www.insize.com



9652-RC02
HANDHELD LCR METER
OPERATION MANUAL

Table of Contents

1. Safety Instructions 3

2. Getting Started 7
2.1 Overview 7
2.2 Appearance 8
2.3 Main Specifications And Features 11
2.4 Connection Of Test Terminal 14
2.5 Battery Installation And Replacement 15
2.6 Battery And Power Supply 16

3. Measure 17
3.1 Function 18
3.2 Frequency 18
3.3 Level 18
3.4 Range 19
3.5 Equivalent Circuit 19
3.6 Speed 19

4. Setup 20
4.1 Auto LCZ 20
4.2 Comp 21
4.3 Beep 21
4.4 Nominal 21
4.5 Tol(±) 23

5. Open/Short 23
5.1 Open Test 30
5.2 Short Test 25

6. System Config 26
6.1 Key Beep 26

6.2 Brightness 27
6.3 Touch Panel 27
6.4 DIM Display 30
6.5 APO 30
6.6 VCOM Endmark 30
6.7 USB-HID PID 31
6.8 Default Set 31
6.9 System Information 32

7. Measurement Examples 33

8. Remote Control 34
8.1 Connect To PC To Ensure Measurement Accuracy 34
8.2 USB-VCOM Virtual Serial Port 34
8.3 USB-HID Device Class 35

9. Command Overview 38
9.1 Usb-Hid Command Package 38
9.2 Specifiers 39
9.3 Data Types 39
9.4 Command List 41
9.5 Commands 42

10. Specifications 49
10.1 General Characteristics 49
10.2 Accuracy 51

1. Safety Instructions

Read the following before any operation to ensure your safety and to keep the instrument in the best possible condition.

Notice:
The test leads are NOT covered by warranty. They are wear parts and may not be repaired.
Please read the manual and operate according to the manual instruction carefully.

Safety Symbols
These safety symbols may appear in this manual or on the instrument.


Risk of electric shock


See instruction manual


Battery


Fuse


Earth


Do not discard this product or throw away.

General Guideline


CAUTION

- AC or DC voltage input is strictly prohibited.
- Discharge capacitors before testing.
- Do not place any heavy object on the instrument.
- When testing inductors, avoid generating induced current, which may cause damage to the instrument.
- Avoid severe impact or rough handling that can lead to damage to the instrument.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Power Supply


WARNING

- The instrument is powered by an internal Li-ion battery for operation.
- You can use a USB power adapter to connect the instrument via the Type-C USB port to charge the internal Li-ion battery.
- The output of the USB power adapter is 5 VDC, 3 A.
- The USB power adapter must comply with CE regulations to ensure safe charging of the instrument.

Battery



WARNING

There is a rechargeable lithium battery inside this product. Please read all safety information carefully to avoid battery overheating, explosion, fire and serious personal injury caused by improper use.

• Please use the original lithium battery to ensure instrument safety. Using non-original batteries may create hazards for the user or damage the instrument.

• Do not expose this product to direct sunlight for a long time.

• Do not use or store this product inside a vehicle in hot weather.

• Do not continue charging once charging is completed.

• Do not place this product near a fire source, and do not throw the product into fire.

• Do not attempt to charge the battery using a damaged charger.

Cleaning the Instrument

• Disconnect the USB cord before cleaning.

• Do not clean the inside of the instrument.

• Use a soft cloth dampened with a mild detergent and water solution. Do not spray any liquid onto the instrument.

Operation Environment

• Location: Indoor, no direct sunlight, dust-free, with nearly non-conductive pollution (Note below)

• Temperature: 0 °C to 40 °C

• Humidity: <80% RH (non-condensing)

• Altitude: <2000 m

Storage Environment

• Location: Indoor

• Temperature: -10 °C to 70 °C

• Humidity: <80% RH (non-condensing)

Disposal

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

Ensure that discarded electrical waste is properly recycled to reduce environmental impact.

2. Getting Started

Read the following before any operation to ensure your safety and to keep the instrument in the best possible condition.

2.1 Overview

Model	Basic accuracy	Test speed	Interface
9652-RC02	±0.2%	10 times/s	USB-C

Measurement frequency:
DC, 50/60/100/120/200/400/500/1k/2k/4k/5k/10k/20k/40k/50k/100kHz

Characteristics

Thank you for choosing this Handheld LCR Meter as your test instrument. This manual contains detailed operating instructions.

To ensure personal safety and protect your equipment and data, please read the instruction before use.

This meter is a handheld precision test instrument featuring automatic real-time measurement controlled by a high-performance microprocessor. It adopts a true-color TFT-LCD screen, supports both keypad and touchscreen operation, and delivers high-precision measurements with easy operation.
The instrument supports a maximum test frequency of 100 kHz and offers signal levels of 0.1 / 0.3 / 0.7 / 1.0 Vrms.

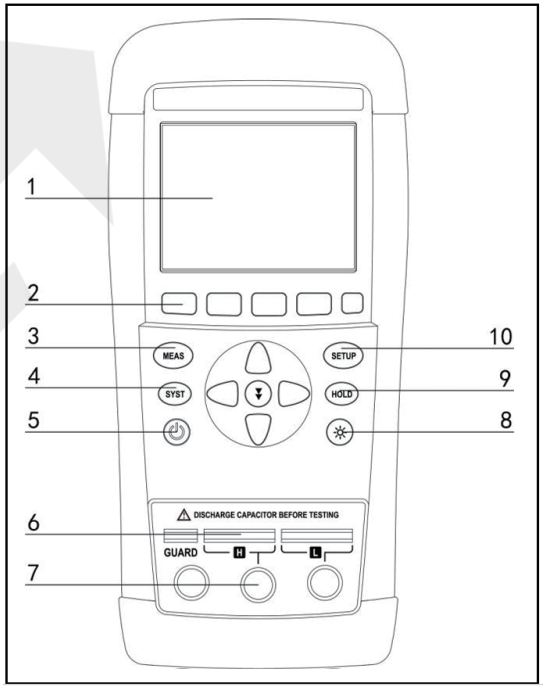
It can automatically measure inductance L, capacitance C, resistance R, complex impedance Z, quality factor Q, dissipation factor D, phase angle and DC resistance Rdc. It has a 50,000-count display for primary and secondary parameter readout, with a basic accuracy of ±0.2%. This makes it suitable for precision testing requirements from component manufacturers, educational institutions, research institutes and metrology & quality inspection departments.

The instrument is equipped with tolerance-mode sorting function, supporting percentage sorting for the main measurement parameter.

USB-HID and USB-VCOM interfaces are standard onboard. The open remote control commands for PC are SCPI (Standard Commands for Programmable Instruments) compatible. Users can develop custom PC software to efficiently implement remote control and data acquisition.

2.2 Appearance

Front Panel



1 LCD TFT LCD

2 Function Used to execute the function assigned to the corresponding position of the Function key.
Soft keys for selecting the corresponding options, located below the LCD screen.

3 Measure This key is used to enter the measurement display page.

4 System This key is used to enter the system setup page.

5 Power Press the power button for about 2 seconds to turn on the instrument. The green indicator on the power button lights up, and the instrument runs on battery power.
Press the power button for about 0.5 s to shut down the instrument, and the button indicator goes out.
When external power is supplied via USB, the power button indicator lights up in red, and the instrument uses external power.

6 Test Socket Five-wire terminal test socket

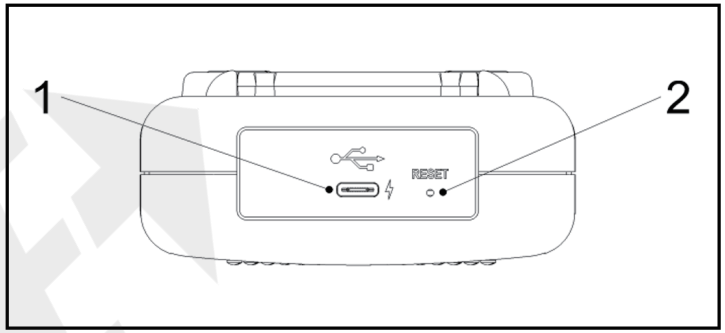
7 Test Jack Three-wire terminal test jack

8 Backlight Local Backlight brightness adjustment: 2 backlight levels, 50% and 100%. This key also serves as the unlock key when the keypad is locked under remote control.

9 Hold When "H" appears on the screen, the displayed reading is frozen.

10 Setup This key is used to enter the setup page.

Top Panel



1 USB USB port (Type-C)
This port is used for remote control and battery charging.
Measurement accuracy is not guaranteed when using an external power supply.

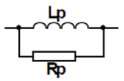
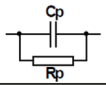
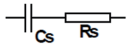
2 Reset If the instrument shuts down unexpectedly or becomes unresponsive, reset and restart it.

