating from an a-c 50- to 65-cps source of 115 or 230 volts, or from a d-c source of 26.4 volts. Also listed is the maximum amount of ripple allowable for each d-c voltage. Ripple voltage is measured with an a-c vtvm. All voltages are measured from point specified to ground unless otherwise indicated. A-c voltages may vary ±3 percent; d-c voltages may vary ±5 percent.

(1) *REC POWER.*
- (*a*) Pin A, +200 volts, d-c .06 volt max, ripple
- (*b*) Pin F, 26.4 volts, a-c or d-c
- (*c*) Pin H, 26.4 volts, a-c or d-c

(2) *XMTR POWER.*
- (*a*) Pin A, +550 volts, d-c .45 volt max, ripple
- (*b*) Pin B, +250 volts, d-c .09 volt max, ripple
- (*c*) Pin C, −20 volts, d-c, .20 volt max, ripple
- (*d*) Pin F, 26.4 volts, a-c or d-c
- (*e*) Pin H, 26.4 volts, a-c or d-c
- (*f*) Pin D to E, 115 volts, a-c

CHAPTER 8

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

205. General

The following instructions are recommended as a guide for preparing the radio set for transportation and storage:

a. Disconnect the intercomponent cables, power cables, handset and speaker cables, and antenna cables. Wind long cables into coils and secure them with tape.

b. Remove the major components from the electrical equipment rack by reversing the procedures given in paragraph 56.

c. Disassemble the antenna group by following the instructions given in paragraph 206.

206. Lowering and Disassembling the Antennas

Disassembly is accomplished by the same procedures as the installation of the antenna system (pars. 45–54) except in reverse order. Parts are to be repacked in the carrying case and bags as illustrated (figs. 14 and 15). The following instructions are recommended as a guide for preparing the antenna group for transportation and storage.

Warning: Shut all power off and disconnect the transmission line from the transmitter or receiver before dismantling the antenna.

a. Lower Antenna. Before lowering the antenna, place the carrying case and bags at convenient locations for repacking (fig. 31) and proceed as follows:

(1) Untie the gin pole and orient it to line up with a guy stake.

(2) Attach two spare guys to the gin pole cap for guying the gin pole and the rope assembly (B, fig. 33).

(3) Detach the mast guys from the guy stake nearest the end of the gin pole and attach them to the above cap assembly. Keep pulling on the mast guys until the next step is completed.

(4) Assemble the above cap assembly to the gin pole in reverse order of installation. Apply tension to the mast guys. The top gin pole guys should be tensioned slightly more than the others to establish an upward bow in the mast when it is being lowered. Guy the gin pole to the two guy stakes at right angles to the gin pole.

(5) Lower the antenna, using two men, in the reverse order to the raising of the mast (par. 53).

b. Transmission Line. Dismantle the transmission line as follows:

(1) Disconnect the transmission line from the terminal block and replace the cap on Receptacle Connector UG–568/U.

Note. Avoid getting moisture or any foreign material in the cable assembly plugs and do not damage the coaxial cable.

(2) Detach the R-f Cable Assemblies CG–718/U from the strain relief clamps on the guy plates, separate them, form in coils, and bind them with friction tape.

(3) Pack the cable assemblies and adapter connectors in Bag BG–102–A.

c. Antenna Array (fig. 35). Detach the antenna array and disassemble as follows:

(1) Detach the mast adapter from the mast and antenna array.

(2) Detach the folded dipole (radiator) elements from the array and adjust to minimum length.

(3) Adjust the director and reflector elements to minimum length and reposition the elements parallel to the boom.

(4) Attach the mast adapter, the boom and box subassembly, and the radiator elements to the cradles in the carrying case (fig. 14).

d. Guys and Rope. Proceed as follows with guys and rope assembly.

(1) Detach gin pole guys at the guy stakes. Lift off the top section of the gin pole and remove gin pole cap assembly.

(2) Detach the rope assembly and all guys. Tie them in individual hanks.

(3) Repack guys, rope and gin pole cap in guy Bag BG–102–T.

e. Mast Sections. Detach all mast sections and guy plates, and repack them in their carrying bags.

f. Mast Base and Guy Stakes. Pull mast base and guy stakes from the ground, using the hammer for loosening. Repack these parts and the mast base plate in their carrying bags.

207. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the condition under which the equipment is to be shipped or stored. Repack the equipment by reversing the unpacking procedures given in paragraph 44. Refer to U. S. Army Specification No. 100–14A for specific export packing instructions.

b. Use the original cartons, cases, and packing materials, if possible. If original boxes are not available, pack the equipment in water-resistant cartons and seal with a waterproof sealing compound or tape. Use original padding, corrugated cardboard, excelsior, or similar materials. The front panels, especially, should be protected. In preparing equipment for oversea shipment, use masking tape to secure all electron tubes not held by tube clamps.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

208. General

The demolition procedures outlined in paragraph 209 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be done only upon order of the commanding officer.

209. Methods of Destruction

a. Smash. Smash the crystals, meters, tubes, controls, handsets, coils, switches, relays, filters, capacitors, and transformers; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut cords, wires, and cables; use axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend the cases, panels, and chassis.

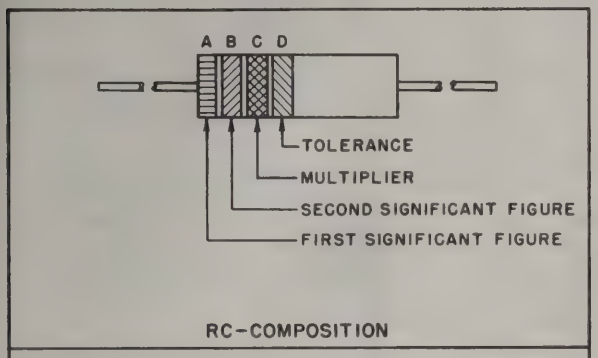
e. Explosives. If explosives are necessary, use firearms, grenades, primacord, composition C, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, foxholes, or other holes, or throw them into streams.

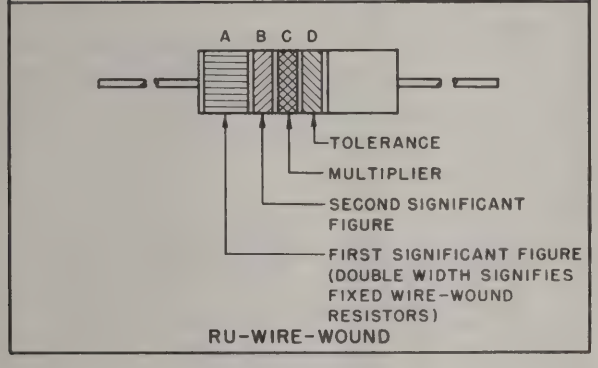
g. Destroy. Destroy everything.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

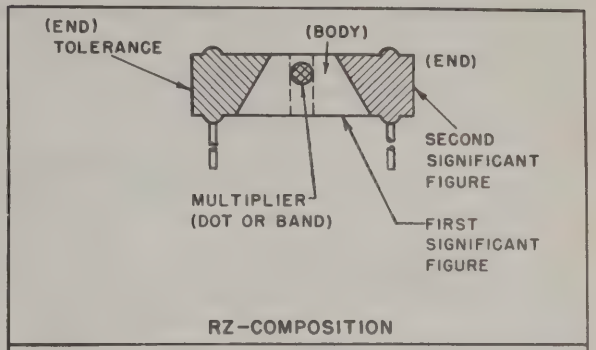


RC-COMPOSITION

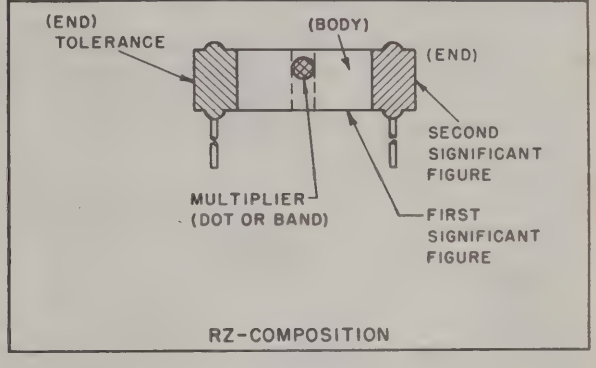


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

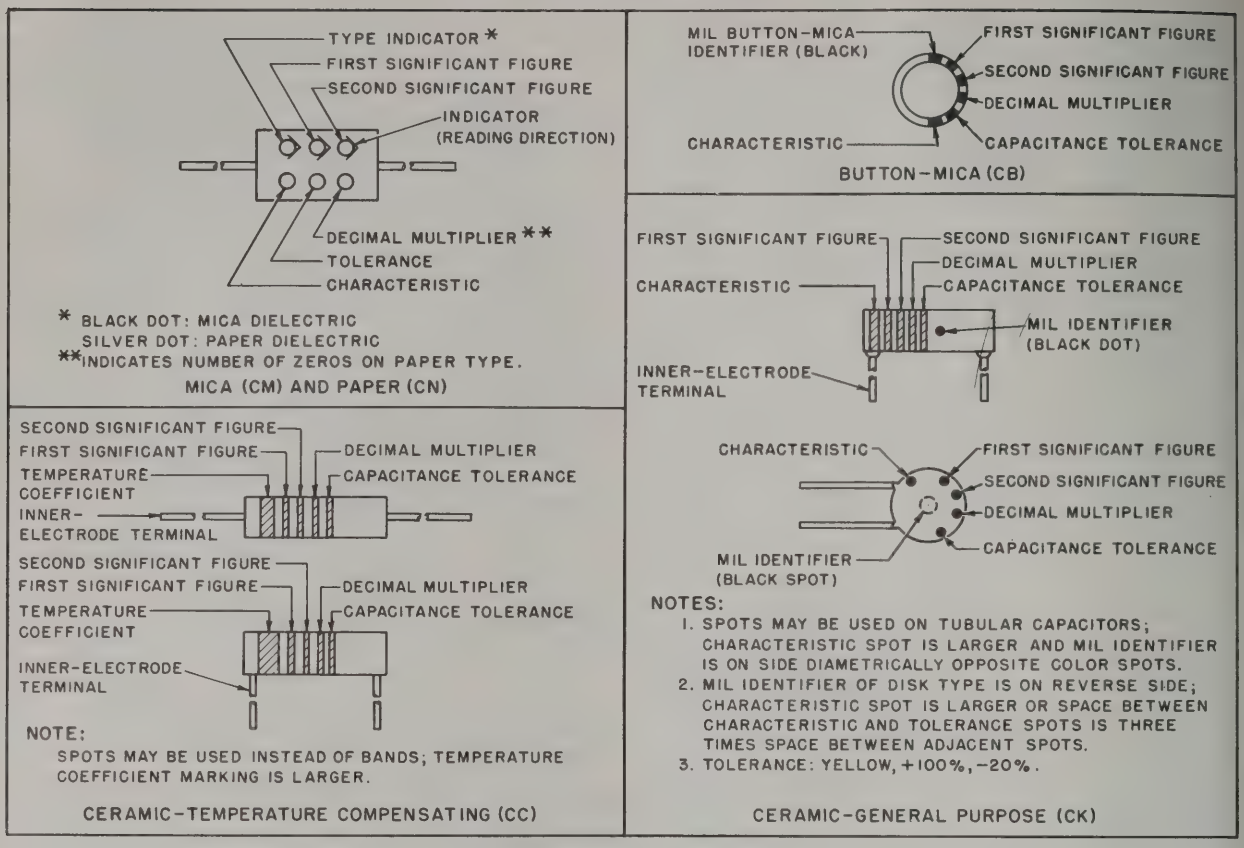
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

Figure 162. Resistor color code marking.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



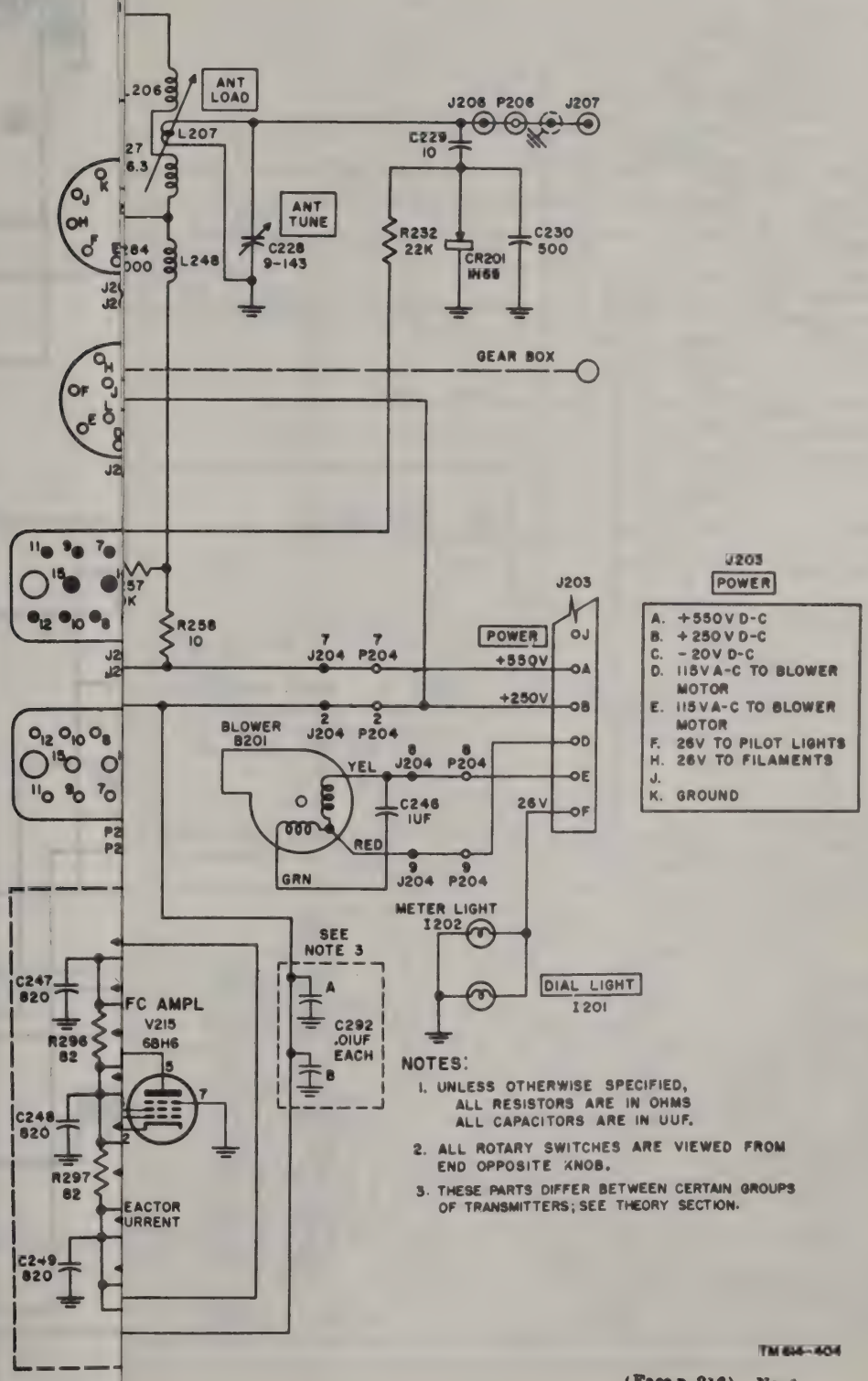
CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 163. Capacitor color code marking.

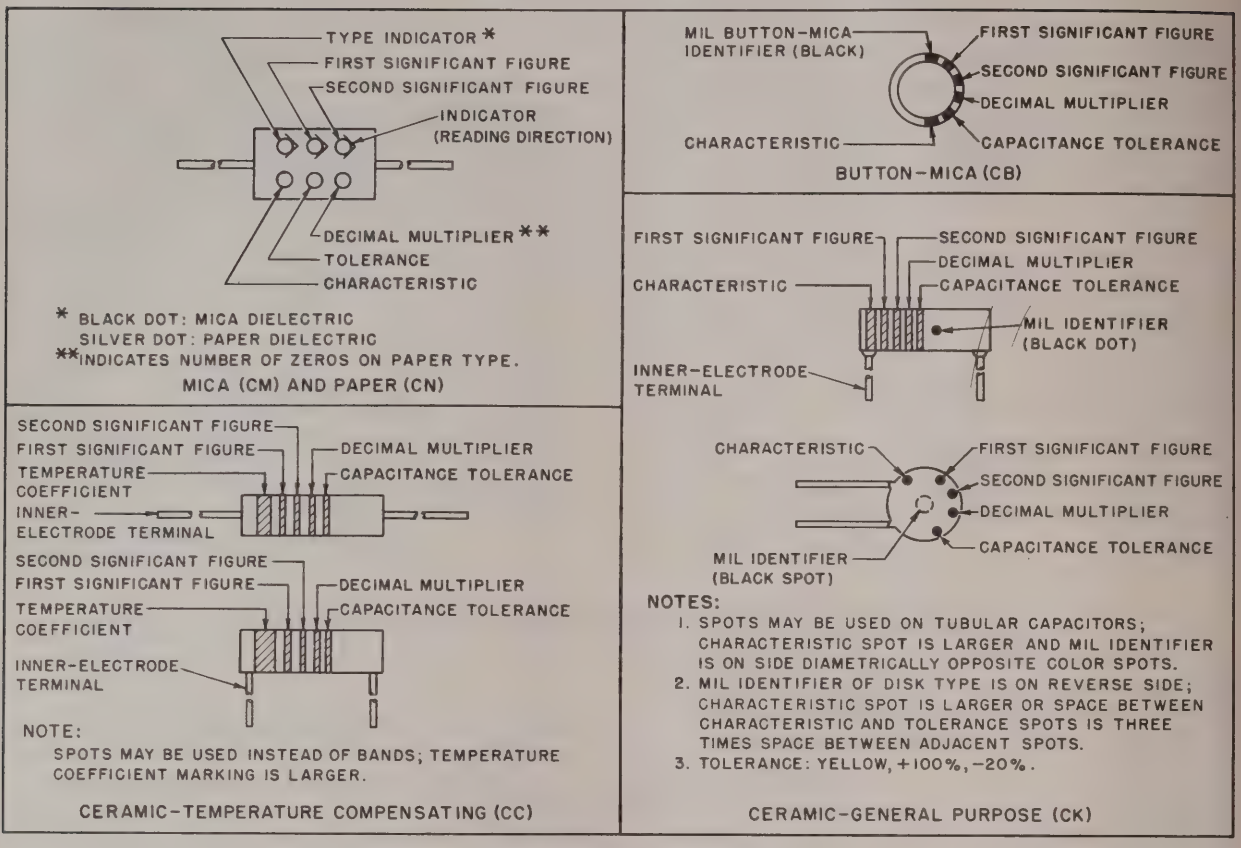


NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS ALL CAPACITORS ARE IN UUF.
2. ALL ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE KNOB.
3. THESE PARTS DIFFER BETWEEN CERTAIN GROUPS OF TRANSMITTERS; SEE THEORY SECTION.

TM 814-404

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 163. Capacitor color code marking.

