CHAPTER 3

TROUBLESHOOTING

Section I. PREVENTIVE MAINTENANCE

26. 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 troubleshooting and repair in that its object is to prevent certain troubles from occurring.

27. General Preventive Maintenance Techniques

a. Use No.0000 sandpaper to remove corrosion.

b. Use a clean, dry lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts with a dry cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Be sure adequate ventilation is provided. Do not use carbon tetrachloride on polyvinyl insulation; it is a solvent for this resin.

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.

d. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.

28. Use of Preventive Maintenance Form (fig. 26)

a. The decision as to which items on DA Form 11–239 are applicable 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 the form appear on the reverse side of the form.

b. Circled items on figure 26 are partially or totally applicable to Radio Sets AN/PRC–8, –9, and –10. References in the ITEM block are to paragraphs that contain additional detailed information.

29. Performing Exterior Preventive Maintenance

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

a. Check for completeness of equipment, spare parts, technical manuals, and accessories.

b. Check for suitable location and correct installation of the radio set.

c. Remove dirt and moisture from the antenna, handset, and connectors (fig. 1).

d. Inspect TUNING control, VOL control, SQUELCH control, and POWER switch (fig. 3) for binding, scraping, excessive looseness, and for positive action.

e. Check for normal operation. Refer to TM 11–612.

f. Clean the radio set, including antenna mount and cable connections.

g. Inspect the cases, antenna, and all exposed metal surfaces for rust, corrosion, and moisture.

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; (X) 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).* FIG. 1	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. TM 11-612	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 29 c	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 30 a	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 29 d	
6	CHECK FOR NORMAL OPERATION. PAR. 29 e	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. FIG. 1	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. FIG. 1	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. FIG. 1	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. FIG. 1	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. FIG. 1	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES.	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR. 29 k	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 29 l	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
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. 30 b	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 30 c	
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. PAR. 30 d	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR. 30 e	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. FIGS. 30 AND 31	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. FIGS. 30 AND 31	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 30 h	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. FIGS. 30 AND 31	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR. 30 j	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES. PAR. 30 k	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS. FIG. 19	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS. FIGS. 30 AND 31	
37	MOISTURE AND FUNGIPROOF. TM 11-612	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 30 o	

DA FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 26—16—64382-1

TM4065-13

Figure 26. DA Form 11-239.

h. Inspect the handset cable for cuts, breaks, raying, deterioration, kinks, and strain.

i. Inspect the antenna for eccentricities, corosion, loose fit, and damaged insulators.

j. Inspect canvas items and cables for milew, tears, and fraying.

k. When the radio set is used in a vehicle nd is powered by Amplifier-Power Supply AM–598/U, inspect vehicular storage battery or dirt, loose terminals, electrolyte level, speific gravity, and a damaged case.

l. Clean dial window (fig. 3).

m. Inspect shelters and covers for adequacy f weatherproofing.

n. If deficiencies noted are not corrected durng inspection, indicate action taken for corection.

0. Performing Interior Preventive Maintenance

Caution: Disconnect all power before perorming the following operations. Upon comletion, reconnect power and check for satisactory operation. For operating instructions, efer to TM 11–612.

a. Inspect seating of readily accessible pluckut items: tubes, plug-in cans, and crystals figs. 30 and 31).

b. Inspect electron tubes for loose envelopes, racked sockets, insufficient socket spring tenion, and emission. Remove dust and dirt from ube pins and sockets.

c. Inspect fixed capacitors for leaks, bulges, and discoloration (figs. 30 and 31).

d. Inspect relay K1 (fig. 30) and relay K2 (fig. 31) for loose mountings, burned, pitted, or corroded contacts, misalined contacts, and insufficient spring tension.

e. Inspect TUNING capacitor C9 (fig. 31) for dirt, moisture, misalinement of plates, and loose mountings.

f. Inspect resistors, bushings, and insulators for cracks, chipping, blistering, discoloration, and moisture.

g. Inspect terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts.

h. Clean and tighten subchassis and terminal blocks within each subchassis (figs. 38 through 44).

i. Inspect terminal blocks for loose connections, cracks, and breaks.

j. Lubricate equipment as specified in paragraph 66.

k. Remove batteries from battery case before shipping or storing.

l. Check batteries for low voltage.

m. Inspect for leaking waterproof gaskets and worn or loose parts.

n. Inspect moistureproofing and fungiproofing.

o. If deficiencies noted are not corrected during inspection, indicate action taken for correction.

Section II. PRELIMINARY TROUBLESHOOTING INFORMATION

31. General

The first step in servicing a defective radio et is to sectionalize the fault. Sectionalization neans tracing the fault to the circuit respon- ible for the abnormal operation of the set. The second step is to localize the fault. Locali- ation means tracing the fault to the defec- ive part responsible for the abnormal condi- ion. Some faults, such as burned-out resistors, f arcing, and shorted transformers, often can e located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltage and resistance.

32. Component Sectionalization and Localization

The tests listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Servicing procedure should cause no further damage to the receiver. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The servicing procedure is summarized as follows:

a. Inspection. The purpose of an inspection

is to locate any visible trouble. Through this inspection alone, the repairman may frequently discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the receiver which might occur through improper servicing methods and in forestalling future failures.

b. Leakage Checks. These measurements (par. 38) prevent further damage to the radio set from possible short circuits. Since this test gives an indication of the condition of the filter circuits, it may help also to locate the fault.

c. Troubleshooting Chart. The trouble symptoms listed in this chart (par. 40) are useful in localizing common troubles.

d. Individual Stage Checks. Individual stage checks (pars. 41–53) utilize the signal substitution method, voltage and resistance measurements, and any other special checks that are indicated for a specific circuit. This procedure is used to locate the stage in which the trouble exists and then to locate the defective component.

e. Stage Gain Charts. These charts (pars. 54–58) are used to locate defects that reduce the sensitivity of the set but do not make it inoperative.

f. Intermittents. Intermittents are troubles that appear and disappear at different times. If present, this type of trouble may be located by tapping or jarring the radio set. This trouble may be due to poor cable conditions or to external conditions.

