RM3542A

RM3542-50
RM3542-51

HIOKI

Instruction Manual

RESISTANCE METER

Check for the latest edition and other language versions.

Read carefully before use.
Keep for future reference.

Safety Information ▶ p.7
Names and Functions of the Parts ▶ p.17
Measurement Settings (Basic Measurements) ▶ p.29
Maintenance and Service ▶ p.201
Error Displays and Solutions ▶ p.203

EN

Dec. 2025 Revised edition 3
RM3542D962-03
600454313

1.888.610.7664 www.calcert.com sales@calcert.com

Contents

Task-Oriented Reference 1
Measurement Flow 3
Introduction 4
Verifying Package Contents 5
Safety Information 7
Operating Precautions 9

Chapter 1 Overview 13

1.1 Product Overview and Features 13
■ Block Diagram 16
1.2 Names and Functions of the Parts 17
1.3 Screen Organization 19

Chapter 2 Measurement Preparations 23

2.1 Connecting the Power Cord 24
2.2 Connecting Measurement Probes and Test Fixtures 25
■ Making Your Own Measurement Probes 26
2.3 Turning the Power On and Off 27

Chapter 3 Measurement Settings (Basic Measurements) 29

3.1 Pre-Operation Inspection 29
3.2 Measuring Object Types 30
3.3 Setting the Measurement Speed 31
3.4 Setting Measurement Start Conditions (Trigger Source) 33
3.5 Selecting the Measurement Range 34
3.6 Measuring with Two-terminal Wiring (Zero Adjustment) 36
3.7 Judging Measurement Values (Comparator Function) 38
■ Enabling and Disabling the Comparator Function 39
■ Decide According to Reference Value and Tolerance (REF% Mode) 39
■ Decide According to Upper/Lower Thresholds (ABS Mode) 41
3.8 Confirming Faulty Measurements 42

Chapter 4 Customizing Measurement Settings 45

4.1 Making Range-Specific Measurement Settings 45
4.2 Setting Pre-Measurement Delay 46
4.3 Compensating Measured Values (Scaling Function) 48
4.4 Setting the Measurement Integration Time Option 50
4.5 Checking for Poor or Improper Contact (Contact Check Function) 52
4.6 Improving Probe Contact (Contact Improver Function) 54
4.7 Detecting Measurement Voltage Faults (Voltage Level Monitor Function) 57
4.8 Applying Current Only When Measuring (Current Mode Setting) 58
4.9 Test for Short-Circuited Probe (Probe Short-Circuit Detection Function) 59
4.10 Comparing the Measurement Settings of Two Instruments (Settings Monitor Function) 61
4.11 Retrying Measurement After a Fault (Retry Function) 64
4.12 Limiting Measurement Voltage (Applied Voltage Limiter Function) 66
4.13 Maintaining Measurement Precision (Self-Calibration Function) 67
4.14 Compensating for Thermal EMF Offset (Offset Voltage Compensation - OVC) 67

Chapter 5 System Settings 69

5.1 Disabling and Enabling Key Operations 69
■ Disabling Key Operations (Key-Lock Function) 69

1.888.610.7664 www.calcert.com sales@calcert.com

■ Re-Enabling Key Operations (Key-Lock Cancel) 70
5.2 Setting the Comparator Judgment and Key Beepers 71
■ Enabling or Disabling the Key Beeper 71
■ Setting the Comparator Judgment Beeper 72
5.3 Power Line Frequency Manual Setting 73
5.4 Setting the Clock 74
5.5 Adjusting Screen Contrast 75
5.6 Adjusting the Backlight 76
5.7 Initializing (Reset) 77
■ Default Settings 78

Chapter 6 Storing and Exporting Data 81

6.1 Storing Data at Specified Timing (Data Memory Function) 82
6.2 Store as soon as Measurement is Stable (Auto-Memory Function) 83
6.3 Performing Statistical Calculations on Measurement Values 86
■ Using Statistical Calculations 87
■ Confirming, Printing, and Erasing Statistical Calculation Results 88
6.4 Auto-Exporting Measurement Values (at End of Measurement) (Data Output Function) 89
6.5 Outputting Measured Values as Relative Values (Percentage Output Function) 90

Chapter 7 Printing 91

7.1 Connecting the Printer 91
■ Connecting the Printer to the Instrument . 92
7.2 Setting the Instrument 93
7.3 Printing 95
■ Printing Measurement Values and Comparator Judgments 95
■ Printing Statistical Calculation Results 95

Chapter 8 External Control 97

8.1 Ext. I/O Connectors and Signals 97
■ Connector Type and Signal Pinouts 98
■ Signal Descriptions 99
8.2 Timing Chart 101
8.3 Internal Circuitry 104
■ Electrical Specifications 105
■ Connection Examples 106
8.4 Ext. I/O Settings 107
■ Setting the End-of-Measurement Signal Output ($\overline{\text{EOM}}$ Signal Setting) 107
■ Setting the Trigger Signal ($\overline{\text{TRIG}}$) Logic . 108
■ Delaying Judgment Result Output (Judgment Output Shift Function) 109
8.5 Q&A Regarding External Control 111
8.6 Supplied Connector Assembly 112

Chapter 9 Communications (RS-232C/ GP-IB Interface) 113

9.1 Overview and Features of Interfaces 113
9.2 Specifications 114
9.3 Connecting 115
■ Using the RS-232C Interface 115
■ Using the GP-IB Interface (RM3542-51 only) 116
9.4 Configuring the Communications Protocol 117
■ Configuring RS-232C Interface Communications Protocol 117
■ Configuring the GP-IB Interface Communication Protocol (RM3542-51 only) 118
■ Set the Measurement Value Transmission format (common for RS-232C and GP-IB) 119
9.5 Communication Methods 120
■ To Cancel the Remote Status (Enter the Local Status) 120
■ Message Format 121
■ Output Queue and Input Buffer 124
■ Status Byte Register 125
■ Event Registers 127
■ Initialization Items 130
■ Command Execution Time 131
■ Errors During Communications 131

1.888.610.7664 www.calcert.com sales@calcert.com

9.6 Message List 132
- Shared Commands 132
- Device-Specific Commands 133

9.7 Message Reference 138
- Message Reference Interpretation 138
- Shared Commands 139
- Device-Specific Commands 143

9.8 Data exporting methods 168
9.9 Sample Programs 170
- Using Visual Basic 5.0 or 6.0 170
- Create with Visual Basic 2005 180
- Sample Programs (Visual Basic 2005) ... 182

9.10 Device Compliance Documents..... 184

Chapter 10 Specifications 187

Chapter 11 Maintenance and Service 201

11.1 Troubleshooting 201
- Inspection and Repair 201

11.2 Cleaning 202
11.3 Error Displays and Solutions 203
11.4 Disposing of the Instrument 205
- Removing the Lithium Battery 205

Appendix A 1

Appendix 1 Four-Terminal (Voltage-Drop) Method..... A 1
Appendix 2 Effect of Thermal emf ..... A 2
Appendix 3 Unstable Measurement Values. A 3
Appendix 4 Rack Mounting..... A 8
Appendix 5 Dimensional diagram ..... A 10
Appendix 6 Calibration..... A 11
Appendix 7 Adjustment..... A 13
Appendix 8 Table of Comparison Commands ADEX AX-162D / for this instrument ..... A 14
Appendix 9 Zero Adjustment ..... A 16

Index Index 1

1.888.610.7664 www.calcert.com sales@calcert.com

Task-Oriented Reference

To minimize measurement error	Setting the Measurement Speed (p. 31) Setting the measurement speed integration time option (p. 50) Measuring with Two-terminal Wiring (Zero Adjustment) (p. 36)
To judge measurement results	Judging Measurement Values (Comparator Function) (p. 38) Comparing the Measurement Settings of Two Instruments (Settings Monitor Function) (p. 61)
To correct faulty measurements	Confirming Faulty Measurements (p. 42) Improving Probe Contact (Contact Improver Function) (p. 54)
To enhance the reliability of inspection	Checking for Poor or Improper Contact (Contact Check Function) (p. 52) Detecting Measurement Voltage Faults (Voltage Level Monitor Function) (p. 57) Test for Short-Circuited Probe (Probe Short-Circuit Detection Function) (p. 59) Comparing the Measurement Settings of Two Instruments (Settings Monitor Function) (p. 61)
To inspect the 03015 mm or 0201 mm (Imperial 008004) size components	Limiting Measurement Voltage (Applied Voltage Limiter Function) (p. 66)
To automatically store measurement values	Store as soon as Measurement is Stable (Auto-Memory Function) (p. 83)
To print measurement results	Printing (p. 91)
To measure by connecting with PLC (Control equipment) (PLC: Programmable Logic Controller)	External Control (p. 97) Communications (RS-232C/ GP-IB Interface) (p. 113)
To connect to a computer	Communications (RS-232C/ GP-IB Interface) (p. 113)

1.888.610.7664 www.calcert.com sales@calcert.com

To enable auto-exporting measurement values to the computer (Available only with RS-232C interface)	▶ Auto-Exporting Measurement Values (at End of Measurement) (Data Output Function) (p. 89)
To check operation	▶ Setting Measurement Start Conditions (Trigger Source) (p. 33) Internal trigger [INT] ▶ Calibration (p. A11)

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement Flow

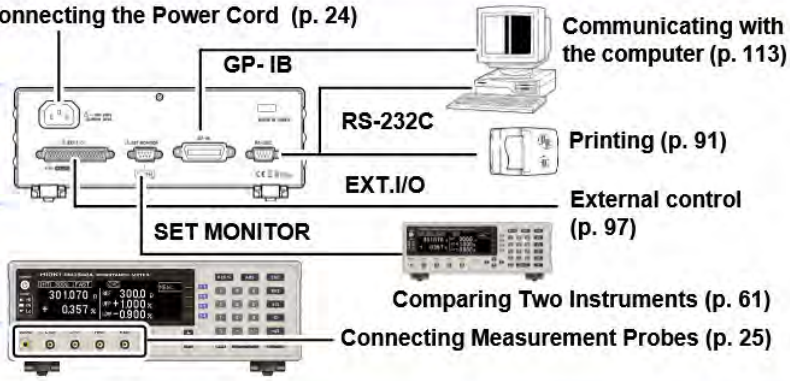
Be sure to read the "Operating Precautions" (p. 9) before use.

Installing, Connecting and Turning On

Installing (p. 9)

Connecting (p. 23)

Turning Power On (p. 27)



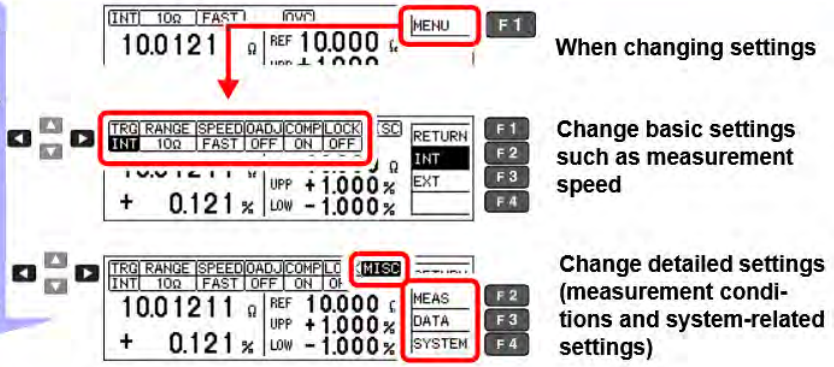
Settings of RM3542A

Setting measuring conditions (as needed)

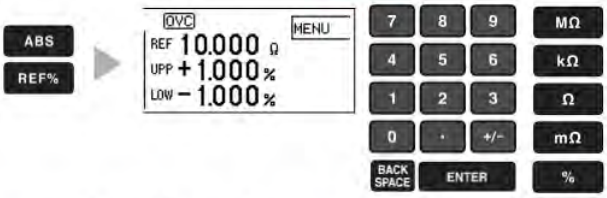
Confirm the screen configuration (p. 19)

Confirm the initial setup (p. 78)

- Basic Settings(p. 29)
- Configure settings for your specific conditions (p. 45)
- System-related settings (p. 69)



Setting judgment criteria (p. 38)



Calculation, Printing, Communication, and External Control Settings

Enable statistical calculation (p. 86)

Computer communications (p. 113)

Transmitting data (p. 89)

External Control (p. 97)

Printing (p. 91)

Instrument interface settings must be configured before printing, using communications or external control.

When Finished

Turning Power Off (p. 27)

1.888.610.7664 www.calcert.com sales@calcert.com

Introduction

Thank you for purchasing the Hioki Model RM3542A (RM3542-50/RM3542-51) Resistance Meter.
To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

Model RM3542-51 includes the GP-IB interface.

Information on download site
For details on the product application, the update file for the instrument, and the instruction manual, please check Hioki's website.

Request for product user registration
We kindly request that you visit the following link to register your product to receive critical updates and information about the product.

Trademark

Visual Basic and Windows are trademarks of the Microsoft group of companies.

1.888.610.7664 www.calcert.com sales@calcert.com

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 authorized Hioki distributor or reseller.

Content confirmation

Confirm that these contents are provided.

☐ This instrument 1

Accessories

☐ Instruction Manual (This document) 1

Please visit Hioki's website to check for versions in other languages.

☐ Operation Guide 1

☐ Power Cord (p. 24)

☐ EXT.I/O Male Connector (p. 112)

1.888.610.7664 www.calcert.com sales@calcert.com

Options

The optional equipment listed below is available for the instrument.
To purchase any optional equipment, please contact your authorized Hioki distributor or reseller. Please note that optional equipment offerings are subject to change without advance notice. For the latest information, check Hioki's website.

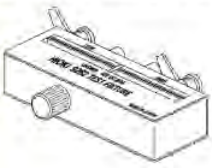
Measurement Probes and Fixtures (connect to measurement jacks)

☐ Model 9140-10 4-terminal Probe

Alligator-clip-type measurement probes.
These general-purpose dual-electrode clips fit a wide range of conductor thicknesses.
Measurable terminal diameter:
0.3 mm to 5 mm

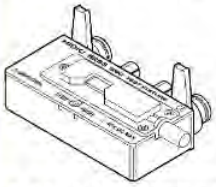
Maximum rated voltage to earth: 30 V rms AC, 42.4 V peak, 60 V DC
Rated voltage: 30 V rms AC, 42.4 V peak, 60 V DC
Rated current: 1 A peak

☐ Model 9262 Test Fixture



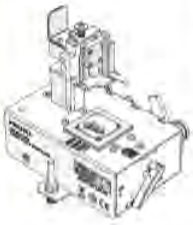
This fixture is for measuring lead components.
Measurable sample dimension:
Lead diameter: ϕ0.3 mm to ϕ2 mm
Lead pitch: 5 mm or more

☐ Model 9263 SMD Test Fixture



This fixture is for measuring chip components.
Measurable sample dimension:
Sample width: 1 mm to 10 mm
(less than 20 mΩ residual resistance after zero adjustment)

☐ Model IM9100 SMD Test Fixture



This fixture is for measuring ultra-small SMD components.
Measurable sample dimension:
JIS(EIA): Approx. L mm x W mm
0402 (01005): 0.4 mm x 0.2 mm
0603 (0201): 0.6 mm x 0.3 mm
1005 (0402): 1.0 mm x 0.5 mm

Interface Cables

☐ Model 9637 RS-232C Cable (9-pin to 9-pin/crossover cable/1.8 m)

☐ Model 9638 RS-232C Cable (9-pin to 25-pin/crossover cable/1.8 m)

☐ Model 9151-02 GP-IB Connector Cable (2 m)

Precautions during shipping

During shipment of the instrument, handle it carefully so that it is not damaged due to a vibration or shock.

1.888.610.7664 www.calcert.com sales@calcert.com

Safety Information

This instrument is designed to conform to IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, using the instrument in a way not described in this manual may negate the provided safety features.
Before using the instrument, be certain to carefully read the following safety notes:

⚠WARNING If persons unfamiliar with electricity measuring instrument are to use the instrument, another person familiar with such instruments must supervise operations.

⚠CAUTION Mishandling during use could damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use.

Marks on This Instrument

⚠	Indicates cautions and hazards. When the symbol is printed on the instrument, refer to a corresponding topic in the Instruction Manual.
~	Indicates AC (Alternating Current).

Alarm Symbols

In this document, the risk seriousness and the hazard levels are classified as follows.

⚠DANGER	Indicates an imminently hazardous situation that will result in death or serious injury to the operator.
⚠WARNING	Indicates a potentially hazardous situation that may result in death or serious injury to the operator.
⚠CAUTION	Indicates a potentially hazardous situation that may result in minor or moderate injury to the operator or damage to the instrument or malfunction.
NOTE	Indicates advisory items related to performance or correct operation of the instrument.

Symbols for Various Standards

CE	Indicates that the product conforms to regulations set out by the EU Directive.
	This symbol indicates laws and regulations regarding the disposal of electrical and electronic appliances in the Member States of EU (WEEE directive).
	Indicates that the product complies with Korean regulations. Declarer: TAISHIN CO., LTD.

1.888.610.7664 www.calcert.com sales@calcert.com

Other Symbols

⃠	Indicates the prohibited action.
(p.)	Indicates the location of reference information.
*	Indicates that descriptive information is provided below.
[ ]	Square brackets indicate instrument display labels (such as setting item names).
SET (Bold characters)	Bold characters within the text indicate operating key labels.

Unless otherwise specified, Windows represents Windows 95, 98, Me, Windows NT4.0, Windows 2000, Windows XP, or Windows Vista.

Click: Press and quickly release the left button of the mouse.
Double click: Quickly click the left button of the mouse twice.

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) The maximum displayable value. 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. a "1" as the least-significant digit.

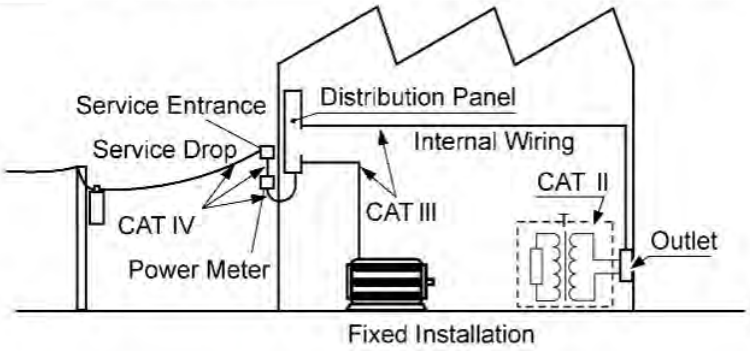
Measurement categories

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

⚠DANGER

- **Using a measuring 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.**
- **Never use a measuring instrument that lacks category labeling in a CAT II to CAT IV measurement environment. Doing so could result in a serious accident.**

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



Operating Precautions

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions. Ensure that the use of the instrument conforms not only to its specifications but also to the specifications of all products to be used, including accessories and optional equipment.

Preliminary Checks

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 authorized Hioki distributor or reseller.

Instrument Installation

⚠WARNING

Installing the instrument in inappropriate locations may cause a malfunction of instrument or may give rise to an accident. Avoid the following locations:

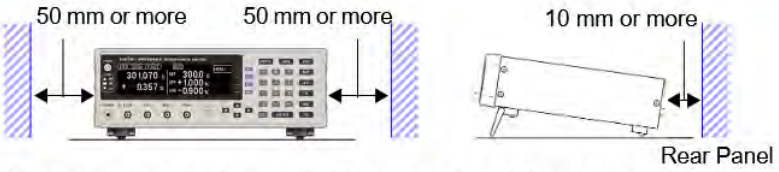
- **Exposed to direct sunlight or high temperature**
- **Exposed to corrosive or combustible gases**
- **Exposed to a strong electromagnetic field or electrostatic charge**
- **Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)**
- **Susceptible to vibration**
- **Exposed to water, oil, chemicals, or solvents**
- **Exposed to high humidity or condensation**
- **Exposed to high quantities of dust particles**

Installing

- To prevent overheating, be sure to leave the specified clearances around the instrument.
- Install the instrument with the bottom facing down.

⚠CAUTION

Do not place the instrument on an unstable table or an inclined place. Dropping or knocking down the instrument can cause injury or damage to the instrument.



The instrument can be used with the stand (p. 18) in the upright position.
It can also be rack-mounted (p. A8).

Unplugging the power cord kills power to the instrument. Be sure to provide enough unobstructed space to unplug the power cord immediately in an emergency.

The instrument is classified as a Class A device under the EN 61326 standard. Use of the instrument in a residential setting such as a neighborhood could interfere with reception of radio and television broadcasts. If this occurs, take appropriate steps to counteract the issue.

1.888.610.7664 www.calcert.com sales@calcert.com

Handling the Instrument

⚠CAUTION To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.

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.

Handling the Fixture

NOTE Before using a test fixture, read the instructions provided with it.

Before Turning Power On

⚠WARNING

- **Before turning the instrument on, make sure the supply voltage matches the voltage indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.**
- **To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord provided only to an outlet.**

⚠CAUTION Avoid using an uninterruptible power supply (UPS) or DC/AC inverter with rectangular wave or pseudo-sine-wave output to power the instrument. Doing so may damage the instrument.

Before Connecting EXT. I/O Connector

⚠WARNING

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to the EXT. I/O connectors:

- **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. Use screws to secure the EXT. I/O connectors.**

⚠CAUTION

To avoid damage to the instrument, always observe the following precautions when connecting to the EXT. I/O connector.

- **Do not apply voltage or current to the EXT. I/O terminals that exceeds their ratings (p. 105).**
- **Ensure that devices and systems to be connected to the EXT. I/O terminals are properly isolated.**
- **When driving relays, be sure to install diodes to absorb counter-electromotive force.**
- **The IISO_5 V pin of the EXT. I/O connector is a 5 V power output. Do not apply external power to this pin. Be careful not to short-circuit ISO_5 V to ISO_COM.**
- **The IISO_12 V pin of the EXT. I/O connector is a 12 V power output. Do not apply external power to this pin. Be careful not to short-circuit ISO_12 V to ISO_COM.**

See "Connector Type and Signal Pinouts" (p. 98).

1.888.610.7664 www.calcert.com sales@calcert.com

Before Connecting to the RS-232C Connector or SET MONITOR Connector

⚠CAUTION

- Use a common ground for both the instrument and connected device.
  Using different ground circuits will result in a potential difference between the instrument's ground and the connected device.
  If the communications cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.
- Before connecting or disconnecting any the communications cable, always turn off the instrument and the connected device. Failure to do so could result in equipment malfunction or damage.
- After connecting the communications cable, tighten the screws on the connector securely. Failure to secure the connector could result in equipment malfunction or damage.

Before Measuring

⚠DANGER

To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximum to the EXT. I/O connectors.

⚠CAUTION

- Do not apply any voltage to the measurement jacks. Doing so may damage the unit.
- Never attempt to measure at a point where voltage is present. In particular, do not measure a transformer or motor immediately after a temperature increase test or withstand-voltage test, as the instrument could be damaged by induced voltage or residual charge.
- Battery internal resistance cannot be measured with this instrument. It will sustain damage. To measure the battery internal resistance, we recommend the Hioki 3554, 3555, BT3562, BT3563 and 3561 Battery HiTesters.

NOTE

- To obtain the guaranteed measurement accuracy, allow at least 30 minutes warm-up.
- The instrument internally retains all settings (but not measurement values), such as measurement range and comparator settings. However, measurement settings made through the RS-232C or GP-IB interface are not memorized.
- In the 100 Ω or higher ranges (LOW POWER: OFF setting), a measurement error may occur due to the influence of thermo electromotive force.
- The DC resistance of a power transformer cannot be measured. When measuring objects with a large L, such as choke coils and other inductors, measurement values may be unstable. In such cases, contact your authorized Hioki distributor or reseller.
- Carefully insulate all H_{CUR}, H_{POT}, L_{POT} and L_{CUR} wiring. Proper 4-terminal measurements cannot be performed and an error will occur if the core and shield wires touch.

1.888.610.7664 www.calcert.com sales@calcert.com

1

Overview Chapter 1

1.1 Product Overview and Features

This instrument employs the 4-terminal method to quickly and accurately measure the DC resistance of components, such as resistors and ferrite beads.

It includes advanced contact-check, comparator, and data output functions. The intuitive user interface and high noise immunity are ideal for use with taping machines and separators.

Resistance Measurement

The factory defaults (initial settings) are optimized for chip-component resistance measurements. It can also measure devices that are otherwise difficult to measure with a high current, such as ferrite bead and small multilayer inductors (low-power resistance measurement) (p.30).
It is also suitable for measuring imperial 008004 sized components with small rated voltage (Applied Voltage Limit Function) (p.66)

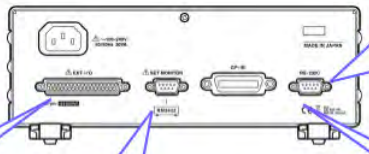
Optional Hioki probes and fixtures are available to connect to the measurement jacks (BNC jacks (p.6)).
Alternatively, commercially available cables, such as the 1.5D-2 V coax, can be used (p.26)

Judge the Measurement Values

Measurement values are compared with a pre-specified reference value or range, and the result is outputted externally and indicated by the COMP indicators (comparator function) (p.38)

Save and Output the Measurement Values

Measurement values can be stored in the internal memory (p.81).
Statistical calculations can be performed on the stored data, which can be transferred to a computer in batch form (however, stored data cannot be confirmed internally).



Send the measurement value and calculation results to the printer.

Use a commercially available printer with a serial interface to print the measurement values and calculation results. (p.91)

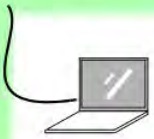
Connect a PLC or I/O Board

By connecting to the EXT. I/O connector, it is possible to control the instrument from a PLC. In addition to the comparator results, various measurement anomaly signals can be outputted. (p.97)
Additionally, the judgment output shift function can be used to generate control signals for test equipment without the need to use a PLC.

When using two instruments, a difference in settings disables measurement and causes a warning notification (Setting Monitor Function) (p.61).

Interface Communications

Connect the instrument to a controller via the RS-232C or GP-IB interface to control this instrument or acquire the measurement data (p.113)



1.888.610.7664 www.calcert.com sales@calcert.com

Features

Ultra Fast and Accurate Measurements Increase Productivity

The factory default settings are optimized for chip-component resistance measurements. Enhanced contact-to-measurement and contact check-to-determination, within 1 ms.
When using the low-power resistance measurement and the 100 mΩ to 10 Ω ranges, the offset-voltage compensation (OVC) function minimizes the effects of thermal emf (p.67).
Because measurement results are judged as pass/fail with a 10 ppm resolution, it is ideal for high-speed Class B resistor testing.

High-Speed Data Output and Ample Memory

The Data Output function transfers measured data at 5 ms/sample, even via RS-232C.
Up to 30,000 measurements can be stored, and all data can be exported at the end of measuring each reel.
This function is ideal for system setup, debugging and process management.

Multiple Interfaces

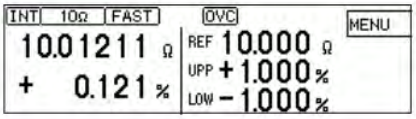
EXT. I/O is a noise proofed structure isolated from the measurement and control circuits (p.97).
All data can be acquired in real time using the built-in 38.4-kbps high-speed RS-232C interface.
Connect the commercially available printer with a serial interface to print the measurement values and statistical calculation results (p.91)
The GP-IB interface can also be used for Model RM3542-51 (specified when shipping (p.113)).

Low-Power Function (p.30)

For ranges from 1000 mΩ to 1000 Ω, the low-power resistance measurement is provided to minimize the measurement current. Safely measure devices that are otherwise difficult to measure with high current, such as ferrite-bead and multilayer inductors.

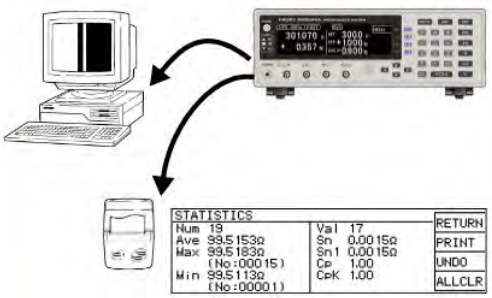
Clearly Visible Display and Intuitive Operation

The high-contrast LCD provides clear visibility, helping to avoid setting mistakes. The optimum range is selected automatically when comparator thresholds are entered.



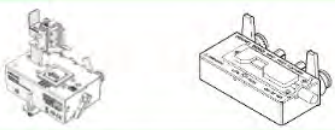
The Auto Memory Function Is Convenient for Sampling Tests(p.83)

The auto memory function is convenient for sampling tests after screen-printing.
When the measurement values become stable, the measurement value is automatically acquired and statistical calculations are performed at the same time.
The beeper gives a notification when the specified number of values are stored.
Selecting [PRINT] (screen display) prints the measurement values and statistical calculation results(p.95).



Fixtures for Component Measurements (p.6)

The BNC-type measurement jacks exhibit good noise immunity.
Ready availability and easy assembly ensure a smooth system setup.
Various test fixtures are available for Hioki LCR HiTesters.

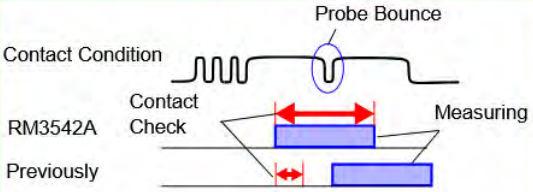


1.888.610.7664 www.calcert.com sales@calcert.com

Features

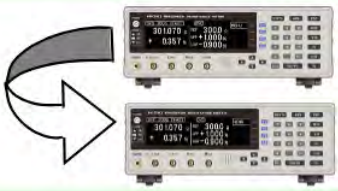
Reliable Contact Checks (p.52)

Contact checking (that was previously performed before and after measuring) is now performed during measurement, so probe bounce and contact resistance fluctuations can be detected. Contact checking time can be shortened, improving tact times.



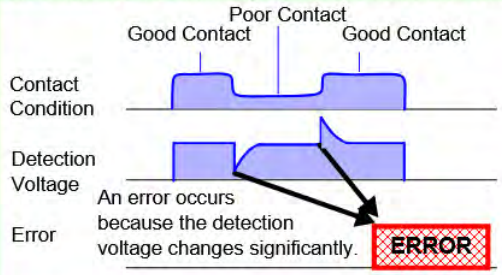
Minimize Human Error and Risk - Settings Monitor Function (p.61)

If the settings are found to be different after comparing the setting conditions of two instruments, an alarm is sounded to prohibit the TRIG input. Helps to prevent human errors by avoiding setting mistakes.



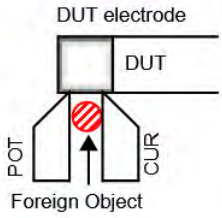
Reject Faulty Data - Voltage Level Monitor Function (p.57)

When the contact resistance of the H_{CUR} and L_{CUR} leads fluctuates, the measurement current changes momentarily. Such momentary changes are not detectable by typical contact checking.
The Voltage Level Monitor Function indicates a contact error if the detection voltage changes significantly. It can enhance the reliability of the measurement value.



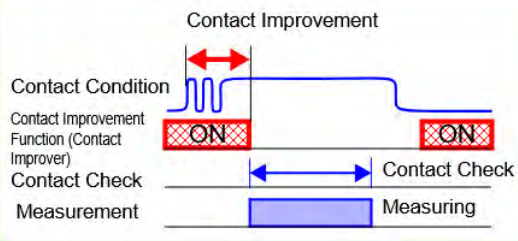
Reliable Four-Terminal Measurement - Probe Short-Circuit Detection Function (p.59)

If a conductive foreign object is present between the POT and CUR probe tips, the reliable four-terminal measurements cannot be maintained. When not measuring, resistance between the POT and CUR probe tips is measured and short-circuit probe anomalies are detected.



Contact Improvement Function (Contact Improver) (p.54)

The Contact Improver function improves bad contacts between probes and test samples. Contacts errors are reduced by penetrating oxidation and impurities between probes and samples.
Reducing contact errors can increase productivity and quality. The intensity of the contact improver function can be adjusted according to probe type.



Measurement Circuit Strongly Immune to Contact Resistance Fluctuations

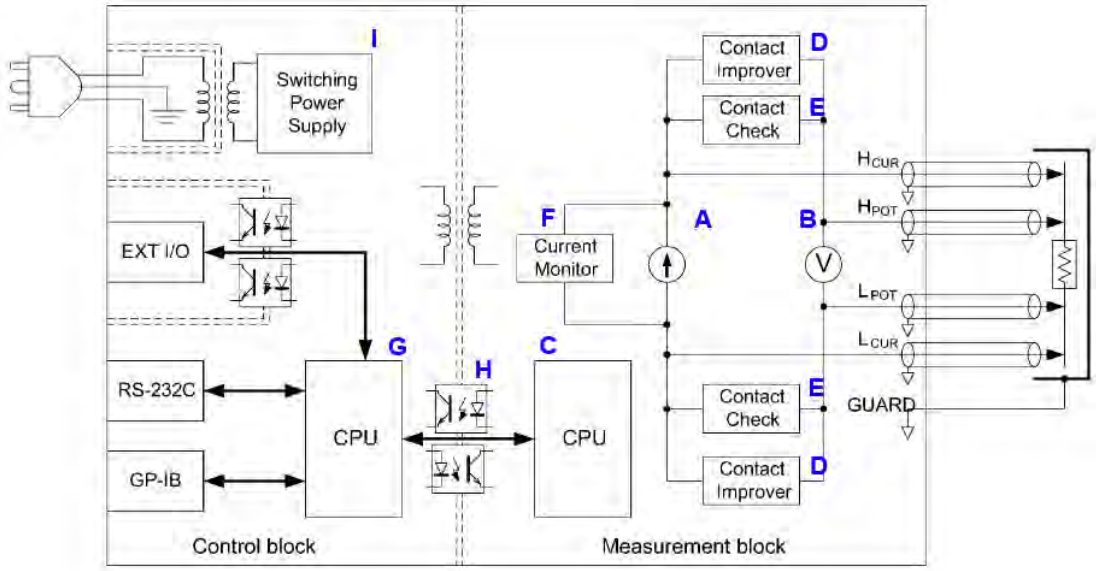
The effects of contact resistance fluctuations are reduced even when scattering occurs near the end of probe life. Such effects are minimized by the fast response of the measurement circuit.

Strong Electrical Noise Immunity

The specified measurement accuracy is achieved even with a ±1.5 kV mixed pulse noise. The floating measurement section design is highly impervious to electrical noise, minimizing the effect on measurement values even when turning large-induction motors on and off.
The free-range power supply input (90 to 264 V) is essentially unaffected by voltage fluctuations, so stable measurements are possible even under poor power conditions.

1.888.610.7664 www.calcert.com sales@calcert.com

Block Diagram



- A constant current (determined by the measurement range) is applied between the H_{CUR} and L_{CUR} terminals while voltage is measured between the H_{POT} and L_{POT} terminals. The resistance value is obtained by dividing the measured voltage (B) by the constant current flow (A). (**A, B**)
- The effects of a large offset voltage, such as from thermal emf, are reduced by reversing the current and measuring twice in positive and negative directions (A). (**A**)
- The constant current source (A) and voltmeter (B) circuit designs are largely unaffected by contact resistance. (**A, B**)
- Faulty measurement values caused by unstable or chattering contact conditions can be eliminated by monitoring (C) the detection voltage (B) waveform (voltage level monitor function). (**B, C**)
- The voltmeter is provided with sufficient time for integration (the default setting is 0.3 ms) to achieve stable measurements. (The integration time can be reduced to 0.1 ms to support higher speeds.) (**B**)

- Before measuring, the Contact Improver circuit (D) optimizes the contact when the probes touch the DUT. (**D**)
- Also, performing contact checking (E) before measuring can detect short circuits between the CUR and POT terminals caused by a clogged probe tip (probe short-circuit detection function). (**E**)
- When measurement starts, the contact check circuit (E) and constant current monitor (F) are activated to monitor for faulty conditions while measuring. (**E, F**)

- The dual CPU (C and G) design provides ultra-high-speed measurements and a fast system response. (**C, G**)

- Protection from electrical noise is provided by the isolation between the Measurement and Control blocks (H). (**H**)
- The 90 V to 264 V wide range switching power supply (I) can provide stable measurements even in poor power quality environments. (**I**)

1.888.610.7664 www.calcert.com sales@calcert.com

1.2 Names and Functions of the Parts

1

Front Panel

Turning the Power On and Off

POWER Button

Turns the instrument on and off. (p.27)

- Off: power is off (When power is not supplied)
- Red light: power is off (when power is supplied)
- Green light: power on

Viewing the Measurement Values and Settings

Display Screen

Monochrome graphical LCD
There are three screen types: Measurement, Basic Settings and Detailed Settings.
Screen Configurations (p.19)

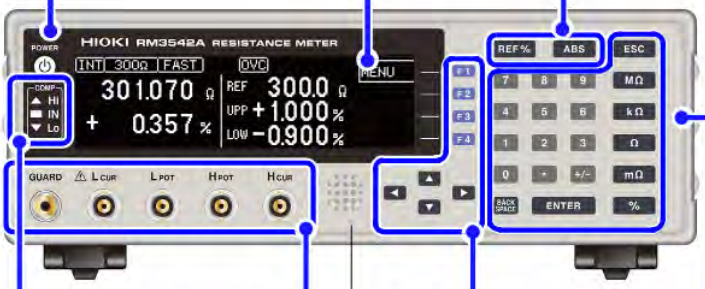
Setting

Judging the Measurement Values (p.38)(Comparator Function)

Set a reference value and range for judging the measurements, which can be confirmed by the **COMP** indicators.

REF% — Select this to judge the measurement values relative to a reference value and tolerance (%).The REF% setting display appears.

ABS — Press this button to judge the measurement values relative to the setting range (absolute value).The ABS setting display appears.



Buzzer beeps.

Entering numerical values

0 · · 9 — Enter a numerical value. (these are called the numeric keys)

+/− — Switches the sign of a numerical value.

mΩ · · MΩ — Selects the unit of measure.

% — Sets the tolerance values.

BACK SPACE — Deletes the value in the selected field.

ENTER — Accepts the displayed comparator threshold values.

ESC — Aborts comparator setting and returns to the previous display.

Viewing the Comparator Results

COMP indicator

Displays Comparator Results (p. 36).

Hi The measurement value is above the upper limit.

IN Pass (meets criteria)

Lo The measurement value is below the lower limit.

Connecting Probes

Measurement jacks

Connect measurement probes and fixtures (p. 23).

- H_{CUR} jack: Current source terminal
- H_{POT} jack: High voltage detection terminal
- L_{POT} jack: Low voltage detection terminal
- L_{CUR} jack: Current detection terminal
- GUARD jack: Shield terminal (for the measurement of GND)

⚠ See "Before Measuring" (p.11)

Selecting the setting contents

(we call these "F keys")

F1 · · F4 — Selects the corresponding item on the right side of the display.

Cursor keys
Move among the displayed setting items.
The cursor location is indicated by reverse characters.

Rear Panel

Connecting the Power Cord

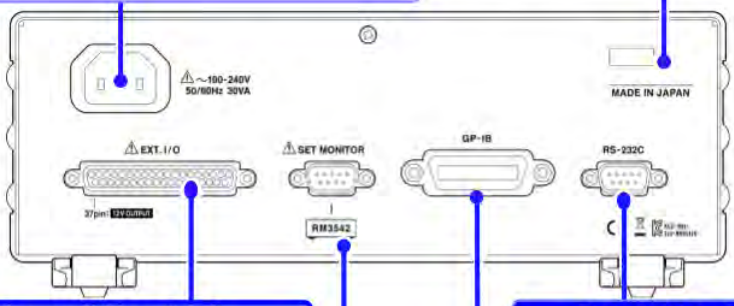
Connect the supplied power cord (p.24).

See "Before Turning Power On" (p.10)

Serial Number

For the latest information, check Hioki's website.

Do not remove this sticker because the number is required for product tracking.



External Control

EXT. I/O Connector

Connect to a PLC or I/O board to control the measurement start time, and to acquire the comparator results (p.97).

See "Before Connecting EXT. I/O Connector" (p.10), "Before Measuring" (p.11)

RS-232C Communications Printer Output

RS-232C Connector

The RS-232C interface can be used to connect to a PLC or computer (p.113).
It is also used to connect to a commercially available printer with a serial interface for printing (p.91).

Compare Two Instruments

SET MONITOR Connector

Connect another instrument to compare the settings of two units (p.61).

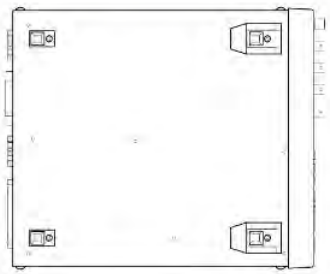
See "Before Connecting to the RS-232C Connector or SET MONITOR Connector" (p.11)

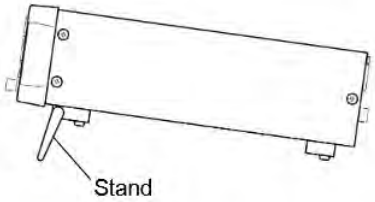
GP-IB Communications

GP-IB Connector (RM3542-51 only)

The GP-IB interface can be used to connect to a computer (p.113).

Bottom Panel





This instrument can be rack mounted.

See: Rack Mounting (p. A8)

Please retain the parts removed from this instrument to be used again.

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.

1.888.610.7664 www.calcert.com sales@calcert.com

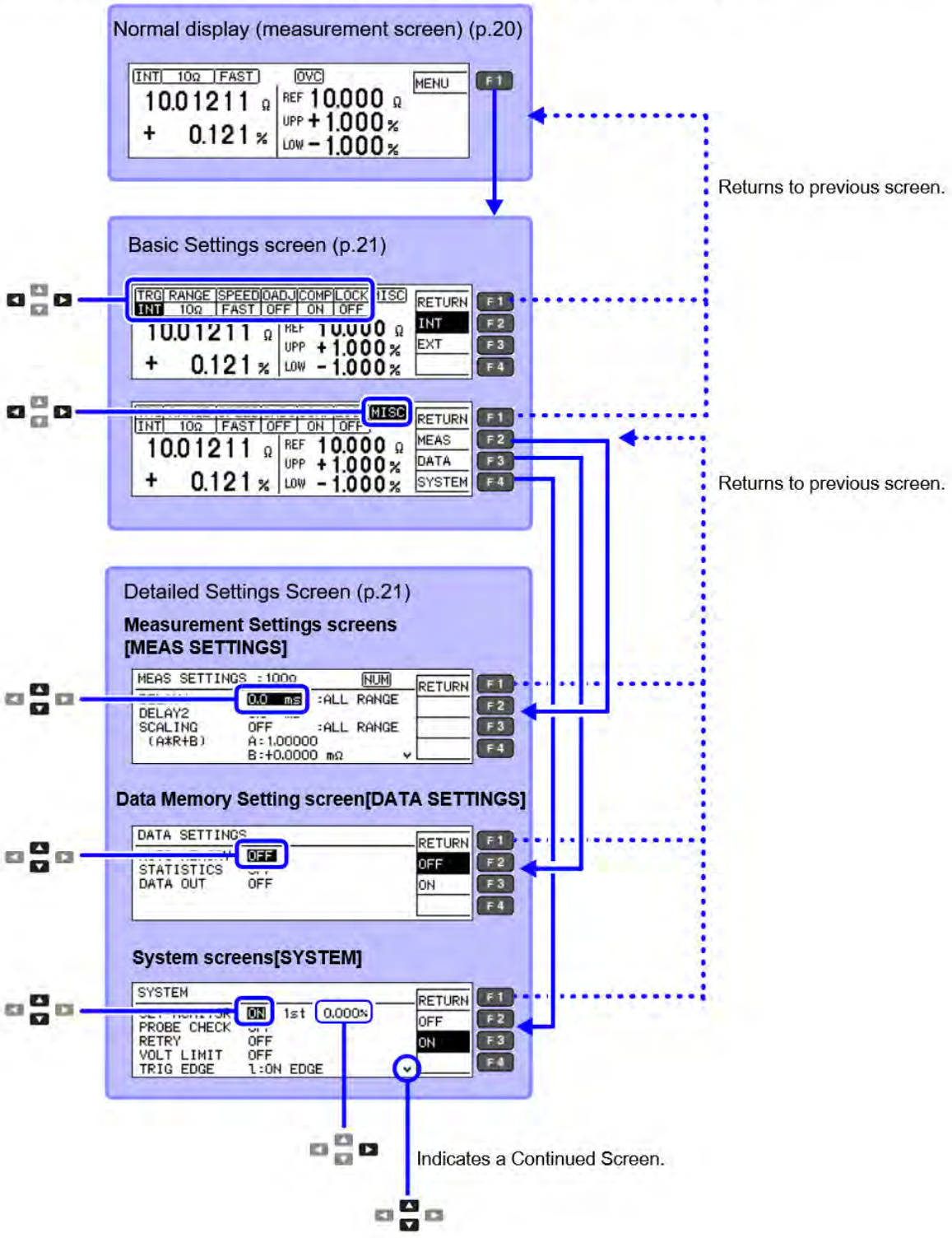
1

1.3 Screen Organization

The instrument has three general display screen types: Measurement, Basic Settings and Detailed Settings.

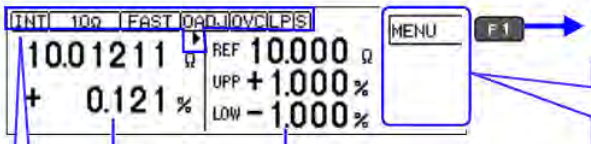
See "11.3 Error Displays and Solutions" "Error Displays and Solutions" (p. 203) for error displays.

The screen examples in this manual are reversed (black on white) for the best visibility on the printed page. However, the instrument screens can actually be displayed only with white characters on a black background.



Normal display (measurement screen)

This screen normally appears while measuring. View currently measurement values and measurement conditions.
Some parts of the display depend on the comparator mode and other settings.
To display the Basic Settings screen



Measurement value

Criteria Setting Values (p.38)
Displayed contents depend on the selected comparator mode.
(Ex.: REF% mode)

Measurement Conditions

Shows current setting contents. Displayed contents depend on the current settings.

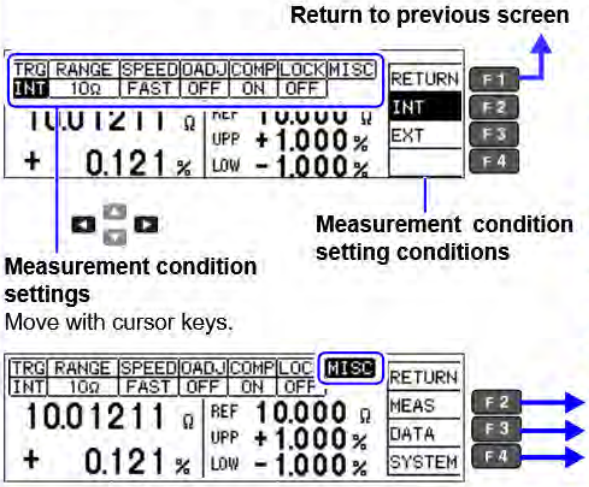
INT/ EXT	Trigger source type (p.33)
Ω	Measurement ranges (p.34)
FAST/ MED/ SLOW	Measurement Speed (p.31)
0ADJ/ OFF (no display)	Appears only when the zero-adjustment is enabled (p.36).
OVC/ OFF (no display)	(OVC: offset voltage compensation) Appears only when the offset voltage compensation is enabled (p.67).
LP/ OFF (no display)	Appears only when the low-power resistance measurement function is enabled (p.30).
S/ OFF (no display)	Appears when scaling function is enabled (p.48)
VL/ OFF (no display)	Appears only when the applied voltage limit function is enabled (p.66)
NUM	Appears only when numeric input is enabled.
RMT	Remote status(p.120)
M.LOCK	Disables all operations except the comparator settings (p.69).
F.LOCK	Disables all operations including the comparator settings (p.69)
▶	Appears only when the judgment output shift function is enabled (p.109)

Settings Menu (corresponding to the F keys)
Displayed contents depend on the current function settings.
Parentheses ( ) indicate the corresponding F key.

MENU (F1)	Displays the Basic Settings screen.
PRINT (F2)	Printing (p.93) Appears only when the interface is set for the printer.
STAT (F3)	Statistical calculation results (p.86) Appears only when statistical calculation is enabled
NUMBER (F4)	Sets the Auto-Memory number (p.83). Appears only when the auto-memory function is enabled Displays the memory number, the number of passed and failed products, in the lower left of the screen.
UNDO (F3)	Deletes the last stored measurement and calculation result (executes only once) (p.88) Appears only when the calculation result screen is displayed.
ALLCLR (F4)	Clears all memory and calculations (p.88). Appears only when calculation results are displayed.
LOCAL (F1)	Cancels the remote status (p.120).
UNLOCK (F1)	Cancels the key-lock status (Hold for one second) (p.70).

1.888.610.7664 www.calcert.com sales@calcert.com

Basic Settings screen



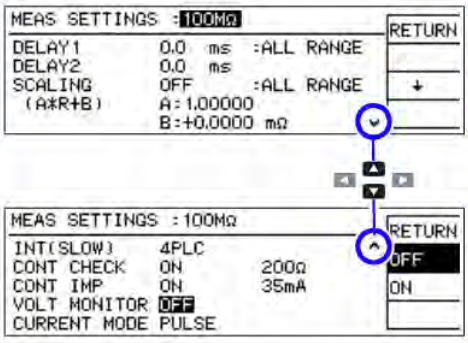
Make basic measurement condition settings on this screen.
Measurement speed and range can be changed while viewing the measurement values (when the Trigger source is set to the internal trigger [INT]).

TRG	Changing the trigger source (start control method) (p.33). When selecting [TRG: EXT], [MANU] appears by pressing the F4 key (Measures manually once).
RANGE	Change the range (p.34).
SPEED	Change the measurement speed (p.31).
0ADJ	Zero-adjustment function ON/OFF (p.36)
COMP	Comparator function ON/OFF(p.38)
LOCK	Key-lock function ON/OFF (p.69)
MISC	To display the Detailed Settings screen.

To the Measurement Settings screen [MEAS SETTINGS]
To the Data Memory Setting screen [DATA SETTINGS]
To the System screen [SYSTEM]

Detailed Settings Screen

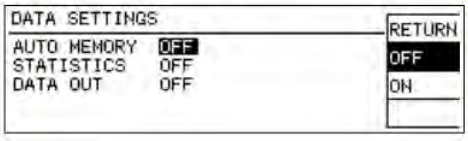
Measurement Settings screens [MEAS SETTINGS]



Shows detailed settings for measurements.
Use when adjusting the measurement speed, stability and measurement fault detection functions.

DELAY1	Adjust the delay between the probing and trigger input (p.46).
DELAY2	Adjust the target electrical response (p.46).
SCALING (A*R+B)	Compensate the measured value using scaling function (p.48)
INT(FAST/ MED/ SLOW)	Make fine adjustment to the integration time (p.50).
CONT CHECK	Contact check threshold setting (p.52)
CONT IMP	Contact improver function setting (p.54)
VOLT MONITOR	Voltage level monitor function setting (p.57)
CURRENT MODE	Current mode setting (p.58)

Data Memory Setting screen (Save, analysis, output) [DATA SETTINGS]

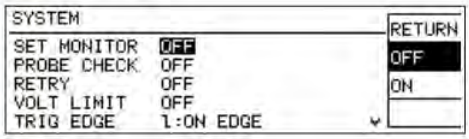


These are settings for memory and statistical calculation functions.

AUTO MEMORY	Auto-memory function ON/OFF (p.83)
STATISTICS	Statistical calculation ON/OFF (p.86)
DATA OUT	Auto-export the measurement values (communication) ON/OFF (p.89)

1.888.610.7664 www.calcert.com sales@calcert.com

System screens [SYSTEM]



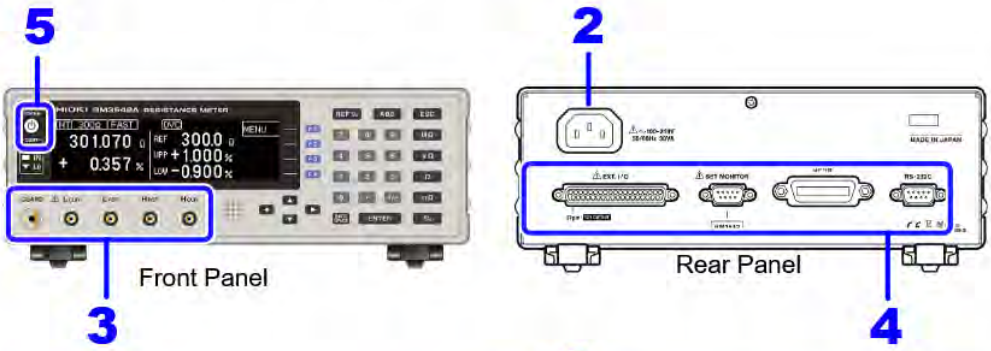
Set instrument system-related settings on this screen.

SET MONITOR	Two units measurement condition comparison ON/OFF(p.61)
PROBE CHECK	Probe short-circuit detection function ON/OFF (p.59)
RETRY	Retry function setting (p.64)
VOLT LIMIT	Sets voltage limit function to ON/OFF (p.66)
TRIG EDGE	(EXT. I/O) Set the trigger rising/falling edge (p.108)
EOM	(EXT. I/O) EOM (end-of-measurement signal) output setting (p.107)
SHIFT OUTPUT	Configures the judgment output shift function (p.109)
INTERFACE	Communications interface settings(p.117)
%OUTPUT	Configures the percentage output function (p.90)
PRINT MODE	Set printing method (p.93)
LOW POWER	Low-power resistance component measurement ON/OFF(p.30)
JUDGE BEEP	Comparator beeper settings (p.72)
KEY BEEP	Key beeper ON/OFF (p.71)
CLOCK (Y-M-D)	Internal clock settings (p.74)
LINE FREQ	Power source frequency settings (p.73)
CONTRAST	Adjust screen contrast (p.75)
BACKLIGHT	Adjust screen backlight (p.76)
RESET	Initializing (p.77)
ADJUST	Instrument Adjustment (p. A13)

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement Preparations Chapter 2

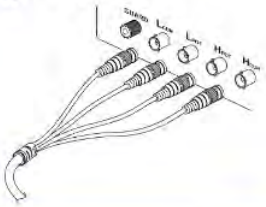
Be sure to read the "Operating Precautions" (p.9) before installing and connecting this instrument.
See "Appendix 4 Rack Mounting" (p. A8) for rack mounting.



1 **Installing this instrument (p. 9)**

2 **Connecting the Power Cord (p. 24)**

3 **Connecting Measurement Probes (p. 25)**



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

- Using the printer (p. 91)
- Using RS-232C or GP-IB interface (p. 113)
- Connecting to the PLC or I/O Board (p. 97)
- Automatically comparing the settings of two instruments (Settings Monitor function) (p. 61)

5 **Turning Power On (p. 27)**

6 **Setting the Instrument (p. 29)**

Connect to the test sample.

After measurements are completed, turn the power off. (p. 27)

1.888.610.7664 www.calcert.com sales@calcert.com

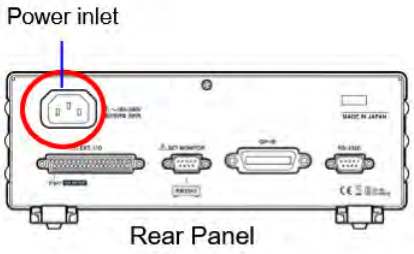
2.1 Connecting the Power Cord

⚠WARNING

- **Before turning the instrument on, make sure the supply voltage matches the voltage indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.**
- **To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord only to a 3-contact (two-conductor + ground) outlet.**
- **Before using the instrument, make sure that the insulation on the power cord is undamaged and that no bare conductors are exposed. Any damage can cause electric shock, contact your dealer or Hioki representative.**

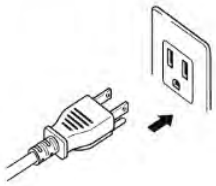
⚠CAUTION

To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.



Rear Panel

1 Confirm that the supply voltage matches the instrument, and connect the power cord to the power inlet on the instrument.



2 Connect the plug of the power cord to the outlet.

The **POWER** button on the front panel lights up in red.

In event of a power outage, operation resumes with the same settings when power is restored (breaker reset, etc.).

1.888.610.7664 www.calcert.com sales@calcert.com

2.2 Connecting Measurement Probes and Test Fixtures

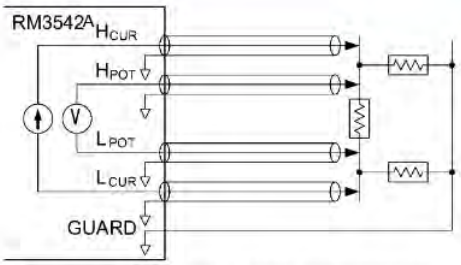
Connect your measurement probes, optional Hioki probes, or test fixtures to the measurement jacks.
Refer to "Options" (p.6) for details of the Hioki option.
See the instructions provided with the fixture for operating details.

⚠CAUTION

- Do not apply any voltage to the measurement jacks. Doing so may damage the unit.
- 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 cle, can damage the connector.

NOTE

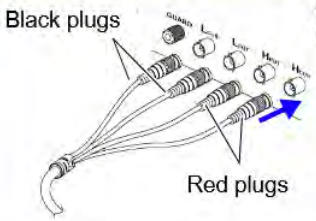
- We recommend using optional Hioki fixtures.
- Use the GUARD jack only for the High-Resistance Measurements shield, and avoid more than a 10 mA current flow. This jack is not for guarding the network resistance measurements.



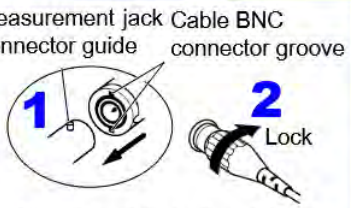
Example of defeated guard measurement

Connection Methods

Connecting measurement probes

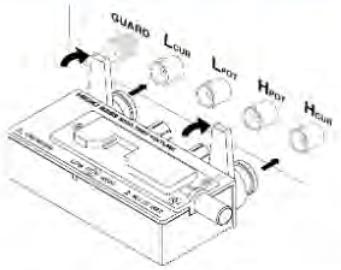


Connect the red plugs to the H_{CUR} and H_{POT} jacks, and the black plugs to the L_{CUR} and L_{POT} jacks.



Align the slots in the BNC plug with the guide pins on the jack on the instrument, then push and twist the plug clockwise until it locks.
Disconnecting BNC connectors Push the BNC plug, twist it counterclock-wise, and pull it out.

Connecting a fixture



Connect it directly to the measurement jacks with the label side facing up, and fix it with the levers on the left and right sides.

Making and extending your own probes (p. 26)

1.888.610.7664 www.calcert.com sales@calcert.com

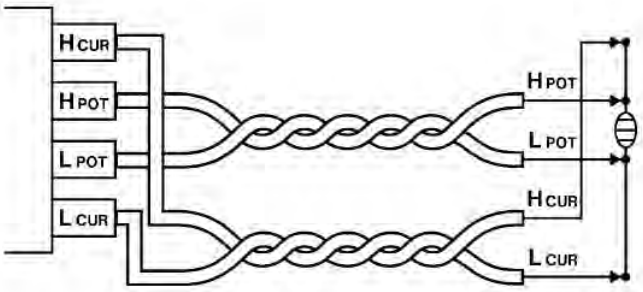
Making Your Own Measurement Probes

Recommended measurement probe specifications

Conductor resistance	500 mΩ/m or less
Capacitance	150 pF/m or less
Cable dielectric material	Polyethylene (PE), TEFLON (TFE), Polyethylene foam (PEF) Insulation resistance 10 GΩ or more
Connector insulating material	TEFLON* (TFE), Polybutylene terephthalate (PBT) Insulation resistance10 GΩ or more
Length	2 m or less

Example: JIS standard 3C-2V, 1.5D-2V MIL standard RG-58A/U
*: Other Trademark

Wiring Diagram



Before Wiring

- Twist the H_{POT} and L_{POT} wires, and the H_{CUR} and L_{CUR} wires together.
  If not twisted together, measurement values may be unstable and errors may occur when measuring with low-power resistance, or low resistance values.
- See the block diagram (p. 16) for the internal circuit details.
- Probes and measuring objects should be shielded at BNC or GUARD jack potential.

When Extending the Measurement Probes

Observe the following when extending the measurement probes.

- Measurement probe length: keep it within 2 m (with a conductor resistance of 500 mΩ/m or less). Long cables are more susceptible to noise, and the measurement values may be unstable.
- Extensions should maintain the four-terminal structure. If the wiring is converted to a two-terminal structure in wiring, the correct measurement may not be possible due to the effects of the wiring and contact resistance.
- Cables and measuring objects should be shielded.
- After extending the measurement probes, verify that the operation and accuracy conform to the "Measurement Specifications" (p.198).
- When cutting off the ends of the optional measurement probes, make sure that the H_{CUR}, H_{POT}, L_{POT}, and L_{CUR} shield wires and core wires do not come into contact. Such contact will made accurate measurement impossible.

