line is terminated at K of REMOTE CONTROL jack J105 and completed to ground through terminals 4 and 5 of switch S107 (segment 3), terminals 5 and 6 of switch S106 (segment 2), and contacts 1 and 3 of squelch relay K601. When BREAK IN switch S106 is at the ON position, the carrier control line is disabled by opening the lead from contact 3 of relay K601. When squelch relay K601 is energized, the carrier control line is disabled by the opening of contacts 1 and 3.

b. Diode rectifier CR101 is used when Radio Receiver R-390/URR is connected in diversity systems (fig. 2). Its function prevents the agc circuits of the passive receiver from loading down the agc circuits of the controlling receiver and to further reduce the gain of the passive receiver by placing the agc voltage on its controlled stages. The crystal diode permits agc current flow in one direction only, and the active set has agc control over the auxiliary equipment.

Figure 56. Break-in circuit, schematic diagram.

(Contained in separate envelope)

Section III. ANALYSIS OF MECHANICAL TUNING SYSTEM

80. General Principles of Operation
(fig. 57)

a. The mechanical tuning system of Radio Receiver R-390/URR controls the permeability tuning and switching elements to provide continuous tuning of the receiver over a range of .5 to 32 mc, in 32 steps (bands). Each band is tuned over a range of 1 mc except for the first band, which is tuned from .5 to 1 mc. The frequency is selected on a countertype dial, which shows the frequency in kilocycles. Figure 57 shows a simplified block diagram of the tuning system.

b. Operation of the MEGACYCLE CHANGE knob is limited to 10 turns by a progressive mechanical stop. As the control knob is turned, the first variable if. is varied within a range of 9 to 18 mc for the frequency range of .5 to 8 mc. (On the other ranges, although the slug (tuning-core) racks are moved, this circuit is disabled.) At the same time, the switches in the first and second crystal oscillators are rotated through 32 positions. The rf band switch is operated by rotation of the MEGACYCLE CHANGE knob through a Geneva system and an overtravel coupler. In addition, the starting point from which a given slug rack is moved by the KILOCYCLE CHANGE knob is established, through a differential, by the MEGACYCLE CHANGE knob. The slug racks thus affected are those controlling the frequency ranges of 16 to 32 mc, 8 to 16 mc, 4 to 8 mc, and 2 to 4 mc.

c. The KILOCYCLE CHANGE knob is connected directly through a 10 turn stop to the vfo and through the gear train to the antenna, rf amplifier, second variable if. slug racks, and the first variable if. can rack. The KILOCYCLE CHANGE knob also is connected to the same differential as the MEGACYCLE CHANGE knob. The KILOCYCLE CHANGE knob provides movement of the slug racks in the four bands (*b* above) from the starting point established by the MEGACYCLE CHANGE knob. A ZERO ADJ. knob on the front panel permits correction, over a small range, between the kilocycle reading on the counter and the mechanical and electrical tuning system.

81. Functional Analysis

a. It is intended only to provide the necessary information required by the repairman to adjust and repair the mechanical tuning system. A careful study of the material in the paragraph relating to mechanical alignment should be made in connection with the following analysis. Figure 58 shows a more detailed block diagram of the mechanical tuning system. As discussed in the theory paragraphs covering the antenna, rf, and variable if. circuits, the rate at which the frequency-determining elements of each stage must be changed varies. For example, to cover the .5- to 1-mc band in the rf stages requires the movement of slugs in coils of T201, Z201, Z207, and Z213 from one extreme to the other, or a distance of approximately 1 inch. However, the slugs in coils Z219, Z220, and Z221 move less than one-eighth of an inch in covering this range. Therefore it is necessary to achieve these various lengths of travel by mechanical gearing under the control of a single knob.

b. Reference to the block diagram (fig. 58) will show which of the circuits are controlled by each of the two front-panel controls. Starting at the right-hand side of the drawing, it can be seen that the KILOCYCLE CHANGE control, working

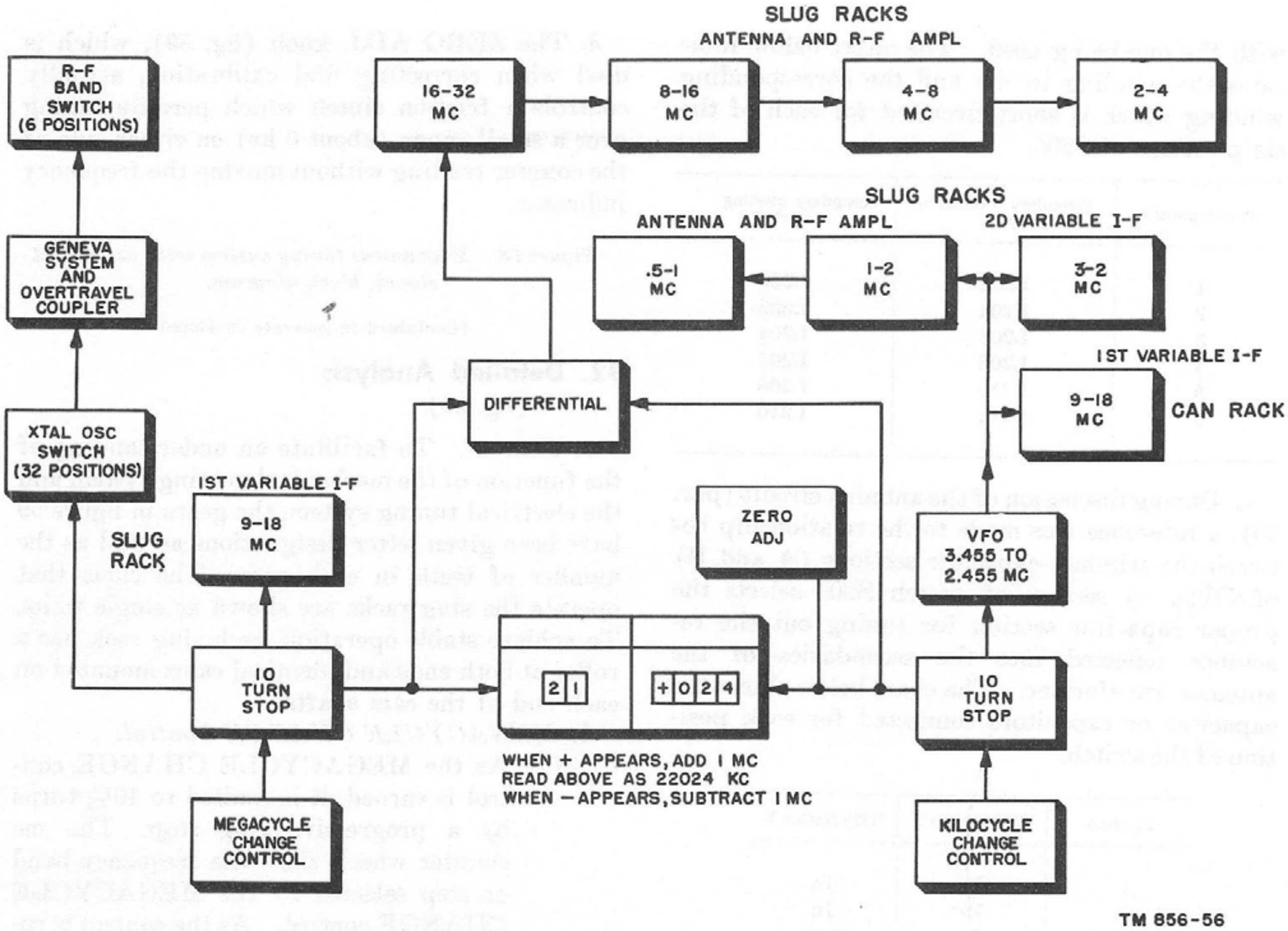


Figure 57. Mechanical tuning system, block diagram.

through the 10-turn stop, varies the position of the variable frequency-oscillator slug, the second variable if. slug rack, the first variable if. can rack, the rf slug rack covering the .5- to 1-mc range, and the rf slug rack covering the 1- and 2-mc range.

c. The MEGACYCLE CHANGE control, through a 10-turn stop and the Geneva system and overtravel coupler, varies the positions of switches S201 through S210. This control also selects the proper crystal frequency for the first and second crystal oscillator stages, by operating the 32-position switch through a system of gears. The MEGACYCLE CHANGE control rotates switches S401 through S404 in the first and second crystal oscillators through 32 steps of frequency coverage. These 32 steps are covered by only 6 transformers or coils, for each stage. Since each set of coils has a frequency ratio of 2 to 1, it is necessary to have the positions of the switches change only 6 times for 32 steps of frequency coverage. This is accomplished by a lost-motion coupler with a few teeth approximately geometrically spaced around the perimeter of the gear. A driven gear associated with this gear will rotate only when it is engaged by one of the teeth on the lost-motion gear. The MEGACYCLE CHANGE control also sets (through the differential) the starting point of the slug racks of the last four bands. From this starting point, the KILOCYCLE CHANGE control moves (through the same differential) these slug racks to cover frequency range of the KILOCYCLE CHANGE control. The first variable if. cans are mounted on a rack which is driven by the KILOCYCLE CHANGE control, as required, to keep these circuits in alignment during tuning.

d. The MEGACYCLE CHANGE control drives switch S205. The front section of the switch is used to short-circuit the secondary winding of the unused adjacent antenna transformer (next lower in frequency) to prevent interaction with the one being used. The chart below indicates the winding in use and the corresponding winding which is short-circuited for each of the six positions of S205.

Switch position	Secondary winding in use	Secondary winding shorted
1	L202	L206
2	L204	L202
3	L206	L204
4	L208	L206
5	L210	L208
6	L212	L210

e. During discussion of the antenna circuit (par. 50), a reference was made to the relationship between the trimmer-capacitor sections (A and B) of C225. A section of switch S203 selects the proper capacitor section for tuning out the reactance reflected into the secondaries of the antenna transformer. The chart below shows the capacitor or capacitors connected for each position of the switch.

Position	C225 Section A	C225 Section B
1	In	In
2	In	In
3	In	Out
4	In	Out
5	Out	In
6	Out	In

f. When inspecting the various gears employed, note that each gear in the Geneva system actually is composed of two gears which are adjacent to each other and are loaded by a spring in opposite directions. This is done to achieve a constant tension at the point where the gear is driven or at which it drives an associated gear. In this manner, lost motion, or backlash, as a result of play between the gear teeth, is prevented. All gears and cams employed are precision-cut, and are designed to give many years of trouble-free service.

g. The calibration oscillator is not a part of the tuning system. It provides calibration signals which are used in correcting small errors in tuning made by the mechanical tuning system. By the use of the proper calibration signal and the ZERO ADJ. control, the receiver counter reading can be made to coincide with the frequency of the received signal.

h. The ZERO ADJ. knob (fig. 59), which is used when correcting dial calibration, actually controls a friction clutch which permits tuning over a small range (about 6 kc) on either side of the counter reading without moving the frequency indicator.

Figure 58. Mechanical tuning system with associated stages, block diagram.

(Contained in separate envelope)

82. Detailed Analysis

(fig. 59)

a. *General*. To facilitate an understanding of the function of the mechanical gearing system and the electrical tuning system, the gears in figure 59 have been given letter designations as well as the number of teeth in each gear. The cams that operate the slug racks are shown as single units. To achieve stable operation, each slug rack has a roller at both ends and identical cams mounted on each end of the cam shafts.

b. *MEGACYCLE CHANGE Control*.

(1) As the MEGACYCLE CHANGE control is turned, it is limited to 10½ turns by a progressive ring stop. The mc counter wheels show the frequency band or step selected by the MEGACYCLE CHANGE control. As the control is rotated, the wheels are driven through gears (A), (B), (C), (D), (E), (F), (RR), (SS), (TT), (UU), (VV), (WW), and (XX).

(2) The control operates the first variable if. slug-rack cam through gears (A), (B), (C), (D), (E), (F), and (G). At the same time, the 32 position crystal oscillator switches are operated by the control through gears (A), (B), (C), (D), (E), an Oldham coupler, and gears (H) and (J). The Oldham coupler is used to correct slight misalinement between the ends of the shafts which are mechanically coupled at the crystal oscillator subchassis.

(3) The 6-position rf band switches are also operated by the MEGACYCLE CHANGE control through gears (A), (B), (C), (D), (E), (K), the Geneva system (L), lost motion gear (GGG), gears (M), (N), and (P). The Geneva

system provides an intermittent motion so that the switch is turned to only one of its six positions. The gear (L) rotates continuously as the control is turned. However, the gears (M), (N) and (P) are driven only during the part of the rotation of the gear (L) when the teeth of lost motion gear (GGG) engage the teeth of the gear (M).

(4) The 2–4 mc, 4–8 mc, 8–16 mc, and 16–32 mc rf slug racks are moved by both the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls through a differential gear system. The 2–4 mc rf slug rack cam is operated by the MEGACYCLE CHANGE control through gears (A), (B), (Q), (R), (S), and (T). The 4–8 mc rf slug rack cam is operated through gears (A), (B), (Q), (R), (S), (T), (U), and (V). The 8–16 mc rf slug rack cam is rotated through gears (A), (B), (Q), (R), (S), (T), (U), (V), (W), and (X). The 16–32 mc rf slug rack cam is turned through gears (A), (B), (Q), (R), (S), (T), (U), (V), (W), (X), (Y), and (Z).

(5) In each of the steps of frequency coverage, it is necessary to have an exact reference or stopping position for the circuit elements controlled by the MEGACYCLE CHANGE. This is accomplished by the mc change detent. A disk with three notches spaced equally around its edge is rotated by gears (B) and (A) when the control is operated. An *L*-shaped bracket made of spring material presses against the disk and produces an effective stop at each notch.

c. KILOCYCLE CHANGE Control.

(1) The KILOCYCLE CHANGE control is limited to 10½ turns by a progressive ring stop. The kc counter wheels show the frequency selected by the KILOCYCLE CHANGE control. To permit overlapping of each band selected, the frequency range of this control is greater than 1 mc. As the KILOCYCLE CHANGE control is rotated, the wheels are driven through gears (AA), (YY), (ZZ), (AAA), (BBB), and (CCC).

(2) The vfo tuning unit is connected through an Oldham coupler to the KILOCYCLE CHANGE control.

(3) As the KILOCYCLE CHANGE control is rotated, the second variable if. slug rack cam and the first variable if. can rack cam are operated through gears (BB), (CC), (DD), (EE), and (FF).

(4) The 2–4 mc, 4–8 mc, 8–16 mc, and 16–32 mc rf slug racks are moved by the KILOCYCLE CHANGE control through a differential gear system. The rf slug rack cams mentioned above are operated through the same gears mentioned in *b*(4) above except for gears (A) and (B). These two gears are replaced by gears (BB), (CC), (GG), (HH), (PP), and (QQ).

(5) The .5–1 mc rf slug rack cam is operated through gears (BB), (CC), (GG), (HH), (JJ), (KK), and (LL). The 1–2 mc rf slug rack cam is operated through gears (BB), (CC), (GG), (HH), (JJ), (KK), (LL), (MM), and (NN).

(6) The gear (EEE) is shown engaged with gear (HH) through gear (FFF). Gear (EEE) does not normally engage gear (DDD), but during disassembly and reassembly procedures it prevents loss of synchronization between the KILOCYCLE CHANGE control and the MEGACYCLE CHANGE control through the differential to the 2–4 mc, 4–8 mc, 8–16 mc and 16–32 mc slug racks. One side of gear (EEE) is covered with green paint. When the green is visible, the synchronization is locked.

d. ZERO ADJ. Control. The ZERO ADJ. control provides a means of correcting errors in calibration. A locking screw operated by the knob releases the clutch and locks the gear (ZZ). Tuning over a range of approximately 6 kilocycles is possible without moving the three right-hand number wheels on the countertype frequency indicator. Operation of the knob in a counterclockwise direction engages the clutch and unlocks gear (ZZ).

Figure 59. Tuning system, exploded view.

(Contained in separate envelope)

CHAPTER 5

FIELD MAINTENANCE

Note. **This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.**

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the receiver, avoid contact with the power supply and plate circuits. The high voltages present in these circuits can cause serious injury.

83. Troubleshooting Procedure

a. General. The first step in servicing a defective Radio Receiver R–390/URR is to sectionalize the fault. Sectionalization consists of tracing the fault to the subchassis responsible for the abnormal operation of the receiver or to the front panel and main frame. The second step is to localize the fault. Localization means tracing the fault to the defective *circuit* on the subchassis or front panel and main frame. Finally, by voltage, resistance, and continuity measurements, the defective *part* is isolated. Some faults, such as burned-out resistors, shorted transformers, and loose connections often can be located by sight, smell, and hearing. The majority of faults, however, must be located by *checking voltage and resistance.*

b. Detailed Procedure. The tests listed below are to be used as a guide in isolating the source of the trouble. To be effective, the procedure should be followed in the order given. Remember that the servicing procedure should cause no further damage to the receiver. The procedure is summarized in (1) through (7) below, which contain references to paragraphs having detailed information for carrying out the tests.

(1) *Initial inspection.* It is often possible to locate troubles within an equipment by inspecting the condition of the wiring and detail parts for visible evidence of failure. Since this inspection (par. 89) can be quickly and simply carried out, and is capable of yielding such rapid results, it is the first to be applied in the troubleshooting procedure. This inspection is of further value in that additional damage to the receiver that might occur through improper servicing methods can possibly be avoided.

(2) *Checking B+ and filament circuits for shorts.* These measurements (par. 90) prevent further damage to the receiver from possible short circuits. Since this test gives an indication of the condition of the filter circuit, its function is more than preventive.

(3) *Operational test.* After it has been determined in the preceding test that a short is not present in the receiver, an operational test (par. 91) is carried out. By using the information gained from observing the symptoms of faulty operation, it is sometimes possible to determine the exact nature of the fault.

(4) *Troubleshooting chart.* The troubleshooting chart (par. 92) presents a systematic method for checking out the receiver by eliminating possible sources of trouble until the actual trouble is finally resolved.

(5) *Signal substitution.* Signal substitution (pars. 94 through 99), when used in conjunction with the troubleshooting chart, provides an effective method for methodically tracking down trouble in a receiver.

(6) *Stage gain charts.* These charts (par.

101) are useful in localizing obscure, hard-to-find troubles.

(7) *Intermittents.* In all these tests the possibility of intermittents should not be overlooked. If present, this type of trouble may be made to appear by tapping or jarring the subchassis or parts under test. It is possible that the trouble is not in the receiver itself, but in the installation (mounting, antenna, ground, auxiliary equipment, or vehicle), or the trouble may be due to external conditions. In this event, test the installation, if possible.

84. Troubleshooting Data

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

Fig. No.	Par. No.	Description
	77	List of series filament circuits.
25		Radio Receiver R–390/URR, top deck, tube location.
26		Radio Receiver R–390/URR, bottom deck, tube location.
60 and 61		Fabrication of bench-test cables.
	101	Stage-gain charts.
	102	Dc resistances of transformers and coils.
	103	Rf and variable if. conversion scheme.
62 through 79		Top and bottom views of receiver subchassis, showing locations of parts.
80 and 81		Radio Receiver R–390/URR, main frame.
82 and 83		Tube-socket voltage and resistance and subchassis receptacle resistance diagrams.
107		Subchassis and interconnection diagram.
108		Radio Receiver R–390/URR, schematic diagram.

85. Test Equipment and Tools Required for Troubleshooting

a. The test equipment required for troubleshooting Radio Receiver R–390/URR is listed below. The technical manuals associated with the test equipment, where applicable, are also listed.

Test equipment	Technical manual
RF Signal Generator Set AN/URM–25, or equal.	TM 11–5551.
Audio Oscillator TS–382/U, or equal	TM 11–2684.
Electronic Multimeter TS–505/U, or equal.	TM 11–5511.
Multimeter TS–352/U, or equal	TM 11–5527.

Figure 60. Assembly instruction for cable No. 1.

(Contained in separate envelope)

b. The tools and materials contained in Tool Equipment TE–113 are required for field maintenance of Radio Receiver R–390/URR.

86. Bench Testing

a. When a cause of equipment failure has been sectionalized to a subchassis, as determined by visual inspection, operational test, or the use of the troubleshooting chart, a bench test of the faulty subchassis may be required to locate the trouble through voltage readings. Since the undersides of the subchassis are not accessible for troubleshooting when the subchassis are mounted in the receiver, it may be necessary to remove the subchassis under test and connect them to the receiver circuits by the extension cables. Directions for the fabrication of the extension cables are given in figures 60 and 61. The amount and type of extension needed can be determined from the chart in *b* below.

b. To prepare a subchassis for bench testing, remove the subchassis from the receiver according to the instructions contained in paragraph 105. *Avoid the possibility of disturbing the synchronization of the gear train with the rf subchassis, crystal oscillator subchassis, and vfo subchassis.* Connect the extension cables between the receiver and subchassis according to the chart below.

Caution: When the subchassis are operated outside the receiver, dangerous voltages are exposed at the tube-socket pins and other points on the undersides of the chassis. Observe the rules for servicing in the presence of high voltage to prevent possible injury.

Subchassis	Cable No.	Connect between
Rf	1	P209–J109
	1	P210–J110
	1	P211–J111
	1	J223–P723
	1	P224–J924
	1	P225–J525
	1	P226–J526
		P221–J421
		P222–J422
	2	J214–P114
Af	3	J619–P119
	4	J620–P120
Ac power supply	5	J818–P118
Crystal oscillator	6	J413–P113
	1	J421–P221
	1	J422–P222
Vfo	7	P715–J115
	1	P723–J223
Calibration oscillator	7	P916–J116
	1	J924–P224
If	1	J512–P112
	1	J525–P225
	1	J526–P226
	8	J517–P117

87. General Precautions

When a receiver is to be serviced, observe the following precautions very carefully:

a. When the receiver is removed from the case, cabinet, or rack for servicing, connect an adequate ground to the main frame and to any subchassis operated outside the main frame before connecting the power cord.

b. Make certain that the receiver is disconnected from the power source or is turned off before contacting high-voltage circuits or changing connections.

c. After disconnecting auxiliary equipment and before testing the receiver, connect pairs of terminals on the back-panel terminal strips as shown in figure 22.

d. After disconnecting tuning shafts for removal of a subchassis, avoid turning the shafts or tuning controls unless necessary for troubleshooting or adjustment. Careful handling may eliminate the need for synchronization. It will be helpful to make a note of the positions of the front-panel controls indicated in the removal procedure upon removal of a subchassis, since a control may be inadvertently disturbed during servicing.

e. Careless replacement of parts often makes new faults inevitable. Note the following points:

(1) Before unsoldering a part, note the position of the leads. If the part has a number of connections, tag each of its leads.

(2) Be careful not to damage other leads while pulling or pushing them out of the way.

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

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

(5) *When a part is replaced in the rf or if. circuits, it must be placed in the exact position of the original part. A part that has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground as in the original wiring. Failure to observe these precautions may result in decreased gain or, possibly, in oscillation of the circuit.*

f. Before taking voltage measurements or performing signal tracing, always check the value of the regulated dc voltage. Approximately 180 volts dc should be obtained at B+ 180V DC jack, J601, located on the af subchassis (fig. 75). This jack is accessible through the main frame of the receiver, at the side.

88. Troubleshooting Notes

a. To avoid the necessity for removing a subchassis when voltage is to be measured or signal injected at a tube-socket pin that does not have a test point, remove the tube, insert into the desired contact a short length of thin insulated wire having both ends bared, and replace the tube. Connection to a voltmeter or signal generator then can be made through the exposed end of the wire. The rf tuning coils and transformers on the rf subchassis can be readily removed, if necessary, to permit measurement of voltage or resistance at the socket contacts, or measurement of the continuity of the coils. Instructions for the removal of the coils and transformers are contained in paragraph 105*q*.

b. If trouble is suspected in the rf subchassis, perform as much detailed troubleshooting as possible to make certain that the trouble is in the subchassis before removing it as removal of the rf subchassis is a difficult and time-consuming procedure.

c. When it is suspected that injection voltage from vfo is not being supplied to the third mixer, check the 3TF7 voltage regulator tube. If the tube does not glow, or if an excessive glow is noted, replace the tube.

d. When the filament of a particular tube fails to light, trouble may be in another tube in the same series filament circuit. Refer to the series filament circuit diagram (fig. 54).

e. When trouble appears to be in regulator tube V605, V606, or V607, first observe that tubes V608 and V609 are glowing normally, and then check B+ voltage at the B+ 180V DC jack before testing regulator tubes in the tube tester.

89. Initial Inspection

When a receiver is brought in from the field for check or repair, remove the top and bottom dust covers, and inspect it as follows, observing the precautions described in paragraph 87.

a. Inspect all cables, plugs, and receptacles. *Check to see that all connectors are seated properly.* This is important because improperly seated connectors are a frequent cause of abnormal operation in equipment. Repair or replace any connectors or cables that are broken or otherwise defective.

b. Inspect for burned insulation and resistors that show signs of overheating. Look for wax leakage and any discoloration of apparatus and wires.

c. Inspect for broken connections to tube sockets, plugs, and other apparatus, as well as for defective soldered connections. Examine for bare wires touching the chassis or adjoining wires.

d. Make sure that all tubes are in their correct positions as shown in figures 25 and 26. Replace or interchange any tubes that are not of the type called for in the illustrations. Replace broken tubes. Inspect for loose tube-socket contacts.

e. Inspect the fuses and replace, if necessary, with fuses of correct rating and type. Check carefully for short circuits (par. 90) wherever a blown fuse is found.

f. See that the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls turn freely. Rough operation or binding indicates a damaged tuning system or need for cleaning and lubrication (par. 106).

g. Check all switches and controls for ease of operation.

90. Checking B+ and Filament Circuits for Shorts

a. To prevent damage to a receiver sent in for repair, always check the resistance of the high-voltage circuits before applying power to the equipment. Repeated burning out of B+ 3/8A fuse, F102, is an indication of a short in one of the high-voltage circuits. Disconnect Power Cable Assembly CX–1358/U from the ac power input, and test the cable assembly (par. 44). After it has been determined that the cable assembly is normal, set the FUNCTION switch at AGC and check the high-voltage circuits as follows:

(1) The resistance measured between the chassis and tube-socket pin 2 or 5 of regulator tube V605 and V606 should be approximately 140,000 ohms. This measurement can be taken at the 3/8A fuse holder by leaving the fuse in place. If the resistance is low, check capacitor C101 (fig. 81) for a short circuit or leakage. If the resistance is abnormally high or infinite, check for an open circuit caused by a break in wiring, poor connector contact, or, possibly, an open capacitor C101.

(2) The resistance measured between the chassis and the B+ 180V DC jack J601 should be approximately 19,000 ohms with the FUNCTION switch at OFF or STAND BY, approximately 9,400 ohms with the FUNCTION switch at AGC, MGC, or CAL, and approximately 8,500 ohms with the FUNCTION switch at SQUELCH. If the resistance is low, check for a short-circuited or leaking bypass capacitor, or for a short circuit in the wiring of one of the plate or screen-grid circuits of the individual subchassis. If the resistance measured is greater than normal, an open screen-grid bleeder and/or dropping resistor is indicated.

(3) If the tests outlined in (1) and (2) above indicate that a short circuit is present in the receiver, determine in which subchassis it is located, as follows:

(*a*) Turn the FUNCTION switch to OFF.

(b) Disconnect all interconnecting cables that carry power to the subchassis.

(c) Replace any blown fuses.

(d) Check to see that the 115V/230V switch on Power Supply PP–621/URR is in the proper position for the available ac power source, and connect Power Cable Assembly CX–1358/U between the receiver and power source. Turn the FUNCTION switch to AGC.

(e) Reconnect (one at a time) the cables that carry power to the individual subchassis in the following order: Power Supply PP–621/URR, af subchassis, if. subchassis with the BFO switch in ON position, vfo subchassis, crystal-oscillator subchassis, rf subchassis, and crystal-calibrator subchassis with the FUNCTION switch in CAL position. If the B+ 3/8A fuse blows after the power cable is connected to a subchassis and, in the case of the if. and rf subchassis, the BFO and FUNCTION switches, respectively, are turned to the positions indicated, there is probably a short circuit in that subchassis.

b. If the tests performed as instructed in *a*(1), (2), and (3) above reveal no trouble, the filament circuits should be checked as follows:

(1) See that all the necessary interconnecting cables are in position and properly connected.

(2) Turn the FUNCTION switch to AGC, and check the filament circuits as described in paragraph 42. A short in the low-voltage or filament circuits will be evidenced by the repeated burning out of AC 3A fuse, F101. In addition to a defective filament circuit, a short circuit to ground in oven heater HR401, HR701, or HR901, or dial lamps I 101 or I 102 will seriously affect the low-voltage circuit. If an abnormal filament circuit is indicated, test the tubes by using one of the techniques described in paragraph 43.

91. Operational Test

a. Operate the equipment as described in the equipment performance check list (par. 47). This check list is important because it frequently aids in sectionalizing the trouble without the need for further testing. Check for overheated parts, faulty controls, and intermittent operation. Observe closely the readings of the CARRIER LEVEL and LINE LEVEL meters. A normal reading on the CARRIER LEVEL meter usually indicates satisfactory operation of the agc circuit and all stages up to and including the fifth if. amplifier. If the LINE LEVEL meter reading is normal, satisfactory operation of the remaining stages, except for second af amplifier, section A of V602, and the local audio channel output stage, V603, is indicated. These latter stages can be checked by listening with a 600-ohm headset or speaker.

b. To check the local audio and if. stages quickly, connect a headset to the PHONES jack on the front panel. Turn the FUNCTION switch to AGC. Starting at the 16–KC position of the BANDWIDTH switch, set the switch in turn to each lower position. If the volume of the rushing sound heard in the headset decreases noticeably with each lower setting, the if. and local audio stages are operating. This test does not necessarily indicate normal operation.

c. The calibration-oscillator signal can be used as a convenient means of quickly localizing trouble in the receiver. Typical methods are described in (1) and (2) below.

(1) To check the contacts of the rf band switch (S201 through S210) (fig. 64) and crystal-oscillator band switch (S401 through S404) (fig. 66), connect a headset to the PHONES jack on front panel. Set the FUNCTION switch at CAL. Set the KILOCYCLE CHANGE control to any 100-kc position. Starting with the lowest detent position of the MEGACYCLE CHANGE control, turn the control to each detent position in succession. Adjust the BFO PITCH control as necessary to obtain a signal in the headset. If no audible signal is heard in a detent position, trouble in contacts of the rf band switch or crystal-oscillator band switch is indicated.

(2) The LINE LEVEL meter, LINE METER switch, and LINE GAIN control are checked as follows: connect a headset to the PHONES jack on the front panel and adjust the KILOCYCLE CHANGE control for an even 100-kc reading on the dial. Set the FUNCTION switch at CAL and turn the BFO

switch to ON; an audible tone should be heard in the headset. Set the LINE METER switch to −10 and adjust the LINE GAIN control so that the LINE LEVEL meter reads 0 vu (upper scale). Turn LINE METER switch to 0. Reading on LINE LEVEL meter should drop to −10 vu. Readjust the LINE GAIN control for a 0-vu reading on LINE LEVEL meter. Turn the LINE METER switch to +10. The LINE LEVEL meter reading should drop to −10 vu. If indications described above are not obtained, check the LINE LEVEL meter and 10-db pads (fig. 85), the LINE METER switch, and the LINE GAIN control.

d. The synchronization of the tuning shafts can be quickly checked as follows:

(1) Set the frequency-indicator reading so that the first two digits are zeros and the last three digits read an even 100 kc or multiple thereof.

(2) Set the FUNCTION switch at CAL.

(3) Advance the RF GAIN control until the reading is obtained on the CARRIER LEVEL meter.

(4) Raise the .5- to 1-mc slug rack (fig. 86) slightly with the hand; the CARRIER LEVEL meter reading should decrease.

Caution: To prevent damage do not depress the slug rack too strongly.

(5) Depress the .5- to 1-mc slug rack slightly with the hand; the meter reading should decrease. If the reading increases when the slug rack is either raised or depressed, the camshaft is out of synchronization.

(6) Repeat the procedures described in (1) through (5) above for each slug rack, setting the megacycle digits on the frequency-indicator dial at a reading within the band covered by the slug rack being checked.

e. If the receiver is not synchronized, refer to paragraph 111.

92. Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the radio receiver. This chart lists the symptoms that the repairman observes, either visually or audibly while making simple tests. The chart also indicates how to localize trouble quickly to the audio, if. or rf stage that is defective. The signal-substitution tests outlined in paragraphs 94 through 99 can then be used to supplement this procedure to aid in locating the defective stage. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of the stage or circuit should ordinarily be sufficient to isolate the defective part.

Symptom	Probable trouble	Correction
1. When FUNCTION switch is in AGC position, receiver fails to operate and dial lamp does not light.	Open AC 3A fuse (F101) on rear panel of receiver.	Replace fuse. If it blows again, check power supply, filament, and oven circuits for shorts. Check primary power connections.
2. Dial lamp lights, but CARRIER LEVEL meter does not deflect. No reception.	No. B+ voltage. Open B+ ⅜A fuse (F102) on rear panel of receiver.	Replace fuse. If it blows again, test capacitor C101 for short. Test plate and screen-grid circuits for shorts (par. 90).
3. No receiver output. CARRIER LEVEL meter raises and dips as KILOCYCLE CHANGE control is rotated.	Fault is in signal circuit after 5th if. stage.	Connect headset in series with a .1-UF capacitor across grid circuit and plate circuits of successive audio stages to localize defective stage. Stage may also be localized by signal substitution (pars. 95 and 96). Test tube of defective stage. (Note series filament circuits (par. 42).) If necessary, check voltages and then resistances of circuits within a stage (fig. 83) to locate a defective part.
4. Af circuits function satisfactorily, but no signal output is obtained when 455-kc modulated signal is applied to if. input (J525 or J526, fig. 68)	Faulty if. stage	Test if. stages by signal substitution method (par. 98). Test tubes. When necessary, localize fault by voltage and resistance measurements (fig. 82).

Symptom	Probable trouble	Correction
5. If. circuits respond to 455-kc signal but no station is received.	Crystal oscillator band switch or vfo tuning shaft out of synchronization. Faulty mixer, oscillator, or rf stage.	Check synchronization of band switch and tuning shaft (par. 110). Test mixer stages, rf stages, and crystal oscillators by signal substitution method (pars. 99 and 100).
6. No beat frequency heard when BFO switch is turned ON and BFO PITCH control varied.	Faulty bfo	Test tube V508. Check voltages at tube-socket pins (fig. 82). Check BFO switch.
7. No calibration signal when FUNCTION switch is at CAL.	Defective calibration oscillator	Test tubes V901 and V902. Substitute crystal Y901 for one that is known to be good. Check voltages and resistances of oscillator circuits (fig. 83).
8. Excessive hum from ac power supply.	Defective filter capacitor or electronic voltage regulator.	Adjust HUM BAL control, R614 (par. 109). Check C101. Test tubes V605, V606, and V607 (par. 88*e*). Check voltage across reference tubes V608 and V609. Check C607 for capacitance and leakage. Check voltage and resistance of voltage regulator (fig. 83).
9. Weak signal	Low voltage. Weak tubes	Check power-input voltage. Check B+ voltage at J601 (fig. 75). Test tubes. Check gain of each stage to localize trouble (par. 101). Check for shorted capacitors. If no fault is indicated by a thorough check of tubes and voltages when the output is weak, aline tuning circuits (pars. 108 through 120).
10. Noisy receiver	Noisy antenna location. Poor connection or shorting elements within a tube.	Short-circuit antenna to ground by setting FUNCTION switch to CAL. (Receiver must not be tuned to even 100-kc frequency, or calibration signal will interfere with test.) A considerable decrease in noise indicates noisy signal from antenna. Use insulated prod to tap each tube. If tapping a tube causes increase in noise in the output, try different tube.
	Loose connection at a terminal or within a part.	Tap the parts. Move terminals slightly, and listen for noisy output. Noise indicates that a connection should be soldered or that a part needs replacing.
11. Receiver output noisy when controls are operated.	Dirty switch contacts. Poor contact at rotor of a gain control.	Clean switch contacts. Clean and lubricate control, or replace.
12. Distorted signal	Weak tube. Incorrect voltage on tube. Leaky capacitor, such as C603 or C610.	Check tubes and replace if necessary. Check voltages and resistance in af subchassis (fig. 83). Use headset connected in series with a .1-μf capacitor to check signal across grid and plate circuits of audio stages and, thus, to localize trouble.

93. Voltage and Resistance Checks

Voltage and resistance diagrams for the various subchassis of the receiver are shown in figures 82, 83, and 84. These drawings show the values that should be obtained at the tube-socket pins, subchassis receptacles, and terminal boards. If a value, as read on the multimeter, varies (outside of reasonable tolerance limits) from the value given in the diagrams, the amount of variance should be noted and used to aid in determining which part is at fault. For instance, if a 100,000-ohm resistance reading is indicated at a given tube-socket pin on a diagram, and the actual reading is 30,000 ohms on the meter, the circuit diagram of the subchassis should be examined for the presence of a resistor in the circuit under test that could, if defective, account for the incorrect read-

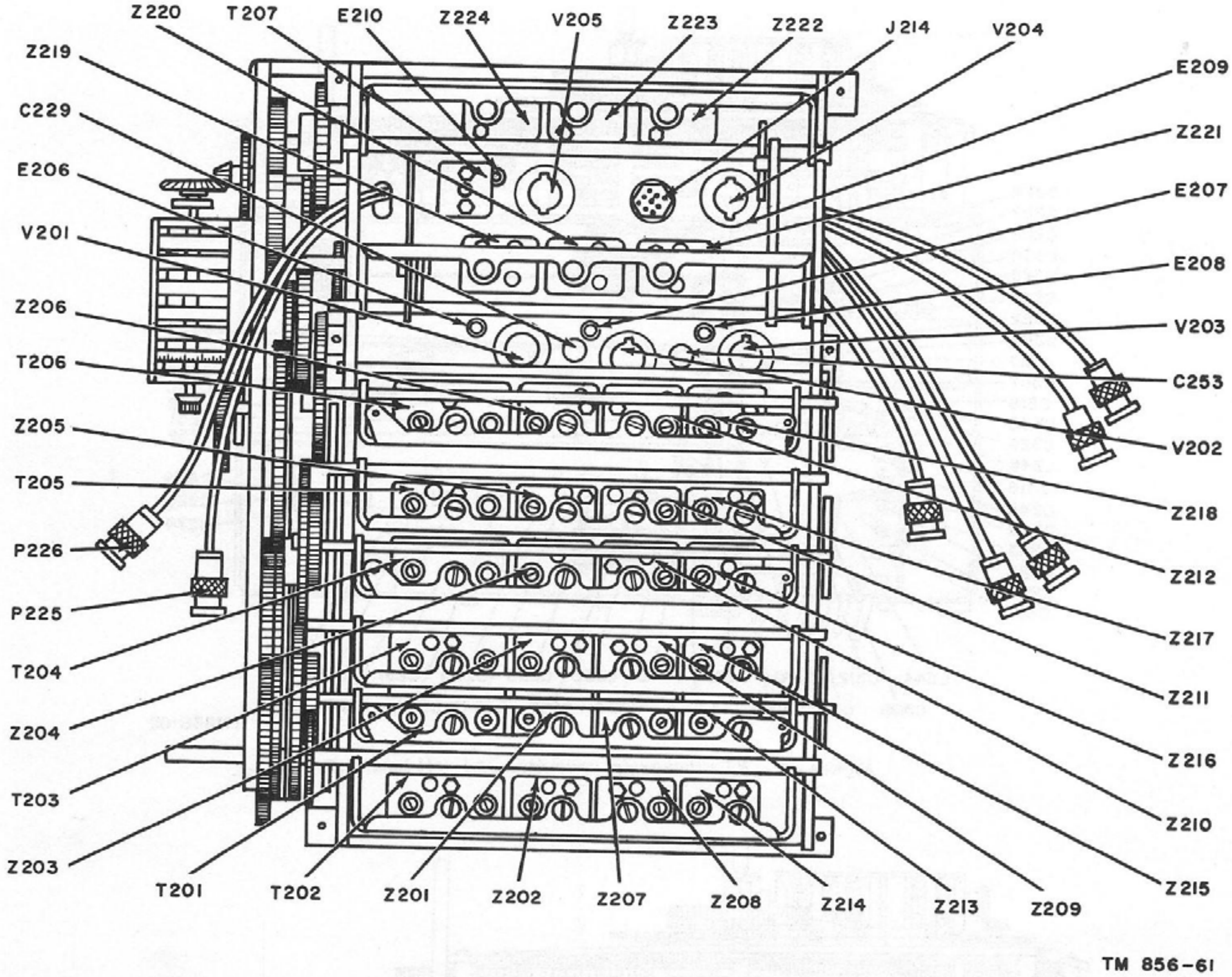


Figure 62. Rf subchassis, top view.

ing. Such a resistor would then be suspected and should be checked Another possibility would be that a capacitor has shorted out and is shunting a resistor. There are many ways of using the voltage and resistance diagrams, depending on the resourcefulness of the repairman.

