Model: MIC-4070D
DIGITAL LCR METER
OPERATION MANUAL

- **Inductance Measurement 0.1μH to 200H**
- **Capacitance Measurement 0.1pF to 20000μF**
- **Resistance Measurement 1mΩ to 20MΩ**
- **Dissipation Factor Measurement**

The Measure of Quality

TABLE OF CONTENTS

ONE : INTRODUCTION

Congratulations! You have just purchased some of the most advanced hand-held digital meters now obtainable. These meters are sure to provide years of reliable service.

The MIC-4070D is designed to measure the parameters of an impedance element with high accuracy and speed. Measurements of inductance, capacitance, resistance (equivalent series resistance) and dissipation factor are provided for over a broad band of ranges. In addition, you'll find that it is ideal for testing SMD type components. Plus, the instrument offers advanced features, such as the ability to perform precision measurements of very low resistances with the 2 ohm and 20 ohm ranges, and ideal for high inductances with the 20H and 200H ranges, along with the unique drop-proof construction, combine to make the unit the most versatile handheld LCR meter available today.

With proper care and use, these meters can provide years of reliable operation. Therefore, it is very important to completely familiarize yourself with the instrument before attempted use.

Please read this manual carefully, paying particular attention to the safety section.

1.1 Inspection

When you unpack your new Meter from its original packaging, carefully check each item for damage that may have occurred in shipment. If anything is damaged or missing, take the entire instrument, including the box and packing materials, back to the distributor from whom it was purchased, where they will either replace the missing or damaged item or the entire instrument.

1.2 Included Items

Meter Test Leads (1 pair) Battery
Fuses (1 installed, 1 spare)
SMD type component test probes TL-06. (optional)

1.3 Unit Description

Please use the drawings of the MIC-4070D, in conjunction with the following descriptions of the controls and connections to help familiarize yourself with the unit :

(1) Liquid Crystal Display . . .Indicates the value of capacitance connected to the test inputs.

(2) LCR/D Mode Switch . . .Selects either LCR or Dissipation Factor measurment mode.

(3) Function/Range Switch . .Selects the function and range for the desired measurement.

(4) Common Terminal Slot . .The negative (common) test connector for all measurements.

(5) Positive Terminal Slot . . .The positive (high) test connector for all measurements.

(6) Common Terminal Jack . .The negative (low) banana jack for measurements requiring the use of test leads.

(7) Positive Terminal Jack . . .The positive (high) banana jack for measurements requiring the use of test leads.

(8) Battery Compartment . . .Access for the battery and the fuse. The spare fuse is also stored here.

(9) Tilt Stand . . . . .Used to hold the instrument at an angle on a level surface, or when reversed to hang it from a projection.

(10) Zero Adjust . . . . .Control used to zero the display.

(11) Power Switch . . . . . . .Turns power to the instrument on and off.

TWO : OPERATION AND MEASUREMENT

2.1 Warning

Electricity can cause severe injuries or even death, sometimes even with relatively low voltages or currents.

Therefore it is vitally important that any electronic instruments such as these meters be totally understood before use.

Please do not use this instrument, or any other piece of electrical or electronic test equipment, without first thoroughly familiarizing yourself with its correct operation and use.

2.2 Cautions

(1) To obtain accurate impedance values, perform zero adjustment before measurements.

(2) Attempted measurement of charged capacitors will overload the instrument and cause the fuse to open. In extreme instances, damage to the unit can occur.

(3) If a dead or partially discharged battery is left in the instrument for an extended period, damage to the unit could result from battery leakage. Therefore it is important to replace a discharged battery promptly. Please dispose of the used battery in a proper manner. Additionally, if the instrument will not be used for an extended period, always remove the battery from the unit and store it separately.

(4) Do not use solvents or aromatic hydrocarbons to clean the instrument, or the plastic case may be damaged. If cleaning is necessary, use only a mild solution of warm water and soap.

(5) Capacitors are manufactured to operate under **certain conditions. Since the meter may test a capacitor under different conditions than of the manufacturer, the values might not be** identical.

This is not due to meter error, just the method of test. Therefore, if this is the case, check the capacitor's dissipation factor (≤ 0.1) and whether the test was conducted in series or parallel mode (ref. Section 3.6). Use the equations to convert between the modes. At this point, one should obtain a value to that stated on the capacitor.

