# HIOKI

# IM3570

Instruction Manual

# IMPEDANCE ANALYZER

**EN**

# Contents

## ii

*Contents*

## Chapter 5   ANALYZER Function            131

# iv

*Contents*

# Appendix        A 1

# Index        Index 1

# Introduction

Thank you for purchasing the HIOKI Model IM3570 Impedance Analyzer.To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.
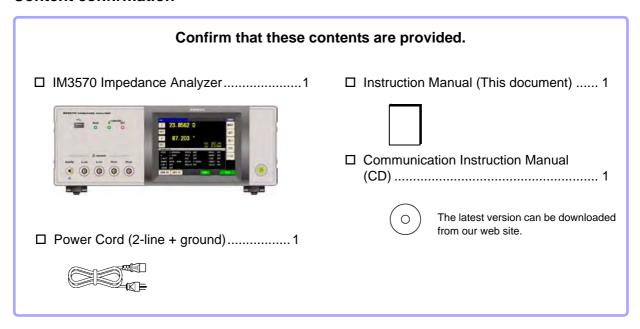
In this document, the "instrument" means the Model IM3570 Impedance Analyzer.

# Verifying Package Contents

## Inspection

When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

## Content confirmation

**Confirm that these contents are provided.**

☐ IM3570 Impedance Analyzer .....................1

☐ Instruction Manual (This document) ...... 1

☐ Communication Instruction Manual (CD) ...................................................... 1

The latest version can be downloaded from our web site.

☐ Power Cord (2-line + ground) ................. 1

**NOTE** Probes, fixture are not supplied with the unit as standard equipment. You should order them separately, according to requirements.

## Transporting the instrument

Use the original packing materials when transporting the instrument, if possible.
**See**

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# Safety Information

⚠️ **WARNING**  **This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument. However, using the instrument in a way not described in this manual may negate the provided safety features.**
**Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.**

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using it, be sure to carefully read the following safety precautions.

## Safety Symbols

| | |
|---|---|
| ⚠️ | In the manual, the ⚠️ symbol indicates particularly important information that the user should read before using the product. |
| | The ⚠️ symbol printed on the product indicates that the user should refer to a corresponding topic in the manual (marked with the symbol) before using the relevant function. |
| ∼ | Indicates AC (Alternating Current). |
| ⏚ | Indicates a grounding terminal. |
| I | Indicates the ON side of the power switch. |
| ○ | Indicates the OFF side of the power switch. |

The following symbols in this manual indicate the relative importance of cautions and warnings.

| | |
|---|---|
| ⚠️ **DANGER** | Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user. |
| ⚠️ **WARNING** | Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user. |
| ⚠️ **CAUTION** | Indicates that incorrect operation presents a possibility of injury to the user or damage to the product. |
| **NOTE** | Advisory items related to performance or correct operation of the product. |

## Symbols for Various Standards

| | |
|---|---|
| 🚮 | Indicates the Waste Electrical and Electronic Equipment Directive (WEEE Directive) in EU member states. |
| CE | This symbol indicates that the product conforms to regulations set out by the EC Directive. |

## Notation

### Marks for individual functions

| | |
|---|---|
| **LCR** | Indicates the function is enabled in LCR mode. |
| **ANALYZER** | Indicates the function is enabled in ANALYZER mode. |
| **CONTINUOUS** | Indicates the function is enabled in CONTINUOUS mode. |

### Symbols in this manual

| | |
|---|---|
| 🚫 | Indicates the prohibited action. |
| (**p.  **) | Indicates the location of reference information. |
| * | Indicates that descriptive information is provided below. |
| **[   ]** | Menus, commands, dialogs, buttons in a dialog, and other names on the screen and the keys are indicated in brackets. |
| **CURSOR** (Bold character) | Bold characters within the text indicate operating key labels. |
| **Windows** | Unless otherwise specified, "Windows" represents Windows 95, 98, Me, Widows NT4.0, Windows 2000, Windows XP, Windows Vista or Windows 7. |
| **Dialogue** | Dialogue box represents a Windows dialog box. |

### Accuracy
We define measurement tolerances in terms of f.s. (full scale), rdg. (reading) and dgt. (digit) values, with the following meanings:

| | |
|---|---|
| **f.s.** (maximum display value or scale length) | The maximum displayable value or scale length. This is usually the name of the currently selected range. |
| **rdg.** (reading or displayed value) | The value currently being measured and indicated on the measuring instrument. |
| **dgt.** (resolution) | The smallest displayable unit on a digital measuring instrument, i.e., the input value that causes the digital display to show a "1" as the least-significant digit. |
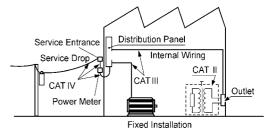
## Measurement categories

To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, and called measurement categories.

| | |
|---|---|
| **CAT II** | Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.) CAT II covers directly measuring electrical outlet receptacles. |
| **CAT III** | Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets. |
| **CAT IV** | The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel). |

Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.
Use of a measurement instrument that is not CAT-rated in CAT II to CAT IV measurement applications could result in a severe accident, and must be carefully avoided.



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# Operating Precautions ⚠

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

## Preliminary Checks

Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

⚠ **DANGER** | **Before using the instrument, make sure that the insulation on the voltage cords is undamaged and that no bare conductors are improperly exposed. Using the instrument in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.**

## Instrument Installation

Operating temperature and humidity to RH or less, Indoors only non-condensating
Storing temperature and humidity to RH or less, Indoors only
Temperature and humidity range for guaranteed accuracy, RH or less

**Avoid the following locations that could cause an accident or damage to the instrument.**

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

Exposed to water, oil, other chemicals, or solvents
Exposed to high humidity or condensation

Exposed to strong electromagnetic fields
Near electromagnetic radiators

Exposed to high levels of particulate dust
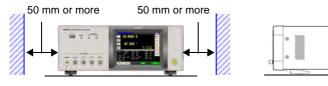
Near induction heating systems (e.g., high-frequency induction heating systems and IH cooking utensils)

Subject to vibration

- The instrument should be operated only with the bottom or rear side downwards.
- The instrument must not be placed on an unstable table or tilted surface.
- Vents must not be obstructed.

50 mm or more          50 mm or more          10 mm or more

Rear

The instrument can be used with the stand.(p. 11)
It can also be rack-mounted. (p.A14)

## Shipping precautions

Hioki disclaims responsibility for any direct or indirect damages that may occur when this instrument has been combined with other devices by a systems integrator prior to sale, or when it is resold.

## Handling the Instrument

⚠ **DANGER**
- **To avoid electric shock, do not remove the instrument's case. The internal components of the instrument carry high voltages and may become very hot during operation.**
- **Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.**

⚠ **CAUTION**
- If the instrument exhibits abnormal operation or display during use, review the information in "Inspection, Repair and Cleaning" (p. 403) and "Error display" (p. 407) before contacting your dealer or Hioki representative.
- Do not connect charged capacitors to measurement terminals or input voltages or currents from an external source. Doing so may damage the instrument.
- This instrument is not designed to be entirely water- or dust-proof. Do not use it in an especially dusty environment, nor where it might be splashed with liquid. This may cause damage.
- To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- To move the instrument, first disconnect all cables, remove any CF card and USB memory, and carry it by the handle.
- Do not apply heavy downward pressure with the stand extended. The stand could be damaged.
- Do not use excessive force on the touch panel, and do not use sharp objects that could damage the touch screen.
- After use, always turn OFF the power.

**NOTE** This instrument may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

## Before Turning Power On

⚠ **WARNING**
- Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.
- Be careful to avoid connecting voltage improperly, as the internal circuitry may be destroyed.
- To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord provided only to a 3-contact (two-conductor + ground) outlet.
- To avoid shock and short circuits, turn off the power to lines to be measured before making connections to terminals to be measured and turning on the instrument.

## About Handling of Cords and Fixtures

⚠ **CAUTION**
- For safety reasons, disconnect the power cord when the instrument is not used.To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.
- Do not apply a voltage to the measurement terminals. Doing so may damage the instrument.
- When disconnecting the BNC connector, be sure to release the lock before pulling off the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable, can damage the connector.
- To avoid breaking the cables or probes, do not bend or pull them.
- Avoid stepping on or pinching cables, which could damage the cable insulation.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.Keep in mind that, in some cases, conductors to be measured may be hot.

**NOTE**
- Use only the specified connection cables. Using a non-specified cable may result in incorrect measurements due to poor connection or other reasons.
- Before using a fixture or the like, read the instruction manual supplied with the product to be used.

## Before Connecting EXT I/O

⚠ **WARNING**
**To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to the EXT I/O connector.**
- **Always turn off the power to the instrument and to any devices to be connected before making connections.**
- **Be careful to avoid exceeding the ratings of external terminals.(p. 377)**
- **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Make sure that connections are secure and use screws to secure the external connectors.**
- **Properly insulate any devices and mechanisms to be connected to the EXT I/O connector.**
- **The ISO_5V pin of the EXT I/O connector is a 5V power output. Do not apply external power to this pin.**

## Handling the CD

⚠️**CAUTION**
- Always hold the disc by the edges, so as not to make fingerprints on the disc or scratch the printing.
- Never touch the recorded side of the disc. Do not place the disc directly on anything hard.
- Do not wet the disc with volatile alcohol or water, as there is a possibility of the label printing disappearing.
- To write on the disc label surface, use a spirit-based felt pen. Do not use a ball-point pen or hard-tipped pen, because there is a danger of scratching the surface and corrupting the data. Do not use adhesive labels.
- Do not expose the disc directly to the sun's rays, or keep it in conditions of high temperature or humidity, as there is a danger of warping, with consequent loss of data.
- To remove dirt, dust, or fingerprints from the disc, wipe with a dry cloth, or use a CD cleaner. Always wipe from the inside to the outside, and do no wipe with circular movements. Never use abrasives or solvent cleaners.
- Hioki shall not be held liable for any problems with a computer system that arises from the use of this CD, or for any problem related to the purchase of a Hioki product.

# Overview      Chapter 1

## 1.1   Product Overview Features

The HIOKI IM3570 impedance analyzer is an impedance measuring instrument which achieves high speed and high accuracy.

It has two functions: an impedance analyzer capable of the sweep measurement of frequencies and measurement signals, and an LCR meter capable of simultaneously displaying up to four items under individual measurement conditions.

This instrument can be used for a wide range of applications because you can set a wide range of measurement conditions - a measurement frequencies from 4 Hz to 5 MHz and a measurement signal levels from 5 mV to 5 V.

### Wide range of measurement conditions(p. 41)

Capable of measurement under a wide range of measurement conditions: measurement frequencies from 4 Hz to 5 MHz and measurement signal levels from 5 mV to 5 V.

### Capable of high-speed measurement

High-speed measurement is possible.
Measurement can be performed at a maximum speed of 0.5 ms (when 100 kHz, FAST, and display OFF).

### Various interfaces supported

Supports the most suitable external I/O (handler interface) for production lines, RS-232C, GP-IB, USB, and LAN.



### Sweep measurement (p. 131)

Measures frequency characteristics and level characteristics, and displays a graph on the color LCD of the instrument.

### Comparator function

LCR function: (p. 86)
Capable of making HI/IN/LO pass/fail judgments based on the measurement values for two parameters.

ANALYZER function: (p. 197)
A pass/fail judgment can be made for sweep measurement results.

### BIN function (p. 93)

With LCR mode, easily ranks measurement items into up to 10 classifications based on the measurement values.

### Continuous measurement function (p. 265)

Capable of consecutive measurements using measurement conditions stored in the memory of the instrument. This function enables, for example, making pass/fail judgment with different measurement conditions.
(Example: Performing C-D measurement with 120 Hz and Rs measurement with 100 kHz in succession)

### Low impedance can be measured with high degree of accuracy
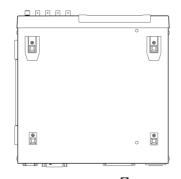
LCR meter mode includes a setting for measuring low impedance with a high degree of accuracy. When this setting is selected, the influence of contact resistance is reduced and a disconnection (incorrect connection of a probe) can be detected during 4-terminal measurement.

## 1.2   Names and Functions of Parts

### Front

**Measurement LEDs**

Lights during measurement.

**Judgment Result Indication LEDs**

Indicates the judgment results for comparator and BIN measurement.
LCR mode (p. 86)
ANALYZER mode (p. 131)

**LCD Display**

This is a touch panel display. Press the keys displayed on the screen to operate the instrument.

**Front USB connector**

Connect a USB flash drive storage device. (p. 330)

**Measurement Terminals**

Connect measurement cables or a fixture. (p. 30)
• $H_{CUR}$ jack: Current source terminal
• $H_{POT}$ jack: Detected voltage high terminal
• $L_{POT}$ jack: Detected voltage low terminal
• $L_{CUR}$ jack: Measurement current detected terminal
• GUARD jack: Shield (measurement ground) terminal

**Power Switch**

Turns the power on and off. (p. 31) (The main power switch is located at the rear.)

### Bottom Panel

**This instrument can be rack mounted.**
**See** "Appendix 10 Rack Mounting"(p. A14)

**Parts removed from this instrument should be stored in a safe place to enable future reuse.**

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**Rear**

**Main power switch**
Turns the power on and off.
(p. 31)

**EXT I/O Connector**
Connect to a PLC or I/O board to control measurement start, and to acquire comparator results
(p. 363)

**LAN Connector**
Connect to a computer to control the instrument with communication commands.
(Communication Instruction Manual "Chapter 2" (CD))

**GP-IB Connector**
The GP-IB interface can be used to connect to a computer
(Communication Instruction Manual "Chapter 2" (CD))

**RS-232C Connector**
The RS-232C interface can be used to connect to a PLC or computer.
(Communication Instruction Manual "Chapter 2" (CD))

You can connect the IM3570 to an RS-232C printer in order to print data. (p. 381)

**Manufacturer's Serial Number**
Shows the serial number. Do not remove this label, as it is required for product support.

**Power Inlet**
Connect the supplied power cord.(p. 29)

**Vent**
Keep clear of obstructions.
(p. 4)
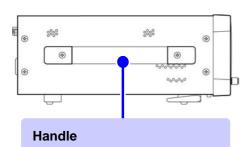
**USB Connector**
Connect to a computer to control the instrument with communication commands.
(Communication Instruction Manual "Chapter 2" (CD))

**MAC address of the LAN**
(p. 306)
(Communication Instruction Manual "Chapter 2" (CD))

**Left side**
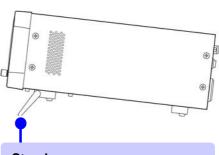
**Handle**
Use to carry the instrument.

**Right side**

**Stand**
Enables the instrument to be tilted.

⚠ **CAUTION**

Do not apply heavy downward pressure with the stand extended. The stand could be damaged.

• **When using the stand**
Extend the stand until it clicks into place.
Make sure to extend both legs of the stand.

• **Collapsing the stand**
Fold in the stand until it clicks into place.

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# 1.3   Screen Configuration and Operation

This instrument allows you to use a touch panel to set and change all measurement conditions.
Gently touch a key on the screen to select the item or numerical value set for that key.
A selected key turns black.
In this manual, to gently touch the screen is referred to as "press."
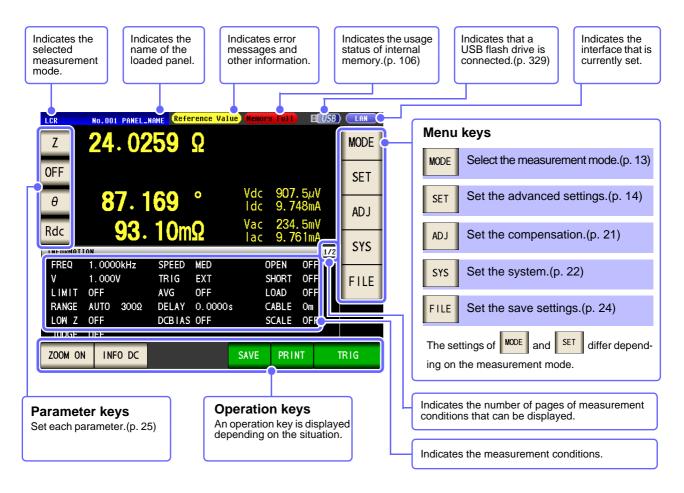
⚠ **CAUTION**  Do not use excessive force on the touch panel, and do not use sharp objects that could damage the touch screen.

## 1.3.1   Initial Screen

This is the screen that is first displayed when the power is turned on. It allows you to perform measurement while checking all of the measurement conditions.
When the power is turned on again, display is in accordance with the measurement mode used immediately before the power was turned off.

Indicates the selected measurement mode.

Indicates the name of the loaded panel.

Indicates error messages and other information.

Indicates the usage status of internal memory.(p. 106)

Indicates that a USB flash drive is connected.(p. 329)

Indicates the interface that is currently set.

| LCR | No.001 PANEL_NAME | Reference Value | Memory Full | USB | LAN |

**Menu keys**

| MODE | Select the measurement mode.(p. 13) |
| SET | Set the advanced settings.(p. 14) |
| ADJ | Set the compensation.(p. 21) |
| SYS | Set the system.(p. 22) |
| FILE | Set the save settings.(p. 24) |

The settings of MODE and SET differ depending on the measurement mode.

Screen values:
24.0259 Ω
87.169 °      Vdc   907.5µV
              Idc   9.748mA
93.10mΩ       Vac   234.5mV
              Iac   9.761mA

INFORMATION

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | EXT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO 300Ω | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |

JUDGE OFF

ZOOM ON | INFO DC | SAVE | PRINT | TRIG

**Parameter keys**
Set each parameter.(p. 25)

**Operation keys**
An operation key is displayed depending on the situation.

Indicates the number of pages of measurement conditions that can be displayed.

Indicates the measurement conditions.

**NOTE**  When a measurement value is outside the guaranteed accuracy range, "**Reference Value**" is displayed in the error display area. When this happens, the cause is likely to be one of the following.
Check the guaranteed accuracy range in "13.2  Measurement Range and Accuracy" (p. 395) and change the measurement conditions or you should consider the measured values as values for reference.

• Perhaps the test signal level is too low, increase the test signal level.
• If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO range, or change the range by manual.

## 1.3.2 Measurement Mode Selection Screen

Select the measurement mode.

**Procedure**

**1** LCR Initial Screen



Press MODE .

**2** Mode Selection



**Select the measurement mode.Select**

| | |
|---|---|
| LCR | LCR measurement (p. 37) |
| ANALYZER | ANALYZER measurement (p. 131) |
| CONTINUOUS | CONTINUOUS measurement (p. 265) |

Initial screen is displayed.

## 1.3.3 Advanced Settings Screen

This screen is for configuring the measurement conditions you want to change and other advanced settings. Select the measurement mode (p. 13) before configuring the advanced settings.

**Procedure**

*1*

LCR Initial Screen

Press SET .
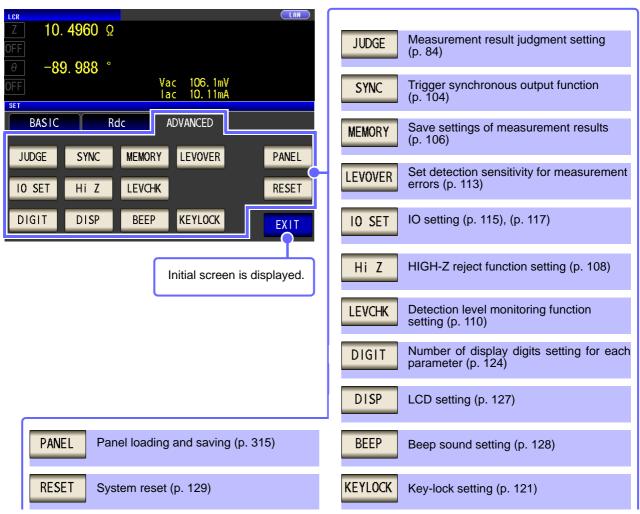
*2* **LC on figure the settings of each of the LCR mode, analyzer mode, and continuous measurement mode.**

### LCR Mode

**Basic setting**

Initial screen is displayed.

| | |
|---|---|
| FREQ | Measurement frequency setting (p. 41) |
| LEVEL | Measurement signal level setting (p. 43) |
| RANGE | Measurement range setting (p. 49) |
| TRIG | Trigger setting (p. 55) |
| DC BIAS | DC bias setting (p. 57) |
| SPEED | Measurement speed setting (p. 59) |
| LIMIT | Voltage and current limit settings (p. 60) |
| AVG | Average setting (p. 62) |
| DELAY | Trigger delay setting (p. 64) |

### ■ DC resistance measurement setting



Initial screen is displayed.

| | |
|---|---|
| LEVEL | Measurement signal level setting (p. 66) |
| RANGE | Measurement range setting (p. 69) |
| DC ADJ | DC adjustment setting (p. 75) |
| SPEED | Measurement speed setting (p. 77) |
| LIMIT | Voltage and current limit settings (p. 78) |
| AVG | Average setting (p. 80) |
| DC DELAY | DC delay setting (p. 82) |

### ■ Application settings



Initial screen is displayed.

| | |
|---|---|
| JUDGE | Measurement result judgment setting (p. 84) |
| SYNC | Trigger synchronous output function (p. 104) |
| MEMORY | Save settings of measurement results (p. 106) |
| LEVOVER | Set detection sensitivity for measurement errors (p. 113) |
| IO SET | IO setting (p. 115), (p. 117) |
| Hi Z | HIGH-Z reject function setting (p. 108) |
| LEVCHK | Detection level monitoring function setting (p. 110) |
| DIGIT | Number of display digits setting for each parameter (p. 124) |
| DISP | LCD setting (p. 127) |
| PANEL | Panel loading and saving (p. 315) |
| BEEP | Beep sound setting (p. 128) |
| RESET | System reset (p. 129) |
| KEYLOCK | Key-lock setting (p. 121) |

## 1.3 Screen Configuration and Operation

◼ **Checking the setting information**



You can check the settings on the measurement screen.

| INFO AC | Displays information regarding the AC signal. |
| INFO DC | Displays information regarding the DC signal. |

## ANALYZER Mode

### Basic setting



| PARA | Measurement parameter setting (p. 133) |
| SOURCE | Sweep parameter setting (p. 135) |
| TRIG | Trigger setting (p. 137) |
| DRAW | Display timing setting (p. 139) |
| TRIG DELAY | Trigger delay setting (p. 140) |
| SEGMENT | Segment setting (p. 142) |
| SWEEP POINT | Sweep point setting (p. 143) |

Initial screen is displayed.

| LEVEL | Measurement signal level setting (p. 157) |
| RANGE | Measurement range setting (p. 160) |
| SPEED | Measurement speed setting (p. 164) |
| AVG | Average setting (p. 165) |
| POINT DELAY | Point delay setting (p. 166) |
| DC BIAS | DC bias setting (p. 167) |

## 1.3 Screen Configuration and Operation

### ▓ Graph setting

| | |
|---|---|
| OVERWRITE | Overwrite setting (p. 176) |
| SCALE | Horizontal axis scale setting (p. 177) |
| SPAN | Span setting (p. 179) |

Initial screen is displayed.

| | |
|---|---|
| COLOR | Draw color setting (p. 181) |
| SCALE | Vertical axis scale setting (p. 183) |
| MANUAL SCALE | Manual scaling setting (p. 184) |
| GRID | Grid display setting (p. 186) |

### ▓ Comparator setting

| | |
|---|---|
| COMP | Comparator setting (p. 197) |

Initial screen is displayed.

## List settings

| EDIT | Sweep point editing (p. 217) |

Initial screen is displayed.

## Application settings

| MEMORY | Memory function setting (p. 219) |

| IO JUDGE | I/O output setting of judgment results (p. 226) |

| IO TRIG | IO trigger setting (p. 228) |

| IO EOM | $\overline{EOM}$ output method setting (p. 229) |

| Hi Z | HIGH-Z reject function setting (p. 222) |

| LEVOVER | Set detection sensitivity for measurement errors (p. 224) |

| DISP | LCD setting (p. 233) |

| BEEP | Beep sound setting (p. 234) |

| KEYLOCK | Key-lock setting (p. 230) |

| SYNC | Trigger synchronous output function (p. 235) |

| CIRCUIT | Equivalent circuit analysis (p. 238) * This key is displayed only when the IM9000 Equivalent Circuit Analysis Firmware has been installed. |

| PANEL | Panel loading and saving (p. 315) |

| RESET | System reset (p. 237) |

Initial screen is displayed.

## 1.3 Screen Configuration and Operation

### Continuous Measurement Mode

#### ■ Basic setting

| OFF | Removes item from targets for continuous measurement(p. 266) |
| ON | Sets item as target for continuous measurement(p. 266) |
| ALL OFF | Removes all items from targets for continuous measurement(p. 266) |
| ALL ON | Sets all items as targets for continuous measurement(p. 266) |
| INFO | Displays panel information(p. 266) |

Initial screen is displayed.

#### ■ Application settings

| DRAW | Display timing setting (p. 269) |
| TRIG | Trigger setting (p. 270) |
| ABORT | Stops continuous measurement (p. 271) |
| DISP | LCD setting (p. 272) |

Initial screen is displayed.

**1**

## 1.3.4 Compensation Settings Screen

**Procedure**

**1** LCR Initial Screen



Press | ADJ | .

**2** Set the compensation condition.



| | |
|---|---|
| **OPEN** | Open circuit compensation setting (p. 273) |
| **SHORT** | Short circuit compensation setting (p. 280) |
| **LOAD** | Load circuit compensation setting (p. 288) |
| **CABLE** | Cable length compensation setting (p. 301) |
| **SCALE** | Scaling setting (p. 302) |

Initial screen is displayed.

## 1.3.5 System Settings Screen

Procedure

**1**    LCR Initial Screen

Press [SYS].

**2** To set the details of the system.

### Interface type settings

| | |
|---|---|
| RS232C | RS-232C Setting (Communication Instruction Manual (CD)) |
| GPIB | GP-IB Setting (Communication Instruction Manual (CD)) |
| USB | USB Setting (Communication Instruction Manual (CD)) |
| LAN | LAN Setting (Communication Instruction Manual (CD)) |
| PRINT | Printer Setting (p. 381) |

Initial screen is displayed.

■ **Check the version of the instrument** (p. 306)

```
SYS
  I/F        INFO       TEST      CLOCK

  IM3570 IMPEDANCE ANALYZER

  Serial No.        123456789
  Software Version  3.00
  FPGA Version      0x15
  Board Version     0
  MAC Address       00-01-67-03-26-39
  USB ID            108f:3570
  OPTION            IM9999

                              EXIT
```

Initial screen is displayed.

■ **Checking the Display Screen**

```
SYS
  I/F        INFO       TEST      CLOCK

    TOUCH SCREEN TEST      CALIBRATION

        DISPLAY & LED TEST

          ROM/RAM TEST

         I/O HANDLER TEST

                              EXIT
```

| TOUCH SCREEN TEST | Panel test (p. 307) |
| CALIBRATION | Panel calibration (p. 308) |
| DISPLAY & LED TEST | Display test (p. 310) |
| ROM/RAM TEST | ROM/RAM test (p. 312) |
| I/O HANDLER TEST | I/O test (p. 313) |

Initial screen is displayed.

■ **Setting the Date and Time** (p. 314)

```
SYS
  I/F        INFO       TEST      CLOCK

   10-05-23 12:34:56

     10-05-23   12:34:56

     ▲  ▲  ▲    ▲  ▲  ▲

     ▼  ▼  ▼    ▼  ▼  ▼

        SET               EXIT
```

Indicates the current date and time set on the instrument.

Initial screen is displayed.

## 1.3.6 Save Settings Screen

**Procedure**

**1**

LCR Initial Screen

Press FILE .

**2** **Set the save destination and type.**

### Save method setting

| | |
|---|---|
| **TYPE** | Save type setting (p. 333) |
| **SAVE TO ...** | Save destination folder setting (p. 344) |

Initial screen is displayed.

### Save the measurement condition

| | |
|---|---|
| **SAVE** | Saves the setting conditions (p. 349) |
| **OPTION >>** | Switches the advanced settings screen (p. 331) |
| **BACK** | Displays the screen immediately above (p. 331) |
| **SELECT** | Selects a file (p. 331) |

Initial screen is displayed.

## 1.3.7   Parameter Settings Screen
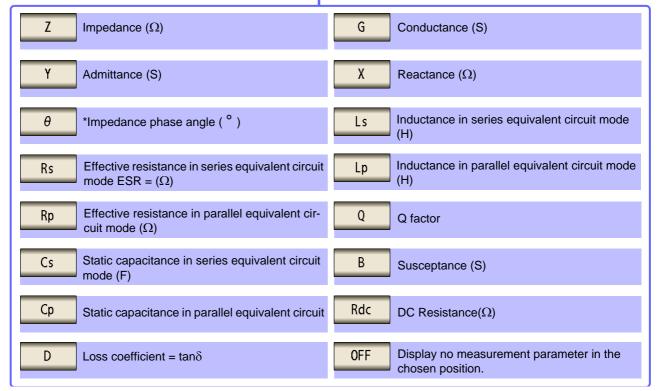
This screen is for selecting the measurement parameters to display.
**See** "4.1.2  Setting Display Parameters" (p. 39), "Appendix 7  Series Equivalent Circuit Mode and Parallel Equivalent Circuit Mode"(p. A11)

**Procedure**

**1  Press the key to set.**

LCR Initial Screen

The first parameter key

The second parameter key

The third parameter key

The fourth parameter key

LCR    No.001 PANEL_NAME   Reference Value  Memory Full   USB  LAN

Z

24.0259 Ω

OFF

θ

87.169 °        Vdc  907.5µV
                Idc  9.748mA

Rdc

93.10mΩ        Vac  234.5mV
                Iac  9.761mA

INFORMATION                                    1/2
FREQ   1.0000kHz   SPEED  MED      OPEN   OFF
V      1.000V      TRIG   EXT      SHORT  OFF
LIMIT  OFF         AVG    OFF      LOAD   OFF
RANGE  AUTO  300Ω  DELAY  0.0000s  CABLE  0m
LOW Z  OFF         DCBIAS OFF      SCALE  OFF
JUDGE  OFF

ZOOM ON  INFO DC            SAVE  PRINT  TRIG

MODE

SET

ADJ

SYS

FILE

**2  Select parameters.**

Parameter Setting

LCR                                           LAN
Z     16.1513kΩ
OFF

θ    −89.991 °              Vac  1.026 V
OFF                         Iac  63.51µA

PARAMETER 1:  Z

| Z | Y | θ | Rs | Rp |
|---|---|---|---|---|
| Cs | Cp | D | G | X |
| Ls | Lp | Q | B | Rdc |

OFF                                    EXIT

| | | | |
|---|---|---|---|
| **Z** | Impedance (Ω) | **G** | Conductance (S) |
| **Y** | Admittance (S) | **X** | Reactance (Ω) |
| **θ** | *Impedance phase angle ( ° ) | **Ls** | Inductance in series equivalent circuit mode (H) |
| **Rs** | Effective resistance in series equivalent circuit mode ESR = (Ω) | **Lp** | Inductance in parallel equivalent circuit mode (H) |
| **Rp** | Effective resistance in parallel equivalent circuit mode (Ω) | **Q** | Q factor |
| **Cs** | Static capacitance in series equivalent circuit mode (F) | **B** | Susceptance (S) |
| **Cp** | Static capacitance in parallel equivalent circuit | **Rdc** | DC Resistance(Ω) |
| **D** | Loss coefficient = tanδ | **OFF** | Display no measurement parameter in the chosen position. |

# Measurement Preparations    Chapter 2

Be sure to read the "Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions." (p. 4) before installing and connecting this instrument.
Refer to "Appendix 10 Rack Mounting"(p. A14) for rack mounting.

## 2.1    Preparation Flowchart
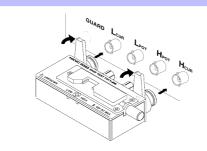
*1* **Installing the Instrument (p. 4)**

*2* **Connecting the Power Cord (p. 29)**

*3* **Connect measurement cables, optional Hioki probes or test fixture (p. 30)**
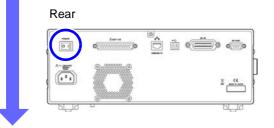


*4* **Connect the external interface** **(as needed)**

- Using the printer (p. 381)
- RS-232C
- GP-IB
- USB
- LAN

**See** Communication Instruction Manual "Chapter 2" (CD)

*5* **Turning Power On (p. 31)**

Rear



Front
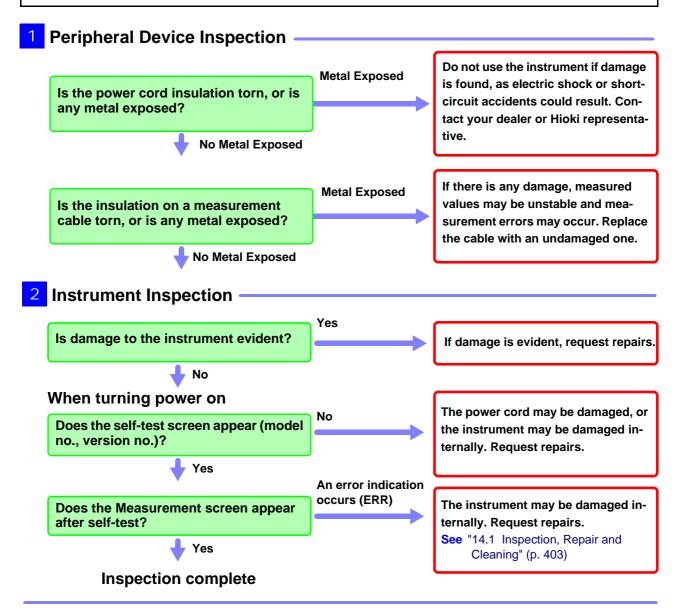


*6* **Make instrument settings**

## 2.2 Pre-Operation Inspection

Before using the instrument for the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

**1** Peripheral Device Inspection ─────────────────────

**Is the power cord insulation torn, or is any metal exposed?**

**Metal Exposed** →

**Do not use the instrument if damage is found, as electric shock or short-circuit accidents could result. Contact your dealer or Hioki representative.**

↓ **No Metal Exposed**

**Is the insulation on a measurement cable torn, or is any metal exposed?**

**Metal Exposed** →

**If there is any damage, measured values may be unstable and measurement errors may occur. Replace the cable with an undamaged one.**

↓ **No Metal Exposed**

**2** Instrument Inspection ─────────────────────

**Is damage to the instrument evident?**

**Yes** →

**If damage is evident, request repairs.**

↓ **No**

**When turning power on**

**Does the self-test screen appear (model no., version no.)?**

**No** →

**The power cord may be damaged, or the instrument may be damaged internally. Request repairs.**

↓ **Yes**

**Does the Measurement screen appear after self-test?**

**An error indication occurs (ERR)** →

**The instrument may be damaged internally. Request repairs.**
**See** "14.1 Inspection, Repair and Cleaning" (p. 403)

↓ **Yes**

**Inspection complete**

**Please read the "Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions." (p. 4) before use.**
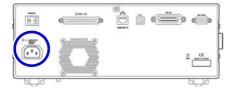
# 2.3  Connecting the Power Cord ⚠
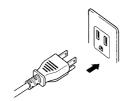
**Be sure to read the "Usage Notes" (p. 7) before connecting power.**
Connect the power cord to the power inlet on the instrument, and plug it into an outlet.

**Connection Procedure**

*1* **Check that the instrument's power switch is turned off.**

*2* **Confirm that the line voltage matches instrument requirements, and plug the power cord into the power inlet on the instrument.**

*3* **Plug the other end of the power cord into an outlet.**

Turn off the power before disconnecting the power cord.

# 2.4 Connecting the Measurement Cables, Probes, or Fixture ⚠
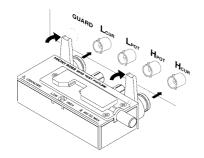
**Be sure to read the "Usage Notes" (p. 7) before connecting measurement cables, probes or test fixture.**

Connect your measurement cables, optional Hioki probes or test fixture to the measurement terminals.
Refer to "Options" (p. 393) for details.
See the instructions provided with the fixture for operating details.

## Connecting a measurement cable/fixture



Connect directly to the measurement jacks with the label side up, and affix with the levers on the left and right.

## Points to pay attention to when making your own probe

- Use 50 $\Omega$ coaxial cable for the measurement cable.
- Ensure that the length of the cable is the same as that set for the instrument.
- Make the portion of the core wire that is exposed as short as possible.
- Connect the $H_{CUR}$, $L_{CUR}$, $H_{POT}$, and $L_{POT}$ shield pairs at the measurement object side.
  (Ensure that a shield is not connected to a core wire.)
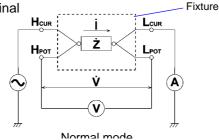
**NOTE**
- Basically, when you make a probe yourself, it may not be able to satisfy the specifications of this instrument.
  **See:** "Options" (p. 393)
- If all four terminals are disconnected, a meaningless number may be displayed on the unit.
- If all four terminals are disconnected, a measurement signal and DC voltage of 6 V may be generated at the $H_{POT}$ terminal, and a DC voltage of 6 V at the $L_{POT}$ terminal.

Measurement Terminal Configuration



Fixture

Normal mode
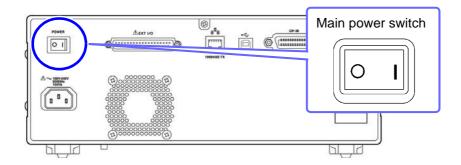
## 2.5 Turning the Power On and Off ⚠

Connect the power cord and voltage and current measurement cables before turning the instrument on.

Main power switch

### Turning main power on

**Turn the MAIN POWER switch on ( | ).**
When the power is turned on, the same setting as when the power was last turned off appears.

Lights green

For high-precision measurements, allow at least 60 minutes warm-up before executing zero adjustment.

### Turning main power off

**Turn the MAIN POWER switch off ( ○ ).**
At that time, the measurement conditions are saved.

OFF

**NOTE** When the power supply is interrupted by a power failure or the like, the instrument recovers in the measurement mode used before the power failure.

**2**

**Chapter 2 Measurement Preparations**

**2.5  Turning the Power On and Off**

## Be on standby

**ON the main power in the state, hold down the front POWER switch 2 seconds approximately.**

Lights red

## To cancel the standby

**The instrument is in standby state, press the POWER switch on the front.**

Lights green

# Measurement Example

# Chapter 3

The following shows measurement examples of the LCR measurement mode and analyzer measurement mode.

## 3.1 When LCR Measurement Mode

**LCR**
**ANALYZER**
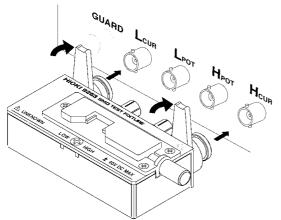
### Measuring a Laminated Ceramic Capacitor

Necessary items: 9263 SMD test fixture
Laminated ceramic capacity you want to measure
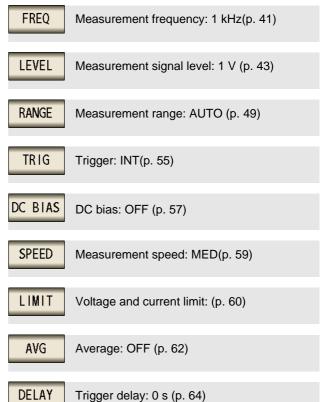
**1** **Connect the 9263 SMD test fixture to the measurement terminals.**



For the connection procedure, refer to the instruction manual supplied with the fixture.
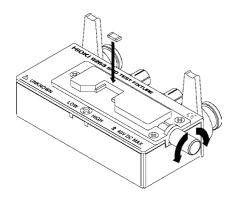
**2** **Set the measurement conditions.**
Select the item you want to set, and set it as follows.



LCR Basic Settings

| FREQ | Measurement frequency: 1 kHz(p. 41) |
|------|-------------------------------------|
| LEVEL | Measurement signal level: 1 V (p. 43) |
| RANGE | Measurement range: AUTO (p. 49) |
| TRIG | Trigger: INT(p. 55) |
| DC BIAS | DC bias: OFF (p. 57) |
| SPEED | Measurement speed: MED(p. 59) |
| LIMIT | Voltage and current limit: (p. 60) |
| AVG | Average: OFF (p. 62) |
| DELAY | Trigger delay: 0 s (p. 64) |

**3** **Connect the test sample to the 9263 SMD test fixture.**



> For the connection procedure of the test sample, refer to the instruction manual supplied with the fixture.

**4** **Check the measurement results.**



- When you want to measure under desired condition and timing
  **See:** "4.2.4 Perform Measurements with User-defined Timing (Trigger Measurement)" (p. 55)

- When you want to judge the measurement results
  **See:** "4.4.1 Judging with Upper and Lower Limit Values (Comparator Measurement Mode)" (p. 86)

- When you want to save the measurement results
  **See:** "4.5.2 Saving Measurement Results (Memory function)" (p. 106)

# 3.2 When Analyzer Measurement Mode

In analyzer measurement mode, the sweep can be performed with frequencies and signal levels within the desired range.
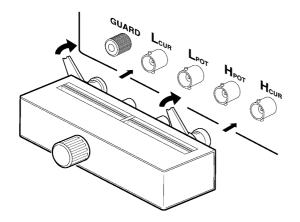
**See** "Chapter 5 ANALYZER Function" (p. 131)

## Measuring Element with Resonance Point

Necessary items:  9262 Test fixture
Element you want to measure
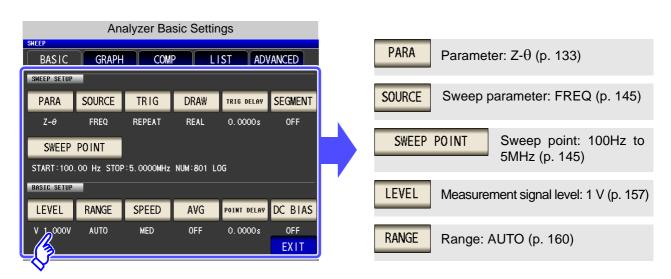
**1** **Connect the 9262 Test Fixture to the measurement terminals.**



GUARD  L_CUR  L_POT  H_POT  H_CUR

> For the connection procedure, refer to the instruction manual supplied with the fixture.

**2** **Set the measurement conditions.**



Analyzer Basic Settings

SWEEP
BASIC   GRAPH   COMP   LIST   ADVANCED

SWEEP SETUP
PARA   SOURCE   TRIG   DRAW   TRIG DELAY   SEGMENT
Z-θ   FREQ   REPEAT   REAL   0.0000s   OFF

SWEEP POINT
START:100.00 Hz STOP:5.0000MHz NUM:801 LOG

BASIC SETUP
LEVEL   RANGE   SPEED   AVG   POINT DELAY   DC BIAS
V 1.000V   AUTO   MED   OFF   0.0000s   OFF

EXIT

| PARA | Parameter: Z-θ (p. 133) |
| SOURCE | Sweep parameter: FREQ (p. 145) |
| SWEEP POINT | Sweep point: 100Hz to 5MHz (p. 145) |
| LEVEL | Measurement signal level: 1 V (p. 157) |
| RANGE | Range: AUTO (p. 160) |

**See** For details on the other items, see from page 131.

Chapter 3 Measurement Example

## 3.2 When Analyzer Measurement Mode

**3** Connect the test sample to the 9263 Test Fixture.



**4** Execute the sweep.



- When you want to check the measurement values.
  **See:** "5.6.1 Setting the Cursor" (p. 188)

- When you want to check the local maximum and local minimum values quickly.
  **See:** "5.6.3 Performing Measurement Value Search" (p. 194)

- When you want to judge sweep results.
  **See:** "Area Judgment" (p. 197)

- When you want to judge whether the peak position is appropriate.
  **See:** "Peak Judgment" (p. 208)

# LCR Function          Chapter 4

## 4.1   About LCR function          `LCR` `ANALYZER`

The LCR function allows you to measure the impedance, phase angle, and other items by applying any frequency or level (effective value) signal to the element you want to measure. This function is suitable for evaluating the passive element of a capacitor, coil, or the like.
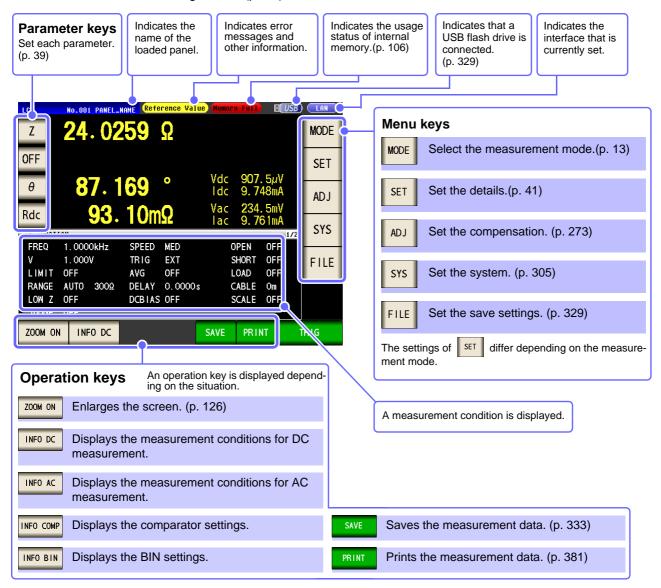
**NOTE**    The settings are synchronized between LCR mode and analyzer mode.

**4**

**Chapter 4  LCR Function**

## 4.1.1 Initial screen

This is the screen that is first displayed when the power is turned on. It allows you to perform measurement while checking the measurement conditions.
When the power is turned on again, display is in accordance with the measurement mode used immediately before the power was turned off.
For details on the screen configuration. (p. 14)

**Parameter keys**
Set each parameter. (p. 39)

Indicates the name of the loaded panel.

Indicates error messages and other information.

Indicates the usage status of internal memory.(p. 106)

Indicates that a USB flash drive is connected. (p. 329)

Indicates the interface that is currently set.

| LCR | No.001 PANEL_NAME | Reference Value | Memory Full | USB | LAN |

| Z | 24.0259 Ω | | | MODE |
| OFF | | | | SET |
| θ | 87.169 ° | Vdc 907.5µV | Idc 9.748mA | ADJ |
| Rdc | 93.10mΩ | Vac 234.5mV | Iac 9.761mA | SYS |
| | | | | FILE |

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | EXT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO 300Ω | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |

| ZOOM ON | INFO DC | | SAVE | PRINT | TRIG |

**Menu keys**

MODE — Select the measurement mode.(p. 13)

SET — Set the details.(p. 41)

ADJ — Set the compensation. (p. 273)

SYS — Set the system. (p. 305)

FILE — Set the save settings. (p. 329)

The settings of [SET] differ depending on the measurement mode.

A measurement condition is displayed.

**Operation keys**
An operation key is displayed depending on the situation.

ZOOM ON — Enlarges the screen. (p. 126)

INFO DC — Displays the measurement conditions for DC measurement.

INFO AC — Displays the measurement conditions for AC measurement.

INFO COMP — Displays the comparator settings.

INFO BIN — Displays the BIN settings.

SAVE — Saves the measurement data. (p. 333)

PRINT — Prints the measurement data. (p. 381)

**NOTE**
When a measurement value is outside the guaranteed accuracy range, "**Reference Value**" is displayed in the error display area. When this happens, the cause is likely to be one of the following. Check the guaranteed accuracy range in "13.2 Measurement Range and Accuracy" (p. 395) and change the measurement conditions or you should consider the measured values as values for reference.

• Perhaps the test signal level is too low, increase the test signal level.
• If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO range, or change the range by manual.

## 4.1.2 Setting Display Parameters

You can select up to four measurement parameters to display in any location from 15 types.
**See** "1.3.7 Parameter Settings Screen" (p. 25)
   "Appendix 2 Measurement of High Impedance Components"(p. A3)
   "Appendix 7 Series Equivalent Circuit Mode and Parallel Equivalent Circuit Mode"(p. A11)
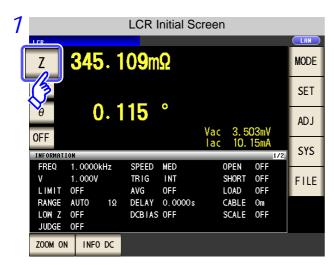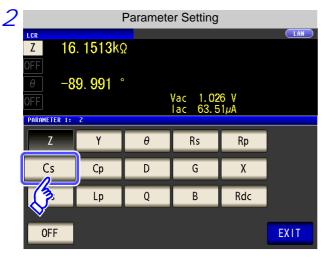
**Procedure**    Example: 1st: Capacitance Cs, 3rd: Loss coefficient D

**1**    LCR Initial Screen

**Press the first parameter key.**

**2**    Parameter Setting

**Press** Cs **.**

**Press** EXIT **to confirm the setting.**

**3**    LCR Initial Screen
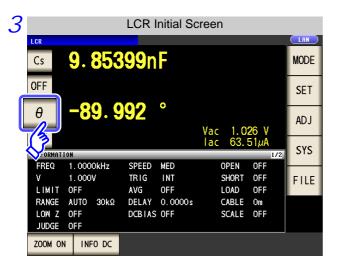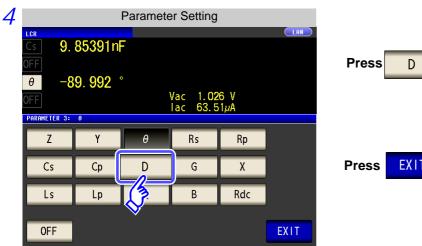
**Press the third parameter key.**

## 4.1 About LCR function

**4**

Parameter Setting

LCR · · · · · · · · · · · · · · · · LAN

Cs   9.85391nF
OFF
θ   −89.992 °
OFF          Vac   1.026 V
             Iac   63.51μA

PARAMETER 3:  θ

| Z | Y | θ | Rs | Rp |
| Cs | Cp | D | G | X |
| Ls | Lp |  | B | Rdc |

OFF                    EXIT

**Press** [ D ] **.**

**Press** [ EXIT ] **to confirm the setting.**

**5**

LCR Initial Screen

LCR · · · · · · · · · · · · · · · · LAN

Cs    9.85386nF
OFF

D     0.00014
OFF          Vac   1.026 V
             Iac   63.51μA

INFORMATION                        1/2

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | INT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO  30kΩ | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |
| JUDGE | OFF |  |  |  |  |

ZOOM ON   INFO DC

MODE
SET
ADJ
SYS
FILE

**Cs** and **D** are set as the parameters.

**NOTE**   If [ OFF ] is selected in the parameter setting, a measurement value is not displayed.
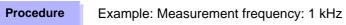
# 4.2 Setting Basic Settings of Measurement Conditions

LCR
ANALYZER
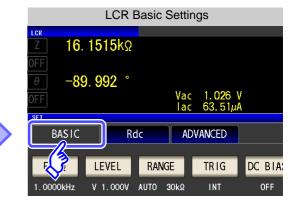
## 4.2.1 Setting the Measurement frequency

Set the frequency of the signal to apply to the test sample. For some test samples, the value may vary depending on the measurement frequency.

**Procedure**    Example: Measurement frequency: 1 kHz

**1**

LCR Initial Screen

LCR Basic Settings

**2**

LCR Basic Settings

**Press**  FREQ .
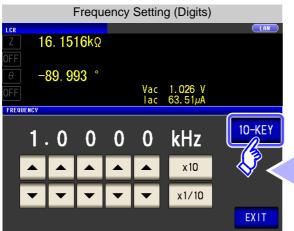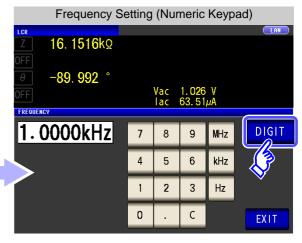
There are the following two frequency input methods.

Press  10-KEY  or  DIGIT  to change the input method.

**3**  Set each digit.

Frequency Setting (Digits)
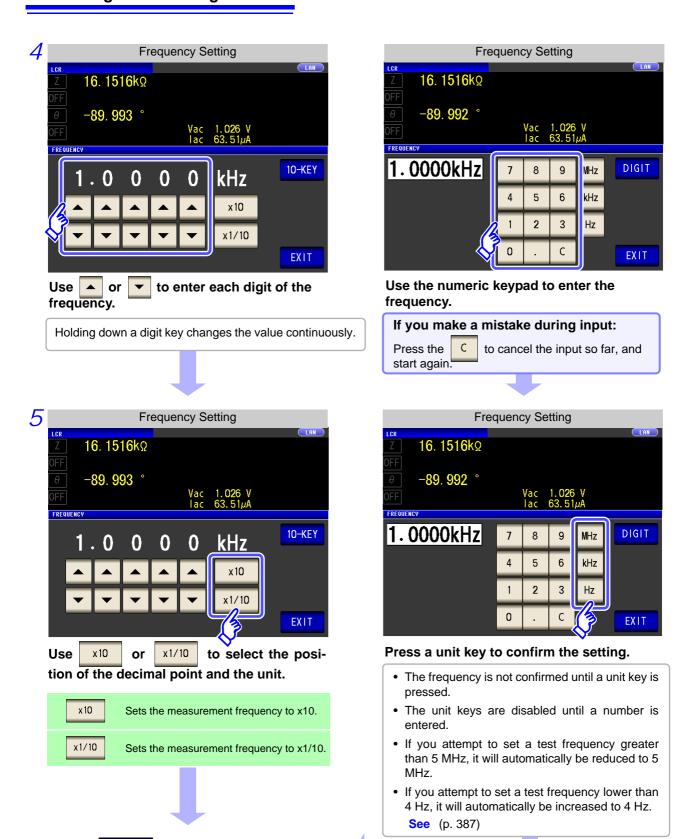
**Set the frequency with the numeric keypad.**

Frequency Setting (Numeric Keypad)

## 4.2 Setting Basic Settings of Measurement Conditions

**4** — Frequency Setting



**Use ▲ or ▼ to enter each digit of the frequency.**

Holding down a digit key changes the value continuously.

**Frequency Setting**



**Use the numeric keypad to enter the frequency.**

**If you make a mistake during input:**

Press the C to cancel the input so far, and start again.

**5** — Frequency Setting



**Use x10 or x1/10 to select the position of the decimal point and the unit.**

| x10 | Sets the measurement frequency to x10. |
|-----|-----------------------------------------|

| x1/10 | Sets the measurement frequency to x1/10. |
|-------|-------------------------------------------|

**Frequency Setting**



**Press a unit key to confirm the setting.**

- The frequency is not confirmed until a unit key is pressed.
- The unit keys are disabled until a number is entered.
- If you attempt to set a test frequency greater than 5 MHz, it will automatically be reduced to 5 MHz.
- If you attempt to set a test frequency lower than 4 Hz, it will automatically be increased to 4 Hz.

**6** Press **EXIT** to close the setting screen.

**NOTE** Setting the measurement frequency may change the setting for the measurement signal level.

## 4.2.2 Setting the Measurement signal level

The value of the test signal level may change according to the sample which is being tested.
This instrument is possible to vary the level of the test signal applied to the object under test over a wide range using the following three methods.

| Set open circuit voltage (V) | ▶ | The value of the open circuit voltage is set. |
| Set constant voltage (CV) | ▶ | The value of the voltage between the terminals of the object under test is set. |
| Set constant current (CC) | ▶ | The value of the current flowing through the object under test is set. |

⚠ **CAUTION** **Do not switch between V, CV and CC while the test sample is still connected to the measurement terminals because doing so may damage the test sample.**

**Procedure**

**1** LCR Initial Screen → LCR Basic Settings



**2** LCR Basic Settings



Press LEVEL .

# 44

## 4.2 Setting Basic Settings of Measurement Conditions

**3** Measurement Signal Level Setting

**To select the measurement signal level.**

| V | open circuit voltage (p. 45) |
|---|---|
| CV | Voltage level between test sample terminals (p. 45) |
| CC | Current level through test sample (p. 47) |

The accuracy of testing varies according to the test signal level.
**See** "13.2 Measurement Range and Accuracy" (p. 395)

**4** Measurement Signal Level Setting

Use ▲ or ▼ to enter the voltage or current value.

**See** "For setting range and accuracy" (p. 45)

**5** Press **EXIT** to close the setting screen.

**NOTE** When the measurement value is outside the guaranteed accuracy range, the following icon appears at the top of the screen.

In this case, you should consider the following possible causes, and you should either change the test conditions while checking the accuracy assured ranges "13.2 Measurement Range and Accuracy" (p. 395), or you should consider the measured values as values for reference.

- Perhaps the test signal level is too low, increase the test signal level.
- If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO range, or change the range by manual.

## About the test signal level

Relationship between the measurement signal level of the instrument and the sample is as follows.

**Open circuit voltage level (V)**

This voltage value is the value which is applied across the two terminals of the series combination of the object which is being tested and the output impedance. As for the voltage which is applied across the terminals of the object which is being tested (by itself), if required, you should either check the monitor voltage value, or select constant voltage (CV) and set a voltage value across these terminals.

**Constant current level (CC)**

You should select this if you wish to set the current passing through the object to be tested to a constant value.

Output impedance

H

Object under test

L

CC

V

CV

**Constant voltage level (CV)**

You should select this if you wish to set the voltage across the terminals of the object to be tested to a constant value.

## For setting range and accuracy

**Open circuit voltage level (V) and Constant voltage level (CV) setting**
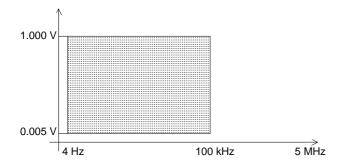
• When normal mode (p. 54)

| Measurement frequency setting range | Open circuit voltage setting range | Open circuit voltage accuracy |
|---|---|---|
| 4 Hz to 1.000 MHz | 0.005 V to 5.000 V | ±10%±10 mV |
| 1.0001 MHz to 5.000 MHz | 0.010 V to 1.000 V | ±20%±10 mV |

## 4.2 Setting Basic Settings of Measurement Conditions

• When Low Z high accuracy mode (p. 54)

| Measurement frequency setting range | Open circuit voltage setting range | Open circuit voltage accuracy |
|---|---|---|
| 4 Hz to 100 kHz | 0.005 V to 1 V | ±10%±10 mV |



- The open circuit voltage that can be set differs depending on the frequency.
- When the test frequency is higher than 1 MHz at an open-circuit voltage of more than 1 V, the voltage is automatically set to 1 V.
- When the measurement frequency is set higher than 1 MHz at an open circuit voltage of less than 0.010 V, the voltage is automatically set to 0.010 V.

**NOTE** Testing some types of sample is not possible using constant voltage. In this case, the following symbol appears on the display:



In such a case, constant voltage testing is not performed. Change the constant voltage level to a value not more than the value being shown as Vmoni.

When a 1 μF capacitance is measured at 10 kHz, the CV operation range can be obtained as follows. Sample impedance $Zm$ becomes as follows:

Sample impedance $Zm$ becomes as follows:

$$Zm = Rm + jXm = 0 \,[\Omega] - j15.9 \,[\Omega] \qquad\qquad Xm = \frac{-1}{(2\pi fC)}$$

The impedance $Zm'$ observed from the generator is as follows:

$$Zm' = Ro + Zm = 100 \,[\Omega] - j15.9 \,[\Omega] \qquad Ro: \text{Output resistance (100 } [\Omega])$$

Accordingly, the voltage $Vm$ across both leads of the sample is as follows:

$$Vm = \frac{|Zm| \times Vo}{|Zm'|} = \frac{15.9\,[\Omega] \times Vo}{101.3\,[\Omega]} \qquad Vo: \text{generator output}$$

Because the generator output voltage range is 5[mV] to 5[V] for 10 kHz, the CV operation range per the above expression is $Vm$ = 0.8[mV] to 0.78[V].
In low Z high accuracy mode, the output resistance $Ro$ becomes 10[Ω].

■ **Constant current level (CC) setting**
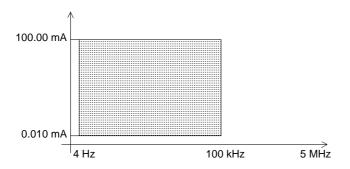
• When normal mode (p. 54)
  However, the constant current operation range differs depending on the test sample to be measured.

| Measurement frequency setting range | Constant current setting range | Constant current accuracy |
|---|---|---|
| 4 Hz to 1.000 MHz | 0.01 mA to 50 mA | ±10%±10 μA |
| 1.0001 MHz to 5.000 MHz | 0.01 mA to 10 mA | ±20%±10 μA |



• When Low Z high accuracy mode (p. 54)
  However, the constant current operation range differs depending on the test sample to be measured.

| Measurement frequency setting range | Constant current setting range | Constant current accuracy |
|---|---|---|
| 4 Hz to 100 kHz | 0.01 mA to 100.00 mA | ±10%±10 μA |



---

- The constant current that can be set differs depending on the frequency.
- When the test frequency is higher than 1 MHz at an constant current of more than 10 mA, the current is automatically set to 10 mA.

---

## 4.2 Setting Basic Settings of Measurement Conditions

**NOTE** Testing some types of sample is not possible using constant current. In this case, the following symbol appears on the display:



In such a case, constant current testing is not performed. Change the constant current level to a value not more than the value being shown as Imoni.
Reference When a 1 mH impedance is measured at 1 kHz, the CC operation range can be obtained as follows.

Sample impedance *Zm* becomes as follows:

$$Zm = Rm + jXm = 0\ [\Omega] - j62.8\ [\Omega] \qquad\qquad Xm\ =\ 2\pi fL$$

The impedance *Zm'* observed from the generator is as follows:

$$Zm' = Ro + Zm = 100\ [\Omega] - j62.8\ [\Omega] \qquad\qquad Ro\text{: output resistance (100 }[\Omega\ ])$$

Accordingly, the current *Im* across both leads of the sample is as follows:

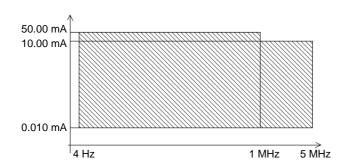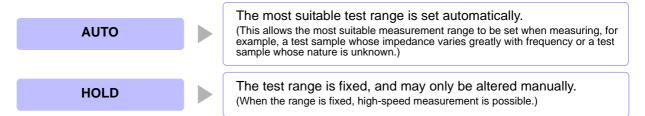$$Im\ =\ \frac{Vo}{|Zm'|}\ =\ \frac{Vo}{118.1\ [\Omega]} \qquad\qquad Vo\text{: generator output}$$

Because the generator output voltage range is 5[mV] to 5[V] for 1 kHz, the CC operation range per the above expression is $Im = 8.47[\mu A]$ to 42.3[mA].
In low Z high accuracy mode, the output resistance *Ro* becomes 10[$\Omega$].

## 4.2.3 Setting the Measurement Range

There are the following two methods for setting the measurement range.

| | | |
|---|---|---|
| **AUTO** | ▶ | The most suitable test range is set automatically.<br>(This allows the most suitable measurement range to be set when measuring, for example, a test sample whose impedance varies greatly with frequency or a test sample whose nature is unknown.) |
| **HOLD** | ▶ | The test range is fixed, and may only be altered manually.<br>(When the range is fixed, high-speed measurement is possible.) |

**NOTE** The ranges are all defined in terms of impedance. Therefore, for a parameter other than impedance, the value is obtained by calculating from the measured values of |Z| and θ.
**See** "Appendix 1 Measurement Parameters and Arithmetic Expressions"(p. A1)

**4**

**Chapter 4 LCR Function**

### 1 Setting AUTO Ranging

**Procedure**

**1**

LCR Initial Screen



LCR Basic Settings



**2**

LCR Basic Settings



Press RANGE .

***3***

| Range Setting |
|---|

LCR                                          LAN

Z    16.1514kΩ
OFF

θ    −89.992 °
OFF                    Vac   1.026 V
                       Iac   63.50μA

RANGE

| 100mΩ | 1Ω | 10Ω | 300Ω | | HOLD |
| 1kΩ | 3kΩ | 10kΩ | 30kΩ | | AUTO |
| 100kΩ | 1MΩ | 10MΩ | 100MΩ | | |

LOW Z    OFF    ON                      EXIT

Press  AUTO .

> If the instrument is being used outside the lim-
> its of its specification, the suitable range may
> not be set in auto ranging function. In this case,
> check the
> accuracy assured ranges in "13.2  Measure-
> ment Range and Accuracy" (p. 395) and then
> change the test conditions.

***4*** **Press  EXIT  to close the setting screen.**

**NOTE**  When an element other than a capacitor or a capacitor with a low DC resistance is measured
while using DC bias, the AUTO range may not work properly and a range may not be able to
be determined.

**2** Setting the Ranging to HOLD

**Procedure**

*1* LCR Initial Screen



➤➤ LCR Basic Settings



*2* LCR Basic Settings



Press RANGE .

*3* Range Setting



Press HOLD .

**4**

Chapter 4  LCR Function

### 4.2 Setting Basic Settings of Measurement Conditions

**2**



Set the test range according to the combined impedance value of the sample to be tested and the test cables.

**To select the measurement range.**

| Test range | Accuracy guaranteed range | AUTO Ranging Range |
|---|---|---|
| 100 MΩ | 8 MΩ to 200 MΩ | 8 MΩ to 999.999 MΩ |
| 10 MΩ | 800 kΩ to 100 MΩ | 800 kΩ to 10 MΩ |
| 1 MΩ | 80 kΩ to 10 MΩ | 80 kΩ to 1 MΩ |
| 100 kΩ | 24 kΩ to 1 MΩ | 24 kΩ to 100 kΩ |
| 30 kΩ | 8 kΩ to 300 kΩ | 8 kΩ to 30 kΩ |
| 10 kΩ | 2.4 kΩ to 100 kΩ | 2.4 kΩ to 10 kΩ |
| 3 kΩ | 800 Ω to 30 kΩ | 800 Ω to 3 kΩ |
| 1 kΩ | 240 Ω to 10 kΩ | 240 Ω to 1 kΩ |
| 300 Ω | 8 Ω to 300 Ω | 8 Ω to 300 Ω |
| 10 Ω | 800 mΩ to 10 Ω | 800 mΩ to 10 Ω |
| 1 Ω | 80 mΩ to 1 Ω | 80 mΩ to 1 Ω |
| 100 mΩ | 1 mΩ to 100 mΩ | 0 Ω to 100 mΩ |

**NOTE**

- The guaranteed accuracy range varies depending on the measurement conditions.
  **See** Check the accuracy assured ranges in "13.2 Measurement Range and Accuracy" (p. 395)
- The measurement range is determined according to the test range setting.If the display for the measured value shows "**OVER FLOW**" or "**UNDER FLOW**", that means that measurement cannot be performed using the currently set test range. Either you should set AUTO ranging so as to select the most suitable test range automatically, or you should set a more suitable test range manually. If a measurement result is outside the display range (p. 387), "**DISP OUT**" is displayed.
- The guaranteed accuracy range is for the measurement values before compensation.

**3** Press **EXIT** to close the setting screen.

**NOTE**

- In the case of a test sample whose impedance changes according to the frequency, when testing is being performed with HOLD set, it may happen, when the frequency is changed over, that measurement cannot be continued to be performed upon the same test range. You should change the test range if this happens.
- The test range setting is made according to the combination of the impedances of the sample being tested and the test cables. Therefore it can happen that testing is not possible, if the test range is held with HOLD only upon the basis of the impedance of the sample under test. If this happens, you should change the test range, making reference to "7.1 Setting Open Circuit Compensation" (p. 273) and "7.2 Short Circuit Compensation" (p. 280).
- When the measurement value is outside the guaranteed accuracy range, the following icon appears at the top of the screen.



In this case, you should consider the following possible causes, and you should either change the test conditions while checking the accuracy assured ranges "13.2 Measurement Range and Accuracy" (p. 395), or you should consider the measured values as values for reference.

- Perhaps the test signal level is too low, increase the test signal level.
- If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO

**3** Low Z High Accuracy Mode

This mode balances the $L_{POT}$ terminal at 0 V to reduce the influence of contact resistance during low imped-ance measurement. Furthermore, since the output resistance becomes 10 $\Omega$ and sufficient current can flow to the test sample to be measured, this mode enables highly accurate measurement.

**Procedure**

*1*

LCR Initial Screen



LCR Basic Settings



*2*

LCR Basic Settings



Press RANGE .

*3*

Range Setting



Select ON/ OFF for the low Z high accuracy mode.

| | |
|---|---|
| OFF | Sets the low Z high accuracy mode to OFF. |
| ON | Sets the low Z high accuracy mode to ON. |

**4**

Chapter 4 LCR Function

**NOTE** With low Z high accuracy mode, the possible setting ranges of the frequency and measurement signal level differ. Refer to the following.

| No. | Measurement range | to 1 kHz | to 10 kHz | to 100 kHz | to 1 MHz | to 5 MHz |
|-----|------------------|----------|-----------|------------|----------|----------|
| 1 | 100 MΩ | | | | | None |
| 2 | 10 MΩ | | | | | |
| 3 | 1 MΩ | | | | | |
| 4 | 100 kΩ | | | | | |
| 5 | 30 kΩ | Normal mode only | | | | |
| 6 | 10 kΩ | (setting not possible for low Z high accuracy mode). | | | | |
| 7 | 3 kΩ | | | | | |
| 8 | 1 kΩ | | | | | |
| 9 | 300 Ω | | | | | |
| 10 | 10 Ω | | | | | |
| 11 | 1 Ω | Low Z high accuracy mode/ normal mode | | | | |
| 12 | 100 mΩ | | | | | |

Settable range of measurement signal level: (p. 45)
Low Z high accuracy mode is only valid when the frequency is between 4 Hz and 100 kHz.

## Detecting Disconnection of 4 Terminals (When Low Z High Accuracy Mode)

This function operates when measurement is being performed in low impedance high accuracy mode (p. 53). It detects whether each of the $L_{POT}$, $H_{POT}$ and $L_{CUR}$ terminals is disconnected.

If a terminal is not connected properly, an indication like the following is displayed.
Check the connections again.
**See** "2.4 Connecting the Measurement Cables, Probes, or Fixture" (p. 30)

The error is also output via EXT I/O.
**See** "Chapter 11 External Control" (p. 363)



**NOTE** When an element other than a capacitor or a capacitor with a low DC resistance is measured while using DC bias, the contact check function may not work properly.
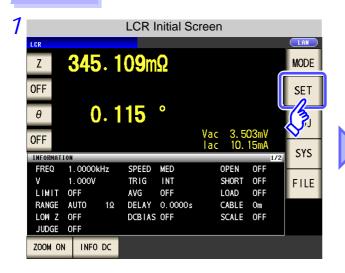
## 4.2.4 Perform Measurements with User-defined Timing (Trigger Measurement)

Triggering is the process of controlling the start and stop of recording by specific signals or conditions (criteria). When recording is started or stopped by a specific signal, we say the trigger is "gapplied" or "triggering occurs".

With this instrument, you can select the following two types of trigger.

| Internal Trigger | ▶ | Trigger signals are automatically generated internally for continuous measurement. |

| External trigger | ▶ | Measurements are triggered by an external signal. Manual measurement triggering is also available. |

**Procedure**

**1**

LCR Initial Screen

LCR Basic Settings



**2**

LCR Basic Settings



Press  TRIG .

**3**



Trigger Setting

**Select the trigger type.**

| INT | Internal trigger | Perform continuous measurement automatically. |
| EXT | External trigger | Input the trigger manually via EXT I/O or from the interface. |

**When** EXT **is selected**

There are the following three types of input method for a trigger.

- **Press** TRIG **on the screen to manually input a trigger:** Measurement is performed once.

- **Input via EXT I/O:** Measurement is performed once each time a negative logic pulse signal is applied.
  **See** "Connector Type and Signal Pinouts" (p. 364)

- **Input from interface:** Measurement is performed once when *TRG is transmitted.
  **See** Included CD

TRIG is displayed on the screen.



External Trigger



When External Trigger

**4** **Press** EXIT **to close the setting screen.**

## 4.2.5 Setting the DC bias

You can superimpose a DC voltage on the measurement signal during capacitor measurement.
You can superimpose a DC signal on the measurement signal.

**Procedure**

**1**

LCR Initial Screen



LCR Basic Settings



**2**

LCR Basic Settings



**Press** DC BIAS **.**

**3**

DC Bias Setting



**Select ON/ OFF for the DC bias.**

| OFF | Sets the DC bias to OFF. |
|-----|--------------------------|
| ON  | Sets the DC bias to ON.  |

| SET EXT | Press this button when using an external DC bias unit. The DC bias will be set to ON, and the bias value will be set to 0.00 V. |
|---------|------|

**4**

DC Bias Setting

| LCR | | | LAN |
| --- | --- | --- | --- |

Z    16.1413kΩ

OFF

θ    −89.994 °

OFF         Vac   1.025 V
              Iac   63.50µA

DC BIAS

0.15 V

[OFF]   [▲] [▲] [▲] [C]

[ON]   [▼] [▼] [▼]

[SET EXT]             [EXIT]

Use [▲] or [▼] to set the DC level to super-impose.

- Settable range: 0.00 V to 2.50 V (Normal mode)
                  0.00 V to 1.00 V (low Z high accuracy mode)
- If you make a mistake during input:

press [C] to cancel the input and start again.

**The setting is not reflected if [ON] is not pressed.**

**5** Press [EXIT] to close the setting screen.

---

**NOTE**

- The DC bias function is specifically for capacitor measurement. If it is used for resistor, inductor, and other elements with low DC resistance, the following are likely.
  - Normal measurement is not possible
  - AUTO ranging is unable to determine a range.
  - In low impedance high accuracy mode, a contact error is generated even though the terminal connections are correct.
- The DC bias function cannot be set during Rdc measurement.
- The DC bias function cannot be set when RDC measurement has been selected with the **:MEASure:ITEM** setting.
- When superimposing a DC voltage of 2.5 V or above, refer to "Appendix5.1 How to Supply a DC Bias Voltage"(p. A7).
- When superimposing a DC voltage on a coil or the like, refer to "Appendix5.2 How to Supply a DC Bias Current"(p. A9).
- A value for which the sum of the effective value of the AC signal level and the DC signal level will exceed 7.07 V cannot be set.
- If the total value for the measurement signal level (AC level + DC bias value) will become $> 5\sqrt{2}$ [V], the measurement signal cannot be raised any higher. Reduce the AC level or DC bias value, and then configure the setting. In low Z high accuracy mode, the AC level and DC bias value can be set when the total value is in the range of $\sqrt{2}$ [V] or below.

## 4.2.6 Setting the Measurement speed

The testing speed can be set. The slower the testing speed is, the more accurate are the results.

**Procedure**

**1** LCR Initial Screen → LCR Basic Settings

**2** LCR Basic Settings

Press SPEED .

**3** Measurement Speed Setting

To select the measurement speed.

| FAST | Performs high-speed measurement. |
|------|----------------------------------|
| MED | This is the normal measurement speed. |
| SLOW | Measurement precision improves. |
| SLOW2 | Measurement accuracy is better than SLOW. |

The testing speed varies according to the number of parameters being displayed, and according to their type.
**See** "About Measurement Times and Measurement Speed" (p. 399)

**4** Press EXIT to close the setting screen.

Chapter 4 LCR Function

**4**

## 4.2.7 Setting the Voltage/Current Limit

Depending on the measurement signal level, in some cases it is possible to damage the sample which is being tested by applying to it a voltage or a current greater than its rated value.

For this reason, set a limit value to restrict the voltage that can be applied to the test sample or current that can flow to the test sample.

| When open circuit voltage (V) or constant voltage (CV) is set: | ▶ | Set the current limit. |
| When constant current (CC) is set: | ▶ | Set the voltage limit. |

**Procedure**

*1*  LCR Initial Screen



LCR Basic Settings



*3* **When the measurement signal level is a voltage (V, CV)**

Current Limit Setting



**When the measurement signal level is a current (CC)**

Voltage Limit Setting



- The present situation can be checked using the monitor display.
- The monitor display is different for V, CV, and CC.

**NOTE**  First set the measurement signal level, and thereafter set the voltage or current limit.
The setting for voltage or current limit changes automatically to current or voltage limit, according to the present measurement signal level setting.
See "4.2.2 Setting the Measurement signal level" (p. 43)

**3** Current Limit Setting



**Select ON/ OFF for the limit function.**

| OFF | Sets the limit function to OFF. |
| ON | Sets the limit function to ON. |

**4** Current Limit Setting



Use ▲ or ▼ to enter the limit value.

Limit range

| Measure-ment signal level | Limit set | Setting range |
|---|---|---|
| V, CV | Current limit | 0.01 mA to 100.00 mA |
| CC | Voltage limit | 0.005 V to 5 V |

Current limit accuracy

| Frequency | Accuracy |
|---|---|
| 4 Hz to 1.000 MHz | ±10%±10 µA |
| 1.0001 MHz to 5.000 MHz | ±20%±10 µA |

Voltage limit accuracy

| Frequency | Accuracy |
|---|---|
| 4 Hz to 1.000 MHz | ±10%±10 mV |
| 1.0001 MHz to 5.000 MHz | ±20%±10 mV |

When the limit function is ON, the display is as shown below.

Example: When constant voltage (CV) setting



If the voltage or current which is applied to the sample under test exceeds the limit value (the current exceeding the limit value flows through the sample even when the open-circuit voltage is set to minimum value.)

Depending on the limit value setting, the voltage or current applied to the sample may not reach the measurement signal level.
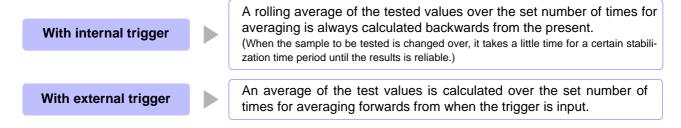
At this time, the voltage or current which exceeds the limit value is not being applied to the sample under test. You should change the test signal level so that it does not exceed the limit value.

**5** Press EXIT to close the setting screen.

**Chapter 4 LCR Function**
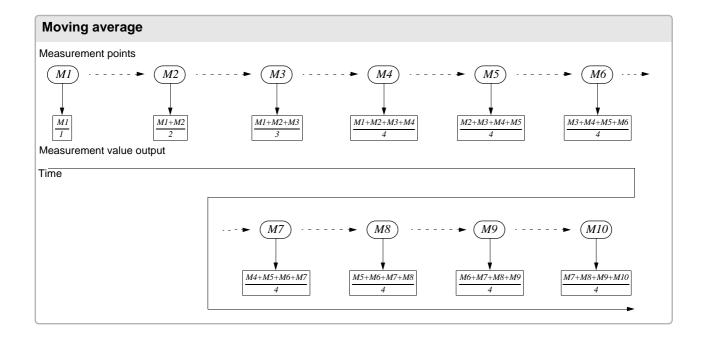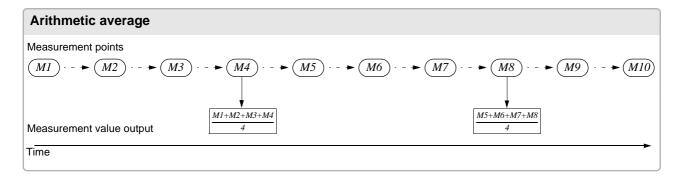
## 4.2.8 Displaying Average Values (Averaging Set)

With the averaging function, the measured values can be averaged. Using this function, it is possible to reduce fluctuations in the measured value display.

| **With internal trigger** | ▶ | A rolling average of the tested values over the set number of times for averaging is always calculated backwards from the present. (When the sample to be tested is changed over, it takes a little time for a certain stabilization time period until the results is reliable.) |
|---|---|---|

| **With external trigger** | ▶ | An average of the test values is calculated over the set number of times for averaging forwards from when the trigger is input. |
|---|---|---|

When the number of averaging times is 4, the number of measurements, measurement output points, and measurement value calculation method during output are as follows.

**Moving average**

Measurement points

$M1$ - - - ▶ $M2$ - - - ▶ $M3$ - - - ▶ $M4$ - - - ▶ $M5$ - - - ▶ $M6$ - - - ▶

$\dfrac{M1}{1}$    $\dfrac{M1+M2}{2}$    $\dfrac{M1+M2+M3}{3}$    $\dfrac{M1+M2+M3+M4}{4}$    $\dfrac{M2+M3+M4+M5}{4}$    $\dfrac{M3+M4+M5+M6}{4}$

Measurement value output

Time

$M7$ - - - ▶ $M8$ - - - ▶ $M9$ - - - ▶ $M10$

$\dfrac{M4+M5+M6+M7}{4}$    $\dfrac{M5+M6+M7+M8}{4}$    $\dfrac{M6+M7+M8+M9}{4}$    $\dfrac{M7+M8+M9+M10}{4}$

**Arithmetic average**

Measurement points

$M1$ - ▶ $M2$ - ▶ $M3$ - ▶ $M4$ - ▶ $M5$ - ▶ $M6$ - ▶ $M7$ - ▶ $M8$ - ▶ $M9$ - ▶ $M10$

$\dfrac{M1+M2+M3+M4}{4}$    $\dfrac{M5+M6+M7+M8}{4}$

Measurement value output

Time

**Procedure**

**_1_** LCR Initial Screen

LCR

Z
345.109mΩ
OFF

θ
0.115 °
OFF

Vac 3.503mV
Iac 10.15mA

INFORMATION 1/2
FREQ 1.0000kHz SPEED MED OPEN OFF
V 1.000V TRIG INT SHORT OFF
LIMIT OFF AVG OFF LOAD OFF
RANGE AUTO 1Ω DELAY 0.0000s CABLE 0m
LOW Z OFF DCBIAS OFF SCALE OFF
JUDGE OFF

ZOOM ON | INFO DC

MODE
SET
SYS
FILE

▶▶

LCR Basic Settings

LCR

Z
16.1515kΩ
OFF

θ
−89.992 °
OFF

Vac 1.026 V
Iac 63.51μA

SET

BASIC | Rdc | ADVANCED

FREQ | LEVEL | RANGE | TRIG | DC BIAS
1.0000kHz | V 1.000V | AUTO 30kΩ | INT | OFF

SPEED | LIMIT | AVG | DELAY
MED | OFF | OFF | 0.0000s

**4**

Chapter 4 LCR Function

**_2_** LCR Basic Settings

LCR

Z
16.1515kΩ
OFF

θ
−89.992 °
OFF

Vac 1.026 V
Iac 63.51μA

SET

BASIC | Rdc | ADVANCED

FREQ | LEVEL | RANGE | TRIG | DC BIAS
1.0000kHz | V 1.000V | AUTO 30kΩ | INT | OFF

SPEED | LIMIT | AVG | DELAY
MED | OFF | | 0.0000s

EXIT

**Press** AVG **.**

**_3_** Number of Averaging Times Setting

LCR

Z
16.1518kΩ
OFF

θ
−89.992 °
OFF

Vac 1.026 V
Iac 63.50μA

AVERAGE

0  0  1

▲ ▲ ▲ | C

▼ ▼ ▼

EXIT

**Use** ▲ **or** ▼ **to enter the number of averaging times.**

Settable range: 1 to 256 times

**When you want to cancel the averaging function:** Press C .

The number of averaging times is set to 001, and the averaging function is set to OFF.

**_4_** **Press** EXIT **to close the setting screen.**

## 4.2.9 Measuring at Desired Time (Trigger Delay)

The delay time period from input of the trigger signal to reading of the test data can be set. With this function it is possible to ensure that testing is started after the connection condition of the object being tested and the test cables has stabilized.

**Procedure**

**1** LCR Initial Screen

LCR
Z  **345.109mΩ**
OFF
θ  **0.115 °**
OFF
Vac 3.503mV
Iac 10.15mA
INFORMATION  1/2
FREQ  1.0000kHz  SPEED MED  OPEN OFF
V  1.000V  TRIG INT  SHORT OFF
LIMIT  OFF  AVG OFF  LOAD OFF

LAN
MODE
SET
SYS
FILE

LCR Basic Settings

LCR
Z  **16.1515kΩ**
OFF
θ  **−89.992 °**
OFF
Vac 1.026 V
Iac 63.51µA
SET
BASIC  Rdc  ADVANCED
FREQ  LEVEL  RANGE  TRIG  DC BIAS

**2** LCR Basic Settings

LCR
Z  **16.1515kΩ**
OFF
θ  **−89.992 °**
OFF
Vac 1.026 V
Iac 63.51µA
SET
BASIC  Rdc  ADVANCED
FREQ  LEVEL  RANGE  TRIG  DC BIAS
1.0000kHz  V 1.000V  AUTO 30kΩ  INT  OFF
SPEED  LIMIT  AVG  DELAY
MED  OFF  OFF  EXIT

Press  DELAY  .

**3** Trigger Delay Setting

LCR
Z  **16.1517kΩ**
OFF
θ  **−89.992 °**
OFF
Vac 1.026 V
Iac 63.50µA
TRIG DELAY
**1.0 0 0 0 s**
▲ ▲ ▲ ▲ ▲  C
▼ ▼ ▼ ▼ ▼
EXIT

Use  ▲  or  ▼  to enter the delay time.

Settable range: 0 to 9.9999 s with resolution of 0.1 ms

**When you want to cancel the trigger delay function:** Press  C  .
The set time is set to 0 s.

**4** Press  EXIT  to close the setting screen.

**NOTE**  When trigger delay is used, the LED for indicating that measurement is in progress is lit from when the trigger is input until measurement ends.

# 4.3 Setting DC Resistance Measurement

*LCR ANALYZER*
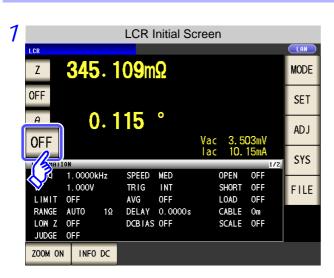
You can output a DC signal of any level (up to 2.5 V) and measure the DC resistance Rdc.
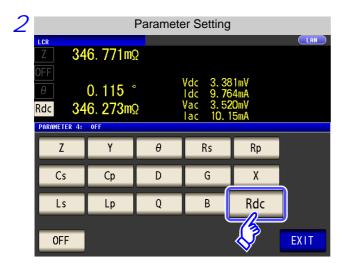
**NOTE**

- To measure DC resistance, you need to set **Rdc** in the measurement parameters beforehand.

    **See** "1.3.7 Parameter Settings Screen" (p. 25)
    "4.1.2 Setting Display Parameters" (p. 39)

- When **Rdc** and other parameters are set, the DC resistance is measured after those other parameters have been measured with the AC signal. The measurement conditions can be set individually.
- The DC bias function cannot be enabled when RDC measurement is performed.

## Adding Rdc to Measurement Parameters

**4**

Chapter 4 LCR Function

**1** LCR Initial Screen

**Select the parameter you want to change.**

**2** Parameter Setting

**Press** `Rdc` .

**3** **Press** `EXIT` **to close the setting screen.**

## 4.3.1   Setting the Measurement signal level

The value of the test signal level may change according to the sample which is being tested.
This instrument is possible to vary the level of the test signal applied to the object under test over a wide range using the following three methods.

| Set open circuit voltage (V) | ▶ | The value of the open circuit voltage is set. |
| Set constant voltage (CV) | ▶ | The value of the voltage between the terminals of the object under test is set. |
| Set constant current (CC) | ▶ | The value of the current flowing through the object under test is set. |

⚠ **CAUTION**  Do not switch between V, CV and CC while the test sample is still connected to the measurement terminals because doing so may damage the test sample.

**Procedure**

**1**

LCR Initial Screen



Rdc Basic Settings



**2**

Rdc Basic Settings



**Press** LEVEL .

**3**   Measurement Signal Level Setting

LCR
Z    347.283mΩ
OFF
θ    0.118 °         Vdc  3.386mV
Rdc  346.745mΩ        Idc  9.764mA
                      Vac  3.525mV
LEVEL                 Iac  10.15mA

V    1.0 0 V
CV
CC

EXIT

**To select the measurement signal level.**

| V | open circuit voltage (p. 45) |
| CV | Voltage level between test sample terminals (p. 45) |
| CC | Current level through test sample (p. 47) |

The accuracy of testing varies according to the test signal level.
**See** "13.2 Measurement Range and Accuracy" (p. 395)

**4**   Measurement Signal Level Setting
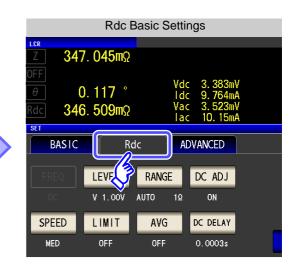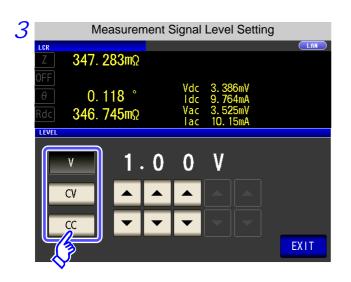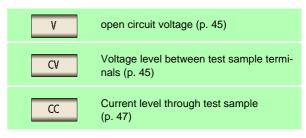
LCR
Z    347.489mΩ
OFF
θ    0.116 °         Vdc  1.692mV
Rdc  347.033mΩ        Idc  4.876mA
                      Vac  3.527mV
LEVEL                 Iac  10.15mA

V    0.5 0 V
CV
CC

EXIT

**Use ▲ or ▼ to enter the voltage or current value.**

**See** "For setting range and accuracy" (p. 68)

**5**  **Press  EXIT  to close the setting screen.**

NOTE   When the measurement value is outside the guaranteed accuracy range, the following icon appears at the top of the screen.