1.888.610.7664 www.calcert.com sales@calcert.com

2.3 Turning the Power On and Off

Turning Power On

Press the **POWER** button (it lights up in green).

After Power-On

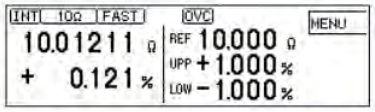
A self-test (instrument diagnostic routine) is performed.
During the self-test, the following information is displayed while the hardware is verified.

Self-test

The following information is displayed during self-testing:

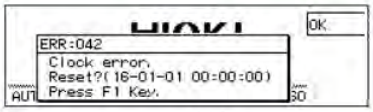
- Manufacturer and model name
- Firmware versions (main, and measurement)
- Communication setting
- Power Line Frequency Setting

No Errors



Normal display (measurement screen)

Error



Indicates an error (p. 203).

When the power is turned on, the same setting as when the power was last turned off appears (backup function).
When powered up for the first time, the default settings appear.
See: "Default Settings" (p.78)

Before Starting Measurement

To obtain precise measurements, provide about 30 minutes for warm-up after turning the power on.
Measurement settings are recalled from when the power was last turned off (settings backup).
However, measurement settings made through the RS-232C or GP-IB interfaces are not retained, although they can be stored using the `:SYSTem:BACKup` command (p. 153).

Turning Power Off

Press the **POWER** button (it lights up in red, power OFF).

Disconnect the power cord from the power inlet to extinguish the **POWER** button light.
When the power is turned on again, operation resumes with the same settings as when last turned off.

NOTE If a power outage (e.g., breaker trip) occurs when the instrument is turned on, it will automatically turn on again when the power is restored without pressing the **POWER** button.

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement Settings (Basic Measurements)

Chapter 3

3

Refer to "Measurement Flow" (p. 3) for an outline of the measurement process from preparation to end-of-measurement.

3.1 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 probe torn, or is any metal exposed?

Metal Exposed → If there is any damage, measurement 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 name, version no.) (p. 27)?

Not displayed → The power cord may be damaged, or the instrument may be damaged internally. Request repairs.

Displayed ↓

Does the Measurement screen appear after self-test?

An error is displayed (Err) → The instrument may be damaged internally. Request repairs.
See: "11.1 Troubleshooting" (p. 201)
"11.3 Error Displays and Solutions" (p. 203)

Displayed ↓

Inspection complete

Please read the "Operating Precautions" (p. 9) before use.

1.888.610.7664 www.calcert.com sales@calcert.com

3.2 Measuring Object Types

The instrument provides two measurement methods: resistance measurement, and low-power resistance measurement. Select the appropriate measurement method for the type of component to be measured. For general-purpose resistor measurements, use the factory defaults. The power applied to the measuring object = Resistance Value x (Measurement Current)^2.

See: "(6) The Sample Becomes Warm" (p. A6)

(Example)If the resistance to be measured is 100 Ω

(Measurement Current)		(Measurement Method)
10 mA	100x0.01^2 = 10 mW	Normal Resistance Measurement, 100 Ω Range
1 mA	100x0.001^2 = 100 μW	Low-Power Resistance Measurement, 100 Ω Range

General-purpose resistors

→ **Normal Resistance Measurement**

Measurement range: 0.0000 mΩ (100 mΩ range) to 120.0000 MΩ (16 ranges)

Hard-to-measure components such as ferrite bead or layered inductors, or other elements sensitive to measurement current

→ **Low-power resistance measurement**

Measurement range: 0.000 mΩ (1000 mΩ range) to 1200.000 Ω (6 ranges)

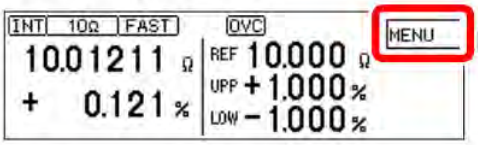
LP

LP appears at the top of the screen.

NOTE

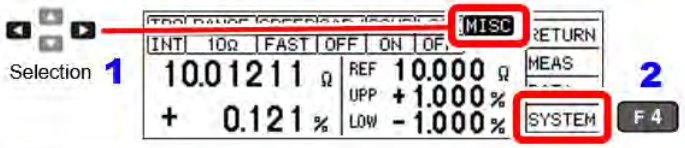
Ranges 1000 Ω range or higher (LOW POWER: OFF) cannot be used for inductor measurements.

1 Open the Basic Settings screen.



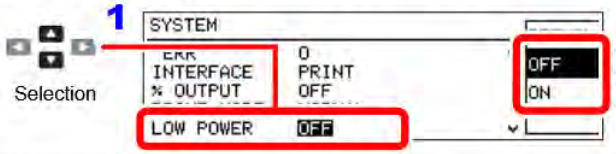
The Basic Settings screen appears.

2 Open the System screen.



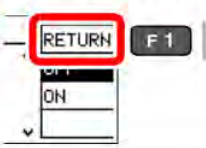
The System screen appears.
[SYSTEM]

3 Select the low-power mode, as needed.

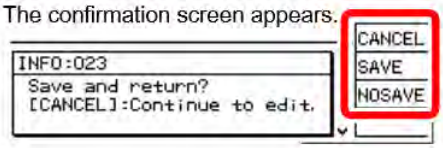


F2 Normal Resistance Measurement (default)
F3 Low-power resistance measurement

4 Return to the Measurement screen.



The confirmation screen appears.



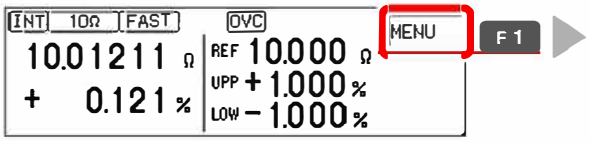
F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

3.3 Setting the Measurement Speed

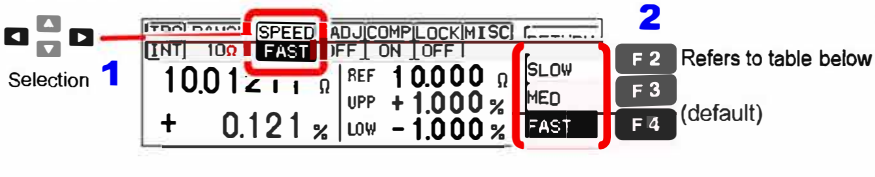
The measurement speed can be set to FAST, MED (MEDIUM), or SLOW. A slower measurement speed provides greater measurement precision.
A faster measurement speed results in greater susceptibility to environmental noise. Ensure that measurement probes and the sample are sufficiently shielded.

1 Open the Basic Settings screen.



The Basic Settings screen appears.

2 Select the measurement speed.



3 Return to the Measurement screen.

Relationship Between Measurement Range and Speed

(factory defaults)

Measurement range	LOW POWER: OFF			LOW POWER: ON		
	FAST	MED	SLOW	FAST	MED	SLOW
100 mΩ	3.8 ms	13 ms	43 ms 36 ms	–	–	–
1000 mΩ	2.0 ms	6.4 ms	41 ms 35 ms	2.3 ms	12 ms	42 ms 35 ms
3 Ω	1.6 ms	6.0 ms	41 ms 34 ms	2.3 ms	12 ms	42 ms 35 ms
10 Ω	1.6 ms	6.0 ms	41 ms 34 ms	2.3 ms	12 ms	42 ms 35 ms
100 Ω	0.9 ms	3.6 ms	21 ms 17 ms	1.7 ms	6.1 ms	41 ms 34 ms
300 Ω	0.9 ms	3.6 ms	21 ms 17 ms	3.2 ms	7.6 ms	43 ms 36 ms
1000 Ω	0.9 ms	3.6 ms	21 ms 17 ms	7.2 ms	12 ms	47 ms 40 ms
10 kΩ	1.0 ms	3.6 ms	21 ms 17 ms	–	–	–
30 kΩ	0.9 ms	3.6 ms	21 ms 17 ms	–	–	–
100 kΩ	1.3 ms	3.8 ms	21 ms 18 ms	–	–	–
300 kΩ	1.3 ms	3.8 ms	21 ms 18 ms	–	–	–
1000 kΩ	2.5 ms	6.0 ms	21 ms 18 ms	–	–	–
3 MΩ	2.5 ms	6.0 ms	21 ms 18 ms	–	–	–
10 MΩ	5.3 ms	23 ms 20 ms	23 ms 20 ms	–	–	–
30 MΩ	5.8 ms	23 ms 20 ms	23 ms 20 ms	–	–	–
100 MΩ	26 ms 22 ms	46 ms 39 ms	86 ms 72 ms	–	–	–

Integration time can be optionally set for each range (p. 50).

Upper value: 50 Hz power line frequency

Lower value: 60 Hz power line frequency

Tolerance ±10%±0.2 ms

1.888.610.7664 www.calcert.com sales@calcert.com

3.4 Setting Measurement Start Conditions (Trigger Source)

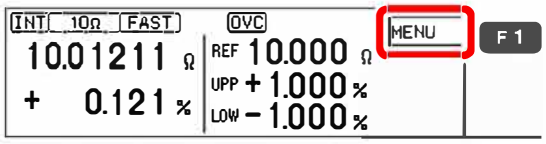
Measurements can be started in two ways.

To measure automatically	**Measure with internal [INT] triggering** Trigger signals are automatically generated internally for continuous measurement.
To measure at specific times **To retain measurement values**	**Measure with external [EXT] triggering** Measurements are triggered by an external signal. Manual measurement triggering is also available. • Apply a trigger signal at the EXT. I/O connector (p. 97) • Send the ***TRG** command by communications interface (p. 142) • Press F4 **[MANU]** (only appears when EXT is selected)

NOTE

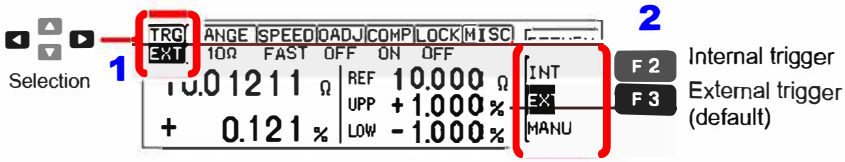
- When internal triggering is selected, the EXT. I/O $\overline{\text{TRIG}}$ signal and the ***TRG** command are ignored (except for memory storage and statistical calculations).
- To measure samples such as inductors that require time to settle, adjust delay time (DELAY2). Start with a long delay, and gradually shorten it while watching for the measurement value to settle.
  See: "4.2 Setting Pre-Measurement Delay" (p. 46)
- When external triggering [EXT] is enabled, the Auto-Memory function is forcibly disabled (OFF).

1 Open the Basic Settings screen.



The Basic Settings screen appears.

2 Select internal [INT] or external [EXT] trigger.



Press F3 [EXT] to display the F4 [MANU] indicator.
Press to trigger a measurement manually.

3 Return to the Measurement screen.

Continuous measurement (`:INITiate:CONTinuous ON`) is the normal trigger state when operating from the front panel. Selecting the internal [INT] trigger source activates continuous triggering ("free-run"). When external [EXT] triggering is selected, each external trigger event initiates one measurement.
Continuous measurement can be disabled by sending the `:INITiate:CONTinuous OFF` command via RS-232C or GP-IB. When continuous measurement is disabled, trigger acceptance is controlled only by the host (computer or PLC).
See: Refer to "Trigger" (p. 157) and "9.8 Data exporting methods" (p. 168) for trigger commands.

1.888.610.7664 www.calcert.com sales@calcert.com

3.5 Selecting the Measurement Range

The measurement range can be set as follows.
When the threshold values of the comparator are set with the panel keys, the measurement range is selected automatically according to the settings (reference values or upper/lower thresholds, refer to the following table).
When the comparator settings are made by remote control commands, the measurement range is not affected.

Changing the Range

If the resistance value of the measuring object is very small compared to the measurement range, the measurement error increases.

NOTE

Ranges 1000 Ω range or higher (LOW POWER: OFF) cannot be used for inductor measurements.

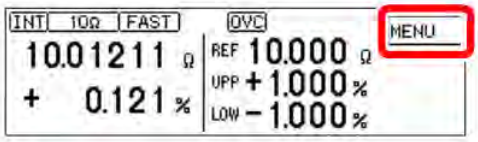
Auto-Range (when making comparator settings)

LOW POWER: OFF (p. 30) VOLTAGE LIMIT: OFF (p. 66)		LOW POWER: OFF (p. 30) VOLTAGE LIMIT: ON (p. 66)		LOW POWER: ON (p. 30)	
Reference value (REF%) and upper limit (ABS) ranges	Selected range	Reference value (REF%) and upper limit (ABS) ranges	Selected range	Reference value (REF%) and upper limit (ABS) ranges	Selected range
0.00 mΩ to 100.09 mΩ	100 mΩ	0.00 mΩ to 100.09 mΩ	100 mΩ	–	–
100.1 mΩ to 1000.9 mΩ	1000 mΩ	100.1 mΩ to 1000.9 mΩ	1000 mΩ	0.0 mΩ to 1000.9 mΩ	1000 mΩ
1.001 Ω to 3.009 Ω	3 Ω	1.001 Ω to 3.009 Ω	3 Ω	1.001 Ω to 3.009 Ω	3 Ω
3.010 Ω to 10.009 Ω	10 Ω	3.010 Ω to 10.009 Ω	10 Ω	3.010 Ω to 10.009 Ω	10 Ω
10.01 Ω to 100.09 Ω	100 Ω	10.01 Ω to 100.09 Ω	100 Ω	10.01 Ω to 100.09 Ω	100 Ω
100 .1 Ω to 300.9 Ω	300 Ω	100.1 Ω to 300.9 Ω	300 Ω	100.1 Ω to 300.9 Ω	300 Ω
301.0 Ω to 1000.9 Ω	1000 Ω	301.0 Ω to 1000.9 Ω	1000 Ω	301.0 Ω to 1200.0 Ω	1 000 Ω
1.001 kΩ to 10.009 kΩ	10 kΩ	1.001 kΩ to 5.009 kΩ	10 kΩ	–	–
10 .01 kΩ to 30.09 kΩ	30 kΩ	5.01 kΩ to 15.09 kΩ	30 kΩ	–	–
30.10 kΩ to 100.09 kΩ	100 kΩ	15.10 kΩ to 50.09 kΩ	100 kΩ	–	–
100.1 kΩ to 300.9 kΩ	300 kΩ	50.1 kΩ to 150.9 kΩ	300 kΩ	–	–
301.0 kΩ to 1000.9 kΩ	1000 kΩ	151.0 kΩ to 500.9 kΩ	1000 kΩ	–	–
1.001 MΩ to 3.009 MΩ	3 MΩ	0.501 MΩ to 1.509 MΩ	3 MΩ	–	–
3.010 MΩ to 10.009 MΩ	10 MΩ	1.510 MΩ to 5.009 MΩ	10 MΩ	–	–
10.01 MΩ to 30.09 MΩ	30 MΩ	5.01 MΩ to 15.09 MΩ	30 MΩ	–	–
30.10 MΩ to 120.00 MΩ	100 MΩ	15.10 MΩ to 120.00 MΩ	100 MΩ	–	–

1.888.610.7664 www.calcert.com sales@calcert.com

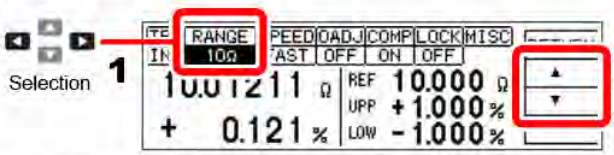
Manual Range Selection

1 Open the Basic Settings screen.



The Basic Settings screen appears.

2 Select the range.



Press the up/down cursor keys to change the setting.

Selectable ranges depend on the low-power resistance setting (p. 30).

- When low-power resistance measurement is set to OFF: 100 mΩ, 1000 mΩ, 3 Ω, 10 Ω, 100 Ω, 300 Ω, 1000 Ω, 10 kΩ, 30 kΩ, 100 kΩ, 300 kΩ, 1000 kΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ (default)
- When low-power resistance measurement is set to ON: 1000 mΩ, 3 Ω, 10 Ω, 100 Ω, 300 Ω, 1000 Ω

3 Return to the Measurement screen.

1.888.610.7664 www.calcert.com sales@calcert.com

3.6 Measuring with Two-terminal Wiring (Zero Adjustment)

When four-terminal measurement (Kelvin connection) is not practical such as when measuring very small samples, the additional inherent resistance of the two-terminal wiring should be canceled out. The zero-adjustment function can cancel out up to 10 Ω additional resistance.

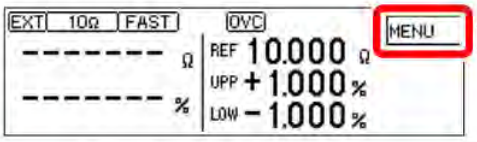
NOTE

Before Zero Adjustment

- The guaranteed accuracy of the instrument applies to four-terminal connections without zero adjustment.When using four-terminal connections, do not execute zero adjustment.
  Executing zero adjustment with incorrect wiring may amplify measurement error. However, zero adjustment may be needed even with four-terminal measurements if they are affected by a large offset voltage, such as due to thermal emf (LOW POWER: OFF, in 100 Ω to 100 MΩ range).
- Execute zero adjustment when the ambient temperature has changed, or when a probe is replaced.

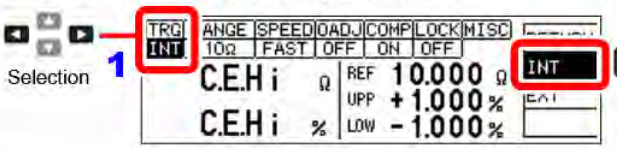
Execute zero adjustment after the warm-up period following power on.

1 Open the Basic Settings screen.



The Basic Settings screen appears.

2 Select the internal [INT] trigger mode.



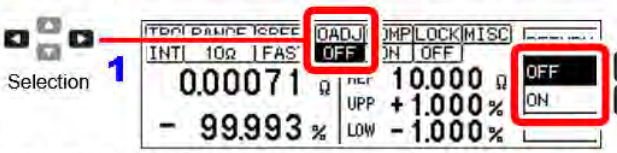
Internal trigger

Press the up/down cursor keys to change the setting.

3 Short the probes together.

4 Confirm that the measurement value does not exceed 10 Ω.
If no measurement value is displayed, increment the measurement range (p. 34).

5 Select whether to enable or disable zero adjustment.



F2 Disables zero adjustment (cancel).
F3 Executes zero adjustment.

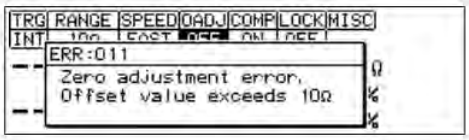
After confirming that the measurement value does not exceed 10 Ω, execute zero adjustment.

6 Return to the Measurement screen.

1.888.610.7664 www.calcert.com sales@calcert.com

When Zero Adjustment Fails

If zero adjustment fails, the following error message appears.



Before attempting zero adjustment again, confirm the following:

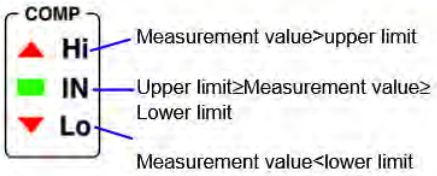
- When measuring with the 10 Ω range, confirm that the displayed value does not exceed 10 Ω.
- Confirm that the probe connections are correct.

1.888.610.7664 www.calcert.com sales@calcert.com

3.7 Judging Measurement Values (Comparator Function)

Comparator results can be output to an external device (via EXT. I/O connector) when the comparator reference/tolerance or upper/lower threshold values have been set.

See: "Chapter 8 External Control" (p. 97)



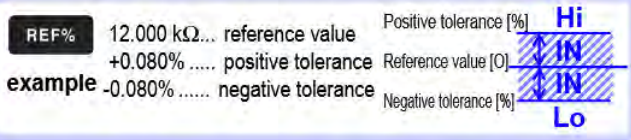
Comparator results are also indicated by the COMP Hi/IN/Lo panel lamps, and by audible beeper (disabled by default).

See: "Setting the Comparator Judgment Beeper" (p. 72)

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

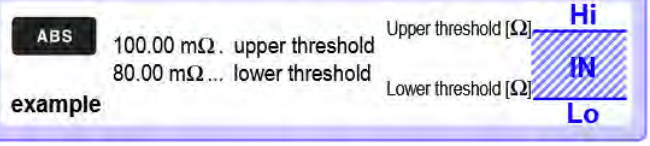
Decide whether a measurement value is within specified tolerance limits relative to a specified reference value (p. 39)

Select the REF% (relative values) judgment



Decide whether a measurement value is between specified upper and lower threshold values (absolute values) (p. 41)

Select the ABS (absolute values) judgment



Before Using the Comparator Function

- When the measurement value is out of the selected measurement range, comparator judgment indicators appear as follows. In the event of a measurement fault, no judgment is made.

  See:"3.8 Confirming Faulty Measurements" (p. 42)

Out-of-Range Display	Comparator judgment indicators (COMP indicator LEDs)
+OvrRng	**Hi**
-OvrRng	**Lo**

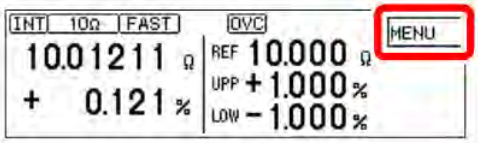
- If power is turned off during comparator setting, changes to settings are lost as they revert to their previous values. To accept the settings, press the **ENTER** key.
- When setting comparator criteria, the appropriate range is selected automatically.
  Refer to "Auto-Range (when making comparator settings)" (p. 34) for range settings.
- The comparator's reference, upper limit, and lower limit values are displayed on the instrument's screen rounded to 4 or 5 digits. However, the judgment is performed using unrounded values.

1.888.610.7664 www.calcert.com sales@calcert.com

Enabling and Disabling the Comparator Function

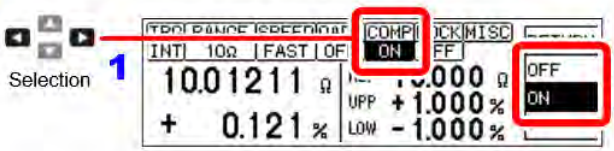
The comparator function is enabled by default.
When the function is disabled, comparator settings are ignored.

1 Open the Basic Settings screen.

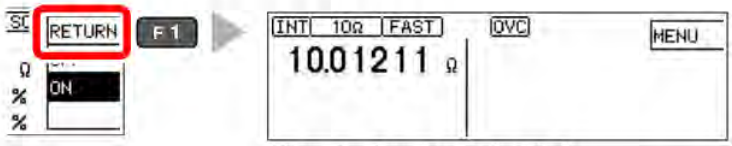


The Basic Settings screen appears.

2 Enable or disable the comparator function.



3 Return to the Measurement screen.



(When the function is disabled)
Comparator judgments are indicated only when the function is enabled.

Decide According to Reference Value and Tolerance (REF% Mode)

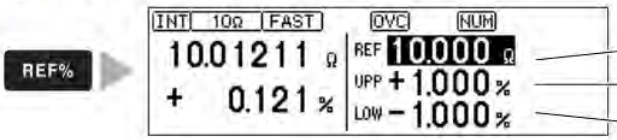
$$\text{Relative value} = \left(\frac{\text{Measurement value}}{\text{Reference value}} - 1 \right) \times 100\ [\%]$$

Setting range:
-9.999% to +9.999% (When 10% or less)
-99.99% to +99.99% (When more than 10%)

Example: Set a reference value of 10.5 Ω with +4.5% and -4.5% judgment tolerances.

To abort the setting process, press ESC. Settings are abandoned and the display returns to the previous screen.

1 Open the relative tolerance setting screen.

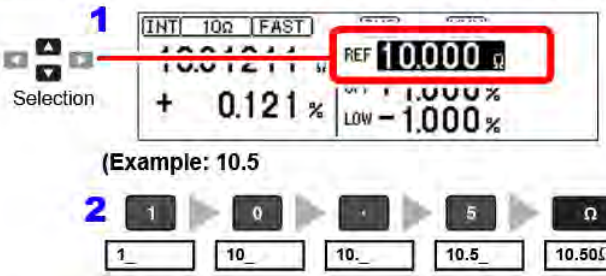


Reference value
Positive tolerance (upper judgment threshold)
Negative tolerance (lower judgment threshold)

1.888.610.7664 www.calcert.com sales@calcert.com

2 Set the reference value.

Pressing an inoperative key during setting sounds a low-pitch beep (when the key beeper is enabled).



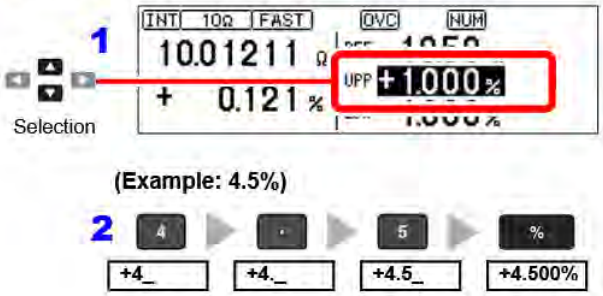
To Reset Numerical Values

BACK SPACE Deletes entered digits.
This key is enabled only when entering numerical values.

To change the value after selecting the units, use the cursor ▲▼ keys to select the item to change, then enter the new value with the numeric keys.

Press the units key to accept the setting and move the cursor to the upper threshold.

3 Set the positive tolerance.



To Reset Numerical Values

BACK SPACE Deletes entered digits.
This key is enabled only when entering numerical values.

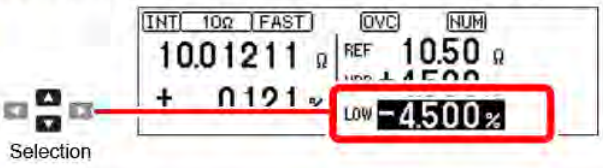
To change the value after selecting the units, use the cursor ▲▼ keys to select the item to change, then enter the new value with the numeric keys.

To Set a Negative Value

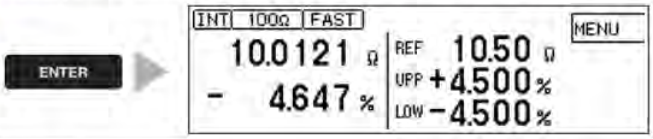
+/− Press this key to change the sign, as needed.

Press the % key to accept the setting and move the cursor to the negative tolerance value.
The negative tolerance is initially set to the same absolute value as the positive tolerance (change as needed).

4 Set the negative tolerance in the same way (as needed)



5 Accept the settings and return to the Measurement screen.



NOTE

- Internal calculations are performed on floating-point values, and judgments round up any fraction of the least-significant digit.
- Displayed values of the reference and tolerances are rounded according to the selected range. Internal calculations use data not rounded off, so judgments are based on the entered (setting) values.
- An error message appears if you press **ENTER** with the positive tolerance < the negative tolerance.
See:"11.3 Error Displays and Solutions" (p. 203) (ERR:001)

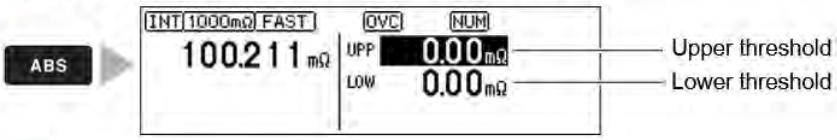
1.888.610.7664 www.calcert.com sales@calcert.com

Decide According to Upper/Lower Thresholds (ABS Mode)

Setting example: Upper threshold 150 mΩ, lower threshold 50 mΩ

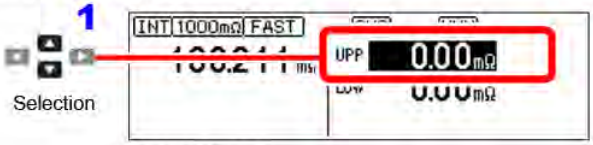
To abort the setting process, press ESC. Settings are abandoned and the display returns to the previous screen.

1 Open the absolute value threshold setting screen.



2 Set the positive tolerance.

Pressing an inoperative key during setting sounds a low-pitch beep (when the key beeper is enabled). Error message is not displayed.



(Example: 150

2 [1] ▶ [5] ▶ [0] ▶ [mΩ]

1_ | 15_ | 150_ | 150.0 mΩ

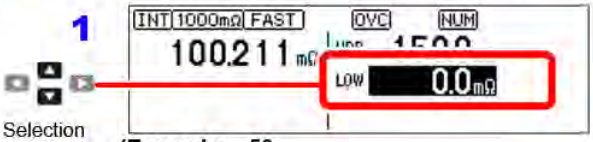
To Reset Numerical Values

BACK SPACE Deletes entered digits. This key is enabled only when entering numerical values.

To change the value after selecting the units, use the cursor ▲▼ keys to select the item to change, then enter the new value with the numeric keys.

Press the units key to accept the setting and move the cursor to the lower threshold value.

3 Set the negative tolerance in the same way.



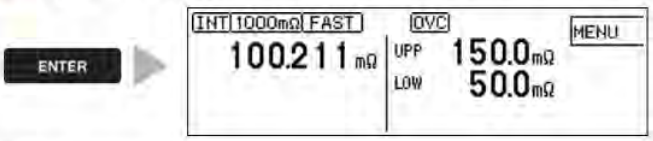
(Example: 50

2 [5] ▶ [0] ▶ [mΩ]

5_ | 50_ | 50.0 mΩ

Press the units key to accept the setting and move the cursor to the upper threshold.

4 Accept the settings and return to the Measurement screen.



NOTE

- Internal calculations are performed on floating-point values, and judgments round up any fraction of the least-significant digit.
- Displayed values of the reference and tolerances are rounded according to the selected range. Internal calculations use data not rounded off, so judgments are based on the entered (setting) values.
- An error message appears if you press **ENTER** with the positive tolerance < the negative tolerance.
  See:"11.3 Error Displays and Solutions" (p. 203) (ERR:001)

1.888.610.7664 www.calcert.com sales@calcert.com

3.8 Confirming Faulty Measurements

When a measurement is not performed correctly, a measurement fault indicator appears and a measurement fault signal is output at the $\overline{ERR}$ pin of the EXT. I/O connector (except for out-of-range detection).

The instrument detects measurement faults by the following four methods.

Measurement out of range

See: "Out-of-Range Detection Function" (p. 43)

Display	
+OvrRng -OvrRng	Appears when the measurement value is outside of the measurement or display range. Check for a broken sample component. The comparator result is Hi when +OvrRng is displayed, and Lo when -OvrRng is displayed. No external measurement fault signal ($\overline{ERR}$) is output.

Contact Check Fault

See: "4.5 Checking for Poor or Improper Contact (Contact Check Function)" (p. 52)

Display	
C.E. Hi C.E. Lo	The resistance between the H_{POT} and H_{CUR} probe contacts, and between the L_{POT} and L_{CUR} probe contacts, are measured and compared with specified contact fault values. An error message appears when the measurement value reaches or exceeds the specified contact fault values. If this error persists, probe wear or cable failure may be the cause. If the error is not cleared by shorting the tips of a known-good measurement probe, the instrument requires repair.

Voltage Monitor fault

See: "4.7 Detecting Measurement Voltage Faults (Voltage Level Monitor Function)" (p. 57)

Display	
C.E. Volt	This method monitors the stability of the voltage between H_{POT} and L_{POT} probe contacts. An error message appears when voltage instability is detected due to chattering of the probe contacts. If this error is displayed frequently, the probes may be degraded due to wear. C.E. Volt may also be displayed when external noise is strong.

Current Monitor Fault

See: "Current Monitor Function" (p. 43)

This method monitors the regulated measurement current for normal flow through the measuring object.
An error is detected mainly when a measurement fault occurs due to an open measuring object or poor contact between the H_{CUR} and L_{CUR} probes.
The error display depends on the contact check and voltage level monitor states (refer to the table below).

-------	This display appears after changing measurement settings and before the next measurement is performed.

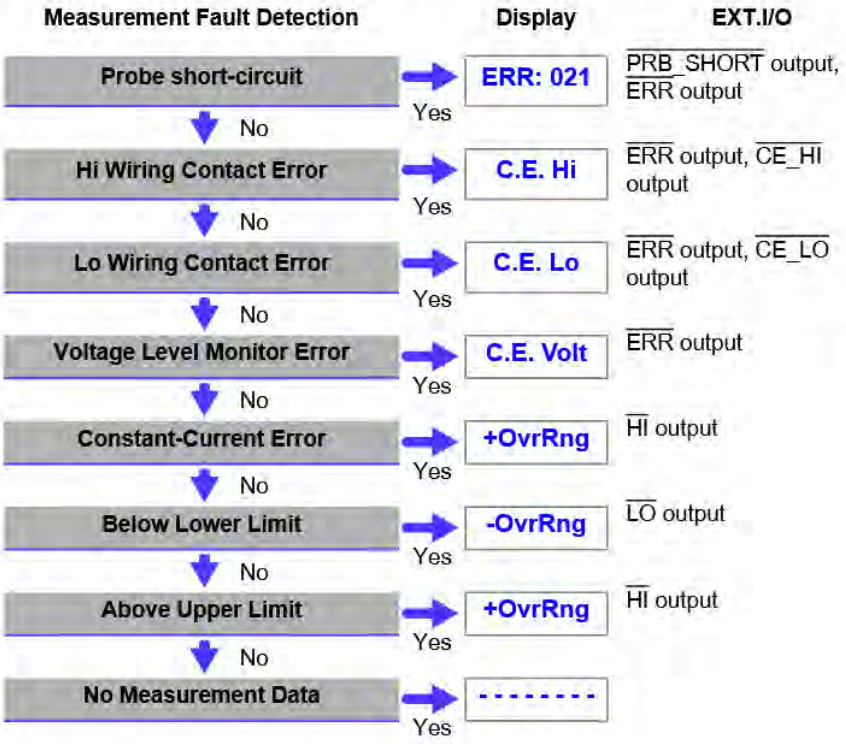
Display Examples: Display Measurement State and Appearance with Open-Circuit Probe

Display Measurement State		Current Monitor Results	
		Normal (PASS)	Fault (FAIL)
Contact Check Results Voltage Level Monitor Results	Normal (PASS)	Display: Measurement Value COMP indicator: According to the measurement value	Display: **+OvrRng/ -OvrRng** COMP indicator: **Hi/ Lo** (when connection to the measuring object is broken)
	Fault (FAIL)	Display: **C.E. Hi/ C.E. Lo/ C.E. Volt** COMP indicator: No judgment EXT.I/O: $\overline{ERR}$ signal output	Display: **C.E. Hi/ C.E. Lo/ C.E. Volt** COMP indicator: No judgment EXT.I/O: $\overline{ERR}$ signal output

The measurement fault display differs according to detection order and settings.

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement Fault Detection Order



NOTE

Measurement fault detection proceeds in the order shown at the left, ending with display of the first detected error.

Corresponding measurement fault signals are also output at the EXT. I/O connector.

3

Out-of-Range Detection Function

Examples of Out-of-Range Faults

Out-of-Range Detection	Measurement Example
The measurement value is outside of the measurement range.	10 kΩ range is used to measure 13 kΩ.
The relative tolerance (%) display of the measurement value exceeds the display range (999.999%).	Measuring 500 Ω (+2400%) with a reference value of 20 Ω
The zero-adjusted value is outside of the display range.	1 In the 1 Ω range with 0.5 Ω zero-adjustment in effect, measuring 0.1 Ω provides a zero-adjusted value of -0.4 Ω, which is outside of the display range.
While measuring, input voltage exceed the A/D converter input range.	Measuring a large resistance value in an electrically noisy environment

Current Monitor Function

The instrument supplies constant measurement current through the measuring object via the H_{CUR} and L_{CUR} probes. A current monitor fault occurs if constant current cannot be attained. If the contact check and voltage level monitor results are normal, the out-of-range and comparator result displays indicate "Hi".

Example of Current Monitor Fault

- Broken DUT (open work)
- H_{CUR} or L_{CUR} probe contact fault
- H_{CUR} or L_{CUR} cable break

1.888.610.7664 www.calcert.com sales@calcert.com

Customizing Measurement Settings
Chapter 4

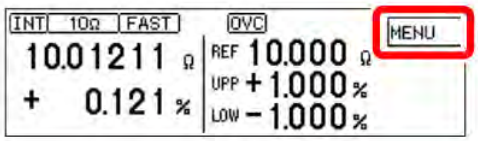
(set as needed)

Change measurement settings as appropriate for your application.
Refer to "Detailed Settings Screen" (p. 21) for the available settings.

4.1 Making Range-Specific Measurement Settings

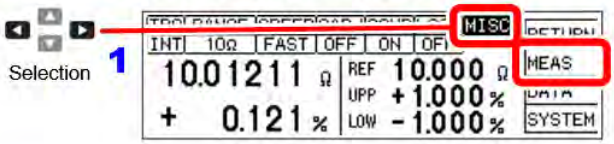
The setting affects only the selected range (except for the DELAY1 setting).

1 Open the Basic Settings screen.



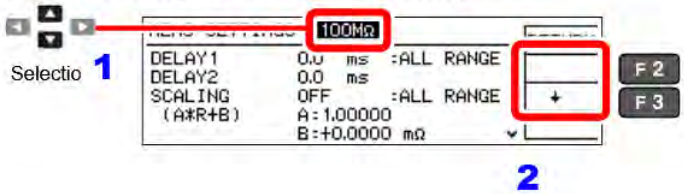
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

3 Select the range to change the setting.



Selects the range to use.

4 Set the items as needed.

1.888.610.7664 www.calcert.com sales@calcert.com

4.2 Setting Pre-Measurement Delay

This setting specifies the delay between trigger signal input and the start of measurement.
Adjust this setting to delay measurement until the measurement value has time to stabilize, so that even if the sample is connected after triggering, measurement starts only after the specified delay.
The delay can be set by two methods, as follows.

Adjust this setting to allow for probe contact mechanical stabilization.

Set DELAY1

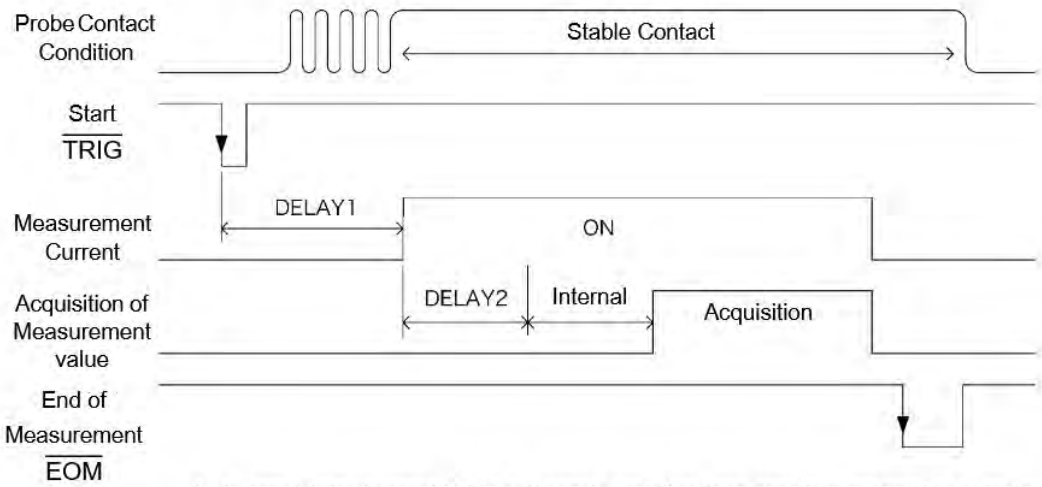
The DELAY1 setting is common to all ranges.
The default setting is 0 ms (corresponding to trigger signal input at the same time as probe contacts become stable).
Setting DELAY1 affects measurements in all ranges.

Adjust this setting to allow for stabilization of the measurement sample.

Set DELAY2

Set DELAY2 to the time needed for stabilization after measurement current is applied, such as may be required for inductive components.
The setting affects only the selected range.
The default setting is 0 ms (corresponding to resistance measurement of non-inductive components).

DELAY1 and DELAY2 Timing Chart



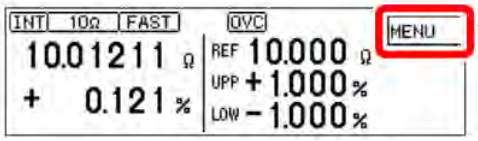
* Internal delay is provided to suit purely resistive (non-reactive) measuring objects, and is different for each measurement range.
See:"8.2 Timing Chart" (p. 101)

1.888.610.7664 www.calcert.com sales@calcert.com

Estimated Delay time

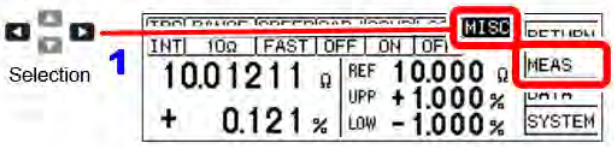
Set the delay so that inductance does not affect measurements.
To fine tune the delay, begin with a longer delay than necessary, then gradually shorten it while watching the measurement value.

1 Open the Basic Settings screen.



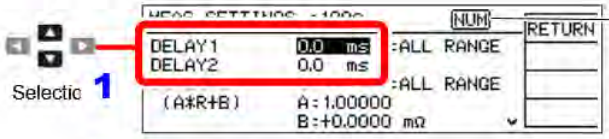
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

3 Set [DELAY1] or [DELAY2].



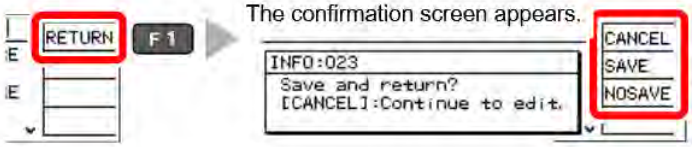
Numerci keypad

[DELAY1] is common to all ranges, while [DELAY2] can be set for each range independently (p. 45).

2 [0] ---- [9] / [.] Setting range: 0.0 ms (default) to 100.0 ms

3 [ENTER]

4 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

4.3 Compensating Measured Values (Scaling Function)

When measuring the resistance of current sensing resistors, there may be a discrepancy between the resistance value at the time of mounting on the board being used and the resistance value obtained when measuring the component alone (due to the effects of the probing location and other factors). The scaling function corrects the measured resistance value obtained from the component alone to yield the resistance value during actual use. Scaling is performed by mean of the following equations:

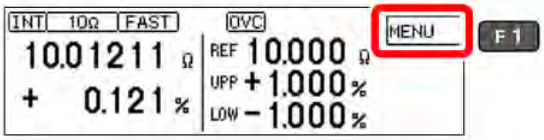
$R_S = A \times R + B$

R : Measured value before compensation
R_S: Resistance value after compensation
A : Compensation coefficient setting range: 0.50000 to 2.00000 (default:: 1.00000)
B : Offset resistance setting range: ±0.0000 mΩ to ±99.9999 MΩ (default: 0.0000 mΩ)

NOTE

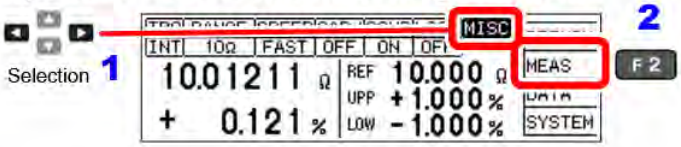
- Scaling calculation will be performed on a measured value after zero-adjustment. Consequently, measure value may not be equal to zero after zero-adjustment.
- Changing the comparator settings automatically sets the scaling function to OFF.

1 Open the Basic Settings screen.



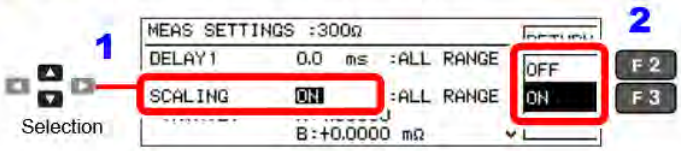
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

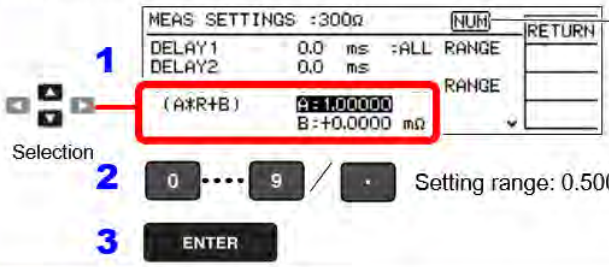
3 Enable or disable the scaling function.



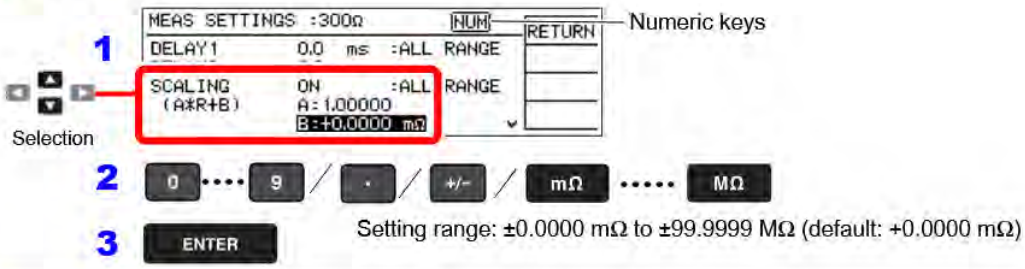
Disables the function(default)
(go to step 6)
Enables the function

1.888.610.7664 www.calcert.com sales@calcert.com

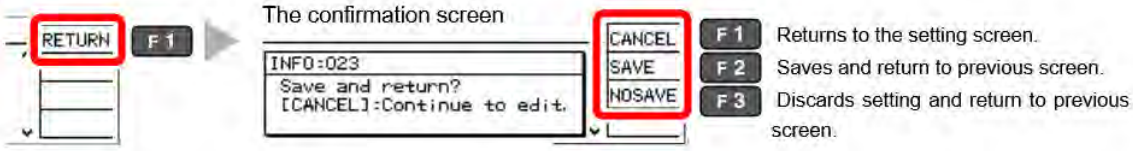
4 Set the compensation coefficient.



5 Set the offset.



6 Return to the Measurement screen.



1.888.610.7664 www.calcert.com sales@calcert.com

4.4 Setting the Measurement Integration Time Option

The integration time can be optionally set for each range by selecting FAST, MED, or SLOW measurement speed.
Integration time can be set in ms or PLC* units.

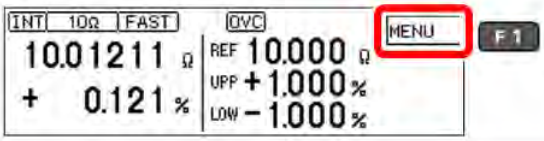
* PLC = Power Line Cycle, where one PLC is the time equivalent to one period of the power line waveform.
At 50 Hz, one PLC = 1/50th of a second, and at 60 Hz, one PLC = 1/60th of a second.
PLC setting units are useful where measurements may be affected by power line noise (high- or low-resistance measurements)

Default setting

Range	LOW POWER*1: OFF				LOW POWER*1: ON			
	Integration time			OVC	Integration time			OVC
	FAST	MED	SLOW		FAST	MED	SLOW	
100 mΩ	0.5 ms	5.0 ms	1 PLC	ON*2	–	–	–	–
1000 mΩ	0.3 ms	2.5 ms	1 PLC	ON*2	0.5 ms	5.0 ms	1 PLC	ON*2
3 Ω	0.3 ms	2.5 ms	1 PLC	ON*2	0.5 ms	5.0 ms	1 PLC	ON*2
10 Ω	0.3 ms	2.5 ms	1 PLC	ON*2	0.5 ms	5.0 ms	1 PLC	ON*2
100 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON*2
300 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON*2
1000 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON*2
10 kΩ	0.3 ms	3.0 ms	1 PLC	OFF	–	–	–	–
30 kΩ	0.3 ms	3.0 ms	1 PLC	OFF	–	–	–	–
100 kΩ	0.5 ms	3.0 ms	1 PLC	OFF	–	–	–	–
300 kΩ	0.5 ms	3.0 ms	1 PLC	OFF	–	–	–	–
1000 kΩ	1.5 ms	5.0 ms	1 PLC	OFF	-	-	-	-
3 MΩ	1.5 ms	5.0 ms	1 PLC	OFF	-	-	-	-
10 MΩ	2.5 ms	1 PLC	1 PLC	OFF	-	-	-	-
30 MΩ	2.5 ms	1 PLC	1 PLC	OFF	-	-	-	-
100 MΩ	1 PLC	2 PLC	4 PLC	OFF	-	-	-	-

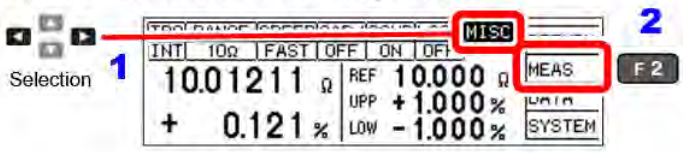
*1. Low-power resistance measurement (p. 30)
*2. Two measurements are made within the above integration time.

1 Open the Basic Settings screen.



The Basic Settings screen appears.

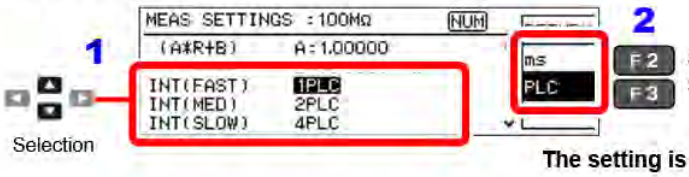
2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]
(The settings for the current measurement range are displayed.)

1.888.610.7664 www.calcert.com sales@calcert.com

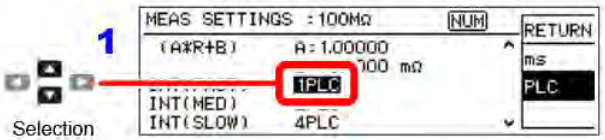
3 Select the integration setting units.



F2 Sets in units of time.
F3 Sets in units of power line cycles.

The setting is specific to the selected range (p. 45).

4 Select the integration time.

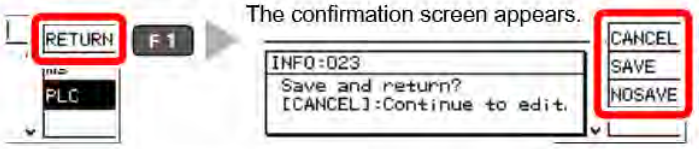


2 [0] ···· [9] / [.]

3 [ENTER]

Setting range:
- When setting in ms units:
  0.1 ms to 100.0 ms
- When setting power-line-cycle units:
  1 to 6 PLC (60 Hz), 1 to 5 PLC (50 Hz)

5 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves and return to previous screen.
F3 Discards setting and return to previous screen.

NOTE

- The instruments accuracy specifications are applicable only with the default integration times. Investigate your measurement requirements carefully before changing the integration time.
- When the effects of power line noise can be ignored, the integration time can be set longer than the default to reduce scattering of measurement values. On the other hand, if the integration time is too short, scattering increases. For high-or low-resistance and low-power resistance measurements that are easily affected by power line noise, we suggest setting according to the power line period (PLC units).

1.888.610.7664 www.calcert.com sales@calcert.com

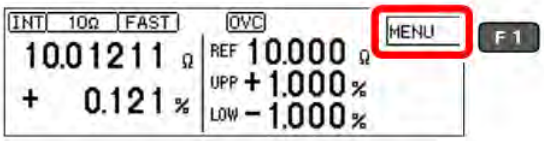
4.5 Checking for Poor or Improper Contact (Contact Check Function)

This function detects poor contact between the probes and measuring object, and broken measurement probes.
The instrument continually monitors the resistance between the H_{CUR} and H_{POT} probes and the L_{CUR} and L_{POT} probes from the start of integration (including response time) and while measuring. When the resistance is outside of the specified value, a contact check fault occurs and the **C.E. Hi** or **C.E. Lo** error message appears. No comparator judgment is applied to the measurement value.
When these error messages appear, check the probe contacts, and check for broken measurement probes.
(If the error is not cleared by shorting the tips of a known-good measurement probe, the instrument requires repair.)

NOTE

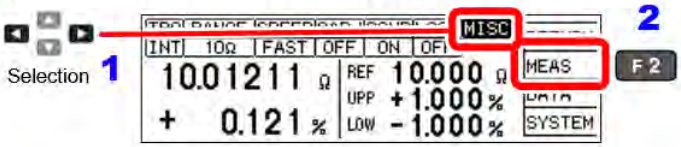
- During low-resistance measurement, poor contact of the H_{CUR} or L_{CUR} probe may be detected as an out-of-range measurement.
- When contact checking is disabled, measurement values may be displayed even when a probe is not contacting the measuring object.

1 Open the Basic Settings screen.



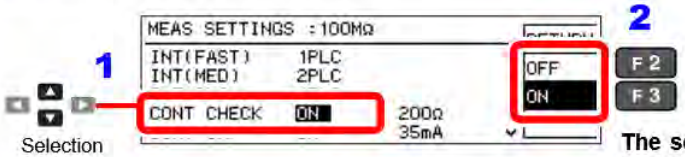
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

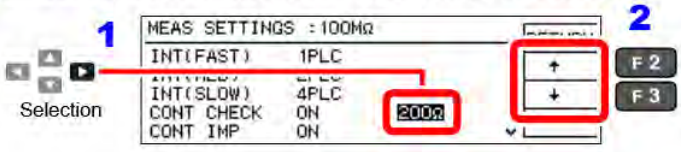
3 Enable or disable the function.



F2 Disables the function (go to step 5).
F3 Enables the function (default).

The setting is specific to the selected range (p. 45)

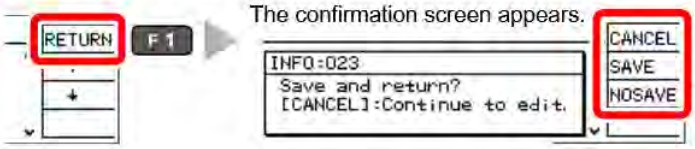
4 Select the contact check fault threshold resistance.



50 Ω, 100 Ω, 150 Ω, 200 Ω (default), 300 Ω, 400 Ω, 500 Ω
A contact fault occurs when a measured value exceeds the threshold setting.

1.888.610.7664 www.calcert.com sales@calcert.com

5 Return to the Measurement screen.



The confirmation screen appears.

F 1 Returns to the setting screen.

F 2 Saves and return to previous screen.

F 3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

4.6 Improving Probe Contact (Contact Improver Function)

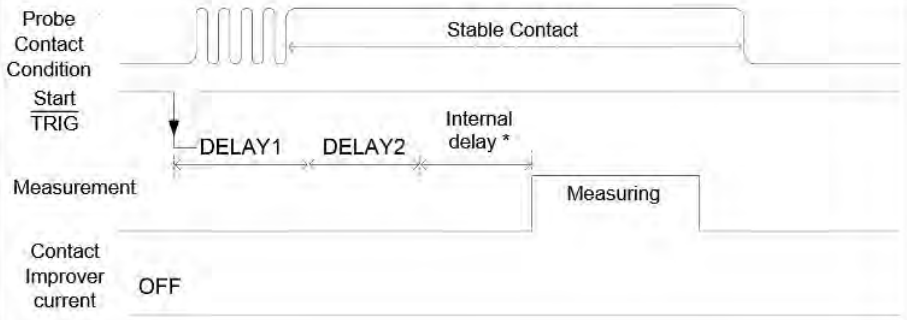
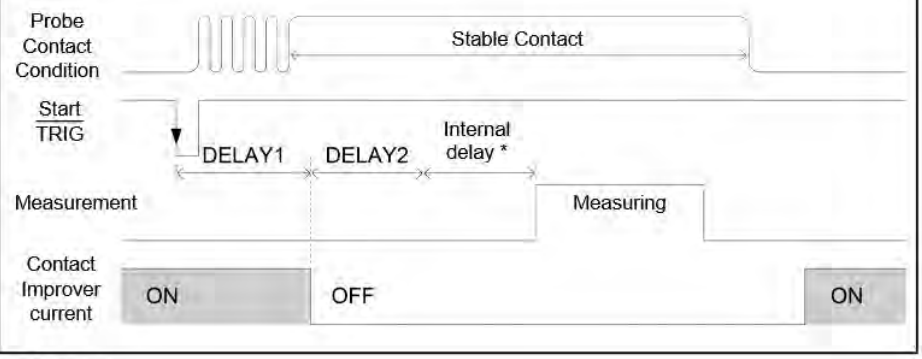
Probe contacts can be improved by applying current from the POT to the CUR probes before measuring.

⚠CAUTION The Contact Improver function applies voltage to the sample. Be careful when measuring samples with characteristics that may be affected.

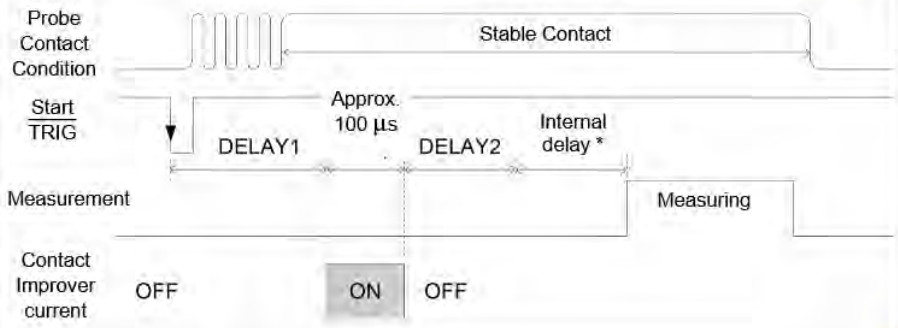
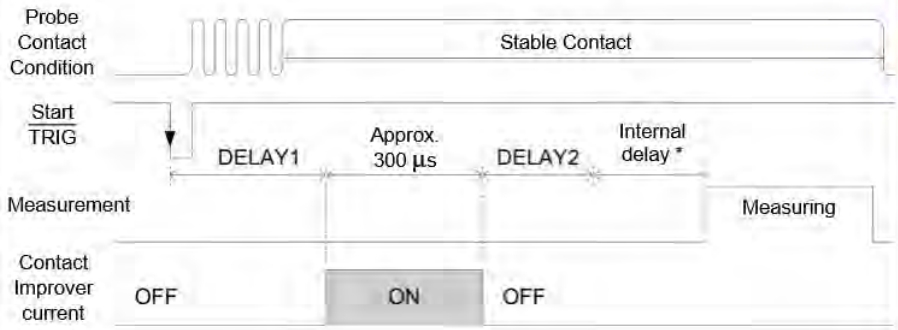
The current used for the Contact Improver functions can be selected as follows.
17 mA, 25 mA, 35 mA (default), 50 mA
Higher current provides more effective contact improvement, but at the cost of faster probe deterioration.
Contact Improver current can be set to be disabled (OFF), enabled (ON), or PULSE.
The PULSE setting applies the contact improvement current for approx. 100 µs to 300 µs immediately before measurement. The PULSE setting is useful to decrease Joule heating of the DUT based on contact improvement current if the measuring object is susceptible to change in characteristics.

	100 mΩ range to 100 kΩ range	300 kΩ range to 100 MΩ range
DUT current *	2 mA max.	60 mA max.
DUT voltage	20 V max.	15 V max.

*. It takes several microseconds for the DUT current to reach the steady-state value. Until the steady-state value is reached, a transient current that is approximately equal to the contact improvement current setting (default setting: 35 mA) will flow.

Setting	Timing chart (Contact Improver Function)
OFF	
ON	

*Internal delay is different for each range.

Setting	Timing chart (Contact Improver Function)
PULSE When both applied voltage limiter and low-power resistance measurement function are disabled.	
PULSE When the applied voltage limit function or low-power resistance measurement function is enabled.	

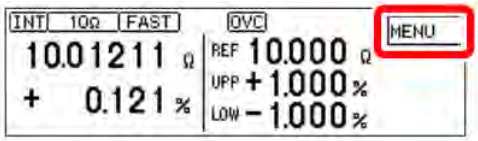
*Internal delay is different for each range.

4

NOTE

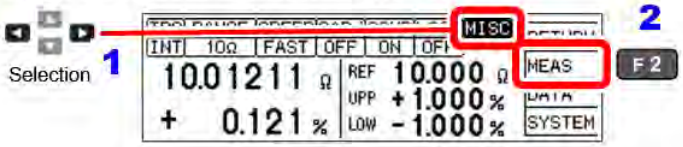
For ranges between 300 kΩ and 100 MΩ, the [PULSE] setting is enabled by default.
Before measuring in the ranges from 300 kΩ to 100 MΩ with the Contact Improver function set to [ON], verify that measurements are not biased.

1 Open the Basic Settings screen.



The Basic Settings screen appears.

