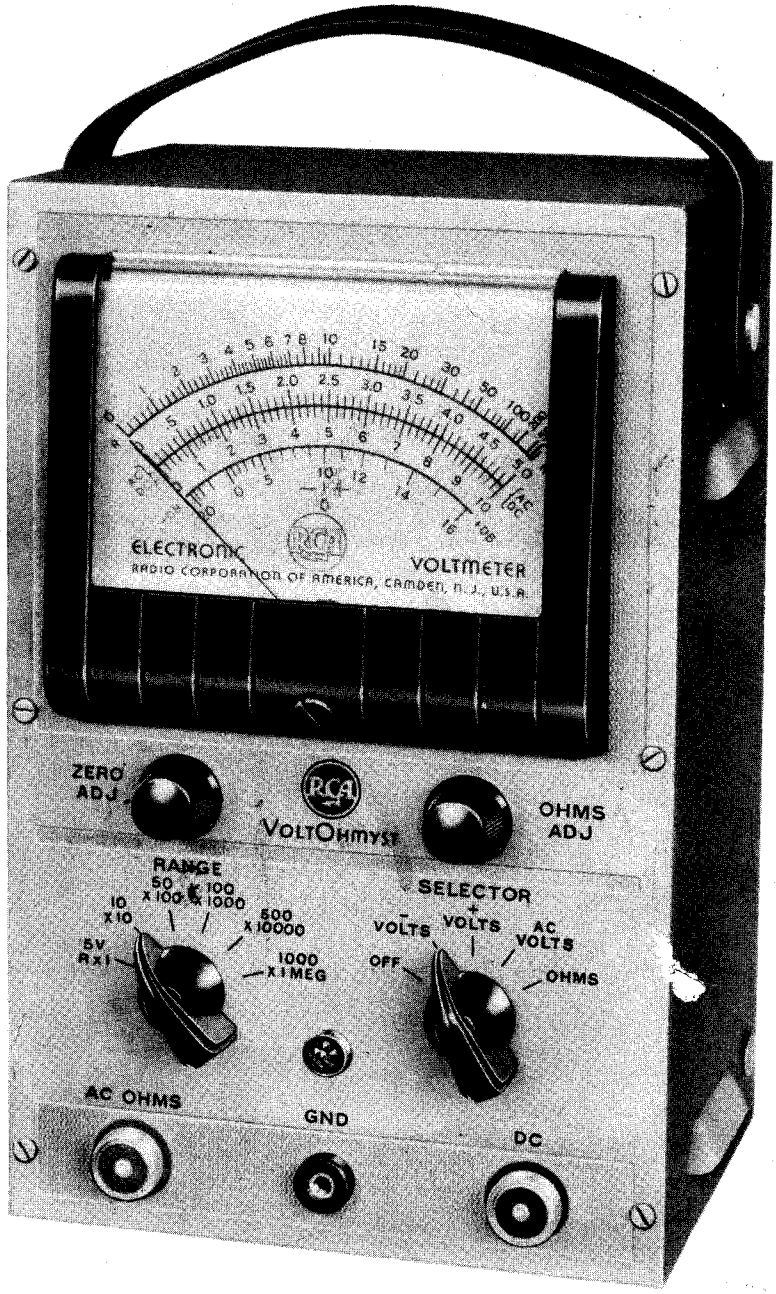
Schrenk

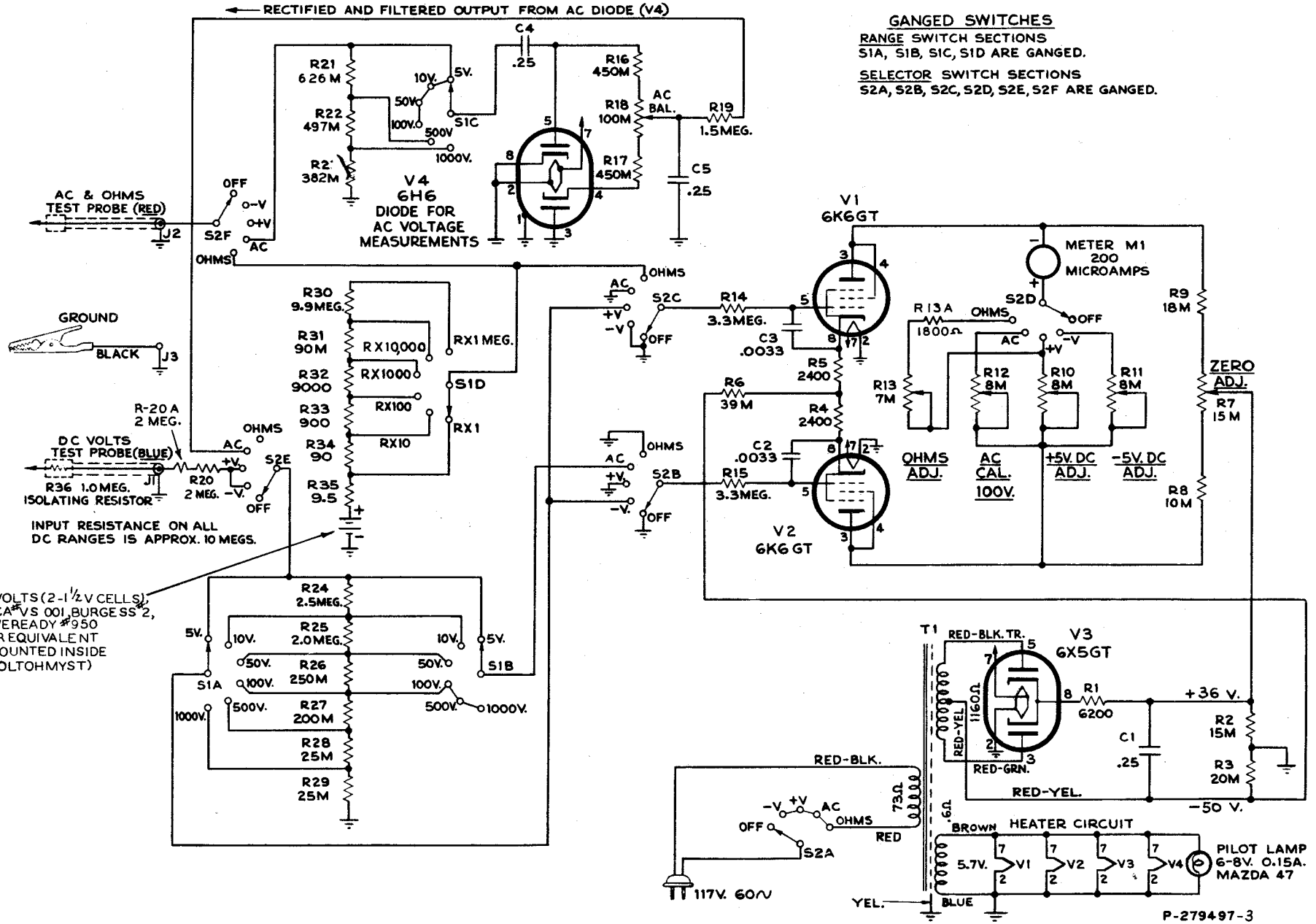
VOLTOHMYST®
TYPE No. 195-A



RADIO CORPORATION of AMERICA

TEST AND MEASURING EQUIPMENT — HARRISON, N. J.

