33A1-8-12-31

NAVSHIPS 91283

T. O. 33A1-7-24-1

# INSTRUCTION BOOK

for

# R. F. SIGNAL GENERATOR SET AN/URM-25

REVISION NOTICE

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Published by Direction of the Chief, Bureau of Ships, and accepted by the Secretary of the Air Force.

AF-WP-REPRINT-O-OCT 59 800

21 FEBRUARY 1955

REVISED 1 MAY 1959

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| 6-1 | 1 May 1959 |

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# SAFETY NOTICE

This equipment employs voltage which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

## KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all time observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

## DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

## DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

# RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE.

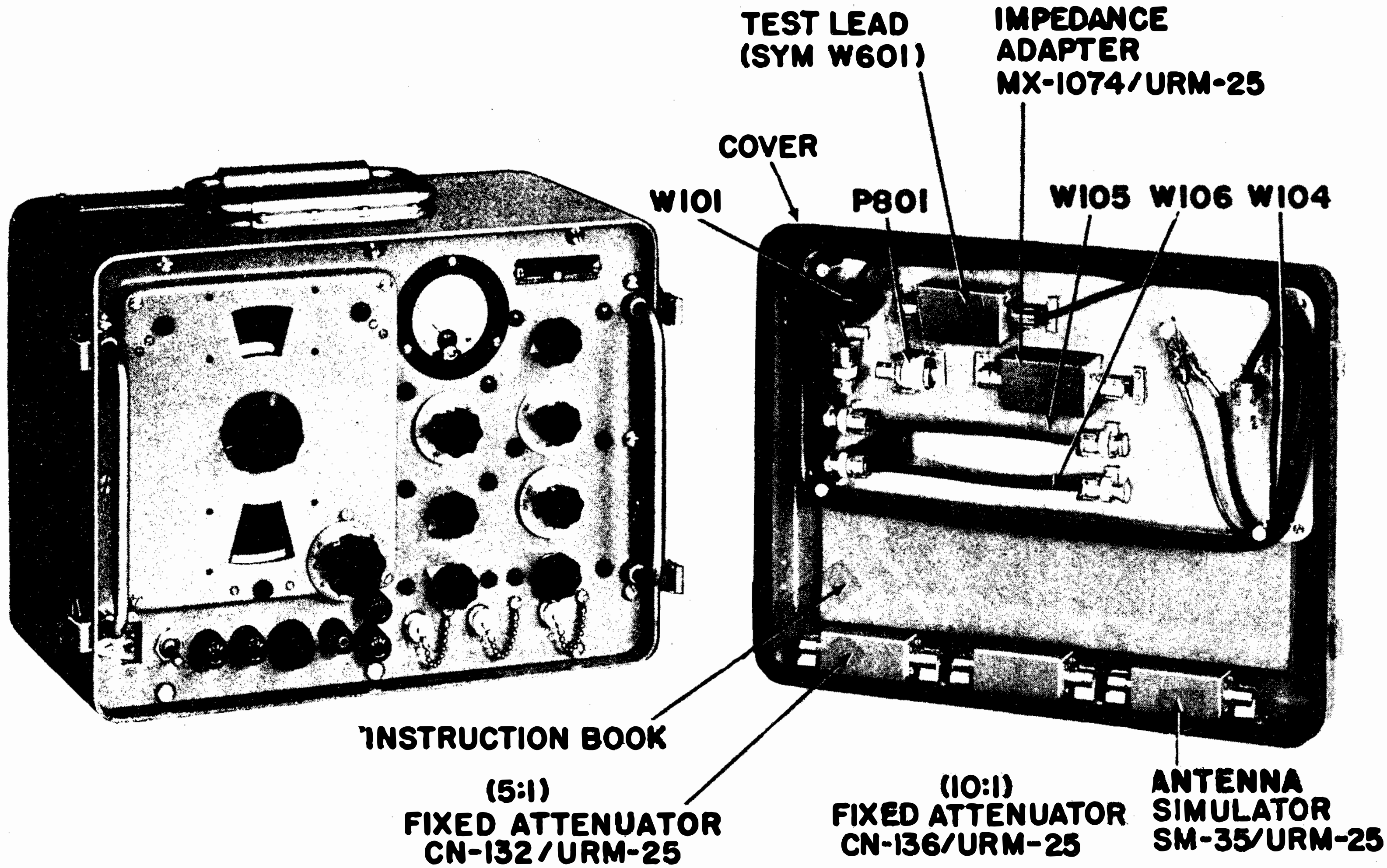



*Figure 1-1. RF Signal Generator Set AN/URM-25, Complete Equipment*

# SECTION 1

# GENERAL DESCRIPTION

## 1. INTRODUCTION.

*a.* The RF Signal Generator Set AN/URM-25 is a test instrument for generating radio frequency signals, either modulated or unmodulated, over a continuous range of frequencies from 10 to 50,000 kilocycles. One of its principal attributes is that it has been miniaturized physically without any loss of accuracy or applicability.

*b.* All units including the power supply, are incorporated in a single portable cabinet (See figure 1–1). The units supplied with their corresponding weights are shown in Table 1–1.

*c.* The AN/URM-25 operates from a source potential of approximately 103 to 126 volts, 50 to 1600 cycles, single phase AC. The equipment is so constructed and shielded that an approximately accurate known radio frequency voltage is obtainable at its output terminals in varying strength as indicated by a meter and associated multiplier indicator.

*d.* The complete equipment consists of the following units:

(1) RF Signal Generator SG-44/URM-25
(2) Power Supply PP-562/URM-25
(3) Impedance Adapter MX-1074/URM-25
(4) Antenna Simulator SM-35/URM-25
(5) (5:1) Fixed Attenuator CN-132/URM-25
(6) (10:1) Fixed Attenuator CN-136/URM-25
(7) Test Lead CX-1363/U
(8) RF Cable Assembly CG-409/U (4′0″)
(9) RF Cable Assembly CG-409/U (7″)—qty 2
(10) Coaxial Adapter UG-201/U
(11) AC Line Cable Assembly

## 2. REFERENCE DATA

*a.* Nomenclature — RF Signal Generator Set AN/URM-25

*b.* Contract—NObsr 43410, 30 June 1949

*c.* Contractor—Federal Manufacturing & Engineering Corporation, 199 Steuben Street, Brooklyn 5, New York

*d.* Cognizant Naval Inspector — Inspector of Naval Material, New York, N. Y.

*e.* Number Of Packages Involved Per Complete Shipment — one package including equipment spares (equipment spares not supplied on shipments to Bureau of Aeronautics).

*f.* Total Cubical Contents — see Table 1–1

*g.* Total Weight — see Table 1–1

*h.* Frequency Range — 10 kilocycles to 50,000 kilocycles ± .5%

*i.* Tuning Bands And Range Of Each Band —

(1) Band A — 10 to 27 kc
(2) Band B — 27 to 80 kc
(3) Band C — 80 to 230 kc
(4) Band D — 230 to 680 kc
(5) Band E — .68 to 2 mc
(6) Band F — 2 to 8.3 mc
(7) Band G — 8.3 to 18 mc
(8) Band H — 18 to 50 mc

*j.* Types Of Modulation —

(1) Amplitude modulation — 0 to 80% (indicated accuracy within ± 10%).

(2) Internal modulation frequencies

(*a*) 400 cycles per second ± 5%
(*b*) 1000 cycles per second ± 5%.

(3) External modulation frequency — 100 to 15,000 cycles per second.

*k.* Output Voltage.

(1) 0.1 to 100,000 mocrivolts (± 10%) continuously variable (across a 53.5 ohm external load).

(2) Approximately 2 volts-adjustable (across a high load impedance).

*l.* Output Impedance.

(1) 53.5 ohms at the X MULT RF OUTPUT jack (J–102).

(2) 500 ohms at the X 20,000 RF OUTPUT jack (J–101).

*m.* Power Supply PP–562/URM–25.

(1) Power source requirements — 115 volts AC (± 10%) 50 to 1600 cycles per second, single phase.

(2) Power consumption of equipment is approximately 45 watts.

## 3. DETAILED DESCRIPTION.

*a.* The rated frequency range is 10 kilocycles to 50,000 kilocycles per second. This range is covered in eight bands by a band selector switch located on the front panel. Within each band the frequency is varied by means of a straight line frequency capacitor. Percentage frequency change is therefore proportional to capacitor dial rotation. The frequency generated can be read from a main frequency scale, which is geared to this variable capacitor.

*b.* The output is continuously variable from 0.1 to 100,000 microvolts and is determined by a meter reading in association with a multiplier and external attenuator settings. An adjustable two volt, open circuit, output is also available.

*c.* The output may be either modulated or unmodulated. Modulation is adjustable between 0 and 80 percent. An internal modulation source of either 400 or 1000 cycles per second is provided. Provision is also made for external modulation.

## 4. ELECTRON TUBE COMPLEMENT.

The quantities and types of electron tubes used with the AN/URM-25 are listed in Table 1-3.

### TABLE 1-1. EQUIPMENT SUPPLIED

| QUANTITY PER EQUIPMENT | NAME OF UNIT | NAVY TYPE OR A-N DESIGNATION | OVER-ALL DIMENSIONS (INCHES) | | | VOLUME (CU. IN.) | WEIGHT (LBS.) |
|---|---|---|---|---|---|---|---|
| | | | HEIGHT | WIDTH | DEPTH | | |
| 1 | RF Signal Generator Set | AN/URM-25 | 10-1/4 | 13 | 10-1/4 | 1300 | 35 |
| 1 | a. RF Signal Generator | SG-44/URM-25 | | | | | |
| 1 | b. Power Supply | PP-562/URM-25 | | | | | |
| 1 | c. Impedance Adapter | MX-1074/URM-25 | | | | | |
| 1 | d. Antenna Simulator | SM-35/URM-25 | | | | | |
| 1 | e. (5:1) Fixed Attenuator | CN-132/URM-25 | | | | | |
| 1 | f. (10:1) Fixed Attenuator | CN-136/URM-25 | | | | | |
| 1 | g. Test Lead | CX-1363/U | | | | | |
| 1 | h. RF Cable Assembly (sym W104) | CG-409/U (4'0") | | | | | |
| 2 | i. RF Cable Assembly (sym W105, W106) | CG-409/U (7") | | | | | |
| 1 | j. AC Line Cable Assembly (sym W101) | | | | | | |
| 1 | k. Coaxial Adapter (sym P701) | UG-201/U | | | | | |
| 1 | Equipment Spares (not supplied on Bureau of Aeronautics shipments) | | 6 | 9 | 12 | 648 | 8 |

### TABLE 1-2. SHIPPING DATA

| NUMBER OF BOXES | CONTENTS | | OVERALL DIMENSIONS (INCHES) | | | VOLUME (CU. IN.) | WEIGHT (LBS.) |
|---|---|---|---|---|---|---|---|
| | NAME | DESIGNATION | HEIGHT | WIDTH | DEPTH | | |
| | RF Signal Generator Set | AN/URM-25 | | | | | |
| 1 | a. When Shipped with Equipment Spares (Buships Shipments) | | 16 | 25 | 19 | 7600 | 55 |
| OR 1 | b. When Shipped with Equipment Spares (Coast Guard Shipments) | | 16 | 25 | 19 | 7600 | 55 |
| OR 1 | c. When Shipped Less Equipment Spares (Buaer Shipments) | | 14 | 17 | 15 | 3570 | 44 |

### TABLE 1-3. ELECTRON TUBE COMPLEMENT

| NUMBER REQUIRED | TUBE TYPE | SYMBOL DESIG. | FUNCTION | LOCATION |
|---|---|---|---|---|
| 1 | 12AU7 | V101 | Voltmeter Bridge | Audio Compartment |
| 1 | 12AU7 | V102 | Modulation Oscillator | Audio Compartment |
| 1 | 6AL5 | V103 | Modulation Diode | Audio Compartment |
| 1 | 6J4 | V104 | Buffer-Amplifier | Buffer-Amplifier Compartment |
| 1 | 9006 | V105 | RF Diode | Buffer-Amplifier Compartment |
| 1 | 6J6 | V106 | Carrier Oscillator | Carrier Oscillator Compartment |
| 1 | 6X4 | V201 | B+ Rectifier | Power Supply PP-562/URM-25 |
| 1 | 0D3/VR-150 | V202 | B+ Regulator | Power Supply PP-562/URM-25 |

RF Signal Generator SG-44/URM-25

# SECTION 2
# THEORY OF OPERATION

## 1. GENERAL DESCRIPTION OF CIRCUITS.

(See figure 2–1).

*a.* The purpose of this section is to give the Electronics Technician a better understanding of the RF Signal Generator Set AN/URM–25 so that he can apply himself to the operation and maintenance problems that may arise.

*b.* The functional principle of the AN/URM–25 is similar to that of a radio frequency transmitter. This association will become more apparent as the technician reads and studies this section. A carrier oscillator (par. 2) generates a variable RF signal which is applied to the control grid of a buffer-amplifier (par. 3). A modulation oscillator (par. 4) generates an audio voltage (400 or 1000 cycles) which is also applied to the control grid of the buffer-amplifier to grid modulate the RF signal. The modulated signal is then taken from the buffer-amplifier and fed to a step attenuator circuit (par. 6) where the desired output amplitude is selected. An electron tube voltmeter, consisting of an RF diode, modulation diode and voltmeter bridge, is provided for measuring the carrier output and percentage modulation. Provision is also made for external modulation.

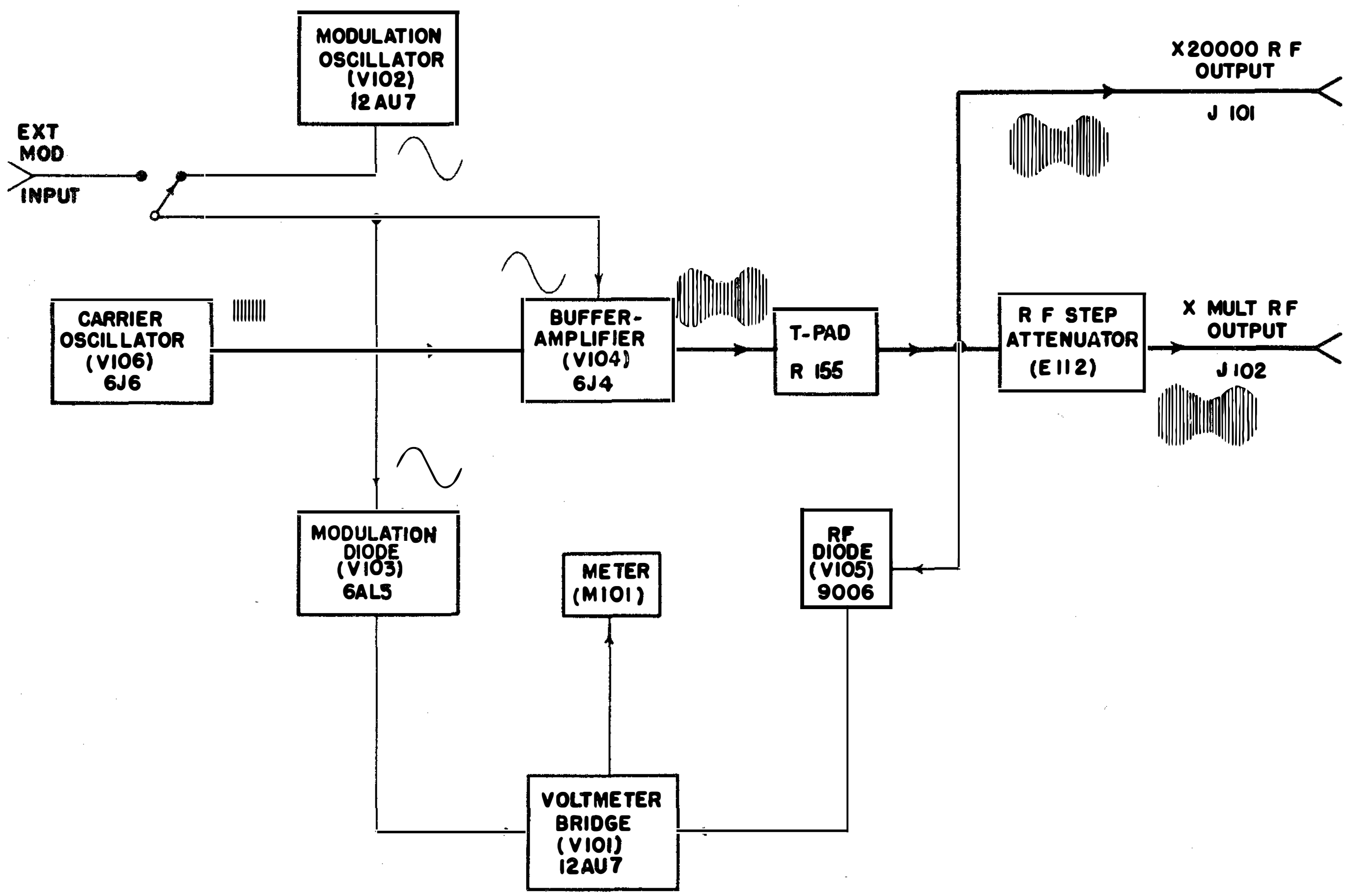



*Figure 2–1. RF Signal Generator SG-44/URM-25, Functional Block Diagram*

*c.* A detailed analysis of the principle circuit assemblies is covered in this section under the following headings and paragraphs.



## 2. CARRIER OSCILLATOR.

(See figure 2–2).

*a.* With the exception of plate choke L-103, filament choke L-104, capacitor C-122, and CARRIER CONTROL R-123, the carrier oscillator circuit is completely enclosed in a shielded compartment located on the left side of the signal generator unit. It is of the conventional Hartley type with adjustable high Q iron core inductances (L–105 through L–111) and trimmer capacitors (C–128 through C–134) provided for frequency ranges A through G. There is no trimmer capacitor or adjustable inductance provided for the highest frequency range (band H). The accuracy of frequency calibration is ± .5%, and the oscillator may be calibrated by means of these adjustable inductances and capacitors. (see section 6 par. 9).

*b.* The range of frequencies covered is from 10 kilocycles to 50 megacycles per second in 8 bands with an overlap of at least 3%. The desired band (A through H) is selected by the FREQUENCY BAND SWITCH (S–105). This switch is of the rotary selector, shorting type and serves three functions as follows:

(1) Selects applicable "inductance-capacitance" combination.

(2) Selects proper grid leak resistance and blocking capacitance combination for V–106.

(3) Shorts to ground "inductance-capacitance" combinations not utilized at the selected frequency band.

The alternate shorting of "inductance-capacitance" combinations is necessary in eliminating stray inductance and capacitance at the frequency range selected.

*c.* The principal electrical features of the carrier oscillator are shown in the simplified schematic diagram, figure 2–2. For purposes of simplifying the circuit analysis, the mechanics of the FREQUENCY BAND SWITCH (S–105) have not been included in this figure. M and N represent the contact positions of the FREQUENCY BAND SWITCH (S–105) when set at band E. The details of the carrier oscillator are covered in the overall schematic diagram (figure 6–23) near the end of Section 6.

*d.* The oscillator tube (V–106) is a type 6J6 dual triode with both sections connected in parallel. The frequency of the oscillations is determined by the L-C constant of the resonant tank circuit. The main tuning capacitor (C–127) is of the straight line frequency type, designed to give a linear frequency change with rotation except at the extreme ends of the frequency range. All frequency bands, with the exception of the highest band (H), can be calibrated by adjustment of the associated trimmer capacitor and variable iron core inductance. If necessary, band H can be calibrated by varying the spacing between the turns of L–105. This is discussed in Section 6, par. 9.

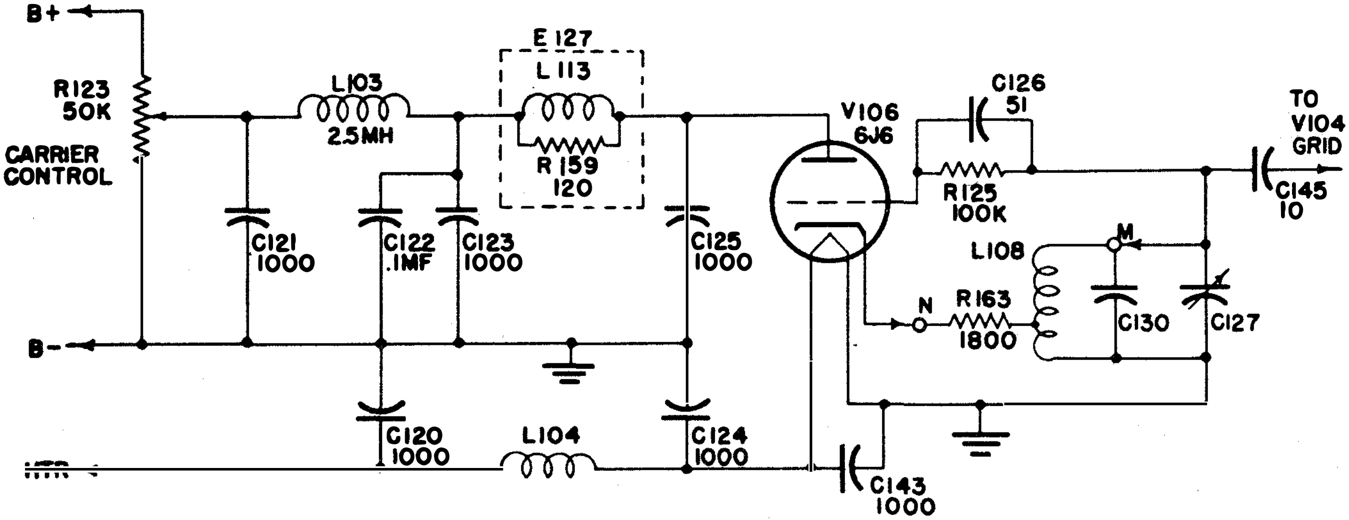



*Figure 2–2. Simplified Schematic Diagram of the Carrier Oscillator*

*e.* Bias for the oscillator tube (V–106) is provided by grid current which charges the grid blocking capacitor (C–126) through the cathode to grid resistance-(R–125). The resistor (R–125) in parallel with the capacitor (C–126) allows this capacitor to discharge during the portion of the RF cycle when the grid is not positive with respect to the cathode. The net result is a bias on the grid which is proportional to the amplitude of the RF voltage across the grid tank circuit. When the FREQUENCY BAND SWITCH (S–105) is set fór bands G or H, a 2200 ohm resistor (R–124) shunts the 100,000 ohm grid leak resistor (R–125) presenting an effective grid leak resistance of 2200 ohms for these bands. This is shown in the schematic diagram, figure 6–23 near the end of Section 6.

*f.* A parasitic suppressor (E-127) consisting of an inductance (L-113) wound around a resistor (R-159) serves to suppress spurious oscillations which are apt to be more pronounced at the highest frequency range (18 to 50 mc) of the signal generator. The filter network in the plate circuit, consisting of an inductance (L-103) and three capacitors (C-121, C-122, C-123) serves to eliminate stray RF currents from the oscillator compartment and interconnecting leads. Feedthru capacitor C-121 permits the entry of the lead from the CARRIER CONTROL (R-123) into the filter network and also bypasses stray RF currents along this lead.

*g.* The carrier amplitude is adjusted to the required value by means of the CARRIER CONTROL (R-123) which is a linear potentiometer that varies the voltage applied to the plate of the oscillator tube (V-106). A different V-106 cathode resistor (R-158, R-160, R-162, R-163) is switched into the circuit for bands A, B, D, and E to improve the output voltage linearity of R-123 on these ranges.

*h.* In changing frequency bands, the main tuning capacitor (C–127) is shunted by the corresponding inductance and trimmer capacitance and is connected between the grid leak resistor and ground. This tuning capacitor is geared to the frequency scale (N–101, see figure 4–1). The scale rotates through 180 degrees and is divided into eight frequency ranges (bands A thru H).

*i.* The FREQUENCY BAND SWITCH (S–105) has a scale mask (H–101) connected to it, so that only the frequency range or band selected can be viewed through the front panel of the signal generator. A more complete discussion of the frequency adjusting system is given in Section 4, par. 4.

### 3. BUFFER-AMPLIFIER.

(See figure 2–3).

*a.* The buffer-amplifier is an untuned RF amplifier inserted electrically and physically between the carrier oscillator and audio compartments and is completely enclosed in a shielded compartment. It consists of a triode type 6J4 (V–104) and associated circuit. This circuit serves the dual function of isolating the carrier oscillator from output terminal loading and introducing the amplitude modulation.

*b.* As a buffer stage, the buffer-amplifier makes the carrier oscillator independent of the setting of either the MICROVOLTS control (R–155) or MULTIPLIER (E–112–Step Attenuator), as well as independent of any load that may be presented to the output of the signal generator. (See figure 6–23).

*c.* Modulation is accomplished by introducing the audio voltage from the modulation oscillator (V–102) or from an external source to the grid of the buffer-amplifier tube (V-104). Due to the nature of the circuit, the amplitude of this audio voltage is directly correlated to the degree of modulation and adjustable by means of the % MODULATION control (R-111). Coupling capacitor C-108 is provided to block the DC grid bias of V-104 from the audio circuit. This audio voltage is also applied to the plate circuit of the modulation diode (V-105) where it is rectified and fed to the voltmeter bridge circuit for indication of % Modulation on M-101 (see Section 2, par. 5).

*d.* A decoupling network consisting of C-114 and R-164 serves to minimize the presence of incidental frequency modulation effects on the carrier oscillator circuit.

*e.* The plate supply voltage of V-104 is unregulated at +240 volts DC. The grid bias is preset by adjustment of the cathode BIAS resistor (R-113) to introduce a DC grid voltage of approximately 3.5 volts. This voltage is critical and is selected to maintain a minimum of both carrier and audio distortion.

*f.* The output of V-104 is coupled to the attenuator circuit through a network selected by the CARRIER RANGE switch (S-104). When operating the signal generator at frequency bands A thru C, this switch should be set at position ABC. In this position the output is taken from the plate of V-104 through two parallel capacitors (C-112, C-113) which offer a total capacitance of 10,510 micromicrofarads. These capacitors present a low reactance to permit sufficient output at low carrier frequencies (below 230 kc). Too low an output reactance would result in the presence of audio voltage in the output circuit. To avoid this condition carrier frequencies below 230 kc should never be modulated by audio frequencies above 1000 cycles. The CARRIER RANGE switch (S-104) should be set at the DEFG position when operating on frequency bands D thru G. In this position, the output of V-104 is fed through a single 510 microfarad capacitor (C-112). The isolation of audio voltage from the output is thus improved at high frequencies. A peaking inductance L-104 is provided for the highest frequency range (band H). This inductance is inserted when S-104 is set in the H position. It compensates for the distributed output capacitance of the buffer-amplifier and serves to decrease RF distortion and increase output on band H of the signal generator.

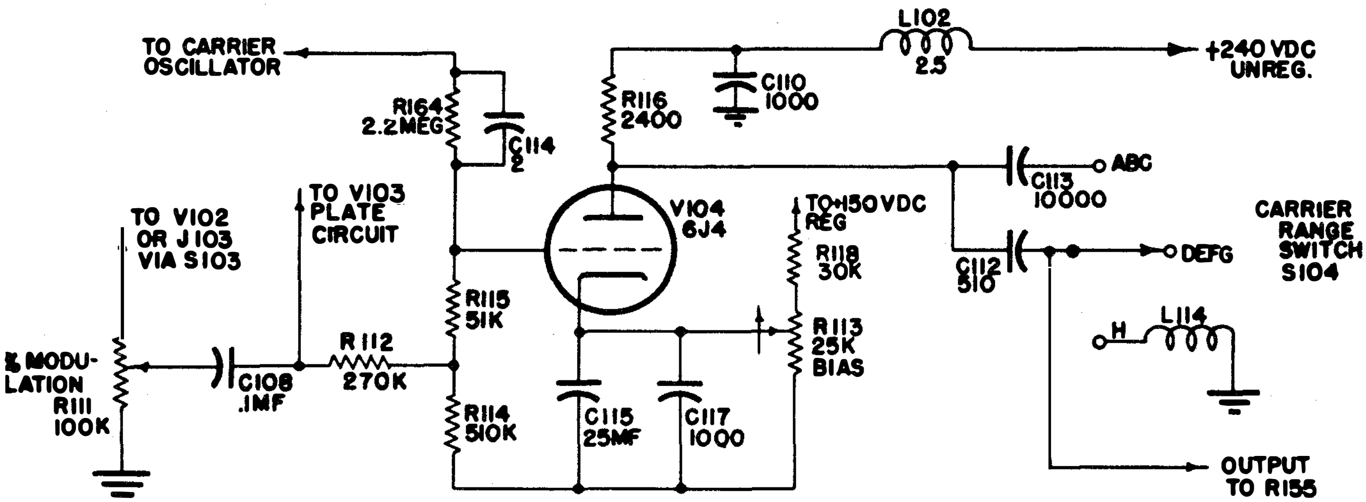



*Figure 2–3. Simplified Schematic Diagram of the Buffer-Amplifier*

**4. MODULATION OSCILLATOR.**

(See figure 2–4).

*a.* The modulation oscillator is contained in the audio compartment and is a standard Wien-bridge oscillator utilizing a 12AU7 dual triode tube (V–102). It is capable of generating an audio signal frequency of either 400 or 1000 cycles per second depending upon the position of the MOD SELECTOR switch (S–103). When the MOD SELECTOR switch is in the "EXT" position, the modulation oscillator is inoperative and an external modulating voltage may be applied to the EXTERNAL MOD INPUT jack (J–103) and thus directly across the % MODULATION control (R–111). Figure 2–4 is a simplified schematic circuit of the modulation oscillator. For purposes of discussion clarity, the mechanics of the MOD SELECTOR switch (S–103) have been omitted. Points X and Y indicate the electrical positions of this switch when set for 1000 cycles per second operation. The complete modulation oscillator is shown in figure 6–23 near the end of Section 6.

*b.* Tube section V–102B acts as an amplifier and inverter. Even without the Wien-bridge circuit, this system could oscillate since any signal that appears on the grid of V–102A is amplified and inverted by both V–102A and V–102B. The voltage fed back to the grid of V–102A then must reinforce the initial signal and cause oscillations to be set up and maintained. This type of system, however, would amplify voltages of a very wide range of frequencies. The bridge circuit is used to eliminate feedback voltages of all frequencies except the single frequency desired in the output. The bridge allows a voltage of only one frequency to be effective in the circuit because of the degeneration and phase shift provided. Oscillations can take place only at the frequency which permits the voltage across resistor R–104 (input signal to V–102A) to be in phase with the output voltage from V–102B, and for which the positive feedback voltage exceeds the negative feedback voltage. Voltages of any other frequency cause a phase shift between the output signal of V–102B and the input to V–102A. Undesired frequencies are thus attenuated by a high degree of degeneration so that the feedback voltage is insufficient to sustain oscillations at frequencies other than the desired frequency.

*c.* The degenerative or negative feedback voltage is provided by the voltage divider network consisting of the cathode resistor (R–105), a potentiometer (R–110) and series resistor (R–117). Since there is no phase shift across this voltage divider, and since the resistances are practically constant for all frequencies, the amplitude of the negative feedback voltage is constant for all audio frequencies that may be present at the output of V–102B. The degeneration control potentiometer (R–110) is preset to sustain oscillation at both 400 and 1000 cycles per second, with minimum distortion.

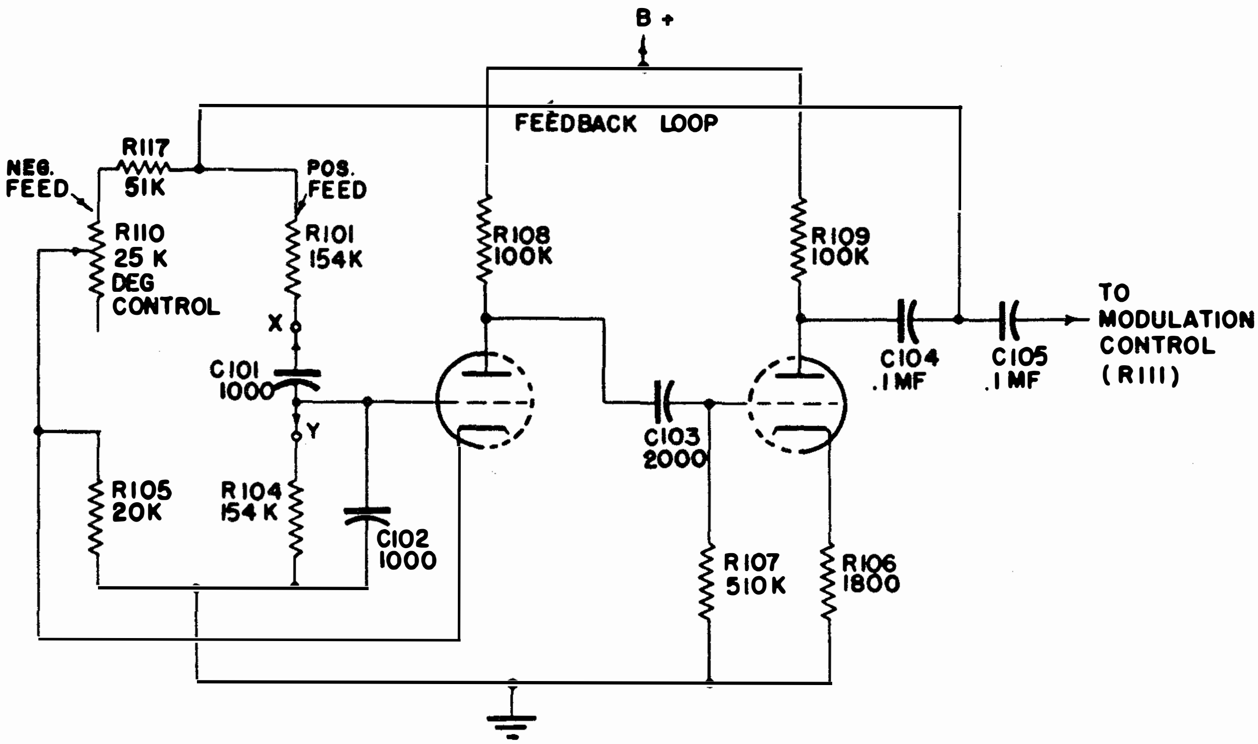



*Figure 2–4. Simplified Schematic Diagram of the Modulatin Oscillator*

*d.* Regeneration or positive feedback is provided by a voltage divider consisting of two resistors (R–101, R–104) and two capacitors (C–101, C–102), when the MOD SELECTOR switch is set for 1000 cycle operation. At very high frequencies the reactance of C–102 is low and any positive feedback voltage applied to the grid of V–102A will be at a minimum. At very low frequencies, the reactance of C–101 will be high and the positive feedback voltage applied to the grid of V–102A will subsequently be low. It can also be shown that for maximum regeneration at the desired frequency, the voltage across resistor R–104 will be in phase with the output from V–102B when :R–101 × C–101 = R–104 × C–102.

## 5. ELECTRON TUBE VOLTMETER.

The electron tube voltmeter consists of three fundamental circuits, namely, the RF diode (V–105), the modulation diode (V–103) and the voltmeter bridge (V–101). The voltmeter bridge tube (V–101) and modulation diode (V–103) circuits are contained in the audio compartment, whereas the RF diode (V–104) circuit is located in the buffer-amplifier compartment. A meter (M–101) is provided on the front panel of the signal generator to give the appropriate voltage indication. This voltmeter circuit makes it possible to determine both the carrier output strength and percentage of modulation.

*a.* RF DIODE. (See figure 2–5).

(1) The RF diode (V–104) rectifies the carrier output signal of the buffer-amplifier (V–105) which is then applied to the voltmeter bridge (V–101) circuit. The strength of this RF signal is indicated on the meter (M–101).

(2) V–104 is a type 9006 tube. The RF voltage is taken from the plate circuit of the buffer-amplifier (V–105) and applied across V–104. Through a T pad described in paragraph 6i of this section.

(3) The rectified RF signal appears across the cathode resistors R–126 and R–127. A 56 micromicrofarad capacitor (C–142) and a 1000 micromicrofarad capacitor (C–136) serve to bypass the RF energy from the voltmeter bridge circuit. An additional feedthru type RF bypass capacitor (C–137) permits the entry of the RF diode (V–105) output into the audio compartment. The bypass capacitor C–135 filters the RF energy from the filament lead to V–105. A part of the rectified RF signal voltage is taken across R–127 and applied to the grid of the bridge tube (V–101B) when the METER READS switch (S–102) is in the RF position. The RF voltage is read from the upper scale of the meter (M–101). This scale is calibrated from 0 to 100 microvolts. When the meter indicates 100 microvolts, two volts output, open circuit, is present at the X 20,000 RF OUTPUT jack (J-101). When J-101 is terminated in its characteristic impedance (500 ohms) a meter reading of 100 microvolts represents an output of one volt. Similarly, if the output is taken from the X MULT RF OUTPUT jack (J-102), and this jack is terminated in its characteristic impedance (53.5 ohms), the voltage at

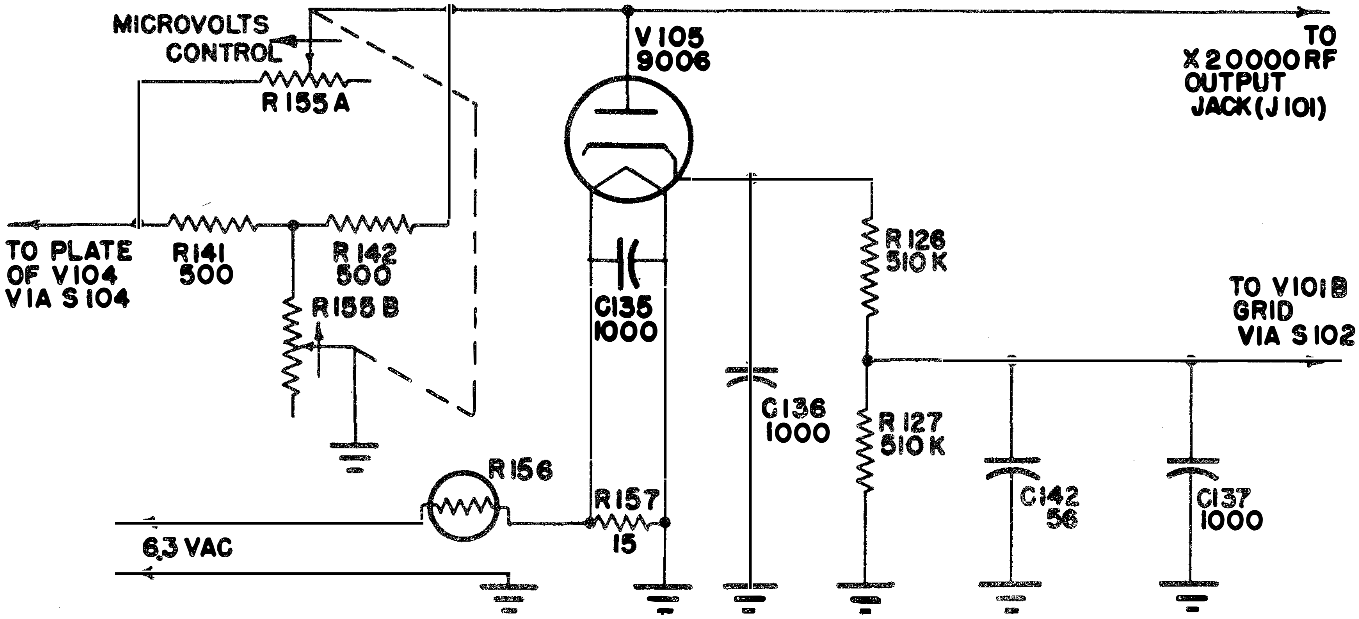



*Figure 2–5. Simplified Schematic Diagram of the RF Diode*

J-102 is determined by multiplying the MULTIPLIER dial (I-104) setting by the meter reading. (See Section 2 par. 6 and par. 7).

(4) A ballast regulator lamp (R-156) connected in series with the filament of V-105 minimizes the effects of varying line voltage on the contact potential of the tubes. This contact potential is an emission characteristic which is prevalent in diodes. Its static effects are eliminated by adjustment of the RF COMP control (R-128), a screwdriver adjustment located on the audio compartment (See figure 2–7). The filament shunt resistor (R-157) improves the regulation characteristics of the ballast lamp by decreasing the cold to hot resistance change of the ballast load.

*b.* MODULATION DIODE. (See figure 2–6).

(1) The modulation diode (V-103) is a type 6AL5 dual diode with only one tube section used. It rectifies the modulating voltage. This rectified voltage is

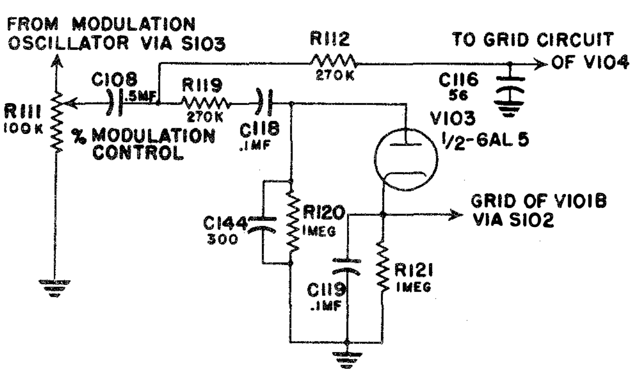



*Figure 2–6. Simplified Schematic Diagram of the Modulation Diode*

then applied to the grid of the voltmeter bridge tube (V-101B) for determination of percentage modulation. The same voltmeter bridge is used for reading percentage modulation as is used for determining carrier output strength. The principal features of the modulation diode are shown in Figure 2–6.

(2) The percentage modulation of the carrier frequency is determined by the modulation voltage applied to the control grid of the buffer-amplifier (V-104). This modulation voltage is taken from the 100,000 ohm % MODULATION potentiometer (R-111) and applied across the modulation diode (V-103) circuit where it is rectified. Resistors R-119 and R-121 serve as a voltage divider. A part of this rectified audio voltage is taken across R-121 and applied to V-101B when the METER READS switch (S-102) is in the % MOD position. Capacitors C-108 and C-118 block the DC grid voltage of V-104 from R-111 and V-103. Due to the modulation characteristic of the buffer-amplifier circuit, the degree of modulation is a function of audio voltage and independent of the carrier amplitude. The audio voltage amplitude applied to the grid of V-104 is therefore correlated to the percentage of modulation and read directly from the lower scale of M-101.

*c.* VOLTMETER BRIDGE CIRCUIT. (See figure 2–7).

(1) The voltmeter bridge (V-101) circuit provides a means for applying the rectified signals from either the RF or modulation diodes to the meter (M-101). The bridge circuit utilizes a tube type 12AU7 (V-101) dual triode and is located in the audio compartment. The principal electrical features of the voltmeter bridge circuit are shown in figure 2–7.

