TM 11-295

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO RECEIVING SET AN/GRR-5

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HEADQUARTERS DEPARTMENT OF THE ARMY
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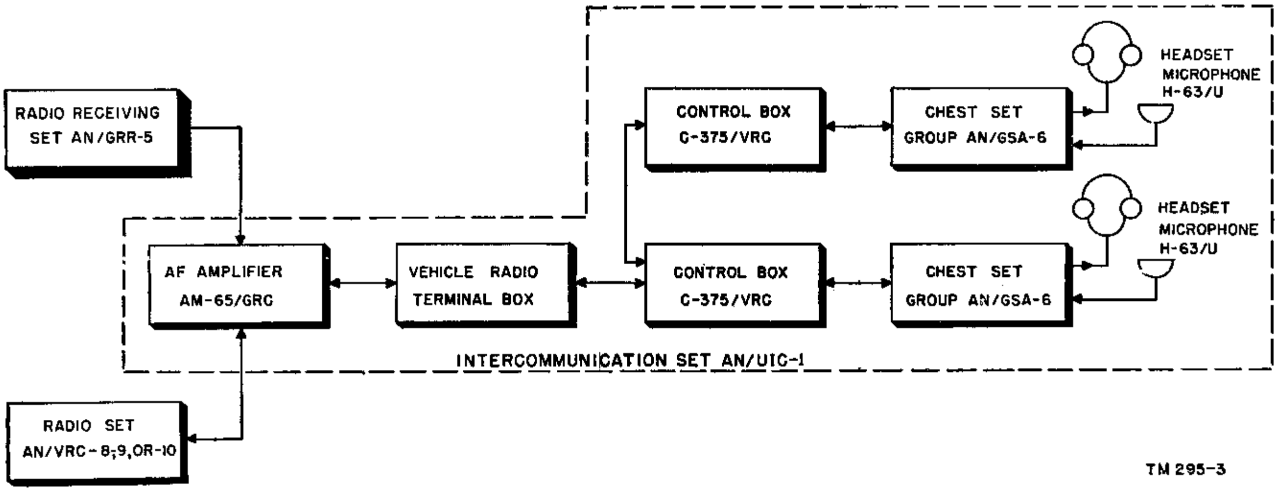


Figure 2. Radio Receiving Set AN/GRR–5, typical system application, simplified block diagram.

5. Technical Characteristics of Radio Receiving Set AN/GRR–5

Receiver type__________Superheterodyne.

Types of signals which can be received______________A-m, c-w, or m-c-w (modulated continuous wave).

Frequency range:
- Band 1____________1.5 mc to 2.7 mc.
- Band 2____________2.7 mc to 5 mc.
- Band 3____________5 mc to 9.5 mc.
- Band 4____________9.5 mc to 18 mc.

Type of tuning_________Continuous, with provision for presetting detents for any 10 channel frequencies.

Number of tubes:
- Receiver___________8.
- Power supply______4.

Intermediate frequency____________455 kc (kilocycle).

Method of calibration___________Built-in crystal frequency calibrator.

Calibration points_______________Every 200 kc.

Audio output:
- High______________90 mw (milliwatt).
- Low_______________20 mw.

Distortion______________10 percent or less for 70 mw output, measured at 5 mc with 400-cycle, 30 percent modulation.

Sensitivity:
- a-m_______________5 uv (microvolt) or better for 10 mw output, with a signal-plus-noise to noise ratio of 10 to 1.
- c-w________________2 uv or better for 10 mw output, with a signal-plus-noise to noise ratio of 10 to 1.

I-f selectivity:
- 6 db (decibel) down____________ 6.5 kc.
- 20 db down_________13 kc.
- 40 db down_________20 kc.
- 60 db down_________28 kc.

Power input:

For vehicular operation:
- 6 volts__________6.9 amperes, 41.4 watts.
- 12 volts_________3.22 amperes, 38.6 watts.
- 24 volts__________2.55 amperes, 61.2 watts.

For field operation:
- 90 volts (2 Battery BA–419/U)__ 27 ma (milliampere).
- 1.5 volts (1 Battery BA–405/U)__ 350 ma.

For fixed installation:
- 115 volts ac, 50 or 60 cyc__ 455 ma, 52.4 watts.

Antenna_______________Mast Sections MS–116–A (2 ea), MS–117–A, and MS–118–A or any suitable reel antenna.

Weight of receiver and power supply in cabinet__________________60.5 lb.

Weight of accessories___15.05 lb.

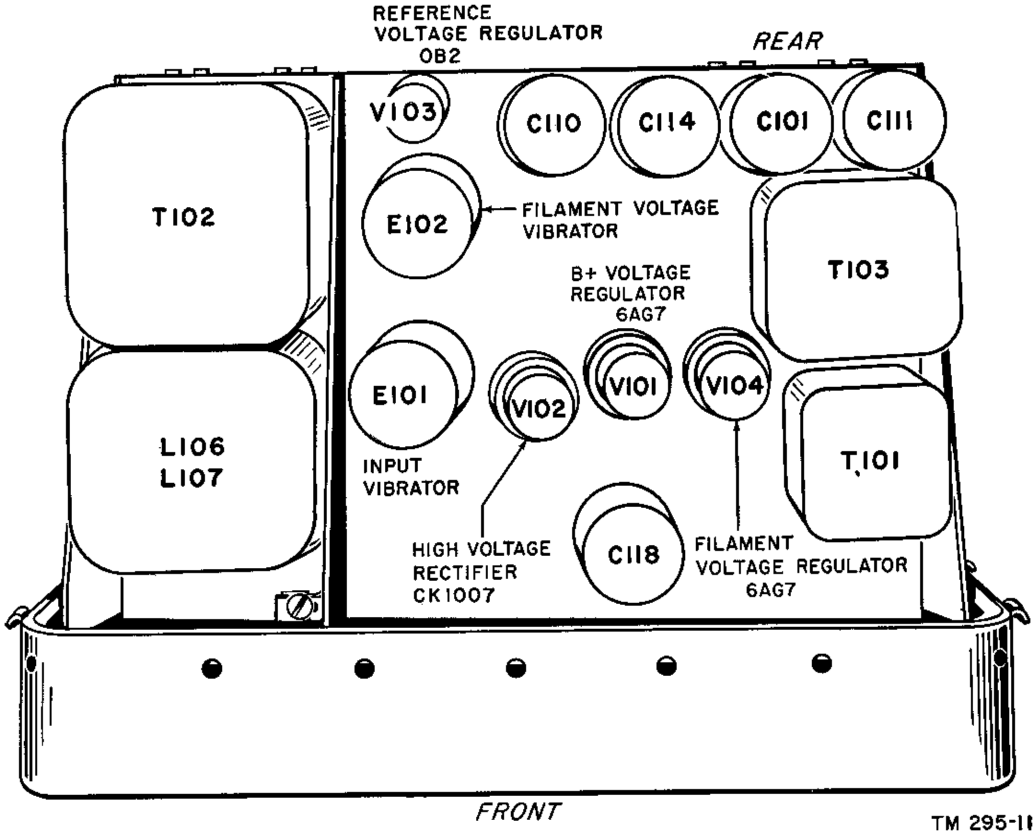


Figure 5. Power Supply PP–308/URR, tube location.

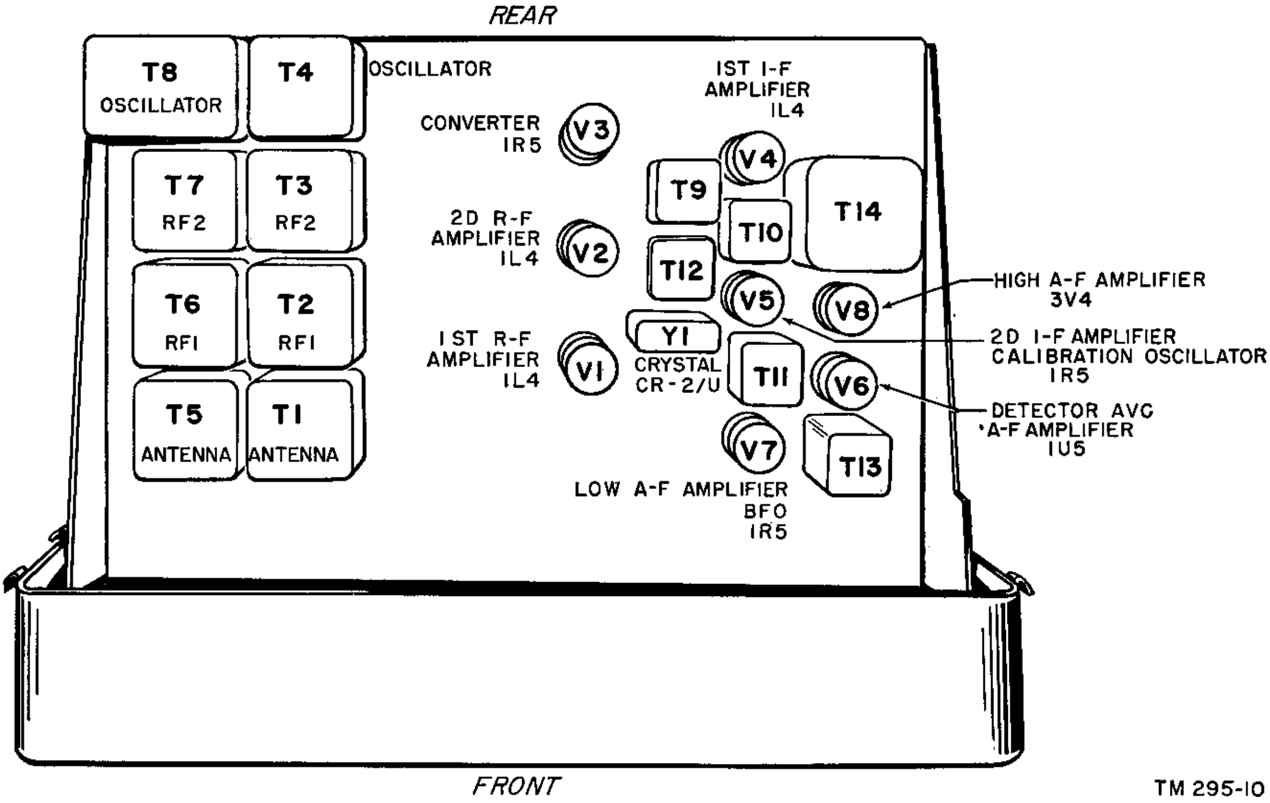


Figure 6. Radio Receiver R–174/URR, tube location.

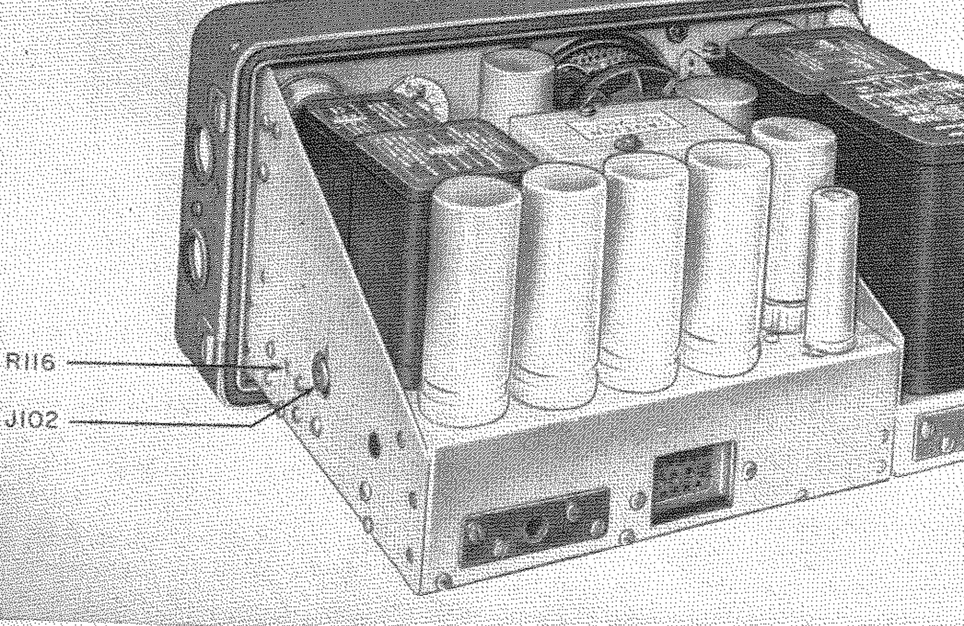


Figure 11. Power Supply PP-308/URR, rear oblique view.

Section III. OPERATION UNDER USUAL CONDITIONS

Caution: Reception on the loudspeaker of early models of the receiving set has a tendency to become distorted after short periods of operation, because of air pressure which builds up within the power supply and has no outlet. To prevent this condition, loosen the cap of the SPARE FUSES compartment before operating the set. A hole has been drilled in the rear of the SPARE FUSES compartment to allow reduction of air pressure. All units which incorporate this expedient have a caution notice affixed to the lower flange of the receiver front panel.

20. Preliminary Control Setting

Before starting the equipment (and during shut-down periods) set the front panel controls as follows:

Control	Position
POWER SELECTOR switch.	6V, 12V, 24V, or DRY BAT.
POWER switch	OFF.
SPEAKER switch	ON (OFF, if headset is used alone).
OUTPUT switch	HIGH (LOW when dry batteries are used).
A.F. GAIN control	Halfway clockwise.
R.F. GAIN control	Halfway clockwise.

NOTES

1. For 115-volt a-c operation, the POWER SELECTOR switch may be in any position except when the receiver is used with a transmitter. The switch must then be in either the 6V or DRY BAT. position.

2. Although the OUTPUT switch normally is set at LOW, when power source is dry batteries, it may be set at HIGH for emergency. The normal LOW setting conserves the batteries.

21. Reception of Modulated Signals

With the equipment connected properly for the available power source (par. 15), and controls set as directed in paragraph 20, operate the equipment in the following manner.

a. Turn the POWER switch to ON.

b. If the equipment has not been used for one week or longer, connect a 20,000-ohm-per-volt meter to J102 on the power supply (fig. 11), and adjust R116 for a reading of 1.4 volts (par. 15*d*).

c. Set the BAND SW. switch (S1) to the band which includes the desired frequency.

d. Turn PHN.-C.W.-NET-CAL. switch S2 to PHN.

e. Tune the receiver to the desired frequency. Depress the DIAL LIGHT switch while tuning, only if the receiver is being operated in an area that is poorly lit.

(1) If the desired frequency has not been preset, tune to the signal by rotating the outer ring of the MANUAL-PRESET TUNING control.

(2) If the desired frequency has been preset, pull out the fine-tuning control, lift the cam arm, and rotate the MANUAL-PRESET TUNING CONTROL until the *arrowed hole* is over the desired numbered detent.

f. Adjust the ANT. TRIMMER control for maximum output signal.

g. Adjust the R.F. GAIN and A.F. GAIN controls to the desired level.

22. Code Reception

With the equipment connected properly for the available power source (par. 15), and controls set as directed in paragraph 20, operate the equipment in the following manner.

a. Turn the POWER switch to ON.

b. If the equipment has not been used for a week or longer, connect a 20,000 ohms per-volt meter to J102 on the power supply (fig. 11), and adjust R116 for a reading of 1.4 volts (par. 15*d*).

c. Set PHN.-C.W.-NET-CAL. switch to C.W.

d. Set the BAND SW. switch (S1) to the band that includes the desired frequency.

e. Tune in a coded signal and adjust the B.F.O. control to obtain the desired pitch of the beat note. The desired tone may be obtained by setting the B.F.O. control to either side of zero beat. Depress the DIAL LIGHT switch for illumination, if necessary.

(1) If the desired frequency has not been preset, tune to the signal by rotating

CHAPTER 4
THEORY

Section I. POWER SUPPLY PP–308/URR

44. Block Diagram
(fig. 16)

a. Operating voltage for the receiver is obtained from Power Supply PP–308/URR. This unit operates from a standard 115-volt 60-cycle line; a 6-, 12-, or 24-volt, d-c vehicular storage battery; or a 90-volt and 1.5-volt dry-battery source. Output voltages are 90 volts dc ±3 volts, 1.4 volts dc, and —4.2 volts dc.

b. For 115-volt a-c operation, the line voltage is stepped down by a transformer and the lower voltage is supplied to rectifier CR101 (fig. 18). The rectified voltage energizes relay K101. When relay K101 is energized, the 115-volt a-c line is completed to the rectifier circuit associated with V102, and the output of rectifier CR101 is supplied to filament voltage vibrator E102. Bias and hv (high voltage) are developed by the circuit associated with V102. Filament voltage is developed by V104, E102, and CR102. Regulator tubes V101, V103, and V104 maintain substantially constant output voltages.

c. For 6-volt, 12-volt, or 24-volt operation, the input voltage energizes vibrator E101, which develops an alternating voltage to drive the rectifier circuit associated with V102. Rectification, filtering, and regulation are the same as for 115-volt a-c operation. E102 also is energized by the input voltage (K101 is inoperative) and, in conjunction with V104 and CR102, develops filament voltage.

d. For dry-battery operation, the voltages are supplied from the batteries to the receiver through the power supply.

45. H-v Rectifier, Filament Voltage, and Voltage Regulation Circuits
(fig. 17)

a. In all modes of operation, except dry-battery, the h-v rectifier develops the B+, bias, and filament voltages for the receiver. Voltage regulation is used to deliver a constant output despite changes in input voltage. In the following analysis, the circuits connected to the secondary of transformer T102 (common to all modes of operation) are discussed in detail. Primary voltage of T102 is discussed in detail in the analysis of the different modes of operation (pars. 46 through 50).

b. High voltages from the transformer secondary are connected to the plates of rectifier tube V102 (type CK1007) through hash filters L111 and L112. Capacitor C113 is a buffer for the vibrator circuit associated with the primary of T102 during 6-, 12-, and 24-volt operation (pars. 47 through 49). Since each plate is connected to opposite ends of the transformer secondary and the center tap is returned to ground through resistor R109 (or resistors R108 and R109), tube V102 operates as a conventional full-wave rectifier. The pulsating dc is filtered by capacitor C114 and bleeder resistor R110.

c. Resistor R108 in the B— circuit is shorted to ground through section 6, rear, of POWER SELECTOR switch S101 for all modes of operation except DRY BATTERY, and resistor R109 is used to develop bias for tubes V7 and V8 in the receiver. For DRY BATTERY operation, resistor R108 is added in series with R109. The bias voltage is supplied to the receiver through pin 8 of J101.

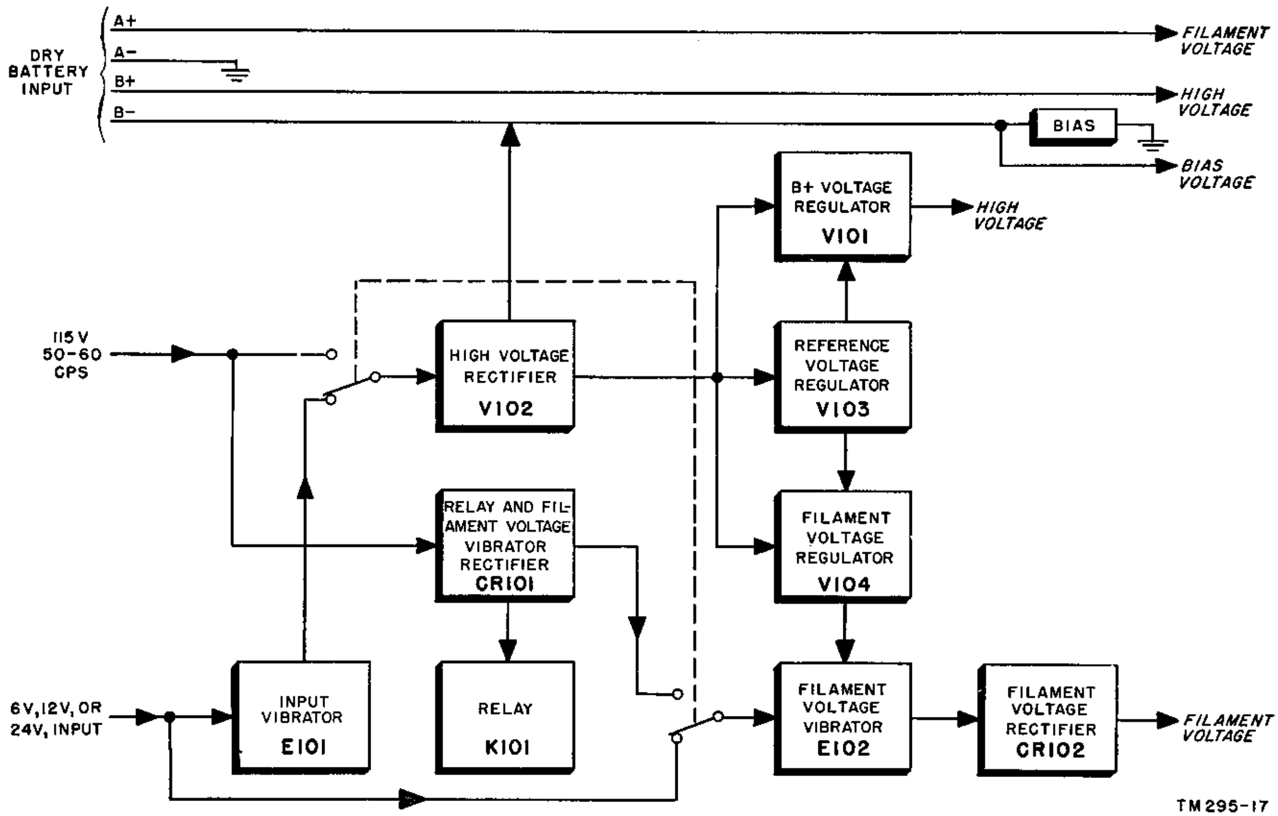


Figure 16. Power Supply PP–308/URR, block diagram.

d. For 115-volt a-c operation, the positive voltage across capacitor C114 is supplied to the receiver through series regulator V101, resistor R111, contacts 3 and 2 of relay K101, and pin 6 of J101. For d-c operation, contacts of POWER SELECTOR switch S101 and contacts 1 and 2 of K101 are used in place of relay contacts 3 and 2.

e. The positive voltage across C114 also is supplied to contacts of filament voltage vibrator E102 through a series circuit which includes regulator V104, resistors R115 and R116, the primary winding of T103, and chokes L109 and L110. Operation of the vibrator is explained in *g* below.

f. Series regulators V101 and V104 maintain the receiver B+ and filament voltages constant, despite changes in input voltage. For this purpose, the full positive output across C114 is supplied to the plates and screens of V101 and V104 and the control grids of these tubes are maintained at a constant potential by the action of reference-voltage regulator V103. The reference-voltage regulator is connected in series with current-limiting resistor R113 between the full B+ output and ground. If the B+ voltage increases or decreases, the resistance of V103 changes so as to maintain a constant voltage across the tube. It is this constant voltage which is supplied to the control grids of V101 and V104. In the case of V104, the voltage is supplied through isolation and grid-current-limiting resistor R114. Although the control grids of the regulators are held at a constant potential, variations in B+ voltage (because of the variations of input voltage) are present at the plates of these tubes. Variation in plate voltage causes a change in plate current and a corresponding change in cathode bias. Although an increased plate potential lowers the resistance of the regulators, the resultant increase in bias raises the resistance. Similarly, decreased plate voltage causes increased resistance and decreased cathode bias, but the decreased bias causes a decrease in resistance. The overall effect is a substantially constant load potential at the cathodes of V101 and V104. The cathode potential of V101 is supplied to the receiver as B+ voltage (*d* above) and the cathode potential of V104 is supplied to the filament-voltage vibrator, E102. Potentiometer R116 in the cathode circuit of V104 provides a means of adjusting the level of voltage which is supplied to the vibrator.