(6) To ascertain if the meter is accurate, please use a standard capacitor that states test conditions.

2.3 MIC-4070D Zero Adjustments and Impedance Measurements

IMPORTANT INFORMATION :

1. As an added feature, the MIC-4070D has +/– offsets. The +/– offsets allow for measurements when the LCD is not at zero. The +/–offsets are applicable to components that are measured in the following modes: capacitor parallel (Cp), inductor series (Ls) and resistance series (Rs). The +/– offsets are not applicable for components that are tested Cs, Lp or Rp. To use this feature, just simply add/subtract the value from the measured value of a component.
2. For impedance measurements there are two different test modes: parallel and series. These distinct test modes obtain different results. Refer to section 2.4 for conversions.

2.3.1 Zero Adjustment and Capacitance Measurement

(1) Set the power switch to the "on" position.
(2) Set the mode switch to the "LCR" position.
(3) Set the Function/Range switch to the appropriate capacitance range for the capacitor under test. If the capacitance value is unkown, select the 200pF range.

NOTE : If test leads will be used in the measurement, have them plugged in the banana jacks, but not connected.

200pF, 2nF, 20nF, 200nF & 2μF Range (Cp) : Zero Adjustment (Cp Mode)

(4) Set the Capacitance meter to the selected Capacitance range.

(5) Using a small, flat-blade screwdriver, slowly turn the "O Adj" control to calibrate the display for a zero reading. Now the meter is calibrated for these four ranges.

(6) Set the meter to the proper capacitance range and go to step seven to measure capacitance.

20μF, 200μF, 2mF & 20mF (Cs) : Range Zero Adjustment (Cs Mode)

(4) Set the Capacitance meter to the 2μF Capacitance range.

(5) Using a small, flat-blade screwdriver, slowly turn the "O Adj" control to calibrate the display for a zero reading. Now the meter is calibrated for these four ranges.

(6) Set the meter to the proper capacitance range and go to step seven to measure capacitance.

Capacitance & Dissipation Factor Measurements

(7) Discharge the capacitor to be measured.

(8) Insert the capacitor leads into the component test sockets at the front of the meter. If the capacitor leads are too short, use the alligator clip leads provided with the instrument to connect to the capacitor. Be sure to observe the proper polarity if the capacitor is a polarized type.

(9) Read the capacitance value in the display. If "1– – –" (a one with the following 3 digits blanked) is shown (which indicates an over-range reading), move the range switch to the next higher capacitance. If necessary, perform zero adjustment before measurement.

(10) To measure the "Dissipation Factor" of the capacitor, set the mode switch to the "D" position, and read the dissipation factor value in the display.

(11) ESR Fur capacitors

"Equivalent series resistance" is typically much larger than the actual "ohmic" series resistance of the wire leads and foils that are physically in series with the heart of a capacitor, because ESR includes also the effect of dielectric loss. ESR is related to D by the formula ESR = Rs = D/wCs (where w represents "omega" = 2 pi times frequency). In 20mf range, the dissipation factor can be obtained by the formular D = WCsRs where Cs in the measured value and Rs is measured by 2Ω range.

NOTE: To avoid possible damage to the instrument, discharge all capacitors before attempting to measure the value or dissipation factor. Connecting a charged capacitor or applying a voltage to the input connectors may cause the 125mA fuse to open.

2.3.2 Zero Adjustment and Inductance Measurements

200μH, 2mH, 20mH, 200mH range (Ls) : Zero Adjustment & Measurements

(1) Set the power switch to the "on" position.

(2) Set the mode switch to the "LCR" position.

(3) Set the Function/Range switch to the appropriate range for the inductor under test. If the inductance value is unknown, select the 200μH range.

NOTE: Each range must have zero adjustment performed.

(4) Using a short piece of wire, such as a paper clip, temporarily connect the positive and negative measurement terminals together. Alternatively, if the clip leads will be used for the measurement, plug them into the banana jacks and connect the clips together.

(5) Use a small, flat-blade screwdriver and slowly turn the "O Adj" control to calibrate the display for a zero reading. Remove the calibration short.

