3504-40
3504-50
3504-60

HIOKI

Instruction Manual

C HiTESTER

EN

Sept. 2018 Revised edition 4

1.800.561.8187 www.itm.com information@itm.com

Contents

Introduction....1
Verifying Package Contents....1
Safety Information....2
Operating Precautions....4

Chapter 1 Overview 7

1.1 Product Overview....7
1.2 Features....7
1.3 Entire Workflow....8
1.4 Names and Functions of Parts....10

Chapter 2 Measurement Preparations 17

2.1 Preparation Flowchart....17
2.2 Checking the Power Voltage....18
2.3 Connecting the Power Cord....19
2.4 Connecting the Probes and Fixtures....20
2.5 Turning the Power On and Off....21

Chapter 3 Basic Measurement 23

3.1 Pre-Operation Inspection....23
3.2 Measurement Example....24
3.3 Setting the Measurement Conditions....26
3.3.1 Measurement Mode....26
3.3.2 Measurement Frequency....26
3.3.3 Measurement Signal Level....27
3.3.4 Measurement Speed....28
3.3.5 Equivalent Circuit Mode....29
3.3.6 Measurement Range....31
3.3.7 Trigger Signal....36

Chapter 4
Compensatefor errors ____ 37

4.1 Open Circuit Compensation and Short Circuit Compensation ... 37
4.2 Load Compensation ... 47
4.3 Offset Compensation ... 54
4.4 Self Calibration ... 58

Chapter 5
Judging measurement results ____ 61

5.1 Comparator Function ... 61
5.2 BIN Measurement Function (Model 3504-50, 3504-60 only) ... 75

Chapter 6
Application Functions ____ 91

6.1 Setting the Average Function ... 91
6.2 Trigger Delay Setting ... 93
6.3 Evaluate Contact Check Function ... 95
6.3.1 Setting the Low C Reject Function ... 96
6.3.2 Measurement Level Monitoring Function Settings ... 98
6.3.3 Contact Check Function Settings (Model 3504-60 only) ... 100
6.4 Setting the Display ON/ OFF ... 103
6.5 Trigger Synchronous Output Function ... 104
6.6 Disable Key Control (Keylock Function) ... 106
6.7 Save the Measurement Conditions (Panel Save Function) ... 107
6.8 Load the Measurement Conditions (Panel Load Function) ... 108
6.9 Setting Beep Tones ... 112
6.9.1 Setting the Beep Tone for Judgment Results of Comparator and BIN ... 112
6.9.2 Setting the Beep Tone for Key Operations ... 114
6.10 Switching the displayed item (SUB display) ... 115
6.11 Performing a System Reset ... 117
6.12 Printing Function ... 118
6.12.1 Preparation Prior to Connecting the Printer ... 118

1.800.561.8187 www.itm.com information@itm.com

6.12.3 Printing 122

Chapter 7
EXT I/O _____ 123

7.1 About the EXT I/O Connector 123
7.2 Circuit Configuration and Connections of the EXT I/O Connector 125
7.3 About Input and Output Signals 126
7.4 About Measurement Times 128

Chapter 8
Controlling the Unit from a PC _____ 131

8.1 Outline and Features 131
8.2 Specifications 132
8.2.1 RS-232C Specifications 132
8.2.2 GP-IB Specifications
(Only for Models 3504-50, 3504-60) 133
8.3 Connection and Setting Procedures 134
8.3.1 Connecting the RS-232C Cable / GP-IB Cable 134
8.3.2 Setting the Interface Communication Conditions 136
8.4 Remote Function 139
8.5 Communication Procedure 140
8.6 Things to Know before Beginning Communication 141
8.6.1 About Message Formats 141
8.6.2 About the Output Queue and Input Buffer 146
8.6.3 About the Status Byte Register 147
8.6.4 About Event Registers 149
8.7 Message List 154
8.8 Ability to Use Commands by State 167
8.8.1 Common Commands 167
8.8.2 Unique Commands 167
8.9 Message Reference 172
8.9.1 Common Commands 173
8.9.2 Unique Commands 178
8.9.3 Response Format of Queries for Returning Values 243
8.10 Initialized Items 245
8.11 Creating Programs 246
8.11.1 Creation Procedure 246
8.11.2 Sample Programs 248