Note. The metal cases of the 6AG7 regulator tubes are connected to the suppressor grids which are at a high potential above ground. Do not replace the insulated clamps used on the 6AG7 tubes with the metallic clamps used on the CK1007 tube.

g. Filament voltage for the receiver is developed when the coil of vibrator E102 is energized. For 115-volt a-c operation, the coil is energized by the rectified output of T101 through normally open contacts 20 and 21 of relay K101. For 6-, 12-, or 24-volt d-c operation, a d-c voltage is supplied to the coils through normally closed contacts 21 and 22 of relay K101 (pars. 47 through 49). D-c voltage, to be interrupted by the vibrator, is supplied from the cathode circuit of V104 through the primary of transformer T103 and coils L109 and L110. Capacitors C115, C116, and C117, in conjunction with L108, L109, and L110, are hash filters. Changing the setting of R116 regulates the d-c voltage to the vibrator. C119 is the buffer capacitor. The interrupted d-c voltage is stepped down by transformer T103 and

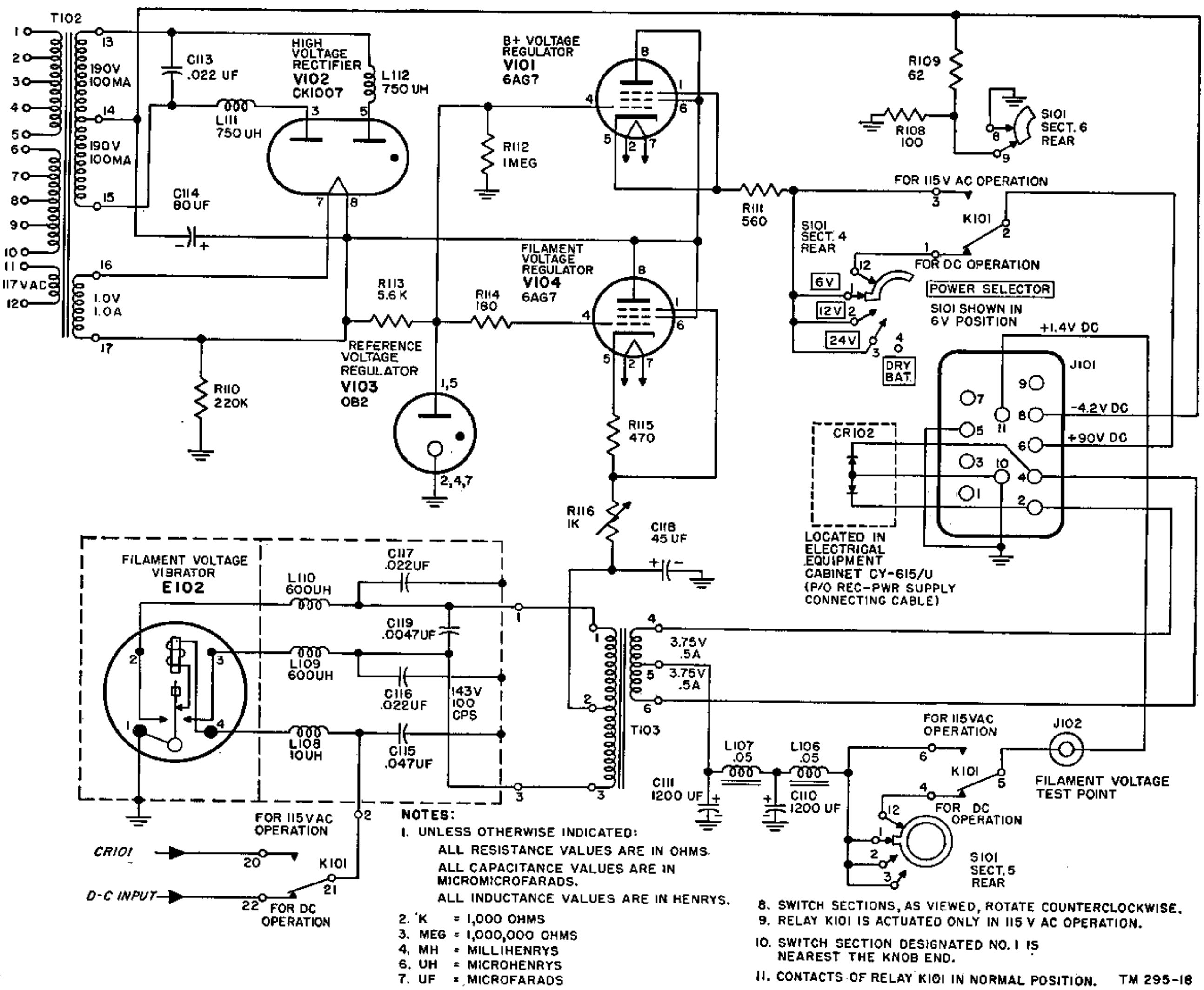


Figure 17. Power Supply PP-308/URR, h-v rectifier, voltage regulator, and filament voltage supply, functional schematic.

fed to selenium rectifier CR102, located on Electrical Equipment Cabinet CY–615/URR, through pins 2 and 4 of J101. The filter circuit, connected to the center tap of the secondary winding of T103, consists of L106, L107, C110, and C111. The filament voltage is fed to jack J102 and to pin 11 on J101 through relay K101 contacts 6 and 5, for 115-volt a-c operation, or through POWER SELECTOR switch S101 and normally closed contacts 4 and 5 of relay K101 for d-c operation.

46. Analysis of 115-volt A-c Operation
(fig. 18)

For 115-volt a-c operation, the line voltage is supplied directly to h-v transformer T102 (par. 45*b*) and a stepped-down a-c voltage is supplied to the driving coil of filament-voltage vibrator E102 (par. 45*g*). Operation of power supply on 115 volts ac is independent of the setting of POWER SELECTOR switch S101. Circuit details are as follows:

a. The 115-volt line at contacts A and D of POWER INPUT receptacle J103 is connected to the primary of T101 through fuse F101 (110V. 1A), and section 1 of POWER ON-OFF switch S103. Capacitors C102A and C102B are line filters. The secondary voltage of T101 is rectified by CR101, filtered by C101, and fed to the operating coil of relay K101. When K101 is energized, the 115-volt a-c line is completed to the primary of T102 through relay contacts 14 and 13, and the 6-volt d-c output of the rectifier is supplied to filament-voltage vibrator E102 through relay contacts 20 and 21.

b. In this mode of operation, winding 1–4 of

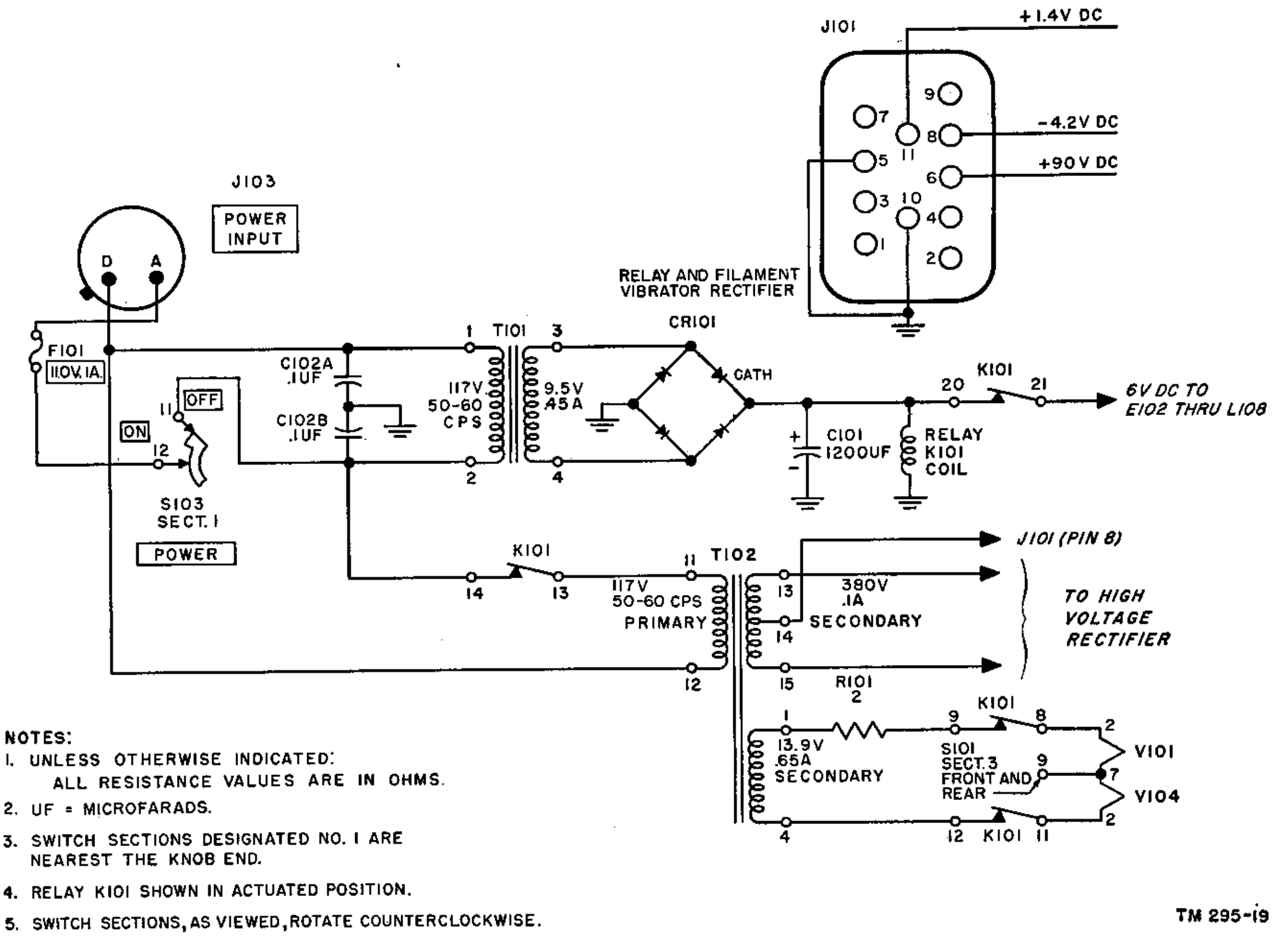


Figure 18. Power Supply PP–308/URR, 115-volt a-c operation, functional schematic.

T102 is connected as a secondary winding, and the voltage developed is used for the filaments of V101 and V104. The filaments are series connected across the winding in series with resistor R101, contacts 9 and 8 of relay K101, and contacts 11 and 12 of relay K101.

c. The voltage across secondary winding 13–14–15 of T102 is supplied to the h-v rectifier where it is utilized as explained in paragraph 45.

47. Analysis of 6-volt D-c Operation
(fig. 19)

For 6-volt d-c operation, the input voltage is supplied directly to the driving coil of filament-voltage vibrator E102 (par. 45*g*) and to the coil and contacts of input vibrator E101. Vibrator E101 develops an a-c voltage which is supplied to the primary of T102.

a. The 6-volt d-c potential required to energize the vibrator is supplied from contact B of J103 to contact 3 of E101 through section 1 of S101, fuse F104 (6V. 8A.), paralleled contacts 7 and 8 of sections 1 and 2 of S103, normally closed contacts 23 and 24 of relay K101, section 2 of S101, and L101. The combination of capacitor C104 and coil L101 make up a hash filter. Sections 1 and 2 of S103 are connected in parallel to prevent burning of the contacts.

b. The 6-volt d-c potential to be interrupted at contacts 2 and 5 of E101 is fed from contact B of POWER INPUT receptacle J103 to contact 2 of input vibrator E101 through section 1 of POWER SELECTOR switch S101, fuse F104, section 2 of POWER ON-OFF switch S103, contacts 26 and 25 paralleled by contacts 27 and 28 of relay K101, section 3 of S101, winding 7–6 of T102, section 4, front, of S101 and L102. The 6-volt d-c potential at terminal 7 of T102 also is fed to contact 5 of E101 through the primary winding 7–8 of T102, section 1 of S101, and L104. The voltage to be interrupted at contacts 1 and 4 of E101 is taken from the junction of contacts 25 and 28 of K101 and is fed to terminal 4 of T102 through section 3 of S101. From terminal 4 of T102, the voltage is fed to contact 1 of E101 through winding 4–3 of T102, section 2 of S101, and L105. The voltage at terminal 4 of T102 also is fed to contact 4 of E101 through winding 4–5 of T102, section 6, front, of S101, and L103. L101 through L105 and C104 through C108 are hash filters. Capacitor C109 is a line filter. Capacitor C112 is a buffer capacitor. When the vibrator is energized, pulsating d-c voltage is developed across windings 3–4–5 and 6–7–8 of T102. The secondary circuits of T102 are the same as described in paragraph 45.

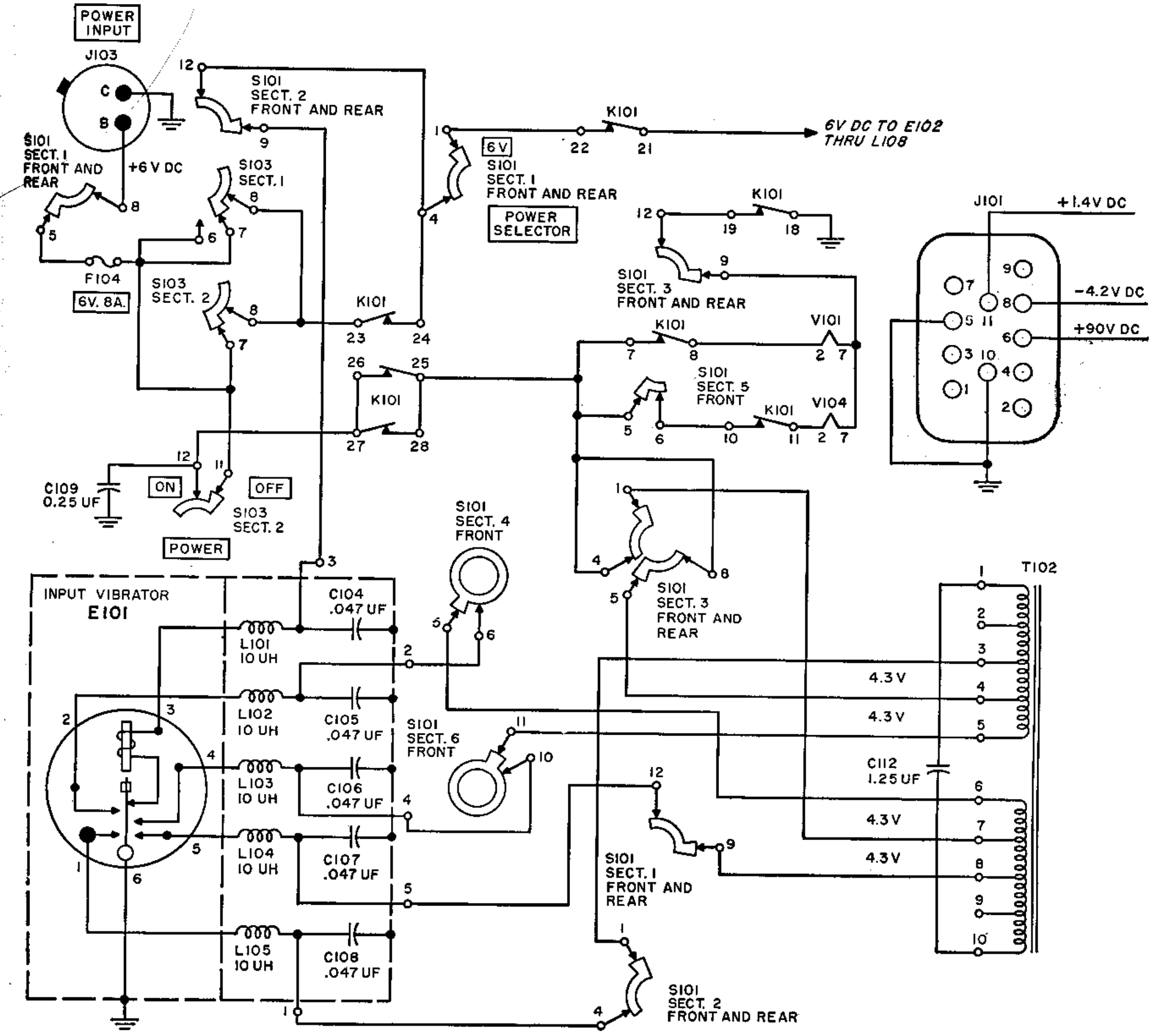
c. The 6-volt potential at contact B of POWER INPUT receptacle J103 also is supplied to the operating coil of filament-voltage vibrator E102 through section 1 of S101, fuse F104, paralleled contacts 7 and 8 of sections 1 and 2 on S103, normally closed contacts 23 and 24 of relay K101, section 1 of S101, and contacts 22 and 21 of relay K101. (Refer to paragraph 45*g* for circuit details of vibrator E102.)

d. For 6-volt operation, the heaters of V101 and V104 are connected in parallel. The 6-volt d-c potential required for the heaters is taken from the junction of contacts 25 and 28 of K101 and is supplied through contacts 7 and 8 of K101 to pin 2 of V101, and through section 5 of S101 and contacts 10 and 11 of K101 to pin 2 of V104. Pins 7 of V101 and V104 are connected together and completed to ground through section 3 of S101 and contacts 18 and 19 of K101.

48. 12-volt D-c Operation
(fig. 20)

The circuit of the power supply for 12-volt operation is similar to that for 6-volt operation, except for the addition of series resistance to limit the current to the vibrator coils, the use of different taps on transformer T102, the series connections of the heaters of V101 and V104, and the fuse used.

a. Voltage for the driving coil of vibrator E101 is supplied from J103, contact B, through section 1 of POWER SELECTOR switch S101, fuse F103 (12V.4A.), parallel contacts 7 and 8 on sections 1 and 2 of POWER ON-OFF



NOTES:

1. UNLESS OTHERWISE INDICATED:
   ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
   ALL INDUCTANCE VALUES ARE IN HENRYS.
2. UH = MICROHENRYS.
3. UF = MICROFARADS.
4. SWITCH SECTIONS DESIGNATED NO. 1 ARE NEAREST THE KNOB END.
5. CONTACTS OF K101 NORMALLY CLOSED.
6. SWITCH SECTIONS, AS VIEWED, ROTATE COUNTERCLOCKWISE.

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Figure 19. Power Supply PP–308/URR, 6-volt d-c operation, functional schematic.

switch S103, contacts 23 and 24 of relay K101, section 2 of S101, resistor R104, and L101. R104 drops the 12-volt input voltage to the 6 volts required to energize E101. The combination of L101 and C104 makes up a hash filter.

b. The 12-volt d-c potential to be interrupted by the vibrator is fed from POWER INPUT receptacle J103, contact B, to pins 1 and 5 of vibrator E101. The voltage is fed through section 1 of POWER SELECTOR switch S101, fuse F103, section 2 of POWER ON-OFF switch S103, contacts 26 and 25 paralleled by 27 and 28 of relay K101, to section 3 of POWER SELECTOR switch S101. From this point, the voltage is supplied to contact 5 of E101 through winding 6–9 of T102, section 1 of S101, and L104, and to contact 1 of E101 through winding 5–2 of T102, section 2 of S101, and L105. C112 is a buffer capacitor; capacitors C107 and C108, in conjunction with L104 and L105, are hash filters. The interrupted voltage is used as the primary voltage for T102. High voltage is developed in the secondary of T102 in the same manner as described in paragraph 45.

c. Voltage for the driving coil of vibrator E102 is taken from the junction of contact 24 of K101 and contact 12 on section 2 of S101, and supplied through section 1 of S101, resistor R102, contacts 22 and 21 of K101, and L108. Resistor R102 drops the input voltage to 6 volts. Operation of E102 is described in paragraph 45*g*.

d. In the 12-volt operation, the heaters of V101 and V104 are connected in series. The required 12-volt potential is taken from the junction of paralleled contacts 27–28 and 26–25 on K101 (*a* above) and is connected across the heater through contacts 7 and 8 of K101, contacts 11 and 10 of relay K101, section 3 of S101, and contacts 19 and 18 of relay K101.

e. The 12-volt d-c potential available at contact 24 of K101 also is connected through section 4, rear, of S101 to pin 7 of J101. This potential is used for receiver disabling.

