Precision LCR Meter

LCR-800

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SAFETY INSTRUCTIONS

This chapter contains important safety instructions that you must follow when operating or storing the LCR-800. Read the following before any operation to insure your safety and to keep the LCR-800 in the best possible condition.

Safety Symbols
These safety symbols may appear in this manual or on the LCR-800.

⚠️ WARNING
Warning: Identifies conditions or practices that could result in injury or loss of life.

⚠️ CAUTION
Caution: Identifies conditions or practices that could result in damage to the LCR-800 or to other properties.

⚠️ DANGER High Voltage
Attention Refer to the Manual

⚠️ Protective Conductor Terminal
Earth (ground) Terminal

Do not dispose electronic equipment as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased.

Safety Guidelines

General Guideline

- Do not place any heavy object on the LCR-800.
- Avoid severe impact or rough handling that leads to damaging the LCR-800.
- Do not discharge static electricity to the LCR-800.
- Do not block or obstruct the cooling fan vent opening.
- Do not perform measurement at circuits directly connected to Mains (Note below).
- Do not disassemble the LCR-800 unless you are qualified as service personnel.

(Measurement categories) EN 61010-1:2001 specifies the measurement categories and their requirements as follows. LCR-800 falls under category I.

- Measurement category IV is for measurement performed at the source of low-voltage installation.
- Measurement category III is for measurement performed in the building installation.
- Measurement category II is for measurement performed on the circuits directly connected to the low voltage installation.
- Measurement category I is for measurements performed on circuits not directly connected to Mains.

Power Supply

- AC Input voltage: 100V-240V, 50-60/400Hz

⚠️ WARNING
- The power supply voltage should not fluctuate more than 110V-240V ±10%.
- Connect the protective grounding conductor of the AC power cord to an earth ground, to avoid electrical shock.

 Fuse

- Fuse type: FUSE 5TT 3A/250V

⚠️ WARNING
- Make sure the correct type of fuse is installed before powering up.
SAFETY INSTRUCTIONS

- To ensure fire protection, replace the fuse only with the specified type and rating.
- Disconnect the power cord before fuse replacement.
- Make sure the cause of fuse blowout is fixed before fuse replacement.

Cleaning LCR-800
- Disconnect the power cord before cleaning.
- Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid.
- Do not use chemical or cleaner containing harsh material such as benzene, toluene, xylene, and acetone.

Operation Environment
- Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution (Note below)
- Relative Humidity: < 85%
- Altitude: < 2000m
- Temperature: 10°C to 50°C

(Pollution Degree) EN 61010-1:2001 specifies the pollution degrees and their requirements as follows. LCR-800 falls under degree 2.

Pollution refers to “addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity”.

- Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
- Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

Storage Environment
- Location: Indoor
- Relative Humidity: < 85%
- Temperature: −20°C to 60°C

Disposal
Do not dispose this instrument as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased. Please make sure discarded electrical waste is properly recycled to reduce environmental impact.
SAFETY INSTRUCTIONS

Power cord for the United Kingdom

When using the LCR-800 in the United Kingdom, make sure the power cord meets the following safety instructions.

NOTE: This lead/appliance must only be wired by competent persons

⚠️ WARNING: THIS APPLIANCE MUST BE EARTHED

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

- Green/ Yellow: Earth
- Blue: Neutral
- Brown: Live (Phase)

As the colours of the wires in main leads may not correspond with the colours marking identified in your plug/appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⚡ or coloured Green or Green & Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse: refer to the rating information on the equipment and/or user instructions for details. As a guide, cable of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal /replacement must be destroyed by removal of any fuse & fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if a engaged in live socket. Any re-wiring must be carried out in accordance with the information detailed on this label.
Main Features

Performance
- 12Hz ~ 200kHz wide test frequency (LCR-821)
- 5 digit measurement resolution
- 2V DC bias voltage
- 0.05% basic measurement accuracy (LCR-821/819/817)
- 0.1% basic measurement accuracy (LCR-829/827/826)

Operation
- Automatic and manual measurements
- Dual measurement display
- Measurement in absolute values or as a deviation from a nominal value.
- Precision four wire fixture
- Component Sorting
- Up to 30V DC external bias voltage
- Internal memory
- Large Dot matrix display, 240x128 resolution
- Intuitive user interface, comprehensive measurement functions

Interface
- RS-232C (LCR-821), LCR-819/817/816 optional
- Handler Interface (LCR-829/827/826)

Model comparison

<table>
<thead>
<tr>
<th>LCR model</th>
<th>Test Frequency</th>
<th>821</th>
<th>819</th>
<th>829</th>
<th>817</th>
<th>827</th>
<th>816</th>
<th>826</th>
</tr>
</thead>
<tbody>
<tr>
<td>12Hz-200kHz</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12Hz-100kHz</td>
<td>●●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12Hz-10kHz</td>
<td>●●●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100Hz-2kHZ</td>
<td>●●●●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measurement Types

Measurement item

Primary measurements
- Capacitance (C)
- Inductance (L)
- Impedance (Z)
- Resistance (R)

Secondary measurements
- Dissipation factor (D)
- Quality factor (Q)(=1/D)
- Resistance (R)
- Phase Angle (θ)

Measurement combination
- ●:Available, —:Not available

<table>
<thead>
<tr>
<th>1st measurement</th>
<th>2nd measurement</th>
<th>Circuit model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (C)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Inductance (L)</td>
<td>●●</td>
<td>●●</td>
</tr>
<tr>
<td>Impedance (Z)</td>
<td>●●●</td>
<td>●●●</td>
</tr>
<tr>
<td>Resistance (R)</td>
<td>●●●●</td>
<td>●●●●</td>
</tr>
</tbody>
</table>

*Only the LCR-821 can select L/R and Z/θ measurement modes.
GETTING STARTED

Front Panel Overview

LCD Display
- 240 by 128, dot matrix LCD display.

Function keys
- Assigned to the menu on the right side of the display.

Number pad/menu keys
- Used to enter numerical values or access secondary menu functions.

LCR-800 User Manual

7. Bias
- The bias key selects an internal or external bias. The bias will be displayed on the bottom of the LCD display as INT.B (internal bias) or EXT.B (external bias).

8. On/Off
- The On/Off key turns the internal or external bias on or off.

4. PPM
- Measures Dissipation and Quality factor as PPM.

1. C.V
- Turns constant voltage mode on or off.

0. R.H
- Used to turn Range Hold On or Off.

-. FREQ
- Used to enter test frequencies.

Numerical numbers
- Used to enter numbers, decimals and negative values.

Enter
- The Enter key is used to confirm menu and number entries.
### GETTING STARTED

**Start**

The Start key is used to start measuring when in manual mode. The start key can also be used to select automatic or manual measuring modes.

 Hold the Start key for 3 seconds to toggle between auto and manual mode.

**Terminals**

Force and Sense terminals

- **LFORCE** Current return
- **LSENSE** Low potential
- **HSENSE** High potential
- **HFORCE** Current output

**Power Switch**

Turns the power on or off.

- **POWER**
  - On
  - Off

---

### Rear Panel Overview

**Contrast control**

The LCD contrast control

**External bias**

The positive and negative external bias.

- 30V (35V tolerable) Max voltage
- 200mA Max current
GETTING STARTED

Fuse / Power Socket

The fuse holder contains the main fuse, 5TT 3A/250V. For fuse replacement details, see page 123. The mains socket accepts the power cord. See page 18 for power-up details.

Ground

Ground input.

Handler Interface

Handler interface for binning (LCR-829/827/826 only).

RS-232 Interface

RS232 interface (LCR-821). RS232 interface is used for remote control with the LCR-Viewer software. RS232 is also available as a factory installed option (LCR-816/817/819).

Power Up

Tilt stand

Low Angle  Ensure the stand is up.

High Angle  Ensure the stand is down.

Panel operation

1. Connect the power cord to the socket.

2. Press the power button. The display becomes active in 2~3 seconds.

3. Use the contrast knob on the rear panel to adjust the LCD display contrast.
Fixture Connection

Fixture structure

The standard fixture is a four-wire type (Kelvin 4 wire). The outer terminals (Hforce and Lforce) provide the current and the inner terminals (Hsense and Lsense) measure the potential.

Diagram

**Description**

<table>
<thead>
<tr>
<th>Description</th>
<th>HFORCE</th>
<th>HSENSE</th>
<th>LSENSE</th>
<th>LFORCE</th>
<th>GND</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carries the signal current source.</strong> Connected to the + side of the device under test.</td>
<td>Carry the signal current source. Connected to the + side of the device under test.</td>
<td>Carry the signal current source. Connected to the + side of the device under test.</td>
<td>Carry the signal current source. Connected to the + side of the device under test.</td>
<td>Accepts the signal current return. Connected to the – side of the device under test.</td>
<td>If the test component has a large metal area NOT connected to either of the terminals, connect to the GND input to minimize noise level.</td>
</tr>
</tbody>
</table>
Fixture connection

Panel operation

1. Discharge the test component before connecting the fixture set.

2. Connect the Kelvin clip test lead into the front terminals. Line the lead fixture up to the front terminals and slide in. Turn the BNC handle counter clockwise to unlock the fixture. Turn the handles clockwise to lock the fixture.

3. Connect the fixture to the test component. If the component has polarity, connect the H side to the positive lead and the L side to the negative lead. Make sure the distance between the lead base and fixture clip is short enough.

4. If the test component has an outer case unconnected to either of the leads, connect to the ground terminal for noise level reduction.

External voltage bias connection

Background
An external voltage bias of 0-30 volts with a maximum of 200mA can be applied to the external voltage bias terminals on the rear panel. The external bias voltage must be floating and not connected to ground. For details for setting the external bias voltage see page 34.

1. Connect the voltage bias terminals to a bias voltage. Leave ground floating.
Zeroing

Zeroing calibration

Background
Open and short circuit calibration (zeroing) should be performed on a daily basis to correct for cable and fixture errors before taking measurements. When test fixtures or test cables are changed, the zeroing process should be performed again. All data performed during the calibration is stored in the internal memory of the LCR-800.

The Open circuit calibration determines the stray admittance and compensates high impedance measurements. The short calibration determines the residual impedance and is used when determining low impedance measurements.

Open circuit
The Open circuit calibration measures the stray admittance of the test fixture. This is used for high impedance measurements.

Procedure

1. Insert the test fixture or cable. Ensure the cables are not shorted and are open.

2. Press the MENU key, then OFFSET, followed by CAP OFFSET.

3. Wait for the calibration to finish. If the OPEN TEST was successful, the screen will display the following message:

   OPEN TEST OK
**GETTING STARTED**

**Warning**
If the test failed, ensure your cables or test fixtures are open and not shorted. Ensure R.H is OFF. After inspection try again.

**Short circuit**
The short test will calibrate the short circuit impedance of the cables or test fixtures. This is used for low impedance measurements.

4. Short the cables or test fixtures using a short thick copper wire if necessary.

5. Press R/L offset in the offset menu.

6. Wait for the calibration to finish. If the SHORT TEST was successful the following message is displayed.

**SHORT TEST** OK

**Warning**
If the test failed, ensure your cables or test fixtures are shorted. Ensure R.H is OFF. After inspection try again.

**Component Measuring Guidelines**

**Background**
For measuring Impedance, Capacitance, Inductance, and Resistance, series or parallel equivalent circuit models are available. Usually a component manufacturer will specify how a component should be measured and at what frequency. If not, use the guidelines below. Select the equivalent circuit and frequency according to the component value. For more information about equivalent circuit models and theory see page 124.

**General Inductors**
Inductors have always traditionally been measured in series equivalent circuits. For large inductors a lower test frequency yields more accurate results. For small inductors, higher frequencies are more accurate.

<table>
<thead>
<tr>
<th>Test Frequency</th>
<th>Expected Inductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1kHz</td>
<td>&lt;10μH</td>
</tr>
<tr>
<td>1kHz</td>
<td>10μH-1mH</td>
</tr>
<tr>
<td>10kHz</td>
<td>1mH-1H</td>
</tr>
<tr>
<td>100kHz</td>
<td>&gt;1H</td>
</tr>
</tbody>
</table>

Failure to pass both tests will result in erroneous measurements.
General Capacitors

Capacitors are usually measured in series except for extremely small capacitance. Like with inductors, larger capacitors should be measured with low frequencies. Small capacitors with high frequencies.

<table>
<thead>
<tr>
<th>Test Frequency</th>
<th>Expected Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10pF</td>
<td>10pF~400pF</td>
</tr>
<tr>
<td>0.1~0.12 kHz</td>
<td>1kHz</td>
</tr>
<tr>
<td>1kHz</td>
<td>10kHz</td>
</tr>
<tr>
<td>10kHz</td>
<td>100kHz</td>
</tr>
<tr>
<td>100kHz</td>
<td>Parallel</td>
</tr>
</tbody>
</table>

General Resistors

A series inductance circuit is the best equivalent circuit for low resistance (<1kΩ) and a parallel capacitance circuit for high resistances (>10MΩ).

<table>
<thead>
<tr>
<th>Test Frequency</th>
<th>Expected Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1kΩ</td>
<td>1kΩ~10MΩ</td>
</tr>
<tr>
<td>0.03kHz</td>
<td>0.25kHz</td>
</tr>
<tr>
<td>1kHz</td>
<td>Series</td>
</tr>
</tbody>
</table>

Metal component case connection

A large area of metal can add noise to the measurement. Here is how to minimize the effect.