33. Figure Reference

The following list of figures is useful in troubleshooting:

Fig.	Title
51	Radio Set AN/PRC–8, schematic diagram.
52	Radio Set AN/PRC–9, schematic diagram.
53, 54	Radio Set AN/PRC–10, schematic diagram.
2	Radio receiver-transmitter, block diagram.
21	Control circuits.
23	Relay circuit.
28	Voltage and resistance measurements, bottom and rear of chassis.
29	Voltage and resistance measurements, top and front of chassis.
9	Discriminator frequency response curve.
25	Handset H–33/PT schematic diagram.
30	Top view of receiver-transmitter chassis.
31	Bottom view of receiver-transmitter chassis.
39	First rf box, inside view.
40	Second rf box, inside view.
41	Receiver oscillator box, inside view.
42	Transmitter oscillator box, inside view.
43	Mixer box, inside view.
44	Afc box, inside view.
37	Vacuum tubes and if. and discriminator cans.
38	If. shelf with shield removed.
19	Battery BA–279/U, schematic diagram.
20	Battery and receiver-transmitter cases, separated.
49	Resistor color codes.
50	Capacitor color codes.

34. Required Test Equipment

The test equipment required for use with Radio Sets AN/PRC–8, –9, and –10, is listed below.

Test equipment	Common name	Technical manual
Audio Oscillator TS–382A/U	Audio oscillator	TM 11–2684A
Signal Generator AN/URM–48	RF signal generator	TM 11–1257
Signal Generator I–208	If. signal generator	TM 11–317
Multimeter TS–352A/U	Multimeter	TM 11–5527
Electronic Multimeter TS–505/U	Vtvm	TM 11–5511
Output Meter TS–585A/U	Output meter	TM 11–5017
RF Wattmeter ME–11/U	Rf wattmeter.	
Frequency Meter TS–174B/U	Frequency meter	TM 11–5044
Battery Tester TS–183/U	Battery tester	TM 11–2571
Electronic Multimeter ME–6A/U	Millivoltmeter	TM 11–5549
Electron Tube Test Set TV–7/U	Tube tester	TM 11–5083

Caution: Flat subminiature tubes that are tested in the flat subminiature sockets of tube testers may be inadvertently inserted in reverse. This places B+ on the filament and causes the tube filament to burn out. To prevent this, always aline the red mark on the tube with the red mark on the tube socket.

35. Unreliability of Oscillator Tube Type 1AD4 in Radio Sets AN/PRC–8 and AN/PRC–10

a. Tube Failure. An undetermined quantity of tubes type 1AD4, manufactured by Ratheon, have a useful life of as little as 10 hours when used as the receiver oscillator (V8) in Radio Sets AN/PRC–8 and AN/PRC–10. These tubes are in lot numbers 202 through 226. Failure of this tube is evidenced by oscillation, interrupted at a low repetition rate resembling motor-boating. This type of failure will not be indicated on a tube tester. Present available information indicates that this phenomenon is the result of grid contamination occasioned by an improper aging processing during manufacture.

b. Replacement. If oscillation of this type occurs, remove the original tube and replace it with a new tube (Sig C stock No. 2J1AD4). When replacing this tube, be sure that the red dot on the tube corresponds to the pimple on the socket.

36. Correction of Defect in Socket of Battery BA–279/U

Note. The procedures below apply to Battery BA–279/U procured on Orders No. 16613–Phila–51, 16517–Phila–51, 14453–Phila–51, and 15609–Phila–51.

a. Reason for Failure of Radio Sets AN/PRC–8, –9, and –10. Reports have indicated operational failure because of intermittent or poor contact between battery plug P1 and the socket of Battery BA–279/U. Investigation discloses that the following factors are primarily responsible for such difficulties.

(1) The jacket socket opening is too small to allow the battery plug to be seated properly in the socket.

(2) The battery socket has sufficient *give* under pressure to prevent proper mating because of inadequate support in the socket well.

b. Corrective Action in Production. These difficulties have been corrected in production on contracts awarded after 21 December 1951 by increasing the diameter of the jacket socket opening from 1¼ inches to 1⅜ inches and by providing improved support in the battery socket well.

c. Corrective Action in Field. Application of either of the following measures will insure proper mating between the plug and the connector, whether or not the battery socket is supported adequately in the socket well:

(1) With a knife or other suitable instrument, cut the top of the battery jacket, at the socket end, free from the sides for a depth of 2 inches to permit that portion of the jacket to be folded back from the socket.

(2) Increase the size of the jacket socket opening to approximately 1⅜ inches in diameter by trimming away a portion of the periphery of the jacket socket opening.

37. Modification Work Orders and Technical Bulletin

The following modification work orders and the technical bulletin, which have been issued for Radio Sets AN/PRC–8, –9, and –10, are to be used to modify all early models that do not incorporate the changes described in these work orders and the bulletin.

a. MWO SIG 11–612–1. Modification of Radio Receiver-Transmitter RT–176/PRC–10 To Prevent the Phenolic Inserts of the Battery Connectors from Separating from the Shells.

b. MWO SIG 11–612–2. Modification of Radio Sets AN/PRC–8, AN/PRC–9, and AN/PRC–10 To Replace Antenna Jacks J1 and J2.

c. MWO SIG 11–612–3. Modification of Radio Sets AN/PRC–8, AN/PRC–9, and AN/PRC–10 To Prevent Damage to the Dial Pointer Adjust Mechanism.

d. MWO SIG 11–612–4. Modification of Radio Sets AN/PRC–8, AN/PRC–9, and AN/PRC–10 To Eliminate Sources of Frequency Drift and To Prevent the Runners from Becoming Disengaged from the Battery Case.

e. MWO SIG 11–612–5. Modification of Radio Sets AN/PRC–8, AN/PRC–9, and AN/

PRC–10 To Permit Use of Tube 1AD4 in the Receiver Local Oscillator (V8) When Tube 5676 Fails.

f. TB 11–4065–1. Instructions for Replacing Tuning Gear Assembly on Variable Tuning Capacitor of Radio Receiver-Transmitters RT–174/PRC–8, RT–175/PRC–9, or RT–176/PRC–10 with an Improved Gear Assembly.

Section IV. TROUBLESHOOTING

38. Leakage Checks

Before making any leakage checks, separate the receiver-transmitter and battery cases, remove battery plug P1 (fig. 20) from the battery, and remove the receiver-transmitter chassis from its case. First release the two snap-catches which fasten the receiver-transmitter case to the battery case, and separate the two cases by a few inches. Then remove the battery plug from the battery socket. Then release the two snap-catches which fasten the front panel of the receiver-transmitter to its case, and remove the receiver-transmitter panel and chassis assembly from its case.

a. Battery Cable. With an ohmmeter, measure the resistance between each pin of plug P1 on the battery cable and each of the remaining pins. Also measure the resistance between each pin of plug P1 and the receiver-transmitter case. Any reading below infinity indicates a defective plug or battery cable.

b. POWER Switch S1.

