B+K PRECISION®

Model 880

Dual Display LCR METER

INSTRUCTION MANUAL





Safety Summary

⚠WARNING

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by B&K Precision.

Failure to comply with these precautions or with warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the instrument. B&K Precision assumes no liability for a customer's failure to comply with these requirements.

Category rating

The IEC 61010 standard defines safety category ratings that specify the amount of electrical energy available and the voltage impulses that may occur on electrical conductors associated with these category ratings. The category rating is a Roman numeral of I, II, III, or IV. This rating is also accompanied by a maximum voltage of the circuit to be tested, which defines the voltage impulses expected and required insulation clearances. These categories are:

Category I (CAT I): Measurement instruments whose measurement inputs are not intended to be connected to the mains supply. The voltages in the environment are typically derived from a limited-energy transformer or a battery.

Category II (CAT II): Measurement instruments whose measurement inputs are meant to be connected to the mains supply at a standard wall outlet or similar sources. Example measurement environments are portable tools and household appliances.

Category III (CAT III): Measurement instruments whose measurement inputs are meant to be connected to the mains installation of a building. Examples are measurements inside a building's circuit breaker panel or the wiring of permanently-installed motors.

Category IV (CAT IV): Measurement instruments whose measurement inputs are meant to be connected to the primary power entering a building or other outdoor wiring.

⚠WARNING

Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument.

⚠WARNING

You must ensure that each accessory you use with this instrument has a category rating equal to or higher than the instrument's category rating to maintain the instrument's category rating. Failure to do so will lower the category rating of the measuring system.

Electrical Power

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 115 V RMS or 230 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

⚠CAUTION

If the instrument will not be used for a long period of time, remove the batteries.

⚠WARNING

When changing the instrument's batteries, disconnect all leads and wires connected to the instrument before replacing the batteries. Replace with the battery types specified in this manual.

Battery replacement

⚠WARNING

Remove all test leads from the instrument before replacing the batteries.

Do not operate in an explosive or flammable atmosphere

⚠WARNING

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

⚠WARNING

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In relative humidity conditions outside the instrument's specifications.
- In environments where there is a danger of any liquid being spilled on the instrument or where any liquid can condense on the instrument.
- In air temperatures exceeding the specified operating temperatures.
- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.
- In environments with restricted cooling air flow, even if the air temperatures are within specifications.
- In direct sunlight.

⚠WARNING

Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates.

⚠CAUTION

- This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0 °C to 40 °C and 20% to 80% relative humidity, with no condensation allowed.
- Measurements made by this instrument may be outside specifications if the instrument is used in non-office-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

Do not operate instrument if damaged

⚠WARNING

If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument.

Clean the instrument only as instructed

⚠WARNING

Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual.

Not for critical applications

⚠WARNING

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

Do not touch live circuits

⚠WARNING

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed. To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltage-sensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with known-operating voltage sources and test for both DC and AC voltages. Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present.
Do not insert any object into an instrument's ventilation openings or other openings.

⚠WARNING

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

Fuse replacement

⚠WARNING

Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace fuses only with new fuses of

the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

⚠WARNING

The replacement of current-measurement mode protection fuses in multimeters is especially important. These fuses must be replaced with fuses that are of the proper type, manufacturer, and rating as specified in this manual to maintain the safety category rating of the instrument.

Servicing

⚠CAUTION

Do not substitute parts that are not approved by B&K Precision or modify this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety and performance features are maintained.

⚠CAUTION

It is recommended that the instrument be returned to B&K Precision for service and periodic calibration to ensure the instrument is performing within its specifications

Do not substitute parts or modify the instrument

⚠WARNING

Do not install substitute parts or perform any unauthorized modifications to this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety features are maintained.

ESD sensitivity

⚠WARNING

This product uses components which can be damaged by electrostatic discharge (ESD). To avoid damage, follow proper procedures for handling, storing and transporting parts and subassemblies which contain ESD-sensitive components.

Resistance measurements

⚠CAUTION

Measurement of DC resistance in circuits that contain small DC biases (for example, thermoelectric voltages) can produce incorrect results. To minimize the effect of such biases, measure the DC resistance with normal and reversed test lead polarity and algebraically average the results, even if one of the measurements results in a negative resistance.

Shipment

It is recommended that you retain the original packing that the instrument was shipped in. This will allow you to return it to B&K Precision if needed. If the original packing is not available, use substitute packaging with at least the same protection and cushioning of the original packaging. Contact B&K Precision for shipping advice if you're unsure of how to ship the instrument.

Safety Guidelines

To ensure that you use this device safely, follow the safety guidelines listed below:

- This meter is for indoor use, altitude up to 2,000 m.
- The warnings and precautions should be read and well understood before the instrument is used.
- When measuring in-circuit components, first de-energize the circuits before connecting to the test leads.
- Discharge capacitor before testing.
- The meter is safety-certified in compliance with EN61010 (IEC 1010-1) Installation Category II (CAT. II) 50 V, Pollution Degree 2 environment.
- Use the meter only as specified in this manual. Otherwise, the protection provided by the meter may be impaired.
- The power for the meter is supplied with a single standard 9V battery. But also a line operation is possible using a 12V AC to DC adapter. If a power adapter is selected, please be sure it fulfills the safety requirements of a relevant IEC standard.

Other safety considerations

For continued safe use of the instrument

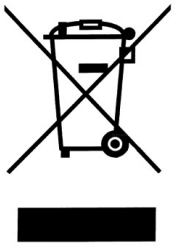
- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.
- Do not place a hot soldering iron on the instrument.
- Do not pull the instrument with the power cord, connected probe, or connected test lead.
- Do not move the instrument when a probe is connected to a circuit being tested.

Safety Symbols

	Refer to the user manual for warning information to avoid hazard or personal injury and prevent damage to instrument.
	Electric Shock hazard
	Alternating current (AC)
	Chassis (earth ground) symbol.
	Ground terminal
	DC Current
	Indicates inside pin is positive (+), outside is negative (-)
	CAUTION indicates a hazardous situation which, if not avoided, will result in minor or moderate injury
	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury
	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	NOTICE is used to address practices not related to physical injury.

Compliance Statements

Disposal of Old Electrical & Electronic Equipment (Applicable in the European Union and other European countries with separate collection systems)



This product is subject to Directive 2002/96/EC of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.

Environmental Conditions

Operating Environment	0 °C to 40 °C
Storage Humidity	0 – 80% R.H.
Storage Environment	-20 °C to +50 °C
Pollution degree	Pollution degree 2

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INTRODUCTION

B&K Precision's 880 handheld LCR meter is designed for measuring the inductance, capacitance and resistance of components. This LCR meter provides a 40,000-count primary parameter reading and a secondary parameter reading with a resolution of 0.0001 with an accuracy of up to 0.1%.

The meter provides direct and accurate measurements in series or parallel modes with selectable testing frequencies, voltage levels and 4-wire measurements.

The auto range can rapidly display the measuring results and automatically choose the desirable testing parameters in accordance with the components properties.

Front panel push buttons maximize the convenience of function and feature selection such as data hold, maximum, minimum and average record mode, relative mode, tolerance sorting mode, frequency and LCR selection.

The test data can be transferred to PC through a Mini USB connection, great for applications that require data logging.

PACKAGE CONTENTS

The model was carefully inspected electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any signs of physical damage that may have occurred during transit. Report any damage to the shipping agent immediately. Save the original packing carton for possible future shipment. The following items are included with every model order:

- 880 handheld LCR meter
- Quick start insert
- Mini USB interface cable
- Red & black banana to alligator test leads
- TLBSB Shorting Plate
- TL8KC1 Four terminal shielded Kelvin test lead
- TL LCR SMD test lead
- Battery charger
- 9V Ni-MH rechargeable battery (installed in meter)

Please locate the contents of the original packaging to ensure nothing is missing. If any of the items are missing, please contact B&K Precision immediately.

FRONT PANEL OVERVIEW

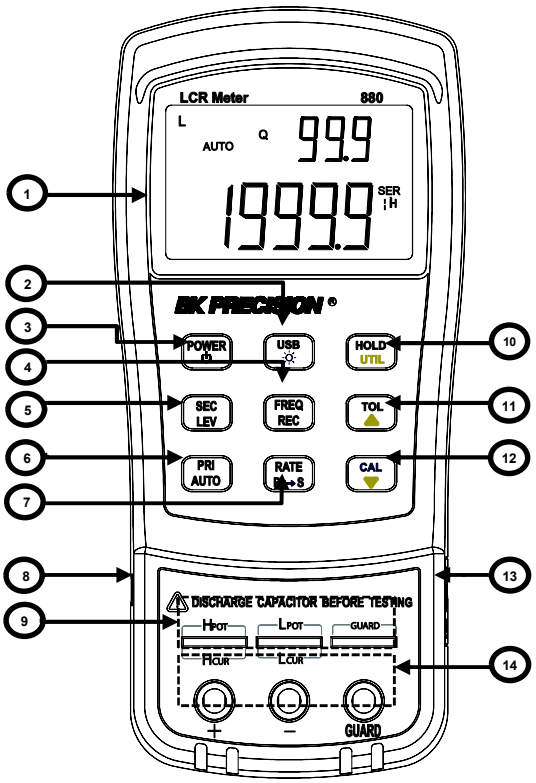

Figure 1 - Front Panel Display

Front Panel Display Descriptions

1. LCD display
2. USB communication / *Back light button
3. Power ON/OFF button
4. Frequency and record mode selection
5. Secondary display mode (D/Q/θ/ESR, etc.)/ Test Level
6. Primary display mode (L/C/R/Z/DCR, etc.)/ auto LCR selection
7. Rate/equivalent mode selection
8. Standard mini USB port (for remote control)
9. 5-terminal test sockets (direct measurement on lead components or use of test fixture)
10. Hold mode/ utility menu
11. Tolerance mode/ utility arrow up key
12. Open/short calibration/ utility arrow down key
13. 12VDC external power input (use with an external power adapter)*
14. 3-terminal test jacks (for use of Banana plugs—Alligator clip Test Leads)

Note: *Use with included power adapter only. Use with improper power adapters may damage the instrument. Use power adapter only when there is a rechargeable battery inserted or when there is no battery.*

***WARNING: Before connecting an external power adapter, please check the battery compartment in the rear side of the unit. If a battery is installed, be sure that the polarity matches the (+) and (-) labels as indicated inside the battery compartment. See "Installing Battery" section for details. DO NOT, at any time, connect an external power adapter when a battery is installed incorrectly or is the wrong type. Doing so will damage the instrument or the battery and void the instrument's warranty.**

Front Panel Buttons

With the exception of the power button, all front panel buttons have specific colored labels on them. They are all marked in white, blue or yellow color. Each color has a specific representation, as described below:

White—the primary function, these functions will be set or configured upon pressing the button.

Blue—the secondary function, this function will be set or configured if that button is pressed and held down for 2 seconds.

Yellow —the utility function, this function will be set or configured if the HOLD UTIL button is pressed and held down for a couple of seconds. See "Utility Menu (UTIL)" section for details.