IB-4195-6



Schematic Circuit Diagram

VoltOhmyst

Type No. 195-A

SPECIFICATIONS

MECHANICAL DATA

Overall Dimensions..Height (including feet) 9⅝". Width 6⁵⁄₁₆". Depth (including bracket, etc.) 6¾".

Weight .....Net, 9 lbs.

External Finish .....Case-steel, with baked grey wrinkle finish; Panel—brass, direct-etched, with brushed chrome finish.

POWER SUPPLY

Rating .....105-125 volts, 50-60 cycle (specifications based on 117 volts, 60 cycles).

Power Consumption..14 watts.

CABLE CONNECTOR LEADS

1 Shielded D-C Voltmeter Cable and Probe (blue)
1 Shielded A-C Cable and Probe (red)
1 Ground Lead (black)

D-C VOLTMETER

6 ranges .....0 to 5, 10, 50, 100, 500, 1000 volts.

Input resistance ....10 megohms constant for all ranges; includes 1 megohm in probe (blue cable).

Sensitivity (max.) ..2 megohms per volt on 5V. range.

Circuit .....Differential vacuum tube bridge.

Zero-center Scale

ELECTRONIC OHMMETER

6 ranges .....Measuring from 0.1 ohm to 1000 megohms.

A-C (AF) VOLTMETER

6 linear scales .....0 to 5, 10, 50, 100, 500, 1000 volts, r.m.s.

Input impedance with cable .....Approx. 170 mmf. shunted by an equivalent resistance of approximately 200,000 ohms.

Frequency response .Flat 30 to 100,000 cycles, up to 100 volts. Flat at power-line frequencies up to 1000 volts.

Circuit .....Balanced linear diode.

OUTPUT METER

Decibel Scale Calibration .....Based on volume unit system, with zero reference level of 1.0 milliwatt at 600 ohms (0.775 volts across 600 ohms).

METER

Sensitivity .....200 micro-amps D-C.

MULTIPLIERS

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

BATTERY

2 .....1½ V. flashlight cells (for ohmmeter circuit).

TUBE COMPLEMENT

2 .....RCA 6K6-GT In Meter Bridge (V1, V2).
1 .....RCA 6H6 Meter Diode (V4).
1 .....RCA 6X5-GT Rectifier (V3).

GENERAL DESCRIPTION

The VoltOhmyst, Type 195-A, is designed to measure D-C, A-C (AF) voltages and resistances over an extremely wide range. Outstanding features of the instrument are its ease of operation; high input resistance; foolproof voltmeter which is automatically protected against burn-out; "ZERO ADJ." and "OHMS ADJ." that do not have to be reset when changing ranges; and its "signal tracing" type of test probe which permits dynamic voltage measurements in signal-carrying circuits.

Measurements of D-C and A-C (AF) voltages in six ranges up to 1000 volts are provided. The ohmmeter section will measure up to 1000 megohms.

A feature of the Type 195-A VoltOhmyst is a diode circuit capable of measuring throughout the audio spectrum, up to 100 volts r.m.s. on a linear scale. It may be used to measure voltages of power-line frequencies up to 1000 volts.

A new feature introduced in the Type 195-A VoltOhmyst is the zero-center scale for use in aligning FM or AFC discriminator circuits, indicating bridge balance, etc.

The instrument uses a push-pull D-C electronic vacuum tube voltmeter circuit, characterized by excellent linearity and stability. Two type 6K6-GT tubes are linked by means of a common high resistance (R6) and because of this coupling any change in the input voltage to the grid of one tube changes the cathode bias of the other and as a result the change in the plate current of one is accompanied by a simultaneous opposite change in the plate current of the other. The differential voltage thus developed across the load resistors R8 and R9 is applied to the meter which is calibrated in terms of the voltage applied to the grid, and in terms of resistance when the instrument is being used as an ohmmeter.

HOW TO USE THE RCA VOLTOHMYST

INITIAL ADJUSTMENT OPERATION

Connect the red lead to the terminal marked A-C OHMS, the blue lead to the D-C terminal and the black lead to the GND terminal. Before turning the instrument on, check the zero setting of the meter pointer. If the pointer is not on zero, refer to instructions under "Maintenance" for setting the meter pointer.

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

SELECTOR .....to +VOLTS. Allow several minutes for the instrument to warm up.
ZERO ADJ. .....set voltmeter pointer to zero at left end of scale.
SELECTOR .....to OHMS (in this position the pointer will deflect to approximately full scale).
OHMS ADJ. .....set control so that the meter pointer reads exactly to the last line on the "R" (ohms) scale.

The instrument is now ready for use to measure resistance and A-C (AF) or D-C voltage.

D-C VOLTAGE MEASUREMENTS

Explanation

The Electronic Voltmeter has 6 ranges: 0 to 5, 10, 50, 100, 500 and 1000 volts. The desired range is set on the RANGE switch and read direct from one of the two voltage scales of the meter. Controls and connections are set as follows:

Operation

SELECTOR .....to + Volts or – Volts.
RANGE .....to the desired voltage range.
ZERO ADJ. .....to set voltmeter pointer to zero.
GND .....black lead clip always to grounded or low side of source to be measured.
D-C .....blue cable probe to high side of source to be measured.

Caution Note

HIGH VOLTAGES are Dangerous! Use the utmost care to avoid accidental contact with or even close proximity to high voltage points. Keep the fingers and all parts of the body as far away as conveniently possible from any high potential point. If at all possible when making high voltage measurements, attach the ground clip and then the probe to the circuit to be measured with *the power turned off* in that circuit. For your personal safety these precautions and those listed below should be observed:

(a) When working alone, notify someone that you are about to test high voltage.
(b) Warn others to keep away.
(c) Keep the fingers well away from the probe tip.
(d) Use only one hand. Put the other hand in your pocket.
(e) Discard or repair leads if they should become accidentally cut or burned or in any way damaged. Inspect them before using.
(f) Do not leave the probe tip connected to a high voltage point after measurement has been made. Turn the power off and remove probe as soon as the voltage measurements are completed.
(g) Keep dry—stand on well insulated flooring.

