LCR-600

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High Precision 100 kHz LCR Meter
User Manual

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1 Safety

1.1 Precautions ⚠

WARNING: The normal use of test equipment involves a certain amount of risk from electrical shock. The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of the instrument. The manufacturer assumes no liability for the customer’s failure to comply with these requirements.

You will significantly reduce the risk factor if you know and observe the following safety precautions:

- Don’t expose yourself to high voltage needlessly.
- Remove housings and covers only when necessary.
- Turn off equipment while making test connections on high voltage circuits.

- Discharge high voltage capacitors after removing power.
- If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
- Use an insulated floor material or large insulated floor to stand on, and an insulated work surface on which to place equipment. Make certain such surfaces are not damp or wet.
- Use the time proven "one hand in the pocket" technique while handling an instrument probe.
- Be particularly careful to avoid contacting a nearby metal object, which could provide an unwanted ground return path.
- When testing AC power equipment, remember that AC line voltage is usually present on some power input circuits such as the on-off switch, fuse, power transformer, etc. anytime the equipment is connected to an AC outlet, even if the equipment is turned off.
- Some equipment with two-wire AC power cords, including some with polarized power plugs, are the "hot chassis" type. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched.
- On test instruments, or any equipment with a 3-wire AC power plug, use only a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements grounded.

1.2 Compliance

The LCR-600 is CE compliant.

2 Product Contents and Inspection

This unit is tested prior to shipment. It is therefore ready for immediate use upon receipt. An initial physical inspection should be made to ensure that no damage has been sustained during shipment.

Inspect the packing box on receipt for any external damage. If any external damage is evident, remove the instrument and visually inspect its case and parts for any damage. If damage to the instrument is evident, a description of the damage should be noted on the carrier's receipt and signed by the driver or carrier agent. Save all shipping packaging for inspection. Forward a report of any damage to the agent through which the unit is procured.

Retain the original packing in case subsequent repackaging for return is required. Use of the original packing is essential.

After the mechanical inspection, verify the contents of the shipment. The items included in this package are:

- LCR Meter
- Power Cord
- User Manual
- BNC Plug to Clip Lead Wire

3 Introduction

3.1 Overview

The LCR-600 is a high precision test instrument used for measuring the inductance (L), capacitance (C), and resistance (R) of an electrical component.

The LCR-600 has an operational frequency range of 100 Hz to 100 kHz and basic measurement accuracy of 0.3%. There is a dual LCD display, measurement voltage fixed at 0.6 V, auto-detect function, and open-circuit /short-circuit compensation.

Use the LCR-600 to:

- Check ESR values of capacitors and inductors
- Sort and/or select components
- Measure unmarked and unknown components
- Measure capacitance, inductance, or resistance of cables, switches, circuit board foils, etc.

3.2 Impedance Parameters

The LCR-600 provides both DC and AC impedance measurements. Electrical impedance is the measurement of the opposition that a circuit presents to current when a voltage is applied.

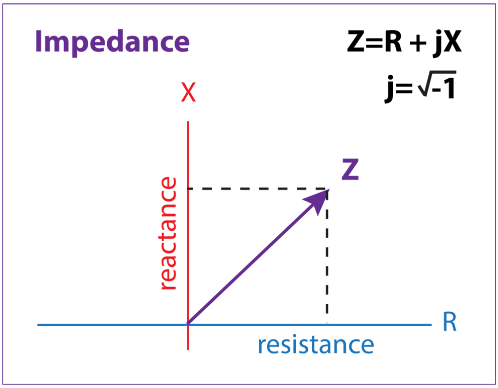


Figure 1

When showing the impedance as vector (Z), it is the addition of resistance (R) and reactance (X). On the Cartesian coordinate system this will be as shown in Figure 1.

$$Z=(R^2 + X^2)^{½}$$

$$\theta= Tan^{-1} (X/R)$$

Z= (Impedance)

R= (Resistance)

X= (Reactance)

Reactance contains (Inductive) X_L and (Capacitive) X_C components :

$$X_L = \omega L = 2\pi fL$$

$$X_C = 1/(\omega C)= 1/(2\pi fC)$$

C = Capacitance (F)

f = Frequency (Hz)

