TM 11-244

WAR DEPARTMENT TECHNICAL MANUAL

RADIO SETS

SCR-281-A,

-B, AND -D

WAR DEPARTMENT • APRIL 1945

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This manual supersedes TM 11-244, 5 August 1943

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Refer to FM 21–6 for explanation of distribution formula.

CONTENTS

DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW—1. Smash—Use Sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, machetes.

2. Cut—Use axes, handaxes, machetes.

3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use firearms, grenades, TNT.

5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash—Variable capacitors, tubes, relays, coils, fuses, meter, handset, speaker, and switches.

2. Cut—All wires and cables.

3. Bend—Brackets, chassis, and shields.

4. Burn—Records, logs, messages, codes, charts, all papers, books, and documents.

5. Bury or scatter—Any or all of the above pieces after breaking.

DESTROY EVERYTHING

SAFETY NOTICE

Voltages as high as 450 volts are used in the operation of this equipment. These voltages are dangerous to life.

Do not change tubes or make adjustments inside the set with the high-voltage supply ON.

A few service checks must be made inside the set with the high voltage on. When making these checks, always have present another person capable of rendering aid. Keep one hand in your pocket while making high-voltage measurements. This precaution will prevent touching the electrical circuit with more than one part of the body at one time.

High r-f (radio-frequency) voltages are present on the antenna of this radio set. Do not touch the antenna while the set is turned on.

This manual supersedes TM 11–244, 5 August 1943.

PART ONE

INTRODUCTION

Section I. DESCRIPTION OF RADIO SET SCR–281–(*)

1. Purpose

Radio Set SCR–281–(*) is an a-m (amplitude-modulated) radiotelephone transmitter and receiver designed for operation on coastal and harbor vessels or in land stations for communication with such vessels. The set cannot be used for radiotelegraph transmission or reception. The

Figure 1. Radio Receiver and Transmitter BC–441–(*).

set operates from a 115-volt 60-cycle power source. Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this technical manual. This Radio Set SCR–281–(*) represents Radio Sets SCR–281–A, –B, and –D, which are treated together in this manual.

2. Application

a. General. The basic component of Radio Set SCR–281–(*) is Radio Receiver and Transmitter BC–441–(*) (fig. 1). The receiver uses a conventional superheterodyne circuit. The receiver can be operated

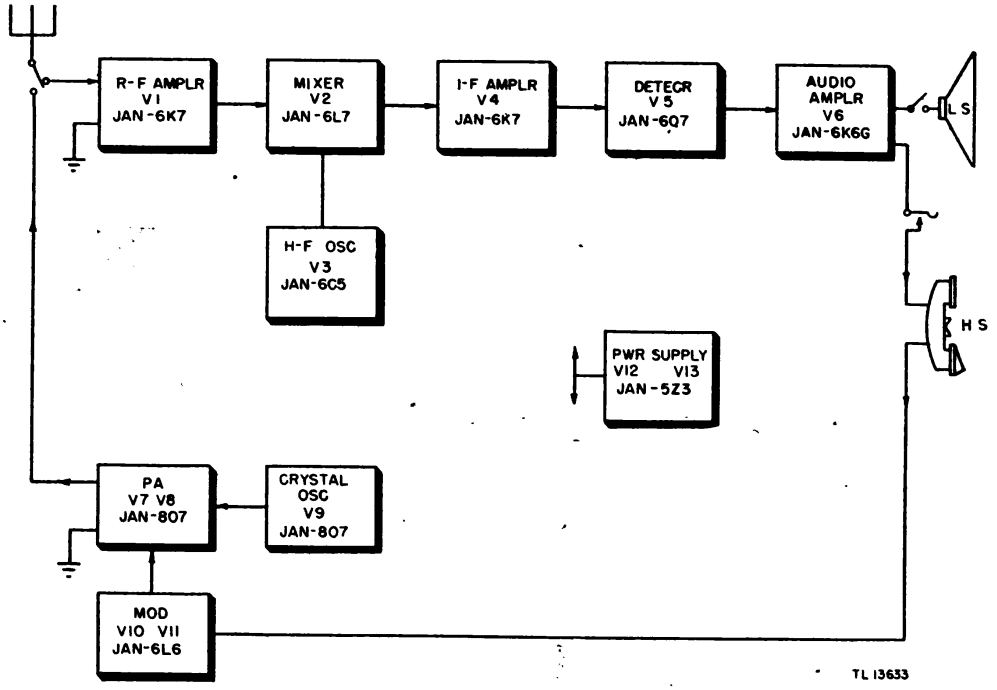


Figure 2. Radio Set SCR–281–(*)—simplified block diagram.

over its entire band manually or on four preselected frequencies by means of plug-in crystal units. The transmitter is a-m and can be operated on four preselected frequencies by means of plug-in crystal units. A simple block diagram of Radio Set SCR–281–(*) is shown in figure 2. Antenna Tuning Unit BC–619–A is used with the set to help load and resonate a 35-foot whip type antenna or Antenna AN–44–A.

b. Receive-transmit Switch. Change-over from reception to transmission is accomplished by operating the switch on the handle of the handset. The switch effects the change-over by actuating relays which ground the receiver input during transmission, switch the antenna from

receiver input to transmitter output, switch the positive high voltage from receiver to transmitter, short circuit the receiver bias network, and switch the primary voltage on the power transformer to the transmitting tap.

c. TYPE OF ANTENNA. Radio Set SCR–281–(*), when used with Antenna Tuning Unit BC–619–A, is designed to transmit or receive with either Antenna AN–44–A or a 35-foot whip type antenna. Without Antenna Tuning Unit BC–619–A, the set is intended for use with a single-wire antenna and ground. Optimum length is about 85 feet including lead-in, but shorter or longer antennas may be used.

d. APPLICATION OF POWER. The 115-volt, 60-cycle, single-phase a-c (alternating-current) power is applied to the set by means of the POWER ON-OFF switch located on the front panel.

3. Technical Characteristics

Frequency range:	
Transmitter	1,700 to 2,750 kc
Receiver	1,700 to 2,750 kc
Types of signals emitted	a-m voice
Types of signals which can be received	a-m voice, mcw
Type of modulation	amplitude modulation
Percentage modulation	normally greater than 90%
Number of tubes:	
Transmitter	5
Receiver	6
Power supply	2
Distance range	10 miles over land 25 miles over water
Type of transmitter	crystal-controlled, plate- and screen-modulated
Type of receiver	a-m superheterodyne
Power output of transmitter	25 watts
Power input: 115-volt, 60-cycle, single-phase ac.	
Transmitter	230 watts (90% pf)
Receiver	107 watts (90% pf)

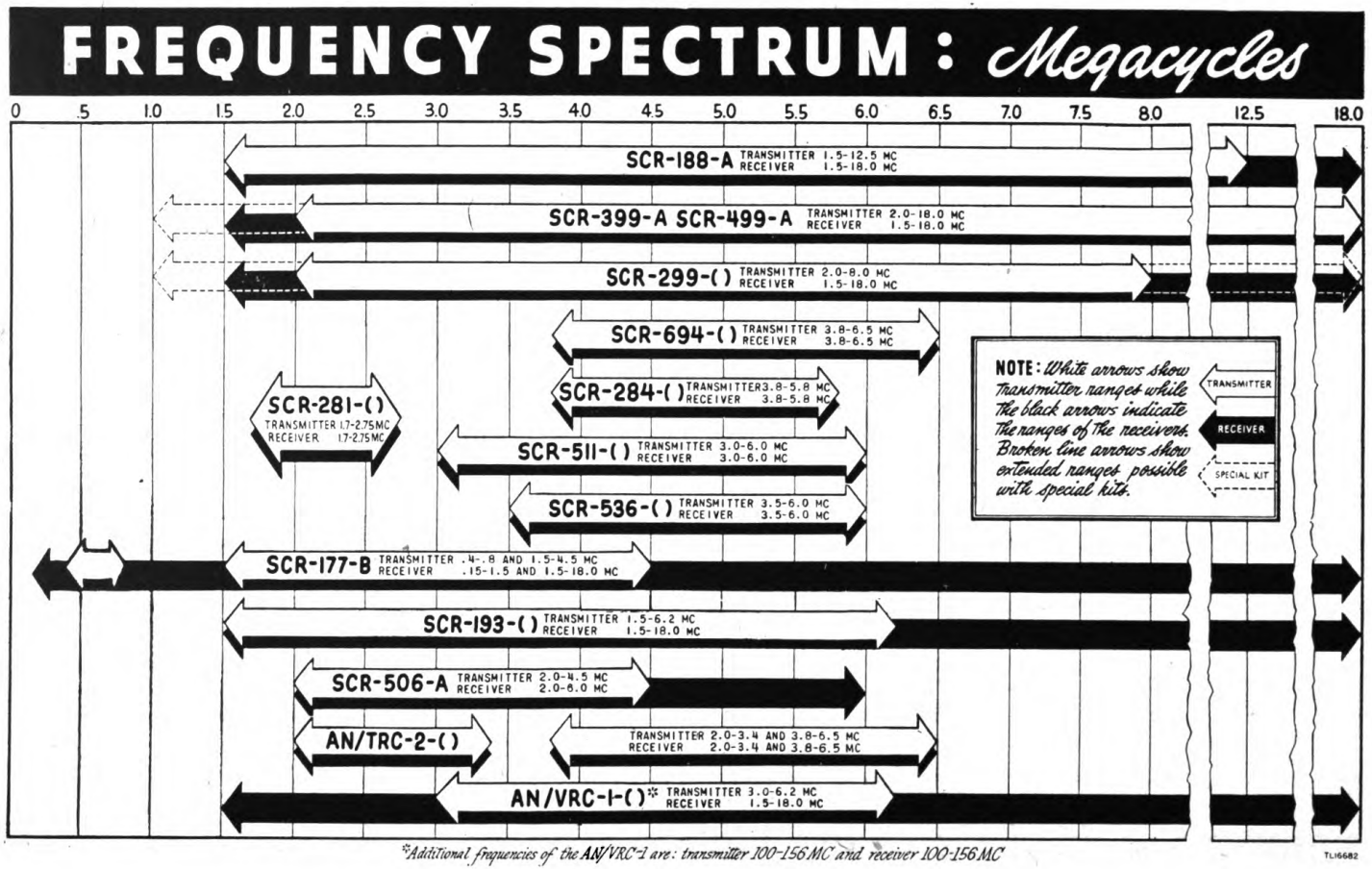


Figure 3. Radio Set SCR–281–(*), frequency spectrum chart.

4. Communication with Other Radio Sets

Radio Set SCR–281–(*) has a frequency coverage of 1,700 to 2,750 kc and can communicate with any voice a-m set within this frequency band (fig. 3).

5. Component Parts

Components of Radio Set SCR–281–(*) are listed in the following table and illustrated in figure 4. Check and correct this list upon receiving equipment. This table is to be used as a guide and not as a basis for issue.

Component	Required number	Height (in.)	Depth (in.)	Length (in.)	Unit weight (lb.)
Radio Receiver and Transmitter BC–441–D	1	16 1/16	10	16	102.00
or					
Radio Receiver and Transmitter BC–441–A or –B	1	16 1/16	10	16	93.00
Handset (attached to Radio Receiver and Transmitter BC–441–(*))	1				
Shockproof mounting bracket	2	1 7/16	2 1/2	17 7/8	4.00
Wall brackets WML-WMR	2	4 3/4	3/4	4 3/4	0.65
Crystals (4 transmitting, 4 receiving) not supplied with Radio Receiver and Transmitter BC–441–D)	8				
Tube JAN-807 (3 installed, 3 spare)	6				0.94
Tube JAN-6L6 (2 installed, 2 spare)	4				0.63
Tube JAN-5Z3 (2 installed, 2 spare)	4				0.5
Tube JAN-6K7 (2 installed, 2 spare)	4				0.38
Tube JAN-6L7 (1 installed, 1 spare)	2				0.13
Tube JAN-6C5 (1 installed, 1 spare)	2				0.13
Tube JAN-6Q7 (1 installed, 1 spare)	2				0.13
Tube JAN-6K6G (1 installed, 1 spare)	2				0.13
Box of misc spare parts	1	4 11/16	8 11/16	21 5/8	8.5

6. Shipping Weights and Dimensions of Packed Sets

A single Radio Set SCR–281–(*) is packed in a crate 16 by 26½ by 24½ inches. The total weight is 143 pounds. The cubage is 6 cubic feet. For dimensions of the unpacked set, see figure 5 and paragraph 5.

7. Description of Major Components

a. Radio Receiver and Transmitter BC–441–(*). Radio Receiver and Transmitter BC–441–(*) consists of the radio chassis, power supply,

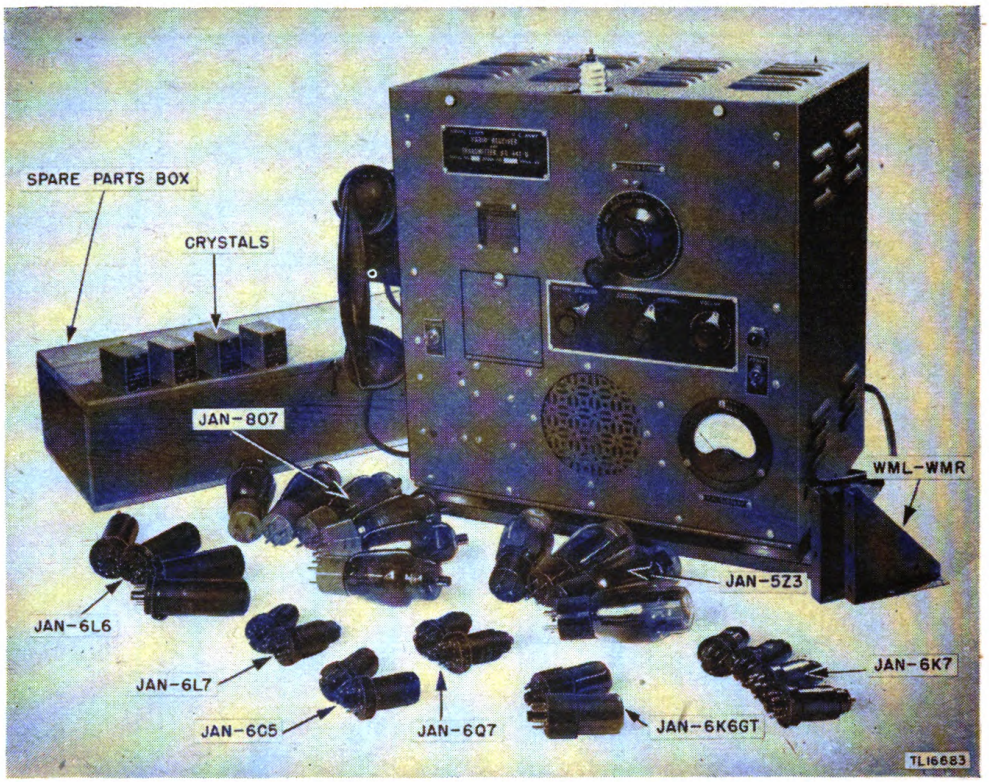


Figure 4. Radio Set SCR–281–(*), component parts.

and front panel of the set mounted in a metal case. The chassis is mounted half-way up the back side of the front panel (fig. 6) and the two can be tilted forward to expose the chassis by loosening the two knurled nuts on the top of the front panel. The power supply is mounted on the inside bottom of the case and is stationary. A handset is mounted on the side of the case and a speaker is built into the panel.

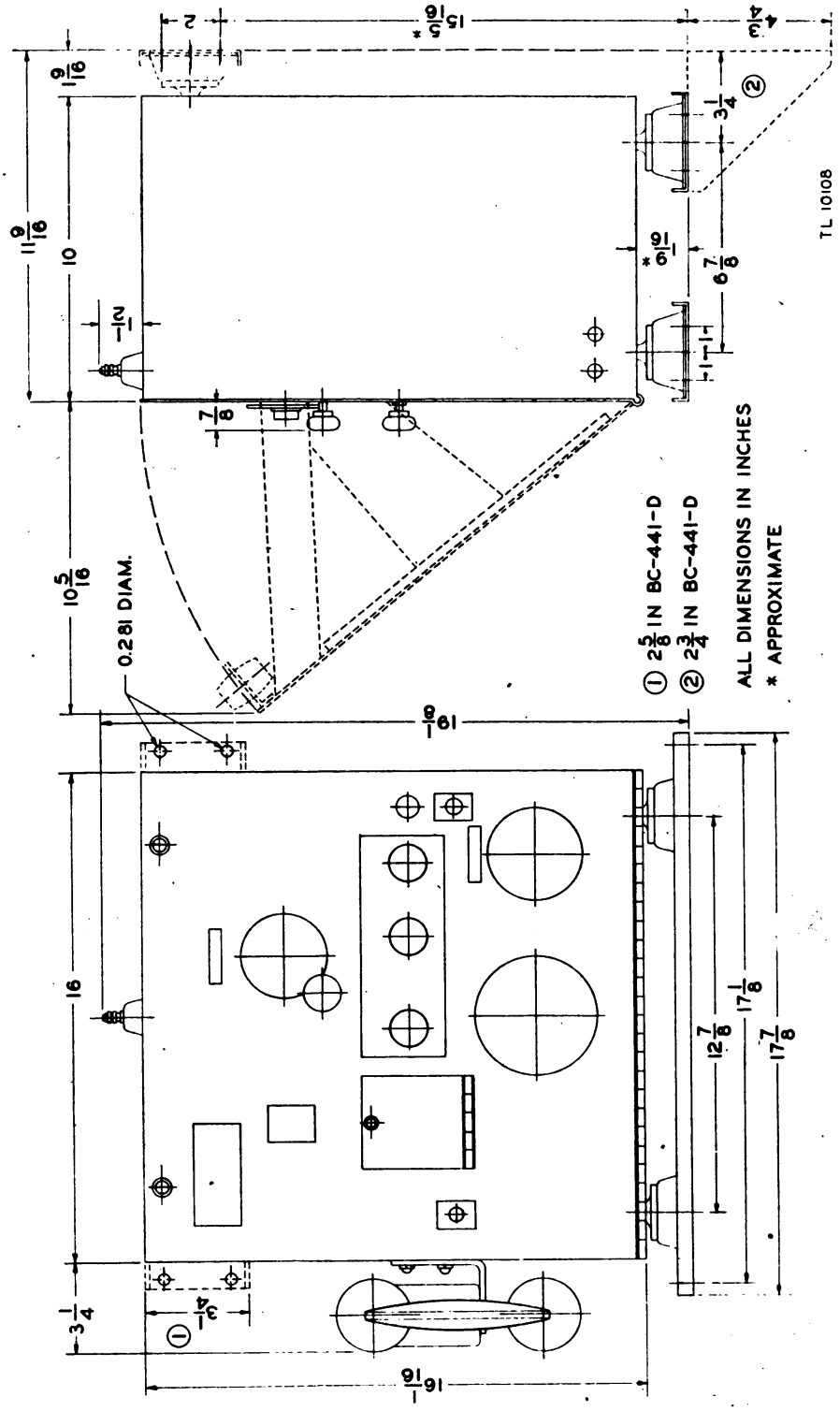


Figure 5. Radio Receiver and Transmitter BC-441-(*)—outline dimension drawing.

b. HOUSING. Radio Receiver and Transmitter BC–441–(*) is housed in a rust-proof, painted steel cabinet, 10 inches deep, 16 inches wide, and $16\frac{1}{16}$ inches high.

c. CONTROLS. For a description of the controls of Radio Receiver and Transmitter BC–441–(*), see paragraph 14.

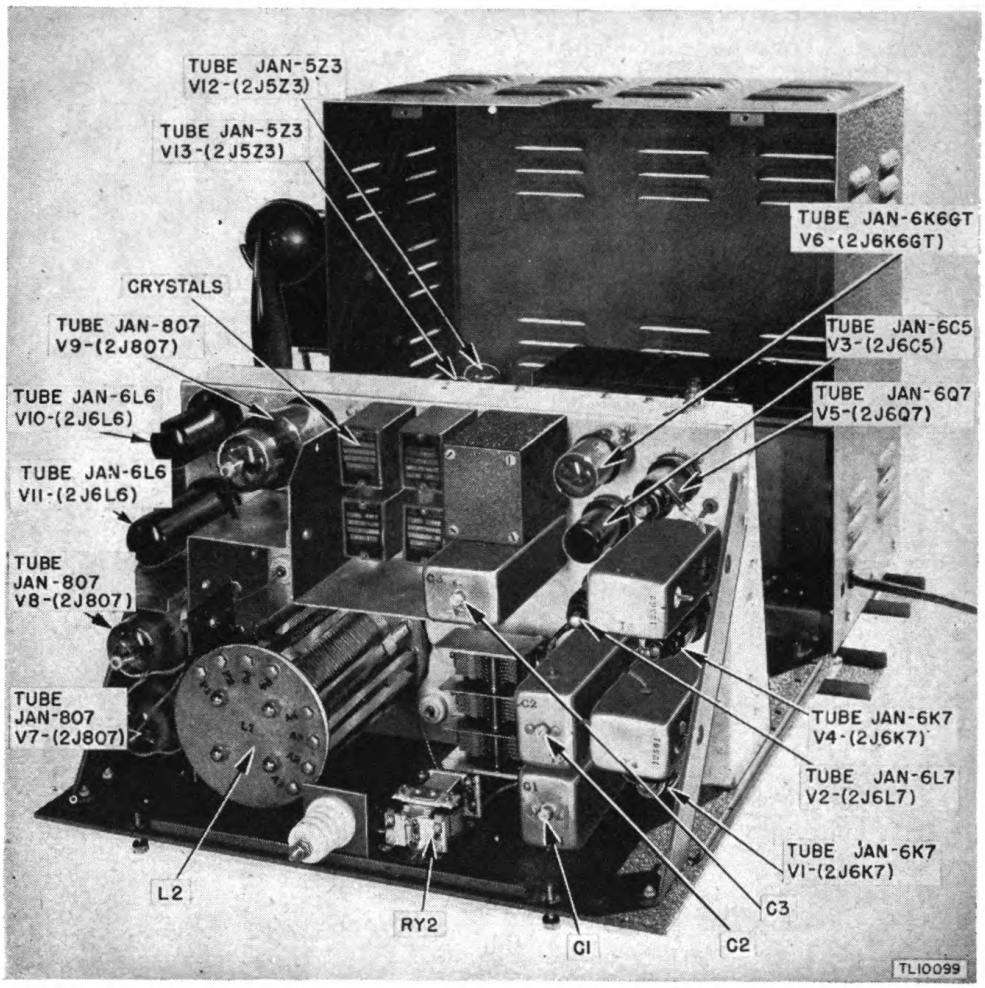


Figure 6. Radio Receiver and Transmitter BC–441–(*)—front panel open, exposing chassis. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

8. Differences in Models

Radio Sets SCR–281–A and –B are identical except for the method of coupling the oscillator and mixer stages. Radio Set SCR–281–D is essentially the same as Radio Set SCR–281–A and –B, having only minor differences in circuit wiring, components, and general characteristics. This manual is based on the D model; however, where differences exist between models, the suffix letter of each set is given. The partial sche-

matic diagrams are of the D model. For equivalent parts in the A and B models, see cross reference chart, paragraph 66.

Section II. INSTALLATION

9. Unpacking New Equipment

Unpack the equipment carefully and inspect it for possible damage during shipment. Radio Receiver and Transmitter BC–441–(*) is shipped with all tubes and crystals with the exception of the D model which is shipped less crystals.

10. Mounting

Radio Receiver and Transmitter BC–441–(*) may be mounted either on a horizontal surface such as a shelf or table, or on a vertical surface such as a bulkhead or wall, using the dimensions given for the appropriate set (fig. 5).

Note: Always remove the power and handset cords from the terminal strips at the front of the lower chassis before attempting to remove the lower chassis from the case.

a. For horizontal mounting, attach the shockproof mountings to the bottom of the cabinet.

b. For vertical mounting, remove the forward channel of the mountings and bolt it to the upper rear of the cabinet, while securing the rear channel to the mounting brackets WML and WMR (left and right) for this position (see the dotted lines in fig. 5). When mounting in this manner, use at least ¼-inch bolts and washers which are large enough to prevent the bolts from pulling through the wall.

c. When mounting the equipment, be sure to select a position near the antenna lead-in, a good ground connection, and the proper a-c source of power supply. Provide a clearance of at least 2 inches around all sides and top of the equipment. The equipment may be recessed into the wall if these instructions are followed.

11. Antenna and Ground Connections

a. ANTENNA. Radio Receiver and Transmitter BC–441–(*) is intended for use with a single-wire antenna. The optimum length is about 85 feet including the lead-in, but shorter or longer antennas may be used. However, any length shorter than 25 feet will seriously impair operation. Use a lead-in of at least No. 12 wire between the entrance insulator and the equipment. This lead-in should be as short as possible. When connecting to the cabinet insulator, leave enough wire so that the front panel

may be tilted forward for tuning adjustments without removing the lead-in wire.

b. GROUND. No. 12 wire also should be used for the connection between the ground and the ground binding post. This lead should be as short and direct as possible. For land installations, a water pipe makes a good ground connection but, if it is not available, a 6- to 8-foot rod driven into the ground will serve the purpose.

12. Shipboard Installation

a. GENERAL. In a shipboard installation, the antenna and the lead-in constitute the antenna system. The free end of the antenna should be kept high, with as much antenna as possible clear of surrounding objects. Use tension insulators of glass, glazed porcelain, or glazed ceramic with an 8-inch leakage path, rather than strain or egg-shaped insulators. Use No. 12 enamel, hard-drawn copper, or copper-coated steel wire. On metal vessels, make the ground connection directly to the hull. On wooden vessels, ground the set by fastening a copper plate of at least 20 square feet to the outside of the hull below the water line. This plate can be painted after installation. Bond all large masses of metal to the ground system.

b. SMALL POWER VESSEL. It is difficult to install the antenna on a small power vessel. A 25-foot (or longer) vertical rod gives the best results. Wire rigging guys may be used if they are broken in several places by insulators. The vertical antenna may be hinged and lowered when approaching low bridges and other such obstructions.

c. ANTENNA EXPEDIENT. If the use of a vertical antenna is impossible, run a wire from a stub mast on the cabin forward to the bow, putting the lead-in through the top of the cabin. This antenna may also be extended aft, forming a **T**, but, because of ignition interference problems it should not be extended aft when gasoline engines furnish the power. Use a pyrex or porcelain bowl lead-in insulator with a leakage path of at least 8 inches. Any r-f (radio-frequency) leakage due to poor lead-in or antenna insulators will seriously impair communication.

