



# HAM TIPS



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## HAM SHACK TROUBLE-SHOOTER

### Solve Your Operations Problems with the Versatile RCA VoltOhmyst

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This feature is Part I of a two-part article covering the use of vacuum-tube voltmeters in the ham shack. Hams everywhere are finding the VTVM an indispensable tool because of the variety and wide range of measurements which can be made with these versatile and accurate instruments.

To the amateur who has used an RCA VoltOhmyst® for routine checking and trouble-shooting in his ham shack, the vacuum-tube voltmeter has become the first rival of the soldering iron.

VoltOhmysts\* are useful in dozens of trouble-shooting applications in receivers, frequency meters, variable-frequency and crystal oscillators, exciter units, power amplifiers, power supplies of all sizes, and speech amplifiers and modulators. Factory construction and calibration on all functions and ranges against precise laboratory standards make the VoltOhmysts exceptionally dependable.

These instruments have an input resistance of 11 megohms on all dc-voltage ranges, making possible precise voltage measurements in power supplies which have limited current-drain characteristics.

VoltOhmysts are versatile measuring devices. The RCA WV-98A Senior VoltOhmyst,

for example, can measure—in seven ranges—dc voltages up to 1500 volts, ac voltages up to 1500 volts rms (4200 v p-p), and resistance values up to 1000 megohms. When used with the WG-289 high-voltage probe, RCA VoltOhmysts can measure dc voltages up to 50 Kv. When the accessory WG-301A crystal-diode probe is used, rf measurements can be made up to 250 Mc. Because these instruments read resistance values up to 1000 megohms, they are invaluable in checking equipment for leaky capacitors and other high-resistance shorts which might not be detected with ordinary low-range ohmmeters.

### Voltage Measurements

Before making any voltage measurements, always connect the ground cable of the VoltOhmyst to the equipment ground point. Greatest accuracy will be obtained when the scale which gives a reading nearest the full-scale point is used.

All of the VoltOhmysts are equipped with a single switch-type probe and cable for measuring both ac and dc voltages and resistances. For dc-voltage measurements, set the switch to "DC." It is now possible to make dc-voltage measurements in circuits which also contain an ac signal. This feature is valuable when trouble-shooting receivers and low-power exciter stages.

Set the switch to the "AC/Ohms" position for ac-voltage and resistance measurements.

\*"VoltOhmyst" is a registered trademark of the Radio Corporation of America.

### Resistance Measurements

The first rule to observe in making resistance measurements is to *remove all power from the circuit being tested*. Failure to observe this precaution may result in damage to the test instrument. It is also advisable to discharge all capacitors in the circuit under test to prevent their residual charge from adversely affecting the meter reading. The accuracy of the resistance measurement can be increased by using the scale which provides a reading nearest the centerscale point on the meter.

In a complex electronic circuit, shunt-circuit resistance may be difficult to determine. In such cases, it will be necessary to unsolder individual components or to disconnect major leads or buses before resistance measurements are made.

### Measurements in RF Fields

Strong rf fields in transmitters may affect the meter measurement of either ac or dc voltages. In making such measurements in the presence of rf, always connect the Volt-Ohmyst ground cable to a point near the test point. If an auxiliary rf probe is used, ground the short lead on the probe as near as possible to the test point. If the rf field still upsets the meter reading, move the instrument to another position and re-orient the test leads.

The WG-301A crystal-diode probe (see inset of Figure 1) is a slip-on type which attaches to the front end of the WG-299C dc/ac-ohms probe and cable, and provides for the measurement of rf voltages up to 250 Mc. The WG-301A can be used to check relative signal levels in receiver oscillators and low-power exciter stages. With this probe combination, it is not usually possible to measure the rf-signal voltages in power oscillators and amplifiers because the peak values of such voltages are relatively high. Before making rf measurements, make sure that estimated signal voltage values do not exceed the input-voltage ratings of the probe.