DO NOT CONNECT GROUND LEAD TO HIGH VOLTAGE POINT. Since the VoltOhmyst case is connected directly to the ground terminal, the ground terminal of the instrument must not be connected to a high voltage source. Failure to observe this precaution may result in severe shock. It is also good practice to keep the instrument at ground potential to avoid incorrect readings due to potential differences between the case and the chassis of the apparatus under test.

A-C AND AF VOLTAGE MEASUREMENTS

Explanation

A-C and AF VOLTAGES are rectified in a diode circuit of improved design. Potential changes in the circuit due to cathode temperature variations which cause zero drift with line voltage changes have been virtually eliminated. The meter is calibrated to read r.m.s. voltage values of sinusoidal wave form, which is equivalent to 0.707 of the peak value.

R.m.s. value of AF peak voltages may be measured up to 100 volts. A-C voltages at power line frequencies may be measured up to 1000 volts. The input loading of the instrument with cable, is approximately 170 mmf. shunted by an equivalent resistance of approximately 200,000 ohms.

Operation

A-C and AF voltage measurements are read direct from the AC (AF) meter scale. Controls and connections are as follows:

SELECTOR .....to (+) volts (for zero adjustment check).
ZERO ADJ. .....to set voltmeter pointer to zero.
SELECTOR .....reset to A-C volts.
RANGE .....to the desired voltage range.
GND .....black lead clip to ground or low side of source to be measured.
A-C .....red cable probe to high side of source to be measured. *Caution:* When approximate voltage of source is unknown, start with the highest range, and lower to a suitable one. This procedure will prevent damage due to over-loading of the A-C diode.

OUTPUT METER

When the RANGE switch is set at "5V," with SELECTOR knob at "A-C VOLTS," the power level in a 600-ohm circuit can be read directly in decibels on the DB scale, which is calibrated from

–20 to +16 db, *based on a reference level of 1.0 milliwatt and 600 ohms.*

To measure higher levels, turn the RANGE switch to the required higher setting, read decibels on the DB scale, and add to this reading the range factor given below:

Range Switch Position	*Add These Range Factors*
10V	6db
50V	20db
100V	26db
500V	40db
1000V	46db

EXAMPLES:

(a) RANGE at "10V," reading on DB scale = –8db.
The correction for "10V" range = +6db.
Actual decibel level = –8 +6 = –2db.

(b) RANGE at "100V," reading on DB scale = +10db.
The correction for "100V" scale = +26db.
Actual decibel level = +10 +26 = +36db.

Use the RED probe cable in the A-C OHMS connector for all decibel measurements, with the SELECTOR at A-C VOLTS.

Measuring Gain in Decibels

If an amplifier has the same values of input and output impedance, measure the input and output levels on the decibel scale. Correct these levels by adding the appropriate range factor. The difference between these corrected levels is the gain of the amplifier in decibels.

EXAMPLE:

Input level read on DB scale with RANGE at "5V" is –15db.

Output level read on DB scale with RANGE at "50V" is +14db, to which must be added the "50V" range factor of +20db: +14 +20 = +34db.

The gain is the difference between –15 and +34, or 49db.

An alternate method of determining gain in decibels is to measure the input and output voltages with the A-C (AF) scales on the VoltOhmysts, and refer to the graph "Voltage Ratio/DB" to determine the equivalent db for this voltage ratio.

EXAMPLE:

Measured input = .1 volt.
Measured output = 50 volts.

$$\text{The voltage ratio} = \frac{50}{.1} = 500.$$

From the graph, a voltage ratio of 500 = 54db.

If the amplifier has *unequal input and output impedance,* determine the gain in decibels as described in either of the two methods above, and then make a correction for the ratio of input and output impedance, using the graph "Impedance Ratio/DB Correction."

EXAMPLE:

An amplifier has 10,000-oms input impedance and 10-ohms output impedance. The impedance ratio is $\frac{10{,}000}{10} = 1000$. From the graph, the equivalent db correction is 30db.

Add the correction when the input impedance is *more* than the output impedance.

Subtract the correction when the input impedance is *less* than the output impedance.

NOTES:

(1) The correct values of input and output impedance must be known when making measurements of power level and gain.

(2) It is not intended that the VoltOhmyst should be used to measure very low levels, unless used in conjunction with a calibrated amplifier.

(3) When measuring across high-impedance circuits, the capacity of the A-C probe cable and the input resistance of the A-C diode circuit must be taken into account.

Correcting for Impedance Ratio

The decibel scale in Type 195-A VoltOhmyst is based on a reference level (zero db) of 1.0 milliwatt and 600 ohms.

When measurement of power level is made across a load impedance that is higher or lower than 600 ohms, it is necessary to make a correction, as follows:

(1) Determine the ratio of the load impedance and 600 ohms.

(2) Find the equivalent db correction for this impedance ratio in the graph "Impedance Ratio/DB Correction."

(3) If the particular load impedance is *less* than 600 ohms, *add* the db correction to the decibel meter reading.

If the particular load impedance is *more* than 600 ohms, *subtract* the db correction from the decibel meter reading.

EXAMPLE:

Assume that the decibel meter indicates 14db on maximum undistorted output of an amplifier across a 3-ohm load impedance.

$$\text{The impedance ratio is } \frac{600}{3} = 200.$$

The graph shows that the correction for an impedance ratio of 200 = 23db.

The load impedance is *less* than 600 ohms, so *add* the 23db correction to the decibel meter reading.

The corrected power level is therefore +14 +23 = +37db.

(To find the equivalent power output in watts, refer to the 1.0 milliwatt curve in the graph "Decibel Level vs Power Level," which shows that +37db = 5 watts.)

Correcting for Reference Level

Three different power reference levels are in common use: 1.0, 6.0, and 12.5 milliwatts.

There is a tendency to standardize on a reference level (zero db) of 1.0 milliwatt, which is equivalent to .775 volts across 600 ohms. This is known as a Volume Unit or VU. The decibel scale in the VoltOhmyst is based on this reference level.

To convert power levels in decibels from one reference level to another, refer to the graph "Decibel Level vs Power Level."

EXAMPLE:

A power of 10 watts—
= +40db, based on a zero db of 1.0 milliwatt.
= +32db, based on a zero db of 6.0 milliwatts.
= +29db, based on a zero db of 12.5 milliwatts.

