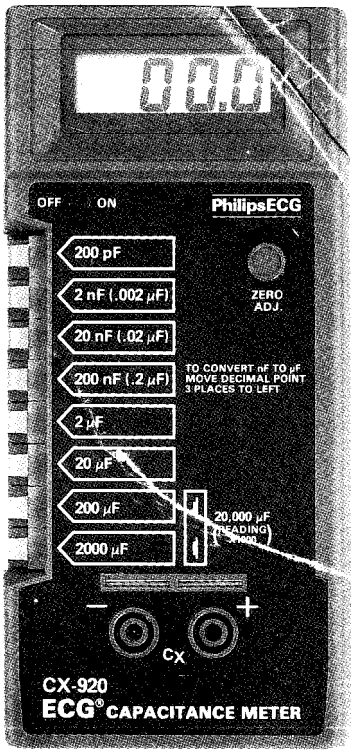
ECG®
Digital Capacitance Meter
Model CX-920



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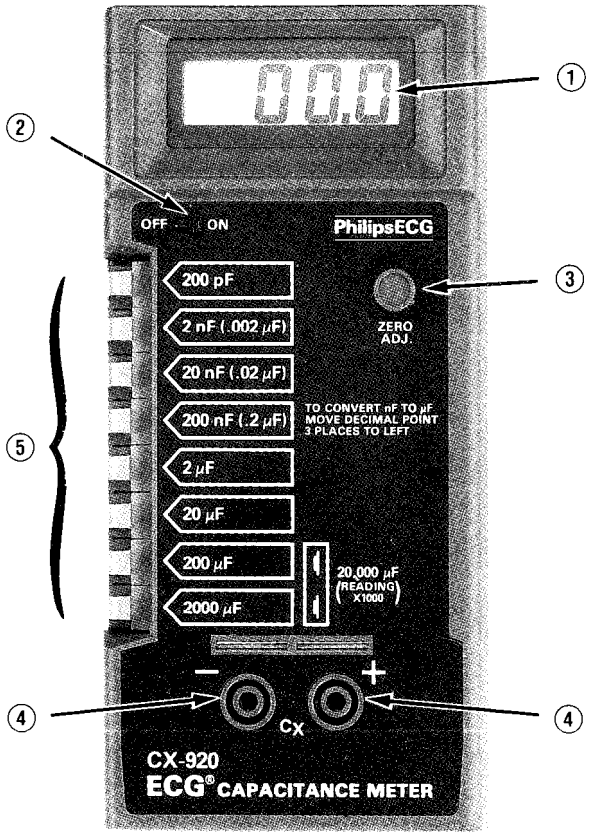
- 20,000 μF Measurement Capability
- 0.5% Basic Accuracy
- 3½ Digit LCD, 0.5" H
- Zero Adjustment



Operating Features

1. **Display**: 3½ digit LCD (1999), 0.5" H, decimal point, overrange and LO BAT indicators.
2. **Power Switch**: Slide switch for turning the instrument OFF and ON.
3. **Zero Capacitance Adjust Knob**: Use to adjust to zero, approx. ±20pF (200 pF, 2 nF and 20 nF ranges only).
4. **"+, –" Input Connectors and Jacks**: Polarized for polarized capacitors.
5. **Range Select Switches**: Interlocked push-button switches for selecting ranges (9 ranges from 200 pF to 20,000 μF). **Do not pull switches to select a range.**

The CX-920 Digital Capacitance Meter displays readings on a 3½ digit LCD. The 9 ranges give precision readings from 0.1 pF to 20,000 μF. These ranges cover virtually all the capacitors used in electronic engineering labs, production, service shops and schools. This meter can be used to check tolerances, sort values, select precision values, measure unmarked capacitors, select matched sets plus measure cable, switch or PCB layout capacitances. Battery operation, light weight and compactness makes the CX-920 a truly portable instrument.