NOTE: *In the button operational instructions, we will use the button name to express the button operation without differentiating the type of button. The secondary function of each button can be accessed by a long press of that button, indicated by a beep when the secondary function has been accessed.*

LCD DISPLAY OVERVIEW

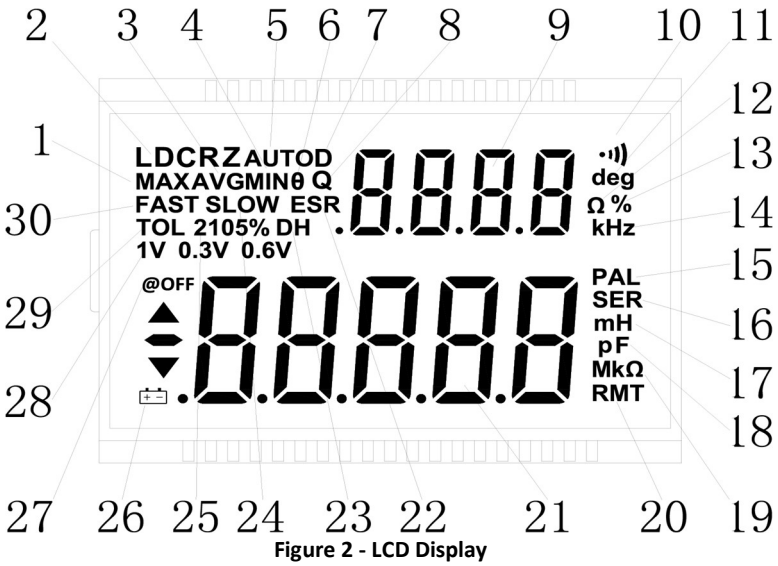

Figure 2 - LCD Display

LCD Display Descriptions

1. MAX – Maximum reading indicator in the record mode
2. LDCRZ – Primary parameters display
3. AVG – Average reading indicator in the record mode
4. MIN – Minimum reading indicator in the record mode
5. AUTO – Automatic LCR indicator
6. θ – Phase angle indicator for secondary display
7. D – Dissipation indicator
8. Q – Quality factor indicator
9. 8.8.8.8 – Secondary parameter display
10. •))) – Beeper tone indicator for tolerance mode
11. deg – Phase angle (θ) units indicator
12. Ω – ESR(ohm) units indicator
13. % - Percentage indicator (in tolerance mode)
14. kHz – Frequency units indicator
15. PAL – Parallel mode indicator
16. SER – Series mode indicator
17. mH – Inductance units (L) indicator
18. pF –Capacitance units (C) indicator
19. MkΩ – Resistance(R) /impedance units indicator
20. **RMT**– Remote mode indicator
21. 8.8.8.8.8 – Primary parameter display
22. ESR – Series mode indicator for secondary parameters
23. DH – Data hold indicator
24. SLOW – measuring rate indicator
25. 2105% - Limits indicator in tolerance mode

26.  – Low battery/charging indicator
27. @OFF –Auto power-off indicator
28. 1V 0.6V 0.3V- Display test level
29. TOL –Tolerance mode indicator
30. FAST- Fast/Slow measuring rate indicator

Special Display Indicators

SHrt	Indicates short connectors
OPEN	Indicates open connectors
Err	Error indication
CAL	Indicates calibration mode
FUSE	Indicates damaged or open fuse
E01	AD converter error
E02	AD converter error

Test Port

The 880 is designed with two test ports: the 3-terminal port for convenience and a 5-terminal port for higher accuracy.

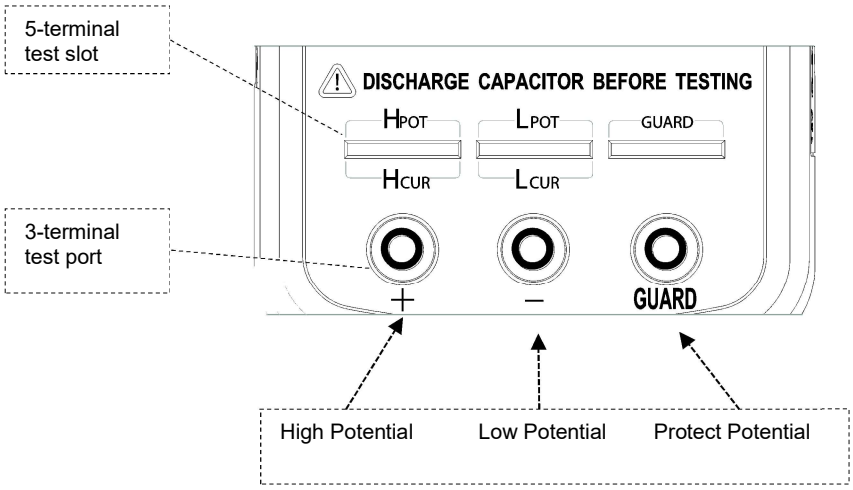

Figure 3 - Test Ports

The standard banana plugs allow the connection of banana to alligator test lead. This configuration has lower testing accuracy when compared to the 5-terminal test port. The test lead length should be kept as short as possible.

For a more accurate measurement when using external testing leads, the 880 LCR meter is designed with a 5-terminal test port and exclusive test fixtures that provide a 4-wire connection with a shield for increased measuring accuracy.

POWERING INSTRUMENT

Before beginning to operate the instrument, a power source is necessary for it to turn on. There are two methods to power the instrument: Battery and external source.

Installing Battery

The 880 LCR meters can use a battery to provide power to the instrument so that it can be portable.

The meters use a standard 9V size battery (or NEDA 1604, JIS006P, IEC6F22 carbon-zinc or alkaline battery) or a rechargeable Ni-MH battery.

To install the battery:

1. Place the meter upside down. Open up the back-flip stand, and locate the screw that tightens the battery compartment cover as indicated in Figure 4. Use a screwdriver to unscrew and remove the cover.



Figure 4 - Back Cover

2. Insert 9V battery into compartment. Note the positive (+) and negative (-) terminals as indicated inside the battery compartment (See Figure 5). Be sure to insert the battery with matching polarity.

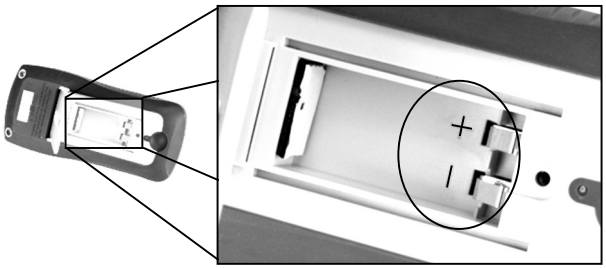

Figure 5 - Battery Compartment

3. Place the battery compartment cover piece by sliding it into the top slid first. Place screw at the bottom of the cover piece and tighten down with a screwdriver.
4. Push and hold down the POWER button for 2 seconds to turn on the instrument.

Connecting External Power Source

The 880 can also be powered using an external AC adapter. The model 880 comes with this adapter included in the package.

Note: For external power, use AC adapter rated for output 12VDC, 150mA, center pin positive 4mm connector only.

WARNING: Use of the incorrect adapter may damage the instrument.

To connect the adapter, do the following:

1. If a battery is installed, please check the battery compartment again insuring the polarity of the battery matches the polarity as indicated by the labels inside the compartment. If it is not, please remove and insert the battery with matching polarity. If a battery is not installed, continue to the next step.

   WARNING: DO NOT, at any time, connect an external power adapter when:
   - **The battery inside the unit is NOT rechargeable. Doing so will cause the battery to burst, be damaged, or possibly catch fire.**
   - **A battery is installed incorrectly (reverse polarity or non-matching polarity to indicator of battery compartment). Doing so will damage the instrument and void its warranty.**

2. Connect the AC adapter connector into the right side panel of the instrument. See Figure 6 below.
3. Now, connect the AC Adapter socket into an electrical outlet.
4. Push and hold down the POWER button for 2 seconds to turn on the instrument.

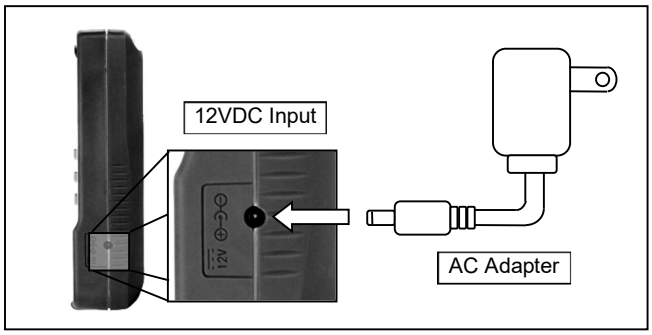

Figure 6 - Connecting AC Adapter to Meter

Note: *The meter can be operated with a rechargeable battery installed while an AC adapter is plugged in at the same time (As long as the battery is inserted properly with correct polarity and is rechargeable). In this event, the meter will automatically switch to consume power from the AC adapter instead of the battery to preserve battery life.*

Low Battery Indication

The LCR meter has a low battery indicator to notify the user when to replace the battery. When the display starts flashing the + − indicator, the battery voltage is below normal working voltage. In this case, accuracy of the meter will also decrease. It is recommended that the battery be replaced as soon as possible before continuing operation. See "Installing Battery" for instructions.

Backlit Display

Model 880 LCR meter has a backlit display that allows you to see the LCD display in dark conditions.

To turn **<u>on</u>** the back light, press and hold down USB button for 2 seconds. Back light will turn on and brighten the LCD display.

To turn **<u>off</u>** the back light at any time, press and hold down USB button for 2 seconds again. Back light will turn off and return to normal display.

When Using Battery Power

When the meter is powered using 9V battery, the back light display will turn on upon holding down the USB button for 2 seconds. It will stay at maximum brightness for 30 seconds and then the light will automatically turn off to conserve battery power.

When Using External Power

When the meter is powered using an external AC adapter, the back light display will turn on upon holding down the 

button for 2 seconds. It will stay at maximum brightness continuously until the user presses and holds down the 

button for 2 seconds again.

Note: *If a rechargeable battery is installed while using an AC adapter simultaneously, unplugging the AC adapter will automatically turn off the back light after it has been lit for 30 seconds.*

Charging Circuit

When the external power adapter is plugged in, the power mode will automatically switch and charge the internal rechargeable battery.
Single charge cycle is about 160 minutes and charge current is approximate 120mA. If a battery is fully charged, then the 880 will stop charging the battery.

WARNING: DO NOT connect to external power when a non-rechargeable battery is installed. Doing so will cause the battery to burst and possibly catch fire.

 **:** ***It indicates low power of a battery if the unit is being powered by the battery. After connecting the unit to the power adapter the same icon is used to indicate that the battery is being charged.***

OPERATION INSTRUCTIONS

WARNING: *If the component to be measured is a capacitor, be sure that the capacitor is fully discharged BEFORE inserting it into the input sockets or terminals. For large capacitors, it may take longer periods of time for a full discharge. Inserting a charged or partially charged capacitor into the meter's input sockets or terminals may produce an electric hazard and may also damage the instrument, making it unusable.*

Data Hold (HOLD)

The data hold function allows the user to freeze the display when pressed, holding the measured value until data hold is turned off.

Turn On Data Hold

To use data hold, press the 

button once. The "**DH**" indicator will display on the screen when data hold is active.

Turn Off Data Hold

To disable the data hold, press the 

button again. The "**DH**" indicator will disappear on the screen, and the meter will remain in normal operation mode.

Note: *Changing the primary function, secondary function, or test frequency will automatically turn off the data hold.*

Data Record Mode (REC)

If the data stability of tested components is poor and the data fluctuates in a range, data record mode can aid the reading of data.
This mode is used for dynamically recording maximum, minimum, and average values in a range.

Enable Static Recording

Press and hold down the 

button for two seconds to enter the static recording mode. The display should indicate "**MAX AVG MIN**" simultaneously. This indicates the meter is in static recording mode and recording is performed immediately.

Using Static Recording

There are four different modes that can be selected in static recording. Per press of the 

button (in recording mode, FREQ will be disabled), the modes will change and repeat in the following order:

→Recording mode→Maximum Mode →Minimum Mode →Average Mode

Recording State

This is the default mode when static recording is enabled. In this mode, LCD will display "MAX AVG MIN" indicator. In a relatively stable range of test data, a beep tone will sound once a recording has been stored.

NOTE: *When the data fluctuation range is higher than 1%, data record will dynamically be refreshed.*

Maximum Display

Press the 

button until the "**MAX**" indicator is shown on the display. This indicates that the value in the primary display represents the recorded maximum value.

Minimum Display

Press the 

button until the "**MIN**" indicator is shown on the display. This indicates that the value in the primary display represents the recorded minimum value.

Average Display

Press the 

button until the "**AVG**" indicator is shown on the display. This indicates that the value in the primary display represents the recorded average value.

Disable Static Recording

To exit this mode, press and hold the 

button for two seconds. The "**MAX AVG MIN**", "**MAX**", "**MIN**", or "**AVG**" indicator will disappear on screen.

NOTE: *Changing the type of test parameters will automatically turn off static recording.*

Calibration (CAL)

This mode is used when the user wants to "zero" the meter based on a reference value or wants to obtain a reading that is relative to a reference value.
For example, if test leads are going to be used in a measurement, the user may want to set a reference with the test leads inserted into the input terminals so that any measurements taken will not take into account the test leads.

There are two functions under **CAL Mode**:

- **Open Cal** will reduce the effects of contact resistors and test leads.
- **Short Cal** will minimize the influence of distributed capacitors and resistors on testing high impedance elements.