Using the DB Scale for Receiver Alignment

The db scale can be used during receiver alignment:

(1) Connect the RED cable probe and the black ground lead across the voice coil.

(2) Set *SELECTOR* to A-C VOLTS. RANGE at 5V.

(3) Feed a 400-cycle modulated R-F or I-F signal into the receiver.

Keep receiver volume control at maximum, and adjust signal-generator output to produce a small deflection on DB scale.

As alignment adjustments are made, thus increasing the sensitivity, the DB scale will show the improvement directly in decibels.

The effective attenuation of wave traps, in decibels, can be determined by noting the decrease in decibels as the trap is tuned through resonance.

To Measure Power Output in Watts

$$\text{Use formula: Watts} = \frac{\text{Output Voltage Squared}}{\text{Load Impedance}}$$

EXAMPLE:

The maximum undistorted output voltage across a 2-ohm load is 5 volts:

$$\text{Watts} = \frac{5 \times 5}{2} = \frac{25}{2} = 12.5 \text{ watts.}$$

This power level can be expressed in decibels with reference to a zero db level of 1.0, 6.0, or 12.5 milliwatts by reference to the table "Decibel Level vs. Power Level," which gives corresponding decibel levels of +41, +33, and +30db respectively.

(If the rated impedance values are marked on the secondary of the output transformer, connect a dummy load resistor of correct value to the secondary and measure the voltage across the resistor.)

ZERO-CENTER APPLICATIONS

In some applications, for example in aligning the discriminator in FM or AFC circuits, it is convenient to use a zero-center D-C voltmeter, because the D-C output of the discriminator changes from + to − or − to + as the secondary of the discriminator transformer is tuned or as the input frequency is varied above and below resonance.

This zero-center feature can be obtained as follows:

(1) SELECTOR at + VOLTS.

(2) RANGE at 5 V. (higher if necessary).

(3) Turn ZERO ADJ. knob to bring the meter pointer to the zero mark in the center of the scale.

(4) Connect the black lead to low side of the discriminator load.

(5) Connect the blue cable probe to the high side of the discriminator load.

(6) When the secondary of a conventional discriminator is correctly tuned, there is zero D-C output, and the meter will indicate zero. The sensitivity in volts per division of the VoltOhmyst when operated in this way is approximately the same as when adjusted to zero on the left end of the scale. However, due to the automatic meter protection characteristics of the VoltOhmyst, the scales are not linear near the ends when operated with the zero in the center. When it is desired to make accurate voltage measurements the meter should be adjusted to the zero on the *left end* of the scale with the "ZERO ADJ." control.

D-C RESISTANCE MEASUREMENTS

Operation

Before attempting any resistance measurements, care should be taken to see that the resistance being measured is not connected across any source of voltage and also that no voltage exists between either terminal of the resistance and ground. Controls and connections are set as follows:

SELECTOR .....to OHMS (SEE INITIAL ADJUSTMENT).
RANGE .....to the desired "R" range.
GND .....black lead to one side of resistance to be measured.
OHMS .....probe (red) to other side of resistance to be measured.

Explanation

The position of the RANGE switch indicates the factor to multiply the value indicated on the meter (OHMS "R" scale).

Operation Note

It is recommended that the "Rxl" position of the "RANGE" switch be used only for resistance measurements below 20 ohms.

To cancel the lead resistance error when making measurements below 2 ohms short the test leads together and reset the "ZERO ADJ." control so that the pointer reads exactly zero. This new setting will be slightly different from the original setting because of the resistance of the test leads. Then make the regular resistance check. When the measurement has been completed the "ZERO ADJ." control should be reset in accordance with the procedure given above under subject heading "INITIAL ADJUSTMENT."

When measuring high resistances the fingers should be kept away from the red cable probe. This will eliminate possible error due to leakage and stray pickup. This is especially important on the "Rx10,000" and "Rxl MEG." ranges.

Caution

Since the instrument applies a voltage up to three volts across the resistance being measured, it is possible to burn out low-filament-voltage tubes in attempting a continuity or resistance test across their filaments. Always use a resistor of 10 ohms or more in series with the test lead for such cases, or any range above RX10.

Battery

Battery replacement is generally necessary, when the ohmmeter readings become unstable, especially on the "R X 1" scale.

It is suggested that the batteries be tested occasionally to insure accuracy of ohmmeter readings. See instructions in maintenance section for replacement of battery.

RESISTANCE MEASUREMENTS ABOVE 1000 MEGOHMS

Explanation

The VoltOhmyst can be used to measure resistance higher than those covered on the "R X 1 MEG." range. This application is especially useful for the measurement of the leakage resistance of paper and mica condensers which for the smaller capacities, is usually above 1000 megohms.

An external voltage supply is required as shown in Figure 1. This voltage may range in value from approximately 20 to 500 volts. The higher the voltage the higher the value of resistance which it is possible to measure.

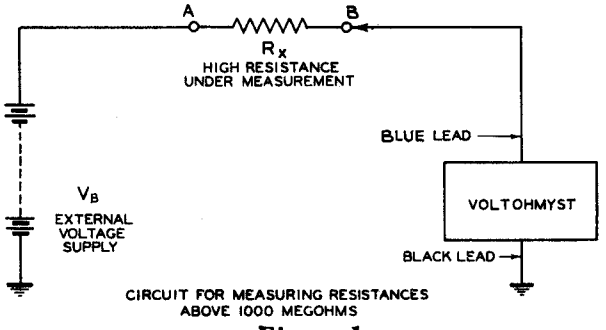


Figure 1

Operation

Make connections as shown in Figure 1 and note the D-C voltage readings on the voltmeter scale at "A" and "B" using the most convenient D-C range for each measurement. If the voltage at "B" is too small to be accurately readable increase the value of the external voltage supply until the voltage at "B" can be readily measured. The unknown resistance can then be found from the following formula.

$$\text{Unknown Resistance} = 10 \times \frac{\text{Reading at "A" minus Reading at "B"}}{\text{Reading at "B"}}$$

Explanation

EXAMPLE:

External voltage supply, reading at "A" (on 1000 V. range scale of Voltmeter) = 500. Reading at "B" (on 5 V. range scale of Voltmeter) = 2.

$$\text{Unknown Resistance} = 10 \times \frac{500-2}{2}$$

$$= 2490 \text{ Megohms}$$

MAINTENANCE

Explanation

While extraordinary care has been taken in the manufacture and test of the RCA VoltOhmyst and each instrument is laboratory tested under strict engineering supervision, in the course of use, it is possible that the instrument may require checking and servicing.