LCR        Reference Value      USB
Z    9.95886 Ω          MO
OFF                      SE
θ    -0.010 °           AD

**Reference Value**

In this case, you should consider the following possible causes, and you should either change the test conditions while checking the accuracy assured ranges "13.2 Measurement Range and Accuracy" (p. 395), or you should consider the measured values as values for reference.

- Perhaps the test signal level is too low, increase the test signal level.
- If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO range, or change the range by manual.

Chapter 4 LCR Function

## 4.3 Setting DC Resistance Measurement

### About the test signal level

Relationship between the measurement signal level of the instrument and the sample is as follows.
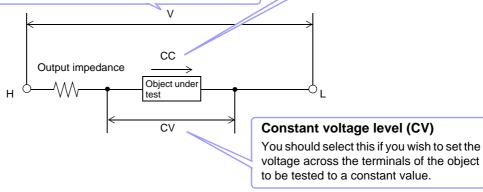
**Open circuit voltage level (V)**
This voltage value is the value which is applied across the two terminals of the series combination of the object which is being tested and the output impedance. As for the voltage which is applied across the terminals of the object which is being tested (by itself), if required, you should either check the monitor voltage value, or select constant voltage (CV) and set a voltage value across these terminals.

**Constant current level (CC)**
You should select this if you wish to set the current passing through the object to be tested to a constant value.

**Constant voltage level (CV)**
You should select this if you wish to set the voltage across the terminals of the object to be tested to a constant value.

### For setting range and accuracy

**Open circuit voltage level (V) setting**

• When normal mode (p. 74)

| Open circuit voltage setting range | Open circuit voltage accuracy |
|---|---|
| 0.10 to 2.50 V | ±10% ±10 mV |

• When Low Z high accuracy mode (p. 74)

| Open circuit voltage setting range | Open circuit voltage accuracy |
|---|---|
| 0.10 to 1.00 V | ±10% ±10 mV |

**Constant voltage level (CV) setting**

• When normal mode (p. 74)

| Constant voltage setting range | Constant voltage accuracy |
|---|---|
| 0.10 to 2.50 V | ±10% ±10 mV |

• When Low Z high accuracy mode (p. 74)

| Constant voltage setting range | Constant voltage accuracy |
|---|---|
| 0.10 to 1.00 V | ±10% ±10 mV |

**Constant current level (CC) setting**

• When normal mode (p. 74)
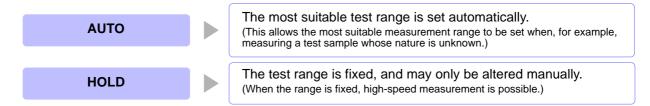
| Constant current setting range | Constant current accuracy |
|---|---|
| 0.01 to 25.00 mA | ±10% ±10 µA |

• When Low Z high accuracy mode (p. 74)

| Constant current setting range | Constant current accuracy |
|---|---|
| 0.01 to 100.00 mA | ±10% ±10 µA |

## 4.3.2 Setting the Measurement Range

There are the following two methods for setting the measurement range.

| AUTO | ▶ | The most suitable test range is set automatically.<br>(This allows the most suitable measurement range to be set when, for example, measuring a test sample whose nature is unknown.) |
|------|---|---|
| HOLD | ▶ | The test range is fixed, and may only be altered manually.<br>(When the range is fixed, high-speed measurement is possible.) |

### 1 Setting AUTO Ranging

**Procedure**

**1** LCR Initial Screen



Rdc Basic Settings



**2** Rdc Basic Settings



Press **RANGE** .

**4**

## 4.3 Setting DC Resistance Measurement

**3**

| Range Setting | | | | |
|---|---|---|---|---|
| LCR | | | | LAN |

Z   347.704mΩ

OFF

θ   0.115 °

Rdc   346.360mΩ

Vdc   337.9μV
Idc   975.6μA
Vac   3.529mV
Iac   10.15mA

**RANGE**

| 100mΩ | 1Ω | 10Ω | 300Ω | HOLD |
| 1kΩ | 3kΩ | 10kΩ | 30kΩ | AUTO |
| 100kΩ | 1MΩ | 10MΩ | 100MΩ | |

LOW Z   OFF   ON     EXIT

**Press** AUTO **.**

> If the instrument is being used outside the limits of its specification, the suitable range may not be set in auto ranging function. In this case, check the
> accuracy assured ranges in "13.2 Measurement Range and Accuracy" (p. 395) and then change the test conditions.

**4** **Press** EXIT **to close the setting screen.**

**2** Setting the Ranging to HOLD

**Procedure**

*1*

LCR Initial Screen

*2*

Rdc Basic Settings

Press RANGE .

*3*

Range Selection

Press HOLD .

**4**

Chapter 4 LCR Function

## 4.3  Setting DC Resistance Measurement

**4**    Range Selection
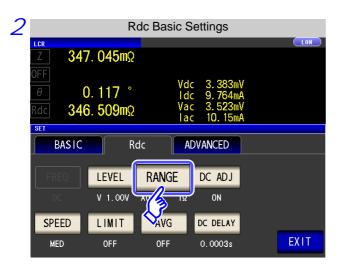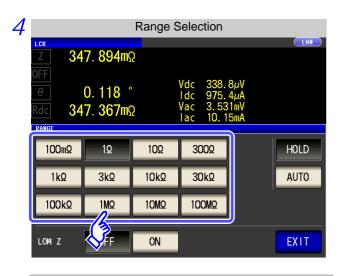
| LCR | | | LAN |
| --- | --- | --- | --- |
| Z | 347. 894mΩ | | |
| OFF | | | |
| θ | 0. 118 ° | Vdc 338.8μV | |
| Rdc | 347. 367mΩ | Idc 975.4μA | |
| | | Vac 3.531mV | |
| | | Iac 10.15mA | |

**RANGE**

| 100mΩ | 1Ω | 10Ω | 300Ω | | HOLD |
| 1kΩ | 3kΩ | 10kΩ | 30kΩ | | AUTO |
| 100kΩ | 1MΩ | 10MΩ | 100MΩ | | |

LOW Z   OFF   ON                    EXIT

Set the test range according to the combined impedance value of the sample to be tested and the test cables.

**To select the measurement range.**

| Test range | Accuracy guaranteed range | AUTO Ranging Range |
| --- | --- | --- |
| 100 MΩ | 8 MΩ to 200 MΩ | 8 MΩ to 999.999 MΩ |
| 10 MΩ | 800 kΩ to 100 MΩ | 800 kΩ to 10 MΩ |
| 1 MΩ | 80 kΩ to 10 MΩ | 80 kΩ to 1 MΩ |
| 100 kΩ | 24 kΩ to 1 MΩ | 24 kΩ to 100 kΩ |
| 30 kΩ | 8 kΩ to 300 kΩ | 8 kΩ to 30 kΩ |
| 10 kΩ | 2.4 Ω to 100 kΩ | 2.4 kΩ to 10 kΩ |
| 3 kΩ | 800 Ω to 30 kΩ | 800 Ω to 3 kΩ |
| 1 kΩ | 240 Ω to 10 kΩ | 240 Ω to 1 kΩ |
| 300 Ω | 8 Ω to 300 Ω | 8 Ω to 300 Ω |
| 10 Ω | 800 mΩ to 10 Ω | 800 mΩ to 10 Ω |
| 1 Ω | 80 mΩ to 1 Ω | 80 mΩ to 1 Ω |
| 100 mΩ | 10 mΩ to 100 mΩ | 0 Ω to 100 mΩ |

**NOTE**
- The guaranteed accuracy range varies depending on the measurement conditions.
  - **See**  Check the accuracy assured ranges in "13.2  Measurement Range and Accuracy" (p. 395)
- The measurement range is determined according to the test range setting.If the display for the measured value shows "**OVER FLOW**" or "**UNDER FLOW**", that means that measurement cannot be performed using the currently set test range. Either you should set AUTO ranging so as to select the most suitable test range automatically, or you should set a more suitable test range manually. If a measurement result is outside the display range (p. 387), "**DISP OUT**" is displayed.

**5** **Press** **EXIT** **to close the setting screen.**

**NOTE**
- The test range setting is made according to the combination of the impedances of the sample being tested and the test cables. Therefore it can happen that testing is not possible, if the test range is held with HOLD only upon the basis of the impedance of the sample under test. If this happens, you should change the test range, making reference to "7.1 Setting Open Circuit Compensation" (p. 273) and "7.2  Short Circuit Compensation" (p. 280).
- When the measurement value is outside the guaranteed accuracy range, the following icon appears at the top of the screen.

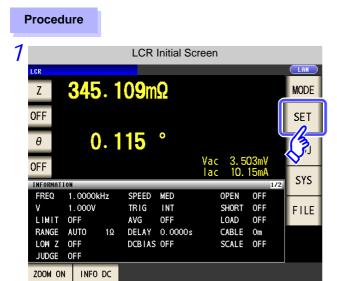| LCR | Reference Value | USB |
| --- | --- | --- |
| Z | 9. 95886 Ω | MOD |
| OFF | | SE |
| θ | −0. 010 ° | ADJ |

**Reference Value**

In this case, you should consider the following possible causes, and you should either change the test conditions while checking the accuracy assured ranges "13.2  Measurement Range and Accuracy" (p. 395), or you should consider the measured values as values for reference.
- Perhaps the test signal level is too low, increase the test signal level.
- If the current measurement range (during HOLD setting) is not appropriate, set again in the AUTO range, or change the range by manual.

**3** Low Z High Accuracy Mode

This mode balances the $L_{POT}$ terminal at 0 V to reduce the influence of contact resistance during low impedance measurement. Furthermore, since the output resistance becomes 10 $\Omega$ and sufficient current can flow to the test sample to be measured, this mode enables highly accurate measurement.

**Procedure**

**1** LCR Initial Screen



Rdc Basic Settings



**2** Rdc Basic Settings



Press RANGE .

**3** Range Setting



**Select ON/ OFF for the low Z high accuracy mode.**

| | |
|---|---|
| OFF | Sets the low Z high accuracy mode to OFF. |
| ON | Sets the low Z high accuracy mode to ON. |

## 4.3  Setting DC Resistance Measurement

NOTE  With low Z high accuracy mode, the possible setting range of the measurement signal level differs. Refer to the table below.

| Measurement range | |
|---|---|
| 100 MΩ | Normal mode only (setting invalid for low Z high accuracy mode) |
| 10 MΩ | |
| 1 MΩ | |
| 100 kΩ | |
| 30 kΩ | |
| 10 kΩ | |
| 3 kΩ | |
| 1 kΩ | |
| 300 Ω | |
| 10 Ω | |
| 1 Ω | Low Z high accuracy mode/ normal mode |
| 100 mΩ | |

Settable range of measurement signal level: (p. 68)

## Detecting Disconnection of 4 Terminals (When Low Z High Accuracy Mode)

This function operates when measurement is being performed in low impedance high accuracy mode (p. 53). It detects whether each of the $L_{POT}$, $H_{POT}$ and $L_{CUR}$ terminals is disconnected.

If a terminal is not connected properly, an indication like the following is displayed.
Check the connections again.
**See** "2.4  Connecting the Measurement Cables, Probes, or Fixture" (p. 30)

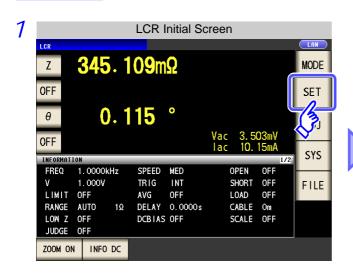The error is also output via EXT I/O.
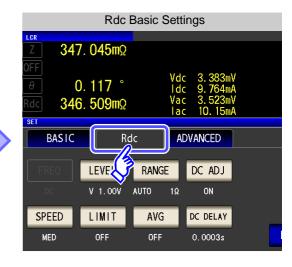**See** "Chapter 11  External Control" (p. 363)

## 4.3.3   Setting the DC Adjustment Function

DC adjustment sets the generation voltage to 0 V, obtains the offset value generated in the internal circuit of the instrument, and reduces the measurement error.
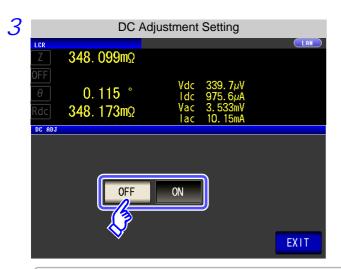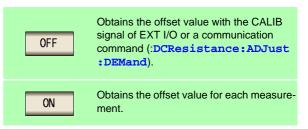
**Procedure**

*1*  LCR Initial Screen



Rdc Basic Settings



*2*  Rdc Basic Settings



**Press** `DC ADJ` **.**

## 4.3 Setting DC Resistance Measurement

**3**

DC Adjustment Setting

| LCR | | LAN |
|---|---|---|
| Z | 348.099mΩ | |
| OFF | | |
| θ | 0.115 ° | Vdc 339.7μV<br>Idc 975.6μA |
| Rdc | 348.173mΩ | Vac 3.533mV<br>Iac 10.15mA |

DC ADJ

OFF | ON

EXIT

**Select ON/ OFF for DC adjustment.**

| OFF | Obtains the offset value with the CALIB signal of EXT I/O or a communication command (:**DCResistance:ADJust :DEMand**). |
|---|---|
| ON | Obtains the offset value for each measurement. |
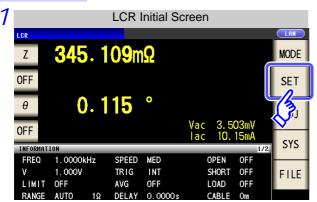
**NOTE**
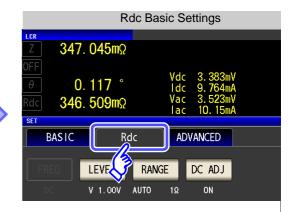
- Since the transient response time becomes long as a result of the impedance value of the measurement object, set a long DC delay time.(p. 82)
  When DC adjustment is ON, the measurement time becomes about twice as long because time is required both for normal measurement and for offset measurement.
- DC adjustment measurement is performed in the following cases even if DC adjustment is set to OFF.
  - When measurement is first performed after the power is turned on
  - When the DC delay time is changed
  - When the measurement range is changed
  - When low Z high accuracy mode is turned ON/OFF
  - When the measurement signal level is changed
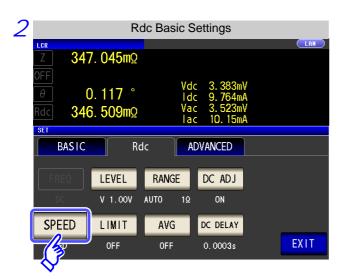
**4** Press **EXIT** to close the setting screen.

## 4.3.4 Setting the Measurement speed

The testing speed can be set. The slower the testing speed is, the more accurate are the results.

**Procedure**

**1** LCR Initial Screen



Rdc Basic Settings

**2** Rdc Basic Settings



Press SPEED .

**3** Measurement Speed Setting



**To select the measurement speed.**

| FAST | Performs high-speed measurement. |
|---|---|
| MED | This is the normal measurement speed. |
| SLOW | Measurement precision improves. |
| SLOW2 | Measurement accuracy is better than SLOW. |

The testing speed varies according to the number of parameters being displayed, and according to their type.
**See** "About Measurement Times and Measurement Speed" (p. 399)
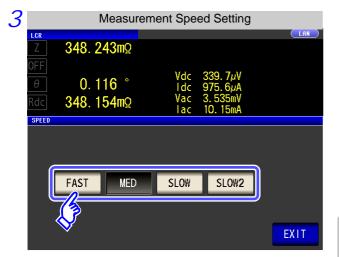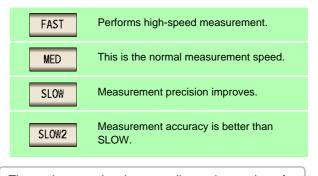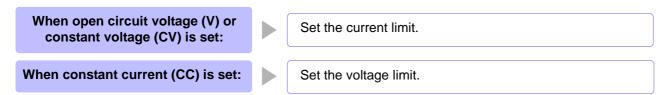
**4** Press EXIT to close the setting screen.

## 4.3.5   Setting the Voltage/Current Limit

Depending on the measurement signal level, in some cases it is possible to damage the sample which is being tested by applying to it a voltage or a current greater than its rated value.

For this reason, set a limit value to restrict the voltage that can be applied to the test sample or current that can flow to the test sample.

| When open circuit voltage (V) or constant voltage (CV) is set: | ▶ | Set the current limit. |
|---|---|---|
| When constant current (CC) is set: | ▶ | Set the voltage limit. |

**Procedure**

**1**

LCR Initial Screen / Rdc Basic Settings



**2** When the measurement signal level is a voltage (V, CV)

Measurement Signal Level Setting



When the measurement signal level is a current (CC)

Measurement Signal Level Setting



- The present situation can be checked using the monitor display.
- The monitor display is different for V, CV, and CC.

**NOTE**  First set the measurement signal level, and thereafter set the voltage or current limit.
The setting for voltage or current limit changes automatically to current or voltage limit, accord-

**3** Measurement Signal Level Setting



**Select ON/ OFF for the limit function.**

| | |
|---|---|
| OFF | Set the limit function to OFF. |
| ON | Set the limit function to ON. |

**4** Measurement Signal Level Setting



**Use ▲ or ▼ to enter a limit value.**

Limit range:

| Measurement signal level | Limit set | Setting range |
|---|---|---|
| V, CV | Current limit | 0.01 mA to 100 mA |
| CC | Voltage limit | 0.10 V to 2.5 V |

Current limit accuracy: ±10%±10 μA
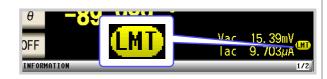
Voltage limit accuracy: ±10%±10 mV

---

When the limit function is ON, the display is as shown below.

Example: When constant voltage (CV) setting





If the voltage or current which is applied to the sample under test exceeds the limit value (the current exceeding the limit value flows through the sample even when the open-circuit voltage is set to minimum value.)

If the test signal level which is being applied to the sample under test exceeds the limit value. Then the test signal level is stopped changing.

At this time, the voltage or current which exceeds the limit value is not being applied to the sample under test. You should change the test signal level so that it does not exceed the limit value.

**5** Press EXIT to close the setting screen.
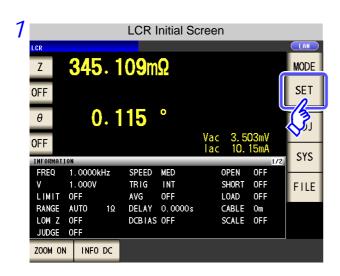
## 4.3.6  Displaying Average Values (Average set)
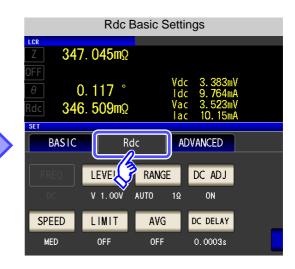
With the averaging function, the measured values can be averaged. Using this function, it is possible to reduce fluctuations in the measured value display.
After the signal level and range are set, measurement is performed for the set number of averaging times and the measurement values are displayed.

NOTE  The averaging process during Rdc measurement performs arithmetic averaging processing regardless of the trigger setting.
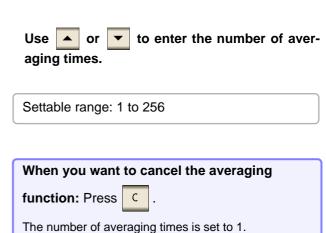
Procedure

**1**

LCR Initial Screen



Rdc Basic Settings



**2**

Rdc Basic Settings



**Press** AVG **.**

**3** No. of Averaging Times Setting

Use ▲ or ▼ to enter the number of averaging times.

Settable range: 1 to 256

**When you want to cancel the averaging function:** Press C .

The number of averaging times is set to 1.

**4** Press **EXIT** to close the setting screen.

## 4.3.7 Setting the Delay Time
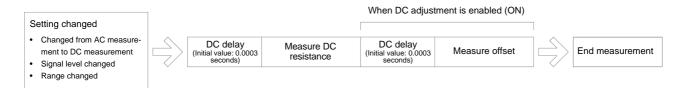
In cases such as the following, set the time to wait before starting DC resistance measurement.
- When measurement is changed from AC signal measurement to DC resistance measurement.
- When the voltage level is changed.
- When DC adjustment is enabled.
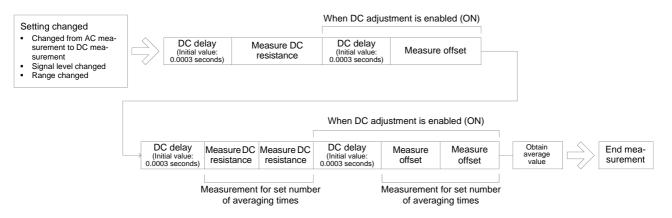
This delay time is for delaying measurement until the DC level and 0 VDC has stabilized.

When measuring DC resistance, observe the measurement waveform and then insert the delay time required until the transient phenomenon disappears because the time required until the DC level stabilizes differs depending on the test sample.

■ When number of averaging times is 1

When DC adjustment is enabled (ON)

| Setting changed | | DC delay (Initial value: 0.0003 seconds) | Measure DC resistance | DC delay (Initial value: 0.0003 seconds) | Measure offset | | End measurement |

Setting changed
- Changed from AC measurement to DC measurement
- Signal level changed
- Range changed
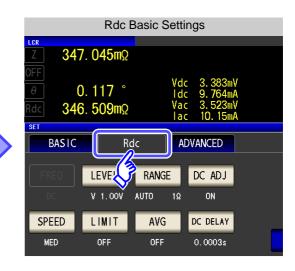
■ When the number of averaging times is 2 or more
(The number of times is 2 in this example)

When DC adjustment is enabled (ON)

Setting changed
- Changed from AC measurement to DC measurement
- Signal level changed
- Range changed

DC delay (Initial value: 0.0003 seconds) | Measure DC resistance | DC delay (Initial value: 0.0003 seconds) | Measure offset

When DC adjustment is enabled (ON)

DC delay (Initial value: 0.0003 seconds) | Measure DC resistance | Measure DC resistance | DC delay (Initial value: 0.0003 seconds) | Measure offset | Measure offset | Obtain average value | End measurement

Measurement for set number of averaging times

Measurement for set number of averaging times

**Procedure**

*1*

LCR Initial Screen

345.109mΩ

0.115 °

Vac 3.503mV
Iac 10.15mA

MODE
SET
ADJ
SYS
FILE

INFORMATION 1/2

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | INT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO | 1Ω | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |
| JUDGE | OFF |

ZOOM ON | INFO DC

Rdc Basic Settings

347.045mΩ

0.117 °

346.509mΩ

Vdc 3.383mV
Idc 9.764mA
Vac 3.523mV
Iac 10.15mA

SET

BASIC | Rdc | ADVANCED

FREQ | LEVEL | RANGE | DC ADJ
DC | V 1.00V | AUTO 1Ω | ON

SPEED | LIMIT | AVG | DC DELAY
MED | OFF | OFF | 0.0003s

**NOTE** The time required until the DC signal level stabilizes differs depending on the test sample to be measured. To ensure measurement is performed accurately, observe the measurement waveform in advance and then set the delay time required until the DC signal level stabilizes.

**2**  Rdc Basic Settings

Press DC DELAY .

**3**  Delay Time Setting

Use ▲ or ▼ to enter the delay time.

Settable range: 0.0003 to 9.9999 s

**When you want to cancel setting of the delay time**: Press C .
The set time is set to 0.0003 s.

**4** Press EXIT to close the setting screen.

# 4.4 Judging Measurement Results

The measurement results are compared to an arbitrarily set reference and then the judgment results are displayed. This function is useful for quality evaluation and the like.

There is comparator measurement which compares one judgment reference and the measurement values, and BIN measurement which compares multiple judgment reference values (up to 10) and the measurement values.

Judgment by comparator measurement and BIN measurement is performed for the first parameter and third parameter.
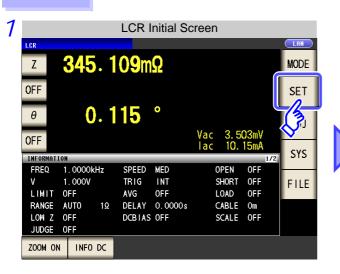
| Judgment Target | Result Display |
| --- | --- |
| First parameter | Second parameter area |
| Third parameter | Fourth parameter area |

Therefore, set the measurement values you want to judge for the first parameter and third parameter in advance.
**See** "4.1.2 Setting Display Parameters" (p. 39)

## Setting the judgment mode

Use the following procedure to select and set one of the modes.

**Procedure**

*1*  LCR Initial Screen                    Application Settings

**2**

Application Settings



Press JUDGE .

**3**

Judgment Mode Setting



**To select the judgment mode.**

| OFF | Cancels the comparator and BIN measurement settings. |
|---|---|
| COMP | Sets comparator measurement. (p. 86) |
| BIN | Sets BIN measurement. (p. 93) |
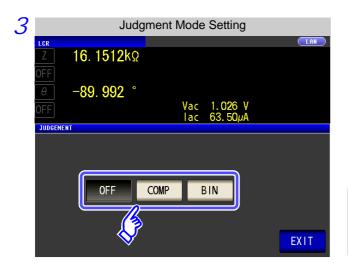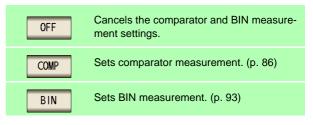
When comparator measurement and BIN measurement are performed, only the first and third parameters can be set.
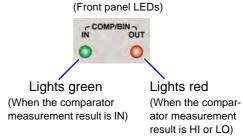The second and fourth parameters become LMT.

**4** Press EXIT to close the setting screen.

**4**

**Chapter 4 LCR Function**
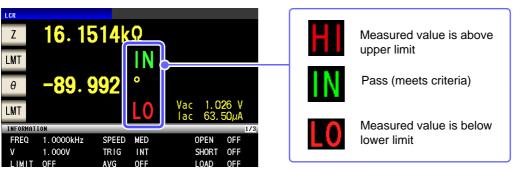
## 4.4.1 Judging with Upper and Lower Limit Values (Comparator Measurement Mode)

The comparator measurement allows you to do the following.
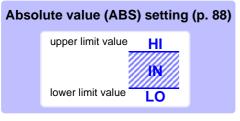
- Preset a reference value and upper and lower limit values as the judgment reference, and display a judgment result as **HI** (higher than the upper limit value), **IN** (within the range set for the upper and lower limit values), or **LO** (lower than the lower limit value).

- Output the judgment results to an external device (via the EXT I/O connector).

- Select different settings and perform judgment for up to two parameters.

- Be notified of judgment results by buzzer.
  **See** "4.5.13 Setting Operation Sounds (Beep Sounds)" (p. 128)

- Confirm the judgment result from the judgment result indication LEDs on the front panel of the instrument.
  **See** "Judgment Result Indication LEDs" (p. 10)

(Front panel LEDs)

Lights green
(When the comparator measurement result is IN)

Lights red
(When the comparator measurement result is HI or LO)

**HI** Measured value is above upper limit

**IN** Pass (meets criteria)

**LO** Measured value is below lower limit

The comparator decision mode can be set as one of the following:

**Absolute value (ABS) setting (p. 88)**

upper limit value **HI**
**IN**
lower limit value **LO**

▶ Set absolute values for the upper limit and lower limit values of the measurement parameters.
The measurement values displayed are the same as those of the measurement parameters.

**Percent (%) Setting (p. 89)**

upper limit value[%] **HI**
**IN**
reference value[Ω] **IN**
lower limit value[%] **LO**

▶ Enter reference values and then set percentages corresponding to the reference values as the upper limit and lower limit values.
The measurement values displayed are the same as those of the measurement parameters.

**Deviation Percent (Δ%) Setting (p. 91)**

upper limit value[Δ%] **HI**
**IN**
reference value[Ω] **IN**
lower limit value[Δ%] **LO**

▶ Enter reference values and then set percentages corresponding to the reference values as the upper limit and lower limit values.
The measurement values are displayed in deviations (Δ%) from the reference value.

*1: The following equation is used to calculate the comparison upper limit value and comparison lower limit value.
(In the case of the comparison lower limit value, if a value that is lower than the reference value is set, the minus (-) sign is required for the percentage setting value.)

Upper limit comparison value (Lower limit comparison value) = reference value+ |reference value| × $\dfrac{\text{Percentage set value}}{100}$

*2: The following equation is used to calculate the Δ% value.

$$\Delta\% = \frac{\text{measurement}}{|\text{reference value}|} \times 100$$

**NOTE**
- The comparator judgment is made in the following order.

  **1.** If the measurement value is "OVER FLOW", **HI** is displayed.
  (However, LO is displayed when the parameters are Y, Cs, Cp, G, and B.)
  If the measurement value is "UNDER FLOW", **LO** is displayed.
  (However, HI is displayed when the parameters are Y, Cs, Cp, G, and B.)
  If the measurement value is "L NO CNTCT" or "H NO CNTCT", **HI** is displayed.

  **2.** Whether the measurement value is higher than the lower limit value is judged, and **LO** is displayed if the judgment is NG.

  **3.** Whether the measurement value is lower than the upper limit value is judged, and **HI** is displayed if the judgment is NG.

  **4.** When both 2 and 3 are satisfied, **IN** is displayed.

  **No test is performed to ensure that the upper limit value is greater than the lower limit value, so no error message will be displayed if you set the upper limit value and lower limit value the wrong way around.**

- If the power is turned off while the comparator measurement screen is displayed, the comparator measurement screen will be displayed when the instrument starts the next time you turn the power on.

**4**

**Chapter 4  LCR Function**

## 4.4 Judging Measurement Results

**1** Setting the Upper or Lower Limit Value as an Absolute Value (ABS) (Absolute Value mode)

**Procedure**

**1**

LCR Initial Screen

Press LMT .

**2**

Comparator Condition Setting

Press ABS .

**3**

Upper Limit Value Setting

Press HI and use the numeric keypad to set the upper limit value.

Settable range: -9.999999 G to 9.999999 G

Changing the unit (**a/ f/ p/ n/ μ/ m/ None/ k/ M/ G**)

| x10³ | Step the units up. |
| 1/10³ | Step the units down. |

**When you do not want to set the upper and lower limit values:** Press OFF .

**4** Press ENTER to confirm the upper limit value.

**5** Return to step **2**, press LO , use the numeric keypad to set the lower limit value, and press ENTER .

Settable range: -9.999999 G to 9.999999 G

**2** Setting the Upper or Lower Limit Value as a Percentage (%) Relative to a Reference Value (Percentage mode)

**Procedure**

*1* LCR Initial Screen



Press LMT .

*2* Comparator Condition Setting



Press % .

*3* Reference Value Setting



Press REF and use the numeric keypad to set the reference value.

Settable range: -9.999999G to 9.999999G

Changing the unit (**a/ f/ p/ n/ μ/ m/ None/ k/ M/ G**)

| x10³ | Step the units up. |
|---|---|
| 1/10³ | Step the units down. |

*4* Press ENTER to confirm the reference value.

Chapter 4 LCR Function

**4**

## 4.4 Judging Measurement Results

**5**

| Upper Limit Value Setting |
| --- |

LCR      LAN

Z   **16. 1513kΩ**
LMT    ---
θ   **−89. 992 °**
LMT    ---    Vac   1.026 V
     Iac   63.50μA

COMP 1

| 7 | 8 | 9 | − | OFF |
| 4 | 5 | 6 | x10³ |
| 1 | 2 | 3 | 1/10³ |
| 0 | . | C | ENTER |

REF   16.00000k

HI   0

OFF

**Press** [ HI ] **and use the numeric keypad to set the upper limit value.**

Set the upper limit value as a percentage relative to the reference value.

> **When you do not want to set the upper limit: Press** [ OFF ] **.**

- Settable range: -999.9999% to 999.9999%
- The actual internal operation consists of calculating the upper-limit value of comparison using the equation given below, and comparing it to the measurement value to enable a decision to be made.

$$\text{Upper limit comparison value} = \text{reference value} + |\text{reference value}| \times \frac{\text{Percentage set value}}{100}$$

**6** **Press** [ENTER] **to confirm the upper limit value.**

**7** **Return to step** *2*, **press** [ LO ] , **use the numeric keypad to enter the lower limit value, and press** [ENTER] .

- Settable range: -999.9999% to 999.9999%
- The actual internal operation calculates the lower limit comparison value with the following equation, and when a value that is lower than the reference value is set, the minus (-) sign is required for the percentage setting value.

$$\text{Lower limit comparison value} = \text{reference value} + |\text{reference value}| \times \frac{\text{Percentage set value}}{100}$$

**8** **Press** [EXIT] **to close the setting screen.**

**NOTE**   The set reference value and upper and lower limit values are common to percentage mode and percentage deviation mode.

**3**   Setting Upper and Lower Limit Values as (Δ%) Values Relative to the Offset from the Reference Value (Deviation Percentage Mode)

**Procedure**

*1*

LCR Initial Screen



**Press** LMT **.**
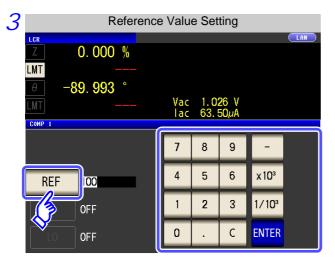
- In the deviation percentage mode, the measurement value is displayed as a deviation (Δ%) from the reference value.
- The reference value and upperand lower limit values are set in the same manner as in the percentage mode.

  **See**   "Setting the Upper or Lower Limit Value as a Percentage (%) Relative to a Reference Value (Percentage mode)" (p. 89)

- The settings of the reference value and the upper and lower limit values are common to both the percentage mode and deviation percentage mode.
- The Δ% value is calculated using the following equation:

$$\Delta\% = \frac{\text{measurement value - reference value}}{|\text{reference value}|} \times 100$$

*2*

Comparator Condition Setting



**Press** Δ% **to select deviation percentage mode.**

*3*

Reference Value Setting



**Press** REF **and use the numeric keypad to enter the reference value.**

Settable range: -9.999999G to 9.999999G

x10³ / 1/10³     a/ f/ p/ n/ µ/ None/ k/ M/ G

*4*   **Press** ENTER **to confirm the reference value.**

**4**

Chapter 4 LCR Function

**5**

| Upper Limit Value Setting | |
| --- | --- |

```
LCR                                    LAN
 Z      0.000 %
LMT          ---
 θ    -89.993 °
LMT          ---      Vac  1.026 V
                      Iac  63.50µA
COMP 1
                   7   8   9   -   OFF
       REF  100.0000
                   4   5   6  x10³
       HI  |0        1   2   3  1/10³
              OFF    0   .   C  ENTER
```

Press  **HI**  and use the numeric keypad to set the upper limit value.
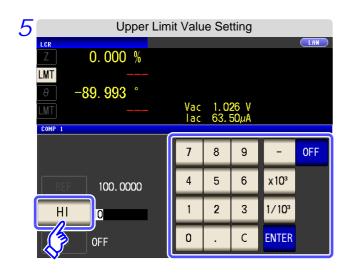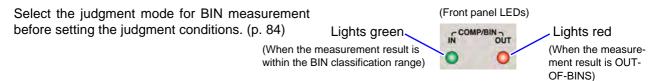
> Settable range: -999.9999% to 999.9999%

> **When you do not want to set the upper limit:** Press **OFF** .

**6** Press **ENTER** to confirm the upper limit value.

**7** Return to step **2**, press  **LO** , and use the numeric keypad to enter the lower limit value.
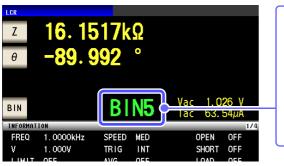
> Settable range: -999.9999% to 999.9999%

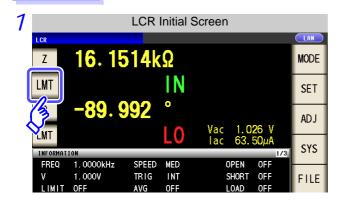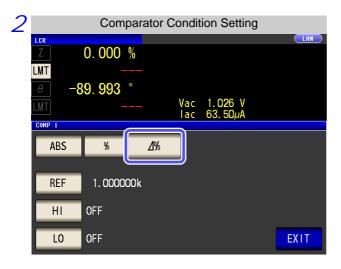**8** Press **EXIT** to close the setting screen.

**NOTE** The set reference value and upper and lower limit values are common to percentage mode and percentage deviation mode.

## 4.4.2 Classifying Measurement Results (BIN Measurement)

Set the upper and lower limit values for two parameters and display up to 10 classifications of judgment results.You can also output the judgment results to an external device.

Select the judgment mode for BIN measurement before setting the judgment conditions. (p. 84)

(Front panel LEDs)

Lights green
(When the measurement result is within the BIN classification range)

Lights red
(When the measurement result is OUT-OF-BINS)



**BIN5** When BIN judgment

**———** When BIN is not set

**OUT OF BINS** When does not match any BIN
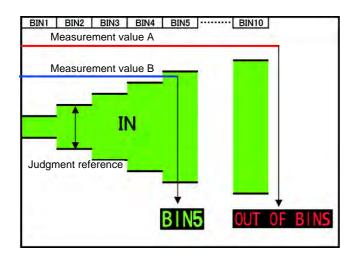
### About BIN function

Perform judgment in the order of BIN1 to BIN10. The BIN number for when a measurement value is first judged to be within the set judgment reference is displayed.



In the example above, measurement value A is judged not to be within all of the set judgment references, so **OUT OF BINS** is displayed. In contrast, the first reference that measurement value B is judged to be within is the judgment reference that was set for BIN5, so **BIN 5** is displayed.

## 4.4 Judging Measurement Results

The comparator decision mode can be set as one of the following:

**Absolute value (ABS) setting (p. 88)**

upper limit value  **HI**

**IN**

lower limit value  **LO**

▶ Set absolute values for the upper limit and lower limit values of the measurement parameters.
The measurement values displayed are the same as those of the measurement parameters.

**Percent (%) Setting (p. 89)**

upper limit value[%]  **HI**

**IN**

reference value[Ω]

**IN**

lower limit value[%]  **LO**

▶ Enter reference values and then set percentages corresponding to the reference values as the upper limit and lower limit values.
The measurement values displayed are the same as those of the measurement parameters.

**Deviation Percent (Δ%) Setting (p. 91)**

upper limit value[Δ%]  **HI**

**IN**

reference value[Ω]

**IN**

lower limit value[Δ%]  **LO**

▶ Enter reference values and then set percentages corresponding to the reference values as the upper limit and lower limit values.
The measurement values are displayed in deviations (Δ%) from the reference value.

*1: The following equation is used to calculate the comparison upper limit value and comparison lower limit value.
(In the case of the comparison lower limit value, if a value that is lower than the reference value is set, the minus (-) sign is required for the percentage setting value.)

$$\text{Upper limit comparison value (Lower limit comparison value)} = \text{reference value} + |\text{reference value}| \times \frac{\text{percentage set value}}{100}$$

*2: The following equation is used to calculate the Δ% value.

$$\Delta\% = \frac{\text{measurement value - reference value}}{|\text{reference value}|} \times 100$$

**NOTE**
- If the power is turned off in BIN measurement mode, the mode will be BIN measurement mode when the instrument starts the next time you turn the power on.
- For a BIN number that does not require a BIN judgment, set the upper and lower limit values to OFF.
- The measurement conditions that are used when normal measurement is performed are inherited as is for the measurement conditions when BIN is performed.

**1** Setting the Upper or Lower Limit Value as an Absolute Value (ABS) (Absolute Value mode)

**Procedure**

**1**



Press BIN .

**2**



Press Z .

The button display differs depending on the measurement parameter.

**3**



Press ABS .

Press EXIT to return to the BIN setting screen.

**4**

**Chapter 4 LCR Function**

## 4.4  Judging Measurement Results

**4**

| | BIN Settings | | | |
|---|---|---|---|---|
| BIN | | | | |
| | Z ABS | | θ ABS | |
| No. | Hi | Lo | Hi | Lo |
| BIN 1 OFF | OFF | OFF | OFF | |
| BIN 2 OFF | OFF | OFF | OFF | |
| BIN 3 OFF | OFF | OFF | OFF | |
| BIN 4 OFF | OFF | OFF | OFF | |
| BIN 5 OFF | OFF | OFF | OFF | |
| BIN 6 OFF | OFF | OFF | OFF | |
| BIN 7 OFF | OFF | OFF | OFF | |
| BIN 8 OFF | OFF | OFF | OFF | |
| BIN 9 OFF | OFF | OFF | OFF | |
| BIN10 OFF | OFF | OFF | OFF | |

EDIT ▼ ▲ EXIT

Use ▼ or ▲ to select the BIN number to set, and press  EDIT .

**5**

Upper/Lower Limit Value Settings

BIN
Z ABS   θ ABS
BIN 1
Z
HI  FF
  OFF
θ
HI  OFF
LO  OFF

EXIT

EDIT ▼ ▲ EXIT

Press  HI .

**6**

Upper Limit Value Setting

BIN
Z ABS   θ ABS
BIN 1
Z
HI  17k
LO  OFF
θ
HI  OFF
LO  OFF

7 8 9 – OFF
4 5 6 x10³
1 2 3 1/10³
0 . C ENTER

EDIT ▼ ▲ EXIT

Use the numeric keypad to set the upper limit value of the first parameter.

Settable range: -9.999999G to 9.999999G

Press  ENTER  to confirm the upper limit value.
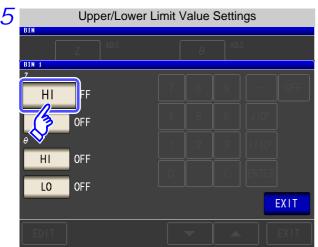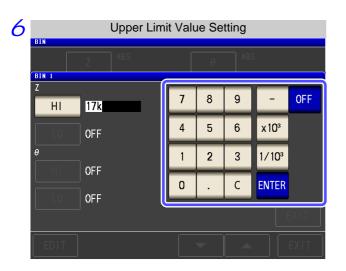
When you do not want to set the upper and lower limit values: Press  OFF .
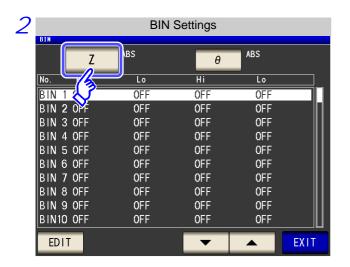
**7**    **Return to step _5_, press**    LO   **, and use the numeric keypad to set the lower limit value.**

> Settable range: -9.999999G to 9.999999G

**8**    **Press** ENTER **to confirm the lower limit value.**

**9**    **Return to step _4_, and set the upper and lower limit values of the second parameter in the same way.**

**10**  **Press** EXIT **to return to the BIN setting screen.**

**11**  **Press** EXIT **to close the setting screen.**

**2** Setting the Upper or Lower Limit Value as a Percentage (%) Relative to a Reference Value (Percentage mode)
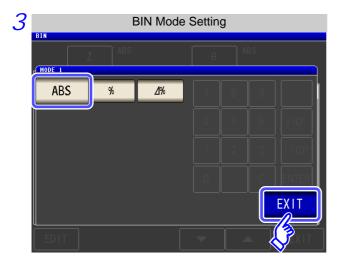
**Procedure**

**1**

**Press** `BIN` .

**2**

**Press** `Z` .

The button display differs depending on the measurement parameter.

**3**

**Press** `%` **to select percentage mode.**

*4*

Reference Value Setting

| 7 | 8 | 9 | – |
| 4 | 5 | 6 | x10³ |
| 1 | 2 | 3 | 1/10³ |
| 0 | . | C | ENTER |

REF  1.000000k

**Press** `REF` .

**Use the numeric keypad to enter the reference value and press** `ENTER` .

Settable range: -9.999999G to 9.99999G

*5*

BIN Mode Setting

ABS  %  Δ%

REF  1.000000k

EXIT

**Press** `EXIT` **to return to the BIN setting screen.**

*6*

BIN Settings

| No. | Hi | Lo | Hi | Lo |
|---|---|---|---|---|
| BIN 1 | OFF | OFF | OFF | OFF |
| BIN 2 | OFF | OFF | OFF | OFF |
| BIN 3 | OFF | OFF | OFF | OFF |
| BIN 4 | OFF | OFF | OFF | OFF |
| BIN 5 | OFF | OFF | OFF | OFF |
| BIN 6 | OFF | OFF | OFF | OFF |
| BIN 7 | OFF | OFF | OFF | OFF |
| BIN 8 | OFF | OFF | OFF | OFF |
| BIN 9 | OFF | OFF | OFF | OFF |
| BIN10 | OFF | OFF | OFF | OFF |

EDIT  ▼ ▲  EXIT

**Use** ▲ **or** ▼ **to select the BIN number to set, and press** `EDIT` .

**Chapter 4  LCR Function**

## 4.4 Judging Measurement Results

**7** Upper/Lower Limit Value Settings

Press HI .

**8** Upper Limit Value Setting

**Use the numeric keypad to enter the upper limit value of the first parameter.**

Settable range: -999.9999% to 999.9999%

**Press ENTER to confirm the upper limit value.**

**When you do not want to set the upper and lower limit values:** Press OFF .

**9** Return to step **7**, press LO , and use the numeric keypad to enter the lower limit value.

Settable range: -999.9999% to 999.9999%

**10** Press ENTER to confirm the lower limit value.

**11** Return to step **6**, and set the upper and lower limit values of the second parameter in the same way.

**12** Press EXIT to return to the BIN setting screen.

**13** Press EXIT to close the setting screen.

**NOTE** The set reference value and upper and lower limit values are common to percentage mode and percentage deviation mode.

**3** | Setting Upper and Lower Limit Values as (Δ%) Values Relative to the Offset from the Reference Value (Deviation Percentage Mode)

**Procedure**

**1**



Press [BIN].

**2**



Press [Z].

The button display differs depending on the measurement parameter.

**3**



Press [Δ%] to select percentage mode.

**4**

**Chapter 4 LCR Function**

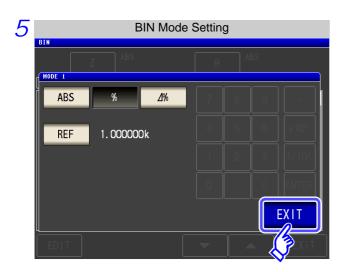## 4.4 Judging Measurement Results
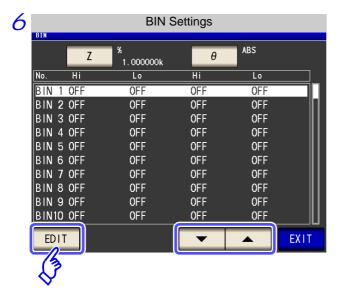
**4**

Reference Value Setting

**Press** REF **.**

**Use the numeric keypad to enter the reference value and press** ENTER **.**

Settable range: -9.999999G to 9.999999G

**5**

BIN Mode Setting

**Press** EXIT **to return to the BIN setting screen.**

**6**

BIN Settings

| No. | Hi | Lo | Hi | Lo |
|-----|-----|-----|-----|-----|
| BIN 1 | OFF | OFF | OFF | OFF |
| BIN 2 | OFF | OFF | OFF | OFF |
| BIN 3 | OFF | OFF | OFF | OFF |
| BIN 4 | OFF | OFF | OFF | OFF |
| BIN 5 | OFF | OFF | OFF | OFF |
| BIN 6 | OFF | OFF | OFF | OFF |
| BIN 7 | OFF | OFF | OFF | OFF |
| BIN 8 | OFF | OFF | OFF | OFF |
| BIN 9 | OFF | OFF | OFF | OFF |
| BIN10 | OFF | OFF | OFF | OFF |

**Use** ▲ **or** ▼ **to select the BIN number to set, and press** EDIT **.**

**7**  Upper/Lower Limit Value Settings

Press [ HI ] .

**8**  Upper Limit Value Setting

Use the numeric keypad to enter the upper limit value of the first parameter.

Settable range: -999.9999% to 999.9999%

Press [ENTER] to confirm the upper limit value.

When you do not want to set the upper and lower limit values: Press [OFF] .

**9**  Return to step **7**, press [ LO ] , and use the numeric keypad to enter the lower limit value.

Settable range: -999.9999% to 999.9999%

**10**  Press [ENTER] to confirm the lower limit value.

**11**  Return to step **6**, and set the upper and lower limit values of the second parameter in the same way.

**12**  Press [ EXIT ] to return to the BIN setting screen.

**13**  Press [ EXIT ] to close the setting screen.

**NOTE**  The set reference value and upper and lower limit values are common to percentage mode and percentage deviation mode.

Chapter 4 LCR Function

**4**

# 4.5 Setting Application Settings

## 4.5.1 Synchronizing Measurement (Trigger Synchronous Output Function)

This function enables the measurement signal to be output after measurement is triggered and ensures that the signal is applied to the sample only during measurement.
Thus reducing the generation of heat in the sample and decreasing electrode wear.
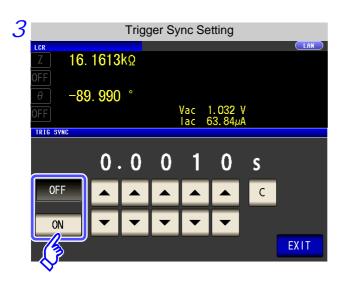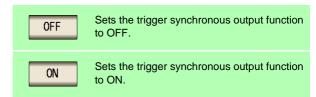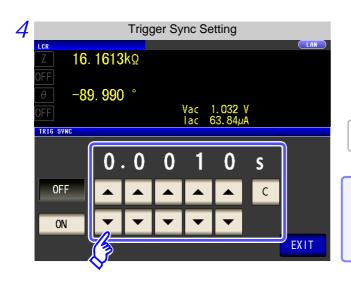
**Procedure**

**1**
LCR Initial Screen



Application Settings



**2**
Application Settings



Press **SYNC** .

**3**  Trigger Sync Setting

LCR
Z  16.1613kΩ
OFF
θ  −89.990 °
OFF
Vac  1.032 V
Iac  63.84μA
TRIG SYNC

0.0010 s

OFF
ON

C

EXIT

**Select ON/ OFF for the trigger synchronous output function.**

| OFF | Sets the trigger synchronous output function to OFF. |
| ON | Sets the trigger synchronous output function to ON. |

**4**  Trigger Sync Setting

LCR
Z  16.1613kΩ
OFF
θ  −89.990 °
OFF
Vac  1.032 V
Iac  63.84μA
TRIG SYNC

0.0010 s

OFF
ON

C

EXIT

**Use ▲ or ▼ to set the wait time from after the measurement signal is output by applying a trigger to the start of measurement.**

Settable range: 0.0010 to 9.9999 s

**When you want to return the time to the initial state:** Press C .

The set time is set to 0.0010 s.

**5**  Press **EXIT** to close the setting screen.

**NOTE**
- When the trigger synchronous output function is set to ON, there is a measurement time delay because the unit enters a wait time which spans from when the measurement signal is output to when measurement starts.
See"13.3 About Measurement Times and Measurement Speed" (p. 399)
- When the trigger synchronous output function is set to ON, the set DC level may be output if a measurement condition is changed. Also, output will stop when measurement is performed once.
- The measurement signal is output when the trigger signal is input and stops after measurement ends.
- In continuous measurement mode, the measurement signal stops after measurement of the last panel ends.

Chapter 4 LCR Function

## 4.5.2 Saving Measurement Results (Memory function)

You can save the measurement results inside the instrument. (Up to 32,000 items) The saved measurement results can be saved to a USB flash drive. They can also be acquired using a communication command. (The memory function is the same in [ LCR ] mode and [ ANALYZER ] mode.)

The items saved to memory are in accordance with the **:MEASure:VALid** setting.

For details on how to acquire the saved measurement results or set **:MEASure:VALid**, refer to the included CD.

### Saving Measurement Values

**Procedure**

**1**


LCR Initial Screen → Application Settings

**2**


Application Settings

Press [ MEMORY ] .

**3**


Memory Function Setting

Use [▲] or [▼] to set the number of measurement results.

Settable range: 1 to 32000
The number of measurement results can only be set when the memory function is set to OFF.

**4** Memory Function Setting

LCR
Z  16.1515kΩ
OFF
θ  −89.992 °
OFF
         Vac  1.026 V
         Iac  63.50μA

MEMORY

OFF    0 1 0 0 0
IN     ▲ ▲ ▲ ▲ ▲
ON     ▼ ▼ ▼ ▼ ▼

         CLEAR   SAVE         EXIT

**Select ON/ OFF for the memory function.**

| OFF | Sets the memory function to OFF. |
|---|---|
| IN | Saves the measurement results to memory only when a pass judgment is made for all of the parameters judged with the comparator and BIN functions. (The measurement results are not saved if even one of the comparator results is Hi or Lo or the BIN result is OUT-OF-BINS.) |
| ON | Saves all measurement values to memory. |

If the comparator and BIN functions are not set, the operation for [IN] is the same as that of [ON].

**5** Press [EXIT] to close the setting screen.

| CLEAR | Clears all of the saved measurement results from the instrument memory. |
|---|---|
| SAVE | Saves the measurement values stored in the instrument memory to a USB flash drive and then clears the measurement values from the instrument memory. The measurement values are saved to the MEMORY folder in the USB flash drive. The file name is automatically assigned from the date and time. |

**4**

Chapter 4 LCR Function

**NOTE**

• If the memory function is set to ON, the number of memory items currently saved is displayed in the measurement screen.

LCR                    2929        MODE
Z  16.1532kΩ
OFF                                SET
θ  −89.992 °                       ADJ

Indicates that the number of memory items currently saved is 2,929.

• Save the measurement results stored in the instrument to a USB flash drive or acquire them with the **:Memory?** command.
• The internal data is lost when the memory function setting is changed.
• When the instrument memory becomes full, the following message appears on the measurement screen. If this message appears, subsequent measurement results will not be saved.
To resume saving, load or clear the measurement results from the instrument memory.

LCR  No.001 PANEL_NAME  Reference Value  Memory Full  USB  LAN
Z  24.0259 Ω                              MODE
OFF                                       SET
θ  87.169 °    Vdc  907.5μV               ADJ
               Idc  9.748mA

**Memory Full**

## 4.5.3 Detecting OPEN during 2-terminal Measurement (HIGH-Z Reject Function)

This function is for outputting a measurement terminal connector error when the measurement result is high relative to the set judgment reference value. The setting value can be set as an absolute value, and the error is output via the EXT I/O.

**See** "Chapter 11 External Control" (p. 363)

The judgment reference is calculated from the nominal value (range name) of the current measurement range and the judgment reference value as shown below.

Judgment reference = Nominal value of current measurement range × Judgment reference value (%)

Example  Current measurement range: 30 kΩ
Judgment reference value: 150%
Judgment reference = 30 k × 1.50 = 45 k
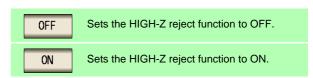
**Procedure**

**1**

LCR Initial Screen



Application Settings



**2**

Application Settings



**Press** Hi Z .

*3*

HIGH-Z Setting

**Select ON/ OFF for the HIGH-Z reject function.**

| OFF | Sets the HIGH-Z reject function to OFF. |
| ON | Sets the HIGH-Z reject function to ON. |

*4*

HIGH-Z Setting

**Use ▲ or ▼ to set the judgment reference value.**

Settable range: 0 to 30000%
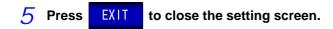
- A ratio is set using the range name as the reference value.
  Example: When the 1 kΩ range is used:
  A ratio to the value of 1 kΩ is set.
- If you make a mistake during input:
  press C to cancel the input and start again.

*5* **Press** EXIT **to close the setting screen.**

### 4.5.4 Monitoring the Detection Level (Monitoring the Detection Level Function)

Measurement waveform errors that occur when the test sample and instrument contact each other can be detected by monitoring the voltage effective value and current effective value.
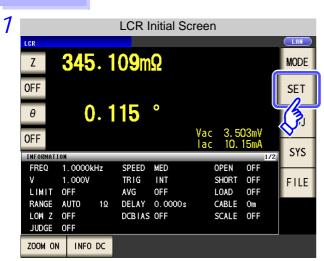
The voltage effective value and current effective value are calculated several times during analog measurement.

The effective value of each of the voltage and current that is calculated the first time is treated as the reference value, and then following calculation expression is used to calculate the $\Delta\%$ value for the voltage effective value and current effective value calculated for the second and subsequent times.

$$\Delta\% = \left| \frac{(\text{Effective value - reference value})}{\text{reference value}} \right| \times 100 [\%]$$

An error is detected when $\Delta\%$ exceeds the set limit value.

**Procedure**

**1**

LCR Initial Screen

Application Settings

**2**

Application Settings

**Press** LEVCHK .

**3** Detection Level Monitoring Function Setting
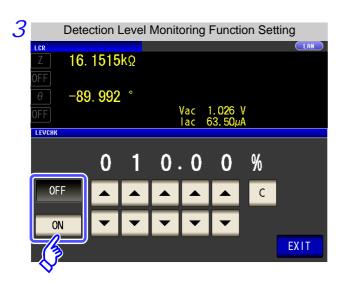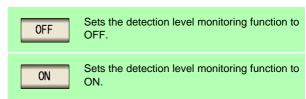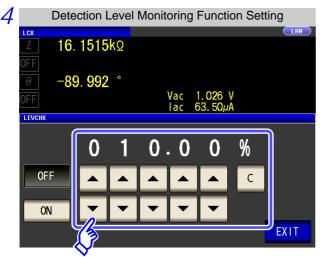


**Select ON/OFF for the function to monitor the detection level.**

| | |
|---|---|
| OFF | Sets the detection level monitoring function to OFF. |
| ON | Sets the detection level monitoring function to ON. |

**4** Detection Level Monitoring Function Setting



**Use** ▲ **or** ▼ **to enter the limit value.**

Settable range: 0.01 to 100.00%

**5** Press **EXIT** to close the setting screen.

## Monitoring the Detection Level Function Operation by Set Frequency

The number of waves that can be monitored differs depending on the frequency set on the instrument.

| Frequency | FAST | MED | SLOW | SLOW2 |
|---|---|---|---|---|
| DC | × | ● | ● | ● |
| 4.00 Hz to 19.99 Hz | × | ● | ● | ● |
| 20.00 Hz to 100.00 Hz | × | ● | ● | ● |
| 100.01 Hz to 999.99 Hz | × | ● | ● | ● |
| 1.0000 kHz to 3.0000 kHz | × | ● | ● | ● |
| 3.0001 kHz to 10.000 kHz | × | ● | ● | ● |
| 10.001 kHz to 30.000 kHz | ● | ● | ● | ● |
| 30.001 kHz to 100.00 kHz | ● | ● | ● | ● |
| 100.01 kHz to 300.00 kHz | 1/2 | 1/2 | 1/2 | 1/2 |
| 300.01 kHz to 1.0000 MHz | 1/4 | 1/4 | 1/4 | 1/4 |
| 1.0001 MHz to 5.0000 MHz | ● | ● | ● | ● |

× : The monitoring the detection level function is not activated.

● : The monitoring the detection level function is activated for all acquired waves.

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**Chapter 4 LCR Function**

# 112

## 4.5 Setting Application Settings

**NOTE**

- If a detection level error is detected, the following comment is displayed at the top of the screen.



- The detection level error is reflected in the response result of **:MEASure?**, **:MEMory?**.
  **See** Description of communications commands on the included CD (**:MEASure?**, **:MEMory?**)
  Furthermore, it is output as a measurement error to the ERR terminal (10-pin) of the EXT I/O.
  **See** "Connector Type and Signal Pinouts" (p. 364)
- Even in a normal contact state, an error may be output due to the influence of external noise. (It is possible to judge external noise.)
  Use the shielding process as a measure against external noise.
- Chattering monitoring is not performed during offset measurement when DC adjustment is enabled.
  **See** "4.3.3 Setting the DC Adjustment Function" (p. 75)

## 4.5.5   Setting the Detection Sensitivity for Measurement Errors (Overflow or Underflow)

The instrument monitors the detectable range of the measurement signals (voltage and current) during measurement, and displays a measurement error (OVERFLOW or UNDERFLOW) if that range is exceeded.
However, if measurement is performed under a noisy environment, the detection range may be exceeded resulting in a measurement error regardless of whether an appropriate measurement range is set.
Under normal circumstances, the countermeasures described in "Appendix 4  Countermeasures Against Incorporation of External Noise"(p. A5) need to be taken but if a measurement error occurs even after taking the countermeasures, increase the setting value which defines the error of the measurement signal to reduce the detection sensitivity for measurement errors so that you can reduce the frequency of measurement error occurrence.

**Procedure**



**1**  LCR Initial Screen

**Application Settings**

**2**  Application Settings

**Press** LEVOVER .

## 4.5  Setting Application Settings

**3**

Level Value Setting

LCR

Z
OFF

16. 1515kΩ

θ
OFF

−89. 992 °

Vac  1. 026 V
Iac  63. 50μA

LEVOVER

0  1

EXIT

**Use** ▲ **or** ▼ **to enter the level value.**

Settable range: 1 to 32

**4**  **Press**  EXIT  **to close the setting screen.**

**NOTE**    The higher the setting value, the greater the measurement errors. If the setting value is set to 2 or higher, the accuracy specifications may not be able to be satisfied.
Furthermore, shifting to the most suitable range may not occur during auto range operation.

## 4.5.6 Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results

You can set the delay time for the period from the output of the comparator and BIN judgment results until the output of EOM (LOW) from the EXT I/O.
You can also set whether to reset the comparator and BIN judgment results simultaneously with the measurement start signal.
**See** "11.2 Timing Chart" (p. 369)

**Procedure**

**1** LCR Initial Screen

Application Settings

**2** Application Settings

Press  IO SET .

**3** I/O Setting

Press IO JUDGE .

**4**

**Chapter 4 LCR Function**

**4**

I/O Judgment Setting

Z 16. 1515kΩ
OFF
θ −89. 992 °
OFF
Vac 1.026 V
Iac 63.50µA

IO JUDGE

JUDGE-EOM  0. 0 0 0 0 s

▲ ▲ ▲ ▲  C

▼ ▼ ▼ ▼

JUDGE RESET  OFF  ON  EXIT

Use ▲ or ▼ to set the delay time for the period from the output of the comparator and BIN judgment results until the output of EOM (LOW).

- Settable range: 0.0000 s to 0.9999 s

- If you make a mistake during input:

  press C to cancel the input and start again.

**5**

I/O Judgment Setting

Z 16. 1515kΩ
OFF
θ −89. 992 °
OFF
Vac 1.026 V
Iac 63.50µA

IO JUDGE

JUDGE-EOM  0. 0 0 0 0 s

▲ ▲ ▲ ▲  C

▼ ▼ ▼ ▼

JUDGE RESET  OFF  ON  EXIT

Select whether to reset the comparator and BIN judgment results simultaneously with the measurement start signal.

| OFF | Stores the last judgment results until the next judgment results are output. |
| ON | Resets the judgments results at the time of the measurement start signal. |

**6** Press EXIT to close the setting screen.

## 4.5.7 Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input

You can select whether to enable or disable trigger input from the EXT I/O during measurement (during $\overline{EOM}$ (HI) output after trigger is received). Furthermore, you can also select either the rising edge or falling edge as the valid edge of trigger input from the EXT I/O.

**See** "11.2 Timing Chart" (p. 369)

**Procedure**

**1** LCR Initial Screen



Application Settings



**2** Application Settings



Press **IO SET** .

**3** I/O Setting



Press **IO TRIG** .

**4**

Chapter 4 LCR Function

## 4.5 Setting Application Settings

**4**

### I/O Trigger Setting

LCR · LAN

Z 16. 1514kΩ
OFF

θ −89. 992 °
OFF

Vac 1. 026 V
Iac 63. 50μA

IO TRIG

TRIG ENABLE [ OFF ][ ON ]

TRIG EDGE [ DOWN ][ UP ]

[ EXIT ]

**Select the I/O trigger function setting.**

| | |
|---|---|
| OFF | Disables trigger input from the EXT I/O during measurement (during $\overline{EOM}$ (HI) output after trigger is received). |
| ON | Enables trigger input from the EXT I/O during measurement (during $\overline{EOM}$ (HI) output after trigger is received). |
| DOWN | Sets the falling edge as the valid edge of trigger input. |
| UP | Sets the rising edge as the valid edge of trigger input. |
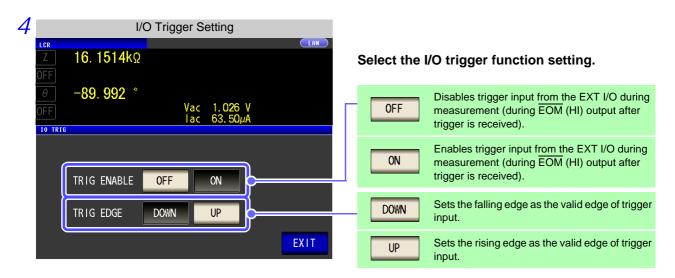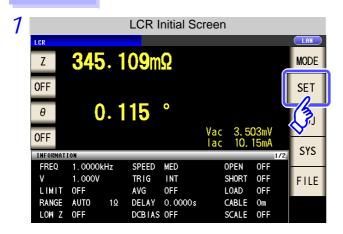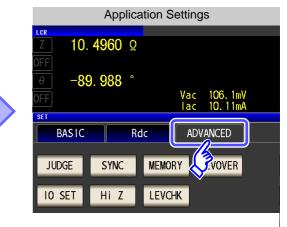
**5** Press [ EXIT ] to close the setting screen.

## 4.5.8 Setting the $\overline{\text{EOM}}$ Output Method

The higher the measurement frequency, the shorter the time that $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$ are high (off). When the high (off) time is too short due to characteristics of the input circuit, the instrument can be configured to maintain the low (on) state for a preset time once $\overline{\text{EOM}}$ changes to low (on) before reverting the signal to high (off) after the completion of measurement. The $\overline{\text{INDEX}}$ output method can be changed in the same manner.

**See** "Chapter 11  External Control" (p. 363)

**Procedure**

**1**  LCR Initial Screen

**Application Settings**

**2**  Application Settings

**Press** IO SET .

**3**  I/O Setting

**Press** IO EOM .

**4** Setting the $\overline{EOM}$ output method



**Setting the output method.**

> For HOLD and PULSE timing charts, see "Chapter 11 External Control" (p. 363).

Use ▲ or ▼ to set the $\overline{EOM}$ output time for the PULSE setting.

> Settable range: 0.0001 to 0.9999 s

**5** Press **EXIT** to close the setting screen.

## 4.5.9 Disabling Key Operation (Key-lock Function)

If you turn the key-lock function ON, all operations except disabling the key-lock are disabled to protect the settings. You can also set a passcode (security code).

**Procedure**

**1**

LCR Initial Screen

Application Settings

**2**

Application Settings

Press KEYLOCK .

**3**

Key Lock Setting

Press ON .

**4** Press EXIT to close the setting screen.

**NOTE**
- In the case of an external trigger, the key lock is not enabled for TRIG .
- Turning off the power does not cancel the key-lock function.

Chapter 4 LCR Function

## Setting the Passcode of the Key-lock

Input Passcode

Press PASSCODE when the key-lock setting is ON .

Use the numerical keypad to enter the passcode, press ENTER , and then press EXIT .

Settable range: 1 to 4 digits

NOTE  If a passcode is set, it needs to be entered to disable the key-lock.
Take care not to forget the set passcode.

## Disabling the Key-lock

Disable Key Lock

Press UNLOCK when the key-lock is enabled.

Input Passcode

**When a passcode is set**

Enter the passcode and press UNLOCK .

The entered passcode is indicated as ✳ on the screen.

(To cancel input: Press C )

**When a passcode is not set**

Press UNLOCK .

**When you want cancel the disabling of the key-lock:** Press CANCEL .

NOTE  If you forget the passcode, perform a full reset to restore the instrument to the factory default settings (p. 406).

Key Lock Disable Error

If the error indication shown on the left appears, check the following items.

| Cause | Remedy |
|---|---|
| **UNLOCK** **was pressed before you entered the passcode.** | Press C and enter the passcode. |
| **The entered passcode is incorrect.** | Press C and enter the passcode again. |

## 4.5.10 Setting the Number of Display Digits

You can set the number of effective digits of the measurement value for each parameter.

**Procedure**

**1**

LCR Initial Screen

Application Settings

**2**

Application Settings

Press DIGIT .

*3*

No. of Display Digits Setting

| | |
|---|---|
| LCR | LAN |
| Z | 16. 1518kΩ |
| OFF | |
| θ | −89. 992 ° |
| OFF | Vac 1.026 V  Iac 63.50µA |

DIGIT

| | | |
|---|---|---|
| PARA1 | ▼ 6 ▲ | |
| PARA2 | ▼ 6 ▲ | |
| PARA3 | ▼ 6 ▲ | |
| PARA4 | ▼ 6 ▲ | EXIT |

**Use** ▲ **or** ▼ **to set the number of display digits.**
**(For each parameter)**

Settable range: 3 to 7 digits

| Setting Value | Parameter | | | | |
|---|---|---|---|---|---|
| | θ | D | Q | Δ% | Other |
| 7 | Up to three decimal places | Up to six decimal places | Up to three decimal places | Up to four decimal places | Up to 7 digits |
| 6 | Up to three decimal places | Up to five decimal places | Up to second decimal place | Up to three decimal places | Up to 6 digits |
| 5 | Up to second decimal place | Up to four decimal places | Up to one decimal place | Up to second decimal place | Up to 5 digits |
| 4 | Up to one decimal place | Up to three decimal places | Up to zero decimal places | Up to one decimal place | Up to 4 digits |
| 3 | Up to zero decimal places | Up to second decimal place | Up to zero decimal places | Up to zero decimal places | Up to 3 digits |

**4** Press EXIT **to close the setting screen.**

Chapter 4 LCR Function

**4**
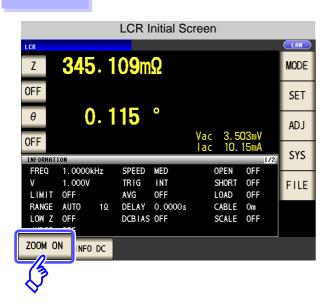
## 4.5.11 Enlarging Display of Measurement Values
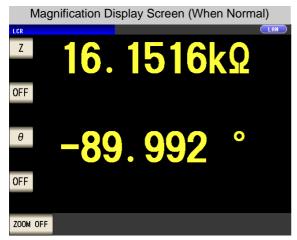
The measurement values and comparator decision results can be displayed in enlarged form.
This function is convenient when the unit is used under constant measurement conditions.
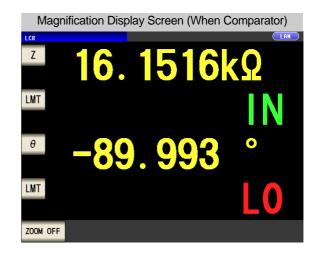
If the power is turned off when ZOOM ON is displayed, ZOOM ON will be displayed when the instrument starts the next time you turn the power on.

**Procedure**

LCR Initial Screen
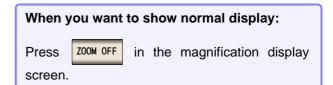


Press ZOOM ON in the initial screen to display the magnification display screen.

Magnification Display Screen (When Normal)



Magnification Display Screen (When Comparator)



**When you want to show normal display:**

Press ZOOM OFF in the magnification display screen.

## 4.5.12 Setting the LCD to ON/ OFF

You can turn the LCD ON/ OFF.
Setting the LCD to OFF saves power because the LCD turns off if the panel is not touched for 10 seconds.

**Procedure**

**1** LCR Initial Screen

**Application Settings**

**2** Application Settings

Press DISP .

**3** LCD setting

Select the LCD setting, and press EXIT to close the setting screen.

OFF: Turns OFF the LCD.
The LCD turns off after approximately 10 seconds elapse since the touch panel was last touched.

ON: Sets the LCD to always on.

**When you want to turn the backlight on again:**
If you touch the touch panel while the backlight is off, the backlight will turn on again.

4 Chapter 4 LCR Function

## 4.5.13 Setting Operation Sounds (Beep Sounds)

You can set the operation sound and each of the beep sounds for judgment results.

**Procedure**

**1**

LCR Initial Screen

| Z |
| OFF |
| θ |
| OFF |

345.109mΩ

0.115 °

Vac  3.503mV
Iac  10.15mA

INFORMATION                                    1/2
FREQ  1.0000kHz    SPEED  MED      OPEN   OFF
V     1.000V       TRIG   INT      SHORT  OFF

LAN
MODE
SET
J
SYS
FILE

Application Settings

| Z |
| OFF |
| θ |
| OFF |

10.4960 Ω

−89.988 °

Vac   106.1mV
Iac   10.11mA

SET
BASIC    Rdc    ADVANCED

JUDGE   SYNC   MEMORY   VOVER   P.

**2**

Application Settings

| Z |
| OFF |
| θ |
| OFF |

10.4960 Ω

−89.988 °

Vac   106.1mV
Iac   10.11mA

SET
BASIC    Rdc    ADVANCED

JUDGE   SYNC   MEMORY   LEVOVER   PANEL
IO SET  Hi Z   LEVCHK             RESET
DIGIT   DISP   BEEP   KEYLOCK     EXIT

Press  BEEP  .

**3**

Beep Sound Settings

| Z |
| OFF |
| θ |
| OFF |

16.1516kΩ

−89.992 °

Vac   1.026 V
Iac   63.50µA

BEEP

JUDGE   OFF   IN   NG
KEY     OFF   ON

EXIT

**Beep sound settings for when comparator judgment**

| OFF | When a comparator judgment is made, no beep sound is emitted. |

• When judgment performed with 1 comparator

| IN | When the comparator result is IN, a beep sound is emitted. |
| NG | When the comparator result is LO or HI, a beep sound is emitted. |

• When judgment performed with 2 comparators

| IN | When both of these comparator results are IN, a beep sound is emitted. |
| NG | When either one is LO or HI, a beep sound is emitted. |

**Beep sound setting for when key pressed**

| OFF | When a key is pressed, no beep sound is emitted. |
| ON | When a key is pressed, a beep sound is emitted. |

**4** Press  EXIT  to close the setting screen.

## 4.5.14 Initializing (System Reset)

In the event of the instrument malfunctioning, check "Before returning for repair" (p. 405).
If you do not know the cause of the problem, perform a system reset to restore the instrument to its factory default settings.
A system reset can also be performed with the **\*RST** and **:PRESet** communication commands.
**See** Description of communications commands on the included CD

**Procedure**

**1**   LCR Initial Screen                Application Settings

**2**   Application Settings

Press  RESET .

**3**   System Reset

> ⚠ All settings are initialized.

Press  **RESET**  to restore the factory default settings and automatically redisplay the initial screen.

**When you want to cancel the system reset:**

Press  **CANCEL** .

**NOTE**   If the initialization screen cannot be displayed, perform a full reset. (p. 406)

**Chapter 4  LCR Function**

**4**
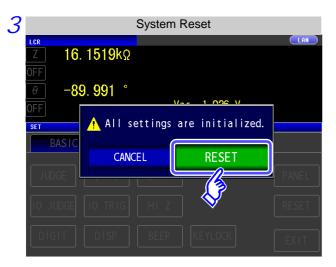
# ANALYZER Function

# Chapter 5

## 5.1 About ANALYZER function

LCR
ANALYZER

The analyzer function allows you to perform measurement while sweeping the measurement frequency and measurement signal level.
The measurement results can be displayed in a graph. Use this function for measuring frequency characteristics and level characteristics.
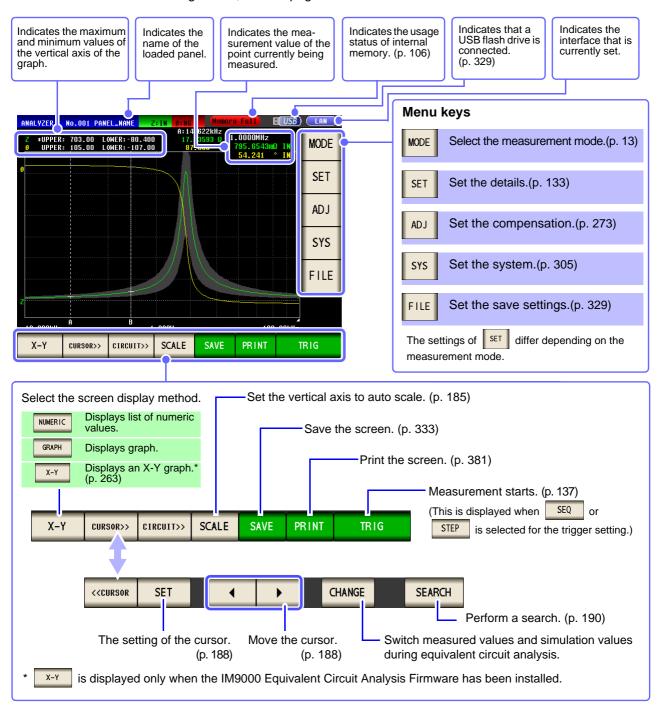
**NOTE** The settings are synchronized between LCR mode and analyzer mode.

**5**

**Chapter 5 ANALYZER Function**

## 5.1.1 Initial screen

This is the screen that is first displayed when the power is turned on. It allows you to perform measurement while checking the measurement conditions.
For details on the screen configuration, refer to page 17.

Indicates the maximum and minimum values of the vertical axis of the graph.

Indicates the name of the loaded panel.

Indicates the measurement value of the point currently being measured.

Indicates the usage status of internal memory. (p. 106)

Indicates that a USB flash drive is connected. (p. 329)

Indicates the interface that is currently set.

**Menu keys**

| | |
|---|---|
| MODE | Select the measurement mode.(p. 13) |
| SET | Set the details.(p. 133) |
| ADJ | Set the compensation.(p. 273) |
| SYS | Set the system.(p. 305) |
| FILE | Set the save settings.(p. 329) |

The settings of SET differ depending on the measurement mode.

Select the screen display method.

| | |
|---|---|
| NUMERIC | Displays list of numeric values. |
| GRAPH | Displays graph. |
| X-Y | Displays an X-Y graph.* (p. 263) |

Set the vertical axis to auto scale. (p. 185)

Save the screen. (p. 333)

Print the screen. (p. 381)

Measurement starts. (p. 137)
(This is displayed when SEQ or STEP is selected for the trigger setting.)

Perform a search. (p. 190)

The setting of the cursor. (p. 188)

Move the cursor. (p. 188)

Switch measured values and simulation values during equivalent circuit analysis.

* X-Y is displayed only when the IM9000 Equivalent Circuit Analysis Firmware has been installed.

## 5.2 Setting Basic Settings of Measurement

LCR
ANALYZER

You can set the basic settings for any of NUMERIC and GRAPH first.
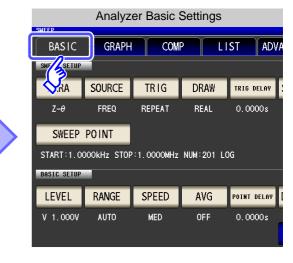
### 5.2.1 Setting the measurement parameter
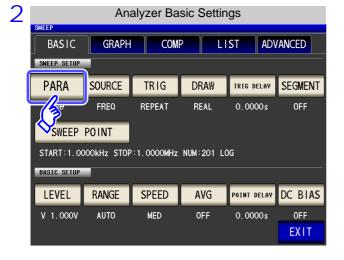
Set the measurement parameter for analyzer mode.

NOTE  DC resistance measurement cannot be performed in analyzer mode.

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



Press PARA .

**5**

Chapter 5 ANALYZER Function

## 5.2 Setting Basic Settings of Measurement

**3**

| Measurement Parameter Setting | | | | |
|---|---|---|---|---|

SWEEP PARAMETER

**PARA1**

| Z | Y | θ | Rs | Rp |
|---|---|---|---|---|
| Cs | Cp | D | G | X |
| Ls | Lp | Q | B | OFF |

**PARA2**

| Z | Y | θ | Rs | Rp |
|---|---|---|---|---|
| Cs | Cp | D | G | X |
| Ls | Lp | Q | B | OFF |

EXIT

**Select the first parameter.**

**Select the second parameter.**

- In analyzer mode, two types of parameter measurement can be performed: PARA1 and PARA2.
- The parameter settings of LCR mode and parameter settings of analyzer mode are synchronized as shown below.

| LCR mode | ANALYZER mode |
|---|---|
| PARA1 | PARA1 |
| PARA2 | Unused |
| PARA3 | PARA2 |
| PARA4 | Unused |

**4** Press **EXIT** **to close the setting screen.**

## 5.2.2 Setting the Sweep Parameter
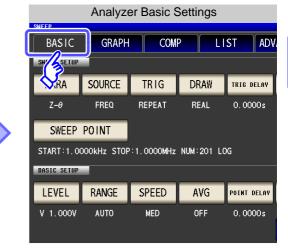
Set the sweep parameter. In analyzer mode, measurement is performed during sweeping for the parameter set for this item. The following four types of parameter can be set as the sweep parameter.
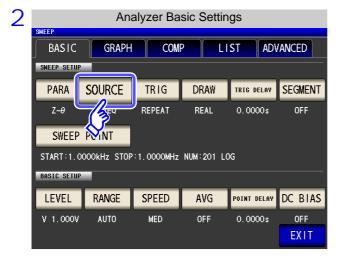
- Frequency
- Open circuit voltage
- Constant voltage
- Constant current

**NOTE** When the sweep parameter is changed, the comparator setting and sweep points are initialized.

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings
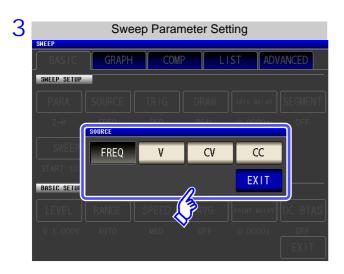


Press SOURCE .

## 5.2 Setting Basic Settings of Measurement

**3**

Sweep Parameter Setting

| SWEEP | | | | | |
|---|---|---|---|---|---|
| BASIC | GRAPH | COMP | LIST | ADVANCED | |

SWEEP SETUP

| PARA | SOURCE | TRIG | DRAW | TRIG DELAY | SEGMENT |
|---|---|---|---|---|---|

SOURCE

| FREQ | V | CV | CC |
|---|---|---|---|

EXIT

**Select the sweep parameter.**

| | |
|---|---|
| FREQ | Performs frequency sweep. |
| V | Performs open circuit voltage sweep. |
| CV | Performs constant voltage sweep. |
| CC | Performs constant current sweep. |

**4** Press  EXIT  to close the setting screen.

## 5.2.3　Setting the Trigger
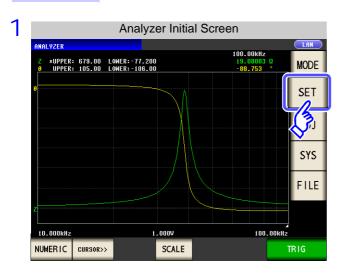
Set the trigger. In analyzer mode, sweeping is performed in accordance with the trigger setting that is set for this item.
The following three types of trigger can be set as the trigger setting.
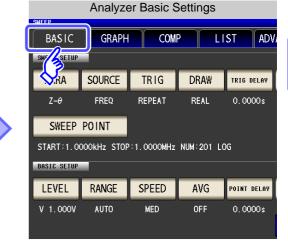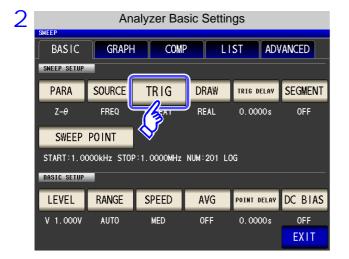
- Sequential sweep
- Repeat sweep
- Step sweep

For details on each of the triggers, refer to Step **1**.

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



Press ⬚TRIG⬚ .

**3**

Trigger Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

SWEEP SETUP

| PARA | SOURCE | TRIG | DRAW | TRIG DELAY | SEGMENT |
| Z-θ | FREQ | SEQ | REAL | 0.0000s | OFF |

SWEEP POINT

START:10.000kHz STO

TRIGGER

| SEQ | REPEAT | STEP |

EXIT

BASIC SETUP

| LEVEL | RANGE | SPEED | AVG | DC BIAS |
| V 1.000V | AUTO | MED | OFF | 0.0000s | OFF |

EXIT

**Select the trigger setting.**

| | |
|---|---|
| SEQ | Performs a sequential sweep. When an external trigger is input, sweep measurement is performed once only. |
| REPEAT | Performs a repeat sweep. An internal trigger results in a sweep being performed repeatedly. |
| STEP | Performs a step sweep. When an external trigger is input, measurement is performed at the current measurement point and then the process moves to the next measurement point. |

- If this is set to SEQ or STEP , TRIG is displayed in the measurement screen.

- Each time you press TRIG , a sequence sweep or step sweep is performed.

**4** Press EXIT to close the setting screen.

NOTE  The trigger setting that is set for this item differs from the trigger setting of LCR mode. (It does not influence the trigger setting of LCR mode.)

## 5.2.4   Setting the Display Timing
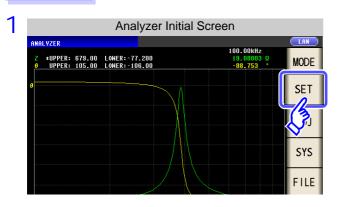
Set the timing for drawing the graph or list.
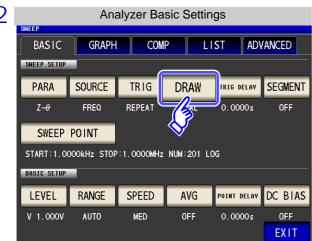
If the display timing is set to REAL , the time for one sweep becomes long because the screen is updated every time each sweep point is measured.

If it is set to AFTER to give priority to the measurement time, the screen update time becomes short.

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



Press DRAW .

**3**

Draw Timing Setting



**Set the timing for display.**

| | |
|---|---|
| REAL | Sequentially draws after measurement of each sweep point. |
| AFTER | Draws all after one sweep is finished. |

## 5.2.5   Setting the Trigger Delay
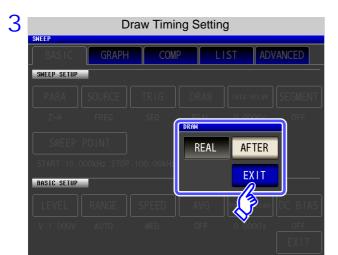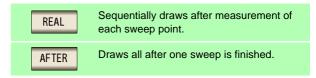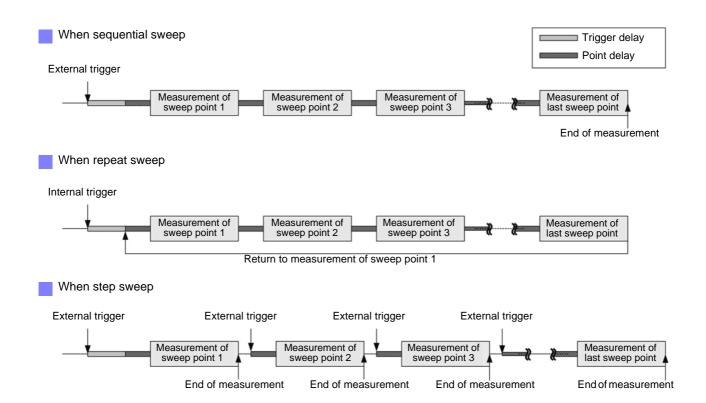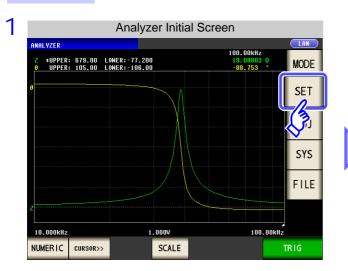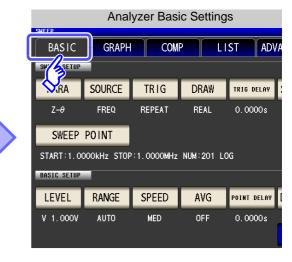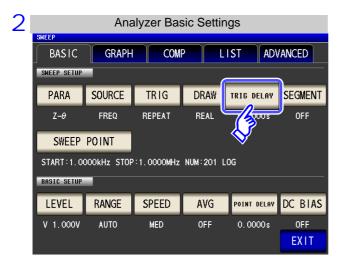
Set the delay time from when a trigger is input until measurement starts.
There are two delay settings: "Trigger Delay" and "Point Delay."
With this item, only the setting for the trigger delay is configured.

**When sequential sweep**

| | Trigger delay |
|---|---|
| | Point delay |

External trigger

| Measurement of sweep point 1 | Measurement of sweep point 2 | Measurement of sweep point 3 | | Measurement of last sweep point |

End of measurement

**When repeat sweep**

Internal trigger

| Measurement of sweep point 1 | Measurement of sweep point 2 | Measurement of sweep point 3 | | Measurement of last sweep point |

Return to measurement of sweep point 1

**When step sweep**

External trigger       External trigger       External trigger       External trigger

| Measurement of sweep point 1 | Measurement of sweep point 2 | Measurement of sweep point 3 | | Measurement of last sweep point |

End of measurement       End of measurement       End of measurement       End of measurement

**Procedure**

**1** Analyzer Initial Screen

Analyzer Basic Settings

**2** Analyzer Basic Settings

Press TRIG DELAY .