Enter CAL Mode

For convenience, OPEN CAL and SHORT CAL are designed to share a button. By pressing the CAL button, the meter will automatically choose either Open Cal or Close Cal.

Open Cal

First select frequency to Cal and keep test clip and test slot be open. Enter into **CAL** by pressing the CAL button, and a moment later the OPEN indicator will appear on secondary display after the automatic measurement judging. If user decides to perform open Cal, another press of CAL should be done.

***NOTE:** "----" indicator on secondary display indicates that test terminal is out of open state and Open Cal cannot be performed.*

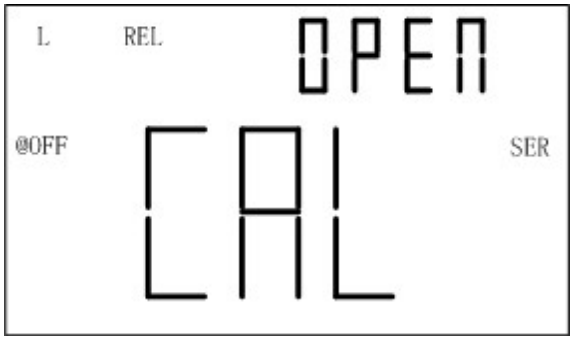

Figure 7 - Open Cal

Short Cal

First choose test frequency to Cal and then insert a short plate to test slot. If SMD test tweezers or test clip probes are used, the short plate should be connected to the ends of the probe in order to account for the probes properties. Enter into Cal mode by pressing the CAL button, and a moment later the SHrT indicator will appear on secondary display after the automatic measurement judging. If user decides to perform short Cal, press again the CAL button.

***NOTE:** "----" indicator on secondary display indicates that test terminal is out of short state and short Cal cannot be performed.*

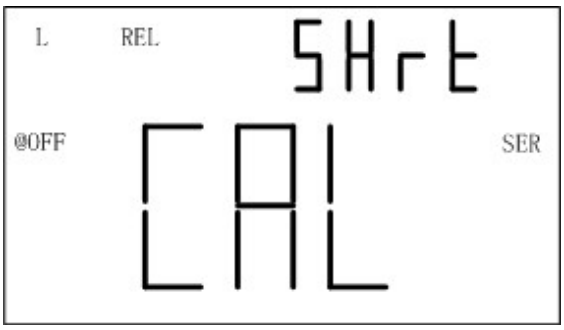

Figure 8 - Short Calibration

Notes:

1. *If test frequency is changed, calibration should be done again before making precision measurements. Once calibration is done on a selected test frequency, calibration data will remain until power off.*
2. *Either open or short calibration is not associated with measurement function, therefore changing the test function does not require re-calibration.*
3. *Re-calibration may be necessary depending on many factors such as prolonged use, changing environments, and contact variation (i.e. alligator test leads or socket contacts).*

Note: *To achieve optimal measurement results, both open and short calibration should be done. It is highly recommended to calibrate extremely high or low values for L, C, R and Z before making precision measurements.*

Primary Parameter (PRI)

The primary display of the LCR meter is used to indicate measured values under four different modes. These modes are: L (inductance), C (capacitance), R (resistance), and Z (impedance).

To change between these four primary modes of measurement, press the PRI AUTO button. The modes will change and repeat upon each button press. On the screen, the indicators "**L**", "**C**", "**R**", or "**Z**") will be displayed to indicate which mode the meter is in.

NOTE: *After changing primary parameter, secondary display indicates the preset frequency. No secondary parameter display in DCR state. If it is required to display corresponding secondary parameters, press the secondary button.*

Secondary Parameter (SEC)

The secondary display of the LCR meter is used to display measured values of four parameters, which provide additional information about the component being tested. These parameters are: D (Dissipation factor), Q (Quality factor), θ (Phase angle), and ESR (Equivalent series resistance).

To change between these measurements parameters, press the 

button. The parameters for measurement will change and repeat upon each button press. On the screen, the indicators "**D**", "**Q**", "**θ**" or "**ESR**" will be displayed to indicate which secondary mode the meter is in.

Auto Detect Mode (AUTO)

Auto detect function will automatically select the corresponding primary parameter and its secondary parameter and suitable series/parallel equivalent mode of L, C, R. The selection is done by evaluating the impedance property of the component according to the test result. This mode is convenient for the measurements of mixed or unknown components.

Enable Auto Detect Mode

Long press of AUTO button will activate auto LCR mode. The "AUTO" indicator on LCD indicates that auto LCR mode is activated.
In auto LCR mode, each primary parameter has a secondary parameter associated with it, shown below:

Primary Parameter	Secondary Parameter
Capacitance (C)	Dissipation (D)
Inductance (L)	Quality Factor (Q)
Resistance (R)	Phase Angle (θ)

Table 1- Auto LCR Mode

In auto LCR mode, series or parallel equivalent mode is selected in accordance with the magnitude of impedance. Parallel mode is selected at high impedance and series mode at low impedance.

Disable Auto LCR Mode

Long press the PRI AUTO button again will disable auto LCR mode. The unit will not continue changing the primary and secondary modes, series/parallel equivalent mode and frequency mode. “AUTO” indicator on LCD will disappear when auto LCR mode is turned off.

Test Frequency (FREQ)

The 880 LCR meter uses an AC signal to test and measure components at the input sockets or terminals. With this measurement method, a test frequency must be selected. The test frequency can affect the accuracy of the results depending on what frequency is selected, and what type and value of component is being measured or tested.
For details on selecting the optimal test frequency for measurement, refer to the “**SUPPLEMENTAL INFORMATION**” section.

Selecting Frequency

To select or change the test frequency, push the FREQ REC button once. With each press, the test frequency will be indicated on the secondary display of the meter. This will remain displayed until a different function for the secondary display is selected.

The selectable test frequencies for **880** meter are:
100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz.

Test Voltage Level (LEV)

The 880 handheld LCR Meter applies an AC signal to the device under test. The Test Voltage Level is the amplitude of the AC signal. Some high-sensitivity components could display different test results when using different test voltage levels. Therefore, a suitable test level should be selected before measurement.

Press the SEC LEV button for 2 seconds to access the Test Voltage Level options. Every time the SEC LEV button is pressed, the 880 will cycle between the available levels, which are: **0.6V, 0.3V and 1V**.

Measurement Rate (RATE)

There are two selectable measurement rates in this instrument: fast and slow. The rate of fast measurement is about 4~5 times/sec and slow measurement is approximate 1.5 times/sec. The stability of slow measurement is higher than fast measurement.

The fast and slow rates can be directly switched by pressing the RATE P↔S button. “FAST” indicator will be displayed on LCD at fast rate and “SLOW” indicator at slow rate.

Parallel and Series Measurement Mode

The LCR meter offers the option to select between parallel or series measurement modes. Depending on which mode is selected, the method used to measure the component will be different. Additionally, one measurement mode may provide better accuracies over the other measurement mode depending on the type of component and the value of the component to be tested. For more details, refer to the "**SUPPLEMENTAL INFORMATION**" section.

Default Settings

For **Capacitance** and **Resistance** measurements, the default measurement mode is **parallel**.

For **Inductance** measurements, the default measurement mode is **series**.

Selecting Measurement Mode

The measurement mode of the meter is displayed by the indicators "**SER**" or "**PAL**" on the LCD screen. "**SER**" means meter is in series measurement mode. "**PAL**" means meter is in parallel measurement mode. To toggle between the two modes, press and hold down 

button for 2 seconds. The indicators on the display should toggle between "**SER**" and "**PAL**".

Tolerance (TOL)

The tolerance mode feature is used for component sorting purposes. Users who need to test and sort through a large number of components will find this function quite helpful.

Tolerance Range

The tolerance function is configured by range as a percentage, meaning a percentage is used to define whether a measured value is within tolerance or out of tolerance.

In tolerance mode, the selectable values for sorting are: 1%，5%，10%，20%.
The data indicated in the primary display will be recorded as the nominal value.
The secondary display will display the range of percentage.

Displayed value in percentage: =

$$100 * (Mx - Nom)/Nom\%$$

Where, **Mx**: the primary parameter display;
Nom: the nominal value recorded.

Setup Tolerance Mode

1. Select the primary measurement mode based on the type of components to be measured. This is done by pressing the PRI AUTO button to configure the desired measurement mode.

   Note: *Be sure to select the correct measurement mode, as tolerance mode cannot be activated unless the correct mode is selected. For example, if the component is a capacitor, be sure to select "C" for capacitance. If not, tolerance mode will not be activated following the proceeding steps below.*

2. Configure the proper test frequency and series/parallel equivalent mode.
3. Perform the operation of calibration (**CAL)** if necessary.
4. Insert a known "good" component that will be used for testing against all other components.
   This component will be the "standard" reference value
   *(See **Figure 9** for illustration*)

   Note: *The tolerance mode cannot be activated unless the meter senses a component is connected to either the input sockets or terminals.*

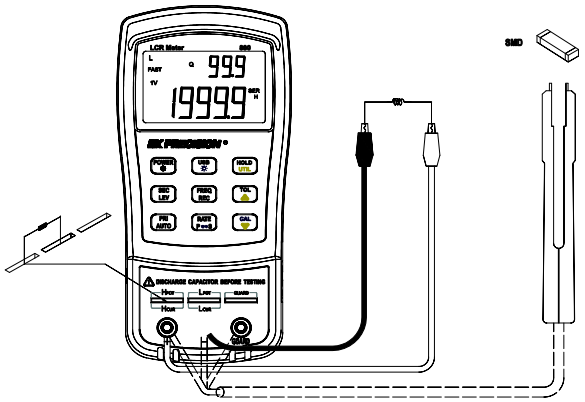

Figure 9 - Inserting Components to Inputs

5. Once the desired measured reading is displayed, press the TOL button once to store the reading as the "standard" value or test reference value. At this point, the "**TOL**" will be displayed on the screen, indicating that the tolerance mode is activated.

   Note: Any value which appears on the LCD display, such as DH (data hold) or MAX/MIN/AVG, can also be used as the "standard" value or test reference value for sorting components.

6. To select the tolerance range, press the 

button once more. For each button press, the meter will cycle through the tolerance range percentage in this order: **1%**, **5%**, **10%**, **20%** which will also be indicated on the LCD. The component to be tested will be verified with the tolerance within the selected % of the "standard" value or test reference value (as configured from step 5).
7. Within a few seconds, an audible tone will be heard.

   One single "beep" or tone means the component is <u>within tolerance</u>.

   Three "beeps" or tone means the component is <u>out of tolerance</u>.

Disable Tolerance Mode

To disable or exit out of tolerance mode, simply press and hold down the 

button for two seconds. The "**TOL**" and/or the percentage indicators "**1%**", "**5%**", "**10%**", or "**20%**" will disappear from the LCD display.

Note: *Changing the primary function, secondary function, or test frequency will automatically disable tolerance mode.*

Utility Menu (UTIL)

The LCR meter has a built-in utility menu that allows you to configure some user preferences and settings. The buttons used to set and control the menu are colored in yellow: They are 

, 

and 

.

Entering Utility Menu

Press and hold down the 

button for two seconds or until the primary display shows "**dCdLy**". This indicates the meter is currently in the utility menu.

Configuration and Settings

There are four different menu options and configurable settings under each option. Below is a table that lists these options and settings.

Menu Options	Settings/Parameters
dCdly	DCR trigger delay
bEEP	ON / OFF
AoFF	5 / 15 / 30 / 60 / OFF
PuP	PrE / Set
dEF	yES / NO
bAtt	Battery Voltage

Table 2 - Utility Menu Options and Settings

The 6 menu options allow users to control or check the following options:

- DCR trigger delay function: (dCdLy: DCR delay)
- Control beep sound: (bEEP: beep sound)
- Set auto power-off: (AoFF: auto power off)
- Set power-up state: (PuP: power-up state)
- Reset to default settings: (dEF: default settings)
- Indicate battery voltage: (bAtt: battery voltage)

By default, the first option after entering the utility menu is "**dCdLy**". The primary display indicates the menu option, and the secondary display indicates the current settings or parameters configured for the selected option. To change the settings or parameters, use the FREQ REC and TOL arrow keys. To change or select a different menu option, press the HOLD UTIL button once. For each HOLD UTIL button press, the meter will traverse through each menu options and will repeat itself in the following order:

dCdly→bEEP →AoFF →PuP →dEF →bAtt

Note: *The settings and parameters are temporarily "remembered" once the HOLD UTIL button is pressed to select a different menu option. To save all settings permanently, exit the menu using the save and exit method. With the exception of "**bEEP**" and "**AoFF**" settings, in which case under these settings, changes are temporarily saved even when exiting the menu without saving. (See "*Exit Utility Menu*" section for details).*

DCR Trigger delay Setup (dCdLy)

The "dCdLy" menu option is used to set the trigger delay time ranging from 0000 to 9999ms.

