OPERATING INSTRUCTIONS

for

TYPE 1612-A

R-F CAPACITANCE METER

Form 689-B
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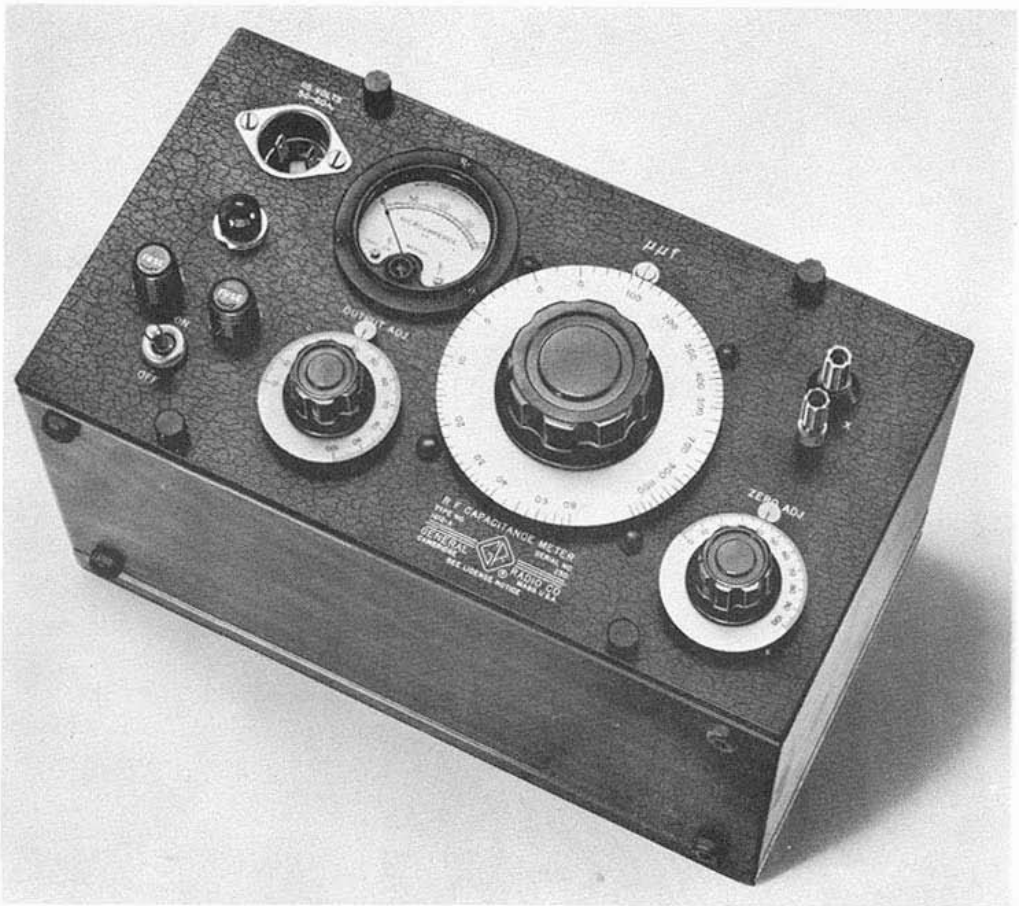
GENERAL RADIO COMPANY
CAMBRIDGE 39 MASSACHUSETTS
NEW YORK CHICAGO LOS ANGELES
U. S. A.



Panel View of the 1612-A R-F Capacitance Meter.

Specifications

Capacitance Range: 0 to 1200 μμf in two bands, 0 to 80 μμf and 1 to 1200 μμf. Ranges are switched automatically as Capacitance Dial is rotated.

Accuracy of Capacitance Indication:

Low Range:	0 - 10 μμf ± 0.4 μμf
	10 - 80 μμf ± 4%
High Range:	0 - 100 μμf ± 4 μμf
	100 - 1200 μμf ± 4%

Capacitance Scale: Scale is spread out at low end of dial and nearly linear at high end. Smallest division is 1 μμf on low band and 20 μμf on high band. Minimum measurable capacitance is influenced by sharpness of resonance as well as scale distribution, and is about one-half the smallest division.

Oscillator Frequency: 1 megacycle ± 1%.

Resonance Indicator: A 1N34 crystal rectifier is used with a microammeter to indicate resonance.

Tube: A 117N7-GT tube is used in the oscillator circuit, and is supplied.

Power Input:

Power from line: 12w at 115v 50-60 cycles
11w at 115v d.c.

Dimensions: (Length) 12 x (height) 6-5/8 x (depth) 7-1/2 inches, over-all.