13. Power Supply

a. Where a 60-cycle, single-phase, a-c power source of other than 115 volts is available, use an autotransformer to supply 115 volts.

b. Where there is a d-c (direct-current) power source, or one having a frequency other than 60 cycles, use a suitable motor generator or rotary converter between the power source and the equipment. This machine

should have good voltage regulation so that, with only the receiver operating, the line voltage does not rise above 129 volts. Higher voltages will seriously reduce tube life or damage the equipment. A line voltage between 110 and 120 volts will give satisfactory transmission, but if regulation is poor, install an automatic line-voltage regulator or manual regulator with an a-c line meter mounted near the equipment.

c. Use No. 18 (or heavier) rubber-covered insulated wires for the power leads. These wires are brought in the right side of the cabinet through a grommet and fastened to the two terminals on terminal strip TS1.

PART TWO

OPERATING INSTRUCTIONS

Note: For information on destroying the equipment to prevent enemy use, refer to the destruction notice at the front of the manual.

Section III. CONTROLS AND THEIR USE

14. Description

The function of the various controls, jacks, and terminals which are mounted on the front panel of Radio Receiver and Transmitter BC–441–(*) (fig. 7), are briefly described below:

a. POWER ON-OFF SWITCH. The POWER ON-OFF switch is the main power control for both the transmitter and receiver. The switch controls the power input to the radio set.

b. SPEAKER ON-OFF SWITCH. The SPEAKER ON-OFF switch allows the speaker mounted on the front of the panel to be cut off or turned on. The switch is in the input circuit of the speaker.

c. VOLUME CONTROL. The VOLUME control varies the output of the receiver. This control has no effect on the transmitter.

d. CRYSTAL-MANUAL CONTROL. The CRYSTAL-MANUAL control permits the receiver to be operated either as a crystal controlled or manually controlled receiver.

e. CRYSTAL SELECTOR SWITCH. The CRYSTAL selector switch permits selection of any one of four preselected crystal frequencies both for transmitter operation and crystal operation of the receiver.

f. RECEIVER TUNING CONTROL. The RECEIVER TUNING control allows manual tuning of the receiver when the CRYSTAL-MANUAL control is on manual. It is directly calibrated over the frequency range of the receiver.

g. HANDSET SWITCH. The handset switch is located on the handset mounting. Removing the handset from its mounting allows this hook type switch to close, connecting the handset receiver into the receiver audio-output circuit.

h. PUSH-TO-TALK SWITCH. The PUSH-TO-TALK switch is located on the handset. Pressing the switch turns on the transmitter and turns off the receiver.

i. POWER-AMPLIFIER TUNING CAPACITORS. The p-a (power-amplifier) tuning capacitors are located behind the small door in the left center of the front panel.

j. ANTENNA TERMINAL. The antenna terminal is located on the top front center of the case.

k. GROUND TERMINAL. The ground terminal is located on the lower left side of the case.

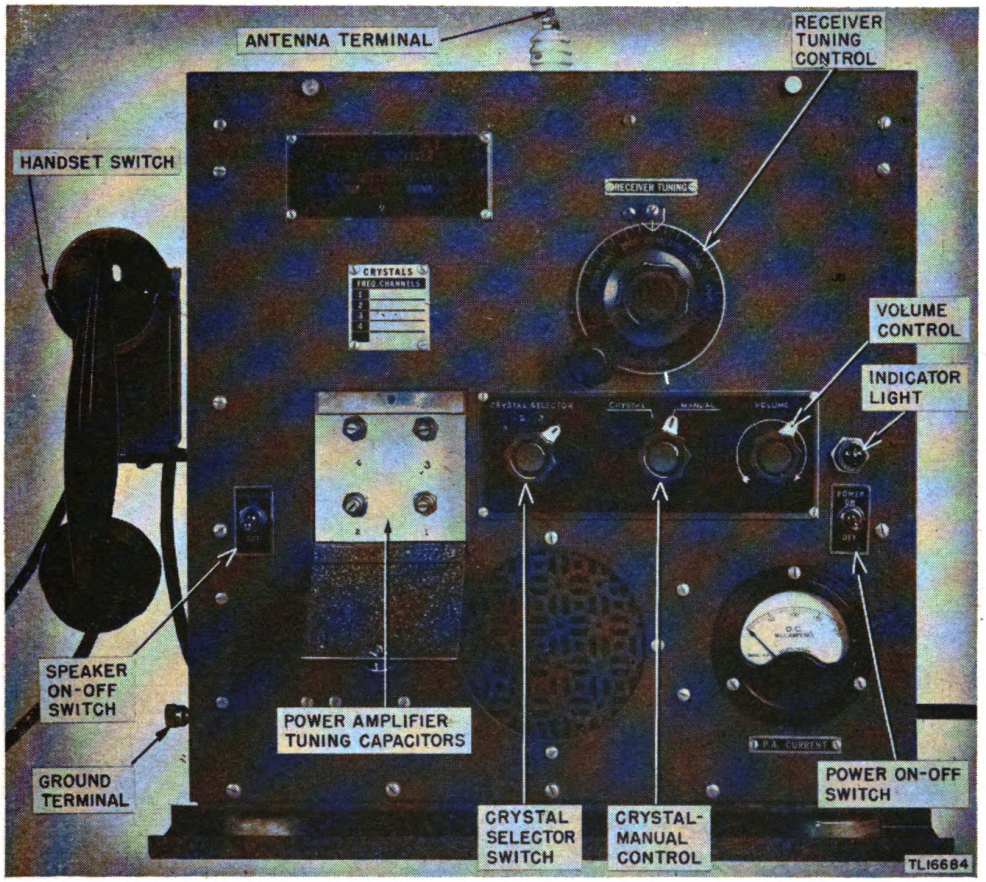


Figure 7. Radio Receiver and Transmitter BC–441–(*)—front panel view showing location of controls.

Section IV. OPERATION

15. Starting Procedure

When the set has been installed as described in part one, put the set into operation by using the starting procedure below:

a. POWER SUPPLY. Determine whether a 115-volt, 60-cycle, single-phase, a-c supply is available. Connect the power cable from the set to this source. Open Radio Receiver and Transmitter BC–441–(*) (par. 7).

Be sure the connecting cable between the upper unit and the power supply is securely plugged into socket TS4, (fig. 25) located in the forward center portion of the power supply unit.

b. TUBES. Check all tubes to see that they are firmly seated and that all grid and plate cap leads are put in place.

c. CRYSTALS. Set the crystals into the sockets (fig. 6) in any desired order and enter the frequencies on the tuning chart on the front panel. Each crystal holder contains two crystals, one for transmitting and one for receiving on the same channel.

16. Receiver Operation

After the radio set has been installed and prepared for use, the receiver may be operated.

a. MANUAL TUNING. Turn switch marked POWER ON-OFF, to ON. The indicating lamp should light. Turn the SPEAKER ON-OFF switch to ON, place the CRYSTAL-MANUAL switch at MANUAL, and turn the VOLUME control to the right until a rushing noise is heard in the speaker. Rotate the RECEIVER TUNING dial to tune in the stations.

b. CRYSTAL CONTROL. Make sure that the crystals are in their sockets (par. 15). Turn the CRYSTAL-MANUAL switch to CRYSTAL and the CRYSTAL SELECTOR switch to the desired channel, indicated on the chart on the front panel (fig. 7). Turn the RECEIVER TUNING dial to the corresponding frequency. Exact tuning will be indicated by a maximum of background noise or signal and will be most noticeable on weak signals. When the signal is strong, turning the RECEIVER TUNING dial will have little effect on reception. Lift the handset from its mounting; the signal will now be heard in the handset receiver.

17. Transmitter Operation

a. Preset the four transmitting channels as described in paragraph 90. After these adjustments have been made, the set is ready for operation with crystal control of the transmitter.

b. To transmit, press the handset press-to-talk switch and speak into the microphone in a normal voice. Speaking too loudly will not damage equipment but may cause some interference with stations on adjacent channels.

18. Stopping Procedure

To turn off the set, place the handset back on its mounting, turn the VOLUME control all the way to the left, and throw the POWER ON-OFF switch to OFF.

19. General Operating Instructions

The operation of Radio Set SCR–281–(*) is basically simple. Familiarity will come with continued use. *Remember the following points:*

a. Check the power source carefully before plugging in the power cord. Radio Set SCR–281–(*) requires a 115-volt, 60-cycle, single-phase alternating current.

b. Check the antenna. Remember the set requires at least a 25-foot antenna.

c. When transmitting speak close to the microphone in a clear voice. Do not shout.

d. Keep transmissions short. Long transmissions allow the enemy's direction finders more time to plot your position.

e. When operating Radio Set SCR–281–(*) on shipboard, take particular care to keep the set dry. This set is not waterproof.

f. When the set is not in use, keep the POWER ON-OFF switch at OFF.

g. Above all, handle the set carefully. Although ruggedly built, this is a precision instrument and requires good treatment in order to be accurate and reliable.

Section V. EQUIPMENT PERFORMANCE CHECK LIST

20. Purpose and Use of Check List

a. General. The equipment performance check list (par. 21) will help the operator to determine whether Radio Set SCR–281–(*) is functioning properly. The check list gives the item to be checked, the conditions under which the item is checked, the normal indications of correct operation, and the corrective measures that the operator can take. Items 1 to 3 are checked before starting, items 4 and 5 when starting, items 6 to 11 during operation, and item 12 when stopping.

b. Action or Condition. For some items the information given in the action or condition column consists of the settings of various switches and controls under which the item is to be checked. For other items it represents an action that must be taken in order to check the normal indication given in the normal indication column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator will perceive when he checks the items. In the case of meter readings, the allowable tolerances of the readings are given. When a meter reads between the limits specified, operation can be considered satisfactory. A meter reading outside the limits given is a sign of impending trouble. If the indications are not normal, the operator should apply the recommended corrective measures.

d. CORRECTIVE MEASURES. The corrective measures listed are those that the operator can make without turning the equipment in for repairs. Reference to part five in the table indicates that the correction of the trouble cannot be effected during operation and that trouble shooting by an experienced repairman is called for. If the set is completely inoperative or if the recommended procedures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible for him to do so.

e. ITEMS 1 TO 5. Items 1 to 5 should be checked each time the equipment is put in operation.

f. ITEMS 6 TO 11. These items represent general operating characteristics of the equipment. The operator must become familiar with the characteristics of the set during normal operation; he must use that knowledge as a basis for recognizing changes in audible and visual indications, such as relay clicks, meter readings, volume control settings, etc., when the set is not operating properly.

g. ITEM 12. When operation is completed item 12 should always be checked to prevent the possibility of leaving the equipment in the ON position unnecessarily.

21. Equipment Performance Check List

	No. Item	Item	Action or condition	Normal Indications	Corrective measures
PREPARATORY	1	Antenna.	Lead-in wire connected. Insulator clean and not cracked.		
	2	Ground.	Terminal clean and tightened on lead.		
	3	Power connection.	Power cable connected to 115-volt, 60-cycle, a-c supply.		
STARTING	4	POWER ON-OFF switch.	Switch to ON position.	Indicator light on panel lights.	Check lamp. Check fuses. Check power cable connections.
	5	SPEAKER ON-OFF switch.	Switch to ON position.	Rushing noise or signals are heard in speaker.	Put POWER ON-OFF switch in ON position. Allow receiver to warm up. Turn volume control clockwise.
EQUIPMENT PERFORMANCE	6	CRYSTAL-MANUAL switch.	Set switch for type of operation desired.		
	7	VOLUME control.	Turn VOLUME control clockwise.	Rushing noise or signals are heard in handset or loudspeaker.	Check POWER ON-OFF switch.
	8	RECEIVER TUNING.	Rotate dial.	Stations are tuned in and out.	Set CRYSTAL-MANUAL switch to MANUAL.
	9	CRYSTAL SELECTOR switch.	Set to desired channel.		
	10	Handset.	Press switch to transmit.	Rushing noise or signals heard in handset disappear when switch is pressed.	Refer to par. 77.
	11	P. A. CURRENT.	Press handset switch.	Meter reads from 110 to 140 ma.	Put POWER ON-OFF switch in ON position. Check antenna connections.
STOPPING	12	POWER ON-OFF switch.	Switch to OFF position.	Indicator light on panel goes out.	

PART THREE

PREVENTIVE MAINTENANCE

Section VI. PREVENTIVE MAINTENANCE TECHNIQUES

22. Meaning of Preventive Maintenance

Preventive maintenance is a systematic series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs and unwanted interruptions in service, and to keep the equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish between preventive maintenance, trouble shooting, and repair. The prime function of preventive maintenance is to *prevent* break-downs and, therefore, the need for repair. On the other hand, the prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. An entire system of radio communication depends upon each set's being *on the air* when it is needed and upon its *operating efficiently*. It is therefore vitally important that radio operators and repairmen maintain their radio sets properly. See TB SIG 123, Preventive Maintenance Practices for Ground Signal Equipment.

Note: The operations in sections VI and VII are first and second echelon (organization operators and repairmen) maintenance. Some operations in sections XII and XIII are higher echelon maintenance.

23. Description of Preventive Maintenance Techniques

a. GENERAL. Most of the electrical parts used in Radio Set SCR–281–(*) require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. Because hit-or-miss maintenance techniques cannot be applied, definite and specific instructions are needed. This section of the manual contains these specific instructions and serves as a guide for personnel assigned to perform the six basic maintenance operations namely: Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the lettering system for the six operations will be as follows:

F—Feel*	C—Clean
I—Inspect	A—Adjust
T—Tighten	L—Lubricate

*The Feel operation is inapplicable to Radio Set SCR–281–(*).

The first two operations establish the need for the other four. The selection of operations is based on a general knowledge of field needs. For example, the dust encountered on dirt roads during cross-country travel filters into the equipment no matter how much care is taken to prevent it. Rapid changes in weather (such as heavy rain followed by blistering heat), excessive dampness, snow, and ice tend to cause corrosion of exposed surfaces and parts. Without frequent inspections and the necessary performance of tightening, cleaning, and lubricating operations, equipment becomes undependable and subject to break-down when it is

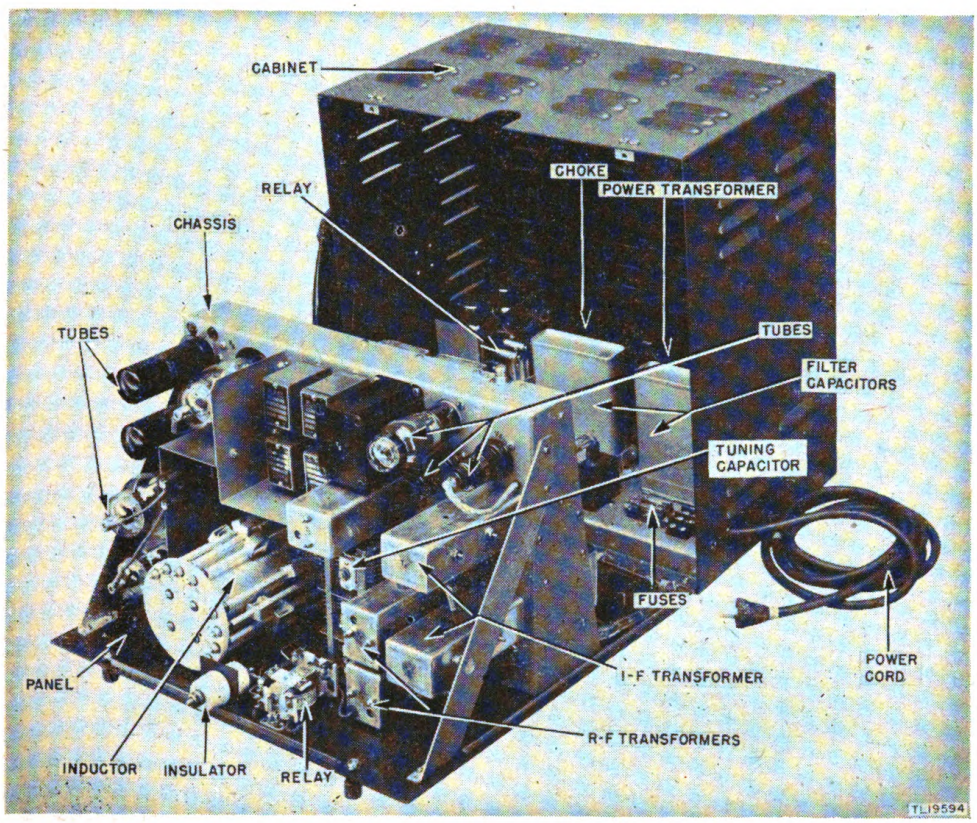


Figure 8. Typical components of Radio Set SCR–281–(*) requiring preventive maintenance.

most needed. Figures 8 and 9 show typical components requiring preventive maintenance.

b. INSPECT. Inspection is the most important operation in the preventive maintenance program. A careless observer will overlook evidences of minor trouble. Although these defects may not interfere with performance of the equipment, valuable time and effort can be saved if they are corrected *before* they lead to major break-downs. Make every effort to become thoroughly familiar with indications of *normal* functioning, to be able to recognize the signs of a defective set. Inspection consists

of carefully observing all parts of the equipment, noticing their color, placement, state of cleanliness, etc. Inspect for the following conditions:

(1) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

(2) Placement, by observing that all leads and cabling are in their original positions.

(3) Cleanliness, by carefully examining all recesses in the units for accumulation of dust, especially between connecting terminals. Parts,

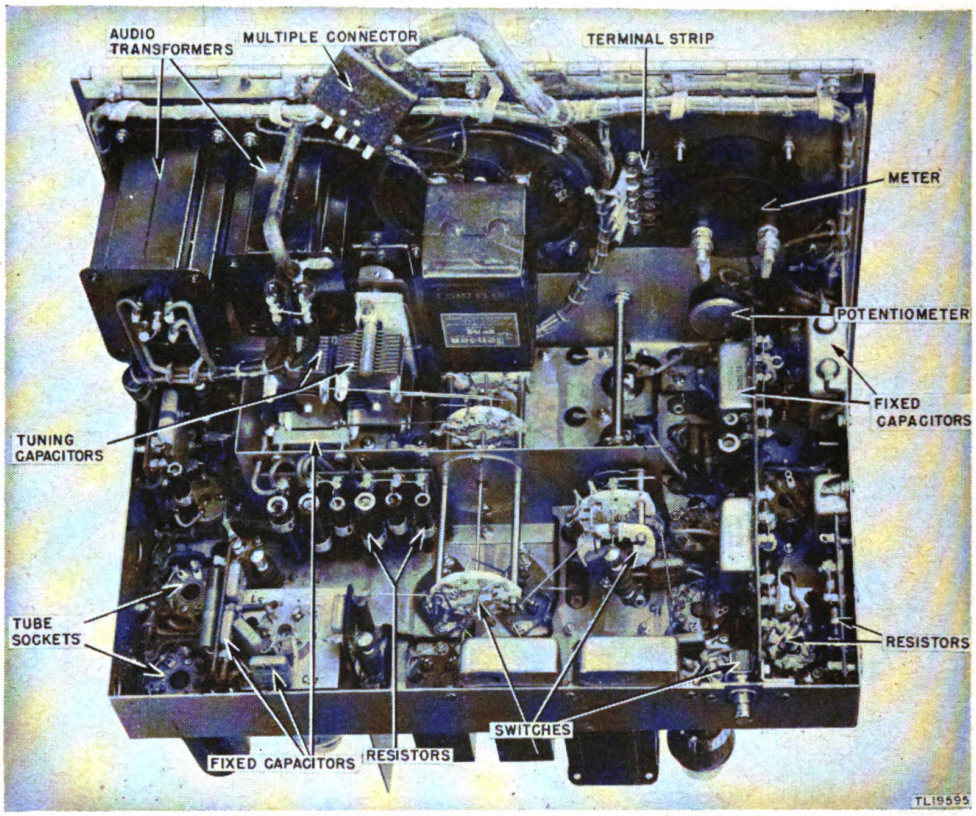


Figure 9. Typical components of Radio Set SCR–281–(*) requiring preventive maintenance.

connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity locations, look for fungus growth and mildew.

(4) Tightness, by testing any connection or mounting which appears to be loose.

c. TIGHTEN, CLEAN, AND ADJUST. These operations are self-explanatory. Specific procedures to be followed in performing them are given wherever necessary throughout part three.

Caution: Screws, bolts, and nuts should not be tightened carelessly.

Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

Whenever a loose connection is tightened, it should be moistureproofed and fungiproofed again by applying the varnish with a small brush. See section IX for details of moistureproofing and fungiproofing.

d. LUBRICATE. Lubrication refers to the application of grease or oil to the bearings of motors or other rotating shafts. It may also mean that application of a light oil to door hinges or other sliding surfaces on the equipment.

24. Vacuum Tubes

Note: Avoid doing work on the tubes immediately after shut-down. Severe burns may result from contact with the envelopes of hot tubes.

a. INSPECT (I). (1) Inspect glass and metal tube envelopes, tube caps, and tube connector clips for accumulation of dirt and for corrosion. When tubes with loose plate or grid caps or envelopes are found, replace if possible.

(2) The spring clips that make contact with the grid caps must be examined for corrosion for loss of tension with resulting looseness. Also check the condition of the wires soldered to the spring clips. The wires should be free of frayed insulation or broken strands.

(3) Inspect the firmness of tubes in their sockets. This is accomplished by pressing the tubes down in the sockets and testing them in that position, and *not* by partially withdrawing the tubes and jiggling them from side to side. Movement of a tube tends to weaken the pins in the base and unnecessarily spread the contacts in the socket. It is desirable to inspect the sockets of the tubes at the time the tubes are removed.

(4) When it is necessary to remove a tube from its socket, especially if it is a high-power tube, great care must be used. Never jar a warm tube. Connections to the grid and plate caps must always be removed.

b. TIGHTEN (T). Tighten all loose connections to the tube sockets or to the tubes. If the connections are dirty or corroded, clean before tightening. When tightening locknuts that hold the sockets in the insulated bushings, do not apply excessive pressure. Too much pressure will crack the bushings.

c. CLEAN (C). (1) Clean the tubes, but only if inspection shows cleaning to be necessary. Tubes operated at high voltages and with exposed plate and grid connections must be kept free of dirt and dust because of possible leakage between grid and plate terminals. In contrast, tubes operating at low voltages and not having exposed grid and plate caps do not require frequent cleaning. However, do not permit dirt to accumulate on low-voltage tubes.

(2) Remove dust and dirt from the glass or metal envelopes with a

clean, lint-free, dry cloth. If proper care is exercised, the grid and plate caps may be cleaned with a piece of #0000 sandpaper. Wrap the paper around the cap and *gently* run along the surface. Excessive pressure is not needed; neither is it necessary to grip the cap tightly. Wipe with a clean dry cloth.

(3) When tube sockets are cleaned and the contacts are accessible, fine sandpaper may be used to remove corrosion, oxidation, and dirt.

d. ADJUST (A). Adjust loose tube connector clips. Do not flatten tube connector clips during adjustment. Flattened clips do not make adequate contact with the surface of the tube cap. If the clip is made of thin metal, it can be adjusted by gently compressing it with the fingers. If it is made of heavy-gauge metal, suitable pressure can be applied with a pair of long-nose pliers.

25. Capacitors

a. INSPECT (I). (1) Inspect the terminals of large fixed capacitors for corrosion and loose connections. Carefully inspect the mountings to discover loose mounting screws, studs, or brackets. Examine the leads for poor insulation, for cracks, and for evidences of dry rot. Frayed strands on the insulation should be cut away. If the wire is exposed, wrap it with friction tape. The terminals of the capacitors should not be cracked or broken.

(2) Thoroughly inspect the case of each large fixed capacitor for leaks, bulges, and discoloration.

(3) Inspect the plates of variable capacitors for dirt, dust, or lint. Examine the movable set of plates for signs of damage or misalignment that would cause them to touch the fixed plates during tuning. Rotate the movable plates, using the panel tuning control, and thus check for proper operation of the capacitor.

b. TIGHTEN (T). Tighten loose terminals, mountings, and connections on the capacitors, whenever they are observed. Do not break the bushing or damage the gasket.

c. CLEAN (C). (1) Clean the case of fixed capacitors, the insulating bushings, and dirty or corroded connections. The capacitor cases and bushings can usually be cleaned with a dry cloth, but if the deposit of dirt is hard to remove, moisten the cloth in a dry-cleaning solvent.

(2) Clean the plates of variable capacitors with a small soft brush, removing all dust and lint.

d. LUBRICATE (L). The bearings of variable capacitors are usually of the ball-bearing type, lubricated and sealed at the factory. These bearings will *not* need relubrication during the life of the equipment.

26. Resistors

a. GENERAL. Various types of resistors are used in Radio Set SCR–281–(*). The connections to the various resistors are either of the pigtail or solder lug type.

b. INSPECT (I). Inspect the coating of the vitreous-enamelel resistors for signs of cracks and chipping, especially at the ends. Examine the bodies of all types of resistors for blistering, discoloration, and other indications of overheating. Inspect leads and all other connections for corrosion, dirt, dust, looseness, and broken strands in the connecting wires. Check the security of all mountings. Do not attempt to move resistors with pigtail connections, because there is danger of breaking the connections at the point where they enter the body of the resistor. Such defects cannot be repaired.

c. TIGHTEN (T). Tighten resistor connections and mountings whenever they are found loose. If a resistor is allowed to remain loose, vibration may break the connection or damage the body.

d. CLEAN (C). (1) Clean all carbon resistors with a small brush.

(2) The vitreous-enameled resistors must be kept clean to avoid leakage between the terminals. They will ordinarily be wiped with a dry cloth. However, if the dirt deposit is unusually hard to remove, use a dry-cleaning solvent.

(3) Resistors with discolored bodies cannot be cleaned. Discoloration indicates that there has been overloading and overheating at some time prior to the inspection. The discoloration is probably due to circuit trouble which requires analysis and correction. Trouble-shooting procedures are described in part five.

27. Fuses

a. GENERAL. Fuses used in Radio Set SCR–281–(*) have glass cases. Fuses should be thrown away when they blow. The glass case fuses are easily removed for inspection. See that the fuse ends and holding clips are kept clean and tight. If they are not, arcing and burning will occur and make the replacement of the complete holder necessary.

b. INSPECT (I). Inspect the fuse caps for evidence of burning, charring, and corrosion; the fuse clips for dirt, loose connections, and proper tension.

c. TIGHTEN (T). The tension of the fuse clips may be increased by pressing the sides closer together. If necessary, use a pair of pliers to adjust the tension.

d. CLEAN (C). Clean fuse ends and fuse clips with emery cloth; then wipe them with a clean cloth. When using a file to remove deep pits on

the clips, fuse ends, or contacts, always finish up with emery cloth in order to leave a smooth contact surface. As a final step, wipe the surface with a clean, dry cloth.

28. Bushings and Insulators

a. DESCRIPTION. (1) Insulated bushings are used in the high-voltage and r-f (radio-frequency) circuits. They are constructed of ceramic material with a glazed surface. An insulator is no better than its surface, so deposits of foreign substances on the surface will materially reduce the insulation value of the bushing. Therefore, it is very important that all bushings used in the high-voltage circuits be inspected frequently.