2.3 Main Specifications and Features

Test Function
C-D, C-Q, C-R, L-D, L-Q, L-R, L-Rdc, R-Q, R-X, R-Rdc, Rdc, Z-D, Z-Q, Z-θr, Z-θd

Equivalent Circuit
Series (subscript s), parallel (subscript p).
Actual capacitors, inductors, and resistors are not ideal components of pure reactance and pure resistance. They usually have both resistive and reactive components. An actual impedance element can be simulated by an ideal resistor and an ideal reactor (inductance or capacitance) in series or in parallel.
It can be converted mathematically with a formula, but the two forms are different, and the inconsistency depends on the quality factor Q (or loss D).

Table 2-1 Equivalent Circuit

Circuit		Dissipation Factor	Conversion
L		D=2πFLp/Rp=1/Q	Ls=Lp/(1+D²) Rs=RpD²/(1+D²)
		D=Rs/2πFLs=1/Q	Lp=(1+D²)Ls Rp=(1+D²)Rs/D²
C		D=1/(2πFCpRp)=1/Q	Cs=(1+D²)Cp Rs=RpD²/(1+D²)
		D=2πFCsRs=1/Q	Cp=Cs/(1+D²) Rp=Rs(1+D²)/D²

Q, D, Xs definition: Q=Xs/Rs, D=Rs/Xs, Xs=1/(2πFCs)=2πFLs

Suggestion:
For components with low impedance Z (large-value capacitors and small-value inductors), use the series equivalent circuit.

For components with high impedance Z (small-value capacitors and large-value inductors), use the parallel equivalent circuit.

The selection of equivalent circuit depends on the practical application of the component. For example, a series equivalent model is adopted for capacitors used in power filtering, while a parallel equivalent model is used for capacitors in LC oscillator circuits.

Test Frequency:
50 Hz, 60 Hz, 100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 40 kHz, 50 kHz, 100 kHz
Accuracy: 0.02%

Test Level: 0.1, 0.3, 0.7 and 1.0 Vrms
Accuracy: ±10%

Output Impedance: 100Ω
Accuracy: 5%

Range: Auto, Hold range. Total 8 Ranges.

Speed: 2 speeds: slow and fast.

Fast: 10 times/s (at 1 kHz, HOLD range).

Slow: 2.5 times/s (at 1 kHz, HOLD range).

Basic Accuracy : 0.2%

Display Range

Table 2-2

	Function	Display Range
Measurement Display Range	L	0.001μH ～ 999.9H
	C	0.001pF ～ 999.9mF
	R、X、Z、Rdc	0.0001Ω ～ 99.99MΩ
	D	0.0001 ～ 9.999
	Q	0.0001 ～ 999.9
	θd	-179.99°～179.99°
	θr	-3.1416 ～ 3.1416
	%	-999.9% ～ 999.9%

System Settings
1. Data hold function.

2. Measurement parameter settings are automatically saved.

3. Touch screen settings.

4. Power saving mode settings (Automatic power off, APO; Screen dimming time setting, DIM DISPLAY; Screen brightness adjustment, BRIGHTNESS).

Interface
The instrument supports USB communication interface, which can be set to two interfaces: HID and virtual serial port (VCOM).

USB-HID remote control:
Support USB high-speed mode 48MHz, ASCII transmission.
USB-VCOM remote control:
Virtual serial port communication, baud rate adaptive, maximum baud rate 115200, ASCII transmission.

Comparator function
The instrument can perform percentage sorting of a group of main parameters, and the secondary parameters do not participate in the sorting.

2.4 Connection Of Test Terminal

The instrument has two kinds of test ports: five-terminal and three-terminal test ports. If you want to meet the accuracy specification of the instrument, you must use the five-terminal test terminal, and s.pecifications are not guaranteed for three-terminal measurements.

Insert the plug of the test fixture vertically into the five-terminal socket.

Move the plug of the test fixture to the right and fix it in the center to avoid poor contact during the test.

Removing the test fixture, first move the plug of the fixture to the left, and then pull it out upwards.

Figure: Connection of Test Terminals



2.5 Battery Installation And Replacement

The instrument has a built-in rechargeable lithium battery, which has been installed in the battery compartment of the instrument at the factory. If you need to replace the battery, follow the steps below.
1. Use a screwdriver to loosen the 3 screws on the battery cover and remove the battery cover.

2. Remove the plug on the old battery, plug in the plug of the new battery, pay attention to the direction of the plug.

3. Put the new battery into the battery compartment, cover the battery cover, and tighten the screws.

Figure: Installing and Replacing the Battery



WARNING:
Please use the original lithium battery (LCR-305) to ensure the safety of the instrument.
Using non-original batteries may cause danger to the user or damage the instrument.

2.6 Battery And Power Supply

Please power off the instrument before USB charging and avoid operating it during charging.
The USB port can only charge the battery and cannot power the instrument for operation.
Use a USB charger complying with CE or UL specifications to prevent personal injury or instrument damage caused by non-compliant chargers.
When charging the instrument battery via a USB charger, AC power supply noise may interfere with normal measurement.
When the instrument connects to a computer via Type-C for communication, it runs on battery power only to preserve measurement accuracy.
1. Battery no-load operation: 8.2 V, 1.5 W

2. Type-C input: 5 V, 3 A

3. Battery continuous runtime: 50% brightness: 9 hours; 100% brightness: 7 hours

4. Charging time: Approximately 3 hours from empty to full (5V, 3 A)

Power Button light color
1. Green (steady): Powered on, normal operation, sufficient battery.

2. Green (blinking): Powered on, low battery.

3. Orange: Powered on, charging (battery icon with lightning mark displayed on LCD).

4. Red: Powered off, charging in progress.

5. Light off: Powered off, charging completed.

LCD charging/battery status display: (upper right corner)
1. Battery icon (white): Sufficient battery.

2. Battery icon (orange): Low battery.

3. Battery icon (red): Critically low battery.

4. Battery icon with lightning symbol (orange): Charging.

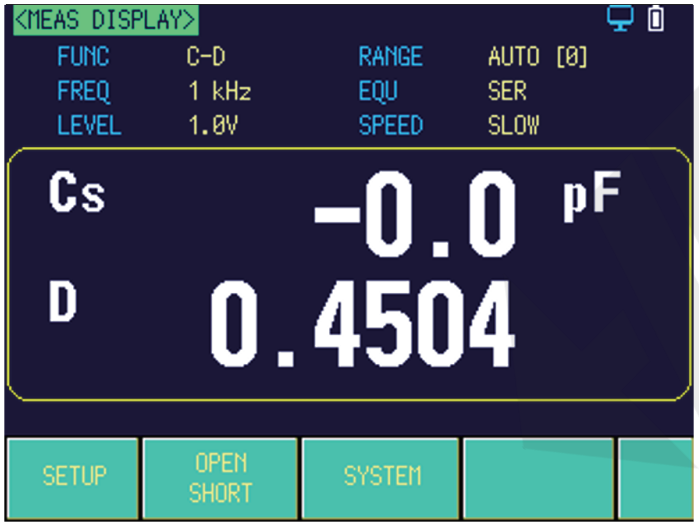
5. Battery icon with screen symbol: Remote control mode, not charging. 

NOTE
Avoid wrong connection, which would lead to incorrect reading value. In order to ensure the accuracy of the instrument, please use recommended accessories test cables for test.

WARNING
Before connecting the test leads, make sure the test leads are not connected to any component to avoid personal injury or damage to the instrument.

3. Measure

You can enter the [MEAS DISPLAY] page at any time by pressing the MEAS key. Use the direction keys to move the cursor to the setting item. Optional parameters will appear at the bottom of the LCD; press the corresponding soft key to complete the setting.



3.1 Function

Measurement Parameters
There are 15 measurement function combinations available:
C-D, C-Q, C-R, L-D, L-Q, L-R, L-Rdc, R-Q, R-X, R-Rdc, Rdc, Z-D, Z-Q, Z-θr, Z-θd

Measurement Parameter Definition:

L	Inductance
C	Capacitance
Rdc	DC Resistance
R	Resistance
Z	Impedance
θdeg	Phase angle of impedance(degree)
θrad	Phase angle of impedance(radian)
Q	Quality Factor, (Q = 1/D)
D	Dissipation Factor, Loss coefficient (tanδ)
X	Reactance

3.2 Frequency

Measurement Frequency: 50 Hz, 60 Hz, 100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 40 kHz, 50 kHz, 100 kHz
Frequency Accuracy: ±0.02%

3.3 Level

Measurement Signal Level: 0.1 Vrms, 0.3 Vrms, 0.7 Vrms, 1.0 Vrms
Level Accuracy: ±10%

3.4 Range

There are 8 ranges, including: 10 Ω, 100 Ω, 300 Ω, 1 kΩ, 3 kΩ, 10 kΩ, 30 kΩ, 100 kΩ.
AUTO: Automatically selects the range.
The instrument will select the appropriate range according to the impedance |Z| of the device under test.
HOLD: Locks on the current range.
Provides the fastest test speed.
INCR +: Locks on the current range and increases the range number.
DECL -: Locks on the current range and decreases the range number.