Net weight: 11 pounds.

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R-F CAPACITANCE METER

SECTION 1.0 DESCRIPTION

1.1 PURPOSE

The Type 1612-A R-F Capacitance Meter is a device for conveniently measuring capacitances of the magnitude usually encountered in radio frequancy applications. It can also be used for comparing losses in dielectric samples. It was designed to provide, in a simple compact form, all equipment necessary for making capacitance measurements easily and quickly.

1.2 CAPACITANCE RANGE

The capacitance range is covered in two steps. A low range covers from 0 to 80 $\mu\mu$f and a high range covers from 0 to 1200 $\mu\mu$f. The ranges are switched automatically as the Capacitance Dial is rotated.

1.3 VOLTAGE ACROSS UNKNOWN

Full-scale meter deflection corresponds to about 55 volts across the unknown on the low-capacitance range and 10 volts on the high-capacitance range. The indication is approximately square-law, so a half-scale deflection corresponds to approximately 39 volts on the low- and 7 volts on the high-capacitance range.

SECTION 2.0 OPERATING INSTRUCTIONS

2.1 CONTROLS

The controls of the instrument consist of the following: OFF-ON switch with a pilot light indicating when the instrument is on; Capacitance Dial; ZERO ADJust control; and an Oscillator OUTPUT ADJust control.

2.2 MEASURING CAPACITANCES UP TO 80 $\mu\mu$f

Allow about 1-1/2 minutes for the instrument to warm up after turning it on. Set the Capacitance Dial to the low zero and adjust the ZERO ADJust control for a maximum indication on the microammeter. The Oscillator OUTPUT ADJust control is used to adjust for full-scale indication on the meter. The unknown capacitance is now connected to the X terminals of the instrument and the Capacitance Dial rotated to return to resonance as indicated by a maximum deflection of the microammeter. The capacitance of the unknown is read from the Capacitance Dial. When it is necessary to use leads to connect the unknown capacitance, the initial zero adjustment should be made with the leads attached to the instrument terminals and in approximately the position for connecting the unknown.

The amount the microammeter indication differs from its initial full-scale value when measuring a capacitance is useful as a means of comparing the losses in capacitances of the same capacitance value. See Paragraph 2.4.

2.3 MEASURING CAPACITANCES FROM 80 TO 1200 $\mu\mu$f

The procedure is the same for the high range as for the low range, except that the zero is standardized at the high zero position of the Capacitance Dial. The indication of relative losses is not as effective on this range as on the low range.

2.4 COMPARING DIELECTRIC SAMPLES

If the terminals of the instrument are provided with two electrodes between which dielectric samples can be placed, comparison of the losses can be made. Before a sample is placed between the electrodes, a full-scale microammeter indication at resonance is first set by means of the Oscillator OUTPUT ADJust control. The Capacitance Dial is then set to a point on the low range where resonance can be obtained with the various samples in place by changing the position of one of the electrodes on the sample. The amount the microammeter indication differs from full scale at resonance, with a sample in place, is an index of the losses in that particular sample. The comparison of samples should be made at one capacitance setting because the indication is relative to shunt conductance rather than to dissipation factor.

SECTION 3.0 PRINCIPLES OF OPERATION

3.1 FUNCTIONAL CIRCUIT

The functional diagram illustrates the principle of operation. The instrument consists of a one-megacycle oscillator whose controlled output is fed by a loosely coupled link to a resonant detector circuit. The resonance indicator consists of a crystal rectifier, a small pickup coil, and a d-c microammeter.

Measurement is made by a substitution method in which the capacitance of the calibrated capacitor is reduced to re-establish resonance after an unknown capacitance is placed across the X terminals.

3.2 CIRCUIT

The complete circuit diagram shows the actual arrangement of the instrument.

3.21 Oscillator: The oscillator consists of the pentode section of the 117N7-GT connected as a triode in a Hartley oscillator circuit. The frequency is preset to one megacycle by means of a powdered iron core. The output to the detector circuit is taken from a coupling link through an oscillator OUTPUT ADJust control.

3.22 Power Supply: The heater of the 117N7-GT operates directly from the 115-volt line. The rectifier section in conjunction with an r-c filter furnishes the plate supply of the oscillator. When a d-c supply is used and the proper polarity observed, the rectifier conducts continuously and direct current is furnished directly to the r-c filter. The instrument, therefore, can be operated either from an a-c or a d-c supply.