Component parts of the VoltOhmyst are indicated by symbol number as shown in schematic wiring diagram.

Tube locations, calibration controls and parts layout are shown in the accompanying drawing.

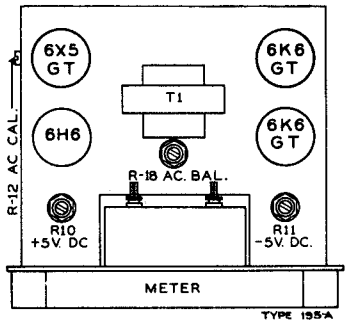


Figure 2—Tube and Adjustment Layout

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 outside of 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 coating should be renewed. 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.

Calibration

Before attempting to recalibrate the VoltOhmyst, the following precautions should be observed:

1. Be sure the contemplated adjustment is understood and is necessary.
2. Check the mechanical zero of the meter with power off.
3. Check line voltage. Line voltage should be 117 volts, 60 cycles.
4. The instrument should be allowed to "heat-up" to its ambient heat stability (30 to 60 minutes).

Calibration Procedure

D-C VOLTAGE CALIBRATION

1. Check and only if necessary, set mechanical zero with power off. Tap meter, to be sure that it remains at zero after a deflection.
2. Turn SELECTOR to + VOLTS position and allow instrument to warm up for about 20 minutes to one-half hour. Adjust electrical zero with ZERO ADJ. control. Turn RANGE to 5 volts.
3. Connect ground lead and blue cable to a standard source of D-C voltage applying 4 volts of accurately measured D-C to the input through the D-C probe.

Adjust R-10, the D-C positive voltage calibrating control, until the meter reads exactly 4 volts on 5 Volt Scale.

4. Reverse cable connections at the standard voltage source and set SELECTOR switch to – volts. Adjust R-11, D-C negative voltage calibrating control, until meter reads exactly 4 volts.
5. Check other ranges by applying 8 volts on 10 volt range, 40 volts on 50 volt range and etc.

A-C VOLTAGE CALIBRATIONS

D-C calibration must precede that of A-C.

1. Disconnect instrument from A-C power supply.

2. Before the A-C section of the meter can be calibrated, it will be necessary to connect a .25 mfd. capacitor between the cathode (pin 4) of the 6H6 tube and the junction of the range switch (S1-C) arm and capacitor C-4. Capacitor C-4 is the middle capacitor of the three located on the rear of the selector switch. See Figure 3.

3. Set SELECTOR to A-C VOLTS.
   a. Reconnect instrument to power supply.
   b. Set SELECTOR to + VOLTS.
   c. Adjust ZERO ADJUST (R7) until meter reads zero.

4. Set RANGE to 100 and apply approximately 100 volts, 60 cycles, through the A-C (red) and GND (black) leads.

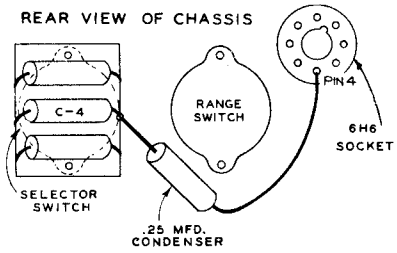


Figure 3—AC Voltage Calibrations

5. Adjust the A-C-BAL (R-18) balancing control until the meter reads zero.

6. Remove the 100 volts A-C and the .25 mfd. capacitor and note zero meter setting. After slightly tapping the meter, this should be within plus or minus one scale division of the zero mark on the 5 volt range.

7. Set RANGE to 5 volts and apply exactly 4 volts r.m.s., 60 cycles, as measured by a standard.

8. Adjust the A-C-CAL (R-12) control on under side of chassis to give a reading of exactly 4 volts on the meter.

9. Other ranges up to 100 can be checked but this is not necessary if the D-C range test was found satisfactory, since this portion of the A-C range test is made with the same multipliers.

The high voltage ranges can be checked with 400 volts on the 500 range and 800 volts on the 1000 range if standards for such are available.

TUBES

The VoltOhmyst employs two type 6K6-GT, one type 6H6 and one type 6X5-GT RCA preferred type tubes. Because of the low operating voltages the tube life will be unusually long. However, when replacement becomes necessary, care should be taken to see that the two type 6K6-GT tubes are approximately balanced. If they are unbalanced, it will be impossible to bring the pointer to zero 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, the tubes have different characteristics and each one should be matched with another tube in order to obtain a balanced pair. When the tubes are matched, it will be possible to bring the pointer both to the normal zero at the left end of the scale and to the zero in the center of the scale with the "ZERO ADJ." control. The unique circuit design of the 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 "RANGE" switch is changed from the 5 volt position to the 50 volt position while the "SELECTOR" switch is in the "+ VOLTS" position.

METER

METER POINTER OFF SCALE: If the meter pointer drives violently off scale when no test is being made, the cause may be due to the meter circuit being grounded. Check circuit for grounds, being sure the grounded covers of the potentiometers (R-7, R-10, R-11, R-12 or R-13) are not making contact with any part of the circuit both inside and out.

If it becomes necessary to insulate the inside of a potentiometer cover, be careful not to disturb the adjustments of R-10, R-11 or R-12 or recalibration with a voltage standard will be necessary.

BATTERY

BATTERY REPLACEMENT: To replace batteries, remove the instrument from its case by first removing the six front-panel screws. Remove plug button on side of case and loosen screw inside. Remove retaining plate and then the battery terminal connectors.

Be certain battery contacts are clean and tight so there will be no possibility of resistance at the connections. Use two RCA No. VS 001, or two Burgess No. 2, or two Eveready No. 950 Flashlight Cells, or equivalent. When replacing instrument in case, be careful not to pinch the battery leads.

Battery replacement is generally necessary, when the ohmmeter readings become unstable, especially on the "R x 1" scale.

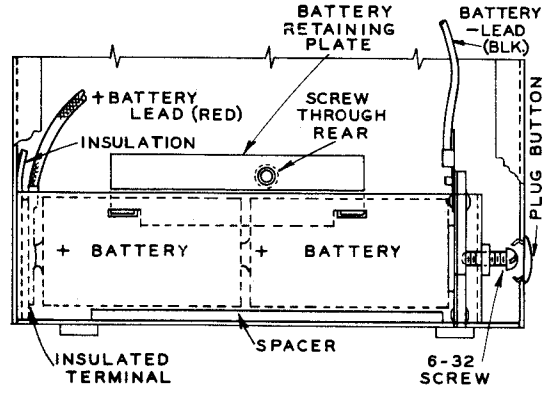


Figure 4—Battery Connections

It is suggested that the batteries be tested occasionally to insure accuracy of ohmmeter readings as follows:

Set "RANGE" for "R x 1" scale and adjust "OHMS ADJ." until pointer reads full scale. Short circuit test leads (red and black) for about 10 seconds. Relieve short and immediately observe the full scale deflection. If shorting of the leads causes a substantial drop in the full scale reading, it is an indication that batteries are in a weakened condition.