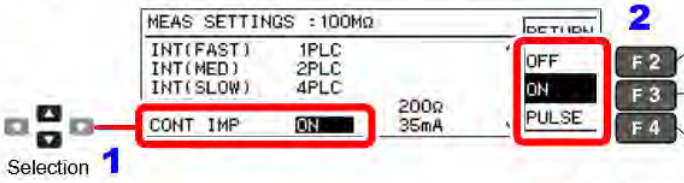
2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

1.888.610.7664 www.calcert.com sales@calcert.com

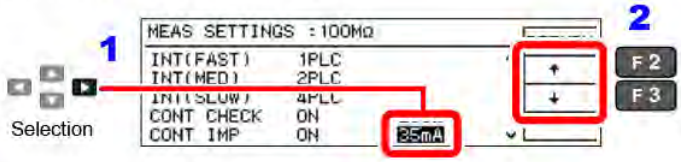
3 Set the Contact Improver current timing to disabled (OFF), enabled (ON), or PULSE.



Disables probe contact improvement (go to step 4).
Enables probe contact improvement.
Contacts improvement current is applied immediately before measuring only.

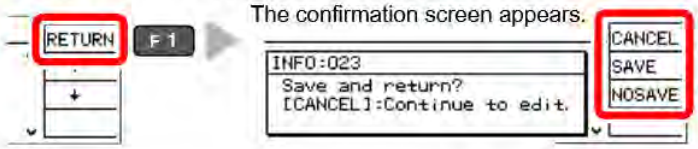
The setting is specific to the selected range (p. 45)

(When selecting ON or PULSE)
Set the current limit value.



17 mA, 25 mA, 35 mA (default), 50 mA

4 Return to the Measurement screen.



Returns to the setting screen.
Saves and return to previous screen.
Discards setting and return to previous screen.

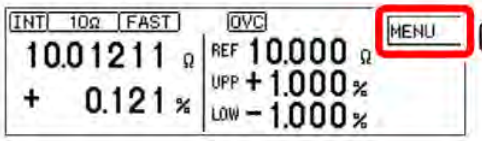
4.7 Detecting Measurement Voltage Faults (Voltage Level Monitor Function)

When a measurement voltage fault occurs due to probe chattering, the C.E. Volt error message appears on the measurement screen and an $\overline{\text{ERR}}$ signal is output. The C.E. Volt error may also appear when external noise is strong.

Check the following if errors occur frequently:

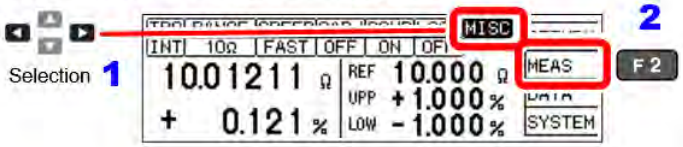
- Check for probe deterioration.
- Provide additional noise suppression."Appendix 3 Unstable Measurement Values" (p. A3)
- Set the voltage level monitor to Loose, or OFF (disable).

1 Open the Basic Settings screen.



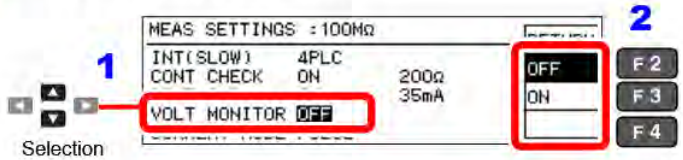
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

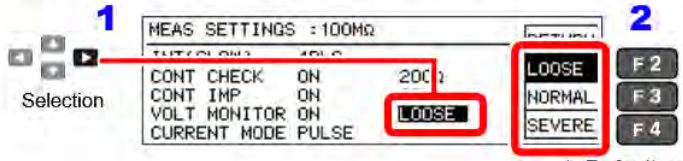
3 Enable or disable the function.



F2 Disables the function (default) (go to step 5).
F3 Enables the function.
F4 Disables the function of all ranges (go to step 5).

The setting is specific to the selected range (p. 45)

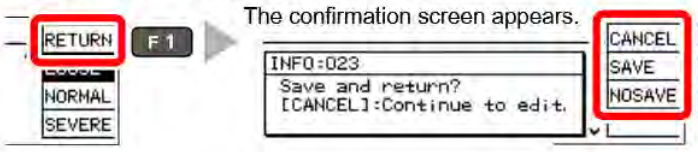
4 Select the voltage level monitor threshold.



F2 LOOSE*
F3 NORMAL*
F4 SEVERE

*. Default setting: LOOSE is the default for the 100 MΩ range, and NORMAL for ranges other than 100 MΩ.

5 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

4.8 Applying Current Only When Measuring (Current Mode Setting)

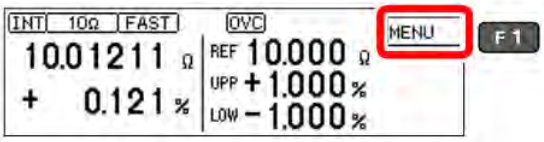
When the Contact Improver function is set to Pulse or disabled (CONT IMP: PULSE or OFF) and measurement current is set for pulse output, open-circuit voltage when not measuring does not exceed 20 mV.

See: "4.6 Improving Probe Contact (Contact Improver Function)" (p. 54)

NOTE

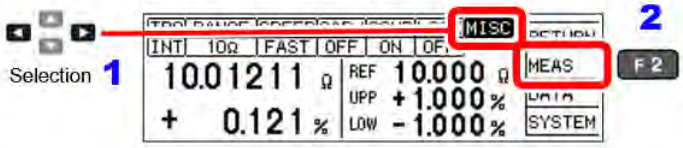
When the Contact Improver function is enabled (CONT IMP: PULSE or ON setting), the current mode setting is ignored even if set to continuous (CURRENT MODE: CONT setting). (The Contact Improver function forces pulse operation with measurement current applied only during measurement.)

1 Open the Basic Settings screen.



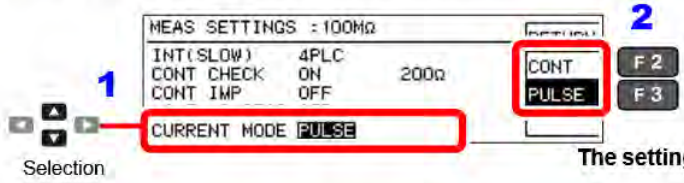
The Basic Settings screen appears.

2 Open the Measurement Settings Screen.



The Measurement Settings Screen appears.
[MEAS SETTINGS]

3 Select whether to apply current when not measuring.



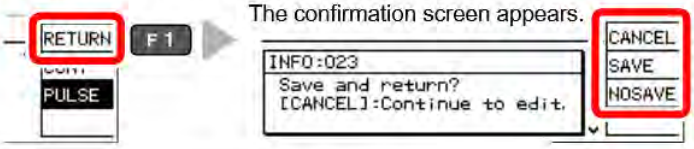
Measurement current is applied while awaiting trigger.

Measurement current is applied only while measuring (default).

The setting is specific to the selected range (p. 45)

To apply measurement current continuously (CONT setting) even when waiting for a trigger, confirm that the Contact Improver function is disabled (CONT IMP: OFF, (p. 54)).

4 Return to the Measurement screen.

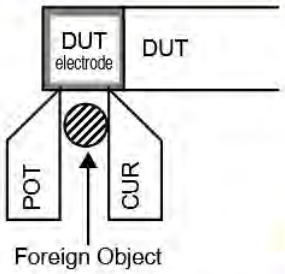


F1 Returns to the setting screen.
F2 Saves and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

4.9 Test for Short-Circuited Probe (Probe Short-Circuit Detection Function)

Four-terminal measurements are not possible when a conductive foreign object is present between the POT and CUR probe tips. To detect short-circuited probes, this function measures the resistance between the CUR and POT terminals after a specific time (initially 5 ms) following the end of measurement.
Probe short-circuit detection is disabled by default.



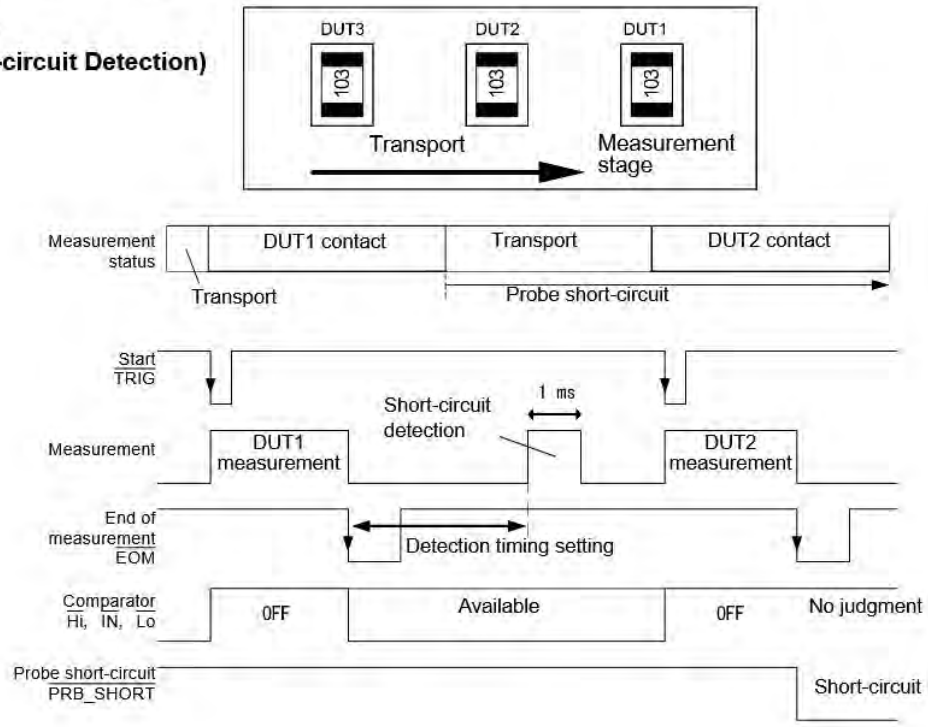
When a probe short-circuit is detected, an error message appears on the measurement screen, and the $\overline{\text{PRB_SHORT}}$ and $\overline{\text{ERR}}$ signals are output.
(**ERR:021 Probe short error**)

Short-circuit detection can also be controlled by asserting the active-low $\overline{\text{PRB_CHECK}}$ of the EXT. I/O signal. Asserting the $\overline{\text{PRB_CHECK}}$ signal while measuring causes short-circuit detection to be performed after the end of measurement (p. 97).

About Probe Short-Circuit Detection

- If probes are connected to the measuring object during probe short-circuit detection, it is determined as probe short circuit. Ensure that the probes have sufficient time to separate from the measuring object.
- Probe short-circuit detection occurs within about 1 ms.
- The threshold for probe short-circuit detection is fixed at 500 Ω, so if the resistance between CUR and POT probes is larger, detection is not possible.

Timing chart
(Probe Short-circuit Detection)

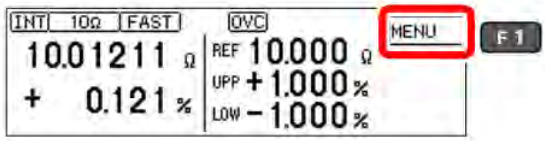


NOTE

- Even while the probe short-circuit detection function is set to be disabled, short-circuit detection is performed when the EXT. I/O PRB_CHECK signal is asserted.
- When the internal trigger [TRG: INT] source is selected, short-circuit detection is not performed after the end of measurement. However, short-circuit detection can still be executed by asserting the PRB_CHECK signal is executed.

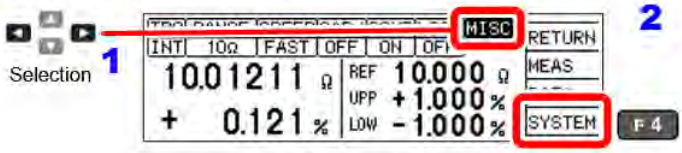
Enables/Disables Probe Short-Circuit Detection Function

1 Open the Basic Settings screen.



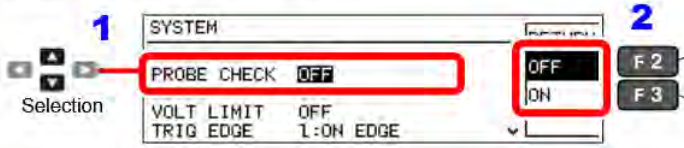
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears. [SYSTEM]

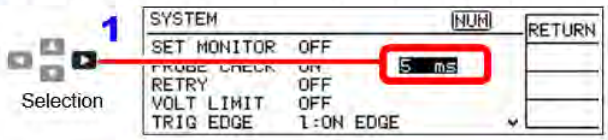
3 Enable or disable the function.



Probe short-circuit detection is not used (default) (go to step 5).

Probe short-circuit detection is used.

4 Set the probe short-circuit detection timing.

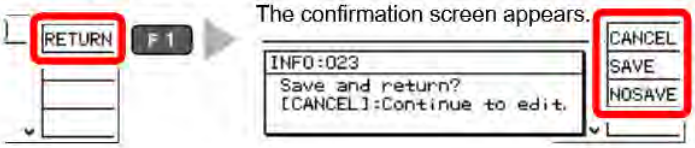


Short-circuit detection is delayed for the specified time following the end of measurement.

2 0 .... 9 Setting range: 1 to 100 ms, 5 ms (default)

3 ENTER

5 Return to the Measurement screen.



Returns to the setting screen.

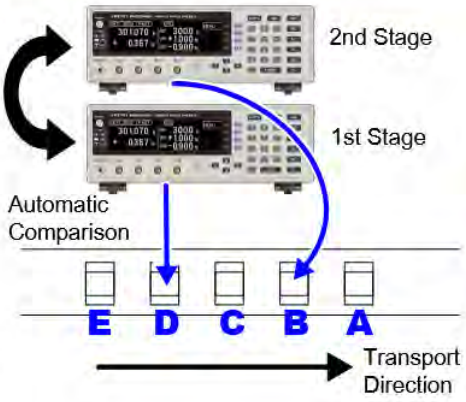
Saves and return to previous screen.

Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

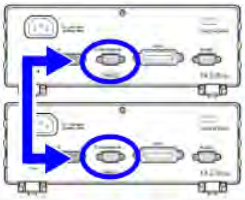
4.10 Comparing the Measurement Settings of Two Instruments (Settings Monitor Function)

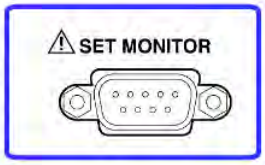
This function automatically compares the settings of two instruments to determine whether they are the same.
Only comparator settings and measurement speed are compared.
When the settings differ, an alarm notification is displayed and subsequent.
$\overline{\text{TRIG}}$ signal input is prevented from starting measurement.



When the settings of two instruments match, TRIG input is accepted and measurement starts.
However, if the range defined by the upper and lower thresholds of the second stage is broader than that of the first stage, measurement still starts despite the different threshold settings.

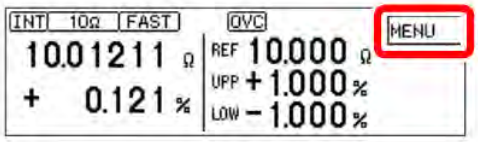
1 Connect the SET MONITOR connectors of the two instruments using a Hioki 9637 RS-232C cable.





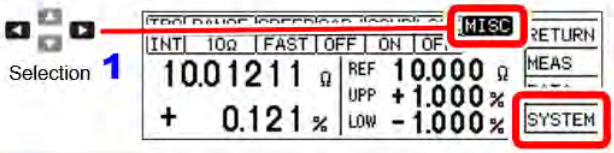
The SET MONITOR connectors are identical to RS-232C connectors.
Be careful to avoid connecting the wrong connectors.

2 Open the Basic Settings screen.



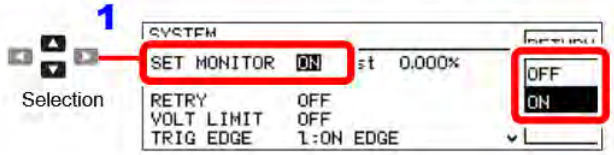
The Basic Settings screen appears.

3 Open the System screen.



The System screen appears.
[SYSTEM]

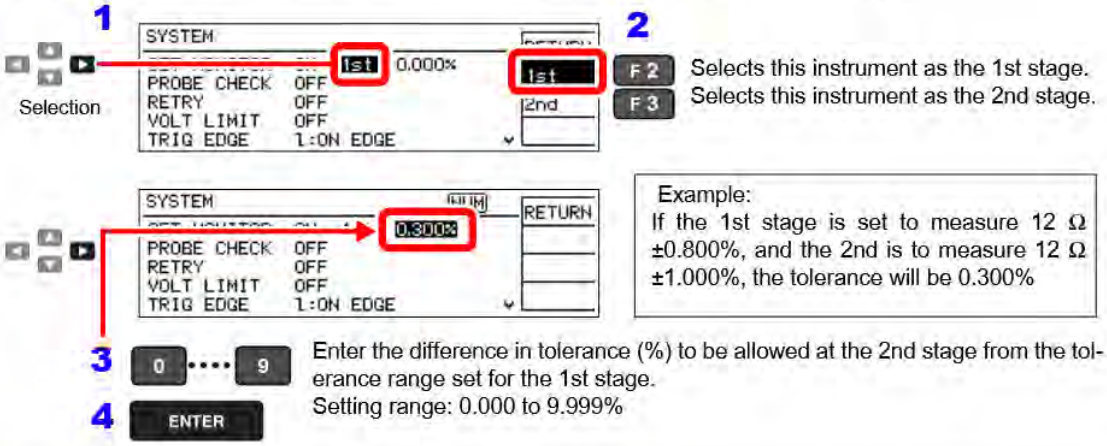
4 Enable or disable the function. Enable the function on both instruments.



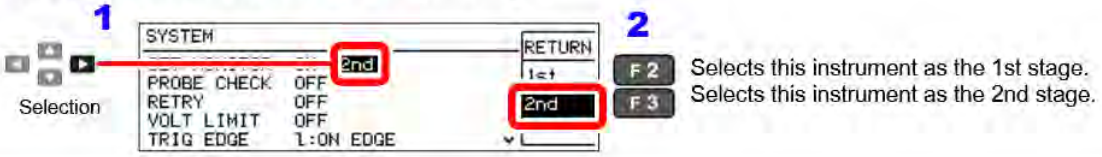
The setting is not monitored (default) (go to step 7).
The setting is monitored.

1.888.610.7664 www.calcert.com sales@calcert.com

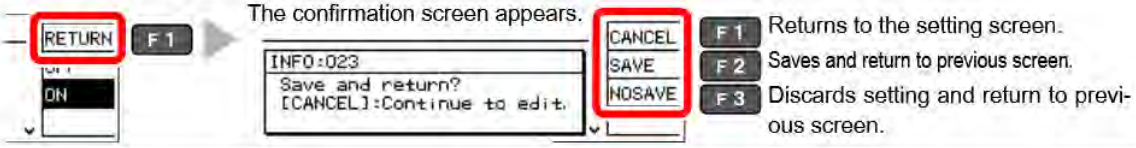
5 Select the instrument to serve as the 1st stage, and set its tolerance range.



6 Set the instrument to serve as the 2nd stage.



7 Return to the Measurement screen.

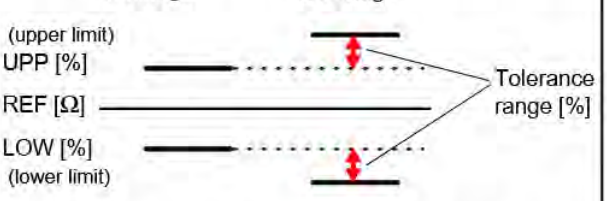


Tolerance Range Setting Conditions

Permissible tolerance is calculated using floating-point values, so the setting must be at least 0.001% larger than the difference between 2nd and 1st stage ranges.
Set the upper and lower comparator thresholds according to the following conditions:

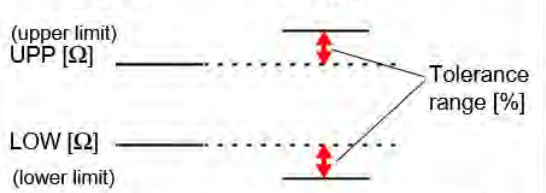
1st stage upper threshold < 2nd stage upper threshold
1st stage lower threshold > 2nd stage lower threshold

REF% setting



Tolerance range [%] > 2nd upper limit [%] - 1st upper limit [%]

ABS setting



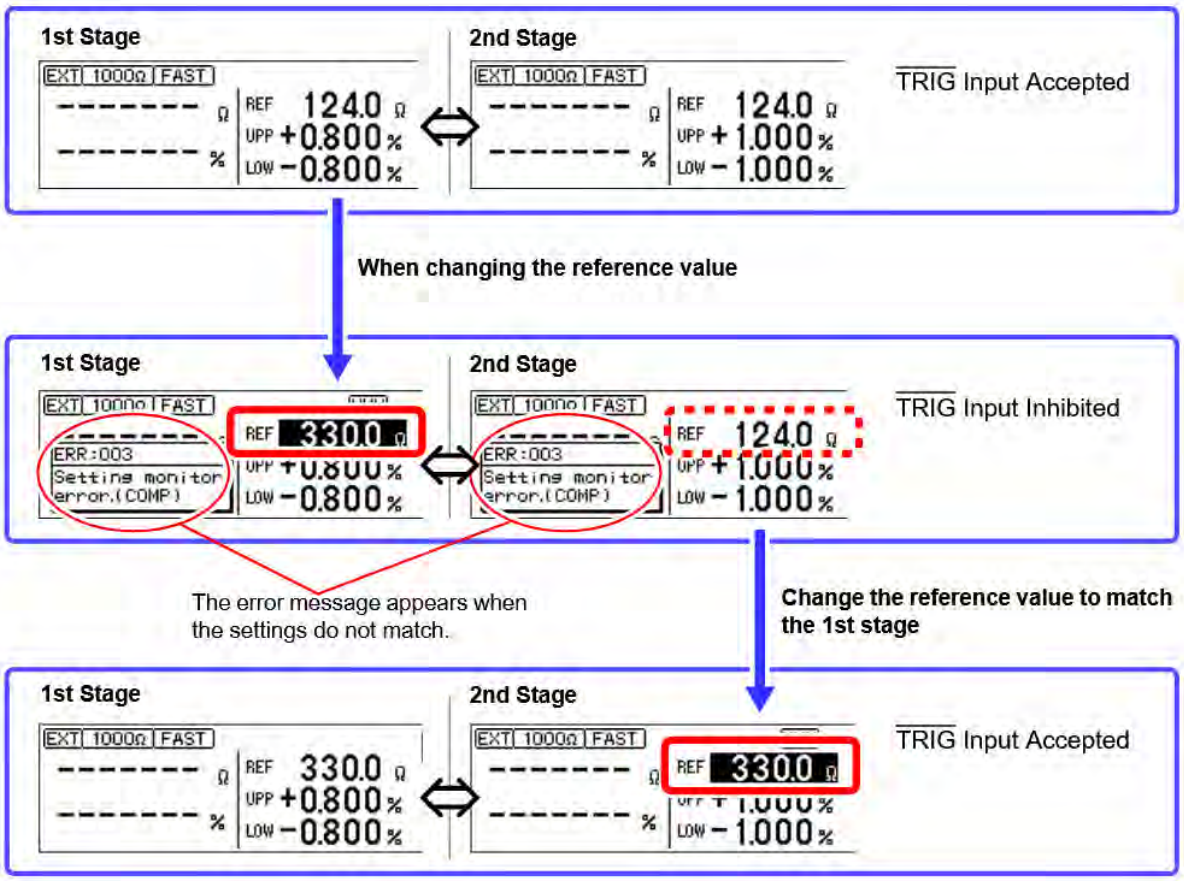
$$\text{Tolerance range [\%]} > \frac{\text{2nd upper limit - 1st upper}}{\text{1st upper limit}} \times 100$$

$$\text{Tolerance range [\%]} > \frac{\text{1st lower limit - 2nd lower}}{\text{1st lower limit}} \times 100$$

1.888.610.7664 www.calcert.com sales@calcert.com

Practical Example

SET MONITOR: ON 1st 0.300% (on the SET MONITOR: ON 2nd (on the System screen)



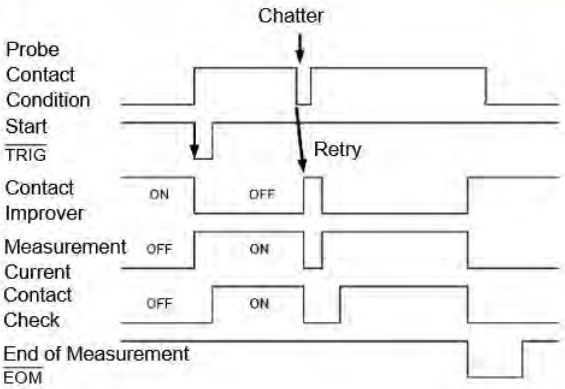
When an error is displayed

ERR:003 **Setting monitor error. (COMP)**	Comparator settings do not match. Please check.
ERR:004 **Setting monitor error. (SPEED)**	Measurement speed settings do not match. Please check.

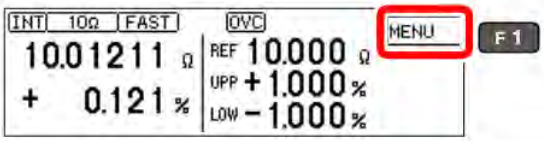
1.888.610.7664 www.calcert.com sales@calcert.com

4.11 Retrying Measurement After a Fault (Retry Function)

The Retry function enables measurement to be automatically retried when a measurement fault occurs due to probe chatter.
During Retry, all measurement operations including Contact Improvement and DELAY2 (but excluding DELAY1) are restarted.
If a measurement fault persists after the specified continuous retry interval (e.g., if the measured object is not connected), retrying is aborted and the EOM signal is output.
When Retry is enabled, the maximum time to end-of-measurement occurs when recovering from a measurement fault immediately before the retry interval expires, which approaches the sum of the retry interval setting plus normal measurement time.
Decreasing test throughput may indicate probe maintenance is required.

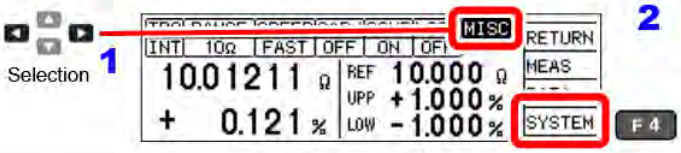


1 Open the Basic Settings screen.



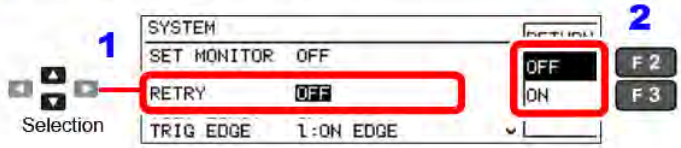
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears.
[SYSTEM]

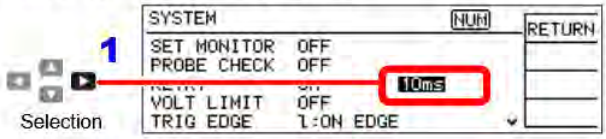
3 Enable or disable the function.



F2 Retries disabled (go to step 5).
F3 Retries enabled (default).

1.888.610.7664 www.calcert.com sales@calcert.com

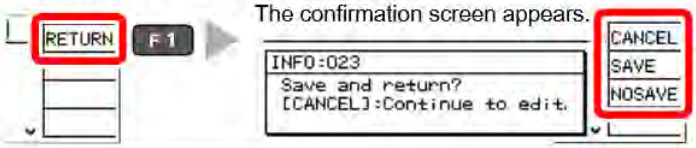
4 Set a continuous retry interval.



2 0 ···· 9 Setting range: 1 to 50 ms (default: 2 ms)

3 ENTER

5 Return to the Measurement screen.



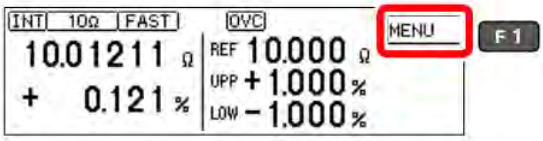
F 1 Returns to the setting screen.
F 2 Saves and return to previous screen.
F 3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

4.12 Limiting Measurement Voltage (Applied Voltage Limiter Function)

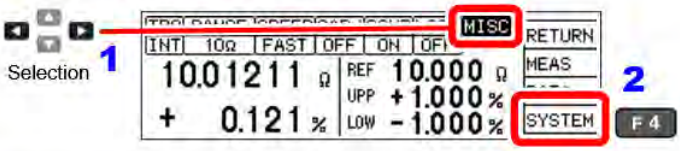
Applied voltage used for measurements can be limited to 5 V or lower.
When [ON] is selected, an adequate measurement range in which the "measured current × reference value or upper comparator threshold" (voltage) does not exceed 5 V will be automatically selected.

1 Open the Basic Settings screen.



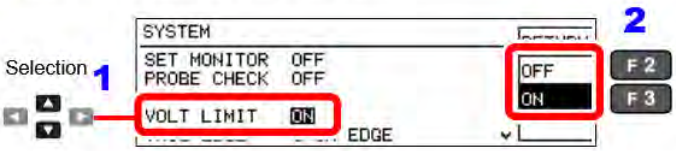
The Basic Settings screen appears.

2 Open the System screen.



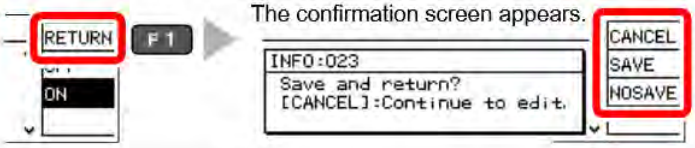
The System screen appears.
[SYSTEM]

3 Enable or disable the function.



F2 Applied voltage is not limited(default).
F3 Applied voltage is limited.

4 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves and return to previous screen.
F3 Discards setting and return to previous screen.

NOTE The instrument will display OvrRng (over range) when measuring a sample with applied voltage of 5 V or greater.

1.888.610.7664 www.calcert.com sales@calcert.com

4.13 Maintaining Measurement Precision (Self-Calibration Function)

To maintain measurement precision, the instrument self-calibrates every ten minutes to compensate for internal circuit offset voltage and gain drift. This function cannot be disabled.

During self-calibration, the subsequent measurement is delayed for about 6 PLC + 10 ms (PLC = Power Line Cycles) for internal circuit compensation.

Self-Calibration Timing
Supplied power 50 Hz: 130 ms, 60 Hz: 110 ms

- When the timing of self-calibration overlaps with a measurement, self-calibration is postponed until the end of measurement.
- When a trigger signal (measurement start signal) is applied during self-calibration, the start of the triggered measurement is postponed until self-calibration is finished.
- Self-calibration executes automatically after changing comparator or measurement speed settings.
- During self-calibration, measurement current and the Contact Improver current are inhibited.

4.14 Compensating for Thermal EMF Offset (Offset Voltage Compensation - OVC)

This function automatically compensates for offset voltage resulting from thermal emf or internal instrument bias. (OVC: Offset Voltage Compensation)

See: "Appendix 2 Effect of Thermal emf" (p. A2)

The following value is known to be a true resistance value from R_P (>0), the value measured with current flowing in the positive direction, and R_N (<0), the value measured with current flowing in the negative direction.

$$\frac{R_P - R_N}{2}$$

Offset voltage compensation is automatically enabled in the following conditions, and cannot be modified or disabled:

- When a range from 100 mΩ to 10 Ω is selected.
- Low Power Resistance Measurement (LOW POWER ON)

NOTE

When the test object is inductive, some delay [DELAY2] is required (p. 46) to allow adequate current flow before starting measurement.

1.888.610.7664 www.calcert.com sales@calcert.com

System Settings Chapter 5

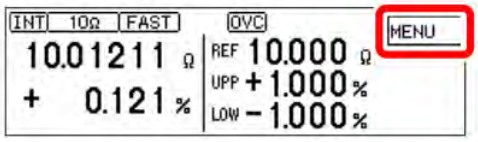
5.1 Disabling and Enabling Key Operations

Disabling Key Operations (Key-Lock Function)

Activate the key-lock function to disable the instrument's front panel key operations.
Three key-lock levels are available to suit specific purposes.

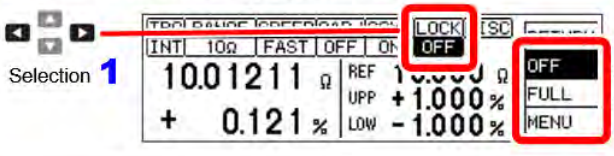
Only comparator settings are enabled.	**Disabling All Except Comparator Settings** Key operations other than comparator settings (REF%, ABS, units and numeric keys) and F1 [UNLOCK] keys are disabled. To disable key operations: [M.LOCK] is displayed when returning to the [MENU] measurement screen.
Key operations to change settings are disabled. (although key-lock can be canceled)	**Disabling All Key Operations Including Comparator** All key operations except F1 [UNLOCK] are disabled. To disable key operations: [F.LOCK] is displayed when returning to the [FULL] measurement screen.
All key operations are disabled.	**Disabling All Panel Keys** Asserting (Low) the EXT. I/O $\overline{\text{KEY_LOCK}}$ signal disables all panel keys, including F1 [UNLOCK] and F1 [LOCAL] (disables remote control) (p. 97). To disable the key-lock function and re-enable the keys, de-assert (High) the $\overline{\text{KEY_LOCK}}$ signal.

1 Open the Basic Settings screen.



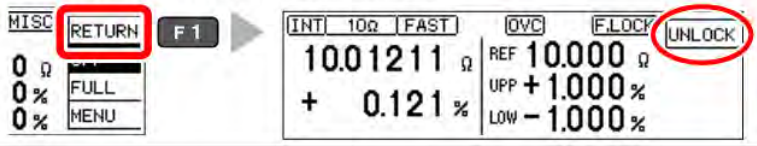
The Basic Settings screen appears.

2 Enable or disable key operations.



F2 Key operations enabled (default).
F3 Disables all except key-lock cancel.
F4 Disables all except key-lock cancel and comparator setting change.

3 Return to the Measurement screen.



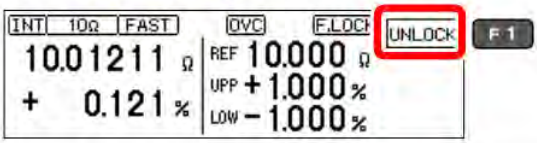
[UNLOCK] is displayed only when key-lock is enabled by front panel key operations.

1.888.610.7664 www.calcert.com sales@calcert.com

Re-Enabling Key Operations (Key-Lock Cancel)

Key-lock can be canceled only when [UNLOCK] is displayed.

Press and hold **F1 [UNLOCK]** for one second.



NOTE

If key operations are disabled by the $\overline{\text{KEY_LOCK}}$ signal, de-assert (High) the signal to unlock the keys.

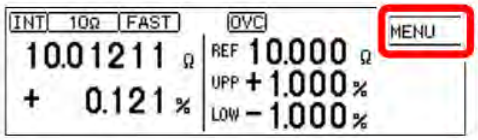
1.888.610.7664 www.calcert.com sales@calcert.com

5.2 Setting the Comparator Judgment and Key Beepers

Enabling or Disabling the Key Beeper

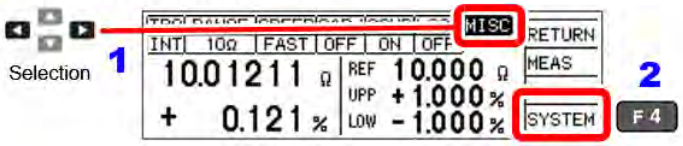
The key beeper sound can be enabled and disabled.
The key beeper is enabled (ON) by default.

1 Open the Basic Settings screen.



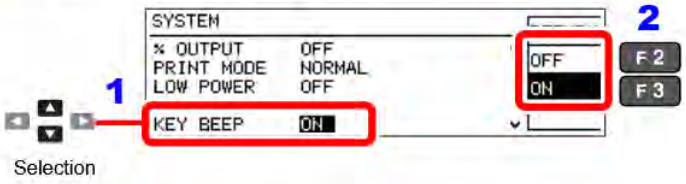
The Basic Settings screen appears.

2 Open the System screen.



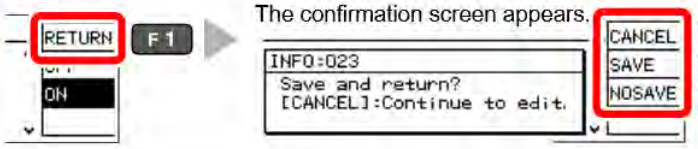
The System screen appears.
[SYSTEM]

3 Select whether to enable or disable the key beeper.



Disables the beeper.
Enables the beeper (default).

4 Return to the Measurement screen.



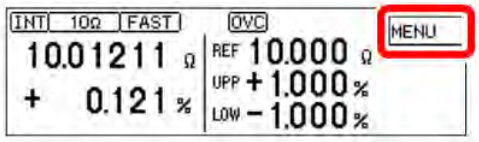
Returns to the setting screen.
Saves setting and return to previous screen.
Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

Setting the Comparator Judgment Beeper

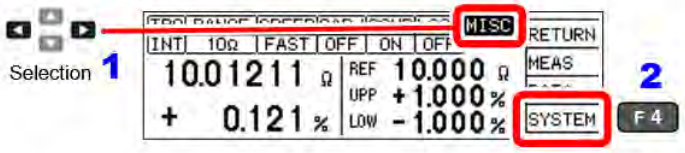
The comparator judgment beeper can be enabled and disabled.
The judgment beeper is disabled (OFF) by default.

1 Open the Basic Settings screen.



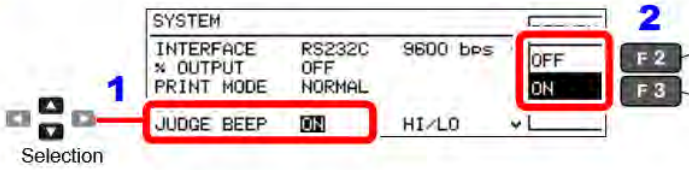
The Basic Settings screen appears.

2 Open the System screen.



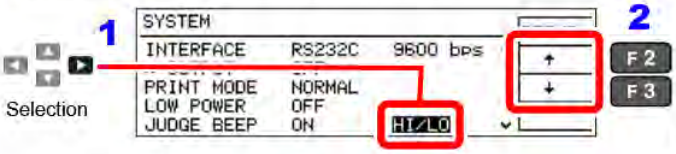
The System screen appears.
[SYSTEM]

3 Select whether to enable or disable the judgment beeper.



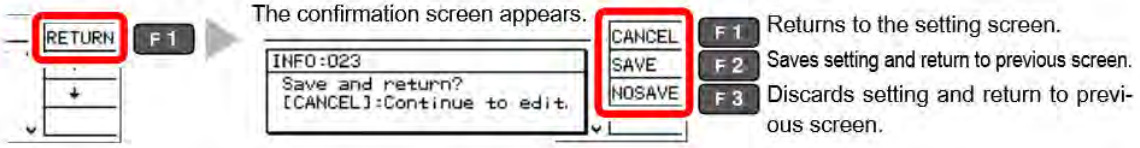
F2 Disables the beeper (default) (go to step 5).
F3 Enables the beeper.

4 Select the judgment beep conditions.



F2 IN (beep when within range)
F3 HI/LO (beep when out of range)
LOW (beep when below lower threshold)
HIGH (beep when above upper threshold)

5 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

5.3 Power Line Frequency Manual Setting

For proper electrical noise suppression, the instrument needs to be set to match the power line frequency.
With the default setting (AUTO), the instrument attempts to automatically detect the line frequency, but manual setting is also available.
Unless the line frequency is set correctly, measurement values may be unstable.
An error message appears if line noise is high enough to prevent correct frequency detection (ERR:041 (p. 203)). In that case, set the instrument's line frequency manually.

NOTE

When the [AUTO] setting is selected, the line frequency is automatically set to 50 or 60 Hz when the instrument is turned on or reset.

However, automatic detection is not available when the line frequency changes after turning power on or resetting.

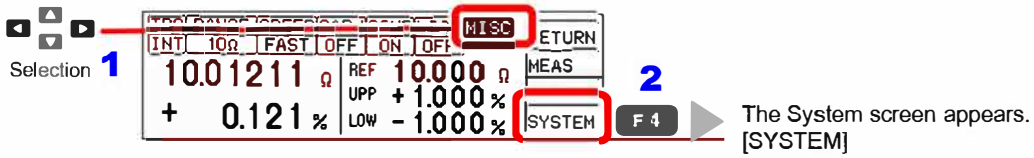
If the actual line frequency deviates from 50 or 60 Hz, it is set to one of the closest frequencies.

Examples: If the actual line frequency is 50.8 Hz, select the 50 Hz setting.
If the actual line frequency is 59.3 Hz, select the 60 Hz setting.

1 Open the Basic Settings screen.

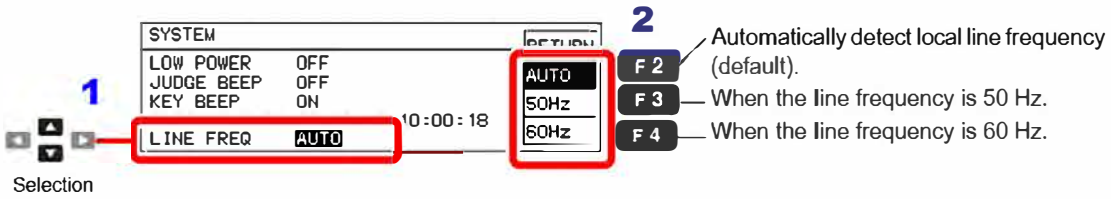
The Basic Settings screen appears.

2 Open the System screen.



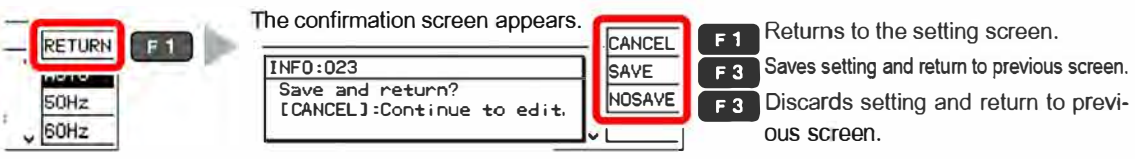
The System screen appears.
[SYSTEM]

3 Select the line frequency to be used.



Automatically detect local line frequency (default).
When the line frequency is 50 Hz.
When the line frequency is 60 Hz.

4 Return to the Measurement screen.



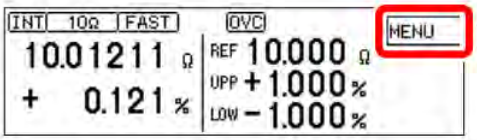
F 1 Returns to the setting screen.
F 3 Saves setting and return to previous screen.
F 3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

5.4 Setting the Clock

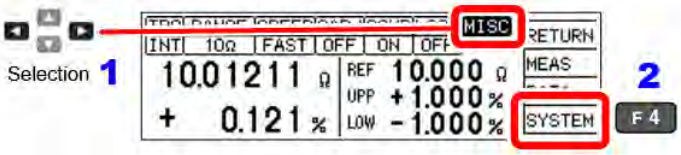
To record and print the correct time when using statistical calculations (p. 86), the clock needs to be set correctly.
The time of printing is also output when printing statistical calculation results.

1 Open the Basic Settings screen.



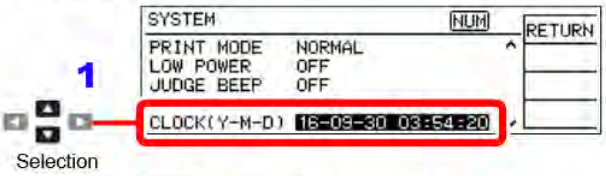
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears.
[SYSTEM]

3 Set the date and time.



2 0 9

Enter the last two digits of the year, and the month, day, hour, minutes and seconds in that order.
(The cursor will move automatically.)

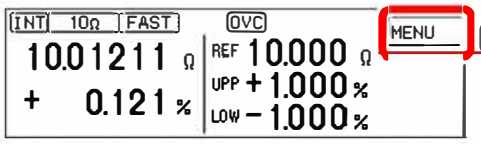
4 Return to the Measurement screen.

Clock settings cannot be canceled.

5.5 Adjusting Screen Contrast

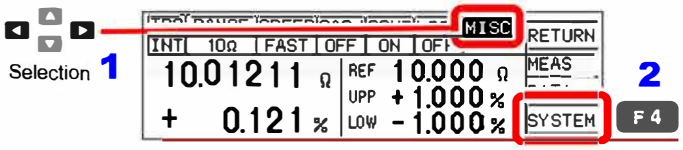
The screen may become hard to see when ambient temperature changes. In this case, adjust the contrast.

1 Open the Basic Settings screen.



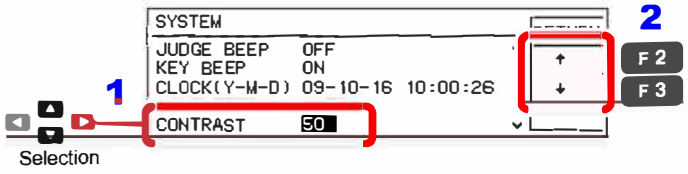
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears.
[SYSTEM]

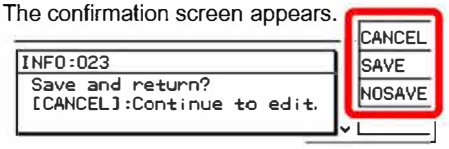
3 Adjust the contrast.



0~100%, 5% step
50% (default)

4 Return to the Measurement screen.

The confirmation screen appears.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

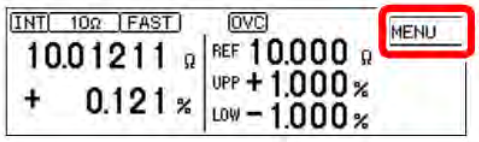
5.6 Adjusting the Backlight

Adjust backlight brightness to suit ambient illumination.

NOTE

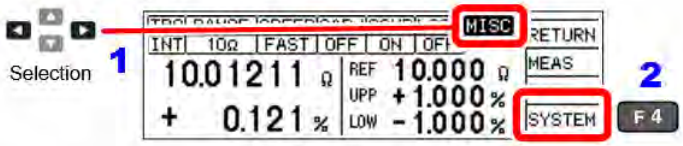
- When external triggering [TRG: EXT] is selected, backlight brightness is automatically reduced after non-operation for one minute.
- Be aware that the display may be hard to see when brightness is set too low (near 0%).

1 Open the Basic Settings screen.



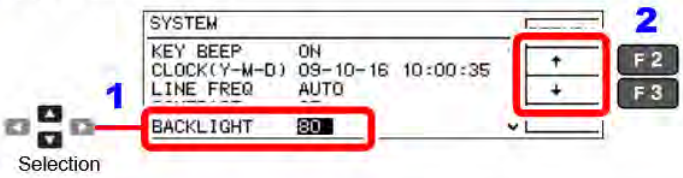
The Basic Settings screen appears.

2 Open the System screen.



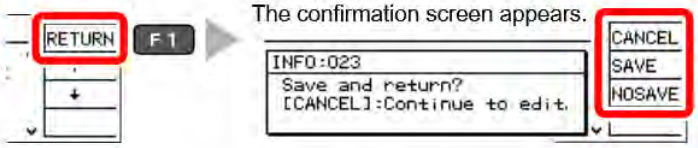
The System screen appears.
[SYSTEM]

3 Adjust the backlight.



0~100%, 5% step
80% (default)

4 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

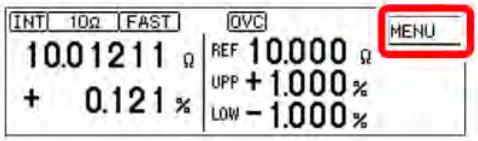
5.7 Initializing (Reset)

The instrument can be reset by following three methods.

- System reset from the System screen: Returns all settings (except the clock) to factory defaults.
- Turn the instrument on while simultaneously holding the REF% and ABS keys: Returns all settings (except the clock) to factory defaults.
- Reset by remote control command: returns all settings (except communication and clock settings) to their factory defaults.
  *RST command (non-backup) (p. 139)
  :SYSTem:RESet command (p. 156)

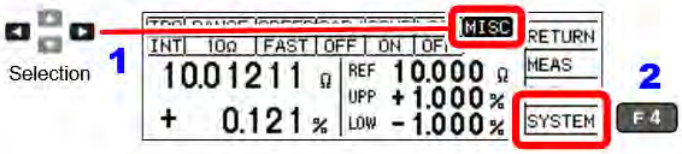
This procedure describes system reset from the System screen.

1 Open the Basic Settings screen.



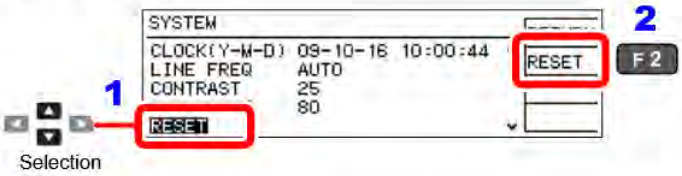
The Basic Settings screen appears.

2 Open the System screen.



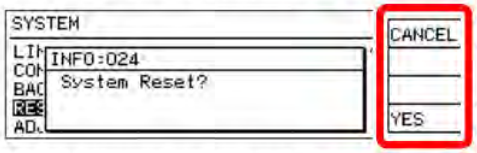
The System screen appears.
[SYSTEM]

3 Select RESET.



Returns all settings to their factory defaults.

4 Select whether to cancel or proceed to execute system reset.



Cancels the operation.

Executes.

The Measurement screen is displayed when system reset finishes.

1.888.610.7664 www.calcert.com sales@calcert.com

Default Settings

Display		Setting value	Default value	Settings
MENU	**TRG**	INT/ EXT/ MANU	EXT	Trigger setting function (p. 33)
	RANGE	↑/ ↓ [When low-power resistance measurement is set to OFF] 100 mΩ/ 1000 mΩ/ 3 Ω/ 10 Ω/ 100 Ω/ 300 Ω/ 1000 Ω/ 10 kΩ/ 30 kΩ/ 100 kΩ/ 300 kΩ/ 1000 kΩ/ 3 MΩ/ 10 MΩ/ 30 MΩ/ 100 MΩ (default) [When low-power resistance measurement is set to ON] 1000 mΩ/ 3 Ω/ 10 Ω/ 100 Ω/ 300 Ω/ 1000 Ω	100 MΩ	Range switching function (p. 34)
	SPEED	SLOW/ MED/ FAST	FAST	Measurement speed (p. 31)
	0ADJ	OFF/ ON	OFF	Zero adjustment function (p. 36)
	COMP	OFF/ ON	ON	Comparator function (p. 38)
	LOCK	OFF/ FULL / MENU	OFF	Key-Lock function (p. 69)
	MISC	MEAS/ DATA/ SYSTEM		(Miscellaneous settings)
MISC				
MEAS	**DELAY1**	0 to 100 ms (all ranges)	0 ms	Probe delay setting (p. 46)
	DELAY2	0 to 100 ms	0 ms	DUT response setting (p. 46)
	SCALING	OFF/ON Coefficient A Offset B	OFF A:1 B:0	Scaling function (p. 48)
	INT (FAST)	0.1 ms to 100 ms 1PLC to 6PLC (60 Hz) 1PLC to 5PLC (50 Hz)	Depends on measurement range	Integration time (p. 50)
	INT (MED)			
	INT (SLOW)			
	CONT CHECK	OFF/ ON 50 Ω/ 100 Ω/ 150 Ω/ 200 Ω/ 300 Ω/ 400 Ω/ 500 Ω	ON, 200 Ω	Contact check (p. 52)
	CONT IMP	OFF/ ON/ PULSE 17 mA/ 25 mA/ 35 mA/ 50 mA	ON, 35 mA (ranges from 100 mΩ to 100 kΩ) PULSE, 35 mA (ranges from 300 kΩ to 100 MΩ)	Contact Improvement (p. 54)
	VOLT MONITOR	OFF/ ON/ ALLOFF LOOSE/ NORMAL/ SEVERE	ON, NORMAL (LOOSE when 100 MΩ range)	Voltage Monitor Function (p. 57)
	CURRENT MODE	CONT/ PULSE	PULSE	Current mode setting function (p. 58)
DATA	**AUTO MEMORY**	OFF/ ON	OFF	Auto-Memory function (p. 83)
	STATISTICS	OFF/ ON	OFF	Statistical calculation function (p. 86)
	DATA OUT	OFF/ ON	OFF	Data output function (p. 89)

1.888.610.7664 www.calcert.com sales@calcert.com

Display		Setting value	Default value	Settings
SYSTEM	**SET MONITOR**	OFF/ ON, 1st/ 2nd, 0.000% to 9.999%	OFF, 1st, 0.000%	Settings Monitor function (p. 61)
	PROBE CHECK	OFF/ ON, 0 to 100 ms	OFF, 5 ms	Probe short-circuit detection function (p. 59)
	RETRY	OFF/ ON, 1 to 50 ms	ON, 2 ms	Retry function (p. 64)
	VOLT LIMIT	OFF/ ON	OFF	Applied Voltage Limiter Function (p. 66)
	TRIG EDGE	OFF EDGE/ ON EDGE	ON EDGE	Start Logic Setting (p. 108)
	EOM	PULSE/ HOLD 1 to 100 ms	PULSE, 5 ms	End-of-measurement pulse width (p. 107)
	SHIFT OUTPUT **IN** **NG** **ERR**	OFF/ ON 0 ~ 99 0 ~ 99 0 ~ 99	OFF 0 0 0	Judgment Output Shift Function (p. 109)
	INTERFACE	GP-IB/ RS232C/ PRINT	RS232C, 9600bps GP-IB, ADR01, LF	Interface setting (p. 117)
	% OUTPUT	OFF/ ON	OFF	Percentage Output Function (p. 90)
	PRINT MODE	NORMAL/ SAMPLE, 1 to 100, ALL/ IN, 1/L/ 3/L	NORMAL, 100, ALL, 3/L	Set printing method (p. 93)
	LOW POWER	OFF/ ON	OFF	Low-Power Resistance Measure-ment (p. 30)
	JUDGE BEEP	OFF/ ON OFF/ IN/ HI/LO/ LOW/ HIGH	OFF, HI/LO	Comparator judgment beeper (p. 72)
	KEY BEEP	OFF/ ON	ON	Key beeper (p. 71)
	CLOCK			Clock setting (p. 74)
	LINE FREQ	AUTO/ 50 Hz/ 60 Hz	AUTO	Line frequency (detection) setting (p. 73)
	CONTRAST	0 ~100	50	Screen contrast adjustment (p. 75)
	BACK LIGHT	0 ~100	80	Screen backlight adjustment (p. 76)
	RESET	-	-	Reset (p. 77)
	ADJUST	-	-	Adjustment screen (p. A13)

1.888.610.7664 www.calcert.com sales@calcert.com

Storing and Exporting Data Chapter 6

Measurement values can be stored or automatically exported, according to application. Stored data can be output to a printer, RS-232C or GP-IB. Also, statistical calculations can be applied to internally stored data.

Stored measurement data are lost when the instrument is turned off.
Therefore, be sure to print out or export important data to a PC.

Store measurement values at specified timing.
This is convenient for batch exporting data to a controller while switching reels.

→ **Data Memory Function (p. 82)**

Stores up to 30,000 measurement data using the EXT. I/O $\overline{\text{TRIG}}$ signal or by pressing the F4 [MANU] key on the Basic Settings screen.

Store data after measurement value has stabilized.
This is convenient for sample inspection after printing (vapor deposition) resistors on a board.

→ **Auto-Memory Function (p. 83)**

Measurement values are automatically stored as they become stable.
When the specified number of data points (up to 99) is acquired, the beeper sounds and auto-storing halts.

Automatically output (export) measurements at the end of measurement.

→ **Data Output Function (p. 89)**

Minimizes transfer time by eliminating the need for transmit requests from the remote controller.
(RS-232C interface only)

1.888.610.7664 www.calcert.com sales@calcert.com

6.1 Storing Data at Specified Timing (Data Memory Function)

Measurement values are stored in the instrument's internal memory at the following timings (up to 30,000 points).

- All measurements performed by external (EXT) triggering
- When a trigger is applied during internally (INT) triggered measurement

The following three storage methods are available:

- Stores when an EXT. I/O $\overline{\text{TRIG}}$ signal is received (p. 97)
- Stores when a ∗**TRG** command is received (p. 142)
- Stores when the F4 [MANU] key on the [MENU] - [TRG] setting screen is pressed.

NOTE

- This function can only be enabled by remote control. The data memory function should be enabled by remote command beforehand. This setting is not available on the front panel.
- Stored memory data cannot be viewed on the instrument's screen. Use remote control commands to export stored data.
- When the percentage output function (p. 90) is enabled, data that can be acquired using commands takes the form of relative values.

Data Memory Function Operating Procedure

1 Enable data memory mode.

Send this remote command to enable the data memory function:
`:MEMory:MODE MEMory` (p. 161)

2 Store measurement values.

Execute external trigger measurement, or apply a trigger during internally triggered measurement.

3 Export the stored data.

Send this remote command to export the measurement values stored in the instrument:
`:MEMory:DATA?` (p. 162)

4 Clear measurement data from instrument memory.

Send this remote command to erase the data from instrument memory:
`:MEMory:CLEar` (p. 161)

Moreover, stored data is automatically erased at the following timings:

- When the memory function setting (including auto-memory) is changed (p. 161)
- When the range is changed (p. 34)
- When changing comparator settings (p. 38)
- When printing the statistical calculations (p. 95)
- When the measuring object is changed (p. 30)
- Upon system reset (p. 77)

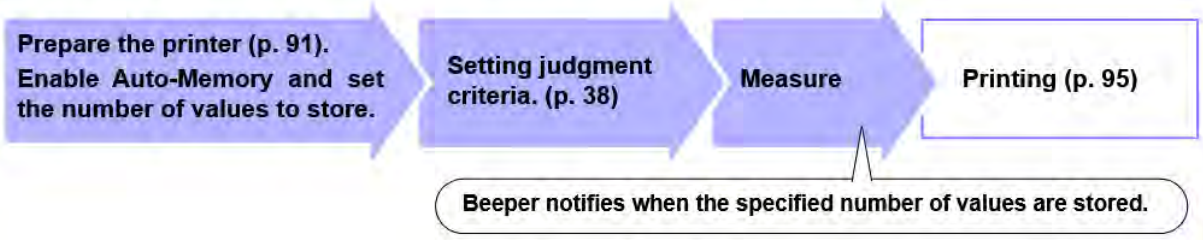
1.888.610.7664 www.calcert.com sales@calcert.com

6.2 Store as soon as Measurement is Stable (Auto-Memory Function)

This function automatically stores the measurement value each time the probes contact the sample with internal triggering.
When the specified number of values have been acquired, auto-storage operation stops.
Statistical calculations are applied to the stored data, with results output to the screen or printer (RS-232C).

See: "6.3 Performing Statistical Calculations on Measurement Values" (p. 86)
"Chapter 7 Printing" (p. 91)

Data storage and printing can be automatically controlled by the Auto-Memory function.



The Auto-Memory function is disabled by default.
Enable the Auto-Memory function before setting the number of values to store.
Enabling the Auto-Memory function affects other functions as follows:

- Statistical calculation is forcibly turned on.
- The voltage level monitor function is forcibly turned off (the setting itself is not set to OFF, but the function is disabled).
- The trigger source setting is forcibly turned to internal [TRG: INT].

NOTE

When the trigger source is set to external [TRG: EXT], the Auto-Memory function is forcibly disabled.

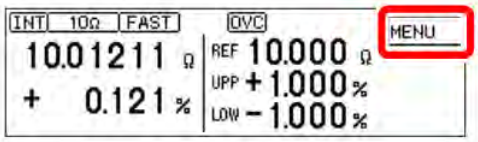
Deleting Stored Data

Stored data is automatically erased at the following timings:

- When the memory function setting (including data-memory) is changed (p. 161)
- When the range is changed (p. 34)
- When changing comparator settings (p. 38)
- When the power is turned off
- When printing (p. 95)
- When the measuring object is changed (p. 30)
- Upon system reset (p. 77)
- Upon setting the auto-memory number of values to store (p. 84)

Enabling the Auto-Memory Function

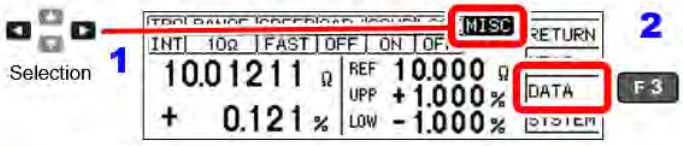
1 Open the Basic Settings screen.



The Basic Settings screen appears.