**3** Trigger Delay Setting

Use ▲ or ▼ to set the delay time.

- Settable range: 0 to 9.9999 s with resolution of 0.1 ms
- If you make a mistake during input: press C to cancel the input and start again.

**4** Press EXIT to close the setting screen.

5

Chapter 5 ANALYZER Function

# 5.2.6 Segment Setting

Set whether to perform a normal sweep or segment sweep.

| Normal Sweep (p. 143) | ▶ | Set the sweep range and number of sweep points and then perform measurement.<br>(For each sweep point, the measurement conditions, except for the sweep parameter, are the same. It is also possible to fix the sweep parameter and perform interval measurement which measures at a set time interval.) |
|---|---|---|
| Segment Sweep (p. 169) | ▶ | Divide the sweep range into ranges called segments and then perform sweep measurement.<br>(The sweep range, sweep points, and measurement conditions can be set for each segment.) |
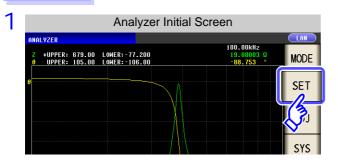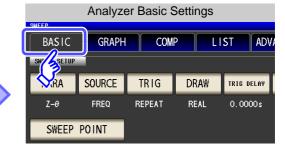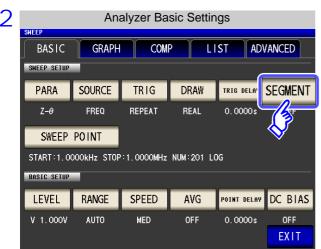
**Procedure**

**1**

Analyzer Initial Screen

Analyzer Basic Settings

**2**

Analyzer Basic Settings

Press SEGMENT .

**3**

Segment Setting

**Select the segments.**

| OFF | Normal Sweep (p. 143) |
|---|---|
| ON | Segment Sweep (p. 169) |

## 5.3 Normal Sweep
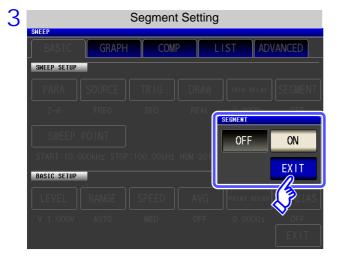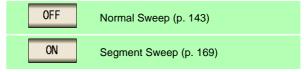
Set just one type for each of the sweep range and number of sweep points and then perform measurement.

## 5.3.1 Setting Sweep Points

The sweep range setting differs depending on the setting of the sweep parameter ( SOURCE ). (p. 135)

- When FREQ (p. 143)
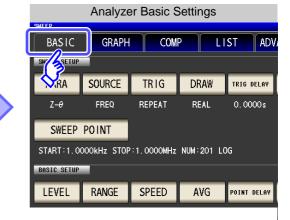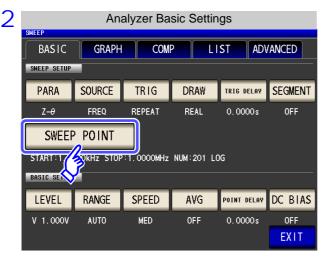
- When V or CV (p. 148)

- When CC (p. 152)

> ⚠️ **CAUTION**
>
> Do not switch between V, CV and CC while the test sample is still connected to the measurement terminals because doing so may damage the test sample. (p. 45)

| When the SOURCE setting is FREQ |
| --- |

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



Press SWEEP POINT .

## 5.3 Normal Sweep

**3**

| Sweep Range Setting |
|---|

SWEEP POINT

**START-STOP** | CENTER-SPAN | START-STEP | INTVL MEAS

| ~~T~~ | 1.0000kHz | 7 | 8 | 9 | M |
| STOP | 1.0000MHz | 4 | 5 | 6 | k |
| NUM | 201 | 1 | 2 | 3 | x1 |
| LINEAR | LOG | 0 | . | C | m |

CANCEL | SET

**Select the setting method of the sweep range.**

For details on the settings, refer to the following figures.

**When you want to cancel the setting:**
Press CANCEL .

---

**START-STOP**
Sets the start value and end value of the sweep. Each sweep point is automatically calculated from the number of sweep points.

**Start value** **End value**

**Number of sweep points**

---

**START-STEP**
Sets the start value of the sweep and the step width of sweep points.
Each sweep point is automatically calculated from the number of sweep points.

**Start value**

**Step Width**

---

**CENTER-SPAN**
Sets the center value of the sweep range and the sweep width.
Each sweep point is automatically calculated from the number of sweep points.

**Center value**

**Sweep Width**

---

**INTVL MEAS**
Fixes the sweep parameter and performs measurement at a set time interval.

**Time interval**

**Number of sweep points**

Time

---

**START-STOP** **Setting the start value and end value of the sweep**

START-STOP Settings

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 1.0000kHz |
| STOP | 1.0000MHz |
| NUM | 201 |
| LINEAR | LOG |

Numeric keypad: 7 8 9 M / 4 5 6 k / 1 2 3 x1 / 0 . C

CANCEL   SET

If you make a mistake during input:
press **C** to cancel the input and start again.

1. Press **START** and use the numeric keypad to set the start value of the sweep.

   Settable range: 4 Hz to 5 MHz

2. Press **M**, **k**, or **x1** key to confirm the setting.

3. Press **STOP** and use the numeric keypad to set the end value of the sweep.

   Settable range: 4 Hz to 5 MHz

4. Press **M**, **k**, or **x1** key to confirm the setting.

5. Press **NUM** and use the numeric keypad to enter the number of sweep points.

   Settable range: 2 to 801

6. Press **x1** key to confirm the setting.

7. Select the setting method for sweep points (when frequency sweep).

| **LINEAR** | The sweep points are calculated linearly from the setting values of **START**, **STOP**, and **NUM**. |
| **LOG** | The sweep points are calculated logarithmically from the setting values of **START**, **STOP**, and **NUM**. |
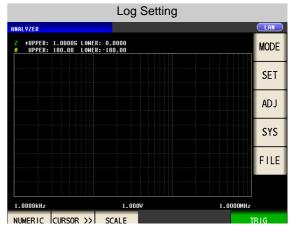
8. Press **SET** to confirm the setting.

**NOTE** • The setting method of the sweep points can only be selected when the sweep parameter is frequency and the setting method of the sweep range is **START-STEP**. In other cases, the setting method of the sweep points is fixed to linear.

• If the setting method of the sweep points is changed, the horizontal axis scale of the graph display screen changes as shown in the figures below. (The horizontal axis scale of the graph can also be changed with the horizontal axis scale setting.)

   **See:** "Horizontal Axis Scale Setting" (p. 177)

When the **SCALE** setting is **LINEAR**.

Linear Setting

ANALYZER                          LAN
Z  *UPPER: 1.0000G LOWER: 0.0000
θ   UPPER: 180.00  LOWER:-180.00
                                 MODE
                                 SET
                                 ADJ
                                 SYS
                                 FILE
1.0000kHz   1DIV:100.00kHz  1.000V   1.0000MHz
NUMERIC  CURSOR >>  SCALE          TRIG

When the **SCALE** setting is **LOG**.

Log Setting

ANALYZER                          LAN
Z  *UPPER: 1.0000G LOWER: 0.0000
θ   UPPER: 180.00  LOWER:-180.00
                                 MODE
                                 SET
                                 ADJ
                                 SYS
                                 FILE
1.0000kHz        1.000V        1.0000MHz
NUMERIC  CURSOR >>  SCALE          TRIG

**5**

Chapter 5 ANALYZER Function

## CENTER-SPAN Setting the center value of the sweep range and the sweep width

### CENTER-SPAN Setting

**SWEEP POINT**

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| CENTER | 5. 25mA |
| SPAN | 9. 50mA |
| NUM | 50 |

Keypad: 7 8 9 M / 4 5 6 k / 1 2 3 x1 / 0 . C

CANCEL  SET

If you make a mistake during input:
press **C** to cancel the input and start again.

**1.** Press **CENTER** and use the numeric keypad to set the center value of the sweep range.

Settable range: 4 Hz to 5 MHz

**2.** Press **M**, **k**, or **x1** key to confirm the setting.

**3.** Press **SPAN** and use the numeric keypad to set the sweep width.

Settable range: 4 Hz to 5 MHz

**4.** Press **M**, **k**, or **x1** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** key to confirm the setting.

**NOTE** The sweep width set with **SPAN** is centered on the frequency that was set with **CENTER**. Therefore, the range of values that you can set with **SPAN** varies depending on the value set with **CENTER**.

## START-STEP Setting the start value of the sweep and the step width of the sweep point

### START-STEP Settings

**SWEEP POINT**

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 1. 0000kHz |
| STEP | 4. 9950kHz |
| NUM | 201 |

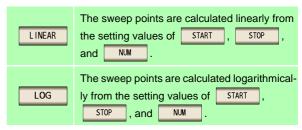Keypad: 7 8 9 M / 4 5 6 k / 1 2 3 x1 / 0 . C

CANCEL  SET

If you make a mistake during input:
press **C** to cancel the input and start again.

**1.** Press **START** and use the numeric keypad to set the start value of the sweep.

Settable range: 4 Hz to 5 MHz

**2.** Press **M**, **k**, or **x1** key to confirm the setting.

**3.** Press **STEP** and use the numeric keypad to set the step width of the sweep point.

Settable range: 4 Hz to 5 MHz

**4.** Press **M**, **k**, or **x1** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** key to confirm the setting.

**NOTE** The range of values that can be set for **STEP** varies depending on the values set with **START**

| | INTVL MEAS | **Fixing sweep parameter and setting measurement to be performed at a set time interval (Time interval measurement)** |

**INTERVAL Setting**

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| POINT | 1.0000kHz | 7 | 8 | 9 | M |
| INTERVAL | 0.0000s | 4 | 5 | 6 | k |
| NUM | 201 | 1 | 2 | 3 | x1 |
| | | 0 | . | C | m |

CANCEL    SET

If you make a mistake during input:

press  C  to cancel the input and start again.

**1.** Press  POINT  and use the numeric keypad to set the start value of the sweep.

Settable range: 4 Hz to 5 MHz

**2.** Press  M ,  k , or  x1  key to confirm the setting.

**3.** Press  INTVL MEAS  and use the numeric keypad to set the measurement time interval.

Settable range: 0 s to 10000 s

**4.** Press  x1  key to confirm the setting.

**5.** Press  NUM  and use the numeric keypad to enter the number of measurements.

Settable range: 2 to 801

**6.** Press  x1  key to confirm the setting.

**7.** Press  SET  key to confirm the setting.

**NOTE**    When the sweep range setting method is changed, the measurement interval for INTERVAL measurement is reflected in the point delay time.

**5**

Chapter 5 ANALYZER Function

When the SOURCE setting is V or CV

**Procedure**    Example: When V

**1**

Analyzer Initial Screen



**2**



Press SWEEP POINT .

**3**

| START-STOP Settings |
|---|

SWEEP POINT

**START-STOP**  CENTER-SPAN  START-STEP  INTVL MEAS

START 0.050V

STOP 1.000V

NUM 50

7 8 9 M
4 5 6 k
1 2 3 x1
0 . C m

CANCEL  SET

**Select the setting method of the sweep range.**

For details on the settings, refer to the following figures.

> **When you want to cancel the setting:**
>
> Press CANCEL .

**START-STOP**  Sets the start value and end value of the sweep. Each sweep point is automatically calculated from the number of sweep points.

Start value     End value

**Number of sweep points**

**START-STEP**  Sets the start value of the sweep and the step width of sweep points. Each sweep point is automatically calculated from the number of sweep points.

Start value

**Step Width**

**CENTER-SPAN**  Sets the center value of the sweep range and the sweep width. Each sweep point is automatically calculated from the number of sweep points.

Center value

**Sweep Width**

**INTVL MEAS**  Fixes the sweep parameter and performs measurement at a set time interval.

Time interval

**Number of sweep points**

Time

**5**

**Chapter 5 ANALYZER Function**

| START-STOP | **Setting the start value and end value of the sweep** |

### START-STOP Settings

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 0.050V |
| STOP | 1.000V |
| NUM | 50 |

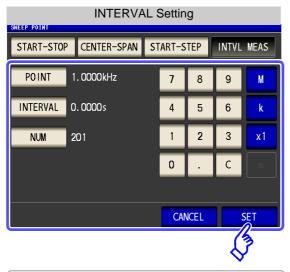Keypad: 7 8 9 M / 4 5 6 k / 1 2 3 x1 / 0 . C m

CANCEL    SET

If you make a mistake during input:
press C to cancel the input and start again.

**1.** Press START and use the numeric keypad to set the start value of the sweep.

Settable range: 0.005 to 5.000 V

**2.** Press x1 key to confirm the setting.

**3.** Press STOP and use the numeric keypad to set the end value of the sweep.

Settable range: 0.005 to 5.000 V

**4.** Press x1 key to confirm the setting.

**5.** Press NUM and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press x1 key to confirm the setting.

**7.** Press SET to confirm the setting.

**NOTE** When V or CV is set for the sweep parameter, the setting method of the sweep points is fixed to linear.

| CENTER-SPAN | **Setting the center value of the sweep range and the sweep width** |

### CENTER-SPAN Setting

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| CENTER | 0.525V |
| SPAN | 0.950V |
| NUM | 50 |

Keypad: 7 8 9 M / 4 5 6 k / 1 2 3 x1 / 0 . C m

CANCEL    SET

If you make a mistake during input:
press C to cancel the input and start again.

**1.** Press CENTER and use the numeric keypad to set the center value of the sweep range.

Settable range: 0.005 to 5.000 V

**2.** Press x1 key to confirm the setting.

**3.** Press SPAN and use the numeric keypad to set the sweep width.

Settable range: 0.005 to 5.000 V

**4.** Press x1 key to confirm the setting.

**5.** Press NUM and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press x1 key to confirm the setting.

**7.** Press SET to confirm the setting.

**NOTE** The sweep width set with SPAN is centered on the frequency that was set with CENTER. Therefore, the range of values that you can set with SPAN varies depending on the value set with CENTER.

**START-STEP** | **Setting the start value of the sweep and the step width of the sweep point**

### START-STEP Settings

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 0.050V | | 7 | 8 | 9 | M |
| STEP | 0.019V | | 4 | 5 | 6 | k |
| NUM | 50 | | 1 | 2 | 3 | x1 |
| | | | 0 | . | C | m |

CANCEL | SET

If you make a mistake during input:
press C to cancel the input and start again.

**1.** Press **START** and use the numeric keypad to set the start value of the sweep.

Settable range: 0.005 to 5.000 V

**2.** Press x1 key to confirm the setting.

**3.** Press **STEP** and use the numeric keypad to set the step width of the sweep point.
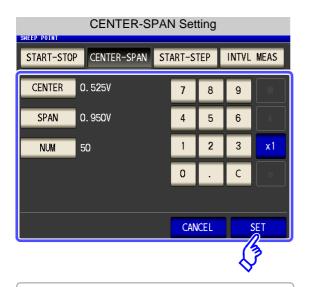
Settable range: 0.005 to 5.000 V

**4.** Press x1 key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press x1 key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**NOTE** The range of values that can be set for **STEP** varies depending on the values set with **START** and **NUM**.

**INTVL MEAS** | **Fixing sweep parameter and setting measurement to be performed at a set time interval (Time interval measurement)**

### INTERVAL Setting

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| POINT | 0.050V | | 7 | 8 | 9 | M |
| INTERVAL | 0.0000s | | 4 | 5 | 6 | k |
| NUM | 50 | | 1 | 2 | 3 | x1 |
| | | | 0 | . | C | m |

CANCEL | SET

If you make a mistake during input:
press C to cancel the input and start again.

**1.** Press **POINT** and use the numeric keypad to set the start value of the sweep.

Settable range: 0.005 to 5.000 V

**2.** Press x1 key to confirm the setting.

**3.** Press **INTVL MEAS** and use the numeric keypad to set the measurement time interval.

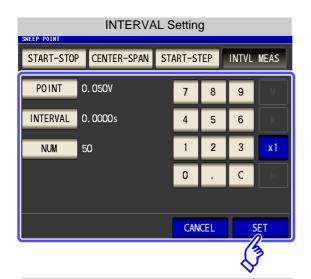Settable range: 0 s to 10000 s

**4.** Press x1 key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of measurements.

Settable range: 2 to 801

**6.** Press x1 key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**5**

**Chapter 5 ANALYZER Function**

When the SOURCE setting is CC

**Procedure**

**1**

Analyzer Initial Screen

ANALYZER                                     LAN

Z  *UPPER: 679.00  LOWER:-77.200      100.00kHz
θ   UPPER: 105.00  LOWER:-106.00       19.08003 Ω
                                        -88.753  °

θ

Z

10.000kHz          1.000V          100.00kHz

NUMERIC  CURSOR>>        SCALE          TRIG

MODE
SET
J
SYS
FILE

SWEEP

BASIC  GRAPH  COMP  LIST  ADV.

SWEEP SETUP

PARA  SOURCE  TRIG  DRAW  TRIG DELAY

Z-θ    CC    REPEAT  REAL  0.0000s

SWEEP POINT

START:0.50mA STOP:10.00mA NUM:50 LIN

BASIC SETUP

FREQ  RANGE  SPEED  AVE  POINT DELAY

1.0000kHz  AUTO  MED  OFF  0.0000s

**2**

SWEEP

BASIC  GRAPH  COMP  LIST  ADVANCED

SWEEP SETUP

PARA  SOURCE  TRIG  DRAW  TRIG DELAY  SEGMENT

Z-θ    CC    REPEAT  REAL  0.0000s  OFF

SWEEP POINT

START:0.50mA STOP:10.00mA NUM:50 LIN

BASIC SE

FREQ  RANGE  SPEED  AVE  POINT DELAY  DC BIAS

1.0000kHz  AUTO  MED  OFF  0.0000s  OFF

EXIT

**Press** SWEEP POINT .

**3**

| START-STOP Settings |
|---|
| SWEEP POINT |
| **START-STOP** CENTER-SPAN START-STEP INTVL MEAS |
| START 0. 50mA |
| STOP 10. 00mA |
| NUM 50 |
| CANCEL SET |

**Select the setting method of the sweep range.**

For details on the settings, refer to the following figures.

**When you want to cancel the setting:**

Press CANCEL .

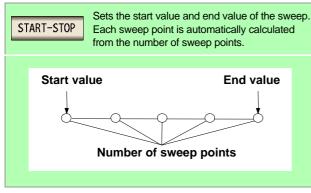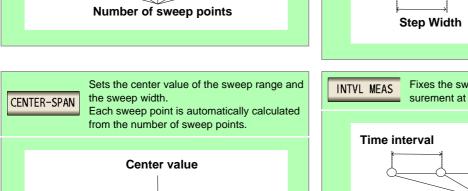START-STOP | Sets the start value and end value of the sweep. Each sweep point is automatically calculated from the number of sweep points.

**Start value**      **End value**

**Number of sweep points**

START-STEP | Sets the start value of the sweep and the step width of sweep points. Each sweep point is automatically calculated from the number of sweep points.

**Start value**

**Step Width**

CENTER-SPAN | Sets the center value of the sweep range and the sweep width. Each sweep point is automatically calculated from the number of sweep points.

**Center value**

**Sweep Width**

INTVL MEAS | Fixes the sweep parameter and performs measurement at a set time interval.

**Time interval**

**Number of sweep points**

Time

**5**

**Chapter 5 ANALYZER Function**

**START-STOP** **Setting the start value and end value of the sweep**

Sweep start value and end value settings

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 0.50mA |
| STOP | 10.00mA |
| NUM | 50 |

Numeric keypad: 7 8 9 | 4 5 6 | 1 2 3 x1 | 0 . C m | M k

CANCEL  SET

If you make a mistake during input:
press **C** to cancel the input and start again.

**1.** Press **START** and use the numeric keypad to set the start value of the sweep.

Settable range: 0.01 mA to 50 mA

**2.** Press **m** key to confirm the setting.

**3.** Press **STOP** and use the numeric keypad to set the end value of the sweep.

Settable range: 0.01 mA to 50 mA

**4.** Press **m** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**NOTE** When **CC** is set for the sweep parameter, the setting method of the sweep points is fixed to linear.

---

**CENTER-SPAN** **Setting the center value of the sweep range and the sweep width**

CENTER-SPAN Setting

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| CENTER | 5.25mA |
| SPAN | 9.50mA |
| NUM | 50 |

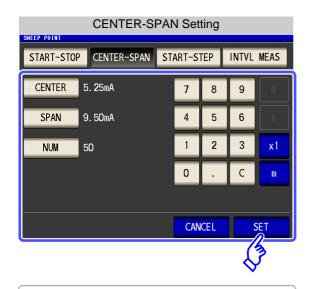Numeric keypad: 7 8 9 | 4 5 6 | 1 2 3 x1 | 0 . C m | M k

CANCEL  SET

If you make a mistake during input:
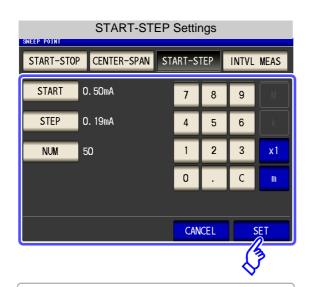press **C** to cancel the input and start again.

**1.** Press **CENTER** and use the numeric keypad to set the center value of the sweep range.

Settable range: 0.01 mA to 50 mA

**2.** Press **m** key to confirm the setting.

**3.** Press **SPAN** and use the numeric keypad to set the sweep width.

Settable range: 0.01 mA to 50 mA

**4.** Press **m** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**NOTE** The sweep width set with **SPAN** is centered on the frequency that was set with **CENTER**. Therefore, the range of values that you can set with **SPAN** varies depending on the value set with **CENTER**.

**START-STEP** **Setting the start value of the sweep and the step width of the sweep point**

| START-STEP Settings |
|---|

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| START | 0.50mA | 7 | 8 | 9 | M |
| STEP | 0.19mA | 4 | 5 | 6 | k |
| NUM | 50 | 1 | 2 | 3 | x1 |
| | | 0 | . | C | m |

CANCEL    SET

If you make a mistake during input:
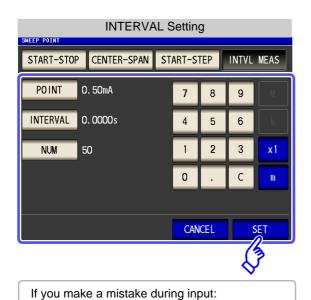press C to cancel the input and start again.

**1.** Press **START** and use the numeric keypad to set the start value of the sweep.

Settable range: 0.01 mA to 50 mA

**2.** Press **m** key to confirm the setting.

**3.** Press **STEP** and use the numeric keypad to set the step width of the sweep point.

Settable range: 0.01 mA to 50 mA

**4.** Press **m** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of sweep points.

Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**NOTE** The range of values that can be set for **STEP** varies depending on the values set with **START** and **NUM**.

**INTVL MEAS** **Fixing sweep parameter and setting measurement to be performed at a set time interval (Time interval measurement)**

| INTERVAL Setting |
|---|

SWEEP POINT

| START-STOP | CENTER-SPAN | START-STEP | INTVL MEAS |

| POINT | 0.50mA | 7 | 8 | 9 | M |
| INTERVAL | 0.0000s | 4 | 5 | 6 | k |
| NUM | 50 | 1 | 2 | 3 | x1 |
| | | 0 | . | C | m |

CANCEL    SET

If you make a mistake during input:
press C to cancel the input and start again.

**1.** Press **POINT** and use the numeric keypad to set the start value of the sweep.

Settable range: 0.01 mA to 50 mA

**2.** Press **m** key to confirm the setting.

**3.** Press **INTVL MEAS** and use the numeric keypad to set the measurement time interval.

Settable range: 0 s to 10000 s

**4.** Press **x1** key to confirm the setting.

**5.** Press **NUM** and use the numeric keypad to enter the number of measurements.
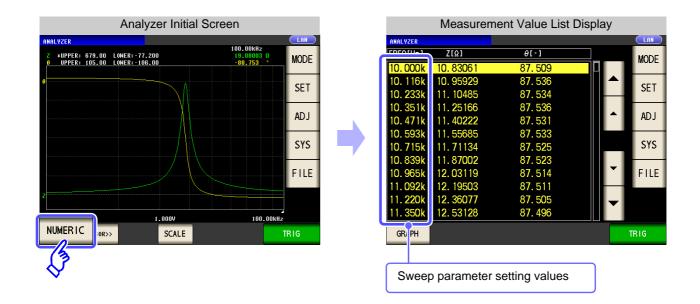
Settable range: 2 to 801

**6.** Press **x1** key to confirm the setting.

**7.** Press **SET** to confirm the setting.

**NOTE** The measurement interval for INTERVAL measurement is reflected in the point delay time.
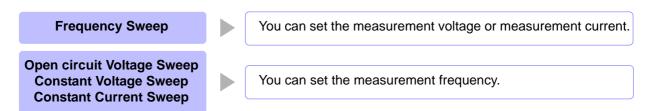
## How to Check the Set Sweep Points

You can check the sweep point setting values in the sweep parameter setting section of the numerical value list display screen.
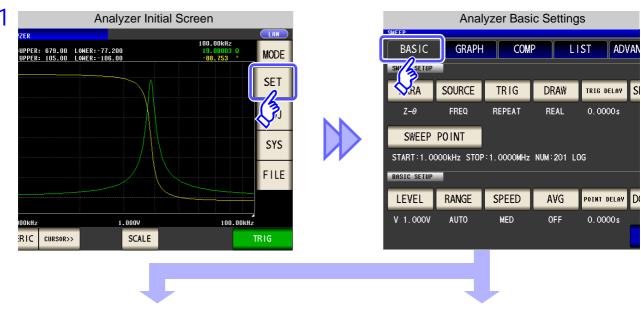


Sweep parameter setting values

## 5.3.2 Setting the Measurement Signal
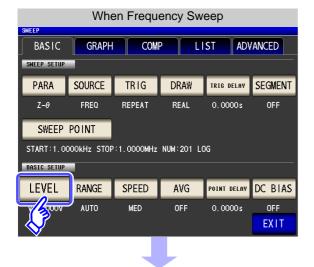
For the measurement signal setting, either the measurement frequency or measurement signal level can be set as a measurement signal other than the sweep parameter, depending on the setting of the sweep parameter.

| Frequency Sweep | ▶ | You can set the measurement voltage or measurement current. |

| Open circuit Voltage Sweep<br>Constant Voltage Sweep<br>Constant Current Sweep | ▶ | You can set the measurement frequency. |

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2** When the **SOURCE** setting is **FREQ**

When Frequency Sweep



When the **SOURCE** setting is **V**, **CV**, or **CC**

When Open-circuit Voltage Sweep, Constant Voltage Sweep, & Constant Current Sweep

**3** Open-circuit Voltage, Constant Voltage, & Constant Current Settings

Frequency Setting

**Select the measurement level.**

| V | Open circuit voltage level (p. 45) |
|---|---|
| CV | Voltage level between test sample terminals (p. 45) |
| CC | Current level through test sample (p. 47) |

Use ▲ or ▼ to enter the voltage or current value.

Use ▲ or ▼ to enter each digit of the frequency.

- Settable range: 4.00 Hz to 5.0000 MHz
- Press 10-KEY or DIGIT to change the input method.

**4** Press EXIT to close the setting screen.

⚠ **CAUTION** Do not switch between V, CV and CC while the test sample is still connected to the measurement terminals because doing so may damage the test sample.

**NOTE** The frequency and measurement level that can be set vary depending on the set sweep point range.
Example: When the sweep parameter is set to open circuit voltage level, the settable range of frequencies is 4.00 Hz to 1.0000 MHz if there is a sweep point of 1 V or above.
For details, refer to "4.2.1 Setting the Measurement frequency" (p. 41) and "4.2.2 Setting the Measurement signal level" (p. 43) of the LCR function.

## How to Check the Set Measurement Signal



Analyzer Initial Screen

You can check the measurement signal setting value in the measurement signal setting section of the graph display screen.

### 5.3.3 Setting the Measurement Range

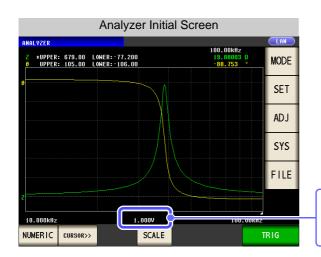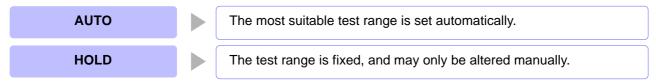When measuring, for example, a test sample whose impedance varies greatly with frequency or a test sample whose nature is unknown, the most suitable measurement range can be set with AUTO. And, fixing the range with HOLD enables high speed measurement.
There are the following two methods for setting the measurement range.
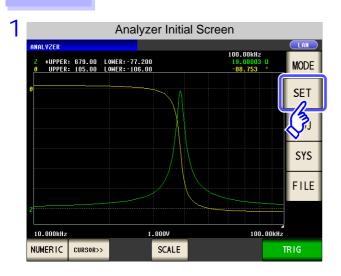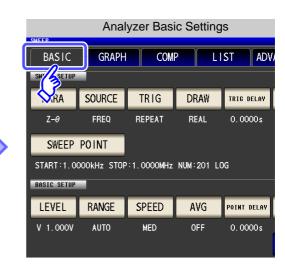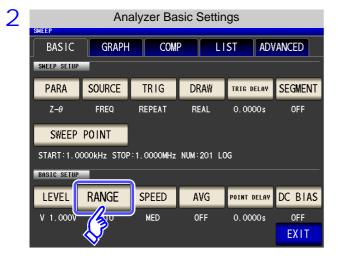
| AUTO | ▶ | The most suitable test range is set automatically. |
| HOLD | ▶ | The test range is fixed, and may only be altered manually. |

NOTE
- The ranges are all defined in terms of impedance. Therefore, for a parameter other than impedance, the value is obtained by calculating from the measured values of |Z| and θ.
  **See**"Appendix 1  Measurement Parameters and Arithmetic Expressions"(p. A1)
- In analyzer mode, low Z high accuracy mode is set to OFF.

**1  Setting AUTO Ranging**

Procedure

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



**Press** RANGE .

**3**

Range Setting



Press AUTO .

If the instrument is being used outside the limits of its specification, the suitable range may not be set in auto ranging function. In this case, check the accuracy assured ranges in "13.2 Measurement Range and Accuracy" (p. 395) and then change the test conditions.

**4** Press EXIT to close the setting screen.

NOTE  When an element other than a capacitor or a capacitor with a low DC resistance is measured while using DC bias, the AUTO range may not work properly and a range may not be able to be determined.

## 5.3 Normal Sweep

### 2 Setting the Ranging to HOLD

**Procedure**

**1**

Analyzer Initial Screen

ANALYZER

Z  *UPPER: 679.00  LOWER:-77.200
θ   UPPER: 105.00  LOWER:-106.00

100.00kHz
19.08003 Ω
-88.753  °

LAN

MODE

SET

ADJ

SYS

FILE

10.000kHz          1.000V          100.00kHz

NUMERIC   CURSOR>>        SCALE          TRIG

Analyzer Basic Settings

SWEEP

BASIC    GRAPH    COMP    LIST    ADVA
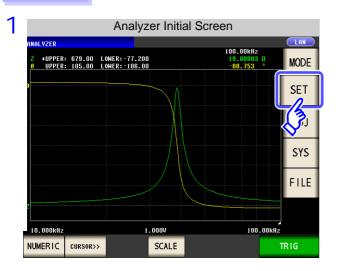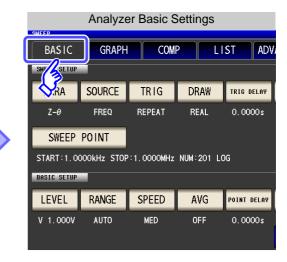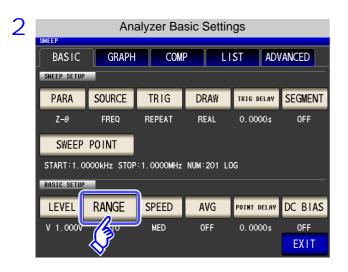
SWEEP SETUP

PARA    SOURCE    TRIG    DRAW    TRIG DELAY

Z-θ      FREQ    REPEAT    REAL    0.0000s

SWEEP POINT

START:1.0000kHz STOP:1.0000MHz NUM:201 LOG

BASIC SETUP

LEVEL    RANGE    SPEED    AVG    POINT DELAY

V 1.000V    AUTO    MED    OFF    0.0000s

**2**

Analyzer Basic Settings

SWEEP

BASIC    GRAPH    COMP    LIST    ADVANCED

SWEEP SETUP

PARA    SOURCE    TRIG    DRAW    TRIG DELAY    SEGMENT

Z-θ      FREQ    REPEAT    REAL    0.0000s    OFF

SWEEP POINT

START:1.0000kHz STOP:1.0000MHz NUM:201 LOG

BASIC SETUP

LEVEL    RANGE    SPEED    AVG    POINT DELAY    DC BIAS

V 1.000V    AUTO    MED    OFF    0.0000s    OFF

EXIT

Press RANGE .

**3**

Range Hold Setting

SWEEP

BASIC    GRAPH    COMP    LIST    ADVANCED

SWEEP SETUP

RANGE

100mΩ    1Ω    10Ω    300Ω    HOLD

1kΩ    3kΩ    10kΩ    30kΩ

100kΩ    1MΩ    10MΩ    100MΩ    EXIT

BASI

LEVEL    RANGE    SPEED    AVG    POINT DELAY    DC BIAS

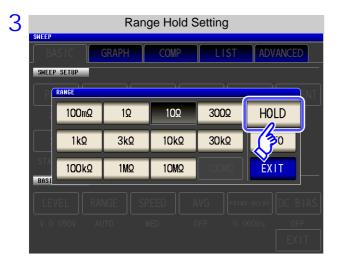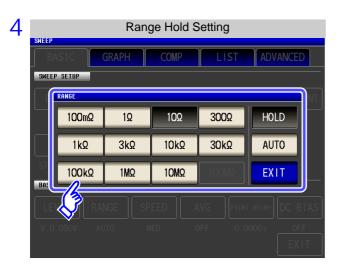V 0.050V    AUTO    MED    OFF    0.0000s    OFF

EXIT

Press HOLD .

**4**  Range Hold Setting



Set the test range according to the combined impedance value of the sample to be tested and the test cables.

**To select the measurement range.**

| Test range | Accuracy guaranteed range | AUTO ranging range |
|---|---|---|
| 100 MΩ | 8 MΩ to 200 MΩ | 8 MΩ to 999.999 MΩ |
| 10 MΩ | 800 kΩ to 100 MΩ | 800 kΩ to 10 MΩ |
| 1 MΩ | 80 kΩ to 10 MΩ | 80 kΩ to 1 MΩ |
| 100 kΩ | 24 kΩ to 1 MΩ | 24 kΩ to 100 kΩ |
| 30 kΩ | 8 kΩ to 300 kΩ | 8 kΩ to 30 kΩ |
| 10 kΩ | 2.4 Ω to 100 kΩ | 2.4 kΩ to 10 kΩ |
| 3 kΩ | 800 Ω to 30 kΩ | 800 Ω to 3 kΩ |
| 1 kΩ | 240 Ω to 10 kΩ | 240 Ω to 1 kΩ |
| 300 Ω | 8 Ω to 300 Ω | 8 Ω to 300 Ω |
| 10 Ω | 800 mΩ to 10 Ω | 800 mΩ to 10 Ω |
| 1 Ω | 80 mΩ to 1 Ω | 80 mΩ to 1 Ω |
| 100 mΩ | 1 mΩ to 100 mΩ | 0 Ω to 100 mΩ |

**NOTE**
- The guaranteed accuracy range varies depending on the measurement conditions.
  **See:** Check the guaranteed accuracy range in "13.2 Measurement Range and Accuracy" (p. 395).
- The measurement range is determined according to the test range setting.If the display for the measured value shows "**OVER FLOW**" or "**UNDER FLOW**", that means that measurement cannot be performed using the currently set test range. Either you should set AUTO ranging so as to select the most suitable test range automatically, or you should set a more suitable test range manually.
- If the measurement range setting exceeds the range in the table above when the measurement frequency is set, it is automatically changed to the maximum setting. For example, if the frequency is set to 1.001 MHz when the measurement range is in the 1 MΩ range state, the measurement range is changed to the 100 kΩ range.
- If FREQ (frequency) is set for sweep (p. 143), some ranges cannot be used depending on the frequency range.
  - 10 MΩ range: Up to 1.0000 MHz
  - 100 MΩ range: Up to 100.00 kHz
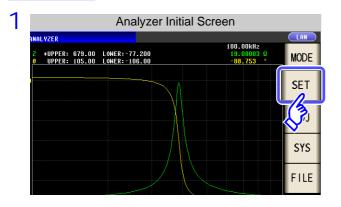
**5**  Press  EXIT  to close the setting screen.
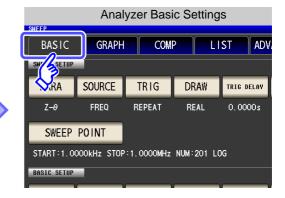
**NOTE**
- With a test sample whose impedance varies with frequency, if the frequency is changed during measurement using HOLD, measurement within the same range may not be possible. When this happens, change the measurement range.
- The test range setting is made according to the combination of the impedances of the sample being tested and the test cables. Therefore it can happen that testing is not possible, if the test range is held with HOLD only upon the basis of the impedance of the sample under test. If this happens, you should change the test range, making reference to "7.1 Setting Open Circuit Compensation" (p. 273) and "7.2 Short Circuit Compensation" (p. 280).

**5**

**Chapter 5 ANALYZER Function**

## 5.3.4 Setting the Measurement speed

The testing speed can be set. The slower the testing speed is, the more accurate are the results.

**Procedure**

**1**

Analyzer Initial Screen

Analyzer Basic Settings

**2**

Analyzer Basic Settings

Press **SPEED** .

**3**

Measurement Speed Setting

**To select the measurement speed**

| | |
|---|---|
| **FAST** | Performs high-speed measurement. |
| **MED** | This is the normal measurement speed. |
| **SLOW** | Measurement precision improves. |
| **SLOW2** | Measurement accuracy is better than SLOW. |

The testing speed varies according to the number of parameters being displayed, and according to their type. The speeds given in the table relate to the case of |Z| only being displayed.
**See** "About Measurement Times and Measurement Speed" (p. 399)

**4** Press **EXIT** to close the setting screen.

## 5.3.5 Displaying as Average Values (Average set)
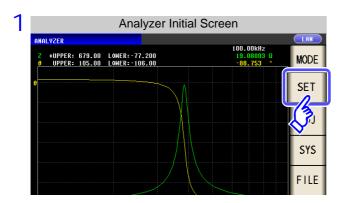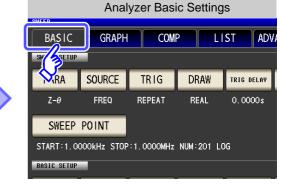
With the averaging function, the measured values can be averaged. Using this function, it is possible to reduce fluctuations in the measured value display.
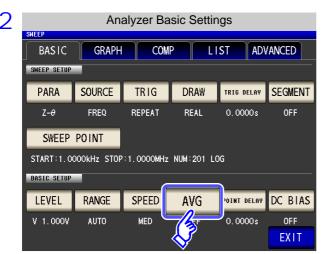
**NOTE** The measurement values are averaged by arithmetic averaging during analyzer measurement regardless of the trigger setting.
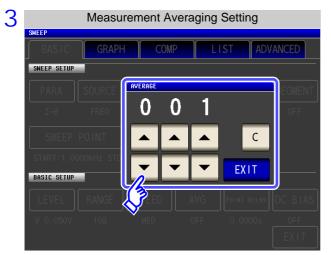
**Procedure**

**1** Analyzer Initial Screen



Analyzer Basic Settings



**2** Analyzer Basic Settings



Press **AVG**

**3** Measurement Averaging Setting



Use ▲ or ▼ to enter the number of averaging times.

Settable range: 1 to 256 times

**When you want to cancel the averaging function:** Press C .
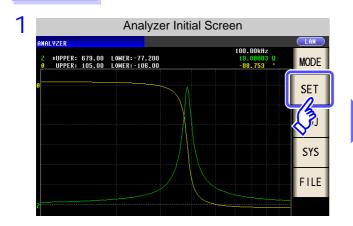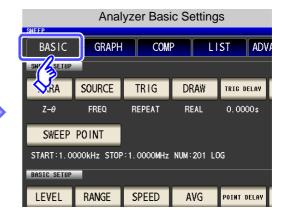
The number of averaging times is set to 001.
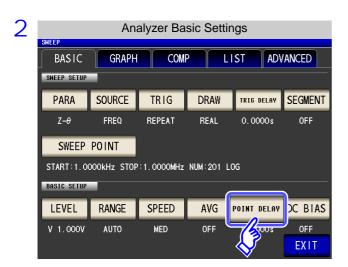
## 5.3.6 Setting the Point Delay

For the point delay setting, set the delay time for each sweep point.
**See** "5.2.5 Setting the Trigger Delay" (p. 140)

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Analyzer Basic Settings



Press POINT DELAY .

**3**

Point Delay Setting



Use ▲ or ▼ to enter the delay time.
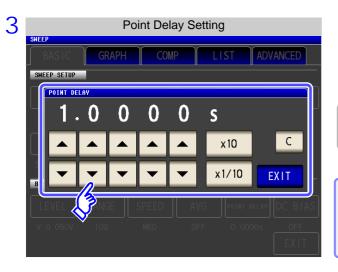
Settable range: 0.0000 s to 10000 s with resolution of 0.1 ms

**When you want to cancel the point delay function:** Press C .
The setting value is cleared to 0.
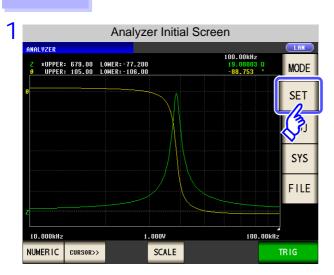
**4** Press EXIT to close the setting screen.

## 5.3.7 Setting the DC Bias
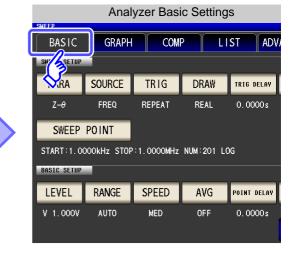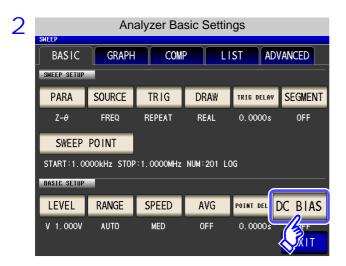
For the DC bias setting, set the DC bias value for when sweep measurement is performed.
If the DC bias is set, a DC signal can be superimposed on the measurement signal.

**Procedure**

**1**  Analyzer Initial Screen    Analyzer Basic Settings

**2**  Analyzer Basic Settings

Press  DC BIAS .

**3**  DC Bias Setting

**Select ON/ OFF for the DC bias.**

| OFF | Sets the DC bias to OFF. |
|-----|--------------------------|
| ON  | Sets the DC bias to ON.  |

| SET EXT | Press this button when using an external DC bias unit. The DC bias will be set to ON, and the bias value will be set to 0.00 V. |
|---------|----|

**5**

**Chapter 5 ANALYZER Function**

**4**

DC Bias Setting



Use ▲ or ▼ to set the DC bias.

Settable range: 0.00 V to 2.5 V

If you make a mistake during input:

press C to cancel the input and start again.

**5** Press EXIT to close the setting screen.

**NOTE**

- The DC bias function is specifically for capacitor measurement. If it is used for resistor, inductor, and other elements with low DC resistance, the following are likely.
  - Normal measurement is not possible
  - AUTO ranging is unable to determine a range.
  - In low impedance high accuracy mode, a contact error is generated even though the terminal connections are correct.
- The DC bias function cannot be set during Rdc measurement.
- The DC bias function cannot be set when RDC measurement has been selected with the **:MEASure:ITEM** setting.
- When superimposing a DC voltage of 2.5 V or above, refer to "Appendix5.1  How to Supply a DC Bias Voltage"(p. A7).
- When superimposing a DC voltage on a coil or the like, refer to "Appendix5.2  How to Supply a DC Bias Current"(p. A9).
- A value for which the sum of the effective value of the AC signal level and the DC signal level will exceed 7.07 V cannot be set.
- If the total value for the measurement signal level (AC level + DC bias value) will become $> 5\sqrt{2}$ [V], the measurement signal cannot be raised any higher. Reduce the AC level or DC bias value, and then configure the setting.

## 5.4 Segment Sweep

You can set multiple sweep ranges (up to 20) for the frequency or level and perform the sweep continuously.

> **What is a Segment?**
>
> A segment refers to one block for which individual settings such as the sweep range, number of sweep points, and measurement signal level can be set.

## 5.4.1 Select Segments

Set the segment settings [ ON ] beforehand in "5.2.6 Segment Setting" (p. 142).

You can set up to 20 segments (total of 801 points).
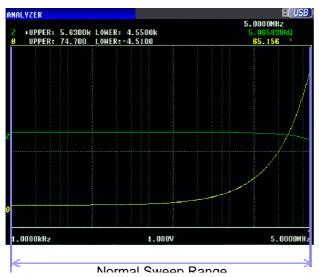
**NOTE**
- The sweep range setting differs depending on the setting of the sweep parameter ( SOURCE ). (p. 135)
- If a segment is edited (including with ADD and DELETE) or the sweep points are edited, the comparator setting becomes invalid. (p. 197)

**5**

**Chapter 5 ANALYZER Function**

### Comparison of Normal Sweep and Segment Sweep

#### When normal sweep

| Sweep Setting Items | Segment |
|---|---|
| Sweep parameter | Frequency |
| Sweep Range | 1.0000 kHz to 5.0000 MHz |
| Number of sweep point | 801 points |
| Setting method of sweep points | Log |
| Measurement signal type | Open circuit voltage level |
| Measurement signal level | 1.000 V |
| Range | AUTO |
| Average | 5 times |
| Measurement speed | FAST |
| Point delay | 0.0005 s |



Normal Sweep Range
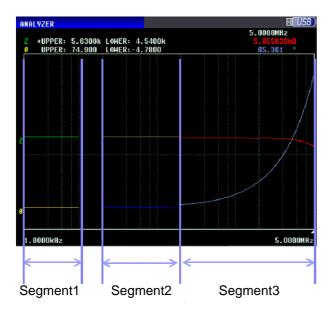
### When segment sweep

| Sweep Settings | Segment 1 | Segment 2 | Segment 3 |
|---|---|---|---|
| Sweep parameter | Frequency | Frequency | Frequency |
| Sweep Range | 1.0000kHz to 5.0000kHz | 10.000kHz to 100.00kHz | 100.00 kHz to 5.0000MHz |
| Number of sweep point | 201 points | 201 points | 399 points |
| Setting method of sweep points | Log | Log | Linear |
| Measurement signal type | Open circuit voltage level | Open circuit voltage level | Open circuit voltage level |
| Measurement signal level | 1.000V | 1.500V | 0.500V |
| Range | AUTO | 3 k$\Omega$ | AUTO |
| Average | 10 times | 3 times | OFF |
| Measurement speed | FAST | MEDIUM | SLOW |
| Point delay | 0.0000 s | 0.0005 s | 0.0000 s |



Segment1    Segment2    Segment3
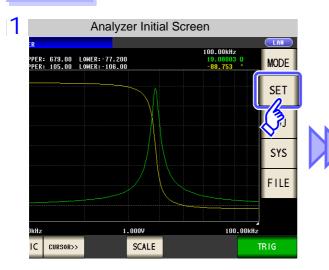
As shown in the figure above, when a segment sweep is performed, the following items can be set individually for each segment.
- Sweep range
- Number of sweep point
- Setting method of sweep points
- Measurement signal level
- Range
- Average
- Measurement speed
- Point delay
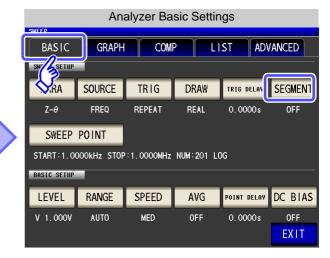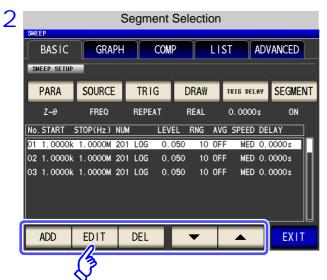
**NOTE** The following settings are common to all segments.
- Measurement parameter
- Sweep parameter
- Measurement signal type
- Trigger
- Trigger delay
- DC bias level

**Procedure**

**1**

Analyzer Initial Screen



Analyzer Basic Settings



**2**

Segment Selection



Use [▼] or [▲] to select the segment for which to change the setting, and press [EDIT].

**When you want to add a segment:**

Press [ADD].

**When you want to delete a segment:**

Use [▼] or [▲] to select the segment and press [DEL].

**3**

Segment Setting



(Example: When the [SOURCE] setting is [FREQ])

(When the [SOURCE] setting is [V], [CV], or [CC])

**Select the segment setting.**

| | |
|---|---|
| [LEVEL] | Setting the measurement level. |
| [RANGE] | Setting the measurement range. |
| [SPEED] | Setting the measurement speed. |
| [AVG] | Setting the average. |
| [POINT DELAY] | Setting the trigger delay. |
| [DC BIAS] | Setting the DC bias. |

The setting for DC bias is common to all segments. A different value cannot be set for each segment.

**5**

Chapter 5  ANALYZER Function

## Sweep Point Setting

**Segment Setting**

SEGMENT 1

START  1.0000kHz
STOP  1.0000MHz
NUM  201
LINEAR  LOG

LEVEL  RANGE  SPEED  AVG  POINT DELAY  DC BIAS
0.050V  10Ω  MED  OFF  0.0000s  0.00V

CANCEL  SET

- The setting method of the sweep points is fixed to **START-STOP** (sweep start value and end value settings).
- For the advanced setting method of sweep points, refer to "5.3.1 Setting Sweep Points" (p. 143).

---

**LEVEL** **Setting the measurement level. (When the SOURCE setting is FREQ )**

**Measurement Level Setting**

SEGMENT 1

LEVEL

V  CV  CC

0.050 V

EXIT

**1.** Press **LEVEL** .

**2.** Select the measurement level.

| | |
|---|---|
| V | Open voltage level (p. 45) |
| CV | Voltage level between test sample terminals (p. 45) |
| CC | Current level between test sample terminals (p. 47) |

**3.** Use ▲ or ▼ to enter the voltage or current value.

**4.** Press **EXIT** to close the setting screen.

> The setting for the measurement level type is common for all segments.
> A different type of measurement level cannot be set for each segment.
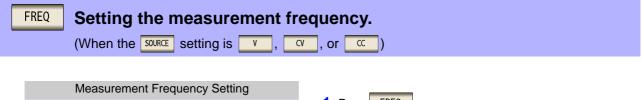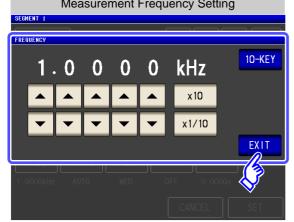
**NOTE** The frequency and measurement level that can be set vary depending on the set sweep point range.
For details, refer to "4.2.1 Setting the Measurement frequency" (p. 41) and "4.2.2 Setting the Measurement signal level" (p. 43) of the LCR function.

| FREQ | **Setting the measurement frequency.** |
|---|---|
| | (When the SOURCE setting is V , CV , or CC ) |

Measurement Frequency Setting

**1.** Press FREQ .

**2.** Use ▲ or ▼ to set the frequency.

Settable range: 4.00 Hz to 5.0000 MHz

**3.** Press EXIT to close the setting screen.

Press 10-KEY or DIGIT to change the input method.
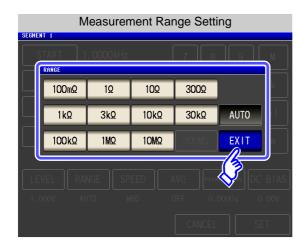
**NOTE** The measurement frequency that can be set varies depending on the set sweep point range.
Example: When the sweep parameter is set to open circuit voltage level, the settable range of frequencies is 4.00 Hz to 1.0000 MHz if there is a sweep point of 1 V or above.
For details, refer to "4.2.1 Setting the Measurement frequency" (p. 41) and "4.2.2 Setting the Measurement signal level" (p. 43) of the LCR function.

| RANGE | **Setting the measurement range.** |
|---|---|

Measurement Range Setting
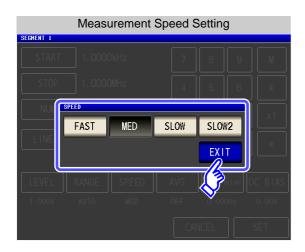
**1.** Press RANGE .

**2.** Select the measurement range.

**3.** Press EXIT to close the setting screen.

**See** "5.3.3 Setting the Measurement Range" (p. 160)

**5**

Chapter 5 ANALYZER Function

**SPEED** **Setting the measurement speed.**

Measurement Speed Setting

SEGMENT 1

| START | 1.0000kHz | | 7 | 8 | 9 | M |
| STOP | 1.0000MHz | | 4 | 5 | 6 | k |

SPEED

| FAST | MED | SLOW | SLOW2 |

EXIT

**1.** Press SPEED .

**2.** Select the measurement speed.

| FAST | High-speed measurement |
| MED | Normal-speed measurement |
| SLOW | Increases measurement accuracy. |
| SLOW2 | Measurement accuracy is better than SLOW. |
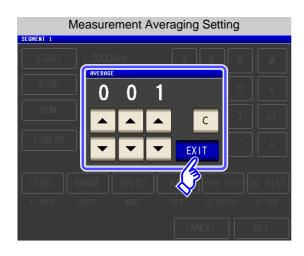
**3.** Press EXIT to close the setting screen.

---

**AVG** **Setting the average.**
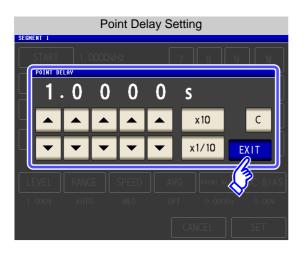
Measurement Averaging Setting

SEGMENT 1

AVERAGE

**0 0 1**

▲ ▲ ▲    C

▼ ▼ ▼    EXIT

**1.** Press AVG .

**2.** Use ▲ or ▼ to enter the number of averaging times.

Settable range: 1 to 256 times

**3.** Press EXIT to close the setting screen.

**See** "5.3.5 Displaying as Average Values (Average set)" (p. 165)

If you make a mistake during input:
press C to cancel the input and start again.

---

**POINT DELAY** **Setting the trigger delay.**

Point Delay Setting

SEGMENT 1

POINT DELAY

**1. 0 0 0 0 s**

▲ ▲ ▲ ▲ ▲   x10    C

▼ ▼ ▼ ▼ ▼   x1/10   EXIT
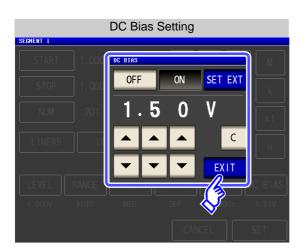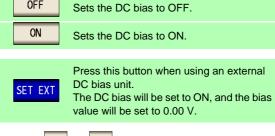
**1.** Press POINT DELAY .

**2.** Use ▲ or ▼ to enter the delay time.

Settable range: 0 to 10000 s with resolution of 0.1 ms

**3.** Press EXIT to close the setting screen.

If you make a mistake during input:
press C to cancel the input and start again.

**DC BIAS** **Setting the DC bias**



DC Bias Setting

**1.** Press DC BIAS .

**2.** Select ON/ OFF for the DC bias.

| OFF | Sets the DC bias to OFF. |
|---|---|

| ON | Sets the DC bias to ON. |
|---|---|

| SET EXT | Press this button when using an external DC bias unit. The DC bias will be set to ON, and the bias value will be set to 0.00 V. |
|---|---|

**3.** Use ▲ or ▼ to enter the DC bias value.

**4.** Press EXIT to close the setting screen.

- If you make a mistake during input:

  press C to cancel the input and start again.

- The setting for DC bias is common to all segments. A different value cannot be set for each segment.

**5**

**Chapter 5 ANALYZER Function**

## 5.5 Setting the Graph Display Method  LCR ANALYZER
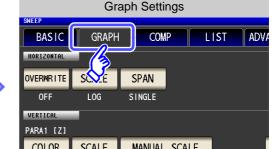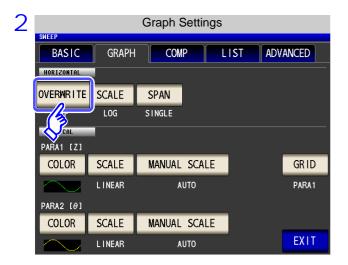
### 5.5.1 Setting the Horizontal Axis

### 1 Overwrite Setting
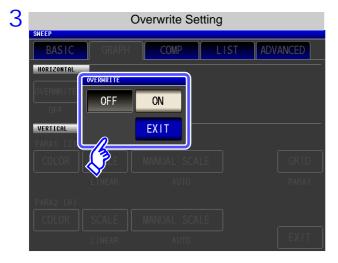
When sweep measurement is to be performed repeatedly, set the graph draw method.
If you set overwrite, you can check the variations of the element in a graph.

**Procedure**

**1**

Analyzer Initial Screen



Graph Settings



**2**

Graph Settings



Press OVERWRITE .

**3**

Overwrite Setting
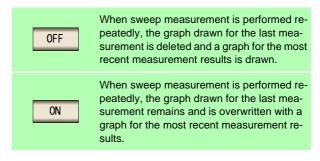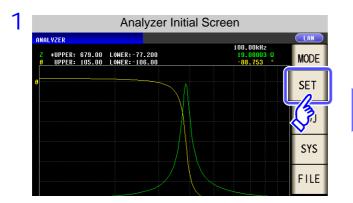


**Select the overwrite setting.**

| | |
|---|---|
| OFF | When sweep measurement is performed repeatedly, the graph drawn for the last measurement is deleted and a graph for the most recent measurement results is drawn. |
| ON | When sweep measurement is performed repeatedly, the graph drawn for the last measurement remains and is overwritten with a graph for the most recent measurement results. |
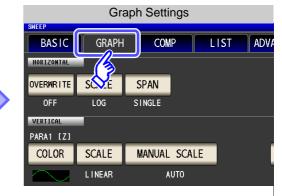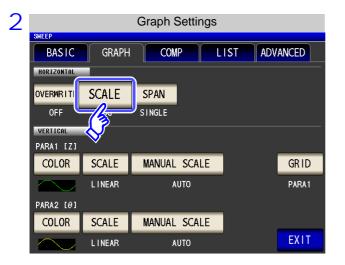
## 2 Horizontal Axis Scale Setting

Set the scale of the horizontal axis.

**Procedure**

**1**

Analyzer Initial Screen



Graph Settings



**2**

Graph Settings



Press SCALE .

**3**

Horizontal Axis Scale Setting
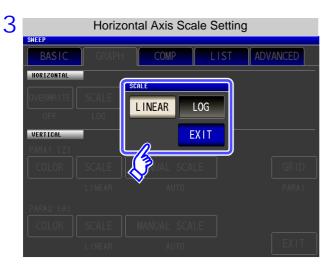


**Select the draw type.**

| | |
|---|---|
| LINEAR | Sets the horizontal axis to linear (linear axis). |
| LOG | Sets the horizontal axis to log (logarithmic axis). |

**4** Press EXIT **to close the setting screen.**

**5**

**Chapter 5 ANALYZER Function**
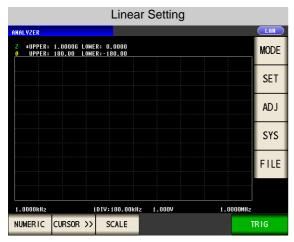
## 5.5 Setting the Graph Display Method

## How to Check the Set Horizontal Axis Scale
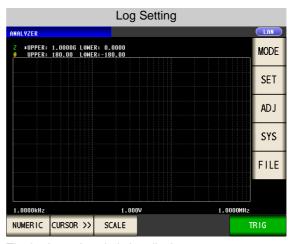
If the horizontal axis display scale is changed, the horizontal axis scale of the graph display screen changes as shown in the figures below.
(The horizontal axis scale of the graph also changes when the setting method of the sweep points is changed.)

 **See** "Setting the start value and end value of the sweep" (p. 145)

Linear Setting

The horizontal scale is linear display.

Log Setting

The horizontal scale is log display.

## 3 Span Setting

The span can only be set for segment sweep.
With this instrument, you can select single span mode and segment span mode.
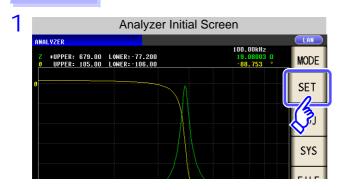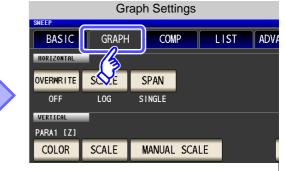
| Single Span Mode | ▶ | Draws the measurement result for each segment on the same horizontal axis. |
| Segment Span Mode | ▶ | Draws a graph for each segment. |
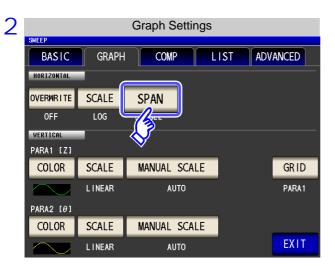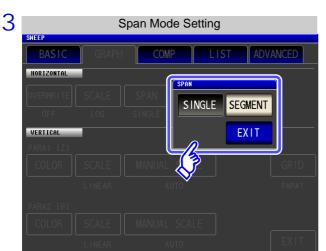
**Procedure**

**1** 

Analyzer Initial Screen ▶▶ Graph Settings

**2** Graph Settings

Press **SPAN** .

**3** Span Mode Setting

**Select the span mode.**

| SINGLE | Sets single span mode. |
| SEGMENT | Sets segment span mode. |

**4** Press EXIT to close the setting screen.
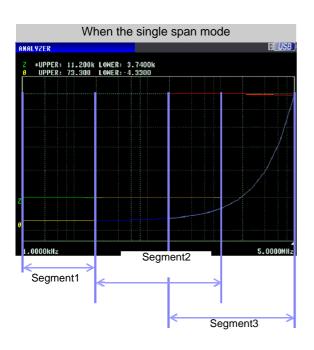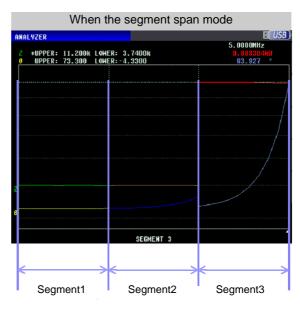
**5.5 Setting the Graph Display Method**

## Comparison of Single Span Mode and Segment Span Mode

The following shows an example of the graph display methods for single span mode and segment mode.
In this example, sweep ranges such as the following are set for the sweep parameter frequency.

| Sweep Settings | Segment1 | Segment2 | Segment3 |
|---|---|---|---|
| Sweep parameter | Frequency | Frequency | Frequency |
| Sweep range | 1.0000 kHz to 10.000 kHz | 10.000 kHz to 500.00 kHz | 100.00 Hz to 5.0000 MHz |

When the single span mode

When the segment span mode
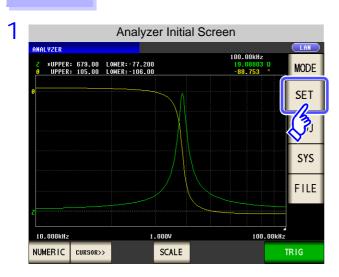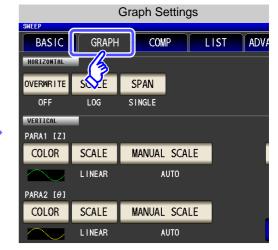
## 5.5.2   Setting the Vertical Axis
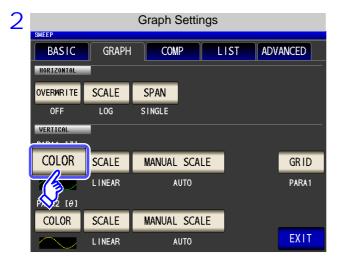
### 1   Draw Color Setting

Set the color of the graph to display on the screen. You can set a graph color for each parameter. Furthermore, in the case of segment sweep, you can set a color for each segment.

**Procedure**

**1**

Analyzer Initial Screen



Graph Settings



**2**

Graph Settings



**Press** COLOR **.**
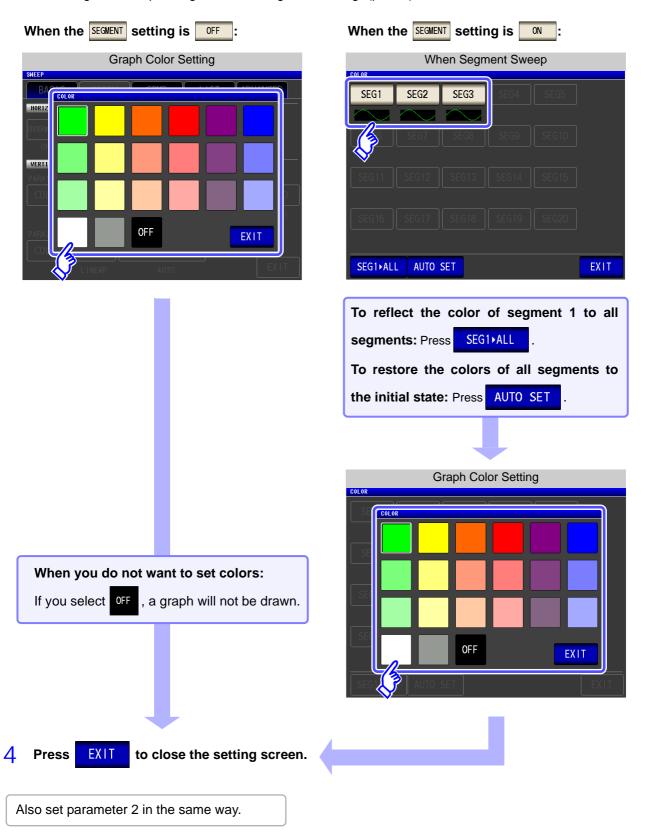
**3** **Select the segment for which to set the color.**

The setting differs depending on "5.2.6  Segment Setting" (p. 142).

When the `SEGMENT` setting is `OFF` :



Graph Color Setting

When the `SEGMENT` setting is `ON` :



When Segment Sweep

**To reflect the color of segment 1 to all segments:** Press `SEG1▸ALL` .

**To restore the colors of all segments to the initial state:** Press `AUTO SET` .



Graph Color Setting

**When you do not want to set colors:**

If you select `OFF`, a graph will not be drawn.

**4** **Press** `EXIT` **to close the setting screen.**

Also set parameter 2 in the same way.
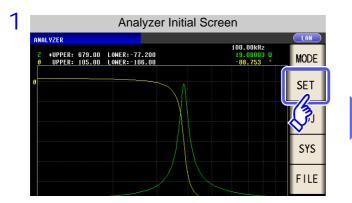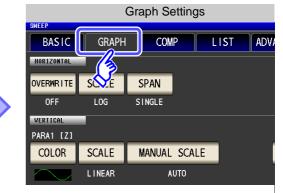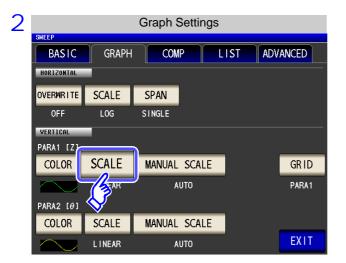
## 2 Vertical Axis Scale Setting

Set the draw method for the vertical axis scale to linear axis or logarithmic axis.
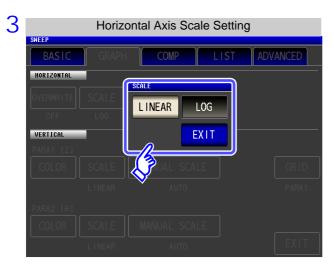
**Procedure**
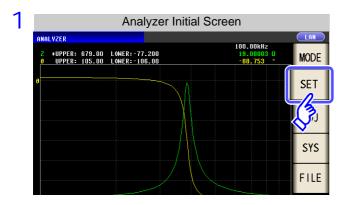
**1** Analyzer Initial Screen



Graph Settings



**2** Graph Settings



Press SCALE .

**3** Horizontal Axis Scale Setting



**Select the draw type.**

| LINEAR | Sets the vertical axis to linear (linear axis). |
| LOG | Sets the vertical axis to log (logarithmic axis). |

Also set parameter 2 in the same way.

**4** Press EXIT **to close the setting screen.**
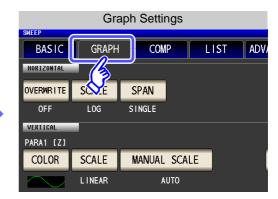
**3  Manual Scaling Setting**

Set the upper and lower limit values for the vertical axis.
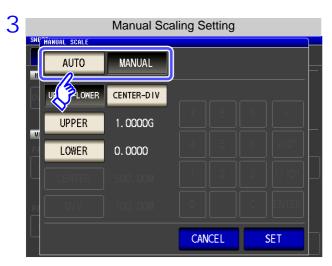
**Procedure**
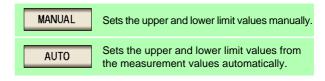
**1**

Analyzer Initial Screen

Graph Settings

**2**

Graph Settings

**Press** `MANUAL SCALE` .

**3**

Manual Scaling Setting

**Select the draw mode.**

| `MANUAL` | Sets the upper and lower limit values manually. |
| `AUTO` | Sets the upper and lower limit values from the measurement values automatically. |

**When you want to cancel the setting:**

Press `CANCEL` .
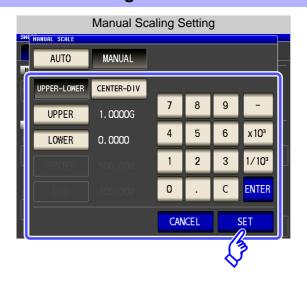
**NOTE** When measurement starts, the display range of the scale is set to the range from the maximum value to the minimum value or the scaling that was set when measurement ended last time.
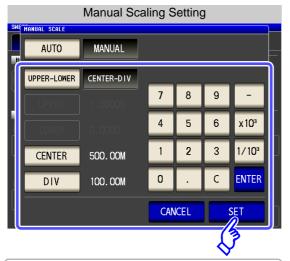
To set the optimal scaling in accordance with the measurement results, press `SCALE` in the measurement screen.

## MANUAL setting


Manual Scaling Setting
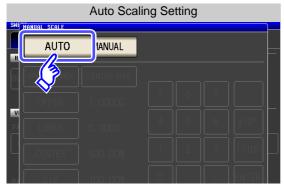
| UPPER-LOWER | **Set the upper and lower limit values.** |

**1.** Press UPPER-LOWER .

**2.** Press UPPER and use the numeric keypad to enter the upper limit value.

Settable range: -9.9999G to 9.9999G

**3.** Press ENTER to confirm the setting.

**4.** Press LOWER and use the numeric keypad to enter the lower limit value.

Settable range: -9.9999G to 9.9999G

**5.** Press ENTER to confirm the setting.

**6.** Press SET to confirm the setting.


Manual Scaling Setting

| CENTER-DIV | **Set the center value and the width of the vertical axis.** |

**1.** Press CENTER-DIV .

**2.** Press CENTER and use the numeric keypad to set the center value of the vertical axis.

Settable range: -9.9999G to 9.9999G

**3.** Press ENTER to confirm the setting.

**4.** Press DIV and use the numeric keypad to set the width of the vertical axis.

Settable range: -9.9999G to 9.9999G

**5.** Press ENTER to confirm the setting.

**6.** Press SET to confirm the setting.

If you make a mistake during input:

press C to cancel the input and start again.

**NOTE**
- The width of the vertical axis set with DIV is centered on the value that was set with CENTER . Therefore, the range of values that you can set with DIV varies depending on the value set with CENTER .
- When LOG is selected in the SCALE setting, the CENTER-DIV setting becomes invalid.

## AUTO setting


Auto Scaling Setting

Press SET to confirm the setting.
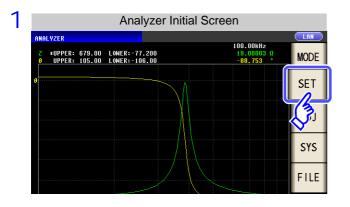
If two parameters are set to AUTO, the measurement results of both parameters are displayed so that they become optimal. If any one of them is set to AUTO, the measurement result of that parameter is dis-
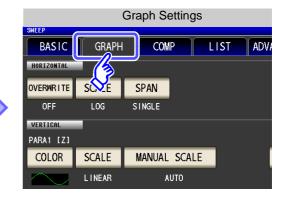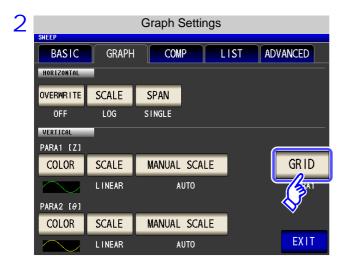
### 5.5.3  Setting Grid Display

Set the sweep parameter for which to display grid lines.
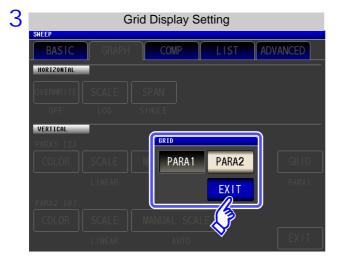
**Procedure**

**1**

Analyzer Initial Screen



Graph Settings



**2**

Graph Settings



**Press** GRID **.**

**3**

Grid Display Setting



**Select the sweep parameter for which to display grid lines.**

| PARA1 | Displays grid lines for sweep parameter 1. |
|-------|--------------------------------------------|
| PARA2 | Displays grid lines for sweep parameter 2. |
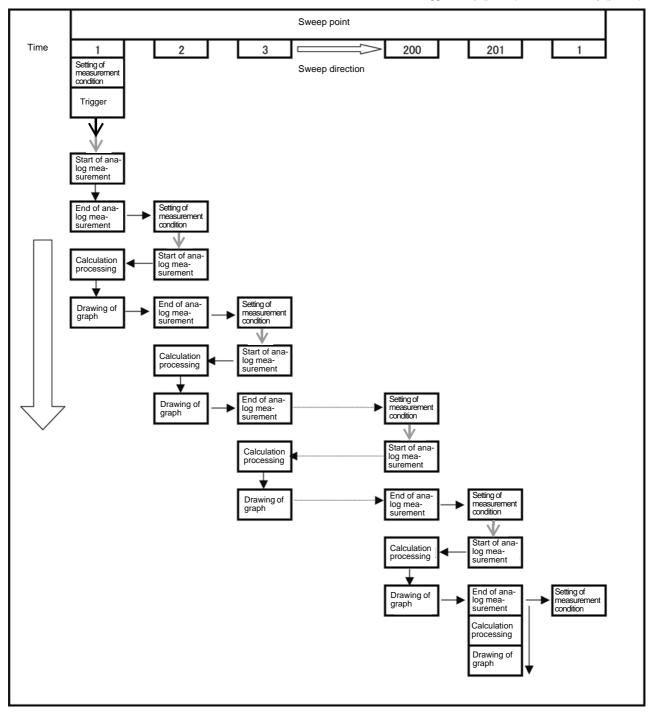
**4**  **Press** EXIT **to close the setting screen.**

## About the Timing for Graph Drawing

With this instrument, in order to perform analog measurement efficiently, the timing with which measurement is actually performed and timing with which the data is reflected in the graph differs slightly.

The following shows the timing with which analog measurement is performed continuously for multiple measurement points and the timing with which the graph is drawn.

→ : Trigger delay (p. 140)    ⇢ : Point delay (p. 166)

## 5.6   Checking the Measurement Values [LCR] [ANALYZER]

You can display a cursor in the measurement screen to check the measurement value of a measurement point.
You can use the search function to easily find the maximum value, minimum value, and peak value.
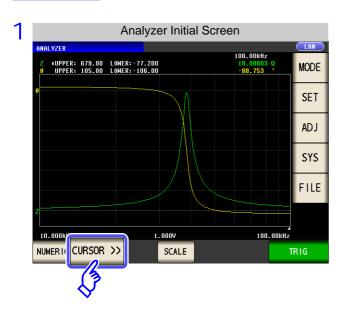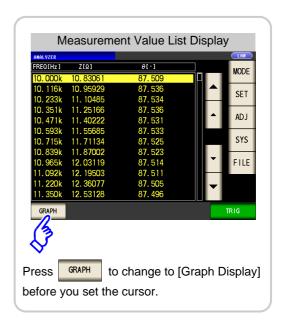
### 5.6.1   Setting the Cursor
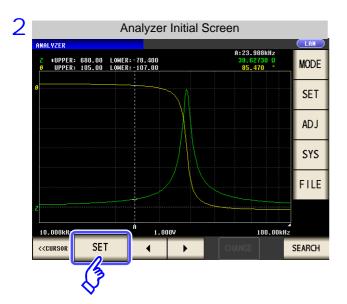
Set the cursor to display in the measurement screen.
The two cursors "A" and "B" are available for use.

**Procedure**

**1**

Analyzer Initial Screen



Measurement Value List Display



Press [GRAPH] to change to [Graph Display] before you set the cursor.

**2**

Analyzer Initial Screen



**Press** [SET] .

**3**

Cursor Move Setting



Cursor display setting (p. 189)

Cursor move setting (p. 190)

Cursor A search setting (p. 190)

Cursor B search setting (p. 190)

Auto search setting (p. 192)

**4** Press **EXIT** to close the setting screen.

**1 Cursor Display Setting**
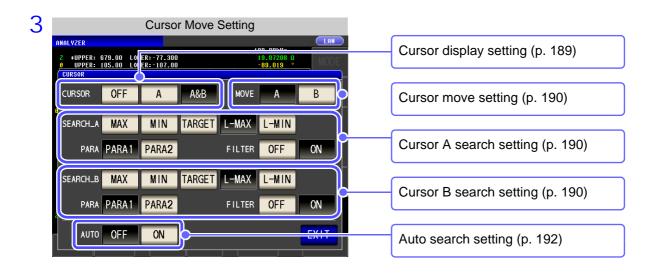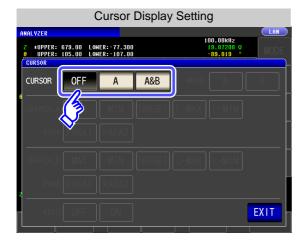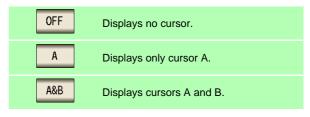
Cursor Display Setting



**Set the cursor to display in the measurement screen.**

| OFF | Displays no cursor. |
|---|---|
| A | Displays only cursor A. |
| A&B | Displays cursors A and B. |

## 2 Cursor Move Setting
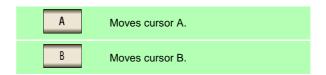
This can only be set when [ A&B ] is selected for the display cursor setting.



Cursor Move Setting
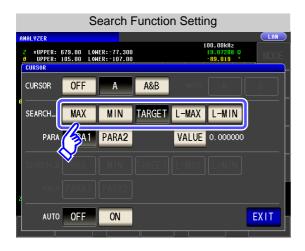
**Select the cursor to move using the cursor move keys on the measurement screen.**

**See** "5.6.2 Moving the Cursor" (p. 193)

| | |
|---|---|
| A | Moves cursor A. |
| B | Moves cursor B. |

## 3 Search Function Setting
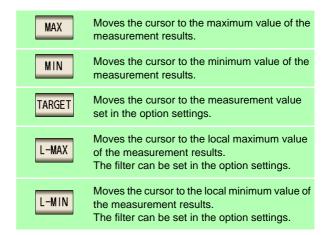


Search Function Setting
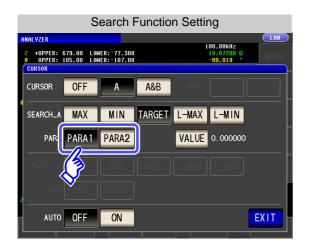
**Set the search function.**

**See** "Performing Measurement Value Search" (p. 194)

| | |
|---|---|
| MAX | Moves the cursor to the maximum value of the measurement results. |
| MIN | Moves the cursor to the minimum value of the measurement results. |
| TARGET | Moves the cursor to the measurement value set in the option settings. |
| L-MAX | Moves the cursor to the local maximum value of the measurement results. The filter can be set in the option settings. |
| L-MIN | Moves the cursor to the local minimum value of the measurement results. The filter can be set in the option settings. |

The search function does not work during a sweep.

When you use the search function, the [ TRIG ] setting needs to be set to [ SEQ ] or [ STEP ].

**See** "5.2.3 Setting the Trigger" (p. 137)

**4  Search Target Parameter Setting**



**Set the search target parameter.**

| PARA1 | Sets the measurement result of parameter 1 as the search target. |
|---|---|
| PARA2 | Sets the measurement result of parameter 2 as the search target. |
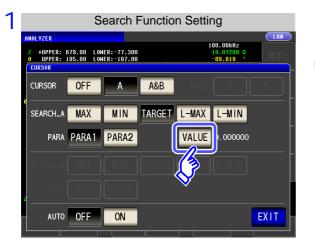
**5  Option setting**

**Set the measurement value for which to search.**
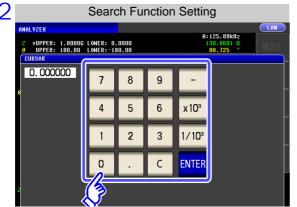
? This can be set when [A] or [A&B] is selected for the cursor display setting (p. 189), and [TARGET] for the search function setting (p. 190).

? Set the value for which to search when executing a target search.

**1**  Search Function Setting



Press [VALUE].

**2**  Search Function Setting



**Set the measurement value for which to search.**

Settable range: -9.999999G to 9.999999G

Press [ENTER] to confirm the setting.

**5**

**Chapter 5 ANALYZER Function**
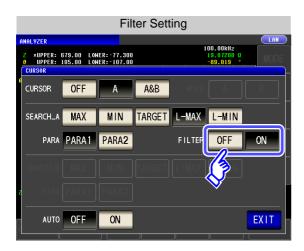
### Set the filter.

This can be set when L-MAX or L-MIN is selected for the search function setting.

**See** "Performing Measurement Value Search" (p. 194)

- When judging the local maximum value or local minimum value, set a filter.
- Applying a filter allows you to reduce the misjudgments of variations in measurement values caused by noise and other interference being judged as local maximum values or local minimum values.



Filter Setting

**Set the filter type.**

| | |
|---|---|
| OFF | Disables the filter function. |
| ON | Enables the filter function. |
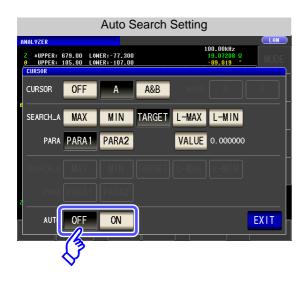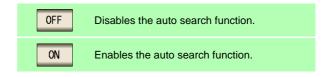
**NOTE** The filter setting is common to cursors A and B.

## 6  Auto Search Setting



Auto Search Setting

If you turn auto search ON, the search function is executed after sweep measurement ends, and the cursors move in accordance with the search settings.

| | |
|---|---|
| OFF | Disables the auto search function. |
| ON | Enables the auto search function. |
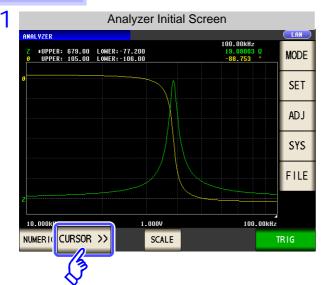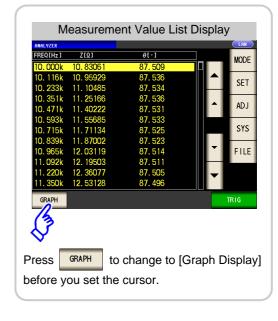
## 5.6.2 Moving the Cursor
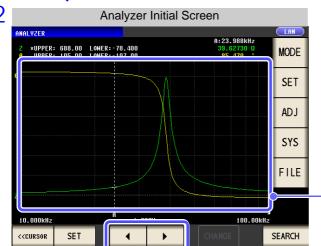
You can move a cursor and check the measurement value at the current cursor position.

The cursor(s) set in [ A ] or [ A&B ] of "Cursor Display Setting" (p. 189) and [ A ] or [ B ] of "Cursor Move Setting" (p. 190) can be moved.

**Procedure**

**1**

Analyzer Initial Screen



Measurement Value List Display



Press [ GRAPH ] to change to [Graph Display] before you set the cursor.

**2**

Analyzer Initial Screen
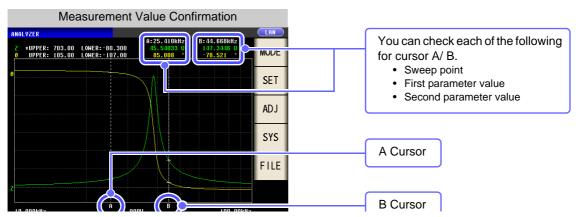


Press the following keys to move the cursor.

| | |
|---|---|
| ◀ | Moves the cursor to the left by 1 sweep point |
| ▶ | Moves the cursor to the right by 1 sweep point. |

You can move the cursor by touching the graph display screen.

### Cursors in Graph Display Screen and How to Check Measurement Values

Measurement Value Confirmation



You can check each of the following for cursor A/ B.
- Sweep point
- First parameter value
- Second parameter value

A Cursor

B Cursor

**5**

Chapter 5 ANALYZER Function

### 5.6.3 Performing Measurement Value Search
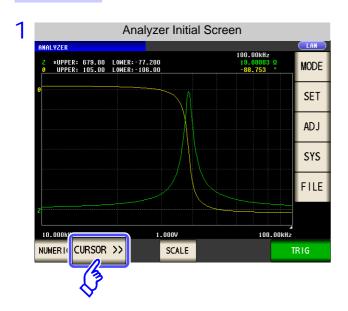
You can perform a measurement value search for the measurement results of one sweep using the method set in the search function setting ( MAX , MIN , TARGET , L-MIN , or L-MAX ).
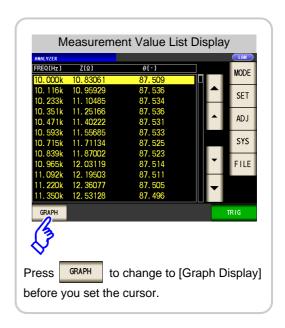
When you perform a search, the cursor moves to the search result point so that you can check the search execution result. (p. 193)
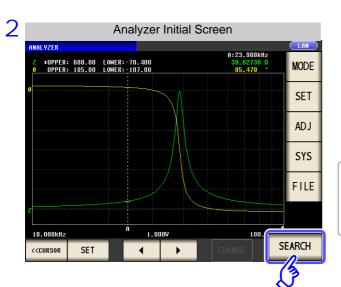
The search target parameter is the parameter set in "Search Target Parameter Setting" (p. 191)

( PARA1 or PARA2 ).

**Procedure**

**1** Analyzer Initial Screen



**Measurement Value List Display**



Press GRAPH to change to [Graph Display] before you set the cursor.

**2** Analyzer Initial Screen



**Press SEARCH to move the cursor to the sweep point that matches the condition set for the search function setting.**
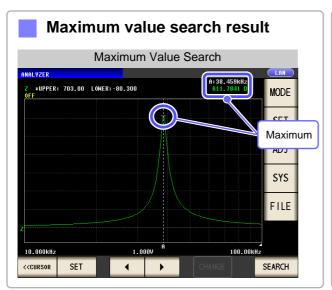
If more than one search point matches the condition, the cursor moves each time you press SEARCH .
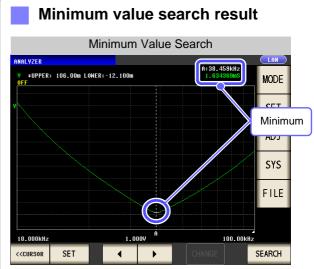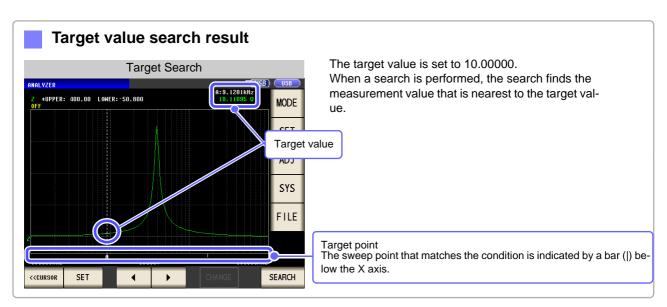
**NOTE** A search cannot be performed when the trigger setting is REPEAT .
See "5.2.3 Setting the Trigger" (p. 137)
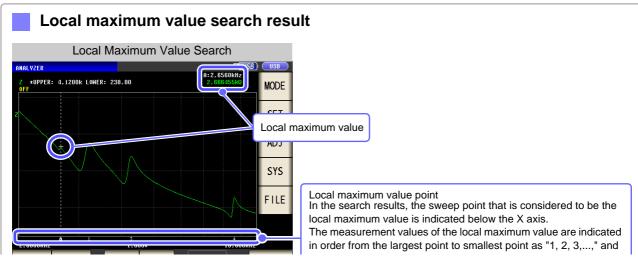
## Search Execution Result for Each Search Function Setting

In the search example, only parameter 1 is enabled.