Range and corresponding test range

Range number	Range definition	Impedance measurement range
7	10 Ω	0 Ω ~ 10.5 Ω
6	100 Ω	10.2 Ω ~ 320 Ω
5	300 Ω	300 Ω ~ 990 Ω
4	1 kΩ	950 Ω ~ 3.2 kΩ
3	3 kΩ	3 kΩ ~ 9.9 kΩ
2	10 kΩ	9.5 kΩ ~ 32 kΩ
1	30 kΩ	3 kΩ ~ 99 kΩ
0	100 kΩ	95 kΩ ～ ∞

3.5 Equivalent Circuit

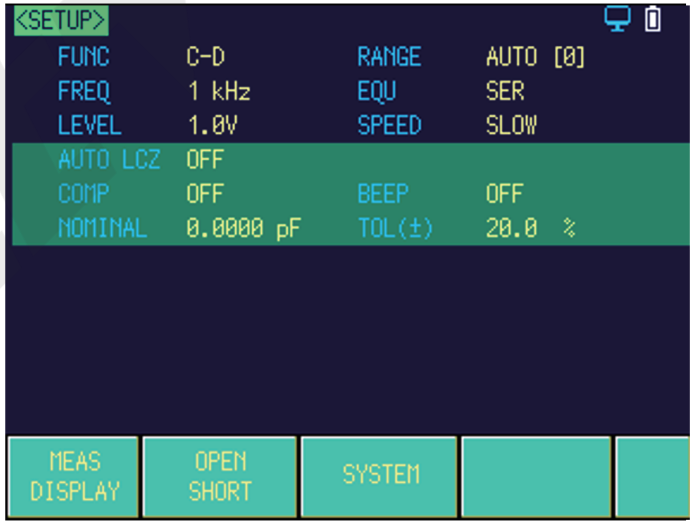
Equivalent Circuit methods: Series (SER) and Parallel (PAL).
Provide equivalent mode selection for R, L, and C, and obtain the measurement parameters of Rs/Rp, Ls/Lp, and Cs/Cp.

3.6 Speed

Measurement speed: SLOW and FAST.
Slow: 2.5 times/s (at 1 kHz, AUTO range).
Fast: 10 times/s (at 1 kHz, AUTO range).

4. Setup

You can enter the [SETUP] page at any time by pressing the SETUP key.
Use the direction keys to move the cursor to the target setting item. Optional parameters appear at the bottom of the LCD; press the corresponding function key to complete configuration.
The first six setting items are the same as those on the [MEAS DISPLAY] page. Refer to the [MEAS DISPLAY] section for detailed descriptions.



4.1 Auto LCZ

The AUTO LCZ function automatically selects the best-suited parameters and equivalent-circuit method.
If the range is set to AUTO, the LCR meter enters a fully automatic test state.
After AUTO-LCZ is turned on, the FUNC item shows [AUTO-LCZ], and the EQU item shows [AUTO].
Note: With the automatic-parameter function enabled, this function will be turned off once the user reconfigures [FUNC] or [EQU].

4.2 Comp

The instrument is equipped with a built-in simple comparator function. It compares main parameters and displays the relative deviation percentage on the measurement display page.
The formula for the comparator is as follows:

$$Tol = \frac{Rx - Nom}{Nom} \cdot 100\%$$

Rx: Current measured value
Nom: Entered nominal value

4.3 Beep

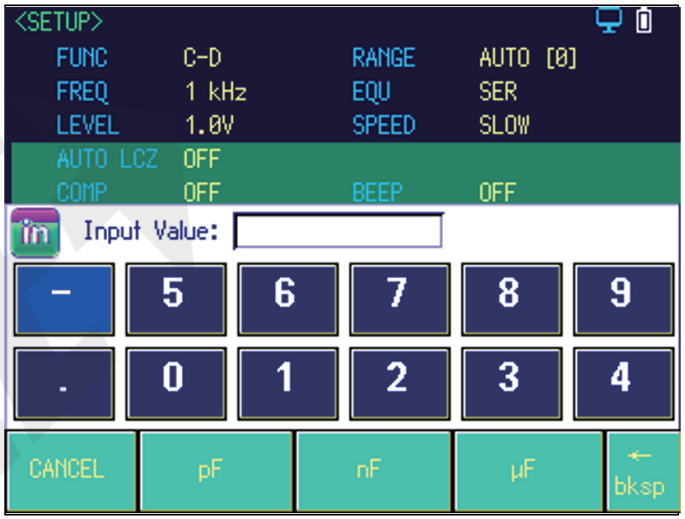
Two kinds of beep functions are available: pass-qualified beep and fail-bad beep. They provide audible prompts for test results.
The buzzer will beep continuously until the test status changes.
Normally, set BEEP to [Pass] to enable the beep notification function.

4.4 Nominal

When the COMP function is enabled, the nominal value must be entered before the formula can be calculated.
Keypad Input: Enter values manually using the touch-screen keyboard.
Meas Input: Obtain the nominal value by measuring a standard reference component.

Keypad Input: After pressing the [KEYPAD INPUT] key, the keyboard input box will appear. Tap the numeric keys on the touch screen to enter the nominal value, or use the direction keys to select a value and press the ▼ key to confirm the nominal value.
Finally, press the unit function key to complete the input.

Figure: Keyboard input box



Note: If the touch screen is disabled in the system settings, it will be automatically enabled when the input box is activated to allow touch input.

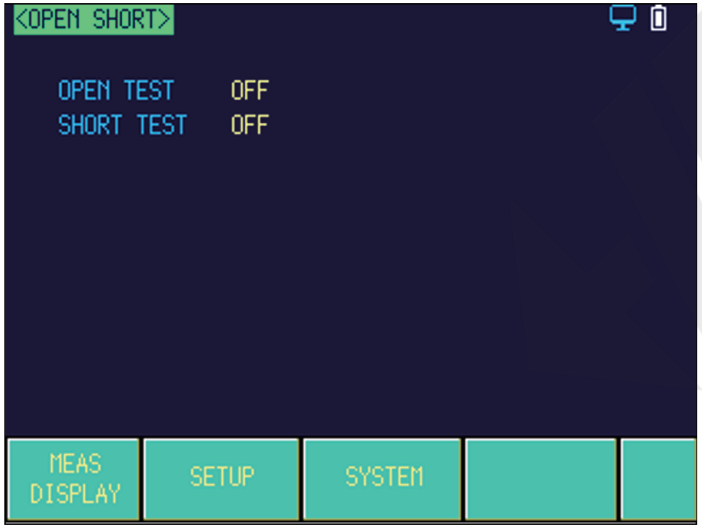
MEAS INPUT
After pressing the [MEAS INPUT] key, the LCD shows the prompt: ⓘPlug a Standard Component...
Insert the standard component, then press the [OK] key to measure it. The measured value will appear in the nominal value field.

4.5 Tol(±)

When the COMP function is enabled, a percentage threshold must be set for the measurement result to determine PASS or FAIL.
Enter the relative deviation (percentage deviation) via the touchscreen keyboard. Four preset values are also available: 1%, 5%, 10% and 20%.

5. Open/Short

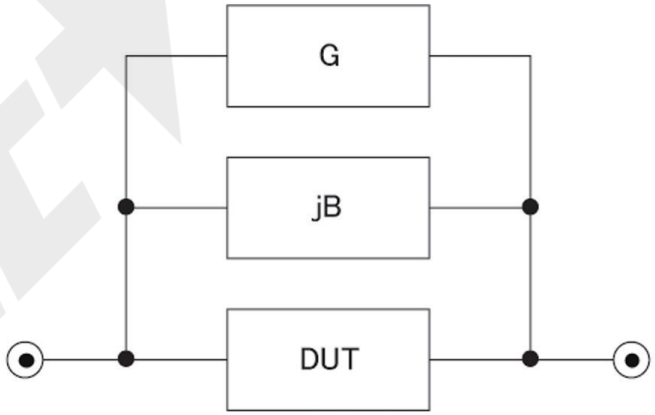
Before measurement, perform fixture correction to eliminate stray capacitance and series impedance introduced by the test fixture.
After power-on and instrument warm-up, execute open-circuit and short-circuit correction prior to measurement to ensure the instrument meets its published accuracy specifications.
Re-run open-short correction whenever the test fixture or test cable is replaced.
Carry out open-short correction promptly in case of significant temperature changes.
On the [MEAS DISPLAY] page, press the [OPEN SHORT] key to access the [OPEN SHORT] page.
Two options are available on this page:
OPEN TEST — Open-circuit correction
SHORT TEST — Short-circuit correction



5.1 Open Test

Open-circuit correction eliminates errors originating from stray admittance (G, B) of the test fixture.

Figure: Stray admittance



ON/OFF: Enable or disable the open-circuit correction function.
MEAS OPEN: Open-circuit correction for LCR measurement only.
DCR OPEN: Open-circuit correction for DCR measurement only.