If the metal is connected to one of the terminals, this should be connected to the Hforce terminal side.

If the metal is NOT connected to either of the terminals, connect to the GND terminal.

Wire capacitance

When measuring the wire capacitance, the fixture clips that are marked with Hf (High Force)/Hs (High Sense) should always be connected to the point that is influenced the most by noise.

Air-cored coils

Air-cored coils can pick up noise very easily, therefore they should be kept well clear of any test equipment that may contain power transformers or display scan circuitry. Also, keep the coils away from metal objects which may modify inductor characteristics.

Iron-cored and ferrite inductor

The effective value of iron-cored and ferrite inductors can vary widely with magnetization and test signal level. Measure them at the AC level and frequency in use. Unlike most inductors, a parallel equivalent circuit is most suitable for iron-cored inductors. When core materials are damaged by excessive magnetization (for example: tape heads and microphone transformers), check that the test signal is acceptable before connection.
Basic Measurement details how to measure individual components and how to configure the LCR-800 settings. Basic Measurement also describes how to save and recall memory. Advanced functions such as the handler menu or remote control are detailed on page 48 and 72, respectively.

### Measurement Item Description

In general, two measurement items, primary and secondary, are combined in a single measurement. The following table shows the available combinations. Details of the measurement modes and the circuit theory and formula can be found in the appendix, page 124.

#### Measurement combination

<table>
<thead>
<tr>
<th>1st measurement</th>
<th>2nd measurement</th>
<th>Circuit model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (C)</td>
<td>- - - - - - - -</td>
<td>Series Parallel</td>
</tr>
<tr>
<td>Inductance (L)</td>
<td>- - - - - - - -</td>
<td>Series Parallel</td>
</tr>
<tr>
<td>Impedance (Z)</td>
<td>- - - - - - - *</td>
<td>Series Parallel</td>
</tr>
<tr>
<td>Resistance (R)</td>
<td>- - - - - - - -</td>
<td>Series Parallel</td>
</tr>
</tbody>
</table>

*: available, __: not available

---

### Display overview

**Normal mode**

![Display diagram](diagram.png)

- **F1**: Speed
- **F2**: Display value
- **F3**: Mode
- **F4**: Frequency
- **F5**: Voltage model

- **L**: 0.23456 mH
- **Q**: 0.6789
Parameter Configuration

Measurement Speed

The LCR-800 series support 3 different measurement speeds: slow, medium or fast at approximately 1, 5 or 12 (LCR-829/827/826) measurements per second. The faster the measurement speed, the lower the accuracy. Conversely the slower the measurement speed, the higher the accuracy. The measurement speed and accuracy are dependent on the mode, voltage and frequency. For detailed information, see the specification table on page 136.

<table>
<thead>
<tr>
<th>LCR-817/819/821</th>
<th>Accuracy</th>
<th>Measurements/second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>0.05%</td>
<td>At least 1</td>
</tr>
<tr>
<td>Medium</td>
<td>0.1%</td>
<td>At least 3</td>
</tr>
<tr>
<td>Fast</td>
<td>0.24%</td>
<td>At least 7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR-816/826/827/829</th>
<th>Accuracy</th>
<th>Measurements/second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>0.1%</td>
<td>At least 1</td>
</tr>
<tr>
<td>Medium</td>
<td>0.2%</td>
<td>At least 3</td>
</tr>
<tr>
<td>Fast</td>
<td>0.48%</td>
<td>At least 7</td>
</tr>
</tbody>
</table>

Panel operation

1. From the main menu, press the SPEED menu key to cycle between the various speeds.

Displayed measurement unit

Measurement units

All measurement unit results can be displayed as the absolute values, delta values or delta percentage values.

Value will show the absolute value of the measurement in Ohms (Ω), Henries (H) or Farads (F). The primary measurement has resolution of 5 digits; the secondary has a resolution of 4 digits (θ, 2 digits).

Delta% will show the percentage deviation of L, C, R or Z from a nominal (stored) value.

Delta will show the deviation from a nominal value as an absolute value in Ohms (Ω), Henries (H) or Farads (F).

<table>
<thead>
<tr>
<th>Units</th>
<th>Value</th>
<th>Δ%</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ω, H, F</td>
<td>Absolute deviation (Ω, H, F)</td>
<td>% deviation</td>
<td></td>
</tr>
</tbody>
</table>
Measurement Modes

The LCR-800 has a number of different measurement modes. Primary and secondary measurements are displayed on the screen simultaneously. For detailed information regarding the measurement combinations, see the specifications on page 136. The measurement combinations are shown in the table below.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C/D)</td>
<td>Capacitance/Dissipation</td>
</tr>
<tr>
<td>(C/R)</td>
<td>Capacitance/Resistance</td>
</tr>
<tr>
<td>(L/R)*</td>
<td>Inductance/Resistance</td>
</tr>
<tr>
<td>(L/Q)</td>
<td>Inductance/Quality factor</td>
</tr>
<tr>
<td>(Z/θ)*</td>
<td>Impedance/Phase factor</td>
</tr>
<tr>
<td>(R/Q)</td>
<td>Resistance/Quality factor</td>
</tr>
</tbody>
</table>

Panel operation

1. From the main menu, press the MODE menu key to cycle between the different modes.

Note: Only the LCR-821 can select L/R and Z/θ measurement modes.

Select Equivalent Circuit Type

Series or Parallel equivalent circuits can be selected. Not all measurement modes can be used with both series and parallel equivalent circuits. For details about circuit types see the circuit theory chapter on page 124.

<table>
<thead>
<tr>
<th>Measurement type</th>
<th>Series</th>
<th>Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (C)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Inductance (L)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Impedance (Z)</td>
<td>●</td>
<td>—</td>
</tr>
<tr>
<td>Resistance (R)</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Set Bias voltage

Background

Voltage bias can be set internally or externally. An internal voltage bias of 2 volts is normally applied to a DUT. External voltage bias is able to accept 0 to 30 volts with a maximum current of 200mA. For external bias voltage connections see page 22. When measuring a DUT, please allow 1 second to stabilize a DUT after a bias voltage is applied. In general a bias voltage should only be applied to capacitors. If a bias voltage is applied to devices with low impedance, inaccurate measurements will occur.

Note: When an external voltage is applied, constant voltage mode (C.V.ON) must be enabled, page 39.
Panel operation

1. Press the 7/Bias key on the number pad to cycle from internal to external bias. The bottom of the screen will display internal or external bias.

2. Press 8/ON/OFF to turn the bias voltage on or off. The bottom of the screen will display the internal or external bias as on or off.

Set measurement frequency

Background

The measurement frequency, together with the measurement voltage is used to define the electrical characteristics of each measurement item. Make sure the appropriate frequency is selected according to the component characteristics.

The frequency range of each model is as follows:

- **100Hz~2kHz**: LCR-816/826
- **12Hz~10kHz**: LCR-817/827
- **12Hz~100kHz**: LCR-819/829
- **12Hz~200kHz**: LCR-821

The LCR-821 can provide 504 different frequencies with a 5 digit resolution including decimal places. Any frequency can be keyed from the number pad, and the closest available frequency (of 504) will be selected automatically. The LCR-818/829 has 503 different frequencies and the LCR-817/827 and LCR-816/826 have 489 and 245, respectively.

To calculate the different possible frequencies, use the tables below.

<table>
<thead>
<tr>
<th>LCR-821</th>
<th>Frequency range</th>
<th>Formula</th>
<th>n range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.012</td>
<td>0.23077kHz</td>
<td>3kHz/n</td>
<td>13 to 250</td>
</tr>
<tr>
<td>0.23438</td>
<td>15kHz</td>
<td>60kHz/n</td>
<td>4 to 256</td>
</tr>
<tr>
<td>15.385</td>
<td>200kHz</td>
<td>200kHz/n</td>
<td>1 to 13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR-819/829</th>
<th>Frequency range</th>
<th>Formula</th>
<th>n range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.012</td>
<td>0.23077kHz</td>
<td>3kHz/n</td>
<td>13 to 250</td>
</tr>
<tr>
<td>0.23438</td>
<td>15kHz</td>
<td>60kHz/n</td>
<td>4 to 256</td>
</tr>
<tr>
<td>15.385</td>
<td>100kHz</td>
<td>200kHz/n</td>
<td>2 to 13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR-817/827</th>
<th>Frequency range</th>
<th>Formula</th>
<th>n range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.012</td>
<td>0.23077kHz</td>
<td>3kHz/n</td>
<td>13 to 250</td>
</tr>
<tr>
<td>0.23438</td>
<td>10kHz</td>
<td>60kHz/n</td>
<td>6 to 256</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR-816/826</th>
<th>Frequency range</th>
<th>Formula</th>
<th>n range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10000</td>
<td>0.23077kHz</td>
<td>3kHz/n</td>
<td>13 to 30</td>
</tr>
<tr>
<td>0.23438</td>
<td>2kHz</td>
<td>60kHz/n</td>
<td>30 to 256</td>
</tr>
</tbody>
</table>

Panel operation

1. Press the -/FREQ key on the number pad.

2. Enter the frequency using the numerical keys, and then press ENTER.

1.0kHz
1.1kHz

The nearest frequency will be selected from the 504(LCR-281) nominal frequencies, and updated in the display. Here, the nearest frequency to 1.1kHz is 1.0909kHz.

F : 1.0909 kHz

Note After the test frequency has been changed, the zeroing must be performed again. See page 24

Set measurement voltage

Background Along with frequency, voltage can be set. Make sure the appropriate voltage is selected, according to the component characteristics.

Range 5mV ~ 1.275V (5mV steps) <200kHz
100mV ~ 1.275 (5mV steps) @200kHz

Voltage setting

1. From the main menu, press MENU (F5) followed by SETTING (F3) and VOLT (F2)
2. Enter the voltage using the numerical keys, and then press ENTER.
3. Press (F5) EXIT to exit the Setting menu.

The voltage is updated in the display. If the voltage entered is outside the allowable voltage range, the nearest voltage is selected.

Set PPM for D/Q measurements

Background Dissipation and Quality Factor (D/Q) measurements can be shown in parts per million (PPM) if D/Q is less than 0.0100. This increases the resolution by a factor of 100. The units of D and Q are dimensionless and are expressed as a decimal ratio with a multiplier of 1,000,000.

Ensure the operating mode has a D or Q component. See page 33.

Panel operation

1. Press 4/PPM to turn PPM on or off for all D/Q measurements
Set constant voltage source

Background If a DUT needs to be tested at a set voltage, the constant voltage function can be used. Using the C.V. function the LCR will maintain a source resistance of 25Ω. Therefore the test voltage is constant for any DUT impedance greater than 25Ω. Using the constant voltage feature will reduce the accuracy of measurements by a factor of 3.

Panel operation 1. Press 1/C.V to turn constant voltage on or off.

C.V ON / OFF is toggled each time the 1/C.V button is pressed.

Set Range hold

Background When DUTs are disconnected from the test cables/fixtures during continuous testing, Range Hold can be used to avoid range switching. This is particularly useful for repetitively testing a number of DUTs. For more information on Range and range hold, see the specifications, page 136.

Panel operation 1. Press 0/R.H to turn Range Hold on or off.

R.H ON / OFF is toggled each time the 0/R.H button is pressed.

Set Average

Background An arbitrary number of tests can be averaged to produce an averaged test result. 1-255 tests can be averaged. The larger the number of tests that are averaged, the longer the test time.

Panel operation 1. From the main menu, press MENU, followed by SETTING and AVGE.

2. Enter the number of number of averages (tests) using the numerical keys, and then press ENTER.
The average of 10 tests

2. Press EXIT to exit to the main menu.

Set Nominal Values

Background
The LCR-800 series are able to set nominal values when using the DELTA and DELTA% measuring modes. Nominal values can be set to up to 5 digits including decimal places. Each primary measuring unit can have the nominal value set.

Panel operation
1. From the main menu, choose the measuring mode that you wish to change by pressing (F3) MODE until the correct measuring mode is displayed.

   For example, if L/Q mode is selected, an inductance (mH) nominal value can be set.

3. Press MENU (F5), followed by SORT (F2) and NOM.VAL (F1).

   Enter the nominal number using the numerical pad, followed by ENTER. Up to 5 digits can be entered.

   0.6800mH

   The NOM.VAL key and screen will be updated when a nominal value is entered.

4. Press EXIT to exit to the main menu.
Running Measurement

Select Single measurement

Background Measurements can be manually controlled (MANU) or automatically updated (AUTO).
In manual mode, one measurement is performed by pressing the start key.

Panel operation 1. Press the START key to manually perform a measurement when in manual mode.

Select Automatic measurement

Background Measurement can be manually controlled (MANU) or automatically updated (AUTO).
In continuous mode (AUTO), measurements are automatically done and the display is updated according to the measurement speed setting.

Panel operation 1. Hold the START key for a few seconds to toggle between automatic (AUTO) and manual (MANU) mode.
2. When in AUTO mode, measurements will start automatically until AUTO mode is switched back to MANU.

The bottom of the screen will indicate if AUTO or MANU mode is activated.
Testing will appear on the screen each time a measurement is completed.
Store Recall

Store or Recall Memory Settings

Background  The LCR-800 series have 100 blocks of memory available for saving settings.

⚠️ Note  All memory is stored using an internal battery. The battery should last 3 years before replacement. If any files cannot be saved or recalled, please contact your local GW Instek distributor to have the battery changed.

The LCR-827/829 can also use the stored memory settings for Binning (page 48).