1.800.561.8187 www.itm.com information@itm.com

8.12 Troubleshooting the Interface 250
8.13 Device Document Requirements (Only for Models 3504-50, 3504-60)..... 252

Chapter 9 Specifications 255

9.1 Basic Specifications 255
9.2 Accuracy 259
9.3 Measurement Parameters and Arithmetic Expressions 261

Chapter 10 Maintenance and Service 263

10.1 Inspection, Repair, and Cleaning 263
10.2 Replacing the Power Fuse 265
10.3 Discarding the Unit 266

Appendix A1

Appendix 1 Countermeasures Against Incorporation of External Noise A1
Appendix 1.1 Countermeasures Against Incorporation of Noise from the Power Line 1
Appendix 1.2 Countermeasures Against Incorporation of Noise from the Input Line (Types of Probe) 2
Appendix 2 Measurement of High Impedance Components A3
Appendix 3 Measurement of In-circuit Components A4
Appendix 4 Mounting the Unit in a Rack A5
Appendix 5 External View A7
Appendix 6 Options A8
Appendix 7 Initial Settings Table A11

Index i

1.800.561.8187 www.itm.com information@itm.com

Introduction

Thank you for purchasing the HIOKI “Model 3504-40, 3504-50, 3504-60 C HiTester.” To obtain maximum performance from the unit, please read this manual first, and keep it handy for future reference.

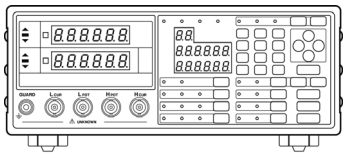
Verifying Package Contents

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

Confirm that these contents are provided.

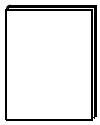
This unit

☐ 3504-40 C HiTester
3504-50 C HiTester
3504-60 C HiTester

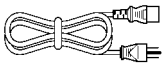


Accessories

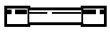
☐ Instruction Manual..... 1



☐ Power cord..... 1



☐ Spare fuse for power supply
(according to voltage specification)..... 1



100 V, 120 V setting: 250 VF 1.0 AL5 x 20 mm dia
220 V, 240 V setting: 250 VF 0.5 AL5 x 20 mm dia

NOTE

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

Options

Appendix 6 "Options" (p. A8)

1.800.561.8187 www.itm.com information@itm.com

Safety Information

⚠WARNING

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

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

Safety Symbols

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

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

⚠WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
⚠CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the unit.
NOTE	Indicates advisory items related to performance or correct operation of the unit.

Other Symbols

	Indicates a prohibited action.
See	Indicates the location of reference information.
	Indicates quick references for operation and remedies for troubleshooting.
*	Indicates that descriptive information is provided below.

Accuracy

We define measurement tolerances in terms of rdg. (reading) and dgt. (digit) values, with the following meanings:

rdg. (reading or displayed value)	The value currently being measured and indicated on the measuring unit.
dgt. (resolution)	The smallest displayable unit on a digital measuring unit/ device/ product, i.e., the input value that causes the digital display to show a "1" as the least-significant digit.

Measurement categories

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

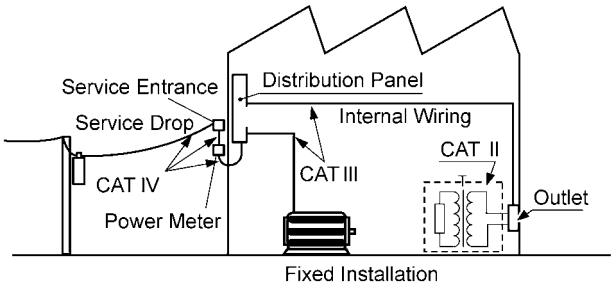
CAT II: Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.) CAT II covers directly measuring electrical outlet receptacles.