Model CX-920 Specifications

General

Display: 3½ digit LCD, 0.5" H with polarity.
Overrange Indication: A "1" with the 3 least significant digits blanked.
Operating Environment: 18°C to 28°C (below 80% relative humidity).
Storage Environment: −20°C to 60°C battery removed and below 80% relative humidity.
Temperature Coefficient: (0°C to 18°C and 28°C to 50°C), less than 0.15 x applicable accuracy specification.
Power: 9V alkaline or carbon-zinc battery (NEDA 1604).
Battery Life: 100 hours typical with carbon-zinc cells, 200 hours typical with alkaline cells.
Battery Indicator: Display indicates "LO BAT" when 20% of battery life remains.
Dimensions, Weight: 180 mm long x 85 mm wide x 38 mm thick (7.1" x 3.3" x 1.5"), 300 g (10.5 oz.).
Capacitance:

Range	Resolution	Accuracy
200 pF	0.1 pF	±0.5% of rdg + 1D + 0.5 pF
2 nF (.002 μF)	1 pF	±0.5% of rdg + 1D
20 nF (.02 μF)	10 pF	±0.5% of rdg + 1D
200 nF (.2 μF)	100 pF	±0.5% of rdg + 1D
2 μF	1 nF	±0.5% of rdg + 1D
20 μF	10 nF	±0.5% of rdg + 1D
200 μF	100 nF	±0.5% of rdg + 1D
2000 μF	1 μF	±1% of rdg + 1D
20,000 μF	10 μF	±2% of rdg + 1D

NOTE

pF = pico Farad (10^{-12} Farads)
nF = nano Farad (10^{-9} Farads)
μF = micro Farad (10^{-6} Farads)

Accuracy is based on a 1-year calibration cycle and an operating temperature of 18°C to 28°C (64°F to 82°F) at relative humidity up to 80%.

Test Voltage: 3.2 volts peak maximum, "+" input terminal voltage is always higher than "−" input terminal.
Overload Protection: The meter is protected against damage from charged capacitors (greater than 50 VDC) by a 0.25 A/250 V, fast blow fuse.
Zero Capacitance Adjustment Range: Approx. ±20 pF.

These specifications are subject to change at any time and no obligation is assumed as to future manufacture of the product herein described nor adherence to this data in case of such future manufacture.

Meter Safety

1. Observe polarity when connecting polarized capacitors.
2. Fully discharge any capacitor.
3. Never apply voltage to the test connectors, serious damage may result.
4. Do not short the test leads together. This will cause a large power drain on the battery and will show an overrange on all ranges.

Capacitance Measurement

1. Insert any test leads or fixtures and slide the power switch to "ON".
2. Push range selector button to a range on the capacitance scale higher than the expected capacitance to be measured.
3. If the 200 pF, 2 nF or 20 nF range has been selected and the display does not read zero, use the zero adjust knob to bring the reading to zero. The adjustment is limited to approximately ±20 pF.
4. To measure capacitances between 2000 μF and 20,000 μF depress both the 200 μF and 2000 μF buttons. Multiply the displayed reading by 1000.
5. Connect the alligator clips to the capacitor leads or insert capacitor leads into the capacitor test sockets.
6. Read the display value on the LCD. If display shows "1", it indicates an overrange measurement. If the display indicates one or more leading zero's, shift to the next lower range scale to improve the resolution of the measurement.

Measurement Considerations

1. If the capacitance value is unknown, start with the 200 pF range and push successive higher range buttons until the overrange indication disappears and a reading is obtained.
2. A shorted capacitor will indicate an overrange on all ranges. A capacitor with low voltage leakage will read overrange, or a much higher value than normal.

3. Very low capacitances should be measured by using extremely short leads in order to avoid introducing any stray capacitances.
4. When using the optional test leads, remember that the leads introduce a measurable capacitance.
5. Capacitors, especially electrolytics, often have wide tolerances. The measured value may be greater than the value marked on the capacitor. However, values are seldom drastically below the rated value.
6. The existence of a leaky capacitor may be detected if the value changes significantly as the ranges are changed.