Panel operation

1. From the main menu, press MENU, SETTING AND MEMORY.

2. Press 2 to save the current measurement settings, or 1 to recall a previously saved memory setting.

3. Use the number pad to select a memory number and ENTER to confirm the selection. Range: 1~100

   Memory slot 10

4. The RECALL NO. or STORE NO. will be set accordingly.

   Recall Calibration Settings

   Background  When measurement values are inaccurate, original calibration settings can be recalled.

   Panel operation

1. From the main menu, press MENU, SETTING AND RECALL.

5. Press EXIT to exit to the main menu.

6. Press ENTER at any of the memory options to cancel.

Recall Calibration Settings

Background  When measurement values are inaccurate, original calibration settings can be recalled.

Panel operation

1. From the main menu, press MENU, SETTING AND RECALL.
2. Press 1 to recall the calibration settings or 2 to cancel.

OR

3. When the status bar has completed, the calibration settings are recalled.

4. Press EXIT to exit to the main menu.

⚠️ CAUTION

If the function keys are not active after calibration settings have been recalled, DO NOT turn off the instrument. Wait a few minutes and try again.

**BIN FUNCTIONS**

The Handler interface is used to sort components into different bins. The handler menu compares results from a number of different user defined limits. Component sorting can be accomplished in either manual or automatic mode. For more information on using the handler interface to sort components please see page 114.
Bin Summary Menu Overview ................................... 68
Bin Summary/Results ................................................. 70

Binning Menu

Handler Menu Overview

Mode Setting
- SET BIN
- BIN SUM
- CIRCUIT
- DISPLAY

Measurement Results
- F: 1.0000 kHz
- V: 1.000 V
- RANGE: 1
- DELAY: 0000ms

Settings
- Parameter: BIN, VALUE, OFF

Mode Setting
The mode setting area shows basic settings for the current bin mode.
- SET BIN Configures the Bin settings
- MODE Measurement mode
- SPEED Measurement speed
- BIN SUM Displays the Bin test results
- CIRCUIT Selects between serial and parallel circuits
- DISPLAY Selects what measurement unit is displayed.

Measurement Results
The primary and secondary measurement results are displayed.

Settings
The testing settings for the DUT can be edited here.
- F Frequency - model dependant
- V Voltage – model dependant
- Range Displays the current range
BIN FUNCTIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay</td>
<td>Delay between each measurement</td>
</tr>
<tr>
<td></td>
<td>Parameter 0~99999 ms</td>
</tr>
<tr>
<td>MANU/AUTO</td>
<td>Selects between automatic and manual mode</td>
</tr>
<tr>
<td>INT.B/EXT.B</td>
<td>Internal and External voltage Bias</td>
</tr>
<tr>
<td>C.V</td>
<td>Constant voltage</td>
</tr>
<tr>
<td>AVG</td>
<td>Number of Averages</td>
</tr>
</tbody>
</table>

Menu Keys

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>Scroll up through the menu items</td>
</tr>
<tr>
<td>↓</td>
<td>Scroll down through the menu items</td>
</tr>
<tr>
<td>SET</td>
<td>Edit the menu items</td>
</tr>
<tr>
<td>EXIT</td>
<td>Exit the menu</td>
</tr>
</tbody>
</table>

Handler Menu

Background
Before Bin Sorting, the measurement settings must be configured.

Panel operation
1. To access the handler menu, press MENU, SORT, HANDLER from the main menu.

2. The Handler menu appears.

Mode Setting

Background
Use the mode setting to change the measurement mode in the handler menu.

Panel Operation
1. Use the arrow menu keys (F1/F2) to move the cursor to MODE.

2. Press SET repeatedly to scroll through the different modes.

R/Q → C/D → C/R → L/Q
**Circuit Setting**

**Background**
Use Circuit setting to change the equivalent circuit.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to CIRCUIT.
   
   **CIRCUIT : SER.**
   
   2. Press SET repeatedly to select either serial or parallel circuits.
      
      | SER. | PAR. |
      |------|-----|
      | Serial Circuit | Parallel Circuit |

**Speed Setting**

**Background**
Use the Speed setting to change the measurement speed.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to SPEED.
   
   **SPEED : FAST**
   
   2. Press SET repeatedly to select FAST, MEDIUM or SLOW.

**Display Setting**

**Background**
Use the Display setting to change the measurement results as values or bins.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to Display.
   
   **DISPLAY : VAL.**
   
   2. Press SET repeatedly to make a selection.
      
      | VAL. | BIN | OFF |
      |------|-----|-----|
      | Display the primary and secondary measurement results as values. | Display the bin result (BIN1~13) | Don’t display results |

**Frequency Setting**

**Background**
Set the testing frequency.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to F (Frequency)
   
   **F : 1.0000 kHz**
   
   2. Use the number pad to enter a frequency and press ENTER to confirm.
      
      1.0000kHz
Select/Run Auto/Manu Sorting

Background Set the test mode from manual to automatic.

Panel operation
1. Hold the START key for a few seconds to toggle from automatic or manual bin sorting.
   The center of the screen will indicate if AUTO or MANU mode is activated.

2. To test in MANU mode, press the START key for each test. Testing will begin automatically in AUTO mode.

3. Results will be updated in the display, depending on the settings. Each time a test result has been completed, an asterisk will appear on the screen.

Voltage Setting

Background Set the testing voltage.

Panel Operation
1. Use the arrow menu keys (F1/F2) to move the cursor to V (Voltage)

   \[ V : 1.000 \text{ V} \]

2. Use the number pad to enter a voltage and press ENTER to confirm.

   1.000 V
BIN FUNCTIONS

Bias Setting

Background Set internal or external bias voltage.

Panel Operation
1. Use the arrow menu keys (F1/F2) to move the cursor to INT.B or EXT.B.

**INT.B OFF**

2. Press INT (F3) to use internal biasing.

3. Press EXT (F4) to use external biasing.

4. Use the arrow menu keys to highlight OFF/ON.

**INT.B OFF**

5. Press ON (F3) to turn bias voltage on.

6. Press OFF (F4) to turn bias voltage off.

Range Setting

Background The range can be selected from 1 to 4. Different ranges should be used for different components and component values and to ensure accurate readings.

<table>
<thead>
<tr>
<th>Range</th>
<th>Inductor</th>
<th>Component</th>
<th>Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range1</td>
<td>1–16mH/f</td>
<td>1.6–25uF/f</td>
<td>6.25–100Ω</td>
</tr>
<tr>
<td>Range2</td>
<td>16–256mH/f</td>
<td>100–1600nF/f</td>
<td>0.1–1.6kΩ</td>
</tr>
<tr>
<td>Range3</td>
<td>256–4100mH/f</td>
<td>6.4–100nF/f</td>
<td>1.6–25.6kΩ</td>
</tr>
<tr>
<td>Range4*</td>
<td>4.1–65H/f</td>
<td>400–6400pF/f</td>
<td>25.6–410kΩ</td>
</tr>
</tbody>
</table>

\[ f \text{ = test frequency in kHz} \]

* This range is not used above 20 kHz

Panel Operation
1. Use the arrow menu keys (F1/F2) to move the cursor to RANGE.

**RANGE: 1**

2. Press F3 (UP) to increase the range or F4 (DOWN) to decrease the range.

Constant Voltage Setting

Background Constant voltage is usually used when a set voltage is needed. For details about constant voltage, see page 39.

Panel Operation
1. Use the arrow menu keys (F1/F2) to move the cursor to C.V.

**C.V : OFF**
2. Press ON (F3) to turn constant voltage on.

3. Press OFF (F4) to turn constant voltage off.

Delay Setting

**Background**
The Delay Setting determines the delay time in milliseconds between each measurement.

**Note**
Delay time can also delay the menu response. When the instrument is in AUTO mode, any panel key presses will be delayed as well. This will result in a delay proportional to the Delay Settings.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to DELAY.

   **DELAY**: 00000mS

2. Use the number pad to enter the delay time followed by the Enter key

   100ms

**Average Setting**

**Background**
The average function chooses how many averages (1-255) are used for each measurement.

**Panel Operation**
1. Use the arrow menu keys (F1/F2) to move the cursor to AVERAGE.

   **AVG**: 1

2. Use the number pad to enter the number of averages followed by the Enter key

   100 averages
Set Bin Menu

Set Bin Menu Overview

**Bin number**
- Displays the current bin.

**Bin settings**
- **SORT BY**
  - Chooses the primary or secondary measurement to sort test results.
- **Tot_Bin**
  - Configures the amount of sort bins.
- **R_Nom.Val**
  - Sets the nominal value, depending on the **SORT BY R/Q** settings.
- **Q_Nom.Val**
  - Sets the nominal value, depending on the **SORT BY R/Q** settings.

**Bin parameters**
- Configures the maximum and minimum sort limits for the current bin.
  - **Max**: Sets the maximum bin as an absolute value.
  - **Min**: Sets the minimum bin as an absolute value.
  - **Ω+**: Sets the maximum bin value as a positive percentage offset from the nominal value.
  - **Ω-**: Sets the minimum bin value as a negative percentage offset from the nominal value.

---

Bin Menu

**Background**
- Before Bin Sorting, the measurement settings must be configured.

**Panel operation**
1. To access the handler menu, press MENU, SORT, HANDLER.
2. The Handler menu appears.
2. Use the arrow menu keys (F1/F2) to move the cursor to SET BIN.

SET BIN

4. Press SET (F3).

5. The Bin menu appears.

Sort Type

Background Depending on the measurement mode, items can be sorted by either the primary or secondary measurements.

Panel operation 1. Move the cursor to SORT BY in the Bin menu.

SORT BY R

2. Press F3 to switch from primary or secondary sorting.

Set Nominal Value

Background Depending on the measurement mode, a nominal value can be set. The nominal value unit depends on the measurement type, see Sort Type, page 63.

Panel operation 1. Move the cursor to Nom.Val in the Bin menu.

Nom.Val:

2. Use the number pad to enter a nominal value for the current sort bin.
BIN FUNCTIONS

Set Max/Min Absolute Limit

Background
The maximum and minimum absolute limits of the current bin can be set. The limit units depend on the measurement type, see Sort Type, page 63.

Panel operation
1. Move the cursor to MAX to set the absolute maximum limit.
2. Use the number pad to enter the maximum absolute value for the current sort bin. For example: 20 Ω.
3. Repeat the above procedure for MIN.

Set Max/Min Percentage Limit

Background
The maximum and minimum limits of the current bin can be set as a percentage of the nominal value. The limit units depend on the measurement type, see Sort Type, page 63.

Panel operation
1. Move the cursor to +% to set the positive percentage limit.
2. Use the number pad to enter the maximum percentage value for the current sort bin. For example: 10%.
3. Repeat the above procedure for -%.

Set Max/Min Secondary Measurement Limits

Background
The absolute maximum and absolute minimum limits of the secondary measurements can also be set.

Panel operation
1. Move the cursor to X_MAX, where X is the secondary measurement item.
2. Use the number pad to enter the maximum value for the current sort bin. For example: 0.1000.
3. Repeat the above procedure for X_MIN. Ensure that MIN is smaller than or negative compared to MAX.
Clear Bins

Background  All the bin settings can be cleared for all the bins.

Panel operation  1. Press NEXT BIN until BIN1 is the current bin.
2. Move the cursor to SORT BY in the Bin menu.
3. Press F1 to clear all the bin settings.
4. Press F2(YES ->) to confirm the clear or press F1(NO->) to cancel.

Note  Bin settings can only be cleared from Bin1.

Exit Set Bin Menu

Panel operation  1. Press EXIT at any time to exit the Bin Set menu.

Bin Summary Menu

Bin Summary Menu Overview

Bin Parameters  Shows the basic bin parameters used for the bin sorting.
SORT BY  Displays what measurement was used.
NOM_VAL  Displays the nominal value
*_MIN  Displays the secondary measurement sort limits.

Test Results- Fail  Shows all the failed test results. Any tests that failed bin sorting will appear here.
**BIN FUNCTIONS**

- **PHI**: Indicates that a test result is greater than the maximum limit.
  
  **PHI** = Primary Hi

- **PLO**: Indicates that a test result is less than the minimum limit.
  
  **PLO** = Primary Lo

- **SREJ**: The secondary limit is out of range (NG).
  
  **SREJ** = Secondary Rejection

- **TOTAL**: Displays the total amount of failed test results.

**Test Results - Pass**: Shows the total amount of passed results.

**Bin1-Bin2**: Displays the bin range and the total amount of passed test results.

**Bin Results**: Shows the results for each Bin.

- **BIN**: Shows the Bin number
- **MAX X**: Displays the maximum limit for each bin
- **MIN X**: Displays the minimum limit each bin
- **TOTAL**: Displays the total results for each bin.

**Menu Keys**

- **NEXT PAGE**: Goes to the next results page.
- **LAST PAGE**: Goes to the previous results page.
- **CLR.**: Clears the results.
- **EXIT**: Exits the Bin Summary menu.

---

**LCR-800 User Manual**

**Bin Summary/Results**

**Background**

After the bins have been set up (page 61) and sorting has been completed (page 55) the measurement results/summary can be shown.