94. Signal Substitution Notes

a. Signal substitution for Radio Receiver R–390/URR requires an audio oscillator, such as Audio Oscillator TS–382/U, for checking the line and local audio channels, and a signal generator, such as RF Signal Generator Set AN/URM–25, to provide a source of modulated rf and if. signals for checking the rf, variable if., and fixed if. stages. In addition to producing an if. signal of 455 kc, the signal generator should cover an rf range of at least 400 kc to 32 mc. The signal generator should be capable of furnishing an rf signal output at any level between 1 microvolt and 1 volt.

b. A multimeter, such as Electronic Multimeter TS–505/U, and tube tester, such as Electron Tube Test Set TV–2/U, are needed to isolate the defective part after the faulty stage has been indicated by signal substitution.

c. For the tests described in paragraphs 95 through 99 inclusive, connect the ground lead of the audio oscillator or signal generator to the subchassis being tested, and connect the signal output lead through a capacitor (aprx. .05 μf), to the point specified. The bench-testing information in paragraph 86 and the information in paragraph 88*a* indicate the method of preparing the subchassis for signal tracing.

d. Note the volume, and listen for distortion from the speaker or headset at various points in

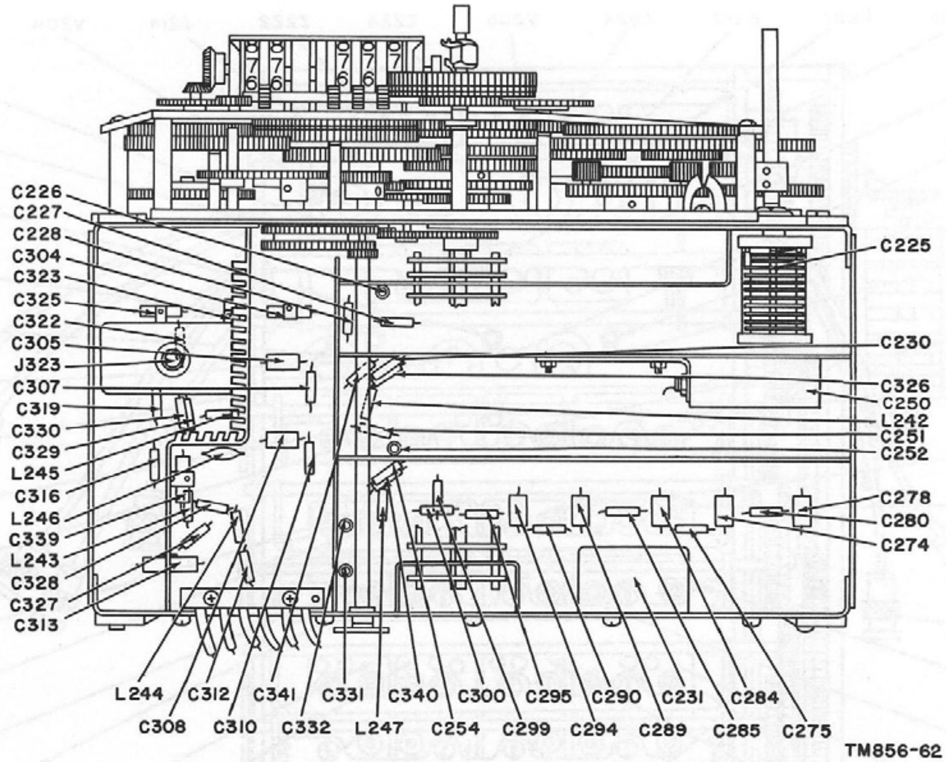


Figure 63. Rf subchassis, capacitor and coil location.

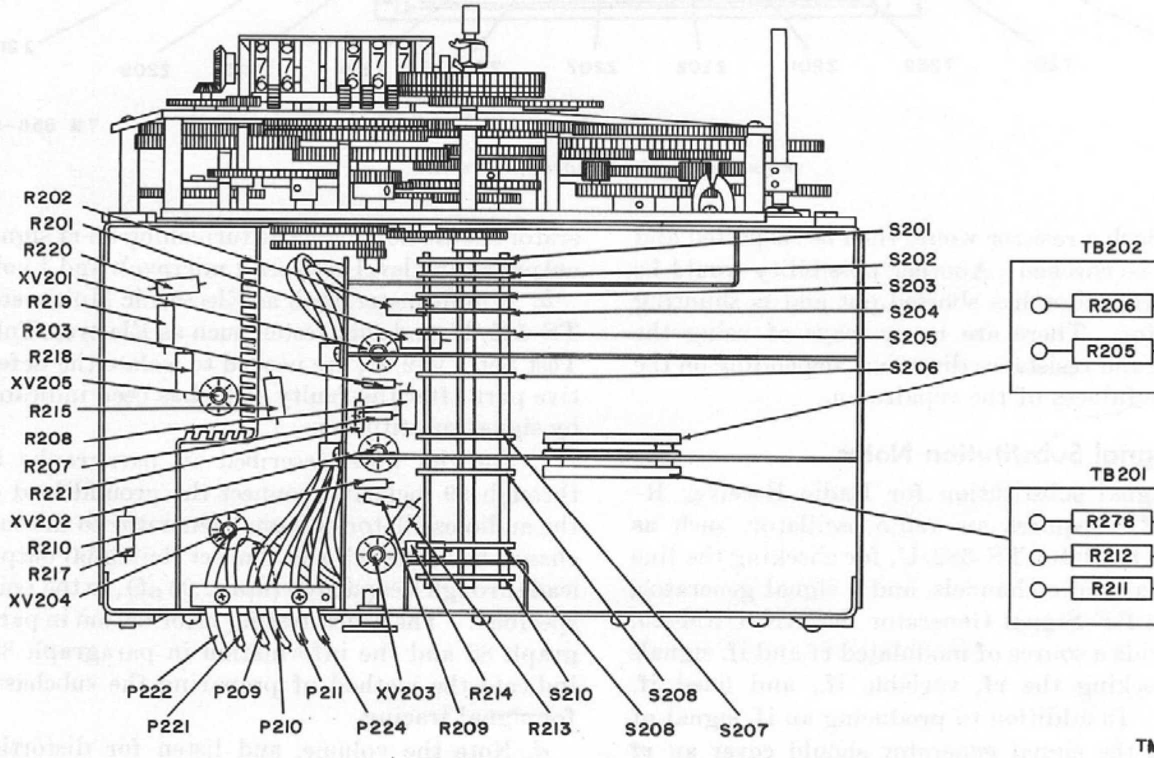


Figure 64. Rf subchassis, bottom view.

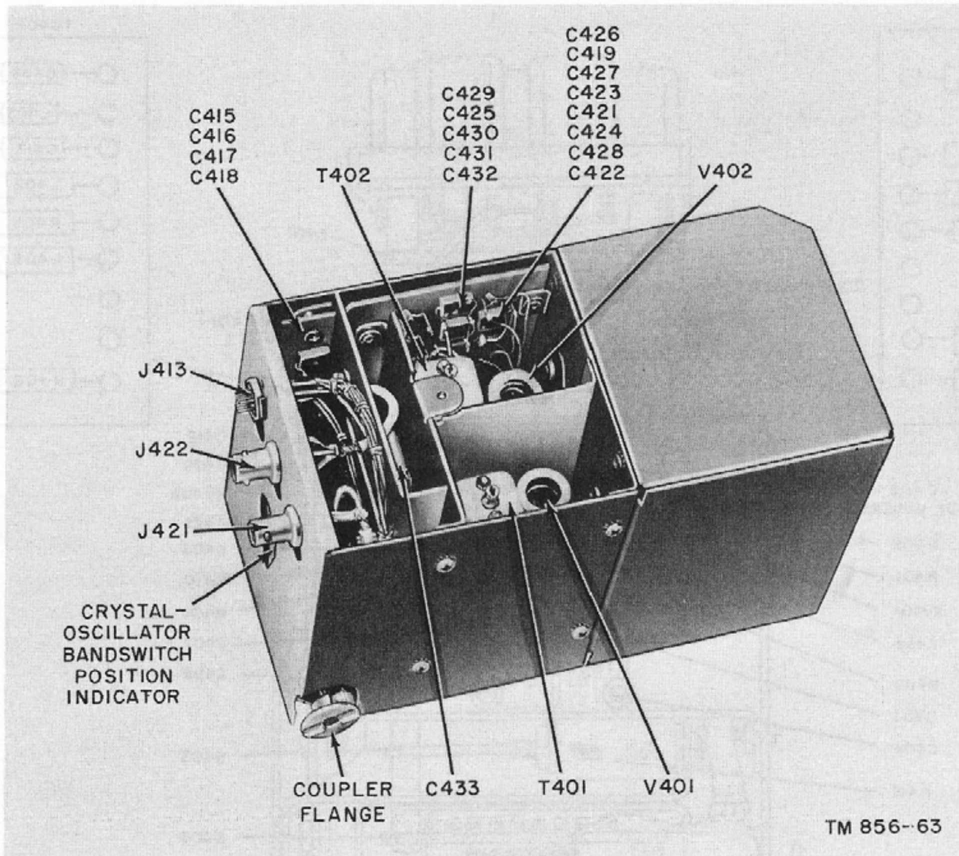


Figure 65. Crystal-oscillator subchassis, top view.

the signal-substitution procedure. Make certain that the LIMITER control is in the OFF position: if it is in the ON position, it may be the cause of the distortion. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. If possible, compare results with a receiver known to be in good condition.

e. Check the wiring and soldering in each stage during the procedure.

f. A tuning shaft that is out of synchronization or a trimmer adjustment that is misalined may cause reduced output or may prevent any output. Synchronization of the shafts and cams (par. 110*a*) should be checked, and the position of the rf and crystal oscillator band switches should be checked (par. 110*b* and *c*) before the adjustment of individual tuning circuits (pars. 111 through 116) is attempted.

g. When trouble is localized in a given stage, first test the tube, if such a test is indicated. Then measure the voltage and, finally, the resistance of the circuits of that stage (figs. 82, 83, and 84).

h. Trouble in a circuit or stage does not always change the voltage and resistance measurements at the tube socket or terminal board. Instructions included in this paragraph merely serve as a guide, and suggest other procedures, such as voltage and resistance measurements of individual parts.

i. When testing, remove only *one* tube at a time. Check the type number of the tube, test the tube, and, if it is not defective, return it to its proper socket before removing another tube.

j. At each step it is assumed that all previous steps were completed satisfactorily. Isolate and clear any trouble discovered before proceeding with succeeding steps.

k. Refer to the notes in paragraph 88 while performing the tests.

95. Local-Audio-Channel Tests

a. Pin 5 of V603 (Plate of Local AF output Tube). Apply an af signal to pin 5 of tube socket

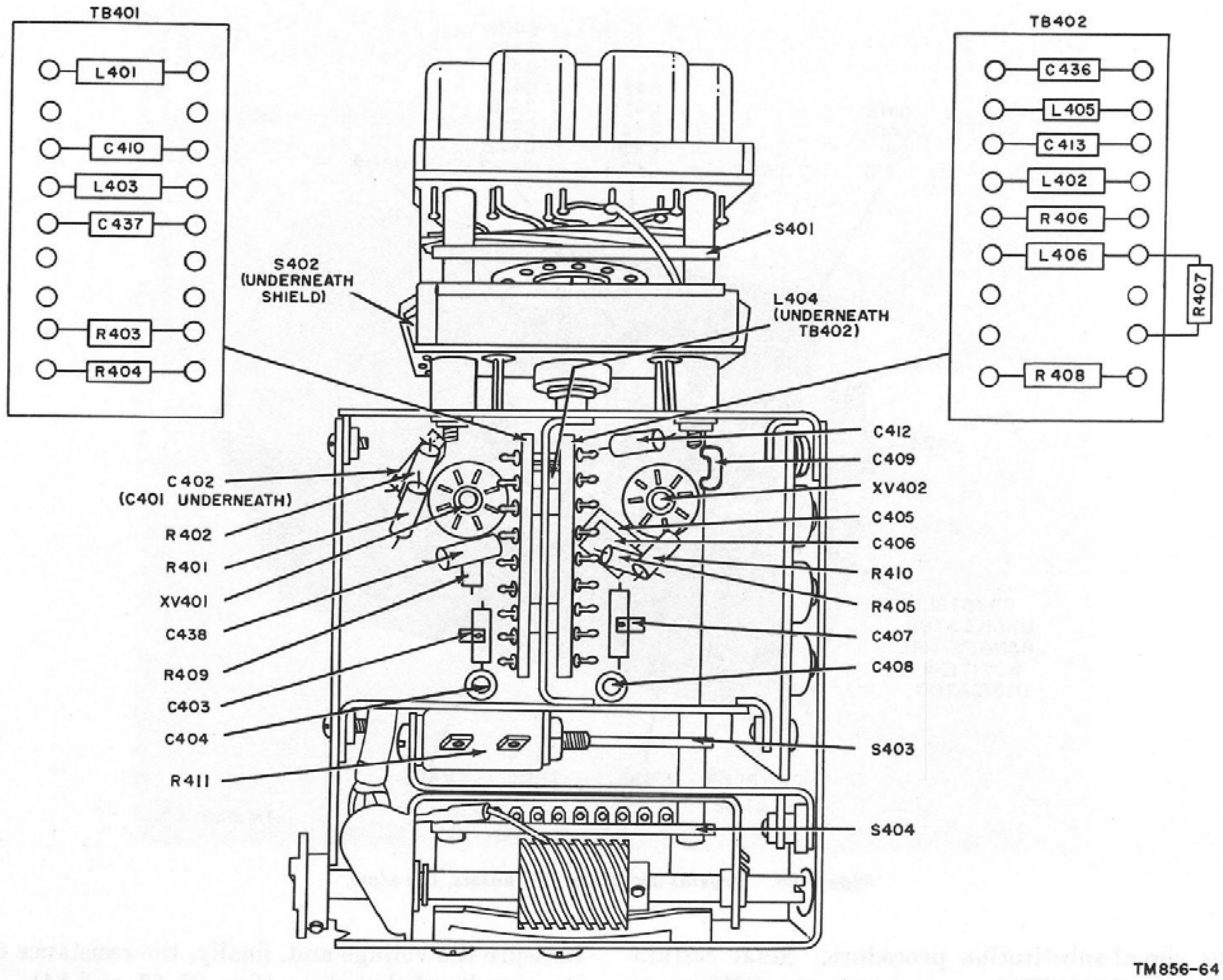


Figure 66. Crystal-oscillator subchassis, bottom view.

XV603 (fig. 75). Listen to the signal from a headset or speaker connected to the local audio output. The volume should be very low. If no signal is audible, check the connections to output transformer T602, and test capacitor C604 for a short circuit (fig. 75).

b. Pin 1 of V603 (Grid of Local Af Output Tube). Apply the signal to pin 1 of tube socket XV603. Listen for an increased output over that obtained in the preceding step (*a* above). If no signal is audible, test the tube and the voltages at the socket pins. When the signal is distorted or when there is a positive dc voltage on the control grid with respect to the chassis, test capacitor C603 for leakage (fig. 75).

c. Pin 1 of V602 (Plate of Local Af Amplifier). Connect the output of the generator to pin 1 of tube socket XV602 (fig. 75). If the signal output decreases, test capacitor C603 (fig. 75).

d. Pin 2 of V602 (Grid of Local Af Amplifier). Turn the LOCAL GAIN control fully on. Apply the signal to pin 2 of tube socket XV602. The output signal should be much louder than that obtained in the previous step (*c* above). If the signal is weak, check the tube and the voltages at the tube socket pins (fig. 83).

96. Line-Audio-Channel Tests

Connect the headset to the LINE AUDIO output, terminals 10 and 13 of the rear terminal strip (fig. 22). After the LINE LEVEL meter has been checked, using Multimeter TS-352/U, it may be used as an output indicator. Rely on the headset, however, to detect noise and distortion.

a. Pin 5 of V604 (Plate of Line Af Output Tube). Insert the audio-oscillator signal at pin 5 of tube socket XV604 (fig. 75). The volume

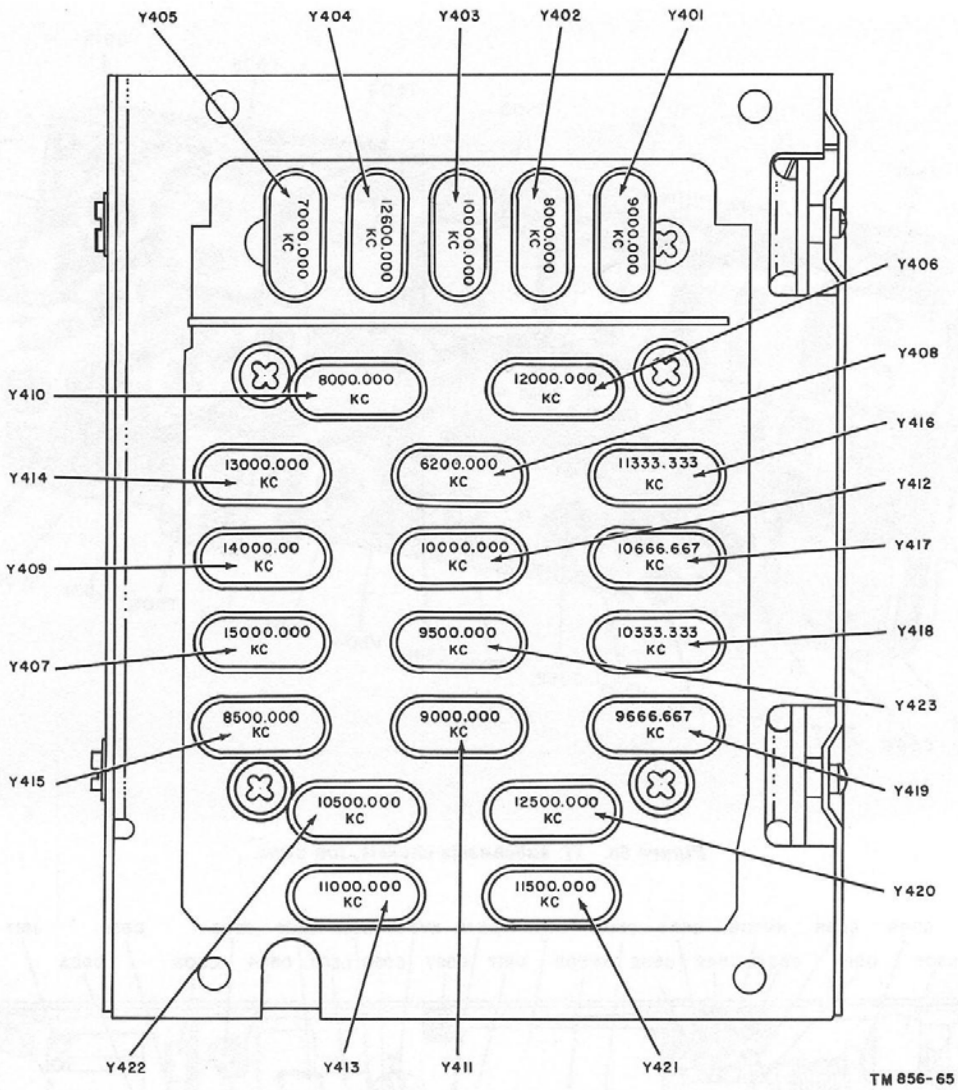


Figure 67. Crystal-oscillator subchassis, location of crystals.

should be very low, as heard in the headset. If no signal is audible, check the leads to output transformer T603. The center leads of the secondary winding must be connected by a jumper between terminals 11 and 12 of the rear terminal strip (fig. 22). Test capacitor C611 (fig. 75).

b. Pin 1 of V604 (Grid of Line Af Output Tube). Apply the signal to pin 1 of tube socket XV604. The output signal should be much louder than that obtained in the previous step (*a* above). If the output is unsatisfactory, check the tube and the voltages at the tube socket pins (fig. 83). If the grid bias is incorrect, as indicated by distortion or excessive plate current, check capacitor C610 for leakage (fig. 75). Check the operation of the LINE METER switch and the LINE LEVEL meter.

c. Pin 6 of V602 (Plate of Line Af Amplifier). Apply the audio-oscillator signal to pin 6 of tube socket XV602 (fig. 75). Rotate the LINE GAIN control fully on. If the signal output decreases noticeably, test capacitor C610 (fig. 75).

97. Af Amplifier Tests

a. Pin 6 of V601 (Plate). Introduce the signal from the audio-oscillator at pin 6 of tube socket XV601 (fig. 75). Set the AUDIO RESPONSE switch to MED. The signal output should be somewhat less than that obtained when the signal was applied to pin 7 of V602. If no signal is heard, or if the signal is weak, check capacitor

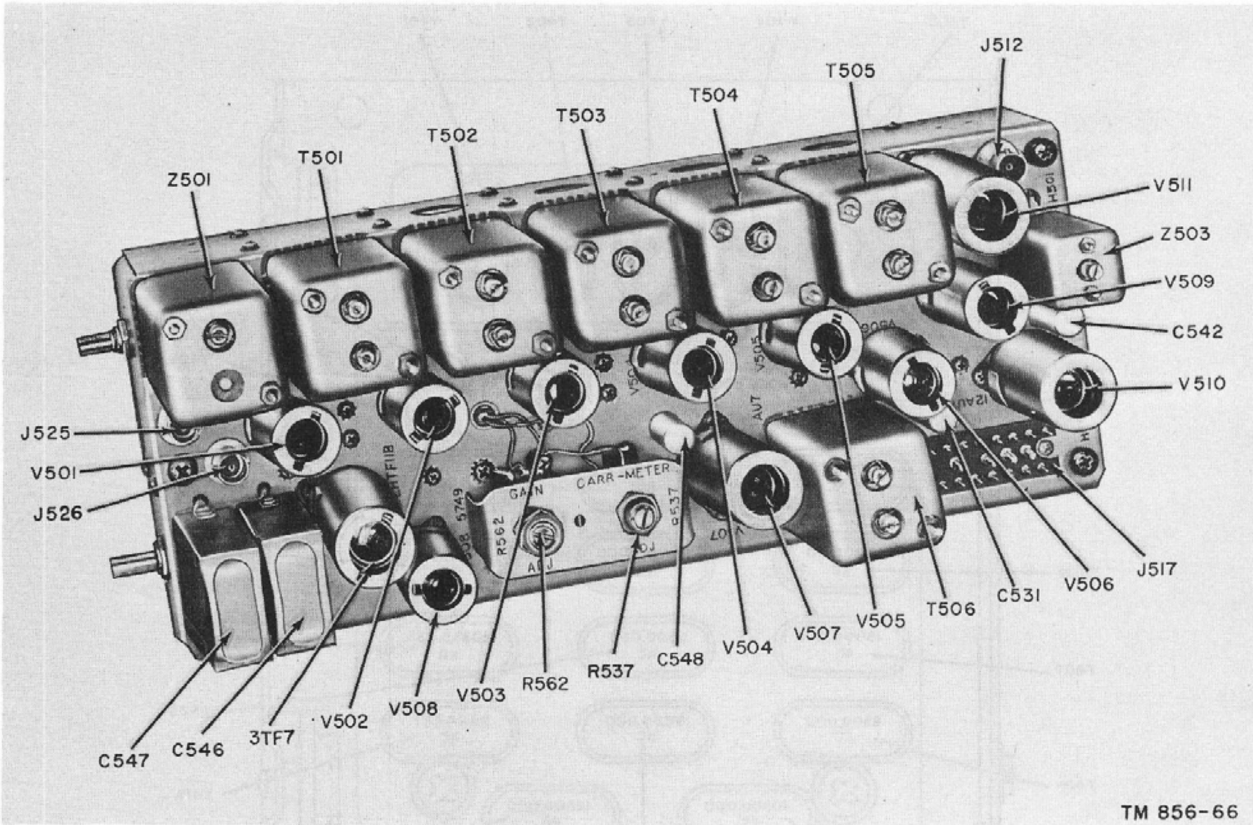


Figure 68. If. subchassis chassis, top view.

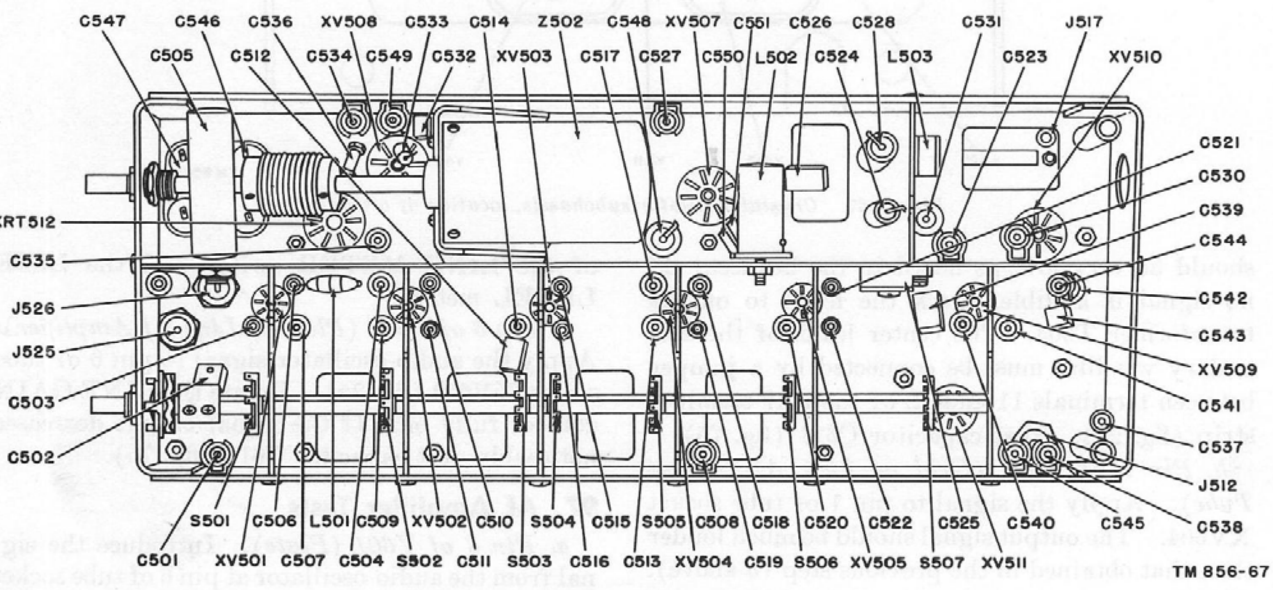


Figure 69. If. subchassis, bottom view.

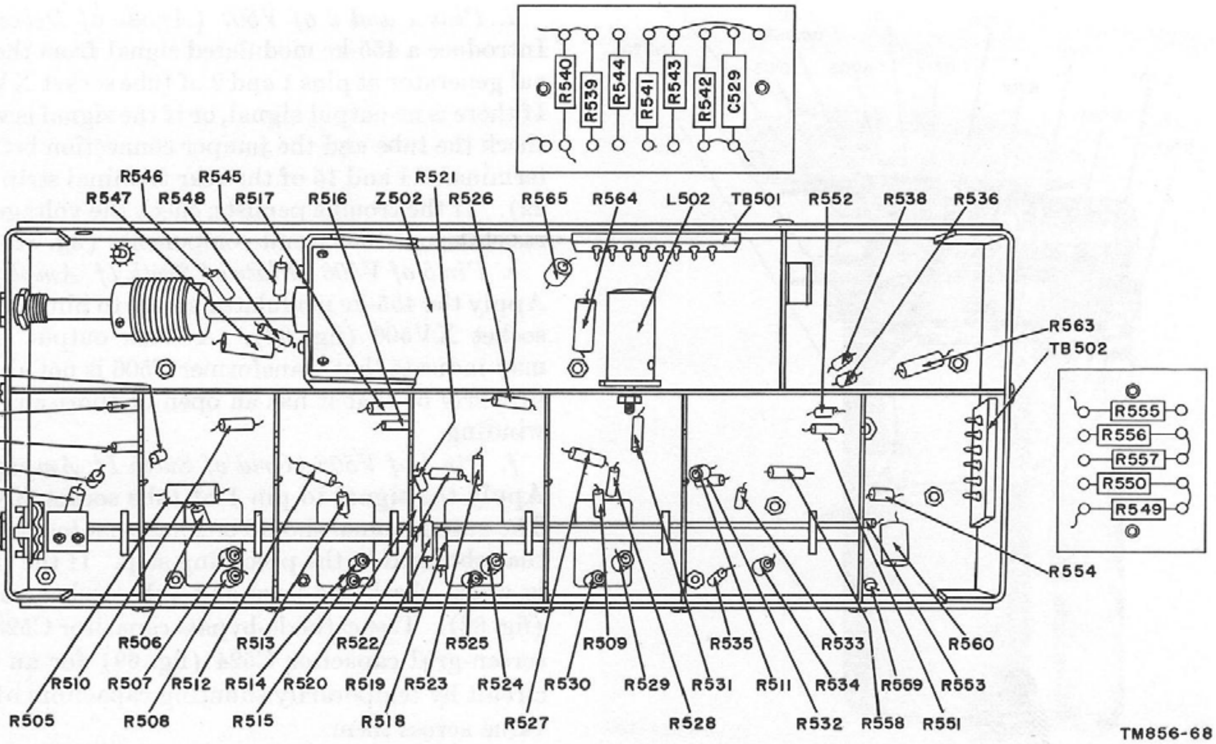


Figure 70. If. subchassis, location of resistors.

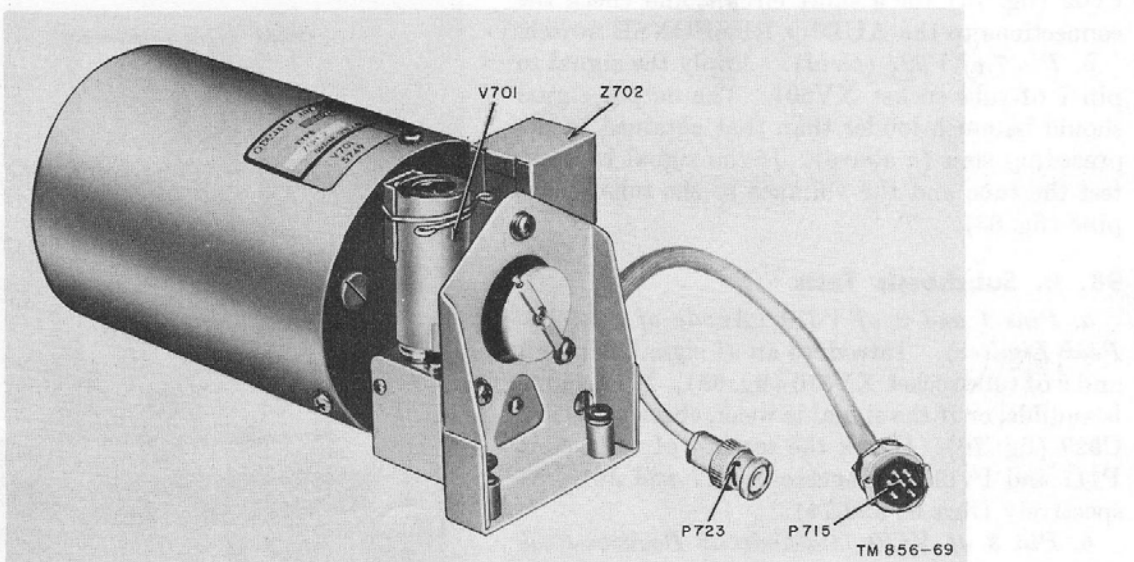


Figure 71. Vfo subchassis, top view.

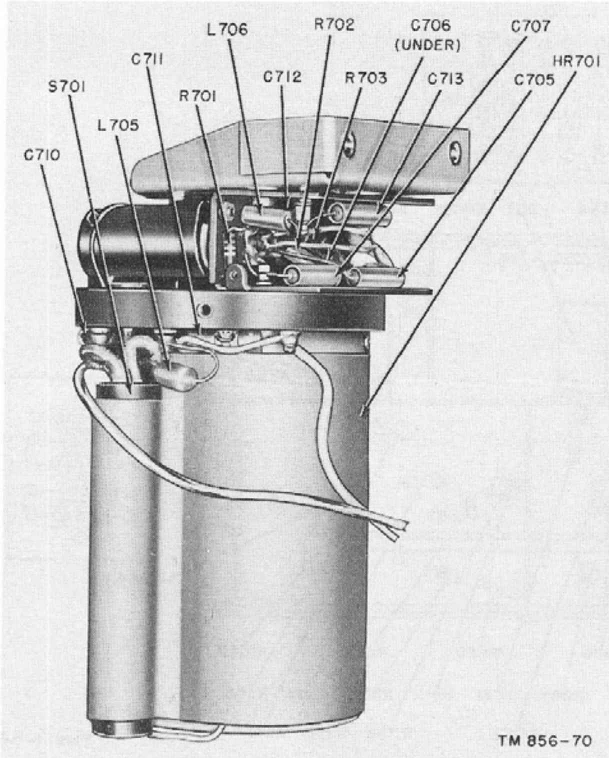


Figure 72. Vfo subchassis, bottom view.

C602 (fig. 75) for a short circuit, and check the connections to the AUDIO RESPONSE switch.

b. Pin 7 of V601 (Grid). Apply the signal to pin 7 of tube socket XV601. The output signal should be much louder than that obtained in the preceding step (*a* above). If the signal is weak, test the tube and the voltages at the tube socket pins (fig. 83).

98. If. Subchassis Tests

a. Pins 1 and 2 of V510 (Anode of Positive-Peak Limiter). Introduce an af signal at pins 1 and 2 of tube socket XV510 (fig. 69). If no signal is audible, or if the signal is weak, check capacitor C529 (fig. 70). Check the seating of connectors P117 and P119 in connectors J517 and J619, respectively (figs. 68 and 74).

b. Pin 3 of V510 (Cathode of Positive-Peak Limiter). Apply the af signal to pin 3 of tube socket XV510. A weak signal may indicate that V510 is defective or that resistor R542 or R544 is open (fig. 70).

c. Pins 6 and 7 of V507 (Anode of Negative Peak Limiter). Apply the af signal to pins 6 and 7 of tube socket XV507 (fig. 69). If the signal is weak, check V507 and resistor R541.

d. Pins 1 and 2 of V507 (Anode of Detector). Introduce a 455-kc modulated signal from the signal generator at pins 1 and 2 of tube socket XV507. If there is no output signal, or if the signal is weak, check the tube and the jumper connection between terminals 14 and 15 of the rear terminal strip (fig. 22). If the trouble persists, check the voltage and resistance of the circuit components (fig. 82).

e. Pin 5 of V506 (Plate of Sixth If. Amplifier). Apply the 455-kc modulated signal to pin 5 of tube socket XV506 (fig. 69). A weak output signal may indicate that transformer T506 is not aligned properly or that it has an open or short-circuited winding.

f. Pin 1 of V506 (Grid of Sixth If. Amplifier). Apply the signal to pin 1 of tube socket XV506. The output signal should be somewhat louder than that obtained in the preceding step. If the signal is weak, check the tube and tube socket voltage (fig. 82). Test cathode-bypass capacitor C523 and screen-grid capacitor C524 (fig. 69) for an open circuit by temporarily shunting capacitors of like value across them.

g. Pins 5 and 1 (Plate and Grid of First Five If. Amplifiers). Set the FUNCTION switch at

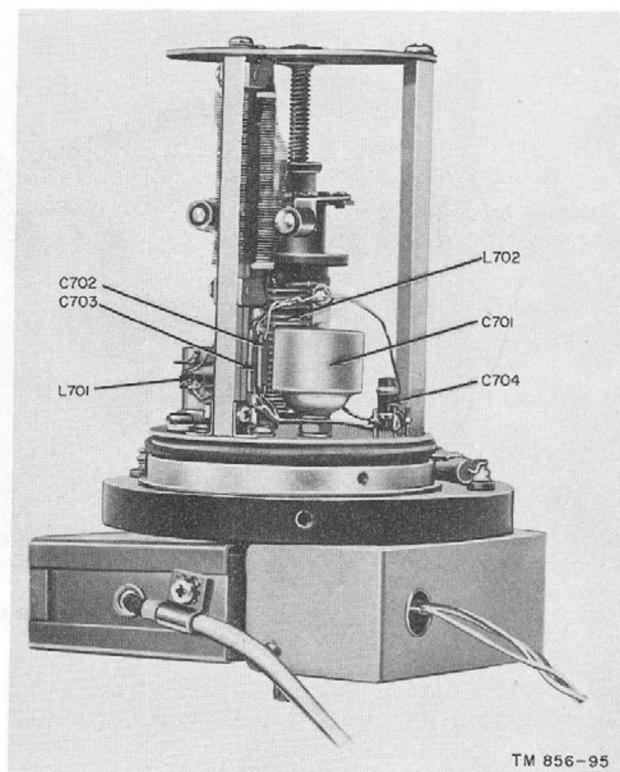


Figure 73. Vfo subchassis, sealed circuit cover removed.

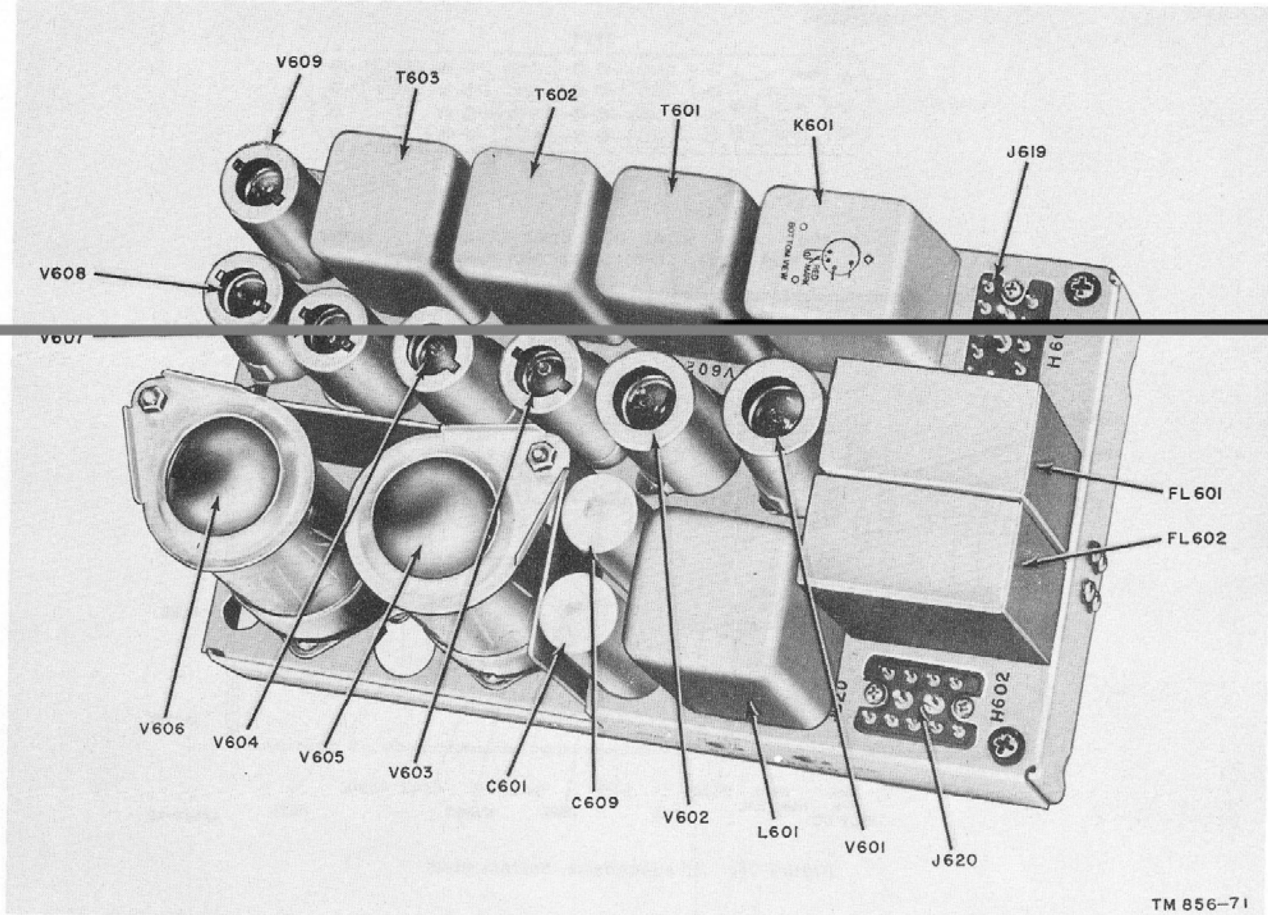


Figure 74. Af subchassis, top view.

MGC, turn the RF GAIN control fully on, and set the BANDWIDTH switch at the 4–KC position. Apply the 455-kc modulated signal in turn to pins 5 and 1 of the tube socket of the first five 455-kc if. amplifiers, proceeding from the fifth stage to the first (fig. 69). Correct any faults found in a stage before proceeding to the next.

99. Rf Subchassis Tests

a. Pin 1 of V205 (Plate of Third Mixer). Introduce the 455-kc modulated signal at pin 1 of tube socket XV205 (fig. 64). If no signal is heard, check transformer T207 and the signal connections to the if. subchassis.