Using the 

and 

arrow keys to add or minus the time by 1. Long time pressing 

and 

arrow keys can move the current cursor to left or right. The setup is promptly effective once modified.

NOTE: when the setting is not 0000, the higher the setting time, the DCR measurement speed becomes more slowly. It is suggested to set the time to 0000.

Default setting: 0000

Beep Sound Setting (bEEP)

The "**bEEP**" menu option allows the user to enable or disable the beep sound for every key press.

Note: *This option only disables the beep sound for each key press. It does not disable the beep sound for "**Static Recording**" and "**Tolerance**" mode, as well as the "**auto power-off**" warning.*

To turn **ON** the beep, push either the 

or 

arrow keys until the secondary display shows "**ON**".

To turn **OFF** the beep, push either the 

or arrow keys until the secondary display shows "**OFF**".

Default Setting: ON

Auto power-off Setting (AoFF)

The "**AoFF**" menu option allows the user to select the auto power-off timer. This timer is always counting continuously. It resets every time a button is pressed or if an action occurred. If the meter is left untouched or unattended, the timer will count until the configured time is up. This is particularly important if the user wants to preserve battery life or run the meter continuously without interruption.

Note: *When the timer has reached the configured time, the meter will make an audible "beep" sound continuously for 10 seconds before auto power-off. To stop the "beep" sound, simply press any button to resume operation and reset the timer count.*

The available timer settings are: **5 minutes**, **15 minutes**, **30 minutes**, **60 minutes**, and **off**.

When the primary display shows "**AoFF**", push the 

or 

button to select the timer setting. The settings will be shown on the secondary display as follows:

SECONDARY DISPLAY	REPRESENTATION
5	5 minutes
15	15 minutes
30	30 minutes
60	60 minutes
OFF	No timer. Manual power off only

Table 3 - Auto Power-Off Options

Default Setting: 5 mins

When the auto power-off option is set to any of the configured settings in Table 3 above (**Error! Reference source not found.**except for "**OFF**"), upon exiting the utility menu the LCD display will have a "**@OFF**" indicator. This means a timer has been set for auto power-off. To set the auto power-off select the desired minutes and press the HOLD UTIL button for 2 seconds.

Note: *When an external 12VDC AC adapter is used to power the instrument, the auto power-off feature will automatically be disabled. This is indicated on the LCD display when the "**@OFF**" indicator disappears. Under this condition, the meter will remain powered ON continuously. In this state, powering off the instrument would require manually pushing and holding down the* POWER *button for 2 seconds.*

*When external power is removed, the meter will automatically re-enable auto power-off again and "**@OFF**" indicator will re-appear if a time has been set from the "**AoFF**" option of the utility menu.*

Power-up State (PuP)

The "**PuP**" menu option allows user to configure the power-up state of the LCR meter, allowing user to restore settings saved into internal EEPROM memory at power-up.
In the utility menu, when the primary display shows "**PuP**", there are two settings selectable and shown on the secondary display. "**PrE**" and "**SEt**".

Default Setting: *PrE*

Storable Settings

- Primary function mode (i.e. L/C/R)
- Secondary function mode (i.e. D/Q)
- Test frequency
- Measurement rate

- Auto LCR
- Tolerance mode state
- Reference value for Tolerance mode

Configure and Save Power-up State

Follow the below procedure to setup and store a power-up state into internal memory.

1. Before entering into the utility menu, configure all the settings and parameters desired for power up state. Do this by turning on any modes and setting values as desired. (Only the settings listed above in "Storage Settings" are stored). If the meter is currently in the utility menu, exit first and setup the desired settings for recalling at power-up. (*see "*Exit Utility Menu*" for details*)
2. Once settings are configured, enter/re-enter the utility menu by holding down the button 

for 2 seconds.
3. Traverse through the utility menu until you see "**PuP**" on the primary display. The secondary display should also show "**PrE**".
4. In order to save the current meter settings for power-up state into internal memory, use either 

or 

button to change the settings so that the secondary display shows "**SEt**".
5. Press 

button to select the next menu option. Once all other utility options are configured, exit the utility menu by holding down 

button for 2 seconds.
6. The meter has now saved all current settings into internal memory. The next time the meter is powered-up, the saved settings will be restored.

Note: *The meter allows one set of settings to be stored into memory. Therefore, the same procedure is used to overwrite previously stored settings into memory.*

Prevent Overwrite of Stored Settings

In the utility menu, the "**PuP**" option default setting is always "**PrE**". This represents "previous settings". Keeping this setting will prevent the meter from overwriting previously stored settings for power-up state. Therefore, when entering the utility menu, be sure not to change to "**SEt**" to prevent overwriting any previously stored power-up settings.

Reset Default Settings (dEF)

The last option in the utility menu allows you to reset the meter to default settings. When the primary display shows "**dEF**", the secondary display will show "**NO**" by default. The meter will also default this setting to "**NO**" to prevent accidental reset of instrument settings.

Default Setting: *No*

To reset the meter to default settings, first select the "**dEF**" menu option by using the use 

button to browse through the utility menu. When the primary display shows "**dEF**", either press 

or 

button to change the setting so that the secondary display shows "**yES**". Upon saving and exiting the utility menu, the instrument will automatically reset back to its original settings. Below is a table of all the settings that will be restored.

Settings	Default Configuration
Primary Function	C (capacitance)
Secondary Function	None (frequency)
Auto LCR function	Off
Equivalent Method	SER (series)
Measurement Frequency	1kHz
Measurement Level	0.6V
Measurement Speed	Slow (SLOW)
Tolerance Mode	Off

Table 4 - Instrument Default Settings

Note: *In the case where under "**PuP**" option, "**SEt**" is selected and "**dEF**" is set to "**yES**", the "**PuP**" setting has priority over the "**dEF**" setting. This means the instrument will not be set back to default upon saving and exiting the utility menu. Instead, the power-up settings will be stored and will be recalled upon the next power-up of the instrument.*

Indicate battery voltage (bAtt)

When menu option changes to "bAtt", the secondary display will indicate battery voltage that is for reference instead of for operational function.

Exit Utility Menu

There are two methods for exiting the utility menu. One saves all the changed settings before exiting, and the other exits the menu without saving any changes.

Saving and Exiting

To save all utility menu option settings and to exit the menu, press and hold down the HOLD UTIL button for 2 seconds. After this, the meter will exit the menu, and all settings will be saved.

Exiting without Saving

If user decides to exit the utility menu without making any changes or saving any changes to "**PuP**" or "**dEF**", it can be done by simply pressing any front panel buttons except HOLD UTIL, TOL, CAL, and POWER. Note that settings that are changed under "**bEEP**" and "**AoFF**" options are still temporarily set until the next power-up of the instrument.

USB

The USB button USB are used for remote communication. See "Error! Reference source not found." section for details.

Automatic Fuse Detection

The LCR meter has an internal fuse that protects the inputs from severely damaging the instrument. When the meter detects that the protective fuse is open, the "**FUSE**" indicator will appear on the primary display (see Figure 10 below) and an internal "beep" will sound continuously. In this situation, none of the function buttons can be operated and all other meter functions will be disabled.

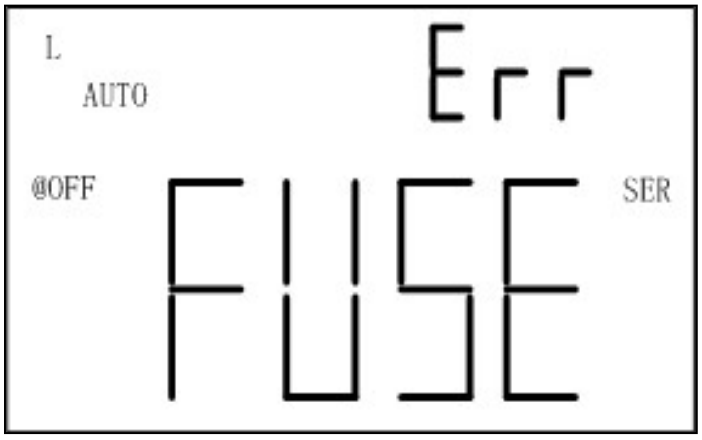

Figure 10 - Fuse Error Display

In the event that the above screen is displayed, a fuse replacement is required. Turn off the meter by pressing and holding down the button POWER for 2 seconds. If this does not power off

the meter, remove external AC adapter if used and/or remove the battery from the battery compartment. Refrain from further operation until the fuse is replaced. Please contact B&K Precision for assistance.

QUICK START GUIDE

⚠CAUTION

- Do not measure a capacitor that is not fully discharged. Connecting a charged or partially charged capacitor to the input terminals will damage the instrument.
- When measuring within a circuit, the circuit must be de-energized before connecting the test leads.
- When used in a dusty environment, the instrument should be wiped and cleaned regularly.
- Do not leave the instrument exposed to direct heat from the sun for long periods of time.
- Before removing the cover, ensure that the instrument is disconnected from any circuit and is powered OFF.

Note:

*To achieve optimum precision for all L, C, and R measurements at either the highest or lowest ranges, calibrate the meter before testing. See "***SUPPLEMENTAL INFORMATION***" section for details.*

Inductance Measurement

1. Press down POWER button for one second to turn on the meter.
2. Press PRI AUTO button until "**L**" is displayed on the screen to select inductance measurement.
3. Insert an inductor into either the input sockets or connect alligator leads into the banana jack input terminals and connect the clips to the component leads as illustrated in Figure 11.
4. Press TOL button until the desired test frequency is displayed on screen.
5. Press SEC LEV button to select between D factor, Q factor, θ angle, or ESR measurement for secondary display.
6. Read the display readings for inductance measured values and selected measured values on secondary display.

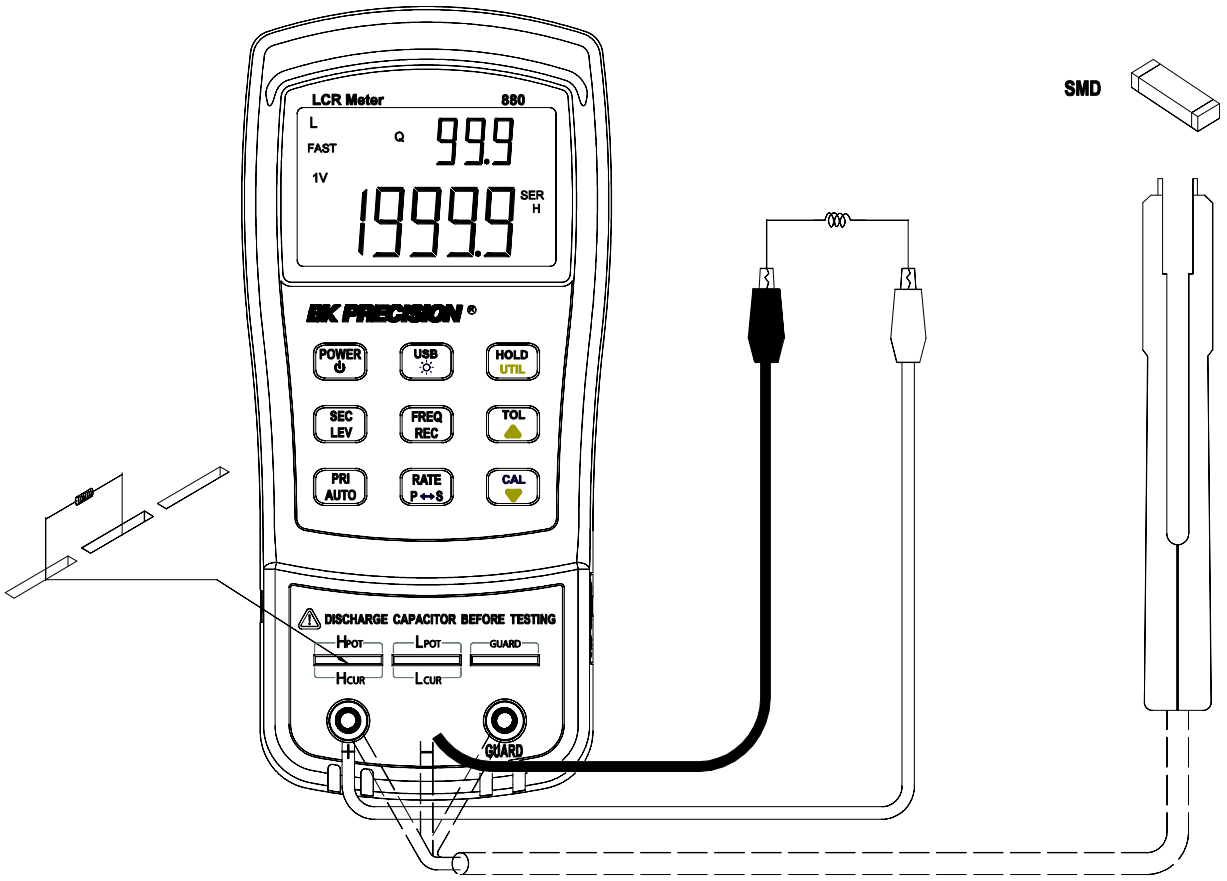

Figure 11 - Inductance Measurement Setup

Capacitance Measurement

⚠WARNING

*Fully discharge capacitor **BEFORE** inserting it into the instrument. Failure to do this may result in damage to the meter and may cause electrical hazards.*

