PHILCO SERVICE

PHILCO Factory-Supervised Service

New Product News

JUNE, 1951

RADIO

THE NEW PHILCO CIRCUIT MASTER MODEL 7004

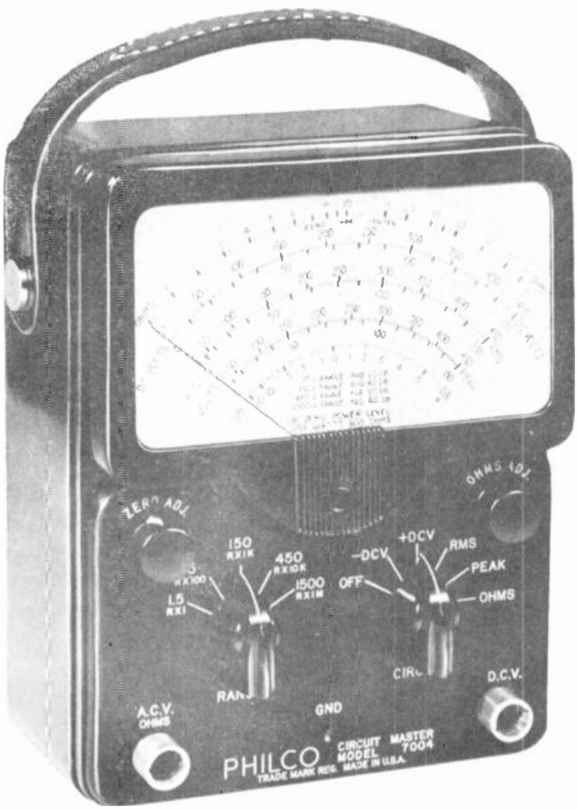


FIGURE 1

Philco is now introducing a new multitester to its well known line of service equipment. This new unit, the Philco Circuit Master — Model 7004, has several outstanding qualities that add to its versatility and general usefulness as a service instrument. These features are as follows:

An accurate, A-C operated, vacuum tube volt-ohm meter.

A small, compact instrument the same size as an ordinary, battery operated 20,000 ohms/volt tester.

The full scope of the Circuit Masters' usefulness and a better appreciation of the instrument's accuracy and reliability can be gained by examining the specifications which follow:

Ruggedly mounted in a bakelite housing with leather handle. This unit gives the maximum of portability.

The instrument may be used as a Galvanometer on any of the DC ranges by simply shifting the electrical zero to center scale.

The outstanding electrical features of the Circuit Master are concerned with the reading of AC voltages.

RMS reading of sine wave voltage — In the majority of vacuum tube volt-ohm meters, it has been the custom to read peak voltages but to calibrate the scale in the equivalent RMS sine wave voltage. When the wave is not a pure sine, considerable error results due to the fact that a peak voltage of a sine wave is 41% higher than the RMS. The use of thermo couple or dynamometer type instruments (two generally accepted means of measuring RMS voltages) have serious disadvantages in electronic work. However, quite accurate measurements can be made using an instrument based on AVERAGE voltage which differs from sinusoidal RMS voltages by only 11%. In the PHILCO Model 7004, the RMS voltages are AVERAGE but calibrated in RMS.

The meter has been provided with a scale calibrated in PEAK voltages and when used for this function the basic circuit is converted to a PEAK reading device.

The AC (either RMS or PEAK) attenuator is compensated for good high frequency response up to and including the 150 volt range.

SPECIFICATIONS

D. C. Voltages:

Ranges 1.5, 15, 150, 450 and 1500 volts. Input resistance — 10 megohms for all ranges. D.C. Probe — 1 megohm isolating resistor. Polarity — Plus or minus.

A.C. Voltages at Power Frequency (PEAK or RMS):

Ranges 1.5, 15, 150, 450 and 1500 volts. Input Impedance with cable — 150 mmfd. shunted with 5 megohms.

Audio and Radio Frequency Voltages (PEAK): Ranges 1.5, 15, 150 volts. Input Impedance with cable — 150 mmfd. shunted with 5 megohms. Frequency Response — from 30 cps to 10 KC within 2 DB.

Ohms:

Ranges:

RX1 — 1000 ohms (center 10)
RX100 — 100,000 ohms (center 1000)
RX1000 — 1 megohm (center 10,000)
RX10,000 — 10 megohms (center 100,000)
RX1,000,000 — 1000 megohms (center 1,000,000)

Decibels (based on PEAK voltages):

Ranges — 5 steps. — 20 to +62 O DB is equal to 1.095 volts peak based on .001 watt across 600 ohms.

Galvanometer:

Zero on all DC ranges can be shifted to center of scale for FM discriminator alignment.

Accuracy (at 115 volts, 60 cps line):

DC Voltage ±3% of full scale. AC Voltages at power frequency ±5% of full scale. Resistance ±3% of mechanical scale length. Decibels ±5% of full scale.

Power Supply:

105 to 125 volts, 50 to 60 cycles. Power consumption — 4 watts at 115 volts, 60 cycles.

