PHILCO MODEL 028 VACUUM-TUBE VOLTMETER

The Philco Model 028 is a combination vacuum-tube voltmeter, voltmeter (A.C. and D.C.), milliammeter, ammeter, output meter, and capacity meter.

The vacuum-tube voltmeter circuit contains a 1A7G tube and is energized by batteries. The following ranges are available for tests:

Volts: 10, 30, 100, 300, 1000 A.C., D.C., or Output.
Milliamperes: 10, 100 D.C.
Amperes: 10 D.C.
Resistance: 150, 15,000 ohms, 1.5 megohms.
Vacuum-Tube Voltmeter: 10 volts, A.C. or D.C.

All functions of this instrument are controlled by three switches. The switch located on the side of the case turns the vacuum-tube voltmeter circuit on and off. The left switch on the front of the panel selects the meter functions, and the right switch is used in adjusting the ohmmeter to the zero point when the test leads are shorted. All D-C voltages are measured on the black scales of the meter, and all A-C voltages are measured on the red scales of the meter.

A-C VOLTMETER:

1. To measure A-C volts, turn the left selector knob to the "A.C." position, and the ohmmeter knob to the "Off" position (extreme left).
2. Insert the pin tip of the black test lead in the jack marked "A.C.±" and the pin tip of the red test lead into the red jack of the voltage range desired.
3. Read the A-C voltage ranges on the red scales of the meter as follows: 0 to 10, 0 to 100 and 0 to 1000 on the 0 to 10 red scale. Multiply by 10 for 100 volts and by 100 for 1000 volts. The bottom red scale is used for 0 to 30 and 0 to 300 volts. Multiply by 10 for 300 volts on this scale.

D-C VOLTMETER:

1. Turn the selector knob to the "D.C." position and the ohmmeter knob to the "Off" position.
2. Insert the pin tip of the black test lead in the jack marked "D.C.–" and the red test lead into the red jack of the voltage range desired. These ranges are read on the meter as follows: 0 to 10, 0 to 100 and 0 to 1000 volts D-C top black scale (0 to 10). When using either the 100 or 1000-volt ranges, multiply the readings on the scale by 10 and 100 respectively.

The 0 to 30 and 0 to 300-volt ranges are read on the black 0 to 30-volt scale. Multiply the reading on this scale by 10 for 300 volts.

D-C MILLIAMMETER:

1. Turn the selector knob to the range desired "10 mils" or "100 mils" and insert the black test lead in the black (mils–) jack. The red test lead is placed in the 10 or 100 jack beneath the "Mils" jack depending on the range desired. The ohmmeter knob must be in the "Off" position.
2. Read milliamperes on the 0 to 10-volt black scale. Multiply by 10 when using the 100-mil range.

D-C AMMETER:

1. Turn the selector switch to "Amps" position and connect the test leads to binding posts marked "10 amps."
2. Read current on the 0 to 10-volt scale (black).

MEASURING RESISTANCES (150 ohms, 15,000 ohms and 1.5 megohms):