(1) With the POWER switch at OFF, measure the resistance between pins B, F, and J of connector J5 (fig. 27) and chassis ground. Any reading below infinity indicates a defective switch (or connector J5).

(2) With the POWER switch at OFF, measure the resistance between each of terminals 2, 3, 6, 7, 10, 11, and 12 of POWER switch S1 (fig. 27) and chassis ground. Any reading below infinity indicates a defective switch (or connector J5).

c. B+ Supply Circuits. Measure the resistance between terminals D and E of J5 and chassis ground. Any reading below 50 megohms indicates a defect in the 67.5-volt or the 135-volt supply circuit.

39. Purpose and Use of Troubleshooting Chart

The troubleshooting chart is used to locate trouble in the receiver-transmitter, the battery, or in connections between battery and receiver-transmitter. The radio set is connected as in normal operation, with the receiver-transmitter in its case and connected to the battery case. This chart lists the symptoms obtained by the repairman while making a few simple tests. The chart also indicates how to localize trouble to the audio, if. or rf stages of the radio set. The individual stage checks described in paragraphs 41 through 53 then can be used to supplement this procedure and to locate the defective stage. After the trouble has been localized to a stage or circuit, tube checks and voltage and resistance measurements are used to locate the defective part. Voltage and resistance measurements are shown on figures 28 and 29. When using the troubleshooting chart, perform the steps in the order in which they are given. Correct each defect before proceeding with the next step.

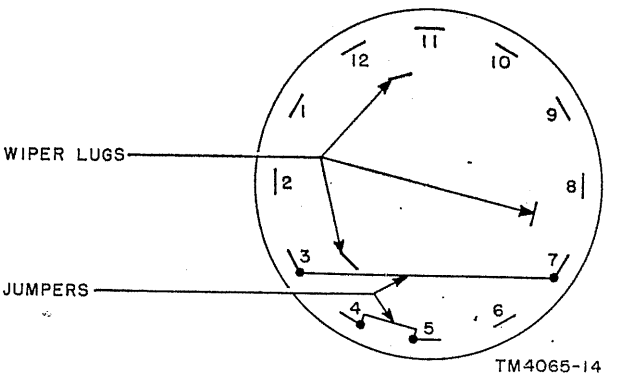
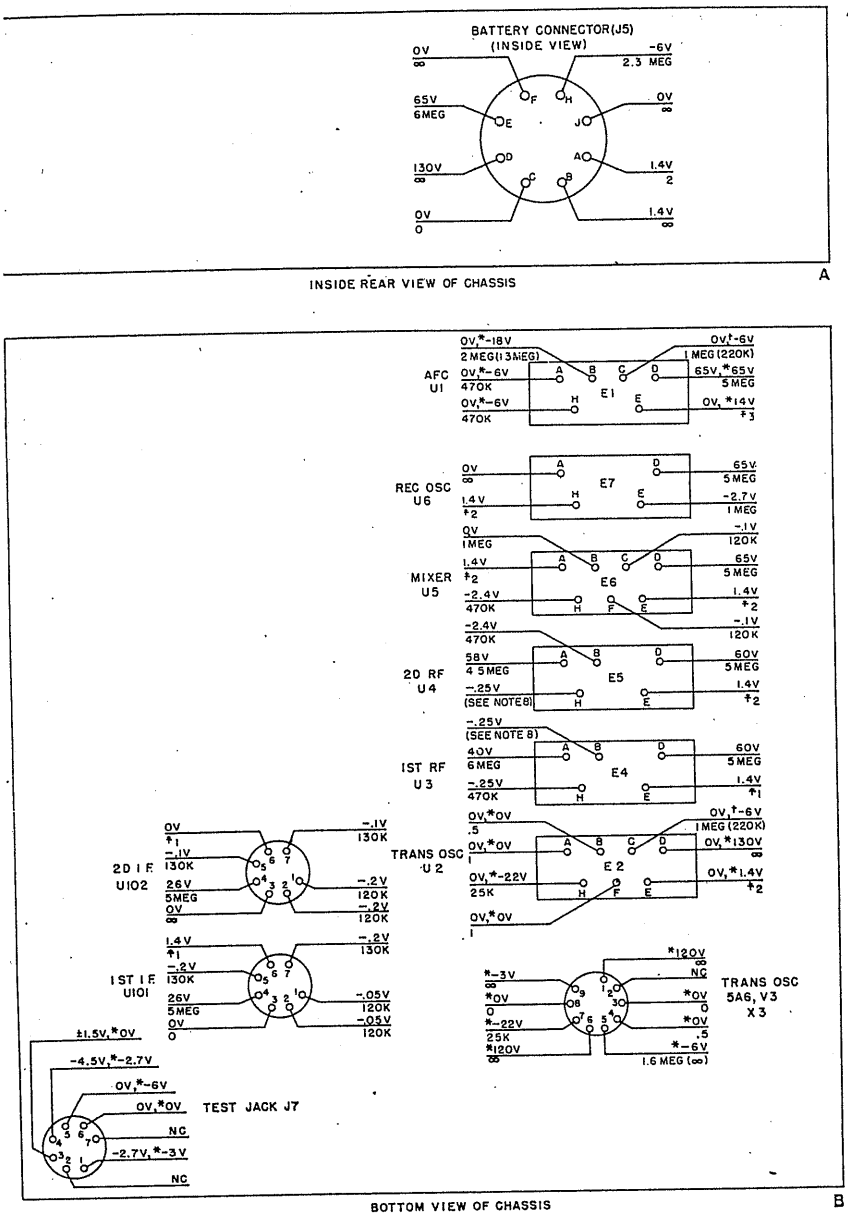


Figure 27. Rear view of terminal locations of power switch S1.