(2) Insulating bushings are used as supports for high-voltage tube sockets, for high-voltage terminals of capacitors, and for tank coils. They are used as mountings for resistors in high-voltage circuits and as supports for panels which mount other parts. The condition of insulator bushings that are used solely as panel supports is not too critical, but the condition of bushings used as high-voltage insulators is extremely important.

b. INSPECT (I). Inspect the physical condition of the insulator bushings. They should be clean without cracks or chips. It is posssible for a highly glazed insulator to develop fine-line surface cracks where moisture and dust will accumulate and eventually form a leakage for a high-voltage flash-over. Consequently, the surface of the bushings must be inspected to detect such cracks. As a rule, the bushings are held in position with nuts screwed onto the threaded conductors. These can be replaced very easily. If replacement is not possible because of a shortage of supplies, frequently clean the defective bushing thoroughly with dry-cleaning solvent. Sometimes it is difficult to see dust on a glazed surface. A satisfactory check can be made by sliding a clean finger across the bushing.

c. TIGHTEN (T). The procedure to be used in tightening loose bushings is self-evident. However, one precaution must be observed. *Avoid forcing the nuts or screws down too tight.* If excessive pressure is exerted on the bushings, damage or breakage is almost certain. Sometimes the threads on bushing stud bolts may be found stripped so they cannot be tightened. The only solution is replacement of the entire bushing.

d. CLEAN (C). Insulating bushings are easily cleaned. Never use abrasive materials because the glazed finish will be destroyed, thus permitting moisture to be absorbed. A clean cloth is usually satisfactory. If deposits of grime or dirt on the surface of a bushing are hard to remove, use dry-cleaning solvent. After the surface has been cleaned with a solvent, it should be carefully polished with a dry cloth. Otherwise, a thin film of the solvent will be left which may impair the effectiveness of the bushing as a high-voltage insulator.

29. Relays

A relay is considered normal if: the exterior is free from dirt or dust; the contacts are not burned, pitted, or corroded; the contacts are lined up and correctly spaced; the moving parts travel freely and function in a satisfactory manner; the connections to the relay are tight; the wire insulation is not frayed or torn; the relay assembly is securely mounted; the field coil shows no signs of overheating.

a. INSPECT (I). (1) Inspect the relay to detect defects. The contacts may be examined with the aid of a flashlight and mirror.

(2) The mechanical action of the relays should be checked to make certain that when the moving and stationary contacts come together they make positive contact and are directly in line with each other.

b. TIGHTEN (T). Tighten all loose connections and mounting screws, but do not apply enough force to damage the screw or to break the parts it holds.

c. CLEAN (C). (1) *Relay exterior.* Brush the exterior of the relay with a soft brush. If it is very dirty, clean it with a brush dipped in dry-cleaning solvent. If loose connections are found, clean and tighten them. If they are dirty or corroded, remove and clean them and replace carefully.

(2) *Relay contacts.* (*a*) *Hard-alloy contacts.* Hard-alloy contacts are cleaned by drawing a strip of thin, clean cloth or paper between them while holding them together. In some cases, it may be necessary to moisten the cloth with dry-cleaning solvent. Use a dry cloth or paper strip for polishing. Corroded, burned, or pitted contacts must be cleaned with the point file or burnishing tool and crocus cloth.

(*b*) *Solid-silver contacts.* Solid-silver contacts on relays are easily cleaned with a cloth or brush dipped in dry-cleaning solvent, or by rubbing lightly with crocus cloth. After cleaning, polish the contacts with a dry cloth.

30. Switches

a. INSPECT (I). (1) Inspect the mechanical action of each switch and, while so doing, look for signs of dirt or corrosion on all exposed elements. In some cases, it will be necessary to examine the elements of the switch visually; in others, check the action of the switch by flipping the control knob or toggle, or press the switch button and note the freedom of movement and amount of spring tension.

(2) Examine ganged switches to see if they are properly lubricated and contacts are clean. Inspection is visual. Do not pry the leaves of the switch apart. The rotary members should make good contact with the stationary members; and as the former slides into the latter, a spreading of the stationary contact leaves should be visible. Switch action should

be free. Wiping action of contacts usually removes any dirt at the point of contact.

b. CLEAN (C). Clean the exterior surfaces of switches with a stiff brush, moistened with dry-cleaning solvent.

c. LUBRICATE (L). If necessary, lubricate bearings or detent mechanism with Oil, Lubricating, Preservative, Special, U. S. Army Specification 2–120 (par. 53).

Caution: Apply oil sparingly with a pipe cleaner or small brush. Wipe off the excess with a cloth. Oil forms an insulating film; keep it off contacts.

31. Potentiometers

a. INSPECT (I). (1) Inspect the mechanical condition of the potentiometers. The arm should be keyed tightly to the shaft, and the shaft should turn easily in the bushing which supports it.

(2) Inspect the assembly and mounting screws, setscrews, and nuts.

(3) Examine the insulating body of the potentiometer for dust, dirt, cracks, and chipped places.

(4) Examine all metallic parts for dust, dirt, and corrosion.

b. TIGHTEN (T). Tighten loose assembly or mounting screws.

c. CLEAN (C). (1) Clean the exposed contact surfaces of the potentiometer and the connections, whenever they are found in a dirty or corroded condition.

(2) Remove grease and dirt from the parts with dry-cleaning solvent.

(3) If the contact surfaces are corroded, clean them with crocus cloth.

(4) Clean the contact surface of the arm by inserting a strip of crocus cloth between the arm and the winding and drawing the cloth back and forth.

32. Transformers and Chokes

a. INSPECT (I) Inspect all transformers for loose mounting bolts. Check the terminals to see that they are clean and tight. Examine the cases of power transformers and chokes for signs of overheating such as discoloration or blisters. Check cases and terminals for dirt, dust, and corrosion.

b. TIGHTEN (T). Tighten all mounting screws and terminal connectors. Keep core bolts of power transformers and chokes tight to avoid noise from loose laminations.

c. CLEAN (C). Clean the case and terminal strip with a soft cloth and brush. If terminals are corroded, clean them with a piece of #0000 sandpaper. Clean i-f and r-f transformer shield cans, being careful not to change the position of alignment adjustments,

33. Terminal Strips

a. INSPECT (I). Inspect the terminal strips for loose connections. Examine for dust, dirt, and corrosion. If connections to terminal strips are found to be misaligned to such an extent that a short circuit might result, correct this condition.

b. TIGHTEN (T). Tighten any loose or poor connections. Be certain that connections are clean before tightening. Tighten any loose terminal strip mountings.

c. CLEAN (C). Clean corrosion from connections with #0000 sandpaper. Use a soft brush to remove dust and dirt. If accumulations of dust and dirt are difficult to remove, dip the brush in dry-cleaning solvent.

34. Meters

a. INSPECT (I). Inspect the meter for general cleanliness. Look for poor or loose connections to the meter. Check to see that the meter reads 0 when the power is turned off.

b. TIGHTEN (T). Tighten all loose meter mountings. Tighten loose meter connections. Be sure meter connections are clean before tightening. Use caution while tightening connections to avoid damaging the meter case or stripping the threads on the meter studs or nuts.

c. CLEAN (C). Remove dust and dirt from the meter with a clean, dry cloth. Clean corrosion from meter connections with #0000 sandpaper.

d. ADJUST (A). Adjust the meter so that it reads 0 with all the power turned off. Adjustment to the meter should be made before cleaning because the friction of a clean, dry cloth on the meter glass often sets up static charges on the meter glass which deflects the needle and gives the impression that the meter is out of adjustment. If a meter is adjusted when a static charge is on the glass, the meter will not read correctly when the static charge drains off.

35. Cords and Cables

The cables in Radio Sets SCR–281–(*) are the life lines of the equipment. Condition of the cabling must be closely observed. Equipment operated in all kinds of weather, and moved on all kinds of roads, subjects cabling to a great deal of punishment.

a. INSPECT (I). Inspect the cables for cracked or deteriorated insulation, frayed or cut insulation at the connecting and supporting points, and improper placement which places the cables or connections under strain. Also watch for kinks and improper supports.

b. TIGHTEN (T). Tighten loose cable clamps, coupling rings, and cable connections.

c. CLEAN (C). Clean connections on cables when they are dirty or

corroded. Clean corroded connectors with #0000 sandpaper. It is important that the entire surface of the connector be cleaned. No attempt should be made to remove individual prongs from cable plugs.

36. Plugs

Plugs require very little attention, and then only at infrequent intervals. Occasionally it will be necessary to clean the contacts, or increase the spring tension. Remove dirt with a brush and dry-cleaning solvent; remove corrosion with a piece of crocus cloth followed by a clean cloth. Increase spring tension, when necessary. It is recommended that the action of the plug be tried after each adjustment. Be careful to keep all soldered connections intact. For cleaning telephone type plugs use Polish, Metal, or Paste, Signal Stock No. 6G1516. After cleaning, remove all traces of polish remaining on the plugs.

37. Pilot Lights

a. INSPECT (I). Pilot lights indicate when power is applied to the equipment. Inspect pilot lights for loose connections or corroded contacts. Pilot lamps whose glass has become blackened through use should be replaced since this blackening is an indication that the lamp has been in service for its expected life term. Inspect lamps to see that they are tight in their sockets.

b. TIGHTEN (T). Tighten loose pilot lamp mountings and loose connections.

c. CLEAN (C). Clean pilot light reflector glass. Wipe dust from pilot lamps. Remove corrosion from pilot light contacts and connections with #0000 sandpaper.

38. Multiple Connectors

a. INSPECT (I). Inspect multiple connectors for loose connections, dirt, and corrosion. Look for bent or loose fitting pins. Examine for broken strands of wire at the connections to the pins. Solder loose strands to the pins or the adjacent wires of the same lead. Wrap the exposed wires with tape to avoid short circuits.

b. CLEAN (C). Clean dust and dirt from the multiple connectors with a soft brush. Accumulations of dirt that are not readily removed with a dry brush may be removed by dipping the brush in dry-cleaning solvent. Corrosion at the pins will result in poor contact. Remove corrosion with #0000 sandpaper. Do not attempt to remove individual pins from the connector.

39. Rotary Shafts

a. INSPECT (I). Inspect rotating shafts for cleanliness and corrosion. Examine the bearing surfaces of the shafts for need of lubricant.

b. CLEAN (C). Remove all dirt and dust from the rotating shafts with a clean, dry cloth. Rust and corrosion should not be permitted to accumulate. Remove all corrosion and rust with #0000 sandpaper.

c. LUBRICATE (L). Do not lubricate unless binding occurs. If lubricant is necessary, apply one drop of Oil, Lubricating, Preservative, Special, U. S. Army Specification 2–120 on shaft bearings. Wipe off all excess lubricant with a clean, lint-free cloth.

40. Knobs and Controls

a. INSPECT (I). Inspect all knobs and controls for cleanliness and tightness. See that knobs do not bind on the panel.

b. TIGHTEN (T). Tighten all loose knobs. If a knob is found to be rubbing on the panel, loosen the knob, move it back on the shaft, and tighten it in place. Controls which do not operate freely should be investigated. If the cause for trouble is of such a nature that it cannot be corrected in a few minutes, it should be reported to a higher echelon for trouble shooting and repair.

c. CLEAN (C). Remove all dust and dirt from knobs with a clean, dry cloth.

41. Cabinets, Chassis, and Mountings

a. INSPECT (I). Inspect for dirt, rust, and corrosion. Look for loose screws, nuts, and bolts. Make certain that adjustments on coils and capacitors are not mistaken for screws. If such adjustments are tampered with, the operation of the equipment will be impaired.

b. TIGHTEN (T). Tighten all loose mounting screws, nuts, and bolts on the cabinets, chassis, and mountings.

c. CLEAN (C). Remove all dust and dirt from the cabinets, chassis, and mountings. Use #0000 sandpaper to remove rust and corrosion. Use touch-up paint to cover bare metal spots.

42. Antennas

a. INSPECT (I). Inspect the antennas and their connections for general cleanliness. Look for rust and corrosion. Examine the antenna mounting base for loose bolts. Examine the antenna insulators for cracks and other signs of deterioration. Cracked insulators must be replaced at the earliest opportunity. See that antenna lead-in wires have no sharp right-angle bends.

b. TIGHTEN (T). Tighten loose mounting bolts. Tighten loose antenna lead-in clamps and all connections.

c. CLEAN (C). Remove all dust, dirt, and other foreign matter from the antenna, antenna lead-in wire, connectors, and mountings. Use #0000 sandpaper to remove rust or corrosion from the antenna and mounting. Touch up bare metal spots with touch-up paint. Clean antenna insulators with a clean cloth dampened in dry-cleaning solvent. Wipe dry and polish with a clean, dry cloth.

43. Inductors

a. INSPECT (I). Inspect all inductors for general cleanliness. Look for poor or loose connections at the terminals. Check for loose or shorted turns, charred insulation, and charred or blistered forms. Check to see that each tap on the p-a inductor contacts only one turn.

b. TIGHTEN (T). Tighten all loose connections. In tapped inductors with screw connections to the taps, be very careful not to tighten the screws too tightly as damage to the turns of the inductor will result.

c. CLEAN (C). Clean inductors with a soft brush. Use #0000 sandpaper to remove corrosion from the terminals. Be careful to avoid damaging the turns of the inductor.

Section VII. ITEMIZED PREVENTIVE MAINTENANCE

44. Introduction

For ease and efficiency of performance, preventive maintenance on Radio Set SCR–281–(*) will be broken down into operations that can be performed at different time intervals. In this section the preventive maintenance work to be performed on the radio set at the specified time intervals is broken down into units of work called items. The general techniques involved and the application of the FITCAL operations in performing preventive maintenance on individual parts are discussed in section VI. These general instructions are not repeated in this section. When performing preventive maintenance, refer to section VI if more information is required on the following items. All work is to be performed with the power removed from the equipment. After preventive maintenance has been performed on a given day, the equipment should be put into operation and checked for satisfactory performance. (See par. 21.)

45. Common Materials Needed

The following materials will be needed in performing preventive maintenance:

Common hand tools (TE–41 or equivalent).
Clean, soft rags

Water
Camel's-hair brush
Metal polish
Emery cloth
#0000 sandpaper
Set of socket wrenches

Note: Gasoline will not be used as a cleaning fluid for any purpose. Solvent, Dry-cleaning, Federal Specification P–S–661a, is available as a cleaning fluid, through established supply channels. Oil, Fuel, Diesel, U. S. Army Specification 2–102B, may be used for cleaning purposes when dry-cleaning solvent is not at hand. Carbon tetrachloride, or fire-extinguishing liquid (carbon tetrachloride base), will be used, if necessary, *only on contact parts of electronic equipment.*

46. Item 1, Exterior of Radio Receiver and Transmitter BC–441–(*)

OPERATIONS.

ITC	Cabinet.
ITC	Knobs and controls.
ITC	Meter (exterior panel side only).

REMARKS. These operations should include only those which can be accomplished without opening the cabinet.

47. Item 2, Cords and Cables

OPERATIONS.

ITC	Cords and cables.
ITC	Multiple connectors.

48. Item 3, Receiver and Transmitter Unit

ITCA	Vacuum tubes.
ITC	Capacitors.
ITC	Inductors.
ITC	Resistors.
ITC	Terminal strips.
ICL	Rotary shafts.
ITCAL	Switches.
ITC	Resistors and potentiometers.
ITCA	Meter.
ITCA	Relays.
ITC	Pilot light.

49. Item 4, Power Supply

ITCA	Vacuum tubes.
ITC	Capacitors.

ITC Transformers.
ITC Resistors.
ITC Terminal strips.

50. Item 5, Antenna Tuning Unit BC–619–A

ITC Cabinet, chassis, and mountings.
ITCA Relays.
ITC Capacitors.
ITC Inductors.

51. Item 6, Antenna

ITC Antenna.

52. Preventive Maintenance Check List

a. GENERAL. The following check list is a summary of the preventive maintenance operations to be performed on Radio Set SCR–281–(*). The time intervals shown on the check list may be reduced at any time by the local commander. For best performance of the equipment, perform operations at least as frequently as called for in the check list. The echelon column indicates which operations are first echelon maintenance and which operations are second echelon maintenance. Operations are indicated by the letters of the word FITCAL. For example, if the letters ITCA appear in the "Operations" column, the item to be treated must be inspected (I), tightened (T), cleaned (C), and adjusted (A).

b. PREVENTIVE MAINTENANCE CHECK LIST.

Item No.	Operations	Item	When performed							
			Before operation	After operation	Daily	Weekly	Monthly	Semi-annually	Yearly	Echelon
1	I T C	Exterior of Radio Receiver and Transmitter BC–441–(*)			x					1st
2	I T C	Cords and cables			x					1st
3	I T C A	Receiver and Transmitter unit				x				2d
4	I T C A	Power supply				x				2d
5	I T C A	Antenna tuning unit				x				2d
6	I T C	Antenna				x				2d

F Feel* I Inspect T Tighten C Clean A Adjust L Lubricate

* The Feel operation is inapplicable to Radio Set SCR–281–(*).

Section VIII. LUBRICATION

53. Radio Set SCR–281–(*)

No War Department Lubrication Order is furnished for Radio Set SCR–281–(*). Lubrication, where required, is specified in section VII under the respective components. The following lubricants are used in Radio Set SCR–281–(*).

Product symbol	Nomenclature	Specification	Issuing service	Mean Atm temp for use	Container size	ASF supply catalog No.
PS	Oil, Lubricating, Preservative, Special	U. S. Army 2–120	Ord	Above 70°F	2 oz. can	14–C–2883–992
GL	Grease, Lubricating, Special	Ord AXS637 (revision 1)	Ord	Above 40°F	8 oz. tube	14–G–1196–400
SD	Solvent, Dry-cleaning	Federal P–S–661a (Amend. 1)	QMC	Below flash point	1 gal. can	51–S–4385–1

54. Antenna Tuning Unit BC–619–A

No lubrication is necessary on Antenna Tuning Unit BC–619–A.

Section IX. MOISTUREPROOFING AND FUNGIPROOFING

55. General

When operated in tropical areas where temperature and relative humidity are extremely high, Signal Corps equipment requires special attention. These are some of the problems met:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

b. Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

c. Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

56. Treatment

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against

fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

Caution: Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

57. Radio Set SCR–281–(*)

a. PREPARATION. Test the unit thoroughly and make all repairs, replacements, and adjustments necessary for the proper operation of the equipment.

b. DISASSEMBLY. (1) Loosen the two knurled nuts on the top edge of the front panel.

(2) Lower the front panel by rotating 90° about its hinge.

(3) Disconnect plug TS–5 (fig. 28) which connects the panel components to the lower unit mounted in the bottom of the case.

(4) Remove the front panel from the case by removing the fastening screws located on the case side of the hinge.

(5) Remove the power unit from the case by disconnecting the power and handset cords and removing the screws which hold the unit in the case.

(6) Remove the shockproof mounting feet.

(7) Remove the handset switch from the side of the case by removing the two mounting bolts.

(8) Remove the four crystal holder assemblies from their respective sockets.

(9) Remove the fuses from the clips located on the power chassis.

(10) Remove the tubes from their sockets, and mark them so that they can be replaced in their original positions.

Note: All screws and nuts should be replaced immediately after removal of attached parts. This will facilitate the reassembly of the unit after spraying. All electrical connections (screws, nuts, and mounting screws) must be tightened before spraying.

c. CLEANING. Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

Note: The cleaning operation must be thorough or the effectiveness of the moistureproofing and fungiproofing treatment will be reduced.

d. Masking Top of Receiver and Transmitter Chassis (fig. 10). Mask the following components:

Note: The following subparagraph numbers correspond to the part numbers on figure 10.

(1) R-f inductor. Mask by molding paper around the coil, holding the paper in place with masking tape.

(2) Tuning capacitor and trimmer capacitors on top of the tuning capacitor. Use paper held in place by masking tape.

(3) Top of all vacuum-tube sockets.

(4) All grid and plate clip leads.

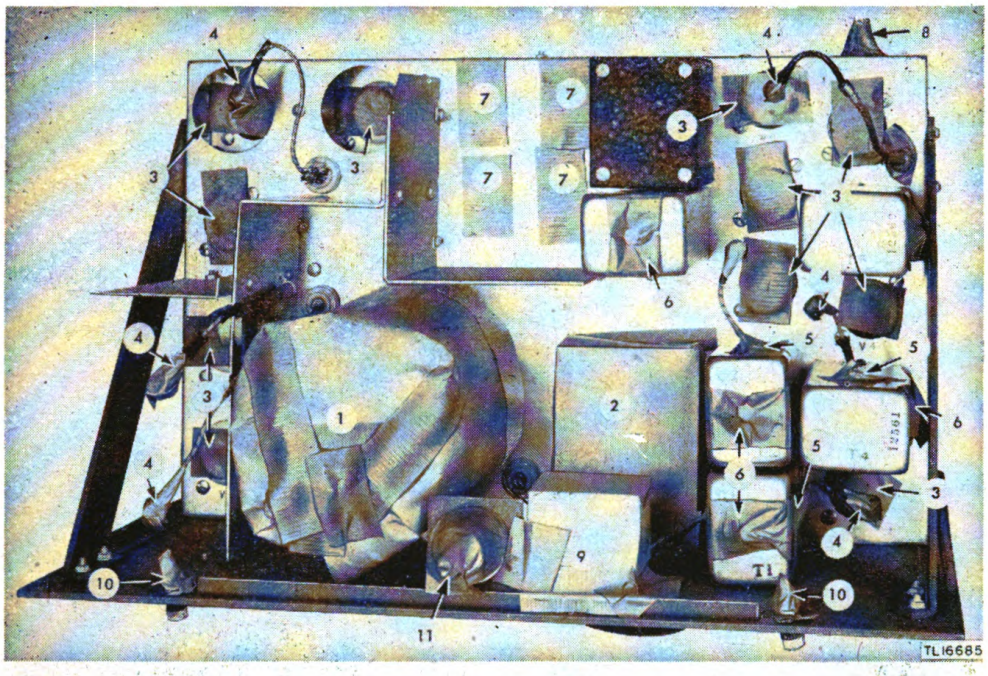


Figure 10. Radio Receiver and Transmitter BC–441–(*), masked r-f chassis—top view.

(5) Rubber grommets on transformer cans. Varnish is injurious to rubber.

(6) Trimmer screws on transformer cans. Tape must completely seal holes.

(7) Crystal sockets.

(8) Interlock switch.

(9) Antenna change-over relay with paper and tape.

(10) The two knurled nuts on the top of the front panel.

(11) Porcelain antenna insulator.

e. Masking Bottom of Receiver and Transmitter Chassis (fig 11). Mask the following components:

(1) Power-amplifier plate tuning capacitors. Mold paper around

capacitors making certain that shafts and bearings are protected from varnish spray. Fasten paper in place with masking tape.

(2) Bottom of the four crystal sockets.

(3) Bottom of sockets for the three Tubes JAN–807.

(4) Crystal rotary switch and crystal rotary selector switch with paper and masking tape.

(5) Interconnecting plug.

(6) Terminal strip.

(7) Both sides of the panel support hinge located along the bottom of the panel.

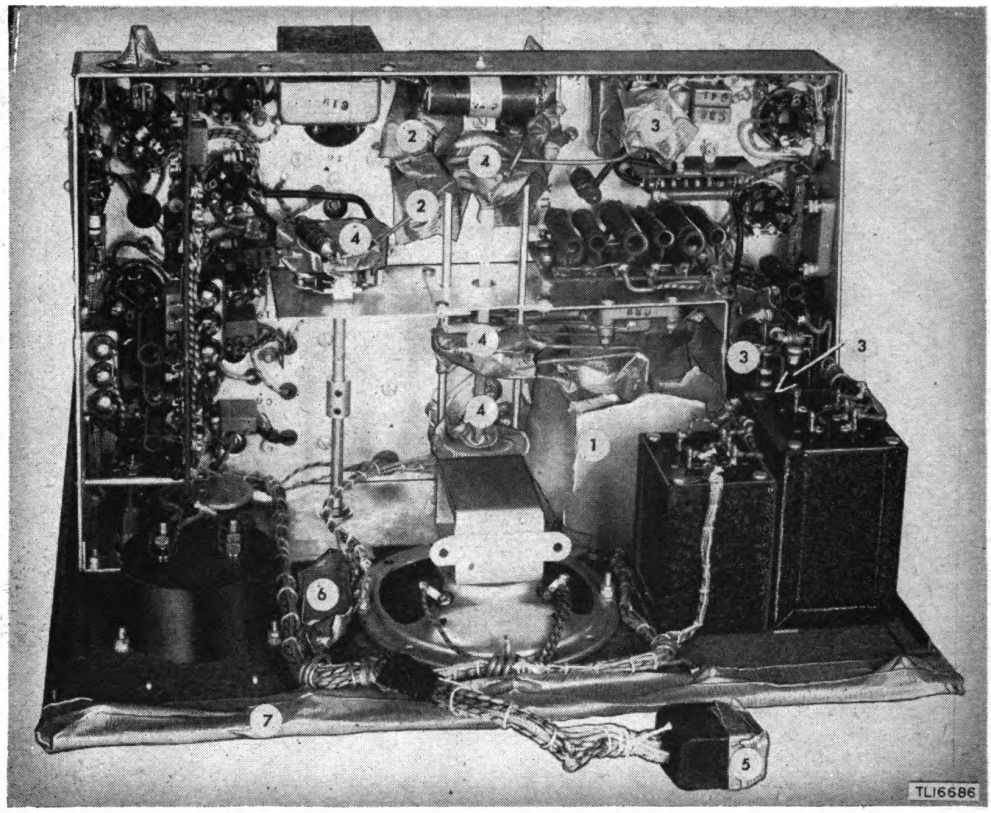


Figure 11. Radio Receiver and Transmitter BC–441–(*), masked chassis—bottom view.

f. Masking Power Chassis (figs. 12 and 13). Mask the following components:

(1) Fuse clips.

(2) Terminal screws on the power and handset terminal strips.

(3) Interconnecting plug receptacle.

(4) Two relays.

(5) Tube sockets.

(6) Bottom of tube sockets (fig. 13).

