MASTER VOLTOHMYST

TYPE WV-95A

PH256

TEST AND MEASURING EQUIPMENT SECTION

RADIO CORPORATION OF AMERICA

CAMDEN, NEW JERSEY, U.S.A.

IB-4095-1

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LIST OF ILLUSTRATIONS

IMPORTANT

THIS INSTRUMENT IS SHIPPED WITHOUT BATTERIES. REFER TO THE INSTRUCTIONS ON PAGE 10 FOR THEIR INSERTION.

MASTER VOLTOHMYST

TYPE WV-95A

TECHNICAL SUMMARY

Electrical Characteristics

D-C VOLTMETER
- Ranges .....0 to 5-10-50-100-500-1000 volts.
- Input resistance ....11 megohms for all ranges —includes 1 megohm in probe.
- Sensitivity (max.) ..2.2 megohms per volt on 5-volt range.
- Circuit .....Differential degenerative vacuum-tube bridge.

D-C AMMETER
- Ranges .....0 to 10-100 microamperes, 0 to 1-10-100 milliamperes using d-c amplifier; 0 to 1-10 amperes direct to meter.

OHMMETER
- Ranges .....0.1 ohm to 1000 megohms in 6 ranges.

A-C VOLTMETER (AUDIO FREQUENCY)
- Ranges .....0 to 1-5-10-50-100-500-1000 volts rms.
- Input impedance (with cable) .....Approx. 5 megohms resistance shunted with approx. 125 mmfd. capacity.
- Frequency response..Flat from 30 to 20,000 cycles.
- Circuit .....A-f feedback amplifier and balanced linear diode with d-c bridge amplifier.

CAPACITY METER
- Ranges .....4 mmfd. to 1000 mfd. in 6 ranges.
- Polarizing voltage ..50 volts d.c. available on high-capacity range.

MULTIPLIERS
- Accuracy .....±1% matched pair, aged resistors.

INDICATING METER
- Sensitivity .....200 microamperes (full-scale).
- Accuracy .....±2% of full-scale indication.

TUBE COMPLEMENT
- 2 RCA 6AK6 .....Vacuum-tube bridge.
- 1 RCA 6AL5 .....Diode.
- 1 RCA 6AU6 .....Audio amplifier.
- 1 RCA 6X4 .....Rectifier.

POWER SUPPLY
- Voltage rating .....105-125 volts, 50-60 cycles (specifications are based on 117 volts, 60 cycles).
- Power consumption..15 watts.
- Battery for ohmmeter circuit .....Two 1.5-volt flashlight cells (RCA VS006 or equivalent).

ACCESSORIES (Available but not supplied as part of the WV-95A)
- RCA Diode Probe (MI-8275) .....For r-f measurements up to 100 volts rms and at frequencies to 250 mc.
- RCA Crystal Probe (MI-8263) .....For r-f measurements at frequencies up to 250 mc and at potentials not exceeding 20 volts positive peak in which a very low input capacity is required.

Mechanical Characteristics

- Overall Dimensions..Height, 9⅞"; width; 13¾"; depth, 7½".
- Weight .....15 lbs.
- Finish .....Blue-grey hammeroid case with anodized satin aluminum panels.

GENERAL DESCRIPTION

The Master VoltOhmyst, Type WV-95A, is an electronic meter designed to measure resistance, capacitance, direct current, d-c voltage, and a-c voltage (audio frequency and radio frequency) over extremely wide ranges. Outstanding features of the instrument are: ease of operation; isolated measuring circuit for reading up to 1000 volts d-c or 230 volts rms (a-c) above ground; high input resistance; automatic protection of the indicating meter against burnout; simplicity of meter scales; "Zero Adjust" that does not have to be reset when ranges are changed; a zero-center scale for use in

aligning f-m and a-f-c discriminator circuits; and provision for the use of the RCA Diode Probe or the RCA Crystal Probe to measure r-f voltages up to 250 megacycles.

The principal part of this instrument consists of two RCA 6AK6 miniature tubes in a push-pull d-c vacuum-tube voltmeter circuit which is characterized by excellent linearity and stability. Both tubes are coupled to a common, high-value bias resistor. The control grid of one of the tubes is permanently grounded, and the voltage to be measured is applied to the grid of the other tube. This voltage is always a d-c voltage; moreover, it is proportional to the magnitude of the quantity being measured. For instance, variations in the values of resistances or capacitances being measured are converted to corresponding variations in the value of the d-c voltage applied to the vacuum-tube bridge. Because of the common cathode coupling, any change in the voltage applied to the grid of one tube produces a change in the cathode bias of the other. As a result, the change in plate current of one tube is accompanied by a simultaneous opposite change in the plate current of the other. The differential voltage developed across the plate load resistors by the plate current is applied, through a polarity-reversing switch, to the meter, which is calibrated in direct current, d-c volts, a-c volts, resistance, and capacity.

Audio-frequency voltage to be measured is passed through a range attenuator to an RCA-6AU6 audio amplifier. The use of feedback in this circuit results in a linear amplifier with good stability and high input impedance. The amplified a-c voltage is applied to an RCA-6AL5 diode rectifier, which furnishes the vacuum-tube bridge with a d-c voltage proportional to the positive-peak value of the measured a-c voltage. The meter scale is calibrated in r-m-s values of a sine wave.

Direct current, on all but the 1- and 10- amp ranges, is measured by passing the current through suitable shunts, and utilizing the resulting voltage drop to drive the vacuum-tube bridge. On the 1- and 10-amp ranges, the current is passed directly through the indicating meter and a low-impedance meter shunt. This is done to keep the instrument from introducing an excessive voltage drop into low-voltage circuits where high-current measurement might be required.

Radio-frequency voltages can be measured when the RCA Diode Probe is used with the Master VoltOhmyst. This probe, which is stocked as MI-8275, is available on separate order. Also available for this purpose is the RCA Crystal Probe, MI-8263.

A special circuit is used to measure capacity over wide ranges with a single meter scale. The unknown capacity is connected in series with a capacity standard and a 0.01- mfd. capacitor. Across the series combination is applied a 60-cycle voltage of proper magnitude. This 60-cycle voltage is distributed across the capacitors in the series circuit in proportion to their reactances at this frequency. The drop across the 0.01-mfd capacitor is measured by means of the audio amplifier and diode circuits, and the resulting meter deflection is read on a meter scale calibrated directly in mfd, or mmfd., according to the range in use. Polarizing voltage from the d-c power supply is applied through a 100,000-ohm resistor to the capacity test jacks on the highest-capacity range. By means of this polarizing voltage, electrolytic capacitors may be measured with d-c voltage applied.

An RCA-6X4 miniature rectifier is employed to supply the d-c voltages required by the Master VoltOhmyst. The power transformer is of special design, having in addition to plate and filament windings, a special winding which supplies the a-c voltages required by the capacity-measuring circuit. This special winding is shielded by three electrostatic shields, two of which are ungrounded.

The low side of the measuring circuit is isolated from the chassis, and a separate case ground terminal is provided. This allows measurements to be made in circuits where both meter leads will be above ground potential. Under this condition the Master VoltOhmyst case alone can be grounded for safety reasons.