NOTES:

1. ALL VOLTAGES MEASURED WITH VTVM WITH RADIO SET IN RECEIVE CONDITION, POWER SWITCH AT ON, SQUELCH CONTROL AT OFF, VOL CONTROL AT EXTREME CLOCKWISE POSITION, AND HANDSET OUT UNLESS OTHERWISE INDICATED.
2. VALUES BELOW THE LINE ARE IN OHMS MEASURED WITH VTVM WITH BATTERY CABLE OUT, POWER SWITCH AT OFF, SQUELCH CONTROL AT OFF, VOL CONTROL AT EXTREME CLOCKWISE POSITION, V3 OUT, AND HANDSET OUT.
3. * INDICATES VOLTAGE MEASURED WITH V3 IN AND RADIO SET IN TRANSMIT CONDITION.
4. † INDICATES VOLTAGE (MEASURED WITH V3 IN AND RADIO SET IN TRANSMIT CONDITION) WHICH DIFFERS SLIGHTLY IN INDIVIDUAL SETS.
5. ‡ TO AVOID BURNING OUT FILAMENTS, USE OHMMETER ON RANGE OF RX10 OR GREATER.
6. NC INDICATES NO CONNECTION.
7. VALUES IN PARENTHESES APPLY TO FOLLOWING MODELS OF RADIO SETS AN/PRC-9 AND -10:

ORDER NO.	SERIAL NOS.	
	AN/PRC-9	AN/PRC-10
15176-PHILA-52	4976 THROUGH 8926	4001 THROUGH 12433
15178-PHILA-52	———	LATER MODELS
3432-PHILA-52	———	ALL MODELS

8. RESISTANCE READINGS AT TERMINALS E5H AND E4B ARE 470K FOR ALL MODELS OF RADIO SETS AN/PRC-8 AND -9. FOR RADIO SETS AN/PRC-10, READINGS ARE 18K FOR ALL MODELS EXCEPT THOSE LISTED BELOW, IN WHICH THE READINGS ARE 360K:

ORDER NO.	SERIAL NOS.
1758-PHILA-51	1 THROUGH 4699
3374-PHILA-52	21562 THROUGH 23561

TM4065-CI-11

Figure 28. Voltage and resistance measurements, bottom and rear of chassis.

40. Troubleshooting Chart

Action	Symptom	Probable trouble	Correction
1. POWER switch at ON, VOL control turned to its extreme clockwise position, SQUELCH control at OFF.	No rushing noise heard in handset receiver.	Weak battery	Replace battery.
		Broken lead in battery cable or at J5, J6, or P1.	Repair broken lead.
		Tube burned out	Check all tubes and replace defective tube.
		Defective handset	Replace handset.
2. SQUELCH control turned clockwise until rushing noise stops.	Rushing noise does not stop.	Defective SQUELCH control R35.	Replace R35.
		Weak battery	Replace battery.
		Defective V11	Replace V11.
		Defective K2	Clean or replace K2.

Action	Symptom	Probable trouble	Correction
3. SQUELCH control at OFF, POWER switch held at CAL & DIAL LITE position, TUNING control varied slowly from low to high end of dial.	Dial light does not light--- Beat notes are not heard at every whole number mc point on dial.	Defective dial lamp E8---- Defective V9 or V10, or crystal Y1 or Y2.	Replace E8. Replace V9, V10, Y1, and Y2.
4. POWER switch at ON, handset push-to-talk button pressed, operator talks into microphone.	Transmitter inoperative -- Transmitter off frequency ..	Defective V3 ---------- Defective K1 ---------- Defective V1 or V2 ------- Transmitter or afc circuit out of alinement.	Replace V3. Clean or replace K1. Replace V1 and V2. Aline afc and transmitter circuits.

Section V. INDIVIDUAL STAGE CHECKS

41. General

When making individual stage checks, refer to figures 30 and 31 for location of components and test points. Individual stage checks are made with the receiver-transmitter removed from its case and powered by a bench test battery pack. If a bench test battery pack is not available, J5 of the receiver-transmitter chassis may be plugged directly into the socket of Battery BA–279/U. When a Battery BA–279/U is used, it is convenient to use an extension cable between the battery and the receiver-transmitter chassis. This cable must be made up of two plugs, one to mate with the battery socket and the other to mate with J5. The cable must have leads from terminal A on one plug to terminal A on the other, B to B, C to C, and so on. The length of the cable should be about 2 to 5 feet.

Caution: Accidental shorting of the +67.5-volt or +135-volt supplies to ground causes several tubes to burn out either when the POWER switch is at OFF and the handset push-to-talk button is pressed, or when the POWER switch is at REMOTE. Therefore, when making checks inside the receiver-transmitter chassis, be sure that the POWER switch is not at REMOTE, and that the handset push-to-talk button is not pressed by hand or taped down when the POWER switch is at OFF.

42. Audio Amplifier V7

a. Remove the receiver-transmitter chassis from its case and connect it to the power source. Then proceed as follows:

(1) Set the POWER switch at ON.

(2) Set the SQUELCH control at OFF.

(3) Set the VOL control to its extreme clockwise position.

(4) Connect a handset to the AUDIO connector.

b. Connect the output of a 400- or 1,000-cycle audio oscillator across terminal 3 of output transformer T3 and ground. The audio signal should be heard in the handset receiver. If no signal is heard, disconnect power from the receiver-transmitter and make an ohmmeter check of T3 and connections from T3 to the handset.

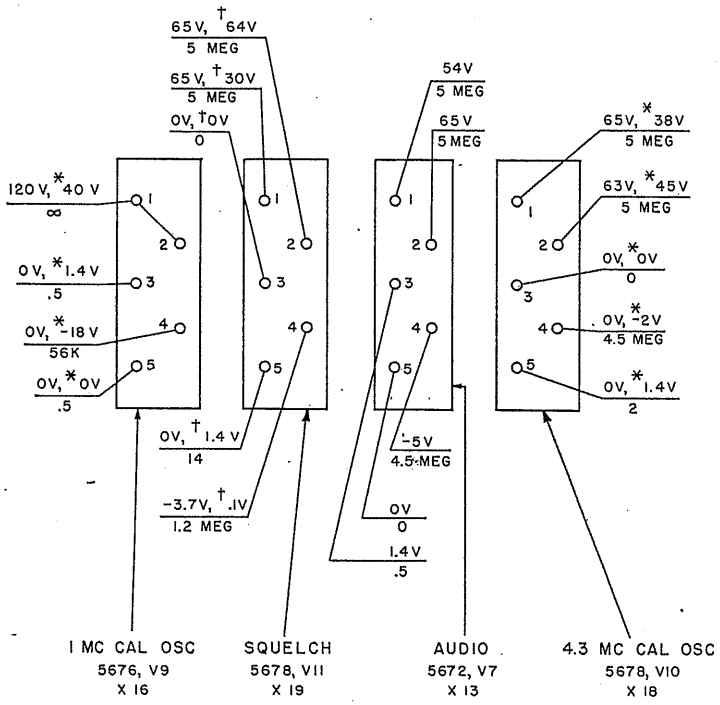
c. Connect a .01-μf capacitor to the end of the ungrounded lead of the audio oscillator, and connect the other end of this capacitor to terminal 2 of T3. The audio signal should be heard in the handset. This checks the primary of T3.