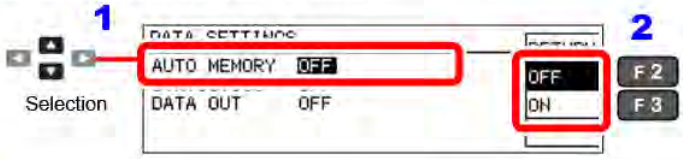
1.888.610.7664 www.calcert.com sales@calcert.com

2 Open the Data Memory Settings screen.



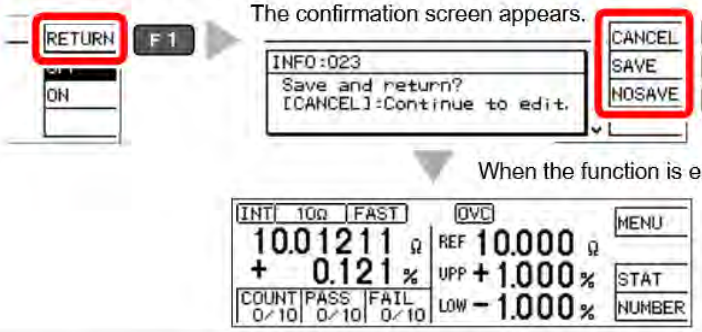
The Data Settings screen appears.
[DATA SETTINGS]

3 Enable or disable the function.



F 2 Auto-Memory function is not used (default).
F 3 Auto-Memory function is used.

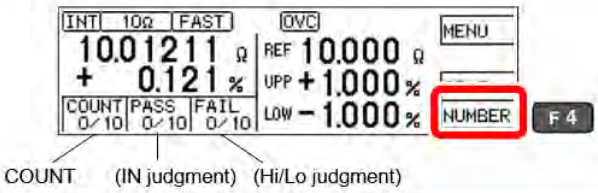
4 Return to the Measurement screen.



F 1 Returns to the setting screen.
F 2 Saves setting and return to previous screen.
F 3 Discards setting and return to previous screen.

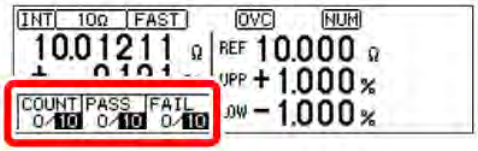
Setting the Number of Values to Store

1 Open the Auto-Memory Settings screen.



Displays the Auto-Memory setting screen.

2 Enter the number of values to store.

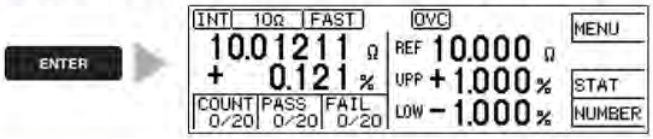


To Reset Numerical Values
BACK SPACE Deletes entered digits.
This key is enabled only when entering numerical values.

0 ···· 9 Setting range: 1 to 99

To abort the setting process, press ESC. Settings are abandoned and the display returns to the previous screen.

3 Accept the settings and return to the Measurement screen.



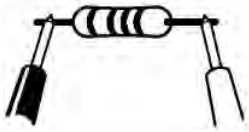
(Example: 20 values are set to be stored.)

1.888.610.7664 www.calcert.com sales@calcert.com

Acquiring Measurement Values Automatically

1 Momentarily disconnect (open-circuit) the probes.

2 Connect the probes to the measuring object.



When the measurement is stable, the value is automatically stored and the count is incremented. When the count reaches the specified number of values, a long beep sounds, and subsequent measurements are not stored.
The (one) last acquired value can be deleted. (Undo function (p. 88)).

1.888.610.7664 www.calcert.com sales@calcert.com

6.3 Performing Statistical Calculations on Measurement Values

Statistical calculations can be performed and results displayed for up to 30,000 measurement values.
Printing is also available (p. 95).

Calculation types: average, maximum and minimum values, population standard deviation, sample standard deviation, and process compatibility indices

Maximum	$X_{max} = MAX\ (x_1, ..., x_n)$
Minimum	$X_{min} = MIN\ (x_1, ..., x_n)$
Mean	$\bar{x} = \frac{\sum x}{n}$
Population standard deviation	$\sigma_n = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n}}$
Standard deviation of sample	$\sigma_{n-1} = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n-1}}$
Process capability index* (variation)	$Cp = \frac{\lvert Hi - Lo \rvert}{6\sigma_{n-1}}$
Process capability index* (bias)	$CpK = \frac{\lvert Hi - Lo \rvert - \lvert Hi + Lo - 2\bar{x} \rvert}{6\sigma_{n-1}}$

In these formulas, n represents the number of valid data samples.

Hi and Lo are the upper and lower thresholds of the comparator.

* The process capability index represents the quality achievement capability created by a process, which is the "Quality variation and width bias possessed by the process".
Generally, depending on the values of Cp and CpK, process capability is evaluated as follows:

	Process capability
Cp, CpK > 1.33	Ideal
1.33 ≥ Cp, CpK > 1.00	Adequate
1.00 ≥ Cp, CpK	Inadequate

- When only one valid data sample exists, standard deviation of sample and process capability indices are not displayed.
- When $\sigma_{n-1} = 0$, Cp and Cpk are 99.99.
- The upper limit of Cp and CpK is 99.99. If Cp and CpK>are 99.99, the value 99.99 is displayed.
- Negative values of CpK are considered as CpK = 0.
- If statistical calculation is turned off and then back on without first clearing the calculation results, calculation resumes from the point when it was turned off.
- Measurement speed is reduced when statistical calculation is enabled.
- When Auto-Memory is enabled (ON), statistical calculation is forcibly enabled (ON).
- When statistical calculation is disabled (OFF), Auto-Memory is forcibly disabled (OFF).

Deleting Statistical Calculation Results

Stored data is automatically erased at the following timings:

- When the memory function setting (including data-memory) is changed (p. 161)
- When the range is changed (p. 34)
- When changing comparator settings (p. 38)
- When printing the statistical calculations (p. 95)
- When the measuring object is changed (p. 30)
- Upon system reset (p. 77)
- Upon setting the auto-memory number of values to store (p. 84)

1.888.610.7664 www.calcert.com sales@calcert.com

Using Statistical Calculations

When statistical calculation is set to ON and an EXT. I/O trigger signal is applied, operation will be performed as follows depending on the trigger source setting:

- With external [EXT] triggering: One measurement is performed and subject to statistical calculation.
- With internal [INT] triggering: The next measurement value after the trigger signal is subjected to statistical calculation.

Operation is the same in the following cases:

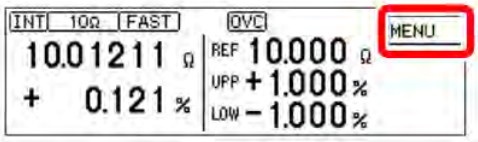
(Key Operations)

- When the **F4 [MANU]** key on the [MENU] - [TRG] selection screen is pressed.
- When the **F2 [PRINT]** key on the Measurement screen is pressed (with internal triggering and Auto-Memory disabled. Appears only when the interface is set for the printer.).
- When acquiring measurement values with the Auto-Memory function (p. 83).

(Remote Control)

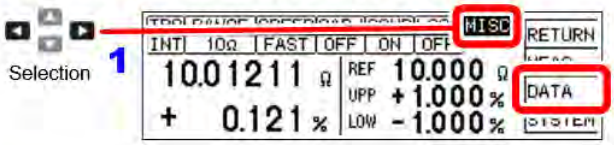
- *When a **TRG** remote control command is received.
- When an EXT. I/O $\overline{\text{PRINT}}$ signal is applied on the Measurement screen (with internal triggering and Auto-Memory disabled).

1 Open the Basic Settings screen.



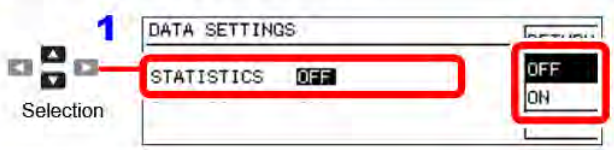
The Basic Settings screen appears.

2 Open the Data Memory Settings screen.



The Data Settings screen appears.
[DATA SETTINGS]

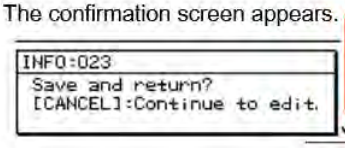
3 Enable or disable the function.



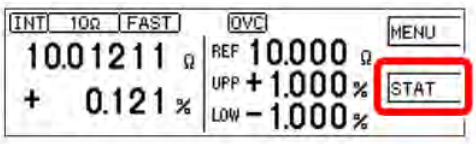
Disables statistical calculation (default).
Enables statistical calculation.

4 Return to the Measurement screen.

The confirmation screen appears.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.



When statistical calculation is enabled, **F3 [STAT]** appears on the Measurement screen.
Confirm calculation results (p. 88)

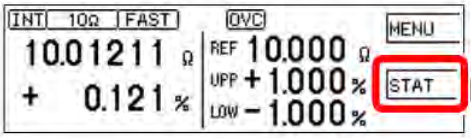
1.888.610.7664 www.calcert.com sales@calcert.com

Confirming, Printing, and Erasing Statistical Calculation Results

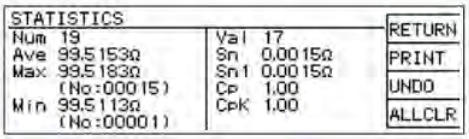
Statistical calculation results are displayed on the screen.
Printing is available using commercially available printers having a serial interface. Statistical calculation results are automatically erased after printing.
Before printing, select the [PRINT] interface setting.
See: "7.2 Setting the Instrument" (p. 93)

The number of valid samples can be confirmed on the Statistical Calculation Results screen.
- When the number of valid samples (Val) is zero, calculation results are not displayed.
- When only one valid data sample exists, no standard deviation or process capability indices are displayed.

1 Display the Calculation Results screen.



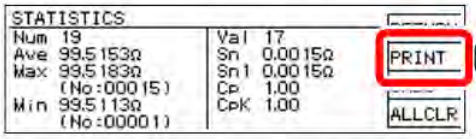
Calculation Results screen is displayed (only if statistical calculation is enabled).



Num	Total data count	**Val**	Number of valid measurement values (error-free data) (Valid)
Ave	Mean	**Sn**	Population standard deviation
Max	Maximum	**Sn1**	Standard deviation of sample
Min	Minimum	**Cp**	Process capability index (variation)
		Cpk	Process capability index (bias)

2 To print

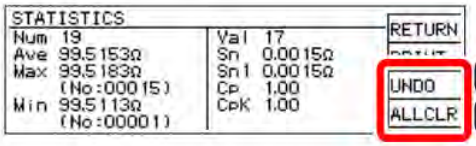
To print, select the printer as the interface setting on the System screen (p. 93).



Output to the printer.
"Example Printouts (PRINT MODE: NORMAL)" (p. 96)

Statistical calculation results and stored data are erased when printing finishes.

To erase



Erases the last measurement and calculation result (executes only once).
Erases all measurement values and statistical calculation results.

After selecting, a confirmation screen appears.

1.888.610.7664 www.calcert.com sales@calcert.com

6.4 Auto-Exporting Measurement Values (at End of Measurement) (Data Output Function)

At the end of measurement, the measurement value is exported to a computer via RS-232C.

See: "Chapter 9 Communications (RS-232C/ GP-IB Interface)" (p. 113)

NOTE

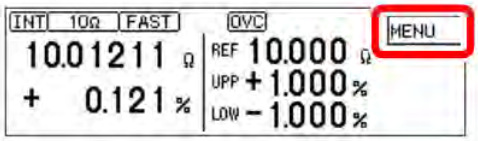
- Set the interface to [RS232C] beforehand. This function is not applicable to the GP-IB Interface.

See: "9.4 Configuring the Communications Protocol" (p. 117)

- When internal [TRG: INT] triggering is selected, data is exported only when a $\overline{\text{TRIG}}$ signal is applied.
- Executing a :READ? query command exports duplicate measurement values.
- Even when using other queries, ensure that the query response and auto-exporting of measured values do not overlap.
- The data format for measurement values can be selected as ASCII (default) or BINARY. Transfer time is minimized when BINARY is selected.

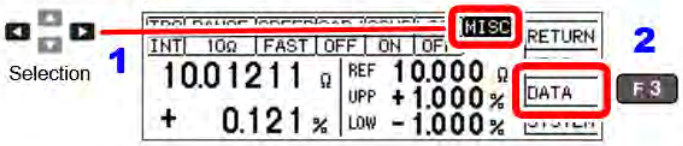
See: ":SYSTem:FORMat <ASCii/ BINary>" (p. 154)

1 Open the Basic Settings screen.



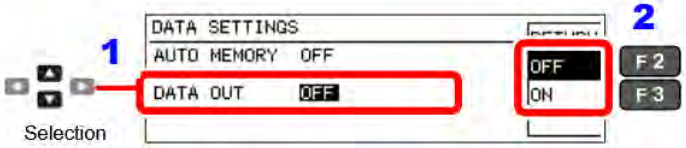
The Basic Settings screen appears.

2 Open the Data Memory Settings screen.



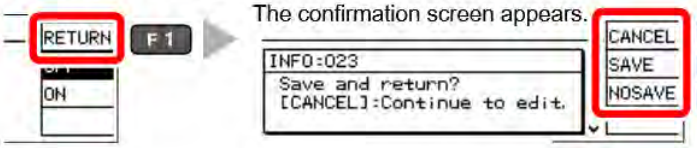
The Data Settings screen appears.
[DATA SETTINGS]

3 Enable or disable the function.



Disables auto-exporting (default).
Enables auto-exporting.

4 Return to the Measurement screen.



Returns to the setting screen.
Saves setting and return to previous screen.
Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

6.5 Outputting Measured Values as Relative Values (Percentage Output Function)

When the comparator function is set to REF% mode, you can change transmitted measurement data to relative values.

See: "3.7 Judging Measurement Values (Comparator Function)" (p. 38)

This setting applies to the following message responses (transmit data).

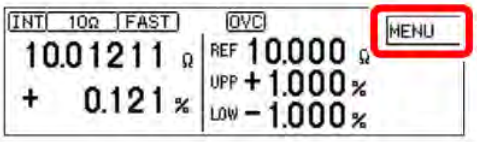
- `:FETCh?`
- `:READ?`
- `:MEMory:DATA?`

It also applies to transmit data that is output using the data output function.

See: "6.4 Auto-Exporting Measurement Values (at End of Measurement) (Data Output Function)" (p. 89)

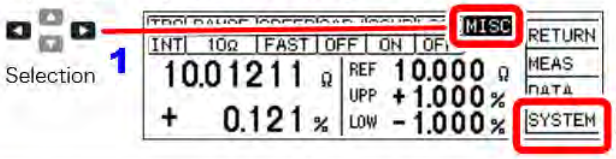
The output data range is as follows:
-999.9990[%] to +999.9990[%]

1 Open the Basic Settings screen.



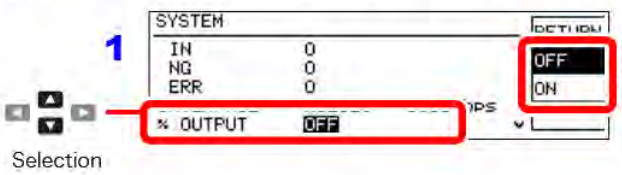
The Basic Settings screen appears.

2 Open the System Settings screen.



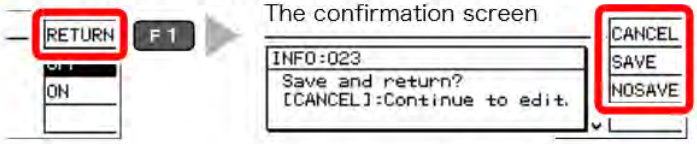
The System Screen appears.
[SYSTEM]

3 Enable the percentage output function.



F2 Disable (default)
F3 Enable the function.

4 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

Measured value format (when the percentage output function is enabled)

Relative value	When displaying ±OvrRng %	When displaying ±Ovr-Rng Ω	Measurement fault
± XXX . XXXX E+0	±100.0000E+7	±100.0000E+7	+100.0000E+8

NOTE

If the comparator function is set to ABS mode, measurement outliers occurring while the percentage output function is disabled will be output.

See: "Measurement Value Format" (p. 159)

1.888.610.7664 www.calcert.com sales@calcert.com

Chapter 7 Printing

Connecting the printer to the instrument → Setting the Instrument (p. 93) → Make printer settings → Printing (p. 95)
- Measurement values and comparator judgments
- Statistical calculation results

7.1 Connecting the Printer

Before 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.
- The recording paper may jam if it move at angle relative to the roller.

Compatible printer

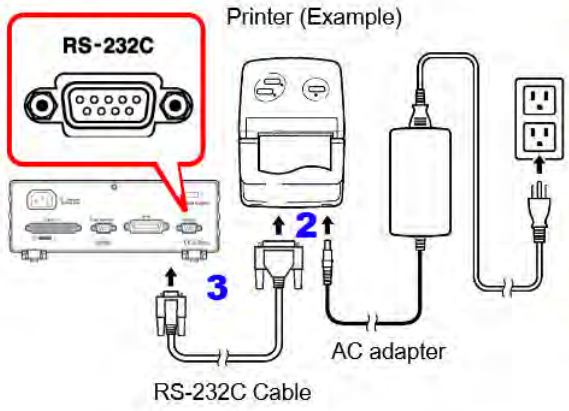
The requirements for a printer to be connected to the instrument are as follows.
Confirm compatibility and make the appropriate settings on the printer before connecting it to the instrument.
See: "7.2 Setting the Instrument" (p. 93)

- Interface RS-232C
- Characters per line ..... At least 45
- Communication speed..... 9600 bps
- Data bits 8
- Parity ..... none
- Stop bits 1
- Flow control ..... none

1.888.610.7664 www.calcert.com sales@calcert.com

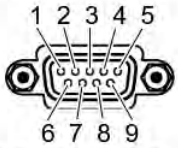
Connecting the Printer to the Instrument

Connection Methods

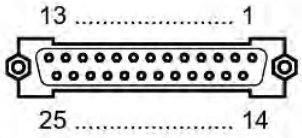


1. Confirm that the instrument and the printer are turned off.
2. Connect the AC adapter to the printer, and insert the power plug into an outlet.
3. Connect the RS-232C cable to the RS-232C connectors on the instrument and printer.
4. Turn the instrument and printer on.

Connector Pinouts



RM3542A (9-pin) Connector



Printer's (25-pin) connector (Example)

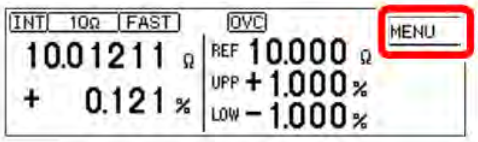
Circuit Name	Signal name	Pin No.
Receiving data	RxD	2
Transmitting data	TxD	3
Signal ground or common return	GND	5

Pin No.	Signal name	Circuit Name
2	TxD	Transmitting data
3	RxD	Receiving data
7	GND	Signal ground or common return
4	RTS	Request to Send
5	CTS	Clear to Send

1.888.610.7664 www.calcert.com sales@calcert.com

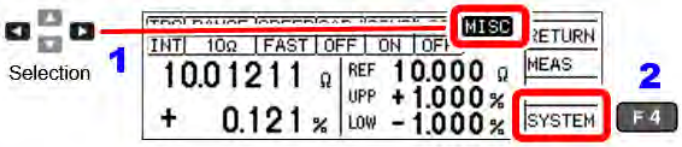
7.2 Setting the Instrument

1 Open the Basic Settings screen.



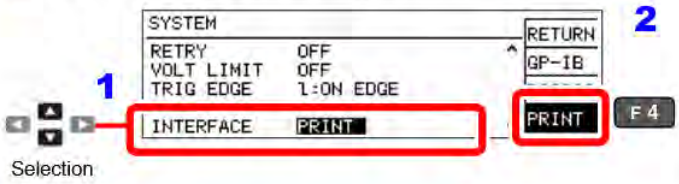
The Basic Settings screen appears.

2 Open the System screen.



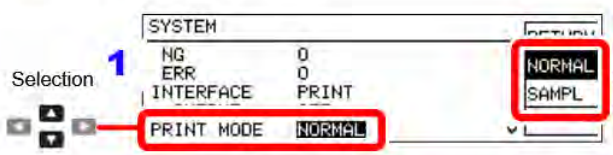
The System screen appears.
[SYSTEM]

3 Select print as the interface type.



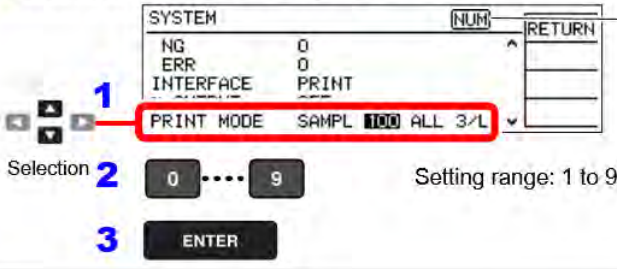
Using the printer.

4 Select the printing method.



Normal printing method (default) (go to step 8).
Sampling type

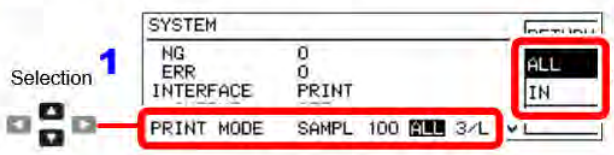
5 Select the number of samples.



Numeric keypad

Setting range: 1 to 999 (default: 100)

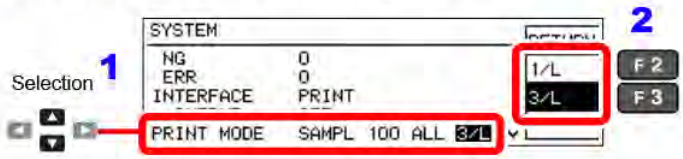
6 Select the printing conditions.



Prints all independent of comparator judgment (default).
Prints only if the comparator judgment is

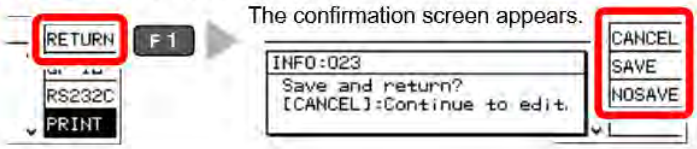
7

7 Select the number of data sets per line.



Prints one data set per line (default).
Prints three data sets per line.

8 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

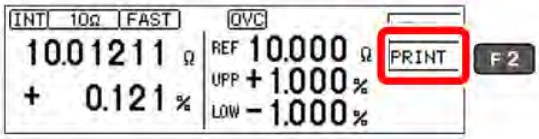
7.3 Printing

Before Printing
Verify that the instrument and printer settings (p. 93) are correct.

Printing Measurement Values and Comparator Judgments

Printing by key operation

Press the **PRINT** key to print the measurement value currently displayed on the Measurement screen.



Printing by external control

Measurement values and comparator judgments can be printed when the $\overline{\text{PRINT}}$ signal (the instrument's EXT. I/O connector) is set to Low (ON) (shorted with ISO_GND*).

* ISO_GND is one of the pins of the instrument's EXT. I/O connector.

NOTE

When statistical calculation is enabled [STATISTICS: ON] and triggering source is set to internal triggering [TRG: INT], statistical calculations are performed and measurement values are printed. When external [TRG: EXT] triggering is selected, only measurement values are printed. Use the $\overline{\text{TRIG}}$ signal to perform statistical calculations with external triggering.

Printing Statistical Calculation Results

Statistical calculation results can be printed when auto-memory or statistical calculation is enabled [ON]. To print, select PRINT on the screen or set the $\overline{\text{PRINT}}$ signal (the instrument's EXT. I/O connector) to Low (ON) (shorted with ISO_GND*).

To enable auto-memory:
See: "6.2 Store as soon as Measurement is Stable (Auto-Memory Function)" (p. 83)

To enable statistical calculation:
See: "6.3 Performing Statistical Calculations on Measurement Values" (p. 86)

(When statistical calculation is enabled)

If no valid data exists, only the data set is printed. When only one valid data set exists, standard deviation of sample and process capability index cannot be printed.

1.888.610.7664 www.calcert.com sales@calcert.com

Example Printouts (PRINT MODE: NORMAL)

Resistance measurements

```
  1    0.8725mOhm Lo
  2     0.484mOhm Lo
  3  10.99998 Ohm IN
  4  -10.0026 Ohm Lo
 27    9.9986 Ohm Hi
 28     9.996 Ohm Hi
 29   0.01003kOhm Hi
 30   0.00012MOhm Hi
```

Measurement fault values

```
  1    OvrRng     Hi
  2   -OvrRng     Lo
  3    C.E.Hi     --
  4    C.E.Lo     --
  5  C.E.Volt     --
  6  --------     --
```

Auto-memory data and statistical calculation results

```
Date(Y-M-D): 09-02-01   Time: 06:18:00
Ref: 1000.000 Ohm Upp:  +1.000% Low:  -1.500%
  1   999.885 Ohm   -0.011% IN
  2  1001.885 Ohm   +0.189% IN
  3  1002.394 Ohm   +0.239% IN
  4  1002.892 Ohm   +0.289% IN
  5  1012.894 Ohm   +1.289% Hi
  6  1000.897 Ohm   +0.090% IN
  7   998.902 Ohm   -0.110% IN
  8   994.888 Ohm   -0.511% IN
  9  1000.391 Ohm   +0.039% IN
 10   979.892 Ohm   -2.011% Lo
Hi:    1  IN:    8  Lo:    1  OR:    0
Number:   10  Valid:   10
Max   1012.894 Ohm   +1.289% (    5)
Min    979.892 Ohm   -2.011% (   10)
Avg    999.492 Ohm   -0.051%
Sn     7.83568 Ohm
Sn-1   8.25953 Ohm
Cp        0.50
CpK       0.42
```

Example Printouts (PRINT MODE: SAMPL)

Resistance measurement values

```
***********   HIOKI RM3542A  ***********
Date(Y-M-D): 3/1/2016   Time: 1:45:50 PM
Ref: 10.00000 Ohm Upp:  +10.00% Low:  -10.00%
-91.2750/Lo-95.1600/Lo +9.9998/IN
200.0260/Lo
```

Measurement error values

```
***********   HIOKI RM3542A  ***********
Date(Y-M-D): 3/1/2016   Time: 1:45:50 PM
Ref: 10.00000 Ohm Upp:  +10.0000% Low:  -
10.0000%
999.9999%/Hi999.9999%/Lo MEAS.ERR/--
 MEAS.ERR/-- MEAS.ERR/-- MEAS.ERR/--
```

Auto-memory data and statistical calculation results

```
Date: 09-02-01   Time: 06:18:00
Ref: 1000.000 Ohm Upp:  +1.000% Low:  -1.500%
 -0.011%/IN +0.189%/IN +0.239%/IN
 +0.289%/IN +1.289%/IN +0.090%/IN
 -0.110%/IN -0.511%/IN +0.039%/IN
 -2.011%/Lo
Hi:    1  IN:    8  Lo:    1  OR:    0
Number:   10  Valid:   10
Max   1012.894 Ohm   +1.289% (    5)
Min    979.892 Ohm   -2.011% (   10)
Avg    999.492 Ohm   -0.051%
Sn     7.83568 Ohm
Sn-1   8.25953 Ohm
Cp        0.50
CpK       0.42
```

- The "Valid" statistical calculation result indicates the number (count) of data samples not subject to errors such as measurement faults.
- Among the comparator judgment result counts (Hi, IN, Lo, and OR), "OR" indicates the number (count) of out-of-range measurements.

1.888.610.7664 www.calcert.com sales@calcert.com

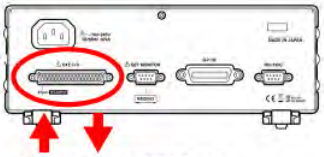
External Control Chapter 8

The EXT. I/O connector on the rear of the instrument supports the external control by providing signals for the end-of-measurements and comparator judgment signals, and by accepting the input of the measurement trigger and key-lock signals.
All signals are isolated by optocouplers. (inputs and outputs share a common signal ground.)

Confirm input and output ratings, understand the safety precautions for connecting a control system, and use accordingly.

Connect the EXT. I/O connector of this instrument with the signal output or input device

Setting the Instrument (p. 107)



Signal input/output

8.1 Ext. I/O Connectors and Signals

⚠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.**
- **During operation, a disconnected wire coming in contact with another conductive object may cause a serious hazard. Make sure that the connections are secure and use screws to secure the external connectors.**
- **Properly insulate any devices and instruments to be connected to the EXT. I/O connector.**

⚠CAUTION

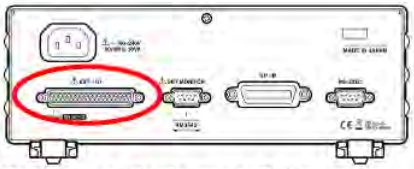
To avoid damage to the instrument, observe the following cautions:

- Do not apply voltage or current to the EXT. I/O connectors 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. 98)

1.888.610.7664 www.calcert.com sales@calcert.com

Connector Type and Signal Pinouts



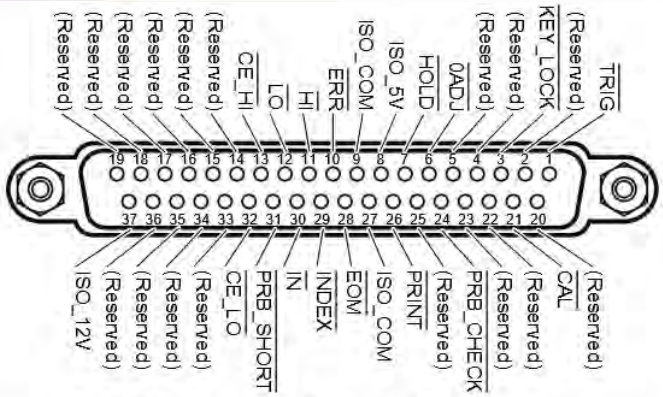
Connector: (Instrument Side)

- 37-pin D-sub female with #4-40 inch screws

Mating Connectors:

- DC-37P-ULR (solder type)
- DCSP-JB37PR (pressure weld type)

Japan Aviation Electronics Industry Ltd.



EXT. I/O Connector (Instrument Side)

Pin	Signal name	I/O	Functions	Logic	
1	$\overline{\text{TRIG}}$	IN	External trigger	Pos/ Neg	Edge
2	(Reserved)	–	–	–	–
3	KEY_LOCK	IN	Key-Lock	Neg	Level
4	(Reserved)	–	–	–	–
5	(Reserved)	–	–	–	–
6	$\overline{\text{0ADJ}}$	IN	Execute zero-adjustment	Neg	Edge
7	$\overline{\text{HOLD}}$	IN	Enable external triggering	Neg	Level
8	ISO_5V	-	Isolated 5 V power output	–	–
9	ISO_COM	-	Isolated common signal ground	–	–
10	$\overline{\text{ERR}}$	OUT	Measurement faults	Neg	Level
11	$\overline{\text{HI}}$	OUT	Comparator judgment result HI	Neg	Level
12	$\overline{\text{LO}}$	OUT	Comparator judgment result Lo	Neg	Level
13	$\overline{\text{CE_HI}}$	OUT	Probe (HI side) contact error	Neg	Level
14	(Reserved)	–	–	–	–
15	(Reserved)	–	–	–	–
16	(Reserved)	–	–	–	–
17	(Reserved)	–	–	–	–
18	(Reserved)	–	–	–	–
19	(Reserved)	–	–	–	–

Pin	Signal name	I/O	Functions	Logic	
20	(Reserved)	–	–	–	–
21	$\overline{\text{CAL}}$	IN	Execute self-calibration	Neg	Edge
22	(Reserved)	–	–	–	–
23	(Reserved)	–	–	–	–
24	$\overline{\text{PRB_CHECK}}$	IN	Probe short-circuit detection Execute	Neg	Edge
25	(Reserved)	–	–	–	–
26	$\overline{\text{PRINT}}$	IN	Print measurement value	Neg	Edge
27	ISO_COM	-	Isolated common signal ground	–	–
28	$\overline{\text{EOM}}$	OUT	End of measurement	Neg	Edge
29	$\overline{\text{INDEX}}$	OUT	Analog measurement finished	Neg	Edge
30	$\overline{\text{IN}}$	OUT	Comparator judgment result IN	Neg	Level
31	$\overline{\text{PRB_SHORT}}$	OUT	Probe short-circuit error	Neg	Level
32	$\overline{\text{CE_LO}}$	OUT	Probe (LO side) contact error	Neg	Level
33	(Reserved)	–	–	–	–
34	(Reserved)	–	–	–	–
35	(Reserved)	–	–	–	–
36	(Reserved)	–	–	–	–
37	ISO_12V	–	Isolated 12 V power output	–	–

Reserved pins are not connected inside the instrument. Do not connect to the reserved pins.

NOTE

- The $\overline{\text{0ADJ}}$ signal should be asserted (Low) for at least 10 ms.
- 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.

1.888.610.7664 www.calcert.com sales@calcert.com

Signal Descriptions

Input Signals

TRIG	When external triggering [EXT] is enabled, one measurement is performed at the falling (ON) or rising (OFF) edge of the TRIG signal. Falling (ON) or rising (OFF) edge triggering can be selected on the Settings screen. (default: falling (ON)) When internal triggering [INT] is enabled, external triggering is disabled. Also, when the Settings Monitor function (p. 61) is enabled and an error occurs, triggering is disabled. The TRIG signal performs the following operations in addition to external triggering. • Stores statistical calculation data (when statistical calculation is enabled) • Stores measured data to internal memory (when the data memory function is enabled) (also operates with internal triggering)	(p. 108)
0ADJ	Changing the 0ADJ signal from High (OFF) to Low (ON) causes one zero-adjustment operation to be performed at the edge of the change. **To avoid a malfunction, this signal should be asserted (Low) for at least 10 ms.**	(p. 36)
PRINT	Changing the PRINT signal from High (OFF) to Low (ON) prints the current measurement value at the edge of the change.	(p. 95)
CAL	Changing the CAL signal from High (OFF) to Low (ON) on the Self Calibration Manual Setting screen executes self calibration at the edge of the change. The time required for self calibration is as follows: Approximately 110 ms (with the 60 Hz line frequency setting), or 130 ms (with the 50 Hz setting) If asserted during measurement, executes after the end of measurement.	(p. 67)
HOLD	While holding the HOLD signal at a low level, set the trigger source to external triggering, [EXT]. When the HOLD signal is high, returns to the settings made on the Settings screen or by commands.	
PRB_CHECK	Changing the PRB_CHECK signal from High (OFF) to Low (ON) executes the probe short-circuit detection at the edge of the change. If asserted during measurement, executes after the specified time from the end of measurement.	(p. 59)
KEY_LOCK	When the KEY_LOCK signal is low (ON), all front panel key operations (excluding the POWER button) are disabled. (Unlocking and remote status cancellation key operations are also disabled.)	(p. 69)

Output Signals

ERR	This signal indicates that a measurement error has occurred (except for out-of-range detection). It is updated simultaneously with the EOM signal. At this time, all comparator judgment result outputs are High (OFF).	(p. 42)
CE_HI	This signal indicates that a contact check error has occurred between the H_{CUR} and H_{POT} contacts. It is updated simultaneously with the EOM signal. At this time, all comparator judgment result outputs are High (OFF).	(p. 52)
CE_LO	This signal indicates that a contact check error has occurred between the L_{CUR} and L_{POT} contacts. It is updated simultaneously with the EOM signal. At this time, all comparator judgment result outputs are High (OFF).	(p. 52)
PRB_SHORT	This signal indicates that a foreign object is shorting the POT and CUR contacts in a four-terminal probe tip. At this time, all comparator judgment result outputs are High (OFF).	(p. 59)
INDEX	This signal indicates that A/D conversion in the measurement circuit is finished. When this signal changes from High (OFF) to Low (ON), you can remove the measuring object from the probe.	

8

1.888.610.7664 www.calcert.com sales@calcert.com

EOM	This signal indicates the end of a measurement. At this time, the states of the comparator judgment outputs and ERR, CE_HI, CE_LO and PRB_SHORT are all determined.	(p. 107)
HI, IN, LO	These are the comparator judgment output signals.	

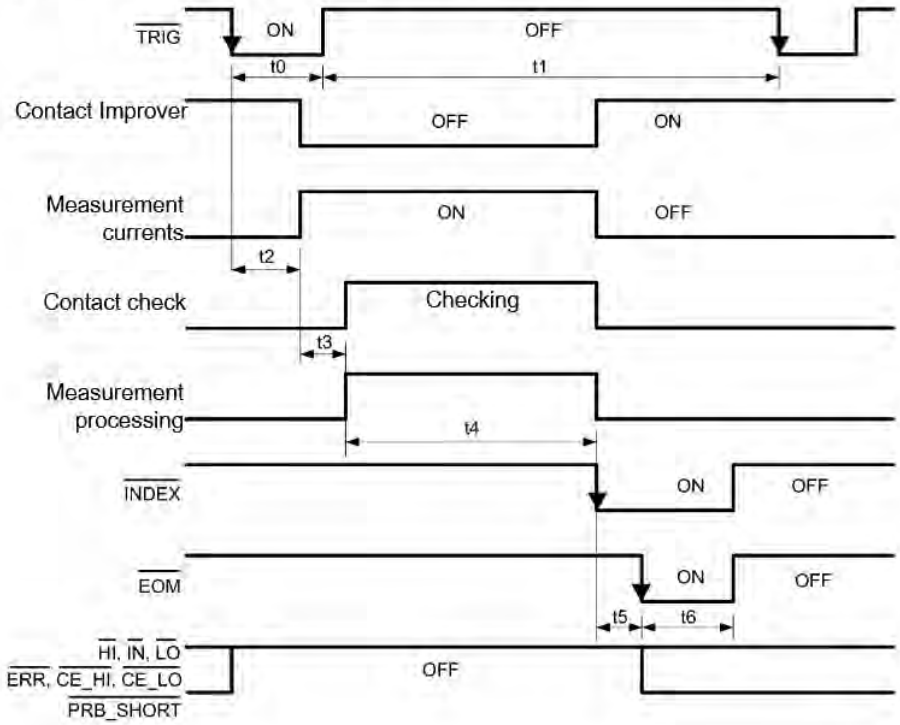
NOTE

- Input signals are ignored when the following are displayed: Basic, Detailed, and Comparator Settings screens; Statistical Calculation Results screen (except for the print signal); and error messages (except for the Setting Monitor errors).
- EXT. I/O input and output signals are not usable while changing the measurement settings.

1.888.610.7664 www.calcert.com sales@calcert.com

8.2 Timing Chart

Each signal level indicates a corresponding voltage level.



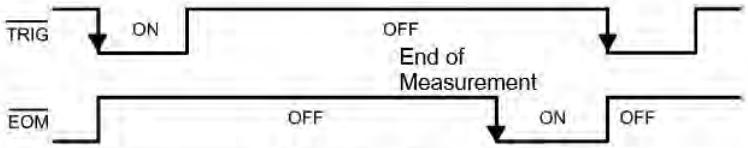
NOTE

- This shows the operations when the trigger source setting is [EXT] and the EOM output setting is Pulse.
- A self calibration measurement (approximately 130 ms) is automatically performed every 10 minutes. (between measurements). During that time, a TRIG signal input is accepted but the corresponding measurement is delayed until self calibration is finished.
- Do not apply a TRIG signal while measuring using external triggering (the signal is ignored).
- When changing settings, such as the measurement range, allow for processing time (approximately 150 ms) before applying a TRIG signal.
- Input signals are ignored when the following are displayed: Basic, Detailed, and Comparator Settings screens; Statistical Calculation Results screen (except for the PRINT signal); and error messages (except for the Setting Monitor errors).
- The INDEX signal OFF timing is the same as that of the EOM signal OFF timing.
- The output of the comparator judgments and error signals are determined before the EOM signal turns ON.
- With internal triggering, [INT], the EOM signal is fixed at High (OFF). Also, comparator judgments and error signals are not de-asserted (OFF) when measurement starts.

8

EOM operation when the EOM Output setting is Hold

At the end of the measurement, the EOM signal is asserted ON.
Until the next TRIG signal is input and measurement starts again, the EOM signal continues to be asserted.



See: "Setting the End-of-Measurement Signal Output (EOM Signal Setting)" (p. 107)

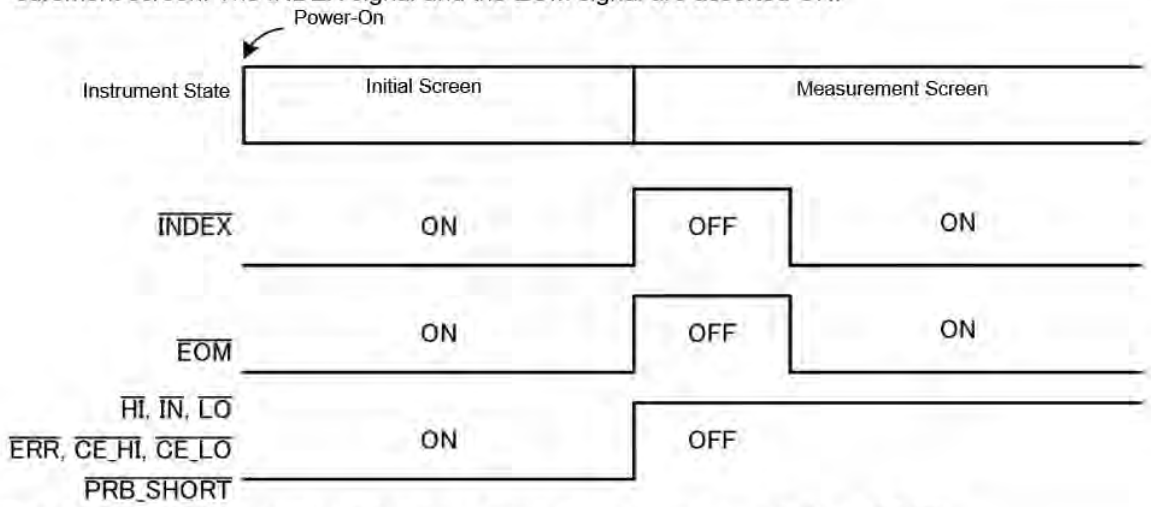
NOTE

When the next measurement is started by accepting the next TRIG signal, the EOM signal is de-asserted (OFF).

1.888.610.7664 www.calcert.com sales@calcert.com

Output Signal State at Power-On

When the power is turned on, all signals are asserted ON.
All output signals become OFF (de-asserted active-low) when changing from the initial screen to the Measurement screen. The INDEX signal and the EOM signal are asserted ON.



This shows the operations when the trigger source is set to an external trigger, [EXT].

Timing Chart Interval Descriptions

Item	Description	Duration	Remarks
t0	Trigger Pulse Asserted (ON) Time	0.1 ms or more	Falling (ON)-/rising (OFF)-edge selectable
t1	Trigger Pulse De-asserted (OFF) Time	0.1 ms or more	
t2	Delay 1	0 to 100 ms	Setting-dependent
t3	Delay 2	0 to 100 ms	Setting-dependent (When the Contact Improver function is set to Pulse, 0.1 ms or 0.3 ms is added)
t4	Measurement time	0.1 to 100 ms	OVC OFF: Integration Time + Internal Delay (see the following table) OVC ON: (Integration Time + Internal Delay) x 2 + Delay2
t5	Calculation time	0.1 ms	When statistical calculation and memory function are ON, calculation time increases.
t6	EOM pulse width	1 to 100 ms	Setting-dependent

1.888.610.7664 www.calcert.com sales@calcert.com

Internal Delay

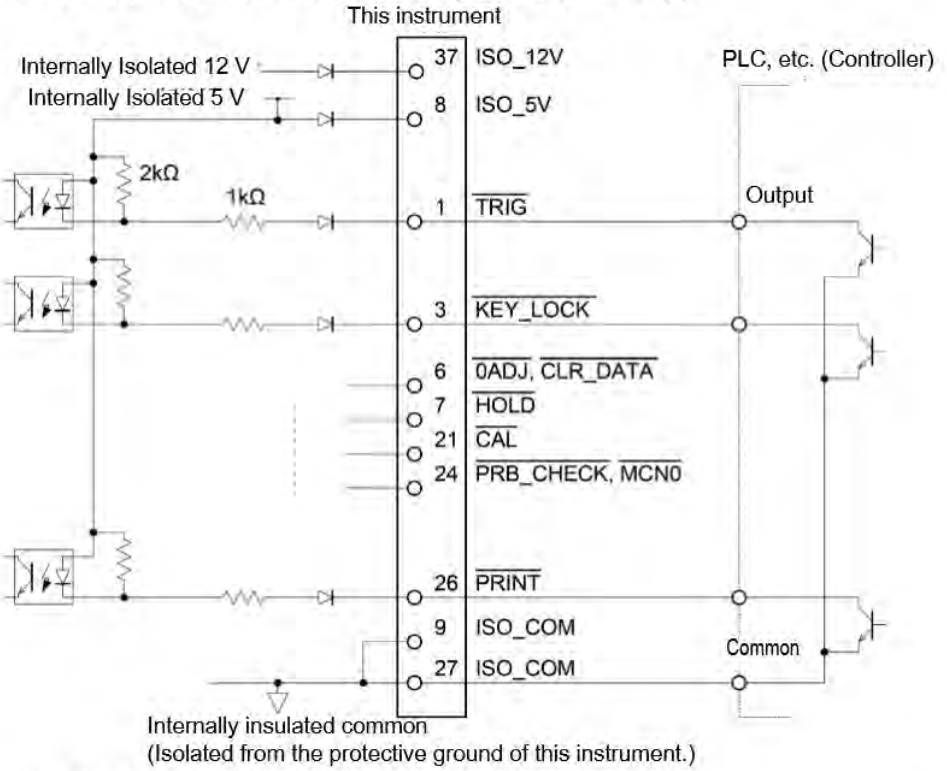
Range	Internal Delay	
	LOW POWER: OFF	LOW POWER: ON
100 mΩ	1.4 ms	–
1000 mΩ	0.7 ms	0.6 ms
3 Ω	0.5 ms	0.6 ms
10 Ω	0.6 ms	0.6 ms
100 Ω	0.6 ms	0.5 ms
300 Ω	0.6 ms	1.3 ms
1000 Ω	0.6 ms	3.3 ms
10 kΩ	0.6 ms	–
30 kΩ	0.6 ms	–
100 kΩ	0.8 ms	–
300 kΩ	0.8 ms	–
1000 kΩ	0.9 ms	–
3 MΩ	0.9 ms	–
10 MΩ	2.7 ms	–
30 MΩ	3.2 ms	–
100 MΩ	5.2 ms	–

Total processing time before and after measurements

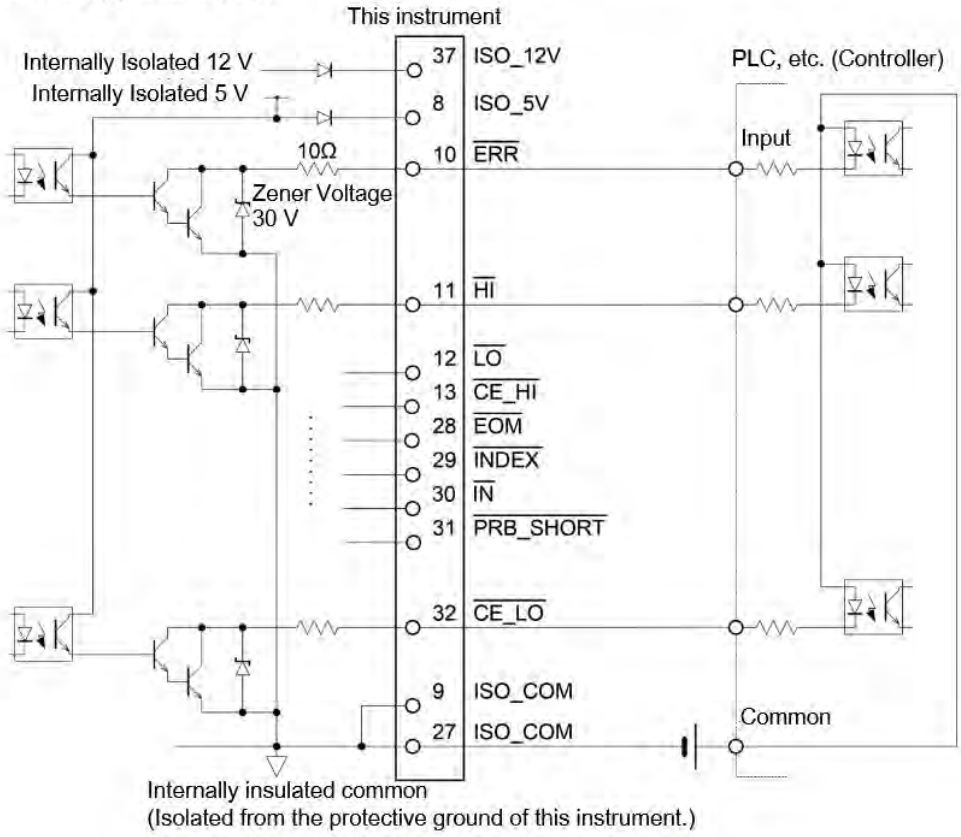
1.888.610.7664 www.calcert.com sales@calcert.com

8.3 Internal Circuitry

Input Circuit Pins 8 and 37 should not be connected to any external power supply.



Output Circuit Do not apply external power



1.888.610.7664 www.calcert.com sales@calcert.com

Electrical Specifications

Input Signals	Input type	Optocoupler-isolated, non-voltage contact inputs (compatible with current sink output, active-low) (negative logic)
	Input ON voltage	1 V or less
	Input 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) (negative logic)
	Maximum load voltage	30 V
	Maximum output current	50 mA/ch
	Residual voltage	1 V (10 mA), 1.5 V (50 mA)
Built-in Isolated Power Supply	**+5 V power output**	
	Output voltage	4.5 to 5.0 V
	Maximum output current	100 mA
	+12 V power output	
	Output voltage	11.0 to 13.0 V
	Maximum output current	20 mA
	External power input	none

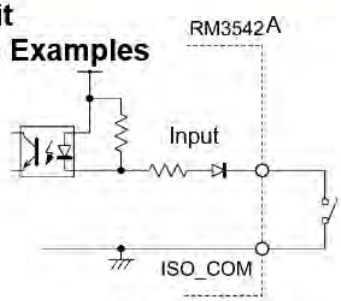
- The values of the maximum output current of +5 V output power and +12 V output power are the respective values when they are used independently.
  Do not take the load simultaneously from each power supply.

8

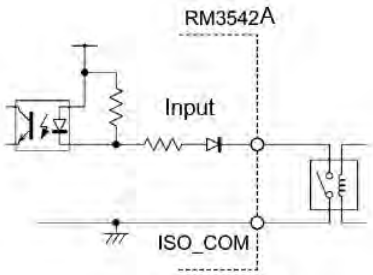
1.888.610.7664 www.calcert.com sales@calcert.com

Connection Examples

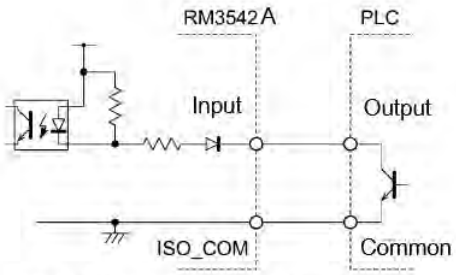
Input Circuit Connection Examples



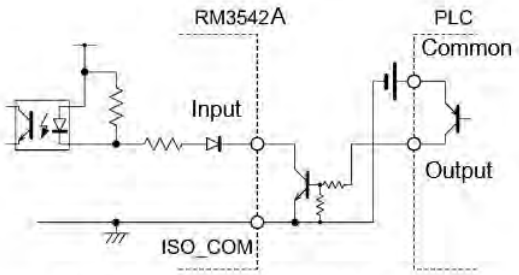
Switch Connections



Relay Connections

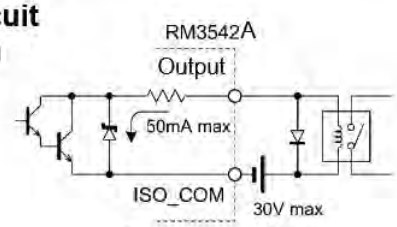


PLC Output (Sink Output) Connections

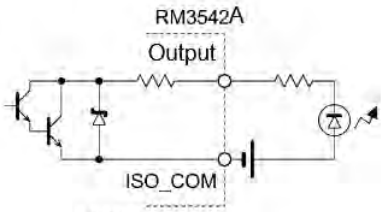


PLC Output (Source Output) Connections

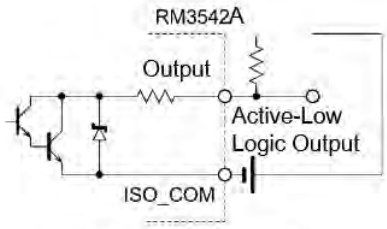
Output Circuit Connection Examples



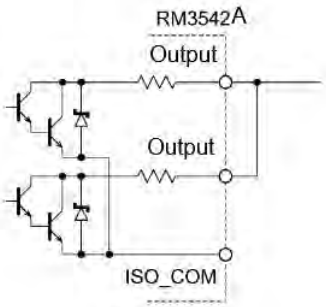
Relay Connections



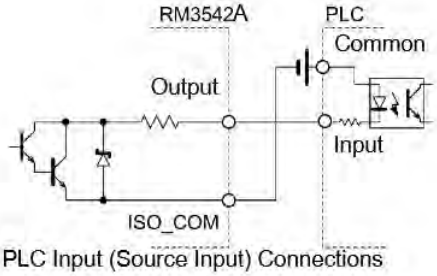
LED Connection



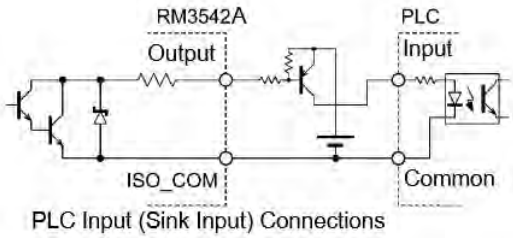
Active-Low Logic Output



Wired OR



PLC Input (Source Input) Connections



PLC Input (Sink Input) Connections

1.888.610.7664 www.calcert.com sales@calcert.com

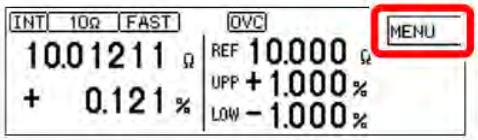
8.4 Ext. I/O Settings

These settings affect the logic of the end-of-measurement and trigger signals.

Setting the End-of-Measurement Signal Output (EOM Signal Setting)

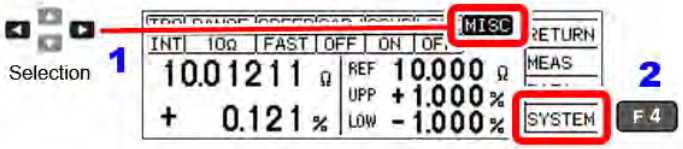
Select whether the EOM (End-of-Measurement Signal) output level is retained until the next trigger input, or set for the specified pulse width.

1 Open the Basic Settings screen.



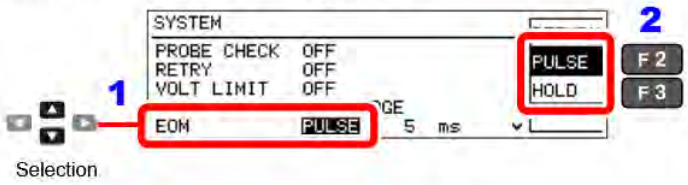
The Basic Settings screen appears.

2 Open the System screen.



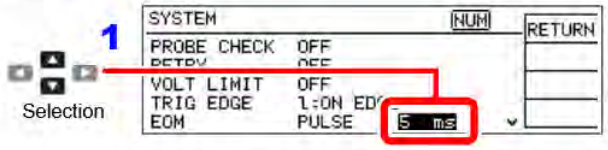
The System screen appears.
[SYSTEM]

3 Select the EOM signal output type.



The specified pulse is outputted after the end-of-measurement (default).
The EOM signal is retained after the end-of-measurement (go to step 5).

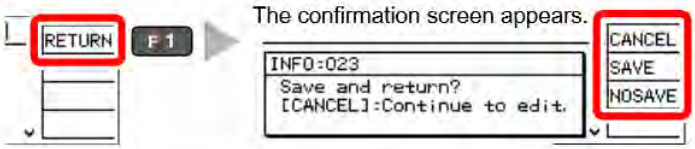
4 (When PULSE is selected)
Set the pulse width.



2 0 .... 9 Setting range: 1 ms to 100 ms (default: 5 ms)

3 ENTER

5 Return to the Measurement screen.



Returns to the setting screen.
Saves setting and return to previous screen.
Discards setting and return to previous screen.

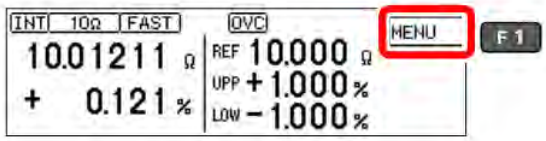
8

1.888.610.7664 www.calcert.com sales@calcert.com

Setting the Trigger Signal (TRIG) Logic

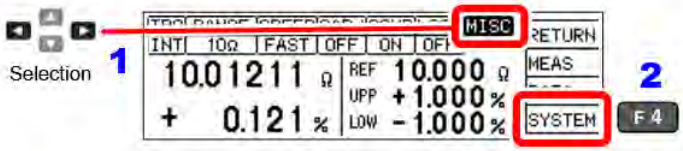
Select whether triggering occurs on the falling (ON) or rising (OFF) edge.

1 Open the Basic Settings screen.



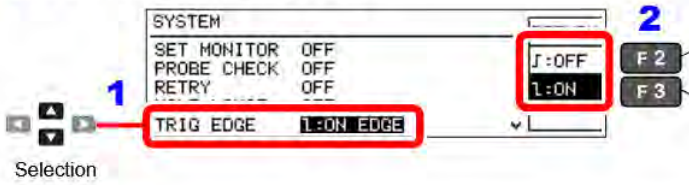
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears.
[SYSTEM]

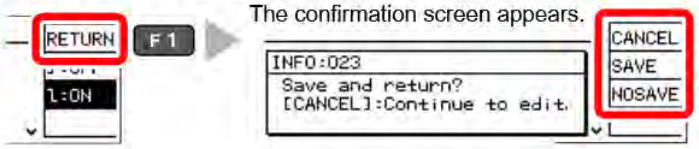
3 Select the triggering logic edge.



Starts the measurement with the rising signal (OFF edge).

Starts the measurement with the falling signal (ON edge) (default settings).

4 Return to the Measurement screen.



Returns to the setting screen.

Saves setting and return to previous screen.

Discards setting and return to previous screen.

1.888.610.7664 www.calcert.com sales@calcert.com

Delaying Judgment Result Output (Judgment Output Shift Function)

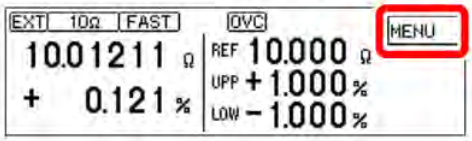
This function allows you to delay output of comparator function judgment results from the EXT. I/O connector for a set cycle count. The comparator judgment results OK (IN signal), NG (HI and LO signals), and measurement error (ERR signal) output signals can be set to be delayed, each for a specified shift count.

See: "Chapter 8 External Control" (p. 97)

When sorting components such as chip resistors, the HI, LO, and ERR signals can be connected in a “wired or” configuration and used as a FAIL component reject control signal. (p. 106)

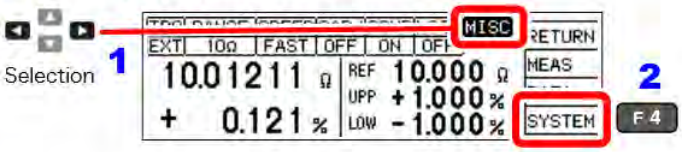
If you wish to perform separate processing for untested components that generate a measurement error, you can change the shift count for the ERR signal and use the ERR signal alone as a separate control signal.

1 Open the Basic Settings screen.



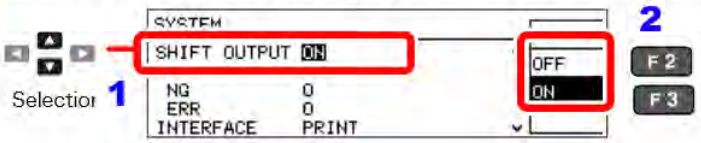
The Basic Settings screen appears.

2 Open the System screen.



The System screen appears. [SYSTEM]

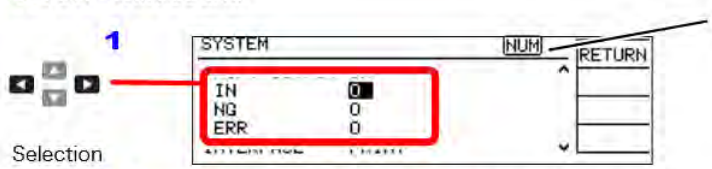
3 Enable the measured value judgment output shift function.