Steps
1. Press the [OPEN SHORT] key to enter the [OPEN SHORT] page.

2. Use the arrow keys to select the [OPEN TEST] item.

3. Select [LCR OPEN] or [DCR OPEN] to start open-circuit correction.
LCD prompt: ⚠ Open-circuit the test terminals. Keep the test terminals or test fixture in open-circuit condition; do not touch any objects.

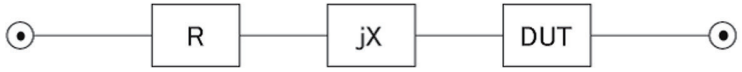
4. Press [OK] to start correction.
A progress bar will be shown on the LCD during correction. Press the [CANCEL] key to abort the correction procedure.

5. When correction is complete, the LCD displays: LCR/DCR correction finished.
If correction fails, the LCD prompts: LCR/DCR correction fail! Please check for errors.
- If the H/L test poles of the test fixture are adjustable, set the gap between test poles to the same distance used during actual measurement.

5.2 Short Test

Short-circuit correction compensates for residual impedances (R, X), including impedance of test cables and DUT connection terminals.

Figure: Residual impedances



ON/OFF: Enable or disable the short-circuit correction function.
MEAS SHORT: Short-circuit correction for LCR measurement only.
DCR SHORT: Short-circuit correction for DCR measurement only.

Steps
1. Press the [OPEN SHORT] key to enter the [OPEN SHORT] page.

2. Use the arrow keys to select the [SHORT TEST] item.

3. Select [LCR SHORT] or [DCR SHORT] to start short-circuit correction.
LCD prompt: ⚠ Short-circuit the test terminals
Insert the short bar onto the test terminals or short the test fixtures together.

4. Press [OK] to start correction.
A progress bar will be shown on the LCD during correction. Press the [CANCEL] key to abort the correction.

5. When correction is complete, the LCD displays: LCR/DCR correction finished.
If correction fails, the LCD prompts: LCR/DCR correction fail! Please check for errors.

6. System Config

Press the SYST key at any time to access the [SYSTEM CONFIG] page.
Use the arrow keys to move the cursor to the setting item. Available parameters will appear at the bottom of the LCD; press the corresponding function key to make adjustments.
All system configuration settings are saved automatically upon power-off.
Two options are available on this page:
SYSTEM INFO — Displays the instrument model, serial number, and firmware/hardware version. No user-configurable options are available here.
SYSTEM SERVICE — Engineering mode. User operation is prohibited.



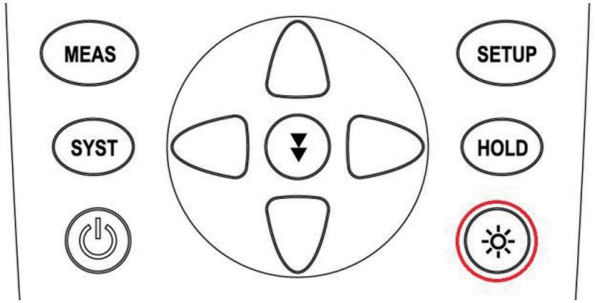
6.1 Key Beep

Turn ON or OFF key and touch screen sounds.

6.2 Brightness

The instrument has two levels of LCD screen brightness for adjustment: 50%, 100%.
When powered by external power supply, the screen brightness will be automatically adjusted to 100%.
When powered by battery, you can select 50% brightness to reduce instrument power consumption and extend operating time.
It can be directly adjusted by keyboard key.

Figure: brightness adjustment keys

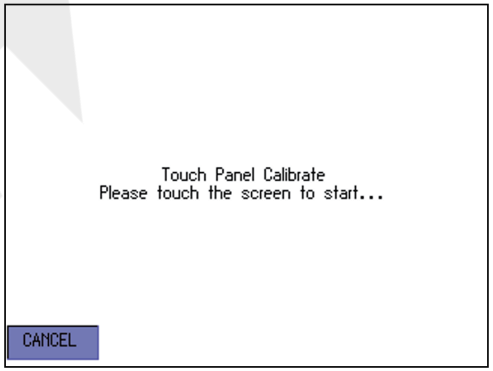


6.3 Touch Panel

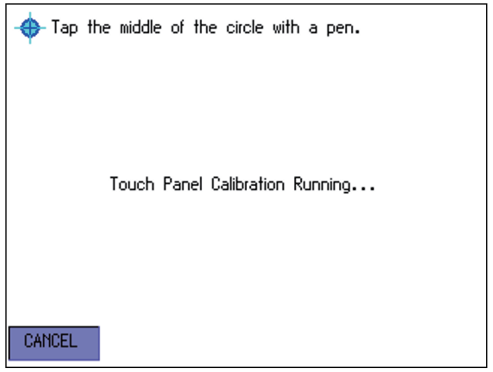
The instrument supports measurement operations via arrow keys and function keys.
The touchscreen is required for value entry.
If the touchscreen is disabled when an input box pops up, it will be enabled automatically.

Available options:
ENABLE: Enable the touchscreen function
DISABLE: Disable the touchscreen function
CALIBRATE: Calibrate touchscreen coordinates
RESET: Restore touchscreen coordinates to the instrument factory defaults.

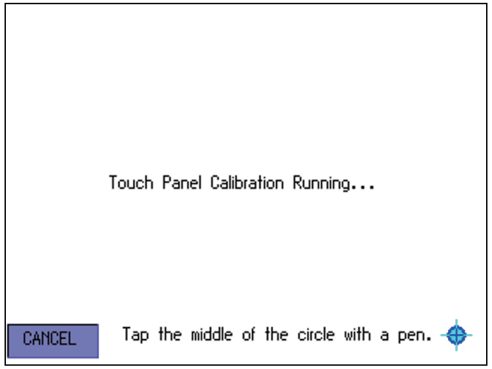
Touchscreen Calibration Steps
1. A stylus is required for touchscreen calibration; a stylus for mobile phones or tablets can be used.
Finger calibration is not recommended. The contact area of a finger is too large and will lead to inaccurate results.
Press the [CALIBRATE] function key to enter the calibration page. Tap the screen with the stylus to start calibration.



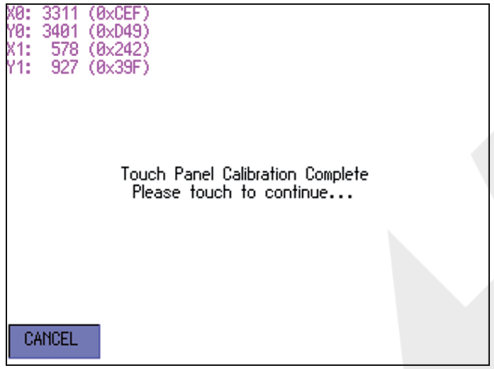
2. Calibrate the first point: tap the cross mark at the upper-left corner.



3. Calibrate the second point: tap the cross mark at the lower-right corner.



4. Calibration completed. Tap the screen to exit calibration.



6.4 Dim Display

Backlight dimming timer setting.
When operating on battery power, the instrument can reduce the screen backlight automatically if no keypad or touchscreen operation is detected within the set time, to conserve battery power.
Available time settings: 5, 10, 20, 30 minutes.
NOTE: This function is only active under battery power.

6.5 APO

Auto Power-Off Timer Setting.
When running on battery power, the instrument can be set to shut down automatically after a period of inactivity.
Available time settings: 5, 10, 20, 30 minutes.
NOTE: This function is only active under battery power.

6.6 VCOM Endmark

USB virtual serial port terminator.
The meter has a built-in USB-VCOM virtual serial port for communication with the host computer. USB-VCOM supports the following configurations:
• Data bits: 8 bits
• Stop bit: Adaptive, 1 or 2 bits
• Parity: None
• Baud rate: adaptive, up to 115200bps.
The meter communication protocol uses a simple SCPI protocol, which only supports single-line instructions and does not support instruction cascading.
1. The end character must be added at the end of the command sent by the host computer, and the instrument will respond.

2. The end character sent by the host computer must be one of them: NUL (0x00), LF (0x0A), CR (0x0D), CR+LF (0x0D0A), which does not need to be the same as the VCOM ENDMARK setting.

3. The setting of VCOM ENDMARK will be added at the end of the data returned by the instrument.

Available parameter:
NUL: HEX 0x00
LF: HEX 0x0A
CR: HEX 0x0D
CR+LF: HEX 0x0D0A

6.7 USB-HID PID

Instrument identification setting.
The instrument integrates a standard USB-HID communication interface for high-speed communication with the host computer.
By configuring the USB-HID PID, the host computer can communicate with up to 8 instruments simultaneously.
For multi-device communication, ensure each instrument is assigned a unique PID.

Available parameter:
9601: HEX 0x9601
9602: HEX 0x9602
9603: HEX 0x9603
9604: HEX 0x9604
9605: HEX 0x9605
9606: HEX 0x9606
9607: HEX 0x9607
9608: HEX 0x9608

6.8 Default Set

Reset settings to factory defaults.