49. 24-volt D-c Operation
(fig. 21)

In 24-volt operation, the circuit of the power supply is the same as for 12-volt operation, except for the addition of voltage-dropping resistors, a change in the winding used as primary of T102, and the use of fuse F102 (24V. 3A.).

a. In this mode of operation, resistors R102 and R103 are in series, and R104 and R105 are in series, to limit the current to the driving coils of the vibrators. Operation of the vibrators is the same as for 12-volt operation. Windings 1–5 and 6–10 are used as the primary of transformer T102. Resistor R107 is used to limit the current through the primary windings, thus reducing the primary interrupted voltage to give a secondary voltage of the same magnitude as the other modes of operation.

b. The filaments of V101 and V104 are connected in series, with resistor R106 to limit the current and to reduce the 24 volts input to 12 volts across the heaters.

c. The 24-volt d-c potential is taken from contact 24 of K101 and connected through section 4, rear, of S101 to pin 1 of J101 as a receiver disabling voltage source.

50. Dry-battery Operation
(fig. 22)

In dry-battery operation, the power supply is used merely as a connecting device.

a. B+ voltage (90 volts dc) is fed from DRY BATTERY receptacle J104, contact A, to pin 6 of J101 through section 1 of POWER ON-OFF switch S103, section 4 of POWER SELECTOR switch S101, and contacts 1 and 2 of relay K101.

b. Filament voltage (1.4 volts dc) is fed from J104, contact B, to J102 and pin 11 of J101, through section 2 of S103, section 5 of S101, and contacts 4 and 5 of relay K101.

c. Bias for tubes V7 and V8 in the receiver is supplied from J104, contact D, to pin 8 of J101. Pin 8 of J101 is —4.2 volts dc from ground because of the ground return through resistors R109 and R108.

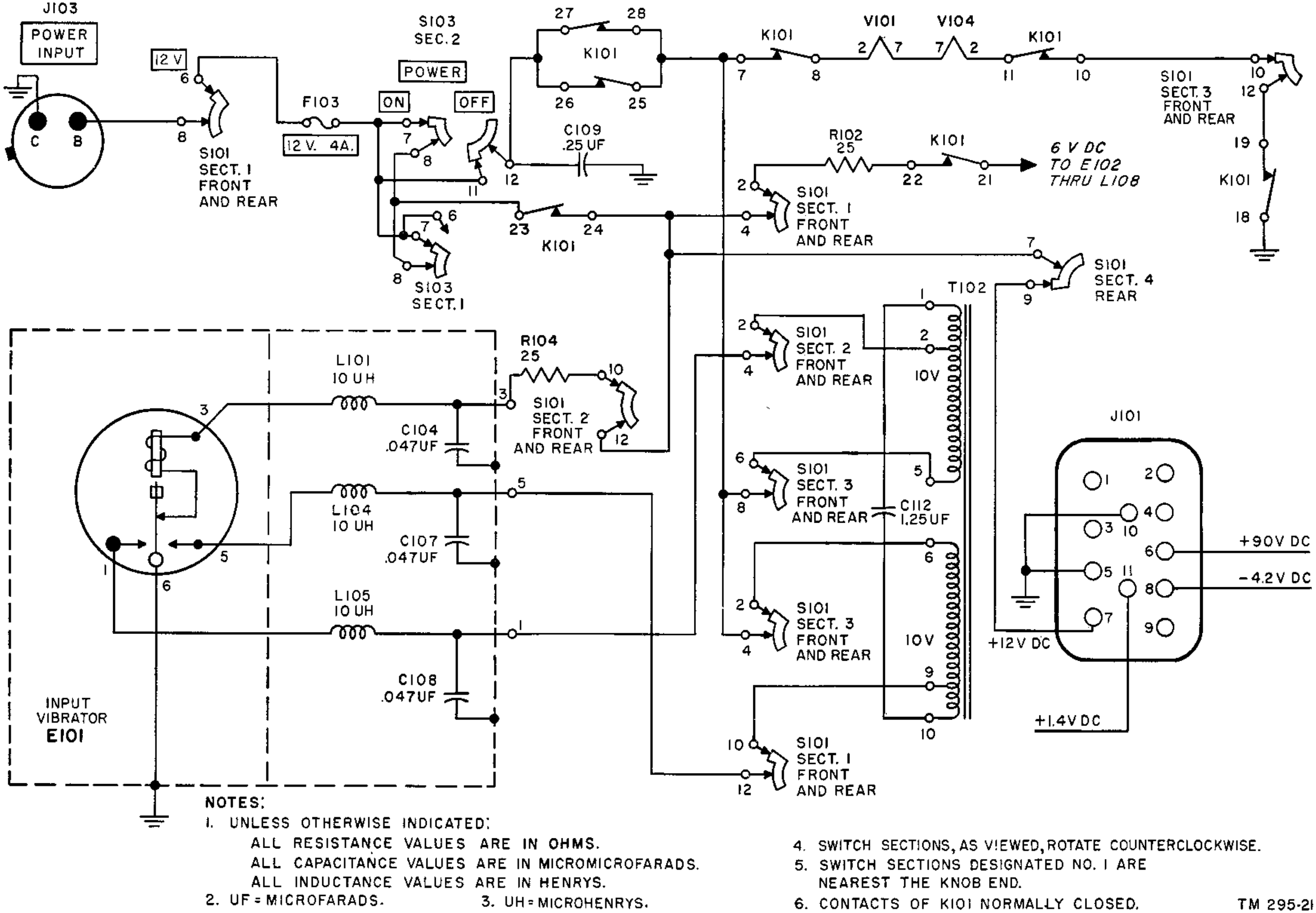
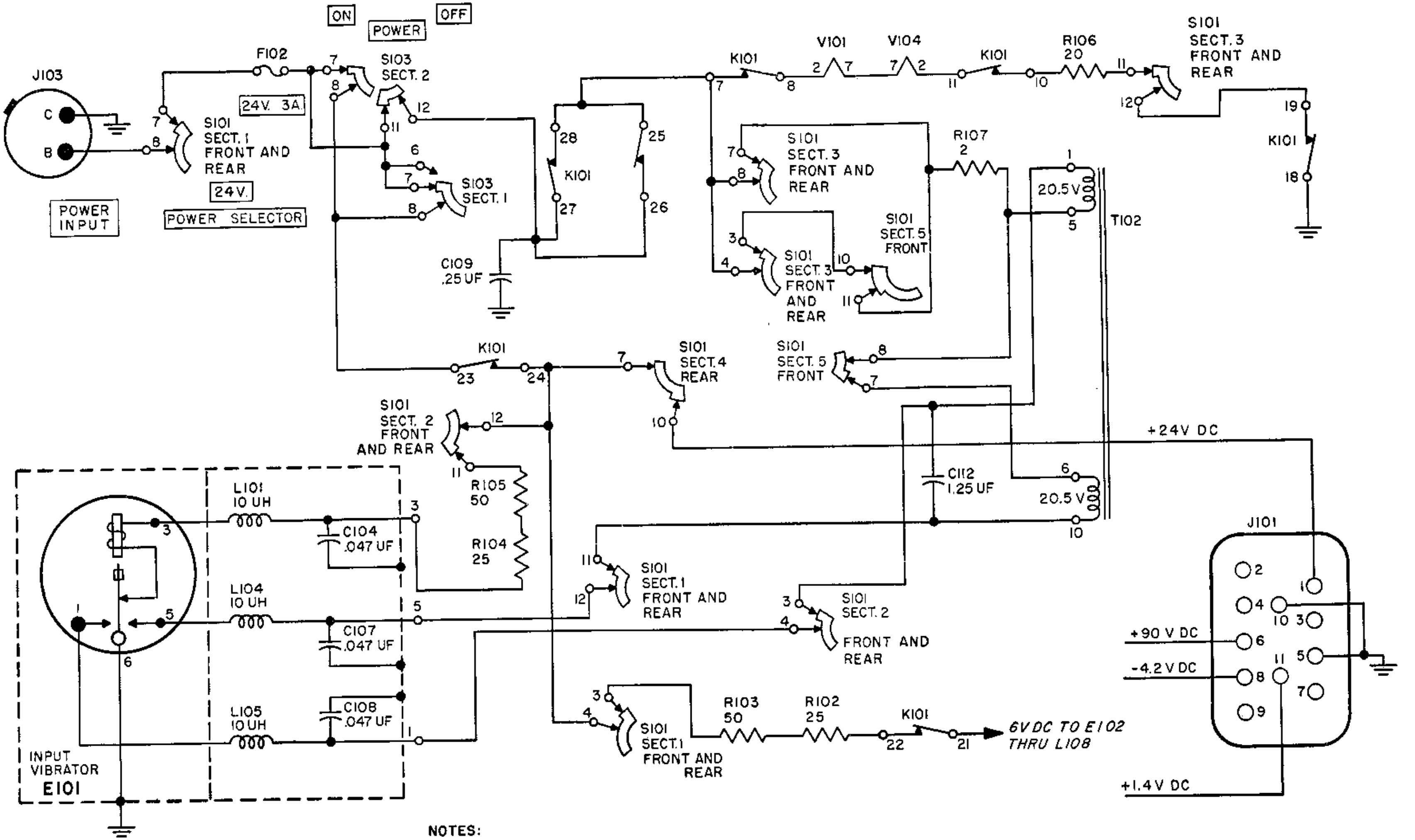


Figure 20. Power Supply PP-308/URR, 12-volt d-c operation, functional schematic.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS
2. UH = MICROHENRYS
3. UF = MICROFARADS
4. CONTACTS OF K101 NORMALLY CLOSED
5. SWITCH SECTIONS DESIGNATED NO. 1 ARE NEAREST THE KNOB END.
6. SWITCH SECTIONS, AS VIEWED, ROTATE COUNTERCLOCKWISE.

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Figure 21. Power Supply PP-308/URR, 24-volt d-c operation, functional schematic.

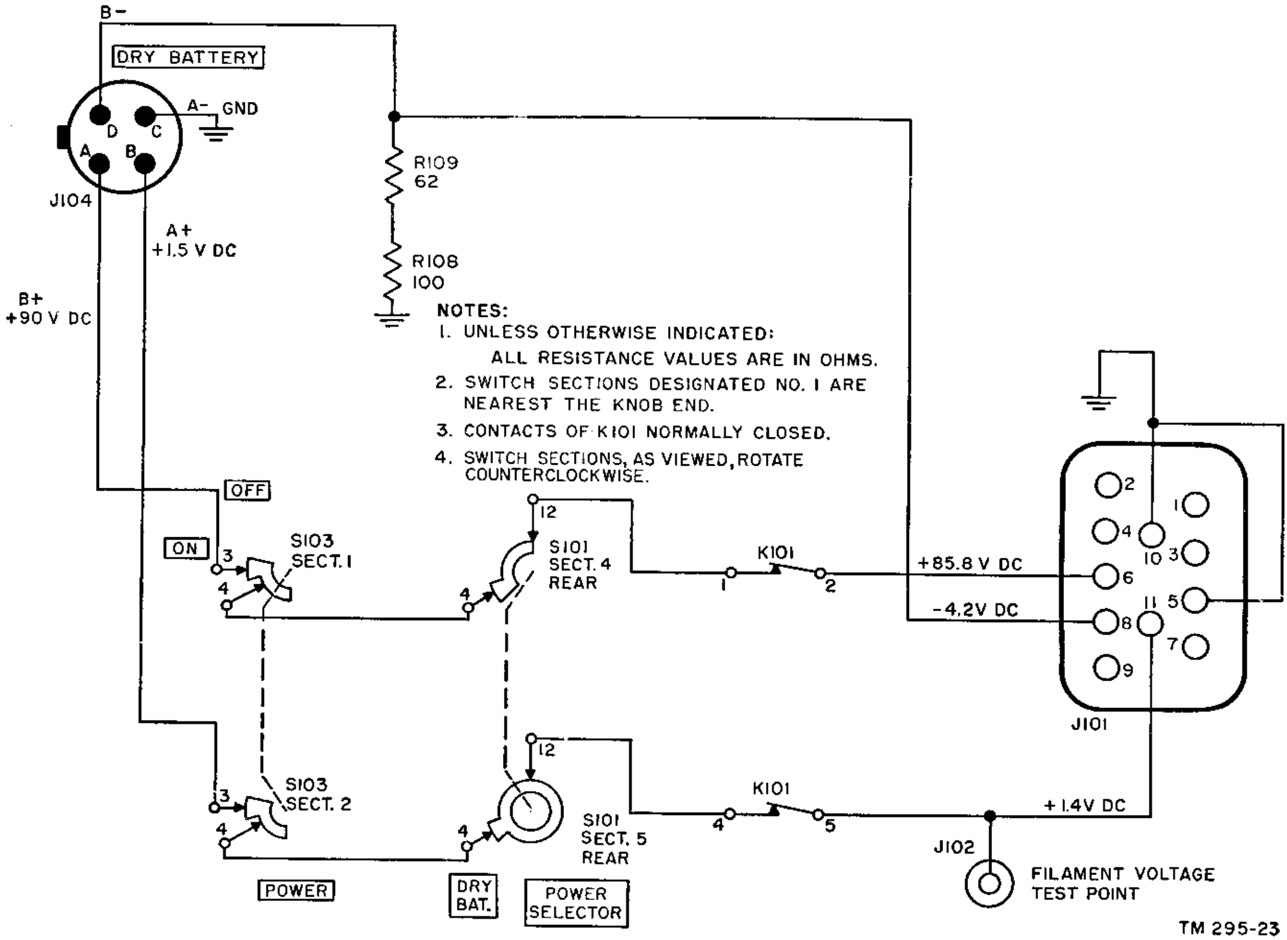


Figure 22. Power Supply PP–308/URR, dry-battery operation, functional schematic.

Section II. RADIO RECEIVER R–174/URR

51. Block Diagram
(fig. 23)

a. Radio Receiver R–174/URR is a portable receiver operating over a frequency range of 1.5 mc to 18 mc. Either a-m or c-w signals may be received. The signal path is shown in figure 23.

b. The signal voltage induced in the antenna is amplified by r-f amplifier stages V1 and V2 connected in cascade, and the amplified signal is coupled into converter tube V3. The antenna, r-f amplifier, and converter input circuits are tuned manually to the radio-frequency signal. A locally generated signal, which tracks 455 kc above the received signal, is mixed electronically with the incoming signal in the converter stage. The output of converter tube V3 is tuned to the difference frequency (455 kc), and this signal is supplied to the first i-f amplifier tube, V4.

c. The 455-kc i-f signal is amplified successively in the first and second i-f stages, V4 and V5 respectively. The i-f output of V5 is fed to the diode section of tube V6.

d. The diode section of V6 rectifies the i-f signal, and a detected audio signal is coupled to the pentode section of V6. Audio amplification is provided by the pentode section of V6 and by either V7 or V8. The output of either V7 or V8 is supplied through OUTPUT HIGH-LOW switch S4 to the PHONES connectors and the loudspeaker in Power Supply PP–308/URR.

SPEAKER ON-OFF switch S102 can be used to open the speaker circuit and permit operation of the receiver with headsets only.

e. Voltage for avc is developed across a portion of the diode load in the circuit of V6. This voltage is fed to i-f amplifier tube V4 and r-f amplifier tubes V1 and V2, when PHN.-C.W.-NET-CAL. switch S2 is in the PHN. position. For all other positions of S2, the avc voltage is grounded.

f. For reception of continuous waves (switch S2 in C.W. position), the triode section of tube V7 functions as a bfo at a frequency of 151.66 kc, ±1 to 1.167 kc. The third harmonic of the oscillator output (455 kc ±3.5 kc) is coupled to second i-f amplifier tube V5, where it mixes with the i-f signal to produce an audio tone in the detector portion of V6. The bfo tube is operative also when switch S2 is set at NET or CAL.; it is inoperative only for the PHN. setting of S2.

g. For checking the calibration of the receiver dial, the triode section of V5 functions as a crystal-controlled oscillator at a fundamental frequency of 200 kc. The output of the oscillator (200 kc and the harmonics) is radiated within the receiver. The signals are picked up by the r-f section of the receiver, amplified, detected, and beat with the bfo to develop a beat note every 200 kc on the dial. The crystal calibration oscillator is disabled when PHN.-C.W.-NET-CAL. switch S2 is in any position other than CAL.

h. For monitoring purposes, a-f amplifier V6 is disabled, the sidetone signal of a transmitter may be connected to the receiver audio section, and the audio output of the receiver may be coupled to the remote location.

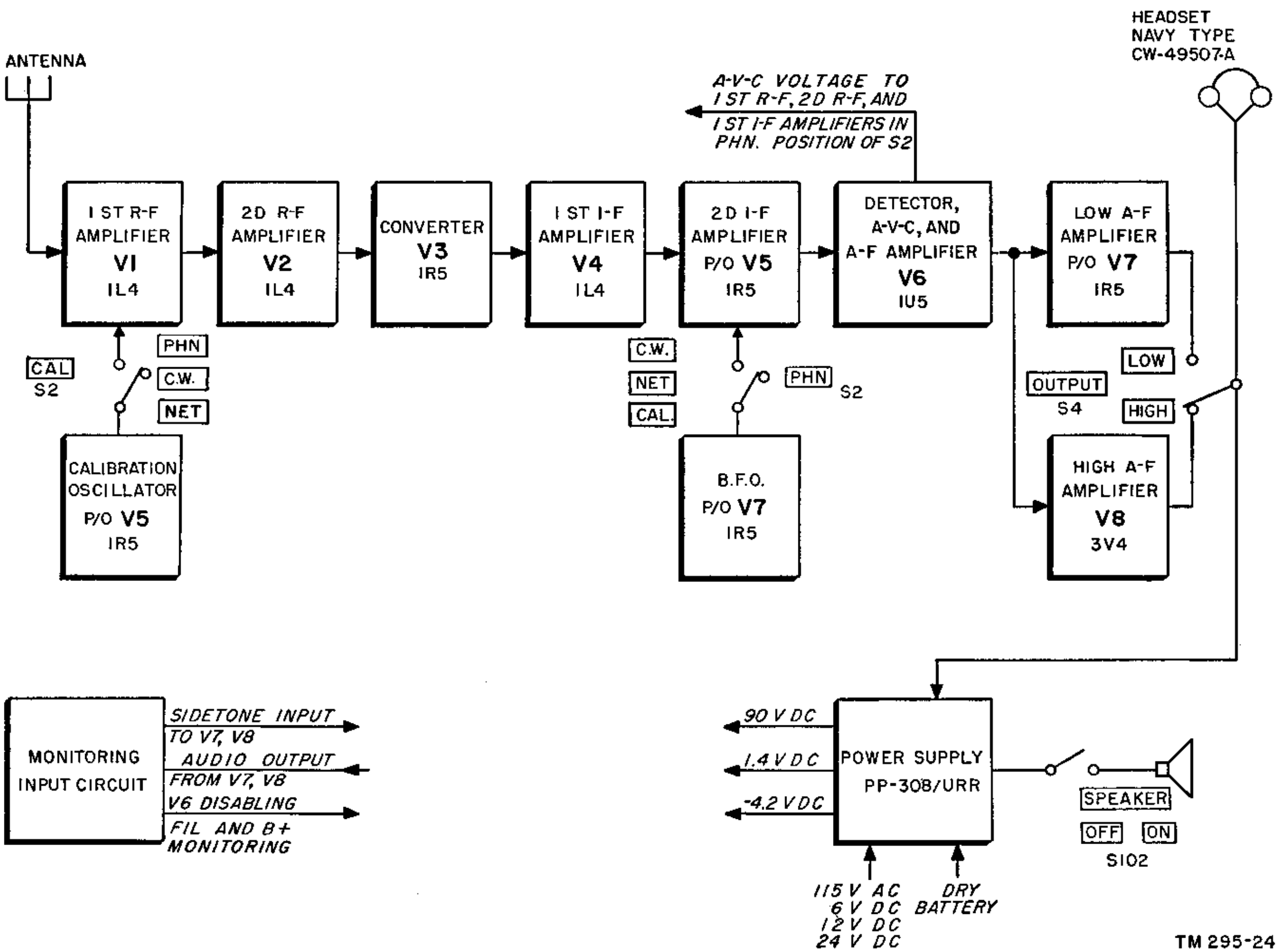


Figure 23. Radio Receiver R–174/URR, block diagram.

52. First R-f Amplifier V1
(figs. 24 and 43)

The first r-f amplifier covers the tuning range of the receiver in four bands. In the following analysis, the band 1 circuits (1.5 to 2.7 mc) are discussed in complete detail. The analyses of bands 2, 3, and 4 are concerned only with the circuit variations that are accomplished by band switching.

a. The signals picked up by the antenna are developed across the primary winding of transformer T1 (fig. 43). Contacts on PHN.-C.W.-NET-CAL. switch S2 (section 2, rear) and BAND SW. switch S1 (section 2, rear) couple the antenna to the transformer winding. Neon tube E2 protects the transformer primary winding from overload. The primary of T1 is shunted by a 75-$\mu\mu$f (micromicrofarad) capacitor connected internally within the transformer assembly.

b. The secondary winding of transformer T1 is tuned by one section of the MANUAL-PRESET TUNING capacitor, C1A, and ANT. TRIMMER C2 (fig. 43). Section 3, rear, of the BAND SW. switch connects the capacitors across the winding. The tuned circuit is coupled to the grid (pin 6) of V1 through capacitor C3. Resistor R1 and avc circuit provide a d-c return for the grid circuit. Capacitor C11 is a part of the avc filter circuit. While band 1 is in use, another section of the BAND SW. switch (section 3, front) grounds the secondaries of all antenna coils not in use—in this case, winding C of T1 and B and D windings of T5 (fig. 24).

c. The first r-f amplifier utilizes a 1L4 pentode tube (fig. 43). Filament voltage for the tube is obtained from the 1.4-volt d-c potential at pin 11 of J4. Screen voltage is supplied from the arm of R.F. GAIN control R32 through voltage-dropping resistor R2 and section 3, rear, of function switch S2. The gain control is connected across the 90-volt potential present between pin 6 of J4 and ground. Capacitor C49 provides noise filtering, and capacitor C4 places the screen at r-f ground potential. Plate voltage is obtained from the 90-volt supply through resistor R3, the primary of T2 (winding C) and section 4, front, of BAND SW. switch S1. Resistor R3 and capacitor C5 form a plate-circuit decoupling network.

d. Tube V1 amplifies the antenna signals and develops the amplified signal across the untuned primary of T2 (winding C). The signal is coupled inductively to the tuned secondary winding in the grid circuit of second r-f amplifier V2. C10 couples the signal from the secondary winding of T2 to the control grid of V2.

e. When BAND SW. switch S1 is placed in the band 2 position, the following circuit changes are effected to allow coverage of the 2.7- to 5-mc band (fig. 24).