(6) Insert the inductor leads into the component test sockets at the front of the meter. If the leads are too short, use the alligator clip leads provided with the instrument to connect to the inductor.

(7) Read the inductance value in the display. If "1 – – –" (a one with the following 3 digits blanked) is shown, move the range switch to the next higher range until the overrange indication is gone from the display. Repeat steps 4-7.

2H, 20H, 200H range (Lp): Zero Adjustment & Measurements

(1) Set the power switch to "on" position.

(2) Set the mode switch to the "LCR" position.

NOTE: These three range (Lp mode) must be zero calibrated at 200mH range.

(3) Set the Function/Range switch to the 200mH range.

(4) Using a short piece of wire, such as a paper clip, temporarily connect the positive and negative measurement terminals together. Alternatively, if the clip leads will be used for the measurement, plug them into the banana jacks and connect the clip together.

(5) Use a small, flat-blade screwdriver and slowly turn the "O Adj" control to calibrate the display for a zero reading. Remove the calibration short.

(6) Insert the inductor leads into the component test sockets at the front of the meter. If the leads are too short, use the alligator clip leads provided with the instrument to connect to the inductor.

(7) Read the inductance value in the display. If "1 – – –" (a one with the following 3 digits blanked) is shown, move the range switch to the next higher range until the overrange indication is gone from the display and a value is obtained.

(8) To measure the "Dissipation Factor" of the inductor, set the mode switch to the "D" position, and read the dissipation factor value in the display.

2.3.3 Resistance Measurements

NOTE: A. The 2, 20, 200, 2K, 20K, 200K ohm ranges of

resistance needs to be zero adjusted separately.

B. It can not be zero adjusted at 2M and 20M range. There is always a reading about .120 - .140 when input terminal are is short to zero adjust, set the range switch to the 200K range and zero adjust.

(1) Turn unit on.

(2) Set the mode switch to the "LCR" position.

(3) Set the Function/Range switch to the appropriate resistance range. If the value of resistance is unknown, select the 2 ohm range.

(4) Using a short piece of wire, such as a paper clip, temporarily connect the positive and negative measurement terminals together. Alternatively, if the clip leads will be used for the measurement, plug them into the banana jacks and connect the clips together.

(5) Use a small, flat-blade screwdriver and slowly turn the "O Adj" control to calibrate the display for a zero reading. Remove the calibration short.

(6) Insert the resistor leads into the component test sockets at the front of the meter. If the leads are too short, use the alligator clip leads provided with the instrument to connect to the resistor.

(7) Read the resistor value in the display. If "1———" (a one with the following 3 digits blanked) is shown, move the range switch to the next higher range until the overrange indication is gone from the display and a value is obtained. Repeat steps 3-7

2.4 Measurement Parameter Conversions

The parameter value for a component measured in a parallel-equivalent circuit and that value measured in a series-equivalent circuit may be different from each other. This means that the parallel-measured capacitance (inductance) of any given capacitor (inductor) will not be equal to the series-measured capacitance (inductance) unless the dissipation factor of the capacitor (inductor) equals zero. The equations in the table below show the relationship between the parallel- and the series-measured parameters of any given component :

Dissipation Factor Equations
(see table 1)

E.G. 1: With a measurement frequency of 1 kHz, a parallel-mode capacitance of 1000pF with a dissipation factor of 0.5 is equal to a series-mode capacitance of 1250pF.

$$Cs = (1 + D * D) * Cp$$
$$Cs = (1 + 0.5 * 0.5) \times 1000pF$$
$$Cs = 1250pF$$

E. G. 2: With a measurement frequency of 1 kHz, a series inductance of 1000μH with a dissipation factor of 0.5 has a series resistance of 3.14 ohms.

$$Rs = 2 * 3.14 * f * Ls * D$$
$$Rs = 2 * 3.14 * 1K * 1m \times 0.5$$
$$Rs = 3.14$$

However, at any given measurement frequency, the dissipation factor of a component is the same for both parallel equivalent and series equivalent circuits.

Additionally, the reciprocal of the dissipation factor (1/D) is equivalent to the Quality Factor (Q).