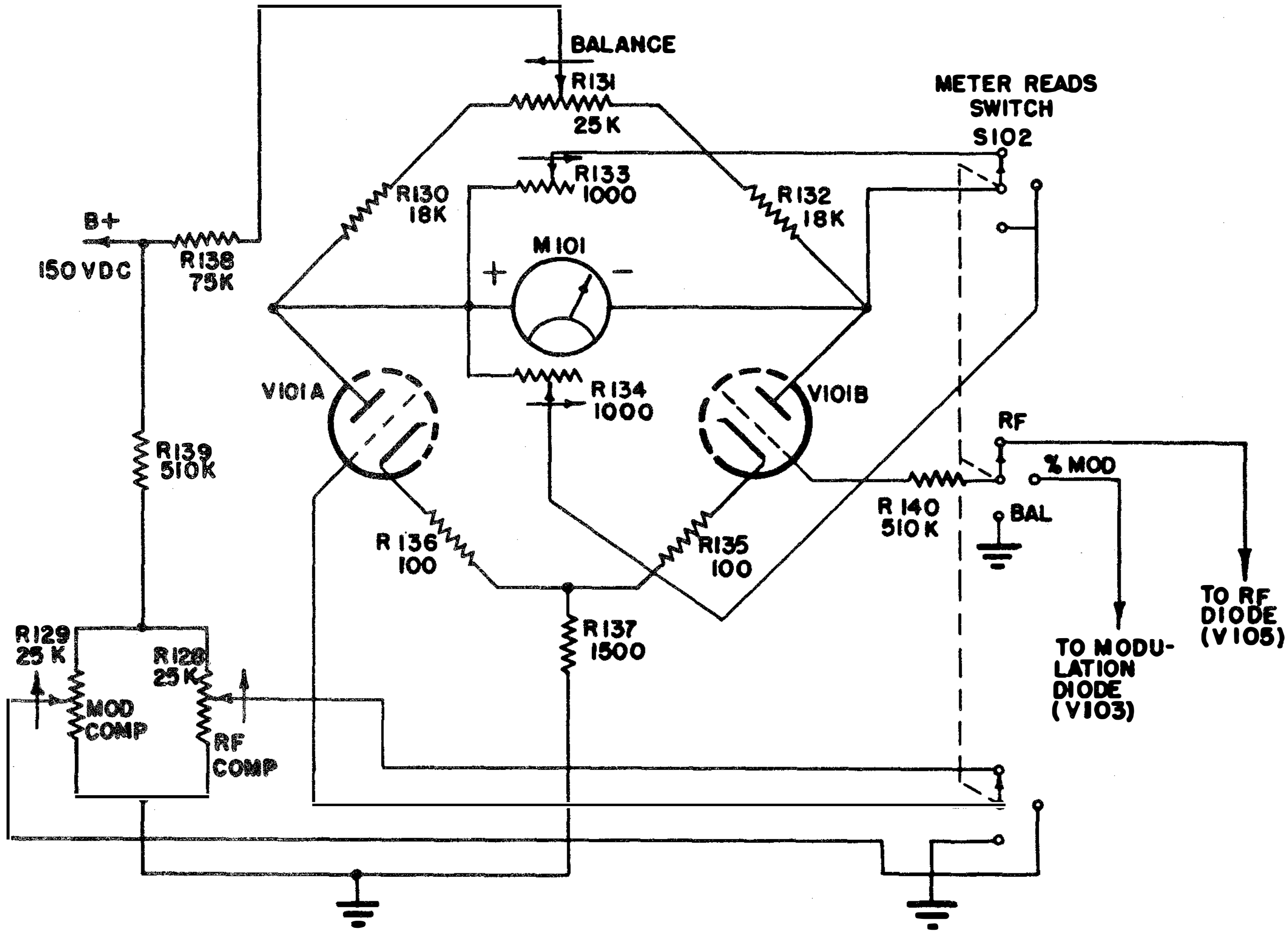



*Figure 2–7. Schematic Diagram of the Voltmeter Bridge Circuit*

(2) The fundamental principle of the voltmeter bridge is that of a Wheatstone bridge in which the DC plate resistances of the triode sections form two of the arms. When the bridge is balanced, the DC plate resistances of both triode sections are equal and no current flows through the meter (M-101). The movement of this meter is such that 100 microamperes gives full scale deflection. Tube section V-101B is the "unbalancing" part of the bridge, its DC plate resistance varying in accordance with the bias supplied by the rectified voltage from the RF diode (V-105) or modulation diode (V-103). The degree of unbalance is determined by the strength of the carrier signal or modulation voltage and is indicated by a reading on M-101.

*d.* VOLTMETER BRIDGE ADJUSTMENTS.

(1) The RF COMP (R-128) and MOD COMP (R-129) controls are located on the audio compartment. They are provided to compensate for the contact potential of V-105 and V-103. This contact potential is due to the static emission present when the heated tube filaments create electrostatic fields in these diodes resulting in some flow of current. The effects of contact potential can be detected by first adjusting R-131 for zero meter reading with the METER READS switch (S-102) in the BAL position. Resistor R-131 varies the relative B+ voltage applied to the plates of both sections of V-101 until the bridge is balanced. With the MICROVOLTS control (R-155) and % MODULATION control (R-111) set fully counterclockwise M-101 should read zero in either the RF or % MOD position of S-102. A residual meter reading in either switch position indicates the presence of contact potential at the grid of V-101B. Adjustment of R-128 places a balancing potential on the grid of V-101A to compensate for this effect in the RF position of S-102. Resistor R-129 has a similar effect for the % MOD position of S-102.

(2) R-133 and R-134 are the meter sensitivity controls for the RF and % MODULATION scales of M-101. These potentiometers are adjusted whenever it is suspected that either meter range is incorrect. This procedure is discussed in Section 6 par. 10.

## 6. VARIABLE RF ATTENUATOR.

(See figure 2–8).

*a.* The RF attenuator circuit consists of a step attenuator (E-112) and dual potentiometer MICROVOLTS control (R-155), both located in the shielded buffer-amplifier compartment. Both controls vary the carrier voltage applied to the X MULT RF OUTPUT jack (J-102) but only the MICROVOLTS control (R-155) affects the voltage at the X 20,000 RF OUTPUT jack (J-101). The value of the voltage at the X MULT RF OUTPUT jack (J-102) is determined by multiplying the meter (M-101) reading by the indicated position of the MULTIPLIER dial (I-104). The entire circuit is effectively resistive so that the attenuation introduced is substantially independent of frequency within the limits of the instrument. The output impedance of the attenuator system as taken from the X MULT RF jack (J-102) is constant at 53.5 ohms for any position of the attenuator MULTIPLIER dial (I-104). The attenuator (E-112) and associated circuit are shown schematically in figure 2–8.

*b.* The X 20,000 RF OUTPUT jack (J-101) voltage is taken from the dual potentiometer MICROVOLT control (R-155) and is not attenuated by the step attenuator (E-112). The voltage developed across this jack depends upon the setting of the CARRIER CONTROL (R-123) and MICROVOLT control (R-155) and its output impedance is constant at 500 ohms. When this jack is terminated in its characteristic impedance (500 ohms), the output voltage is determined by multiplying the meter (M-101) reading by 10,000. When it is not terminated (open circuited), the output voltage will be 20,000 times the indicated reading on the meter (M-101).

*c.* Whenever the frequency of the signal generator is changed, reset the X 20,000 RF OUTPUT jack (J-101) voltage for a meter (M-101) reading of "100," by rotating the MICROVOLT control (R-155) fully clockwise and then rotating the CARRIER CONTROL (R-123) in a clockwise direction until the meter reads "100." This represents two volts open circuit output from J-101 and one volt output when this jack is terminated in its characteristic impedance (500 ohms).

*d.* The step attenuator (E-112) attenuates the output from the X MULT RF OUTPUT jack (J-102) in steps of ten as indicated on the dial plate (I-104). The voltage at J-101 will not be affected by the position of this dial.

*e.* The useful output voltage from the X MULT RF OUTPUT jack (J-102) is always based on terminating this jack in its characteristic impedance (53.5 ohms); thus, when the output from J-102 is fed to a receiver under test, with the impedance properly matched, the reading on the signal generator meter will indicate the input voltage to the receiver under test. This is discussed more fully in section 2, paragraph 7, TERMINATING THE SIGNAL GENERATOR.

*f.* When the voltage from the X 20,000 RF OUTPUT jack (J-101) is set at "100" on the meter, the maximum output from the X MULT RF OUTPUT jack (J-102), when correctly terminated (53.5 ohms) will be 0.1 volts. Within each step of the attenuator (E-112), the output from the X MULT RF OUTPUT jack (J-102) is varied by rotating R-155. The output voltage from this jack is determined in microvolts by multiplying the meter (M-101) reading by the corresponding position of the MULTIPLIER dial (I-104). Since the accuracy of all meters is expressed in terms of percentage error for full scale deflection, the technician should avoid using the meter calibrations below "20." Use the (5:1) FIXED ATTENUATOR CN-132/URM-25 whenever a meter voltage indication in this range is required. This attenuator is discussed more fully in paragraph 8 of this section.

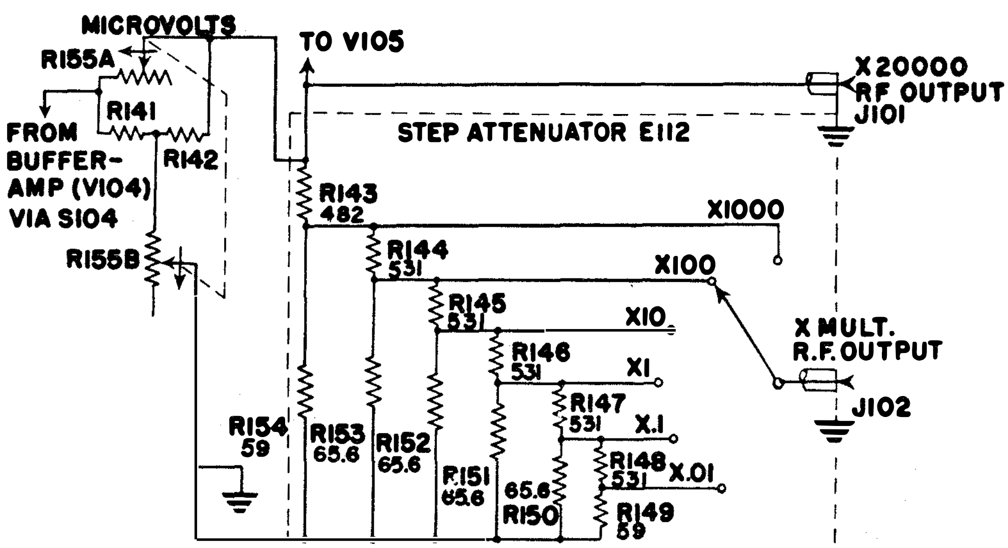



*Figure 2–8. Schematic Diagram of the Variable RF Attenuator Circuit*

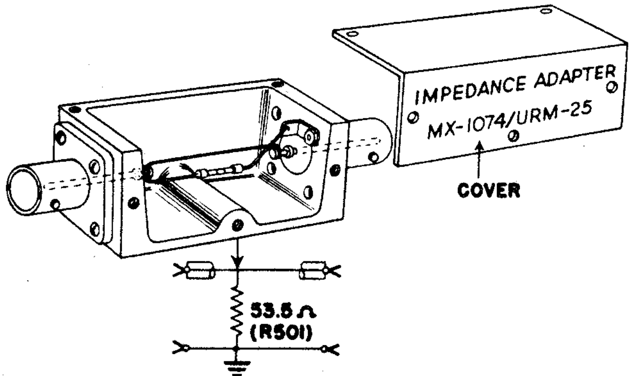



*Figure 2–9. Impedance Adapter MX-1074/URM-25*

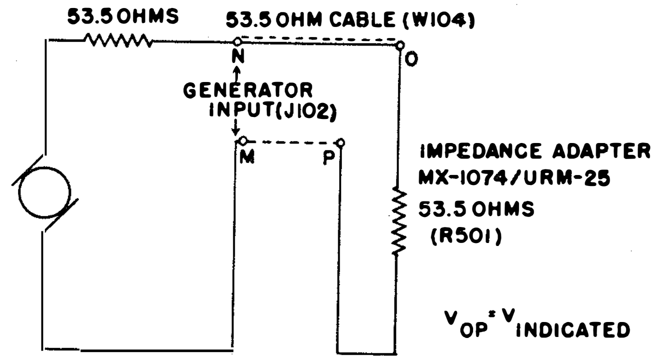



*Figure 2–10. Equivalent Circuit of X MULT RF OUTPUT (J-102) with Impedance Adapter MX-1074/URM-25 Added*

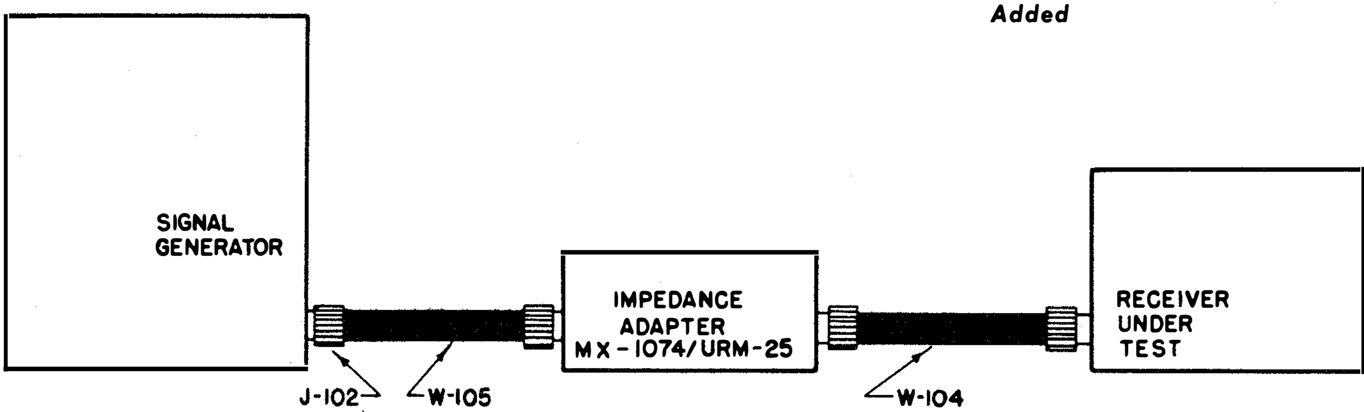



*Figure 2–11. Method for Inserting Impedance Adapter MX-1074/URM-25 at J-102*

*g.* For any particular carrier frequency, once the CARRIER CONTROL (R-123) has been rotated to give the required "100" meter indication, its setting should never be changed. The output from each attenuated step and from the X 20,000 RF OUTPUT jack (J-101) is varied by adjusting the MICROVOLTS control (R-155). Whenever the generator frequency is changed, however, the CARRIER CONTROL must be reset to give the required "100" meter indication. This adjustment is made only after R-155 has again been rotated to the fully clockwise position.

*h.* When R-123 and R-155 have been adjusted to introduce a two volt signal (M-101 reads "100" and J-101 unterminated) to the step attenuator (E-112), the series voltage dropping resistor (R-143) reduces this voltage to 0.2 volts. The maximum output voltage available from the X MULT RF OUTPUT jack (J-102) when this jack is terminated in 53.5 ohms, will, therefore, be 0.1 volts. This will also be the maximum input voltage from this jack to a properly matched receiver under test. (See Section 2 par. 7). It is this voltage, under terminated conditions, that is actually indicated on the M-101.

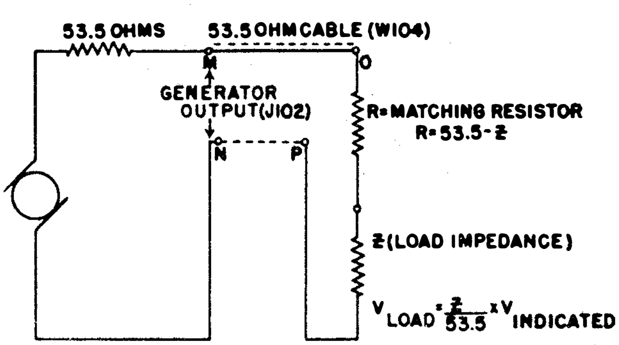



*Figure 2–12. Equivalent Circuit of X MULT RF OUTPUT (J-102) with Series Matching Resistor Added*

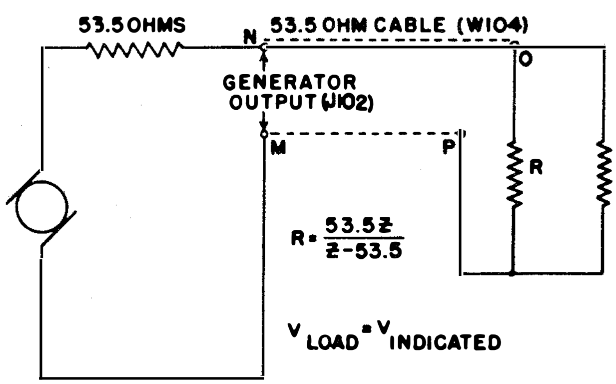



*Figure 2–13. Equivalent Circuit of X MULT RF OUTPUT (J-102) with Shunt Resistor Added*

*i.* The MICROVOLTS control (R-155) is a two section potentiometer connected with two 500 ohm resistors (R-141, R-142) in the form of a T pad. It provides a smooth control of the voltage applied to the step attenuator, at the same time maintaining a constant impedance (500 ohms) across the output of the buffer-amplifier (V-104) and across the X 20,000 RF OUTPUT jack (J-101).

*j.* The step attenuator (E-112) is a six section ladder resistive network and its output is attenuated in six steps. With the MICROVOLTS control (R-155) and the attenuator (E-112) in combination, any desired voltage between zero and 100,000 microvolts can be obtained at the X MULT RF OUTPUT jack (J-102) when J-102 is terminated in its characteristic impedance (53.5 ohms). The input voltage to the receiver under test is thus determined by multiplying the meter (M-101) reading (upper scale) by the decimal multiplier indicated by the position of the MULTIPLIER dial (I-104). The lowest calibrated output voltage is 0.1 microvolts.

## 7. TERMINATING THE SIGNAL GENERATOR.

*a.* The termination principles herein discussed are based on the assumption that the load is essentially resistive in nature. This is true for most applications for which this equipment is used in the field. In cases where the load is not resistive, it will be necessary for the technician to interpret these principles with respect to the nature of the load.

*b.* A CG-409/U (4′0″) coaxial output cable assembly (W-104) consisting of a four foot length of RG 58/U cable and terminated at each end with a type UG-88/U connector is supplied with the signal generator. This cable is intended for use with the X MULT RF OUTPUT jack (J-102) and has a characteristic impedance of 53.5 ohms.

*c.* Cable W-104 has a capacitance of 28.5 mmf/ft or a total capacitance of 114 micromicrofarads for the entire four foot length. The resultant reactance would have no appreciable effect on the output of J-102 at frequencies below 1 mc and therefore, standing waves do not introduce a termination problem at these frequencies.

*d.* At frequencies greater than one megacycle, the decrease in cable reactance begins to introduce a pronounced shunting effect on the 53.5 ohm generator terminal (J-102) impedance and it becomes necessary to correctly terminate the receiving end of W-104 in order to eliminate standing waves. There is no need to terminate the signal generator end of the cable since its characteristic impedance of 53.5 ohms is the same as the characteristic impedance across J-102.

*e.* The characteristic impedance across the X 20,000 RF OUTPUT jack (J-101) is 500 ohms and the cable assembly W-104 should not be used with this jack. An accessory seven inch CG-409/U (7″) cable assembly (W-105) consisting of RG58/U cable and one UG-88/U connector at each end is provided for use with J-101. Since this cable is much shorter than the four foot cable assembly, the effects of a mismatch at the X 20,000 RF OUTPUT jack (J-101) are negligible.

*f.* When the 53.5 ohm cable assembly (W-104) is plugged into the X MULT RF OUTPUT jack (J-102), and terminated properly (53.5 ohms), no standing waves will be present. An IMPEDANCE ADAPTER MX-1074/URM-25 consisting of a 53.5 ohm composition resistor (R-501) contained in a rectangular aluminum case (See figure 2–9) is supplied with the equipment. This unit has one UG-185/U connector at each end and is inserted between the receiver under test and the receiver end of cable W-104 when the receiver load impedance is at least ten times the generator output impedance (i.e. approximately 500 ohms).

It is apparent from figure 2–10 that the voltage appearing across this terminating resistor at points OP will be one half the open circuit voltage across the generator output at J-102 represented by points MN. However, since the meter (M-101) was calibrated with respect to a correctly terminated load, the reading on the meter will actually reflect the input voltage to the receiver under test. Figure 2–11 illustrates the method for inserting the impedance adapter.

*g.* When the load impedance is less than 53.5 ohms, the impedance adapter cannot be used. In this case, a non-inductive composition resistor should be added in series with the input element at the receiver under test, so that the sum of the receiver input impedance and this resistor will be 53.5 ohms (See figure 2–12). The total load impedance will then match the signal generator impedance at J-102 and standing waves will be minimized. The actual receiver input voltage can then be calculated from the formula indicated in figure 2–12. When applying this procedure, it will probably be necessary to file down a larger standard resistor to get the precise value required. Use the Resistance Bridge ZM-4/U or equivalent to measure the resistance. For example; if the load impedance of the receiver (Z) is equal to 30 ohms, a series resistor (R) of 23.5 ohms must be added in series with the receiver. A meter (M-101) indication of 10,000 microvolts will then represent an actual receiver input as follows:

$$E\ \text{load} = \frac{30}{53.5} \times 10{,}000 = 5607\ \text{microvolts}$$

To minimize leakage and other losses, this series resistance should be inserted as closely as possible to the input element of the receiver or instrument under test.

*h.* If the load impedance is considerably less than 500 ohms, but more than 53.5 ohms, the impedance adapter is replaced by a non-inductive composition resistor which shunts the load (see figure 2–13). The equivalent impedance of the shunt and load should equal the generator impedance (53.5 ohms). The receiver input voltage will then be equal to the meter indication. For example; if the receiver input impedance (Z) is 120 ohms, select the correct shunt resistor (R) as follows:

$$R = \frac{53.5 \times 120}{120 - 53.5} = \frac{6420}{66.5};$$

$$R = 96.05 \text{ ohms}$$

It is apparent that the meter (M-101) indication will be the same as the actual input voltage to the receiver. If an accurate voltage indication is required, it will be necessary to file down a standard resistor until the desired value is obtained. Use the Resistance Bridge ZM-4/U or equivalent to determine when this value has been reached.

*i.* Table 2–1 shows the most desirable type of termination for any particular load impedance.

**TABLE 2–1: METHODS FOR CORRECTLY TERMINATING THE SIGNAL GENERATOR AT J-102**

| LOAD IMPEDANCE | METHOD | FIGURES | PARAGRAPH |
|---|---|---|---|
| Less than 53.5 ohms | Series Resistor | 2-12 | 7g |
| 53.5 ohms to approximately 500 ohms | Parallel Resistor | 2-13 | 7h |
| 500 ohms or greater | Impedance Adapter MX-1074/URM-25 | 2-9; 2-10; 2-11 | 7f |

## 8. (5:1) FIXED ATTENUATOR CN-132/URM-25.

(See figure 2–14).

*a.* The (5:1) Fixed Attenuator CN-132/URM-25 consists of a two section rectangular aluminum case approximately 2″ long x 1″ high x 1″ wide. A type UG-185/U connector is provided at each end to fit W-104 output cable CG-409/U (4′0″), W-105 and W-106 output cables CG-409/U (7″). These cables are used as required to make the necessary connections.

*b.* The schematic diagram and outlined drawing of the 5:1 fixed attenuator is shown in figure 2–14. It is designed to be used when the input impedance of the receiver under test is 53.5 ohms and consists of four resistors (R-303, R-304, R-305, R-306) connected in parallel to give an equivalent resistance of 22.3 ohms. These parallel resistors are then connected with two 35.6 ohms resistors to form a "T" network. It can readily be calculated that the output terminal voltage of this attenuator unit will be one fifth its input voltage when the CN-132/URM-25 is properly terminated in 53.5 ohms. It therefore follows that the voltage output from the fixed attenuator will be one fifth the voltage indicated by M-101.

*c.* The 5:1 fixed attenuator is designed for a 53.5 ohm terminating impedance and should be used in conjunction with the X MULT RF OUTPUT jack (J-102), never with the X 20,000 RF OUTPUT jack (J-101).

*d.* Although this unit was designed primarily for use with a load impedance of 53.5 ohms, it may also be used when the receiver under test presents an impedance other than 53.5 ohms. In such case, it will be necessary to apply the terminating principles as outlined in paragraph 7 and in Table 2-1 of this section. For example;

(1) If the load impedance is 1000 ohms, connect one end of W-104 to J-102 on the signal generator. Connect the other end of W-104 to the fixed attenuator and terminate the fixed attenuator with the impedance adapter. This assembly is then connected to the load. A meter indication of 10,000 microvolts now reflects an actual load input voltage of 2000 microvolts.

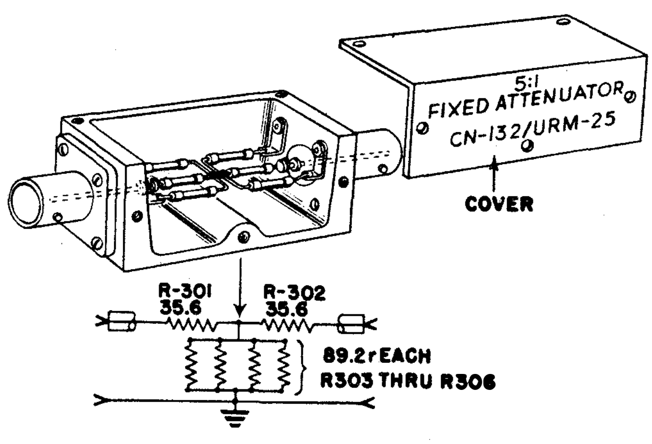



*Figure 2–14. (5:1) Fixed Attenuator CN-132/URM-25 with Schematic Diagram Shown*

(2) If the load impedance is 30 ohms do not use the impedance adapter. Insert a 23.5 ohm non-inductive resistor in series with the output of the fixed attenuator and then connect to the 30 ohm load. A meter indication of 10,000 microvolts now represents an actual load voltage as follows:

$$E \text{ load} = \frac{30}{53.5} \times \frac{10,000}{5};$$

$$E \text{ load} = \frac{60,000}{53.5} = 1122 \text{ microvolts}$$

*e.* A coaxial adapter UG-201/U is also provided with the equipment to allow for adapting the output cables type BNC connectors (i.e. UG-88/U) to a type N connector found on many receivers.

### 9. (10:1) FIXED ATTENUATOR CN-136/URM-25.

*a.* The (10:1) Fixed Attenuator CN-136/URM-25 is physically identical to the (5:1) Fixed Attenuator CN-132/URM-25. It consists of four 43.2 ohm resistors (R-803 thru R-806) connected in parallel to give an equivalent resistance of 10.8 ohms. These parallel resistors are connected with two 43.8 ohm resistors (R-801, R-802) to form a "T" network. This unit is the same in principle as the 5:1 attenuator (see Section 2, par. 8) but introduces a voltage attenuation of 10:1 instead of 5:1 when terminated in 53.5 ohms.

*b.* This 10:1 fixed attenuator is provided for use at frequencies above 18 mc (band H) when extremely accurate low level signal generator outputs are required. This applies only to the last two steps (X.01, X.1) of the step attenuator (E-112), where the presence of some residual leakage voltage or faulty grounds might effect the output accuracy at these higher signal generator frequencies. For example; if it is desired to select an accurate 6 microvolt output at 30 mc, the MULTIPLIER dial (I-104) should be set at X1 with the output meter (M-101) adjusted for a reading of "60." Insert the 10:1 fixed attenuator at J-102 and terminate it in 53.5 ohms as described in paragraph 7 of this section. The output across the 53.5 ohm load will then have an accurate value of 6 microvolts.

### 10. ANTENNA SIMULATOR SM-35/URM-25.

*a.* Antenna Simulator SM-35/URM-25 is contained in an aluminum case of the same type and physical dimensions as the impedance adapter and fixed attenuator units. One type UG-185/U connector is provided at each end for connecting to any one of output cables W-104, W-105, or W-106.

(See figure 2–15).

*b.* The circuit consists of a 200 micromicrofarad capacitor (C-401) in series with a series-parallel arrangement consisting of a 400 micromicrofarad capacitor (C-402), a 400 ohm resistor (R-401), and a 20 microhenry inductor (L-401). At frequencies above 2.5 megacycles, the antenna simulator unit acts like a pure resistance of

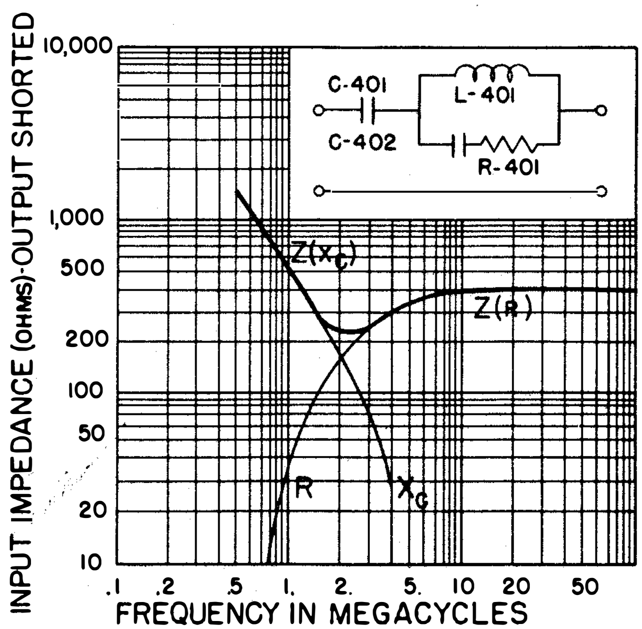



*Figure 2–15. Schematic Diagram of the Antenna Simulator SM-35/URM-25 with Input Impedance-Frequency Curve*

from 220 ohms to 400 ohms. Below 1.6 megacycles, the circuit acts like a capacitance of 200 micromicrofarads in series with an inductance of 20 microhenries and a resistance of 15 ohms.

*c.* From the impedance curve (figure 2–15), it can be seen that the minimum impedance of the antenna simulator will be approximately 220 ohms. When using this unit, first connect one end of the Impedance Adapter MX-1074/URM-25 to the output cable (W-104) and plug the other end of W-104 into J-102 on the signal generator. Using the auxiliary cable (W-105), connect the antenna simulator to the impedance adapter. If necessary, the second auxiliary cable (W-106) may then be used to connect the antenna simulator to the receiver under test.

*d.* In using the antenna simulator, it should be realized that the significant voltage is the input and not output voltage of the antenna simulator. The reason for this is that the antenna simulator approximates a standard antenna which forms a part of the overall sensitivity measurement of a receiver designed for use with it. For example; if the output frequency of the signal generator is 20 mc, it can be seen, from figure 2–15 that the series impedance of the antenna simulator will be approximately 400 ohms resistive. Make the necessary connections as indicated in paragraph 10c of this section. A meter indication of 10,000 microvolts represents an input voltage of 10,000 microvolts to the antenna simulator.

*e.* For accurate receiver output voltage indication, it should be remembered that the total load impedance represented by the antenna simulator in series with the load of the instrument under test should be at least 500 ohms. From figure 2–15, it is apparent that the accuracy will be sufficiently good at frequencies above 5mc. Below 5mc, the impedance falls off to approximately 220 ohms and the receiver input load should be sufficiently high (approximately 280 ohms or greater) to maintain the accuracy.

## 11. TEST LEAD CX-1363/U.

(See figure 2–16).

*a.* The Test Lead CX-1363/U should be used for making interstage receiver measurements. It consists of a 0.1 microfarad capacitor (C-601) in parallel with a 510 micromicrofarad capacitor (C-602) enclosed in an aluminum case similar to the antenna simulator and fixed attenuator units. One end of this case is terminated in a type UG-185/U connector. Two 18" long clip leads extend from the other end. The capacitor network is in series with the red lead, whereas the black lead is grounded to the case.

*b.* The capacitor network is inserted to protect the attenuator (E-112) of the signal generator from accidental test probing at points of B+ potential and should always be used when making interstage receiver tests.

*c.* The reactance of the test lead capacitors should not normally affect the accuracy of the meter (M-101) voltage indication since, in most cases, the impedance at receiver interstage measurement points will be high. It must be realized, however, that when the CX-1363/U is used at test points of low impedance (below 400 ohms) the meter indication can no longer be depended upon to reflect the actual signal voltage applied.

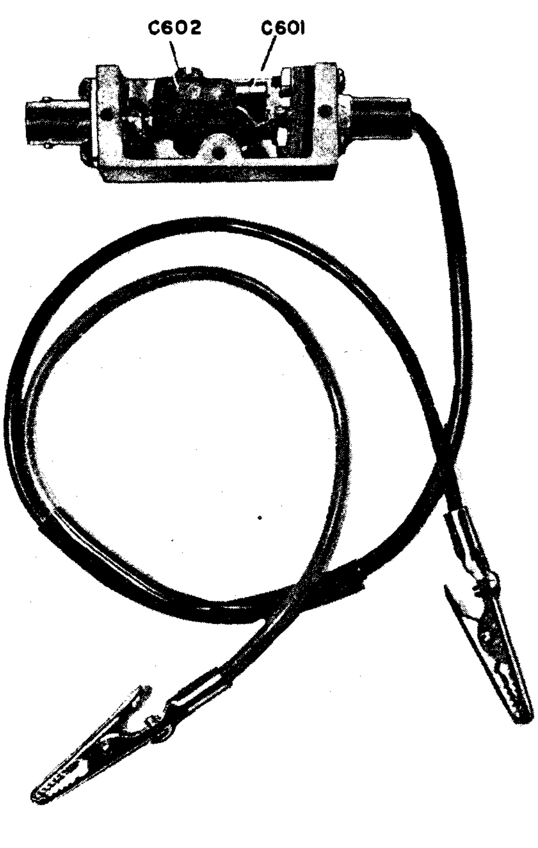



*Figure 2–16. Test Lead CX-1363/U*

## 12. POWER SUPPLY PP 562/URM-25.

(See figure 2–17).

*a.* The power supply is an integral part of the RF Signal Generator Set AN/URM-25 and is completely contained in a separate sub-chassis located to the rear of the RF signal generator unit SG-44/URM-25. It employs a full wave rectifier type 6x4 tube (V-201). The interconnecting power cable (W-102) is a two conductor cable with a two prong connector (P-101) on one end. The other end of this cable is soldered to the AC input fuses (F-101, F-102) located on the front panel of the signal generator. When the connector (P-101) is plugged into the power supply input power receptacle (J-201), this cable assembly (W-102) transfers AC power from the front panel to the rectifier sub-chassis. This interconnecting cable is connected in place and need not be installed prior to using the signal generator. A type OD3 (V-202) regulator tube is used for maintaining a regulated 150 volt DC output to all tubes except the buffer-amplifier (V-104). The principal electrical features of the rectifier power unit are shown in figure 2–17.

*b.* The power transformer (T-201) has a 450 volt center tapped high voltage secondary and a 6.3 volt filament secondary. It is so designed to permit satisfactory operation from a 115V (±10%), single phase AC source of from 50 to 1600 cycles per second. Each side of the input AC line is fused (F-101, F-102). An RF filter network consisting of two 1000 micromicrofarad capacitors (C-138, C-139) and two RF chokes (L-115, L-116) enclosed in a metal shield is mounted on the rear of the front panel of the RF Signal Generator SG-44/URM-25 (see figure 6–12). This network by-passes stray RF currents from the power line.

*c.* The plate supply voltage derived from the high voltage secondary and rectifier tubes (points PQ on figure 2–17) is approximately 240 Volts DC and must be reduced to the required 150 Volts DC regulated supply for all tubes except V-104. This voltage drop is achieved by the DC series dropping network (L-201, R-201). A PI filter consisting of a choke (L-201) and three 4 microfarad capacitors (C-201, C-202, C-203) is provided as a ripple filter. The two 4 microfarad capacitors (C-202, C-203) are connected in parallel to increase the effective capacitance. A single 8 microfarad capacitor would introduce a problem of physical location. An additional .15 microfarad capacitor (C-204) is inserted in parallel with L-201 to form a 120 cycle resonant filter. This resonant filter lowers the 120 cycle power supply hum level.

*d.* In a regulator tube such as the OD3 (V-202), the voltage across the tube (150vDC) remains constant over a fairly wide range of current (5 to 40 ma) through the tube. This property exists because the degree of ionization of the gas in the tube varies with the amount of current that the tube conducts. When a large current is passed, the gas is highly ionized and the internal impedance of the tube is low. When a small current is passed, the gas is ionized to a lesser degree and the internal impedance is high. Over the operating range of the tube, the product (I×R) of the current through the tube and the internal impedance of the tube is practically constant. If the supply voltage (points PQ on figure 2–17) drops, the voltage across the glow tube (V-202) would tend to drop. However, the gas in the glow tube deionizes slightly and less current passes through the tube. The current passing through the series DC dropping network (L-201, R-201) is also decreased by the amount of this current decrease in the glow tube. This would develop sufficiently smaller voltage drops across the series DC network to maintain the required stable 150 volts drop across the glow tube. A rise in supply voltage is similarly compensated for.

*e.* The regulator glow tube (V-202) also provides for a stable output voltage when the load impedance varies. If the load increased, more current would flow through the dropping network (L-201, R-201). This would tend to drop the 150vDC output voltage across the glow tube. Instead this voltage drop tendency slightly deionizes the glow tube resulting in an increase in its internal impedance. This increase in glow tube impedance, relative to the DC impedance of the series dropping network, again raises the power unit output voltage to the required 150vDC.

*f.* The 6.3 volt filament supply (one side B–) and the 150vDC output are connected to the power unit output receptacle (J-202). These voltages are transferred to the signal generator sub-chassis through power cable W-103. The B-lead from J-202 is not grounded to the power supply chassis but is carried to a single ground point in the audio compartment. The power supply chassis, however, is grounded to the other units of the signal generator. The reason for this separate B– ground is to eliminate RF leakage due to ground voltage gradients. Whenever the power supply is tested separately from the signal generator, voltage measurements should, therefore, be made between the test voltage point and B– not to the chassis.

## 13. INCIDENTAL FREQUENCY MODULATION.

*a.* Some incidental frequency modulation is present in the RF Signal Generator Set AN/URM-25, as in other amplitude modulated type signal generators. Figures 2–18 through 2–21 were taken at the Naval Research Laboratories in Washington, D. C., and show the carrier and side bands of the AN/URM-25 at the frequencies indicated when 30% modulated at 400 cycles. Figure 2–18 shows the carrier and a single pair of sidebands. This condition of low incidental FM is generally characteristic of the AN/URM-25 for most carrier frequencies at low degrees of modulation. As a slight degree of frequency modulation develops, the two side bands become unequal in amplitude. This is shown in Figures 2–19 and 2–20. With the presence of increasing degrees of incidental frequency modulation, additional side bands develop. This is represented in Figure 2–21.

*b.* For greatest accuracy in all amplitude modulated signal generators, sensitivity, selectivity, image ratio, AVC characteristics, and other receiver measurements (except audio response) should be made with an unmodulated carrier signal. This method is discussed in Section 4, par. 13a. When the technician uses a modulated carrier signal, the degree of modulation should be kept as low and the audio frequency as high as will serve the purpose of the measurement. In addition, make use of the frequency band overlap by setting the signal generator at the low (maximum capacitance) end of the band wherever possible.

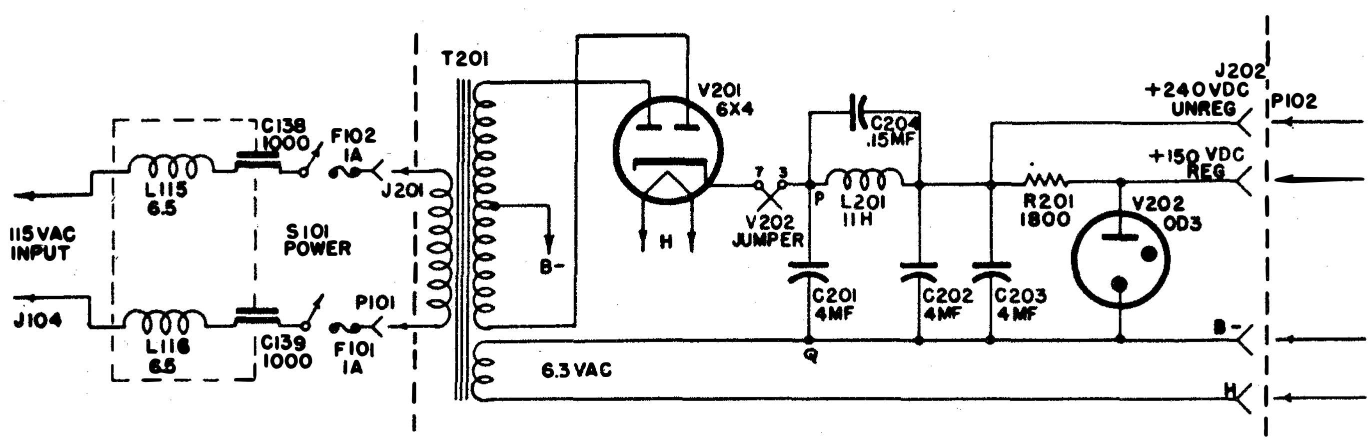



*Figure 2–17. Schematic Diagram of the Power Supply PP-562/URM-25*

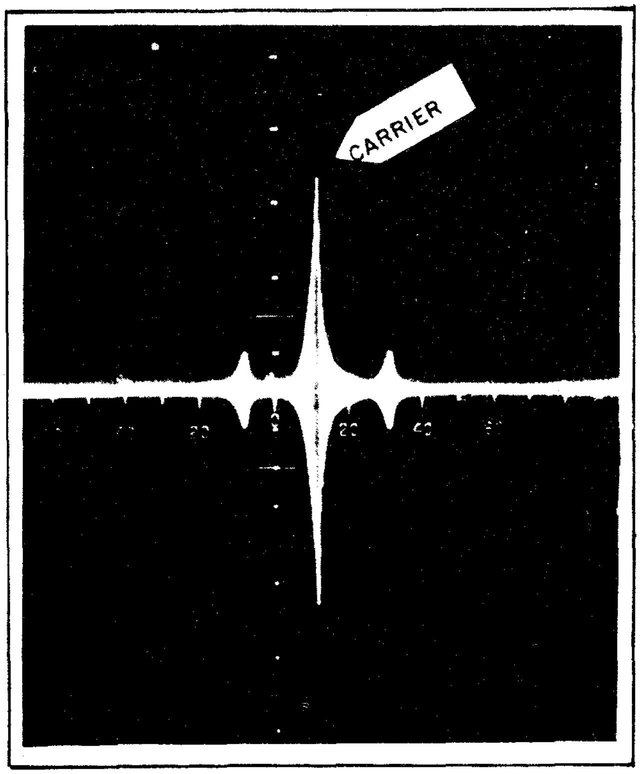



*Figure 2–18. Frequency Spectrum with 400 Cycle 30% Modulation at 240 kc on Band D*

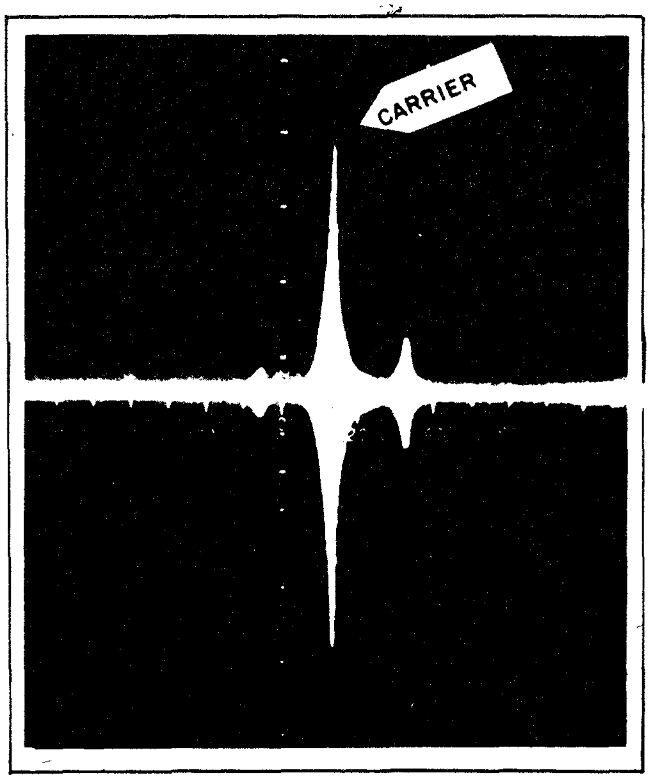



*Figure 2–19. Frequency Spectrum with 400 Cycle 30% Modulation at 660 kc on Band D*

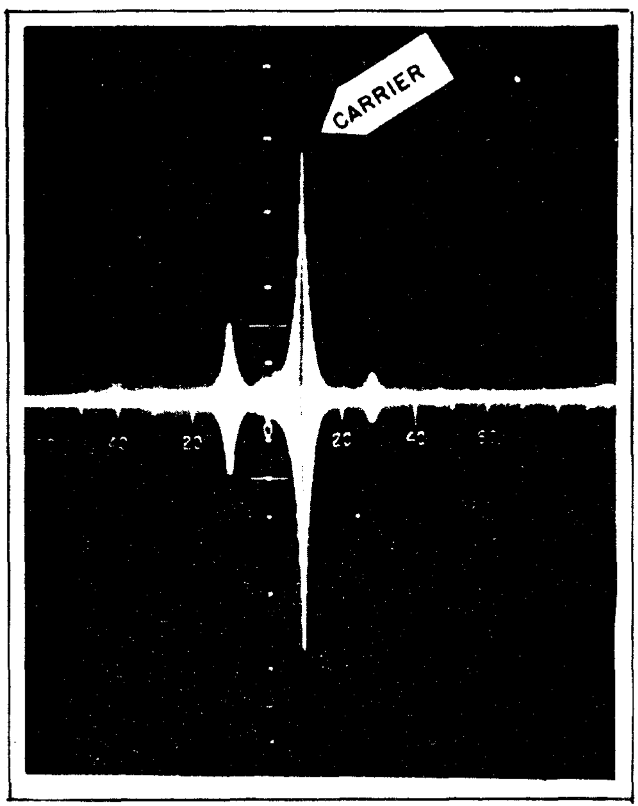
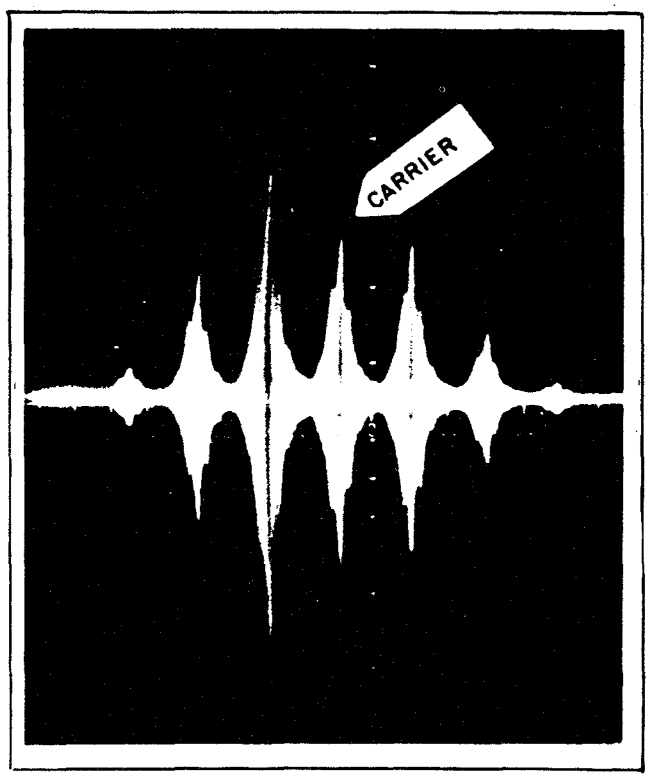



*Figure 2–20. Frequency Spectrum with 400 Cycle 30% Modulation at 16 mc on Band H*




*(NOTE: This is beyond specified range of Band G)*
*Figure 2–21. Frequency Spectrum with 400 Cycle 30% Modulation at 19 mc on Band G*

# SECTION 3
# INSTALLATION

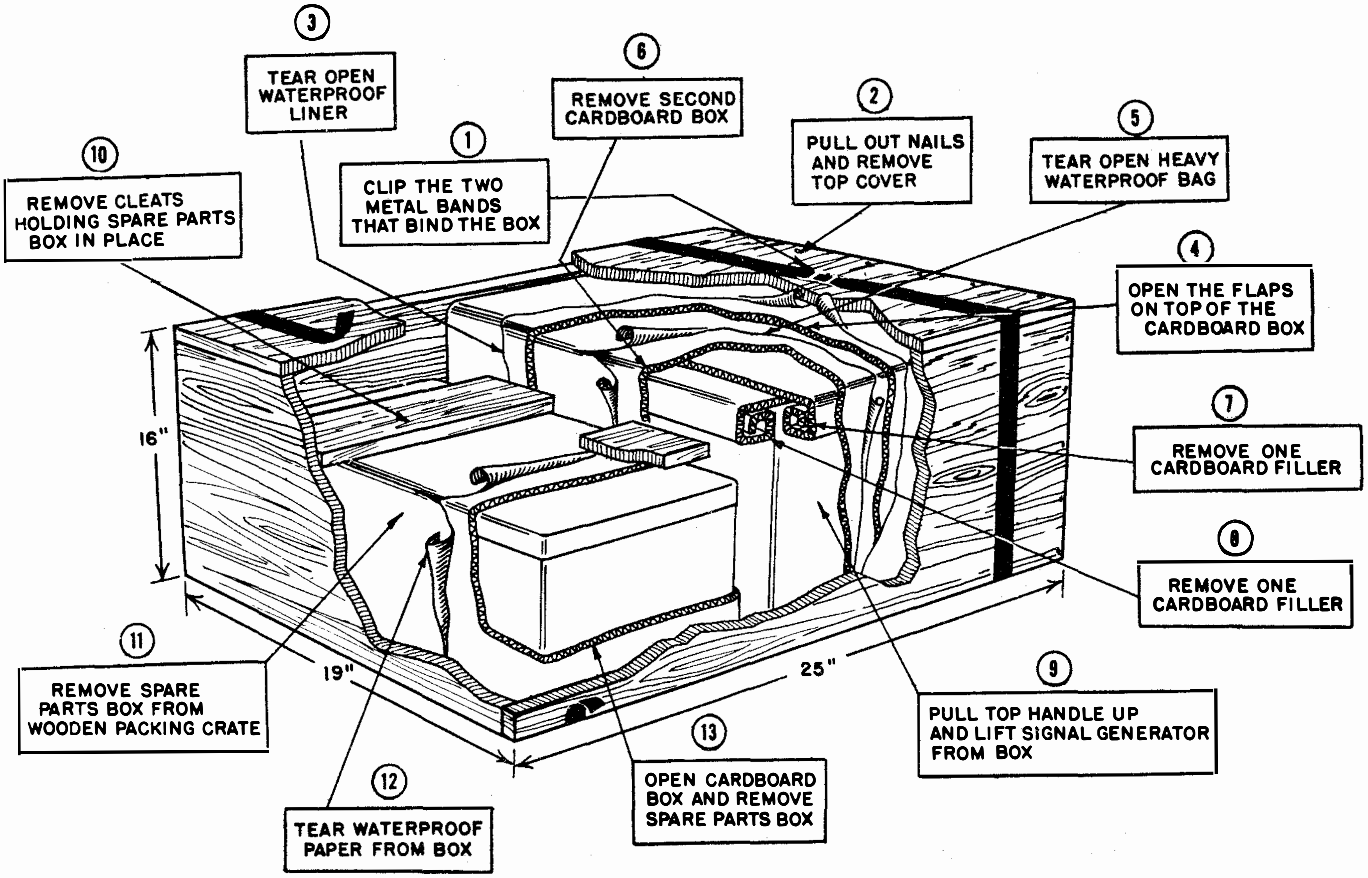



*Figure 3–1. RF Signal Generator Set AN/URM-25, Unpacking Procedure for Sets Shipped with Equipment Spares*

## 1. UNPACKING.

*a.* The AN/URM-25 is packed in a wooden box together with a set of equipment spares (parts peculiar). Electron tubes are shipped in place. The signal generator with its accessories, and the set of spares are in turn enclosed in separate, specially cushioned cardboard cartons. Exercise great care in removing these items (See figure 3–1).