HOW TO USE THE RCA MASTER VOLTOHMYST

SAFETY PRECAUTIONS

HIGH VOLTAGES ARE DANGEROUS! For your personal safety, the following precautions should be observed while you are working around high-voltage equipment:

a. Avoid working alone when possible. Serious consequences of electrical shock can be avoided by the presence of a second person to remove power and apply resuscitation when necessary.

b. Avoid contact with or even close proximity to high-voltage points. If you are not familiar with the equipment, find out where high-voltage points exist before proceeding with measurements.

c. If possible, when making high-voltage measurements, remove the voltage from the circuit under test while attaching the meter leads.

d. If it is impracticable to turn the power off during measurements, the following precautions are recommended:

1. Connect the CASE terminal of the instrument to a good ground.
2. Make sure that the clip on the lead from the COMMON terminal is securely attached to the low side of the voltage to be measured. Use of the RCA Binding Post Pin Plugs will prevent the test leads from becoming detached from the Volt-Ohmyst case.
3. Keep your fingers well away from the probe tip.
4. Avoid contact between any part of your body and ground. If the floor is not insulated, find some dry insulating material to stand on. Do not lean against or rest your free hand on an equipment rack, a metal bulkhead or anything else providing a ground return.

e. Do not use leads with defective insulation.

f. Never leave the meter connected to a high-voltage point after measurements have been completed.

g. Do not depend on immediate removal of voltage from high-voltage circuits when the main power switch is opened. Sometimes filter capacitors will retain sufficient charge to cause serious injury. In cases where high voltage is supplied by a motor-generator set, the main switch may turn off only the motor power, so that voltage will be present until the machine stops.

h. DO NOT CONNECT THE CASE TERMINAL OF THE MASTER VOLTOHMYST TO A HIGH-VOLTAGE POINT!!! Failure to observe this precaution may result in a severe shock, since the CASE terminal connects directly to the metal case of the instrument.

PRELIMINARY ADJUSTMENT

Connect as required, the blue lead to the terminal marked VOLTS DC, one of the black leads to the COMMON terminal, the red lead to the RES/MA terminal, and the red probe lead to the VOLTS AC terminal. Before turning the instrument on, check the zero setting of the meter pointer. If the pointer is not on zero, refer to the instructions under "Maintenance" for setting the meter pointer.

Plug the power cord into a 117-volt, a-c supply, and adjust the controls as follows:

POLARITY—Set to "+" or "—" (this switch applies power to the instrument)

SELECTOR—Turn to "DC".

ZERO ADJ—Set so that the meter pointer reads zero on all scales.

SELECTOR—Turn to "RES" (the pointer should deflect to approximately full scale)

RES/CAP ADJ—Set so that the meter pointer reads exactly to the last line on the "R" scale.

The instrument is now ready for use in the measurement of resistance, direct current, d-c voltage, and audio- and radio-frequency voltage.

NOTE—When accurate readings are required, the instrument should be allowed to warm up for at least ten minutes before the adjustments described above are made.

OPERATION

-C Voltage Measurements—The d-c voltmeter nas six ranges: 0 to 5, 10, 50, 100, 500, and 1000 volts. When the proper range has been selected on the VOLTS switch, the voltage may be read directly from one of the two center d-c voltage scales. The d-c voltmeter will not read when the VOLTS switch is set on "1"; therefore, this position of the switch is never used when d-c voltages are being measured. For d-c voltage measurements, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set on "+" or "–".

SELECTOR—Set on "DC".

VOLTS—Select a range including the value of the voltage to be measured.

Terminal Connections:

COMMON—Connect the black clip-lead to the grounded or low side of the voltage to be measured (see Safety Precautions).

DC VOLTS—Connect or touch the d-c probe (blue lead) to the high side of the voltage to be measured.

NOTE—When high voltages are to be measured, connect the CASE terminal of the instrument to a good ground, such as a cold-water pipe.

Zero-Center Application—Provisions have been made to shift the d-c zero reading to the center of the scale when it is desirable to observe the d-c voltage variation around zero volts. Both positive and negative voltage excursions can be observed

without resetting the POLARITY switch each time the polarity of the voltage changes.

To use the zero-center feature of the Master VoltOhmyst, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set on "+ ".

SELECTOR—Set on "DC".

ZERO ADJ—Set so that the meter pointer is directly over the "0" mark at the center of the meter scale.

VOLTS—Set to the desired voltage range.

Terminal Connections:

COMMON—Connect the black clip-lead to the grounded or low side of the voltage to be measured.

VOLTS DC—Connect or touch the d-c probe (blue lead) to the high side of the voltage to be measured.

Direct Current Measurements—The direct-current meter has seven ranges: 0 to 10, 100 microamperes; 0 to 1, 10, 100 milliamperes; and 0 to 1, 10 amperes. When the proper range has been selected on the CURRENT switch, the current may be read directly from the direct-current scale.

For direct-current measurements, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set on "+" or "−".

SELECTOR—Set on "CUR".

CURRENT—Select a range including the value of the current to be measured.

Terminal Connections:

COMMON—Connect the black clip-lead into circuit so that the current to be measured must flow through this lead.

RES/MA—If the current to be measured is less than 100 ma, connect the red lead between this terminal and the other side of the circuit.

1 AMP—If the current to be measured is between 100 ma and 1 amp, connect the red lead to this terminal.

10 AMP—If the current to be measured is between 1 amp and 10 amps, connect the red lead to this terminal.

CAUTION—In the "1-10 AMP" position of the CURRENT switch, the measured current flows directly through the indicating meter, so that the anti-meter-burnout feature of the Master VoltOhmyst is not effective. Reasonable precautions should be taken to prevent meter burnout when the "1-10 AMP" setting of the CURRENT switch is employed.

NOTE—The zero-center feature of the instrument is also available when metering direct current. The procedure is analagous to that described under "Zero Center Applications," except, of course, the SELECTOR switch is set on "CUR," and the CURRENT switch is used to select the proper ranges.

Audio-Frequency Voltage Measurements—The a-c (audio-frequency) voltmeter has seven ranges: 0 to 1, 5, 10, 50, 100, 500, and 1000 volts. When the proper range has been selected on the VOLTS switch, the voltage may be read directly from one of the two center scales. If the a-c voltage is a sine wave, then the voltage is read from the meter scale as the r-m-s value. If the voltage is not a sine wave, then the meter reading, when multiplied by 1.414, will give the positive-peak value of the voltage.

For audio-frequency voltage measurements, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set on "+" or "−".

SELECTOR—Set on "AC".

VOLTS—Select a range including the value of the voltage to be measured. If the ZERO ADJ control has been previously set as described under "Preliminary Adjustments," then, when the VOLTS switch is on "1," the meter pointer will be automatically aligned with the small red zero on the bottom half of the center scale. This zero appears just to the right of the normal zero for that scale, and is the zero which should be used when the VOLTS switch is on "1." If the pointer does not automatically read to this zero, then the AC ZERO control inside the case should be adjusted as described in the Maintenance section of this book. For all other positions of the VOLTS switch, the black zero is used.

Terminal Connections:

COMMON—Connect the black clip-lead to the grounded or low side of the voltage to be measured.

VOLTS AC—Connect or touch the a-c probe (red lead with 4-prong plug) to the high side of the voltage to be measured.

Radio-Frequency Voltage Measurements— For this application, the RCA Diode Probe or Crystal Probe is required. These are not supplied with the Master VoltOhmyst, but are available on separate order. The application of the Diode Probe only will be considered here. Instructions for using the Crystal Probe are furnished with the probe. The r-f voltmeter has four ranges: 0 to 5, 10, 50 and 100 volts. When the proper range has been selected on the VOLTS switch, the voltage may be read directly from one of the two bottom red scales on the two lower ranges (0 to 5, 10),

or from one of the two center black scales on the two upper ranges (0 to 50, 100). If the a-c voltage is a sine wave, then the voltage is read from the meter scale as the r-m-s value. If the voltage is not a sine wave, then the meter reading, when multiplied by 2.83, will give the peak-to-peak value of the voltage.

CAUTION—To avoid damage to the probe, refer to the "ACCESSORIES" section of the Specifications and do not exceed the input voltage indicated.

For r-f voltage measurements with the Diode Probe, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set on "+" or "–".