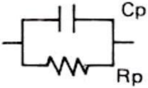
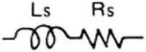
THREE : SPECIFICATIONS

3.1 Power Source

Battery Type: 006P 9V battery.
Power Consumptions: 155mW
Fuse Rate: 125mA 250V F(quick acting)

Section 2.4 Measurement Parameter Conversions

Table 1. Dissipation Factor Equations

Circuit Mode		Dissipation Factor	Conversiom to other modes
Cp mode		$D = \frac{1}{2\pi f C p R p} \left(= \frac{1}{Q}\right)$	$Cs = (1 + D^2)\, Cp, \quad Rs = \frac{D^2}{1 + D^2} \cdot Rp$
Cs mode		$D = 2\pi f Cs Rs \left(= \frac{1}{Q}\right)$	$Cp = \frac{1}{1 + D^2}\, Cs, \quad Rp = \frac{1 + D^2}{D^2} \cdot Rs$
Lp mode		$D = \frac{2\pi f Lp}{Rp} \left(= \frac{1}{Q}\right)$	$Ls = \frac{1}{1 + D^2}\, Lp, \quad Rs = \frac{D^2}{1 + D^2} \cdot Rp$
Ls mode		$D = \frac{Rs}{2\pi f Ls} \left(= \frac{1}{Q}\right)$	$Lp = (1 + D^2)\, Ls, \quad Rp = \frac{1 + D^2}{D^2} \cdot Rs$

* f : Test signal frequency

3.2 INSTRUMENT SPECIFICATIONS

Electrical Specifications

(see tables 2)

NOTE: (1) The test leads should be as short as possible to minimize the measurement error.

(2) For best accuracy, zero adjustment should be performed appropriately before testing.

FOUR: USER MAINTENANCE

4.1 Battery Replacement

When the instrument displays the "LO BAT" indication, the battery must be replaced to maintain proper operation. Please perform the following steps to change the battery :

(1) Remove the battery hatch by sliding it towards the bottom of the instrument.

(2) Unsnap the battery clip from the old battery. Snap the clip in place on a new battery. Please dispose of used batteries in a proper manner.

(3) Place the new battery in the battery compartment.

Table 2.

CAPACITANCE

Range	*Accuracy	Resolution	Test Condition	Overload Protection
200pf	1%+2	0.1pf	Parallel Mode 1KHz, 0.5Vrms	0.125A fuse
2nf		1pf		
20nf		10pf		
200nf		100pf		
2µf		1000pf		
20µf		0.01µf	Series Mode 120Hz,1mArms	
200µf		0.1µf	Series Mode 120Hz, 10mArms	
2mf	2%+10	1µf		
20mf		10µf		

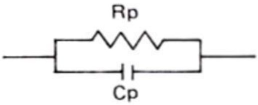
* Accuracy is ± (% of reading + number of digits) When D $\leqslant$ 0.1
The accuracy is applied from 10 to 100% of full scale range in series mode measurements.

DISIPATION FACTOR

Range		Accuracy		
0~1.999	200pf	2nf≤Cx≤2µf	2µf<Cx≤2mf	20mf
	N.S.	$1\%+10+\frac{2000}{Cx}$	$2\%+20+\frac{2000}{Cx}$	N.S.

Accuracy is ± (% of reading + number of digits).
Cx is capacitance readout in counts.
Accuracy is applied when C is from 20 to 100% of full scale range in series mode measurements.

Parallel Mode $Dc = \frac{1}{2\pi f\ CpRp}$



Series Mode $Dc = 2\pi f\ CsRs$

RESISTANCE

Range	Accuracy	Resolution	Test Condition		Overload Protection
2Ω	1%+5	1mΩ	Series Mode 1KHz	10mArms	0.125A fuse
20Ω	1%+2	10mΩ		10mArms	
200Ω		100mΩ		1mArms	
2KΩ		1Ω		0.1mArms	
20KΩ		10Ω		10μ Arms	
200KΩ		100Ω		1μ Arms	
2MΩ	2%+2	1KΩ	Parallel Mode 1KHz, 0.5Vrms		
20MΩ		10KΩ			

Accuracy is ± (% of reading + number of digits) and is applied from 10 to 100% of full scale range in parallel mode measurements.

