



SIMPLIFIED SENSITIVE MULTIMETER

By Charles A. Starks, W2URP

A SENSITIVE DC MULTIMETER is always a handy instrument in the amateur radio station. However, complex instruments of this type can be expensive.

"But, they don't have to be," says

W2URP adjusts the control grid bias in his SSB transmitter with his Simplified Sensitive Multimeter. Well-equipped station — and workshop too — includes kilowatt linear amplifier next to SSB transmitter, and matching receiver to right of amplifier. W2URP is an engineer in the Power Rectifier Engineering section of General Electric's Power Tube Department at Schenectady, N.Y. Chuck's favorite bands are 3.9 and 7-MC. SSB, and 7-MC. CW.

Chuck, W2URP. "Look at my simple, sensitive DC voltmeter that the average amateur can duplicate in a single evening.

"I needed a DC voltmeter with very high resistance to check and precisely adjust the negative bias on the control grids of the output stage in the new SSB transmitter I added to my station recently. A conventional 1,000 ohms-per-volt meter would have loaded down the circuit excessively and given me a lower-than-actual reading.

"A quick scan through my junk box under the workbench turned up a 100-microampere DC current meter, a sloping panel meter box, and some miscellaneous banana plugs and jacks, terminal boards and hardware.

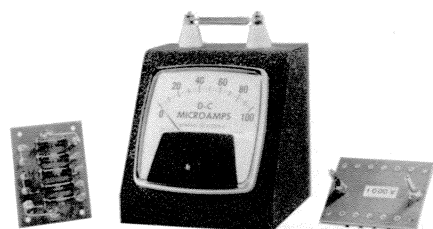
"A few minutes of figuring with a pencil — after referring to the 'Measurements' chapter of the *Radio Amateur's Handbook* — and I had the multiplier resistance values required for several popular DC voltage ranges. I used the following formula to calculate the multiplier values: $R = \frac{1000E}{I}$; where R is the

resistance in ohms; E is the desired full-scale voltage; and I is the full-scale reading of the meter in milliamperes. The 100-microampere meter thus gave a sensitivity of 10,000 ohms per volt.

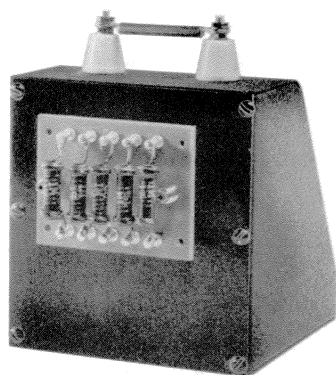
"Rather than switch in the various multipliers with a tap switch, I decided that each multiplier could be mounted on a terminal board that would plug into the back of the meter case. This provided for future needs by allowing additional ranges to be added at any time."

This is the philosophy with which the Simplified Sensitive Multimeter was designed.

THE CIRCUIT of the multimeter is extremely simple, as shown in the schematic, Fig. 1. Multipliers plug into J₄ and J₅, and the leads running to the circuit to be measured plug into J₁ and J₂. Provision can also be made to measure currents with this instrument by plugging in a shunting resistance of suitable value across the meter at J₃ and J₅.



CLOSEUP VIEW of Simplified Sensitive Multimeter with boards containing multiplier resistors beside it. Shunt for measuring current also can be connected between feedthru terminals, as shown here. CAUTION: Exposed terminals and multiplier strip should be covered with insulation when high voltage circuits are being measured.



REAR VIEW of meter showing multiplier board plugged into J₄ and J₅ on rear of meter box. A multiplier with a single resistor can be made from a narrow strip of insulating board, with the resistor connected between soldering lugs on the plugs.

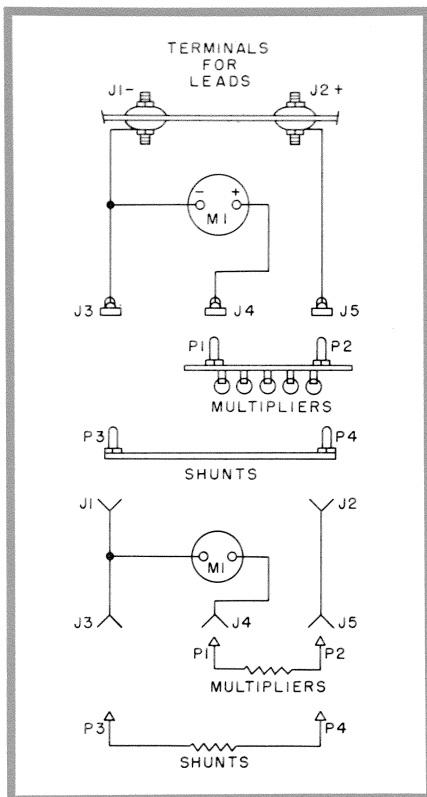


Fig. 1. Schematic diagram of the simple multimeter. Terminals J₁ and J₂ are feedthru insulators with either stud terminals or banana jacks. Jacks J₃, J₄ and J₅ are banana jacks for the multipliers and shunts. Plugs P₁ and P₂ are mounted on the insulating boards holding the multiplier resistors. Plugs P₃ and P₄ are on the shunting resistances.

TABLE I — METER MULTIPLIER CHART

Full Scale Meter Reading Desired	Multiplier for 20 ua meter	Multiplier for 50 ua meter	Multiplier for 100 ua meter	Multiplier for 250 ua meter	Multiplier for 500 ua meter
0.1 Volt	5,000 ohms	2,000 ohms	1,000 ohms	400 ohms	200 ohms
1.0 Volt	50,000 ohms	20,000 ohms	10,000 ohms	4,000 ohms	2,000 ohms
10.0 Volts	0.5 megohm	0.2 megohm	0.1 megohm	40,000 ohms	20,000 ohms
100 Volts	5 megohms	2.0 megohms	1.0 megohm	0.4 megohm	0.2 megohm
1,000 Volts	50 megohms	20.0 megohms	10.0 megohms	4.0 megohms	2.0 megohms