SELECTOR—Set on "RF". In this position of the switch the pointer will normally deflect to the left, unless the Diode Probe is in its socket.

VOLTS—Select a range including the value of the voltage to be measured. As mentioned before, only the "5", "10", "50", and "100" positions of the VOLTS switch are used in this particular application.

Terminal Connections:

VOLTS AC—For high radio-frequency measurements the center pin of the RCA Diode Probe should be connected directly to the high side of the voltage to be measured, while the knurled ring of the probe should be connected directly to the grounded or low side. The grounding ring is tapped for a 5/8"-24 N.E.F.2 thread, so that the probe will mate with an Amphenol 83-1R connector, a Navy type CPH 49194 connector, an Army type SO-239 connector or any similar type. In cases where direct connection to one of these connectors is impracticable, satisfactory results can be obtained by using a short extension made of coaxial cable.

For low radio-frequency measurements the clips may be used. The large clip screws on the center pin of the probe; the short black clip-lead screws into the tapped hole in the side of the grounding ring.

Measuring A-C (audio or radio frequency) when D-C is Present—When both alternating and direct voltages are present, the a-c component of the voltage can be measured with the Master VoltOhmyst by following the procedure outlined for audio- and radio-frequency measurements. If the d-c component exceeds 600 volts, a one-microfarad (or larger) capacitor of adequate voltage rating should be used in series with the probe input.

Resistance Measurements—Before attempting to measure resistance, see that no voltage exists across the component to be checked. Resistance is read directly in ohms from the upper black scale of the meter.

For resistance measurements, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set to "+" or "–".

SELECTOR—Set to "RES".

RES/CAP—Select a range including the value of the resistance to be measured. It is recommended that the "RX1" position of the RES/CAP switch be used only for resistances below 20 ohms.

RES/CAP ADJ—Set so that the meter pointer is aligned to the last line on the right-hand side of the resistance scale.

Terminal Connections:

COMMON—Connect the black clip-lead to one side of the resistance to be measured.

RES/MA—Connect the red clip-lead to the other side of the resistance.

To cancel the lead-resistance error when making resistance measurements below two ohms, short the test leads together and reset the ZERO ADJ control so that the pointer reads exactly zero. When the low-resistance checks have been completed, the ZERO ADJ control should be reset so that the meter pointer reads zero when the SELECTOR switch is on "DC."

When measuring high resistances, keep the fingers away from the tip of the ohms probe (red lead) to eliminate a possible leakage or stray-pickup error. This is especially important when the "RX10,000" and "RX1 MEG" positions of the RES/CAP switch are employed.

CAUTION—The Master VoltOhmyst applies up to three volts across the resistance being measured when the RES/CAP switch is set to "RX1" or "RX10." When it is necessary to check the continuity or to measure the resistance of a low-resistance device having a small current-carrying capacity, such as the filament of a low-voltage vacuum tube or a thermocouple, then a resistor should be used in series with the ohmmeter leads, or a range above "RX10" should be used.

A periodic check of the battery voltage should be made to insure accurate ohmmeter readings. Refer to the "Maintenance" section for instructions on replacing batteries.

Measuring Resistance Above 1000 Megohms—The Master VoltOhmyst can be used to measure resistances higher than those covered by the "RX1 MEG" setting of the RES/CAP switch. This application is especially useful for the measurement of capacitor or insulation leakage resistance.

The method requires an external voltage source, ranging in value from 20 to 500 volts, to produce

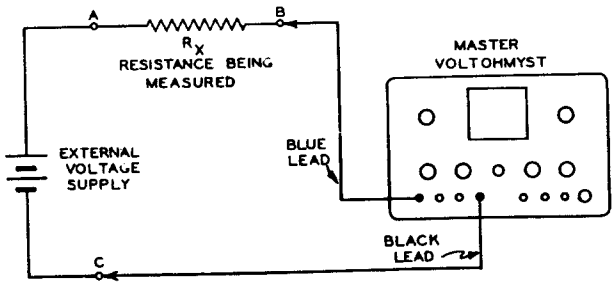

Figure 1

a measureable current through the resistance being checked.

Make the connections portrayed in Figure 1. Set the SELECTOR switch to "DC" and measure the voltage from point "B" to point "C." Then measure the voltage between point "A" and point "C." For accurate measurements, the value of voltage from the external source must be sufficient to produce a readable meter deflection when the meter is connected between "B" and "C." The unknown resistance can be computed from the following formula:

$$\text{Unknown Resistance in megohms} = 11 \times \frac{\text{VOLTS}_{AC} - \text{VOLTS}_{BC}}{\text{VOLTS}_{BC}}$$

Example:

Suppose the voltage between "A" and "C" is 500 volts; the voltage between "B" and "C" is 2 volts.

Then:

$$\text{Unknown resistance} = 11 \times \frac{500 - 2}{2} = 2739 \text{ megohms}$$

Capacity Measurements—The capacity meter has six ranges: CX10 mmf; CX100 mmf; CX.001 mf; CX.01 mf; CX0.1 mf; and CX1.0 mf. When the proper range has been selected on the RES/CAP switch, the capacity can be read directly from the upper red meter scale.

To make capacity measurements, set the controls and connect the terminals as follows:

Controls:

POLARITY—Set to "+" or "−".

SELECTOR—Set to "CAP".

ZERO ADJ—Set so that the meter pointer is aligned with the small red zero on the bottom half of the upper scale. This zero appears just to the right of the zero for the resistance scale.

RES/CAP ADJ—Short circuit the COMMON and CAP terminals, then adjust this control until the meter pointer is aligned with the last mark on the right-hand side of the upper scale.

RES/CAP—Select a range including the value of the capacity to be measured.

Terminal Connections:

CAP—Connect one side of the capacitor to be tested to this terminal.

COMMON—Connect the other side of the capacitor to this terminal.

When the "CX1.0 mf" setting of the RES/CAP switch is employed, a polarizing voltage of 50 volts is applied between the CAP and COMMON terminals. If electrolytic capacitors are to be checked, the positive side of the capacitor should be connected to the CAP terminal, and the negative side to the COMMON terminal.

Since leaky capacitors will give an inaccurate capacity indication, capacitors suspected of leakage should be checked with the ohmmeter section of the instrument to determine whether or not a high-resistance d-c leak exists. Then, if no leak is present, the capacity measurement can be made.

When making measurements on very small capacities (on the order of a few micro-microfarads), the capacitors should be attached to the binding post terminals so that they are positioned as far away from the front panel as possible. Also, all stray matter (test leads, hands, etc.) should be kept away from the capacitor under test while the measurement is being made. It should be remembered that the Master VoltOhmyst measures the actual capacity between the CAP and COMMON terminals, which includes the capacity under test plus any stray capacity. Anything that will minimize the stray capacity will increase the accuracy of the measurement.

SPECIAL APPLICATIONS

The RCA Master VoltOhmyst will be found useful for many applications in the servicing of all types of electronic equipment. Its possible uses in this field are too numerous to be covered in detail in this book. However, several applications which are considered to be of particular interest are described in the following paragraphs:

Measuring Oscillator Strength—The negative d-c voltage developed at the grid of an oscillator is proportional to the strength of oscillation. This voltage can be measured readily with the Master VoltOhmyst. To determine the relative strength of oscillation of a radio-receiver local oscillator at different frequencies, comparative readings should

be taken for each band while the main tuning capacitor is rotated through its range. Measurements of this type are made possible because of the isolating resistor in the d-c probe.

Measuring A-V-C Voltage—The automatic-volume-control voltage developed by an incoming signal can be measured at several places in a radio receiver: across the diode load resistor, at points along the a-v-c bus, and at the grids of the r-f or i-f tubes being controlled. *The d-c voltage appearing across the diode load resistor is a very convenient output indication for receiver alignment.*

Measuring Bias-Cell Voltage—Bias-cell voltage can be measured accurately with this instrument. Its high input impedance prevents excessive current drain and consequent damage to cells.