In series mode measurements, the compliance voltage (Voltage drop on the device under test) should be less than 0.2 Vrms.

INDUCTANCE

Range	Accuracy	Resolution	Test Condition		Overload Protection
200μ H	2%+2	0.1μ H	Series Mode	10mArms, 1KHz	0.125A fuse
2mH	1%+2	1μ H		10mArms, 1KHz	
20mH		10μ H		1mArms, 1KHz	
200mH		100μ H		0.1mArms, 1KHz	
2H	2%+2	1mH	Parallel Mode 120Hz, 0.5Vrms		
20H		10mH			
200H	3%+2	100mH			

Accuracy is ± (% of reading + number of digits) When D$\leqslant$0.1
The accuracy is applied from 10 to 100% of full scale range in parallel mode measurements.

DISSIPATION FACTOR

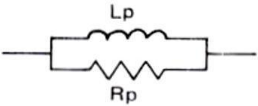
Range	Accuracy	
	$Lx \leq 200mH$	$200mH < Lx < 200H$
0~1.999	$1\% + 10 + \frac{2000}{Lx}$	$2\% + 20 + \frac{2000}{Lx}$

Accuracy is ± (% of reading + number of digits).

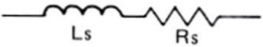
Lx is inductance readout in counts.

Accuracy is applied when L is from 20 to 100% of full scale range in parallel mode measurements.

Parallel Mode $D_L = 2\pi f \frac{Lp}{Rp}$



Series Mode $D_L = \frac{Rs}{2\pi f Ls}$



NOTE: **ALL THE ACCURACY IS GUARANTEED AT TEMPERATURE OF 15°C TO 28°C, RELATIVE HUMIDITY TO 80% AND HALF-YEAR CALIBRATION CYCLE.**

General Specifications

Power	Single 9V 006P Battery
Display	0.5" digital height, 3½-digits liquid crystal display with "LOBAT" and decimal annunicators
Low Battery Warning	Display will show "LOBAT" in the last 5% of battery life
Current Consumption	17.3mA
Temperature	0℃~40℃, Operating −20℃-70℃, Storage
Dimensions	177×88×40mm
Weight	400 gram
Standard Accessories	Test Clips (red & black) 1 pair Spare Fuse (0.125A/F) 1 piece Operation Manual 1 piece
Optional Accessories	Measurement clip TL-06 for SMD type component

(4) Replace the battery hatch by reversing the procedure used to remove it.

4.2 Fuse Replacement

If the fuse is suspected of being defective, it should be inspected and, if necessary, replaced. Fuse replacement is not normally required, but inadvertent measurement of a charged capacitor will cause the fuse to open. To inspect or replace the fuse, please perform the following steps :

(1) Remove the battery hatch by sliding it towards the bottom of the instrument.

(2) Remove the fuse from the fuse holder. Test for electrical continuity with an ohmmeter.

(3) If the fuse is found to be open, replace it with a 0.125 amp, 250 volt replacement fuse, like the spare included in the lower-left corner of the battery compartment.

(4) Replace the battery hatch by reversing the procedure used to remove it.

NOTE: USE OF ANY FUSE OTHER THAN THE 0.125 AMP, 250 VOLT UNIT SPECIFIED WILL DISABLE THE OVERLOAD PROTECTION AND MAY CAUSE DAMAGE TO THE INSTRUMENT.

4.3 In Case of Difficulties

These meters are designed to be accurate, reliable, and easy-to-use. However, it is possible that you may experience difficulties during operation. If there appears to be any kind of problem during use of the instrument, please perform the following steps to help determine the source :

(1) Reread the operating instructions. It is very easy to inadvertently make mistakes in operating procedure.

(2) Remove and test the fuse. The instrument will not function properly with an open fuse.

(3) Inspect and check the continuity of the test leads. The instrument will not function properly with broken test leads.

(4) Remove and test the battery. The instrument will not function properly with a discharged battery.

If the proceding four steps fail to resolve the problem, please refer to the "Obtaining Service" section.

NOTE: ATTEMPTED REPAIR, MODIFICATIONS, OR TAMPERING BY UNAUTHORIZED PERSONNEL WILL VOID THE WARRANTY.