1. Press POWER button for one second to turn on the meter.
2. Press PRI AUTO button until "**C**" is on the screen to select capacitance measurement.
3. **CAUTION: BEFORE inserting a capacitor or capacitive component into the input sockets or terminals, be sure to fully discharge the component. Some larger capacitive components may take longer to discharge. In these cases, please allot enough time for a full discharge. If proper discharging of the component is not done correctly, it will damage the meter.**
4. Insert the DISCHARGED capacitor or capacitive component into the input sockets or connect alligator leads into the banana jack input terminals and connect the clips to the component leads as illustrated in Error! Reference source not found..
5. Press FREQ REC button until the desired test frequency is displayed on screen.
6. Press SEC LEV button to select between D factor, Q factor, θ angle, or ESR measurement for secondary display.
7. Read the display readings for capacitance measured values and selected measured values on secondary display.

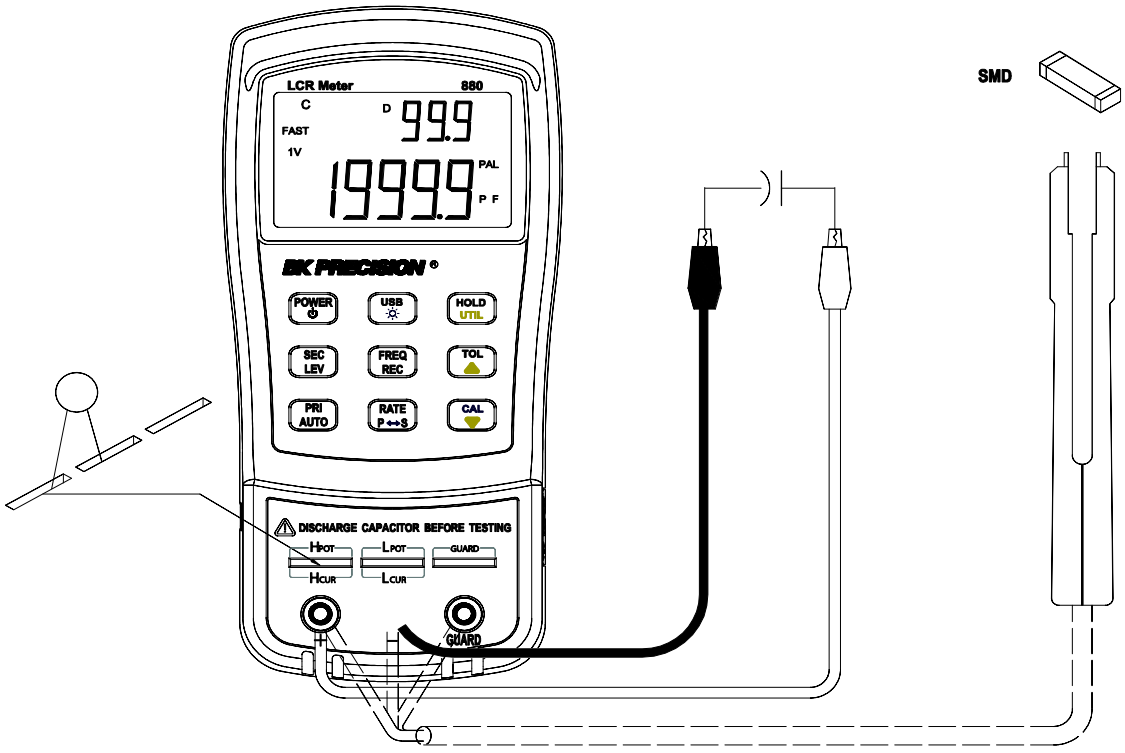

Figure 12 - Capacitance Measurement Setup

AC Resistance Measurement

1. Press down POWER button for one second to turn on the meter.
2. Press PRI AUTO button until "**R**" is on the screen to select resistance measurement.
3. Insert resistor or resistive component into the input sockets or connect alligator leads into the banana jack input terminals and connect the clips to the component leads as illustrated in Figure 13 – AC Resistance Measurement Setup
4. Press FREQ REC button until the desired test frequency is displayed on screen.

5. Read the display readings for resistance measured values.

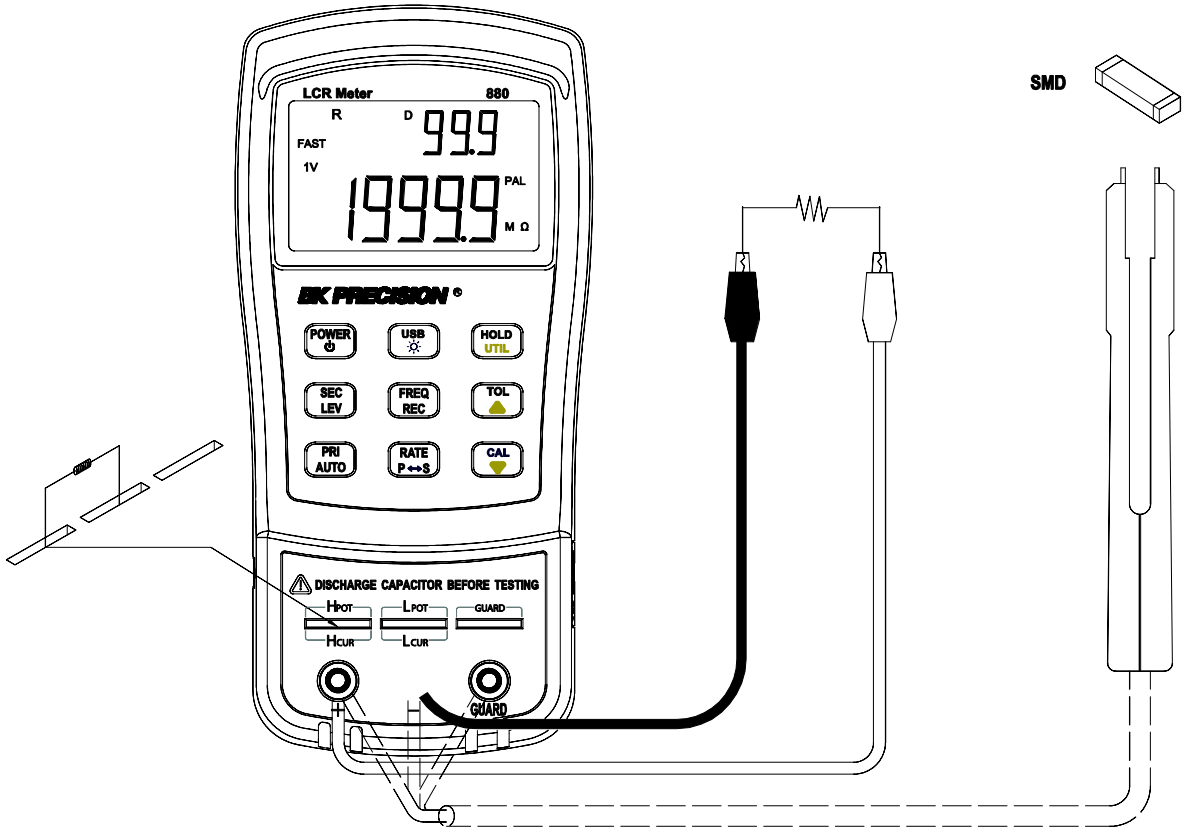

Figure 13 – AC Resistance Measurement Setup

Direct Current Resistance (DCR) Measurement

1. Press the POWER button for 2 seconds to turn the instrument on.
2. Press the PRI AUTO button until "DCR" is displayed on the screen to select direct current resistance measurement.
3. Insert impedance (resistor, capacitor or inductor) into test slots or connect tested impedance through a proper test accessory (i.e., banana plug-crocodile clip test leads, test fixture or SMD test tweezers).
4. Read the readings on LCD for impedance measured values.

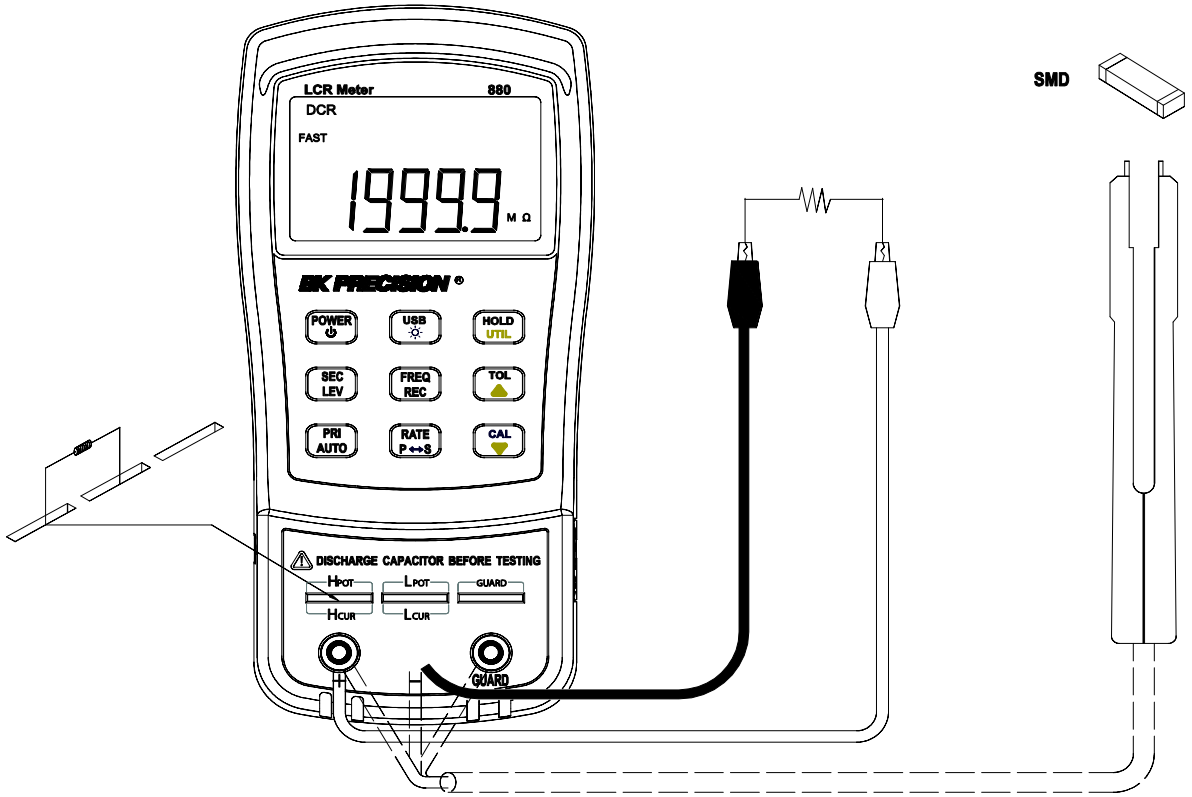

Figure 14 - DCR Measurement Setup

Impedance Measurement

1. Press POWER button for one second to turn on the meter.
2. Press PRI AUTO button until "**Z**" is on the screen to select impedance measurement.
3. Insert component into the input sockets or connect alligator leads into the banana jack input terminals and connect the clips to the component leads as illustrated in Figure 15 - Impedance Measurement Setup
4. Press FREQ REC button until the desired test frequency is displayed on screen.