Disable (default settings) (go to step 5)

Enable the function.

4 Set the shift count.

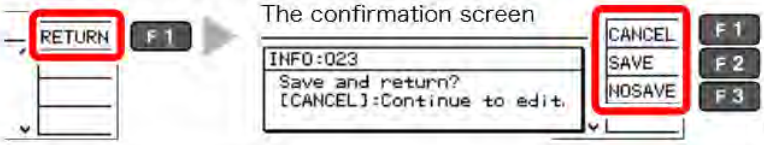


2 [0] · · [9] Setting range: 0 to 99 (default: 0)

3 [ENTER]

1.888.610.7664 www.calcert.com sales@calcert.com

5 Return to the Measurement screen.



Returns to the setting screen.
Saves setting and return to previous screen.
Discards setting and return to previous screen.

NOTE

- When changing the instrument's settings while using the judgment output shift function, add a wait of at least 1 sec. before trigger input.
- If the instrument is set to the free-run state, the judgment output shift function will be disabled automatically.
- The initialization conditions for the judgment output shift function (i.e., the conditions under which the saved judgment results will be deleted) are as follows:
- When the instrument is turned on
- When the shift count is changed
- When the comparator settings are changed
- When judgment output shift initialization is performed via a command
- When the instrument is changed to the free-run state

See: "Trigger" (p. 157)

1.888.610.7664 www.calcert.com sales@calcert.com

8.5 Q&A Regarding External Control

Common Questions	Answers
How do I connect external trigger input?	Short-circuit the $\overline{\text{TRIG}}$ 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.
To confirm output signals	Confirm voltage waveforms with an oscilloscope. To do this, pull up (through several kO) the output pins, such as the $\overline{\text{EOM}}$ and comparator judgment outputs, to the power supply and check the voltage.
I cannot input the (control) properly. How can I confirm it?	For example, if triggering does not operate properly, bypass the PLC and short the $\overline{\text{TRIG}}$ signal directly to an ISO_COM pin. Be careful to avoid power shorts.
Is the comparator judgment signal ($\overline{\text{HI}}$, $\overline{\text{IN}}$, $\overline{\text{LO}}$) retained during measurement (or is it turned OFF)	The state is determined at the end of measurement, and is off once at the start of measurement.
Why would the $\overline{\text{EOM}}$ signal not be detected?	Try using the Pulse setting for the EOM output. When the measurement time is short and the EOM output is set to Hold, the time to de-assert may be too short to be detected by the PLC. When the EOM output is set to Pulse, after the completion of EOM, the signal is asserted (ON) for the specified pulse width and then turned (OFF), therefore the $\overline{\text{EOM}}$ signal can be detected by the PLC even if the time to de-assert is too short.
What situations cause measurement faults to occur?	An error is displayed in the following cases: • A probe is not connected. • A contact is unstable. • A probe or measuring object is dirty or covered by an oxide layer. • Measuring object resistance is much higher than the measurement range.
Is a connector or flat cable for connection provided?	A solder-type connector is supplied. The cable must be prepared at the user's side.
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.)
Is it possible to use the communication of RS-232C and the EXT. I/O control simultaneously?	After setting up measurement conditions with the communications interface, 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 EXT. I/O input and output signals all operate from an internal, isolated power source. Therefore, power must not be supplied from the PLC side (prohibited).
I want to acquire a measurement value using the foot switch while free-running.	The software for acquiring measurement values is available for download from our website for free. Please use the software.

1.888.610.7664 www.calcert.com sales@calcert.com

8.6 Supplied Connector Assembly

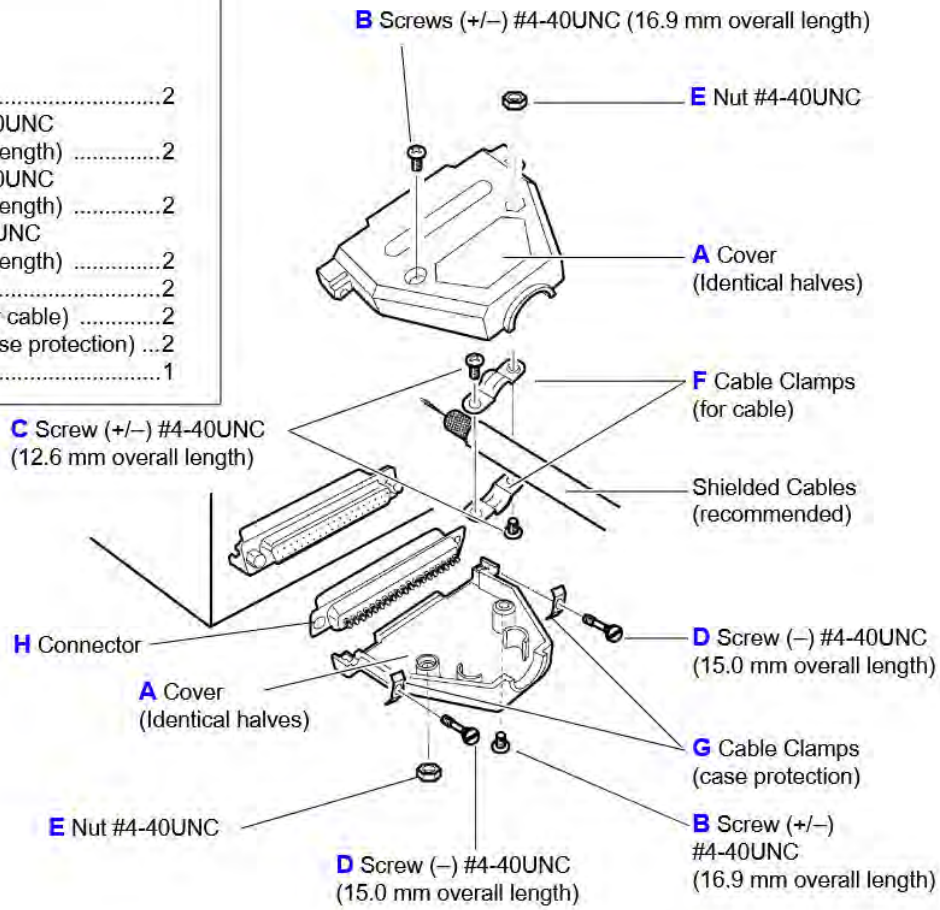
The EXT. I/O connector and cover are supplied with the instrument. Assemble as shown below.

NOTE

- Use shielded cables to connect a PLC to the EXT. I/O connector.
  Using non-shielded conductors may result in system errors from electrical noise.
- Connect the shield to the ISO_COM pin of the EXT. I/O connector.

Required tools:
- Screwdriver
- Shielded cable
- Soldering iron

Accessories
- **A** Cover 2
- **B** Screws (+/-) #4-40UNC (16.9 mm overall length) 2
- **C** Screws (+/-) #4-40UNC (12.6 mm overall length) 2
- **D** Screws (–) #4-40UNC (15.0 mm overall length) 2
- **E** Nuts #4-40UNC 2
- **F** Cable Clamps (for cable) 2
- **G** Cable Clamps (case protection) ...2
- **H** Connector 1



Assembly Sequence

1. Solder the (shielded) cable wires to the supplied EXT. I/O connector (H) pins.
2. Affix the cable clamps (F) on the cable with screws (C).
3. Position the cable clamps (F) to fit properly inside the cover (A).
4. Insert screws (D) through the saddle washers (G).
5. In one half of cover (A), place connector (H), clamps (F), saddle washers (G) and screws (D).
6. Place the other half of cover (A) on top.
7. Affix the halves of the cover (A) together with screws (B) and nuts (E).
   Be careful not to overtighten the screws, which could damage the covers.

1.888.610.7664 www.calcert.com sales@calcert.com

Communications (RS-232C/ GP-IB Interface) Chapter 9

The symbols shown below indicate that the following instructions are specific to theRS-232C or GP-IB interface. Instructions without these symbols are for both the RS-232C and GP-IB interfaces.
RS-232C : RS-232C only
GP-IB : GP-IB only

Before communication

- Always make use of the connector screws to fix the GP-IB or RS-232C connectors.
- When issuing commands that contain data, make certain that the data is provided in the specified format.
- External command operation is not guaranteed when the Printer is selected as the interface type. In this case, commands should not be sent.

Connecting (p. 115)
Connect the instrument and controller with a GP-IB or RS-232C Interface Cable

Communications Protocol Settings (p. 117)
GP-IB Entering an address
RS-232C Set the instrument to the same communications protocol as the controller
Select the transmission format

9.1 Overview and Features of Interfaces

The instrument can be controlled by GP-IB or RS-232C. Instrument settings can also be reset.
RS-232C The measurement values can be printed by connecting the instrument to commercially available printers with a serial interface. (p. 91)

GP-IB IEEE 488.2-1987 standard (required) commands can be used.
- Applicable standard IEEE 488.1-1987*1
- Reference Standard IEEE 488.2-1987*2

If the output queue becomes full, a query error is generated and the output queue is cleared. Therefore, clearing the output queue and query error output *3from the deadlocked condition as defined in IEEE 488.2 is not supported.
For details about the communications commands, see "Message Format" (p. 121) and "Message Reference Interpretation" (p. 138).

*1. ANSI/IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation (ANSI/IEEE Standard 488.1-1987. Programmable measuring device digital interface based on the IEEE Standard)
*2. ANSI/IEEE Standard 488.2-1987, IEEE Standard Codes, Formats, Protocols, and Common Commands (ANSI/IEEE Standard 488.2-1987.Code, format, protocol and standard commands based on the IEEE Standard)
*3. The situation in which the input buffer and the output queue become full, so that processing cannot continue.

1.888.610.7664 www.calcert.com sales@calcert.com

9.2 Specifications

Precautions for use	RS-232C and GP-IB communications cannot be used simultaneously.

RS-232C Specifications

Transfer method	Communication method: Full duplex Synchronization: Start-stop synchronization
Transmission speed	9600 bps/ 19200 bps/ 38400 bps
Data length	8 bit
Parity	none
Stop bit	1 bit
Message terminator (delimiter)	When receiving: CR+LF/ CR When transmitting: CR+LF
Flow control	none
Electrical specification	Input voltage levels5 to 15 V: ON, -15 to -5 V: OFF Output voltage levels 5 to 9 V: ON, -9 to -5 V: OFF
Connector	RS-232C Interface Connector Pinout (Male 9-pin D-sub, with #4-40 attachment screws) The I/O connector is in the DTE (Data Terminal Equipment) configuration. Recommended cables: Model 9637 RS-232C Cable (for PC) Model 9638 RS-232C Cable (for the 25-pin D-sub connector)

Operating Code: ASCII codes

GP-IB Specifications (Interface Functions) (RM3542-51 only)

SH1	All Source Handshake functions	●
AH1	All Acceptor Handshake functions	●
T6	Basic talker functions	●
	Serial poll functions	●
	Talk-only mode	–
	The talker cancel function based on MLA (My Listen Address)	●
L4	Basic listener functions	●
	Listen-only mode	–
	The listener cancel function based on MTA (My Talk Address)	●
SR1	All Service Request functions	●
RL1	All Remote/Local functions	●
PP0	Parallel Poll functions	–
DC1	All Device Clear functions	●
DT1	All Device Trigger functions	●
C0	No Controller functions	–

Operating Code: ASCII codes

1.888.610.7664 www.calcert.com sales@calcert.com

9.3 Connecting

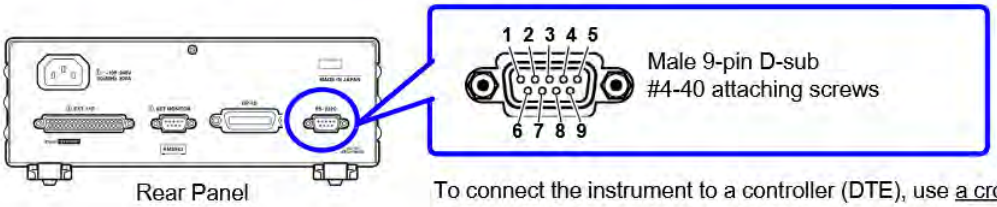
⚠WARNING **Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.**

⚠CAUTION

- To avoid damage to the instrument, do not short-circuit the terminal and do not input voltage to the terminal.
- If the connectors are not securely mated, the operation may fail to meet the specifications, and could result in damage.

Using the RS-232C Interface

Connect the RS-232C cable to the RS-232C connector.



Rear Panel

To connect the instrument to a controller (DTE), use a crossover cable compatible with the connectors on both the instrument and the controller.
The I/O connector is in the DTE (Data Terminal Equipment) configuration.
This instrument uses pins 2, 3, and 5 only. The other pins are not used.

Pin Number	Signal Name			Signal	Remarks
	Code Addr.	EIA	JIS		
1	DCD	CF	CD	Carrier Detect	Not used
2	RxD	BB	RD	Receive Data	
3	TxD	BA	SD	Transmit Data	
4	DTR	CD	ER	Data Terminal Ready	Active (ON) level is +5 to +9 V (constant)
5	GND	AB	SG	Signal Ground	
6	DSR	CC	DR	Data Set Ready	Not used
7	RTS	CA	RS	Request to Send	Active (ON) level is +5 to +9 V (constant)
8	CTS	CB	CS	Clear to Send	Not used
9	RI	CE	CI	Ring Indicator	Not used

1.888.610.7664 www.calcert.com sales@calcert.com

Connecting the instrument to a PC

Use a crossover cable with female 9-pin D-sub connectors at both ends.

Crossover Wiring

Female 9-pin D-sub Instrument connector		Female 9-pin D-sub PC/AT-end	
	Pin No.	Pin No.	
DCD	1	1	DCD
RxD	2	2	RxD
TxD	3	3	TxD
DTR	4	4	DTR
GND	5	5	GND
DSR	6	6	DSR
RTS	7	7	RTS
CTS	8	8	CTS
	9	9	

Recommended cables: Hioki Model 9637 RS-232C Cable (1.8 m)

Connecting a controller with a 25-pin D-sub female port

Use a crossover cable with a female 9-pin D-sub and a male 25-pin D-sub connector.
As shown in the figure, use a crossover cable in which the RTS and CTS pins are shorted together and connected to the DCD connector of the instrument.

Crossover Wiring

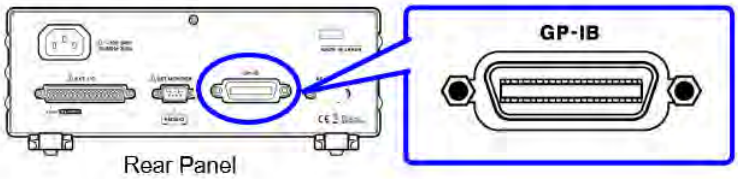
Female 9-pin D-sub This instrument side		Male 25-pin D-sub PC end	
	Pin No.	Pin No.	
DCD	1		
RxD	2	2	TxD
TxD	3	3	RxD
DTR	4	4	RTS
GND	5	5	CTS
DSR	6	6	DSR
RTS	7	7	GND
CTS	8	8	DCD
	9	20	DTR

Note that the combination of a dual male 25-pin D-sub cable and a 9- to 25-pin adapter cannot be used.

Recommended cables: Hioki Model 9638 RS-232C Cable

Using the GP-IB Interface (RM3542-51 only)

Connect the GP-IB cable to the GP-IB connector.



Rear Panel

Recommended cable
9151-02 GP-IB Connector Cable (2 m)

1.888.610.7664 www.calcert.com sales@calcert.com

9.4 Configuring the Communications Protocol

Configuring RS-232C Interface Communications Protocol

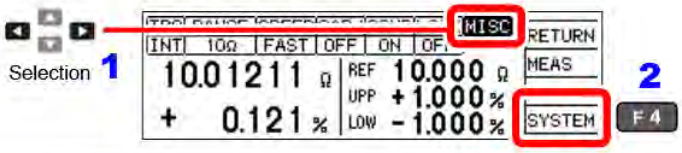
Configure the interface on the System screen.
External command operation is undetermined when the Printer is selected as the interface type. In this case, commands should not be sent.

Make these instrument settings.

1 Open the Basic Settings screen.

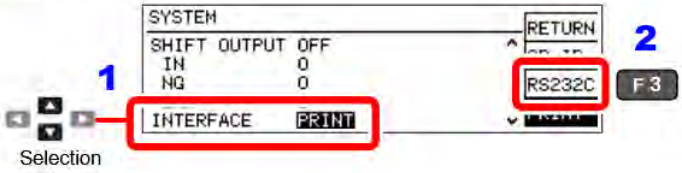
The Basic Settings screen appears.

2 Open the System screen.



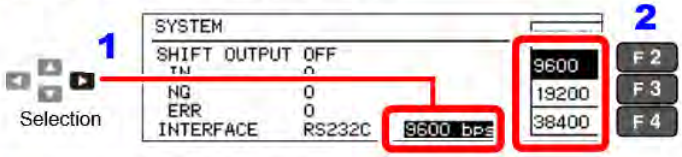
The System screen appears.
[SYSTEM]

3 Select the interface type.



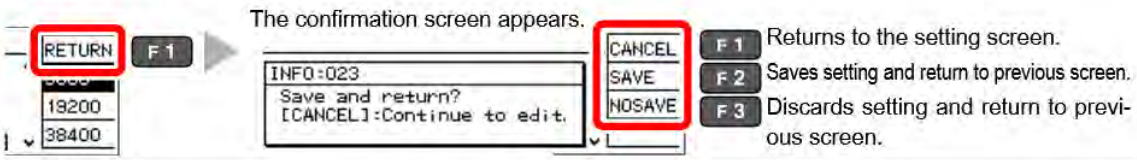
RS-232C Interface

4 Select the interface transfer rate.



9600 (bps) (default)
19200 (bps)
38400 (bps)

5 Return to the Measurement screen.



Returns to the setting screen.
Saves setting and return to previous screen.
Discards setting and return to previous screen.

Configure the Controller (PC or PLC).

Be sure to set the controller as shown below.

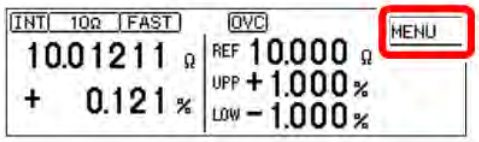
- Start-stop synchronization method
- Transmission Speed: 9600bps/ 19200bps/ 38400bps
  (Set it to match the setting of this instrument.)
- Stop bit: 1
- Data length: 8
- Parity check: none

1.888.610.7664 www.calcert.com sales@calcert.com

Configuring the GP-IB Interface Communication Protocol (RM3542-51 only)

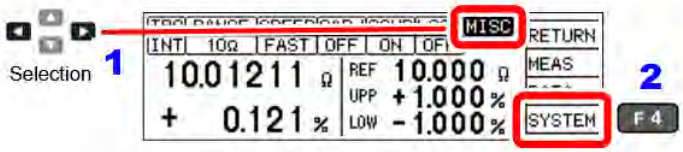
Set the GP-IB address and message terminator on the System screen.

1 Open the Basic Settings screen.



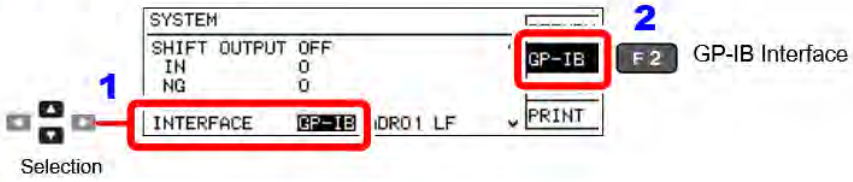
The Basic Settings screen appears.

2 Open the System screen.



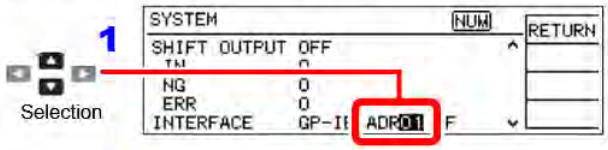
The System screen appears.
[SYSTEM]

3 Select the interface type.



GP-IB Interface

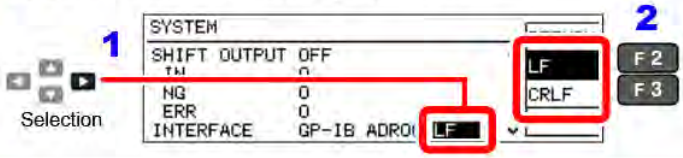
4 Select the instrument's address.



2 0 ---- 9 From 0 to 30 (default: 1)

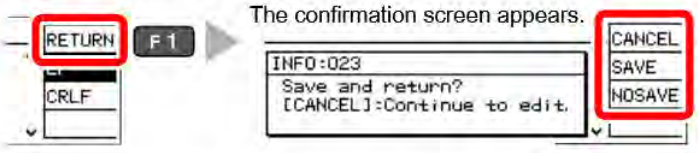
3 ENTER

5 Select the interface message terminator.



LF (default)
CRLF

6 Return to the Measurement screen.



F1 Returns to the setting screen.
F2 Saves setting and return to previous screen.
F3 Discards setting and return to previous screen.

NOTE "GP-IB" is displayed only for RM3542-51 which is equipped with GP-IB.

1.888.610.7664 www.calcert.com sales@calcert.com

Set the Measurement Value Transmission format (common for RS-232C and GP-IB)

Use the communications commands to set the measurement value transmission format to text or binary.

See: ":SYSTem:FORMat <ASCii/ BINary>" (p. 154)

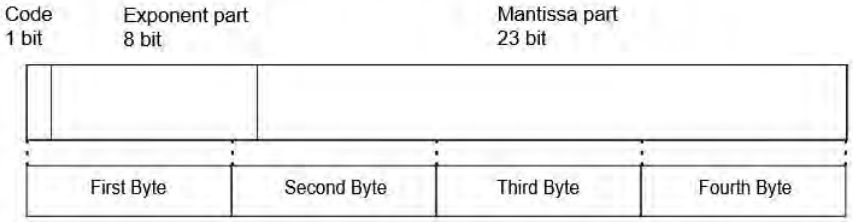
This setting applies only to the data to be sent in response to the following query messages.

- **:FETCh?**
- **:READ?**
- **:MEMory:DATA?**

It also applies to data output sent by the data output functions.

Binary Data Format

Binary data is in the IEEE single-precision (32-bit) floating-point format.



Binary data is sent in four-byte sequences beginning with the first byte (which includes the sign bit).

Responses to queries that return a single value, such as **:FETCh?**, the floating-point binary data of measurement values are transmitted as 4-bytes. The delimiter is not sent.

example
Transmit **:FETCh?** + (Delimiter)
Receive (4-byte floating-point data)

In case of data with multiple values such as memory data, the delimiter (,) is not transmitted and only the binary data is transmitted continuously.

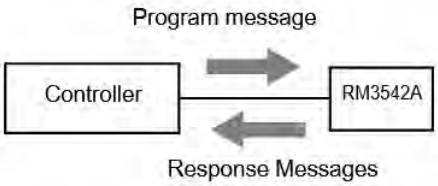
example
Transmit **:MEMory:DATA?** + (Delimiter)
Receive (4-byte floating-point data) + (4-byte floating-point data)+ ... + (4-byte floating-point data)

1.888.610.7664 www.calcert.com sales@calcert.com

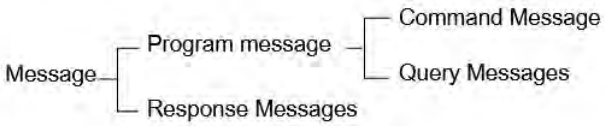
9.5 Communication Methods

Various messages are available for controlling the instrument through the interfaces.

Messages can be either program messages sent from the controllers such as PC's, to the instrument, or response messages sent from the instrument to the controllers.



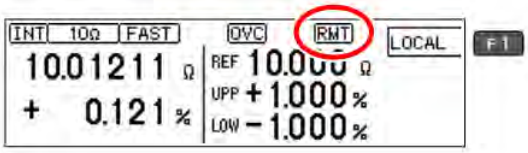
Message types are further categorized as follows



When issuing commands that contain data, make certain that the data is provided in the specified format.

To Cancel the Remote Status (Enter the Local Status)

During remote control operation, **RMT** appears on the Measurement screen, and all operation keys except the F1 key are disabled.
Pressing the **F1 [LOCAL]** key disables remote control and re-enables the operating keys.



In the local lockout state (GP-IB command LLO: Local Lock Out (p. 130)), selecting the [LOCAL] display on the screen is disabled.
In this state, send the GTL command, or turn the instrument off and back on to re-establish local control.
If the Setting screen was displayed when remote control was enabled, the instrument returns to the Measurement screen automatically.

1.888.610.7664 www.calcert.com sales@calcert.com

Message Format

Program Messages

Program messages can be either Command Messages or Query Messages.

(1) Command Message

Instructions to control the instrument, such as to change settings or reset

Example: instructions to set the measurement range

```
:RESistance:RANGe 100E3
```

Header portion Space Data portion

(2) Query Messages

Requests for responses relating to the results of the operation or measurement, or the status of the instrument settings.
Example: (request for the current measurement range)

```
:RESISTANCE:RANGE?
```

Header portion Question Mark

For details:

See: "Headers" (p. 122), "Separators" (p. 123),"Data Formats" (p. 123)

Response Messages

When a query message is received, its syntax is checked and a response message is generated.
The "`:SYSTem:HEADer`" command determines whether headers are affixed to response messages.

Header ON `:RESISTANCE:RANGE 100.000E+03`
Header OFF `100.000E+03`
(The current resistance measurement range is100 kΩ.)

During power-on, Header OFF is selected.
If an error occurs when a query message is received, no response message is generated for that query.
Header is not added to commands used only for queries, such as `:FETCh?` and `:CALCulate:LIMit:RESult?`

Command Syntax

Command names are chosen to mnemonically represent their function, and can be abbreviated. The full command name is called **"long form"**, and the abbreviated name is called the **"short form"**.
The commands in this manual are denoted using capital letters for the short form, and small letters for the long form, although the commands are not case-sensitive in actual usage.

`FUNCTION`	OK (long form)
`FUNC`	OK (short form)
`FUNCT`	Error
`FUN`	Error

Response messages generated by the instrument are in **long form and in capital letters**.

1.888.610.7664 www.calcert.com sales@calcert.com

■ Headers

Headers must always be added to program messages.

(1) Command Program Headers

There are three types of commands: Simple, Compound and Standard.

- **Headers for Simple Commands**
  This header is a single word starting with an English alphabet.
  `:ESE 0`
- **Headers for Compound Commands**
  These headers consist of multiple simple command headers separated by colons ":".
  `:SAMPle:RESet`
- **Headers for Standard Commands**
  This header type begins with an asterisk "*",
  indicating that it is a standard command defined by IEEE 488.2.
  `*RST`

(2) Query Program Header

These commands are used to interrogate the instrument for the results of the operations, measurement values and the current status of instrument settings.
As shown in the following examples, a query has a question mark "?"

`:FETCh?`

`:CALCulate:LIMit:REFerence?`

NOTE Characters enclosed by square brackets [ ] may be omitted.

`[:SENSe:]FUNCtion` ⟶ `:SENSe:FUNCtion` / `:FUNCtion` Either form is valid

■ Message Terminators

This instrument recognizes the following message/terminators (delimiters):

GP-IB
- LF
- CR+LF
- EOI
- LF with EOI

RS-232C
- CR
- CR+LF

From the instrument's interface settings, the following can be selected as the terminator for response messages.

GP-IB
- LF with EOI (initial setting)
- CR+LR with EOI

RS-232C
- CR+LF

See: "Delimiter Setting" (p. 152)

1.888.610.7664 www.calcert.com sales@calcert.com

Separators

(1) Message Unit Separator

Multiple message can be written in one line by separating them with semicolons ";"

```
:SYSTem:LFRequency 60;*IDN?
```

- When messages are combined in this way and if one command contains an error, all subsequent messages up to the next terminator will be ignored.
- A query error occurs if a query command is combined with an immediately following semicolon and subsequent command.

(2) Header Separator

In a message consisting of both a header and data, the header is separated from the data by a space " " (ASCII code 20H).

```
:SYSTem:HEADer OFF
```

(3) Data Separator

In a message containing multiple data items, commas are required to separate the data items from one another.

```
:CALCulate:LIMit:ABS 1.00035,0.99965
```

Data Formats

The instrument uses "Character Data" and "Decimal value data", distinguished based on the command.

(1) Character Data

Always starts with an English alphabets and consists of alphabets and numbers. Character data is not case-sensitive, although the response messages from the instrument are only in capital letters.

```
SYSTem:HEADer OFF
```

(2) Decimal Numeric Data

Three formats are used for numeric data, identified as NR1, NR2 and NR3. Numeric values may be signed or unsigned. Unsigned numeric values are handled as positive values.
Values exceeding the precision handled by the instrument are rounded to the nearest valid digit.

- NR1 Integer data(e.g.: +12, -23, 34)
- NR2 Fixed-point data(e.g.: +1.23, -23.45, 3.456)
- NR3 Floating-point exponential representation data (e.g.: +1.0E-2, -2.3E+4)

Formats which include these three types are called "NRf format".
The instrument accepts NRf format data.
The format of response data is specified for each command, and the data is sent in that format.

```
:ESE0 106
:FETCh?
+106.571
```

GP-IB The instrument does not fully support IEEE 488.2. As much as possible, please use the data formats shown in the Reference section.
Also, avoid constructing single commands that could overflow the input buffer or output queue.

1.888.610.7664 www.calcert.com sales@calcert.com

Compound Command Header Omission

When several commands having a common header are combined to form a compound command (e.g.,`:CALCulate:LIMit:REFerence` and `:CALCulate:LIMit:PERCent`), if they are written together in sequence, the common portion (here, `:CALCulate:LIMit:`) can be omitted after its initial occurrence.
This common portion is called the "current path" and, until it is cleared, the interpretation of subsequent commands assumes that they share the same common portion (in which the "current path" has been omitted).

This usage of the current path is shown in the following example:

Full expression

```
:CALCulate:LIMit:REFerence
1.0E+3;:CALCulate:LIMit:PERCent 1.0,-1.5
```

Compacted expression

```
:CALCulate:LIMit:REFerence 1.0E+3;PERCent 1.0,-1.5
```

This portion becomes the current path, and can be omitted from the messages immediately following.

The current path is cleared when the power is turned on, when reset by key input, by a colon ":" at the start of a command, and when a message terminator is detected.
Standard command messages can be executed regardless of the current path.
They have no effect upon the current path.

A colon ":" is not required at the start of the header of a Simple or Compound command. However, to avoid confusion with abbreviated forms and operating mistakes, we recommend that a colon is always placed at the start of a header.

Output Queue and Input Buffer

Output Queue

Response messages are stored in the output queue until read by the controller and then cleared. The output queue is also cleared in the following cases:

- Power on
- Device clear GP-IB
- Query error

The output queue capacity of the instrument is 64 bytes. If response messages overflow the buffer, a query error is generated and the output queue is cleared.
Also, with GP-IB, if a new message is received while data remains in the output queue, the output queue is cleared and a query error is generated.

Input Buffer

The input buffer capacity of the instrument is 256 bytes.
If 256 bytes are accumulated in the buffer and it becomes full, the GP-IB interface bus enters the waiting state until space is cleared in the buffer.
The RS-232C interface cannot accept data beyond 256 bytes.

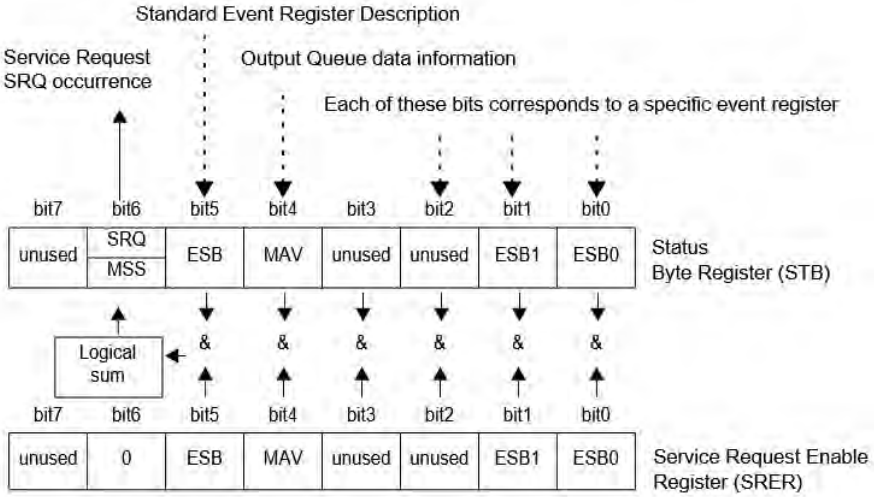
NOTE **Ensure that the commands are maintained below 256 bytes.**

1.888.610.7664 www.calcert.com sales@calcert.com

Status Byte Register

GP-IB

This instrument implements the status model defined in IEEE 488.2 for the serial poll function using the service request line.
The term "event" refers to any occurrence that generates a service request.



Overview of Service Request Occurrence

The Status Byte Register contains information about the event registers and the output queue. Required items are selected from this information by masking with the Service Request Enable Register. When any bit selected by the mask is set, bit 6 (MSS; the Master Summary Status) of the Status Byte Register is also set, which generates an SRQ (Service Request) message and dispatches a service request.

NOTE

SRQ (Service Request) is a GP-IB function only.
However, STB (Status Byte Register) information can be acquired with RS-232C using the ***STB?** command.

9

RS-232C

RS-232C does not provide a function for issuing service requests. However, SRER setup and STB reading are enabled.

1.888.610.7664 www.calcert.com sales@calcert.com

Status Byte Register (STB)

During serial polling, the contents of the 8-bit Status Byte Register are sent from the instrument to the controller.
When any Status Byte Register bit enabled by the Service Request Enable Register has switched from 0 to 1, the MSS bit becomes 1. Consequently, the SRQ bit is set to 1, and a service request is dispatched.

The SRQ bit is always synchronous with service requests, and is read and simultaneously cleared during serial polling. Although the MSS bit is only read by an ***STB?** query, it is not cleared until a clear event is initiated by the ***CLS** command.

Bit 7		unused
Bit 6	**SRQ**	Set to 1 when a service request is dispatched.
	MSS	This is the logical sum of the other bits of the Status Byte Register.
Bit 5	**ESB**	Standard Event Status (logical sum) bit This is the logical sum of the Standard Event Status Register.
Bit 4	**MAV**	Message available Indicates that a message is present in the output queue.
Bit 3		unused
Bit 2		unused
Bit 1	**ESB1**	Event Summary (logical sum) bit 1 This is the logical sum of Event Status Register 1.
Bit 0	**ESB0**	Event Summary (logical sum) bit 0 This is the logical sum of Event Status Register 0.

Service Request Enable Register (SRER)

This register masks the Status Byte Register. Setting a bit of this register to 1 enables the corresponding bit of the Status Byte Register to be used.

1.888.610.7664 www.calcert.com sales@calcert.com

Event Registers

Standard Event Status Register (SESR)

The Standard Event Status Register is an 8-bit register.
If any bit in the Standard Event Status Register is set to 1 (after masking by the Standard Event Status Enable Register), bit 5 (ESB) of the Status Byte Register is set to 1.

See: "Standard Event Status Register (SESR) and Standard Event Status Enable Register (SESER)" (p. 128)

The Standard Event Status Register is cleared in the following situations:

- When a "***CLS**" command is executed
- When an event register query (***ESR?**) is executed
- When the instrument is powered on

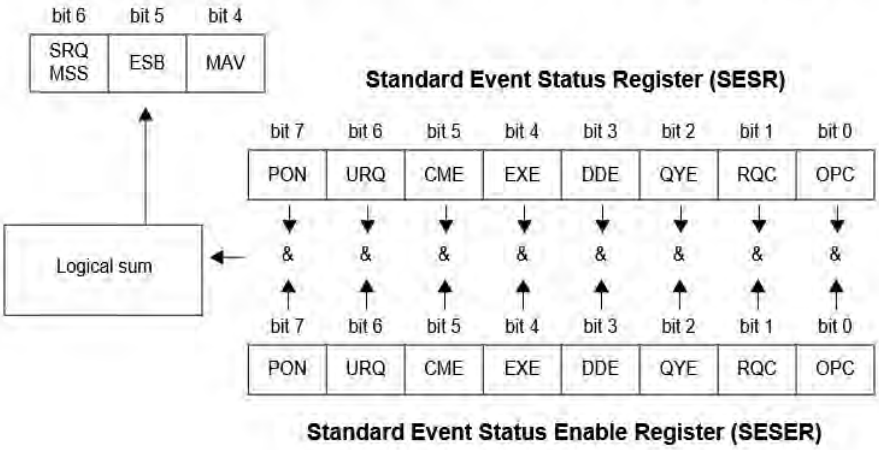
Bit 7	PON	**Power-On Flag** Set to 1 when the power is turned on, or upon recovery from an outage.
Bit 6	URQ	**User Request** unused
Bit 5	CME	**Command error (The command to the message terminator is ignored.)** This bit is set to 1 when a received command contains a syntactic or semantic error: • Program header error • Incorrect number of data parameters • Invalid parameter format • Received a command not supported by the instrument
Bit 4	EXE	**Execution Error** This bit is set to 1 when a received command cannot be executed for some reason. • The specified data value is outside of the set range • The specified setting data cannot be set • Execution is prevented by some other operation being performed
Bit 3	(unused) DDE	Not used by this instrument **Device-Dependent Error** This bit is set to 1 when a command cannot be executed due to some reason other than a command error, a query error or an execution error.
Bit 2	QYE	**Query Error (the output queue is cleared)** This bit is set to 1 when a query error is detected by the output queue control. • When an attempt has been made to read an empty output queue (GP-IB only) • When the data overflows the output queue • When data in the output queue has been lost • When the next command is received while there is data in the output queue
Bit 1	RQC (unused)	**Request Control**
Bit 0	OPC	**Operation Complete** This bit is set to "1" in response to an "***OPC**" command. • It indicates the completion of the operations of all messages up to the ***OPC** command.

1.888.610.7664 www.calcert.com sales@calcert.com

Standard Event Status Enable Register (SESER)

Setting any bit of the Standard Event Status Enable Register to 1 enables access to the corresponding bit of the Standard Event Status Register.

Standard Event Status Register (SESR) and Standard Event Status Enable Register (SESER)



Device-Specific Event Status Registers (ESR0 and ESR1)

This instrument provides two event status registers for controlling events.
Each event register is an 8-bit register.

When any bit in one of these event status registers enabled by its corresponding event status enable register is set to 1, the following happens:

- In case of Event Status Register 0:
  Status Byte Register (STB) bit 0 (ESB0) is "1".
- In case of Event Status Register 1:
  Status Byte Register (STB) bit 1 (ESB1) is "1".

Event Status Registers 0 and 1 are cleared in the following situations:

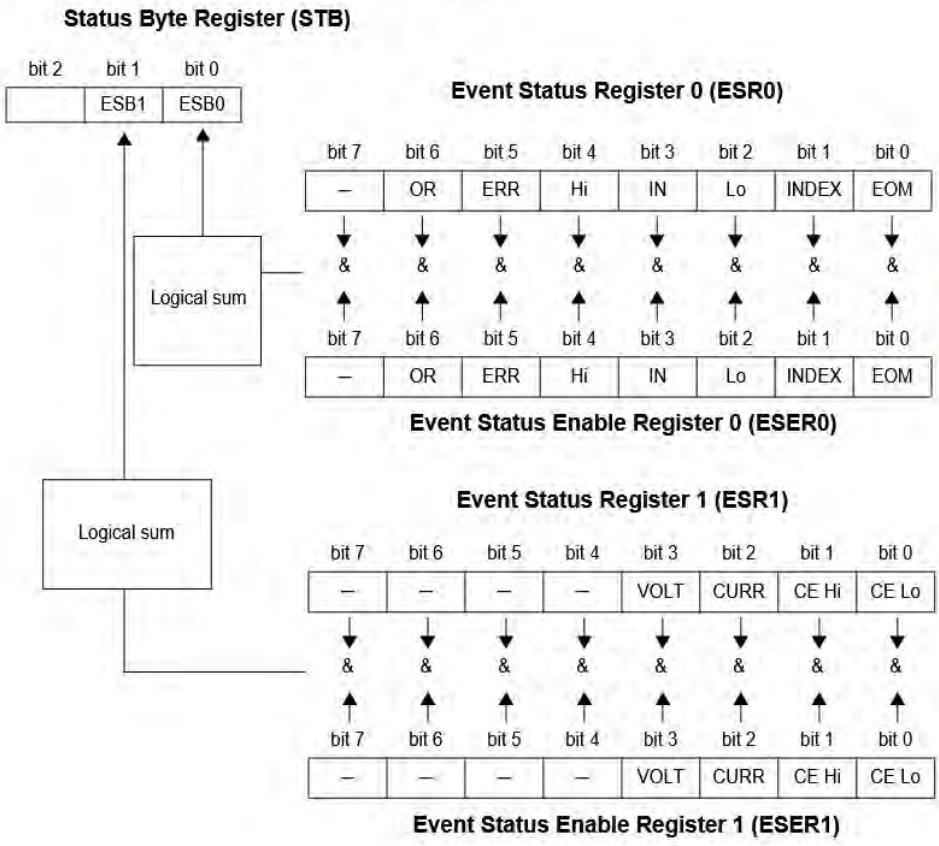
- When a "**`*CLS`**" command is executed.
- When an Event Status Register query is executed.
  (**`:ESR0?`**, **`:ESR1?`**)
- When the instrument is powered on.

1.888.610.7664 www.calcert.com sales@calcert.com

Event Status Register 0 (ESR0)		
Bit 7	–	unused
Bit 6	OvrRng	Out-of-Range Detection Fault
Bit 5	ERR	Measurement faults
Bit 4	Hi	High Comparator Result
Bit 3	IN	IN Comparator Result
Bit 2	Lo	Low Comparator Result
Bit 1	INDEX	A/D Conversion Finished
Bit 0	EOM	End of Measurement

Event Status Register 1 (ESR1)		
Bit 7	–	unused
Bit 6	–	unused
Bit 5	–	unused
Bit 4	–	unused
Bit 3	VOLT	Voltage Monitor fault
Bit 2	CURR	Current Monitor Fault
Bit 1	CE Hi	Contact Check Hi side Fault
Bit 0	CE Lo	Contact Check Lo Side Fault

Event Status Register 0 (ESR0), 1 (ESR1) and
Event Status Enable Register 0 (ESER0), 1 (ESER1)



9

Register Reading and Writing

Register	Read	Write
Status Byte Register	*STB?	–
Service Request Enable Register	*SRE?	*SRE
Standard Event Status Register	*ESR?	–
Standard Event Status Enable Register	*ESE?	*ESE
Event Status Register 0	:ESR0?	–
Event Status Enable Register 0	:ESE0?	:ESE0
Event Status Register 1	:ESR1?	–
Event Status Enable Register 1	:ESE1?	:ESE1

GP-IB Commands

The following commands can be used for performing interface functions.

Command	Description	
GTL	Go To Local	Cancels the Remote state and enters the Local state.
LLO	Local Lock Out	Disables all keys, including the Local (F1) key.
DCL	Device CLear	Clears the input buffer and the output queue.
SDC	Selected Device Clear	Clears the input buffer and the output queue.
GET	Group Execute Trigger	When an external trigger occurs, sampling is processed once.

Initialization Items

Item \ Initialization Method	Power source When powered on	Keys Reset	*RST Command	Device Clear (GP-IB only)	*CLS Command	Factory Default
GP-IB Address	–	1	–	–	–	1
RS-232C setting (communication speed)	–	9600	–	–	–	9600
Device-specific functions (Range, etc.)	–	●	●	–	–	●
Output Queue	●	●	–	●	–	●
Input buffer	●	●	–	●	–	●
Status Byte Register	●	●	–	– *1	●*2	●
Event registers	●*3	●	–	–	●	●
Enable register	●	●	–	–	–	●
Current path	●	●	–	●	–	●
Headers ON/OFF	OFF	OFF	OFF	–	–	OFF
Response message terminator (GP-IB)	LF+EOI	LF+EOI	–	–	–	LF+EOI
Response message separator	;	;	;	–	–	;

*1. Only the MAV bit (bit 4) is cleared.
*2. All bits except the MAV bit are cleared.
*3. Except the PON bit (bit 7).

1.888.610.7664 www.calcert.com sales@calcert.com

Command Execution Time

Command execution time indicates the time for analyzing and processing long form commands.
However, the command execution time for commands with data is the time described according to the data format specified in the <data portion>, and for query commands it is the time when the header is ON.

- Display delays may occur depending on the frequency of communication processes and process contents.
- All commands except *TRG and :INIT are processed sequentially.
- In communications with the controller, time must be added for data transmission.
  GP-IB transfer time depends on the controller.
  The time for the RS-232C transfers for a total of 10 bits (the start bit is 1, the data length is 8, no parity, the stop bit is 1) is shown below.
  9600 bps: approximately 960 characters/s
- Wait until measurements stabilize after a change before using a setting command.

Command	Execution time (except communication time)
*RST	200 ms or less
:FUNCtion :RESistance:RANGe :LPResistance:RANGe :SPEEd :SYSTem:CALibration :RESistance:APERture :LPResistance:APERture :RESistance:NPLCycles :LPResistance:NPLCycles	150 ms or less
:ADJust?	2 s or less
:FETCh?	3 ms or less
:READ?	Measurement time + 3 ms or less
:SYSTem:BACKup	200 ms or less
*TST?	1 s or less
Commands other than those above	10 ms or less

9

Errors During Communications

An error occurs when messages are executed in the following cases:

- **Command Error**
  When message syntax (spelling) is invalid. When the data format in a command or query is invalid.
- **Query error**
  When the response message exceeds 64 bytes.
- **Execution Error**
  When invalid character or numeric data is present.

1.888.610.7664 www.calcert.com sales@calcert.com

9.6 Message List

Commands specific to RS-232C or GP-IB are identified by RS-232C or, GP-IB respectively.

Shared Commands

Message	Data Formats	Description	Ref page
***CLS**		Clears the event registers and the Status Byte Register.	140
***ESE**	0 to 255	Sets the contents of the Standard Event Status Enable Register.	141
***ESE?**	[0 to 255]	Queries the Standard Event Status Enable Register.	141
***ESR?**	[0 to 255]	Queries the Standard Event Status Register.	141
***IDN?**	[<Manufacturer's name>,<Model name>,0,<Software version>]	Queries the Device ID.	139
***OPC**		Requests an SRQ after execution completion.	140
***OPC?**	1	Queries execution completion.	140
***RST**		Initialize Device	139
***SRE**	0 to 255	Sets the Service Request Enable Register.	142
***SRE?**	[0 to 255]	Queries the contents of the Service Request Enable Register.	142
***STB?**	[0 to 255]	Queries the Status Byte Register.	142
***TRG**		Executes one sampling.	142
***TST?**	[0 to 7]	Initiates a self-test and queries the result.	139
***WAI**		Wait for operations to finish.	140

Notes:
- < >: indicates contents of the data portion.
- [ ]: indicates Response data.

1.888.610.7664 www.calcert.com sales@calcert.com

Device-Specific Commands

Message	Data Formats [ ]: Response data.	Description	Ref page
Event registers			
:ESE0	0 to 255	Sets and queries Event Status Enable Register 0.	143
:ESE0?	[0 to 255]		
:ESR0?	[0 to 255]	Reads Device-Specific Event Status Register ESR 0.	143
:ESE1	0 to 255	Sets and queries Event Status Enable Register 1.	143
:ESE1?	[0 to 255]		
:ESR1?	[0 to 255]	Queries Event Status Register 1.	143
Resistance Measurement			
[:SENSe:]FUNCtion	RESistance/ LPResistance	Sets and queries the resistance measurement method.	144
[:SENSe:]FUNCtion?	[RESISTANCE/ LPRESIS-TANCE]		
Measurement ranges			
[:SENSe:]LPResistance:RANGe	0 to 1200	Sets and queries Low-Power Resistance measurement range.	144
[:SENSe:]LPResistance:RANGe?	[1000.00E-3 to 1000.00E+0]		
[:SENSe:]RESistance:RANGe	0 to 120E+6	Sets and queries resistance measurement range.	144
[:SENSe:]RESistance:RANGe?	[100.000E-3 to 100.0000E+6]		
Zero Adjustment			
:ADJust?	[0/ 1]	Executes zero-adjustment.	145
:ADJust:CLEar		Cancels zero-adjustment.	145
Measurement Speed			
:SPEEd	FAST/ MEDium/ SLOW	Sets and queries measurement speed.	145
:SPEEd?	[FAST/ MEDIUM/ SLOW]		
Statistical functions			
:CALCulate:STATistics:STATe	1/ 0/ ON/ OFF	Sets and queries statistical calculation function execution.	146
:CALCulate:STATistics:STATe?	[ON/ OFF]		
:CALCulate:STATistics:CLEar		Clears statistical calculation results.	146
:CALCulate:STATistics:NUMBer?	[<Total data count>,<Valid data count>]	Queries the data count.	146
:CALCulate:STATistics:MEAN?	[<Mean>]	Queries the mean value.	146
:CALCulate:STATistics:MAXimum?	[<Maximum value>,<Data no. of Maximum value>]	Queries the maximum value.	146
:CALCulate:STATistics:MINimum?	[<Minimum value>,< Data no. of Minimum value>]	Queries the minimum value.	146
:CALCulate:STATistics:LIMit?	[<Number of Hi>,< number of IN>,< number of Lo>, < number of measurement faults>,<number of Out-of-Range measurements>]	Queries comparator results.	147
:CALCulate:STATistics:DEViation?	[<σn>,< σn-1 >]	Queries standard deviation.	147
:CALCulate:STATistics:CP?	[<Cp>,<CpK>]	Queries the process capability indices.	147

Notes:
- < >: contents of the data portion.indicates contents of the data portion.
- [ ]: indicates Response data.

9

1.888.610.7664 www.calcert.com sales@calcert.com

Message	Data Formats [ ]: Response data.	Description	Ref page
Comparator			
:CALCulate:LIMit:STATe	1/ 0/ ON/ OFF	Execute and Query Comparator	147
:CALCulate:LIMit:STATe?	[ON/ OFF]		
:CALCulate:LIMit:BEEPer	OFF/ HI/ LO/ HL/ IN	Set and Query Beeper State	147
:CALCulate:LIMit:BEEPer?	[OFF/ HI/ LO/ HL/ IN]		
:CALCulate:LIMit:MODE	ABS/ REF	Set and Query Judgment Mode	148
:CALCulate:LIMit:MODE?	[ABS/ REF]		
:CALCulate:LIMit:ABS	<Upper threshold>,<Lower threshold>	Set and Query ABS Mode Upper/ Lower Comparator Threshold Values	148
:CALCulate:LIMit:ABS?	<Upper threshold>,<Lower threshold>		
:CALCulate:LIMit:REFerence	<Reference Resistance>	Set and Query REF% Mode Reference Resistance	148
:CALCulate:LIMit:REFerence?	[<Reference Resistance>]		
:CALCulate:LIMit:PERCent	<Upper limit value (%)>,<Lower limit value (%)>	Set and Query REF% Mode Upper/ Lower Comparator Threshold Percentages	148
:CALCulate:LIMit:PERCent?	<Upper limit value (%)>,<Lower limit value (%)>		
:CALCulate:LIMit:RESult?	[HI/ IN/ LO/ OFF/ ERR]	Queries the comparator result	148
Scaling			
:CALCulate:SCALing	<1/ 0/ ON/ OFF>	Set and Query Scaling Function	149
:CALCulate:SCALing?	[ON/ OFF]		
:CALCulate:SCALing:PARameterA	<coefficient>	Set and Query Coefficient	149
:CALCulate:SCALing:PARameterA?	[0.50000 to 2.00000]		
:CALCulate:SCALing:PARameterB	<offset>	Set and Query Offset	149
:CALCulate:SCALing:PARameterB?	[-99.9999E+6 to 99.9999E+6]		
Self-Calibration			
:SYSTem:CALibration		Execute Self-Calibration	150
:SYSTem:CALibration:AUTO	1/ 0/ ON/ OFF	Set and Query Self-Calibration Execution State	150
:SYSTem:CALibration:AUTO?	[ON/ OFF]		
Key Beeper			
:SYSTem:BEEPer:STATe	1/ 0/ ON/ OFF	Set and Query the Key Beeper Setting	150
:SYSTem:BEEPer:STATe?	[ON/ OFF]		
Line Frequency			
:SYSTem:LFRequency	AUTO/ 50/ 60	Set and Query the Line Frequency Setting	150
:SYSTem:LFRequency?	[AUTO/ 50/ 60]		
Key-Lock			
:SYSTem:KLOCk	1/ 0/ ON/ OFF	Set and Query the Key-Lock State	151
:SYSTem:KLOCk?	[ON/ OFF]		
Header Present			
:SYSTem:HEADer	1/ 0/ ON/ OFF	Set and Query the Header Present Setting	151
:SYSTem:HEADer?	[ON/ OFF]		
EOM Output			
:SYSTem:EOM:MODE	HOLD/ PULSe	Set and Query the EOM Output Method	151
:SYSTem:EOM:MODE?	[HOLD/ PULSE]		
:SYSTem:EOM:PULSe	0.001 to 0.100	Set and Query the EOM Pulse Width Setting	151
:SYSTem:EOM:PULSe?	[0.001 to 0.100]		

Notes:
• < >: contents of the data portion.indicates contents of the data portion.
[ ]: indicates Response data.

1.888.610.7664 www.calcert.com sales@calcert.com

Message	Data Formats [ ]: Response data.	Description	Ref page
Delimiter (Terminator)			
:SYSTem:TERMinator GP-IB	0/ 1	Sets and queries the GP-IB command delimiter.	152
:SYSTem:TERMinator? GP-IB	[0/ 1]		
System			
:SYSTem:DATE	<Year>,< Month>,< Day>	Sets and queries the system date.	152
:SYSTem:DATE?	[<Year>,< Month>,< Day>]		
:SYSTem:TIME	<Hours>,< Minutes>, < Seconds>	Sets and queries the system time.	152
:SYSTem:TIME?	[<Hours>,< Minutes>, < Seconds>]		
:SYSTem:BACKup		Backs up measurement settings.	153
:SYSTem:SETMonitor	1/ 0/ ON/ OFF	Sets and queries the Settings Monitor function.	153
:SYSTem:SETMonitor?	[ON/ OFF]		
:SYSTem:SETMonitor:ORDer	1/ 2	Sets and queries the 1st/2nd stage setting conditions (Settings Monitor function).	153
:SYSTem:SETMonitor:ORDer?	[1/ 2]		
:SYSTem:SETMonitor:ALLowance	0 to 9.999(%)	Sets and queries the tolerance range (Settings Monitor function).	153
:SYSTem:SETMonitor:ALLowance?	[0 to 9.999]		
:SYSTem:LOCal		Enables the local control state.	153
:SYSTem:DATAout RS-232C	1/ 0/ ON/ OFF	Sets and queries measurement-synchronized data output.	153
:SYSTem:DATAout? RS-232C	[ON/ OFF]		
:SYSTem:FORMat	ASCii/ BINary	Sets and queries the measurement data format.	154
:SYSTem:FORMat?	[ASCII/ BINARY]		
:SYSTem:4WCHeck	1/ 0/ ON/ OFF	Sets and queries probe short-circuit detection.	154
:SYSTem:4WCHeck?	[ON/ OFF]		
:SYSTem:4WCHeck:TIME	0.001 to 0.1	Sets and queries probe short-circuit detection time.	154
:SYSTem:4WCHeck:TIME?	[0.001 to 0.1]		
:SYSTem:RETRy	1/ 0/ ON/ OFF	Enables the measurement retry function.	154
:SYSTem:RETRy?	[ON/ OFF]		
:SYSTem:4WCHeck:TIME	0.001 to 0.1	Sets and queries probe short-circuit detection time.	154
:SYSTem:4WCHeck:TIME?	[0.001 to 0.1]		
:SYSTem:VOLTLimit	0/ 1/ ON/ OFF	Sets and queries the applied voltage limit function.	155
:SYSTem:VOLTLimit?	[ON/OFF]		
: SYSTem:SHIFtout	1/ 0/ ON/ OFF	Set and Query the Judgment Output Shift Function.	155
:SYSTem:SHIFtout?	[ON/OFF]		
:SYSTem:SHIFtout:IN	0 to 99	Set and Query the IN Signal Shift Count.	155
:SYSTem:SHIFtout:IN?	[0 to 99]		
:SYSTem:SHIFtout:NG	0 to 99	Set and Query the Hi Signal and Lo Signal Output Shift Counts.	155
:SYSTem:SHIFtout:NG?	[0 to 99]		
:SYSTem:SHIFtout:ERRor	0 to 99	Set and Query the ERR Output Shift Count.	155
:SYSTem:SHIFtout:ERRor?	[0 to 99]		
:SYSTem:SHIFtout:CLEar		Initializes shifted judgment results.	155
:SYSTem:PERCent	1/ 0/ ON/ OFF	Set and Query the percentage output function	155
:SYSTem:PERCent?	[ON/OFF]		
:SYSTem:SERIal?	[<Serial Number>]	Query the Serial Number	156
:SYSTem:RESet		Executes a system reset.	156

Notes:
• < >: contents of the data portion.indicates contents of the data portion.
[ ]: indicates Response data.

1.888.610.7664 www.calcert.com sales@calcert.com

Message	Data Formats [ ]: Response data.	Description	Ref page
Trigger			
:INITiate:CONTinuous	1/ 0/ ON/ OFF	Sets and queries continuous measurement.	158
:INITiate:CONTinuous?	[ON/ OFF]		
:INITiate[:IMMediate]		Trigger Wait Setting	158
:TRIGger:SOURce	IMMediate/ EXTernal	Sets and queries the trigger source.	158
:TRIGger:SOURce?	[IMMEDIATE/ EXTERNAL]		
:TRIGger:DELay1	0 to 0.100	Sets and queries Trigger Delay 1 time.	159
:TRIGger:DELay1?	[0 to 0.100]		
:TRIGger:EDGE	RISE/ FALL	Sets and queries trigger (falling (ON)/ rising (OFF)) logic.	159
:TRIGger:EDGE?			
Reading Measurement Values			
:FETCh?	[<Measurement value>]	Reads the most recent measurement.	160
:READ?	[<Measurement value>]	Waits for trigger and reads the measurement value.	160
Memory Function			
:MEMory:MODE	OFF/ MEMory/ AUTO	Sets and queries the memory mode.	161
:MEMory:MODE?	[OFF/ MEMORY/ AUTO]		
:MEMory:CLEar		Clears memory data.	161
:MEMory:COUNt?	[0 to 30000]	Queries the number of measurements stored in memory.	161
:MEMory:DATA?	[<Measurement value>,<measurement value>,..., <measurement value>]	Reads the measurements stored in the memory.	162
:MEMory:POINt	1 to 30000	Sets and queries the number of measurement points to store.	162
:MEMory:POINt?	[1 to 30000]		
Setting Printing Method			
:PRINter:MODE	NORMal/SAMPle	Sets and queries the printing method.	163
:PRINter:MODE?	[NORMAL/SAMPLE]		
:PRINter:SAMPle:NUMBer	1 to 999	Sets and queries of the number of samples for sample printing.	163
:PRINter:SAMPle:NUMBer?	[1 to 999]		
:PRINter:SAMPle:CONDition	ALL/IN	Sets and queries the sample printing conditions.	163
:PRINter:SAMPle:CONDition?	[ALL/IN]		
:PRINter:SAMPle:LINE	1/3	Sets and queries the number of data for the sample printing.	163
:PRINter:SAMPle:LINE?	[1/3]		

Notes:

• < >: indicates contents of the data portion.
[ ]: indicates Response data.

1.888.610.7664 www.calcert.com sales@calcert.com

Message	Data Formats [ ]: Response data.	Description	Ref page
Range-Specific Resistance Measurement Settings (Low Power Resistance Measurement Settings)			
:LPResistance:DELay2	<Range>,< Delay 2 time>	Sets and queries Delay 2 time.	164
:LPResistance:DELay2?	<Range> [0 to 0.100]		
:LPResistance:NPLCycles	<Range>,<Speed>, <Integration time (NPLC)>	Sets and queries integration time (multiples of power line cycles).	164
:LPResistance:NPLCycles?	<Range>,<Speed> [0.01 to 6]		
:LPResistance:APERture	<Range>,<Speed>, <integration time (s)>	Sets and queries integration time (in seconds).	165
:LPResistance:APERture?	<Range>,<Speed> [0.0001 to 0.1]		
:LPResistance:CIMProve	<Range>,<OFF/ HOLD/ PULSe>	Sets and queries contact improver operating mode.	165
:LPResistance:CIMProve?	<Range> [OFF/ HOLD/ PULSE]		
:LPResistance:CIMProve:LEVel	<Range>,<Level>	Sets and queries contact improver level.	165
:LPResistance:CIMProve:LEVel?	<Range> [L1/ L2/ L3/ L4]		
:LPResistance:CURRent	<Range>,<PULSe/CON-Tinuous>	Sets and queries measurement current mode.	166
:LPResistance:CURRent?	<Range> [PULSE/ CONTINUOUS]		
:LPResistance:CONTactcheck	<Range>,<1/ 0/ ON/ OFF>	Sets and queries contact check operation.	166
:LPResistance:CONTactcheck?	<Range> [ON/ OFF]		
:LPResistance:CONTactcheck:LEVel	<Range>,<Level>	Sets and queries contact check threshold.	167
:LPResistance:CONTactcheck:LEV--el?	<Range> [L1/ L2/ L3/ L4/ L5/ L6/ L7]		
:LPResistance:VMONitor	<Range>,<1/ 0/ ON/ OFF>	Sets and queries voltage level monitor level.	167
:LPResistance:VMONitor?	<Range> [ON/ OFF]		
:LPResistance:VMONitor:LEVel	<Range>,<Level>	Sets and queries voltage level monitor level.	167
:LPResistance:VMONitor:LEVel?	<Range> [L1/ L2/ L3]		

Notes:
- < >: indicates contents of the data portion.
- [ ]: indicates Response data.
- <Range>
  For :RESistance commands: RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
  For :LPResistance commands: RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

1.888.610.7664 www.calcert.com sales@calcert.com

9.7 Message Reference

Messages specific to the RS-232C or GP-IB interface are denoted by RS-232C or GP-IB .