L = Inductance (H)

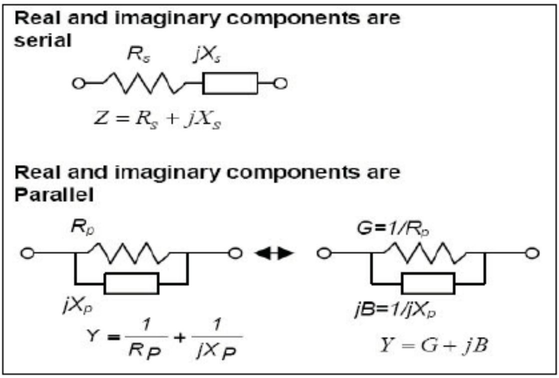
3.3 ESR or RP

Ideally, capacitors, inductors, or resistors only contribute capacitance, inductance, or resistance (respectively) to a circuit. But in reality, these components will always have non-zero values of the other two characteristics. For instance, a capacitor will not simply offer capacitance but will have some degree, however small, of resistance and inductance. These non-zero values we call the parasitics. Often they are negligible but depending on the degree of accuracy needed, they can be quite significant.

To more accurately describe a component we can imagine that rather than having one real-world capacitor let's say, instead we have an ideal capacitor (zero parasitics) in series with a resistor. We call this imaginary resistor the ESR (equivalent series resistance). By using this ESR method, we get a much more accurate value for the true capacity or inductance of the component.

The measurement of the equivalent impedance can be calculated both in series (ESR) and parallel (RP) relationship between the real and imaginary components. Their equations are as follows:

Figure 2



3.4 Quality and Dissipation Factors

Other, secondary measurements of the LCR-600 include Quality Factor (Q) and Dissipation Factor (D). These two measurements are actually reciprocals of each other. They refer to the damping characteristic of the electrical component. A higher Quality Factor (Q) means that the energy being transmitted through the component will “die out” more slowly. The component holds onto the energy longer. Dissipation Factor means just the opposite. It is a measure of how quickly the energy degrades.

$$Q = 1/D = \omega L_s/R_s = 1/\omega C_s R_s = \omega C_p R_p$$

Usually, Quality Factor (Q) relates to the inductance measurement and the Dissipation Factor (D) relates to the capacitance measurement.

4 Product Description

4.1 Primary Measurement Display

DCR: DC Resistance
Lp: Parallel Inductance
Ls: Serial Inductance
Cp: Parallel Capacitance
Cs: Serial Capacitance
Rp: Parallel Resistance
Rs: Serial Resistance

4.2 Secondary Measurement Display

L/C mode:

θ:	Phase Angle
D:	Dissipation Factor
Q:	Quality Factor
RP:	Parallel Impedance
ESR:	Serial Impedance

4.3 Front Panel Description

Figure 3

Control/Indicator Description
1 Main Display LCD
2 Secondary Display LCD
3 Power Button
4 FUNC (Auto LCR/L/C/R/DCR Function)
5 FREQ (Frequency Range)

6 CAL (Open Circuit / Short Circuit Calibration)
7 D/Q/ESR/θ Function
8 PC Function
9 SER /PAL (Series / Parallel Function)
10 HOLD (Display Hold)
11 SORT (Sorting Function Mode)
12 TEST (Sorting Function Test)
13 %ERR (Percentage Error)
14 UNIT (Unit Change)
15 Key Pad
16 Decimal Point
17 Enter
18 HPOT Terminal
19 HCUR Terminal
20 LPOT Terminal
21 LCUR Terminal