Note. For the remainder of the signal substitution tests, tune the receiver to a frequency of 2 mc in the 1- to 2-mc band by setting the frequency-indicator reading at 01+000.

b. Pins 6 and 7 of V205 (Grid and Cathode of Third Mixer). Apply a 2-mc modulated signal to test point E210 (fig. 62). If no output signal is heard, connect an antenna or a 2-mc signal source to the antenna terminals of the receiver, and, at the same time, apply a strong 2,455-kc unmodulated signal to pin 7 of tube socket XV205 (fig. 64). The reception of static or signal when the 2,455-kc signal is substituted for the receiver oscillator signal indicates a faulty vfo. To check for injection voltage from the vfo, set the FUNCTION switch at STANL BY, and measure the dc voltage using the vtvm at test point E210 (fig. 62). The voltage should be between 3 and 11 volts dc. (This is a reference voltage only.) This voltage is present because tube V205 is rectifying the vfo oscillator signal. If the voltage is within these limits, injection voltage from the vfo is available. Measure the amount of injection voltage from the vfo by disconnecting P723 (fig. 88) and connecting the ac probe of Electronic Multimeter TS–505/U to the

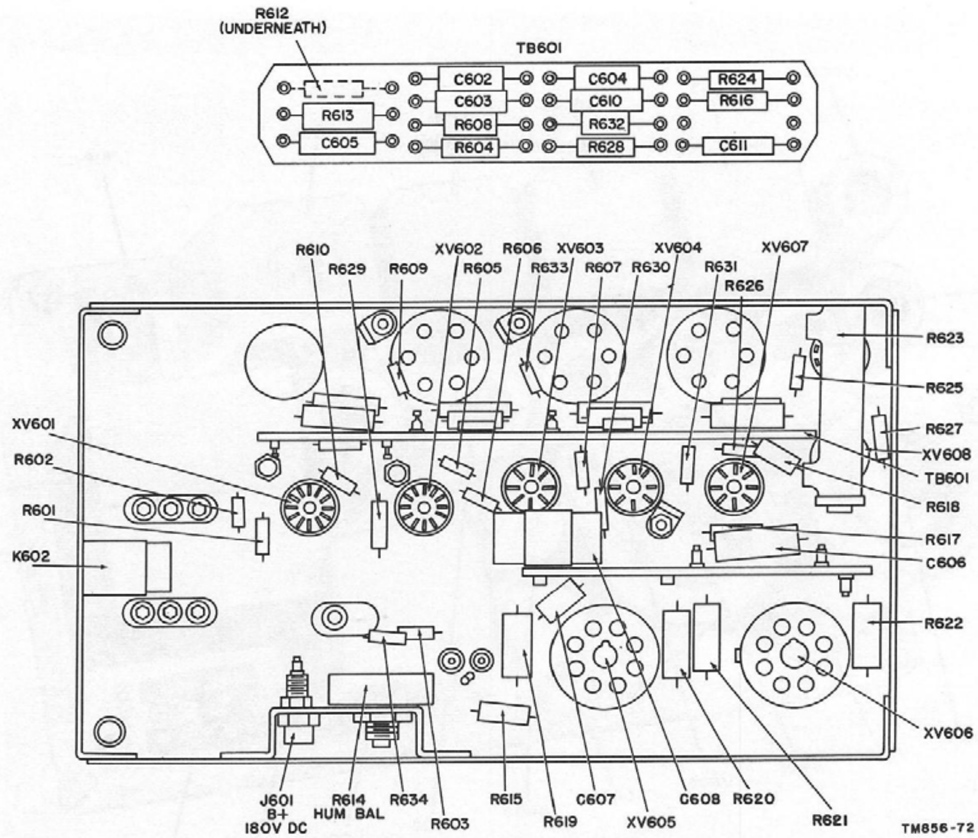


Figure 75. Af subchassis, bottom view.

contact of the plug. The voltage should measure approximately 2 to 3 volts ac for normal operation. When the trouble is in the vfo, check its tube (V701), check for loose coupling at the oscillator tuning shaft (par. 110*d*), and check the tube socket voltages. If no output signal is heard when the 2,455-kc unmodulated signal is applied to pin 7 of V205, check the third mixer, V205, and its tube socket voltages (fig. 82).

c. Pin 1 of V204 (Plate of Second Mixer). With the FUNCTION switch at MGC, apply the modulated 2-mc signal to pin 1 of tube socket XV204 (fig. 64). A weak output signal may indicate that plate resonant circuits Z222, Z223, and Z224 are not synchronized with the other tuning circuits (par. 110*a*) or are not individually alined correctly.

d. Pins 6 and 7 of V204 (Grid and Cathode of Second Mixer). Apply a 10-mc modulated signal to test point E209 (fig. 62). If no output signal is audible, either the second mixer stage or the second crystal oscillator stage is defective. To determine which stage is at fault, apply a strong, 12-mc unmodulated signal to pin 7 while the antenna terminals are connected to an antenna or to a 2-mc signal source. The reception of static or signal when the 12-mc signal is applied indicates a faulty second crystal oscillator. Check for injection voltage from the second crystal oscillator by measuring the dc voltage with the vtvm at test point E209 (fig. 62), with the FUNCTION switch at STAND BY. A reading of −3 to −11 volts indicates that injection voltage is available from the second crystal oscillator. The amount of injection voltage available is determined by disconnecting P222 from J422 (fig. 86) and measuring the voltage at the contact of J422, using the ac probe of the multimeter. A reading of approximately 2 to 3 volts ac indicates normal output from the second crystal oscillator. If normal output is not obtained, test tube V402, the tube socket voltages (fig. 82), the alinement of the oscillator circuits, and the oscillator crystals (par. 100). Check synchronization (par. 110). If a crystal is defective, the band or bands associated with that crystal will be inoperative. If no output is heard

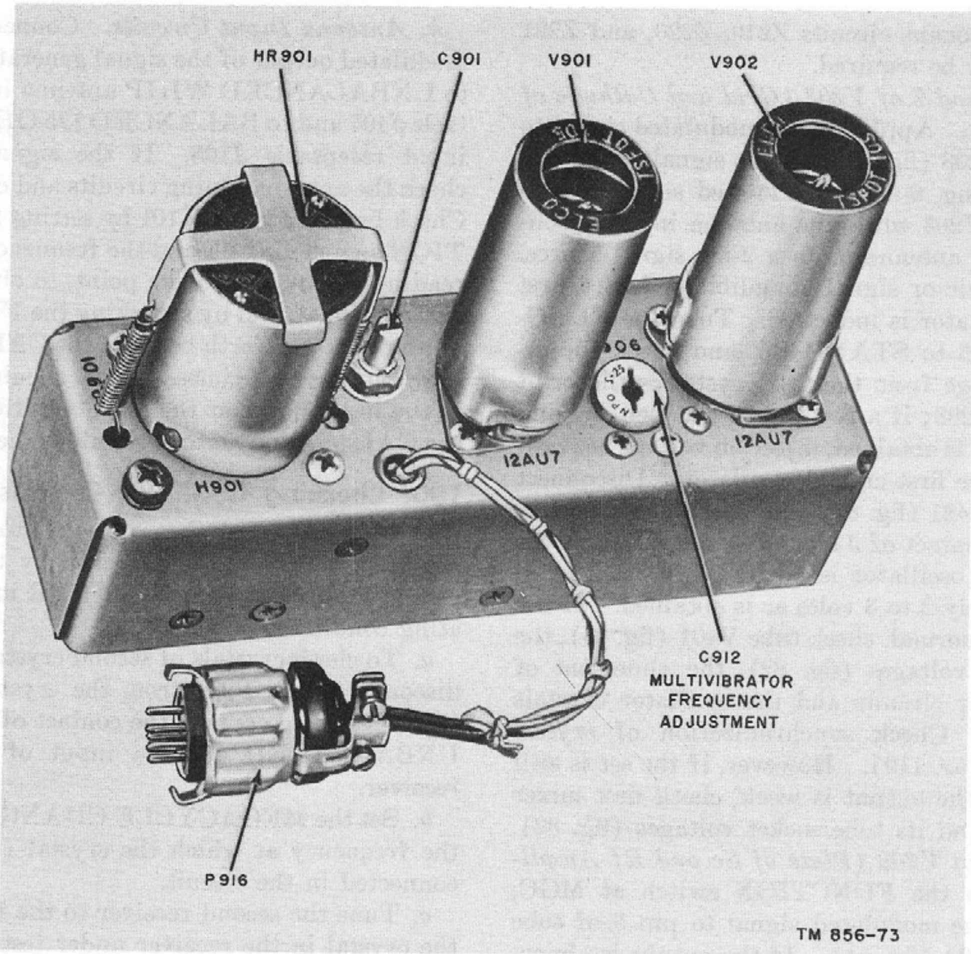


Figure 76. Calibration-oscillator subchassis, top view.

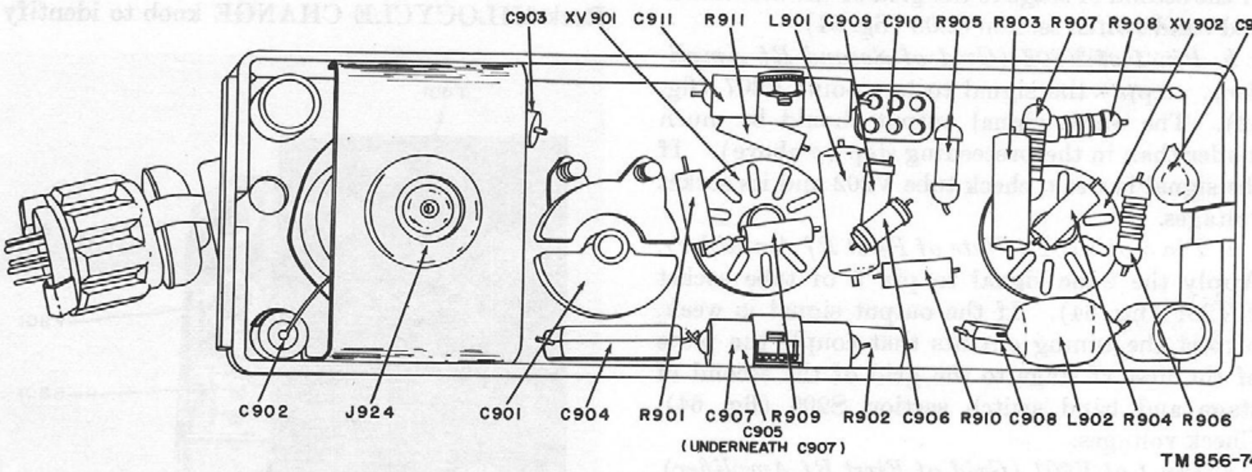


Figure 77. Calibration-oscillator subchassis, bottom view.

when the signal is applied to pin 7, check second mixer V204 and its tube socket voltages (fig. 82).

e. Pin 1 of V203 (Plate of First Mixer). With the FUNCTION switch at MGC, apply at 10-mc modulated signal to pin 1 of tube socket XV203 (fig. 64). If the output signal is weak, check the synchronization of the first if. slug rack and the first if. can rack. Alinement of the individual slugs for resonant circuits Z219, Z220, and Z221 (fig. 62) may be required.

f. Pins 6 and 7 of V203 (Grid and Cathode of First Mixer). Apply a 2-mc modulated signal to test point E208 (fig. 62). If no signal is audible, apply a strong, 8-mc unmodulated signal to terminal 7 of V203 while the antenna input is connected to an antenna or to a 2-mc signal source. Then, if static or signal is audible, a faulty first crystal oscillator is indicated. Turn the FUNCTION switch to STAND BY and check for injection voltage from the first crystal oscillator at test point E208; if a reading of between −3 and −11 volts dc is obtained, injection voltage is available from the first crystal oscillator. Disconnect P221 from J421 (fig. 86) and measure the ac voltage at the contact of J421. The output from the first crystal oscillator is normal if a reading of approximately 2 to 3 volts ac is obtained. If the output is abnormal, check tube V401 (fig. 65), the tube socket voltages (fig. 82), the alinement of the oscillator circuits and the oscillator crystals (par. 100). Check synchronization of crystal oscillator (par. 110). However, if the set is still dead, or if the output is weak, check first mixer tube V203 and its tube socket voltages (fig. 82).

g. Pin 5 of V202 (Plate of Second Rf Amplifier). With the FUNCTION switch at MGC, apply a 2-mc modulated signal to pin 5 of tube socket XV202 (fig. 64). If the output is abnormal, check the tuning circuits that couple the plate of the second rf stage to the grid of the first mixer and band switch section S208 (fig. 64).

h. Pin 1 of V202 (Grid of Second Rf Amplifier). Apply the signal to test point E207 (fig. 62). The audio signal output should be much louder than in the preceeding step (*g* above). If the signal is weak, check tube V202 and its socket voltages.

i. Pin 5 of V201 (Plate of First Rf Amplifier). Apply the 2-mc signal to pin 5 of tube socket XV201 (fig. 64). If the output signal is weak, inspect the tuning circuits that couple the plate of the first rf stage to the grid of the second rf stage and band switch section S206 (fig. 64). Check voltages.

j. Pin 1 of V201 (Grid of First Rf Amplifier). Apply the 2-mc modulated signal to test point E206 (fig. 62). The output signal should be louder than that obtained in the preceding step (*i* above). If the signal is weak, test tube V201 and its socket voltages (fig. 82).

k. Antenna Input Circuits. Connect the 2-mc modulated output of the signal generator, in turn, to UNBALANCED WHIP antenna input receptacle J107 and to BALANCED 125 OHM antenna input receptacle J108. If the signal is weak, check the antenna tuning circuits and connections. Check break-in relay K101 by setting the FUNCTION switch at CAL and the frequency-indicator reading at an even 100-kc point, to obtain a calibration signal, and by switching the FUNCTION switch back and forth between the CAL and MGC positions several times. Tone should be heard in the headphones at the MGC position, while at the CAL position no tone should be heard.

100. Checking Oscillator Crystals

If it is suspected that an oscillator crystal is faulty, it can be readily checked by the use of a second Radio Receiver R–390/URR in good operating condition, as follows:

a. To check crystals of second crystal oscillator, disconnect plug P222 from the crystal-oscillator subchassis, and connect the contact of J422 to the UNBALANCED antenna input of the second receiver.

b. Set the MEGACYCLE CHANGE control to the frequency at which the crystal (par. 103) is connected in the circuit.

c. Tune the second receiver to the frequency of the crystal in the receiver under test, and set its BFO switch to ON. An audible signal should be heard in a headset connected to PHONES jack. Rock KILOCYCLE CHANGE knob to identify

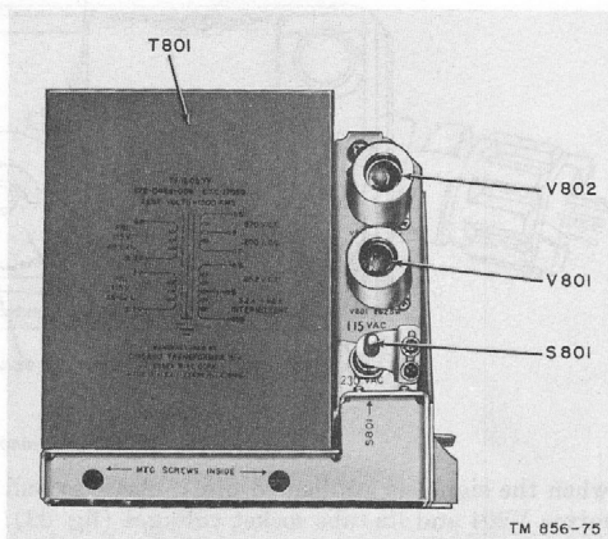


Figure 78. Power Supply PP–621/URR, top view.

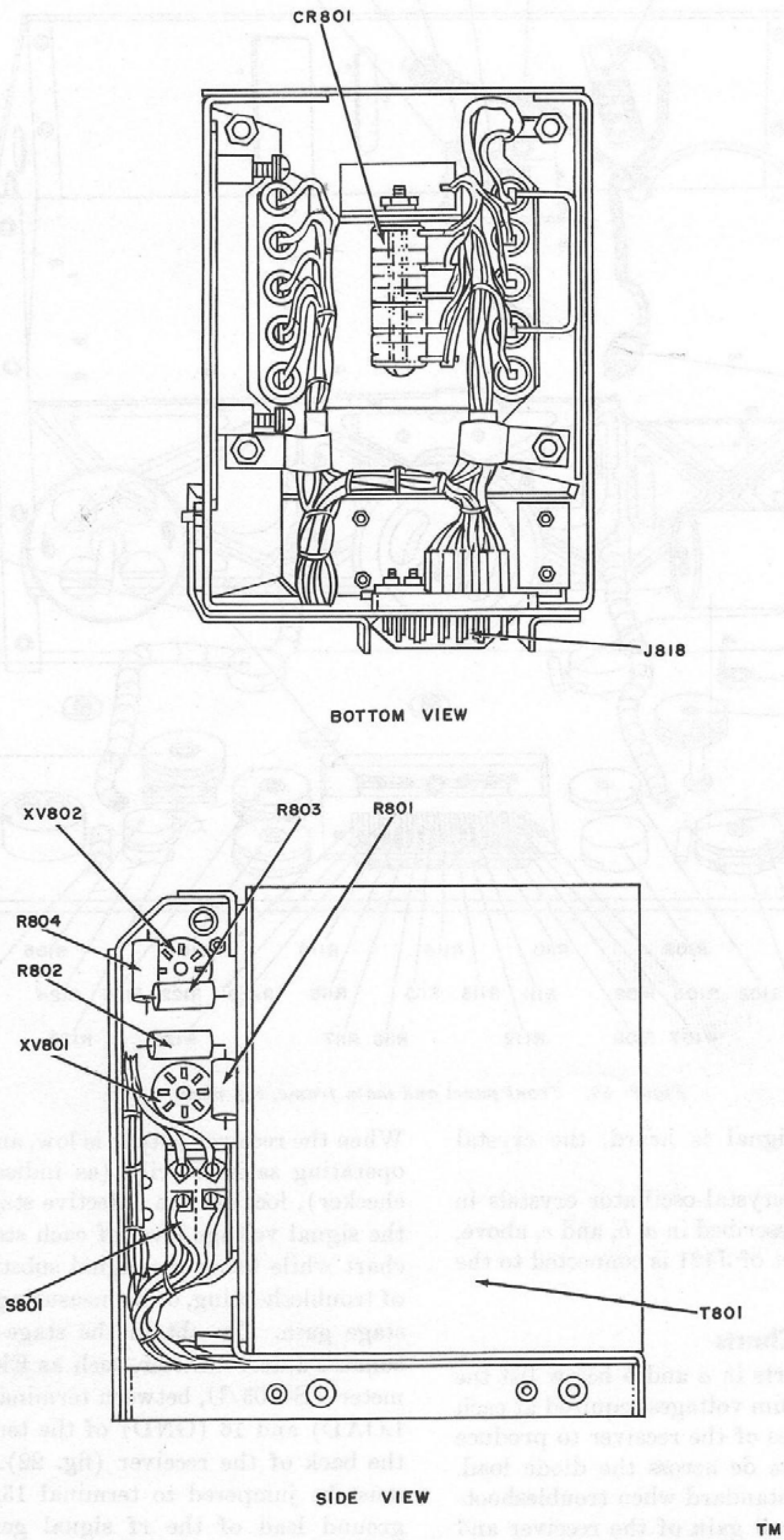


Figure 79. Power Supply PP-621/URR, bottom and side views.

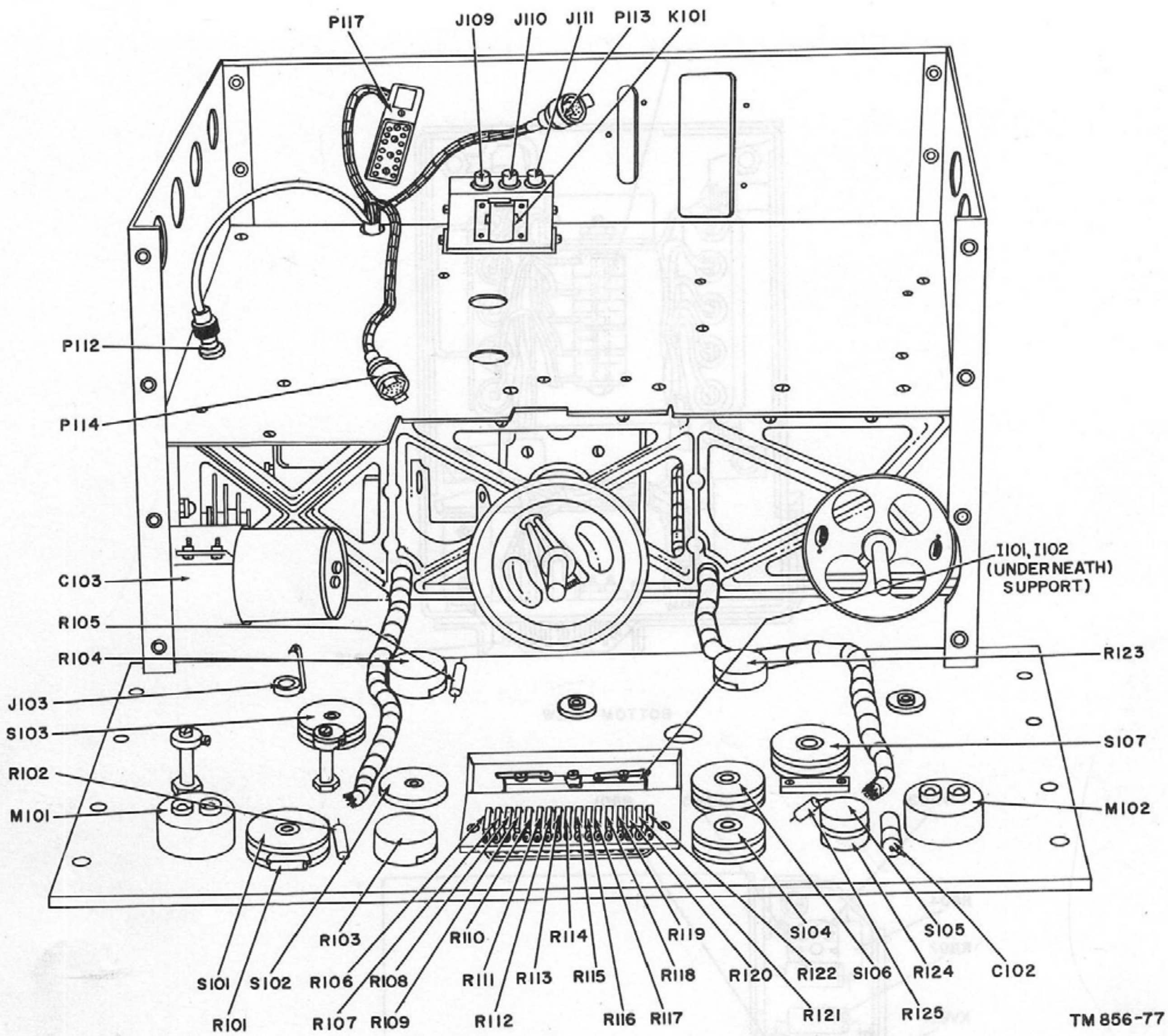


Figure 80. Front panel and main frame, top view.

the signal. If no signal is heard, the crystal should be replaced.

d. Check the first crystal-oscillator crystals in the same manner as described in *a*, *b*, and *c*, above, except that the contact of J421 is connected to the second receiver.

101. Stage Gain Charts

The stage gain charts in *a* and *b* below list the minimum and maximum voltages required at each of the rf and if. stages of the receiver to produce a voltage of −7 volts dc across the diode load. Use these charts as a standard when troubleshooting to check the overall gain of the receiver and the gain of each rf or if. stage or group of stages. When the receiver output is low, and the tubes are operating satisfactorily (as indicated by a tube checker), localize the defective stage by checking the signal voltage level of each stage against the chart while using the signal substitution method of troubleshooting, or by measuring the individual stage gain. To obtain the stage-gain readings, connect a dc voltmeter, such as Electronic Multimeter TS–505/U, between terminals 14 (DIODE LOAD) and 16 (GND) of the terminal strip on the back of the receiver (fig. 22). Terminal 14 must be jumpered to terminal 15. Connect the ground lead of the rf signal generator to the receiver ground, and connect the generator output

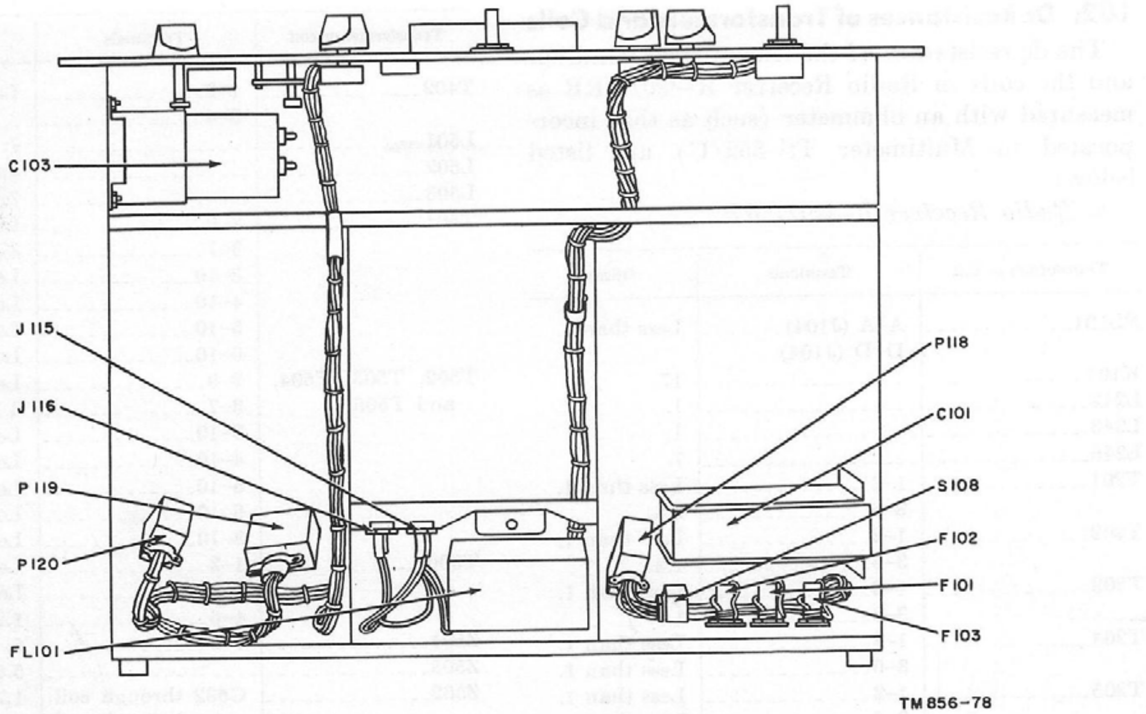


Figure 81. Front panel and main frame, bottom view.

lead through a .1-μf capacitor to the receiver points indicated in the chart. When checking the 455-kc if. stages, access to the injection points can be gained by operating the subchassis outside the receiver, using the extension cables (par. 86), or by inserting a short length of wire into the tube socket terminal (par. 88*a*). Check the output from the signal generator required to obtain the diode-load reference voltage of −7 volts dc against the figures given in the charts. The lowest figure is the minimum and the highest is the maximum that should be required over the specified frequency range for normal operation. However, a reading that is slightly outside this range does not necessarily indicate improper functioning.

a. Rf Subchassis Stages.

Signal generator output connection	Balanced ant.	Test point E206 (1st rf grid V201)	Test point E207 (2d rf grid V202)	Test point E208 (1st mixer grid V203)		Test point E209 (2d mixer grid V204)			Test point E210 (3d mixer grid V205)	
Frequency (mc)	.5–32	.5–32	.5–32	.5–8	9–18	9–18	3–2	8–32	3–2	.455
Signal generator output (microvolts).	1–4	4–16	28–78	40–62	36–53	43–59	23–28	41–71	92–117	22–50

b. If. Subchassis Stages.

Signal generator output connection	Signal generator output (microvolts)			
	2-kc bandwidth	4-kc bandwidth	8-kc bandwidth	16-kc bandwidth
1st if. grid V501	130 to 180			
2d if. grid V502	1,500 to 1,900	1,400 to 2,000	880 to 1,400	860 to 1,700
3d if. grid V503	2,300 to 5,000	3,000 to 5,000	1,100 to 2,000	770 to 1,300
4th if. grid V504	7,000 to 12,000	7,000 to 11,500	6,000 to 8,700	5,200 to 7,600
5th if. grid V505	16,000 to 20,000	16,000 to 18,000	23,000 to 28,000	32,000 to 38,000
6th if. grid V506	420,000 to 500,000	420,000 to 500,000	420,000 to 500,000	420,000 to 500,000

102. Dc Resistances of Transformers and Coils

The dc resistances of the transformer windings and the coils in Radio Receiver R–390/URR as measured with an ohmmeter (such as that incorporated in Multimeter TS–352/U) are listed below:

a. Radio Receiver R–390/URR.

Transformer or coil	Terminals	Ohms
FL101	A–A (J104) D–D (J104)	Less than 1.
K101		17.
L242		1.
L243		1.
L246		7.
T201	1–2	Less than 1.
	3–6	2.5.
T202	1–2	Less than 1.
	3–6	1.8.
T203	1–2	Less than 1.
	3–6	1.1.
T204	1–2	Less than 1.
	3–6	Less than 1.
T205	1–2	Less than 1.
	3–6	Less than 1.
T206	1–2	Less than 1.
	3–6	Less than 1.
T207	1–5	2.8.
	2–4	4.5.
Z201		2.4.
Z202		1.9.
Z203		1.1.
Z204		Less than 1.
Z205		Less than 1.
Z206		Less than 1.
Z207		2.4.
Z208		1.8.
Z209		1.
Z210		Less than 1.
Z211	1–3	Less than 1.
Z212		Less than 1.
Z213		2.5.
Z214		1.8.
Z215		1.1.
Z216		Less than 1.
Z217		Less than 1.
Z218		Less than 1.
Z219		Less than 1.
Z220	Less than 1	
Z221	Less than 1	
Z222		1.6.
Z223		1.6.
Z224		1.6.
L401		7.
L402		7.
L403		1.
L404		1.
L405		1.
L406		7.
T401	1–2	Less than 1.
	3–4	Less than 1.
T402	1–2 3–4	Less than 1.
L501		7.
L502		4.5.
L503		7.
T501	2–9	Less than 1.
	3–7	3.1.
	3–10	Less than 1.
	4–10	Less than 1.
	5–10	Less than 1.
	6–10	Less than 1.
T502, T503, T504, and T505.	2–9	Less than 1.
	3–7	3.1.
	3–10	Less than 1.
	4–10	Less than 1.
	5–10	Less than 1.
	6–10	Less than 1.
	8–10	Less than 1.
T506	1–2	Less than 1.
	1–9	Less than 1.
	4–6	1.2.
Z501	1–2	5.
Z503		5.5.
Z502	C532 through coil to pin 7 of V508.	1.7.
	Pin 7 of V508 through coil to gnd.	Less than 1
FL601	IN-OUT	50.
	IN-Gnd	24.
	OUT-Gnd	24.
FL602	IN-OUT	37.
	IN-Gnd	230.
	OUT-Gnd	250.
K601	4–5	10K.
K602	3–4	8.
L601		90.
T601	1–2	850.
	3–4	24.
	5–6	26.
T602* and T603*	1–2	850.
	3–4	24.
	5–6	26.
L901		Less than 1.
L902		7.

*Readings taken with speaker disconnected.

b. Power Supply PP–621/URR.

Transformer or coil	Terminals	Ohms
T801	1–2	Less than 1.
	3–4	Less than 1.
	5–6	25.
	6–7	25.
	5–7	50.
	8–9	Less than 1.
	9–10	Less than 1.
	8–10	Less than 1.

103. Rf and Variable If. Conversion Scheme

In order that the frequency conversion scheme of Radio Receiver R-390/URR may be easily understood, the chart is provided below. The frequency range of the second variable if. is from 2.5 to 2.0 mc for the .5- to 1.0-mc band, and from 3.0 to 2.0 mc for all other bands. The frequency range of the vfo is 3.455 to 2.455 mc for all bands. The fixed output if. of the third mixer is 455 kc. The following is an example of the use of the chart.

Frequency of station being received	5.5 mc
Frequency indicator reading	05 500
Band	5–6
Position of switch S201	4
Frequency range of antenna and rf coils	4–8 mc
Position of switch S401	5
First crystal-oscillator crystal frequency	8 mc
First crystal-oscillator output frequency	8 mc
First variable if	13.5 mc

Note. The first variable if. equals the first crystal oscillator output frequency plus the frequency of the signal received.

Second crystal-oscillator frequency	8 mc
Second crystal-oscillator output frequency	16 mc
Second variable if	2. 5 mc

Note. The second variable if. equals the difference frequency between the second crystal oscillator output frequency and the first variable if.

Vfo frequency	2. 955 mc

Note. The vfo frequency equals the second variable if. plus the fixed if. output of the third mixer.

Third mixer fixed if. output	455 kc

Band (mc)	Position of switch S201	Range of antenna and rf coils (mc)	Position of switch S401	1st xtal-osc crystal freq (mc)*	1st xtal-osc output freq (mc)*	1st variable if. range (mc)*	2d xtal-osc crystal freq (mc)	2d xtal-osc output freq (mc)
0. 5–1	1	0. 5–1	0	9	9	9. 5–10	12	12
1–2	2	1–2	1	8	8	9–10	12	12
2–3	3	2–4	2	10	10	12–13	15	15
3–4			3	12. 6	12. 6	15. 6–16. 6	6. 2	18. 6
4–5	4	4–8	4	7	7	11–12	14	14
5–6			5	8	8	13–14	8	16
6–7			6	9	9	15–16	9	18
7–8			7	10	10	17–18	10	20
8–9	5	8–16	8				11	11
9–10			9				12	12
10–11			10				13	13
11–12			11				14	14
12–13			12				15	15
13–14			13				8. 0	16
14–15			14				8. 5	17
15–16			15				9. 0	18
16–17	6	16–32	16				9. 5	19
17–18			17				10	20
18–19			18				10. 5	21
19–20			19				11	22
20–21			20				11. 5	23
21–22			21				12	24
22–23			22				12. 5	25
23–24			23				13	26
24–25			24				9	27
25–26			25				14	28
26–27			26				9. 666	29
27–28			27				10	30
28–29			28				10. 333	31
29–30			29				10. 666	32
30–31			30				11	33
31–32			31				11. 333	34

*Not in use after first eight frequency bands.

Figure 82. *Radio Receiver R–390/URR, tube voltage and resistance and subchassis receptacle resistance diagram, top deck.*

(Contained in separate envelope)

Figure 83. *Radio Receiver R–390/URR tube, voltage and resistance and subchassis receptacle resistance diagram, bottom deck.*

(Contained in separate envelope)

Figure 84. *Radio Receiver R–390/URR, terminal boards voltage and resistance diagram.*

(Contained in separate envelope)

104. B+ Voltage Distribution

The input voltage from the power line to the power supply is controlled by FUNCTION switch S107 (figs. 21 and 52). In addition, this switch also controls the application of B+ to the various circuits, with the exception of the first and second crystal oscillators and the vfo (fig. 98). B+ is always connected to these circuits, so that the temperature of the components will remain constant. In the MGC and the AGC positions of S107, regulated B+ voltage is applied to all circuits of the receiver except the calibration oscillator and the squelch circuit (fig. 98). In the CAL position of the switch, the plate circuit of the calibration oscillator is energized, and the dc output of the dry-disk rectifier is applied to the antenna relay (fig. 56). In the SQUELCH position, B+ is connected to all receiver circuits as well as to the plate circuit of the squelch tube, section B of V601 (fig. 98). In the STAND BY position, all B+ circuits except to the oscillators are disconnected, and dc voltage is applied to the antenna relay (figs. 56 and 98).

Section II. REPAIRS

105. Removals and Replacements

Directions for removing and replacing the subchassis and various detail parts of the receiver for bench testing or repair are contained in *a* through *t* below. All the subchassis, except the rf, can be removed from the receiver without prior removal of any of the other assemblies. While the rf, if., and vfo subchassis are outside the receiver, avoid changing the positions of the KILOCYCLE CHANGE, bfo, and vfo tuning shafts, if possible. Disturbing the positions of these shafts necessitates synchronization. Make any necessary presettings of the receiver controls, where possible, before removing the subchassis. Subchassis mounting screws are color-coded with green heads. In most cases these are captive screws, and need be loosened only until they are free of the main frame to remove the subchassis. When replacing the subchassis, the captive screws should first be started one at a time to locate the subchassis before tightening the screws all the way. The reference designations of the coaxial plugs are marked on bands fastened to the cables, near the plugs. To remove a coaxial plug, press the plug in slightly and twist counterclockwise to release; then pull the plug straight out. Where coaxial plugs are not readily accessible, scissors-type Tube Puller TL201, supplied with Tool Set TE-41, can be used. To remove 7-pin plugs P113, P114, P715, and P916, first twist the metal shell slightly counterclockwise to release the clamp, then pull the plug. Make sure that the pins are properly alined with the jack contacts when replacing multi-contact plugs; the pins are easily bent. When loosening the clamp screws, be careful not to overdraw the screws; this will cause the nut to drop off. Do not tighten clamp screws too far; the threads may be stripped. Make sure that the Bristo wrench is fully inserted into the screw to avoid stripping the slots in the head.

a. Removal of Front Panel (figs. 21 and 80). To gain access to the wiring and parts on the back of the front panel, or to prepare for removal of the rf subchassis, remove the front panel and proceed as follows:

(1) Remove the top and bottom dust covers from the receiver.

(2) Remove the two handles from the front panel by removing the nuts and washers that secure the handles at the rear of the panel.

(3) Place wooden blocks under the side plates of the receiver main frame, in back of the front panel, so that the panel is clear of the bench and the receiver tilted backward.

(4) Rotate the MEGACYCLE CHANGE and KILOCYCLE CHANGE control knobs fully counterclockwise to the home stop position.

(5) Position the ANT. TRIM control at -4, and remove the knob.

(6) Position the BFO PITCH control at 0. Position the BANDWIDTH control at 16 KC. Loosen the collars on the BANDWIDTH and BFO PITCH control shafts.

(7) Remove the KILOCYCLE CHANGE and MEGACYCLE CHANGE control knobs.

(8) Remove the DIAL LOCK and ZERO ADJ. knobs. Loosen the nut on the DIAL LOCK bushing and disengage the

lock from the KILOCYCLE CHANGE control locking disk (fig. 85).

(9) Remove the four flat-head Phillips screws that secure the front panel to the main frame.

(10) Remove the front panel by grasping the edges and drawing it straight out from the receiver. Replace the handles and place the panel face down on the bench, resting on the handles. Handle the panel carefully.

b. Replacement of Front Panel. To replace the front panel, reverse procedures in (1) through (10) above. When replacing the ZERO ADJ. knob, be sure that the threaded cap on the end of the shaft is rotated clockwise finger-tight. Place the knob on the shaft so that the spring-loaded movable part of the stop mechanism fits into the notch in the knob. Rotate the knob clockwise until the stop is reached. Allow the knob to rotate counterclockwise approximately one-sixteenth of an inch and tighten the set screw. If the bushings for the KILOCYCLE CHANGE and MEGACYCLE CHANGE controls have been moved, they should be loosened before the front panel is replaced and tightened after it is replaced. This helps to line them up and prevent binding of controls.

c. Removal of Rf Subchassis (figs. 21 and 85). To remove the rf subchassis, first disconnect coaxial connector P723 from J223 on the bottom deck of the receiver (fig. 88); use scissors-type tube puller TL201. Then remove the front panel as described in *a* above and proceed as follows:

(1) Remove the green-coded offset gear from the upper left part of the rf gear plate and place it in mesh with the gear train as shown in figure 87.

Note. The offset gear is used to maintain synchronization of the gear train when the rf subchassis is removed from the receiver.

(2) Disengage the following coaxial connectors on the top deck of receiver: P209 from J109, P210 from J110, P211 from J111, P221 from J421, P222 from J422, P224 from J924, P225 from J525, and P226 from J526. (It may be necessary to temporarily remove V501 and its shield to disengage this connector.)

(3) Remove the dust cover from the top of the rf subchassis; then disconnect P114 from J214.

(4) Rotate the KILOCYCLE CHANGE control shaft slightly counterclockwise to stop position. The frequency indicator reading should be 00−972. (Note minus sign.)

(5) Remove the two green ½-inch, color-coded screws that secure the subchassis to the end plate of the main frame. Make sure that only these screws are used when replacing the subchassis.

(6) Loosen the three green color-coded captive screws, two at the left-hand corners of the subchassis, and one in the upper right-hand corner.

(7) Lift the subchassis up and out of the receiver, disengaging the Oldham coupler on the crystal-oscillator band switch shaft. The floating disk of the coupler will drop down; do not lose this disk. The subchassis should be placed on its side or on top of the test bench, but never in such a position that it is supported by the gear train that extends beyond the frame of the subchassis.

Caution: When the rf subchassis is removed from the receiver, the tension of the loading springs on the MEGACYCLE CHANGE control split gear and KILOCYCLE CHANGE control split gear (counter drive gear) (fig. 88) is relieved, allowing the springs to hang loosely from the gears. Remove the springs and place them in an envelope. The two loading springs of the KILOCYCLE CHANGE split gear are shorter than those of the MEGACYCLE CHANGE split gear.

d. Replacement of Rf Subchassis (figs. 85, 86, and 88). Before replacing the rf subchassis, check its synchronization (par. 110*a*). To replace, proceed as follows:

(1) Loosen the front clamp that holds the KILOCYCLE CHANGE control locking disk (fig. 85) and move the disk forward.

(2) Loosen the Oldham coupler clamp (fig. 86) on the crystal oscillator and move the coupler back.

(3) To set the 10-turn stops, rotate the KILOCYCLE CHANGE and MEGACYCLE CHANGE control shafts fully counterclockwise.

(4) Place the rf subchassis on the frame in the receiver and loosely tighten the rear left and rear right green mounting screws. Engage but do not tighten the front left green mounting screw.

(5) Raise the front left side of the rf subchassis by placing a screwdriver between if. and the main frame, near the if. subchassis.

(6) Load the large brass split gear (fig. 87) two teeth. Pull out the screwdriver ((5) above). The intermediate gear will mesh with the pinion gear (fig. 88).

(7) Tighten front and rear left green mounting screws.

(8) Raise the front side of the rf subchassis with a screwdriver to disengage the driven gear (fig. 87) from the MEGACYCLE CHANGE control drive gear (fig. 85).

Caution: While performing the last step make sure that the intermediate gear does not disengage from the pinion gear ((6) above).

(9) Load the MEGACYCLE CHANGE control drive gear two teeth.

(10) Pull out the screwdriver ((8) above) and mesh the MEGACYCLE CHANGE control drive gear to the driven gear.

(11) Insert the two green mounting screws on the right side of the frame.

(12) To replace the KILOCYCLE CHANGE control locking disk, engage one-half of the counter drive gear (fig. 88); load the gears two teeth, and then engage the front half of the counter drive gear.

(13) Remove the green-coded offset from the gear train and mount it in its position at the upper left part of the rf gear plate.

(14) Tighten the front clamp on the KILOCYCLE CHANGE control locking disk.

(15) To check the detent, rotate the MEGACYCLE CHANGE control fully clockwise. The stop must fall where the first two digits on the frequency indicator read approximately halfway between 31 and 32.

(16) Set the MEGACYCLE CHANGE control so that the Oldham coupler (fig. 86) protrusion is horizontal. Slide on the removable disk and mate the rear disk to the removable disk.

(17) Check the reading on the crystal-oscillator band switch position indicator (fig. 65). See that it agrees with the reading on the megacycle portion of the frequency indicator. If it does not, turn the SYNC XTAL OSC control (fig. 22) until the two readings correspond.

(18) Tighten the rear clamp on the Oldham coupler.

(19) Reconnect the following coaxial connectors: P209, P210, P211, P221, P222, P224, P225, and P226.

(20) Reconnect P114 with J214, and replace the dust cover over the rf subchassis.

(21) Reconnect P723 with J223.

(22) Replace the front panel (*b* above).

(23) Recheck synchronization (par. 110*a*).

(24) Check synchronization of the vfo tuning shaft (par. 110*d*).

(25) Check alinement of the rf subchassis (pars. 114, 115, and 116).

e. Removal of Crystal-Oscillator Subchassis (fig. 86). To remove the crystal-oscillator subchassis, proceed as follows:

(1) Remove the top dust cover of the receiver.

(2) Disconnect plugs P113 from J413, P221 from J421, and P222 from J422, on the crystal-oscillator subchassis (fig. 65).

(3) Remove the cover from the top of the subchassis.

(4) Rotate the MEGACYCLE CHANGE control until the set screw in the clamp of the crystal-oscillator band switch coupler is accessible. Loosen the setscrew and push back the flange.

(5) Remove the two, green, $\frac{5}{16}$-inch color-coded screws that secure the subchassis to the rear panel of the receiver. When replacing the subchassis, make sure that only these screws are used, because longer screws can cause a short circuit in the crystal-oscillator subchassis.

(6) Loosen the two green captive screws inside the subchassis, one near tube V401 and the other near the point where the switch shaft enters the subchassis.