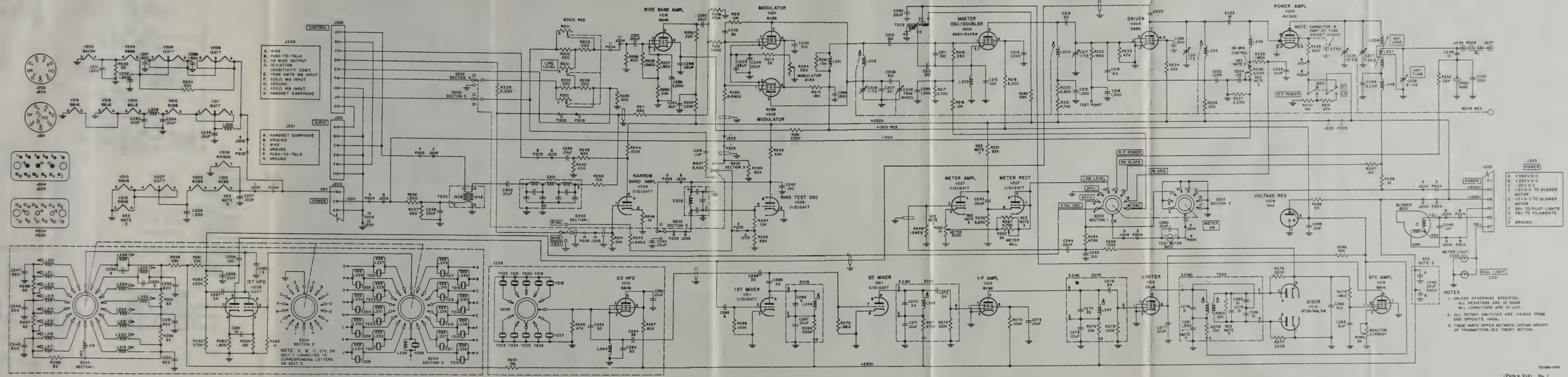
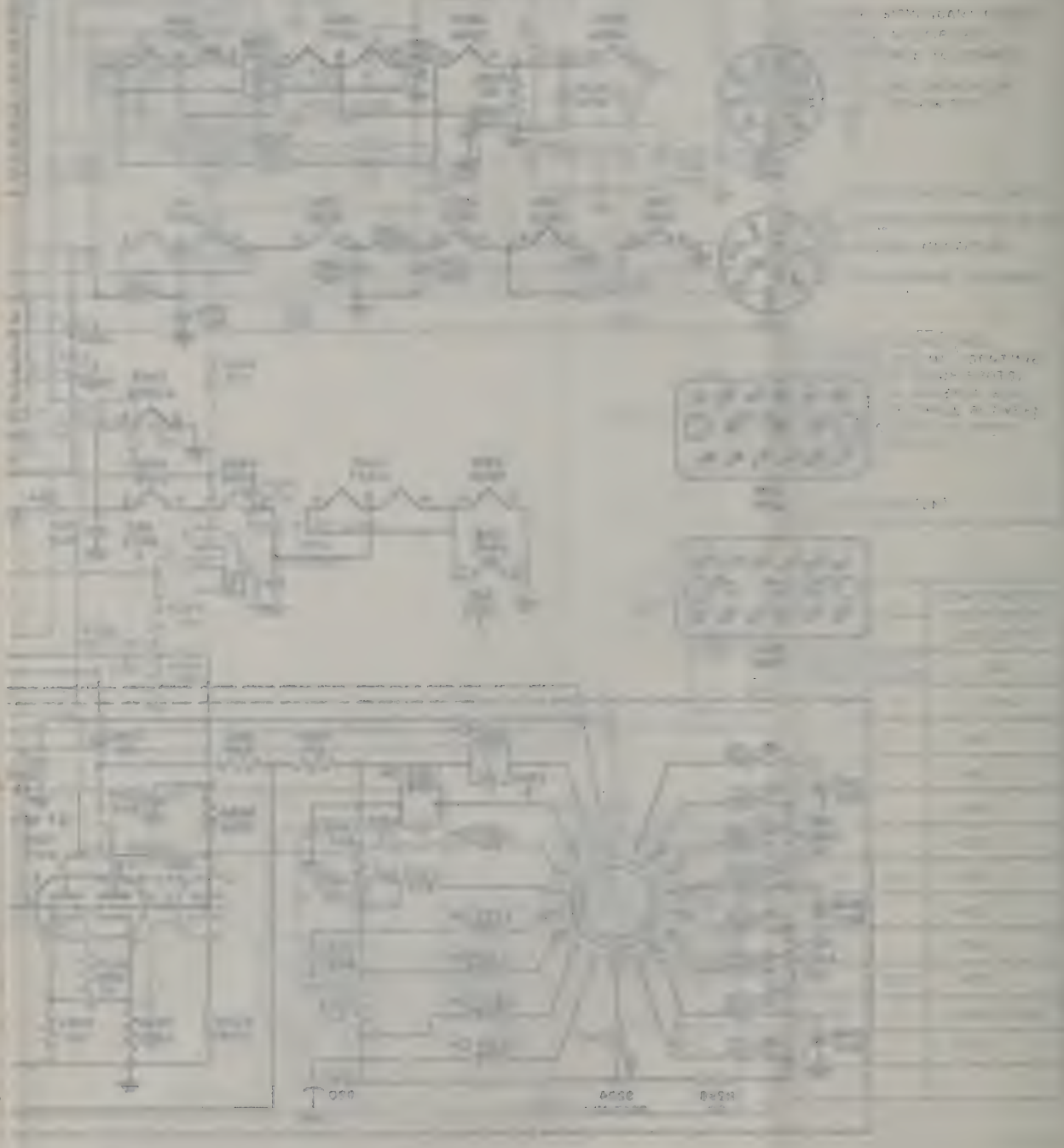
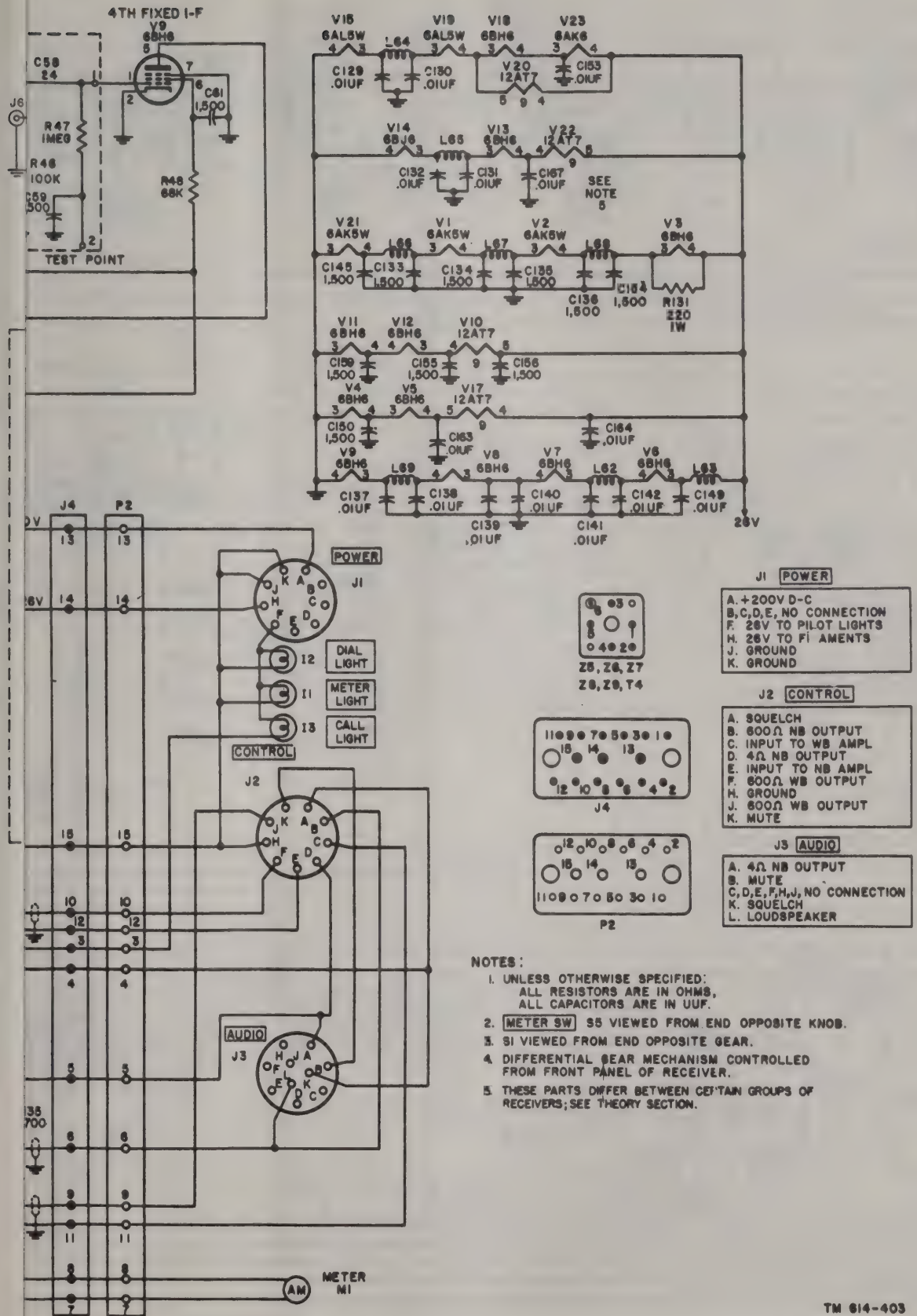


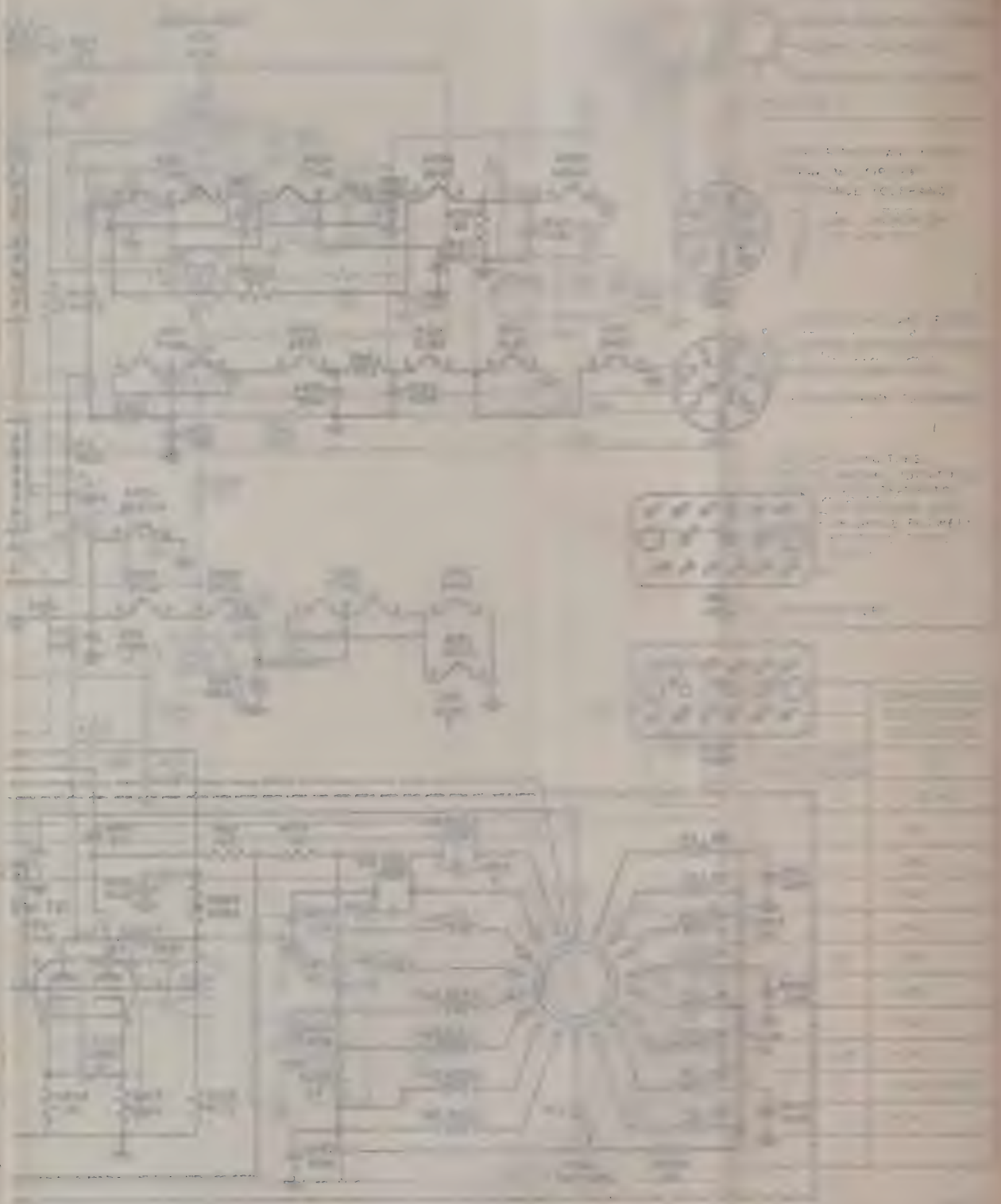
Figure 184. Radio Transmitter T-235/GRC 16, schematic diagram.





NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS,
   ALL CAPACITORS ARE IN UUF.
2. METER SW S5 VIEWED FROM END OPPOSITE KNOB.
3. S1 VIEWED FROM END OPPOSITE GEAR.
4. DIFFERENTIAL GEAR MECHANISM CONTROLLED FROM FRONT PANEL OF RECEIVER.
5. THESE PARTS DIFFER BETWEEN CERTAIN GROUPS OF RECEIVERS; SEE THEORY SECTION.



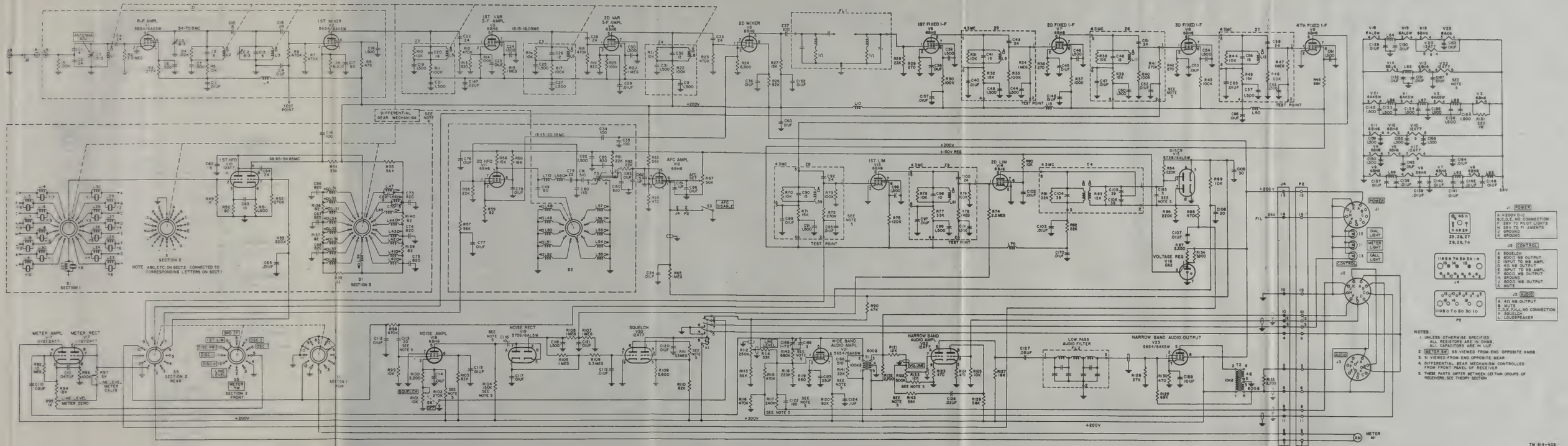
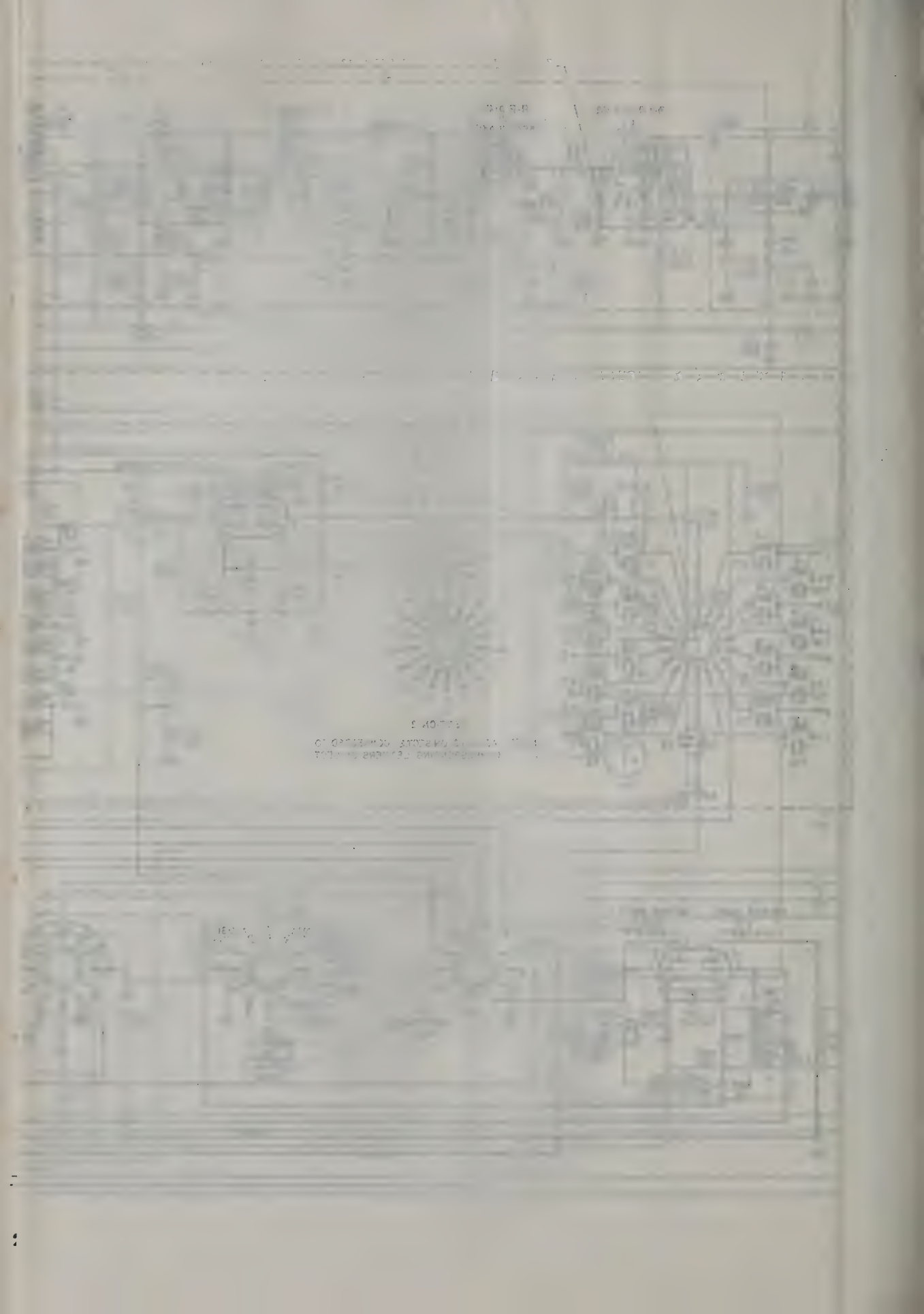
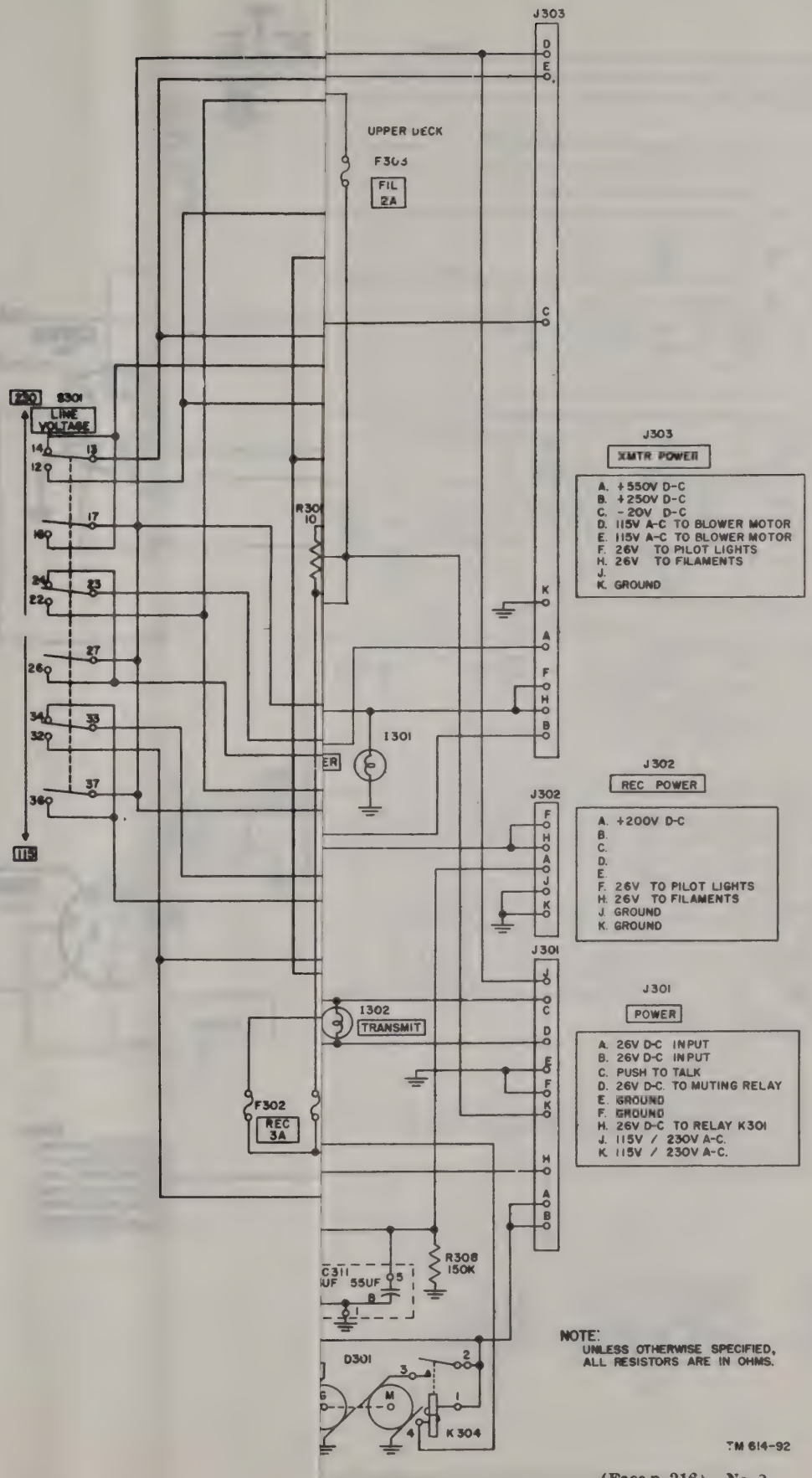