(1) Section 2, rear, and section 3, rear, select the C windings of T1 in place of the B windings as the antenna coil.

(2) Section 3, front, removes the ground from the C winding of T1, and places a ground on the B winding.

(3) Section 4 selects the D section of T2, in place of the C section, as the plate load for V1.

f. When BAND SW. switch is placed in band 3 position (fig. 24), coverage of the 5- to 9.5-mc band is provided through circuit changes simiIiar to those detailed for band 2. When switch S1 is set to band 3, sections 2, rear, and 4, front, select the B windings of T5 and the D windings of T6 as antenna coil and V1 plate load, respectively. Section 3, front, of the switch grounds the unused secondaries of the antenna transformers. A 25-$\mu\mu$f capacitor is in shunt with the primary of the antenna coil.

g. When BAND SW. switch is in band 4 position (fig. 24), windings D of T5 and winding E of T6 are selected to provide coverage of the 9.5- to 18-mc band. A 2,400-$\mu\mu$f capacitor (in series with the secondary of T5) is used as a padder to provide proper tracking.

h. Function switch S2, section 2, rear (fig. 43), connects the antenna to transformer T1 or T5 in the PHN. C.W., and NET positions. When the switch is turned to CAL., section 2, rear, grounds the antenna coil and opens the antenna circuit. The calibration signal may be supplied to the r-f amplifier in place of the antenna signal (par. 67).

53. Second R-f Amplifier V2
(figs. 24 and 43)

The second r-f amplifier covers the tuning range of the receiver in the same manner as the first r-f amplifier.

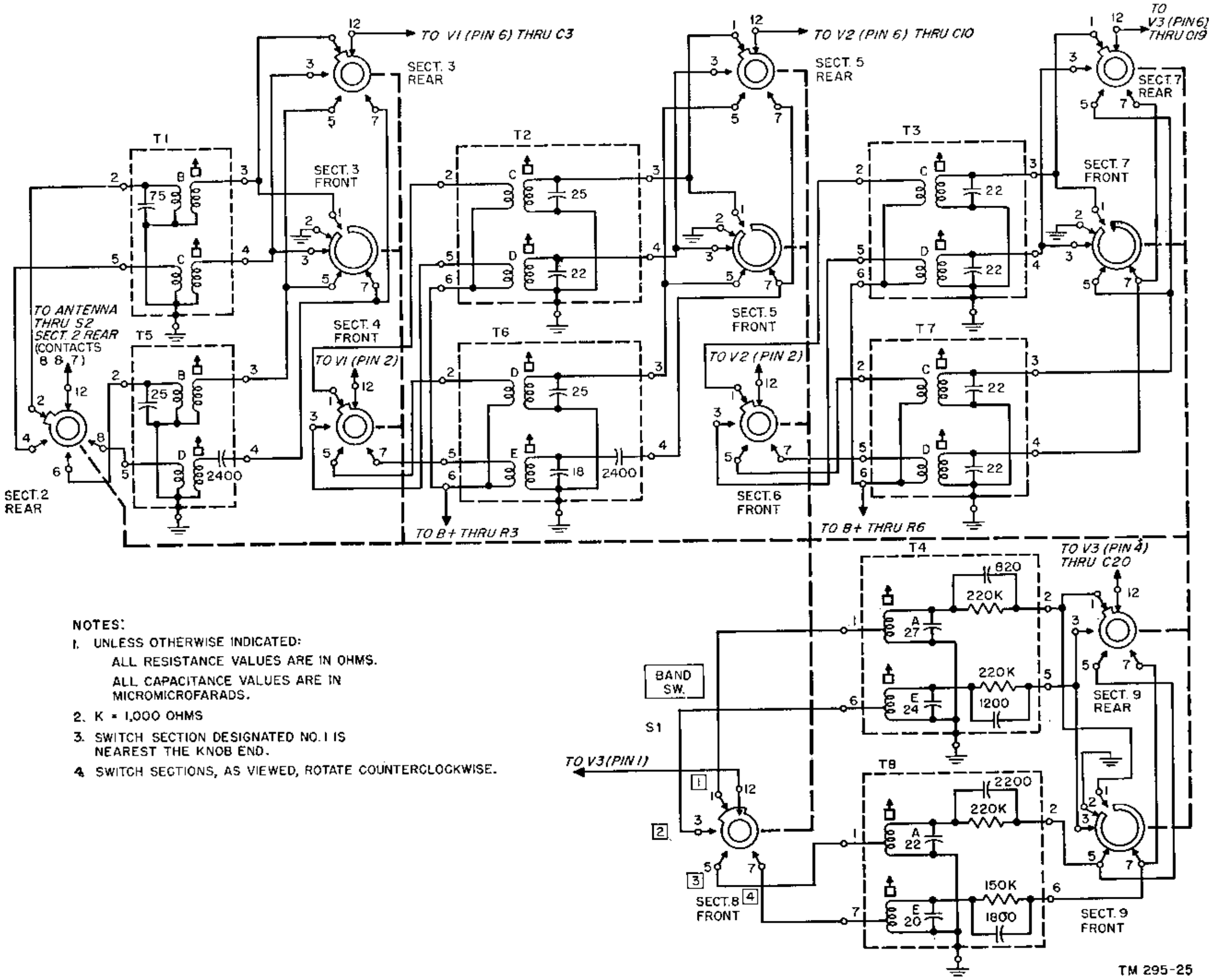


Figure 24. Radio Receiver R-174/URR, simplified control circuit of BAND SW. switch.

a. The signals amplified by V1 are coupled inductively to the second r-f amplifier (fig. 43, par. 52*d*). On band 1, the signals developed across the secondary of winding C of T2 are supplied to the grid (pin 6) of tube V2 through section 5, rear, of S1 and capacitor C10. The switch also shunts tuning capacitor C1B across the transformer. The tuning circuit of this band consists of a 25-$\mu\mu$f fixed capacitor, connected internally in the transformer assembly, MANUAL-PRESET TUNING capacitor C1B, and trimmer C9. Resistor R4 and the avc circuit provide a d-c return for the grid circuit. While band 1 is in use, section 5, front, of the BAND SW. switch (fig. 24) grounds the secondaries of the first r-f plate coils not in use—in this case, winding D of T2 and windings D and E of T6.

b. The second r-f amplifier utilizes a 1L4 pentode tube (fig. 43). Filament voltage for the tube is obtained from the 1.4-volt d-c potential at pin 11 of J4. Capacitor C12 bypasses the filament for rf to ground. Screen voltage is supplied through voltage-dropping resistor R5 from the 90-volt potential present between pin 6 of J4 and ground. Capacitor C13 places the screen at r-f ground potential. Plate voltage is obtained from pin 6 of J4, through voltage-dropping resistor R6, the C winding of T3, and section 6 of BAND SW. switch S1. Resistor R6 and capacitor C14 form a plate-circuit decoupling network.

c. Tube V2 amplifies the r-f signals and develops these signals across the untuned primary of T3 (winding C). The signal is coupled inductively to the tuned secondary winding in the grid circuit of converter tube V3.

d. When BAND SW. switch S1 is placed in the band 2 position (fig. 24), the following circuit changes are effected to allow coverage of the 2.7- to 5-mc band.

(1) Section 5, rear, selects the D winding of T2 in place of the C winding as the grid r-f coil. In parallel with the D winding is a 22-μμf fixed tuning capacitor.

(2) Section 5, front, removes the ground from the D winding and trimmer capacitor C8 (fig. 48), and places a ground on the C winding and capacitor C9

(3) Section 6, front, selects the D winding of T3 in place of the C winding as the plate load for V2.

e. When BAND SW. switch is placed in band 3 position (fig. 24), coverage of the 5- to 9.5-mc band is provided through circuit changes similar to those detailed for band 2. Sections 5, rear, and 6, front, select the D winding of T6 and the C winding of T7 as the V2 grid coil and plate coil, respectively. A 25-μμf capacitor acts as the fixed tuned capacitor in parallel with the D winding of T6. Section 5, front, grounds the unused r-f coils.

f. When BAND SW. switch is set to band 4 position (fig. 24) windings E of T6 (paralleled by an 18-μμf fixed tuned capacitor) and D of T7 are selected to provide coverage of the 9.5- to 18-mc band. Section 5, front, grounds the unused coils. A 2,400-μμf capacitor (connected in series with secondary winding E of T6) is the padder to provide proper tracking.

54. Local Oscillator of V3

(figs. 24 and 25)

The local oscillator covers the range of the receiver tuning at a frequency 455 kc above the incoming signals on all four bands. In the following analysis, the circuit for band 1 is discussed in detail, and the analyses of bands 2, 3, and 4 discuss only the variations which are accomplished by band switching.

a. The local oscillator uses a tapped Hartley circuit with the plate circuit (second grid of V3) at r-f ground (fig. 25). The grid circuit is tuned by the A winding of T4, a 27-μμf fixed tuning capacitor, trimmer capacitor C50, and MANUAL-PRESET TUNING capacitor C1D.

b. Section 8, front, of BAND SW. switch S1 connects the tap of the A winding to the filament cathode, and section 9, rear, connects the tuned output of the tank across C1D and thence to the grid circuit. The 220K-ohm grid d-c return resistor and the 820-μμf fixed padder capacitor are connected internally in the coil assembly. Resistor R8 and capacitor C20 form the grid-leak bias network for the oscillator. Section 9, front, of BAND SW. switch S1 grounds the unused winding E of T4 and windings A and E of T8 (fig. 24).

c. The local oscillator uses the filament and first two grids of a 1R5 pentagrid converter tube (fig. 25). Filament voltage for the tube is obtained from the 1.4-volt d-c potential at pin 11 of J4, through r-f choke L1. L1 maintains the filament above r-f ground potential. Oscillator plate (pin 3) voltage is supplied through voltage-dropping resistor R9 from the 90-volt d-c potential appearing between pin 6 of J4 and ground. Capacitor C21 places the oscillator plate at r-f ground potential.

d. When BAND SW. switch is placed in band 2, the following circuit changes are effected (fig. 24):

(1) Section 8, front, removes winding A of T4 from the cathode circuit and connects in winding E of T4.

(2) Section 9, rear, removes winding A of T4 from the grid circuit and connects in winding E of T4.

(3) Section 9, front, grounds winding A of T4, and removes the ground from winding E.

(4) A 1,200-μμf capacitor is the padder, and the 220K-ohm resistor provides the oscillator grid d-c return. This parallel network is connected to the grid-leak bias network, and trimmer capacitor C51 is substituted in the tuning circuit (fig. 48).

e. When BAND SW. switch S1 is placed in band 3 position (fig. 24), circuit changes are provided similar to those detailed for band 2.

Sections 8 and 9, rear, select winding A of T8. Section 9, front, grounds the unused windings. The padder network changes.

f. When BAND SW. switch S1 is placed in band 4 position (fig. 24), winding E of T8 is used, and all other windings are grounded.

g. The capacitors connected across the windings of all the r-f transformers except T1 and T5, and contained within the coil assemblies, are negative-temperature compensating capacitors. These capacitors are used to prevent drift of the oscillator. Thus, on all bands, the oscillator is temperature-stabilized to compensate for the normally expected expansion of other components and thus minimize oscillator frequency drift.

55. Converter V3
(figs. 24 and 25)

The analysis of the converter stage will be discussed in complete detail for band 1. The analyses of bands 2, 3, and 4 will discuss the circuit variations that are accomplished by band switching.

a. The incoming signals are coupled inductively to the secondary of winding C of T3 (fig. 25). This winding is tuned by section C1C of the MANUAL-PRESET TUNING capacitor. Section 7, rear, of BAND SW. switch S1 connects the capacitor across the winding. The tuned circuit is coupled to the grid (pin 6) of V3 through capacitor C19. Resistor R7 provides bias voltage and a d-c return for the grid circuit. When BAND SW. switch S1 is in band 1 position, section 7, front (fig. 24), grounds the secondaries of the r-f transformers not in use—in this case, D winding of T3, C and D windings of T7.

b. The converter utilizes a 1R5 pentagrid converter tube. Filament voltage for the tube is obtained from pin 11 of J4 through r-f choke L1. Screen voltage is supplied through voltage-dropping resistor R9 from the 90-volt d-c potential present between pin 6 of J4 and ground. Capacitor C21 provides an r-f ground for the screen. Plate voltage is obtained from the 90-volt d-c potential through the primary of T9 which is fixed tuned by a 270-$\mu\mu$f capacitor.

c. Tube V3 mixes the r-f signal input and the signal of the local oscillator (par. 54), and develops a signal at the difference frequency of 455 kc. The signal is developed in the primary of T9 and coupled inductively to the secondary of T9.

d. When BAND SW. switch S1 is in band 2 position, the following circuit changes are effected (fig. 24):

(1) Section 7, rear, selects the D winding of T3 in place of the C winding.

(2) Section 7, front, grounds the C winding of T3 and removes the ground from the D winding.

e. In band 3 position of BAND SW. switch S1 (fig. 24), section 7, rear, selects the C winding of T7, and section 7, front, grounds the D winding of T3.

f. In band 4 position of BAND SW. switch S1 (fig. 24), section 7, rear, selects C winding of T7, and section 7, front, grounds D winding of T7.

56. First I-f Amplifier V4
(fig. 26)

The i-f amplifier stage is tuned to 455 kc and operates at this frequency for all bands of operation of the receiver.

a. The signal developed in the converter stage is coupled inductively to the grid (pin 6) of V4, through the windings of transformer T9. The avc circuit (through R15 and R18) provides a d-c return for the grid, when PHN.-C.W.-NET-CAL. switch S2 is in PHN. position. Capacitor C22 is the avc filter capacitor. When function switch S2 is in any position other than PHN., the grid is returned to ground through section 1, rear, of S2.

b. The first i-f amplifier uses a 1L4 pentode tube. Filament voltage for the tube is obtained from the 1.4-volt d-c potential at pin 11 of J4. Screen voltage is supplied through voltage-dropping resistor R10 and section 3, rear, of function switch S2 from the arm of R.F. GAIN control R32. The gain control is connected across the 90-volt potential present between pin 6 of J4 and ground. Capacitor C49 is a noise filter, and capacitor C23 places the screen at r-f ground potential. Plate voltage is supplied from the 90-volt potential through the primary of T10.

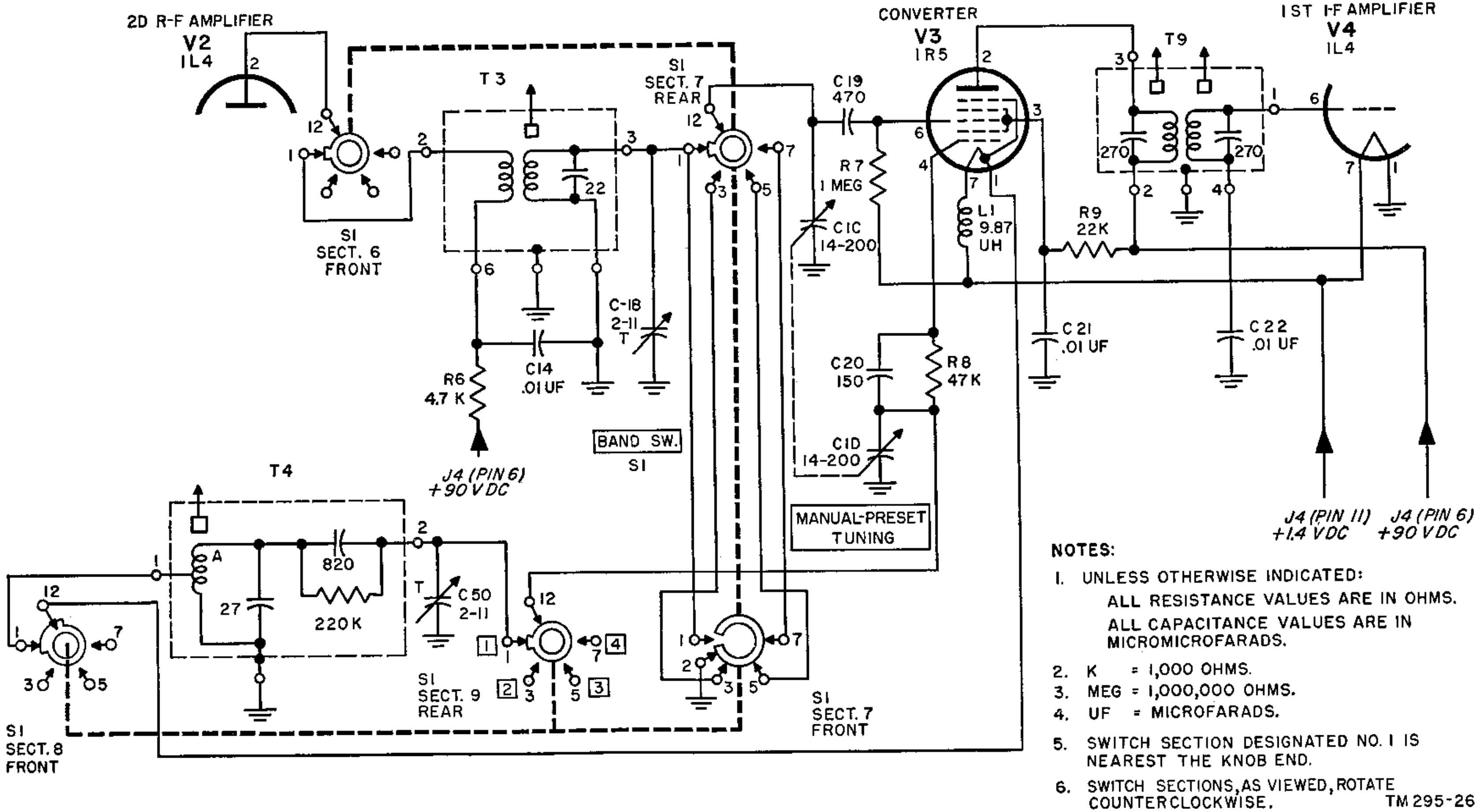


Figure 25. Radio Receiver R-174/URR, local oscillator and converter for band 1, functional schematic.

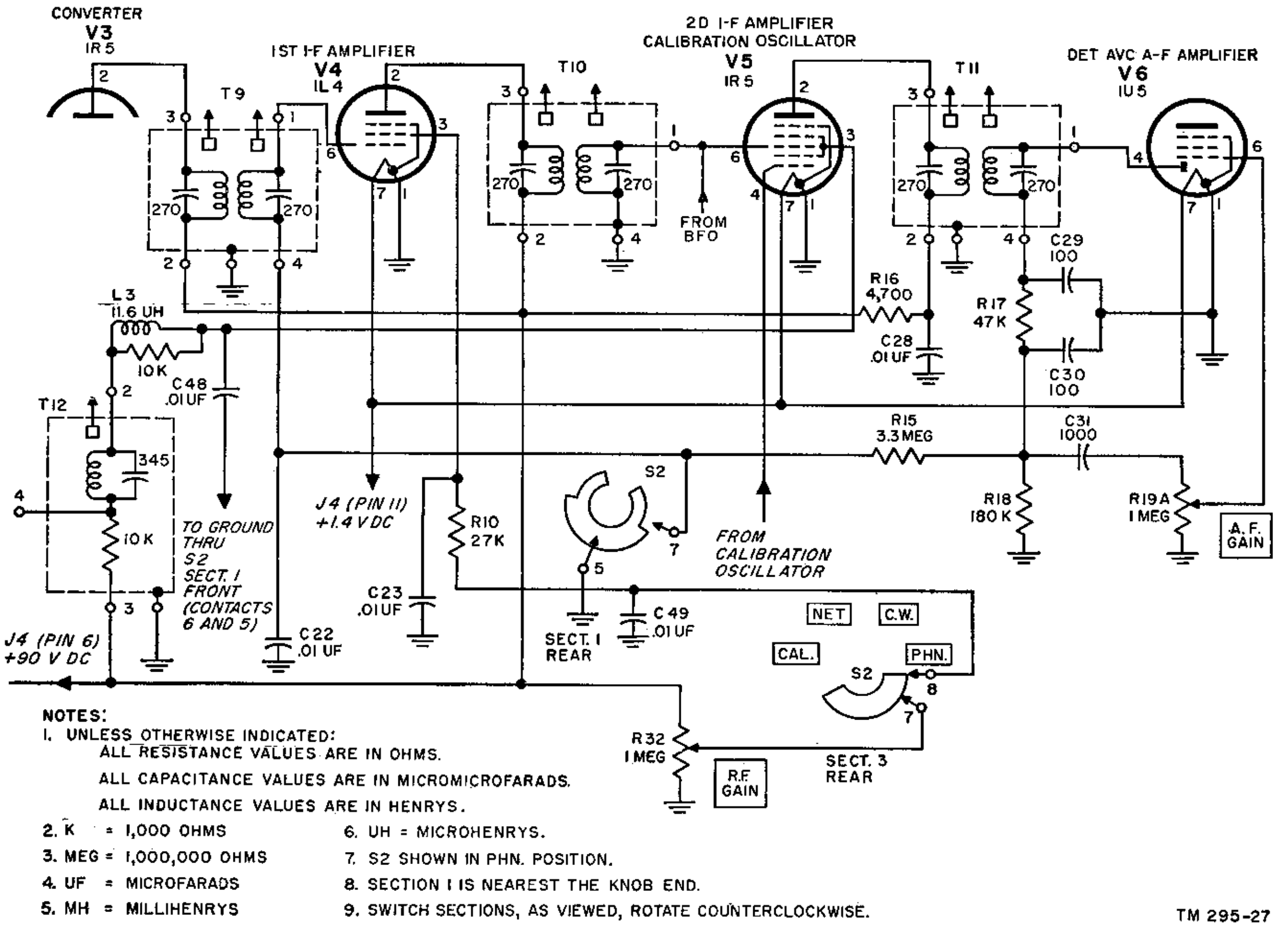


Figure 26. Radio Receiver R–174/URR, first and second i-f amplifiers, functional schematic.

c. Tube V4 amplifies the i-f signal and develops the signal across the tuned primary of i-f transformer T10. The signal is coupled inductively to the tuned secondary winding in the grid circuit of the second i-f amplifier V5.