CAT III: Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.

CAT IV: The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).

Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.

Use of a measurement instrument that is not CAT-rated in CAT II to CAT IV measurement applications could result in a severe accident, and must be carefully avoided.



Operating Precautions

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

Preliminary Checks

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

⚠WARNING

Before using the unit, make sure that the insulation on the probes and cables is undamaged and that no bare conductors are improperly exposed. Using the unit in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.

Unit Installation

Operating Temperature and Humidity: 0 to 40°C), 80%RH or less, no condensation

Storage Temperature and Humidity: -10 to 55°C, 80%RH or less, no undonesation

Accuracy-guaranteed temperature and humidity ranges: 23±5°C, 80%RH

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

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

Exposed to liquids
Exposed to high humidity or condensation

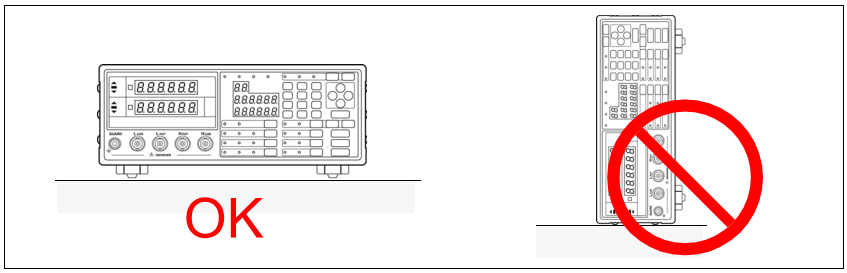
Exposed to strong electromagnetic fields
Near electromagnetic radiators

Exposed to high levels of particulate dust

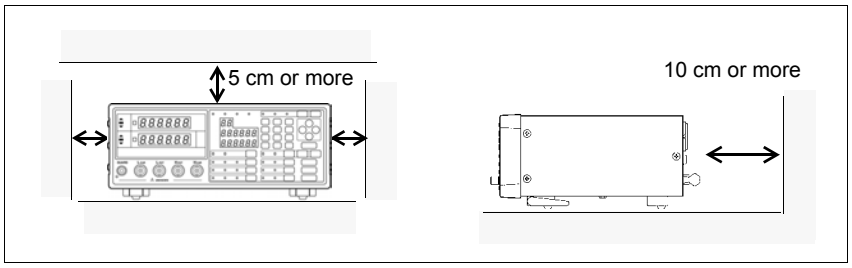
Subject to vibration

Installing

- Do not install the unit with any side except the bottom facing down.



- Vents must not be obstructed.



⚠CAUTION

- To avoid damage to the unit, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- Do not apply heavy downward pressure with the stand extended. The stand could be damaged.

Handling this device

⚠WARNING

Never modify the unit. Only Hioki service engineers should disassemble or repair the unit. Failure to observe these precautions may result in fire, electric shock, or injury.

⚠CAUTION

If anything unusual happens during operation of the unit, turn off the power switch immediately and contact any HIOKI service facility for help, advice and service.

NOTE

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

1.800.561.8187 www.itm.com information@itm.com

Before connection and powering on

⚠WARNING

- **Before turning the unit on, make sure the supply voltage matches that indicated on the its power connector. Connection to an improper supply voltage may damage the unit and present an electrical hazard.**
- **The power supply voltage for this unit is switchable. To avoid electrical accidents, check that the voltage selector is set correctly for the supply voltage you are using.**
  See Setting Procedure for the Power Voltage : 2.2 "Checking the Power Voltage" (p. 18)
- **To avoid electrical accidents and to maintain the safety specifications of this unit, connect the power cord provided only to a 3-contact (two-conductor + ground) outlet.**
  See Connection Procedure : 2.3 "Connecting the Power Cord" (p. 19)
- **To avoid shock and short circuits, turn off all power before connecting probes.**

⚠CAUTION

Check the connections carefully in order to avoid any chance of setting up a short-circuit etc.