Figure 165. Radio Receiver R-125/GRC-10, schematic diagram.





(Face p. 216) No. 3



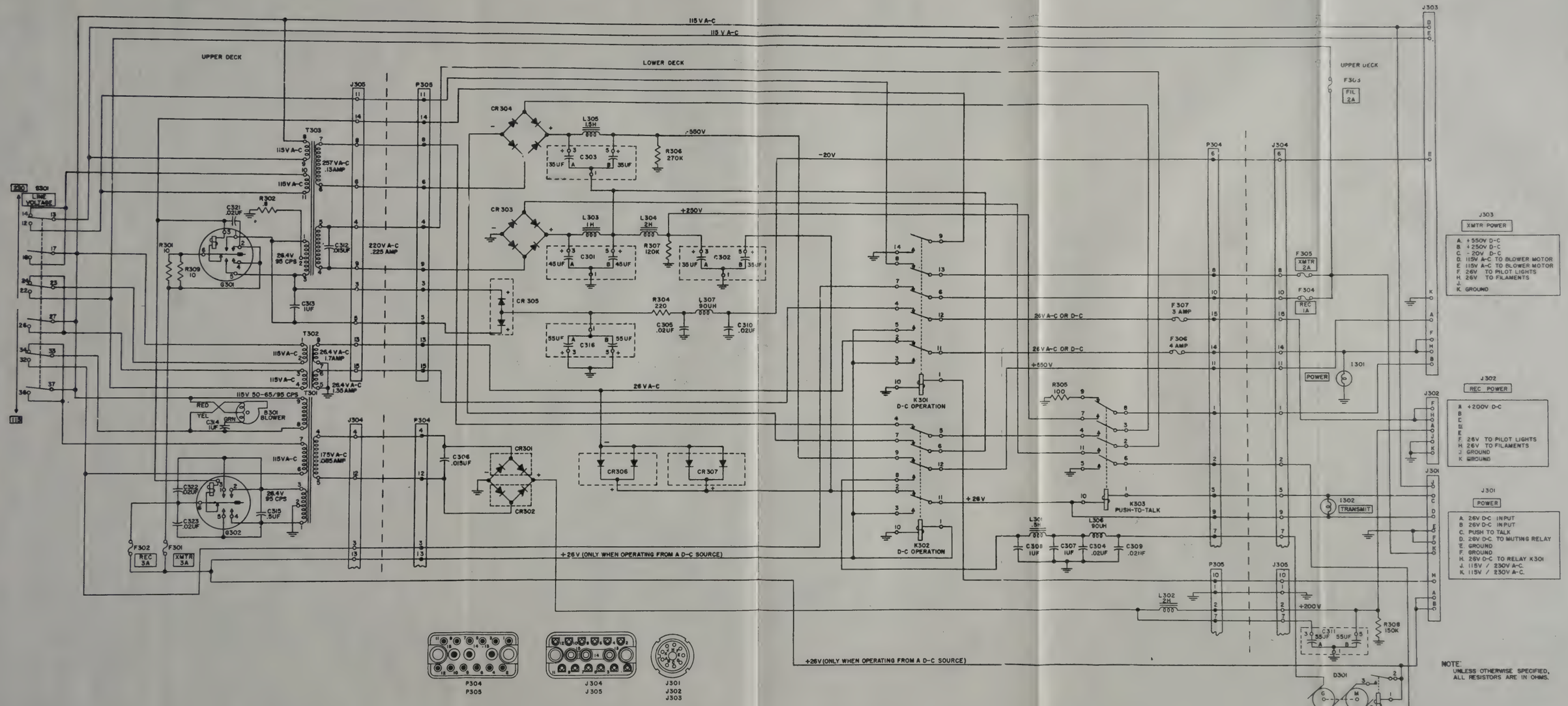
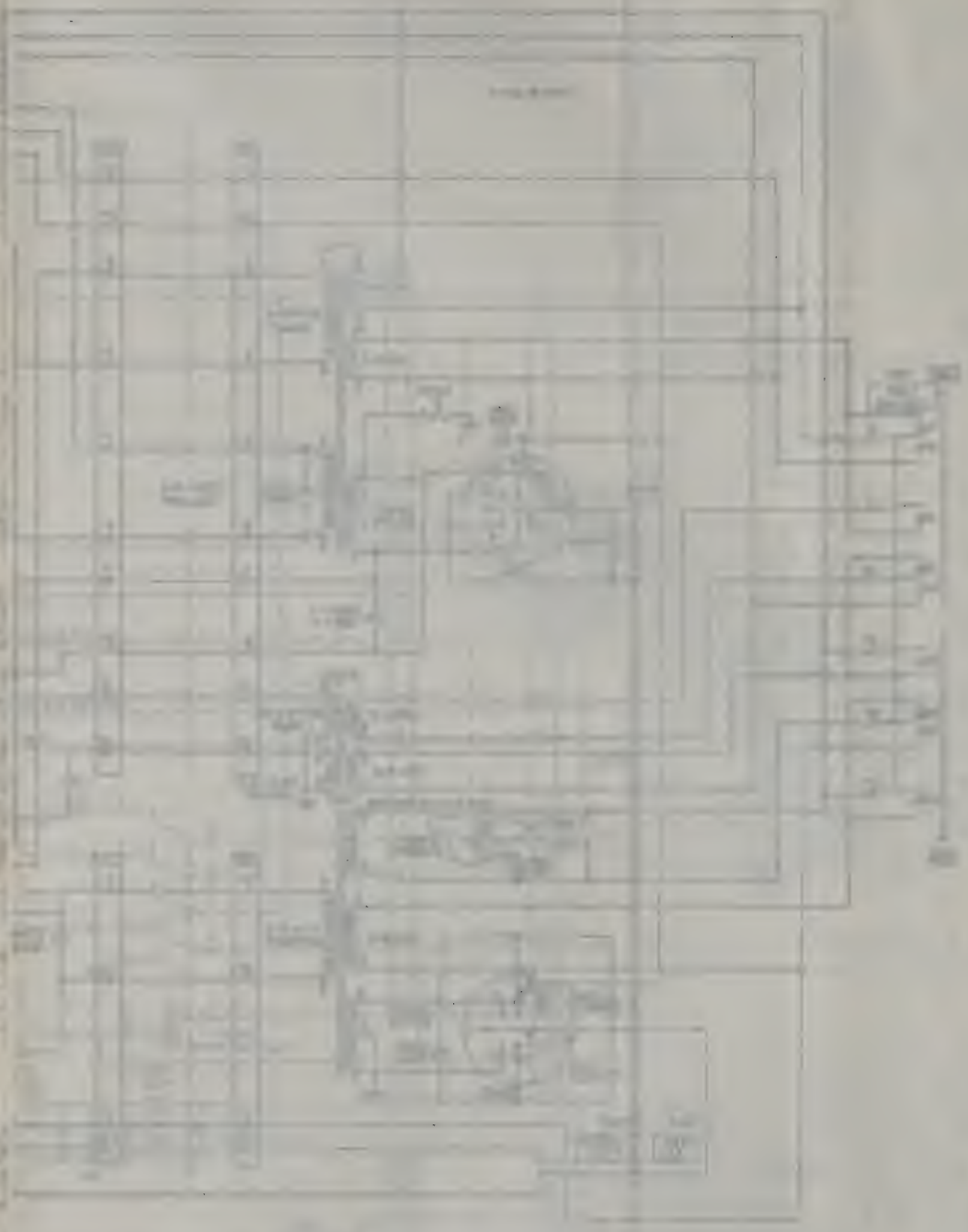
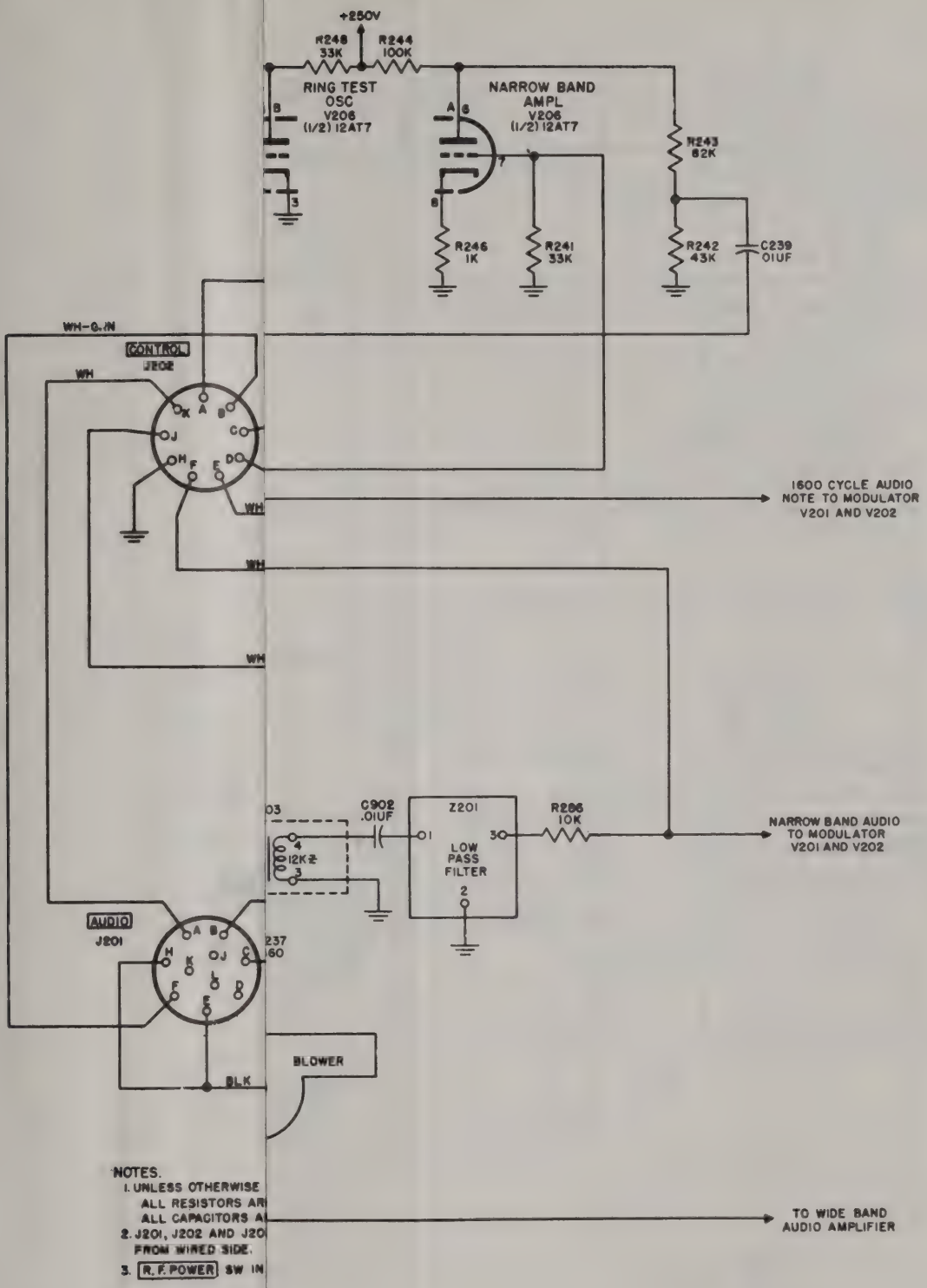
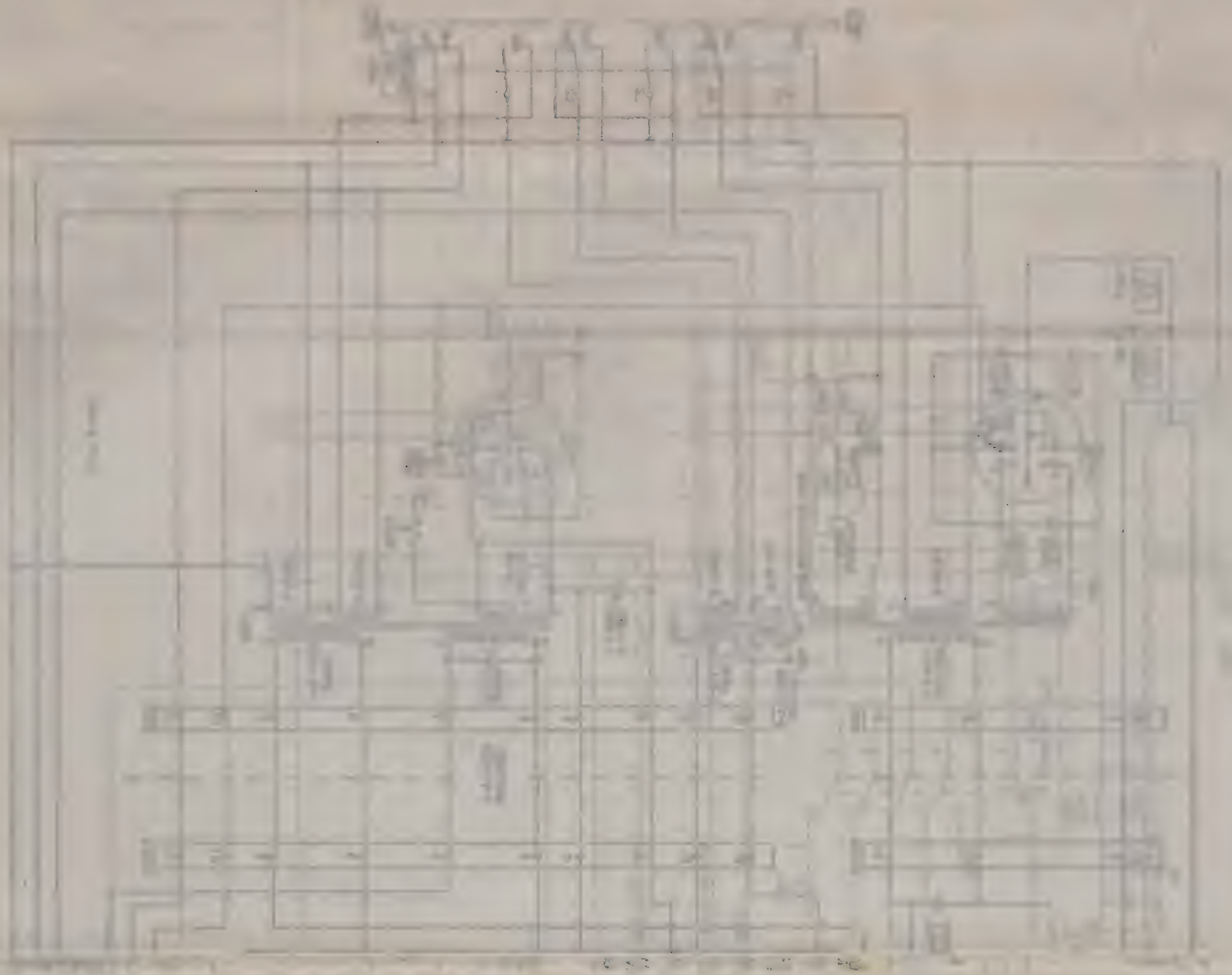