Adjustment of Discriminator Circuits—The voltage developed across the discriminator circuits of f-m receivers or a-f-c circuits can be measured directly at the discriminator, or, in a-f-c circuits, at the grid of the oscillator-control tube.

The zero-center-scale feature of the Master VoltOhmyst is useful in the adjustment of discriminator circuits for zero voltage output. When the discriminator transformer is tuned, the meter pointer swings right or left from the zero-center mark, thus indicating the polarity and the relative amplitude of the d-c voltage developed. As the correct adjustment is approached, the sensitivity of the meter can be increased by setting the VOLTS switch on a lower range, so that the final adjustment will be very accurate.

D-C Supply Voltages—The d-c power-supply voltage can be measured at the rectifier cathode and in the filter circuit; plate voltages at the plates of the various tubes; screen voltages at the screen grids; cathode voltages at the cathodes.

A-C Voltages—The a-c voltmeter is extremely useful in measuring all a-c voltages encountered in the average radio receiver. These voltages include the power-transformer voltages and the audio-frequency voltages developed anywhere from the second-detector load resistor to the speaker voice coil.

The Master VoltOhmyst can therefore be used as an audio-amplifier signal-tracing indicator; it can also be used to measure stage gain or overall gain in an audio amplifier.

Television Receiver Adjustments—This instrument can be used to measure the voltage developed across the picture-channel second-detector load resistor. This measurement is useful in the selection of the optimum orientation and position for the television antenna as well as in the adjustment of antenna matching sections.

Gassy Tubes—The effect of gas in a tube is to cause a voltage, positive with respect to ground, to appear across the tube grid-leak resistor. The effect is to reduce the normal operating bias of the tube, and in some cases even to make the net bias positive, with resultant distortion. In the case of a gassy audio-amplifier tube which is connected directly to the contact arm of the volume control, the grid current due to gas may in time cause the volume control to become noisy. This may happen even though the amount of gas is insufficient to produce a noticeable change in the receiver operation. Consequently, if repeated difficulty is experienced with noisy volume controls in this type of circuit, the Master VoltOhmyst should be used to check for a positive voltage across the grid leak (in this case, between the volume control arm and the low or grounded tap). A positive voltage here may also be caused by a leaky plate-to-grid coupling capacitor; however, if the tube suspected of being gassy is removed and the grid-leak voltage falls to zero, then the tube is definitely gassy.

Pulse Measurements—The peak-to-peak value of voltage pulses can be measured with an accuracy of approximately 2% for pulse-width repetition-rate relations shown graphically in Figure 6. The peak-to-peak value is 2.83 times the reading obtained on the voltage scale (see Figures 2 and 3). For measuring the peak-to-peak values of narrow pulses, the RCA Diode Probe must of course be used as an accessory to the Master VoltOhmyst.

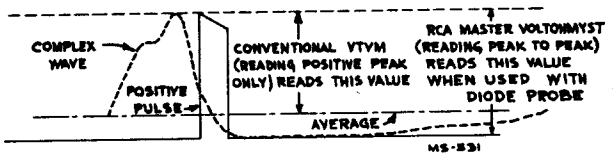

Figure 2

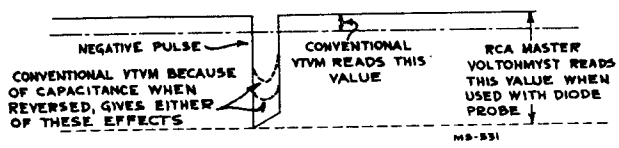

Figure 3

MAINTENANCE

Although extraordinary care has been taken in the manufacture and design of the RCA Master VoltOhmyst, and despite the fact that each instrument is laboratory tested under strict engineering supervision, it is possible that the instrument may in time require checking and servicing.

To facilitate service, the tube locations, calibration controls, and parts layout are shown in Figure 5. A schematic diagram of the instrument is shown in Figure 7.

The peformance of the Master VoltOhmyst, like that of any other precision instrument, is dependent upon the rating and quality of its components. Therefore, if it becomes necessary to replace a part, the REPLACEMENT PARTS list in this book should be consulted for specifications. Only RCA Replacement Parts or other parts having identical characteristics should be used.

Meter-Pointer Zero Adjustment—The meter pointer should be aligned with the zero marks on the meter scales when the power is off. If it is not, the following check should be made:

Vigorously wipe the meter case window with a clean, soft, dry cloth. If the pointer moves away from zero and remains in a deflected position for several minutes, then the anti-static coating on the inside of the window is ineffective. In this case, the only remedy is to renew the coating. Additional details about this coating material may be obtained by writing to the Test and Measuring Equipment Section, RCA, Camden, New Jersey.

If the meter pointer did not respond to the static test, the following procedure should be used to adjust the mechanical position of the pointer:

1. Unscrew the meter adjustment plug.

2. Insert a scriber or similar tool to engage the meter-pointer adjusting pawls. Move the pawls sideways until the pointer reads exactly zero.

3. Replace the meter adjustment plug.

CAUTION—Extreme care must be taken to prevent insertion of the tool to a depth where it will injure the pointer spring. The guarantee does not cover damage resulting from this adjustment.

Tube Replacement —All tubes are located on the chassis and are accessible for replacement after the rear panel is removed from the case. To remove the rear panel, unscrew the four screws on the rear of the case. To remove the instrument from the case, unscrew the four screws in the corners of the front panel, and the two screws underneath the case, then withdraw the panel-and-chassis assembly.

If it becomes necessary to replace tubes, care should be taken to see that the two RCA-6AK6 tubes are approximately balanced. If they are unbalanced, it will be impossible, when the POLARITY switch is on "+," to bring the pointer to the zeros at the left end of the scale and in the center by means of the ZERO ADJ control. If this should happen, the tubes should be interchanged and the adjustment tried again. If it is still impossible to bring the pointer to zero at both the center and left-hand edge of the meter scale, the tubes have different characteristics and each one should be tried with another tube in order to obtain a matched pair. When the tubes are matched, it will be possible to bring the pointer to zero both at the center of the scale and at the left-hand end of the scale with the ZERO ADJ control. This can be done only when the POLARITY switch is on "+." When this switch is on "–," then it should be impossible to set the pointer to the center-scale zero.

NOTE—Before replacing an RCA-6AK6, age the replacement tube by applying 6.3 volts to its filament for 12 hours.

The circuit design of the Master VoltOhmyst is such that grid current is reduced to a negligible value. However, when replacing tubes, it is advisable to check for grid current as occasionally a gassy tube will be found. The presence of gas is indicated by an appreciable change in the pointer position when the VOLTS switch is changed from "5" to "50" while the SELECTOR switch is in the "DC" position and while no voltage is being measured.

Battery Replacement—Do not allow exhausted batteries to remain in the Master VoltOhmyst. Chemicals leaking from the deteriorated batteries may damage the interior of the instrument. Steel-clad batteries such as the RCA VS-006 are recommended because of their long life and small chance of chemical leakage.

Battery replacement is generally necessary when the ohmmeter readings become unstable, especially on the "RX1" position of the RES/CAP switch. To insure accuracy of the ohmmeter readings, it is suggested that the batteries be checked occasionally as follows:

1. Set the SELECTOR switch to "RES."

2. Set the RES/CAP switch to "RX1," and adjust the RES/CAP ADJ control until the pointer reads full scale.

3. Short circuit the RES/MA and COMMON terminals for about ten seconds.

4. Open the short circuit and immediately observe the meter deflection. A substantial deviation from a full-scale reading indicates that the batteries are weak and should be replaced.