4.4 Rear Panel Description

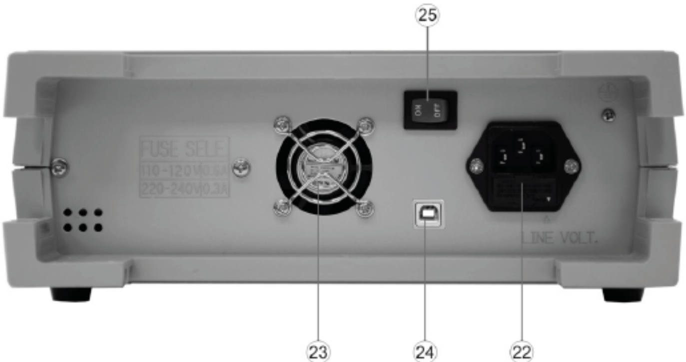


Figure 4

Control/Indicator Description
22 Input AC Power Selector and Fuse
23 DC Fan
24 USB Terminal
25 Line Power Switch

5 Operating Instructions

5.1 Connecting the LCR-600

Connect the power cable to your meter. Now connect the BNC Plug to Clip Lead Wire to the BNC terminals on the LCR-600. Make sure that you connect according to the color bands.

5.2 Powering On

LCR-600 has two power switches: Line Power Switch [25] on the rear panel for the transformer and then the Power Button [3] on the front panel for the operational system.

Switch “ON” the Line Power Switch [25] on the rear panel then press the Power Button [3] on the front panel to light the LCD.

5.3 Open Circuit / Short Circuit Compensation

LCR-600 provides open circuit and short circuit compensation so that you can measure high resistance and low resistance more accurately. You must first calibrate these functions. Start by making sure the clip ends of the leads are not touching each other. Set the display at “OPEN” by pressing the CAL [6] key for 2 seconds. The main LCD will display [Open]. Then press CAL [6] again to start the open circuit calibration. The calibration will need about 30 seconds, after which the LCD will display [PASS]. The LCR-600 has now automatically finished the open circuit calibration.

Now for the short circuit calibration, connect the two clip ends of the lead together to create a short circuit. Press the CAL [6] key again for 2 seconds. The main LCD will display [Srt]. Now press the CAL [6] key again to start the short circuit calibration. As with the open circuit calibration, wait 30 seconds. Afterwards, the LCD should display [PASS].

For more information about the purpose open circuit and short circuit compensation, see the appendix.

5.4 Auto LCR Mode

Press FUNC [4] key until the main display shows [Auto LCR]. This is the “quick-start” or most basic measuring mode. In this mode you can connect a component to the leads and the meter will automatically identify the item as inductor, capacitor, or resistor and read out a measurement accordingly. Press the FREQ [5] key to select a different frequency range. The meter will automatically select parallel or serial mode for the component. You will not be able to switch this. You will also not be able to select the D/Q/ESR/θ factor. To have more flexibility to change these items, switch over to Auto Mode.

5.5 Auto Mode

Press FUNC [4] key to change the function until the main LCD displays [Auto]. There are actually three modes available: Auto for inductors, capacitors, and resistors. Keep pushing the FUNC [4] to shift between them. The meter will automatically default to series measuring. Therefore you will see Ls, Cs, and Rs consecutively. For parallel mode press the SER/PAL [9] after you have arrived at the correct series measurement (Ls, Cs, or Rs). Now the meter will read Lp, Cp, or Rp respectively).

Auto Modes	Main LCD Display
Inductor parallel mode	Lp
Capacitor parallel mode	Cp
Resistor parallel mode	Rp
Inductor serial mode	Ls
Capacitor serial mode	Cs
Resistor serial mode	Rs
DC equivalent impedance	DCR

5.6 Measuring Inductance

Press the FUNC [4] key until the main display shows “Ls”. For parallel mode, press the SER/PAL [9]. Press again to switch back. Press the D/Q/ESR/θ [7] key to select the appropriate parasitic to measure.

5.7 Measuring Capacitance

When C is small and impedance is high, parallel impedance between C and Rp will become significantly higher than Rs. Thus the meter setting for measuring capacitance should be Cp. When C is large and impedance is small, parallel impedance for C and Rp is not as significant. Therefore, Cs should be used for the meter setting to measure capacitance. A good rule of thumb to select the impedance setting is to use Cp for capacitor impedance values greater than 10 kΩ and Cs for less than 10 Ω.