If upon repeating the above test the drop is still noticeable it is advisable to replace the batteries.

CAUTION: Batteries should not be allowed to remain in test equipment after they have become exhausted or in equipment that is to remain idle for a long period of time as they deteriorate and may damage the instrument.

VOLTOHMYST APPLICATIONS

As Applied to Radio Equipment

OSCILLATOR STRENGTH: The negative D-C voltage developed on the oscillator grid is always directly proportional to the strength of oscillation. This voltage can be measured very readily at the oscillator grid while the band switch is changed to the various bands and in each of its positions the main tuning condenser rotated from minimum to maximum capacity. This will give an indication of the strength of oscillation at all frequencies within the oscillator's range.

AVC VOLTAGE: The automatic volume control voltage developed by the incoming signal can be measured at a number of places in the receiver. This negative voltage first appears across the diode load resistor. It may also be measured along the AVC bus and at the grids of the r-f tubes being controlled. THIS D-C VOLTAGE MEASURED AT THE DIODE LOAD RESISTOR IS A VERY CONVENIENT OUTPUT INDICATION DURING RECEIVER ALIGNMENT.

Owing to the high input resistance of the VoltOhmyst, it is possible to measure bias (AVC) voltage on the grid of R-F and I-F amplifier tubes without disrupting the signal.

D-C SUPPLY VOLTAGES: The power supply D-C voltage can be measured at the rectifier filaments and in the filter circuit; plate voltages at the plates of the various tubes; screen voltages at the screen voltages dropping resistor; and cathode voltages at the tube cathodes.

BIAS CELL VOLTAGE: The VoltOhmyst will accurately measure the voltage delivered by a bias cell. Most voltmeters are not capable of making this measurement and in many cases will damage the cell if it is attempted. This voltage should be measured across the cell.

AFC DISCRIMINATOR VOLTAGE: The discriminator voltage developed in radio receivers employing automatic frequency control can be measured directly at the discriminator and also at the grid of the oscillator control tube.

F. M. DISCRIMINATOR VOLTAGE: The D-C voltage developed by the discriminator in a frequency modulation receiver can be measured right at the discriminator. For convenience in this application, the VoltOhmyst ZERO ADJ. knob should be set so the pointer is on the ZERO mark in the center of the scale, so the pointer can swing positive or negative without changing the polarity switch.

TELEVISION RECEIVER ADJUSTMENTS: The VoltOhmyst is very useful for measuring the D-C voltage developed in the picture channel of a television receiver across the second-detector load resistor. This measurement is most useful when adjusting antenna orientation and position as well as when adjusting antenna-matching sections.

GASSY TUBES: One effect of a gassy tube is to reduce the normal negative grid bias, or even make the grid positive. The VoltOhmyst is ideal for measuring the voltage directly at the control grid of any tube in order to determine whether or not this effect is present. Excessive gas will cause the tube to cease operating normally and in an audio amplifier, will usually cause distortion. In the case of a gassy audio amplifier tube where the control grid is connected directly to the contact arm of the volume control, the grid current due to the gas may in time cause the volume control to become noisy. This amount of gas will not always produce a noticeable change in the operation of the radio receiver. Consequently if repeated difficulty is experienced with volume controls becoming noisy, in this type of circuit, the VoltOhmyst should be used to check for incorrect bias.

A-C VOLTAGES: The A-C voltmeter within the VoltOhmyst is extremely useful in measuring all A-C voltages encountered in the average radio receiver. The measurements include, all voltages from power transformer secondaries, and audio voltages developed across the output transformer or voice coil as an indication of output during receiver alignment. When making such measurements all readings should be taken with respect to ground, and other cautions under A-C voltage measurements should be observed.

The VoltOhmyst can be used to check for presence of audio signals at grids and plates of audio amplifiers, etc.

A-C MEASUREMENTS WHEN D-C IS ALSO PRESENT

In circuits where both A-C and D-C voltage components are present, the A-C (AF) range of the VoltOhmyst will measure the A-C component only.

A-C measurements can be made in the presence of D-C when the D-C voltage is not over 150 volts. When D-C voltages are higher than 150 volts, a one microfarad (or larger) capacitor of adequate voltage rating should be used in series with the A-C (red) test lead.

MEASUREMENT OF RESISTORS, COILS, AND INSULATION RESISTANCE

The VoltOhmyst because of the extremely wide range it covers when used as an ohmmeter can be