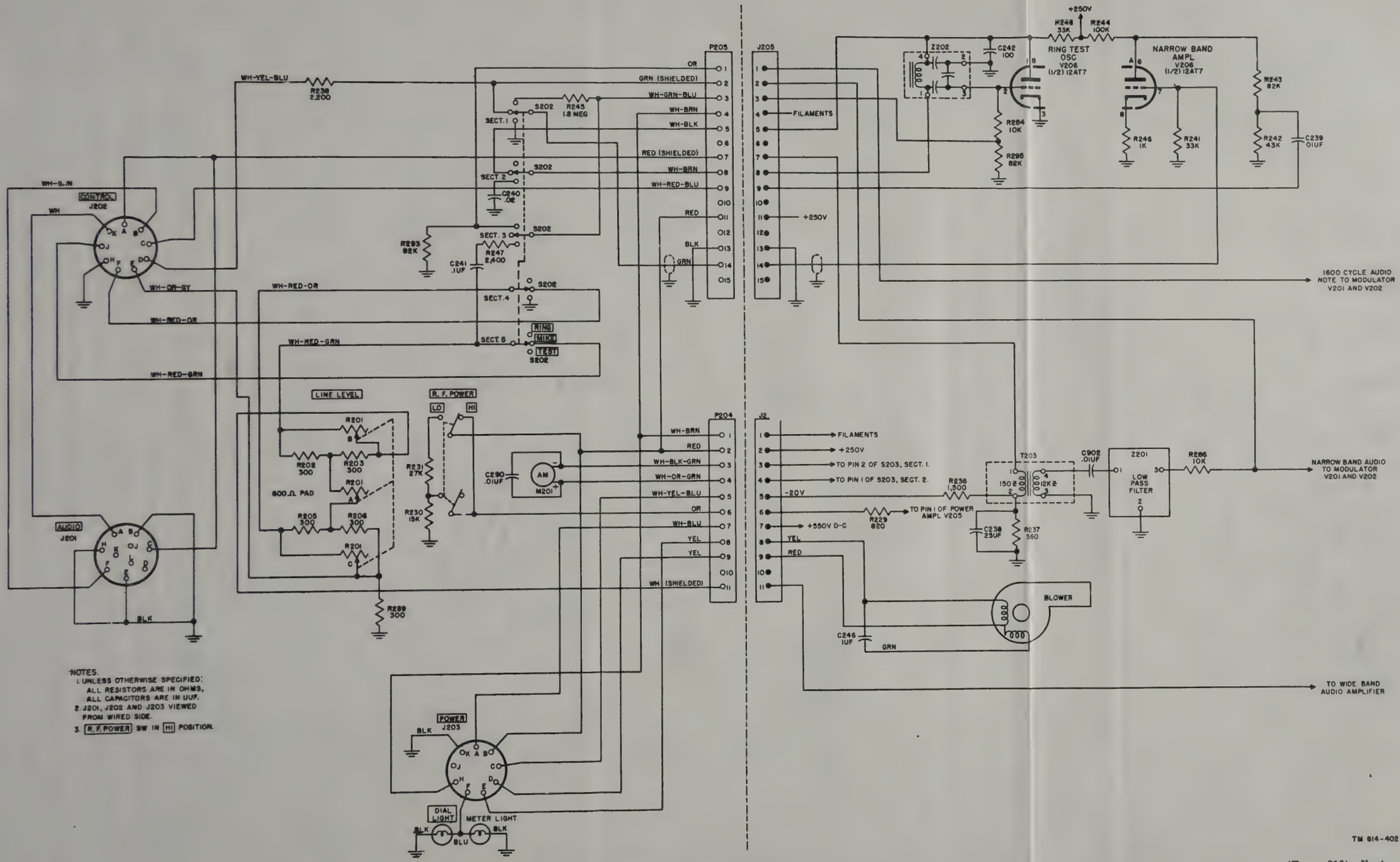
Figure 166. Dynamotor-Power Supply DY-94/GRC-10, schematic diagram.

(Face p. 216)




+250V
R248 33K
R244 100K
RING TEST OSC V206 (1/2) 12AT7
NARROW BAND AMPL V206 (1/2) 12AT7
R243 82K
R246 1K
R241 33K
R242 43K
C239 01UF
WH-G-IN
CONTROL J202
WH
1600 CYCLE AUDIO NOTE TO MODULATOR V201 AND V202
C902 .01UF
Z201
LOW PASS FILTER
R266 10K
NARROW BAND AUDIO TO MODULATOR V201 AND V202
12K Ω
AUDIO J201
BLOWER
BLK
NOTES.
1. UNLESS OTHERWISE
ALL RESISTORS AR
ALL CAPACITORS A
2. J201, J202 AND J20
FROM WIRED SIDE.
3. R.F. POWER SW IN
TO WIDE BAND AUDIO AMPLIFIER



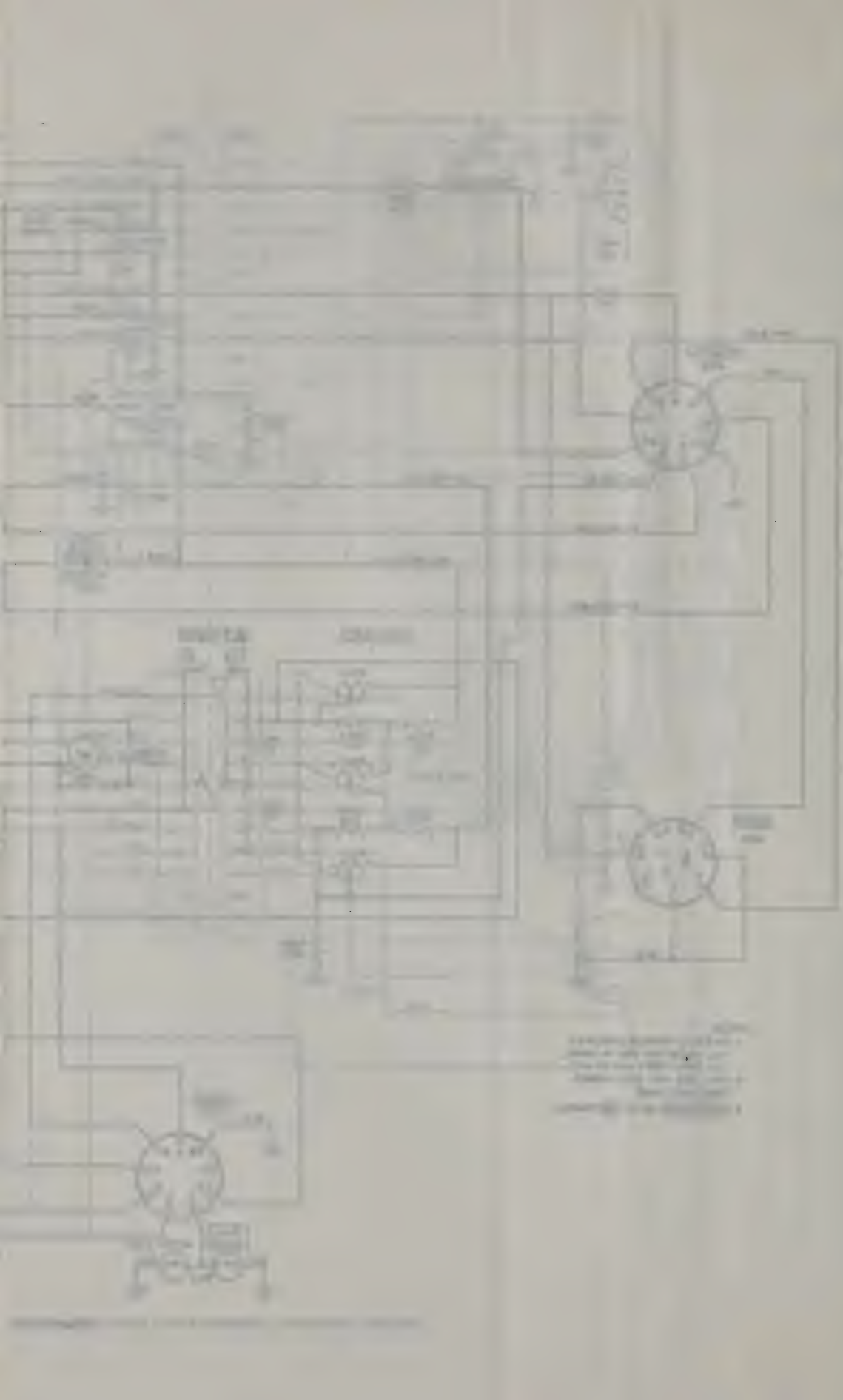


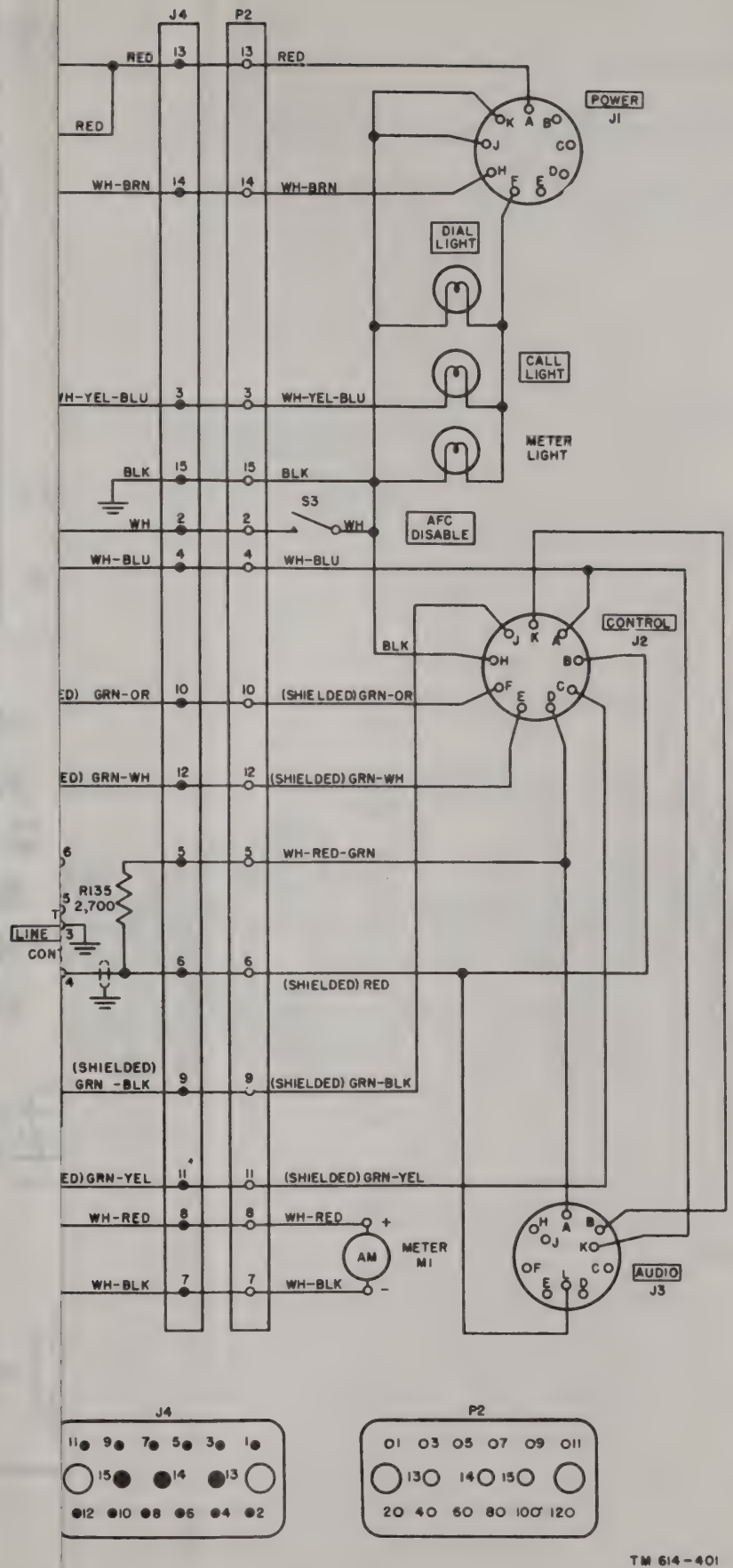
NOTES.
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. J201, J202 AND J203 VIEWED FROM WIRED SIDE.
3. R.F. POWER SW IN HI POSITION.

TM 614-402

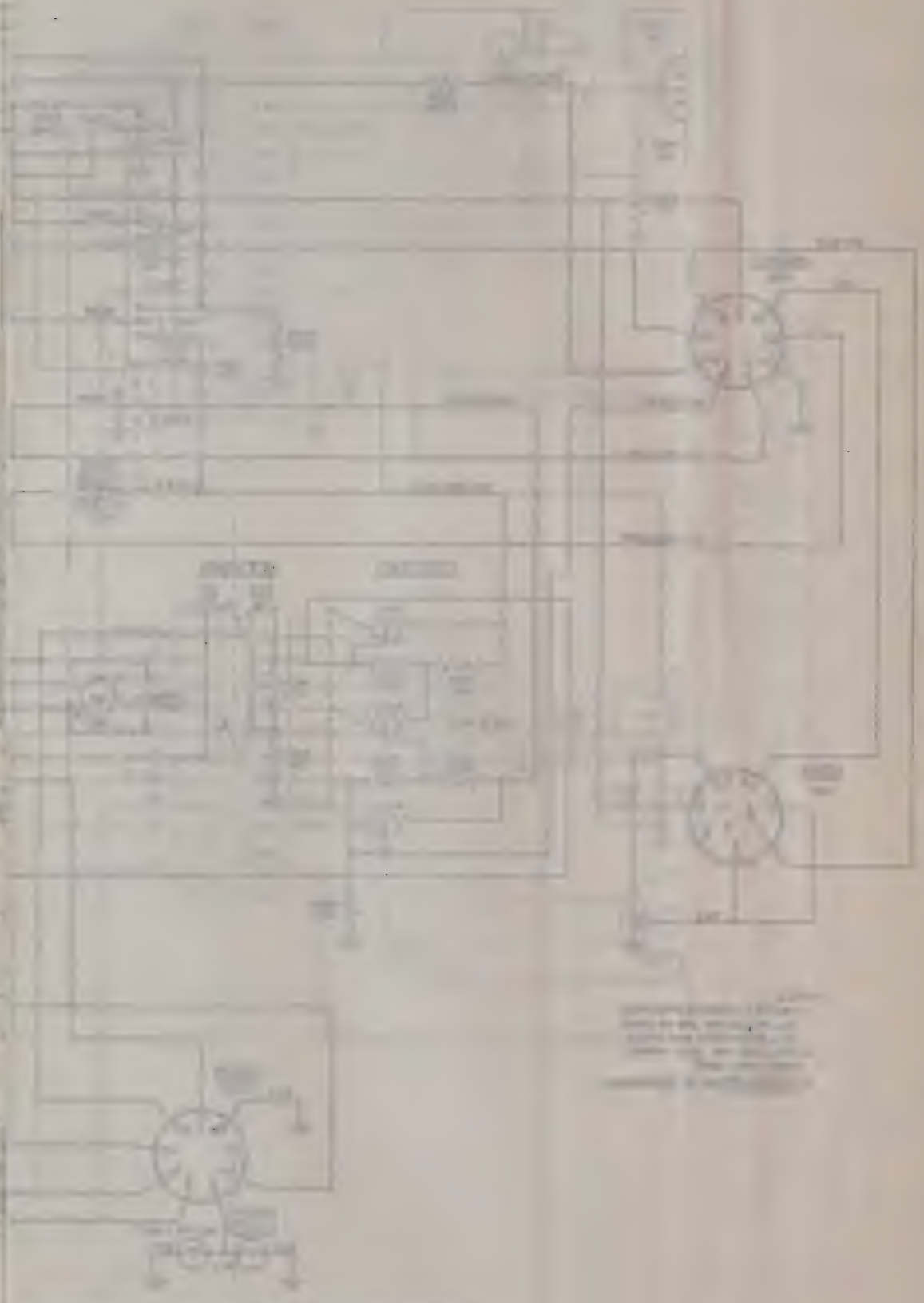
Figure 167. Transmitter front panel assembly, schematic diagram.

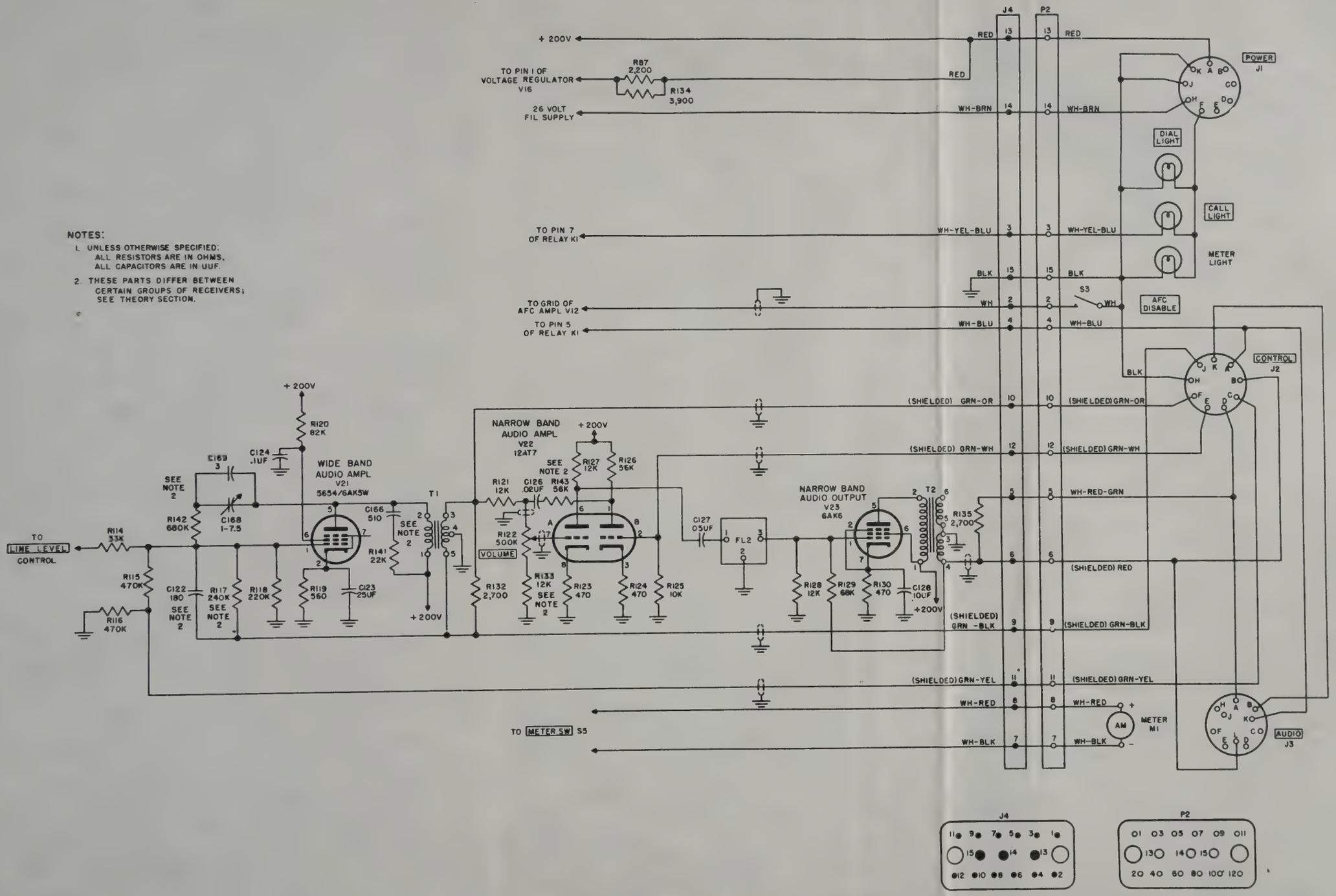
(Face p. 216) No. 4




J4
P2
RED
13
RED
RED
POWER
J1
WH-BRN
14
WH-BRN
DIAL LIGHT
CALL LIGHT
WH-YEL-BLU
3
WH-YEL-BLU
METER LIGHT
BLK
15
BLK
S3
WH
2
WH
AFC DISABLE
WH-BLU
4
WH-BLU
CONTROL
J2
BLK
(SHIELDED) GRN-OR
10
(SHIELDED) GRN-OR
(SHIELDED) GRN-WH
12
(SHIELDED) GRN-WH
WH-RED-GRN
R135
2,700
LINE
CONT
(SHIELDED) RED
(SHIELDED) GRN-BLK
9
(SHIELDED) GRN-BLK
(SHIELDED) GRN-YEL
11
(SHIELDED) GRN-YEL
WH-RED
8
WH-RED
+
AM
METER M1
WH-BLK
7
WH-BLK
-
AUDIO
J3
J4
P2