For some excellent resources on measuring capacitors see: TDK Tech Notes at: http://product.tdk.com/capacitor/mlcc/en/faq/faq00021.html

5.8 Percentage Error

This function allows you to compare the value the meter is displaying with a known or “theoretical” value. Take a measurement so that the screen is displaying a reading on the main display. Now press the REL [13], “Percentage Error” key. Enter the known or standard value onto the secondary display using the keypad. Now press the Enter [17] key. If the units must be changed, press UNIT [14] key to change the unit. Press the Enter [17] key again if needed. The secondary display will now give the difference between the standard value and the measuring value in “%”. The equation is as follows:

% error = | experimental value – theoretical value | / theoretical value x 100%

Note: If the percentage error is higher than 9999%, the LCD will display only [----].

5.9 Sorting Function Mode

The SORT function allows you to rapidly compare a reading to an established tolerance for a PASS or FAIL test. For instance, if your capacitors should be within 1% of 100 μF, then you can connect a capacitor and the LCR-600 will read out PASS or FAIL.

Press the SORT key to enter the sorting function mode. Key in the maximum percentage error (1%) and press Enter [17] key. Key in the standard value (100 μF) and press Enter [17]. Connect a component (capacitor) to test. Wait until the primary display shows a value for the component being tested. Press the Test [12] key. The secondary LCD will display [PASS] if the object is within the given tolerance or [FAIL] if not.

5.10 Display Hold Mode

Press HOLD [10] key. The LCR-600 will hold the previously recorded value. Press the HOLD [10] key again to release the value.

5.11 Measuring Frequency

Press FREQ [5] key to select the measuring frequency. The range can be one of five: 100 Hz,120 Hz,1 kHz, 10 kHz & 100 kHz.

5.12 Measuring DC Resistance

Press FUNC [4] key to change the LCR-600 function until the main LCD displays [DCR]. The LCR-600 is now under “DC Resistance Measuring Mode”.

5.13 Connecting to a Computer

The LCR-600 has a USB jack for you to connect to a computer. You will need to write your own software however, to link with the RS232 interface on the meter. Codes are provided in the appendix. Press PC [8] key. In the second LCD display will appear [RS232].

6 Maintenance

6.1 Preventive Maintenance

Please follow the following preventive steps to ensure the proper operation of your instrument.

- Never place heavy objects on the instrument.
- Never place a hot soldering iron on or near the instrument.

- Never insert wires, pins, or other metal objects into the ventilation fan.
- Never move or pull the instrument by the power cord or input lead.
- Never move the instrument while power cord is connected.
- Do not obstruct the ventilation holes in the rear panel as this will increase the internal temperature.
- Clean and check the calibration of the instrument on a regular basis to keep the instrument looking nice and working well.
- When the unit is not turning “ON”, check if the power switch is turned “ON”, or check the power cord. Make sure that the power is properly connected to the unit and ensure the AC supply at your site is the same as the mentioned at the rear chassis of the unit.

6.2 Fuse Replacement

If the fuse blows, both LCDs will not light and the instrument will not operate. Replace with the correct value fuse. The fuse is located on the rear panel adjacent to the power cord receptacle.

Remove the fuse holder assembly as follows.

- Unplug the power cord from the instrument.
- Insert a small screwdriver in the fuse holder slot (location between fuse holder and receptacle).
- Change the fuse and re-insert the holder.

Note: When re-inserting the fuse holder, be sure that the correct line voltage is selected.

6.3 Cleaning

Remove any dirt, dust, and grime whenever they become noticeable. Clean the outside cover with a soft cloth moistened with a mild cleaning solution.

7 Appendix

7.1 USB/RS232 Connection

Push PC function key to enable the RS232 transmission. The packet rate is two times per second. Each transmission includes 17 bytes totally.