*b.* The location of the accessories in the signal generator carton are as follows: (See Section 1, figure 1–1).

(1) Antenna Simulator SM-35/URM-25, (5:1) Fixed Attenuator CN-132/URM-25, (10:1) Fixed Attenuator CN-136/URM-25, Impedance Adapter MX-1074/URM-25, Test Lead CX-1363/U, Coaxial Adapter UG-201/U, and Instruction Book will be found on the inside of the panel cover of the generator. Ferrule clips are provided for mounting these units to the panel.

(2) The power cable (W-101) and output cables (W-104, W-105, W-106), are packed on an aluminum plate in the cabinet cover.

*c.* Dimensions of the signal generator are shown in Figure 3–2.

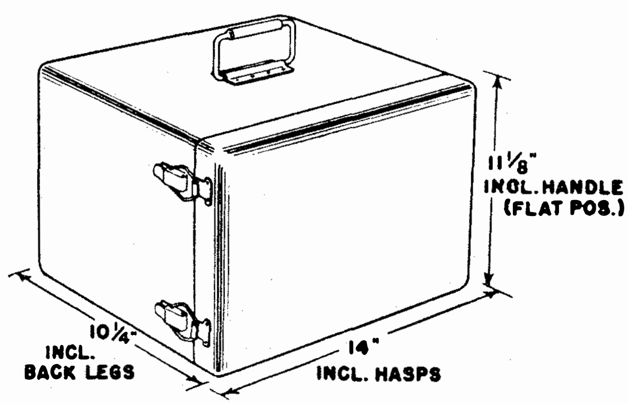



*Figure 3–2. RF Signal Generator Set AN/URM-25, Outline Dimensional Drawing*

## 2. INSTALLATION.

*a.* The AN/URM-25 is a portable signal generator and does not require permanent installation.

*b.* The equipment is intended to be operated with the panel in the vertical position. Rubber supporting feet are provided for the cabinet. These feet protect the finished surface and serve to insulate the cabinet from a grounded desk. This insulation precaution, however, is not normally required.

*c.* The following preliminary settings and checks are required prior to placing the equipment in operation (See figure 4–1).

(1) Turn POWER switch (S-101) to OFF position

(2) Turn CARRIER CONTROL E-101 to the fully counterclockwise position.

(3) Plug power cable W-101 into power receptacle J-104

(4) Insert other end of power cable W-101 into 115 volt AC source.

## 3. ADJUSTMENTS.

*a.* All operating adjustments are described in Section 4 OPERATION

*b.* The following preliminary checks and adjustments may be required in zero setting the meter (M-101). All symbols designations in this paragraph refer to Section 4, figure 4–1.

(1) Turn CARRIER CONTROL E-101 and % MODULATION control E-104 to the fully counterclockwise positions.

(2) Turn the signal generator on by placing POWER switch S-101 to the ON position. (Allow a 15 minute warm-up period).

(3) Set METER READS dial I-105 first in the RF position and then in % MOD and BAL positions. Meter M-101 should read zero in all positions.

(4) If the meter does not read zero, follow the meter calibration procedure outlined in Section 6, par. 10.

# SECTION 4
# OPERATION

## 1. GENERAL.

*a.* It is the purpose of the OPERATION section to instruct personnel in the proper use of the AN/URM-25 as a test instrument. To be thoroughly familiar with the method of operation, it is suggested that both Section 2, THEORY OF OPERATION, and this section be read and studied.

*b.* In the development of this section, an attempt has been made to present each step in the logical sequence necessary to place the equipment in operation. If these steps are carefully adhered to, the operator will not only avoid damaging the signal generator but will be assured of a correct interpretation of the data as prescribed by the instrument. Table 4–1 is an operational summary of all front panel controls.

*c.* The essential details of operation and the necessary precautions to be taken are covered in this section under the following headings and paragraphs:



### NOTE

All reference to symbol designations in this section apply to the front panel diagram Figure 4–1 unless otherwise specified. Primary reference is made to the symbol designation of the front panel knob (i.e. E-102) applicable to the specific circuit element (i.e. R-123). The association between the knob and circuit part is shown on Figure 4–1 by indicating the corresponding circuit element designation following the knob symbol (i.e. E-102 (R-123)).

**TABLE 4–1. OPERATIONAL SUMMARY OF FRONT PANEL CONTROLS (See figure 4–1)**

| SYM. NR. | PANEL CONTROL | FUNCTION |
|---|---|---|
| E-101 | CARRIER CONTROL. | Set carrier level. |
| E-102 | CARRIER RANGE switch. | Set to same range as frequency band (A thru H). |
| E-103 | MICROVOLTS control. | Adjust output. |
| E-104 | % MODULATION control. | Adjust percentage modulation. |
| E-105 | FREQUENCY BAND SWITCH knob. | Select desired frequency band (A thru H). |
| H-101 | Dial Mask. | Makes visible only frequency band selected. |
| I-103 | Main Tuning dial. | Selects desired frequency. |
| I-104 | MULTIPLIER dial. | Attenuates output from J-102 in steps of 10. |
| I-105 | METER READS dial. | Select desired meter indication. |
| I-106 | MOD SELECTOR dial. | Select type of modulation. |
| J-101 | RF OUTPUT X 20,000. | 500 ohms, 2 volts open circuit RF output. |
| J-102 | RF OUTPUT X MULT. | 53.5 ohm step attenuator output. |
| J-103 | EXTERNAL MOD INPUT. | Input for external modulation. |
| N-102 | Frequency scale. | Indicates output frequency. |

## 2. POWER CIRCUIT.

*a.* The CARRIER CONTROL knob (E-101) should be turned fully counterclockwise before turning the POWER switch (S-101) to the ON position.

*b.* Plug the power cable (W-101) into the power receptacle (J-104). Insert the other end of the power cable into the 115 volt AC source.

*c.* Turn the POWER switch (S-101) to the ON position. Line voltage is now applied through the interconnecting power cable (W-102) to the primary of the power transformer (T-201). This is shown schematically in Figure 6–23.

*d.* No other power switches are provided and the signal generator is now in operating condition. A minimum 15 minute warm up period should then be allowed prior to setting the generator for use. This period permits the instrument to reach a stable operating state.

## 3. CALIBRATING THE ELECTRON TUBE VOLTMETER.

### NOTE

Meter M-101 is an hermetically sealed unit and the screw zero set adjustment has been covered with solder. Due to variations in the temper of the meter movement spring, M-101 may not always read zero (meter needle on first line to the left) before the signal generator is turned on. If this condition exists, apply a hot soldering iron to this screw and make the necessary zero setting before applying power to the signal generator.

*a.* Although the electron tube voltmeter is calibrated at the factory, physical agitation, changes in tube characteristics and environmental conditions may make it necessary to recalibrate the meter circuit before the signal

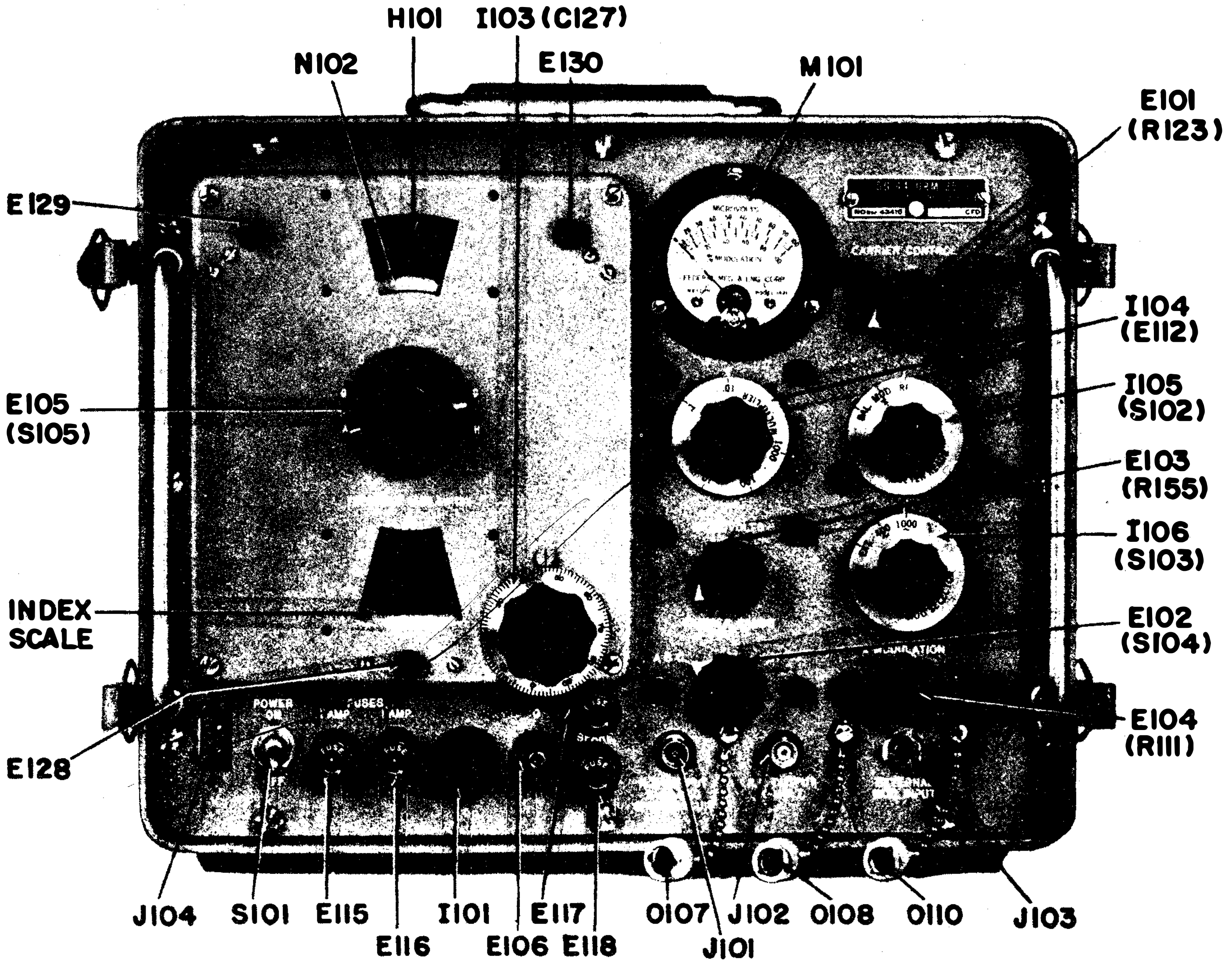



*Figure 4–1. RF Signal Generator SG-44/URM-25, Front Panel Diagram*

generator is used as a test instrument. Since this involves removing the signal generator sub-chassis from the cabinet (see Section 6, par. 4), non-technical personnel should not attempt to calibrate the instrument. For use by the Electronics Technician, a complete discussion of the method for calibrating the voltmeter is given in Section 6, par. 10. The following checks should be made to determine if calibration is necessary:

(1) Set the CARRIER CONTROL (E-101) and the % MODULATION control (E-104) fully counterclockwise.

(2) Turn the POWER switch (S-101) to ON. Allow a 15 minute warm-up period.

(3) The meter (M-101) should read zero in all three positions of the METER READS dial (I-105).

*b.* If the meter (M-101) does not read zero in all positions of METER READS dial (I-105), the technician should follow the calibrating procedure outlined in Section 6, par. 10.

## 4. ADJUSTING CARRIER FREQUENCY.

*a.* Whenever changing the frequency of the signal generator, be sure that the METER READS dial (I-105) is set to the RF position and the CARRIER CONTROL (E-101) is turned fully counterclockwise. The CARRIER RANGE knob (E-102) should be set at the same band position as the FREQUENCY BAND SWITCH knob (E-105).

*b.* The desired frequency is set by selecting the applicable carrier oscillator L-C-R network with the FREQUENCY BAND switch (E-105) and turning the main frequency tuning dial (I-103). The frequency is then read from the frequency scale (N-102). If greater accuracy is required, this reading may be interpolated by utilizing the index scale of N-102, and the reading indicated on the tuning dial (I-103).

*c.* Eight frequency bands (A through H) are available and can be selected by E-105. A scale mask (H-101) is linked to this switch so that only the band scale selected will be made visible. Bands A through D will be made visible through the upper aperture whereas bands E through H will appear through the lower aperture.

*d.* The index scale is located at the bottom of the frequency scale (N-102) and is visible in all positions of the FREQUENCY BAND SWITCH (E-105). This scale is calibrated over a range of 180°.

*e.* The tuning dial (I-103) is calibrated from 0 to 100. One complete revolution of this dial will move the frequency scale (N-102) 100 divisions on the index scale. This index scale and tuning dial vernier reading need only be used when calibrating the AN/URM-25 against a crystal controlled signal generator.

*f.* The following procedure should be followed for selecting the operating frequency of the signal generator.

(1) Turn the CARRIER CONTROL (E-101) to the fully counterclockwise position.

(2) Set the FREQUENCY BAND SWITCH (E-105) to the desired frequency band.

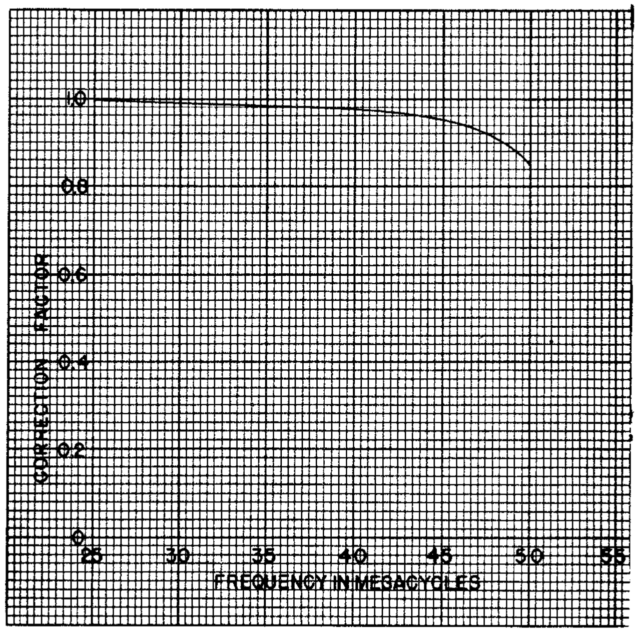



*Figure 4–2. Correction Factor — Frequency Curve for Output Voltage on Band H*

(3) Turn the tuning dial (I-103) until the desired value on the frequency scale (N-102) coincides with the hair-line indicator.

*g.* To avoid a parallax error in reading the frequency scale (N-102), the indicator hairline is placed very close to the scale. The operator should always read the frequency on a straight line of vision with this hairline in order to minimize the effects of parallax.

## 5. ADJUSTING OUTPUT VOLTAGE.

*a.* PRELIMINARY SETTINGS. — Before adjusting the output voltage, the signal generator controls should be set in the following positions:

(1) CARRIER CONTROL (E-101) fully counterclockwise.

(2) METER READS dial (I-105) set at RF.

(3) MOD SELECTOR dial (I-106) set at OFF.

(4) CARRIER RANGE knob (E-102) to the appropriate position.

(5) MICROVOLTS control (E-103) fully clockwise.

### NOTE

Due to the nature of the signal generator voltmeter circuit, the presence of modulating voltage may introduce an error in the output voltage indication of M-101. For most accurate results, always select and read the output before applying modulation.

*b.* ADJUSTMENTS.

(1) Advance the CARRIER CONTROL in a clockwise direction until M-101 reads "100" on the upper (RF) scale. When using the X MULT RF OUTPUT

(J-102), select the attenuation range with the MULTIPLIER dial (I-104) and adjust the MICROVOLTS control (E-103) for the desired output voltage. This voltage is determined in microvolts by multiplying the meter reading by the indicated position of I-104 when J-102 is terminated in its characteristic impedance of 53.5 ohms.

(2) Whenever changing frequency, readjust the CARRIER CONTROL (E-101) for a meter reading of "100" with the MICROVOLTS control (E-103) returned to the fully clockwise position. Select the desired output voltage by rotating the MICROVOLTS control. Do not use the CARRIER CONTROL for this purpose.

(3) To avoid leakage, the X RF OUTPUT jack (J-101) and the EXTERNAL MOD INPUT jack (J-103) should be covered by caps O-107 and O-110. Similarly, the X MULT RF OUTPUT jack (J-102) should be covered by cap O-108 when not in use.

*c.* VOLTAGE CORRECTION AT HIGH FREQUENCIES. — Due to output jack reactance and increased RF distortion at frequencies above 30 mc, the actual output voltage at these frequencies is somewhat less than the voltage indicated by the meter. This can be adjusted by selecting the correction factor from Figure 4–2. Multiply this factor by the meter indication to get the actual output voltage.

For example; to correct an indicated output of 60 microvolts at 50 mc, multiply the correction factor at 50 mc (.85) by the meter indication (i.e. $.85 \times 60 = 51$). A meter indication of 60 mv at 50 mc thus represents an actual output of 51 microvolts.

## 6. INTERNAL MODULATION.

*a.* Set the MOD SELECTOR dial (I-106) to the 400 or 1000 cycle position.

*b.* Set METER READS dial (I-105) to the % MOD position.

*c.* Adjust the % MODULATION control (E-104) until the meter reads the desired percentage of modulation.

## 7. EXTERNAL MODULATION.

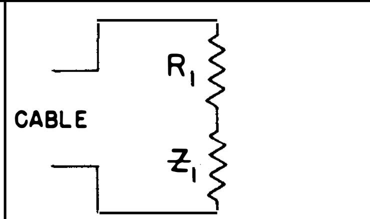
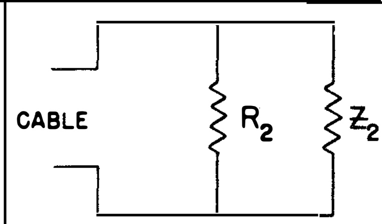
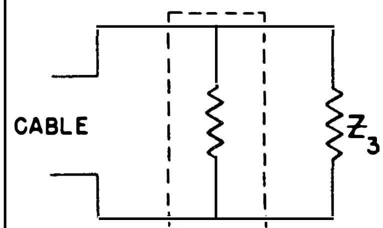
*a.* Set MOD SELECTOR dial (I-106) to EXT.

*b.* Connect an external audio frequency source to the EXTERNAL MOD INPUT jack (J-103). Do not modulate with frequencies above 1000 kc for frequency bands A, B, or C.

## 8. COUPLING TO THE RECEIVER UNDER TEST.

*a.* X MULT RF OUTPUT JACK (J-102). The technician will find that the X MULT RF OUTPUT at J-102 is much more useful than the higher output at J-101 in making receiver measurements. For best results, the ter-

**TABLE 4–2. METHODS FOR CORRECTLY TERMINATING THE SIGNAL GENERATOR AT J-102**

| TYPE OF INPUT | LOAD IMPEDANCE | CIRCUIT | ACCESSORY RESISTOR | VOLTAGE APPLIED TO LOAD IS: |
|---|---|---|---|---|
| I | LESS THAN 53.5 OHMS $Z_1$ |   | $R_1 = 53.5 - Z_1$ | $V_{INDICATED} \times \frac{Z_1}{53.5}$ |
| II | FROM 53.5 OHMS TO APPROXIMATELY 500 OHMS $Z_2$ |   | $R_2 = \frac{53.5\ Z_2}{Z_2 - 53.5}$ | $V_{INDICATED}$ |
| III | 500 OHMS OR MORE $Z_3$ | MX-1074/URM-25   | IMPEDANCE ADAPTER | $V_{INDICATED}$ |

minations principles outlined in Table 4-2 should be followed when using the 53.5 ohm output from J-102. Cables W-104, W-105 and W-106 are provided for making the necessary connections between units and should be used as required. Coaxial adapter UG-201/U is also supplied for use in adapting the BNC connectors on the signal generator cables to a type N connector found on many receivers.

(1) Connect a common ground between the receiver under test and the signal generator using ground terminal G (E-106) or the ground connection in the output cable. At low RF levels it may be necessary to orient the ground connection to obtain best results.

(2) Table 4-2 lists the correct methods for terminating the signal generator at J-102. These methods apply to loads which are fundamentally resistive in nature. The application principles are discussed in Section 2, par. 7.

## CAUTION

Care must be taken to prevent the introduction of voltages back into the attenuators or impedance adapter from the circuit under test. Currents greater than 20 milliampere may burn out the resistances incorporated within these units. Always insert the Test Lead CX-1363/U whenever making point to point measurements in a receiver. This precaution is not necessary when using the antenna simulator since it contains a series capacitor.

*b.* X 20,000 RF OUTPUT JACK (J-101). — The impedance at this jack is a resistance of 500 ohms shunted by the capacitance of the jack (approximately 4 mmf). Below 8 megacycles, this jack shunt reactance has no appreciable effect on the voltage obtainable from J-101. At 40 megacycles, however, the reactance due to the shunt capacitance is only 1000 ohms and a 30% attenuation of signal voltage will be present at this frequency. In any event, a maximum 2 volts across a high impedance load should be available at J-101 for all frequencies. It is reemphasized at this point that the termination methods outlined in Table 4-2 do not apply to this jack since the impedance at J-101 is 500 ohms. When using the X 20,000 RF output, the output voltage in microvolts is determined by multiplying the meter (M-101) reading by 20,000. This will be the actual voltage across a high impedance load (5000 ohms or more).

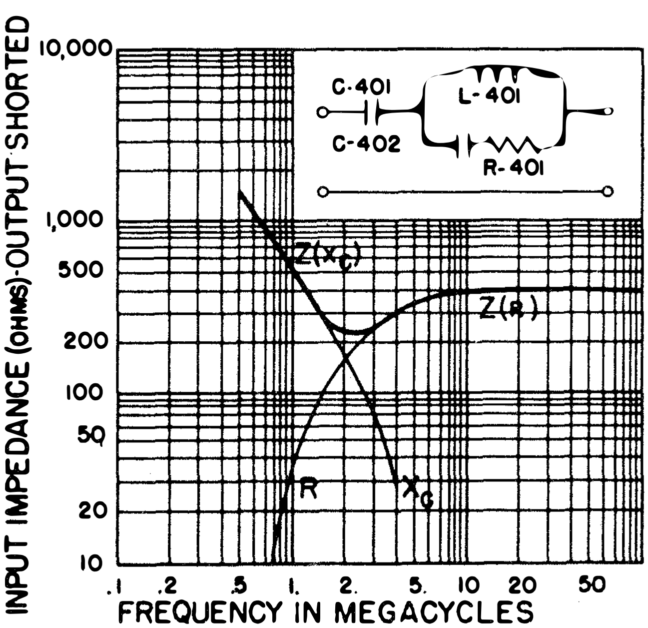



***Figure 4-3. Schematic Diagram of the Antenna Simulator SM-35/URM-25 with Input Impedance-Frequency Curve***

### 9. USE OF ANTENNA SIMULATOR SM-35/URM-25.
(See figure 4-3.)

*a.* The Antenna Simulator SM-35/URM-25 is used when making overall measurements or tests on a receiver designed for use with a standard antenna (see Section 4, par. 13f). The antenna simulator merely approximates the conditions that would exist had we applied our signal to the antenna circuit of the receiver and, therefore, the significant voltage is the input voltage to the simulator and not the input voltage to the receiver.

*b.* Connect the output cable (W-104) to the X MULT RF OUTPUT jack (J-102) and terminate this cable with the Impedance Adapter MX-1074/URM-25. Connect the antenna simulator to the impedance adapter with cable W-105 and to the receiver under test with cable W-106.

*c.* It can be seen from figure 4-3 that the minimum impedance of the antenna simulator will be approximately 220 ohms at 2 megacycles. This impedance becomes extremely high at lower frequencies and approaches 400 ohms at higher frequencies. In using the meter (M-101) of the signal generator it should be realized that a 20 percent maximum error may be introduced at 2 megacycles. If greater meter accuracy is required when using the antenna simulator, the actual impedance of this unit should be calculated from figure 4-3 at the frequency selected.

## NOTE

Figure 4-3 in this section is the same as figure 2-15 in section 2 but has been repeated here to assist the operator in applying the procedures herein outlined for the operation of the antenna simulator.

### 10. USE OF (5:1) FIXED ATTENUATOR CN-132/URM-25.

*a.* The (5:1) Fixed Attenuator CN-132/URM-25 attenuates the output at J-102 in a ratio of 5:1 when terminated in 53.5 ohms. It is very useful when using the meter (M-101) at output levels below "20" where the instrument accuracy falls off. This applies to microvolt ranges below 20,000 mv, 2000 mv, 200 mv, 20 mv, 2 mv, or .2 mv as selected by the MULTIPLIER dial (I-104) and MICROVOLTS control (E-103). In these cases, insert the (5:1) fixed attenuator at the X MULT RF OUTPUT jack (J-102) and terminate it as outlined in Table 4–2 for the required 53.5 ohms. The terminated output voltage is 1/5 the voltage indicated by M-101. The actual load voltage, however, will be 1/5 the meter indication only when the load impedance is exactly 53.5 ohms or greater than 500 ohms. For example; if a signal generator output of 20,000 microvolts into a 600 ohm load is desired, insert the fixed attenuator as follows:

(1) Connect the fixed attenuator to J-102 using cable W-104.

(2) Terminate the (5:1) fixed attenuator with the impedance adapter.

(3) Set the MULTIPLIER dial (I-104) to X 1000.

(4) Set MICROVOLTS (E-103) and CARRIER (E-101) control for "100" meter reading.

(5) The input to the load will be 20,000 microvolts.

*b.* If the load impedance is less than 53.5 ohms, it can be seen from Table 4–2 that the impedance adapter cannot be used, but the output from the (5:1) fixed attenuator must be fed to the load in series with the necessary resistor. The actual load voltage will then be something less than 1/5 the meter indication. For example; if a voltage of approximately 1200 microvolts with a load of 40 ohms is desired, insert a 13.5 ohm non-inductive resistor in series with the load and (5:1) fixed attenuator. The meter setting should be:

$$\text{Vmeter} = \frac{53.5}{40} \times 1200 \times 5 = 150 \times 53.5 = \text{approx.}$$

8000 microvolts.

## 11. USE OF (10:1) FIXED ATTENUATOR CN-136/URM-25.

*a.* The (10:1) Fixed Attenuator CN-132/URM-25 attenuates the output at J-102 in a ratio of 10:1 when terminated in 53.5 ohms. This unit can be used when a high degree of voltage accuracy is desired for low level outputs on band H. There is no need for using the 10:1 fixed attenuator on other bands or steps higher than X.1 on the MULTIPLIER dial (I-104).

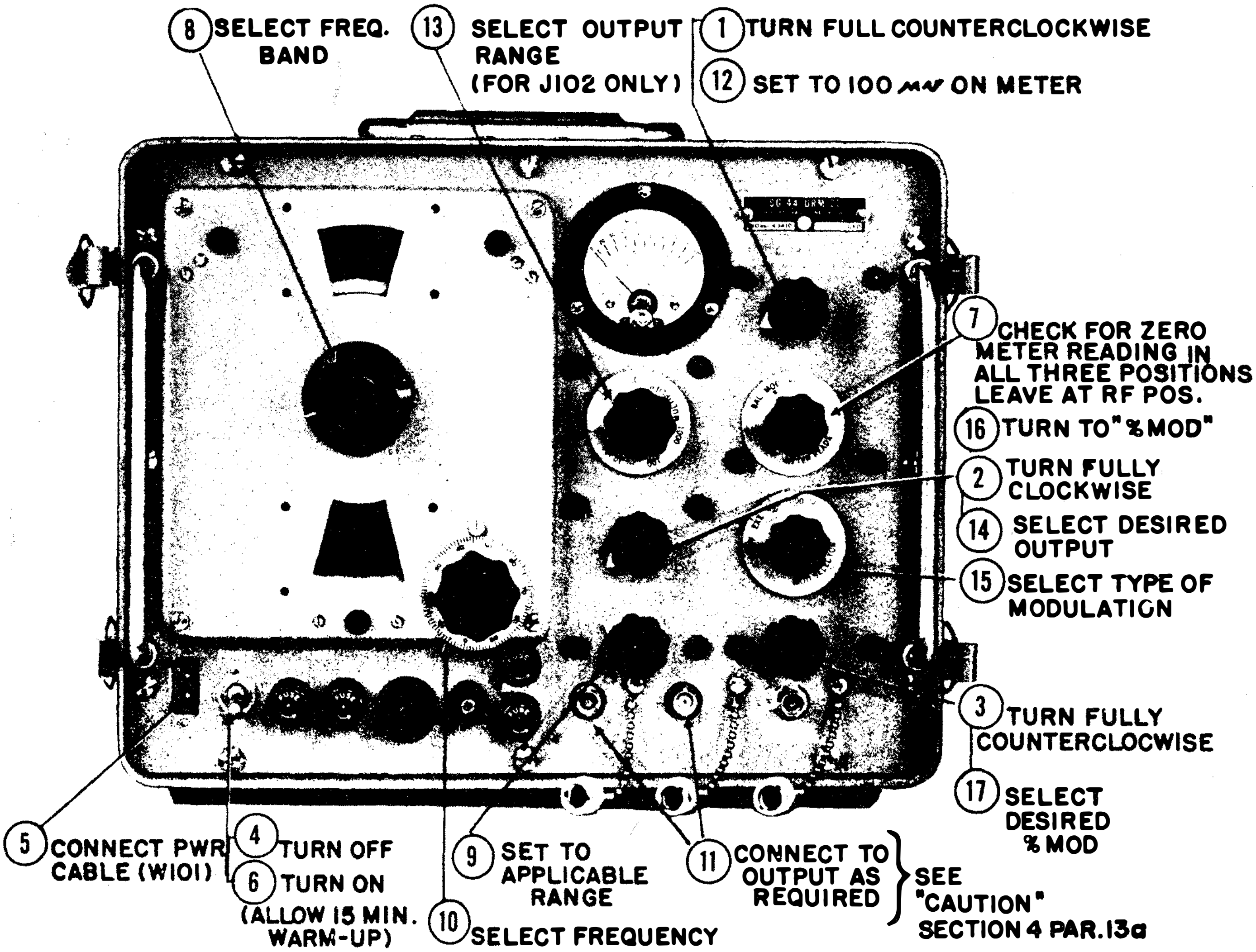



*Figure 4–4. Simplified Procedure for Operating the RF Signal Generator Set AN/URM-25*

Example (1) — Selecting an accurate output of 8 microvolts at 30 mc into a load of 500 ohms or greater.

(*a*) Set signal generator at 30 mc and MULTIPLIER dial (I-104) at X1 range.

(*b*) Adjust MICROVOLTS control (E-103) for reading of "80" on M-101.

(*c*) Insert the 10:1 fixed attenuator at J-102.

(*d*) Terminate 10:1 fixed attenuator with Impedance Adapter MX-1074/URM-25.

(*e*) Feed the output from the impedance adapter to the receiver under test.

(*f*) Input voltage to receiver is now 8 microvolts.

Example (2) — Correcting a .8 microvolts output at 45 mc into a load of 500 ohms or greater:

(*a*) Set signal generator at 45 mc and MULTIPLIER dial (I-104) at X.1 range.

(*b*) Select meter correction factor for 45 mc from Figure 4–2 (i.e. .92).

(*c*) Multiply 80 by correction factor (i.e. 80 × .92 = 73.6).

(*d*) Adjust the MICROVOLTS control (E-103) for a reading of "80" on M-101. This represents an actual output of 7.36 microvolts at J-102.

(*e*) Insert the 10:1 fixed attenuator at J-102.

(*f*) Terminate the 10:1 fixed attenuator with the Impedance Adapter MX-1074/URM-25.

(*g*) Feed the output from the impedance adapter to the receiver under test.

(*h*) Input voltage to the receiver is now .736 microvolts.

## 12. SUMMARY OF OPERATION.

In using the AN/URM-25 as a test oscillator, it will not always be necessary to apply all the procedures outlined in this section. The technician will determine by use, the precision requirements of the equipment under test. Figure 4–4 is a simplified procedure summary for the operation of the signal generator.

## 13. GENERAL INSTRUCTIONS FOR USE.

*a*. DETAILS — for additional details of proper signal testing techniques, the technician is referred to the basic equipment instruction book and also standard commercial texts. However, since most commercial test procedures refer to original broadcast type receivers which differ in principle and test values from standard Naval equipments, certain details of Naval values and methods are included herein.

## CAUTION

Always use the Test Lead CX-1363/U when making point to point tests on a receiver. Failure to do so may result in burning out a resistor in the step attenuator (E-112) or in one of the accessory units.

*b*. RECEIVER TESTS.

(1) GENERAL. — The presence of incidental frequency modulation in an A-M signal generator may introduce asymmetry in the apparent selectivity curve of the receiver being tested. This is particularly true for very sharply tuned circuits. The effects of frequency modulation have been kept at a minimum in the RF Signal Generator Set AN/URM-25 and should introduce no problem in receiver testing. For best results, however, the technician should perform all of the following receiver tests (except audio response) by using the unmodulated carrier signal. In order to eliminate the need for modulation, insert a high impedance DC voltmeter such as Navy Model ME-25/U or equal across the load of the second detector of the receiver. Adjustments can then be made with the meter response giving the necessary indication.

(2) SENSITIVITY. — At high radio frequencies, antenna characteristics cannot easily be reproduced, and considerable care must be taken in making receiver sensitivity tests. The voltage available at the signal generator unit output jack (J-102) is always known, but not the voltage at the receiver input terminals a few feet away. This latter voltage is proportional to the signal generator output voltage, but it may be larger or smaller due to the characteristics and the termination of the "transmission line" between the instruments. (See Section 2, par. 7.)

(3) SELECTIVITY. — The selectivity of a radio receiver is that characteristic which determines the extent to which the receiver is capable of distinguishing between the desired signal and disturbances of other frequencies. Selectivity is expressed in the form of a curve that gives the signal strength required to produce a given receiver output at various frequencies, with the response at resonance taken as the reference. This selectivity curve is normally obtained by disabling the automatic volume control system of the receiver, setting the signal generator to the desired frequency, tuning the receiver to this frequency, and modulating the carrier signal 30 percent at 400 cycles. The carrier frequency output of the signal is then varied by progressively increasing amounts from the frequency to which the receiver is tuned, and the signal generator voltage increased as necessary to maintain a controlled receiver output. The unmodulated carrier method as described in paragraph 13b(1) of this section can also be used. Unless otherwise specified, the normal output is usually taken as 6 milliwatts into 600 ohms.

(4) AUDIO RESPONSE. — The audio response of a receiver shows the manner in which the electrical output at a dummy load depends upon the modulation frequency. In making this test connect an audio oscillator, such as the Navy Model LAJ Series, to the EXTERNAL MOD INPUT (J-103). Set the MOD SELECTOR switch (I-106) to EXT. Set the signal generator to the desired carrier frequency and tune the receiver under test to this signal. Adjust the signal generator until a convenient output is obtained. Observe the variation in receiver output as the modulation frequency of the signal generator is varied from 400 cycles, while keeping the

degree of modulation constant at 30 percent. The results of an audio response test are expressed in the form of a curve with the ratio of actual output to 400 cycles output plotted vertically, and each corresponding audio frequency plotted horizontally. In making this test, care must be taken to avoid applying so great a signal to the receiver as to overload the output. In the event that the noise and hum level in the receiver output is appreciable, it will be necessary to supply a strong enough signal from the generator to override this interfering effect.

(5) MEASURING RECEIVER GAIN PER STAGE. — The RF Signal Generator Set AN/URM-25 is also a useful device for measuring the gain of any particular receiver stage. This is accomplished by applying a signal to the input and output points of the stage in question and recording the signal generator voltage required, in either case, to give the same receiver output. The gain in db is then calculated by applying the formula: GAIN (db) $= 20 \log \frac{V\ out}{V\ in}$.

(6) RECEIVER ALIGNMENT. — The alignment of the intermediate frequency amplifier system of a simple receiver is usually carried out by setting up the signal generator at the proper frequency and working step by step backward through the IF circuits from the second detector to the first detector.

## CAUTION

Consult the particular receiver's instruction book for details of the method applicable to that receiver. This is particularly important for wide band RF or IF amplifiers where over coupled, regenerative or stagger tuning is used. Be sure the aligning frequency is correct. Check with a heterodyne frequency meter such as Navy Model LM or LR series to obtain greater frequency accuracy than obtainable with the signal generator.

Always apply the signal generator to the grid immediately preceding the circuit under adjustment and adjust the trimmers (or variable inductances) for maximum output. In carrying out this procedure, it will of course be necessary to reduce the output of the signal generator each time the signal is applied to the grid of a tube at lower power level. The next step is to align the radio frequency and oscillator circuits of the receiver. This is accomplished by setting the receiver dial near the high end of the band in question and applying a signal of the proper frequency from the generator to the antenna input terminals of the receiver. First adjust the RF stage shunt trimmer capacitors (or iron core inductances) for maximum receiver output and then adjust the oscillator shunt trimmer until the receiver output is maximum. The receiver dial and signal generator are then set at the low frequency end of the receiver dial and the oscillator series padder capacitor is adjusted for maximum output. Recheck the high frequency end of the band and repeat the above procedure as necessary.

(7) RECEIVER ALIGNMENT ABOVE 50 MEGACYCLES. — The RF Signal Generator Set AN/URM-25 can also be used for aligning receivers above 50 mc by using the second harmonic of the frequency selected. Although harmonic distortion has been kept to about 10%, this still allows approximately 10,000 microvolts of second harmonics to be introduced at the X MULT RF OUTPUT jack (J-102). It must be realized, that, when the second harmonic is used, the signal generator meter can no longer be used as an indication of output.

*c.* MODULATED OPERATION. — In using the equipment with modulated output, it should be realized that three waves are emitted, one at the carrier frequency and two "side bands." While either pure or modulated CW signals can be obtained from the signal generator, considerable discretion must be used in employing the modulated method of receiver testing, based on the selectivity of the receiver and the frequency of test, since the carrier and both side bands must be received in true proportion in order to obtain accurate measurements.

*d.* RECEIVER OUTPUT. — In aligning or testing a receiver, a voltmeter, or output meter should be connected across the output terminals, in parallel with the proper resistance output load.

*e.* RECEIVER OVERALL SENSITIVITY. — Some radio receivers have an excess of sensitivity such that at certain frequencies, the inherent noise level is sufficient to saturate the detector or audio tubes, if the sensitivity, volume or gain control is advanced too far. Accordingly, all receivers are measured and rated for both CW and MCW sensitivity on the basis of the sensitivity, volume or gain control being adjusted so that not more than 60 microwatts of noise is present in the output with no input signal impressed. When measuring receiver overall sensitivities obtainable on the first step of the attenuator, it should be remembered that the output of the signal generator may not be attenuated equally at all frequencies to an absolute value of zero when the MULTIPLIER dial (I-104) is set at X.01 and the MICROVOLTS control (E-103) is set fully counterclockwise. The effects of stray or leakage disturbances caused by circulating currents in the case or between panel and case may be minimized by properly orienting the signal generator and using the (10:1) Fixed Attenuator CN-136/URM-25 (see Section 4, par. 11.) Proper orientation of the generator with respect to the receiver will also limit the presence of undesired stray voltages. These stray effects can be ascertained by comparing the output of the receiver with the signal generator turned on and turned off.

*f.* STANDARD ANTENNA ELECTRICAL CONSTANTS. — A standard antenna at low frequencies (below 1600 kilocycles) has essentially the same impedance as a series circuit of 20 microhenries, 200 micromicrofarads and 25 ohms. The resonant frequency is about 2500 kilocycles. The high frequency impedance is approximately 400 ohms resistive. The Antenna Simulator SM-35/URM-25 closely approximates the standard antenna (see Section 4, par. 9, also Section 2, par. 10).