TM 614-401

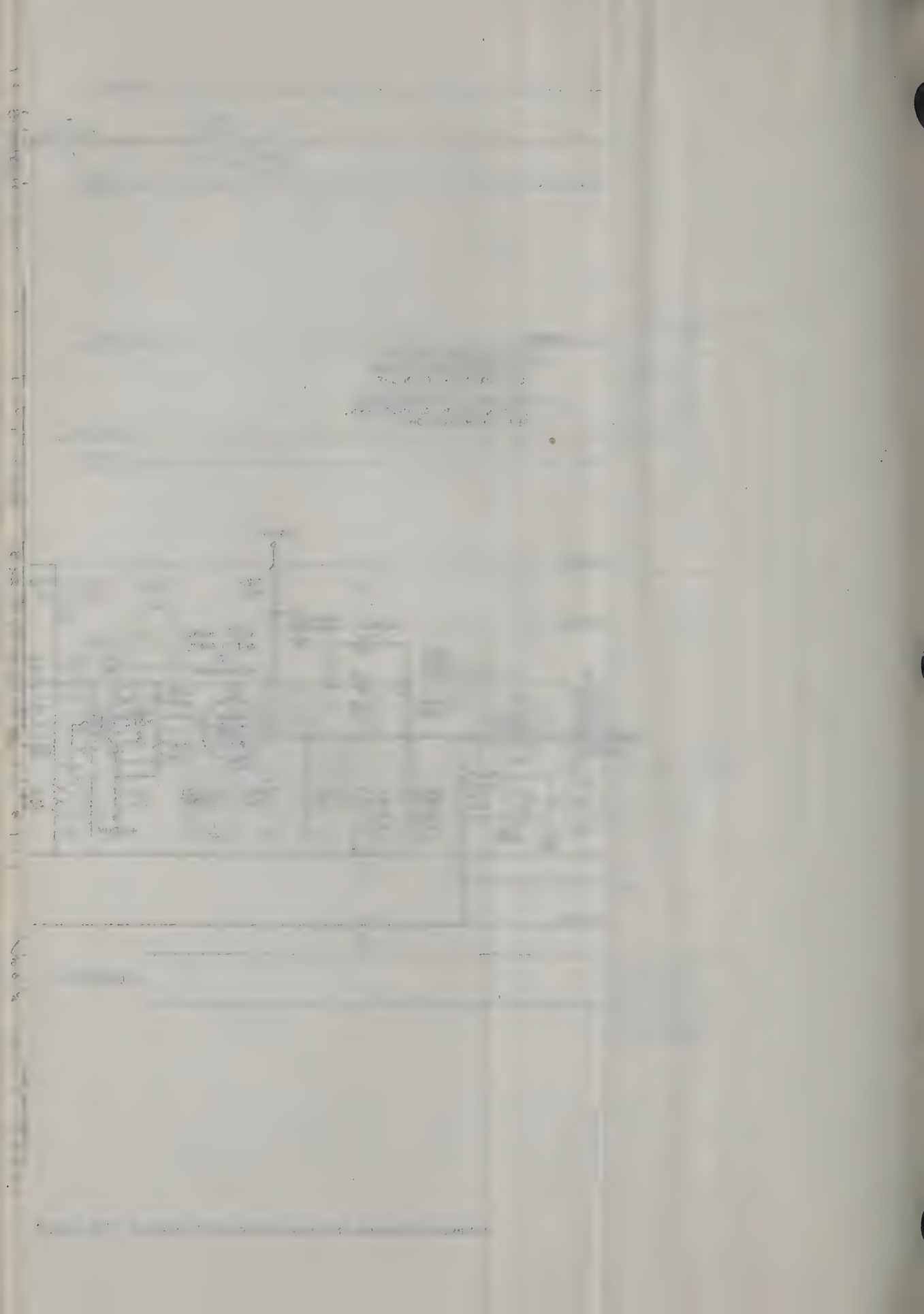


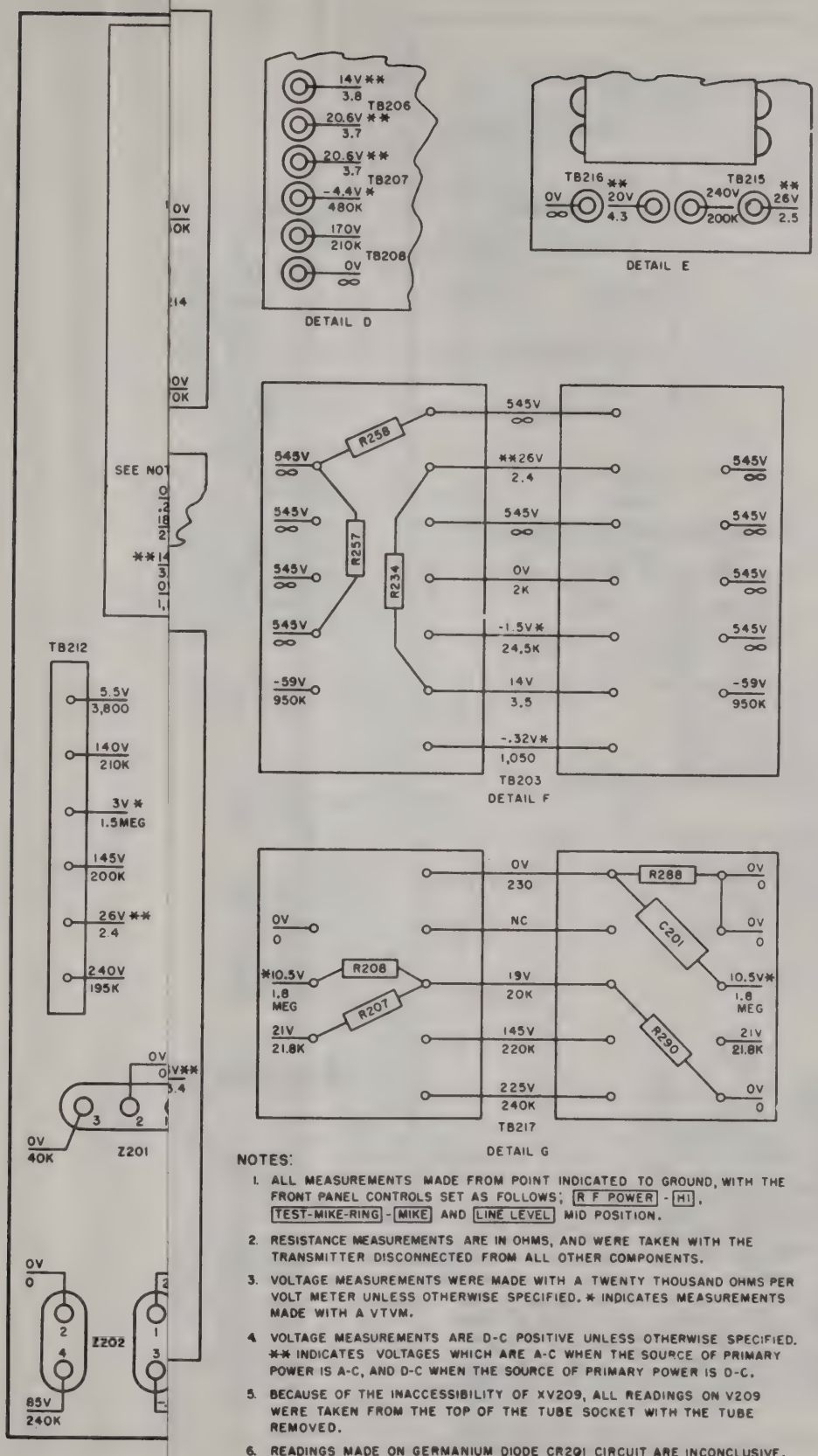


TM 614-401

Figure 168. Receiver front panel assembly, schematic diagram

(Face p. 216) No. 5





NOTES:

1. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND, WITH THE FRONT PANEL CONTROLS SET AS FOLLOWS; R F POWER - HI, TEST-MIKE-RING - MIKE AND LINE LEVEL MID POSITION.
2. RESISTANCE MEASUREMENTS ARE IN OHMS, AND WERE TAKEN WITH THE TRANSMITTER DISCONNECTED FROM ALL OTHER COMPONENTS.
3. VOLTAGE MEASUREMENTS WERE MADE WITH A TWENTY THOUSAND OHMS PER VOLT METER UNLESS OTHERWISE SPECIFIED. * INDICATES MEASUREMENTS MADE WITH A VTVM.
4. VOLTAGE MEASUREMENTS ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED. ** INDICATES VOLTAGES WHICH ARE A-C WHEN THE SOURCE OF PRIMARY POWER IS A-C, AND D-C WHEN THE SOURCE OF PRIMARY POWER IS D-C.
5. BECAUSE OF THE INACCESSIBILITY OF XV209, ALL READINGS ON V209 WERE TAKEN FROM THE TOP OF THE TUBE SOCKET WITH THE TUBE REMOVED.
6. READINGS MADE ON GERMANIUM DIODE CR201 CIRCUIT ARE INCONCLUSIVE.
7. TEST POINT IS LOCATED AT THE TOP OF THE R-F SLUG RACK CHASSIS.
8. SOME MEASUREMENTS DIFFER BETWEEN CERTAIN GROUPS OF TRANSMITTERS; SEE FIELD MAINTENANCE CHAPTER.

TM 614-407



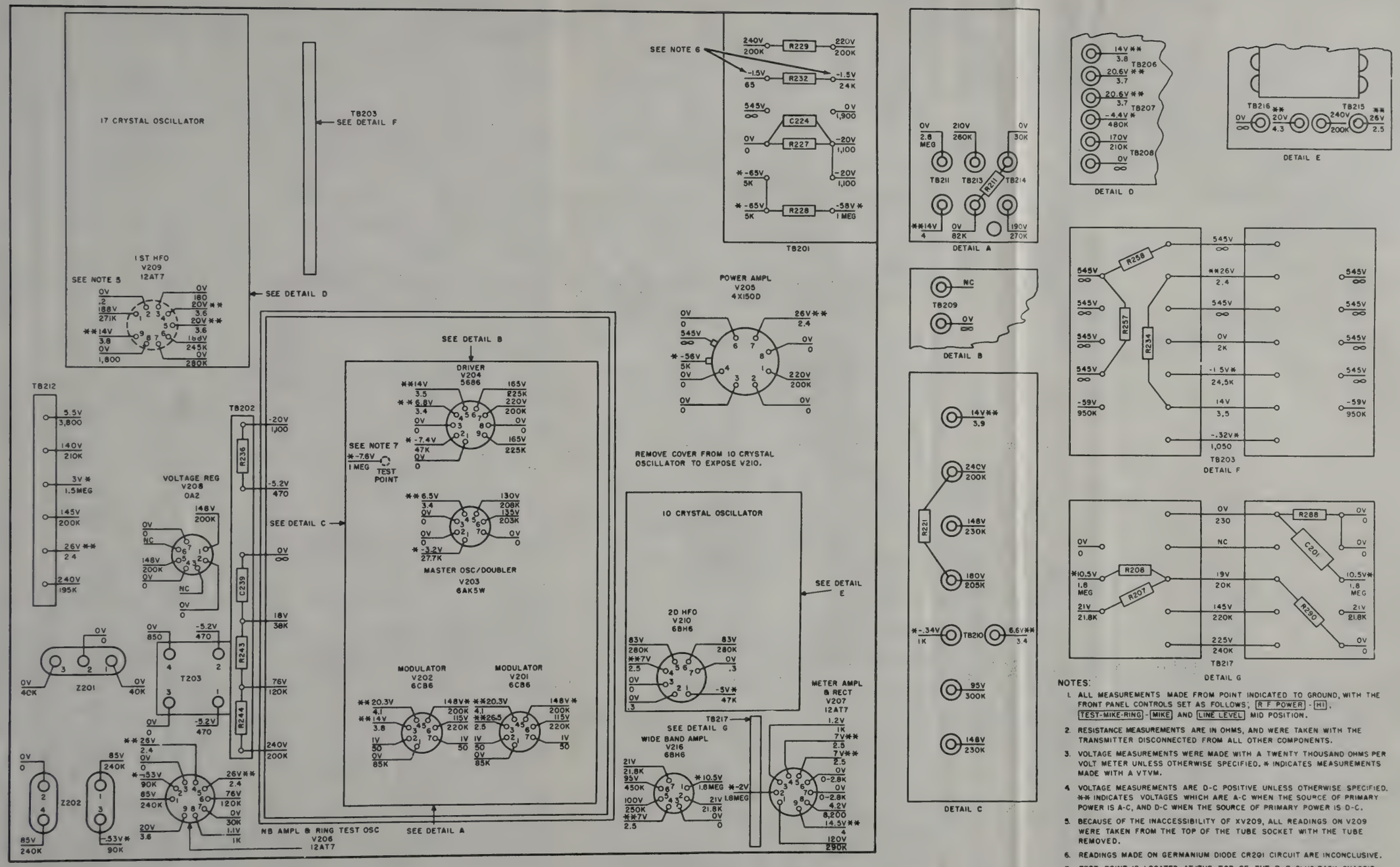
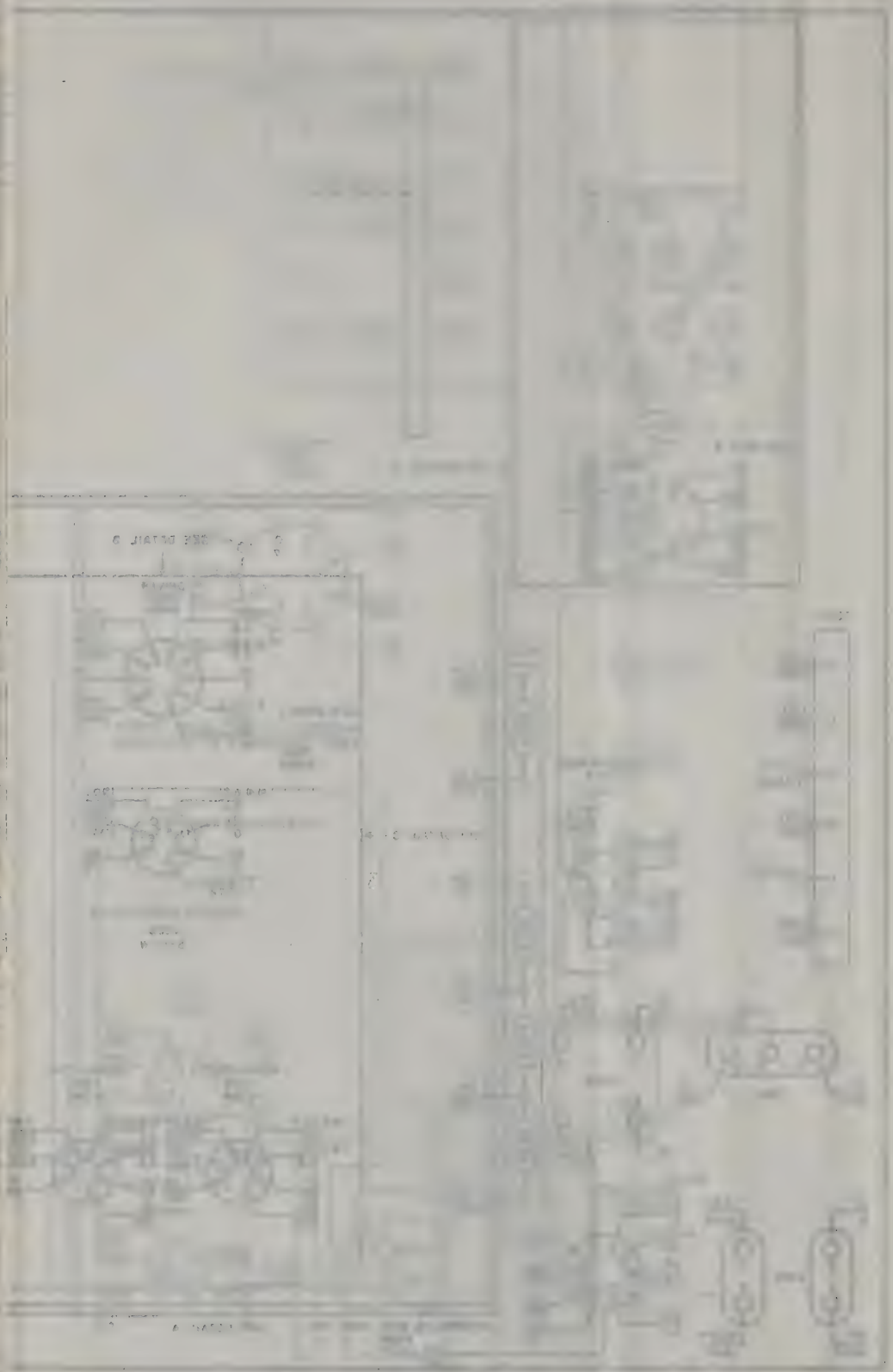


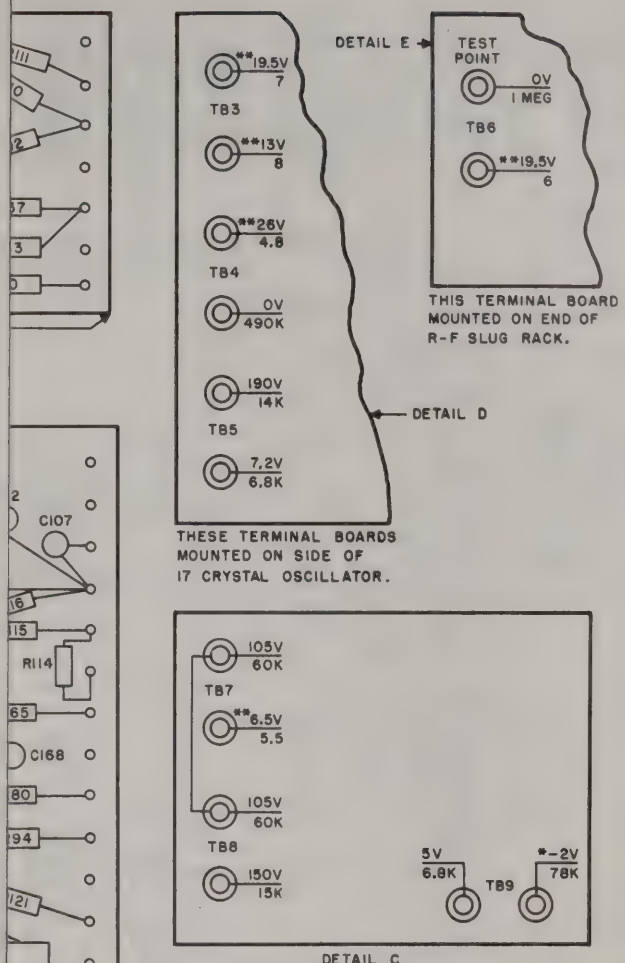
Figure 169. Voltage ana resistance charts, transmitter main chassis.