5. Read the display readings for impedance measured values.

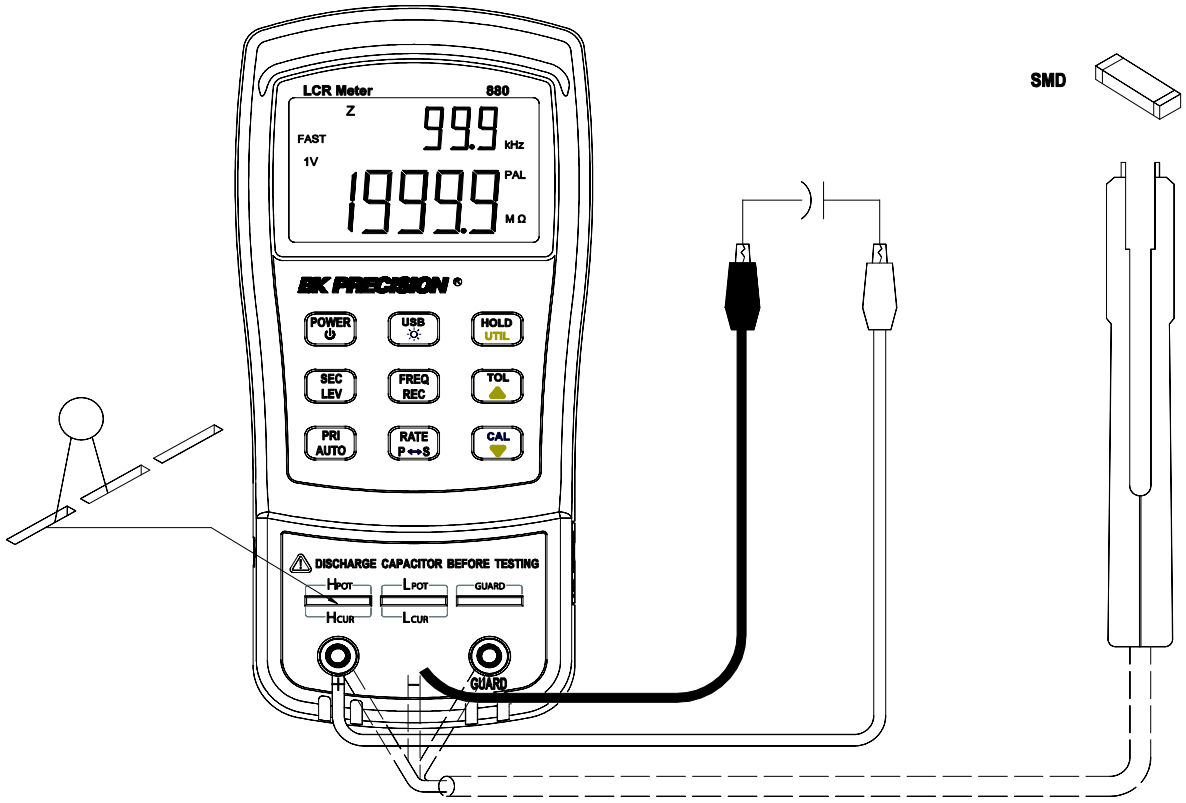

Figure 15 - Impedance Measurement Setup

REMOTE COMMUNICATION

The meter has the capability to communicate with a PC over the mini USB interface. Upon installation of a USB driver, the PC can control the instrument over virtual COM (RS-232). The mini USB communication interface of the meter is designed in full duplex and has a 64-byte input and output buffer, making it reliable and efficient for data transmission.

Connecting Instrument to PC

Follow the below procedures for connection setup.

1. Download the USB drivers from www.bkprecision.com.
2. With the included mini USB cable, connect the mini USB end to the LCR meter and the other end to an available USB port on the PC (see Figure 13).
3. When Windows recognize the USB connection, **do not follow the default Windows driver installation wizard**. Simply run the setup file from the downloaded USB drivers and follow the prompt to install drivers.
4. When completed, the computer will recognize the instrument as a USB (virtual COM) device, meaning it will be detected as a serial COM port. Windows will automatically assign a COM port to the instrument. Please verify which COM port Windows has assigned by going into "Device Manager".

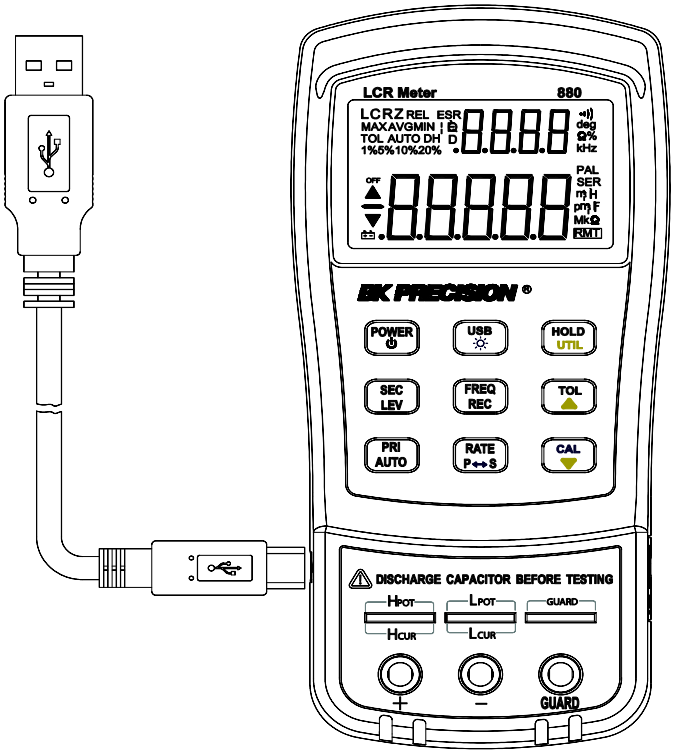

Figure 16 - USB Connection

USB (Virtual COM) Configuration

The USB will be recognized as a virtual COM on the PC, thus serial port settings must be configured properly for remote communication to be successful. Find the settings used by the 880 meter below:

- Baudrate: **9600**
- Data bits: **8**
- Parity: **None**
- Stop bits: **1**
- Flow Control: **None**

USB Operation

There are two modes that describe the operation of the meter when it is setup for remote communication. They are remote mode and auto fetching mode.

Remote Mode

Upon connecting to the instrument, sending any commands listed in the "Command Protocols" section will automatically set the LCR meter into remote mode. In remote mode, the LCD display will show the RMT indicator. When this is shown, all front panel buttons will be disabled, except for the 

button.

To exit remote mode and go back to local mode, press the 

button once. The RMT indicator will disappear on the LCD display. Pushing the same button once more will put the meter into auto fetching mode, which is described in the next section.

Auto Fetching Mode

When connected to a PC, the meter can be configured to auto-fetching mode. This means, the meter will continuously fetch data to the PC after every measurement cycle is completed. It fetches data from measured readings of primary display and secondary display, as well as tolerance compared results. This mode is useful when doing quick data logging using PC.

Enable/Disable Auto Fetching

To toggle between **enabling** and **disabling** auto fetching, press the 

. When enabled, data will be fetched constantly after every measurement cycle is completed. When disabled, no fetched data will be available.

Note: *Alternatively, auto fetching mode can be disabled when a remote command is sent to the instrument, turning it back into remote mode. In this event, the* RMT *indicator will appear on the LCD display, and auto fetching will be disabled automatically. To re-enabled auto fetching again in this state, first press the* USB *button once to exit out of remote mode and return to local mode. Then, press the button once more to have it set to auto fetching mode again.*

Command Protocols

Overview of Command Type and Format

All commands are entered in either the upper case or the lower case. There are two types of the meter programming commands: IEEE 488 common commands and Standard Commands for Programmable Instruments (SCPI). Some commands are device-specific to the meter. They are not included in the version 1999.0 of the SCPI standard. However, these commands are designed with the SCPI format in mind and they follow the syntax rules of the standard.

Common Command Format

The IEEE 488 standard defines the common commands as commands that perform functions like reset and system query. Common commands usually come with the asterisk "*" character, and may include parameters. Some examples of Common command like: *IDN?, *GTL, *LLO.

SCPI Command Format and Query Format

The SCPI commands control instrument functions. A subsystem command has a hierarchical structure that usually consists of a top-level (or root) keyword, one or more lower level keywords, and parameters. The following example shows a command and its associated query:

A. FUNCtion:impa L	Select L as primary parameter
B. FUNCtion:impa?	Return primary parameter

Function is a root level keyword with the second level keyword, impa, and L is the command parameter. The query command ends with a question mark "?".

Note: *SCPI stems from IEEE488.1 and IEEE 488.2. Although the IEEE 488.2 standard addressed some instrument measurements, it principally dealt with common commands and syntax or data formats. Please refer to the IEEE488.2 and SCPI reference manual for more information.*

Termination Character

A terminator is a character sent by a host, which identifies the end of a command string. A valid terminator consists of two-byte data:
<CR> (Carriage Return, ASC (&H0D)) or <LF> (Line Feed, ASC(&H0A)) or <CR><LF>

Responding Message

Returned result

After the meter executes a query command, the return of the result will be in the following format:

<Result> + <CR> <LF>

For example, in auto fetching mode, the meter will send the measured data automatically when the measurement cycle is completed. The format of the printed data will be shown as the following:

<Primary measured data, Secondly measured data, Tolerance Result > + <CR> <LF>

Data Types

Returned message is an ASCII string from the meter responding to a query. A query is a command accompanied a "?" mark. Table 4 below explains the different data types.

Data Type	Explanation	Example
<NR1>	An integer	+800,-200,100,-50
<NR2>	This numeric representation has an explicit radix point	+1.56,-0.001,10.5
<NR3>	This representation has an explicit radix point and an exponent	+2.345678E+04 -1.345678E-01
<Boolean>	A parameter for Boolean setting. Always return "0" or "1" for Boolean query command	ON or OFF
<Literal>	A string is used as command parameters with short literal form	HOLD

Table 5 - Data Type of Responded Messages

Command Reference

IDN?
Query instrument ID.
Return: <instrument model>, <firmware version>, <serial number>

LLO
Local Lockout. This means that all front panel buttons, including the RMT key is not available. (POWER button is enabled.)

GTL
Go to local and remove local lockout. If *LLO is sent, the only way to operate front panel is to go to *GTL.

TRG
Trigger the instrument to take a measurement. Due to the automatically continuous test, *TRG command is of no use.

SCPI Commands

This section described all the SCPI commands supported by the meter. The meter can accept both upper case and lower case commands.

Text Symbol	Meaning
[ ]	Option; can be omitted
|	Exclusive OR
< >	Defined element
( )	Comment
?	Question mark
:	Separated two command keywords

Table 6 - SCPI Symbol Conventions

FREQuency Subsystem commands

FREQuency <value>

Description: Set the test frequency
Parameters: 100, 120, 1000, 10000,100000 or 100Hz,120Hz,1kHz,10kHz,100kHz (model supported)
Example: *FREQuency 100*
Set the frequency to 100Hz

FREQuency?

Description: Query the current test frequency
Return: <100Hz|120Hz|1kHz|10kHz|100kHz>

VOLTage subsystem

VOLTage <value>

Description： set the test level (only effective in L,C,R,Z)
Parameters are 0.3, 0.6, 1 or 3e-1,6e-1,1e0
Example： *VOLTage 0.3*
Set the test level to 0.3 V

VOLTage?

Description: set the current test level
Return：<0.3V|0.6V|1V>

FUNCtion subsystem

FUNCtion:impa < L | C | R | Z | DCR >

Description: Select the primary parameter
Example: *FUNCtion:impa L*
Selects L as the primary parameter

FUNCtion:impa?