Message Reference Interpretation

< >: Indicates the contents (character or numeric parameters) of the data portion of a message.
Character parameters are returned as all capital letters.

Numeric Parameters:
- NRf Number format may be represented by any of the following: NR1, NR2 and NR3.
- NR1 Integer data(e.g.: +12, -23, 34)
- NR2 Fixed-point data (e.g.: +1.23, -23.45, 3.456)
- NR3 Floating-point exponential representation data (e.g.: +1.0E-2, -2.3E+4)

Shows the command description. → **Read/Write the Standard Event Status Enable Registe (SESER)**

Shows the message syntax. Explains the command data or response message. →

Syntax
Command ***ESE** <0 to 255 (NR1)>
Query ***ESE?**
Response <0 to 255 (NR1)>

Describes the message. →

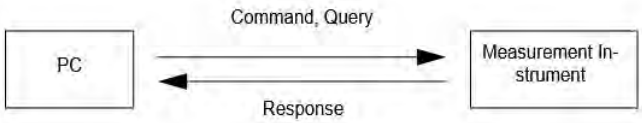
Description
Command The SESER mask is set to the numerical value 0 to 255. The initial value (at power-on) is 0.

Query *The contents of the SESER, as set by the *ESE command, are returned as an NR1 value (0 to 255).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Shows an example of an actual command application. Gives a description (excluding the HEADER command) for the case where HEADER is normally ON. →

Example
*ESE 36
(Sets bits 5 and 2 of SESER)



1.888.610.7664 www.calcert.com sales@calcert.com

Shared Commands

Messages specific to the RS-232C or GP-IB interface are denoted by RS-232C or GP-IB .

(1) System Data Command

Query the Device ID (Identification Code)

Syntax Query `*IDN?`

Response <Manufacturer's name>, <Model name>, <0>, <Software version>

Example `HIOKI,RM3542A,0,V1.00`

The Device ID is HIOKI RM3542A, 0, software version: 1.00.

Note The response message has no header.

(2) Internal Operation Command

Initialize Device

Syntax Command `*RST`

Description Command Resets the instrument to its initial state.

Note
- The communications protocol is not initialized.
- Initialized settings are not backed up.
- The following methods are available if backup is needed:
  Method1. Use the `:SYSTem:BACKup` command
  Method2. Use the `:SYSTem:RESet` command

Execute Self-Test and Query the Result

Syntax Query `*TST?`

Response <0 to 7 (NR1)>

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	unused	unused	unused	unused	non-volatile memory	RAM	ROM

Description Perform the instrument self-test and return the result as a numerical value from 0 to 7.
Returns zero when no error occurs.

Example
```
*TST?
4
```
A non-volatile memory error occurred.
Correct measurement may not be possible. Obtain repair before further use.

1.888.610.7664 www.calcert.com sales@calcert.com

(3) Synchronization Commands

Set the OPC bit of SESR When Finished All Pending Operations

Syntax Command `*OPC`

Description Sets the OPC (bit 0) of the Standard Event Status Register (SESR) when the commands transmitted prior to the ***OPC** commands of all the commands have finished processing.

Respond to output queue with ASCII 1 when all pending operations have finished

Syntax Query `*OPC?`
Response `1`

Description Responds with ASCII 1 when the commands transmitted prior to the ***OPC** commands of all the commands have finished processing.

Execute continuous command after command processing

Syntax Command `*WAI`

Description The instrument waits until all prior commands finish before executing any subsequent commands.

Note The ***WAI** command is supported because it is defined in IEEE 488.2-1987, but because all device-specific commands are sequential types, this command has no actual effect even if the ***WAI** command is used.

(4) Status and Event Control Commands

Clear the Status Byte and Related Queues (Except the Output Queue)

Syntax Command `*CLS`

Description Clears the event status registers. The Status Byte Register bits corresponding to the event status registers are also cleared. (SESR, ESR0, ESR1)

Note RS-232C The output queue is unaffected.

GP-IB The Output Queue, Enable Register and the Status Byte MAV (bit 4) are unaffected.

1.888.610.7664 www.calcert.com sales@calcert.com

Read/Write the Standard Event Status Enable Register (SESER)

Syntax

Command ***ESE** <0 to 255 (NR1)>

Query ***ESE?**

Response <0 to 255 (NR1)>

Description

Command The SESER mask is set to the numerical value 0 to 255.
The initial value (at power-on) is 0. ("Detailed Settings Screen" (p. 21))

Query The contents of the SESER, as set by the ***ESE** command, are returned as an NR1 value (0 to 255).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Example

```
*ESE 36
```

(Sets bits 5 and 2 of SESER)

Read and Clear the Standard Event Status Register (SESR)

Syntax

Query ***ESR?**

Response <0 to 255 (NR1)>

Description

Returns the contents of the SESR as an NR1 value from 0 to 255, then clears register contents.

The response message has no header.

RS-232C

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	unused	CME	EXE	DDE	QYE	unused	unused

GP-IB

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Example

```
*ESR?
32
```

Bit 5 of the SESR was set to 1.

1.888.610.7664 www.calcert.com sales@calcert.com

Write and Read the Service Request Enable Register (SRER)

Syntax

Command ***SRE** <0 to 255 (NR1)>

Query ***SRE?**

Response <0 to 255 (NR1)>

Description

Command

The SRER mask is set to the numerical value 0 to 255. Although NRf numerical values are accepted, values to the right of the decimal are rounded to the nearest integer.

Bit 6 and unused bits 2, 3 and 7 are ignored.

The data is initialized to zero at power-on.

Query

The contents of the SRER, as set by the ***SRE** command, are returned as an NR1 value (0 to 255). Bit 6 and unused bits 2, 3 and 7 are always returned as zero.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
unused	0	ESB	MAV	unused	unused	ESE1	ESE0

Example

```
*SRE 33
```

Set SRER bits 0 and 5 to 1.

```
*SRE?
33
```

SRER bits 0 and 5 have been set to 1.

Read the Status Byte and MSS Bit

Syntax

Query ***STB?**

Response <0 to 255 (NR1)>

Description

The contents of the STB are returned as an NR1 value (0 to 255).

The response message has no header.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
unused	MSS	ESB	MAV	unused	unused	ESE1	ESE0

Example

```
*STB?
16
```

STB bit 4 has been set to 1.

Request a Sample

Syntax

Command ***TRG**

Description

Performs one measurement when external triggering is enabled.

When Statistical Calculation is ON, calculation data is exported.

When the memory function is ON, the measurement value is stored.

Example

```
:TRIGger:SOURce EXTernal;*TRG
```

Note

When an error occurs with the Settings Monitor function enabled, triggering is disabled (p. 61).

1.888.610.7664 www.calcert.com sales@calcert.com

Device-Specific Commands

(1) Event Status Register

Set and Query Device-Specific Event Status Enable Register ESER0

Syntax
Command `:ESE0` <0 to 255 (NR1)>
Query `:ESE0?`
Response <0 to 255 (NR1)>

Description
Command Sets the mask pattern in Event Status Enable Register 0 (ESER0) for the Event Status Register.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Unused	OR	ERR	Hi	IN	Lo	INDEX	EOM

Note Data initializes to zero at power-on.

Read Device-Specific Event Status Register ESR0

Syntax
Query `:ESR0?`
Response <0 to 255 (NR1)>

Note Executing ESR0? clears the contents of ESR0.

Set and Query Device-Specific Event Status Enable Register ESER1

Syntax
Command `:ESE1` <0 to 255 (NR1)>
Query `:ESE1?`
Response <0 to 255 (NR1)>

Description
Command Sets a usable pattern in the Event Status Enable Register 1 (ESER1) for the Event Status Register.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	unused	unused	unused	VOLT	CURR	CE Hi	CE Lo

Note Data initializes to zero at power-on.

Read Device-Specific Event Status Register ESR1

Syntax
Query `:ESR1?`
Response <0 to 255 (NR1)>

Note Executing ESR1? clears the contents of ESR1.

1.888.610.7664 www.calcert.com sales@calcert.com

(2) Measurement-Related

Set and Query the resistance measurement method

Syntax

Command **[:SENSe:]FUNCtion** <RESistance/ LPResistance>

Query **[:SENSe:]FUNCtion?**

Response <RESISTANCE/ LPRESISTANCE>

<RESISTANCE> = Normal Resistance measurement
<LPRESISTANCE> = Low-Power Resistance measurement

Example

```
FUNC LPR
```

Selects the Low-Power Resistance measurement.

```
FUNC?
RESISTANCE
```

The Resistance measurement has been selected.

Note [:SENSe:] may be omitted.

Set and Query the Range Setting

Low-Power Resistance Measurement Range

Syntax

Command **[:SENSe:]LPResistance:RANGe** <Expected measurement value>

Query **[:SENSe:]LPResistance:RANGe?**

Response <Measurement ranges (NR3)>

<Expected measurement value> = 0 to 1200

<Measurement ranges (NR3)> = 1000.000E-3/ 3.00000E+0/ 10.00000E+0/ 100.0000E+0/ 300.000E+0/ 1000.000E+0

Description

Command Enter the expected measurement value. The instrument is set to the most suitable range for measuring the given numerical value data.

Query Queries the measurement range setting.

Example

```
LPR:RANG?
10.0000E+0
```

The Low-Power Resistance measurement has been set to the 10 Ω range.

Resistance Measurement Range

Syntax

Command **[:SENSe:]Resistance:RANGe** <Expected measurement value>

Query **[:SENSe:]RESistance:RANGe?**

Response <Measurement ranges (NR3)>

<Expected measurement value> = 0 to 120E+6

<Measurement ranges (NR3)> = 100.0000E-3/ 1000.000E-3/ 3.00000E+0/ 10.00000E+0/ 100.0000E+0/ 300.000E+0/ 1000.000E+0/ 10.00000E+3/ 30.00000E+3/ 100.0000E+3/ 300.000E+3/ 1000.000E+3/ 3.00000E+6/ 10.00000E+6/ 30.0000E+6/ 100.0000E+6

Description

Command Enter the expected measurement value. The instrument is set to the most suitable range for measuring the given numerical value data.

Query Queries the measurement range setting.

Example

```
RES:RANG 95
```

Sets the Resistance measurement to the 100 Ω range.

1.888.610.7664 www.calcert.com sales@calcert.com

Execute and Clear Zero-Adjustment

Clear Zero-Adjustment

Syntax Command `:ADJust:CLEar`

Description Command Clears any zero-adjustment.

Execute Zero-Adjustment

Syntax Query `:ADJust?`
Response <0/ 1>
0 = Indicates that zero-adjustment has succeeded.
1 = Indicates that the offset resistance value exceeded 10 Ω during zero-adjustment.

(3) Sampling

Set and Query Measurement Speed

Syntax Command `:SPEEd` <FAST/ MEDium/ SLOW>
Query `:SPEEd?`
Response <FAST/ MEDIUM/ SLOW>

Example
```
:SPEE MED
:SPEE?
MEDIUM
```

9

1.888.610.7664 www.calcert.com sales@calcert.com

(4) Calculation

Clear and Query the Statistical Calculation

- A data sample can be taken by the following methods:
  1. Press the **F4 [MANU]** key on the [MENU]-[TRG] selection screen (p. 82).
  2. Apply a $\overline{\text{TRIG}}$ signal from EXT. I/O connector.
  3. Send a ***TRG** command.
- The **:CALCulate:STATistics:STATe** command does not clear the calculation results.
- When the valid data count is 0, σ_{n-1} returns 0.
- When cleared, the Statistical Calculation function is not turned OFF.
- The upper limit of Cp and Cpk is 99.99.If Cp or Cpk> exceeds 99.99, the value 99.99 is returned.

Statistical Calculation Execution State

Syntax Command **:CALCulate:STATistics:STATe** <1/ 0/ ON/ OFF>
Query **:CALCulate:STATistics:STATe?**
Response <ON/ OFF>

Example
```
:CALC:STAT:STAT ON
:CALC:STAT:STAT?
ON
```

Clear Statistical Calculation Results

Syntax Command **:CALCulate:STATistics:CLEar**

Queries the data count

Syntax Query **:CALCulate:STATistics:NUMBer?**
Response <Total data count (NR1)>,<Valid data count (NR1)>

Data count = 0 to 30000

Example
```
:CALC:STAT:NUMB?
23456,23449
```

Query the Mean value

Syntax Query **:CALCulate:STATistics:MEAN?**
Response <Mean (NR3)>

Query the Maximum value

Syntax Query **:CALCulate:STATistics:MAXimum?**
Response <Maximum value (NR3)>,<Data no. of Maximum value (NR1)>

Example
```
:CALC:STAT:MAX?
 12.4859E+3,1124
```

Query the Minimum value

Syntax Query **:CALCulate:STATistics:MINimum?**
Response <Minimum value (NR3)>,< Data no. of Minimum value (NR1)>

1.888.610.7664 www.calcert.com sales@calcert.com

Query Comparator results

Syntax Query `:CALCulate:STATistics:LIMit?`
Response <Number of Hi (NR1)>,< number of IN (NR1)>,<number of Lo (NR1)>, < number of measurement faults (NR1)>,<number of Out-of-Range measurements (NR1)>

Example
```
:CALC:STAT:LIM?
1516,9310,737,16,5
```

Query Standard Deviation

Syntax Query `:CALCulate:STATistics:DEViation?`
Response <σn (NR3)>,< σn-1 (NR3)>

Example
```
:CALC:STAT:DEV?
0.0159E-3,0.0161E-3
```

Query the Process Capability Indices

Syntax Query `:CALCulate:STATistics:CP?`
Response <Cp (NR2)>,<CpK (NR2)>

Example
```
:CALC:STAT:CP?
0.86,0.14
```

(5) Comparator

Set and Query Comparator Settings

- When making comparator settings by commands, the measurement range is not automatically selected.

Execute and Query Comparator

Syntax Command `:CALCulate:LIMit:STATe` <1/ 0/ ON/ OFF>
Query `:CALCulate:LIMit:STATe?`
Response <ON/ OFF>

Example
```
:CALC:LIM:STAT ON
```

Set and Query Beeper State

Syntax Command `:CALCulate:LIMit:BEEPer` <OFF/ HI/ LO/ HL/ IN>
Query `:CALCulate:LIMit:BEEPer?`
Response <OFF/ HI/ LO/ HL/ IN>

Example
```
:CALC:LIM:BEEP HL
```

9

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query Judgment Mode

Syntax
Command :CALCulate:LIMit:MODE <ABS/ REF>
Query :CALCulate:LIMit:MODE?
Response <ABS/ REF>

<ABS> = Upper limit value/Lower limit value comparison
<REF> = Reference value/range comparison

Example
```
:CALC:LIM:MODE REF
```

Set and Query ABS Mode Upper/Lower Comparator Threshold Values

Syntax
Command :CALCulate:LIMit:ABS <Upper threshold>,<Lower threshold>
Query :CALCulate:LIMit:ABS?
Response <Upper threshold>,<Lower threshold>

<Upper limit value> = 0.0000E-3 to 120.000E+6 (NR3)
<Lower limit value> = 0.0000E-3 to 120.000E+6 (NR3)

Note On the instrument screen, upper and lower limit values are rounded to five digits or fewer.

Example
```
:CALC:LIM:ABS 1.00035,0.99965
```

Set and Query REF% Mode Reference Resistance

Syntax
Command :CALCulate:LIMit:REFerence <Reference Resistance>
Query :CALCulate:LIMit:REFerence?
Response <Reference Resistance

<Reference Resistance> = 0.0000E-3 to 120.000E+6 (NR3)

Note On the instrument screen, reference resistance values are rounded to five digits or fewer.

Example
```
:CALC:LIM:REF 1.2E+3
```

Set and Query REF% Mode Upper/Lower Comparator Threshold Percentages

Syntax
Command :CALCulate:LIMit:PERCent <Upper limit value (%)>,
< Lower limit value (%)>
Query :CALCulate:LIMit:PERCent?
Response <Upper limit value (%)>,<Lower limit value (%)>

<Upper limit value (%)> = -99.9900E+0 to 99.9900E+0 (NR3)
<Lower limit value (%)> = -99.9900E+0 to 99.9900E+0 (NR3)

Note Even at 10% or higher, the setting resolution is 0.0001%. (0.01% resolution is achieved when set manually from the front panel)
On the instrument screen, upper and lower limit values are rounded to four digits.

Example
```
:CALC:LIM:PERC 1.505,-2.005
```

Queries the comparator result

Syntax
Query :CALCulate:LIMit:RESult?
Response <HI/ IN/ LO/ OFF/ ERR>

Example
```
:CALC:LIM:RES?
HI
```

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query Scaling Function

Syntax

Command `:CALCulate:SCALing` <1/ 0/ ON/ OFF>

Query `:CALCulate:SCALing?`

Response <ON/ OFF>

Note Enables or disables scaling function.

Set and Query Coefficient

Syntax

Command `:CALCulate:SCALing:PARameterA` <coefficient>

Query `:CALCulate:SCALing:PARameterA?`

Response <coefficient>

<coefficient> = 0.50000 to 2.00000 (NR2)

Note Sets coefficient for the scaling function.

Set and Query Offset

Syntax

Command `:CALCulate:SCALing:PARameterB` <offset>

Query `:CALCulate:SCALing:PARameterB?`

Response <offset>

<offset> = -99.9999E+6 to 99.9999E+6 (NR3)

Note Sets offset for the scaling function.

1.888.610.7664 www.calcert.com sales@calcert.com

(6) System

Self-Calibration State and Setting

Execute Self-Calibration

Syntax Command `:SYSTem:CALibration`

Description Executes self-calibration.

Note If this command is received while measuring, self-calibration executes after measurement is finished.

Set and Query Self-Calibration Execution State

Syntax Command `:SYSTem:CALibration:AUTO` <1/ 0/ ON/ OFF>

Query `:SYSTem:CALibration:AUTO?`

Response <ON/ OFF>

<ON> = Self-Calibration AUTO
<OFF> = Self-Calibration MANUAL

Example

```
:SYST:CAL:AUTO OFF
:SYST:CAL:AUTO?
OFF
```

Note Even when AUTO is selected, Self-Calibration can be manually performed at any time with the :SYSTem:CALibration command.

Set and Query the Key Beeper Setting

Syntax Command `:SYSTem:BEEPer:STATe` <1/ 0/ ON/ OFF>

Query `:SYSTem:BEEPer:STATe?`

Response <ON/ OFF>

Example

```
:SYST:BEEP:STAT ON
:SYST:BEEP:STAT?
ON
```

Set and Query the Line Frequency Setting

Syntax Command `:SYSTem:LFRequency` <AUTO/ 50/ 60>

Query `:SYSTem:LFRequency?`

Response <AUTO/ 50/ 60>

Example

```
:SYST:LFR 50
:SYST:LFR?
50
```

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query the Key-Lock State

Syntax
Command: **:SYSTem:KLOCk** <1/ 0/ ON/ OFF>
Query: **:SYSTem:KLOCk?**
Response: <ON/ OFF>

Description Sets the FULL key-lock state (all settings, including the comparator settings, are disabled).

Example
```
:SYST:KLOC ON
:SYST:KLOC?
OFF
```

Set and Query the Header Present Setting

Syntax
Command: **:SYSTem:HEADer** <1/ 0/ ON/ OFF>
Query: **:SYSTem:HEADer?**
Response: <ON/ OFF>

Description Sets whether to attach headers to query responses. Queries without setting commands have no header.

Example
```
:SYST:HEAD ON
:SYST:HEAD?
:SYSTEM:HEADER ON
```

Note When turning the power on and after giving the *RST command, this is initialized to OFF (no header).

Set the EOM Output Method

The output method for the external I/O $\overline{\text{EOM}}$ (end of measurement) signal can be selected from two options. (Set the $\overline{\text{EOM}}$ signal to ON at EOM and set it to OFF with the specified output method.)

See: "8.2 Timing Chart" (p. 101)

EOM Output Mode Setting

Syntax
Command: **:SYSTem:EOM:MODE** <HOLD/PULSe>
Query: **:SYSTem:EOM:MODE?**
Response: <HOLD/ PULSE>

<HOLD> = Holds the EOM signal until the measurement starts by the next trigger signal.
<PULSE> = Set EOM=OFF according to the specified pulse width.

Example
```
:SYST:EOM:MODE PULS
```

EOM Pulse Width Setting

Syntax
Command: **:SYSTem:EOM:PULSe** <Pulse width>
Query: **:SYSTem:EOM:PULSe?**
Response: <Pulse width>

<Pulse width> = 0.001 sec to 0.100 (NR2) sec

Example
```
:SYST:EOM:PULS 0.005
```


1.888.610.7664 www.calcert.com sales@calcert.com

Delimiter Setting GP-IB

Syntax

Command `:SYSTem:TERMinator <0/ 1>`

Query `:SYSTem:TERMinator?`
Response `<0/ 1>`

<0> = LF+EOI
<1> = CR, LF+EOI

Example

```
:SYST:TERM 1
:SYST:TERM?
0
```

Note

- At power-on, this is set to 0 (LF+EOI).
- The RS-232C terminator is fixed as CR+ LF.

Set and Query the system date

Syntax

Command `:SYSTem:DATE <Year>,<Month>,<Day`

Query `:SYSTem:DATE?`
Response `<Year>,<Month>,<Day>`

<Year> = 00 to 99 [year]
<Month> = 01 to 12 [month]
<Day> = 01 to 31 [day]

Description Sets and queries the date of the real-time system clock.

Error Attempting to set an out-of-range numerical value returns an execution error.
Attempting to set a wrong date (such as 09,06,31) returns an execution error.

Example

```
:SYST:DATE 9,10,5
:SYST:DATE?
09,12,03
```

Set and Query the system time

Syntax

Command `:SYSTem:TIME <Hours>,<Minutes>,<Seconds>`

Query `:SYSTem:TIME?`
Response `<Hours>,<Minutes>,<Seconds>`

<Hours> = 00 to 23 [hours]
<Minutes> = 00 to 59 [minutes]
<Seconds> = 00 sec to 59 sec

Description Sets and queries the time of the real-time system clock.

Example

```
:SYST:TIME 08,25,00
:SYST:TIME?
23,09,53
```

1.888.610.7664 www.calcert.com sales@calcert.com

Back up measurement settings

Syntax Command `:SYSTem:BACKup`

Description Stores current measurement settings in non-volatile memory. The measurement condition setting using communication commands are not backed up. (The settings will be lost when the main power is turned off.)
Use this command to store the settings as occasion demands.

Compare and Query Measurement Settings on Two Instruments (Settings Monitor Function)

Set and Query Settings Comparison

Syntax Command `:SYSTem:SETMonitor <1/ 0/ ON/ OFF>`
Query `:SYSTem:SETMonitor?`
Response <ON/ OFF>

Description This function compares the settings (such as comparator) of two instruments to determine whether they are the same.
See: "4.10 Comparing the Measurement Settings of Two Instruments (Settings Monitor Function)" (p. 61)

Example
```
:SYST:SETM ON
```

Set Settings Monitor Order (1st and 2nd Stages)

Syntax Command `:SYSTem:SETMonitor:ORDer <1/2>`
Query `:SYSTem:SETMonitor:ORDer?`
Response <1/ 2 (NR1)>

Example
```
:SYST:SETM:ORD 1
```

Set and Query Settings Monitor Tolerance

Syntax Command `:SYSTem:SETMonitor:ALLowance <0 to 9.999(%)>`
Query `:SYSTem:SETMonitor:ALLowance?`
Response <0.0000E+0 to 9.9990E+0 (NR3)>[%]

Example
```
:SYST:SETM:ALL 0.5
```

Return to Local Control

Syntax Command `:SYSTem:LOCal`

Description Disables communications remote control and re-enables local control. The panel keys are re-enabled.

Example
```
:SYST:LOC
```

Set and Query Measurement-Synchronized Data Output RS-232C

Syntax Command `:SYSTem:DATAout <1/ 0/ ON/ OFF>`
Query `:SYSTem:DATAout?`
Response <ON/ OFF>

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query Measurement-Synchronized Data Output RS-232C

Description ON: The measurement value is automatically sent each time an externally triggered measurement is finished.
During internal triggering, the measurement values are sent automatically whenever the TRIG signal is applied.
OFF: The measurement values are not automatically sent.
This function cannot be used with GP-IB Interface.

Set and Query the measurement data format

Syntax
Command `:SYSTem:FORMat` <ASCii/ BINary>
Query `:SYSTem:FORMat?`
Response <ASCII/ BINARY>

Description The data format for sending measurement values can be set to ASCII strings or binary data.

Note Binary format supports high-speed transfers, but requires binary data support on the receiving end (p. 119).
When set in binary data format, the delimiter is not sent from this instrument.

Set and Query probe short-circuit detection

Enables/Disables Probe Short-Circuit Detection Function

Syntax
Command `:SYSTem:4WCHeck` <1/ 0/ ON/ OFF>
Query `:SYSTem:4WCHeck?`
Response <ON/ OFF>

Probe Short-Circuit Detection Timing

Syntax
Command `:SYSTem:4WCHeck:TIME` <Time for Detection>
Query `:SYSTem:4WCHeck:TIME?`
Response <Time for Detection>

<Time for Detection> = 0.001 sec to 0.1000 (NR2) sec

Description Probe short-circuit detection is performed after the specified time for detection following end-of-measurement.
At the end of measurement, remove the probes from the measurement object within the time specified for detection.

Example
```
:SYST:4WCH:TIME 0.01
```

Set and Query the Retry Function

Enables/Disables Measurement Retry Function

Syntax
Command `:SYSTem:RETRy` <1/ 0/ ON/ OFF>
Query `:SYSTem:RETRy?`
Response <ON/ OFF>

Example
```
:SYST:RETR ON
```

Set and Query the Retry Interval of the Measurement Retry Function

Syntax
Command `:SYSTem:RETRy:TIME` <0.001 sec to 0.05 sec>
Query `:SYSTem:RETRy:TIME?`
Response <0.001 sec to 0.050 sec (NR2)>

Example
```
:SYST:RETR:TIME 0.02
```

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query the Applied Voltage Limit Function

Enables/Disables Applied Voltage Limit Function

Syntax
Command `:SYSTem:VOLTLimit <1/ 0/ ON/ OFF>`
Query `:SYSTem:VOLTLimit?`
Response <ON/ OFF>

Example `:SYST:VOLTL ON`

Set and Query the Judgment Output Shift Function

Enables/Disables the Judgment Output Shift Function

Syntax
Command `:SYSTem:SHIFtout <1/ 0/ ON/ OFF>`
Query `:SYSTem:SHIFtout?`
Response <ON/ OFF>

<ON> = Enables the judgment output shift function
<OFF> = Disables the judgment output shift function

Description Enabling the judgment output shift function: Output of comparator judgment results is delayed for the set shift count.
Disabling the judgment output shift function: Comparator judgment results are immediately output.

Sets the $\overline{IN}$ Signal Output Shift Count

Syntax
Command `:SYSTem:SHIFtout:IN <Shift Count>`
Query `:SYSTem:SHIFtout:IN?`
Response <Shift Count>

<Shift count> = 0 to 99 (NR1)[Count]

Description Sets the IN signal shift count

Sets the $\overline{Hi}$ Signal and $\overline{Lo}$ Signal Output Shift Counts

Syntax
Command `:SYSTem:SHIFtout:NG <Shift Count>`
Query `:SYSTem:SHIFtout:NG?`
Response <Shift Count>

Description Sets the shift counts for Hi and Lo judgment output.

Sets the $\overline{ERR}$ Output Shift Count

Syntax
Command `:SYSTem:SHIFtout:ERRor <Shift Count>`
Query `:SYSTem:SHIFtout:ERRor?`
Response <Shift Count>

Description Sets the error signal shift count.

The initialization conditions for the judgment output shift

Syntax
Command `:SYSTem:SHIFtout:CLEar`

Description Initializes shifted judgment results.

Set and Query the Percentage Output Function

Enables/Disables the Percentage Output Function

Syntax
Command `:SYSTem:PERCent <1/ 0/ ON/ OFF>`
Query `:SYSTem:PERCent?`
Response <ON/ OFF>

<ON> = Enables the Percentage Output Function

1.888.610.7664 www.calcert.com sales@calcert.com

<OFF> = Disables the Percentage Output Function

Description Changes transmitted measurement data to relative values.

See: "6.5 Outputting Measured Values as Relative Values (Percentage Output Function)" (p. 90)

Query the Serial Number

Syntax Query `:SYSTem:SERIal?`

Response <Serial Number>

Example `:SYST:SERI?`

`123456789`

Description Queries the serial number (9 digits).

System Reset

Syntax Command `:SYSTem:RESet`

Description Initializes all except communications and clock settings.
After initialization, settings are stored in non-volatile memory for backup.

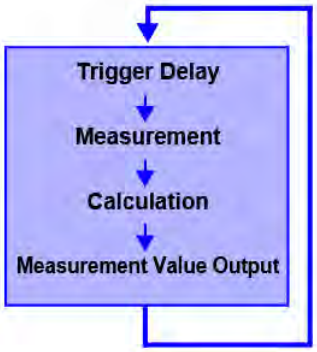
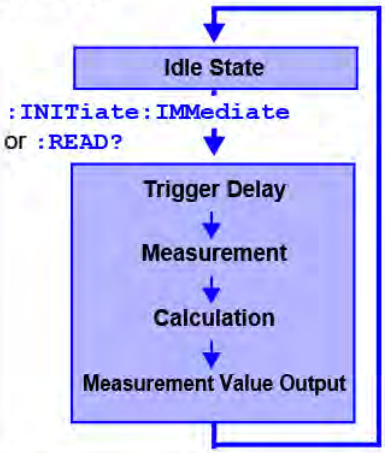
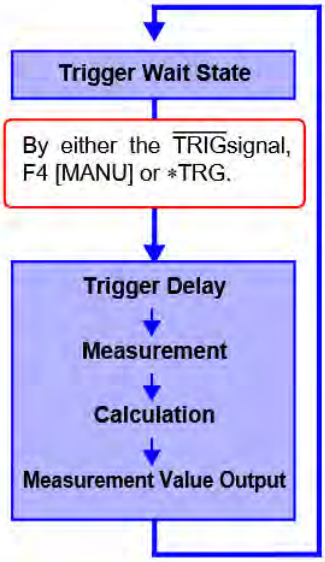
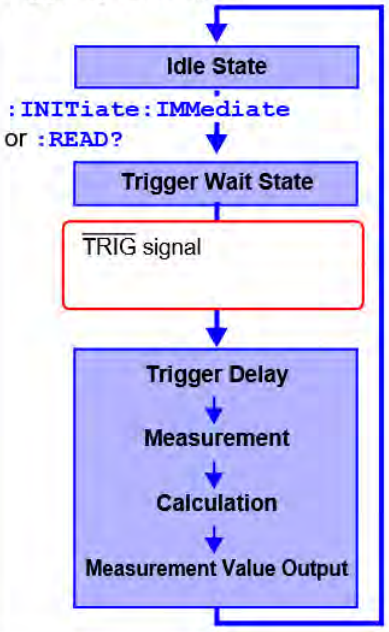
1.888.610.7664 www.calcert.com sales@calcert.com

(7) Trigger

Relationship Between Trigger Source and Continuous Measurement Operation

Operates as follows with the continuous Measurement setting (:INITiate:CONTinuous) (p. 158) and trigger source setting (:TRIGger:SOURce) (p. 158).

See: "9.8 Data exporting methods" (p. 168)

Measurement flow		Continuous Measurement Command setting only	
		:INITiate:CONTinuous ON	:INITiate:CONTinuous OFF
Trigger Source	:TRIGger:SOURce IMM	Free-Run state. Measurement continues automatically. 	Trigger by :INITiate (or :READ?) command. 
	:TRIGger:SOURce EXT	Trigger by the $\overline{\text{TRIG}}$ signal, F4 [MANU], or *TRG command. After measurement, enters the trigger wait state. 	Waits for trigger with :INITiate (or :READ?). Trigger by $\overline{\text{TRIG}}$ signal. 

:INITiate:CONTinuous OFF

It can only be set by the Remote command.

If this has been set to OFF and the operation returns to the Local state or power is turned on again, the following state will be set when the power is turned back on.

:INITiate:CONTinuous ON ("To Cancel the Remote Status (Enter the Local Status)" (p. 120))

How to export measurement values:"9.8 Data exporting methods" (p. 168)

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query the Continuous Measurement Setting

Syntax

Command `:INITiate:CONTinuous` <1/ 0/ ON/ OFF>

Query `:INITiate:CONTinuous?`
Response <ON/ OFF>

<ON> = Continuous Measurement Enabled
<OFF> = Continuous Measurement Disabled

Description

- Continuous Measurement Enabled:
  After measurement, enters the Trigger Wait State. When the trigger source setting is IMMediate, the next trigger occurs immediately (the Free-Run State).
- Continuous Measurement Disabled:
  After measurement, enters the Idle State instead of the Trigger Wait State.
- Triggering is ignored in the Idle State. Executing :INITiate[:IMMediate] enables the Trigger Wait State.
- Continuous measurement is enabled upon exit from the Remote State.

Example

```
:INIT:CONT OFF
:INIT:CONT?
ON
```

Trigger Wait Setting

Syntax

Command `:INITiate[:IMMediate]`

Description

Switches triggering from the Idle State to the Trigger Wait State.

Example

Disable continuous measurement, and read one value for each trigger event.

Sending
`:TRIG:SOUR IMM` ..... Trigger occurs immediately after the system enters the Trigger Wait State
`:INIT:CONT OFF` ..... Disables continuous measurement
`:INIT` ..... Setting the system in the Trigger Wait State execute the triger immediately since :TRIG:SOUR IMM has been set
`:FETC?` ..... Fetch the measurement value

Receiving
`2.16414E+3` ..... Measurement value is 2.16414 kΩ

Error

When continuous measurement is enabled (`:INITiate:CONTinuous ON`), an execution error occurs.

Note

- When the trigger source is IMMediate, triggering occurs immediately before entering the Idle State.
- When the trigger source is EXTernal, the Trigger Wait State is enabled to wait for an external trigger, and when a trigger occurs, one measurement is taken before entering the Idle State.

Trigger Source Setting and Queries

Syntax

Command `:TRIGger:SOURce` <IMMediate/ EXTernal>

Query `:TRIGger:SOURce?`
Response <IMMEDIATE/ EXTERNAL>

<IMMEDIATE> = Internal triggering
<EXTERNAL> = External triggering

Description

Press the F4 [MANU] key on the [MENU]-[TRG] selection screen (Basic settings screen) to trigger by the TRIG signal or ***TRG** command.

Example

```
:TRIG:SOUR IMM
:TRIG:SOUR?
IMMEDIATE
```

Note

When the external [EXT] is set to ON, the auto-memory function will be disabled (OFF).

1.888.610.7664 www.calcert.com sales@calcert.com

Set and query Trigger Delay 1 time

Syntax

Command `:TRIGger:DELay1 <Delay1 time>`

Query `:TRIGger:DELay1?`

Response `<Delay1 time>`

<Delay1 time> = 0.000 sec to 0.100 (NR2) sec

Example

```
:TRIG:DEL1?
0.0100
```

Set and Query the Trigger Signal Logic

Syntax

Command `:TRIGger:EDGE <RISE/FALL>`

Query `:TRIGger:EDGE?`

Response `<RISE/ FALL>`

<RISE> = Rising edge (OFF edge)

<FALL> = Falling edge (ON edge)

Description Set the operating logic of the $\overline{\text{TRIG}}$ signal at the EXT. I/O pins.

Example

```
:TRIG:EDGE?
FALL
```

(8) Reading Measurement Values

Measurement Value Format

When the Percentage Output Function disabled.

Measurement range	Measurement value	When displaying ±OvrRng	Measurement fault
100 mΩ	± XXX.XXXX E-3	±100.0000E+7	+100.0000E+8
1000 mΩ	± XXXX.XXX E-3	±1000.000E+6	+1000.000E+7
3 Ω	± XX.XXXXX E+0	±10.00000E+8	+10.00000E+9
10 Ω	± XX.XXXXX E+0	±10.00000E+8	+10.00000E+9
100 Ω	± XXX.XXXX E+0	±100.0000E+7	+100.0000E+8
300 Ω	± XXXX.XXX E+0	±1000.000E+6	+1000.000E+7
1000 Ω	± XXXX.XXX E+0	±1000.000E+6	+1000.000E+7
10 kΩ	± XX.XXXXX E+3	±10.00000E+8	+10.00000E+9
30 kΩ	± XXX.XXXX E+3	±100.0000E+7	+100.0000E+8
100 kΩ	± XXX.XXXX E+3	±100.0000E+7	+100.0000E+8
300 kΩ	± XXXX.XXX E+3	±1000.000E+6	+1000.000E+7
1000 kΩ	± XXXX.XXX E+3	±1000.000E+6	+1000.000E+7
3 MΩ	± XX.XXXXX E+6	±10.00000E+8	+10.00000E+9
10 MΩ	± XX.XXXXX E+6	±10.00000E+8	+10.00000E+9
30 MΩ	± XXX.XXXX E+6	±100.0000E+7	+100.0000E+8
100 MΩ	± XXX.XXXX E+6	±100.0000E+7	+100.0000E+8

When the Percentage Output Function enables.

Relative value	When displaying ±Ovr-Rng %	When displaying ±Ovr-Rng Ω	Measurement fault
± XXX.XXXX E+0	±100.0000E+7	±100.0000E+7	+100.0000E+8

Note If the comparator function is set to ABS mode, measurement outliers occurring while the percentage output function is disabled will be output. The "+" sign of measurement values is returned as a space (ASCII code 20H).

1.888.610.7664 www.calcert.com sales@calcert.com

The timing at which the measurement values are received is different for the :FETCh? and :READ? commands.

See: "9.8 Data exporting methods" (p. 168)

Reading the Most Recent Measurement

Syntax Query **:FETCh?**

Description Reads the most recent measurement. No trigger occurs.

See: "Measurement Value Format" (p. 159)

Example

```
:FETC?
 1023.579E-3
```

Note Binary data is output when the Binary sending format is selected.

Measuring (Awaiting Triggers and Reading Measurements)

Syntax Query **:READ?**

Description Switches from the Idle State to the Trigger Wait State, then reads the next measurement value after the end of measurement.

(Trigger Source)	Operation
IMMediate	Triggers and reads measurement value.
EXTernal	Triggered by the $\overline{\text{TRIG}}$ signal (EXT. I/O) input, and continuously reads the measurement values.

See: "Measurement Value Format" (p. 159)

Error

- This command causes an execution error if issued during `:INITiate:CONTinuous ON`
- This command causes an execution error if issued during the Trigger Wait State.

Note

- The next command does not execute until measurement is finished.
- When using an external [EXT] trigger source, and the measurement value auto-send function (Auto-Memory function) is enabled (ON), returned measurement values will be duplicated. Therefore, disable the Auto-Memory function (OFF).

See: "6.4 Auto-Exporting Measurement Values (at End of Measurement) (Data Output Function)" (p. 89)

- Binary data is returned when the Binary sending format is selected.

1.888.610.7664 www.calcert.com sales@calcert.com

(9) Memory Function

You can save and load up to 30000 measurement data entries.

Set and Query the Retry Function

Memory Function Execution Mode

Syntax

Command `:MEMory:MODE <OFF/ MEMory/ AUTO>`

Query `:MEMory:MODE?`

Response `<OFF/ MEMORY/ AUTO>`

<OFF> = Memory function OFF
<MEMORY> = Data memory function
<AUTO> = Auto memory function

Description

Selects the memory function operation mode.
The Memory function can be disabled (OFF), or either Data-memory function or Auto-memory function can be enabled (ON).

Example

```
:MEM:MODE MEM
:MEM:MODE?
AUTO
```

Note

- Changing the memory mode setting erases stored data.
- Enabling the AUTO (auto-memory function) mode automatically selects internal [INT] triggering and enables statistical calculation function.

Clear Memory Data

Syntax

Command `:MEMory:CLEar`

Example

```
:MEM:CLE
```

Retrieve the Memory Data Count

Syntax

Query `:MEMory:COUNt?`

Response `<Memory data count >`

<Memory data count > = 0 to 30000 (NR1)

Example

```
:MEM:COUN?
3
```


1.888.610.7664 www.calcert.com sales@calcert.com

Read Memory Data

Syntax

Query `:MEMory:DATA?`

Response <Measurement value (NR3)>,< Measurement value (NR3)>,...,
< Measurement value (NR3)>

Description

Measurement values transferred from memory are separated by commas (,).

The number of stored measurement values to be exported can also be acquired with the :MEMory:COUNt? query.

Data stored by the Data Memory Function and Auto-Memory Function can be acquired by this command.

(Either Data Memory Function or Auto-Memory Function can be enabled (ON))

See: "Measurement Value Format" (p. 159)

Note

- Memory data is available only by remote command.
- Stores measurement values by pressing the F4 [MANU] key on the [MENU]-[TRG] selection screen or applying, the $\overline{\text{TRIG}}$ signal or ***TRG** command.
- Binary data is returned when the Binary sending format is selected.

Set and Query the Memory Point (maximum data quantity)

Syntax

Command `:MEMory:POINt` <1 to 30000>

Query `:MEMory:POINt?`

Response <1 to 30000 (NR1)>

Description

Sets the number of measurement values that can be stored.

When the number of stored values reach the memory point number, no further values are stored. (does not no overwrite)

Example

```
:MEM:POIN 1000
:MEM:POIN?
1000
```

Note

- When the Memory Function is set to Auto-Memory, the upper limit of the memory points is 99.
  : It is possible to set more than 99 points using the :MEMory:POINt command but more than 99 points cannot be stored.
- When the auto-memory function is enabled (ON), stored data is erased when the memory point number is changed.

1.888.610.7664 www.calcert.com sales@calcert.com

(10) Print method setting

Set and Query the Print Method Setting

Syntax

Command: **:PRINter:MODE** <NORMal / SAMPle>

Query: **:PRINter:MODE?**

Response: <NORMAL / SAMPLE>

<NORMAL> = Standard printing
<SAMPLE> = Sample printing

Example

```
:PRIN:MODE SAMP
:PRIN:MODE?
SAMPLE
```

Set and Query of the Number of Samples for Sample Printing

Syntax

Command: **:PRINter:SAMPle:NUMBer** <1 to 999>

Query: **:PRINter:SAMPle:NUMBer?**

Response: <1 to 999 (NR 1)>

Example

```
:PRIN:SAMP:NUMB 30
:PRIN:SAMP:NUMB?
30
```

Set and Query the Sample Printing Conditions

Syntax

Command: **:PRINter:SAMPle:CONDition** <ALL / IN>

Query: **:PRINter:SAMPle:CONDition?**

Response: <ALL / IN>

<ALL> = Print all without relying on the comparator judgment
<IN> = Print only if comparator judgment is "IN"

Example

```
:PRIN:SAMP:COND IN
:PRIN:SAMP:COND?
IN
```

Set and Query the Number of Data for the Sample Printing

Syntax

Command: **:PRINter:SAMPle:LINE** <1 / 3>

Query: **:PRINter:SAMPle:LINE?**

Response: <1 / 3>

<1> = Print 1 data in 1 line
<3> = Print 3 data in 1 line

Example

```
:PRIN:SAMP:LINE 3
:PRIN:SAMP:LINE?
3
```


1.888.610.7664 www.calcert.com sales@calcert.com

(11)Measurement Conditions

Set and Query Delay 2 (Delay time after the measurement current has been applied)

Syntax

Command `:RESistance:DELay2 <Range>,< Delay 2 time>`

Query `:RESistance:DELay2? <Range>`
Response `<Delay 2 time>`

Command `:LPResistance:DELay2 <Range>,< Delay 2 time>`

Query `:LPResistance:DELay2? <Range>`
Response `<Delay 2 time>`

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Delay2 time> = 0.0000 to 0.10000 (NR2) [sec]

Example

```
:RES:DEL2 RNG1000MIL,0.003
:RES:DEL2? RNG10
0.0050
```

Set and Query Integration Time (multiples of power line cycles)

Syntax

Command `:RESistance:NPLCycles <Range>,<Speed>,< Integration time (NPLC)>`

Query `:RESistance:NPLCycles? <Range>,< Speed>`
Response `<Integration time (NPLC)>`

Command `:LPRESistance:NPLCycles <Range>,<Speed>, < Integration time (NPLC)>`

Query `:LPResistance:NPLCycles? <Range>,< Speed>`
Response `<Integration time (NPLC)>`

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Speed> = SLOW/ MEDium/ FAST

<Integration time (NPLC)> = 0.0100 to 6.0000 (NR2)

Description

Sets the integration time as an integer multiple of the power line cycles (PLC).

Note

- For high-resistance measurements, hum noise is suppressed and stable measurement values are acquired by setting an integer multiple of power line cycles.
- The values are converted to seconds, and values over 100 ms are set to 100 ms.
- When the integration time is acquired with a query, the instrument internal variable is converted and output.
  In some cases, the returned value may not match the set value.

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query Integration Time (in seconds)

Syntax

Command: **:RESistance:APERture** <Range>,<Speed>,< Integration time (seconds)>

Query: **:RESistance:APERture?** <Range>,<Speed>
Response: <Integration time (seconds)>

Command: **:LPResistance:APERture** <Range>,<Speed>,<Integration Time (seconds)>

Query: **:LPResistance:APERture?** <Range>,<Speed>
Response: <Integration time (seconds)>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Speed> = SLOW/ MEDium/ FAST

<Integration time (seconds)> = 0.0001 sec to 0.1000 (NR2) sec

Description Sets the integration time, in seconds.

Set and Query Contact Improver operating mode

Syntax

Command: **:RESistance:CIMProve** <Range>,<OFF/ HOLD/ PULSe>

Query: **:RESistance:CIMProve?** <Range>
Response: <OFF/ HOLD/ PULSE>

Command: **:LPResistance:CIMProve** <Range>,<OFF/ HOLD/ PULSe>

Query: **:LPResistance:CIMProve?** <Range>

Response: <OFF/ HOLD/ PULSE>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

Description Sets Contact Improver operation to OFF/ HOLD/ PULSE.

Set and Query Contact Improver level

Syntax

Command: **:RESistance:CIMProve:LEVel** <Range>,<Level>

Query: **:RESistance:CIMProve:LEVel?** <Range>
Response: <Level>

Command: **:LPResistance:CIMProve:LEVel** <Range>,<Level>

Query: **:LPResistance:CIMProve:LEVel?** <Range>
Response: <Level>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Level> = L1/ L2/ L3/ L4 (Applied current)
(L1: 17 mA/ L2: 25 mA/ L3: 35 mA/ L4: 50 mA)

Description Sets the level of current applied by the Contact Improver function.

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query Measurement Current Mode

Syntax

Command `:RESistance:CURRent <Range>,<PULSe/ CONTinuous>`

Query `:RESistance:CURRent? <Range>`
Response `<PULSE/ CONTINUOUS>`

Command `:LPResistance:CURRent <Range>,<PULSe/ CONTinuous>`

Query `:LPResistance:CURRent? <Range>`
Response `<PULSE/ CONTINUOUS>`

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<PULSe> = The measurement current is applied as a pulse only during the measurement.

<CONTinuous> = The measurement current is applied continuously.

Description Selects the method of current application. Select (CONTinuous) when measuring objects that require time for stabilization after applying the measurement current.

Note When using the Contact Improver function (set to HOLD or PULSE), the measurement current is applied only as a pulse, even if CONTinuous has been selected. Therefore, to measure with a continuous current, the Contact Improver function must be disabled (set to OFF) (p. 165).

Set and Query contact check operation

Syntax

Command `:RESistance:CONTactcheck <Range>,<1/ 0/ ON/ OFF>`

Query `:RESistance:CONTactcheck? <Range>`
Response `<ON/ OFF>`

Command `:LPResistance:CONTactcheck <Range>,<1/ 0/ ON/ OFF>`

Query `:LPResistance:CONTactcheck? <Range>`
Response `<ON/ OFF>`

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

Description Enables/disables the Contact Check function.

1.888.610.7664 www.calcert.com sales@calcert.com

Set and Query contact check threshold

Syntax

Command: **:RESistance:CONTactcheck:LEVel** <Range>,<Level>

Query: **:RESistance:CONTactcheck:LEVel?** <Range>
Response: <Level>

Command: **:LPResistance:CONTactcheck:LEVel** <Range>,<Level>

Query: **:LPResistance:CONTactcheck:LEVel?** <Range>
Response: <Level>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Level> = L1/ L2/ L3 / L4/ L5/ L6/ L7
Contact Check Error Threshold:
(L1: 50 Ω/ L2: 100 Ω/ L3: 150 Ω/ L4: 200 Ω/ L5: 300 Ω/ L6: 400 Ω/ L7: 500 Ω)

Description Sets the error threshold value for contact checking.

Set and Query voltage level monitor

Syntax

Command: **:RESistance:VMONitor** <Range>,<1/ 0/ ON/ OFF>

Query: **:RESistance:VMONitor?** <Range>
Response: <ON/ OFF>

Command: **:LPResistance:VMONitor** <Range>,<1/ 0/ ON/ OFF>

Query: **:LPResistance:VMONitor?** <Range>
Response: <ON/ OFF>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

Description Enables/disables the voltage level monitor function.

Set and Query voltage level monitor level

Syntax

Command: **:RESistance:VMONitor:LEVel** <Range>,<Level>

Query: **:RESistance:VMONitor:LEVel?** <Range>
Response: <Level>

Command: **:LPResistance:VMONitor:LEVel** <Range>,<Level>

Query: **:LPResistance:VMONitor:LEVel?** <Range>
Response: <Level>

<Range> = (:RESistance) RNG100MIL/ RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000/ RNG10K/ RNG30K/ RNG100K/ RNG300K/ RNG1000K/ RNG3MEG/ RNG10MEG/ RNG30MEG/ RNG100MEG
(:LPResistance) RNG1000MIL/ RNG3/ RNG10/ RNG100/ RNG300/ RNG1000

<Level> = L1/ L2/ L3
(L1: LOOSE Loose/ L2: NORMAL Normal/ L3: SEVERE Severe)

Description Sets the error level for the voltage level monitor function.

1.888.610.7664 www.calcert.com sales@calcert.com

9.8 Data exporting methods

Basic Data Exporting Methods

Flexible data exporting is available depending on the application.

Free-Run Data Exporting

Default setting
`:INITiate:CONTinuous ON` (continuous measurement enabled)
`:TRIGger:SOURce IMMediate` (internal trigger)

Exporting
`:FETCh?`
Exports the most recent measurement.

Data Export by Host Trigger

Default setting
`:INITiate:CONTinuous OFF` (continuous measurement disabled)
`:TRIGger:SOURce IMMediate` (internal triggering)

Exporting
`:READ?`
A trigger occurs, and a measurement is taken and the result is transferred.

Exporting by pressing the F4 [MANU] Key* *1 or applying the $\overline{\text{TRIG}}$ signal

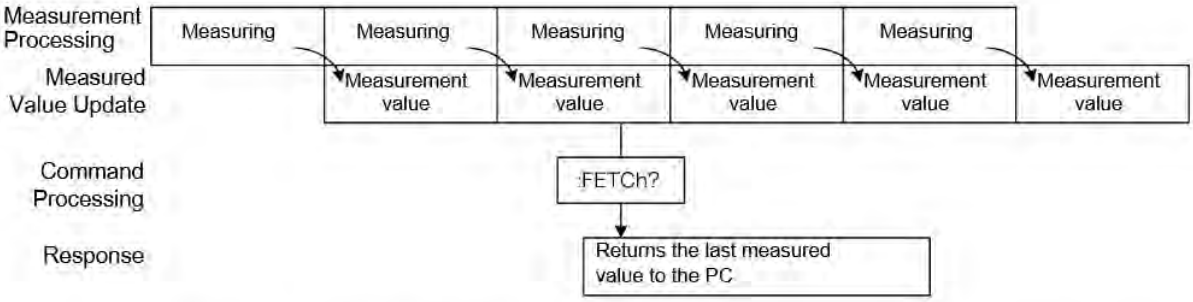
Default setting
`:INITiate:CONTinuous OFF` (continuous measurement disabled)
`:TRIGger:SOURce EXT` (external trigger)

Exporting
`:READ?`
When a TRIG signal is input by pressing the **F4** [MANU] key *1 or $\overline{\text{TRIG}}$ signal, measures and transfers the result.

*1. Press the **F4** [MANU] key displayed when [TRG: EXT] has been set on the Basic Settings Screen.

1.888.610.7664 www.calcert.com sales@calcert.com

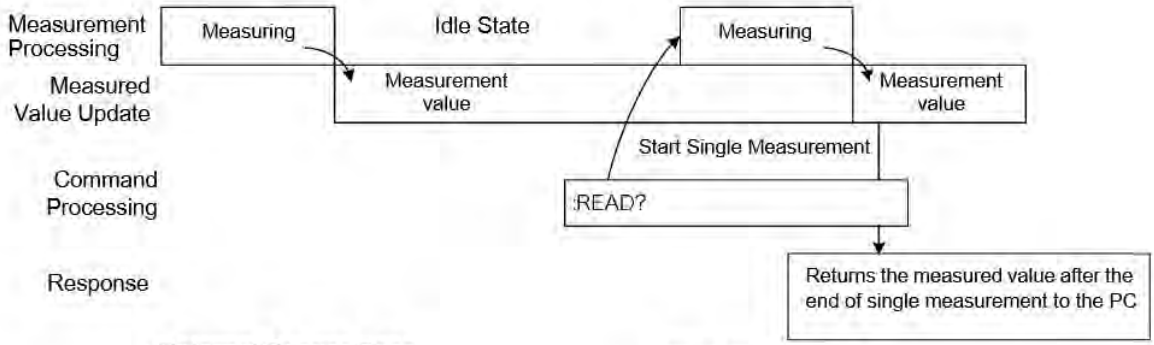
The :FETCh? command is used with continuous measurement and internal trigger enabled



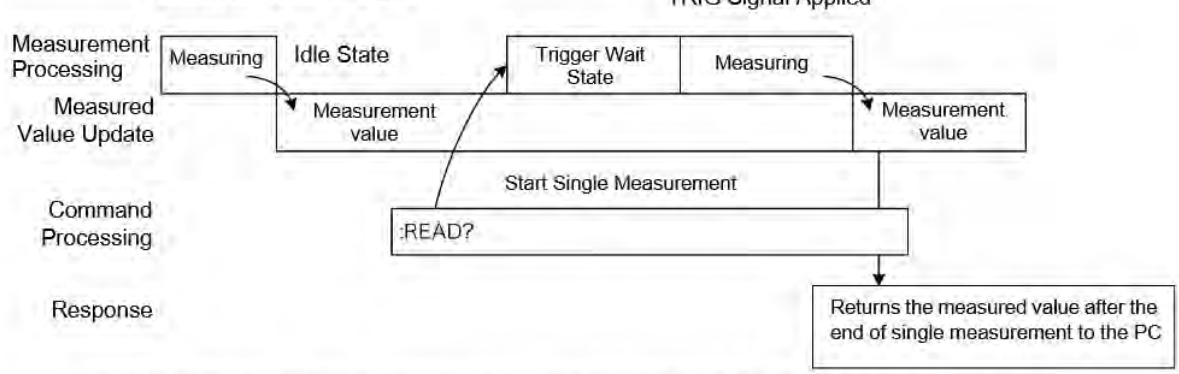
This is the simplest method for exporting measurement values.
It is ideal when there are no severe constraints on the measurement (tact) time, and when external synchronization is not needed.
After connecting to the measuring object, wait for twice the measurement time plus the self-calibration time (about 130 ms) before exporting the measurement value.

Using the :READ? Command while Continuous Measurement is Disabled

Internal Trigger Case



External Trigger Case



Use this method to measure (and export) in synchronization with the PC or external trigger signal.
Measurement time can be minimized.

1.888.610.7664 www.calcert.com sales@calcert.com

9.9 Sample Programs

The method to write these programs using Visual Basic 5.0, 6.0 or Visual Basic 2005 are explained below (p. 180).
Visual Basic is a registered trademark of Microsoft Corporation.

Using Visual Basic 5.0 or 6.0

These sample programs are created with Microsoft Visual Basic 5.0 and 6.0.