(7) Lift the subchassis straight up from the receiver. The floating disk of Oldham coupler will drop down; do not lose it.

f. Replacement of Crystal-Oscillator Subchassis. To replace the crystal-oscillator subchassis, proceed as follows:

(1) Lightly coat the coupler flange on the crystal-oscillator band switch drive shaft (located on the rf subchassis) with grease Place the floating disk against the grease-coated surface of the flange. Grease will hold the disk in place until the flanges of the couplers are mated.

(2) Lower the subchassis carefully into place and start the two green color-coded captive screws.

(3) Replace the 5/16-inch green captive screws in the back panel; tighten the screws.

(4) See that the ridges on the coupler flanges are positioned 90° apart, and that the number showing on the crystal-oscillator band switch position indicator (below J422) agrees with the megacycle reading on the frequency indicator. Mate the flanges and secure the clamp.

(5) Complete the replacement by performing the procedure described in (3), (2), and (1) (in that order) of *e* above.

(6) Check synchronization of the crystal oscillator (par. 110).

g. Removal of If. Subchassis (fig. 86). To remove the if. subchassis, proceed as follows:

(1) Remove the top dust cover of the receiver.

(2) Rotate the BANDWIDTH control to gain access to the clamp that secures the control shaft in back of the panel is accessible. Make a note of the control position.

(3) Set the BFO PITCH at 0.

(4) Loosen the clamp set screws on the BANDWIDTH and BFO PITCH control shafts, and uncouple the shafts by pulling outward on the control knobs.

(5) Disconnect coaxial connectors P225 from J525, P226 from J526 and P112 from J512 on top of the if. subchassis (fig. 68).

(6) Disconnect plug P117 from J517 (fig. 68).

(7) Loosen the three green captive screws, one at the front-center of the subchassis and two at rear corners.

(8) Lift the subchassis straight up from the receiver. Do not disturb the positions of the BANDWIDTH and BFO PITCH tuning shafts after the subchassis is removed from receiver, unless necessary for performing tests.

h. Replacement of If. Subchassis. To replace the if. subchassis, reverse procedures in (1) through (8) above. Before recoupling the BANDWIDTH and BFO PITCH control shafts, be sure that the controls are set at the positions noted during removal. Check the calibration of the bfo (par. 117).

i. Removal of Power Supply PP-621/URR (fig. 88). To remove the power supply subchassis, proceed as follows:

(1) Remove the bottom dust cover from the receiver.

(2) Disconnect large connector P118 from J818 (fig. 88).

(3) Loosen the two captive screws, accessible through holes indicated by arrows marked MTG SCREWS INSIDE.

(4) Loosen the green captive screw in the corner of the subchassis, near tube V802.

(5) Remove the four, green, 7/16-inch screws that secure the power transformer to the side of the main frame; make sure that only these screws are used when replacing the subchassis.

(6) Lift the subchassis straight up from the receiver.

j. Replacement of Power Supply PP-621/URR. To replace the power supply subchassis, proceed in the reverse order of removal. When tightening the color-coded screws, start the screws in the following order: the one captive screw, the four 7/16-inch screws, and the two hidden screws.

k. Removal of Vfo Subchassis (fig. 88). To remove the vfo subchassis, proceed as follows:

(1) Remove the bottom dust cover of the receiver.

(2) Disconnect plug P715, coaxial connector P723, J115, and J223 (fig. 88). Use scissors-type Tube Puller TL201 for removing P723.

(3) Remove the small loading spring from the Oldham coupler on the vfo tuning shaft. *Do not lose the spring.*

(4) Rotate the KILOCYCLE CHANGE control so that the ridge in the flange or the coupler nearest the vfo subchassis is vertical.

Note. If synchronization of the vfo tuning shaft and KILOCYCLE CHANGE control is to be maintained, do not disturb the position of the shaft during the succeeding steps, or after the vfo subchassis has been removed.

(5) Loosen the two green-coded captive screws in the front mounting bracket of the subchassis and the single color-coded captive screw in the rear bracket.

(6) Carefully remove the subchassis from the receiver, lifting straight up to disengage the coupler, and then tilting slightly to clear the receiver. The floating disk will drop down from the coupler; do not lose it.

l. Replacement of Vfo Subchassis. To replace the vfo subchassis, proceed as follows:

(1) If the position of the vfo tuning shaft has been disturbed while the subchassis was removed from the receiver, or if a new vfo is to be installed, synchronize the shaft as described in paragraph 110*d*.

(2) If the position of the shaft has not been disturbed, place the floating disk on the flange of the vfo drive shaft (on the main frame). Position the ridge on the coupler flange of the vfo tuning shaft 90° from that of the flange on the drive shaft, and carefully insert the vfo subchassis into place, tilting it slightly to clear the receiver frame.

(3) Tighten the three green color-coded screws on the subchassis mounting brackets.

(4) Replace the loading spring on the coupler.

(5) Connect P715 to J115 and P723 to J223 (fig. 88).

(6) Replace the dust cover on the receiver.

(7) If the vfo setting has been disturbed, refer to paragraph 110 for synchronization procedures.

m. Removal of Calibration-Oscillator Subchassis (fig. 88). To remove the calibration-oscillator subchassis, proceed as follows:

(1) Remove the bottom dust cover from the receiver.

(2) Disconnect plugs P715 from J115, P916 from J116 (fig. 88). Move the cable attached to P715 to free it of the subchassis.

(3) Disconnect coaxial connector P224 from J924 on the top deck of the receiver (fig. 86).

(4) Loosen the two green captive screws at opposite ends of the subchassis.

(5) Carefully lift the subchassis out of the receiver.

n. Replacement of Calibration-Oscillator Subchassis. To replace the calibration-oscillator subchassis, proceed in the reverse order of removal.

o. Removal of Af Subchassis (fig. 88). To remove the af subchassis, proceed as follows:

(1) Remove the bottom dust cover from the receiver.

(2) Disconnect plugs P119 from J619 and P120 from J620 (fig. 88).

(3) Remove the screw from the cable clamp that secures the cable at side of the af subchassis.

(4) Loosen the screw in the clamp that secures the cable to the casting at the front end of the af subchassis, and swing the clamp free of the cable.

(5) Loosen the three green color-coded captive screws, one at the front end of the subchassis and two at the rear corners.

(6) Move the cable from which the clamps were removed, lift the subchassis straight up, and then tilt the front down slightly to remove the subchassis from the receiver.

p. Replacement of Af Subchassis. To replace the af subchassis, reverse the procedure described in *o* above.

q. Removal of Rf Tuning Coils and Transformers (fig. 62). To remove the rf tuning coils and transformers for voltage and resistance measurements at the sockets or banana-pin contacts. proceed as follows:

(1) Remove the slug rack associated with the coil or transformer, by unhooking the spring located at each end of rack. Then use a bent paper clip hooked through the end of the spring to anchor the spring temporarily to the end plates of the subchassis. Be careful that the springs do not fly into the subchassis.

(2) Insert a Phillips screwdriver, supplied with the receiver, into the two holes in the coil or transformer can, and loosen the screws until they are free of the subchassis.

(3) Withdraw the coil or transformer from the subchassis.

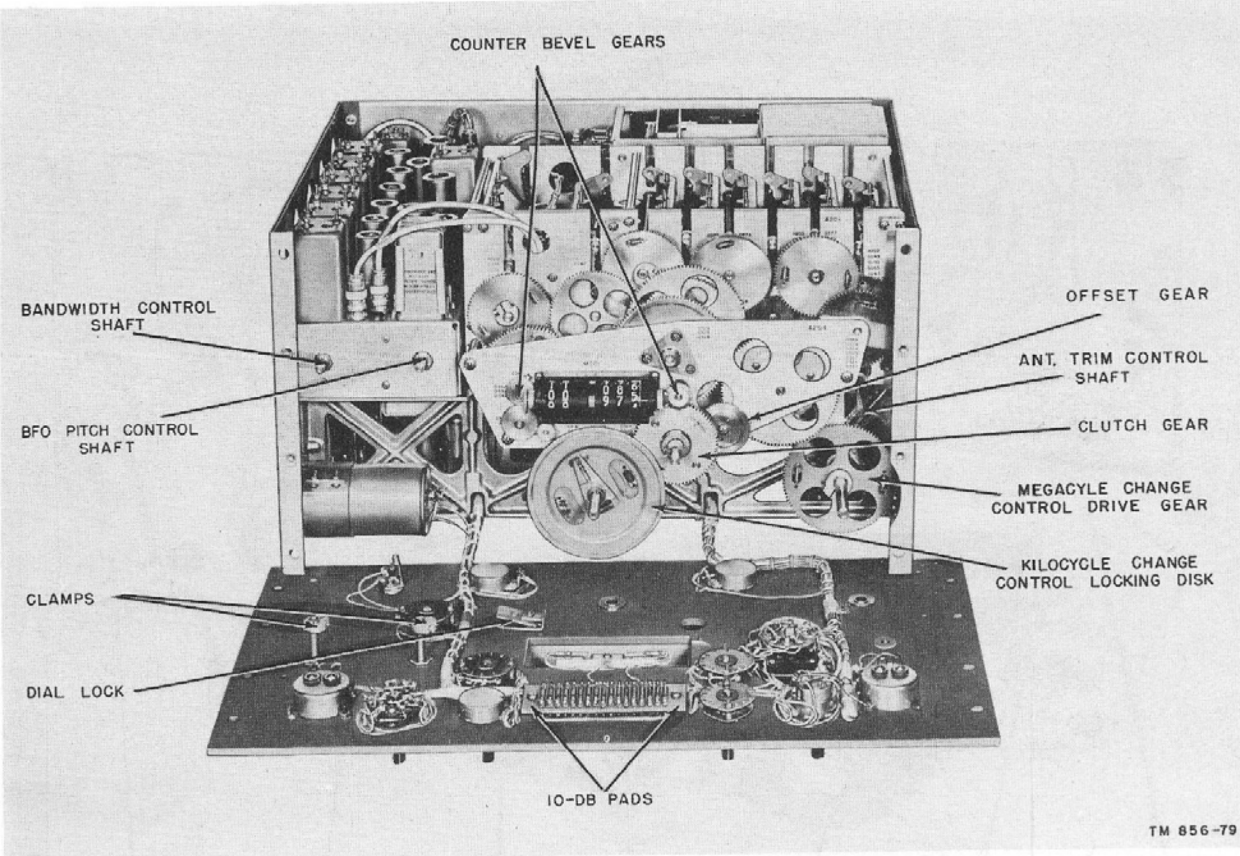


Figure 85. Radio Receiver R–390/URR, front panel removed.

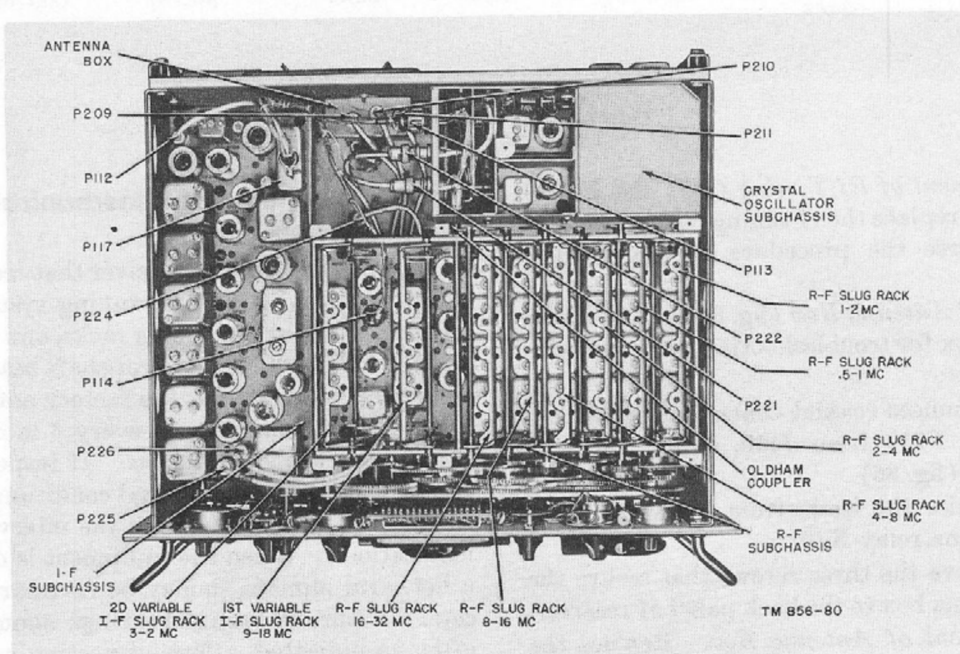


Figure 86. Radio Receiver R–390/URR, top view, dust cover and shields removed.

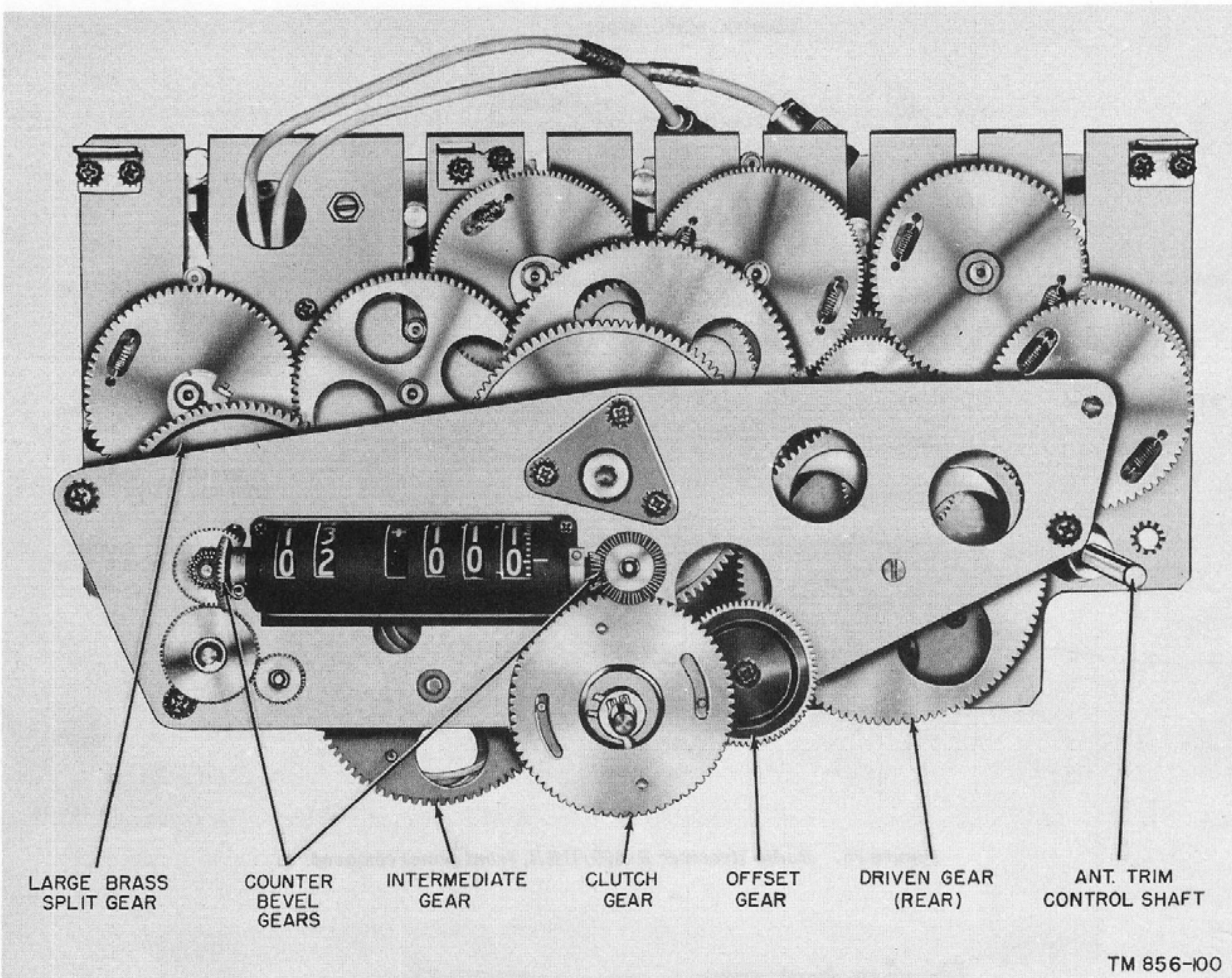


Figure 87. Location of gears.

r. Replacement of Rf Tuning Coils and Transformers. To replace the rf tuning coils and transformers, reverse the procedure described in *q* above.

s. Removal of Antenna Box (fig. 86). To remove the antenna box for troubleshooting or repair, proceed as follows:

(1) Disconnect coaxial connector P209 from J109, P210 from J110, and P211 from J111 (fig. 86).

(2) Unsolder the leads from the winding of antenna relay K101.

(3) Remove the three screws that secure the antenna box to the back panel of receiver.

t. Replacement of Antenna Box. Replace the antenna box by reversing the procedure described in *s* above.

106. Lubrication of Mechanical Tuning System

The only parts of the receiver that require lubrication are the mechanical tuning system (which includes the gear train, slug racks, and cam rack), and the BFO PITCH control-shaft bearing. The receiver is lubricated at the factory and should be lubricated thereafter once every 6 months under normal operating conditions. If inspection indicates the need, or if abnormal conditions or activities are encountered, shorten the interval between lubrications. When the equipment is operated in a hot, arid climate, it may be necessary to lubricate the porous bronze bearings about twice as often as indicated. Overlubrication causes more harm than no lubrication. Check the condition of the mechanical tuning system whenever the re-

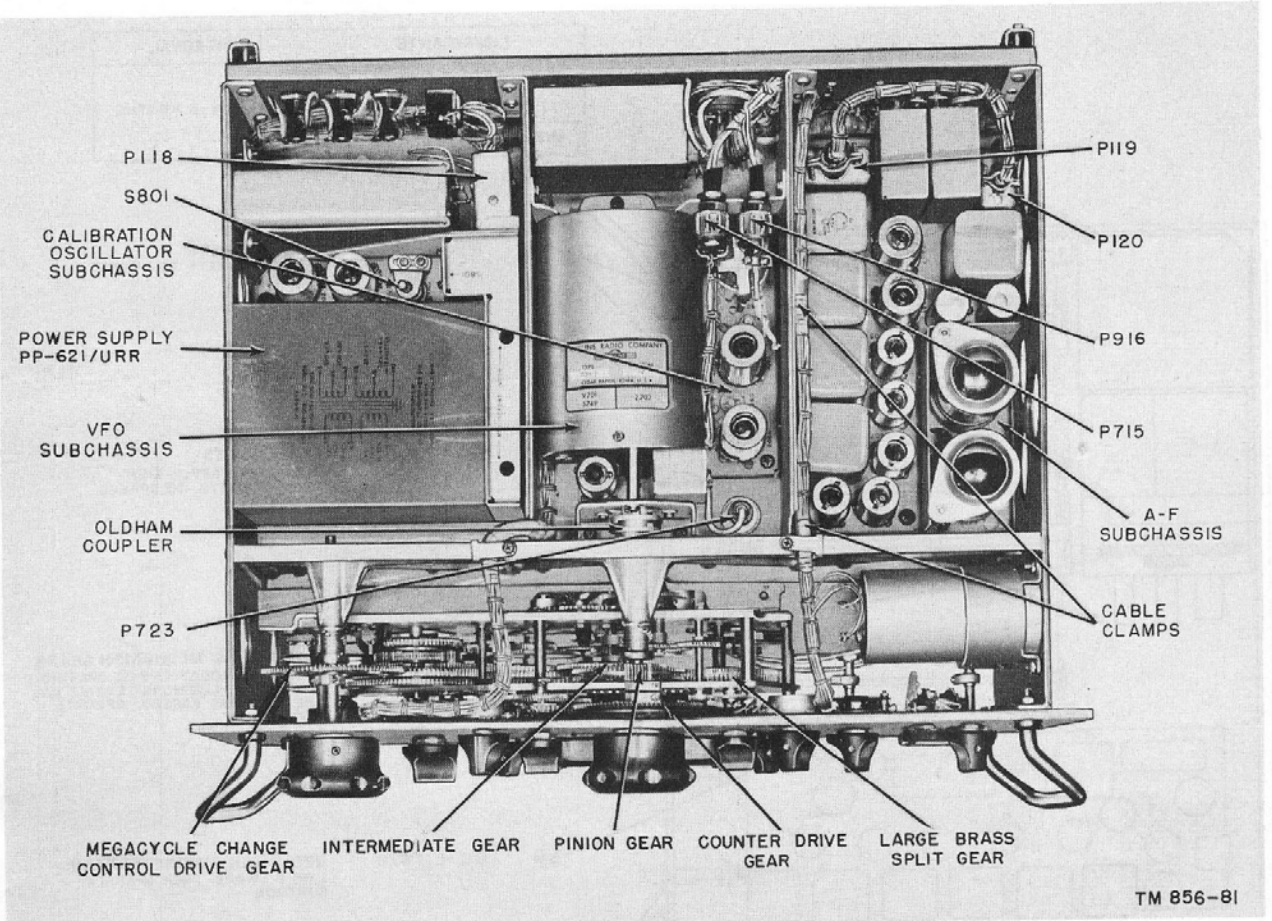


Figure 88. Radio Receiver R–390/URR, bottom view, dust cover removed.

ceiver is withdrawn from the case or rack for servicing. Manually rotate the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls throughout their ranges, and note ease of operation. Check for lack of lubrication on gears, edges of cams, cam rollers, guide slots, and bearings; inspect for gritty grease and oil. Operate the BFO PITCH control; if operation is rough or uneven, check the lubrication of the control-shaft bearing.

Caution: Never attempt to lubricate the sealed oscillator (vfo), regardless of possible noisy operation of the unit during tuning. Unstable operation of the oscillator may result.

a. Cleaning Before Lubrication. Remove the covers from the rf and crystal-oscillator subchassis. Use a thin, long-handled brush with medium bristles, dipped in Solvent, Dry Cleaning (SD). Remove the dirt, oil, and grease from the gears, cams, guide slots, and bearings. To gain access to all of the gear teeth while cleaning, rotate the MEGACYCLE CHANGE and KILOCYCLE CHANGE knobs. After dipping the brush in solvent (SD), remove the excess to prevent solvent from dripping onto connecting cables, wiring, or other electrical parts. Use a clean, lint-free cloth moistened with solvent (SD) to remove grease from the metal casting and chassis. Thoroughly wipe all parts with a clean, dry, lint-free cloth before proceeding with lubrication.

b. Detailed Lubrication Instructions. Lubricate the gear train, slug racks, and cam rack as indicated in figure 89. To apply oil to the bearings, dip a length of wire into the oil to collect a small drop at the end, and transfer the oil to the bearing by touching the end of the wire to the edge of the bearings. Avoid using excessive amounts of oil. A standard grease gun and a

323471 O—55——8

LUBRICANTS	INTERVAL
MIL-L-7870-LUBRICATING OIL GENERAL PURPOSE, LOW TEMPERATURE	6M-6 MONTHS
MIL-G-7421-GREASE	

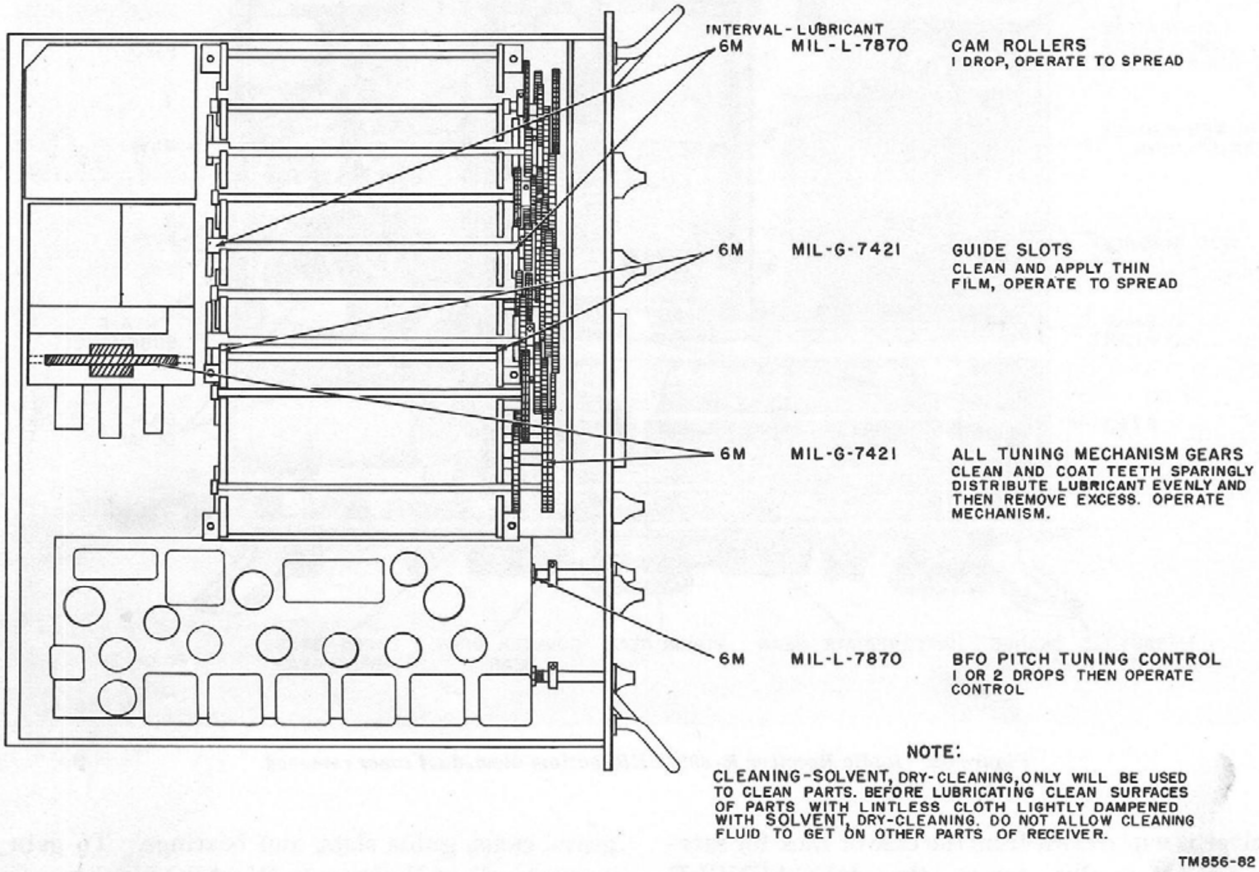


Figure 89. Lubrication of Radio Receiver R–390/URR.

thin, long-handled brush should be used for applying grease to gear teeth, edges of cams, and tuning rack guide slots. Rotate the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls as necessary to expose all gear teeth.

107. Refinishing

Instructions for touchup painting are given in paragraph 40, and instructions for refinishing badly marred panels or an exterior cabinet are contained in TM 9–2851.

Section III. ALINEMENT AND ADJUSTMENT PROCEDURES

108. Test Equipment and Tools Required for Alinement and Adjustment

a. Signal Generator. The signal generator must be an accurately calibrated instrument such as RF Signal Generator Set AN/URM–25, capable of producing rf signals within a frequency range of .455 to 32 mc. The attenuator must be capable of varying the output of signal generator over a range of approximately 1 microvolt to 1 volt.

b. Output Meter. The output meter should be a vacuum-tube voltmeter, such as Electronic Multimeter TS–505/U, having a high resistance input. It must have a dc voltage range suitable for measuring 2 to 10 volts, and a high-frequency probe for measuring 1 to 10 volts ac.

c. Voltohmmeter. A voltohmmeter is required for checking the synchronization of the crystal-oscillator band switch and line voltage measurements. Multimeter TS–352/U is suitable for this purpose.

d. Vtvm. A vacuum-tube voltmeter that has a .01- to .1-volt ac range, such as Electronic Multimeter ME–6/U, is required for performing the regulated voltage hum adjustment.

e. Variable Autotransformer. A variable autotransformer, such as Transformer CN–16/U, is required for performing the regulated-voltage hum adjustment.

f. Resistors. Two 68-ohm, a 75-ohm, and a 95-ohm, noninductive, 1/4-watt resistors must be available for connecting RF Signal Generator AN/URM–25 to the balanced antenna input when alining the rf subchassis.

g. Tools. A bakelite alinement tool is required for adjusting transformer cores and trimmer capacitors. The No. 8 Bristo wrench and the Phillips screwdriver supplied with the receiver are required for adjustments during synchronization of the tuning shafts.

Note. Before performing the alinements, allow the receiver to warm up for 1 hour.

109. Regulated-Voltage Hum Adjustment

If objectionable hum is noted in the output of the receiver, adjust the regulated voltage for minimum hum as follows:

a. Connect Power Cable Assembly CX–1358/U between the receiver and a variable autotransformer, such as Transformer CN–16/U.

b. Connect a voltmeter (such as Multimeter TS–352/U), set at 100- to 200-volt ac range, across the output of the autotransformer.

c. Connect the vtvm (such as Electronic Multimeter ME–6/U) set at .01- to .1-volt ac range, between B+ 180 VDC jack J601 and ground.

Warning: Avoid contact with the B+ 180 VDC jack when the receiver is turned on; the high voltage is present at this jack.

d. Be sure that the receiver is grounded; then connect the autotransformer to 115-volt, 60-cycle source.

e. Check to see that switch S801 on Power Supply PP–621/URR is set at the 115V position; then turn on the receiver and allow it to warm up.

f. Adjust the autotransformer for an accurate 115-volt line-voltage reading on the vtvm.

g. Insert the screwdriver in the slot of HUM BAL control R614 (fig. 75), which is accessible through the right side plate of the main frame, and adjust for minimum reading one Electronic Multimeter ME–6/U.

110. Mechanical and Electrical Synchronization

The receiver tuning shafts, consisting of the 6-position rf band switch shaft, slug-rack camshafts, crystal-oscillator band switch shaft, and the vfo tuning shaft, must be in synchronization with the gear train before attempting to aline the receiver. Follow the procedure given below.

a. Camshafts. The camshafts are synchronized properly if the index line etches on the rear plate of the rf subchassis bisect the holes in each of the rear cams (fig. 90) when the frequency-indicator reading is 02 000. To synchronize the rf subchassis when it is removed from the cabinet, rotate the large brass gear (in the center of the subchassis) and the clutch gear (fig. 87) to positions where the frequency-indicator reading is 02 000. If the index lines do not bisect the holes, follow the procedure outlined in (2) through (7) below. Before replacing the rf subchassis (par. 105*d*), rotate the two gears mentioned above to positions where the first two digits on the frequency indicator indicate halfway between 99 and 00, and the last three digits read −972. (Note the minus sign.) When the rf subchassis is in the cabinet, proceed as follows:

Note. The camshafts are secured to the drive gears by clamps at the hubs of the gears. To position a camshaft, loosen the clamp which (except for the 8–16-mc shaft) is located at the end of the individual shaft in front of the rf subchassis to avoid losing the nut. Do not loosen the clamp more than necessary. Be careful not to strip the screw thread.

(1) Check the 10-turn stop by rotating the MEGACYCLE CHANGE and the KILOCYCLE CHANGE controls fully counterclockwise. The frequency indicator should read halfway between 99 and 00 (off detent position) and −972. (Note the minus sign.) Check the reading on the crystal-oscillator band switch position indicator to see that it agrees with the reading on the megacycle portion of the frequency indicator. If it does not agree, loosen the Oldham coupler clamp (fig. 86) on the crystal oscillator

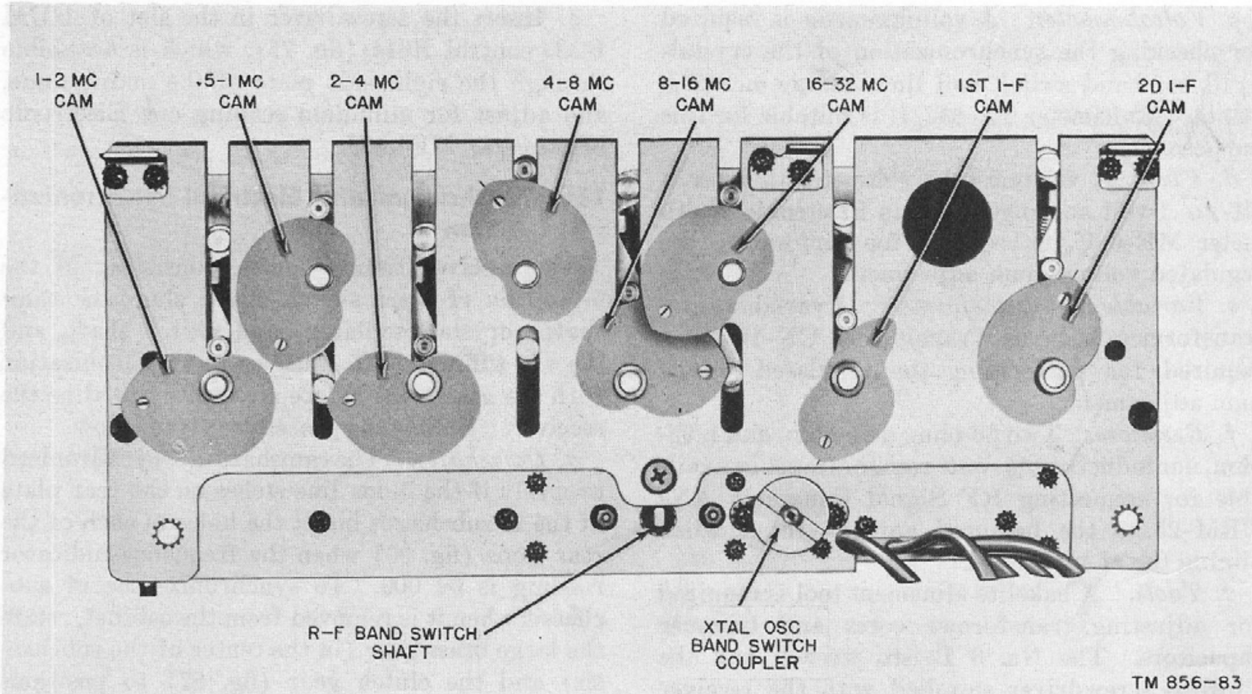


Figure 90. Rf subchassis, rear view.

and turn the SYNC XTAL OSC control (fig. 22) until the two readings correspond. Tighten the clamp on the Oldham coupler. Check the synchronization of each band by noting the position of the cam rollers at the end frequencies of each band. The position of the 1–2 mc band cam shown in figure 90 represents the correct position for the low end of the band. The position of the second if. cam shown in figure 90 represents the correct position for high end of the band (the last three digits of the frequency indicator should read 999). If all the cams are out of synchronization, set the 8–16 mc cam first.

(2) If 1- to 2-mc camshaft (fig. 90) is not positioned properly, loosen the clamp on the front of the shaft and rotate the rear cam until the index line bisects the hole in the cam. Tighten the clamp.

(3) Position the camshaft for .5- to 1-mc slug rack (fig. 90), if necessary, in the same manner as described in (2) above.

(4) Check the position of the 8- to 16-mc camshaft. If it is not alined properly, loosen the clamp on the front of the 2- to 4-mc shaft to position the 8- to 16-mc cam, since the gear for the 8- to 16-mc shaft is pinned through the shaft. After positioning the 8- to 16-mc cam, position the 2- to 4-mc cam while holding the 8- to 16-mc cam in place. Then tighten the clamp on the 2- to 4-mc shaft.

(5) If necessary, position the 4- to 8-mc and 16- to 32-mc cams (fig. 90) in the same manner as described in (2) above.

(6) To position the first variable if. cam (fig. 90), loosen the clamp nearest the front plate of the rf subchassis on the crystal-oscillator band switch shaft. Adjust the position of the cam; then tighten the clamp.

(7) Position second variable if. cam (fig. 90), if necessary, in the same manner as for 1 to 2-, .5 to 1-, 4 to 8-, and 16 to 32-mc cams.

(8) Check the reading of the frequency indicator. If a reading of 02 is not centered within the two left-hand spaces of the indicator, loosen the clamp on the bevel gear on shaft extending from the left side of the indicator (fig. 87). Set the two number wheels for reading of 02, and retighten bevel-gear clamp.

(9) If reading of 000 does not appear in the last three spaces of frequency-indicator dial, loosen the clamp securing bevel gear on the shaft extending from the right side of the indicator. Set the three number wheels for reading of 000.

b. Six-Position Rf Band Switch. The procedure for checking and synchronizing the rf band switch is as follows:

(1) Adjust the KILOCYCLE CHANGE control for a reading of 000 in the last three spaces of the frequency indicator.

(2) Rotate the MEGACYCLE CHANGE control fully counterclockwise, beyond the first detent position.

(3) Connect the ohmmeter, set at the XI scale, between test point E208 (grid of tube V203 (fig. 62)) and ground.

(4) Rotate the MEGACYCLE CHANGE control clockwise through eight detent positions. The meter should read more than 50 ohms in each position.

(5) Rotate the MEGACYCLE CHANGE control clockwise from the eighth to the ninth detent position. The ohmmeter should show a reading. If it does not, proceed as outlined in (6), (7), and (8) below. If the indication is normal, the crystal-oscillator band switch is in synchronization; in this case, proceed with synchronization of the crystal-oscillator band switch as described in *c* below.

(6) Rotate the MEGACYCLE CHANGE control fully counterclockwise; then turn the control clockwise through the two detent positions to the third detent position.

(7) Remove the rf subchassis (par. 105).

(8) Loosen the clamp on the front of the six-position switch shaft, located on the bottom of the rf subchassis. Rotate the shaft until the switch contacts are centered at position 3 by inserting long-nosed pliers in the hole at the rear of the subchassis (fig. 90) and turning the shaft. Positions of the switch contacts are shown in the schematic diagram (fig. 108, part 1). Tighten the clamp after adjustment.

c. Crystal-Oscillator Band Switch. The crystal oscillator band switch should be checked and synchronized as follows:

(1) The rotor of the crystal-oscillator band switch is positioned correctly when the number centered in the slot of the switch position indicator (fig. 65) agrees with the reading of the megacycle portion (first two digits) of the frequency indicator.

(2) If the indication is incorrect, loosen the clamp on the flange of the Oldham coupler and rotate the SYNC XTAL OSC control (fig. 22) to center the proper reading in the slot.

d. Vfo Tuning Shaft (fig. 88). Synchronize the vfo tuning shaft as follows:

(1) Turn on the receiver and allow sufficient time for it to warm up.

(2) Fabricate cable No. 1 (fig. 60), excluding RF Plug UG–88/U.

(3) Disconnect plug P723 from jack J223 on the rf subchassis and connect P723 to RF Jack UG–89/U on fabricated cable.

(4) Insert the center conductor on the other end of cable into UNBALANCED ANTENNA WHIP input receptacle J107 of a second Radio Receiver R–390/URR known to be in good operating condition.

(5) Turn the BFO switch on the second receiver to the ON position, and tune the receiver between 2.2 and 3.7 mc (this represents the frequency range of the vfo) until a signal is heard. Note the frequency on the second receiver.

(6) Loosen the clamp on the side of the Oldham coupler that is closest to the front panel to enable the vfo tuning shaft to turn freely.

(7) Tune the second receiver to 2.955 mc and turn the shaft of the vfo until a signal is heard.

Caution: The vfo will be permanently damaged if the shaft is turned too far in either direction.

Note. With a clockwise rotation of the vfo shaft (as viewed from the front panel) the vfo frequency is decreased.

(8) Reconnect plug P723 into J223 on rf subchassis of the first receiver. Set the FUNCTION switch to CAL and the BFO switch to ON. Connect a headset into the PHONES jack.

(9) With the first two digits of the frequency indicator at any setting, set the KILOCYCLES CHANGE control to 500.

(10) Tighten the clamp on the side of the Oldham coupler.

(11) The receiver should be checked against a known station such as WWV.

111. Alinement of 455–kc If. Stages
(fig. 91)

a. Turn on RF Signal Generator Set AN/URM–25 or equivalent, and connect it to test point E210 (control grid of third mixer tube, V205).

b. For an output meter, connect the grounded lead of a vtvm, such as Electronic Multimeter TS–505/U, to the receiver chassis, and connect the other lead to the DIODE LOAD terminal 14, of rear terminal strip (fig. 22). Set the function switch of the voltmeter for measuring negative dc voltage.

c. Set the BANDWIDTH switch to the .1–KC position, RF GAIN control to 10, BFO switch to OFF, and FUNCTION switch to MGC. Allow the receiver to warm up for several minutes.

d. Tune the signal generator to 455 kc (unmodulated); then adjust its frequency control for peak reading on the vtvm. To obtain peak reading, it may be necessary to set the attenuation of the signal generator for high amplitude output signal (3 volts). If a reading on the vtvm is obtained, proceed with *e* below. If no reading is obtained, perform the procedure outlined in (1) and, if necessary, (2) below to secure approximate alinement before proceeding with *e* below.

(1) With the signal generator tuned to 455 kc and the attenuator set for full output, turn the receiver BANDWIDTH switch to the 16–KC position. If the output reading is not yet obtained, proceed with (2). If it is obtained, adjust the cores of transformers T506 through T501 and T207, in that order, for peak reading on the vtvm. Then, set the BANDWIDTH switch at the next lower position, and repeat the adjustment of the transformer cores for peak output. Repeat this procedure for each setting of the BANDWIDTH switch until peak output is obtained at .1–KC position of the switch; then proceed with *e* below.

Note. The frequency will decrease as the slugs are screwed further into the coils, and will increase as the slugs are withdrawn.

(2) Perform the procedure outlined in (*a*) through (*e*) below only when the transformer cores have been displaced greatly from their normal positions within the coils. Set the BANDWIDTH switch to the 2–KC position, and proceed as follows:

(*a*) Tune the signal generator to 455 kc, and set the attenuator for maximum output. Remove the sixth if. amplifier tube, V506 (fig. 25), and wrap a thin wire lead around pin 1 (grid). Replace the tube, and connect the other end of the lead to the signal generator output.

(*b*) Adjust the cores of transformer T506 for peak reading on the vtvm.

(*c*) Apply the signal generator output to the fifth if. amplifier, V505, in the same manner as described in (*a*) above for V506, and adjust the cores of transformer T505 for maximum indication on the vtvm.

(*d*) Repeat the above procedure for each remaining set of if. tubes and transformers in following order: V504 and T504, V503 and T503, V502 and T502, V501 and T501, and V205 and T207.