Description: Query the primary parameter
Return: <L, C, R, Z, DCR, NULL >

FUNCtion:impb < D | Q | THETA | ESR >

Description: Select the secondary parameter (only effective in L,C,R,Z)
Example: *FUNCtion:impb D*
Select D as the secondary parameter

FUNCtion:impb?

Description: Query the secondary parameter (only effective in L,C,R,Z)
Return: <D, Q, THETA, ESR, NULL>

FUNCtion:EQUivalent< SERies | parallel | PAL >

Description: Set the equivalent mode
(only effective in L,C,R,Z)
Parameters: SERies — series mode
Parallel — parallel mode
Pal — parallel mode
Example: *FUNCtion:EQUivalent SERies*
Set the equivalent mode to series mode

FUNCtion:EQUivalent?

Description: Query the equivalent mode
Return: <SER, PAL>

CALCulate subsystem

CALCulate:TOLerance:STATe < ON | OFF >

Description: Enable or disable tolerance mode
Example: *CALCulate: TOLerance:STATe ON*

CALCulate:TOLerance:STATe?

Description: Query the tolerance mode
Return: <ON, OFF >

CALCulate:TOLerance:NOMinal?

Description: Query the nominal value
Return: NR3 or -----(exceeding data range)

CALCulate:TOLerance:VALUe?

Description: Query the percentage value of tolerance
Return: NR3 or ----- (exceeding data range)

CALCulate:TOLerance:RANGe < 1 | 5 | 10 | 20 >

Description: Set tolerance range as 1%,5%,10% or 20% (20% not available for some models)
Example: *CALCulate:TOLerance:RANGe 1*
Set the tolerance range to 1%

CALCulate:TOLerance:RANGe?

Description: Query the tolerance range
Return: <BIN1, BIN2, BIN3, BIN4 or ---- >
"----" means unset bin

CALCulate:RECording:STATe < ON | OFF >

Description: Enable or disable recording function
Example: CALCulate:RECording:STATe ON

CALCulate:RECording:STATe?

Description: Query the recording state
Return: <ON or OFF>

CALCulate:RECording:MAXimum?

Description: Query the maximum value of recording function
Return: <NR3, NR3> (primary and secondary parameters, when data exceeds limits or there is no data, what returns is "----".)

CALCulate:RECording:MINimum?

Description: Query the minimum value of recording function
Return: <NR3, NR3> (primary and secondary parameters, when data exceeds limits or there is no data, what returns is "----".)

CALCulate:RECording:AVERage?

Description: Query the average value of recording function
Return: <NR3, NR3> (primary and secondary parameters, when data exceeds limits or there is no data, what returns is “----”.)

CALCulate:RECording:PRESent?

Description: Query the present value of recording function
Return: <NR3, NR3> (primary and secondary parameters, when data exceeds limits or there is no data, what returns is “----”.)

FETCh Subsystem

FETCh?

Description: Returns the primary, secondary display value and tolerance compared result (BIN no.).
Return: <NR3, NR3, NR1> when the primary parameter is LCR, Primary parameter, secondary parameter and BIN no. <NR3,NR1> when the primary parameter is DCR,
Primary parameter and BIN no.
Example*: FETCh?*

Summary of Supported SCPI Commands

Command	Parameter	Function
FREQuency	<Value>	Set the Test Frequency
FREQuency?		Query the Test Frequency
VOLTage	<Value>	Set the Test level
VOLTage?		Query the Test level
FUNCtion		
:impa	<Literal>	Select the primary display parameter
:impa?		Query the primary display parameter
:impb	<Literal>	Select the secondary display parameter
:impb?		Query the secondary display parameter
:EQUivalent	<Literal>	Set the equivalent mode
:EQUivalent?		Query the equivalent mode
CALCulate		
:TOLerance		
:STATe	<Boolean>	Enable/disable the tolerance mode
:STATe?		Query the tolerance mode
:NOMinal?		Query the nominal value
:VALUe?		Query the percent of tolerance
:RANG	<Value>	Set the limit bin
:RANGe?		Query the limit bin
:RECording		
:STATe	<Boolean>	Enable/disable the recording function
:STATe?		Query the recording state
:MAXimum?		Query the max. value of recording
:MINimum?		Query the min. value of recording
:AVERage?		Query the average value of recording
:PRESent?		Query the test value of recording
FETCh?		Query the measurement result

Table 7 - Summary of SCPI Commands

Error Codes

If codes or parameters, originated from bus and transmitted to the meter, are fault, the meter will terminate the analysis and execution codes. At the same time, error code will be displayed on LCD and beep will be sound.
Below defines the error description based on the error code.

E10: Unknown command
E11: Parameter Error
E12: Syntax Error

SUPPLEMENTAL INFORMATION

This section provides supplemental information for user consideration when operating the LCR meters. Some recommendations and explanations are provided to help aid in the use of some functions and features, in which can help the user gain optimal and accurate measurement results.

Selecting Test Frequency

Test frequency can greatly affect the results of measurement reading, especially when measuring inductors and capacitors. This section provides some recommendations and suggestions to consider.

Capacitance

When measuring capacitance selecting, the right frequency is important in obtaining the most accurate measurement results. Generally, a 1 kHz test frequency is used to measure capacitors that are 0.01 µF or smaller. For capacitors that are 10 µF or larger, a lower frequency of 120 Hz is used. Following this trend, high test frequencies are best for testing very low capacitance components. For large capacitance components, low frequency would be optimal. For example, if the capacitance of the component is to be in the mF range, than selecting 100 Hz or 120 Hz for test frequency would give much better results. The results will also be obvious because if the same component was tested with 1 kHz or 10 kHz, the measured readings may look erroneous on the display.

In all cases, it is best to check with the manufacturer's data sheet in order to determine the best test frequency to use for measurement.

Inductance

Typically, a 1 kHz test frequency is used to measure inductors that are used in audio and RF circuits. This is because these components operate at higher frequencies and require that they

be measured at higher frequencies such as 1 kHz or 10 kHz. However, a 120 Hz test signal is used to measure inductors that are used for applications such as filter chokes in power supplies, in which are typically operated at 60 Hz AC (in U.S.) with 120 Hz filter frequencies.

In general, inductors below 2 mH should be measured at 1 kHz frequency while inductors above 200 H should be measured at 120 Hz.

In all cases, it is best to check with the manufacturer's data sheet in order to determine the best test frequency to use for measurement.

Selecting Series or Parallel Mode

Just as test frequency can greatly affect measurement results, selecting between series or parallel measurement mode can also affect the accuracy of the meter, especially for capacitive and inductive components. Below are some recommendations to consider.

Capacitance

For most capacitance measurement, selecting **parallel** mode is the best. Hence, the meter defaults to this mode when selecting capacitance mode. Most capacitors have very low dissipation factor (high internal resistance) compared to the impedance of the capacitance. In these cases, the paralleled internal resistance has negligible impact upon the measurement.

Though in some cases, **series** mode would be preferred. For instance, measuring a large capacitor would require using series mode for optimal reading. Otherwise, the meter may show the reading results as out of accuracy or erroneous. Series mode is use because large capacitors often have higher dissipation factor and lower internal resistance.

Inductance

For most inductance measurement, selecting **series** mode is the best. Hence, the meter defaults to this mode when selecting inductance mode. This is because in this mode, accurate Q (quality factor) reading can be obtained from reading low Q inductors and ohmic losses are significant.

Though in some cases, **parallel** mode would be preferred. For example, iron core inductors operating at higher frequencies where hysteresis and eddy currents become significant would require measurement in parallel mode for optimal results.

Accuracy Discrepancies

In some special cases, inaccuracies may occur in the measurement of capacitive, inductive, and resistive components.

Capacitance

When measuring capacitors, it is always most desirable if the dissipation factor is low. Electrolytic capacitors inherently have a higher dissipation factor due to their normally high internal leakage characteristics. In some cases, if the D (dissipation factor) is excessive, measurement accuracy may degrade and even read out of specification.

Inductance

Some inductors are intended to operate at a certain DC bias to achieve a certain inductance value. However, the 880 LCR meter cannot produce such biasing scheme and external biasing should not be attempted because external power would be applied to the instrument and cause serious damage to the meter. Therefore, in some cases, measured inductance reading may not agree with manufacturer's specification. It is important to check if specification pertains to DC biasing or not.

Resistance

When measuring resistance of devices, it is important to know that there are two types or ways of measurement. One type is DC resistance measurement. Another type is AC resistance measurement. The 880 uses AC resistance measurement method and does not provide an option for DC resistance measurements unless you are using the DCR mode (Direct Current Resistance (DCR) Measurement). Therefore, when measuring a resistive component that is designed to be measured with DC, readings will be incorrect or inaccurate. Before using the meter to measure resistance, please verify whether the DUT (device under test) requires DC or AC resistance measurement method. Depending on the method, results will vary greatly.

Guard Terminal

One of the input sockets and terminals is labeled as "**GUARD**". This terminal does not have to be used in all instances for the meter to make measurements. But in some instances, it is very useful. Guard terminal generally serves two purposes.

If user is using test leads, the guard terminal can be used to connect to the shielding of the test leads. Doing so can be useful when making large resistive component measurements. For example, when measuring a 10 MΩ resistor with test leads, at the high range the reading may seem to be unstable as a few digits may continuously be changing. Having the shield of the test leads connected to the guard terminal will help stabilize the reading in some instances.

Guard terminal is also used to minimize noise and to help minimize parasitic effects coming from the component to be measured, thus allowing high precision results.

SPECIFICATIONS

Below are some remarks in regards to all specifications pertaining to the 880 LCR meter.
*Specifications are subject to change without notice.

Notes:

1. Measurement performed at the test socket.
2. Measurements performed after correct open and short calibration.
3. DUT and test leads must be properly shielded to guard if necessary.
4. Based after 30 minutes of warm up time and operated at 23 °C + 5 °C, <75% R.H.
5. Q value is the reciprocal of DF.
6. Accuracies based within 10% to 100% of full scale of range; values outside of range should be used as reference only.
7. Based on battery powered operation.
8. --- means parallel or series measurement mode.

General Specifications

Items	**880**	
Measurement Parameters	L/C/R/Z/DCR/D/Q/θ/ESR	
Test Frequency	100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz(test setting)	
Accuracy is 0.02% of actual frequency	100Hz, 120.048Hz, 1 kHz, 10 kHz (actual frequency)	
Tolerance Mode	1%, 5%, 10%, 20%	
Backlit Display	Yes	
Test Signal Level (typical)	0.3 Vrms, 0.6 Vrms, 1 Vrms. DCR signal：1Vdc	
Measuring Circuit Mode	Series mode / Parallel mode	
Basic accuracy	0.1% (See accuracy specifications for details).	
Ranging Mode	Auto	
Measuring Terminals	3-terminal, 5-terminal with sockets	
Measurement Rate	LCRZ	4 meas/sec,1.5meas/sec
	DCR	3 meas/sec,2.5meas/sec
Response Time (typical)	680 ms	
Auto Power-Off	5, 15, 30, 60 mins, None	
Auto LCR Function	Manual, Auto	
Output Impedance	100Ω	
Count	Max. Counts of Primary Parameter: 40,000; D / Q / θ minimum resolution of secondary parameter: 0.0001.	
Low Battery Indication	Approximately 6.8 Volts	
Battery Life	16 Hours (typical) based on backlight off and new alkaline	
	6 Hours (typical) based on backlight off and new fully charged Ni-	

	MH battery	
Charge Time and Current (typical)	Max.: 160min. Max. Current: 100mA	
Operating Current (with backlight off)	Max.:35mA Typical:25mA (@1kHz, 0.6 Vrms,100Ω load)	
Standby Current (Power Off)	Max. :11μA (typical)	
Power Requirements	1) DC 9V Battery 2)Ext. AC Adapter: DC 9 Vmin –15 Vmax. (Load 50 mA Min.)	
Operation Condition	Temperature	0℃ -- 40℃
	Relative Humidity	≤90% R.H.
Storage Temperature	-4 ° F to 104 °F (0 °C to +50 °C); 0-90 % R.H.	
Dimensions (L/W/H)	7.5 x 3.5 x 1.6” 190mm *90mm *41mm	
Weight	0.7 lbs. (350 g)	

Accuracy Specifications

Testing Conditions:

1. Environnent temperature：23℃±5℃; Humidity: ≤75% R.H.
2. Valid after 10 minutes of warm up time.
3. Test in measuring slots on front panel.
4. Measurements performed after correct open and short correction.
5. Test in the recommended equivalent mode.
6. Accuracy Indication: ± (% reading + number of least significant digits）
7. If the actual measurement exceeds the display range indicated in the table below, the accuracy is not specified
8. When selecting a 0.3V test level, double the accuracy in the tables below
9. Subscript Explanation:
   S—series equivalent; p—parallel equivalent;
   e: accuracy.

