TM 11-5071

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVER

R-257/U



DEPARTMENT OF THE ARMY • DECEMBER 1954

WARNING

HIGH VOLTAGE
is used in the operation
of this equipment.

DEATH ON CONTACT
may result if personnel fail
to observe safety precautions.

TECHNICAL MANUAL
No. 11–5071

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *29 December 1954*

RADIO RECEIVER R–257/U

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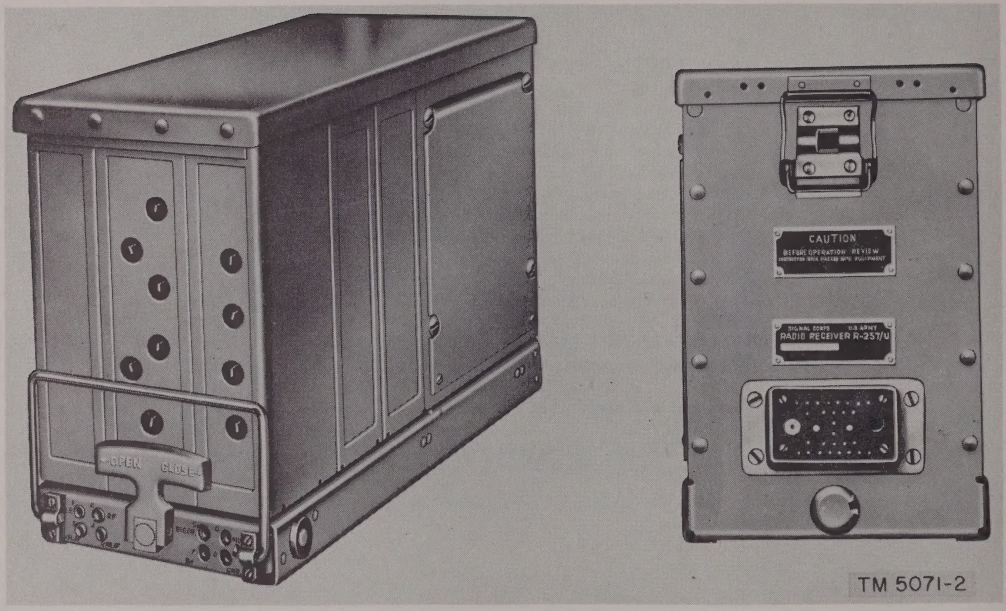


Figure 1. Radio Receiver R–257/U, front and rear.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope of Manual

This manual contains the necessary instructions for the installation, operation, maintenance, and repair of Radio Receiver R–257/U (fig. 1). Theory is also included so that the repairman will have a better understanding of the radio receiver.

2. Forms and Records

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

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army) and Navy Shipping Guide, Article 1850–4 (Navy).

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

c. DA Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 17).

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Radio Receiver R–257/U is a 21-tube double conversion superheterodyne receiver. It operates in the frequency range of 25 to 50 mc (megacycles) at a crystal-controlled preset frequency. The receiver itself does not have any operating controls. These controls are furnished in radio sets in which the receiver is used.

a. The receiver is used for detecting f-m (frequency-modulated) signals and converting them to usable audio signals. A relay can be added to the receiver for controlling the operation of a radio transmitter, such as Radio Transmitter T–417/GR. Spare relay contacts are available on the relay to control other equipment if desired.

b. Physically, the receiver is a compact unit which is built to withstand shocks encountered in mobile use. Operation is simple and operational maintenance is rapid and relatively easy because plug-in type assemblies are used for all the stages. Ordinarily, a defective receiver can be repaired merely by changing one of the plug-in units. The construction is standard for the different radio sets of the group with which it is to be used. This enables interchangeability with other receivers.

c. Agc (automatic gain control) is incorporated to compensate for variations in signal strength as well as to provide more uniform gain among different units of this receiver. In addition to the ordinary circuits of the receiver, a squelch circuit is provided to silence the receiver when no signal is being received.

4. System Application

When Radio Receiver R–257/U is combined with certain pieces of equipment, it can be used as a part of several different radio sets. These sets are Radio Receiving Set AN/FRR–44, Radio Set AN/VRC–6(*), Radio Set AN/FRC–15, and Radio Set AN/TRC–22. Figure 2 is a block diagram outlining the components of

these radio sets. Radio Receiving Set AN/FRR–44 (fig. 3) is the simplest of the group and is designed for single channel reception only. The cabinet is useful for testing Radio Receiver R–257/U. It consists of Radio Receiver R–257/U mounted in Electrical Equipment Cabinet CY–1150/U. The power source required is 115 or 230 volts at 50 to 60 cps (cycles per second). The controls are on the front panel of the cabinet.

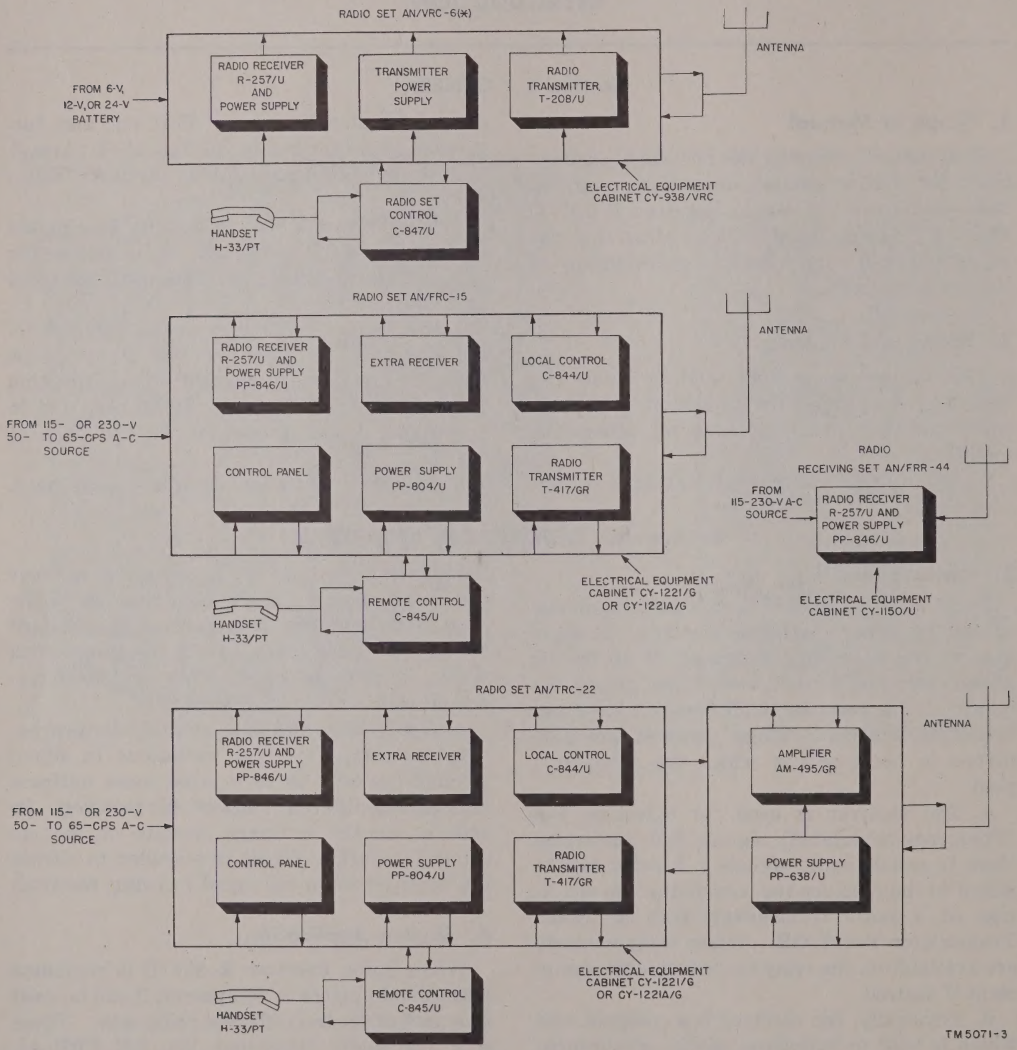


Figure 2. Radio Receiver R–257/U, system application.



Figure 3. Radio Receiving Set AN/FRR–44, less antenna and connecting cord.

5. Technical Characteristics

Frequency range	25 to 50 mc.
Receiver type	Double conversion, crystal controlled, superheterodyne, fixed frequency.
Crystal range:	
First h-f oscillator (third overtone)	16.4 to 28.9 mc (Crystal Unit CR–32/U).
Second h-f oscillator	7.345 mc (Crystal Unit CR–18/U).
Types of signals which can be received	F-m (±15-kc deviation).
Number of tubes	21.
Intermediate frequencies	7.8 mc and 455 kc.
Audio output impedance	8 ohms.
Audio power output	0.5 watt at less than 10% distortion.
Audio frequency response	300 to 2,500 cps ±1 db (without de-emphasis). 6 db per octave ±1 db (with de-emphasis).
Special features	Squelch and muting circuits.
Antenna	Quarter-wave vertical.
Weight	26 pounds (including power supply).

Power input to radio set power supplies:

Voltage source	Power supply	Input current (amperes)
6 volts d-c	Power Supply PP–869/U	3.7.
12 volts d-c	Power Supply PP–868/U	2.0.
24 volts d-c	Power Supply PP–867/U	1.1.
115 or 230 volts a-c	Power Supply PP–864/U	0.4 at 115 volts. 0.2 at 230 volts.

6. Packaging Data

Radio Receiver R–257/U is shipped installed in the radio set case of which it is used as a component. Details of the radio set packaging will be found in the instruction book pertaining to the specific radio set. When it is necessary to ship Radio Receiver R–257/U separately, the packaging will be performed in a manner that will keep it safe from moisture, shock, and vibration. Such packaging consists of one water-resistant carton within a second water-resistant carton. The outside container is a waterproof wooden crate. Adequate padding must be placed between layers of the package to absorb shocks.

7. Description of Radio Receiver R–257/U

The radio receiver consists of a chassis base and eight subassemblies. Three cover plates are provided with the receiver. The top cover plate is fastened down with a latch at the rear end of the receiver. The bottom cover plate fastens to the receiver base with six Airloc fasteners. The side cover plate fastens to the

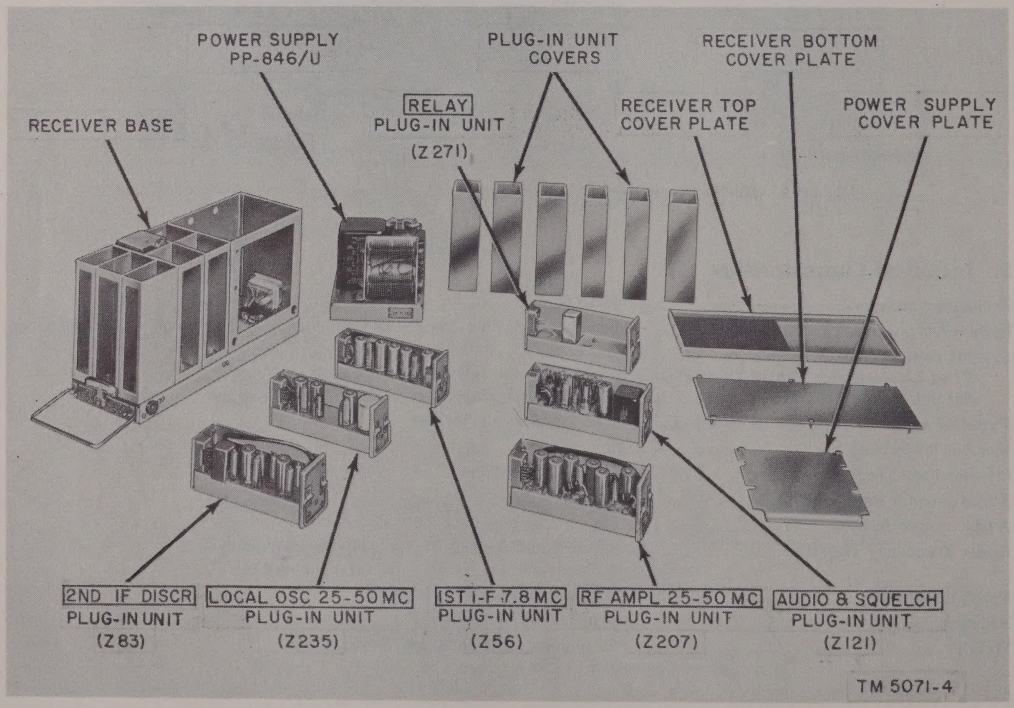


Figure 4. Radio Receiver R–257/U, components disassembled.

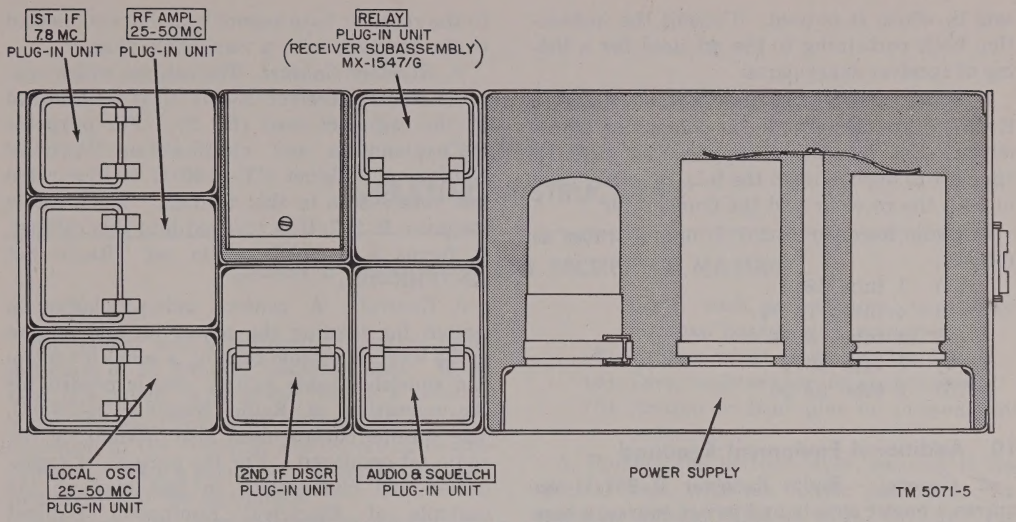


Figure 5. Radio Receiver R-257/U, plug-in unit location.

receiver base with two Airloc fasteners. Six of the subassemblies are provided with the receiver. Two of them, the RELAY plug-in unit and the power supply, must be ordered separately. The subassemblies and their locations in the chassis base are shown on figures 4 and 5 and are listed below:

a. RF AMPL 25–50 MC plug-in unit
b. LOCAL OSC 25–50 MC plug-in unit
c. 1ST IF 7.8 MC plug-in unit
d. 2ND IF DISCR plug-in unit
e. AUDIO & SQUELCH plug-in unit
f. Selectivity filter (shown on fig. 13)
g. RELAY plug-in unit (Receiver Subassembly MX–1547/G)
h. Power supply (par. 8)

8. Power Supplies

Power Supply PP–846/U (fig. 6) is used to supply filament, plate, and bias voltages to Radio Receiver R–257/U in Radio Receiving Set AN/FRR–44. The power supply chassis mounts in a vertical plane and is fastened to the receiver base with six screws. This power supply operates on 115 or 230 volts a-c (alternating current). For further details on Power Supply PP–846/U, see TM 11–5078. Power Supplies PP–867/U, PP–868/U, and PP–869/U (TM 11–5079), which also can be used to power the receiver, are similar to Power Supply PP–846/U except that they operate from 6, 12, or 24 volts d-c (direct current), respectively. The power supplies are additional equipments which are furnished as a part of an overall radio set or requisitioned separately.

9. Running Spares

a. No spare parts are furnished with Radio Receiver R–257/U. However, receiver running spares are furnished with the various radio

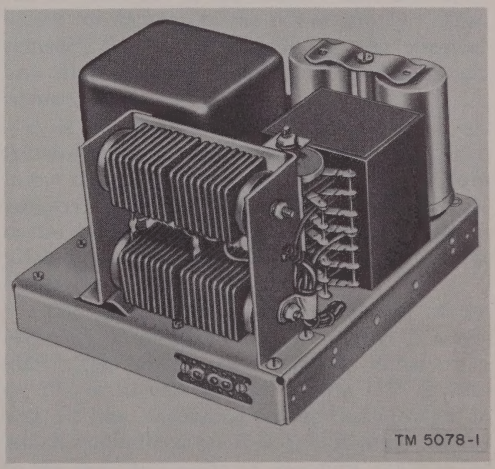


Figure 6. Power Supply PP–846/U.

sets in which it is used. Consult the instruction book pertaining to the set used for a listing of receiver spare parts.

b. Since certain tubes used in Radio Receiver R–257/U are used also in the companion transmitter, the quantities supplied as running spares will depend upon the total quantity used in both the receiver and the transmitter.

c. Radio Receiver R–257/U uses 21 tubes as follows:

(1) 1 tube 5840
(2) 4 tubes 1AD4
(3) 14 tubes 5678
(4) 1 tube 5672
(5) 1 tube 6AK6

10. Additional Equipment Required

a. General. Radio Receiver R–257/U requires a power supply and power source, a case (or housing), a control unit, and an antenna for operation.

b. Power Supply. The power supply used to power Radio Receiver R–257/U depends on the radio set and power source being employed (par. 8). These power supplies are mounted in the receiver base assembly and are connected to the receiver with a removable plug.

c. Receiver Cabinet. The cabinet which contains Radio Receiver R–257/U is determined by the radio set used (fig. 2). For purposes of explanation and clarification, Electrical Equipment Cabinet CY–1150/U is illustrated and referred to in this manual. When Radio Receiver R–257/U is plugged into this cabinet, it forms a complete radio set (Radio Set AN/FRR–44).

d. Control. A control unit, including a switch for turning the power on and off, an audio level or volume control, a squelch control and squelch disable switch, also is needed for the operation of Radio Receiver R–257/U. The specific control used also depends on the radio set employed. For the purpose of explanation and clarification in this manual, the controls of Electrical Equipment Cabinet CY–1150/U (fig. 14) are illustrated and referred to when necessary.

e. Antenna. The antenna used for Radio Receiver R–257/U is a quarter-wave vertical type. Connection is made through a length of coaxial cable.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

11. General

Equipment may be shipped in oversea packing cases or in domestic packing cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and where it is convenient to make a permanent or semipermanent installation of the equipment.

Caution: Be careful when uncrating, unpacking, and handling the equipment. If it becomes damaged or exposed, a complete overhaul may be required or the equipment may be rendered useless.

12. Uncrating, Unpacking and Checking New Equipment

a. Uncrating and Unpacking. Radio Receiver R–257/U usually is not packaged as a separate unit, but as a component in one of the radio sets incorporating its use. Detailed information pertaining to the unpacking and uncrating of the radio sets is contained in the pertinent radio set technical manual.

b. Checking. Inspect Radio Receiver R–257/U for damage which may have occurred during shipment. If a packing slip is contained in the carton, check it against the contents.

c. Repacking. To repack the receiver, reverse the procedure used for unpacking.

13. Installation of Receiver

a. Before installing the receiver, check it for damage by removing the cover plates and examining the internal parts. Remove the top cover by releasing the latch at the rear of the receiver (fig. 7). With the top cover off, all the plug-in units can be removed. Take off the cover on each unit (fig. 4) and examine it for the following items:

(1) Broken or cracked tubes. (Refer to figs. 8 through 12 for tube locations.)
(2) Cracked, loose, or otherwise defective parts, such as resistors, capacitors, terminal boards, and connectors.
(3) Broken wires or frayed insulation.
(4) Dirt, moisture, or foreign material.
(5) Broken or bent pins on plug-in unit connectors.

b. Remove the bottom cover, secured to the receiver base with six Airloc fasteners. Inspect for defects listed in *a*(2), (3), and (4) above, and for obvious damage to mechanical structures. When using Power Supply PP–846/U, connect a jumper between terminals 7 and 8 of terminal board TB251 on the receiver base.

c. Remove the side cover by loosening the two Airloc fasteners and withdrawing the cover. Remove the power supply by first disconnecting plug P251 (on the under side of the receiver base) from the power supply connector (fig. 13) and then loosening and unscrewing the six binder-head screws. The power supply now can be lifted out of the receiver base assembly. Check for damage to the power supply. Then reinsert the power supply in the receiver base and reconnect P251 to the power supply connector.

d. If the receiver passes this inspection satisfactorily, reassemble the plug-in units and insert the receiver in the radio set case. Main receiver connector P252 should engage the connector in the case. After this has been accomplished, tighten the lock-in rod by turning it clockwise.

e. Be sure that the power connector of the radio set is connected and that power is available. The power cable connects either to a 6-, 12-, or 24-volt battery or to a 115- or 230-volt a-c line, depending on the radio system in which Radio Receiver R–257/U is used. Refer to the pertinent radio set technical manual for a specific power connections.

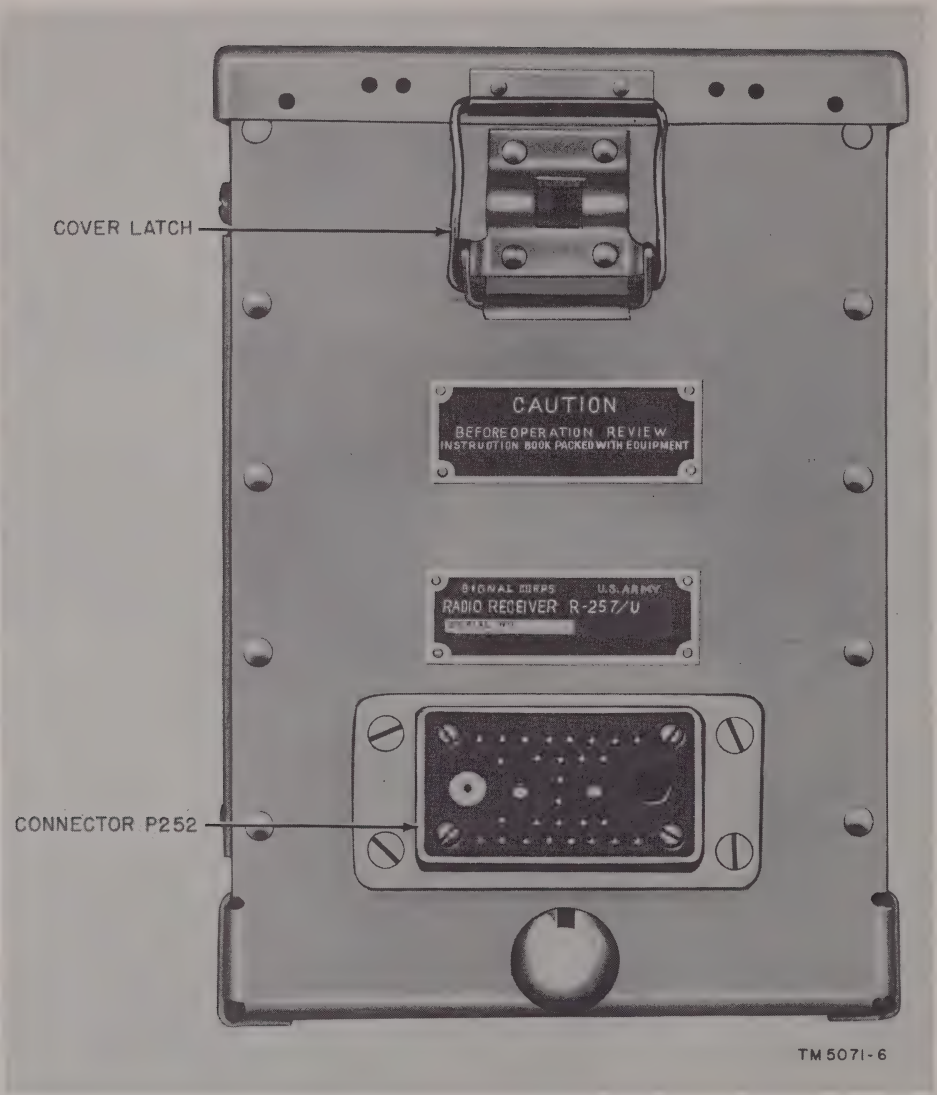


Figure 7. Radio Receiver R–257/U, external connection and cover latch.

14. Service Upon Receipt of Used or Reconditioned Equipment

a. Refer to the instructions given in paragraph 12 when unpacking used or reconditioned equipment.

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

c. Follow the installation procedures given in paragraph 13.

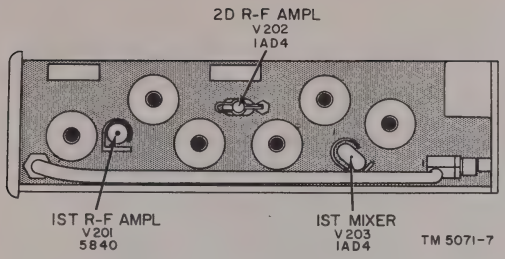


Figure 8. Radio Receiver R-257/U, RF AMPL 25-50 MC plug-in unit, tube location.

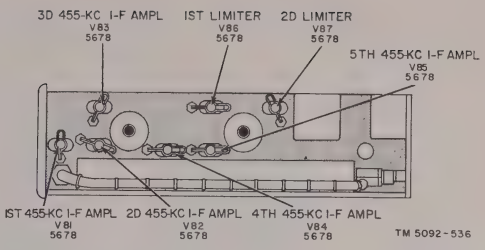


Figure 11. Radio Receiver R-257/U, 2ND IF DISCR plug-in unit, tube location.

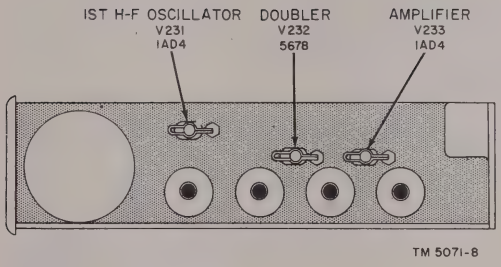


Figure 9. Radio Receiver R-257/U, LOCAL OSC 25-50 MC plug-in unit, tube location.

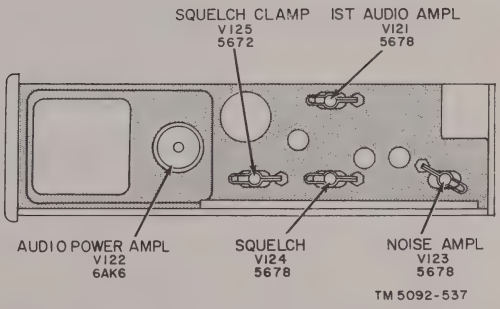


Figure 12. Radio Receiver R-257/U, AUDIO & SQUELCH plug-in unit, tube location.

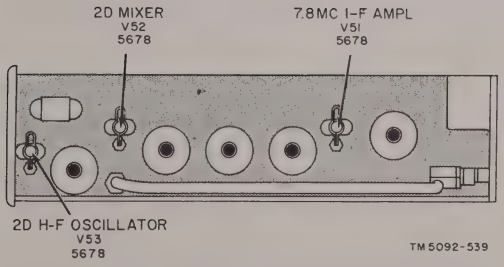


Figure 10. Radio Receiver R-257/U, 1ST IF 7.8 MC plug-in unit, tube location.

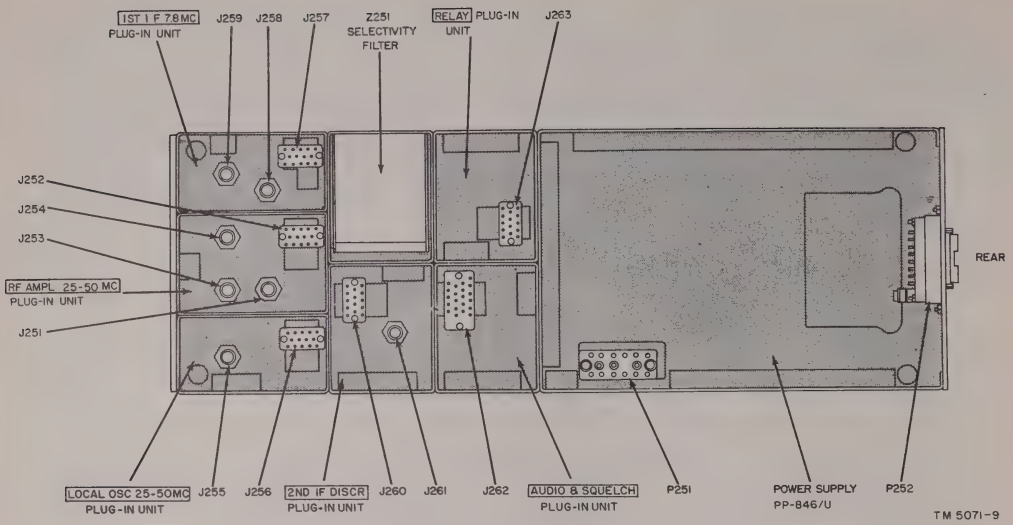


Figure 13. Radio Receiver R–257/U, compartment location.

Section II. CONTROLS AND INSTRUMENTS

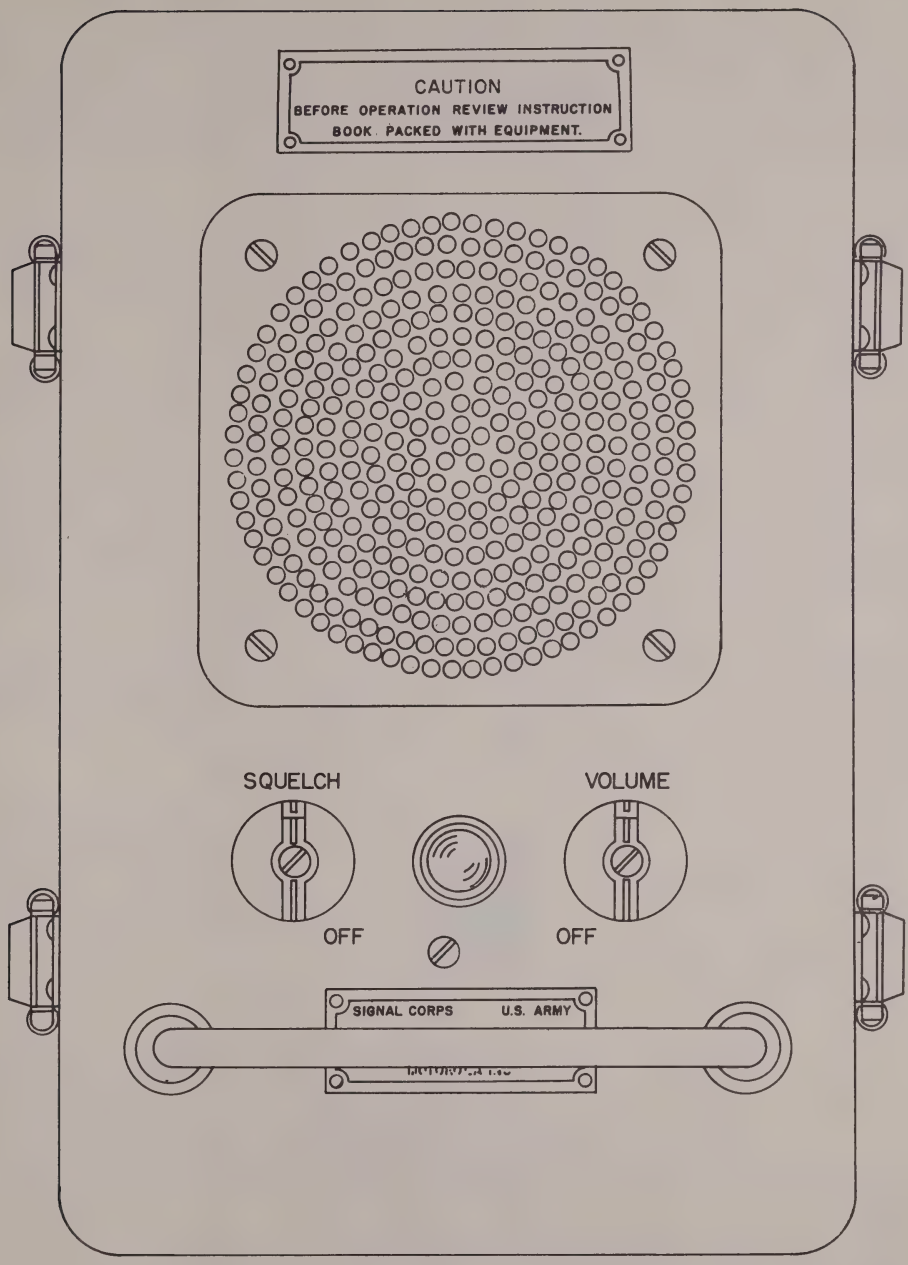
15. General

Haphazard operation or improper settings of the controls often cause damage to electronic equipment. For this reason, it is important to know the function of each control. The actual operation of this equipment is described in paragraphs 17 through 25.

16. Controls and Their Uses
(fig. 14)

The following chart lists the controls of Radio Receiving Set AN/FRR–44. The controls described in this manual are those contained in Electrical Equipment Cabinet CY–1150/U and are similar to those in other systems which include Radio Receiver R–257/U.

Control	Function
SQUELCH control R2408.	Sets the squelch threshold level, as determined by the operator of the receiver. Minimum squelch action is in the clockwise direction.
Squelch OFF switch S2402.	Ganged to R2408. In the extreme clockwise position, the switch is closed and prevents the squelch circuit from operating.
VOLUME control S2401A.	Audio level step attenuator. Operator has option of four fixed audio levels. Maximum volume is in the extreme clockwise position.
Power OFF switch S2401B.	Ganged with S2401A. In the fifth or extreme counterclockwise position the switch opens the circuit to the power source (115 or 230 volts a-c or 6, 12, or 24 volts d-c).
POWER indicator lamp I 2401.	Lamp lights when power is turned on.



TM 5071-10

Figure 14. Radio Receiving Set AN/FRR–44, front panel controls.

17. Initial Adjustment of Receiver

The only adjustment to be performed on Radio Receiver R–257/U prior to actual operation is that of setting it to the required frequency of operation. This operation is performed as follows:

a. Grasp the LOCAL OSC 25–50 MC plug-in unit by the handle and lift it out of the receiver base. Remove the shield cover and locate crystal oven E231 (fig. 15).

b. Remove the crystal oven; use a screwdriver if necessary to pry it out of the octal socket. If the use of a screwdriver is required, be careful not to damage the socket or any of the subminiature tubes.

c. Remove the three screws that secure the cover to the base of the oven and remove the cover. Remove the heater element assembly; note the contact arrangement.

d. Insert the proper Crystal Unit CR–32/U into the socket provided for it.

Caution: The crystal and the thermostat are similar in appearance but the thermostat is painted black. If in doubt about the proper location of each, refer to the decal fastened to the plug-in unit.

e. Select the proper crystal for the frequency of operation desired. Use the following formula to determine the crystal frequency:

$$\text{Crystal frequency (mc)} = \frac{F + 7.8}{2}$$

(where F = frequency in mc of operation desired).

Example:

If the operating frequency is 38 mc, then crystal frequency

$$= \frac{F + 7.8}{2}$$

$$= \frac{38 + 7.8}{2}$$

$$= \frac{45.8 \text{ mc}}{2} = 22.9 \text{ mc}$$

f. Reassemble the crystal oven by reversing the disassembly process, and plug it into the octal socket.

g. Jumper connections as shown on figure 16 are necessary to make the LOCAL OSC 25–50 MC plug-in unit tune to the correct frequency. For frequencies between 25 and 35 mc, connect jumpers across Z231 through Z234 but do not connect a jumper across L234. For frequencies from 35 to 50 mc, connect a jumper across L234 but do not connect jumpers across Z231 through Z234. Insert the LOCAL OSC 25–50 MC plug-in unit, without the shield cover, into the receiver base.

h. Connect one end of the patch cord (figs. 39 and 40) to connector P252 of the receiver and connect the other end of the patch cord to a connector such as J2401 in Electrical Equipment Cabinet CY–1150/U.

i. Remove the RF AMPL 25–50 MC plug-in unit and remove the cover. Connect jumpers across Z201 through Z205, as shown in figure 16, when the receiver is operated in the range from 25 to 35 mc. Remove these jumpers when the receiver is operated in the range from 35 to 50 mc. After the connections have been made properly, insert the RF AMPL 25–50 MC plug-in unit into the receiver base. Aline r-f (radio-frequency) amplifiers V201 and V202 and the LOCAL OSC 25–50 MC plug-in unit as described in paragraph 91.

j. When alinement has been completed, turn the power off, disconnect the patch cord, and install the radio receiver in the cabinet of the radio set in which it is used.

18. Starting Procedure

a. Preliminary. Set the VOLUME and SQUELCH controls on the control unit at OFF.

b. Starting. Turn the VOLUME control to the third position clockwise. The POWER pilot lamp will light and a signal or rushing noise will be heard from the speaker within 15 or 20 seconds.

19. Volume Adjustment

The volume of the receiver is adjusted by advancing the VOLUME switch clockwise for more output. The operator has an option of four audio volume levels. The lowest level is one step clockwise from the OFF position, and the maximum level is at the fully clockwise position. Adjust the switch for a comfortable level of sound.

20. Squelch Adjustment

a. When the SQUELCH control is in the OFF (maximum clockwise) position, the receiver is unsquelched. This permits the receiver to re-

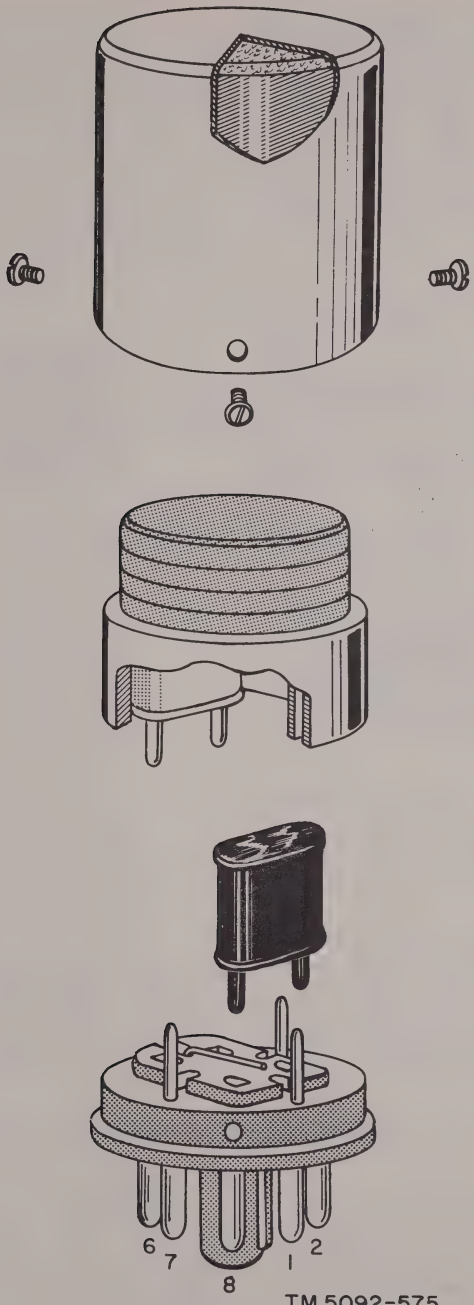


Figure 15. Radio Receiver R–257/U, first h-f oscillator crystal oven.

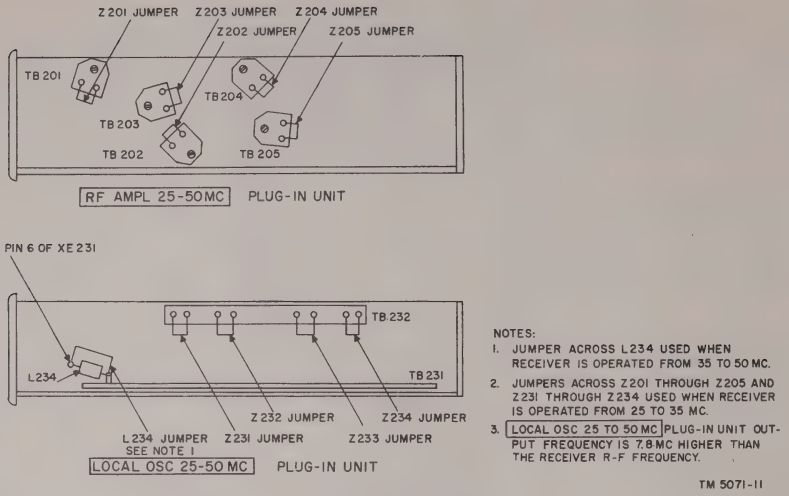


Figure 16. Jumper connections on RF AMPL 25–50 MC and LOCAL OSC 25–50 MC plug-in units.

ceive any strength signal without cutting off the audio output. The SQUELCH control can be adjusted to mute the receiver output when a weak signal or no signal is being received. The setting at which this occurs is called the squelch threshold level.

b. Adjust the SQUELCH control as follows:

(1) Turn the SQUELCH control to its maximum clockwise position and note whether a signal or just noise is being received.

(2) At an interval when no signal is heard, slowly turn the SQUELCH control counterclockwise until the background noise disappears, *but no further.* (If a strong unmodulated signal is being received, there will be no background noise even when the SQUELCH control is at OFF.)

(3) When the noise level is high, and signal strength low, it may be desirable to operate with the SQUELCH control in the OFF position. Otherwise, there will be intermittent or no reception. If the squelch circuit behavior is erratic and repair on this circuit is not practical, the squelch circuit can be disabled by setting the SQUELCH control at the OFF position.

21. Stopping Procedure

a. Rotate the SQUELCH control fully clockwise until a click is heard.

b. Rotate the VOLUME control fully counterclockwise to the OFF position.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

22. General

The operation of Radio Receiver R–257/U may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs, instructions are given for minimizing the effect of these unusual operating conditions.

23. Operation in Arctic Climates

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

a. Handle the equipment carefully.

b. Keep the equipment warm and dry.

c. If water gets into the handset receiver, or if moisture condenses within it, the actuation of the diaphragm may be impeded. When this happens, remove the bakelite cap and remove the ice and moisture from the receiver.

d. When equipment that has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly.