### Bias Measurements

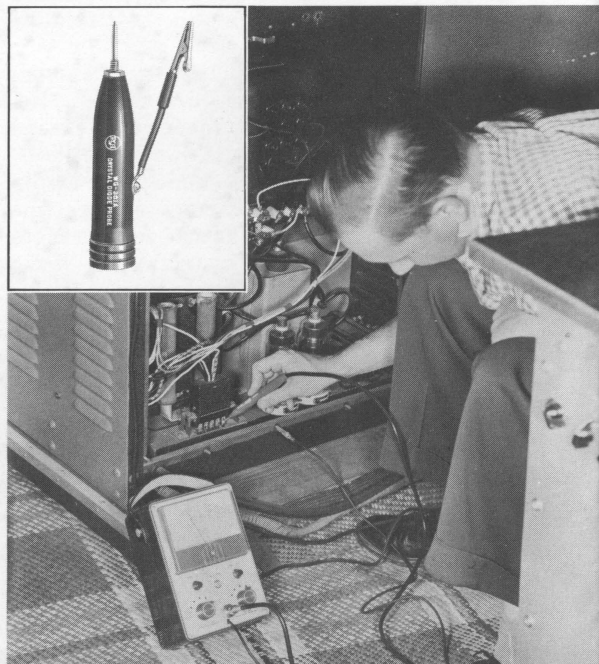
Bias-voltage measurements are important in transmitter stages inasmuch as the bias level determines the class of operation of the stage and greatly affects the drive requirements, power output, and harmonic content. Depending upon the class of amplifier, bias is adjusted to a cutoff or beyond cutoff value. In class C amplifiers utilizing fixed bias, the bias is adjusted so that no plate current flows when excitation is removed. Under class AB<sub>1</sub>, AB<sub>2</sub>, and B conditions, however, some plate

current will flow under key-up conditions. For plate-modulated class C operation, bias is customarily increased to approximately two and one-half times the amount required for plate-current cutoff.

Some of the typical arrangements used to obtain grid bias are shown in Figure 2. In all arrangements, except that of Figure 2-F, the chassis (ground) is the reference point because the cathodes are grounded. Read the bias on the "—DC VOLTS" scales of the Volt-Ohmyst. In the illustrations, the operating bias ( $E_{op}$ ) is the total amount of bias supplied or developed under driving conditions. Fixed or protective bias ( $E_{pr}$ ) is used in the circuits shown in Figures 2-B, 2-C, 2-D, and 2-E. The operating bias in these circuits is made up of the total of the amount of fixed bias plus the bias developed when grid current flows through the grid resistor, if used. In all of the above illustrations, total bias is measured between point X in the grid circuit and the chassis.

Not all grid-circuit arrangements in transmitters contain an rf choke or rf bypass capacitor, and the accuracy of the bias measurement under key-down conditions will depend upon the amount of driving power and VTVM stability under rf conditions.

Figure 1. W21YG uses WV-77C Junior VoltOhmyst with the WG-299C probe and cable to measure 400 volts for driver stage of his 800-watt transmitter. The WV-77C when used with the WG-299C has an input resistance of 11 megohms on all ranges, and will measure voltages up to 1200 v dc. Inset shows WG-301A crystal diode probe for measuring rf voltages up to 250 Mc. The WG-301A slips over the front end of the WG-299C.



### High-Voltage Measurements

The maximum dc-voltage limit of the RCA WV-77C VoltOhmyst is 1200 v; for the WV-87B and WV-98A, 1500 v. To amateurs, the high-voltage probe can quickly become an indispensable measurement accessory. When making high-voltage measurements, first remove all B+ voltages from the transmitter. Next, with probe and ground cable properly connected to the VoltOhmyst, connect the ground clip of the probe to the transmitter chassis. Then, connect the tip of the probe to the high-voltage test point. If measurements and circuit adjustments are to be made simultaneously, clamp or tape the probe tip firmly in position. Next, make sure the VoltOhmyst is set up for plus dc-voltage measurements and that a suitable voltage range is selected.

Apply plate voltage, screen voltage, and grid drive to the amplifier. Because the high-voltage probe attenuates the input voltage by a factor of 100, multiply the meter reading by 100 to obtain the true voltage measurement.