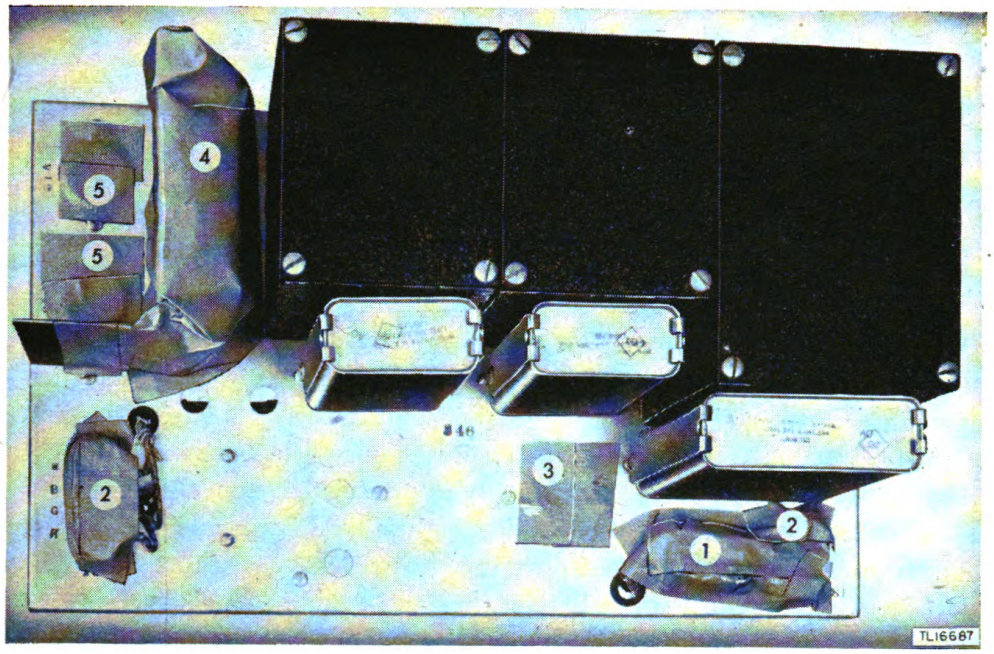


Figure 12. Radio Receiver and Transmitter BC–441–(*), masked power chassis—top view.

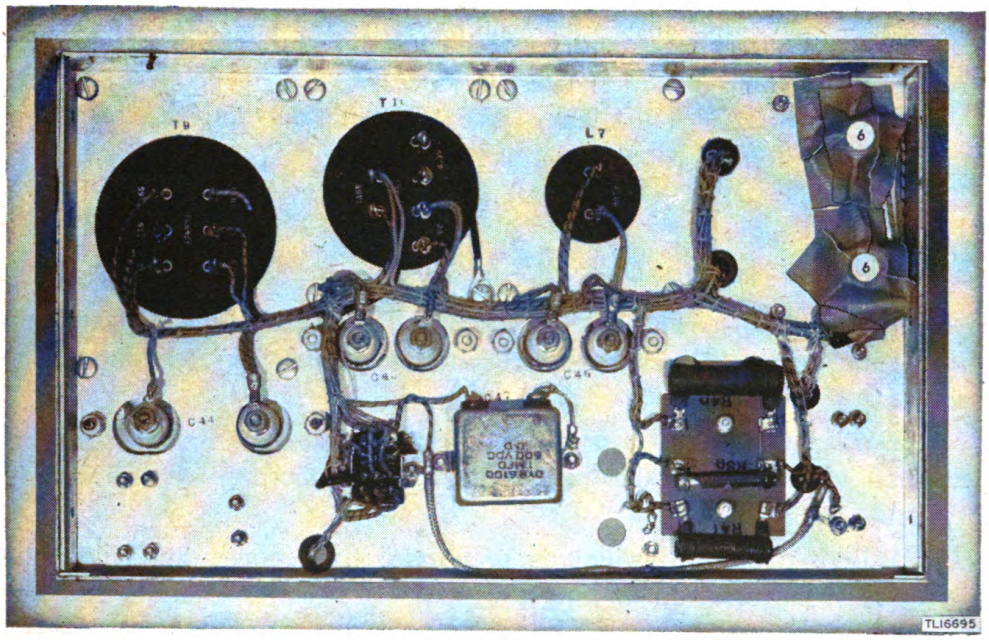


Figure 13. Radio Receiver and Transmitter BC–441–(*), masked power chassis—bottom view.

g. MASKING THE CASE. Mask grounding terminal binding post located on lower left-hand side of case.

h. DRYING. Place the equipment to be treated in a drying oven and bake for 4 to 6 hours at a temperature of 140° F.

Caution: Do not exceed 140° F. If the wax in any component begins to melt, decrease the temperature and increase the drying time 1 hour for each 10° F decrease in temperature. If heat lamps are used as a heat source, they must be baffled so that the direct rays from the lamp do not strike the equipment being dried.

i. VARNISHING. (1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71–2202 (Stock No. 6G1005.3), or equal) with a spray gun. Allow each coat to air-dry for 15 or 20 minutes before applying the next coat.

(2) After each coat of varnish, inspect the equipment and with a brush touch up any points that the spray failed to reach.

(3) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment Varnish applied over the moisture peels off readily after the varnish has dried.

Caution: Do not varnish the handset, the handset switch, the front of the panel, or the outside of the case.

j. REASSEMBLY. (1) Remove all masking tape after the varnish is completely dry. Be careful not to peel varnish from nearby areas.

(2) Clean and burnish all contacts.

(3) Check all switches and variable capacitors for free operation.

(4) Reassemble the set and test its operation.

k. MARKING. Mark the letters MFP and the date of treatment near the nameplate on the front panel of the equipment.

EXAMPLE: MFP—8 Dec 44.

58. Antenna Tuning Unit BC–619–A

a. PREPARATION. Test the equipment thoroughly and make all repairs, replacements, and adjustments necessary for the proper operation of the equipment.

b. DISASSEMBLY. (1) Remove external connections from the feed-through insulator and the ground stud on the bottom of the housing (fig. 14).

(2) Loosen the two wingnuts to unlatch front cover, and allow the cover to swing open on its hinges.

(3) Disconnect external leads from terminal strip TS1 (fig. 15).

(4) Disconnect lead from the terminal on top of the feed-through insulator (fig. 15).

(5) Remove the six bolts that secure the tuning unit to the housing, and remove the tuning unit.

(6) Remove the lacing from the cables on the back of the tuning unit, and spread the wires apart to aid in moisture removal and varnishing.

c. CLEANING. Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

Note: The cleaning operation must be thorough or the effectiveness of the moistureproofing and fungiproofing treatment will be reduced.

d. MASKING. (1) Tighten down all terminal nuts and screws to insure good electrical contact after applying the varnish.

(2) No masking is required because the lacquer is applied by brush.

e. DRYING. Place the equipment to be treated in a drying oven and bake for 4 to 6 hours at a temperature of 140° F.

Caution: Do not exceed 140° F. If the wax in any of the components begins to melt, decrease the temperature and increase the drying time 1 hour for each 10° F, decrease in temperature. If heat lamps are used as a heat source, they must be baffled so that the direct rays of the lamps do not strike the equipment being dried.

f. VARNISHING. (1) Apply two coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71–2201 (Stock No. 6G1005.3) or equal), with a brush, to the chassis, all wiring, terminal strips, the antenna loading coil, coils on the relays, and the inside of the housing. Allow the first coat to air-dry for 15 or 20 minutes before applying the second coat.

(2) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

Caution: Be careful not to get varnish on the contacts of the relays or the ceramic feed-through insulator. The variable capacitors should *not* be varnished.

g. REASSEMBLY. (1) Reassemble the tuning unit by following the instructions for disassembly in reverse order.

(2) Clean and burnish all contacts.

(3) Make a complete operational check of the unit to make certain it is in good operating condition.

h. MARKING. Mark the letters MFP and the date of treatment on the exterior of the case near the large antenna insulator.

EXAMPLE: MFP—8 Dec 44.

59. Moistureproofing and Fungiproofing After Repairs

If, during repair, the coating of protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is completely sealed.

PART FOUR

AUXILIARY EQUIPMENT

Section X. ANTENNA TUNING UNIT BC–619–A

60. Description

Antenna Tuning Unit BC–619–A (figs. 14, 15, and 16) is designed for use with Radio Set SCR–281–(*) to resonate and help load a single vertical antenna to four preselected frequencies between 1,700 and 2,750 kc.

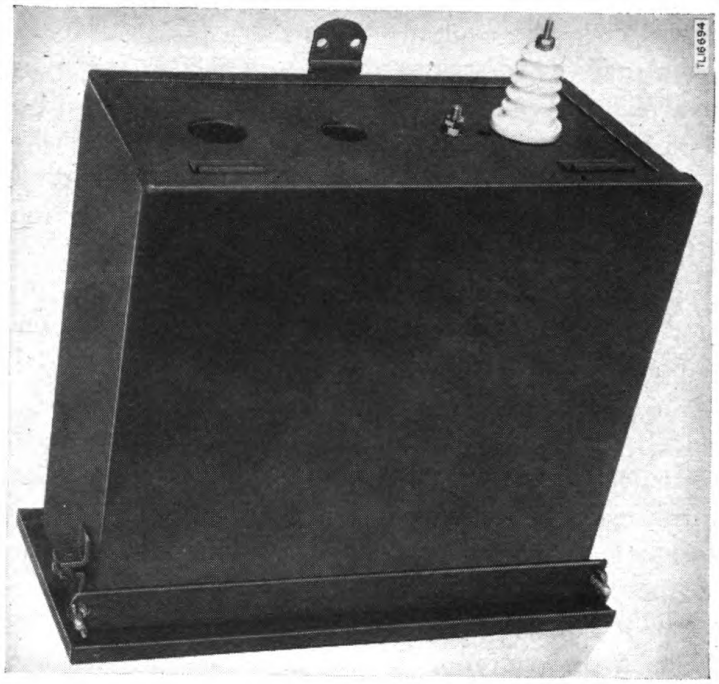


Figure 14. Antenna Tuning Unit BC–619–A.

a. TUNING UNIT. (1) Antenna Tuning Unit BC–619–A is a four-channel, 65- to 75-ohm output-matching tuning unit used with 34-foot Antenna AN–44–A, or a 35-foot whip-type antenna. The tuning unit and antenna with a grounded counterpoise provide an efficient antenna system for Radio Set SCR–281–(*).

(2) Within the 1,700- to 2,750-kc range the unit will operate on any one of four preset frequencies. The circuits are electrically identical and

are adjustable to any frequency throughout the frequency range. Each circuit is independent of the setting of the others.

(3) Selection of the preset inductance and capacitance is obtained by the use of four 115-volt, 60-cycle relays (controlled from section S2.1 of the CRYSTAL SELECTOR switch on the front panel of Radio Set SCR–281–(*)).

(4) The unit is housed in a weatherproof steel case. The front panel is hinged at the bottom, giving access to the four tuning capacitor controls

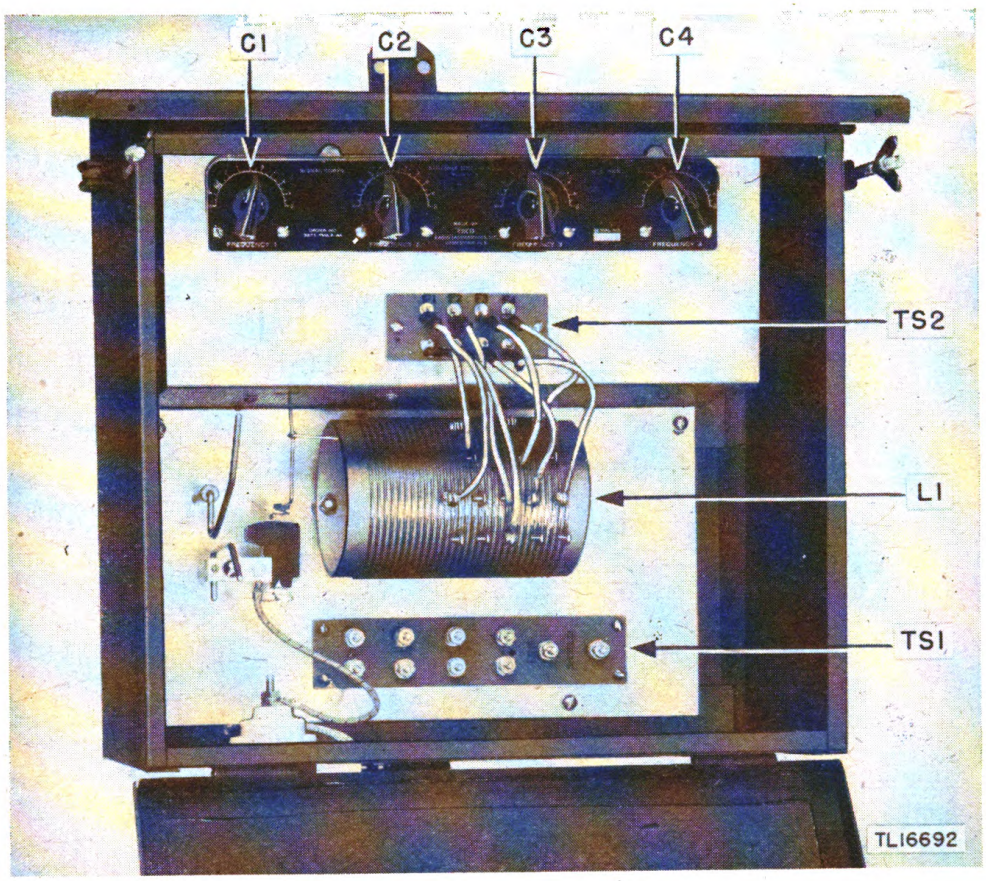


Figure 15. Antenna Tuning Unit BC–619–A—cover open.

and the loading coil and taps. A rubber gasket inside the front panel insures a waterproof seal.

(5) Antenna and ground connections are made at the bottom of the unit. The a-c control cables are passed through one of the two knock-out holes in the bottom of the unit.

b. ANTENNA. Antenna AN–44–A, or a similar vertical whip type antenna of approximately 35 feet is suitable for use with Antenna Tuning Unit BC–619–A.

c. GROUND.

(1) The ground system consists of eight 25-foot bare copper-wire radials attached to a common point.

(2) The radials are buried to a depth of at least 6 inches.

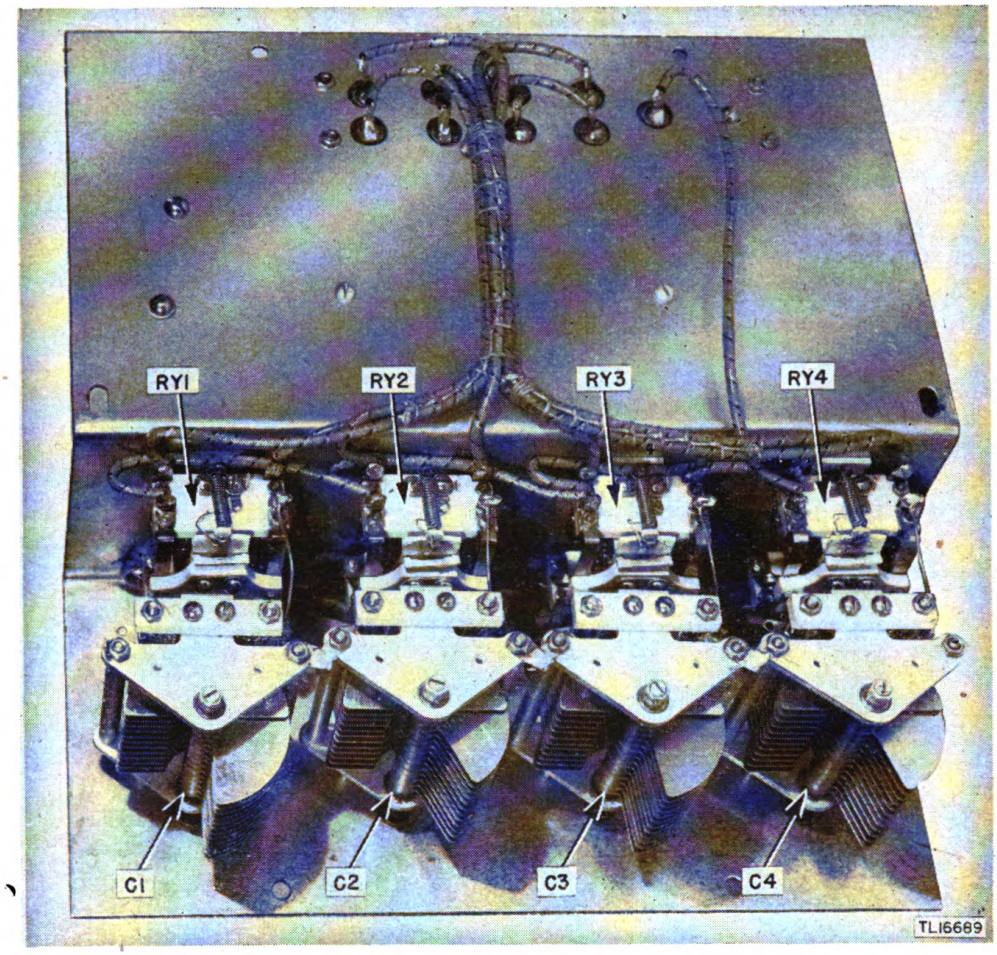


Figure 16. Antenna Tuning Unit BC–619–A—back view of panel.

61. Installation

a. Mount Antenna Tuning Unit BC–619–A near the base of the antenna and leave sufficient room to reach the tuning controls inside the unit.

b. Connect a short length of No. 8 copper wire from the base terminal of the antenna to the antenna terminal on the feed-through insulator on the tuning unit. Keep this lead well away from the mounting and the ground wire.

c. Clean, splice, and solder the radials of the ground system (forming the hub of the grounded counterpoise), and connect a lead of No. 8 copper wire from the hub to the ground terminal of the unit.

d. Insert one end of an amphenol coaxial cable through one of the two knock-out holes in the bottom of the tuning unit, and terminate it at the main terminal strip on the tuning unit. Connect the center conductor of the coaxial cable to the LINE terminal of terminal strip TS1 and the outer conductor or shield to the SHIELD terminal (figs. 15, 17, and 18).

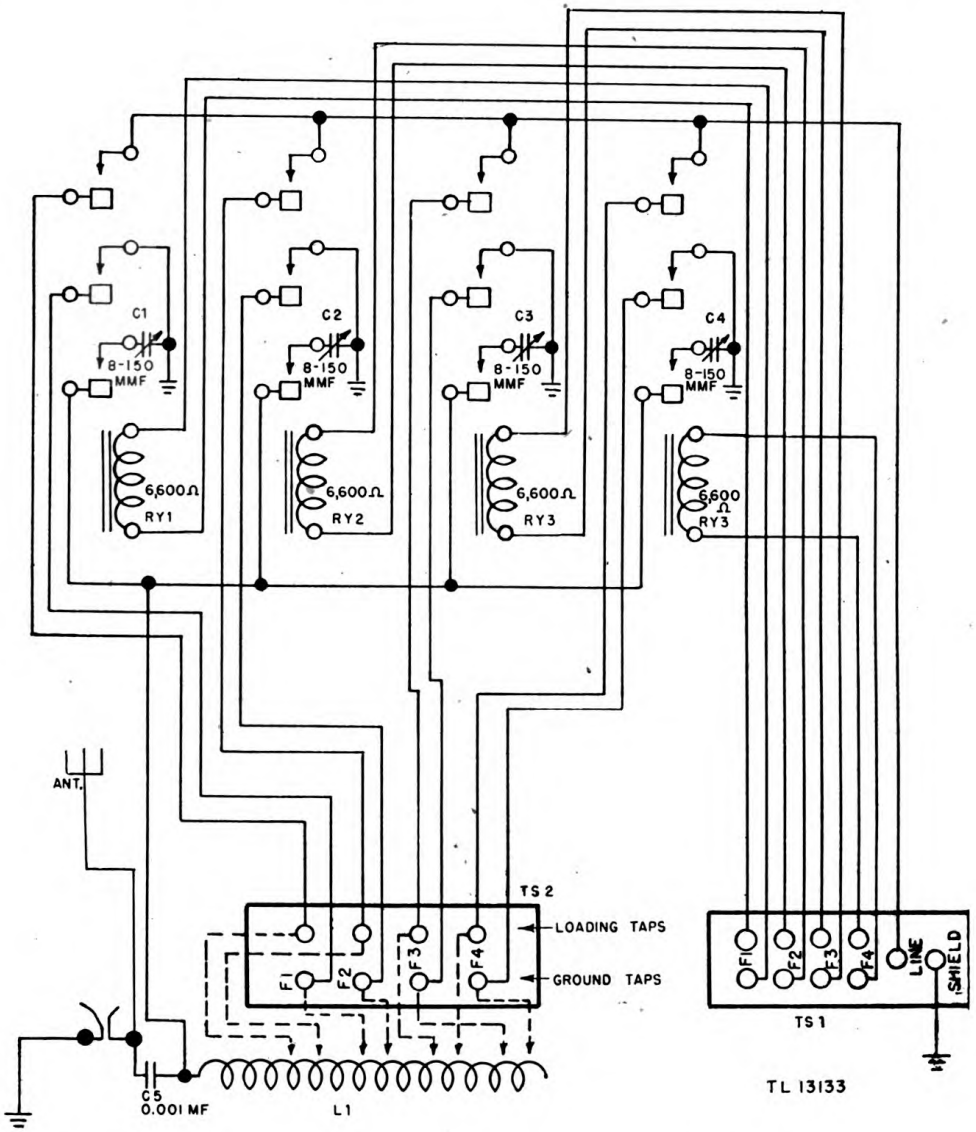


Figure 17. Antenna Tuning Unit BC–619–A—schematic diagram.

e. Connect the other end of the coaxial cable to Radio Set SCR–281–(*), the center conductor to the antenna terminal, and the outer conductor or shield to the ground terminal or a convenient ground on the chassis.

f. Insert one end of the five-conductor, rubber-coated, cotton-covered relay control cable through the other knock-out hole in the bottom of the

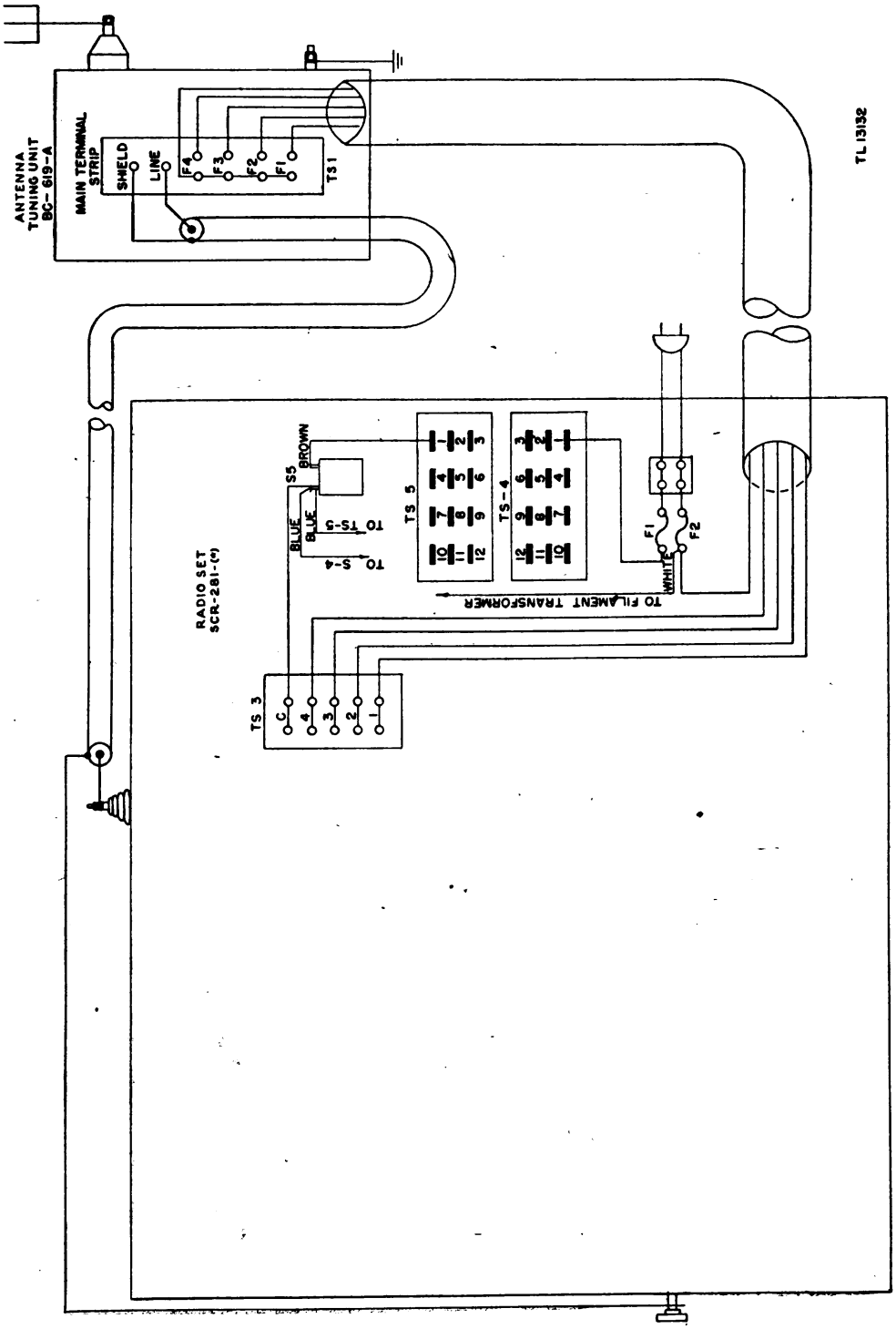


Figure 18. Antenna Tuning Unit BC–619–A—cabling diagram.

tuning unit. Connect conductors 1, 2, 3, and 4 to their respective terminals F1, F2, F3, and F4 on one side of the main terminal strip TS1, as illustrated in figure 18. With a jumper wire, connect together terminals F1, F2, F3, and F4 which are on the other side of the same terminal strip. Connect conductor 5 of the cable to any one of the jumpered terminals.

g. Insert the other end of the relay control cable through the opening (next to the power cord grommet) on the right side of Radio Set SCR–281–(*). Connect conductors 1, 2, 3, and 4 to their respective terminals on terminal strip TS3 (fig. 18). Connect conductor 5 to the terminal of fuse F2 (fig. 25) to which the white lead of the filament transformer is connected.

h. Complete the relay control circuit with a short lead of insulated wire from terminal C of terminal strip TS3 to the terminal of the POWER ON-OFF switch S5 which terminates the two blue wires from switch S4 and plug TS5 (figs. 18 and 28).

i. The operation and adjustment of Antenna Tuning Unit BC–619–A is given in paragraph 62.

62. Adjustment

a. GENERAL. The adjustment for any one of the four preselected frequencies of Antenna Tuning Unit BC–619–A is basically the same. Electrically all four circuits are identical. To obtain resonance during adjustment, remember that approximately all the inductance is used at the low-frequency end of the range and that the inductance is decreased as the frequency increases. The amount of inductance used for any particular frequency is that portion of inductor L1 between the ground tap and the antenna or untapped end of the coil. Loading is adjusted by varying the position of the loading tap (fig. 17). Normally the loading tap is placed about two turns above the ground tap. Selection of each preset circuit is made by rotating the CRYSTAL SELECTOR switch on the front panel of Radio Set SCR–281–(*). One section, S2.1, of the CRYSTAL SELECTOR switch controls the a-c relays which in turn select the circuit for operation.

b. STEP-BY-STEP ADJUSTMENT OF ANTENNA TUNING UNIT BC–619–A. Following are step-by-step instructions for adjusting the first circuit of Antenna Tuning Unit BC–619–A. Adjustment of other circuits is similar.