24. Operation in Tropical Climates

When operated in tropical climates, fixed station radio equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground or in swampy areas, moisture conditions are more acute than normal. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the ambient air. To minimize this condition, place lighted electric bulbs near (or in) the equipment.

25. Operation in Desert Climates

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

b. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, and dirt that enters the radio equipment. The ideal precaution is to house the equipment in a dustproof shelter. Since such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and anchor the side walls of the tent to prevent their flapping in the wind.

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

d. Be careful that the equipment is as free from dust as possible. Make frequent preventive maintenance checks (pars. 26–38).

CHAPTER 3
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

26. Definition of Preventive Maintenance

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

27. Tools, Materials, and Test Equipment Supplied with Radio Receiver R–257/U

An alinement tool is supplied with the receiver. However, other items such as Allen wrenches are furnished with the radio set of which the receiver is a component. Consult the instruction book of the radio set incorporating Radio Receiver R–257/U for a listing of the tools, materials, and test equipment provided.

28. General preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

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

(1) Clean all parts, except electrical contacts, with a cloth or brush moistened with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.

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

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. See that adequate ventilation is provided.

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

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

29. Use of Preventive Maintenance Form (fig. 17)

a. The decision as to which items on DA Form 11–239 are applicable to this equipment is to be made to the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of this form appear on the reverse side of the form.

b. Circled items in figure 17 are partially or totally applicable to Radio Receiver R–257/U. References in the ITEM block refer to paragraphs in the text which contain additional maintenance information.

30. Performing Exterior Preventive Maintenance

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

a. Check for completeness of equipment; spare parts, instruction books, and accessories.

b. Remove moisture from main receiver connector P252.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
RADIO RECEIVER R-257/U	

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

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

DA FORM MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—84382-1

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Figure 17. DA Form 11–239.

c. Check for normal operation. If abnormal results occur at any point in the operating procedure, refer to the equipment performance checklist (par. 38).

d. Clean and tighten the receiver case.

e. Inspect metal surfaces for corrosion, dirt, and moisture.

f. Inspect the test points on the front panel for looseness and cracked insulation.

g. If deficiencies noted are not corrected during inspection, indicate on DA Form 11–239 the action taken to initiate correction.

31. Performing Interior Preventive Maintenance

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect power and check for satisfactory operation (par. 38).

a. Inspect the seating of readily accessible pluck-out items: all plug-in units, tubes, crystal oven E231, crystal Y51, and all plugs and jacks.

b. Inspect cabling under the receiver base for cuts, breaks, fraying, deterioration, kinks, and strain.

c. Inspect all tubes for loose or damaged terminals and insufficient socket spring tension; remove dust and dirt; check emission of all tubes; refer to figures 8 through 12 for tube location diagrams.

d. Inspect all fixed capacitors for leaks, bulges, and excessive discoloration.

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

f. Clean and tighten connections and mountings for audio output transformer T121 and relay K271.

g. Check moistureproofing and fungiproofing.

h. If deficiencies noted are not corrected during inspection, indicate on DA Form 11–239 the action taken to initiate correction.

Section II. LUBRICATION AND WEATHERPROOFING

32. Lubrication

No lubrication is required for Radio Receiver R–257/U.

33. Weatherproofing

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

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

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

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

34. General

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

b. The paragraphs that follow in this section help in determining which of the stages is defective and in localizing the fault in that stage

to the defective item such as a plug-in unit or connector. Figure 42 shows a subassembly partially out of the shield.

35. Inspection

a. Failure of Radio Receiver R–257/U usually will be caused by one of the following faults:

(1) Defective plug-in unit.
(2) Improperly connected power cables.
(3) Plugs and jacks connecting the plug-in units or power supply improperly seated, loose, or damaged.
(4) Burned-out fuse in the receiver power supply.
(5) Wires loose or broken because of excessive vibration or wear.
(6) Defective or loose tubes.
(7) Inactive (dirty or cracked) h-f (high-frequency) oscillator crystals.

Note. If the SQUELCH control is advanced too far clockwise, no audio output will be obtained. To eliminate this possibility, turn the SQUELCH control fully clockwise until the squelch disable switch is locked in the OFF position.

b. When a receiver failure is encountered and the cause is not apparent, check as many of the foregoing items as is practical in accordance with the echelon service level handling the receiver. If the operator, who was using the receiver at the time of failure, is available, consult him for any particulars or details pertaining to the receiver failure.

c. Inspect the antenna system for obvious defects.

36. System Sectionalization of Trouble to Plug-in Unit

Radio Receiver R–257/U is designed so that most defects can be remedied by removing the defective plug-in unit and inserting a similar unit. The procedure to follow when troubleshooting the receiver consists of replacing one plug-in unit at a time until the defective unit is located. (Replacement of plug-in units may be performed only by qualified personnel.) The units used for substitution must be properly alined before substitution. The AUDIO & SQUELCH, 2ND IF DISCR, and 1ST IF 7.8 MC plug-in units are factory adjusted to a fixed setting regardless of the operating signal frequency, but the RF AMPL 25–50 MC and the LOCAL OSC 25–50 MC units must be alined accurately to the specific frequency or channel to be used for reception. If the alinement of these last two units is not correct, the receiver will not be tuned to the desired channel. Be sure to determine the operating frequency of the units beforehand, and remember that the RF AMPL 25–50 MC and LOCAL OSC 25–50 MC units have to be matched (in alinement) to give the desired results. Refer to paragraphs 17 and 91 for alinement of these units.

37. Troubleshooting by Use of Equipment Performance Checklist

a. General. The equipment performance checklist will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. To use this list, follow the items in numerical sequence.

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

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. If the recommended corrective measures do not yield results, higher echelon maintenance is necessary (pars. 64–105). However, if the 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 possible.

38. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Power supply connector.	Power supply connector P251 (on receiver) properly connected to its mating connector in the power supply.		
		Plug-in unit connectors.	Plug-in unit connectors properly connected. Be sure plug-in units are inserted properly in their respective compartments. Cover should be installed correctly and latched.		
	3	Receiver main connector.	Receiver main connector P252 properly engaging its mating connector in the case.		
	4	SQUELCH control	SQUELCH control in extreme clockwise position so that squelch disabling switch is in the OFF position.		
	5	VOLUME control	VOLUME control in the extreme counterclockwise position so that power switch is in the OFF position.		
START	6	VOLUME control	Advance control clockwise 2 or 3 positions.	POWER indicator lamp lights; rushing noise or signal is heard in speaker.	Check power supply fuse. Check power supply connector P251. Check receiver main connector P252. Check receiver plug-in units by substitution (par. 36). If this test reveals a defective plug-in unit, tag it as such and replace it.

38. Equipment Performance Checklist (Continued)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	7	VOLUME control	Turn to extreme clockwise position.	Rushing noise or signal is heard at maximum volume.	If the volume of the noise is low or the signal is low and/or distorted, check the plug-in units by substitution (par. 36).
	8	SQUELCH control	With no signal and only noise coming through the loudspeaker, turn this control to its maximum counterclockwise position and then slowly clockwise until the rushing noise stops.	The rushing noise is quieted. If possible, turn on a transmitter tuned to the receiver frequency. This transmitter signal should be audible in the loudspeaker when modulated (speech).	If the squelch control is inoperative, check by substituting another audio and squelch plug-in unit (par. 36).
			Turn counterclockwise until rushing noise is heard again.	The receiver is now unsquelched.	If the receiver fails to unsquelch, or if it squelches and unsquelches in an uncontrolled manner, check by substitution of the audio and squelch plug-in unit (par. 36). Check SQUELCH control. See radio set instruction book.
STOP	9	SQUELCH control	Turn fully clockwise sc that squelch disable switch is in the OFF position.	Rushing noise or signal continues.	
	10	VOLUME control	Turn fully counterclockwise so that the power switch is in the OFF position.	POWER indicator lamp goes out. No noise or signal is heard in the loudspeaker.	Check for shorted power switch or incorrect radio set connections. See radio set instruction book.

CHAPTER 4
THEORY

39. General

a. Radio Receiver R–257/U is a crystal-controlled, fixed-frequency, double-conversion, superheterodyne f-m receiver. It is designed to operate on a fixed frequency within the 25- to 50-mc band. There are four different power supplies which can power this receiver; the selection of a power supply depends on the power source available and the radio set of which the receiver is a component part.

b. The receiver is not a complete receiving system, as it has no controls or power supply. To maintain continuity and completeness of explanation, a 115- or 230-volt power supply (Power Supply PP–846/U) and a case (Electrical Equipment Cabinet CY–1150/U) that contains the necessary controls for the operation of the receiver are referred to in this manual. When Radio Receiver R–257/U is used with these components, it forms Radio Set AN/FRR–44 which is described in an instruction book.

c. The receiver has six plug-in units which are marked:

(1) RF AMPL 25–50 MC.
(2) LOCAL OSC 25–50 MC.
(3) 1ST IF 7.8 MC.
(4) 2ND IF DISCR.
(5) AUDIO & SQUELCH.
(6) RELAY (optional use).

d. The unique feature of plug-in units necessitates the use of numerous plugs, jacks, and connectors. A thorough familiarity and understanding of these plugs, jacks, and connectors will simplify the work of the technician.

40. Block Diagram
(fig. 18)

a. The signal path through the receiver is shown in the block diagram of figure 18. An f-m signal from the antenna is amplified by first and second r-f amplifiers V201 and V202. The selectivity of the two r-f amplifiers also improves the image and i-f (intermediate-frequency) rejection ratios. The amplified signal is coupled to first mixer V203 together with a signal from the LOCAL OSC 25–50 MC plug-in unit (containing V231, V232, and V233) which is 7.8 mc higher in frequency than the incoming r-f signal. Sum and difference frequencies result, but only the difference frequency (7.8 mc) is passed by the following stage. This stage, 7.8-mc i-f amplifier V51, amplifies the 7.8-mc f-m signal and couples it to second mixer V52. Two frequencies are mixed together which produce sum and difference frequencies: 7.8 mc from 7.8-mc i-f amplifier V51, and 7.345 mc from crystal-controlled second h-f oscillator V53. The difference (beat) frequency is 455 kc (kilocycles). This 455-kc signal is fed through selectivity filter Z251 which is tuned to the second i-f frequency of 455 kc. This signal then is amplified by five 455-kc i-f amplifier stages (tubes V81 through V85). The output of tube V85 passes through two limiter stages (V86 and V87) which maintain a constant amplitude voltage output to the discriminator even though the signal from the antenna may fluctuate due to noise or fading. The discriminator stage changes the f-m signal into an audio voltage which is amplified by first audio amplifier V121 and audio power amplifier V122 to a level sufficient to operate a speaker or handset.

b. Audio output from the discriminator also is fed to a squelch circuit. Noise amplifier V123 amplifies receiver noise and couples this signal to squelch tube V124, which controls the operation of the audio amplifiers (V121 and V122) by biasing their control grids to cut off when no signal is being received. A

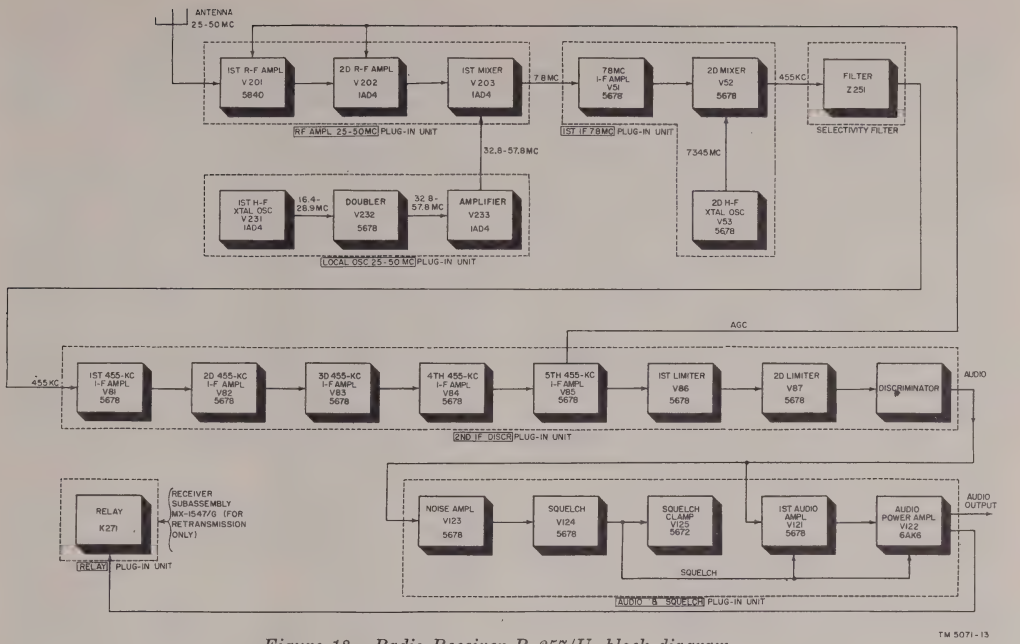


Figure 18. Radio Receiver R–257/U, block diagram.

SQUELCH control and a squelch disabling switch are provided in the various radio set control units. The squelch clamp tube (V125) reinforces the action of the squelch tube (V124).

c. A RELAY plug-in unit (the use of which is optional) contains a relay that is controlled by audio power amplifier V122. This relay can be used to operate external circuits such as call signals, or it can be used to control a transmitter in a retransmission installation.

d. Strong signals produce a negative voltage at the grid of the fifth 455-kc i-f amplifier (V85). A portion of this negative voltage is used as an agc (automatic gain control) source. The gain of the two r-f amplifiers (V201 and V202) is controlled by this agc voltage. The agc voltage varies with the strength of the input signal to the receiver. As the input signal strength increases, this agc voltage increases and lowers the gain of the two r-f amplifiers.

41. First R-f Amplifier

(fig. 19)

a. The first and second r-f amplifiers amplify the f-m signal that comes from the antenna. No operational tuning of these amplifiers is provided other than the normal alinement (par. 91).

b. The first r-f amplifier (V201) uses a subminiature type 5840 tube, isolated from stray r-f by inclosure in a metal shield. This tube has an indirectly heated cathode. The heater requires 6.3 volts a-c or d-c. The signal is fed into the grid circuit by means of a coaxial cable at connector P201. The tuned circuit, Z201, consists of coil L201 in parallel with the series combination of capacitors C202 and C203. The impedance of the coaxial cable is matched by tapping down across a portion of the tuned circuit (connecting to the junction of C202 and C203). Resistor R201 is the d-c antenna ground return. Resistor R202 is the grid-leak resistor. Capacitor C204 couples the r-f signal from tuned circuit Z201 to the control grid of tube V201. Capacitor C208 and L202 form the plate tuned circuit of V201 for frequencies from 35 to 50 mc. Capacitor C211 couples the signal from tuned circuit Z202 to tuned circuit Z203. Capacitor C210 is connected in parallel with C211 when wire jumpers are connected

across TB202 and TB203. This provides increased coupling for operation at 25 to 35 mc. Capacitors C201 and C207 are connected across the grid and plate tuned circuits, respectively, when wire jumpers are connected across the terminals of terminal boards TB201 and TB202, as shown in figure 19. These circuits are then tunable over a range from 25 to 35 mc. When the jumpers are not used, these circuits are tunable over a range from 35 to 50 mc. Terminal boards TB201 and TB202 are shown in figures 16, 19, 61 and 77.

c. Capacitor C205 decouples the grid circuit from any r-f picked up in the agc. Resistor R203 and capacitor C209 decouple the plate and screen circuits of V201 from the B+ supply. Capacitor C206 is the only bypassing required to protect the tube heater from stray r-f signals.

d. An agc voltage is fed through R202 to the control grid of V201. This agc voltage biases the tube in proportion to the strength of the r-f signal being received and controls the gain of the tube. See paragraph 53 for an explanation of the agc circuit.

42. Second R-f Amplifier

(fig. 19)

a. This stage is similar in function to the first r-f amplifier. No operational tuning of this amplifier is provided other than the normal alinement (par. 91).

b. The second r-f amplifier (V202) uses a subminiature type 1AD4 tube. R-f shielding is provided for the tube by a sprayed metallic coating on the outside of the glass envelope which is connected to the filament at pin 3 by a thin wire. This tube has a directly heated filament to which voltage is applied through filament chokes L204 and L205. These two chokes and r-f bypass capacitor C216 prevent stray r-f from getting into the filament circuit. The output from the first r-f amplifier is coupled to the grid of V202 through capacitor C214. Z203 and Z204 are the grid and plate tuned circuits, respectively. When C213 is connected across Z203 by a wire jumper on TB203 and when C217 is connected across Z204 by a wire jumper on TB204, these circuits are tunable over the range from 25 to 35 mc. When these jumpers are not used, Z203 and Z204 are tunable over the range from 35 to 50 mc. This amplified r-f signal is coupled to the grid circuit of first mixer stage V203 with coupling capacitor C221. Terminal boards TB203 and TB204 are shown in figures 16, 19, 61, and 77.

c. Capacitor C215 decouples the grid circuit from any r-f picked up in the agc lead. The plate and screen circuits of tube V202 are decoupled from the B+ supply by a two-section filter comprised of R207 and C220, and R206 and C218. Resistor R205 completes a voltage-dividing circuit between B+ and ground with resistors R206 and R207 to reduce the d-c voltage applied to the plate and screen of V202. Terminals M and N on P204 are jumped together to complete the filament interlock circuit. The complete filament interlock circuit is shown in figure 45.

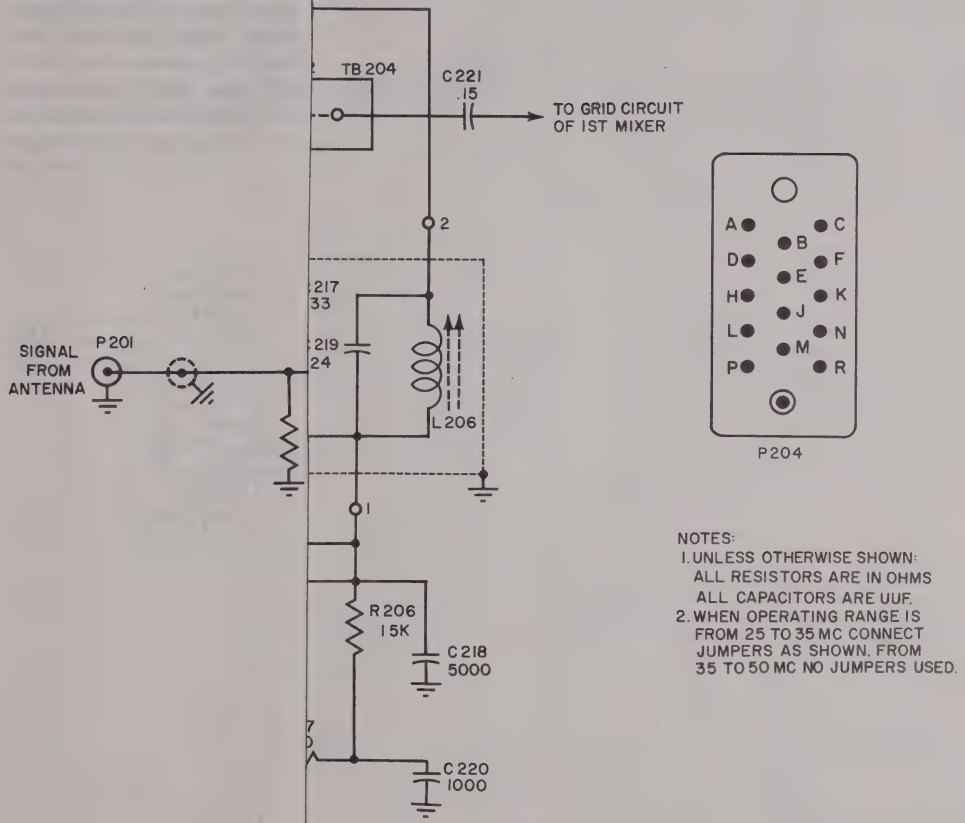
d. An agc voltage is applied to the grid circuit of tube V2 through grid resistor R204. See paragraph 53 for details of the agc circuit.

43. First Mixer

(fig 20)

a. A signal from the LOCAL OSC 25–50 MC plug-in unit is fed through connector P202 to the filament of tube V203. Coils L210 and L209 keep the filament above r-f ground potential. Resistor R211 shunts L210. This broadens the frequency response of the filament circuit and provides for a more constant local oscillator injection voltage at all frequencies. The injected signal from the LOCAL OSC 25–50 MC plug-in unit is 7.8 mc above the r-f signal coupled to the control grid of V203. These two signals beat together and produce a 7.8-mc i-f signal at the plate circuit of tube V203.

b. The first mixer stage (V203) uses a subminiature pentode type 1AD4 tube. The signal from the second r-f amplifier is coupled to tuned circuit Z205 by capacitor C221. Capacitor C224 is connected across Z205 by a wire jumper connected across the two terminals on TB205. This additional capacitance is required to tune the grid circuit from 25 to 35 mc. The grid of V203 is connected to tuned circuit Z205 at the junction of series-connected capacitors C222, C223, and C234. This minimizes capacitive loading of Z205 by the grid-to-cathode interelectrode capacitance of V203. Resistor R209 returns the control grid to



NOTES:
1. UNLESS OTHERWISE SHOWN:
   ALL RESISTORS ARE IN OHMS
   ALL CAPACITORS ARE UUF.
2. WHEN OPERATING RANGE IS
   FROM 25 TO 35 MC CONNECT
   JUMPERS AS SHOWN. FROM
   35 TO 50 MC NO JUMPERS USED.

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across TB202 and TB203. This provides increased coupling for operation at 25 to 35 mc. Capacitors C201 and C207 are connected across the grid and plate tuned circuits, respectively, when wire jumpers are connected across the terminals of terminal boards TB201 and TB202, as shown in figure 19. These circuits are then tunable over a range from 25 to 35 mc. When the jumpers are not used, these circuits are tunable over a range from 35 to 50 mc. Terminal boards TB201 and TB202 are shown in figures 16, 19, 61 and 77.

c. Capacitor C205 decouples the grid circuit from any r-f picked up in the agc. Resistor R203 and capacitor C209 decouple the plate and screen circuits of V201 from the B+ supply. Capacitor C206 is the only bypassing required to protect the tube heater from stray r-f signals.

d. An agc voltage is fed through R202 to the control grid of V201. This agc voltage biases the tube in proportion to the strength of the r-f signal being received and controls the gain of the tube. See paragraph 53 for an explanation of the agc circuit.

42. Second R-f Amplifier

(fig. 19)

a. This stage is similar in function to the first r-f amplifier. No operational tuning of this amplifier is provided other than the normal alinement (par. 91).

b. The second r-f amplifier (V202) uses a subminiature type 1AD4 tube. R-f shielding is provided for the tube by a sprayed metallic coating on the outside of the glass envelope which is connected to the filament at pin 3 by a thin wire. This tube has a directly heated filament to which voltage is applied through filament chokes L204 and L205. These two chokes and r-f bypass capacitor C216 prevent stray r-f from getting into the filament circuit. The output from the first r-f amplifier is coupled to the grid of V202 through capacitor C214. Z203 and Z204 are the grid and plate tuned circuits, respectively. When C213 is connected across Z203 by a wire jumper on TB203 and when C217 is connected across Z204 by a wire jumper on TB204, these circuits are tunable over the range from 25 to 35 mc. When these jumpers are not used, Z203 and Z204 are tunable over the range from 35 to 50 mc. This amplified r-f signal is coupled to the grid circuit of first mixer stage V203 with coupling capacitor C221. Terminal boards TB203 and TB204 are shown in figures 16, 19, 61, and 77.

c. Capacitor C215 decouples the grid circuit from any r-f picked up in the agc lead. The plate and screen circuits of tube V202 are decoupled from the B+ supply by a two-section filter comprised of R207 and C220, and R206 and C218. Resistor R205 completes a voltage-dividing circuit between B+ and ground with resistors R206 and R207 to reduce the d-c voltage applied to the plate and screen of V202. Terminals M and N on P204 are jumped together to complete the filament interlock circuit. The complete filament interlock circuit is shown in figure 45.

d. An agc voltage is applied to the grid circuit of tube V2 through grid resistor R204. See paragraph 53 for details of the agc circuit.

43. First Mixer

(fig 20)

a. A signal from the LOCAL OSC 25–50 MC plug-in unit is fed through connector P202 to the filament of tube V203. Coils L210 and L209 keep the filament above r-f ground potential. Resistor R211 shunts L210. This broadens the frequency response of the filament circuit and provides for a more constant local oscillator injection voltage at all frequencies. The injected signal from the LOCAL OSC 25–50 MC plug-in unit is 7.8 mc above the r-f signal coupled to the control grid of V203. These two signals beat together and produce a 7.8-mc i-f signal at the plate circuit of tube V203.

b. The first mixer stage (V203) uses a subminiature pentode type 1AD4 tube. The signal from the second r-f amplifier is coupled to tuned circuit Z205 by capacitor C221. Capacitor C224 is connected across Z205 by a wire jumper connected across the two terminals on TB205. This additional capacitance is required to tune the grid circuit from 25 to 35 mc. The grid of V203 is connected to tuned circuit Z205 at the junction of series-connected capacitors C222, C223, and C234. This minimizes capacitive loading of Z205 by the grid-to-cathode interelectrode capacitance of V203. Resistor R209 returns the control grid to

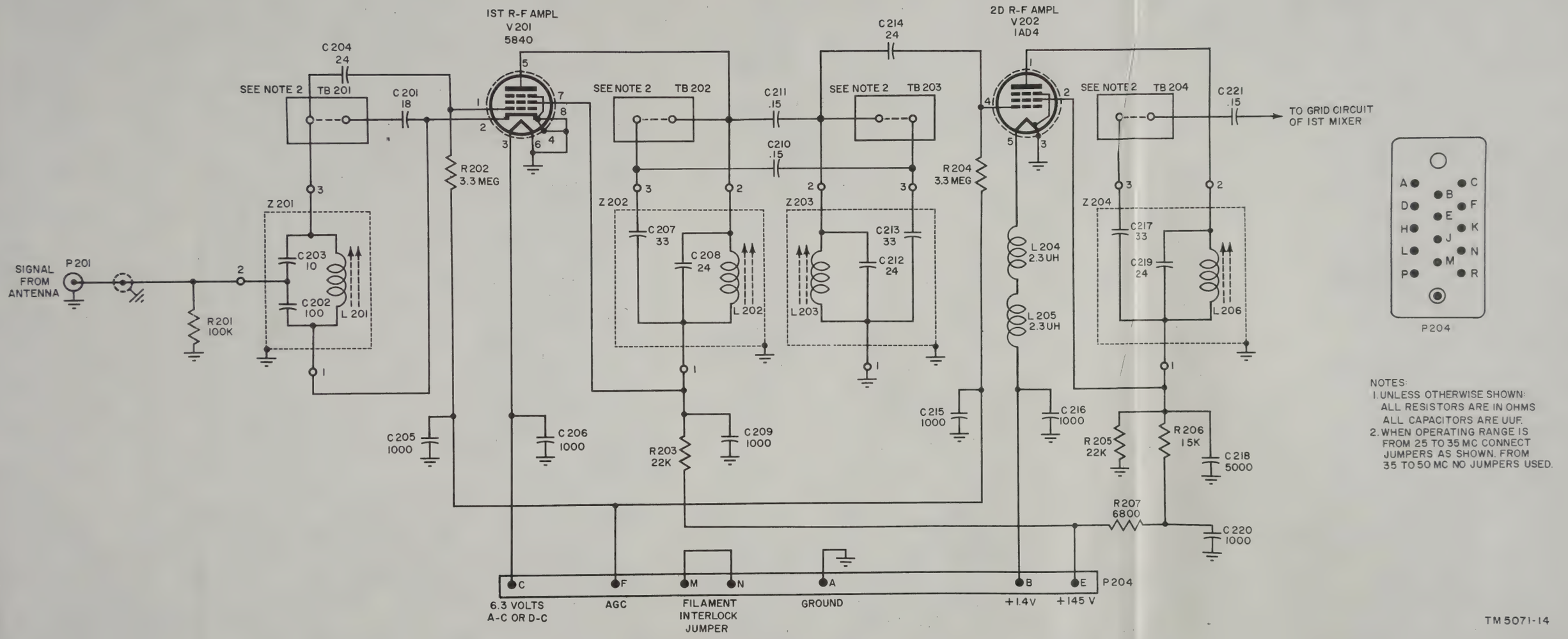


Figure 19. Radio Receiver R–257/U, first and second r-f amplifiers.



ground. Resistor R208 and C233 decouple a d-c test point at the control grid of this tube. This test point, used for measuring grid bias voltage of V203, is located at the front of the receiver and is marked LO (local oscillator). Alinement and testing are accomplished at this test point. Tuned circuit Z206 tunes the plate circuit of the first mixer stage to 7.8 mc. This tuned circuit consists of coil L212 in parallel with C227, C231, and series-connected capacitors C228 and C229. Output from this stage is tied to connector P203 at the low-impedance junction of C228 and C229. Tapping down across the tuned circuit is done to match the coaxial cable impedance between adjacent plug-in units.

c. The filament circuit is protected from stray r-f with choke coils L208 and L209 and capacitors C225, C232, and C226. The plate and screen grid are decoupled with a two-section filter consisting of R207, C220, R210, and C230. Terminals M and N on connector P204 are wired together as part of the receiver filament interlock circuitry.

d. The 1AD4 subminiature tube used as the first mixer stage must be modified by breaking the thin wire connected between pin 3 and the sprayed metallic shield. Without this modification, the signal from the LOCAL OSC 25–50 MC plug-in unit would be shorted to ground. Grounding of the tube shield is accomplished by a tube holddown spring.

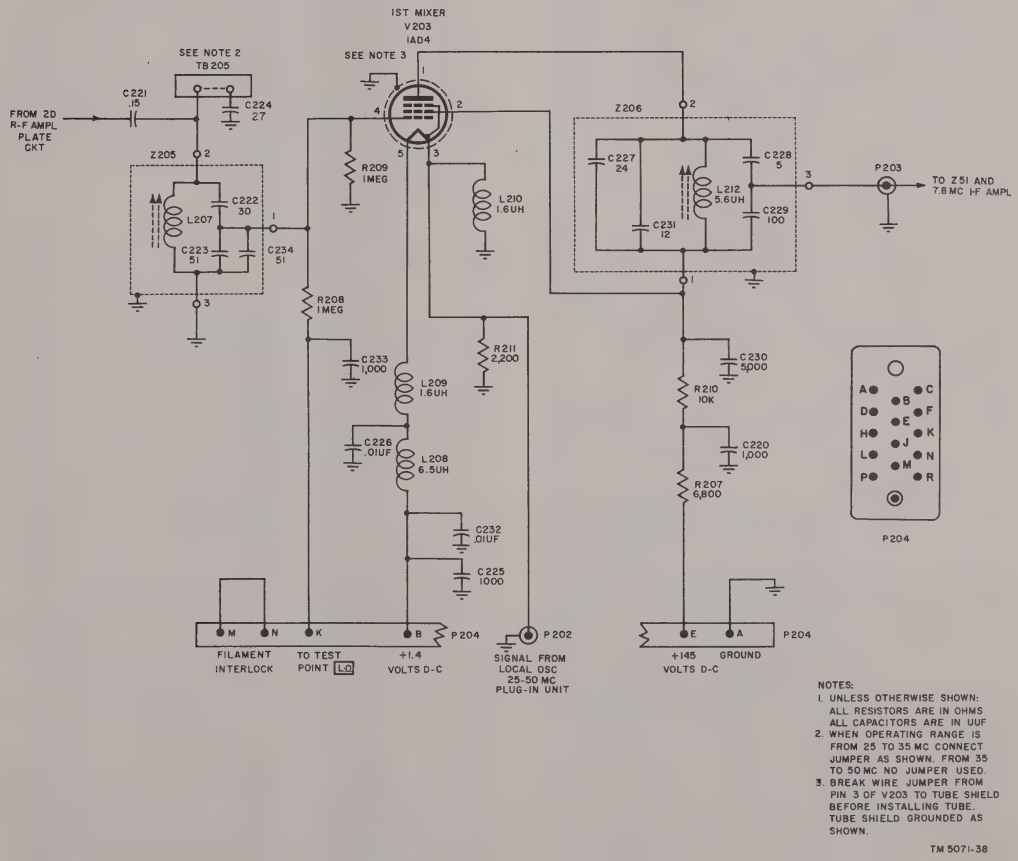


Figure 20. Radio Receiver R–257/U, first mixer.

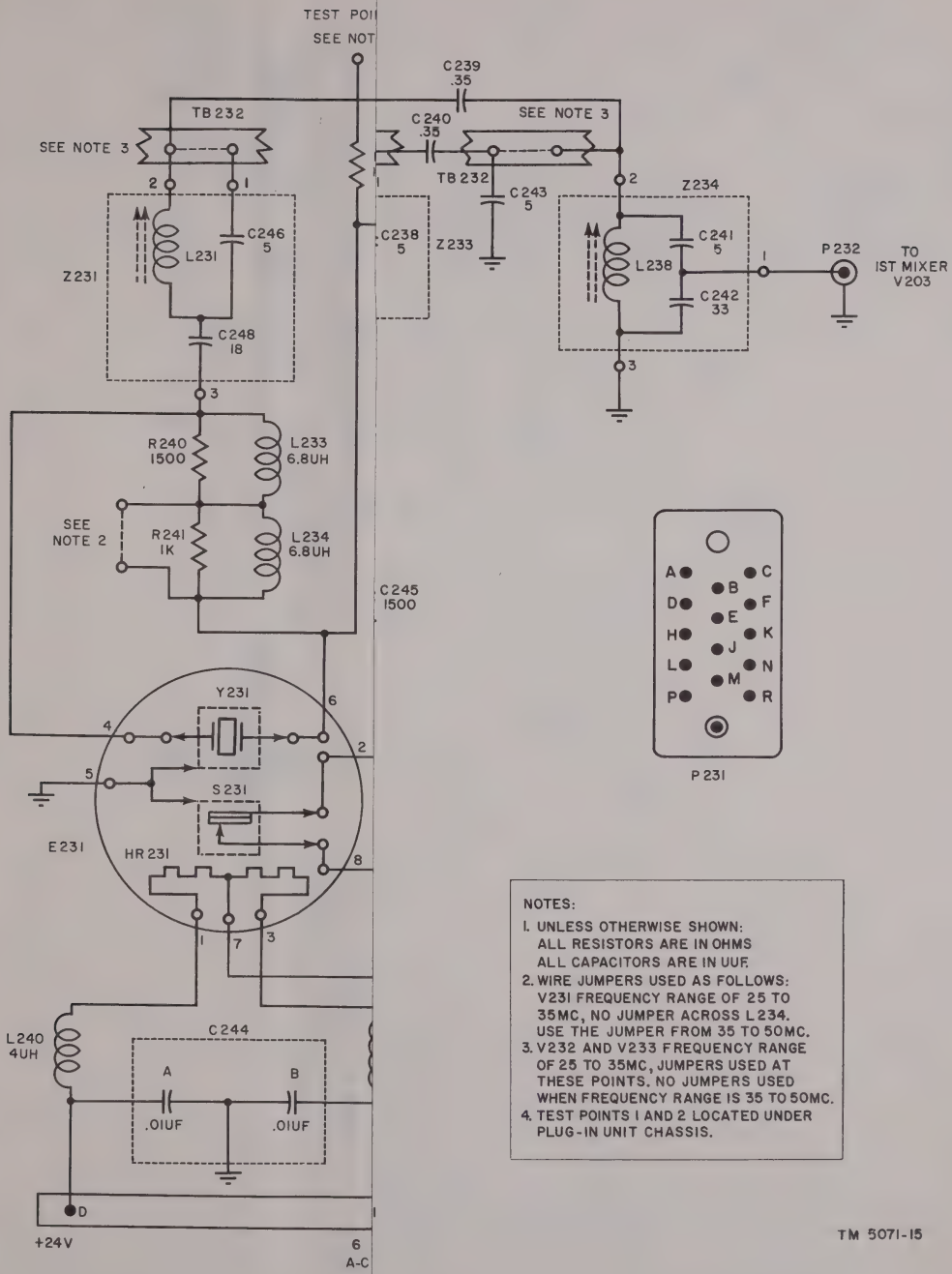
44. LOCAL OSC 25–50 MC Plug-In Unit (fig. 21)

The LOCAL OSC 25–50 MC plug-in unit consists of three stages. These stages are described in *a* through *c* below.

a. First H-F Oscillator (V231). This stage uses a shielded subminiature type 1AD4 tube. The oscillator is a third overtone crystal-controlled oscillator. Because of the stability in frequency required, the crystal (Crystal Unit CR–32/U) is contained in an oven (E231) that maintains a constant temperature of approximately 75° C. (167° F.). Crystal oven E231 contains crystal Y231, heating element HR231, and thermostat S231. The heating element is operated from either 24 volts d-c or 6 volts a-c or d-c, depending on which receiver power supply is used. R-f chokes L239 and L240 and capacitors C244A and C244B keep r-f voltages out of the low voltage circuits. Capacitor C251 bypasses thermostat switch S231 to minimize arcing across the contacts of S231. *Warping* coil L231 (with stray capacity) is in series with the crystal. This slug-tuned coil affords a means of shifting the oscillator frequency slightly in order to tune the receiver accurately to the incoming signal frequency. Capacitor C248 keeps B+ voltage from the control grid of the oscillator. Capacitor C246 is connected across L231 by a jumper connection on TB232 when the receiver is operated in the 25- to 35-mc frequency range. This corresponds to an oscillator frequency range of 16.4 to 21.4 mc. Coils L233 and L234 are connected across the crystal. At resonance, these coils with their stray capacity shunt the crystal with a relatively high impedance. Off resonance, these coils offer a low impedance shunted across the crystal. The coils prevent the crystal from oscillating at undesirable frequencies. Resistors R240 and R241 shunt L233 and L234 and broaden their band-pass characteristics. When the receiver is operated from 35 to 50 mc, coil L234 is shorted out with a wire jumper. This corresponds to an oscillator frequency of 21.4 to 28.9 mc. At these frequencies, L233 and its stray capacity furnish sufficient impedance to allow the crystal to oscillate. A test point is connected to the control grid of the oscillator through isolating resistor R231. The output of the oscillator is resistance coupled to frequency doubler stage V232 through C247. R-f choke coils L235 and L236 and capacitors C236A and C237 keep r-f voltages out of the filament circuits. R232 is the oscillator grid-leak resistor. R233 is a screen grid voltage-dropping resistor, and C234A bypasses the screen grid for r-f frequencies. The plate load consists of R234 across which output from the oscillator is developed. C236B, R237, and C245 decouple the plate circuit from the B+ supply. The oscillator tube is shielded by a sprayed metallic coating which is grounded through pin 3.

b. Doubler Stage (V232). This stage uses a subminiature pentode type 5678 tube. It is an r-f amplifier whose plate circuit is slug-tuned (by means of L232) to the second harmonic of the oscillator frequency. At frequencies from 25 to 35 mc, C249 is connected across L232 by a wire jumper on TB232. The output of this stage is coupled to the amplifier stage (V233) through C235. The control grid of the doubler stage is returned to ground through R235. R242 and C250 form a decoupling filter for the plate and screen grid circuits. This tube is shielded by a sprayed metallic coating which is grounded through pin 3.

c. Amplifier Stage (V233). This stage uses a subminiature type 1AD4 tube that amplifies the r-f signal delivered by the doubler stage. The signal frequency at the output of this stage is twice that of the oscillator frequency. A test point is provided which connects to the grid of this stage through isolating resistor R239. R236 returns the control grid to ground. Resistors R238 and R237 and capacitors C234B, C236B, and C245 comprise a plate and screen grid decoupling filter. The tuned circuit (Z233) is the plate load for the amplifier. Coil L237, with only tube and stray capacity, is slug-tuned from 42.8 to 57.8 mc. Capacitor C238 is wired across L237 with a wire jumper when the LOCAL OSC 25–50 MC plug-in unit is tuned from 32.8 to 42.8 mc. This jumper is used to allow the receiver to operate from 25 to 35 mc. The signal developed across Z233 is coupled to another tuned circuit, Z234, through capacitor C239. When jumpers are placed on TB232, C240 is connected in parallel with C239 to provide increased coupling at the low end of the band (32.8 to 42.8 mc). Slug-tuned coil L238 and series-connected capacitors C241 and C242 tune the high end of the band. When C243 is



NOTES:

1. UNLESS OTHERWISE SHOWN:
   ALL RESISTORS ARE IN OHMS
   ALL CAPACITORS ARE IN UUF.
2. WIRE JUMPERS USED AS FOLLOWS:
   V231 FREQUENCY RANGE OF 25 TO 35MC, NO JUMPER ACROSS L234.
   USE THE JUMPER FROM 35 TO 50MC.
3. V232 AND V233 FREQUENCY RANGE OF 25 TO 35MC, JUMPERS USED AT THESE POINTS. NO JUMPERS USED WHEN FREQUENCY RANGE IS 35 TO 50MC.
4. TEST POINTS 1 AND 2 LOCATED UNDER PLUG-IN UNIT CHASSIS.

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44. LOCAL OSC 25–50 MC Plug-In Unit (fig. 21)

The LOCAL OSC 25–50 MC plug-in unit consists of three stages. These stages are described in *a* through *c* below.