7.1.1 Data Transmission Configuration

Baud rate	Start bit	Data bit	Stop bit	Parity
115200 bps	1bit	8 bits	1 bit	None

7.1.2 Data Code

Byte0	Byte1	Byte 2 ~ Byte13	Byte14	Byte15
BAH	10H	Data	0DH	0AH

7.1.3 Control Code

Byte0	Byte1	Byte2~Byte10	Byte11	Byte12
BAH	0DH	Control	0DH	0AH

7.1.4 Data Format Description

Byte	Data Byte	Function
2	STATUS 0	Status 0 indication
3	STATUS 1	Status 1 indication
4	MMOD	Operation mode of primary display on main LCD
5	MREADH	High byte of primary display data on main LCD
6	MREADL	Low byte of primary display data on main LCD
7	MSCOPE	Ranging information of primary display data on main

		LCD
8	MSTATUS	Status byte of primary display data on main LCD
9	SMOD	Operation mode of secondary display on main LCD
10	SREADH	High byte of secondary display data on main LCD
11	SREADL	Low byte of secondary display data on main LCD
12	SSCOPE	Ranging information of secondary display data on main LCD
13	SSTATUS	Status byte of secondary display data on main LCD

7.2 Open / Short Compensation

For precision impedance-measuring instruments, open and short compensation needs to be used to reduce the parasitic effect of the device under test (DUT). The parasitic effect of the DUT can be considered simple passive components as in Figure 5(a). When the DUT is open, the instrument gets the conductance $Y_o = G_o + J\omega C_o$ (Figure 5(b)). When the DUT is shorted, the instrument gets the impedance $Z_s = R_s + j\omega L_s$ (Figure 5(c)).

After the open and short compensation, the LCR-600 has Y_o and Z_s that will be used for the real Z_{DUT} calculation (Figure 5(d)) .

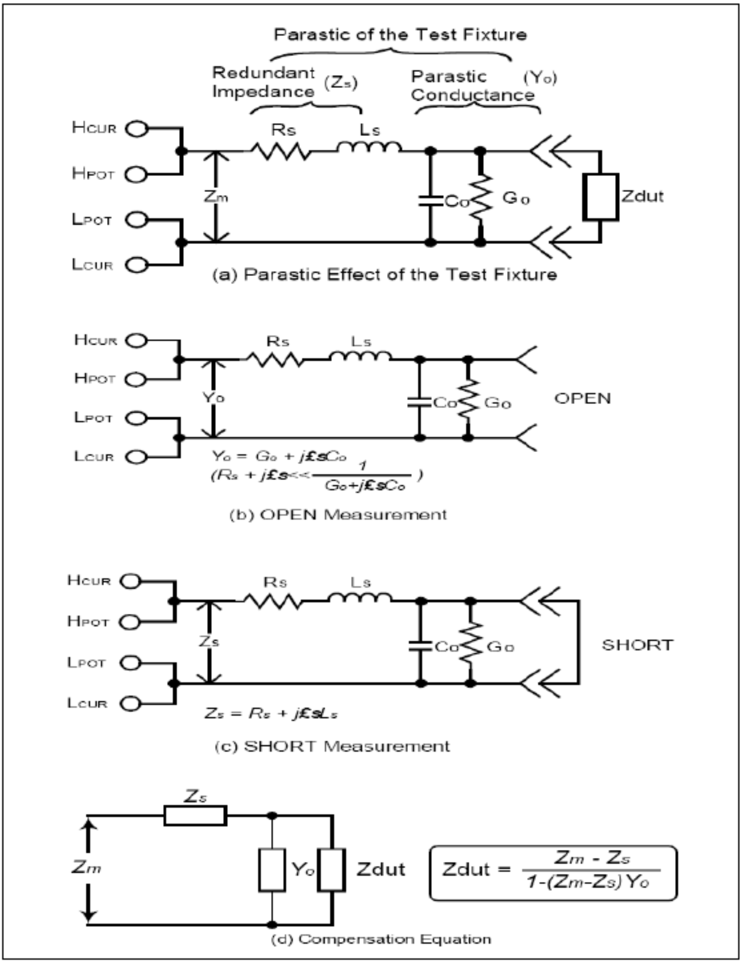


Figure 5

7.3 Selecting the Serial / Parallel Mode

Depending on your application, you may need to switch the measuring mode between series and parallel. It depends on whether you have high or low impedance values as to what mode is best.