*g.* STANDARD LEVELS. — Standard levels are as follows:

(1) Standard output level of reference — 6 milliwatts.

(2) Standard noise level — 60 microwatts.

(3) Standard output load — 600 ohms for low impedance output, or 20,000 ohms for high impedance output, unless special impedances are provided in the receivers and noted in their instruction books.

*h.* VOLTMETER USED AS AN OUTPUT METER. — In making measurements when a voltmeter is used as an output meter, the following approximate wattages correspond to the voltages at the load impedances noted:

| | | |
|---|---|---|
| (1) | 1.9 volts at 600 ohms<br>11.0 volts at 20,000 ohms | 6 milliwatts |
| (2) | 0.19 volts at 600 ohms<br>1.1 volts at 20,000 ohms | 60 microwatts |
| (3) | .77 volts at 600 ohms<br>4.5 volts at 20,000 ohms | 1 milliwatt. |

(4) For receivers provided with output meters having a zero level of 6 milliwatts — 20 decibels equal 60 microwatts.

(5) For receivers provided with output meters having a zero level of 60 microwatts — 20 decibels equal to 6 milliwatts.

# SECTION 5
# PREVENTIVE MAINTENANCE

## 1. ROUTINE MAINTENANCE CHECK CHART.

The construction of the RF Signal Generator Set AN/URM-25 is such that preventive maintenance measures will be limited. Periodic testing of the equipment to determine if it is in proper working order, should be performed in accordance with the step-by-step procedure given in Table 5–1 ROUTINE CHECK CHART. If the signal generator is used frequently (several times a week), these checks should be made prior to use, otherwise they should be made weekly. All symbol designations given in Table 5–1 refer to Front Panel Diagram, Figure 4–1 in Section 4 OPERATION unless otherwise specified.

### NOTE

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF *THE BUREAU OF SHIPS MANUAL,* OF THE LATEST ISSUE.

## 2. FUSE FAILURE.

Symptoms of fuse failure and fuse locations are given in Tables 5–2 and 5–3. Spare fuses are provided in the spare fuseholders (E-117, E-118) located on the front panel.

## 3. LUBRICATION.

No maintenance lubrication will be required by personnel using the signal generator.

### CAUTION

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

### TABLE 5–1. ROUTINE CHECK CHART

| WHAT TO CHECK | HOW TO CHECK | PRECAUTIONS AND REMARKS |
|---|---|---|
| 1. Installation. | Before connecting the power cable (W101) to the signal generator, make sure the equipment is properly set up in accordance with instructions given in Section 3 — INSTALLATION.<br>*a.* POWER switch (S-101) in OFF position.<br>*b.* CARRIER CONTROL (E-101) fully counterclockwise.<br>*c.* MICROVOLTS control (E-103) fully clockwise. | See that all cables and wires are in good condition and electrical connections properly made. |
| 2. Power Supply. | Set controls as follows:<br>*a.* CARRIER CONTROL (E-101) fully counterclockwise.<br>*b.* POWER switch (S-101) to ON position. | The indicator lamp (I-101) and frequency scale lamps (E-128 thru E-130) signal generator should light. If they do not, check front panel fuses (see table 5–3) and lamps. |
| 3. Voltmeter Check (M-101).<br>*a.* Balance. | *a.* Throw POWER switch (S-101) to ON position.<br>*b.* Allow 15 minutes warm up period.<br>*c.* Set METER READS dial (I-105) to BAL position.<br>*d.* Meter should read zero. | If the meter does not read zero in the BAL position R-131 requires adjustment (See Section 6, figure 6–9). This procedure is outlined in Section 6, par. 10. |

## TABLE 5–1. ROUTINE MAINTENANCE CHECK CHART — Continued

| WHAT TO CHECK | HOW TO CHECK | PRECAUTIONS AND REMARKS |
|---|---|---|
| *b.* RF Zero Set. | *a.* Set METER READS dial (I-105) to the RF position.<br>*b.* Meter (M-101) should read zero. | CARRIER CONTROL (E-101) should be turned fully counterclockwise. If the meter does not register zero, the RF COMP control (R-128) requires adjustment (See Section 6, figure 6–9). This procedure is outlined in Section 6, par. 10. |
| *c.* Percent Modulation Zero Set. | *a.* Rotate the % MODULATION control (E-104) to the fully counterclockwise position.<br>*b.* Set METER READS dial (I-105) to the MOD position.<br>*c.* Meter (M-101) should read zero. | If the meter does not register zero, the MOD COMP control (R-129) requires adjustment (See Section 6, figure 6–9). This procedure is outlined in Section 6, par. 10. |
| 4. Carrier Frequency. | Set controls and switches as follows:<br>*a.* CARRIER CONTROL (E-101) to full counterclockwise position.<br>*b.* MICROVOLTS control (E-103) to full clockwise position.<br>*c.* METER READS dial (I-105) to RF.<br>*d.* CARRIER RANGE knob (E-102) to corresponding band position.<br>*e.* POWER switch (S-101) to ON position. | *a.* Meter (M-101) should move up-scale as CARRIER CONTROL (E-101) is rotated in a clockwise direction.<br>*b.* Meter pointer should read "100" in all positions of the FREQUENCY BAND SWITCH (E-105), when the CARRIER CONTROL is advanced in a clockwise direction. |
| 5. Modulation Frequency. | Set controls and switches as follows:<br>*a.* CARRIER CONTROL (E-101) fully counterclockwise.<br>*b.* METER READS dial (I-105) to % MOD.<br>*c.* MOD SELECTOR switch (I-106) to 400 cycles.<br>*d.* CARRIER RANGE switch (E-102) to corresponding band position.<br>*e.* % MODULATION control (E-104) fully counterclockwise.<br>*f.* POWER switch (S-101) to ON. | *a.* When % MODULATION control (E-104) is rotated clockwise, the meter should reach 80% modulation.<br>*b.* Repeat check for 1000 cycles position of MOD SELECTOR switch (I-106). |

## TABLE 5–2. SYMPTOMS OF FUSE FAILURE

| INDICATOR (I-101) AND SCALE (E-128 THRU E-130) LAMPS OF SIGNAL GENERATOR | ALL ELECTRON TUBES | METER M-101 | OPEN FUSE | VALUE (AMPS) | COMMENTS |
|---|---|---|---|---|---|
| None Light | Filaments Off | No Reading | F-101 | 1 | Check also power supply cables, connectors, etc. and the POWER switch (S-101). |
| None Light | Filaments Off | No Reading | F-102 | 1 | |

## TABLE 5–3. FUSE LOCATIONS

| SYMBOLS | LOCATION | PROTECTS | AMPS | VOLTS | NUMBER |
|---|---|---|---|---|---|
| F-101 | 1. Physically located in signal generator front panel fuse-holders (E-115 and E-116). See figure 4–1. 2. Electrically located in primary of power transformer T-201. See figure 6-23. | Primary of power transformer (T-201). | 1.0 | 250 | FUS-10 |
| F-102 | | | 1.0 | 250 | FUS-10 |

# FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.

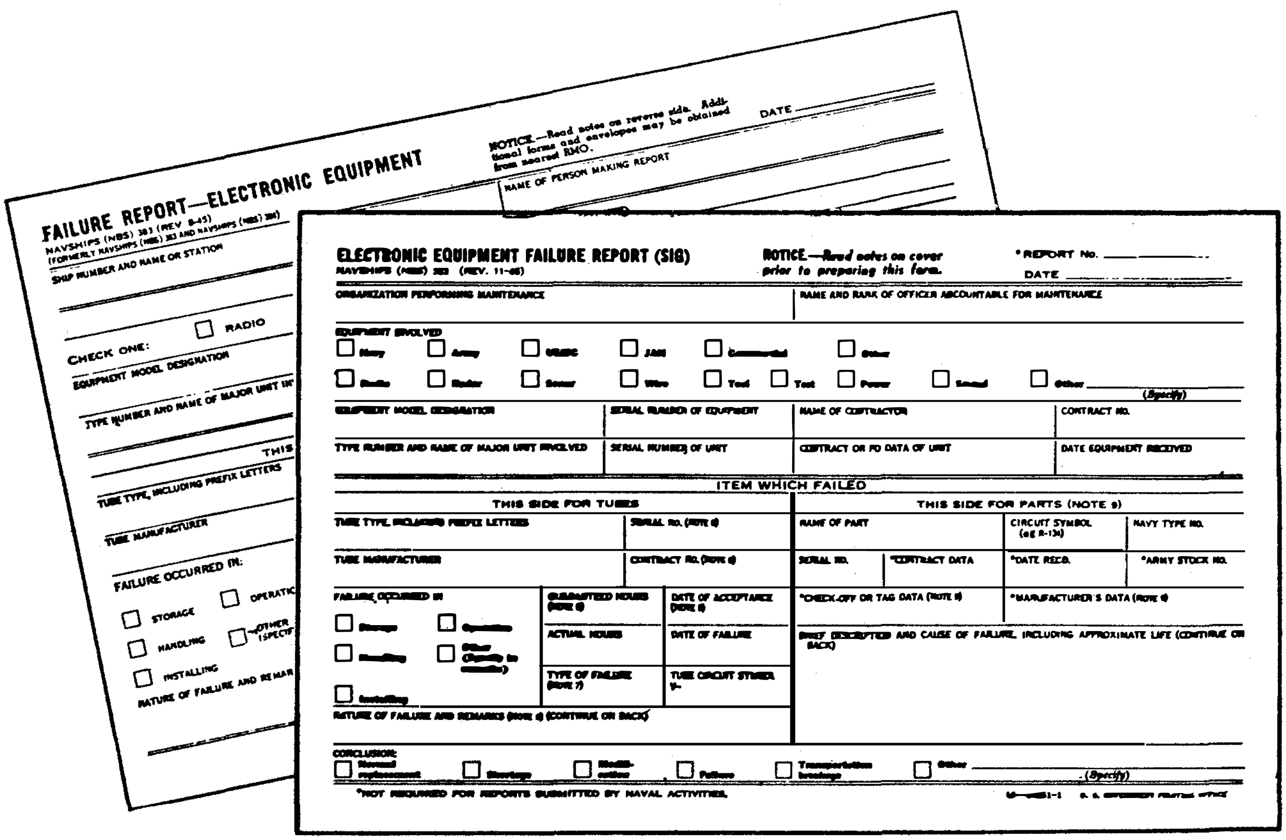



*Figure 6–1. Failure Report, Sample Form*

# SECTION 6
# CORRECTIVE MAINTENANCE

## CAUTION

This section is written primarily for use by the Electronics Technician. A non-technical operator should make no attempt to apply the procedures herein prescribed. Failure to comply with this suggestion may result in considerably greater damage to the signal generator than had originally been incurred by some performance failure.

## 1. GENERAL.

*a.* The fundamental principle of the RF Signal Generator Set AN/URM-25 is similar to that of any radio frequency transmitter. A study of Section 2, THEORY OF OPERATION will make this analogy more obvious. Like any RF transmitter, the AN/URM-25 has an RF oscillator, RF amplifier and provision for modulation. If the technician will bear this in mind, it may simplify his trouble shooting procedures.

*b.* The first step in maintenance or repair is to definitely determine that a defective condition exists. If the equipment is not operated correctly, certain indications of trouble might be presented when there is actually nothing wrong with the equipment. The technician should be thoroughly familiar with Section 4 OPERATION of this book before attempting to analyze the indicated defect.

*c.* After a positive determination is made that the generator is defective, the first step in trouble shooting is to localize the trouble, that is, decide which circuit of the complete system is not functioning as it should. Once the analysis has been narrowed down to the defective circuit, it becomes a relatively simple process of making voltage and resistance checks to locate the faulty circuit part (i.e. resistor, capacitor, etc.). The same system should be followed as is used in trouble shooting a radio frequency transmitter.

## 2. PRINCIPAL MAINTENANCE PROBLEMS.

The chief parts of the signal generator which are subject to wear or deterioration are electronic tubes and the FREQUENCY BAND SWITCH (S-105). In addition, and as a result of aging or excessive temperature variations, the carrier oscillator inductances may vary slightly and require recalibration (See Table 6–1 FREQUENCY CALIBRATION DATA).

3. TEST EQUIPMENT REQUIRED FOR CALIBRATION AND REPAIR.

a. AN/URM-32 or equivalent.

b. Oscilloscope AN/USM-38.

c. Resistance Bridge ZM-4B/U.

d. Test Set, Tube TV-2A/U.

e. Multimeter AN/PSM-6.

f. Hewlett-Packard Model 400C or equivalent.

## 4. REMOVING THE SIGNAL GENERATOR AND POWER SUPPLY FROM THE CABINET.

*a.* REMOVING THE RF SIGNAL GENERATOR SG-44/URM-25. — Since this is a precision instrument, great care should be taken in removing the RF Signal Generator SG-44/URM-25 from the cabinet to make repairs. Before attempting to disassemble the unit, be sure that the equipment is disconnected from the power source. Adhere carefully to the following procedure:

(1) Remove the power cable (W-101).

(2) Loosen the twelve captive screws located around the outer edge of the panel (See figure 6–2).

(3) Gently pull the generator chassis about eight inches from the cabinet, using the lifting handles provided on the front panel. The generator unit cannot be completely removed since the interconnecting power cable (W-102) and output power cable (W-103) are still connected to the power supply sub-chassis.

(4) Remove the output power supply connector (P-102) and the AC input connector (P-101) from the

power supply sub-chassis. The generator sub-assembly can now be removed. The power supply sub-chassis will remain in the cabinet.

*b.* REMOVING THE POWER SUPPLY PP-562/-URM-25.

(1) To remove the power supply, take out the four binding head screws located on the bottom of the cabinet. There are also four screws on the rear of the cabinet which must be removed. (See figure 6–3).

(2) With the signal generator and power supply sub-assemblies removed from the cabinet, the equipment can again be connected for use and testing by applying the following procedure (See figure 6–4).

(*a*) Insert interconnecting power cable plug (P-101) into the power supply input receptacle (J-201) and P-102 into J-202.

(*b*) Insert one end of the power cable (W-101) into the front panel input receptacle (J-104) and plug the other end into the AC source.

## WARNING

Voltages up to 450v will be exposed when the signal generator is being tested outside the cabinet. Exercise great care in handling the instrument under these conditions.

## 5. REMOVAL AND REPLACEMENT OF PARTS.

*a.* Whenever repairs are made involving the removal or replacement of any component part, the part removed should be marked or tagged for identification and its exact position in the equipment carefully noted and recorded so that when the same or new part is replaced the equipment will be precisely as before. This precaution is particularly necessary when replacing RF components, such as coils and capacitors. The location of these parts with respect to associated components will play an important role in the performance of the equipment.

*b.* Whenever any parts are replaced by new one, always use the identical type listed and described in Section 7 PARTS LIST, Table 7–4. If such parts cannot be obtained, substitute only similar parts with equivalent electrical and mechanical characteristics. If precision parts are not available and it is absolutely necessary to use the equipment, a temporary substitute of approximate value may be inserted. This is not recommended as a normal procedure and the exact replacement should be ordered. The unsatisfactory substitute should be removed as soon as the exact replacement is received.

## 6. REPLACING RF OSCILLATOR CIRCUIT COMPONENTS.

*a.* The RF oscillator frequency determining components L-105 through L-112 and C-127 through C-134 should not normally be replaced in the field unless the necessary calibrating instruments are available. These instruments include RF heterodyne frequency meters that cover from 10 kc to 30 mc with an accuracy of at least .05% (e.g. Navy Model LR and Signal Generator TS-535/U).

*b.* Changing the oscillator tube should not normally cause much error in calibration. However, when replacing the oscillator tube, the signal generator should be recalibrated as soon as the necessary test equipment is available (i.e. Navy Model LR and Signal Generator TS-535/U).

NOTE: LOOSEN CAPTIVE SCREWS MARKED "X" TO REMOVE RF SIGNAL GENERATOR SG-44/URM-25 FROM CABINET

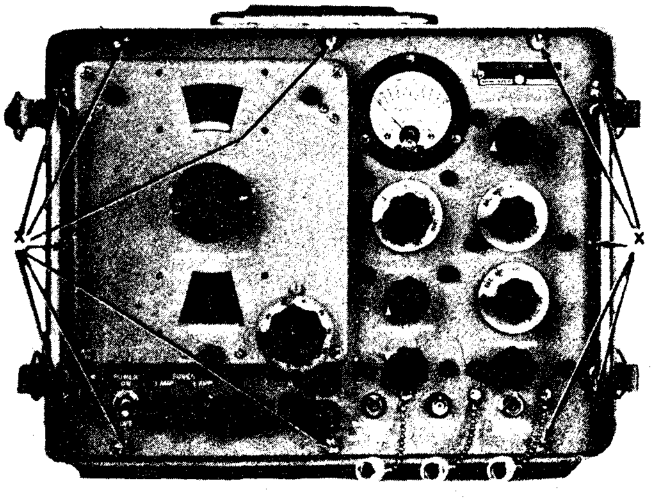



*Figure 6–2. Front Panel View for Removal of RF Signal Generator SG-44/URM-25 from Cabinet*

NOTE: TAKE OUT SCREWS MARKED "Y" TO REMOVE POWER SUPPLY PP-562/URM-25 FROM CABINET

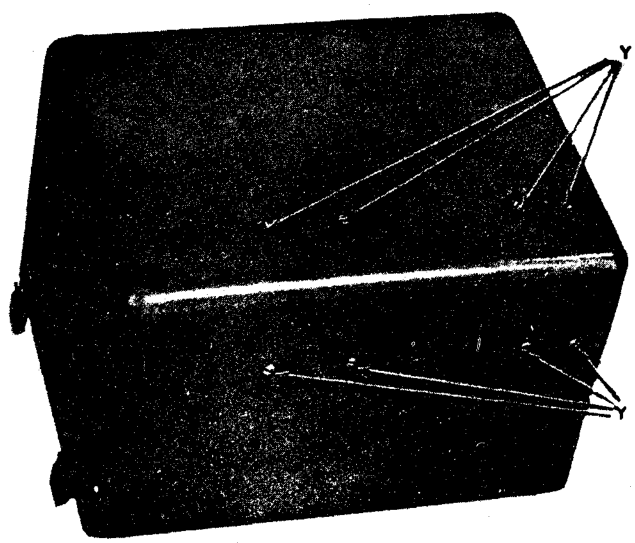



*Figure 6–3. Rear-Bottom View for Removal of Power Supply PP-562/URM-25 from Cabinet*

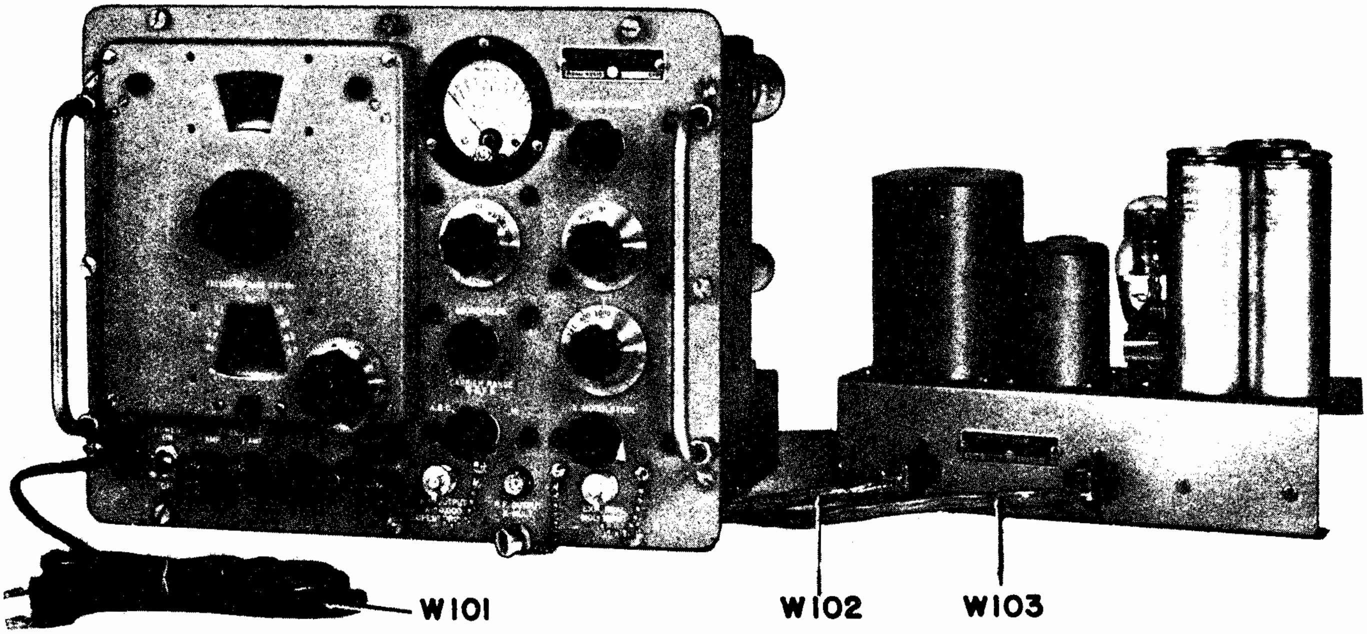



*Figure 6—4. RF Signal Generator SG-44/URM-25 and Power Supply PP-562/URM-25 Connected Outside Cabinet for Testing*

## 7. REPLACING BUFFER-AMPLIFIER CIRCUIT COMPONENTS.

(See figures 6–5 and 6–6).

The buffer-amplifier compartment is located between the carrier oscillator and audio compartments. It contains the buffer-amplifier (V-104) and RF diode (V-105) circuits in addition to the step attenuator (E-112), MICROVOLTS control (R-155), and CARRIER RANGE switch (S-104). The RF diode and buffer-amplifier circuits are contained with the MICROVOLTS control on a separate shelf. Whenever it becomes necessary to repair these units, this shelf must first be removed. This removal should be accomplished in the following manner (See figures 6–5 and 6–6).

*a.* Remove the buffer-amplifier compartment cover plate.

*b.* Unsolder leads to the six feed thru capacitor (C-110, C-111, C-116, C-117, C-135, and C-137), and the lead to the step attenuator (E-112).

*c.* Unsolder lead to J-101 and lead to grid of V-104.

*d.* Unsolder the leads going to the CARRIER RANGE switch (S-104).

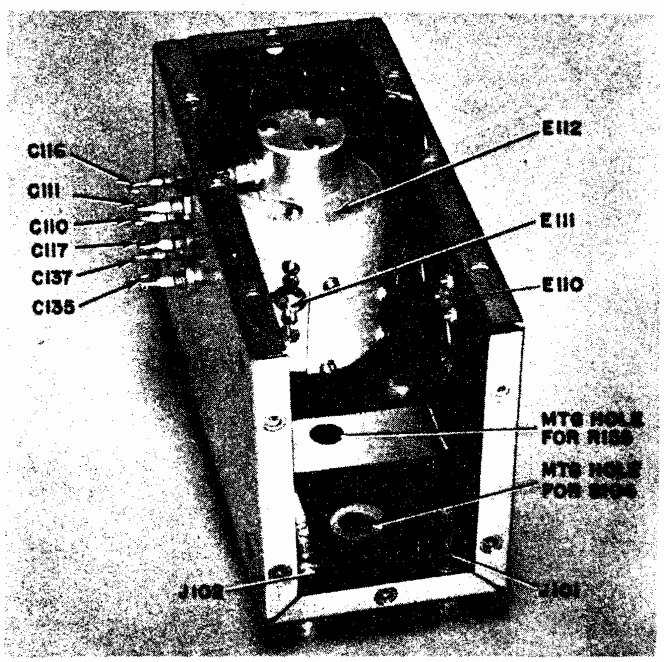



*Figure 6—5. Interior View of Buffer-Amplifier with Tube Shelf and CARRIER RANGE Switch (S-104) Removed*

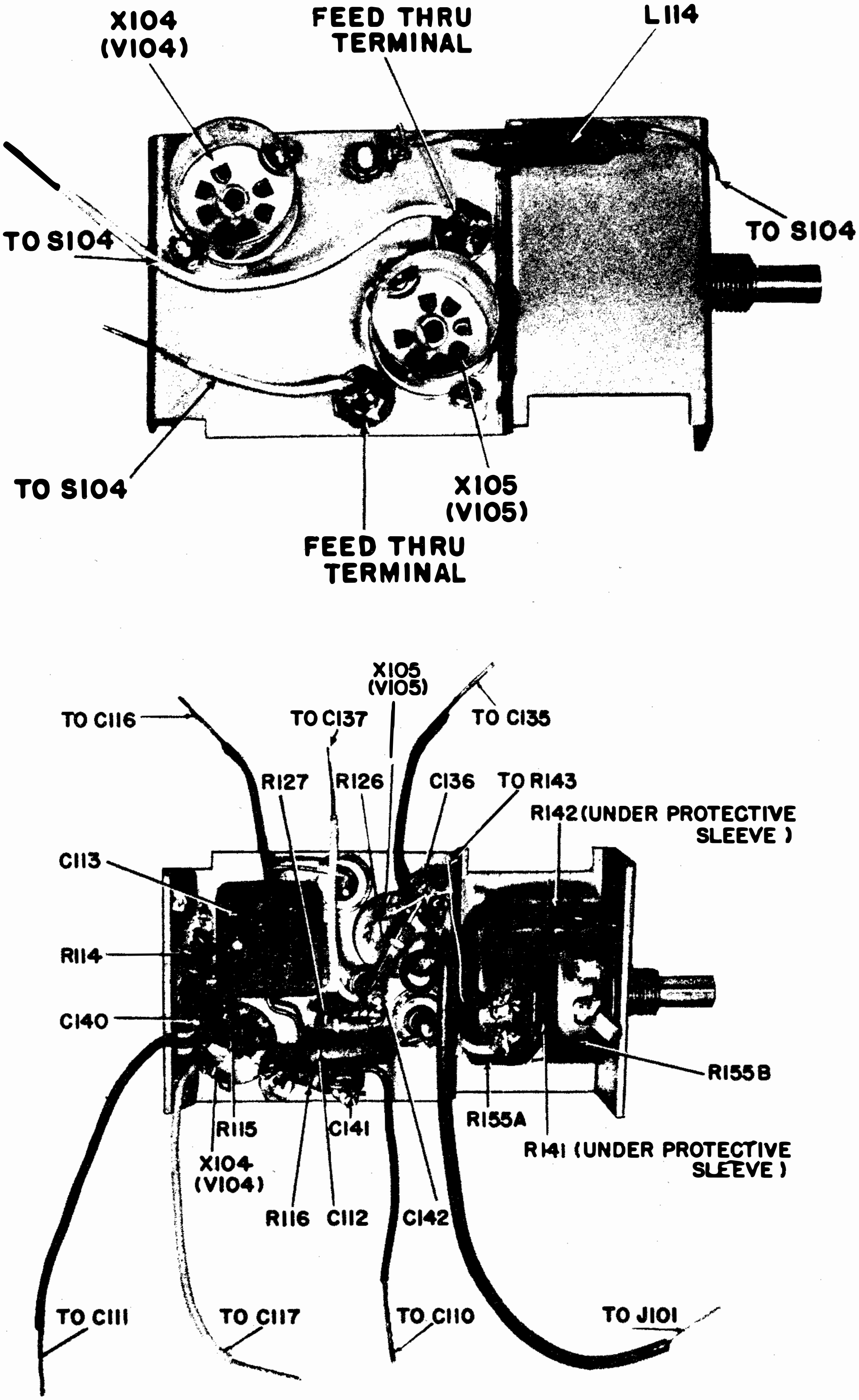



*Figure 6–6. Top and Bottom Views of Buffer-Amplifier Tube Shelf*

*e.* Remove the MICROVOLTS control knob (E-103) and bushing nut.

*f.* The buffer-amplifier-RF diode shelf can now be removed.

## 8. READJUSTMENT OF FREQUENCY CALIBRATION.

(See figure 6–7)

*a.* Any sufficiently accurate method of measuring the frequency at each end of the frequency range in question may be used, but the simplest and most satisfactory method is that employing the following equipments or their equivalents.

(1) Navy Model LR Frequency Meter (160 kc to 30 mc).

(2) Signal Generator TS-535/U (7 to 160 kc).

(3) Set of earphones for zero beating the frequency meters.

*b.* Figure 6–7 indicates the locations of the trimmers and inductances that may require readjustment. Make sure that only the parts relevant to the frequency band being calibrated are adjusted. Do not turn screws indiscriminantly but follow the calibration procedure.

## 9. FREQUENCY CALIBRATION PROCEDURE.

(See figures 6–7 and table 6–1)

*a.* GENERAL

(1) When the frequency error of the signal generator is in excess of 1%, it will be necessary to recalibrate the instrument. In making the necessary adjustments, the RF Signal Generator SG-44/URM-25 must first be removed from the cabinet. Interconnecting cables are of sufficient length as not to require the removal of the Power Supply PP-562/URM-25 sub-chassis. Follow the procedure outlined in Section 6, par. 4, for removing the signal generator unit.

(2) Over the frequency range covered by Bands A through G (10 kc through approx. 18 mc), each oscillator coil has connected across it a trimmer capacitor for adjusting the total capacitance associated with it. Each corresponding coil also has a movable iron core by means of which the inductance of that coil can be adjusted to the required value. The recalibration process on these bands is therefore a simple matter of (*a*) adjusting the inductance for frequency calibration at the low-frequency end of the range, (*b*) adjusting the corresponding trimmer capacitor for a calibration point at the high end of the range, and (*c*) checking the center portion of the range selected.

(3) There is no trimmer capacitor or adjustable core for band H. If absolutely necessary, the inductance may be varied by adjusting the space between the coil (L-105) windings. This adjustment is made with the LR Frequency Meter at 30 mc (approximately mid scale on band H of the RF Signal Generator Set AN/URM-25).

### TABLE 6–1. FREQUENCY CALIBRATION DATA

| FREQUENCY RANGE | LOW END—ADJUST INDUCT. | | HIGH END—ADJUST CAP. | |
|---|---|---|---|---|
| | FREQ. | COIL | FREQ. | COIL |
| A | 10 Kc | L111 | 20 Kc | C136 |
| B | 30 Kc | L110 | 80 Kc | C135 |
| C | 100 Kc | L109 | 200 Kc | C134 |
| D | 250 Kc | L108 | 650 Kc | C133 |
| E | 700 Kc | L107 | 2 Mc | C132 |
| F | 3 Mc | L106 | 6 Mc | C131 |
| G | 7 Mc | L105 | 18 Mc | C130 |
| H | MAKE CENTER BAND ADJUSTMENT AT 30 Mc | | | |

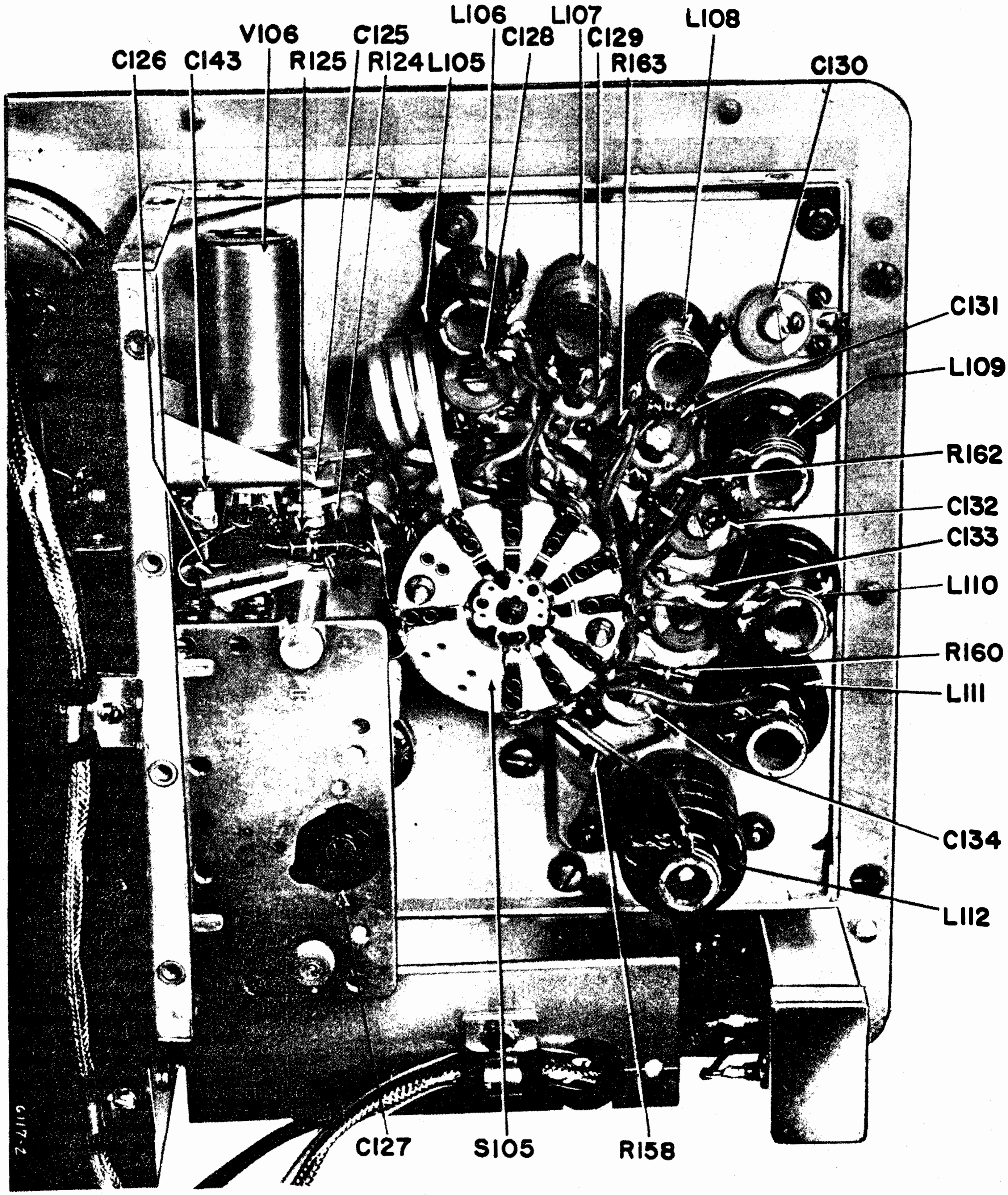



*Figure 6–7. Interior View of Carrier Oscillator Compartment*

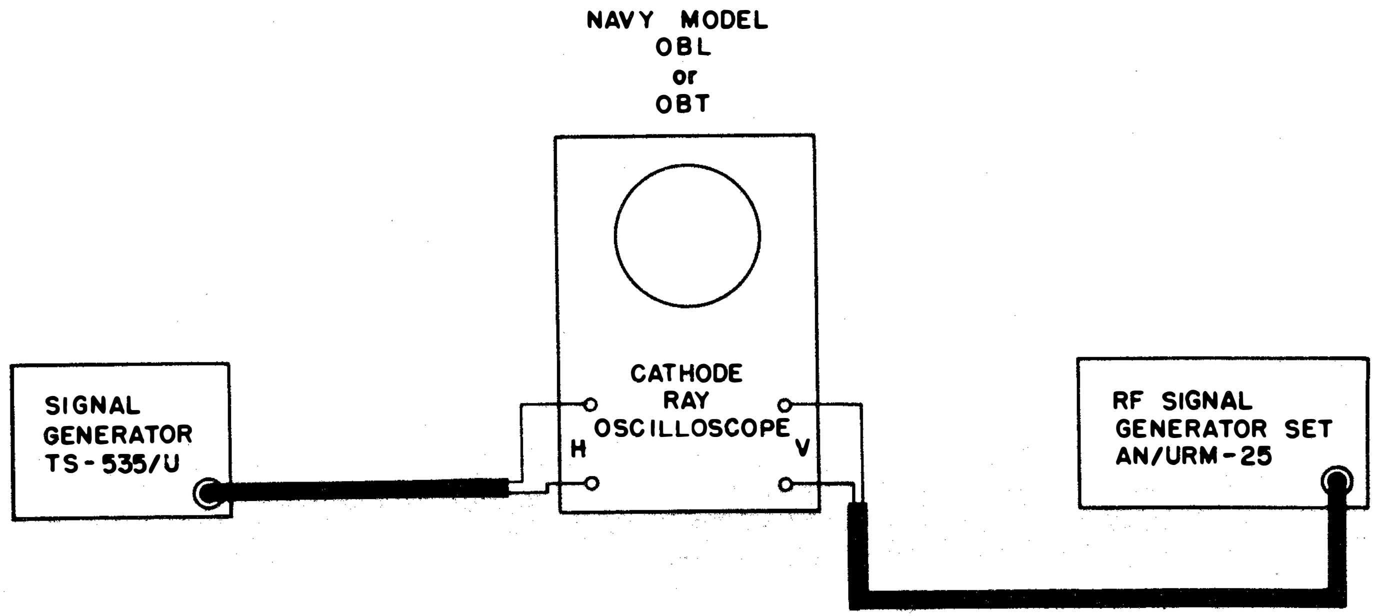



*Figure 6–8. Method for Calibrating the RF Signal Generator Set AN/URM-25 at Frequencies Below 100 Kilocycles*

(4) In using the heterodyne frequency meters referred to in paragraph 7 of this section, connect the output test cable (W-104) to the heterodyne frequency meter. Place a pair of earphones across the output of the frequency meter. Make the necessary capacitance and inductance adjustments while listening for a zero beat on the earphones.

(5) For calibrating frequency ranges below 100 kc, use the Signal Generator TS-535/U. Feed the output from the RF Signal Generator Set AN/URM-25 and Signal Generator TS-535/U to the horizontal and vertical inputs of an oscilloscope such as Navy Models OBL or OBT series (See figure 6–8). Adjust the frequency of the Signal Generator TS-535/U and the frequency of the RF Signal Generator Set AN/URM-25 to the same value. Be sure to calibrate the Signal Generator TS-535/U according to its instruction book before using it as a standard in this procedure.

## NOTE

To make the necessary RF trimmer and coil adjustments, it will be necessary to remove the top shield plate from the carrier oscillator compartment. After the adjustment has been made, replace this plate and recheck calibrations. If the calibrations have been changed when this plate is replaced, readjust the applicable trimmer or core to compensate for this effect.

*b.* FREQUENCY CALIBRATION CHART. Table 6–1 is a chart for calibrating frequency and the necessary adjustment to be made on all bands. When calibrating frequency, follow the points and procedures therein contained.

*c.* ADJUSTING THE RF COILS.

(See figure 6–7 and table 6–1)

(1) Identify the coil that must be readjusted (See figure 6–7).

(2) Set the main tuning dial (I-103) at the selected calibration point for the range in question.

(3) Note the original position of the core slot in the coil form. Move the core slightly in the required direction.

(*a*) *Out* to *reduce* inductance and *increase* frequency.

(*b*) *In* to *increase* inductance and *reduce* frequency.

(4) Replace the oscillator compartment shield and recheck the frequency scale for correction of calibration. (See note in par. 9*a*(5) of this section).

*d.* ADJUSTING THE TRIMMER CAPACITORS.

(1) Access to the trimmer capacitor is made by removing the oscillator compartment shield.

(2) Set the main tuning dial (I-103) at the required calibration point for the range in question.

## CAUTION

After the necessary adjustments have been made, on the upper and lower ends of the band being calibrated, the corresponding calibrations should be correct throughout the frequency range. If not, the main tuning capacitor (C-127) may be defective. One common way that this variable capacitor becomes defective is through "plate bending." Never bend the plates of the main tuning capacitor (C-127) in attempting to make an adjustment.

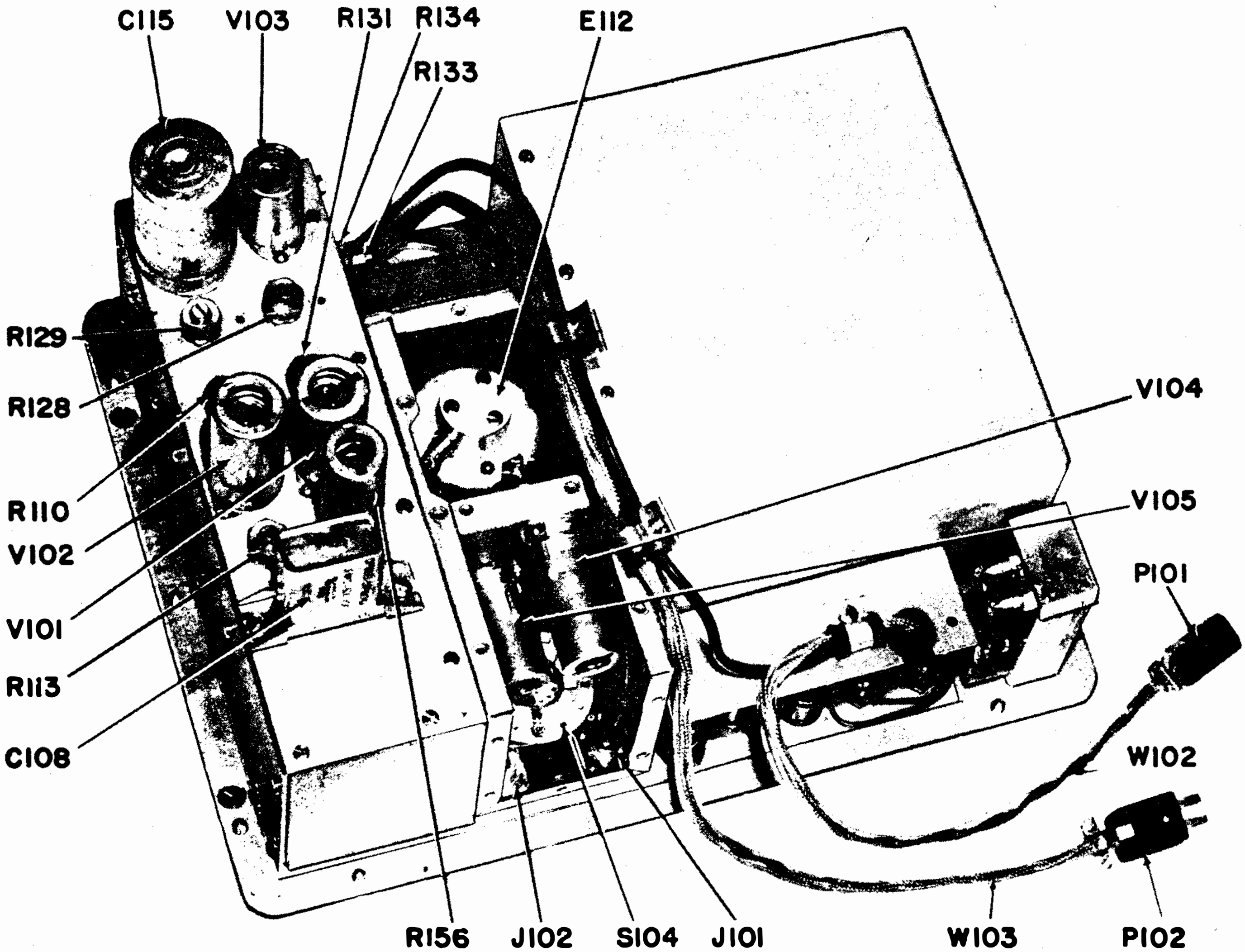



***Figure 6–9. Rear View of RF Signal Generator SG-44/URM-25 with Buffer-Amplifier Cover Plate Removed***

## 10. CALIBRATING THE ELECTRON TUBE VOLTMETER.

(See figure 6–9)

*a.* GENERAL. — In the course of operating the equipment, it may be discovered that the meter (M-101) does not indicate what it should. This can readily be determined by applying the procedures outlined in Section 5 Table 5–1 ROUTINE CHECK CHART and making the necessary adjustments outlined in this paragraph.

### NOTE

All voltmeter adjustments (R-128, R-129, R-131 and R-134) are of the screwdriver type and are located in the audio compartment. Figure 6–9 identifies these controls.

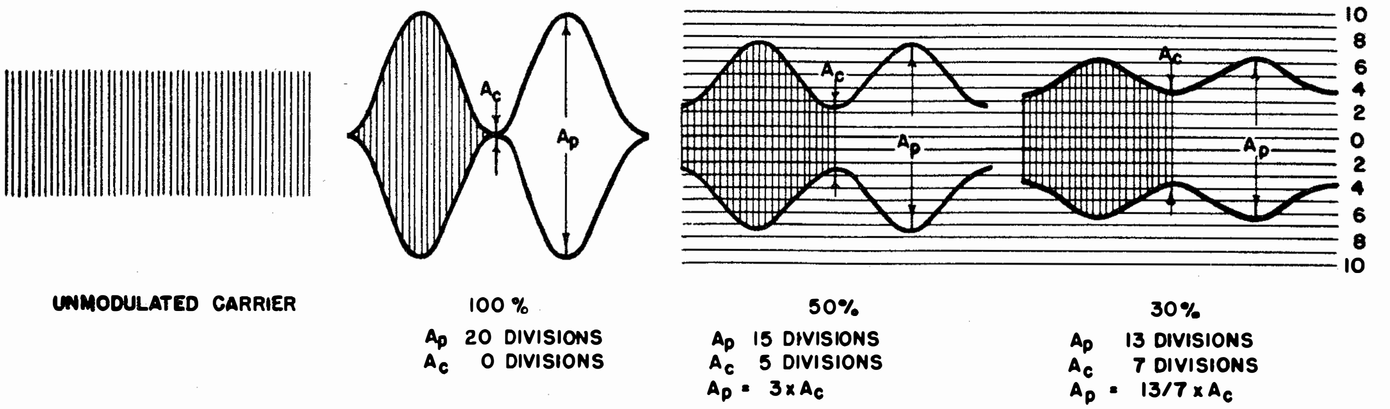
*b.* ZERO ADJUSTMENT. — Make this adjustment if the meter (M-101) does not read zero in all positions of the METER READS switch (S-102) when the CARRIER CONTROL (R-123) and % MODULATION control (R-111) are set fully counterclockwise.