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b. Doubler Stage (V232). This stage uses a subminiature pentode type 5678 tube. It is an r-f amplifier whose plate circuit is slug-tuned (by means of L232) to the second harmonic of the oscillator frequency. At frequencies from 25 to 35 mc, C249 is connected across L232 by a wire jumper on TB232. The output of this stage is coupled to the amplifier stage (V233) through C235. The control grid of the doubler stage is returned to ground through R235. R242 and C250 form a decoupling filter for the plate and screen grid circuits. This tube is shielded by a sprayed metallic coating which is grounded through pin 3.

c. Amplifier Stage (V233). This stage uses a subminiature type 1AD4 tube that amplifies the r-f signal delivered by the doubler stage. The signal frequency at the output of this stage is twice that of the oscillator frequency. A test point is provided which connects to the grid of this stage through isolating resistor R239. R236 returns the control grid to ground. Resistors R238 and R237 and capacitors C234B, C236B, and C245 comprise a plate and screen grid decoupling filter. The tuned circuit (Z233) is the plate load for the amplifier. Coil L237, with only tube and stray capacity, is slug-tuned from 42.8 to 57.8 mc. Capacitor C238 is wired across L237 with a wire jumper when the LOCAL OSC 25–50 MC plug-in unit is tuned from 32.8 to 42.8 mc. This jumper is used to allow the receiver to operate from 25 to 35 mc. The signal developed across Z233 is coupled to another tuned circuit, Z234, through capacitor C239. When jumpers are placed on TB232, C240 is connected in parallel with C239 to provide increased coupling at the low end of the band (32.8 to 42.8 mc). Slug-tuned coil L238 and series-connected capacitors C241 and C242 tune the high end of the band. When C243 is

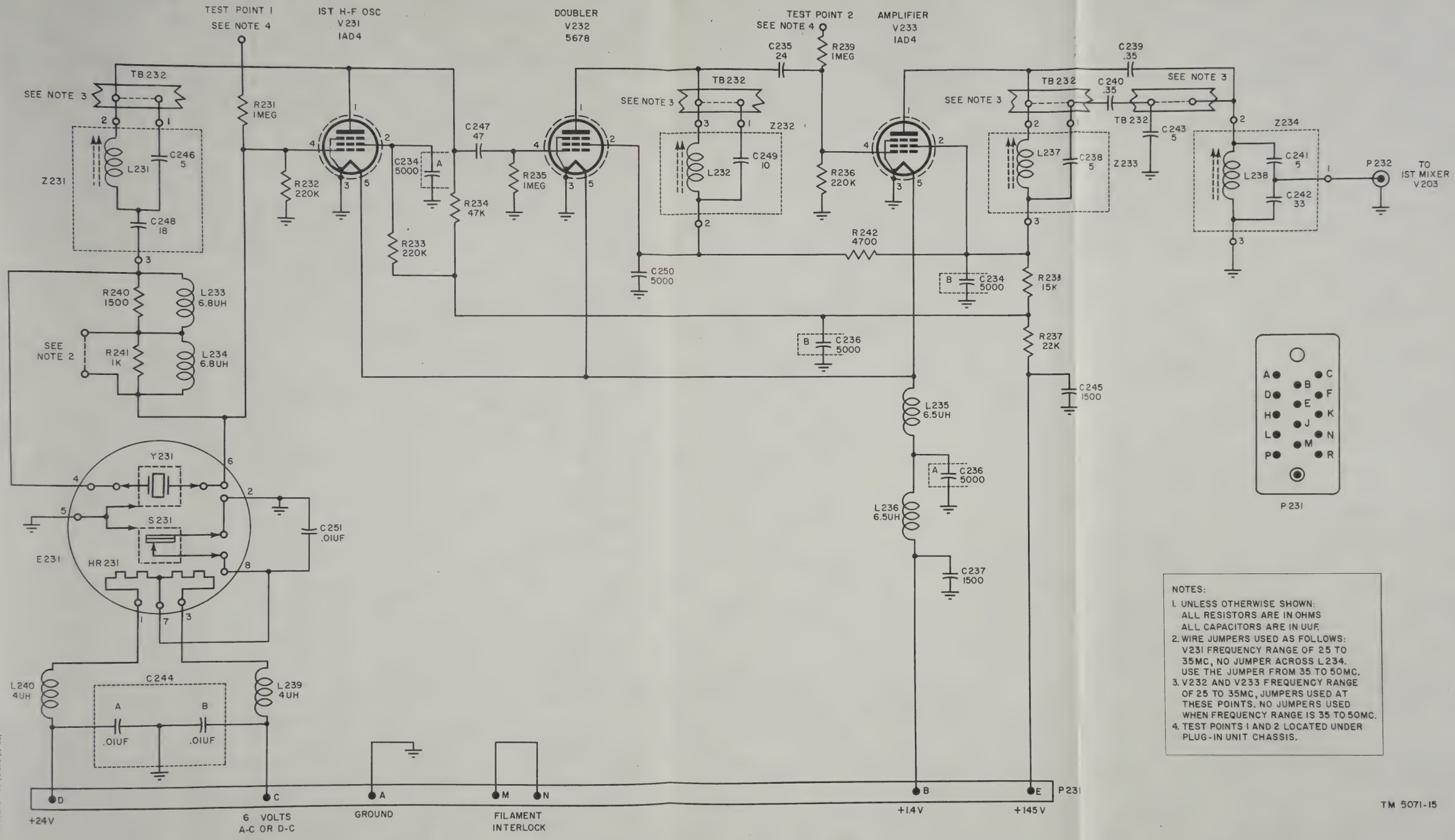


Figure 21. Radio Receiver R-257/U, LOCAL OSC 25-50 MC plug-in unit.

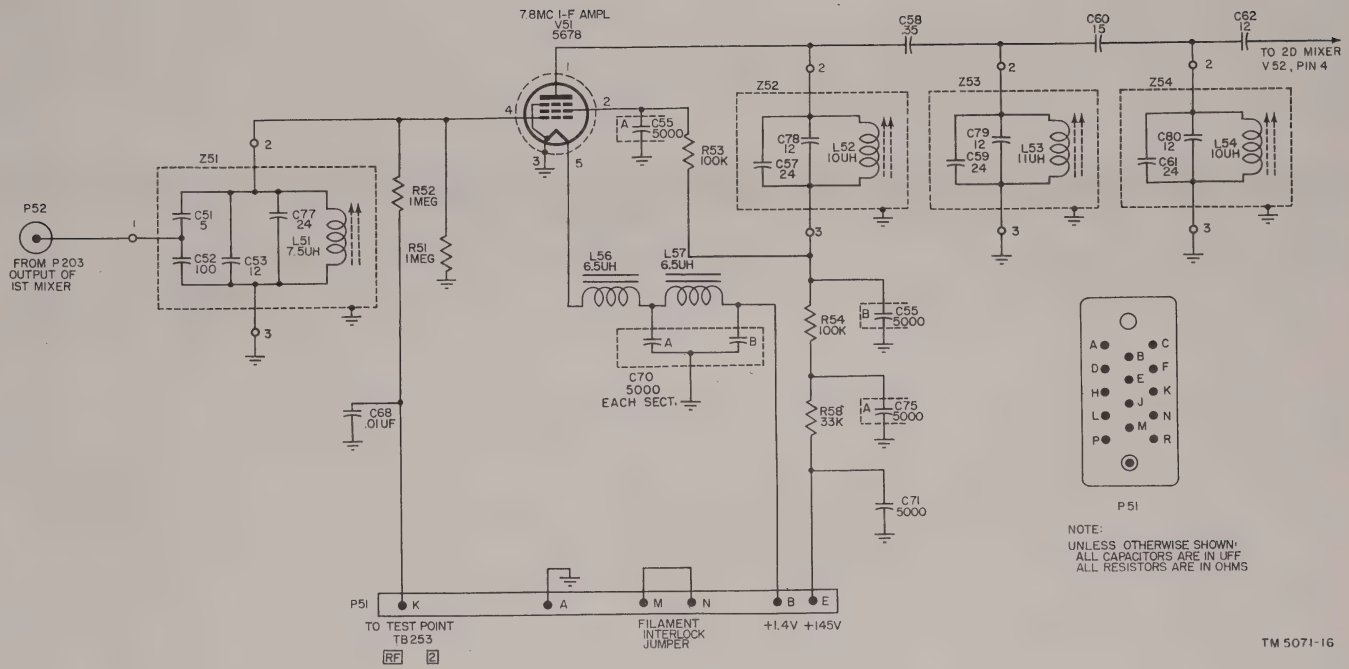


Figure 22. Radio Receiver R–257/U, 7.8-mc i-f amplifier.

connected across L238 by a wire jumper on TB232, the circuit is tuned to the low end of the band. L238 is tapped down at the junction of C241 and C242 to match the coaxial cable at plug P232. The signal produced by the LOCAL OSC 25–50 MC plug-in unit is conveyed through a coaxial cable to first mixer stage V203. The output frequency of the LOCAL OSC 25–50 MC plug-in unit is 7.8 mc above the r-f to which the receiver is tuned. This beats with the r-f signal in the mixer to produce an i-f output of 7.8 mc. Tube V233 is shielded from stray r-f and radiation by a sprayed metallic coating grounded to pin 3.

45. 7.8-mc I-f Amplifier
(fig. 22)

The 7.8-mc i-f amplifier (V51) uses a subminiature type 5678 tube. This stage amplifies the signal from the mixer stage (V203). The grid circuit is tuned by Z51. The plate circuit is tuned by three tuned circuits, Z52, Z53, and Z54, that are coupled loosely through low-value capacitors C58 and C60. These three tuned circuits make this stage very selective. Resistors R54 and R58 and capacitors C55B, C75A, and C71 form a plate circuit decoupling filter. The filament circuit is isolated by r-f choke coils L56 and L57 and capacitors C70A and C70B. R53 is the screen voltage-dropping resistor and is bypassed by C55A. A test point connection to the grid of this stage is provided through the decoupling filter consisting of R52 and C68. This test point terminates at the front panel of the receiver and is marked RF. Output from the amplifier is connected to the second mixer through coupling capacitor C62. R51 is the grid return to ground. Tube V51 is shielded from stray r-f by a sprayed metallic coating which is grounded through a connection to pin 3.

46. Second Mixer
(fig. 23)

a. A 7.8-mc signal and a 7.345-mc signal are applied to second mixer V52. This stage passes the difference frequency (455 kc) resulting from the beating of these two signals. Since the plate circuit is tuned to the difference frequency of 455 kc, all other frequencies are rejected.

b. This stage uses a subminiature type 5678 tube which is shielded from stray r-f by a sprayed metallic coating. The grid of this stage receives a 7.8-mc signal from the 7.8-mc i-f amplifier (V51). R55 is the grid return to ground. The tuned circuit, Z55, contains a loading resistor (R57) which broadens the frequency response of the circuit to the desired width. The capacitors in this assembly have a negative temperature coefficient which compensates for frequency drift due to temperature changes. The 455-kc output signal from this stage is connected to plug P53 with a coaxial cable at the junction of C66 and C67. The signal from second h-f oscillator V53 is connected through C76 and C62 to the grid of the mixer. The value of C76 is very low (1.5 $\mu\mu$f (micromicrofarads)) to isolate the second h-f oscillator (V53) from the i-f and mixer circuits.

47. Second H-f Oscillator
(fig. 23)

a. The second h-f oscillator (V53) develops a 7.345-mc signal that beats with the 7.8-mc signal at the grid of the second mixer stage to produce a 455-kc output at the plate of the mixer.

b. The oscillator is a pentode crystal-controlled oscillator. R59 returns the control grid to ground and also develops the grid-leak bias. The tube filament is bypassed to ground by C70B. R-f coil L58 with its distributed capacitance tunes the plate circuit to a frequency slightly higher than the crystal frequency of 7.345 mc. This produces an inductive feedback voltage from plate to grid in such a phase as to make the circuit regenerative. C73 shunts the grid-to-plate capacitance of the tube and thus increases the positive feedback to the grid circuit required to sustain oscillation. Plate circuit decoupling is provided by resistors R58 and R60 and capacitors C71, C75A, and C75B. C76 couples the 7.345-mc signal to the grid circuit of the second mixer stage. V53 is shielded by a sprayed metallic coating which connects to ground through pin 3.

48. First 455-kc I-F Amplifier
(fig. 24)

The first 455-kc i-f amplifier (V81) uses a shielded subminiature type 5678 tube. This stage is a resistance coupled amplifier with R84

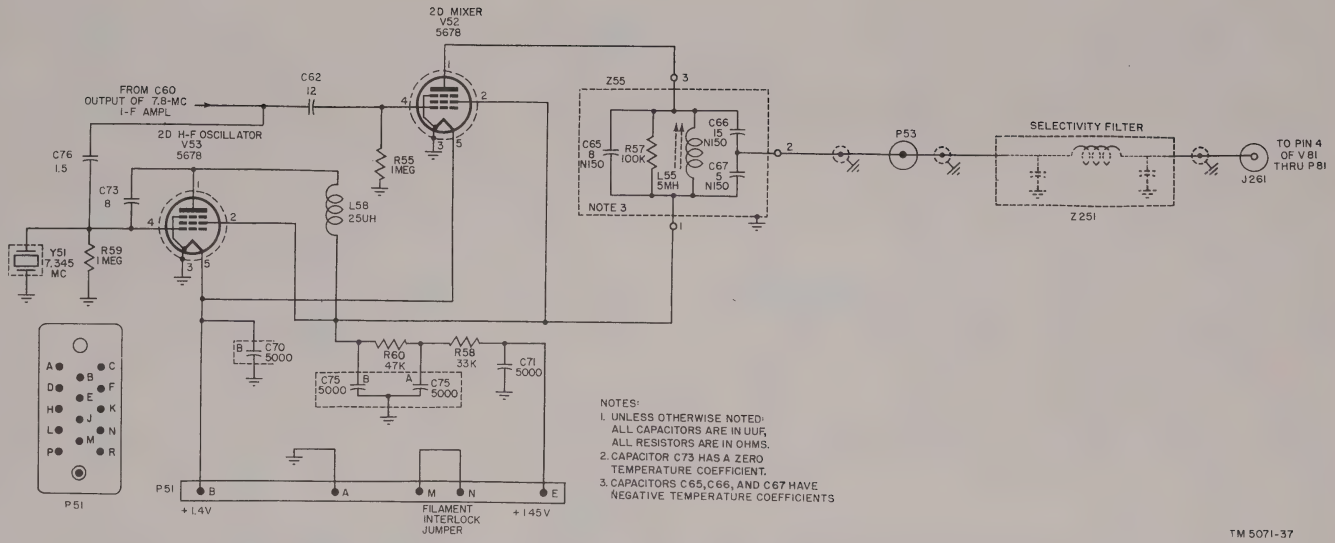


Figure 23. Radio Receiver R–257/U, second mixer and second high-frequency oscillator.

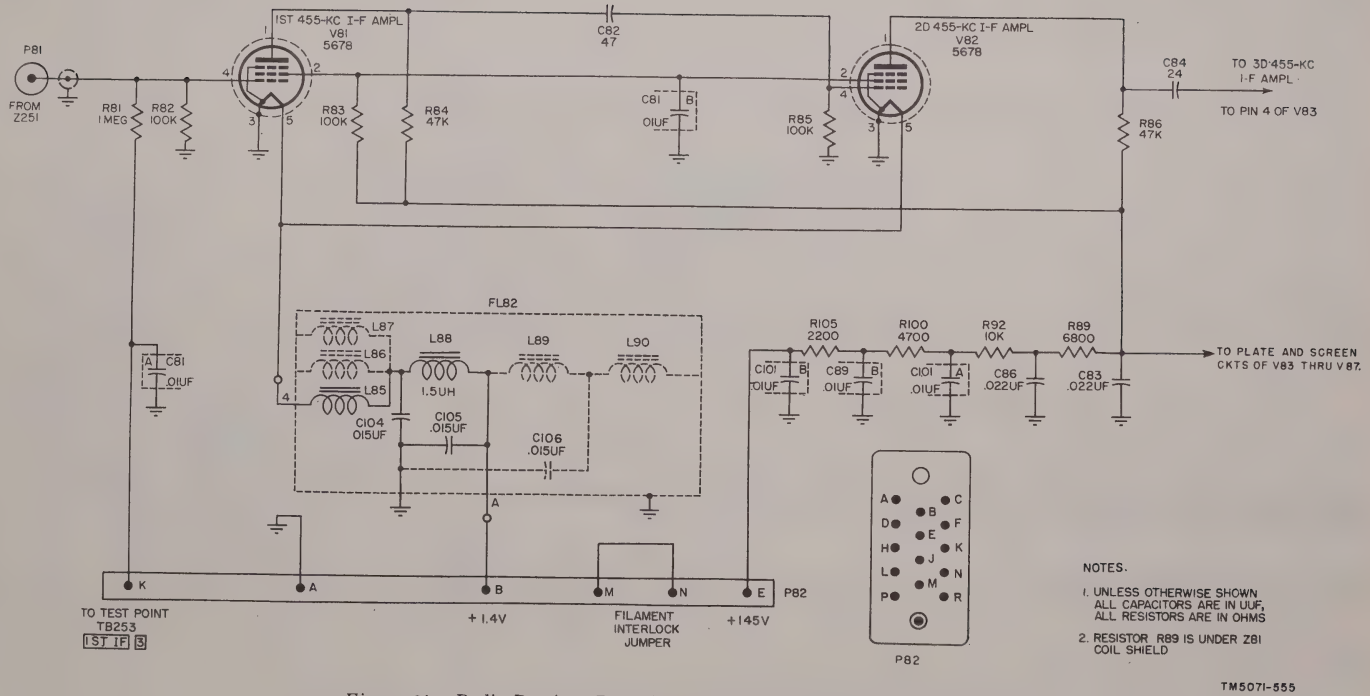


Figure 24. Radio Receiver R–257/U, first and second 455-kc i-f amplifiers.

as the plate load resistance. The selectivity of the 455-kc stages is increased by i-f selectivity filter Z251 (fig. 79). This filter is fastened permanently to the receiver base and is connected with coaxial cables and connectors between second mixer V52 and first 455-kc i-f amplifier V81 (fig. 79). The filter is designed to attenuate appreciably those frequencies which are more than 15 kc above or below 455 kc. The unit is sealed and consists of a network of coils and capacitors. Signal input to the first 455-kc amplifier is through plug P81. A test point connection to the grid of this stage through decoupling resistor R81 can be used to measure the grid bias. It is located on the front panel of the receiver and is marked 1ST IF. C81A is an r-f bypass which forms a de-

49. Second 455-kc I-F Amplifier

(fig. 24)

This stage is similar to the first 455-kc i-f amplifier. Resistor R85 is the grid return and resistor R86 is the plate load resistor. The output voltage is applied to the third 455-kc i-f amplifier through capacitor C84.

50. Third 455-kc I-F Amplifier

(fig. 25)

This stage is a shielded subminiature type 5678 tube. A tuned circuit, Z81, in the plate circuit is tuned to 455 kc. Z81 consists of L81 and C87 which are loaded by R110 to broaden the frequency response. Input to the grid is

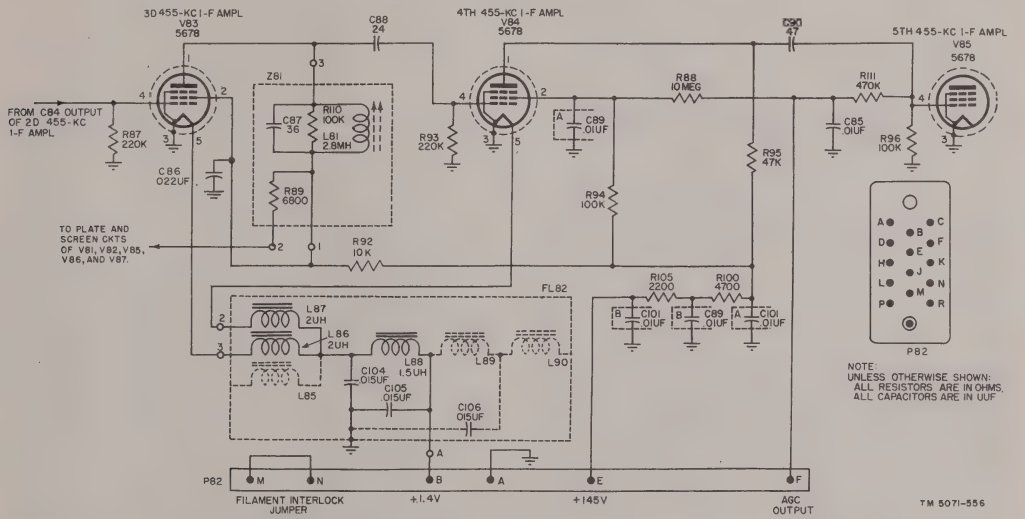


Figure 25. Radio Receiver R–257/U, third and fourth 455-kc i-f amplifiers.

coupling filter together with R81. R82 returns the grid to ground. Filament voltage is supplied through r-f filament filter FL82. Output to second 455-kc i-f amplifier V82 is coupled through C82. B+ decoupling is accomplished with resistors R89, R92, R100, and R105 and capacitors C83, C86, C89B, C101A, and C101B. B+ voltage is applied through this filter to the plates and screens of the five 455-kc i-f amplifiers (V81 through V85) and the two limiter stages (V86 and V87). R83 is the screen grid voltage-dropping resistor for the first and second 455-kc i-f amplifiers (V81 and V82). C81B is an r-f bypass for both screen grids.

supplied through C84 from the previous stage. Output to fourth i-f amplifier V84 is applied through C88. Filament voltage is applied through r-f filament filter FL82. Plate circuit decoupling is provided by the network of resistors R92, R100, and R105 and capacitors C89B, C101A, and C101B.

51. Fourth 455-kc I-F Amplifier

(fig. 25)

The fourth 455-kc i-f amplifier V84 uses a shielded subminiature type 5678 tube. This stage is a resistance coupled amplifier. R93

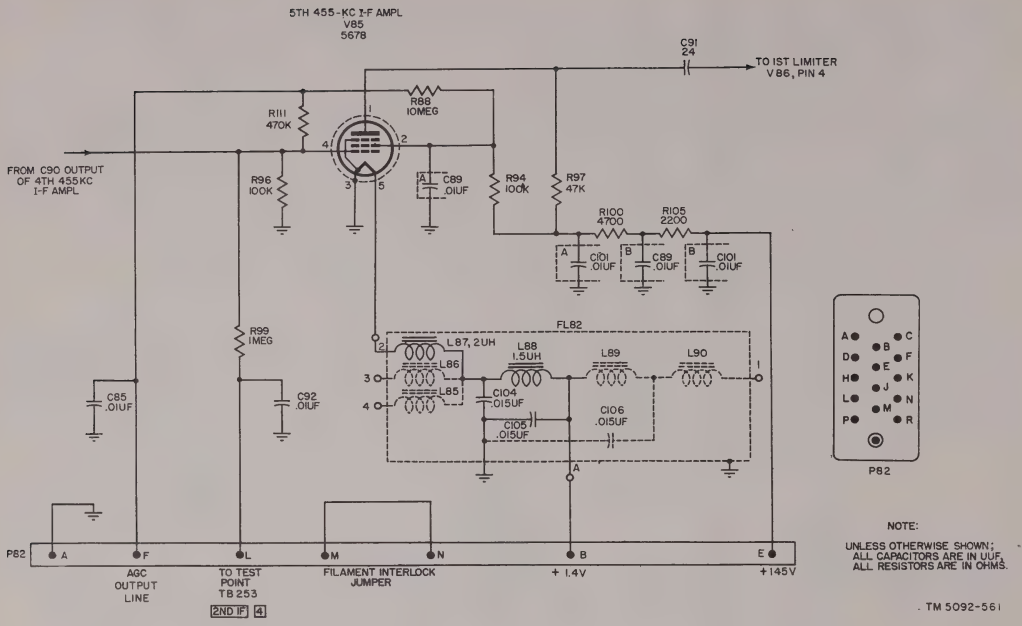


Figure 26. Radio Receiver R–257/U, fifth 455-kc i-f amplifier.

is the grid resistor, R94 is the screen voltage-dropping resistor, and R95 is the plate load resistor. The filament circuit is filtered by passing the filament current through filter FL82. Plate circuit decoupling is provided by resistors R100 and R105, and capacitors C89B, C101A, and C101B. C89A bypasses the screen grid to ground. Output from this stage is coupled to the fifth 455-kc i-f amplifier through C90. C85, R88, and R111 are part of the agc circuit and are described in paragraph 53.

52. Fifth 455-kc I-F Amplifier

(fig. 26)

The fifth 455-kc i-f amplifier (V85) uses a shielded subminiature type 5678 tube. This stage is similar to the other resistance coupled 455-kc i-f amplifiers except that the grid-leak bias of this stage is used as an agc voltage (par. 53). R96 is the grid-leak resistor. A test point connection to the control grid is provided through isolating resistor R99. This test point (marked 2ND IF) terminates at the front panel of the receiver and is bypassed for the i-f by C92. R94 is the screen voltage-dropping resistor, and C89A is the screen bypass. R97 is the plate load resistance, across which the output voltage is developed. Resistors R100 and R105 and capacitors C89B, C101A, and C101B form a plate circuit decoupling filter. Filament current is filtered through filter FL82. See paragraph 53 for a description of C85, R88, and R111. Output is coupled to the control grid of first limiter V86 through C91.

53. Agc Circuit

(fig. 27)

The agc circuit controls the gain of the two r-f amplifiers. A negative bias voltage, obtained from the grid-leak bias of the fifth 455-kc i-f amplifier, is used to increase the negative bias of the r-f amplifiers and reduce their gain, The grid-leak bias of the fifth 455-kc i-f amplifier varies with the strength of the signal applied. Therefore, stronger applied signals produce a greater negative bias at the grid of this tube. This increased negative bias reduces the gain of the two r-f amplifiers. This prevents overloading of the r-f amplifiers. The agc circuit reduces the difference in gain among different units of Radio Receiver R–257/U and among replacement tubes in any one receiver.

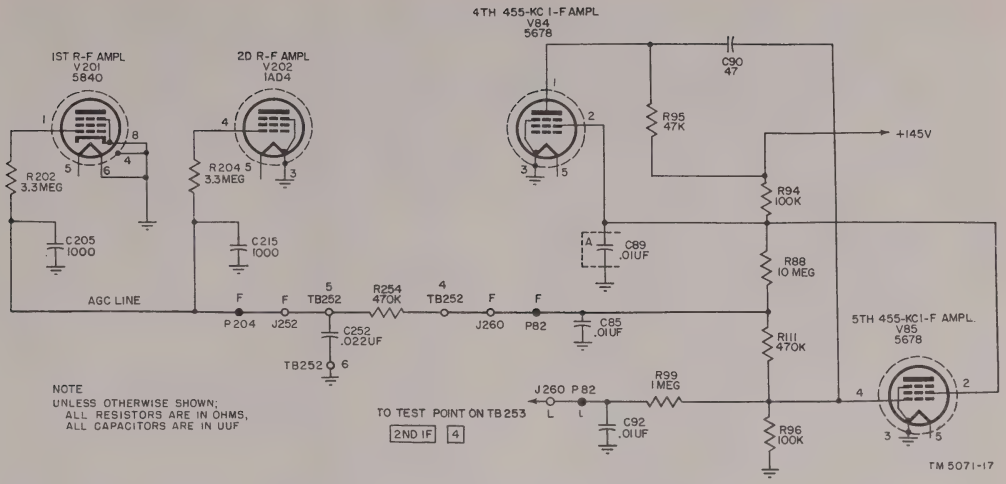


Figure 27. Radio Receiver R–257/U, agc circuit.

a. The negative grid-leak bias of the fifth 455-kc i-f amplifier (V85) is developed across grid-leak resistor R96. The voltage at the junction of R96 and R111 has a value of approximately —5 volts. This negative voltage is too large to apply to the grids of the r-f amplifiers. Therefore, a voltage divider is set up between the screen grid of V85, which is at a potential of about +80 volts, and the control grid, which is at about —5 volts with respect to ground. This voltage divider, consisting of R88 and R111, produces a small negative voltage (much smaller than 5 volts) at the junction of R111 and R88. This voltage is the agc voltage that is applied to the r-f amplifiers.

b. When the strength of the input signal to the receiver changes, the grid-leak bias of V85 changes. Practically the same change in voltage occurs at the junction of R111 and R88. (If an ordinary circuit were used (making use of a potentiometer for R96) to reduce the agc voltage applied to the r-f amplifiers, only a small portion of the change in grid-leak bias across R96 would occur in the agc voltage. This would result in weaker agc action). The voltage at this junction is applied through a decoupling filter (C85, R254, and C252) to the grid circuits of the r-f amplifiers to control their gain. C205 and R202, and C215 and R204 are additional decoupling filters that prevent any r-f picked up in the wiring from being applied to the grids of the r-f amplifiers.

c. A test point marked 2ND IF is connected through decoupling filter C92 and R99 to the grid of V85. This test point is on the front panel of the receiver.

54. First Limiter
(fig. 28)

a. The function of the first limiter stage (V86) is to reduce or eliminate large signal amplitude variations which may be present in the output from the fifth 455-kc i-f amplifier. Strong signals produce a large grid-leak bias at the grid of V86 and operate the tube near cutoff. This clips the negative half-cycles of grid voltage. The positive half-cycles operate the tube at its plate current saturation point. Thus, both halves of a strong signal are clipped and the a-c output of this tube has almost a constant amplitude.

b. Filament current is filtered by filament filter FL82. Grid bias is developed across grid-leak resistor R98. Resistors R103, R104, and R105 and their bypass capacitors C93, C89B, C101B, and C102 decouple the plate circuit from the B+ supply. Z82, the plate load, is resonant at 455 kc. The signal output is coupled to the second limiter through coupling capacitor C95.

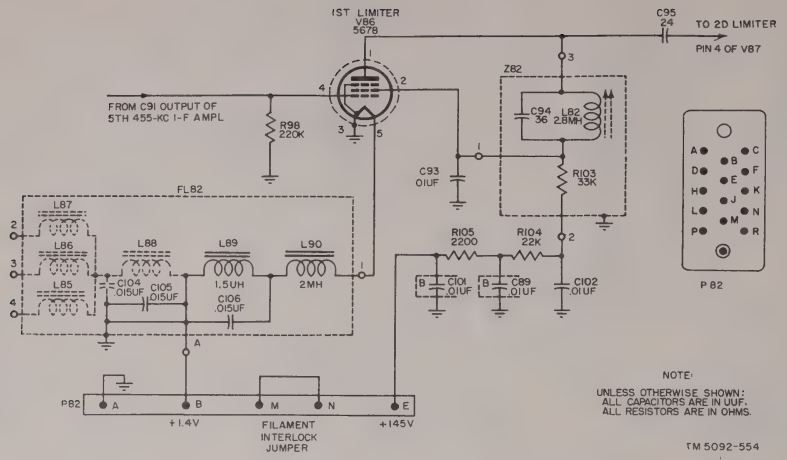


Figure 28. Radio Receiver R–257/U, first limiter.

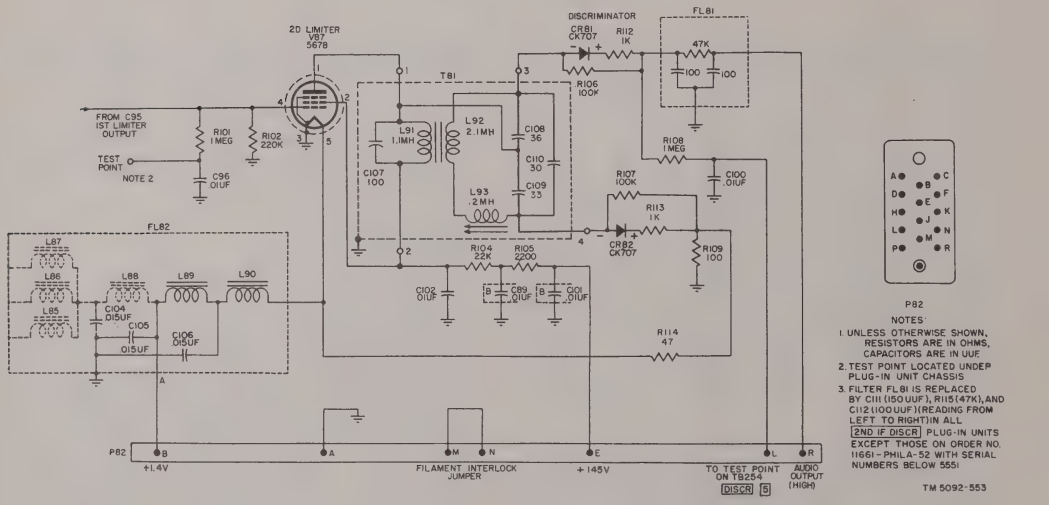


Figure 29. Radio Receiver R–257/U, second limiter and discriminator.

55. Second Limiter

(fig. 29)

a. The second limiter (V87) uses a shielded subminiature pentode tube type 5678. Its function is similar to that of first limiter V86. It removes any amplitude variations in signal that were not completely eliminated by the first limiter stage. This limiting action occurs because of a high negative grid-leak bias and low plate and screen voltages. When the control grid swings into a negative cycle, the plate current cuts off, and when the grid swings positive, plate current saturation results. This limits the positive and negative peaks of output voltage.

b. Output from the first limiter (V86) is applied to the grid of the second limiter. A high grid-leak bias is developed across grid-leak resistor R102. A connection to the grid through isolating filter R101 and C96 is available as a limiter grid bias test point. This test point is located on the 2ND IF DISCR plug-in

chassis. Filament current is supplied through FL82. Screen and plate voltages are supplied from the B+ supply through a double pi-section filter consisting of C101B, R105, C89B, R104, and C102. The connection to the plate is through the primary circuit of T81. T81 is the discriminator transformer assembly. Details of this circuit are described in paragraph 56.

56. Discriminator

a. General. The discriminator is a modified Foster-Seely circuit, consisting of transformer assembly T81, two germanium diode rectifiers, CR81 and CR82 (stock No. 2Z3565–17), and associated resistors and capacitors. It converts the f-m output signal of second limiter V87 to an audio signal. The f-m signal from the second limiter has a center frequency of 455 kc and varies above and below this frequency at the rate of the audio signal by which it is modulated. The maximum deviation from the center frequency is ±15 kc. The primary and secondary circuits of T81 are tuned to 455 kc and have a band pass of ±38 kc. This excess width produces a flat response of both tuned circuits to signals with a frequency of 455 kc ±15 kc.

b. Circuit Analysis (fig. 29). The input signal to the discriminator is applied across the primary circuit of T81 and to the junction of C108 and C109 in the secondary circuit of T81. The voltage across L91 produces a current through L91 which induces a voltage across L92. The voltage across L92 is in phase with the voltage applied to the primary circuit (L91). (The induced voltage across the secondary of a transformer is either in phase or 180° out of phase with the primary voltage, depending on the relationship of the two coil windings.) The induced voltage across L92, E_s, produces a current, I_s, through the tuned secondary circuit (a series resonant circuit). This current is in phase with the induced voltage across L92 at the center frequency (455 kc), lags the induced voltage at frequencies above the center frequency, and leads the induced voltage at frequencies below the center frequency. Since the induced voltage across L92 is in phase with the primary voltage, the current in the secondary circuit has the same phase relationship to the primary voltage as it does to the induced secondary voltage.

c. I-F Voltage at CR81 and CR82 (figs. 29 and 30). The i-f voltage at CR81 is equal to the vector sum of two voltages in series. The first is the voltage applied directly to the junction of C108 and C109. The second is the voltage developed across C108 by the current, I_s, flowing through this capacitor. Similarly, the voltage at CR82 is equal to the vector sum of the voltage applied to the junction of C108 and C109 and the voltage developed across C109 by the current, I_s, flowing through this capacitor. The voltage across a capacitor lags the current flowing through it by 90°.

(1) At the center frequency, when the current, I_s, is in phase with the applied voltage, the voltage across C108 lags the applied voltage, E_p (voltage at the junction of C108 and C109), by 90°. The vector sum of the applied voltage, E_p, and the voltage across C108, E_1, is shown on A, figure 30, and is represented by the resultant vector, E_{CR81}. To obtain the voltage at CR82, it is necessary to add vectorially the voltage across C109, E_2, to the applied voltage, E_p, in the opposite sense from that of C108. Therefore, on A, figure 30, E_2 is drawn straight up, and is 180° out of phase with E_1. The resultant vector E_{CR82}, represents the voltage at CR82. Although both resultant voltages differ in phase, their magnitudes are equal.

(2) When the applied voltage is above the center frequency, the current, I_s, through the secondary circuit lags the applied voltage. In B, figure 30, E_1 is shown lagging I_s by 90°, and E_2 is shown leading I_s by 90°. In this case, it is apparent that the i-f voltage at CR82 is greater than that at CR81.

(3) When the applied voltage is below the center frequency, the current, I_s, through the secondary circuit, leads the applied voltage, E_p. In C, figure 30, E_1 again is shown lagging I_s by 90°, and E_2 is shown leading I_s by 90°. In this case, it is apparent that the i-f voltage at CR81 is greater than that at CR82.

d. Output Voltage of Discriminator. The output of the discriminator is at terminal R of P82 (fig. 29). When there is no discriminator output, this point is at a potential of approximately +1 volt. This is the potential across R109, obtained from the 1.4-volt filament supply through voltage-dropping resistor R47. This low positive voltage provides a bias to CR82 and prevents low hum voltages from entering the discriminator circuit. Since the output of the discriminator is applied to first audio amplifier V121 and to noise amplifier V123 through coupling capacitors, this d-c voltage has no effect on these stages. Only changes in the d-c discriminator output that occur at an audio rate are passed to these stages.

(1) When the i-f signal applied to the discriminator is at the center frequency (455 kc), the voltages at CR81 and CR82 are equal, and equal d-c voltages are developed across R106 and R107. These two voltages, which are connected through L92 and L93, are series opposing. Therefore, the d-c output of the discriminator remains unchanged.

(2) When the i-f signal applied to the discriminator is above the center frequency, the voltage at CR82 exceeds that at CR81 and the d-c voltage across R107 exceeds that across R106. This causes the d-c output of the discriminator to drop.

(3) When the i-f signal applied to the discriminator is below the center frequency, the voltage at CR81 exceeds that at CR82 and the d-c output across R106 exceeds that across R107. This causes the d-c output of the discriminator to rise.

(4) Since the frequency of the i-f signal varies at an audio rate, the d-c output of the discriminator varies at an audio rate. I-f voltages are bypassed to ground by i-f filter FL81. The d-c output of the discriminator at various frequencies is shown on figure 31. The two curves indicate the tolerance limits for a satisfactory discriminator.

e. Miscellaneous. L93, located in the secondary of T81, is adjustable for tuning the discriminator circuit to the i-f center frequency. R112 and R113 are balancing resistors which equalize the forward resistance of the CR81 and CR82 circuits. R108 and C100 form a decoupling filter for the test point on the front of the receiver marked DISCR 5. A meter at this test point can be used to measure a fixed d-c output if a fixed frequency is applied to the receiver.

57. First Audio Amplifier
(fig. 32)

The first audio amplifier (V121) uses a shielded subminiature type 5678 tube. This stage amplifies the audio output of the discriminator. Input is applied through a de-emphasis network which consists of R121, R124, C121, C122, and C124. The de-emphasis network attenuates the higher audio frequencies. The grid circuit is returned through R122 and R128 to the junction between R144 and R145 in the squelch circuit (fig. 33). (Ground potential is at some point within R144.) R128 and C123 form a decoupling filter between the squelch and first audio circuits. Bias is applied to both audio amplifiers from the junction of R144 and R145. (See par. 59 for squelch circuit operation.) Output from

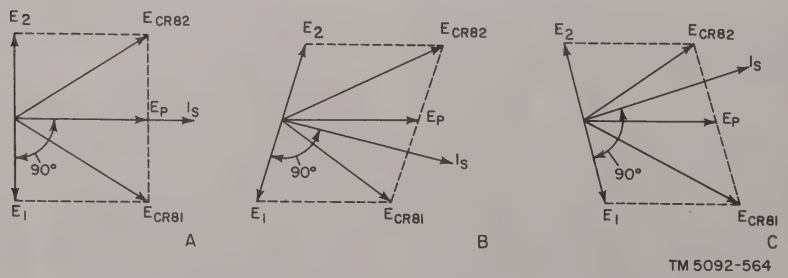


Figure 30. Radio Receiver R-257/U, discriminator vector diagrams.

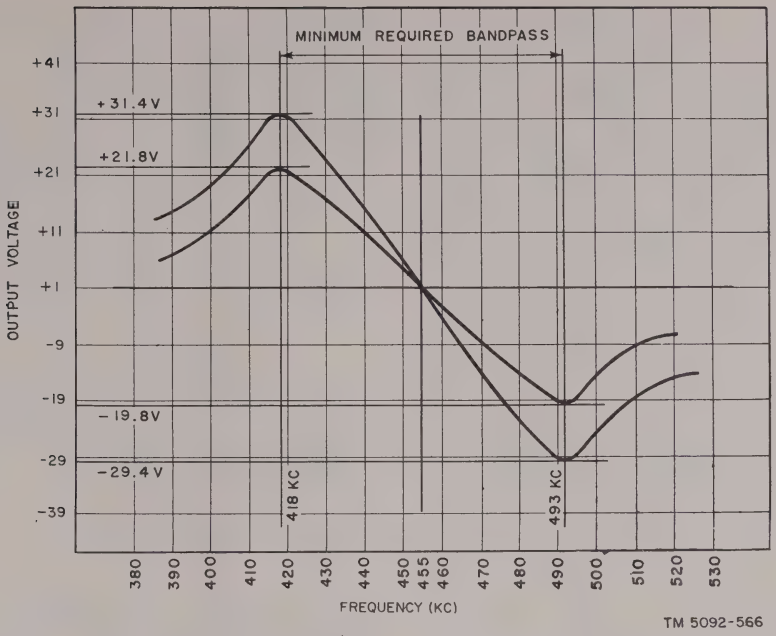


Figure 31. Radio Receiver R-257/U, discriminator response curves.

the first audio amplifier is coupled through C126 to a potentiometer (R127) that controls the voltage input to the audio power amplifier (V122). C122 is an audio coupling capacitor. C123 and R124 decouple the grid from a-f (audio-frequency) voltages developed in the squelch circuit or in the wiring. R123 and R124 shunt the filament to reduce its current to the desired value. R-f filament choke coil L212 prevents r-f from getting into the filament circuit. Resistor R125 and capacitor C125 are the screen dropping resistor and screen grid bypass capacitor. R126 is the plate load resistor across which the amplified audio output is developed. Inverse feedback from plate to grid is provided through C124. This capacitance offers a greater impedance to the lower audio frequencies than to the higher audio frequencies. Therefore, the high a-f feedback voltage is greater. This causes the h-f audio output of the amplifier to be attenuated much more than the l-f (low-frequency) audio output. The h-f de-emphasis produced by the input circuit to the grid of this stage is increased by the action of this circuit.