### ■ Maximum value search result



Maximum Value Search

Maximum

### ■ Minimum value search result



Minimum Value Search

Minimum

### ■ Target value search result



Target Search

Target value

The target value is set to 10.00000.
When a search is performed, the search finds the measurement value that is nearest to the target value.

Target point
The sweep point that matches the condition is indicated by a bar (|) below the X axis.

### ■ Local maximum value search result



Local Maximum Value Search

Local maximum value

Local maximum value point
In the search results, the sweep point that is considered to be the local maximum value is indicated below the X axis.
The measurement values of the local maximum value are indicated in order from the largest point to smallest point as "1, 2, 3,...," and

### Local minimum value search result



Local Minimum Value Search

Local minimum value

Local minimum value point
In the search results, the sweep point that is considered to be the local minimum value is indicated bellows the X axis.
The measurement values of the local maximum value are indicated in order from the smallest point to largest point as "1, 2, 3,...," and from the sixth point by a bar (|).

# 5.7 Judging Measurement Results (Comparator Function)

LCR
ANALYZER

With the comparator function, you can preset a judgment area and judge whether measurement values are within the judgment area.

| Area Judgment | ▶ | Judges whether the measurement values of sweep points are within the judgment area. |

| Peak Judgment | ▶ | Judges whether the peak value of one sweep result is within the judgment area. (p. 208) |
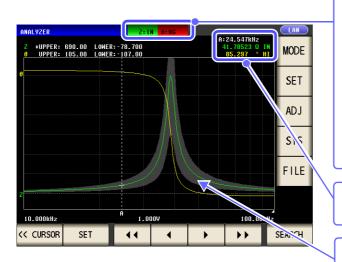
**NOTE** With the comparator function of the analyzer function, whenever possible perform a sweep once before setting the comparator function because there are items and the like for configuring the settings of the judgment area which use the sweep results.

## 1 Area Judgment

With area judgment, you can set the upper and lower limit values of the range to enable IN or NG to be displayed as the judgment result.
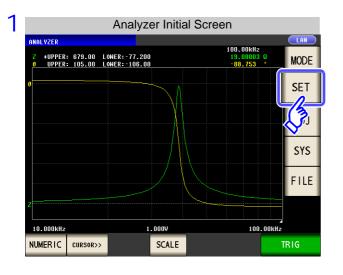


Indicates the overall judgment result.
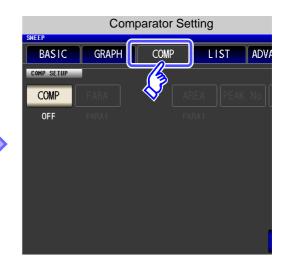
**IN** When the measurement values of sweep points are within the range set with the upper and lower value settings

**NG** When any of the measurement values of the sweep points are not within the range set with the upper and lower value settings

**- -** When judgment is not made
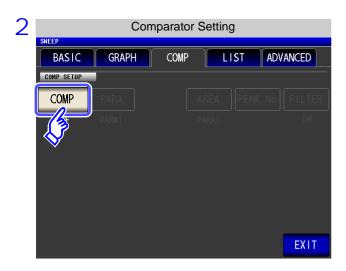
You can use the cursor to check the judgment result of each sweep point.

The comparator range is displayed in gray. (p. 207)

**5**

Chapter 5 ANALYZER Function

## 5.7 Judging Measurement Results (Comparator Function)

**Procedure**

**1**

Analyzer Initial Screen



Comparator Setting



**2**

Comparator Setting



Press COMP .

**3**

Comparator Mode Setting



Press AREA .

Press EXIT to confirm the setting.

**4** Comparator Setting



Press PARA .

**5** Judgment Parameter Setting



**Select the parameter to judge.**

| | |
|---|---|
| PARA1 | Sets the upper and lower limit values and judges the measurement results for the first measurement parameter. |
| PARA2 | Sets the upper and lower limit values and judges the measurement results for the second measurement parameter. |
| P1&P2 | Sets the upper and lower limit values and judges the measurement results for both the first and second parameters. |

**Press** EXIT **to confirm the setting.**

NOTE
• If a parameter is changed, the comparator setting prior to the change becomes invalid, and the comparator function COMP is set to OFF .
• If a measurement point is changed, the comparator setting prior to the change becomes invalid, and the comparator function COMP is set to OFF .
**See:** "5.3.1 Setting Sweep Points" (p. 143)

**5**

Chapter 5 ANALYZER Function

## 5.7 Judging Measurement Results (Comparator Function)

**6**

Comparator Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | EAK No | FILTER |

AREA    PARA1                      1        ON

AREA COMP

PARA1 [Z]

AREA SET PARA1

0.0000%  <Ref> 0.0000%

PARA2 [θ]

AREA SET PARA2

0.0000%  <Ref> 0.0000%

EXIT

Press AREA .

**7**

Judgment Area Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | | | LTER |

AREA    PARA1                               ON

AREA

| PARA1 | PARA2 | OFF |

EXIT

AREA COMP

PARA1 [Z]

AREA SET PARA1

0.0000%  <Ref> 0.0000%

PARA2 [θ]

AREA SET PARA2

0.0000%  <Ref> 0.0000%

EXIT

**Set the judgment area to display in the measurement screen.**

| PARA1 | Displays the judgment area of the first measurement parameter. |
|---|---|
| PARA2 | Displays the judgment area of the second measurement parameter. |
| OFF | Displays no judgment area. |

- PARA1 , PARA2 cannot be selected if the parameter to judge has not been set.
- Both the judgment areas of the first measurement parameter and second measurement parameter cannot be displayed at the same time.

**Press EXIT to confirm the setting.**

**8**

Comparator Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | PEAK No | FILTER |

AREA    PARA1                   PARA1        ON

AREA COMP

AREA SET PARA1

0.0000%  <    0.0000%

PARA2 [θ]

AREA SET PARA2

0.0000%  <Ref> 0.0000%

EXIT

**Press AREA SET PARA1 , and set the judgment area of the first parameter.**

**When the** SEGMENT **setting is** OFF

### Upper/Lower Limit Value Settings

**Set the judgment area.**

| | |
|---|---|
| MEAS VALUE REFERENCE | Sets the upper and lower limit values based on the current measurement values. |
| FIX VALUE REFERENCE | Sets the reference value, upper limit value, and lower limit value. |
| % | Sets the upper and lower limit values as percentage values relative to the reference value. |
| VALUE | Sets the upper and lower limit values as absolute values relative to the reference value. |

**When you want to cancel the setting:**

Press CANCEL .

---

MEAS VALUE REFERENCE **Set the upper and lower limit values based on the current measurement values.**

### Upper/Lower Limit Value Settings

**1.** Press HI and use the numeric keypad to set the upper limit value.
  - Settable range: -999.9999 to 999.9999 (Set as a % value)
  - Settable range: -9.999999G to 9.999999G (Set as a reference value)

**2.** Press ENTER to confirm the upper limit value.

**3.** Press LO and use the numeric keypad to set the lower limit value.
  - Settable range: -999.9999 to 999.9999 (Set as a % value)
  - Settable range: -9.999999G to 9.999999G (Set as a reference value)

**4.** Press ENTER to confirm the lower limit value.

**5.** Press SET to confirm the setting.

If you make a mistake during input:

press C to cancel the input and start again.

**5**

Chapter 5 ANALYZER Function

## 5.7 Judging Measurement Results (Comparator Function)

**FIX VALUE REFERENCE** **Set the reference value, upper limit value, and lower limit value.**

Upper/Lower Limit & Reference Value Settings

| SWEEP | | | | | |
|---|---|---|---|---|---|
| PARA1 | | | | | |

MEAS VALUE REFERENCE    FIX VALUE REFERENCE

| % | VALUE | 7 | 8 | 9 | − |
| REF | 1.000000k | 4 | 5 | 6 | x10³ |
| HI | 50.0000% | 1 | 2 | 3 | 1/10³ |
| LO | −50.0000% | 0 | . | C | ENTER |

CANCEL    SET

If you make a mistake during input:

press **C** to cancel the input and start again.

**1.** Press **REF** and use the numeric keypad to set the reference value.

Settable range: -9.999999G to 9.999999G

**2.** Press **ENTER** to confirm the reference value.

**3.** Press **HI** and use the numeric keypad to set the upper limit value.
- Settable range: -999.9999 to 999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**4.** Press **ENTER** to confirm the upper limit value.

**5.** Press **LO** and use the numeric keypad to set the lower limit value.
- Settable range: -999.9999 to 999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**6.** Press **ENTER** to confirm the lower limit value.

**7.** Press **SET** to confirm the setting.

**When the** SEGMENT **setting is** ON

When the segment function is enabled, a different judgment area can be set for each segment.

**Judgment Area Setting**



**1.** Set the judgment area.

| | |
|---|---|
| MEAS VALUE REFERENCE | Sets the upper and lower limit values based on the current measurement values. |
| FIX VALUE REFERENCE | Sets the reference value, upper limit value, and lower limit value. |
| % | Sets the upper and lower limit values as percentage values relative to the reference value. |
| VALUE | Sets the upper and lower limit values as absolute values relative to the reference value. |

**When you want to cancel the setting:**

Press CANCEL .

**2.** Use ▲ or ▼ to select the segment for which you want to set the judgment area.

**3.** Press EDIT .

**MEAS VALUE REFERENCE** **Set the upper and lower limit values based on the current measurement values.**

Upper/Lower Limit Value Settings

PARA1

PARA1 SEG1

| | |
|---|---|
| HI | 50.0000% |
| LO | −50.0000% |

Keypad: 7 8 9 −, 4 5 6 x10³, 1 2 3 1/10³, 0 . C ENTER

CANCEL    SET

**1.** Press [ HI ] and use the numeric keypad to set the upper limit value.
- Settable range: -999.9999 to999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**2.** Press ENTER to confirm the upper limit value.

**3.** Press [ LO ] and use the numeric keypad to set the lower limit value.
- Settable range: -999.9999 to999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**4.** Press ENTER to confirm the lower limit value.

**5.** Press [ SET ] to confirm the setting.

If you make a mistake during input:

press [ C ] to cancel the input and start again.

FIX VALUE REFERENCE **Set the reference value, upper limit value, and lower limit value.**

Upper/Lower Limit & Reference Value Settings

PARA1

PARA1 SEG1

| REF | 1.000000k | 7 | 8 | 9 | − |
| HI | 50.0000% | 4 | 5 | 6 | x10³ |
| LO | −50.0000% | 1 | 2 | 3 | 1/10³ |
| | | 0 | . | C | ENTER |

CANCEL    SET

SEG1▶ALL    EDIT    CANCEL    SET

If you make a mistake during input:

press C to cancel the input and start again.

**1.** Press REF and use the numeric keypad to set the reference value.

Settable range: -9.999999G to 9.999999G

**2.** Press ENTER to confirm the reference value.

**3.** Press HI and use the numeric keypad to set the upper limit value.
- Settable range: -999.9999 to 999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**4.** Press ENTER to confirm the upper limit value.

**5.** Press LO and use the numeric keypad to set the lower limit value.
- Settable range: -999.9999 to 999.9999 (Set as a % value)
- Settable range: -9.999999G to 9.999999G (Set as a reference value)

**6.** Press ENTER to confirm the lower limit value.

**7.** Press SET to confirm the setting.

Copy Reference & Upper/Lower Limit Values

PARA1

MEAS VALUE REFERENCE    FIX VALUE REFERENCE

%    VALUE

| SEG | REF | HI | LO |
| 01 | 〈MEAS VAL〉 | 5.000000 | −5.000000 |
| 02 | 〈MEAS VAL〉 | 0.000000 | 0.000000 |
| 03 | 〈MEAS VAL〉 | 0.000000 | 0.000000 |

SEG1▶ALL    EDIT    SET    CANCEL

If you press SEG1▶ALL , the setting value of the first segment is copied to all of the other segments.

**9** Press SET to confirm the setting.

**When you want to cancel the setting:**

Press CANCEL .

**5**

Chapter 5 ANALYZER Function

## 5.7 Judging Measurement Results (Comparator Function)

**10**

Upper/Lower Limit Value Settings

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | PEAK No | FILTER |

AREA        P1&P2                    PARA1                    ON

AREA COMP

PARA1 [Z]

AREA SET PARA1

0.0000%    ⟨Ref⟩  0.0000%

AREA SET PARA2

0.0000%    ⟨Ref⟩  0.0000%                    EXIT

**Press** AREA SET PARA2 , and set the judgment area of the second parameter in the same way.

(When the PARA Setting is PARA2 or P1&P2 )

**11** **Press** EXIT **to return to the measurement screen.**

**12** The comparator range is displayed in gray, and the judgment result is displayed after the sweep ends.

When Judgment Result is IN

Judgment result of each parameter

Judgment result of each sweep point

When Judgment Result is NG

When Judgment Result of Each Sweep is LO

When Judgment Result of Each Sweep is HI
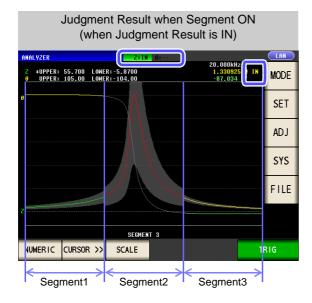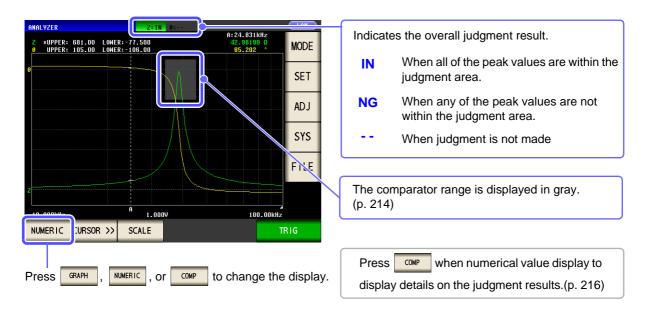
You can set the upper and lower limit values of each sweep point in "5.8 Editing Judgment Points" (p. 217).

Judgment Result when Segment ON (when Judgment Result is IN)

Segment1    Segment2    Segment3
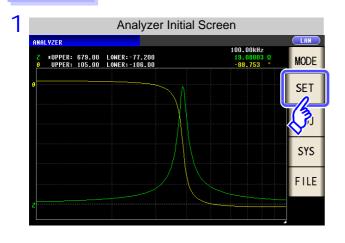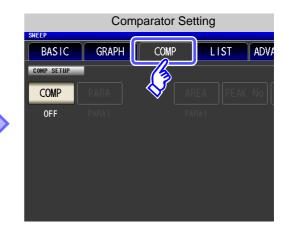
## 2 Peak Judgment

With peak judgment, you can judge whether the peak value is within the judgment area.
The judgment area can be set with the upper, lower, left, and right limit values.



Indicates the overall judgment result.

**IN**     When all of the peak values are within the judgment area.

**NG**     When any of the peak values are not within the judgment area.

**- -**     When judgment is not made

The comparator range is displayed in gray.
(p. 214)

Press `GRAPH` , `NUMERIC` , or `COMP` to change the display.

Press `COMP` when numerical value display to display details on the judgment results.(p. 216)

### Procedure

**1**

Analyzer Initial Screen



Comparator Setting



**2**

Comparator Setting



**Press** `COMP` **.**

**3** Comparator Mode Setting



Press PEAK .

Press EXIT to confirm the setting.

**4** Comparator Setting



Press PARA .

**5** Judgment Parameter Setting



Select the parameter to judge.

| | |
|---|---|
| PARA1 | Sets the judgment area and judges the measurement results for the first measurement parameter. |
| PARA2 | Sets the judgment area and judges the measurement results for the second measurement parameter. |
| P1&P2 | Sets the judgment area and judges the measurement results for both the first and second parameters. |

Press EXIT to confirm the setting.

## 5.7 Judging Measurement Results (Comparator Function)

**6**

Comparator Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | PEAK No | FILTER |

PEAK    PARA1                    1              ON

|       | LEFT | RIGHT |  | LO |
| Z MAX | OFF | OFF | OFF | OFF |
| Z MIN | OFF | OFF | OFF | OFF |

| EDIT | | ▼ | ▲ | EXIT |

**Press** AREA **.**

**7**

Judgment Area Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | | | LTER |
PEAK    PARA1                              ON

AREA

| PARA1 | PARA2 | OFF |

EXIT

|       | LEFT |
| Z MAX | OFF |
| Z MIN | OFF | OFF | OFF |

| EDIT | | ▼ | ▲ | EXIT |

**Set the judgment area to display in the measurement screen.**

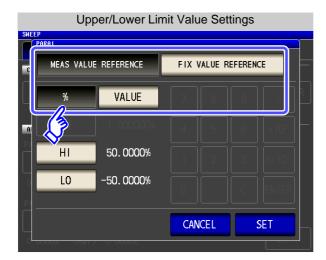| PARA1 | Displays the judgment area of the first measurement parameter. |
| PARA2 | Displays the judgment area of the second measurement parameter. |
| OFF | Displays no judgment area. |

- PARA2 cannot be selected if the parameter to judge has not been set.
- Both the judgment areas of the first measurement parameter and second measurement parameter cannot be displayed at the same time.
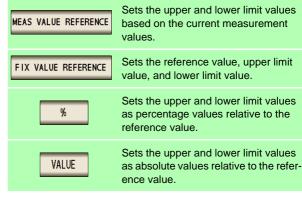
**Press** EXIT **to confirm the setting.**

**8**

Comparator Setting

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | PEAK No | FILTER |

PEAK    PARA1              PARA1           ON

|       | LEFT | RIGHT | HI |
| Z MAX | OFF | OFF | OFF | OFF |
| Z MIN | OFF | OFF | OFF | OFF |

| EDIT | | ▼ | ▲ | EXIT |

**Press** PEAK No **.**

**9** Peak No. Setting

Use ▼ or ▲ to select the number of the local maximum value or local minimum value for peak judgment.

| L-MAX | • Select the number of the local maximum value. |
|-------|---|
| | With regards to the numbers, the values are numbered like "1, 2, 3..." in order from the largest measurement value of the detected local maximum values. |
| | • Settable range: 1 to 5 |
| L-MIN | • Select the number of the local minimum value. |
| | With regards to the numbers, the values are numbered like "1, 2, 3..." in order from the smallest measurement value of the detected local minimum values. |
| | • Settable range: 1 to 5 |
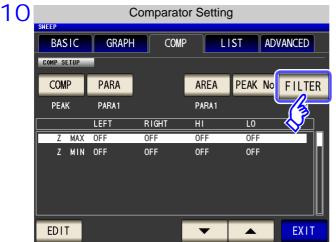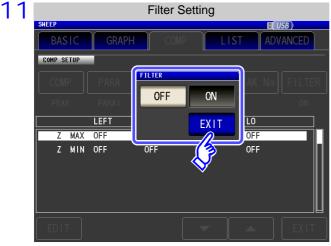
**See** "Search Function Setting" (p. 190)

**10** Comparator Setting

Press EXIT to confirm the setting.

Press FILTER .

**11** Filter Setting

Select enable or disable for the filter.
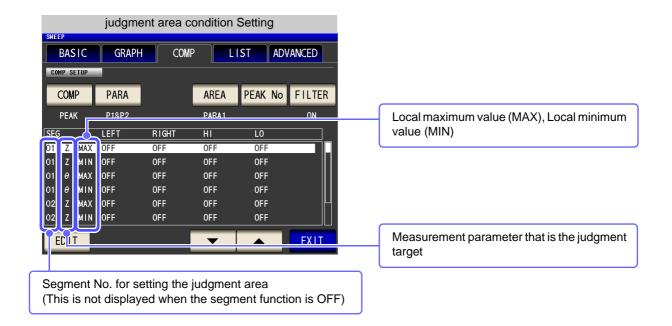
| OFF | Disables the filter function. |
|-----|---|
| ON | Enables the filter function. |

• Applying a filter allows you to reduce the misjudgments of variations in measurement values caused by noise and other interference being judged as local maximum values or local minimum values.
• The filter setting is synchronized with the filter setting of the cursor setting.

  **See:** "Set the filter." (p. 192)

Press EXIT to confirm the setting.

**5**

**Chapter 5 ANALYZER Function**

## 5.7 Judging Measurement Results (Comparator Function)

**12** Use ▼ or ▲ to select the condition to set for the judgment area.
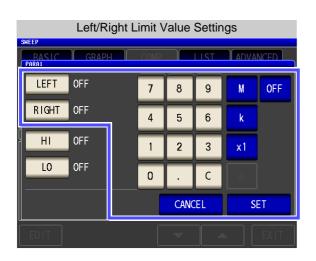
Select any of the following items for the condition to set for the judgment area.
- Segment No.
- Measurement parameter
- Local maximum value/Local minimum value



Local maximum value (MAX), Local minimum value (MIN)

Measurement parameter that is the judgment target

Segment No. for setting the judgment area
(This is not displayed when the segment function is OFF)

**13** Press EDIT and enter the range setting of the selected condition.

**14** **Use the numeric keypad to set the left, right, upper, and lower limit values.**

### Left/Right Limit Value Settings

| | | 7 | 8 | 9 | M | OFF |
| LEFT OFF | | 4 | 5 | 6 | k | |
| RIGHT OFF | | 1 | 2 | 3 | x1 | |
| HI OFF | | 0 | . | C | m | |
| LO OFF | | | CANCEL | | SET | |

> **When you do not want to set the left, right, upper, and lower limit values:** Press `OFF`.

### Upper/Lower Limit Value Settings

| | | 7 | 8 | 9 | – | OFF |
| LEFT OFF | | 4 | 5 | 6 | x10³ | |
| RIGHT OFF | | 1 | 2 | 3 | 1/10³ | |
| HI OFF | | 0 | . | C | ENTER | |
| LO OFF | | | CANCEL | | SET | |

> If you make a mistake during input:
> press `C` to cancel the input and start again.

**1.** Press `LEFT` and use the numeric keypad to enter the left limit value.

The possible setting range differs depending on the sweep parameter.
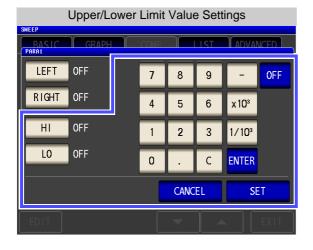
Refer to the following for each of the parameters.
- Frequency: (p. 41)
- Open circuit voltage level: (p. 43)
- Voltage level between test sample terminals: (p. 43)
- Current level between test sample terminals: (p. 43)

**2.** Press a unit key to confirm the setting.

**3.** Press `RIGHT` and use the numeric keypad to enter the right limit value.

The possible setting range differs depending on the sweep parameter.

Refer to the following for each of the parameters.
- Frequency: (p. 41)
- Open circuit voltage level: (p. 43)
- Voltage level between test sample terminals: (p. 43)
- Current level between test sample terminals: (p. 43)

**4.** Press a unit key to confirm the setting.

**5.** Press `HI` and use the numeric keypad to set the upper limit value.

Settable range: -9.999999G to 9.999999G

**6.** Press `ENTER` to confirm the setting.

**7.** Press `LO` and use the numeric keypad to set the lower limit value.

Settable range: -9.999999G to 9.999999G
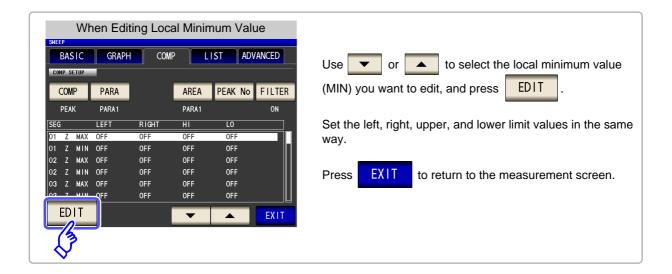
**8.** Press `ENTER` to confirm the setting.

**9.** Press `SET` to confirm the setting.

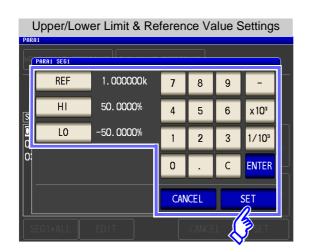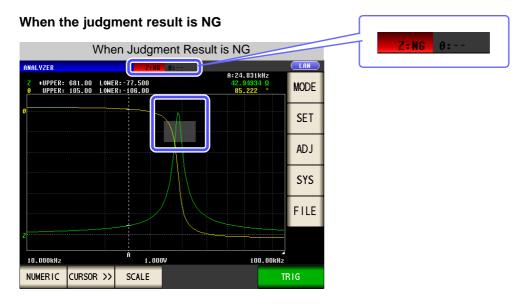> **When you do not want to set a judgment area:** Press `OFF`.
>
> **When you want to cancel the setting:** Press `CANCEL`.

**5**

**Chapter 5 ANALYZER Function**

**When Editing Local Minimum Value**

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

COMP SETUP

| COMP | PARA | | AREA | PEAK No | FILTER |

PEAK    PARA1              PARA1              ON

| SEG | | | LEFT | RIGHT | HI | LO |
| 01 | Z | MAX | OFF | OFF | OFF | OFF |
| 01 | Z | MIN | OFF | OFF | OFF | OFF |
| 02 | Z | MAX | OFF | OFF | OFF | OFF |
| 02 | Z | MIN | OFF | OFF | OFF | OFF |
| 03 | Z | MAX | OFF | OFF | OFF | OFF |
| 03 | Z | MIN | OFF | OFF | OFF | OFF |

EDIT                    ▼    ▲    EXIT

Use ▼ or ▲ to select the local minimum value (MIN) you want to edit, and press EDIT .

Set the left, right, upper, and lower limit values in the same way.
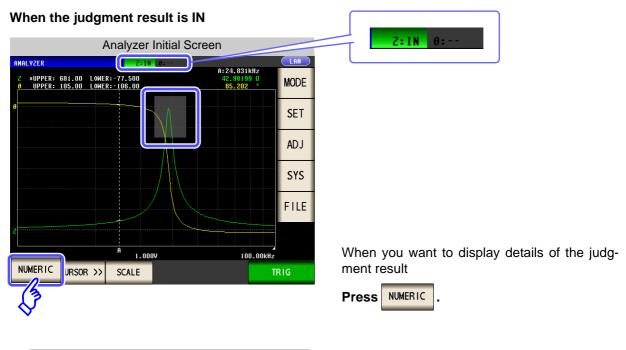
Press EXIT to return to the measurement screen.

**15** The comparator range, overall judgment indication, and details of the judgment result are displayed in the graph.

**When the judgment result is NG**

Z:NG  θ:--

**When Judgment Result is NG**

ANALYZER                                      LAN
                              A:24.831kHz
Z  *UPPER: 681.00  LOWER:-77.500      42.94934 Ω
θ   UPPER: 105.00  LOWER:-106.00       85.222 °

MODE
SET
ADJ
SYS
FILE

10.000kHz        1.000V          100.00kHz

| NUMERIC | CURSOR >> | SCALE | | TRIG |

**When the judgment result is IN**

Analyzer Initial Screen



When you want to display details of the judgment result

**Press** NUMERIC **.**

Measurement Result List



**Press** COMP **.**

Judgment Result Details Display



Display details of the judgment result.
**See** "Viewing Details of the Judgment Result"
(p. 216)

## 5.7 Judging Measurement Results (Comparator Function)

### Viewing Details of the Judgment Result

Whether the peak value set in "Peak Judgment" (p. 208) is within the judgment area is indicated as shown below.

Example: When segment sweep

| | | ANALYZER | | Z:NG  θ:NG | | LAN |
|---|---|---|---|---|---|---|
| SEG | JUDGE | | POINT | VALUE | | |
| 01 | Z | MAX | IN | 7.4131kHz | 9.989475GΩ | MODE |
| 01 | Z | MIN | HI | 841.40kHz | 2.891605MΩ | SET |
| 01 | θ | MAX | LT | 31.623kHz | 179.798 ° | |
| 01 | θ | MIN | LO | 407.38kHz | −178.462 ° | ADJ |
| 02 | Z | MAX | LT | 7.4131kHz | 8.603397GΩ | |
| 02 | Z | MIN | --- | | | SYS |
| 02 | θ | MAX | LO | 72.444kHz | 179.384 ° | |
| 02 | θ | MIN | ?? | | | FILE |

- Segment No.
- parameter
- maximum or minimum value
- Judgment result
- sweep point
- Measurement value

GRAPH     TRIG

The gray part is the judgment area.
The judgment result indicates the position of the detected peak in relation to the judgment area.

| HI-LT | HI | HI-RT |
|---|---|---|
| LT | IN | RT |
| LO-LT | LO | LO-RT |

If the peak could not be detected, "??" is displayed.
If the judgment conditions are not set, "---" is displayed.

**NOTE**
- When a normal sweep is performed, the segment number is not displayed.
- When the judgment area setting is `OFF` , the judgment result is indicated as **[- - -]**.
- This is not displayed for area judgment.

# 5.8 Editing Judgment Points

<span style="border:1px solid">**LCR ANALYZER**</span>
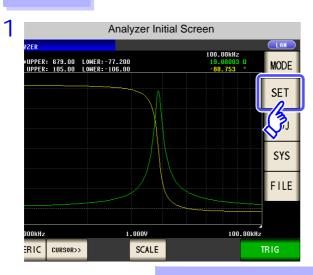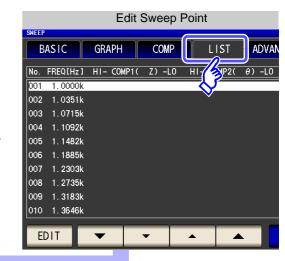
You can edit the setting of each sweep point. For comparator measurement, you can set the upper and lower limit values of each sweep point.
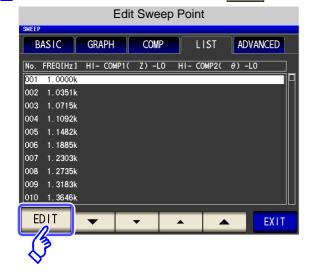
**NOTE**
- When the segment function is ON, the settings of judgment points cannot be edited.
- When the setting of the comparator function is [ PEAK ], only the settings of the measurement point values can be edited. (The upper and lower limit values of each sweep point cannot be set.)

**Procedure**

**1**

Analyzer Initial Screen



Edit Sweep Point



**2** When the comparator setting is [ OFF ]



When the comparator setting is [ ON ]
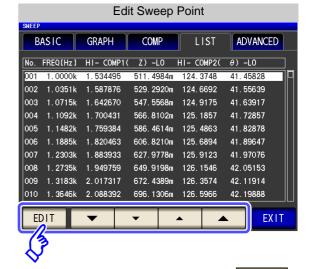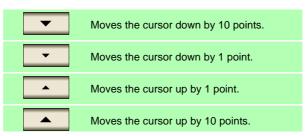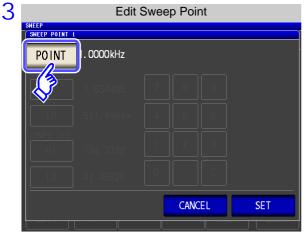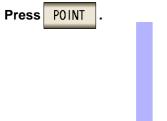


Use the cursor keys to select the sweep point to edit and then press [ EDIT ].

| | |
|---|---|
| ▼ | Moves the cursor down by 10 points. |
| ▼ | Moves the cursor down by 1 point. |
| ▲ | Moves the cursor up by 1 point. |
| ▲ | Moves the cursor up by 10 points. |

**5**

**Chapter 5 ANALYZER Function**

**3**

| Edit Sweep Point | Sweep Point & Upper/Lower Limit Value Settings |
|---|---|

SWEEP
SWEEP POINT 1

POINT .0000kHz

CANCEL  SET

Press POINT .

SWEEP
SWEEP POINT 1

POINT 1.0000kHz

COMP1 [Z]
HI 1.534495
LO 511.4984m

COMP2 [θ]
HI 124.3748
LO 41.45828

CANCEL  SET

Set each of the following settings.

| POINT | Set the sweep point. |
|---|---|
| HI | Set the upper limit value of the comparator. |
| LO | Set the lower limit value of the comparator. |

**4**

| Sweep Point Setting | Sweep Point Setting |
|---|---|

SWEEP
SWEEP POINT 1

POINT 1.0000k

COMP1 [Z]
HI 1.534495
LO 511.4984m

COMP2 [θ]
HI 124.3748
LO 41.45828

7 8 9 M
4 5 6 k
1 2 3 x1
0 . C

CANCEL  SET

SWEEP
SWEEP POINT 1

POINT 1.0000k

COMP1 [Z]
1.534495
511.4984m

COMP2 [θ]
124.3748
41.45828

7 8 9 M
4 5 6 k
1 2 3 x1
0 . C

CANCEL  SET

**Use the numeric keypad to enter the setting of the sweep point and press a unit key to confirm the setting.**

Settable range

| Measurement parameter | Settable range |
|---|---|
| Frequency | 4 Hz to 5 MHz |
| Open circuit voltage level | 0.005 V to 5.000 V |
| Voltage level between test sample terminals | 0.005 V to 5.000 V |
| Current level between test sample terminals | 0.01 mA to 50 mA |

Settable range
• Sweep point:

| Measurement parameter | Settable range |
|---|---|
| Frequency | 4 Hz to 5 MHz |
| Open circuit voltage level | 0.005 V to 5.000 V |
| Voltage level between test sample terminals | 0.005 V to 5.000 V |
| Current level between test sample terminals | 0.01 mA to 50 mA |

• Upper limit value: -9.999999G to 9.999999G
• Lower limit value: -9.999999G to 9.999999G

**5** **Press** SET **to close the setting screen.**

**When you want to cancel the setting:** Press CANCEL .

**6** **Press** EXIT **to close the setting screen.**

# 5.9 Application Settings

## 5.9.1 Saving Measurement Results (Memory function)

You can save the measurement results inside the instrument. (Up to 32,000 items) The saved measurement results can be saved to a USB flash drive.

They can also be acquired using a communication command. (The memory function is the same in ▭LCR mode and ▭ANALYZER mode.)

The items saved to memory are in accordance with the **:MEASure:VALid** setting.

For details on how to acquire the saved measurement results or set **:MEASure:VALid**, refer to the included CD.

### Saving Measurement Values

**Procedure**

**1**

Analyzer Initial Screen

Application Settings

**2**

Application Settings

Press MEMORY .

**Chapter 5 ANALYZER Function**

**5**

**3**

Memory Function Setting



Use ▲ or ▼ to set the number of measurement results.

Settable range: 1 to 32000
The number of measurement results can only be set when the memory function is set to OFF.

**4**

Memory Function Setting



**Select ON/OFF for the memory function.**

| OFF | Sets the memory function to OFF. |
| ON | Saves all measurement values to memory. |

| CLEAR | Clears all of the saved measurement values from the instrument memory. |
| SAVE | Saves the measurement values stored in the instrument memory to a USB flash drive and then clears the measurement values from the instrument memory. The measurement values are saved to the MEMORY folder in the USB flash drive. The file name is automatically assigned from the date and time. |

**5** Press **EXIT** to close the setting screen.

## Clearing the Instrument Memory

Memory Function Setting



Press **CLEAR** to clear the instrument memory.

## Saving Data in Instrument Memory to USB Flash Drive



Connect a USB flash drive. (p. 329)

Press **SAVE** to save the data in the instrument memory to a USB flash drive.

When this function is used to save the data in the instrument memory to a USB flash drive, the data is cleared from the instrument memory automatically.

**NOTE**
- If the memory function is set to ON, the number of memory items currently saved is displayed in the measurement screen.



Indicates that the number of memory items currently saved is 1,144.

- Save the data stored in the instrument to a USB flash drive or acquire it with the **:Memory?** command.
- The data in the instrument memory is lost when the memory function setting is changed.
- When the instrument memory becomes full, the following message appears on the measurement screen.
  If this message appears, subsequent measurement results will not be saved.
  To resume saving, load or clear the measurement results from the instrument memory.



**Memory Full**

**5**

Chapter 5 ANALYZER Function

## 5.9.2 Detecting OPEN during 2-terminal Measurement (HIGH-Z Reject Function)

This function is for outputting a measurement terminal connector error when the measurement result is high relative to the set judgment reference value. The setting value can be set as an absolute value, and the error is output via the EXT I/O.
**See** "Chapter 11  External Control" (p. 363)

The judgment reference is calculated from the nominal value (range name) of the current measurement range and the judgment reference value as shown below.

Judgment reference = Nominal value of current measurement range × Judgment reference value (%)

Example   Current measurement range: 30 k$\Omega$
Judgment reference value: 150%
Judgment reference = 30 k × 1.50 = 45 k

**Procedure**

**1**

Analyzer Initial Screen



Application Settings



**2**

Application Settings



Press [ Hi Z ] .

**3**

| HIGH-Z Setting |
| --- |

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

FUNCTION

Hi Z

MEMORY

| OFF | ON |

1 0 0 0 %

DISP

▲ ▲ ▲ ▲ ▲    C

SETTING

▼ ▼ ▼ ▼ ▼    EXIT

PANEL

EXIT

**Select ON/ OFF for the HIGH-Z reject function.**

| OFF | Sets the HIGH-Z reject function to OFF. |
| --- | --- |
| ON | Sets the HIGH-Z reject function to ON. |

**4**

| HIGH-Z Setting |
| --- |

SWEEP

| BASIC | GRAPH | COMP | LIST | ADVANCED |

FUNCTION

Hi Z

MEMORY

| OFF | ON |

0 1 0 0 0 %

DISP

▲ ▲ ▲ ▲ ▲    C

SETTING

▼ ▼ ▼ ▼ ▼    EXIT

PANEL

EXIT

**Use ▲ or ▼ to set the judgment reference value.**

| Settable range: 0% to 30000% |
| --- |

- A ratio is set using the range name as the reference value.
  Example: When using the 1 kΩ range, a ratio to the value of 1 kΩ is set.
- If you make a mistake during input:

  press C to cancel the input and start again.

**5** **Press EXIT to close the setting screen.**

## 5.9.3  Setting the Detection Sensitivity for Measurement Errors (Overflow or Underflow)

The instrument monitors the detectable range of the measurement signals (voltage and current) during measurement, and displays a measurement error (OVERFLOW or UNDERFLOW) if that range is exceeded.
However, if measurement is performed under a noisy environment, the detection range may be exceeded resulting in a measurement error regardless of whether an appropriate measurement range is set.
Under normal circumstances, the countermeasures described in "Appendix 4  Countermeasures Against Incorporation of External Noise"(p. A5) need to be taken but if a measurement error occurs even after taking the countermeasures, increase the setting value which defines the error of the measurement signal to reduce the detection sensitivity for measurement errors so that you can reduce the frequency of measurement error occurrence.

**Procedure**

**1**

**2**

Press LEVOVER .

**3**

Level Value Setting

| SWEEP | | | | |
|---|---|---|---|---|
| BASIC | GRAPH | COMP | LIST | ADVANCED |

FUNCTION

MEMORY · IO JUDG···    ···VER

LEVOVER

0 1

DISP · BEEP

SETTING

PANEL · RESET

EXIT

EXIT

Use ▲ or ▼ to enter the level value.

Settable range: 1 to 32

**4** Press **EXIT** to close the setting screen.

**NOTE** The higher the setting value, the greater the measurement errors. If the setting value is set to 2 or higher, the accuracy specifications may not be able to be satisfied.
Furthermore, shifting to the most suitable range may not occur during auto range operation.

**5**

Chapter 5 ANALYZER Function

## 5.9.4   Setting the Delay Time from the Output of Comparator Judgment Results until Output of EOM (LOW) and Resetting Judgment Results

You can set the delay time for the period from the output of the comparator and BIN judgment results until the output of EOM (LOW) from the EXT I/O. You can also set whether to reset the comparator and BIN judgment results simultaneously with the measurement start signal.
**See** "11.2  Timing Chart" (p. 369)

**Procedure**

**1**

Analyzer Initial Screen

Application Settings

**2**

Application Settings

**Press** IO JUDGE .

**3**

I/O Judgment Setting

**Use ▲ or ▼ to set the delay time for the period from the output of the comparator judgment results until the output of EOM (LOW).**

Settable range: 0.0000 s to 0.9999 s

If you make a mistake during input:
press  C  to cancel the input and start again.

**4**

| I/O Judgment Setting |
|---|

SWEEP

BASIC | GRAPH | COMP | LIST | ADVANCED

FUNCTION

IO JUDGE

JUDGE-EOM  $0.1000$  s

C

JUDGE RESET  OFF  ON  EXIT

EXIT

Select whether to reset the comparator judgment results simultaneously with the measurement start signal.

| OFF | Stores the last judgment results until the next judgment results are output. |
|---|---|
| ON | Resets the judgments results at the time of the measurement start signal. |

**5** Press **EXIT** to close the setting screen.
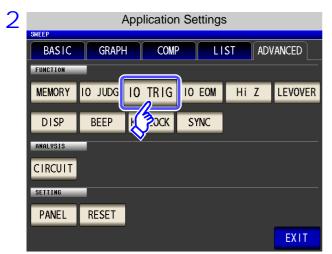
**5**

Chapter 5 ANALYZER Function

## 5.9.5 Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input

You can select whether to enable or disable trigger input from the EXT I/O during measurement (during $\overline{\text{EOM}}$ (HI) output after trigger is received). Furthermore, you can also select either the rising edge or falling edge as the valid edge of trigger input from the EXT I/O.

**See** "11.2 Timing Chart" (p. 369)

**Procedure**

**1**

Analyzer Initial Screen

Application Settings

**2**

Application Settings

Press IO TRIG .

**3**

I/O Trigger Setting

**Select the I/O trigger function setting.**

| | |
|---|---|
| OFF | Disables trigger input from the EXT I/O during measurement (during $\overline{\text{EOM}}$ (HI) output after trigger is received). |
| ON | Enables trigger input from the EXT I/O during measurement (during $\overline{\text{EOM}}$ (HI) output after trigger is received). |
| DOWN | Sets the falling edge as the valid edge of trigger input. |
| UP | Sets the rising edge as the valid edge of trigger input. |
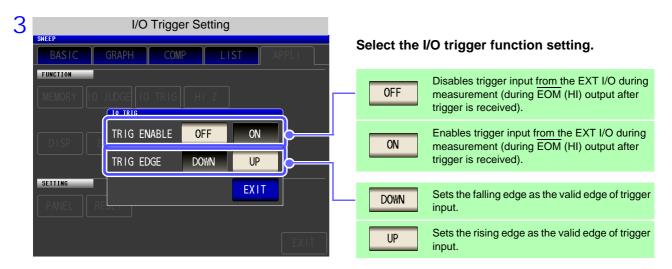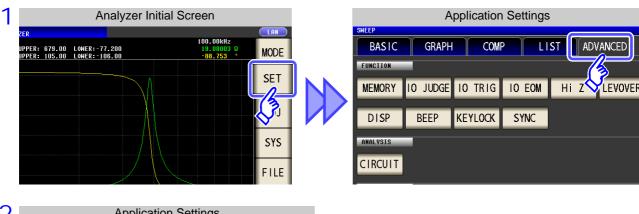
**4** Press EXIT to close the setting screen.

## 5.9.6 Setting the $\overline{\text{EOM}}$ Output Method

The higher the measurement frequency, the shorter the time that $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$ are high (off). When the high (off) time is too short due to characteristics of the input circuit, the instrument can be configured to maintain the low (on) state for a preset time once $\overline{\text{EOM}}$ changes to low (on) before reverting the signal to high (off) after the completion of measurement. The $\overline{\text{INDEX}}$ output method can be changed in the same manner.

**See** "Chapter 11 External Control" (p. 363)

**Procedure**

**1**  Analyzer Initial Screen

**2**  Application Settings

**Press** IO EOM .

**3**  Setting the $\overline{\text{EOM}}$ output method

**Setting the output method.**

For HOLD and PULSE timing charts, see "Chapter 11 External Control" (p. 363).

**Use** ▲ **or** ▼ **to set the** $\overline{\text{EOM}}$ **output time for the PULSE setting.**

Settable range: 0.0001 to 0.9999 s

**4**  **Press** EXIT **to close the setting screen.**

## 5.9.7　Disabling Key Operation (Key-lock Function)

If you turn the key-lock function ON, all operations except disabling the key-lock are disabled to protect the settings. You can also set a passcode (security code).

**Procedure**

**1**　Analyzer Initial Screen　　　　Application Settings

**2**　Application Settings

Press KEYLOCK .

**3**　Key Lock Setting

Press ON .

**4**　Press EXIT to close the setting screen.

NOTE　• In the case of an external trigger, the key lock is not enabled for TRIG .
　　　　• Turning off the power does not cancel the key-lock function.

## Setting the Passcode of the Key-lock

Passcode Setting

Press PASSCODE when the key-lock setting is ON .

Use the numerical keypad to enter the passcode, press ENTER , and then press EXIT .

Settable range: 1 to 4 digits

**NOTE** If a passcode is set, it needs to be entered to disable the key-lock.
Take care not to forget the set passcode.

## Disabling the Key-lock

Disable Key Lock

Press UNLOCK when the key-lock is enabled.

Input Passcode

**When a passcode is set**

Enter the passcode and press UNLOCK .

The entered passcode is indicated as ✹ on the screen.

(To cancel input: Press C )

**When a passcode is not set**

Press UNLOCK .

**When you want cancel the disabling of the key-lock:** Press CANCEL .

**5**

Chapter 5 ANALYZER Function

## 5.9 Application Settings

NOTE   If you forget the passcode, perform a full reset to restore the instrument to the factory default settings.(p. 406)

Key Lock Disable Error

If the error indication shown on the left appears, check the following items.
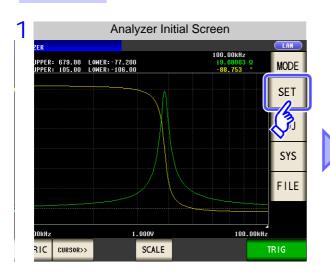
| Cause | Remedy |
|---|---|
| **UNLOCK** was pressed before you entered the passcode. | Press **C** and enter the passcode. |
| The entered passcode is incorrect. | Press **C** and enter the passcode again. |

## 5.9.8 Setting the LCD to ON/ OFF
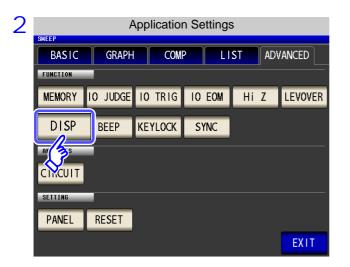
You can turn the LCD ON/ OFF.
Setting the LCD to OFF saves power because the LCD turns off if the panel is not touched for 10 seconds.

**Procedure**

**1** Analyzer Initial Screen



**2** Application Settings



Press  DISP .

**3** LCD setting



Select the LCD setting, and press  EXIT  to close the setting screen.

| OFF | Turns OFF the LCD. The LCD turns off after approximately 10 seconds elapse since the touch panel was last touched. |
|---|---|
| ON | Sets the LCD to always on. |
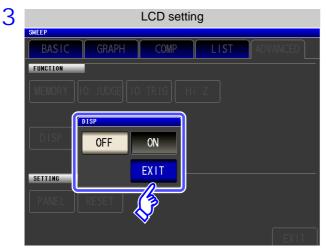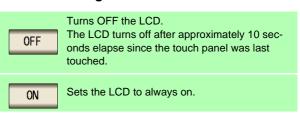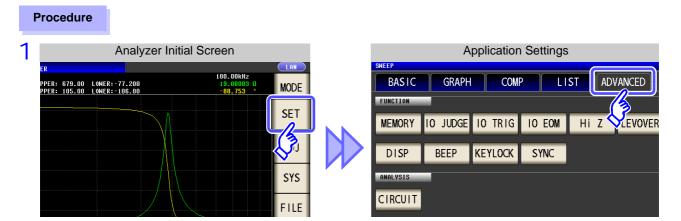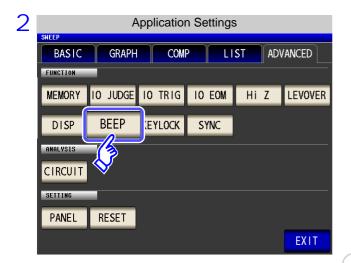
**When you want to turn the backlight on again:**
If you touch the touch panel while the backlight is off, the backlight will turn on again.

## 5.9.9   Setting Operation Sounds (Beep Sounds)

You can set the operation sound and each of the beep sounds for judgment results.

**Procedure**

**1**

Analyzer Initial Screen

Application Settings

**2**

Application Settings

**Press** BEEP **.**

**Beep sound settings for when comparator judgment**

| OFF | When a comparator judgment is made, no beep sound is emitted. |
|---|---|

• When judgment performed with 1 comparator

| IN | When the comparator result is IN, a beep sound is emitted. |
|---|---|

| NG | When the comparator result is LO or HI, a beep sound is emitted. |
|---|---|

• When judgment performed with 2 comparators

| IN | When both of these comparator results are IN, a beep sound is emitted. |
|---|---|

| NG | When either one is LO or HI, a beep sound is emitted. |
|---|---|

**3**

Beep Sound Settings

**Beep sound setting for when key pressed**

| OFF | When a key is pressed, no beep sound is emitted. |
|---|---|

| ON | When a key is pressed, a beep sound is emitted. |
|---|---|

**4**  **Press** EXIT **to close the setting screen.**

## 5.9.10 Applying the Signal to the Sample Only during Measurement (Trigger Synchronous Output Function)

This function enables the measurement signal to be output after measurement is triggered for the initial sweep point only, ensuring that the signal is applied to the sample during measurement only.
Thus reducing the generation of heat in the sample and decreasing electrode wear.
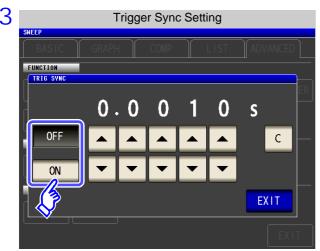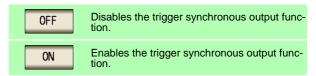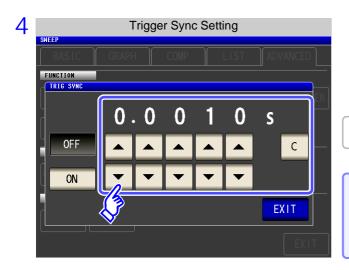
**Procedure**

**1**

ANALYZER Measurement Screen

ANALYZER Application Settings

**2**

ANALYZER Application Settings

Press SYNC .

**3**

Trigger Sync Setting

**Select ON/OFF for the trigger synchronous output function.**

| OFF | Disables the trigger synchronous output function. |
| ON | Enables the trigger synchronous output function. |

**4**

| Trigger Sync Setting |
| --- |

SWEEP

BASIC  GRAPH  COMP  LIST  ADVANCED

FUNCTION

TRIG SYNC

0. 0  0  1  0  s

OFF    ▲ ▲ ▲ ▲ ▲    C
ON     ▼ ▼ ▼ ▼ ▼

EXIT

EXIT

Use ▲ or ▼ to set the wait time from after the measurement signal is output by applying a trigger to the start of measurement.

Settable range: 0.0010 s to 9.9999 s

**When you want to return the time to the initial state:** Press C .

The set time is set to 0.0010 s.

**5** Press **EXIT** to close the setting screen.

**NOTE**
- When the trigger synchronous output function is set to ON, there is a measurement time delay because the instrument enters a wait time which spans from when the measurement signal is output to when measurement starts.
  **See** "13.3 About Measurement Times and Measurement Speed" (p. 399)
- When the trigger synchronous output function is set to ON, the set DC level may be output if a measurement condition is changed.
  Also, output will stop when measurement is performed once.
- The measurement signal is output when the trigger signal is input and stops after measurement ends.
- In CONTINUOUS measurement mode, the measurement signal stops after measurement of the last panel ends.

## 5.9.11 Initializing (System Reset)
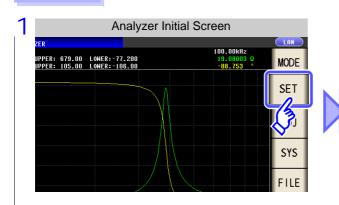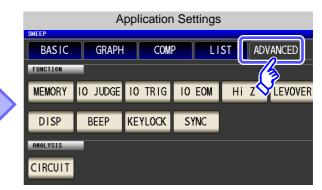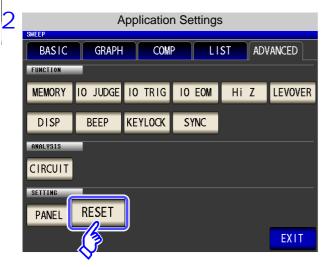
In the event of the instrument malfunctioning, check "Before returning for repair" (p. 405).
If you do not know the cause of the problem, perform a system reset to restore the instrument to its factory default settings.
A system reset can also be performed with the **\*RST** and **:RESet** communication commands.
**See** Description of communications commands on the included CD

**Procedure**

**1** Analyzer Initial Screen          Application Settings

**2** Application Settings

Press **RESET** .

**3** System Reset

⚠ All settings are initialized.
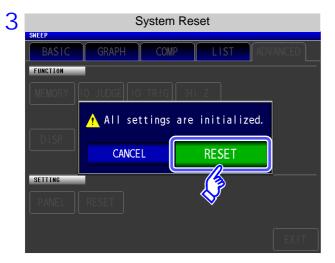
CANCEL          RESET

Press **RESET** to restore the factory default settings and automatically redisplay the initial screen.

**When you want to cancel the system reset:**

Press **CANCEL** .

**NOTE** If the initialization screen cannot be displayed, perform a full reset. (p. 406)

# 5.10 Equivalent Circuit Analysis Function

## 5.10.1 About the Equivalent Circuit Analysis Function

The optional IM9000 Equivalent Circuit Analysis Firmware is required in order to use the equivalent circuit analysis function. You can verify whether the IM9000 is installed on the Version Confirmation screen.

The equivalent circuit analysis function estimates equivalent circuit constants based on measurement results. The IM3570 can estimate 3-element model and 4-element model constants as illustrated below. By using the simulation function, you can display frequency characteristic ideal values using estimation results or user-configured constants.
By using the comparator function, you can judge whether estimation results fall inside the judgment area.

| | Equivalent circuit model | Representative frequency characteristics* | Example sample |
|---|---|---|---|
| A |  |  | Inductor: Inductor with high core loss and low ESR |
| B |  |  | Inductor: Inductor with comparatively high ESR<br>Resistor: Resistor with low resistance value and significant wiring inductance effect |
| C |  |  | Capacitors: Capacitor with significant leak resistance effect<br>Resistor: Resistor with high resistance value and significant stray capacitance effect |
| D |  |  | Capacitors: Typical capacitor |
| E |  |  | Piezoelectric element |

*Typical frequency characteristics graphs
For models A through D, the horizontal axis is logarithmic, the vertical axis (Z) is logarithmic, and θ is linear.
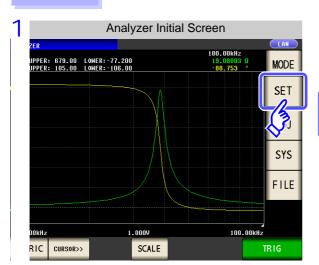
## 5.10.2 Configuring Basic Settings for Analysis
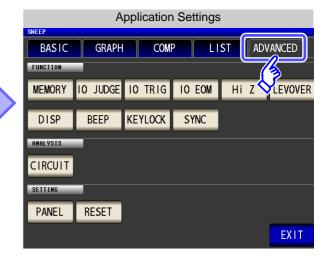
**1** Setting the equivalent circuit model
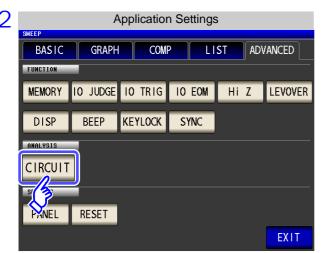
Select the equivalent circuit model you wish to use for equivalent circuit analysis.
By selecting the appropriate equivalent circuit model, you will be able to estimate constants more accurately.
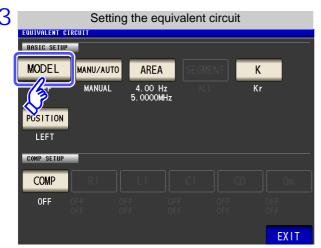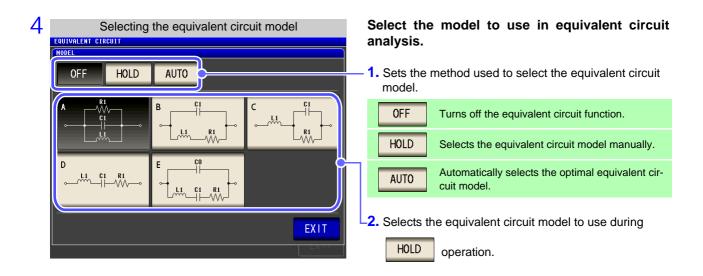
**Procedure**

**1**

Analyzer Initial Screen


Application Settings

**2**

Application Settings

Press **CIRCUIT** .

**3**

Setting the equivalent circuit

Press **MODEL** .

**4** Selecting the equivalent circuit model



**Select the model to use in equivalent circuit analysis.**

**1.** Sets the method used to select the equivalent circuit model.

| | |
|---|---|
| OFF | Turns off the equivalent circuit function. |
| HOLD | Selects the equivalent circuit model manually. |
| AUTO | Automatically selects the optimal equivalent circuit model. |

**2.** Selects the equivalent circuit model to use during HOLD operation.

**5** Press EXIT to close the setting screen.
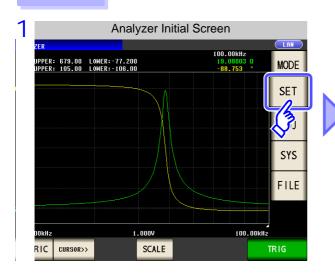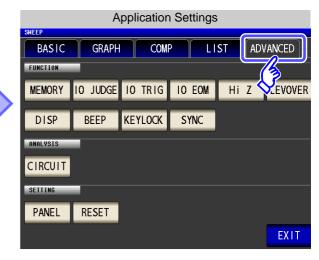
NOTE
- Selecting equivalent circuit models A to E causes the HOLD setting to be selected automatically.
- For more information about how to select the equivalent circuit model, see "Appendix 8  Selecting the Equivalent Circuit Model"(p. A12).
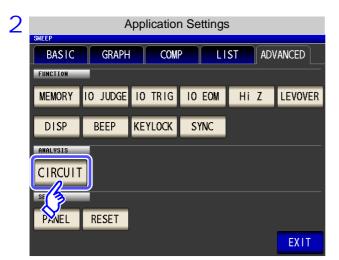
## 2   Setting the method of analysis

This section describes how to set whether to perform equivalent circuit analysis automatically after measurement completes or to wait until ▐ RUN ▐ is pressed.
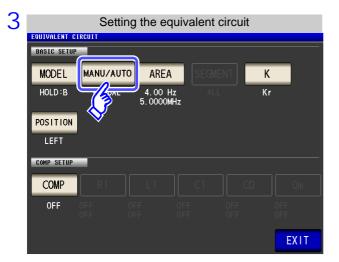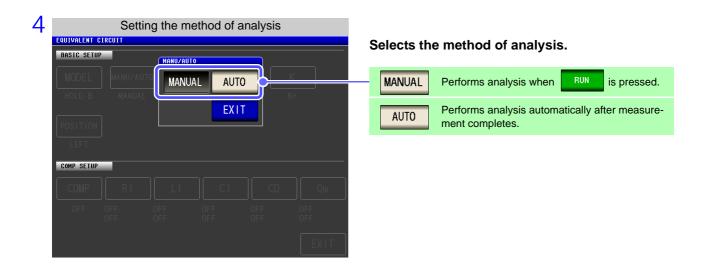
**Procedure**

**1**   Analyzer Initial Screen      Application Settings

**2**   Application Settings

Press ▐ CIRCUIT ▐ .

**3**   Setting the equivalent circuit

Press ▐ MANU/AUTO ▐ .

**4** Setting the method of analysis

EQUIVALENT CIRCUIT

BASIC SETUP

MODEL    MANU/AUTO    MANUAL    AUTO    K

HOLD:B    MANUAL    Kr

POSITION    EXIT

LEFT

COMP SETUP

COMP    R1    L1    C1    C0    Qm

OFF    OFF    OFF    OFF    OFF    OFF
OFF    OFF    OFF    OFF    OFF

EXIT

**Selects the method of analysis.**

| MANUAL | Performs analysis when RUN is pressed. |
| AUTO | Performs analysis automatically after measurement completes. |

**5** Press  EXIT  **to close the setting screen.**

NOTE
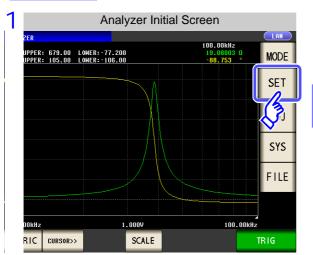
- AUTO is valid only when the trigger is set to "Sequential sweep" or "Step sweep."

  Analysis will not be performed automatically when the trigger is set to "Repeat sweep."

- Equivalent circuit analysis cannot be performed manually on the Continuous Measurement screen. To perform equivalent circuit analysis during continuous measurement, change the setting to auto and save the panel.
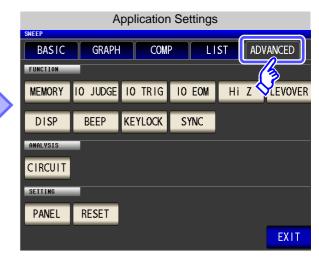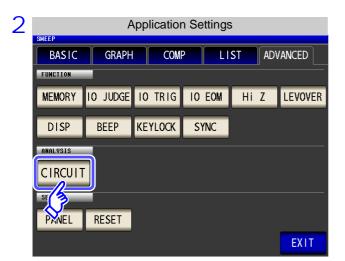
## 3  Setting the frequency range to analyze

This section describes how to set the frequency range for which to perform equivalent circuit analysis when using normal sweep. By using this function, you can limit the local extreme values used in analysis when there are multiple local extreme values in the sweep range. Configure the setting so that the local extreme values are included in the analytical range. This setting is valid only during normal sweep operation.

**Procedure**

**1**  Analyzer Initial Screen



**Application Settings**



**2**  Application Settings



Press CIRCUIT .

**3**  Setting the equivalent circuit



Press AREA .

**4** Setting the frequency range to analyze

**EQUIVALENT CIRCUIT**

| AREA | |
|---|---|
| START | 4.00 Hz |
| STOP | 5.0000MHz |

```
7  8  9  MHz
4  5  6  kHz
1  2  3  Hz
0  .  C
```

RESET    CANCEL    SET

**1.** Press [START] and enter the frequency at which to start analysis with the numeric keypad.

**2.** Press [STOP] and enter the frequency at which to stop analysis with the numeric keypad.

> Settable range: 4 Hz to 5 MHz

To clear the analytical range, press [RESET].

**3.** Press [SET] to accept the frequency range.

**5** Press [EXIT] **to close the setting screen.**

**■ Example of analysis using a set frequency range**

Analysis result

**ANALYZER**                                                            LAN

```
Z  *UPPER: 9.7993k  LOWER: 6.4408          1.0000MHz
θ   UPPER: 26.800   LOWER:-103.00         11.73210 Ω
                                          -64.899  °
```

MODE
SET
ADJ
SYS
FILE

```
MODEL HOLD:E
R1 21.79420 Ω
L1 176.3075mH
C1 2.921744nF
C0 19.66896nF
Qm 11.27128
PARA1 △ 7.077636
PARA2 △ 10.10690
```

1.0000kHz          1.000V          1.0000MHz

<<CIRCUIT   DEFINE   SIMULATE   RUN   TRIG
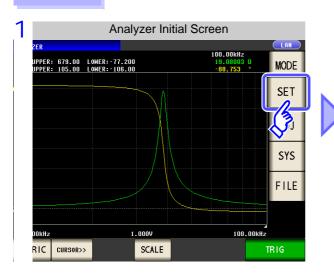
←→ Range over which analysis is performed
150 kHz   300 kHz
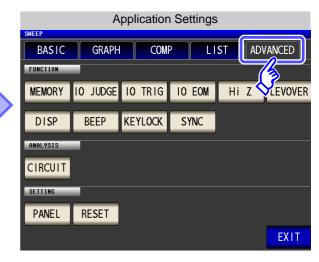
**NOTE** The precision of the analysis may deteriorate if too narrow a frequency range is set.
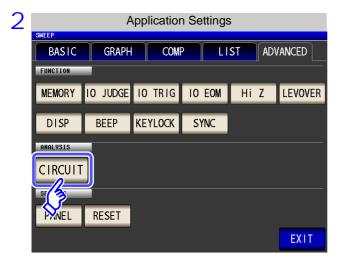
## 4 Selecting the segment to analyze

This section describes how to select which segment to target for estimation during a segment sweep.
By using this function, you can specify which segment to use in analysis when dividing the frequency range into multiple segments for measurement. Set the segment so that it includes local extreme values.
This setting is valid only during segment sweep operation.

**Procedure**

**1** Analyzer Initial Screen / Application Settings

**2** Application Settings

Press CIRCUIT .
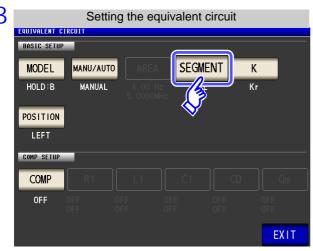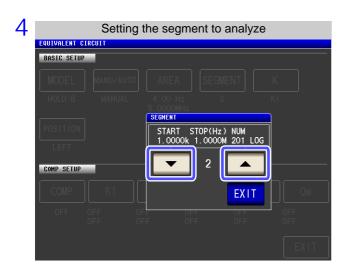
**3** Setting the equivalent circuit

Press SEGMENT .

**5**

Chapter 5 ANALYZER Function

**4** Setting the segment to analyze
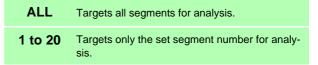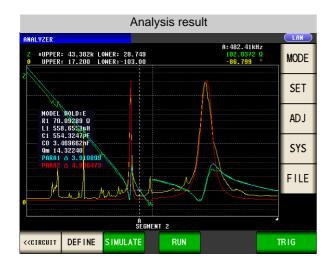


Select the segment number to use in equivalent circuit analysis with [▼] and [▲] .

| ALL | Targets all segments for analysis. |
|---|---|
| 1 to 20 | Targets only the set segment number for analysis. |

**5** Press **EXIT** to close the setting screen.
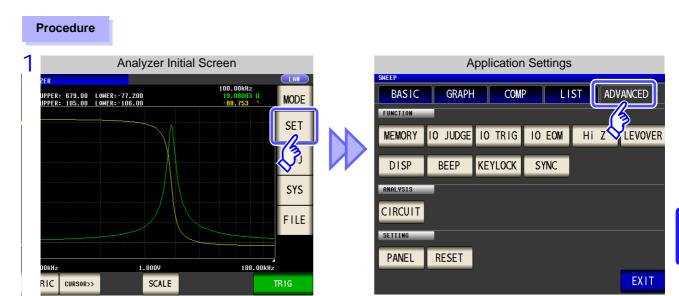
### ◼ Example of analysis using a selected segment

Analysis result
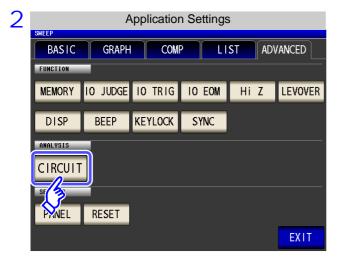


The No. 2 segment has been selected as the segment to use in analysis.
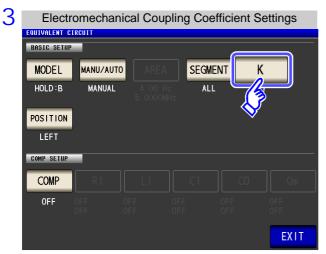
| **5** | **Configuring calculation of the electromechanical coupling coefficient (K)** |
|---|---|

This section describes how to configure settings for calculating the electromechanical coupling coefficient using the E model.

**Procedure**

**1** Analyzer Initial Screen



Application Settings



**2** Application Settings



Press [CIRCUIT].

**3** Electromechanical Coupling Coefficient Settings



Press [K].

**4**

Oscillation Mode Settings

EQUIVALENT CIRCUIT
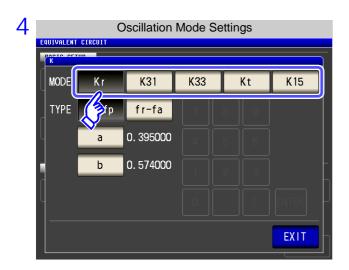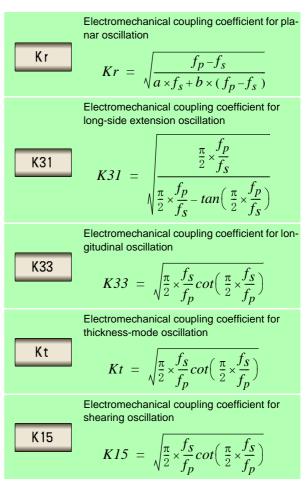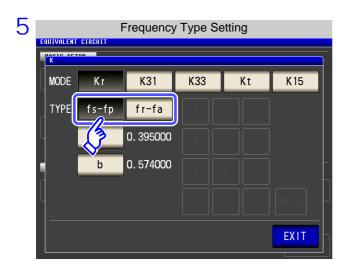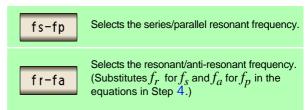
**Select the oscillation mode.**

| MODE | Kr | K31 | K33 | Kt | K15 |
| TYPE | fs-fp | fr-fa |
| a | 0.395000 |
| b | 0.574000 |

EXIT

**Kr** — Electromechanical coupling coefficient for planar oscillation

$$Kr = \sqrt{\frac{f_p - f_s}{a \times f_s + b \times (f_p - f_s)}}$$

**K31** — Electromechanical coupling coefficient for long-side extension oscillation

$$K31 = \sqrt{\frac{\frac{\pi}{2} \times \frac{f_p}{f_s}}{\sqrt{\frac{\pi}{2} \times \frac{f_p}{f_s} - tan\left(\frac{\pi}{2} \times \frac{f_p}{f_s}\right)}}}$$

**K33** — Electromechanical coupling coefficient for longitudinal oscillation

$$K33 = \sqrt{\frac{\pi}{2} \times \frac{f_s}{f_p} cot\left(\frac{\pi}{2} \times \frac{f_s}{f_p}\right)}$$

**Kt** — Electromechanical coupling coefficient for thickness-mode oscillation

$$Kt = \sqrt{\frac{\pi}{2} \times \frac{f_s}{f_p} cot\left(\frac{\pi}{2} \times \frac{f_s}{f_p}\right)}$$

**K15** — Electromechanical coupling coefficient for shearing oscillation

$$K15 = \sqrt{\frac{\pi}{2} \times \frac{f_s}{f_p} cot\left(\frac{\pi}{2} \times \frac{f_s}{f_p}\right)}$$

**5**

Frequency Type Setting

EQUIVALENT CIRCUIT

| MODE | Kr | K31 | K33 | Kt | K15 |
| TYPE | fs-fp | fr-fa |
| | 0.395000 |
| b | 0.574000 |

EXIT

**Select the frequency type**

Select the resonant frequency to use when calculating the electromechanical coupling coefficient.

**fs-fp** — Selects the series/parallel resonant frequency.

**fr-fa** — Selects the resonant/anti-resonant frequency. (Substitutes $f_r$ for $f_s$ and $f_a$ for $f_p$ in the equations in Step **4**.)

**6** Coefficient Settings

EQUIVALENT CIRCUIT

| MODE | Kr | K31 | K33 | Kt | K15 |

TYPE  fs-fp  fr-fa

a  0.395000

b  0.574000

7 8 9
4 5 6
1 2 3
0 . C  ENTER

EXIT

Set a different coefficient relative to Poisson's ratio only when selecting  Kr  (planar oscillation) as the oscillation mode.

Press  a  and set the coefficient with the numeric keypad.

Press  ENTER  to accept the coefficient.

Settable range: 0.000001 to 1.000000
To return to the previous screen without making any change to the set value, press the ENTER key when the screen is in the state with nothing being displayed (the state after pressing the C key).
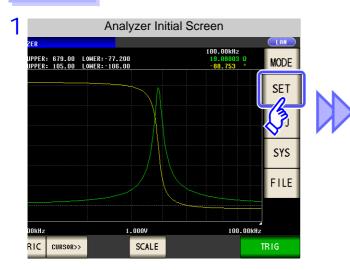
**7** Press  b  to set the same coefficient as  a .

**8** Press  EXIT  to close the setting screen.

Chapter 5 ANALYZER Function
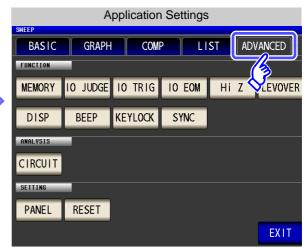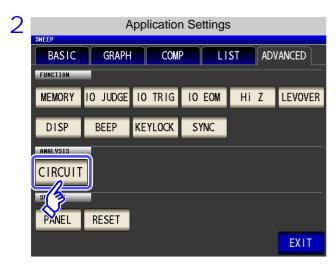
## 6    Setting the position at which to display analysis results

This section describes how to set the position at which to display analysis results.
If the graph and analysis results displays overlap, set the position so that estimated values are easy to read.

**Procedure**

**1**    Analyzer Initial Screen      Application Settings

**2**    Application Settings

Press CIRCUIT .

**3**    Setting the equivalent circuit

Press POSITION .
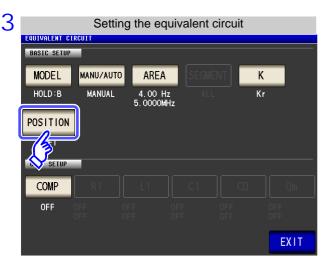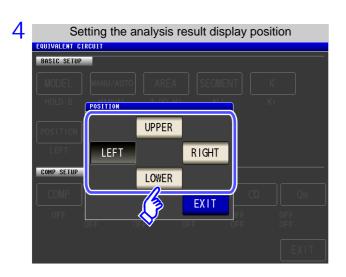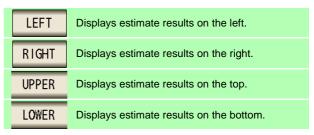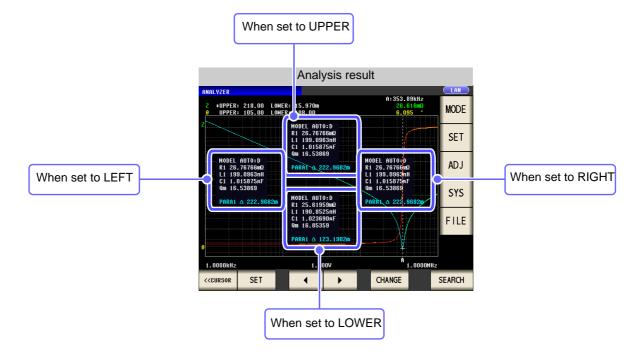
**4** Setting the analysis result display position

**Select the position at which to display analysis results.**

| | |
|---|---|
| **LEFT** | Displays estimate results on the left. |
| **RIGHT** | Displays estimate results on the right. |
| **UPPER** | Displays estimate results on the top. |
| **LOWER** | Displays estimate results on the bottom. |

**5** Press **EXIT** to close the setting screen.

■ **Analysis result display position**

When set to UPPER

Analysis result

When set to LEFT

When set to RIGHT

When set to LOWER

## 5.10.3 Performing Equivalent Circuit Analysis

### 1 Performing frequency sweep measurement
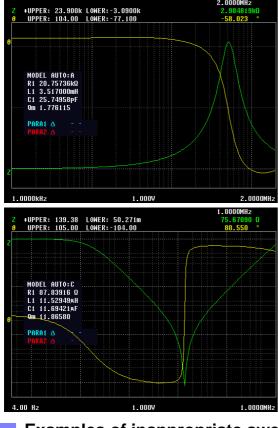
When performing frequency circuit analysis, it is necessary to set the sweep parameter to "Frequency" and acquire the frequency characteristics for the elements being analyzed.
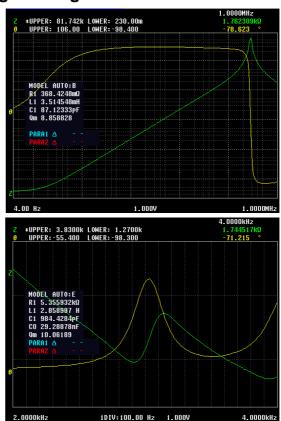
> **See** "5.2.2 Setting the Sweep Parameter" (p. 135)

Since the local maximum and local minimum measurement points are used when performing equivalent circuit analysis with the IM3570, the frequency range should be set to the range for which the local extreme values can be measured. When performing analysis using the B and C models, configure the settings so that the lowest possible frequencies are measured since low-frequency values are used.
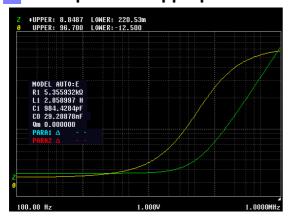
Additionally, when performing analysis using the E model, set the range so that it includes the resonance points for series resonance and parallel resonance.
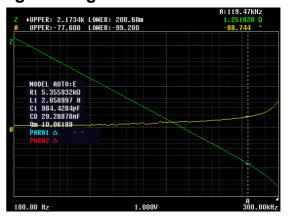
### ■ Examples of appropriate sweep range settings
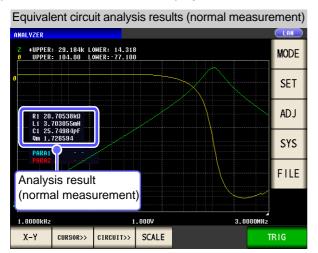


### ■ Examples of inappropriate sweep range settings
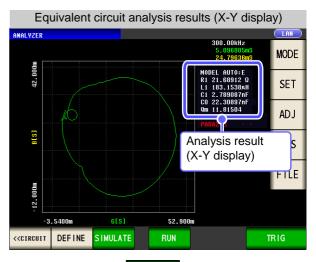
## 2 Performing equivalent circuit analysis
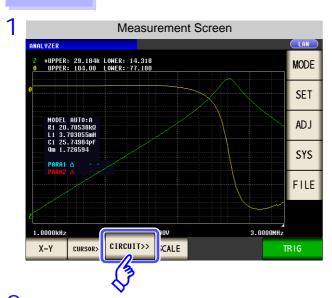
When the method of analysis is set to AUTO, analysis is performed automatically after measurement completes, and the results are displayed.

| Equivalent circuit analysis results (normal measurement) | Equivalent circuit analysis results (X-Y display) |
|---|---|



Analysis result
(normal measurement)

Analysis result
(X-Y display)
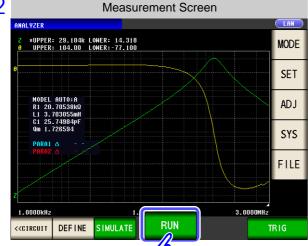
When the method of analysis is set to MANUAL, analysis is performed when RUN is pressed.

**Procedure**

**1** Measurement Screen



Press CIRCUIT>> .

**2** Measurement Screen



Press RUN to perform analysis.

5
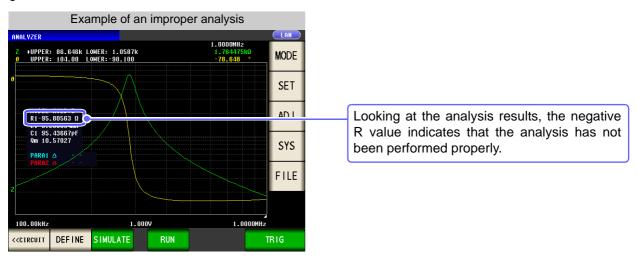
Chapter 5 ANALYZER Function

### A practical method for setting the measurement range
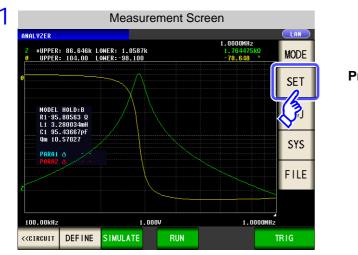
When performing analysis using the B and C models, it is necessary to measure frequencies that are as low as possible, but low-frequency measurement is time-consuming. The IM3570 uses measured values for the lowest frequency in the measurement range. By setting a low frequency for one point in the sweep range, it is possible to conduct a precise analysis in a short period of time.

The following diagram provides an example of a B mode analysis performed using sweep measurement starting at 100 kHz.



Example of an improper analysis

Looking at the analysis results, the negative R value indicates that the analysis has not been performed properly.
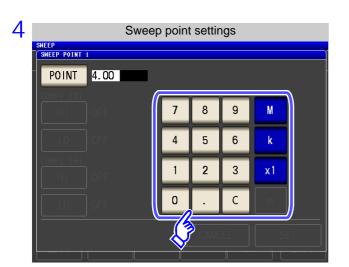
In this case, the sweep range setting should specify measurement of just one low frequency.

**Procedure**

**1**



Measurement Screen

Press **SET** in the [Measurement Screen].
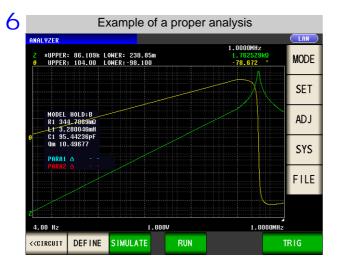
**2** Press **LIST** to display a list of sweep points.

**3** Press **EDIT** .

**4** Sweep point settings



Enter as low a frequency as possible.

**5** Sweep point list



Verify that a low frequency has been set for just one point on the sweep point list.

**6** Example of a proper analysis



Measured is performed and followed by equivalent circuit estimation.

The above procedure allows the R value to be properly estimated.

## When unable to detect resonance points
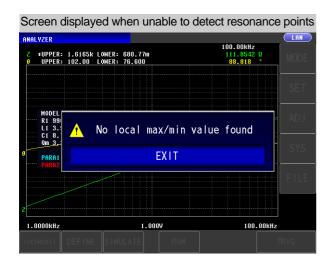
If the instrument is unable to detect the resonance points that are used in analysis, the following error message will be displayed.
Set the sweep range so that it includes resonance points.
Additionally, verify that the frequency range and segments used in the analysis are appropriately configured.

Screen displayed when unable to detect resonance points
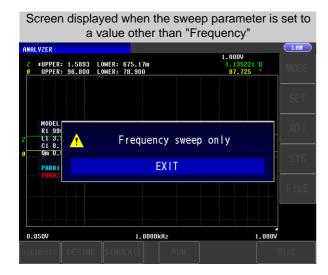


## When the sweep parameter is set to a value other than "Frequency"
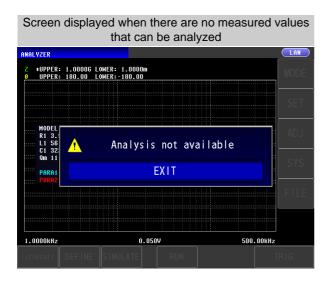
When the sweep parameter is set to a value other than "Frequency," the following error message will be displayed. Set the sweep parameter to "Frequency."

Screen displayed when the sweep parameter is set to a value other than "Frequency"
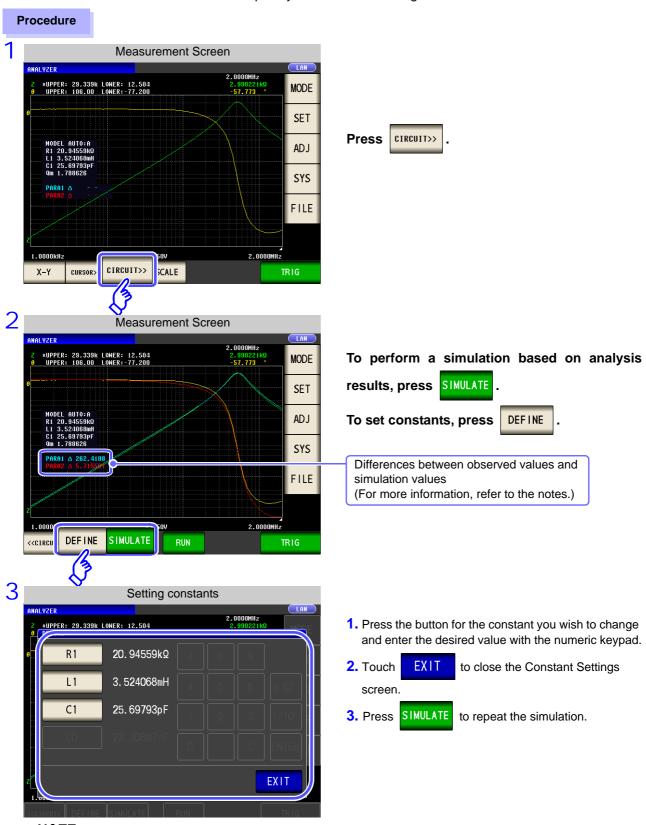
## When there are no measured values that can be analyzed

When there are no measured values that can be analyzed, the following error message will be displayed.
If measurement has not yet been performed, perform equivalent circuit analysis after measurement.



Screen displayed when there are no measured values that can be analyzed

# 5.10.4 Simulating Frequency Characteristics

This section describes how to simulate frequency characteristics using estimated or user-defined constants.

**Procedure**

**1** Measurement Screen

Press CIRCUIT>> .

**2** Measurement Screen

To perform a simulation based on analysis results, press SIMULATE .

To set constants, press DEFINE .

Differences between observed values and simulation values
(For more information, refer to the notes.)

**3** Setting constants

**1.** Press the button for the constant you wish to change and enter the desired value with the numeric keypad.

**2.** Touch EXIT to close the Constant Settings screen.

**3.** Press SIMULATE to repeat the simulation.

**NOTE**
• The simulation graph will be cleared if you change one or more constants or perform a new measurement. To repeat the simulation, press SIMULATE .

**NOTE** The difference between observed values and simulated values is calculated for each measurement parameter in order to judge the suitability of equivalent circuit analysis results. The frequency range that was analyzed or the frequency range for the segment number that was analyzed is used as the range for calculating this difference.

The difference is calculated using the following procedure:
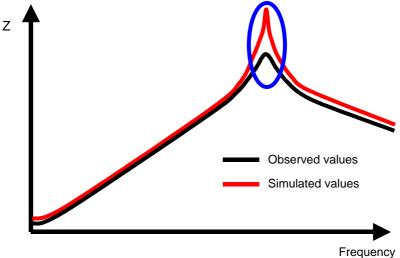
(1) The squares of the difference between each observed and simulated value pair for the frequency sweep count are added together.
(2) The result is divided by the frequency sweep count to obtain the mean residual sum of squares.
(3) The square root is calculated.

More concretely, this can be illustrated as in (A) below:

$$\sqrt{\sum (\text{Observed value} - \text{Simulated value})^2 / n} \quad \cdots\cdots\cdots \text{(A)}$$
$$n = \text{Sweep count}$$

However, when using this method with circuits whose impedance frequency characteristics exhibit local extreme values (local maximum or local minimum values), difference values for frequency ranges that do not contain local extreme values will be less than difference values for frequency ranges near local extreme values, as shown in the figure below. Consequently, the circled area in the figure is excluded when calculating the difference between observed and simulated values. The following calculation procedure is used for the circled area:

(1) The difference value calculated by adding a quantity A to the observed value for the measurement frequency that generated the local extreme value is used as the upper limit value, and the difference calculated by subtracting the quantity A from the observed value for the measurement frequency that generated the local extreme value is used as the lower limit value.
(2) If the simulated value for the measurement frequency that generated the local extreme value falls outside the range defined by the upper and lower limit values calculated in (1) above, the upper and lower limit values for the observed values before and after the local extreme value are calculated as in (1) above and repeatedly compared to the simulated values.
(3) If the simulated value falls inside the range defined by the upper and lower limit values for the measurement frequencies before and after the local extreme value, the area is used to calculate the difference, and the areas used in (1) and (2) above become the circled area.

**5**

Chapter 5 ANALYZER Function
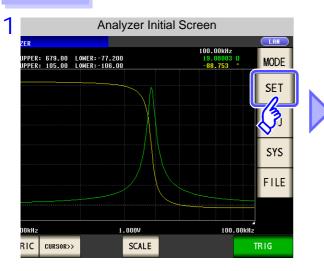
## 5.10.5 Judging analysis results
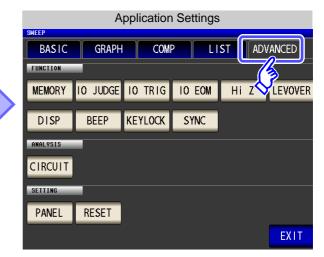
This section describes how to use the comparator function to determine whether estimation results fall within judgment standards.
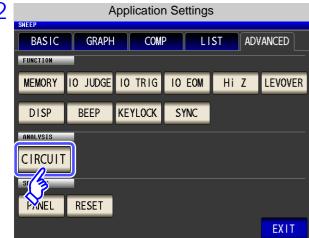
### 1 Setting the Upper or Lower Limit Value

Before using the comparator function, you must set upper and lower limit values for the judgment standards.