57. Second I-f Amplifier V5

(fig. 26)

The operation of the second i-f amplifier is similar to the operation of the first i-f amplifier.

a. The signals amplified by i-f amplifier tube V4 are coupled inductively to the secondary of T10, and fed to the grid (pin 6) of the second i-f amplifier tube V5. The grid circuit is returned directly to ground. During C.W., NET, and CAL. operation, the output of the bfo also is supplied to the grid of V5 (par. 62).

b. The second i-f amplifier tube is a pentagrid converter 1R5 tube. In this circuit, only the filament (cathode), the last three grids, and the plate are used as the i-f amplifier. (The remaining grids are used in the calibration oscillator circuit (par. 63).) Filament voltage for the tube is obtained from the 1.4-volt d-c potential at pin 11 of J4. Screen voltage is supplied through the 10K-ohm voltage-dropping resistor, the coil in T12 assembly, and parasitic suppressor L3. Capacitor C48 places the screen at r-f ground potential. Plate voltage is supplied from the 90-volt d-c potential between pin 6 of J4 and ground, through voltage-dropping resistor R16 and the primary winding of T11. Capacitor C28 and resistor R16 form a plate-circuit decoupling network.

c. The tube amplifies the i-f signals and develops the amplified signal across the primary of T11. The signal is coupled inductively to the secondary of T11 in the detector circuit.

58. Detector and Avc Stage V6
(fig. 27)

The detector circuit converts the i-f signals to intelligence for all modes of operation. The avc circuit develops the avc bias for the first r-f, second r-f, and first i-f tubes in the receiver.

a. The i-f signal is coupled inductively to the secondary winding of T11 and fed to the diode plate (pin 4) of tube V6, a type 1U5 diode-pentode tube. Tube V6 rectifies the i-f signal, and the audio component of the signal is developed across the diode load resistors, R17 and R18. Capacitors C29 and C30, are i-f filters. The audio signal is coupled capacitively to A.F. GAIN control R19A through capacitor C31.

b. At the junction of R17, R18, and C30, avc voltage is picked off by resistor R15. Avc filter capacitor C22 and resistor R15 determine the time-constant of the avc network. The avc voltage is grounded when section 1, rear, of PHN.-C.W.-NET-CAL. switch S2 is in any position other than PHN. For other settings of the switch, the avc voltage is supplied to the r-f stages and the 1st i-f stage.

59. A-f Amplifier V6
(fig. 27)

The a-f amplifier section of V6 amplifies the audio component of the detector output. The circuit is operative for all modes of operation.

a. The audio signal is coupled to the control grid circuit of V6 from the arm of A.F. GAIN control R19A.

b. Filament voltage is supplied from pin 11 of J4. Screen voltage is supplied from pin 6 of J4 (90 volts) through voltage-dropping resistor R20 and contacts C and D of relay K1. (Relay K1 normally is de-energized, and contacts C and D are closed. In system applica-

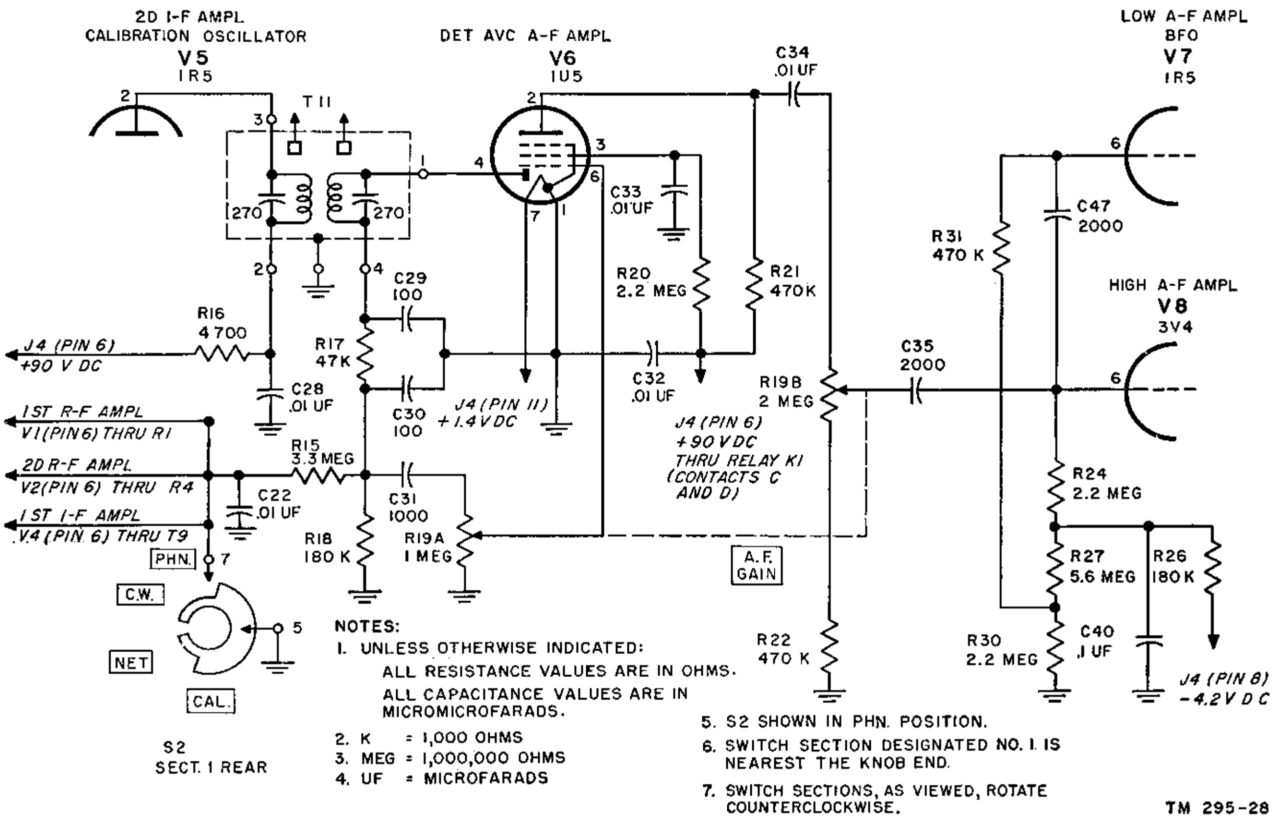


Figure 27. Radio Receiver R–174/URR, detector, avc and a-f amplifier, functional schematic.

tions, relay K1 can be energized through connection to an associated transmitter, to disable the receiver during transmissions.) Capacitor C33 places the screen at a-f ground potential, and C32 decouples the plate and screen circuits from the B+ supply. Plate voltage is supplied from pin 6 of J4 through plate load resistor R21 and the relay circuit.

c. The amplified audio signal is developed across R21 and is coupled capacitively by C34 to A.F. GAIN control R19B and resistor R22. R22 determines the minimum signal voltage fed to the low and high a-f amplifiers. A portion of this signal voltage (depending on A.F. GAIN control setting) is coupled to the high a-f amplifier through C35, and is coupled to the low a-f amplifier through C35 and C47.

60. Low A-f Amplifier V7
(fig. 28)

A-f amplifier V7 is used only when OUTPUT HIGH-LOW switch S4 is in the LOW position. The tube amplifies the audio signal taken from V6 and couples it to the loudspeaker and the headset. The loudspeaker, which is located in the power supply, may be disconnected when SPEAKER ON-OFF switch S102 is in the OFF position.

a. The input signal to tube V7 is coupled from the output of V6 through capacitors C35 and C47. R30 and R31 act as the d-c return resistors for the control grid. R30 also functions as part of a voltage divider (R26, R27, and R30) for the negative voltage present between pin 8 of J4 and ground. The voltage at the junction of resistors R30 and R27 is supplied to the grid of V7 as bias voltage. Section 1, rear, of PHN.-C.W.-NET-CAL. switch S2 short-circuits R30 to ground on all positions of the switch except PHN. This action removes the fixed bias from the stage and improves its stability.

b. The low a-f amplifier stage uses a portion of a 1R5 pentagrid tube, with the filament, last four grids, and the plate as a pentode amplifier. Filament voltage is supplied from the 1.4-volt d-c potential at pin 11 of J4 through r-f choke L2. Capacitor C45 bypasses af to ground at the filament. Screen voltage is supplied from pin 6 of J4 through voltage-dropping resistor R28 and a portion of the winding of bfo tank transformer T13. Capacitor C41 decouples the screen circuit from the power supply. Plate voltage is supplied through the full primary winding of T14 and OUTPUT HIGH-LOW switch S4. Capacitor C42 is an h-f bypass.

c. The signals are amplified by the tube and the output is coupled inductively from the primary of T14 to the secondary of T14. The full secondary winding of T14 is connected to PHONES connectors J2 and J3, and a portion of the secondary is tapped for the loudspeaker. The signal for the speaker is supplied from pin 9 of J4 to pin 9 of J101 in the power supply, thence through SPEAKER ON-OFF switch S102 to the speaker.

d. Section 3, rear, of PHN.-C.W.-NET-CAL. switch S2 connects voltage-dropping resistor R29 in parallel with R28 and increases the screen (bfo plate) voltage of the tube in all positions of function switch S2, except PHN.

61. High A-f Amplifier V8
(fig. 29)

A-f amplifier tube V8 is used only when OUTPUT HIGH-LOW switch S4 is in the HIGH position. The tube amplifies the audio signal taken from V6 and couples it to the loudspeaker and/or phones. The speaker may be disconnected in this mode of operation by turning the SPEAKER ON-OFF switch to OFF.

a. The input signal to tube V8 is coupled from the output of V6 through capacitor C35. Bias voltage is supplied from the voltage divider (R26, R27, and R30) which is connected between pin 8 of J4 and ground. The negative voltage at the junction of R26 and R27 is supplied as bias to the grid (pin 6) of V8 through R24. R24, R27, and R30 form the grid d-c return circuit for the PHN. setting of PHN.-C.W.-NET-CAL. switch S2. For all other settings of the switch, resistor R30 is short-circuited to ground, thus increasing the bias voltage on V8.

b. The high a-f amplifier stage uses a 3V4 pentode tube. The filaments of the tube are connected in parallel through S3 and contacts 4 and 5 of S4 for 1.4-volt operation. Filament voltage is supplied from pin 11 of J4. Capacitor C39 is an a-f filter for the filament circuit.

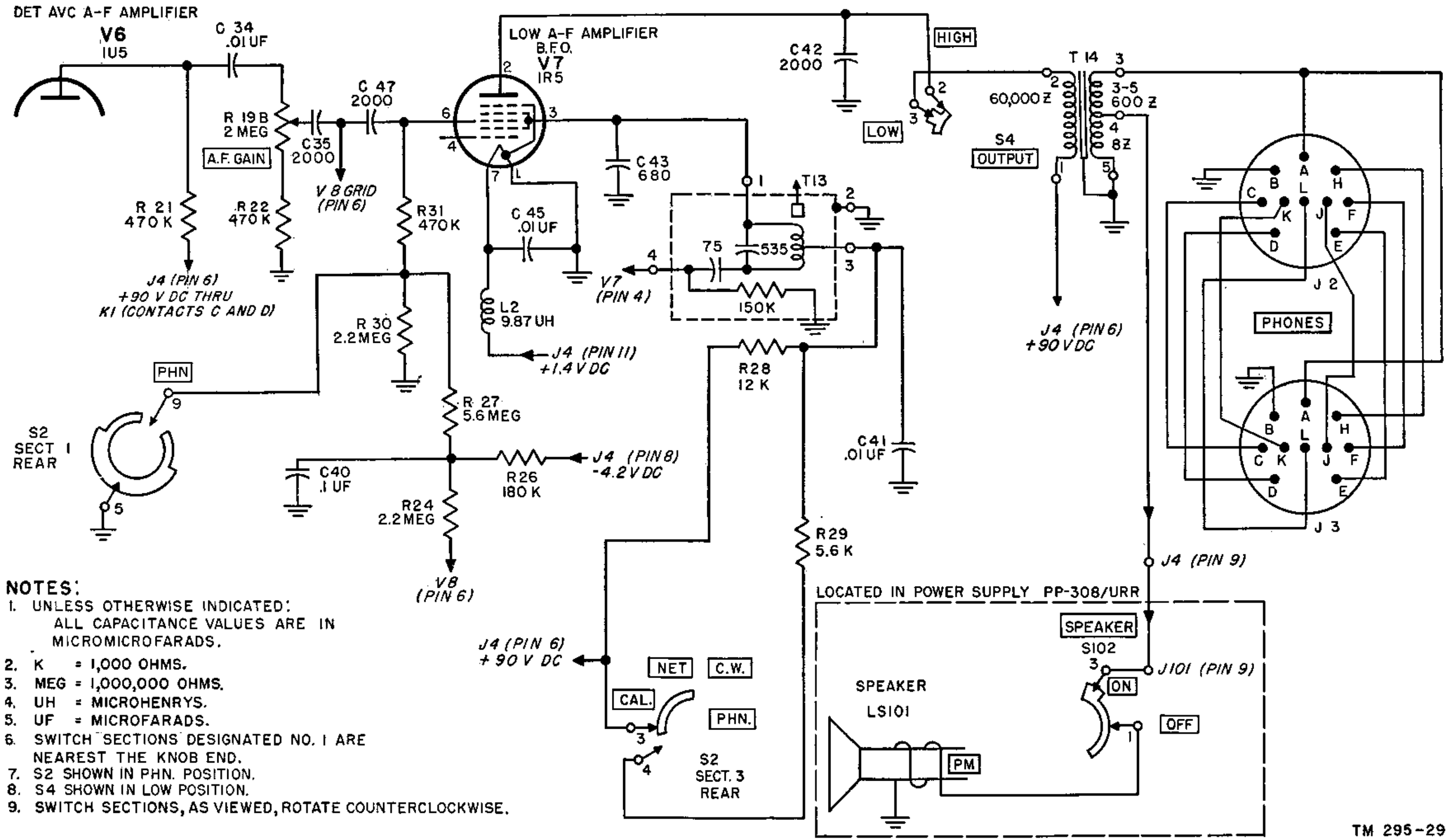


Figure 28. Radio Receiver R–174/URR, low a-f amplifier, functional schematic.

Screen voltage is supplied from the 90-volt d-c potential at pin 6 of J4, through voltage-dropping resistor R25 and OUTPUT HIGH-LOW switch S4 (in HIGH position). Capacitor C38 places the screen at a-f ground potential. Plate voltage is supplied from pin 6 of J4 through a portion of the winding of T14 and OUTPUT HIGH-LOW switch S4. Capacitor C36 is an h-f a-f filter.

c. The signals are amplified by the tube, and the output is inductively coupled from a portion of the primary of T14 to the secondary of T14, thence to the PHONES connectors and the loudspeaker.

d. In the HIGH operation of OUTPUT HIGH-LOW switch S4, B+ voltage (90 volts dc) is connected directly to the plate of low a-f amplifier V7, with a-f bypass capacitor C37 connected from plate to ground. This effectively cancels any output signal from V7.

e. DIAL LIGHT switch S3 can be used to illuminate dial light E1 when required, but reduces the output of tube V8 by removing the filament voltage from half of the filament.

62. Beat-frequency Oscillator, Part of V7
(fig. 30)

The bfo is operative in all positions of PHN.-C.W.-NET-CAL. switch S2, except PHN. The filament and first two grids of V7 are used in the bfo circuit.

a. The oscillator is a self-sustaining, series-fed Hartley oscillator operating at a fundamental frequency of 151.66 kc $\pm$1 to 1.167 kc. The third harmonic (455 kc $\pm$3.5 kc) is coupled to the grid (pin 6) of second i-f amplifier tube V5. The circuit is tuned by T13, the capacitor (535 $\mu\mu$f) connected in the assembly and capacitor C43. Capacitor C44 (B.F.O. trimmer) is used to vary the frequency of the bfo and produce the beat note for the audio section of the receiver.

b. The 75-$\mu\mu$f capacitor and the 150K-ohm resistor in the coil assembly form the grid-leak bias network for the tube.

c. The bfo utilizes the filament and first two grids of a 1R5 pentagrid tube. Filament voltage is obtained from the 1.4-volt d-c potential at pin 11 of J4 through r-f filter choke L2. Capacitor C45 bypasses to ground the audio frequency at the filament. Oscillator plate voltage is supplied from the 90-volt d-c potential at pin 6 of J4 through a portion of T13 and voltage-dropping resistors R28 and R29 connected in parallel, when switch S2 is in C.W., NET, or CAL. position. Capacitor C41 keeps the center tap of the bfo tank coil at r-f ground potential.

d. The third harmonic of the bfo signal is coupled from the grid (pin 4) of V7 and fed through resistor R11 and capacitor C24 to the grid of second i-f amplifier tube V5. The bfo signal mixes with the i-f signal to produce an audible difference frequency, which is detected and amplified in the usual manner.

e. Section 1, rear, of PHN.-C.W.-NET-CAL. switch S2 disables the bfo when the switch is in PHN. position, by connecting the bfo plate circuit to r-f ground through capacitor C46.

63. Calibration Oscillator, Part of V5
(fig. 31)

a. A portion of V5 is connected as a crystal oscillator when PHN.-C.W.-NET-CAL. switch S2 is in the CAL. position, and the output of the oscillator is used to calibrate the receiver dial. The harmonics of the 200-kc fundamental frequency are converted to the intermediate i-f frequency, which is used to beat against the bfo and provide an audio beat for calibration purposes. The filament and first two grids of V5 (pentagrid 1R5) are used in the oscillator circuit.

b. The oscillator is a self-sustaining modified Pierce oscillator, the fundamental frequency of which is crystal controlled. The output at the calibration oscillator plate (pin 3) of V5 is coupled to section 2, front, of BAND SW. switch S1 by means of a long wire used as a radiating element when the oscillator is functioning, and used as a disabling element, connected to ground, in the PHN., C.W., and NET positions of PHN.-C.W.-NET-CAL. switch S2. The tuned circuit for the oscillator consists of Crystal Unit CR-2/U and the paralleled coil and 345-$\mu\mu$f capacitor connected within coil assembly T12.

c. Grid-leak bias is developed when the crystal is excited. Resistor R14 and capacitor C25 form the grid-leak bias network. Filament voltage is obtained from the 1.4-volt d-c potential at pin 11 of J4. Plate voltage is supplied from the 90-volt d-c potential at pin 6 of J4 through the 10K-ohm resistor in T12 coil assembly, the

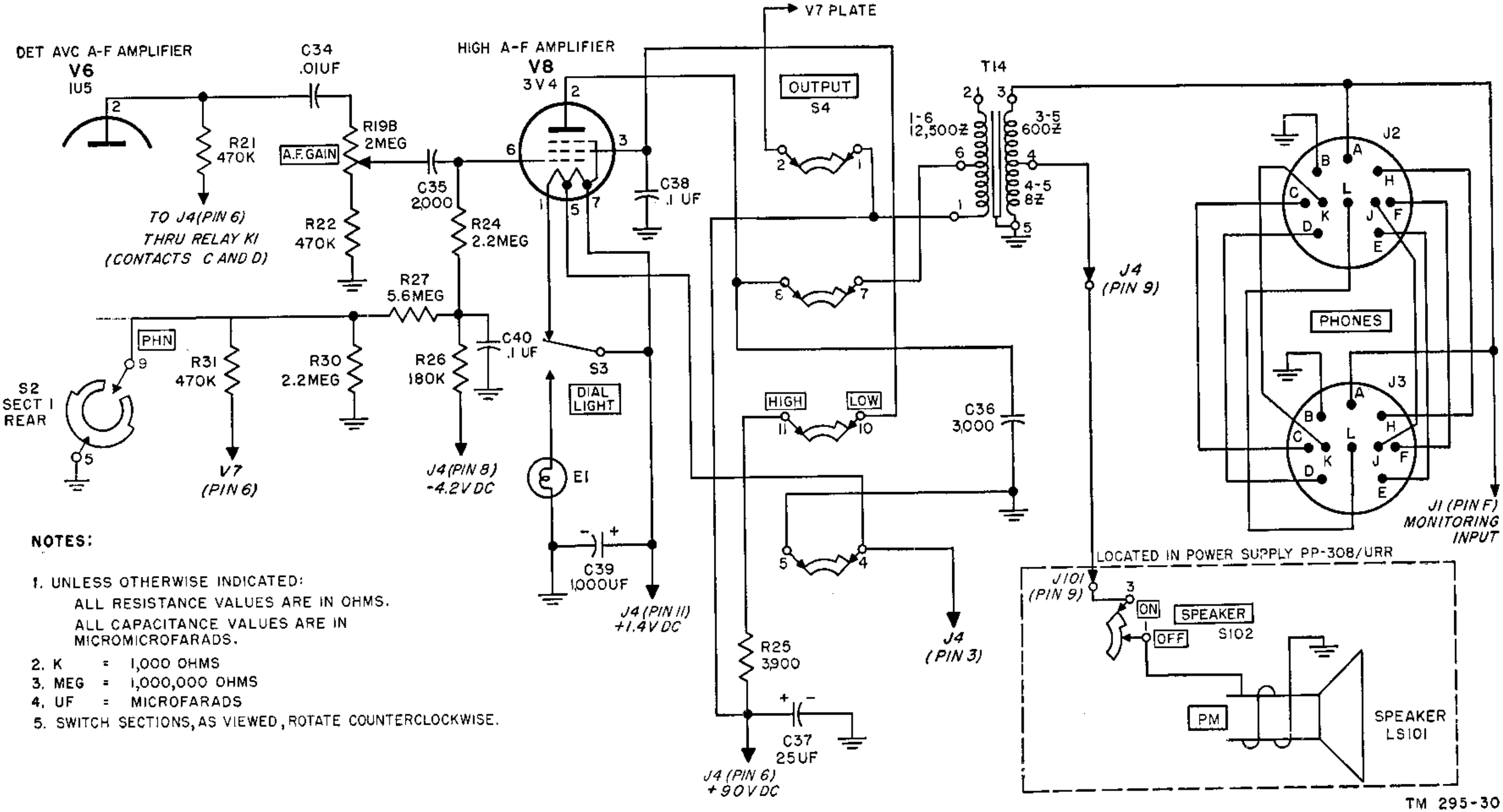


Figure 29. Radio Receiver R-174/URR, high a-f amplifier, functional schematic.