58. Audio Power Amplifier
(fig. 32)

The audio power amplifier (V122) uses a miniature type 6AK6 tube. This stage supplies audio power to the handset or to a loudspeaker in a control unit. The grid of this tube is connected to the movable contact of volume control R127 which has a slotted shaft for screwdriver adjustment. Adjustment of the control presets the audio output of the receiver. Output voltage is coupled through output matching transformer T121 to a speaker or handset. Capacitor C133 is connected across the primary of transformer T121 to bypass unwanted higher frequency audio signals. The grid return is through R127 and R128 to the junction of R144 and R145 in the squelch circuit. (See par. 59 for squelch circuit operation.) This grid return point is grounded when the SQUELCH disable switch is in the OFF position. This allows the two audio amplifier stages to operate regardless of the action of the squelch circuit. Higher plate and screen voltages are supplied to this stage than to the previous stages to obtain a high audio power output.

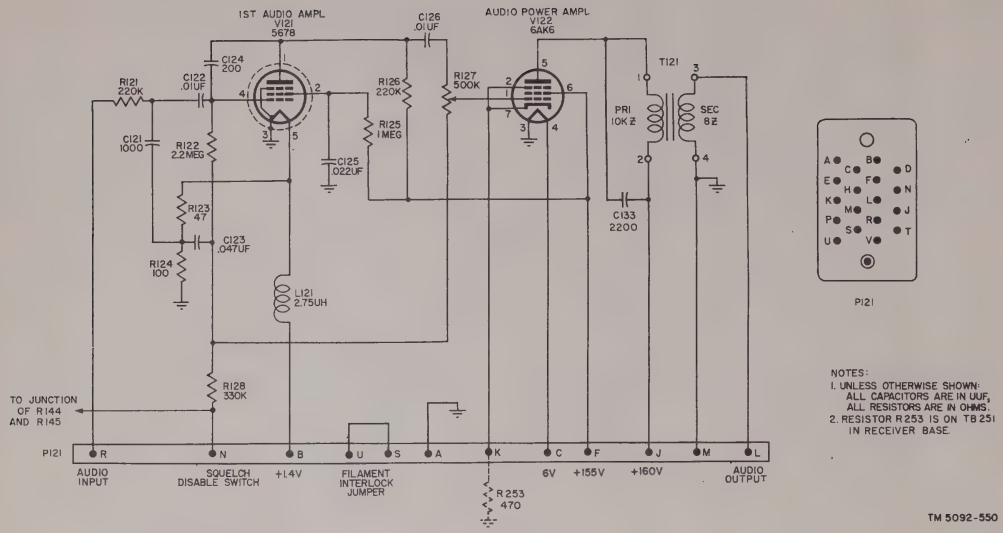


Figure 32. Radio Receiver R–257/U, first audio and audio power amplifiers.

59. Squelch Circuit

(fig. 33)

a. A squelch circuit is used for the purpose of silencing the rushing noise heard in an f-m receiver when a signal is not being received. The squelch circuit used in this receiver disables the audio amplifier tubes, V121 and V122, by biasing these tubes beyond cutoff during no signal input periods.

b. The audio output of the discriminator is applied to noise amplifier V123 through a high-pass filter consisting of C127 and R129, and C128 and R130. This two-section filter rejects audio frequencies (below 5,000 cps) but passes noise frequencies (5,000 to 15,000 cps). C129 couples the noise signals to the grid of V123. When a signal is being received by the receiver, an agc voltage is developed at the grid of the fifth 455-kc i-f amplifier (par. 53). This agc voltage is fed back to the grids of the first and second r-f amplifiers and reduces their gain. The reduced gain of the r-f amplifiers keeps the noise voltage down to a point below that necessary to operate the squelch circuit and squelch the receiver. When no signal is received by the receiver, there is no agc voltage and the r-f amplifiers operate at full gain. This increased amplification results in noise voltages large enough to operate the squelch circuit and squelch the receiver.

c. When the receiver is not squelched, there is a low positive voltage at the grid of V123. This voltage is obtained from a voltage divider consisting of R252 and R2408, in series with the 145-volt supply, and another voltage divider consisting of R136 and CR121, in parallel with R2408. CR121 (stock No. 2Z3565–17) offers a low resistance to electron flow in the direction from ground through it to R136. Therefore, the positive voltage across this rectifier is low. This low positive voltage is applied to the grid of V123 when no noise signal (or a very weak one) is applied. R2408, the SQUELCH control, may be varied (by panel control) to increase or decrease the value of this low positive voltage. The higher this positive voltage is, the greater will be the noise voltage required to squelch the receiver and the lower will be the signal voltage required to unsquelch the receiver. This control, therefore, determines the squelch *threshold level.*

d. When no signal is being received by the receiver, noise voltages are amplified sufficiently by the two r-f amplifiers and the succeeding stages in the receiver to operate the squelch circuit. The noise voltage passes through the high-pass filter in the grid circuit of V123 and

develops a negative grid-leak bias at the grid of this tube. The amplified noise output at the plate of this tube is fed back through C131 to the junction of R136 and R135 in the grid circuit. CR121 shunt rectifies this a-c signal, offering very little resistance to the positive half-cycles of signal that are applied across it from C131 but offering a very high resistance to the negative half-cycles. This results in a rectified negative voltage across CR121 that increases the negative bias on the grid of V123. With a high negative bias on V123, the d-c plate current of this tube is reduced greatly and the d-c plate voltage rises sharply.

e. Before the application of the noise signal to V123, V124 is biased to cutoff (through R147 and R139) by the —40-volt supply. The sharp rise in voltage at the plate of V123 raises the voltage at the grid of V124 and this tube now conducts. Conduction of V124 causes a drop in its plate voltage because of the voltage drop through R142.

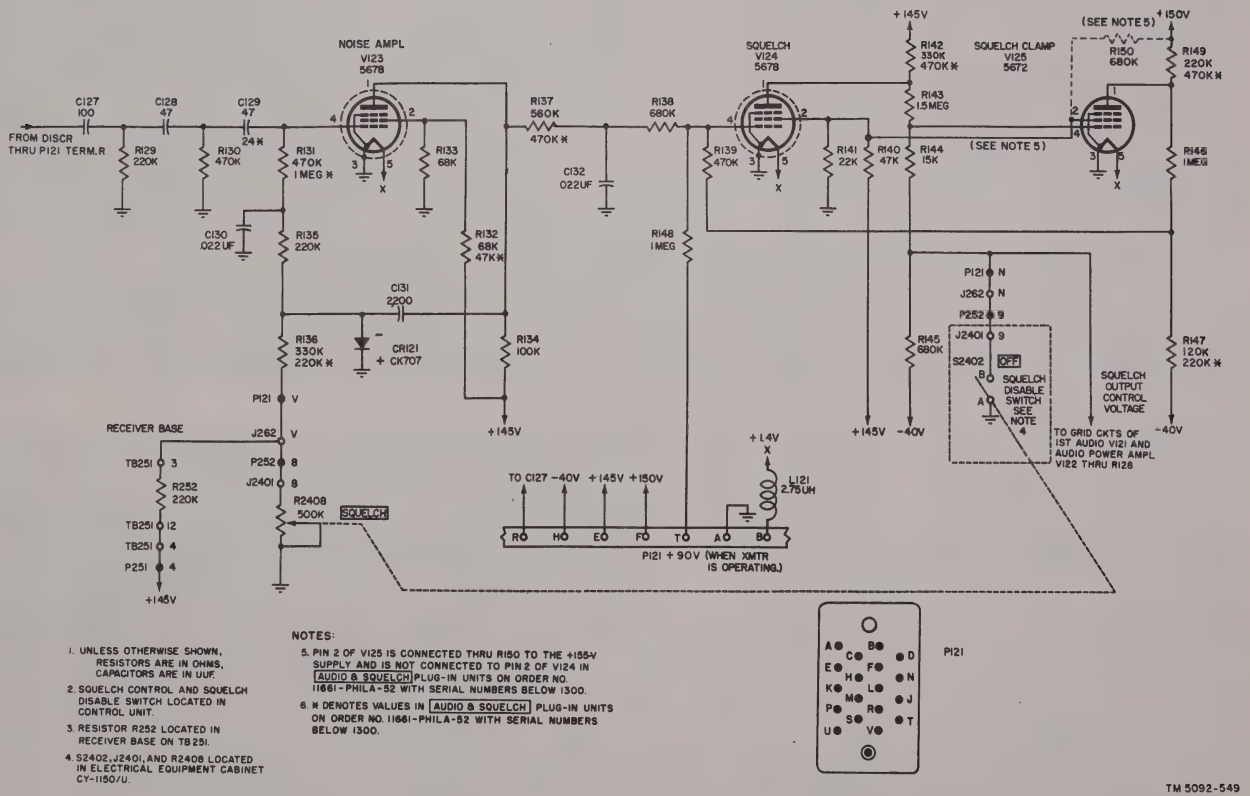
f. A voltage divider exists between the plate of V124 (junction of R142 and R143) and the —40-volt supply. This divider (R143, R144, and R145) produces a very low negative voltage (with respect to ground) at the junction of R144 and R145 when the receiver is not squelched. This voltage is applied to the grids of the two audio amplifiers, V121 and V122, and allows them to operate. However, the drop in plate voltage of V124 (*e* above) causes a drop in voltage at the junction of R144 and R145. This drop in voltage is sufficient to bias the two audio amplifiers beyond cutoff and all sound output from the receiver is squelched.

g. A drop in voltage also is produced at the grid of squelch clamp tube V125. This tube (which normally was conducting) now is biased close to cutoff. Its d-c plate voltage rises and the voltage at the junction of R146 and R147 rises. This rise in voltage is applied through R139 to the grid of V124 to reinforce the action of V123 in raising the grid bias of V124 and causing it to conduct. This action assures a sufficient drop in voltage at the plate of V124 to squelch the two audio amplifiers. More positive squelch action thus is provided by this stage.

h. When a signal is received by the receiver, a considerable agc voltage is developed at the grid of the fifth 455-kc i-f amplifier. The agc voltage is fed back to the two r-f amplifiers and reduces their gain. Therefore, very little noise voltage is applied to the squelch circuit. The negative bias at the grid of V123 leaks off and the low positive voltage that was originally present before the application of the noise signal again is applied to the grid of this tube. The plate current increases and the plate voltage drops. The drop in plate voltage produces a drop in the grid voltage of V124 and the plate current of this tube again is cut off. This causes a rise in its plate voltage and a rise in the voltage at the junction of R144 and R145. The rise in voltage at this junction is applied to the grids of the two audio amplifiers and allows them to conduct and operate. The rise in voltage at the plate of V124 also produces a rise in voltage at the grid of V125 (squelch clamp tube). This increases the plate current of this tube and causes a drop in its plate voltage. This drop in plate voltage produces (through R146 and R139) a further drop in the voltage at the grid of V124 and assures that this tube will remain cut off.

i. A squelch disable switch (S2402) is connected between the junction of R145 and R144 and ground. When the SQUELCH control is in its extreme clockwise position, this switch is closed. This action keeps the junction of R144 and R145 at ground potential regardless of any action of the squelch circuit. Therefore, the audio amplifiers, which obtain their grid bias voltage from this point, cannot be cut off and the receiver will not be squelched.

j. A muting circuit is provided through a connection from terminal T of P121. In some radio sets in which Radio Receiver R–257/U is used with an associated transmitter, it sometimes is desired that the receiver be muted (silenced) while the transmitter is being operated. To accomplish this, a +90-volt potential is supplied to terminal T of P121 from the transmitter. This potential, applied through a voltage divider consisting of R148, R139, and R147, raises the voltage at the grid of V124 and causes the tube to conduct. This produces a drop in voltage at the plate of V124 (and at the junction of R144 and R145) similar to the drop that occurs when squelch action (due to noise) takes place. The audio amplifiers, therefore, are biased beyond cutoff and the receiver is muted (silenced).



NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. SQUELCH CONTROL AND SQUELCH DISABLE SWITCH LOCATED IN CONTROL UNIT.
3. RESISTOR R252 LOCATED IN RECEIVER BASE ON TB251.
4. S2402, J2401, AND R2408 LOCATED IN ELECTRICAL EQUIPMENT CABINET CY-1150/U.
5. PIN 2 OF V125 IS CONNECTED THRU R150 TO THE +155-V SUPPLY AND IS NOT CONNECTED TO PIN 2 OF V124 IN AUDIO & SQUELCH PLUG-IN UNITS ON ORDER NO. 11661-PHILA-52 WITH SERIAL NUMBERS BELOW 1300.
6. M DENOTES VALUES IN AUDIO & SQUELCH PLUG-IN UNITS ON ORDER NO. 11661-PHILA-52 WITH SERIAL NUMBERS BELOW 1300.

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Figure 33. Radio Receiver R-257/U, squelch circuit.

60. Power Supplies
(fig. 34)

a. The power supply referred to in this manual is the 115- or 230-volt a-c Power Supply PP–846/U. This power supply is furnished with Radio Receiving Set AN/FRR–44. This and other power supplies which are used with Radio Receiver R–257/U are listed below:

Power Supply PP–846/U (115- or 230-volt a-c input).
Power Supply PP–867/U (24-volt d-c input).
Power Supply PP–868/U (12-volt d-c input).
Power Supply PP–869/U (6-volt d-c input).

b. These four power supplies are interchangeable; the selection of a power supply depends on the power source available and the radio set being used. Plug P251 in the receiver base connects to the jack in the power supply.

c. Power Supply PP–846/U is powered by a 115- or 230-volt a-c, 50- to 65-cycle power source. The power transformer has two primary windings which are connected in parallel (properly phased) for 115-volt a-c use, and in series (properly phased) for 230-volt a-c use. The 1.4-volt d-c filament power is rectified and regulated by three selenium rectifiers. The plate supply is rectified (full wave) by selenium rectifiers connected in a bridge circuit. The negative 40-volt d-c supply is rectified by a selenium rectifier connected for half-wave operation. The two tubes in the receiver with 6.3-volt filaments are supplied by a 6.3-volt a-c winding on the power transformer. This winding also supplies power to the heater in crystal oven E231.

61. Relay Adaptation in Radio Receiver R–257/U

Radio Receiver R–257/U normally uses a 470-ohm resistor, R253, as the cathode bias resistance of audio power amplifier V122. An alternate circuit is through relay K271, which is a 500-ohm coil. K271 is substituted for R253 when the jumper is removed from terminals 9 and 10 of TB251 and connected across terminals 10 and 11 (fig. 36 and 77). This relay in Radio Receiver R–257/U can be used to con-

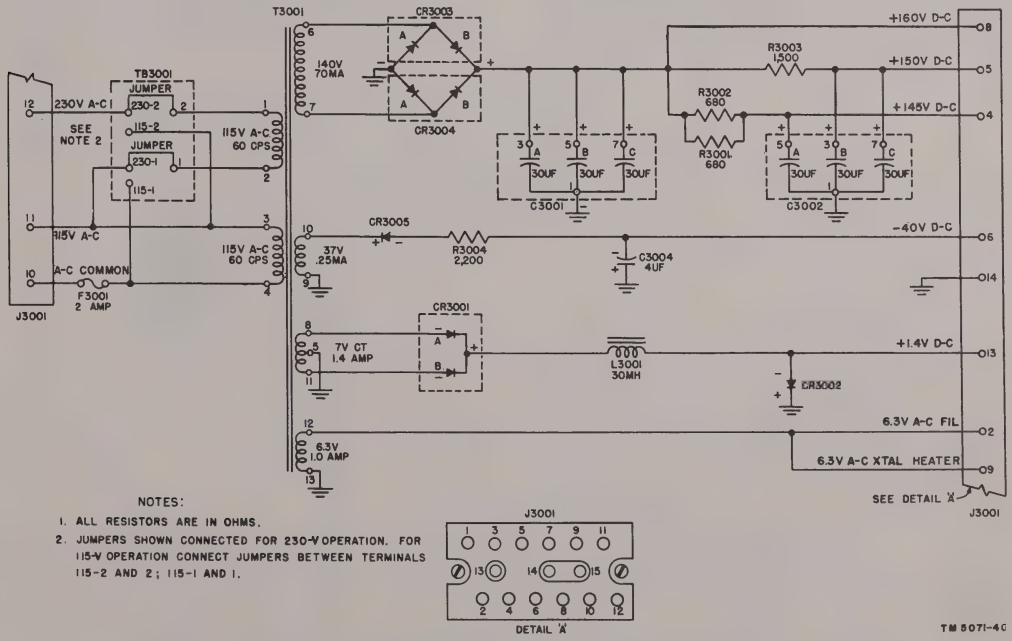


Figure 34. Power Supply PP–846/U, schematic diagram.

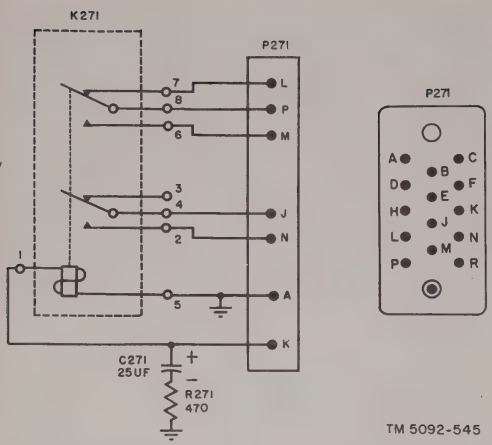


Figure 35. Radio Receiver R–257/U, schematic diagram of RELAY plug-in unit.

trol a transmitter for retransmission, or it can be used as a signaling device to notify the operator when a signal is being received. The relay coil is bypassed for audio with a 25-μf (microfarad) capacitor (C271) in series with a 470-ohm resistor (R271) to provide the same amount of degeneration in the cathode circuit that R253 provides. This causes the audio output of the receiver to be approximately the same with the relay unit as it is when R253 is used for cathode bias. Relay K271 is energized when audio power amplifier V122 draws more than 9 ma (milliamperes) of current.

62. Receiver Base
(fig. 37)

a. General. The receiver base of Radio Receiver R–257/U contains six connectors which accommodate the various plug-in units. It also contains selectivity filter Z251, filament filter Z252, main receiver connector P252, power supply connector P251, eight test jacks which terminate at the front of the receiver, and two terminal boards.

b. Plug P252. This plug provides a connection from the receiver to the radio set case. Various voltages and signals are routed through this plug to the SQUELCH control, audio output, antenna input, squelch relay contacts, and power input to the power supply.

c. Plug P251. This plug provides a connection from the power supply to the receiver. It mates with each of the four power supplies that can be used with this receiver. A small handle on this plug aids connection and disconnection.

d. Filters Z251 and Z252. The i-f selectivity filter, Z251, is connected between the second mixer (V52) and the first 455-kc i-f amplifier

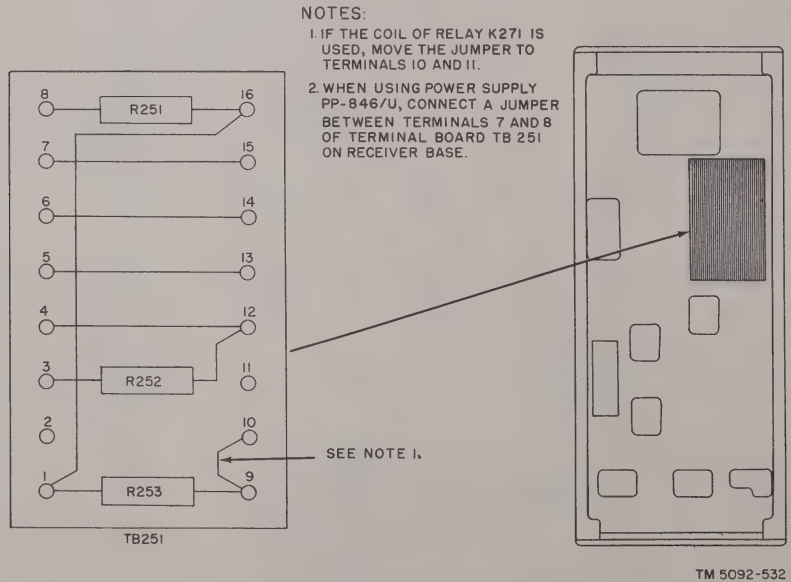
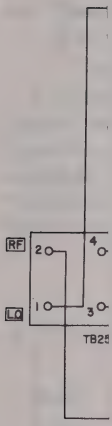


Figure 36. Radio Receiver R–257/U, showing jumper connections on RELAY plug-in unit.





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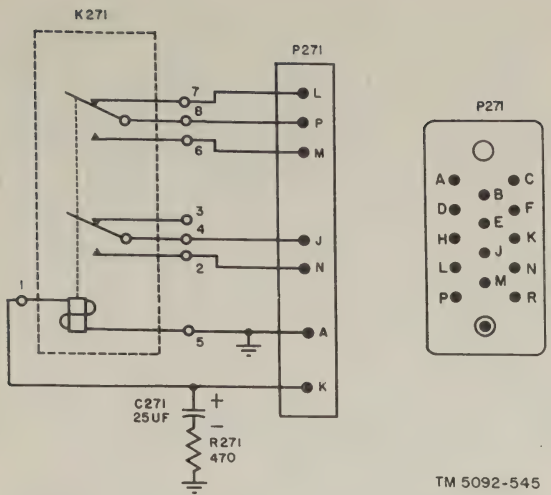


Figure 35. Radio Receiver R–257/U, schematic diagram of RELAY plug-in unit.

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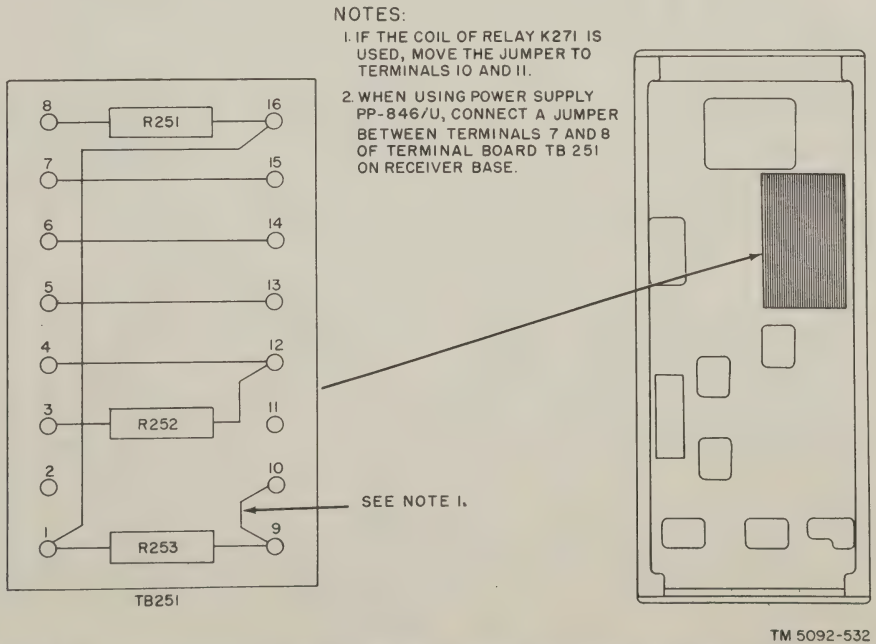


Figure 36. Radio Receiver R–257/U, showing jumper connections on RELAY plug-in unit.

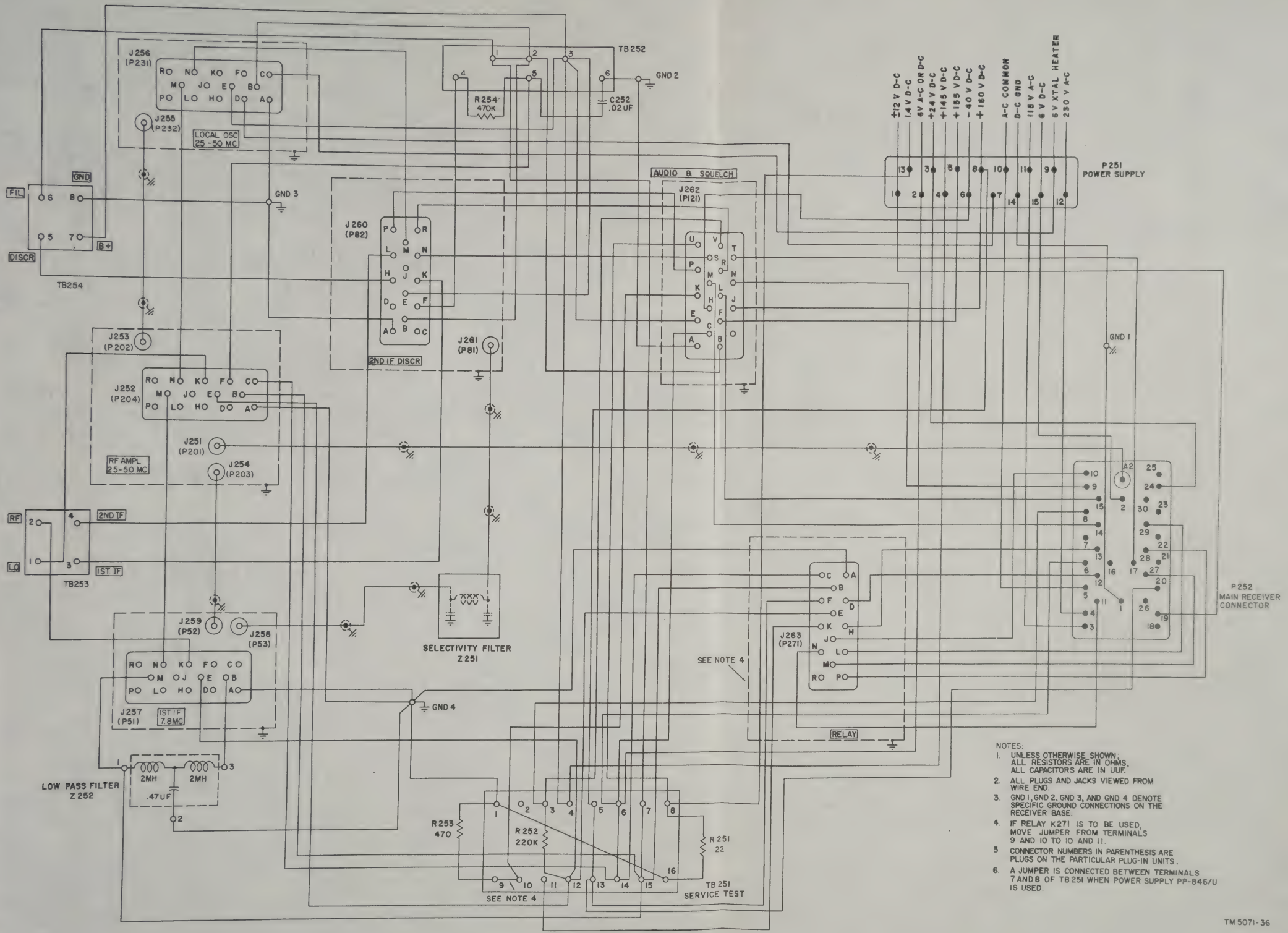


Figure 37. Radio Receiver R-257/U, schematic diagram of receiver base.

(V81). Filament voltage is applied to the 1ST IF 7.8 MC plug-in unit through filament filter Z252. Both filters are wired into the receiver base. Selectivity filter Z251 is referred to in paragraph 48. Filament filter Z252 prevents stray r-f voltage from entering the filaments of V51, V52, and V53.

e. Terminal Boards TB251 and TB252. These terminal boards mount four resistors and one capacitor. A jumper change involving RELAY plug-in unit adaptation is made on TB251 (par. 61). Resistor R254 and capacitor C252 (on TB252) are part of the agc decoupling network. Resistor R251 (on TB251) shunts and limits the 1.4-volt filament voltage. Resistor R252 (on TB251) is in series with the SQUELCH control (in the control unit), and resistor R253 (on TB251) is the cathode bias resistor for audio power amplifier V122.

63. Electrical Equipment Cabinet CY–1150/U

(fig. 38)

a. This case is a compact unit, containing a typical control circuit and a loudspeaker for operation of Radio Receiver R–257/U. The complete assembly is Radio Set AN/FRR–44. This particular case (figs. 3 and 14) houses the receiver and power supply.

b. A blastproof loudspeaker, LS2401, located at the front of the case, is used to convert the audio output voltage into audible sounds. VOLUME control S2401A is a wafer switch wired with resistors R2401 through R2406 and operates as a four-position attenuator control. Maximum volume is obtained when this control is fully clockwise. In the extreme counterclockwise position, switch S2401B (ganged to S2401A) breaks the power circuit of the radio set. POWER indicator lamp I 2401 lights when the power is turned on. Resistor R2407 limits current through this lamp to the desired value.

c. SQUELCH control R2408 and squelch disable switch S2402 connect to the AUDIO & SQUELCH plug-in unit through connector J2401 and P252 (main receiver connector). When S2402 is closed, the audio grid circuits are grounded through this switch and the squelch circuit is disabled.

d. Connector J2401 mates with the main receiver connector P252 in the receiver. Terminal board TB2401 is located at the rear of Electrical Equipment Cabinet CY–1150/U and is used as junction points for power and the squelch relay contacts. The antenna is connected to the radio set through coaxial connectors J2402, P2401, and A 2 on J2401.

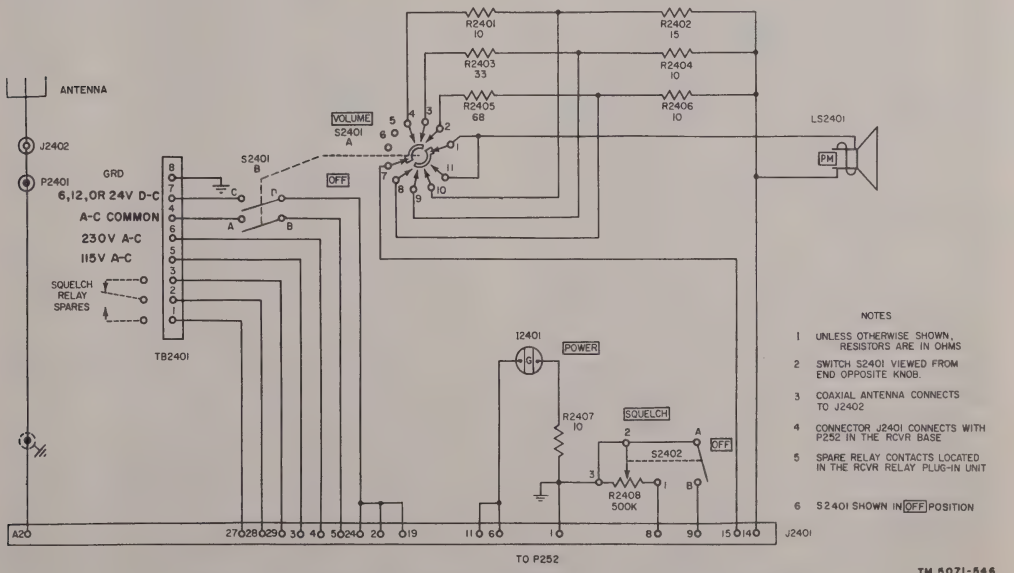


Figure 38. Electrical Equipment Cabinet CY–1150/U, control circuit.

CHAPTER 5
FIELD MAINTENANCE INSTRUCTIONS

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When an external voltage is applied to the receiver, there is a possibility of electrical shock if contact is made with certain terminals or wires in the set. When used with Power Supply PP–846/U, the main receiver connector P252 and the power supply connector P251 have as much as 230 volts a-c on their terminals. The d-c power supplies have voltages as high as 150 volts d-c.

64. Troubleshooting Procedures

The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the plug-in unit or the receiver base containing the defect. 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 and shorted transformers often can be located by sight, smell, and hearing. The majority of the faults, however, must be localized by checking voltage and resistance.

a. System Sectionalization. System sectionalization is described in the instruction books of the radio systems in which Radio Receiver R–257/U is used.

b. Component Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective, the steps in the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the receiver. Trouble should be localized to a particular plug-in unit. Then the trouble should be isolated within the plug-in unit by appropriate voltage and resistance checks. The service procedure is summarized as follows:

(1) *Inspection.* The purpose of inspection is to locate any visible trouble. Through inspection, the technician will frequently discover the trouble, or clues to the trouble. Inspection is valuable in avoiding additional damage to the receiver and in eliminating future failures.

(2) *Input resistance measurements.* These measurements (pars. 69, 70, and 71) prevent further damage to the receiver from possible short circuits. Since this test gives an indication of the condition of bypass capacitors, its function is more than preventive.

(3) *Operational test.* The operational test (par. 72) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. To utilize this information fully, all symptoms must be interpreted in relation to one another.

(4) *Troubleshooting chart.* The trouble symptoms listed in this chart (par. 74) will aid in localizing trouble.

(5) *Signal substitution.* The principal advantage of the signal substitution method (par. 76) is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests.

(6) *Intermittents.* In all these tests the possibility of intermittents should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set. It is possible that the trouble is not

in the receiver itself but in the installation, or the trouble may be due to external conditions. In this event, test the installation, if possible.

65. Troubleshooting Data

Take advantage of the material supplied in this technical manual. It will help in the rapid location of faults. Consult the following figures:

Fig. No.	Title
8 through 12	Radio Receiver R–257/U, plug-in units, tube locations.
37	Radio Receiver R–257/U, schematic diagram of receiver base.
38	Electrical Equipment Cabinet CY–1150/U, control circuit.
44	Radio Receiver R–257/U, B+ distribution diagram.
45	Radio Receiver R–257/U, filament distribution diagram.
47	Radio Receiver R–257/U, RF AMPL 25–50 MC plug-in unit, tube socket voltage and resistance measurements.
48	Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, tube socket voltage and resistance measurements.
49	Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, terminal board voltage and resistance measurements.
50	Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, tube socket voltage and resistance measurements.
51	Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, tube socket voltage and resistance measurements.
52	Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, terminal board voltage and resistance measurements.
53	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers below 1214 on Order No. 11661–Phila–52), tube socket voltage and resistance measurements.
54	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers 1214 and above on Order No. 11661–Phila–52), tube socket voltage and resistance measurements.
55	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers below 1214 on Order No. 11661–Phila–52), terminal board voltage and resistance measurements.
56	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers 1214 and above on Order No. 11661–Phila–52), terminal board voltage and resistance measurements.
57	Radio Receiver R–257/U, RELAY plug-in unit, voltage and resistance measurements.
58	Radio Receiver R–257/U, voltage and resistance measurements of base.
59	Radio Receiver R–257/U, base, bottom view.
60	Radio Receiver R–257/U, RF AMPL 25–50 MC plug-in unit, top chassis view.
61	Radio Receiver R–257/U, RF AMPL 25–50 MC plug-in unit, bottom chassis view.
62	Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, top chassis view.
63	Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, bottom chassis view.
64	Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, top chassis view.
65	Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, bottom chassis view.
66	Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, top chassis view.
67	Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, bottom chassis view.
68	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit, top chassis view.
69	Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit, bottom chassis view.
70	Radio Receiver R–257/U, RELAY plug-in unit, top chassis view.
71	Radio Receiver R–257/U, RELAY plug-in unit, bottom chassis view.
79	Radio Receiver R–257/U, schematic diagram.

66. Test Equipment Required for Troubleshooting

The test equipment required for troubleshooting Radio Receiver R–257/U is listed below. The technical manuals associated with the test equipment also are listed.

Test equipment	Publication
Signal generators:	
Signal Generator Set AN/URM–27, –48 or equal.	TM 11–5522 and TM 11–1275.
RF Signal Generator Set AN/URM–25	TM 11–5551.
Electronic multimeters:	
Electronic Multimeter ME–6A/U, or ME–6B/U, or equal.	TM 11–5549 or TM 11–5549A.
Electronic Multimeter TS–505/U, or equal.	TM 11–5511.
Output Meter TS–585A/U and TS–585B/U.	TM 11–5017.
Frequency Meter TS–174B/U	TM 11–5044.
Audio Oscillator TS–382A/U	TM 11–2684A.
Spectrum Analyzer TS–723/U	TM 11–5032.
Electron Tube Test Set TV–7/U	TM 11–5083.

67. General Precautions

Observe the following precautions when servicing the receiver.

a. Be careful when the power supply cover plate or the receiver base bottom cover is removed; voltages in excess of 230 volts may be present.

b. When removing the power supply, carefully remove power supply plug P251 so that no damage occurs to the plug contacts or wiring.

c. Removal of the subminiature tubes should be accomplished with extreme care because the pins are tiny and fragile. Do not tip or twist these tubes, lift them straight upward and away from the tube socket. When replacing them, be sure the red dots on the chassis and tube line up so that the proper connections are maintained.

d. Do not strip or damage the screws or Airloc fasteners used in the receiver. Always replace the required lockwashers when a part is removed and replaced.

e. Careless replacement of parts can be a source of additional faults. Take the following precautions when replacing a part in the receiver.

(1) Before a part is unsoldered and removed, note the position of the leads. If the part has numerous leads or terminals, tag each wire or make a pencil diagram of the parts and its connections, so that the replacement part will not be wired incorrectly.

(2) Be careful not to damage other parts or wires when it is necessary to remove a part.

(3) Do not allow drops of solder to fall into the receiver; they may cause short circuits.

(4) A carelessly soldered connection may create a new defect. It is important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to detect. Since most of the parts are very small and their leads short, solder connections as rapidly as possible to prevent overheating of the parts.

(5) When a part is replaced in the r-f or i-f circuits, it must be positioned exactly as the original one was. A part that has the same electrical value but a different physical size or location may cause trouble in h-f or vhf (very-high-frequency) circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as the original wiring. Failure to observe these directions may produce either decreased gain or oscillation of the circuit.

(6) Do not disturb the setting of the audio gain control, R127, unless this part is being replaced. If this is the case, adjust R127 as prescribed in paragraph 93. If it is necessary to adjust or test R127 when making a-f tests, mark its setting and re-establish this setting at the conclusion of the test, or adjust it as prescribed.

(7) When removing or replacing any pluck-out items as tubes, the crystal oven, crystals, plugs, or plug-in units, perform this function carefully. Be sure the units are alined properly when being replaced. This receiver and its parts are small and in many instances more fragile than parts used in ordinary radio equipment.

68. Test Installation of Radio Receiver R–257/U

Three patch cords are authorized for use in testing Radio Receiver R–257/U. They are authorized in the Supply catalogs SIG 7 & 8 for the radio sets that include Radio Receiver R–257/U and should be requisitioned through normal supply channels. The patch cords are listed in the chart below.

Description	Stock No.	Function	Authorized echelons
Electrical Special Purpose Cable Assembly CX–2371/U (fig. 39 and 40).	3E4002.75	Connects receiver to its case	All.
Electrical Special Purpose Cable Assembly CX–2511/U.	3E5999A–62	Connects all plug-in units except the AUDIO & SQUELCH plug-in unit to the receiver chassis.	Field maintenance echelons.
Electrical special purpose cable assembly	3E4002.94	Connects AUDIO & SQUELCH plug-in unit to receiver chassis.	Field maintenance echelons.

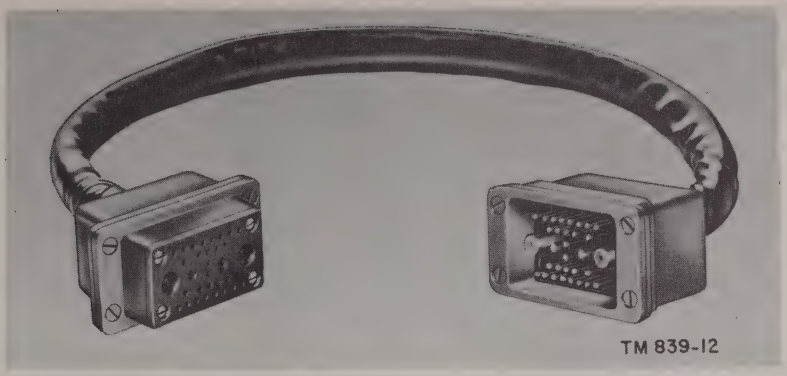


Figure 39. Electrical Special Purpose Cable Assembly CX–2371/U (patch cord).

a. Installation of Power Supply.

(1) If a 115-volt or 230-volt a-c source is available, use Power Supply PP–846/U. If a 115-volt source is used, connect wire jumpers between terminals 1 and 115–1 and between 2 and 2–115 of TB3001 in the power supply. If a 230-volt source is used, connect wire jumpers between terminals 1 and 230–1 and between 2 and 230–2 of TB3001 in the power supply. Install the power supply in the power supply compartment of the receiver (fig. 5) and connect P251 to the power supply connector.

(2) If a 6-volt source of power is used, install Power Supply PP–869/U in the receiver and connect P251 to the power supply connector.

(3) If a 12-volt source of power is used, install Power Supply PP–868/U in the receiver and connect P251 to the power supply connector.

(4) If a 24-volt source of power is used, install Power Supply PP–867/U in the receiver and connect P251 to the power supply connector.

b. Connections to Electrical Equipment Cabinet CY–1150/U. Connect the patch cord between P252 of the receiver and J2401 of the cabinet (fig. 40).

(1) When Power Supply PP–846/U is used with a 115-volt power source, connect the leads of the input power

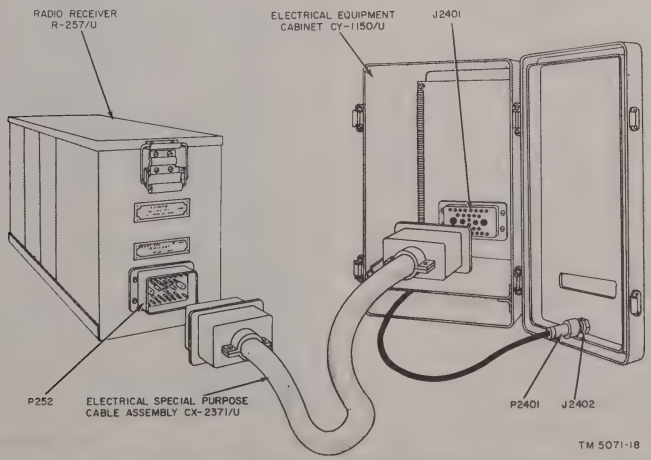


Figure 40. Radio Receiver R–257/U, patch cord connection to Electrical Equipment Cabinet CY–1150/U.

cord to terminals 4 and 5 of TB2401. When a 230-volt source is used, connect the leads of the input power cord to terminals 4 and 6 of TB2401.