When used with PHILCO 45-1752 HI-FREQ. PROBE, range is 15 volts RMS with frequency response from 10 KC to 100 MC.

When used with PHILCO 45-1753 HI-VOLTAGE PROBE, range is 30,000 volts DC.

CIRCUIT DESCRIPTION:

The metering circuit consists of 12AU7 dual triode with the indicating meter connected between the two cathodes. The large amount of negative feedback contributes greatly to the excellent stability of the unit. When measuring DC voltages or resistance, the tubes operate with a small plate current in order to keep the grid current exceedingly small. When measuring AC voltages, the tube operates at a higher mutual conductance. A germanium crystal is used for half wave rectification of the AC voltages. The meter responds to the average value of the rectified signal when measuring RMS voltages. PEAK voltages are obtained by adding a large condenser to integrate the rectified signals.

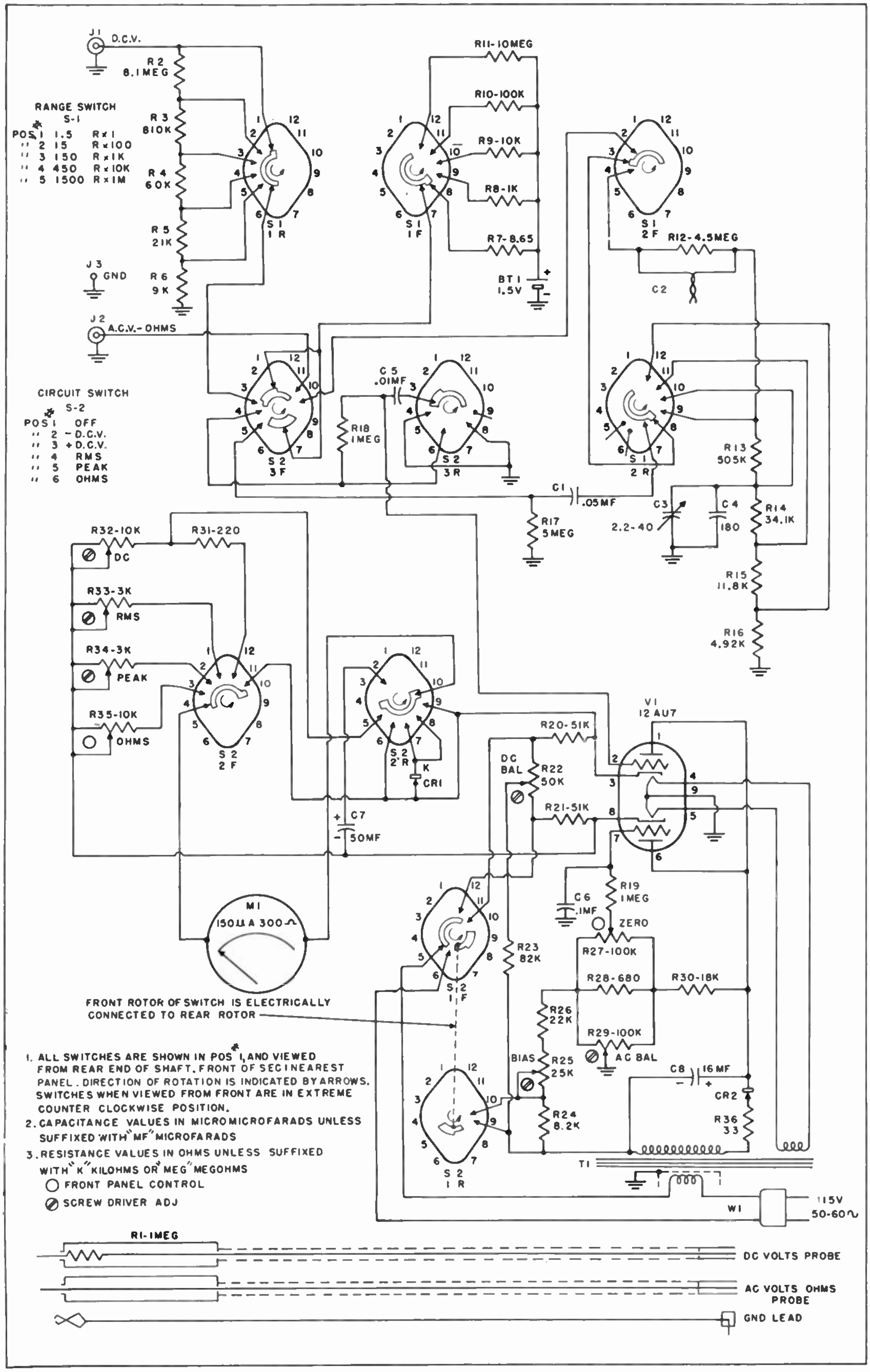
The voltage dividing networks are so designed that the basic meter always operates through the same voltage range regardless of the RANGE switch setting. It is because of this circuitry that a very high input impedance is obtained for both AC and DC and is independent of the setting of the RANGE switch.