The factory settings are as follows:

SETUP	SYSTEM
FUNC: C-D	KEY BEEP: ON
FREQ: 1kHz	TOUCH PANEL: DISABLE
LEVEL: 1.0V	DIM DISPLAY: 5 minutes
RANGE: AUTO	APO: 10 minutes
EQU: SER	VCOM ENDMARK: LF
SPEED: SLOW	USB-HID PID: 9601
AUTO LCZ: OFF	
COMP: OFF	
BEEP: OFF	
NOMINAL: 0.0000pF	
TOL(±): 0.0%	

6.9 System Information

Displays the instrument model, serial number, firmware, hardware, USB version, as well as USB VID and PID.
No user-configurable options are available on this page.



7. Measurement Examples

This example describes the procedure for measuring the capacitance of a thin-film ceramic capacitor.
Before measurement, set the following measurement parameters in accordance with the capacitor specifications.
• DUT: Film capacitor
• Test fixture: If the capacitor can be connected directly to the instrument's test terminals, no additional fixture is required. If not, select a suitable fixture (Kelvin clip or SMD clip).
• Primary parameter: Capacitance (C)
• Secondary parameter: Dissipation factor (D)
• Test frequency: 1 kHz
• Test level: 1 V

Steps
1. Press the power button to power on the instrument. It will enter the page.

2. Use the arrow keys to move the cursor and configure the measurement settings. Warm up the instrument for 30 minutes.
[FUNC]: C-D
[FREQ]: 1 kHz
[LEVEL]: 1.0 V
[RANGE]: AUTO
[EQU]: SER
[SPEED]: SLOW

3. Mount the test fixture or use the instrument's built-in test socket.

4. Perform open-circuit and short-circuit zero calibration as described in the OPEN/SHORT section.

5. Insert the capacitor into the instrument test socket or connect it via the test fixture.

6. Read the measurement result.

NOTE

Do not apply DC voltage or current to the test terminals, or the instrument may be damaged.
Ensure the capacitor is fully discharged before testing; residual voltage may damage the instrument.
Do not operate the instrument in humid or dusty environments.

8. Remote Control

The instrument is equipped with a USB Type-C interface. It supports virtual serial port (VCOM) and USB HID for PC connection and remote control.

8.1 Connect to PC To Ensure Measurement Accuracy

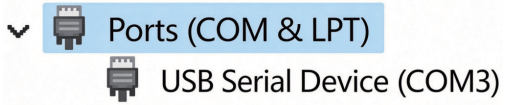
The instrument connects to a PC for command-controlled measurement. To guarantee measurement accuracy, the instrument runs on its internal battery only and does not draw power from the external supply.

When the PC is connected to the instrument's USB port, the LCD shows the prompt: "USB Attached. (Not Charging)". This indicates the battery is not being charged and the PC does not supply power to the instrument. The instrument is powered entirely by its internal battery to maintain measurement precision. Only the connection icon and battery icon are shown in the upper-right corner of the screen. 

It is recommended to fully charge the battery before performing PC-controlled measurement.

8.2 USB-VCOM Virtual Serial Port

When the instrument is connected to a PC, the driver will be installed automatically and a virtual serial port will be created.
The COM port number can be found in Device Manager.



(Device Manager):
USB-VCOM complies with the standard serial communication protocol.
Communication parameters for USB-VCOM:
1. Data bits: 8 bits

2. Stop bit: Adaptive, 1 or 2 bits

3. Parity: None

4. Baud rate: Adaptive, maximum 115200 bps
When communicating with the instrument via USB-VCOM, use the simplified SCPI protocol. Only one single command can be transmitted each time; chained commands are not supported.

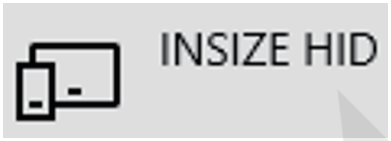
Example:
Valid: SEND> FUNC C-D <terminator>
Invalid: SEND> FUNC C-D;FREQ 1K <terminator>

NOTE

The instrument's USB-VCOM is always enabled, and no additional parameter settings are required.

8.3 USB-HID Device Class

The instrument supports the USB-HID device class. Windows will recognize it automatically once connected to a PC.
No manual driver installation is required. The instrument will be enumerated automatically on Windows. Users can control the instrument by calling native Windows API functions.



The instrument includes free sample communication code for reference. The sample source code is supplied together with this manual.

Communication parameters:
• VID: 0416 (Hex)
• PID: 9601 ~ 9608 (Hex)
• Packet size: 64 bytes

The primary API functions are listed below:
• CreateFile
devDetail->DevicePath, // Device path
GENERIC_READ | GENERIC_WRITE, // Access method
FILE_SHARE_READ | FILE_SHARE_WRITE, // Share mode NULL,
OPEN_EXISTING, // Return failure if the file does not exist
FILE_FLAG_OVERLAPPED, // Open in overlapped (asynchronous) mode NULL);
CreateFile opens the HID device. The device path is obtained by calling SetupDiGetInterfaceDeviceDetail.

• ReadFile(
hDev, // Device handle, returned by CreateFile
recvBuffer, // Receive buffer
IN_REPORT_LEN, // Read length
&recvBytes, // Actual bytes received
&ol); // Asynchronous mode

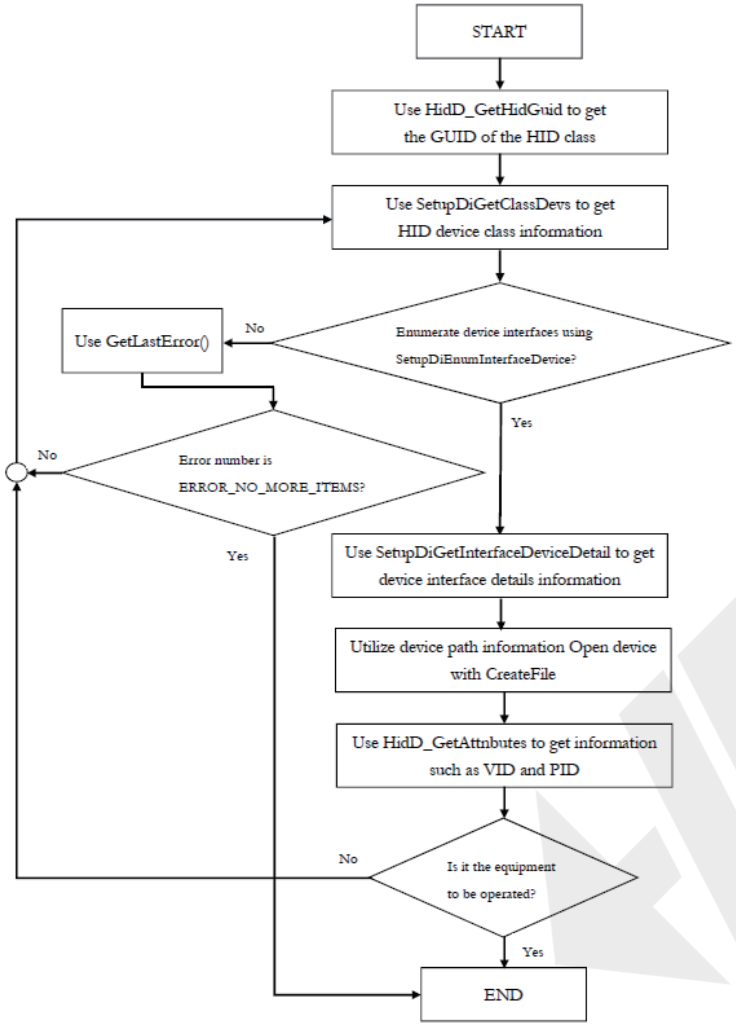
ReadFile reads the input report from the HID device through interrupt IN transfer.
• WriteFile(
hDev, // Device handle, returned by CreateFile
reportBuf, // Transmit buffer
OUT_REPORT_LEN, // Write length &sendBytes, // Actual bytes transmitted&ol); // Asynchronous mode

WriteFile sends an output report to the HID device.

NOTE

• The instrument supports Windows 7 and later operating systems only.

• If you intend to develop custom software, acquire basic knowledge of USB and USB HID beforehand. Relevant resources are available at www.usb.org.



9. Command Overview

The instrument uses the same instruction set for both USB-HID and USB-VCOM interfaces. The distinction is that USB-HID commands must be encapsulated into a packet, whereas USB-VCOM commands can be transmitted directly.