The following are used for communication.
For RS-232C communication: MSComm (Visual Basic Professional Edition)
For GP-IB communication: National Instruments GP-IB Board, Driver and Module for Visual Basic

During communications, the terminator setting is supposed to be as follows:
RS-232C: CR+LF
GP-IB: LF

RS-232C Communication

(Using Microsoft Visual Basic Professional MSComm)

■ Simple Resistance Measurement

Imports measurement values 10 times, and saves measurements in a text file.

```
Private Sub MeasureSubRS()
Dim recvstr As String                                   ' Receiving char string
Dim i As Integer

MSComm1.Settings = "9600,n,8,1"                         ' Communication port setting
MSComm1.PortOpen = True                                 ' Open a port
Open App.Path & "\data.csv" For Output As #1            ' Open a text file to save

MSComm1.Output = ":TRIG:SOUR IMM" & vbCrLf              ' Select internal trigger
MSComm1.Output = ":INIT:CONT ON" & vbCrLf               ' Continuous measurement ON
For i = 1 To 10
   MSComm1.Output = ":FETCH?" & vbCrLf                  ' Send ":FETCH?" to import the most recent measurement

   recvstr = ""                                         ' From here on, continue receiving until an LF code is reached

   While Right(recvstr, 1) <> Chr(10)
      recvstr = recvstr + MSComm1.Input
      DoEvents
   Wend
   recvstr = Left(recvstr, Len(recvstr) - 2)            ' Delete the terminator (CR+LF)
   Print #1, Str(i) & "," & recvstr                     ' Write to the file
Next

Close #1
MSComm1.PortOpen = False
End Sub
```

1.888.610.7664 www.calcert.com sales@calcert.com

Measure Resistance by PC Key

Measures and imports by key input on the PC, and saves measurements in a text file.

```
Private Sub MeasureReadSubRS()
Dim recvstr As String                                   ' Receiving char string
Dim i As Integer

MSComm1.Settings = "9600,n,8,1"                         ' Communication port setting
MSComm1.PortOpen = True                                 ' Open a port
Open App.Path & "\data.csv" For Output As #1            ' Open a text file to save

MSComm1.Output = ":TRIG:SOUR IMM" & vbCrLf              ' Select internal trigger
MSComm1.Output = ":INIT:CONT OFF" & vbCrLf              ' Continuous measurement OFF
For i = 1 To 10
   'Wait for PC key input
   'Create a key input check routine to set InputKey() = True when a key is pressed
   Do While 1
      If InputKey() = True Then Exit Do
      DoEvents
   Loop

   'After confirming key input, measure once, and read the measurement value
   MSComm1.Output = ":READ?" & vbCrLf                   ' Send ":READ?" to measure and import the measurement
   recvstr = ""                                         ' From here on, continue receiving until an LF code is reached

   While Right(recvstr, 1) <> Chr(10)
      recvstr = recvstr + MSComm1.Input
      DoEvents
   Wend
   recvstr = Left(recvstr, Len(recvstr) - 2)            ' Delete the terminator (CR+LF)
   Print #1, Str(i) & "," & recvstr                     ' Write to the file
Next

Close #1
MSComm1.PortOpen = False
End Sub
```


1.888.610.7664 www.calcert.com sales@calcert.com

External Trigger Measurement 1

Measure and import according to the external triggering of the instrument (F4 [MANU] key or TRIG signal input), and save the measurements in a text file.

```
Private Sub MeasureTrigSubRS()
Dim recvstr As String                                   ' Receiving char string
Dim i As Integer

MSComm1.Settings = "9600,n,8,1"                         ' Communication port setting
MSComm1.PortOpen = True                                 ' Open a port
Open App.Path & "\data.csv" For Output As #1            ' Open a text file to save

MSComm1.Output = ":TRIG:SOUR EXT" & vbCrLf              ' Select external trigger
MSComm1.Output = ":INIT:CONT OFF" & vbCrLf              ' Continuous measurement OFF
For i = 1 To 10
   MSComm1.Output = ":READ?" & vbCrLf                   'Send ":READ?" to measure and import the measurement


   recvstr = ""                                         ' From here on, continue receiving until an LF code is reached

   While Right(recvstr, 1) <> Chr(10)
      recvstr = recvstr + MSComm1.Input
      DoEvents


                                                        ' Input a trigger signal to the TRIG input pin of the EXT. I/O connector.
   Wend
   recvstr = Left(recvstr, Len(recvstr) - 2)            ' Delete the terminator (CR+LF)
   Print #1, Str(i) & "," & recvstr                     ' Write to the file
Next

Close #1
MSComm1.PortOpen = False
End Sub
```

1.888.610.7664 www.calcert.com sales@calcert.com

External Trigger Measurement 2

Import according to the external triggering of the instrument (F4 [MANU] key or TRIG signal input), and save the measurements in a text file.
(The instrument imports the most recent measurement at the trigger input timing in the continuous measurement state.)

```
Private Sub MeasureTrig2SubRS()
Dim recvstr As String                                   ' Receiving char string
Dim i As Integer

MSComm1.Settings = "9600,n,8,1"                         ' Comm port setting
MSComm1.PortOpen = True                                 ' Open a port
Open App.Path & "\data.csv" For Output As #1            ' Open a text file to save

MSComm1.Output = ":TRIG:SOUR IMM" & vbCrLf              ' Select internal trigger
MSComm1.Output = ":INIT:CONT ON" & vbCrLf               ' Continuous measurement ON

'Clear confirmation of  Ext. I/O TRIG input
MSComm1.Output = ":IO:IN?" & vbCrLf
recvstr = ""
While Right(recvstr, 1) <> Chr(10)
   recvstr = recvstr + MSComm1.Input
   DoEvents
Wend

For i = 1 To 10
   'Wait for Ext. I/O TRIG input
   Do While 1
      MSComm1.Output = ":IO:IN?" & vbCrLf
      recvstr = ""
      While Right(recvstr, 1) <> Chr(10)
         recvstr = recvstr + MSComm1.Input
         DoEvents
      Wend
      If Left(recvstr, 1) = "1" Then Exit Do
      DoEvents
   Loop

   MSComm1.Output = ":FETCH?" & vbCrLf                  ' Send ":FETCH?" to import the most recent measurement

   recvstr = ""                                         ' From here on, continue receiving until an LF code is reached

   While Right(recvstr, 1) <> Chr(10)
      recvstr = recvstr + MSComm1.Input
      DoEvents
   Wend
   recvstr = Left(recvstr, Len(recvstr) - 2)            ' Delete the terminator (CR+LF)
   Print #1, Str(i) & "," & recvstr                     ' Write to the file
Next

Close #1
MSComm1.PortOpen = False
End Sub
```


1.888.610.7664 www.calcert.com sales@calcert.com

Set Measurement Conditions

Sets the measurement conditions.

```
'Setting measurement conditions
'Setting instrument measurement conditions
' Function: Resistance Measurement
'Range: 1Ω
' Sampling: FAST
' Trigger: External trigger
' Comparator enabled, REF% mode, reference value 1Ω, tolerance +1.0% to -1.5%, beeper sounds when High or Low
Private Sub SettingsSubRS()
MSComm1.Settings = "9600,n,8,1"                    ' Communication port setting
MSComm1.PortOpen = True                            ' Open a port

MSComm1.Output = ":FUNC RES" & vbCrLf              ' Select Resistance function
MSComm1.Output = ":RES:RANG 1E+0" & vbCrLf         ' Select 1000 mΩ range
MSComm1.Output = ":SPEE FAST" & vbCrLf             ' Select FAST sampling
MSComm1.Output = ":TRIG:SOUR EXT" & vbCrLf         ' Select external trigger
MSComm1.Output = ":INIT:CONT ON" & vbCrLf          ' Continuous measurement ON
MSComm1.Output = ":CALC:LIM:MODE REF" & vbCrLf     ' From here on, comparator settings
MSComm1.Output = ":CALC:LIM:BEEP HL" & vbCrLf
MSComm1.Output = ":CALC:LIM:REF 1E+0" & vbCrLf
MSComm1.Output = ":CALC:LIM:PERC 1.0, -1.5" & vbCrLf
MSComm1.Output = ":CALC:LIM:STAT ON" & vbCrLf      ' Comparator ON

MSComm1.PortOpen = False
End Sub
```

1.888.610.7664 www.calcert.com sales@calcert.com

GP-IB Communications

(Using GP-IB Board of National Instruments)

■ Simple Resistance Measurement

Imports measurement values 10 times, and saves measurements in a text file.

```
Private Sub MeasureSub()
Dim buffer As String * 20                    ' Receiving buffer
Dim recvstr As String                        ' Receiving char string
Dim pad As Integer                           ' Controller address
Dim gpibad As Integer                        ' Device address
Dim timeout As Integer                       ' Timeout period
Dim ud As Integer                            ' State (unused)
Dim i As Integer

pad = 0                                      ' Board address 0
gpibad = 1                                   ' RM3542A address 1
timeout = T10s                               ' Timeout about 10 s

Call ibfind("gpib0", 0)                      ' Initialize GP-IB
Call ibdev(pad, gpibad, 0, timeout, 1, 0, ud)
Call SendIFC(pad)
Open App.Path & "\data.csv" For Output As #1 ' Open a text file to save

Call Send(pad, gpibad, ":TRIG:SOUR IMM", NLend)  ' Select internal trigger
Call Send(pad, gpibad, ":INIT:CONT ON", NLend)   ' Continuous measurement ON
For i = 1 To 10
   Call Send(pad, gpibad, ":FETCH?", NLend)      ' Send ":FETCH?" to import the most recent measurement

   Call Receive(pad, gpibad, buffer, STOPend)    ' Receive
   recvstr = Left(buffer, InStr(1, buffer, Chr(10)) - 1)
   Print #1, Str(i) & "," & recvstr              ' Write to the file
Next

Close #1
Call ibonl(pad, 0)
End Sub
```


1.888.610.7664 www.calcert.com sales@calcert.com

Measure Resistance by PC Key

Measures and imports by key input on the PC, and saves measurements in a text file.

```
Private Sub MeasureReadSub()
Dim buffer As String * 20                    ' Receiving buffer
Dim recvstr As String                        ' Receiving char string
Dim pad As Integer                           ' Controller address
Dim gpibad As Integer                        ' Device address
Dim timeout As Integer                       ' Timeout period
Dim ud As Integer                            ' State (unused)
Dim i As Integer

pad = 0                                      ' Board address 0
gpibad = 1                                   ' RM3542A address 1
timeout = T10s                               ' Timeout about 10 s

Call ibfind("gpib0", 0)                      ' Initialize GP-IB
Call ibdev(pad, gpibad, 0, timeout, 1, 0, ud)
Call SendIFC(pad)
Open App.Path & "\data.csv" For Output As #1 ' Open a text file to save

Call Send(pad, gpibad, ":TRIG:SOUR IMM", NLend)   ' Select internal trigger
Call Send(pad, gpibad, ":INIT:CONT OFF", NLend)   ' Continuous measurement OFF
For i = 1 To 10
   'Wait for PC key input
   'Create a key input check routine to set InputKey() = True when a key is pressed
   Do While 1
      If InputKey() = True Then Exit Do
      DoEvents
   Loop

   'After confirming key input, measure once, and read the measurement value
   Call Send(pad, gpibad, ":READ?", NLend)    ' Send ":READ?" to measure and import the measurement
   Call Receive(pad, gpibad, buffer, STOPend) ' Receive
   recvstr = Left(buffer, InStr(1, buffer, Chr(10)) - 1)
   Print #1, Str(i) & "," & recvstr           ' Write to the file
Next

Close #1
Call ibonl(pad, 0)
End Sub
```

1.888.610.7664 www.calcert.com sales@calcert.com

External Trigger Measurement 1

Measure and import according to the external triggering of the RM3542A (F4 [MANU] key or the TRIG signal input), and save the measurements in a text file.

```
Private Sub MeasureTrigSub()
Dim buffer As String * 20                    ' Receiving buffer
Dim recvstr As String                        ' Receiving char string
Dim pad As Integer                           ' Controller address
Dim gpibad As Integer                        ' Device address
Dim timeout As Integer                       ' Timeout period
Dim ud As Integer                            ' State (unused)
Dim i As Integer

pad = 0                                      ' Board address 0
gpibad = 1                                   ' RM3542A address 1
timeout = T100s                              ' Timeout 100 s (because of the external trigger wait
                                               state)

Call ibfind("gpib0", 0)                      ' Initialize GP-IB
Call ibdev(pad, gpibad, 0, timeout, 1, 0, ud)
Call SendIFC(pad)
Open App.Path & "\data.csv" For Output As #1 ' Open a text file to save

Call Send(pad, gpibad, ":TRIG:SOUR EXT", NLend)   ' Select external trigger
Call Send(pad, gpibad, ":INIT:CONT OFF", NLend)   ' Continuous measurement OFF
For i = 1 To 10
   Call Send(pad, gpibad, ":READ?", NLend)        ' Send ":READ?" to measure and import the mea-
                                                    surement
   Call Receive(pad, gpibad, buffer, STOPend)     ' Receive
   recvstr = Left(buffer, InStr(1, buffer, Chr(10)) - 1)
   Print #1, Str(i) & "," & recvstr               ' Write to the file
Next

Close #1
Call ibonl(pad, 0)
End Sub
```


1.888.610.7664 www.calcert.com sales@calcert.com

External Trigger Measurement 2

Import according to the external triggering of the RM3542A (F4 [MANU] key or the TRIG signal input), and save the measurements in a text file. (The instrument imports the most recent measurement at the trigger input timing in the continuous measurement state.)

```
Private Sub MeasureTrig2Sub()
Dim buffer As String * 20                    ' Receiving buffer
Dim recvstr As String                        ' Receiving char string
Dim pad As Integer                           ' Controller address
Dim gpibad As Integer                        ' Device address
Dim timeout As Integer                       ' Timeout period
Dim ud As Integer                            ' State (unused)
Dim i As Integer

pad = 0                                      ' Board address 0
gpibad = 1                                   ' RM3542A address 1
timeout = T100s                              ' Timeout 100 s (because of the external trigger wait
                                             state)

Call ibfind("gpib0", 0)                      ' Initialize GP-IB
Call ibdev(pad, gpibad, 0, timeout, 1, 0, ud)
Call SendIFC(pad)
Open App.Path & "\data.csv" For Output As #1 ' Open a text file to save

Call Send(pad, gpibad, ":TRIG:SOUR IMM", NLend)  ' Select internal trigger
Call Send(pad, gpibad, ":INIT:CONT ON", NLend)   ' Continuous measurement ON

'Clear confirmation of  Ext. I/O TRIG input
Call Send(pad, gpibad, ":IO:IN?", NLend)
Call Receive(pad, gpibad, buffer, STOPend)
recvstr = Left(buffer, InStr(1, buffer, Chr(10)) - 1)
For i = 1 To 10
   'Wait for Ext. I/O TRIG input
   Do While 1
      Call Send(pad, gpibad, ":IO:IN?", NLend)
      Call Receive(pad, gpibad, buffer, STOPend)
      If Left(buffer, 1) = "1" Then Exit Do
      DoEvents
   Loop

   Call Send(pad, gpibad, ":FETCH?", NLend)  ' Send ":FETCH?" to import the most recent mea-
                                             surement
   Call Receive(pad, gpibad, buffer, STOPend)  ' Receive
   recvstr = Left(buffer, InStr(1, buffer, Chr(10)) - 1)
   Print #1, Str(i) & "," & recvstr          ' Write to the file
Next

Close #1
Call ibonl(pad, 0)
End Sub
```

1.888.610.7664 www.calcert.com sales@calcert.com

Set Measurement State

Sets up the measurement setting state.

```
'Setting measurement conditions
'Setting instrument measurement conditions
' Function: Resistance Measurement
' Range: 1Ω
' Sampling: FAST
' Trigger: External trigger
' Comparator enabled, REF% mode, reference value 1 Ω, tolerance +1.0% to -1.5%, beeper sounds when High or Low
Private Sub SettingsSub()
Dim pad As Integer                                  ' Controller address
Dim gpibad As Integer                               ' Device address
Dim timeout As Integer                              ' Timeout period
Dim ud As Integer                                   ' State (unused)

pad = 0                                             ' Board address 0
gpibad = 1                                          ' RM3542A address 1
timeout = T10s                                      ' Timeout about 10 s

Call ibfind("gpib0", 0)                             ' Initialize GP-IB
Call ibdev(pad, gpibad, 0, timeout, 1, 0, ud)
Call SendIFC(pad)

Call Send(pad, gpibad, ":FUNC RES", NLend)          ' Select Resistance function
Call Send(pad, gpibad, ":RES:RANG 1E+0", NLend)     ' Select 1000 mΩ range
Call Send(pad, gpibad, ":SPEE FAST", NLend)         ' Select FAST sampling
Call Send(pad, gpibad, ":TRIG:SOUR EXT", NLend)     ' Select external trigger
Call Send(pad, gpibad, ":INIT:CONT ON", NLend)      ' Continuous measurement ON
Call Send(pad, gpibad, ":CALC:LIM:MODE REF", NLend) ' From here on, comparator settings
Call Send(pad, gpibad, ":CALC:LIM:BEEP HL", NLend)
Call Send(pad, gpibad, ":CALC:LIM:REF 1E+0", NLend)
Call Send(pad, gpibad, ":CALC:LIM:PERC 1.0, -1.5", NLend)
Call Send(pad, gpibad, ":CALC:LIM:STAT ON", NLend)  ' Comparator ON

Call ibonl(pad, 0)
End Sub
```

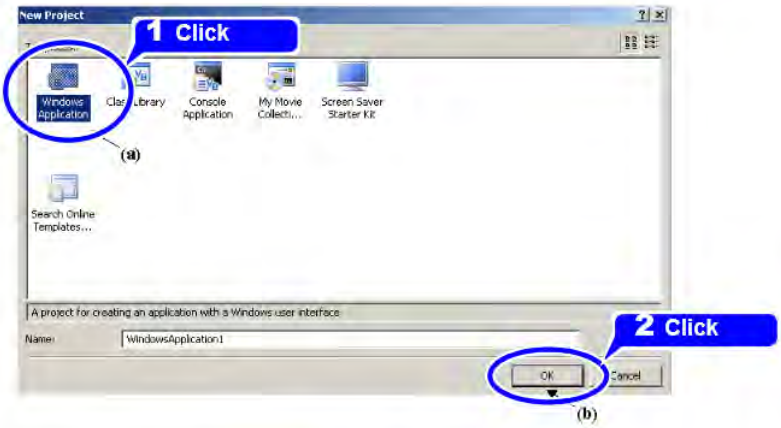

1.888.610.7664 www.calcert.com sales@calcert.com

Create with Visual Basic 2005

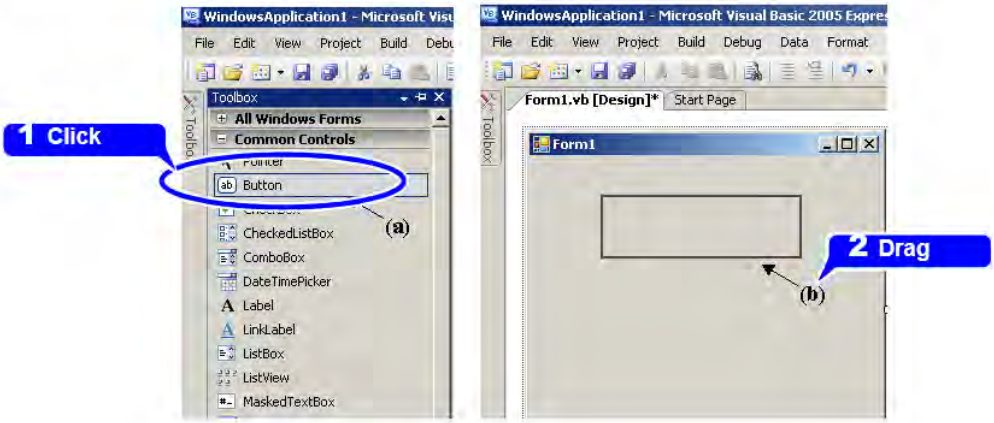
This section describes an example of how to use the Windows development language, Visual Basic 2005 Express Edition to operate the instrument from a PC via RS-232C, to incorporate measurement values and save measurement values to a file.
Visual Basic 2005 is referred to as VB2005 below.

NOTE Depending on the environment of the PC and VB2005, the procedure may differ slightly from the one described here. For a detailed explanation on how to use VB2005, refer to the instruction manual or Help of VB2005.

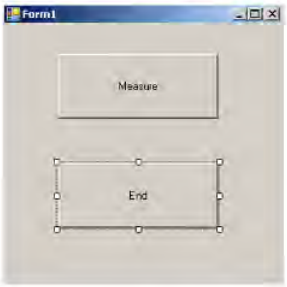
1 Start VB2005. From [File]-[New Project], select [Windows application] and click the [OK] button.



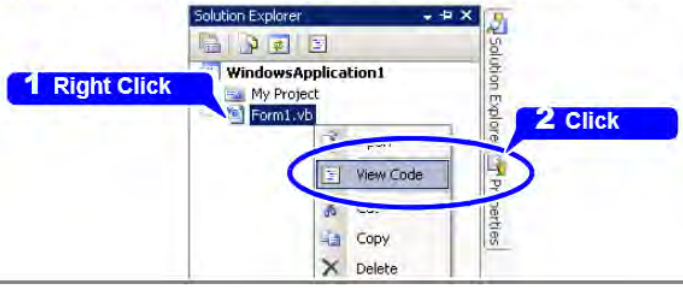
2 Click the common control [Button] icon, and drag the mouse over the form layout screen to paste the button.



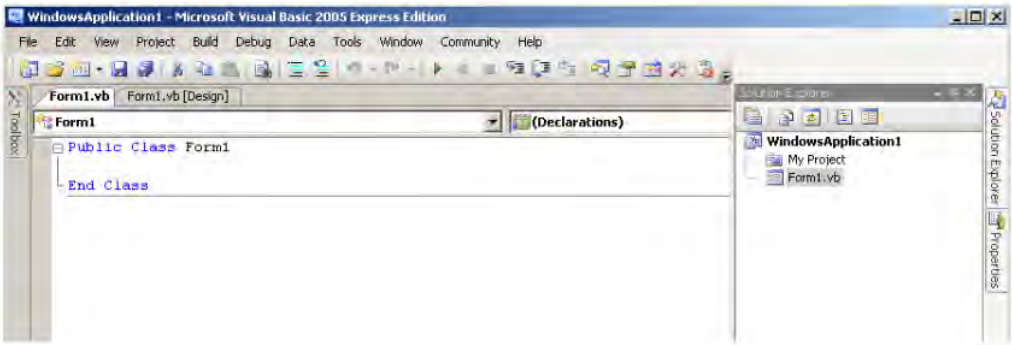
3 Use the method in step 2 to create another button, and edit the Text in the property window of each button to appear as shown in the diagram.



4 Right-click [**Form1**] in the solution explorer, and select [View Code].



Follow the procedure below so that the VB2005 window becomes as shown in the diagram below. Write a program referring to the Sample program, and execute the program.



9

Sample Programs (Visual Basic 2005)

Shown below is a sample program which can be used to enact RS-232C communication with VB2005, set the RM3542A measurement conditions, read measurement results and then save them to file.
The sample program will be written in the following manner.

Creation Procedure (Visual Basic 2005) description	Write using sample program
Button created to begin measurement	Button1
Button created to close application	Button2

When the [Measure] button is pressed, the RM3542A takes 10 measurements and writes the measurement values to a "data.csv" file.
When the [End] button is pressed the program closes.
The following program is written entirely in [Form1] code.

```
Imports System
Imports System.IO
Imports System.IO.Ports

Public Class Form1
- Perform the process to be performed when Button1 is pressed
Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
Dim recvstr As String
    Dim i As Integer

    Try
        Button1.Enabled = False                    ' Disable the buttons during communication ..... (a)
        Button2.Enabled = False
        Dim sp As New SerialPort("COM1", 9600, Parity.None, 8, StopBits.One) ' Communication port setting..... (b)
        sp.NewLine = vbCrLf                        ' Terminator setting ..... (c)
        sp.ReadTimeout = 2000                      ' Time out 2 seconds ..... (d)
        sp.Open()                                  ' Open port
        SendSetting(sp)                            ' Settings of the instrument
        FileOpen(1, "data.csv", OpenMode.Output)   ' Create a text file to be saved ..... (e)
        For i = 1 To 10
            sp.WriteLine(":FETCH?")                ' Begin the measurement and read the measurement results command(f)
            recvstr = sp.ReadLine()                ' Read the measurement results
            WriteLine (1, recvstr)                 ' Write to file
        Next i
        FileClose(1)                               ' Close file
        sp.Close()                                 ' Close port
        Button1.Enabled = True
        Button2.Enabled = True
    Catch ex As Exception
        MessageBox.Show(ex.Message, "Error", MessageBoxButtons.OK, MessageBoxIcon.Error)
    End Try

End Sub
' Set the measurement conditions
Private Sub SendSetting(ByVal sp As SerialPort)
    Try
        sp.WriteLine(":TRIG:SOUR IMM")             ' Select internal trigger
        sp.WriteLine(":INIT:CONT ON")              ' Continuous measurement ON
    Catch ex As Exception
        MessageBox.Show(ex.Message, "Error", MessageBoxButtons.OK, MessageBoxIcon.Error)
    End Try
End Sub
- Close the program when Button2 is pressed
Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button2.Click
Me.Dispose()
End Sub
End Class
```

1.888.610.7664 www.calcert.com sales@calcert.com

(a) This disables the "Measure" and "End" buttons such that they cannot be pressed during communication.
(b) Matches the RM3542A communication conditions and the computer usage conditions.
The port to be used on the computer: 1
Transmission speed: 9600 bps
Parity: none
Data length: 8 bit
Stop bit: 1 bit
(c) Sets CR + LF as the terminator indicating the end of the sent and received character string.
(d) Sets the reading operation time to 2 seconds.
(e) Opens the "data.csv" file. However, if a file with the same name exists,
the previous "data.csv" is deleted and a new file is created.
(f) Sends the command to the RM3542A to perform one measurement and return that measurement result to the computer.

1.888.610.7664 www.calcert.com sales@calcert.com

9.10 Device Compliance Documents

GP-IB

"Information on compliance to standards" based on the IEEE488.2 standard

Item	Description
1. IEEE 488.1 interface functions	See: "GP-IB Specifications (Interface Functions) (RM3542-51 only)" (p. 114)
2. Operation with a device address other than 0 through 30	A setting outside the 0 to 30 range cannot be performed.
3. Timing of changed device address recognition	A change of address is recognized immediately after changing.
4. Device settings at power on	Status information is cleared. Others will be backed up. However, the header on/off setting, response message separator and terminator are all reinitialized.
5. List of message exchange options	• Input buffer capacity and operation See: "Input Buffer" (p. 124) Queries to which multiple response message units are returned. :CALCulate:STATistics:NUMBer? .....2 :CALCulate:STATistics:MAXimum? .....2 :CALCulate:STATistics:MINimum? .....2 :CALCulate:STATistics:LIMit? .....4 :CALCulate:STATistics:DEViation? .....2 :CALCulate:STATistics:CP? .....2 :MEMory:DATA? ..... Number of stored values :CALCulate:LIMit:ABS? .....2 :CALCulate:LIMit:PERCent? .....2 :SYSTem:DATE? .....3 :SYSTem:TIME? .....3 • Queries producing responses when syntax is checked: All queries produce responses when syntax checking is performed. • Whether any queries produce responses when read: There are no queries which produce response messages at the instant they are read in by the controller. • Whether any commands are coupled: 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. • Program message • Program message terminator • Program message unit • Program message unit separator • Command message unit • Query message unit • Command Program Headers • Query Program Header • Program data • Character program data • Decimal program data • Compound commands and program headers
7. Buffer capacity limitations for block data	Block data is not used.

1.888.610.7664 www.calcert.com sales@calcert.com

Item	Description
8. The summary of the program data elements used in the <expressions> and the deepest nesting level allowable in the 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: "9.7 Message Reference" (p. 138)
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 shared commands and queries used	See: "9.6 Message List" (p. 132)
13. Device state after a calibration query has been completed without any problem	The *CAL? command is not used.
14. Existence/nonexistence of "*DDT" command	The *DDT command is not used.
15. Existence/nonexistence of macro command	Macros are not used.
16. For queries related to identification, an explanation of the response to the "*IDN?" query	See: "Shared Commands" (p. 139)
17. The capacity of the protected user data storage area when the "*PUD" command and the "*PUD?" query are executed	The *PUD command and *PUD? query are not used. Further, there is no user data storage area.
18. Explanation of resources when the "*RDT" command and the "*RDT?" query are used	The *RDT command and *RDT? query are not used. Further, there is no user data storage area.
19. Explanation of conditions which are affected 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. See: "Shared Commands" (p. 139) "Initialization Items" (p. 130)
20. Explanation of the self-testing scope executed as a result of the "*TST?" query	See: " Shared Commands";"*TST?" (p. 139)
21. Explanation of additional organization of the status data used in a device status report	See: "Event Registers" (p. 127)
22. Explanation whether commands are overlapping commands or sequential type commands	All the commands are sequential commands.
23. Description of criterion relating to the functions required when termination message is produced, as a response to each command	Termination occurs when the command has been parsed. The :READ? query finishes when the measurement data is received.

1.888.610.7664 www.calcert.com sales@calcert.com

Specifications Chapter 10

Measurement Specifications

LOW POWER: OFF (Four-terminal resistance measurement)	0.0000 mΩ (100 mΩ range) to 120.0000 MΩ (total 16 ranges)
LOW POWER: ON (Low-power four-terminal resistance measurement)	0.000 mΩ (1000 mΩ range) to 1200.000 Ω (total 6 ranges)

Measurement method

Measurement item	DC resistance
Measurement signal	Constant current
Measurement method	DC four-terminal
Measurement jacks	BNC female, 22 mm pitch H_{CUR} jack Current sourcing terminal H_{POT} jack High-side voltage detection terminal L_{POT} jack Low-side voltage detection terminal L_{CUR} jack Current detection terminal GUARD jack (measurement ground potential)

Functional specification

(1) Comparator Function

Operation	Compares setting and measurement values
Default state	ON Reference value 0.00 MΩ, Upper limit value 0.000%, Lower limit value 0.000% REF% mode
Setting	ON/ OFF
Comparator mode	REF%/ ABS
Judgment	Judgments include any fraction of least-significant display digit Hi Measurement value > upper limit value IN Upper limit value ≥ measurement value ≥ lower limit value Lo Lower limit value > measurement value
Display	Absolute and relative value display $\text{Relative value} = \left(\frac{\text{Measurement value}}{\text{Reference value}} - 1 \right) \times 100\ [\%]$
Displayable range	-999.999% to +999.999%

10

REF% Mode

Reference value range	0.00 mΩ to 120.00 MΩ (LOW POWER: OFF) 0.0 mΩ to 1200.0 Ω (LOW POWER: ON)
Upper/Lower limit ranges	-9.999% to +9.999% (when |Upper limit value| and |Lower limit value| are less than 10%) -99.99% to +99.99% (when |Upper limit value| or |Lower limit value| is 10% or greater)

ABS Mode

Upper/Lower limit ranges	0.00 mΩ to 120.00 MΩ (LOW POWER: OFF) 0.0 mΩ to 1200.0 Ω (LOW POWER: ON)

(2) Range Switching

Comparator On	As per following table
Comparator Off	The range is selected by Range key
Default setting	100 MΩ range

Table 1. Ranges of reference (REF%) tolerance and upper limit (ABS) values
Manual setting is available on the Basic Settings screen.

LOW POWER: OFF (p. 30) VOLTAGE LIMIT: OFF (p. 66)		LOW POWER: OFF (p. 30) VOLTAGE LIMIT: ON (p. 66)		LOW POWER: ON (p. 30)	
Range of reference (REF%) and upper limit (ABS) values	Selected range	Range of reference (REF%) and upper limit (ABS) values	Selected range	Range of reference (REF%) and upper limit (ABS) values	Selected range
0.00 mΩ to 100.09 mΩ	100 mΩ	0.00 mΩ to 100.09 mΩ	100 mΩ	–	–
100.1 mΩ to 1000.9 mΩ	1000 mΩ	100.1 mΩ to 1000.9 mΩ	1000 mΩ	100.1 mΩ to 1000.9 mΩ	1000 mΩ
1.001 Ω to 3.009 Ω	3 Ω	1.001 Ω to 3.009 Ω	3 Ω	1.001 Ω to 3.009 Ω	3 Ω
3.010 Ω to 10.009 Ω	10 Ω	3.010 Ω to 10.009 Ω	10 Ω	3.010 Ω to 10.009 Ω	10 Ω
10.01 Ω to 100.09 Ω	100 Ω	10.01 Ω to 100.09 Ω	100 Ω	10.01 Ω to 100.09 Ω	100 Ω
100.1 Ω to 300.9 Ω	300 Ω	100.1 Ω to 300.9 Ω	300 Ω	100.1 Ω to 300.9 Ω	300 Ω
301.0 Ω to 1000.9 Ω	1000 Ω	301.0 Ω to 1000.9 Ω	1000 Ω	301.0 Ω to 1200.0 Ω	1000 Ω
1.001 kΩ to 10.009 kΩ	10 kΩ	1.001 kΩ to 5.009 kΩ	10 kΩ	–	–
10.01 kΩ to 30.09 kΩ	30 kΩ	5.01 kΩ to 15.09 kΩ	30 kΩ	–	–
30.10 kΩ to 100.09 kΩ	100 kΩ	15.10 kΩ to 50.09 kΩ	100 kΩ	–	–
100.1 kΩ to 300.9 kΩ	300 kΩ	50.1 kΩ to 150.9 kΩ	300 kΩ	–	–
301.0 kΩ to 1000.9 kΩ	1000 kΩ	151.0 kΩ to 500.9 kΩ	1000 kΩ	–	–
1.001 MΩ to 3.009 MΩ	3 MΩ	0.501 MΩ to 1.509 MΩ	3 MΩ	–	–
3.010 MΩ to 10.009 MΩ	10 MΩ	1.510 MΩ to 5.009 MΩ	10 MΩ	–	–
10.01 MΩ to 30.09 MΩ	30 MΩ	5.01 MΩ to 15.09 MΩ	30 MΩ	–	–
30.10 MΩ to 120.00 MΩ	100 MΩ	15.10 MΩ to 120.00 MΩ	100 MΩ	–	–

(3) Low-Power Function

Operation	Changes resistance measurement current (setting affects all ranges)
Default setting	LOW POWER: OFF
Setting	ON/ OFF

1.888.610.7664 www.calcert.com sales@calcert.com

(4) Delay Setting

DELAY1

Operation	Adjusts the mechanical delay of trigger input and probing (setting affects all ranges)
Default setting	0.0 ms
Setting range	0.0 ms to 100.0 ms

DELAY2

Operation	Adjusts measuring object response (for each range)
Default setting	0.0 ms
Setting range	0.0 ms to 100.0 ms

(5) OVC (Offset Voltage Compensation)

Operation	Reverses measurement current polarity to eliminate offset voltage effects
Applicable ranges	LOW POWER OFF: 100 mΩ range to 10 Ω range LOW POWER ON: All ranges

(6) Integration Time Setting

Operation	Sets the detection voltage acquisition time span (for each range)
Default setting	As per following table
Setting range	0.1 ms to 100.0 ms, PLC* setting 1 to 5PLC: 50 Hz, 1 to 6PLC: 60 Hz *. PLC: Power Line Cycle, One power line cycle (at 50 or 60 Hz)

Table 2. Integration Time Settings

Range	LOW POWER: OFF				LOW POWER: ON			
	Integration time			OVC	Integration time			OVC
	FAST	MED	SLOW		FAST	MED	SLOW	
100 mΩ	0.5 ms	5.0 ms	1 PLC	ON	–	–	–	–
1000 mΩ	0.3 ms	2.5 ms	1 PLC	ON	0.5 ms	5.0 ms	1 PLC	ON
3 Ω	0.3 ms	2.5 ms	1 PLC	ON	0.5 ms	5.0 ms	1 PLC	ON
10 Ω	0.3 ms	2.5 ms	1 PLC	ON	0.5 ms	5.0 ms	1 PLC	ON
100 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON
300 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON
1000 Ω	0.3 ms	3.0 ms	1 PLC	OFF	0.3 ms	2.5 ms	1 PLC	ON
10 kΩ	0.3 ms	3.0 ms	1 PLC	OFF	–	–	–	–
30 kΩ	0.3 ms	3.0 ms	1 PLC	OFF	–	–	–	–
100 kΩ	0.5 ms	3.0 ms	1 PLC	OFF	–	–	–	–
300 kΩ	0.5 ms	3.0 ms	1 PLC	OFF	–	–	–	–
1000 kΩ	1.5 ms	5.0 ms	1 PLC	OFF	–	–	–	–
3 MΩ	1.5 ms	5.0 ms	1 PLC	OFF	–	–	–	–
10 MΩ	2.5 ms	1 PLC	1 PLC	OFF	–	–	–	–
30 MΩ	2.5 ms	1 PLC	1 PLC	OFF	–	–	–	–
100 MΩ	1 PLC	2 PLC	4 PLC	OFF	–	–	–	–

When OVC is set to ON, two measurements are made using the above integration time.

1.888.610.7664 www.calcert.com sales@calcert.com

(7) Faulty Measurement Detection

Out-of-Range Detection Function

Operation	Indicates under- or over-range values in the following conditions: • Measurement value is outside of the measurement range • The relative calculation value is outside of the display range • Measurement value is outside of the A/D converter input range • The zero-adjusted value is outside of the display range Ex.: Zero-adjustment in the 1Ω range with 0.5 Ω zero-adjustment in effect, measuring 0.1 Ω gives a calculation result of -0.4 Ω, which is outside of the display range.

Contact Check Function

Operation	Checks the connections between H_{POT} and H_{CUR}, and between L_{POT} and L_{CUR} terminals (for each range)
Default setting	ON, 200 Ω
Setting	ON/ OFF
Threshold setting	50 Ω/ 100 Ω/ 150 Ω/ 200 Ω/ 300 Ω/ 400 Ω/ 500 Ω (reference value)

Current Monitor Function

Operation	Detects faults that can obstruct normal measurement current. This function cannot be disabled.

Voltage Level Monitor Function

Operation	Detects an error when the detection voltage is unstable (for each range)
Default setting	ON, NORMAL (LOOSE is the default only for the 100 MΩ range)
Setting	ON/ OFF/ ALLOFF
Threshold setting	LOOSE NORMAL SEVERE

Comparator Judgment and Display Indications

Table 3. Measurement States and Display Indications

		Current monitor	
		PASS	FAIL
Contact check voltage level monitor	PASS	Measurement value is displayed Normal judgment	Out-of-range display Hi/Lo judgment
	FAIL	Contact Error No judgment	Contact Error No judgment

1.888.610.7664 www.calcert.com sales@calcert.com

(8) Probe Short-Circuit Detection Function

Operation	An error is detected after a certain period following the output of $\overline{EOM}$ signal output if a connection between H_{POT} and H_{CUR} or L_{POT} and L_{CUR} terminals lasting more than 1 ms is found.
Default setting	OFF, 5 ms
Setting	Function ON/ OFF Probe short-circuit detection time: 1 ms to 100 ms
Threshold	500 Ω fixed (reference value)

(9) Contact Improvement Function

Operation	Allows a contact improvement current (by applying oxidized film breakdown voltage) to flow between H_{POT} and H_{CUR}, and L_{POT} and L_{CUR} terminals (for each range). The PULSE setting applies the contact improvement current for only 100 µs or 300 µs before measuring. When VOLT LIMIT is ON or LOW POWER is ON, applies the contact improvement current for only 300 µs before measuring.
Default setting	ON, Current-limited to 35 mA (100 mΩ range to 100 kΩ range, LOW POWER: ON for all ranges) PULSE, Current-limited to 35 mA (300 kΩ range to 100 MΩ range)
Setting	OFF/ ON/ PULSE
Applied voltage	20 V max
Current limit	17 mA, 25 mA, 35 mA, 50 mA (peak current reference value)

(10) Current Mode Setting Function

Operation	Sets whether or not to apply the measurement current while measurement is not being carried out. (for each range) The CONT (continuous) setting is available only when the Contact Improver function is disabled.
Default setting	PULSE
Setting	CONT/ PULSE

(11) Scaling Function

Operation	Corrects measured values using a linear expression "y = ax + b " (setting affects all ranges)
Default setting	OFF, a = 1, b = 0
Setting	ON/OFF
Coefficient a	0.50000 to 2.00000
Offset b	±0.0000 mΩ to ±99.9999 MΩ

(12) Zero Adjustment Function

Operation	Nullifies wiring resistance when measuring with the two-terminal method.
Default setting	OFF, 0 Ω
Adjustment range	-1 Ω to 10 Ω

1.888.610.7664 www.calcert.com sales@calcert.com

(13) Measurement-Start Logic Setting Function

Operation	Sets $\overline{\text{TRIG}}$ signal logic for EXT. I/O
Default setting	ON edge
Setting	OFF edge/ ON edge

(14) EOM Pulse Width Setting Function

Default setting	PULSE Pulse width 5 ms
Setting	Mode: HOLD/ PULSE Pulse width: 1 ms to 100 ms

(15) Data Output Function

Operation	Measurement values are automatically output when measurement is finished.
Default setting	OFF
Setting	ON/ OFF

(16) Output Data Format Setting

Default setting	ASCII
Setting	ASCII/ BINARY

(17) Comparator Beeper Setting Function

Default setting	OFF, Hi or Lo
Audibility	ON/ OFF
Signaling criteria	Hi/ Lo/ Hi or Lo/ IN

(18) Key-Press Beeper Setting Function

Default setting	ON
Setting	ON/ OFF

(19) Clock Function

Auto calendar, auto leap year, 24-hour clock	
Accuracy	Approx. 4 minutes/month
Backup battery life	Approx. 10 years (from factory shipping)

(20) Power Line Frequency Setting

Operation	Selects the line voltage frequency
Default setting	AUTO (auto-detect upon power on and resetting)
Setting	AUTO (50 Hz or 60 Hz, fixed)/ 50 Hz / 60 Hz

1.888.610.7664 www.calcert.com sales@calcert.com

(21) Reset Functions

Reset

Operation	Resets settings (except the clock) to factory defaults

∗RST (Remote command)

Operation	Resets settings (except the clock and interface) to factory defaults When power is restored, reverts to the settings before ∗RST was sent

(22) Self-Calibration Function

Operation	Compensates for offset voltage and gain of measurement circuit
Compensation timing	When setting is changed and once every 10 minutes

(23) Memory Function

Operation	Measurement values are stored by an EXT. I/O $\overline{\text{TRIG}}$ signal or by pressing the F4 [MANU]* button * Displayed when EXT is selected on the [MENU]-[TRG] selection screen
Default setting	OFF
Setting	ON/ OFF
Memory capacity	30,000 (volatile memory, no backup)

(24) Auto-Memory Function

Operation	Acquire once the measured value has stabilized using internal continuous trigger manual measurement. A beep will sound once the set count is reached. Memory is cleared when acquired data has been transferred or printed by RS-232C During Auto-Memory operation, the statistical calculation function is always enabled. The voltage level monitor function is disabled.
Default setting	OFF/ 10
Setting	ON/ OFF Number of measurements stored: 1 to 99

(25) Statistical Calculation Function

Operation	Statistical calculations are performed on measurement values in memory.
Default setting	OFF
Setting	ON/ OFF
Calculations	Total data count, Mean, Minimum value (sample no.), Maximum value (sample no.), Standard deviation of sample, Population standard deviation, and Process capability indices

1.888.610.7664 www.calcert.com sales@calcert.com

(26) Settings Monitor Function

Operation	Measurement settings of two instruments are compared, and if different, an alarm sounds and $\overline{\text{TRIG}}$ signal input is blocked. However, the comparator thresholds of the 1st instrument can be smaller than those of the 2nd.
Default setting	OFF, 1st, 0.000%
Setting	Function: ON / OFF Measurement stages: 1st / 2nd Tolerance range: 0.000% to 9.999%
Compared contents	Comparator threshold, measurement speed

(27) Retry Function

Operation	The Retry function enables measurement to be automatically retried when a measurement fault occurs due to probe chatter. If a measurement fault persists after the specified continuous retry interval, retrying is aborted and the $\overline{\text{EOM}}$ signal is output.
Default setting	ON, 2 ms
Setting	Function ON/ OFF Continuous retry interval 1 ms to 50 ms

(28) Applied Voltage Limiter Function

Operation	Limits the voltage applied for resistance measurement (setting affects all ranges).
Default setting	OFF
Setting	ON/ OFF

(29) Self-Test Function

At power-on	ROM/RAM check, non-volatile ROM checksum test

(30) Trigger Source Setting

Default setting	EXT (external)
Settings	INT (Internal)/ EXT (external)

(31) Measurement Speed

Default setting	FAST
Setting	FAST/ MED/ SLOW

(32) Key-Lock Function

Operation	Disables operation of unneeded keys.
Setting	(1) Disables all except the comparator setting and cancel keys (2) Disables all except the cancel key (3) All front panel keys are disabled when the $\overline{\text{KEY_LOCK}}$ signal is received.

1.888.610.7664 www.calcert.com sales@calcert.com

(33) Remote Function

Operation	During REMOTE operation by RS-232C or GP-IB, all front panel operations are disabled.
Cancellation methods	F1 [LOCAL] key By RS-232C :SYSTem:LOCal command By GP-IB GTL command Reset At power-on

(34) Judgment Output Shift Function

Default setting	OFF、0 (IN、NG、ERR)
Settings	Function: ON / OFF Shiift count: 0 to 99 (IN, NG, ERR)

(35) Percentage Output Function

Default setting	OFF
Settings	ON/OFF

1.888.610.7664 www.calcert.com sales@calcert.com

Interface Specification

(1) Display

LCD type	Monochrome graphical LCD, 240 x 64
Backlight	White LED Brightness adjustment range 0 to 100% When using EXT trigger source, brightness is automatically reduced when keys are not used. Brightness recovers upon front panel key operation.
Contrast	Adjustment range 0 to 100%

(2) Keys

⏻, REF%, ABS, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, +/–, BACK SPACE, Period, ENTER, ESC, mΩ, Ω, kΩ, MΩ, %, ▼ , ▲ , ▶, ◀, F1, F2, F3, F4

(3) External Interface

EXT. I/O

Input Signals	$\overline{\text{TRIG}}$, $\overline{\text{HOLD}}$, $\overline{\text{KEY_LOCK}}$, $\overline{\text{0ADJ}}$, $\overline{\text{PRINT}}$, $\overline{\text{CAL}}$, $\overline{\text{PRB_CHECK}}$ Optocoupler-isolated, no-voltage contact inputs Effective voltage: 0 V to 1 V (Input current 3 mA (reference value)) Invalid voltage: OPEN or 5 V to 30 V
Output Signals	$\overline{\text{HI}}$, $\overline{\text{IN}}$, $\overline{\text{LO}}$, $\overline{\text{EOM}}$, $\overline{\text{INDEX}}$, $\overline{\text{ERR}}$, $\overline{\text{PRB_SHORT}}$, $\overline{\text{CE_HI}}$, $\overline{\text{CE_LO}}$ Optocoupler-isolated, NPN open-collector output V_{CE} DC 30 V max Residual voltage 1.5 V or less (I_C = 50 mA) / 1 V or less (I_C = 10 mA) I_C 50 mA max/ch
External power output	(1) Voltage/current: 4.5 V to 5 V, 100 mA max 11 V to 13 V, 20 mA max •The +5 V and +12 V power supplies cannot be used at the same time. (2) Insulation: Floating from protective ground potential and measurement circuit Insulation rating: Voltage to ground 50 V DC, 33 V AC rms, 46.7 V AC peak or less

RS-232C

Communication contents	Remote control, measurement value output (export)
Transfer method	Asynchronous, Full duplex
Transmission speed	9,600bps (default setting)/ 19,200bps/ 38,400bps
Data bit length	8 bit
Stop bit	1
Parity bit	None
Delimiter	Transmit CR+LF, Receive CR/ CR+LF
Handshaking	No X-flow, no hardware flow
Protocol	Non-procedure
Connector	Male 9-pin D-sub, with #4-40 attachment screws

1.888.610.7664 www.calcert.com sales@calcert.com

Printer

Printing Contents	Measured data (PRINT signal input), Total data count, Mean, Minimum value (sample No.), Maximum value (sample No.), Standard deviation of sample, Population standard deviation, and Process capability indices, IN count, Hi count, Lo count, OvrRng count, No. of Measurement faults	
Printing method	Default setting	NORMAL, (100), (ALL), (3/L)
	Setting	Functions NORMAL/SAMPL Number of samplings 1 to 999 (SAMPL only) Printing condition ALL/IN (SAMPL only) Number of characters 1/L / 3/L (SAMPL only)
Communications	Communications method	Asynchronous RS-232C
	Transmission speed	9,600bps
	Data length	8 bits
	Stop bit	1 bit
	Parity bit	None
	Delimiter	Transmit CR+LF, Receive CR/ CR+LF
	Handshake	No X-flow, no hardware flow

GP-IB interface (RM3542-51 only)

Communication contents	Remote control	
Interface Functions	SH1	All Source Handshake functions are supported.
	AH1	All Acceptor Handshake functions are supported.
	T6	Basic talker functions are supported. Serial poll function are supported. No talk-only mode The talker cancel function with MLA (My Listen Address) is supported.
	L4	Basic listener functions are supported. No listen-only mode. The listener cancel function with MTA (My Talk Address) is supported.
	SR1	All Service Request functions are supported.
	RL1	All Remote/Local functions are supported.
	PP0	No Parallel Poll function
	DC1	All Device Clear functions are supported.
	DT1	All Device Trigger functions are supported.
	C0	No Controller function
Miscellaneous	Conforms to IEEE 488.1	

Settings Monitor terminal (SET MONITOR)

Connector	Male 9-pin D-sub, with #4-40 attachment screws
Connection cable	Crossover

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement Specifications

(1) Resistance Measurement Accuracy

Conditions of guaranteed accuracy	
Warm-up time	At least 30 minutes
Integration time	Set longer than the initial "Integration Time Setting" (p. 189). In case of default PLC setting is not specified in ms setting.
Temperature and humidity range for guaranteed accuracy	23°C ±5°C (73°F ±9°F), 80% RH or less
Guaranteed accuracy period	1 year

Temperature variation after self-calibration is within ±2°C. From 0°C to 18°C and from 28°C to 40°C, add the following value as temperature coefficient: ± 1/10th of measurement accuracy/°C.

LOW POWER: OFF

Range	Max. display *1	f.s.	Measurement accuracy ±(% rdg. + % f.s.)			Measurement current *2	Open-circuit voltage
			FAST	MED	SLOW		
100 mΩ	120.0000 mΩ	1,000,000 dgt.	0.015 + 0.008	0.015 + 0.003	0.015 + 0.002	100 mA	20 V max *3, *4, *5
1000 mΩ	1200.000 mΩ	1,000,000 dgt.	0.012 + 0.003	0.012 + 0.002	0.012 + 0.001	100 mA	
3 Ω	3.60000 Ω	300,000 dgt.	0.012 + 0.003	0.012 + 0.002	0.012 + 0.001	33.3 mA	
10 Ω	12.00000 Ω	1,000,000 dgt.	0.010 + 0.003	0.008 + 0.002	0.008 + 0.001	10 mA	
100 Ω	120.0000 Ω	1,000,000 dgt.	0.009 + 0.003	0.007 + 0.002	0.007 + 0.001	10 mA	
300 Ω	360.000 Ω	300,000 dgt.	0.009 + 0.003	0.007 + 0.002	0.007 + 0.001	3.33 mA	
1000 Ω	1200.000 Ω	1,000,000 dgt.	0.008 + 0.003	0.006 + 0.002	0.006 + 0.001	1 mA	
10 kΩ	12.00000 kΩ	1,000,000 dgt.	0.009 + 0.003	0.007 + 0.002	0.007 + 0.001	1 mA	
30 kΩ	36.0000 kΩ	300,000 dgt.	0.009 + 0.003	0.007 + 0.002	0.007 + 0.001	333 µA	
100 kΩ	120.0000 kΩ	1,000,000 dgt.	0.010 + 0.003	0.007 + 0.002	0.007 + 0.001	100 µA	
300 kΩ	360.000 kΩ	300,000 dgt.	0.010 + 0.003	0.007 + 0.002	0.007 + 0.001	33.3 µA	
1000 kΩ	1200.000 kΩ	1,000,000 dgt.	0.010 + 0.003	0.008 + 0.002	0.008 + 0.001	10 µA	
3 MΩ	3.60000 MΩ	300,000 dgt.	0.010 + 0.003	0.008 + 0.002	0.008 + 0.001	3.33 µA	
10 MΩ	12.00000 MΩ	1,000,000 dgt.	0.030 + 0.004			1 µA	
30 MΩ	36.0000 MΩ	300,000 dgt.	0.030 + 0.010			333 nA	
100 MΩ	120.0000 MΩ	1,000,000 dgt.	0.100 + 0.020			100 nA	

LOW POWER: ON

Range	Max. display *1	f.s.	Measurement accuracy ±(% rdg. + % f.s.)			Measurement current *2	Open-circuit voltage
			FAST	MED	SLOW		
1000 mΩ	1200.000 mΩ	1,000,000 dgt.	0.010 + 0.008	0.008 + 0.003	0.008 + 0.002	10 mA	10 V max *3, *5
3 Ω	3.60000 Ω	300,000 dgt.	0.010 + 0.008	0.008 + 0.003	0.008 + 0.002	3.33 mA	
10 Ω	12.00000 Ω	1,000,000 dgt.	0.010 + 0.008	0.008 + 0.003	0.008 + 0.002	1 mA	
100 Ω	120.0000 Ω	1,000,000 dgt.	0.010 + 0.003	0.008 + 0.002	0.008 + 0.001	1 mA	
300 Ω	360.000 Ω	300,000 dgt.	0.010 + 0.003	0.008 + 0.002	0.008 + 0.001	333 µA	
1000 Ω	1200.000 Ω	1,000,000 dgt.	0.020 + 0.003	0.008 + 0.002	0.008 + 0.001	100 µA	

1.888.610.7664 www.calcert.com sales@calcert.com

*1. Negative values can be up to 10% of positive full scale.
*2. Measurement current accuracy is ±5%.
*3. 20 mV or less when not measuring, with Pulse current mode and Contact Improver set to OFF or Pulse (by 10 MΩ input-impedance voltmeter)
*4. When VOLTAGE LIMIT is set to ON: 10 V max.
*5. The total of the allowable measurement probe, measurement target, and contact resistance will be less than the resistance value calculated by dividing the no-load voltage by the measurement current.
Example: For a measurement current of 100 mA, measurements can be made under conditions such that the total of the measurement probe, measurement target, and contact resistance does not exceed 20 Ω.

- f.s. The maximum displayable value. This is usually the name of the currently selected range.
- rdg. (Reading, indicated 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.

(2) Measurement Time (default settings)

Measurement range	LOW POWER: OFF			LOW POWER: ON		
	FAST	MED	SLOW	FAST	MED	SLOW
100 mΩ	3.8 ms	13 ms	43 ms 36 ms	–	–	–
1000 mΩ	2.0 ms	6.4 ms	41 ms 35 ms	2.3 ms	12 ms	42 ms 35 ms
3 Ω	1.6 ms	6.0 ms	41 ms 34 ms	2.3 ms	12 ms	42 ms 35 ms
10 Ω	1.6 ms	6.0 ms	41 ms 34 ms	2.3 ms	12 ms	42 ms 35 ms
100 Ω	0.9 ms	3.6 ms	21 ms 17 ms	1.7 ms	6.1 ms	41 ms 34 ms
300 Ω	0.9 ms	3.6 ms	21 ms 17 ms	3.2 ms	7.6 ms	43 ms 36 ms
1000 Ω	0.9 ms	3.6 ms	21 ms 17 ms	7.2 ms	12 ms	47 ms 40 ms
10 kΩ	1.0 ms	3.6 ms	21 ms 17 ms	–	–	–
30 kΩ	0.9 ms	3.6 ms	21 ms 17 ms	–	–	–
100 kΩ	1.3 ms	3.8 ms	21 ms 18 ms	–	–	–
300 kΩ	1.3 ms	3.8 ms	21 ms 18 ms	–	–	–
1000 kΩ	2.5 ms	6.0 ms	21 ms 18 ms	–	–	–
3 MΩ	2.5 ms	6.0 ms	21 ms 18 ms	–	–	–
10 MΩ	5.3 ms	23 ms 20 ms	23 ms 20 ms	–	–	–
30 MΩ	5.8 ms	23 ms 20 ms	23 ms 20 ms	–	–	–
100 MΩ	26 ms 22 ms	46 ms 39 ms	86 ms 72 ms	–	–	–

Upper value: 50 Hz power line frequency
Lower value: 60 Hz power line frequency

Tolerance ±10% ±0.2 ms
(Without retry)

1.888.610.7664 www.calcert.com sales@calcert.com

General Specifications

Operating environment	Indoors, Pollution degree 2, up to 2000 m (6562-ft.)
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Operating temperature and humidity	0°C to 40°C (32°F to 104°F), 80% RH or less (no condensation)
Dielectric strength	1.69 kV AC, 1 min (Cutoff current 10 mA) between all power terminals and protective ground, interfaces, and measurement jacks
Applicable Standards **Safety** **EMC**	 EN 61010 EN 61326 Class A Effect of radiated radio-frequency electromagnetic field: 3%f.s. at 10 V/m Effect of conducted radio-frequency electromagnetic field: 2%f.s. at 10 V
Power supply	Rated supply voltage 100 V to 240 VAC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) Rated supply frequency: 50 Hz / 60 Hz Anticipated transient overvoltage: 2,500 V Maximum rated power: 30 VA
Dimensions	Approx. 260W x 88H x 300D mm (10.24"W x 3.46"H x 11.81"D)
Mass	Approx. 2.9 kg (102.3 oz.)
Product warranty period	3 years

Accessories

See:"Accessories" (p. 5)

Options

See:"Options" (p. 6)

1.888.610.7664 www.calcert.com sales@calcert.com

Maintenance and Service Chapter 11

11.1 Troubleshooting

Inspection and Repair

⚠WARNING **Do not modify, dismantle or repair the instrument. Doing so may cause a fire, an electric shock or injury.**

Regular calibration is required in order to ensure the instrument will yield measurement results at the specified degree of accuracy.

NOTE

- If a failure is suspected, check "Before Returning for Repair" (p.202) and then contact your authorized Hioki distributor or reseller.

To transport the instrument

- Use the original packing materials when transporting the instrument.
- Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damages. We do not take any responsibility for damages during shipping.

Replaceable Parts and Operating Lifetimes

The service life of parts varies with the operating environment and frequency of use. Parts are not guaranteed to operate throughout the recommended replacement cycle. For replacement parts, contact your authorized Hioki distributor or reseller.

Part	Life
LCD (to half brightness)	Approx. 50,000 hours
Electrolytic Capacitors	Approx. 10 years
Lithium Battery	Approx. 10 years The instrument contains a built-in backup lithium battery. If the date and time deviate substantially when the instrument is switched on, it is the time to replace that battery. Contact your authorized Hioki distributor or reseller.

If no measurement value is displayed even when the probes are shorted together, internal damage may have occurred. Contact your authorized Hioki distributor or reseller.

1.888.610.7664 www.calcert.com sales@calcert.com

Before Returning for Repair

If abnormal operation occurs, check the following items.

Symptom	Check Items	
Nothing is shown on the screen when the power switch is turned on.	• Is the power cord disconnected? • Are the connections made correctly?	Check that the power cord is connected properly. (p. 24)
Keys do not work.	• Is any key being held down? • Is the instrument in the key-lock state (M.LOCK or F.LOCK is displayed)? • Is the remote control communication enabled (RMT is displayed)? • Is the EXT. I/O $\overline{\text{KEY_LOCK}}$ signal asserted to Low (ON)?	Verify the key operation. Cancel Key-Lock: (p. 70) Switch to the local control (p. 120). De-assert the $\overline{\text{KEY_LOCK}}$ signal to High (OFF).
Measurement values are not stable	• Is the measurement object a power transformer or other large inductance? • Are the probes and measuring object adequately shielded?	"Appendix 3 Unstable Measurement Values" (p. A3)
Measurement values are shifted.	• Is zero-adjustment ON? • Were the CUR and POT terminals connected before contacting the measuring object? • Is the measuring object calibrated correctly? • Is a current of more than 10 mA not flowing to the GUARD terminal?(The shell of the GUARD terminal and that of the BNC terminal may have made contact) • There may be a large thermal emf.	"3.6 Measuring with Two-terminal Wiring (Zero Adjustment)" (p. 36)
If the cause is unknown	• Try performing a system reset (p. 77). All settings are returned to their factory defaults.)	

11.2 Cleaning

NOTE

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent.
- Wipe the LCD gently with a soft, dry cloth.

IMPORTANT
Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline. Doing so may deform and discolor the case.

1.888.610.7664 www.calcert.com sales@calcert.com

11.3 Error Displays and Solutions

The following messages are displayed on the screen when the instrument malfunctions or encounters an abnormal measurement state.
If repair is necessary, contact your authorized Hioki distributor or reseller.

Display		Description	Remedy
+OvrRng/-OvrRng		Out-of-Range (p. 42)	Select the appropriate range.
C.E. Hi		Hi wiring contact error (p. 42)	Check for cable breakage and worn out probes.
C.E. Lo		Lo wiring contact error (p. 42)	Check for cable breakage and worn out probes.
C.E. Volt		Voltage Level Monitor Error (p. 42)	Check for worn out probes.
ERR:001	**LOW limit is higher than UPP limit.**	Upper limit is below lower limit.	Check the comparator settings (p. 38).
ERR:002	**[When the Low-Power Resistance Measurement is OFF] Exceeding range. (From 0 Ω to 120 MΩ)** **[When the Low-Power Resistance Measurement is ON] Exceeding range. (From 0 Ω to 1200 Ω)**	Comparator input is out of range. (out-of-range reference value, such as 1000 MΩ)	Check comparator settings (p. 38).
ERR:003	**Setting monitor error. (COMP)**	The comparator settings are different from the other instrument.	Make the comparator settings the same (p. 61).
ERR:004	**Setting monitor error. (SPEED)**	The SPEED settings are different from the other instrument.	Make the SPEED settings the same (p. 61).
ERR:011	**Zero adjustment error. Offset value exceeds 10 Ω.**	Out of zero-adjust range	Check the zero-adjustment procedure (p. 36).
ERR:021	**Probe short error**	Probe short-circuit	Check if the connections are correct (p. 59).
ERR:031	**Command error**	Command Error	Check if the commands (p. 131) are correct.
ERR:032	**Execution error**	Execution Error	Check the last command and instrument status (p. 131).
ERR:033	**RS-232C communication error**	I/F Communications Error	Check communication settings and wiring.
ERR:034	**Setting monitor communication error**	Settings monitor communications error	Check the setting monitor settings and wiring (p. 61).
ERR:041	**Line frequency detection error**	Error detecting the line frequency	Manually set the frequency to match the power line (p. 73).
ERR:042	**Clock error Reset?(16-01-01 00:00:00) Press F1 Key.**	The clock is not set, so pressing F1[OK] displays the default time as 16-01-01 00:00:00.	The back-up battery needs to be replaced. Contact your authorized Hioki distributor or reseller.
ERR:101	**Hardware error (Main CPU ROM)**	Hardware error	Repair is required.
ERR:102	**Hardware error (Main CPU RAM)**	Hardware error	Repair is required.
ERR:103	**Hardware error (SRAM)**	Hardware error	Repair is required.
ERR:104	**Hardware error (Adjustment data)**	Hardware error	Repair is required.