7.3.1 Capacitor

The impedance and capacitance of a capacitor are inversely proportional. Therefore, the larger capacitance means the lower impedance, the smaller capacitance means the higher impedance. Figure 6 shows the equivalent circuit of capacitor. If the capacitance is small, the Rp is more important than the Rs. If the capacitance is large, the Rs cannot be neglected. Hence, it is proper to use parallel mode for low capacitance measurement and series mode for high capacitance measurement.

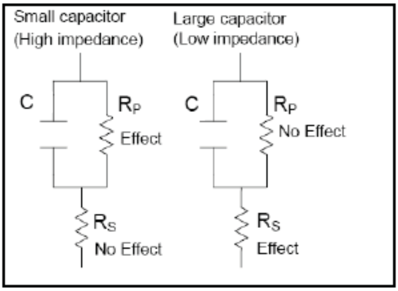


Figure 6

7.3.2 Inductor

The impedance and inductance of an inductor are directly proportional when test frequency is fixed. Therefore, larger inductance means higher impedance and vice versa. Figure.3 shows the equivalent circuit of inductor. When the inductance is small, the Rs becomes more important than the Rp. When the inductance is large, the Rp should be taking into consideration. Therefore, it is properly using series mode to measure an inductor with low inductance and parallel mode to measure an inductor with high inductance.

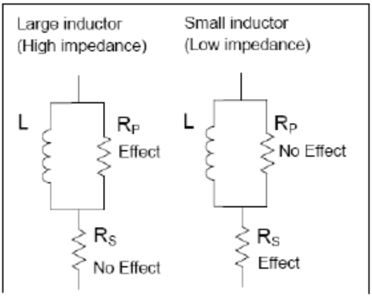


Figure 7

7.4 Calibration Sequence

This operation is for the qualified engineer only, and must use the manufacture's standard resistor. For this operation it is not necessary to switch on the Power Switch [3] on the front panel.

Before switch "ON" the Line Power Switch [25] on the rear panel the LCR-600, open the cabin and short circuit J11. Now switch "ON". The equipment will enter the Calibration Mode automatically. Main LCD will display [u1.08] and then [DCR], [AUTO], [10M Ω] and flash [Cal]. Adjust the voltage of VR(TP6) – VRL(TP7) to -500mV±10mV. Then Calibrate The LCR-600 as the following steps:

Step	Function	Range	Standard	Action
1	DCR	10MΩ	10.000MΩ	Input a standard 10MΩ. The display will flash. After the display was stable. Press CAL key to save the value, the display [10M Ω]will changed to [1MΩ].
2	DCR	1MΩ	1.0000MΩ	Input a standard 1MΩ and operate as step.1, the display will changed to [100KΩ].
3	DCR	100KΩ	100.00KΩ	Input the standard 100KΩ operate as Step.1, the display will be changed to [10KΩ].
4	DCR	10KΩ	10.000KΩ	Input a standard 10KΩ and operate as step.1, the display will changed to [1KΩ].
5	DCR	1KΩ	1.0000KΩ	Input a standard 1KΩ and operate as step.1, the display will changed to [100Ω].
6	DCR	100Ω	100.00Ω	Input a standard 100Ω and operate as step.1, the display will change to [10Ω].
7	DCR	10Ω	10.000Ω	Input a standard 10Ω and operate as step.1, the display will changed to[1Ω].
8	DCR	1Ω	1.0000Ω	Input a standard 1Ω and operate as step.1.