**Panel Operation**

1. Use the arrow menu keys (F1/F2) to move the cursor to BIN SUM.

2. Press SET to enter the BIN SUM menu.

3. The BIN SUM menu appears.

<table>
<thead>
<tr>
<th>SORT BY R</th>
<th>NOM VAL:</th>
<th>Q_MAX:</th>
<th>Q_MIN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1110.0Ω</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL_ITEM</th>
<th>TEST RESULT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI</td>
<td>(R-MAX)</td>
<td></td>
</tr>
<tr>
<td>PLO</td>
<td>(R-MAX)</td>
<td>2</td>
</tr>
<tr>
<td>SREJ</td>
<td>(O-N4)</td>
<td>32</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PASS_ITEM</th>
<th>MAX:</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIN 1—BIN2</td>
<td>855</td>
<td></td>
</tr>
</tbody>
</table>

4. Press NEXT PAGE or LAST PAGE to navigate the result pages.
5. To clear the test results, press CLR followed by F3 (YES->) to confirm.

6. Press EXIT to exit the bin summary results.

---

RS232 REMOTE

The LCR-821 (LCR-816/817/819 as options) includes RS232C remote connectivity. With the RS232 VIEWER software, the LCR meter can be remotely controlled and all test results can be saved to a PC.

<table>
<thead>
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<th>LCR Setup</th>
<th>RS232 Settings .............................................................</th>
<th>73</th>
</tr>
</thead>
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<td>LCR Viewer</td>
<td>LCR VIEWER Display Overview ........................................</td>
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<td></td>
<td>LCR Viewer Connection and File Settings ................................</td>
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<td></td>
<td>LCR Viewer File Settings ..............................................</td>
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<tr>
<td></td>
<td>LCR Viewer Remote Measurement .........................................</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>View Data .....................................................................</td>
<td>81</td>
</tr>
<tr>
<td>Terminal</td>
<td>Configure Terminal Connection ........................................</td>
<td>84</td>
</tr>
<tr>
<td>Connection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LCR Setup

RS232 Settings

Background  RS232 must first be enabled on the LCR-800 before trying to connect with a PC.

Panel operation

1. From the main menu, press MENU, SORT AND RS232.

2. Press F1 to turn the RS232 interface ON or F2 to turn RS232 OFF.

3. RS232 status will be shown on the display.

4. Press EXIT to return to the main menu.

LCR Viewer

LCR VIEWER Display Overview

Background  LCR-Viewer mimics the LCR-800 series front panel and operates in a similar manner.

Menu Bar  Configures all PC settings, connection settings and shows data results.

Virtual Panel Meter  Simulates the LCR-800 series front panel.

Time  The current time, used to tag test results.
Message Area
The message area displays the current status of connection, results, files saved and restored.

Message Display Key
The Message Display Key turns the Message Area on/off.

LCR Viewer Connection and File Settings

Background
Before LCR Viewer can be used the connection settings and file settings must be set appropriately.
Please ensure LCR Viewer has been installed.

Connection Settings
1. Connect the LCR meter to the PC with an RS232 cable.
2. Ensure the LCR-800 is set to manual (single) measurement mode.
3. Ensure RS232 has been enabled on the LCR meter.
4. Run the LCR Viewer program.
5. Go to the Option→Settings menu.
6. The Settings panel appears.
7. Choose the COM port. Please see the Windows Device Manager for the applicable COM port setting.
8. Choose the baud rate. (Default 38400)
9. Left click OK to confirm the connection settings.
10. When the connection settings are completed successfully, the LCR-800 display will show RS232 ONLINE.
LCR Viewer File Settings

Background

The LCR Viewer file system stores 10000 test results per file. The files are comprised of the file name identifier and file number identifier.

The file name identifier consists of 4 user-defined characters. The file number identifier is incremented per 10000 test results. If LCR Viewer is terminated before 10000 test results, the data will be saved and then the next file will start anew. The file number identifier starts at 0001 and increments to a maximum of 9999. The file number identifier cannot be user-defined, but can be reset to 0001.

<table>
<thead>
<tr>
<th>Test Result</th>
<th>File Name Identifier</th>
<th>File Number Identifier</th>
<th>Filename</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–10000</td>
<td>LCR_</td>
<td>0001</td>
<td>LCR_0001.txt</td>
</tr>
<tr>
<td>10001–20000</td>
<td>LCR_</td>
<td>0002</td>
<td>LCR_0002.txt</td>
</tr>
<tr>
<td>99980001–</td>
<td>LCR_</td>
<td>9999</td>
<td>LCR_9999.txt</td>
</tr>
<tr>
<td>99990000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Ensure the LCR-800 is set to manual (single) measurement mode.

2. Go to the Option→Settings menu.
File Settings

3. Choose a drive and directory from the drop down selections.

4. Type a file name identifier in the File_Name panel. LCR_ is the default.

5. Check FileNum Reset if you want the file number identifier to be reset to 0001. Then left-click Yes to confirm.

Confirm Settings

6. Left click OK to confirm the connection and file settings.

Note

All file menus (File, Option, Data, Help) are restricted in Auto mode. To change to manual mode see page 80 to change to Manual mode remotely.

LCR Viewer Remote Measurement

Background

The LCR Viewer Software mimics the LCR-800 meter front panel. Remote operation is identical.

To operate any of the controls remotely, a mouse must be used. A keyboard cannot be used.

Operation of LCR Viewer is the same as the operation of the LCR meter.

Note

If a button is grayed-out, the key or operation is not currently selectable.

Operation

1. To choose a menu key, click any F1~F5 menu key.

2. To use a number key, click any of the number keys.

3. To choose an operating mode, right click the Start button and click the AUTO/MANU pop-up button.

4. To run a measurement in manual mode, click the start button.

5. To stop measuring in Auto mode, right click the start button and click the AUTO/MANU pop-up button.
6. To exit LCR Viewer, press the POWER button or go to the File→ Exit menu.

7. To turn the message area on or off press the Message button.

View Data

Up to 10000 test results are stored in each file. Each test result is stored as comma separated variables in a text file. Each test result stores the test number, mode, primary and secondary measurements and the time.

For more information on the way the files store test results see page 78.

Operation

1. Ensure the LCR-800 is set to manual (single) measurement mode.

2. To view the test result data, go to the Data→ result menu.

3. The test results appear in the data window.

Note All file menus (File, Option, Data, Help) are restricted in Auto mode. To change to manual mode see page 80 to change to Manual mode remotely.

View Help

The Help menu is to view the software version and copyright information

Operation

1. Ensure the LCR-800 is set to manual (single) measurement mode.

2. Go to the Help→ About menu.

3. The About information appears
4. Press OK to exit.

**Note**
All file menus (File, Option, Data, Help) are restricted in Auto mode. To change to manual mode see page 80 to change to Manual mode remotely.

**Exit LCR Viewer**

**Operation**
1. Press the POWER software button or go to File→Exit when in manual mode.

**Note**
All file menus (File, Option, Data, Help) are restricted in Auto mode. To change to manual mode see page 80 to change to Manual mode remotely.

**Terminal Connection**

**Configure Terminal Connection**

**Background**
To connect the LCR-800 to a terminal program, follow the instructions below.

**Connection Settings**

1. Connect the LCR meter to the PC with an RS232 cable.

2. Ensure the LCR-800 is set to manual (single) measurement mode. Page 43

3. Ensure RS232 has been enabled on the LCR meter.

4. Open a terminal program such as MTTTY (Multithreaded TTY).

5. Check the COM port settings on the PC. In Windows use Device Manager. Go to the Control Panel→System→Hardware tab to see the COM port settings.
6. Connect to the terminal program with the following configuration settings:
   - COM port (as per PC)
   - Baud rate- 38400
   - Data bits- 8
   - Stop bit- 1
   - Parity- none
   - Flow control- none

   From the terminal program enter the following commands, with \^END\^M or \^J\^M as the terminal characters.
   Terminal command: COMU?
   LCR Return: COMU:ON..
   Terminal command: COMU:OVER
   LCR Return: COMU:OVER

8. The LCR-800 will display RS232 ONLINE when the connection is successful.

9. See the Programming chapter for remote programming details.
Programming

Command overview lists all the LCR-800 commands and command queries. The command syntax section shows you the basic rules you have to apply when using commands.

Command Syntax

There are a number of different instrument commands and queries. A command sends instructions or data to the LCR meter and a query receives data or status information from the LCR meter. Measurements are automatically sent when a measurement is made in manual or automatic mode.

Command Types

**Command**

Two or more commands separated by a colon (:) with/without a parameter

Example MEMO:STOR 100.<^END^M>

**Query**

A query is a compound command followed by a question mark (?). A parameter (data) is returned.

Example SORT:NOMV?<^END^M>

**Measurement**

Returns measurement data. Can be manually or automatically updated.

Example MAIN:PRIM 32.705<^END^>
As can be seen above, positive input numbers use the ASCII “+” whilst the output will use a “sp” space character to represent a positive number. Negative numbers are identical for both input and output.

Combining Commands

Commands and queries can be combined to form a large continuous command. Each command must be separated with a line feed character `<^END> (or <^J>). The combined command must be terminated with a line feed and carriage return character `<^END^M (or <^J^M>). All messages and parameters will be returned sequentially with a line feed character (`-^END) separator.

**ASCII example**

```
MAIN:FREQ 1.0000<^END>(or <^J>) MAIN:VOLT 1.00<^END>(or <^J>) MAIN:SPEE:FAST<^END^M (or ^J^M)
```

**Hex example**

```
4D 41 49 4E 3A 46 52 45 51 20 31 2E 30 30 30 30 30 0A 4D 41 49 4E 3A 56 4F 4C 54 20 31 2E 30 30 30 0A 4D 41 49 4E 3A 55 50 45 45 53 3A 46 41 53 54 0A 0D (Hex format)
```
SPEED  Command/Query

The speed command sets the measurement speed of the instrument. The faster the measurement speed the lower the accuracy. This command also queries the current measurement speed.

Syntax  MAIN:SPEE:<string><^END^M> or <^J^M>

Parameter

<table>
<thead>
<tr>
<th>&lt;string&gt;</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOW</td>
<td>Slow</td>
</tr>
<tr>
<td>MEDI</td>
<td>Medium</td>
</tr>
<tr>
<td>FAST</td>
<td>Fast</td>
</tr>
</tbody>
</table>

Example  MAIN:SPEE:SLOW<^END^M>
Set the measurement speed to slow.

Query Syntax  MAIN:SPEE?<^END^M> or <^J^M>

Return String

<table>
<thead>
<tr>
<th>&lt;string&gt;</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN:SPEE:SLOW&lt;^END&gt;</td>
<td>Slow</td>
</tr>
<tr>
<td>MAIN:SPEE:MEDI&lt;^END&gt;</td>
<td>Medium</td>
</tr>
<tr>
<td>MAIN:SPEE:FAST&lt;^END&gt;</td>
<td>Fast</td>
</tr>
</tbody>
</table>

Query Example  MAIN:SPEE?<^END>
Currently the display is set at value.

DISPLAY  Command/Query

The display command sets the displayed measurement as a value or as an offset from a nominal value (Delta or Delta%).

Syntax  MAIN:DISP:<string><^END^M> or <^J^M>

Parameter

<table>
<thead>
<tr>
<th>&lt;string&gt;</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALU</td>
<td>Unit Value</td>
</tr>
<tr>
<td>DELP</td>
<td>Delta %</td>
</tr>
<tr>
<td>DELT</td>
<td>Delta</td>
</tr>
</tbody>
</table>

Example  MAIN:DISP:VALU<^END^M>
Set the display to Value

Query Syntax  MAIN:DISP?<^END^M> or <^J^M>

Return String

<table>
<thead>
<tr>
<th>&lt;string&gt;</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN:DISP:VALU&lt;^END&gt;</td>
<td>Value</td>
</tr>
<tr>
<td>MAIN:DISP:DELP&lt;^END&gt;</td>
<td>Delta %</td>
</tr>
<tr>
<td>MAIN:DISP:DELT&lt;^END&gt;</td>
<td>Delta</td>
</tr>
</tbody>
</table>

Query Example  MAIN:DISP?<^END>
Currently the display is set at value.

MODE  Command/Query

The mode command sets the measurement mode of the LCR-800.

Syntax  MAIN:MODE:<string><^END^M> or <^J^M>

Parameter

<table>
<thead>
<tr>
<th>&lt;string&gt;</th>
<th>Primary Measurement</th>
<th>Secondary Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ</td>
<td>Resistance</td>
<td>Quality factor</td>
</tr>
<tr>
<td>CD</td>
<td>Capacitance</td>
<td>Dissipation factor</td>
</tr>
<tr>
<td>CR</td>
<td>Capacitance</td>
<td>Resistance</td>
</tr>
<tr>
<td>LQ</td>
<td>Inductance</td>
<td>Quality factor</td>
</tr>
<tr>
<td>LR*</td>
<td>Inductance</td>
<td>Resistance</td>
</tr>
<tr>
<td>ZQ*</td>
<td>Impedance</td>
<td>Angle</td>
</tr>
</tbody>
</table>

*For the LCR-821 only
### Example

**MAIN:MODE:RQ<^END^M>**

Sets the mode to R/Q (Resistance/Quality factor)

**Query Syntax**

**MAIN:MODE?<^END^M>or<^J^M>**

**Return String**

<string> Current measurement mode

MAIN:MODE:RQ<^END> R/Q
MAIN:MODE:CD<^END> C/D
MAIN:MODE:LQ<^END> L/Q
MAIN:MODE:LR<^END> L/R
MAIN:MODE:ZQ<^END> Z/Q

**Query Example**

MAIN:MODE?<^END^M>
MAIN:MODE:RQ<^END>

Returns the current measurement mode as R/Q

### CIRCUIT

**Command/Query**

The mode command sets the equivalent circuit to series or parallel.