1.888.610.7664 www.calcert.com sales@calcert.com

Display		Description	Remedy
ERR:105	**Hardware error (Backup data) Reset? Press F1 Key.**	Hardware failure (back-up data is corrupted)	Repair is required. Press F1[OK] to reset the instrument.
ERR:106	**Hardware error (Meas CPU communication)**	Hardware error	Repair is required.
ERR:107	**Hardware error (Meas CPU ROM)**	Hardware error	Repair is required.
ERR:108	**Hardware error (Meas CPU RAM)**	Hardware error	Repair is required.
ERR:109	**Hardware error (Measurement end)**	Hardware error	Repair is required.
ERR:110	**Hardware error (Zero measurement end)**	Hardware error	Repair is required.
ERR:111	**Hardware error (F.S. measurement end)**	Hardware error	Repair is required.
ERR:112	**Hardware error (Calibration)**	Hardware error	Repair is required.
ERR:113	**Hardware error (Meas CPU A/D data)**	Hardware error	Repair is required.
ERR:114	**Hardware error (Meas CPU)**	Hardware error	Repair is required.
INFO:001	**Printing...**	Printing in progress.	–
INFO:002	**Memory full**	Memory full.	Delete stored data.
INFO:011	**Zero adjusting...**	Zero-adjust in progress.	–
INFO:012	**Clearing zero adjustment**	Clearing zero-adjust.	–
INFO:021	**Clear all memory and statistics data?**	Confirm deletion of all memory data. (F1:CANCEL/ F2:YES)	–
INFO:022	**Undo memory and statistics data?**	Confirm deletion of one memory data item. (F1:CANCEL/ F2:YES)	
INFO:023	**Save and Return? [CANCEL]: Continue to edit.**	MISC setting confirmation Returns to the previous screen in the case of CANCEL (F1:CANCEL/ F2:SAVE/ F3:NOSAVE)	–
INFO:024	**System Reset?**	Confirm system reset. (F1:CANCEL/ F4:YES)	–
INFO:031	**Press enter code.**	Waiting for key code entry to access adjustment mode.	–
– – – – – – –		Not measuring When awaiting a trigger after changing the settings, and immediately after power-on.	

1.888.610.7664 www.calcert.com sales@calcert.com

11.4 Disposing of the Instrument

The instrument uses a lithium battery for back-up power to the clock.

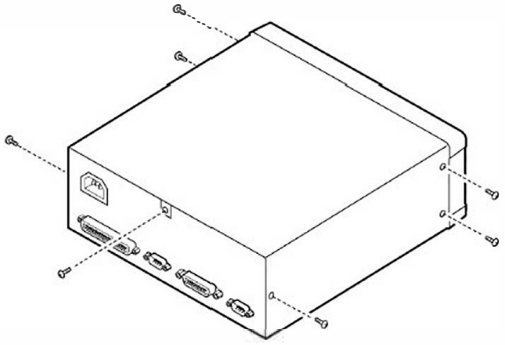
When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

Removing the Lithium Battery

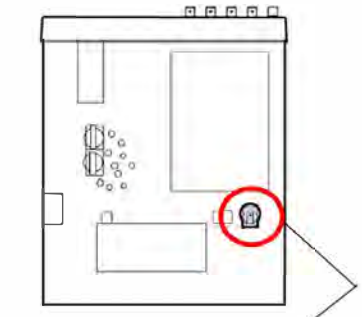
⚠WARNING **To avoid electric shock, turn off the power button and disconnect the power cord and measurement probes before removing the lithium battery.**

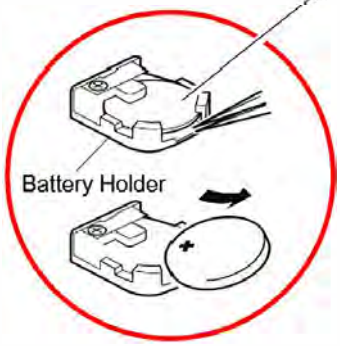
Required tools:

- One Phillips screwdriver (No.1)
- One pair of tweezers (to remove the lithium battery)



(Overhead View)





1 Verify that the power to the instrument is OFF, and unplug the power cord, and any other cords or cables.

2 Remove the six screws from the sides and one screw from the rear.

3 Remove the cover.

4 Insert the tip of tweezers between the battery and battery holder as shown in the diagram and lift up on the battery to remove it.

⚠CAUTION

Be careful not to short circuit + and −.
Doing so may cause sparking.

CALIFORNIA, USA ONLY
Perchlorate Material - special handling may apply.

1.888.610.7664 www.calcert.com sales@calcert.com

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix

Appendix 1 Four-Terminal (Voltage-Drop) Method

The Four-Terminal method is essential for measuring very small resistance values.

With two-terminal measurements (Fig. 1), the resistance of the test leads is included in the measured resistance, resulting in measurement errors.
The Four-Terminal method (Fig. 2) consists of the current source terminals (H_{CUR}, L_{CUR}) for providing a constant current, and the voltage detection terminals (H_{POT}, L_{POT}) for detecting the voltage drop.
Because of the high input impedance of the voltmeter, measurement requires essentially no current flow through the leads connecting the voltage detection terminals to the test object, practically eliminating the effects of lead and contact resistance on the measurement probe.

Two-Terminal Measurement Method

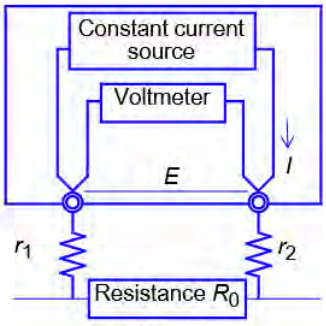


Figure 1

Measurement current I flows through the test object resistance R_0 as well as lead resistances r_1 and r_2. Therefore, voltage measured will be given by $E = I(r_1+R_0+r_2)$ which includes lead resistances r_1 and r_2.

Four-Terminal Measurement Method

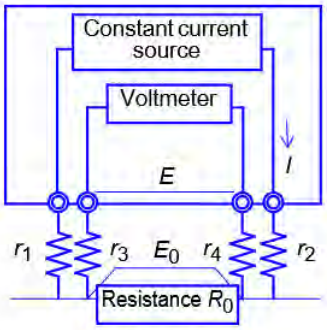
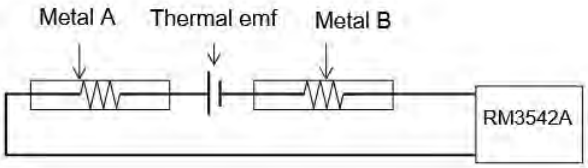


Figure 2

Current I flows from r_2 to r_1 through test object resistance R_0. The voltmeter has an extremely high input resistance, so the measurement current will flow to r_3 and r_4. Therefore, voltage drop across r_3 and r_4 is zero, and the voltage measured as E across the measurement terminals, and the voltage drop E_0 between the test object resistance R_0 are essentially equal, allowing test object resistance to be measured without being affected by r_1 to r_4.

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 2 Effect of Thermal emf



Thermal emf is the potential difference that occurs at the junction of two dissimilar metals, which if sufficiently large, can cause erroneous measurements. Because this instrument functions by measuring potential difference while applying a constant direct current through the test object, the effect of thermal emf can affect measurements. The amplitude of thermal emf depends on the temperature of the measurement environment, with the force generally being greater at higher temperature.
Thermal emf typically occurs at any junction of dissimilar metals, including between the test probe tips and the test object.

Measurement discrepancy caused by thermal emf:
(Example)
When the voltage of thermal emf is 10 µV and the resistance value to be measured is 1 Ω, current in the LP1 Ω range is 10 mA.
Measurement value actually displayed on this instrument will be as follows.
(1 Ω x 10 mA + 10 µV) / 10 mA = 1.00100 Ω

On this instrument, the offset voltage compensation (OVC) function is enabled in the ranges from 100 mΩ to 10 Ω and when using the low-power resistance measurement, to minimize the effect of thermal emf.
The offset voltage compensation (OVC) function employs the principle that the following value is known to be a true resistance value from R_P(>0), the value measured with current flowing in the positive direction, and R_N(<0), the value measured with current flowing in the negative direction.
(R_N is a negative value)

$$\frac{R_P - R_N}{2}$$

When the measured object is inductive, some delay (DELAY2) must be set to allow adequate current flow before starting the measurement (p. 46).
Set the delay so that inductance does not affect measurements.
To fine tune the delay, begin with a longer delay than necessary, then gradually shorten it while watching the measurement value.

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 3 Unstable Measurement Values

If the measurement value is unstable, verify the following.

(1) Effect of Noise from Power Supply Lines

Noise from power supply lines arises from commercial power, and not only from power lines or outlets, but also as radiated emissions from fluorescent lights and home appliances. The frequency of the noise from power supply lines depends on the commercial supplied power frequency, and occurs at a frequency of 50 Hz or 60 Hz.
One method typically used to reduce the effects of noise caused by commercial power supplies is to set the measurement time to a whole-number multiple of the power supply cycle.
The instrument provides 3 measurement speed settings: FAST, MEDIUM, and SLOW. With the FAST setting, measurements are not synchronized with the power line period, so high resistance or low-power resistance measurements may become unstable. In such cases, use the SLOW setting or take noise suppression countermeasures.

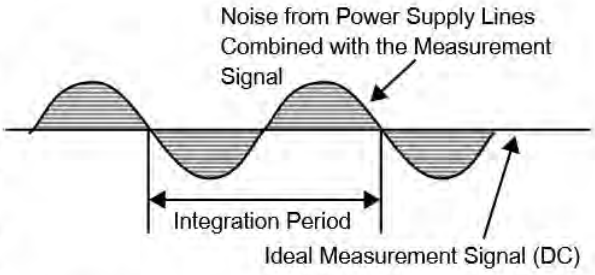


Figure 1. Effect of Noise from Power Supply Lines

For high-resistance measurements, connecting the shield to the GUARD potential is helpful.

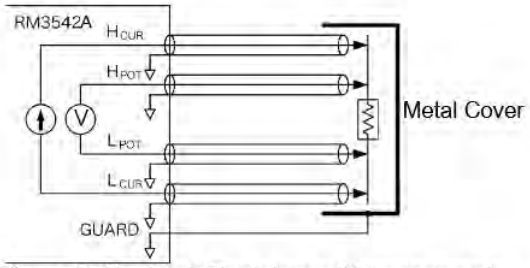


Figure 2. For High-Resistance Measurements

In low-resistance range and low-power resistance measurement, it is effective not only to shield with the GUARD potential, but also to twist the measurement probe lines together where possible.

Even when the integration time is set by a PLC, measurement values are unstable if the power supply line frequency setting is 60 Hz and the instrument is used in a 50 Hz region. Confirm the line frequency setting of the instrument.

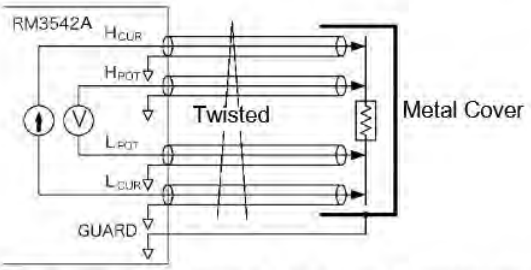


Figure 3. For Low-Power Resistance Measurements

(2) Using Low-Power Resistance Measurement

Low-power resistance measurement employs a smaller measurement current than normal resistance measurements. Therefore, measurements are more susceptible to the effects of external electrical noise and thermal emf.

1.888.610.7664 www.calcert.com sales@calcert.com

Measurement should be conducted as far as possible from devices emitting electric or magnetic fields such as power cords, fluorescent lights, solenoid valves and PC displays. If electrical noise ingress is a problem, prepare the measurement leads as shown in Fig. 2 and Fig. 3.
If thermal emf is a problem, use the RM3542A OVC function. If OVC cannot be used for reasons such as tact time limitations, use a low-thermal emf material such as copper for wiring, and protect against airflow on connecting parts (test object or connectors).

(3) Multi-Point Contacts with Clip Type Probes

The ideal conditions for four-terminal measurements are shown in Fig. 4: current flows from the far probe and voltage is detected with uniform current distribution.

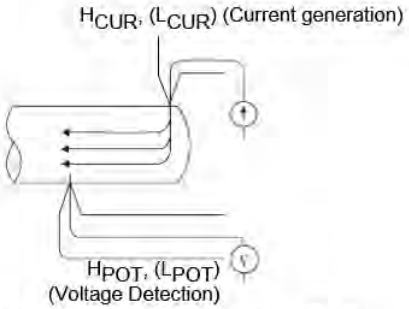


Figure 4. Ideal Four-Terminal Method

To facilitate measurement, the tips of the Model Hioki 9140-10 4-Terminal Probe are jagged. As shown in Fig.5 (enlarged view of probe tip contact area), the measurement current flows from multiple points, and the voltages are detected at multiple points. In such cases, the measurement value varies according to the total contact area.

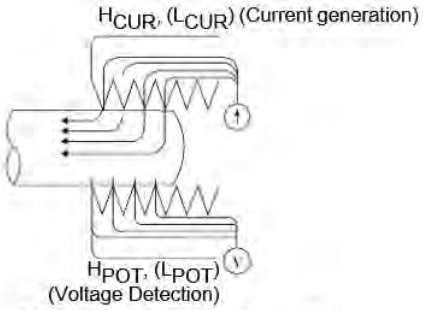


Figure 5. Measurement with Model 9140 4-Terminal Probe

Additionally, as shown in Fig. 6, when measuring the resistance of approximately a 100 mm length of wire, the length between the nearest edges of the clips is 100 mm, but the length between the farthest edges of the clips is 110 mm, so the actual measurement length (and value) has an uncertainty of 10 mm (10%). If measurement values are unstable for any of these reasons, maximize stability by measuring with point contacts as far as possible.

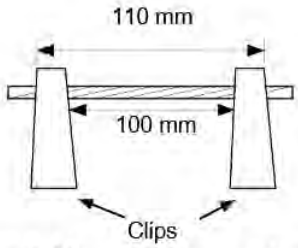


Figure 6. Measuring the resistance of a 100 mm length of wire

1.888.610.7664 www.calcert.com sales@calcert.com

(4) Wider/Thicker DUTs

If the measuring object has a certain width or thickness like boards or blocks, it will be difficult to measure it accurately using Clip Type Probes or Pin Type Probes. By using such measurement probes, there may be considerable fluctuation of the measurement value due to contact pressure or contact angle.
For example, when measuring a W300 x L370 x t0.4 mm metal plate, the measurement values are fairly different, even if measuring the same points, as shown below:
0.2 mm pitch Pin Type Probe: 1.1 mΩ
0.5 mm pitch Pin Type Probe: 0.92 to 0.97 mΩ
Model 9287-10 Clip Type Lead: 0.85 to 0.95 mΩ

This does not depend on the contact resistance between probes and the measuring object, but on the current distribution of the measuring object.

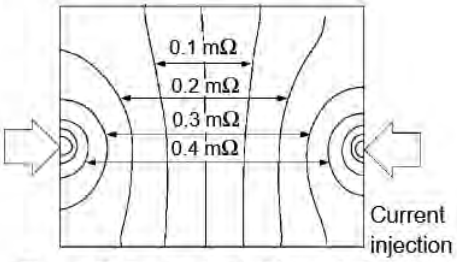


Figure 7. Equipotential line of the metal plate
(W300 mm x L370 mm x t0.4 mm)

*Apply a current of 1 A to the end point and plot the equipotential line for 50 µV levels

Figure 7. is an example plot of equipotential line for a metal plate. Similar to the relation between atmospheric pressure distribution and wind on a weather forecast diagram, current density is higher in locations where the equipotential lines are narrowly spaced, and lower in locations where they are widely spaced. The figure illustrates how the electric potential gradient varies significantly near the point at which current is injected. This variation is due to the fact that the current is in the process of spreading out into the metal plate, increasing the current density in that area. For this reason, when the voltage detection terminals are placed close to the point at which current is injected, minute changes in the position of contact are associated with significant changes in the measured value.

It is known that such effects can be minimized by detecting the voltage within the space between the current injection points. Generally, if the distance between the voltage detection points and their corresponding current injection points is greater than the width (W) or thickness (t) of the DUT, current distribution may be considered uniform.
As shown in Fig. 8, it is desirable for the POT terminals to be positioned at least 3W or 3t inside the CUR terminals.

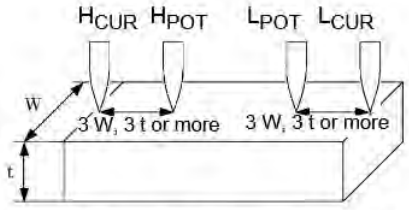


Figure8. Probe Positions for Wider/ Thicker measuring objects

(5) Unstable Temperature of the DUT

Copper wire resistance has a temperature coefficient of about 0.4%/°C. Just holding a copper wire in the hand raises its temperature, causing its resistance to be increased as well. When the hand is removed from the wire, temperature and resistance decrease. Varnished windings are more susceptible to temperature increase, so the resistance tends to be relatively high. If the temperature of the measured object is different from that of the probe, thermal emf occurs and causes an error. Try to measure after the temperature of the measured object becomes close to that of room temperature. Use an instrument with a temperature-compensation function such as the Hioki RM3544, RM3545 and RM3548 to minimize temperature dependence of copper etc.

1.888.610.7664 www.calcert.com sales@calcert.com

(6) The Sample Becomes Warm

The maximum applied power to a measuring object by this instrument is determined as follows.
The resistance of samples with small thermal capacity can change due to heating. In such cases, set the low-power resistance measurement to ON.

Range		Measurement current	The maximum applied power (Measuring object resistance) x (Measurement current)^2	
			VOLTAGE LIMIT: OFF	VOLTAGE LIMIT: ON
	100 mΩ	100 mA	1.2 mW	1.2 mW
	1000 mΩ	100 mA	12 mW	12 mW
	3 Ω	33.3 mA	4 mW	4 mW
	10 Ω	10 mA	1.2 mW	1.2 mW
	100 Ω	10 mA	12 mW	12 mW
	300 Ω	3.33 mA	4 mW	4 mW
	1000 Ω	1 mA	1.2 mW	1.2 mW
	10 kΩ	1 mA	12 mW	12 mW
	30 kΩ	333 µA	4 mW	1.7 mW
	100 kΩ	100 µA	1.2 mW	0.5 mW
	300 kΩ	33.3 µA	400 µW	170 µW
	1000 kΩ	10 µA	120 µW	50 µW
	3 MΩ	3.33 µA	40 µW	17 µW
	10 MΩ	1 µA	12 µW	5 µW
	30 MΩ	333 nA	4 µW	1.7 µW
	100 MΩ	100 nA	1.2 µW	0.5 µW
LP	1000 mΩ	10 mA	120 µW	120 µW
LP	3 Ω	3.33 mA	40 µW	40 µW
LP	10 Ω	1 mA	12 µW	12 µW
LP	100 Ω	1 mA	120 µW	120 µW
LP	300 Ω	333 µA	40 µW	40 µW
LP	1000 Ω	100 µA	12 µW	12 µW

(7) Ingress of External Noise

Measurement should be conducted as far as possible from devices emitting electric or magnetic fields such as power cords, fluorescent lights, solenoid valves and PC displays. If electrical noise ingress is a problem, prepare the measurement leads as shown in Fig. 9.

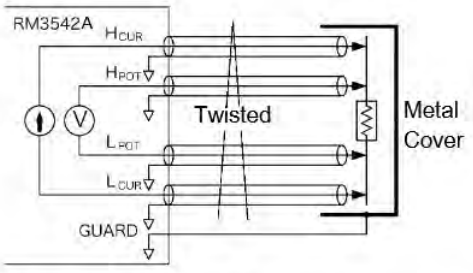


Figure 9. Wiring to Minimize Noise Ingress

(8) Measuring Transformers and Motors

If noise enters an unconnected terminal of a transformer or if motor rotor moves, measurements may be unstable due to induced voltage on the measured winding. Pay attention to the treatment of unconnected terminals on transformers or to motor vibration.

1.888.610.7664 www.calcert.com sales@calcert.com

(9) Measuring Large Transformers or Motors

When measuring high-inductance (high-Q) DUTs such as large transformers or motors, measurement values may be unstable. The RM3542A depends on constant current flow through the DUT, but producing constant current becomes impossible as inductance approaches infinity. To obtain stability in a constant-current source with a large inductance, response time is sacrificed. If you find that resistance values are scattered when measuring large transformers or motors, please consider the above or contact your local Hioki distributor for further assistance.

(10) Non-Four-Terminal Measurements

The four-terminal method requires that four probes be connected to the DUT.

By measuring as shown in Fig.10, the measured resistance includes that of the contacts between the probes and DUT.
Typical contact resistance is several milliohm with gold plating, and several tens of milliohm with nickel plating.
With measurement values of several kΩ, this would not seem to be a problem, but if a probe tip is oxidized or dirty, contact resistance of the order of kΩ is not unusual.

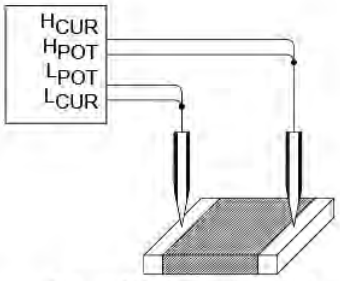


Figure10. Two-Terminal Measurement

To maximize proper measurements, emulate the four-terminal method as closely as possible to the contact points of the sample shown in Figure 11.

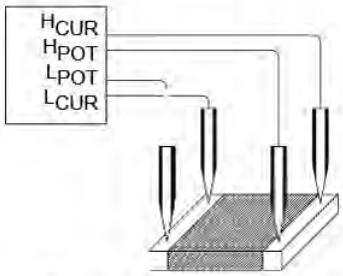


Figure 11. Four-Terminal Measurement

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 4 Rack Mounting

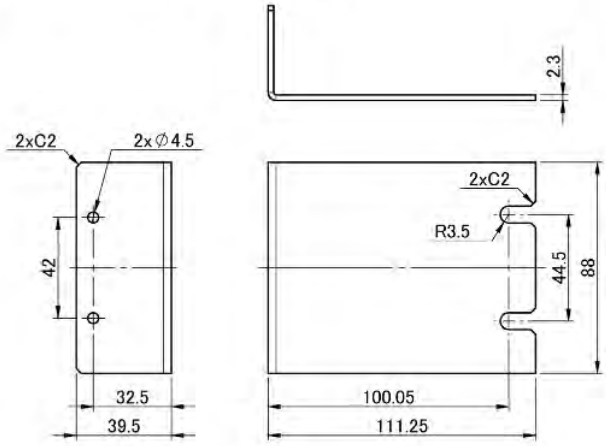
Rack-mounting hardware can be attached to the instrument after removing the screws on the sides.

⚠WARNING **Observe the following precautions regarding the mounting screws to avoid instrument damage and electric shock accidents.**

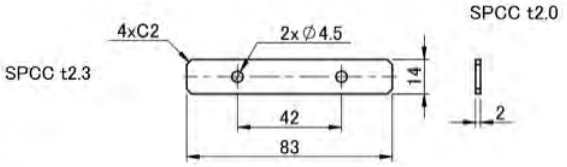
- **When installing the Rack Mounting Plate, the screws must not intrude more than 3.5 mm into either side of the instrument.**
- **When removing the Rack Mounting Plate to return the instrument to stand-alone use, replace the same screws that were installed originally. (Supporting leg: M3 x 6 mm, side: M4 x 6 mm)**

Rack Mounting Plate Reference Figures and Installation Procedures

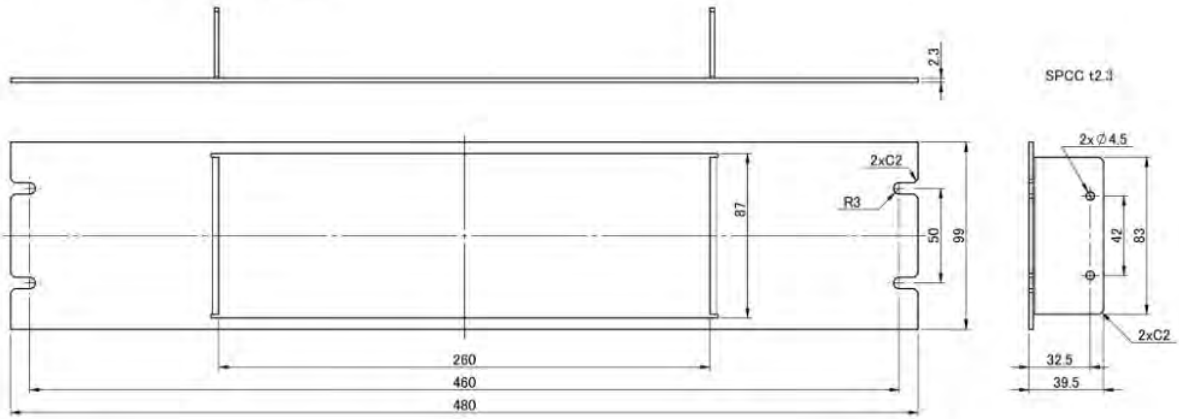
Rack Mounting Blacket (EIA)

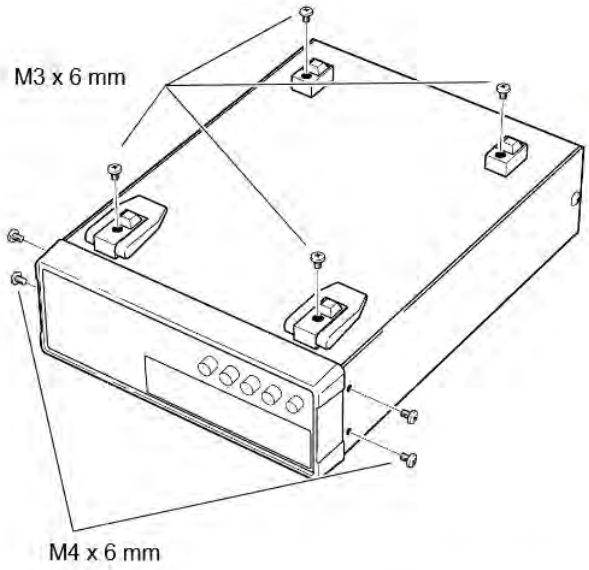


Spacer (Two Required)

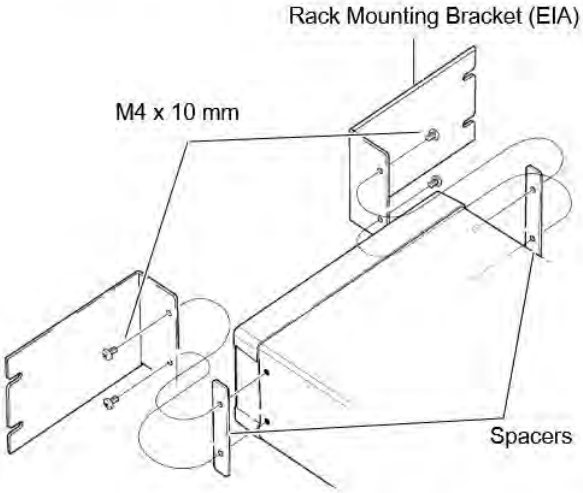


Rack Mounting Blacket (JIS)



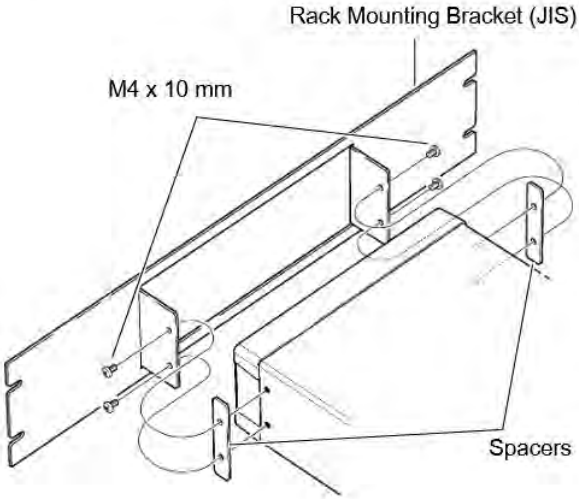


1 Remove the feet from the bottom of the instrument, and the screws from the sides (four near the front).



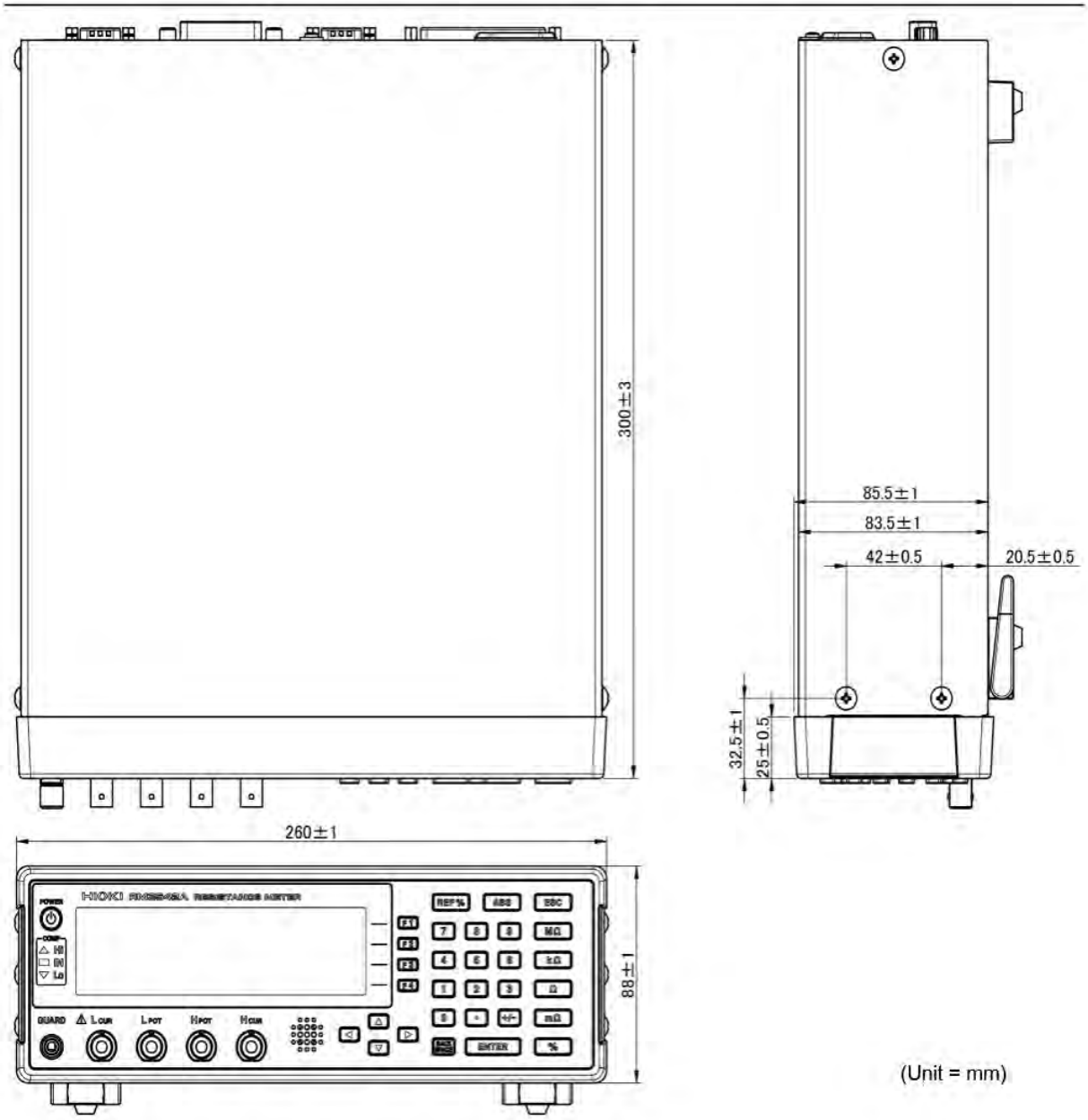
2 Insert the spacers on both sides of the instrument, attach the Rack Mounting Blackets with the M4 x 10 mm screws.

When installing in a rack, support it by a stand or other commercially available items.



1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 5 Dimensional diagram



(Unit = mm)

Appendix 6 Calibration

Calibration Conditions

• Ambient temperature and humidity	23°C±5°C, 80% RH or less
• Warm-up time	30 minutes
• Power source	From 100 V to 240 V±10%, 50 Hz/60 Hz
• Measurement speed	SLOW
• Integration time	Default setting
• Contact improver	OFF (Required when using the Fluke 5700A)
• Measurement current	CONT (Required when using the Fluke 5700A)
• Probe short-circuit detection	OFF
• 0ADJ	OFF (necessary)
• External magnetic field	Environment close to the Earth's magnetic field
• Voltage level monitor	OFF (Required when using the Fluke 5700A)

Calibration equipment

Please use the following for calibration equipment.

See: "Connection Methods" (p. A12)

Resistance measurement equipment

- Fluke 5700A (10 Ω or more) or equivalent
- Alpha Electronics CSR-R10 (100 mΩ or equivalent)
- Alpha Electronics CSR-1R0 (1 Ω or equivalent)

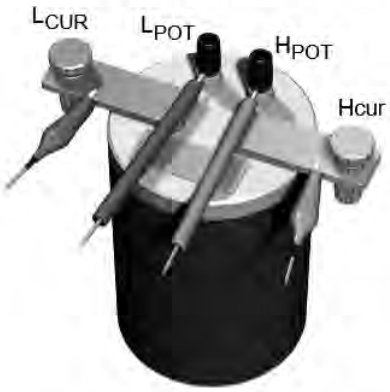
If the Fluke 5700A cannot be used, please use the following equipment.
Alpha Electronics product

- CSR-100 (10 Ω)
- CSR-101 (100 Ω)
- CSR-102 (1 kΩ)
- CSR-103 (10 kΩ)
- CSR-104 (100 kΩ)
- CSR-105 (1 MΩ)
- CSR-106 (10 MΩ)
- CSR-107 (100 MΩ)
-
-

When using the YOKOGAWA 2792 for calibration

Connect four terminals separately to calibrate, as shown in the following figure.
Note that calibration cannot be performed with the Clip Type Probe, such as 9140-10.

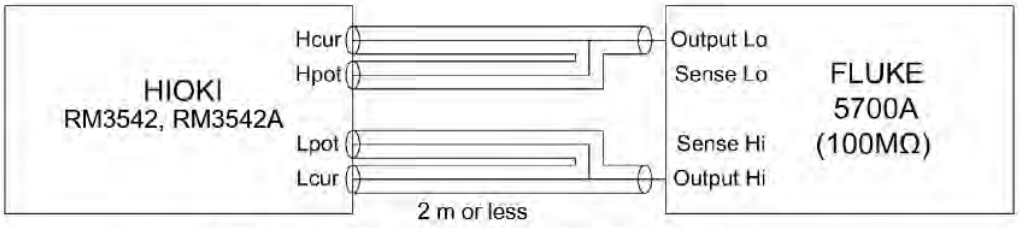
Correct



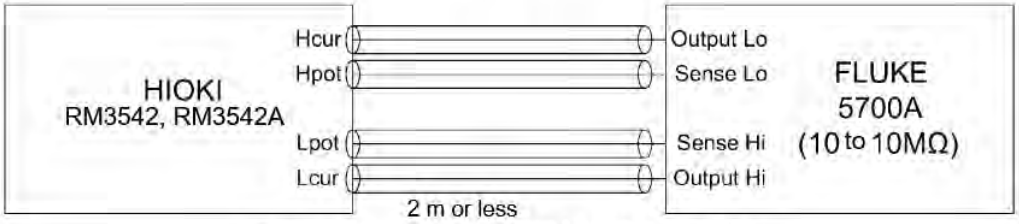
Wrong

1.888.610.7664 www.calcert.com sales@calcert.com

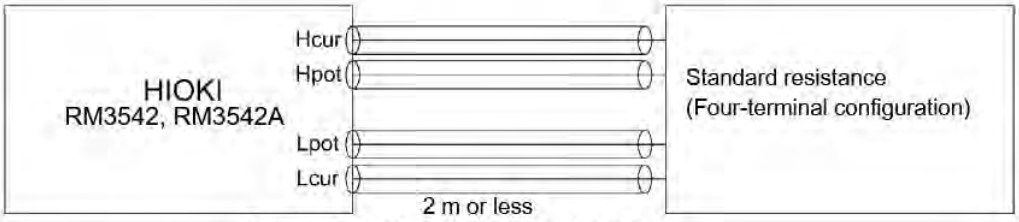
Connection Methods



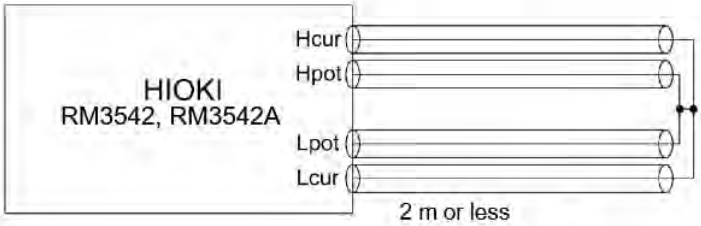
Calibration using Fluke 5700A at 100 MΩ



Calibration using Fluke 5700A at 10 Ω to 10 MΩ



Calibration using standard resistance



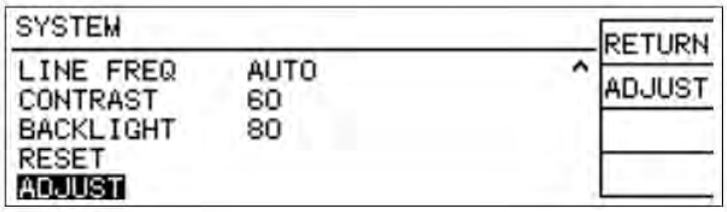
0-Ω calibration

NOTE When calibrating using the Fluke 5700A, measurement values may change during self-calibration (once every 10 minutes).

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 7 Adjustment

The System screen includes an adjustment screen.
The Adjustment screen is used by Hioki for repair and adjustment purposes. It is not for customer use.



1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 8 Table of Comparison Commands ADEX AX-162D / for this instrument

Description	Model AX-162D (Original mode)			Model RM3542A		
	Command	Query	Data	Command	Query	Data
Measurement mode setting	**M***m*	-	*m* = 0/ D (% mode)/1/ R (R mode)	**:CALCulate:LIMit:MODE** *m*	-	*m* = REF% (REF mode)/ ABS (ABS mode)
	M?	**XANS1,M***m*		**:CALCulate:LIMit:MODE?**	*m*	
Measurement range setting	**RNG***r*	-	*r* = 0 to 9	**:RESistance:RANGe** *r*	-	*r* = 0 to 120E+6
	RNG?	**XANS1,RNG***r*		**:RESistance:RANGe?**	*r*	
Reference resistor setting	**RS***float*	-	*float* = 500E-5 to 10900E+4	**:CALCulate:LIMit:REFerence** *float*	-	*float* = 0 to 120.000E+6
	RS?	**XANS1,RS***float*		**:CALCulate:LIMit:REFerence?**	*float*	
% mode upper and lower limit values setting	**LH***float1*	-	*float1* = -9999E-2 to 9999E-2	**:CALCulate:LIMit:PERCent** *float1,float2*	float1, float2	*float1* = -99.990 to 99.990 *float2* = -99.990 to 99.990
	LH?	**XANS1,LH***float1*				
	LL*float2*	-	*float2* = -9999E-2 to 9999E-2	**:CALCulate:LIMit:PERCent?**		
	LL?	**XANS1,LL***float2*				
R mode upper and lower limit values setting	**LH***float1*	-	*float1* = 00001E-5 to 20000E+4	**:CALCulate:LIMit:ABS** *float1,float2*	- float1, float2	*float1* = 0 to 120.000E+6 *float2* = 0 to 120.000E+6
	LH?	**XANS1,LH***float1*				
	LL*float2*	-	*float2* = 00001E-5 to 20000E+4	**:CALCulate:LIMit:ABS?**		
	LL?	**XANS1,LL***float2*				
Shift range up command	**SFTRNGU**	-		(Multiple commands)		*r1* = r x 10
				:RESistance:RANGe?	*r*	
				:RESistance:RANGe *r1*	-	
Shift range down command	**SFTRNGD**	-		(Multiple commands)		*r1* = r/10
				:RESistance:RANGe?	*r*	
				:RESistance:RANGe *r1*	-	
Measurement speed setting	**S***s*	-	*s* = 0 (SLOW mode)/ 1 (FAST mode)	**:SPEEd** *s*	-	*s* = FAST/ MEDium/ SLOW
	S?	**XANS1,S***s*		**:SPEEd?**	*s*	
Trigger	**E**	-		***TRG**	-	

Note: This instrument cannot accept continuous commands (a delimiter is necessary between multiple commands).

Example 1

Measurement function: R mode
Measurement ranges: 10 Ω
Upper limit: 1.900 Ω
Lower limit: 1.100 Ω
Measurement speed: SLOW
Trigger after the above settings

AX-162D (Original mode)	RM3542A
M1	:CALCulate:LIMit:MODE ABS
RNG2	:RESistance:RANGe 10
LH1900E-3	:CALCulate:LIMit:ABS 1900E-3,1100E-3
LL1100E-3	
S0	:SPEEd SLOW
E	*TRG

or

```
M1RNG2LH1900E-3LL1100E-3S0E
```

Note: Although no delimiters are shown, they must be included at the end of each command line.

Example 2

Measurement function: % mode
Reference resistance: 100 kΩ (Measurement range: 100 kΩ)
Upper limit: 10.00%
Lower limit: -10.00%
Measurement speed: FAST
Trigger after the above settings

AX-162D (Original mode)	RM3542A
M0	:CALCulate:LIMit:MODE REF
	:RESistance:RANGe 100E+3
RS100E+3	:CALCulate:LIMit:REFerence 100E+3
LH+1000E-2	:CALCulate:LIMit:PERCent +1000E-2,-1000E-2
LL-1000E-2	
S1	:SPEEd FAST
E	*TRG

or

```
M0RS100E+3LH+1000E-2LL-1000E-2S1E
```

Note:
Although no delimiters are shown, they must be included at the end of each command line.
Even when the reference standard resistance is set on this instrument, the range is not automatically selected.
Use the range setting command to set the same value as the reference standard resistance.
When setting the same value as the reference standard resistance using the range setting command, there are cases in which the range is different from the instrument's auto-ranging selection, depending on the value.

1.888.610.7664 www.calcert.com sales@calcert.com

Appendix 9 Zero Adjustment

Zero adjustment is a function which adjusts the zero point by deducting the residual value obtained during 0 Ω measurement. For this reason, zero adjustment must be performed when the connection is made to 0 Ω. However, connecting a sample with no resistance is difficult and therefore is not practical.
When performing the actual zero adjustment, create a pseudo connection to 0 Ω and then adjust the zero point.

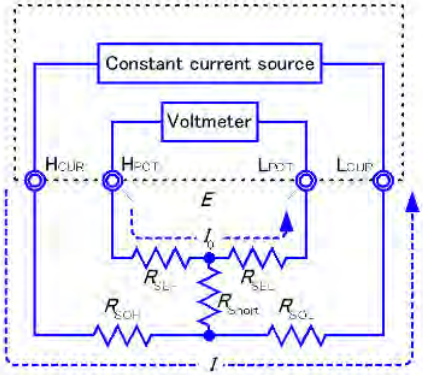
To create the 0 Ω connection state

If an ideal 0 Ω connection is made, according to Ohm's Law, $E = I \times R$, the voltage between H_{POT} and L_{POT} becomes 0 V. In other words, if you set the voltage between H_{POT} and L_{POT} to 0 V, this gives you the same state of 0 Ω connection.

To perform zero adjustment using the instrument

The instrument uses a measurement fault detection function to monitor the state of connection between the four measurement terminals.
For this reason, when performing zero adjustment, you need to make connections between the terminals appropriately in advance (Figure 1).

First, in order to set the voltage between H_{POT} and L_{POT} to 0 V, short between H_{POT} and L_{POT}. If the probe lead resistances $R_{SEH} + R_{SEL}$ are less than a few Ω, there will be no problem. This is because the POT terminal is a voltage measurement terminal in which the current I_0 rarely flows and is in the relational expression, $E = I_0 \times (R_{SEH} + R_{SEL})$, $I_0 = 0$. Therefore, voltage between H_{POT} and L_{POT} becomes almost 0 if the lead resistance of R_{SEH} and R_{SEL} is a few Ω.
Next, connect H_{CUR} and L_{CUR}. This is to avoid display of error when no measurement current flows through. The lead resistance of the probes in use ($R_{SOH} + R_{SOL}$) must be less than or equal to the resistance at which the measurement current will flow.



$$E = (I_0 \times R_{SEL}) + (I_0 \times R_{SEH})$$
$$= (0 \times R_{SEL}) + (0 \times R_{SEH})$$
$$= 0 \text{ [V]}$$

Figure 1. Pseudo connection to 0 Ω

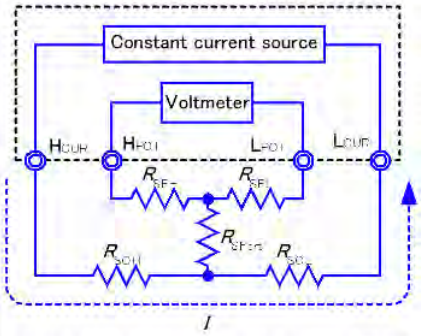
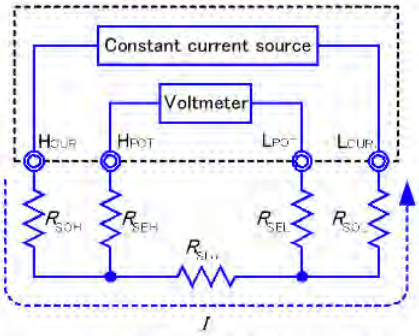
Furthermore, when monitoring the connection status between POT and CUR, POT and CUR must be connected. It will not be problematic for the wiring resistance of the probes in use (R_{Short}) to be on the order of several ohms.
When wired as described above, the measurement current *I* flowing from H_{CUR} will flow to L_{CUR} and not to the H_{POT} or L_{POT} wires. This enables the voltage between H_{POT} and L_{POT} to be kept accurately at 0 V, and the appropriate zero adjustment becomes possible.

1.888.610.7664 www.calcert.com sales@calcert.com

To perform zero adjustment appropriately

Table 1 shows the correct and incorrect connections. The resistances in the figure indicate lead resistances; there will be no problem if they are less than a few Ω respectively.
As in (a), when H_{POT} and L_{POT}, and H_{CUR} and L_{CUR} are connected respectively, and if POT and CUR are connected in a circuit, a potential difference will not be generated between H_{POT} and L_{POT} and 0 V is input. This enables zero adjustment to be carried out correctly.
On the other hand, as in (b), when H_{POT} and H_{CUR}, and L_{POT} and L_{CUR} are connected respectively, and if Hi and Lo are connected in a circuit, the voltage of $I \times R_{Short}$ will be generated between H_{POT} and L_{POT}. For this reason, the pseudo 0 Ω connection state cannot be achieved and zero adjustment cannot be carried out correctly.

Table 1: Connection Methods

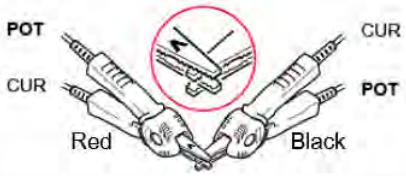
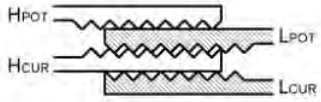
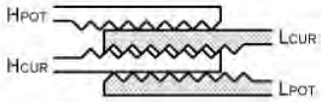
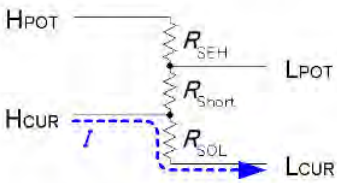
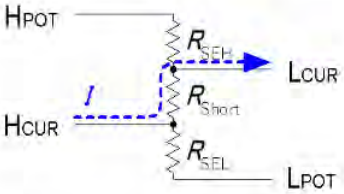
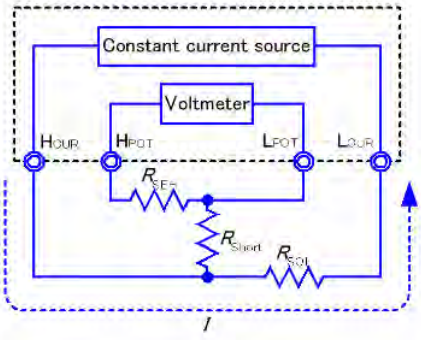
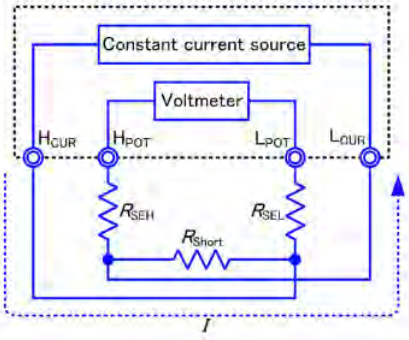
Connection Methods	 (a) Use one point each between POT-CUR for connection	 (b) Use one point each between Hi and Lo for connection
Resistance between H_{POT} and L_{POT}	$R_{SEH} + R_{SEL}$	$R_{SEH} + R_{Short} + R_{SEL}$
Flow path of measurement current I	$R_{SOH} \rightarrow R_{SOL}$	$R_{SOH} \rightarrow R_{Short} \rightarrow R_{SOL}$
Voltage generated between H_{POT} and L_{POT}	0	I c R_{Short}
As connection method for zero adjustment	Correct	Wrong

1.888.610.7664 www.calcert.com sales@calcert.com

To perform zero adjustment using a probe

When you actually perform zero adjustment using a probe, you may unexpectedly create the connection shown in Table 1 (b). Therefore, when performing zero adjustment, you need to pay sufficient attention to the connection state of each terminal.
9287-10 Clip Type Lead Here, is used as an example for the explaining the connection. Table 2 shows the connection state of the tip of the lead and equivalent circuit in the respective correct and wrong connections. As indicated above, a correct connection method will be as shown in Table 1 (a), and the voltage between H_{POT} and L_{POT} will be 0 V. However, a wrong connection will be as shown in Table 1 (b), and the voltage between H_{POT} and L_{POT} will not be 0 V.

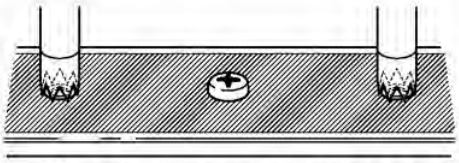
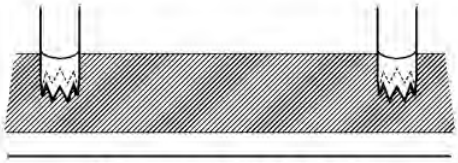
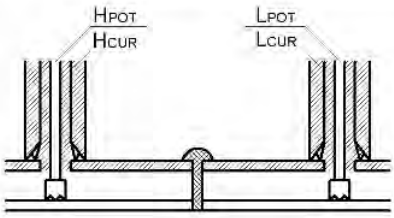
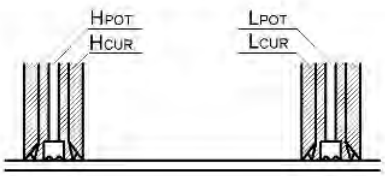
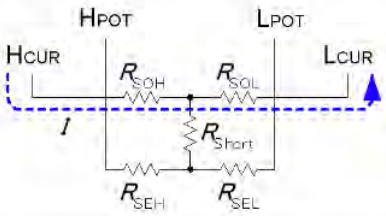
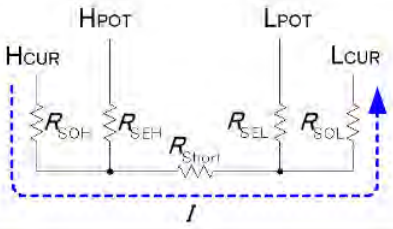
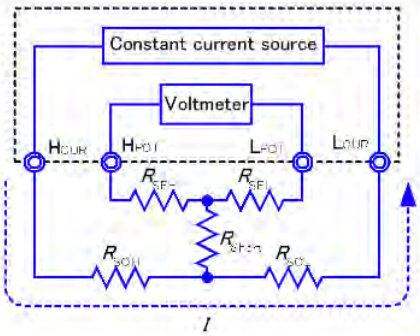
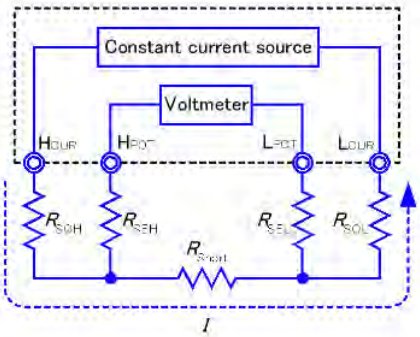
Table 2: Clip type lead connection methods used during zero adjustment

	Correct	Wrong
Connection Methods		
Tip of lead		
Equivalent circuit		
Deformed equivalent circuit		
As connection method for zero adjustment	Correct	Wrong

To perform zero adjustment using 9454 Zero Adjustment Board

When performing zero adjustment, you cannot use a metal board or similar object to replace 9454 Zero Adjustment Board.
9454 Zero Adjustment Board is not just a metal board. Its structure consists of two metal boards screwed together at one point. The zero adjustment board is used when performing zero adjustment of 9465 Pin Type Lead.
Table 3 shows cross sectional diagrams and equivalent circuits of the two connection methods: connecting Pin Type Lead to zero adjustment board, and connecting that to a metal board or similar object. When using the zero adjustment board, connection will be as shown in Table 1 (a), resulting in 0 V between H_{POT} and L_{POT}. However, Table 1 (b) shows the connection using a metal board etc., and 0 V is not obtained between H_{POT} and L_{POT}.

Table 3: Pin type lead connection methods in zero adjustment

Connection Methods	 If the connection is made using a 9454 Zero Adjustment Board	 If the connection is made using a metal board etc
Tip of lead		
Equivalent circuit		
Deformed equivalent circuit		
As connection method for zero adjustment	Correct	Wrong

1.888.610.7664 www.calcert.com sales@calcert.com

If zero adjustment is difficult when using self-made probe to measure

When you perform zero adjustment using a self-made probe to do the measurement, connect the tip of the self-made probe as shown in Table 1 (a). However, if connection as shown in Table 1 (a) is difficult, you can try the following methods.

If DC resistance meter is used

The main purpose of performing zero adjustment is to remove offset of the measurement instrument. For this reason, the value to be deducted as a result of zero adjustment almost does not depend on the probe. Therefore, after using the standard probe to make the connection shown in Table 1 (a) and performing zero adjustment, you can replace it with a self-made probe to measure with the offset removed from the measurement instrument.

If AC resistance meter is used

In addition to removing offset of the measurement instrument, another main purpose of performing zero adjustment is to remove influence of the probe shape. For this reason, when performing zero adjustment, try as much as possible to position and set the form of the self-made probe close to the measurement state. Then, you need to make the connection as shown in Table 1 (a) and perform zero adjustment.
However, when a Hioki product is used, even in the AC resistance measurement, if the required resolution exceeds 100 μΩ, the same zero adjustment method used with the DC resistance meter may be sufficient.

1.888.610.7664 www.calcert.com sales@calcert.com

Index

Number

0ADJ 99

A

ABS 38
Absolute value judgment 38
Accuracy 198
Adjustment ..... A 13
Applied Voltage Limiter Function 66
Auto-exporting 89, 90
Auto-Memory Function 81, 83
Auto-Range 34, 188
Manual Range 35

B

Backlight 76
Backup function 27
Basic Settings screen 19, 21
Binary 119
Block diagram 16
Broken measurement cables 52

C

C.E. Hi 42, 52, 203
C.E. Lo 42, 52, 203
C.E. Volt 42, 57, 203
CAL 99
Calibration ..... A 11
CE_HI 99
CE_LO 99
Clock 74
Command
  Command Message 121
Command Error 127, 131
Command execution time 131
Command Syntax 121
Communications 117
Comparator Function 38
Comparator judgment 38, 72
Comparator judgment beeper 72
Comparator mode 38
Contact Check Fault 42
Contact Check Function 52
Contact Improvement Function (Contact Improver) 54
Continuous measurement 33, 157
Crossover wiring 116
Current Mode Setting Function 58
Current Monitor Fault 42
Current Monitor Function 43

D

Data exporting methods 168
Data Formats 123
Data Memory Function 81, 82, 161
Data Memory Setting screen 19, 21
Data Output Function 81, 89, 90
DATA SETTINGS 19, 21
Default settings 78
DELAY 46
Delay Function 46
Delay time 46
Delimiter 122
Device clear 124, 130
Dimensional diagram ..... A 10
Disposing 205

E

Edge 108
EOM 100
ERR 99, 203
Error displays 203
Estimated Delay time 47
Event registers 127
  Device-Specific Event Status Registers (ESR0 and ESR1) 128
  Standard Event Status Register (SESR) 127
Execution Error 127, 131
EXT I/O Connector 98
EXT. I/O Connector 112
EXT. I/O 97
  Wiring Diagram 106
EXT.I/O 196
External Control 97
  Q&A 111
External trigger 33

F

F.LOCK 69
Fixed-point data 123
Floating-point exponential representation data 123

1.888.610.7664 www.calcert.com sales@calcert.com

Four-Terminal ..... A 1
Free-run 33, 111, 157
Frequency 73
FULL 69

G

GP-IB interface 113, 197

H

Headers 121, 122
  Omission 124
HI 100
HOLD 99

I

IN 100
INDEX 99
INFO 204
Initialization Items (communication) 130
Initializing 77
Input buffer 124
Inspection 29, 201
INT 33
Integer data 123
Integration Time 50, 189
Internal Circuitry 104
Internal trigger 33

J

Judgment Output Shift Function 109

K

Key Beeper 71
Key Operation
  Abnormal Operation. 202
KEY_LOCK 99
Key-Lock Cancel 70
Key-Lock Function 69

L

Line Frequency 73
LO 100
LOCAL 120, 153
long form 121
LOW POWER 30
Low-Power Resistance Measurement ..... 30, A 3

M

M.LOCK 69
Mean 86
MEAS SETTINGS 19, 21
Measure automatically 33
Measurement fault 42
Measurement faults 99, 111
Measurement flow 157
Measuring object 30
Measurement Probes 25
  When extending 26
Measurement range 32, 34, 45, 187
Normal display (measurement screen) 19
Measurement Settings screens 19
Measurement settings 29
Measurement Settings screens 21
Measurement Speed 31, 50
Measurement time 32, 199
Measurement value
  Store as soon as measurement is stable 83
  Storing data 82
  unstable and errors 26
  Unstable measurement or errors .... A 1, A 2, A 3
Measurement Value Format 119, 159
Measurement values
  Unstable ..... A 3
Measurement values are shifted. 202
Measurement values Unstable 202
Memory Function 81, 161
Message terminators 122

N

Noise 26
Normal display (measurement screen) 20
NR1 123
NR2 123
NR3 123
NRf 123

O

Offset Voltage Compensation (OVC) Function .. 67
Open work 43
Out-of-range 42
Out-of-Range Detection Function 43
Output Queue 124
Output Signals 99
OVC 67
OvrRng 38, 42, 203

1.888.610.7664 www.calcert.com sales@calcert.com

P

Percentage Output Function 90
PLC 50
Poor or improper contact 52
Population standard deviation 86
POWER button 27
Power cord 24
Power inlet 24
PRB_CHECK 99
PRB_SHORT 99
PRINT 95, 99
Printer 91, 197
Printing 91, 95
Probe Short-Circuit Detection 59
Process capability index
  bias 86
  Variation 86
Program message 121

Q

Query error 113, 124, 127, 131
Query Messages 121

R

Rack Mounting ..... A 8
Range 32, 34, 45, 199
REF% 38
Reference value 38
Relative value judgment 38
Remote 120
Repair 201
Reset 77
Response Messages 121
Retry Function 64
RS-232C 113, 196

S

Screen contrast 75
Self calibration 99
Self-test 27, 29
Separators 123
Service Request 125
SET MONITOR 61, 197
Settings Monitor Function 61
short form 121
Short-circuited probes 59
Signal pinouts 98
Standard deviation of sample 86
Standard Event Status Register 127
STAT 87
Statistical calculation results 88
Statistical calculation results Printing 95
Statistical Calculations 86, 87
Status Byte Register 125, 126
SYSTEM 19, 22
System screens 19, 22

T

Test fixtures 25
Text 119
Thermal emf ..... 67, A 2
Timing chart 101
  DELAY1/ DELAY2 46
  EXT. I/O 101
  Probe short-circuit detection 59
Tolerance range 38
Transmission speed 114
TRG 87, 142
TRIG 99, 108
Trigger Source 33, 157
Triggering system 157

U

UNLOCK 69
upper and lower threshold values 38
uring 48

V

Voltage Level Monitor Function 57
Voltage Monitor fault 42

W

When Zero Adjustment Fails 37
Wiring 26

Z

Zero Adjustment ..... 36, 99, A 16

1.888.610.7664 www.calcert.com sales@calcert.com

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
   -9. After disassembly, such as opening the product, has been performed by the customer without permission by Hioki
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

25-10 EN-3

1.888.610.7664 www.calcert.com sales@calcert.com

HIOKI

All regional contact information

HIOKI E.E. CORPORATION

2402 EN

Edited and published by HIOKI E.E. CORPORATION Printed in Japan

・Contents subject to change without notice.
・This document contains copyrighted content.
・It is prohibited to copy, reproduce, or modify the content of this document without permission.
・Company names, product names, etc. mentioned in this document are trademarks or registered trademarks of their respective companies.

Europe only

・EU declaration of conformity can be downloaded from our website.
・Contact in Europe: HIOKI EUROPE GmbH

1.888.610.7664 www.calcert.com sales@calcert.com