(2) When Power Supply PP–867/U, PP–868/U, or PP–869/U is used, connect the input power cord to terminals 7 and 8 of TB2401.

(3) Connect the other end of the power cord to the power source (230-volt a-c, 15-volt a-c, or 6-, 12-, or 24-volt d-c). Be sure that the power supply that is used matches the source of input voltage.

69. Checking for B+ Shorts

a. A B+ short can disable the entire receiver, or it can result in erratic operation. Defective capacitors can at times be difficult to detect by an ohmmeter check. Sometimes they become *leaky* which means that they allow direct current to pass through them. References to the B+ distribution schematic diagram (fig. 44) and voltage and resistance illustrations (figs. 46 through 58) will aid in locating B+ shorts.

b. After determining that the trouble is not in the power supply, sectionalize the trouble to the receiver base or one of the plug-in units. A B+ short may not necessarily blow a power supply fuse, but may cause certain resistors to become overheated. If the B+ voltage, as measured at the front panel test point marked B+, is quite low, pull out the plug-in units, one at a time, while watching the voltage reading at this test point. Reinsert each plug-in unit before removing the next one. Removing any plug-in unit will unload the power supply because the filament circuit is opened and the B+ will rise slightly. If one of the plug-in units contains a B+ short that overloads the power supply appreciably, the power supply fuse may blow. Removing one plug-in unit at a time in some cases will indicate which plug-in unit contains the B+ short. Removal of the defective unit will cause the B+ reading to increase to a value slightly higher than that produced by removal of nondefective units.

c. Since a B+ short often will cause resistors or capacitors to overheat, inspect the receiver base and each plug-in unit for evidence of charred or discolored resistors or capacitors. Ceramic-type capacitors, as used in this receiver, often will burn a white spot on their bodies which can be easily detected. If charred resistors are located, check their bypass capacitors with an ohmmeter. It is advisable to locate B+ shorts by resistance checks if parts

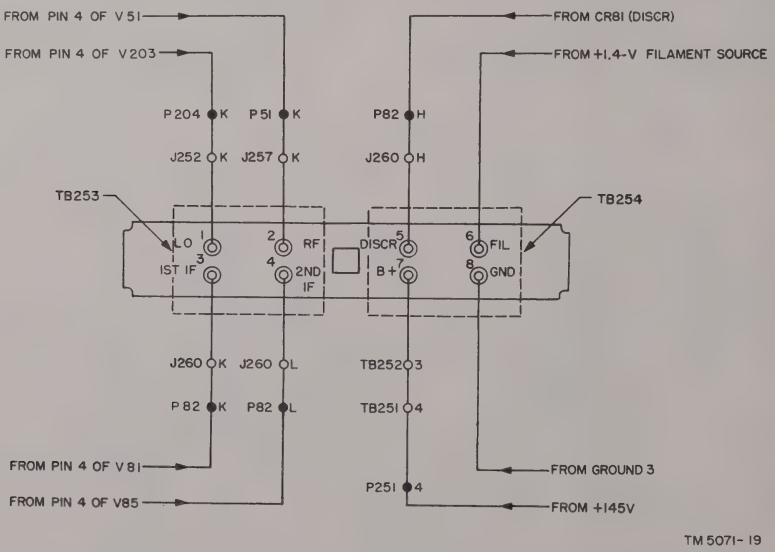


Figure 41. Radio Receiver R–257/U, front panel test points.

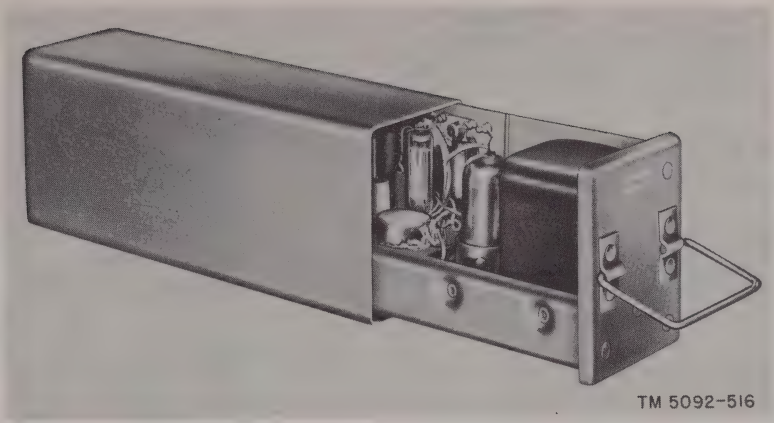


Figure 42. Plug-in unit with cover partially removed.

in the receiver are overheating. If a leaky capacitor is causing the trouble, and none of the parts seems to be overheating, plate voltage and screen voltage measurements with a voltmeter or vtvm (vacuum-tube voltmeter) can localize the trouble to the defective part. Leaky coupling capacitors can be located by checking for a positive voltage on the control grids of the tubes. If this is the case, test the tubes involved because a positive grid voltage may cause excessive plate current and damage the tube.

d. Replace charred or discolored resistors even if they are close to their required value. A resistor that has been overheated may crack, change in value appreciably, or open.

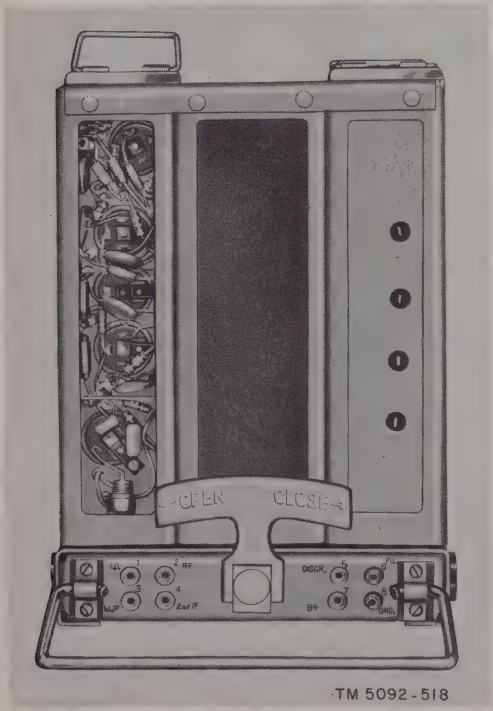


Figure 43. Radio Receiver R–257/U, front view showing accessibility of plug-in units when installed.

70. Checking Filament Circuits

a. Radio Receiver R–257/U uses two filament voltages, 6.3-volt a-c or d-c, and 1.4-volt d-c. Each plug-in unit (except the RELAY plug-in unit) contains an interlock jumper which opens the 1.4-volt filament circuit when the plug-in unit is removed. The normal filament voltage depends on all the tubes drawing their normal current. If it were not for this filament interlock feature, the filament voltage on the remaining tubes would rise whenever one of the plug-in units was removed from the receiver base.

b. Reference to figure 45 shows the filament distribution through the receiver. Ground connections marked GND 1 through GND 4 are specific ground points in the receiver base, and are indicated as such for the purpose of location and identification. This schematic diagram aids in locating defects in the filament circuits.

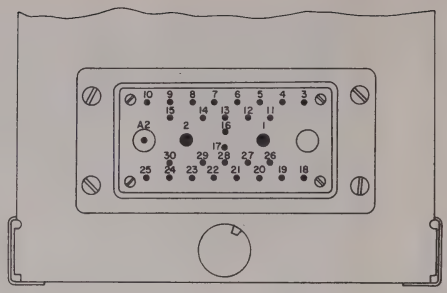
c. Most of the filaments are bypassed to ground with ceramic capacitors. Defects in the filament circuits may be caused by shorts through these capacitors.

71. Checking B+ and Filament Circuit Defects in the Receiver Base

a. The receiver base consists mainly of cables and connectors with the exception of a few resistors and capacitors. If a defect in the B+ circuit or the filament circuit has been sectionalized to the receiver base, check the base as described below.

b. Pull the power cord plug from the source of power. Remove the receiver from its case and also remove the power supply and all the plug-in units. The receiver base schematic diagram (fig. 37) and the overall receiver schematics (fig. 79) will be of assistance in troubleshooting. If the trouble is known to be in the filament circuits, use the filament circuits schematic diagram (fig. 45). If the trouble lies in the B+ circuits, use the B+ distribution diagram (fig. 44).

c. Resistance measurements between points in the receiver base will aid in detecting open circuits. Figure 58 shows voltages obtained in the receiver base when the receiver is operating. Resistance measurements are taken with the receiver disconnected from the radio set case.



TERMINAL	RESISTANCE	TERMINAL	RESISTANCE	TERMINAL	RESISTANCE
1	0	11	∞	21	∞
2	∞	12	∞	22	∞
3	∞	13	∞	23	∞
4	∞	14	0	24	∞
5	∞	15	.6	25	∞
6	4	16	∞	26	∞
7	∞	17	1.8MEG	27	∞
8	140K	18	∞	28	∞
9	1.2 MEG	19	∞	29	∞
10	∞	20	∞	30	∞
				A2	100K

NOTES:

1. RESISTANCE MEASUREMENTS MADE AT CONNECTOR P252 WITH POWER SUPPLY REMOVED FROM THE RECEIVER
2. ALL RESISTANCE MEASUREMENTS MADE WITH A VTVM BETWEEN GROUND AND TERMINALS SPECIFIED.

TM 5092-601

Figure 46. Radio Receiver R–257/U, resistance measurements on main connector P252.

72. Operational Test

After completing the check and repair of any defects in the B+ and filament circuits, operate the receiver as described in paragraphs 17 through 21. If defects still exist, follow the procedure described in the remaining paragraphs of this section (pars. 73 through 82).

73. Sectionalizing Trouble to a Plug-In Unit

a. In most cases, the failure of Radio Receiver R–257/U will be caused by trouble in one of the plug-in units. The first step in troubleshooting the receiver consists of measuring the filament voltage and the B+ voltage at the test jacks (FIL and B+, respectively) on the front panel of the receiver. These tests indicate whether the proper voltage is being applied to the receiver. First r-f amplifier V201 and audio power amplifier V122 are the only tubes using 6 volts as heater voltage. A test for this voltage can be made by removing the RF AMPL 25–50 MC plug-in unit and the AUDIO & SQUELCH plug-in unit and actually feeling these two tubes to determine whether they are warm, as they should be if the 6-volt heater voltage is present.

b. The next step consists of removing each plug-in unit and replacing it with a similar unit known to be in operating condition. For this test to be complete, the RF AMPL 25–50 MC plug-in unit and the LOCAL OSC 25–50 MC plug-in unit being used for the substitution test must be alined previously to the same frequencies as the two similar units under test.

c. After the defective plug-in unit has been isolated it can be checked while installed in the receiver base. Use the troubleshooting chart (par. 74).

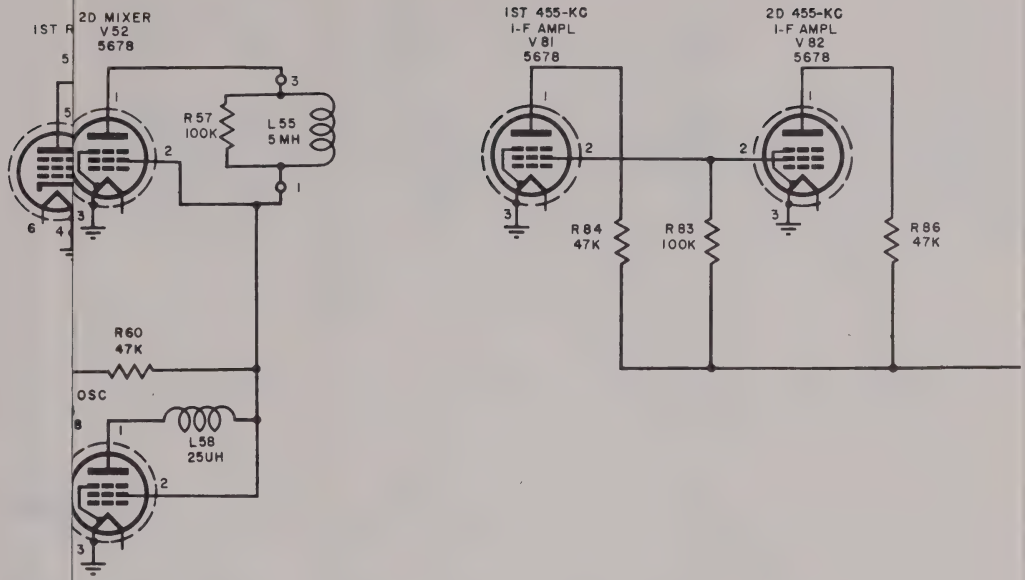


Figure 44. Radio Receiver R-257/U,

455892 O - 58 (Face p. 52) No. 1

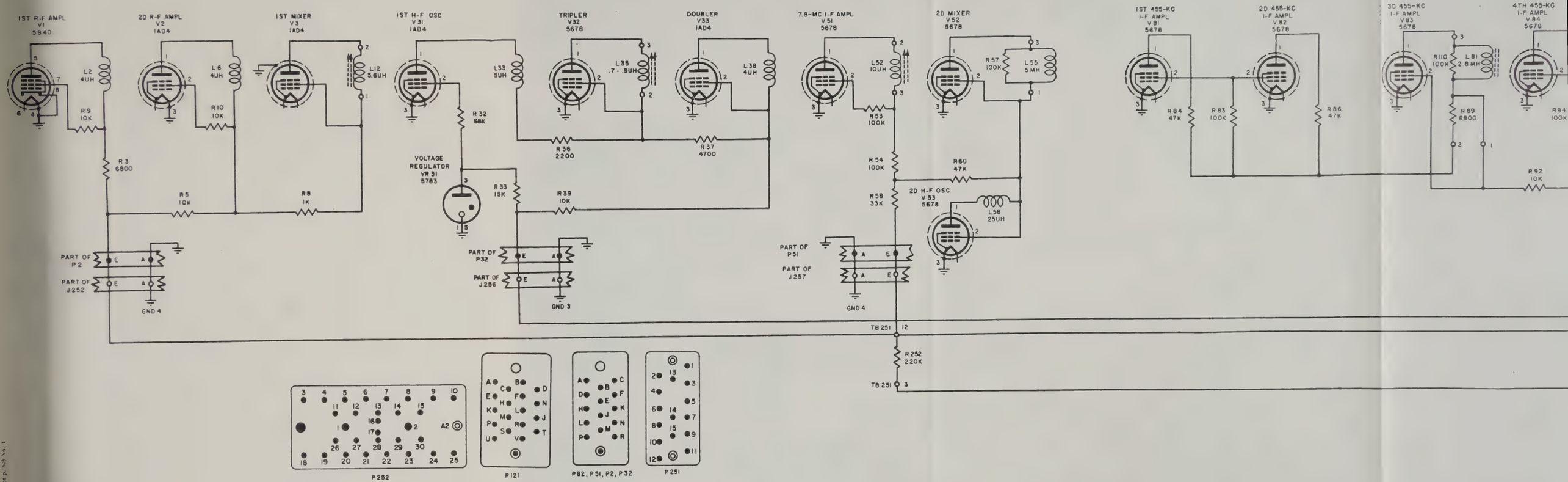
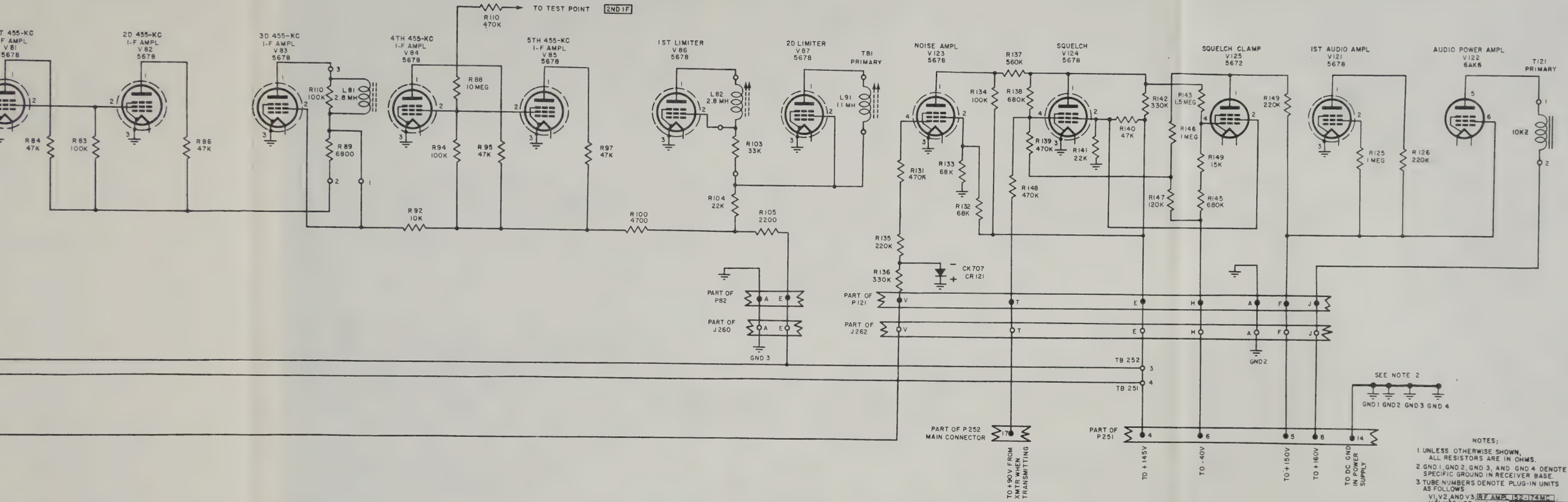


Figure 44. Radio Receiver R-257/U, B+ distribution diagram.

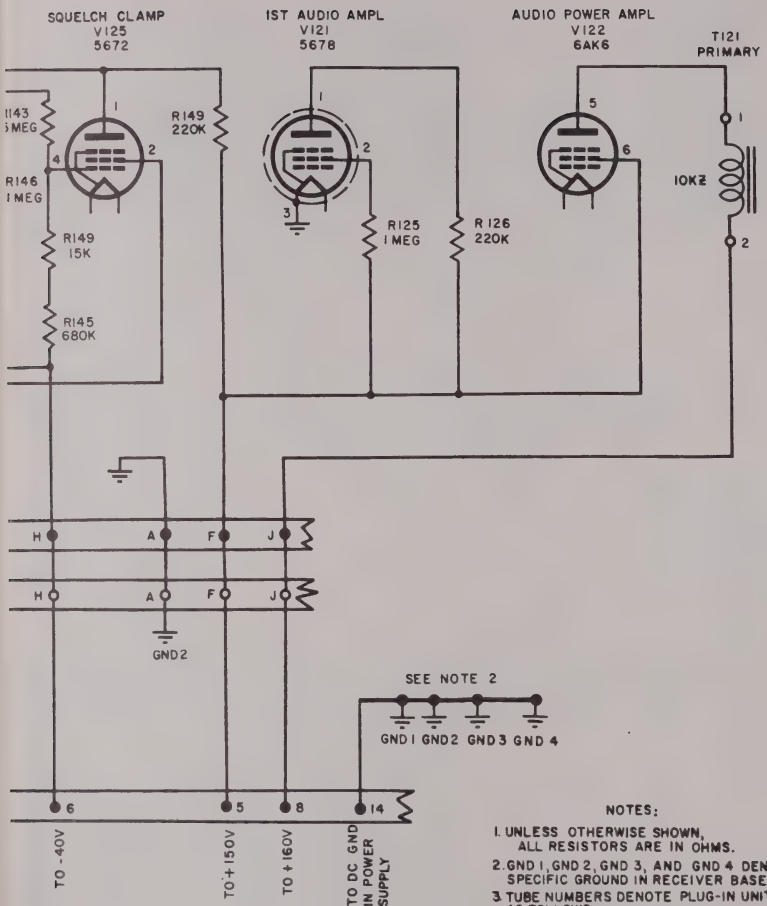


NOTES:

1. UNLESS OTHERWISE SHOWN, ALL RESISTORS ARE IN OHMS.
2. GND 1, GND 2, GND 3, AND GND 4 DENOTE SPECIFIC GROUND IN RECEIVER BASE.
3. TUBE NUMBERS DENOTE PLUG-IN UNITS AS FOLLOWS
   V1, V2 AND V3, R-F AMPL 152-174 MC.
   V31, V32, V33, AND VR31, LOCAL OSC 192-174 MC.
   V51, V52, AND V53, IST I-F 7.8 MC.
   V81 THROUGH V87, 2ND I-F 455 KC.
   V121 THROUGH V125, AUDIO & SQUELCH
4. IN ALL AUDIO & SQUELCH SUBASSEMBLIES ON ORDER NO. 11661-PHILA-52 BEARING SERIAL NUMBERS BELOW 1214.
   THE VALUE OF R131 IS 1MEG;
   THE VALUE OF R136 IS 220K;
   THE VALUE OF R132 IS 47K;
   THE VALUE OF R137 IS 470K;
   THE VALUE OF R142 IS 470K;
   THE VALUE OF R149 IS 470K; AND
   THE VALUE OF R147 IS 220K.
   THE CONNECTION BETWEEN PIN 2 OF V124 AND PIN 2 OF V125 IS OMITTED. R150 (680K) CONNECTS BETWEEN PIN 2 OF V125 AND TERMINAL F OF P121.

Figure 44. Radio Receiver R-257/U, B+ distribution diagram.

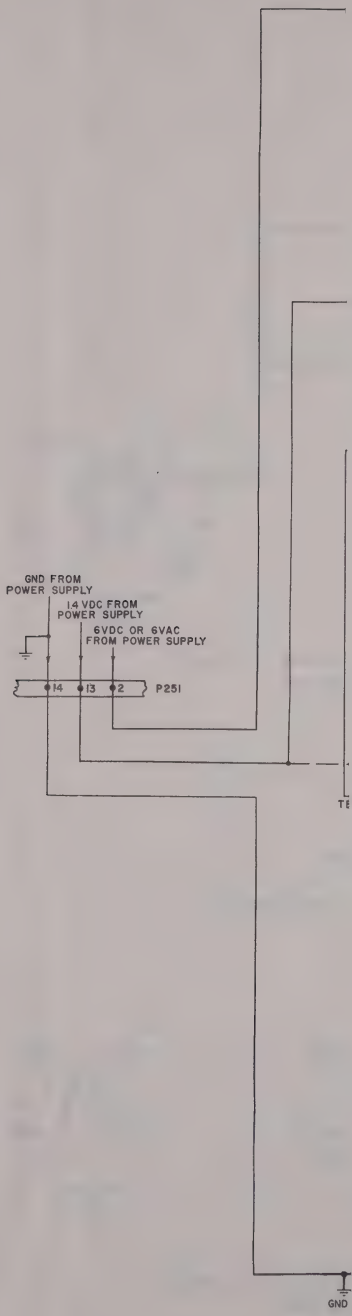
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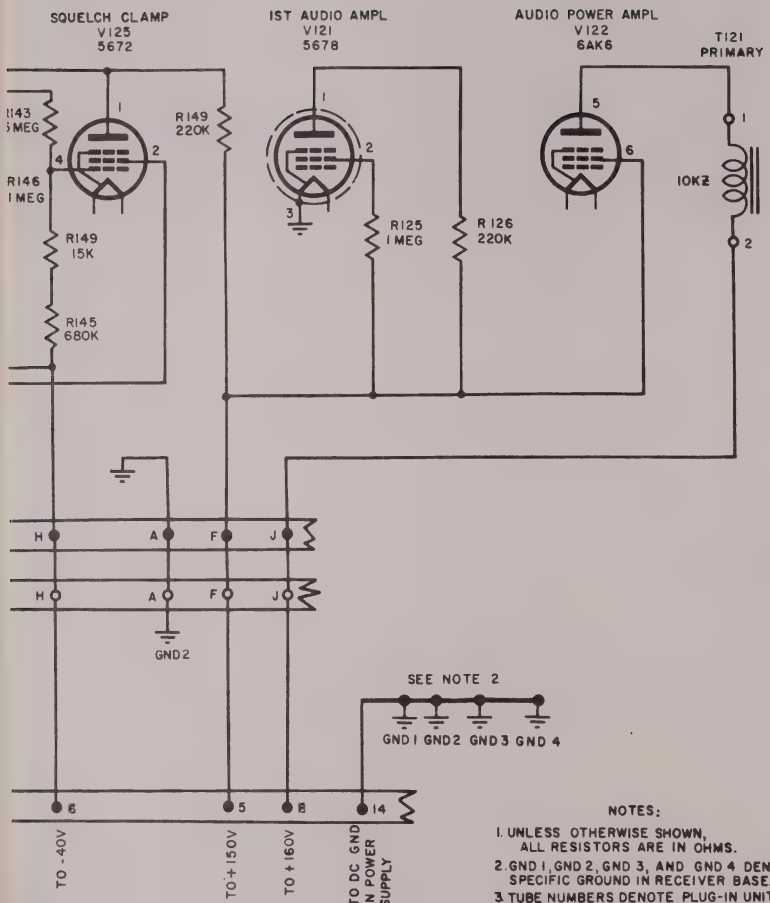


NOTES:

1. UNLESS OTHERWISE SHOWN, ALL RESISTORS ARE IN OHMS.
2. GND 1, GND 2, GND 3, AND GND 4 DENOTE SPECIFIC GROUND IN RECEIVER BASE.
3. TUBE NUMBERS DENOTE PLUG-IN UNITS AS FOLLOWS:
   V1, V2, AND V3, RF AMPL 152-174 MC;
   V31, V32, V33, AND VR 31, LOCAL OSC 152-174 MC.
   V51, V52, AND V53, 1ST IF 7.8 MC.
   V81 THROUGH V87, 2ND IF DISCR.
   V121 THROUGH V125, AUDIO & SQUELCH
4. IN ALL AUDIO & SQUELCH SUBASSEMBLIES ON ORDER NO. 11661 – PHILA – 52 BEARING SERIAL NUMBERS BELOW 1214:
   THE VALUE OF R131 IS 1MEG;
   THE VALUE OF R136 IS 220K;
   THE VALUE OF R132 IS 47K;
   THE VALUE OF R137 IS 470K;
   THE VALUE OF R142 IS 470K;
   THE VALUE OF R149 IS 470K; AND
   THE VALUE OF R147 IS 220K.
   THE CONNECTION BETWEEN PIN 2 OF V124 AND PIN 2 OF V125 IS OMITTED. R150 (680K) CONNECTS BETWEEN PIN 2 OF V125 AND TERMINAL F OF P121.

TM 5071 – 547


GND FROM
POWER SUPPLY
14 VDC FROM
POWER SUPPLY
6VDC OR 6VAC
FROM POWER SUPPLY
14
13
2
P251
GND



NOTES:

1. UNLESS OTHERWISE SHOWN, ALL RESISTORS ARE IN OHMS.
2. GND 1, GND 2, GND 3, AND GND 4 DENOTE SPECIFIC GROUND IN RECEIVER BASE.
3. TUBE NUMBERS DENOTE PLUG-IN UNITS AS FOLLOWS:
   V1, V2, AND V3, RF AMPL 152-174MC.
   V31, V32, V33, AND VR 31, LOCAL OSC 152-174MC.
   V51, V52, AND V53, IST IF 7.8MC.
   V81 THROUGH V87, 2ND IF DISCR.
   V121 THROUGH V125, AUDIO & SQUELCH.
4. IN ALL AUDIO & SQUELCH SUBASSEMBLIES ON ORDER NO. 11661 – PHILA – 52 BEARING SERIAL NUMBERS BELOW 1214:
   THE VALUE OF R131 IS 1MEG;
   THE VALUE OF R136 IS 220K;
   THE VALUE OF R132 IS 47K;
   THE VALUE OF R137 IS 470K;
   THE VALUE OF R142 IS 470K;
   THE VALUE OF R149 IS 470K; AND
   THE VALUE OF R147 IS 220K.
   THE CONNECTION BETWEEN PIN 2 OF V124 AND PIN 2 OF V125 IS OMITTED. R150 (680K) CONNECTS BETWEEN PIN 2 OF V125 AND TERMINAL F OF P121.

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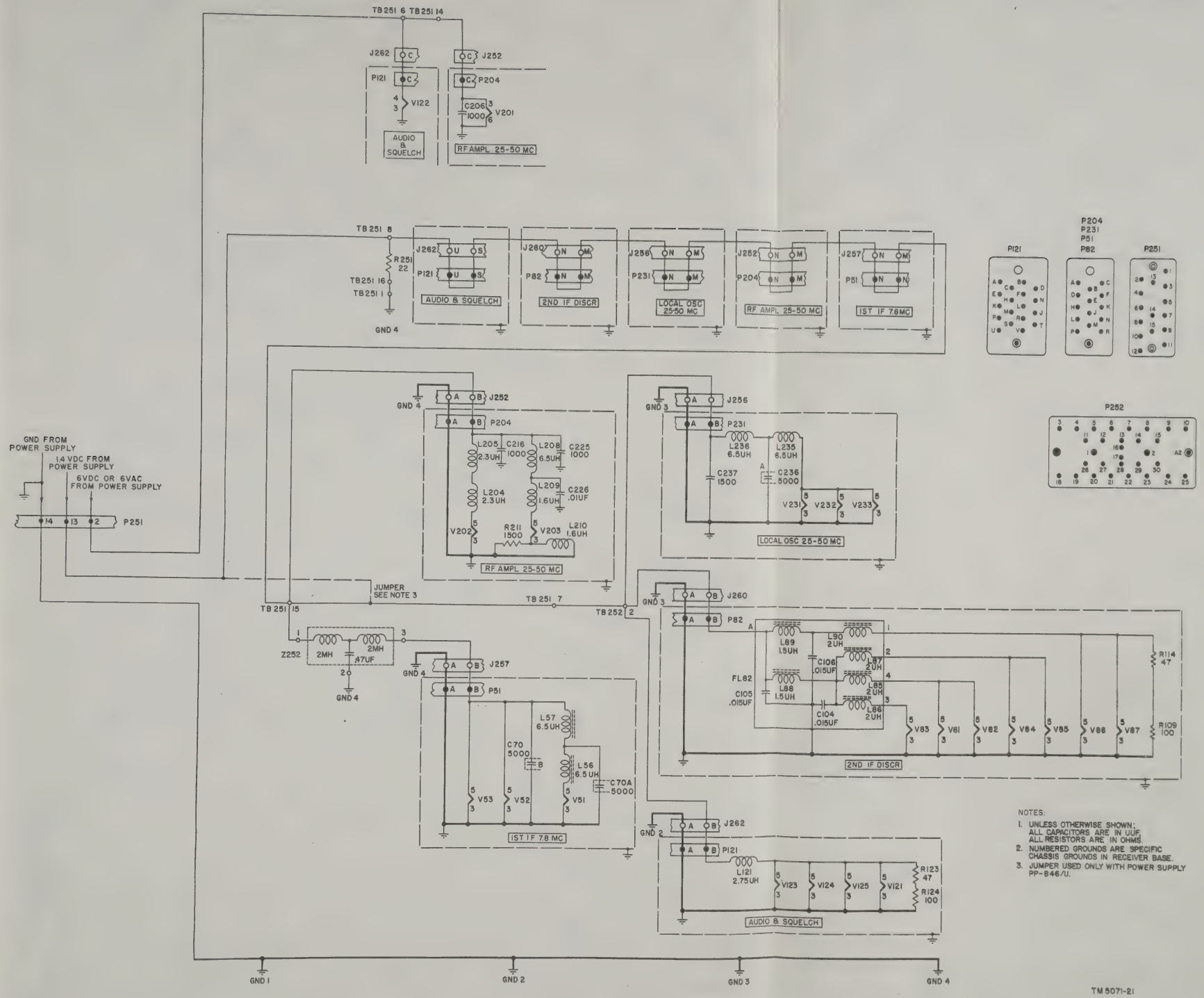


Figure 45. Radio Receiver R-257/U, filament distribution diagram.

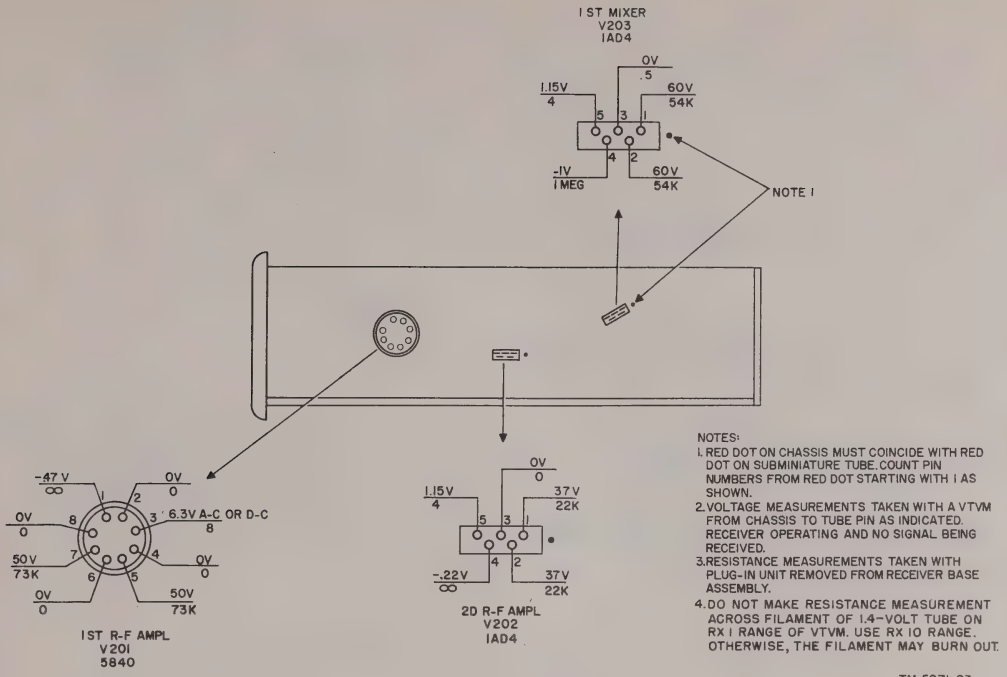


Figure 47. Radio Receiver R-257/U, RF AMPL 25-50 MC plug-in unit, tube socket voltage and resistance measurements.

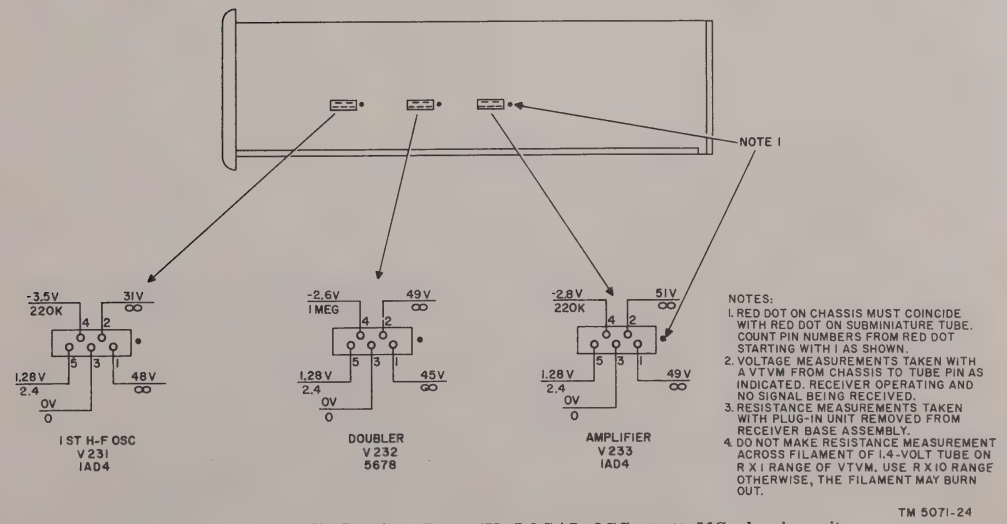


Figure 48. Radio Receiver R-257/U, LOCAL OSC 25-50 MC plug-in unit, tube socket voltage and resistance measurements.

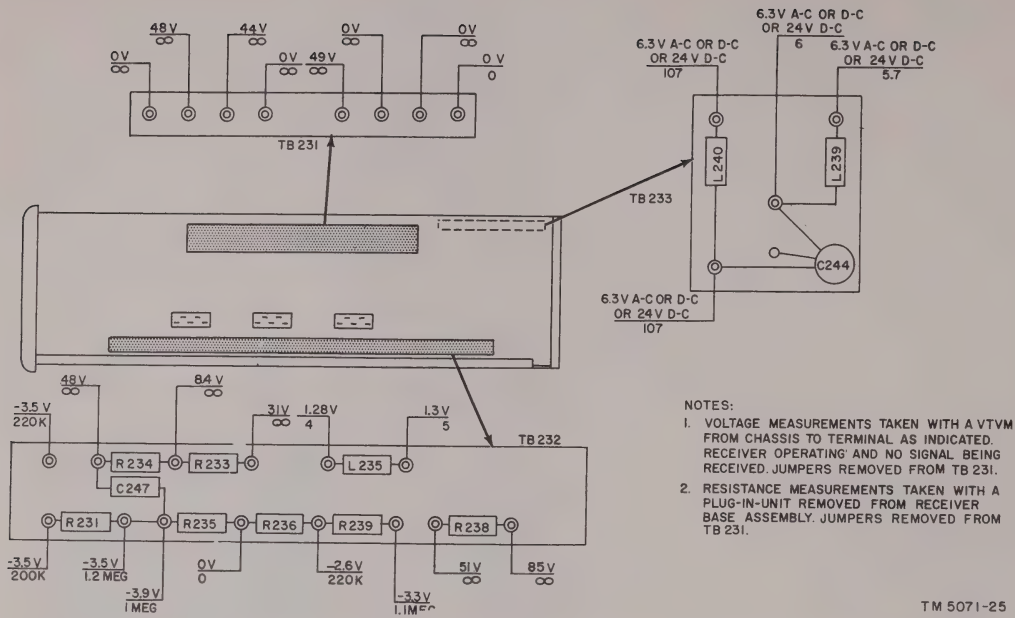


Figure 49. Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, terminal board voltage and resistance measurements.

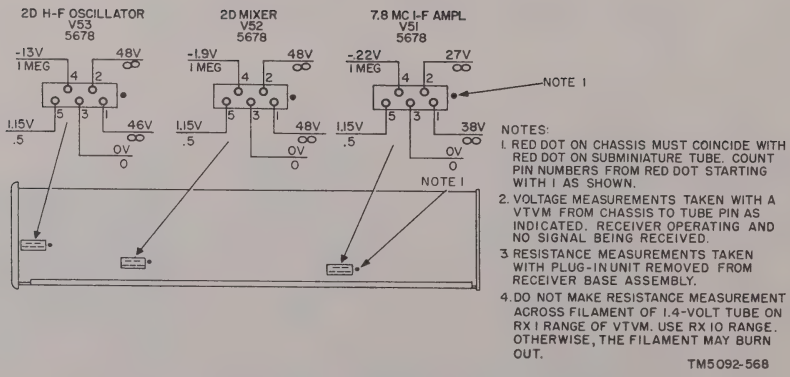


Figure 50. Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, tube socket voltage and resistance measurements.

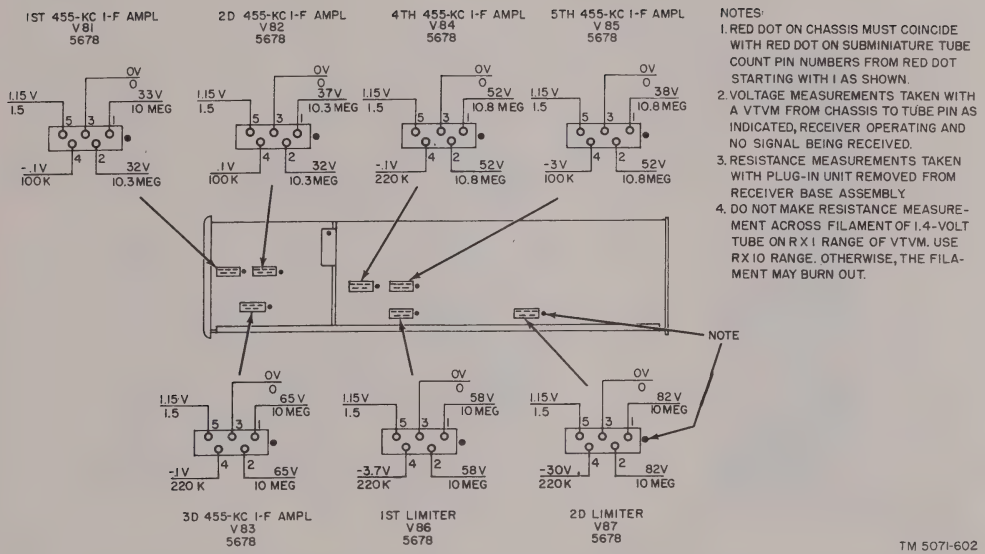


Figure 51. Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, tube socket voltage and resistance measurements.

NOTES:

1. VOLTAGE MEASUREMENTS TAKEN WITH A VTVM FROM CHASSIS TO TERMINALS AS INDICATED. RECEIVER OPERATING AND NO SIGNAL BEING RECEIVED.
2. RESISTANCE MEASUREMENTS TAKEN WITH PLUG-IN UNIT REMOVED FROM RECEIVER BASE ASSEMBLY.
3. NEGATIVE SIDE OF THE OHMMETER GROUNDED.