3.23 Detector Circuit: The detector circuit consists of a resonant circuit and a coupled resonance indicating meter. The capacitance configuration in the tuning circuit is such as to produce a quasi-logarithmic scale distribution on the Capacitance Dial. Range switching is accomplished automatically as the Capacitance Dial is rotated to the appropriate scale. There are individual zero positions of the Capacitance Dial for the two ranges. A panel trimmer permits standardizing the circuit at the zero positions and provides for balancing out the capacitance of leads (up to 5 $\mu\mu f$ effective capacitance) that might be used to connect the unknown capacitance.

On the low-capacitance range, the meter indication at resonance with the unknown connected, relative to that at resonance before it is connected, is a qualitative indication of shunt conductance and, consequently, of the losses in the unknown.

The Oscillator OUTPUT ADJust control permits setting the meter to full scale for establishing an initial reference for this purpose. On the high-capacitance range, sensitivity of this indication of losses is lower and varies considerably with the capacitance of the unknown. The indication of losses just described is intended only for rough intercomparisons and not for quantitative measurements.

SECTION 4.0 CALIBRATION

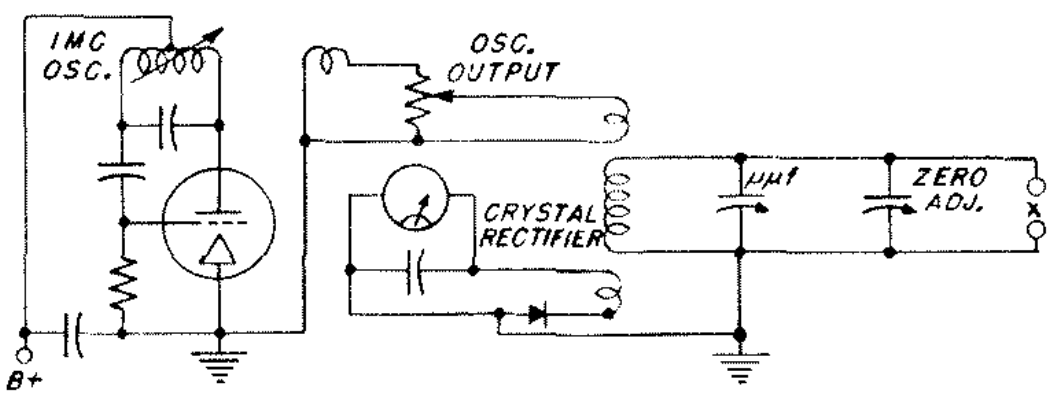
L-1 has an adjustable core for setting the oscillator frequency to one megacycle.

C-12 and C-14 set the span of the low and high ranges, respectively, and should not be touched unless standard capacitors are available for checking the calibration. The low-range adjustment must be made first.

C-15 permits setting the two zeros to coincidence. Due to stray capacitances, the setting of this capacitance may have a slight effect on the calibration. (For normal readjustment, this effect is negligible.)

C-10 is the common internal adjustment and sets the zero capacitance within the range of the ZERO ADJust on the panel.

Since the calibration of this instrument can be easily destroyed by adjustment of the wrong internal controls, it is recommended that none of the internal adjustments be touched unless equipment is available for recalibration.



Elementary Schematic Diagram for the Type 1612-A R-F Capacitance Meter

PARTS LIST

RESISTORS

R-1 =	220 k ohms	±10%	IRC	BTS
R-2 =	50 ohms		GR	301-A
R-3 =	75 ohms	±10%	IRC	BW-1/2
R-4 =	75 ohms	±10%	IRC	BW-1/2
R-5 =	75 ohms	±10%	IRC	BW-1/2
R-6 =	75 ohms	±10%	IRC	BW-1/2
R-7 =	56 ohms	±10%	IRC	BTS
R-8 =	Built into P-1 Socket			