9	Open / Short Calibration	After Step.8, the LCD will display [OPEN]. Keep 2 input tip at “OPEN” condition and press CAL key. The LCD will flash 30sec and display [PASS], then short 2 input tip, the LCE will display [SRT]. Press CAL key, after 30sec. flash, the LCD will display [PASS], then go to step.10. If the LCD display [FAIL], repeat step.9 again.		
10	1KHz	10MΩ	10.000MΩ	The same operation as step.1.
11	1KHz	1MΩ	1.0000MΩ	The same operation as step.1.After step.11, the LCR-600 will changed to 10KHz automatically. Go to step.12.
12	10KHz	1MΩ	1.0000MΩ	The same operation as step.1.
13	10KHz	100KΩ	100.00KΩ	The same operation as step.1. After step.13, the LCD will display [100KHz] Go to step.14
14	100KHz	100KΩ	100.00KΩ	On this step, the resistor should be 100KΩ / 100KHz standard resistor. Operate as step.1
15	100KHz	10KΩ	10.000KΩ	Operate as step.1
16	100KHz	10Ω	10.000Ω	Operate as step.1.
17	100KHz	1Ω	1.0000Ω	Operate as step.1
18	After finished the calibration. The unit will power off automatically. Then please switch “OFF” the power switch and “OPEN” J11 and cover the cabin.			
19	After switching “ON” the unit again, the unit will return normal operation mode. Then press CAL key 2 sec to operate open circuit/short circuit calibration.			

8 Specifications

8.1 General

LCR-600	Specification
Input Power	115/230 V, 50/60 Hz, Fuse: 600/300 mA
Test Voltage	Constant 0.6 Vrms
Operating Environment	Temp: 0°C ~ 40°C (32°F ~ 104°F) Humidity: 20% ~ 80%
Storage Environment	Temperature: -20°C ~ 70°C (32°F ~ 104°F) Humidity: 0% ~ 90%
DCR	0.000 Ω to 9999 M Ω
ESR	0.000 Ω to 9999 Ω
Rp	0.000 Ω to 9999 Ω
D	0.000 to 9999
Q	0.000 to 9999
θ	- 90° to + 90°

8.2 LCD Display

Factor	Range
R	0.000 Ω to 9999 M Ω
L	0.000 uH to 9999 kH
C	0.000 pF to 9999 F
DCR	0.000 Ω to 9999 M Ω
ESR	0.000 Ω to 9999 Ω
Rp	0.000 Ω to 9999 Ω
D	0.000 to 9999
Q	0.000 to 9999
θ	- 90° to + 90°

8.3 Accuracy

All accuracies valid @ T_a = 18 – 28°C

8.3.3 Impedance Accuracy (Ae)

Freq/Z	DCR	100/120 Hz	1 kHz	10 kHz	100 kHz
0.1-1Ω	1.0%+5d	1.0%+5d	1.0%+5d	1.0%+5d	2.0%+5d

1-10Ω	0.5%+3d	0.5%+3d	0.5%+3d	0.5%+3d	1%+5d
10-100kΩ	0.3%+2d	0.3%+2d	0.3%+2d	0.3%+2d	0.5%+3d
100kΩ-1MΩ	0.5%+3d	0.5%+3d	0.5%+3d	0.5%+3d	1%+5d
1MΩ-20MΩ	1.0%+5d	1.0%+5d	1.0%+5d	2.0%+5d	2.0%+5d (1-2MΩ)
20MΩ-200MΩ	2.0%+5d	2.0%+5d	2.0%+5d	N/A	
Note	D < 0.1. If D > 0.1, the accuracy should be multiplied by $\sqrt{1+D^2}$				
	Zc = 1/2πfC if D<<0.1 in capacitance mode Zl = 2πfL if D<<0.1 in inductance mode				

8.3.4 C_{DUT} Accuracy

f	Accuracy (D < 0.1)					
100Hz	1.59mF ~15.9mF	159uF~1.59mF	15.9nF~159uF	1.59nF~15.9nF	79.6pF~1.59nF	7.96pF~79.6pF
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d	2.0%+5d
120Hz	1.33mF~13.3mF	133uF~1.33mF	13.3nF~133uF	1.33nF~13.3nF	66.3pF~1.33nF	6.63pF~66.3pF
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d	2.0%+5d
1kHz	159uF ~1.59mF	1.59uF~159uF	1.59nF~15.9uF	159pF~1.59nF	7.96pF~159pF	0.79pF~7.96pF
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d	2.0%+5d
10kHz	15.9uF ~159uF	1.59uF~15.9uF	159pF~1.59uF	15.9pF~159pF	0.79pF~15.9pF	-
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d	N/A
100kHz	1.59uF ~15.9uF	159nF~15.9uF	15.9pF~159nF	1.59pF~15.9pF	0.79pF~15.9pF	
	2.0%+5d	1.0%+5d	0.5%+3d	1.0%+5d	2.0%+5d	
If D > 0.1, the accuracy should be multiplied by $\sqrt{1+D^2}$						