(1) Radio Set SCR–281–(*): Tune the transmitter to resonance as described in paragraph 90d.

(2) Radio Set: When the dip (minimum plate current) has been obtained, open the front panel and move up slider A1 (fig. 6) *one* turn of the circuit to be tuned. At this point in the adjustment procedure, establish communication between the radio set and the tuning unit.

(3) Radio set: Press the handset press-to-talk switch.

(4) Tuning unit: Test for the presence of radio frequency. The following are two of the ways in which such a test may be made:

(a) Hold a neon lamp at the end of the loading tap. The lamp will glow is radio frequency is present.

(b) Hold a sharpened wooden pencil tightly in such a way that neither the hand nor fingers touch the lead. Touch the end of the loading tap with the lead of the pencil. If radio frequency is present, there will be a small arc at the point of the pencil as it is drawn away from the tap.

Caution: The lead pencil must be grasped tightly when making this test; otherwise an r-f burn may result.

(5) Radio set: If no radio frequency is present at the tuning unit, move up slider A1 of the circuit to be tuned one turn at a time until testing indicates the presence of radio frequency. Keep the loading as low as possible until the antenna is tuned to resonance.

(6) Radio set: Release the handset press-to-talk switch.

(7) Tuning unit: Place the ground tap of the circuit to be tuned on one of the first terminals at the open end of the induction coil. The position of this tap will be determined by the frequency.

(8) Tuning unit: Place the loading tap of the circuit to be tuned *two* turns to the left of the ground tap.

(9) Radio set: Press the handset press-to-talk switch.

(10) Tuning unit and radio set: Turn the tuning capacitor knob on the antenna tuning unit which corresponds to the circuit being tuned for a maximum (peak) reading on the P. A. CURRENT meter of the radio set. (During this operation the P.A. CURRENT meter indication will rise from the unloaded resonant reading of 30 to 50 ma (milliamperes) to a higher value.) When this peak reading has been obtained, the entire antenna system has been brought into resonance at the output frequency of the transmitter. The power supplied to the antenna is represented by the rise in plate current from the unloaded condition. The peak reading should be obtained with the tuning capacitor knob set at or near its midscale position. If the peak occurs at or near either extreme, 1 or 10, reset the loading or ground tap, or both if necessary, until the peak reading occurs at or near midscale. Set the knob exactly on the peak.

(11) Radio set: The above operation sometimes causes the plate circuit of the transmitter output tube to be detuned by capacitance or inductance changes brought about by tuning the antenna system to resonance. To check for detuning rotate the plate tuning capacitor adjusting screw slightly away from its previous position in either direction. If the P.A. CURRENT meter indication increases on either side of the previous setting, the tuning adjustments have been made correctly. However, if a new point is found at which the P.A. CURRENT meter indicates a minimum value, the plate circuit has been detuned by bringing the antenna

system into resonance. Under normal conditions such a change in the capacitor setting is to be expected but the degree of readjustment required should be small. If the variation is small, set the adjustment screw for minimum indication on the P.A. CURRENT meter. If it is large (over 5°), repeat the tuning operations in subparagraphs (6), (7), (8), (9), and (10) above until a minimum change in position of the adjustment screw is required.

(12) After the above steps have been completed satisfactorily, load the transmitter for the desired output as described in paragraph 90e.

63. Special Antennas

a. In all normal installations when not using Antenna Tuning Unit BC–619–A the antenna lead-in is brought directly to the set. In special cases on land, it may be necessary to run a coaxial transmission line some distance from the set. The antenna may be cut at about one-quarter wavelength and terminated directly to the end of the line when only one or several adjacent frequencies are used. If several widely spaced frequencies are used, the antenna should be cut to one-quarter wave at the highest of these frequencies and a tapped loading coil cut in between the antenna and coaxial line at the lower frequencies to tune the antenna.

b. To keep the single-control channel-selector feature, one section of switch S2 is wired to terminal strip TS3 located on the rear of the front panel. From this terminal strip leads may be brought out to operate relays at the site of the remote antenna tuning unit. These relays are used to cut in sufficient loading coil for each frequency.

c. The use of the remote antenna is so diversified that it requires a special study for each type of installation and will not be covered here. The tuning of the transmitter proper is done in exactly the same manner as described for conventional antennas.

PART FIVE

REPAIR INSTRUCTIONS

Note: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD, AGO Form 468 (Unsatisfactory Equipment Report); by Army Air Forces, on Army Air Forces Form 54 (Unsatisfactory Report). If either form is not available, prepare the data according to the sample form reproduced in figure *33*.

Section XI. THEORY OF EQUIPMENT

64. Treatment of Theory

The funcional theory of Radio Receiver and Transmitter BC–441–(*) will be treated in two ways. The first will be a condensed circuit analysis which is keyed to a block diagram (fig. 2) and will show signal paths. It can be used for introductory or quick review purposes. The second presents a detailed analysis of each funcional circuit used in Radio Receiver and Transmitter BC–441–(*).

65. Condensed Theory of Operation

a. Radio Receiver and Transmitter BC–441–(*) consists of a superheterodyne receiver and a crystal-controlled, voice-modulated transmitter arranged to provide rapid change-over from receive to transmit by pressing the push-to-talk switch. Any one of four present transmitter channels may be selected by means of the CRYSTAL SELECTOR switch. The receiver channel may be either crystal- or manually-controlled as selected by the CRYSTAL-MANUAL switch. The block diagram (fig. 2) shows the path of signals through the transmitter and receiver. The same antenna is used for both transmitting and receiving.

b. During reception the incoming signal is passed through r-f amplifier tube V1 to the grid of mixer tube V2. H-f (high-frequency) oscillator tube V3 produces a local oscillator frequency which is mixed in V2 with the incoming signal to produce a 385-kc difference frequency for the i-f (intermediate-frequency) amplifier tube V4. The output of the i-f amplifier is fed into detector tube V5, where it is rectified to provide the a-v-c (automatic-volume-control) voltage and the a-f (audio-frequency) signal voltage. The signal voltage is passed through the triode section of tube V5 where it is amplified and then passed through the audio power ampli-

CROSS-REFERENCE CHART OF REFERENCE NUMBERS IN RADIO SETS SCR–281–A, –B, AND –D

Capacitors		Resistors	
Radio Set SCR–281–D	Radio Sets SCR–281–A and –B	Radio Set SCR–281–D	Radio Sets SCR–281–A and –B
C1	C2	R1	R40
C2	C29	R2	R1
C3	C10	R3	R2
C4	C3	R4	R35
C5	C47	R5	R3
C6	C1	R6	R42 (B only)
C7	——	R7	R41
C8	C24	R8	R18
C9	C5	R9	R17
C10	C6	R10	R9
C11	C9	R11	R10
C12	C49	R12	R14
C13	C7	R13	R12
C14	C16	R14	R8
C15	C15	R15	R13
C16	C17	R16	R34
C17	C19	R17	R20
C18	C18	R18	R19
C19	C41	R19	R6
C20	C23	R20	R16
C21	C8	R21	R15
C22	C14	R22	R4
C23	C55 (B only)	R23	R7
C24	C13	R24	R5
C25	C11	R25	R25
C26	C46	R26	R21
C27	C28	R27	R22
C28	C27	R28	R24
C29	C26	R29	R23
C30	C25	R30	R26
C31	C30	R31	R27
C32	C31	R32	R29
C33	C32	R33	R28
C34	C33	R34	R30
C35	C21	R35	R33
C36	C34	R36	R32
C37	C35	R37	R31
C38	C36	R38	R37
C39	C37	R39	R39
C40	C38	R40	R38
C41	C22	R41	R36
C42	C39	——	R11
C43	C40		
C44	C45		
C45	C44		
C46	C42		
C47	C50		
C48	C20		
C49	C12		
——	C4		
——	C43		
——	C48		

fier V6 to be built up to sufficient strength to operate the handset or the loudspeaker.

c. During transmission transmitter crystal oscillator V9 produces an r-f signal of high stability which drives r-f power amplifiers V7 and V8. The output of the power amplifier is varied at an a-f rate in accordance with the output of modulator tubes V10 and V11.

d. The power-supply section operates from a 115-volt, 60-cycle source and supplies all the voltage and current requirements of Radio Receiver and Transmitter BC–441–(*). Tubes V12 and V13 are connected as a full-wave rectifier.

66. Cross-Reference Chart

Note: Because of the difference between the part numbers in Radio Sets SCR–281–A and –B and those in Radio Set SCR–281–D, unless otherwise stated, reference will be made only to the part number in Radio Set SCR–281–D throughout this and the following sections. For the number of the similar part in Radio Sets SCR–281–A and –B see the following cross-reference chart.

Capacitors C51 through C54 in Radio Sets SCR–281–A and –B are included in the assemblies of transformers T4 and T5 in Radio Set SCR–281–D and are not numbered. Radio Sets SCR–281–A and –B contain no capacitors C7 in Radio Set SCR–281–D. Radio Set SCR–281–D contains no capacitors corresponding to C4, C43, or C48, or resistor corresponding to R11 in Radio Sets SCR–281–A and –B.

67. Radio-Frequency Amplifier

a. In Radio Sets SCR–281–A and –B (fig. 36) the incoming signal is fed to the grid of r-f amplifier Tube JAN–6K7, V1, after passing through the tuned circuit, consisting of transformer T1, trimmer capacitor C2, and tuning capacitor C3.1. C47 is the antenna coupling capacitor. In Radio Set SCR–281–D (fig. 37) the tuned circuit consists of transformer T1, trimmer capacitor C1, and tuning capacitor C4.1. C5 is the antenna coupling capacitor.

b. D-c (direct-current) bias and automatic-volume-control voltage for the grid of V1 are provided through resistor R2, and are isolated from the antenna by capacitor C5 (fig. 19). Resistor R1 drains static charges from the antenna. V1, a high-gain pentode tube, amplifies the signal before feeding it to the grid of Tube JAN–6L7, V2, through a tuned circuit consisting of transformer T2, trimmer capacitor C2, and a second section of tuning capacitor C4.2. In Radio Sets SCR–281–A and –B, additional coupling is provided between tubes V1 and V2 by coupling capacitor C48 (fig. 36). Bypass capacitor C6 provides a low-impedance path to ground for r-f currents (fig. 19). In Radio Set SCR–281–D C10 is a mixer bias bypass capacitor. The tracking between the antenna and

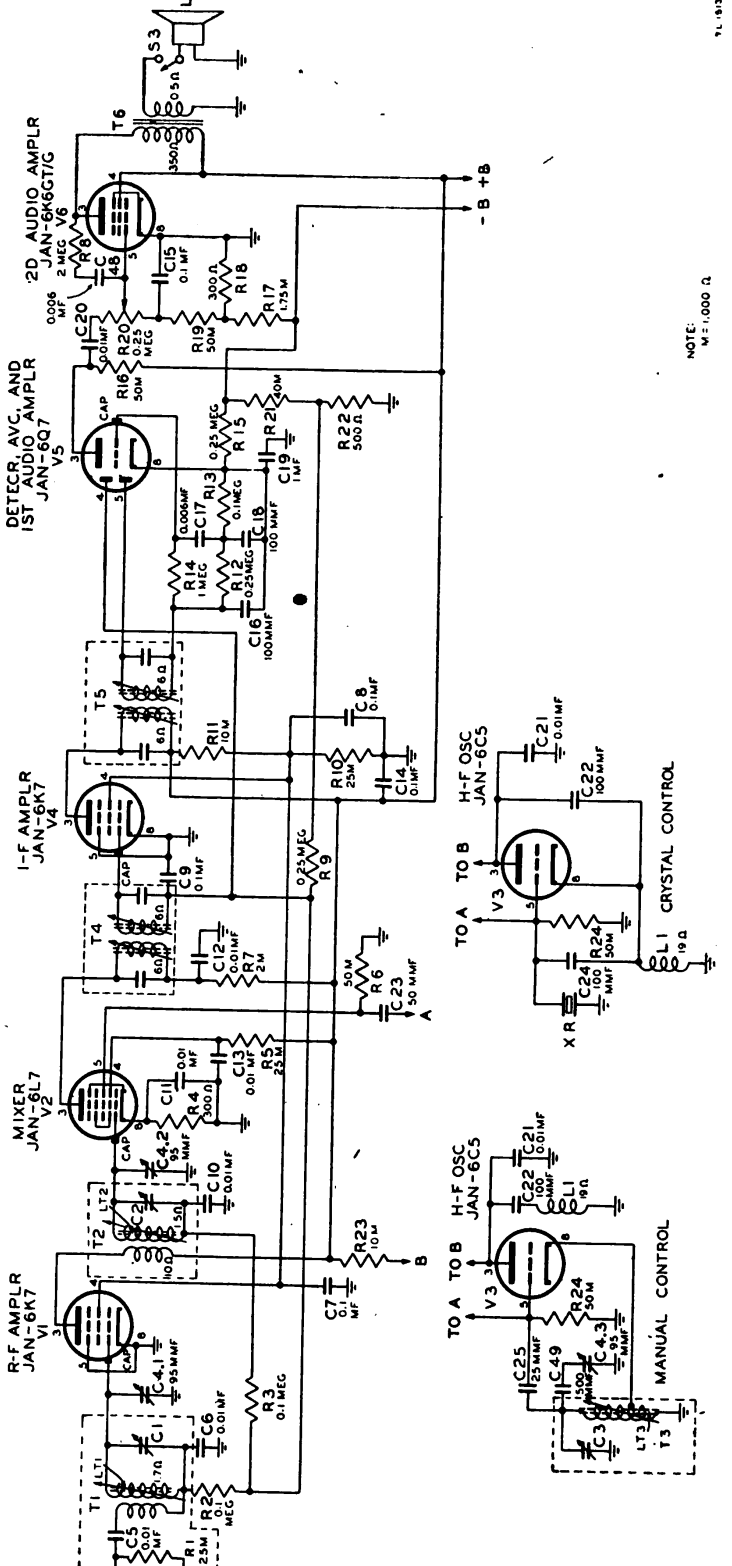


Figure 19. Radio Receiver and Transmitter BC-441-D, simplified receiver circuit.

r-f circuits is acheived by using adjustable iron slugs LT1, LT2, and LT3 to increase or decrease the inductance in each transformer.

68. Mixer Stage

a. The amplifier signal is fed to the control grid of V2. Another signal from h-f oscillator Tube JAN–6C5, V3, is fed to the third or mixer grid of V2, 385 kc higher in frequency than the input signal when the receiver is on MANUAL operation. On CRYSTAL operation, the oscillator frequency is 385 kc higher for signal frequencies from 1,700 to 2,365 kc, and 385 kc lower for signal frequencies above 2,365 kc. In Radio Set SCR–281–A the oscillator signal is fed directly from the oscillator grid (fig. 36). In Radio Set SCR–281–B the signal is fed from the oscillator cathode through capacitor C55 (fig. 36). Resistor R42 is the injector grid resistor. In Radio Set SCR–281–D the signal is fed from the oscillator grid through capacitor C23 (fig. 37). Resistor R6 is the injector grid resistor. In all models the two signals are combined and amplified by V2 which produces a 385-kc beat frequency (intermediate-frequency) signal in its plate circuit.

b. A-v-c voltage and part of the grid bias for V2 are supplied through resistor R3. Additional bias is obtained across cathode resistor R4, bypassed to radio frequencies by capacitor C11. R-f currents at the screen grid of V2 are isolated from the d-c supply by capacitor C13 and resistor R5.

69. High-Frequency Oscillator

a. Tube V3, used as a h-f oscillator (fig. 19), provides a signal 385 kc above or below the received signal frequency. CRYSTAL-MANUAL switch S1 permits crystal-controlled oscillations or self-oscillations tunable over the entire range.

b. When crystal control is used, the crystal acts as a tuned circuit of extremely high stability. Regeneration to produce oscillation is provided by proper division of r-f voltage between grid, cathode, and plate capacitors C24 and C22. Choke L1 allows the cathode of V3 to be at ground potential with respect to direct current, without disturbing the oscillations. Grid bias is developed across R24. The plate is bypassed to ground by capacitor C21 and isolated from the plate voltage supply by resistor R23. Crystals are selected by one section of CRYSTAL SELECTOR switch S2. One receiving crystal and one transmitting crystal are mounted in each holder. The receiver crystals for operating frequencies from 1,700 kc through 2,365 kc are ground to a frequency 385 kc *higher* than associated transmitting crystal frequencies. However, for frequencies over 2,365 kc crystal frequencies are 385 kc *lower* than the transmitting crystal frequencies.

c. When manual control is used a tuned circuit consisting of transformer T3, tuning capacitor C4.3, trimmer C3, and padder C49 determines the frequency of oscillation. By connecting the cathode of V3 to a tap on T3 a modified Hartley oscillator is obtained. Proper proportioning of T3 and C49 permits the oscillator frequency to be kept 385 kc higher than the signal frequency selected by the antenna and r-f tuned circuits, while the main tuning dial is tuned across the band.

70. Intermediate-Frequency Amplifier

The 385-kc signal from the plate of V2 is fed through transformer T4 to the grid of Tube JAN–6K7, V4, where it is amplified and fed through transformer T5 to the detector circuit. Most of the selectivity which results in the rejection of unwanted signals near the carrier frequency is produced by transformers T4 and T5. Grid bias for V4 is fed to the bottom end of the secondary of T4 which is bypassed by capacitor C9.

71. Detector, Automatic Volume Control, and Audio Amplifier

a. The amplified i-f signal from T5 (fig. 19) is applied to one diode plate of V5 where it is rectified. The result is the development of a d-c bias across resistors R12 and R13, as well as an a-f voltage proportional to the voice modulation envelope of the received signal. R-f voltages across resistors R12 and R13 are bypassed to the cathode of V5 by capacitors C16 and C18. The audio signal is fed to the triode section grid of V5 through C17 where it is amplified and appears across resistor R16.

b. Bias for the grid of V5 is supplied through resistor R14. The amount of bias is determined by the d-c voltage across R12 and R13, and is proportional to the signal strength. The cathode of V5 is returned to a negative potential point through resistor R15. With no signal there is considerable drop across R15 which reduces the cathode-to-plate potential, limiting the plate current to a safe value. Under these conditions, a sensitive meter may indicate a small negative voltage between grid and cathode. This voltage is caused by slight imperfections in the tube and should not be confused with normal bias developed across R12 and R13 when a signal is being received. The second diode plate of V5 is returned to ground through resistors R9 and R22. The plate has a small initial negative bias due to the drop across R22 caused by the current furnished through R21 from the negative supply. When a signal is received, the bias on the triode grid of V5 reduces the plate current, and consequently, the voltage across R15.

c. When the voltage across R15 is reduced so that the cathode is negative with respect to the second diode plate, the current flows between the plate and the cathode, resulting in a negative voltage across R9. The

negative voltage is applied to the grid return circuits of V1, V2, and V4. However, in Radio Sets SCR–281–A and –B, this a-v-c voltage is applied only to V1 and V2, through resistor R11 which is bypassed by C4. The result is an automatic reduction in gain with increasing signal strength to give relatively constant audio output from the receiver. Capacitor C19 bypasses audio frequencies which would appear across R15.

72. Audio Amplifier

The audio signal from tube V5 is fed to the grid of Tube JAN–6K6GT, V6, through capacitor C20 and volume control potentiometer R20. V6 amplifies the signal and supplies sufficient power to operate the loudspeaker LS and the handset receiver HS through transformer T6. Bias for V6 is obtained by the drop across R18 and is filtered by R19 and capacitor C15. Resistor R8 and capacitor C48 which were incorporated to reduce distortion at high audio frequencies, have been found unnecessary and have been eliminated on all Radio Receiver and Transmitters BC–441–D starting with Serial No. 1, Order No. 26364–Phila–43.

73. Transmitter Crystal Oscillator

Tube JAN–807, V9, is used as a crystal-controlled oscillator with the grid, cathode, and screen grid as the oscillator elements (fig. 20). The desired crystal is selected by one section of CRYSTAL SELECTOR switch S2. Regeneration to produce oscillation is obtained by dividing the voltage by means of C39 and C40. Choke L6 forms a d-c path to ground from the cathode of V9. Grid bias is developed across resistor R34. Filament, screen grid, and plate return are bypassed by capacitors C41, C38, and C37 respectively. Plate voltage is obtained through resistor R32 and is reduced to the proper value for the screen grid by resistor R33. The r-f oscillation is amplified in the plate circuit of V9, and the output signals appear across choke L5.

74. Transmitter Power Amplifier

a. The oscillator output is fed to the grids of Tubes JAN–807, V7 and V8, through coupling capacitor C36 (fig. 20). V7 and V8 are operated as parallel Class C power amplifiers. Bias is obtained partly by cathode resistor R30 and partly by grid resistor R31. Choke L4 reduces the loading effect of R31 on the oscillator. Plate resistors R26 and R27 and grid resistors R28 and R29 suppress parasitic oscillations in the power amplifier. The cathodes are bypassed at radio frequencies by capacitor C35, the screen grids by capacitors C33 and C34, and the modulated plate supply by capacitor C32. Screen voltage comes from the modulated plate supply through resistor R25, and plate voltage through the parallel-

feed choke L3. D-c voltage is isolated from the antenna circuit by capacitor C31.

b. The antenna tuning circuit must tune a wide range of antenna

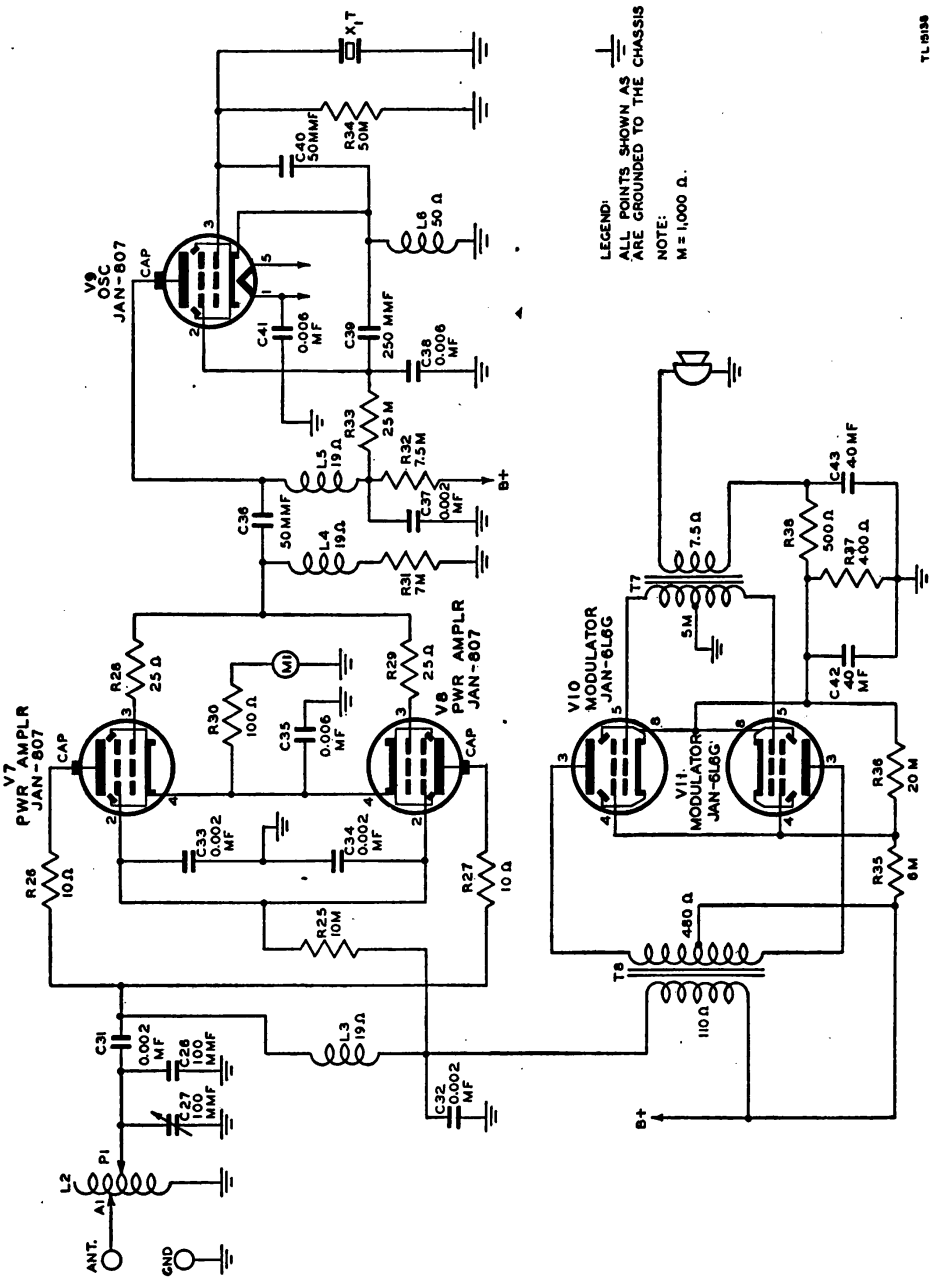


Figure 20. Radio Receiver and Transmitter BC–441–D, simplified transmitter circuit.

impedances to resonance, and, at the same time, present the proper load to the power amplifier. Rough adjustment of antenna tuning and plate loading is accomplished by adjustable taps on coil L2. For fine tuning,

use capacitor C27, C28, C29, or C30. The tuning capacitors are paralleled by fixed capacitor or C26 to insure sufficient capacitance in the tuned circuit. An extra section of CRYSTAL SELECTOR switch S2 is provided for operation with Antenna Tuning Unit BC–619–A or other special antenna systems (par. 60).

75. Modulator

The modulator consists of Tubes JAN–6L6G, V10 and V11, as a push-pull Class AB power amplifier (fig. 20). Audio signals from the handset microphone are fed to the grids of V10 and V11 through transformer T7.

