

OPERATING INSTRUCTIONS  
FOR  
TYPE 546-B MICROVOLTER

Form 344-C # 380



GENERAL RADIO COMPANY  
CAMBRIDGE A, MASSACHUSETTS

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PART 1  
DESCRIPTION

The Type 546-B Microvolter, when used with a suitable oscillator, becomes a 200-ohm source of accurately-known audio-frequency potentials. The output voltage ranges from 1 volt to less than 1 microvolt, and its magnitude is directly indicated by a dial and multiplier switch. Voltages below 1 microvolt are obtainable with a sacrifice in accuracy.

Since the microvolter is a convenient means for adjusting the output of an oscillator to a small, accurately-known value, it has a use in most measurements on audio-frequency circuits. In the broadcast or sound studio it is convenient for measuring transmission loss and frequency response characteristics on circuits and for checking the over-all performance between the speech circuits and the antenna. It is suitable for measuring amplifier gain and for calibrating amplifiers for use as thermionic microvoltmeters.

PART 2  
OPERATION

Connect the INPUT terminals to a suitable source of audio-frequency power. Adjust the source voltage until the voltmeter indicates 2.2 volts. The input impedance is approximately 425. It will be noticed from the wiring diagram that the variation of input resistance as the multiplier switch is turned is compensated by the shunt resistor section of the switch shown in the upper left corner of the circuit diagram. In case it is necessary to operate the Type 546-B Microvolter from a very low power oscillator such as the Type 613-B, R15 may be disconnected, reducing the power requirement very considerably on all except the top multiplier position. When this has been done the instrument will be just as accurate as before but the input impedance will vary over a wider range with multiplier setting. It will be possible to use it at much reduced power input at output levels up to 0.1 volt.

Sources of lower power can, of course, be utilized by maintaining a reference voltage of less than 2.2 volts, in which case the microvolter output voltages are less than their indicated values by the ratio of the reference voltage to 2.2 volts (for example, 1/2 for a 1.1-volt reference).

Connect the OUTPUT terminal marked "G" to the low-potential side of the power source and, where possible, this common connection should be grounded.

For all ordinary measurement purposes the OUTPUT terminals can be considered the terminals of a 200-ohm generator having the open-circuit terminal voltage indicated by the dial and the setting of the MULTIPLIER. More accurate results will, in general, be obtained by setting the multiplier switch so that the desired voltage is obtained for dial settings lying between 1 and 10.

**CAUTION** - Never connect the microvolter OUTPUT terminals across a circuit carrying current, either a-c or d-c, to avoid getting erroneous readings on the voltmeter. Should the drop across the output terminals exceed 4 volts, the microvolter may be permanently damaged.

If the input voltage is not a pure sine wave, the resultant error for absolute measurements can be nearly as great as the percentage of harmonics present.

For low-voltage output (around 10  $\mu$ v) a shielded oscillator and cap-shielded leads should be used.

### PART 3 PERFORMANCE CHARACTERISTICS

**GENERAL** The Type 546-B Microvolter is built for use without calibration charts or correction curves, and, when so used, its accuracy is more than sufficient for most measurements. Where unusual accuracy is required or where the limits of error must be known, the following discussion can be consulted.

**OPEN-CIRCUIT VOLTAGES** The absolute accuracy of open-circuit output voltages will depend on:

- (1) accuracies of the networks and of the dial calibration; and
- (2) accuracy of the voltmeter.

Where voltage ratios only are being measured and the voltmeter indication remains constant, errors in the voltmeter cancel out, hence the accuracy depends only upon that of the two networks and the dial.

**ABSOLUTE ACCURACY** Absolute-voltage values are accurate to  $\pm 2\%$  if correction is made for the temperature coefficient (see below).

**TEMPERATURE ERROR** Any initial error which may be present in the indicating meter has been compensated for in the calibration of the OUTPUT dial. As with all copper-oxide instruments, the meter indication is somewhat affected by temperature variations. The calibration is correct at 77°F., and for room temperatures below this value the correction is -.0046 volts per degree F. For operating temperatures above 77°F., the correction is +.0023 volts per degree F. These corrections are to be applied to the 2.2-volt setting to obtain the correct setting at the operating temperature. For example, at a temperature of 97°F., the meter indication for standard input is 2.246 volts.