**Syntax**

**MAIN:CIRC:<string><^END^M>or<^J^M>**

**Parameter**

<string> Equivalent Circuit

SERI Series
PARA Parallel

**Example**

MAIN:CIRC:SERI<^END^M>

Sets the equivalent circuit to series

**Query Syntax**

**MAIN:CIRC?<^END^M>or<^J^M>**

**Return String**

<string> Equivalent circuit

MAIN:CIRC:SERI<^END> Series

**FREQUENCY**

**Command/Query**

Set or queries the test frequency.

**Syntax**

**MAIN:FREQ <variable><^END^M>or<^J^M>**

**Parameter**

<variable> Frequency (kHz)

0.01200~100.000 (7 characters, including a decimal)

12 Hz~100kHz

**Example**

MAIN:FREQ 0.01200<^END^M>

Sets the frequency to 12Hz (0.012 kHz)

**Query Syntax**

**MAIN:FREQ?<^END^M>or<^J^M>**

**Return String**

<string> Frequency

MAIN:FREQ <variable><^END> (<variable> = 0.01200~100.000)

Returns the test frequency in kHz (12 Hz).

**VOLTAGE**

**Command/Query**

Set or queries the test signal voltage.

**Syntax**

**MAIN:VOLT <variable><^END^M>or<^J^M>**

**Parameter**

<variable> Test signal voltage

**Example**

MAIN:VOLT 0.01200<^END^M>
PROGRAMMING

<table>
<thead>
<tr>
<th>Command/Query</th>
<th>Syntax</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN:VOLT</td>
<td>0.005&lt;^END&gt;M</td>
<td><code>&lt;variable&gt; &gt;= 0.005~1.275</code></td>
</tr>
<tr>
<td>Query Syntax</td>
<td>MAIN:VOLT?&lt;^END&gt;M</td>
<td>Voltage</td>
</tr>
<tr>
<td>Return String</td>
<td>MAIN:VOLT:&lt;variable&gt;&lt;^END&gt;</td>
<td>Returns the test voltage.</td>
</tr>
<tr>
<td>Query Example</td>
<td>MAIN:VOLT?&lt;^END&gt;M</td>
<td>5mV</td>
</tr>
<tr>
<td>AUTO/MANU</td>
<td></td>
<td><code>&lt;String&gt;</code></td>
</tr>
<tr>
<td>Sets automatic or manual measurement mode.</td>
<td>MAIN:TRIG:MANU&lt;^END&gt;M</td>
<td>Test mode</td>
</tr>
<tr>
<td>Syntax</td>
<td>MAIN:TRIG:MANU&lt;^END&gt;M</td>
<td>Manual mode</td>
</tr>
<tr>
<td>Example</td>
<td>MAIN:TRIG:MANU&lt;^END&gt;M</td>
<td>Sets the measuring mode to manual</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>MAIN:TRIG?&lt;^END&gt;M</td>
<td>Voltage</td>
</tr>
<tr>
<td>Return String</td>
<td>MAIN:TRIG:MANU&lt;^END&gt;M</td>
<td>Returns manual mode</td>
</tr>
<tr>
<td>Query Example</td>
<td>MAIN:TRIG?&lt;^END&gt;M</td>
<td>5mV</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Command</th>
<th>Syntax</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td></td>
<td><code>&lt;String&gt;</code></td>
</tr>
<tr>
<td>Starts a measurement in manual mode.</td>
<td>MAIN:STAR&lt;^END&gt;M</td>
<td>Measurement mode</td>
</tr>
<tr>
<td>Example</td>
<td>MAIN:STAR&lt;^END&gt;M</td>
<td>Starts the measurement</td>
</tr>
<tr>
<td>RANGE HOLD</td>
<td></td>
<td><code>&lt;String&gt;</code></td>
</tr>
<tr>
<td>Turns range hold on or off or queries the range hold status.</td>
<td>MAIN:R.H.:&lt;String&gt;&lt;^END&gt;M</td>
<td>Range hold</td>
</tr>
<tr>
<td>Example</td>
<td>MAIN:R.H.:OFF.&lt;^END&gt;M</td>
<td>Range hold is off</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>MAIN:R.H.?&lt;^END&gt;M</td>
<td>Range Hold status</td>
</tr>
<tr>
<td>Return String</td>
<td>MAIN:R.H.?&lt;^END&gt;M</td>
<td>Voltage</td>
</tr>
<tr>
<td>Query Example</td>
<td>MAIN:R.H.?&lt;^END&gt;M</td>
<td>Returns the Range Hold status (On)</td>
</tr>
</tbody>
</table>
## C.V Command/Query

Turns Constant Voltage on or off. Queries the constant voltage status.

<table>
<thead>
<tr>
<th>Syntax</th>
<th>MAIN:C.V.:&lt;string&gt; &lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>&lt;String&gt; Constant Voltage</td>
</tr>
<tr>
<td></td>
<td>OFF. Off</td>
</tr>
<tr>
<td></td>
<td>ON. On</td>
</tr>
</tbody>
</table>

| Example        | MAIN:C.V.:OFF.<^END>M                  |
|                | Turns Constant Voltage off            |

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>MAIN:C.V.?&lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return String</td>
<td>&lt;string&gt; Constant Voltage status</td>
</tr>
<tr>
<td></td>
<td>MAIN:C.V.:OFF.&lt;^END&gt;</td>
</tr>
<tr>
<td></td>
<td>MAIN:C.V.:ON.&lt;^END&gt;</td>
</tr>
</tbody>
</table>

### Example

MAIN:C.V.:OFF.<^END>
Returns the Constant Voltage status (Off).

## BIAS Query

Queries the Bias status.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>MAIN:BIAS?&lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
</table>

| Return String  | <string> Bias Status                |
|                | MAIN:INTB:OFF.<^END>                |
|                | MAIN:INTB:ON.<^END>                 |

### Example

MAIN:BIAS?<^END>
Returns the Bias Status (External Bias is on).

## INT.B Command/Query

Sets and queries the internal bias.

<table>
<thead>
<tr>
<th>Syntax</th>
<th>MAIN:INTB:&lt;string&gt; &lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>&lt;String&gt; Internal Bias</td>
</tr>
<tr>
<td></td>
<td>OFF. Off</td>
</tr>
<tr>
<td></td>
<td>ON. On</td>
</tr>
</tbody>
</table>

| Example        | MAIN:INTB:OFF.<^END>M                |
|                | Turn Internal Bias off               |

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>MAIN:INTB?&lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return String</td>
<td>&lt;string&gt; Internal Bias Status</td>
</tr>
<tr>
<td></td>
<td>MAIN:INTB:OFF.&lt;^END&gt;</td>
</tr>
<tr>
<td></td>
<td>MAIN:INTB:ON.&lt;^END&gt;</td>
</tr>
</tbody>
</table>

### Example

MAIN:INTB:OFF.<^END>
Returns the Internal Bias status (Off).

## EXT.B Command/Query

Sets and queries the External Bias.

<table>
<thead>
<tr>
<th>Syntax</th>
<th>MAIN:EXTB:&lt;string&gt; &lt;^END&gt;M or &lt;^J&gt;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>&lt;String&gt; External Bias</td>
</tr>
<tr>
<td></td>
<td>OFF. Off</td>
</tr>
<tr>
<td></td>
<td>ON. On</td>
</tr>
</tbody>
</table>

| Example        | MAIN:EXTB:ON.<^END>                  |
|                | Returns the Bias Status (External Bias is on). |
### OPEN

This command will perform an open circuit calibration. A return string will indicate if the calibration was successful or not.

**Syntax**

```
OFFS:OPEN<END> or <J>
```

**Return String**

- `<string>`
- **External Bias status**
- **OPEN:OK<END>**
- **OPEN:FAIL<END>**

**Example**

```
OFFS:OPEN<END>
OPEN:OK<END>
```

Returns the open circuit calibration attempt (Successful).

### SHORT

This command will perform a closed (short) circuit calibration. A return string will indicate if the calibration was successful or not.

**Syntax**

```
OFFS:SHOR<END> or <J>
```

**Return String**

- `<string>`
- **Short calibration attempt**
- **SHOR:OK<END>**
- **SHOR:FAIL<END>**

**Example**

```
OFFS:SHOR<END>
SHOR:OK<END>
```

Returns the closed circuit calibration attempt (Successful).

### NOM. VAL

Sets or queries the nominal value. The nominal value unit depends on the measurement mode.

**Syntax**

```
SORT:NOMV<variable><END> or <J>
```

---

### PPM

**Command/Query**

Turns PPM on or off for Dissipation (D) or Quality factor (Q) measurements.

**Syntax**

```
MAIN:PPM.<<string><END> or <J>
```

**Parameter**

- `<String>`
- **PPM**
- **OFF.**
- **On**

**Example**

```
MAIN:PPM:OFF<END>
MAIN:PPM:ON<END>
```

Turns PPM off.

**Query Syntax**

```
MAIN:PPM.<<END> or <J>
```

**Return String**

- `<string>`
- **PPM status**
- **PPM:OK<END>**
- **PPM:FAIL<END>**

**Example**

```
MAIN:PPM:OFF<END>
MAIN:PPM:ON<END>
```

Returns PPM status (On).

---

### OPEN

**Command**

This command will perform an open circuit calibration. A return string will indicate if the calibration was successful or not.

**Syntax**

```
OFFS:OPEN<END> or <J>
```

**Return String**

- `<string>`
- **External Bias status**
- **OFF:OK<END>**
- **OFF:FAIL<END>**

**Example**

```
OFFS:OPEN<END>
OFF:OK<END>
```

Turns External Bias off.

**Query Syntax**

```
MAIN:EXTB?<END> or <J>
```

**Return String**

- `<string>`
- **External Bias status**
- **On**

**Example**

```
MAIN:EXTB?<END>
MAIN:EXTB:ON..<END>
```

Returns the External Bias status (On).

---

### SHORT

**Command**

This command will perform a closed (short) circuit calibration. A return string will indicate if the calibration was successful or not.

**Syntax**

```
OFFS:SHOR<END> or <J>
```

**Return String**

- `<string>`
- **Short calibration attempt**
- **SHOR:OK<END>**
- **SHOR:FAIL<END>**

**Example**

```
OFFS:SHOR<END>
SHOR:OK<END>
```

Returns the closed circuit calibration attempt (Successful).

---

### NOM. VAL

**Command/Query**

Sets or queries the nominal value. The nominal value unit depends on the measurement mode.

**Syntax**

```
SORT:NOMV<variable><END> or <J>
```
Parameter

<table>
<thead>
<tr>
<th>&lt;variable&gt;</th>
<th>Nominal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-XXXXXXX ~ +XXXXXXX</td>
<td>+XXXXXX ~ -XXXXXX (Mode dependant)</td>
</tr>
<tr>
<td>Must be any 8 digit character including a decimal place and signage (- or +).</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>SORT: NOMV -0.12345&lt;^END^M&gt;</td>
</tr>
<tr>
<td>Sets the nominal value to -0.12345</td>
<td></td>
</tr>
<tr>
<td>Query Syntax</td>
<td>SORT: NOMV?&lt;^END^M&gt; or&lt;^J^M&gt;</td>
</tr>
<tr>
<td>Return String</td>
<td>&lt;string&gt; Nominal Value SORT: NOMV &lt;variable&gt;&lt;^END&gt; (variable &gt;= any 8 digit number)</td>
</tr>
<tr>
<td></td>
<td>Returns the nominal value 2Ω</td>
</tr>
</tbody>
</table>

RECALL Command/Query

Recall settings from one of 100 memory slots.

Syntax MEMO: RECA <variable><^END^M> or<^J^M>

<table>
<thead>
<tr>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;variable&gt;</td>
</tr>
<tr>
<td>1.00~100.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Example</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Query Syntax</td>
</tr>
<tr>
<td>Return String</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Query Example</td>
</tr>
</tbody>
</table>

STORE Command

Stores the current settings to one of 100 memory slots. A return string will indicate the save slot used.

Syntax MEMO: STOR <variable><^END^M> or<^J^M>

<table>
<thead>
<tr>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;variable&gt;</td>
</tr>
<tr>
<td>1.00~100.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Example</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Query Syntax</td>
</tr>
<tr>
<td>Return String</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Query Example</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
AVERAGE Command/Query

Sets the average number from 1~255. The average number indicates how many test samples are used to create an averaged test result.

Syntax

STEP:AVER <variable><END>M or <J|M>

Parameter

<variable>  Average number
1.00~255. (integer values)  1~255

Note

Ensure the number has a total of 4 characters. If a number does not use 4 characters, use a “.” and additional zero’s (0) to “pad out” the number.

Example 10 = 10.0

Example

STEP:AVER 255.<END>M
Average is set to 255 samples.

Query Syntax

STEP:AVER?<END>M or <J|M>

Return String

<string> Current average setting

Example

STEP:AVER?<END>M
STEP:AVER 255.<END>
The average number is currently 255.

RECALL CALIBRATION Command

Recalls the calibration settings from memory. A return string indicates if the command was successful.

Syntax

STEP:RECA<END>M or <J|M>

Return String

<string> Recall calibration

Example

STEP:RECA<END>M
RECA:OK<END>
Calibration was recalled successfully

BAUD RATE Command

Sets the baud rate of the RS232 connection.