The 12AU7 dual triode functions as a grounded plate stage difference amplifier with one input fixed. The grid of one tube is the input of the amplifier and the other grid is kept effectively at ground potential through the balancing potentiometers R-27 and R-29. The metering circuits are connected between the two cathodes.

When measuring AC voltages, the two triodes are independent except for the coupling due to the metering circuit. A change of voltage on the input grid causes a proportionate change of voltage of the cathode (Pin 3). A voltage difference then results between the two cathodes and current flows in the metering circuit. This current causes the voltage of the cathode (Pin 8) to vary in the same direction as the other cathode but to a lesser degree. The current in the metering circuit is rectified and a meter indicates the average value of the resulting current. A variable resistor in series with the meter provides a means of adjusting the current to calibrate an RMS voltage scale.

For PEAK voltages, a large condenser is connected across the meter and a variable resistor (R-34). The addition of the condenser causes the meter to indicate PEAK values of the alternating current. The variable resistor provides a means of calibrating the PEAK voltage range.

When measuring DC voltages, a balancing potentiometer (R-22) is introduced between the negative ends of the cathode resistors. A resistor (R-23) is connected between the arm of the poten-



J1 D.C.V.
R2 8.1MEG
RANGE SWITCH S-1
POS# 1 1.5 R×1
" 2 15 R×100
" 3 150 R×1K
" 4 450 R×10K
" 5 1500 R×1M
R3 810K
R4 60K
R5 21K
R6 9K
J3 GND
J2 A.C.V.-OHMS
S1 1R
R11-10MEG
R10-100K
R9-10K
R8-1K
R7-8.65
BT1 1.5V
S1 1F
S1 2F
R12-4.5MEG
C2
CIRCUIT SWITCH S-2
POS# 1 OFF
" 2 -D.C.V.
" 3 +D.C.V.
" 4 RMS
" 5 PEAK
" 6 OHMS
S2 3F
C5 .01MF
R18 1MEG
S2 3R
S1 2R
R13 505K
C1 .05MF
R17 5MEG
C3 2.2-40
C4 180
R14 34.1K
R15 11.8K
R16 4.92K
R32-10K
DC
R31-220
R33-3K
RMS
R34-3K
PEAK
R35-10K
OHMS
S2 2F
S2 2R
K
CR1
C7 50MF
V1 12AU7
R20-51K
DC BAL
R22 50K
R21-51K
M1 150µA 300Ω
R19 1MEG
C6 .1MF
ZERO
R27-100K
R23 82K
R28-680
R30-18K
S2 1F
R26 22K
R29-100K
AC BAL
BIAS
R25 25K
C8 16MF
CR2
R24 8.2K
R36 33
T1
S2 1R
W1
115V 50-60∿
FRONT ROTOR OF SWITCH IS ELECTRICALLY CONNECTED TO REAR ROTOR
1. ALL SWITCHES ARE SHOWN IN POS# 1, AND VIEWED FROM REAR END OF SHAFT. FRONT OF SEC 1 NEAREST PANEL. DIRECTION OF ROTATION IS INDICATED BY ARROWS. SWITCHES WHEN VIEWED FROM FRONT ARE IN EXTREME COUNTER CLOCKWISE POSITION.
2. CAPACITANCE VALUES IN MICROMICROFARADS UNLESS SUFFIXED WITH "MF" MICROFARADS
3. RESISTANCE VALUES IN OHMS UNLESS SUFFIXED WITH "K" KILOHMS OR "MEG" MEGOHMS
FRONT PANEL CONTROL
SCREW DRIVER ADJ
R1-1MEG
DC VOLTS PROBE
AC VOLTS OHMS PROBE
GND LEAD

FIGURE 2

tiometer and the negative supply. As this resistor is common to both cathodes, some coupling occurs between the two triodes, thus increasing the sensitivity of the amplifier.

The addition of the potentiometer (R-22) and common resistor (R-23), along with R-24 in the bias circuit, changes the operating conditions of the tubes. This potentiometer is for balancing the triodes under the new conditions, such as tube replacement.

The meter and another variable resistor (R-23) are connected in series between the two cathodes. This provides a means of calibrating the DC voltage range.

Resistance measurements are made with the tube operating as in making DC voltage measurements. A 1.5 volt dry cell, in series with a selected resistor, supplies a potential for measurements. A variable resistor (R-35), operated from the front panel, is in series with the meter and is used to adjust the full scale sensitivity of the circuit. The resistor to be measured reduces the voltage applied to the grid by the degree of shunting of the battery circuit.

Several practical applications for the Model 7004 PHILCO Circuit Master are presented here to give an idea of the many types of measurements which can be made.

Because of the very high input resistance, true DC voltage measurements can be made in relatively high impedance circuits such as in the A-V-C or oscillator.

The reasonably flat frequency response and the high input resistance makes the AC functions ideal for making voltage gain checks in audio amplifiers. This is possible since the DC has no effect on the measurement of the AC components of the plate circuits. If the wave form is sinusoidal, accurate gain readings can be made in RMS; but when non-sinusoidal wave forms are present, PEAK measurements can be made with assurance that accurate results will be obtained.

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