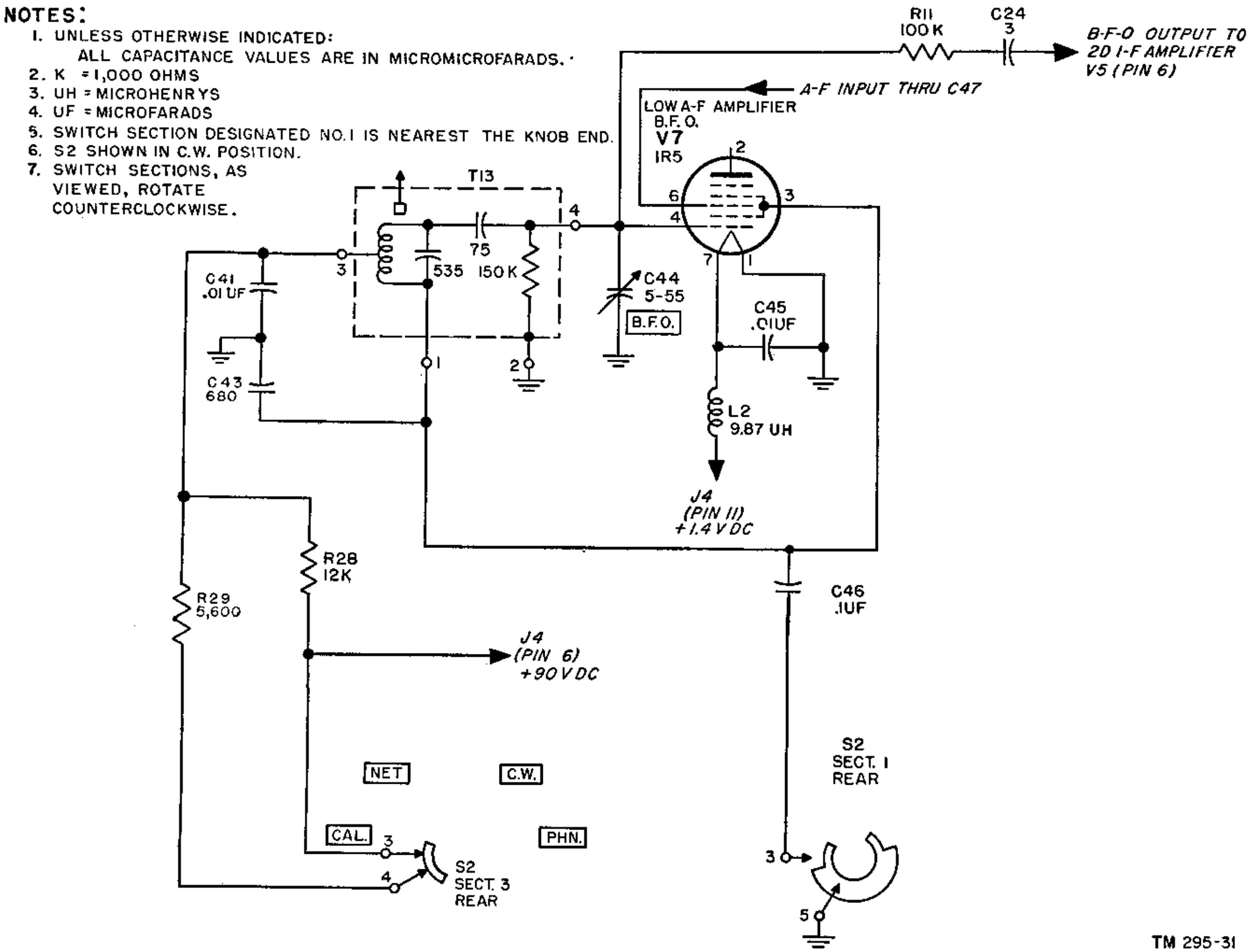


Figure 30. Radio Receiver R–174/URR, bfo, functional schematic.

coil, and parasitic suppressor L3. The 10K-ohm resistor and R13 form a voltage divider. C26 places the oscillator plate return at r-f ground potential.

d. The harmonic frequencies of the oscillator are radiated and picked up by the first r-f amplifier. The signals are amplified through the receiver and beat with the bfo to produce a difference frequency to be detected. This develops a beat note every 200 kc, for calibration of the receiver on bands 1, 2, and 3. When BAND SW. switch S1 is in the band 4 position, the harmonic frequencies are injected into the grid circuit of r-f amplifier tube V1 through section 2, front, of switch S1, capacitor C54, and section 3, rear, of BAND SW. switch S1. Capacitor C3 couples the signals from the tuned grid circuit to the grid (pin 1) of V1.

e. In all positions of PHN.-C.W.-NET-CAL. switch S2, except CAL., the oscillator plate and radiating element is grounded for rf through C48 and section 1, front, of S2.

64. PHN. Operation
(fig. 32)

In the PHN. position of PHN.-C.W.-NET-CAL. switch S2, the receiver is operative for voice signals. The bfo and the crystal calibration oscillator circuits are inoperative. Capacitor C46 is a low-impedance path to ground for the bfo signal, and capacitor C48 is a low-impedance path to ground for the crystal calibration oscillator signal. In this mode of operation, C46 places the screen grid (bfo plate) at a-f ground potential, and C48 is used as an r-f bypass for the screen grid (calibration oscillator plate) of V5. The control grid of V5 also is grounded.

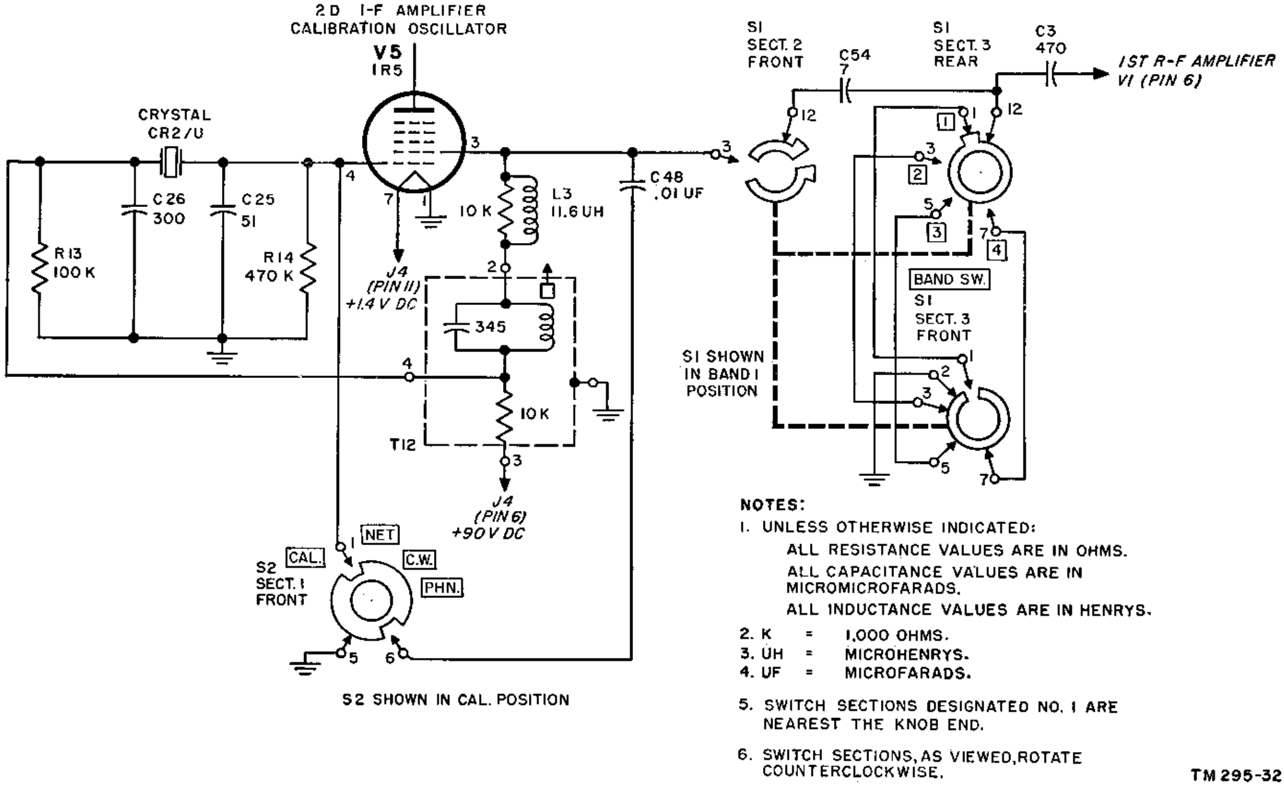


Figure 31. Radio Receiver R–174/URR, calibration oscillator, functional schematic.

65. C.W. Operation
(fig. 32)

When the PHN.-C.W.-NET-CAL. switch is in the C.W. position, the bfo is operative, and the avc voltage is grounded, increasing the gain of the receiver. Section 1, rear, of the switch removes the bfo ground connection and places a ground on the avc bus.

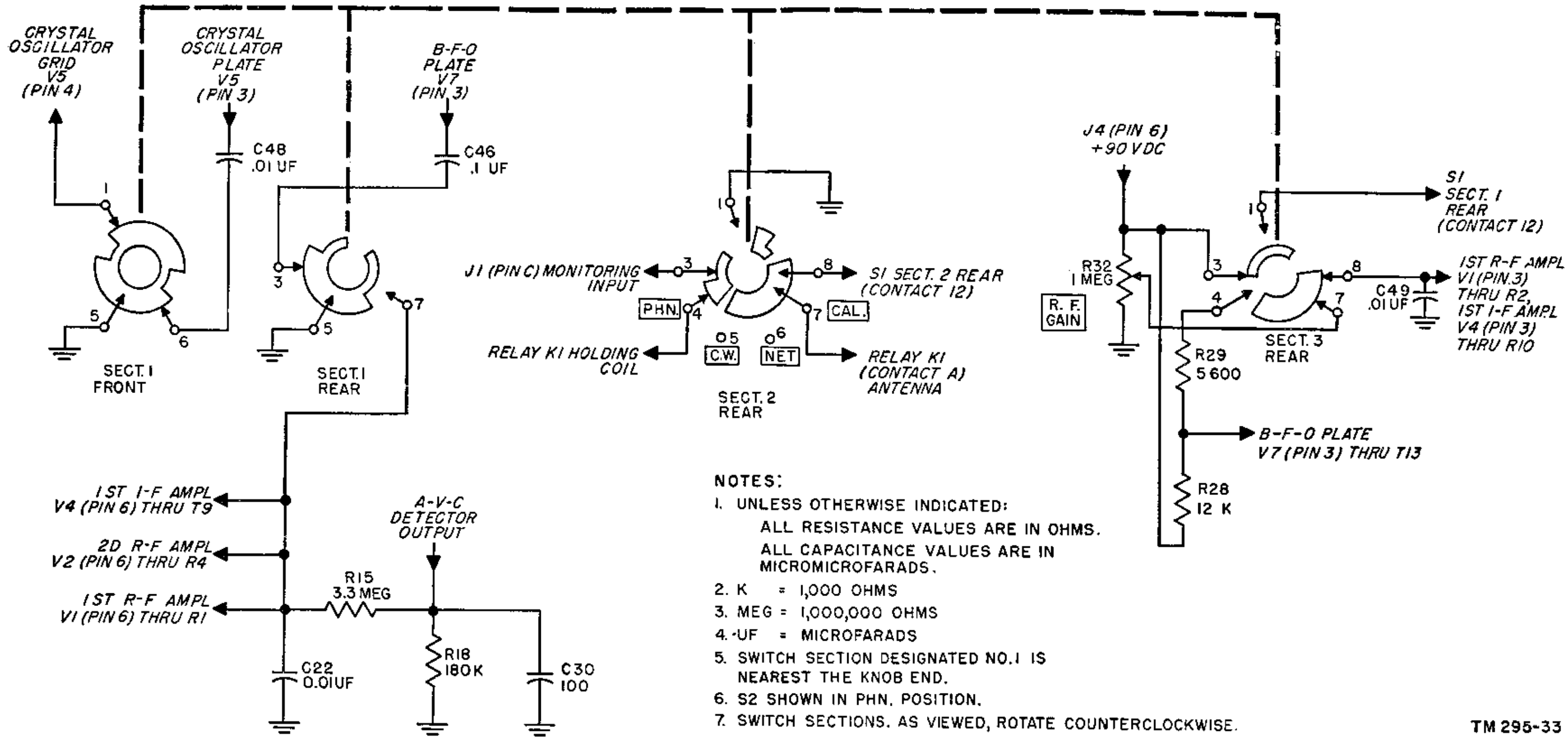
66. NET Operation
(figs. 32 and 34)

In the NET position of the PHN.-C.W.-NET-CAL. switch, the receiver operates in a manner similar to that of C.W., except that the circuit to relay K1 is opened. Section 2, rear, of the switch performs this function. Disabling the relay permits the tuning of the *exciter* of the local transmitter to the Net Control Station frequency. This is accomplished by tuning the receiver to the Net Control Station frequency and tuning the local transmitter *exciter* to the tuned receiver frequency (par. 23). Opening the relay circuit prevents the disabling of the receiver when the local transmitter is turned on during the exciter tuning. After the *exciter* is tuned, the PHN.-C.W.-NET-CAL. switch should be set to PHN. or C.W., before the tuning of the transmitter is completed.

67. CAL. Operation
(figs. 32 and 33)

a. In the CAL. position of PHN.-C.W.-NET-CAL. switch, the receiver is capable of receiving signals only from the crystal calibration oscillator. The conditions are the same as C.W., except that the crystal calibration oscillator is operative (fig. 32), the antenna circuit is open (fig. 33), and the primary of antenna transformer T1 or T5 is shorted (fig. 33). The R.F. GAIN control is inoperative.

b. In this mode of operation, screen voltage for r-f tube V1 and i-f tube V4 is obtained from the 90-volt d-c potential at pin 6 of J4 through section 3, rear, of PHN.-C.W.-NET-CAL. switch S2 and section 1 of BAND SW. switch S1, and the voltage-dropping resistor network consisting of R35, R34, and R33 (fig. 33). These resistors are eliminated successively from the screen circuits of V1 and V4 as BAND SW.



NOTES:
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS.
   ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
2. K = 1,000 OHMS
3. MEG = 1,000,000 OHMS
4. UF = MICROFARADS
5. SWITCH SECTION DESIGNATED NO. 1 IS NEAREST THE KNOB END.
6. S2 SHOWN IN PHN. POSITION.
7. SWITCH SECTIONS, AS VIEWED, ROTATE COUNTERCLOCKWISE.

Figure 32. Radio Receiver R-174/URR, circuit of PHN.-C.W.-NET.-CAL. switch.

switch S1 is turned from position 1 to position 4. This changes the sensitivity of the tubes, increasing it for each higher frequency band.

c. Because of rich harmonic frequencies of the bfo and the calibration oscillator, there is a mixing of the third harmonic of the calibration oscillator and the fourth harmonic of the bfo, causing an audio tone of 6.66 kc in the background which is undesirable but unavoidable.

68. Monitoring Operation
(fig. 34)

a. For purposes of monitoring sidetone in system applications, connection is made from an external transmitter to MONITORING INPUT receptacle J1. In this mode of operation, a 12-volt d-c or a 24-volt d-c input may be used to energize relay K1. This opens the plate and screen voltage for a-f amplifier tube V6, disabling the tube, and shorts the antenna to ground. The low and high a-f amplifiers are still operative.

(1) For 12- and 24-volt vehicular operation, the disabling voltage is obtained directly from the power supply. In 24-volt operation, R23 drops the 24-volt supply to 12 volts to activate relay K1. The coil of disabling relay K1 is completed to ground at the transmitter through pin C of J1, and normally will be connected in such a manner as to cause operation of the relay when the push-to-talk circuit of the transmitter is closed.

(2) For 6-volt vehicular, dry-battery, or 115-volt a-c operation, external dis-

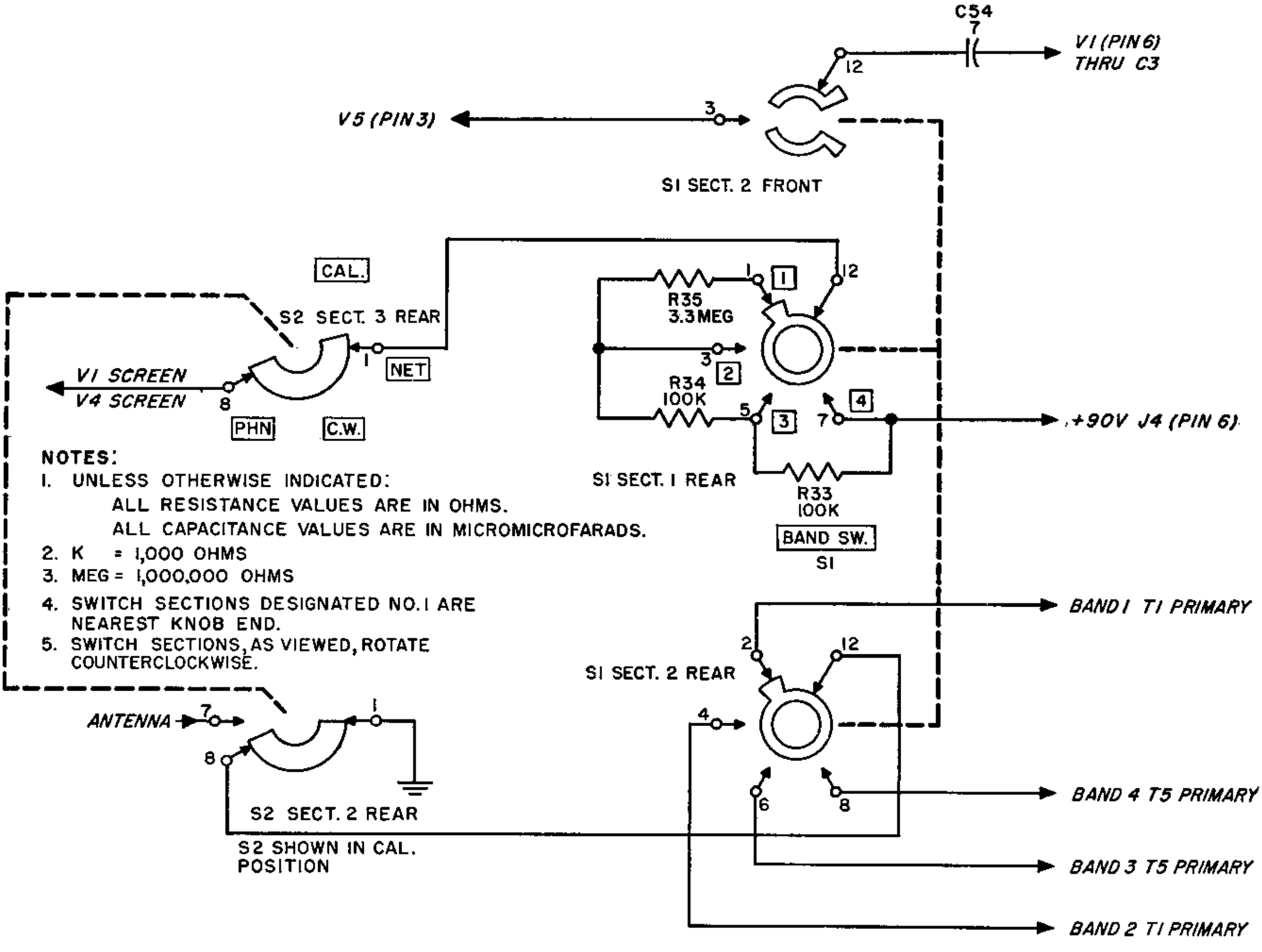


Figure 33. Radio Receiver R-174/URR, calibration, section 1 of BAND SW switch S1, functional schematic.

abling voltage of 12 or 24 volts dc must be supplied by the transmitter. When a 12-volt d-c source for disabling is used, the +12 volts is applied to pin A of J1, and the ground return circuit is connected to pin C of J1. When a 24-volt d-c source is used, the +24 volts is applied to pin B of J1, and the ground return is connected to pin C of J1.

b. The sidetone output of the transmitter should have an impedance of 600 ohms, and one side free to be grounded. Sidetone input is connected to pin D of J1 and pin E of J1 (ground).

(1) Sidetone input voltage is impressed across R36 and is fed into V7 through fixed attenuator R12 and coupling capacitors C27 and C47.

(2) Sidetone input voltage is fed into V8 through R12 and C27.

c. The audio output connections, pin F of J1 and pin E of J1 (ground), are used to supply the receiver output to the transmitter for local monitoring. The audio output of the receiver is taken from the 600-ohm secondary terminal of T14 (pin A of J2 and J3).

d. It is possible to use Radio Receiver R–174/URR without Power Supply PP–308/URR. For this purpose, A+, B+, B—, and ground connections were brought out to J1.

(1) For such operation, the positive terminal of the 1.5-volt d-c source (A+) should connect to pin H and the negative terminal (A—) to pin E (ground). The positive terminal of the 90-volt d-c source (B+) should connect to pin K and the negative terminal (B—) to pin J. Also, it will be necessary to connect a 160-ohm resistor across pins 8 and 10 of J4.