Syntax

COMU:<value><END>M or <J|M>

Parameter

$value$  Baud rate
9600  9600
19.2  19200
38.4  38400
57.6  57600
1152  115200

Return String

<string> Baud rate

Query Example

COMU:1152<END>M
COMU:1152<END>
The baud rate is set to 115200.

MODEL NUMBER Query

This query returns the model number of the LCR-800.

Query Syntax

COMU:MONO<END>M or <J|M>

Return String

<string> Model number

Example

COMU:MONO:816.<END>
COMU:MONO:817.<END>
LCR-816
LCR-817
COMU:MONO:819.<^END> LCR-819
COMU:MONO:821.<^END> LCR-821

Query Example
COMU:MONO:<^END>M
COMU:MONO:816.<^END>
The model number is LCR-816

ON-LINE

The On-line function queries the RS232 connection status.
Query Syntax COMU?<^END>M or <J>M
Return String
<string> RS232 connection
COMU:ON..<^END> Connection on
COMU:OFF.<^END> Connection off
Query Example
COMU?<^END>M>
COMU:ON..<^END>
The RS232 connection is on.

MEASURE HOLD

The Measure hold command is used to suspend measurement to issue a new command when the LCR meter is busy. When the new command is issued the Measure Recover command can be used to resume measurement.
Syntax COMU:HOLD<^END>M or <J>M
Example COMU:HOLD<^END>M>
Measurement is suspended.

MEASURE RECOVER

The Measure Recover command is used to resume measurements after the Measure Hold command has been used.
Syntax COMU:RECO<^END>M or <J>M
Example COMU:RECO<^END>M>
Resume measurement. (recover measurement).

LEVEL DISPLAY

Displays a menu level on the LCR-800 display. Returns the menu level.
Syntax LEVE:<string><^END>M or <J>M
Parameter
<string> Menu Level
MAIN Main display
MENU menu display
PARA Setting (Parameter) menu
SORT Sort (Handler) menu
OFFS Offset menu.
Return String
<string> Menu level
LEVE:MAIN<^END> Main display
LEVE:MENU<^END> Menu display
LEVE:PARA<^END> Setting (Parameter) menu
LEVE:SORT<^END> Sort (Handler) menu
LEVE:OFFS<^END> Offset menu.
Example LEVE:MAIN<^END>M>
LEVE:MAIN<^END>
Set the display to the main display.

PRIMARY FACTOR

Primary factor returns the primary measurement result, sans the measurement unit. This measurement is the first measurement displayed after measurements have been started.
Return Syntax MAIN:PRIM <value><^END>
Example COMU:RECO<^END>M>
Resume measurement. (recover measurement).
<value> Test result

Any 7 digit ASCII including sp (+) or – characters and a decimal point.

Example MAIN:PRIM 32.705<^END>

The primary measurement is 32.705 (primary measurement unit).

---

**PRIMARY OV01 Measurement**

Primary OV01 indicates that the primary measurement exceeds the measurement range of the LCR meter. For example: If the impedance of the DUT is less than the measurement range.

Return Syntax PRIM:OV01<^END>

Example PRIM:OV01<^END>

Note, no units are returned

---

**PRIMARY OVER SECONDARY OVER Measurement**

When both the primary and secondary factors exceed the range (OVER), OVER will be returned.

Return Syntax PRIM:OVER<END>

Example PRIM:OVER<END>

Note, no units are returned

---

**SECONDARY FACTOR & PRIMARY UNIT Measurement**

Returns the secondary measurement results and the primary unit (R/Q C/D L/Q only). This measurement is the second measurement displayed after measurements have been started.

Return Syntax MAIN:SECO <value><unit1><^END>

Example MAIN:SECO .0045nF<^END>

The secondary measurement is .0045 (D) and nF is the primary measurement unit.

---

**SECONDARY OVER & PRIMARY UNIT Measurement**

Secondary Over indicates that the secondary measurement exceeds the measurement range of the LCR meter. The unit returned refers to the primary measurement. Applicable for (R/Q, C/D, L/Q, Z/θ) equivalent circuits.

Return Syntax SECO:OVER<unit1><^END>

Example SECO:OVER nF<^END>

The secondary measurement is OVER(exceeds range) and nF is the primary measurement unit.
SECONDARY FACTOR, PRIMARY UNIT, SECONDARY UNIT  
Measurement

Secondary measurement result is returned along with the primary unit and secondary unit (C/R, L/R only). This measurement is the second measurement displayed after measurements have been started.

Return Syntax  
MAIN:SECO <value><unit1><unit2><^END>

Example  
MAIN:SECO .0045nFk<^END>

SECONDARY OVER, PRIMARY UNIT, SECONDARY UNIT  
Measurement

Secondary Over indicates that the secondary measurement exceeds the measurement range of the LCR meter. Applicable for C/R & L/R equivalent circuits with the display set to Value.

Return Syntax  
SECO:OVER <unit1><unit2><^END>

Example  
SECO:OVER nFk<^END>

INITIATION HAS FINISHED (Initiate)  
Command

Initiates the RS232 connection. A string is returned when the initiation has been completed.

Syntax  
COMU:OVER<^END> or<^J>

Return String

Example  
COMU:OVER<^END>

OFF LINE  
Command

Terminates the RS232 connection. A string is returned when the initiation has been completed.

Syntax  
COMU:OFF.<^END> or<^J>

Return String

Example  
COMU:OFF<^END>

The secondary measurement result exceeds the range. kΩ is the secondary unit and nF is the primary unit.

The secondary measurement result is .0045 with kΩ as the unit. The primary unit is nF.

The secondary measurement result exceeds the range.

Communication initiation has completed.

“RS232 ONLINE” will be displayed on the LCR-800 display panel.

The RS232 connection has been terminated.
This chapter describes basic interface aspects of the RS-232 and Handler interfaces.

<table>
<thead>
<tr>
<th>RS232 Interface Configuration</th>
<th>Configure RS-232 interface</th>
<th>Connector</th>
<th>DB-9, Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td></td>
<td>Baud rate</td>
<td>38400 (default)</td>
</tr>
<tr>
<td>Signal Characteristics</td>
<td>Signal Overview</td>
<td>Parity</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Handler Timing</td>
<td>Data bit</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stop bit</td>
<td>1</td>
</tr>
</tbody>
</table>

Connect the RS-232 cable to the rear panel port: DB-9 male connector.

**Pin assignment**

1: DCD (Data Carrier Detect)  
2: RxD (Receive Data)  
3: TxD (Transmit Data)  
4: DTR (Data Terminal Ready)  
5: GND  
6: DSR (Data Set Ready)  
7: RTS (Request To Send)  
8: CTS (Clear To Send)  
9: No connection
<table>
<thead>
<tr>
<th>Connection</th>
<th>DB9 Pin</th>
<th>Pin Assignment</th>
<th>Signal</th>
<th>LCR Meter Pin Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RxD</td>
<td>PIN 1</td>
<td>TxD</td>
<td>DB9 Pin 3</td>
</tr>
<tr>
<td>3</td>
<td>TxD</td>
<td>PIN 2</td>
<td>RxD</td>
<td>DB9 Pin 2</td>
</tr>
<tr>
<td>4</td>
<td>DTR</td>
<td>PIN 3</td>
<td>DSR, DCD</td>
<td>DB9 Pin 6,1</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>PIN 4</td>
<td>GND</td>
<td>DB9 Pin 5</td>
</tr>
<tr>
<td>6,1</td>
<td>DSR, DCD</td>
<td>PIN 5</td>
<td>DTR</td>
<td>DB9 Pin 4</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>PIN 6</td>
<td>CTS</td>
<td>DB9 Pin 8</td>
</tr>
<tr>
<td>8</td>
<td>CTS</td>
<td>PIN 7</td>
<td>RTS</td>
<td>DB9 Pin 7</td>
</tr>
</tbody>
</table>

**Handler interface**

Connect the male DSUB 25 pin cable to the Handler interface socket.

**Pin assignment**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>O_BIN_1</td>
<td>Go, Assigned BIN 1</td>
</tr>
<tr>
<td>O_BIN_2</td>
<td>Go, Assigned BIN 2</td>
</tr>
<tr>
<td>O_BIN_3</td>
<td>Go, Assigned BIN 3</td>
</tr>
<tr>
<td>O_BIN_4</td>
<td>Go, Assigned BIN 4</td>
</tr>
<tr>
<td>O_BIN_5</td>
<td>Go, Assigned BIN 5</td>
</tr>
<tr>
<td>O_BIN_6</td>
<td>Go, Assigned BIN 6</td>
</tr>
<tr>
<td>O_BIN_7</td>
<td>Go, Assigned BIN 7</td>
</tr>
<tr>
<td>O_BIN_8</td>
<td>Go, Assigned BIN 8</td>
</tr>
<tr>
<td>O_BIN_9</td>
<td>Go, Assigned BIN 9</td>
</tr>
<tr>
<td>O_BIN_10</td>
<td>Go, Assigned BIN 10</td>
</tr>
</tbody>
</table>
## Signal Overview

### Background

The signal overview section describes the functions and the overall characteristics of the signals used in the handler interface.

### Parameter Output Signals

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/O_INDEX</td>
<td>The Index signal will become low when the Analog measurement time has completed. When the Index signal is low, the test component can be replaced with the next component. The signal goes high when the next trigger is active.</td>
</tr>
<tr>
<td>/O_BIN_1~ /O_BIN_13</td>
<td>The Bin Go/No-Go signals go active low when a successful comparison has been made. For example if a component is assigned to Bin_1, /O_BIN_1 signal goes low until time T4. All the remaining signals (/O_BIN_2~ /O_BIN_13) remain high.</td>
</tr>
<tr>
<td>/O_P_HI</td>
<td>When the primary measurement is higher than the MAX limit, O_P_HI will go low until time T4.</td>
</tr>
<tr>
<td>/O_P_LO</td>
<td>When the primary measurement is lower than the MIN limit, O_P_LO will go low until time T4.</td>
</tr>
<tr>
<td>/O_P_OVER</td>
<td>When the primary measurement is higher or lower than the MAX/MIN, O_P_OVER will go low until time T4.</td>
</tr>
</tbody>
</table>
The /O_S_REJ or /O_S_OVER signal will go low when the secondary measurement is over D_Max or under D_Min, whilst in C/D, R/Q, C/R or L/R mode. The signals will go high at time T4.

The End of Measurement signal becomes active low when the Bin comparison/assignment has completed. The signal goes high after the next time I_E_TRIG is active low.

### Electrical Characteristics

**Output Characteristics**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Output Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>/O_BIN1-BIN13</td>
<td></td>
</tr>
<tr>
<td>/O_S_OVER</td>
<td></td>
</tr>
<tr>
<td>/O_S_REJ</td>
<td></td>
</tr>
<tr>
<td>/O_P_OVER</td>
<td></td>
</tr>
<tr>
<td>/O_P_LO</td>
<td>≤0.5V, +5V~+24V*</td>
</tr>
<tr>
<td>/O_P_HI</td>
<td></td>
</tr>
<tr>
<td>Control Signals</td>
<td></td>
</tr>
<tr>
<td>/O_INDEX</td>
<td></td>
</tr>
<tr>
<td>/O_EOM</td>
<td></td>
</tr>
</tbody>
</table>

* Pull-up resistors R408–R427 must be replaced to output greater than 5V.

**Input Signals**

- **/I_E_TRUNC**: Measurement start signal. This signal will trigger the LCR-800 to start a measurement when the signal is pulsed for at least 5us. It is triggered by the falling edge of the pulse.
- **/I_K_LOCK**: The key lock signal disables the panel keys when the signal is low, and enables the panel keys when the signal is high.

### Input Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Input Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>/I_E_TRUNC</td>
<td>Measurement start signal. This signal will trigger the LCR-800 to start a measurement when the signal is pulsed for at least 5us. It is triggered by the falling edge of the pulse.</td>
</tr>
<tr>
<td>/I_K_LOCK</td>
<td>The key lock signal disables the panel keys when the signal is low, and enables the panel keys when the signal is high.</td>
</tr>
</tbody>
</table>

### Electrical Characteristics

<table>
<thead>
<tr>
<th>Signal</th>
<th>Input Voltage</th>
<th>Input Current (Low)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>/I_E_TRUNC</td>
<td>≤1V</td>
<td>+5V~15V</td>
</tr>
<tr>
<td>/I_K_LOCK</td>
<td>≤1V</td>
<td>+5V~15V</td>
</tr>
</tbody>
</table>
Handler Timing

**Background**

The handler timing characteristics are described in the timing diagram. Times T1 to T6 are described in the relevant tables.