d. Connect the audio oscillator across the grid (pin 4) of V7 (socket X13) and ground. The signal heard in the handset receiver should be much louder than in *b* and *c* above if the output voltage of the audio oscillator is kept constant. If no noticeable increase in loudness is obtained, replace V7.

e. Connect the audio oscillator across pin 3 of test connector J7 and ground. The signal in the handset should be as loud as in *d* above. Slowly turn the VOL control counterclockwise. The loudness of the tone in the handset should be reduced gradually until it is inaudible. The complete absence of a signal at the handset may

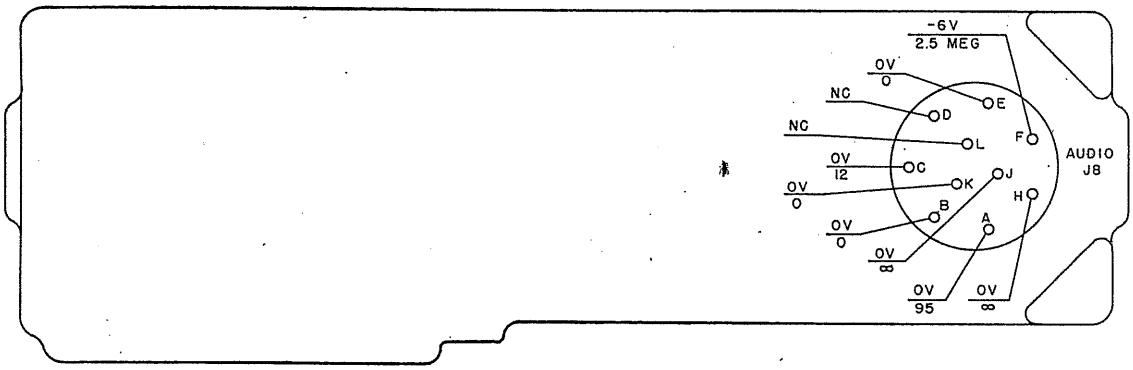
NOTES:

1. ALL VOLTAGES MEASURED WITH VTVM WITH RADIO SET IN RECEIVE CONDITION, POWER SWITCH AT ON, SQUELCH CONTROL AT OFF, VOL CONTROL AT EXTREME CLOCKWISE POSITION, AND HANDSET OUT UNLESS OTHERWISE INDICATED.
2. VALUES BELOW THE LINE ARE IN OHMS MEASURED WITH VTVM WITH BATTERY CABLE OUT, POWER SWITCH AT OFF, SQUELCH CONTROL AT OFF, VOL CONTROL AT EXTREME CLOCKWISE POSITION, V3 OUT, AND HANDSET OUT.
3. * INDICATES VOLTAGE MEASURED WITH POWER SWITCH HELD AT CAL AND DIAL LITE.
4. † INDICATES VOLTAGE MEASURED WITH SQUELCH CONTROL AT MINIMUM ON POSITION.
5. NC INDICATES NO CONNECTION.



TOP VIEW OF CHASSIS

A



FRONT VIEW OF PANEL

B

TM 4065-151

Figure 29. Voltage and resistance measurements, top and front of chassis.

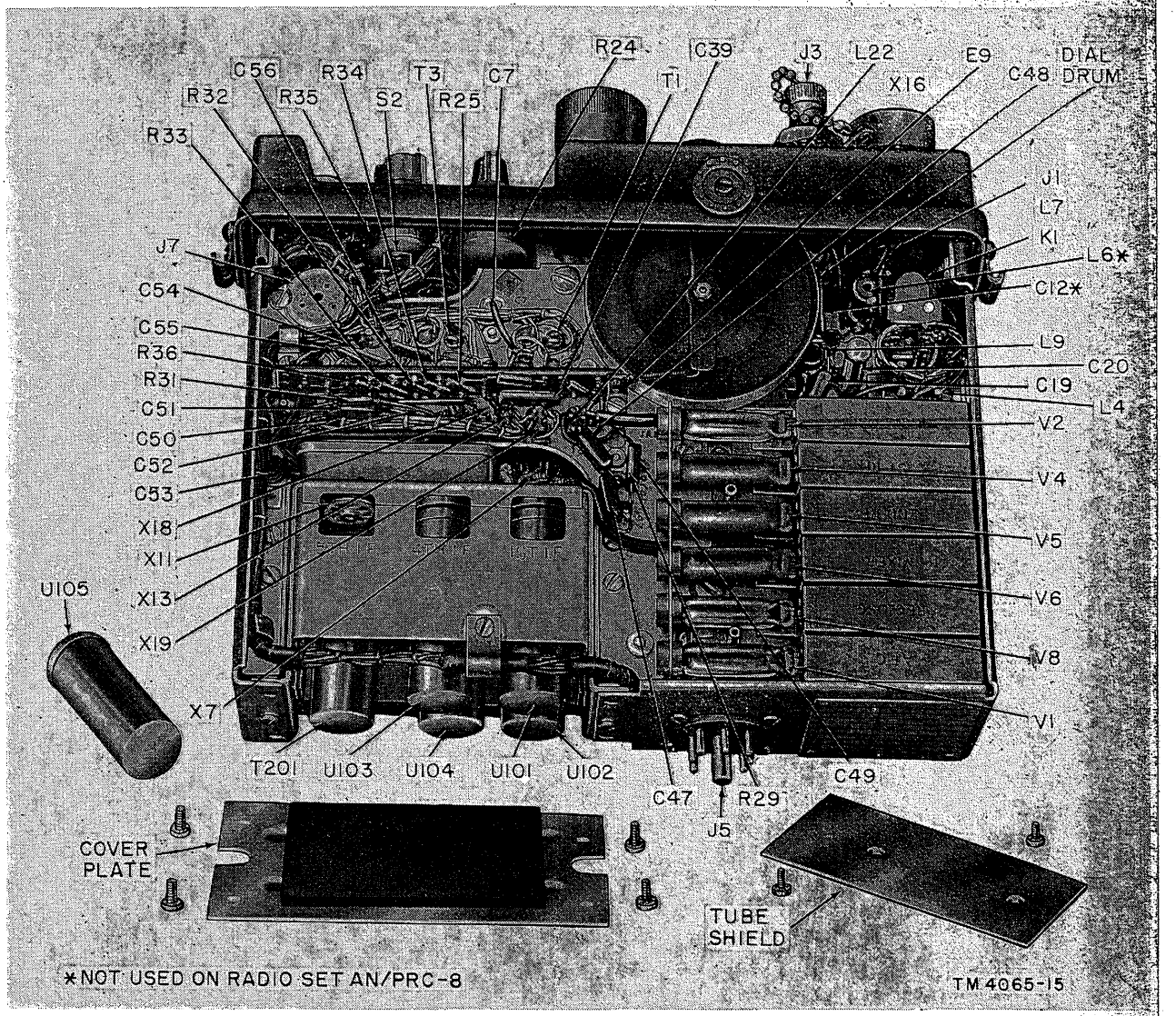


Figure 30. Top view of receiver-transmitter chassis.

be caused by sticky contacts of SQUELCH relay K2, by a short in C38, or a short in VOL control R24.