(1) Set CARRIER CONTROL (R-123) and % MODULATION control (R-111) to the fully counterclockwise positions (zero carrier and zero modulation voltage).

(2) Set METER READS switch (S-102) to the BAL position.

(3) Adjust the BALANCE control (R-131) for zero meter reading. This potentiometer (R-131) varies the relative B+ voltage applied to the plates of the bridge tube (V-101) until a balance is obtained in the two arms of the bridge. When both branches are thus balanced, no current flows through the meter (M-101) and it indicates zero.

(4) Set the METER READS switch (S-102) to the RF position. The output from the RF diode (V-105) is now applied to the grid of the bridge tube (V-105B). Since the CARRIER CONTROL (R-123) was set for zero signal output (fully counterclockwise), there should be no voltage applied to the grid of the tube (V-101B) and the meter (M-101) should still indicate zero. However, if a reading other than zero is reflected by the meter,




$$\% \text{ MODULATION} = \frac{A_p - A_c}{A_p + A_c} 100$$

*Figure 6–10. Percentage Modulation Chart*

adjust the RF COMP control (R-128) until a zero meter reading is obtained. This adjustment compensates for the contact potential that may be present across the RF diode (V-105).

(5) Set the METER READS switch (S-102) to the % MOD position. The output from the modulation diode (V-103) is now applied to the bridge tube (V-101B). Since the % MODULATION control (R-111) was set to the fully counterclockwise position, there should be no voltage applied to the grid of the bridge tube (V-101B). Here again, the contact potential of the modulation diode (V-103) may cause a reading other than zero to be indicated on the meter (M-101). Adjust the MOD COMP control (R-129) for zero meter reading.

*c.* RF OUTPUT VOLTAGE CALIBRATION (upper meter scale).

(1) Turn the MICROVOLTS control (R-155) to the fully clockwise position.

(2) Set the CARRIER CONTROL (R-123) to the fully counterclockwise position.

(3) Set METER READS switch (S-102) to the RF position.

(4) Turn MOD SELECTRO switch (S-103) to OFF.

(5) Set frequency at 100 kc.

(6) Place an electronic voltmeter such as Multimeter ME-25/U or equal between one center contact of the X 20,000 RF OUTPUT jack (J-101) and ground.

(7) Rotate the CARRIER CONTROL (R-123) in a clockwise direction until 2.0 volts are indicated on the test meter. The signal generator meter (M-101) should read "100" on the upper scale. This represents 2.0 volts output when the X 20,000 RF OUTPUT jack (J-101) is open circuited.

(8) Adjust the RF Sens control (R-133) until the. signal generator meter (M-101) reads "100" on the upper scale when the test meter reads 2.0 volts.

(9) To maintain a calibrated output voltage from the X MULT RF OUTPUT jack (J-102), when operating the signal generator, first rotate the CARRIER CONTROL potentiometer (R-123) to the fully counterclockwise position. Turn the CARRIER CONTROL in a clockwise direction until the meter (M-101) reads "100." The output from this jack can now be varied by rotating the MICROVOLTS potentiometer (R-111) in a counterclockwise direction and by selecting the desired attenuation with the MULTIPLIER dial (I-104). Once the carrier level has been set at "100," the CARRIER CONTROL (R-123) should never be used to vary the output from the X MULT RF OUTPUT jack (J-102). Before changing frequency, the CARRIER CONTROL (R-123) should first be returned to the fully counterclockwise position and then advanced to the carrier level of "100," after the desired frequency has been selected.

*d.* PERCENTAGE MODULATION CALIBRATION (lower meter scale).

(See figure 6–10)

(1) Set carrier frequency at 100 kc.

(2) Set METER READS switch (S-102) to the % MOD.

(3) Set MOD SELECTOR switch (S-103) for 400 cycles per second.

(4) Set CARRIER RANGE switch (S-104) to the ABC position.

(5) Feed the output from the X MULT RF OUTPUT jack (J-102) to the vertical input of a test oscilloscope.

(6) Place a graduated celluloid screen over the face of the oscilloscope.

(7) With the MULTIPLIER dial (I-104) and MICROVOLTS control (R-155), adjust the modulated signal amplitude to cover approximately 75 per cent of the face of the oscilloscope.

(8) Adjust the % MODULATION control (R-111) on the front panel until 50 percent modulation is indicated on the oscilloscope (See figure 6–10.)

(9) Adjust the Mod Sens control (R-134) until the

meter (M-101) also indicates 50 percent on the modulation scale (lower scale).

(10) Adjust the % MODULATION control (R-111) on the front panel until 30 percent modulation is indicated on the oscilloscope.

(11) Check the reading of the meter.

(12) If necessary, readjust R-134 until 30 percent and 50 percent readings are both as accurate as possible, favoring the 30 percent adjustment since this value is used most often.

## 11. CALIBRATING THE STEP ATTENUATOR (E-112).

*a.* The voltage attenuation of the step attenuator (E-112) should be checked whenever a resistor in this unit is replaced. Use the (10:1) Fixed Attenuator CN-136/URM-25 and a radio receiver such as Navy Model RBA Series or equivalent for making this check as follows:

(1) Set the RF Signal Generator Set AN/URM-25 for 100 kc carrier frequency with 30% modulation at 400 cycles.

(2) Connect the (10:1) Fixed Attenuator CN-136/-URM-25 to J-102 and terminate it with the Impedance Adapter MX-1074/URM-25.

(3) Connect the impedance adapter output to the RBA (or equivalent) receiver.

(4) Adjust the output of the signal generator for a reading of "100" on M-101.

(5) Set the MULTIPLIER dial (I-104) one range above the range in which the resistor was replaced.

(6) Connect a voltmeter such as the Multimeter ME-25/U series or equivalent across the output of the RBA receiver.

(7) Tune the receiver to the frequency (100 kc) of the signal generator and record a reference receiver output as indicated by the multimeter.

(8) Reset the MULTIPLIER dial (I-104) to the attenuation range in question (next lower range).

(9) Remove the (10:1) Fixed Attenuator CN-136/-URM-25 and connect the signal generator output at J-102 to the Impedance Adapter MX-1074/URM-25.

(10) Advance the MICROVOLTS control (E-103) in a clockwise direction for a meter reading of "100."

(11) The receiver output should be the same now as was indicated in step 7 above. If it is not, the resistor on this range should be replaced.

### NOTE

Use a very hot soldering iron when replacing resistors in the step attenuator (E-112). Apply the iron to the solder surface for a very short period of time. Too long a period of heating may cause the precision resistors to change in value.

*b.* Whenever it is suspected that the step attenuator ratios are not correct, the procedures outlined in paragraph 11a above may be used as a check. A more complete analysis of step attenuator troubles is given in Table 6–4 CHART OF SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE, paragraph 7.

## 12. TROUBLE SHOOTING CHARTS.

*a.* In employing any systematic method for trouble shooting, the methods and procedures followed by the technician will vary greatly. Any method employed is satisfactory as long as it will produce accurate results with the greatest expediency.

*b.* To assist the Electronics Technician in applying himself to the maintenance problems of the RF Signal Generator Set AN/URM-25, a trouble symptoms chart and two trouble shooting tables are listed near the end of this section. The first, Table 6–2 TROUBLE SYMPTOM CHART is a listing of some common trouble symptoms with suggested checks for locating the defect; the second, Table 6–3 GENERAL TEST PROCEDURES FOR LOCALIZING TROUBLE is a systematic procedure for determining the unit or component which is the source of trouble; the third, Table 6–4 SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE gives some hints that may be applied in finding the specific part that may be defective.

## 13. TUBE OPERATING VOLTAGES AND CURRENTS.

Electron tube operating voltages and currents under normal operating conditions are given in Table 6–5 TUBE OPERATING VOLTAGES AND CURRENTS, located near the end of this section. The measurements indicated in this table were made wtih the signal generator set for 100 kc operation and the METER READS switch (S-102) in the BAL position. Readings that vary with the position of the CARRIER CONTROL (R-123) are also indicated.

## 14. TUBE SOCKET ELECTRICAL MEASUREMENTS.

(*a*) As a further aid in maintenance work figure 6–11 SIGNAL GENERATOR VOLTAGE AND RESISTANCE CHART will be found near the end of this section. This chart lists diagramatically, the voltage and resistances measured from all tube socket connections to ground.

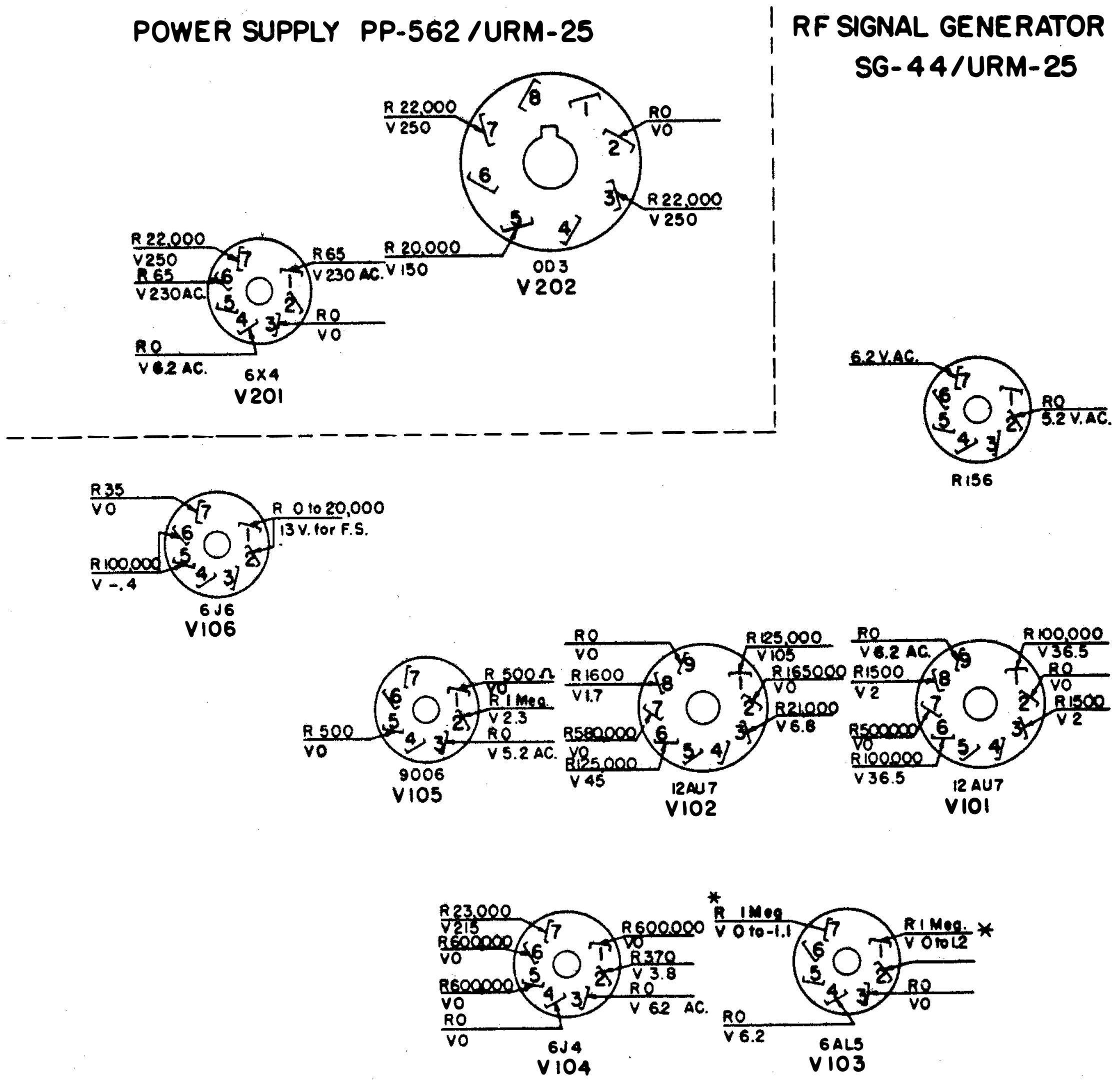
(*b*) As is indicated by the footnotes to this chart, all measurements were made with 20,000 ohms per volt DC meter such as in the Navy Model OE Series Analyzing Equipment.

## 15. WINDING DATA.

Complete winding data for all wire-wound units (except resistors) in the AU/URM-25 is given in Table 6–7 WINDING DATA.

## 16. EXTERIOR AND INTERIOR VIEWS OF UNITS.

To assist the technician doing maintenance work in locating the positions of the various coils, capacitors, resistors, switches, etc., comprising the signal generator, there will be found at the back of this section additional photographic illustrations. They show every part of the RF Signal Generator Set AN/URM-25 with the corresponding symbol designation indicated. These will facilitate the easy and quick identification of all parts. Table 6–8 CROSS REFERENCE BETWEEN SYMBOL NUMBER AND FIGURE LOCATION gives the figure in which these parts are identified.




NOTES:

ALL DC READINGS TAKEN WITH A 20,000 OHMS /VOLT METER

ALL AC READINGS TAKEN WITH A 1,000 OHMS /VOLT METER

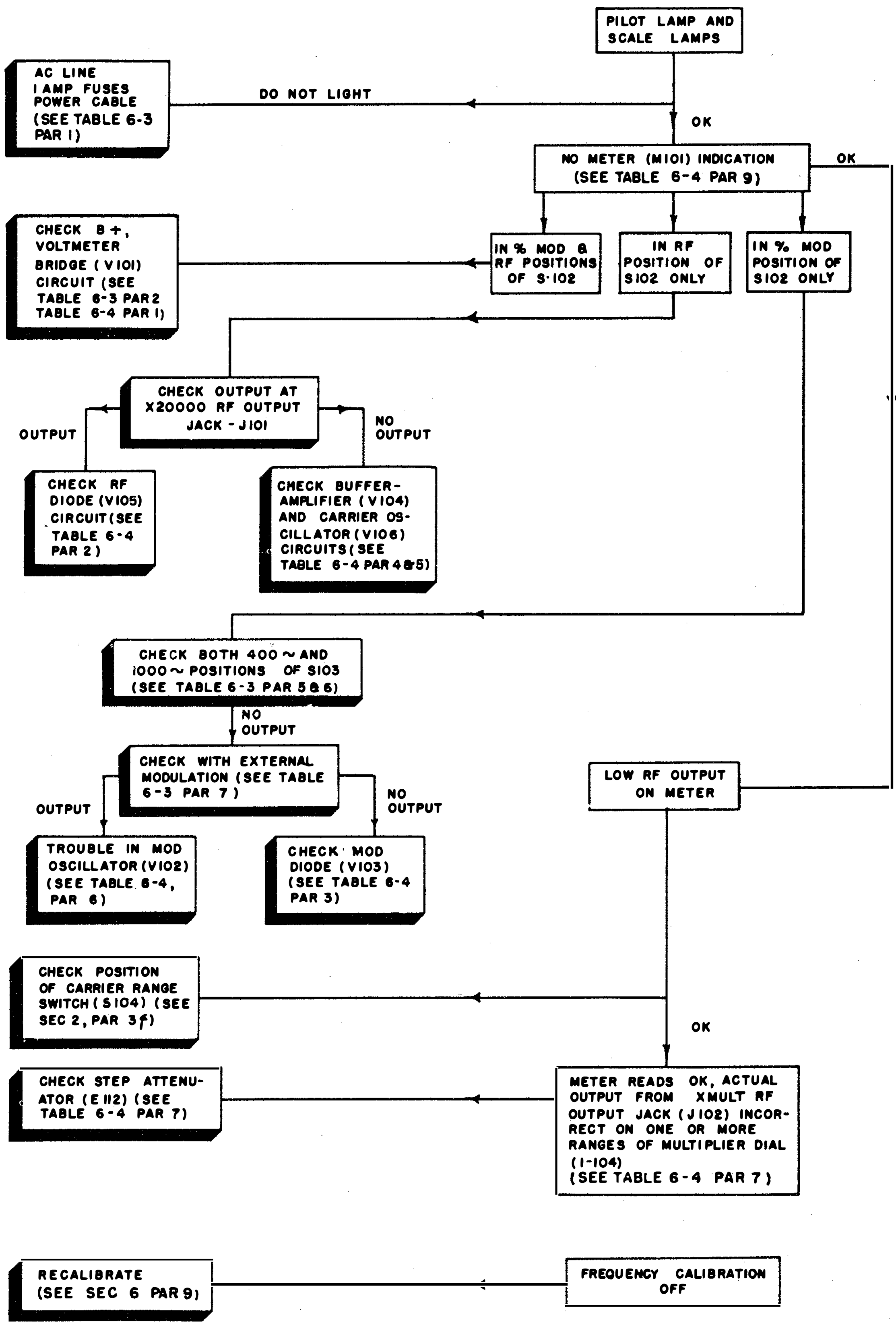
READINGS MADE WITH SIGNAL GENERATOR IN FOLLOWING OPERATING CONDITIONS

1. CARRIER FREQUENCY 100 KC
2. METER SET TO FULL SCALE FOR RF
3. S 102 IN BAL POSITION
4. S 103 AT "1000" CYCLES

* VOLTAGE DEPENDS ON POSITION OF R 111

*Figure 6-11. Signal Generator Voltage and Resistance Chart.*

## TABLE 6-2. TROUBLE SYMPTOM CHART



## TABLE 6–3. CHART OF GENERAL TEST PROCEDURE FOR LOCALIZING TROUBLE

Note: The CARRIER (R-123) and % MODULATION (R-111) controls should always be turned fully counterclockwise before turning power on.

| LOCATION AND TYPE OF TROUBLE | SUGGESTED METHOD FOR LOCALIZING TROUBLE |
|---|---|
| POWER SUPPLY. (See par. 11 for additional check.) | Make sure the indicating lamp (I-101) or scale lamps (E-128 thru E-130) have been made to light, as evidence that the 115 volt supply mains, fuses, and at least a part of the power supply system, is in working order. If none of these lamps light, see Table 6–4, par. 8 on POWER SUPPLY. |
| VOLTMETER BRIDGE. (See par. 10 for additional checks.) | **1.** Set the signal generator controls in the following position:<br>*a.* POWER switch (S-101) OFF.<br>*b.* MOD SELECTOR switch (S-103) OFF.<br>*c.* METER READS switch (S-102) at RF.<br>*d.* CARRIER RANGE switch (S-104) at applicable range.<br>*e.* CARRIER CONTROL (R-123) in extreme counterclockwise position.<br>*f.* % MODULATION control (R-111) in extreme counterclockwise position.<br>*g.* FREQUENCY BAND SWITCH (S-105) set for any one of the eight ranges.<br>**2.** Turn the POWER switch (S-101) ON. The meter needle should be at the first line on the left. If it is not, see Table 6–4, par. 1 on VOLTMETER BRIDGE CIRCUIT TROUBLE. |
| CARRIER OSCILLATOR, RF DIODE, BUFFER-AMPLIFIER. | **3.** Advance the CARRIER CONTROL (R-123) slowly in a clockwise direction. The meter needle should correspondingly move up scale. If it does, the voltmeter bridge, RF diode, carrier oscillator (at least one range) buffer-amplifier, and power supply are functioning.<br>**4.** Set the FREQUENCY BAND SWITCH (S-105) successively for each range to see if operation (as in Par. 3 above) is obtained for all ranges. If it is, the carrier oscillator and buffer-amplifier are probably functioning. Operation on some bands and not on others probably indicates a defect in the carrier oscillator (see Table 6–4, par. 5 on CARRIER OSCILLATOR), since the buffer-amplifier is untuned and should respond at all frequencies if it responds at once.<br>**5.** If, in Par. 3 and 4 above, the meter does not move up scale, turn the METER READS switch (S-102) to the % MOD position. Set MOD SELECTOR switch (S-103) to the 400 cycle position. Slowly advance the % MODULATION control (R-111) in a clockwise direction. If the meter now moves up scale, it indicates that there is trouble in the carrier oscillator, RF diode, or buffer-amplifier circuits (see Table 6–4 Sections on CARRIER OSCILLATOR, RF DIODE, BUFFER-AMPLIFIER.) This also indicates that the modulation oscillator, modulation diode and voltmeter bridge circuits are functioning. |
| MODULATION OSCILLATOR. | **6.** If the meter responds to the tests in par. 4, but not in par. 5 above, the trouble is in the modulation oscillator or modulation diode.<br>**7.** With the METER READS switch (S-102) in the % MOD position; MOD SELECTOR switch (S-103) at EXT, CARRIER RANGE switch (S-104) at applicable range, apply an external audio signal (1000 cycles) to the EXTERNAL MOD INPUT jack (J-103). Slowly advance the % MODULATION control (R-111) in a clockwise direction. If the meter now moves up scale, it indicates that the trouble is in the modulation oscillator. |
| MODULATION DIODE. | **8.** If the meter still does not respond to the % MODULATION control, feed the output signal from the X MULT RF OUTPUT jack (J-102) to a test oscilloscope. Set the carrier frequency at 100 kc. Place the METER READS switch (S-102) in the RF position. Advance the CARRIER CONTROL (R-123) in a clockwise direction until a reading of "100" is obtained on the upper meter scale. With the external modulation applied as in par. 7 above, the modulated pattern should appear on the oscilloscope (see figure 6–10). If it does, the trouble was in the modulation diode circuit. |
| STEP ATTENUATOR (E-112) OR OUTPUT CABLES. | **9.** If the meter responds to the above tests in a satisfactory manner, but there is still no output voltage at the end of the output cable (W-104), the trouble is in the attenuator (E-112) or output test cable (see Table 6–4 Sections on STEP ATTENUATOR and OUTPUT CABLES). |

**TABLE 6–3. CHART OF GENERAL TEST PROCEDURE FOR LOCALIZING TROUBLE — Continued**

| LOCATION AND TYPE OF TROUBLE | SUGGESTED METHOD FOR LOCALIZING TROUBLE |
|---|---|
| VOLTMETER BRIDGE. | **10.** If no meter response, whatsoever, is obtained, but it is determined that output voltage is available, the trouble is probably in the voltmeter bridge circuit (see Table 6–4, par. 1 on VOLTMETER BRIDGE). |
| POWER SUPPLY. | **11.** If no meter response or output voltage is obtained from the foregoing tests, the trouble is probably in the power supply (see Table 6–4, par. 8 on POWER SUPPLY). |

**TABLE 6–4. CHART OF SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE**

Note: The CARRIER (R-123) and % MODULATION (R-111) controls should always be turned fully counter clockwise before turning power on.

| TYPE OF TROUBLE | SUGGESTED METHOD OF TEST AND REPAIR |
|---|---|
| **1.** VOLTMETER BRIDGE CIRCUIT (V-101).<br><br>*a.* INOPERATIVE. | If preliminary tests have indicated that the voltmeter bridge circuit (V-101) is inoperative, remove the RF signal Generator Unit SG-44/URM-25 from the cabinet and proceed with the following tests (see Section 6, par. 4a).<br>(1) Test voltage of bridge tube V-101 with the POWER switch (S-101) ON and METER READS switch (S-102) in BAL position.<br>Heater Voltage — 6.3v AC<br>Plate Voltage (V-101A) — 36.5v DC (± 5V)<br>Plate Voltage (V-101B) — 36.5v DC (± 5V)<br>Grid Voltage (V-101B) — 0<br>Grid Voltage (V-101B) — 0<br>Cathode Voltage (V-101A) — 2v DC<br>Cathode Voltage (V-101B) — 2v DC<br>**NOTE**<br>Voltages measured from tube socket connections to ground with a 20,000 ohms per volt voltmeter such as contained in Navy Model OE Series Receiver Analyzing Equipment.<br>(2) If voltages are correct, disconnect power cable and make circuit continuity check with an ohmmeter until the defect is located (see figure 6–11). |
| *b.* METER (M-101) ZERO ADJUSTMENT. | (1) Turn the POWER switch (S-101) to ON position. Both the CARRIER CONTROL (R-123) and the % MODULATION control (R-111) should be in the fully counterclockwise position. Apply the following procedure:<br>(*a*) Set the METER READS switch (S-102) in the BAL position. The meter (M-101) should read zero. If it does not, adjust the BALANCE control (R-131) screw driver adjustment (located on the audio compartment) for zero reading.<br>(*b*) Place METER READS switch (S-102) in the RF position. If the meter does not read zero, adjust the RF COMP control (R-128) screwdriver adjustment (located on the audio compartment) for zero reading.<br>(*c*) Place METER READS switch (S-102) in the % MOD position. If the meter does not read zero, adjust the MOD COMP control (R-129) screwdriver adjustment (located on the audio compartment) for zero reading.<br>(2) Repeat the procedure outlined in paragraphs a, b, and c, above until the meter reads zero in all positions of the METER READS switch.<br>(3) If unable to set meter to zero in all positions of the METER READS switch, one of the associated circuit parts is probably defective. Make continuity checks accordingly. |
| **2.** RF DIODE INOPERATIVE (V-105). | *a.* The RF diode (V-105) rectifies the RF signal which is applied to the voltmeter bridge (V-101) circuit and read on the upper scale of the meter (M-101) when the METER READS switch (S-102) is in the RF position. If it is determined that this circuit is defective the first and simplest thing to do is to replace the tube (V-102). When doing this, it will be necessary to readjust the RF COMP control (R-128) for zero meter reading.<br>*b.* If replacing the RF diode (V-105) does not alleviate the trouble, make continuity checks within the circuit. |

**TABLE 6-4. CHART OF SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE — Continued**

| TYPE OF TROUBLE | SUGGESTED METHOD OF TEST AND REPAIR |
|---|---|
| 3. MODULATION DIODE INOPERATIVE (V-103). | *a.* The modulation diode (V-103) rectifies the modulation signal which is applied to the voltmeter bridge (V-101) circuit and read on the lower scale of the meter (M-101) when the METER READS switch (S-102) is in the % MOD position. If it is determined that this circuit is defective, the first and simplest thing to do is to replace the tube (V-103). When doing this it will be necessary to readjust the MOD COMP control (R-129) for zero meter reading.<br><br>*b.* If replacing the modulation diode does not cure the trouble, make continuity checks throughout the circuit. |
| 4. BUFFER-AMPLIFIER INOPERATIVE (V-104). | *a.* If preliminary tests have indicated that the buffer-amplifier is inoperative, remove the signal generator from the cabinet and proceed with the following tests (see Section 6, par. 4).<br><br>*b.* Test DC voltages with the tube (V-104) in the socket; M-101 set for "100" and MOD SELECTOR switch (S-103) OFF (see figure 6–11). Carrier frequency should be set to 100 kc.<br>Heater Voltage — 6.3v AC<br>Plate Voltage — 215v DC<br>Cathode Voltage — 3.8v DC (Adjust to this value with R-113)<br>Control Grid Voltage — 0<br>All measurements made from socket terminals to chassis with a 20,000 ohms per volt voltmeter such as contained in the Navy Model OE Series Receiver Analyzing Equipment.<br><br>*c.* If the voltages are correct, but the buffer-amplifier is still inoperative, make a circuit continuity test with an ohmmeter until the defect is located.<br><br>**NOTE**<br><br>It is a good idea to check the tube with a tube checker even though voltage checks are correct. Change in tube characteristics (i.e. transconductance etc.) may not show up in voltage checks but may actually be the source of trouble. |
| 5. CARRIER OSCILLATOR (V-106).<br>*a.* INOPERATIVE. | (1) If preliminary tests have indicated that the carrier oscillator is inoperative in all ranges, remove the signal generator from its cabinet and proceed with the following tests:<br><br>(*a*) Set the POWER switch (S-101) in ON position and the frequency to 100 kc with the carrier oscillator tube (V-106) in its socket, test the tube voltages.<br><br>Heater Voltage: 6.3v AC<br>Plate Voltage: Varies between 0 and 150v DC depending on setting of CARRIER CONTROL (R-123). (Checking this may or may not cause circuit to stop oscillating.)<br>Grid Voltage: 0 to —.5v DC (Varies with rotation of CARRIER CONTROL R-123).<br>Cathode Voltage: 0.<br><br>(*b*) Turn the POWER switch (S-101) to OFF position and make the following resistance checks from grid to ground and grid to cathode, setting the FREQUENCY BAND SWITCH (S-105) to each corresponding position:<br><br>SWITCH POSITION — RESISTANCE (grid to ground) — RESISTANCE (grid to cathode)<br>Band A — 100,000 ohms — 175,000 ohms<br>B — 100,000 ohms — 118,000 ohms<br>C — 100,000 ohms — 100,000 ohms<br>D — 100,000 ohms — 104,700 ohms<br>E — 100,000 ohms — 101,800 ohms<br>F — 100,000 ohms — 100,000 ohms<br>G — 2,200 ohms — 2,200 ohms<br>H — 2,200 ohms — 2,200 ohms<br><br>(*c*) If the ohmmeter reads "open" in any position of the FREQUENCY BAND SWITCH. either the corresponding coil, grid resistor or cathode resistor is open. Since Bands A through F have a common grid leak resistor, the exact open element can easily be determined.<br><br>(*d*) If all voltage and continuity checks are correct, replace the tube and check results. |

**TABLE 6–4. CHART OF SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE — Continued**

| TYPE OF TROUBLE | SUGGESTED METHOD OF TEST AND REPAIR |
|---|---|
| *b.* ERRATIC PERFORMANCE. | (1) Erratic performance of the carrier oscillator in a given band position is often difficult to trace. As a remedy, the following may be tried:<br>(*a*) Substitute a new tube.<br>(*b*) Check contacts of FREQUENCY BAND SWITCH (S-105).<br>(*c*) Check for a dirty or faulty CARRIER CONTROL (R-123).<br>(*d*) Make visual inspection of main tuning capacitor (C-127) for dirt, bent plates, etc.<br>(2) Make visual inspection of the oscillator coil for the range in question. |
| *c.* EXCESSIVE VOLTAGE NEEDED ON CARRIER CONTROL (R-123). | (1) Often, defects in the resonant system (oscillator coils, capacitors and grid leak resistors) can be suspected if a greater than normal amount of plate voltage is necessary in order to develop the required voltage output.<br>(2) Check normal voltages between the slider (center lug) of the CARRIER CONTROL (R-123) and ground, in the following manner. (The CARRIER CONTROL should be set in the fully counterclockwise position.)<br>(*a*) POWER switch (S-101) ON.<br>(*b*) CARRIER RANGE switch (S-104) to applicable range.<br>(*c*) MOD SELECTOR switch (S-103) OFF.<br>(*d*) METER READS switch (S-102) at RF.<br>(*e*) Main tuning dial (I-103) set at beginning of all bands.<br>(*f*) Oscillator plate voltages required for "100" meter leading.<br>(*1*) Bands A through F — less than 50v DC.<br>(*2*) Band G and H — less than 150v DC. |
| **6.** MODULATION OSCILLATOR.<br>*a.* INOPERATIVE ON BOTH 400 AND 1000 CYCLES. | (1) If it is indicated that the modulation oscillator is inoperative on both frequencies (400 and 1000 cycles) the probable defective part is some element common to both frequency position of the METER READS switch (S-102).<br>(2) One possible trouble is too high a degree of degeneration. This degeneration is dependent upon the resistance ratio of (R-105 and R-110). Although the DEGEN control (R-110) is a locking type potentiometer, vibration may have changed its value. If its resistance is too small, the degeneration will be too great and oscillations will be inhibited. Sometimes increasing the resistance (R-110) will assist the oscillator in breaking into oscillation. If this is the case, set this resistor at the point where oscillations just begin.<br>(3) If a spare tube is available, it is sometimes most expedient to replace the old tube.<br>(4) If replacing the tube does not solve the problem, continuity and voltage checks should be made. In making these voltage checks, refer to Table 6–5 TUBE OPERATING VOLTAGES AND CURRENTS. |
| *b.* INOPERATIVE ON ONLY ONE FREQUENCY (400 CYCLES OR 1000 CYCLES). | (1) If the modulation oscillator is inoperative on only one frequency, the solution is relatively simple.<br>(2) The defective element is probably one of the bridge resistors (R-101, R-102, R-103, or R-104).<br>(3) Make the necessary resistance checks. |
| *c.* ERRATIC OPERATION OR PRESENCE OF AMPLITUDE DISTORTION. | (1) If the locking device on the degeneration resistor (R-110) is loosened, mechanical vibration may cause a variation of resistance and hence degeneration. This may result in erratic operation or amplitude distortion. Check this control and tighten the locknut. |
| **7.** STEP ATTENUATOR (E-112).<br>*a.* NO OUTPUT ON ALL STEPS. | (1) If there is output from J-101 but no output from J-102 in all steps of E-112, the 482 ohm resistor (R-143) is probably burned out.<br>(2) Disconnect one lead of R-143 and check its resistance with an ohmmeter. |
| *b.* NO OUTPUT ON ONE OR MORE, BUT NOT ALL STEPS. | (1) One of the step attenuator series resistors (R-144 through R-148) is probably burned out.<br>(2) Check the series resistor preceding the step where there is no output. Always check these resistors with one lead disconnected to avoid shunting resistance paths. |

## TABLE 6-4. CHART OF SUGGESTED TESTS FOR LOCATING THE SPECIFIC TROUBLE — Continued

| TYPE OF TROUBLE | SUGGESTED METHOD OF TEST AND REPAIR |
|---|---|
| *c.* APPROXIMATELY 2:1 OR LESS INSTEAD OF 10:1 ATTENUATION BETWEEN TWO SUCCESSIVE STEPS. | (1) One of the step attenuator shunt resistors (R-149 through R-154) is probably burned out.<br>(2) Check the impedance of J-102 at the step attenuator position in question, using a multimeter ME-25/U series or equivalent. If the shunt resistor is burned out, an impedance of about 250 ohms instead of 53.5 ohms will be present. |
| *d.* REPLACING STEP ATTENUATOR RESISTORS. | (1) Recalibrate step attenuator ratios for range in which resistor was replaced, using the (10:1) Fixed Attenuator CN-136/URM-25 and a radio receiver such as Navy Model RBA series or equivalent. Follow the procedure outlined in Section 6, par. 11.<br>**CAUTION**<br>Resistance measurements at J-102 should be made with a resistance bridge such as the type ZM-4/U or equivalent to avoid burning out one of the step attenuator resistors. If the Electronics Technician uses an ordinary ohmmeter great care must be exercised to see that this ohmmeter does not place a current in excess of 20 milliamperes through the attenuator circuit while testing. |
| **8.** POWER SUPPLY PP-562/URM-25.<br>*a.* INOPERATIVE. | (1) Check line fuses F-101 and F-102.<br>(2) Check interconnecting cables W-102 and W-103 for continuity with an ohmmeter.<br>(3) Check power transformer T-201.<br>(4) If no B+, check rectifier tube V-201, filter choke L-201 and series resistor R-201. |
| *b.* OVERHEATING. | (1) Check short circuited turns on T-201.<br>(2) Check for partial breakdown of C-201, C-202 and C-203. It is sometimes best to replace one or all of these capacitors, if it is suspected that one of them is defective. A voltage or ohmmeter check will not always identify this trouble. |
| *c.* LOSS OF REGULATION. | (1) Check with a variac or variable voltage source. Change the line voltage from 103v to 126v AC. The + 150v DC output should not change. This does not apply to the unregulated + 240v DC supply.<br>(2) Replace regulator V-202 if the B+ does not remain steady at 150v DC. |
| **9.** HUM MODULATION. | *a.* Listen for power line hum (impressed on carrier frequency).<br>*b.* Check for unshielded leads between signal generator and receiver. All leads between these units should be shielded.<br>*c.* Check for mechanical vibrations of T-201. Tightly secure the transformer mounting. |
| **10.** ACCESSORY UNITS.<br>*a.* IMPEDANCE ADAPTER MX-1074/URM-25.<br>*b.* ANTENNA SIMULATOR SM-35/URM-25.<br>*c.* (5:1) FIXED ATTENUATOR CN-132/URM-25.<br>*d.* (10:1) FIXED ATTENUATOR CN-136/URM-25.<br>*e.* TEST LEAD CX-1363/U. | If it is suspected that any one of these accessory units is defective, a simple continuity check will readily indicate the source of trouble.<br>**CAUTION**<br>When making a resistance check on the Impedance Adapter MX-1074/URM-25 be sure the lowest ohmmeter resistance range is used. Ohmmeters with internal batteries larger than 1.5v may burn out the resistor in the impedance adapter. Where great accuracy is desired, resistance measurements should be made with the Resistance Bridge ZM-4/U or equivalent. |
| **11.** OUTPUT CABLES. | Check leakage resistance with a megger (high resistance ohmmeter). |

## TABLE 6–5. TUBE OPERATING VOLTAGES AND CURRENTS

| SYMBOL NUMBER | TUBE TYPE | FUNCTION | PLATE P (E) | PLATE (MA) | SCREEN (E) | SCREEN (MA) | SUPP. (E) | CATH. (E) | GRID (E) | HEATER VAC |
|---|---|---|---|---|---|---|---|---|---|---|
| V101A | 12AU7 | Voltmeter Bridge Tube | 36.5 | 1.3 | | | | 2 | 0 | 6.2 |
| V101B | 12AU7 | Voltmeter Bridge Tube | 36.5 | 1.3 | | | | 2 | 0 | 6.2 |
| V102A | 12AU7 | Modulation Oscillator | [5]105 | [5].3 | | | | 6.8 | 0 | 6.2 |
| V102B | 12AU7 | Modulation Oscillator | 45 | .8 | | | | 1.7 | 0 | 6.2 |
| V103 | 6AL5 | Modulation Diode | 0 to —1.1 | 0 to .001 | | | | 0 to 1.2 | | 6.2 |
| V104 | 6J4 | Buffer Amplifier | 215 | 1.0 | | | | 3.8 | 0 | 6.2 |
| V105 | 9006 | R.F. Diode | 0 | — | | | | 2.3 | | 5.2 |
| V106 | 6J6 | Carrier Oscillator | 13 | app. 1 | | | | 0 | —.4 | 6.2 |
| V201 | 6X4 | Rectifier | 230 VAC | | | | | 250 | | 6.2 |
| V202 | OD3/VR-150 | B+ Regulator | 150 | | | | | 0 | | |

NOTE: All measurements made with a 20,000 ohm/volt DC and 1000 ohm/volt AC meter with the Signal Generator set in the following operation condition:

1. CARRIER FREQUENCY — 100 kc.
2. METER READS "100" in RF position of S-102.
3. S-102 set to "BAL."
4. S-103 set to "1000" Cycles.
5. Bias control R-113 set for 3.8v bias.
6. Power supply voltages should be checked when W-103 is connected to Signal Generator.

## TABLE 6–6. RATED TUBE CHARACTERISTICS

| TUBE TYPE | FILAMENT VOLTAGE (V) | FILAMENT CURRENT (A) | PLATE VOLTAGE (V) | GRID BIAS (V) | SCREEN VOLTAGE (V) | PLATE CURRENT (MA) | SCREEN CURRENT (MA) | A-C PLATE RESISTANCE (OHMS) | VOLTAGE AMPLIFICATION FACTOR (MU) | TRANSCONDUCTANCE (MICROMHOS) NORMAL | TRANSCONDUCTANCE (MICROMHOS) MINIMUM | EMISSION Is (MA) | EMISSION TEST VOLTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12AU7 | [1]6.3 (12.6) | [1].3 (.15) | 250 | —8.5 | — | 14.5 | — | 7700 | 18.5 | 3100 | 1750 | 70 | 30 |
| 6AL5 | 6.3 | .3 | [2]150 | — | — | [3]9 | — | [4]300 | — | — | — | 40 | 10 |
| 6J4 | 6.3 | .4 | 150 | 2 | — | 20 | — | 5000 | 55 | 12000 | 9000 | 70 | 10 |
| 9006 | 6.3 | .15 | [5]270 | — | — | [6]5 | — | [4]100 | — | — | — | 13 | 20 |
| 6J6 | 6.3 | .45 | 150 | —10 | — | 30 | — | 7100 | 38 | 5300 | 3450 | 40 | 10 |
| 6x4 | 6.3 | .6 | [7]650 | — | — | 70 | — | — | — | — | — | 140 | 50 |
| OD3/ VR-150 | — | — | 150 | — | — | 5 to 40 | — | — | — | — | — | — | — |

NOTES:

1. 6.3v at .3A for parallel filaments; 12.6v at .15A for series fil.
2. A.C. plate voltage per plate (RMS).
3. D.C. output current per plate.
4. Minimum total effective late supply impedance.
5. A.C. plate voltage for typical rectifier operation.
6. D.C. output current.
7. A.C. plate to plate supply voltage (RMS) for capacitor input.