The voltage regulation of the power supply may be determined by measuring its output voltage under two conditions: (1) with no excitation applied to the amplifier without load and (2) with excitation applied to the amplifier with load. The percent change in output voltage between zero load and load is the voltage regulation. As the load increases, the output voltage will tend to decrease.

The plate power input to the amplifier stage can be determined simply by multiplying the plate voltage as read on the meter scale by the total amount of plate current in amperes drawn from the supply.

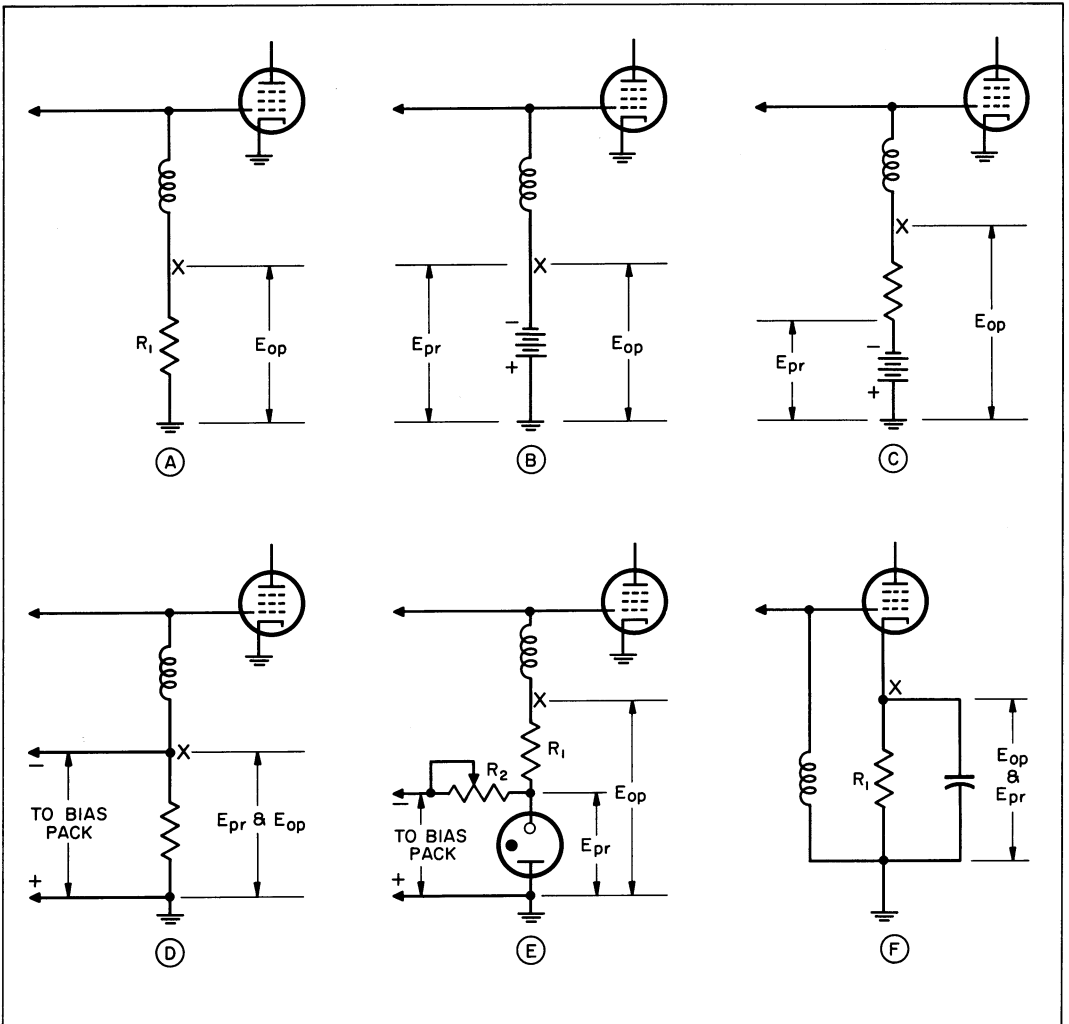


Figure 2. Typical arrangements used to obtain grid bias.