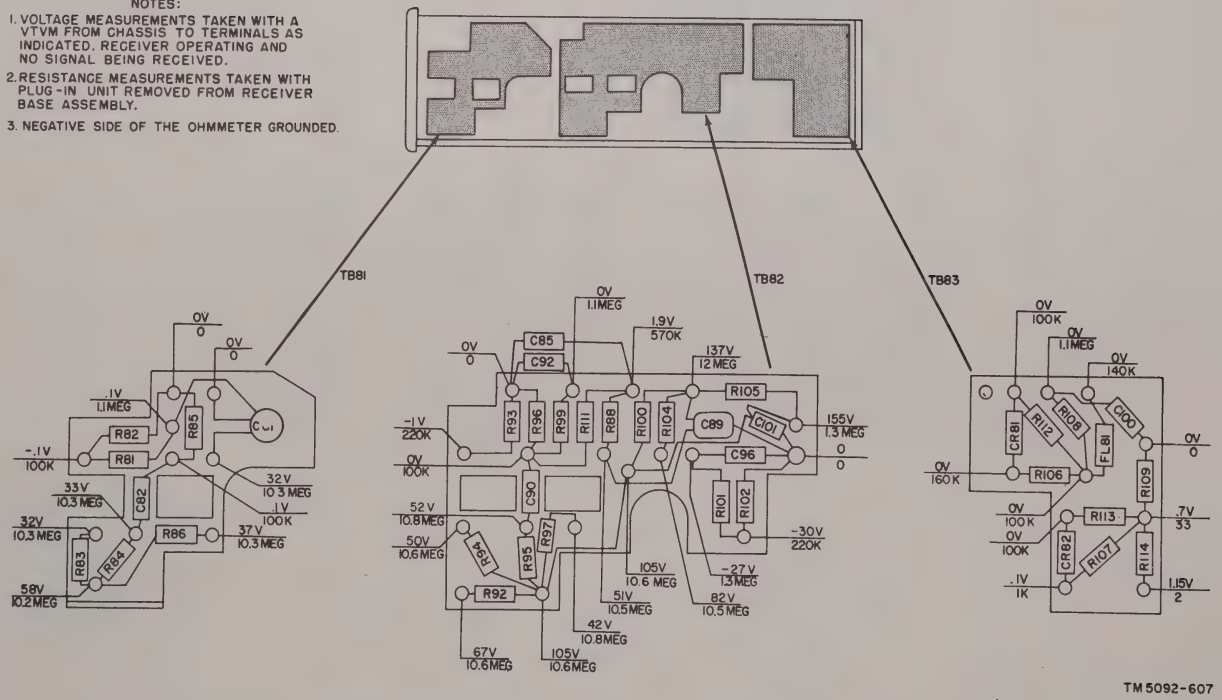
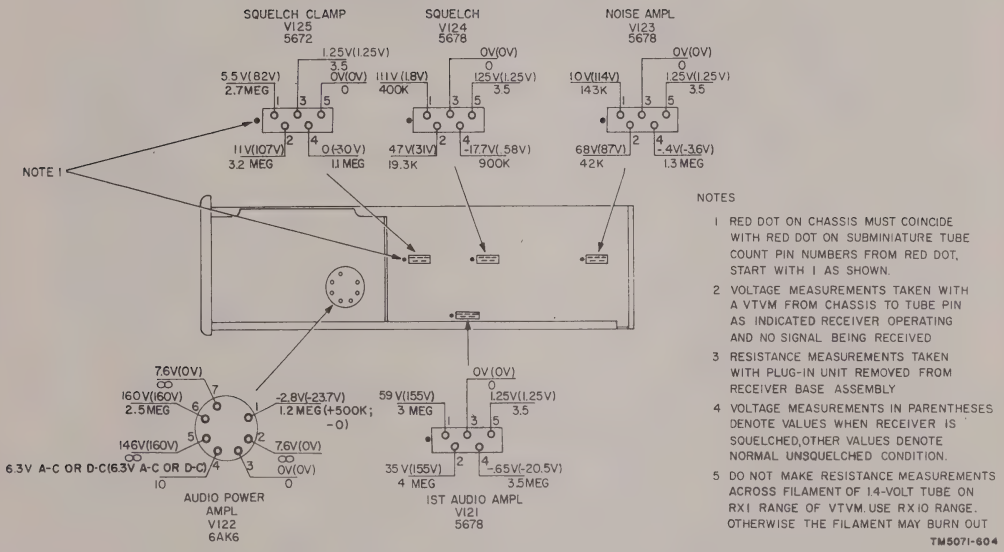


Figure 52. Radio Receiver R-257/U, 2ND IF DISCR plug-in unit, terminal board voltage and resistance measurements.



NOTES

1. RED DOT ON CHASSIS MUST COINCIDE WITH RED DOT ON SUBMINIATURE TUBE COUNT PIN NUMBERS FROM RED DOT, START WITH 1 AS SHOWN.
2. VOLTAGE MEASUREMENTS TAKEN WITH A VTVM FROM CHASSIS TO TUBE PIN AS INDICATED RECEIVER OPERATING AND NO SIGNAL BEING RECEIVED
3. RESISTANCE MEASUREMENTS TAKEN WITH PLUG-IN UNIT REMOVED FROM RECEIVER BASE ASSEMBLY
4. VOLTAGE MEASUREMENTS IN PARENTHESES DENOTE VALUES WHEN RECEIVER IS SQUELCHED, OTHER VALUES DENOTE NORMAL UNSQUELCHED CONDITION.
5. DO NOT MAKE RESISTANCE MEASUREMENTS ACROSS FILAMENT OF 1.4-VOLT TUBE ON RX1 RANGE OF VTVM. USE RX10 RANGE. OTHERWISE THE FILAMENT MAY BURN OUT

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Figure 53. Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers below 1214 on Order No. 11661–Phila–52), tube socket voltage and resistance measurements.

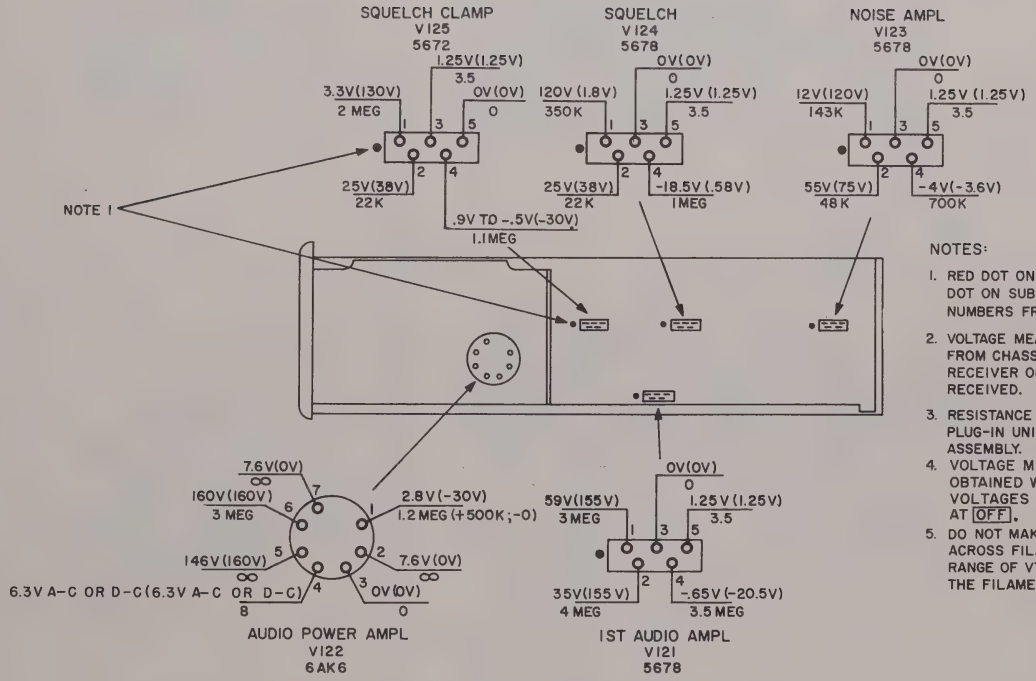
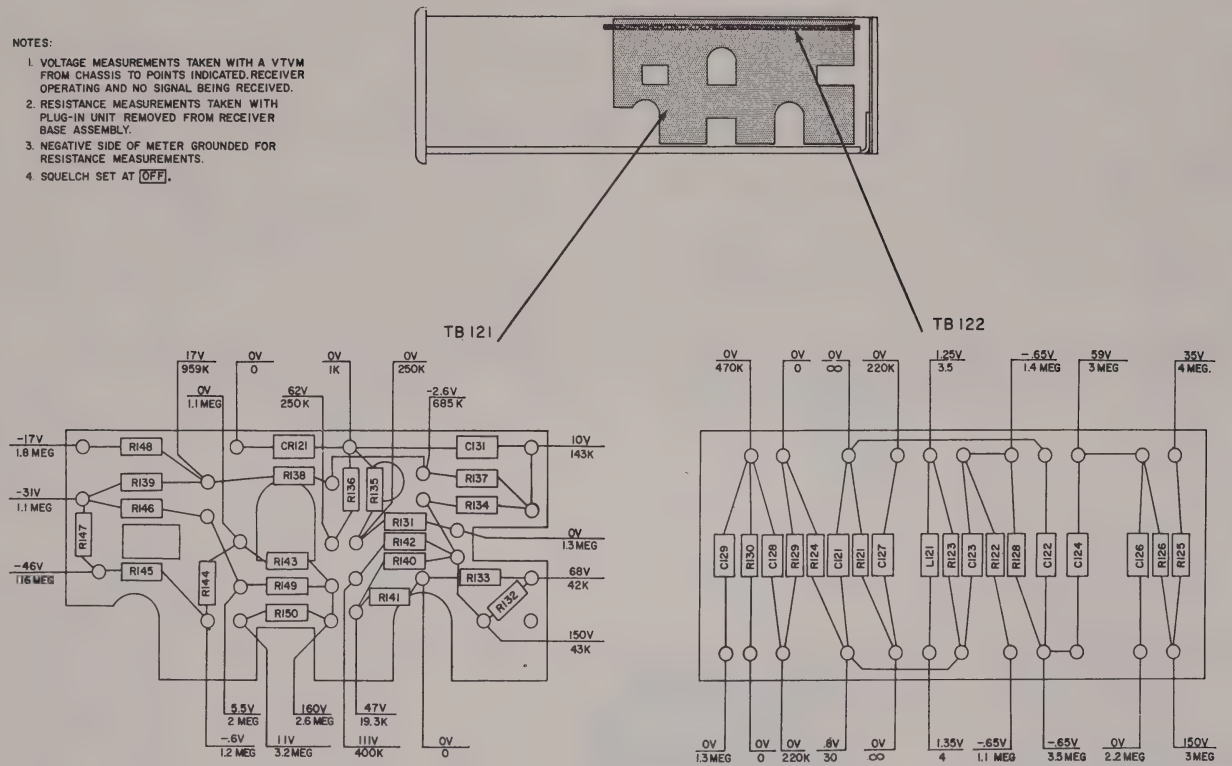


Figure 54. Radio Receiver R-257/U, AUDIO & SQUELCH plug-in unit (serial numbers 1214 and above on Order No. 11661-Phila-52), tube socket voltage and resistance measurements.

NOTES:

1. VOLTAGE MEASUREMENTS TAKEN WITH A VTVM FROM CHASSIS TO POINTS INDICATED. RECEIVER OPERATING AND NO SIGNAL BEING RECEIVED.
2. RESISTANCE MEASUREMENTS TAKEN WITH PLUG-IN UNIT REMOVED FROM RECEIVER BASE ASSEMBLY.
3. NEGATIVE SIDE OF METER GROUNDED FOR RESISTANCE MEASUREMENTS.
4. SQUELCH SET AT OFF.



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Figure 55. Radio Receiver R-257/U, AUDIO & SQUELCH plug-in unit (serial numbers below 1214 on Order No. 11661-Phila-52), terminal board voltage and resistance measurements.

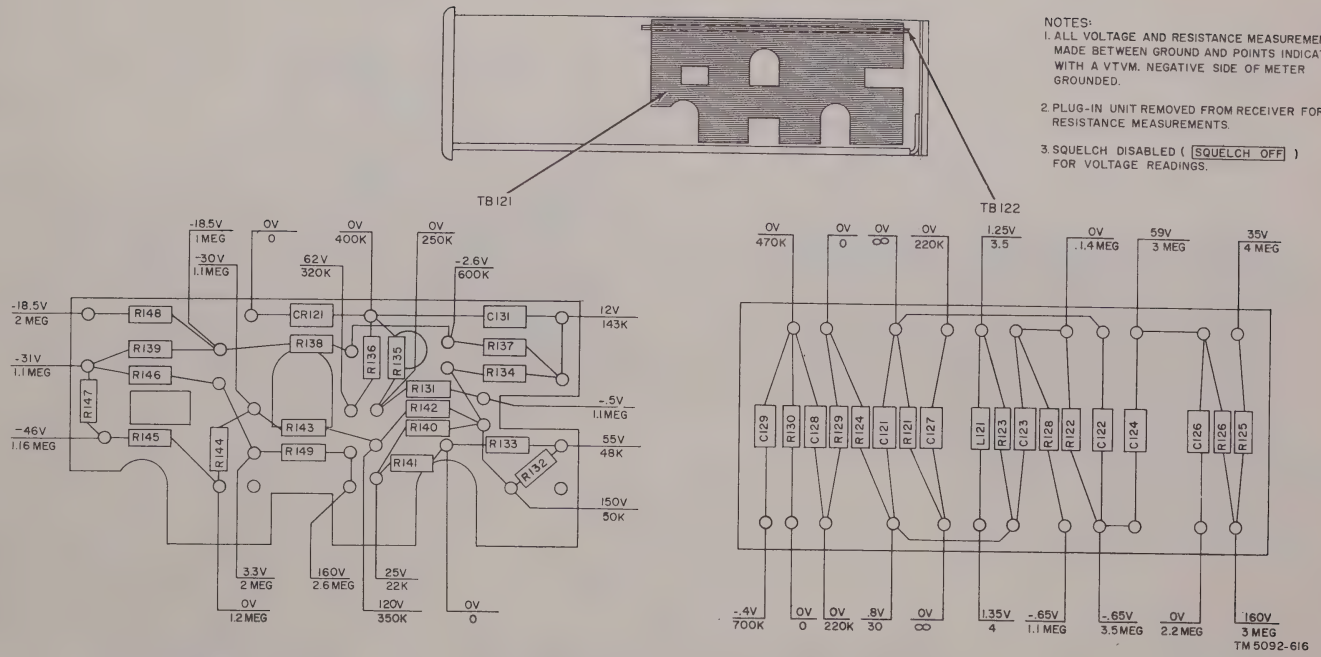


Figure 56. Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit (serial numbers 1214 and above on Order No. 11661–Phila–52), terminal board voltage and resistance measurements.

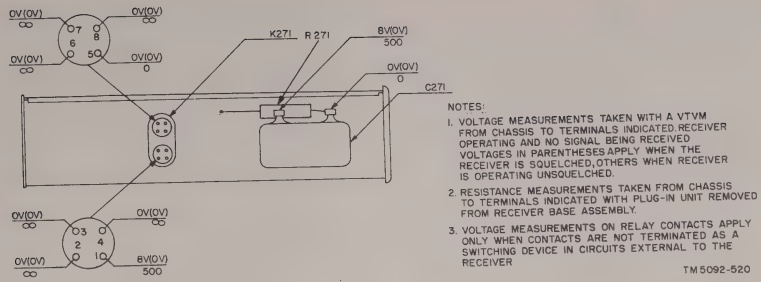


Figure 57. Radio Receiver R–257/U, RELAY plug-in unit, voltage and resistance measurements.

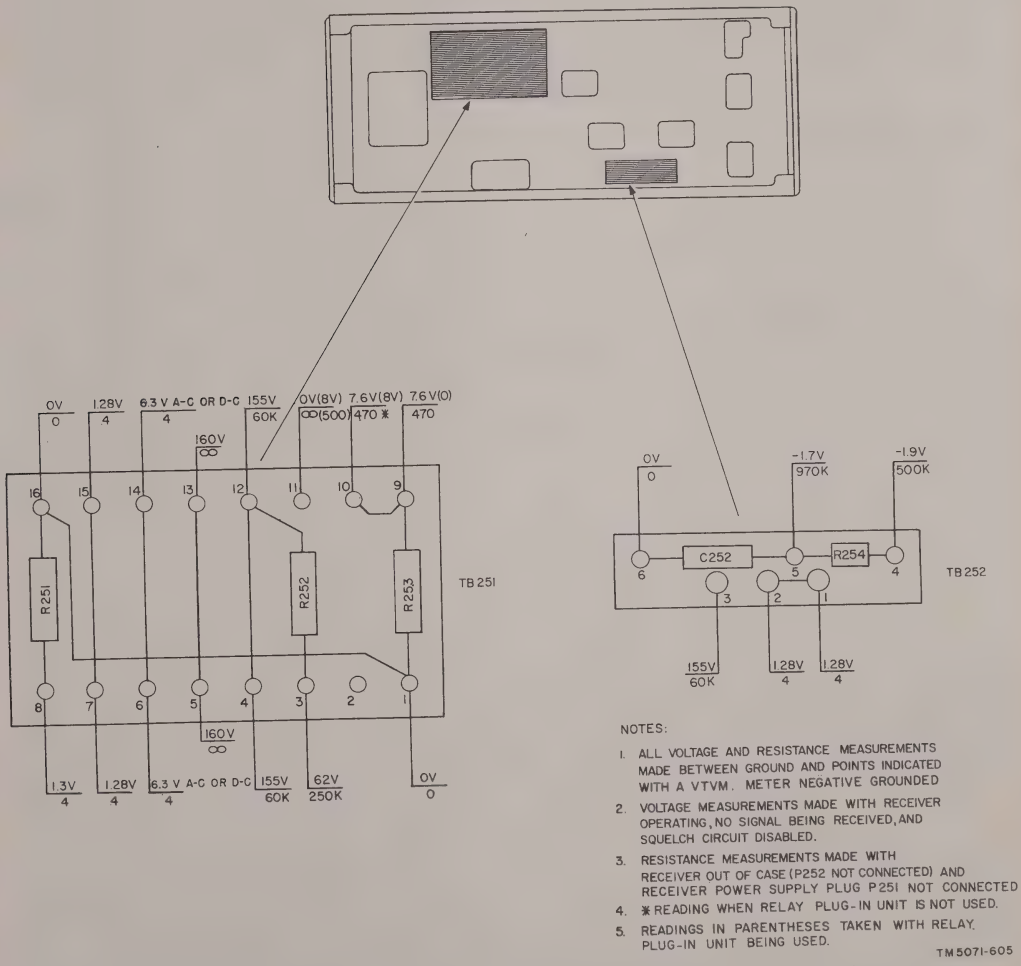


Figure 58. Radio Receiver R–257/U, voltage and resistance measurements of base.

74. Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the receiver. It lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. The signal substitution test outlined in paragraph 76 then can be used to supplement this procedure and to determine the defective stage. After the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit should be sufficient to isolate the defective parts. Normal voltage and resistance measurements are given in figures 46 through 58.

Symptom	Probable trouble	Correction
1. VOLUME control on control unit turned clockwise so power to receiver is turned on. POWER pilot lamp in control unit fails to light.	Receiver main connector P252 not making good contact.	Remove receiver from case and inspect P252 and its mating connector. Replace receiver carefully and test for power at test points B+ and FIL.
2. No audio output even when SQUELCH control is turned fully clockwise so as to set the squelch disable switch in the OFF position.	Defective tubes (V121 or V122)	Test and replace, if necessary.
	T121 open or C133 shorted	Check with ohmmeter; replace if necessary.
	C126 or R121 open	Test by bridging a new part across the original part. Replace if necessary.
	C125, C124, or C121 shorted	Check with ohmmeter; replace if necessary.
3. Receiver output and noise very low or completely dead.	V81 through V87 defective	Check tubes; replace defective one.
	Resistor or capacitor failure	Check voltages and resistances. Also check resistances of coils for failure.
	V51 or V52 defective	Check tubes V51 and V52, replace defective tube.
	Voltages and resistances not normal due to part failure. Check with vtvm.	Isolate and replace defective part.
4. Rushing noise being received, but no signal from a transmitter (known to be operating on the receiver frequency).	Trouble could be in the RF AMPL 25–50 MC plug-in unit, LOCAL OSC 25–50 MC plug-in unit, or the 1ST IF 7.8 MC plug-in unit.	Check these units by substitution of units known to be in proper operating condition and alined to the correct frequencies. Repair or aline the defective unit, as required.
	The first h-f oscillator V231, or the second h-f oscillator V53 not oscillating.	Check the control grids of these tubes with a vtvm. The voltage should be negative with respect to ground. If the reading is not negative, check the tubes, voltages, and crystals.
5. No receiver signal output, but receiver noise exists.	Failure of the LOCAL OSC 25–50 MC plug-in unit.	Follow instructions below.
	Defective V231, V32, V233	Replace.
	Crystal Y231 defective	Replace.
	Resistor, capacitor or coil failure	Check circuit with a vtvm; replace defective part.
	Second h-f oscillator V53 not oscillating. Check pin 4 (grid) of V53 for a negative voltage.	Check V53, crystal Y51; also check voltages on plate and screen. Isolate and replace defective part.
	Tube V203 defective.	Replace.
6. Receiver output and noise lower than normal.	Leaky coupling capacitors C82, C84, C88, C90, C91, and C95.	Check with vtvm; replace defective capacitor.
7. Receiver noise is audible but sensitivity poor.	Tubes V201 or V202 defective	Check and replace defective tube.
	Resistor, capacitor, or coil defective	Check parts with a vtvm; replace.

Symptom	Probable trouble	Correction
8. Audio output from receiver weak, distorted, or both.	Defect in audio amplifier stages of AUDIO & SQUELCH plug-in unit, or in discriminator circuit of the 2ND IF & DISCR plug-in unit.	Replace both of these units, one at a time. If one of them is faulty, test the tubes, voltages, and resistances.
	C126, C124, C122, C121, or C123 leaky.	Unsolder one lead from each; test with ohmmeter; replace if necessary.
	CR81 or CR82 open	Check front and back resistance with an ohmmeter; replace if necessary.
	T81 out of alignment	Aline.
9. Receiver will not unsquelch unless SQUELCH control is in OFF position.	V123 defective	Replace.
	Defective component in squelch circuit.	Check voltages and resistances.
10. Receiver will not squelch	V124 defective	Replace.
	Defective component in squelch circuit.	Check voltages and resistances.
11. Audio output distorted when squelch disable switch is open.	V125 defective	Replace.
12. Receiver blocks on strong signals, operates normally on weak ones.	Capacitor C205, C252, C85, or C215 shorted or leaky.	Replace.
13. Frequency of LOCAL OSC 25–50 MC plug-in unit drifts.	Crystal oven E231 not functioning properly. Check heater winding and thermostat.	Replace defective part.
	Crystal Y231 defective.	Replace crystal and check for drift.

75. Additional Troubleshooting Information

a. D-C Resistance of Coils and Chokes in RF AMPL 25–50 MC Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
L201 (Z201)	1–3	Less than 0.1.
L202 (Z202)	1–2	Less than 0.1.
L203 (Z203)	1–2	Less than 0.1.
L204	Wire leads	Less than 0.5.
L205	Wire leads	Less than 0.5.
L206 (Z204)	1–2	Less than 0.1.
L207 (Z205)	2–3	Less than 0.1.
L208	Wire leads	Less than 0.5.
L209	Wire leads	Less than 0.4.
L210	Wire leads	Less than 0.5.
L212 (Z206)	1–2	Less than 0.3.

b. D-C Resistance of Coils and Chokes in LOCAL OSC 25–50 MC Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
HR231 heater	1–7	110.
HR231 heater	3–7	6.
L232 (Z232)	2–3	Less than 0.1.
L233	Wire leads	2.
L234	Wire leads	2.
L235	Wire leads	Less than 0.1.
L236	Wire leads	Less than 0.1.
L237 (Z233)	2–3	Less than 0.1.
L238 (Z234)	2–3	Less than 0.1.
L239	Wire leads	Less than 0.6.
L240	Wire leads	Less than 0.6.

c. D-C Resistance of Coils and Chokes in the 1ST IF 7.8 MC Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
L51 (Z51)	2–3	Less than 0.3.
L52 (Z52)	2–3	Less than 0.3.
L53 (Z53)	2–3	Less than 0.3.
L54 (Z54)	2–3	Less than 0.3.
L55 (Z55)	1–3	45.
L56	Wire leads	Less than 0.1.
L57	Wire leads	Less than 0.1.
L58	Wire leads	4.

d. D-C Resistance of Chokes, Coils, and Transformers in 2ND IF DISCR Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
L85 to L90 inclusive (coils in filament filter FL82, a potted unit).	A–1	1
	A–2	
	A–2	1
	A–3	1
	A–4	1
L81 (Z81)	1–3	30
L82 (Z82)	2–3	28
T81	1–2	25
T81	3–4	43

e. D-C Resistance of Transformers and Chokes in the AUDIO & SQUELCH Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
T121	1–2	500
T121	3–4	.5
L121	Wire leads	.5

f. D-C Resistance of the Relay Coil in the RELAY Plug-In Unit.

Choke or coil	Terminals	Resistance (ohms)
K271	1–5	500

76. Directions for Signal Substitution

a. Signal substitution (pars. 77 through 82) requires a source of audio, i-f and/or r-f signals. Use a signal generator that will produce the signal required in any specific test (par. 66).

b. A vtvm and a tube tester also are needed to isolate the defective parts after the faulty stage has been indicated by signal substitution.

c. In the tests indicated in paragraphs 77 through 82, ground one side of the signal generator output to the receiver chassis, and connect the other side through a capacitor, as instructed in the specific test, to the points in the receiver under test.

d. Note the volume obtained, and listen for serious distortion or abnormal noise. When working back through the receiver from the audio output stage towards the input stages, reduce the signal generator output as required to eliminate the possibility of forcing a signal through a defective circuit. If a similar receiver, in good operating condition, is available, compare the results obtained from the receiver being tested with the receiver known to be operating properly.

e. If a certain point in the receiver that requires signal injection is difficult to touch with the test probe or clip, select another point directly connected to the first point. Such a test may be at the junction of two resistors, two capacitors, or on a terminal board. The serviceman must use his own judgment when such a circumstance arises.

f. Be very careful when probing in the receiver. Connections and parts are small and in very close proximity with other parts. Check the wiring and solder connections while testing by signal substitution. A poor solder connection or similar fault may be the trouble being investigated.

77. A-F Tests

Note. Before attempting any of the tests, be sure the squelch disable switch in the control unit is in the OFF position. Set the VOLUME control in the control unit to the extreme clockwise position.

a. Terminal 5 of V122 (Plate of Audio Power Amplifier). Apply an audio signal through a series capacitor (approximately .05 μf) to terminal 5 of V122. If the output of the audio generator is sufficient, an audio tone should be heard in the loudspeaker. If no audio signal is heard, inspect the audio output connections from the loudspeaker back to the audio output transformer, T121. Check this transformer for an open winding or capacitor C133 for a short.

b. Terminal 1 of V122 (Grid of Audio Power Amplifier). Place the audio signal from the signal generator on terminal 1 of V122. Reduce the audio output from the a-f generator if the volume becomes excessive. There should be a noticeable increase in volume as compared with the previous test. If no volume increase is obtained, or no audio signal is heard, check tube V122. If the tube tests are satisfactory, check the plate and screen voltages of V122. If these tests reveal no fault, measure the resistance from pin 7 of V122 to ground. This checks the 470-ohm resistor, R253, on TB251 in the receiver base or the 500-ohm winding of relay K271 if the relay is used instead of R253.

c. Terminal 1 of V121 (Plate of 1st Audio Amplifier). Apply the audio signal to pin 1 of V121. If no audio signal is heard, check capacitor C126. If the audio signal is greatly reduced as compared with that of the previous test, advance potentiometer R127 clockwise noting any increase in volume. (Mark setting of R127 before performing this step.) If the volume increase is erratic, check potentiometer R127.

d. Terminal 4 of V121 (Grid of 1st Audio Amplifier). Apply the audio signal to pin 4 of V121. The audio signal should be greatly increased as compared with that of the previous test. If the audio tone from the loudspeaker is excessive, reduce the output from the a-f generator. If no volume increase is

apparent, or no audio output is obtained, check tube V121. If the tube tests satisfactorily, check the plate and screen voltages of V121; also check cathode resistors R123 and R124.

e. Junction of C127 and R121 (Audio Input to AUDIO & SQUELCH Plug-In Unit). Inject the audio signal from the signal generator at the junction of C127 and R121 and listen for the audio tone in the loudspeaker. If there is no output, check C121, C122, and R121. If this check reveals no fault, check R122 and C123. As a final check, break the connection to terminal R on P121. If audio noise can be obtained by injecting the signal generator at the junction of C127 and R121, the trouble probably is in the connection between the AUDIO & SQUELCH plug-in unit and the 2ND IF DISCR plug-in unit.

f. Junction of Terminal R on P82 and I-F Filter FL81 (Audio Output in 2ND IF DISCR Plug-In Unit). Apply the audio signal from the signal generator to the junction of terminal R on P82 and i-f filter FL81. If an audio signal is heard in the loudspeaker, apply the audio signal to the second terminal on FL81 (not the grounded one). If at this point no audio is obtained, check i-f filter FL81.

Note. Filter FL81 is used only in 2ND IF DISCR plug-in units on Order No. 11661–Phila–52 bearing serial numbers 1 through 5550. In units with serial numbers 5551 and higher, FL81 is replaced by C111, R115, and C112.

78. Squelch Test

a. Test Set-Up.

(1) Set the SQUELCH control to the extreme counterclockwise position.

(2) Connect the audio oscillator between ground and the junction of C127 and R121. Adjust the audio oscillator to deliver 12,000 cps. Connect an a-c vtvm across the audio oscillator. Connect a d-c vtvm between ground and terminal 1 of V122.

b. Squelch Circuit Test. Set the audio oscillator attenuator control for zero output. The reading on the d-c vtvm should be about .25 volt negative. Slowly advance the output attenuator control on the audio oscillator until the needle suddenly jumps up to approximately a negative 25 volts. At this point, take a reading on the a-c vtvm. The reading should be between 2.5 and 4.0 volts rms (root mean square). Note the reading just obtained and slowly decrease the output from the audio oscillator. When the d-c vtvm reading suddenly drops to approximately .25 volt negative, again read the a-c vtvm. This voltage should be ½ volt rms less than the 12,000 cps voltage required to squelch the audio tubes.

c. Troubleshooting Squelch Circuit. Refer to paragraph 59 for squelch circuit theory. When the audio tubes are unsquelched, noise amplifier tube V123 and squelch clamp tube V125 are conducting heavily as evidenced by the large voltage drops across their respective plate resistors. When the audio tubes are squelched, squelch tube V124 conducts heavily as evidenced by the low plate voltage. Reference to the voltage and resistance data in figures 53 and 54 will be of assistance in troubleshooting the squelch circuit. Possible sources of trouble other than tubes or the germanium diode CR121 are the numerous series-connected resistors in this circuit. An open resistor or one that has changed in value appreciably will be a definite source of trouble.

d. Alternate Squelch Test. Another method of checking the operation of the squelch circuits consists of measuring the plate voltage of noise amplifier V123, squelch tube V124, and squelch clamp V125 as the 12,000 cps test signal is turned on and off. The voltages should agree approximately with the voltages given in figures 53 or 54, and 55 or 56.

79. I-F Tests

a. 2ND IF DISCR Plug-In Unit. Set the SQUELCH control in the OFF position and the VOLUME control in the maximum clockwise position.

(1) *Plate of second limiter V87.* Connect a d-c vtvm across terminal R of P82 and ground. Apply an unmodulated 455-kc signal across terminal 1 of T81 (fig. 65) and ground. Vary the signal frequency up to 490 kc and down to 420 kc. The meter reading should be approximately —20 to —30 volts at 490 kc, approximately +1 volt at 455 kc, and approximately +20 to +30 volts at 420 kc. If the above results are not obtained, make an ohmmeter check on T81, CR81, CR82, FL81, and their associated components.

Note. FL81 is replaced by C111, R115, and C112 on all 2ND IF DISCR plug-in units on Order No. 11661–Phila–52 bearing serial numbers 5551 and higher.

(2) *Control grid of second limiter V87.* Connect the signal generator across terminal 4 of V87 and ground and vary the frequency as in (1) above. Reduce the output of the signal generator, if necessary. If the same results as in (1) above are not obtained, check the plate and screen voltages of V87 and check V87.

(3) *Plate of first limiter V86.* Repeat the above procedure with the signal generator connected across pin 1 of V86 and ground. If satisfactory results are not obtained, check C95 by bridging it with a similar capacitor.

(4) *Control grid of first limiter V86.* Repeat the above procedure with the signal applied across pin 4 of V86 and ground. If results are not satisfactory, check the plate and screen voltages of V86. Also check for a defective V86, Z82, C93, or R98.

(5) *Plate of fifth 455-kc i-f amplifier V85.* Apply the signal across pin 1 of V85 and ground. If results are not satisfactory, check C91 by bridging it with a similar capacitor.

(6) *Control grid of fifth 455-kc i-f amplifier V85.* Apply the signal across pin 4 of V85 and ground. If results are satisfactory, check plate and screen voltages of V85. Also check V85, R100, R97, R96, R88, and R111.

(7) *Fourth, third, second, and first 455-kc i-f amplifiers V84 through V81.* Apply the signal in turn to the plates and grids of V84 through V81. Check for defective components as in the preceding steps. Note the following:

(*a*) The absence of plate or screen grid voltages can be caused by open resistors or shorted bypass capacitors.

(*b*) Positive control grids indicate leaky or shorted coupling capacitors, or a gassy tube.

(*c*) If plate or screen grid voltages are absent or low, refer to the Radio Receiver R–257/U schematic diagram (fig. 79) and the B+ distribution diagram (fig. 44).

(*d*) Sometimes tubes develop short circuits and upset the plate and screen grid voltage readings. Be sure this is not the case before troubleshooting for defective capacitors or resistors.

b. 1ST IF 7.8 MC Plug-In Unit.

(1) *Plate of second mixer V52.* Apply the same test signals as in *a* above to pin 1 of V52. If satisfactory results are not obtained, check Z55, Z251, and the coaxial connections between the 1ST IF 7.8 MC and the 2ND IF DISCR plug-in units.

(2) *Control grid of second mixer V52.* Apply a 7.8-mc unmodulated signal to pin 4 of V52 through a small mica capacitor. Vary this signal approximately 30 kc above 7.8 mc and 30 kc below 7.8 mc. The d-c output at terminal R of P82 should be the same as in (1) above. If satisfactory results are not obtained, check the plate and screen voltages of V52. Check V52. Check second h-f oscillator V53. Also check the plate, screen, and control grid voltages of V53. The absence of a negative voltage on the control grid of V53 indicates that this stage is not oscillating. If this is so, check, and if necessary, replace crystal Y51 (Crystal Unit CR–18/U).

(3) *Plate of 7.8-mc i-f amplifier V51.* Apply the 7.8-mc signal at pin 1 of V51. If the test fails, check the three coupling capacitors C58, C60, and C62 by injecting the 7.8-mc signal on their tie points while working towards second mixer V52.

(4) *Control grid of 7.8-mc i-f amplifier V51.* Apply the test signal to pin 4 of V51. If the test fails, check V51. Check the plate and screen grid voltages if the tube is satisfactory.

80. R-F Tests

a. Control Grid of First Mixer V203. Tune the signal generator to the receiver frequency and inject a strong signal frequency modulated ±15 kc with 1,000 cps at terminal 4 of V203

through a small mica capacitor (100 $\mu\mu$f). If no audio is heard in the speaker, increase the output of the signal generator and vary the signal generator frequency above and below its initial setting. If no audio is obtained, or the signal is weak, check V203. If the tube is satisfactory, check its plate and screen voltages. Also measure the d-c voltage at the test point on the front panel marked LO. If the local oscillator is operating, this voltage should be about —1 volt.

b. Plate of Second R-F Amplifier V202. If the signal injection test in the preceding subparagraph indicates that the trouble is ahead of 1st mixer V203, tune the signal generator to the receiver frequency and inject a signal on terminal 1 of V202. If this test suggests a failure, check coupling capacitor C221 and coil assemblies Z204 and Z205.

c. Control Grid of Second R-F Amplifier V202. Apply the r-f signal to terminal 4 of V202. An increase in receiver output should be noticeable. If this is not the case, test V202. Return the tube to its socket if it is satisfactory and check tube voltages and resistances.

d. Plate of First R-F Amplifier V201. Inject the r-f signal into terminal 5 of V201. The response should be comparable with that of the preceding test. If not, check coupling capacitors C211 and C214 and coil assemblies Z202 and Z203.

e. Control Grid of First R-F Amplifier V201. Apply the r-f signal to terminal 1 of V201. An increase in receiver output should be noticeable. If a failure is apparent in this stage, check the tube voltages and resistances. Proceed to the antenna input connector P201 and apply the signal at this point. If the output is reduced, trouble may be located in coil assembly Z201 or in connector P201.

81. Agc Test

a. Radio Receiver R–257/U uses an agc circuit that applies a negative bias to the control grids of r-f amplifiers V201 and V202. This bias is proportional to the signal strength of the received signal. The fifth 455-kc i-f amplifier develops this bias at its control grid. A portion of this bias is fed back to the r-f amplifiers through an RC (resistance and capacitance) network which is designed to filter out a-c pick-up such as that resulting from ignition noise or similar types of interference.

b. Connect the signal generator to antenna input connection P201 and a d-c vtvm to the test points marked 2ND IF and GND on the front of the receiver. With the signal generator tuned to the receiver frequency and set at zero output, note the reading on the vtvm. Increase the output from the signal generator to maximum. The agc bias should increase also. Check this bias with a vtvm at the low end of the grid return resistors (R202 and R204) of V201 and V202 respectively. If this bias is not apparent at the tubes, one of the components in the agc RC network, capacitors C205, C215, C252, or C85, or resistors R254, R96, R111, or R88 may be defective. If R88 is open, the agc voltage will be too high and reduce the receiver sensitivity. Absence of agc voltage causes serious receiver overloading. A gassy condition of tubes V201 and V202 also will impair operation of the agc circuit.

82. Stage Gain Charts

a. General. Stage gain measurements allow a check on the gain of individual stages in the receiver. In troubleshooting, the measurements serve to locate the defective stage, which may be operative although low in signal output. The test signals injected into particular parts of the circuit are adjusted to develop a predetermined output signal, either in the form of an audio output signal or the bias voltage developed across the grid resistor of the fifth 455-kc i-f amplifier. As the source of test signal is moved from the output circuits toward the antenna input circuit of the receiver, less test signal voltage should be required to develop the required output. The receiver has no controls except the screwdriver-adjusted audio volume control (R127) in the AUDIO & SQUELCH plug-in unit.

b. Test Conditions.

(1) Use a 115- or 230-volt a-c power supply (Power Supply PP–846/U). Adjust the line voltage to 115 or 230 volts.

(2) Allow the receiver and test equipment to warm up for at least 10 minutes.

(3) Turn the audio gain control (R127) in the AUDIO & SQUELCH plug-in unit fully clockwise (maximum gain).

(4) Turn the SQUELCH control in the control unit to the OFF position.

(5) The stage gain of individual stages should fall within the limits specified below. The limits are broad enough to accommodate variations in the quality of replacement tubes. However, the overall sensitivity of the receiver should be better than .5 microvolt, as pointed out in paragraphs 97 and 98.

c. Audio Stage Gain Chart. Connect an 8-ohm load across the secondary (terminals 3 and 4) of the audio-output transformer T121. The VOLUME control circuit and loudspeaker in Electrical Equipment Cabinet CY–1150/U will apply the 8-ohm load if this cabinet is used. Also connect a power output meter across terminals 3 and 4. If the power output meter supplies the 8-ohm audio load, no additional speaker circuit or resistor loading should be used. Connect a high impedance a-c vtvm across the output terminals of the audio oscillator. Feed the 1,000-cps audio test signal to the points indicated. Use resistor R253 (470 ohms) as the cathode bias resistor of tube V122. This resistor is connected in the circuit when the jumper on TB251 is connected between terminals 9 and 10.

Input connection	Input voltage (volts)		Power at T121 secondary (watt)
	min	max	
Pin 1 of V122	6.1	13.6	0.5
Pin 4 of V121	.075	.165	.5
Terminal R of P121	2.0	4.4	.5
Junction of R112 and FL81.	2.4	5.4	.5

d. 455-KC I-F Stage Gain Chart.

(1) Connect a d-c vtvm to the receiver test points marked GND and DISCR. Connect the i-f signal generator to pin 4 of V84 through a 1,000-$\mu\mu$f mica capacitor. The d-c vtvm should read +1 volt when the signal generator is tuned to 455 kc (unmodulated), indicating correct alinement of the discriminator. As the signal generator is varied above and below 455 kc, the needle on the vtvm should swing rapidly positive and negative. Use a test signal that will develop a negative 3 volts at the test point marked 2ND IF. Vary the i-f signal frequency above and below 455 kc. The discriminator output voltage (measured at the DISCR test point) should swing between the limits of 20 and 30 volts plus and minus. A larger test signal should not change these limits because of the limiting action of V86 and V87. Stage gain tests on these two stages indicate limiting action by an increase in grid leak bias developed at the grids of V86 as the input test signal is increased. A test point at the grid of V87 is decoupled at the junction of R101 and C96.

(2) Connect the d-c vtvm to the receiver test points marked GND and 2ND IF. Output voltage is measured at the control grid of V85 through the decoupling filter consisting of R99 and C92. Adjust the output of the unmodulated 455-kc i-f test signal to obtain a —3-volt reading on the vtvm. Test the gain of the 455-kc i-f stages as follows:

Input connection	Input voltage (uv)		Output at 2ND IF (volts)
	min	max	
Pin 4 of V84	27,000	61,500	−3
Pin 4 of V83	7,500	16,900	−3
Pin 4 of V82	830	1,870	−3
Pin 4 of V81	93	210	−3
Pin 4 of V52	24	54	−3

e. 7.8-MC I-F Stage Gain Chart. Use the same vtvm connection used for the 455-kc i-f tests. Feed an unmodulated 7.8-mc i-f test signal to the circuits indicated through a 1,000-$\mu\mu$f mica capacitor.