9.1 USB-HID Command Package

Below is the format of the command packet transmitted from the PC (defined as a C-language structure; implementations in other programming languages shall adopt an equivalent layout):

```
#define program pack(1)
typedef __packed struct
{
   uint      cSize;          //Packet size 4 =60
   char      sHeader[24];    //Command 24
   char      sPara[28];      //Parameter 28
   uint      nSignature;     //Signature 4 =0x88805550
   uint      nChecksum;      //Checksum 4
} TUSB_CMD;
#define program pack()
```

in,

cSize: always 60
nSignature: always 0x88805550
sCmd and sPara: see SCPI command set
nChecksum: 32-bit checksum

A complete sending instruction package (PC side) is as follows:

cSize: 0x0000003C,
sHeader: IDN?
sPara: (empty)
nSignature: 0x88805550
nChecksum: 0x00002BC1

The format and byte length of the transmit command packet are fixed. If the command or parameter content occupies fewer bytes than the allocated length, the remaining bytes shall be padded with hexadecimal 0x00. An example of a complete transmit packet in hexadecimal format is shown below:

Table A command to send packet data

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	00	00	40	49	44	4E	3F	00	00	00	00	00	00	00	00
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
00	00	00	00	00	00	00	00	88	80	55	50	00	00	2B	C1

The response packet from the instrument is also 64 bytes long. Any unused bytes are padded with 0x00. (Note: this is not the ASCII character "0".)
A sample received packet (from the instrument) is shown below:
ASCII format: INSIZE,9652-RC02,0,REV A1.09

9.2 Specifiers

Certain specifiers are used in the command descriptions. These specifiers are not part of the actual command and are provided only for explanatory purposes. Do not include them when sending commands.

Table Specifiers

Specifier	Description
< >	Angle brackets denote parameter names.
[ ]	Square brackets indicate optional content.
|	Denotes multiple options (select one only).

9.3 Data Types

The instrument supports several data types.

Table List of data formats

Format	Description	Example
<NR1>	Integer	100, +100, -100
<NR2>	Real number	1.23, +1.23, -1.23
<NR3>	Floating-point number	1.23E4, +1.23E4, -1.23e-4
<NR4>	Floating-point number with multiplier	1.23K, 1.23N, 1.23U (refer to the multiplier table below)

Table Magnification

Definition	Suffix
1E18 (EXA)	EX
1E15 (PETA)	PE
1E12 (TERA)	T
1E9 (GIGA)	G
1E6 (MEGA)	MA
1E3 (KILO)	K
1E-3 (MILLI)	M
1E-6 (MICRO)	U
1E-9 (NANO)	N
1E-12 (PICO)	P
1E-15 (EMTO)	F
1E-18 (ATTO)	A

9.4 Command List

Summary of all USB commands

Command (sHeader)	Parameter (sPara)	Description
DISP:PAGE	MEAS|SETUP|SYSTem|CSET|SINF	Switch display page
DISP:PAGE?	—	Query the name of the currently displayed page
DISP:LINE	String (maximum 28 characters)	Display the string on the bottom prompt bar
FUNC	C-D|C-Q|C-R|L-D|L-Q|L-R|L-Rdc|R-Q|R-X|R-Rdc|Rdc|Z-D|Z-Q|Z-thr|Z-thd	Set the measurement function
FUNC?	—	Query available main parameter options
FUNC:EQU	SERIAL|PARALLEL|AUTO	Set equivalent circuit mode
FUNC:EQU?	—	Query the selected equivalent mode
FUNC:LCR:RANG	0~7	Set LCR measurement range
FUNC:LCR:RANG?	—	Query the current LCR range index
FUNC:DCR:RANG	0~7	Set DCR measurement range
FUNC:DCR:RANG?	—	Query the current DCR range index
FUNC:RANG:AUTO	ON|OFF|1|0	Enable or disable auto-range
FUNC:RANG:AUTO?	—	Query the auto-range status
FREQ	50|60|100|120|200|400|500|1k|2k|4k|5k|10k|20k|40k|50k|100k	Set test frequency
FREQ?	—	Query current test frequency
APER	SLOW|FAST	Set measurement speed
APER?	—	Query current measurement speed
FETC?	—	Retrieve measurement results
COMP	ON|OFF|1|0	Enable or disable comparator function
COMP:BEEP	OFF|PASS|FAIL	Configure buzzer trigger condition
COMP:NOM	<float number>	Set nominal reference value
COMP:NOM?	—	Query the nominal value
COMP:TOL	<float number>	Set tolerance percentage
COMP:TOL?	—	Query the tolerance percentage

Command (sHeader)	Parameter (sPara)	Description
CORR:OPEN:STAT	ON|OFF|1|0	Open-circuit reset switch
CORR:OPEN:STAT?	—	Query the open-circuit reset switch status
CORR:SHOR:STAT	ON|OFF|1|0	Short-circuit reset switch
CORR:SHOR:STAT?	—	Query the short-circuit reset switch status
CORR:OPEN:LCR	—	Execute LCR open-circuit calibration
CORR:SHOR:LCR	—	Execute LCR short-circuit calibration
CORR:OPEN:DCR	—	Execute DCR open-circuit calibration
CORR:SHOR:DCR	—	Execute DCR short-circuit calibration
SYST:KEYL	ON|OFF|1|0	Keypad lock switch
IDN?	—	Query device information and version
RST	—	Perform warm restart
ERR?	—	Query error code and message

9.5 Commands

DISP:PAGE <meas|setup|system>
DISP:PAGE?

Function: It sets or queries the display page.
Description:
Set parameter <MEAS|SETUP|SYSTem|CSET|SINF>
Set syntax DISP:PAGE
Query syntax DISP:PAGE?
Return data <meas|setup|cset|sinf|system>

Note:
• MEAS: Measurement display page
• SETUP: Setup page
• SYSTem: System page
• CSET: OPEN/SHORT calibration page
• SINF: System Information page

DISP:LINE <string>
Function: It displays the specified character string in the help prompt column of the instrument.
Description:
Set parameter <string> The content of the string to be displayed, the maximum length of the string is 28 bytes, if the length exceeds, it will be ignored.
Set syntax DISP:LINE

FUNC <C-D, C-Q, C-R, L-D, L-Q, L-R, L-Rdc, R-Q, R-X, R-Rdc, Rdc, Z-D, Z-Q, Z-θr, Z-θd> FUNC?

Function: It sets or queries the measurement parameters.
Description:
Set parameter
<C-D|C-Q|C-R|L-D|L-Q|L-R|L-Rdc|R-Q|R-X|R-Rdc|Rdc|Z-D|Z-Q|Z-thr|Z-thd>
Set syntax FUNC
Query syntax FUNC?
Return data
<C-D|C-Q|C-R|L-D|L-Q|L-R|L-Rdc|R-Q|R-X|R-Rdc|Rdc|Z-D|Z-Q|Z-thr|Z-thd>

Note
• When AUTO-LCZ is ON, after sending FUNC command, AUTO-LCZ will be turned off.

FUNC:EQU <SERIAL|PARALLEL>
FUNC:EQU?
Function: It sets or queries the equivalent mode.
Description:
Set parameter <SERIAL|PARALLEL>
Set syntax FUNC:EQU
Query syntax FUNC:EQU?
Return data <SERIAL|PARALLEL>

Note
• When AUTO-LCZ is ON, after sending FUNC:EQU command, AUTO-LCZ will be turned off.

FUNC:LCR:RANG <0|1|2|3|4|5|6|7>
FUNC:LCR:RANG?

Function: It sets or queries the LCR measurement range.
Description:
Set parameter <0|1|2|3|4|5|6|7>

0~7 represents the range number.
Set syntax FUNC:LCR:RANG
Query syntax FUNC:LCR:RANG?
Return data <0|1|2|3|4|5|6|7>

FUNC:DCR:RANG <0|1|2|3|4|5|6|7>
FUNC:DCR:RANG?

Function: It sets or queries the DCR measurement range.
Description:
Set parameter <0|1|2|3|4|5|6|7>
0~7 represents the range number.
Set syntax FUNC:DCR:RANG
Query syntax FUNC:DCR:RANG?
Return data <0|1|2|3|4|5|6|7>

FUNC:RANG:AUTO <ON|OFF|1|0>
FUNC:RANG:AUTO?

Function: It sets or queries the range mode.
Description:
Set parameter <ON|OFF|1|0>
Set syntax FUNC:RANG:AUTO
Query syntax FUNC:RANG:AUTO?
Return data <ON|OFF|1|0>

FREQ <50|60|100|120|200|400|500|1k|2k|4k|5k|10k|20k|40k|50k|100k>
FREQ?

Function: It sets or queries the test frequency.
Description:
Set parameter <50|60|100|120|200|400|500|1k|2k|4k|5k|10k|20k|40k|50k|100k>
Set syntax FREQ
Query syntax FREQ?
Return data
<50|60|100|120|200|400|500|1000|2000|4000|5000|10000|20000|40000|50000|100000>

Note
• The frequency value can accept any numerical format, but the data must be the frequency value of the instrument, and the incorrect frequency value will use the closest correct frequency value.

APER <SLOW|FAST>
APER?

Function: It sets or queries the test speed.
Description:
Set parameter <SLOW|FAST>
Set syntax APER
Query syntax APER?
Return data <SLOW|FAST>

FETC?