NOTES:

1. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND, WITH THE FRONT PANEL CONTROLS SET AS FOLLOWS; R F POWER - HI, TEST-MIKE-RING - MIKE AND LINE LEVEL MID POSITION.
2. RESISTANCE MEASUREMENTS ARE IN OHMS, AND WERE TAKEN WITH THE TRANSMITTER DISCONNECTED FROM ALL OTHER COMPONENTS.
3. VOLTAGE MEASUREMENTS WERE MADE WITH A TWENTY THOUSAND OHMS PER VOLT METER UNLESS OTHERWISE SPECIFIED. * INDICATES MEASUREMENTS MADE WITH A VTVM.
4. VOLTAGE MEASUREMENTS ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED. ** INDICATES VOLTAGES WHICH ARE A-C WHEN THE SOURCE OF PRIMARY POWER IS A-C, AND D-C WHEN THE SOURCE OF PRIMARY POWER IS D-C.
5. BECAUSE OF THE INACCESSIBILITY OF XV209, ALL READINGS ON V209 WERE TAKEN FROM THE TOP OF THE TUBE SOCKET WITH THE TUBE REMOVED.
6. READINGS MADE ON GERMANIUM DIODE CR201 CIRCUIT ARE INCONCLUSIVE.
7. TEST POINT IS LOCATED AT THE TOP OF THE R-F SLUG RACK CHASSIS.
8. SOME MEASUREMENTS DIFFER BETWEEN CERTAIN GROUPS OF TRANSMITTERS; SEE FIELD MAINTENANCE CHAPTER.

TM 614-407





, ALL READINGS ON VIO WERE TAKEN FROM THE TOP OF THE

ICATED TO GROUND WITH THE FRONT PANEL CONTROLS SET AS
VEL -MAXIMUM CLOCKWISE, SQUELCH - OFF, METER SW - DISC-
ENTY THOUSAND OHMS PER VOLT METER EXCEPT * INDICATES

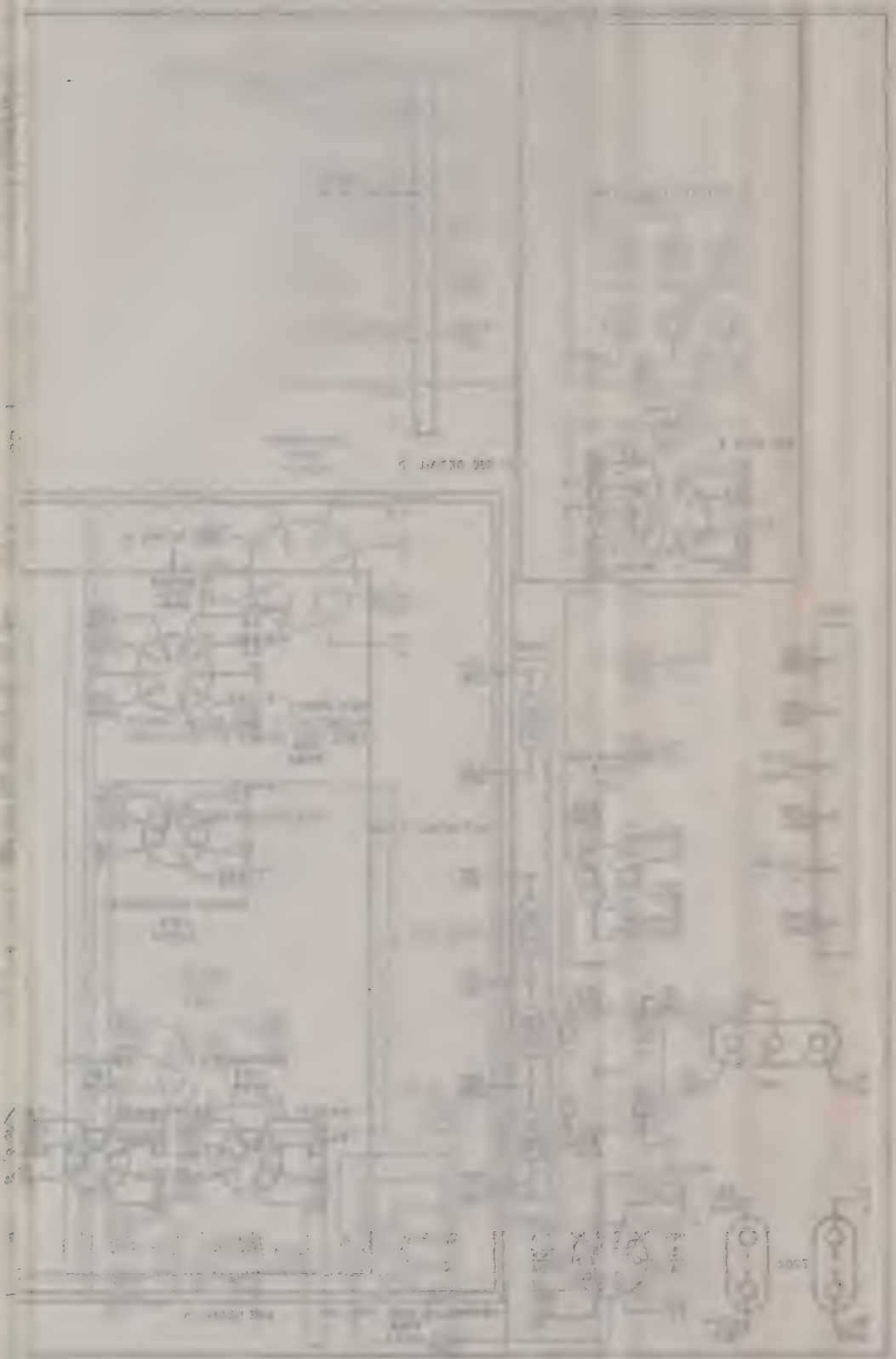
E UNLESS OTHERWISE SPECIFIED. ** INDICATES VOLTAGES WHICH
POWER IS A-C, AND D-C WHEN SOURCE OF PRIMARY POWER IS D-C.

IGNAL.

OHMS, AND MADE WITH THE RECEIVER DISCONNECTED FROM ALL

SET CONTROL.

IN GROUPS OF RECEIVERS; SEE FIELD MAINTENANCE CHAPTER.



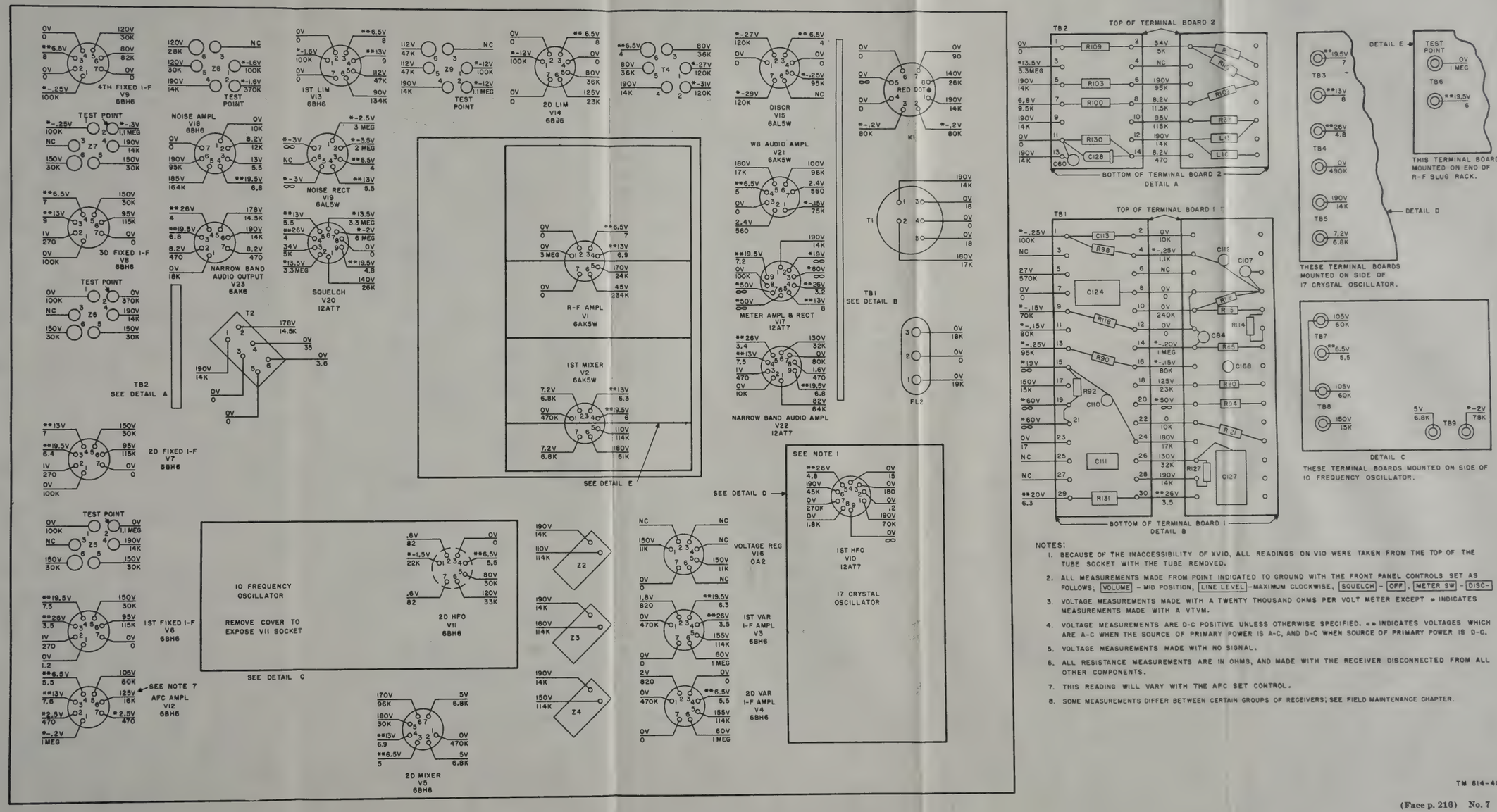
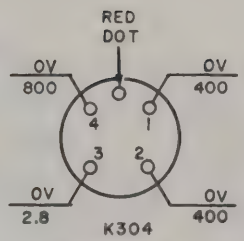


Figure 170. Voltage and resistance charts, receiver.

NOTES:

1. BECAUSE OF THE INACCESSIBILITY OF XV10, ALL READINGS ON V10 WERE TAKEN FROM THE TOP OF THE TUBE SOCKET WITH THE TUBE REMOVED.
2. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND WITH THE FRONT PANEL CONTROLS SET AS FOLLOWS; VOLUME - MID POSITION, LINE LEVEL - MAXIMUM CLOCKWISE, SQUELCH - OFF, METER SW - DISC-
3. VOLTAGE MEASUREMENTS MADE WITH A TWENTY THOUSAND OHMS PER VOLT METER EXCEPT * INDICATES MEASUREMENTS MADE WITH A VTVM.
4. VOLTAGE MEASUREMENTS ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED. ** INDICATES VOLTAGES WHICH ARE A-C WHEN THE SOURCE OF PRIMARY POWER IS A-C, AND D-C WHEN SOURCE OF PRIMARY POWER IS D-C.
5. VOLTAGE MEASUREMENTS MADE WITH NO SIGNAL.
6. ALL RESISTANCE MEASUREMENTS ARE IN OHMS, AND MADE WITH THE RECEIVER DISCONNECTED FROM ALL OTHER COMPONENTS.
7. THIS READING WILL VARY WITH THE AFC SET CONTROL.
8. SOME MEASUREMENTS DIFFER BETWEEN CERTAIN GROUPS OF RECEIVERS; SEE FIELD MAINTENANCE CHAPTER.





DETAIL A

NOTES:

1. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND UNLESS OTHERWISE SHOWN.

2. RESISTANCE MEASUREMENTS ARE IN OHMS AND MADE WITH THE POWER SUPPLY DISCONNECTED FROM THE OTHER COMPONENTS AND THE POWER SOURCE.

3. ALL VOLTAGE MEASUREMENTS MADE WITH A 20,000 OHMS PER VOLT METER, AND ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED.
   * INDICATES A-C VOLTAGE.

4. ALL VOLTAGE MEASUREMENTS MADE WITH THE POWER SUPPLY OPERATING UNDER FULL LOAD AND CONNECTED TO A POWER SOURCE OF 115V A-C.

TM 614-127



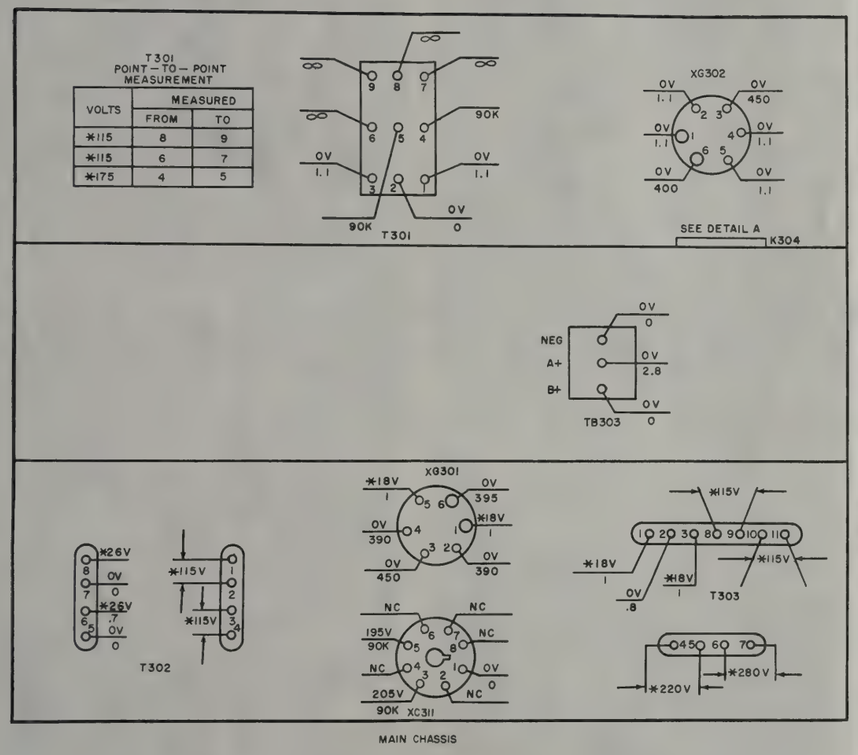
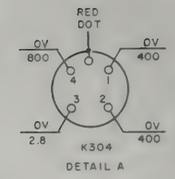


Figure 171. Voltage and resistance charts, power supply.

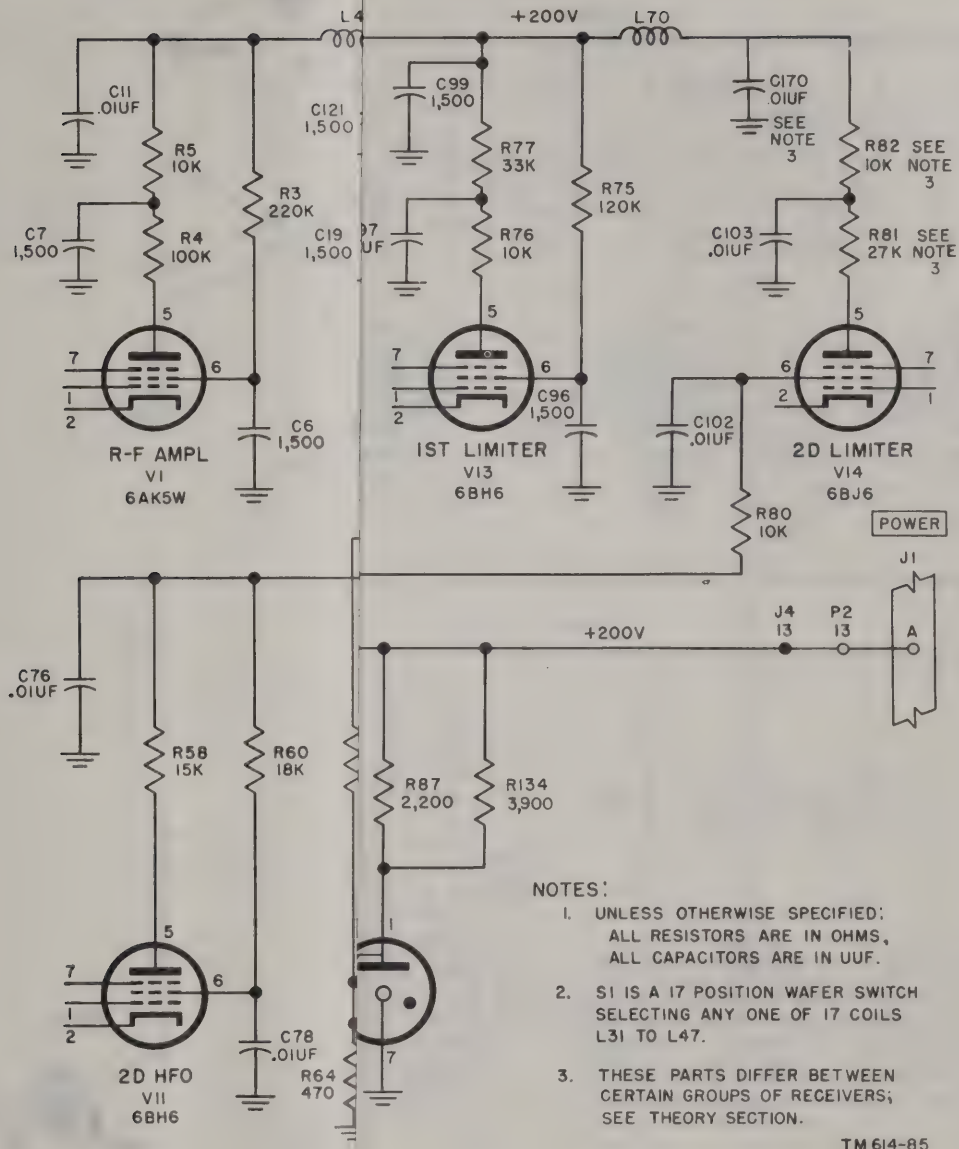


NOTES:

1. ALL MEASUREMENTS MADE FROM POINT INDICATED TO GROUND UNLESS OTHERWISE SHOWN.
2. RESISTANCE MEASUREMENTS ARE IN OHMS AND MADE WITH THE POWER SUPPLY DISCONNECTED FROM THE OTHER COMPONENTS AND THE POWER SOURCE.
3. ALL VOLTAGE MEASUREMENTS MADE WITH A 20,000 OHMS PER VOLT METER, AND ARE D-C POSITIVE UNLESS OTHERWISE SPECIFIED. * INDICATES A-C VOLTAGE.
4. ALL VOLTAGE MEASUREMENTS MADE WITH THE POWER SUPPLY OPERATING UNDER FULL LOAD AND CONNECTED TO A POWER SOURCE OF 115V A-C.