Input connection	Input voltage (uv)		Output at 2ND IF (volts)
	min	max	
Pin 4 of V51	32	72	−3
Pin 4 of V203	11	25	−3

f. R-F Stage Gain Chart. Couple in an r-f test signal of 25 to 50 mc as listed in the chart below through a 100-$\mu\mu$f mica capacitor. Be careful not to disturb any of the wiring in the RF AMPL 25–50 MC plug-in unit. The

accuracy of the test at pin 4 of V202 depends on the amount of detuning and circuit loading resulting from the test connection at this point. Keep the mica capacitor as close to pin 4 of V202 as possible. When feeding the test signal into the antenna input circuit (terminal 3 of Z201 or the antenna input connector of Electrical Equipment Cabinet CY–1150/U), the output impedance of the signal generator must be 50 ohms.

Input connection	Input voltage (uv)		Output at 2ND IF (volts)
	min	max	
Pin 4 of V202	8	18	–3
Terminal 3 of Z201	33	75	–3

Section II. REPAIRS

83. Special Tools Required for Replacement of Subminiature Parts

a. No special tools are shipped with Radio Receiver R–257/U. The smallest general purpose radio tools available are most suited for the repair of this receiver. Such tools as needle-nosed pliers and small diagonal cutters are more useful than the ordinary radio long-nosed pliers and cutters.

b. The tips on the test probes used for testing and alining this receiver should be kept clean. If possible, a point should be filed on the end of each probe tip in order to contact the parts being tested without exerting a force which could result in a broken part or wire.

84. Replacement of Parts

a. General. Refer to figures 59 through 71 for locations of the parts in the assemblies of Radio Receiver R–257/U.

b. Subminiature Tubes. Be careful when removing the subminiature tubes. Lift them straight up away from the socket. When replacing the subminiature tubes, be sure the red dot on the tube lines up with the red dot on the chassis. New subminiature tubes have long wire leads which must be cut to the proper length. Use the tube being replaced as a guide for the proper length of the wire leads. Terminal numbers on the tubes begin with number 1 at the red dot and progress to number 5. When replacing V203, refer to paragraph 43*d*.

c. Coaxial Connectors of Plug-in Units. Loosen and remove the flathead screws on the bottom plate of the plug-in unit. This releases the bottom plate and the coaxial connector can be removed after first unsoldering and removing the cable or wire attached to it.

d. R-F Bypass Capacitors with Solder Lugs. There are eight r-f bypass capacitors on the RF AMPL 25–50 MC plug-in unit which are soldered to the chassis. Unsolder the wire leads connected to them, and then heat the lugs that are used to fasten them to the chassis. When performing this operation be careful not to burn the other parts with the soldering iron. Replace the new bypass capacitor by first soldering it to the chassis and then connecting the wires removed from the original one.

e. R-F and I-F Coils and Shield Cans. If the replacement of one of the r-f or i-f coil shield cans becomes necessary, proceed as follows:

(1) Unsolder all wires, capacitors, and resistors connected to the coil assembly.
(2) Remove the coil from the coil shield by removing the screws which retain it. Replace the coil with a new one if it is damaged.
(3) Remove all tubes in the vicinity of the coil shield to be replaced.
(4) Remove the original defective coil shield by cutting it away at its base. Use diagonal cutters or any tools capable of this function. Be sure no sharp edges remain. Use a small file to remove burrs.
(5) The replacement coil shield is mounted with two spade-type lugs or studs. Measure, mark, and drill two holes on the plug-in unit for mounting this replacement coil shield. When drilling, be careful not to damage the other parts. Remove any metal chips caused by drilling or filing.
(6) Install the new coil shield and secure it with nuts and lockwashers.
(7) Insert the coil; note the correct positioning so that wires previously removed will fit.
(8) Reconnect wires, capacitors, and resistors.
(9) Check alinement of this plug-in unit.

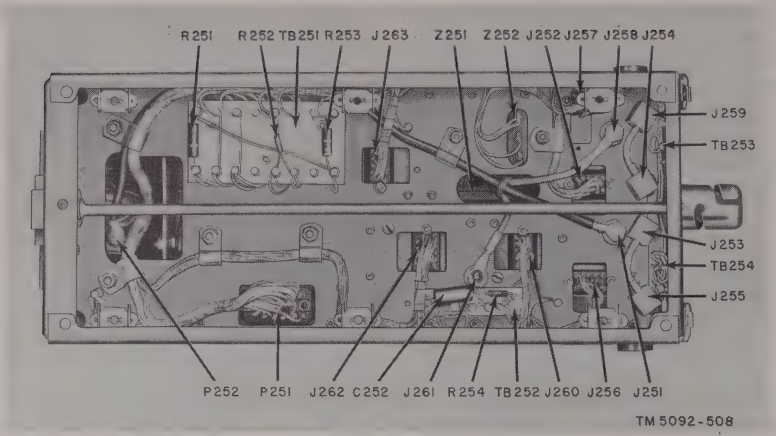


Figure 59. Radio Receiver R–257/U base, bottom view.

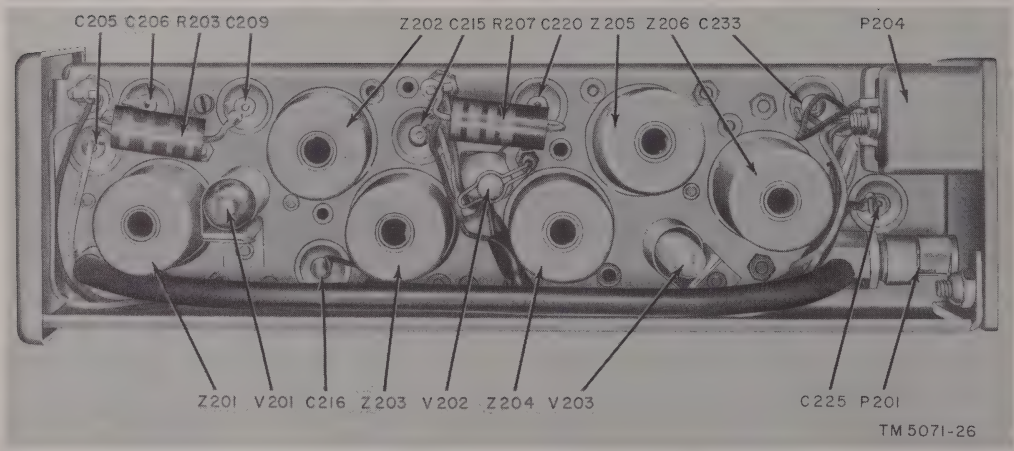


Figure 60. Radio Receiver R–257/U, RF AMPL 25–50 MC plug-in unit, top chassis view.

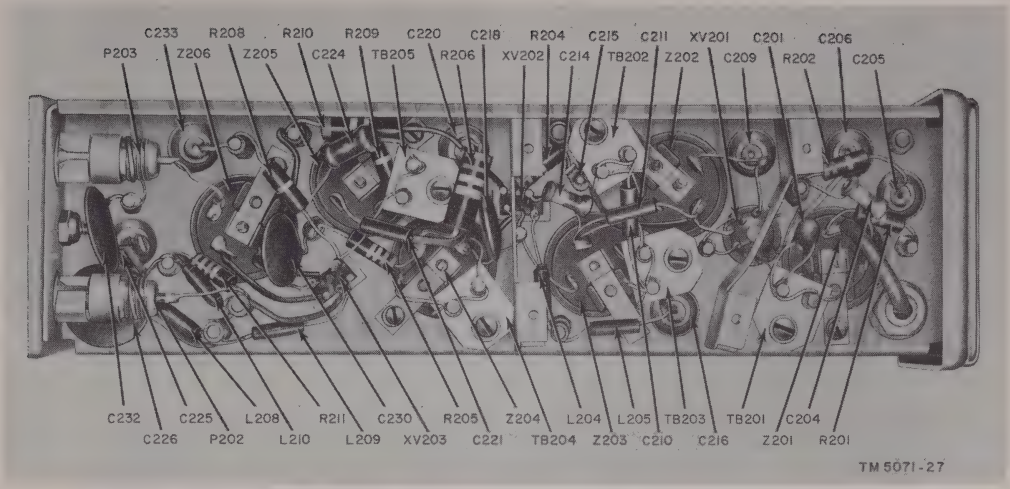


Figure 61. Radio Receiver R–257/U, RF AMPL 25–50 MC plug-in unit, bottom chassis view.

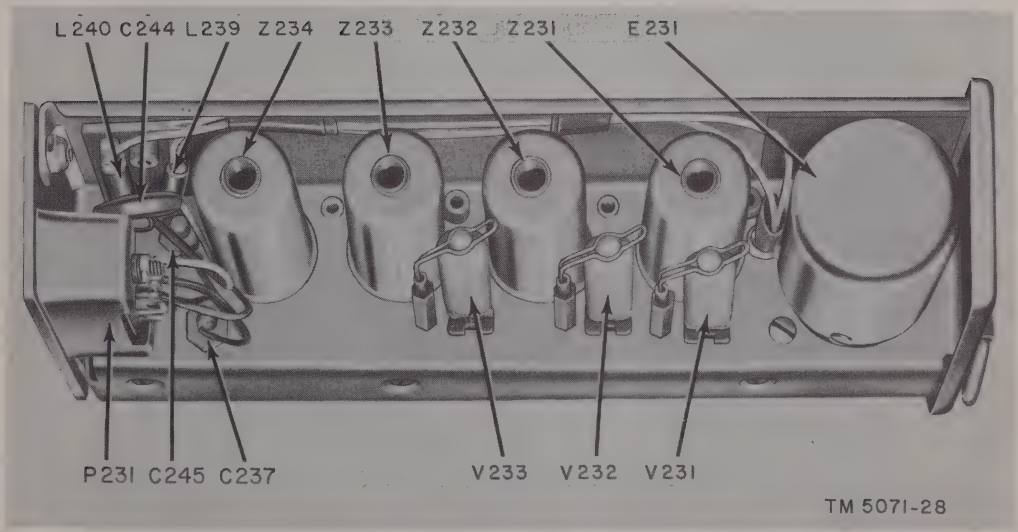


Figure 62. Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, top chassis view.

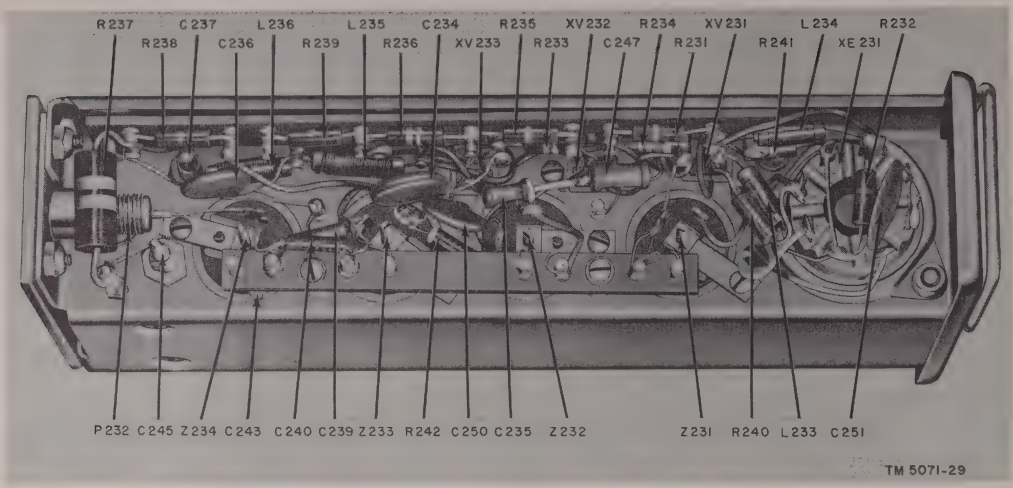


Figure 63. Radio Receiver R–257/U, LOCAL OSC 25–50 MC plug-in unit, bottom chassis view.

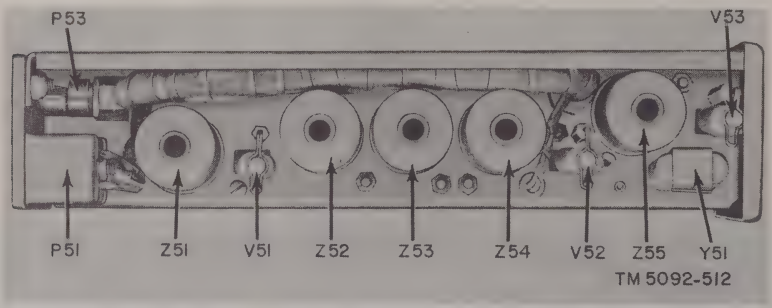


Figure 64. Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, top chassis view.

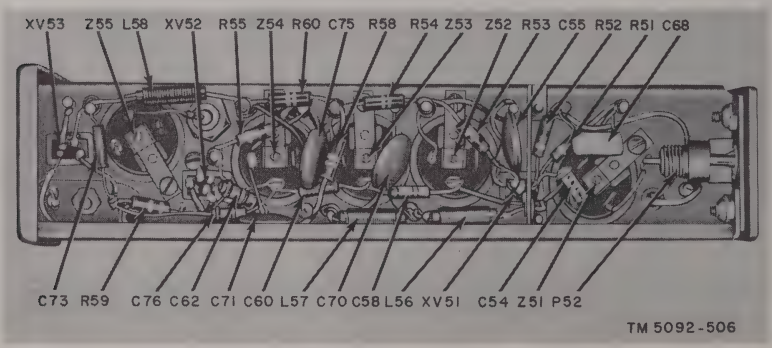


Figure 65. Radio Receiver R–257/U, 1ST IF 7.8 MC plug-in unit, bottom chassis view.

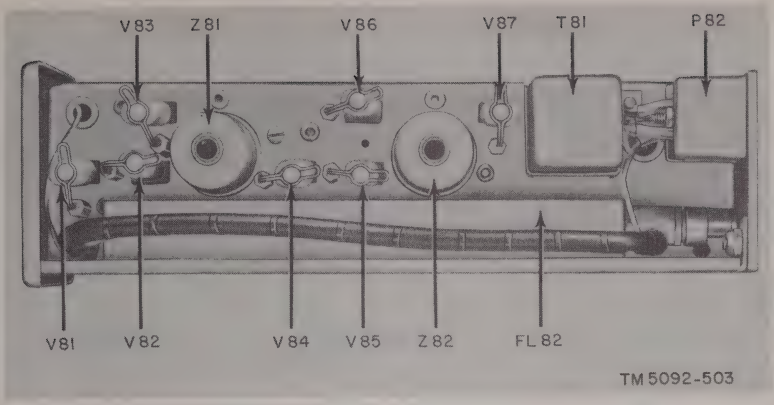


Figure 66. Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, top chassis view.

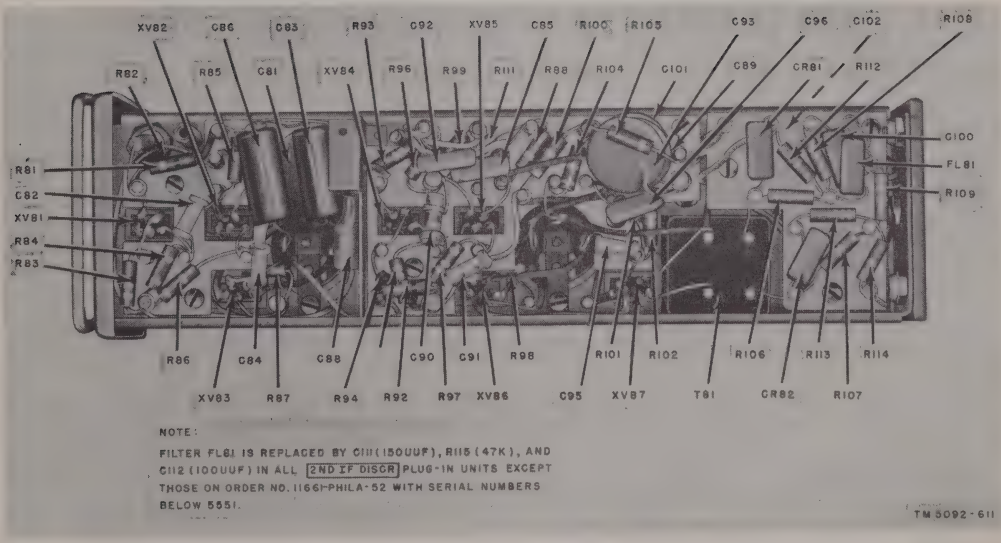


Figure 67. Radio Receiver R–257/U, 2ND IF DISCR plug-in unit, bottom chassis view.

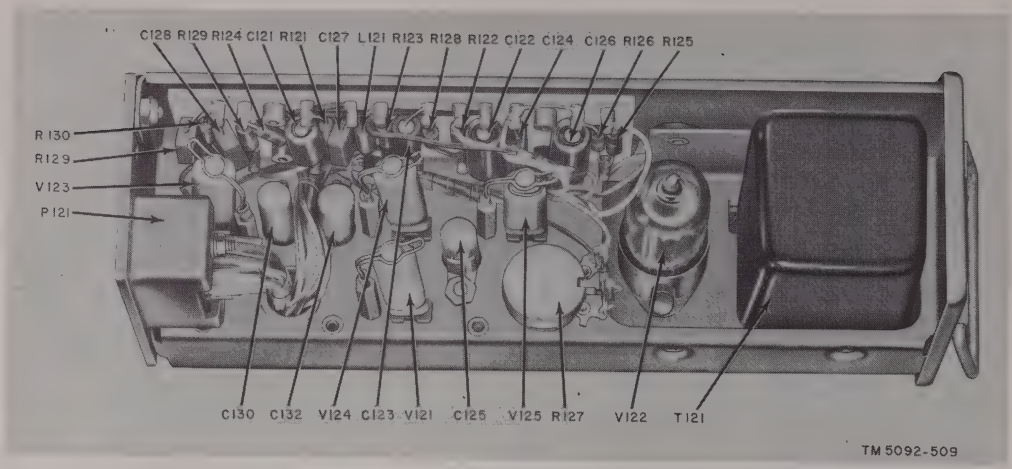


Figure 68. Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit, top chassis view.

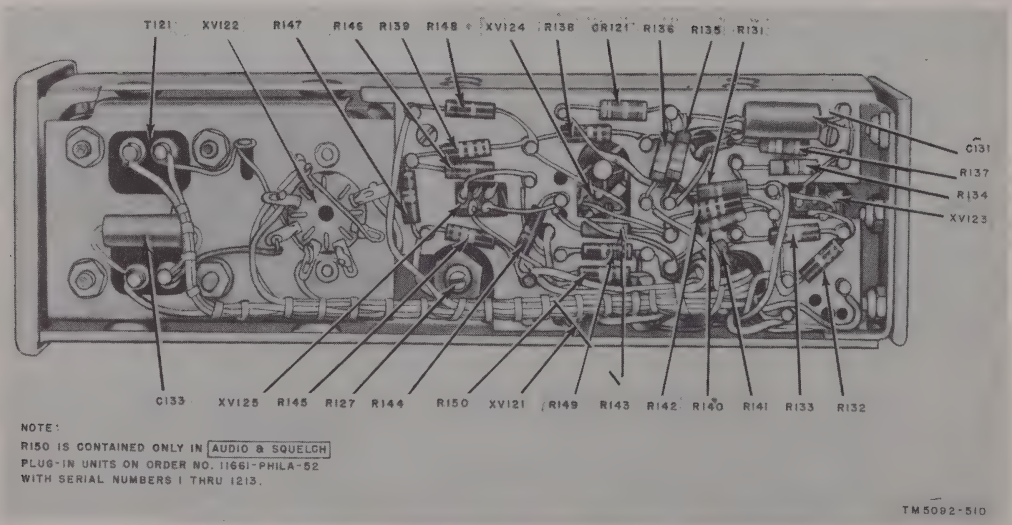


Figure 69. Radio Receiver R–257/U, AUDIO & SQUELCH plug-in unit, bottom chassis view.

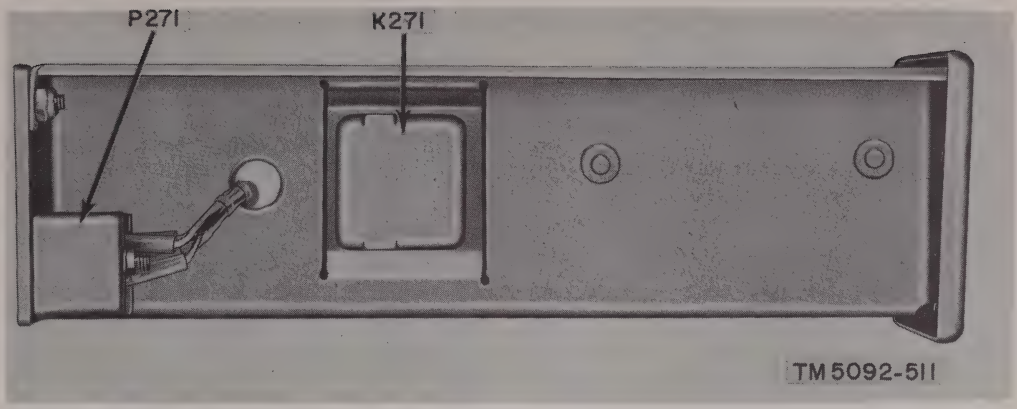


Figure 70. Radio Receiver R–257/U, RELAY plug-in unit, top chassis view.

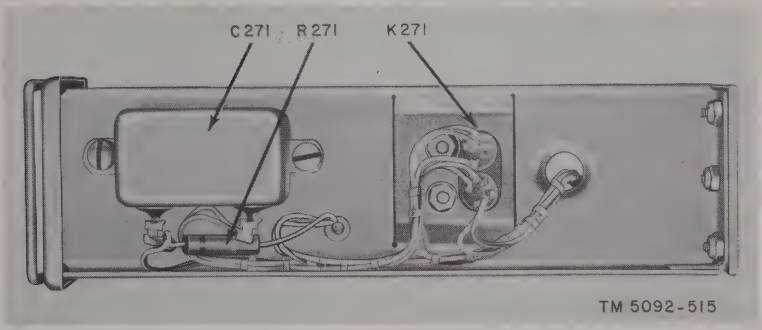


Figure 71. Radio Receiver R–257/U, RELAY plug-in unit, bottom chassis view.

85. Disassembly of Terminal Boards from Plug-In Units

In the event that replacement of one of the terminal boards becomes necessary, observe the following precautions.

a. Unsolder the wires, capacitors, resistors, and coil that are connected to terminals on the terminal board from points not on the terminal board. Be extremely cautious not to damage or break other terminals, especially on the subminiature tube sockets. Tag each lead wire or group of wires so that it will be properly wired when the new terminal board is installed.

b. If the terminal board being replaced is one that contains numerous terminals, draw a pencil sketch of the board; number each terminal with numbers that will agree with the numbers on the tagged wire leads. To remove the terminal board, remove its securing screws. Solder the components on the replacement terminal board before mounting the terminal board on the chassis.

c. If it is necessary to replace a part on one of the terminal boards and the part is difficult to remove because of its location in the plug-in unit, remove the attaching parts of the terminal board and move it slightly to make the part to be removed more accessible.

86. Refinishing

Instructions for refinishing are given in TM 9–2851, Painting Instructions for Field Use. Refinish outer surfaces when necessary.

Section III. ALINEMENT AND ADJUSTMENT PROCEDURES

87. General Alinement Precautions

a. Before attempting alinement of the receiver, be certain that alinement is necessary. If the sensitivity of the receiver is below that which is required, the trouble may be due to weak tubes or other circuit defects. If a complete alinement of the receiver is necessary, the 455-kc alinement must be done first and then the 7.8-mc i-f alinement; next the circuits in the LOCAL OSC 25–50 MC plug-in unit; and finally the r-f circuits in the RF AMPL 25–50 MC plug-in unit. If the 455-kc i-f circuits are not alined properly, subsequent alinements will be incorrect also. It is recommended that the frequency settings of the signal generator be checked with a frequency meter such as Frequency Meter TS–174B/U.

b. The RF AMPL 25–50 MC plug-in units have five terminal boards (fig. 16) with two terminals on each one. When the receiver is operated between 25 and 35 mc, jumpers must be wired across the terminals of TB201, TB202, TB203, TB204 and TB205. This operation shunts the tuned circuits with the additional capacitance necessary to tune the low end of the 25- to 50-mc range. When the receiver is operated in the range from 35 to50 mc, remove these jumpers.

c. Similarly, the LOCAL OSC 25–50 MC plug-in unit must be jumpered when the receiver operates in the range from 25 to 35 mc. The jumper connection across L234 (fig. 16) must be removed, and jumper connections must be made across the pairs of terminals on TB232 which are connected respectively to terminals 1 and 2 of Z231, terminals 1 and 3 of Z232, terminals 1 and 2 of Z233, and terminal 2 of Z234 and the junction of C240 and C243. When the receiver operates in the range from 35 to 50 mc, the jumper connection is made across L234 and the jumper connections across the four pairs of terminals on TB232 are removed.

88. Test Equipment Required for Alinement

a. Signal Generators. The signal generator required for r-f alinement, such as Signal Generator Set AN/URM–27 or –48, must cover the frequency range of 25 to 50 mc and must be capable of delivering a signal frequency modulated at least ±15 kc (deviation) with a 1,000-cps audio signal. The output should be accurately calibrated from zero up to 1 volt with a low-impedance connection such as 50 ohms. The i-f signal generator (RF Signal Generator Set AN/URM–25 or equivalent) should be capable of delivering the two i-f frequencies, 445 kc and 7.8 mc, the 7.8-mc signal either unmodulated or frequency modulated ±15 kc (deviation) with a 1,000-cps audio signal.

b. Output Meter. The output meter used for determining the audio-output power of the receiver (Output Meter TS–585/U or equivalent) should have an input impedance of 8 ohms (which matches the secondary impedance of the audio-output transformer T121). Electronic Multi-meter ME–6/U, in parallel with an 8-ohm load resistor, can be used in place of the power meter. The maximum audio power developed by the receiver will seldom be in excess of approximately .5 watt. Therefore, any meter that will give accurate readings from this .5-watt level down to and including zero will be satisfactory.

c. Frequency Meter. The practice of calibrating the signal generator with an accurate frequency meter, such as Frequency Meter TS–174B/U or Frequency Meter Set SCR–211(*) is required. Such practice as this assures accurate alinement.

d. D-C Vtvm. A d-c vtvm is also required for alinement as well as for troubleshooting. The hot lead should be shielded to minimize r-f pick-up. This d-c vtvm is used for measuring voltages across high resistance circuits. Because of its high input impedance (over 10 megohms), the loading of the circuit, due to the vtvm input impedance, is negligible. Electronic Multimeter TS–505/U or equivalent is recommended for this purpose.

e. A-C Vtvm. An a-c (Electronic Multimeter ME–6/U, or equivalent) is necessary for measuring audio voltages pertaining to tests and adjustment of the AUDIO & SQUELCH plug-in unit. As in the case of the d-c vtvm, the high input impedance of this vtvm is highly desirable.

f. Distortion Analyzer. A distortion analyzer is required to adjust audio gain control R127 on the AUDIO & SQUELCH plug-in unit. This instrument also is required for final test-

ing the receiver. Spectrum Analyzer TS–723/U is recommended for this purpose.

g. Alinement Tool. A special alinement tool is required for adjusting the slugs in the various coil assemblies used in the receiver. The alinement tool has a hollow head which engages the adjusting screw in a manner that prevents the tool from slipping off the screw.

89. Alinement Procedures

a. Radio Receiver R–257/U can be alined with the receiver connected to its case with a patch cord. Remove the shield covers that slip over the individual plug-in units before inserting the plug-in units in the receiver base.

b. It is important to have test conditions favorable to good alinement practice. The use of a metal-topped bench, or a sheet of metal (preferably copper sheet) placed under and bonded to the receiver to be alined, is considered good practice. The test equipment should be bonded to the metal sheet also. The shelter or room where the alinement is performed should be free from stray r-f fields, such as those found in the vicinity of other electronic equipment. If possible, a grounded and screened room should be used. The receiver should be warmed up before alinement. Fifteen minutes of warmup time is essential; 30 minutes is even better. The receiver power supply (Power Supply PP–846/U) should be fed from a regulated voltage supply delivering 115 volts a-c. All adjustments on the receiver should be performed with nonmetallic alinement tools because metal ones may unbalance the various magnetic fields present in electronic circuits, especially in the RF AMPL 25–50 MC plug-in unit. All the alinement

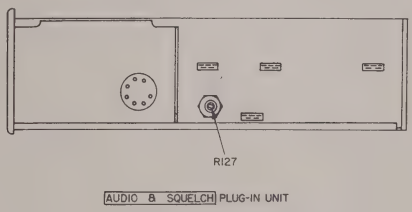


Figure 72. Radio Receiver R–257/U, alinement points.

points in the receiver are located in the bottom sections of the plug-in units (fig. 72) and are accessible for adjustment when installed in the receiver base.

c. Unless otherwise directed, set the controls on the control unit to the following positions preparatory to alinement:

(1) VOLUME control to any position clockwise so that the POWER lamp lights.
(2) SQUELCH control fully clockwise so that the squelch disable switch is in the OFF position.

90. I-F Alinement Procedures

Caution: The 455-kc i-f amplifiers must be alined before any other alinement is attempted. (This does not apply to the frequency-changing procedure which involves realinement of the LOCAL OSC 25–50 MC and the RF AMPL 25–50 MC plug-in units.)

a. 455-kc I-f Alinement Procedure. The 455-kc i-f alinement is performed as indicated in the chart below. If the 455-kc i-f stages are far out of alinement, it may be necessary to use a large output from the signal generator to obtain an indication on the vtvm. Use a 455-kc unmodulated signal. As the tuned circuits are alined and the vtvm reading increases appreciably, decrease the signal generator output to prevent overloading. Use the lowest d-c range on the vtvm.

Step	Vtvm connection	Signal generator connection	Adjustment	Indication
1	Test points on front of receiver marked DISCR and GND.	Pin 4 of V52 (second mixer) through a .05-μf capacitor. Use approximately 100-uv output.	Discriminator T81 secondary.	+1-volt reading on vtvm.
2	Test point at the junction of R101 and C96 (vtvm on lowest negative range).	Pin 4 of V52 (second mixer) through a .05-μf capacitor. Keep output low to prevent saturation of V86.	Z82	Maximum output.
3	Test points on front of receiver marked 2ND IF and GND.	Pin 4 of V52 (second mixer) through a .05-μf capacitor. Keep output low.	Z81 and Z55	Maximum output.

b. 7.8-mc I-f Alinement Procedure. Before performing the 7.8-mc i-f alinement procedure, be sure the 455-kc i-f stages are alined accurately. Connect the signal generator to pin 4 of V203 through a small mica capacitor and the chassis. Adjust the signal generator to 7.8 mc and check with the frequency meter. After each adjustment, reduce the signal generator output if necessary, to prevent overloading. If this procedure does not produce a maximum (peak) reading on the vtvm, connect the signal generator to pin 4 of V52 and adjust Z55 for maximum reading. Then connect the signal generator to pin 4 of V51 and adjust Z52, Z53, and Z54 for maximum reading. Then connect the signal generator to pin 4 of V203 and adjust Z54, Z53, Z52, Z51, and Z206 for maximum reading as indicated in the chart below.

Step	Vtvm connection	Adjustments	Indications
1	Test points marked 2ND IF and GND.	Z54, Z53, Z52, Z51, and Z206.	Maximum output.

91. R-f Alinement

a. Presetting Tuning Cores in RF AMPL 25–50 MC Plug-in Unit. The tuning cores of Z201, Z202, Z203, Z204, and Z205 first must be adjusted approximately to their correct positions to allow the test signal to pass through the r-f stages. The following chart lists various receiver frequencies and the corresponding number of turns that the tuning cores must be adjusted for each frequency. Columns 2, 3, and 4 list the number of turns that the core slugs must be turned *in* from the extreme counterclockwise positions. To use these three columns, each of the five tuning cores first must be turned to its extreme counterclockwise position. In this position, the top of the core adjusting screw is approximately 13/16-inch above the chassis. If the equipment is received directly from the factory, the receivers are already tuned for 34.1 mc; columns 5, 6, and 7 list the direction and number of turns that the tuning cores must be changed from the factory-

set positions. (A spot of paint or some other type of mark on the alinement tool will make it easier to count the number of turns.)

1	2	3	4	5	6	7
Receiver frequency (mc)	Number of clockwise turns of tuning cores			Number of clockwise turns of tuning cores from factory-set position (34.1 mc)		
	Z201, Z204, and Z204	Z203	Z205	Z201, Z204, and Z204	Z203	Z205
25	28½	26½	30	18¼	18½	17
26	26½	24½	28	16	16½	15
27	24	22½	26	13¾	14½	13
28	22	20½	20	11¾	12½	11
29	20	18½	22	9¾	10½	9
30	18	16½	20	7¾	8½	7
31	16	14	18	5¾	6	5
32	14	12	16	3¾	4	3
33	12	10	14½	1¾	2	1½
34	10¼	8	13	0	0	0
35 (with jumpers).	9½	7½	12½	¾*	½*	½[1]*
35 (without jumpers).	29	28	33	18¾	20	20
36	27	26	30	16¾	18	17
37	25½	24½	27½	15¼	16½	14½
38	24	23	26	13¾	15	13
39	22¾	21½	24½	12½	13½	11
40	21½	20	23	11¼	12	10
41	20¼	19	22	10	11	9
42	19¼	18	21	9	10	8
43	18¼	17	20	17	9	7
44	17¼	16	19	16	8	6
45	16	15	18	5¾	7	5
46	14¾	13¾	17	4½	5¾	4
47	13¾	13	16	3½	5	3
48	13	12	15	2¾	4	2
49	12	11	14	1¾	3	1
50	10¾	9½	13	½	1½	0

[1] Counterclockwise.

b. Final Adjustment.

(1) Follow the instructions given in paragraph 87*b* concerning jumper connections on TB201 through TB205.

(2) Connect a signal generator between the antenna coaxial connector and chassis ground. Set the signal generator output to 20 microvolts. This should be sufficient to allow a signal to pass through the preset stages.

(3) Connect a vtvm between the 2ND IF and GND test points located on the front panel of the receiver.

(4) Adjust Z201, Z202, Z203, Z204, and Z205 for maximum negative output on the vtvm. Repeat this procedure at least three times. If the vtvm reads off-scale, reduce the signal generator output.

c. LOCAL OSC 25–50 MC Alinement.

(1) Before alining the LOCAL OSC 25–50 MC plug-in unit, inspect the existing jumper connections (fig. 16). If the receiver is to be alined to a frequency between 25 and 35 mc, the jumpers must be as follows: jumpers across Z231, Z232, Z233, and Z234 and no jumper across L234. If the receiver is to be alined to a frequency between 35 and 50 mc, the jumpers must be as follows: a jumper across L234 and no jumpers across Z231, Z232, Z233, and Z234. Align the LOCAL OSC 25–50 plug-in unit as follows:

Step	Vtvm connection	Adjustment	Indication
1	None	Z231 unscrewed almost all the way counterclockwise.	None.
2	R231 at terminal on TB231 and GND test point.	Z231	Maximum negative voltage.
3	R239 at terminal on GND test point.	Z232	Maximum negative voltage.
4	LO and GND test points.	Z233 and Z234.	Maximum negative voltage.

(2) At this point, it is possible to adjust the receiver frequency to the transmitter frequency by adjusting *warping* coil Z231 which can shift the receiver frequency a few kc in either direction. This feature compensates for slight variations in crystals and alinement. Adjust *warping* coil Z231 as follows:

Vtvm connection	Signal generator connection	Adjustment
Test points on front of receiver marked DISC R and GND.	No signal generator used. Turn on the transmitter. (Set to the desired frequency.)	Adjust Z231 for a +1-volt reading on the vtvm.

92. Crystal Insertion

a. Removal of Crystal. Crystal oven E231 contains crystal Y231, thermostat S231, and dual heater winding HR 231 that can be operated from 6.3-volt a-c or d-c or from 24-volt d-c. This oven is disassembled as follows (fig. 73) :

(1) Remove crystal oven E231 from the LOCAL OSC 25–50 MC plug-in unit.

(2) Loosen and remove the three binding head screws from the shell, and then remove the shell.

(3) Lift the heater winding off octal base E237.

(4) The crystal and the thermostat can now be removed. Since the crystal and the thermostat are similar in appearance, they can be reversed accidentally. However, the crystal has its third overtone frequency marked on it. A decal fastened to the LOCAL OSC 25–50 MC plug-in unit near the octal oven socket will also guide the serviceman in returning the crystal and thermostat to their correct locations.

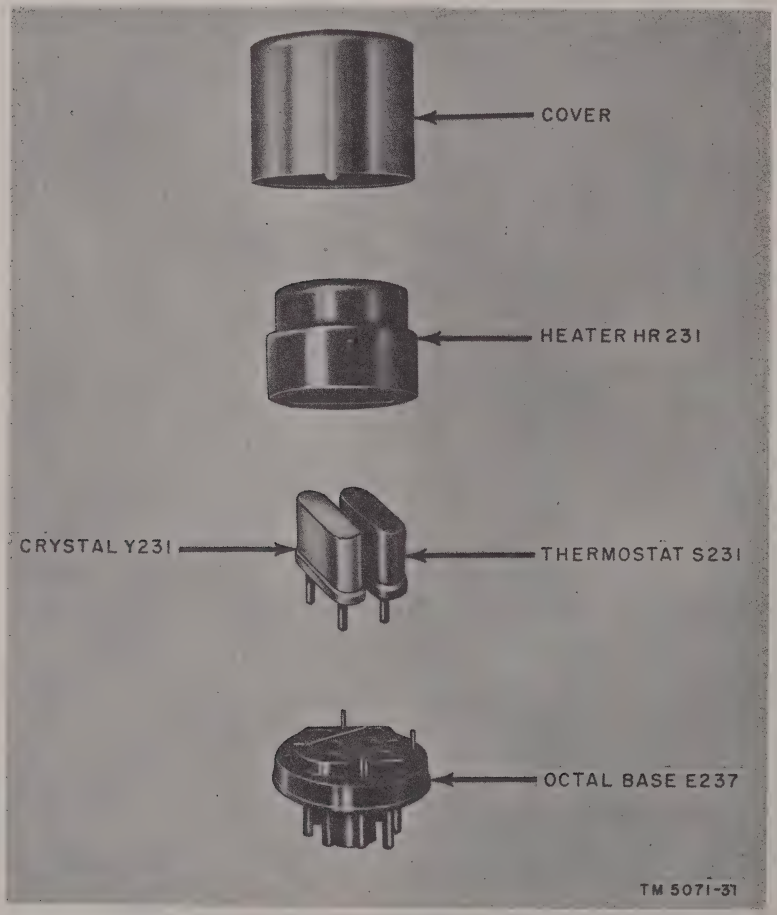


Figure 73. Radio Receiver R–257/U, crystal oven shown disassembled.

b. Crystal Selection. The selection of the proper crystal can be made by applying this formula:

$$\text{Crystal frequency} = \frac{\text{Receiving frequency (mc)} + 7.8 \text{ mc}}{2}$$

c. Reassembling Crystal Oven.

(1) Plug the crystal and thermostat into the octal oven base.

(2) Slip the dual heater winding over the crystal and thermostat; observe the location of the contact pins and their proper holes in the octal base.

(3) Replace the cover and the three binding head screws.

(4) Plug the crystal oven into the octal socket in the LOCAL OSC plug-in unit.

93. Adjustment of Audio Volume Control

Should readjustment of the audio volume control, R127 (fig. 69), become necessary, proceed as follows:

a. Connect Signal Generator Set AN/URM–27, or –48, frequency modulated ±15 kc with 1,000 cps and tuned to the frequency of the receiver, to P201 on the RF AMPL 25–50 MC plug-in unit.

b. Connect a vtvm to the front panel test points marked DISCR and GND, and tune the signal generator to the receiver frequency.

c. Connect an audio output meter and a distortion analyzer to the speaker output terminals (loaded 8 ohms).

d. Advance R127 so that the receiver output is .5 watt. The harmonic distortion should not exceed 10 percent. (Voltage across 8 ohms for .5 watt is 2 volts.)

Section IV. FINAL TESTING

94. General

This section is intended as a guide to be used in determining the quality of a repaired Radio Receiver R–257/U. The minimum test requirements outlined in paragraphs 95 through 105 may be performed by qualified maintenance personnel with adequate test equipment. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

95. Test Equipment Required for Final Testing

The instruments needed for testing Radio Receiver R–257/U are listed below:

a. Signal Generator. An f-m signal generator capable of producing signals frequency-modulated ±15-kc (deviation) with a 1,000-cps audio tone is required for the r-f alinement of the receiver. In addition, the attenuator should be calibrated so that the output voltage can be determined accurately. Signal Generator Set AN/URM–27, or –48, or equivalent (par. 66), is required for this purpose. Also, a signal generator, such as RF Signal Generator Set AN/URM–25, is required for testing the 7.8-mc i-f amplifier and the 455-kc i-f amplifiers and limiters.

b. Output Meter. An output meter, such as Output Meter TS–585/U or equivalent, is required for measuring the audio-output power of the receiver. The impedance of this meter must match the 8-ohm output impedance of the receiver. An a-c vtvm with an 8-ohm resistor across the output of the receiver can be used for determining power output also.

c. A-c and D-c Vtvm. A d-c vtvm, such as Electronic Multimeter TS–505/U or equivalent, and an a-c vtvm, such as Electronic Multimeter ME–6A/U or equivalent, are required for various tests.

d. Audio Oscillator. An audio oscillator, such as Audio Oscillator TS–382/U or equivalent, is satisfactory for producing audio signals from 20 cps up to 20,000 cps and having a voltage amplitude of at least 10 volts.

e. Distortion Analyzer. A distortion analyzer, such as spectrum Analyzer TS–723/U or equivalent, is required for measuring accurately audio distortion at a point of maximum audio output.

96. Standard Test Conditions

a. General. Final testing will be performed under *standard test conditions.* For Radio Receiver R–257/U, these conditions are as follows:

(1) Audio output shall be .5 watt at the output terminals of the audio-output transformer.

(2) Quieting sensitivity shall be at least 20 *db* (decibels).