43. Discriminator

Put a 100-micromicrofarad ($\mu\mu$f) capacitor in series with the hot lead of an rf signal generator, which is putting out an amplitude-modulated 4.3-mc signal. Apply this signal across the plate (pin 1) of V10 (socket X18). (This point connects to the input of the discriminator.) Shift the generator frequency above and below 4.3 mc while listening for a signal in the handset. The audio tone should be heard only when the signal is slightly above or below 4.3 mc. If no tone is heard, replace the discriminator can.

44. If. Amplifiers U101 through U105

a. It is difficult to gain access to the third, fourth, and fifth if. stages because of the shield that is placed over the sockets (X9, X10, and X11) of the if. cans. Feed an unmodulated 4.3-mc signal to pin 5 of sockets X8 (second if. can), and connect a vtvm (10-volt range) to pin 4 of test connector J7. The negative bias voltage obtained at pin 4 of J7 indicates the level of signal at the input to the fifth if.

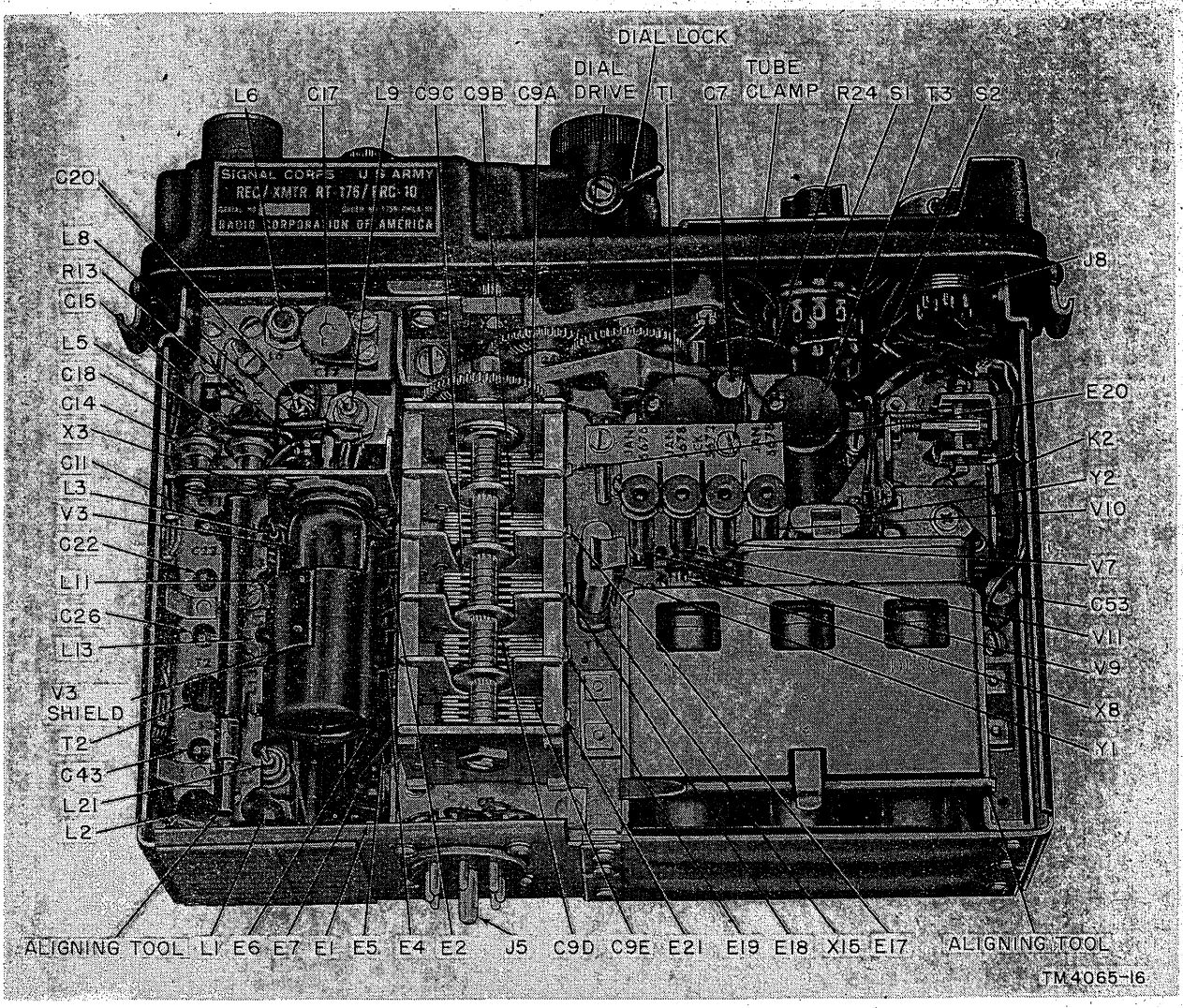


Figure 31. Bottom view of receiver-transmitter chassis.

amplifier and should change when the amplitude of the signal applied at pin 5 of X8 is changed. If no indication is obtained, replace the third, fourth, and fifth if. cans, one at a time, until an indication is obtained. If an indication is obtained, replace the fifth if. can with either the third or fourth. If no indication is obtained after this change is made, the can that was originally in the fifth if. location is defective.

b. An alternate check of the fifth if. can may be performed by connecting the vtvm to pin 3 of J7 and applying a 4.3-mc signal to pin 5 of X8. Vary this signal frequency above and below 4.3 mc. The vtvm reading should vary from positive to negative as the frequency is varied.

c. Apply the 4.3-mc signal to pin 2 of X8. The added gain of the second if. amplifier is now obtained, and the signal output of the generator that is required to produce the same output voltage at the vtvm should now be less than in *a* above. If no indication is obtained on the vtvm or if the input signal required to produce the same output voltage on the vtvm is not considerably less than in *a* above, replace the second if. can.

d. Apply the 4.3-mc signal to pin 2 of X7 (first if. can). Vary the output control of the generator so that the reading on the vtvm (connected to pin 4 of J7) is the same as in *c* above. The input signal should now be considerably less than that applied in *c* above. If it is not, replace the first if. can.