Large Unknown Capacitance Test Method

To test a large unknown capacitance of more than 20,000 μF, use the following procedure:

1. Select a capacitor with a known value (over 10,000 μF and as close to 20,000 μF as possible), this value becomes Ck.
2. Place the unknown capacitor (Cx) in series with the known value capacitor (see Figure 1).
3. Measure the capacitance of this series combination. The measured value becomes Cs.
4. The unknown capacitor's value can now be calculated by using the following formula:

$$Cx = \frac{Ck \times Cs}{Ck - Cs}$$

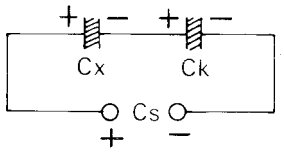


Figure 1

Useful Conversions

pF	nF	μF	Farad
1,000	1.0	0.001	
10,000	10.0	0.01	
100,000	100.0	0.1	
1,000,000	1000.0	1.0	
	10,000	10.0	
	100,000	100.0	
	1,000,000	1000.0	0.001
		10,000	0.01

Calibration Procedure

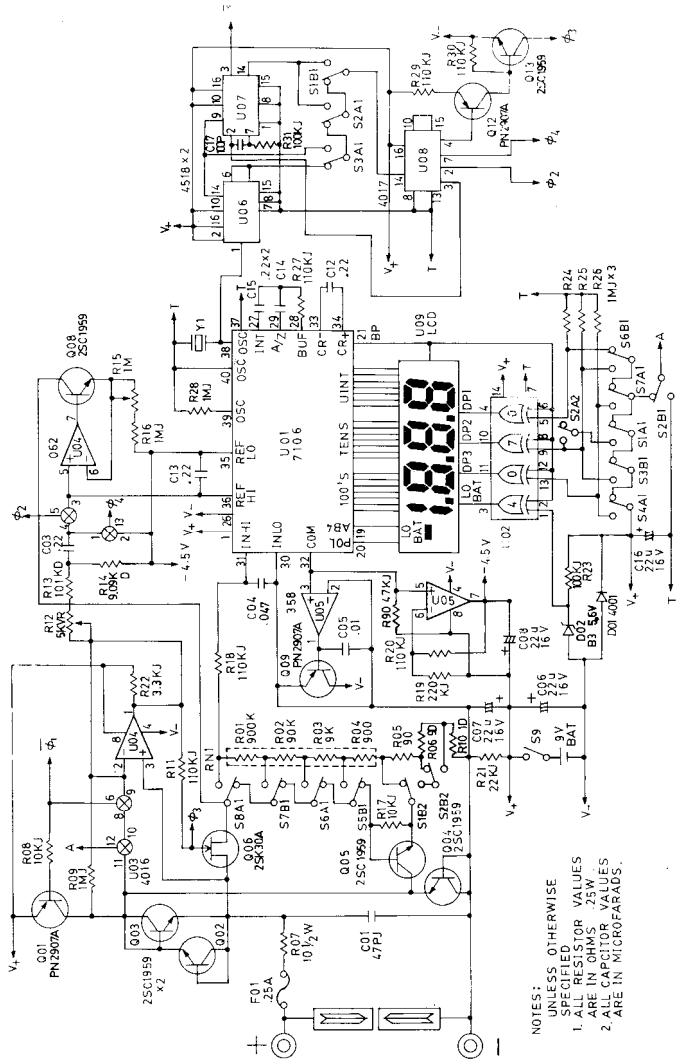
1. Press the 200 pF range button and adjust the zero capacitance knob until the display reads zero.
2. Connect a standard capacitor whose value is near a full scale reading on one of the higher ranges, and is known to have within $\pm 0.1\%$ accuracy.
3. Select the appropriate range scale.
4. Adjust R12 for display reading equal to the known standard capacitance.