(3) Signal-plus-noise to noise ratio shall be at least 10 *db*.
(4) Input voltage shall be 6.3, 12.6, 26.2 volts d-c or 115 volts or 230 volts at 60 cps depending on the receiver power supply used.
(5) Temperature and humidity shall be 59° F. to 86° F. with 50 to 70 percent relative humidity.
(6) Warmup period shall be at least 15 minutes.
(7) These tests will be modified by the specific test to be used.

b. Controls. Set the controls on the control unit at the following positions unless instructions are otherwise.
(1) VOLUME control fully clockwise from the OFF position.
(2) SQUELCH control fully clockwise so that the squelch disable switch is in the OFF position.
(3) Audio volume control R127 (fig. 69) turned fully clockwise for maximum gain.

c. Test Set-Up. Figure 74 shows a typical set-up of equipment for final test procedure.
(1) Connect the r-f signal generator to antenna connector P201 on the RF AMPL 25–50 MC plug-in unit.
(2) Connect the output meter (8-ohm load) across the secondary of T121. Connect a distortion analyzer to the same points.

d. Converting to Db Units. When meter scales are not calibrated in *db*, power ratios and voltage ratios can be converted into db by substituting the units in the following formulas:

(1) $Db = 10 \log \frac{P2}{P1}$, where P_1 and P_2 are the two units of power in watts to be compared. For example:

Let $P_2 = 50$ watts, and $P_1 = 10$ watts.

Then $db = 10 \log \frac{P2}{P1} = 10 \log \frac{50}{10}$

$= 10 \times \log 5 = 10 \times .70 =$ 7.0 *db*.

(2) $Db = 20 \log \frac{E_2}{E_1}$, where E_1 and E_2 are two voltages (across the same or equal resistances) to be compared. For example:

Let $E_2 = 50$ volts and $E_1 = 2$ volts.

Then $db = 20 \log \frac{E_2}{E_1} = 20 \log \frac{50}{2}$

$= 20 \times \log 25 = 20 \times 1.40$
$= 28$ *db*.

(3) When two meter readings are obtained directly in *db*, the *db* gain (or loss) is calculated by subtracting the lower *db* reading from the higher one.

97. Sensitivity

a. The sensitivity of the receiver is measured at the low end, the high end, and the middle of the frequency band. Sensitivity is defined as the signal (number of uv (microvolts)) neces-

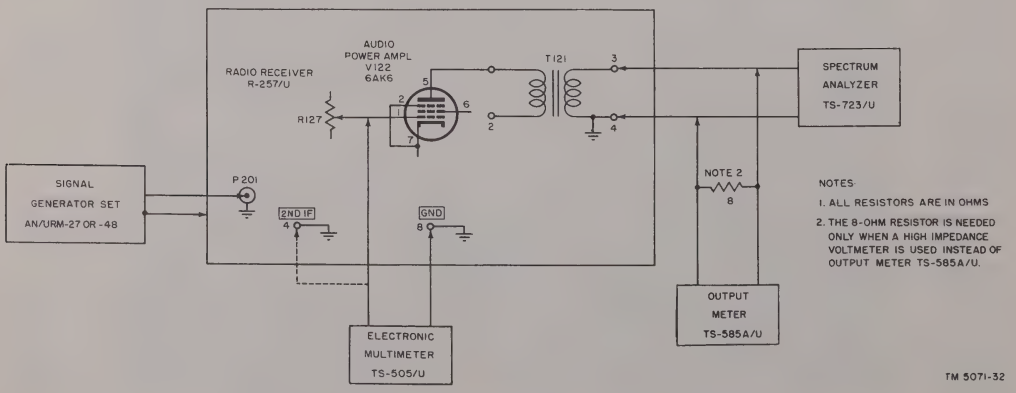


Figure 74. Final test set-up for Radio Receiver R–257/U.

sary to produce a signal-plus-noise to noise ratio of 10 *db*.

b. Determine the sensitivity of the receiver by measuring the lowest signal generator input with 1,000-cps ±15-kc modulation that will give a 10-*db* signal-plus-noise to noise ratio. The signal generator input voltage should be no greater than .5 uv.

(1) Connect the signal generator to antenna connector P201 and apply a .5-uv ±15-kc f-m signal with a 1,000 cps tone. Note the output reading on the output meter.

(2) Turn off the signal generator modulation. The reading on the output meter should be at least 10 *db* lower than that obtained in (1) above.

98. Power Output and Distortion

a. The power output and distortion test is used to determine how much audio power can be developed with a specified percentage of allowable distortion.

b. Use the standard test conditions (par. 96) with audio volume control R127 turned fully clockwise (maximum gain). Apply a 100-uv (1,000-cps) ±15-kc f-m signal to P201 with the signal generator.

c. The power output must be at least .5 watt with the distortion not exceeding 10 percent. If the distortion as indicated on the distortion analyzer exceeds 10 percent, slowly turn R127 counterclockwise until the distortion is exactly 10 percent. At this point, the power output must equal or exceed .5 watt.

99. Overall Audio-Frequency Response

a. The overall audio-frequency response (fig. 75) of the receiver is designed to favor voice communication. A de-emphasis circuit preceding the first audio amplifier attenuates the high frequency audio signals at the rate of 6 *db* ±1 *db* per octave.

b. Apply a 100-uv f-m signal modulated ±15 kc with a 1,000-cps audio signal to antenna connector P201. Use this audio-output figure as a 0-*db* reference level and make a frequency response test at audio frequencies between 100 cps and 4,000 cps keeping the deviation at ±15 kc. The response should agree with the values in the chart below within 1 *db*. For this test, the r-f signal generator requires an external source of audio modulation (Audio Oscillator TS–382A/U).

Frequency (cps)	100	300	500	1,000	2,000	2,500	4,000
Response (db)	17.5	10	6	0	−6	−8	−13.2

100. Image Rejection Ratio

a. In Radio Receiver R–257/U, the first h-f oscillator frequency is 7.8 mc higher than the signal frequency to which the r-f amplifiers are tuned. The beating of these two signals in the mixer stage produces an i-f of 7.8 mc. However, a signal 7.8 mc higher than that of the local oscillator (or 15.6 mc higher than that of the desired receiver input signal) also will beat with the oscillator signal in the first mixer stage to produce an i-f of 7.8 mc. For example, if the desired r-f signal is 40 mc, then the undesired image frequency is 40 ±15.6, which equals 55.6 mc. The tuned circuits of the r-f amplifiers must reject this image signal.

b. With no signal applied to the radio set, note the reading on the output meter caused by noise. Determine the image frequency as outlined in *a* above and accurately tune the signal generator to this frequency. Turn on the signal generator and adjust the output for 20-*db* quieting. Record the output voltage of the signal generator.

c. Repeat the procedure in *b* above except tune the signal generator to the receiver frequency. Record the generator output for this step and compare it with the value obtained in *b* above. The ratio of these two input voltages is the image rejection ratio. Image rejection ratio $= \frac{uv \text{ (from } b)}{uv \text{ (from } c)}$. This image rejection ratio should not be less than 100,000 (100 *db*).

101. I-F Rejection Ratio

a. Signals, reaching the antenna that have the same frequencies as the i-f stages of the receiver, may be passed by the receiver and produce interference to normal reception. The two r-f amplifiers in this receiver, V201 and V202, are designed to provide a high rejection

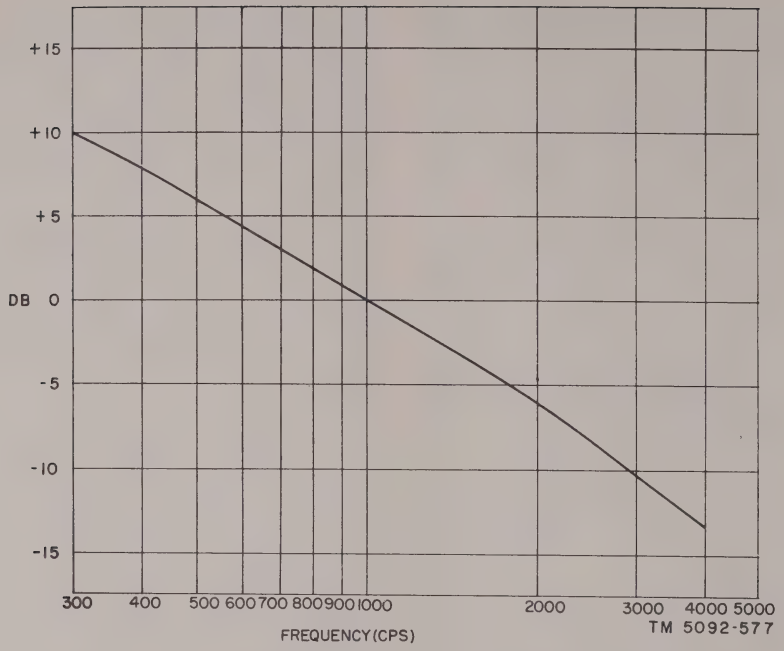


Figure 75. Radio Receiver R–257/U, overall audio frequency response curve.

ratio for these 7.8-mc and 455-kc signals. The ratio of the input signals at the i-f frequencies and the input signals at the receiver frequency required to give 20-*db* quieting is the i-f rejection ratio.

b. Adjust the signal generator to deliver an unmodulated 455-kc signal to the antenna input to give 20-*db* quieting. Record this signal generator output.

c. Adjust the signal generator to deliver 7.8 mc to the antenna input to give 20-*db* quieting. Record this signal generator output.

d. Adjust the signal generator to the receiver frequency and adjust the signal generator output to give 20-*db* quieting. Record this signal generator output figure.

e. 455 kc i-f rejection ratio $= \frac{uv \text{ (from } b)}{uv \text{ (from } d)}$

7.8 mc i-f rejection ratio $= \frac{uv \text{ (from } c)}{uv \text{ (from } d)}$

The i-f rejection ratio should be at least 100,000 (100 *db*).

102. Adjacent and Alternate Channel Selectivity

a. Adjacent and alternate channel selectivity is a measure of the receiver's ability to reject signals existing on frequencies 50 kc and 100 kc removed from the receiver frequency. The adjacent channel frequency shall be attenuated at least 80 db below the receiver frequency, and the alternate channel frequency shall be attenuated at least 100 db below the receiver frequency. These tests are accomplished best by comparing the signal injected from a signal generator at the receiver frequency with the signal injected at the adjacent or alternate channel frequency which will produce the same output from the receiver.

b. Since the output developed from the receiver is a voltage, db units must be interchanged with a voltage ratio; 80 db corresponds to a voltage ratio of 10,000 and 100 db corresponds to a voltage ratio of 100,000.

c. Procedure for determining adjacent and

alternate channel selectivity is as follows:

(1) Connect a d-c vtvm between the test points on the front of the receiver marked 2ND IF and GND. With the signal generator tuned to the receiver frequency with no modulation and zero output, observe the vtvm reading resulting from receiver noise.

(2) Carefully increase the output from the signal generator until the reading on the vtvm begins to rise. Switch the signal generator on and off several times to be sure the increased vtvm reading is the result of the applied signal. Do not set the signal generator output any higher than necessary to obtain the indication mentioned previously. Record the output of the signal generator and the reading on the vtvm.

(3) Shift the signal generator frequency above the receiver frequency 50 kc and increase the signal generator output so that the vtvm reading from (2) above is duplicated. Repeat the same operation at a frequency 40 kc below the receiver frequency. The signal generator output required for duplicating the vtvm reading from (2) above should be similar for adjacent channel frequencies (40 kc) above and below the receiver frequency and increased at least 80 *db*, a voltage ratio of 10,000 to 1.

(4) Repeat the instructions of (3) above except tune the signal generator to alternate channel frequencies (80 kc) above and below the receiver frequency. The alternate channel selectivity should be at least 100 *db*, a voltage ratio of 100,000 to 1.

103. Squelch Test

a. This test is designed to determine whether the squelch circuit sensitivity is adequate. The test is used to measure the ratio between the receiver noise with the squelch circuit disabled and no signal input as against the receiver noise resulting from the minimum signal required to squelch the receiver when the squelch control is set in a position of maximum sensitivity.

b. Follow the procedure below for testing the squelch circuit:

(1) Tune the signal generator to the receiver frequency with no modulation and zero output.

(2) Connect a d-c vtvm to pin 1 of audio-output tube V122.

(3) Connect the output meter across terminals 3 and 4 of audio-output transformer T121.

(4) With the SQUELCH control at OFF (maximum clockwise position) and with zero output from the signal generator, read the output meter and record this reading.

(5) Turn the SQUELCH control to its maximum counterclockwise position; then turn it slowly clockwise and stop at the point where the audio circuits become squelched, as indicated by a reading of approximately —25 volts on the vtvm.

(6) Advance the output of the signal generator slowly until the vtvm reading drops to almost zero. The receiver is again unsquelched. Take a reading on the output meter.

(7) Determine the squelch sensitivity as follows:
Squelch sensitivity (*db*) = value from step (4) (*db*) minus value from step (6) (*db*).
The squelch sensitivity should be less than 10 *db*.

104. Overall Receiver Selectivity

a. General. The overall selectivity of the receiver is a measure of the band-pass characteristics from antenna connector P201 to the output terminals. Since the audio stages have a fixed response, output measurements from this test are taken at the grid of the fifth 455-kc i-f amplifier. This test compares the receiver gain at resonance and at points off resonance.

b. Procedure for Determining Receiver Selectivity.

(1) Connect a d-c vtvm between the front test points of the receiver marked 2ND IF and GND. With the signal generator tuned to the receiver frequency with no modulation and zero output, observe the vtvm reading resulting from receiver noise.

(2) Carefully increase the output from the signal generator until the reading on the vtvm begins to rise. Switch the signal generator on and off to be sure the increased vtvm reading is the result of the applied signal. Do not set the signal generator output any higher than necessary to obtain the indication mentioned previously. Record the output of the signal generator and the reading on the vtvm.

(3) Shift the signal generator frequency above the receiver frequency 15 kc and increase the signal generator output so that the vtvm reading in (2) above will be duplicated. Repeat the same operation at a frequency 15 kc below the receiver frequency. The signal generator output for frequencies 15 kc above the receiver frequency should be similar to the output 15 kc below the receiver frequency and not more than twice the signal generator output recorded from (2) above (6 *db*).

(4) Repeat (3) above except shift to frequencies 35 kc above and below the receiver frequency. The ratio between the signal generator output required for this step and step (2) should be approximately 100,000 (100 *db*). Figure 76 shows a typical overall frequency response curve of a properly functioning receiver.

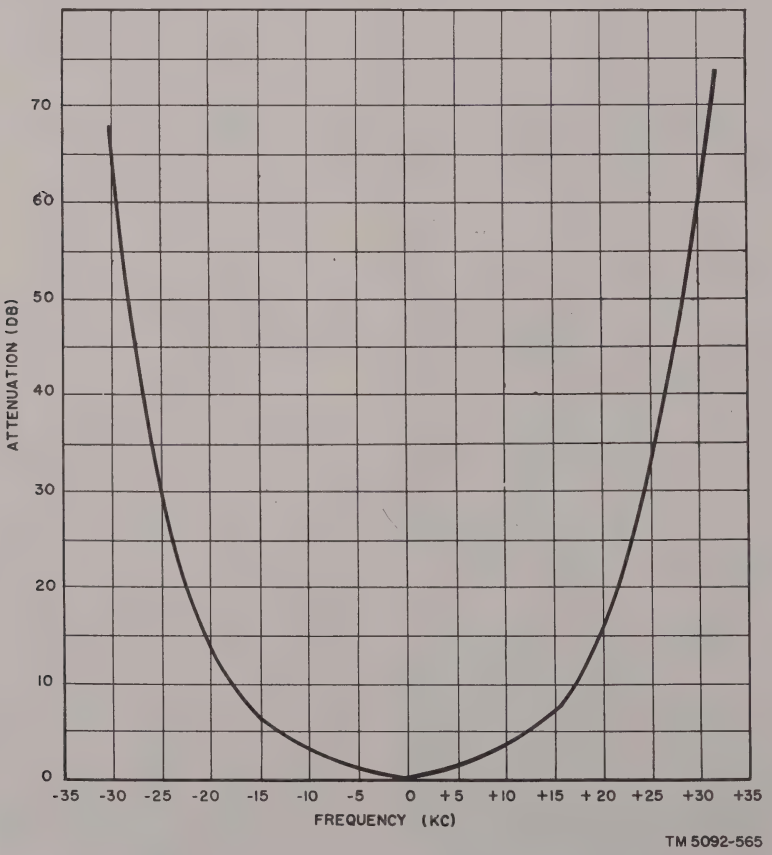


Figure 76. Overall selectivity curve of Radio Receiver R–257/U.

105. Discriminator Test

a. General. The discriminator test gives an indication of proper discriminator operating conditions as shown graphically in figure 31. The input signal to this stage is varied above and below the second i-f of 455 kc and the d-c output of the discriminator is measured.

b. Procedure for Discriminator Test.

(1) Connect a d-c vtvm between ground and the junction of C96 and R101, the test point from the grid of the second limiter V87. Tune the i-f signal generator to 455 kc, without modulation, and feed the output through a small mica capacitor (approximately 1,000 $\mu\mu$f) to the control grid of the second mixer V52 and ground. Adjust the output of the signal generator to give an approximate vtvm reading of —25 volts. Move the vtvm to the front panel test points marked DISCR and GND. The discriminator output should be +1 volt when properly aligned.

(2) Carefully tune the signal generator below 455 kc to that frequency which gives a maximum negative indication on the vtvm. Carefully tune back and forth through this point to be sure the setting of the signal generator gives the maximum vtvm indication. Record this reading. Do the same for the frequency above 455 kc that gives a maximum positive indication on the vtvm. The points of maximum positive and negative indications must be at least 35 kc removed from 455 kc (420 and 490 kc).

(3) Tune the signal generator to 440 kc and 470 kc and record the vtvm readings. Both readings should be a minimum of 7 volts removed from the original +1 volt reading (+8 volts and —6 volts). The change in discriminator output voltage produced by the 440-kc signal must not differ from that produced by the 470-kc signal by more than 3 volts.

(4) Tune the signal generator to 420 kc and 490 kc, and record the discriminator output voltages (as in (2) above). The readings of both polarities on the vtvm should be a minimum of 14 volts removed from the original +1 volt reading (+15 volts and —13 volts). The change in discriminator output voltage produced by the 420-kc signal must not differ from that produced by the 490-kc signal by more than 6 volts.

(5) If the minimum requirements given in (2), (3), and (4) above are not obtained, the discriminator stage requires realinement, repair, or replacement.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

106. Repacking for Shipment or Limited Storage

a. The exact procedure used in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the case or carton which contains the receiver. Protect it with a waterproof paper barrier. Seal the seams with sealing compound or tape. Provide at least 3 inches of excelsior padding between the paper barrier and packing case.

107. Demolition of Materiel to Prevent Enemy Use

The demolition procedures described in paragraph 108 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only on order of the commander.

108. Methods of Destruction

a. Smash. Smash the crystals, controls, tubes, coils, switches, capacitors, and transformers; use sledges, axes, handaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut cords and wiring; use axes. handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinets, and chassis.

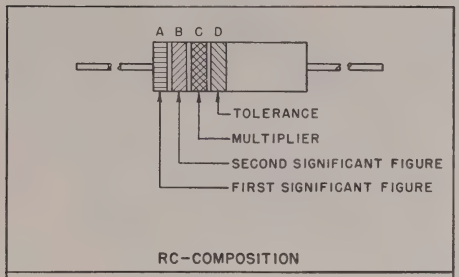
e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Burn or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

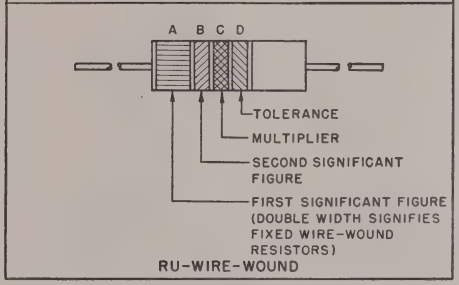
g. Destroy. Destroy everything.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

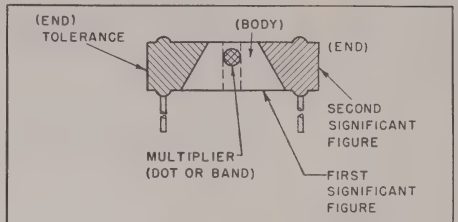


RC-COMPOSITION

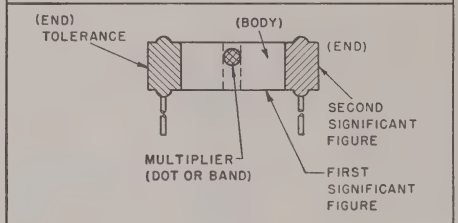


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

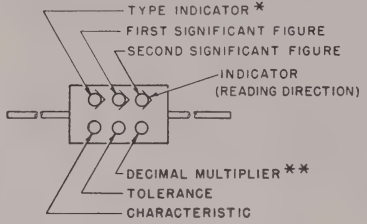
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

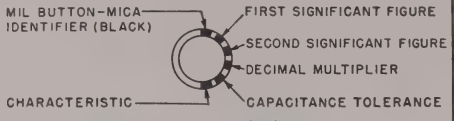
Figure 77. Resistor color codes.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)

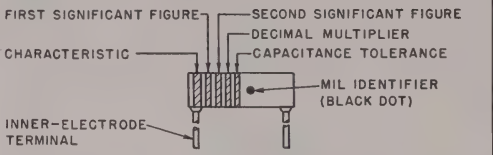


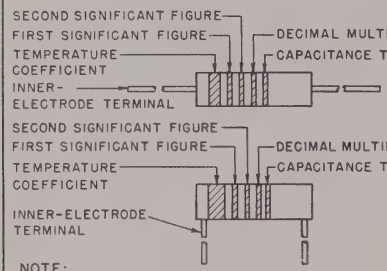
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
**INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)



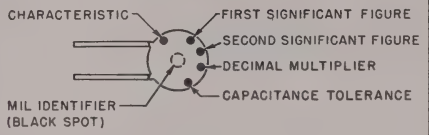
BUTTON-MICA (CB)





NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, −20%.

CERAMIC-GENERAL PURPOSE (CK)

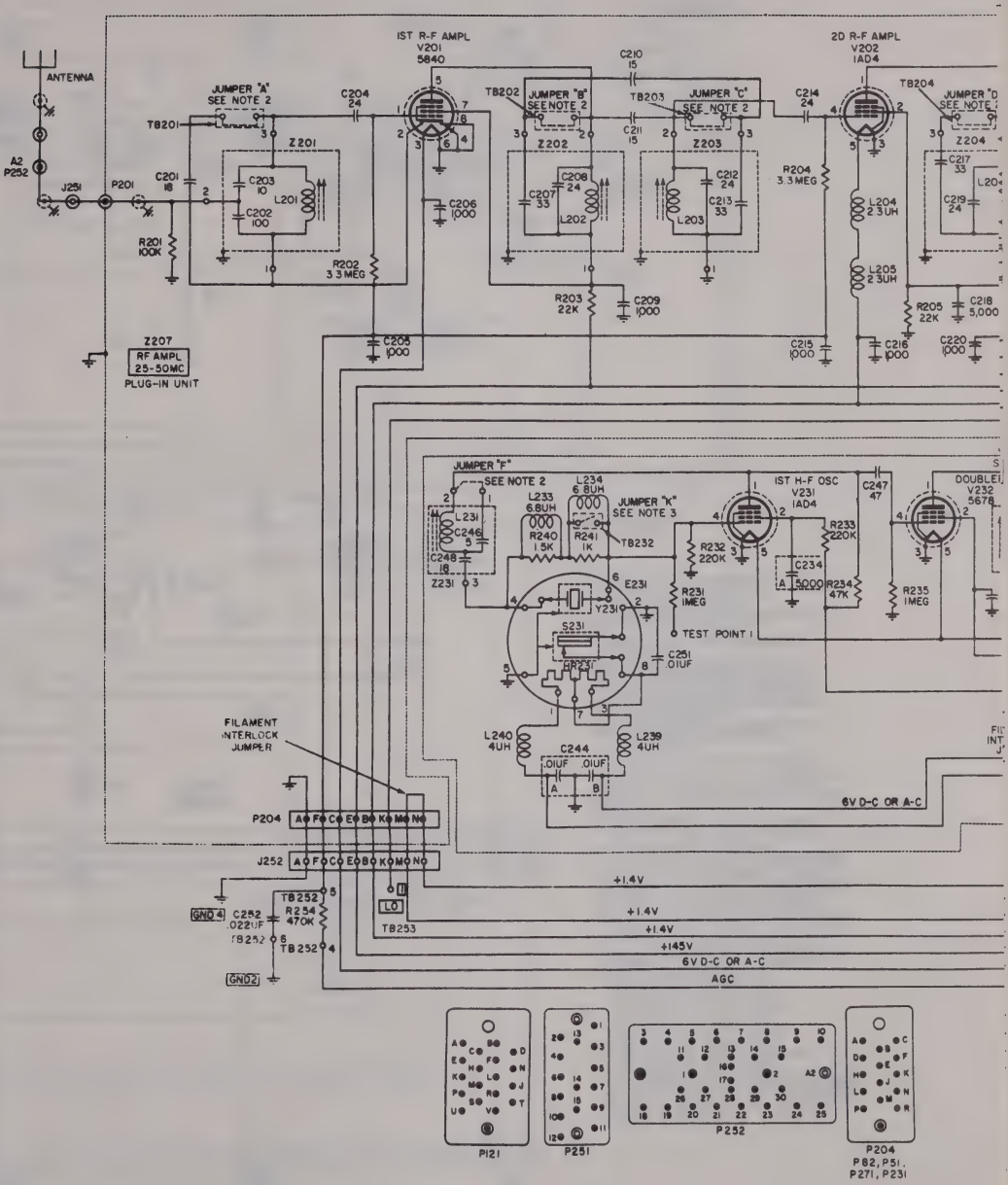
CAPACITOR COLOR CODE

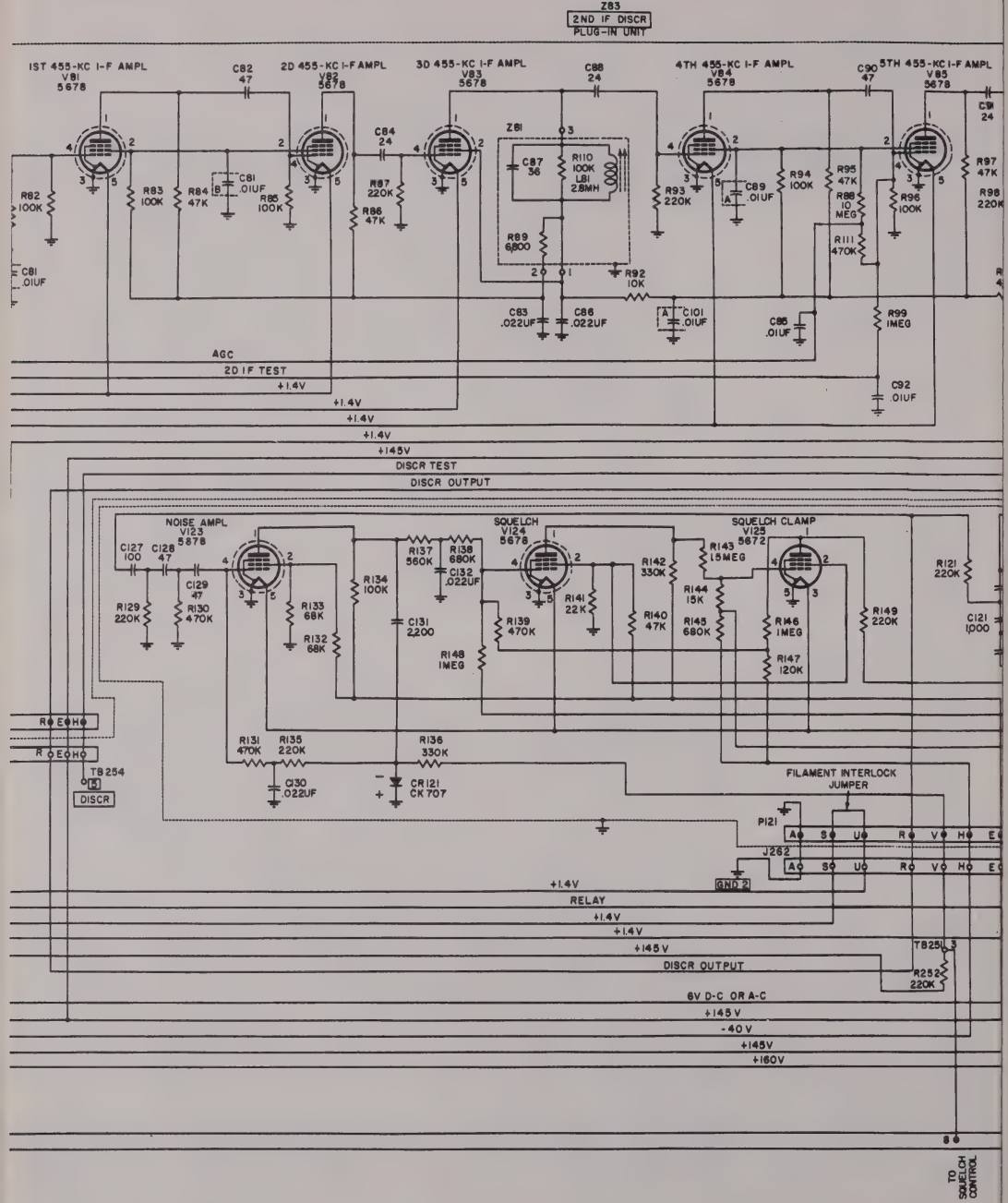
COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		−30
RED	2	100	2	C	H		X	2		2	2		−80
ORANGE	3	1,000	3	D	J	D			30				−150
YELLOW	4	10,000	4	E	P								−220
GREEN	5		5	F	R						5	0.5	−330
BLUE	6		6		S								−470
PURPLE (VIOLET)	7		7		T	W							−750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	−330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-C1

Figure 78. Capacitor color codes.


ANTENNA
A2
P252
J251
P201
Z207
RF AMPL
25-50MC
PLUG-IN UNIT
1ST R-F AMPL
V201
5840
2D R-F AMPL
V202
1AD4
JUMPER "A"
SEE NOTE 2
JUMPER "B"
SEE NOTE 2
JUMPER "C"
SEE NOTE 2
JUMPER "D"
SEE NOTE 2
TB201
TB202
TB203
TB204
Z201
Z202
Z203
Z204
C201 18
C202 100
C203 10
L201
C204 24
C205 1000
C206 1000
C207 33
C208 24
L202
C209 1000
C210 15
C211 15
C212 24
C213 33
L203
C214 24
C215 1000
C216 1000
C217 33
C218 5,000
C219 24
C220 1000
L204 2.3UH
L205 2.3UH
R201 100K
R202 3.3MEG
R203 22K
R204 3.3MEG
R205 22K
JUMPER "F"
SEE NOTE 2
JUMPER "K"
SEE NOTE 3
L231
C246 5
C248 18
Z231
L233 6.8UH
L234 6.8UH
R240 1.5K
R241 1K
TB232
IST H-F OSC
V231
1AD4
R232 220K
R233 220K
C234 A 5000
R234 47K
C247 47
R235 1MEG
DOUBLER
V232
5678
E231
Y231
S231
AR231
C251 .01UF
R231 1MEG
TEST POINT 1
L240 4UH
L239 4UH
C244 .01UF .01UF
A
B
FILAMENT
INTERLOCK
JUMPER
P204
J252
6V D-C OR A-C
+1.4V
+1.4V
+1.4V
+145V
6V D-C OR A-C
AGC
GND 4
GND 2
C252 .022UF
TB252
R254 470K
TB253
LO
P121
P251
P252
P204
P82, P51,
P271, P231


Z83
2ND IF DISCR
PLUG-IN UNIT
1ST 455-KC I-F AMPL
V81
5678
2D 455-KC I-F AMPL
V82
5678
3D 455-KC I-F AMPL
V83
5678
4TH 455-KC I-F AMPL
V84
5678
5TH 455-KC I-F AMPL
V85
5678
C82
47
C88
24
C90
47
C84
24
Z81
C87
36
R110
100K
L81
2.8MH
R82
100K
R83
100K
R84
47K
C81
.01UF
R85
100K
R86
47K
R87
220K
R89
6800
R92
10K
R93
220K
C89
.01UF
R94
100K
R95
47K
R88
10
MEG
R96
100K
R111
470K
R97
47K
R98
220K
C83
.022UF
C86
.022UF
C1101
.01UF
C85
.01UF
R99
1MEG
C92
.01UF
AGC
2D IF TEST
+1.4V
+1.4V
+1.4V
+1.4V
+145V
DISCR TEST
DISCR OUTPUT
NOISE AMPL
V123
5878
SQUELCH
V124
5678
SQUELCH CLAMP
V125
5672
C127
100
C128
47
C129
47
R129
220K
R130
470K
R133
68K
R132
68K
R134
100K
R137
560K
R138
680K
C132
.022UF
C131
2200
R148
1MEG
R139
470K
R141
22K
R142
330K
R140
47K
R143
1.5MEG
R144
15K
R145
680K
R146
1MEG
R147
120K
R149
220K
R121
220K
C121
1000
R131
470K
R135
220K
C130
.022UF
R136
330K
CR121
CK707
T8254
DISCR
FILAMENT INTERLOCK
JUMPER
P121
J252
GND 2
+1.4V
RELAY
+1.4V
+1.4V
+145V
DISCR OUTPUT
T825
R252
220K
6V D-C OR A-C
+145V
-40V
+145V
+160V
TO
SQUELCH
CONTROL

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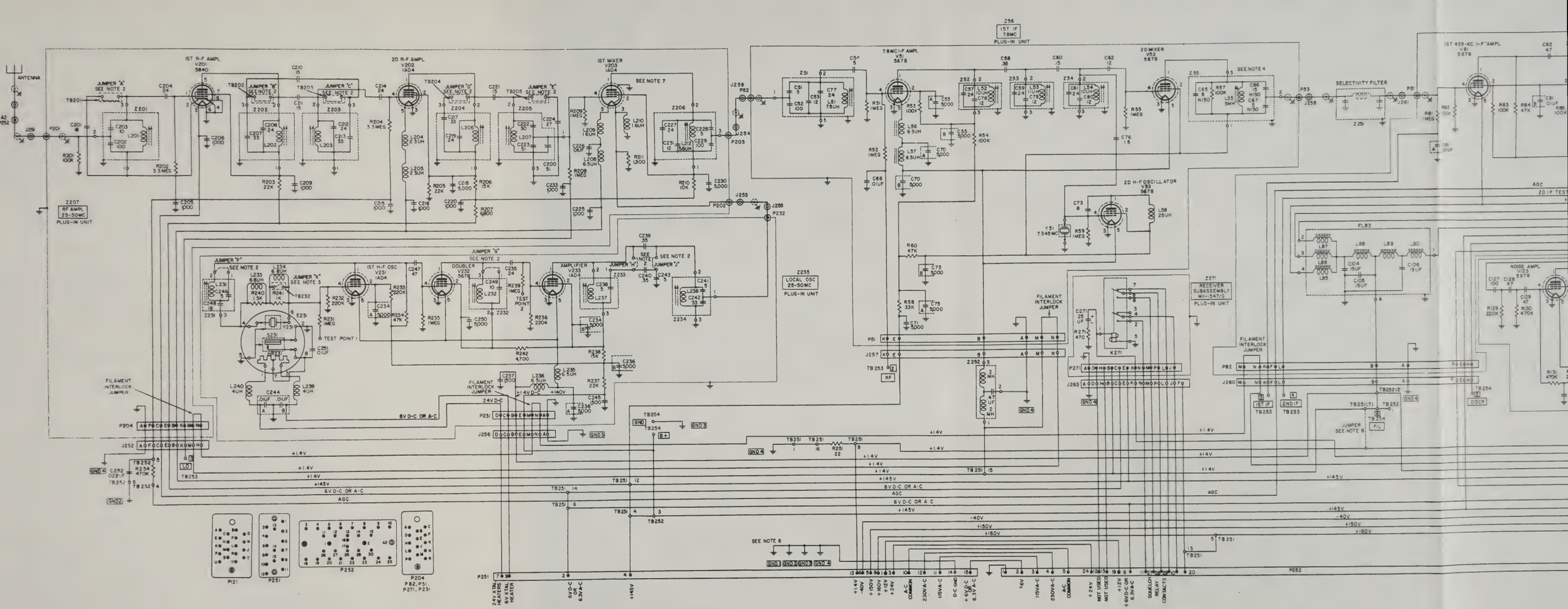
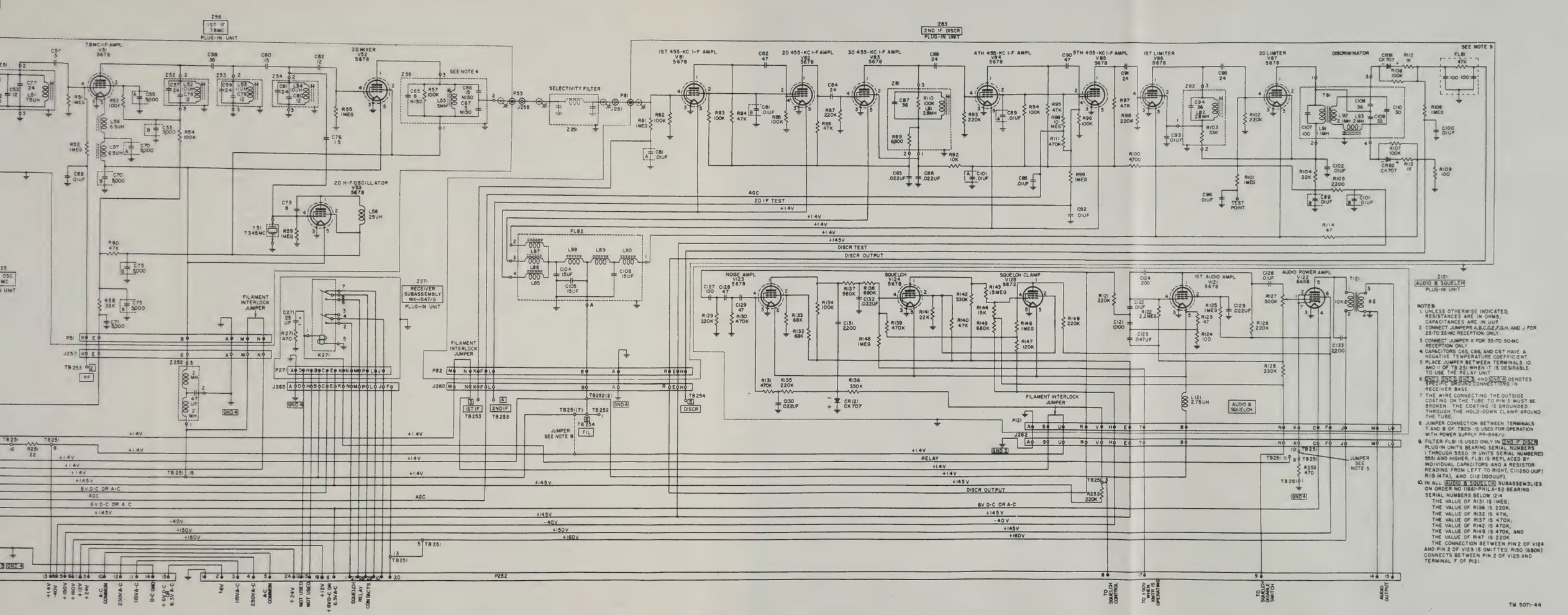


Figure 79. Radio Receiver R-257/U, schematic diagram.



NOTES

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
2. CONNECT JUMPERS A,B,C,D,E,F,G,H, AND J FOR 25-TO 35-MC RECEPTION ONLY.
3. CONNECT JUMPER K FOR 35-TO 50-MC RECEPTION ONLY.
4. CAPACITORS C65, C66, AND C67 HAVE A NEGATIVE TEMPERATURE COEFFICIENT.
5. PLACE JUMPER BETWEEN TERMINALS 10 AND 11 OF TB 251 WHEN IT IS DESIRABLE TO USE THE RELAY UNIT.
6. GND 1, GND 2, GND 3, AND GND 4 DENOTES SPECIFIC GROUND CONNECTIONS IN RECEIVER BASE.
7. THE WIRE CONNECTING THE OUTSIDE COATING ON THE TUBE TO PIN 3 MUST BE BROKEN. THE COATING IS GROUNDED THROUGH THE HOLD-DOWN CLAMP AROUND THE TUBE.
8. JUMPER CONNECTION BETWEEN TERMINALS 7 AND 8 OF TB251 IS USED FOR OPERATION WITH POWER SUPPLY PP-846/U.
9. FILTER FL81 IS USED ONLY IN 2ND IF DISCR PLUG-IN UNITS BEARING SERIAL NUMBERS 1 THROUGH 5550 IN UNITS SERIAL NUMBERED 555 AND HIGHER, FL81 IS REPLACED BY INDIVIDUAL CAPACITORS AND A RESISTOR READING FROM LEFT TO RIGHT, C111 (50 UUF) R113 (47K), AND C112 (100UUF).
10. IN ALL AUDIO & SQUELCH SUBASSEMBLIES ON ORDER NO 11681-PHILA-52 BEARING SERIAL NUMBERS BELOW 1214
    THE VALUE OF R131 IS 1MEG;
    THE VALUE OF R136 IS 220K,
    THE VALUE OF R132 IS 47K;
    THE VALUE OF R137 IS 470K,
    THE VALUE OF R142 IS 470K,
    THE VALUE OF R149 IS 470K, AND
    THE VALUE OF R147 IS 220K
    THE CONNECTION BETWEEN PIN 2 OF V124 AND PIN 2 OF V125 IS OMITTED. R150 (680K) CONNECTS BETWEEN PIN 2 OF V125 AND TERMINAL F OF P121.

Figure 79. Radio Receiver R-257/U, schematic diagram.

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[AG 413.44 (9 Nov 54)]

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For explanation of abbreviations used, see SR 320–50–1.

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