45. Mixer V6

a. Keep the vtvm at pin 4 of J7. Apply a 4.3-mc signal to terminal E1H on the afc box. The vtvm reading should be about the same as in the previous test. If it is not, C31 may be open. Check this capacitor by placing another capacitor of approximately equal value across it and again apply the 4.3-mc signal to terminal E1H.

b. Apply the 4.3-mc signal through a 100-$\mu\mu$f capacitor to terminal E19 of main TUNING capacitor C9. If no indication is obtained at the vtvm, replace the mixer tube or box and aline the receiver-transmitter (ch. 5). If an indication is obtained at the vtvm, change the frequency of the signal generator from 4.3-mc to the receiver-transmitter frequency (as indicated on its tuning dial). If a vtvm indication is obtained, the mixer and receiver oscillator are operating. If no vtvm indication is obtained, receiver oscillator V8 is not operating or is off frequency.

46. Receiver Oscillator V8

a. To check whether receiver oscillator V8 is operating, connect the vtvm across terminal 1 of J7 and ground. This measures the grid-leak bias voltage of V8. If V8 is oscillating, the bias voltage will be about —3 volts; if it is not, the bias voltage will be zero.

b. If no bias voltage is obtained, replace tube V8; if this does not correct the trouble, remove V3 and make resistance and voltage checks at E7 (fig. 28). Be sure to disconnect the power source from the receiver-transmitter before making resistance checks. Replace any defective component.

c. After replacing the defective component, aline the receiver oscillator (par. 73).

47. Rf Amplifiers V4 and V5

Tune the receiver-transmitter to the middle of its frequency range. Tune the signal generator to the same frequency and apply a signal through a 100-$\mu\mu$f capacitor to test point E19 (output of second rf amplifier). Then apply this signal successively to E18, E20, and to the antenna jacks. Test points E18, E19, and E20, are lugs on the stators of C9C, C9D, and C9A, respectively. The defective point is indicated by a loss of signal. Check voltages and, after disconnecting power, check resistances in the defective stage or circuit.

48. Squelch Amplifier V11

Slowly turn the SQUELCH control clockwise until squelch relay K2 is energized (pulls in). If the relay armature does not pull in, disconnect power from the receiver-transmitter and move the armature by hand to check for sticky contacts. If this is not the trouble, replace V11. Also check for low battery voltages. If these tests do not locate the trouble, make voltage and resistance checks on the entire squelch stage.

49. Transmitter Oscillator V3

a. Press the push-to-talk button on the handset and observe receiver-transmit relay K1. If the relay armature does not pull in, disconnect power fom the receiver-transmitter and move the relay armature by hand to check for sticking contacts or for an accumulation of rust on the end of the relay core below the armature. If the contacts are not sticky, check the circuit through the coil of K1.

b. Connect RF Wattmeter ME–11/U to the AUX ANT connector and press the push-to-talk button on the handset. The rf power output should be approximately 1 to 2 watts. An alternative check of transmitter oscillator operation is a measurement with the vtvm of the negative dc bias at the junction of R11 and C15. This voltage should be about —5 volts.

c. If the power output of the transmitter oscillator is low, replace V3. If it is still low, aline this stage (par. 76).

d. If replacing V3 fails to result in any output from the transmitter oscillator, make a complete voltage and resistance check of this stage (fig. 28).

50. Modulator V2

a. Off-frequency transmitter operation and lack of modulation may be caused by a defective modulator stage. Check V2 and L4 and replace them if necessary.

b. If the transmitter frequency is correct but there is no modulation, check the audio input

circuit, which includes modulation transformer T1, the handset microphone, and the 1.5-volt supply.

c. If modulation is satisfactory but the transformer oscillator drifts off frequency, a defect exists in the afc circuit (par. 51).

51. Afc Driver V1

a. While pressing the push-to-talk button, measure the voltage between E1B and E1A with a vtvm. E1B should be about 15 volts negative with respect to E1A. Disable receiver oscillator V8 by placing a finger on lug E21 on the stator of main TUNING capacitor C9E. The voltage should drop to 0.

b. Repeat the procedure in *a* above with the vtvm connected between E1B and E1C. E1C should be about 15 volts positive with respect to E1B. When a finger is placed on E21, the voltage should drop to 0.

c. If the results in *a* and *b* above are not obtained, the afc circuit is defective. This may be caused by a defective afc driver tube or by an afc discriminator which is not properly alined or contains defective components. Remove the afc box and check the circuit. To check crystals CR1 and CR2, remove them from the box and measure their resistances. Then reverse the ohmmeter leads and measure their resistances again. Replace a crystal if its high resistance is less than 300,000 ohms.

52. Calibration Oscillators V9 and V10

a. While holding the POWER switch at CAL & DIAL LITE, measure the voltage at pin 4 of 1-mc calibration oscillator V9 with a vtvm. This should be about —20 volts. If no negative voltage is obtained, replace Y1. If the oscillator still does not operate, check the circuit for shorted or open capacitors, resistors, or broken leads.

b. Make the same checks on 4.3-mc calibration oscillator V10. The voltage at pin 4 of V10 should be about —2 volts.

53. Miscellaneous Checks

a. Coil Resistances. Resistance measurements of the components shown in the chart below give readings approximately as shown.

Symbol	Component	Resistance in ohms		
		Primary	Secondary	Coil
K1	Receive-transmit relay	-------	-------	43
K2	Squelch relay	-------	-------	16,000
L4	Modulation transformer.	3,500	0.2	
T1	Microphone transformer.	12	4,700	
T2	Mixer to if. coupling transformer.	0.7	0.1	
T3	Audio output transformer.	2,400	75	

b. Battery Cable. If a receiver-transmitter operates when the panel and chassis assembly is out of the case, but does not operate when it is in the case, the trouble may be in the battery cable, which is connected to the case. Insert the receiver-transmitter chassis in another case and operate the radio set. If the trouble was in the first battery cable, the radio set will not operate. To make a continuity check of the battery cable, disconnect the cable from the battery and remove the plate at the back of the receiver-transmitter case (which covers connector J6) by removing the four securing screws. Then make a continuity test with an ohmmeter between each lettered terminal on plug P1 and the corresponding lettered terminal on J6 (A to A, B to B, and so on). There should be continuity (0 ohms) for all eight leads.

c. Retransmission Cable. If two radio sets operate (reception and transmission) individually but do not operate as a relay station when connected by the relay cable, the trouble is in this cable. To check the cable, make continuity tests using figure 24.

d. Battery BA–279/U. Use Battery Tester TS–183/U to check the battery. The chart on figure 19 is a duplicate of one that is printed on the battery. This indicates which jack of the battery tester is to be used for each measurement. The two prods of the battery tester are placed across the two terminals of the battery to be tested. In order not to damage the meter, connect the positive prod to the positive

terminal. When the voltage across $+B_1$ to $+B_2$ is to be measured, connect the positive prod to the $+B_2$ terminal.

e. Handset H–33/PT. The resistance measurements made at the terminals of the handset connector specified in the chart below, locate defects in the handset. See figure 25 for the schematic diagram of Handset H–33/PT.