Procedure

**1**

Analyzer Initial Screen



Application Settings



**2**

Application Settings



Press CIRCUIT .

**3**

Setting the equivalent circuit



Press COMP .

**4** Comparator Setting



Press [ ON ] to enable the comparator function.

Press [ EXIT ] key to confirm the setting.

**5** Setting the equivalent circuit
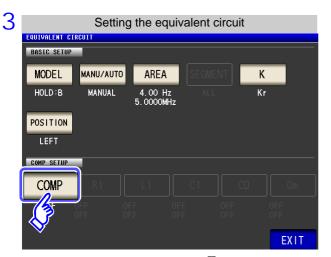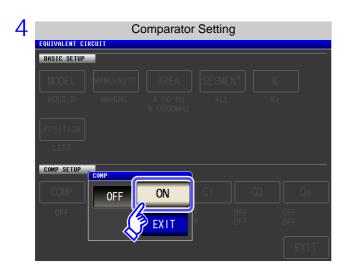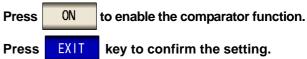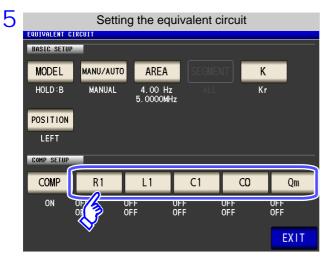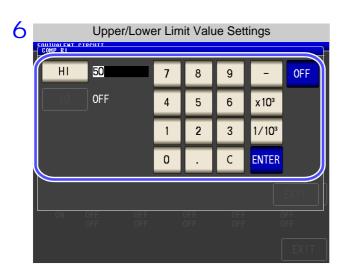


Select the constant for which you wish to set judgment standards.

**6** Upper/Lower Limit Value Settings



Press [ HI ] and use the numeric keypad to set the upper limit value.

Press [ENTER] key to confirm the setting.

Press [ LO ] and use the numeric keypad to set the lower limit value.

Press [ENTER] key to confirm the setting.

Settable range: -9.999999 G to 9.999999 G

Changing the unit (**a/ f/ p/ n/ μ/ m/ None/ k/ M/ G**)

| [ x10³ ] | Step the units up. |
| [ 1/10³ ] | Step the units down. |

**When you do not want to set the upper and lower limit values:** Press [ OFF ].

Press [ EXIT ] to close the setting screen.

**5**

**Chapter 5 ANALYZER Function**

**7** Setting the equivalent circuit



You can check the set upper and lower limit values on the Equivalent Circuit Settings screen.

Top row : Upper limit values
Bottom row : Lower limit values
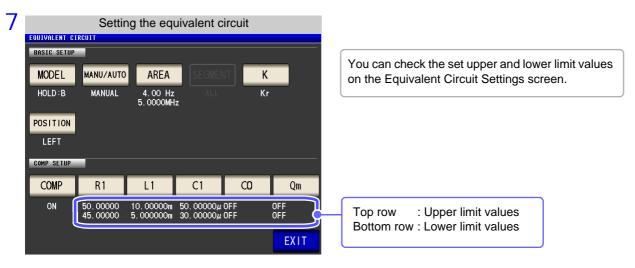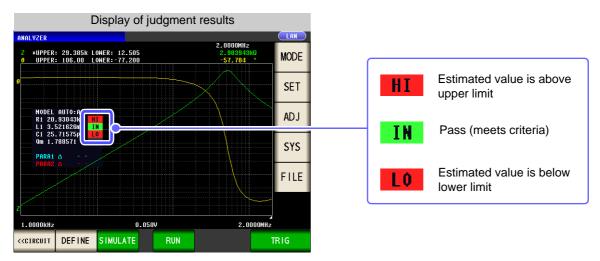
**8** Press **EXIT** to close the setting screen.

## 2 Making judgments using analysis results

When the comparator is on and a judgment area has been set, the estimated values and judgment results will be displayed after equivalent circuit estimation. Judgment results can also be acquired using communications commands or external output (EXT I/O).

Display of judgment results



**HI** Estimated value is above upper limit

**IN** Pass (meets criteria)

**LO** Estimated value is below lower limit

NOTE Changing estimated values manually causes judgment results to be cleared.
The overall judgment result is output with the front panel's LED as well as from EXT I/O pin 14.
**See** "Chapter 11 External Control" (p. 363)
However, the judgment content differs depending on whether you are performing analysis manually or automatically.
For more information, see the following table:

| Method of analysis | Judgment timing | Overall judgment result |
|---|---|---|
| MANUAL | When measurement completes | Outputs the area comparator or peak comparator judgment result. Outputs nothing when the area comparator or peak comparator have not been configured. |
| | When equivalent circuit analysis is performed manually | Clears the area comparator or peak comparator judgment results and outputs the overall judgment result for the equivalent circuit analysis results. |
| AUTO | When equivalent circuit analysis is performed after measurement | Outputs the area comparator or peak comparator judgment results as well as the overall judgment result for the equivalent circuit |
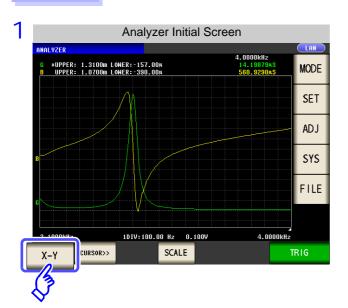
# 5.10.6 Generating X-Y Displays

When the IM9000 Equivalent Circuit Analysis Firmware is installed, you can generate an X-Y display of measurement results. This display consists of a graph with measured values for the No. 1 parameter on the X-axis and measured values for the No. 2 parameter on the Y-axis.
Parameters can be combined to create Cole-Cole plots and admittance circle displays.
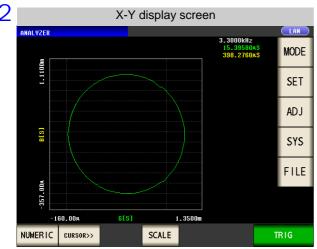
## 1 Creating an X-Y display

**Procedure**

**1** Analyzer Initial Screen

Press [ X-Y ] .

**2** X-Y display screen

**NOTE**  To display a Cole-Cole plot or admittance circle, make the following settings:

| | |
|---|---|
| Cole-cole plot | Set the No. 1 parameter to Rs. |
| | Set the No. 2 parameter to X. |
| | Reverse the No. 2 parameter's polarity (set the compensation coefficient to A = -1 with scaling compensation). |
| Admittance circle display | Set the No. 1 parameter to G. |
| | Set the No. 2 parameter to B. |

# Continuous Measurement Function

# Chapter 6

## 6.1   Initial Screen

CONTINUOUS
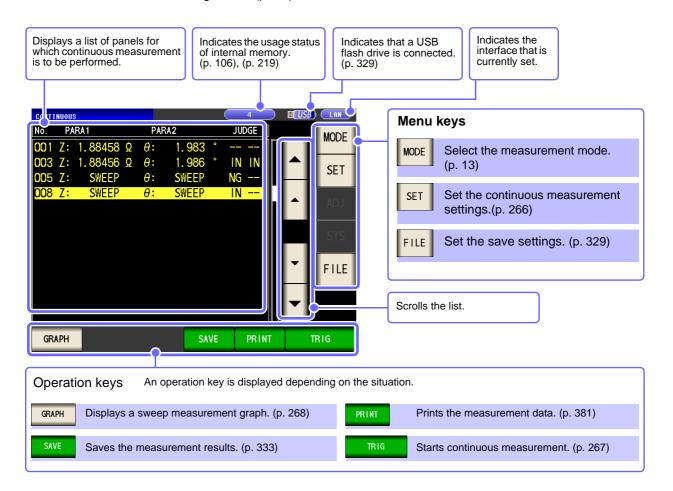
The continuous measurement function reads in order the measurement conditions saved with the panel save function, and performs a number of measurements continuously. It is possible to mix the measurement conditions of the LCR and analyzer.
The continuous measurement of up to 32 items is possible.
For details on the screen configuration (p. 20).

Displays a list of panels for which continuous measurement is to be performed.

Indicates the usage status of internal memory. (p. 106), (p. 219)

Indicates that a USB flash drive is connected. (p. 329)

Indicates the interface that is currently set.

| No. | PARA1 | PARA2 | JUDGE |
|-----|-------|-------|-------|
| 001 | Z: 1.88458 Ω | θ: 1.983 ° | -- -- |
| 003 | Z: 1.88456 Ω | θ: 1.986 ° | IN IN |
| 005 | Z: SWEEP | θ: SWEEP | NG -- |
| 008 | Z: SWEEP | θ: SWEEP | IN -- |

**Menu keys**

| MODE | Select the measurement mode. (p. 13) |
|------|--------------------------------------|
| SET | Set the continuous measurement settings.(p. 266) |
| FILE | Set the save settings. (p. 329) |

Scrolls the list.

**Operation keys**      An operation key is displayed depending on the situation.

| GRAPH | Displays a sweep measurement graph. (p. 268) | PRINT | Prints the measurement data. (p. 381) |
|-------|----------------------------------------------|-------|---------------------------------------|
| SAVE | Saves the measurement results. (p. 333) | TRIG | Starts continuous measurement. (p. 267) |

**NOTE**

- Setting the measurement conditions so that the measurement frequency or measurement signal level differs for each panel allows you to simply evaluate the characteristics of the test sample.
- Continuous measurement can also be performed from the EXT I/O.(p. 364)
- If the power is turned off when the [Continuous Measurement Screen] is displayed, the [Continuous Measurement Screen] will be displayed when the instrument starts the next time you turn the power on.

1.888.610.7664          www.calcert.com          sales@calcert.com
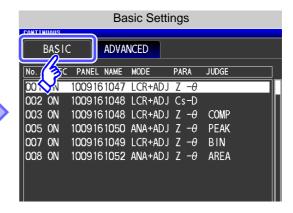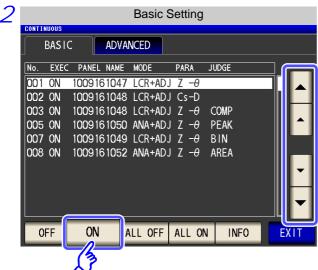
# 6.2 Setting Continuous Measurement `CONTINUOUS`
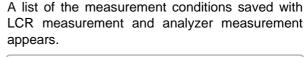
Before you perform continuous measurement, set which panels are target for continuous measurement.
Save the measurement conditions with the panel save function in LCR mode or analyzer mode in advance.

**Procedure**

**1**   Continuous Measurement Initial Screen

Basic Settings

**2**   Basic Setting

A list of the measurement conditions saved with LCR measurement and analyzer measurement appears.
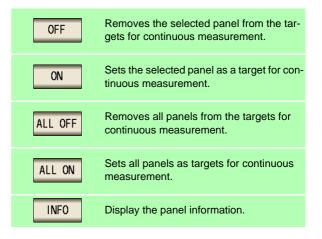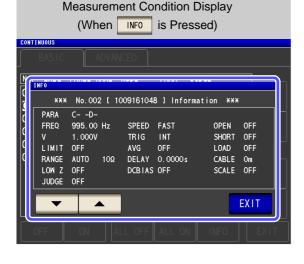
> Any panel for which only the compensation value (ADJ) was saved is not displayed.

Use ▲ or ▼ to select a panel for which to perform continuous measurement, and press ON .

| | |
|---|---|
| OFF | Removes the selected panel from the targets for continuous measurement. |
| ON | Sets the selected panel as a target for continuous measurement. |
| ALL OFF | Removes all panels from the targets for continuous measurement. |
| ALL ON | Sets all panels as targets for continuous measurement. |
| INFO | Display the panel information. |

Measurement Condition Display

(When INFO is Pressed)

**3** Press EXIT to close the setting screen.
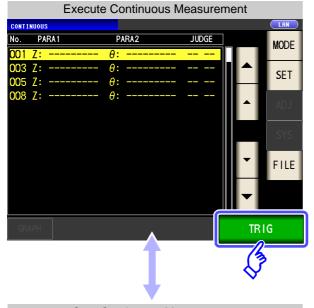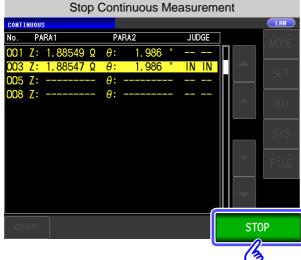
# 6.3 Performing Continuous Measurement

<u>**CONTINUOUS**</u>

**Execute Continuous Measurement**

| No. | PARA1 | PARA2 | JUDGE |
|-----|-------|-------|-------|
| 001 | Z: --------- | θ: --------- | -- -- |
| 003 | Z: --------- | θ: --------- | -- -- |
| 005 | Z: --------- | θ: --------- | -- -- |
| 008 | Z: --------- | θ: --------- | -- -- |

CONTINUOUS · LAN · MODE · SET · ADJ · SYS · FILE · GRAPH · **TRIG**

Panels that were set to **ON** in the setting screen are displayed in the list.

**Press** **TRIG** .

**Stop Continuous Measurement**

| No. | PARA1 | PARA2 | JUDGE |
|-----|-------|-------|-------|
| 001 | Z: 1.88549 Ω | θ: 1.986 ° | -- -- |
| 003 | Z: 1.88547 Ω | θ: 1.986 ° | IN IN |
| 005 | Z: --------- | θ: --------- | -- -- |
| 008 | Z: --------- | θ: --------- | -- -- |

CONTINUOUS · LAN · MODE · SET · ADJ · SYS · FILE · GRAPH · **STOP**

**When you want to stop continuous measurement:** Press **STOP** .
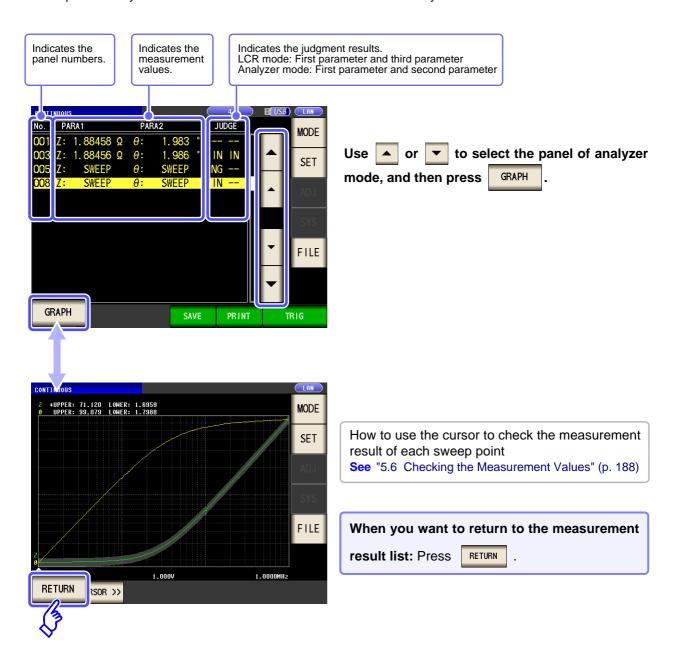
**NOTE** In the following circumstances, measurement will not continue after it:
- When the measurement result yields a contact check error or HIGH-Z reject error in low Z high accuracy mode
- When the instrument is configured to halt measurement when the judgment result is FAIL (**HI**/ **LO**/ **OUT OF BINS**) and the judgment function for the measured panel (comparator, BIN function) is enabled

**6**

Chapter 6 Continuous Measurement Function

# 6.4 Checking the Continuous Measurement Results

CONTINUOUS

Example: When you want to check the measurement results of analyzer mode

Indicates the panel numbers.

Indicates the measurement values.

Indicates the judgment results.
LCR mode: First parameter and third parameter
Analyzer mode: First parameter and second parameter

Use ▲ or ▼ to select the panel of analyzer mode, and then press GRAPH .

How to use the cursor to check the measurement result of each sweep point
**See** "5.6 Checking the Measurement Values" (p. 188)

**When you want to return to the measurement result list:** Press RETURN .

NOTE  The measurement values of LCR mode are only displayed for the first parameter and third parameter.

# 6.5  Setting Application Settings $\boxed{\textit{CONTINUOUS}}$

## 6.5.1  Setting the Display Timing
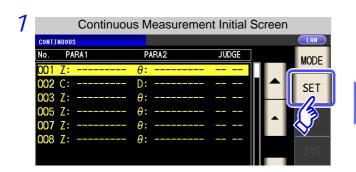
Set the draw timing for during continuous measurement.
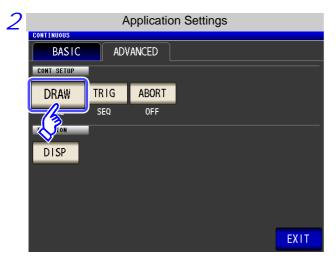
If the display timing is set to $\boxed{\text{REAL}}$ , the time for continuous measurement becomes long because the screen is updated every time measurement is performed.

If it is set to $\boxed{\text{AFTER}}$ to give priority to the measurement time, the screen update time becomes short.

**Procedure**

**1**  Continuous Measurement Initial Screen

Application Settings

**2**  Application Settings

Press $\boxed{\text{DRAW}}$ .

**3**  Draw Timing Setting

Set the timing for display.

| $\boxed{\text{REAL}}$ | Sequentially draws after measurement of each panel. |
|---|---|
| $\boxed{\text{AFTER}}$ | Draws all after continuous measurement is finished. |

**Chapter 6  Continuous Measurement Function**

**6**
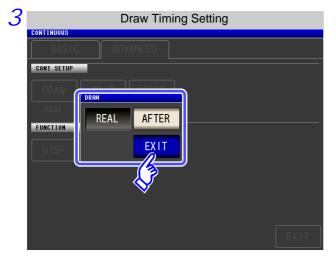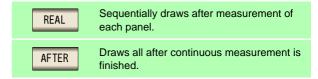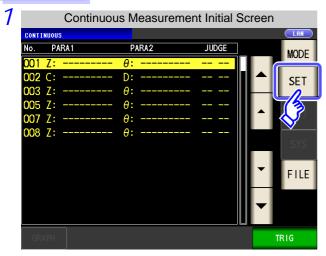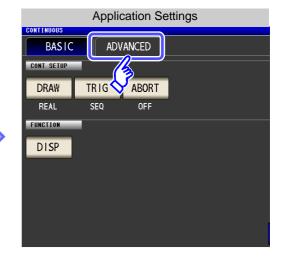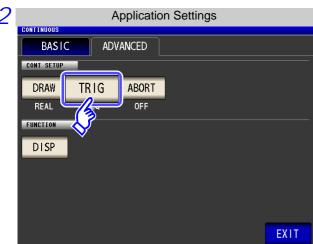
## 6.5.2 Setting the Trigger

This section describes how to set the trigger. In continuous measurement mode, measurement will be performed in accordance with the trigger settings configured as described in this section. Two types of triggers can be set: sequential measurement and step measurement.

**Procedure**

**1**

Continuous Measurement Initial Screen

| No. | PARA1 | PARA2 | JUDGE |
|-----|-------|-------|-------|
| 001 | Z: --------- | θ: --------- | -- -- |
| 002 | C: --------- | D: --------- | -- -- |
| 003 | Z: --------- | θ: --------- | -- -- |
| 005 | Z: --------- | θ: --------- | -- -- |
| 007 | Z: --------- | θ: --------- | -- -- |
| 008 | Z: --------- | θ: --------- | -- -- |

MODE  SET  FILE  TRIG

Application Settings

BASIC  ADVANCED
CONT SETUP
DRAW  TRIG  ABORT
REAL  SEQ  OFF
FUNCTION
DISP

**2**

Application Settings

BASIC  ADVANCED
CONT SETUP
DRAW  TRIG  ABORT
REAL  OFF
FUNCTION
DISP
EXIT

**Press** TRIG **.**

**3**

Trigger Setting

BASIC  ADVANCED
CONT SETUP
DRAW  TRIG
REAL  SEQ
FUNCTION
DISP

TRIGGER
SEQ  STEP
EXIT

**Select the trigger setting.**

| | |
|---|---|
| SEQ | Performs sequential measurement. When the external trigger is input, all panels set to ON on the setting screen are measured. |
| STEP | Performs step measurement. When the external trigger is input, the panel set to ON on the setting screen is measured, and the instrument switches to the next panel's measurement conditions. |

**4** Press EXIT to close the setting screen

## 6.5.3 Halting Continuous Measurement at a FAIL judgment result

Measurement can be halted when the judgment result is FAIL (**HI**/ **LO**/ **OUT OF BINS**) and the judgment function for the measured panel (comparator, BIN function) is enabled. Continuous measurement is halted regardless of the settings when the measurement result yields a contact check error or HIGH-Z reject error in low Z high accuracy mode.

**Procedure**

**1**   Continuous Measurement Initial Screen



**2**   Application Settings



Press  ABORT .

**3**   Continuous Measurement Halt Method Setting
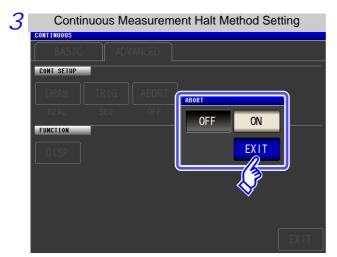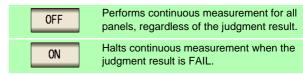


**Turn the setting to halt continuous measurement on or off.**
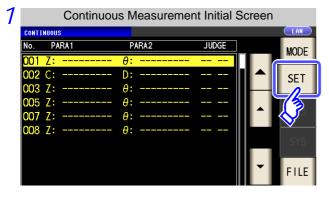
| | |
|---|---|
| OFF | Performs continuous measurement for all panels, regardless of the judgment result. |
| ON | Halts continuous measurement when the judgment result is FAIL. |

**4**   Press   EXIT   **to close the setting screen.**

## 6.5.4   Setting the LCD to ON/ OFF

You can turn the LCD ON/ OFF.
Setting the LCD to OFF saves power because the LCD turns off if the panel is not touched for 10 seconds.

**Procedure**

**1**   Continuous Measurement Initial Screen

Application Settings

**2**   Application Settings

Press  DISP .

**3**   LCD setting

Select the LCD setting, and press  EXIT  to close the setting screen.

| | |
|---|---|
| OFF | Turns OFF the LCD. The LCD turns off after approximately 10 seconds elapse since the touch panel was last touched. |
| ON | Sets the LCD to always on. |
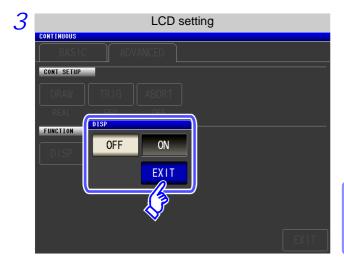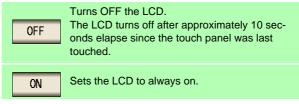
**When you want to turn the backlight on again:**
If you touch the touch panel while the backlight is off, the backlight will turn on again.

# Error Compensation    Chapter 7

Compensate for errors caused by a fixture or measurement cable.

## 7.1   Setting Open Circuit Compensation ‖LCR ANALYZER‖

With open circuit compensation, it is possible to reduce the influence of the floating impedance of the test cables and thereby to enhance the accuracy of measurement.
It is effective for test samples whose impedance is relatively high.
The comparator decision mode can be set as one of the following:

| All Compensation | ▷ | The compensation values are obtained for all test frequencies. |
| Spot Compensation | ▷ | The compensation values are obtained at the set test frequency only. |
| OFF | ▷ | Open circuit compensation data becomes invalid. |

**NOTE**
- Before open circuit compensation, always set the cable length.
  **See** "7.4  Compensating Measurement Cable Errors (Cable Length Compensation)" (p. 301)
- The measurement accuracy values defined in the specifications are for when open circuit compensation and short circuit compensation are performed.
- Be sure to perform compensation again after replacing the measuring cable.
  You will be unable to obtain correct values if measurement is performed in the compensation state prior to replacement.
- For SPOT compensation, the open circuit compensation will be valid only when the measurement frequency agrees with the SPOT compensation frequency.
- When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
  ex. Servo Motor, switching power source, high-voltage cable and etc.
- For SPOT compensation, the open circuit compensation will be valid only when the measurement frequency agrees with the SPOT compensation frequency.
- The compensated value is preserved in the memory of the main unit even when power is turned off.
- If the setting of the low Z high accuracy mode is changed, the compensation value becomes invalid.

### Before Performing Screen Operations
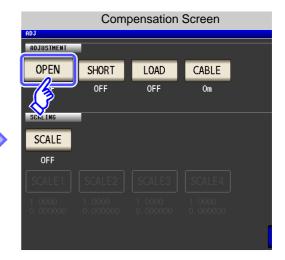


- Arrange the test leads as they will be when measurement will actually be performed. Changing the configuration of the leads may result in compensation not being performed properly.
-  Create an open state between the HIGH terminals and LOW terminals of the probes or fixture in accordance with the width of the measurement object. (Connect $H_{CUR}$ and $H_{POT}$, and connect $L_{CUR}$ and $L_{POT.}$)
- When the open circuit compensation is performed, execute the guarding process.

## 7.1 Setting Open Circuit Compensation
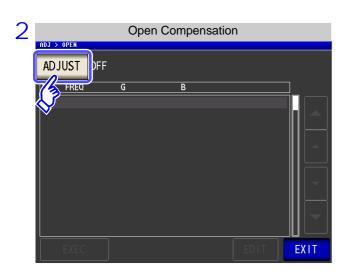
## 7.1.1 All Compensation

Simultaneously acquire the open compensation values for all measurement frequencies.

**Procedure**

**1**

| LCR Initial Screen | Compensation Screen |

**2**

Open Compensation

Press **ADJUST** .

**3**

Open Compensation Setting

Select **ALL** and press **EXIT** to close the setting screen.

## 7.1 Setting Open Circuit Compensation

**4**

| | | All Compensation | | |

ADJ > OPEN

ADJUST  ALL

| No | FREQ | G | B |
|----|------|------|------|
| 01 | DC | 0.0000nS | 0.0000nS |
| 02 | 4.00 Hz | 0.0000nS | 0.0000nS |
| 03 | 19.99 Hz | 0.0000nS | 0.0000nS |
| 04 | 20.00 Hz | 0.0000nS | 0.0000nS |
| 05 | 100.00 Hz | 0.0000nS | 0.0000nS |
| 06 | 100.01 Hz | 0.0000nS | 0.0000nS |
| 07 | 999.99 Hz | 0.0000nS | 0.0000nS |
| 08 | 1.0000kHz | 0.0000nS | 0.0000nS |
| 09 | 3.0000kHz | 0.0000nS | 0.0000nS |
| 10 | 3.0001kHz | 0.0000nS | 0.0000nS |

EXEC          EDIT   EXIT

The compensation values from last time are displayed in a confirmation screen.
(If compensation has never been performed, the compensation values become 0.)

> Check that the measurement cable is in an open circuit state.

**Press**  EXEC .

> **When you do not want to acquire the compensation values:** Press  EXIT .
> The setting screen is redisplayed, and the compensation values from last time become valid.

**5**

| | | Performing Open Compensation | |

ADJ > OPEN

ADJUST  ALL

| No | FREQ | G | B |
|----|------|------|------|
| 01 | DC | 0.000000 S | 0.000000 S |
| 02 | 4. | | |
| 03 | 19. | | |
| 04 | 20. | | |
| 05 | 100. | | |
| 06 | 100. | | |
| 07 | 999. | | |
| 08 | 1.00 | | |
| 09 | 3.0000kHz | 0.000000 S | 0.000000 S |
| 10 | 3.0001kHz | 0.000000 S | 0.000000 S |

Now Adjusting...

52%

CANCEL

Compensation starts.

Compensation value acquisition time:
Approximately 2 minutes

> **When you want to cancel compensation:** Press  CANCEL .
> Compensation is cancelled and the compensation screen is redisplayed.
> (The open circuit compensation value state from last time remains.)

Indicates the compensation numbers.

Indicates the measurement frequencies.

Indicates the compensation results. (Conductance, susceptance)

**6**

| | | All   Compensation | |

AD > OPEN

ADJUST  ALL

| No | FREQ | G | B |
|----|------|------|------|
| 01 | DC | −0.1118nS | 0.0000nS |
| 02 | 4.00 Hz | 0.0079nS | 0.0111nS |
| 03 | 19.99 Hz | 0.0041nS | 0.0690nS |
| 04 | 20.00 Hz | 0.0067nS | 0.0690nS |
| 05 | 100.00 Hz | 0.0151nS | 0.3395nS |
| 06 | 100.01 Hz | 0.0141nS | 0.3402nS |
| 07 | 999.99 Hz | 0.1112nS | 3.2572nS |
| 08 | 1.0000kHz | 0.1071nS | 3.2570nS |
| 09 | 3.0000kHz | 0.3300nS | 9.5306nS |
| 10 | 3.0001kHz | 0.3249nS | 9.5253nS |

EXEC          EDIT   EXIT

You can use ▲ and ▼ to check the Conductance, susceptance of each compensation point.

- If compensation ends normally, the conductance and susceptance are displayed.
- Compensation can be performed for impedances of at least 1 kΩ.

> **When compensation failed:** (p. 279)

**7** **Press**  EXIT  **to close the setting screen.**

## 7.1 Setting Open Circuit Compensation

### Acquiring open compensation values for some frequencies only

**Procedure**

**1**

| All Compensation |
| --- |

ADJ > OPEN

ADJUST  ALL

| No | FREQ | G | B |
| --- | --- | --- | --- |
| 01 | DC | 0.0000nS | 0.0000nS |
| 02 | 4.00 Hz | 0.0000nS | 0.0000nS |
| 03 | 19.99 Hz | 0.0000nS | 0.0000nS |
| 04 | 20.00 Hz | 0.0000nS | 0.0000nS |
| 05 | 100.00 Hz | 0.0000nS | 0.0000nS |
| 06 | 100.01 Hz | 0.0000nS | 0.0000nS |
| 07 | 999.99 Hz | 0.0000nS | 0.0000nS |
| 08 | 1.0000kHz | 0.0000nS | 0.0000nS |
| 09 | 3.0000kHz | 0.0000nS | 0.0000nS |
| 10 | 3.0001kHz | 0.0000nS | 0.0000nS |

EXEC    EDIT    EXIT

Press [EDIT] in the all compensation screen.

**Configuring DC open compensation**

| [ON] | Performs DC open compensation. |
| --- | --- |
| [OFF] | Does not perform DC open compensation. |
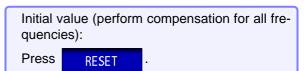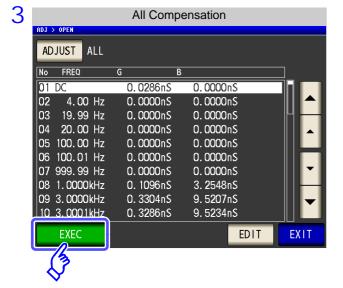
**Configuring AC open compensation**

Press [START] and set the start frequency for open compensation with the numeric keypad.

**2**

| Setting the compensation range |
| --- |

ADJ > OPEN

AREA

DC

OFF    ON

AC

START    1.0000kHz

STOP    1.0000MHz

RESET    CANCEL    SET

Press [STOP] and set the stop frequency for open compensation with the numeric keypad.

Press [SET] to accept the settings.

Initial value (perform compensation for all frequencies):

Press [RESET].

**3**

| All Compensation |
| --- |

ADJ > OPEN

ADJUST  ALL

| No | FREQ | G | B |
| --- | --- | --- | --- |
| 01 | DC | 0.0286nS | 0.0000nS |
| 02 | 4.00 Hz | 0.0000nS | 0.0000nS |
| 03 | 19.99 Hz | 0.0000nS | 0.0000nS |
| 04 | 20.00 Hz | 0.0000nS | 0.0000nS |
| 05 | 100.00 Hz | 0.0000nS | 0.0000nS |
| 06 | 100.01 Hz | 0.0000nS | 0.0000nS |
| 07 | 999.99 Hz | 0.0000nS | 0.0000nS |
| 08 | 1.0000kHz | 0.1096nS | 3.2548nS |
| 09 | 3.0000kHz | 0.3304nS | 9.5207nS |
| 10 | 3.0001kHz | 0.3286nS | 9.5234nS |

EXEC    EDIT    EXIT

Press [EXEC] to start acquiring compensation values.

## 7.1.2 Spot Compensation

Acquire the compensation values at the set measurement frequencies. Measurement frequencies can be set for up to five points.

**Procedure**

**1**

Open Compensation Setting

ADJ > OPEN
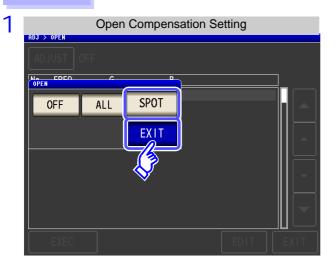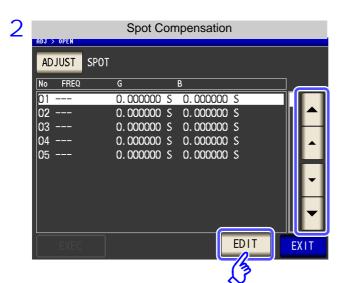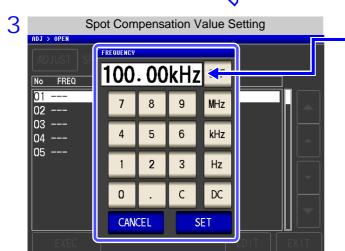
Select **SPOT** in the open circuit compensation screen, and press **EXIT** to confirm the selection.

**2**

Spot Compensation

ADJ > OPEN

| No | FREQ | G | B |
|----|------|---|---|
| 01 | --- | 0.000000 S | 0.000000 S |
| 02 | --- | 0.000000 S | 0.000000 S |
| 03 | --- | 0.000000 S | 0.000000 S |
| 04 | --- | 0.000000 S | 0.000000 S |
| 05 | --- | 0.000000 S | 0.000000 S |

Use ▲ or ▼ to select the compensation point you want to set or edit, and press **EDIT**.

**When you do not want to perform compensation:** Press **EXIT**.

Compensation is not performed and the compensation screen is redisplayed.

**3**

Spot Compensation Value Setting

ADJ > OPEN

FREQUENCY

**100.00kHz**

Until one of these keys is pressed for input of a numerical value, the previous frequency for which SPOT compensation was performed is displayed.

**Use the numeric keypad to enter a frequency for compensation.**

- Settable range: DC, 4 Hz to 5.000 MHz
  If a value in excess of 5 MHz is entered, the measurement frequency will automatically set to 5 MHz.
- If a value less than 4 Hz is entered, the measurement frequency will automatically set to 4 Hz.
- If you make a mistake during input:
  press **C** to cancel the input and start again.

Chapter 7 Error Compensation

## 7.1 Setting Open Circuit Compensation

**5**

Spot Compensation Value Setting

| No | FREQ | G | B |
|----|------|---|---|
| 01 | 100.00kHz | 0.000000 S | 0.000000 S |
| 02 | --- | 0.000000 S | 0.000000 S |
| 03 | --- | 0.000000 S | 0.000000 S |
| 04 | --- | 0.000000 S | 0.000000 S |
| 05 | --- | 0.000000 S | 0.000000 S |

ADJUST  SPOT

EXEC   EDIT  EXIT

The compensation values from last time are displayed in a confirmation screen.
(If compensation has never been performed, the compensation values become 0.)

Check that the measurement cable is in an open circuit state.

**Press** EXEC .

**When you do not want to acquire the compensation values:** Press EXIT .
The setting screen is redisplayed, and the compensation values from last time become valid.

**6**

Performing Open Compensation

ADJUST  SPOT

| No | FREQ | G | B |
|----|------|---|---|
| 01 | 100.00kHz | 0.000000 S | 0.000000 S |
| 02 | --- | | |
| 03 | --- | | |
| 04 | --- | | |
| 05 | --- | | |

Now Adjusting...

0%

CANCEL

EXEC   EDIT  EXIT

Compensation starts.

Compensation value acquisition time:
Approximately 5 seconds

**When you want to cancel compensation:**
Press CANCEL .
Compensation is cancelled and the compensation screen is redisplayed.
(The open circuit compensation value state from last time remains.)

Indicates the compensation numbers.

Indicates the measurement frequencies.

Indicates the compensation results. (Conductance, susceptance)

**7**

Spot Compensation

ADJUST  SPOT

| No | FREQ | G | B |
|----|------|---|---|
| 01 | 100.00kHz | -219.5501pS | 11.56738nS |
| 02 | --- | 0.000000 S | 0.000000 S |
| 03 | --- | 0.000000 S | 0.000000 S |
| 04 | --- | 0.000000 S | 0.000000 S |
| 05 | --- | 0.000000 S | 0.000000 S |

EXEC   EDIT  EXIT

You can use ▲ and ▼ to check the Conductance, susceptance of each compensation point.

- If compensation ends normally, the conductance and susceptance are displayed.
- Compensation can be performed for impedances of at least 1 kΩ.

**When compensation failed:** (p. 279)

**8** **Press** EXIT **to close the setting screen.**

## When Open Compensation Failed

If compensation fails, a window such as the following will be displayed.

When an error message appears and compensation has stopped (when EXIT is touched), open circuit compensation is turned OFF.
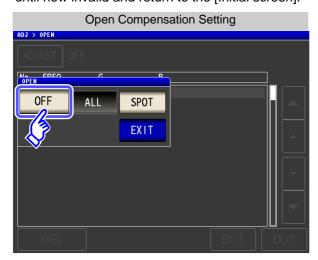


The open circuit compensation process is quite sensitive to noise - both noise originating externally and induced noise.Therefore, if open circuit compensation has been interrupted with a fault, you should check the following points before starting the compensation process again:

• Check that the test cables are properly connected.
• Check that nothing is connected to the test cables. (Open circuit compensation cannot be performed while any test sample is connected to the test cables.)
• Check that the test leads are arranged as closely as possible to their configuration in which measurement will be performed.
• During the compensation process, be sure not to disturb the test cables or to move your hand near them.
• Execute the guarding process.
   **See**"Appendix 2  Measurement of High Impedance Components"(p. A3)

## When You Want to Make Open Circuit Compensation Data Invalid

Press OFF in Step **3** of [Open Compensation Setting] (p. 274) to make the compensation data for up until now invalid and return to the [Initial screen].



**NOTE**  The compensation values that are stored internally are not cleared by the operation

# 7.2 Short Circuit Compensation

LCR
ANALYZER
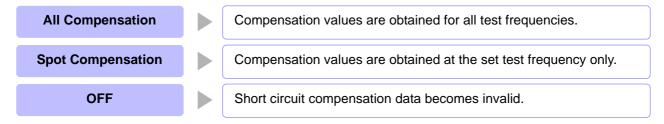
With short circuit compensation, it is possible to reduce the influence of the residual impedance of the test cables and thereby to enhance the accuracy of measurement.
It is effective for test samples whose impedance is relatively low.
The comparator decision mode can be set as one of the following:

| All Compensation | ▶ | Compensation values are obtained for all test frequencies. |
| Spot Compensation | ▶ | Compensation values are obtained at the set test frequency only. |
| OFF | ▶ | Short circuit compensation data becomes invalid. |
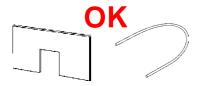
**NOTE**

- Before short circuit compensation, always set the cable length.
  **See:** "7.4 Compensating Measurement Cable Errors (Cable Length Compensation)" (p. 301)
- The measurement accuracy values defined in the specifications are for when open circuit compensation and short circuit compensation are performed.
- Be sure to perform compensation again after replacing the measuring cable.
  You will be unable to obtain correct values if measurement is performed in the compensation state prior to replacement.
- For spot compensation, short circuit compensation will be valid only when the measurement frequency and spot compensation frequency match.
- When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
  ex. Servo Motor, switching power source, high-voltage cable and etc.
- For SPOT compensation, the open circuit compensation will be valid only when the measurement frequency agrees with the SPOT compensation frequency.
- The compensated value is preserved in the memory of the main unit even when power is turned off.
- If the setting of the low Z high accuracy mode is changed, the compensation value becomes invalid.

## Before Performing Screen Operations

Necessary item: Shorting bar
This shorting bar is for short circuiting together the ends of the test leads. Use an object whose impedance is as low as possible.

**OK**
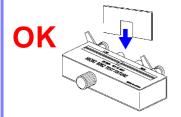
If you use a metallic wire or the like as a shorting bar, try to ensure that it is as thick and short as possible.

Usage example:
Arrange the test leads as closely as possible to their configuration in which measurement will be performed, and short circuit together the HIGH and LOW leads.

(When using a fixture)
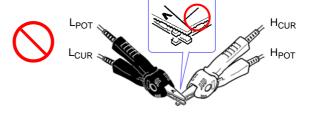
In order to keep external influences as low as possible, be sure to thrust the shorting bar in all the way.

**OK**

(When using optional L2000)

Short-circuit the tips with the **V** marks on the clips aligned as shown in the diagram, and then perform short compensation.

**OK**

$L_{POT}$
$L_{CUR}$
$H_{POT}$
$H_{CUR}$

$L_{POT}$
$L_{CUR}$
$H_{CUR}$
$H_{POT}$

**7**

**Chapter 7 Error Compensation**
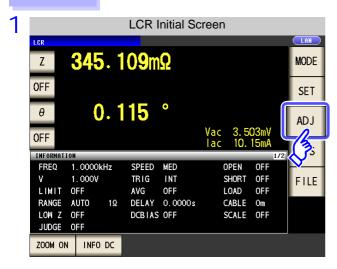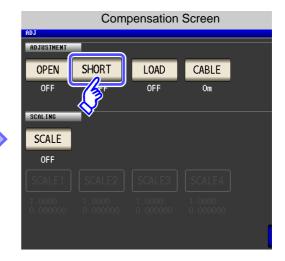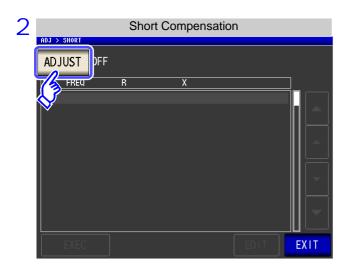
## 7.2.1 All Compensation

Simultaneously acquire the short compensation values for all measurement frequencies.

**Procedure**

**1**

LCR Initial Screen

Compensation Screen

**2**

Short Compensation

Press ADJUST .

**3**

Short Compensation Setting

Select **ALL** and press **EXIT** to close the setting screen.

**4**

| All Compensation | | |
|---|---|---|

ADJ > SHORT

ADJUST  ALL

| No | FREQ | R | X |
|---|---|---|---|
| 01 | DC | 0.000mΩ | 0.000mΩ |
| 02 | 4.00 Hz | 0.000mΩ | 0.000mΩ |
| 03 | 19.99 Hz | 0.000mΩ | 0.000mΩ |
| 04 | 20.00 Hz | 0.000mΩ | 0.000mΩ |
| 05 | 100.00 Hz | 0.000mΩ | 0.000mΩ |
| 06 | 100.01 Hz | 0.000mΩ | 0.000mΩ |
| 07 | 999.99 Hz | 0.000mΩ | 0.000mΩ |
| 08 | 1.0000kHz | 0.000mΩ | 0.000mΩ |
| 09 | 3.0000kHz | 0.000mΩ | 0.000mΩ |
| 10 | 3.0001kHz | 0.000mΩ | 0.000mΩ |

EXEC     EDIT    EXIT

The compensation values from last time are displayed in a confirmation screen.
(If compensation has never been performed, the compensation values become 0.)

> Check that the measurement cable is in a short-circuit state.

**Press** EXEC .

> **When you do not want to acquire the compensation values:** Press EXIT .
> The setting screen is redisplayed, and the compensation values from last time become valid.

**5**

| Performing Short Compensation | | |
|---|---|---|

ADJ > SHORT

ADJUST  ALL

| No | FREQ | R | X |
|---|---|---|---|
| 01 | DC | 0.000000 Ω | 0.000000 Ω |
| 02 | 4. | | |
| 03 | 19. | | |
| 04 | 20. | | |
| 05 | 100. | | |
| 06 | 100. | | |
| 07 | 999. | | |
| 08 | 1.00 | | |
| 09 | 3.0000kHz | 0.000000 Ω | 0.000000 Ω |
| 10 | 3.0001kHz | 0.000000 Ω | 0.000000 Ω |

Now Adjusting...    57%    CANCEL

EXEC     EDIT    EXIT

Compensation starts.

Compensation value acquisition time:
Approximately 2 minutes

> **When you want to cancel compensation:**
> Press CANCEL .
> Compensation is cancelled and the compensation screen is redisplayed.
> (The short circuit compensation values from last time remain.)

Indicates the compensation numbers.

Indicates the measurement frequencies.

Indicates the compensation results.
(Effective resistance, reactance)

**6**

| Short Compensation | | |
|---|---|---|

ADJ > SHORT

ADJUST  ALL

| No | FREQ | R | X |
|---|---|---|---|
| 01 | DC | 0.773mΩ | 0.000mΩ |
| 02 | 4.00 Hz | 0.769mΩ | 0.006mΩ |
| 03 | 19.99 Hz | 0.764mΩ | 0.015mΩ |
| 04 | 20.00 Hz | 0.766mΩ | 0.010mΩ |
| 05 | 100.00 Hz | 0.765mΩ | 0.046mΩ |
| 06 | 100.01 Hz | 0.763mΩ | 0.047mΩ |
| 07 | 999.99 Hz | 0.793mΩ | 0.369mΩ |
| 08 | 1.0000kHz | 0.791mΩ | 0.369mΩ |
| 09 | 3.0000kHz | 0.856mΩ | 0.991mΩ |
| 10 | 3.0001kHz | 0.854mΩ | 0.990mΩ |

EXEC     EDIT    EXIT

Use ▲ or ▼ to check the effective resistance and reactance of each compensation point.

> • If compensation ends normally, the effective resistance and reactance are displayed.
> • The possible compensation range is 1 kΩ or less for impedance.

> **When compensation failed:** (p. 287)

**7** Press EXIT to close the setting screen.

## Acquiring short compensation values for some frequencies only

**Procedure**

**1** All Compensation

| No | FREQ | R | X |
|----|------|---|---|
| 01 | DC | 0.000mΩ | 0.000mΩ |
| 02 | 4.00 Hz | 0.000mΩ | 0.000mΩ |
| 03 | 19.99 Hz | 0.000mΩ | 0.000mΩ |
| 04 | 20.00 Hz | 0.000mΩ | 0.000mΩ |
| 05 | 100.00 Hz | 0.000mΩ | 0.000mΩ |
| 06 | 100.01 Hz | 0.000mΩ | 0.000mΩ |
| 07 | 999.99 Hz | 0.000mΩ | 0.000mΩ |
| 08 | 1.0000kHz | 0.000mΩ | 0.000mΩ |
| 09 | 3.0000kHz | 0.000mΩ | 0.000mΩ |
| 10 | 3.0001kHz | 0.000mΩ | 0.000mΩ |

ADJUST ALL — EXEC — EDIT — EXIT

**Press** EDIT **in the all compensation screen.**

**Configuring DC short compensation**

| ON | Performs DC short compensation. |
|----|----|
| OFF | Does not perform DC short compensation. |

**Configuring AC short compensation**

**Press** START **and set the start frequency for short compensation with the numeric keypad.**

**Press** STOP **and set the stop frequency for short compensation with the numeric keypad.**

**Press** SET **to accept the settings.**

Initial value (perform compensation for all frequencies):
Press RESET .

**2** Setting the compensation range

AREA
DC: OFF / ON
AC: START 100.00 Hz / STOP 4.0000kHz
RESET — CANCEL — SET

**3** All Compensation

| No | FREQ | R | X |
|----|------|---|---|
| 01 | DC | 0.767mΩ | 0.000mΩ |
| 02 | 4.00 Hz | 0.000mΩ | 0.000mΩ |
| 03 | 19.99 Hz | 0.000mΩ | 0.000mΩ |
| 04 | 20.00 Hz | 0.000mΩ | 0.000mΩ |
| 05 | 100.00 Hz | 0.767mΩ | 0.046mΩ |
| 06 | 100.01 Hz | 0.766mΩ | 0.046mΩ |
| 07 | 999.99 Hz | 0.794mΩ | 0.366mΩ |
| 08 | 1.0000kHz | 0.794mΩ | 0.363mΩ |
| 09 | 3.0000kHz | 0.857mΩ | 0.983mΩ |
| 10 | 3.0001kHz | 0.853mΩ | 0.981mΩ |

ADJUST ALL — EXEC — EDIT — EXIT

**Press** EXEC **to start acquiring compensation values.**

**NOTE** The DC on/off setting and AC start/stop setting apply to both open compensation and short
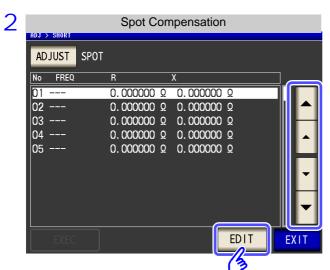
## 7.2.2 Spot Compensation

Acquire the compensation values at the set measurement frequencies. Measurement frequencies can be set for up to five points.

**Procedure**

**1** Short Compensation Setting

ADJ > SHORT

ADJUST OFF

SHORT

| OFF | ALL | SPOT |

EXIT
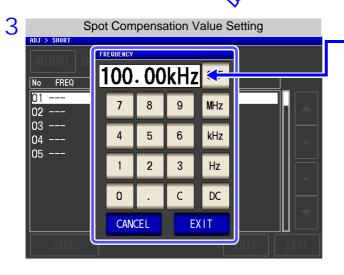
Select **SPOT** in the short circuit compensation screen, and press **EXIT** to confirm the selection.

**2** Spot Compensation

ADJ > SHORT

ADJUST SPOT

| No | FREQ | R | X |
|---|---|---|---|
| 01 | --- | 0.000000 Ω | 0.000000 Ω |
| 02 | --- | 0.000000 Ω | 0.000000 Ω |
| 03 | --- | 0.000000 Ω | 0.000000 Ω |
| 04 | --- | 0.000000 Ω | 0.000000 Ω |
| 05 | --- | 0.000000 Ω | 0.000000 Ω |

EXEC    EDIT    EXIT

Use **▲** or **▼** to select the compensation point you want to set or edit, and then press **EDIT** .

> **When you do not want to perform compensation:** Press **EXIT** .
>
> Compensation is not performed and the compensation screen is redisplayed.

**3** Spot Compensation Value Setting

ADJ > SHORT

FREQUENCY

**100.00kHz** ←

| 7 | 8 | 9 | MHz |
| 4 | 5 | 6 | kHz |
| 1 | 2 | 3 | Hz |
| 0 | . | C | DC |

CANCEL    EXIT

| No | FREQ |
|---|---|
| 01 | --- |
| 02 | --- |
| 03 | --- |
| 04 | --- |
| 05 | --- |

> Until one of these keys is pressed for input of a numerical value, the previous frequency for which SPOT compensation was performed is displayed.

**Use the numeric keypad to enter a frequency for compensation.**

> - Settable range: DC, 4 Hz to 5.000 MHz
> - If a value in excess of 5 MHz is entered, the measurement frequency will automatically set to 5 MHz.
> - If a value less than 4 Hz is entered, the measurement frequency will automatically set to 4 Hz.
> - If you make a mistake during input:
>
>   press **C** to cancel the input and start again.

**4** Press **EXIT** to confirm the frequency for compensation.

**5**

### Spot Compensation Value Setting

```
ADJ > SHORT
ADJUST  SPOT

No   FREQ      R           X
01  100.00kHz  0.000000 Ω  0.000000 Ω
02  ---        0.000000 Ω  0.000000 Ω
03  ---        0.000000 Ω  0.000000 Ω
04  ---        0.000000 Ω  0.000000 Ω
05  ---        0.000000 Ω  0.000000 Ω

         ▲
         ▲
         ▼
         ▼

EXEC              EDIT   EXIT
```

The compensation values from last time are displayed in a confirmation screen.
(If compensation has never been performed, the compensation values become 0.)

> Check that the measurement cable is in a short-circuit state.

Press **EXEC**.

> **When you do not want to acquire the compensation values:** Press **EXIT**.
>
> The setting screen is redisplayed, and the compensation values from last time become valid.

**6**

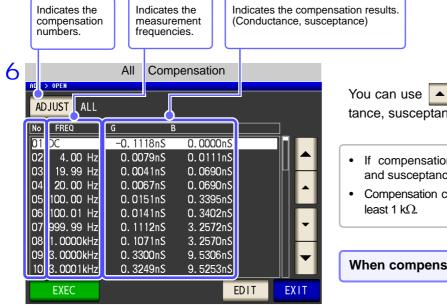### Performing Short Compensation

```
ADJ > SHORT
ADJUST  SPOT

No   FREQ      R           X
01  100.00kHz  0.000000 Ω  0.000000 Ω
02  ---
03  ---   Now Adjusting...
04  ---
05  ---                         0%

                        CANCEL

EXEC              EDIT   EXIT
```

Compensation starts.

Compensation value acquisition time:
Approximately 5 seconds

> **When you want to cancel compensation:**
>
> Press **CANCEL**.
>
> Compensation is cancelled and the compensation screen is redisplayed.
> (The short circuit compensation values from last time remain.)

> Indicates the compensation numbers.

> Indicates the measurement frequencies.

> Indicates the compensation results. (Effective resistance, reactance)

**7**

### Spot Compensation

```
ADJ > SHORT
ADJUST  SPOT

No   FREQ      R           X
01  100.00kHz  155.0384mΩ   35.93694mΩ
02  ---        0.000000 Ω   0.000000 Ω
03  ---        0.000000 Ω   0.000000 Ω
04  ---        0.000000 Ω   0.000000 Ω
05  ---        0.000000 Ω   0.000000 Ω

         ▲
         ▲
         ▼
         ▼

EXEC              EDIT   EXIT
```

Use ▲ or ▼ to check the effective resistance and reactance of each compensation point.

- If compensation ends normally, the effective resistance and reactance are displayed.
- The possible compensation range is 1 kΩ or less for impedance.

> **When compensation failed:** (p. 287)

**8** Press **EXIT** to close the setting screen.

## When Short Compensation Failed

**EXIT** When an error message appears and compensation has stopped, short circuit compensation is turned off.

Error

ADJ > OPEN

| No | FREQ | G | B |
|----|------|---|---|
| 01 | DC | 0.0000nS | 0.0000nS |
| 02 | 4. | | |
| 03 | 19. | Adjustment Failure | |
| 04 | 20. | | |
| 05 | 100. | | 0% |
| 06 | 100. | | |
| 07 | 999. | | EXIT |
| 08 | 1.00 | | |
| 09 | 3.0000kHz | 0.0000nS | 0.0000nS |
| 10 | 3.0001kHz | 0.0000nS | 0.0000nS |

EXEC          EDIT    EXIT
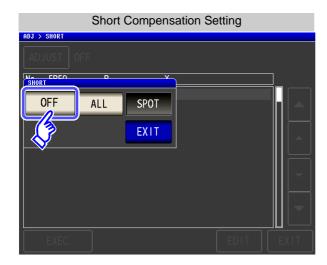
Check the following points before starting the short circuit compensation process again:
• Check that the test cables are properly connected.
• Check that the test cables are properly shorted together with the shorting bar. (Short circuit compensation cannot be performed while any test sample is connected to the test cables.)
• Check that the test leads are arranged as closely as possible to their configuration in which measurement will be performed.
• During the compensation process, be sure not to disturb the test cables or to move your hand near them.

## When You Want to Make Short Circuit Compensation Data Invalid

Press **OFF** in Step **3** of [Short Compensation Setting] (p. 282) to make the compensation data for up until now invalid and return to the [Initial screen].

Short Compensation Setting

ADJ > SHORT

ADJUST    OFF

No    FREQ    R    X

SHORT

OFF    ALL    SPOT

EXIT

EXEC          EDIT    EXIT

**NOTE** The compensation values that are stored internally are not cleared by the operation described above. When ALL or SPOT is selected, the stored compensation values can be used.

# 7.3 Compensating Values to Match Reference Values (Load Compensation) [LCR] [ANALYZER]
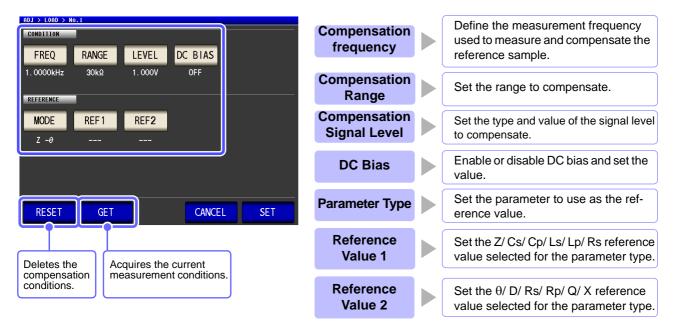
Compensate measurement values to match the element that will be the reference.

With load compensation it is possible to calculate the compensation coefficient by measuring a reference sample with known data and perform the compensation for the test data obtained from the target sample.

The compensation coefficient can be acquired using up to five compensation conditions. The reference value of each compensation condition can be set independently.

The following seven compensation conditions should be set for each measurement frequency:

| Box | Description |
|---|---|
| **Compensation frequency** | Define the measurement frequency used to measure and compensate the reference sample. |
| **Compensation Range** | Set the range to compensate. |
| **Compensation Signal Level** | Set the type and value of the signal level to compensate. |
| **DC Bias** | Enable or disable DC bias and set the value. |
| **Parameter Type** | Set the parameter to use as the reference value. |
| **Reference Value 1** | Set the Z/ Cs/ Cp/ Ls/ Lp/ Rs reference value selected for the parameter type. |
| **Reference Value 2** | Set the θ/ D/ Rs/ Rp/ Q/ X reference value selected for the parameter type. |

Screen labels: ADJ > LOAD > No.1 — CONDITION: FREQ 1.0000kHz, RANGE 30kΩ, LEVEL 1.000V, DC BIAS OFF — REFERENCE: MODE Z –θ, REF1 ---, REF2 ---. Buttons: RESET, GET, CANCEL, SET. RESET: Deletes the compensation conditions. GET: Acquires the current measurement conditions.

The compensation coefficient is computed from the reference values of Z and θ obtained from the set values and the actual data acquired from the reference sample at each of the compensation frequencies.

Compensation coefficient of Z = (Reference value of Z) / (Actual data of Z)
Compensation value of θ = (Reference value of θ) - (Actual data of θ)

The measured values of Z and θ are first compensated using the following equations, and then individual parameters from the compensated Z and Éý values are employed.

Z = (Z before compensation) × (Compensation coefficient of Z)
θ = (θ before compensation) + (Compensation value of θ)

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

**NOTE**
- When all of the compensation conditions match for load compensation, compensation is performed under the optimal conditions.
- If the current measurement frequency and compensation frequency do not match, an error like the following is displayed in the initial screen.

```
INFORMATION                                    1/2
FREQ   2.0000kHz    SPEED  MED      OPEN   OFF
V      1.000V       TRIG   INT      SHORT  OFF
LIMIT  OFF          AVG    OFF      LOAD   ON  ERR
RANGE  HOLD  30kΩ   DELAY  0.0000s  CABLE  0m
LOW Z  OFF          DCBIAS OFF      SCALE  OFF
```
**ERR**
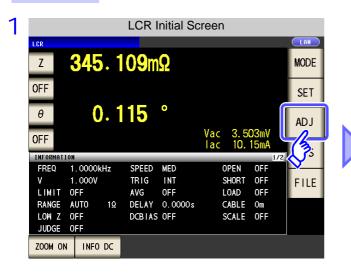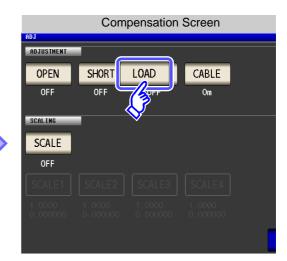
- If a condition other than the compensation frequency does not match, compensation is performed but a warning like the following is displayed in the initial screen.

```
INFORMATION                                    1/2
FREQ   1.0000kHz    SPEED  MED      OPEN   OFF
V      1.000V       TRIG   INT      SHORT  OFF
LIMIT  OFF          AVG    OFF      LOAD   ON  ?
RANGE  HOLD  30kΩ   DELAY  0.0000s  CABLE  0m
LOW Z  OFF          DCBIAS OFF      SCALE  OFF
```
**?**

- When the OPEN or SHORT compensation is valid, the load compensation is performed for Z and θ processed by the OPEN or SHORT compensation.
- In acquiring load compensation data (i.e., reference sample measurement), the OPEN/SHORT compensation settings, that were defined before entry into the Load Compensation Screen, are valid.
- If the setting of the low Z high accuracy mode is changed, the compensation value becomes invalid.

**7**

**Chapter 7 Error Compensation**

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

**Procedure**

**1** 

LCR Initial Screen

Compensation Screen

**2**

Load Compensation Value List

Press ADJUST .

**3**

Load Compensation Setting

Select ON , and press EXIT to confirm the selection.

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

**4** Load Compensation Value List

ADJ > LOAD

ADJUST ON

| No | Freq | Range | Level | Ref1 | Ref2 |
|----|------|-------|-------|------|------|
| 1 | --- | --- --- | --- | --- |  |
| 2 | --- | --- --- | --- | --- |  |
| 3 | --- | --- --- | --- | --- |  |
| 4 | --- | --- --- | --- | --- |  |
| 5 | --- | --- --- | --- | --- |  |

EXEC   EDIT   ▼   ▲   EXIT
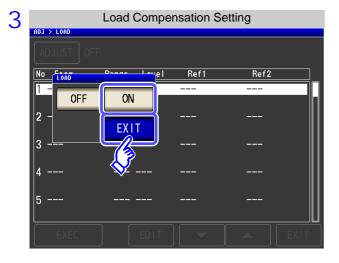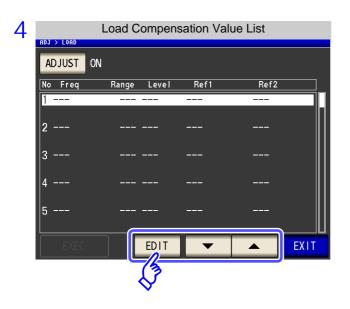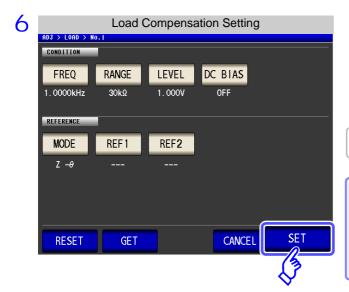
Use ▲ or ▼ to select the number of the load compensation condition to set.

Press **EDIT**.

**5** **Set the compensation condition.**

- Compensation frequency (p. 293)
- Compensation range (p. 294)
- Type and value of the compensation level (p. 295)
- DC bias (p. 296)
- Parameter to use for reference value (p. 297)
- Reference value (p. 298)

**6** Load Compensation Setting

ADJ > LOAD > No.1

CONDITION

FREQ   RANGE   LEVEL   DC BIAS

1.0000kHz   30kΩ   1.000V   OFF

REFERENCE

MODE   REF1   REF2

Z -θ   ---   ---

RESET   GET   CANCEL   SET

Press **SET** to confirm the compensation conditions.

The load compensation screen is redisplayed.

Attach the reference sample to the test fixtures.

**When you want to cancel compensation:**

Press **CANCEL**.
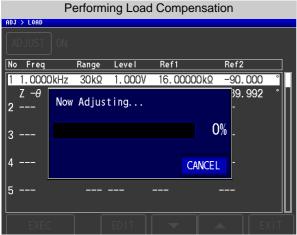
The compensation conditions are discarded and the load compensation screen is redisplayed.

**7**

**Chapter 7 Error Compensation**

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

**7**

**Load Compensation Value List**

ADJ > LOAD

ADJUST ON

| No | Freq | Range | Level | Ref1 | Ref2 | |
|----|------|-------|-------|------|------|---|
| 1 | 1.0000kHz | 30kΩ | 1.000V | 16.00000kΩ | −90.000 | ° |
| | $Z$ −$\theta$ | | | 16.15220kΩ | −89.992 | ° |
| 2 | --- | --- --- | --- | --- | | |
| 3 | --- | --- --- | --- | --- | | |
| 4 | --- | --- --- | --- | --- | | |
| 5 | --- | --- --- | --- | --- | | |

EXEC   EDIT   ▼   ▲   EXIT
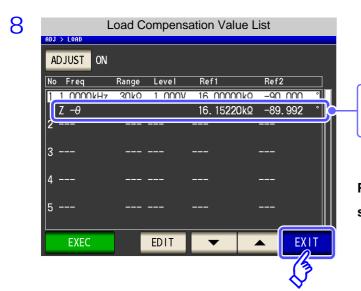
If you select **EXEC**, the compensation values are acquired.

- When data acquisition is completed, the reference sample compensation data is displayed on the screen.
- When an error occurs during data acquisition, a "beep" sound is generated and the compensation data is invalidated.
- If even one of the load compensation conditions is changed following data acquisition, the acquired compensation data is invalidated.

**Performing Load Compensation**

ADJ > LOAD

ADJUST ON

| No | Freq | Range | Level | Ref1 | Ref2 | |
|----|------|-------|-------|------|------|---|
| 1 | 1.0000kHz | 30kΩ | 1.000V | 16.00000kΩ | −90.000 | ° |
| | $Z$ −$\theta$ | | | | 89.992 | ° |

Now Adjusting...

0%

CANCEL

EXEC   EDIT   ▼   ▲   EXIT

**When you want to cancel compensation data acquisition:** Press **CANCEL** .

**When compensation failed:** (p. 300)

**8**

**Load Compensation Value List**

ADJ > LOAD

ADJUST ON

| No | Freq | Range | Level | Ref1 | Ref2 | |
|----|------|-------|-------|------|------|---|
| 1 | 1.0000kHz | 30kΩ | 1.000V | 16.00000kΩ | −90.000 | ° |
| | $Z$ −$\theta$ | | | 16.15220kΩ | −89.992 | ° |
| 2 | --- | --- --- | --- | --- | | |
| 3 | --- | --- --- | --- | --- | | |
| 4 | --- | --- --- | --- | --- | | |
| 5 | --- | --- --- | --- | --- | | |

EXEC   EDIT   ▼   ▲   EXIT

When acquisition of the compensation value is completed, the compensation value is displayed.

Press **EXIT** from the load compensation screen to return to the initial screen.

**9** 

LCR Initial Screen

Z
16.0001kΩ
OFF

θ
−90.001 °
OFF

Vac 1.025 V
Iac 63.47µA

MODE
SET
ADJ
SYS
FILE

INFORMATION                                    1/2
FREQ   1.0000kHz    SPEED  MED      OPEN   OFF
V      1.000V       TRIG   INT      SHORT  OFF
LIMIT  OFF          AVG    OFF      LOAD   ON
RANGE  HOLD  30kΩ   DELAY  0.0000s  CABLE  OFF
LOW Z  OFF          DCBIAS OFF      SCALE  OFF
JUDGE  OFF

ZOOM ON    INFO DC
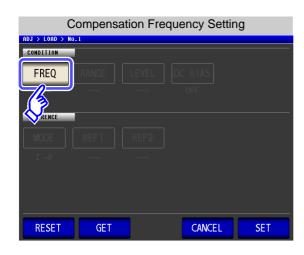
When the load compensation is valid for the set measurement conditions, ON appears on the LOAD parameter in the Initial Screen.
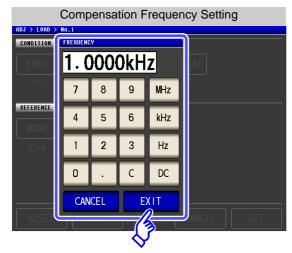
When the same compensation frequency has been set to multiple load compensation groups, only the group with the smallest number will be valid.
When the current measurement frequency does not agree with the load compensation frequency, the load compensation will be invalid and ON will not appear.

**FREQ**  Set the compensation frequency.

Compensation Frequency Setting
ADJ > LOAD > No.1
CONDITION
FREQ  RANGE  LEVEL  DC BIAS
                           OFF
REFERENCE
MODE  REF1  REF2
Z −θ

RESET  GET    CANCEL  SET

**1.** Press **FREQ** .

Compensation Frequency Setting
ADJ > LOAD > No.1
CONDITION  FREQUENCY
FREQ    1.0000kHz
7 8 9 MHz
4 5 6 kHz
1 2 3 Hz
0 . C DC
CANCEL  EXIT
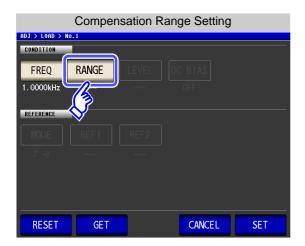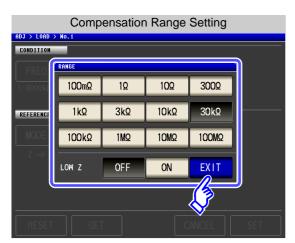
**2.** Use the numeric keypad to enter the compensation frequency.
Settable range: DC, 4.00 to 5.0000 MHz

**3.** Press a unit key to confirm the setting.

**4.** Press **EXIT** to close the setting screen.

- When performing load compensation for DC resistance measurement: Press **DC** .
- If you make a mistake during input:
press **C** to cancel the input and start again.
- When you want to cancel input:
Press **CANCEL** to close the compensation frequency setting screen.

**7**

Chapter 7 Error Compensation

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

**RANGE** Setting the Compensation Range

**Compensation Range Setting**

ADJ > LOAD > No.1

CONDITION

| FREQ | RANGE | LEVEL | DC BIAS |
|------|-------|-------|---------|
| 1.0000kHz | | --- | OFF |

REFERENCE

| MODE | REF1 | REF2 |
|------|------|------|
| Z -θ | --- | --- |

RESET  GET  CANCEL  SET

**1.** Press **RANGE** .

**Compensation Range Setting**

ADJ > LOAD > No.1

CONDITION

RANGE

| 100mΩ | 1Ω | 10Ω | 300Ω |
| 1kΩ | 3kΩ | 10kΩ | 30kΩ |
| 100kΩ | 1MΩ | 10MΩ | 100MΩ |

LOW Z  OFF  ON  EXIT

REFERENCE

MODE

RESET  GET  CANCEL  SET

- To enable LOW Z: Press **ON** of LOW Z.
- If you make a mistake during input:

  press **C** to cancel the input and start again.

**2.** Select the range for compensation.

The range that can be set varies depending on the compensation frequency.

| Frequency | Settable Range | Range Setting Screen |
|-----------|----------------|----------------------|
| DC<br><br>4.00 Hz to 100.00 kHz | Entire range | RANGE<br>100mΩ 1Ω 10Ω 100Ω<br>1kΩ 3kΩ 10kΩ 30kΩ<br>100kΩ 1MΩ 10MΩ 100MΩ<br>LOW Z OFF ON EXIT |
| 100.01 kHz to 1.0000 MHz | 100 mΩ to 10 MΩ | RANGE<br>100mΩ 1Ω 10Ω 100Ω<br>1kΩ 3kΩ 10kΩ 30kΩ<br>100kΩ 1MΩ 10MΩ<br>LOW Z OFF ON EXIT |
| 1.0001 MHz to 5.0000 MHz | 100 mΩ to 1 MΩ | RANGE<br>100mΩ 1Ω 10Ω 100Ω<br>1kΩ 3kΩ 10kΩ 30kΩ<br>100kΩ 1MΩ<br>LOW Z OFF ON EXIT |

**3.** Press **EXIT** to close the setting screen.

**NOTE** If the compensation frequency is not set, the compensation range cannot be set.
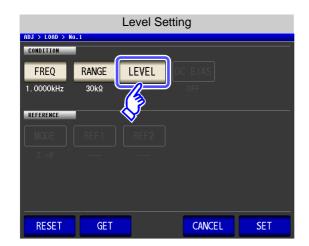
## 7.3 Compensating Values to Match Reference Values (Load Compensation)
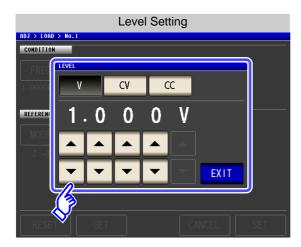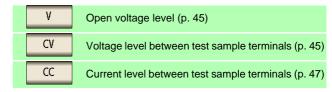
**LEVEL** Setting the Type and Value of the Compensation Level
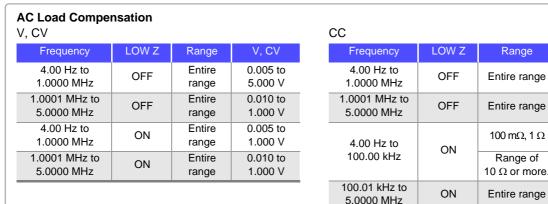
Level Setting

ADJ > LOAD > No.1

CONDITION

FREQ | RANGE | LEVEL | DC BIAS
1.0000kHz | 30kΩ | | OFF

REFERENCE

MODE | REF1 | REF2
Z -θ | --- | ---

RESET | GET | | CANCEL | SET

**1.** Press **LEVEL** .

Level Setting

ADJ > LOAD > No.1

CONDITION

LEVEL

V | CV | CC

**1.0 0 0 V**

▲ ▲ ▲ ▲   ▲

▼ ▼ ▼ ▼   ▼   EXIT

RESET | GET | CANCEL | SET

**2.** Select the compensation level type.

| V | Open voltage level (p. 45) |
| CV | Voltage level between test sample terminals (p. 45) |
| CC | Current level between test sample terminals (p. 47) |

**3.** Use ▲ or ▼ to enter the voltage or current value. For the possible compensation setting ranges, see the following figures.

**4.** Press **EXIT** to close the setting screen.

### AC Load Compensation

V, CV

| Frequency | LOW Z | Range | V, CV |
|---|---|---|---|
| 4.00 Hz to 1.0000 MHz | OFF | Entire range | 0.005 to 5.000 V |
| 1.0001 MHz to 5.0000 MHz | OFF | Entire range | 0.010 to 1.000 V |
| 4.00 Hz to 1.0000 MHz | ON | Entire range | 0.005 to 1.000 V |
| 1.0001 MHz to 5.0000 MHz | ON | Entire range | 0.010 to 1.000 V |

CC

| Frequency | LOW Z | Range | CC |
|---|---|---|---|
| 4.00 Hz to 1.0000 MHz | OFF | Entire range | 0.01 m to 50.00 mA |
| 1.0001 MHz to 5.0000 MHz | OFF | Entire range | 0.01 m to 10.00 mA |
| 4.00 Hz to 100.00 kHz | ON | 100 mΩ, 1 Ω | 0.01 m to 100.00 mA |
| | | Range of 10 Ω or more. | 0.01 m to 10.00 mA |
| 100.01 kHz to 5.0000 MHz | ON | Entire range | 0.01 m to 10.00 mA |

### DC Load Compensation

V, CV

| LOW Z | Range | V, CV |
|---|---|---|
| OFF | Entire range | 0.1 V to 2.50 V |
| ON | Entire range | 0.1 V to 1.00 V |

CC

| LOW Z | Range | CC |
|---|---|---|
| OFF | Entire range | 0.01 m to 25.00 mA |
| ON | 100 mΩ, 1 Ω | 0.01 m to 100.00 mA |
| | Range of 10 Ω or more. | 0.01 m to 25.00 mA |
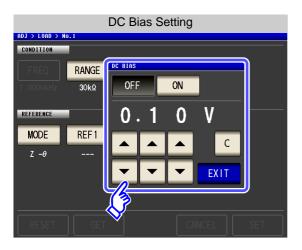
**NOTE** If the compensation range is not set, the compensation level cannot be set.

**Chapter 7 Error Compensation**

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

### DC BIAS  Setting the DC Bias

| DC Bias Setting |
| --- |
| ADJ > LOAD > No.1 |

**CONDITION**

FREQ | RANGE | LEVEL | DC BIAS
1.0000kHz | 30kΩ | 1.000V |

**REFERENCE**

MODE | REF1 | REF2
Z -θ | --- | ---

RESET | GET | CANCEL | SET

**1.** Press DC BIAS .

| DC Bias Setting |
| --- |
| ADJ > LOAD > No.1 |

**CONDITION**

FREQ | RANGE
1.0000kHz | 30kΩ

**DC BIAS**

OFF | ON

0 . 1 0 V

▲ ▲ ▲ | C

▼ ▼ ▼ | EXIT

**REFERENCE**

MODE | REF1
Z -θ | ---

RESET | GET | CANCEL | SET

**2.** Select ON/ OFF for the DC bias.

| OFF | Sets the DC bias to OFF. |
| ON | Sets the DC bias to ON. |

**3.** Use ▲ or ▼ to enter the DC bias value.

Settable range: 0.00 to 2.50 V
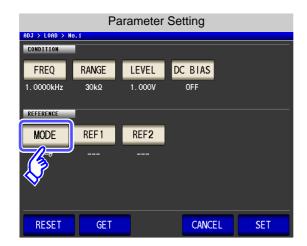
**4.** Press EXIT to close the setting screen.

If you make a mistake during input:
press C to cancel the input and start again.
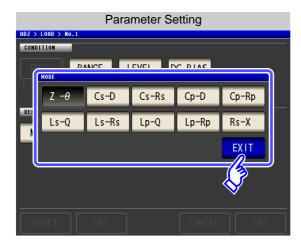
**NOTE** • If the compensation frequency, compensation range, and compensation level are not set, the DC bias setting cannot be set.
• When DC is selected for the compensation frequency setting, the DC bias setting cannot be set.

### 7.3 Compensating Values to Match Reference Values (Load Compensation)

| MODE | Setting of Parameter to Use for Reference Value |
|------|--------------------------------------------------|

**Parameter Setting**

ADJ > LOAD > No.1

CONDITION

| FREQ | RANGE | LEVEL | DC BIAS |
|------|-------|-------|---------|
| 1.0000kHz | 30kΩ | 1.000V | OFF |

REFERENCE

| MODE | REF1 | REF2 |
|------|------|------|
| | --- | --- |

RESET   GET   CANCEL   SET

**1.** Press MODE .

---

**Parameter Setting**

ADJ > LOAD > No.1

CONDITION

RANGE   LEVEL   DC BIAS

MODE

| $Z-\theta$ | Cs-D | Cs-Rs | Cp-D | Cp-Rp |
|------------|------|-------|------|-------|
| Ls-Q | Ls-Rs | Lp-Q | Lp-Rp | Rs-X |

EXIT

RESET   GET   CANCEL   SET
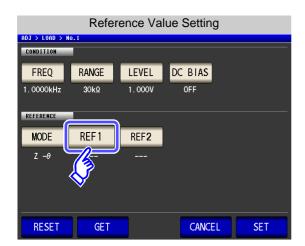
**2.** Select the parameter mode of the reference value to be set.

**3.** Press EXIT to close the setting screen.
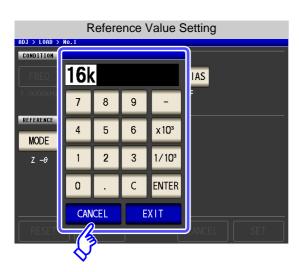
**See** "1.3.7 Parameter Settings Screen" (p. 25)

---

NOTE
- If the compensation frequency, compensation range, and compensation level are not set, the parameter to use for the reference value setting cannot be set.
- When DC is selected for the compensation frequency setting, Rdc is selected automatically and the parameter to use for the reference value setting cannot be set.
- If you change the parameter to use as the reference value, the settings of reference value 1 and reference value 2 are cleared.

**7**

**Chapter 7 Error Compensation**

## 7.3 Compensating Values to Match Reference Values (Load Compensation)

| REF1 | and | REF2 | Reference Value Settings |

Reference Value Setting

ADJ > LOAD > No.1

CONDITION

FREQ | RANGE | LEVEL | DC BIAS
1.0000kHz | 30kΩ | 1.000V | OFF

REFERENCE

MODE | REF1 | REF2
Z -θ | --- | ---

RESET | GET | CANCEL | SET

**1.** Press REF1 .

Reference Value Setting

ADJ > LOAD > No.1

CONDITION

FREQ

REFERENCE

MODE

Z -θ

16k

7 8 9 −
4 5 6 x10³
1 2 3 1/10³
0 . C ENTER

CANCEL | EXIT
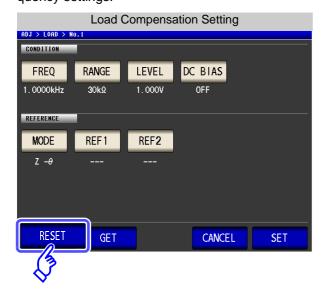
**2.** Use the numeric keypad to enter the reference value.

**3.** Press a unit key to confirm the setting.

**4.** Press EXIT to confirm the setting.

**5.** Also set REF2 in the same way.

- If the compensation frequency, input mode or reference values are incorrectly set, the load compensation cannot be executed.
- If you make a mistake during input:

  press C to cancel the input and start again.

NOTE
- If the compensation frequency, compensation range, and compensation level are not set, the reference value setting cannot be set.
- When DC is selected for the compensation frequency setting, only reference value 1 can be set.
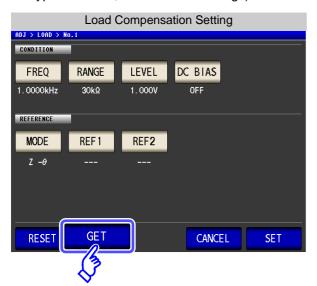
## When You Want to Reset All Settings  RESET

If you press  RESET , all settings are cancelled and you can start again from the compensation frequency settings.

```
            Load Compensation Setting
ADJ > LOAD > No.1
 CONDITION
  FREQ     RANGE     LEVEL    DC BIAS
1.0000kHz   30kΩ     1.000V    OFF

 REFERENCE
  MODE     REF1      REF2
   Z -θ     ---       ---



  RESET     GET              CANCEL    SET
```

## When You Want to Use the Current Measurement Conditions as the Load Compensation Conditions  GET

Press  GET  to acquire the current measurement conditions (frequency, range, measurement signal type and level, and DC bias settings) and use them as the load compensation conditions.

```
            Load Compensation Setting
ADJ > LOAD > No.1
 CONDITION
  FREQ     RANGE     LEVEL    DC BIAS
1.0000kHz   30kΩ     1.000V    OFF

 REFERENCE
  MODE     REF1      REF2
   Z -θ     ---       ---



  RESET     GET              CANCEL    SET
```
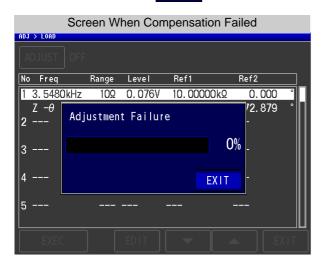
NOTE  When the measurement conditions are acquired with  GET ,  MODE  ("Setting of Parameter to Use for Reference Value" (p. 297)) is initialized to Z-θ.

**7**

*Chapter 7 Error Compensation*

**7.3  Compensating Values to Match Reference Values (Load Compensation)**

## When Load Compensation Failed

If compensation fails, a window like the following appears. An error message is displayed, and if compensation is cancelled with  EXIT , load compensation is turned OFF.

Screen When Compensation Failed
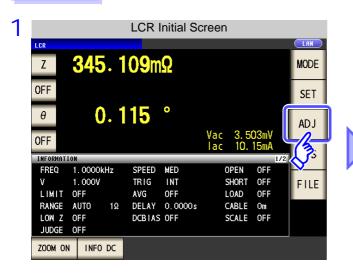


## When You Want to Disable Load Compensation
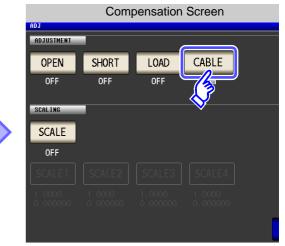
Press  OFF  in the [Load Compensation Setting] to disable load compensation.
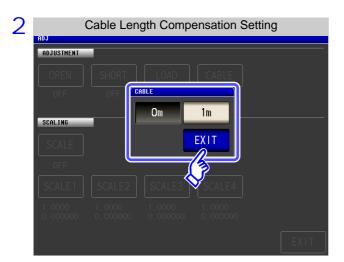
## 7.4 Compensating Measurement Cable Errors (Cable Length Compensation)

LCR
ANALYZER
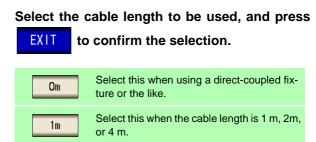
With high frequency measurement, the influence of the cable results in large measurement errors.
Setting the cable length enables you to reduce the measurement errors.
Use a coaxial cable with 50 Ω impedance.

**Procedure**

**1**

LCR Initial Screen

Compensation Screen

**2** Cable Length Compensation Setting

**Select the cable length to be used, and press** EXIT **to confirm the selection.**

| Om | Select this when using a direct-coupled fixture or the like. |
| 1m | Select this when the cable length is 1 m, 2m, or 4 m. |

**3** Press EXIT **to close the setting screen.**

**NOTE**
- When a 2 m cable is used, the guaranteed accuracy is 1 MHz.
- When a 4 m cable is used, the guaranteed accuracy is up to 100 kHz.

**Chapter 7 Error Compensation**

# 7.5 Calculating Values Scaling

LCR ANALYZER

Scaling applies a compensation function to the measurement value.This function can be used to provide compatibility among measurement devices. Set the compensation coefficients a and b for the measurement values of the first to fourth parameters to compensate by the following expression.
**See** "Appendix 1 Measurement Parameters and Arithmetic Expressions"(p. A1)
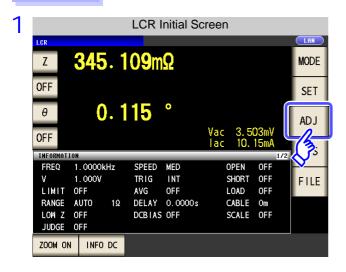
$$Y = a \times X + b$$
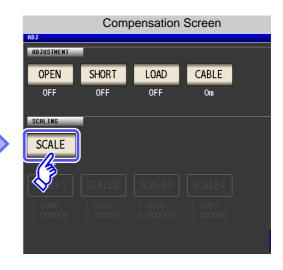
However, if the parameter corresponding to X is either D or Q, scaling is applied to θ as shown in the following expression, and then D or Q is obtained from θ '.
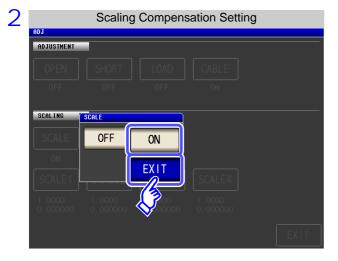
$$\theta ' = a \times \theta + b$$

X: the first to fourth parameter measurement value
a: integration value of the measured value X
Y: the last measurement value
b: the value added to measured value X
θ ': compensation value of θ
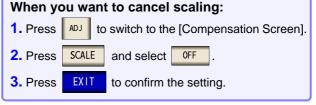
**Procedure**
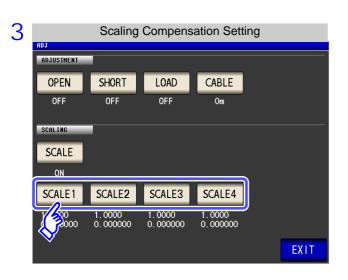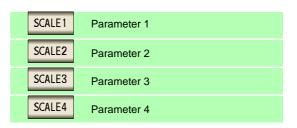
**1**

LCR Initial Screen



Compensation Screen



**2**

Scaling Compensation Setting



Select [ON], and press [EXIT] to confirm the selection.

**When you want to cancel scaling:**
**1.** Press [ADJ] to switch to the [Compensation Screen].
**2.** Press [SCALE] and select [OFF].
**3.** Press [EXIT] to confirm the setting.

**3**

Scaling Compensation Setting
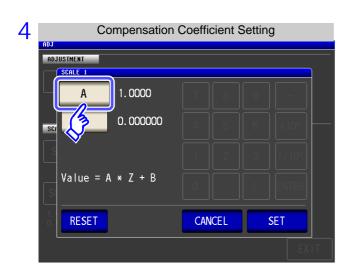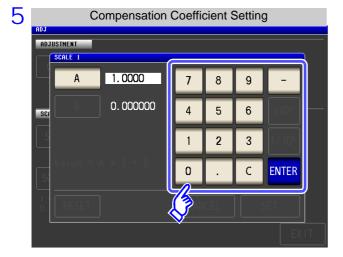
**Select the compensation coefficient of the parameter you want to change.**

The parameters and compensation coefficient numbers correspond as shown below.

| SCALE1 | Parameter 1 |
|--------|-------------|
| SCALE2 | Parameter 2 |
| SCALE3 | Parameter 3 |
| SCALE4 | Parameter 4 |

**4**

Compensation Coefficient Setting

$$Value = A * Z + B$$

**Press**  A .

**5**

Compensation Coefficient Setting
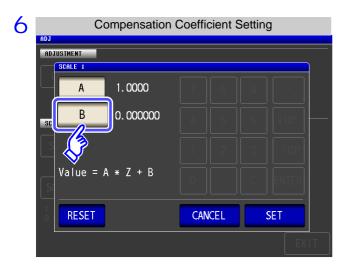
**Use the numeric keypad to set compensation coefficient A.**
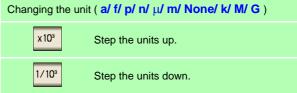
Settable range: -999.9999 to 999.9999

To return to the previous screen without making any change to the set value, press the ENTER key when the screen is in the state with nothing being displayed (the state after pressing the C key).