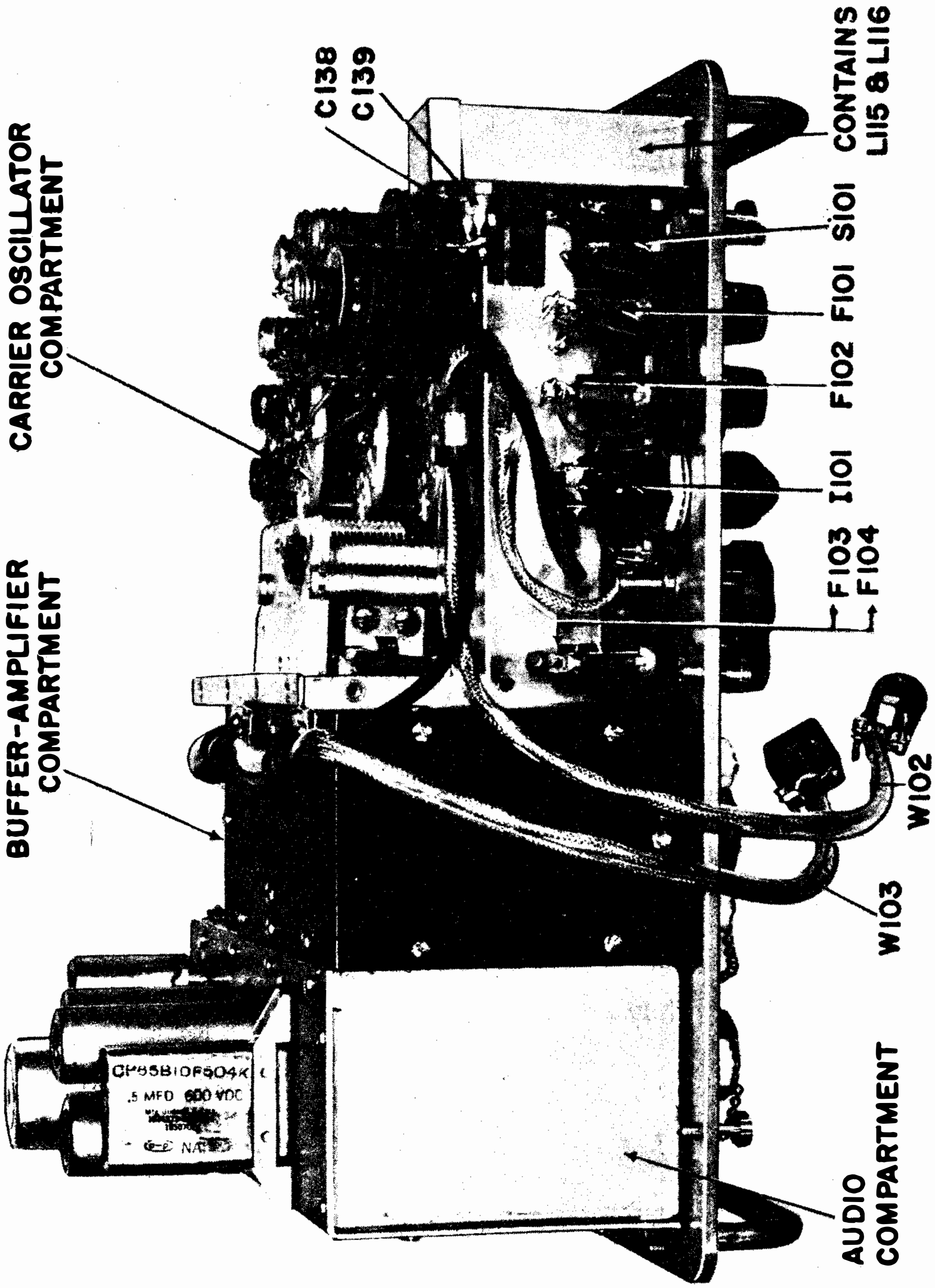



*Figure 6-12. Bottom View of RF Signal Generator SG-44/URM-25*

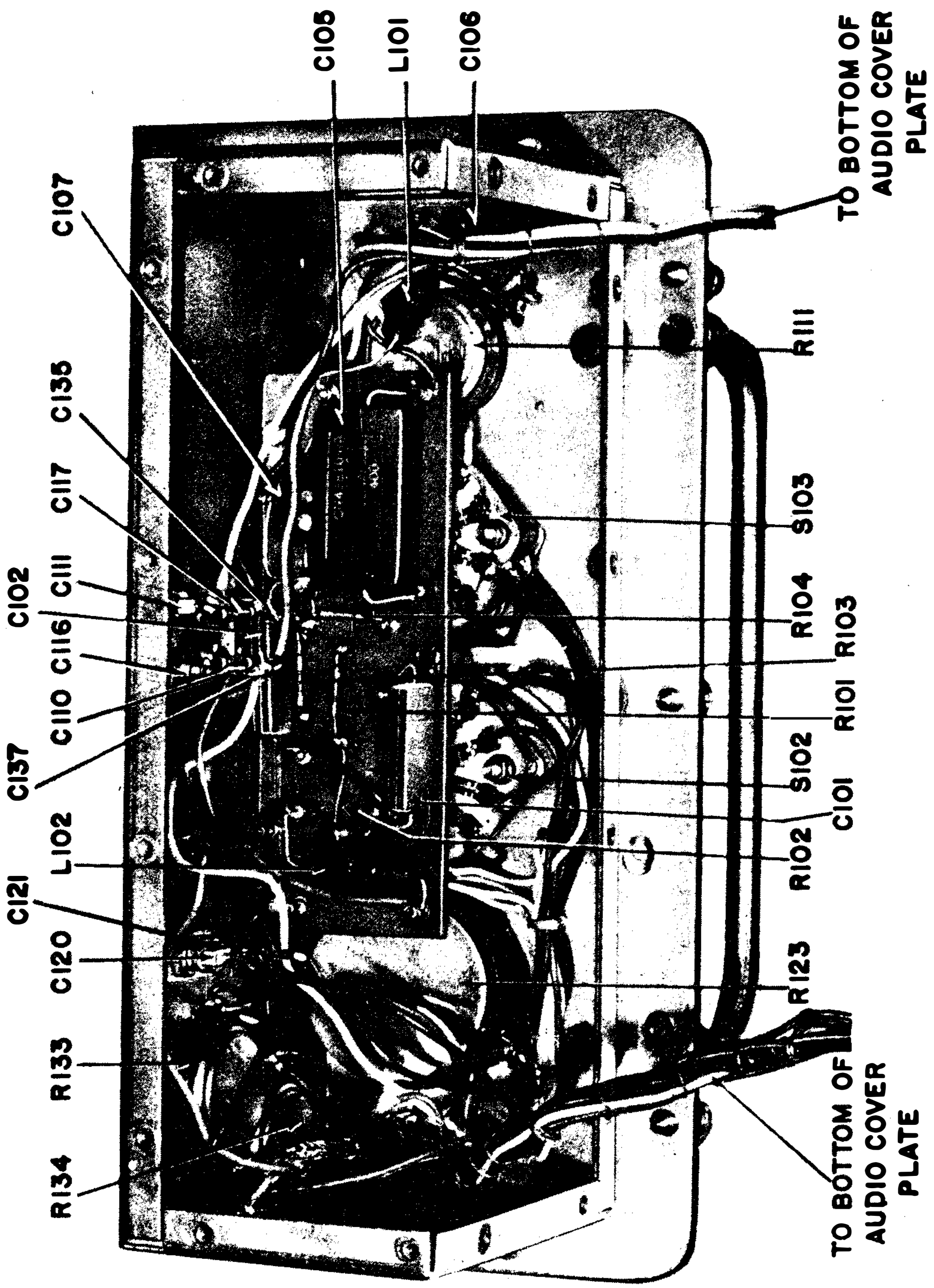



*Figure 6-13. Interior View of Audio Compartment.*

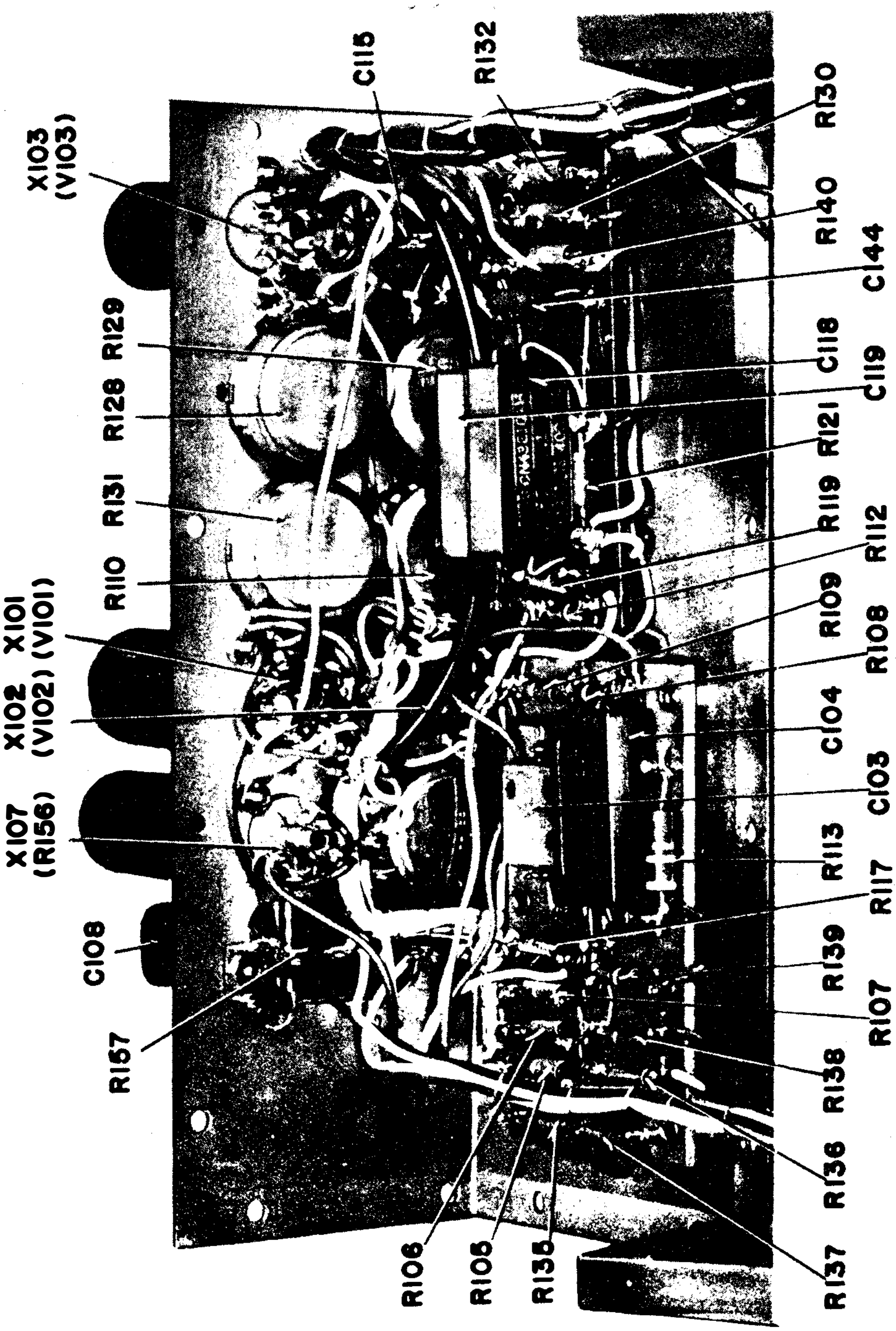



Figure 6-14. Bottom View of Audio Cover Plate.

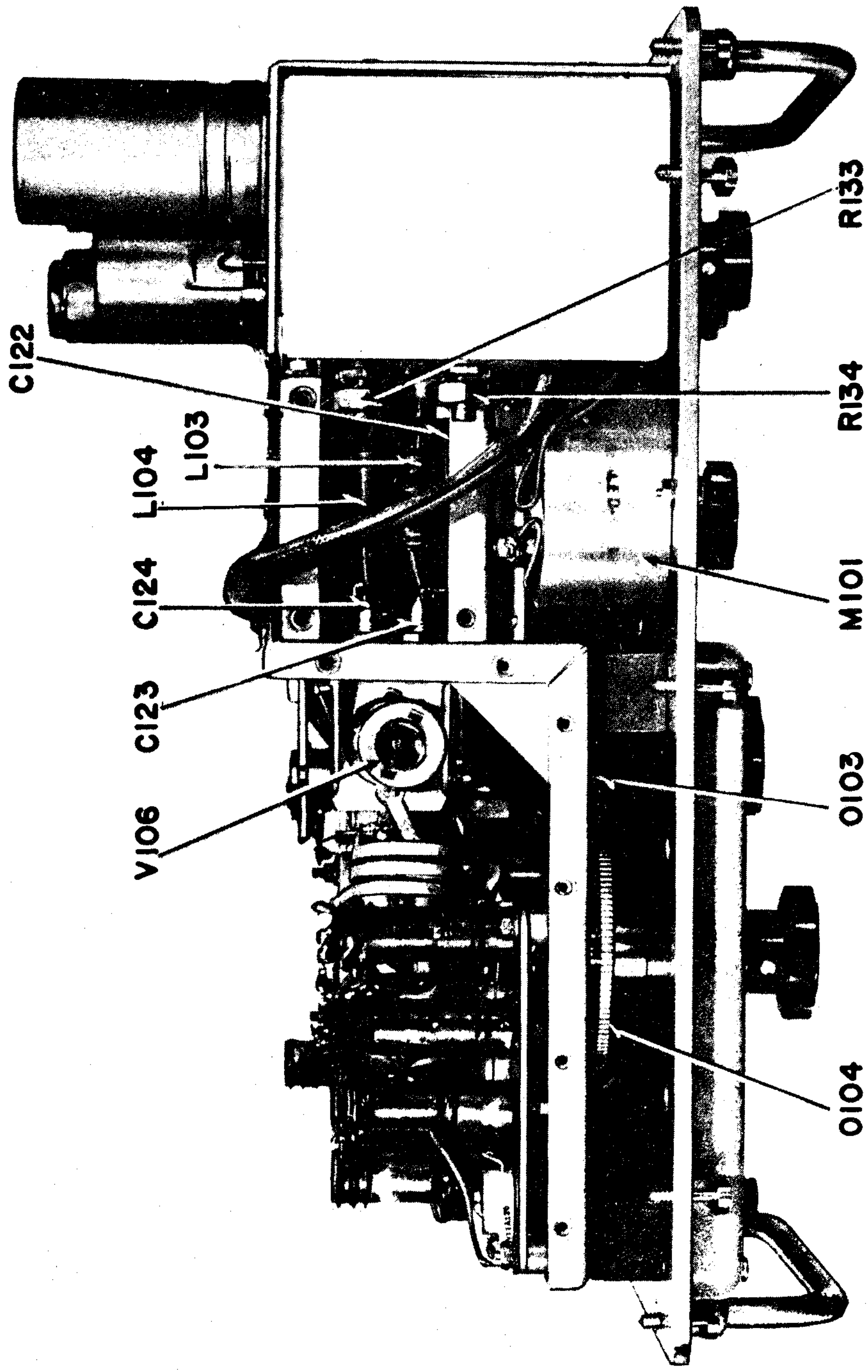



*Figure 6-15. Top View of RF Signal Generator SG-44/URM-25.*

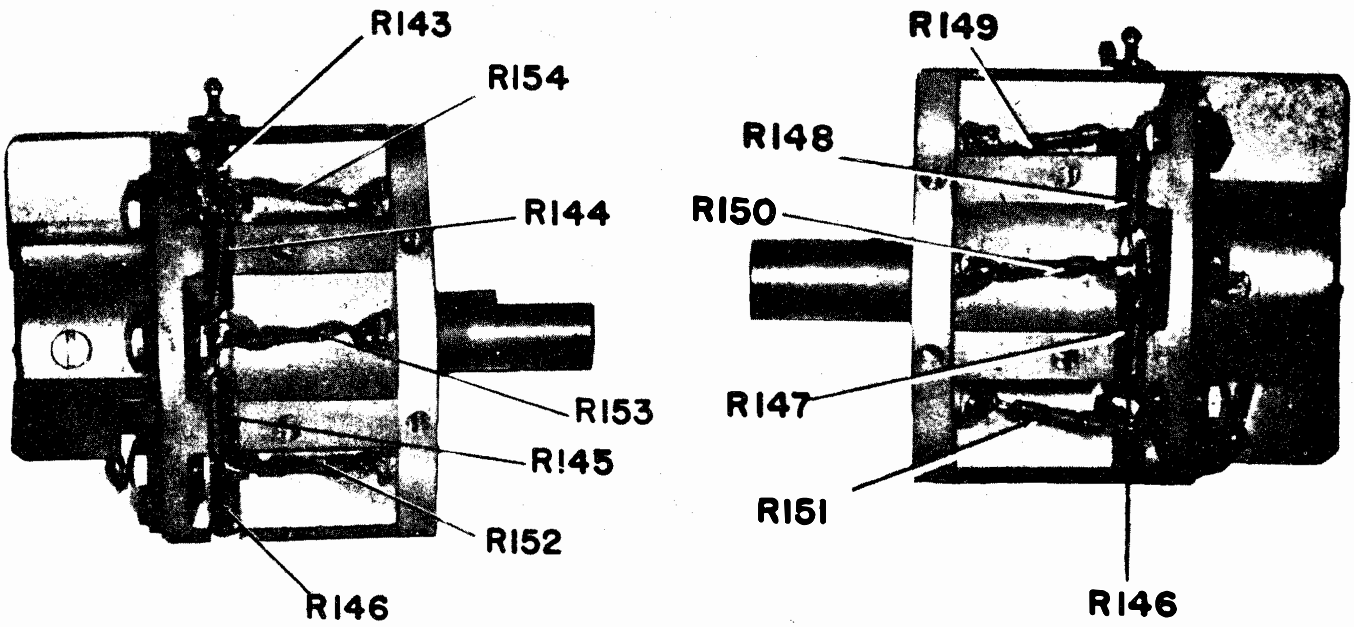



*Figure 6-16. Interior Views of the Step Attenuator (E112) with All Resistors Shown.*

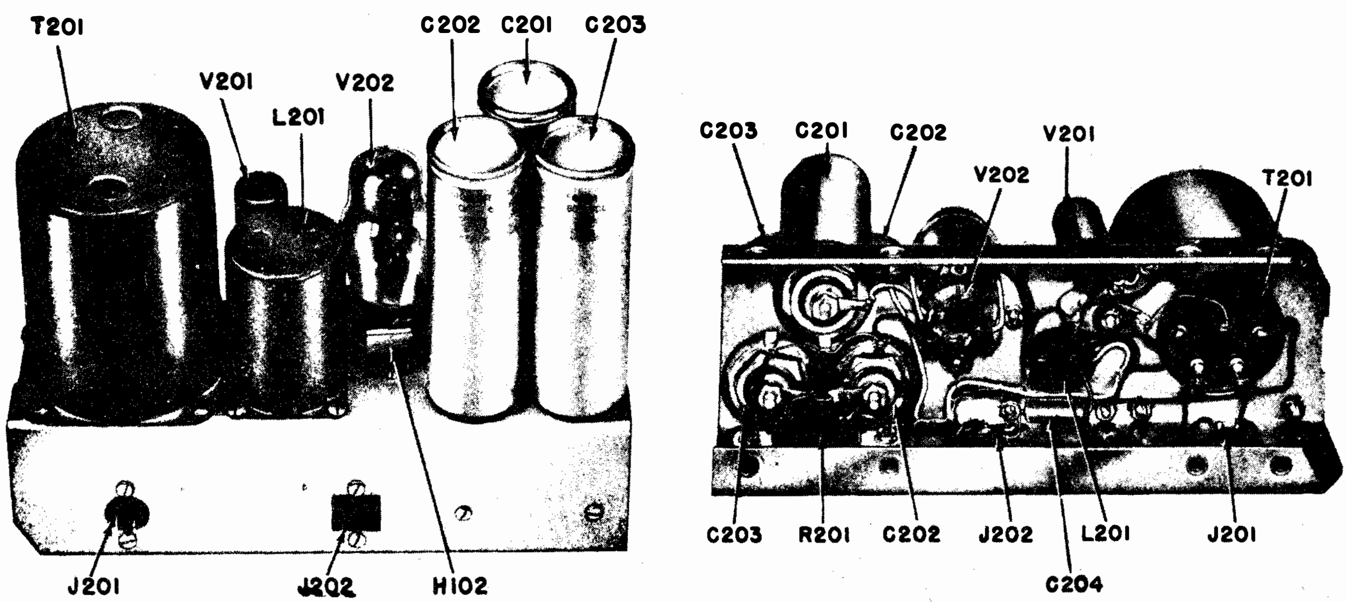



*Figure 6-17. Top and Bottom Views of the Power Supply PP-562/URM-25.*

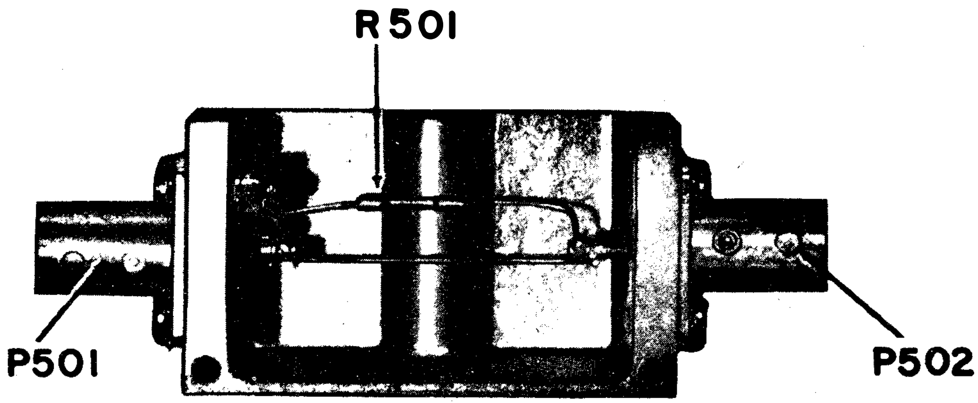



Figure 6-18. Interior View of Impedance Adapter MX-1074/URM-25.

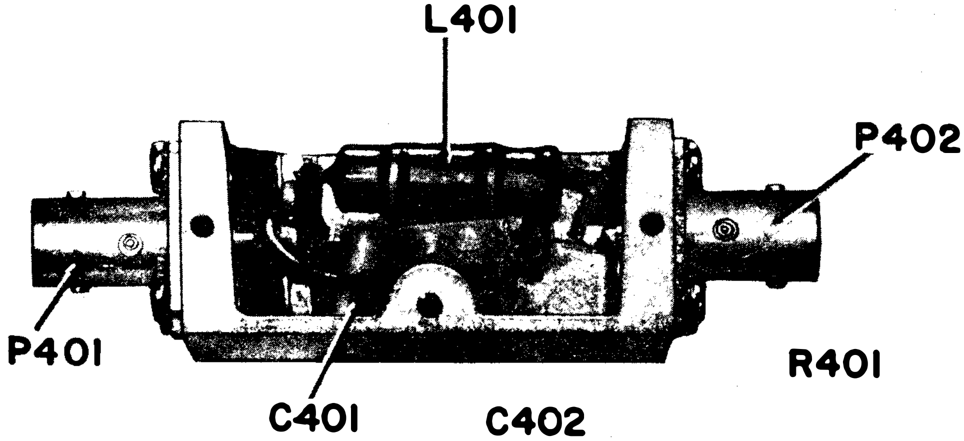



Figure 6-19. Interior View of Antenna Simulator SM-35/URM-25.

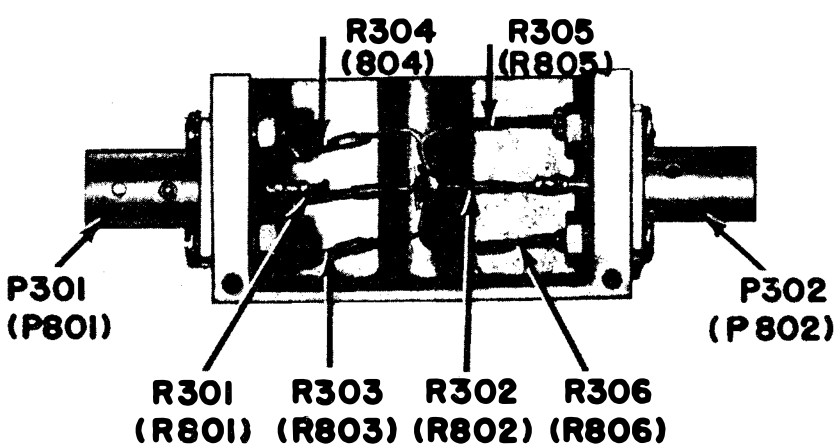



Figure 6-20. Interior View of (5:1) Fixed Attenuator CN-132/URM-25.

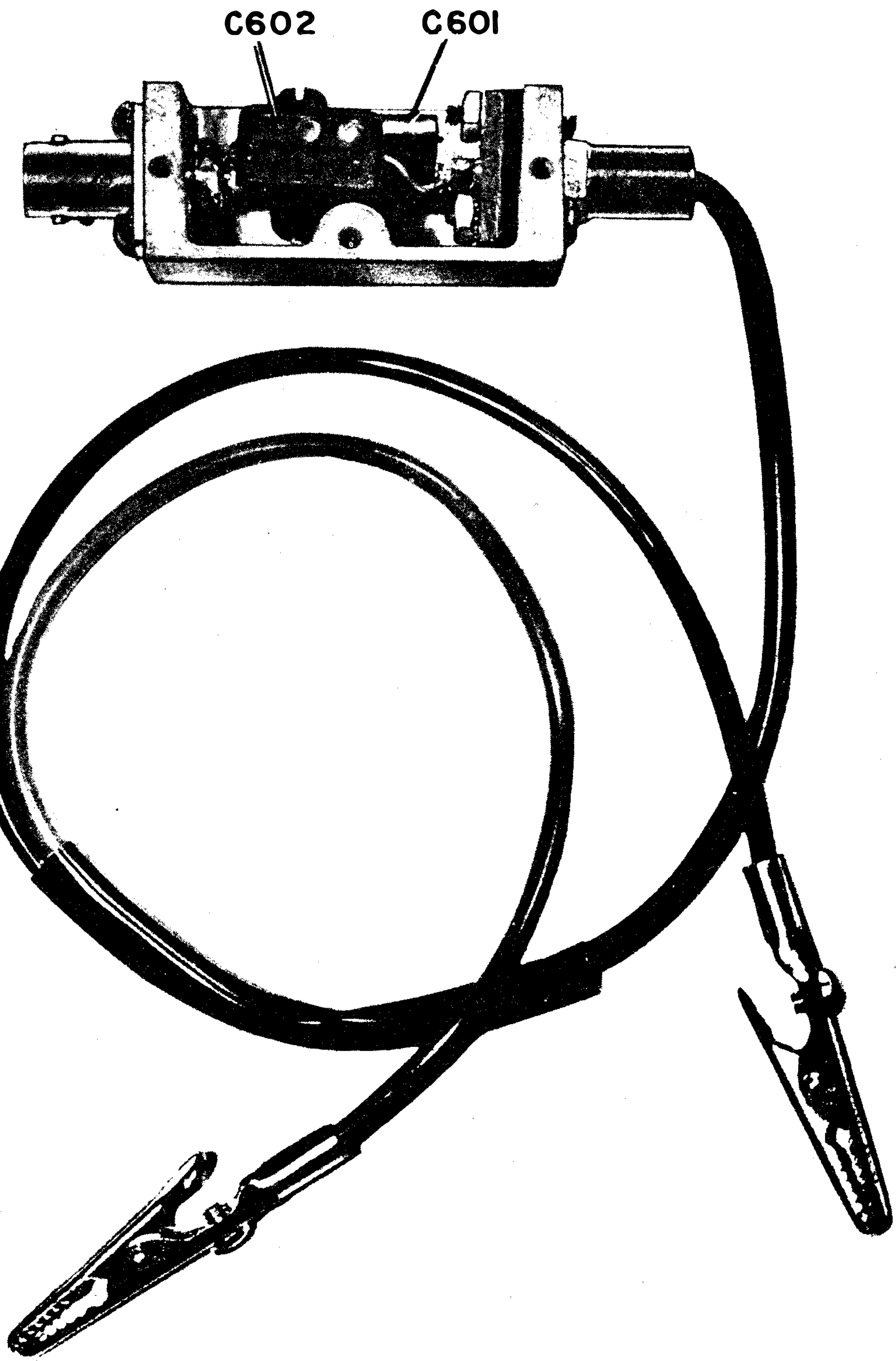



Figure 6-21. Interior View of Test Lead CX-1363/U

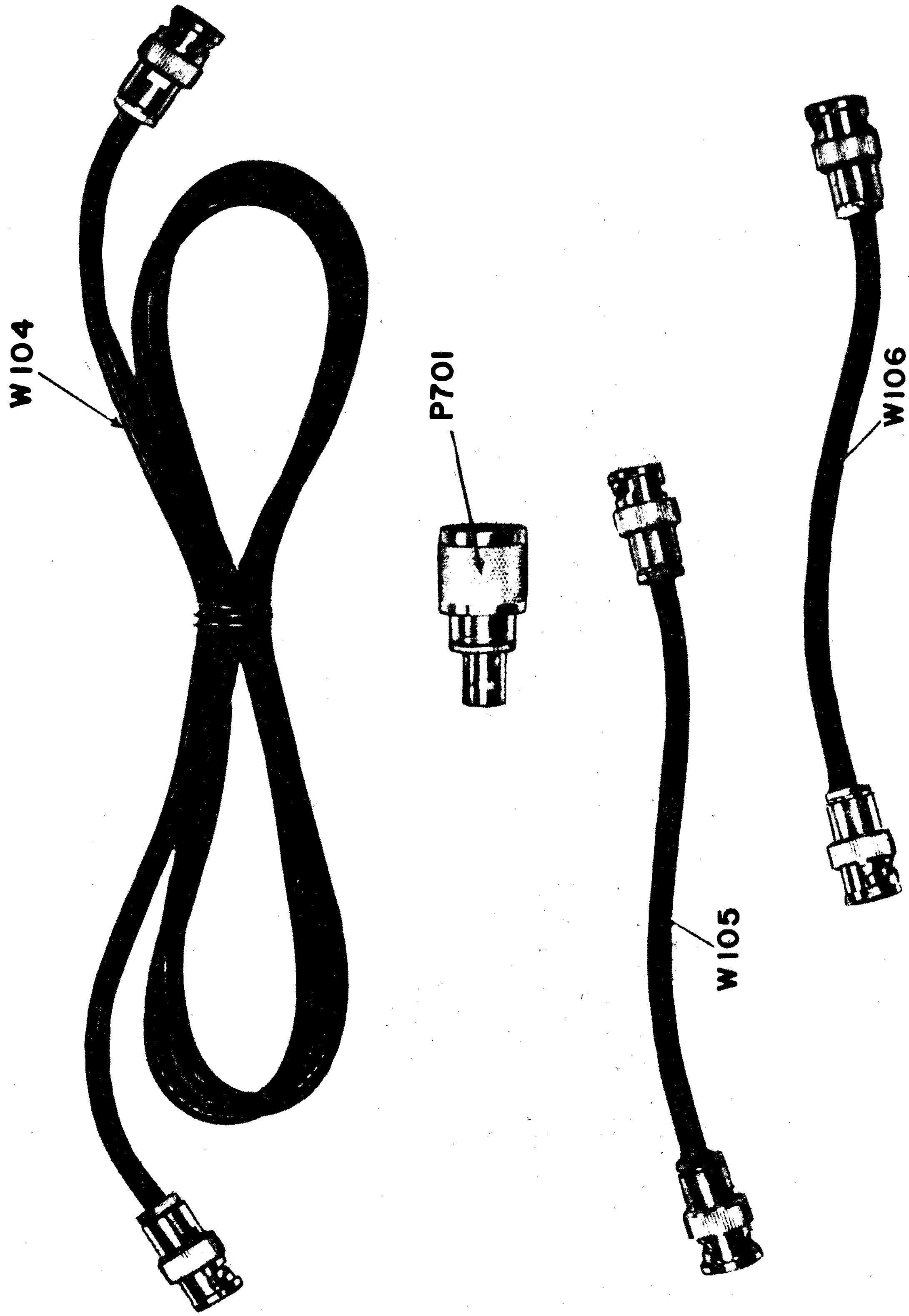



*Figure 6-22. RF Cable Assemblies.*

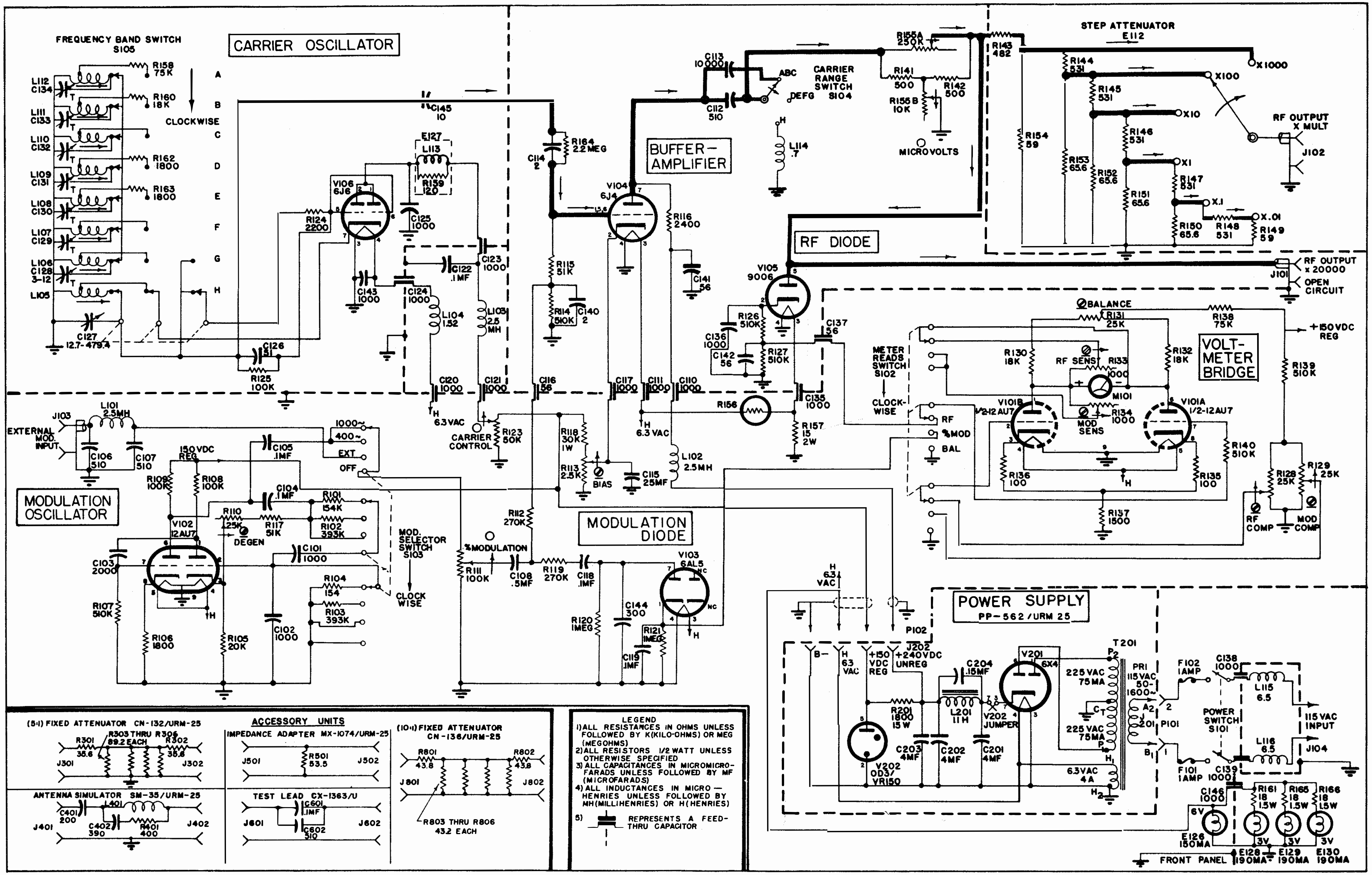
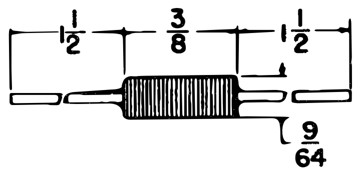
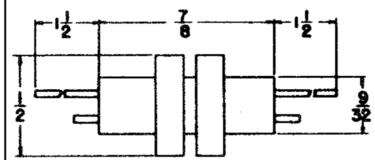
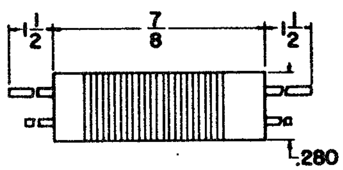
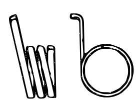
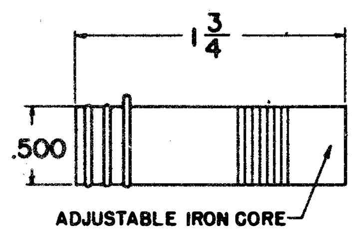
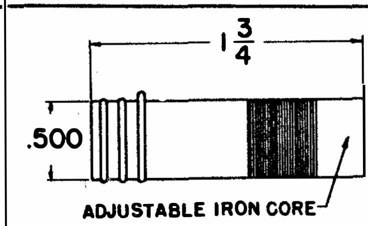
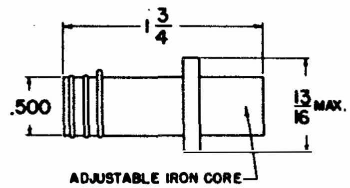
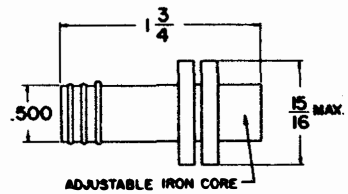
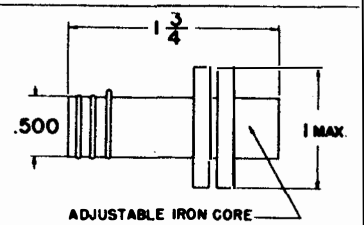
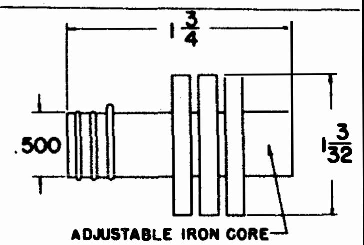



*Figure 6-23. RF Signal Generator Set AN/URM-25, Overall Schematic Diagram.*

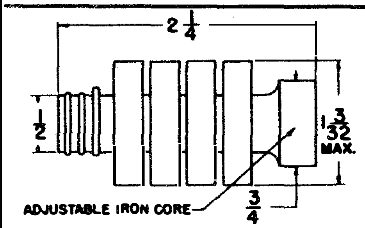
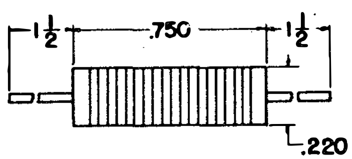
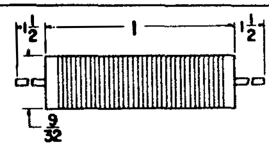
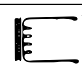
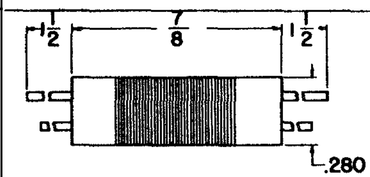
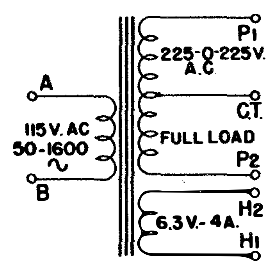
## TABLE 6–7. WINDING DATA

| DESIGNATION SYMBOL | FED. MFG. & ENG. PART NO. | DIAGRAM | WINDING | WIRE SIZE | TURNS | DC RESISTANCE IN OHMS | IMPEDANCE RATIO | HIPOT A-C VOLTS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| E-127 | CHO-3B |  | Single | #36 Enameled copper wire | 38 Close wound | | | | Inductance: 2.7 microhenries ± 10% at 9.7 megacycles.<br>Current: 35 milliamperes.<br><br>1 coat HARVEL Varnish #612-C and bake.<br>Coil form 120 ohm 1/2 watt resistor ALLEN BRADLEY Type EB-1211. |
| L-101, L-102, L-103 | CHO-1B |  | Universal wound 2 section | #38 Single nylon enameled copper wire | | 25 ± 20% | | | Inductance: 2.5 millihenries ± 5% at 1000 cycles.<br>Capacity: 1.5 μμf ± 50%.<br>Current rating: 30 ma.<br><br>1 coat HARVEL Varnish #612-C and bake.<br>Coil form STACKPOLE CARBON CO. #A-9456. |
| L-104 | CHO-4B |  | Single | #22 Enameled copper wire | 24 Close wound | | | | Inductance: 1.52 microhenries ± 5% at 10 megacycles.<br>Capacity: .65 μμf.<br>Current: 1.5 amps max.<br><br>1 coat HARVEL Varnish #612-C and bake.<br>Coil form STACKPOLE CARBON CO. #DR-3. |
| L-105 | 295-62A |  | Soft copper strip | 1/8 wide 1/16 thick | Approx. 3 | | | | |
| L-106 | 295-67C |  | Single layer space wound 22 turns per inch tap at 4 turns from RH end | #28 Double nylon covered copper wire | 8 | | | | Inductance: ground to grid, 1.32 mic h at 20 mc ground to tap, .412 mic h at 20 mc.<br>Capacity: 2.1 μμf ± 20%.<br><br>1 coat HARVEL Varnish #612-C and bake. |

# TABLE 6–7. WINDING DATA — Continued

| DESIGNATION SYMBOL | FED. MFG. & ENG. PART NO. | DIAGRAM | WINDING | WIRE SIZE | TURNS | DC RESISTANCE IN OHMS | IMPEDANCE RATIO | HIPOT A-C VOLTS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| L-107 | 295-66C |   | Single | #28 Double nylon covered copper wire | 28 Close wound tap at 12 turns from RH end | | | | Inductance: ground to grid, 12.3 mic h at 5 mc. Ground to tap, 2.52 mic h at 5 mc.<br>Capacity: 2.8 μμf ± 20%.<br>1 coat HARVEL Varnish #612-C and bake. |
| L-108 | 295-44B |   | Universal wound 1 section | #38 Quadruple nylon covered copper wire | | | | | Inductance: ground to grid, 120 mic h at 2 mc. Ground to tap, 25.7 mic h at 2 mc.<br>Capacity: 3.2 to 3.4 μμf.<br>1 coat HARVEL Varnish #612-C and bake. |
| L-109 | 295-43B |   | Universal wound 2 section | #38 Quadruple nylon covered copper wire | | | | | Inductance: grid to ground, 1.02 mil h at .5 mc. Ground to tap, .253 mil h at .5 mc.<br>Capacity: 2.8 μμf ± 20%.<br>1 coat HARVEL Varnish #612-C and bake. |
| L-110 | 295-42B |   | Universal wound 2 section | #38 Double nylon covered copper wire | | | | | Inductance: ground to grid, 9.3 mil h at 200 kc. Ground to tap, 1.57 mil h at 200 kc.<br>Capacity: 5 μμf ± 20%.<br>1 coat HARVEL Varnish #612-C and bake. |
| L-111 | 295-41B |   | Universal wound 3 section | #38 Single nylon enameled copper wire | | | | | Inductance: ground to grid, 72.5 mil h at 1 kc. Ground to tap, 13.9 mil h at 1 kc.<br>Capacity: 4.9 μμf ± 20%.<br>1 coat HARVEL Varnish #612-C and bake. |

## TABLE 6-7. WINDING DATA — Continued

| DESIG-NATION SYMBOL | FED. MFG. & ENG. PART NO. | DIAGRAM | WINDING | WIRE SIZE | TURNS | DC RESISTANCE IN OHMS | IMPEDANCE RATIO | HIPOT A-C VOLTS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| L-112 | 295-69B |   | Universal wound 4 section | #38 Single nylon enameled copper wire | | | | | Inductance: Ground to grid, 570 mil h at 1 kc. Ground to tap, 92 mil h at 1 kc.<br>Capacity: 4.2 μμf ± 20%.<br><br>1 coat HARVEL Varnish #612-C and bake. |
| L-114 | CHO-6A |   | Single layer space wound 32 turns per inch | #30 Double silk covered copper wire | 19 | | | | Inductance: 0.7 microhenries ± 5% at 18.5 megacycles.<br>Capacity: 0.6 μμf.<br>Current: 135 ma max.<br><br>1 coat HARVEL Varnish #612-C and bake.<br>Coil form STACKPOLE CARBON CO. #DR-1. |
| L-115, L-116 | CHO-7 |   | Single | | | | | | Inductance: 6.5 microhenries ± 10%.<br>Current: 1000 ma.<br><br>OHMITE Type Z-50. |
| L-201 | 295-7A |  | | | | 400 ± 10% | | | Inductance: 11 henries min at 75 ma DC. |
| L-401 | 295-236 |   | Single | #32 Double silk covered copper wire | 38 | | | | Inductance: 20 μf ± 10% at 5 mc.<br>Capacity: 1.4 μμf.<br>Current: 100 ma max.<br><br>1 coat HARVEL Varnish #612-C and bake. |
| T-201 | 295-6A |   | | | | | | | 225-0-225V AC.<br>Full load 6.3v at 4A.<br>Coil to be vacuum impregnated. To withstand 1500v RMS — 60 cps from HV windings to ground and from HV windings to all other windings. To withstand 500v RMS — 60 cps from pri windings to ground and from fil windings to ground. Laminations grounded. |

## TABLE 6–8. CROSS REFERENCE BETWEEN SYMBOL NUMBER AND FIGURE LOCATION

| SYMBOL NR. | FIGURE NR. | SYMBOL NR. | FIGURE NR. |
|---|---|---|---|
| C-101 | 6-13 | C-204 | 6-17 |
| C-102 | 6-13 | C-401 | 6-19 |
| C-103 | 6-14 | C-402 | 6-19 |
| C-104 | 6-14 | C-601 | 6-21 |
| C-105 | 6-13 | C-602 | 6-21 |
| C-106 | 6-13 | E-101 | 4-1 |
| C-107 | 6-13 | E-102 | 4-1 |
| C-108 | 6-9 | E-103 | 4-1 |
| C-109 | Not used | E-104 | 4-1 |
| C-110 | 6-5 | E-105 | 4-1 |
| C-111 | 6-5 | E-106 | 4-1 |
| C-112 | 6-6 | E-110 | 6-5 |
| C-113 | 6-6 | E-111 | 6-5 |
| C-114 | Not shown | E-112 | 6-5 |
| C-115 | 6-9 | E-126 | 4-1, 6-10 (Contained in I-101) |
| C-116 | 6-5 | | |
| C-117 | 6-5 | E-128, E-129, E-130 | 4-1 |
| C-118 | 6-14 | F-101 thru F-104 | 4-1 (Contained in E-115 thru E-118) |
| C-119 | 6-14 | | |
| C-120 | 6-13 | H-101 | 4-1 |
| C-121 | 6-13 | I-101 | 4-1 |
| C-122 | 6-15 | I-102 | 4-1 |
| C-123 | 6-15 | I-103 | 4-1 |
| C-124 | 6-15 | I-104 | 4-1 |
| C-125 | 6-7 | I-105 | 4-1 |
| C-126 | 6-7 | I-106 | 4-1 |
| C-127 | 6-7 | J-101 | 4-1, 6-5 |
| C-128 thru C-134 | 6-7 | J-102 | 4-1, 6-5 |
| C-135 | 6-5 | J-103 | 4-1 |
| C-136 | 6-6 | J-104 | 4-1 |
| C-137 | 6-5 | J-201 | 6-17 |
| C-138 | 6-12 | J-202 | 6-17 |
| C-139 | 6-12 | J-301, J-302 | 6-21 |
| C-140 | 6-6 | J-401, J-402 | 6-19 |
| C-141 | 6-6 | J-501, J-502 | 6-18 |
| C-142 | 6-6 | J-601 | 6-21 |
| C-143 | 6-7 | L-101 | 6-13 |
| C-144 | 6-14 | L-102 | 6-13 |
| C-145 | C-7 | L-103 | 6-15 |
| C-201 | 6-17 | L-104 | 6-15 |
| C-202 | 6-17 | L-105 thru L-1:2 | 6-7 |
| C-203 | 6-17 | L-201 | 6-17 |

**TABLE 6-8. CROSS REFERENCE BETWEEN SYMBOL NUMBER AND FIGURE LOCATION — Continued**

| SYMBOL NR. | FIGURE NR. | SYMBOL NR. | FIGURE NR. |
|---|---|---|---|
| L-401 | 6-9 | R-134 | 6-9 |
| M-101 | 4-1 | R-135 | 6-14 |
| O-103, O-104 | 6-15 | R-136 | 6-14 |
| O-107, O-108, O-109 | 4-1 | R-137 | 6-14 |
| P-101 | 6-12 | R-138 | 6-14 |
| P-102 | 6-12 | R-139 | 6-14 |
| P-103 thru P-109, P-701 | 6-22 (part of cable assemblies) | R-140 | 6-14 |
| | | R-141 | 6-6 |
| R-101 | 6-13 | R-142 | 6-6 |
| R-102 | 6-13 | R-143 thru R-154 | 6-16 |
| R-103 | 6-13 | R-155A | 6-6 |
| R-104 | 6-13 | R-155B | 6-6 |
| R-105 | 6-14 | R-156 | 6-9 |
| R-106 | 6-14 | R-157 | 6-14 |
| R-107 | 6-14 | R-158 | 6-7 |
| R-108 | 6-14 | R-160, R-162, R-163 | 6-7 |
| R-109 | 6-14 | R-164 | Not shown |
| R-110 | 6-9 | R-201 | 6-17 |
| R-111 | 6-13 | R-301 thru R-306 | 6-20 |
| R-112 | 6-14 | R-401 | 6-19 |
| R-113 | 6-9 | R-501 | 6-18 |
| R-114 | 6-6 | S-101 | 4-1 |
| R-115 | 6-6 | S-102 | 6-13 |
| R-116 | 6-6 | S-103 | 6-13 |
| R-117 | Not used | S-104 | 6-9 |
| R-118 | 6-14 | S-105 | 6-7 |
| R-119 | 6-14 | T-201 | 6-17 |
| R-120 | Not shown | V-101 | 6-9 |
| R-121 | 6-14 | V-102 | 6-9 |
| R-122 | Not used | V-103 | 6-9 |
| R-123 | 6-13 | V-104, V-105 | 6-9 |
| R-124 | 6-7 | V-106 | 6-7 |
| R-125 | 6-7 | V-201 | 6-17 |
| R-126 | 6-6 | V-202 | 6-17 |
| R-127 | 6-6 | W-101 | 6-4 |
| R-128 | 6-9 | W-102 | 6-4 |
| R-129 | 6-9 | W-103 | 6-4 |
| R-130 | 6-14 | W-104 | 6-22 |
| R-131 | 6-9 | W-105 | 6-22 |
| R-132 | 6-14 | W-106 | 6-22 |
| R-133 | 6-9 | W-601 | 6-21 |

# SECTION 7

# PARTS LISTS

## CAUTION

Navy stock numbers in this parts list have been set in two lines because of the length of the stock numbers and the restricted column space. Be certain that the complete stock number is used when ordering parts.