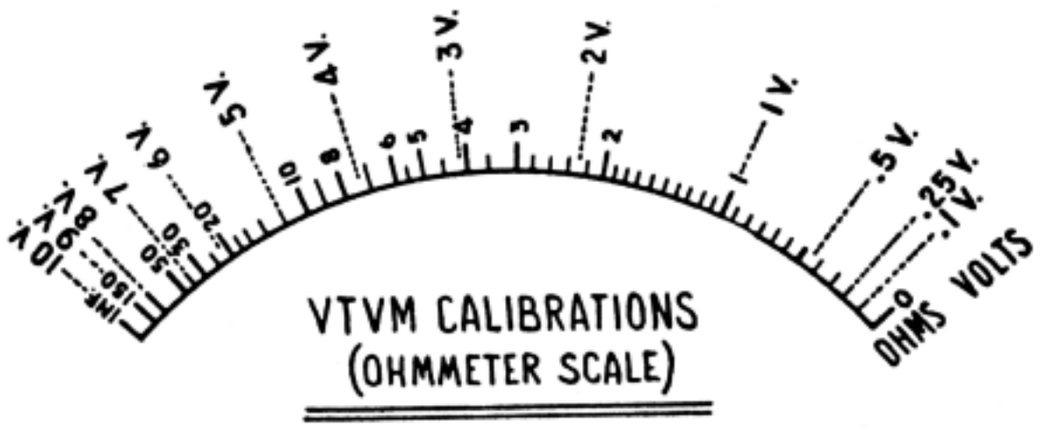
1. Set the selector switch to the resistance range desired (150, 15,000 ohms, or 1.5 megohms).
2. Insert the black test leads into the jack marked "Ohms" and the red test lead into the "150", "15,000" or "1.5 meg." jack depending on the position of the selector switch.
3. Turn the ohmmeter knob "On" (clockwise), then shorting the test leads, adjust the knob until the meter reads "zero" ohms on the top of the black scale. This is indicated by the needle being on the extreme right index line of the top scale. Resistance values are read on the top scale.
4. If the 0 to 15,000-ohm range is used, add two zeros to the meter readings. For the 0 to 1.5 megohm-range add four zeros to the meter readings.

OUTPUT METER:

1. Turn the selector switch to the "A.C." position. Insert one of the two special tube adapter leads into the jack marked "output" and the other lead into any one of the red jacks directly below depending on the strength of the signal to be measured. The other ends of the leads are then connected to the plate and cathode of any audio tube or across the speaker voice coil.

VACUUM TUBE VOLTMETER:

The Vacuum Tube Voltmeter is a highly sensitive instrument used for Voltage Measurements of the R-F, I-F and Audio circuits of receivers in cases where no current should be drawn by the meter.



When using the Philco Model 028 Vacuum Tube Voltmeter, a few precautions should be observed.

1. Measurement of D-C voltages is made by connecting the short lead to Negative (–) and the long lead to Positive (+). Before connecting the leads to the D-C source under test, adjust the pointer for zero reading by shorting the leads together and adjusting the "0 Adj." knob until the pointer is on the right-hand "0" of the top scale.
2. A-C voltage measurements of R-F, I-F and A-F circuits are made with the short lead and clip connected to that point in the circuit with the highest A-C potential with respect to ground (example: grid or plate). In A-C work the length of this lead is critical and should not be increased. A 3000-mmfd. condenser should be connected in series with this lead.
3. In measuring all R-F, I-F or A-F voltages, the Vacuum Tube Voltmeter leads should be connected as outlined above across the voltage source under test when no voltage is present in the source. The *zero adjustment of the Vacuum Tube Voltmeter should be made under these conditions.* If the source under measurement is a tuned circuit it should be repadded after connection of the Vacuum Tube Voltmeter to correct for the detuning effect of the leads. After zero adjustment and repadding, the position of the leads should not be disturbed.
4. No potential higher than 50 volts should be connected to the Vacuum Tube Voltmeter terminals.
5. No cable or shielded leads should be connected to the two test leads of the Vacuum Tube Voltmeter.

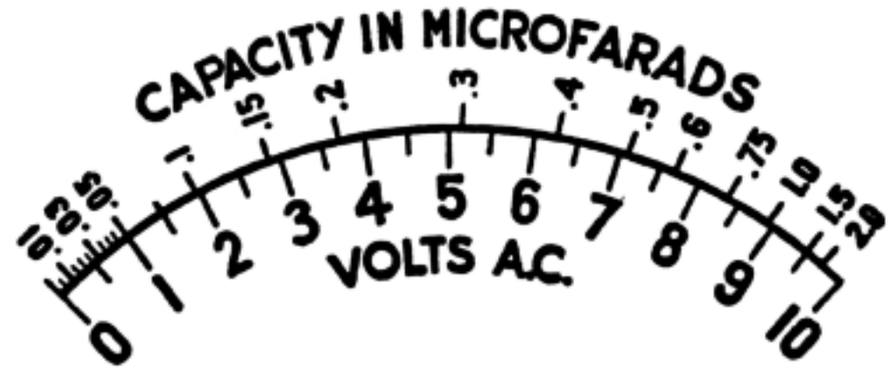
OPERATION OF THE VACUUM TUBE VOLTMETER:

1. Turn the switch located on the side of the case to "on" position (clockwise). Then set the Selector Switch (front of panel) to the "1.5" megohm position.
2. Clip the two V.T.V.M test leads to the circuit being tested and make zero adjustment of the pointer by turning the "0 Adj." knob and following the precautions indicated above.
3. After these connections and adjustments are made, the voltage can be measured by using the top resistance scale in conjunction with the calibrated chart (V.T.V.M. chart).

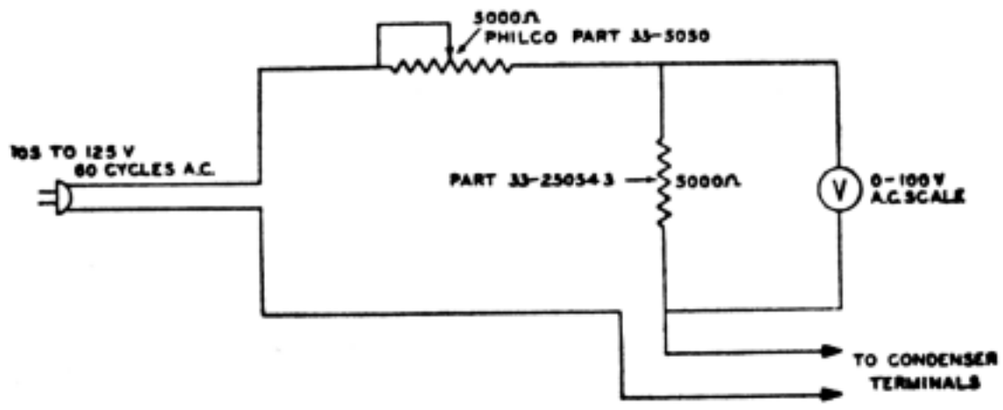
CAPACITY METER:

To measure capacity it will be necessary to use a Philco potentiometer and a cartridge-type resistor, value shown in diagram herewith.

Make the connections as shown in the diagram, using the 0-100-volt A-C scale of the meter and adjusting potentiometer for 100 volts with the test prods (leading to condenser to be tested) shorted together. Use calibration chart for capacity test.



CALIBRATION CHART FOR CAPACITY



EXTERNAL CIRCUIT FOR CAPACITY METER

REPLACING BATTERIES:

Model 028 requires two 22½-volt dry battery units, size 4" x 3" x 2½", with a 3-volt tap and one 1½-volt flashlight cell, size No. 2, for operation of the ohmmeter circuit.

To install the batteries, take off the front instrument panel from the case by removing the screws around the outer edge of panel. The 22½-volt batteries are then secured to the inside top and bottom of the case by clamps which are held in place by bolts and nuts.

The batteries should be replaced when their voltage drops below 17 volts (indicated by inability to obtain a "zero adjustment").

Connect the + terminal of the top battery to the –22½ terminal of the bottom battery. Connect the green lead to the –22½ terminal of the top battery, the white lead to the + terminal of the bottom battery, and the red to the –3 terminal of the bottom battery.