Parts List

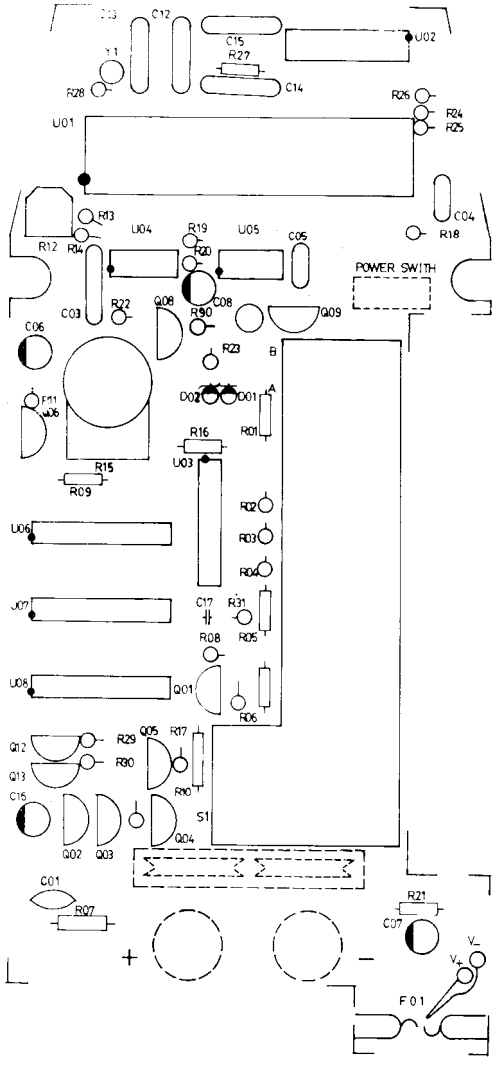
Part	Description
U01	IC, A/D Converter 7106CPL
U02	IC, CMOS MC14070BCP
U03	IC, CMOS MC14016BCP
U04	IC, Op Amp TL062
U05	IC, Op Amp LM358
U06,07	IC, CMOS MC14518BCP
U08	IC, CMOS MC14017BCP
U09	3½ Digit LCD
Q01,09,12	TR PNP PN2907A
Q02,03,04,05, 08,13	TR NPN 2SC1959
Q06	FET N-Ch 2SK30A
D01	Diode Rect. 1N4001
D02	Zener Diode 5.6 V
R01	Resistor 898 KΩ ¼ W 0.5% Metal Film
R02	Resistor 89.8 KΩ ¼ W 0.5% Metal Film
R03	Resistor 8.98 KΩ ¼ W 0.5% Metal Film
R04	Resistor 898 Ω ¼ W 0.5% Metal Film
R05	Resistor 89.8 Ω ¼ W 0.5% Metal Film
R06	Resistor 8.98 Ω ¼ W 0.5% Metal Film
R07	Resistor 10 Ω ½ W 5% Carbon
R08,17	Resistor 10 KΩ ¼ W 5% Carbon

Part	Description
R09,16,24,25, 26,28	Resistor 1 MΩ ¼ W 5% Carbon
R10	Resistor 1 Ω ½ W 0.5% Metal Film
R11,18,20,27, 29,30	Resistor 110 KΩ ¼ W 5% Carbon
R12	Resistor 5 KΩ Variable
R13	Resistor 100 KΩ ¼ W 1% Metal Film
R14	Resistor 9.09 KΩ ¼ W 0.5% Metal Film
R15	Resistor 1 MΩ Variable
R19	Resistor 220 KΩ ¼ W 0.5% Carbon
R21	Resistor 22 KΩ ¼ W % Carbon
R22	Resistor 3.3 KΩ ¼ W 5% Carbon
R23,31	Resistor 100 KΩ ¼ W 5% Carbon
C01	Capacitor 47 pF 50 V 5% Ceramic
C03,12,13,14, 15	Capacitor 0.22 μF 50 V 10% Metalized Poly
C04	Capacitor 0.047 μF 50 V 10% Mylar
C05	Capacitor 0.01 μF 50 V 5% Mylar
C06,07,08,16	Capacitor 22 μF 16 V Electrolytic
C17	Capacitor 100 pF 50 V 5% Ceramic
Y01	Crystal 32.768 kHz
F1	Fuse 250 mA/250 V

CX-920 Schematic Diagram



CX-920 Component Layout



Limited Warranty

Philips ECG, Inc. warrants to the original consumer purchaser that this Multimeter ("UNIT") shall be free from any defect in material and workmanship for a period of (1) year from the date of purchase. If a defect covered by this warranty occurs during this warranty period, you should return the unit to Philips ECG, Inc., freight prepaid, (CAREFULLY PACKED TO AVOID TRANSIT DAMAGE), together with your dated proof-of-purchase and a description of the defect to:

Philips ECG, Inc.
1025 Westminster Drive
Williamsport, PA. 17701
ATTN: Warranty Service

THIS WARRANTY DOES NOT COVER batteries or fuses, damage or malfunction resulting from improper handling, accident, misuse, abuse, damage while in transit for repairs, repairs by unauthorized person or agency or any other reason not due to defect in material or workmanship.

Philips ECG's liability is limited, in its sole discretion, to the repair or replacement of the UNIT with a new or reconditioned model of equivalent quality. In the event of replacement with a new or reconditioned model, the replacement will continue the warranty period of the original UNIT.

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