To replace the batteries, remove the rear panel as described under "Tube Replacement," and replace the batteries with two RCA VS-006 1.5-volt cells or the equivalent. The proper position for the cells is shown in Figure 5. Be sure all contacts are clean and tight so that contact resistance will be kept to a minimum.

Calibration—Before adjustments of the calibration controls are made, see that the pointer is mechanically set on zero, and allow the instrument to warm up for 30 minutes. All of the calibration adjustments are located on the rear and left-side aprons of the chassis, and are clearly marked. All calibration adjustments are cemented in place at the factory; the cement can be softened with acetone thinner.

The following procedures are recommended for calibrating the Master VoltOhmyst:

DC + CAL:

1. Set the VOLTS switch on "5," and the POLARITY switch on "+."

2. Set the SELECTOR switch on "DC," and rotate the ZERO ADJ control until the pointer reads zero.

3. Insert the black lead into the COMMON terminal, and the blue probe lead into the VOLTS DC terminal.

4. Connect a standard d-c voltage of four volts between the two test leads. This voltage should be metered with a high-quality, accurate, d-c voltmeter in parallel with the Master VoltOhmyst.

5. Adjust the DC + CAL control until the pointer reads exactly 4 on the scale.

6. Check the accuracy of the instrument on all settings of the VOLTS switch by employing standard voltages of different value on each range. If the accuracy of the meter is not better than ±3% of the full-scale indication on all ranges, then check the multiplier resistors (R17 to 28 incl., R39, 40 and the 1 meg. resistor in the probe) with a reliable bridge.

DC – CAL:

Follow the same procedure given under DC + CAL with the POLARITY switch set on "–," and with the polarity of the standard voltage source reversed. If the various settings of the VOLTS switch checked correctly under the previous DC + CAL test, it will not be necessary to repeat step 6.

AC ZERO; AC CAL:

1. Set the POLARITY switch on "+" or "–," the VOLTS switch on "1," and the SELECTOR switch on "DC."

2. Zero the meter pointer with the ZERO ADJ control.

3. Set the SELECTOR switch on "AC."

4. Plug the a-c probe into the VOLTS AC socket and short-circuit this probe to the COMMON lead.

5. Set the AC ZERO control so that the pointer is aligned with the small red zero on the a-c volts scale.

6. Connect a 60-cycle sine wave of exactly 0.3 volt rms between the a-c probe and the COMMON lead. Adjust the AC CAL control until the meter reads exactly 0.8 volt on the center scale.

7. Check all settings of the VOLTS switch by applying appropriate voltages to the instrument for each setting. If the accuracy is not better than ±3% of the full-scale indication on all ranges, then check the multiplier resistors (R19 to 23 incl., R48 to 51 incl.) with a reliable bridge.

RF ZERO; RF CAL:

1. Set the POLARITY switch on "+" or "–," the VOLTS switch on "5," and the SELECTOR switch on "DC."

2. Zero the meter pointer with the ZERO ADJ control.

3. Set the SELECTOR switch on "RF."

4. Plug the RCA Diode Probe Cable into the VOLTS AC socket and short circuit the probe center-pin to the grounding ring.

5. Set the RF ZERO control so that the meter pointer reads zero. Allow the reading to stabilize, as response to this adjustment is slow.

6. Set the VOLTS switch on "50."

7. Apply a 60-cycle sine wave of exactly 40 volts rms to the probe.

8. Adjust the RF CAL control until the pointer reads exactly 40.

9. Check all settings of the VOLTS switch by applying appropriate voltages to the probe for each setting. Since the multipliers used with the diode probe are the same as those used for d-c voltage measurements, any fault in these multipliers should have been discovered during the DC + CAL test previously described.

CX10 ADJ MAX; CX10 ADJ C.S.; CX100 ADJ MAX:

1. Set the SELECTOR switch on CAP and adjust the ZERO ADJ control for zero pointer reading (small red zero on capacity scale).

2. Set the RES/CAP switch on "CX0.1."

3. Short-circuit the CAP and COMMON terminals, then rotate the RES/CAP ADJ control until the pointer is aligned with the last line on the right-hand side of the top scale.

4. Set the RES/CAP switch to "CX.01," then to "CX.001." The meter should still read full scale.

5. Set the RES/CAP switch to "CX1.0 mf." The meter reading should be within –1.5 divisions of full scale on the center scale.

6. Set the RES/CAP switch to "CX10 mmf," then set the CX10 ADJ MAX trimmer until the meter reads exactly full scale.

7. Remove the short circuit from the CAP and COMMON jacks, and in its place connect a 100-mmf standard capacitor.

8. Set the CX10 ADJ C.S. trimmer for a meter reading of exactly ten on the capacity scale. If this adjustment cannot be made, the capacity-measuring winding on the power transformer probably has excess distributed capacity.

9. Remove the capacitor. The meter should indicate less than two mmf. (less than 0.2 on the capacity scale). If the reading is greater than this, the power transformer probably has a defective shield.

10. Set the RES/CAP switch to "CX100 mmf." and short-circuit the CAP and COMMON terminals.

11. Set the CX100 ADJ MAX trimmer for a full-scale meter reading.

12. Remove the short circuit and in its place connect a 1000-mmf standard capacitor. The meter reading should not differ from the capacitor value by more than ±10%.

13. Remove the capacitor. The meter should read less than one scale division.

Replacing Diode in Diode Probe—Failure of the RCA 6AL5 diode in the Diode Probe will normally cause the meter to deflect sharply to the left when the SELECTOR switch is on "RF." An open filament can usually be detected by feeling the probe since the diode heater warms the probe body slightly. RF calibration should be checked whenever the diode is replaced.

To gain access to the RCA-6AL5 in the probe for examination or replacement refer to Figure 4 and proceed as follows:

CAUTION—Do not attempt to unscrew the knurled ring on the probe front until step 6 of the following procedure has been completed.

1. Unscrew the streamlined cap from the rear of the probe and push cap, washer, and bakelite cover back over the cable.

2. Unscrew the hex nut at the rear of the probe, being careful not to turn the bushing with respect to the metal probe body.

3. Push the bushing into the probe body far enough to disengage the locking pin.

4. Unscrew the rear half of the probe body from the front half, and push the rear half back over the cable. The 6AL5 will then be exposed, making examination or replacement possible.

5. If it is necessary to remove the diode socket and capacitor assembly, unscrew the threaded bushing which holds the two halves of the probe together. This operation is facilitated by inserting a nail or some similar instrument through the holes in the bushing.

6. Heat the probe tip with a soldering iron until the solder is melted, then withdraw the diode socket and capacitor assembly from the rear of the front half of the probe body.