Push-to-talk switch	Terminals of connector	Required reading (ohms)
Unoperated or operated.	A and B	30 (click heard when ohmmeter connection is made or broken).
Operated	F and H	0
Unoperated	F and H	Infinity.
Operated	D and E	0
Unoperated	D and E	Infinity.
Unoperated or operated.	C and D	150 (click heard when ohmmeter connection is made or broken).
Unoperated or operated.	D and F	Infinity.

Section VI. STAGE GAIN MEASUREMENTS

54. General

Stage gain measurements are useful in locating a defective stage when the radio set is operating with reduced sensitivity. Under such conditions, the gain of each stage is compared with the required gain for that stage. The stage which shows a gain appreciably below its required gain then may be checked carefully by resistance and voltage measurements to locate and repair the defect.

55. Receiver RF Stages and Antenna Circuit

The gain of the rf stages and the antenna circuit is checked by adjusting the signal input voltage. This produces the same limiter grid voltage at the fifth if. grid (terminal 4 of test socket J7) as the input signal voltage is changed from stage to stage. Make all rf measurements at the center of the frequency range of the radio set being tested. If gain is low, replace the tube of the stage being tested; then aline the radio set. If gain is still low, remove the rf box and make resistance measurements to locate the trouble.

a. Test Conditions.

(1) Vtvm connected across terminal 4 of test socket J7 and ground.

(2) SQUELCH control at OFF.

(3) Vary frequency control of signal generator slightly until maximum output is obtained.

(4) Input signal voltage is adjusted to produce a reading of —5 volts at terminal 4 of J7. Although input voltages may show some variation from one set to another, the gain for similar stages should be fairly constant. Stage gain shown in the fourth column of the chart in *b* below is calculated from the ratio of two successive input voltage readings. For example, the gain of 3.2 is the ratio of 120/37.5.

(5) Use a 2,000-$\mu\mu$f capacitor in series with the hot lead of the generator except when the signal is applied at AUX ANT conector J3.

b. Stage Gain Chart.

Input signal (μv) (approx)	Input terminal	Reading at terminal 4 of J7 (dc volts)	Stage gain	Remarks
120	E19	—5	-------	Provides first figure from which to calculate gain.
37.5	E18	—5	3.2	Gain of second rf stage.
3.05	E20	—5	12.3	Gain of first rf stage.
0.5	J3	—5	6.2	Gain of antenna circuit. (Use 33-ohm resistor, in series with hot lead of generator, instead of 2,000-$\mu\mu$f capacitor.)

56. Receiver If. and Discriminator Stages

One set of conditions is given for an overall measurement of the gain of all the if. stages

because access to the sockets of the last three if. stages is difficult. Location of the defective stage is accomplished by the substitution of a spare if. can.

a. Conditions.

(1) Vtvm connected between terminal 4 of J7 and ground. (This is grid bias voltage of the fifth if. amplifier.)

(2) SQUELCH control at OFF.

(3) Input signal is 4.3 mc; 2,000-$\mu\mu$f capacitor is connected in series with output lead of signal generator.

b. If. Stage Gain Chart.

Input signal (μv)	Terminal	Vtvm reading (volts)
70	Pin 2 of X7	—5

c. Discriminator.

(1) Increase the output of the signal generator until the vtvm reading no longer increases. (This is necessary to operate the limiters at saturation.)

(2) Change the vtvm lead from terminal 4 of J7 to terminal 3. (The vtvm will now measure the dc output of the discriminator.)

(3) Shift the signal generator frequency 15 kc above, then 15 kc below 4.3 mc. An output of 2.8 volts at each of these frequencies indicates normal discriminator sensitivity.

57. Receiver Audio and Squelch Stages

a. Audio Amplifier. Apply a 2-volt, 1,000-cps signal to the grid (pin 4) of audio amplifier V7. Connect Output Meter TS–585A/U, adjusted to provide a 600-ohm load, across terminal 3 of transformer T3 and ground. The output reading must be at least 7.5 milliwatts (mw).

b. Squelch Circuit.

(1) Short AUX ANT connector J3 to ground.

(2) Turn the SQUELCH control slowly clockwise to the point where squelch relay K2 just pulls in (rushing noise stops).

(3) Measure the voltage at terminal 4 of J7 with a vtvm. This voltage should be about —1.5 volts (squelch bias voltage).

(4) Slowly turn the SQUELCH control counterclockwise to the point where K2 just releases. The voltage at terminal 4 of J7 should now be about —2.5 volts (or about 1 volt more negative than the pull-in bias voltage). If the difference between the two readings is considerably more than 1 volt, the squelch circuit is defective.

58. Transmitter Modulator and Afc Discriminator Stages

a. Modulator. The measure of modulator sensitivity is the amount of frequency shift of the transmitter with a given change in modulator (V2) grid voltage.

(1) Tune the receiver-transmitter to the center of its frequency range.

(2) Press the push-to-talk button of the handset to operate the transmitter and check the frequency with Frequency Meter TS–174B/U. The frequency should be the frequency indicated on the dial.

(3) Short terminal 5 of J7 to ground. The frequency of the transmitter should increase by more than 700 kc as measured by the frequency meter.

(4) Remove the short. The transmitter frequency should be the same as in (2) above.

b. Afc Discriminator.

(1) Apply a 1-volt 4.3-mc signal from Signal Generator I–208 to terminal E6H in the mixer box.

(2) Press the push-to-talk button on the handset (to operate the transmitter) and place a finger on terminal E19 (fig. 31) to disable the receiver oscillator.

(3) With a vtvm connected between terminal E1B and ground, the reading should be approximately —18 volts.

(4) Connect the vtvm between terminal E1C and ground and measure the voltage at this point. The reading should be approximately —5 volts.

(5) Raise the frequency of the signal generator to 4.33 mc. The voltage change at terminal E1C should be approximately 3 volts (or about .1 volt per kc deviation).