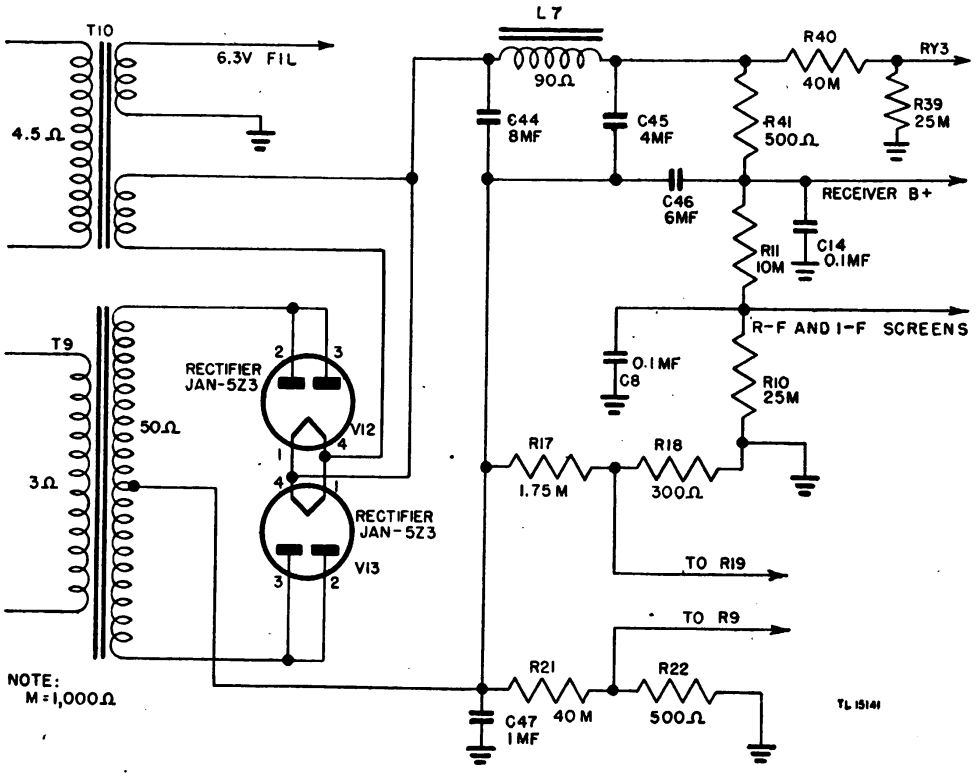


Figure 21. Radio Receiver and Transmitter BC–441–D, power supply circuits, receiving.

The amplified power output is fed through transformer T8 to modulate the d-c plate and screen voltage of V7 and V8 in accordance with the voice input. Resistor R37 furnishes bias to V10 and V11 as well as voltage to the microphone through resistor R38. These resistors are bypassed to audio frequencies by capacitors C42 and C43.

76. Power Supply

The power supply (figs. 21 and 22) operates from a 115-volt, 60-cycle a-c source through fuses F1 and F2 and POWER ON-OFF switch S5.

Filament heating power for all tubes is supplied by transformer T10. Figures 21 and 22 are simplified schematics showing the power supply of Radio Set SCR–441–D during reception and transmission. Power is delivered to the plates of rectifier Tubes JAN–5Z3, V12 and V13, by transformer T9. The transformer has a tap on the primary for raising the plate supply voltage during transmission to a value higher than that used by the receiver (figs. 36 and 37). This voltage change is controlled by one section of relay RY1. Tubes V12 and V13 are connected in a full-wave rectifier circuit and supply rectified current to a filter consisting of input capacitor C44, smoothing choke L7, and filter capacitor C45.

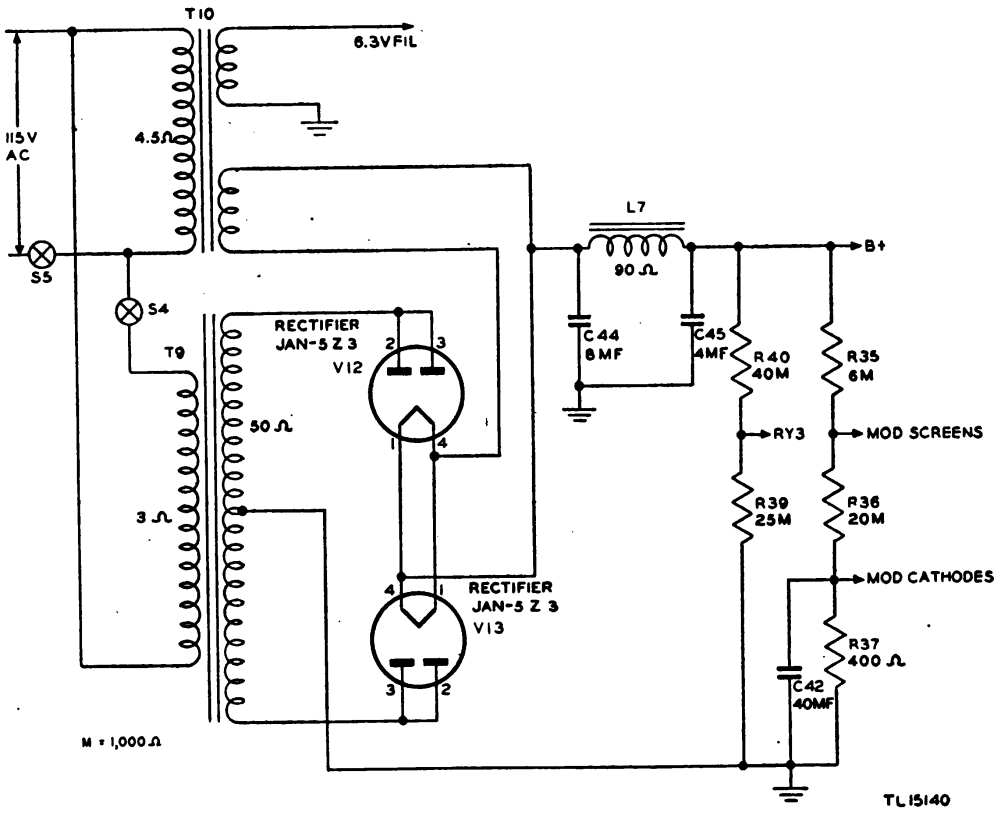


Figure 22. Radio Receiver and Transmitter BC–441–D, power supply circuit, transmitting.

Receiver bias is obtained by the drop across R17 and R18 (fig. 21). The receiver voltage is further filtered by capacitor C46, filter resistor R41, and in Radio Receiver and Transmitters BC–441–A and –B, by capacitor C43. The center tap of transformer T9 is placed at ground potential during transmission (fig. 22), eliminating receiver bias by means of the second section of relay RY1. The receiver plate and screen supplies are further bypassed by capacitors C16 and C24 in Radio Receiver and Transmitters

BC–441–A and –B, respectively (fig. 36), and by capacitors C14, C7, and C8 in Radio Receiver and Transmitter BC–441–D (fig. 37). Receiver screen supply is obtained from the bleeder network R10 and R11. Receiver bias is filtered by capacitor C47.

77. Control Circuits

Power is applied to the receiver by POWER ON-OFF switch S5 with all relays in the receiving position as shown in figures 36 and 37. SPEAKER ON-OFF switch S3 allows the loudspeaker to be cut off. Push-button switch S6 is located in the handle of the handset. Closing this switch operates control relay RY3 for which voltage is obtained from bleeder network R39 and R40. The single contact of this relay, when operated, applies power to a-c relays RY1 and RY2. Power relay RY1 switches the primary tap on transformer T9 to increase the transmitting voltage, short circuits the receiver bias network, and switches the positive high voltage from the receiver to the transmitter. Antenna relay RY2 switches the antenna from receiver input to transmitter output, and a second section grounds the receiver input during transmission.

78. Antenna Tuning Unit BC–619–A (Fig. 17)

When Antenna Tuning Unit BC–619–A is used with Radio Receiver and Transmitter BC–441–(*), selection of any desired frequency channel applies power through one section of crystal selector switch S2 to one of the relays in the antenna tuning unit. Energizing any of the relays automatically connects a parallel tuned circuit consisting of inductor L1 and variable capacitor C1, C2, C3, or C4 (in the antenna tuning unit) into the antenna circuit. The four circuits are preadjusted so that during normal operation the selection of a crystal-controlled frequency at the transmitter results in the proper loading of the antenna for maximum efficiency at that particular frequency.

Section XII. TROUBLE SHOOTING

79. General Trouble-Shooting Information

No matter how well equipment is designed and manufactured, faults occur in service. When such faults occur, the repairman must locate and correct them as rapidly as possible. This section contains general information to aid personnel engaged in the important duty of trouble shooting.

a. Trouble-shooting Data. Take advantage of the material supplied in this manual to help in the rapid location of faults. Consult the following trouble-shooting data when necessary:

(1) Block diagram of Radio Set SCR–281–(*) (fig. 2).

(2) Complete schematic diagrams (figs. 36 and 37).

(3) Simplified and partial schematic diagrams (figs. 19, 20, 21, and 22). These diagrams are particularly useful in trouble shooting, because the repairman can follow the electrical functioning of the circuits more easily than on the regular schematics, thus speeding trouble location.

(4) Voltage and resistance data for all socket connections (figs. 31 and 32).

(5) Illustrations of components. Front, top, and bottom views which aid in locating and identifying parts (figs. 23 through 30).

(6) Pin connections. Pin connections on sockets, plugs, and receptacles are numbered or lettered on the various diagrams.

(*a*) Seen from the bottom, pin connections are numbered in a clockwise direction around the sockets. On octal sockets the first pin clockwise from the keyway is the No. 1 pin.

(*b*) Plugs and receptables are numbered on the side to which the associated connector is attached. To avoid confusion, some individual pins are identified by letters which appear directly on the connector.

(7) Resistor and capacitor color codes (figs. 38 and 39).

b. Trouble-shooting Steps. The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the component or circuit responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults such as burned-out resistors, r-f arcing, and shorted transformers can be located by sight, smell, and hearing. The majority of faults, however, must be located by checking voltage and resistance.

c. Sectionalization. Careful observation of the performance of the radio set while turning the equipment on often sectionalizes the fault to the transmitter or the receiver, and careful observation of the meters on the transmitter front panel often determines the stage or circuit at fault.

d. Localization. Paragraph 83 contains a trouble-shooting chart which lists abnormal symptoms and their probable causes. This chart assists in localizing faults.

e. Voltage Measurements. Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are taken easily, because they are always made between two points in a circuit and the circuit need not be interrupted.

(1) The voltages listed on the voltage charts (figs. 31 and 32) are measured between the indicated points and ground.

(2) Always begin by setting the voltmeter on the highest range so that the voltmeter will not be overloaded. Then, if it is necessary to obtain increased accuracy, set the voltmeter to a lower range.

(3) In checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open. The resistance of the

meter may act as a cathode resistor. Thus, the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before the cathode voltage is measured, make a resistance check with a cold circuit to determine whether the cathode resistor is normal.

f. Precautions Against High Voltage. Certain precautions must be followed when measuring voltages above a few hundred volts. High voltages are dangerous and can be fatal. When it is necessary to measure high voltages, observe the following rules:

(1) Connect the ground lead to the voltmeter.

(2) Place one hand in your pocket. This will eliminate the possibility of making accidental contact with either ground or another part of the circuit thus causing the electricity to travel from one hand to the other.

(3) If the voltage is less than 300 volts, connect the test lead to the hot terminal (which may be either positive or negative with respect to ground).

(4) If the voltage is greater than 300 volts, shut off the power, connect the hot lead, step away from the voltmeter, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points which are above ground.

g. Voltmeter Loading. It is essential that the voltmeter resistance be at least 10 times as large as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is comparable to the circuit resistance, the voltmeter will indicate a voltage lower than the actual voltage present when the voltmeter is removed from the circuit.

(1) The resistance of the voltmeter on any range can always be calculated by the following simple rule: Resistance of the voltmeter equals the ohms per volt multiplied by the full-scale range in volts. For example: the resistance of a 1,000-ohm-per-volt meter on the 300-volt range is 300,000 ohms (R = 1,000 ohms per volt times 300 volts = 300,000 ohms).

(2) To minimize the voltmeter loading in high-resistance circuits, use the highest voltmeter range. Although only a small deflection will be obtained (possible only 5 divisions on a 100-division scale), the accuracy of the voltage measurement will be increased. The decreased loading of the voltmeter will more than compensate for the inaccuracy which results from reading only a small deflection on the scale of the voltmeter.

(3) When a voltmeter is loading a circuit, the effect can always be noted by comparing the voltage reading on two successive ranges. If the voltage readings on the two ranges do not agree, voltmeter loading is excessive. The reading (not the deflection) on the highest range will be greater than that on the lowest range. If the voltmeter is loading the

circuit heavily, the deflection of the pointer will remain nearly the same when the voltmeter is shifted from one range to another.

(4) The ohm-per-volt sensitivity of the voltmeter used to obtain the readings recorded on the voltage and resistance charts in this manual is printed on each chart. Use a meter having the same ohm-per-volt sensitivity; otherwise it will be necessary to consider the effect of loading.

80. Trouble-Shooting Procedures

a. When equipment becomes disabled or inoperative, it is recommended that the following procedure be adopted:

(1) Be sure that the power cable is connected to the 115-volt, 60-cycle a-c source of power.

(2) Be certain the POWER ON-OFF switch is in the ON position.

(3) If no sound is heard, turn the volume control as far clockwise as possible.

(4) Turn the CRYSTAL-MANUAL switch to MANUAL and tune the receiver over the entire band, making sure the antenna relay is operating properly.

b. Attempt to localize the trouble by examining the equipment carefully, noting any abnormal effects. To analyze without test equipment proceed as follows:

(1) Disconnect the power cord. Open the main front panel and swing it out. Examine all wiring for poorly soldered connections, damaged parts, parts shorting against each other, the chassis, or case; and bad sockets or socket connections.

(2) Examine for parts which appear abnormal such as *bloated* capacitors, charred or broken resistors, broken sockets, tubes, controls, etc.

(3) If no tube checker or continuity checker is available, replace the tubes one at a time with others that are known to be in good condition.

(4) Feel the various components for signs of excessive heating.

(5) Shorted parts or parts through which excessive current is passing usually give off a strong odor. Check for the presence of an unusual odor.

(6) Inspect the antenna for correct position and for freedom from local interference. Make certain that the antenna is in the clear and not touching overhanging eaves, wires, or branches.

(7) Refer to paragraph 83 for a list of specific troubles and their causes.

(8) If the above methods have failed to localize the trouble, test equipment must be used.

81. Instrument Test Methods

a. Tests may be made with Test Set I–56–( ). This equipment is issued to using units as a general test set, and contains a tube checker, set analyzer, voltohmmeter, and an output meter. The use of this equipment is fully explained in TM 11–303, TM 11–321, TM 11–2613, TM 11–2626, and TM 11–2627.

b. Figures 32 and 33 give the correct values of d-c voltage and resistance for this equipment. The values given are based on actual tests on Radio Receiver and Transmitters BC–441–A, –B, and –D, using a 1,000-ohm-per-volt meter. The transmitter test data was measured by using a 200-mmf (micro-microfarad) capacitor and 30-ohm resistor as a dummy antenna on Radio Receiver and Transmitters BC–441–A and –B, and a 500-mmf capacitor and 30-ohm resistor as a dummy antenna on Radio Receiver and Transmitter BC–441–D. The receiver-voltage measurements were made with no signal input. The line voltage was 115 volts. The receiver resistance measurements were made with power cord disconnected, the VOLUME control full on, and the CRYSTAL-MANUAL switch on MANUAL. (It is normal for the screen grid and grid voltages given in the charts to vary considerably with crystals of different activity and frequency, as well as with antenna loading.)

82. Signal Tracing and Substitution

Signal tracing and signal substitution may be used to localize trouble that cannot be found by voltage and current checks. For information and instructions in the use of signal generators and other equipment used in signal tracing and signal substitution, refer to the technical manuals supplied with these instruments.

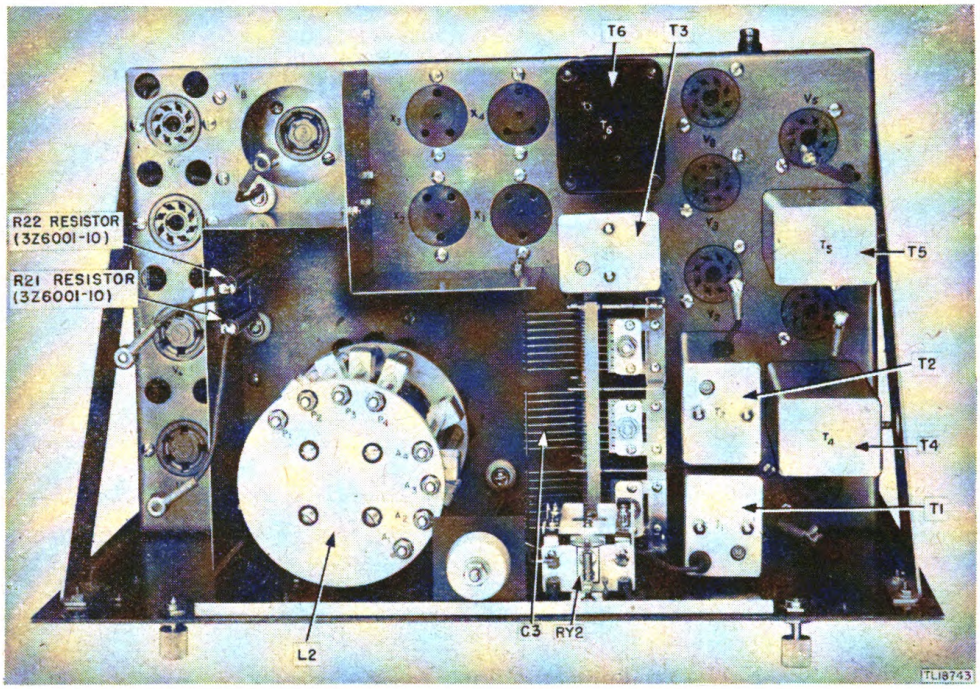


Figure 23. Radio Recceiver and Transmitter BC–441–A and –B, r-f chassis—top view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

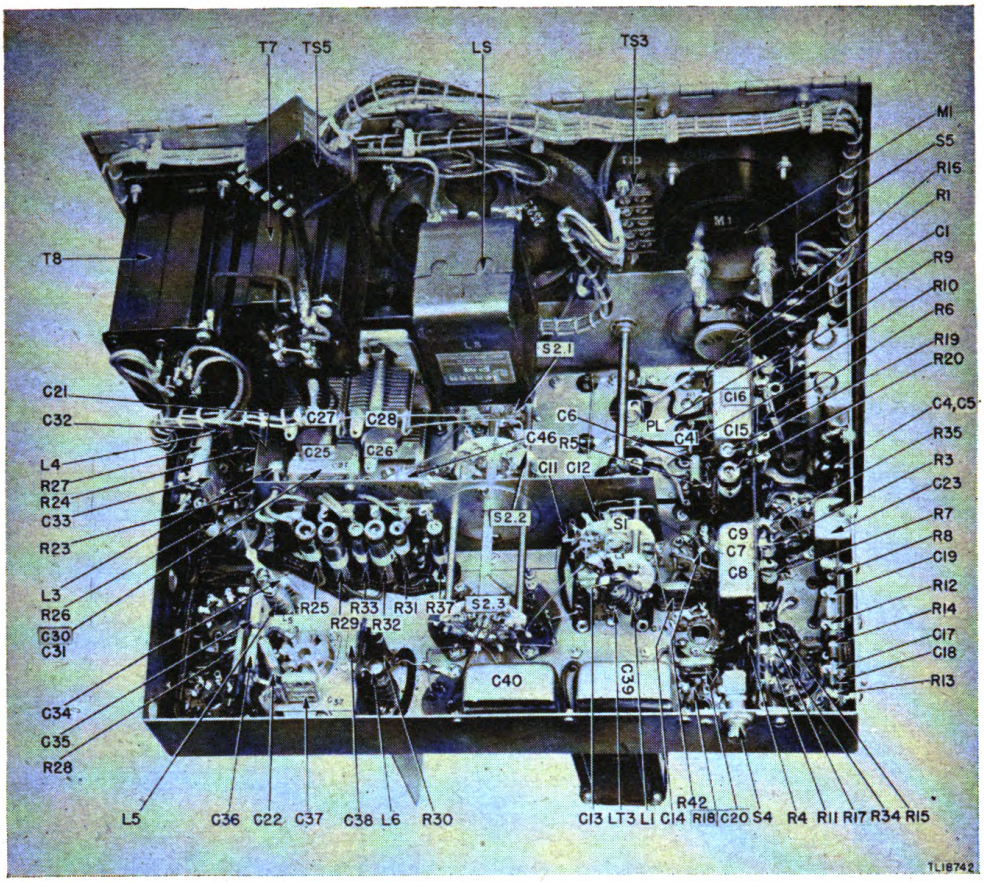


Figure 24. Radio Receiver and Transmitter BC–441–A, and –B, r-f chassis—bottom view.

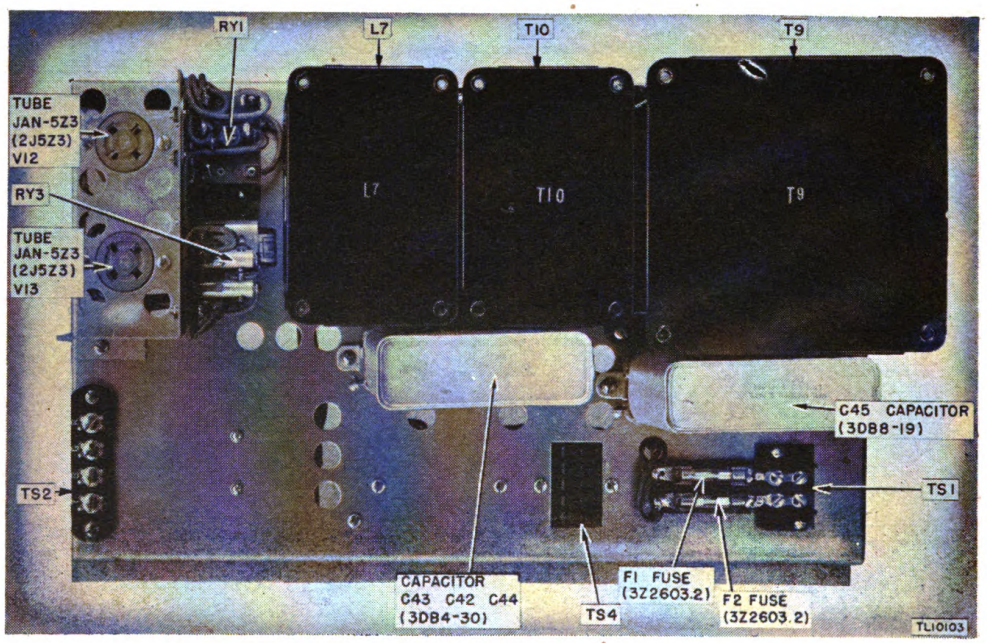


Figure 25. Radio Receiver and Transmitter BC–441–A and –B, power supply—top view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

PARTS IN STATION STOCK

Reference symbol	Part	Signal Corps stock No.	Reference symbol	Part	Signal Corps stock No.
C4, C7	Capacitor assembly	3DA50–23	R12, R13	Resistor	3Z6700–6
			R15	Resistor	3Z6640–2
C13, C14	Capacitor	3D9100–39	R18	Resistor	3Z6802–5
C15	Capacitor	3DA100–65	R19	Resistor	3Z6027
C17, C18	Capacitor	3D9100–20	R20	Resistor	3Z6170–1
C19, C20, C21, C22	Capacitor	3DA6–15	R23, R24	Resistor	3Z6002E5–2
			R31	Resistor	3Z6040–9
C23	Capacitor	3DA20–16	R32	Resistor	3Z6620–32
C30, C31	Capacitor	3DA2–53	R33	Resistor	3Z6560–6
C32, C33	Capacitor	3DA2–46	R34	Same as R5	
C34	Capacitor	3D9050–32	R35	Resistor	3Z6030–12
C35	Capacitor	3DA2–50	R37	Resistor	3Z6050–17
C36	Capacitor	3DA4–15	R42	Same as R5	
C37	Capacitor	3D9250–23			
C38	Capacitor	3D9050–31			
C39, C40	Capacitor	3DB40–5			
C41	Capacitor	3DB1.4100–1			
C46	Capacitor	3D9100–100			
L1, L3, L4, L5, L6	Choke	2C5341A/C1			
PL	Lamp	2Z5952			
R5, R6	Resistor	3Z6650–45			
R7	Resistor	3Z6610–16			
R11, R14	Resistor	3Z6725–17			

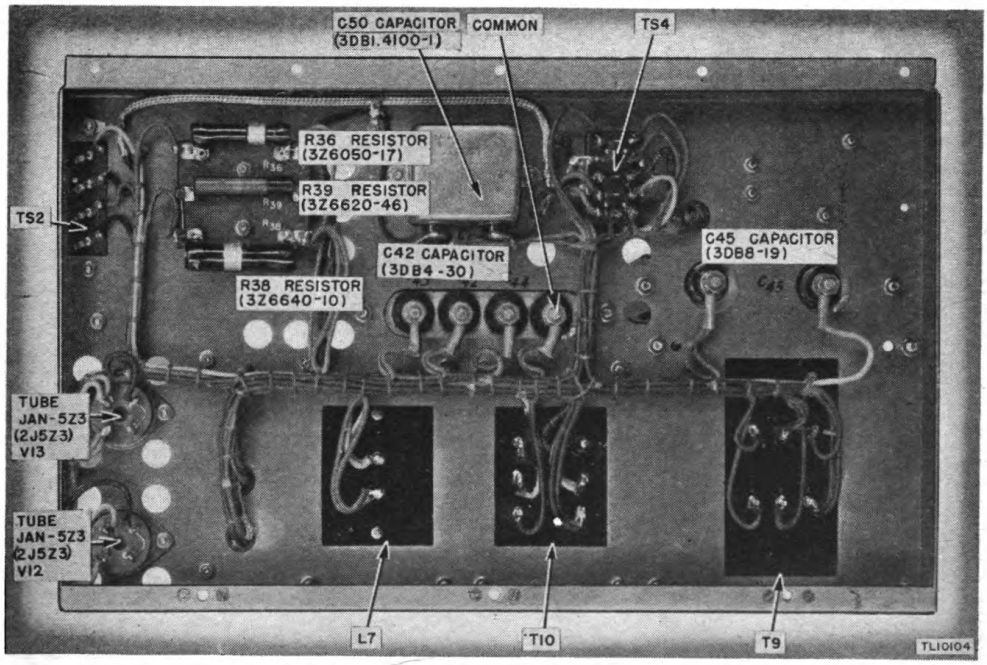


Figure 26. Radio Receiver and Transmitter BC–441–A and –B, power supply—bottom view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