**7**

**Chapter 7 Error Compensation**

## 7.5 Calculating Values Scaling

**6**

Compensation Coefficient Setting

ADJ
ADJUSTMENT
SCALE 1

A  1.0000

B  0.000000

Value = A * Z + B

RESET     CANCEL     SET

EXIT

Press **B** and use the numeric keypad to set compensation coefficient **B** in the same way as for **A**.

Settable range: -9.999999G to 9.999999G
To return to the previous screen without making any change to the set value, press the ENTER key when the screen is in the state with nothing being displayed (the state after pressing the C key).

Changing the unit ( **a/ f/ p/ n/ μ/ m/ None/ k/ M/ G** )

| x10³ | Step the units up. |
| 1/10³ | Step the units down. |

**7** Press **SET** to return to the [Scaling Compensation Setting].

**NOTE**
- If the same parameter is selected multiple times and a different compensation coefficient is set for each of them, the compensation coefficient of the parameter with the smallest number is used to perform scaling for all of the parameters of the parameter numbers. (The compensation coefficients of the other parameter numbers become invalid.)
- In the case of the following settings, scaling is performed using the compensation coefficient of parameter 1 for all Z of parameters 1, 2, and 4. (The compensation coefficients of parameters 2 and 4 are invalid.)

Reference value 1

| Display Parameter Setting | Compensation Coefficient Setting |
|---|---|
| Parameter 1: Z | a = 1.5000, b = 1.500000 |
| Parameter 2: Z | a = 1.7000, b = 2.500000 |
| Parameter 3: θ | a = 0.7000, b = 1.000000 |
| Parameter 4: Z | a = 1.9000, b = 3.500000 |
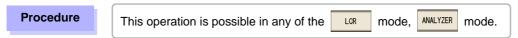
# Setting the SYSTEM

# Chapter 8

## 8.1 Setting the Interface

You can control the instrument from a computer via the GP-IB, RS-232C, USB, and LAN interfaces. Printing can also be performed with an RS-232C printer.

**Procedure** | This operation is possible in any of the LCR mode, ANALYZER mode.

### 1 LCR Initial Screen

0. 115 °

Vac 3.503mV
Iac 10.15mA

| 000kHz | SPEED | MED | OPEN | OFF |
| 000V | TRIG | INT | SHORT | OFF |
| | AVG | OFF | LOAD | OFF |

SET
ADJ
SYS

### Interface Settings

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

BAUD RATE | 9600 | 19200 | 38400 | 57600

### 2 Select the interface type.

#### RS-232C Settings

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

BAUD RATE | 9600 | 19200 | 38400 | 57600

HANDSHAKE | OFF | HARD | XON/OFF | BOTH

TERM | CR+LF | CR

EXIT

#### GPIB Setting

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

ADDRESS 01 ▼

TERM | LF | CR+LF

EXIT

#### USB Setting

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

TERM | CR+LF

EXIT

#### LAN Settings

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

IP ADDRESS | 192.168.000.001 | PORT | 03570

SUBNETMASK | 255.255.255.000 | TERM | CR+LF | CR

GATEWAY | OFF

EXIT

**When setting other than a printer:**
See Communication Instruction Manual "Chapter 2" (CD)

#### Printer Setting (p. 384)

| I/F | INFO | TEST | CLOCK |

RS232C | GPIB | USB | LAN | PRINT

BAUD RATE | 9600 | 19200 | 38400 |

HANDSHAKE | OFF | HARD | XON/OFF | BOTH

### 3 Select SET and check each of the settings, and press EXIT to close the setting screen.

**8**

**Chapter 8 Setting the SYSTEM**

## 8.2 Checking the Version of the Instrument

**Procedure**

This operation is possible in any of the ⬚ LCR mode, ⬚ ANALYZER mode.

**1**

LCR Initial Screen

**LCR**

Z
345.109mΩ
OFF

θ
0.115 °
OFF

Vac   3.503mV
Iac   10.15mA

MODE
SET
ADJ
SYS

INFORMATION                    1/
FREQ   1.0000kHz   SPEED   MED      OPEN    OFF
V      1.000V      TRIG    INT      SHORT   OFF
LIMIT  OFF         AVG     OFF      LOAD    OFF
RANGE  AUTO    1Ω  DELAY   0.0000s  CABLE   0m
LOW Z  OFF         DCBIAS  OFF      SCALE   OFF
JUDGE  OFF

ZOOM ON   INFO DC

Instrument Info

**SYS**

I/F          INFO          TEST          CLOCK

IM3570  IMPEDANCE ANALYZER

Serial No.           123456789
Software Version     3.00
FPGA Version         0x15
Board Version        0
MAC Address          00-01-67-03-26-39
USB ID               108f:3570
OPTION               IM9000

**2**

Instrument Info

**SYS**

I/F          INFO          TEST          CLOCK

IM3570  IMPEDANCE ANALYZER

Serial No.           123456789
Software Version     3.00
FPGA Version         0x15
Board Version        0
MAC Address          00-01-67-03-26-39
USB ID               108f:3570

OPTION               IM9000

EXIT

Check the version of the instrument.

This text is displayed only when the IM9000 Equivalent Circuit Analysis Firmware has been installed.

**3** Press  **EXIT**  to close the setting screen.

NOTE

Opening Screen

**HIOKI**

IM3570
IMPEDANCE ANALYZER

+ IM9000 EQUIVALENT CIRCUIT

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Software Version 3.00

The instrument's version number can also be checked on the opening screen that is shown when it starts up.

The message "+ IM9000 EQUIVALENT CIRCUIT" is displayed when the IM9000 Equivalent Circuit Analysis Firmware has been installed.

# 8.3 Self Checks (Self Diagnosis)

You can check the display screens of the instrument.

## Panel Test

You can check the touch panel.

**Procedure**    This operation is possible in any of the `LCR` mode, `ANALYZER` mode.

**1**    LCR Initial Screen

| | |
|---|---|
| Z | 345.109mΩ |
| OFF | |
| θ | 0.115 ° |
| OFF | Vac 3.503mV<br>Iac 10.15mA |

MODE
SET
ADJ
SYS

INFORMATION
FREQ 1.0000kHz   SPEED MED   OPEN OFF
V 1.000V   TRIG INT   SHORT OFF
LIMIT OFF   AVG OFF   LOAD OFF
RANGE AUTO   1Ω   DELAY 0.0000s   CABLE 0m

Self Checks

I/F   INFO   TEST   CLOCK

TOUCH SCREEN TEST   CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST

**2**    Self Checks

I/F   INFO   TEST   CLOCK

TOUCH SCREEN TEST   CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST

EXIT

**Press** `TOUCH SCREEN TEST` .

**3**    Panel Test

TOUCH SCREEN TEST

EXIT

Press the ☐ keys displayed on the screen.
If the pressed keys are highlighted and the green
○ appears, the touch panel is working properly.

Perform panel compensation (p. 308) if they are not
highlighted or the red ✗ appears.
If there is still problem after performing panel calibration,
the panel may be malfunctioning. Contact your dealer or
Hioki representative.
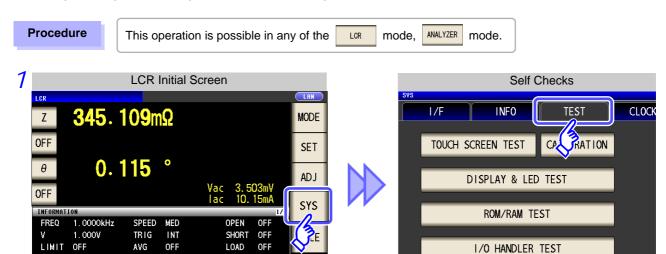
**8**

**Chapter 8 Setting the SYSTEM**

# 308

## 8.3 Self Checks (Self Diagnosis)

<div style="background:blue;color:white">

### Panel Compensation
</div>

You can perform position compensation of the touch panel.

**Procedure**  This operation is possible in any of the LCR mode, ANALYZER mode.

**1** 

LCR Initial Screen

Self Checks

**2**

Self Checks

Press CALIBRATION .

**3**

Panel Compensation

CALIBRATION
Touch two cross marks.

CANCEL
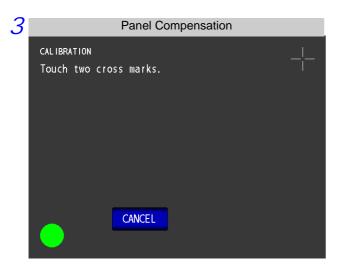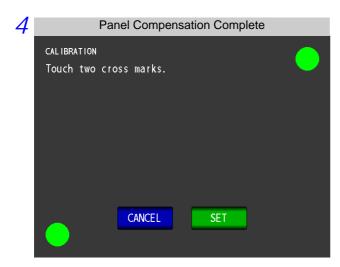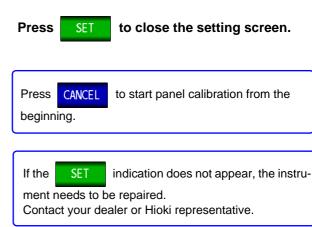
Press in the location of ┼ continuously until the green ● appears.

*4*

| Panel Compensation Complete |
|---|
| CALIBRATION<br>Touch two cross marks. |

**Press** SET **to close the setting screen.**

Press CANCEL to start panel calibration from the beginning.

If the SET indication does not appear, the instrument needs to be repaired.
Contact your dealer or Hioki representative.
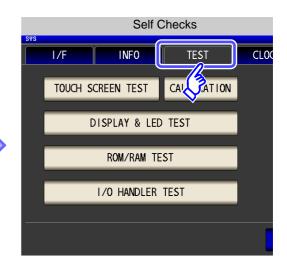
## 8.3 Self Checks (Self Diagnosis)
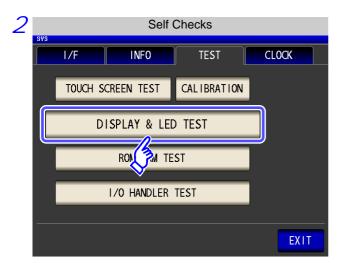
## Screen Display Test

Check the display state of the screen and lighting state of the LEDs.

**Procedure**   This operation is possible in any of the `LCR` mode, `ANALYZER` mode.

**1**   LCR Initial Screen

LCR
Z **345.109mΩ**
OFF
θ **0.115 °**
OFF
Vac 3.503mV
Iac 10.15mA

INFORMATION
| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | INT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO 1Ω | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |
| JUDGE | OFF | | | | |

ZOOM ON  INFO DC

MODE
SET
ADJ
SYS

Self Checks

SYS
I/F    INFO    TEST    CLOC

TOUCH SCREEN TEST    CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST

**2**   Self Checks

SYS
I/F    INFO    TEST    CLOCK

TOUCH SCREEN TEST    CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST

EXIT

**Press** DISPLAY & LED TEST .

**3** Each time you touch the screen, the screen color and front panel LEDs change as shown in the following table.

| Screen Color | Front Panel LEDs |
|---|---|
| Red |  All LEDs turn on |
| Green |  All LEDs turn off |
| Blue |  The [OUT] LED turns on |
| Black |  The [IN] LED turns on |
| White |  The [MEAS] LED turns on |

If the entire screen does not appear to be the same color or if the LEDs do not turn on as shown in the figure on the left, the instrument needs to be repaired.
Contact your dealer or Hioki representative.

**4** Press **EXIT** to close the setting screen.

**8**

**Chapter 8 Setting the SYSTEM**

## 8.3 Self Checks (Self Diagnosis)

### ROM/RAM Test
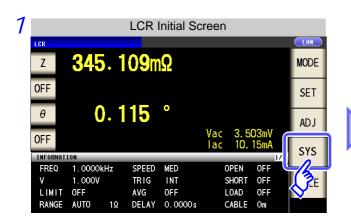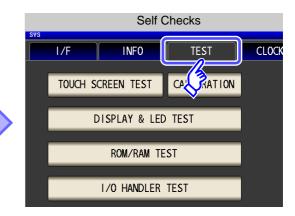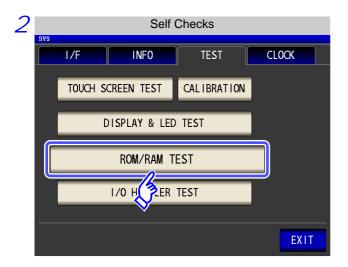
Check the internal memory (ROM and RAM) of the instrument.

**Procedure** | This operation is possible in any of the LCR mode, ANALYZER mode.

**1**

LCR Initial Screen

Self Checks

**2**

Self Checks

Press ROM/RAM TEST .
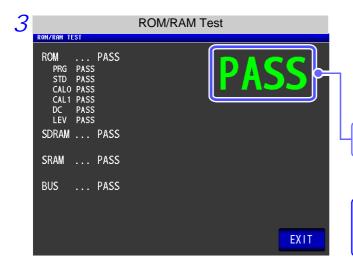
**Never turn off the power during a test.**

- Press the ROM/RAM TEST button to start the test automatically. (Approx. 40 seconds)
- No operation is possible during the ROM/RAM test.

**3**

ROM/RAM Test

```
ROM  ... PASS
  PRG  PASS
  STD  PASS
  CALO PASS
  CAL1 PASS
  DC   PASS
  LEV  PASS
SDRAM ... PASS

SRAM  ... PASS

BUS   ... PASS
```

PASS

If the overall judgment result indication is **[PASS]**, the test ended normally.

Overall judgment result

If the overall judgment result indication is [NG], the instrument needs to be repaired.
Contact your dealer or Hioki representative.
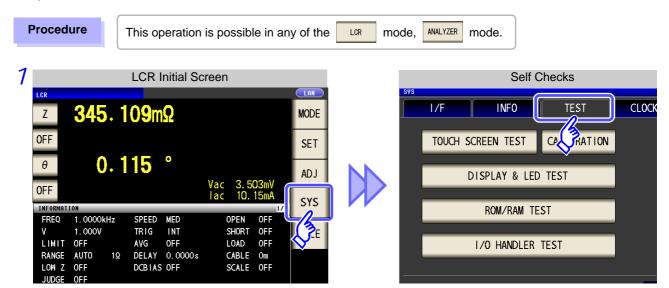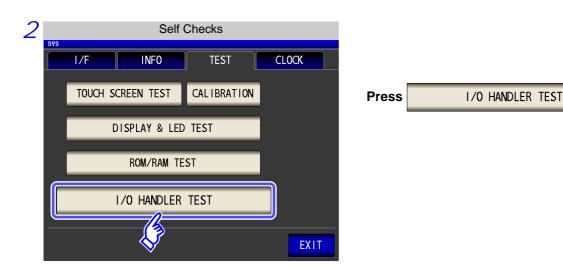
**4** Press EXIT to close the setting screen.
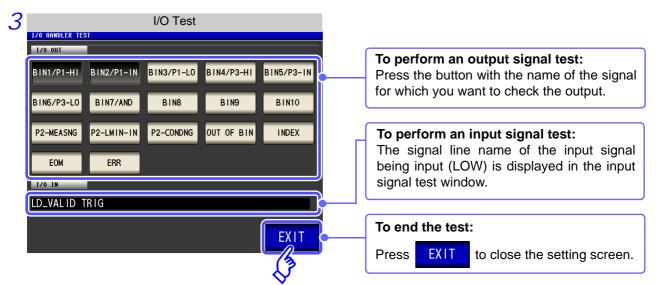
## I/O Test

Check whether an output signal is output normally from the EXT I/O, and whether an input signal is read normally.

**Procedure**  This operation is possible in any of the [LCR] mode, [ANALYZER] mode.

**1** LCR Initial Screen

```
LCR                                    LAN
Z    345.109mΩ          MODE
OFF
θ      0.115 °           SET
OFF                      ADJ
                Vac  3.503mV
                Iac  10.15mA
INFORMATION                    SYS
FREQ  1.0000kHz  SPEED  MED   OPEN  OFF
V     1.000V     TRIG   INT   SHORT OFF
LIMIT OFF        AVG    OFF   LOAD  OFF
RANGE AUTO   1Ω  DELAY  0.0000s CABLE 0m
LOW Z OFF        DCBIAS OFF   SCALE OFF
JUDGE OFF
```

Self Checks

```
SYS
I/F    INFO    TEST    CLOCK
TOUCH SCREEN TEST   CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST
```

**2** Self Checks

```
SYS
I/F    INFO    TEST    CLOCK
TOUCH SCREEN TEST   CALIBRATION
DISPLAY & LED TEST
ROM/RAM TEST
I/O HANDLER TEST
                        EXIT
```

**Press** I/O HANDLER TEST .

**3** I/O Test

```
I/O HANDLER TEST
I/O OUT
BIN1/P1-HI BIN2/P1-IN BIN3/P1-LO BIN4/P3-HI BIN5/P3-IN
BIN6/P3-LO BIN7/AND  BIN8  BIN9  BIN10
P2-MEASNG P2-LMIN-IN P2-CONDNG OUT OF BIN INDEX
EOM   ERR
I/O IN
LD_VALID TRIG
                        EXIT
```

**To perform an output signal test:**
Press the button with the name of the signal for which you want to check the output.

**To perform an input signal test:**
The signal line name of the input signal being input (LOW) is displayed in the input signal test window.

**To end the test:**
Press EXIT to close the setting screen.

## 8.4 Setting the Date and Time

You can set the date and time of the instrument.
Data is recorded and managed based on the set date and time.

**Procedure**    This operation is possible in any of the LCR mode, ANALYZER mode.

*1*    LCR Initial Screen

345.109mΩ

0.115 °

Vac  3.503mV
Iac  10.15mA

| | | |
|---|---|---|
| Q | 1.0000kHz | SPEED MED | OPEN OFF |
| | 1.000V | TRIG INT | SHORT OFF |
| IT | OFF | AVG OFF | LOAD OFF |
| GE | AUTO 1Ω | DELAY 0.0000s | CABLE 0m |
| Z | OFF | DCBIAS OFF | SCALE OFF |
| GE | OFF | | |

MODE
SET
ADJ
SYS

ON  INFO DC

Date & Time Settings

I/F    INFO    TEST    CLOCK

10-05-23 12:34:56

10-05-23    12:34:56

SET    EXIT

*2*    Date & Time Settings

I/F    INFO    TEST    CLOCK

10-05-23 12:34:56

10-05-23    12:34:56

SET    EXIT

**Use ▲ or ▼ to set the date and time.**

(Year-Month-Day   Hour-Minute-Second)

Settable range:
00:00:00, January 1, 2000, to
23:59:59, December 31, 2099

**Press    SET    to confirm the setting.**

*3*  **Press    EXIT    to close the setting screen.**

# Saving and Loading Panel Information

## Chapter 9

This instrument allows you to save and load data, and edit saved data.

(Data for the point in time ⬛ SAVE is pressed is saved.)

These operations are possible in both ⬛ LCR mode and ⬛ ANALYZER mode.

| **Saving Data** | ▷ | • Measurement conditions and compensation values(p. 317) |

| **Loading Data** | ▷ | • Measurement conditions and compensation values(p. 322) |

| **Editing Saved Data** | ▷ | • Change panel name(p. 324)<br>• Delete panel(p. 326) |

**NOTE**
• The instrument contains a built-in backup lithium battery.
• When the life of the built-in battery ends, the measurement conditions will no longer be able to be saved.
  Submit a request for replacement of the battery to the Hioki repair service. (A fee will be charged.)

## About the Save Screen

Indicates the panel number. (001 to 128)

Indicates the panel name. **See** When you want to change a panel name (p. 324)

Indicates the number of panels currently saved.(p. 317)
The text color changes in accordance with the number of data items currently saved as shown in the table below.

| MODE | White | Yellow | Red |
|------|-------|--------|-----|
| LCR | 0 to 14 | 15 to 29 | 30 |
| ANALYZER | 0 | 1 | 2 |
| ADJ | 0 to 63 | 64 to 127 | 128 |

```
PANEL
SAVE TYPE  ALL          LCR:00/30  ANALYZER:0/2  ADJ:000/128
No.  PANEL NAME  MODE       INFORMATION
001 ----- NO SAVE -----
002 ----- NO SAVE -----
003 ----- NO SAVE -----
004 ----- NO SAVE -----
005 ----- NO SAVE -----
006 ----- NO SAVE -----
007 ----- NO SAVE -----
008 ----- NO SAVE -----
009 ----- NO SAVE -----
010 ----- NO SAVE -----
<< OPTION  RENAME  DELETE                      EXIT
```

Indicates basic information on the saved panels.
In order from the left

| MODE | Measurement Parameters | Judgment Mode |
|------|------------------------|---------------|
| LCR | **[PARA1]** - **[PARA2]** - **[PARA3]** - **[PARA4]** | **[COMP]** or **[BIN]** |
| ANALYZER | **[PARA1]** - **[PARA2]** | **[PEAK]** or **[AREA]** |

Indicates the save type.(p. 317)

When saving with  ALL  : **[LCR+ADJ]** or **[ANA+ADJ]**

When saving with  HARD  : **[LCR]** or **[ANA]**

When saving with  ADJ  : **[ADJ]**

Indicates that nothing is saved.

Loads the save conditions. (p. 322)

Saves the measurement conditions. (p. 317)

Allows you to check the information of the selected panel. (p. 320)

```
LOAD  SAVE  VIEW  OPTION >>        EXIT
```

```
<< OPTION  RENAME  DELETE          EXIT
```

Allows you to changes the panel name. (p. 324)

Deletes the panel. (p. 326)

# 9.1 Saving Measurement Conditions (Panel Save Function)

You can save the measurement condition and compensation value.
However, each of the measurement condition and compensation value is counted as one save data item when saved with ALL .
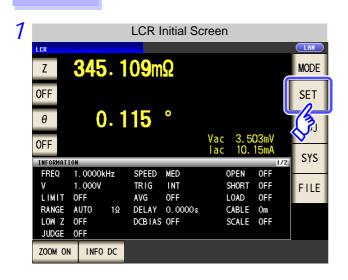
(Example: When saving is performed with ALL in LCR mode, LCR is counted as one item, and the compensation value as one item.)

| LCR Measurement Condition | ▶ | Up to 30 items |
| Analyzer Measurement Condition | ▶ | Up to 2 items |
| Compensation Value | ▶ | Up to 128 items |

## Setting the Type to Save

**Procedure**
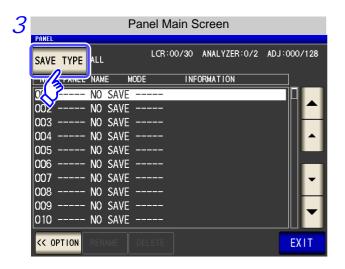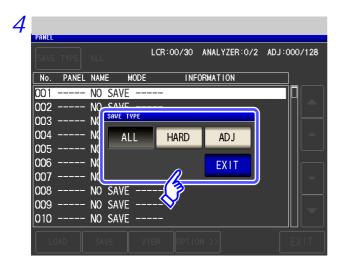
**1** LCR Initial Screen ▶▶ Application Settings

**2** Application Settings

Press PANEL .

## 9.1 Saving Measurement Conditions (Panel Save Function)

**3**

Panel Main Screen

Press SAVE TYPE .

**4**

**Select the save type.**

| ALL | Saves both the measurement condition and compensation value. |
| --- | --- |
| HARD | Saves only the measurement condition. |
| ADJ | Saves only each of the setting values and compensation values of open compensation, short compensation, load compensation, cable length compensation, and scaling compensation. |

**5** Press EXIT **to close the setting screen.**

When analyzer measurement mode

You can save a panel in the same way in analyzer measurement mode.

Analyzer Initial Screen

Common Settings
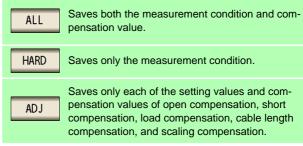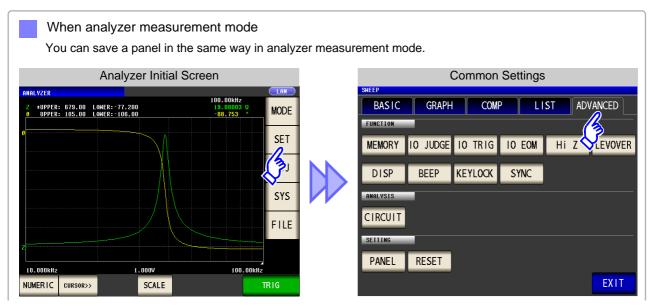
## Setting the Save Conditions

**Procedure**

**1** LCR Initial Screen



Application Settings



**2** Application Settings



Press PANEL .

**3** Panel Main Screen
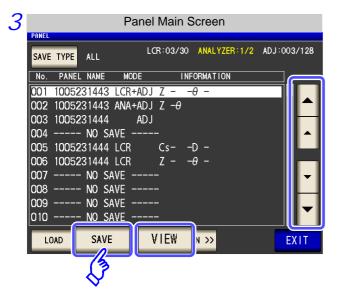


Use ▲ or ▼ to select the number of the panel to save.

- Display range: No. 001 to No. 128
- When you want to check the information of a saved panel:

  Press VIEW .
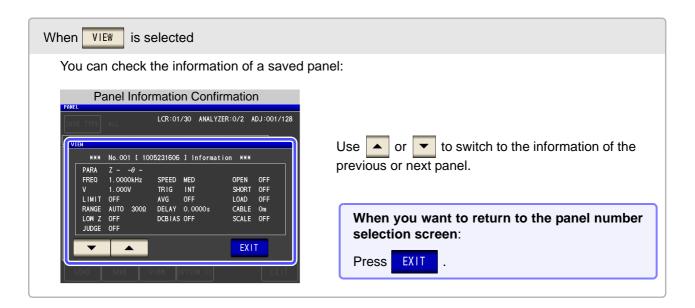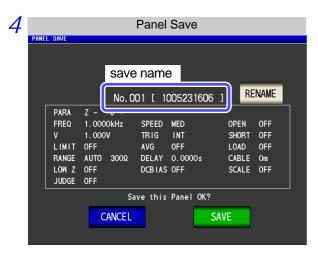
Press SAVE .

**When you want to cancel saving:**

Press EXIT .

## 9.1 Saving Measurement Conditions (Panel Save Function)

---

When VIEW is selected

You can check the information of a saved panel:

Panel Information Confirmation

```
PANEL
SAVE TYPE   ALL        LCR:01/30  ANALYZER:0/2  ADJ:001/128
VIEW
    ***  No.001 [ 1005231606 ] Information  ***
   PARA   Z - -θ -
   FREQ   1.0000kHz   SPEED  MED      OPEN   OFF
   V      1.000V      TRIG   INT      SHORT  OFF
   LIMIT  OFF         AVG    OFF      LOAD   OFF
   RANGE  AUTO  300Ω  DELAY  0.0000s  CABLE  0m
   LOW Z  OFF         DCBIAS OFF      SCALE  OFF
   JUDGE  OFF
      ▼        ▲                        EXIT
   LOAD    SAVE    VIEW   OPTION >>     EXIT
```

Use ▲ or ▼ to switch to the information of the previous or next panel.

**When you want to return to the panel number selection screen**:

Press EXIT .

---

**4** Panel Save

```
PANEL SAVE

           save name
         No.001 [ 1005231606 ]    RENAME

   PARA   Z - -θ -
   FREQ   1.0000kHz   SPEED  MED      OPEN   OFF
   V      1.000V      TRIG   INT      SHORT  OFF
   LIMIT  OFF         AVG    OFF      LOAD   OFF
   RANGE  AUTO  300Ω  DELAY  0.0000s  CABLE  0m
   LOW Z  OFF         DCBIAS OFF      SCALE  OFF
   JUDGE  OFF
            Save this Panel OK?
      CANCEL              SAVE
```

The save name and the measurement condition to be saved are displayed.

| | |
|---|---|
| RENAME | Changes the save name. **See** Step **5** |
| CANCEL | Returns to the previous screen. |
| SAVE | Saves the measurement condition under the displayed save name. (The initial screen is redisplayed automatically.) |

**5** When RENAME is pressed

Panel Name Setting

```
PANEL SAVE
PANEL NAME
Please input PANEL name.
1005231606              CLEAR  BS
A B C D E F G   7 8 9
H I J K L M N   4 5 6
O P Q R S T U   1 2 3
V W X Y Z _     0 + -
KEY TYPE    CANCEL   PANEL NAME
```

⟷

Panel Name Setting

```
PANEL SAVE
PANEL NAME
Please input PANEL name.
1005231606              CLEAR  BS
1 2 3 4 5 6 7 8 9 0
Q W E R T Y U I O P
A S D F G H J K L +
Z X C V B N M _ -
KEY TYPE    CANCEL   PANEL NAME
```

Enter the save name.(Up to 12 characters)

| | |
|---|---|
| CLEAR | Deletes all input characters. |
| BS | Deletes the last character. |
| KEY TYPE | Changes the keyboard type |

**6** After you enter the save name, press PANEL NAME to return to step *4*, and press SAVE to confirm saving.

Panel Overwrite Confirmation

PANEL SAVE

OVER WRITE

Panel No.001 has already been preserved.
OverWrite this Panel OK?

CANCEL     OVER WRITE

JUDGE   OFF

CANCEL     SAVE

If a panel of the same name already exists, an overwrite confirmation window appears.

To enter a different save name:  CANCEL

To overwrite the save name:  OVER WRITE

**7** Press EXIT to close the setting screen.

# 9.2 Loading Measurement Conditions (Panel Load Function)

You can read saved measurement conditions with the panel load function.

**Procedure**
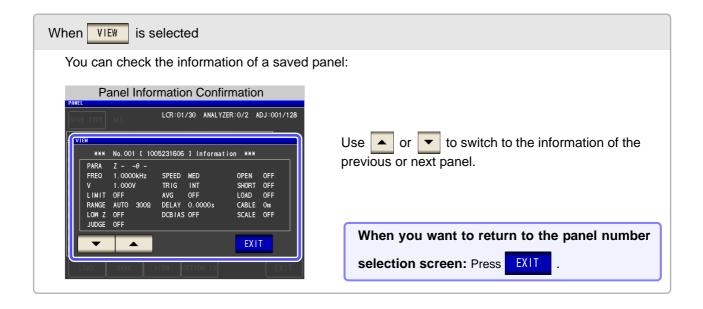
**1**

LCR Initial Screen

Application Settings

**2**

Application Settings

Press PANEL .

**3**

Panel Main Screen

Use ▲ or ▼ to select the number of the panel to load.

- Display range: No. 001 to No. 128
- When you want to check the information of a saved panel: Press VIEW .
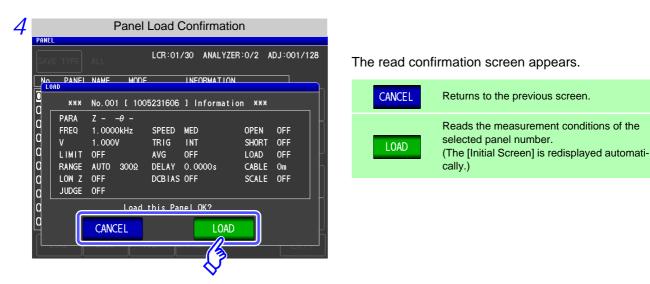
Press LOAD .

**When you want to cancel loading:**

When **VIEW** is selected

You can check the information of a saved panel:

Panel Information Confirmation

Use ▲ or ▼ to switch to the information of the previous or next panel.

**When you want to return to the panel number selection screen:** Press **EXIT** .

*4* Panel Load Confirmation

The read confirmation screen appears.

| | |
|---|---|
| **CANCEL** | Returns to the previous screen. |
| **LOAD** | Reads the measurement conditions of the selected panel number. (The [Initial Screen] is redisplayed automatically.) |
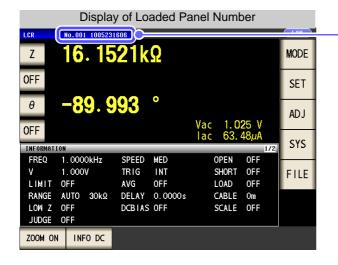
*5* **When reading of the measurement conditions is finished, the [Initial Screen] is redisplayed automatically.**

Display of Loaded Panel Number
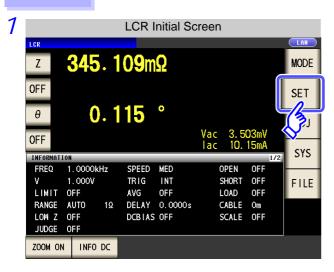
The loaded panel number is displayed in the initial screen.

**16. 1521kΩ**

**−89. 993 °**

Vac  1.025 V
Iac  63.48µA
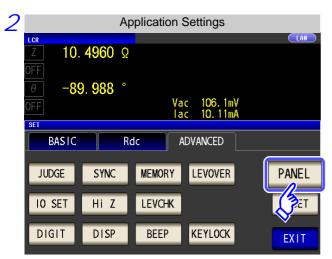
## 9.3  Changing a Panel Name

You can change the name of a panel saved to the instrument.

**Procedure**

**1**

LCR Initial Screen

Application Settings

**2**

Application Settings

Press PANEL .

**3**

Panel Main Screen
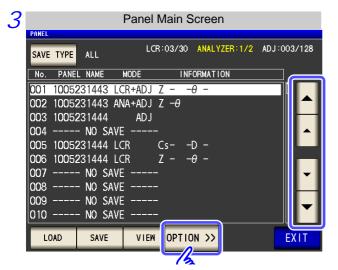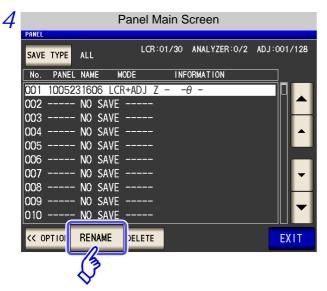
Use ▲ or ▼ to select the number of the panel to rename.

Press OPTION >> .

**When you want to cancel saving:**

Press EXIT .

**4**

Panel Main Screen

Press [RENAME] .

**5**

Change Panel Name — Change Panel Name

⟷

Enter the save name. (Up to 12 characters)

| [CLEAR] | Deletes all input characters. |
| [BS] | Deletes the last character. |
| [KEY TYPE] | Changes the keyboard type. |

**6**

Change Panel Name
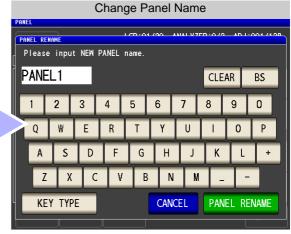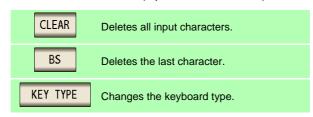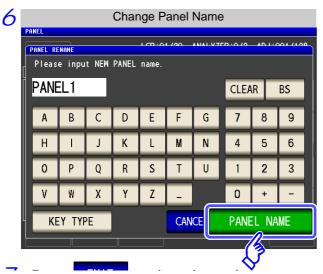
After you enter the new save name, press [PANEL NAME] to confirm the name.
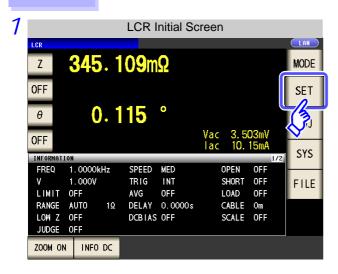
# 9.4 Deleting a Panel

You can delete a panel saved to the instrument.

**Procedure**

**_1_**

LCR Initial Screen

Application Settings

**_2_**                Application Settings

Press PANEL .

**_3_**                Panel Main Screen
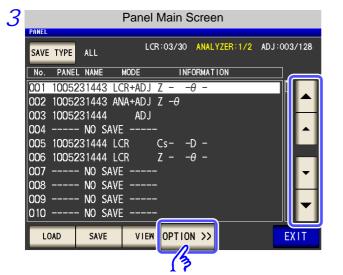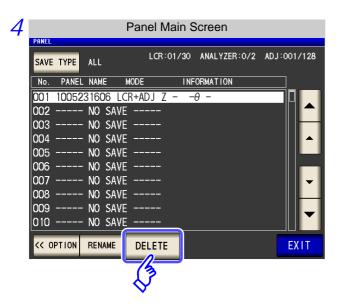
Use ▲ or ▼ to select the number of the panel to delete.

Press OPTION >> .

**4** Panel Main Screen

Press DELETE .

Some of the information saved to the panel is displayed.

**5** Panel Delete Confirmation

Check the information saved to the panel.

A panel cannot be restored once it is deleted.

**When you want to cancel deletion:**

Press CANCEL .

Press DELETE .

**6** Press EXIT to close the setting screen.

# Using USB Flash Drive Chapter 10

You can save measurement values to a USB flash drive (commercially available). The instrument settings can also be saved and read.

| **Saving Data** | ▶ | • Measurement values, measurement conditions, compensation values, instrument settings (p. 333)<br>• Currently displayed screen (p. 341) |

| **Reading Data** | ▶ | • Measurement conditions, compensation values, measurement values, instrument settings (p. 353)<br>• Saved screen (p. 343) |

| **File Operations** | ▶ | • Formatting a USB Flash Drive (Initializing) (p. 357)<br>• Create folders (p. 360)<br>• Delete files and folders (p. 359) |
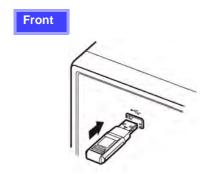
**USB Specifications**

| Connector | USB type A |
|---|---|
| Electrical specification | USB2.0 |
| Power supply | 500 mA maximum |
| No. of ports | 1 |
| Compatible USB device | USB Mass Storage Class |

**⚠CAUTION**

- Hioki cannot recover data from damaged or faulty storage media resulting from abnormalities. We are also unable to provide compensation for such data loss, regardless of the contents or cause of the failure or damage. We recommend making a backup of all important data such as a computer.
- Avoid forcing insertion of storage media backwards or in the wrong orientation, as this could damage the media or instrument.
- When a USB flash drive is accessed, the color of the USB icon changes from blue to red. Do not turn off the power of the instrument while the USB flash drive is being accessed. Also, never remove the USB flash drive from the instrument. Doing so may result in the data in the USB flash drive being lost.
- When transporting the instrument, remove the USB flash drive. Failing to do so may result in the instrument or USB flash drive being damaged.
- Do not move the instrument with a USB flash drive installed. Otherwise, the instrument or media could be damaged.
- Some USB flash drives are easily affected by static electricity. Be careful handling the USB flash drive to avoid damage to the drive or instrument malfunctions due to static electricity.
- Some USB flash drives may prevent the instrument from turning on when inserted. In this case, turn the instrument on before inserting the USB flash drive.

**NOTE**  USB flash drives have a limited usable lifetime. After long-term use, data reading and writ-

Chapter 10 Using USB Flash Drive

10

# 10.1 Inserting and Removing USB flash drive

Front

■ **Inserting a USB Flash Drive**

**Inert the USB flash drive into the USB port on the front panel of the instrument.**

- Do not insert a USB flash drive that is not Mass Storage Class compatible.
- Not all commercially available USB flash drives are compatible.
- If a USB flash drive is not recognized, try using another USB flash drive.

■ **Removing a USB Flash Drive**
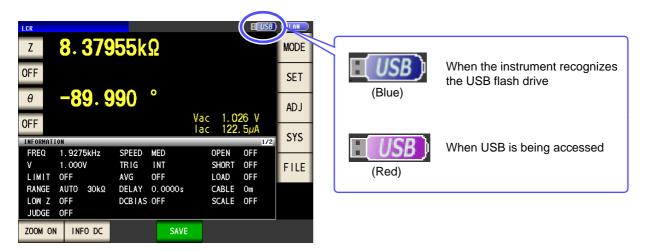
**Check that the USB flash drive is not being accessed (saving, reading, etc.) by the instrument, and then remove it.**

(No remove operation needs to be performed on the instrument.)

## Screen Display when Using USB

When a USB flash drive has been recognized properly, the USB flash drive icon is displayed at the top of the measurement screen.
The icon is red while the USB flash drive is being accessed.



| USB (Blue) | When the instrument recognizes the USB flash drive |
| USB (Red) | When USB is being accessed |

## About File Types

The following files can be handled by the instrument.

| Content | Type (file extension) | Indication on instrument |
|---|---|---|
| - | Folder | FDR |
| Measurement data | CSV file | CSV |
| Screen copy | BMP file | BMP |
| Instrument settings data | Settings file | SET |
| Panel save data | Panel settings file | PNL |

The instrument cannot display double-byte characters (Japanese, etc.). A double-byte characters is replaced by "??."
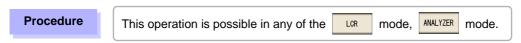
# 10.2 About the File Operation Screen
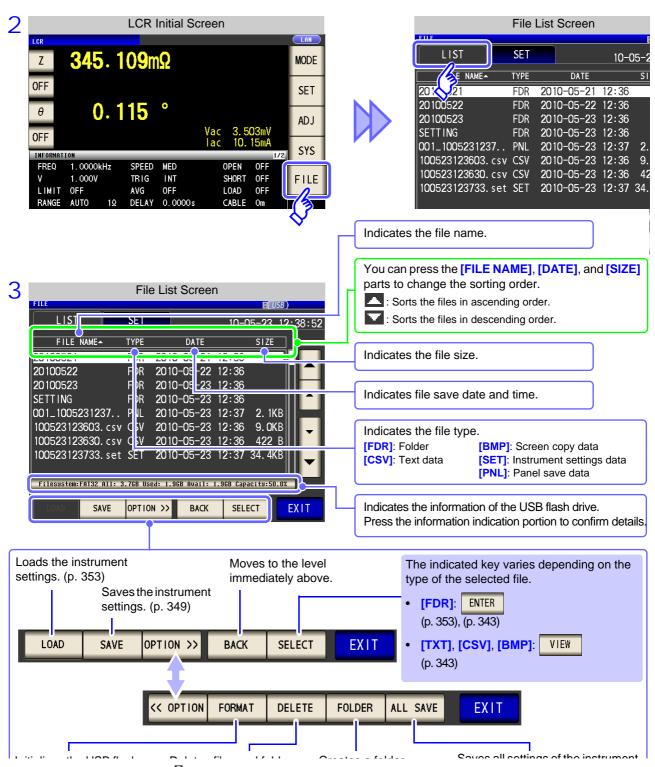
This screen displays a list of the files saved in the USB flash drive.
It also allows you to perform file operations such as creating a folder and deleting a file. The instrument can recognize file names of up to 127 single-byte characters. File names that exceed that length are not recognized.

**Procedure**    This operation is possible in any of the [ LCR ] mode, [ ANALYZER ] mode.

**1**    Insert the USB flash drive into the USB port (front panel).

**2**
| LCR Initial Screen | File List Screen |

Indicates the file name.

You can press the **[FILE NAME]**, **[DATE]**, and **[SIZE]** parts to change the sorting order.
▲ : Sorts the files in ascending order.
▼ : Sorts the files in descending order.

**3**    File List Screen

Indicates the file size.

Indicates file save date and time.

Indicates the file type.
**[FDR]**: Folder            **[BMP]**: Screen copy data
**[CSV]**: Text data        **[SET]**: Instrument settings data
                                    **[PNL]**: Panel save data

Indicates the information of the USB flash drive.
Press the information indication portion to confirm details.

Loads the instrument settings. (p. 353)

Saves the instrument settings. (p. 349)

Moves to the level immediately above.

The indicated key varies depending on the type of the selected file.

• **[FDR]**: [ ENTER ]
  (p. 353), (p. 343)

• **[TXT]**, **[CSV]**, **[BMP]**: [ VIEW ]
  (p. 343)

**Chapter 10  Using USB Flash Drive**

**10**

## 10.3 About the File Save Setting Screen
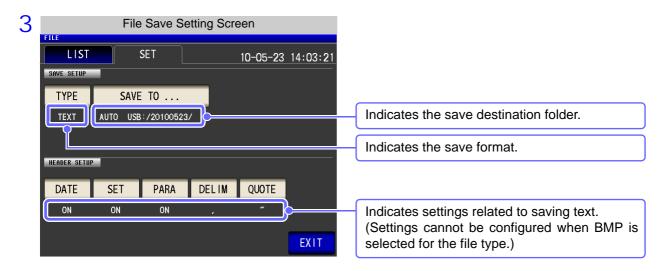
You can configure settings such as the file save format, save destination, and text save format.
Check the settings before using the file save function.

**Procedure**   This operation is possible in any of the [ LCR ] mode, [ ANALYZER ] mode.

**1**   Insert the USB flash drive into the USB port (front panel).

**2**
LCR Initial Screen



File Save Setting Screen



**3**
File Save Setting Screen



Indicates the save destination folder.

Indicates the save format.

Indicates settings related to saving text.
(Settings cannot be configured when BMP is selected for the file type.)
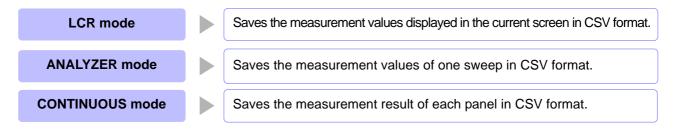
# 10.4 Saving Measurement Data
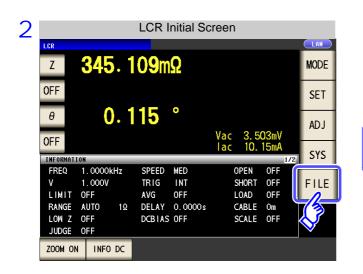
You can save the measurement data to a USB flash drive in CSV format.

| LCR mode | ▶ | Saves the measurement values displayed in the current screen in CSV format. |
| ANALYZER mode | ▶ | Saves the measurement values of one sweep in CSV format. |
| CONTINUOUS mode | ▶ | Saves the measurement result of each panel in CSV format. |
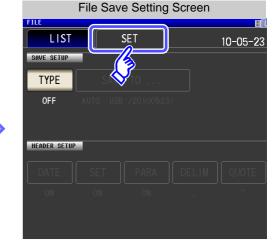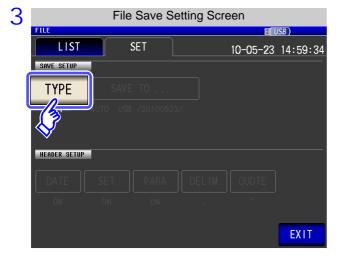
## 1   Saving Measurement Data

**Procedure**

**1**   **Insert the USB flash drive into the USB port (front panel).**

**2**

LCR Initial Screen



File Save Setting Screen



**3**

File Save Setting Screen



Press  TYPE  .

**4**

File Type Setting

| FILE | | |
|---|---|---|
| LIST | SET | 11-06-20 18:30:30 |

SAVE SETUP

TYPE
OFF

TYPE
TEXT  OFF | ON
BMP  OFF | COLOR | MONO
EXIT

HEADER SETUP

DATE  SET  PARA  DELIM  QUOTE
ON  ON  ON

EXIT
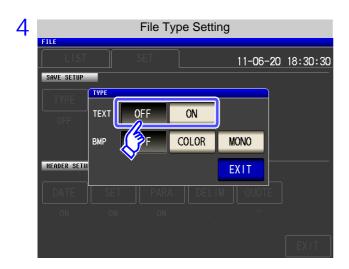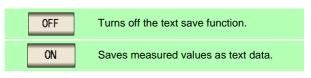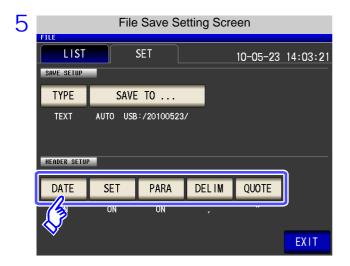
**Turn on the text save setting.**

| OFF | Turns off the text save function. |
|---|---|
| ON | Saves measured values as text data. |

**Press** EXIT **.**

**5**

File Save Setting Screen

| FILE | | |
|---|---|---|
| LIST | SET | 10-05-23 14:03:21 |

SAVE SETUP

TYPE  SAVE TO ...
TEXT  AUTO  USB:/20100523/

HEADER SETUP

DATE  SET  PARA  DELIM  QUOTE
ON  ON  ,  "

EXIT
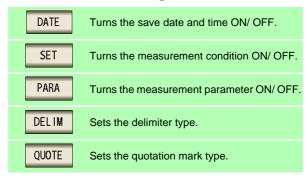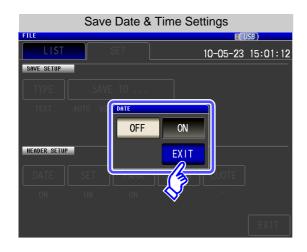
Set the header of the text file.

**Select the header setting.**

| DATE | Turns the save date and time ON/ OFF. |
|---|---|
| SET | Turns the measurement condition ON/ OFF. |
| PARA | Turns the measurement parameter ON/ OFF. |
| DELIM | Sets the delimiter type. |
| QUOTE | Sets the quotation mark type. |

DATE Save Date and Time Setting

Save Date & Time Settings

**FILE** | **USB**

LIST | SET | 10-05-23 15:01:12

SAVE SETUP

TYPE | SAVE TO ...

TEXT | AUTO | US

DATE

OFF | ON

EXIT

HEADER SETUP

DATE | SET | PARA | | QUOTE

ON | ON | ON

EXIT
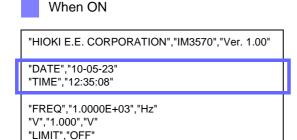
**1.** Select ON/ OFF for the save date and time.

| OFF | Does not record the save date and time. |
| ON | Records the save date and time. |

**2.** Press EXIT to close the setting screen.

When ON

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:08"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
```

When OFF
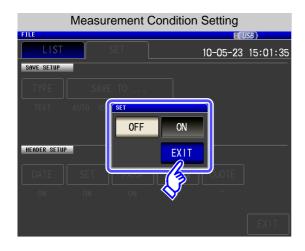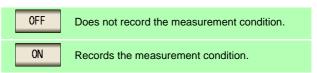
```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
```

Chapter 10 Using USB Flash Drive

**10**

**SET** Measurement Condition Setting
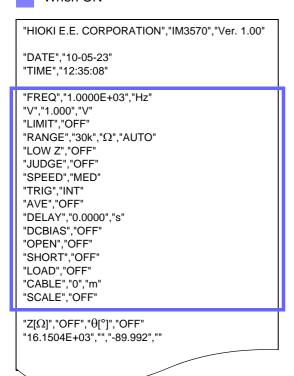
**1.** Select ON/ OFF for the measurement condition setting.

| OFF | Does not record the measurement condition. |
| ON | Records the measurement condition. |

**2.** Press **EXIT** to close the setting screen.

### When ON

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:08"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVE","OFF"
"DELAY","0.0000","s"
"DCBIAS","OFF"
"OPEN","OFF"
"SHORT","OFF"
"LOAD","OFF"
"CABLE","0","m"
"SCALE","OFF"

"Z[Ω]","OFF","θ[°]","OFF"
"16.1504E+03","","-89.992",""
```

### When OFF

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:27"

"Z[Ω]","OFF","θ[°]","OFF"
"16.1505E+03","","-89.992",""
```

**PARA** Measurement Parameter Setting

Measurement Parameter Setting

FILE ⬛(USB)

LIST | SET | 10-05-23 15:03:03

SAVE SETUP

TYPE | SAVE TO . . .

TEXT | AUTO | US

PARA

OFF | ON

EXIT

HEADER SETUP

DATE | SET | PARA | | QUOTE
ON | ON | ON

EXIT

**1.** Select ON/ OFF for measurement parameter recording.

| OFF | Does not record the measurement parameter. |
| ON | Records the measurement parameter. |

**2.** Press **EXIT** to close the setting screen.

⬛ When ON

```
"DATE","10-05-23"
"TIME","12:35:08"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVE","OFF"
"DELAY","0.0000","s"
"DCBIAS","OFF"
"OPEN","OFF"
"SHORT","OFF"
"LOAD","OFF"
"CABLE","0","m"
"SCALE","OFF"

"Z[Ω]","OFF","θ[°]","OFF"
16.1504E+03 , , -89.992 ,
```

⬛ When OFF

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:35"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVE","OFF"
"DELAY","0.0000","s"
"DCBIAS","OFF"
"OPEN","OFF"
"SHORT","OFF"
"LOAD","OFF"
"CABLE","0","m"
"SCALE","OFF"

"16.1504E+03","","-89.992",""
```

## DELIM Delimiter Setting

| Delimiter Setting |
|---|
| FILE ⬛USB |
| LIST SET 10-05-23 15:03:50 |
| SAVE SETUP |
| TYPE SAVE TO ... |
| TEXT |
| DELIM |
| , TAB ; SPACE |
| HEADER SET EXIT |
| DATE SET PARA DELIM |
| ON ON ON , |
| EXIT |

**1.** Select the delimiter setting.

| , | Sets the delimiter to a comma (,). |
|---|---|
| TAB | Sets the delimiter to a tab. |
| ; | Sets the delimiter to a semicolon (;). |
| SPACE | Sets the delimiter to a space. |

**2.** Press EXIT to close the setting screen.

### ■ When comma

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:08"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVE","OFF"
"DELAY","0.0000","s"
```

### ■ When tab

```
"HIOKI E.E. CORPORATION"  "IM3570"  "Ver. 1.00"

"DATE"  "10-05-23"
"TIME"  "12:35:43"

"FREQ"  "1.0000E+03"  "Hz"
"V"  "1.000"  "V"
"LIMIT"  "OFF"
"RANGE"  "30k"  "Ω"  "AUTO"
"LOW Z"  "OFF"
"JUDGE"  "OFF"
"SPEED"  "MED"
"TRIG"  "INT"
"AVE"  "OFF"
"DELAY"  "0.0000"  "s"
"DCBIAS"  "OFF"
"OPEN"  "OFF"
```

### ■ When semicolon

```
"HIOKI E.E. CORPORATION";"IM3570";"Ver. 1.00"

"DATE";"10-05-23"
"TIME";"12:35:48"

"FREQ";"1.0000E+03";"Hz"
"V";"1.000";"V"
"LIMIT";"OFF"
"RANGE";"30k";"Ω";"AUTO"
"LOW Z";"OFF"
"JUDGE";"OFF"
"SPEED";"MED"
"TRIG";"INT"
"AVE";"OFF"
"DELAY";"0.0000";"s"
```

### ■ When space

```
"HIOKI E.E. CORPORATION" "IM3570" "Ver. 1.00"

"DATE" "10-05-23"
"TIME" "12:35:55"

"FREQ" "1.0000E+03" "Hz"
"V" "1.000" "V"
"LIMIT" "OFF"
"RANGE" "30k" "Ω" "AUTO"
"LOW Z" "OFF"
"JUDGE" "OFF"
"SPEED" "MED"
"TRIG" "INT"
"AVE" "OFF"
"DELAY" "0.0000" "s"
"DCBIAS" "OFF"
```

**QUOTE** Quotation Mark Setting

Quotation Mark Setting

FILE ( USB )

LIST　　SET　　　　　10-05-23 15:04:25

SAVE SETUP

TYPE　　SAVE TO . . .

TEXT　AUTO US

QUOTE

OFF　　"　　　'

HEADER SETUP

EXIT

DATE　SET　PARA　DELIM

ON　　ON　　ON

EXIT

**1.** Select the quotation mark setting.

| OFF | No quotation marks are added. |

| " | Sets the quotation mark to a double quotation mark ("). |

| ' | Sets the quotation mark to a single quotation mark ('). |

**2.** Press **EXIT** to close the setting screen.

**When OFF**

```
HIOKI E.E. CORPORATION,IM3570,Ver. 1.00

DATE,10-05-23
TIME,12:36:04

FREQ,1.0000E+03,Hz
V,1.000,V
LIMIT,OFF
RANGE,30k,Ω,AUTO
LOW Z,OFF
JUDGE,OFF
SPEED,MED
TRIG,INT
AVE,OFF
DELAY,0.0000,s
```

**When double quotation mark**

```
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","12:35:08"

"FREQ","1.0000E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVE","OFF"
"DELAY","0.0000","s"
```

**When single quotation mark**

```
'HIOKI E.E. CORPORATION','IM3570','Ver. 1.00'

'DATE','10-05-23'
'TIME','12:36:11'

'FREQ','1.0000E+03','Hz'
'V','1.000','V'
'LIMIT','OFF'
'RANGE','30k','Ω','AUTO'
'LOW Z','OFF'
'JUDGE','OFF'
'SPEED','MED'
'TRIG','INT'
'AVE','OFF'
'DELAY','0.0000','s'
```

**Chapter 10 Using USB Flash Drive**

**10**

**6** Press EXIT .

**7**
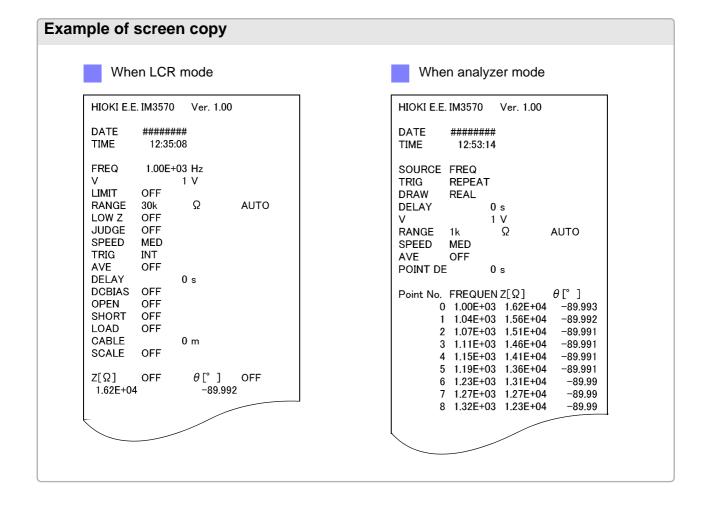


**Press** SAVE **in the measurement screen.**
The measurement data is saved.

When SAVE is pressed, a folder is automatically created in the USB flash drive and the file is saved.

- The date is used for the name of the folder created when you press SAVE .
- The date and time are automatically assigned to the file name.

**See** "Changing the Save Folder" (p. 344)

---

## Example of screen copy

### When LCR mode

```
HIOKI E.E. IM3570     Ver. 1.00

DATE      ########
TIME         12:35:08

FREQ       1.00E+03 Hz
V                  1 V
LIMIT     OFF
RANGE     30k      Ω          AUTO
LOW Z     OFF
JUDGE     OFF
SPEED     MED
TRIG      INT
AVE       OFF
DELAY            0 s
DCBIAS    OFF
OPEN      OFF
SHORT     OFF
LOAD      OFF
CABLE            0 m
SCALE     OFF

Z[Ω]      OFF        θ[°]     OFF
  1.62E+04                 −89.992
```

### When analyzer mode

```
HIOKI E.E. IM3570     Ver. 1.00

DATE      ########
TIME         12:53:14

SOURCE    FREQ
TRIG      REPEAT
DRAW      REAL
DELAY            0 s
V                1 V
RANGE     1k       Ω          AUTO
SPEED     MED
AVE       OFF
POINT DE         0 s

Point No.  FREQUEN Z[Ω]      θ[°]
      0  1.00E+03  1.62E+04   −89.993
      1  1.04E+03  1.56E+04   −89.992
      2  1.07E+03  1.51E+04   −89.991
      3  1.11E+03  1.46E+04   −89.991
      4  1.15E+03  1.41E+04   −89.991
      5  1.19E+03  1.36E+04   −89.991
      6  1.23E+03  1.31E+04    −89.99
      7  1.27E+03  1.27E+04    −89.99
      8  1.32E+03  1.23E+04    −89.99
```

## 2 Saving a Copy of the Screen

You can save the screen currently displayed to the USB flash drive in bmp file format (256-color or mono-chrome [2-color]). The file extension is bmp.

**Procedure**

**1** **Insert the USB flash drive into the USB port (front panel).**

**2**

| LCR Initial Screen | File Save Setting Screen |
|---|---|

**3** File Save Setting Screen

Press TYPE .

**4** File Type Setting
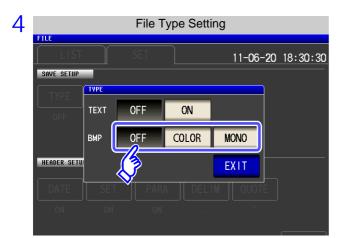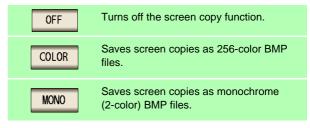
**Turn on the BMP save setting.**
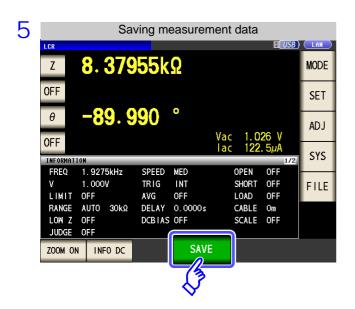
| OFF | Turns off the screen copy function. |
|---|---|
| COLOR | Saves screen copies as 256-color BMP files. |
| MONO | Saves screen copies as monochrome (2-color) BMP files. |

Press EXIT to close the setting screen.

## 10.4 Saving Measurement Data

**5** Saving measurement data
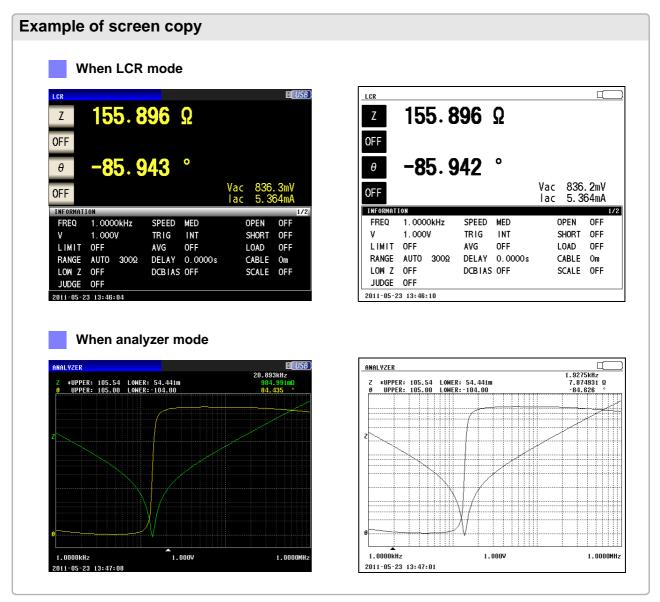


**Press** SAVE **in the [Measurement Screen].**

A copy of the screen is saved.

When SAVE is pressed, a folder is automatically created in the USB flash drive and the file is saved.

- The date is used for the name of the folder created when you press SAVE .
- The date and time are automatically assigned to the file name.

**See** "Changing the Save Folder" (p. 344)

---

### Example of screen copy

**When LCR mode**



**When analyzer mode**
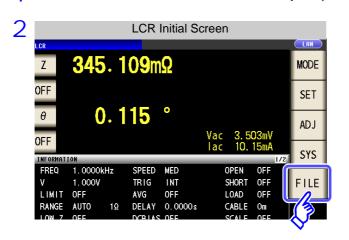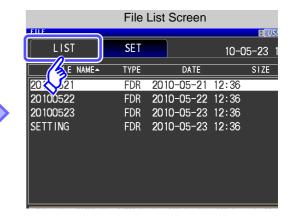
### 3  Checking the Contents of Files
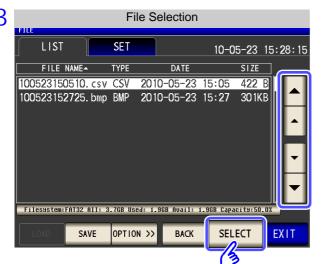
You can check files saved to a USB flash drive in text format ([TXT], [CSV]) and BMP format on the screen.

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen

| Z | 345.109mΩ | MODE |

345.109mΩ

0.115 °

Vac  3.503mV
Iac  10.15mA

INFORMATION                                    1/2
FREQ   1.0000kHz   SPEED  MED    OPEN   OFF
V      1.000V      TRIG   INT    SHORT  OFF
LIMIT  OFF         AVG    OFF    LOAD   OFF
RANGE  AUTO   1Ω   DELAY  0.0000s  CABLE  0m

MODE
SET
ADJ
SYS
FILE

File List Screen

LIST    SET         10-05-23

FILE NAME▲   TYPE    DATE          SIZE
20100521     FDR   2010-05-21  12:36
20100522     FDR   2010-05-22  12:36
20100523     FDR   2010-05-23  12:36
SETTING      FDR   2010-05-23  12:36

**3**

File Selection

LIST    SET         10-05-23  15:28:15

FILE NAME▲   TYPE    DATE          SIZE
100523150510.csv  CSV   2010-05-23  15:05   422 B
100523152725.bmp  BMP   2010-05-23  15:27   301KB

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

LOAD  SAVE  OPTION >>  BACK  SELECT  EXIT

Use ▲ or ▼ to select the file to check.

Press **SELECT** to check the file.

The indicated key varies depending on the type of the selected file.
- When **[FDR]**: SELECT
- When **[TXT]**, **[CSV]**, or **[BMP]**: VIEW

CSV File Display

File: 100523150510.csv
"HIOKI E.E. CORPORATION","IM3570","Ver. 1.00"

"DATE","10-05-23"
"TIME","15:05:10"

"FREQ","1.9275E+03","Hz"
"V","1.000","V"
"LIMIT","OFF"
"RANGE","30k","Ω ","AUTO"
"LOW Z","OFF"
"JUDGE","OFF"
"SPEED","MED"
"TRIG","INT"
"AVG","OFF"
"DELAY","0.0000","s"
"DCBIAS","OFF"
"OPEN","OFF"
"SHORT","OFF"
"LOAD","OFF"
"CABLE","0","m"

BMP File Display

ANALYZER                          69.183kHz
Z +UPPER: 650.00  LOWER:-73.500   34.89277 Ω
θ  UPPER: 105.00  LOWER:-106.00   -87.476 °

10.000kHz          1.000V

**4** Press **EXIT** to close the setting screen.

## 10.4 Saving Measurement Data
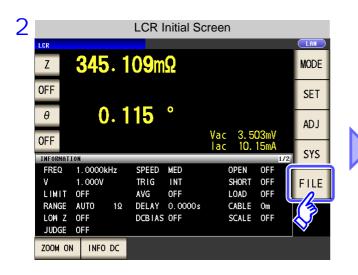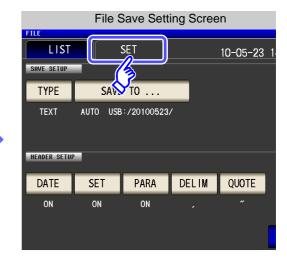
<div style="background:blue;">**4** Changing the Save Folder</div>

You can set the save destination for data automatically or set the desired folder.

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen

File Save Setting Screen

**3**

File Save Setting Screen

Press ⬚ SAVE TO ... .

**4**

Save Folder Setting
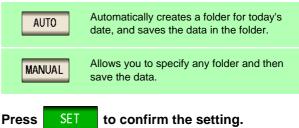
**Select the setting procedure of the save folder.**

| AUTO | Automatically creates a folder for today's date, and saves the data in the folder. |
|------|-----------------------------------------------------------------------------------|
| MANUAL | Allows you to specify any folder and then save the data. |

**Press** SET **to confirm the setting.**

**When you want to cancel the setting:**

Press CANCEL

**NOTE** The following restrictions apply to the folder that can be selected with MANUAL .
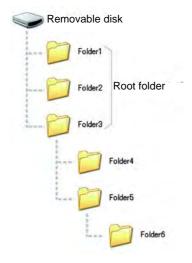
- The folder name must be all single-byte characters (a folder name containing Japanese or other double-byte characters cannot be specified).
- The folder name must be no more than 12 characters.

**5** Press EXIT to close the setting screen.

**NOTE**
- Only folders in the root directory of the USB flash drive can be selected with MANUAL .
- If the folder specified as the save destination folder has been deleted, create a folder when saving files.

**What is the root directory?**

The root directory refers to the top-most directory in the hierarchy of the USB flash drive.



Removable disk

Folder1
Folder2    Root folder
Folder3
Folder4
Folder5
Folder6

# 10.5 Loading Measurement Data

This section describes how to load analyzer measurement data saved to the instrument's USB memory and display it in graph form or use it to perform equivalent circuit analysis. Since this function only loads measured values, measurement conditions such as measurement parameters and sweep frequencies must be restored to the same conditions that were used when the loaded measurement data was acquired using panel save/load or similar functionality.

**See** "Chapter 9 Saving and Loading Panel Information" (p. 315)
"10.4 Saving Measurement Data" (p. 333)
"10.7 Reading Setting Conditions" (p. 353)

Parameters for loaded measurement data must be saved in the following format:
$Z$-$\theta$, Cs-D, Cs-Rs, Cp-D, Cp-Rp, Ls-Q, Ls-Rs, Lp-Q, Lp-Rp, Rs-X
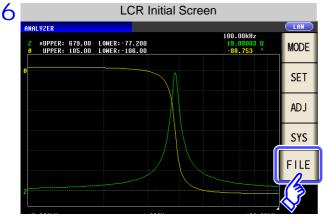
*NOTE*
- This functionality can only be used when the IM9000 Equivalent Circuit Analysis Software has been installed.
- Steps 1 through 4 below can be set by loading measurement conditions saved to the instrument or its USB memory.

  **See:** "9.2 Loading Measurement Conditions (Panel Load Function)" (p. 322)
  "10.7 Reading Setting Conditions" (p. 353)

**Procedure**
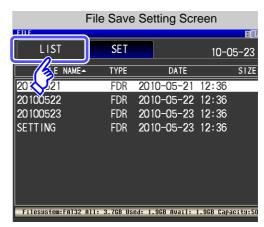
**1** **Change the measurement mode to analyzer mode.**
**See** "1.3.2 Measurement Mode Selection Screen" (p. 13)

**2** **Set the measurement parameters to the same parameters that were used when the loaded measurement data was acquired.**

**3** **Set the trigger mode to sequential sweep or step sweep.**
**See** "5.2.3 Setting the Trigger" (p. 137)

**4** **Set the sweep frequency, number of sweep points, and other settings to the same conditions that were used when the loaded measurement data was acquired.**

**5** **Insert the USB memory stick into the USB connector (on the front of the instrument).**

**6**


LCR Initial Screen

File Save Setting Screen

**7** Folder Selection

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20100521 | FDR | 2010-05-23 12:36 | |
| 20100522 | FDR | 2010-05-23 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |

LIST  SET  10-05-23 15:09:36

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

LOAD  SAVE  OPTION >>  BACK  SELECT  EXIT

**Select the folder in which the measurement data was saved with ▲ and ▼.**

**Press SELECT.**

**8** Measurement Data Selection

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 100523123633.csv | CSV | 2010-05-23 12:36 | 8.9KB |

LIST  SET  10-05-23 15:19:05

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

LOAD  SAVE  OPTION >>  BACK  VIEW  EXIT

**Select the measurement data to load with ▲ and ▼.**

**Press LOAD.**

**9** Loading Measurement Data

LIST  SET  10-05-23 15:19:27

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 100523123633.csv | CSV | 2010-05-23 12:36 | 8.9KB |

LOAD
Load Analyzer Data
100523123633.csv
CANCEL  LOAD

**Press LOAD on the load confirmation screen. The measurement data will be loaded and applied as measured values.**

**When you want to cancel the load operation:** Press CANCEL.

Chapter 10 Using USB Flash Drive

**10**

## When a loading error is displayed