(*e*) Set the BANDWIDTH switch to the .1–KC position, and proceed with the procedure outlined in *e* below.

e. With the signal generator output connected to the test point, set the generator frequency at 455 kc. While adjusting the attenuator of the signal generator to maintain an output of approximately 6 volts (as read on the vtvm), carefully tune the generator to the exact frequency required to obtain peak output reading on the vtvm. Do not disturb this frequency setting while carrying out the procedures outlined in *f*, *g*, and *h* below. Check the setting repeatedly during these steps to make sure it has not been changed.

f. Set the BANDWIDTH switch to the 2–KC position.

g. Adjust the cores of transformers T506, T505, T504, T503, T502, and T207, in that order, for peak output reading, while continuously adjusting the attenuator of the signal generator to maintain a reading of approximately 6 volts on the vtvm. Repeat these adjustments until no further increase in output is noticeable.

h. Change the setting of the BANDWIDTH switch to the 8–KC position, and adjust the cores of transformer T501 for maximum output. Repeat the adjustment of cores until no further increase in output can be produced.

i. Return the BANDWIDTH switch to the .1–KC position.

j. Set the attenuator of the signal generator for a reading of approximately 6 volts on the vtvm, and note the attenuator setting. Tune the generator in one direction, away from the frequency required for peak reading, increasing the output of the generator to restore the vtvm reading to its original value. Continue tuning the generator in this direction until the voltage output required to obtain the original reading on the vtvm is 1,000 times the voltage required at peak frequency.

k. Adjust the phasing capacitor in the crystal filter, Z501, for minimum vtvm reading, and note the position of the capacitor slot.

l. Tune the signal generator to the opposite side of the frequency required for peak output, and set the attenuator for increased output, as directed in *j* above.

m. Adjust the phasing capacitor for minimum reading, and note the position; then set the capacitor approximately halfway between the two noted settings. To avoid possible incorrect readings, caused by tuning through the positions of minimum or maximum capacitance, the two settings for minimum output must be less than 45° apart.

n. With the BANDWIDTH switch in the .1–KC position, tune the signal generator to obtain peak output. Set the BANDWIDTH switch to the .1–KC position. Adjust the core of the tuning coil in the crystal filter (Z501) until the frequency reading required for obtaining peak output, with the BANDWIDTH switch in .1–KC position, corresponds exactly with the frequency reading required for peak output with the BANDWIDTH switch in the .1–KC position. Retune the signal generator, and alternately change positions of the BANDWIDTH switch as required to complete this adjustment.

o. Set the BANDWIDTH switch to the .1–KC position, and tune the signal generator for maximum output as described in *e* above. Do not disturb this frequency setting during the adjustment of the agc tuning circuit in the following steps.

p. Disconnect the vtvm lead from terminal 14 of the rear terminal strip, and connect it to terminal 4 of the rear terminal strip (fig. 22).

q. Set the FUNCTION switch to AGC, and the BANDWIDTH switch to the 2–KC position.

r. Adjust the cord of Z503 for a maximum voltage reading on the vtvm, while adjusting the attenuator of the signal generator to maintain a peak reading of approximately 2 volts. When the adjustment is completed, disconnect the meter.

Note. If a signal generator is not available, the procedures given in *e* through *r* above may be followed by using the output of the calibration oscillator and the CARRIER LEVEL meter and by utilizing the RF GAIN control as an attenuator. The frequency of the calibration oscillator must be checked (par. 127), before using it for alinement.

112. Alinement of Second Crystal Oscillator (fig. 91)

a. Connect the vtvm set for reading negative dc volts, between test point E209 (fig. 62) (grid of second mixer V204) and ground.

b. Turn the OVENS switch to ON and the FUNCTION switch to STAND BY. Allow the receiver to warm up.

c. Set the MEGACYCLE CHANGE control so that the frequency indicator reads 31.

d. Screw the slug of T402 (fig. 65) out until only one peak reading on the vtvm can be obtained, while operating trimmer 31 (fig. 91) throughout its full range.

e. Set the trimmer slightly off the position for peak reading, and adjust the slug for peak indication on the vtvm.

f. Adjust the second crystal-oscillator trimmers (large group of trimmers on rear panel (fig. 92) using the table below. Set the MEGACYCLE CHANGE control for a megacycle reading on the frequency indicator shown in first column, and adjust the trimmer designated in second column for the meter indication shown in the last column. Where a trimmer is used in the crystal oscillator circuit at more than one frequency setting of the MEGACYCLE CHANGE control, it is listed only for the first setting and is adjusted for maximum only at this setting. For subsequent frequency settings of the MEGACYCLE CHANGE control involving a previously adjusted trimmer, check only for an indication on the vtvm. If no indication is obtained, the crystal-oscillator band switch should be checked.

Dial reading	Adjust trimmer	Meter indication
31	31	Maximum.
30	30	Maximum.
29	29	Maximum
28	28	Maximum.
27	27	Maximum.
26	26	Maximum.
25	25	Maximum.
24	24	Maximum.
23	23	Maximum.
22	22	Maximum.
21	21	Maximum.
20	20	Maximum.
19	19	Maximum
18	18	Maximum.
17	7, 17	Maximum.
16	16	Maximum.
15	3, 6, 15	Maximum.
14	14	Maximum.
13	5, 13	Maximum.
12	2, 12	Maximum.
11	4, 11	Maximum.
10	10	Maximum.
09	0, 1, 9	Maximum.
08	8	Maximum.
07	------------	Check for indication.
06	------------	Check for indication.
05	------------	Check for indication.
04	------------	Check for indication.
03	------------	Check for indication.
02	------------	Check for indication.
01	------------	Check for indication.
00	------------	Check for indication.

113. Alinement of First Crystal Oscillator

(fig. 91)

a. Connect the vtvm and set for reading negative dc volts, between test point E208 (fig. 62) (grid of first mixer V203) and ground.

b. Turn OVENS switch to ON and FUNCTION switch to STAND BY. Allow the receiver to warm up.

c. Set the MEGACYCLE CHANGE control so that the megacycle reading on the frequency indicator is 03.

d. Adjust the slug of T401 (fig. 65) for peak indication on the vtvm.

e. Adjust first crystal-oscillator trimmers (group of five trimmers on the rear panel (fig. 92)) using chart below in a manner described in paragraph 112.

Dial reading	Adjust trimmer	Meter indication
07	2, 7	Maximum.
06	0, 6	Maximum.
05	1, 5	Maximum.
04	4	Maximum.
03	3	Maximum.
02	------------	Check for indication.
01		
00		

114. Alinement of Second Variable If. Stage

(fig. 91)

a. Set the vtvm to measure the negative dc voltages of approximately 5 volts. Connect the ground lead to the receiver chassis, and the input lead to DIODE LOAD terminal 14 of rear terminal strip (fig. 22).

b. Connect the output lead of the signal generator to test point E209 (fig. 62) (control grid of second mixer V204). Connect the ground lead of the signal generator to the receiver chassis.

c. Set the FUNCTION switch to AGC position, and the RF GAIN control to 10.

d. With the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls, set the frequency-indicator reading to 01 900.

e. Connect the headset to the PHONES jack. Turn on the signal generator modulation (30 percent at 400 cycles), and tune the generator to approximately 2100 kc to obtain an audible receiver output. While observing the output meter, tune the signal generator to the exact frequency which produces peak reading on the output meter. Change the attenuator setting of the signal generator continuously to maintain a reading of less than 5 volts on the vtvm.

f. Adjust the slugs of tuned circuits Z222, Z223, and Z224 for peak reading on the output meter. The three slugs are mounted on the second variable if. slug rack.

g. With the KILOCYCLE CHANGE control, tune the receiver to 1100 kc.

h. Tune the signal generator to 2900 kc, and then set it to the exact frequency which produces peak reading on the output meter.

i. Adjust the three trimmers mounted within the shield cans of tuned circuits Z222, Z223, and Z224 for peak output.

j. Repeat the procedure described in *e* through *i* until no increase in output can be obtained. While making all adjustments, set the attenuator of the signal generator so that the reading on the vtvm is less than 5 volts.

k. If no test equipment is available, the second variable if. stage can be aligned, using the CARRIER LEVEL meter and the signal from the internal calibration oscillator. Disconnect coaxial connectors P209 from J109, P210 from J110, and P211 from J111, on the antenna box (fig. 86); set the FUNCTION switch at CAL and the RF GAIN control at 10; and then proceed with the alinement, using the receiver frequencies indicated in *e* and *g* above. Utilize the RF GAIN control as an attenuator to maintain the meter reading at approximately midscale while adjusting the tuned circuits.

115. Alinement of First Variable If. Stage (fig. 92)

a. Connect the signal generator lead to test point E208 (fig. 62) (control grid of first mixer tube V203). The vtvm should be connected as described in paragraph 114*a*.

b. With the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls, set the frequency-indicator reading to 01 500.

c. Tune the signal generator to 9.5 mc. Reduce the output of the signal generator as required to maintain vtvm reading of less than 5 volts.

d. Adjust slugs of tuned circuits Z219, Z220, and Z221 for peak output reading. Slugs are mounted on the first variable if. slug rack.

e. Adjust the MEGACYCLE CHANGE control for a reading of 07 500 on the frequency indicator.

f. Tune the signal generator to 17.5 mc. Change the attenuator setting of the signal generator continuously to maintain a reading of less than 5 volts on the vtvm.

g. Adjust the three trimmers mounted within the shield cans of tuned circuits Z219, Z220, and Z221 for peak output.

h. Repeat the procedure described in *c* through *g* above until no increase in output can be obtained.

i. The first variable if. stage can be alined, in the absence of test equipment, in the same manner described in paragraph 114*k*. Use the receiver frequencies indicated in *b* and *e* above.

116. Alinement of Rf Stages

a. Set the FUNCTION switch to AGC, and the RF GAIN control to 10.

b. Connect one lead of the vtvm to DIODE LOAD terminal 14 on the rear terminal strip (fig. 22) and the other lead to the receiver chassis. The meter should be set to measure negative dc voltages of approximately 5 volts, with respect to chassis.

c. If preliminary adjustments (*d* below) are unnecessary, connect the signal generator to the balanced antenna input terminals by connecting either antenna input terminal of BALANCED ANTENNA 125 OHM connector J108 to the receiver ground and to the ground lead of the signal generator. Connect the other antenna input terminal, through the 95-ohm noninductive series resistor, to the output lead of the signal generator. Connect a 75-ohm noninductive resistor from the output lead of the signal generator to ground. Proceed with the procedure outlined in *e* below.

d. If preliminary adjustments are necessary because of extreme misalinement, connect the signal generator through .01-μf capacitor to points listed in the last column of the chart below instead of connecting it to the antenna input terminals, and proceed with alinement as directed in *e* through *j* below and in the chart. After completing the preliminary procedure, connect the signal generator to the antenna input terminals as described in *c* above; then repeat the alinement, making all adjustments in the order listed in the chart.

e. With MEGACYCLE CHANGE control, set up the digits listed in the second column of chart in the first two spaces of the frequency indicator dial. With the KILOCYCLE CHANGE control, set up the digits listed in the third column in the last three spaces of the frequency indicator.

f. After setting the receiver frequency indicator reading for a group of adjustments, tune the signal generator to the frequency listed in the fourth column. To obtain the exact required frequency, tune the signal generator for peak reading on the vtvm; do not depend on the calibration of the signal generator.

g. During the alinement procedure, change the setting of the signal-generator attenuator as required to maintain an output reading of less than 5 volts.

h. When alining rf transformers, adjust the slugs for a set of transformers while the receiver is tuned to a lower frequency indicated in the chart for that set of transformers; adjust the trimmer capacitors while the receiver is tuned to a higher frequency. Adjust the slugs of the set of transformers listed in the fifth column for peak output; then, after changing the frequency settings of the receiver and signal generator, adjust the trimmer capacitors of the set of transformers listed in the sixth column for peak output. Trimmer capacitors are accessible through holes in the top of shield cans, and should be adjusted with an insulated screwdriver. For antenna transformers, adjust the trimmer capacitors mounted nearest to the back of the receiver for peak output reading. Front trimmers are used to balance the antenna input circuits. *Repeat the adjustments for each set of rf coils until no further change is noticeable.*

i. Set the ANT. TRIM control to 0.

j. Proceed with the rf alinement by performing adjustments in the order listed in the chart below. Refer to figure 91 for location of slugs and trimmer capacitors.

1 Set of rf coils	2 Megacycle reading	3 Kilocycle reading	4 Signal generator frequency (tune for peak output) in kc	5 Adjust slugs for peak output	6 Adjust trimmer capacitors for peak output	7 Signal generator connection (preliminary alinement only)
5–1 mc	00	600	600	Z213 Z207 Z201 T201		E207. E207. E206. BALANCED antenna. J108.
	00	900	900		Z213 Z207 Z201 T201 (rear trimmer)	E207. E207. E206. J108.
1–2 mc	01	100	1, 100	Z214 Z208 Z202 T202		E207. E207. E206. J108.
	01	900	1, 900		Z214 Z208 Z202 T202 (rear trimmer)	E207. E207. E206. J108.
2–4 mc	02	200	2, 200	Z215 Z209 Z203 T203		E207. E207. E206. J108.
	03	800	3, 800		Z215 Z209 Z203 T203 (rear trimmer)	E207. E207. E206. J108.
4–8 mc	04	400	4, 400	Z216 Z210 Z204 T204		E207. E207. E206. J108.
	07	600	7, 600		Z216 Z210 Z204 T204 (rear trimmer)	E207. E207. E206. J108.
8–16 mc	08	800	8, 800	Z217 Z211 Z205 T205		E207. E207. E206. J108.

1	2	3	4	5	6	7
Set of rf coils	Megacycle reading	Kilocycle reading	Signal generator frequency (tune for peak output) in kc	Adjust slugs for peak output	Adjust trimmer capacitors for peak output	Signal generator connection (preliminary alinement only)
8–16 mc	15	200	15, 200	----------	Z217.	E207.
					Z211	E207.
					Z205	E206.
					T205 (rear trimmer)	J108.
16–32 mc	17	600	17, 600	Z218		E207.
				Z212		E207.
				Z206		E206.
				T206		J108.
	30	400	30, 400	----------	Z218	E207.
					Z212	E207.
					Z206	E206.
					T206 (rear trimmer)	J108.

k. Connect two 68-ohm resistors in series and connect the free ends to the BALANCED 125 OHM ANTENNA input terminals. Connect the output lead of RF Signal Generator Set AN/URM–25 to the junction of these resistors. Be sure that the ground lead of the signal generator is connected to the receiver chassis.

l. Set the tuning controls for the frequency-indicator reading listed in the first column of the chart in *n* below and then tune the signal generator to this frequency for peak receiver output.

m. Adjust the trimmer capacitor closest to the front panel of the transformers listed in the second column of *n* below for *minimum* output. During the alinement procedure, change the setting of the signal generator attenuator to increase the output reading to approximately 5 volts.

n. In the manner described in *k*, *l*, and *m*, above, adjust the balance trimmers in the following order:

Dial reading	Transformer (front trimmer)
00 950	T201
01 900	T202
03 600	T203
07 500	T204
13 500	T205
31 500	T206

o. The rf stages may be alined without test equipment by using the CARRIER LEVEL meter and calibration-oscillator signal as described in paragraph 114*k*, and using the receiver frequencies given in the preceding charts in this paragraph.

117. Calibration of Bfo

The bfo should be calibrated after replacing the front panel or if. subchassis subsequent to removal. Calibrate the bfo as follows:

a. Set the BANDWIDTH switch at the .1–KC position, and turn the FUNCTION switch to CAL.

b. Connect the headset to the PHONES jack. Adjust the KILOCYCLE CHANGE control for maximum response on the CARRIER LEVEL meter at any 100-kc calibration check point.

c. Set the BFO switch at ON, and adjust the BFO PITCH control for zero beat; zero beat should occur at the position of the control marked 0. If not, loosen the knob and position the knob at 0.

118. Adjustment of GAIN ADJ Potentiometer R562

a. Disconnect coaxial connectors P225 and P226 from J525 and J526, located on the if. subchassis (fig. 68).

b. Connect RF Signal Generator Set AN/URM–25 or equivalent between J526 and the receiver ground (chassis). Turn on the signal generator and tune it to 455 kc, modulated 30 percent at 400 cycles. Adjust the attenuator for an output of 150 microvolts (μv).

c. Connect a vtvm, such as Electronic Multimeter TS–505/U, between DIODE LOAD termi-

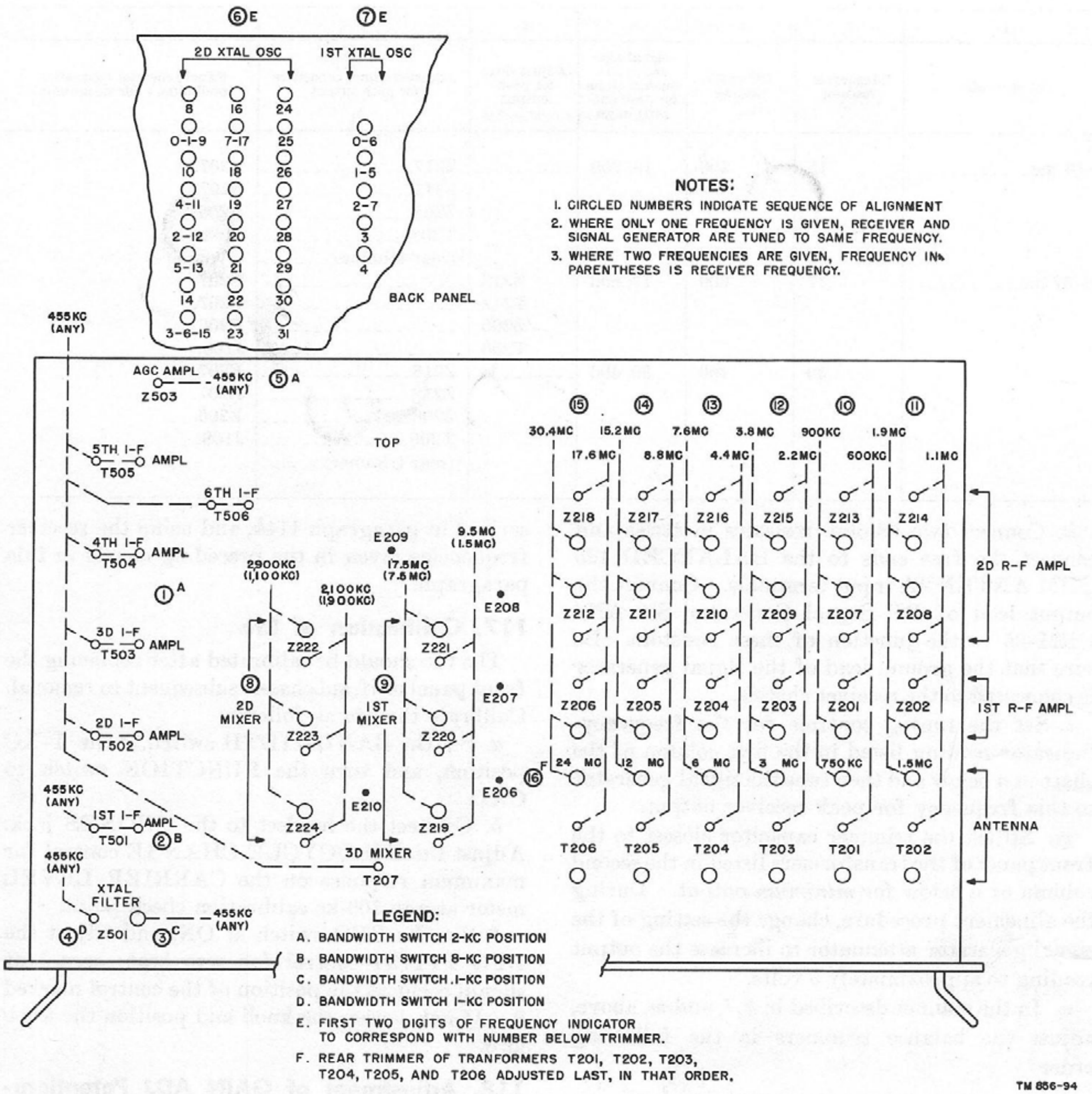


Figure 91. Radio Receiver R-390/URR, alinement chart.

nal 14, on the rear terminal strip of the receiver and the receiver ground (fig. 22). Set the function switch of the meter for measuring negative dc volts.

d. Turn the receiver FUNCTION switch to MGC and RF GAIN control to position 10. Adjust GAIN ADJ potentiometer R562 (fig. 68) for a reading of −7 volts on the vtvm. Reconnect P225 and P226 after completing the adjustment.

119. Adjustment of CARR-METER ADJ Potentiometer R537

The CARRIER LEVEL meter is zero-adjusted using the CARR-METER ADJ potentiometer as follows: set the FUNCTION switch at AGC and rotate the RF GAIN control to its extreme counterclockwise position. Adjust R537 (fig. 68) for a reading of 0 on the CARRIER LEVEL meter.

120. Adjustment of Neutralizing Capacitor C525

Adjust capacitor C525 after alinement of tuning circuits has been completed, or at any time when a minimum bfo signal at the IF OUTPUT 50 OHM jack is required.

a. Connect an ac vtvm such as Electronic Multimeter ME–6/U from IF OUTPUT 50 OHM jack to ground.

b. Remove plug P225 from jack J525 (fig. 86). Use the shortest length of wire possible to ground the center terminal of the jack.

c. Turn BANDWIDTH switch to 2 KC, RF GAIN full on, BFO PITCH to 0, BFO to ON, and the FUNCTION switch to AGC.

d. Insert a screwdriver that has an insulated shank through the hole in the main frame (fig. 8) and engage trimmer capacitor C525. Turn the trimmer to obtain minimum reading on the vtvm.

Caution: The screwdriver for adjusting C525 must be insulated to prevent short-circuiting bare wires within the if. subchassis. A metallic screwdriver that has a length of spaghetti tubing covering the shank is satisfactory.

Section IV. FINAL TESTING

121. General

This section gives the final performance tests of the equipment. Repaired equipment meeting these performance tests will furnish uniformly satisfactory operation. All of the tests in this section are to be performed while operating the receiver with a 115-volt ac input. Allow the receiver to warm up for a few minutes before making any measurements.

Warning: The voltages used are sufficiently high to endanger human life. Every precaution should be taken by personnel to minimize the danger of shock. The receiver chassis should be grounded during these tests.

122. Test Equipment Required

The test equipment required for final testing of Radio Receiver R–390/URR is listed below:

a. Electronic Multimeter TS–505/U.
b. Spectrum Analyzer TS–723/U.
c. RF Signal Generator Set AN/URM–25.
d. Audio Oscillator TS–382/U.
e. Electron Tube Test Set TV–2/U.
f. Multimeter TS–352/U.
g. Electronic Multimeter ME–6/U.

123. Preliminary Checks

Before testing the receiver further, perform the following preliminary checks:

a. Check to see that all controls are operative and that they do not bind.

b. Measure B+ with Electronic Multimeter TS–505/U, or equal, with the positive lead connected to B+ 180 VDC jack J601 (fig. 75) and the negative lead connected to terminal 16, marked GND, of the rear terminal strip (fig. 22). The meter should indicate 180 volts ±5 volts.

c. Check to see that all tubes and dial lights are lighted.

d. Check the antenna relay (par. 99*k*).

e. Check the bfo (par. 117).

124. If. Response

To check the if. response, proceed as follows:

a. Connect a vtvm (such as Electronic Multimeter TS–505/U) across DIODE LOAD terminal 14 and chassis ground on rear terminal strip (fig. 22). Set the vtvm to a negative 2-volt scale.

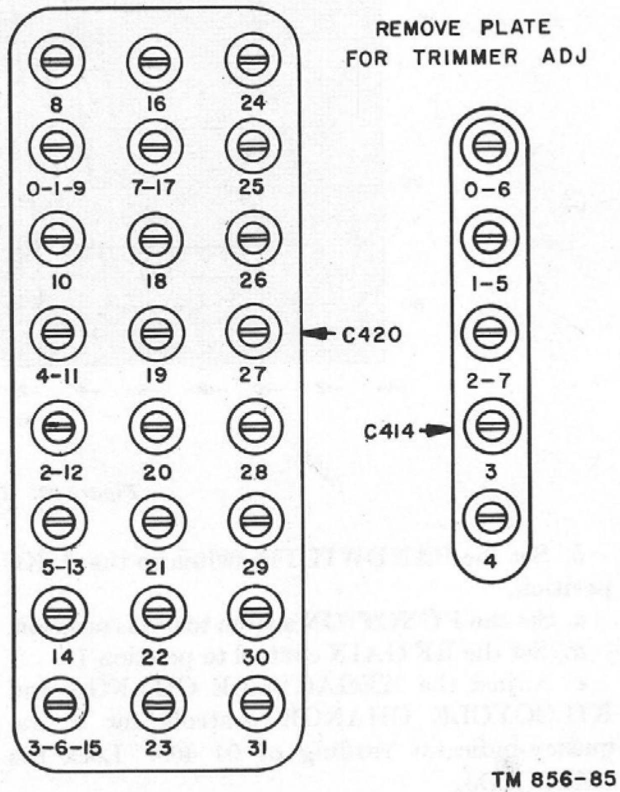


Figure 92. Crystal-oscillator trimmers.

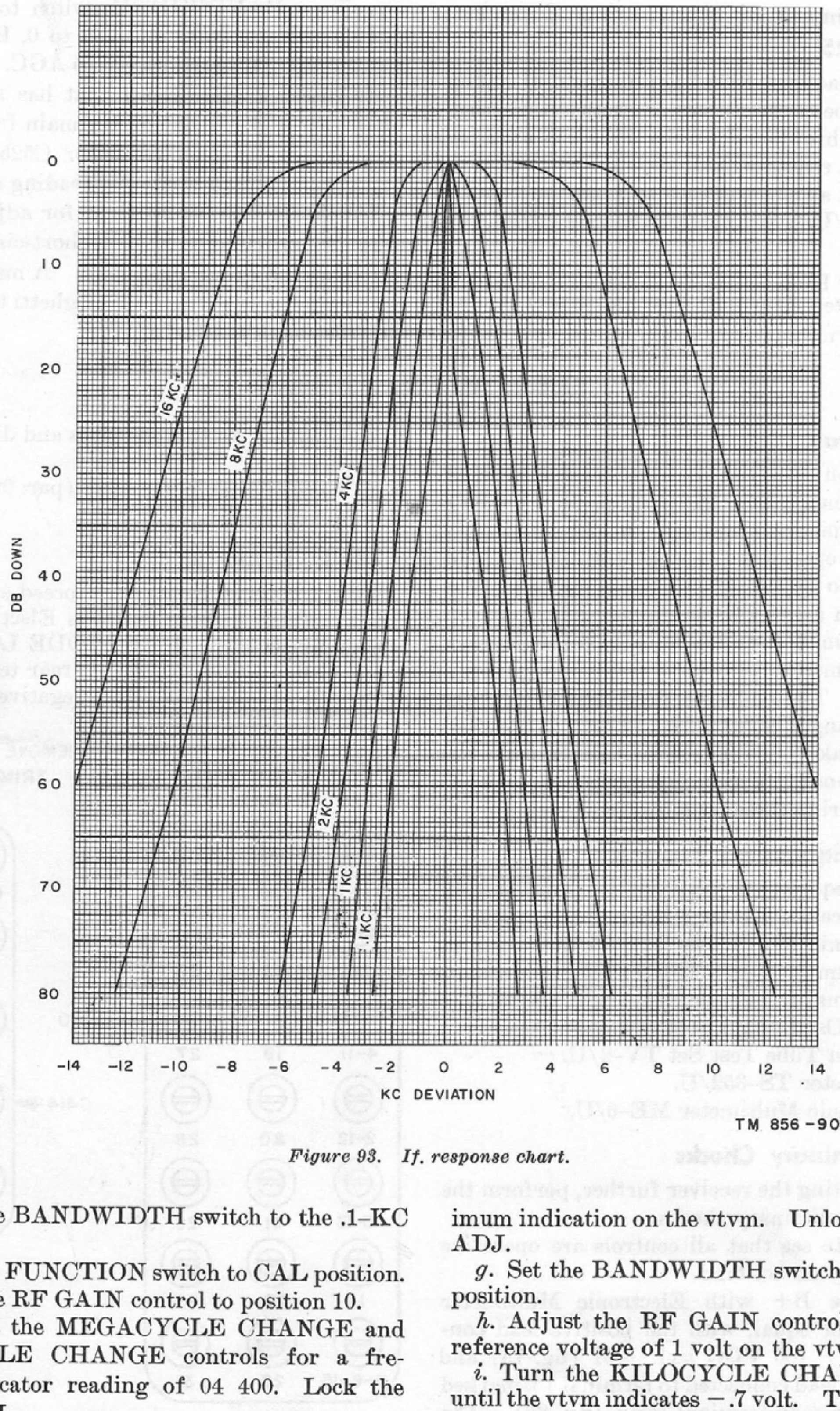


Figure 93. If. response chart.

b. Set the BANDWIDTH switch to the .1–KC position.

c. Set the FUNCTION switch to CAL position.

d. Set the RF GAIN control to position 10.

e. Adjust the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a frequency-indicator reading of 04 400. Lock the ZERO ADJ.

f. Tune Radio Receiver R–390/URR for a maximum indication on the vtvm. Unlock the ZERO ADJ.

g. Set the BANDWIDTH switch to the 8–KC position.

h. Adjust the RF GAIN control to obtain a reference voltage of 1 volt on the vtvm.

i. Turn the KILOCYCLE CHANGE control until the vtvm indicates – .7 volt. The frequency-indicator reading should be 04 396. Note the readings.

j. Turn the KILOCYCLE CHANGE control in the direction opposite to that described in *i* above until the vtvm indicates −.7 volt. The frequency indicator reading should be 04 404. Note the readings. The voltage obtained in *i* and *k* represents 3-db points. Repeat the steps in *i* and *k* for a −.5 volt indication on the vtvm. Note readings. These are the 6-db points.

k. Repeat *h* through *l* above with the BANDWIDTH switch set to the 16–KC position.

l. Compare the readings obtained for the 8 and 16–KC bandwidths with the following chart and the curves shown in figure 93.

Bandwidth	Frequency—Kilocycles	Voltage at 6-db points	Voltage at 3-db points	Reference voltage
8–KC	4 395	−.5		
8–KC	4 396		−.7	
8–KC	4 400			−1
8–KC	4 404		−.7	
8–KC	4 405	−.5		
16–KC	4 392	−.5		
16–KC	4 393		−.7	
16–KC	4 400			−1
16–KC	4 407		−.7	
16–KC	4 408	−.5		

125. Sensitivity

The test frequencies used in the sensitivity tests should be the center and the high- and low-frequency ends of each tuning range. The sensitivity of the receiver at a signal-plus-noise to noise power-output ratio is 10 to 1 for amplitude-modulation (am.) and continuous-wave (cw.) signals. To check sensitivity, proceed as follows:

a. Connect Cord CG–409A/U to J102 on RF Signal Generator AN/URM–25 and to Impedance Adapter MX–1074/URM–25. Connect another Cord CG–409A/U to the other end of Impedance Adapter MX–1074/URM–25 and to Adapter Connector UG–636/U. Connect Adapter Connector UG–636/U to Adapter Connector UG–971/U which is attached to BALANCED 125 OHM ANTENNA jack J108.

b. Connect Electronic Multimeter TS–505/U in parallel with a 600-ohm 1-watt noninductive resistor to LOCAL AUDIO terminals 6 and 7 of rear terminal strip (fig. 22).

c. Turn off the signal generator modulation.

d. Adjust the LOCAL GAIN control for a .8-volt noise indication on the vtvm.

e. Turn on signal generator modulation.

f. Adjust the output of the signal generator for a 2.45-volt ac signal-plus-noise indication on the vtvm. The output reading of the signal generator is the sensitivity for a 10- to 1-db signal-plus-noise to noise ratio for am. signals.

Note. The CARRIER LEVEL meter may be used instead of Electronic Multimeter TS–505/U.

g. The overall sensitivity of the receiver with a signal being fed into the balanced antenna should be better than 3.3 μv for signals in the .5- to 16-mc frequency range and better than 4.4 μv in the 16- to 32-mc frequency range.

126. Overall Audio Response

To check the overall audio response, proceed as follows:

a. Connect Cord CG–409A/U to J102 on RF Signal Generator Set AN/URM–25 and to Impedance Adapter MX–1074/URM–25. Connect another Cord CG–409A/U to the other end of Impedance Adapter MX–1074/URM–25 and to Adapter Connector UG–636. Connect Adapter Connector UG–636 to Adapter Connector UG–971 which is attached to BALANCED 125 OHM ANTENNA jack J108.

b. Connect Audio Oscillator TS–382/U to RF Signal Generator AN/URM–25 according to the instructions in the technical manual supplied with the oscillator.

c. Connect Electronic Multimeter TS–505/U in parallel with a 600-ohm 1-watt noninductive resistor to LOCAL AUDIO terminals 6 and 7, of the rear terminal strip (fig. 22).

d. The output of the signal generator is modulated at 30 percent. Make sure the percentage of modulation does not vary.

e. Set the BANDWIDTH switch to the 8–KC position.

f. Set the AUDIO RESPONSE switch to WIDE.

g. Set the frequency of Radio Receiver R–390/URR to the signal generator frequency.

h. Set the FUNCTION switch to the AGC position.

i. Set the frequency of the audio oscillator at 1,000 cps.

j. Set the LOCAL GAIN control to where the output meter reads 2.5 volts ac. (This will be considered a 0-db reference level.)

k. Vary the audio oscillator frequency between 100 and 10,000 cps.

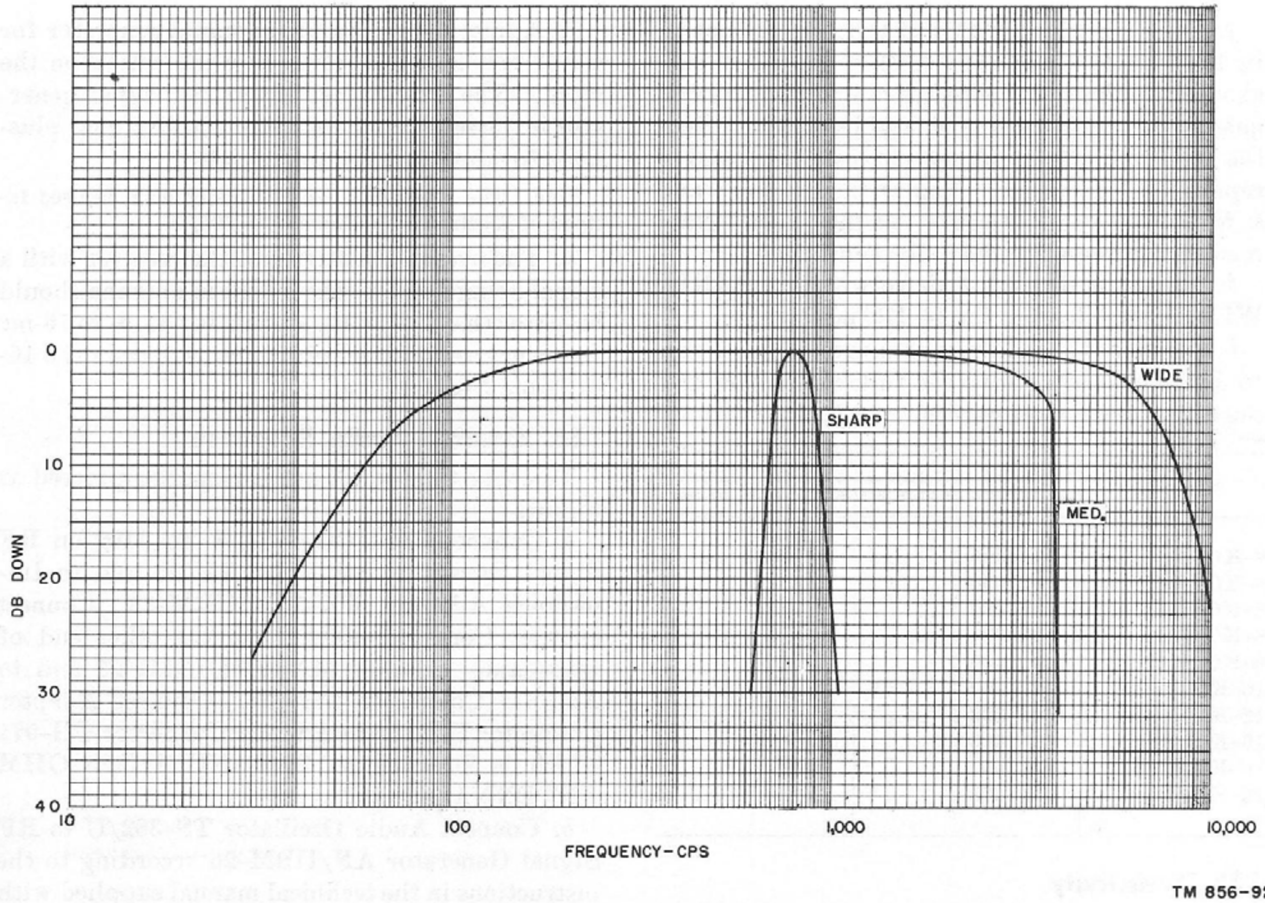


Figure 94. Overall audio response chart.

l. Note the reading on the output meter and compare readings with the chart in figure 94.

$$\text{Db down} = 20 \log \frac{2.5 \text{ volts}}{\text{voltage reading on output meter}}$$

m. Repeat the steps in *i* through *l* above for the MED. and SHARP positions of the AUDIO RESPONSE switch.

127. Testing of Calibration Oscillator

To test the calibration oscillator, proceed as follows:

a. Set the BANDWIDTH switch to .1-KC position.

b. Set the AUDIO RESPONSE switch to MED.

c. Connect a headset into PHONES jack.

d. Turn the FUNCTION switch to CAL. In this position, a note will be heard at every multiple of 100 kc as the KILOCYCLE CHANGE control is rotated. The pitch of the note depends on the setting of the BFO PITCH control.

e. Rotate the KILOCYCLE CHANGE control through a minimum of ten 100-kc steps. If a note is not heard exactly at the 100-kc steps, adjust capacitor C912 (fig. 76). Check at least eleven 100-kc positions to make sure a note is heard only in 100-kc steps.

f. Set the FUNCTION switch to AGC, and adjust the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls to obtain 10-mc reading (transmitting frequency of WWV) on frequency indicator. If WWV cannot be heard on 10-mc, try other frequencies such as 2.5-mc, 5-mc, 15-mc, or 20-mc.

g. Adjust BFO PITCH control to zero.

h. Adjust KILOCYCLE CHANGE control to zero beat to station WWV.

i. Turn FUNCTION switch to the CAL position.

j. Disconnect antenna from receiver.

k. Adjust capacitor C901 (fig. 76) for a zero beat indication.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

128. Disassembly

The following instructions are presented as a guide for preparing Radio Receiver R–390/URR for transportation and storage.

a. Disconnect antenna lead-in cable, Power Cable Assembly CX–1358/U and all connections to the auxiliary equipment, if used.

b. Disconnect the headphones from the front panel.

c. Remove the receiver from the rack.

129. Repacking for Shipment or Limited Storage

a. The exact procedure for repacking depends on the available material and the conditions under which the equipment is to be shipped or stored. Reverse the procedure order in paragraph 15 for repacking.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the receiver. Wrap the receiver and spare parts box in corrugated paper, and protect each package with a waterproof barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected components in a padded wooden crate, providing at least three inches of excelsior or similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

130. General

The demolition procedures outlined in paragraph 131 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

131. Methods of Destruction

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

b. Cut. Cut cords, headsets, 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 bombs.

d. Bend. Bend dials, cabinet, and chassis.

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

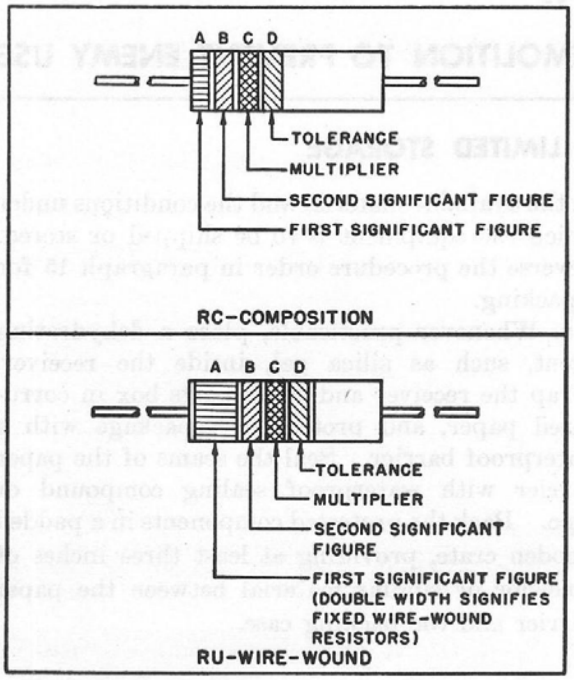
f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Destroy. Destroy everything.

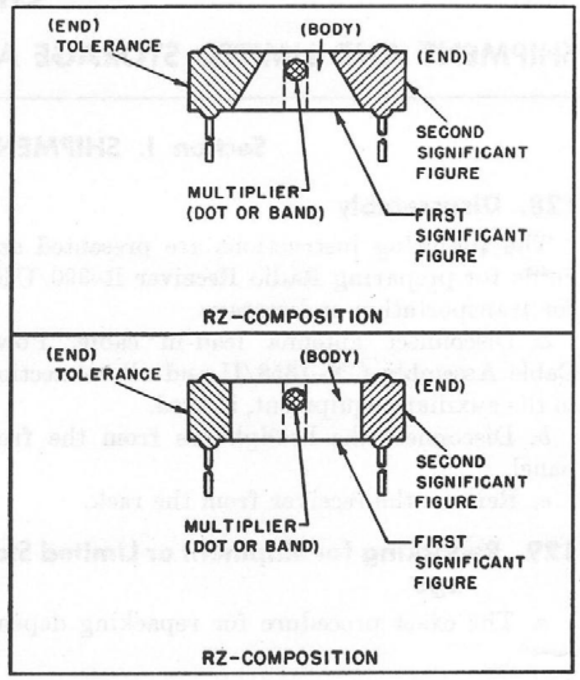
823471 O—55——9

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



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.