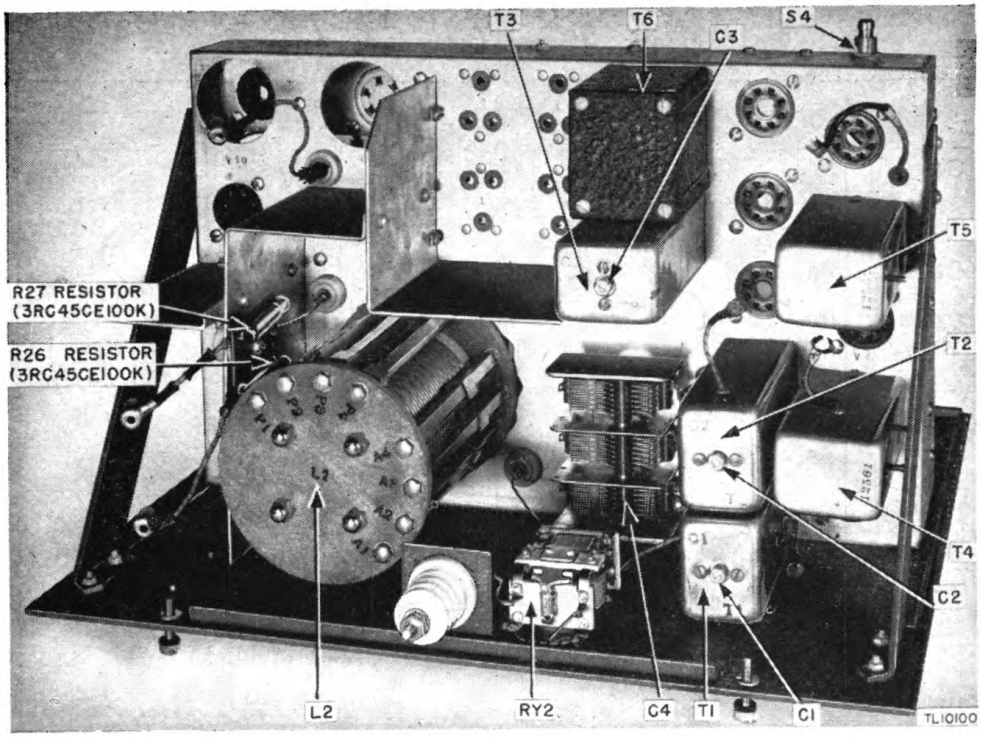


Figure 27. Radio Receiver and Transmitter BC–441–D, r-f chassis—top view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

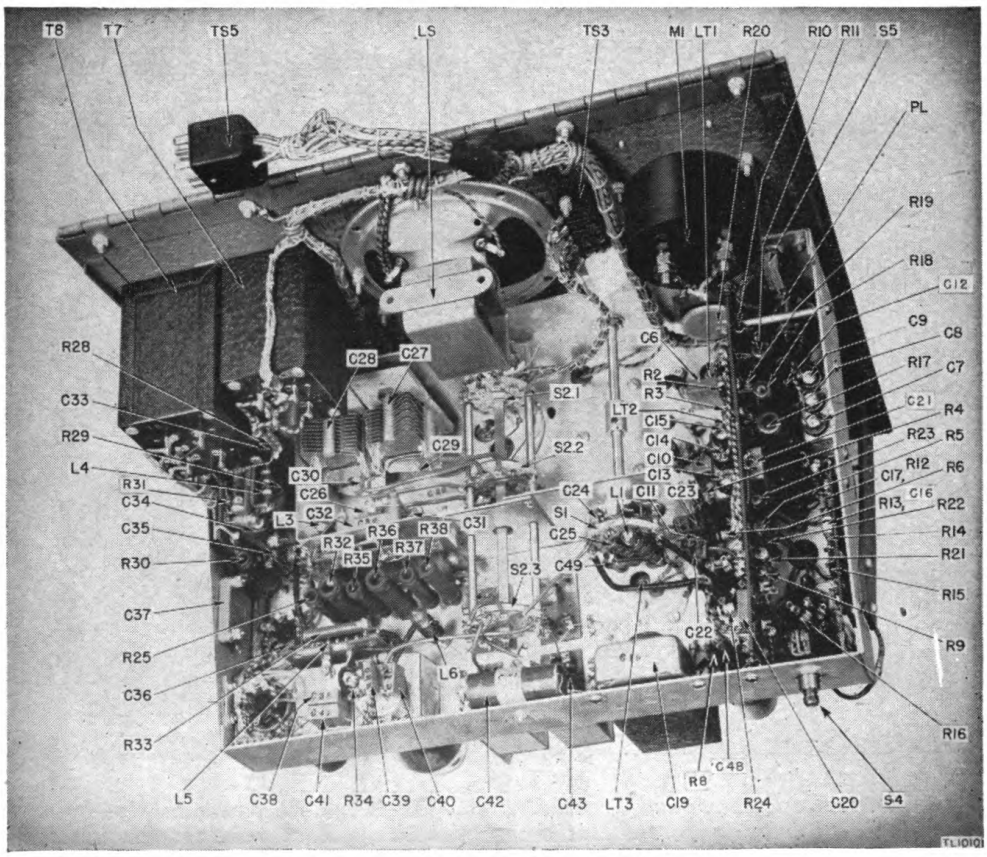


Figure 28. Radio Receiver and Transmitter BC–441–D, r-f, chassis—bottom view.

PARTS IN STATION STOCK

Reference symbol	Part	Signal Corps stock No.	Reference symbol	Part	Signal Corps stock No.
C6	Capacitor assembly	3DA10–117	PL	Lamp	2Z5925
C7	Capacitor	3DKA100–9Z.1	R2, R3	Resistor	3Z4550
C10	Same as C6		R4	Resistor	3Z6030–41
C11, C12	Same as C6		R5	Resistor	3Z6625–61
C13, C14, C15	Same as C7		R6	Resistor	3ZK6650–75
C16	Capacitor	3K2010121	R7	Resistor	3RC20AE202J
C17	Capacitor	3DA6–15	R8	Resistor	3Z6802–21
C18	Same as C16		R9	Resistor	3Z6725–29
C19	Capacitor	3DB1.6100B	R10	Same as R5	
C20, C21	Same as C6		R11	Resistor	3Z6610–121
C22	Same as C16		R12	Same as R9	
C23	Capacitor	3D9050–59	R13	Same as R2	
C24	Same as C16		R14	Resistor	3Z6801–36
C26	Capacitor	3D9100–37	R15	Same as R9	
C31, C32	Capacitor	3DA2–25	R16	Same as R6	
C35	Same as C17		R17	Resistor	3Z6175–2
C36	Same as C23		R18	Resistor	3Z6030–70
C38	Same as C17		R19	Same as R6	
C40	Same as C23		R21	Resistor	3Z6640–31
C41	Same as C17		R22	Resistor	3Z6050–32
C42, C43	Capacitor	3DB40–25	R23	Resistor	3RC45CE103K
C48	Same as C17		R24	Same as R6	
L1, L3, L4, L5	Choke	3C327–3	R25	Same as P.11	
			R28, R29	Resistor	3Z6002E5–23
			R30	Resistor	3ZK6010–83
			R31	Resistor	3Z6570–15
			R32	Resistor	3Z6575–49
			R33	Same as R5	
			R34	Same as R6	
			R35	Resistor	3Z6560–31
			R36	Resistor	3Z6620–102
			R37	Resistor	3Z6040–33
			R38	Resistor	3Z6050–150

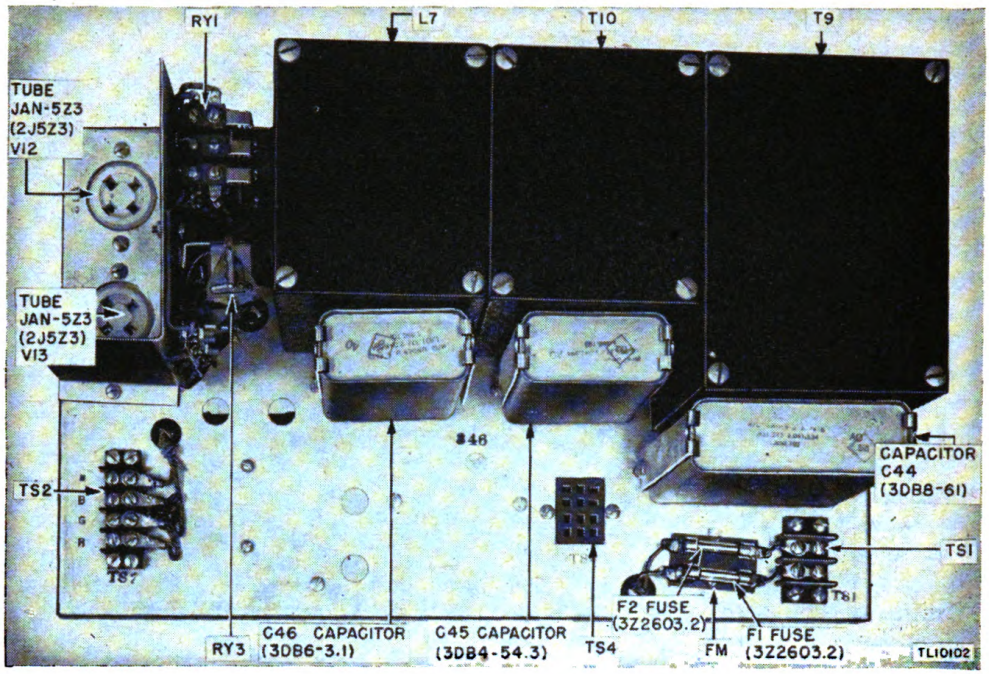


Figure 29. Radio Receiver and Transmitter BC–441–D, power supply—top view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)

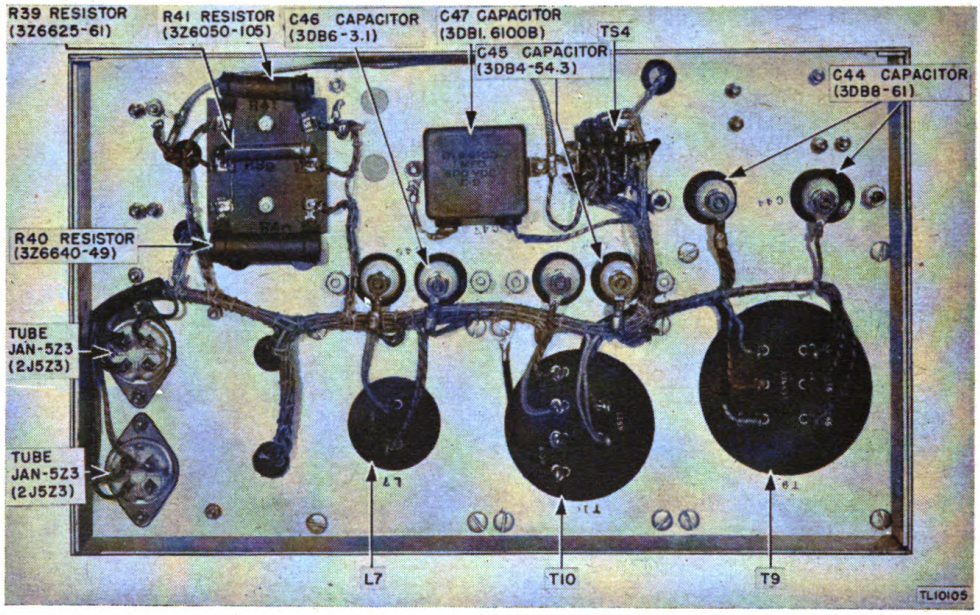
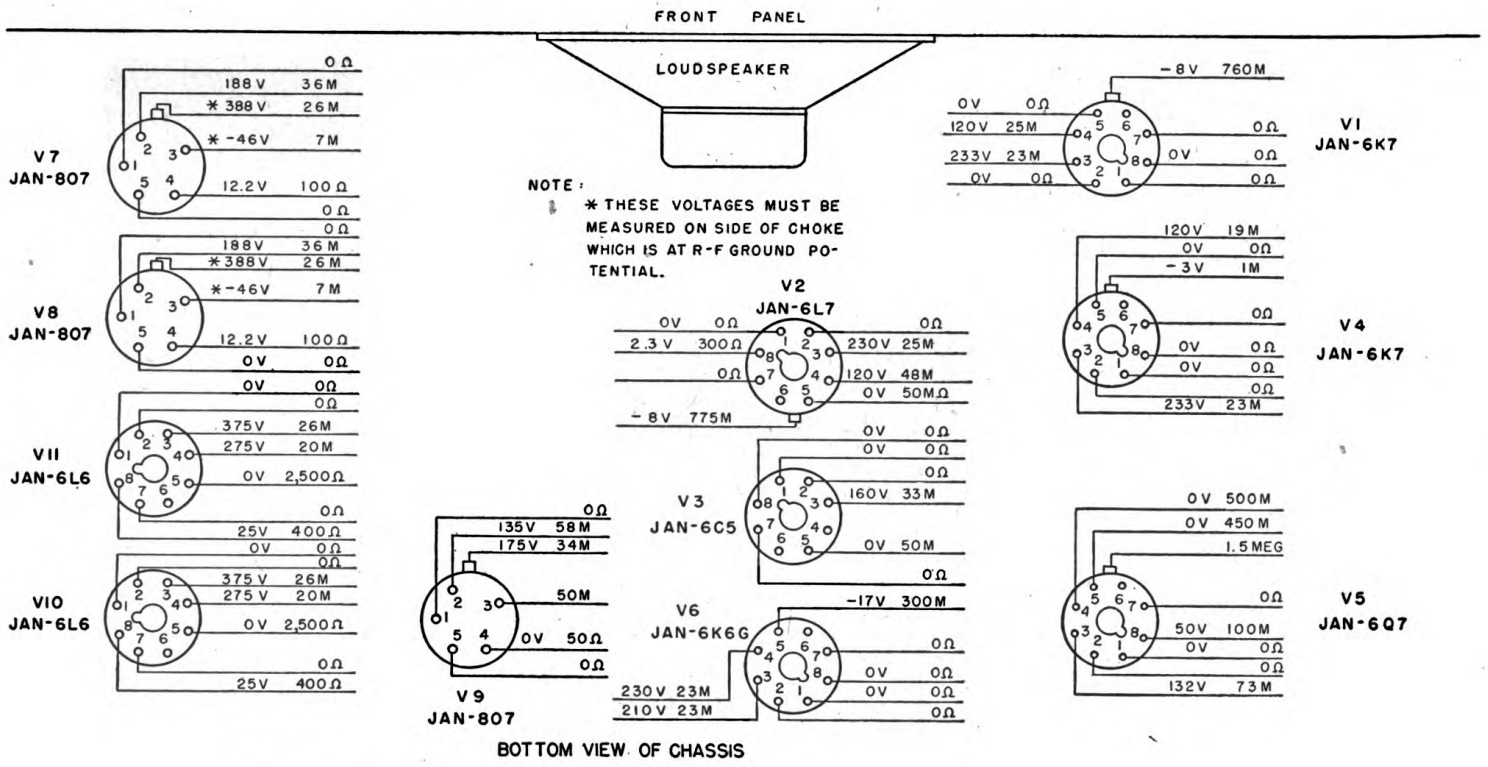


Figure 30. Radio Receiver and Transmitter BC–441–D, power supply—bottom view. (The numbers in parentheses are Signal Corps stock numbers for items in station stock.)



NOTE:

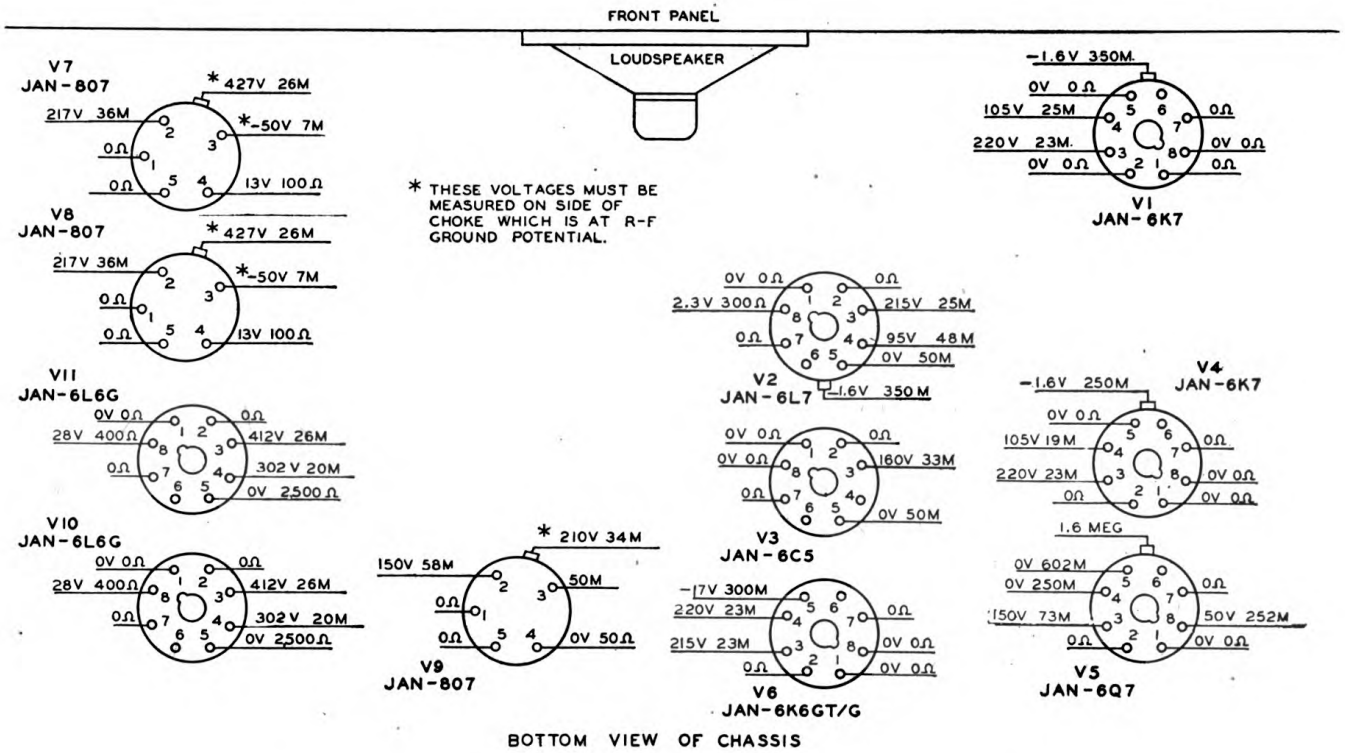
ALL MEASUREMENTS MADE FROM POINT INDICATED TO CHASSIS. RESISTANCE MEASUREMENTS MADE WITH POWER SOURCE DISCONNECTED, TUBES IN SOCKETS, CRYSTAL-MANUAL SWITCH AT MANUAL, AND VOLUME CONTROL AT MAXIMUM.

VOLTAGE MEASUREMENTS MADE WITH 1,000-OHM-PER-VOLT METER, 115-VOLT INPUT, NO SIGNAL INPUT TO RECEIVER, AND TRANSMITTER LOADED TO 130-MILLIAMPERE METER READING.

M=1,000Ω

TL 16690

Figure 31. Radio Receiver and Transmitter BC–441–A and –B, d–c voltage and resistance chart.



NOTE:
ALL MEASUREMENTS MADE FROM POINT INDICATED TO CHASSIS. RESISTANCE MEASUREMENTS MADE WITH POWER SOURCE DISCONNECTED, TUBES IN SOCKETS, CRYSTAL-MANUAL SWITCH AT MANUAL, AND VOLUME CONTROL AT MAXIMUM. VOLTAGE MEASUREMENTS MADE WITH 1,000-OHM-PER-VOLT METER, 115-VOLT INPUT, NO SIGNAL INPUT TO RECEIVER, AND TRANSMITTER LOADED TO 130-MILLIAMPERE METER READING.
M = 1,000 OHMS

TL 16691

Figure 32. Radio Receiver and Transmitter BC–441–D, d-c voltage and resistance chart.

83. Localizing Trouble in Radio Set SCR–281–(*)

Symptoms	Probable trouble	Corrections
1. Radio Set SCR–281–(*) dead; indicator light on panel not lighted.	1. Fuse F1 or F2 blown. Defective switch S5, or defective power cable. No power.	1. Replace fuse. Replace switch. Repair or replace power cable. Check power source.
2. Radio Set SCR–281–(*) dead; indicator light on panel lighted.	2. Defective interlock switch S4, or panel not fully closed.	2. Replace interlock switch S4. Tighten knurled nuts at top of front panel.
3. Receiver functions normally; handset switch does not turn on the transmitter.	3. Handset switch S7 or relay RY1 or RY3 not operating properly.	3. Repair handset switch. Clean and adjust relay contacts.
4. No dip in plate current reading found when tuning the transmitter.	4. Improper crystals or defective crystals in the oscillator.	4. Check crystals and try a new crystal in channel being checked.
5. Plate current falls off after several seconds operation of transmitter.	5. Defective Tubes JAN–807 in the transmitter.	5. Replace Tubes JAN–807 one at a time and note the results.
6. Impossible to obtain proper antenna loading or tune the p-a tank circuit near the low frequency end of the band.	6. Defective capacitor C46 in Radio Set SCR–281–A and –B or C26 in Radio Set SCR–281–D.	6. Replace capacitor.
7. Modulation is weak or badly distorted.	7. Defective modulator tubes V10 and V11.	7. Replace tubes V10 and V11, (JAN–6L6G); check tube voltages at sockets.
8. Receiver operates on CRYSTAL, but not on MANUAL position.	8. Defective transformer T3, or switch S1	8. Check transformer T3 and check and clean contacts on switch S1.
9. Receiver operates on MANUAL but not on CRYSTAL position.	9. Defective crystal unit, or switch S1.	9. Try a new crystal in same position and clean contacts on switch S1.
10. Intermittent operation of receiver.	10. Loose connection, defective capacitor or resistor, or gassy mixed tube V2.	10. Inspect capacitors and resistors for signs of overheating. Check for loose connections. Replace tube V2 (JAN–6L7).
11. Serious distortion on strong signals which disappears when antenna is removed from receiver.	11. Low resistance path from chassis to avc circuit.	11. Check resistance between grid cap of V2 and chassis. Value should be over 500,000 ohms in Radio Sets SCR–281–A and –B, and over 300,000 ohms in Radio Set SCR–281–D.

Section XIII. REPAIRS

84. Replacement of Parts

a. Most of the parts in Radio Set SCR–281–(*) are readily accessible and are easily replaced if they are found to be faulty. If the CRYSTAL SELECTOR switch requires replacement, the wires connected to the switch should be marked carefully with tags or other devices to avoid misconnection when the new switch is installed. This practice is recommended in all cases where the replacement requires the disconnection of numerous wires.

b. When installing a new part, clip all leads as short as possible and avoid using more solder than is necessary to make a good connection. Be careful when soldering. Do not heat lugs or connections more than is absolutely necessary. Excessive heat will damage the near-by parts. Do not provide space for working on a part by carelessly pushing aside other parts which are in the way. Never change the location of parts or wiring as undesirable oscillations may result.

85. Rustproofing and Repainting

When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up the bared surfaces as follows:

a. Use #00 or #000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

Caution: Do not remove the rust with steel wool. Small particles of steel wool frequently enter the case and cause shorting and grounding of circuits.

b. When a touch-up job is necessary apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the radio set from the case and spray the case. Remove rust from the case by cleaning corroded metal with dry-cleaning solvent. In severe cases it may be necessary to use dry-cleaning solvent to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with the existing regulations.

86. Unsatisfactory Equipment Report

a. When trouble in equipment used by Army Ground Forces or Army Service Forces occurs more often than repair personnel feel is normal, War Department Unsatisfactory Equipment Report, WD AGO Form 468 should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more

often than repair personnel feel is normal, Army Air Forces Form 54 should be filled out and forwarded through channels.

c. If either form is not available, Form 468 (fig. 33) may be reproduced, filled out, and forwarded through channels. When Army Air Forces Form 54 is required but unavailable, reproduce Form 468 and forward it through channels in accordance with directions on Form 468.

WAR DEPARTMENT
UNSATISFACTORY EQUIPMENT REPORT

FOR	TECHNICAL SERVICE: Signal Corps — MATÉRIEL	DATE: 1 Feb 45
FROM	ORGANIZATION: 175 Signal Repair Co.	STATION: APO 102
TO	NEXT SUPERIOR HEADQUARTERS: Supply Sec. Hq Fourth Army Sig Sv. — STATION: APO 110	TECHNICAL SERVICE: Signal Corps

COMPLETE MAJOR ITEM

NOMENCLATURE: Radio Transmitter BC-123-A	TYPE: Ground, vehicular		MODEL: A
MANUFACTURER: American Radio Corp	U. S. A. REG. No.: Order No. 1234-Phila-45	SERIAL NO.: 12345	DATE RECEIVED: 5 Jan 45
EQUIPMENT WITH WHICH USED (*If applicable*): Radio Set SCR-456-A	Tank, Medium, M4		

DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE

PART No.: Sig C Stk. No. 3E47-2	TYPE: Capacitor C20:fixed; 1-mf; 500 vdcw	MANUFACTURER: American Radio Corp	DATE INSTALLED: when manufactured

DESCRIPTION OF FAILURE AND PROBABLE CAUSE (*If additional space is required, use back of form*)
Capacitor C20 shorts out due to humid operating conditions

DATE OF INITIAL TROUBLE	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE					
	YEARS	MONTHS	DAYS	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
15 Jan 45	-	-	-	0	0	5		-	-

BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN
Operation in tropics; heavy rainfall. Was replaced and set given moistureproofing and fungiproofing treatment, 20 Jan 45.

TRAINING OR SKILL OF USING PERSONNEL			RECOMMENDATIONS (*If additional space is required, use back of form*)
POOR	FAIR	GOOD: X	Substitute capacitor designed for tropical operation

ORIGINATING OFFICER

TYPED NAME, GRADE, AND ORGANIZATION	SIGNATURE
E.A. WILSON, 1st Lt., Sig C. 175 Sig Repair Co.	E.A. Wilson

FIRST ENDORSEMENT

TO CHIEF	TECHNICAL SERVICE	OFFICE	
NAME, GRADE, AND STATION		STATION	DATE

Instructions

1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design, or operational defects in matériel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of matériel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 3).
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service; one copy will be forwarded through command channels.
8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. Form No. 468
30 August 1944

This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.

U. S. GOVERNMENT PRINTING OFFICE 16—41546-1

TL 19589

Figure 33, W.D., A.G.O. Form No. 468, War Department Unsatisfactory Equipment Report, sample form properly filled out.

Section XIV. ALIGNMENT AND ADJUSTMENT

87. Receiver Alignment

a. EQUIPMENT REQUIRED. The following equipment is required for alignment of the receiver of Radio Receiver and Transmitter BC–441–(*):

(1) Standard signal generator such as Signal Generator I–72–( ).
(2) Frequency Meter Set SCR–211–( ).
(3) Output meter such as provided in Test Set I–56–( ).
(4) 0.01-mf capacitor.
(5) 10,000-ohm resistor.
(6) 0.0005-mf capacitor.
(7) 30-ohm resistor.

b. PREPARATION. Unscrew the two knurled nuts at top of panel and pull out the front panel, releasing safety interlock switch S4. *Remove the line cord plug from the power source.* Insert a clip to hold the safety switch closed, or clip a connector across the terminals of this switch. Set the RECEIVER TUNING dial to 1,700 kc, the CRYSTAL-MANUAL switch to MANUAL, the VOLUME control to maximum, SPEAKER switch to OFF and POWER ON-OFF switch to ON.

c. I-F ALIGNMENT. (1) Turn signal generator on. Set it for 385 kc modulated output. Check frequency of signal generator using frequency meter set. (See TM 11–300.)