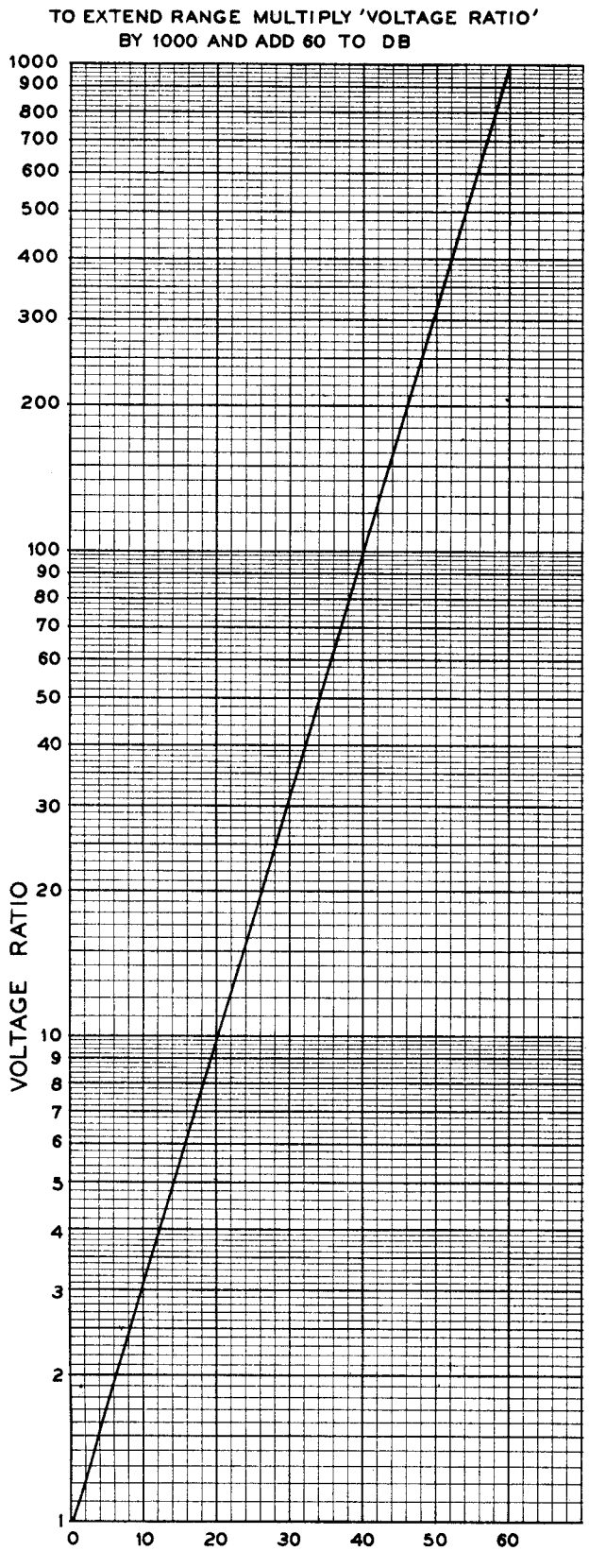


Figure 5—Voltage Ratio/DB

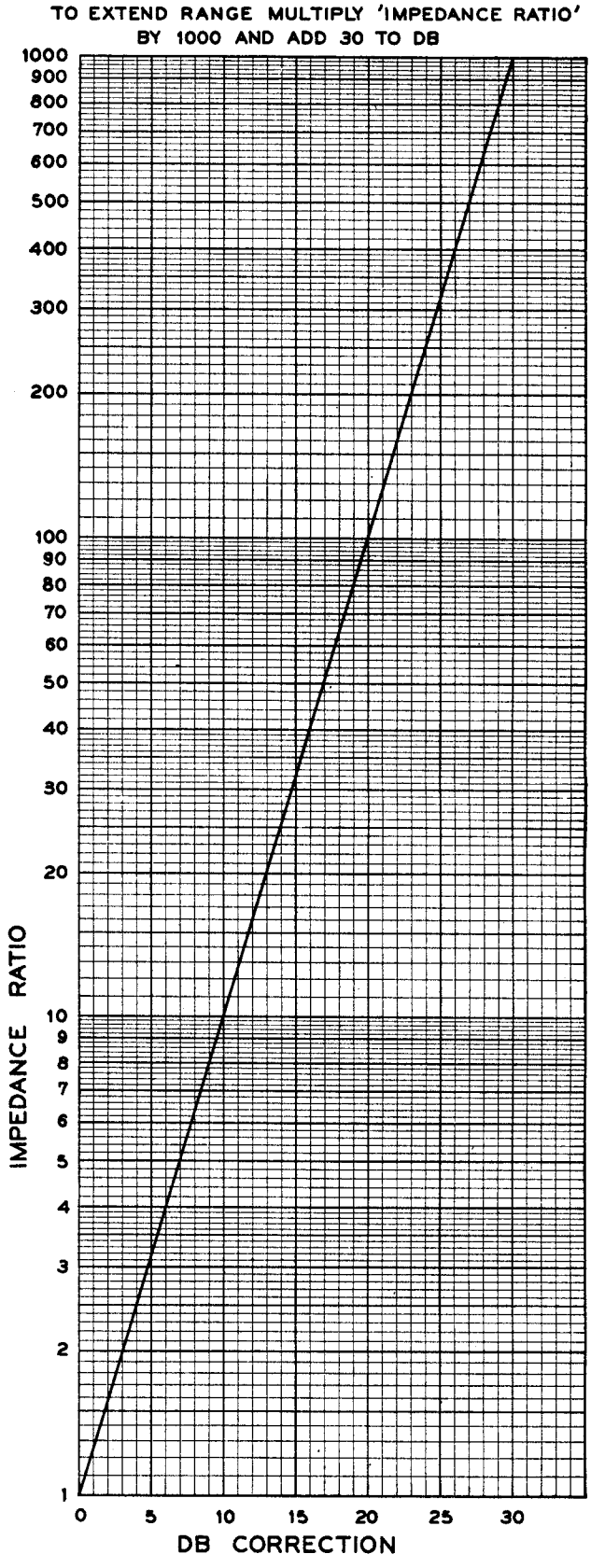


Figure 6—Impedance Ratio/DB Correction

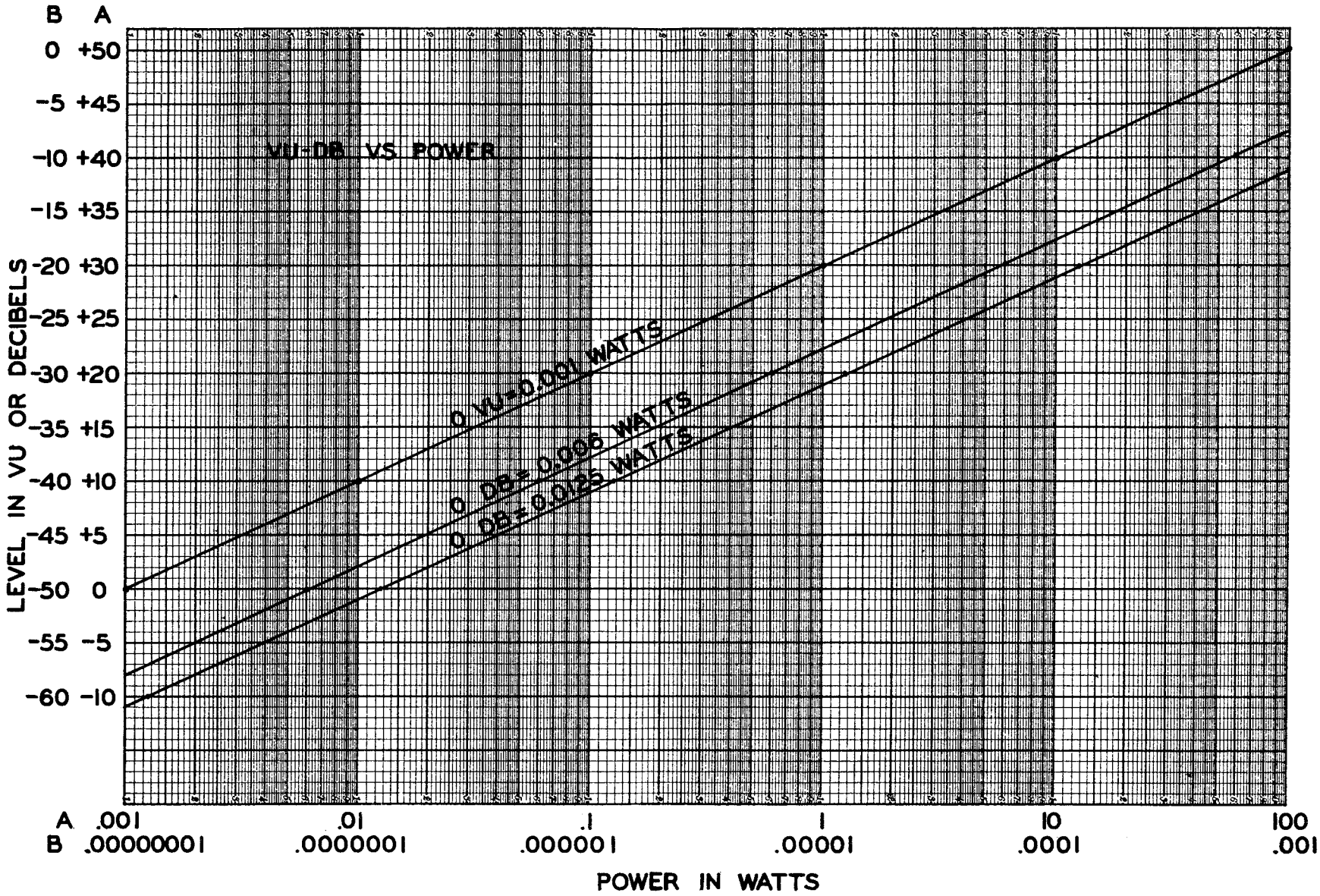


Figure 7—Decibel Level vs. Power Level

used to measure accurately the value of all resistors used in modern radio receivers. It can also measure the D-C resistance value of all coils such as r-f, oscillator, detector, i-f, power transformer, audio transformer, filter reactors, and others. Leakage through the insulation of condensers, coil windings, etc., can be measured directly using the ohmmeter section, or if above 1000 megohms, with the extended range circuit described in the text. If such condensers are used for coupling purposes between the plate of one tube and the grid of the following tube, leakage in the insulation will manifest itself as a positive voltage applied to the grid of the second tube. This voltage can be readily measured using the D-C voltmeter portion of the VoltOhmyst.

WARRANTY

This instrument is warranted to be free from defects in material and workmanship, in accordance with the terms of the guarantee card which accompanies each instrument.

REPLACEMENT PARTS

SYMBOL NO.	DESCRIPTION	STOCK NO.	SYMBOL NO.	DESCRIPTION	STOCK NO.
A1	Lamp – Pilot	31480	R28,29	25000 ohms ± 1%, 1/2 watt, composition	56727
C1,4,5	0.25 μf ± 10%, 300 volts	70618	R30	9.9 megohms ± 1%, 1/2 watt, composition	56726
C2,3	3300 μμf ± 20%, 500 volts	50804	R31	90000 ohms ± 1%, 1/2 watt, composition	56725
J1,2	Connector – "AC and Ohms" or "DC" (For chassis)	54695	R32	9000 ohms ± 1%, 1/2 watt, composition	56723
J3	Jack – Pin (For ground connection)	56326	R33	900 ohms ± 1%, 1/2 watt, composition	54197
M1	Meter – 0–200 μa	49002	R34	90 ohms ± 1%, composition	55859
R1	6200 ohms ± 5%, 1/2 watt		R35	9.5 ohms ± 1%, 1 watt, wire wound	56735
R2	15000 ohms ± 5%, 1/2 watt		S1A,B,C,D,	Switch – Range	48991
R3	20000 ohms ± 5%, 1/2 watt		S2A,B,C,D, E,F	Switch – Selector	48992