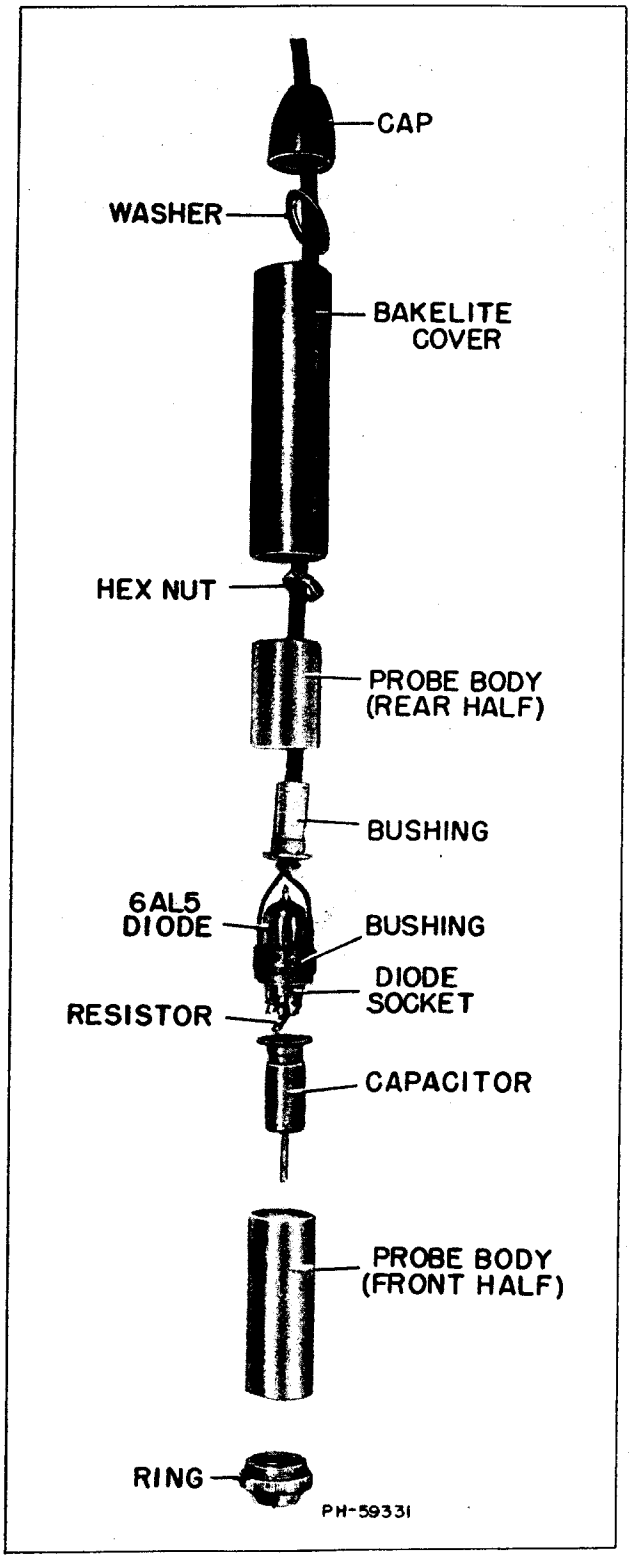

Figure 4—Exploded View of RCA Diode Probe

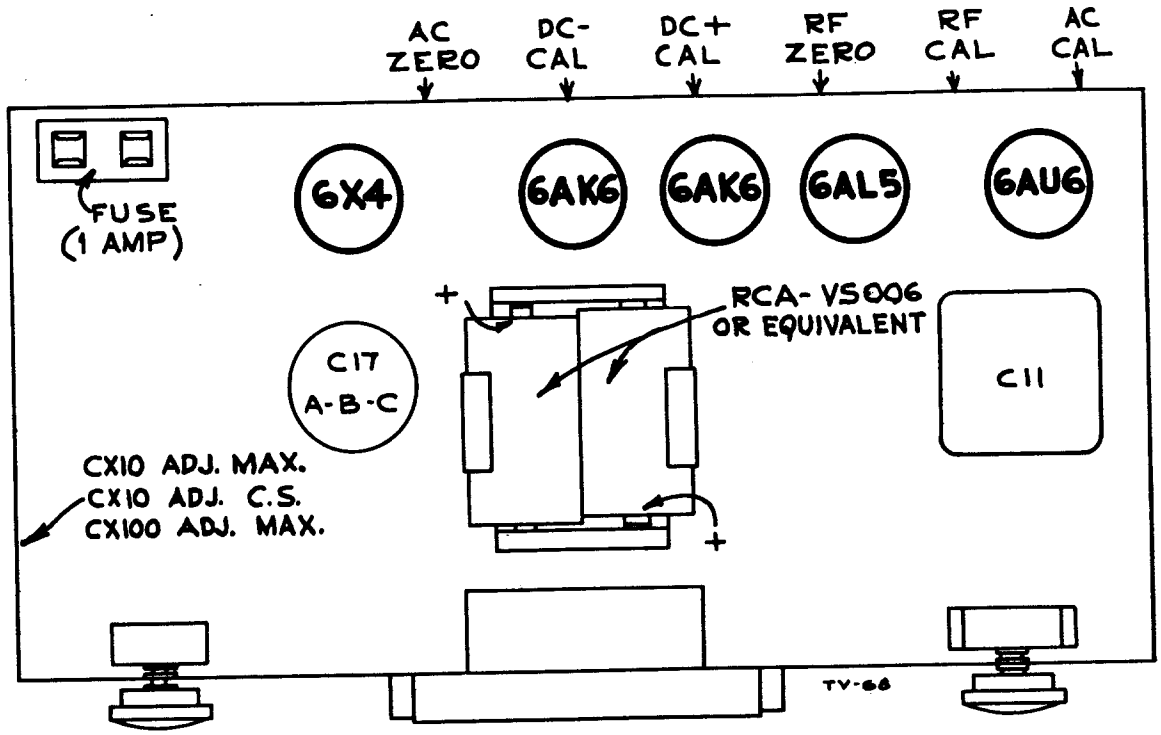

Figure 5—Tube and Adjustment Layout

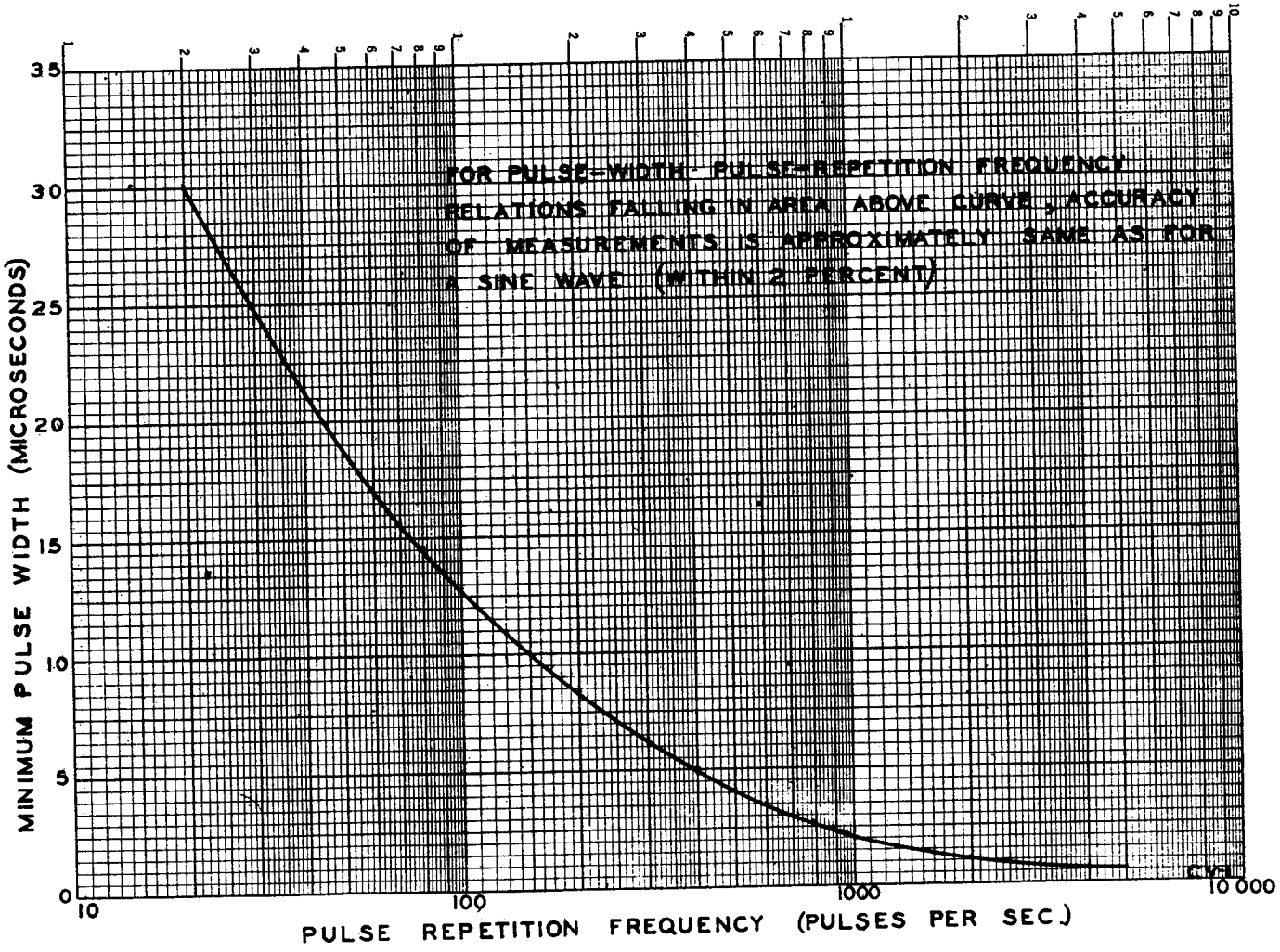

Figure 6—Pulse-Width Repetition-Rate Relation Curve for Use with RCA Diode Probe

SYMBOL	SWITCH FUNCTION	POSITION 1	POSITION 2	POSITION 3	POSITION 4	POSITION 5	POSITION 6	POSITION 7
S1	SELECTOR	CURRENT	D.C. VOLTS	R.F. VOLTS	A.C. VOLTS	CAPACITY	RESISTANCE	———
S2	RES/CAP RANGE	R X 1 C X 10 MMFD	R X 10 C X 100 MMFD	R X 100 C X .001 MFD	R X 1000 C X .01 MFD	R X 10,000 C X .1 MFD	R X 1 MEG C X 1 MFD	———
S3	VOLTS RANGE	1 VOLT (A.C. ONLY)	5 VOLTS	10 VOLTS	50 VOLTS	100 VOLTS	500 VOLTS	1000 VOLTS
S4	CURRENT RANGE	10 UA	100 UA	1 M.A.	10 M.A.	100 M.A.	1.0 AMPS	———
S5	POWER & POLARITY	(POWER) OFF	(D.C.) +	(D.C.) −	———	———	———	———

ALL RESISTANCE VALUES IN OHMS.
ALL CAPACITANCE VALUES BELOW ONE IN MF. AND ABOVE ONE IN MMF UNLESS OTHERWISE NOTED.

ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION

ALL SWITCH SECTIONS VIEWED FROM FRONT OR KNOB END OF SWITCH

ROTORS SHOWN IN EXTREME COUNTER CLOCKWISE (LEFT) POSITION

SWITCH LEGEND

DUMMY LUGS
LONG LUG
THROUGH ELECTRICAL CONNECTION
SHORT LUG
INSULATED LUG
THROUGH ELECTRICAL CONNECTION

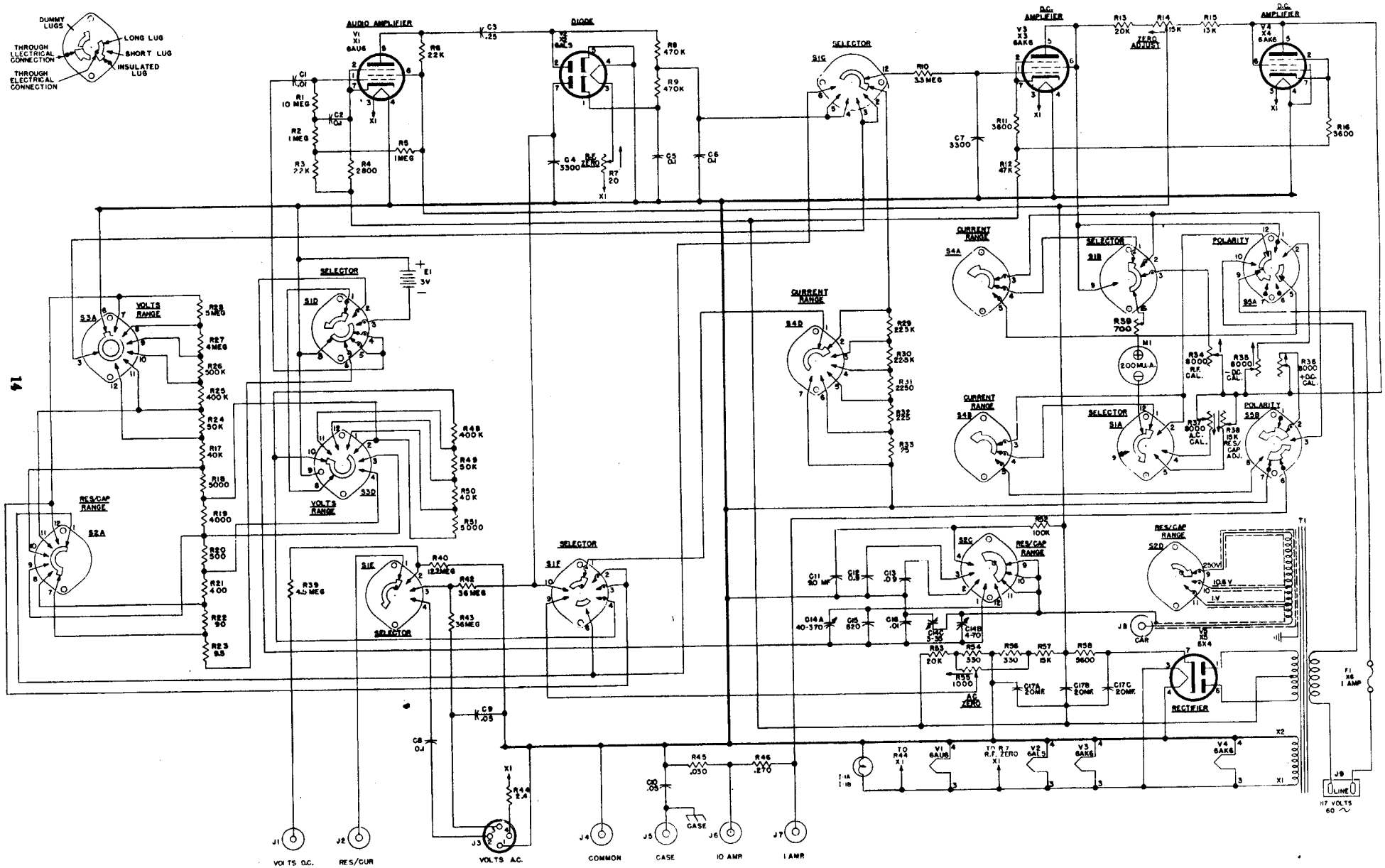

Figure 7—Schematic Circuit Diagram

REPLACEMENT PARTS LIST

TYPE WV-95A MASTER VOLTOHMYST

SYMBOL NO.	DESCRIPTION	STOCK NO.
C-1	Capacitor—Paper Tubular, .01 mfd., 20% 400 Volts	70610
C-2	Capacitor—Paper Tubular, .1 mfd., 20%, 200 Volts	70617
C-3	Capacitor—Paper Tubular, .25 mfd., 20%, 400 Volts	70618
C-4	Capacitor—Fixed Mica, 3300 mmfd., 20%, 500 Volts	39664
C-5, 6	Same as C-2	
C-7	Same as C-4	
C-8	Capacitor—Paper Tubular, .1 mfd., 20%, 600 Volts	70639
C-9	Capacitor—Paper Tubular, .05 mfd., 20%, 400 Volts	70615
C-10	Capacitor—Paper Tubular, .05 mfd., 20%, 1000 Volts	70657
C-11	Capacitor—Paper, Steel Case, 9.0 mfd., 5%, 100 V. D. C.	55847
C-12	Capacitor—Paper Tubular, 0.9 mfd., 5%, 100 Volts	55848
C-13	Capacitor—Paper Tubular, .09 mfd., 5%, 100 Volts	55875
C-15	Capacitor—Fixed Mica, 820 mmfd., 5%, 500 Volts	39650
C-14A, B, C	Capacitor—Variable Trimmer, 40-370 mmfd., 4-70 mmfd., 3-35 mmfd.	56179
C-16	Capacitor — Fixed Mica, 10,000 mmfd., 5%, 300 Volts	92036
C-17A, B, C	Capacitor—Dry Electrolytic, 20-20-20 mfd., 150 Volts	37637
F-1	Fuse—Glass Tubular, 1 Ampere	14133
I-1A	Lamp—Pilot Lamp	11891
I-1B	Socket—Pilot Light Socket Assembly	54495
J-1	Connector—Chassis, with Terminal and Int. Tooth, Volts DC	68439
J-2, 6, 7, 8	Jacla—Pin, RES/MA., CAP., 10 AMP., 1 AMP. (Red)	55238
J-3	Connector—Chassis, 4 Contact (Female) Volts AC	52823
J-4, 5	Jack—Pin, Common, Case (Blue)	55239
J-9	Plug—Chassis, Line Voltage, 2 Contacts (Male)	71448

SYMBOL NO.	DESCRIPTION	STOCK NO.
M-1	Meter—200 Microamps. Complete with Case and Scale	55845
R-1	Resistor — Fixed Composition, 10 Megohms, 20%, ½ Watt	
R-2	Resistor — Fixed Composition, 1.0 Megohm, 20%, ½ Watt	
R-3	Resistor—Fixed Composition, 22,000 Ohms, 5%, ½ Watt	
R-4	Resistor—Fixed Composition, 2800 Ohms, 1%, ½ Watt	55850
R-5	Resistor — Fixed Composition, 1 Megohm, 5%, ½ Watt	
R-6	Resistor—Fixed Composition, 22,000 Ohms, 1%, ½ Watt	55851
R-7	Resistor — Variable, Wire Wound, RF Zero, 20 Oms, 2 Watt	52822
R-8, 9	Resistor — Fixed Composition, 470,000 Ohms, 5%, ½ Watt	
R-10	Resistor — Fixed Composition, 3.3 Megohms, 20%, ½ Watt	
R-11	Resistor—Fixed Composition, 3600 Ohms, 1%, ½ Watt	55852
R-12	Resistor—Fixed Composition, 47,000 Ohms, 1%, ½ Watt	55853
R-13	Resistor—Fixed Composition, 20,000 Ohms, 5%, ½ Watt	
R-14	Resistor — Variable, Composition, RES/CAP ADJ, 15,000 Ohms, Linear Curve	55844
R-15	Resistor—Fixed Composition, 13,000 Ohms, 5%, ½ Watt	
R-16	Same as R-11	
R-17	Resistor—Fixed Composition, 40,000 Ohms, 1%, ½ Watt	55854