Function: It queries the test results.
Description:
Query syntax FETC?
Return data <primary parameter result, secondary parameter result>

Note
• The instrument returns the test results of the primary and secondary parameters NR3 type.
If the secondary parameter is closed, it will return data +0.000000e+00
• Example: +7.929158e-15,+0.000000e+00

COMP <ON | OFF | 0 | 1>
COMP?

Function: It sets or queries the status of the comparator.
Description:
Set parameter <ON | OFF | 0 | 1>
Set syntax COMP
Query syntax COMP?
Return data <on|off>

COMP:BEEP <OFF | PASS | FAIL>
COMP:BEEP?

Function: It sets or queries the status of the beep.
Description:
Set parameter <OFF | PASS | FAIL>
Set syntax COMP:BEEP
Query syntax COMP:BEEP?
Return data <OFF | PASS | FAIL>

COMP:NOM <NR1|NR2|NR3|NR4>
COMP:NOM?

Function: It inputs and queries the data of nominal value.
Description:
Set parameter <NR1|NR2|NR3|NR4> any form of data
Set syntax COMP:NOM
Query syntax COMP:NOM?
Return data <NR3> Example: 1.000000e-09

COMP:TOL <NR1|NR2|NR3>
COMP:TOL?

Function: It inputs and queries the percentage deviation.
Description:
Set parameter <NR1|NR2|NR3> any form of data, the input data is percentage data (no need to divide by 100), Do not enter the percent sign %,
Example: COMP:NOM 2 //Indicates 2%
Set syntax COMP:TOL
Query syntax COMP:TOL?
Return data <NR2> Example: 10.0

CORR:OPEN:STAT <ON|OFF|1|0>
CORR:OPEN:STAT?

Function: It sets and queries the status of the open circuit correction function.
Description:
Set parameter <ON|OFF|1|0>
Set syntax CORR:OPEN:STAT
Query syntax CORR:OPEN:STAT?
Return data <on|off>

CORR:SHORT:STAT <ON|OFF|1|0>
CORR:SHORT:STAT?

Function: It sets and queries the status of the short circuit correction function.
Description:
Set parameter <ON|OFF|1|0>
Set syntax CORR:SHORT:STAT
Query syntax CORR:SHORT:STAT?
Return data <on|off>

CORR:OPEN:LCR
Function: It executes LCR open circuit correction.
Description:
Set syntax CORR:OPEN:LCR
Return data <pass|fail>

Note
• “LCR open” is prompted when the correction starts
• Prompt “pass or fail” after correction

CORR:SHORT:LCR
Function: It executes LCR short circuit correction.
Description:
Set syntax CORR:SHORT:LCR
Return data <pass|fail>

Note
• “LCR short” is prompted when the correction starts
• Prompt “pass or fail” after correction

CORR:OPEN:DCR
Function: It executes DCR open circuit correction.
Description:
Set syntax CORR:OPEN:DCR
Return data <pass|fail>

Note
• “DCR open” is prompted when the correction starts
• Prompt “pass or fail” after correction

CORR:SHORT:DCR
Function: It executes DCR short circuit correction.
Description:
Set syntax CORR:SHORT:DCR
Return data <pass|fail>
Note
• “DCR short” is prompted when the correction starts
• Prompt “pass or fail” after correction

SYST:KEYL <ON | OFF | 1 | 0>
Function: It locks or unlocks the keypad and touch screen.
Description:
Set parameter <ON | OFF | 1 | 0>
Set syntax SYST:KEYL

Note
• When the keys and touch screen are locked, the user can press the LOCAL key to unlock!
• The power button and key tone still work.

SYST:HOLD <ON | OFF | 1 | 0>
Function: It holds or releases the current screen data.
Description:
Set parameter <ON | OFF | 1 | 0>
Set syntax SYST:HOLD
Note
• When the measured value is held, a red symbol H will be displayed on the upper right corner of the screen.
• This command is valid only on the "MEAS DISPLAY" page.

IDN?
Function: It is used to query the manufacturer, model, serial number and version information of the instrument.
Description:
Query syntax IDN?
Return data manufacturer, model, serial number, version
Example: INSIZE,9652-RC02,<SN>,REV A1.09

ERR?
Function: It queries whether the command sent before is wrong.
Description:
Query syntax ERR?
Return data Error message

Error codes and messages

0 No error	No error
1 Bad command	Command error
2 Parameter error	Parameter error
3 Missing parameter	Missing parameter
4 Invalid multiplier	Multiplier error
5 Numeric data error	Numerical data error
6 Value too long	The value is too long
7 Invalid command	Invalid command, indicating that the command is invalid in the current state

10. Specifications

If the following conditions are met during the measurement, the measurement result can reach the basic accuracy.
Warranted performance. All specifications apply at 23 ± 5 °C, unless otherwise stated, and 30 minutes after the instrument has been turned on.
• Calibration: Yearly
• Reset adjustment: Perform correction before testing
• Test port of the instrument
• Test cable length: 0m
• Open and short calibration has been performed
• When using external power, the accuracy is unspecified.

10.1 General Characteristics

Specification Conditions
Temperature: 23 ± 5 °C
Humidity: ≤ 70% RH (non-condensing)
Operating Environment
Temperature Range: 0 ~ 40 °C
Relative Humidity: ≤ 80% RH (non-condensing)
Storage Conditions
Temperature Range: -10 ~ 70 °C
Relative Humidity: ≤ 90% RH (non-condensing)
Power Supply
Power source: Rechargeable lithium battery
Instrument operating power: 1.5 W
Battery continuous operating time: 7 hours (100% backlight), 9 hours (50% backlight)
Battery charging rating: 5 VDC, 3 A
Battery charging time: Approximately 3 hours
Weight
Approximately 380 g (including battery)

Item	Specification
Display	2.8" color LCD touch screen
Backlight	50%, 100%
Display Dimming Timer	5 min / 10 min / 20 min / 30 min / Off*Active only under battery power
Auto Power-off Timer	5 min / 10 min / 20 min / 30 min / Off *Active only under battery power
Measured parameters	C-D, C-Q, C-R, L-D, L-Q, L-R, L-Rdc, R-Q, R-X, R-Rdc, Rdc, Z-D, Z-Q, Z-θr, Z-θd
Display resolution	50000 counts
Basic accuracy	0.20%
Equivalent circuit	Series, Parallel
Range mode	Auto range, Hold range
Measurement speed	Slow: 2.5 readings/s; Fast: 10 readings/s
Test level	0.1 V, 0.3 V, 0.7 V, 1.0 V rms (±10% accuracy)
Test frequency	50 Hz, 60 Hz, 100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 40 kHz, 50 kHz, 100 kHz
Frequency accuracy	0.02%
Output Impedance (RO)	100 Ω (±5% accuracy)
Correction	Open correction, Short correction
Comparator	Tolerance based on main parameter (%); beep alarm for Pass / Fail
Test Terminals	5-terminal and 3-terminal
Interface	USB Type C: HID device, Virtual COM port (VCOM)

10.2 Accuracy

The accuracy specifications below are guaranteed only when measurements are performed with the 5-wire test socket or matching test fixture.
Measurements taken via the 3-wire test socket are for quick reference only and are not guaranteed.
Test Cable
When measuring directly with the 5-wire test socket, the accuracy error follows the values listed in the table only.
If a Kelvin clip or tweezer fixture is connected, the additional error contributed by the test cable length shall be included.
Accuracy formula: ±(A × B) (% of reading)
• A: Basic accuracy defined in the specification table
• B: Test cable accuracy factor
B = 1 + (L × F)
L: Test cable length factor, L = 0.05
F: Test frequency (kHz)

Accuracy C and D

50Hz/60Hz/100Hz/120Hz/200Hz/400Hz/500Hz

Range	Display Range	Accuracy Ce	Accuracy De
20 mF	5.0000 mF ~ 19.999 mF	2.0% + 5 counts	0.0200
5 mF	500.0 µF ~ 4.9999 mF	1.0% + 3 counts	0.0100
500 µF	50.00 µF ~ 499.99 µF	0.5% + 2 counts	0.0050
50 µF	5.000 µF ~ 49.999 µF	0.35% + 2 counts	0.0020
5 µF	500.0 nF ~ 4.9999 µF	0.2% + 2 counts	0.0020
500 nF	50.00 nF ~ 499.99 nF	0.2% + 2 counts	0.0020
50 nF	5.000 nF ~ 49.999 nF	0.6% + 3 counts	0.0030
5 nF	500 pF ~ 4.9999 nF	2.0% + 5 counts	—