Inductance (L) and Quality Factor (Q)***Range***		***Display Range***	***Accuracy***		***Recommended Equivalent Mode***
			Le	**De ***	
100Hz/120Hz	1000H	400.0H~1000.0H	1%+3 digits	1.00%+3 digits	Parallel
	400H	40.00H~399.99H	0.35%+2 digits	0.35%+2 digits	Parallel
	40H	4.000H~39.999H	0.1%+2 digits	0.1%+2 digits	Parallel
	4H	400.0mH~3.9999H	0.1%+2 digits	0.1%+2 digits	----
	400mH	40.00mH~399.99mH	0.1%+2 digits	0.1%+2 digits	Series
	40mH	4.000mH~39.999mH	0.45%+2 digits	0.45%+2 digits	Series
	4mH	0uH~3.999mH	1.4%+5 digits	Not Specified	Series
1kHz	100H	40.00H~100.00H	1 %+3 digits	1%+3 digits	Parallel
	40H	4.000H~39.999H	0.35%+2 digits	0.35%+2 digits	Parallel
	4H	400.0mH~3.9999H	0.1%+2 digits	0.1%+2 digits	Parallel
	400mH	40.00mH~399.99mH	0.1%+2 digits	0.1%+2 digits	----
	40mH	4.000mH~39.999mH	0.1%+2 digits	0.1%+2 digits	Series
	4mH	400.0uH~3.9999mH	0.45%+2 digits	0.45%+2 digits	Series
	400µH	0.0uH~399.9µH	1.4%+5 digits	Not Specified	Series
10kHz	1000mH	400.0mH~999.99mH	0.8%+3 digits	0.8%+3 digits	Parallel
	400mH	40.00mH~399.99mH	0.35%+2 digits	0.35%+2 digits	Parallel
	40mH	4.000mH~39.999mH	0.1%+2 digits	0.1%+2 digits	----
	4mH	400.0uH~3.9999mH	0.3%+2 digits	0.3%+2 digits	Series
	400µH	40.00uH~399.99µH	0.45%+2 digits	0.45%+2 digits	Series
	40µH	0.00uH~39.99µH	1.4%+5 digits	Not Specified	Series
100kHz	100mH	40.00mH~399.99mH	1.5%+5 digits	1.5%+5 digits	Parallel
	40mH	4.000mH~39.999mH	1.5%+2 digits	1.5%+2 digits	Parallel
	4mH	400.0uH~3.9999mH	0.5%+2 digits	0.5%+2 digits	----
	400µH	40.00uH~399.99µH	0.5%+2 digits	0.5%+2 digits	Series
	40µH	4.000uH~39.999µH	0.8%+5 digits	0.8%+5 digits	Series
	4µH	0.000uH~3.999µH	2.5%+10 digits	Not Specified	Series

*Note: Accuracy of De is assessed when De <0.5

Quality factor Q and Accuracy Qe is calculated by the following formula:

For $Q_x \times D_e \leqslant 1$,

$$Q_e = \pm \frac{Q_x{}^2 \times D_e}{1 \mp Q_x \times D_e}$$

Q_x is the measurement value.

Capacitance(C) and Dissipation (D)

Range		Display Range	Accuracy		Recommended Equivalent Mode
			Ce	De*	
100Hz/120Hz	20mF	4.000mF~20.000mF	5%+5 digits	5%+5 digits	Series
	4mF	400.0μF~3.9999mF	1%+3 digits	1%+3 digits	Series
	400μF	40.00μF~399.99μF	0.35%+2 digits	0.35%+2 digits	Series
	40μF	4.000μF~39.999μF	0.1%+2 digits	0.1%+2 digits	Series
	4μF	400.0nF~3.9999μF	0.1%+2 digits	0.1%+2 digits	----
	400nF	40.00nF~399.99nF	0.1%+2 digits	0.1%+2 digits	Parallel
	40nF	4.000nF~39.999nF	0.35%+3 digits	0.35%+3 digits	Parallel
	4nF	0pF~3.999nF	1.25%+5 digits	Not Specified	Parallel
1kHz	1000μF	400.0μF~999.99μF	2%+5 digits	2%+5 digits	Series
	400μF	40.00μF~399.99μF	1%+3 digits	1%+3 digits	Series
	40μF	4.000μF~39.999μF	0.35%+2 digits	0.35%+2 digits	Series
	4μF	400.0nF~3.9999μF	0.1%+2 digits	0.1%+2 digits	Series
	400nF	40.00nF~399.99nF	0.1%+2 digits	0.1%+2 digits	----
	40nF	4.000nF~39.999nF	0.1%+2 digits	0.1%+2 digits	Parallel
	4nF	400.0pF~3.9999nF	0.35%+3 digits	0.35%+3 digits	Parallel
	400pF	0.0pF~39.99nF	1.25%+5 digits	Not Specified	Parallel
10kHz	100μF	40.00μF~100.00μF	3%+5 digits	3%+5 digits	Series
	40μF	4.000μF~39.999μF	1.5%+3 digits	1.5%+3 digits	Series
	4μF	400.0nF~3.9999μF	0.35%+2 digits	0.35%+2 digits	Series
	400nF	40.00nF~399.99nF	0.1%+2 digits	0.1%+2 digits	Series
	40nF	4.000nF~39.999nF	0.1%+2 digits	0.1%+2 digits	----
	4nF	400.0pF~3.9999nF	0.1%+2 digits	0.1%+2 digits	Parallel
	400pF	40.00pF~399.99pF	0.35%+3 digits	0.35%+3 digits	Parallel
	40pF	0.00pF~39.99pF	1.5%+5 digits	Not Specified	Parallel
100kHz	10μF	4.000μF~10.000μF	6%+20 digits	6%+20 digits	Series
	4μF	400.0nF~3.9999μF	2.5%+10 digits	2.5%+10 digits	Series
	400nF	40.00nF~399.99nF	0.8%+5 digits	0.8%+5 digits	Series
	40nF	4.000nF~39.999nF	0.5%+2 digits	0.5%+2 digits	Series
	4nF	400.0pF~3.9999nF	0.5%+2 digits	0.5%+2 digits	----
	400pF	40.00pF~399.99pF	0.8%+2 digits	0.8%+2 digits	Parallel
	40pF	4.000pF~39.999pF	1.2%+5 digits	1.2%+5 digits	Parallel
	4pF	0.000pF~4.999pF	Not Specified	Not Specified	Parallel

Impedance（Z）and Phase Angle（ϑ）

Range		Display Range	Accuracy		Recommended Equivalent Mode
			Ze	θe	
100Hz -- 10kHz	10MΩ	4.000MΩ~10.000MΩ	3%+5 digits	±1.75°	Parallel
	4MΩ	400.0kΩ~3.9999MΩ	1%+3 digits	±0.75°	Parallel
	400kΩ	40.00kΩ~399.99kΩ	0.35%+2 digits	±0.25°	Parallel
	40kΩ	4.000kΩ~39.999kΩ	0.1%+2 digits	±0.1°	Parallel
	4kΩ	400.0Ω~3.9999kΩ	0.1%+2 digits	±0.1°	----
	400Ω	40.00Ω~399.99Ω	0.1%+2 digits	±0.1°	Series
	40Ω	4.000Ω~39.999Ω	0.35%+2 digits	±0.25°	Series
	4Ω	0.4000Ω~3.9999Ω	1.00%+3 digits	±0.60°	Series
	0.4Ω	0.0000Ω~0.3999Ω	3.00%+5 digits	Not Specified	Series
100kHz	10MΩ	4.000MΩ~10.000MΩ	8%+ 20 digits	±4.6°	Parallel
	4MΩ	400.0kΩ~3.9999MΩ	3%+10 digits	±1.75°	Parallel
	400kΩ	40.00kΩ~399.99kΩ	1.2%+5 digits	±0.69°	Parallel
	40kΩ	4.000kΩ~39.999kΩ	0.8%+2 digits	±0.46°	Parallel
	4kΩ	400.0Ω~3.9999kΩ	0.5%+2 digits	±0.3°	----
	400Ω	40.00Ω~399.99Ω	0.5%+2 digits	±0.3°	Series
	40Ω	4.000Ω~39.999Ω	0.8%+5 digits	±0.46°	Series
	4Ω	0.4000Ω~3.9999Ω	2.5%+10 digits	±1.43°	Series
	0.4Ω	0.0000Ω~0.3999Ω	6%+20 digits	Not Specified	Series

*Note: Accuracy of De is assessed when De <0.5

DCR

	Range	Display Range	Accuracy
DCR	20MΩ	4.000MΩ~20.000MΩ	2 %+20 digits
	4MΩ	400.0kΩ~3.9999MΩ	1%+10 digits
	400kΩ	40.00kΩ~399.99kΩ	0.5%+5 digits
	40kΩ	4.000kΩ~39.999kΩ	0.1%+2 digits
	4kΩ	400.0Ω~3.9999kΩ	0.1%+2 digits
	400Ω	40.00Ω~399.99Ω	0.1%+2 digits
	40Ω	4.000Ω~39.999Ω	0.1%+2 digits
	4Ω	0.4000Ω~3.9999Ω	0.5%+10 digits
	0.4Ω	0.0000Ω~0.3999Ω	2%+20 digits

Equivalent Series Resistance

Accuracy of equivalent series resistance is calculated according to the below formula:

Rse = $\pm X_x \times \phi_e$

X_x : Actual impedance,

$X_x = 2\pi f L_x$ or $X_x = 1/2\pi f C_x$

ϕe is the phase angle accuracy, $\phi_e = \theta_e \times \frac{\pi}{180}$

Notice: *The accuracies of ESR and Rs are same.*

Equivalent Parallel Resistance

Accuracy of equivalent series resistance is calculated according to the below formula:

$$Rpe = \pm \frac{R_{px} \times \phi_e}{D_x \mp \phi_e}$$

Rpx is the measurement value of Rp, Dx is the dissipation value.

MAINTENANCE

⚠WARNING

Do not perform any service by yourself. Service should only be done by qualified personnel and trained technicians.

Service

If the instrument fails to operate, check battery and test leads. Replace them as necessary. If the instrument still cannot work, verify with the operating instructions to make sure correct procedures are followed.

When servicing, use specified replacement parts only.

Note: *The meter must be completely turned off while replacing the battery. Refer to "*Installing Battery*" section for details.*

Cleaning

⚠WARNING

To avoid electrical shock or damaging the meter, prevent water from getting inside the case. In the case that water gets inside, remove the battery immediately and do not operate the instrument immediately. Doing so will immediately damage the instrument and void its warranty.

Before cleaning this meter, make sure the power is OFF and remove external AC adapter if one is used. To clean the meter, wipe the dirty parts with a soft cloth soaked with diluted neutral detergent. Avoid having the instrument too wet to prevent the detergent from penetrating into the inside components of the meter, causing damages. After cleaning, make sure the instrument is completely dried before operating it again.

SERVICE INFORMATION

Warranty Service: Please go the support and service section on our website www.bkprecision.com to obtain a RMA #. Return the product in the original packaging with proof of purchase to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device.

Non-Warranty Service: Please go the support and service section on our website www.bkprecision.com to obtain a RMA #. Return the product in the original packaging to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device. Customers not on an open account must include payment in the form of a money order or credit card. For the most current repair charges please refer to the service and support section on our website.

Return all merchandise to B&K Precision Corp. with pre-paid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North America is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact B&K Precision Corp.

B&K Precision Corp.
22820 Savi Ranch Parkway
Yorba Linda, CA 92887
www.bkprecision.com
714-921-9095

Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

LIMITED WARRANTY

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To help us better serve you, please complete the warranty registration for your new instrument via our website www.bkprecision.com

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you. This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

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Printed in China v120324