R4,5	2400 ohms ± 5%, 1/2 watt		T1	Transformer – Power	48993
R6	39000 ohms ± 5%, 1/2 watt		X1,2,3,4	Socket – Tube	48998
R7	15000 ohms, potentiometer	51156		Bumper – Rubber, for case (4 req'd)	51583
R8	10000 ohms ± 5%, 1/4 watt			Cable – "DC", shielded lead (blue) with probe	48994
R9	18000 ohms ± 5%, 1/4 watt			Cable – "Ground", (black) with clip	48996
R10,11,12	8000 ohms, variable	43916		Cable – "AC and ohms", shielded lead (red) with probe	48995
R13	7000 ohms, variable	43917		Case – Metal	50802
R13-A	1800 ohms ± 5%, 1/2 watt			Clip – Alligator, for "ground" lead	35262
R14,15	3.3 megohms ± 10%, 1/4 watt			Connector – Battery (1 set)	49001
R16,17	450000 ohms, ± 1%, composition	56732		Connector – For "ac and ohms" cable	48982
R18	100000 ohms, potentiometer	48983		Connector – For "dc" cable	48982
R19	1.5 megohms ± 5%, 1/2 watt			Cord – Power	14086
R20,20A	2 megohms ± 5%, 1 watt			Handle – Carrying	44091
R21	626000 ohms ± 1%, 1 watt, composition	56730		Socket Assembly – For pilot lamp, with jewel	48997
R22	497000 ohms ± 1%, 1 watt, composition	56731		Knob – Bar	32116
R23	382000 ohms ± 1%, 1/2 watt, composition	56729		Knob – Round	4323
R24	2.5 megohms ± 1%, 1 watt, composition	56724		Plug – Pin, for ground lead	47089
R25	2 megohms ± 1%, 1 watt, composition	56734			
R26	250000 ohms ± 1%, 1/2 watt, composition	56728			
R27	200000 ohms ± 1%, 1/2 watt, composition	56738			

Type 195, Codes 644 and 645; change schematic to read: R4 = 2300, R5 = 2300, R6 = 56000, R21 = 630000, R22 = 495000, R23 = 375000. (Code 645 included a revised resistance scale).
Type 195, Code 745: R21 = 630000, R22 = 495000, R23 = 375000.
Type 195-A*, Codes 645, 146: R21 = 630000, R22 = 495000, R23 = 375000.
Type 195-A, Codes 448, 149, 449, 649: R20–R20A were replaced by R20 = 3.9 megohms.
Type 195-A, Code 149-A: C1 = 1 μf.

* All codes, type 195-A, have = "–0+" center point indicated on the meter scale.

Replacement parts are within Engineering Specification Tolerance.

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