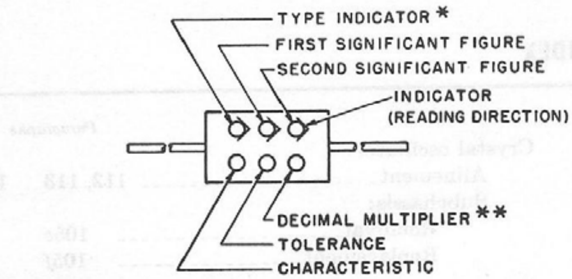
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

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-R1

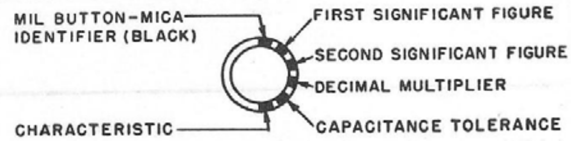
Figure 95. MIL-STD resistor color code.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)

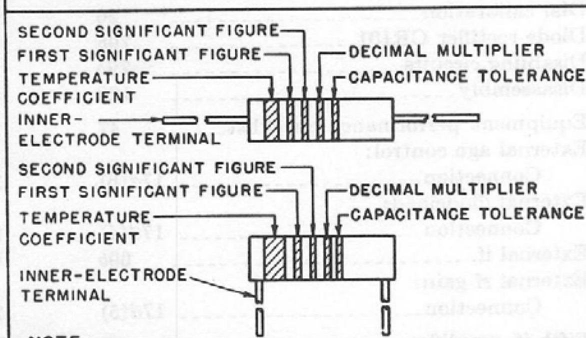


* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
**INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

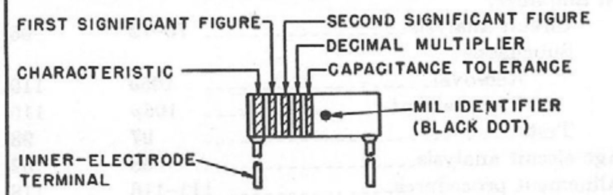


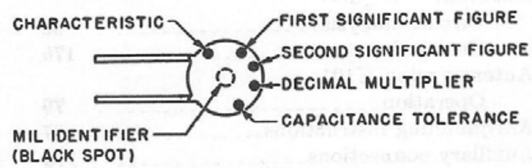
BUTTON-MICA (CB)



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)
											CC		
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	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 96. MIL–STD capacitor color code.

INDEX

	Paragraphs	Page
Additional equipment required	13	15
Adjustments	118–120	123
Af amplifier:		
Circuit analysis	70–72	66
Subchassis:		
Removal	105*o*	110
Replacement	105*p*	110
Tests	97	93
Agc circuit analysis	68	62
Alinement procedures	111–116	118
Antenna:		
Circuit analysis	50	43
Connection	17*b*	19
Antenna relay K101:		
Operation	79	76
Antijamming instructions	27	27
Auxiliary connections	17*d*	20
Bench testing	86	83
Bfo:		
Calibration	117	123
Circuit analysis	67	61
Block diagram	49	41
B+ voltage distribution	104	106
Break-in relay:		
Connection	17*d*(1)	20
Buffer amplifier	76	73
Cabinets and cases, description	9	10
Calibration oscillator:		
Circuit analysis	74	71
Subchassis:		
Removal	105*m*	110
Replacement	105*n*	110
CARR-METER ADJ	119	124
Cathode follower	69	65
Components, table	7	7
Connections:		
Antenna:		
Balanced 125 ohm	17b(2)	20
Unbalanced whip	17*b*(1)	19
Audio output	17*c*	20
Auxiliary	17*d*	20
Ground	17	18
Power input	17*a*	19
Space-diversity, radioteletype operation	4	3
Space-diversity reception	4	3
Space - diversity, single - sideband radioteletype operation	4	3
Control circuits	79	76
Controls	20, 21	22, 24
Crystal checking	100	100
Crystal filter:		
Circuit analysis	59	53
Crystal oscillator:		
Alinement	112, 113	119, 120
Subchassis:		
Removal	105*e*	108
Replacement	105*f*	109
Dc resistance of transformers and coils	102	104
Description	8–11	7
Destruction	131	129
Detector	66	59
Dial calibration	26	26
Diode rectifier CR101	79*b*	78
Disabling circuits	79*a*	76
Disassembly	128	129
Equipment performance checklist	47	38
External agc control:		
Connection	17*d*(6)	21
External diodeload:		
Connection	17*d*(4)	21
External if.	69*b*	65
External rf gain:		
Connection	17*d*(5)	21
Fifth if. amplifier	64	57
Final tests:		
Calibration oscillator	127	128
General	121	125
If. response	124	125
Overall audio response	126	127
Preliminary checks	123	125
Sensitivity	125	127
Test equipment	122	125
First crystal oscillator	54	46
First if. amplifier	61	55
First mixer	53	46
Forms and records	2	3
Fourth if. amplifier	63	56
Frequency indicator calibration	26	26
Front panel:		
Removal	105*a*	106
Replacement	105*b*	107
Function switch	78	75
GAIN ADJ	118	123
If.:		
Alinement	111	118
Circuit analysis	60–65	55
Stage gain chart	101	102
Subchassis:		
Removal	105*g*	109
Replacement	105*h*	109
Tests	98	96
Initial inspection	89	85
Installation:		
Antenna	16*a*	18
Radio Receiver R-390/URR	16*b*	18

	Paragraphs	Page
Intermittents	83*b*(7)	83
Limiter	66	59
Line audio channel	72	68
Tests	96	92
Line level meter	72*b*	69
Local audio channel	71	67
Tests	95	91
Lubrication	106	112
Mechanical tuning system	80–82	78
Multivibrator	75	72
Operation	22–27	25
Operational test	83*b*(3)	82
Packaging data	6	7
Power Cable Assembly CX-1358/U	11	11
Power Supply PP-621/URR:		
Circuit analysis	77*a*	73
Description	10	11
Removal	105*i*	109
Replacement	105*j*	109
Preventive maintenance	35–38	29
Purpose	3	3
Radio Receiver R-390/URR:		
Block diagram	49	41
Description	8	7
Controls	21	24
Operation:		
Arctic climate	30	28
Desert climate	32	28
Principles	48	41
Tropical climate	31	28
Purpose	3	3
Starting procedure	22	25
Stopping procedure	28	27
Technical characteristics	5	6
Reconditioned equipment, service	19	22
Refinishing	107	114
Regulated-voltage hum adjustment	109	115
Regulation, voltage	77*b*	74
Repacking	129	129
Rf amplifier:		
Alinement	116	121
Circuit analysis	51, 52	45
Stage gain chart	101	102
Subchassis:		
Removal	105*c*	107
Replacements	105*d*	107
Tests	99	97
Rf and variable if. conversion scheme	103	105
Running spares	12	11
Rustproofing and painting	40	33
Scope	1	3
Second crystal oscillator	56	49
Second if. amplifier	62	56
Second mixer	55	47
Sidetone:		
Signal substitution	94	89
Siting requirements:		
External	14*a*	16
Internal	14*b*	16
Sixth if. amplifier	65	58
Special tools	34	29
Squelch circuit	73	69
Stage gain charts	101	102
Starting	22	25
Stopping	28	27
Subchassis testing	45	36
Synchronization of tuning shafts	110	115
System application	4	3
Technical characteristics	5	6
Test equipment	85, 108	83, 114
Third if. amplifier	63	56
Third mixer	57	50
Tone-modulated radiotelegraph reception	24	26
Tools and materials	33	29
Troubleshooting:		
Chart	92	87
Data	84	83
Field maintenance level	83	82
Checking B+ and filament circuits	90	85
Notes	88	84
Organizational level	41	33
Precautions	87	84
Procedure	83	82
Test equipment	85	83
Tube testing	45	36
Uncrating and unpacking:		
Domestic	15*b*	16
Overseas	15*b*	16
Uncrating, unpacking, and checking new equipment:		
Checking	15*c*	17
Installation of Radio Receiver R-390/URR	16*b*	18
Used equipment	19	22
Vfo:		
Circuit analysis	58	51
Subchassis:		
Removal	105*k*	109
Replacement	105*l*	110
Visual inspection	42	34
Voice reception	23	26
Voltage and resistance checks	93	88
Weatherproofing	39	33

[AG 413.44 (15 Oct 54)]

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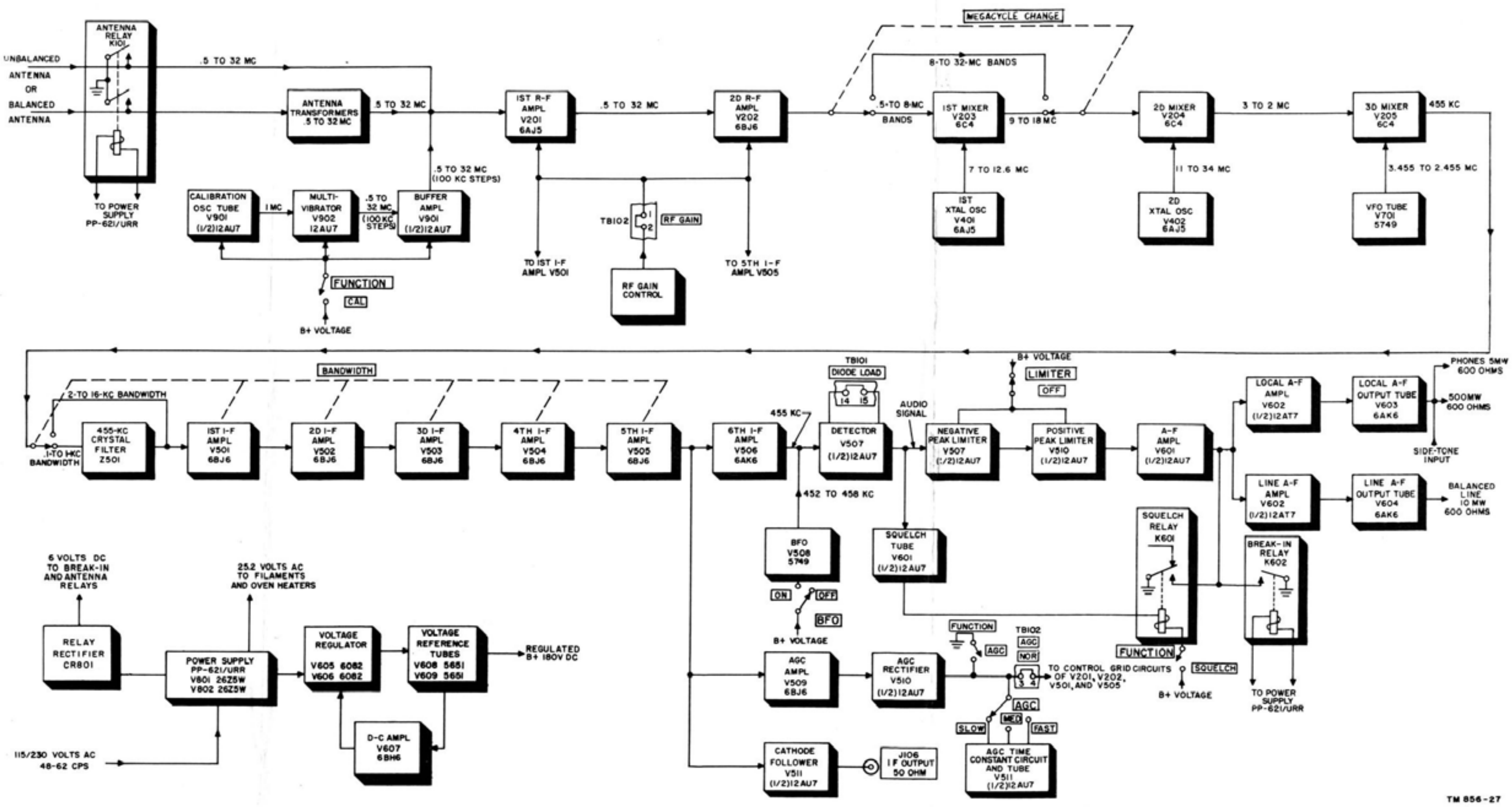

Figure 27. Radio Receiver R-390/URR, block diagram.

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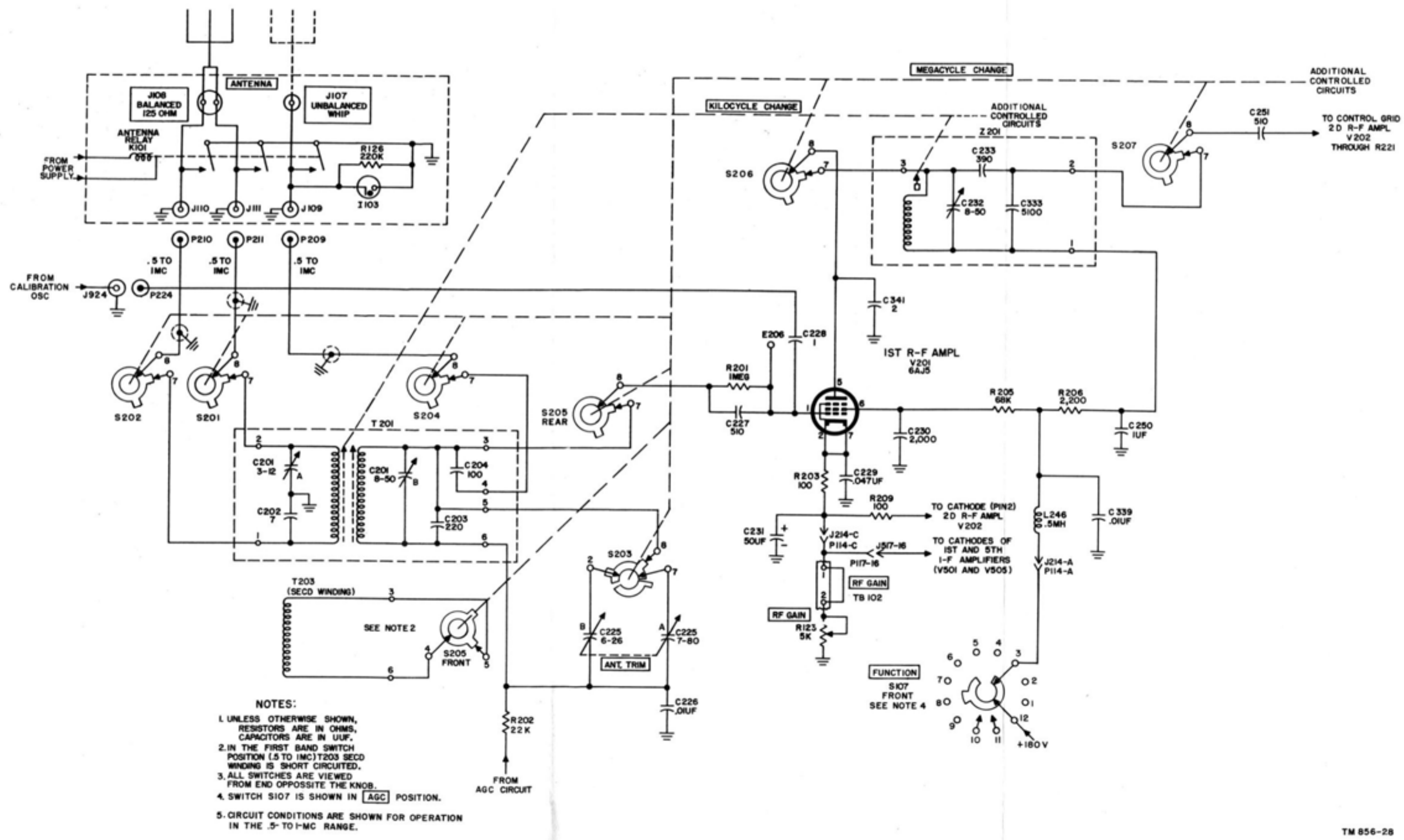

TM 856-28

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Figure 28. Antenna circuit and first rf amplifier, schematic diagram

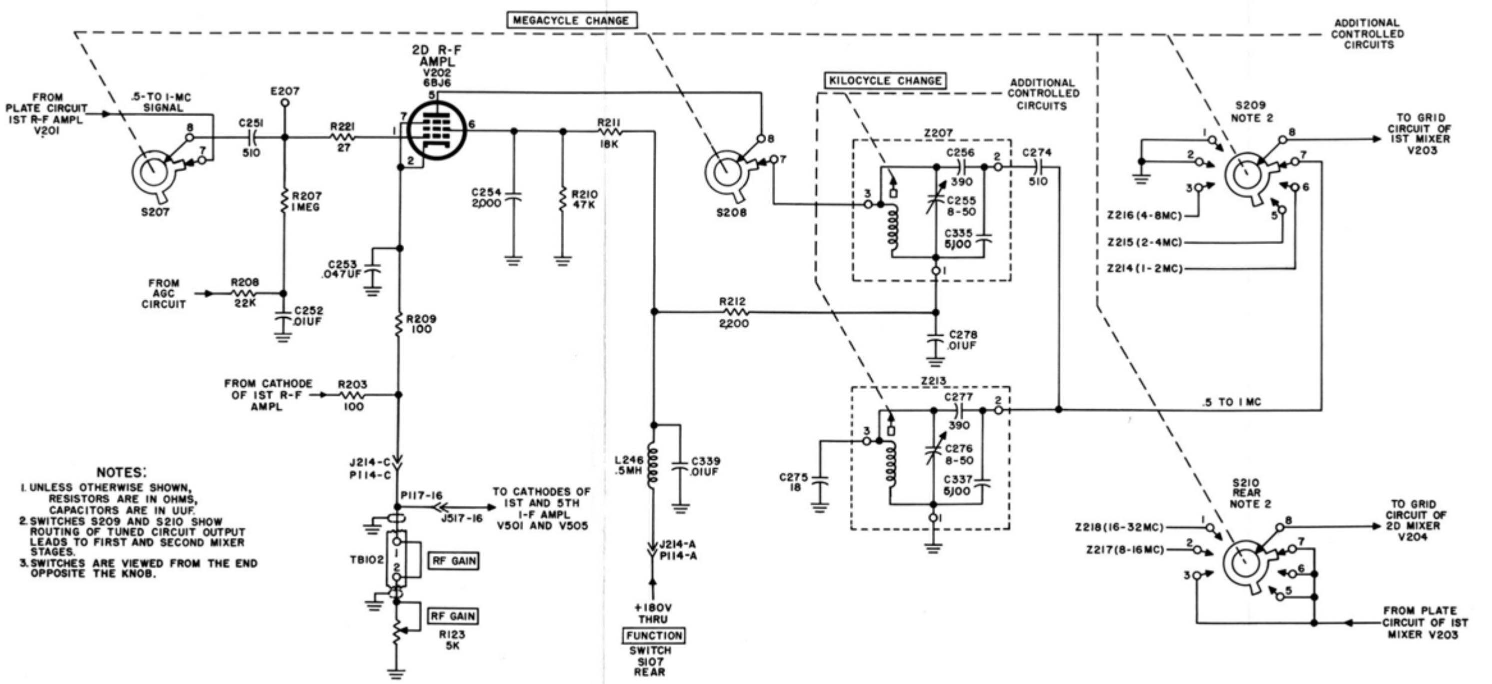

Figure 29. Second rf amplifier, schematic diagram.

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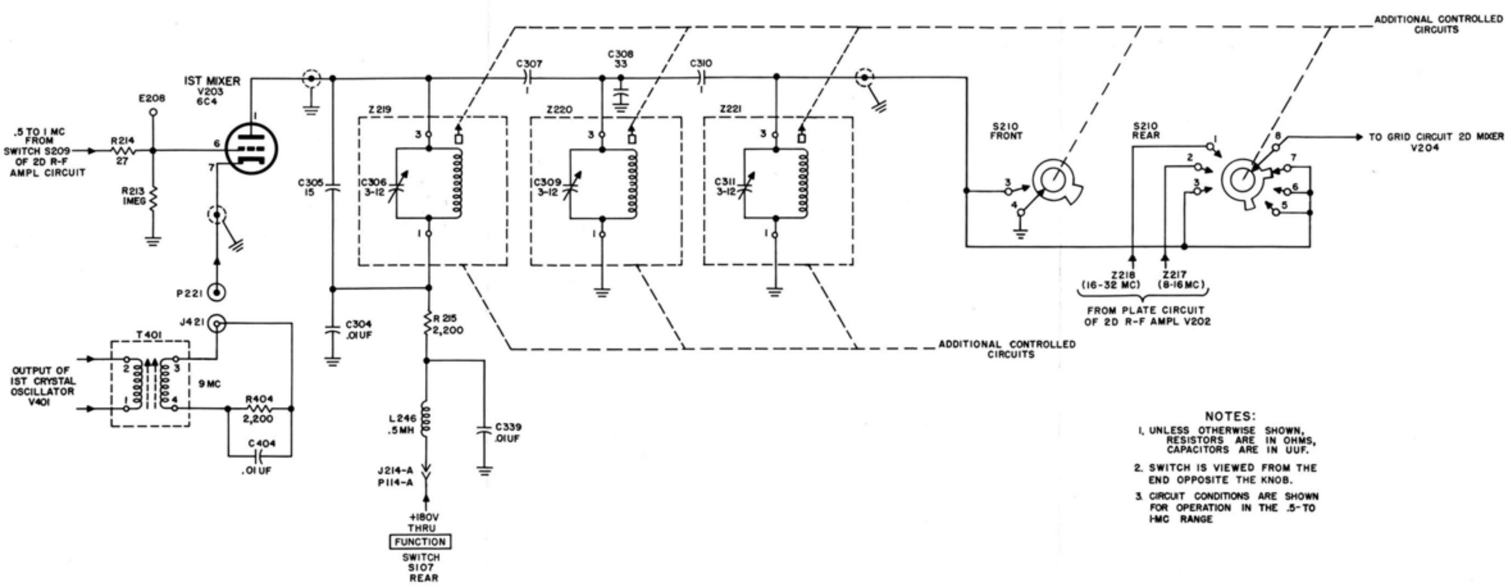

Figure 30. First mixer stage, schematic diagram.

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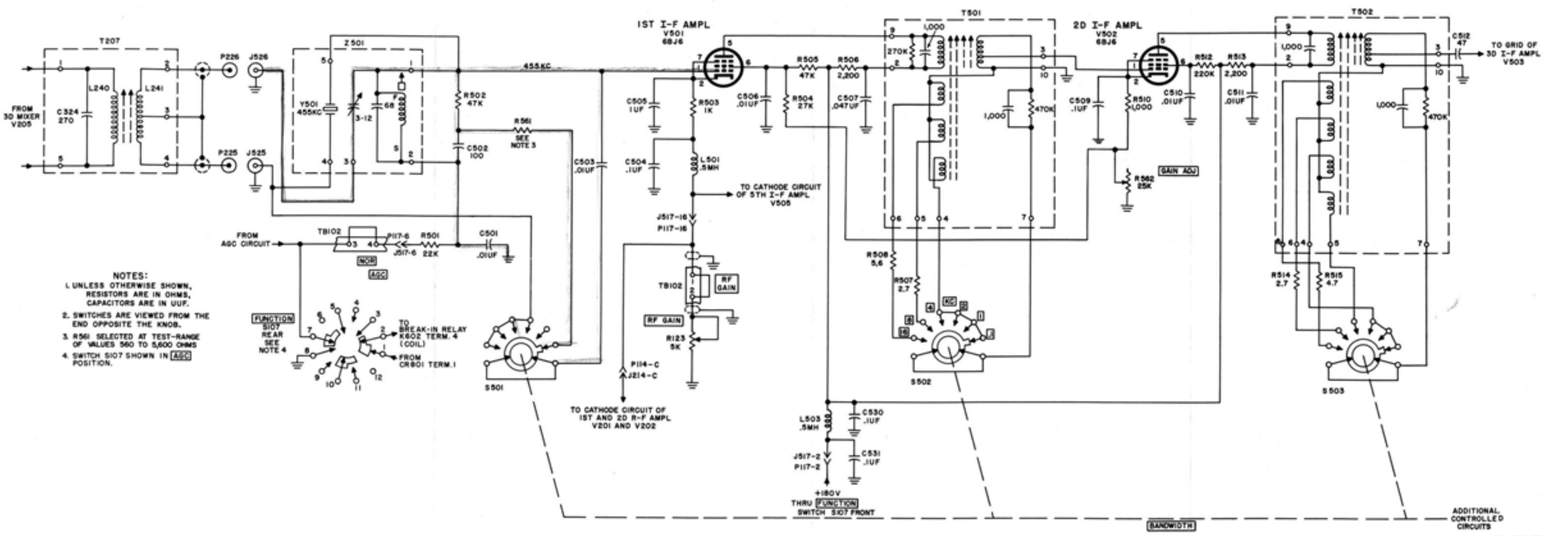
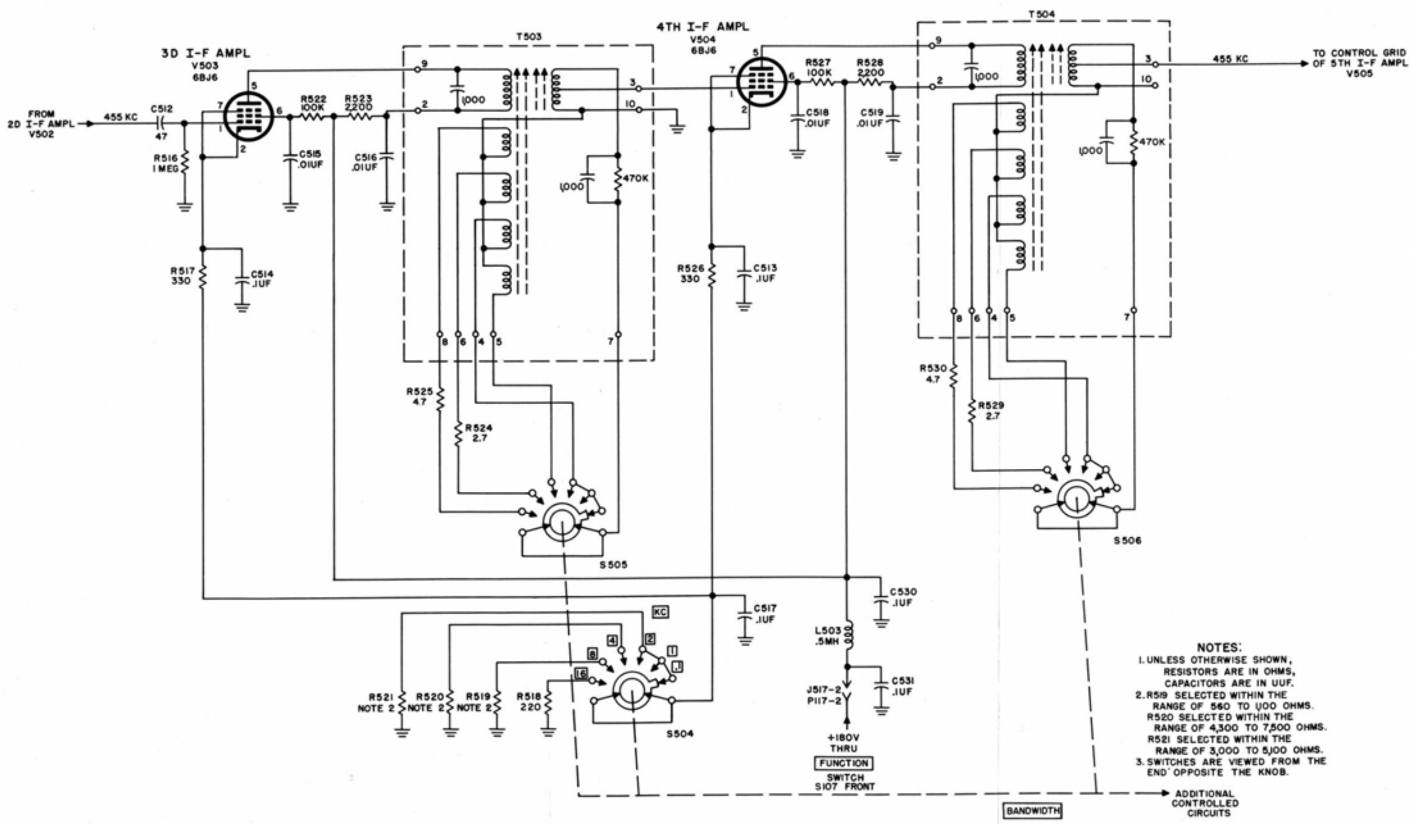


Figure 37. First and second i.f. amplifiers, schematic diagram.

TM 856-37

325471 O—55 (Face p. 56) No. 1



TM 856-38

Figure 38. Third and fourth i.f. amplifiers, schematic diagram.

323471 O—55 (Face p. 56) No. 2

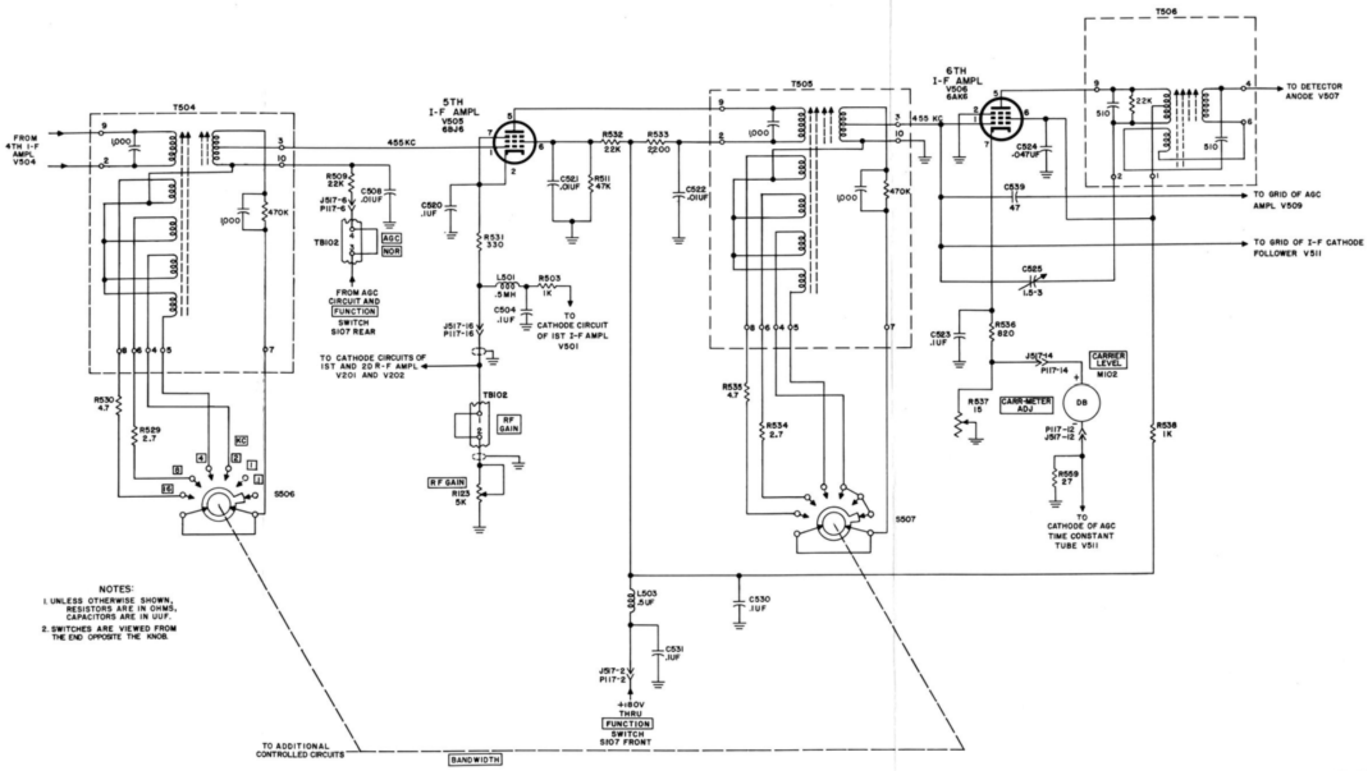


Figure 39. Fifth and sixth i.f. amplifiers, schematic diagram.

TM 856-39

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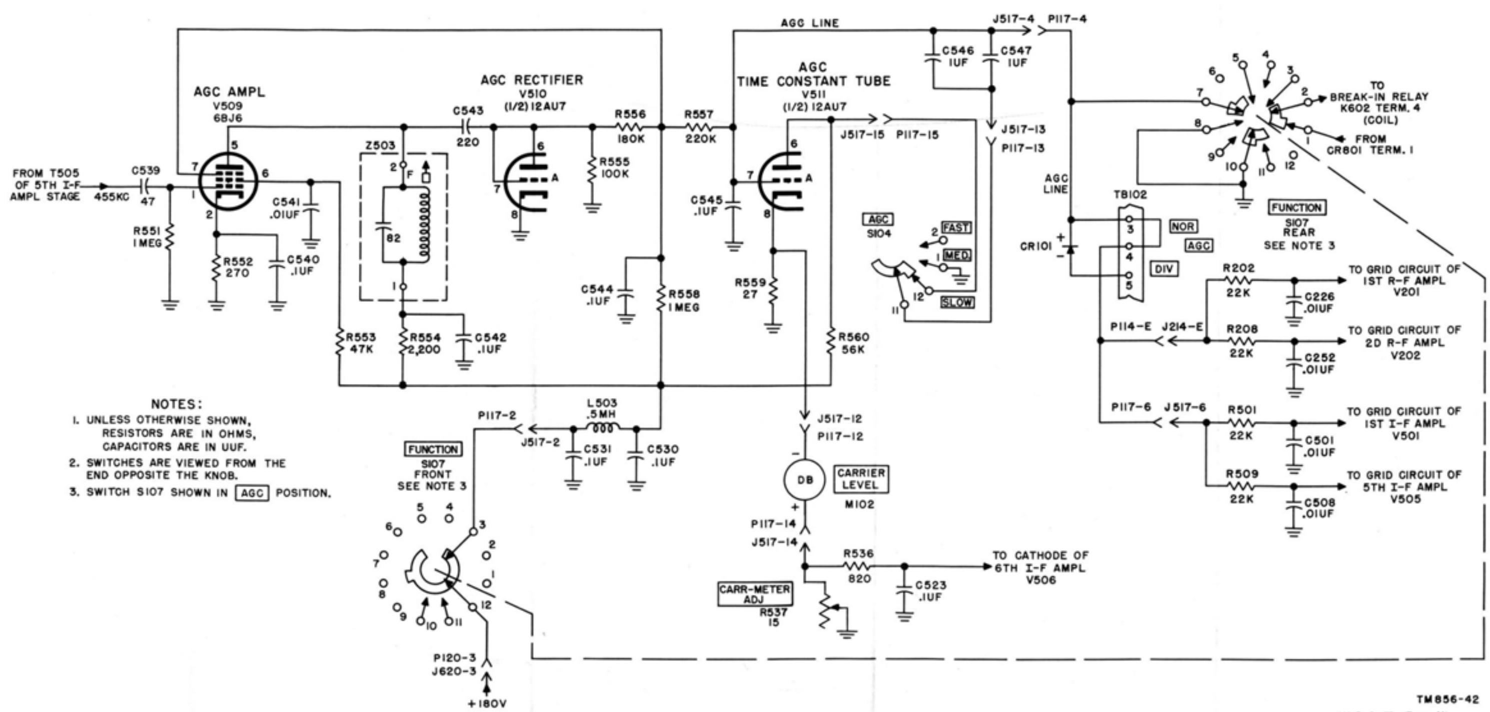
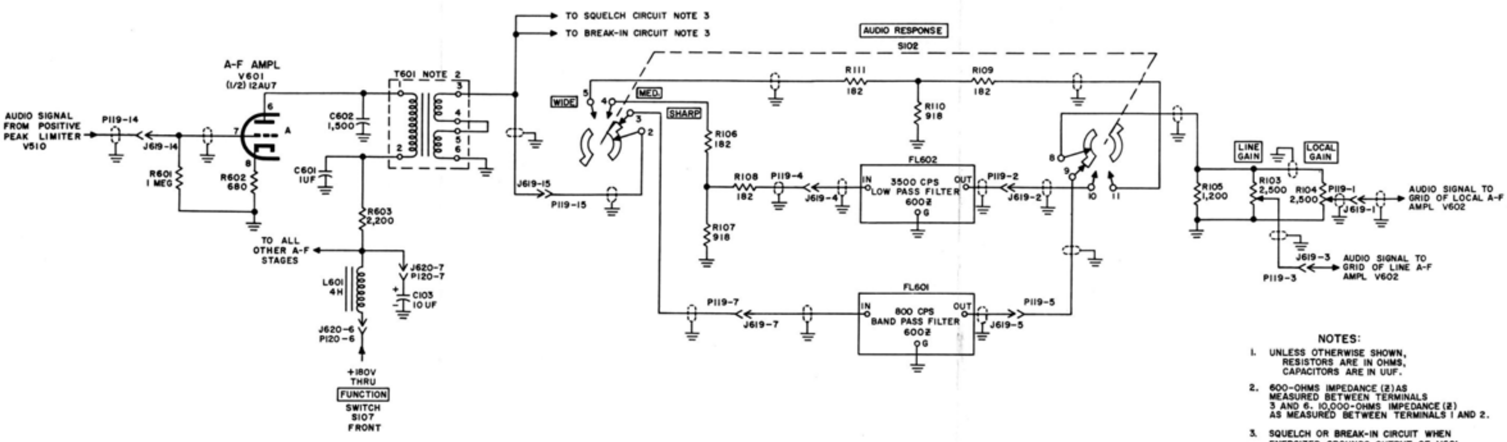


Figure 42. Agc circuit, schematic diagram.



NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. 600-OHMS IMPEDANCE (2) AS MEASURED BETWEEN TERMINALS 3 AND 6. 10,000-OHMS IMPEDANCE (2) AS MEASURED BETWEEN TERMINALS 1 AND 2.
3. SQUELCH OR BREAK-IN CIRCUIT WHEN ENERGIZED GROUNDS OUTPUT OF V601.
4. SWITCH IS VIEWED FROM THE END OPPOSITE THE KNOB.
5. SWITCH S102 SHOWN IN SHARP POSITION.

Figure 45. Af amplifier, schematic diagram.

323471 O - 55 (In envelope) No. 6

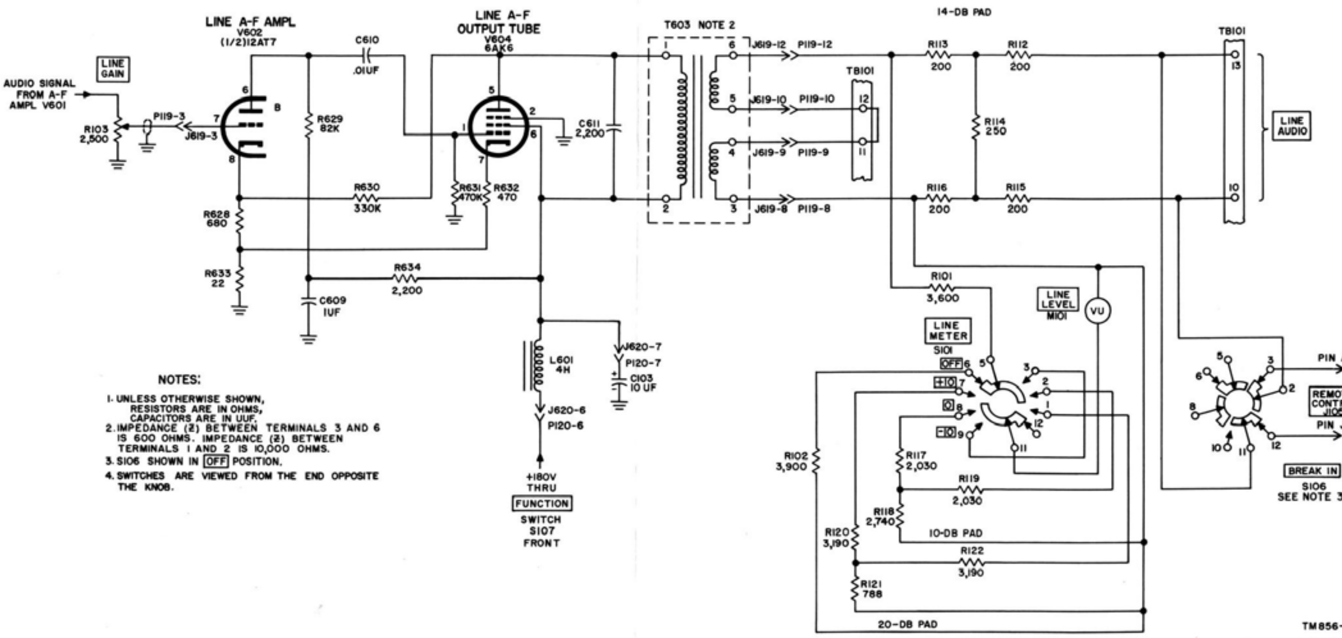


Figure 47. Line audio channel, schematic diagram.

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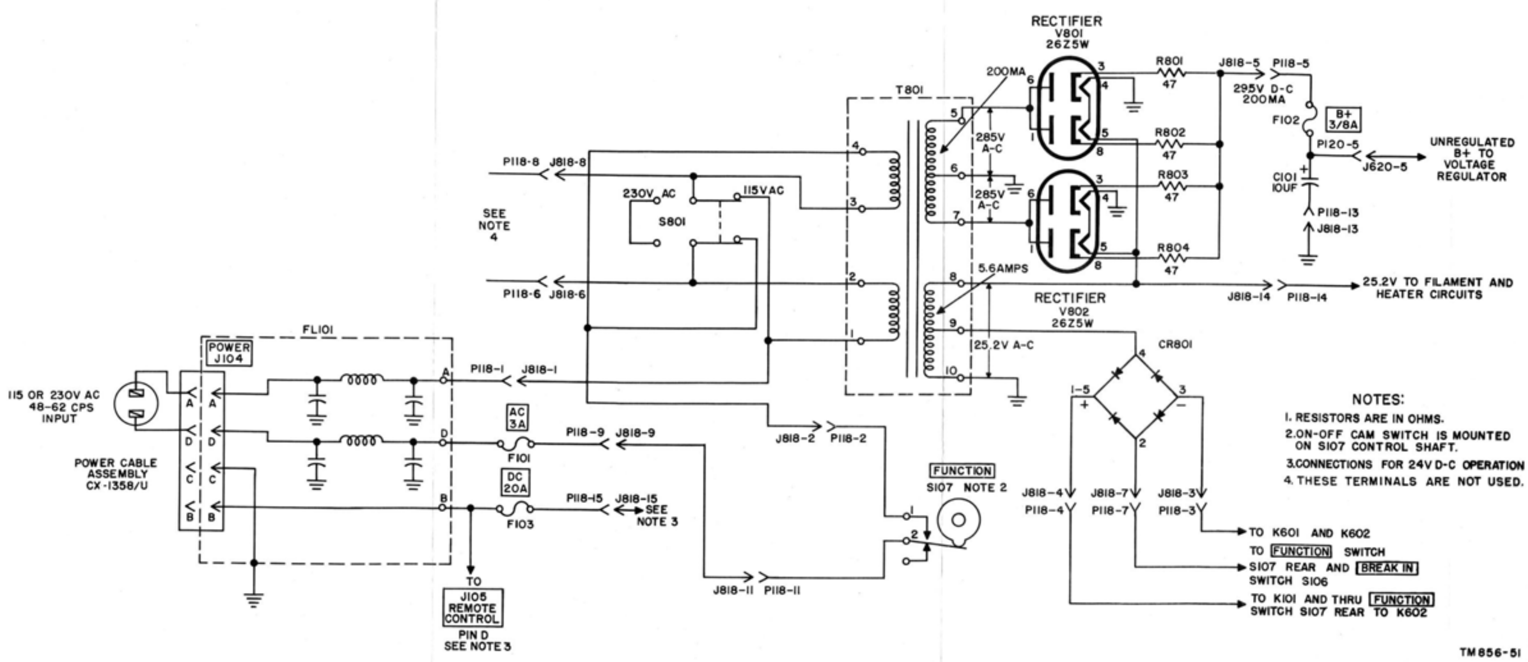


Figure 52. Power Supply PP-621/URR, schematic diagram.