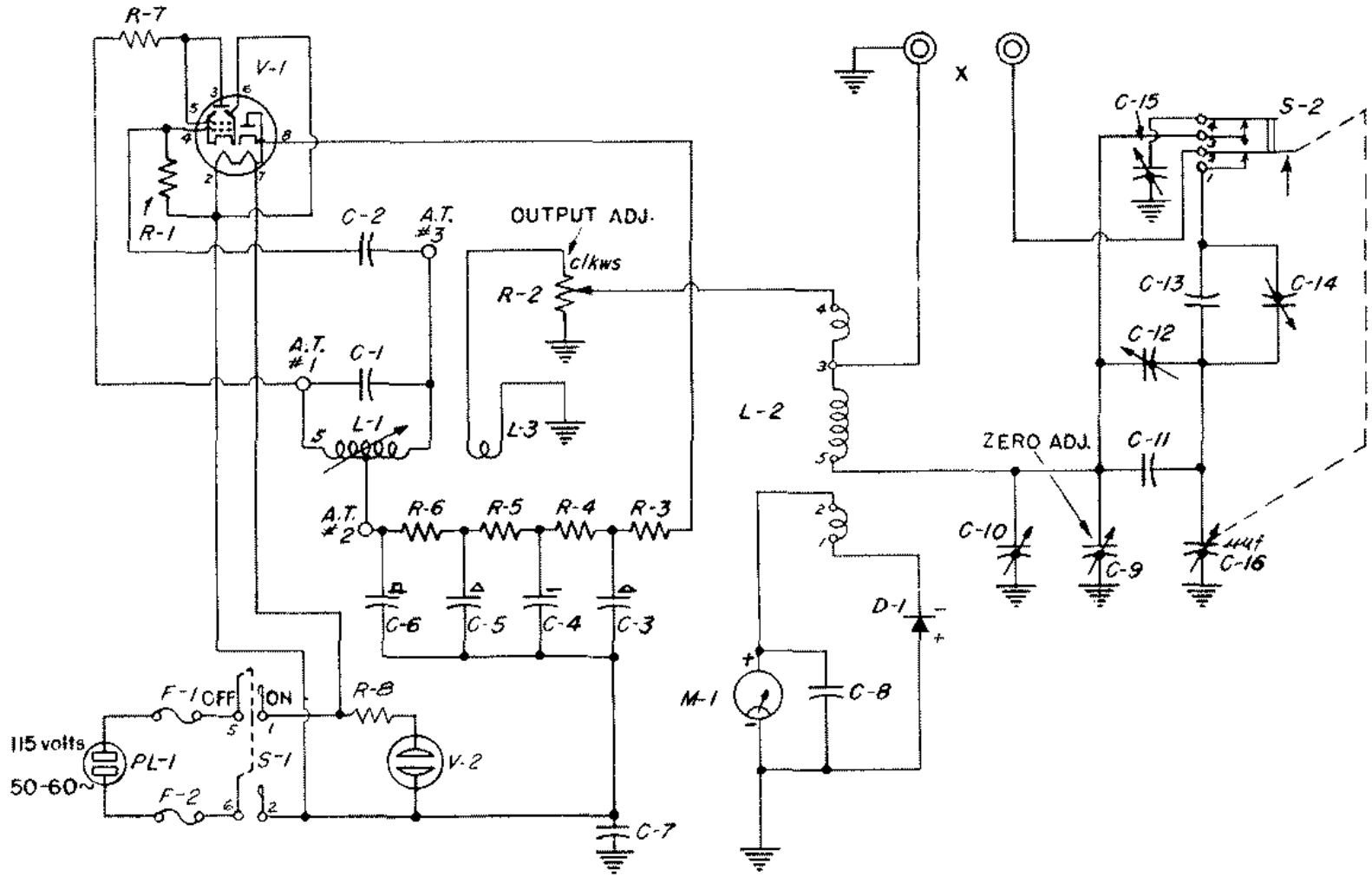
CONDENSERS

C-1 =	0.001 μf	±10%	Aerovox	1468L
C-2 =	0.0002 μf	±10%	Aerovox	1468
C-3 =	40 μf	±50%, -10%		COEB-15
C-4 =	40 μf			
C-5 =	40 μf			
C-6 =	40 μf			
C-7 =	0.01 μf	±10%	Aerovox	1441W
C-8 =	0.002 μf	±10%	Aerovox	1467
C-9 =	10 μμf		GR	846-AK
C-10 =	50 μμf			COA-2
C-11 =	0.00012 μf	± 5%	Aerovox	1468
C-12 =	50 μμf			COA-2
C-13 =	0.00091 μf	± 5%	Aerovox	1468
C-14 =	7 - 140 μμf			COA-5
C-15 =	10 μμf			COA-25
C-16 =	500 μμf		GR	1612-36

MISCELLANEOUS

L-1 =	Inductor	1612-26	M-1 =	Meter	MED-22
L-2 =	Inductor	1612-25	D-1 =	Crystal Detector	IN34-A
L-3 =	Pickup Coil	1612-88	PL-1 =	Plug	CDPP-562A
S-1 =	Switch DPST	SWT-333	V-1 =	Tube	117N7-GT
S-2 =	Switch (Part of 848-405)	848-310	V-2 =	Pilot Light	NE-51

F-1 = Fuse 0.15 amp. Slow Blow 3AG FUF-1
F-2 = Fuse 0.15 amp. Slow Blow 3AG FUF-1



Wiring Diagram for the Type 1612-A R-F Capacitance Meter.