(2) Remove grid lead from top of Tube JAN–6L7, V2 (fig. 34(2)).

(3) Connect 10,000-ohm resistor between grid of V2 and chassis.

(4) Connect hot lead of signal generator through 0.01-mf capacitor to grid of V2.

(5) Connect ground lead of signal generator to chassis.

(6) Connect output meter across the two outside terminals of TS2 (fig. 34(1)).

(7) Turn receiver on by plugging line cord into power source. Allow receiver to warm up 15 minutes before proceeding.

(8) Adjust secondary (fig. 34 (3)) and primary (fig. 34 (4)) of second i-f transformer, T5, for maximum output as indicated on output meter.

Note: Use the smallest possible input from the signal generator consistent with obtaining an output meter indication that will show clearly above the noise level of the receiver. Too great an input will cause a-v-c action and give apparent broad tuning action to the trimmers. Not over two microvolts input should be required for the final adjustment.

(9) Adjust secondary (fig. 34(5)) and primary (fig. 34(6)) of first i-f transformer, T4, for maximum output as indicated on output meter.

(10) Repeat steps 8 and 9 above.

(11) Remove 10,000-ohm resistor and 0.01-mf capacitor, and replace grid cap of V2.

d. H-F OSCILLATOR ALIGNMENT. (1) Leave the signal generator tuned to 385 kc, but remove its modulation. Couple its hot lead loosely to the grid of V2 by one turn of insulated wire wound around the lead to the grid cap.

(2) Connect a wire to the output binding post of the frequency meter set and place the free end of the wire *near but not touching* the lead to the grid cap of V2.

(3) Tune receiver dial and frequency meter set to 2,700 kc.

(4) Adjust h-f oscillator trimmer capacitor C3 (fig. 34(7)) for zero beat as heard in the handset of the receiver.

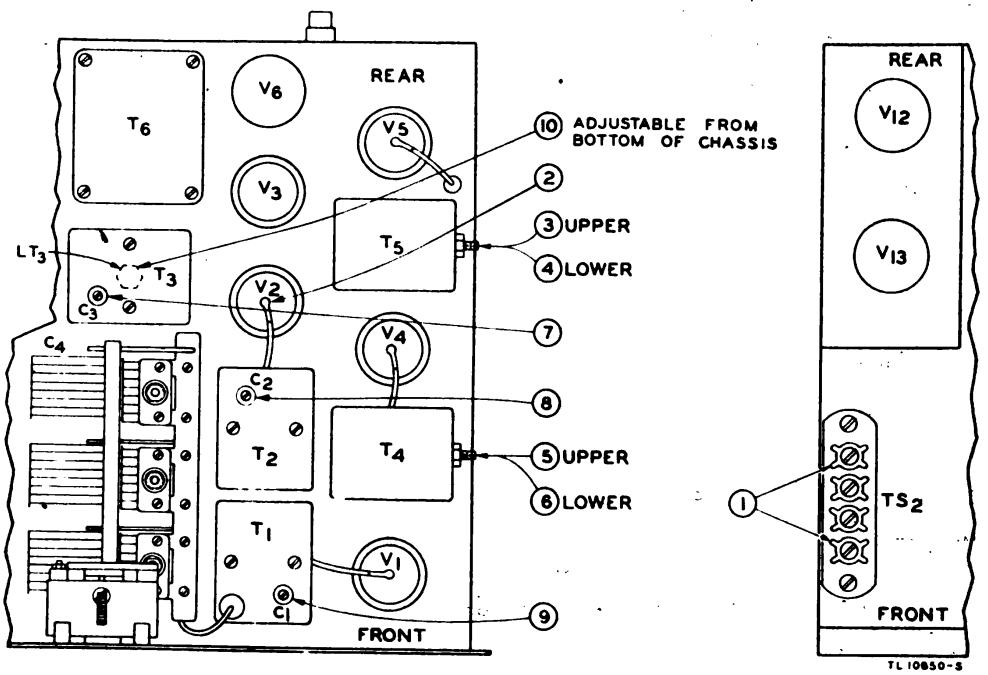


Figure 34. Receiver alignment adjustments showing r-f chassis—top view, at left; power supply—top view, at right.

Caution: Do not press the handset press-to-talk switch during this procedure, or transmitting voltages will be applied to the set.

(5) Tune receiver dial and frequency meter set to 1,800 kc.

(6) Loosen locknut and adjust h-f oscillator coil slug LT3 (fig. 34(10)) for zero beat as heard in handset of receiver.

(7) Repeat steps 3, 4, 5, and 6 above until alignment is correct at both ends of the frequency band. Then tighten locknut on LT3, making certain the adjusting screw does not shift.

(8) Disconnect the signal generator and frequency meter set.

e. R-F ALIGNMENT. (1) Loosely couple unmodulated output of signal

generator to frequency meter set which is tuned to 2,700 kc. Tune signal generator for zero beat, to assure its setting at exactly 2,700 kc.

(2) Connect signal generator hot lead through series 30-ohm resistor and 0.0005-mf capacitor to antenna terminal of set. Use modulated signal.

(3) Tune receiver dial to 2,700 kc.

(4) Adjust antenna and mixer grid coil trimmer capacitors C1 and C2 (fig. 34(8) and (9)) for maximum indication on output meter.

(5) Disconnect signal generator. Remove the line cord plug from the power source. Remove the clip or connector from the safety switch before closing the front panel.

(6) Replace line cord plug.

Note: When tuning the signal generator or the receiver through signal resonance after alignment a slight rise in the output meter reading will occur on either side of resonance. This rise is caused by the extreme a-v-c characteristic of the receiver and is normal. True resonance will be the point that gives minimum hiss in the output.

88. Transmitter Alignment

Transmitter alignment consists of the presetting operations detailed in paragraph 90.

Section XV. PRESETTING

89. Receiver Presetting

Receiver presetting consists of plugging in the proper crystals as explained in paragraph 15. Receiver crystals control the frequency of the high frequency oscillator when the receiver CRYSTAL-MANUAL switch is in the CRYSTAL position. There is no presetting of the receiver antenna and mixer tuned circuits; the RECEIVER TUNING dial must be turned to the desired signal frequency for greatest receiver sensitivity even in CRYSTAL position.

90. Transmitter Presetting

a. GENERAL. All transmitter tuning is preadjusted for subsequent selection of communication channels by means of the CRYSTAL SELECTOR switch. Tuning of this transmitter is slightly more difficult than of the conventional transmitter with continuous tuning. Since the crystal oscillator is not adjustable, the only tuning adjustments are in the antenna circuit.

b. EQUIPMENT REQUIRED. A screwdriver is the only tool required for transmitter presetting. It is used to adjust p-a tuning capacitors from the front panel. The P.A. CURRENT meter on the front panel is used as a resonance and loading indicator.

c. PREPARATION. (1) Unscrew the two knurled nuts at top of panel

and pull out the front panel. Install the four crystal holders in their sockets in any order, and record the channel frequencies on the tuning chart on the front panel.

(2) Close the front panel.

(3) Connect the antenna to the set.

(4) Set CRYSTAL SELECTOR switch to channel 1.

(5) Plug in line cord and turn POWER ON-OFF switch to ON.

d. TUNING TO RESONANCE. (1) Open the front panel and set slider A1 at bottom of the tank coil L2 (fig. 35). The slider will engage in a notch when properly seated.

(2) Set slider P1 near the top of the tank coil. The setting is usually near the top of the coil for the lowest frequencies (1,700 kc) and about one-third to one-half way down the coil for the highest frequencies (2,750 kc).

(3) Close the front panel. Open the small tuning door at left center of panel so the p-a tuning capacitors are accessible (fig. 7).

(4) Remove handset from hook and press the press-to-talk switch. With a screwdriver, rotate p-a tuning capacitor No. 1 until a dip in reading of the P. A. CURRENT meter is obtained. This indicates resonance.

(*a*) The meter reading at dip should be 30 to 50 ma.

(*b*) If there is no dip, reset slider P1 a few turns and repeat the above procedure.

(*c*) The meter dip should occur at about half capacity of the p-a tuning capacitor. If it does not, reset slider P1 a few turns and repeat. (Half capacity will be with the screw slot vertical on Radio Set SCR–281–D; with a reading of 2–8 on the scale of Radio Sets SCR–281–A and –B.)

e. LOADING TRANSMITTER. (1) Open the front panel and move slider A1 up a few turns from the bottom of the coil.

(2) Close the front panel, press handset button, and retune p-a tuning capacitor for dip on meter.

(*a*) Proper loading will be with 130 ma at dip on meter.

(*b*) If current reading is too low or too high, reset slider A1, more turns from the bottom of the coil for higher reading, fewer turns for lower reading.

(*c*) For some antenna lengths, loading of antenna by moving slider A1 will cause meter dip to occur at different setting of p-a tuning capacitor. Correct this condition by resetting slider P1 so that dip occurs at half capacity on p-a tuning capacitor.

(*d*) For antennas less than 85 feet in length, move slider P1 down a turn or two each time slider A1 is moved up. This will keep meter dip approximately at the half-capacity setting of p-a tuning capacitor.

f. RESONATING AND LOADING ON CHANNELS 2, 3, AND 4. Channels 2, 3, and 4 are tuned using the same procedure as outlined above for channel

1. In tuning channel 2, set the CRYSTAL SELECTOR switch to channel 2, adjust sliders A2 and P2, and tune p-a tuning capacitor No. 2. Channel 3 is tuned with sliders A3 and P3 and capacitor 3; and channel 4 with sliders A4 and P4 and capacitor 4.

g. FINAL CHECK. After all channels are tuned, carefully recheck the setting of each of the four p-a tuning capacitors for minimum dip on the meter. The reading should be 130 ma for best operation; however, satisfactory communication will be obtained with meter readings ranging from 110 to 140 ma. After all channels have been adjusted, speak into the microphone in a tone louder than normal. A slight flicker of the P.A. CURRENT meter will indicate modulation.

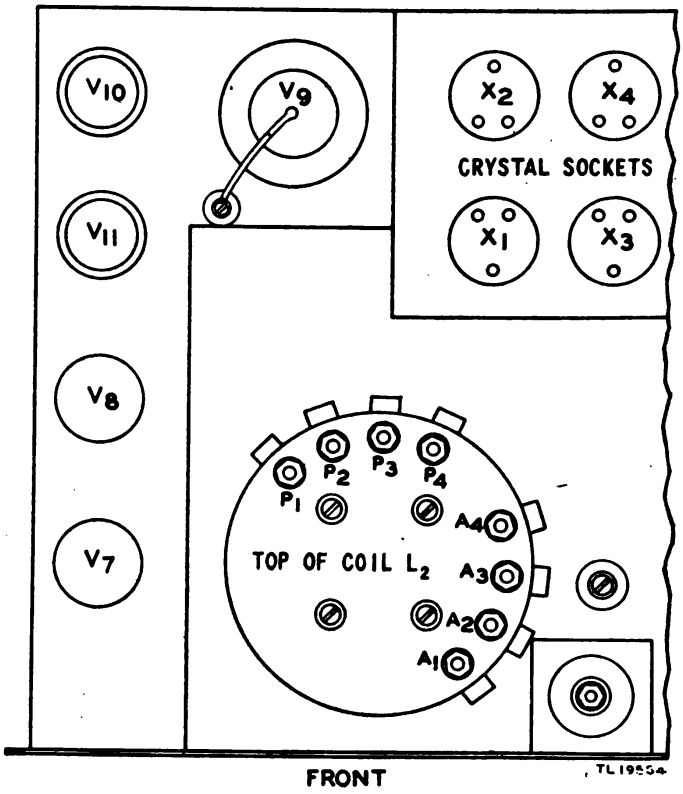


Figure 35. Transmitter presetting adjustments, showing r-f chassis—top view.

APPENDIX I

MAINTENANCE PARTS

Radio Sets SCR–281–A, –B, and –D, and Antenna Tuning Unit BC–619–A

The following information was compiled on 8 March 1945. The appropriate sections of the ASF Signal Supply Catalog for Radio Sets SCR–281–A, –B, and –D are:

SIG 10–54, Fixed Plant Maintenance Lists.
SIG 10–54.1, Fixed Plant Maintenance Lists.
SIG 10–108, Fixed Plant Maintenance Lists.

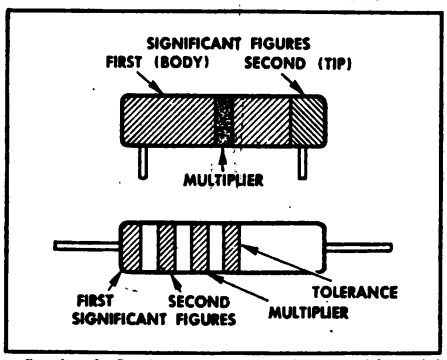
For the latest index of available catalog sections, see ASF Signal Supply Catalog SIG 2.

Reference symbol	Watts	Reference symbol	D-c voltage
R1	½	C1	1,000 (test)
R2	½	C4	600 (working)
R3	2	C5	600 (working)
R4	½	C6	1,000 (test)
R5	½	C7	600 (working)
R6	½	C8	600 (working)
R7	2	C9	600 (working)
R8	½	C11	500 (working)
R9	2	C12	600 (test)
R10	10	C13	1,000 (test)
R11	½	C14	1,000 (test)
R12	½	C15	600 (working)
R13	½	C16	600 (working)
R14	½	C17	1,000 (test)
R15	1	C18	1,000 (test)
R17	½	C19	600 (test)
R18	½	C20	600 (test)
R19	10	C21	600 (test)
R20	20	C22	600 (test)
R21	2	C23	600 (working)
R22	2	C24	600 (working)
R23	½	C30	1,200 (working)
R24	½	C31	1,200 (working)
R25	20	C32	600 (working)
R26	10	C33	600 (working)
R27	2	C34	1,000 (test)
R28	2	C35	1,000 (test)
R29	20	C36	300 (working)
R30	1	C37	500 (working)
R31	10	C38	1,000 (test)
R32	20	C39	150 (working)
R33	10	C40	150 (working)
R34	½	C41	400 (working)
R35	½	C42, C43, C44	600–600–1,000 (working)
R36	10		
R37	10	C45	1,000 (working)
R38	20	C46	2,500 (working)
R39	2	C47	600 (working)
R40	½	C48	600 (working)
R41	½	C49	600 (working)
R42	½	C50	400 (working)

Reference symbol	D-c voltage	Reference symbol	Watts
C5	600 (working)	R1	½
C6	300 (working)	R2	½
C7	600 (working)	R3	½
C8	600 (working)	R4	½
C9	600 (working)	R5	2
C10	300 (working)	R6	½
C11	300 (working)	R7	½
C12	300 (working)	R8	½
C13	600 (working)	R9	½
C14	600 (working)	R10	2
C15	600 (working)	R11	10
C16	1,000 (test)	R12	½
C17	600 (test)	R13	½
C18	1,000 (test)	R14	½
C19	600 (working)	R15	½
C20	300 (working)	R16	½
C21	300 (working)	R17	20
C22	1,000 (test)	R18	10
C23	1,000 (test)	R19	½
C24	1,000 (test)	R21	1
C25	1,000 (test)	R22	½
C26	5,000 (test)	R23	2
C31	2,500 (test)	R24	½
C32	2,500 (test)	R25	10
C33	600 (working)	R26	2
C34	600 (working)	R27	2
C35	600 (test)	R28	½
C36	1,000 (test)	R29	½
C37	600 (working)	R30	10
C38	600 (test)	R31	2
C39	600 (working)	R32	20
C40	1,000 (test)	R33	2
C41	600 (test)	R34	½
C42	150 (working)	R35	10
C43	150 (working)	R36	20
C44	1,000 (working)	R37	10
C45	1,000 test	R38	10
C46	600 (working)	R39	2
C47	600 (working)	R40	20
C48	600 (test)	R41	10
C49	600 (working)		

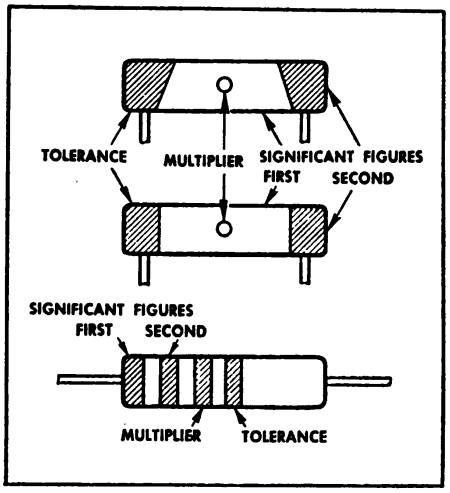
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS



Insulated fixed composition resistors with axial leads are designated by a natural tan background color. Non-insulated fixed composition resistors with axial leads are designated by a black background color.

AWS COLOR CODE FOR FIXED COMPOSITION RESISTORS



The exterior body color of insulated resistors may be any color except black. The usual color is natural tan. The exterior body color of uninsulated resistors with axial leads may be either black or white. The exterior body color of uninsulated resistors with radial leads may be black or it may be the color of the first significant figure of the resistance value.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	
RED	2	100	
ORANGE	3	1000	
YELLOW	4	10,000	
GREEN	5	100,000	
BLUE	6	1,000,000	
VIOLET	7	10,000,000	
GRAY	8	100,000,000	
WHITE	9	1,000,000,000	
GOLD		0.1	5
SILVER		0.01	10
NO COLOR			20

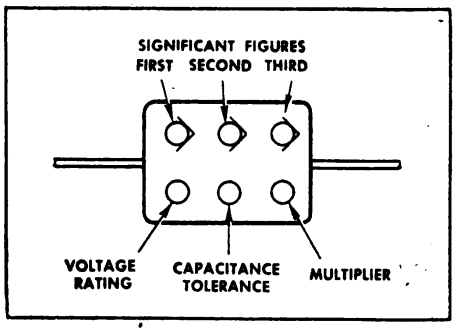
RMA: *Radio Manufacturers Association*
AWS: *American War Standard (American Standards Association)*

TL 13418

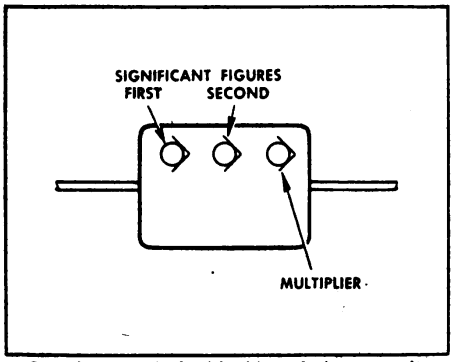
Figure 38. Resistor color code.

CAPACITOR COLOR CODES

RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

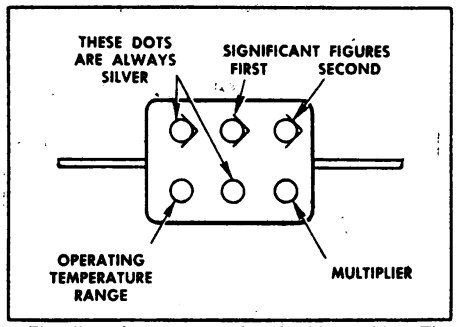


RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



Capacitors marked with this code have a voltage rating of 500 volts.

AWS 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS

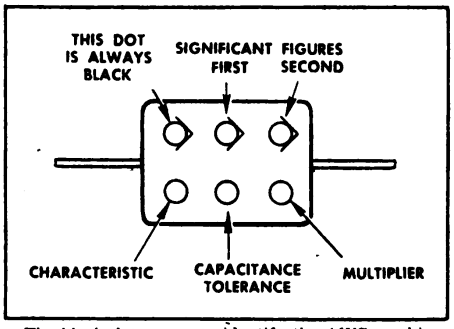


The silver dots serve to identify this marking. The sixth dot shows whether the capacitor has a maximum operating temperature of 167°F (black) or 185°F (brown).

COLOR	SIGNIFICANT FIGURE	MULTIPLIER		VOLTAGE RATING (VOLTS)	CHARACTERISTIC (AWS MICA-DIELECTRIC)
		RMA MICA- AND CERAMIC-DIELECTRIC AWS MICA- AND PAPER-DIELECTRIC	AWS CERAMIC-DIELECTRIC		
BLACK	0	1	1		A
BROWN	1	10	10	100	B
RED	2	100	100	200	C
ORANGE	3	1000	1000	300	D
YELLOW	4	10,000		400	E
GREEN	5	100,000		500	F
BLUE	6	1,000,000		600	G
VIOLET	7	10,000,000		700	
GRAY	8	100,000,000	0.01	800	
WHITE	9	1,000,000,000	0.1	900	
GOLD		0.1		1000	
SILVER		0.01		2000	
NO COLOR				500	

Figure 39. Capacitor color code.

AWS 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

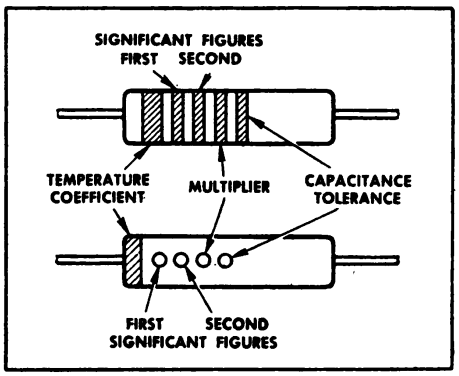


The black dot serves to identify the AWS marking. Capacitors marked with this code are rated at 500 volts, except the following. AWS type CM35 capacitors with capacitances of 6,800, 7,500, and 8,200 micromicrofarads, and AWS type CM40 capacitors with capacitances of 9,100 and 10,000 micromicrofarads are rated at 300 volts.

RMA: *Radio Manufacturers Association*
AWS: *American War Standard (American Standards Association)*

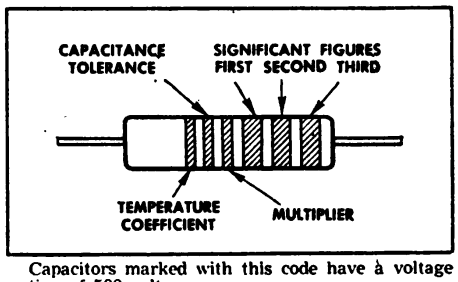
NOTE: These color codes give all capacitances in *micromicrofarads*.

AWS COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



Capacitors marked with this code have a voltage rating of 500 volts.

RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



Capacitors marked with this code have a voltage rating of 500 volts.

CAPACITANCE TOLERANCE				TEMPERATURE COEFFICIENT OF CAPACITANCE $\times 10^{-6}$ MMF/MMF/°C
RMA & AWS MICA- AND PAPER-DIELECTRIC (PERCENT)	RMA CERAMIC-DIELECTRIC (PERCENT)	AWS CERAMIC-DIELECTRIC GREATER THAN 10 MMF (PERCENT)	AWS CERAMIC-DIELECTRIC LESS THAN 10 MMF (MMF)	
20	20	20	2.0	0
1	1	1		− 30
2	2	2		− 80
3	3	2.5	0.25	−150
4	4			−220
5	5	5	0.5	−330
6	6			−470
7	7			−750
8	2.5			+ 30
9	10	10	1.0	Not specified
5				
10				
20				TL 13417

APPENDIX II

REFERENCES

1. Army Regulations

AR 380–5	Safeguarding Military Information.

2. Supply Publications

SIG 1	Introduction to ASF Signal Supply Catalogue.
SIG 2	Complete Index to ASF Signal Supply Catalogue.
SIG 3	List of Items for Troop Issue.
SIG 4–1	Allowances of Expendable Supplies.
SIG 4–2	Allowances of Expendable Supplies for Schools, Training Centers, and Boards.
SIG 5	Stock List of All Items.
SIG 6	Sets.
SIG 10–54	Fixed Plant Maintenance Lists.
SIG 10–54.1	Fixed Plant Maintenance Lists.
SIG 10–108	Fixed Plant Maintenance Lists.
SB 11–8	Chests for Running Spares.
SB 11–10	Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.
SB 11–17	Electron Tube Supply Data.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–300	Frequency Meter Sets SCR–211–( ).
TM 11–303	Test Sets I–56–C, I–56–D, I–56–H, and I–56–J.
TM 11–321	Test Set I–56–E.
TM 11–2613	Voltohmmeter I–166.
TM 11–2626	Test Unit I–176.
TM 11–2627	Tube Tester I–177.
TM 11–472	Repair and Calibration of Electrical Measuring Instruments.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication and Ground Signal Equipment.

5. Shipping Instructions

U. S. Army Spec. No. 100-14A	Army-Navy General Specification for Packaging and Packing for Overseas Shipment.

6. Decontamination

TM 3–220	Decontamination.

7. Demolition

FM 5–25	Explosives and Demolitions.

8. Camouflage

FM 5–20	Camouflage, Basic Principles.

9. Other Technical Publications

FM 21–6	List of Publications for Training.
FM 24–18	Radio Communication.
TB SIG 5	Defense Against Radio Jamming.
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Ground Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TM 1–455	Electrical Fundamentals.
TM 11–227	Signal Communication Equipment Directory Radio Communication Equipment.
TM 11–310	Schematic Diagrams for Maintenance of Ground Radio Communication Sets.
TM 11–314	Antennas and Antenna Systems.
TM 11–453	Shop Work.
TM 11–462	Reference Data.
TM 11–483	Suppression of Radio Noises.

TM 11–496	Training Text and Applicatory Exercises for Amplitude-modulated Radio Sets.
TM 11–499	Radio Propagation.
TM 37–250	Basic Maintenance Manual.

10. Forms

WD AGO Form 468	(Unsatisfactory Equipment Report).
Army Air Forces Form 54	(Unsatisfactory Report).

11. List of Abbreviations

a-c	alternating-current
a-f	audio-frequency
amp	ampere
amplr	amplifier
a-m	amplitude-modulated
ANT	antenna
AUX	auxiliary
a-v-c	automatic-volume-control
BC	basic component
cps	cycles per second
detcr	detector
d-c	direct-current
diam	diameter
fig.	figure
fil	filament
gnd	ground
h-f	high-frequency
ID	inside diameter
i-f	intermediate-frequency
JAN	Prefix designation for radio electron tubes procured under joint Army-Navy Specification JAN-1A.
kc	kilocycles
ma	milliamperes
max	maximum
mc	megacycles
m-c-w	modulated-continuous-wave
meg	megohms
mf	microfarads
mfd	manufactured
mh	millihenries
min	minimum

mmf	micromicrofarads
mo	master oscillator
mod	modulator
MTR	meter
NC	no connection
No.	number
OD	outside diameter
od	olive drab
osc	oscillator
p-a	power-amplifier
par.	paragraph
pf	power factor
PWR	power
recvr	receiver
rect	rectifier
r-f	radio-frequency
ry	relay
SCR	Signal Corps Radio
sec	section
SO	socket
v	volts
w	watts
WD AGO	War Department, Adjutant General's Office
x	by
μh	microhenries
Ω	ohms