**FREQUENCY ERROR** There is no appreciable error with frequency between 10 cycles per second and 20 kc.

**VOLTAGE RATIOS** The error in voltage-ratio measurements will be less than 2%, independent of frequency, for open-circuit output voltages of greater than 100 microvolts.

up to 100 kc

The errors in absolute-voltage values can be reduced to about the same amount as errors in voltage-ratio measurements by checking the microvolter against a vacuum-tube voltmeter whose indications are known to be sufficiently accurate. Set the microvolter for 1000 millivolts output, and then adjust the input voltage until the standard voltmeter indicates 1 volt. The voltage indicated on the microvolter voltmeter can then be maintained at the value thus obtained. This check can, if desired, be repeated for different frequencies and for different operating temperatures.

**INTERNAL OUTPUT IMPEDANCE** Since the microvolter indicates open-circuit voltage, the internal output impedance must be taken into account when working into low-impedance loads. For loads greater than 100,000 ohms no correction need be made.

The internal output impedance varies between 194 and 204 ohms over the range of output settings.

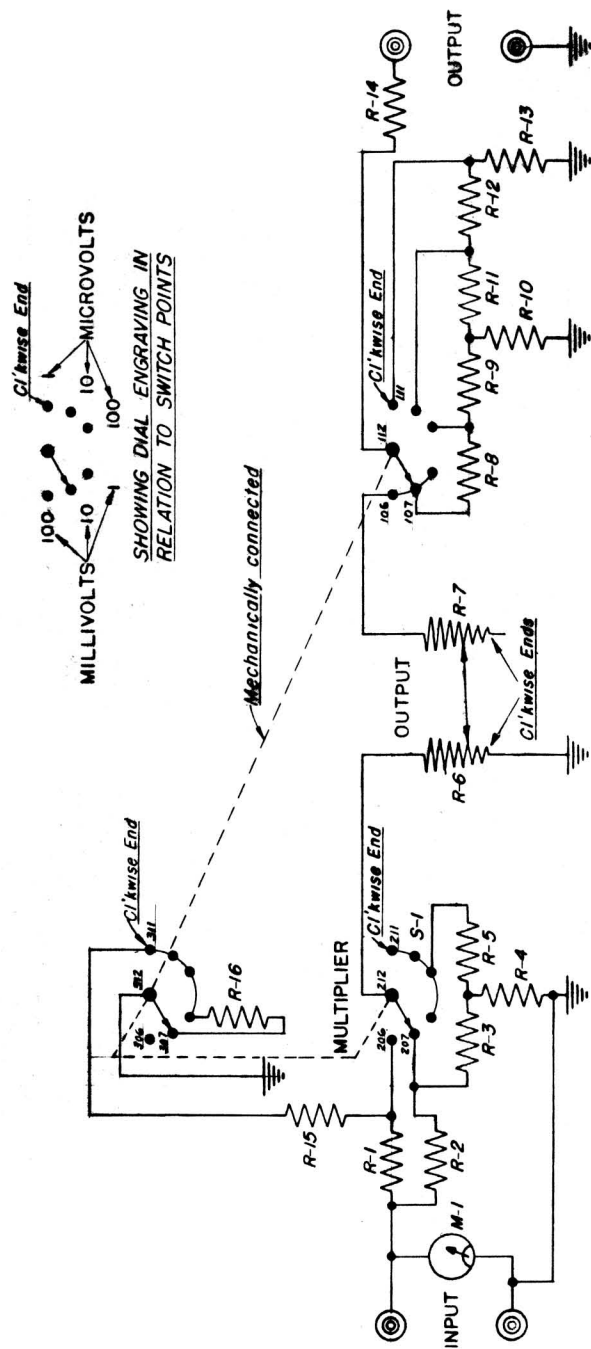


FIGURE 1. Wiring Diagram for Type 546-B Audio-Frequency Microvoltmeter

## PARTS LIST

### Resistors

R-1	=	400 $\Omega$ + 0.2%	R-9	=	178 $\Omega$ + 0.2%
R-2	=	4 k $\Omega$ + 0.2%	R-10	=	22.2 $\Omega$ + 0.5%
R-3	=	400 $\Omega$ + 0.2%	R-11	=	178 $\Omega$ + 0.2%
R-4	=	44.44 $\Omega$ + 0.2%	R-12	=	1800 $\Omega$ + 0.2%
R-5	=	356 $\Omega$ + 0.2%	R-13	=	200 $\Omega$ + 0.2%
R-6	=	400 $\Omega$ + 10% - 0	R-14	=	18.2 $\Omega$ + 2%
R-7	=	200 $\Omega$ + 5%	R-15	=	400 $\Omega$ + 5%
R-8	=	1800 $\Omega$ + 0.2%	R-16	=	8 $\Omega$ + 10%

### Meter

M-1 = 488-303 (Weston Model 892)

### Switch

S-1 = 546-321 (Yaxley)