1kHz/2kHz/4kHz/5kHz

Range	Display Range	Accuracy Ce	Accuracy De
1 mF	500.0 µF ~ 0.9999 mF	1.0% + 5 counts	0.0500
500 µF	50.00 µF ~ 499.99 µF	0.3% + 3 counts	0.0300
50 µF	5.000 µF ~ 49.999 µF	0.2% + 2 counts	0.0030
5 µF	500.0 nF ~ 4.9999 µF	0.2% + 2 counts	0.0020
500 nF	50.00 nF ~ 499.99 nF	0.2% + 2 counts	0.0020
50 nF	5.000 nF ~ 49.999 nF	0.2% + 2 counts	0.0020
5 nF	500.0 pF ~ 4.9999 nF	0.3% + 3 counts	0.0030
500 pF	50.0 pF ~ 499.9 pF	0.65% + 5 counts	—

10kHz/20kHz/40kHz

Range	Display Range	Accuracy Ce	Accuracy De
50 µF	5.000 µF ~ 49.999 µF	1.0% + 3 counts	0.0100
5 µF	500.0 nF ~ 4.9999 µF	0.3% + 2 counts	0.0030
500 nF	50.00 nF ~ 499.99 nF	0.2% + 2 counts	0.0020
50 nF	5.000 nF ~ 49.999 nF	0.2% + 2 counts	0.0020
5 nF	500.0 pF ~ 4.9999 nF	0.2% + 2 counts	0.0020
500 pF	50.00 pF ~ 499.9 pF	0.3% + 3 counts	0.0030
50 pF	5.00 pF ~ 49.99 pF	1.2% + 5 counts	—

50kHz/100kHz

Range	Display Range	Accuracy Ce	Accuracy De
5 µF	500.0 nF ~ 4.9999 µF	3.0% + 10 counts	0.0300
500 nF	50.00 nF ~ 499.99 nF	0.3% + 5 counts	0.0030
50 nF	5.000 nF ~ 49.999 nF	0.2% + 2 counts	0.0020
5 nF	500.0 pF ~ 4.9999 nF	0.2% + 2 counts	0.0020
500 pF	50.00 pF ~ 499.99 pF	0.3% + 2 counts	0.0020
50 pF	5.000 pF ~ 49.999 pF	1.0% + 5 counts	0.0100
5 pF	1.000 pF ~ 4.999 pF	3% + 10 counts	—

Accuracy L and Q

50Hz/60Hz/100Hz/120Hz/200Hz/400Hz/500Hz

Range	Display Range	Accuracy Le	Accuracy Qe
1000 H	500.0 H ~ 1000.0 H	1.0% + 3 counts	0.0100
500 H	50.00 H ~ 499.99 H	0.3% + 2 counts	0.0030
50 H	5.000 H ~ 49.999 H	0.2% + 2 counts	0.0020
5 H	500.0 mH ~ 4.9999 H	0.2% + 2 counts	0.0020
500 mH	50.00 mH ~ 499.99 mH	0.3% + 2 counts	0.0100
50 mH	5.000 mH ~ 49.999 mH	0.5% + 3 counts	0.0500
5 mH	50 μH ~ 4.999 mH	1.4% + 5 counts	—

1kHz/2kHz/4kHz/5kHz

Range	Display Range	Accuracy Le	Accuracy Qe
100 H	50.00 H ~ 99.99 H	1.0% + 3 counts	0.0100
50 H	5.000 H ~ 49.999 H	0.3% + 2 counts	0.0030
5 H	500.0 mH ~ 4.9999 H	0.2% + 2 counts	0.0020
500 mH	50.00 mH ~ 499.99 mH	0.2% + 2 counts	0.0100
50 mH	5.000 mH ~ 49.999 mH	0.2% + 2 counts	0.0500
5 mH	500.0 μH ~ 4.9999 mH	0.5% + 3 counts	0.0700
500 μH	50.0 μH ~ 499.9 μH	1.4% + 5 counts	—

10kHz/20kHz/40kHz

Range	Display Range	Accuracy Le	Accuracy Qe
1000 mH	500.0 mH ~ 999.9 mH	1.0% + 3 counts	0.0100
500 mH	50.00 mH ~ 499.99 mH	0.2% + 2 counts	0.0020
50 mH	5.000 mH ~ 49.999 mH	0.3% + 2 counts	0.0500
5 mH	500.00 μH ~ 4.9999 mH	0.3% + 2 counts	0.0700
500 μH	50.00 μH ~ 499.9 μH	1.0% + 3 counts	0.0800
50 μH	5.00 μH ~ 49.99 μH	1.4% + 5 counts	—

50kHz/100kHz

Range	Display Range	Accuracy Le	Accuracy Qe
100 mH	50.00 mH ~ 99.99 mH	1.2% + 5 counts	0.0120
50 mH	5.000 mH ~ 49.999 mH	1.0% + 2 counts	0.0700
5 mH	500.0 μH ~ 4.9999 mH	0.65% + 2 counts	0.0500
500 μH	50.00 μH ~ 499.99 μH	0.65% + 2 counts	0.0500
50 μH	5.000 μH ~ 49.999 μH	1.0% + 5 counts	0.0700
5 μH	0.500 μH ~ 4.999 μH	2.5% + 10 counts	—

Q's accuracy is defined below:

$$Q_e = \pm \frac{{Q_x}^2 \times D_e}{1 \mp Q_x \times D_e} \text{ (when } Q_x \times D_e < 1)$$

Where:
Qx: Measured Q value
De: Accuracy of D

Accuracy Z and θ
<=10kHz

Range	Display Range	Accuracy Ze	Accuracy θe
10 MΩ	5.000 MΩ ~ 10.000 MΩ	3.0% + 5 counts	2.0 °
5 MΩ	500.0 kΩ ~ 4.9999 MΩ	1.2% + 3 counts	0.7 °
500 kΩ	50.00 kΩ ~ 499.99 kΩ	0.3% + 3 counts	0.2 °
50 kΩ	5.000 kΩ ~ 49.999 kΩ	0.2% + 2 counts	0.2 °
5 kΩ	500.0 Ω ~ 4.999 kΩ	0.2% + 2 counts	0.2 °
500 Ω	50.00 Ω ~ 499.99 Ω	0.2% + 2 counts	0.2 °
50 Ω	5.000 Ω ~ 49.999 Ω	0.3% + 3 counts	0.2 °
5 Ω	0.5000 Ω ~ 4.9999 Ω	0.65% + 3 counts	0.6 °
0.5 Ω	0.0500 Ω ~ 0.4999 Ω	3.0% + 3 counts	—

>10kHz

Range	Display Range	Accuracy Ze	Accuracy θe
5 MΩ	500.0 kΩ ~ 4.9999 MΩ	3.0% + 10 counts	2.0 °
500 kΩ	50.00 kΩ ~ 499.99 kΩ	1.2% + 5 counts	0.7 °
50 kΩ	5.000 kΩ ~ 49.999 kΩ	0.3% + 2 counts	0.3 °
5 kΩ	500.0 Ω ~ 4.999 kΩ	0.2% + 2 counts	0.2 °
500 Ω	50.00 Ω ~ 499.99 Ω	0.2% + 2 counts	0.2 °
50 Ω	5.000 Ω ~ 49.999 Ω	0.3% + 5 counts	0.3 °
5 Ω	0.5000 Ω ~ 4.9999 Ω	1.0% + 10 counts	1.0 °
0.5 Ω	0.0500 Ω ~ 0.4999 Ω	3.0% + 20 counts	—

Accuracy of ESR and Phase Angle (Φ)

ESR is the series equivalent resistance (Rs).

ESR accuracy formula: $RS_e = \pm X_x \cdot \phi_e\,[\Omega]$

Where: θe: Accuracy of phase angle θ

Xx: Measured reactance

$$X_x = 2\pi f L_x \text{ or } X_x = \frac{1}{2\pi f C_x}$$

Phase Angle Accuracy: $\phi_e = \theta_e \cdot \frac{\pi}{180}$

Where:

Lx: Measured inductance [H]

Cx: Measured capacitance [F]

θe: Accuracy of phase angle θ

Parallel equivalent resistance accuracy formula:

$$R_{pe} = \pm \frac{R_{px} \cdot \phi_e}{D_x \mp \phi_e}\,[\Omega]$$

Where:

Rpx: Measured parallel equivalent resistance Rp [Ω]

Dx: Measured dissipation factor D

De: Accuracy of D

Accuracy DCR

DCR

Range	Display range	Accuracy
10 MΩ	5.000 MΩ – 10.000 MΩ	3.0% + 5 counts
5 MΩ	500.0 kΩ – 4.9999 MΩ	1.2% + 3 counts
500 kΩ	50.00 kΩ – 499.99 kΩ	0.3% + 3 counts
50 kΩ	5.000 kΩ – 49.999 kΩ	0.2% + 2 counts
5 kΩ	500.0 Ω – 4.999 kΩ	0.2% + 2 counts
500 Ω	50.00 Ω – 499.99 Ω	0.2% + 2 counts
50 Ω	5.000 Ω – 49.999 Ω	0.3% + 3 counts
5 Ω	0.5000 Ω – 4.9999 Ω	0.65% + 3 counts
0.5 Ω	0.0500 Ω – 0.4999 Ω	3.0% + 3 counts