```
Measurement Data Loading Error
FILE                                    USB
LIST        SET              10-05-23 15:20:29
FILE NAME▲    TYPE      DATE         SIZE
100523123633.csv CSV  2010-05-23 12:36  8.9KB
LOAD
Load Error.(4)
CANCEL        LOAD
Filesystem:FAT32 All: 3.7GB Used: 1.8GB Avail: 1.8GB Capacity:50.0%
LOAD  SAVE  OPTION >>  BACK  VIEW  EXIT
```

If an error is displayed after you press **LOAD**, you may be experiencing one of the issues listed below.

| Symptom | Check Item, or Cause | Solution/reference |
|---|---|---|
| **Load Error.(1)** | The instrument is not in analyzer mode. | Load measurement data after changing to analyzer mode.<br>See "1.3.2 Measurement Mode Selection Screen" (p. 13) |
| **Load Error.(2)** | The trigger settings in analyzer mode have been set to repeat sweep. | Load the measurement data after setting the trigger settings to sequential sweep or step sweep.<br>See "5.2.3 Setting the Trigger" (p. 137) |
| **Load Error.(3)** | The measurement data file is corrupt. | Load a file that is not corrupt. |
| **Load Error.(4)** | There is no measurement data that can be loaded by the instrument. | Load analyzer data that was saved by the instrument. |
| **Load Error.(5)** | The measurement signal setting is not set to frequency sweep. | Load measurement data after setting the sweep parameter to frequency sweep.<br>See "5.2.2 Setting the Sweep Parameter" (p. 135) |
| **Load Error.(6)** | Measurement data has been saved in a parameter format that cannot be loaded. | Verify that the measured values being loaded are the following parameters:<br>Z-θ, Cs-D, Cs-Rs, Cp-D, Cp-Rp, Ls-Q, Ls-Rs, Lp-Q, Lp-Rp, Rs-X |
| **Load Error.(7)** | The measurement data parameters do not match the current settings. | Load measurement data after configuring the instrument's parameters so that they match the parameters of the measured values being loaded.<br>See "5.2.1 Setting the measurement parameter" (p. 133) |
| **Load Error.(8)** | The measurement data includes erroneous values.<br>Example: No measurement after power supply activation: 8888888E+28<br>Overflow: 9999999E+28 | Load measured values that do not contain erroneous values.<br>See Description of communications commands on the included CD (:MEASure?) |
| **Load Error.(9)** | Parameter information was not saved with the measurement data. | Load measurement data that includes measurement parameter information.<br>See "10.4 Saving Measurement Data" (p. 333) |
| **Load Error.(10)** | The number of sweep points in the measurement data does not match the current setting. | Load measurement data after configuring the settings so that the number of measurement points with which the instrument has been configured matches the number of points in the measured values being loaded.<br>See "5.3.1 Setting Sweep Points" (p. 143) |

# 10.6 Saving Instrument Settings

## 1 Saving Instrument Settings

Save various setting information of the instrument as a setting file to the USB flash drive.
The extension of the setting file is ".SET." This function is convenient for when you want to back up the setting state of the instrument.
For the settings that are saved, refer to "Initial Setting List."
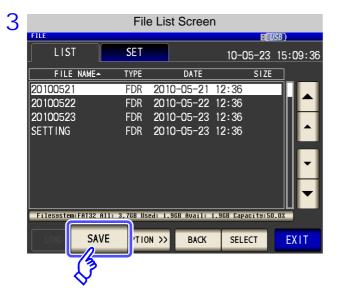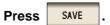
**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen

File List Screen

**3**

File List Screen

**Press** [SAVE].

## 10.6 Saving Instrument Settings

**4**



**Press** [SAVE] **in the save confirmation screen.**
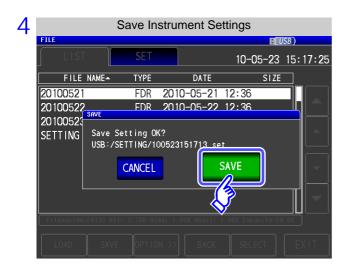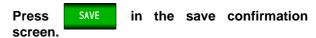
The measurement data is saved.

- The setting file is saved to the **[SETTING]** folder in the USB flash drive.
- The date and time are automatically assigned to the file name.

**When you want to cancel saving:**

Press [CANCEL] .

**2** Saving All Settings of Instrument (ALL SAVE Function)
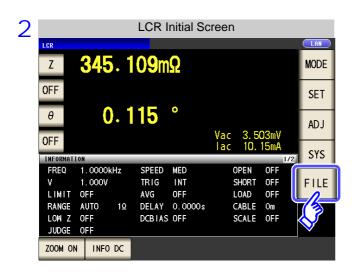
Save various setting information of the instrument including the panel save information as a setting file to the USB flash drive.
The extension of the setting file is ".SET." The extension of the panel save is ".PNL."
For the settings that are saved, refer to "Appendix 12 Initial Settings Table" (p. A17).
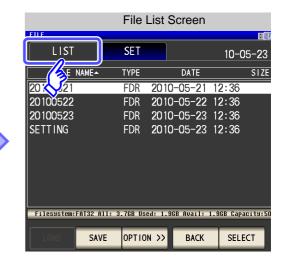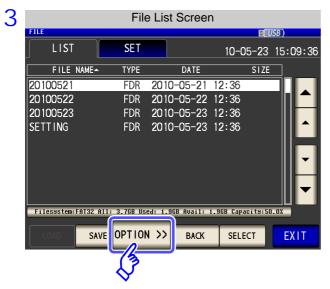
**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2** LCR Initial Screen

FREQ    1.0000kHz    SPEED    MED    OPEN    OFF
V       1.000V       TRIG     INT    SHORT   OFF
LIMIT   OFF          AVG      OFF    LOAD    OFF
RANGE   AUTO    1Ω   DELAY    0.0000s CABLE  0m
LOW Z   OFF          DCBIAS   OFF    SCALE   OFF
JUDGE   OFF

File List Screen

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20100521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |
| SETTING | FDR | 2010-05-23 12:36 | |

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50

**3** File List Screen

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20100521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |
| SETTING | FDR | 2010-05-23 12:36 | |

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

Press OPTION >> .

**Chapter 10 Using USB Flash Drive**

**10**

**4**

File List Screen

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20100521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |
| SETTING | FDR | 2010-05-23 12:36 | |

LIST    SET    10-05-23 16:07:13

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

<< OPTION   FORMAT   DELETE   FOLDER   ALL SAVE   EXIT

**Press** ALL SAVE .

**5**

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20100521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | | | |
| SETTING | | | |

LIST    SET    10-05-23 15:39:48

ALL SAVE
Save All Setting OK?
USB:/SETTING/100523153943/

CANCEL    SAVE

<< OPTION   FORMAT   DELETE   FOLDER   ALL SAVE   EXIT

**Press** SAVE **in the save confirmation screen.**

The measurement data is saved.

- The setting file and panel save data are saved to a folder of the save date and time that is created automatically in the **[SETTING]** folder.
- The date and time are automatically assigned to the folder name and file name.

**When you want to cancel saving:**

Press CANCEL .
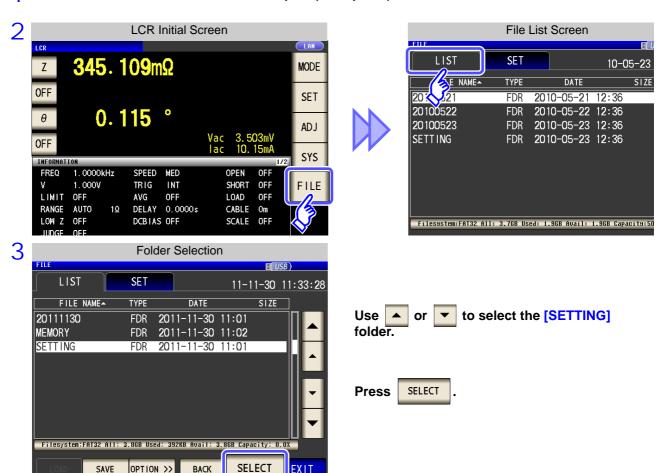
# 10.7 Reading Setting Conditions

## 1 Loading instrument settings

Read a setting file or panel save file that is saved to the USB flash drive, and restore the settings.

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen

| Z | 345.109mΩ | | MODE |
| OFF | | | SET |
| θ | 0.115 ° | | ADJ |
| OFF | | Vac 3.503mV | SYS |
| | | Iac 10.15mA | |

INFORMATION 1/2
FREQ 1.0000kHz SPEED MED OPEN OFF
V 1.000V TRIG INT SHORT OFF
LIMIT OFF AVG OFF LOAD OFF
RANGE AUTO 1Ω DELAY 0.0000s CABLE 0m
LOW Z OFF DCBIAS OFF SCALE OFF
JUDGE OFF

FILE

File List Screen

| LIST | SET | 10-05-23 |

| FILE NAME▲ | TYPE | DATE | SIZE |
| 20100521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |
| SETTING | FDR | 2010-05-23 12:36 | |

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50

**3**

Folder Selection

| LIST | SET | 11-11-30 11:33:28 |

| FILE NAME▲ | TYPE | DATE | SIZE |
| 20111130 | FDR | 2011-11-30 11:01 | |
| MEMORY | FDR | 2011-11-30 11:02 | |
| SETTING | FDR | 2011-11-30 11:01 | |

Filesystem:FAT32 All: 3.8GB Used: 392KB Avail: 3.8GB Capacity: 0.0%

LOAD SAVE OPTION >> BACK SELECT EXIT

Use ▲ or ▼ to select the [SETTING] folder.

Press SELECT .

**4**

Setting File Selection

| LIST | SET | 10-05-23 15:19:05 |

| FILE NAME▲ | TYPE | DATE | SIZE |
| 100523123633.set | SET | 2010-05-23 12:36 34.4KB | |

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

LOAD SAVE OPTION >> BACK VIEW EXIT

Use ▲ or ▼ to select the setting file or panel save file to read.

Press LOAD .

**Chapter 10 Using USB Flash Drive**

**10**

**5**

Read Settings

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 100523123633.set | SET | 2010-05-23 12:36 | 34.4KB |

LOAD

Load Setting
100523123633.set

CANCEL    LOAD

**Press** LOAD **in the read confirmation screen.**
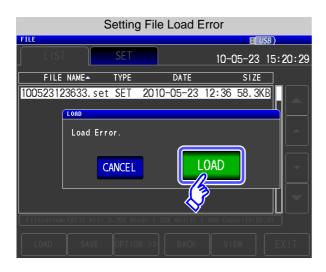
The measurement data is read, and reflected as the current settings.

**When you want to cancel reading:**

Press CANCEL .

## When the Read Confirmation Screen Appears

Setting File Load Error

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 100523123633.set | SET | 2010-05-23 12:36 | 58.3KB |

LOAD

Load Error.

CANCEL    LOAD

If an error appears when LOAD is pressed, one of the following are likely to be cause.

• The setting file is damaged.

• The file is not a setting file that can be read by the instrument.

**When you want to cancel reading:**

Press CANCEL .

**2** **Loading all settings saved on a USB flash drive (ALL LOAD Function)**
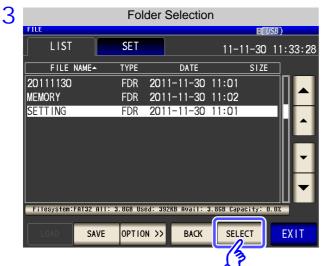
Load and restore instrument settings, including panels saved to USB memory using the all save function.
See "Saving All Settings of Instrument (ALL SAVE Function)" (p. 351)

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Measurement Screen

| | |
|---|---|
| Z | 345.109mΩ |
| OFF | |
| θ | 0.115 ° |
| OFF | Vac  3.503mV |
| | Iac  10.15mA |

INFORMATION 1/2

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
|---|---|---|---|---|---|
| V | 1.000V | TRIG | INT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO 1Ω | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |
| JUDGE | OFF | | | | |

ZOOM ON   INFO DC

MODE / SET / ADJ / SYS / **FILE**

File List Screen

FILE

**LIST**   SET   10-05-23

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 2010521 | FDR | 2010-05-21 12:36 | |
| 20100522 | FDR | 2010-05-22 12:36 | |
| 20100523 | FDR | 2010-05-23 12:36 | |
| SETTING | FDR | 2010-05-23 12:36 | |

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50

LOAD   SAVE   OPTION >>   BACK   SELECT

**3**

Folder Selection

FILE   USB

LIST   **SET**   11-11-30 11:33:28

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 20111130 | FDR | 2011-11-30 11:01 | |
| MEMORY | FDR | 2011-11-30 11:02 | |
| SETTING | FDR | 2011-11-30 11:01 | |

Filesystem:FAT32 All: 3.8GB Used: 392KB Avail: 3.8GB Capacity: 0.0%

LOAD   SAVE   OPTION >>   BACK   **SELECT**   EXIT

Use ▲ or ▼ to select the **[SETTING]** folder.

Press **SELECT** .

**4**    Folder Selection

FILE                                    USB
LIST    SET            11-11-30 11:35:01

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 111130110313 | FDR | 2011-11-30 11:03 | |

Filesystem:FAT32 All:15.1GB Used: 512KB Avail:15.1GB Capacity: 0.0%

LOAD | SAVE | OPTION >> | BACK | SELECT | EXIT

**Using the** ▲ **and** ▼ **buttons, select the folder to which settings were saved with the all save function.**

**5**    Setting File Selection

FILE                                    USB
LIST    SET            11-11-30 11:35:41

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 001_1112141522.. | PNL | 2011-11-30 11:03 | 3.2KB |
| 002_1112141522.. | PNL | 2011-11-30 11:03 | 3.2KB |
| 003_1112141522.. | PNL | 2011-11-30 11:03 | 2.1KB |
| 005_1112141523.. | PNL | 2011-11-30 11:03 | 1.2KB |
| 006_1112141523.. | PNL | 2011-11-30 11:03 | 1.2KB |
| 007_1112141524 | PNL | 2011-11-30 11:03 | 3.2KB |
| 111130110313.all | ALL | 2011-11-30 11:03 | 3.3KB |
| 111130110313.set | SET | 2011-11-30 11:03 | 35.7KB |

Filesystem:FAT32 All:15.1GB Used: 512KB Avail:15.1GB Capacity: 0.0%

ALL LOAD | SAVE | OPTION >> | BACK | VIEW | EXIT

**Using the** ▲ **and** ▼ **buttons, set [TYPE] to [ALL] files.**

**Press** ALL LOAD .

**6**    Read Settings

FILE                                    USB
LIST    SET            11-11-30 11:36:13

| FILE NAME▲ | TYPE | DATE | SIZE |
|---|---|---|---|
| 001_1112141522.. | PNL | 2011-11-30 11:03 | 3.2KB |
| 002_1112141522 | PNL | 2011-11-30 11:03 | 3.2KB |
| 003_1112 | | | |
| 005_1112 | | | |
| 006_1112 | | | |
| 007_1112 | | | |
| 1113011 | | | |
| 111130110313.set | SET | 2011-11-30 11:03 | 35.7KB |

LOAD
Load Setting
111130110313.all
CANCEL    LOAD

Filesystem:FAT32 All:15.1GB Used: 512KB Avail:15.1GB Capacity: 0.0%

ALL LOAD | SAVE | OPTION >> | BACK | VIEW | EXIT

**Press** LOAD **in the read confirmation screen.**

All measurement data saved in the folder will be loaded and applied to the current settings.

**When you want to cancel reading:**

Press CANCEL .

NOTE • Selecting [LOAD] will cause the instrument's current settings to be deleted.
• If the instrument is unable to load the settings file, a beep will sound.

# 10.8 File and Folder Operations

You can edit files and folders saved to the USB flash drive.

## 1 Formatting a USB Flash Drive

Perform this operation if the USB flash drive to be used is not formatted (initialized). Insert the USB flash drive to be formatted into the USB port (on the front panel) (p. 330) and start the format.
The IM3570 formats drives using FAT32.

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen



File List Screen



**3**

File List Screen



Press OPTION >> .

**4**



Press FORMAT .

**5**

Format USB Flash Drive



A confirmation screen appears.

Press FORMAT .

**When you want to cancel the format:**

Press CANCEL .

Formatting



No operation is possible during formatting.

When formatting ends, the file list screen is redisplayed.

**NOTE**
- When you perform a format, all of the data saved to the USB flash drive is deleted and cannot be restored. Carefully check the contents before you perform a format.
- We recommend making a backup of any important data on a USB flash drive.
- When formatting is performed with the instrument, the volume label of the USB flash drive becomes **[NO NAME]**.

**What is a Volume Label?**

A name that is assigned to a drive such as a USB flash drive.
In Windows, you can check the volume label of each drive in My Computer.
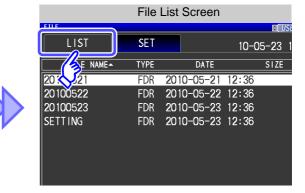
## 2   Deleting Files and Folders

You can delete a file or folder saved to the USB flash drive.

**Procedure**

**1**   **Insert the USB flash drive into the USB port (front panel).**

**2**

| LCR Initial Screen | File List Screen |
|---|---|

LCR Initial Screen:
Z  OFF
345.109mΩ
θ  OFF
0.115 °
Vac  3.503mV
Iac  10.15mA

INFORMATION 1/2
FREQ 1.0000kHz  SPEED MED  OPEN OFF
V 1.000V  TRIG INT  SHORT OFF
LIMIT OFF  AVG OFF  LOAD OFF

MODE
SET
ADJ
SYS
FILE

File List Screen:
FILE
LIST  SET  10-05-23
FILE NAME▲  TYPE  DATE  SIZE
20100521  FDR  2010-05-21 12:36
20100522  FDR  2010-05-22 12:36
20100523  FDR  2010-05-23 12:36
SETTING  FDR  2010-05-23 12:36

**3**   File List Screen

FILE
LIST  SET  10-05-23 15:09:36
FILE NAME▲  TYPE  DATE  SIZE
20100521  FDR  2010-05-21 12:36
20100522  FDR  2010-05-22 12:36
20100523  FDR  2010-05-23 12:36
SETTING  FDR  2010-05-23 12:36

Filesystem:FAT32 All: 3.7GB Used: 1.9GB Avail: 1.9GB Capacity:50.0%

LOAD  SAVE  OPTION >>  BACK  SELECT  EXIT

Use ▲ or ▼ to select the file or folder you want to delete.

Press OPTION >> .

**4**   Delete File

FILE
LIST  SET  10-05-23 15:26:35
FILE NAME▲  TYPE  DATE  SIZE
100523150510.csv CSV  2010-05-23 15:05  422 B

DELETE
Delete the file  100523150510.csv
CANCEL  DELETE

A deleted file or folder cannot be restored once it is deleted.

Confirm the file or folder to be deleted, and then press DELETE

**When you want to cancel deletion:**

Press CANCEL .

**NOTE**

If the folder to be deleted contains a file, it cannot be deleted. To delete the folder, delete all of the files in the folder.
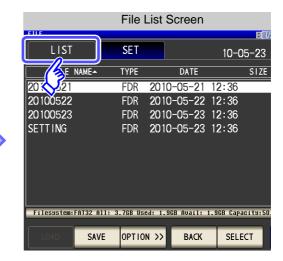
**3** Creating Folders

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen



File List Screen



**3**

File List Screen



Press OPTION >> .

**4**

File List Screen



Press FOLDER .

**5**

Input Folder Name

CREATE FOLDER
Please input NEW FOLDER name.

MYCT

| CLEAR | BS |

| A | B | C | D | E | F | G | 7 | 8 | 9 |
| H | I | J | K | L | M | N | 4 | 5 | 6 |
| O | P | Q | R | S | T | U | 1 | 2 | 3 |
| V | W | X | Y | Z | _ | | 0 | + | − |

KEY TYPE    CANCEL    CREATE FOLDER

⟷

Input Folder Name

CREATE FOLDER
Please input NEW FOLDER name.

MYCT

| CLEAR | BS |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| Q | W | E | R | T | Y | U | I | O | P |
| A | S | D | F | G | H | J | K | L | + |
| Z | X | C | V | B | N | M | _ | − |

KEY TYPE    CANCEL    CREATE FOLDER

Enter the save name. (Up to 12 characters)

| CLEAR | Deletes all input characters. |
| BS | Deletes the last character. |
| KEY TYPE | Changes the keyboard type. |

**6**

Input Folder Name

CREATE FOLDER
Please input NEW FOLDER name.

MYCT

| CLEAR | BS |

| A | B | C | D | E | F | G | 7 | 8 | 9 |
| H | I | J | K | L | M | N | 4 | 5 | 6 |
| O | P | Q | R | S | T | U | 1 | 2 | 3 |
| V | W | X | Y | Z | _ | | 0 | + | − |

KEY TYPE    CANCEL    CREATE FOLDER

**Press** CREATE FOLDER **to create a folder.**

**7** **Press** EXIT **to close the setting screen.**

Chapter 10 Using USB Flash Drive

**10**
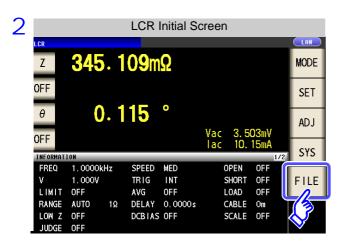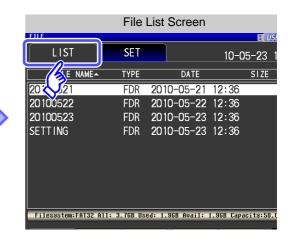
### 4 Displaying the USB Flash Drive Information
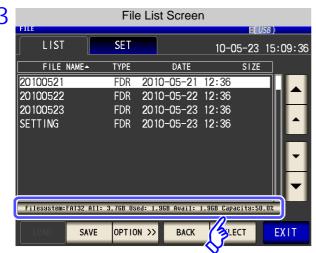
You can check the usage rate and file system of the USB flash drive.

**Procedure**

**1** Insert the USB flash drive into the USB port (front panel).

**2**

LCR Initial Screen

File List Screen

**3**

File List Screen

Press the part indicating the disc information.

**4**

USB Flash Drive Info Display

**[Filesystem]**: File system type
**[All]**: Total size
**[Used]**: Space used
**[Avail]**: Space free

**5** Press **EXIT** to close the setting screen.

# External Control Chapter 11

The EXT I/O connector on the rear of the instrument supports external control by providing output of the end-of-measurement and comparator decision signals, and accepting input of measurement
trigger and panel load signals. All signals are isolated by optocouplers (inputs and outputs share a common signal ground (ISO_COM signal ground).)

Confirm input and output ratings, understand the safety precautions for connecting a control system, and use accordingly.

| **Connect the instrument's EXT I/O connector to the signal output or input device.** | **Make instrument settings** | |
|---|---|---|

**Signal input/output**

## 11.1 External Input/Output Connector and Signals ⚠

⚠ **WARNING** **To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to the EXT I/O terminals.**
- **Always turn off the power to the instrument and to any devices to be connected before making connections.**
- **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Make sure that connections are secure and use screws to secure the external connectors.**
- **Ensure that devices and systems to be connected to the EXT I/O terminals/ are properly isolated.**
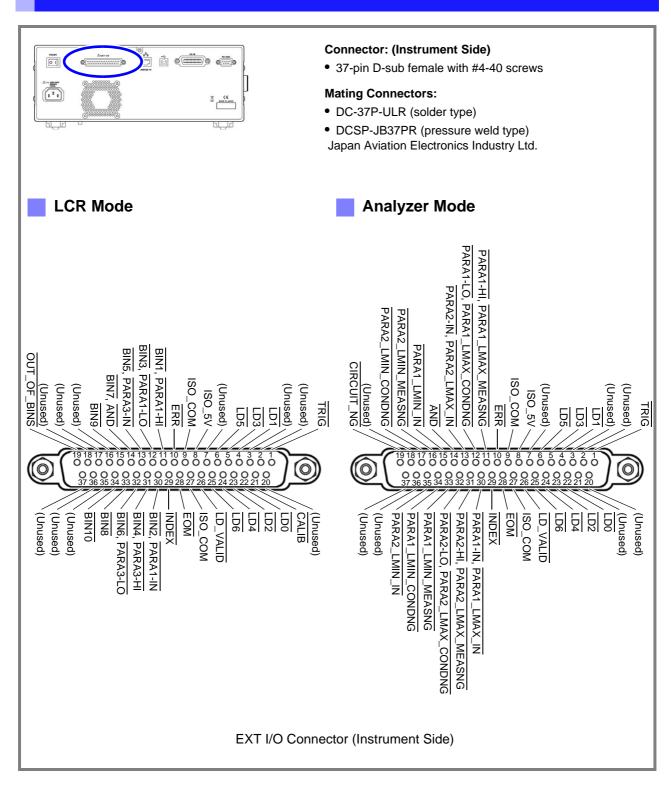
⚠ **CAUTION** To avoid damage to the instrument, observe the following cautions:
- Do not apply voltage or current to the EXT I/O terminals that exceeds their ratings.
- When driving relays, be sure to install diodes to absorb counter-electromotive force.
- Be careful not to short-circuit ISO_5V to ISO_COM.

**See** "Connector Type and Signal Pinouts" (p. 364)

Chapter 11 External Control

**11**

## Connector Type and Signal Pinouts

**Connector: (Instrument Side)**
- 37-pin D-sub female with #4-40 screws

**Mating Connectors:**
- DC-37P-ULR (solder type)
- DCSP-JB37PR (pressure weld type)

Japan Aviation Electronics Industry Ltd.

### LCR Mode

Top row (pins 19–1):
OUT_OF_BINS, (Unused), (Unused), (Unused), BIN9, BIN7, AND, BIN5, PARA3-IN, BIN3, PARA1-LO, BIN1, PARA1-HI, ERR, ISO_COM, ISO_5V, (Unused), LD5, LD3, LD1, (Unused), TRIG

Bottom row (pins 37–20):
(Unused), (Unused), (Unused), BIN10, BIN8, BIN6, PARA3-LO, BIN4, PARA3-HI, BIN2, PARA1-IN, INDEX, EOM, ISO_COM, LD_VALID, LD6, LD4, LD2, LD0, CALIB, (Unused)

### Analyzer Mode

Top row (pins 19–1):
CIRCUIT_NG, (Unused), PARA2_LMIN_CONDNG, PARA2_LMIN_MEASNG, PARA1_LMIN_IN, AND, PARA1_LMIN_MEASNG, PARA2-IN, PARA2_LMAX_IN, PARA2-IN, PARA1_LMAX_CONDNG, PARA1-LO, PARA1_LMAX_MEASNG, PARA1-HI, ERR, ISO_COM, ISO_5V, (Unused), LD5, LD3, LD1, (Unused), TRIG

Bottom row (pins 37–20):
(Unused), (Unused), PARA2_LMIN_IN, PARA1_LMIN_CONDNG, PARA1_LMIN_MEASNG, PARA2_LMAX_CONDNG, PARA2-HI, PARA2_LMAX_MEASNG, PARA2-LO, PARA1_LMAX_IN, PARA1-IN, INDEX, EOM, ISO_COM, LD_VALID, LD6, LD4, LD2, LD0, (Unused)

EXT I/O Connector (Instrument Side)

---

**NOTE**

The connector shell is conductively connected to the metal instrument chassis and the protective earth pin of the power plug. Be aware that it is not isolated from ground.

| Pin | I/O | LCR Mode | | ANALYZER Mode | | Logic | |
|---|---|---|---|---|---|---|---|
| | | Signal name | Function | Signal name | Function | | |
| 1 | IN | $\overline{\text{TRIG}}$ | External trigger | $\overline{\text{TRIG}}$ | External trigger | Pos | Edge |
| 2 | - | (Unused) | - | (Unused) | - | - | - |
| 3 | - | (Unused) | - | (Unused) | - | - | - |
| 4 | IN | $\overline{\text{LD1}}$ | Select panel number | $\overline{\text{LD1}}$ | Select panel number | Neg | Level |
| 5 | IN | $\overline{\text{LD3}}$ | Select panel number | $\overline{\text{LD3}}$ | Select panel number | Neg | Level |
| 6 | IN | $\overline{\text{LD5}}$ | Select panel number | $\overline{\text{LD5}}$ | Select panel number | Neg | Level |
| 7 | - | (Unused) | - | (Unused) | - | - | - |
| 8 | - | ISO_5V | Isolated 5 V power output | ISO_5V | Isolated 5 V power output | - | - |
| 9 | - | ISO_COM | Isolated common signal ground | ISO_COM | Isolated common signal ground | - | - |
| 10 | OUT | $\overline{\text{ERR}}$ | Measurement fault | $\overline{\text{ERR}}$ | Measurement fault | Neg | Level |
| 11 | OUT | $\overline{\text{BIN1}}$, $\overline{\text{PARA1-HI}}$ | BIN judgment results Comparator judgment results of the first parameter | $\overline{\text{PARA1-HI}}$, $\overline{\text{PARA1\_LMAX\_MEASNG}}$ | Analyzer comparator results of the first parameter in AREA mode (Output if even one HI judgment) Analyzer comparator results for the local maximum value of the first parameter in PEAK mode (Output if the vertical axis (measurement value) is out of the range or there is no comparison peak) | Neg | Level |
| 12 | OUT | $\overline{\text{BIN3}}$, $\overline{\text{PARA1-LO}}$ | BIN judgment results Comparator judgment results of the first parameter | $\overline{\text{PARA1-LO}}$, $\overline{\text{PARA1\_LMAX\_CONDNG}}$ | Analyzer comparator results of the first parameter in AREA mode (Output if even one LO judgment) Analyzer comparator results for the local maximum value of the first parameter in PEAK mode (Output if the horizontal axis (sweep setting) is out of the range or there is no comparison peak) | Neg | Level |
| 13 | OUT | $\overline{\text{BIN5}}$, $\overline{\text{PARA3-IN}}$ | BIN judgment results Comparator judgment results of the third parameter | $\overline{\text{PARA2-IN}}$, $\overline{\text{PARA2\_LMAX\_IN}}$ | Analyzer comparator results of the second parameter in AREA mode (Output if all judgment results are IN) Analyzer comparator results for the local maximum value of the second parameter in PEAK mode (Output if PEAK is IN) | Neg | Level |
| 14 | OUT | $\overline{\text{BIN7}}$, $\overline{\text{AND}}$ | BIN judgment results Comparator judgment results AND | $\overline{\text{AND}}$ | Comparator judgment result AND | Neg | Level |
| 15 | OUT | $\overline{\text{BIN9}}$ | BIN judgment results | $\overline{\text{PARA1\_LMIN\_IN}}$ | Analyzer comparator results for the local minimum value of the first parameter in PEAK mode (Output if PEAK is IN) | Neg | Level |
| 16 | OUT | (Unused) | - | $\overline{\text{PARA2\_LMIN\_MEASNG}}$ | Analyzer comparator results for the local minimum value of the second parameter in PEAK mode (Output if the vertical axis (measurement value) is out of the range or there is no comparison peak) | Neg | Level |
| 17 | OUT | (Unused) | - | $\overline{\text{PARA2\_LMIN\_CONDNG}}$ | Analyzer comparator results for the local minimum value of the second parameter in PEAK mode (Output if the horizontal axis (sweep setting) is out of the range or there is no comparison peak) | Neg | Level |

**Chapter 11 External Control**

**11**

## 11.1 External Input/Output Connector and Signals

| Pin | I/O | LCR Mode | | ANALYZER Mode | | Logic | |
|-----|-----|----------|---|--------------|---|-------|---|
| | | Signal name | Function | Signal name | Function | | |
| 19 | OUT | OUT_OF_BINS | BIN judgment results | CIRCUIT_NG | Equivalent circuit analysis comparator judgment result output (output when logical AND of judgment results is FAIL) | Neg | Level |
| 20 | - | (Unused) | - | (Unused) | - | - | - |
| 21 | IN | CALIB | DC adjustment request | (Unused) | - | Neg | Level |
| 22 | IN | LD0 | Select panel number | LD0 | Select panel number | Neg | Level |
| 23 | IN | LD2 | Select panel number | LD2 | Select panel number | Neg | Level |
| 24 | IN | LD4 | Select panel number | LD4 | Select panel number | Neg | Level |
| 25 | IN | LD6 | Select panel number | LD6 | Select panel number | Neg | Level |
| 26 | IN | LD_VALID | Execute panel load | LD_VALID | Execute panel load | Neg | Level |
| 27 | - | ISO_COM | Isolated common signal ground | ISO_COM | Isolated common signal ground | - | - |
| 28 | OUT | EOM | End of measurement | EOM | End of measurement | Neg | Edge |
| 29 | OUT | INDEX | Analog measurement finished | INDEX | Analog measurement finished | Neg | Edge |
| 30 | OUT | BIN2, PARA1-IN | BIN judgment results Comparator judgment results of the first parameter | PARA1-IN, PARA1_LMAX_IN | Analyzer comparator results of the first parameter in AREA mode (Output if all judgment results are IN) Analyzer comparator results for the local maximum value of the first parameter in PEAK mode (Output if PEAK is IN) | Neg | Level |
| 31 | OUT | BIN4, PARA3-HI | BIN judgment results Comparator judgment results of the third parameter | PARA2-HI, PARA2_LMAX_MEASNG | Analyzer comparator results of the second parameter in AREA mode (Output if even one HI judgment) Analyzer comparator results for the local maximum value of the second parameter in PEAK mode (Output if the vertical axis (measurement value) is out of the range or there is no comparison peak) | Neg | Level |
| 32 | OUT | BIN6, PARA3-LO | BIN judgment results Comparator judgment results of the third parameter | PARA2-LO, PARA2_LMAX_CONDNG | Analyzer comparator results of the second parameter in AREA mode (Output if even one LO judgment) Analyzer comparator results for the local maximum value of the second parameter in PEAK mode (Output if the horizontal axis (sweep setting) is out of the range or there is no comparison peak) | Neg | Level |
| 33 | OUT | BIN8 | BIN judgment results | PARA1_LMIN_MEASNG | Analyzer comparator results for the local minimum value of the first parameter in PEAK mode (Output if the vertical axis (measurement value) is out of the range or there is no comparison peak) | Neg | Level |
| 34 | OUT | BIN10 | BIN judgment results | PARA1_LMIN_CONDNG | Analyzer comparator results for the local minimum value of the first parameter in PEAK mode (Output if the horizontal axis (sweep setting) is out of the range or there is no comparison peak) | Neg | Level |
| 35 | OUT | (Unused) | - | PARA2_LMIN_IN | Analyzer comparator results for the local minimum value of the second parameter in PEAK mode (Output if PEAK is IN) | Neg | Level |
| 36 | | (Unused) | | (Unused) | | | |

## Signal Descriptions

You can select rising or falling for the valid edge of a trigger.
**See** "Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input" (p. 117), (p. 228)

### Input

| $\overline{\text{TRIG}}$ | • When the trigger setting is the external trigger  EXT , measurement is performed once with the falling (ON) or rising (OFF) edge of the TRIG signal. The edge direction can be set in the setting screen. (Initial value: Falling (ON))<br>**See:** "Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input" (p. 117), (p. 228)<br>• When the trigger source is set to the internal trigger  INT , trigger measurement is not performed.<br>• You can set whether to enable or disable TRIG signal input during measurement (during output of the EOM signal (HI)).<br>**See:** "Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input" (p. 117), (p. 228) |
|---|---|

$\overline{\text{LD0}}$ to $\overline{\text{LD6}}$

Selects the number of the panel to load.
If a trigger signal is input in external trigger mode, the selected panel is loaded and used for measurement.(p. 377)

0: (HIGH: 5 V to 24 V), 1: (LOW: 0 V to 0.9 V)

| PIN No. | $\overline{\text{LD6}}$ | $\overline{\text{LD5}}$ | $\overline{\text{LD4}}$ | $\overline{\text{LD3}}$ | $\overline{\text{LD2}}$ | $\overline{\text{LD1}}$ | $\overline{\text{LD0}}$ |
|---|---|---|---|---|---|---|---|
| Panel 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Panel 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Panel 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Panel 8 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Panel 16 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Panel 32 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Panel 64 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Panel 127 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Panel128 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| $\overline{\text{LD-VALID}}$ | Inputs a negative logic signal from an external device so that the selected panel number is recognized as valid.<br>After $\overline{\text{TRIG}}$ input, maintain a Low level until $\overline{\text{INDEX}}$ is outputted. |
|---|---|
| $\overline{\text{CALIB}}$ | When the DC adjustment function for during DC resistance measurement is set to OFF, the offset value generated in the internal circuit can be obtained at the desired timing.<br>After $\overline{\text{TRIG}}$ input, maintain a Low level until $\overline{\text{INDEX}}$ is outputted. |

**Chapter 11 External Control**

**11**

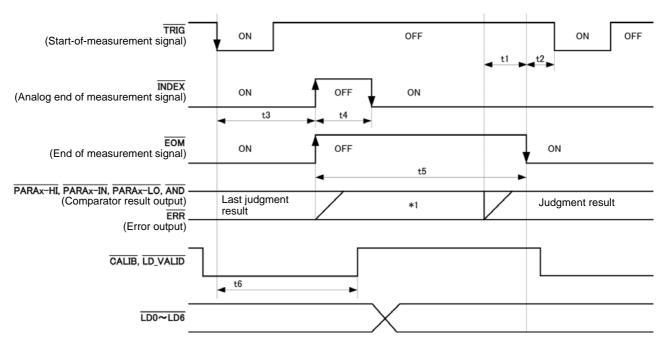### Output

| | |
|---|---|
| PARA1-HI, PARA1-LO, PARA1-IN | LCR mode: Outputs the comparator judgment result for the measurement values of the first parameter.<br>Analyzer mode: Outputs the analyzer comparator result of the first parameter in AREA mode. |
| PARA3-HI, PARA3-LO, PARA3-IN | LCR mode: Outputs the comparator judgment result for the measurement values of the third parameter.<br>Analyzer mode: Outputs the analyzer comparator result of the third parameter in AREA mode. |
| PARA1_LMAX_MEASNG, PARA1_LMAX_CONDNG, PARA1_LMAX_IN | Analyzer mode: Outputs the analyzer comparator result for the local maximum value of the first parameter in PEAK mode.<br>(Outputs PARA1_LMAX_MEASNG if the vertical axis (measurement value) is out of the range or there is no comparison peak, outputs PARA1_LMAX_CONDNG if the horizontal axis (sweep setting) is out of the range or there is no comparison peak, and outputs PARA1_LMAX_IN if the PEAK is IN.) |
| PARA2_LMAX_MEASNG, PARA2_LMAX_CONDNG, PARA2_LMAX_IN | Analyzer mode: Outputs the analyzer comparator result for the local maximum value of the second parameter in PEAK mode.<br>(Outputs PARA2_LMAX_MEASNG if the vertical axis (measurement value) is out of the range or there is no comparison peak, outputs PARA2_LMAX_CONDNG if the horizontal axis (sweep setting) is out of the range or there is no comparison peak, and outputs PARA2_LMAX_IN if the PEAK is IN.) |
| PARA1_LMIN_MEASNG, PARA1_LMIN_CONDNG, PARA1_LMIN_IN | Analyzer mode: Outputs the analyzer comparator result for the local minimum value of the first parameter in PEAK mode.<br>(Outputs PARA1_LMIN_MEASNG if the vertical axis (measurement value) is out of the range or there is no comparison peak, outputs PARA1_LMIN_CONDNG if the horizontal axis (sweep setting) is out of the range or there is no comparison peak, and outputs PARA1_LMIN_IN if the PEAK is IN.) |
| PARA2_LMIN_MEASNG, PARA2_LMIN_CONDNG, PARA2_LMIN_IN | Analyzer mode: Outputs the analyzer comparator result for the local minimum value of the first parameter in PEAK mode.<br>(Outputs PARA2_LMIN_MEASNG if the vertical axis (measurement value) is out of the range or there is no comparison peak, outputs PARA2_LMIN_CONDNG if the horizontal axis (sweep setting) is out of the range or there is no comparison peak, and outputs PARA2_LMIN_IN if the PEAK is IN.) |
| AND | Outputs the result that takes the AND of the judgment results of the measurement values of the two parameters judged in both LCR mode and analyzer mode.<br>The result is output when both judgment results are IN or if either one of the first and third parameters is not judged and the judgment result of the judged parameter is IN. |
| BIN1 to BIN10 OUT OF BINS | Outputs the judgment result of BIN measurement. |
| CIRCUIT_NG | Outputs the equivalent circuit analysis comparator judgment results. |
| INDEX | This is the signal to indicate that A/D conversion in the measurement circuit has ended.<br>When this signal changes from HIGH (OFF) to LOW (ON), the test sample can be changed. |
| EOM | This is the end of measurement signal.<br>At this point in time, the comparator judgment result is confirmed. |
| ERR | Outputs when there is a sampling error, constant voltage/current error, voltage/current limit value exceeded error, contact check error in low Z high accuracy mode, HIGH-Z reject error or monitoring the detection level. |

# 11.2 Timing Chart

## 11.2.1 LCR Measurement

If you set the judgment condition for the comparator (the trigger setting is external trigger) and then in that state a trigger signal is input from the EXT I/O or [ TRIG ] is pressed in the screen, the judgment result is output from the signal line for comparator result output of the EXT I/O after measurement ends.
Furthermore, if the panel number is selected with the panel load signal when a trigger signal is input from the EXT I/O, the measurement condition of that panel number is loaded and then measurement is performed.

The following shows examples of the measurement timing.
(In the timing examples, the valid edge of the TRIG signal is set to falling (ON).)



*1: Reset at the same time as analog measurement starts.: HIGH

Not reset at the same time as analog measurement starts.: Last judgment result remains

**NOTE** Whether the judgment results of comparator and BIN measurement are reset at the time of the measurement start signal or updated at the point in time when measurement ends can be selected on the instrument or by a communication command.

**See** "Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results" (p. 115),(p. 226)
Description of communications commands on the included CD (`:IO:RESult:RESet`)

Chapter 11 External Control

**11**

## 11.2 Timing Chart

**Timing Chart Interval Descriptions**

| Interval | Description | Time (Approximate) |
|----------|-------------|--------------------|
| t1 | From Comparator, BIN Judgement Result to $\overline{EOM}$ (LOW): Setting value for delay time[*1] | 40 μs |
| t2 | From $\overline{EOM}$ width (LOW) to $\overline{TRIG}$ (LOW): Minimum time from end of measurement to next trigger[*2, 5] | 400 μs |
| t3 | From $\overline{TRIG}$(LOW) to $\overline{INDEX}$ (HIGH): Time from trigger to circuit response[*3, 5] | 700 μs |
| t4 | $\overline{INDEX}$ width (HIGH): Minimum chuck time, switching chuck with $\overline{INDEX}$ (LOW) is possible[*4] | 220 μs |
| t5 | $\overline{EOM}$ width (HIGH): Measurement time[*4] | 600 μs |
| t6 | From $\overline{TRIG}$ width (LOW) to $\overline{LD\text{-}VALID}$ (HIGH) and $\overline{CALIB}$ (HIGH): Time to recognize panel number | t3 |

*1: There is an approximate error of 100 μs in the delay time entered for Judgement Result ⇔ $\overline{EOM}$ for the setting value. t1 is the reference value for when the setting value is 0.0000 s.

*2: t2 is the reference value for when trigger input for during measurement is disabled.(p. 117), (p. 228)

*3: • When the panel number is read by the panel load function, the response time is as shown in the table below.

| Measurement mode | Load mode | Response time |
|------------------|-----------|---------------|
| LCR | LCR+ADJ | 12 ms |
| | HARD | 9 ms |
| | ADJ | 4 ms |
| ANALYZER | ANA+ADJ | 120 ms |
| | HARD | 120 ms |
| | ADJ | 8 ms |

• When the trigger synchronous output function and trigger delay is enabled, wait times are included.

*4: Reference value for Measurement frequency: 100 kHz, Measurement speed: FAST, Measurement range: HOLD (p. 399)

*5: With the conditions shown in the table below, the time is added.

| Range | Level | Frequency | Low Z High Accuracy Mode | DC Bias | Time |
|-------|-------|-----------|--------------------------|---------|------|
| 100 mΩ, 1 Ω | All levels | DC, 4 Hz to 999.99 Hz | ON | OFF | 2 ms |

### NOTE

• Since the speed of the rise (LOW ⤞ HIGH) of the comparator/BIN judgment result differs depending on the configuration of the circuit connected to the EXT I/O, there is the likelihood of an incorrect judgment if the level of the comparator/BIN judgment result acquired immediately after $\overline{EOM}$ output is used. To prevent this from happening, a delay time (t1) between the comparator/BIN judgment result and the $\overline{EOM}$ can be set. Furthermore, if the judgment result signal line of the EXT I/O is set to be reset simultaneously with the measurement start signal, and a forced transition to the HIGH level is performed at the same time as TRIG, the transition from LOW to HIGH does not occur when the judgment result is output after measurement ends. As a result, the delay time between the judgment result and the $\overline{EOM}$ can be set to the minimum level. However, be careful because the judgment result confirmation interval is until the next trigger is accepted. Furthermore, if the judgment result signal line of the EXT I/O is set to be reset simultaneously with the measurement start signal, and a forced transition to the HIGH level is performed at the same time as $\overline{TRIG}$, the transition from LOW to HIGH does not occur when the judgment result is output after measurement ends. As a result, the delay time between the judgement result output and $\overline{EOM}$ can be set to the minimum level. As a result, the delay time between the judgement result output and $\overline{EOM}$ can be minimized. However, take note that the evaluation result confirmation range is valid until the following triggers are accepted.

• During measurement, a trigger input from EXT /IO or communicating by interface may lead to a bigger dispersion of delay time between comparator or BIN judgement result output and $\overline{EOM}$. As far as possible, try not to control from external sources when carrying out measurement.

## NOTE

• The higher the measurement frequency, the shorter the time that $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$ are high (off). When the high (off) time is too short due to characteristics of the input circuit, the instrument can be configured to maintain the low (on) state for a preset time once $\overline{\text{EOM}}$ changes to low (on) before reverting the signal to high (off) after the completion of measurement.

When trigger input is received at $\overline{\text{EOM}}$:LOW and $\overline{\text{INDEX}}$:LOW, the signal transitions to high (off) when measurement starts.

Setting the $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$ output method
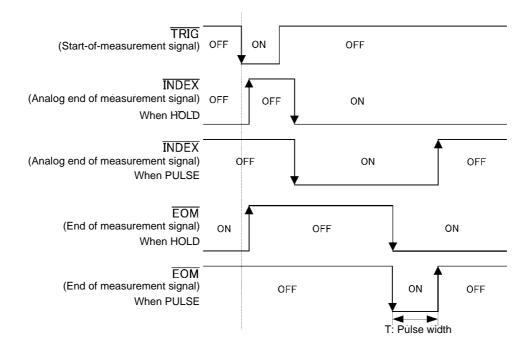
**See** "4.5.8 Setting the EOM Output Method" (p. 119)
Description of communications commands on the included CD (`:IO:EOM:MODE`)

Setting the pulse width for which low (on) $\overline{\text{EOM}}$ is held

**See** "4.5.8 Setting the EOM Output Method" (p. 119)
Description of communications commands on the included CD (`:IO:EOM:PULSe`)

1.888.610.7664        www.calcert.com        sales@calcert.com
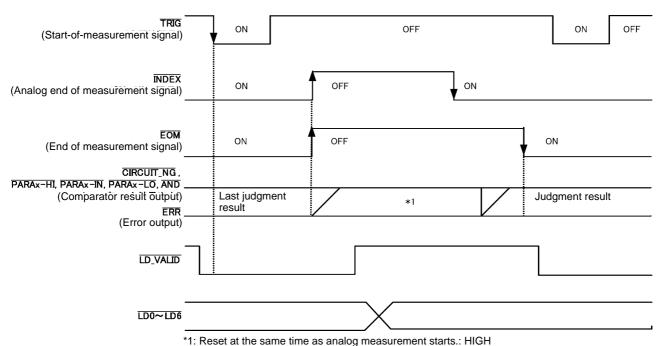
## 11.2.2 Analyzer Measurement

In analyzer mode, if a trigger signal is input from the EXT I/O or [ TRIG ] is pressed in the screen, the judgment results are output from the signal line for comparator result output of the EXT I/O.

Furthermore, if the panel number is selected with the panel load signal when a trigger signal is input from the EXT I/O, the measurement condition of that panel number is loaded and then measurement is performed.

The following provides an example of measurement timing when the trigger setting is [ SEQ ] or [ REPEAT ].
(In the timing examples, the valid edge of the TRIG signal is set to falling (ON).)



*1: Reset at the same time as analog measurement starts.: HIGH

   Not reset at the same time as analog measurement starts.: Last judgment result remains

| Signal line | Description |
|---|---|
| $\overline{\text{INDEX}}$ | The transition to HIGH is performed when measurement of the first sweep point starts after trigger signal input and the transition to LOW is performed when the analog measurement of the last sweep point ends.<br>(The HIGH level is maintained during sweep measurement.) |
| $\overline{\text{EOM}}$ | The transition to HIGH is performed when measurement of the first sweep point starts after trigger signal input. Measurement of the last sweep point ends and the transition to LOW is performed after judgment result output.<br>(The HIGH level is maintained during sweep measurement.) |

**NOTE**
- If the trigger setting is set to STEP, $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$ transition to LOW every time the measurement for each point ends, and then transition to HIGH when there is trigger input.
  $\overline{\text{ERR}}$ also transitions to LOW each time measurement completes if a measurement error occurs.
- Whether the judgment results of comparator measurement are reset at the time of the measurement start signal or updated at the point in time when measurement ends can be selected on the instrument or by a communication command.
  **See:**
       Description of communications commands on the included CD (`:IO:RESult:RESet`)
-

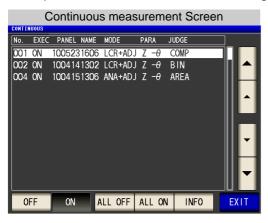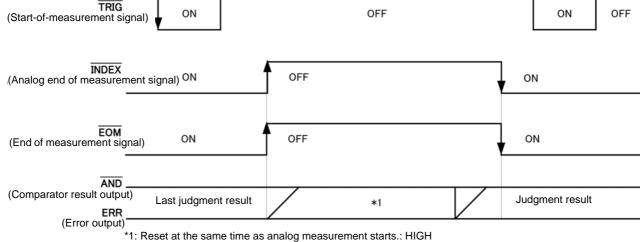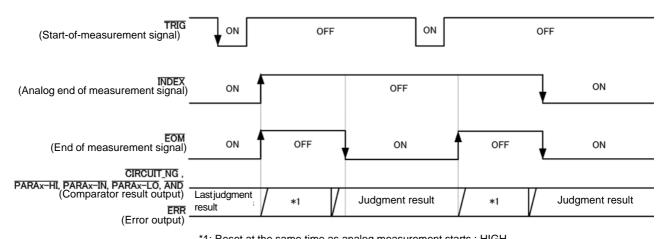## 11.2.3 Continuous Measurement (Sequential Operation)

With continuous measurement, if a trigger signal is input from the EXT I/O or [TRIG] is pressed in the screen, after measurement of all of the panel numbers set to be executed on the screen is finished, the judgment results are output from the signal line for comparator result output of the EXT I/O.
The following provides an example of measurement timing with the sequential trigger setting.
(In the timing examples, the valid edge of the TRIG signal is set to falling (ON).)

Example: Continuous measurement using panel numbers 1, 2, and 4

Continuous measurement Screen

| No. | EXEC | PANEL NAME | MODE | PARA | JUDGE |
|-----|------|------------|------|------|-------|
| 001 | ON | 1005231606 | LCR+ADJ | Z −θ | COMP |
| 002 | ON | 1004141302 | LCR+ADJ | Z −θ | BIN |
| 004 | ON | 1004151306 | ANA+ADJ | Z −θ | AREA |

OFF | ON | ALL OFF | ALL ON | INFO | EXIT

$\overline{\text{TRIG}}$
(Start-of-measurement signal)    ON    OFF    ON    OFF

$\overline{\text{INDEX}}$
(Analog end of measurement signal)    ON    OFF    ON

$\overline{\text{EOM}}$
(End of measurement signal)    ON    OFF    ON

$\overline{\text{AND}}$
(Comparator result output)    Last judgment result    *1    Judgment result
$\overline{\text{ERR}}$
(Error output)

*1: Reset at the same time as analog measurement starts.: HIGH

Not reset at the same time as analog measurement starts.: When measurement of the first panel number completes, $\overline{\text{AND}}$ will transition to HIGH, and $\overline{\text{ERR}}$ will transition to HIGH (if no error) or LOW (if error).

| Signal line | Description |
|-------------|-------------|
| $\overline{\text{INDEX}}$, $\overline{\text{EOM}}$ | For both $\overline{\text{INDEX}}$ and $\overline{\text{EOM}}$, a transition to HIGH is performed when the first panel measurement starts after the trigger signal is input, and a transition to LOW is performed after measurement of the last panel is finished and the judgment result has been output. (The HIGH level is maintained during continuous measurement.) |
| $\overline{\text{AND}}$ | When the judgment results of all panels are IN, LOW is output. |

NOTE
- $\overline{\text{ERR}}$ transitions to LOW each time measurement completes if a measurement error occurs.
- In the continuous measurement screen, comparator result output signals other than AND and panel load signals (LD-VALID, LD0 to LD6) cannot be used.

    **See:** "Chapter 6  Continuous Measurement Function" (p. 265)

- Whether the judgment results of comparator measurement are reset at the time of the measurement start signal or updated at the point in time when measurement ends can be selected on the instrument or by a communication command.

    **See:** "Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results" (p. 115),(p. 226)
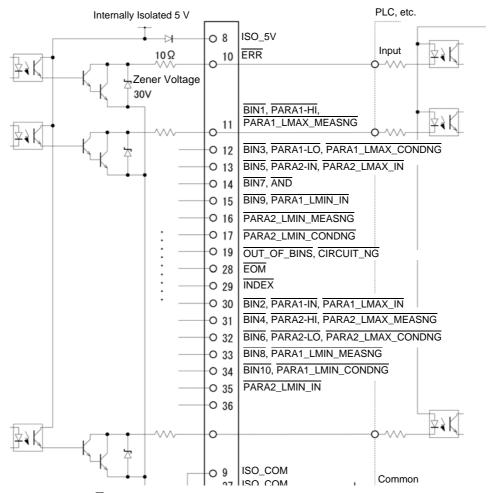    Description of communications commands on the included CD (`:IO:RESult:RESet`)

- For other timing chart times, refer to "11.2.1  LCR Measurement" (p. 369).

## 11.2.4 Continuous Measurement (Step Operation)

In continuous measurement mode, pressing [ TRIG ] on the screen asking whether a trigger signal will be input from EXT I/O will cause the judgment result to be output from the EXT I/O comparator result output signal lines after measurement of the panel set to be executed on the screen completes. The following provides an example of measurement timing with the [ STEP ] trigger setting.

(In this timing example, the TRIG signal active edge is set to the falling edge (ON).)



*1: Reset at the same time as analog measurement starts.: HIGH

Not reset at the same time as analog measurement starts.: Last judgment result remains

| Signal line | Description |
|---|---|
| INDEX | For both INDEX, a transition to HIGH is performed when the first panel measurement starts after the trigger signal is input, and a transition to LOW is performed after measurement of the last panel is finished and the judgment result has been output.<br>(The HIGH level is maintained during continuous measurement.) |
| EOM | EOM transitions to HIGH at the start of measurement after trigger signal input and to LOW each time measurement completes. |
| Comparator result output | The judgment result and ERR vary according to the measurement state each time measurement completes. |

NOTE
- Panel load signals (LD-VALID, LD0 to LD6) cannot be used on the continuous measurement screen.
  See: "Chapter 6 Continuous Measurement Function" (p. 265)
- Comparator judgment results are output just as they are during measurement in LCR or analyzer mode.
- Whether the judgment results of comparator measurement are reset at the time of the measurement start signal or updated at the point in time when measurement ends can be selected on the instrument or by a communication command.
  See: "Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results" (p. 115),(p. 226)
  Description of communications commands on the included CD (`:IO:RESult:RESet`)
- For other timing chart times, refer to "11.2.1 LCR Measurement" (p. 369).
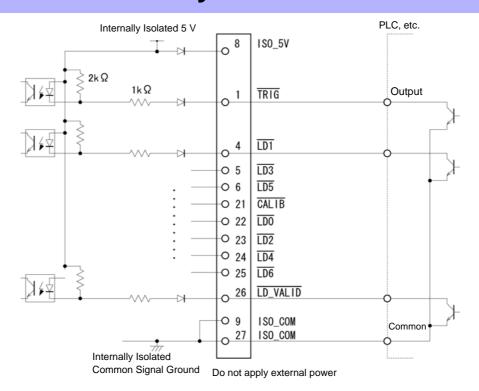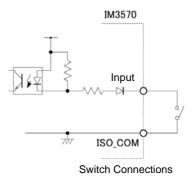
# 11.3 Internal Circuitry

Input Circuit



Output Circuit
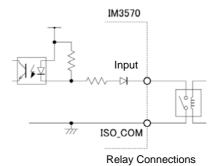
## Electrical Specifications
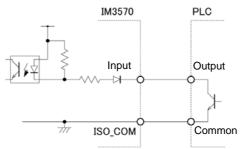
| Input Signals | | |
|---|---|---|
| | Input type | Optocoupler-isolated, non-voltage contact inputs (source input, active-low) |
| | Input asserted (ON) voltage | 1 V or less |
| | Input de-asserted (OFF) voltage | Open or 5 to 30 V |
| | Input asserted (ON) current | 3 mA/ch |
| | Maximum applied voltage | 30 V |

| Output Signals | | |
|---|---|---|
| | Output type | Optocoupler-isolated npn open-collector outputs (current sink, active-low) |
| | Maximum load voltage | 30 V |
| | Maximum output current | 50 mA/ch |
| | Residual voltage | 1 V (10 mA), 1.5 V (50 mA) |

| Internally Isolated | | |
|---|---|---|
| | Power Output | 4.5 V to 5.0 V |
| | Maximum output current | 100 mA |
| | External power input | none |

**Chapter 11 External Control**

**11**

## Connection Examples

**Input Circuit Connection Examples**

IM3570

Input

ISO_COM

Switch Connections

IM3570

Input

ISO_COM

Relay Connections

IM3570     PLC

Input     Output

ISO_COM     Common
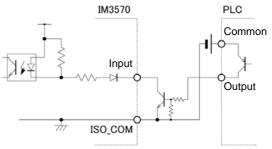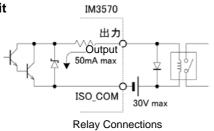
PLC Output (Sink Output) Connections

IM3570     PLC

Common

Input     Output

ISO_COM
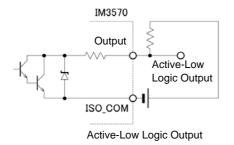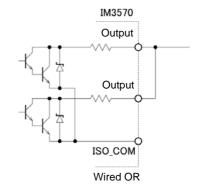
PLC Output (Source Output) Connections

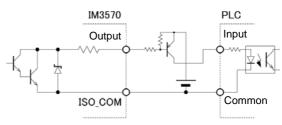**Output Circuit Connection Examples**

IM3570

出力
Output
50mA max

ISO_COM   30V max
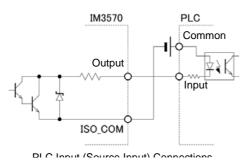
Relay Connections

IM3570

Output

ISO_COM

LED Connection

IM3570

Output

Active-Low
Logic Output

ISO_COM

Active-Low Logic Output

IM3570

Output

Output

ISO_COM

Wired OR

IM3570     PLC

Common

Output

Input

ISO_COM

PLC Input (Source Input) Connections

IM3570     PLC

Output     Input

ISO_COM     Common

PLC Input (Sink Input) Connections

# 11.4 External I/O Settings

There are the following setting items for the output timing of the judgment result output signal and the logic of the trigger signal.

## Setting Delay Time from Output of Comparator and BIN Judgment Results until Output of EOM (LOW)

The delay time for the period from the output of the comparator and BIN judgment results until the output of EOM (LOW) from the EXT I/O can be set on the instrument or by a communication command.
For the setting procedure, refer to the following.

**See** "Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results" (p. 115),(p. 226)
Description of communications commands on the included CD (`:IO:OUTPut:DELay`)

## Setting Reset of Judgment Results

Whether to reset the comparator and BIN judgment results simultaneously with the measurement start signal can be selected on the instrument or by a communication command.
For the setting procedure, refer to the following.

**See** "Setting the Delay Time from the Output of Comparator and BIN Judgment Results until Output of EOM (LOW) and Resetting Judgment Results" (p. 115),(p. 226)
Description of communications commands on the included CD (`:IO:RESult:RESet`)

## Enabling Trigger Input for during Measurement

Whether to enable or disable trigger input from the EXT I/O during measurement (during EOM (HI) output) can be selected on the instrument or by a communication command.
For the setting procedure, refer to the following.

**See** "Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input" (p. 117), (p. 228)
Description of communications commands on the included CD (`:IO:TRIGger:ENABle`)

## Setting Valid Edge of Trigger Input

Either the rising edge or falling edge can be selected as the valid edge of trigger input from the EXT I/O.
For the setting procedure, refer to the following.

**See** "Enabling Trigger Input for during Measurement and Setting the Valid Edge of Trigger Input" (p. 117), (p. 228)
Description of communications commands on the included CD (`:IO:TRIGger:EDGe`)

**Chapter 11 External Control**

**11**

# 11.5 External Control Q&A

| Common Questions | Answers |
|---|---|
| How do I connect external trigger input? | Connect the (active low) $\overline{\text{TRIG}}$ input pin to an ISO_COM pin using a switch or open-collector output. |
| Which pins are common ground for input and output signals? | The ISO_COM pins. |
| Are the common (signal ground) pins shared by both inputs and outputs? | Both common ground pins can be shared by inputs and outputs. |
| How do I confirm output signals? | Confirm voltage waveforms with an oscilloscope. To do this, the output pins such as $\overline{\text{EOM}}$ and comparator decision outputs need to be pulled up (through several k$\Omega$). |
| How do I troubleshoot input (control) signal issues? | For example, if triggering does not operate properly, bypass the PLC and short the $\overline{\text{TRIG}}$ pin directly to an ISO_COM pin. Be careful to avoid power shorts. |
| Are the comparator decision signals retained during measurement (or can they be off)? | They are initially set to be confirmed at the end of measurement and turned OFF when measurement starts.<br>However, it is possible to change the settings so that the judgment results from last time are also stored during measurement.<br>**See** "Setting Reset of Judgment Results" (p. 379) |
| When are measurement error signals displayed? | An error is displayed in the following cases.<br>• When sampling error<br>• When constant voltage/constant current error<br>• When voltage/current limit value exceeded error<br>• When contact check error in low Z high accuracy mode<br>• When HIGH-Z reject error |
| Is a connector or flat cable for connection provided? | A connector and cable are not supplied, so you need to provide them yourself. |
| Is direct connection to a PLC possible? | Direct connection is supported for relay or open-collector outputs and positive-ground optocoupler inputs. (Before connecting, confirm that voltage and current ratings will not be exceeded.) |
| Can external I/O be used at the same time as RS-232C or other communications? | After setting up communications, it is possible to control measurement with the $\overline{\text{TRIG}}$ signal while acquiring measurement data via a communications interface. |
| How should external power be connected? | The instrument's external I/O input and output signals all operate from an internal isolated power source, so power must not be supplied from the PLC side. |

# 11.6 Measurement Using a Computer

You can control the instrument with communication commands from a computer via the GP-IB, RS-232C, USB, and LAN interfaces.
To enable communication, the communication conditions need to be set on the instrument.
For details on the communication condition settings, refer to "8.1  Setting the Interface" (p. 305).
For the details on the communication control procedure, refer to the supplied Communication Instruction Manual (CD).

<table>
<tr><td>**Printing**</td><td colspan="2">**Chapter 12**</td></tr>
</table>

| Connecting the printer to the instrument | → | Make instrument settings (p. 383) | → | Make printer settings | → | **Printing (p. 384)** • Measurement values and comparator decisions • Screens |

## 12.1 Connecting the Printer

### Connecting the Printer

**⚠ WARNING**
> **Because electric shock and instrument damage hazards are present, always follow the steps below when connecting the printer.**
> • **Always turn off the instrument and the printer before connecting.**
> • **A serious hazard can occur if a wire becomes dislocated and contacts another conductor during operation. Make certain connections are secure.**

**NOTE**
- As much as possible, avoid printing in hot and humid environments. Otherwise, printer life may be severely shortened.
- Use only compatible recording paper in the printer. Using non-specified paper may not only result in faulty printing, but printing may become impossible.
- If the recording paper is skewed on the roller, paper jams may result.

### Recommended printer

The IM3570 has been verified to operate properly with Sanei Electric Inc.'s model SD1-31S thermal printer.

The requirements for a printer to be connected to the instrument are as follows.
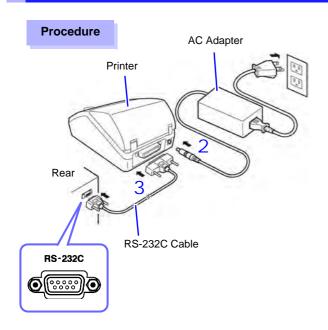Confirm compatibility and make the appropriate settings on the printer before connecting it to the instrument.

- Interface ....................... RS-232C
- Characters per line ....... At least 45
- Communication speed . Initial value: 9,600 bps
- Data bits ...................... 8bit
- Parity ........................... none
- Stop bits ...................... 1bit
- Flow control ................. none

**NOTE**   The communication speed and flow control can be changed with instrument settings. However, the IM3570 and printer must be configured with the same settings.
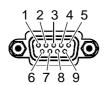
Chapter 12 Printing

**12**

## Connecting the Printer to the Instrument

**Procedure**

AC Adapter

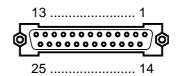Printer

Rear

**2**

**3**

RS-232C Cable

**RS-232C**

**1** Confirm that the instrument and printer are turned off.

**2** Connect the AC adapter to the printer, and insert the power plug into an outlet.

**3** Connect the RS-232C cable to the RS-232C connectors on the instrument and printer.

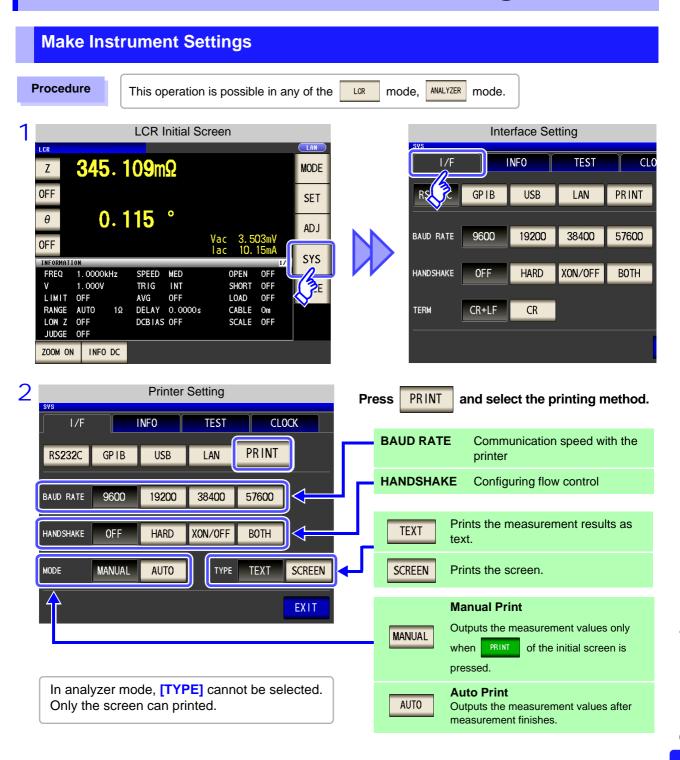**4** Turn the instrument and printer on.

## Connector Pinouts

1 2 3 4 5

6 7 8 9

IM3570 (9-pin) Connector

13 ...................... 1

25 ...................... 14

Printer (25-pin) Connector

| Function | Signal Name | Pin | | | Pin | Signal Name | Function |
|---|---|---|---|---|---|---|---|
| Receive Data | RxD | 2 | | | 2 | TxD | Transmit Data |
| Transmit Data | TxD | 3 | | | 3 | RxD | Receive Data |
| Signal or Common Ground | GND | 5 | | | 7 | GND | Signal or Common Ground |
| Request to Send | RTS | 7 | | | 4 | RTS | Request to Send |
| Clear to Send | CTS | 8 | | | 5 | CTS | Clear to Send |

**NOTE** To use hardware flow control, you will need an RS-232C cable whose RTS and CTS wires are connected (7-pin at instrument to 5-pin at printer or 8-pin at instrument to 4-pin at printer). Hardware flow control cannot be used with cables whose RTS and CTS wires are shorted together.

# 12.2 Instrument and Printer Settings

## Make Instrument Settings

**Procedure** — This operation is possible in any of the [ LCR ] mode, [ ANALYZER ] mode.

**1** LCR Initial Screen / Interface Setting

```
LCR                                              LAN
Z    345.109mΩ                          MODE
OFF
θ     0.115 °                            SET
OFF                        Vac  3.503mV  ADJ
                           Iac  10.15mA
INFORMATION                          1/  SYS
FREQ  1.0000kHz  SPEED MED    OPEN  OFF
V     1.000V     TRIG  INT    SHORT OFF
LIMIT OFF        AVG   OFF    LOAD  OFF
RANGE AUTO   1Ω  DELAY 0.0000s CABLE 0m
LOW Z OFF        DCBIAS OFF    SCALE OFF
JUDGE OFF
ZOOM ON  INFO DC
```

```
SYS
I/F      INFO      TEST      CLO
RS232C  GPIB  USB  LAN  PRINT
BAUD RATE  9600  19200  38400  57600
HANDSHAKE  OFF  HARD  XON/OFF  BOTH
TERM       CR+LF  CR
```

**2** Printer Setting

```
SYS
I/F      INFO      TEST      CLOCK
RS232C  GPIB  USB  LAN  PRINT
BAUD RATE  9600  19200  38400  57600
HANDSHAKE  OFF  HARD  XON/OFF  BOTH
MODE  MANUAL  AUTO    TYPE  TEXT  SCREEN
                                      EXIT
```

Press [ PRINT ] and select the printing method.

| | |
|---|---|
| **BAUD RATE** | Communication speed with the printer |
| **HANDSHAKE** | Configuring flow control |

| | |
|---|---|
| TEXT | Prints the measurement results as text. |
| SCREEN | Prints the screen. |

| | |
|---|---|
| MANUAL | **Manual Print** Outputs the measurement values only when [ PRINT ] of the initial screen is pressed. |
| AUTO | **Auto Print** Outputs the measurement values after measurement finishes. |

In analyzer mode, **[TYPE]** cannot be selected. Only the screen can printed.

**3** Select [ SET ] and check each of the settings, and press [ EXIT ] to close the setting screen.

The printer's communication speed (baud rate) and flow control settings are the same as the RS-232C settings. If the communication speed is changed, you may need to increase the print speed. It is also necessary to change the printer's communication speed setting. When the communication speed is increased, the printer may be unable to keep up, preventing data from being printed properly. If this occurs, use hardware or software flow control. For more information, see the instruction manual that came with the printer.

**Chapter 12 Printing**

**12**

# 12.3 Printing

**Before Printing**

Verify that the instrument and printer settings (p. 383) are correct.
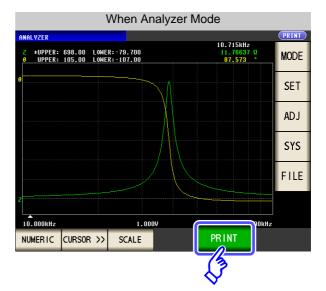
## When the Printing Method is Set to [AUTO]

Prints automatically after measurement completes.

## When the Printing Method is Set to [MANUAL]

Prints the state when [PRINT] is pressed in the initial screen.

| When LCR Mode | When Analyzer Mode |
|---|---|
| | |

**When LCR Mode**

LCR     PRINT

Z   **16. 1520kΩ**

OFF

θ   **−89. 992 °**

OFF

Vac   1.025 V
Iac   63.48μA

INFORMATION   1/2

| FREQ | 1.0000kHz | SPEED | MED | OPEN | OFF |
| V | 1.000V | TRIG | INT | SHORT | OFF |
| LIMIT | OFF | AVG | OFF | LOAD | OFF |
| RANGE | AUTO 30kΩ | DELAY | 0.0000s | CABLE | 0m |
| LOW Z | OFF | DCBIAS | OFF | SCALE | OFF |
| JUDGE | OFF | | | | |

MODE / SET / ADJ / SYS / FILE

ZOOM ON | INFO DC | **PRINT**

**When Analyzer Mode**

ANALYZER     PRINT

10.715kHz
Z   *UPPER: 698.00   LOWER:-79.700   11.76637 Ω
θ   UPPER: 105.00   LOWER:-107.00   87.573 °

10.000kHz   1.000V   00kHz

MODE / SET / ADJ / SYS / FILE

NUMERIC | CURSOR >> | SCALE | **PRINT**

## Example Printouts

The print content varies depending on the printer settings of the instrument.
**See** "12.2 Instrument and Printer Settings" (p. 383)

### When LCR Mode

■ When the **[TYPE]** setting is TEXT

**Normal measurement**

```
Z    1.84557 ohm
PH      2.024 deg
```

**Comparator measurement**
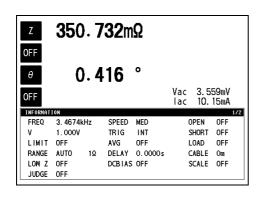
```
Z    1.85223 ohm  IN
PH      2.011 deg  HI
```

**BIN measurement**

```
Z    1.85377 ohm
PH      2.010 deg
BIN3
```

■ When the **[TYPE]** setting is SCREEN

```
Z   350.732mΩ

θ    0.416 °
              Vac   3.559mV
              Iac   10.15mA
INFORMATION                    1/2
FREQ  3.4674kHz  SPEED  MED    OPEN   OFF
V     1.000V     TRIG   INT    SHORT  OFF
LIMIT OFF        AVG    OFF     LOAD   OFF
RANGE AUTO   1Ω  DELAY  0.0000s CABLE  0m
LOW Z OFF        DCBIAS OFF     SCALE  OFF
JUDGE OFF
```
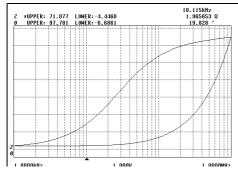
NOTE    When the display is enlarged, the print type is text even when **[TYPE]** is set to SCREEN .
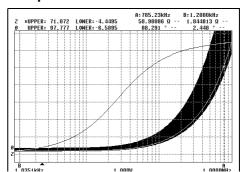
### When Analyzer Mode

In analyzer mode, only printing the screen is available for the print type (**[TYPE]**).

**Normal measurement**

```
Z  *UPPER: 71.077  LOWER:-4.4460        10.115kHz
θ   UPPER: 97.781  LOWER:-6.6061        1.965653 Ω
                                        19.828 °
```

**Comparator measurement**

```
Z  *UPPER: 71.072  LOWER:-4.4495   A:785.23kHz   B:1.2000kHz
θ   UPPER: 97.777  LOWER:-6.5895   50.98086 Ω --  1.844813 Ω --
                                   88.291 ° --    2.448 ° --
```
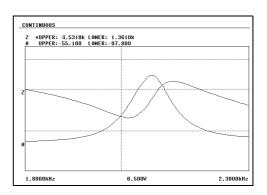
## When Continuous Measurement Mode

The measured value display will be printed in text, or the graph display will be printed as a screen image.

Measured value display

Graph display