**Timing Characteristics**

<table>
<thead>
<tr>
<th>Trigger Pulse Width</th>
<th>T1</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement start delay time</td>
<td>T2</td>
<td>MIN</td>
<td>MAX</td>
</tr>
<tr>
<td>/O_EOM Delay Time After Data Output</td>
<td>T3</td>
<td>MIN</td>
<td>MAX</td>
</tr>
<tr>
<td>Calculation and binning time</td>
<td>T4</td>
<td>MIN</td>
<td>MAX</td>
</tr>
</tbody>
</table>

**Analog Measurement time**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Slow</th>
<th>Medium</th>
<th>Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.012kHz</td>
<td>817ms</td>
<td>817ms</td>
<td>817ms</td>
</tr>
<tr>
<td>0.1kHz</td>
<td>901ms</td>
<td>125ms</td>
<td>125ms</td>
</tr>
<tr>
<td>0.12kHz</td>
<td>901ms</td>
<td>105ms</td>
<td>103ms</td>
</tr>
<tr>
<td>1kHz</td>
<td>903ms</td>
<td>59ms</td>
<td>27ms</td>
</tr>
<tr>
<td>10kHz</td>
<td>873ms</td>
<td>53ms</td>
<td>17ms</td>
</tr>
<tr>
<td>100kHz</td>
<td>873ms</td>
<td>53ms</td>
<td>17ms</td>
</tr>
</tbody>
</table>

**Trigger Wait Time**

<table>
<thead>
<tr>
<th>After /O_EOM Output</th>
<th>T6</th>
<th>Slow</th>
<th>Medium</th>
<th>Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
<td></td>
</tr>
<tr>
<td>BIN</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
<td></td>
</tr>
<tr>
<td>VALUE</td>
<td>16ms</td>
<td>16ms</td>
<td>16ms</td>
<td></td>
</tr>
</tbody>
</table>

**Binning Accuracy**

<table>
<thead>
<tr>
<th>LCR_827</th>
<th>Fast</th>
<th>Medium</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>0.2%</td>
<td>0.1%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR_829</th>
<th>Fast</th>
<th>Medium</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>0.2%</td>
<td>0.1%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR_826</th>
<th>Fast</th>
<th>Medium</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>0.2%</td>
<td>0.1%</td>
<td></td>
</tr>
</tbody>
</table>
FAQ

Q1. What is the correct procedure for Open/Short Zeroing when using the LCR-06A test fixture?

A1. The LCR-06A test fixture is very sensitive and thus must be used correctly.
- For Open Zeroing, make sure that the test fixture wires do not move and that there is nothing in close proximity to the test clips.
- For Short Zeroing ensure the clips are properly shorted. See page 24 for details.

Q2. Why does Short Zeroing fail?

A2. There are two possible reasons that Short Zeroing can fail.
- The test fixture has an open circuit between the wires and terminal.
- Some functions can impede the short test. Ensure Range Hold and Internal/External Bias (R.H and INT.B/EXT.B) are disabled. See pages 40, 39 & 34.

Q3. I cannot see the display clearly.

A3. Use the display contrast control on the rear panel to adjust the contrast.

Q4. When using a terminal program I cannot execute a command.

A4. Make sure the correct terminal characters are used. For example use “CTRL J” “CTRL M” as the <^J^M> message terminator in a terminal session.
**APPENDIX**

**Fuse Replacement**

1. Disconnect the power cord and then remove the fuse socket using a flat screwdriver.

2. Replace the fuse in the holder.

Rating 5TT 3A/250V

---

**Circuit Theory and Formula**

**Series/Parallel circuit models**

**Background**

Below are the circuit diagrams and formulas describing the six types of series and parallel equivalent circuits: Capacitive, Inductive and Resistive. The formulas for all the primary and secondary measurement types are also shown.

**Capacitance (C)**

**Series formula**

\[ C_s = C_p \left(1 + D^2\right) \]

\(D=\text{dissipation factor}\)

**Parallel formula**

\[ C_p = \frac{C_s}{\left(1 + D^2\right)} \]

\(D=\text{dissipation factor}\)

**Inductance (L)**

**Series formula**

\[ L_s = \frac{L_p}{\left(1 + \frac{1}{Q^2}\right)} \]

\(Q=\text{quality factor}\)

**Parallel formula**

\[ L_p = L_s \left(1 + \frac{1}{Q^2}\right) \]

\(Q=\text{quality factor}\)
Resistance (R) and Conductance (G = 1/R) Formula

Background
Resistence measures how difficult it is for the electricity to flow between two terminals. Conductance is the reciprocal of Resistance and measures how easily the electricity flows.

Note
Conductance is only shown for its relation to Resistance. Conductance is not a measurable feature of the LCR-800 series.

Type | Resistance | Conductance
--- | --- | ---
- Series Resistance $R_S$ | - Parallel Conductance $G_P (\approx 1/R_P)$
- Parallel Resistance $R_P$ | -
- DC Resistance $R_{dc}$ | -

Formula

- $R = \frac{V}{I} = \frac{1}{G} = Z_S - jX$
- $G_P = \frac{I}{V} = \frac{1}{R} = Y_P - jB$
- $\angle Z_S = \sqrt{R^2 + X^2}$
- $\angle Y_P = \frac{GB}{\sqrt{G^2 + B^2}}$
- $\angle Z_P = \frac{RX}{\sqrt{(R^2 + X^2)}}$
- $\angle Y_P = \sqrt{G^2 + B^2}$
- $R_S = |Z| \cos \theta$
- $G_P = |Y| \cos \theta$
Capacitance (C) Formula

**Background** Capacitance measures the amount of electronic charge stored between two terminals.

**Type**
- Series Capacitance \(C_S\)
- Parallel Capacitance \(C_P\)

**Formula**
\[
Z_S = R - j \frac{1}{\omega C_S} \\
Q = \frac{1}{\omega C_S R_S} \\
D = \omega C_S R_S \\
Y_p = G + j \omega C_P \\
Q = \omega C_P R_p \\
D = \frac{G_p}{\omega C_P}
\]

Inductance (L) Formula

**Background** Inductance measures the amount of magnetic flux generated in certain electrical current.

**Type**
- Series Inductance \(L_S\)
- Parallel Inductance \(L_P\)

**Formula**
\[
Z_S = R + j \omega L \\
Q = \frac{\omega L_S}{R_S} , \quad D = \frac{R_S}{\omega L_S} \\
Y_p = G - j \frac{1}{\omega L_P} \\
Q = \frac{R_P}{\omega L_P} , \quad D = \omega L_P G_P
\]

Reactance (X) and Susceptance (B = 1/X) Formula

**Background** Reactance measures the imaginary part of Impedance (Z) caused by capacitors or inductors. Susceptance is the reciprocal of Reactance and measures the imaginary part of Admittance (Y), which is the reciprocal of Impedance.

**Note** Reactance and Susceptance is only shown for their relation to impendence. Reactance and Susceptance are not measurable features of the LCR-800 series.

**Type**
- Series Reactance \(X_S\)
- Parallel Susceptance \(B_P\)

**Formula**
\[
X = \frac{1}{B} = |Z| \sin \theta \\
B = \frac{1}{X} = |Y| \sin \theta \\
|Z_S| = \sqrt{R^2 + X^2} \\
|Y_S| = \frac{G B}{\sqrt{G^2 + B^2}} \\
|Z_P| = R_X \frac{X}{\sqrt{R^2 + X^2}} \\
|Y_P| = \sqrt{G^2 + B^2} \\
X_S = |Z| \sin \theta \\
B_P = |Y| \sin \theta
\]
Impedance (Z) and Admittance (Y = 1/Z) Formula

**Background**

Impedance measures the total amount of opposition between two terminals in an AC circuit. Admittance is the reciprocal of Impedance and measures how easily the electricity flows in an AC circuit.

**Note**

Admittance is only shown for its relation to impedance. Admittance is not measurable with the LCR-800 series.

<table>
<thead>
<tr>
<th>Type</th>
<th>Impedance (Z)</th>
<th>Admittance (Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>$Z = \frac{E}{I} = \frac{1}{Y}$</td>
<td>$Y = \frac{I}{E} = \frac{1}{Z}$</td>
</tr>
<tr>
<td></td>
<td>$Z_s = R + jX$</td>
<td>$Y_p = G + jB$</td>
</tr>
<tr>
<td></td>
<td>$= R + j\omega L = R - \frac{j}{\omega C}$</td>
<td>$= G + j\omega C = G - \frac{j}{\omega L}$</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>Z_s</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>Z_p</td>
</tr>
<tr>
<td></td>
<td>$R_s =</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>$X_s =</td>
<td>Z</td>
</tr>
</tbody>
</table>

Quality factor (Q) and Dissipation factor (D) Formula

**Background**

Both Quality factor and its reciprocal, Dissipation factor, are used for measuring the rate of energy dissipation relative to the measurement frequency.

- Low energy dissipation: high Q, low D
- High energy dissipation: low Q, high D

<table>
<thead>
<tr>
<th>Type</th>
<th>Quality factor (Q)</th>
<th>Dissipation factor (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>$Q = \frac{\omega L_s}{R_s} = \frac{1}{\omega C_s R_s}$</td>
<td>$D = \frac{R_s}{\omega L_p} = \omega C_s R_s$</td>
</tr>
<tr>
<td></td>
<td>$= \frac{R_p}{\omega L_p} = \omega C_p R_p$</td>
<td>$= \frac{G_p}{\omega C_p} = \omega L_p G_p$</td>
</tr>
<tr>
<td></td>
<td>$= \frac{1}{\tan(90 - \theta)} = \frac{1}{D}$</td>
<td>$= \tan(90 - \theta) = \frac{1}{Q}$</td>
</tr>
</tbody>
</table>
## Angle (θ) Formula

### Background
The Angle (θ) measures the phase on which Impedance (Z), Admittance (Y), Quality factor (Q), and Dissipation factor (D) are measured.

### Type
**Angle (θ)**

### Formula

- $Z_s = R + jX$
- $Y_p = G + jB$
- $Q = \frac{1}{\tan(90 - \theta)}$
- $R_s = |Z| \cos \theta$
- $X_s = |Z| \sin \theta$
- $G_p = |Y| \cos \theta$
- $B_p = |Y| \sin \theta$

### Accuracy Definitions

#### Primary Measurement Readout Error Formula

**C**

| 2 counts $\pm 0.03\% + 0.02\% [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + D) (1 + Kb + Kc) |

**R**

| 2 counts $\pm 0.03\% + 0.02\% [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + Q) (1 + Kb + Kc) |

**L**

| 2 counts $\pm 0.03\% + 0.02\% [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + Q) (1 + Kb + Kc) |

\[ |Z| \]

$Ze = \text{Depends on whether the component is a capacitor} (C), \text{resistor} (R) \text{or}\text{inductor} (L):$

**Circuit**

- Formula for relevant circuit

**Secondary Measurement Readout Error Formula**

**D(C/D)**

| 2 counts $\pm 0.0003 + 0.0002 [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + D) (1 + Kb + Kc) |

**Q(R/Q)**

| 2 counts $\pm 0.0003 + 0.0002 [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + Q) (1 + Kb + Kc) |

**Q(L/Q)**

| 2 counts $\pm 0.0003 + 0.0002 [1 + Ka] * \text{or} [X/Y \text{max}] * \text{or} (Y \text{min}/X) * ] (1 + Q) (1 + Kb + Kc) |

**θ( Z/θ)**

| $\theta_e = \left(\frac{180}{\pi}\right) x \left(\frac{Ze}{100}\right)$ |

**R(C/R)**

- $D \geq 1$
  | 2 counts $\pm 0.02\% [1 + Ka] * \text{or} [X/R \text{max}] * \text{or} (Y \text{min}/Rx) * ] (1 + D) (1 + Kb + Kc) + 0.03\% |

- $D \leq 1$
  | 2 counts $\pm 0.02\% [1 + Ka] * \text{or} [X/C \text{max}] * \text{or} (Y \text{min}/Cx) * ] (1 + D) (1 + Kb + Kc) + 0.03\% |
### APPENDIX

**R(L/R)** | \( Q \leq 1 \) & 2counts + 0.02\%[(1+\( Ka \)) or (\( Rx/R_{\text{max}} \)) or (\( R_{\text{min}}/Rx \))] \( (1+\left\lvert Q \right\rvert)(1+K_{b}+K_{c})+0.03\% \)
| \( Q \geq 1 \) & 2counts + 0.02\%[(1+\( Ka \)) or (\( Lx/L_{\text{max}} \)) or (\( L_{\text{min}}/Lx \))] \( (1+\left\lvert Q \right\rvert)(1+K_{b}+K_{c})+0.03\% \)

### Conditions

1. if \( X > Y_{\text{max}} \), please select \( (X/Y_{\text{max}}) \)
2. if \( X < Y_{\text{min}} \), please select \( (Y_{\text{min}}/X) \)
3. if \( Y_{\text{min}} \leq X \leq Y_{\text{max}} \), please select \( (1+Ka) \)
4. \( Ze \) is impedance error
5. \( \theta_{e} \) is \( \theta \) error

* 1. if \( Rx \geq R_{\text{max}} \), please select \( (Rx/R_{\text{max}}) \)
2. if \( Rx \leq R_{\text{min}} \), please select \( (R_{\text{min}}/Rx) \)
3. if \( R_{\text{min}} \leq Rx \leq R_{\text{max}} \), please select \( (1+Ka) \)

** 1. if \( Cx > C_{\text{max}} \), please select \( (Cx/C_{\text{max}}) \)
2. if \( Cx < C_{\text{min}} \), please select \( (C_{\text{min}}/Cx) \)
3. if \( C_{\text{min}} \leq Cx \leq C_{\text{max}} \), please select \( (1+Ka) \)