(2) A suitable cabinet should be used that will fit properly against the waterproof gasket around the rim of the receiver.

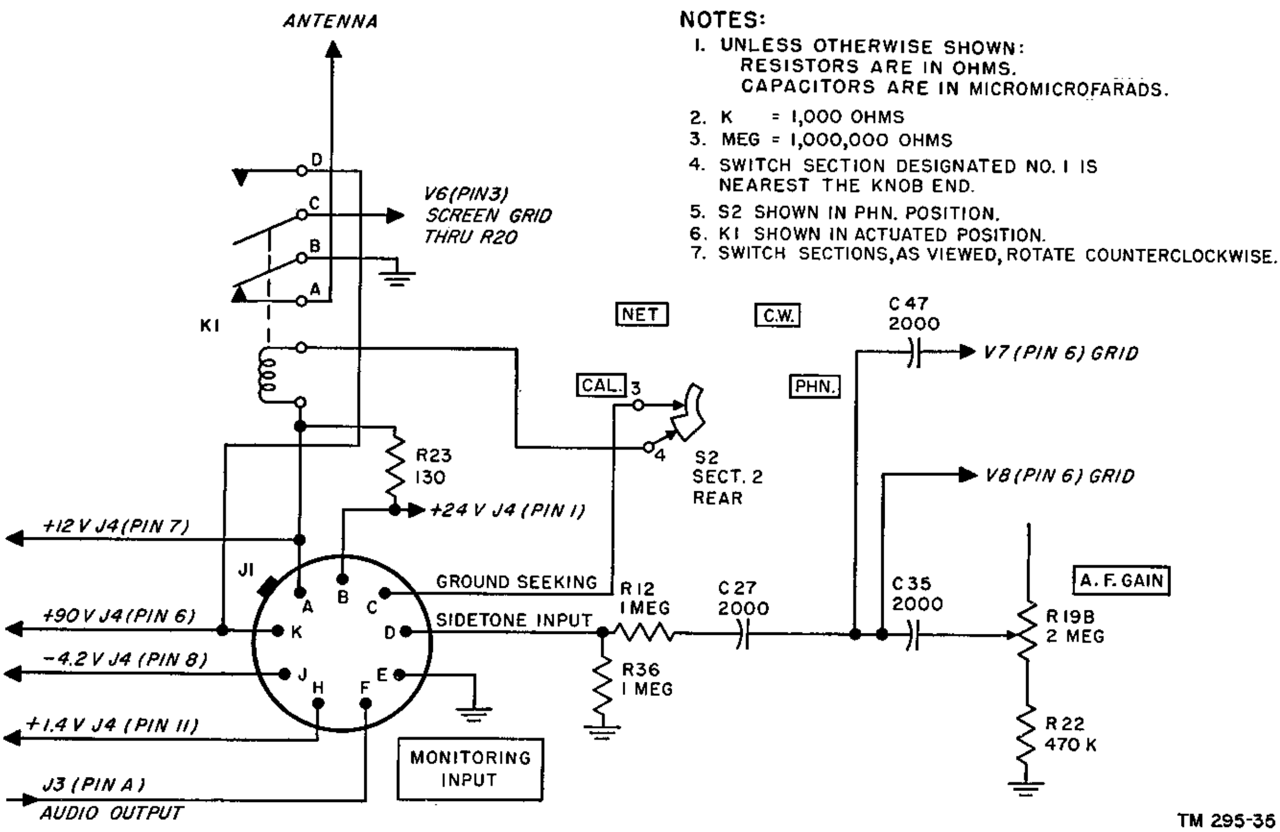


Figure 34. Radio Receiver R–174/URR, monitoring input, functional schematic.

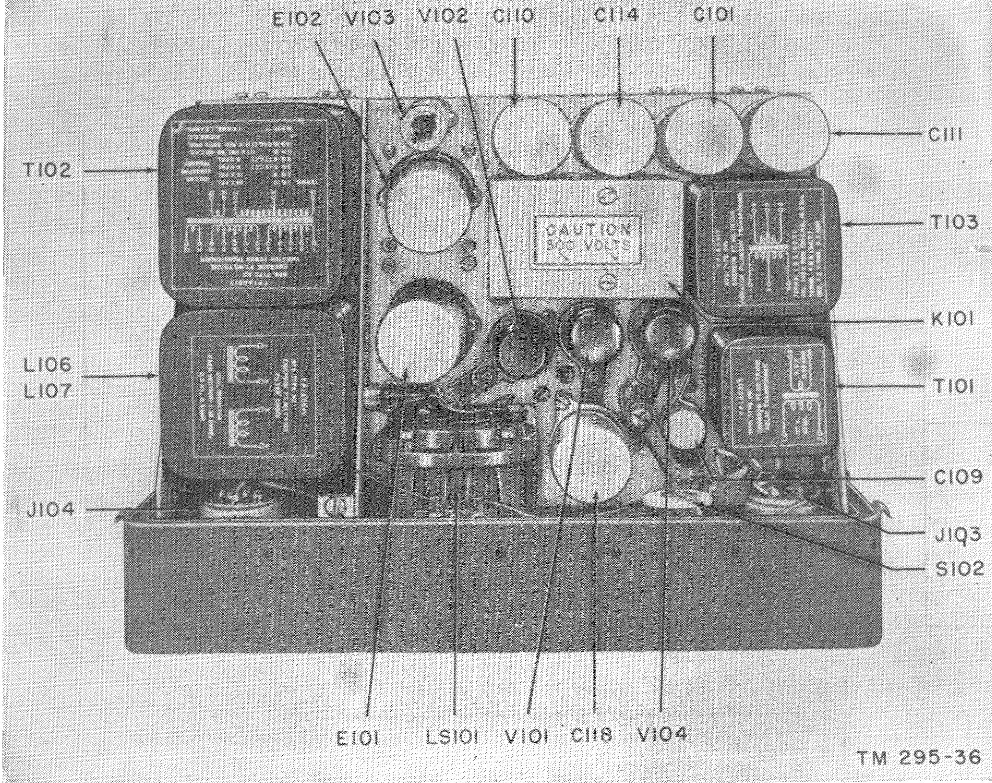


Figure 35. Power Supply PP–308/URR, top view of chassis, with cover removed.

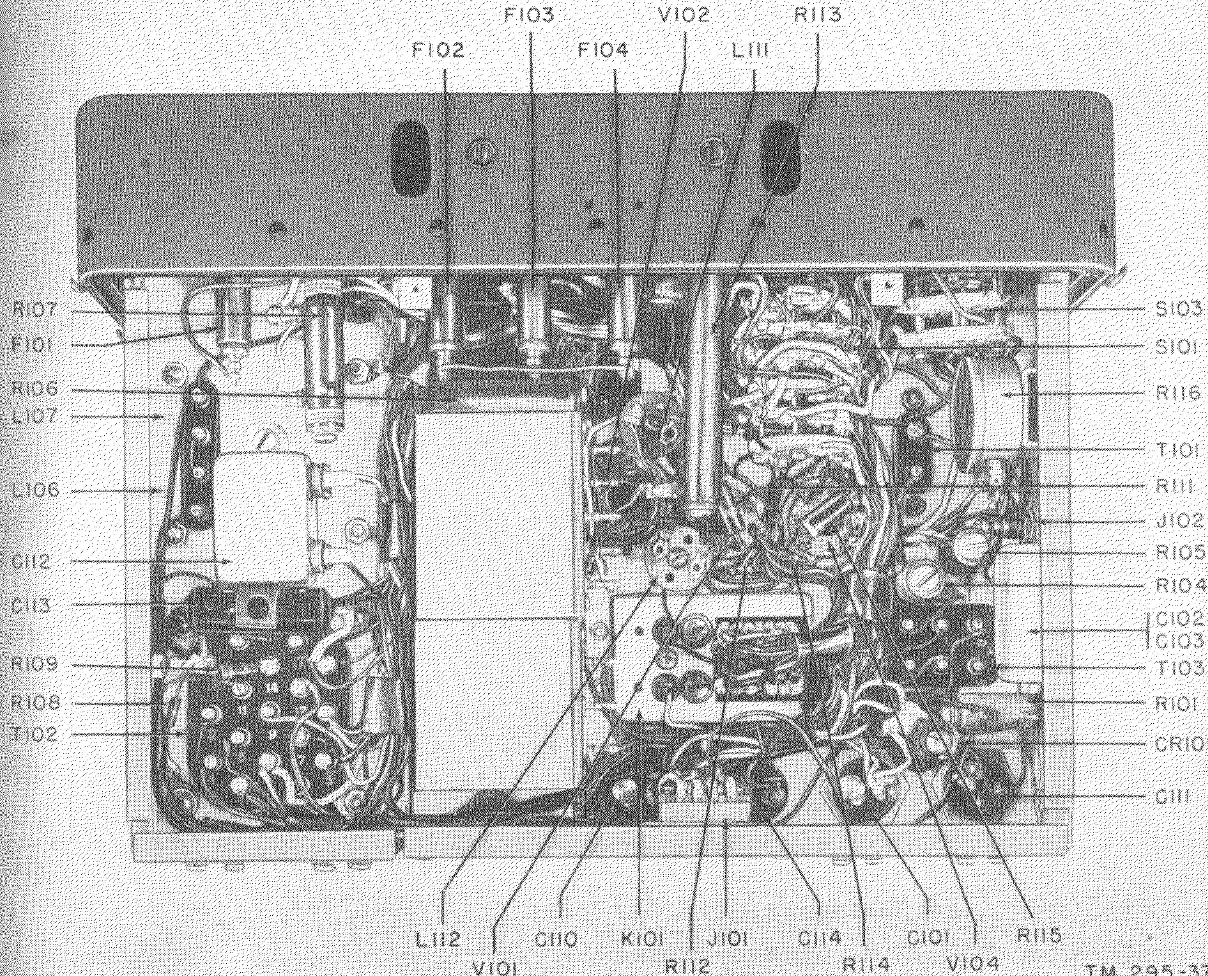


Figure 36. Power Supply PP-308/URR, bottom view of chassis, with cover removed.

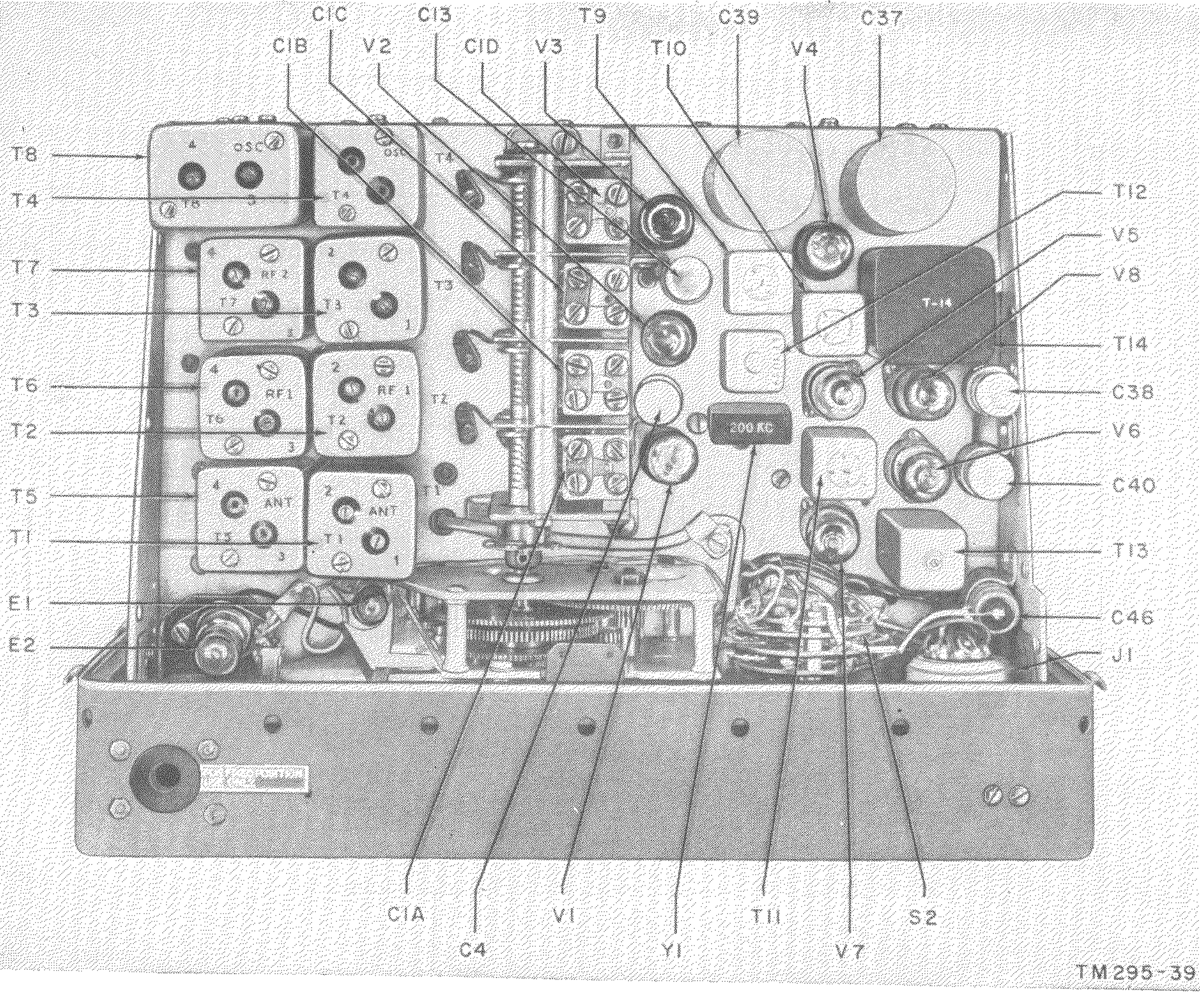


Figure 38. Radio Receiver R–174/URR, top view of chassis with cover removed.

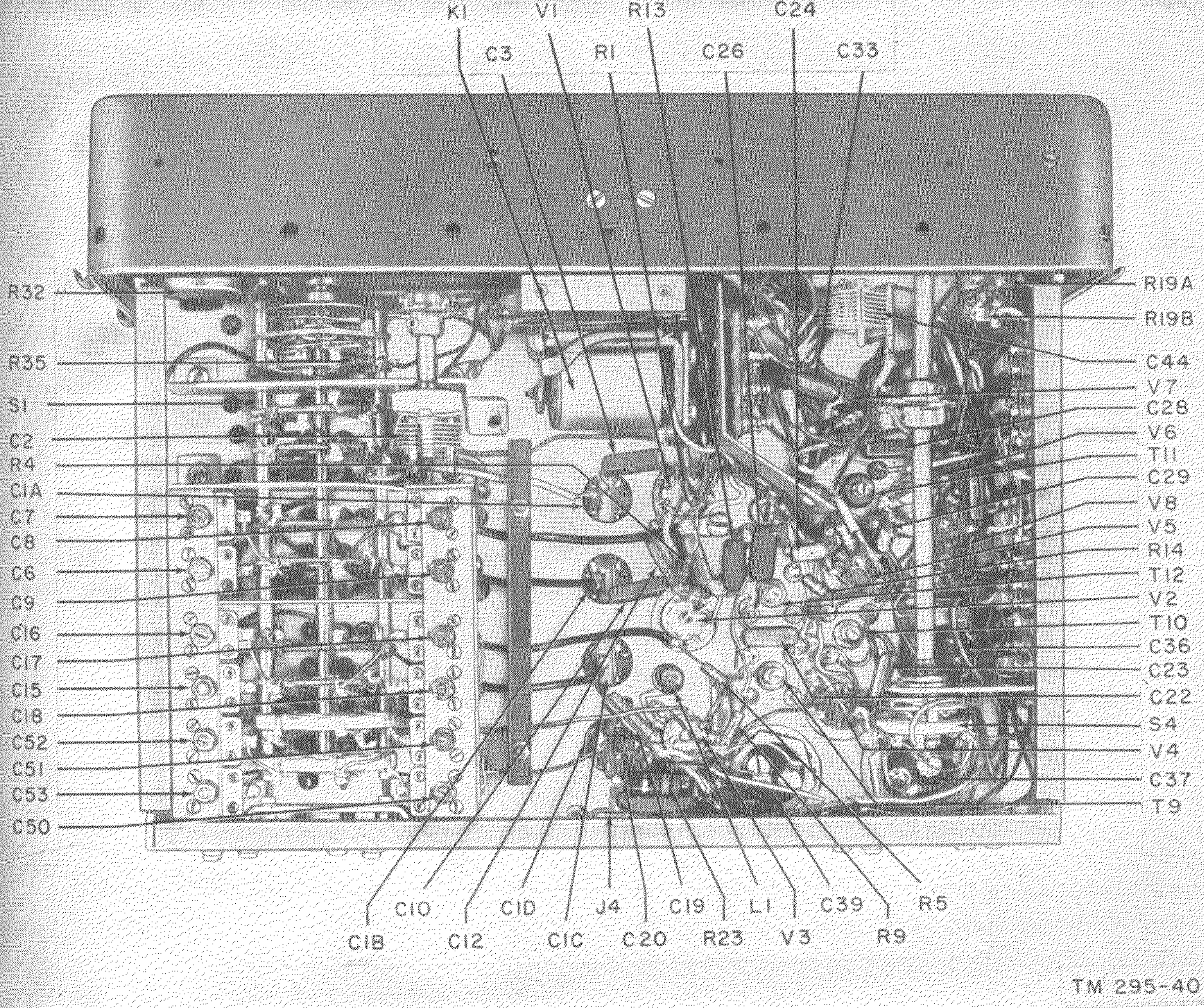
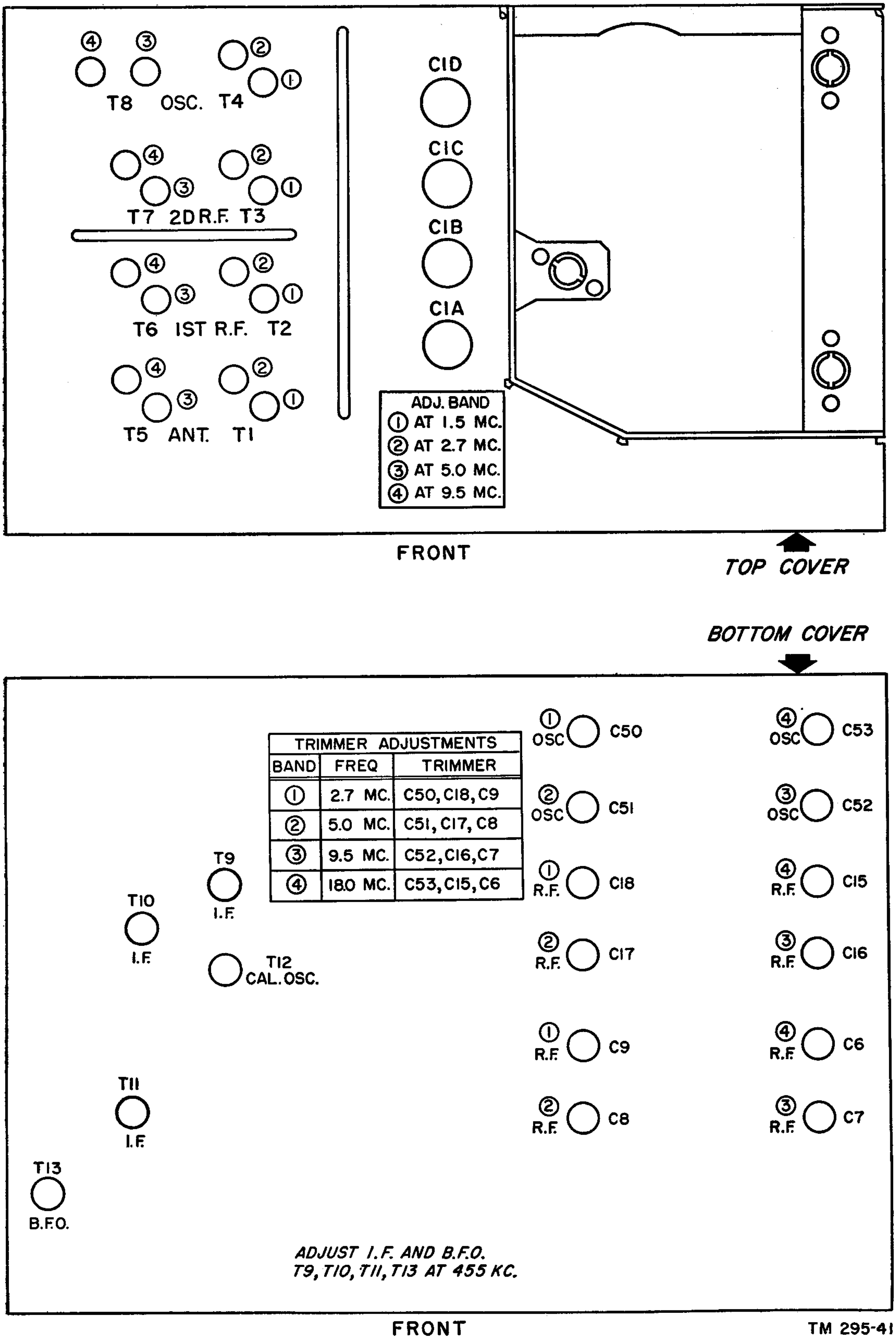


Figure 39. Radio Receiver R–174/URR, bottom view of chassis, with cover removed.



TRIMMER ADJUSTMENTS		
BAND	FREQ	TRIMMER
①	2.7 MC.	C50, C18, C9
②	5.0 MC.	C51, C17, C8
③	9.5 MC.	C52, C16, C7
④	18.0 MC.	C53, C15, C6

Figure 40. Radio Receiver R–174/URR, alinement charts.