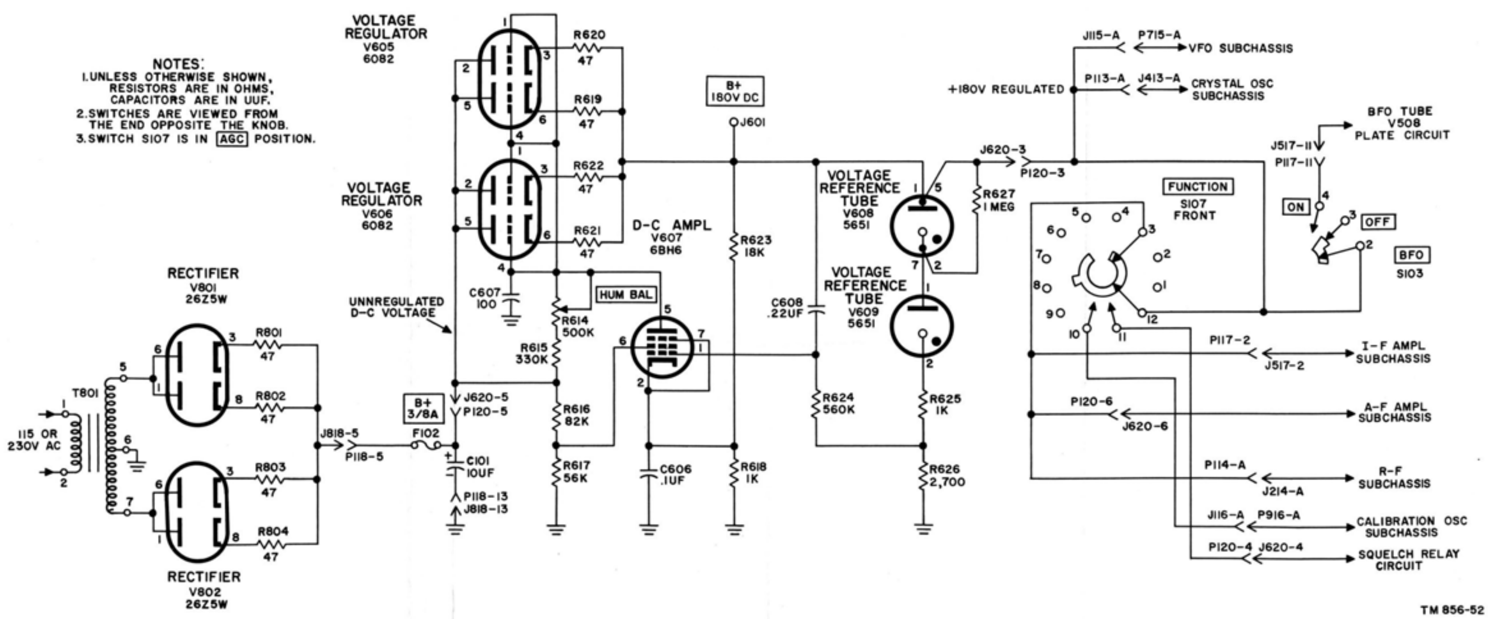


Figure 55. Voltage regulator circuit, schematic diagram.

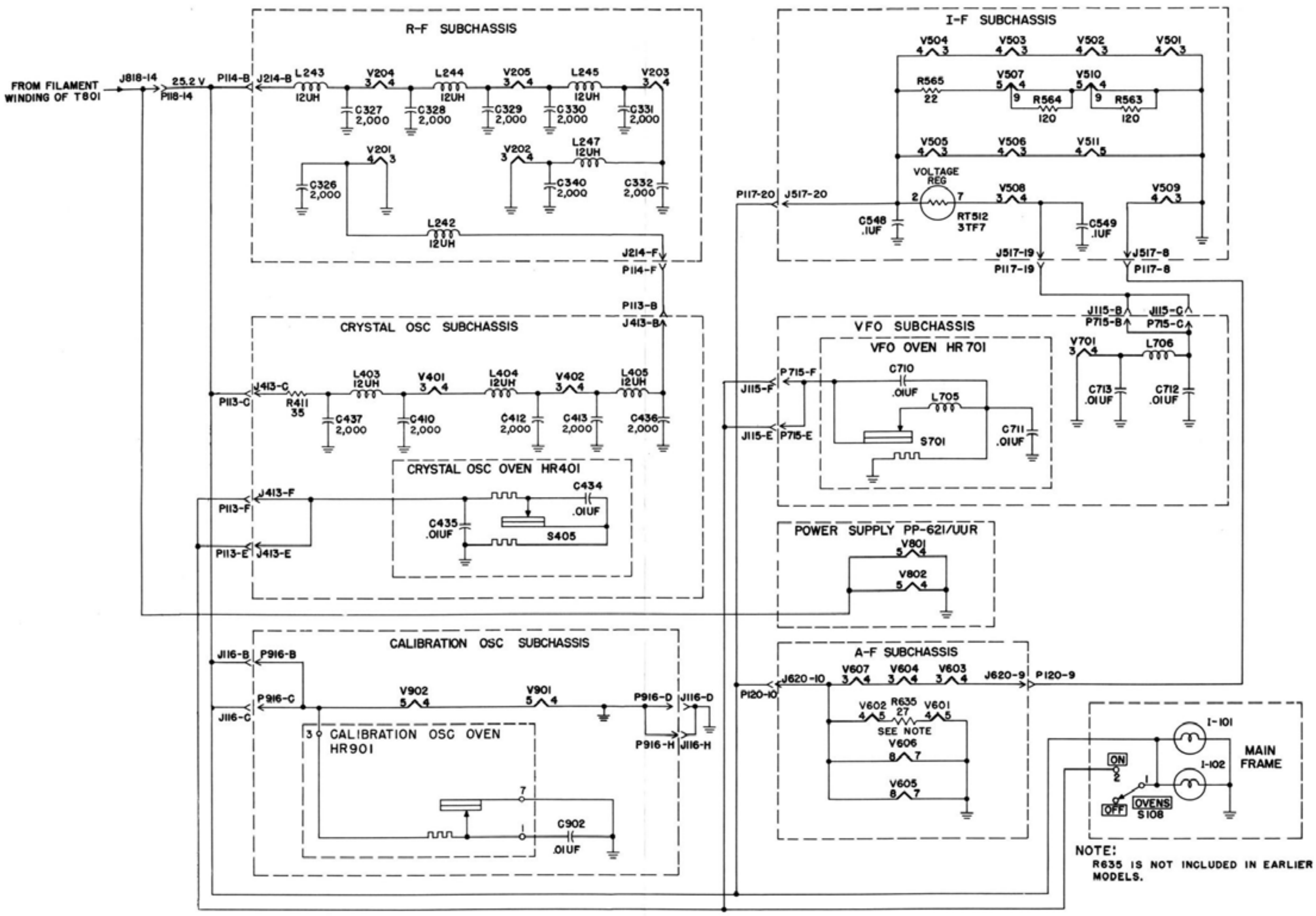
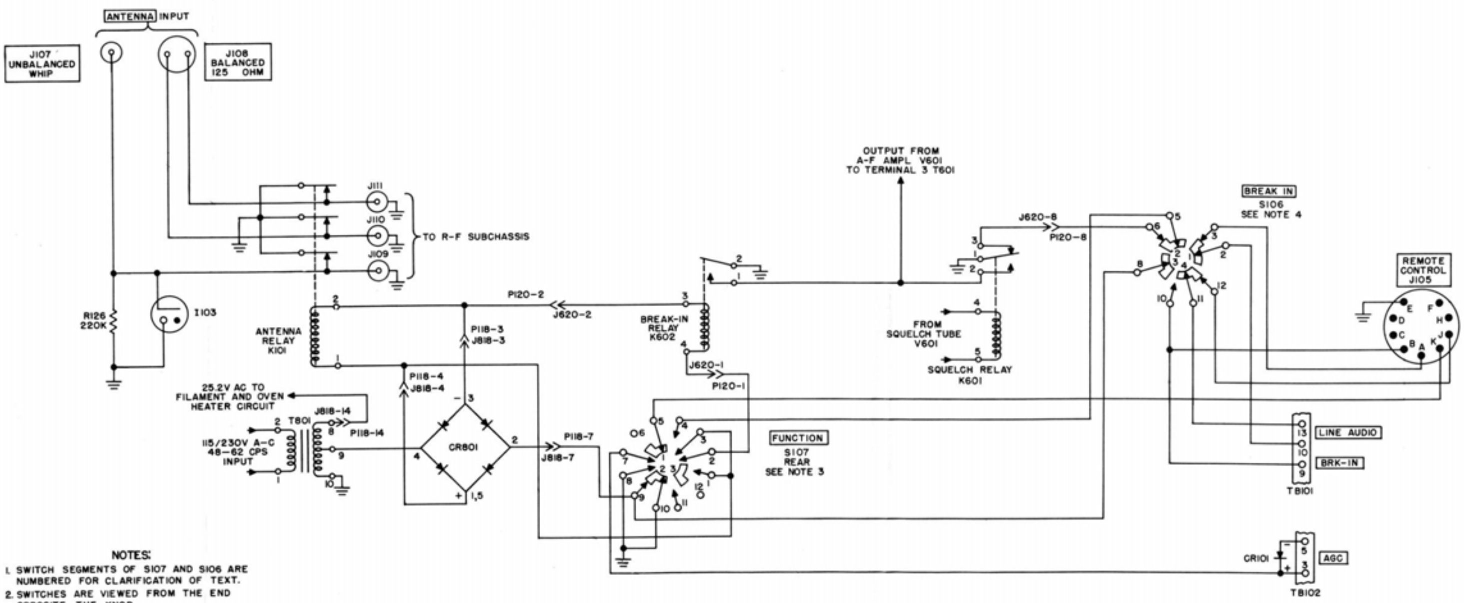


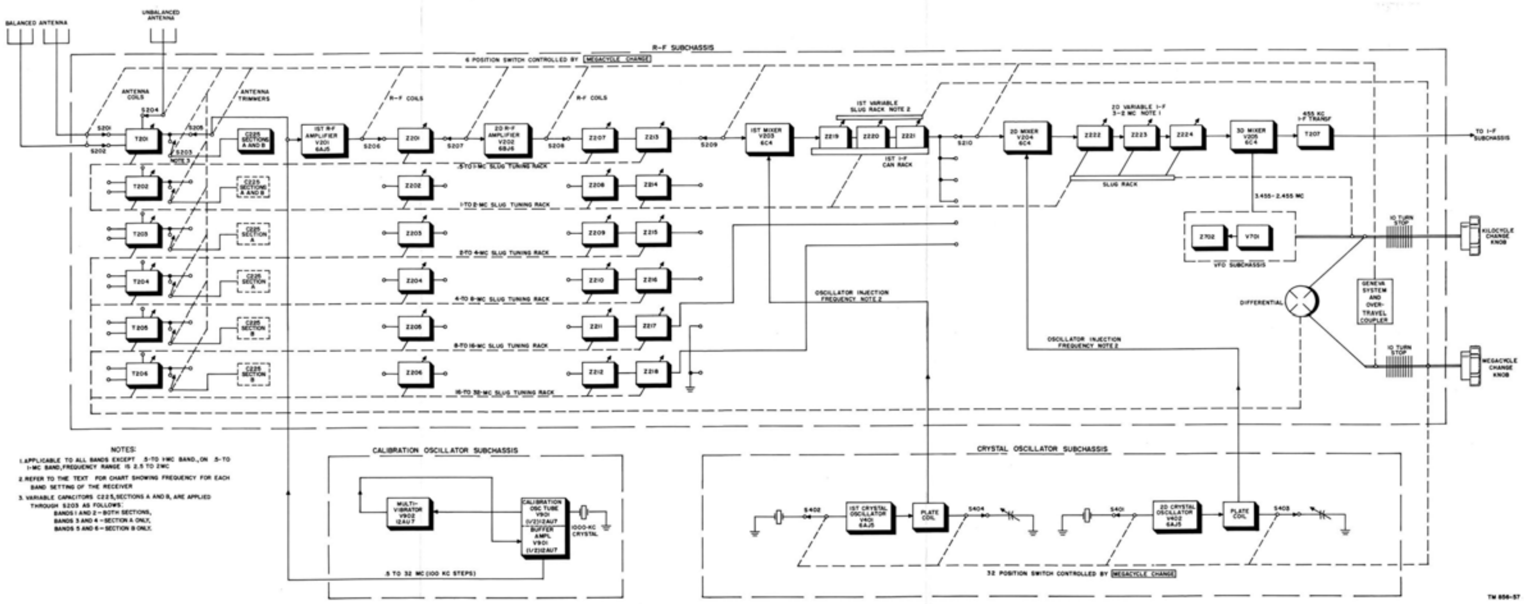
Figure 54. Filament and oven heater circuits, schematic diagram.



NOTES:
1. SWITCH SEGMENTS OF S107 AND S106 ARE NUMBERED FOR CLARIFICATION OF TEXT.
2. SWITCHES ARE VIEWED FROM THE END OPPOSITE THE KNOB.
3. SWITCH S107 SHOWN IN STAND BY POSITION.
4. SWITCH S106 SHOWN IN OFF POSITION.

Figure 56. Break-in circuit, schematic diagram.

323471 O - 55 (In envelope) No. 10



NOTES:

1. APPLICABLE TO ALL BANDS EXCEPT .5-TO 1-MC BAND., ON .5-TO 1-MC BAND, FREQUENCY RANGE IS 2.5 TO 2MC
2. REFER TO THE TEXT FOR CHART SHOWING FREQUENCY FOR EACH BAND SETTING OF THE RECEIVER
3. VARIABLE CAPACITORS C225, SECTIONS A AND B, ARE APPLIED THROUGH S203 AS FOLLOWS:
   BANDS 1 AND 2 – BOTH SECTIONS,
   BANDS 3 AND 4 – SECTION A ONLY,
   BANDS 5 AND 6 – SECTION B ONLY.

Figure 58. Mechanical tuning system with associated stages, block diagram.

323471 O - 55 (In envelope) No. 11

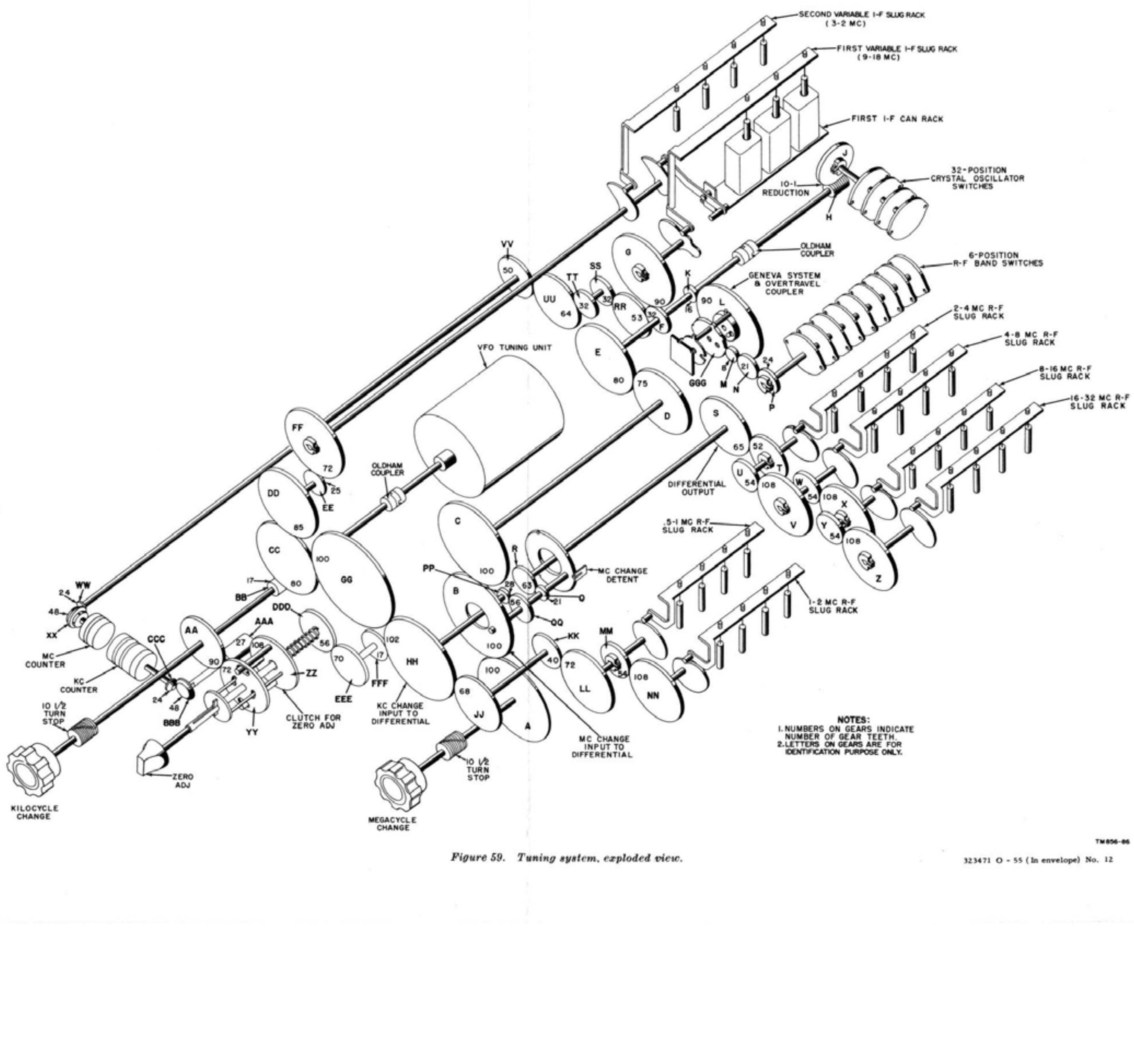


Figure 59. Tuning system, exploded view.

NOTE:

INSTRUCTIONS ARE GIVEN BELOW, IN STEP-BY-STEP SEQUENCE, FOR ATTACHING RADIO FREQUENCY JACK UG-89/U TO ONE END OF THE CABLE. RADIO FREQUENCY PLUG UG-88/U IS ATTACHED TO OTHER END OF CABLE BY FOLLOWING SAME PROCEDURE AS FOR FEMALE CONNECTOR, EXCEPT THAT A MALE CONTACT AND PLUG BODY ARE SUBSTITUTED.

CABLE NO. 1

COMPLETED CABLE

ASSEMBLING RADIO FREQUENCY JACK UG-89/U

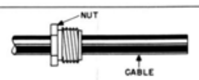
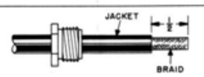
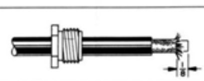
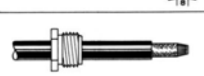
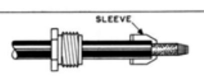
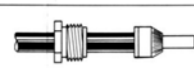
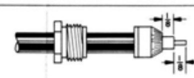
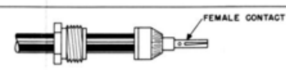
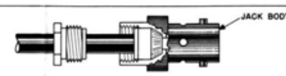
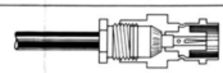
STEP 1		CUT END OF CABLE EVEN.
STEP 2		REMOVE OUTER JACKET 1/2"—*DON'T NICK BRAID.*
STEP 3		PUSH BRAID BACK, AND REMOVE 1/8" OF INSULATION AND CONDUCTOR.
STEP 4		TAPER BRAID.
STEP 5		SLIDE SLEEVE OVER TAPERED BRAID. FIT INNER SHOULDER OF SLEEVE SQUARELY AGAINST END OF JACKET.
STEP 6		WITH SLEEVE IN PLACE, COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN, AND TRIM 3/32".
STEP 7		BARE CENTER CONDUCTOR 1/8"—*DON'T NICK CONDUCTOR.*
STEP 8		TIN CENTER CONDUCTOR OF CABLE. SLIP FEMALE CONTACT IN PLACE AND SOLDER. REMOVE EXCESS SOLDER. *BE SURE CABLE DIELECTRIC IS NOT HEATED EXCESSIVELY AND SWOLLEN SO AS TO PREVENT DIELECTRIC ENTERING BODY.*
STEP 9		PUSH INTO BODY AS FAR AS IT WILL GO. SLIDE NUT INTO BODY AND SCREW INTO PLACE, WITH WRENCH, UNTIL MODERATELY TIGHT. HOLD CABLE AND SHELL RIGIDLY AND ROTATE NUT.
STEP 10		ASSEMBLED CONNECTOR.

Figure 60. Assembly instruction for cable No. 1

323471 O - 55 (In envelope) No. 13

NOTES:

1. THE MULTI-CONDUCTOR EXTENSION CABLES ARE TO BE FABRICATED OF NO. 18 TO 22 GAGE SHIELDED, STRANDED WIRE FOR AUDIO CONDUCTORS INDICATED BY ◌, NO. 18 GAGE STRANDED WIRE FOR CONDUCTORS MARKED °, AND NO. 22 GAGE STRANDED WIRE FOR ALL OTHER CONDUCTORS. INSULATION MUST BE RATED AT 600V.

2. CONNECTORS SHOWN VIEWED FROM REAR. COVERS TO BE USED WITH FEMALE CONNECTORS. AMPHENOL 86-834 COVER USED WITH 26-192 CONNECTOR.

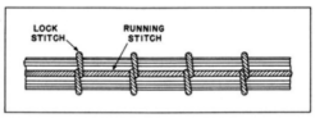
3. CABLES TO BE LACED WITH NO. 6 VINYLITE LACING CORD AS SHOWN IN INSERT.

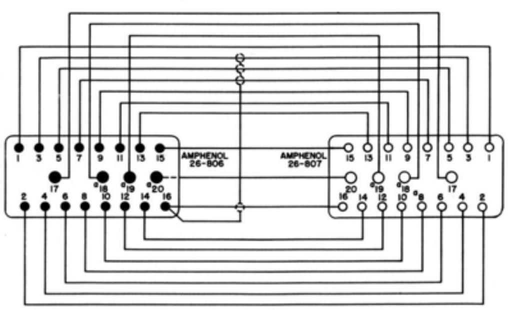
4. MAXIMUM LENGTH OF ALL CABLES IS 24 IN.

5. CHECK CONTINUITY AFTER COMPLETING FABRICATION.

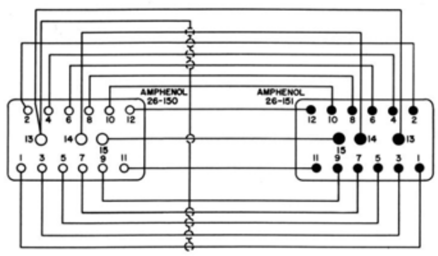
6. LABEL EXTENSION CABLES FOR IDENTIFICATION.

7. NORMALLY, ONE EACH OF EXTENSION CABLES IS REQUIRED. IF VFO AND CALIBRATION OSC SUBCHASSIS ARE OPERATED OUTSIDE RECEIVER AT SAME TIME, TWO NO. 7 CABLES ARE NEEDED.





CABLE NO.8



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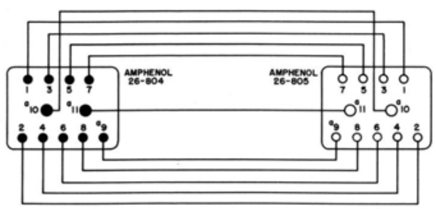

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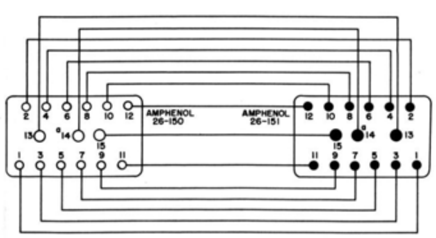
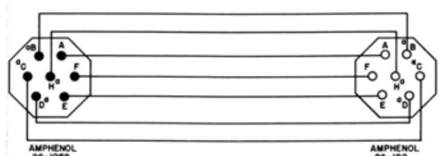


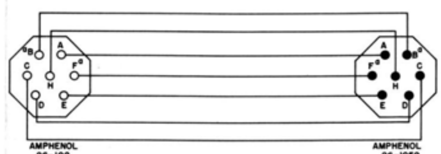
CABLE NO.5

Figure 61. Assembly instructions for multiconductor cables.

CABLE NO.6

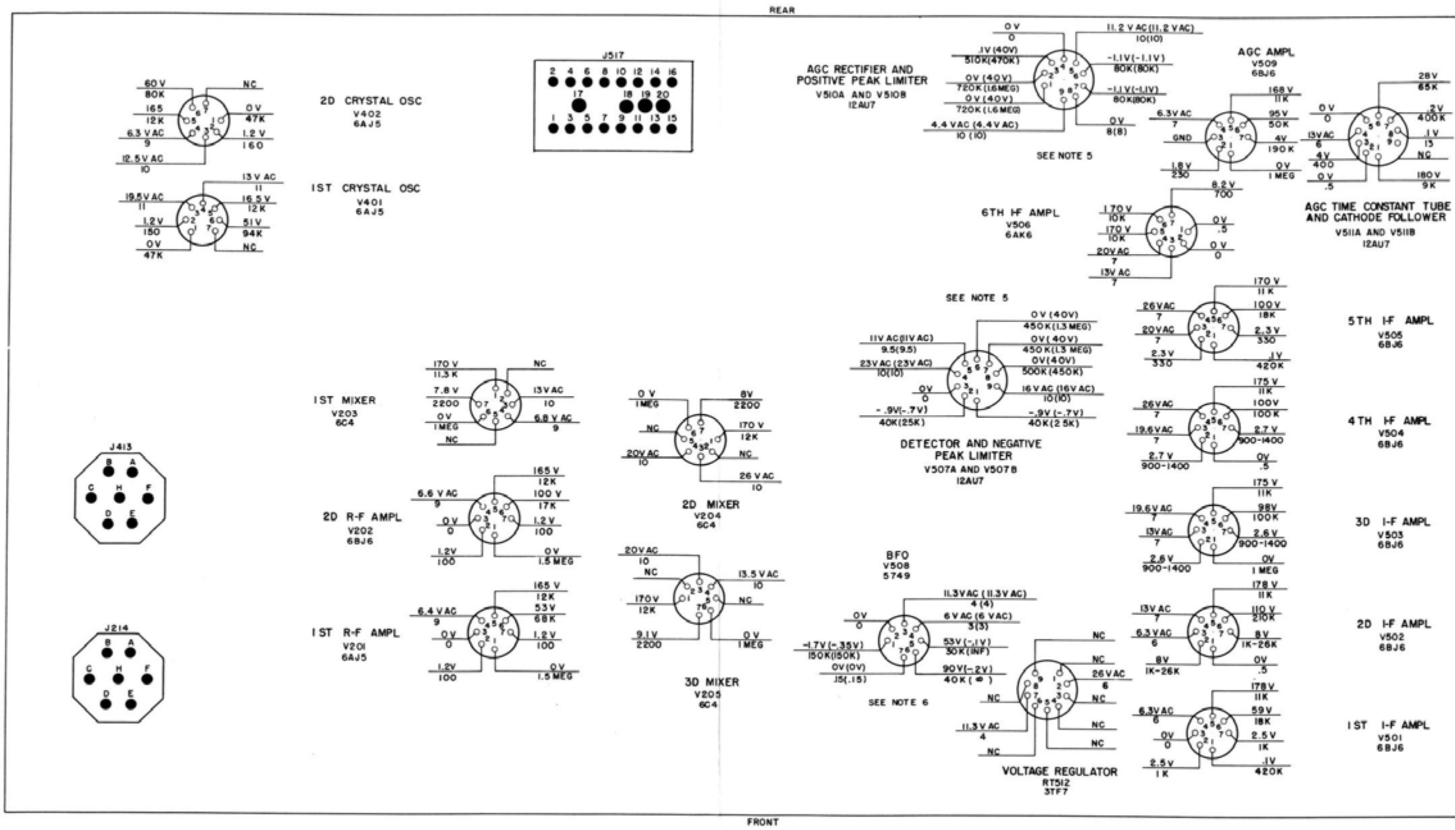


CABLE NO.7



CABLE NO.2

323471 O—55 (Face p. 84)



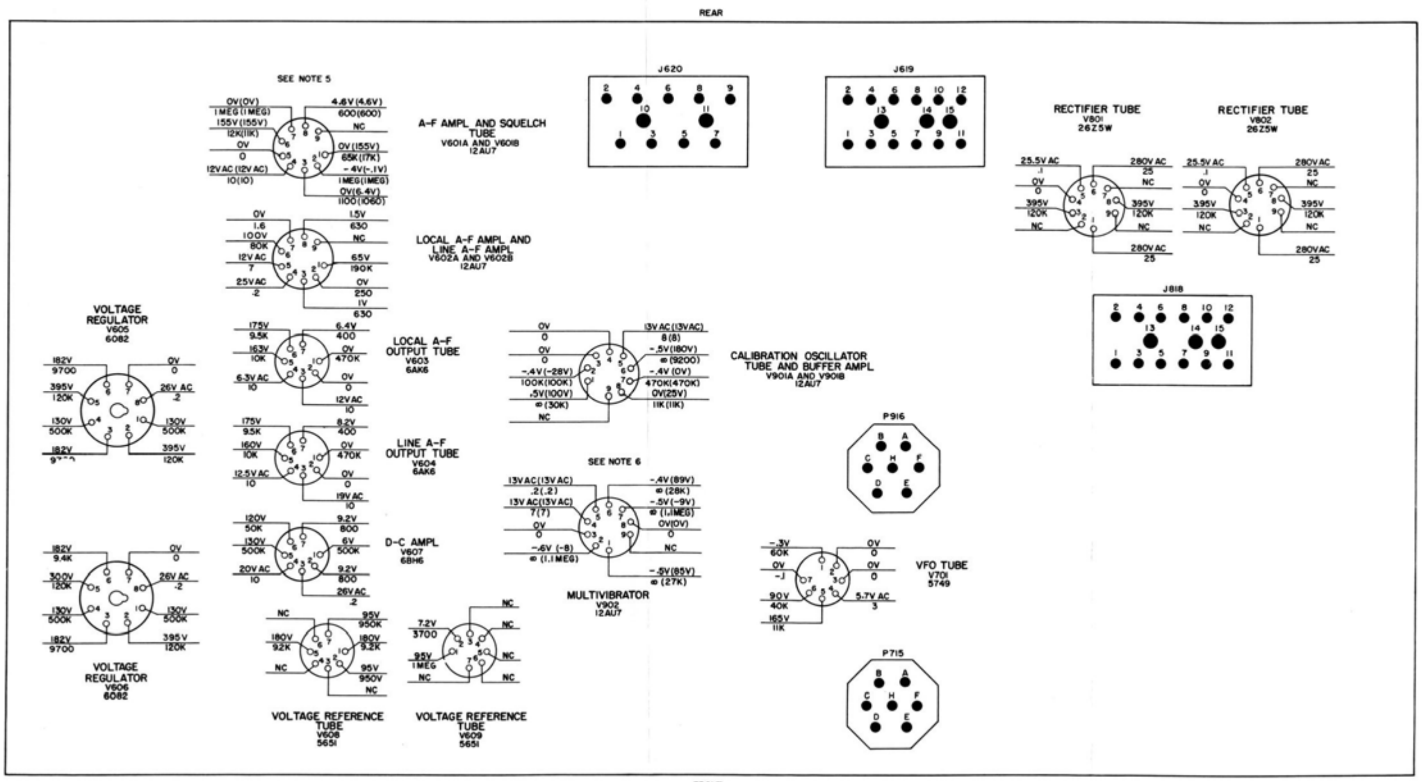
NOTES:

1. UNLESS OTHERWISE SHOWN,
   RESISTORS ARE IN OHMS AND ARE MEASURED FROM PIN SOCKET TO GROUND WITH A 20,000 OHMS-PER-VOLT METER (SUCH AS MULTIMETER TS-352/U),
   VOLTAGES ARE DC AND ARE MEASURED FROM PIN SOCKET TO GROUND WITH A VTVM (SUCH AS ELECTRONIC MULTIMETER TS-505/U).
   READINGS ARE THE SAME ON ALL BANDS.
2. NC INDICATES NO CONNECTION
3. ∞ INDICATES INFINITY
4. UNLESS OTHERWISE NOTED, SET CONTROLS AS FOLLOWS:
   SET S801 TO 115 VOLTS AC, FUNCTION TO AGC, AUDIO RESPONSE TO MED, RF GAIN TO 10, LOCAL GAIN TO 10, AND BANDWIDTH TO 8 KC.
5. READINGS IN PARENTHESES ARE MADE WITH LIMITER AT OFF, OTHER READINGS ARE WITH LIMITER AT 10.
6. READINGS IN PARENTHESES ARE MADE WITH BFO AT OFF.
7. RECEPTACLE RESISTANCE READINGS ARE TAKEN WITH PLUG DISCONNECTED.

TM 856-59

Figure 82. Radio Receiver R-390/URR, tube voltage and resistance and subchassis receptacle resistance diagram, top deck.

323471 O - 55 (In envelope) No. 14



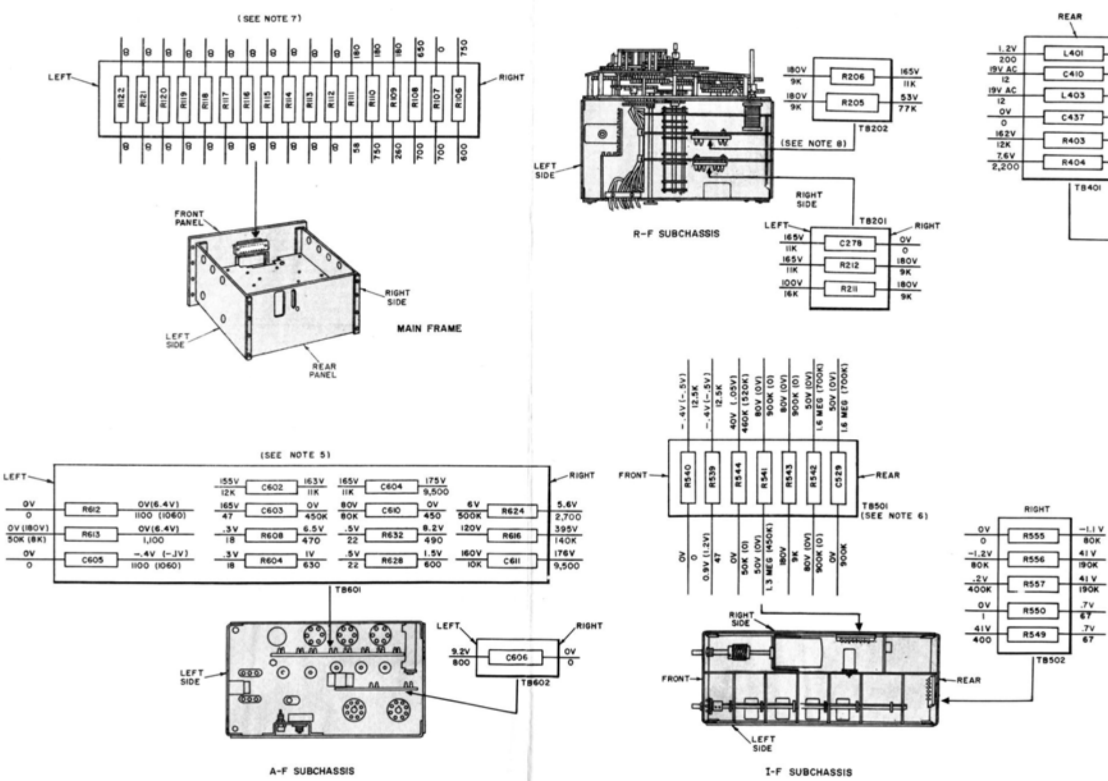
NOTES:

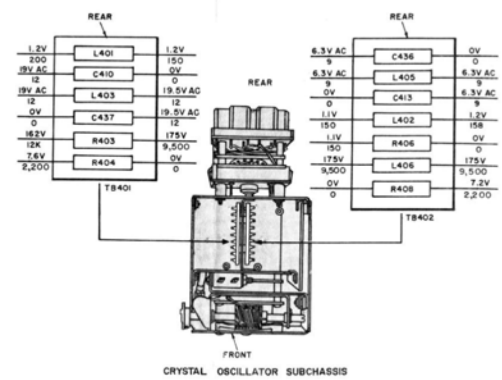
1. UNLESS OTHERWISE SHOWN
   RESISTORS ARE IN OHMS AND ARE MEASURED FROM PIN SOCKET TO GROUND WITH A 20,000 OHM-PER-VOLT METER (SUCH AS MULTIMETER TS-352/U).
   VOLTAGES ARE DC AND ARE MEASURED FROM PIN SOCKET TO GROUND WITH A VTVM (SUCH AS TRIPLETT ELECTRONIC MULTIMETER TS-505/U).
   READINGS ARE THE SAME ON ALL BANDS.
2. NC INDICATES NO CONNECTION.
3. ∞ INDICATES INFINITY.
4. UNLESS OTHERWISE NOTED, SET CONTROLS AS FOLLOWS:
   SET S801 TO 115 VOLTS AC, FUNCTION TO AGC
   AUDIO RESPONSE TO MED, RF GAIN TO 10 LOCAL GAIN
   TO 10, AND BANDWIDTH TO 8KC
5. READING IN PARENTHESES ARE MADE WITH SQUELCH AT ON.
6. READINGS IN PARENTHESES ARE MADE WITH FUNCTION AT CAL.
7. RECEPTACLE RESISTANCE READINGS ARE TAKEN WITH PLUG DISCONNECTED.

TM 856-60

Figure 83. Radio Receiver R-390/URR, tube voltage and resistance and subchassis receptacle resistance diagram, bottom deck.

323471 O - 55 (In envelope) No. 15





NOTES:

1. UNLESS OTHERWISE SHOWN,
   RESISTORS ARE IN OHMS, AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A 20,000 OHMS-PER-VOLT METER (SUCH AS MULTIMETER TS-352/U).
   VOLTAGES ARE DC AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A VTVM (SUCH AS ELECTRONIC MULTIMETER TS-505/U).
2. READINGS ARE THE SAME ON ALL BANDS.
3. ∞ INDICATES INFINITY.
4. UNLESS OTHERWISE NOTED, SET CONTROLS AS FOLLOWS: SET S801 TO 115-VOLTS A-C, FUNCTION SWITCH TO AGC, AUDIO RESPONSE SWITCH TO MED, RF GAIN CONTROL TO 10, LOCAL GAIN CONTROL TO 10, AND BANDWIDTH SWITCH TO 8KC.
5. READINGS IN PARENTHESES ARE MADE WITH FUNCTION SWITCH AT SQUELCH.
6. READINGS IN PARENTHESES ARE MADE WITH LIMITER CONTROL AT 10, OTHER READINGS ARE WITH LIMITER AT 10 OR OFF.
7. NO VOLTAGE READINGS ARE TAKEN, ALL RESISTANCE READINGS ARE MADE WHILE A 600-OHM LOUDSPEAKER IS CONNECTED TO LOCAL AUDIO TERMINALS 6 AND 7 ON REAR PANEL.
8. TB202 IS LOCATED IN BACK OF TB201 IN LATER MODELS.

Figure 84. Radio Receiver R-390/URR, terminal boards voltage and resistance diagram.

323471 O - 55 (In envelope) No. 16

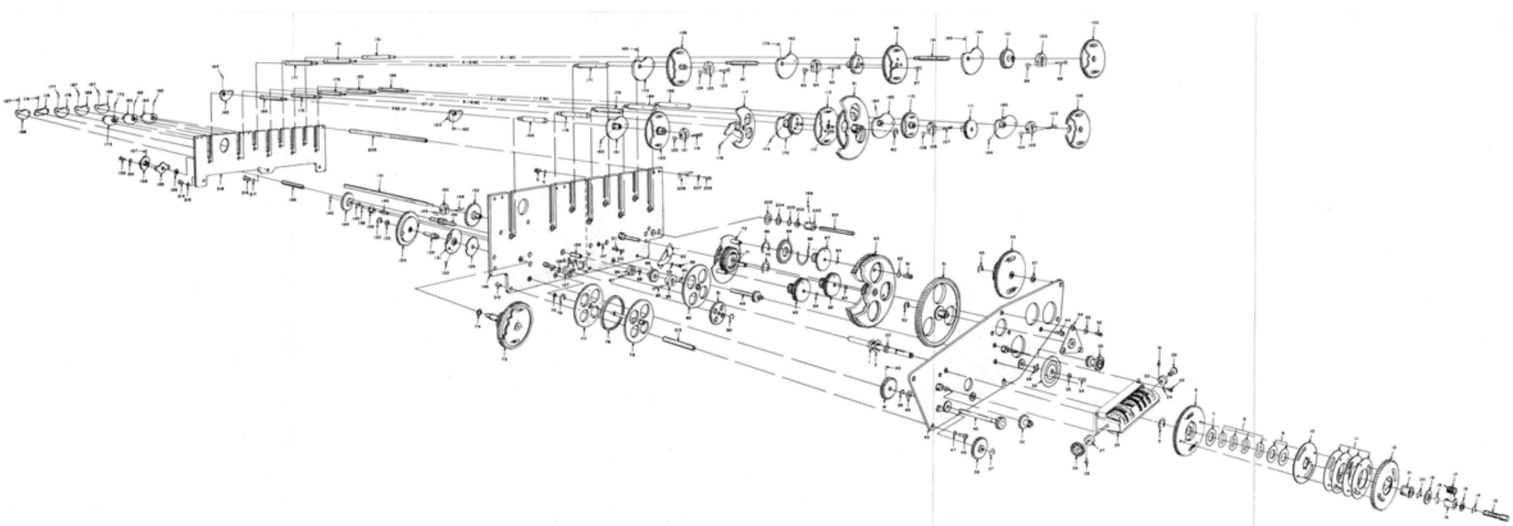


Figure 88.1. (Added) RF gear train, exploded view.