8.3.5 L_{DUT} Accuracy

Freq.	Accuracy (Q > 10 or D < 0.1)				
100Hz	159uH~15.9mH	1.59mH~15.9mH	15.9mH~159H	159H~1.59kH	1.59Kh~20kH
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d
120Hz	133uH~1.33mH	1.33mH~13.3mH	13.3mH~133H	133H~1.33kH	1.33kH~20kH
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d
1kHz	1.59uH ~159uH	159uH~1.59mH	1.59mH~15.9H	15.9H~159H	159H~2.0kH
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	1.0%+5d
10kHz	1.59uF~15.9uH	15.9uH~159uH	159uH~1.59H	1.59H~15.9H	15.9H~20H
	1.0%+5d	0.5%+3d	0.3%+2d	0.5%+3d	2.0%+5d
100kHz	0.159uH ~1.59uH	1.59uH~15.9uH	15.9uH~159mH	159mH~200mH	
	2.0%+5d	1.0%+5d	0.5%+3d	1.0%+5d	
If D > 0.1, the accuracy should be multiplied by $\sqrt{1+D^2}$					

8.3.6 D Value Accuracy

f/Z	0.1–1Ω	1-10Ω	10–100kΩ	100k–1MΩ	1M-20MΩ	20M-200MΩ
100/120Hz	±0.010	±0.005	±0.003	±0.005	±0.010	±0.020
1kHz	±0.010	±0.005	±0.003	±0.005	±0.010	±0.050
10kHz	±0.010	±0.005	±0.003	±0.005	±0.002	
100kHz	±0.020	±0.010	±0.005	±0.010	±0.020	

8.3.7 Q value Accuracy

$$Qe = \pm \frac{Q^2 \times De}{1 \pm Q \times De}$$

8.3.8 θ value Accuracy

f/Z	0.1–1Ω	1-10Ω	10–100kΩ	100k–1MΩ	1M-20MΩ	20M-200MΩ
100/120Hz	±0.57°	±0.29°	±0.17°	±0.29°	±0.57°	±1.15°
1kHz	±0.57°	±0.29°	±0.17°	±0.29°	±0.57°	±2.86°
10kHz	±0.57°	±0.29°	±0.17°	±0.29°	±1.15°	N/A
100kHz	±1.15°	±0.57°	±0.29°	±0.57°	±1.15°	

8.3.9 Secondary Display Parameter Accuracy

- A_e = Impedance Accuracy
- Definition: Q = 1/D
- Rp = ESR (or Rs) x (1+1/D2)
- D value accuracy De = ±Ae x (1+D)
- ESR accuracy Re = ±Zm x Ae(Ω)
- Zm = impedance calculated by 1/2πfC or 2πfL
- Phase angle θ accuracy θe = ±(180/π) x Ae(deg)

Note: Specifications and information contained in this manual are subject to change without notice.

9 Service and Warranty Information

9.1 Warranty

Global Specialties warrants the LCR-600 to be free from defective material or workmanship for a period of 2 year from date of original purchase. Under this warranty, Global Specialties is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within the warranty period.

Units returned to Global Specialties that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Global Specialties, or that have been repaired by unauthorized persons will not be covered by this warranty.

Global Specialties reserves the right to discontinue models, change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Global Specialties is authorized to assume any other obligation in connection with the sale and purchase of this device.

9.2 Calibration and Repair

If you have a need for any calibration or repair services, please visit us on the web at: globalspecialties.com. See the “Service” tab. Or contact us via the “Contact” tab. You may also contact us at:

Test Equipment Depot - 800.517.8431 - 99 Washington Street Melrose, MA 02176
TestEquipmentDepot.com

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