### Variables

<table>
<thead>
<tr>
<th>( Ka )</th>
<th>Constant Voltage factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{Constant Voltage On, } Ka = 2 )</td>
<td></td>
</tr>
<tr>
<td>( \text{Constant Voltage Off, } Ka = 0 )</td>
<td></td>
</tr>
<tr>
<td>( Kb )</td>
<td>Test Speed factor</td>
</tr>
<tr>
<td>( \text{Speed = SLOW, } Kb = 0 )</td>
<td></td>
</tr>
<tr>
<td>( \text{Speed = MEDIUM, } Kb = 3 )</td>
<td></td>
</tr>
<tr>
<td>( \text{Speed = FAST, } Kb = 10 )</td>
<td></td>
</tr>
<tr>
<td>( K_{c} )</td>
<td>Frequency &amp; RMS Voltage factor (refer to table1&amp;2)</td>
</tr>
<tr>
<td>( X )</td>
<td>X is value of the component being tested.</td>
</tr>
<tr>
<td>( Cx )</td>
<td>Value of the component being tested (capacitance)</td>
</tr>
<tr>
<td>( Rx )</td>
<td>Value of the component being tested (resistance)</td>
</tr>
<tr>
<td>( Lx )</td>
<td>Value of the component being tested (inductance)</td>
</tr>
<tr>
<td>( C_{\text{max}} )</td>
<td>Range constant for Capacitor Max table 3/4</td>
</tr>
<tr>
<td>( C_{\text{min}} )</td>
<td>Range constant for Capacitor Min in table 3/4</td>
</tr>
<tr>
<td>( R_{\text{max}} )</td>
<td>Range constant for Resistor Max in table 3/4</td>
</tr>
<tr>
<td>( R_{\text{min}} )</td>
<td>Range constant for Resistor Min in table 3/4</td>
</tr>
<tr>
<td>( L_{\text{max}} )</td>
<td>Range constant for Inductor Max in table 3/4</td>
</tr>
<tr>
<td>( L_{\text{min}} )</td>
<td>Range constant for Inductor Min in table 3/4</td>
</tr>
<tr>
<td>( Y_{\text{max}} )</td>
<td>Range constant for either Capacitor/Resistor or Inductor Max in table 3/4</td>
</tr>
<tr>
<td>( Y_{\text{min}} )</td>
<td>Range constant for either Capacitor/Resistor or Inductor Min in table 3/4</td>
</tr>
</tbody>
</table>

---

### Table 1

**KC (Ranges 1,2,3) Frequency & RMS Voltage factor**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>( 0.03 \leq V &lt; 0.1 )</th>
<th>( 0.1 \leq V &lt; 0.25 )</th>
<th>( 0.25 \leq V &lt; 1 )</th>
<th>( 1 \leq V \leq 1.265 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.012 \leq f &lt; 0.03 )</td>
<td>35</td>
<td>12</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>( 0.030 \leq f &lt; 0.1 )</td>
<td>30</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>( 0.1 \leq f &lt; 0.25 )</td>
<td>25</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>( 0.25 \leq f &lt; 1 )</td>
<td>20</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
| \( 1 \leq f 
| 14 | 4 | 1 | 0 |
| \( 1 \leq f < 3 \) | 15 | 5 | 2 | 1 |
| \( 3 \leq f < 6 \) | 15 | 6 | 3 | 2 |
| \( 6 \leq f < 10 \) | 15 | 8 | 5 | 3 |
| \( 10 \leq f < 20 \) | 20 | 10 | 6 | 5 |
| \( 20 \leq f < 50 \) | 30 | 22 | 18 | 15 |
| \( 50 \leq f < 100 \) | 50 | 40 | 35 | 30 |
| \( 100 \leq f \) | 80 | 50 | 45 |

* \( f \) = frequency in kHz.

---

### Table 2

**KC (Range 4) Frequency & RMS Voltage factor**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>( 0.03 \leq V &lt; 0.1 )</th>
<th>( 0.1 \leq V &lt; 0.25 )</th>
<th>( 0.25 \leq V &lt; 1 )</th>
<th>( 1 \leq V \leq 1.265 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.012 \leq f &lt; 0.03 )</td>
<td>70</td>
<td>20</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>( 0.030 \leq f &lt; 0.1 )</td>
<td>50</td>
<td>13</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>( 0.1 \leq f &lt; 0.25 )</td>
<td>35</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>( 0.25 \leq f &lt; 1 )</td>
<td>25</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>( 1 \leq f &lt; 3 )</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>( 3 \leq f &lt; 6 )</td>
<td>17</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>( 6 \leq f &lt; 10 )</td>
<td>25</td>
<td>15</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>( 10 \leq f &lt; 20 )</td>
<td>60</td>
<td>30</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>( 20 \leq f &lt; 50 )</td>
<td>Not specified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( 50 \leq f &lt; 200 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( f \) = frequency in kHz.

---

### Table 3

<table>
<thead>
<tr>
<th>Voltage</th>
<th>( 0.03 \leq V &lt; 0.1 )</th>
<th>( 0.1 \leq V &lt; 0.25 )</th>
<th>( 0.25 \leq V &lt; 1 )</th>
<th>( 1 \leq V \leq 1.265 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.012 \leq f &lt; 0.03 )</td>
<td>70</td>
<td>20</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>( 0.030 \leq f &lt; 0.1 )</td>
<td>50</td>
<td>13</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>( 0.1 \leq f &lt; 0.25 )</td>
<td>35</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>( 0.25 \leq f &lt; 1 )</td>
<td>25</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>( 1 \leq f &lt; 3 )</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>( 3 \leq f &lt; 6 )</td>
<td>17</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>( 6 \leq f &lt; 10 )</td>
<td>25</td>
<td>15</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>( 10 \leq f &lt; 20 )</td>
<td>60</td>
<td>30</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>( 20 \leq f &lt; 50 )</td>
<td>Not specified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( 50 \leq f &lt; 200 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( f \) = frequency in kHz.
Table 3
Y Range constant- Range Hold

<table>
<thead>
<tr>
<th>Component</th>
<th>Range</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductor</td>
<td>Range1</td>
<td>16mH/f</td>
<td>1mH/f</td>
<td>25uF/f</td>
<td>1.6uF/f</td>
<td>100Ω</td>
<td>6.25Ω</td>
</tr>
<tr>
<td>Capacitor</td>
<td>Range2</td>
<td>256mH/f</td>
<td>16mH/f</td>
<td>1600nF/f</td>
<td>100nF/f</td>
<td>1.6kΩ</td>
<td>0.1kΩ</td>
</tr>
<tr>
<td>Resistor</td>
<td>Range3</td>
<td>4100mH/f</td>
<td>256mH/f</td>
<td>100nF/f</td>
<td>6.4nF/f</td>
<td>25.6kΩ</td>
<td>1.6kΩ</td>
</tr>
<tr>
<td></td>
<td>Range4*</td>
<td>65H/f</td>
<td>4.1H/f</td>
<td>6400pF/f</td>
<td>400pF/f</td>
<td>410kΩ</td>
<td>25.6kΩ</td>
</tr>
</tbody>
</table>

f = test frequency in kHz

* This range is not used above 20 kHz

Table 4
Y Range constant- Auto Range

<table>
<thead>
<tr>
<th>Component</th>
<th>Range</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductor</td>
<td>Auto range</td>
<td>65H/f</td>
<td>1mH/f</td>
<td>25uF/f</td>
<td>400pF/f</td>
<td>410kΩ</td>
<td>6.25Ω **</td>
</tr>
<tr>
<td>Capacitor</td>
<td>***: Above 20kHz, Cmin = 6.4 nF/f, and Lmax = 4100mH/f</td>
<td>f = test frequency in kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistor</td>
<td>**</td>
<td>0.00001mH ~ 99999H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specifications

Specification accuracy is only applicable when the LCR meter has been warmed up for 30 minutes with an operating temperature of 18°C ~ 28°C.

| Measurement Parameters | Inductance (Ls/Lp)*, Capacitance (Cs/Cp), Resistance (Rs/Rp), Dissipation (D), Quality Factors (Q), Equivalent Series Resistance (ESR) and Equivalent Parallel Resistance (EPR), Impedance (|Z|), Phase angle of Impedance [degree] (θ). |
|------------------------|---------------------------------------------------------------|
| Measurement Modes      | R/Q, C/D, C/R, L/Q, Z/θ, L/R                                  |
| Display Ranges         | Primary Display Inductance (L) | Capacitance 0.00001pF ~ 99999 μF (C) |
|                        |                   | Resistance 0.0001 Ω ~ 99999kΩ (R) |
|                        |                   | Absolute of Impedance 0.0001 Ω ~ 99999kΩ (Z) |
|                        | Secondary Display Dissipation factor (D)* | 0.0001 ~ 9999 |
|                        |                   | Quality factor (Q)** | 0.0001 ~ 9999 |
|                        |                   | Phase angle of Impedance [-180.00° ~ 180.00°] (degree) |
|                        |                   | Equivalent Series Resistance (ESR)* | 0.0001 Ω ~ 9999 kΩ |
|                        |                   | Equivalent Parallel Resistance (EPR)* | 0.0001 Ω ~ 9999 kΩ |
### Dissipation factor (D+)

1 ppm ~ 9999 ppm

### Quality factor (Q)**

1 ppm ~ 9999 ppm

### DELTA %

0.0001% ~ 99999%

*s=series, p=parallel
** with L or R
+ with C

Note: Only LCR-821 has Z/θ and L/R measurement parameters.
If any of these quantities is negative, the "-" negative indicator is displayed.

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>LCR-821/819/817</th>
</tr>
</thead>
<tbody>
<tr>
<td>R, L, C, Z</td>
<td>0.05% (Basic)</td>
</tr>
<tr>
<td>D, Q</td>
<td>0.0005 (Basic)</td>
</tr>
<tr>
<td>θ</td>
<td>0.03° (Basic)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LCR-829/827/826/816</th>
</tr>
</thead>
<tbody>
<tr>
<td>R, L, C, Z</td>
</tr>
<tr>
<td>D, Q</td>
</tr>
</tbody>
</table>

*Please refer to the accuracy definition on page 132 for details.

| Basic Accuracy | 0.05% LCR-821/819/817 |
|               | 0.1% LCR-829/827/826/816 |

| Test Frequency | LCR-821 12Hz~200kHz (504 Steps) |
|               | LCR-819/829 12Hz~100kHz (503 Steps) |
|               | LCR-817/827 12Hz~10kHz (489 Steps) |
|               | LCR-816/826 100Hz~2kHz (245 Steps) |

<table>
<thead>
<tr>
<th>Measurement displays</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R/Q, C/D, C/R, L/Q, Z/θ, L/R</td>
<td></td>
</tr>
<tr>
<td>R/Q, C/D, C/R, L/Q, Z/θ, L/R</td>
<td>*The resolution of primary display (L, C, R or Z) is five digits.</td>
</tr>
<tr>
<td>R/Q, C/D, C/R, L/Q, Z/θ, L/R</td>
<td>*The resolution of secondary display (D, Q, R with C, or R with L) is four digits.</td>
</tr>
<tr>
<td>R/Q, C/D, C/R, L/Q, Z/θ, L/R</td>
<td>*The resolution of secondary display (θ) is 2 digits after decimal place.</td>
</tr>
</tbody>
</table>

---

**Delta%**

Delta% shows the percent deviation of the measured L, C, R or Z value from a saved NOMINAL VALUE. The deviation is indicated.

**Delta**

Delta is similar to the DELTA% except that the deviation is shown in suitable units (ohms, henries, etc.)

### Measurement

<table>
<thead>
<tr>
<th>Speed</th>
<th>LCR-816/817/819/821</th>
<th>LCR-826/827/829</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>896ms</td>
<td>Please refer to the Handler timing diagram on page 119 for details.</td>
</tr>
<tr>
<td>Medium</td>
<td>286ms</td>
<td></td>
</tr>
<tr>
<td>Fast</td>
<td>135ms</td>
<td></td>
</tr>
</tbody>
</table>

### Equivalent circuit

| Parallel L/R, L/Q, C/D, C/R, R/Q |
| Serial L/R, L/Q, C/D, C/R, R/Q, Z/θ |

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Auto/Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1-255</td>
</tr>
</tbody>
</table>

### Battery

3V-DC lithium ion (BR-2/3A) used for memory and calibration data backup. (Recommended replacement every three years. *The battery should only be replaced by a GW Instek approved service center.

### Memory

100 blocks of memory

### Display

240X128 dot matrix C.C.F.L. back lit LCD (contrast adjustable)

### Test voltage

LCR-817/819/827/829/821 5mV~1.275V (5mV steps) 0.1V~1.275V (5mV steps)

Note: When the test frequency is at 200kHz, test voltage must be greater than 100mV.

### DC bias

Internal 2V

External Up to 30VDC (200mA max), tolerable up to 35VDC.

### Operation

Indoor use

### Environment

Altitude up to 2000M

Installation category II

Pollution degree 2

Operating temperature 10°C~50°C, <85% relative humidity

### Storage

-20°C~60°C
Power Source | Line Voltage | 100V~240V AC, 50~60Hz/400Hz
--- | --- | ---
Power Consumption | 45 Watts maximum
Fuse | Slow-blow 5X20 mm, 3A/250V UL/CSA 5TT GMD
Dimensions | 330mm (W) × 149mm (H) × 437mm (D)
Weight | 5.5kg

---

**EC Declaration of Conformity**

We
GOOD WILL INSTRUMENT CO., LTD.
No. 7-1, Jhongsing Rd., Tucheng City, Taipei County 236, Taiwan
GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.
No. 69 Lushan Road, Suzhou New District Jiangsu, China.
declare that the below mentioned products:
LCR-817/819/827/829/816/826/821
are herewith confirmed to comply with the requirements set out in
the Council Directive on the Approximation of the Law of Member
States relating to Electromagnetic Compatibility (2004/108/EC) and

© EMC

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