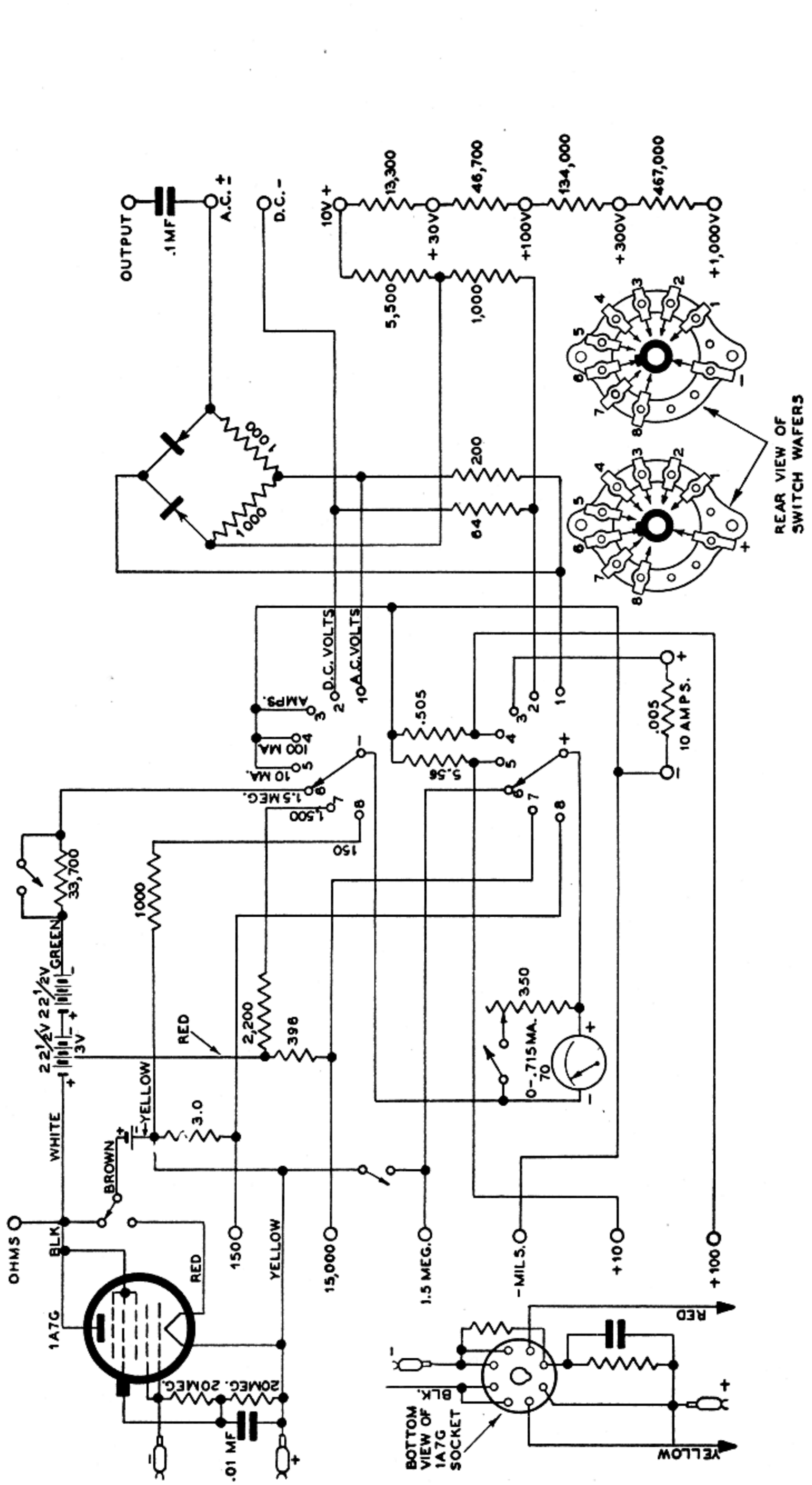
To install or replace the 1½-volt cell simply remove the plates and spring on the back of the 028 case.

CAUTIONS

Make certain that the switch mounted on the side of the cabinet is in OHMS position before "zeroing" ohmmeter on 1.5-megohm range, otherwise, the meter will be damaged by the application of 45 volts.

While the test leads are shorted, do not turn the selector switch from VOLTS to OHMS.

Before making any continuity checks on the instrument, the leads must be disconnected or the meter shorted.



PHILCO MODEL 028 VACUUM-TUBE VOLTMETER (SCHEMATIC DIAGRAM)