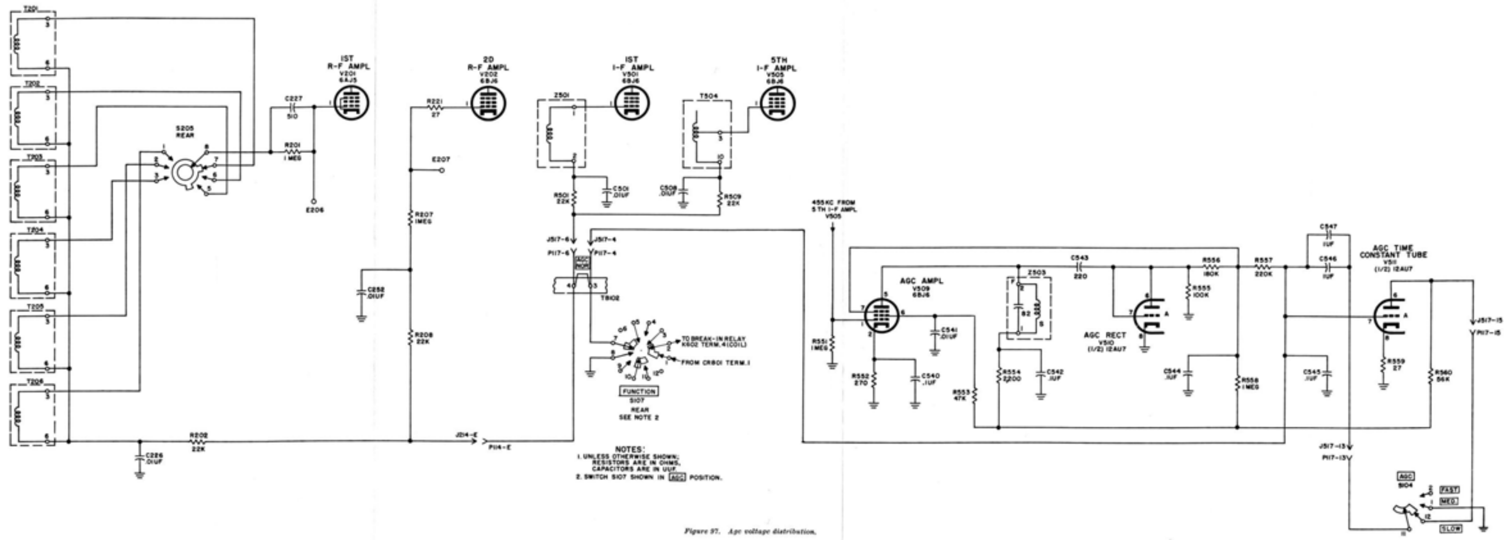


Figure 97. Agc voltage distribution.

TM 856-88

323471 O - 55 (In envelope) No. 17

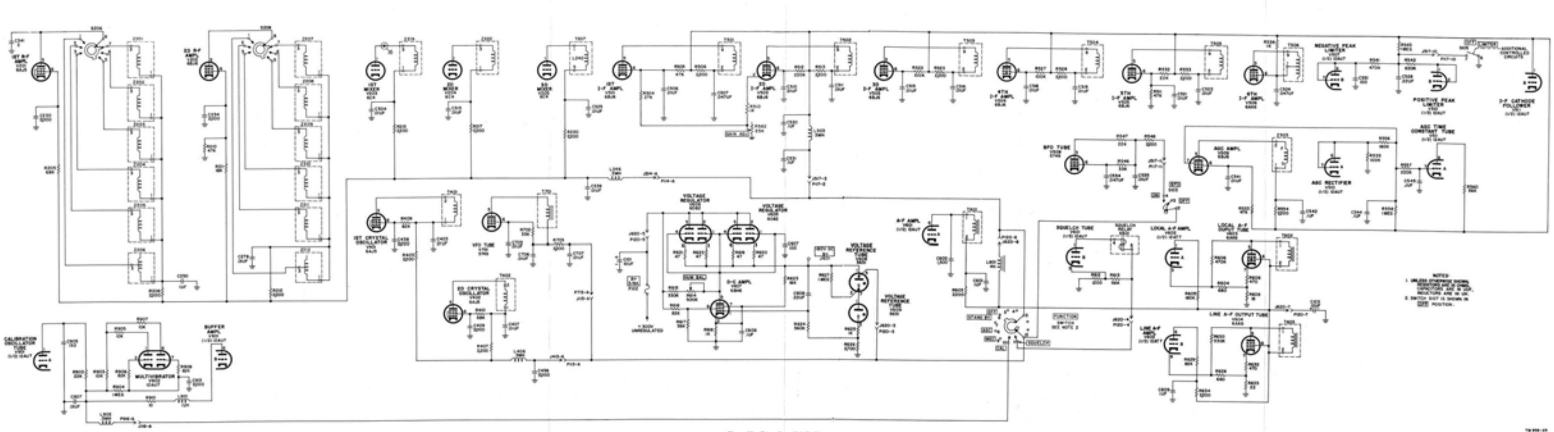
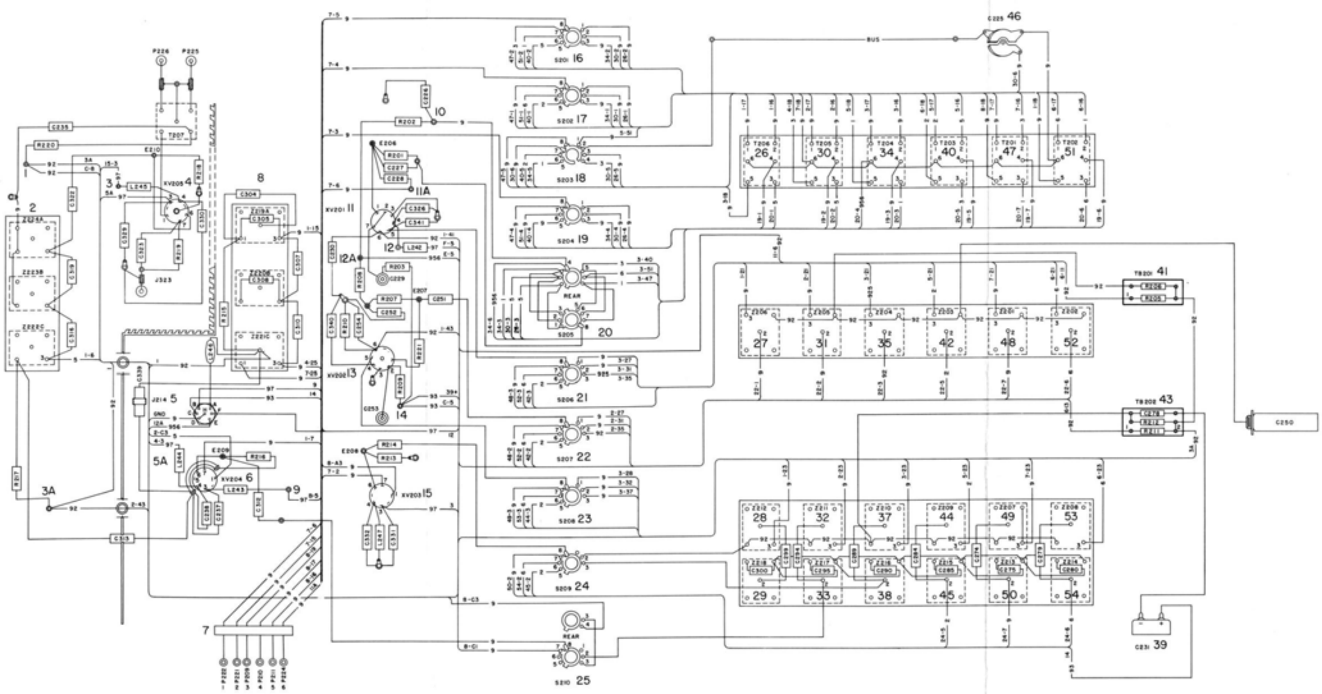


Figure 86. B+ voltage distribution.



NOTES:

1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

STATION NUMBER
DESTINATION WITHIN STATION
4-3
923
WIRE COLOR CODE

Figure 99. Radio Receiver R-390/URR, rf subchassis, wiring diagram.

TM 856-102

323471 O - 55 (In envelope) No. 19

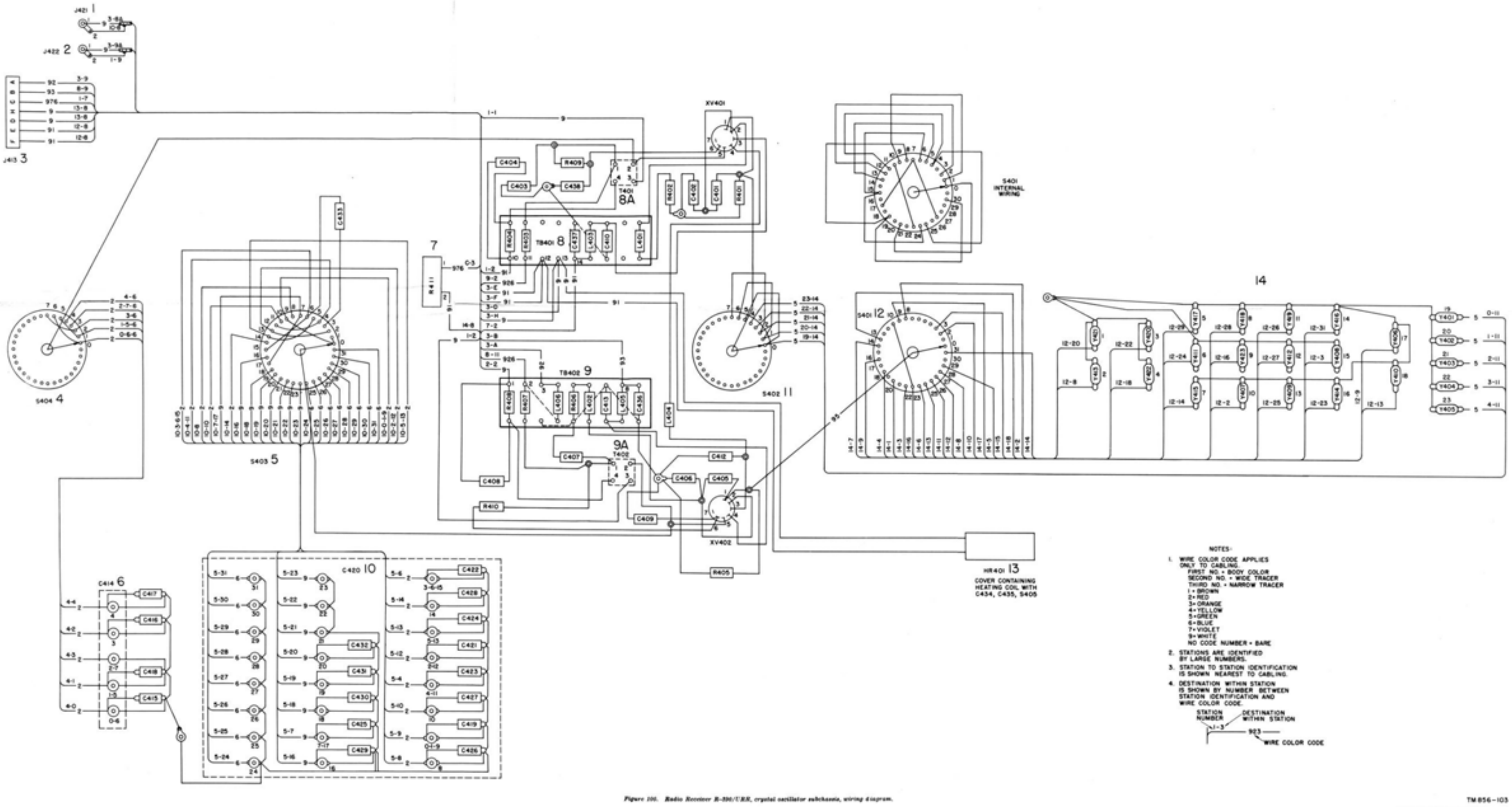
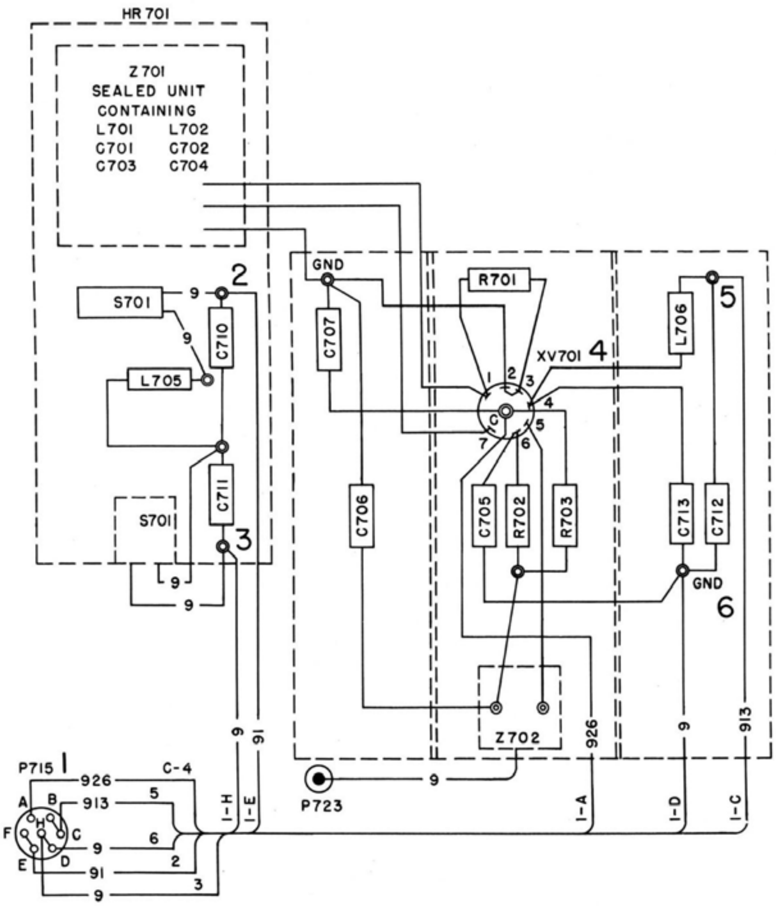


Figure 100. Radio Receiver R-390/URR, crystal oscillator subchassis, wiring diagram.



NOTES:

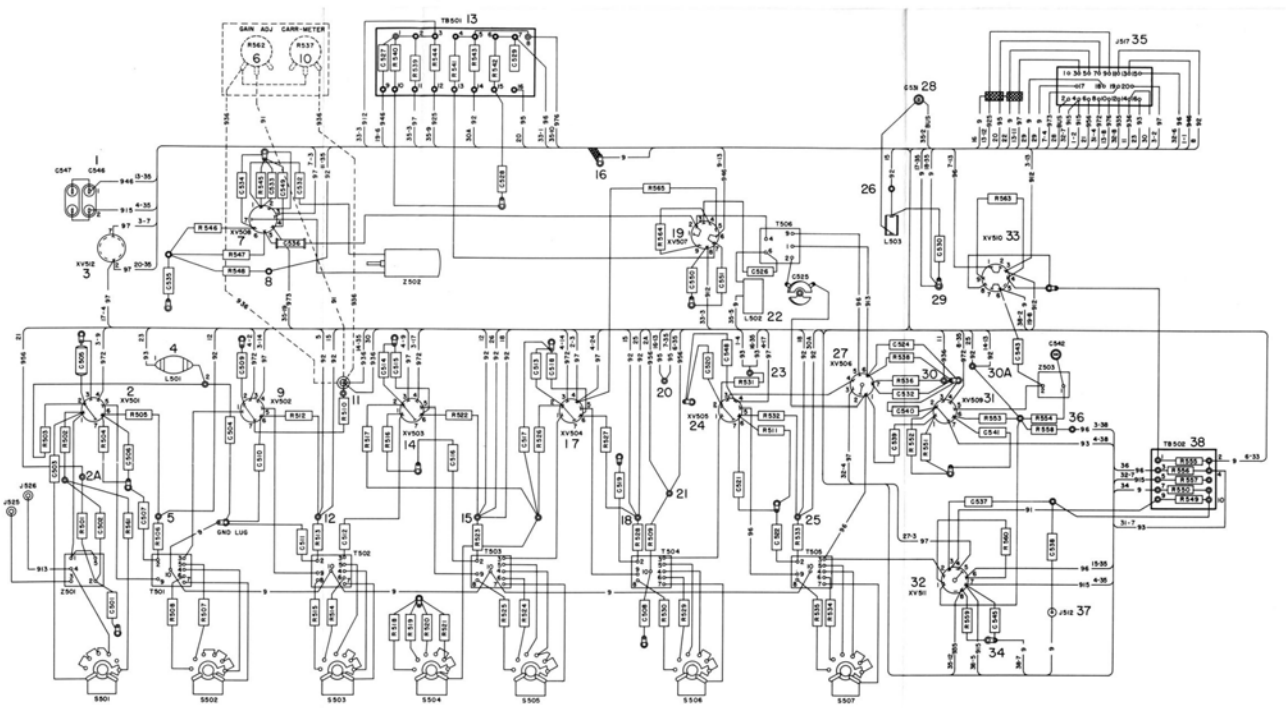
1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

STATION NUMBER
DESTINATION WITHIN STATION
1-3
923
WIRE COLOR CODE

TM 856-106

Figure 101. Radio Receiver R-390/URR, variable frequency oscillator subchassis, wiring diagram.

323471 O - 55 (In envelope) No. 21



NOTES:

1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

STATION NUMBER — DESTINATION WITHIN STATION

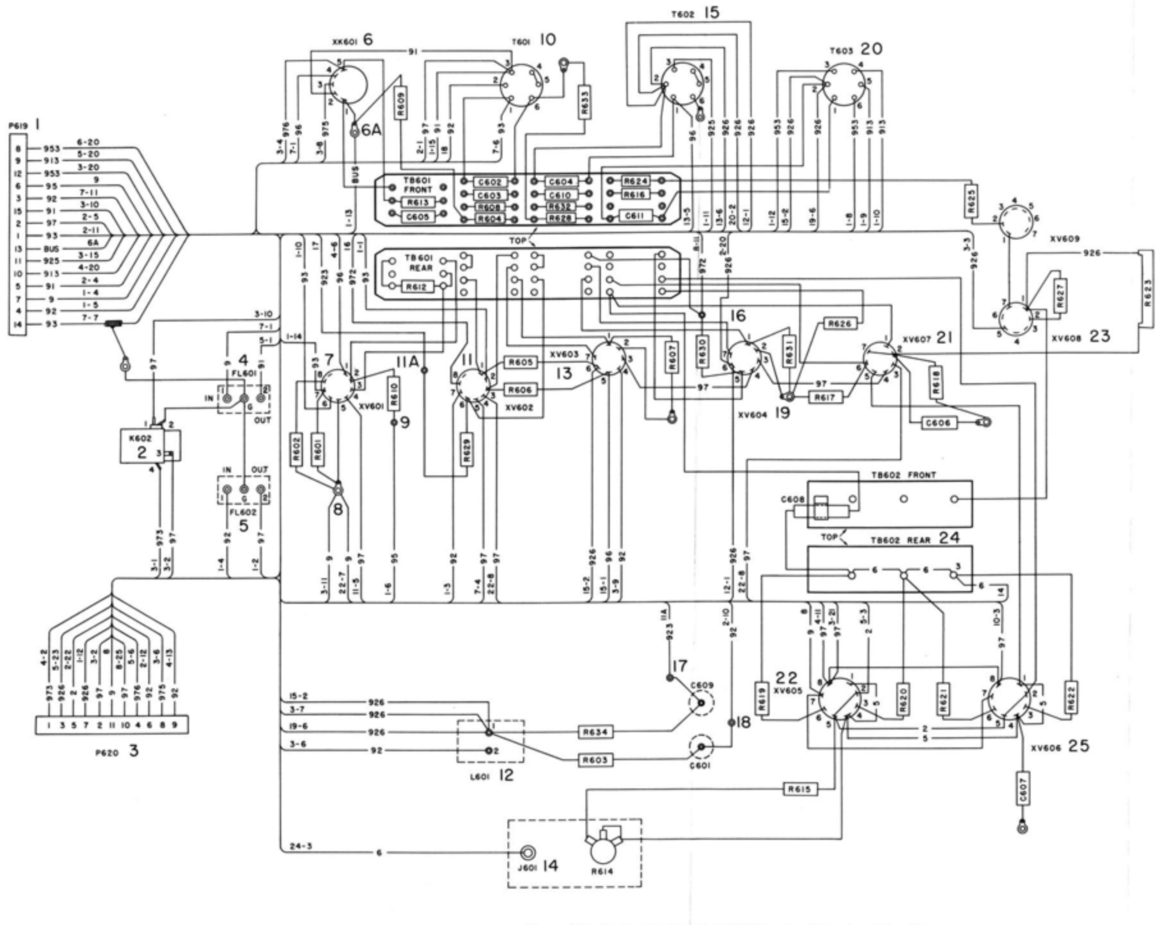
1-2 — 923

WIRE COLOR CODE

TM 856-104

Figure 102. Radio Receiver R-390/URR, if. subchassis wiring diagram.

323471 O - 55 (In envelope) No. 22



NOTES:

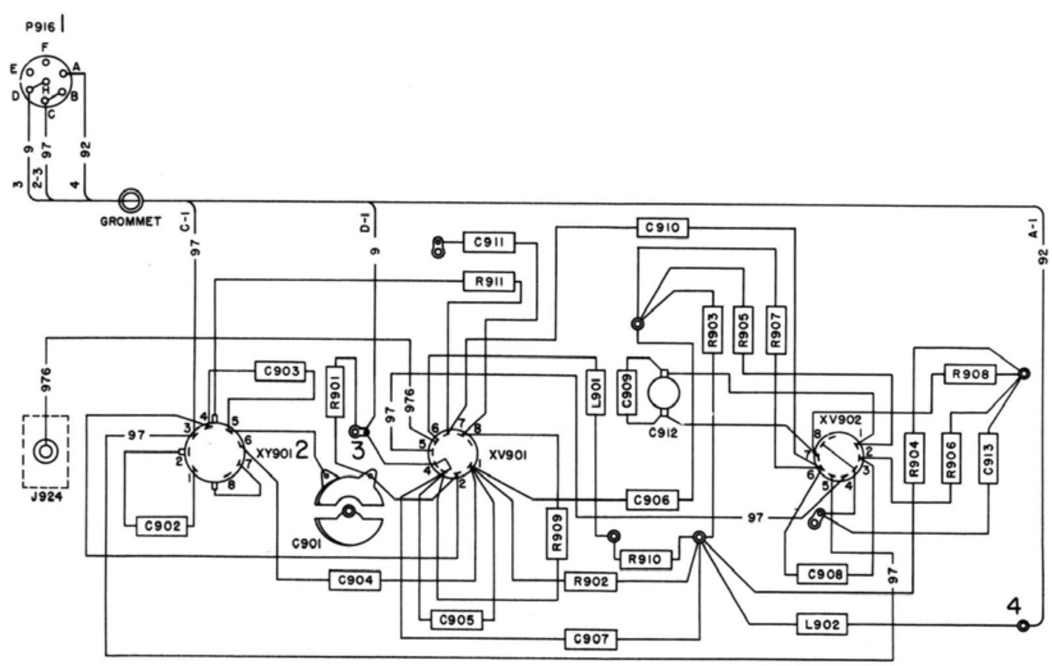
1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. • BODY COLOR
   SECOND NO. • WIDE TRACER
   THIRD NO. • NARROW TRACER
   1 • BROWN
   2 • RED
   3 • ORANGE
   4 • YELLOW
   5 • GREEN
   6 • BLUE
   7 • VIOLET
   9 • WHITE
   NO CODE NUMBER • BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

   STATION NUMBER — 1-3 — DESTINATION WITHIN STATION
   923 — WIRE COLOR CODE

TM 856-105

Figure 103. Radio Receiver R-390/URR, af subchassis, wiring diagram.

323471 O - 55 (In envelope) No. 23



NOTES.

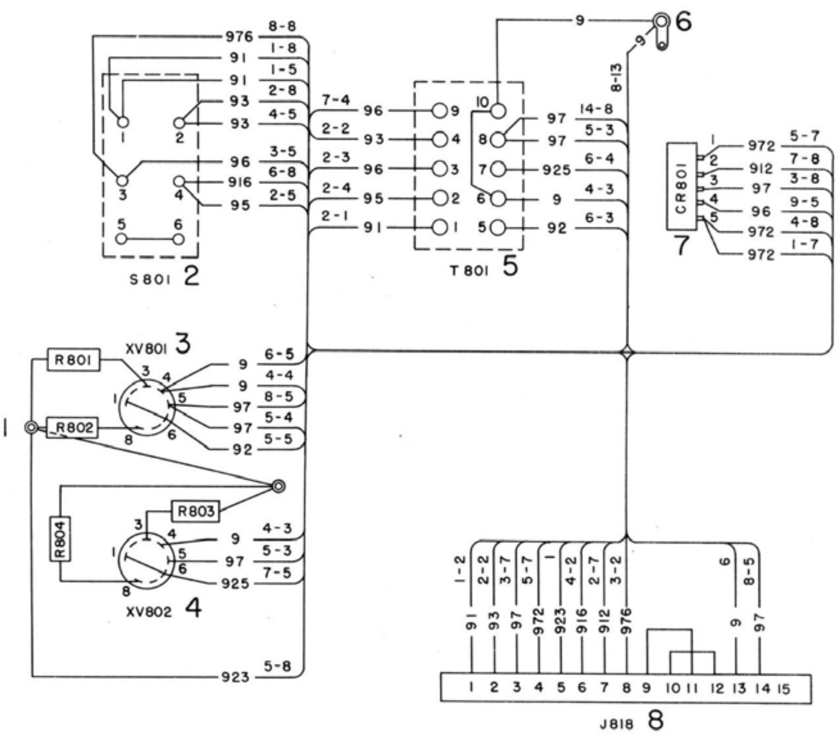
1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBERS BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

STATION NUMBER
DESTINATION WITHIN STATION
1-3
923
WIRE COLOR CODE

TM856-91

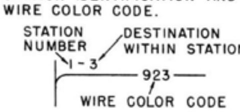
Figure 104. Radio Receiver R–390/URR, calibration oscillator subchassis, wiring diagram.

323471 O - 55 (In envelope) No. 24



NOTES:

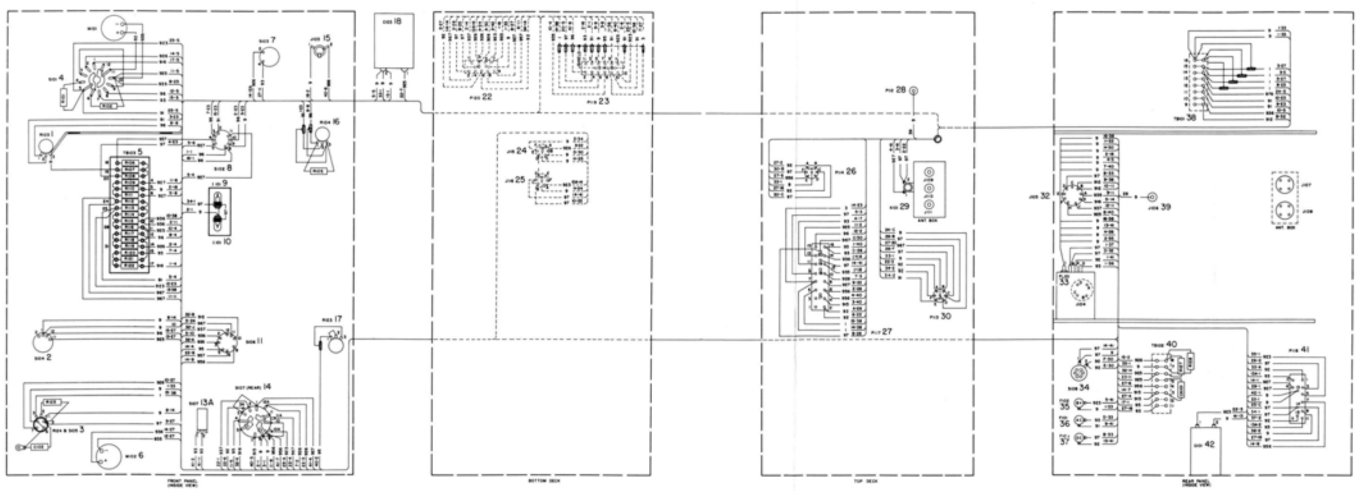
1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.



TM 856-98

Figure 105. Power Supply PP-621/URR, wiring diagram.

323471 O - 55 (In envelope) No. 25



NOTES

1. WIRE COLOR CODE APPLIES ONLY TO CABLING.
   FIRST NO. = BODY COLOR
   SECOND NO. = WIDE TRACER
   THIRD NO. = NARROW TRACER
   1 = BROWN
   2 = RED
   3 = ORANGE
   4 = YELLOW
   5 = GREEN
   6 = BLUE
   7 = VIOLET
   9 = WHITE
   NO CODE NUMBER = BARE
2. STATIONS ARE IDENTIFIED BY LARGE NUMBERS.
3. STATION TO STATION IDENTIFICATION IS SHOWN NEAREST TO CABLING.
4. DESTINATION WITHIN STATION IS SHOWN BY NUMBER BETWEEN STATION IDENTIFICATION AND WIRE COLOR CODE.

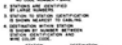


Figure 106. Radio Receiver R-390/URR, main frame, wiring diagram.

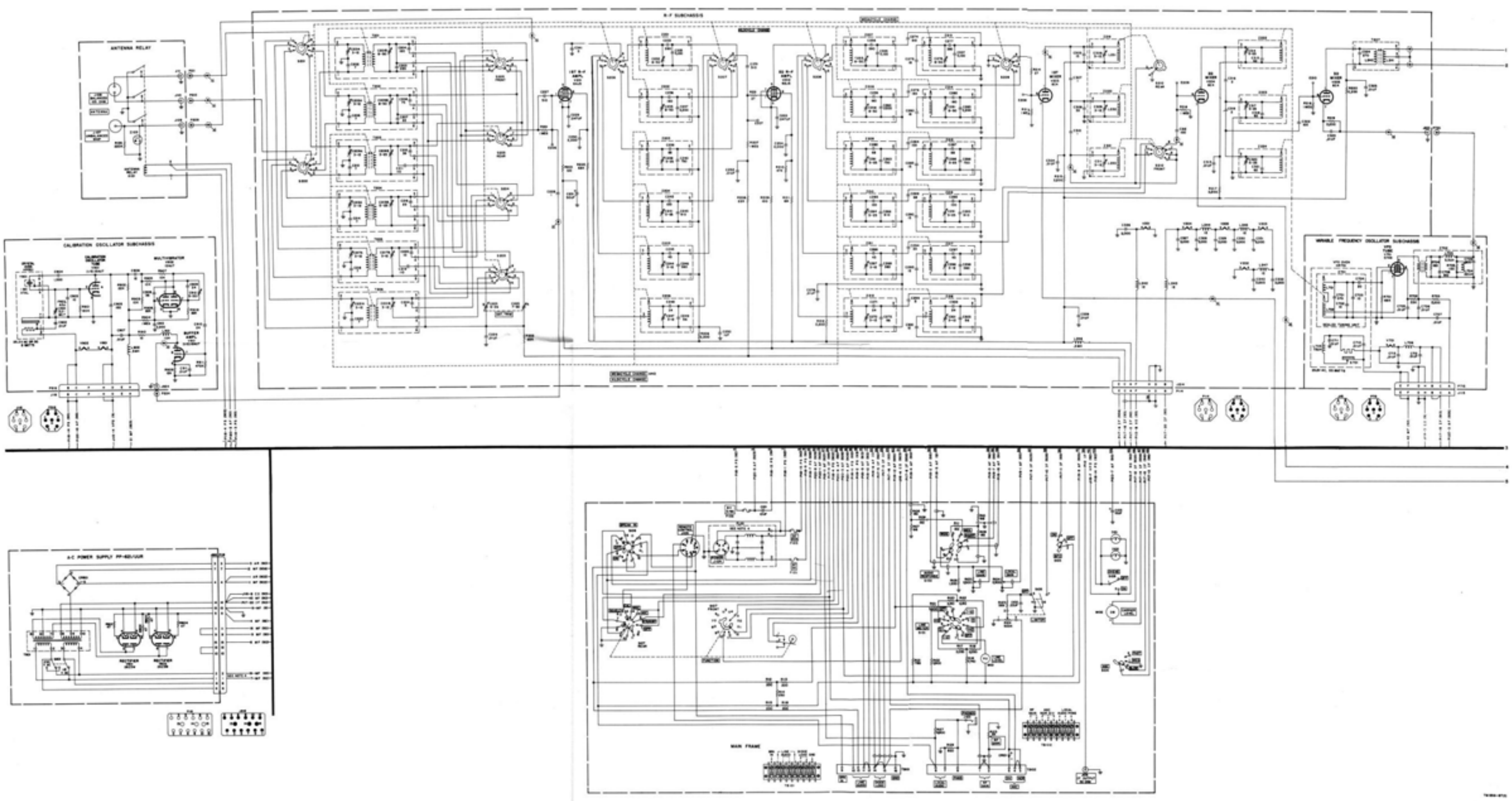


Figure 107 (Part 1). Radio Receiver R-390/URR, subchassis and interconnection diagram.

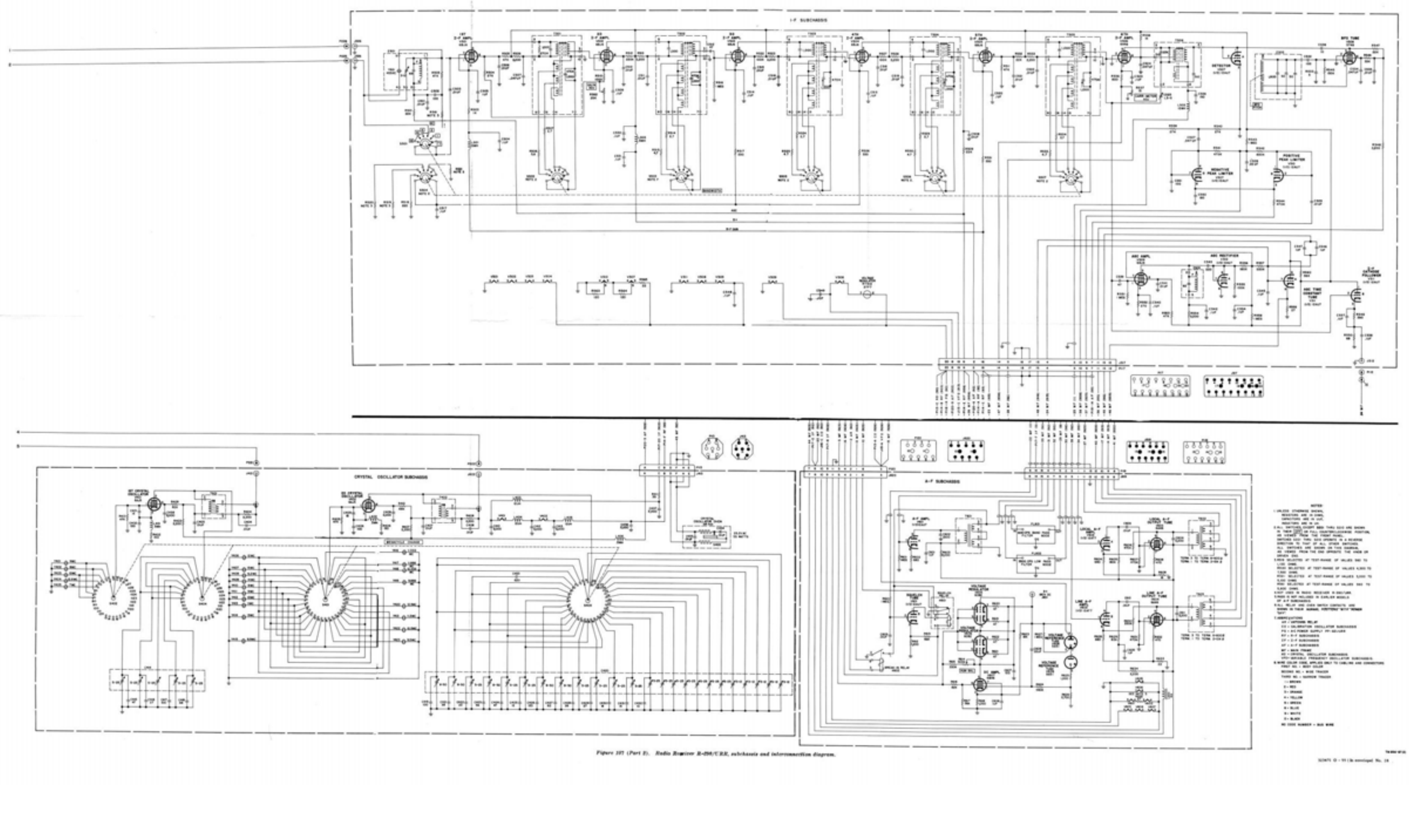


Figure 107 (Part 2). Radio Receiver R-390/URR, subchassis and interconnection diagram.

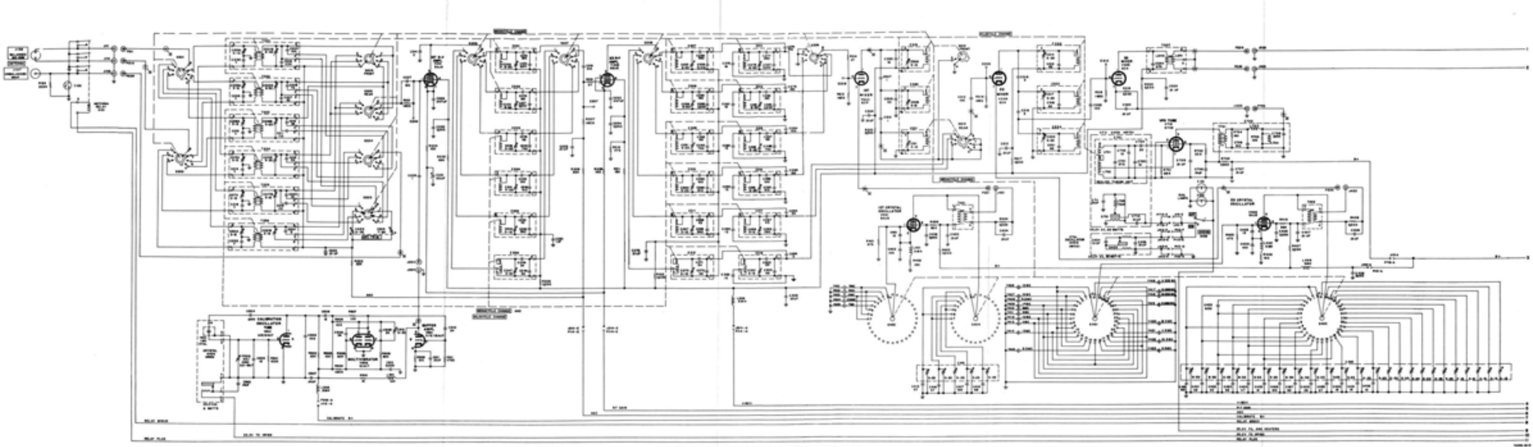


Figure 108 (Part 1). Radio Receiver R-390/URR, schematic diagram.

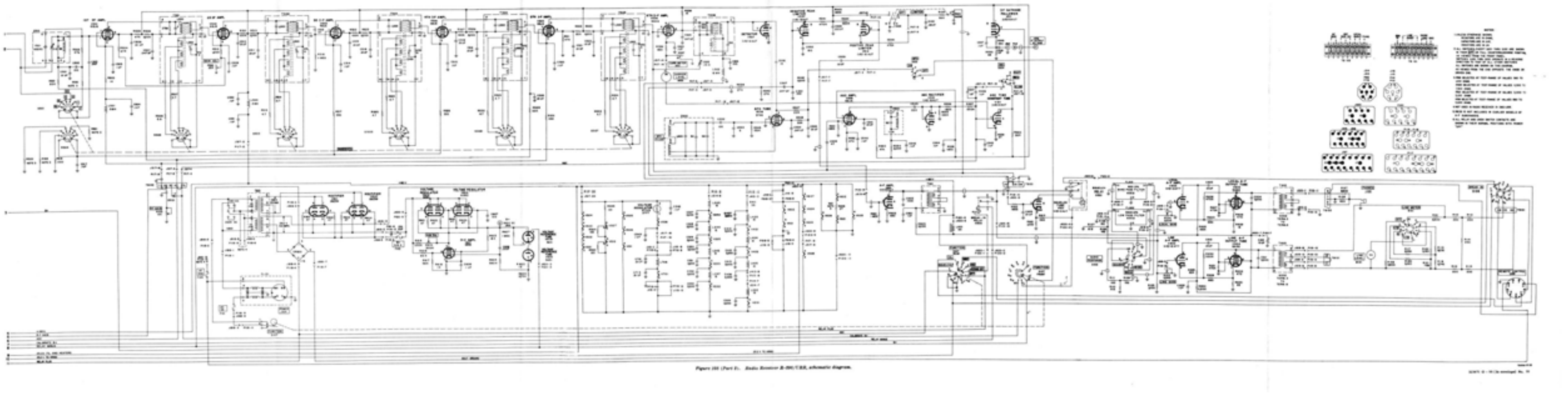


Figure 155 (Part 2). Radio Receiver R-390/URR, schematic diagram.