TM 614-127





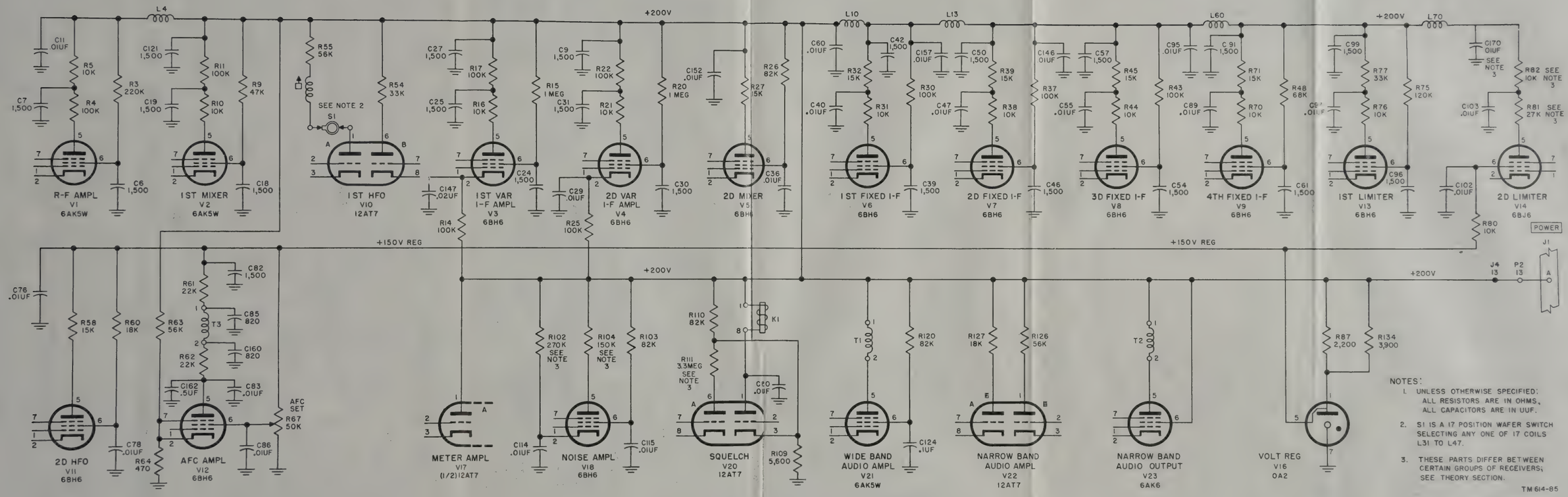
NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. S1 IS A 17 POSITION WAFER SWITCH SELECTING ANY ONE OF 17 COILS L31 TO L47.
3. THESE PARTS DIFFER BETWEEN CERTAIN GROUPS OF RECEIVERS; SEE THEORY SECTION.

TM 614-85

(Face p. 216) No. 9





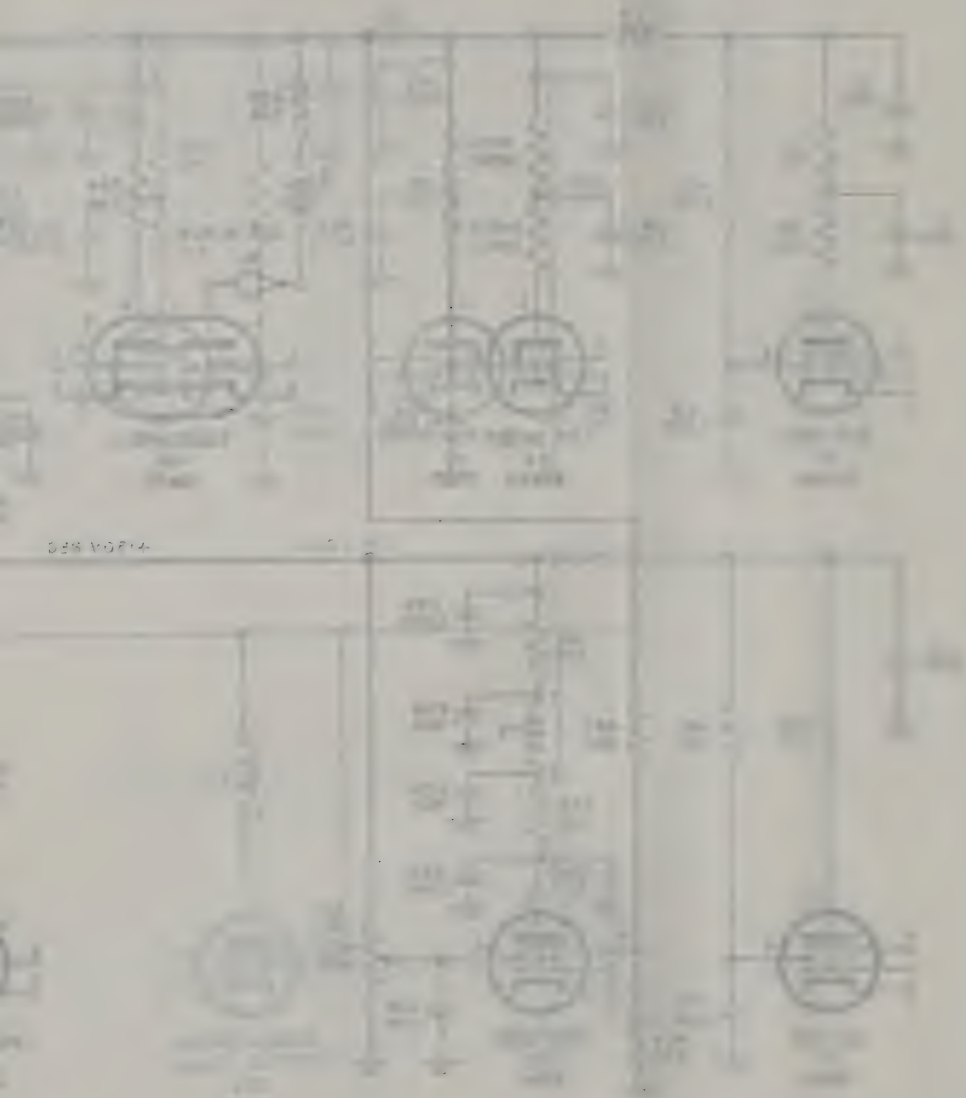
NOTES:

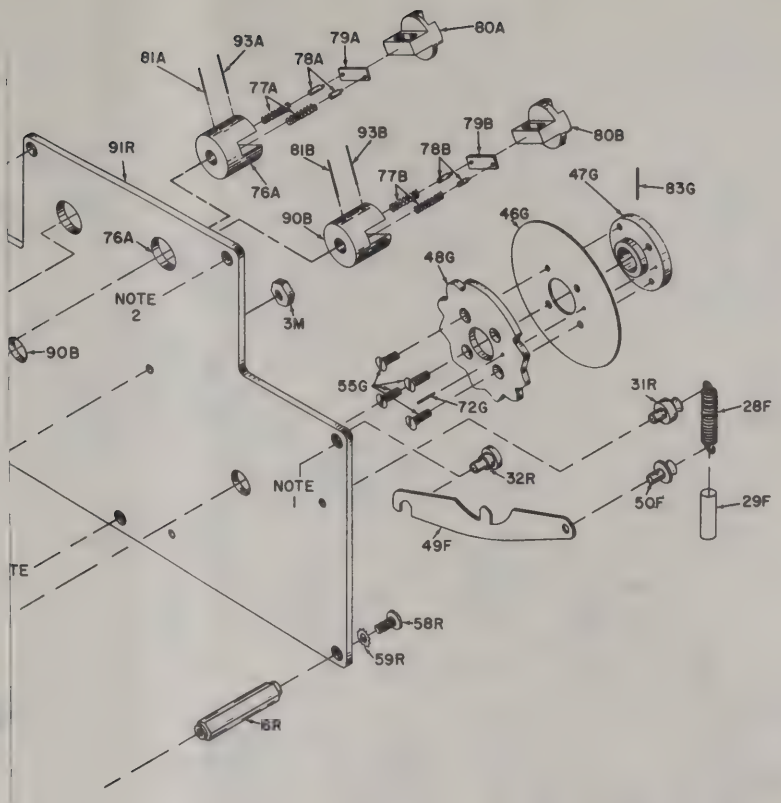
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF.
2. S1 IS A 17 POSITION WAFER SWITCH SELECTING ANY ONE OF 17 COILS L31 TO L47.
3. THESE PARTS DIFFER BETWEEN CERTAIN GROUPS OF RECEIVERS; SEE THEORY SECTION.

TM 614-85

Figure 172. Radio Receiver R-125/GRC-10, B+ distribution.

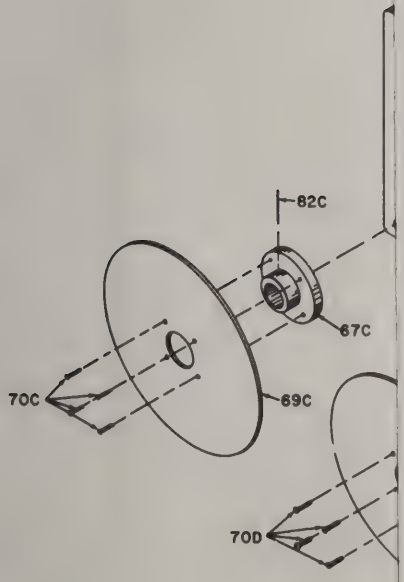
(Face p. 216) No. 9

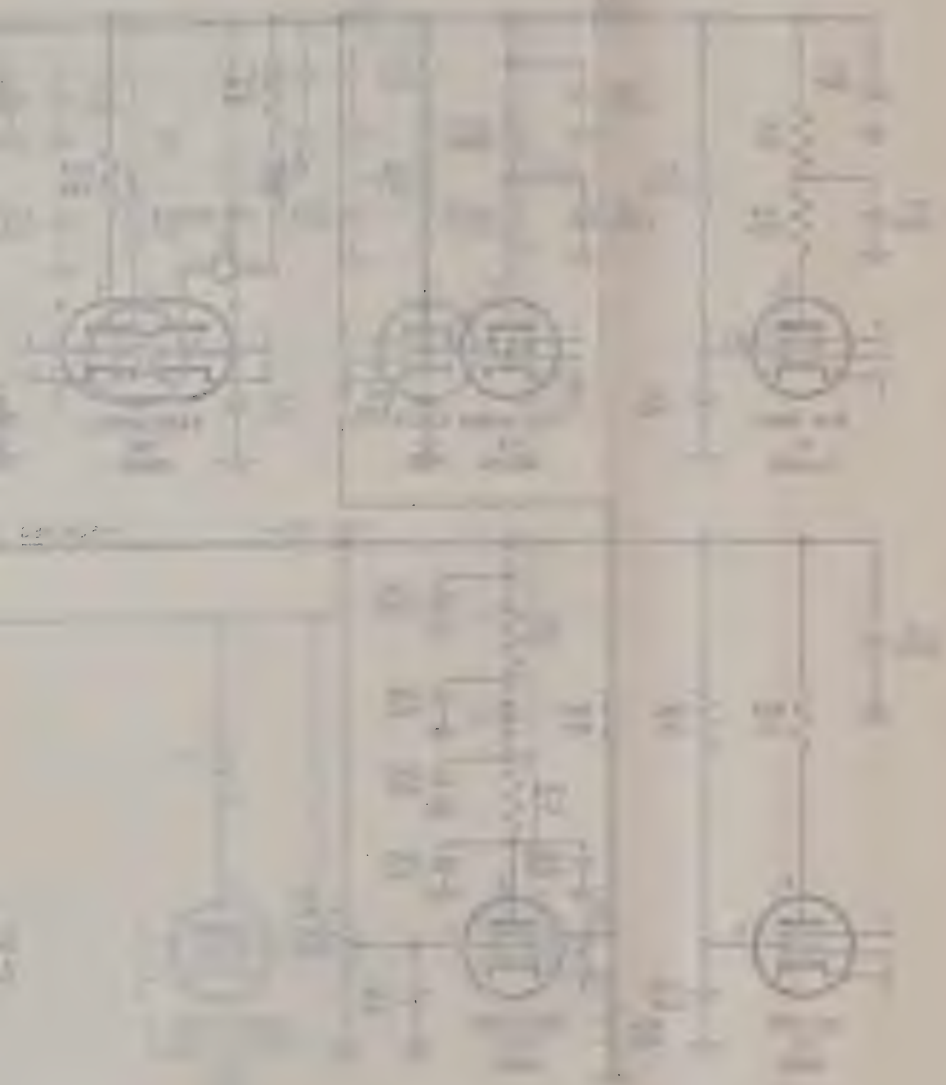




NOTES:

1. A SPACER POST TYPE 7R MATES WITH FRONT AND REAR MOUNTING PLATES.
2. A SPACER POST TYPE 6R MATES WITH FRONT AND REAR MOUNTING PLATES.
3. BALL RACE 52S AND 52P FILLED WITH GREASE MIL. G-7118.





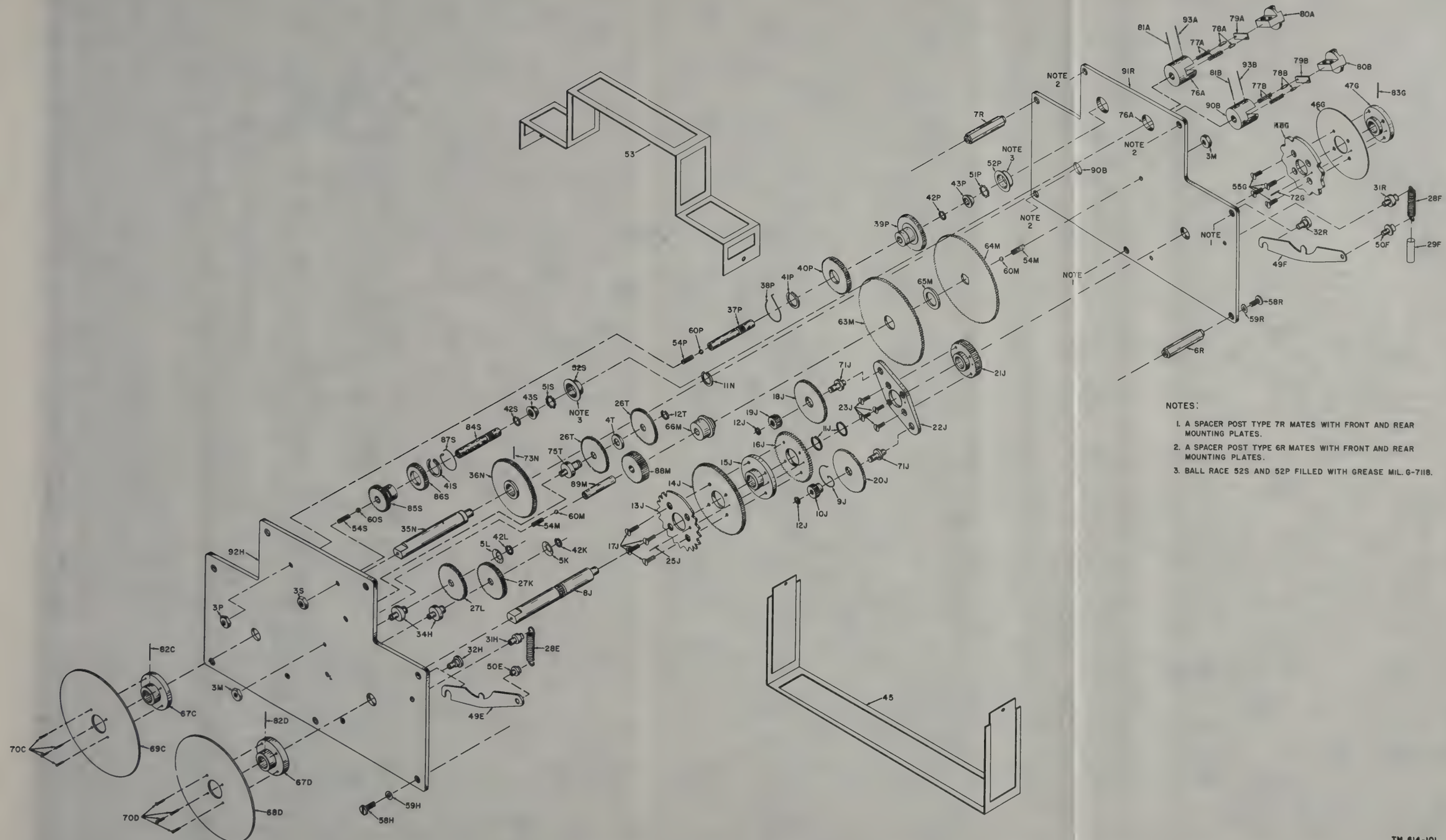
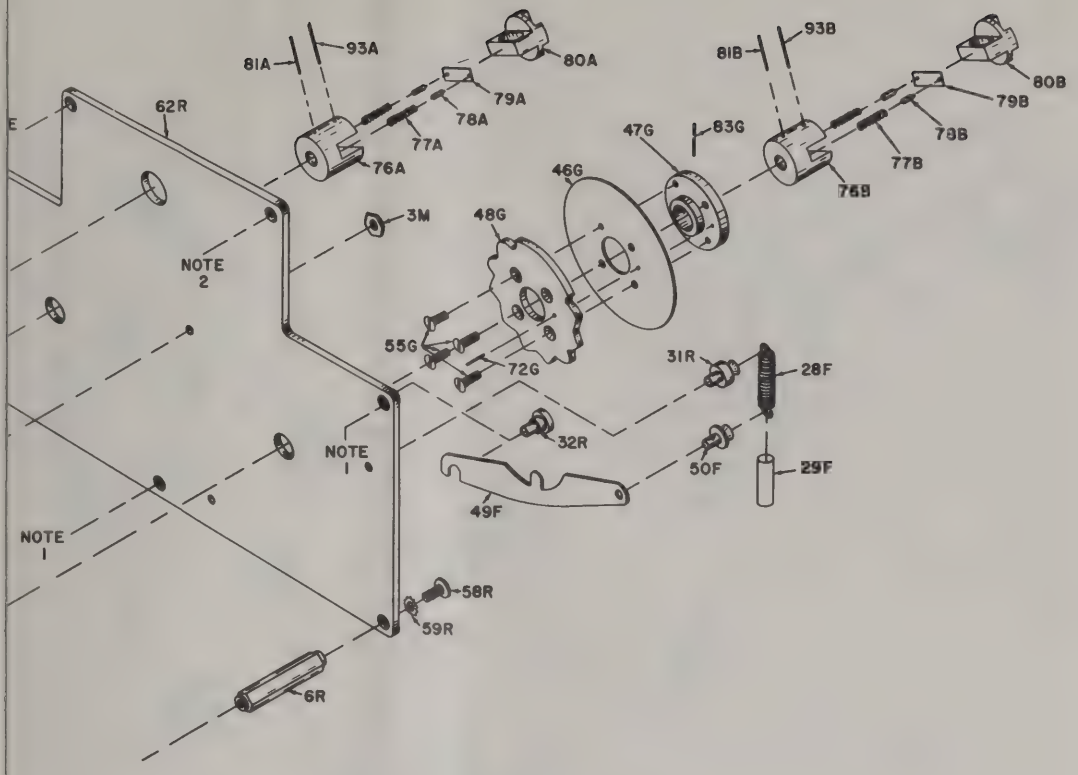


Figure 173. Transmitter gear train, exploded view.