*Items marked with an asterisk in the Symbol No. Column of Table 7–4 can not be requisitioned from Supply. In the event of failure they should be repaired or new items fabricated.

## TABLE 7-1. WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

| EQUIPMENT SPARES | | | | | | | STOCK SPARES | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONTRACT ITEM NUMBERS | SHIP-MENT TO | Overall Dimensions (Inches) | | | VOL-UME (CU IN) | WEIGHT (LBS) | CONTRACT ITEM NUMBERS | SHIP-MENT TO | Overall Dimensions (Inches) | | | VOL-UME (CU IN) | WEIGHT (LBS) |
| | | Height | Width | Depth | | | | | Height | Width | Depth | | |
| 10.2, 11.2, 12.2, 13.2, 14.1, 15.2, 16.2, 19.2 | BuShips | 6 | 12 | 9 | 648 | 8 | *14.2, 17.2, 19.3 | BuShips | — | — | — | — | — |
| 20.2 | Coast Guard | 6 | 12 | 9 | 648 | 8 | *23.2 | BuAer | — | — | — | — | — |

*Shipped in bulk quantities

## TABLE 7-2. SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

| EQUIPMENT SPARES | | | | | | | STOCK SPARES | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONTRACT ITEM NUMBERS | SHIP-MENT TO | Overall Dimensions (Inches) | | | VOL-UME (CU IN) | WEIGHT (LBS) | CONTRACT ITEM NUMBERS | SHIP-MENT TO | Overall Dimensions (Inches) | | | VOL-UME (CU IN) | WEIGHT (LBS) |
| | | Height | Width | Depth | | | | | Height | Width | Depth | | |
| 10.2, 11.2, 12.2, 13.2, 14.1, 15.2, 16.2, 19.2 | BuShips | 9 | 15 | 12 | 1620 | 13 | *14.2, 17.2, 19.3 | BuShips | | | | | |
| 20.2 | Coast Guard | Shipped with equipment | | | | | *23.2 | BuAer | | | | | |

*Weight and dimensions determined as shipped

## TABLE 7-3. LIST OF MAJOR UNITS

| SYMBOL GROUP | QUANTITY | NAME OF MAJOR UNIT | NAVY TYPE OR A-N DESIGNATION |
|---|---|---|---|
| 101 to 199 | 1 | RF Signal Generator | SG-44/URM-25 |
| 201 to 299 | 1 | Power Supply | PP-562/URM-25 |
| 301 to 399 | 1 | (5:1) Fixed Attenuator | CN-132/URM-25 |
| 401 to 499 | 1 | Antenna Simulator | SM-35/URM-25 |
| 501 to 599 | 1 | Impedance Adapter | MX-1074/URM-25 |
| 601 to 699 | 1 | Test Lead | CX-1363/U |
| 801 to 899 | 1 | (10:1) Fixed Attenuator | CN-136/URM-25 |
| P-701 | 1 | Coaxial Adapter | UG-201/U |
| W-101 | 1 | AC Line Cable Assembly | |
| W-104 | 1 | RF Cable Assembly | CG-409/U(4'0") |
| W-105, W-106 | 2 | RF Cable Assembly | CG-409/U(7") |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST

PARTS

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | | | **CAPACITORS** | | | | | |
| C-101 | CAPACITOR, fixed: mica dielectric; 1000 mmf ± 2%; 500vdcw, characteristic lttr D; 1-1/16" lg x 15/32" wd x 7/32" thk; molded low loss phenolic case; 2 axial wire leads; spec JAN-C-5. | V-102 bridge capacitor | CM25D102G | N16-C-31080-2522 | (13) Pt. # CM25D102G | Pt. # CPM-603 | C101, C102 | 2 |
| C-102 | Same as C-101. | V-102 bridge capacitor | | | | | | |
| C-103 | CAPACITOR, fixed: mica dielectric; 2000 mmf ± 5%; 500vdcw; characteristic lttr B; 53/64" lg x 53/64" wd x 9/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5. | V-102 coupling capacitor | CM30B202K | | (13) Pt. # CM30B202K | Pt. # CPM-165 | C-103 | 1 |
| C-104 | CAPACITOR, fixed: paper dielectric; 100,-000 mmf ± 20%; 400vdcw; 1-15/32" lg x 49/64" wd x 13/32" thk; 2 axial wire leads; spec JAN-C-91. | V-102 coupling capacitor | CN43E104M | N16-C-45805-6200 | (26) Pt. # CN43E104M | Pt. # CPP-5 | C104, C105, C118, C119, C122 | 5 |
| C-105 | Same as C-104. | V-102 output coupling capacitor | | | | | | |
| C-106 | CAPACITOR, fixed: mica dielectric; 510 mmf ± 5%; 500vdcw; characteristic lttr D; 51/64" lg x 15/32" wd x 7/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5. | External modulation RF filter capacitor | CM20D511J | N16-C-30188-5066 | (13) Pt. # CM20D511J | Pt. # CPM-129 | C106, C107, C112, C602 | 4 |
| C-107 | Same as C-106. | External modulation RF filter capacitor | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| C-108 | CAPACITOR, fixed: paper dielectric; 500,000 mmf ± 10%; 600vdcw; hermetically sealed metal can; 2-5/16" lg x 49/64" wd x 2" h; two ceramic insulated solder lug term 17/32" diam x 3/4" h on 5/8" mtg/c, located on bottom of case; two .156 mtg slots on 1-15/16" mtg/c; spec JAN-C-25. | V-104 audio coupling capacitor | CP65B1DF504K | N16-C-47297-1109 | (13) Pt. # CP65B1DF504K | Pt. # CPP-111 | C108 | 1 |
| C-109 | Not used. | | | | | | | |
| C-110 | CAPACITOR, fixed: ceramic dielectric; 1000 mmf ± 20%; var temp coef; 500vdcw; 5/8" lg x 5/16" diam; 2 axial wire leads terminated in a 1/8" loop; one #12-28 x 11/32" lg axial screw for mtg; uninsulated. | V-104 plate RF bypass capacitor (feedthru) | | N16-C-18657-8801 | (16) Style 357 (HI-K) | Pt. # CPC-21 | C110, C111, C117, C120, C121, C123, C124 C135, C138, C139, C146 | 11 |
| C-111 | Same as C-110. | V-104 heater RF bypass capacitor (feedthru) | | | | | | |
| C-112 | Same as C-106. | V-104 output coupling capacitor | | | | | | |
| C-113 | CAPACITOR, fixed: mica dielectric; 10,000 mmf ± 5%; 500vdcw; characteristic lttr B; 53/64" lg x 53/64" wd x 11/32" thk, molded phenolic case; 2 axial wire leads; spec JAN-C-5. | V-104 output coupling capacitor | CM35B103J | N16-C-33617-4741 | (13) Pt. # CM35B103J | Pt. # CPM-602 | C113 | 1 |
| C-114 | CAPACITOR, fixed: ceramic dielectric; 2 mmf ± .25 mmf; neg temp coef zero (tol + 120-182 mmf/mf/°C); 500vdcw; .562" lg x .250" diam; 2 axial wire leads, insulated; spec JAN-C-20A. | V-106 output coupling capacitor | CC21CJ020C | | (16) Pt. # CC21CJ020C | Pt. # CPC-184 | C114 | 1 |
| C-115 | CAPACITOR, fixed: electrolytic; single section; 25 mf; 150vdcw; working temp range —40°C to 85°C; 2-1/4" lg x 1-3/8" diam; hermetically sealed metal can two solder lug term on bottom; both term insulated from can; one 7/8"-16 x 1/2" lg mtg bshg; spec JAN-C-62. | V-104 cathode bypass capacitor | CE41C250J | | (1) Pt. # CE41C250J | Pt. # CPE-6 | C115 | 1 |
| C-116 | CAPACITOR, fixed: ceramic dielectric; 56 mmf ± 10%; neg temp coef 470 mmf/mf/°C; 1000vdcw ; 5/8" lg x 5/16" diam; 2 axial wire leads each terminated in a 1/8" lg loop; one #12-28 x 11/32" lg axial screw for mtg; uninsulated. | V-104 RF bypass capacitor (feedthru) | | | (16) Type 357 | Pt. # CPC-15 | C116, C137 | 2 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | | **CAPACITORS—Continued** | | | | | | |
| C-117 | Same as C-110. | V-104 cathode bypass capacitor (feedthru) | | | | | | |
| C-118 | Same as C-104. | V-103 input coupling capacitor | | | | | | |
| C-119 | Same as C-104. | V-103 cathode bypass capacitor | | | | | | |
| C-120 | Same as C-110. | V-106 heater bypass capacitor (feedthru) | | | | | | |
| C-121 | Same as C-110. | V-106 plate circuit RF bypass capacitor (feedthru) | | | | | | |
| C-122 | Same as C-104. | V-106 plate circuit RF bypass capacitor | | | | | | |
| C-123 | Same as C-110. | V-106 plate circuit RF bypass capacitor | | | | | | |
| C-124 | Same as C-110. | V-106 heater bypass capacitor (feedthru) | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| C-125 | CAPACITOR, fixed: ceramic dielectric; 1000 mmf ± 20%; special temp coef; 500vdcw; .520" lg x .250" diam; one #3-48 x 11/32" lg axial screw terminal; one axial wire terminal .38" lg x .067" diam; uninsulated. | V-106 plate circuit bypass capacitor | | N16-C-18659-7701 | (16) Style 319 (HI-K) | Pt. # CPC-82 | C125, C136, C143 | 3 |
| C-126 | CAPACITOR, fixed: ceramic dielectric; 51 mmf ± 5%; neg temp coef 300 (± 500) mmf/mf/°C; 500 vdcw; .812" lg x .250" diam; 2 axial wire leads; spec JAN-C-20A. | V-106 grid blocking capacitor | CC26SL510J | N16-C-16596-2514 | (16) Pt. # CC26SL510J | Pt. # CPC-164 | C126 | 1 |
| C-127 | CAPACITOR, variable: air dielectric; plate meshing type; single section; 12.7 mmf to 479.4 mmf; SLF; 29/32" lg x 2-29/32" h x 3-9/16" w; round metal shaft 1/4" diam x 3/8" lg; 27 silver plated plates, 180° clockwise rotation; two #10-32 front mtg holes on 1" mtg/c and two #10-32 rear mtg holes on 1" mtg/c. | Main tuning capacitor | | N16-C-61910-9901 | (25) #886716 (special) | Dwg # 295-47 | C127 | 1 |
| C-128 | CAPACITOR, variable: ceramic dielectric; compression type, single section; 2.5 mmf to 13 mmf; 500vdcw; .843" lg x .640" wd x .312" h less term; 2 solder lug term; two .120" diam holes on .437" mtg/c for mtg; screwdriver slot adj; ceramic base. | Carrier Oscillator band G trimmer | | | (10) Type 822BZ | Pt. # CPT-3 | C128, C129, C130, C131, C132, C133, C134 | 7 |
| C-129 | Same as C-128. | Carrier Oscillator band F trimmer | | | | | | |
| C-130 | Same as C-128. | Carrier Oscillator band E trimmer | | | | | | |
| C-131 | Same as C-128. | Carrier Oscillator band D trimmer | | | | | | |
| C-132 | Same as C-128. | Carrier Oscillator band C trimmer | | | | | | |
| C-133 | Same as C-128. | Carrier Oscillator band B trimmer | | | | | | |
| C-134 | Same as C-128. | Carrier Oscillator band A trimmer | | | | | | |
| C-135 | Same as C-110. | V-105 heater bypass capacitor (feedthru) | | | | | | |
| C-136 | Same as C-125. | V-105 cathode bypass capacitor | | | | | | |
| C-137 | Same as C-110. | V-104 voltage divider bypass capacitor (feedthru) | | | | | | |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **CAPACITORS—Continued** | | | | | | | |
| C-138 | Same as C-110. | 115 vAC line filter | | | | | | |
| C-139 | Same as C-110. | 115 vAC line filter | | | | | | |
| C-140 | CAPACITOR, fixed: ceramic dielectric; 2 mmf ± 10%; neg temp coef 330 (± 500) mmf/mf/°C; 500vdcw; .520" lg x .250" diam; one #3-48 x 11/32; lg axial screw term, one axial wire term .067" diam x .38" lg; uninsulated. | V-104 RF cathode bypass capacitor | | N16-C-15431-5525 | (16) Style 319 | Pt. # CPC-51 | C140 | 1 |
| C-141 | CAPACITOR, fixed: ceramic dielectric; 56 mmf ± 10%; neg temp coef 330 (± 500) mmf/mf/°C; 500vdcw; .520" lg x .250" diam; one #3-48 x 11/32" lg axial screw term, one axial wire term .38" lg x .067" diam; uninsulated. | V-104 RF bypass capacitor | | N16-C-16669-3500 | (16) Style 319 | Pt. # CPC-68 | C141, C142 | 2 |
| C-142 | Same as C-141. | V-105 RF bypass capacitor | | | | | | |
| C-143 | Same as C-125. | V-106 heater bypass capacitor | | | | | | |
| C-144 | CAPACITOR, fixed: mica dielectric; 300 mmf ± 5%; 500vdcw; characteristic lttr B; 5-1/64" lg x 15/32" wd x 7/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5. | V-103 shunt capacitor | CM20B301J | N16-C-29660-8996 | (13) Pt. # CM20B301J | Pt. # CPM-123 | C144 | 1 |
| C-145 | CAPACITOR, fixed: ceramic dielectric; 10 mmf ± 5%; neg temp coef 330 (+ 500-718) mmf/mf/°C; .562" lg x .250" diam; 2 axial wire leads; insulated; spec JAN-C-20A. | V-106 output coupling capacitor | CC21SL100J | | (16) Pt. # CC21SL100J | Pt. # CPC-222 | C145 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| C-146 | Same as C-110. | E-128, E-129, E-130, feedthru | | | | | | |
| C-201 | CAPACITOR, fixed: paper dielectric; single section; 4 mf ± 10%; 600vdcw; hermetically sealed metal can; 4-1/2" lg x 1-1/2" diam; one terminal internally grounded to case; one 3/4-16 x 1/2" lg mtg bshg; single screw term; spec JAN-C-25. | Power supply filter capacitor | CP40C2FF405K | N16-C-49958-5145 | (13) Pt. # CP40C2FF405K | Pt. # CPP-108 | C201, C202, C203 | 3 |
| C-202 | Same as C-201. | Power supply filter capacitor | | | | | | |
| C-203 | Same as C-201. | Power supply filter capacitor | | | | | | |
| C-204 | CAPACITOR, fixed: paper dielectric; single section; .15 mf ± 10%; 400vdcw; hermetically sealed tubular metal can; 15/32" diam x 1-1/16" lg; both term ins from case; vinylite jacket; 2 axial wire leads. | Power supply 120 cycle resonant filter capacitor | | | (38) Type XFS-1856 | Pt. # CPP-257 | C204 | 1 |
| C-401 | CAPACITOR, fixed: mica dielectric; 200 mmf ± 5%; 500vdcw; characteristic lttr D; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic case; 2 axial wire leads; spec JAN-C-5. | Antenna simulator series capacitor | CM20D201J | N16-C-29265-3006 | (13) Pt. # CM20D201J | Pt. # CPM-119 | C402 | 1 |
| C-402 | CAPACITOR, fixed: mica dielectric; 390 mmf ± 2%; characteristic lttr D; 500vdcw; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic case; 2 axial wire leads; spec JAN-C-5. | Antenna simulator shunting capacitor | CM20D391G | N16-C-29893-2126 | (13) Pt. # CM20D391G | Pt. # CPM-604 | C402 | 1 |
| C-601 | CAPACITOR, fixed: paper dielectric; single section; 100,000 mmf + 20-10%; 400vdcw; tubular metal can; .400" diam x 13/16" lg; both term insulated from case; 2 axial wire leads. | B+ blocking capacitor part of W-601 | | | (38) Type XF-1816 | Pt. # CPP-253 | C601 | 1 |
| C-602 | Same as C-601. | W-601 inductance compensating capacitor | | | | | | |
| | **PANEL KNOBS AND MISCELLANEOUS ELECTRICAL ACCESSORIES** | | | | | | | |
| E-101 | KNOB: round; black bakelite; for 1/4" diam shaft; two #8-32 set screws; 1" diam x 5/8" lg overall with 5/8" white vinylite pointer; brass insert; shaft hole 7/16" deep. | CARRIER CONTROL (R-123) knob | | N16-K-700302-606 | (23) S-619-64-BB with 40275 pointer | Pt. # KNB-106 | E101, E102, E103, E104 | 4 |
| E-102 | Same as E-101. | CARRIER RANGE (S-104) knob | | | | | | |
| E-103 | Same as E-101. | MICROVOLTS control (R-155) knob | | | | | | |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **PANEL KNOBS AND MISCELLANEOUS ELECTRICAL ACCESSORIES — Continued** | | | | | | | |
| E-104 | Same as E-101. | % MODULATION control (R-111) knob | | | | | | |
| E-105 | KNOB: round; skirted; black bakelite; for 1/4" diam shaft; two #10-32 set screws; 1-3/4" diam x 27/32" h; brass insert; shaft hole 41/64" deep; white mark on skirt. | FREQUENCY BAND SWITCH (S-103) knob | | N16-K-700374-431 | (23) S-381-64-L-BB | Pt. # KNB-103 | E105 | 1 |
| E-106 | POST, binding: screw type; 5/8" diam x 1-1/16" lg FMS; one #10-32 x 1" lg mtg stud threaded 3/4" black bakelite cap; hole for #12 wire; captive nut type cap with hole for 3/16" diam banana plug. | Front panel ground post | | N17-P-69135-6205 | (28) Pt. # DF-308C (nickel plated stud) | Pt. # PBG-1 | E106 | 1 |
| E-107 | TERMINAL, stud (style 47): double ended cylindrical shape; brown PBE (LTS-E-4) phenolic; 1" lg x 2-9/64" OD overall including 2 axial silver pltd brass solder lug term; 3800 v RMS at 60 cyc breakdown voltage; one integral brass nickel pltd hex flange 3/8" wd across flats, one 1/4-28 x 1/4" lg brass nickel pltd mtg bshg for 1/4" diam hole in 3/16" thk panel; one 1/4-28 hex nut for mtg. | Feedthru terminal for RF diode — buffer amplifier shelf | | N17-T-28244-2501 | (9) Pt. # X1795A | Pt. # TER-24 | E107, E108 | 2 |
| E-108 | Same as E-107. | | | | | | | |
| E-109 * | BOARD, terminal: resistor capacitor mounting strip; 17 brass silver pltd solder lug term; non-uniform mtg centers between term; micarta grade 254 board; 4-9/16" lg x 1-5/8" wd x 3/32" thk less term and mtg studs; three mtg holes for #4 screws triangularly located on a 1-7/8" mtg radius, three 1-5/16" lg stainless steel standoff mtg studs. | Audio compartment resistor capacitor mounting strip | | | (17) Dwg # 295-169 | Dwg # 295-169 | E109 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| E-110 | INSULATOR, bushing: cylindrical shape; brown XXX bakelite; 15/32" lg overall; 5/8" OD flange x .245" diam hub x .063" diam hole; three .096" diam mtg holes spaced 120° on 7/32" radius. | Carrier Oscillator to buffer amplifier feedthru | | N17-I-49969-8501 | (17) Dwg # 295-120 | Dwg # 295-120 | E110 | 1 |
| E-111 | INSULATOR, feedthru; double ended cylindrical shape; brown XXX bakelite; 45/64" lg overall including 2 axial brass silver pltd terminals; .372" OD, fits 1/4" diam x 1/8" thk panel hole. | Input terminal to step attenuator | | | (17) Dwg # 295-93 | Dwg # 295-93 | E111 | 1 |
| E-112 | ATTENUATOR, variable: balanced ladder net work; composition; input 53.5 ohms, output 53.5 ohms ± 3%; aluminum silver dipped case 2" diam x 2-3/8" lg overall; flatted metal shaft 3/8" diam x 3/4" lg; 0 to 100 db; 5 steps, 20 db per step, linear taper; 2 solder lug term; two #4-40 mtg holes on a 21/32" radius. | Step attenuator | | | (17) Dwg # 295-81 | Dwg # 295-81 | E112 | 1 |
| E-113 * | BOARD, terminal: resistor-capacitor mounting strip; 16 brass, silver pltd solder lug term; non-uniform mtg center between term; micarta grade 254 board; 3-9/16" lg x 1-1/2" wd x 3/32" thk excluding term; three #4-40 brass mtg inserts triangularly located on a 1-5/16" mtg radius. | Audio compartment resistor-capacitor mounting strip | | N17-B-78083-7093 | (17) Dwg # 295-168 | Dwg # 295-168 | E113 | 1 |
| E-114 * | BOARD, terminal: resistor-capacitor mtg strip; 25 brass, silver pltd solder lug term; non-uniform mtg centers between term; micarata grade 254 board; 3-11/16" lg x 2-3/16" wd x 3/16" h brass mtg inserts triangularly located on a 1-5/8" mtg radius. | Audio compartment resistor-capacitor mounting strip | | | (17) Dwg # 295-181A | Dwg # 295-181A | E114 | 1 |
| E-115 | HOLDER, fuse; extractor post type; for single 3AG cartridge fuse; black bakelite; 250 volts at 15 amp; 2-3/8" lg x 11/16" diam overall; 1/2" x 24" x 1/2" lg threaded bakelite body for panel hole mtg; 3/32" hole drilled through cap. | Holder for F-101 | | N17-F-74267-5701 | (8) type HKM-H | Pt. # HOF-4 | E115, E116, E117, E118 | 4 |
| E-116 | Same as E-115. | Holder for F-102 | | | | | | |
| E-117 | Same as E-115. | Holder for F-103 | | | | | | |
| E-118 | Same as E-115. | Holder for F-104 | | | | | | |
| E-119 | SHIELD, electron tube: copper, nickel pltd; cylindrical, open top; twist lock mtg to socket saddle; 1-3/8" lg x .810" diam x .930" diam of flange piece; with compression spring; spec JAN-S-28A. | Tube shield for V-103 | TSFOT101 | | (11) TSFOT101 | Pt. # SHT-1 | E119, E120 | 2 |
| E-120 | Same as E-119. | Tube shield for V-105 | | | | | | |

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| **PANEL KNOBS AND MISCELLANEOUS ELECTRICAL ACCESSORIES—Continued** | | | | | | | | |
| E-121 | SHIELD, electron tube: copper nickel pltd; cylindrical open top; twist lock mtg to socket saddle; 1-3/4" lg x .810" diam x .930" diam of flange piece with compression spring; spec JAN-S-28A. | Tube shield for V-104 | TSFOT102 | | (11) TSFOT102 | Pt. # SHT-2 | E121, E125 | 2 |
| E-122 | SHIELD, electron tube: copper nickel pltd; cylindrical open top; twist lock mtg to socket saddle; 2-1/4" lg x .810" diam x .930 diam of flange piece; with compression spring; spec JAN-S-28A. | Tube shield for R-157 | TSFOT103 | N16-S-34607-8400 | (11) TSFOT103 | Pt. # SHT-3 | E122, E201 | 2 |
| E-123 | SHIELD, electron tube: copper, nickel pltd, cylindrical, open top; twist lock mtd to socket saddle; 1-15/16" lg x .950" diam x 1.050 diam of flange piece; with compression spring; spec JAN-S-28A. | Tube shield for V-101 | TSFOT105 | N16-S-34576-6513 | (11) TSFOT105 | Pt. # SHT-5 | E123, E124 | 2 |
| E-124 | Same as E-123. | Tube shield for V-102 | | | | | | |
| E-125 | Same as E-121. | Tube shield for V-106 | | | | | | |
| E-126 | LAMP, incandescent: 6-8v .15 amp; bulb T 3-1/4 clear; 1-1/8" lg overall; miniature bayonet base; tungsten filament; burn any position. | Panel indicator lamp | | 17-L-6297 | (29) No. 47 | Pt. # LAI-1 | E126 | 1 |
| E-127 • | SUPPRESSOR, parasitic; resistor and coil type; .141" diam x 13/32" lg; 45 turns #36 AWG enameled copper wire wound on 120 ohm, 1/2 watt composition resistor; uncased; two axial wire leads. (consists of L113 and R159) | V-106 plate parasitic suppressor | | N16-S-89924-7460 | (17) Dwg # CHO-3A | Dwg/Pt. # CHO-3A | E127 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| E-128 | LAMP, incandescent: 3v, 190 ma; bulb T-1-1/4 clear, 35/64" lg overall; special screw base; C-2R tungsten filament; burn any position. | Illuminates frequency scale | Navy Type TS-112 | | (36) Pt. # LM-32 | Pt. # LAI-3 | E128, E129, E130 | 3 |
| E-129 | Same as E-128. | Illuminates frequency scale | | | | | | |
| E-130 | Same as E-128. | Illuminates frequency scale | | | | | | |
| E-201 | Same as E-122. | Tube shield for V-201 | | | | | | |
| E-202 | Same as E-122. | Tube shield for V-202 | | | | | | |
| | | | | **FUSES** | | | | |
| F-101 | FUSE, cartridge: 1 amp; open in 1 hr at 135% load; rated continuous at 110% load; 250v; one time; glass body; ferrule term; 1-1/4" lg x 1/4" diam o/a; term 5/16" lg x 1/4" diam. | Line fuse | N.T. 28032-1 | N-17-F 16302-80 | (8) Type 3AG-1 | Pt. # FUS-10 | F101, F102, F103, F104 | 4 |
| F-102 | Same as F-101. | Line fuse | | | | | | |
| F-103 | Same as F-101. | Spare fuse | | | | | | |
| F-104 | Same as F-101. | Spare fuse | | | | | | |
| | | | | **HARDWARE AND MECHANICAL ACCESSORIES** | | | | |
| H-101 • | MASK, dial: for masking and uncovering ranges on the frequency scale; aluminum with black enamel finish; round; 5-1/2" diam x .040" thk; mounts by three .093" diam holes spaced 120° apart on .531" radius, 13/16" center hole for shaft bshg; six slots 1/4" w x 1-1/4" average length, located on four different radii. | Frequency scale (N-102) mask | | N16-M-16001-1002 | (17) Dwg. # 295-59B | Dwg. # 295-59B | H101 | 1 |
| H-102 | CLAMP: electron tube; round, closes to 1-1/8" diam; single mtg leg 3/4" h with oblong mtg hole 3/16" wd x 5/16" lg, locking flange 1/8" wd, 1/4" from mtg hole center. | For securing V-202 | Navy type 49496 | N16-C-301009-628 | (7) Type 926A-14 | Pt. # CLA-4 | H102 | 1 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **DIALS AND INDICATING DEVICES** | | | | | | | |
| I-101 | LIGHT, indicator: without lens; for miniature bayonet base, T-3-1/4 bulb; enclosed shell; aluminum black nickel pltd mtg bushing; 1-9/16" lg x 7/8" wd overall for mtg in 11/16" diam mtg hole x approx 5/16" max panel thickness; horizontally mtd, replaceable from rear of panel; two solder lug term on opposite sides of socket base. | Indicator lamp (E-126) holder assembly | | | (33) per Federal dwg./pt. # LGI-3-1 | Dwg./pt. # LGI-3-1 | I101 | 1 |
| I-102 | LENS, indicator light: red; threaded type; 1/2" diam frosted glass disk lens; 13/16" diam bezel x 9/16"-24 outside thread; aluminum bezel; variable aperture lens adjustable from blackout to maximum light. | Indicator lens (mounts) in I-101 | | | (33) per Federal dwg./pt. # LGI-3-2 | Dwg./pt. # LGI-3-2 | I102 | 1 |
| I-103 | DIAL, frequency tuning: anodized aluminum dial plate and bakelite knob; round; 1-3/4" diam dial plate, 1-3/8" diam knob, brass insert 1/4" I.D.; two #10-32 holes for attachment to 1/4" diam shaft; dial plate marked in 100 equally spaced divisions. | Main tuning dial | | | (17) Dwg. # 295-264 | Dwg. 295-264 | I103 | 1 |
| I-104 | DIAL, attenuator indicator: anodized aluminum dial plate and black bakelite knob; round; 1-5/8" diam dial plate, 1-1/8" diam knob; brass insert 1/4" ID; two #8-32" holes for attachment to 1/4" diam shaft; dial plate has two stops and is marked "MULTIPLIER," .01, .1, 1, 10, 100, 1000. | MULTIPLIER dial | | N16-D-46339-5524 | (17) Dwg. # 295-270B | Dwg. # 295-270B | I104 | 1 |
| I-105 | DIAL; meter selector: anodized aluminum dial plate and bakelite knob; 1-5/8" diam dial plate, 1" dial knob, brass insert 1/4" ID; two #8-32 holes for attachment to 1/4" diam shaft; dial plate marked "METER READS," "BAL," "% MOD," "RF." | METER READS dial | | N16-D-46338-9301 | (17) Dwg. # 295-266 | Dwg. # 295-266 | I105 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I-106 | DIAL; modulation selector: anodized aluminum dial plate and bakelite knob; 1-5/8" diam dial plate, 1" diam knob, brass insert 1/4" ID; two #8-32 holes for attachment to 1/4" diam shaft; dial plate marked "MOD SELECTOR," "1000," "400," "EXT," "OFF." | MOD SELECTOR dial | | N16-D-46338-9326 | (17) Dwg. # 295-268 | Dwg. # 295-268 | I106 | 1 |
| | **CONNECTORS (JACKS AND RECEPTACLES)** | | | | | | | |
| J-101 | CONNECTOR, receptacle: 1 round coaxial female contact; straight; 1-1/16" lg x 3/8" diam with 11/16" square mtg flange; 52 ohms impedance; cylindrical brass silver pltd body, locking type; molded polystyrene insert; four #3-56 tapped holes on 1/2" x 1/2" mtg centers; spec JAN-C-17. | X 20,000 RF OUTPUT jack | UG290/U | N17-C-73108-1267 | (20) Type # 2700 | Pt. # CON-15 | J101, J103 | 2 |
| J-102 | CONNECTOR, receptacle: 1 round coaxial female contact; straight type; 11/16" lg x 11/16" wd x 1-1/32" h; 52 ohms impedance; cylindrical brass silver plated body, locking type; molded polystyrene insert; cable opening approx 7/32" diam; four #3-56 tapped holes on 1/2" x 1/2" mtg/c; spec JAN-C-17. | X MULT RF OUTPUT jack | UG291/U | N17-C-73108-1262 | (20 ) Type # 5000 | Pt. # CON-19 | J102 | 1 |
| J-103 | Same as J-101. | EXTERNAL MOD INPUT jack | | | | | | |
| J-104 | CONNECTOR, receptacle: two round male contacts; straight 1-5/8" lg x 5/8" wd x 1/4" deep less contacts and tem; 7 amp at 125v; rectangular metal shell; molded bakelite insert; two .140" diam mtg holes on 1.250 mtg/c. | AC input receptacle on front panel | | N17-C-73439-4929 | (11) Pt. # 13056 | Dwg./pt. # CON-1 | J104 | 1 |
| J-201 | CONNECTOR, receptacle: 2 flat polarized blades; 21/32" diam x 1/2" lg less contacts: 45 volt 5 amps, 115v at 2 amps; cylindrical black bakelite body; flange type metal mtg bracket with two .152" diam mtg holes on 31/32" mtg/c. | AC input receptacle on power supply sub-chassis | | N17-C-73425-8451 | (22) Code P-302-AB | Pt. # CON-8 | J201 | 1 |
| J-202 | CONNECTOR, receptacle; 4 rectangular polarized female contacts, straight; 3/4" lg x 11/16" wd x 1/2" deep less contacts; 45v at 5 amp or 150v at 1 amp; rectangular molded bakelite body; metal mounting bracket with two .152 diam mtg holes on a 1" mtg/c. | Power supply output receptacle | | N17-C-73185-1208 | (22) Code S-304-AB | Pt. # CON-9 | J202 | 1 |
| J-301 | CONNECTOR, receptacle: 1 round coaxial female contact; straight type; 1-1/16" lg x 3/8" diam with 3/4" square mtg flange; 52 ohms impedance; four .136 diam mtg holes on a 1/2" x 1" mtg/c; spec JAN-C-17. | Connector for (5:1) Fixed Attenuator CN-132/URM-25 | UG185/U | N17-C-73108-2028 | (20) Type 4500 | Pt. # CON-5 | J301, J302, J401, J402, J501, J502, J601, J801, J802 | 9 |

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | | **CONNECTORS (JACKS AND RECEPTACLES) — Continued** | | | | | | |
| J-302 | Same as J-301. | Connector for (5:1) Fixed Attenuator CN-132/URM-25 | | | | | | |
| J-401 | Same as J-301. | Connector for Antenna Simulator SM-35/URM-25 | | | | | | |
| J-402 | Same as J-301. | Connector for Antenna Simulator SM-35/URM-25 | | | | | | |
| J-501 | Same as J-301. | Connector for Impedance Adapter MX-1074/URM-25 | | | | | | |
| J-502 | Same as J-301. | Connector for Impedance Adapter MX-1074/URM-25 | | | | | | |
| J-601 | Same as J-301. | Connector for W-601 | | | | | | |
| J-801 | Same as J-301. | Connector for (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |
| J-802 | Same as J-301. | Connector for (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |

## INDUCTORS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| L-101 | COIL, RF: choke; single winding, 2 pie universal wound; unshielded; 2.5 MH ± 5% at 1000 cycles; 30 ma, 25 ohms ± 20% dc resistance 7/8" lg x 1/2" diam; phenolic form, air core; two 1-1/2" lg pigtail leads. | External modulation RF filter | | N16-C-74661-4082 | (19) per Federal dwg./pt. # CHO-1B | Dwg./pt. # CHO-1B | L101, L102, L103 | 3 |
| L-102 | Same as L-101. | V-104 plate RF choke | | | | | | |
| L-103 | Same as L-101. | V-106 plate RF choke | | | | | | |
| L-104 | COIL, RF: choke; single winding, single layer wound; unshielded; 24 turns #22 AWG enameled wires; .280" OD x 7/8" lg; solid phenolic form; two 1-1/2" lg axial pigtail leads. | V-106 filament choke | | | (19) per Federal dwg./pt. # CHO-4B | Dwg./pt. # CHO-4A | L104 | 1 |
| L-105 | COIL, RF: oscillator; single winding, single layer wound unshielded; three turns of 1/8" x1/16" silver plated copper strip; air core; 15/16" diam x 1/2" lg, tapped at two turns, mounts to circuit components by three .040" dia holes in body strip. | Band H oscillator coil | | | (19) per Federal dwg. # 295-62A | Dwg. # 295-62A | L105 | 1 |
| L-106 | COIL, RF: oscillator, single winding, single layer wound, unshielded; 8 turns of #28 double nylon covered copper wire, tapped at 4 turns; 1/2" diam x 2-1/2" lg; ceramic form, powdered iron core; adjustable iron core; screw driver adjustment; 1/4"/28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band G oscillator coil | | | (19) per Federal dwg. # 295-67C | Dwg. # 295-67C | L106 | 1 |
| L-107 | COIL, RF: oscillator, single winding, single layer wound, unshielded; 28 turns of #28 double nylon covered copper wire, tapped at 12 turns; 1/2" diam x 2-1/4" lg; ceramic form, powdered iron core; adjustable iron core; screw driver adjustment at bottom of coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band F oscillator coil | | | (19) per Federal dwg. # 295-66C | Dwg. # 295-66C | L107 | 1 |
| L-108 | COIL, RF: oscillator; single winding, universal wound; 1/2" diam x 2-1/4" lg; ceramic form, powdered iron core; adjustable iron core; screw driver adjustment at bottom coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top. | Band E oscillator coil | | | (19) per Federal dwg. # 295-44B | Dwg. # 295-44B | L108 | 1 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIGNATION | CONTRACTOR DRAWING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **INDUCTORS — Continued** | | | | | | | |
| L-109 | COIL, RF: oscillator; single winding; 2 pie universal wound; 1/2" diam x 2-1/4" lg; ceramic form; powdered iron core; adjustable iron core; screw driver adjustment at bottom of coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band D oscillator coil | | | (19) per Federal dwg. # 295-43B | Dwg. # 295-43B | L109 | 1 |
| L-110 | COIL, RF: oscillator; single winding, 2 pie universal wound; 1/2" diam x 2-1/4" lg; ceramic form, adjustable iron core; screw driver adjustment at bottom of coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band C oscillator coil | | | (19) per Federal dwg. # 295-42B | Dwg. # 295-42 B | L110 | 1 |
| L-111 | COIL, RF: oscillator, single winding; 3 pie universal wound; 1/2" diam x 2-1/4" lg; ceramic form, powdered iron core; adjustable iron core; screw driver adjustment at bottom of coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band B oscillator coil | | | (19) per Federal Dwg. # 295-41B | Dwg. # 295-41B | L111 | 1 |
| L-112 | COIL, RF: oscillator; single winding; 4 pie universal wound; 3/4" diam x 2-3/4" lg; ceramic form, powdered iron core; adjustable iron core; screw driver adjustment at bottom of coil; 1/4"-28 x 1/4" lg mtg bushing; three solder lug term at top; coated with varnish. | Band A oscillator coil | | | (19) per Federal Dwg. # 295-69B | Dwg. # 295-69B | L112 | 1 |
| L-113 | Part of E-127. | Inductance element of E-127 | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| L-114 | COIL, RF: choke; single winding; single layer wound; .7 uh at 18.5 mc, .6 mmf dist capacitance; .750" lg x .220" diam; 2 axial wire leads. | Band H peaking coil | | | (19) per Federal Pt. # CHO-6A | Pt. # CHO-6A | | 3 |
| L-115 | COIL, RF: choke; single winding; unshielded; 6.5 uh at 50 mc; 1" lg x 9/32" diam; phenolic form, air core; 2 axial wire leads. | RF line choke | | | (35) Pt. # Z50 | Pt. # CHO-7 | L115, L116 | 2 |
| L-116 | Same as L116. | | | | | | | |
| L-201 | REACTOR: filter choke; 11 hy 75 ma; 400 ohms dc resistance; 500v RMS test; hermetically sealed metal case; 2-1/2" lg x 1-13/16" wd x 1-13/16" h; four .166" mtg holes on a 1-1/2" x 1-1/2" mtg/c; two solder lug terminals on bottom of case. | Power supply filter | | | (30) Pt. # E7635 | Dwg. # 295-7A | L201 | 1 |
| L-401 | COIL, RF: antenna simulator single winding, single layer wound; unshielded; 40 turns #32 AWG DSC copper wire; .280" diam x 7/8" lg; powdered iron core form; two 1-1/2" lg axial wire term. | Antenna simulator coil | | N16-C-73292-4516 | (17) Dwg. # 295-236 | Dwg. # 295-236 | L401 | 1 |
| | | | | **METERS** | | | | |
| M-101 | METER multiscale: DC; range 0 to 100 microamps; hermetically sealed round metal flush mtg case; 2-3/16" barrel diam x 1-3/8" deep behind panel, 2-11/16" diam flange; meter accuracy ± 2%; 100 microamps full scale deflection, approx 10,000 ohms per volt sensitivity; calibrated for non magnetic panel; white background, black numerals, 21 scale divisions upper scale, 20 scale divisions lower scale; three 1/8" diam mtg holes on 1.22 R; two stud term #8-32 x 7/16" lg; two scales, upper scale marked 0 to 100 MICROVOLTS, lower scale marked 0 to 100% MODULATION. | RF output and % modulation meter | | N17-M-29400-5001 | (31) per Federal Dwg. # 295-261B | Dwg. # 295-261B | M101 | 1 |
| | | | | **SCALES** | | | | |
| N-101 • | PLATE, index: dial indicator; clear lucite; 2-3/4" lg x 1-11/16" wd x 1/16" thk overall; two .149" diam mtg holes on 2.375" mtg/c; black hairline engraved in the center and perpendicular to the long axis. | Hairline indicator for bands A thru D on frequency scale (N-102) | | N16-P-403561-116 | (17) Dwg. # 295-258 | Dwg. # 295-258 | N101, N103 | 2 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIGNATION | CONTRACTOR DRAWING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **SCALES — Continued** | | | | | | | |
| N-102 | SCALE: to read RF output frequency; round 6" diam x 1/16" thk; eight scales covering 180° each in two groups of four, top group in kilocycles covering 10 to 27 kc, 27 to 80 kc, 80 to 230 kc, 230 to 680 kc, bottom group in megacycles covering .68 mc to 2 mc, 2 mc to 6.3 mc, 6.3 mc to 18 mc, 18 mc to 50 mc, additional arbitrary scale marked 0 to 1000 covering 180° on bottom section, 3% scale overlap; 5/16" ID hole for shaft, three 1/8" holes spaced 120° on 1/4" R for mtg to flange. | Frequency scale | | | (17) Dwg. # 295-57A | Dwg. # 295-57A | N102 | 1 |
| N-103 | Same as N-101. | Hairline indicator for bands E thru H on frequency scale (N-102) | | | | | | |
| | **MECHANICAL PARTS** | | | | | | | |
| O-101 | GEAR: spur; brass; tuning dial pinion; straight teeth; 24 teeth; 48 pitch .500" pitch diam; .5416" diam x 1/8" thk; concave face; 1/4" diam x 1-11/16" lg steel shaft integrally attached to center bore of gear. | Main tuning dial (I-104) pinion | | | (17) Dwg. # 295-18B | Dwg. # 295-18B | O101 | 1 |
| O-102 | GEAR; spur; brass; frequency tuning; straight teeth; one two section split gear, 96 teeth each section, one single section gear 24 teeth; all sections 48 pitch, split gear 2.000" pitch diameter, single section gear .500" diameter; split gear 2.0416" diam x 3/64" thk each section, single gear .5416" diam x 1/8" thk; straight face; single gear integral part of 1/4" ID hub; split gear section held by tension spring, single gear on integral hub approx 7/32" from face of split gear. | Driven by O-101 | | | (17) Dwg. # 295-11 | Dwg. # 295-11 | O102 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| O-103 | GEAR: spur; brass; tuning capacitor; straight teeth; split three section, 120 teeth each section; 48 pitch, 2.500" pitch diam each section; all sections 2.5416" diam, mtg on common 1/4" ID hub; straight face; 7/8" diam x 1/4" h common hub; for attaching to 1/4" diam shaft; gear sections held by two tension springs. | Main tuning capacitor (C-127) gear, driven by O-102 | | | (17) Dwg. # 295-25 | Dwg. # 295-25 | O103 | 1 |
| O-104 | GEAR: spur; brass; drives frequency scale; straight teeth; 120 teeth; 48 pitch, 2.500" pitch diam 2.5416" diam x 1/4" ID of integral hub x 1/8" thk; straight face; 3/4" OD x 1/4" ID; mounts on 1/4" diam shaft; hub has three #6-32 holes on upper face. | Frequency scale (N-102) drive gear, driven by O-103 | | | (17) Dwg. # 295-54A | Dwg. # 295-54A | O104 | 1 |
| O-105 * | RING, retainer: for securing gear on shaft; stainless steel; for securing to 3/16" shaft. | For securing O-102 to shaft | | N16-R-651091-190 | (15) 3/16" series 2 | Pt. # RNG-1 | O105 | 1 |
| O-106 * | RING, retainer: for securing gear on shaft; stainless steel; for securing to 1/4" shaft. | For securing O-101 to panel bushing | | N16-R-651091-191 | (15) 1/4" series 2 | Pt. # RNG-2 | O106 | 1 |
| O-107 | CAP: for types UG-290/U and UG-291/U connectors; brass silver plated; round; approx 5/8" lg x 9/16" diam; twist lock mtg; approx 2" lg chain for securing to panel. | Protective cap for J-101 | Army-Navy type CW123/U | N17-C-200964-601 | (20) Type 1500 | Dwg./pt. # CAC-2 | O107, O108, O110 | 3 |
| O-108 | Same as O-107. | Protective cap for J-102 | | | | | | |
| O-109 | COUPLING, flexible: couple tuning capacitor to drive gear; nickel plated brass hubs and phosphor bronze flexible arms, ceramic insulation; 6000v breakdown; round; 13/16" lg x 1-1/4" diam overall; two #6-32 cadmium plated steel set screws for securing coupling to shaft. | Mechanically couples tuning capacity (C-127) to driving gear | | | (18) Code FC-46-S | Dwg./pt. # CUP-1A | O109 | 1 |
| O-110 | Same as O-107. | Protective cap for J-103 | | | | | | |
| O-111 | CLIP: alligator; for test lead; copper, cad pl; 2" lg x 5/16" wd x 1/2" h overall; one screw connection; 5/16" max jaw opening. | Part of W-601 | | | (37) Pt. # 60CS (cadmium pl) | Pt. # CLP-3 | O111 | 1 |
| O-112 | Same as O-111. | Part of W-601 | | | | | | |
| O-113 | SPRING: helical compression - extension type; gear back lash spring; .020" diam stainless spring steel; 1/8" OD x 3/8" lg overall; approx 12 turns; looped ends. | Back-lash spring for O-102 | | | (17) Dwg. # 295-23 | Dwg. # 295-23 | O113, O114, O115 | 3 |
| O-114 | Same as O-113. | Back-lash spring for O-103 | | | | | | |

**TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued**

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **MECHANICAL PARTS — Continued** | | | | | | | |
| O-115 | Same as O-113. | Back-lash spring for O-103 | | | | | | |
| | **CONNECTORS (PLUGS)** | | | | | | | |
| P-101 | CONNECTOR, plug; 2 rectangular female polarized contacts; straight type; 21/32" diam x 15/16" lg less contacts and cable clamp; 5 amp 45v, 2 amp 115v; cylindrical black crystal finish metal body; molded black bakelite insert; cable opening 3/8" diam max; includes adjustable grip cable clamp. | Part of W-102 | | N17-C-71126-4813 | (22) Code S302 CCT | Dwg./pt. # CON-22 | P-101 | 1 |
| P-102 | CONNECTOR, plug; 4 flat polarized blades; straight type; 3/4" wd x 11/16" h x 15/16" lg less contacts and cable clamp; 5 amp 45v, 1 amp 150v; crystal finish rectangular black metal body; molded black bakelite insert; cable opening 3/8" diam max; includes adjustable grip cable clamp. | Part of W-103 | | N17-C-71480-2351 | (22) Code P304 CCT | Dwg./pt. # CON-23 | P-102 | 1 |
| P-103 | CONNECTOR, plug: one round coaxial male contact; straight type; 31/32" lg x 27/64" diam overall; 52 ohms impedance; cylindrical brass, silver pltd, locking type body; molded polystyrene insert; cable opening approx 7/32" diam; spec JAN-C-17. | Part of W-104 | UG-88/U | N17-C-71408-4241 | (20) Type 1200 | Pt. # CON-17 | P103, P104, P105, P106 | 4 |
| P-104 | Same as P-103. | Part of W-104 | | | | | | |
| P-106 | Same as P-103. | Part of W-105 | | | | | | |
| P-107 | Same as P-103. | Part of W-105 | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| P-108 | Same as P-103. | Part of W-106 | | | | | | |
| P-109 | Same as P-103. | Part of W-106 | | | | | | |
| P-701 | CONNECTOR, adapter: male one end, female other end; coax male type N at one, coax female type BNC other end; straight type; adapts female type N to male type BNC connector; 3/4" diam x 1-9/16" lg overall; 52 ohms impedance; cylindrical, brass silver pltd; molded polystyrene insert; JAN-C-17. | Coaxial adapter | AN type UG-201/U | N17-C-67990-2447 | (20) Type 1400 | Pt. # CON-21 | P701 | 1 |
| | **RESISTORS** | | | | | | | |
| R-101 | RESISTOR, fixed: composition; 154,000 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated, 2 axial wire leads. | V-102 1000 cycle bridge resistor | | | (32) Type CP-1/4 | Pt. # RES-1011 | R101, R104 | 2 |
| R-102 | RESISTOR, fixed: composition; 393,000 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | V-102 400 cycle bridge resistor | | | (32) Type CP-1/4 | Pt. # RES-1012 | R102, R103 | 2 |
| R-103 | Same as R-102. | V-102 400 cycle bridge resistor | | | | | | |
| R-104 | Same as R-101. | V-102 1000 cycle bridge resistor | | | | | | |
| R-105 | RESISTOR, fixed: composition; 20,000 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-102 cathode degeneration resistor | RC20BF203J | N16-R-50362-0431 | (2) Pt. # EB2035 | Pt. # RES-79 | R105 | 1 |
| R-106 | RESISTOR, fixed: composition; 1800 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-102A cathode bias resistor | RC20BF182J | N16-R-49984-0431 | (2) Pt. # EB1825 | Pt. # RES-54 | R106, R162 R163 | 3 |
| R-107 | RESISTOR, fixed: composition; 510,000 ohms ± 5%; 1/2 W; characteristic F; .486" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-102B grid leak resistor | RC20BF514J | N16-R-50839-0431 | (2) Pt. # EB5135 | Pt. # RES-113 | R107, R114, R126, R127, R139, R140 | 6 |
| R-108 | RESISTOR, fixed: composition; 100,000 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; leads; spec JAN-R-11. | V-102A plate load resistor | RC20BF104J | N16-R-50632-0431 | (2) Pt. # EB1045 | Pt. # RES-96 | R108, R109, R125 | 3 |
| R-109 | Same as R-108. | V-102B plate load resistor | | | | | | |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **RESISTORS — Continued** | | | | | | | |
| R-110 | RESISTOR, variable: composition; 25,000 ohms ± 10%; 2 W; 3 solder lug terminals; metal case 1-1/16" diam x 9/16" deep; slotted metal shaft 1/4" diam x 5/8" lg FMS; A taper; #3/8-32 x 1/2" lg mtg bag; non turn device on 17/32" rad at 3 and 9 o'clock. | V-102 DEGEN control | | N16-R-87749-4560 | (2) Cat. # JLU-2531 | Pt. # RRV-1 | R110, R128, R129, R131 | 4 |
| R-111 | RESISTOR, variable: composition; 100,000 ohms ± 10%; 2 W; 3 solder lug terminals; metal case 1-1/16" diam x 9/16" deep; flatted metal shaft 1/4" diam by 3/4" FMS; A taper; #3/8-32 x 1/4" lg mtg bshg. | % MODULA-TION control | | N16-R-88009-4164 | (2) Type JU1041 | Dwg. # 295-150 | R111 | 1 |
| R-112 | RESISTOR, fixed: composition; 270,000 ohms ± 5%; 1/2 W; characteristic F; .486" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | Audio series dropping resistor | RC20BF274J | N16-R-50740-0431 | (2) Pt. # EB2745 | RES-106 | R112, R119 | 2 |
| R-113 | RESISTOR, variable: composition; 2500 ohms ± 10%; 2 W; 70°C; three solder lug term; enclosed metal case 1-11/16" diam x 9/16" d; slotted metal shaft 5/8" lg x 1/4" diam; A taper; contact arm insulated from case; without off position; normal shaft torque with locking device; #3/8-32 x 1/2" lg mtg bshg. | V-104 BIAS control | | N16-R-87419-4350 | (2) Cat. # JLU2521 | Pt. # RRV-4 | R113 | 1 |
| R-114 | Same as R-107. | Part of V-104 grid leak circuit | | | | | | |
| R-115 | RESISTOR, fixed: composition; 51,000 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | Part of V-104 grid leak circuit | RC20BF513J | N16-R-50497-0431 | (2) Pt. # EB5135 | Pt. # RES-89 | R115, R117 | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R-116 | RESISTOR, fixed: composition; 2400 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-104 plate load resistor | RC20BF242J | N16-R-50020-0431 | (2) Pt. # EB2425 | Pt. # RES-57 | R116 | 1 |
| R-117 | Same as R115. | V-104 degen resistor | | | | | | |
| R-118 | RESISTOR, fixed: composition; 30,000 ohms ± 5%; 1 W; characteristic F; .750" lg x .280" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-104 voltage dropping resistor | RC30BF303J | N16-R-50407-0751 | (2) Pt. # GB-3035 | Pt. # RES-383 | R118 | 1 |
| R-119 | Same as R-112. | V-103 series dropping resistor | | | | | | |
| R-120 | RESISTOR, fixed: composition; 1 meg ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-103 shunt resistor | RC20BF105J | N16-R-50974-0431 | (2) Pt. # EB1055 | Pt. # RES-120 | R120, R121 | 2 |
| R-121 | Same as R-120. | V-103 output resistor | | | | | | |
| R-122 | Not used. | | | | | | | |
| R-123 | RESISTOR, variable: wire wound; 50,000 ohms ± 10%; 4w 40°C max continuous operating temp; 3 solder lug term; encl bakelite case w/metal cover 1-21/32" diam x 15/16" lg; flatted metal shaft 1/4" diam x 3/4" lg FMS; A taper; no off position; normal torque; mtg bushing 3/8-32 thd x 1/4" lg; non-turn device located on 17/32" rod at 9 o'clock. | CARRIER CONTROL | | N16-R-91568-8175 | (2) per Federal Dwg. # 295-157A | Dwg. # 295-157A | R123 | 1 |
| R-124 | RESISTOR, fixed: composition; 2200 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads spec JAN-R-11. | V-106 bands G and H grid leak resistor | RC20BF222J | N16-R-50011-431 | (2) Pt. # EB2225 | Pt. # RES-56 | R124 | 1 |
| R-125 | Same as R-108. | V-106 grid leak resistor | | | | | | |
| R-126 | Same as R-107. | V-105 voltage divider resistor | | | | | | |
| R-127 | Same as R-107. | V-105 voltage divider resistor | | | | | | |
| R-128 | Same as R-110. | RF COMP control | | | | | | |
| R-129 | Same as R-110. | MOD COMP control | | | | | | |
| R-130 | RESISTOR, fixed: composition; 18,000 ohms ± 5%; 1/2 W; characteristic F; .486" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-101A plate load resistor | RC20BF183J | N16-R-50353-0431 | (2) Pt. # EB1835 | Pt. # RES-78 | R130, R132, R160 | 3 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIGNATION | CONTRACTOR DRAWING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **RESISTORS — Continued** | | | | | | | |
| R-131 | Same as R-110. | V-101 BALANCE control | | | | | | |
| R-132 | Same as R-130. | V-101B plate load resistor | | | | | | |
| R-133 | RESISTOR, variable: composition 1000 ohms ± 10%; 2 W; 3 solder lug terminals; metal case 1-1/16" diam x 9/16" d; slotted metal shaft 1/4" diam x 5/8" lg; A taper; #3/8-32 x 1/2" lg mtg bshg; non-turn device on 17/32" rod at 3 and 9 o'clock. | RF SENS control | | N16-R-87349-4560 | (2) Cat. # JLU-1021 | Pt. # RRV-2 | R133, R134 | 2 |
| R-134 | Same as R-133. | MOD SENS control | | | | | | |
| R-135 | RESISTOR, fixed: composition; 100 ohms ± 5%; 1/2 W; characteristic F; .368" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-101B cathode bias resistor | RC20BF101J | N16-R-49579-0431 | (2) Pt. # EB1015 | Pt. # RES-25 | R135, R136 | 2 |
| R-136 | Same as R-135. | V-101A cathode bias resistor | | | | | | |
| R-137 | RESISTOR, fixed: composition; 1500 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-101 cathode bias resistor | RC20BF152J | N16-R-49966-0431 | (2) Pt. # EB1525 | Pt. # RES-52 | R137 | 1 |
| R-138 | RESISTOR, fixed: composition; 75,000 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-101 B+ dropping resistor | RC20BF753J | N16-R-50569-0431 | (2) Pt. # EB7535 | Pt. # RES-93 | R138, R158 | 2 |
| R-139 | Same as R-107. | Voltmeter bridge B+ voltage divider | | | | | | |
| R-140 | Same as R-107. | V-101B grid leak resistor | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R-141 | RESISTOR, fixed: composition; 500 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of output impedance T pad circuit | | N16-R-72953-6911 | (32) Type CP-1/4 | Pt. # RES-1004 | R141, R142 | 2 |
| R-142 | Same as R-141. | Part of output impedance T pad circuit | | | | | | |
| R-143 | RESISTOR, fixed: composition; 482 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of step attenuator E-112 | | N16-R-72952-3901 | (32) Type CP-1/4 | Pt. # RES-1000 | R143 | 1 |
| R-144 | RESISTOR, fixed: composition; 531 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of step attenuator E-112 | | N16-R-72956-3876 | (32) Type CP-1/4 | Pt. # RES-1001 | R144, R145, R146, R147, R148 | 5 |
| R-145 | Same as R-144. | Part of step attenuator E-112 | | | | | | |
| R-146 | Same as R-144. | Part of step attenuator E-112 | | | | | | |
| R-147 | Same as R-144. | Part of step attenuator E-112 | | | | | | |
| R-148 | Same as R-144. | Part of step attenuator E-112 | | | | | | |
| R-149 | RESISTOR, fixed: composition; 59 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of step attenuator E-112 | | N16-R-72865-7451 | (32) Type CP-1/4 | Pt.# RES-1002 | R149, R154 | 2 |
| R-150 | RESISTOR, fixed: composition; 65.6 ohms ± 1%; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of step attenuator E-112 | | N16-R-72872-9701 | (32) Type CP-1/4 | Pt. # RES-1003 | R150, R151, R152, R153 | 4 |
| R-151 | Same as R-150. | Part of step attenuator (E-112) | | | | | | |
| R-152 | Same as R-150. | Part of step attenuator (E-112) | | | | | | |
| R-153 | Same as R-150. | Part of step attenuator (E-112) | | | | | | |
| R-154 | Same as R-149. | Part of step attenuator (E-112) | | | | | | |
| R-155 | RESISTOR, variable: composition; two section, one section 10,000 ohms ± 10%, other section 250,000 ohms ± 10%; 2 W at 70°C each section; two solder lug term on each section; 1-1/16" diam x 1-3/16" lg; enclosed case; flatted metal shaft 1/4" diam x 13/16" lg; special taper each section; contact arm insulated from case; without off position; normal torque, without locking device; one #3/8-32 x 5/16" lg mtg bshg. | MICROVOLTS control | | N16-R-88915-7601 | (2) per Federal Dwg. # 295-138C | Dwg. # 295-138C | R155A, R155B | 1 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **RESISTORS — Continued** | | | | | | | |
| R-155A | Part of R-155 (250,000 ohm section). | Bridge section of MICROVOLTS control (R-155) | | | | | | |
| R-155B | Part of R-155 (10,000 ohm section). | Shunt section of MICROVOLTS control (R-155) | | | | | | |
| R-156 | TUBE, ballast: glass; .7 to 1.7 v, .460 to .505 ma; 2-5/16" lg x 3/4" diam bulb; 2-1/2" lg overall; 7 contact miniature base. | V-105 heater regulator | | | (4) Pt. # 5T1A | Dwg./pt. # RBR-2C | R156 | 1 |
| R-157 | RESISTOR, fixed: composition; 15 ohms ± 5%; 2 W; characteristic F; .750" lg x .370" diam; 2 axial wire leads; insulated; spec JAN-R-11. | V-105 filament shunt resistor | RC42BF150J | | (2) Pt. # HB1505 | Pt. # RES-604 | R157 | 1 |
| R-158 | Same as R-138. | V-106 band A cathode resistor | | | | | | |
| R-159 | RESISTOR, fixed: composition; 120 ohms ± 5%; 1/2 W; characteristic F; .468" lg x .243" diam; insulated; 2 axial wire leads; spec JAN-R-11. | Part of E-127 | RC20BF121J | N16-R-49597-0431 | (2) Pt. # EB1215 | Pt. # RES-27 | R159 | 1 |
| R-160 | Same as R-130. | V-106 band B cathode resistor | | | | | | |
| R-161 | RESISTOR, fixed: wire wound; 17 ohms ± 10%; 1-1/2 W; 3-3/5" lg x 5/32" diam; 2 axial wire leads; uninsulated. | E-128 series dropping resistor | | | (17) Dwg. # 295-324 | Dwg. # 295-324 | R161, R165, R166 | 3 |
| R-162 | Same as R-106. | V-106 band D cathode resistor | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R-163 | Same as R-106. | V-106 band E cathode resistor | | | | | | 1 |
| R-164 | RESISTOR, fixed: composition; 2.2 megohms ± 5%; 1/2 W; characteristic F; .468" lg x .249" diam; insulated; 2 axial wire leads; spec JAN-R-11. | V-106 output decoupler | RC20BF225J | N16-R-51064-0431 | (2) Pt. # EB2255 | Pt. # RES-128 | R164 | 1 |
| R-165 | Same as R-161. | E-129 series dropping resistor | | | | | | |
| R-166 | Same as R-161. | E-130 series dropping resistor | | | | | | |
| R-201 | RESISTOR, fixed: wire wound; 1800 ohms ± 5%; 15 W at 25°C; 1-1/4" lg x 1-3/16" wd x 5/8" h; 2 solder lug term; integral mtg bracket with two 0.196" diam mtg holes on 2" mtg/c; spec JAN R-26A. | Power supply series dropping resistor | RW20G182 | | (34) Pt. # RW20G182 | Pt. # RWF-9 | R201 | 1 |
| R-301 | RESISTOR, fixed: composition; 35.6 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | (22) Type CP-1/4 | Pt. # RES-1013 | R301, R302 | 2 |
| R-302 | Same as R-301. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | | | | |
| R-303 | RESISTOR, fixed: composition; 89.2 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | (32) Type CP-1/4 | Pt. # RES-1014 | R303, R304, R305, R306 | 4 |
| R-304 | Same as R-303. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | | | | |
| R-305 | Same as R-303. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | | | | |
| R-306 | Same as R-303. | Part of (5:1) Fixed Attenuator CN-132/URM-25 | | | | | | |
| R-401 | RESISTOR, fixed: composition; 400 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated moisture resistant; 2 axial wire leads. | Part of Antenna Simulator SM-35/URM-25 | | N16-R-72943-7721 | (32) Type CP-1/4 | Pt. # RES-1008 | R401 | 1 |
| R-501 | RESISTOR, fixed: composition; 53.5 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of Impedance Adapter MX-1074/URM-25 | | N16-R-72860-7476 | (32) Type CP-1/4 | Pt. # RES-1005 | R501 | 1 |
| R-801 | RESISTOR, fixed: composition; 43.8 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | (32) Type CP-1/4 | Pt. # RES-1006 | R801, R802 | 2 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| **RESISTORS — Continued** | | | | | | | | |
| R-802 | Same as R801. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |
| R-803 | RESISTOR, fixed: composition; 43.2 ohms ± 1%; 1/4 W; characteristic F; 3/8" lg x 1/16" diam; uninsulated; 2 axial wire leads. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | | Pt. # RES-1007 | R803, R804, R805, R806 | 4 |
| R-804 | Same as R803. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |
| R-805 | Same as R803. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |
| R-806 | Same as R803. | Part of (10:1) Fixed Attenuator CN-136/URM-25 | | | | | | |
| **SWITCHES** | | | | | | | | |
| S-101 | SWITCH, toggle: DPST; 5 amps, 125v dc; phenolic body; 1-9/32" lg x 23/32" wd x 31/32" d; 11/16" lg bat type handle; normally open; solder lug term; single hole mtg bushing 15/32"-32, 15/32" lg; spec JAN-S-23. | POWER ON-OFF switch | ST22K | N17-S-73082-9028 | (14) Pt. # ST22K | Pt. # SWT-1 | S101 | 1 |
| S-102 | SWITCH, rotary: 3 pole, 3 position; single section; silver alloy contacts; ceramic body; 1-7/8" diam x 29/32" d; shorting type solder lug terminals; single hole mtg bushing 3/8-32" x 1/4" lg; 1/4" diam flatted metal shaft 3/4" lg. | METER READS switch | | N17-S-62121-3441 | (24) Type HL (special) per Federal Dwg. # 295-171C | Dwg. # 295-171C | S102 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S-103 | SWITCH, rotary: 3 pole, 4 position; single section; silver alloy contacts; ceramic body; 1-7/8" diam x 31/32" d; shorting type; solder lug terminals; single hole mtg; bushing 3/8-32 x 1/4" lg, 1/4" diam flatted metal shaft 7/8" lg. | MOD SELECTOR switch | | N17-S-62206-1751 | (24) Type HL (special) per Federal Dwg. # 295-172A | Dwg. # 295-172A | S103 | 1 |
| S-104 | SWITCH, rotary: 1 pole 3 position; single section silver alloy contacts; ceramic body; 1-7/8" diam x 29/32" d, shorting type; solder lug term; single hole mtg; bushing 3/8-32 x 1/4" lg; 1/4" diam flatted metal shaft 3/4" lg. | CARRIER RANGE switch | | | (24) Type HL (special) per Federal Dwg. # 295-137B | Dwg. # 295-137B | S104 | 1 |
| S-105 | SWITCH, rotary: 4 pole 8 position; three section, silver alloy contacts; ceramic body; 2-1/16" diam x 2-17/32" d; shorting type; solder lug term; single hole mtg; bushing 3/8-32 x 1/4" lg, 1/4" dia flatted metal shaft 2" lg. | FREQUENCY BAND SWITCH | | N17-S-65463-8001 | (24) Type HC (special) per Federal Dwg. # 295-63B | Dwg. # 295-63B | S105 | 1 |
| **TRANSFORMERS** | | | | | | | | |
| T-201 | TRANSFORMER, power: filament and plate type; 115v 50 to 1600 cyc, single ph; two output windings; secd #1-6.3v at 4 amp, secd #2-450v CT at 75 ma; 1500v RMS ins; vacuum impregnated, sealed in pitch; hermetically sealed metal case; 3-3/4" h x 3" wd x 4" lg less terminals; cylindrical w/mtg fl 2-15/16" d, seven 1/4" diam x 7/16" h standoff terminals, six located on a 5/8" radius, one located at center, four .193" diam mtg holes on 2-3/8" x 2-3/8" mtg/c; Buships spec 16-T-30. | Power transformer | | N17-T-74159-8201 | (30) per Federal Dwg. # 295-6A | Dwg. # 295-6A | T-201 | 1 |
| **ELECTRON TUBES** | | | | | | | | |
| V-101 | TUBE, electron: dual triode. | Voltmeter bridge | JAN I-A 12AU7 | N16-T-58241 | | | V101, V102 | 2 |
| V-102 | Same as V-101. | Modulation oscillator | | | | | | |
| V-103 | TUBE, electron: dual diode. | Modulation diode | JAN I-A 6AL5 | N16-T-56195 | | | V103 | 1 |
| V-104 | TUBE, electron: triode. | | JAN I-A 6J4 | N16-T-56349 | | | V104 | 1 |
| V-105 | TUBE, electron: diode. | RF diode | JAN I-A 9006 | N16-T-79006 | | | V105 | 1 |

## TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued

| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| **CABLE ASSEMBLIES** | | | | | | | | |
| V-106 | TUBE, electron: dual triode. | Carrier oscillator | JAN I-A 6J6 | N16-T-56360 | | | V106 | 1 |
| V-201 | TUBE, electron: dual diode. | Power supply rectifier | JAN I-A 6X4 | N16-T-56840 | | | V201 | 1 |
| V-202 | TUBE, electron: gas regulator type. | B+ regulator | JAN I-A OD3/VR150 | N16-T-53060 | | | V202 | 1 |
| W-101 | CABLE ASSEMBLY, power: type POSJ cable; two #18 AWG stranded conductors; 5 ft 10-1/4" lg, less terminations; one male two contact plug molded at one end, one female two contact plug molded at other end. | AC power line cable | | | (6) Pt. # 1777 | Pt. # CAB-4 | W101 | 1 |
| W-102 * | CABLE ASSEMBLY, power: two #20 AWG stranded conductors, synthetic resin insulated, 3000v RMS test, skeleton braid, synthetic jacket; 2 ft lg, excluding terminations; Jones type S-302-CCT connector at one end, other end terminated in two 2" lg tinned leads. | Interconnecting AC power cable | | | (17) Dwg. # 295-240 | Dwg. # 295-240 | W102 | 1 |
| W-103 * | CABLE ASSEMBLY, power: three #20 AWG stranded conductors, synthetic resin insulated, 3000v RMS test, skeleton braid, synthetic jacket; 16" lg, excluding terminations; Jones type P-304 CCT connected at one end; other end terminated in two 2" lg tinned leads and tinned braid for ground. | Power supply output power cable | | | (17) Dwg. # 295-139 | Dwg. # 295-139 | W103 | 1 |
| W-104 * | CABLE ASSEMBLY, RF: JAN type RG-58/U cable; 46" lg excluding terminations; 4 ft lg overall; one JAN type UG-88/U connector at each end. | RF output cable | CG-409/U(4'0") | | (17) Dwg. # 295-243 | Dwg. # 295-243 | W104 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| W-105 * | CABLE ASSEMBLY, RF: JAN type RG-58/U cable, 5" lg excluding terminals; 7" lg overall; one JAN type UG-88/U connector at each end. | Accessory RF output cable | CB-409/U(7") | | (17) Dwg. # 295-247 | Dwg. # 295-247 | W105 | 1 |
| W-106 * | Same as W-105. | Accessory RF output cable | | | | | | |
| W-601 | LEAD, test: one red lead JAN type SRIR-1(7)-20-C-2; one black lead JAN type SRIR-1(7)-20-C-0; 15-3/8" lg each wire less term; one end at each wire term in Mueller type 60 CS alligator clip, other end of red lead connected in series with a parallel combination consisting of one Gudeman type XF-1816 paper capacitor .1 mf and one JAN type CM20D511J capacitor, both capacitors contained in rectangular aluminum case, black lead grounded to case; aluminum capacitor case 3-1/8" lg x 1-1/8" wd x 7/8" h overall, one type UG-185/U connector at one end, 5/32" ID bushing at other end to permit entry of both leads, 1/4" OD vinylite jacks and over both leads extends 9" lg from bushing. | Output test lead with protective capacitor unit | CX-1363/U | | (17) Dwg. # 295-183 | Dwg. # 295-183 | W601 | 1 |
| | **ELECTRON TUBE SOCKETS** | | | | | | | |
| X-101 | SOCKET, tube: 9 contact miniature; brass saddle top mounting; two 1/8" mtg/c; round plastic body .940" diam less saddle x 5/8" h including saddle, less contacts; phosphor bronze silver pltd contacts; without shock shield, with 1/8" diam center shield; with brass saddle for mtg socket and twist lock tube shield; spec JAN-S-28A. | Tube socket for V-101 | TSE9T101 | N16-S-64063-6718 | (11) Pt. # TSE9T101 | Pt. # SKT-5 | X101, X102 | 2 |
| X-102 | Same as X-101. | Tube socket for V-102 | | | | | | |
| X-103 | SOCKET, tube: 7 contact miniature, brass saddle top mounting; two 1/8" diam hole on 7/8" mtg/c; round plastic body .800" diam x 5/8" h including saddle less contacts; phosphor bronze silver pltd contacts; without shock shield, with 1/8" diam center shield, with brass saddle for mounting socket and for mounting twist lock tube shield; spec JAN-S-28A. | Tube socket for V-103 | TSE7T101 | N16-S-62603-6692 | (11) Pt. # TSE7T101 | Pt. # SKT-3 | X103, X107, X201 | 3 |

TABLE 7-4. COMBINED PARTS AND SPARE PARTS LIST—Continued







| SYMBOL DESIG. | NAME OF PART AND DESCRIPTION | FUNCTION | JAN. AND (NAVY TYPE) NO. | STANDARD NAVY AND (SIGNAL CORP.) STOCK NO. | MFGR. AND MFGR'S DESIG-NATION | CON-TRACTOR DRAW-ING AND PART NO. | ALL SYMBOL DESIG. INVOLVED | QUAN. PER EQUIP. |
|---|---|---|---|---|---|---|---|---|
| | **ELECTRON TUBE SOCKETS — Continued** | | | | | | | |
| X-104 | SOCKET, tube: contact miniature; brass saddle top mounting; two 1/8" diam holes on a 7/8" mtg/c; round ceramic body .800" diam x 3/4" h including saddle less contacts; beryllium copper-silver pltd contacts; without shock shield; with .156" OD center shield; with brass saddle for mounting socket and for mounting twist lock shield; spec JAN-S-28. | Tube socket for V-104 | S010C | | (11) Pt. # S010C | Pt. # SKT-1 | X104, X105, X106 | 3 |
| X-105 | Same as X-104. | Tube socket for V-105 | | | | | | |
| X-106 | Same as X-104. | Tube socket for V-106 | | | | | | |
| X-107 | Same as X-103. | Socket for R-156 ballast regulator | | | | | | |
| X-201 | Same as X-103. | Tube socket for V-201 | | | | | | |
| X-202 | SOCKET, tube: octal; one piece saddle mtg; two .156" diam holes on 1-1/2" mtg/c; round phenolic body 1-3/8" diam x 5/8" h excluding term; phosphor bronze silver pltd contacts; spec JAN-S-28A. | Tube socket for V-202 | TSB8T101 | N16-S-63515-4151 | (11) Pt. # TSB8T101 | Pt. # SKT-4 | X202 | 1 |

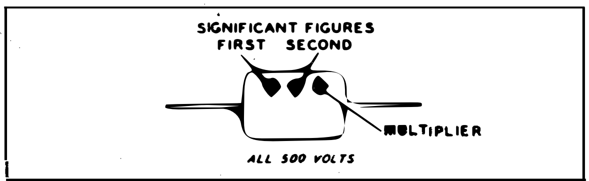
## TABLE 7-5. CROSS REFERENCE PARTS LIST

| JAN (OR AWS) | KEY SYMBOL | JAN (OR AWS) | KEY SYMBOL | STANDARD NAVY STOCK NO. | KEY SYMBOL | STANDARD NAVY STOCK NO. | KEY SYMBOL | STANDARD NAVY STOCK NO. | KEY SYMBOL |
|---|---|---|---|---|---|---|---|---|---|
| CC21CJ020C | C114 | TSE7T101 | X103 | N16-C-15431-5525 | C140 | N16-R-50407-0751 | R118 | N17-C-67990-2447 | P701 |
| CC21SL100J | C145 | TSE9T101 | X101 | N16-C-16596-2514 | C126 | N16-R-50497-0431 | R115 | N17-C-71126-4813 | P101 |
| CC26SL510J | C126 | TSF0T101 | E119 | N16-C-16669-3500 | C141 | N16-R-50569-0431 | R138 | N17-C-71408-4241 | P103 |
| CE41C250J | C115 | TSF0T102 | E121 | N16-C-18657-8801 | C110 | N16-R-50632-0431 | R108 | N17-C-71480-2351 | P102 |
| CM20B301J | C144 | TSF0T103 | E122 | N16-C-18659-7701 | C125 | N16-R-50740-0431 | R112 | N17-C-73108-1262 | J102 |
| CM20D120G | C101 | TSF0T105 | E123 | N16-C-29265-3006 | C401 | N16-R-50839-0431 | R107 | N17-C-73108-1267 | J101 |
| CM20D201J | C401 | UG-185/U | J301 | N16-C-29660-8996 | C144 | N16-R-50974-0431 | R120 | N17-C-73108-2028 | J301 |
| CM20D391G | C402 | UG-201/U | P701 | N16-C-29893-2126 | C402 | N16-R-51064-0431 | R164 | N17-C-73185-1208 | J202 |
| CM20D511J | C106 | UG-290/U | J101 | N16-C-301069-628 | H102 | N16-R-651091-190 | O105 | N17-C-73425-8451 | J201 |
| CM30B202K | C103 | UG-291/U | J102 | N16-C-30188-5066 | C106 | N16-R-651091-191 | O106 | N17-C-73439-4929 | J104 |
| CM35B103J | C113 | UG-88/U | P103 | N16-C-31080-2522 | C101 | N16-R-72860-7476 | R501 | N17-F-16302-80 | F101 |
| CN43E104M | C104 | | | N16-C-33617-4741 | C113 | N16-R-72865-7451 | R149 | N17-F-74267-5701 | E115 |
| CP40C2FF405K | C201 | | | N16-C-45805-6200 | C104 | N16-R-72872-9761 | R150 | N17-I-49969-8501 | E110 |
| CP65B1DF504K | C108 | | | N16-C-47297-1109 | C108 | N16-R-72943-7721 | R401 | N17-M-29400-5001 | M101 |
| RC20BF101J | R135 | | | N16-C-49958-5145 | C201 | N16-R-72952-3901 | R143 | N17-P-69135-6205 | E106 |
| RC20BF104 | R108 | | **KEY** | N16-C-61910-9901 | C127 | N16-R-72953-6911 | R141 | N17-S-62121-3441 | S102 |
| RC20BF105J | R120 | **NAVY TYPE** | **SYMBOL** | N16-C-72826-4658 | L104 | N16-R-72956-3876 | R144 | N17-S-62206-1751 | S103 |
| RC20BF121J | R159 | | | N16-C-73292-4516 | L401 | N16-R-87349-4560 | R133 | N17-S-65463-8001 | S105 |
| RC20BF152J | R137 | 28032-1 | F101 | N16-C-74661-4082 | L101 | N16-R-87419-4350 | R113 | N17-S-73082-9028 | S101 |
| RC20BF182J | R106 | 49496 | H102 | N16-D-46338-9301 | I105 | N16-R-87749-4560 | R110 | N17-T-28244-2501 | E107 |
| RC20BF183J | R130 | | | N16-D-46338-9326 | I106 | N16-R-88009-4164 | R111 | N17-T-74159-8201 | T201 |
| RC20BF203J | R105 | | | N16-D-46339-5524 | I104 | N16-R-88915-7601 | R155 | N17-L-6297 | E126 |
| RC20BF222J | R124 | | | N16-K-700302-606 | E101 | N16-R-91568-8175 | R123 | | |
| RC20BF225J | R164 | | | N16-K-700374-431 | E105 | N16-S-34576-6513 | E123 | | |
| RC20BF242J | R116 | | | N16-M-16001-1002 | H101 | N16-S-34607-8400 | E122 | | |
| RC20BF274J | R112 | **ARMY-NAVY** | **KEY** | N16-R-403561-116 | N101 | N16-S-89924-7460 | E127 | | |
| RC20BF472J | R162 | **TYPE** | **SYMBOL** | N16-R-49579-0431 | R135 | N16-T-53060 | V202 | | |
| RC20BF513J | R115 | | | N16-R-49597-0431 | R159 | N16-T-56349 | V104 | | |
| RC20BF514J | R107 | CG-409/U(4'0") | W104 | N16-R-49966-0431 | R137 | N16-T-56360 | V106 | | |
| RC20BF753J | R138 | CG-409/U(7") | W105 | N16-R-49984-0431 | R106 | N16-T-56840 | V201 | | |
| RC30BF303J | R118 | CW-123/U | W105 | N16-R-50011-0431 | R124 | N16-T-58241 | V101 | | |
| RC42BF150J | R157 | | | N16-R-50020-0431 | R116 | N16-T-79006 | V105 | | |
| RW20G182- | R201 | | | N16-R-50128-0431 | R162 | | | | |
| SO10C | X104 | | | N16-R-50353-0431 | R130 | | | | |
| ST22K | S101 | | | N16-R-50362-0431 | R105 | N17-B-78083-7093 | E113 | | |
| TSB8T101 | X202 | | | | | N17-C-200964-601 | O107 | | |

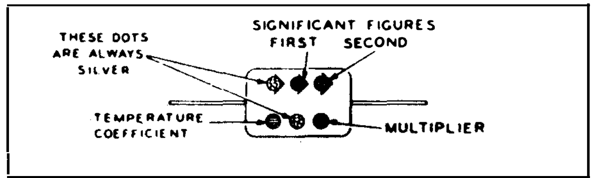
# TABLE 7-6. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

## CAPACITOR COLOR CODES

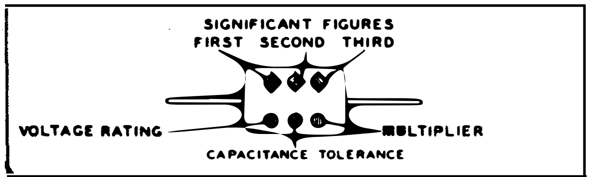
*RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS*



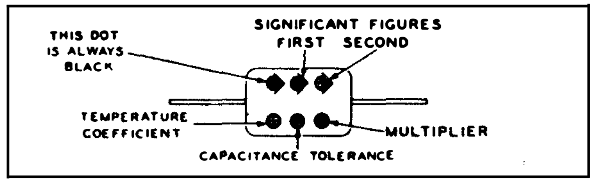

*JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS*



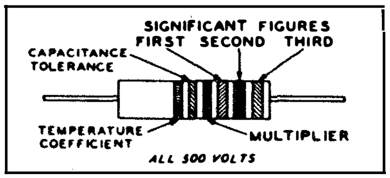

*RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS*




*JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS*

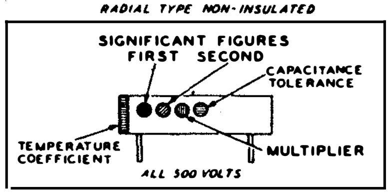



*RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS*

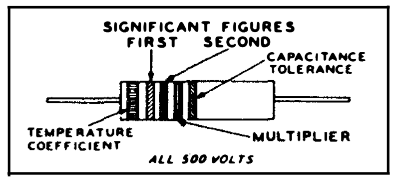



*JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS*

*RADIAL TYPE NON-INSULATED*




*AXIAL TYPE INSULATED*



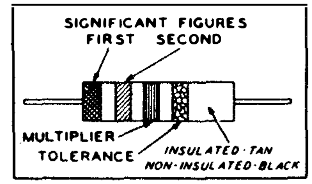

*RMA: RADIO MANUFACTURERS ASSOCIATION*
*JAN: JOINT ARMY-NAVY*

| RESISTORS | | | | CAPACITORS | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | MULTIPLIER | | | | |
| TOLERANCE | MULTIPLIER | SIGNIFICANT FIGURE | COLOR | RMA MICA AND CERAMIC-DIELECTRIC | JAN MICA AND PAPER-DIELECTRIC | JAN CERAMIC DIELECTRIC | VOLTAGE RATING | TEMPERATURE COEFFICIENT |
| | 1 | 0 | BLACK | 1 | 1 | 1 | | A |
| | 10 | 1 | BROWN | 10 | 10 | 10 | 100 | B |
| | 100 | 2 | RED | 100 | 100 | 100 | 200 | C |
| | 1,000 | 3 | ORANGE | 1,000 | 1000 | 1000 | 300 | D |
| | 10,000 | 4 | YELLOW | 10,000 | | | 400 | E |
| | 100,000 | 5 | GREEN | 100,000 | | | 500 | F |
| | 1,000,000 | 6 | BLUE | 1,000,000 | | | 600 | G |
| | 10,000,000 | 7 | VIOLET | 10,000,000 | | | 700 | |
| | 100,000,000 | 8 | GRAY | 100,000,000 | | 0.01 | 800 | |
| | 1,000,000,000 | 9 | WHITE | 1,000,000,000 | | 0.1 | 900 | |
| 5 | 0.1 | | GOLD | 0.1 | 0.1 | | 1000 | |
| 10 | 0.01 | | SILVER | 0.01 | 0.01 | | 2000 | |
| 20 | | | NO COLOR | | | | 500 | |

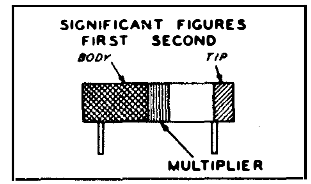
## RESISTOR COLOR CODES

*RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*

*AXIAL TYPE*

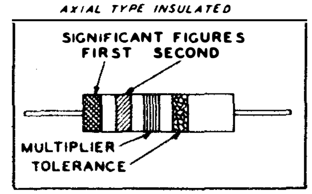



*RADIAL TYPE*

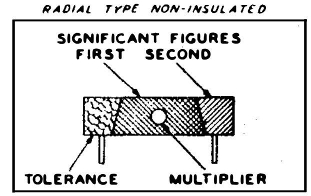



*JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS*

*AXIAL TYPE INSULATED*




*RADIAL TYPE NON-INSULATED*



### TABLE 7-7. LIST OF MANUFACTURERS

| ABBREVI-ATIONS | PREFIX | NAME | ADDRESS | ABBREVI-ATIONS | PREFIX | NAME | ADDRESS |
|---|---|---|---|---|---|---|---|
| 1 | CPH | Aerovox Corp. | New Bedford, Mass. | 20 | CARD | Industrial Products Co. | Danbury, Conn. |
| 2 | CBZ | Allen-Bradley Co. | Milwaukee, Wisc. | 21 | CIR | International Resistance Corp. | Philadelphia, Pa. |
| 3 | CPH | American Phenolic Corp. | Chicago, Ill. | 22 | CJC | Jones, Howard B. | Chicago, Ill. |
| 4 | CAGK | Amperite Co. | New York, N. Y. | 23 | CAUP | Kurz-Kasch, Inc. | Dayton, Ohio |
| 5 | | Atlantic India Rubber Works | Chicago, Ill. | 24 | COC | Oak Mfg. Co. | Chicago, Ill. |
| 6 | CQG | Belden Mfg. | Chicago, Ill. | 25 | CRK | Radio Condenser Co. | Camden, N. J. |
| 7 | CAIS | Birtcher Corp. | Los Angeles, Calif. | 26 | CSF | Sprague Specialties Co. | N. Adams, Mass. |
| 8 | CFA | Bussman Mfg. Co. | St. Louis, Mo. | 27 | CSA | Stackpole Carbon Co. | St. Marys, Pa. |
| 9 | CAMQ | Cambridge Thermionic Corp. | Cambridge, Mass. | 28 | CABU | Superior Electric Co. | Bristol, Conn. |
| 10 | CBN | Central Radio Lab. Div. of Globe Union | Milwaukee, Wisc. | 29 | CHS | Sylvania Electric Products, Inc. | Emporium, Pa. |
| 11 | CMG | Cinch Mfg. Co. | Chicago, Ill. | 30 | CUT | United Transformer Corp. | New York, N. Y. |
| 12 | CMC | Clarostat Mfg. Co. | Brooklyn, N. Y. | 31 | CV | Weston Electrical Instrument Corp. | Newark, N. J. |
| 13 | CD | Cornell-Dubilier | South Plainfield, N. J. | 32 | CBIQ | Wilkor Products | Cleveland, Ohio |
| 14 | CAE | Cutler-Hammer, Inc. | Milwaukee, Wisc. | 33 | CAYZ | Dial Light Corp. | New York, N. Y. |
| 15 | | Eaton Mfg. Co., Stamping Division | Detroit, Mich. | 34 | CAO | Ward Leonard Co. | Mount Vernon, N. Y. |
| 16 | CER | Erie Resistor Corp. | Erie, Pa. | 35 | COM | Ohmite Mfg. Co. | Chicago, Ill. |
| 17 | CFD | Federal Mfg. & Eng. Corp. | Brooklyn, N. Y. | 36 | | Herzog Miniature Lamp Works | New York, N. Y. |
| 18 | CHC | Hammarlund Mfg. Co. | New York, N. Y. | 37 | CBIT | Mueller Electric Co. | Cleveland, Ohio |
| 19 | CBEJ | Harnett Electric Corp. | Port Washington, N. Y. | 38 | CGF | Gudeman Co. | Chicago, Ill. |

# INDEX