R-18	Resistor—Fixed Composition, 5,000 Ohms, 1%, ½ Watt	55855
R-19	Resistor—Fixed Composition, 4,000 Ohms, 1%, ½ Watt	55856
R-20	Resistor — Fixed Composition, 500 Ohms, 1%, ½ Watt	55857
R-21	Resistor — Fixed Composition, 400 Ohms, 1%, ½ Watt	55858
R-22	Resistor — Fixed Composition, 90 Ohms, 1%, ½ Watt	55859
R-23	Resistor — Fixed Composition, 9.5 Ohms, 1%, ½ Watt	55860

REPLACEMENT PARTS LIST (CONTINUED)

SYMBOL NO.	DESCRIPTION	STOCK NO.
R-24	Resistor—Fixed Composition, 50,000 Ohms, 1%, ½ Watt	55861
R-25	Resistor—Fixed Composition, 400,000 Ohms, 1%, ½ Watt	55862
R-26	Resistor—Fixed Composition, 500,000 Ohms, 1%, ½ Watt	52819
R-27	Resistor — Fixed Composition, 4.0 Megohms, 1%, 1 Watt	55863
R-28	Resistor — Fixed Composition, 5.0 Megohms, 1%, 1 Watt	55864
R-29	Resistor—Fixed Composition, 225,000 Ohms, 1%, ½ Watt	55865
R-30	Resistor—Fixed Composition, 22,500 Ohms, 1% ½ Watt	55866
R-31	Resistor—Fixed Composition, 2250 Ohms, 1%, ½ Watt	55867
R-32	Resistor — Fixed Composition, 225 Ohms, 1%, ½ Watt	55868
R-33	Resistor — Fixed Composition, 25 Ohms, 1%, ½ Watt	55869
R-34, 35, 36 37	Resistor — Variable, Wire Wound, 8000 Ohms	43916
R-38	Same as R-14	
R-39	Resistor — Fixed Composition, 4.5 Megohms, 1%, 1 Watt	55870
R-40	Resistor—Fixed Composition, 12.2 Megohms, 1%, 1 Watt	55871
R-42, 43	Resistor — Fixed Composition, 36 Megohms, 1%, 1 Watt	55872
R-44	Resistor—Wire Wound, 2.4 Ohms, 10%	51953
R-48	Resistor—Fixed Composition, 400,000 Ohms, 1%, 2 Watt	55873
R-49	Same as R-24	
R-50	Same as R-17	
R-51	Same as R-18	
R-52	Resistor—Fixed Composition, 100,000 Ohms, 20%, ½ Watt	
R-53	Same as R-13	
R-54	Resistor — Fixed Composition, 330 Ohms, 5%, ½ Watt	
R-55	Resistor — Variable, Composition, AC ZERO, 1000 Ohms	53863
R-56	Same as R-54	
R-57	Resistor—Fixed Composition, 15,000 Ohms, 5%, ½ Watt	
R-58	Resistor—Fixed Composition, 5600 Ohms, 10%, ½ Watt	
R-59	Resistor—Adjustable Wire Wound, Overall Resistance—700 Ohms, 10%, 2 Watt	55874
S-1A, B, C D, E, F	Switch — Selector, Rotary Wafer Type, 3 Sections, 8 Circuit, 6 Positions	55840
S-2A, C, D	Switch — RES/CAP Range, Rotary Wafer Type, 2 Sections, 3 Circuits	55842
S-3A, S-3D	Switch — VOLTS Range, Rotary Wafer Type, 2 Sections, 2 Circuit, 7 Positions	55841
S-4A, B, L	Switch—CURRENT Range, Rotary Wafer Type, 2 Sections, 6 Positions	55839
S-5A, B	Switch — POLARITY, Rotary Wafer Type, 1 Section, 5 Circuit, 3 Positions	55843
T-1	Transformer—Power, Pri.-117 Volt, 50/60 Cycle	56127
	Sec. No. 1—5.7 V., 1.63 Amp.	
	Sec. No. 2—94 V. (DC) 60 Ma.	
	Sec. No. 3—Tapped for 1.0 V., 4 Ma., 10.64 V. and 250 Volt	
X-1, 2, 3, 4, 5	Socket—Tube, Miniature, 7 Contacts	73115
	Board—Fuse Mounting	55316
	Case—Meter	55846
	Handle—Carrying Handle	53704
	Knob—Large, for ZERO ADJ, POLARITY, RES/CAP, VOLTS, SELECTOR, CURRENT	53683
	Knob—Small, RES CAP ADJ Control (Blue)	53689
	Plate—Capacitor Mounting	28452
	Pointer—For Large Control Knob.	53684