NOTES:

1. SPACER POST TYPE 7R MATES WITH FRONT AND REAR MOUNTING PLATES.
2. SPACER POST TYPE 6R MATES WITH FRONT AND REAR MOUNTING PLATES.
3. BALL RACE 52S AND 52P FILLED WITH GREASE MIL. G-7118.



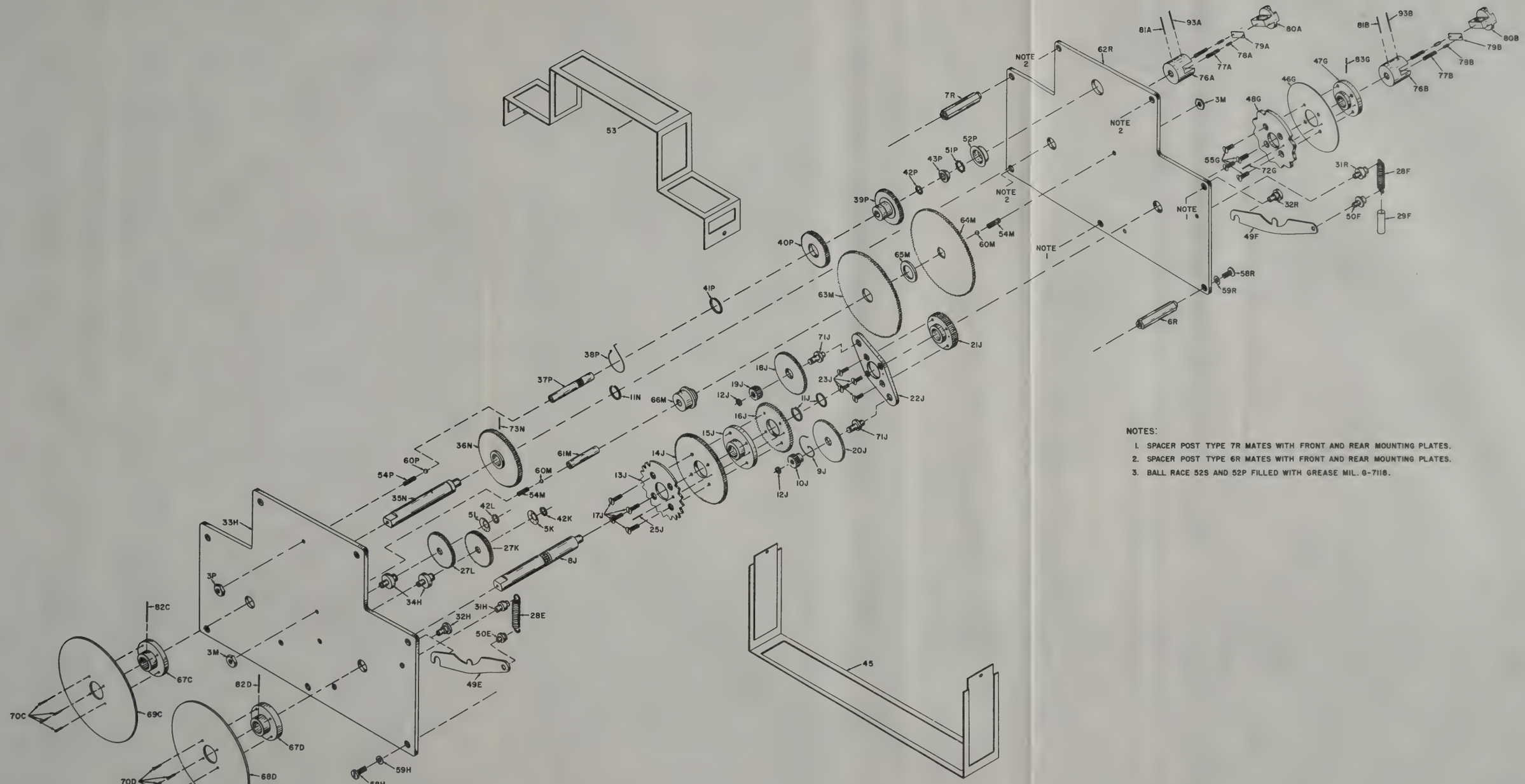
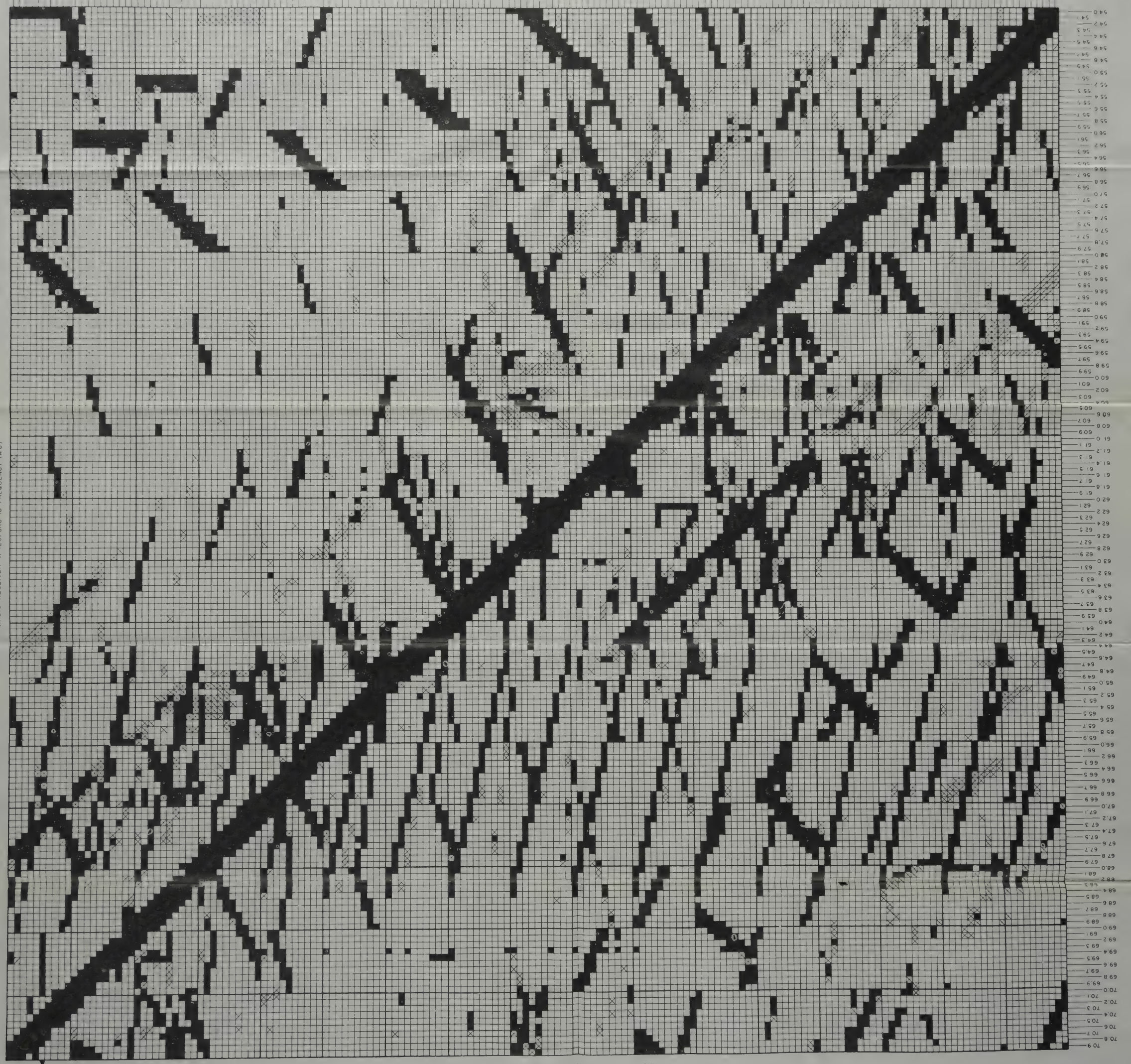


Figure 174. Receiver gear train, exploded view.




RADIO RECEIVER R-125/GRC-10 FREQUENCY (MC)
RADIO TRANSMITTER T-235/GRC-10 FREQUENCY (MC)
TM 614-9

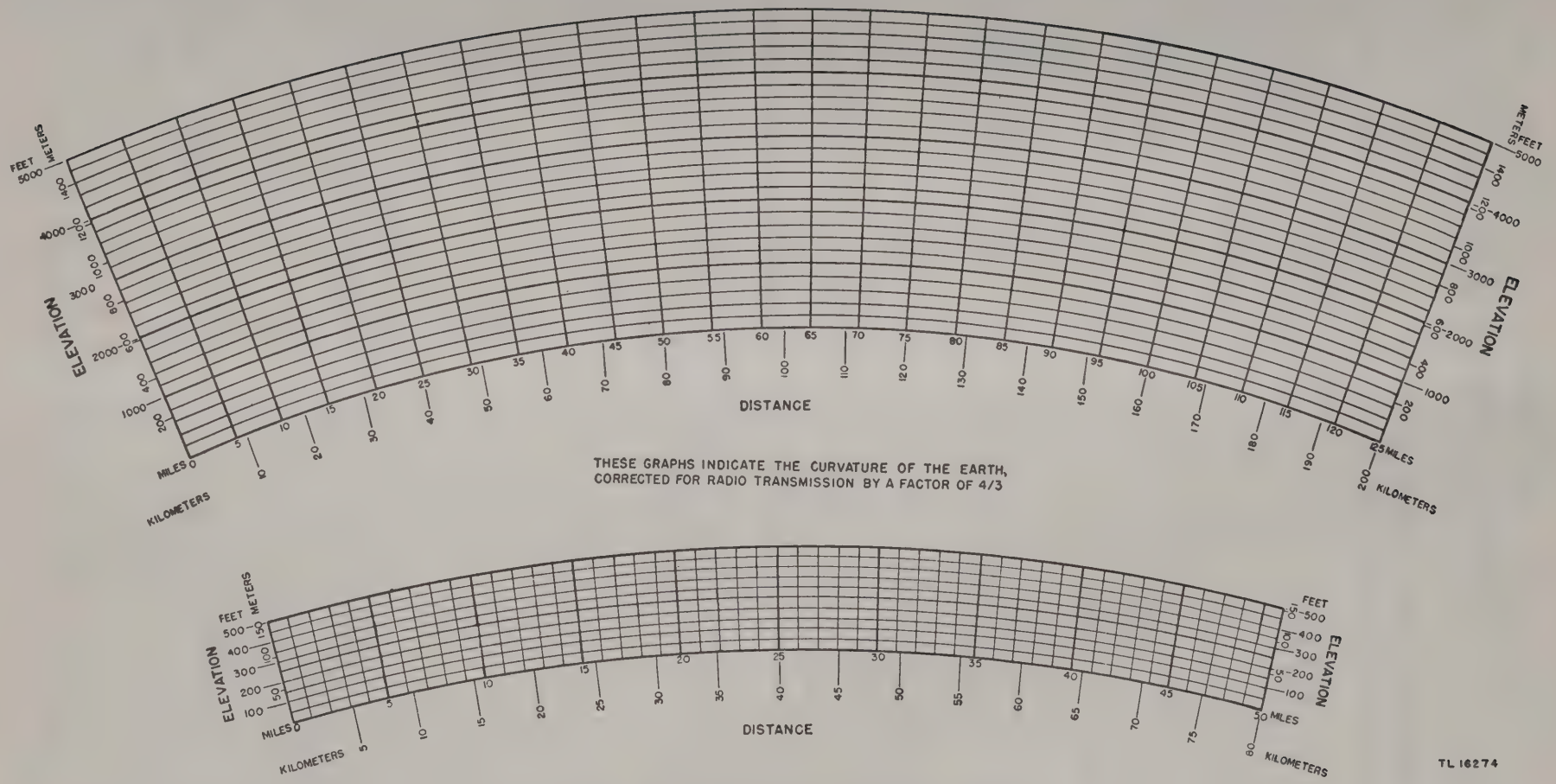


Figure 176. Typical graphs for plotting profiles.

APPENDIX

TABLES OF COMPONENTS

1. Tables of Components, Radio Set AN/GRC–10

a. The components (fig. 13) of Radio Set AN/GRC–10 (less Antenna Group OA–249/GRC–10) are listed below:

Component	Quantity	Height (in.)	Depth (in.)	Length (in.)	Volume (cu in.)	Weight (lb)
Radio Receiver R–125/GRC–10	1	9¼	13	11¼	1, 353	31. 00
Radio Transmitter T–235/GRC–10	1	9¼	13	11¼	1, 353	34. 50
Dynamotor-Power Supply DY–94/GRC–10	1	9¼	13	11¼	1, 353	59. 50
Radio Set Control C–632/GRC–10	1	4	13	18	936	18. 00
Electrical Equipment Rack MT–700/GRC–10	1	5	12½	33⅝	2, 101	33. 00
Special Purpose Cable Assembly CX–2324/U	5			*3⅝		3. 50
Loudspeaker LS–166/U	1	5	3⅛	5	78	4. 00
Special Purpose Cable Assembly CX–2325/U	1			* 241½		6. 00
Handset H–33/PT	1	1½	3¼	8⅜	41	. 88
Accessories Case CY–1097/GRC–10	1	4⅛	8⅝	14⅝	520	3. 25
Running spare parts kit, Radio Receiver R–125/GRC–10	1	10⅛	12⅞	3¾	489	1. 00
Running spare parts kit, Radio Transmitter T–235/GRC–10	1	10⅛	12⅞	3¾	489	1. 00
Running spare parts kit, Dynamotor-Power Supply DY–94/GRC–10.	1	10⅛	12⅞	3¾	489	1. 00
Running spare parts kit, Radio Set Control C–632/GRC–10	1	4⅝	14	3⅝	235	. 75
Technical manuals for Radio Set AN/GRC–10	2	2	11	8½	70	3. 00
Total						199. 50

*Measured from center to center of cable connectors.

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisitioning of spare parts.

b. The components of Antenna Group OA–249/GRC–10 are listed in the following tables.

(1) Components for two arrays, Antenna AS–620/GRC–10 (fig. 14), are contained in one antenna case and in Bag BG–102–A tabulated below.

Component	Number reqd	Quantity	Length (in.)	Width (in.)	Depth (in.)	Weight (lb)
Antenna Case CY–1252/GR contains the following		1	61⅝	11¼	10½	44. 00
Boom and block subassembly	1	2	59¾	5	5¾	7. 13
Radiator element	2	4	53	3⅝	1	1. 00
Master Adapter MX–1463/G	1	2	9⅜	3	3	1. 00
Frequency-setting chart	1	2	5½	3⅞	1/16	. 06
Spares in antenna case lid:						
Radiator element		2	53	3⅝	1	1. 00
Director element (red)		2	51½	2⅛	1	. 50
Reflector element (blue)		2	58½	2⅛	1	. 63
Receptacle Connector UG–568/U		2	2 1/16	1	1	. 06
Bag BG–102–A contains the following		1	14	10	12	1. 18
Rf Cable Assembly CG–718/U (65 feet)	1	2	780	¾	¾	6. 37
Rf Cable Assembly CG–718/U (35 feet)	1	2	420	¾	¾	4. 00
Ground plate adapter		1	10	3	3	1. 00
In zipper pocket:						
Adapter Connector UG–567/U	1	4	1 17/32	1 5/32	¾	. 15
Roll tape	1	2	½	5	5	. 25
Frequency-setting chart	1	4	5½	3⅞	1/16	. 06
Adapter Connector UG–643/U	1	4	1 3/32	¾	¾	. 06
Total						68. 45

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisitioning of spare parts.

(2) Components for the two Masts AB–301/G (fig. 15) are contained in four carrying bags. Parts for one mast are contained in a set of one Mast Section Cover CW–294/U and one Bag BG–102–A. The carrying bags are packed as shown in the following table:

Component	Number reqd for 1 mast	Quantity	Length (in.)	Width (in.)	Depth (in.)	Weight (lb)
Two Mast Section Covers CW–294/U that contain the following in each	1	2	67	7	9	6. 25
Mast Section AB–300/G	10	10	66	1⅝	1⅝	3. 50
Guy Stake GP–111/G	4	5	18½	1¼	1¼	2. 25
Two Bags BG–102–A that contain the following in each	1	2	14	10	12	2. 14
Guy MX–1469/G (52 ft)	4	5	600	1½	1	. 69
Guy MX–1469/G (44 ft)	4	5	480	1½	1	. 56
Guy MX–1469/G (34 ft)	4	5	372	1½	1	. 50
Rope assembly (25 ft)	1	1	240	1¾	1	1. 00
Mast Base AB–318/U	1	2	20	8	2⅞	1. 50
Hammer HM–1, 2 lb	1	1	15	4½	1¾	3. 00
In the zipper pocket:						
Gin pole cap assembly	1	1	7¼	3	¾	. 13
Guy Plate MX–1468/G	3	4	4⅜	3 1/16	15/16	. 25
Mast base plate	1	1	6	6	⅛	. 25
Total						22. 02

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisitioning of spare parts.

2. Table of Components, Radio Terminal Set AN/GRC–39

The components of Radio Terminal Set AN/GRC–39 (fig. 6) are listed below:

Component	Quantity	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. in.)	Weight (lb.)
Radio Set AN/GRC–10	2		See paragraph 1			
Dynamic Loudspeaker LS–166/U	1		See paragraph 1			
Power Unit PE–75	2	24½	19	36	16, 758	298. 00
Junction Box J–85/G	1	4	5½	5	110	9. 00
Junction Box JB–110	1	2	4½	12½	112. 5	6. 00
Telephone Cable Assembly CX–1512/U	1			144		5. 50
Cord CD–711	1			600		8. 00

3. Table of Components, Radio Relay Set AN/GRC–40

The components of Radio Relay Set AN/GRC–40 (fig. 4) are listed below:

Component	Quantity	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. in.)	Weight (lb.)
Radio Set AN/GRC–10	3		See paragraph 1			
Dynamic Loudspeaker LS–166/U			See paragraph 1			
Power Unit PE–75	2	24½	19	36	16, 758	298. 00
Junction Box J–85/G	1	4	5½	5		9. 00
Junction Box JB–110	1	2	4½	12. 5	112. 5	6. 00
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For explanation of abbreviations used, see SR 320–50–1.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1964 O - 723-933