```
001 Z     SWEEP     PH     SWEEP     NG NG
002 Ls   15.1962mH  D     0.05958    IN HI
```

```
CONTINUOUS
 Z  *UPPER: 4.5318k LOWER: 1.3610k
 θ    UPPER:-55.100  LOWER:-97.800

1.8000kHz          0.500V          2.3000kHz
```

**NOTE** Since printer settings cannot be configured in continuous measurement mode, set the instrument to either LCR mode or analyzer mode in order to changing the printer settings.

# Specifications Chapter 13

## 13.1 General Specifications

### 1.Basic Specifications

| | |
|---|---|
| Measurement mode | (1) LCR mode: Measurement with single condition<br>(2) Analyzer mode: Measurement frequency sweep, measurement level sweep<br>  • Measurement points: 2 to 801<br>  • Sweep method: Normal sweep/segment sweep<br>    Normal sweep: START-STOP/ CENTER-SPAN/ START-STEP, maximum 801 points<br>    Segment sweep: START-STOP, maximum 20 segments (total of 801 points)<br>  • Display: List display/graph display<br>(3) Continuous measurement mode: Consecutive measurements with saved conditions<br>  • LCR mode: Up to 30 conditions<br>  • Analyzer mode: Up to 2 conditions<br>  * Continuous measurements including a mixture of LCR mode and analyzer mode are possible. |
| Measurement items | Z (Impedance), Y (Admittance), $\theta$ (Phase angle), Rs (Equivalent series resistance (ESR)), Rp (Parallel equivalent resistance), X (Reactance), G (Conductance), B (Susceptance), Ls (Series equivalent inductance), Lp (Parallel equivalent inductance), Cs (Series equivalent capacitance), Cp (Parallel equivalent capacitance), Q (Q factor), D (Loss coefficient $\tan\delta$), Rdc (DC resistance) |
| Display range | Z, Y, Rs, Rp, Rdc, X, G, B, Ls, Lp, Cs, Cp: ± (0.000000 (unit) to 9.999999G (unit))<br>                                       * Absolute value display for Z and Y only<br>$\theta$:        ± (0.000° to 999.999°)<br>D:        ± (0.000000 to 9.999999)<br>Q:        ± (0.00 to 99999.99)<br>$\Delta$%:        ± (0.0000% to 999.9999%)<br>* DISP OUT is displayed when the upper limit is exceeded. |
| Measurement frequency | (1)Frequency range<br>    4 Hz to 5 MHz<br>(2)Setting resolution<br>    5-digit resolution (however, the minimum resolution is 10 mHz)<br>(3)Frequency accuracy<br>    ±0.01% |
| Output impedance<br>(Hc terminal, when 1 kHz) | Normal mode: 100 Ω ±10 Ω<br>Low impedance accuracy mode: Approx. 10 Ω (100 mΩ and 1 Ω ranges of 100 kHz or less)<br>                                       Approx. 100 Ω (Except for the above)<br>* The following impedances are connected to the Lc terminal.<br>1 Ω range or less (100 kHz or less) when low impedance high accuracy mode: 5 Ω or less<br>1 V or less of other than the above:<br>                          3 kΩ range or more...............Approx. 35 Ω<br>                          1 kΩ range or less...............Approx. 5 Ω<br>1.001 V or more of other than the above:<br>                          30 kΩ range or more...............Approx. 35 Ω<br>                          10 kΩ range or less...............Approx. 5 Ω |

## 13.1 General Specifications

## 1.Basic Specifications

| Measurement signal level | (1) Open circuit terminal voltage (V) mode and constant voltage (CV) mode |
|---|---|

**Measurement signal level**

(1) Open circuit terminal voltage (V) mode and constant voltage (CV) mode
- Level range
  Normal mode: 5 mV to 5 V, maximum 50 mA (up to 1.0000 MHz)
                    10 mV to 1 V, maximum 10 mA (from 1.0001 MHz)
  Low Z high accuracy mode: 5 mV to 1 V, maximum 100 mA (up to 100.00 kHz)
- Setting resolution   1 mV steps
- Setting accuracy     ±10% of setting ±10 mV (up to 1.0000 MHz)
                        ±20% of setting ±10 mV (from 1.0001 MHz)

(2) Constant current (CC) mode
- Level range
  Normal mode: 10 μA to 50 mA, maximum 5 V (up to 11.0000 MHz)
                    10 μA to 10 mA, maximum 1 V (from 1.0001 MHz)
  Low Z high accuracy mode: 10 μA to 100 mA, maximum 1 V (100 mΩ and 1 Ω ranges
                                        of 100 kHz or less)
                                        10 μA to 10 mA (other than the above)
- Setting resolution  10 μA steps
- Setting accuracy     ±10% of setting ±10 μA (up to 1.0000 MHz)
                        ±20% of setting ±10 μA (from 1.0001 MHz)

**Measurement range**

The measurement range is determined according to impedance Z.
The values of the other measurement items can be calculated.
Ranges: 100 mΩ, 1 Ω, 10 Ω, 300 Ω, 1 kΩ, 3 kΩ, 10 kΩ, 30 kΩ, 100 kΩ, 1 MΩ,
         10 MΩ, 100 MΩ (12 ranges)

| Measurement range | Guaranteed Accuracy Range | AUTO Ranging Range |
|---|---|---|
| 100 MΩ | 8 MΩ to 200 MΩ | 8 MΩ to 999.999 MΩ |
| 10 MΩ | 800 kΩ to 100 MΩ | 800 kΩ to 10 MΩ |
| 1 MΩ | 80 kΩ to 10 MΩ | 80 kΩ to 1 MΩ |
| 100 kΩ | 24 kΩ to 1 MΩ | 24 kΩ to 100 kΩ |
| 30 kΩ | 8 kΩ to 300 kΩ | 8 kΩ to 30 kΩ |
| 10 kΩ | 2.4 kΩ to 100 kΩ | 2.4 kΩ to 10 kΩ |
| 3 kΩ | 800 Ω to 30 kΩ | 800 Ω to 3 kΩ |
| 1 kΩ | 240 Ω to 10 kΩ | 240 Ω to 1 kΩ |
| 300 Ω | 8 Ω to 300 Ω | 8 Ω to 300 Ω |
| 10 Ω | 800 mΩ to 10 Ω | 800 mΩ to 10 Ω |
| 1 Ω | 80 mΩ to 1 Ω | 80 mΩ to 1 Ω |
| 100 mΩ | 1 mΩ to 100 mΩ | 0 Ω to 100 mΩ |

- The guaranteed accuracy range differs depending on the measurement conditions. (p. 398)
- Out of guaranteed accuracy is displayed when out of the ranging range
  OVERFLOW or UNDERFLOW is displayed when out of the A/D input range

## 1.Basic Specifications

| Low Z High Accuracy Mode | Improves measurement accuracy in the 100 mΩ and 1 Ω ranges of 100 kHz or less. |

- The influence of contact resistance is reduced by changing to a circuit configuration that sets the Lp terminal to 0 V.
- The measurement current is increased (maximum 100 mA, maximum applied voltage 1 V) and the measurement accuracy is improved by setting the output resistance to 10 Ω.
- A contact check (disconnection detection) can be performed for four terminals.
- Cable length compensation is for only 0 m and 1 m.

Setting range of low Z high accuracy mode

| No | Measurement range | to 1 kHz | to 10 kHz | to 100 kHz | to 1 MHz | to 5 MHz |
|----|----|----|----|----|----|----|
| 1 | 100 MΩ | | | | | None |
| 2 | 10 MΩ | | | | | |
| 3 | 1 MΩ | | | | | |
| 4 | 100 kΩ | | | | | |
| 5 | 30 kΩ | | Normal mode only (setting not possible for low Z high accuracy mode). | | | |
| 6 | 10 kΩ | | | | | |
| 7 | 3 kΩ | | | | | |
| 8 | 1 kΩ | | | | | |
| 9 | 300 Ω | | | | | |
| 10 | 10 Ω | | | | | |
| 11 | 1 Ω | Low Z high accuracy mode/normal mode | | | | |
| 12 | 100 mΩ | | | | | |

| Period of guaranteed accuracy | 1 year |
|----|----|
| Warm-up time | At least 60 minutes |
| Measurement time | Approx. 0.5 ms (100 kHz, representative value, LCD display OFF) |
| Measurement speed | FAST, MED, SLOW, SLOW2 |
| Terminal structure | 4-terminal structure |
| Backup battery life | Approx. 10 years (25°C (77°F) reference value) |
| Product warranty period | 3 year |

## 2.Function

| Monitor functions | (1) Monitor voltage |
|----|----|
| | • Monitor range    0.000 V to 5.000 V |
| | • Monitor accuracy   ±10% rdg. ±10 mV (up to 1.0000 MHz) |
| |                           ±20% rdg. ±10 mV (from 1.0001 MHz) |
| | (2) Monitor current |
| | • Monitor range    0.000 mA to 100.0 mA |
| | • Monitor accuracy   ±10% rdg. ±10 µA (up to 1.0000 MHz) |
| |                           ±20% rdg. ±10 µA (from 1.0001 MHz) |
| Limit function | (1) Current limit (when V or CV) |
| | • Limit range      10 µA to 100.00 mA |
| | • Limit accuracy    ±10% rdg. ±10 µA (up to 1.0000 MHz) |
| |                         ±20% rdg. ±10 µA (from 1.0001 MHz) |
| | (2) Voltage limit (when CC set) |
| | • Limit range      0.005 V to 5.000 V |
| | • Limit accuracy    ±10% rdg. ±10 mV (up to 1.0000 MHz) |
| |                         ±20% rdg. ±10 mV (from 1.0001 MHz) |

## 13.1 General Specifications

## 2.Function

| | |
|---|---|
| DC bias measurement | Superimposing a DC voltage and then performing measurement is possible.<br>DC voltage   Normal mode: 0 V to 2.50 V (10 mV resolution)<br>Low impedance high accuracy mode: 0 V to 1.00 V (10 mV resolution)<br>Occurrence accuracy: ±10% of setting ±($V_{AC}$×0.01+30 mV)<br>* $V_{AC}$: AC signal voltage setting value [V] |
| DC resistance measurement | Settable when setting the Rdc measurement item.<br>The measurement condition when DC resistance measurement is settable to other than AC measurement<br>• Measurement signal level: Normal mode: 100 mV to 2.50 V (10 mV resolution)<br>Low impedance high accuracy mode: 100 mV to 1.00 V(10 mV resolution)<br>Occurrence accuracy: ±10% of setting ±20mV<br>• Measurement range, voltage/current limit, measurement speed, average<br>• DC adjustment setting (measurement of circuit offset, function for cancel)<br>• Delay time (common wait time when level switching, DC and AC switching, and DC adjustment) |
| Average | 1 to 256 (1 step) |
| Trigger function | An internal trigger or external trigger can be set. |
| Trigger delay | 0 to 9.9999 s (100 µs resolution) |
| Interval measurement | Interval 0.0001 s to 10000 s Maximum 801 points |
| BIN measurement | 10 classifications for 2 items, OUT OF BINS<br>Absolute value setting, Δ% setting, % setting |
| Comparator | • LCR mode:<br>First item: Hi/IN/Lo<br>Third item: Hi/IN/Lo<br>Absolute value setting, Δ% setting, % setting<br>• Analyzer mode:<br>Area judgment: Hi/IN/Lo for each point<br>Absolute value setting, % setting<br>Peak judgment: Hi/IN/Lo for local maximum and local minimum frequency and measurement values<br>Absolute value setting |
| Compensation | • Open and short circuit compensation<br>• Load circuit compensation<br>• Cable length compensation: 0 m, 1 m (to 5 MHz)<br>Normal mode: Guaranteed accuracy up to 4 m when cable length compensation of 1 m set<br>Cable compensation is only 0 m and 1 m when low Z high accuracy mode |
| Correlation compensation | Enter the compensation coefficients a and b of the following expression.<br>[Measurement value after compensation] = a × [measurement value] + b |
| Residual charge protection function<br>(Provides protection against a discharge voltage from a charged capacitor) | $$V = \sqrt{\frac{10}{C}}$$<br>C: Capacitance [F] of test sample<br>However, V = maximum 400 V |
| Magnification display function | The display of measurement values and comparator judgment results can be magnified. |
| Continuous measurement | Perform continuous measurement with saved conditions from the screen. |
| Display digits setting function | The number of display digits for measurement values can be set to 3, 4, 5, 6, and 7.<br>However, the setting differs depending on the parameter. (The initial value is 6 digits) |
| Display setting function | The LCD can be set to ON/ OFF. |
| Key-lock function | Can be enabled and disabled by front panel key operation.<br>Can be enabled and disabled by password input |
| Trigger synchronous output function | Applies a measurement signal during analog measurement only. |

## 2.Function

| | |
|---|---|
| Panel save and load function | LCR mode (single frequency): 30 different measurement conditions can be saved.<br>Sweep measurement: 2 different measurement conditions can be saved.<br>Compensation value only: 128 different measurement conditions can be saved.<br>Any measurement condition can be load by key operation or a control signal via the EXT I/O. |
| Memory function | 32,000 measurement result items can be saved to the instrument.<br>(Reading via RS-232C, GP-IB, USB, and LAN is possible.) |
| Contact check | (1) 4-terminal contact check (only when low Z high accuracy mode 100 m$\Omega$ range, 1 $\Omega$ range)<br>    Performs a contact (disconnection) check between $H_{CUR}$ and $H_{POT}$ and between $L_{CUR}$ and $L_{POT}$.<br>    When the current monitor value is 0.1 mA or less, a contact error is output.<br>(2) HIGH-Z reject function (detection of OPEN state during 2-terminal measurement)<br>    When the measurement value is higher than the judgment reference, a contact error is output.<br>    Judgment reference: The impedance Z value can be set to between 0 to 30,000% of the measurement range.<br>    Error output: An error is output from the EXT I/O.<br>(3) Detection level monitoring function<br>    Detects a contact error (chattering detection).<br>    A comparison is made with the effective value of the first waveform that is acquired, and a contact error is output when a variation in the effective value of a subsequent waveform exceeds the judgment reference.<br>    Judgment reference: 0.01% to 100.00% (0.01% resolution) relative to the reference value can be set.<br>    Error output: An error is displayed on the LCD and output from the EXT I/O. |
| Print function | The measurement values and graph can be printed.<br>* Requires a printer that supports RS-232C communications. |
| Buzzer sound | The buzzer for the comparator judgment result (IN or NG) can be set to ON/ OFF.<br>The buzzer sound for key input can be set to ON/ OFF. |

## 3.Interface

| | |
|---|---|
| Display | 5.7-inch color TFT |
| Handler interface | Equipped as standard |
| RS-232C interface | Equipped as standard |
| GP-IB interface | Equipped as standard |
| USB(HI SPEED) interface | Equipped as standard<br>Full-Speed/Hi-Speed supported |
| LAN interface | Equipped as standard<br>10BASE-T/100BASE-TX |
| USB flash drive | The measurement conditions, measurement values, and screen can be saved.<br>The measurement conditions can be load.<br>Saved measurement values and screens can be displayed.<br>File deletion, folder creation, and disk formatting |

## 4.Environmental and Safety Specifications

| | |
|---|---|
| Operating temperature and humidity | 0 to 40°C (32 to 104°F),80% RH or less (non-condensating) |
| Storage temperature and humidity | -10 to 50°C (15 to 122°F) 80% RH or less (non-condensating) |
| Operating environment | Indoors, Pollution degree 2, altitude up to 2000 m (6562-ft.) |
| Rated supply voltage | AC90 V to 264 V |
| Rated supply frequency | 50/ 60 Hz |
| Maximum rated power consumption | 150 VA |
| Dimensions | Approx. 330 W × 119 H × 307 D mm (12.99" W × 4.69" H × 12.09" D) (excluding protrusions) |
| Mass | Approx. 5.8 kg (204.6 oz.) |
| Applicable StandardsSafety EMC | EN61010<br>EN61326 Class A<br>EN61000-3-2<br>EN61000-3-3<br>Influence of radiation induced by radio frequency electromagnetic fields: Z in 10 V/m: ±5% rdg $\theta$: ±5°<br>Influence of conduction induced by radio-frequency fields: Z in 3 V: ±5% rdg $\theta$: ±5° |
| Dielectric strength | Between the power wire and ground wire: 1.62 kV AC for 60 seconds |

## 5.Accessories, Options

| | |
|---|---|
| Accessories | Power Cord...................................................... 1<br>Instruction Manual ........................................... 1<br>Communication Instruction Manual (CD)......... 1 |
| Options | Model 9261-10 Test Fixture<br>Model 9262 Test Fixture<br>Model L2001 Pincher Probe<br>Model IM9901 Contact Tips (for model L2001)<br>Model IM9902 Contact Tips (for model L2001)<br>Model 9263 SMD Test Fixture<br>Model 9677 SMD Test Fixture<br>Model 9699 SMD Test Fixture<br>Model 9699 SMD Test Fixture<br>Model IM9100 SMD Test Fixture<br>Model L2000 4-Terminal Probe<br>Model 9140-10 4-Terminal Probe<br>Model 9500-10 4-Terminal Probe<br>Model IM9000 Equivalent Circuit Analysis Firmware<br>Model 9268-10 DC Bias Voltage Unit<br>Model 9269-10 DC Bias Current Unit |

## Options

### L2001
### Pincher Probe

Measurable range: DC to 8 MHz
Maximum applied voltage: ±42 Vpeak(AC+DC)
Maximum applied current: ±1 Apeak(AC+DC)
Electrode tip spacing: 0.3 to approx. 6 mm
　　　　　　IM9901: 0603 to 2220 (EIA)
　　　　　　IM9902: 0201 to 2220 (EIA)

### L2000
### 4-terminal Probe

▼ Alligator-clip-type measurement probes.
These general-purpose dual-electrode clips fit a wide range of conductor thicknesses.

Measurable range: DC to 8 MHz
Maximum voltage: ±42 Vpeak (AC+DC)
Maximum current: ±1 Apeak (AC+DC)
Measurement terminal hole diameter: 5 mm or less
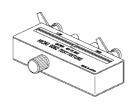
### 9140-10
### 4-terminal Probe

Measurable range: DC to 200 kHz
Maximum voltage: ±42 Vpeak (AC+DC)
Maximum current: ±1 Apeak (AC+DC)Measurement terminal hole diameter: φ0.3 mm to 5 mm

### 9500-10
### 4-terminal Probe

Measurable range: DC to 200 kHz
Maximum voltage: ±42 Vpeak (AC+DC)
Maximum current: ±1 Apeak (AC+DC)
Measurement terminal hole diameter: φ0.3 mm to 2.0 mm

### 9261-10
### 4-terminal Probe

Measurable range: DC to 8 MHz
Maximum voltage: ±42 Vpeak (AC+DC)
Maximum current: ±1 Apeak (AC+DC)
Measurement terminal hole diameter: 0.3 mm to 5 mm

### 9262
### Test Fixture
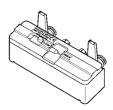
▼ This fixture is for measuring lead components. (less than 10 mΩ residual resistance after zero adjustment)

Measurable range: DC to 8 MHz
Maximum applied voltage: DC±40 V
Test sample dimensions: Lead diameter of 2 mm or less
Lead pitch of 5 mm or more
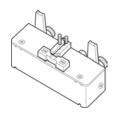
### 9263
### SMD Test Fixture

▼ This fixture is for measuring chip components. (less than 10 mΩ residual resistance after zero adjustment)

Measurable range: DC to 8 MHz
Maximum applied voltage: DC±40 V
Test sample dimensions: Test sample width of 1 to 10 mm

### 9677
### SMD Test Fixture

Measurable range: DC to 120 MHz
Maximum applied voltage: DC±40 V
Test sample width of 3.5±0.5 mm or less

## 13.1 General Specifications

### 9699
### SMD Test Fixture
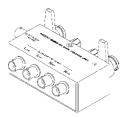
▼ This fixture is for the bottom surface of electrodes.

Measurable range: DC to 120 MHz
Maximum applied voltage: DC±40 V
Test sample dimensions: Test sample width of 1 to 4 mm
Test sample height of 1.5 mm or less

### IM9100
### SMD Test Fixture

Measurable range: DC to 8 MHz
Maximum applied voltage: ±42 Vpeak (AC+DC)
Maximum applied current: ±0.15 A rms (±0.15 ADC)
Measurement test sample dimensions: 0.4×0.2 mm, 0.6×0.3 mm,
1.0×0.5 mm

### 9268-10
### DC Bias Voltage Unit

Measurable range: 40 Hz to 5 MHz
Maximum applied voltage: DC±40 V

### 9269-10
### DC Bias Voltage Unit

Measurable range: 40 Hz to 2 MHz
Maximum applied current: DC2 A

### IM9000
### Equivalent Circuit Analysis Firmware

▼ This option enables equivalent circuit analysis and other IM3570 functionality.

- Equivalent circuit analysis (automatic, fixed): 5 patterns
- PASS/FAIL judgments for equivalent circuit elements
- Analysis result simulation
- Cole-cole plot display/admittance circle display

# 13.2 Measurement Range and Accuracy

The measurement accuracy is calculated from a basic accuracy, which is based on the accuracy for impedance Z (% rdg.) and phase angle θ (° ), and the following coefficients.

> **Measurement accuracy = Basic accuracy × C × D × E × F × G**
>
> C: Level coefficient/ D: Measurement speed coefficient/ E: Cable length coefficient/
> F:DC bias coefficient/ G: Temperature coefficient

## Basic accuracy

Measurement conditions of basic accuracy coefficient table
- Using the Model 9262 Test Fixture
- Measurement speed: SLOW2
- Cable length: 0 m
- Operation 60 minutes after the power is turned on.
- Open circuit compensation and short circuit compensation both being performed.
- DC adjustment ON (when DC resistance measurement)
- Temperature and humidity: 23±5°C, 80%RH or less

When the measurement conditions differ from the above, multiply the level coefficient (C), measurement speed coefficient (D), cable length coefficient (E), DC bias coefficient (F), and temperature coefficient (G) by the basic accuracy.

The basic accuracy is calculated by determining coefficient A and B from the basic accuracy coefficient table in accordance with the measurement frequency*1 and measurement range, and then using the following expression.

The basic accuracy becomes the accuracy [%] of Z and accuracy [° ] of θ.

*1    When the measurement frequency is 1.001 MHz or more, (f [MHz] +3)/4 must be multiplied to the basic accuracy.

1 kΩ range or more

$$\text{Basic accuracy} = \pm \left( A + B \times \left| \frac{10 \times Zx[\Omega]}{\text{Range } [\Omega]} - 1 \right| \right)$$

100 Ω range or less

$$\text{Basic accuracy} = \pm \left( A + B \times \left| \frac{\text{Range}[\Omega]}{Zx[\Omega]} - 1 \right| \right)$$

Zx: Impedance (effective value or value obtained by the following expression) of the test sample

$$\begin{aligned} Zx[\Omega] &= \omega L \,[H] & (\text{when } \theta = 90°) \\ &= 1 / \omega C \,[F] & (\text{when } \theta = -90°) \\ &= R[\Omega] & (\text{when } \theta = 0°) \end{aligned}$$

## 13.2  Measurement Range and Accuracy

### Accuracy table

Upper portion: Impedance Z (Unit: %)   Lower portion:  Phase angle θ (Unit: °)

| Range | | DC | 4.00 Hz to 99.99 Hz | 100.00 Hz to 999.99 Hz | 1.0000 kHz to 10.000 kHz | 10.001 kHz to 100.00 kHz | 100.01 kHz to 1.0000 MHz | 1.0001 MHz to 5.0000 MHz |
|---|---|---|---|---|---|---|---|---|
| 100 MΩ | Z | A= 4  B= 6 | A= 6  B= 5 | A= 3  B= 2 | A= 3  B= 2 | A= 8  B= 4 | -  - | -  - |
|  | θ |  | A= 5  B= 3 | A= 2  B= 2 | A= 2  B= 2 | A= 3  B= 2 | -  - | -  - |
| 10 MΩ | Z | A= 0.5  B= 0.3 | A= 0.8  B= 1 | A= 0.5  B= 0.3 | A= 0.5  B= 0.3 | A= 1  B= 0.7 | A= 3  B= 2 | -  - |
|  | θ |  | A= 0.8  B= 0.5 | A= 0.4  B= 0.2 | A= 0.4  B= 0.2 | A= 1  B= 0.2 | A= 3  B= 1 | -  - |
| 1 MΩ | Z | A= 0.2  B= 0.1 | A= 0.4  B= 0.08 | A= 0.3  B= 0.05 | A= 0.3  B= 0.05 | A= 0.3  B= 0.08 | A= 1  B= 0.5 | A= 2  B= 1 |
|  | θ |  | A= 0.3  B= 0.08 | A= 0.2  B= 0.02 | A= 0.2  B= 0.02 | A= 0.3  B= 0.08 | A= 1  B= 0.5 | A= 2  B= 1 |
| 100 kΩ | Z | A= 0.1  B= 0.01 | A= 0.3  B= 0.01 | A= 0.2  B= 0.01 | A= 0.15  B= 0.01 | A= 0.25  B= 0.04 | A= 0.4  B= 0.3 | A= 2  B= 0.5 |
|  | θ |  | A= 0.3  B= 0.01 | A= 0.1  B= 0.01 | A= 0.1  B= 0.01 | A= 0.2  B= 0.02 | A= 0.3  B= 0.3 | A= 2  B= 0.3 |
| 30 kΩ | Z | A= 0.1  B= 0.01 | A= 0.3  B= 0.01 | A= 0.2  B= 0.005 | A= 0.12  B= 0.005 | A= 0.25  B= 0.01 | A= 0.4  B= 0.05 | A= 2  B= 0.1 |
|  | θ |  | A= 0.3  B= 0.01 | A= 0.1  B= 0.003 | A= 0.08  B= 0.003 | A= 0.15  B= 0.005 | A= 0.3  B= 0.03 | A= 2  B= 0.1 |
| 10 kΩ | Z | A= 0.1  B= 0.01 | A= 0.3  B= 0.01 | A= 0.2  B= 0.01 | A= 0.12  B= 0.005 | A= 0.2  B= 0.02 | A= 0.3  B= 0.03 | A= 1.5  B= 0.2 |
|  | θ |  | A= 0.3  B= 0.01 | A= 0.1  B= 0.005 | A= 0.08  B= 0.002 | A= 0.08  B= 0.02 | A= 0.2  B= 0.05 | A= 1  B= 0.2 |
| 3 kΩ | Z | A= 0.1  B= 0.01 | A= 0.3  B= 0.02 | A= 0.2  B= 0.005 | A= 0.12  B= 0.005 | A= 0.2  B= 0.005 | A= 0.3  B= 0.01 | A= 1.5  B= 0.02 |
|  | θ |  | A= 0.2  B= 0.01 | A= 0.1  B= 0.002 | A= 0.08  B= 0.002 | A= 0.08  B= 0.005 | A= 0.15  B= 0.01 | A= 1  B= 0.03 |
| 1 kΩ | Z | A= 0.1  B= 0.01 | A= 0.3  B= 0.02 | A= 0.2  B= 0.01 | A= 0.1  B= 0.005 | A= 0.2  B= 0.01 | A= 0.3  B= 0.01 | A= 1.5  B= 0.01 |
|  | θ |  | A= 0.2  B= 0.01 | A= 0.1  B= 0.005 | A= 0.08  B= 0.002 | A= 0.08  B= 0.01 | A= 0.15  B= 0.01 | A= 1  B= 0.01 |
| 300 Ω | Z | A= 0.1  B= 0.02 | A= 0.4  B= 0.02 | A= 0.3  B= 0.02 | A= 0.08  B= 0.02 | A= 0.2  B= 0.02 | A= 0.3  B= 0.03 | A= 1.5  B= 0.05 |
|  | θ |  | A= 0.2  B= 0.01 | A= 0.15  B= 0.01 | A= 0.05  B= 0.01 | A= 0.08  B= 0.02 | A= 0.15  B= 0.02 | A= 1  B= 0.05 |
| 10 Ω | Z | A= 0.2  B= 0.15 | A= 0.5  B= 0.2 | A= 0.4  B= 0.05 | A= 0.3  B= 0.05 | A= 0.3  B= 0.05 | A= 0.4  B= 0.2 | A= 2  B= 1.5 |
|  | θ |  | A= 0.3  B= 0.1 | A= 0.3  B= 0.03 | A= 0.15  B= 0.03 | A= 0.15  B= 0.03 | A= 0.3  B= 0.1 | A= 2  B= 1 |
| 1 Ω | Z | A= 0.3  B= 0.3 | A= 2  B= 1 | A= 0.6  B= 0.3 | A= 0.4  B= 0.3 | A= 0.4  B= 0.3 | A= 1  B= 1 | A= 3  B= 3 |
|  | θ |  | A= 1  B= 0.6 | A= 0.5  B= 0.2 | A= 0.25  B= 0.2 | A= 0.25  B= 0.2 | A= 0.7  B= 0.5 | A= 3  B= 2 |
| 100 mΩ | Z | A= 3  B= 2 | A= 10  B= 10 | A= 3  B= 3 | A= 3  B= 2 | A= 2  B= 2 | A= 4  B= 3 | -  - |
|  | θ |  | A= 6  B= 6 | A= 2  B= 2 | A= 2  B= 1.5 | A= 2  B= 1.5 | A= 3  B= 4 | -  - |

## C  Level coefficient

The coefficient corresponding to the setting for measurement level is obtained from the measurement level coefficient table and then multiplied by the basic accuracy.

| | 0.005 V to 0.999 V | 1 V to 5 V |
|---|---|---|
| Level coefficient | $1+\dfrac{0.1}{V}$  (30 kΩ range or less of other than DCR) | 1 |
| | $1+\dfrac{0.3}{V}$  (Except for the above) | 1 |

V: Setting value (equivalent to when V mode) [V]

## D  Measurement speed coefficient

The coefficient corresponding to the setting for measurement speed is obtained from the measurement speed coefficient table and then multiplied by the basic accuracy.

| | FAST | NORMAL | SLOW | SLOW2 |
|---|---|---|---|---|
| Speed coefficient | 8 | 4 | 2 | 1 |

## E Cable length coefficient

The coefficient corresponding to the setting for measurement cable length is obtained from the measurement cable length table and then multiplied by the basic accuracy.

| | 0 m | 1 m | 2 m | 4 m |
|---|---|---|---|---|
| Cable length coefficient | 1 | 1.5 | $2\left(1+\dfrac{fm}{100}\right)$ | $4\left(1+\dfrac{fm}{100}\right)$ |

fm: Measurement frequency [kHz]
Guaranteed Accuracy Range: 0 m and 1 m = 4 Hz to 5 MHz, 2 m = 4 Hz to 100 kHz, 4 m = 4 Hz to 10 kHz

## F DC bias coefficient

The coefficient corresponding to the setting for ON/ OFF of DC bias is obtained from the DC bias coefficient table and then multiplied by the basic accuracy.

| | DC Bias Setting OFF | DC Bias Setting ON |
|---|---|---|
| DC bias coefficient | 1 | $2\left(1+\dfrac{0.1}{V_{AC}}\right) \times \alpha$ |

$V_{AC}$: AC signal voltage setting value [V]
$\alpha$ : This is 2 when 100.01 kHz or more of the 10 $\Omega$ range or less, and 1 in cases other than that.

## G Temperature coefficient

The coefficient corresponding to the operating temperature is obtained from the operating temperature coefficient table and then added to the basic accuracy.

| | 0°C $\leq$ t < 18°C, 28°C < t $\leq$ 40°C | 18°C $\leq$ t $\leq$ 28°C |
|---|---|---|
| Temperature coefficient | 1+0.1 $\times$ \|t - 23\| | 1 |

When the operating temperature (t) is 23°C ±5°C, the coefficient is 1.

## 13.2  Measurement Range and Accuracy

### Guaranteed Accuracy Range

The guaranteed accuracy range differs depending on the measurement frequency, measurement signal level, and measurement range.

| Range | DC | 4.00 Hz to 99.99 Hz | 100.00 Hz to 999.99 Hz | 1.0000 kHz to 10.000 kHz | 10.001 kHz to 100.00 kHz | 100.01 kHz to 1.0000 MHz | 1.0001 MHz to 5.0000 MHz |
|---|---|---|---|---|---|---|---|
| 100 MΩ | 0.1 V to 2.5 V | 0.101 V to 5 V | | | 0.501 V to 5 V | | |
| 10 MΩ | 0.1 V to 2.5 V | 0.050 V to 5 V | | | 0.101 V to 5 V | 0.501 V to 5 V | |
| 1 MΩ | | | | | 0.050 V to 5 V | 0.101 V to 5 V | 0.501 V to 1 V |
| 100 kΩ | | | | | | 0.050 V to 5 V | 0.101 V to 1 V |
| 30 kΩ | | | | | | | |
| 10 kΩ | | | | | | | |
| 3 kΩ | | 0.005 V to 5 V | | | | | 0.05 V to 1 V |
| 1 kΩ | | | | | | | |
| 300 Ω | | | | | | | |
| 10 Ω | | | | | | | |
| 1 Ω | | 0.005 V to 5 V *2 | | | | 0.101 V to 5 V | 0.501 V to 1 V |
| 100 mΩ | 0.1 V to 2.5 V *1 | 0.101 V to 5 V *3 | | | | 0.501 V to 5 V*3 | |

The above voltages are the voltage settings equivalent to when V mode.

*1 The guaranteed accuracy is 10 mΩ or higher

*2 The guaranteed accuracy for when DC bias is 0.101 to 5 V.

*3 The guaranteed accuracy for when DC bias is 10 mΩ or higher and 1.001 to 5 V.

**NOTE**
The above measurement specification was determined using a 1.5C-2 V coaxial cable with an established cable length for the unit.

Using a cable other than a 1.5C-2 V, or a cable that not an established length for the unit in question increases the chance of measurement inaccuracy. A large capacitance between the H terminal and grounding capacitance (GND) or the L terminal and GND may result in measurement inaccuracy. Please set the GND to 10 pF or less.

# 13.3 About Measurement Times and Measurement Speed

Measurement times differ depending on the measurement conditions. Refer to the following values.

NOTE   All of the values are reference values. Note that they may differ depending on the conditions of use.

## Analog measurement signal (INDEX)

|  | FAST | MED | SLOW | SLOW2 |
|---|---|---|---|---|
| DC | 1 ms+0.6 ms | 10 ms+0.6 ms | 100 ms+0.6 ms | 400 ms+0.6 ms |
| 4.00 Hz to 19.99 Hz | Tf+0.6 ms | 2 × Tf+0.6 ms | 3 × Tf+0.6 ms | 4 × Tf+0.6 ms |
| 20.00 Hz to 100.00 Hz | Tf+0.6 ms | 2 × Tf+0.6 ms | 8 × Tf+0.6 ms | 64 × Tf+0.6 ms |
| 100.01 Hz to 999.99 Hz | Tf+0.6 ms | 4 × Tf+0.6 ms | 16 × Tf+0.6 ms | 128 × Tf+0.6 ms |
| 1.0000 kHz to 3.0000 kHz | Tf+0.2 ms | 8 × Tf+0.2 ms | 32 × Tf+0.2 ms | 256 × Tf+0.2 ms |
| 3.0001 kHz to 10.000 kHz | Tf+0.2 ms | 16 × Tf+0.2 ms | 64 × Tf+0.2 ms | 512 × Tf+0.2 ms |
| 10.001 kHz to 30.000 kHz | 4 × Tf+0.2 ms | 64 × Tf+0.2 ms | 256 × Tf+0.2 ms | 2048 × Tf+0.2 ms |
| 30.001 kHz to 100.00 kHz | 8 × Tf+0.1 ms | 128 × Tf+0.1 ms | 512 × Tf+0.1 ms | 4096 × Tf+0.1 ms |
| 100.01 kHz to 300.00 kHz | 32 × Tf+0.1 ms | 512 × Tf+0.1 ms | 2048 × Tf+0.1 ms | 16384 × Tf+0.1 ms |
| 300.01 kHz to 1.0000 MHz | 64 × Tf+0.1 ms | 1024 × Tf+0.1 ms | 4096 × Tf+0.1 ms | 32768 × Tf+0.1 ms |
| 1.0001 MHz to 5.0000 MHz | 400 × Tf+0.1 ms | 6400 × Tf+0.1 ms | 25600 × Tf+0.1 ms | 204800 × Tf+0.1 ms |

Tolerance: ±5% ±0.2 ms Tf [s]=1 ÷ measurement frequency
The DC time is the time when DC adjustment is OFF. The time is about twice as long when DC adjustment is ON.

When there is an external trigger, the corresponding time shown in the table below is added to the analog measurement signal.

| Range | Level | Frequency | Low Z High Accuracy Mode | DC Bias | Time |
|---|---|---|---|---|---|
| 100 mΩ, 1 Ω | All levels | DC, 4 Hz to 999.99 Hz | ON | OFF | 5 ms |
| 100 mΩ, 1 Ω | All levels | 1 kHz to 5 MHz * | ON | OFF | 1 ms |
| 100 mΩ, 1 Ω | All levels | ALL frequency * | ON | ON | 1 ms |
| 100 mΩ, 1 Ω | All levels | DC, ALL frequency | OFF | OFF | 1 ms |
| 10 Ω | 0.005 V to 0.1 V | DC, ALL frequency | OFF | OFF | 1 ms |
| 10 Ω | 0.101 V to 1 V | DC, 4 Hz to 1 MHz | OFF | OFF | 1 ms |

* Low Z high accuracy mode is only valid when the frequency is between 4 Hz and 100 kHz.

## 13.3  About Measurement Times and Measurement Speed

### Measurement times (EOM)

**Measurement times= INDEX + A + B + C + D + E + F**

**A.** Calculation time (no OPEN /SHORT/ LOAD compensation, HOLD range, normal measurement)

| | FAST | MED | SLOW | SLOW2 |
|---|---|---|---|---|
| All frequencies | 0.5 ms | | | |

Tolerance: ±10% ±0.1 ms

**B.** OPEN/ SHORT/ LOAD compensation

| OPEN/ SHORT/ LOAD compensation | |
|---|---|
| No | 0.0 ms |
| Yes | MAX 0.4 ms |

**C.** Measurement mode

| Measurement mode | |
|---|---|
| Normal measurement | 0.0 ms |
| Comparator measurement | MAX 0.4 ms |
| BIN measurement | MAX 0.8 ms |

**D.** Screen Display

| Screen display | |
|---|---|
| When no screen display | 0.0 ms |
| When screen display | MAX 0.3 ms |

**E.** Saving to memory

| Saving to memory | |
|---|---|
| Memory function ON/ IN | MAX 0.4 ms |
| Memory function OFF | 0.0 ms |

**F.** Equivalent circuit analysis (optional IM9000)

| Equivalent circuit analysis* | |
|---|---|
| Analysis OFF | 0.0 ms |
| Equivalent circuit model: A to D | MAX 2.5 ms |
| Equivalent circuit model: E | MAX 3.5 ms |

* Using 201 sweep points, equivalent circuit model selection
  hold, and auto analysis.

## Wait time

**• When the frequency is changed:**
The wait time differs depending on the frequency changed.

$$\text{Wait time} = \left| \frac{1}{\text{Frequency before change}} - \frac{1}{\text{Frequency after change}} \right|$$

Furthermore, if the range of the measurement frequencies is divided into the following seven categories and the frequency is changed to one in a different range, a wait time of 1 ms is added. However, if the frequency is changed to one that spans 1.0001 MHz, a wait of 3 ms is added.

| Range classification | Measurement frequency |
|:---:|:---:|
| 1 | DC |
| 2 | 4 Hz to 10 kHz |
| 3 | 10.001 kHz to 100 kHz |
| 4 | 100.01 kHz to 1 MHz |
| 5 | 1.0001 MHz to 5 MHz |

**• When switching levels**
When the AC signal level is changed, the wait time is 300 μs.
Also, the range of measurement signal levels is divided into the following five categories.
When the level is changed to one in a different range, the wait time is 1 ms.

| Range classification | Measurement signal level |
|:---:|:---:|
| 1 | 0.005 V to 0.049 V |
| 2 | 0.05 V to 0.1 V |
| 3 | 0.101 V to 0.5 V |
| 4 | 0.501 V to 1 V |
| 5 | 1.001 V to 5 V |

**• When switching ranges**
When the range is changed, the wait time is 1 ms.
Also, when low Z impedance high accuracy mode is turned ON/ OFF, the wait time is 1 ms.

**• When DC bias**
When DC bias is changed to ON/ OFF and when the DC bias level is changed, the wait time is 300 μs.

**• When DC resistance measurement**
When the measurement signal level for DC resistance measurement is changed, the wait time is 300 μs. Each time the measurement signal level is changed during DC adjustment, the wait time is 300 μs. When a DC delay is set, that wait time occurs again in order to change the measurement signal level.

**• When panel load**
After all changes are made, the wait time is the sum of the wait time when the frequency is changed and the maximum value of other wait times of the corresponding wait times above.
(If the measurement level and range linked to, for example, a change in the measurement frequency are changed, there is a wait for the maximum value of the corresponding wait time above after all of the linked changes are made.)

# Maintenance and Service  Chapter 14

## 14.1 Inspection, Repair and Cleaning

Before requesting instrument repair or inspection, please read "Before returning for repair" (p. 405) and Section "Error display" (p. 407).

### Inspection and Repair

⚠ **WARNING** Do not attempt to modify, disassemble or repair the instrument; as fire, electric shock and injury could result.

**NOTE**
- If damage is suspected, check the "Before returning for repair" (p. 405) section before contacting your dealer or Hioki representative.
- If the fuse blows, do not attempt to replace the fuse or repair the instrument: contact your dealer or Hioki representative.
- If damage is suspected, check the"Before returning for repair" (p. 405) section before contacting your dealer or Hioki representative.
  However, in the following cases, immediately stop using the instrument, unplug the power cord and contact your dealer or Hioki representative.
  - When the nature of the damage is clearly evident
  - When measurement is impossible
  - After long-term storage in adverse conditions such as high temperature or humidity
  - After being subject to severe shock during transport
  - After severe exposure to water, oil, or dust (internal insulation can be degraded by oil or water, causing increase hazard of electric shock or fire)
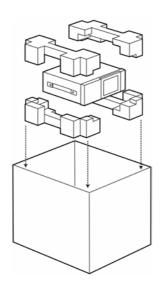
### Replaceable Parts

Certain parts require replacement periodically and at the end of their useful life: (Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods)

| Part | Life | Remarks |
|------|------|---------|
| Electrolytic Capacitors | Approx. 10 years | The useful life of electrolytic capacitors depends on the operating environment.Periodic replacement is necessary. |
| Lithium battery | Approx. 10 years | The instrument incorporates a lithium battery for backup. The life of the backup battery is approximately 10 years. If the date and time greatly differ from the actual date and time when the power is turned on or a backup error appears at startup, it is time to replace the battery. Contact your dealer or Hioki representative. |
| Fan motor | Approx. 50,000 hours | Periodic replacement is necessary. |
| LCD backlight (to half brightness) | Approx. 50,000 hours | Periodic replacement is necessary. |

## Transporting the instrument



- Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We do not take any responsibility for damage incurred during shipping.
- Use the original packing materials when transporting the instrument, if possible.

## Cleaning

**NOTE**
- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- Wipe the LCD gently with a soft, dry cloth.

# 14.2 Troubleshooting

## Before returning for repair

In the event of the instrument malfunctioning, check the following items.

| Symptom | Check Item, or Cause | Remedy and Reference |
|---|---|---|
| The display does not appear when you turn the power on. | Is the power cord unplugged? Is it properly connected? | Confirm that the power cord is properly connected. See (p. 29) |
| Keys do not work. | Are the keys locked? | Disable the key lock. See (p. 121), (p. 230) |
| | Is the unit being remotely operated from an external device using the communication cable? | Switch to the local state. |
| A key other than the pressed one is pressed. | Have you performed panel compensation? | Perform panel compensation. See (p. 308) |
| Cannot print. | Is the recording paper loaded properly? Are the printer settings correct? (Communication speed, interface, etc.) Are the instrument and printer properly connected with a suitable cable? | See (p. 381) |
| Nothing is displayed on the screen. | The LCD may be set to automatically turn off after a set time. See (p. 127) | Touch the screen. |
| Key response and screen drawing are slow. | Is the measurement value automatic output function enabled? | When the measurement value automatic output function is enabled, key response and screen drawing may become slow in order to give priority to measurement and measurement value output. See Description of communications commands on the included CD |
| The measurement values differ when a standard resistor, standard capacitor, or other known test sample is measured. The measurement values differ when a standard resistor, standard capacitor, or other known test sample is measured. | Do the measurement conditions of the known test sample and measurement conditions of the instrument match? | Make sure the measurement conditions match. |
| | Did you perform open and short compensation properly? | Perform open and short compensation again. See (p. 273) |
| | Is load compensation set? | Turn load compensation off. See (p. 288) |
| | Is the wait time for from connecting the test sample until performing measurement insufficient? | Ensure there is an appropriate trigger delay and trigger synchronization output wait time. See (p. 64), (p. 104), (p. 140) |
| | Is a test sample other than a capacitor being measured using the DC bias function? | Turn the DC bias function OFF. |
| The LCD appears blurred. | Are you pressing the LCD screen too hard? | Press the LCD screen gently. Slight blurring may occur but this is normal. |
| Cannot perform measurement correctly. | Is a high-impedance element which is influenced by noise being measured? | Use guarding. See (p.A3) |
| | Is an element of other than a capacitor being measured using the DC bias function? | Turn the DC bias function OFF. See (p. 57) |

| Symptom | Check Item, or Cause | Remedy and Reference |
|---|---|---|
| AUTO ranging is unable to determine a range. | Is a high-impedance element which is influenced by noise being measured? | Use guarding. See (p.A3) |
| | Is an element of other than a capacitor being measured using the DC bias function? | Turn the DC bias function OFF. See (p. 57) |
| A contact error is generated even though the connections are correct. | Is an element of other than a capacitor being measured using the DC bias function? | Turn the DC bias function OFF. See (p. 57) |
| An error beep sound is emitted continuously. | Is the measurement value automatic output function enabled? | When the measurement value automatic output function is enabled, a send error occurs on the measuring instrument side if the receive operation is not performed on the PC side, and a send error sound is emitted continuously when, for example, there is an internal trigger. Perform the receive operation on the PC side and then perform measurement on the measuring instrument side, or disable the measurement value automatic output function. See Description of communications commands on the included CD |

## When no apparent cause can be established

Perform a system reset.
This will return all settings to their factory defaults.
**See** (p. 129), (p. 237)

## Full Reset Procedure

Performing a full reset will restore all of the settings to the factory default settings.
Only perform a full reset in the following cases.
- When the normal reset screen cannot be displayed because of a problem with the instrument.
  (After the full reset, perform a self check to confirm that there are no problems. (p. 307))
- When you have forgotten the passcode for the key lock.

If the instrument still does not operate normally after the full reset, it needs to be repaired.
Contact your dealer, or a Hioki representative if you are not sure where the instrument was purchased.

Opening Screen

HIOKI

IM3570
IMPEDANCE ANALYZER

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Software Version 1.00

**1** **Connect the power cable.**

**2** **Turn ON the switch on the back panel.**

**3** **While the opening screen is displayed, press the top right of the screen continuously.**

**4** **The full reset is complete when a beeping sound is emitted.**

After the full reset, the panel calibration screen is displayed automatically. (p. 308)

# 14.3 Error display

Chapter 14 Maintenance and Service

When any of the following indications appear on the screen, check the corresponding reference page.

| Error display | Description | Remedy and Reference |
|---|---|---|
| Error: 4<br>The interior temperature is abnormal | The internal temperature of the instrument is increasing. | Turn off the power and check whether the ventilation holes are blocked. (p. 11) |
| AC+DC limit error | The sum of the AC measurement signal and DC measurement signal exceeds the upper limit. | Reduce the AC signal level or DC signal level. (p. 43) |
| Change AC Level | If the sum of the AC signal level and DC signal level exceeds the upper limit when the signal level mode is changed, the AC signal level is forcefully controlled so that it becomes within the setting range. | Reduce the AC signal level or DC signal level. (p. 43) |
| IM3570 IMPEDANCE ANALYZER<br>BACKUP BATTERY IS DEAD | The life of the RAM backup battery has ended. | The instrument needs to be repaired. Contact your dealer or Hioki representative. |
| Reference Value | This is displayed when a measurement value is outside of the guaranteed accuracy range. | Increase the measurement signal level or change the measurement range to one that matches the impedance of the element to be measured.(p. 43), (p. 49) |
| ERR | • This is displayed when load compensation is enabled and the load compensation frequency does not match the current measurement frequency.<br>• This is displayed when constant voltage measurement and constant current measurement cannot be performed. | • When load compensation: Match the current measurement frequency to the compensation frequency.(p. 288)<br>• When constant voltage measurement or constant current measurement: Reduce the constant voltage level or constant current level. (p. 45) |

## 14.3 Error display

| Error display | Description | Remedy and Reference |
|---|---|---|
| **LMT** | This is displayed when a signal level that is lower than the set value is applied to the test sample as a result of the voltage/current limit value setting. | Set the limit value again or change the measurement signal level so that the limit value is not exceeded. (p. 60) |
| **?** | This is displayed when load compensation is enabled and a load compensation condition other than the frequency does not match the current measurement condition. | Match the current measurement condition to the load compensation condition. (p. 288) |
| **Memory Full** | This is displayed when the measurement results for the setting values are stored in the memory of the instrument. | Load or clear them from the memory of the instrument.(p. 219) |
| **DISP OUT** | This is displayed when a measurement value is outside of the screen display range. | Change the measurement range to one that matches the impedance of the element to be measured. (p. 49) |
| **SAMPLE ERR** | This is displayed when measurement does not end because of an internal circuit error. | The instrument needs to be repaired. Contact your dealer or Hioki representative. |
| **OVERFLOW** | This is displayed when a measurement value is at or above the upper limit value of the auto ranging range. | Change the measurement range to a high-impedance range. (p. 49) |
| **UNDERFLOW** | This is displayed when a measurement value is at or below the lower limit value of the auto ranging range. | Change the measurement range to a low-impedance range.(p. 49) |
| **L NO CNTCT** | This is displayed when the terminal of either $L_{POT}$ or $L_{CUR}$ is not connected because of, for example, a broken wire in low impedance high accuracy mode. | • Check the connection of each terminal. (p. 54)<br>• This may sometimes be displayed when an element of other than a capacitor is measured when using DC bias. (p. 54) |
| **H NO CNTCT** | This is displayed when the terminal of either $H_{POT}$ or $H_{CUR}$ is not connected because of, for example, a broken wire in low impedance high accuracy mode. | • Check the connection of each terminal. (p. 54)<br>• This may sometimes be displayed when an element of other than a capacitor is measured when using DC bias. (p. 54) |
| **Hi Z** | This is displayed when a measurement result is high in relation to the judgment reference set for the HIGH-Z reject function. | Check the connection of each terminal. (p. 108) |
| **Level Error** | This is displayed when a detection level error is detected while the detection level monitoring function is ON. | Check the connection of each terminal. (p. 110) |

# 14.4 Discarding the Instrument

When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

⚠ **WARNING**
- **To avoid electric shock, turn off the power switch and disconnect the power cord and measurement cables before removing the lithium battery.**
- **Battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.**
- **Keep batteries away from children to prevent accidental swallowing.**
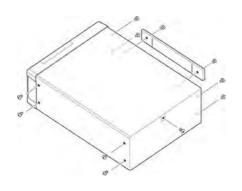
⚠ **CAUTION**
If the protective functions of the instrument are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.

## Lithium Battery Removal

**Required tools:**
- One Phillips screwdriver
- One wire cutter (to remove the lithium battery)

(Overhead View)

**1** Verify that the power is off, and remove the connection cables and power cord.

**2** Remove the six screws from the sides and one screw from the rear.

**3** Remove the cover.

**4** Insert the tweezers between the battery and battery holder as shown in the diagram below and lift up the battery.

Lithium Battery

Battery Holder

⚠ **CAUTION**

Take care not to short the + and -.
Doing so may cause sparks.

CALIFORNIA, USA ONLY
This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

1.888.610.7664　　www.calcert.com　　sales@calcert.com
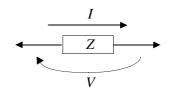
# Appendix

## Appendix 1 Measurement Parameters and Arithmetic Expressions
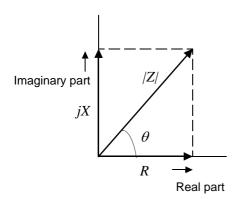
In general, impedance $Z$ is used to evaluate the characteristics of, for example, circuit components. Measure voltage and current vectors for circuit components relative to AC measurement frequency signals. The unit uses these values to obtain the impedance $Z$ and phase difference $\theta$. The following values can be obtained from impedance $Z$ by rotating the impedance $Z$ around the complex plane.



$$Z = R + jX$$

$$\theta = tan^{-1}\frac{X}{R}$$

$$|Z| = \sqrt{R^2 + X^2}$$
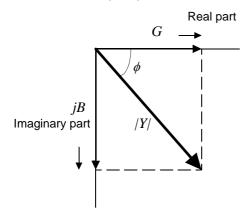
$Z$ : Impedance ($\Omega$)
$\theta$ : Phase angle (deg)
$R$ : Resistance ($\Omega$)
$X$ : Reactance ($\Omega$)
$|Z|$ : Absolute value of impedance ($\Omega$)

Furthermore, admittance $Y$ that is the reciprocal of impedance $Z$ can also be used depending on the characteristics of circuit components. As in the case
of impedance $Z$, the following values can also be obtained from admittance $Y$ by rotating the admittance $Y$ around the complex plane.



$$Y = G + jB$$

$$\phi = tan^{-1}\frac{B}{G}$$

$$|Y| = \sqrt{G^2 + B^2}$$

$Y$ : Admittance (S)
$\phi$ : Phase angel (deg) = $-\theta$
$G$ : Conductance (S)
$B$ : Susceptance (S)
$|Y|$ : Absolute value of admittance (S)

**Appendix**

# A2

## Appendix 1 Measurement Parameters and Arithmetic Expressions

From the voltage $V$ which is applied between the terminals of the sample under test, the current I which flows through the test sample at this time, the phase angle $\theta$ between this voltage $V$ and this current I, and the angular velocity $\omega$ which corresponds to the test frequency.

**NOTE** The phase angle $\theta$ is shown based on the impedance $Z$. When measuring based on the admittance $Y$, the sign of the phase angle $\theta$ must be reversed.

| Item | Series equivalent circuit mode | Parallel equivalent circuit mode |
|------|-------------------------------|----------------------------------|
| Z | $\|Z\| = \dfrac{V}{I}\left(= \sqrt{R^2 + X^2}\right)$ | |
| Y | $\|Y\| = \dfrac{1}{\|Z\|}\left(= \sqrt{G^2 + B^2}\right)$ | |
| R | $R_S = ESR = \|Z\| \cos\theta$ | $R_P = \dfrac{1}{\|Y\| \cos\phi}\left(= \dfrac{1}{G}\right)$ * |
| X | $X = \|Z\| \sin\theta$ | —————— |
| G | —————— | $G = \|Y\| \cos\phi$ * |
| B | —————— | $B = \|Y\| \sin\phi$ * |
| L | $L_S = \dfrac{X}{\omega}$ | $L_P = -\dfrac{1}{\omega B}$ |
| C | $C_S = -\dfrac{1}{\omega X}$ | $C_P = \dfrac{B}{\omega}$ |
| D | $D = \dfrac{\cos\theta}{\|\sin\theta\|}$ | |
| Q | $Q = \dfrac{\|\sin\theta\|}{\cos\theta}\left(= \dfrac{1}{D}\right)$ | |
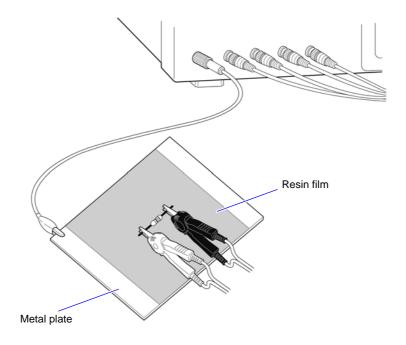
\* $\phi$ : phase angle of admittance Y ($\phi = -\theta$)

$Ls$, $Rs$, $Cs$: The measured values of $L$, $C$, and $R$ in series equivalent circuit mode.
$Lp$, $Rp$, $Cp$: The measured values of $L$, $C$, and $R$ in parallel equivalent circuit mode.

## Appendix 2   Measurement of High Impedance Components

The measured value obtained when testing a high impedance element (such as, for example, a resistor with resistance higher than 100 kΩ) is sometimes unreliable, because such an element is vulnerable to the effects of external interference and the like. In this case, reliable testing can be performed by the use of guarding, that is, connecting a metallic plate to the GUARD terminal and carrying out the measurement on the metallic plate.



Resin film

Metal plate
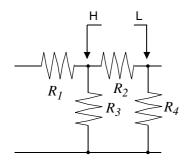
When measuring components on a metal plate, use, for example, resin film as insulation to ensure terminals and the like are not short-circuited.

**NOTE**   Open circuit compensation is high impedance measurement, so be sure to use the shielding process. If it is not used, the compensation values may become unstable and affect the measurement values.
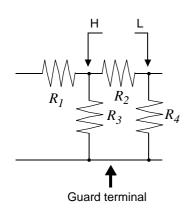
## Appendix 3   Measurement of In-circuit Components

Measure an in-circuit component after providing guarding.

$$R = R_2 \cdot \frac{R_3 + R_4}{R_2 + R_3 + R_4}$$



Referring to the following figure, when measuring a resistance value for the resistor $R_2$, even if the tips of the two probes are contacted against the ends of the resistor $R_2$, considering the sum of the current flowing through the resistor $R_2$ and the current flowing through the resistors $R_3$ and $R_4$, what is obtained is the resistance value for the parallel combination:



Guard terminal
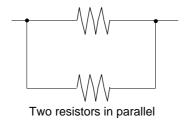
If as shown in the next figure a guard terminal is used, the current flowing through the resistors $R_3$ (not flowing through $R_4$) is absorbed by this guard terminal, so that the resistance value for the resistor $R_2$ is accurately measured.
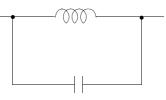
**NOTE**
- The accuracy of measurement will not be improved in cases where for example $R_2 \gg R_3$ and $R_3$ is close to zero.
- Individual elements cannot be isolated and measured separately in compound circuits consisting of the same element, for example two resistors as shown in the diagram.
  However, individual elements can be isolated and measured separately in compound circuits such as an inductor and capacitor by using the IM9000 Equivalent Circuit Analysis Firmware (option).
  Isolated measurement is supported for five equivalent circuit models.
  **See**



Two resistors in parallel            Coil and capacitor in parallel

# Appendix 4　Countermeasures Against Incorporation of External Noise

The unit is designed to be resistant to errors caused by interference from the test cables or the power supply line. However, if the level of the interference is particularly large, this can cause measurement errors or faulty operation.

Refer to the examples given below for examples of countermeasures which can be taken against interference which has caused faulty operation etc.

## Appendix4.1 Countermeasures Against Incorporation of Noise from the Power Line
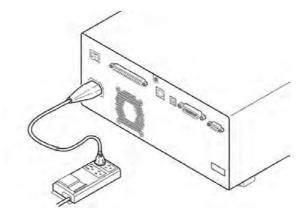
You can use the following countermeasures to reduce the effect of noise being incorporated from the power line.

### Grounding Using a Protective Ground Wire

The unit is structured so that the ground wire of the power cable can be used as protective grounding for the unit. Protective grounding plays an important role in not only the prevention of electrical accidents but also the use of an internal filter to eliminate the incorporation of noise from the power line. Use the supplied power cord.

### Attaching a Noise Filter to the Power Line

Connect a commercial plug-in noise filter to the power outlet and then connect the unit to the output of the noise filter in order to suppress the incorporation of noise from the power line.
Plug-in noise filters are commercially available from various specialist manufacturers.



**Appendix**
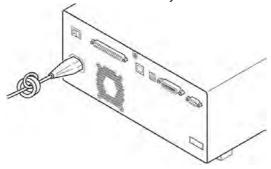
## Attaching an EMI Suppression Ferrite Core to the Power Cord

Pass the power cord through a commercially available EMI suppression ferrite core and secure the core as close as possible to the AC power inlet of the unit in order to suppress the incorporation of noise from the power line.

Suppression is even more effective if you also attach an EMI suppression ferrite core close to the power plug of the power source.

If a toroidal ferrite core or split ferrite core with a large enough internal diameter is used, the amount of noise suppression can be increased by passing the power cord through the core several times.

EMI ferrite cores and ferrite beads are commercially available from various specialist manufacturers.
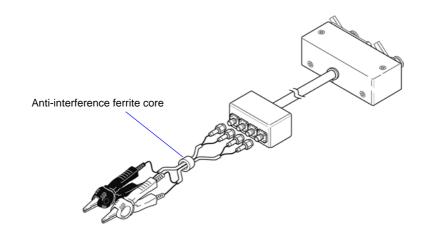


## Appendix4.2 Countermeasures Against Noise from the measurement Cables

If interference is producing noise in the measurement cables, its influence can be moderated by the following countermeasure.

## Fitting an anti-interference ferrite core on the measurement cables

Pass the test cables through a commercially available anti-interference ferrite core, and fix it close to the measurement terminals, so as to suppress noise from the measurement cables.

Moreover, if the internal diameter of the ferrite core allows, winding the measurement cables several times around the ferrite core (as with the power cord as described above) may further reduce the amount of noise.



Anti-interference ferrite core

# Appendix 5   Supplying DC Bias

Supplying DC bias means that a DC voltage is supplied as a bias to a sample for test whose characteristics are voltage dependent, such as an electrolytic capacitor or a ceramic capacitor.

Further, a DC current can be supplied as a bias to a sample for test whose characteristics are current dependent, such as a choke coil.

This instrument does not provide a DC bias input terminal. DC bias should be applied using the method described below.
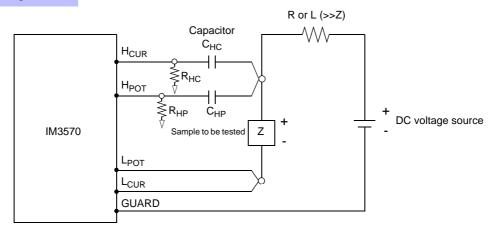
⚠**CAUTION** A voltage must not be applied to the measurement terminals of the instrument from an external source.
If a voltage is applied from an external source, the instrument may be damaged.

# Appendix5.1 How to Supply a DC Bias Voltage

When you want to apply a DC voltage bias, refer to the following explanation.
Apply a DC voltage bias to a capacitor or other test sample as shown below.

DC Bias Voltage Circuit



- Use a resistance (R) or inductance (L) which has a large enough impedance with reference to the sample under test (Z).
- A $H_{CUR}$ side capacitor must have a small enough impedance (i.e. a large enough capacitance) relative to the output resistance (100 Ω) while a $H_{POT}$ capacitor must have a small enough impedance to the $R_{HP}$.
- Be careful about the polarity when connecting together the probes, the sample to be tested, and the DC voltage source.
- It takes a little time for the DC voltage which is being supplied to the sample under test to reach the set voltage, so you should wait for a certain stabilization time period (which depends upon the sample) before performing
- testing. Be careful, because if you perform testing before this stabilization time period has elapsed, the results will not be reliable.
- After testing is completed, drop the voltage of the DC voltage source to zero, and remove the sample under test from the probes after having discharged any electric charge which may have built up.
- If you have removed the sample under test from the probes without first having discharged the accumulated electric charge, you should be careful to do so immediately.
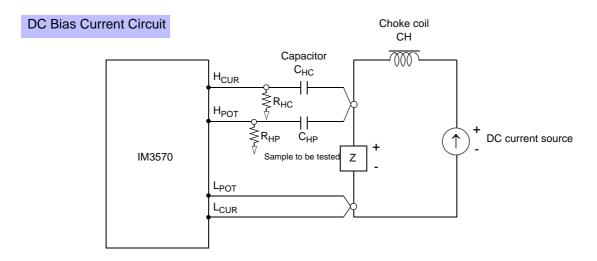
1.888.610.7664          📱 www.calcert.com          sales@calcert.com

# A8

## Appendix 5 Supplying DC Bias

⚠️**CAUTION**

- In order to avoid electric shock accident, be absolutely sure not to touch the test terminals while the DC bias voltage is being supplied to them.
- If you disconnect the sample under test from the test terminals with the DC bias voltage still being supplied, then the test sample is left charged, which is very dangerous. In order to avoid electric shock
- accident, be absolutely sure to discharge the test sample.
- Do not short circuit between the clips of the test probes with the DC bias voltage still being supplied. Doing so may damage the probes or cause a short circuit accident.
- When measuring the element whose DC resistance is not high enough, DC current will flow to the main unit and the measurement will not be performed properly.

## Appendix5.2 How to Supply a DC Bias Current

When you want to apply a DC current bias, refer to the following explanation.
With regards to a DC current bias for a transformer, choke coil, or other test sample, configure the external bias circuit as shown below.

DC Bias Current Circuit



- Connect the sample to the measuring probe and then gradually raise the voltage of the DC source to the specified DC bias level. To disconnect the sample, gradually reduce the voltage of the DC source until the DC bias supplied to the sample is decreased to zero. You may disconnect the sample after this is achieved.
- Use a choke coil (CH) which has a large enough impedance with reference to the sample under test (Z).
- A $H_{CUR}$ side capacitor must have a small enough impedance (i.e. a large enough capacitance) relative to the output resistance (100 Ω) while a $H_{POT}$ capacitor must have a small enough impedance to the $R_{HP}$.
- Be careful about the polarity when connecting together the probes, the sample to be tested, and the DC current source.
- Be careful not to magnetically saturate the choke coil (CH) with the DC bias current.
- It takes a little time for the DC current which is being supplied to the sample under test to reach the set value, so you should wait for a certain stabilization time period (which depends upon the sample) before performing testing. Be careful, because if you perform testing before this stabilization time period has elapsed, the results will not be reliable.

⚠ **CAUTION**
- In order to avoid electric shock accident, be absolutely sure not to touch the test terminals while the DC bias is being supplied to them.
- Due to the inductance of the coil and the sample, counter electromotive force is generated when the sample is removed or inserted with the DC bias supplied. This may result in damage to the unit or to the DC source.
- When measuring the element whose DC resistance is high (incl. open state), a high voltage occurred on the H side may cause damage on the main unit.

# A10

## Appendix 6   The Residual Charge Protection Function

The unit has been enhanced by the incorporation of a residual charge protection function. If by mistake a charged capacitor is connected to the measurement terminals, this function protects the internal circuitry of the unit from discharge of such residual charge.

The maximum voltage from which the unit can be protected by this function is determined from the capacitance value of the sample under test by the following equation:

$$V = \sqrt{\frac{10}{C}}$$

V: voltage (volts) (maximum 400 VDC)
C: capacitance (farads)

**⚠ CAUTION**
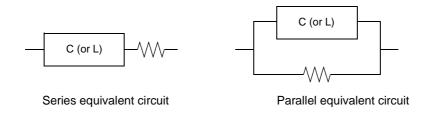
- The quoted maximum voltage from which the unit can be protected by this function is for reference purposes only, and is not a guaranteed value. There may be danger of damage to the unit, depending upon the operational circumstances and upon how often such charged capacitors are connected. In general, you should not rely upon this protection function; be sure to discharge charged capacitors properly before connecting them to the test terminals.

- The residual charge protection function is for protection of the unit against the discharge of voltage present in charged capacitors, and is not capable of protecting the unit against DC voltage which is constantly applied such as a superimposed DC voltage. If this is done, there is a danger of damage to the unit.

  **See:** Appendix 5  Supplying DC Bias (p.A7)

# Appendix 7   Series Equivalent Circuit Mode and Parallel Equivalent Circuit Mode

The instrument measures the current flowing to the test sample and the voltage at both ends of the test sample, and determines Z and $\theta$. Other measurement items such as L, C, and R are calculated from Z and $\theta$. At this time, the mode for calculation becomes series equivalent circuit mode if the resistance components for C (or L) are assumed to be in series, and the mode becomes parallel equivalent circuit mode if the resistance components for C (or L) are assumed to be in parallel. It is, therefore, necessary to select the correct equivalent circuit mode to reduce errors because the calculation expression differs for series equivalent circuit mode and parallel equivalent circuit mode.

Generally, for measurement of a low impedance device (approx. less than 100 $\Omega$) like a large capacitance capacitor or a low inductance, a seriesequivalent circuit mode will be selected. While, for a high impedance device (approx. more than 10 k$\Omega$) like a small capacitance capacitor or a high inductance, a parallel-equivalent circuit mode will be selected. When you are not sure about selection of circuit mode, please ask the parts maker. (ex. a impedance approx. between 100 $\Omega$ and 10 k$\Omega$)

Series equivalent circuit

Parallel equivalent circuit

**NOTE** Because measurement value in each equivalent circuit mode is obtained through calculation, measurement values of both modes can be displayed. However, please note that the appropriate equivalent circuit depends on the test sample.

# Appendix 8   Selecting the Equivalent Circuit Model

When using the equivalent circuit function, it is important to select an appropriate equivalent circuit model. The following table provides examples of measurement targets and equivalent circuit models:
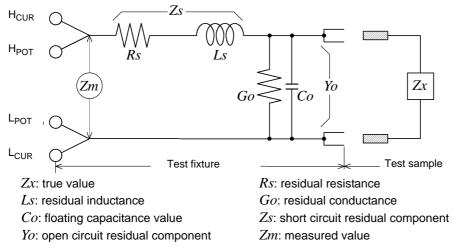
| Measurement target | | Corresponding equivalent circuit model |
|---|---|---|
| Inductor | Inductor with high core loss and low ESR | A |
| | Comparatively high ESR | B |
| Capacitor | Significant leak resistance effect | C |
| | Typical capacitor | D |
| Resistor | Low resistance value, significant inductance effect | B |
| | High resistance value, significant stray capacitance effect | C |
| Piezoelectric element | - | E |

Since the models for which parameters can be accurately acquired varies with observed values, perform a simulation for estimated results and select the equivalent circuit model based on a comparison with observed values.

When automatically selecting the equivalent circuit model, it will not be possible to select the optimal model when the acquisition of frequency characteristics fails to yield local extreme values. Consequently, set the sweep range so that resonance characteristics can be accurately acquired.

# Appendix 9   Open Circuit Compensation and Short Circuit Compensation

The residual impedance component of the test fixture can be considered in terms of an equivalent circuit as shown in the figure. Further, because the measured value $Zm$ for impedance includes this residual component, therefore, in order to obtain the genuine impedance value, it is necessary to compensate the measured value in terms of the open circuit impedance residual component and the short circuit residual component, which accordingly must be obtained.



$Zx$: true value
$Ls$: residual inductance
$Co$: floating capacitance value
$Yo$: open circuit residual component

$Rs$: residual resistance
$Go$: residual conductance
$Zs$: short circuit residual component
$Zm$: measured value

In this case, for the measured value $Zm$:

$$Zm \;=\; Zs + \cfrac{1}{Yo + \cfrac{1}{Zx}}$$

The residual components can be determined in the following manner:

- **Open circuit compensation**
  The terminals of the test fixture are left separated (open circuited). Because the short circuit residual component $Zs$ is now zero, therefore the open circuit residual component $Yo$ can be determined.

- **Short circuit compensation**
  The terminals of the test fixture are connected together (short circuited).
  Because the open circuit residual component $Yo$ is now zero, therefore the short circuit residual component $Zs$ can be determined.

These residual components thus obtained are recorded as compensation values, and the compensation process may then be performed by substituting them into the above equation.

> **NOTE** The determination of test range is performed according to the measured value $Zm$ for impedance. Therefore it may happen that testing cannot be performed, when HOLD is on, if the test range is determined merely according to the value of impedance of the sample under test. In this case, you should set the test range in consideration both of the impedance of the test sample and also of the residual impedance components of the test fixture.

Deviations in the measured values can become comparatively large in the following cases:

- **If only short circuit compensation has been performed.**
  With short circuit compensation only having been performed, since no compensation can be performed in terms of the open circuit residual component $Yo$ (which is not available), thereby deviation in the resultant values will become large if the value of that open circuit residual component $Yo$ is relatively large.

- **If only open circuit compensation has been performed.**
  With open circuit compensation only having been performed, since no compensation can be performed in terms of the short circuit residual component $Zs$ (which is not available), thereby deviation in the resultant values will become large if the value of that short circuit residual component $Zs$ is relatively large.
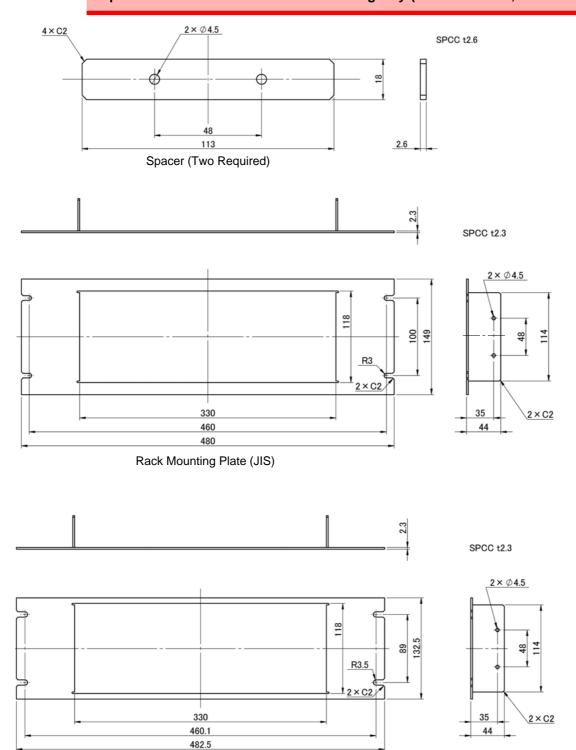
# Appendix 10  Rack Mounting

Rack mounting brackets can be attached to the instrument.

⚠ **WARNING**  **Observe the following precautions regarding the mounting screws to avoid instrument damage and electric shock accidents.**
- **When installing the Rack Mounting Plate, the screws must not intrude more than 6 mm into either side of the instrument.**
- **When removing the Rack Mounting Plate to return the instrument to stand-alone use, replace the same screws that were installed originally. (Feet: M3 × 6 mm, Sides: M4 × 6 mm)**



Spacer (Two Required)

Rack Mounting Plate (JIS)
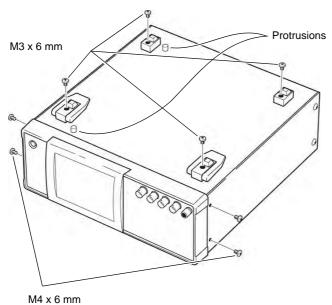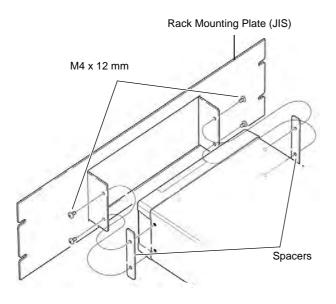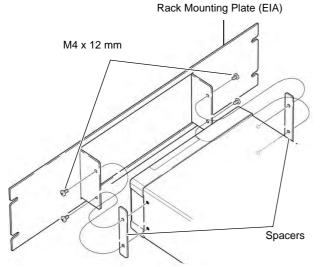
## Installation Procedure



M3 x 6 mm

Protrusions

M4 x 6 mm

**1.** Remove the feed from the bottom of the instrument, and the screws from the sides (four near the front).



Rack Mounting Plate (JIS)

M4 x 12 mm

Spacers
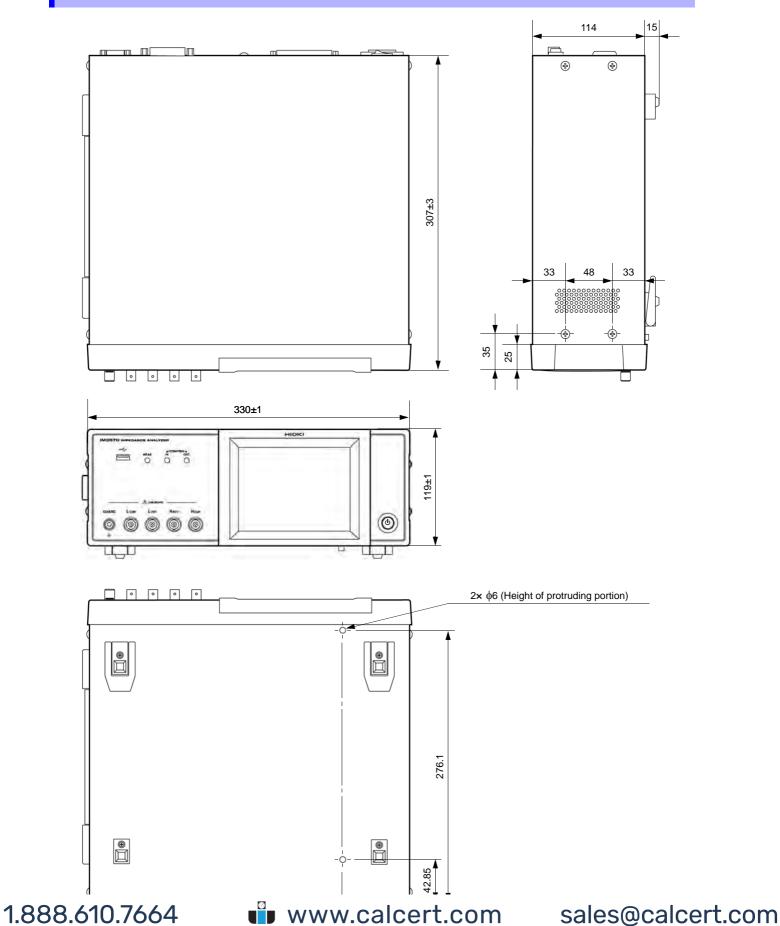
**2.** Installing the spacers on both sides of the instrument, affix the Rack Mounting Plate with the M4 x 12 mm screws.

- When installing into the rack, reinforce the installation with a commercially available support stand.
- Please note that protrusions with a diameter of 6 mm protrude from the bottom of the instrument by 4 mm.For details on the positions of the protrusions, refer to the external view on the next page.



Rack Mounting Plate (EIA)

M4 x 12 mm

Spacers

1.888.610.7664    www.calcert.com    sales@calcert.com

## Appendix 11  Dimensional Diagram

# Appendix 12 Initial Settings Table

The following table shows the initial settings of the instrument.

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/ Load*1 LCR mode | Panel Save/ Load*1 ANALYZER mode | File Save/ load |
|---|---|---|---|---|---|---|---|---|---|---|
| Measurement mode | | | LCR | ← | ← | ← | No | Yes | Yes | Yes |
| Measurement parameter | | | Z/OFF/θ/OFF | ← | ← | ← | No | Yes | Yes | Yes |
| Magnification display | | | OFF | ← | ← | ← | No | No | No | Yes |
| LCR basic settings | Measurement frequency | | 1 kHz | ← | ← | ← | No | Yes | Yes | Yes |
| | Measurement signal level | Mode | V | ← | ← | ← | No | Yes | Yes | Yes |
| | | V | 1.000 V | ← | ← | ← | No | Yes | Yes | Yes |
| | | CV | 1.000 V | ← | ← | ← | No | Yes | Yes | Yes |
| | | CC | 10.00 mA | ← | ← | ← | No | Yes | Yes | Yes |
| | Measurement range | Mode | AUTO | ← | ← | ← | No | Yes | Yes | Yes |
| | | Range | 100 Ω | ← | ← | ← | No | Yes | Yes | Yes |
| | | LOW Z | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | Trigger mode | | INT (Internal Trigger) | ← | ← | ← | No | Yes | Yes | Yes |
| | DC bias | ON/OFF | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Bias value | 0.00 V | ← | ← | ← | No | Yes | Yes | Yes |
| | Measurement speed | | MED | ← | ← | ← | No | Yes | Yes | Yes |
| | Limit | ON/OFF | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Current limit value | 100.00 mA | ← | ← | ← | No | Yes | Yes | Yes |
| | | Voltage limit value | 5.000 V | ← | ← | ← | No | Yes | Yes | Yes |
| | Number of times for average | | 1 | ← | ← | ← | No | Yes | Yes | Yes |
| | Trigger delay | | 0.0000 s | ← | ← | ← | No | Yes | Yes | Yes |
| LCR DC resistance measurement | Measurement signal level | Mode | V | ← | ← | ← | No | Yes | No | Yes |
| | | V | 1.00 V | ← | ← | ← | No | Yes | No | Yes |
| | | CV | 1.00 V | ← | ← | ← | No | Yes | No | Yes |
| | | CC | 10.00 mA | ← | ← | ← | No | Yes | No | Yes |
| | Measurement range | Mode | AUTO | ← | ← | ← | No | Yes | No | Yes |
| | | Range | 100 Ω | ← | ← | ← | No | Yes | No | Yes |
| | | LOW Z | OFF | ← | ← | ← | No | Yes | No | Yes |
| | DC adjustment | | ON | ← | ← | ← | No | Yes | No | Yes |
| | Measurement speed | | MED | ← | ← | ← | No | Yes | No | Yes |
| | Limit | ON/OFF | OFF | ← | ← | ← | No | Yes | No | Yes |
| | | Current limit value | 100.00 mA | ← | ← | ← | No | Yes | No | Yes |
| | | Voltage limit value | 2.50 V | ← | ← | ← | No | Yes | No | Yes |
| | Number of times for average | | 1 | ← | ← | ← | No | Yes | No | Yes |
| | DC delay | | 0.0003 s | ← | ← | ← | No | Yes | No | Yes |

**Appendix**

## Appendix 12 Initial Settings Table

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/Load*1 LCR mode | Panel Save/Load*1 ANALYZER mode | File Save/load |
|---|---|---|---|---|---|---|---|---|---|---|
| Application settings | LCR judgment mode | | OFF/COMP/BIN | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | Trigger synchronous output | ON/OFF | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Trigger time | 0.0010 s | ← | ← | ← | No | Yes | Yes | Yes |
| | Memory | OFF/IN/ON | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Number of memory items | 1000 | ← | ← | ← | No | Yes | Yes | Yes |
| | HIGH-Z Reject | ON/OFF | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Judgment reference value | 1000% | ← | ← | ← | No | Yes | Yes | Yes |
| | Detection level monitoring | ON/OFF | OFF | ← | ← | ← | No | Yes | Yes | Yes |
| | | Detection level | 10.00% | ← | ← | ← | No | Yes | Yes | Yes |
| | Detection sensitivity for measurement errors | | 1 | ← | ← | ← | No | No | No | Yes |
| | Judgment result | Delay between judgment results and EOM | 0.0000 s | ← | ← | ← | No | No | No | Yes |
| | | Reset | ON | ← | ← | ← | No | No | No | Yes |
| | IO trigger | ENABLE | ON | ← | ← | ← | No | No | No | Yes |
| | | Edge | DOWN | ← | ← | ← | No | No | No | Yes |
| | IO-EOM | Mode | HOLD | ← | ← | ← | No | No | No | Yes |
| | | EOM output time | 0.0050 s | ← | ← | ← | No | No | No | Yes |
| | Key-lock | ON/OFF | OFF | ← | ← | ← | No | No | No | Yes |
| | | Passcode | 3570 | ← | ← | ← | No | No | No | Yes |
| | Display digits | | 6/6/6/6 | ← | ← | ← | No | Yes | Yes | Yes |
| | Backlight | | ON | ← | ← | ← | No | No | No | Yes |
| | Beep sound | Judgment result | NG | ← | ← | ← | No | Yes | Yes | Yes |
| | | Key | ON | ← | ← | ← | No | No | No | Yes |
| LCR Comparator | Mode | | ABS/ABS | ← | ← | ← | No | Yes | No | Yes |
| | Absolute value mode | Upper limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | Percent mode | Reference value | 1.000000k/ 10.00000 | ← | ← | ← | No | Yes | No | Yes |
| | | Upper limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| BIN | Mode | | ABS/ABS | ← | ← | ← | No | Yes | No | Yes |
| | Absolute value mode | Upper limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | Percent mode | Reference value | 1.000000k/ 10.00000 | ← | ← | ← | No | Yes | No | Yes |
| | | Upper limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | Yes | No | Yes |

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/ Load*1 LCR mode | Panel Save/ Load*1 ANALYZER mode | File Save/ load |
|---|---|---|---|---|---|---|---|---|---|---|
| ANALYZER Basic settings | Sweep parameter | | Z-θ | ← | ← | ← | No | No | Yes | Yes |
| | Main sweep parameter | | FREQ | ← | ← | ← | No | No | Yes | Yes |
| | Trigger | | REPEAT | ← | ← | ← | No | No | Yes | Yes |
| | Display timing | | REAL | ← | ← | ← | No | No | Yes | Yes |
| | Trigger delay | | 0.0000 s | ← | ← | ← | No | No | Yes | Yes |
| | Segment sweep | | OFF | ← | ← | ← | No | No | Yes | Yes |
| | Normal sweep | Sweep method | START-STOP | ← | ← | ← | No | No | Yes | Yes |
| | | Sweep start value | 1 kHz | ← | ← | ← | No | No | Yes | Yes |
| | | Sweep end value | 1 MHz | ← | ← | ← | No | No | Yes | Yes |
| | | Number of points | 201 | ← | ← | ← | No | No | Yes | Yes |
| | | Setting method of measurement points | LOG | ← | ← | ← | No | No | Yes | Yes |
| | Sweep signal | | 1.000 V (V mode) | ← | ← | ← | No | No | Yes | Yes |
| | Measurement range | | AUTO | ← | ← | ← | No | No | Yes | Yes |
| | Measurement speed | | MED | ← | ← | ← | No | No | Yes | Yes |
| | Number of times for average | | 1 | ← | ← | ← | No | No | Yes | Yes |
| | Point delay | | 0.0000 s | ← | ← | ← | No | No | Yes | Yes |
| | DC bias | ON/OFF | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Bias value | 0 V | ← | ← | ← | No | No | Yes | Yes |
| Analyzer graph settings | Horizontal | Overwrite | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Scale | LOG | ← | ← | ← | No | No | Yes | Yes |
| | | Span | SINGLE | ← | ← | ← | No | No | Yes | Yes |
| | Vertical | Color | 1/2 | ← | ← | ← | No | No | Yes | Yes |
| | | Scale | LINEAR | ← | ← | ← | No | No | Yes | Yes |
| | | Scale mode | AUTO | ← | ← | ← | No | No | Yes | Yes |
| | Grid display | | PARA1 | ← | ← | ← | No | No | Yes | Yes |
| ANALYZER Comparator settings | Mode | | OFF | ← | ← | ← | No | No | Yes | Yes |
| | Parameter | | PARA1 | ← | ← | ← | No | No | Yes | Yes |
| | Area display | | PARA1 | ← | ← | ← | No | No | Yes | Yes |
| | Peak No. to judge | Local minimum | 1 | ← | ← | ← | No | No | Yes | Yes |
| | | Local maximum | 1 | ← | ← | ← | No | No | Yes | Yes |
| | Filter for peak search | OFF/ON | ON | ← | ← | ← | No | No | Yes | Yes |
| | Reference value settings | | MEAS VALUE REFERENCE | ← | ← | ← | No | No | Yes | Yes |
| | Reference value | | 1.000000k | ← | ← | ← | No | No | Yes | Yes |
| | Area Judgment | Upper limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |
| | Peak Judgment | Left limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Right limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Upper limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF/OFF | ← | ← | ← | No | No | Yes | Yes |

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/Load*1 LCR mode | Panel Save/Load*1 ANALYZER mode | File Save/load |
|---|---|---|---|---|---|---|---|---|---|---|
| Analyzer cursor and search settings | Cursor display | ON/OFF | OFF | ← | ← | ← | No | No | Yes | Yes |
| | Cursor to move | | A | ← | ← | ← | No | No | Yes | Yes |
| | Cursor A | Search mode | L-MAX | ← | ← | ← | No | No | Yes | Yes |
| | | Parameter | PARA1 | ← | ← | ← | No | No | Yes | Yes |
| | | Target value | 0.000000 | ← | ← | ← | No | No | Yes | Yes |
| | Cursor B | Search mode | L-MAX | ← | ← | ← | No | No | Yes | Yes |
| | | Parameter | PARA1 | ← | ← | ← | No | No | Yes | Yes |
| | | Target value | 0.000000 | ← | ← | ← | No | No | Yes | Yes |
| | Filter | ON/OFF | ON | ← | ← | ← | No | No | Yes | Yes |
| | Auto search | ON/OFF | OFF | ← | ← | ← | No | No | Yes | Yes |
| Equivalent circuit analysis function (optional IM9000) | Model selection method | | OFF | ← | ← | ← | No | No | Yes | Yes |
| | Equivalent circuit model | | A | ← | ← | ← | No | No | Yes | Yes |
| | Analysis execution method | | MANUAL | ← | ← | ← | No | No | Yes | Yes |
| | Analysis start frequency | | 4 Hz | ← | ← | ← | No | No | Yes | Yes |
| | Analysis stop frequency | | 5 MHz | ← | ← | ← | No | No | Yes | Yes |
| | Segment to analyze | | ALL | ← | ← | ← | No | No | Yes | Yes |
| | Electromechanical coupling coefficient (K) | Oscillation mode | Kr | ← | ← | ← | No | No | Yes | Yes |
| | | Frequency type | fs-fp | ← | ← | ← | No | No | Yes | Yes |
| | | Coefficient a | 0.395000 | ← | ← | ← | No | No | Yes | Yes |
| | | Coefficient b | 0.574000 | ← | ← | ← | No | No | Yes | Yes |
| | Display position | | LEFT | ← | ← | ← | No | No | Yes | Yes |
| | Estimated value | R1 | 0.0 | ← | ← | ← | No | No | Yes | Yes |
| | | L1 | 0.0 | ← | ← | ← | No | No | Yes | Yes |
| | | C1 | 0.0 | ← | ← | ← | No | No | Yes | Yes |
| | | C0 | 0.0 | ← | ← | ← | No | No | Yes | Yes |
| Equivalent circuit analysis comparator function (optional IM9000) | Comparator | ON/OFF | OFF | ← | ← | ← | No | No | Yes | Yes |
| | R1 | Upper limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | L1 | Upper limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | C1 | Upper limit value | OFF | ← | ← | *RST | No | No | Yes | Yes |
| | | Lower limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | C0 | Upper limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | Qm | Upper limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| | | Lower limit value | OFF | ← | ← | ← | No | No | Yes | Yes |
| Continuous measurement | Measurement target | ON/OFF | ON | ← | ← | ← | No | No | No | No |
| | Display timing | | REAL | ← | ← | ← | No | No | No | Yes |
| | Trigger | | SEQUENTIAL | ← | ← | ← | No | No | No | Yes |
| | Measurement halt at FAIL judgment result | | OFF | ← | ← | ← | No | No | No | Yes |
| Open circuit compensation | Compensation mode | | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Parameter type | | G-B | ← | No Change | G-B | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Correction value | G Correction value | 0.0000nS | ← | No Change | 0.0000 nS | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | B Correction value | 0.0000nS | ← | No Change | 0.0000 nS | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Open compensation conditions | | All valid | ← | No Change | All valid | No | Yes (ADJ) | Yes (ADJ) | Yes |

## Appendix 12 Initial Settings Table

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/Load*1 LCR mode | Panel Save/Load*1 ANALYZER mode | File Save/ load |
|---|---|---|---|---|---|---|---|---|---|---|
| Short circuit compensation | Compensation mode | | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Parameter type | | Rs-X | ← | No Change | Rs-X | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Correction value | R Correction value | 0.000 mΩ | ← | No Change | 0 Ω | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | X Correction value | 0.000 mΩ | ← | No Change | 0 Ω | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Short compensation conditions | | All valid | ← | No Change | All valid | No | Yes (ADJ) | Yes (ADJ) | Yes |
| Load circuit compensation | ON/OFF | | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation mode | | Z-θ | ← | No Change | Z-θ | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Reference value | Impedance reference value | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | Phase reference value | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation frequency | | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation signal level | Mode | V | ← | No Change | V | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | V | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | CV | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | CC | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation range | Range | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | LOW Z | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation DC bias | ON/OFF | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | Bias value | 0.00 V | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation value | Impedance coefficient | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | Phase coefficient | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| Cable length compensation | | | 0 m | ← | No Change | 0 m | No | Yes (ADJ) | Yes (ADJ) | Yes |
| Scaling compensation | ON/OFF | | OFF | ← | No Change | OFF | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | Compensation value | A | 1.0000 | ← | No Change | 1.0000 | No | Yes (ADJ) | Yes (ADJ) | Yes |
| | | B | 0.000000 | ← | No Change | 0.000000 | No | Yes (ADJ) | Yes (ADJ) | Yes |

# A22

## Appendix 12 Initial Settings Table

<div align="right">

Yes: Available/ ←: The same as the left/ No: Unavailable
*1: When TYPE=ALL is set, the items indicated by Yes (ADJ) are also saved.

</div>

| Setting Items | | | Initial setting | Unit Reset Operation Full reset | :PRESet | *RST | Return to initial settings when power is turned on | Panel Save/Load*1 LCR mode | Panel Save/Load*1 ANALYZER mode | File Save/load |
|---|---|---|---|---|---|---|---|---|---|---|
| Interface | RS-232C | Baud rate | 9600 | ← | No Change | No Change | No | No | No | Yes |
| | | Terminator | CR+LF | ← | No Change | No Change | No | No | No | Yes |
| | | Handshake | OFF | ← | No Change | No Change | No | No | No | Yes |
| | GPIB | Terminator | LF | ← | No Change | No Change | No | No | No | Yes |
| | | Address | 01 | ← | No Change | No Change | No | No | No | Yes |
| | USB | Terminator | CR+LF | ← | No Change | No Change | No | No | No | Yes |
| | LAN | IP address | 192.168.000.001 | ← | No Change | No Change | No | No | No | Yes |
| | | Subnet mask | 255.255.255.000 | ← | No Change | No Change | No | No | No | Yes |
| | | Gateway | OFF | ← | No Change | No Change | No | No | No | Yes |
| | | Port | 3570 | ← | No Change | No Change | No | No | No | Yes |
| | | Terminator | CR+LF | ← | No Change | No Change | No | No | No | Yes |
| | Printer | Mode | MANUAL | ← | No Change | No Change | No | No | No | Yes |
| | | Type | TEXT | ← | No Change | No Change | No | No | No | Yes |
| | Header | | OFF | ← | No Change | OFF | Yes | No | No | Yes |
| | Status Byte register | | 0 | No Change | No Change | No Change | Yes | No | No | Yes |
| | Event register | | 0 | No Change | No Change | No Change | Yes | No | No | Yes |
| | Enable register | | 0 | No Change | No Change | No Change | Yes | No | No | Yes |
| | :MEASure:ITEM | | 0,0 | ← | ← | ← | No | Yes | Yes | Yes |
| | :MEASure:VALid | | 14 | ← | ← | ← | No | Yes | Yes | Yes |
| | Automatic output of measurement values | | OFF | ← | ← | ← | No | No | No | Yes |
| | Transfer format | | ASCII | ← | ← | ← | No | No | No | Yes |
| | Long format | | OFF | ← | ← | ← | No | No | No | Yes |
| File | Save Format | | OFF | ← | ← | ← | No | No | No | Yes |
| | Save folder | | AUTO | ← | ← | ← | No | No | No | Yes |
| | Header | Date and time | ON | ← | ← | ← | No | No | No | Yes |
| | | Measurement conditions | ON | ← | ← | ← | No | No | No | Yes |
| | | Measurement parameters | ON | ← | ← | ← | No | No | No | Yes |
| | | Delimiter | , (Comma) | ← | ← | ← | No | No | No | Yes |
| | | Quote | " (Double quote) | ← | ← | ← | No | No | No | Yes |
| Touch panel compensation | | | No compensation | ← | No Change | No Change | No | No | No | No |
| Clock | | | - | No Change | No Change | No Change | No | No | No | No |
| Panel | Save type | | ALL | ← | ← | ← | No | No | No | Yes |
| | Panel | | No registration | Clear all data | No Change | Clear all data | No | No | No | Only when ALL SAVE |

## Appendix 13 Device Compliance Statement

"Information on compliance to standards" based on the IEEE 488.2 standard

| Item | Description |
|---|---|
| **1. IEEE 488.1 interface functions** | **See** Communication Instruction Manual (CD) |
| **2. Operation with a device address other than 0 through 30** | Such a setting is not possible. |
| **3. Timing of changed device address recognition** | A change of address is recognized immediately after changing. |
| **4. Device settings at power on** | The status information is cleared, and all other items are preserved. However, the header on/off setting, and response message separator and terminator are all reinitialized. |
| **5. List of message exchange options** | • Input buffer capacity and operation<br>**See** Included CD<br><br>Queries to which multiple response message units are returned<br>`:BIN:FLIMit:ABSolute?` .................... 2<br>`:BIN:FLIMit:DEViation?` ................. 2<br>`:BIN:FLIMit:PERcent?` .................... 2<br>`:BIN:SLIMit:ABSolute?` ................... 2<br>`:BIN:SLIMit:DEViation?`.................. 2<br>`:BIN:SLIMit:PERcent?`..................... 2<br>`:COMParator:FLIMit:ABSolute?`............ 2<br>`:COMParator:FLIMit:DEViation?`........... 3<br>`:COMParator:FLIMit:PERcent?`............. 3<br>`:COMParator:SLIMit:ABSolute?`............ 2<br>`:COMParator:SLIMit:DEViation?`........... 3<br>`:COMParator:SLIMit:PERcent?`............. 3<br>`:CORRection:LOAD:CONDition?`............. 7<br>`:CORRection:LOAD:DCResistance:CONDition?` ..... 4<br>`:CORRection:LOAD:REFerence?`............. 3<br>`:CORRection:SCALe:DATA?`................. 2<br>`:FILE:INFOrmation?`...................... 5<br>`:MEASure?`............................... *<br>`:MEASure:ITEM?`.......................... 2<br>`:MONItor?`............................... 4<br>`:SYSTem:DATE?`........................... 3<br>`:SYSTem:TIME?`........................... 3<br>`:COMParator:AREA:FIX?`................... 4<br>`:COMParator:AREA:LIMit?`................. 2<br>`:COMParator:AREA:MEAS?`.................. 3<br>`:COMParator:PEAK?`....................... 4<br>`:COMParator:PEAK:NO?`.................... 2 |

**Appendix**

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## Appendix 13 Device Compliance Statement

| Item | Description |
|---|---|
| | `:GRAPh:VERTical:CENTerdiv?` .............. 2 <br> `:GRAPh:VERTical:UPPerlower?` ............ 2 <br> `:LIST:CENTerspan?` ...................... 3 <br> `:LIST:INTerval?` ........................ 3 <br> `:LIST:STARt:STEP?` ...................... 3 <br> `:LIST:STARt:STOP?` ...................... 4 <br> `:MEASure:COMParator:PEAK:MAX?` .......... * <br> `:MEASure:COMParator:PEAK:MIN?` .......... * <br> `:SEGMent:STARt:STOP?` ................... 4 <br> `:MEASure:CONTinuous:PEAK?` .............. * <br> * The number of response messages varies depending on the settings. <br><br> • Queries producing responses as syntax checking is performed: <br> All queries produce responses when syntax checking is performed. <br> • Whether any queries produce responses when read: <br> There are no queries which produce response messages at the instant they are read in by the controller. <br> • Whether any commands are coupled: <br> There are no relevant commands. |
| 6. **Summary of functional elements for use when constructing device specific commands, and whether compound commands or program headers can be used:** | The followings can be used <br> • Program message <br> • Program message terminator <br> • Program message unit <br> • Program message unit separator <br> • Command message unit <br> • Query message unit <br> • Command program header <br> • Query program header <br> • Program data <br> • Character program data <br> • Decimal program data <br> • Compound commands and program headers |
| 7. **Buffer capacity limitations for block data** | Block data is not used. |
| 8. **Summary of program data elements used in expressions, and deepest nesting level allowable in sub-expressions, including syntax restrictions imposed by the device.** | Sub-expressions are not used. Character data and decimal data are the only program data elements used. |
| 9. **Response syntax for queries** | **See** Included CD |
| 10. **Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages** | There are no device to device messages. |
| 11. **Response capacity for block data** | Block data does not appear in responses. |
| 12. **Summary of standard commands and queries used** | **See** Included CD |
| 13. **Device state after a calibration query has been completed without any problem** | The "**\*CAL?**" query is not used. |
| 14. **Existence/nonexistence of "\*DDT" command** | The "**\*DDT**" query is not used. |
| 15. **Existence/nonexistence of macro command** | Macros are not used. |

| Item | Description |
|------|-------------|
| 16. **F**or queries related to identification, explanation of the response to the "**\*IDN?**" query | **See** Included CD |
| 17. **Capacity of the user data storage area reserved for when the "\*PUD" command and the "\*PUD?" query are being executed** | The "**\*PUD**" command and the "**\*PUD?**" query are not used. Further, there is no user data storage area. |
| 18. **Resources when the "\*RDT" command and the "\*RDT?" query are being used** | The "**\*RDT**" command and the "**\*RDT?**" query are not used. Further, there is no user data storage area. |
| 19. **Conditions which are influenced when "\*RST", "\*LRN?", "\*RCL?", and "\*SAV" are used** | "**\*LRN?**", "**\*RCL?**", and "**\*SAV**" are not used. The"**\*RST**" command returns the unit to its initial state. <br> **See** Included CD |
| 20. **Scope of the self-testing executed as a result of the "\*TST?" query** | **See** Included CD |
| 21. **Additional organization of the status data used in a device status report** | **See** Included CD |
| 22. **Whether commands are overlap or sequential type** | All commands except **:MEASure?**, **:MEMory?**, **:CORRection:OPEN**, **:CORRection:SHORt**, and **:CORRection:LOAD** are sequence commands. |
| 23. **Criterion relating to the functions required at the instant that the termination message is produced, as a response to each command** | Termination occurs when the command has been parsed. |

# Index

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| Key | Description | Refer-ence |
|---|---|---|
| **A** | Cursor A display setting and movement | 189 |
| | Compensation coefficient A setting | 303 |
| **a** | Planar oscillation mode coefficient setting | 249 |
| **A&B** | Cursor A and cursor B display settings and movement | 189 |
| **ABORT** | Measurement halt at FAIL judgment result setting | 271 |
| **ABS** | Absolute value mode setting | 88, 95 |
| **ADD** | Add segment | 171 |
| **ADJ** | Compensation settings | 21 |
| **ADJ** | Save only compensation value with panel save function | 318 |
| **ADJUST** | Compensation type setting | 274, 282 |
| **AFTER** | Draw after measurement ends | 139, 269 |
| **ALL** | ALL compensation settings | 274, 282 |
| **ALL OFF** | Remove all panels from the targets for continuous measurement | 266 |
| **ALL ON** | Set all panels as targets for continuous measurement | 266 |
| **ALL LOAD** | Loading all settings saved on a USB flash drive | 355 |
| **ALL SAVE** | Save all saved data | 351 |
| **ANALYZER** | Analyzer measurement | 131 |
| **AREA SET PARA1** | Area judgment range setting of parameter 1 | 200 |
| **AREA** | Drawing parameter setting when area judgment | 200 |
| | Setting the frequency range for which to perform equivalent circuit analysis | 243 |
| **AUTO** | Auto range setting | 49, 69, 161 |
| | Auto setting of save folder | 344 |
| | Auto print setting | 383 |
| **AUTO** | Auto setting of draw mode (Automatically set upper and lower limit values from set measurement values) | 184 |

| Key | Description | Refer-ence |
|---|---|---|
| **AUTO SET** | To restore the colors of all segments to the initial state | 182 |
| **AVG** | Average setting | 62, 80, 165, 169, 174 |
| **B** | Susceptance (S) | 25 |
| | Cursor B movement | 190 |
| | Compensation coefficient B setting | 304 |
| **b** | Planar oscillation mode coefficient setting | 249 |
| **BACK** | Display folder immediately above | 331 |
| **BEEP** | Beep settings | 128, 234 |
| **BIN** | BIN function settings | 93 |
| **BIN** | BIN function settings | 84 |
| **BMP** | Save copy of screen | 341 |
| **BOTH** | Set handshake to hardware + software (Refer to the Communication Instruction Manual (CD)) | |
| **BS** | Delete last character | 320, 325, 361 |
| **C** | Cancel input | |
| **CABLE** | Cable length compensation | 301 |
| **CALIBRATION** | Panel compensation | 308 |
| **CC** | Constant current sweep | 135 |
| **CENTER** | Center value of sweep range setting | 146 |
| | Center value of vertical axis | 185 |
| **CENTER-DIV** | Center value and width of vertical axis settings | 185 |
| **CENTER-SPAN** | Center value of sweep range and sweep width settings | 146 |
| **CIRCUIT** | Equivalent circuit settings | 239 |
| **CIRCUIT>>** | Configuring and executing equivalent circuit analysis | 253 |
| **CLEAR** | Delete all input characters | 320, 325, |

| Key | Description | Reference |
|---|---|---|
| CLEAR | Clear all measurement values saved to instrument memory | 106, 219 |
| COLOR | Draw color setting | 181 |
| | Saves screen copies as 256-color BMP files. | 341 |
| COMP | Area judgment setting | 197 |
| | Detail display of peak judgment result | 208 |
| | Configuring the equivalent circuit analysis comparator | 260 |
| CONTINUOUS | Continuous measurement | 265 |
| Cp | Static capacitance in parallel equivalent circuit mode (F) | 25 |
| CR | Set terminator to CR (Refer to the Communication Instruction Manual (CD)) | |
| CR+LF | Set terminator to CR+LF (Refer to the Communication Instruction Manual (CD)) | |
| Cs | Static capacitance in series equivalent circuit mode (F) | 25 |
| CURSOR >> | Cursor settings | 188 |
| CV | Constant voltage sweep | 135 |
| D | Loss coefficient = tan$\delta$ | 25 |
| DATE | Save date and time setting | 335 |
| DC ADJ | DC adjustment setting | 75 |
| DC BIAS | DC bias setting | 57 |
| DC DELAY | Delay time setting | 82 |
| DEFINE | Setting circuit element constants | 258 |
| DEL | Delete segment | 171 |
| DELAY | Trigger delay setting | 64 |
| DELETE | Delete selected item | |
| DELIM | Delimiter type setting | 334 |
| DIGIT | Switch numerical input method | 41, 158 |
| | Number of display digits setting | 124 |

| Key | Description | Reference |
|---|---|---|
| DISP | LCD settings | 127 |
| DISPLAY & LED TEST | Screen display test | 310 |
| DIV | Vertical axis width setting | 185 |
| DOWN | Enable falling edge | 117 |
| DRAW | Graph and list draw timing setting | 139, 269 |
| EDIT | Change segment settings | 169 |
| ENTER | Confirm entered numerical values | |
| EXEC | Start compensation | 273, 280, 288 |
| EXIT | Check settings | |
| | Close setting screen | |
| EXT | External trigger | 56 |
| FAST | High-speed measurement setting | 164 |
| FILE | Save settings | 315, 329 |
| FILTER | Filter setting | 192, 211 |
| FIX VALUE REFERENCE | Judgment area settings (Reference value, upper limit value, and lower limit value settings) | 202 |
| FOLDER | Create folder | 360 |
| FORMAT | Format USB flash drive | 357 |
| FREQ | Frequency setting | 41 |
| | Frequency sweep | 135 |
| fr-fa | Resonant/anti-resonant frequency setting | 248 |
| fs-fp | Series/parallel resonant frequency setting | 248 |
| G | Conductance (S) | 25 |
| GET | Set current compensation conditions as load compensation conditions | 299 |
| GPIB | GP-IB setting | 22 |

| Key | Description | Refer-ence |
|---|---|---|
| GRAPH | Waveform graph display | 132 |
| GRID | Grid display setting | 186 |
| HARD | Save only measurement condi-tions with panel save function | 318 |
| HI | Upper limit value setting | |
| Hi Z | Hi-Z reject function setting | 108, 222 |
| HOLD | HOLD setting | 51, 71, 162 |
| IN | Beep sound when result is IN judgment | 128, 234 |
| INFO | Display panel information | 266 |
| INFO AC | Display measurement condi-tions for AC measurement | 38 |
| INFO BIN | Display BIN settings | 38 |
| INFO COMP | Display comparator settings | 38 |
| INFO DC | Display measurement condi-tions for DC measurement | 38 |
| INT | Internal trigger | 56 |
| INTVL MEAS | Fix sweep parameter and set measurement to be performed at set time interval | 147 |
| I/O HANDLER TEST | I/O test | 313 |
| IO EOM | EOM output method setting | 119 229 |
| IO JUDGE | I/O judgment | 115 226 |
| IO SET | EXT I/O setting | 115 117 |
| IO TRIG | I/O trigger setting | 117 228 |
| JUDGE | Judgment mode setting | 84 |
| K | Electromechanical coupling co-efficient setting | 247 |
| K15 | Shear oscillation electrome-chanical coupling coefficient | 248 |
| K31 | Long-side extension oscillation electromechanical coupling co-efficient | 248 |

| Key | Description | Refer-ence |
|---|---|---|
| K33 | Longitudinal oscillation electro-mechanical coupling coefficient | 248 |
| Kr | Planar oscillation electrome-chanical coupling coefficient | 248 |
| Kt | Thickness-mode oscillation electromechanical coupling co-efficient | 248 |
| KEY TYPE | Switch keyboard type | 320, 325, 361 |
| KEYLOCK | Key lock function | 121, 230 |
| L-MAX | Move cursor to local maximum value of measurement results | 190 |
| L-MIN | Move cursor to local minimum value of measurement results | 190 |
| LAN | LAN settings | 22 |
| LCR | LCR measurement | 37 |
| LEFT | Left limit setting | 213 |
| LEFT | Selecting the equivalent circuit estimation results display posi-tion | 251 |
| LEVEL | Level setting | 43, 66, 157 |
| LEVCHK | Detection level monitoring function setting | 110 |
| LEVOVER | Set detection sensitivity for measurement errors | 113, 224 |
| LIMIT | Voltage/current limit settings | 60, 78 |
| LINEAR | Calculate sweep points linearly | 145 |
| LINEAR | Set horizontal axis of draw type to linear (linear axis) | 177 |
| LMT | Comparator function upper and lower limit value settings | 86 |
| LO | Lower limit value setting | |
| LOAD | Load compensation settings | 288 |
| LOG | Calculate sweep points loga-rithmically | 145 |
| LOG | Set horizontal axis of draw type to log (logarithmic axis) | 177 |
| LOWER | Lower limit value setting | |
| LOWER | Selecting the equivalent circuit estimation results display posi-tion | 251 |
| Lp | Inductance in parallel equiva- | 25 |

| Key | Description | Reference |
|---|---|---|
| Ls | Inductance in series equivalent circuit mode (H) | 25 |
| MANU/AUTO | Setting the equivalent circuit analysis method | 241 |
| MANUAL SCALE | Manual scaling setting | 184 |
| MANUAL | Set upper and lower limit values manually in draw mode | 184 |
| MANUAL | Specify any folder and then save data | 344 |
| MANUAL | Manual print setting | 383 |
| MAX | Move cursor to maximum value of measurement results | 190 |
| MEAS VALUE REFERENCE | Judgment area settings (Set upper and lower limit values based on current measurement values) | 202 |
| MED | Set normal measurement speed | 59, 77, 164, 174 |
| MEMORY | Save measurement results | 106, 219 |
| MIN | Move cursor to minimum value of measurement results | 190 |
| MODE | Measurement mode setting | 13 |
| MODE | Parameter mode setting | 291 |
| MODEL | Equivalent circuit model selecting | 239 |
| MONO | Saves screen copies as monochrome (2-color) BMP files. | 341 |
| NG | Beep sound when result is LO or HI | 128, 234 |
| NUM | Sweep point setting | 145, 146 |
| NUM | Number of sweep times setting | 147 |
| NUMERIC | Display list of numerical values | 131 |
| OFF | Set to OFF | |
| ON | Set to ON | |
| OPEN | Open compensation settings | 273 |
| OPTION >> | Option settings | 324, 326, 351, 359 |

| Key | Description | Reference |
|---|---|---|
| OVER WRITE | Overwrite save name | 321 |
| OVERWRITE | Overwrite setting | 176 |
| P1&P2 | Set both parameters 1 and 2 | |
| PANEL NAME | Confirm save name | 321 |
| PANEL | Panel save function setting | 317, 319 |
| PANEL | Panel load function setting | 322 |
| PANEL | Change panel name | 324 |
| PANEL | Delete panel | 326 |
| PARA1 | Parameter 1 setting | |
| PARA2 | Parameter 2 setting | |
| PARA | Parameter settings | 133, 199, 209, 334 |
| PASSCODE | Passcode setting | 122, 218 |
| PEAK No | Peak number setting | 210 |
| PEAK | Peak judgment setting | 209 |
| POINT DELAY | Point delay setting | 166 |
| POINT | Sweep point setting | 218 |
| POSITION | Setting the equivalent circuit analysis results display position | 250 |
| PRINT | Print method setting | 383 |
| Q | Q factor | 25 |
| QUOTE | Quotation mark type setting | 334 |
| RANGE | Range setting | |
| Rdc | DC Resistance($\Omega$) | 25 |
| REAL | Draw after measurement of each sweep point. | 139 |
| REF1 | Parameter reference value 1 setting | 298 |
| | Parameter reference value 2 | |

| Key | Description | Refer-ence |
|-----|-------------|------------|
| REF | Reference value settings | |
| RENAME | Change save name | 320 |
| REPEAT | Repeat sweep setting | 138 |
| RESET | System Reset | 129, 237 |
| RIGHT | Right limit value setting | 213 |
| | Selecting the equivalent circuit estimation results display position | 251 |
| ROM/RAM TEST | ROM/RAM test | 312 |
| Rp | Effective resistance in parallel equivalent circuit mode ($\Omega$) | 25 |
| Rs | Effective resistance in series equivalent circuit mode = ESR($\Omega$) | 25 |
| RS232C | RS-232C setting | 22 |
| RUN | Executing equivalent circuit analysis | 253 |
| SAVE TO ... | Change save folder | 344 |
| SAVE | Save | |
| SAVE TYPE | Save type setting | 318 |
| SCALE | Scale setting | 177, 183 |
| | Scaling setting | 302 |
| SCALE1 | Perform scaling compensation for parameter 1 | 303 |
| SCALE2 | Perform scaling compensation for parameter 2 | 303 |
| SCALE3 | Perform scaling compensation for parameter 3 | 303 |
| SCALE4 | Perform scaling compensation for parameter 4 | 303 |
| SCREEN | Print hardcopy of screen | 383 |
| SEARCH | Search | 194 |
| SEG1▶ALL | Apply settings of first segment to all other segments | 182 205 |

| Key | Description | Refer-ence |
|-----|-------------|------------|
| SEGMENT | Segment settings | 142 |
| | Segment span mode setting | 179 |
| | Setting the segment for which to perform equivalent circuit analysis | 245 |
| SELECT | Check contents of file | 343 |
| SEQ | Sequential sweep setting | 138 |
| SET | Measurement condition setting | 14 |
| SET | Confirm settings | |
| SET EXT | Use external DC bias unit | 57 |
| SHORT | Short compensation | 280 |
| SIMULATE | Simulating frequency characteristics | 258 |
| SINGLE | Single span mode setting | 179 |
| SLOW2 | Measurement speed SLOW2 setting | 59, 77, 164, 174 |
| SLOW | Measurement speed SLOW setting | 59, 77, 164, 174 |
| SOURCE | Sweep parameter settings | 135 |
| SPACE | Set delimiter to space | 338 |
| SPAN | Span Setting | 179 |
| SPEED | Measurement speed setting | 59, 77, 164, 174 |
| SPOT | Spot compensation settings | 277, 285 |
| START | Sweep start value setting | 145 |
| START-STEP | Start value of sweep and step width of sweep point settings | 146 |
| START-STOP | Start value and end value of sweep settings | 145 |
| STEP | Step sweep setting | 138 |
| | Step width of sweep point setting | 146 |

| Key | Description | Refer-ence |
|---|---|---|
| STOP | Sweep end value setting | 145 |
| SWEEP POINT | Sweep point setting | 143 |
| SYNC | Trigger synchronous output function setting | 104, 235 |
| SYS | System settings | 22 |
| TAB | Set delimiter to tab | 338 |
| TARGET | Move cursor to measurement value set in option settings | 190 |
| TEXT | Save measurement results as text | 333 |
| TOUCH SCREEN TEST | Panel test | 307 |
| TRIG DELAY | Trigger delay setting | 140 |
| TRIG | Trigger setting | 55, 137 |
| TYPE | Setting for type of data to save to USB | 333, 341 |
| UNLOCK | Disable key lock | 121, 230 |
| UP | Enable rising edge | 117 |
| UPPER | Upper limit value setting | |
| UPPER | Selecting the equivalent circuit estimation results display position | 251 |
| UPPER-LOWER | Upper and lower limit value settings | 185 |
| USB | USB settings | 22 |
| V | Open-circuit voltage sweep | 135 |
| VALUE | Setting for measurement value to find | 191 |
| VALUE | Set upper and lower limit values as absolute values relative to reference value | 203 |
| VIEW | Check file content | 343 |
| X | Reactance ($\Omega$) | 25 |
| XON/OFF | Set handshake to software (Refer to the Communication Instruction Manual (CD)) | |
| Y | Admittance (S) | 25 |

| Key | Description | Refer-ence |
|---|---|---|
| Z | Impedance ($\Omega$) | 25 |
| ZOOM OFF | Disable enlarged view of measurement values | 126 |
| ZOOM ON | Enlarge measurement values | 126 |
| 0m | Set cable length to 0 m | 301 |
| 1m | Set cable length to 1 m | 301 |
| 10-KEY | Switch numerical input method | 41, 158 |
| Δ% | Deviation percentage mode setting | 91, 101 |
| θ | Impedance phase angle (°) | 25 |
| % | Percent mode setting | 89, 98 |
| % | Set upper and lower limit values as percentage values relative to reference value | 201 |
| x1/10 | Set measurement frequency to ×1/10 | 42 |
| x10 | Set measurement frequency to ×10 | 42 |
| x10³ | Set setting value to ×1000 | |
| 1/10³ | Set setting value to ×1/1000 | |
| " | Set quotation mark to double quotation mark (") | 339 |
| , | Set delimiter to comma (,) | 338 |
| ; | Set delimiter to semicolon (;) | 338 |
| ◀ | Move cursor to left by 1 sweep point | 193 |
| ▶ | Move cursor to right by 1 sweep point | 193 |
| ▲ | Select top item | |
| ▼ | Select bottom item | |

# Warranty Certificate

# HIOKI

| Model | Serial number | Warranty period |
|---|---|---|
| | | Three (3) years from date of purchase ( ___ / ___ ) |

Customer name: _____

Customer address: _____

**Important**
- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.
Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

**Warranty terms**
1. The product is guaranteed to operate properly during the warranty period (three [3] years from the date of purchase). If the date of purchase is unknown, the warranty period is defined as three (3) years from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warrantied for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
   -1. Malfunctions or damage of consumables, parts with a defined service life, etc.
   -2. Malfunctions or damage of connectors, cables, etc.
   -3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
   -4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
   -5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
   -6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
   -7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
   -8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   -2. Damage arising from measurement results provided by the product
   -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

**HIOKI E.E. CORPORATION**

18-07 EN-3