92. Test Instruments Required for Alinement

a. Signal Generator. The signal generator should be an accurately calibrated instrument producing modulated and unmodulated r-f signals, such as Signal Generator TS–588/U or RF Signal Generator AN/URM–25. The frequency range must extend from 400 kc to 25 mc. The alinement frequencies are shown in paragraphs 94 through 96. If necessary, the second harmonic generally can be used when the fundamental is not available. The generator should have an output of at least 5,000 μv for best results in alining the r-f, h-f oscillator, and i-f circuits. Frequency calibration of the signal generator is extremely important to insure that the receiver dial calibration will be correct.

b. Output Meter. The output meter should respond to audio frequencies and should provide at least half-scale deflection for 2.5 volts (approximately 10 mw). It should have a 600-ohm input impedance. Use Output Meter TS–585/U (or an equivalent meter), set at 600 ohms.

c. Frequency Meter. When a highly accurate signal generator is not available, use a frequency meter to check the accuracy of the generator. Frequency Meter Set SCR–211 is suitable.

d. Headset or Permanent-Magnet Loudspeaker. The integrally mounted loudspeaker or the headset supplied may be used for rough alinement.

e. Alinement Tools. A suitable alinement tool, supplied with the receiver, or an insulated screw driver and insulated nut driver are required.

93. Calibration of Signal Generator

When the signal generator calibration is not acceptable, accurate alinement of the h-f oscillator in the receiver requires the use of a frequency meter to check the signal generator setting, as follows:

a. Place the generator and the frequency meter near each other.

b. Turn on both equipments and allow them to warm up for at least 15 minutes.

c. Calibrate the frequency meter according to the instructions furnished with that unit.

d. Attach a piece of wire to the signal generator output connection and place the wire near the frequency meter antenna.

e. Set the meter to the exact frequency at which the generator is to be used.

f. While listening to the headset connected to the frequency meter, tune the generator to zero beat with the meter. The signal generator is now set for the frequency desired.

g. Turn off the frequency meter and remove the wire attached to the signal generator output connection.

94. I-f Alinement Procedure
(figs. 38, 39, and 40)

Note. Keep the output reading at 10 mw during these tests.

a. Set the output meter to 600 ohms and connect it to the receiver PHONES connector. Connect a suitable headset into the other connector for listening purposes.

b. Set the signal generator to 455 kc, modulated 30 percent at 400 cycles, and connect its output through a .05-μf, or larger, blocking capacitor to the signal grid of the second i-f amplifier tube (pin 6 of V5).

c. Set the receiver and power supply front panel controls as follows:

Control	Setting
OUTPUT HIGH-LOW switch (S4)	HIGH
PHN.-C.W.-NET-CAL. switch (S2)	PHN.
R.F. GAIN control (R32)	Maximum
SPEAKER ON-OFF switch (S102)	OFF
BAND SW. switch (S1)	Band 2
MANUAL-PRESET TUNING control.	5 mc
A.F. GAIN (R19A and R19B)	Adjusted to read to 10 mw on output meter
POWER SELECTOR switch (S101).	Mode of operation used
POWER ON-OFF switch (S103)	ON

d. Allow the receiver and power supply to warm up for approximately 5 minutes before making any adjustments. Be sure that no outside signal is coming in through the antenna circuit. Adjust filament voltage control R116 to obtain a reading of 1.4 volts dc at J102 (par. 15).

e. Adjust the top and bottom slugs of transformer T11 for maximum output indication on the output meter.

f. Connect the signal generator lead to the grid of the first i-f stage (pin 6 of V4) and adjust the top and bottom of transformer T10; lower the input signal from the generator as each circuit is tuned.

g. To aline the first i-f transformer, connect the signal generator to the stator terminal of C1C (fig. 38) and adjust the slugs of transformer T9 for maximum output indication. At this point, peaking of all i-f transformers should be rechecked to overcome any slight regeneration that may be present.

95. Bfo Alinement Procedure
(figs. 38, 39, and 40)

a. Set the signal generator to 455 kc unmodulated. Connect the generator output through a .05-μf capacitor to the grid (pin 6 of V4) of the first i-f amplifier. Set the B.F.O. trimmer to the vertical white line on the panel. Set the PHN.-C.W.-NET-CAL. switch to C.W.

b. Connect an output meter and headset as instructed in paragraph 94*a*. Adjust coil T13 at the bottom of the receiver chassis until a zero-beat note is heard, or adjust it to minimum output indication on the output meter. Connect a vacuum-tube voltmeter through a 68,000-ohm isolating resistor to pin 4 of V7. The voltage at the grid, pin 4, should read approximately —15 volts dc to —20 volts dc.

96. R-f Alinement Procedure
(figs. 38, 39, and 40)

The step-by-step procedure for r-f alinement is indicated in the chart in *g* below.

a. Panel Controls. Set the panel controls as follows:

Control	Setting
OUTPUT HIGH-LOW switch (S4)	HIGH
PHN.-C.W.-NET-CAL. switch (S2)	PHN.
BAND SW. switch (S1)	1
R.F. GAIN control (R32)	Maximum clockwise
SPEAKER ON-OFF switch (S102)	ON
POWER ON-OFF switch (S103)	ON
A.F. GAIN control (R19A, R19B)	Adjusted to 10 mw on output meter

b. Dial Pointer Check. Before proceeding with the alinement, see that the dial pointer coincides with the vertical master line.

c. Trimmer Locations. Adjustments are located on the top and bottom of the receiver chassis (figs. 38, 39, and 40). Adjustments are to be made with the special tools provided.

d. Calibration Accuracy. The accuracy of the tuning calibration depends largely on the h-f oscillator operating frequency, which is continuously set at 455 kc above the operating frequency. Although the frequency of this oscillator can be measured directly, it is simpler to use the system indicated in the chart, where the tuning dial is adjusted to the operating frequency, and then the trimmers are used to peak the signal.

e. Image Frequency Check. To check the receiver for correct alinement, set the signal generator to the image frequency which will appear at a higher frequency on the signal generator dial. This is the radio frequency plus twice the intermediate frequency. As an example, with the receiver dial set at 2.7 mc, the image will appear at 3.6 mc (2.7 mc +.910 mc) on the generator dial. The image must be the weaker signal, and a large input from the generator should be required to obtain the desired output. The procedure should be followed to check the alinement on all bands. If the signal frequency appears at a lower frequency on the generator dial than that indicated on the receiver dial, the receiver is alined incorrectly and must be realined. Note that in the alinement of the oscillator, two signal peaks will appear when the trimmer is varied. The peak with the minimum capacity is the correct peak.

f. Connections. Connect the signal generator to terminal post A through a 110-$\mu\mu$f capacitor, and the ground lead of the generator to terminal G. Connect the output meter in parallel with a 600-ohm resistor across one of the PHONES connectors.

g. R-f Alinement, Band 1.

Step	Generator freq (mc)	Receiver tuning dial (mc)	Tuned circuit adjustment for peak output	Circuit	Remarks
1	1.5	1.5	T4(1)	Oscillator tank.	
2	2.7	2.7	C50	Oscillator tank.	Rock.
3	Repeat steps 1 and 2.	Repeat steps 1 and 2.			
4	1.5	1.5	T3(1) T2(1) T1(1)	R-f transformers.	Low end calibration point.
5	2.7	2.7	C18	Second r-f transformer.	Rock high end calibration point.
			C9	First r-f transformer.	Rock.
			C2	ANT. TRIMMER.	
6	Repeat steps 4 and 5.	Repeat steps 4 and 5			
7	3.61	2.7			Image frequency check.

h. R-f Alinement, Band 2.

Step	Generator freq (mc)	Receiver tuning dial (mc)	Tuned circuit adjustment for peak output	Circuit	Remarks
1	2.7	2.7	T4(2)	Oscillator tank.	
2	5	5	C51	Oscillator tank.	Rock.
3	Repeat steps 1 and 2.	Repeat steps 1 and 2.			
4	2.7	2.7	T3(2) T2(2) T1(2)	R-f transformers.	Low end calibration point.
5	5	5	C17	Second r-f transformer.	Rock.
			C8	First r-f transformer.	Rock.
			C2	ANT. TRIMMER.	High end calibration point.
6	Repeat steps 4 and 5.	Repeat steps 4 and 5.			
7	5.91	5			Image frequency check.

i. R-f Alinement, Band 3.

Step	Generator freq (mc)	Receiver tuning dial (mc)	Tuned circuit adjustment for peak output	Circuit	Remarks
1	5	5	T8(3)	Oscillator tank.	
2	9.5	9.5	C52	Oscillator tank.	Rock.
3	Repeat steps 1 and 2.	Repeat steps 1 and 2.			
4	5	5	T7(3) T6(3) T5(3)	R-f transformers.	Low end calibration point.

Step	Generator freq (mc)	Receiver tuning dial (mc)	Tuned circuit adjustment for peak output	Circuit	Remarks
5	9.5	9.5	C16	Second r-f transformer.	Rock.
			C7	First r-f transformer.	Rock.
			C2	ANT. TRIMMER.	High end calibration point.
6	Repeat steps 4 and 5.	Repeat steps 4 and 5.			
7	10.41	9.5			Image frequency check.

j. R-f Alinement, Band 4.

Step	Generator freq (mc)	Receiver tuning dial (mc)	Tuned circuit adjustment for peak output	Circuit	Remarks
1	9.5	9.5	T8(4)	Oscillator low end.	
2	18	18	C53	Oscillator high end.	Rock.
3	Repeat steps 1 and 2.	Repeat steps 1 and 2.			
4	9.5	9.5	T7(4) T6(4) T5(4)	R-f transformers.	Low end calibration point.
5	18	18	C15	Second r-f transformer.	High end calibration point.
			C6	First r-f transformer.	
			C2	ANT. TRIMMER	
6	Repeat steps 4 and 5.	Repeat steps 4 and 5.			
7	18.91	18			Image frequency check.

97. Calibration Oscillator Alinement Procedure
(fig. 40)

Set PHN.-C.W.-NET-CAL. function switch to CAL. Connect a vacuum-tube voltmeter through a 68K-ohm isolating resistor to pin 4 of V5. Adjust the bottom slug of T12 for maximum deflection of the meter. The reading should be approximately —25 volts dc.

Section IV. FINAL TESTING

98. General

This section is intended as a guide in determining the quality of a repaired Radio Receiving Set AN/GRR–5. The minimum test requirements are outlined in the paragraphs 99 through 102. These may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation. All of the following tests are to be performed while operating the receiver with a 115-volt a-c input, if available. Allow the receiver to warm up for a few minutes before making any measurements.

99. Test Equipment Required

The instruments needed for testing the repaired equipment are listed in paragraph 71. Use equivalent instruments when the items listed cannot be obtained.

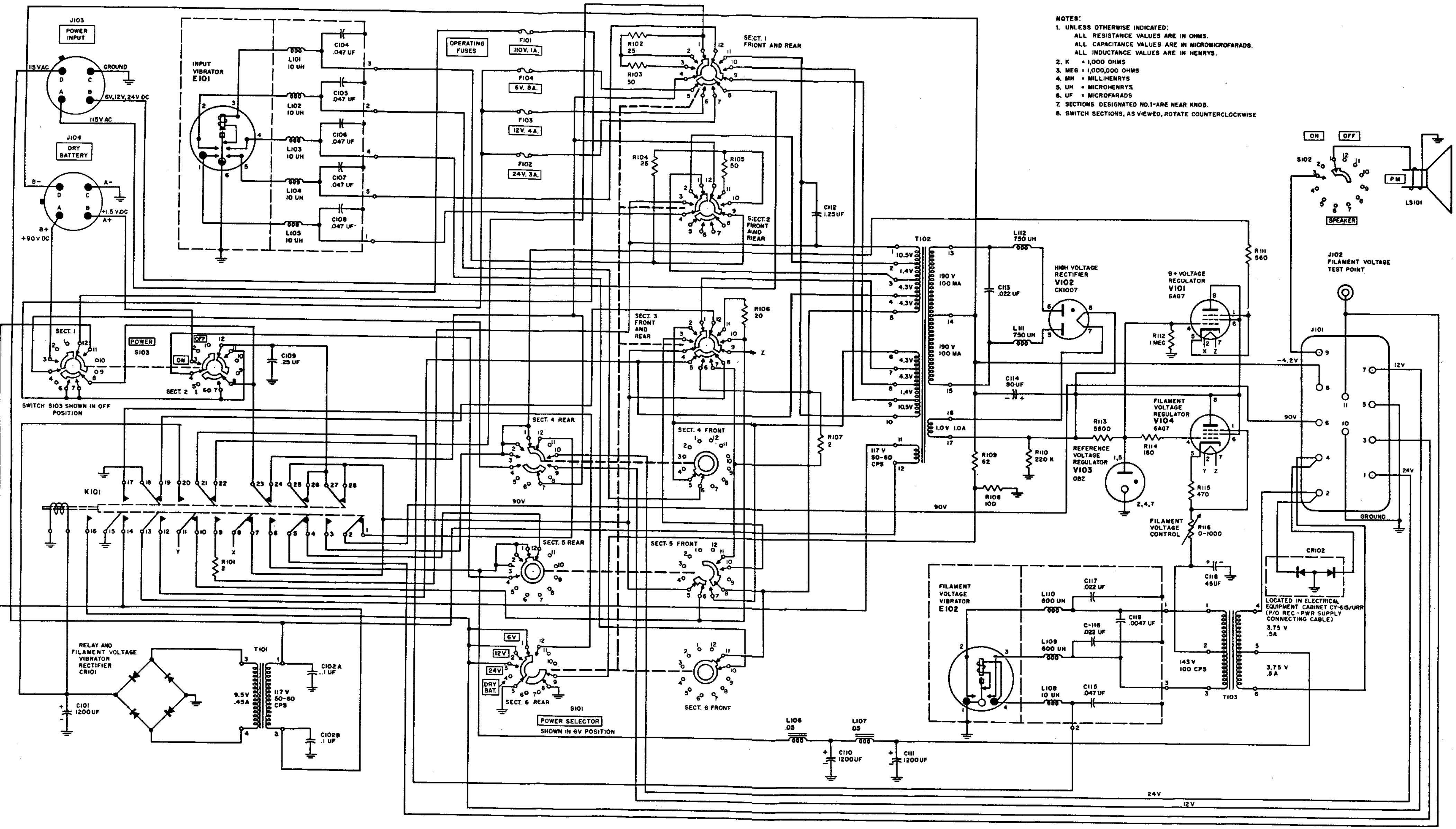


Figure 47. Power Supply PP-308/URR, schematic diagram.

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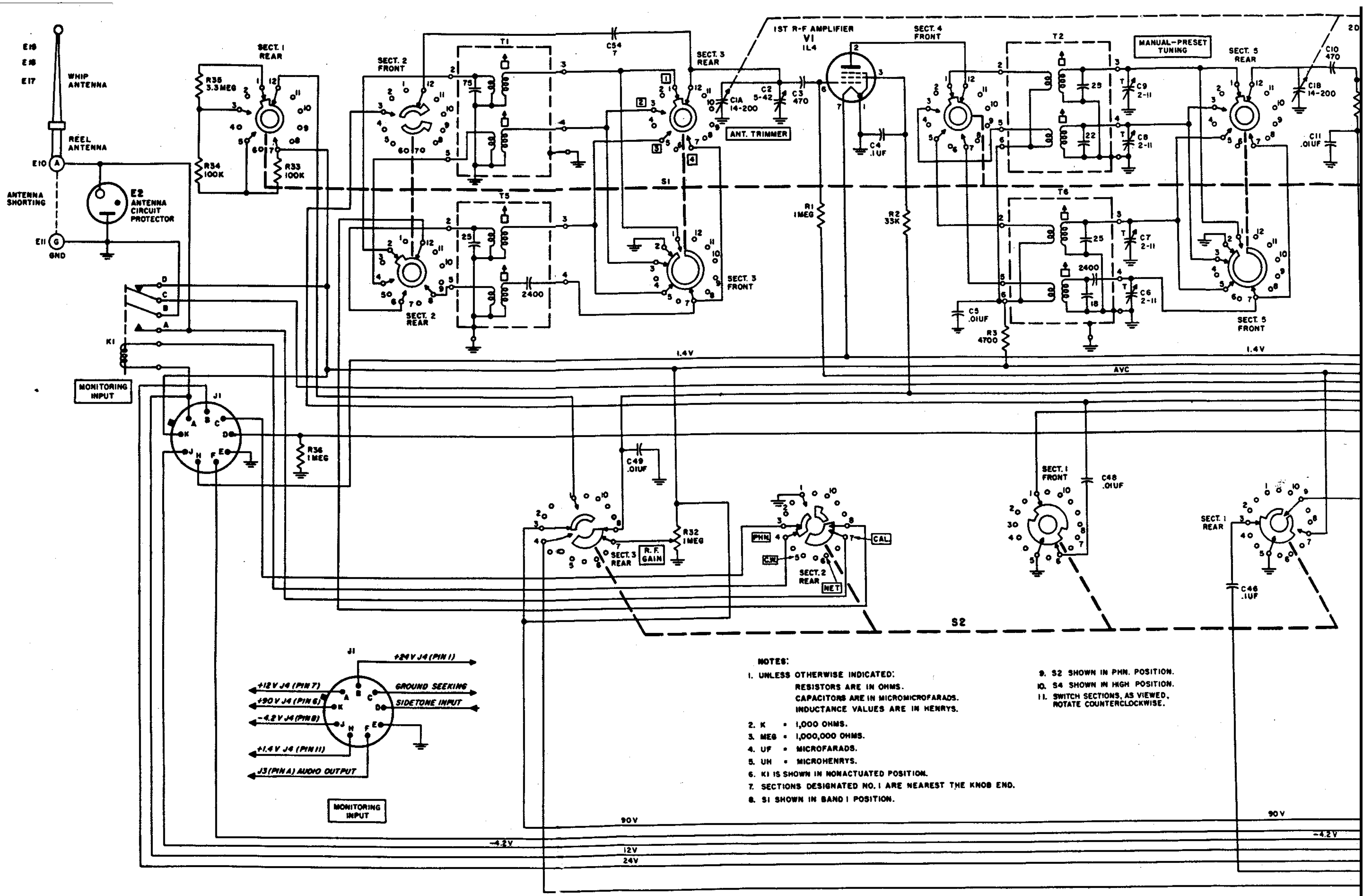

NOTES:

1. UNLESS OTHERWISE INDICATED:
   RESISTORS ARE IN OHMS.
   CAPACITORS ARE IN MICROMICROFARADS.
   INDUCTANCE VALUES ARE IN HENRYS.
2. K = 1,000 OHMS.
3. MEG = 1,000,000 OHMS.
4. UF = MICROFARADS.
5. UH = MICROHENRYS.
6. K1 IS SHOWN IN NONACTUATED POSITION.
7. SECTIONS DESIGNATED NO. 1 ARE NEAREST THE KNOB END.
8. S1 SHOWN IN BAND 1 POSITION.
9. S2 SHOWN IN PHN. POSITION.
10. S4 SHOWN IN HIGH POSITION.
11. SWITCH SECTIONS, AS VIEWED, ROTATE COUNTERCLOCKWISE.

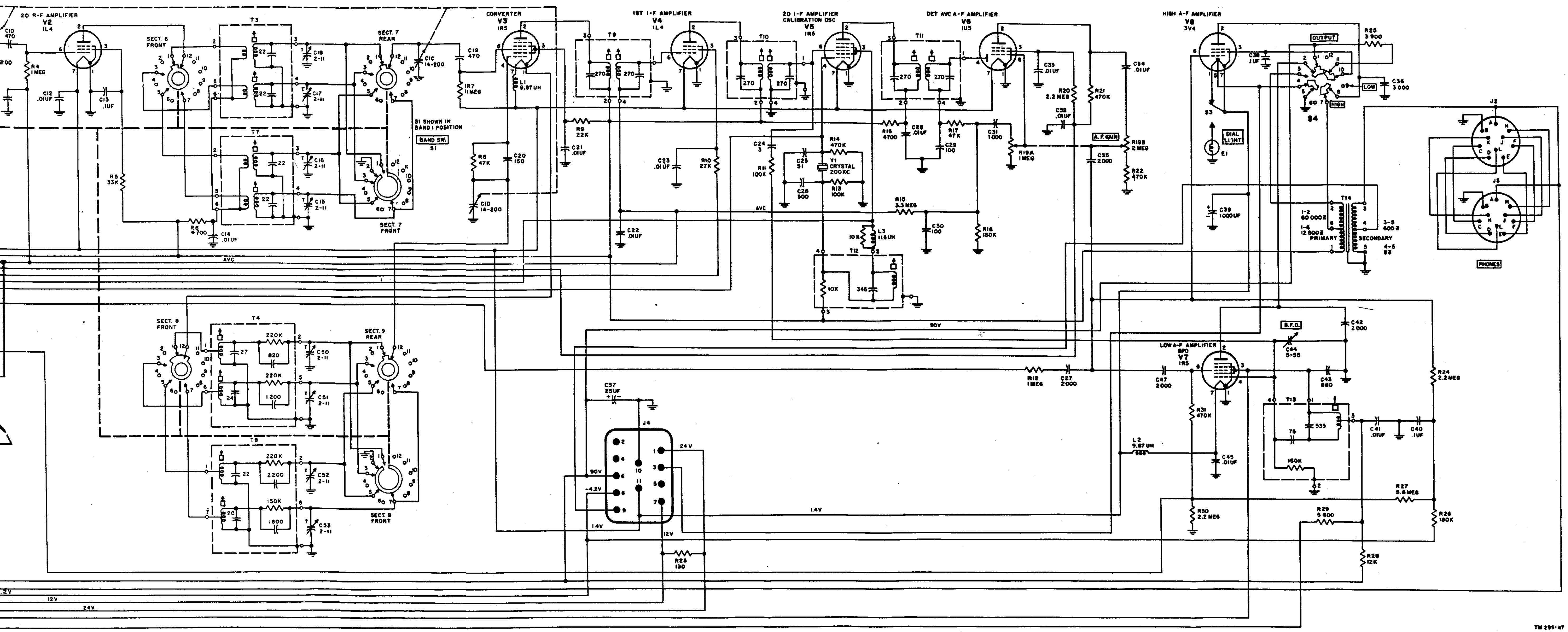

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Figure 48. Radio Receiver R–174/URR, schematic diagram.