About the guarantee

You should be aware that HIOKI cannot accept any responsibility directly or indirectly if the unit has been incorporated in some other system, or if it is resold to a third party.

Shipping precautions

Use the original packing materials when transporting the unit, if possible.

1.800.561.8187 www.itm.com information@itm.com

Overview Chapter 1

1.1 Product Overview

The HIOKI Model 3504-40, 3504-50 and 3504-60 C HiTesters are capacitance meters employing 120 Hz and 1 kHz frequencies to measure large-value multi-layer ceramic capacitors with constant voltage at high speed and high accuracy. Primary applications include pass-fail judgment and ranking of capacitors on tape machines and sorters.

1.2 Features

Capacitance-specific units

These capacitance meters use 120 Hz and 1 kHz measurement frequencies.

High-speed measurement

The Model 3504-40, 3504-50 and 3504-60 are capable of high-speed measurement: 2 ms at measurement frequency 1 kHz, and 10 ms at 120 Hz.

Constant-voltage measurements

Provides constant-voltage measurement capability.
With 1 kHz selected 1 V: to 70 μF 500 mV, 100 mV (Model 3504-60 only): to 170 μF
With 120 Hz selected1 V: to 0.7 mF 500 mV, 100 mV (Model 3504-60 only): to 1.45 mF

Bin sorting function (Model 3504-50, 3504-60 only) (p. 75)

Capacitors are easily ranked according to C (Capacitance*1) measurement values into as many as 14 classifications.

Comparator function (p. 61)

Easily perform pass-fail judgment of components according to measurements of both C and D (Dissipation Factor*2).

LED display

Provides superior visibility.

Equipped with standard data transfer interfaces (p. 131)

The Model 3504-40, 3504-50 and 3504-60 offers external I/O for sequencing, a standard RS-232C interface, and a standard GP-IB interface (Model 3504-50, 3504-60 only).

Measurement value memory (p. 232)

Up to 32,000 measurement values can be stored in memory.

Trigger-synchronous measurement capability (p. 104)

The measurement signal can be input to the sample in sync with a trigger.

Contact check function (p. 100)

You can check connection problems between the measurement terminal and the object to be measured.

*1 Capability to store electric charge *2 An indicator of capacitor losses

1.800.561.8187 www.itm.com information@itm.com

1.3 Entire Workflow

Measurement Preparations

See Chapter 2 "Measurement Preparations" (p. 17)

1. Check the power voltage.
2. Connect the power cord.
3. Connect the probes or fixture (option) to the measurement terminals.
4. Turn the power on.
5. Connect the sample.

Pre-Operation Inspection

See 3.1 "Pre-Operation Inspection" (p. 23)

Be sure to perform pre-operation inspection prior to measurement.

Basic Measurement

See 3.2 "Measurement Example" (p. 24)

1. Prepare the unit, fixture, and sample.
2. Connect the fixture to the measurement terminals.
3. Set the measurement conditions.
4. Connect the sample to the fixture.
5. Check the measurement results.

1.800.561.8187 www.itm.com information@itm.com

Application Functions

Function	Description	Reference Section
Open and Short circuit compensation	Eliminates measurement errors due to residual impedance.	(p. 37)
Load compensation	Allows interchangeability between measuring instruments by measuring a known sample.	(p. 47)
Offset compensation	Allows interchangeability between measuring instruments by subtracting the set value from the measurement value.	(p. 54)
Comparator measurement function	Set the upper limit and lower limit values and judge whether samples pass or fail.	(p. 61)
Self calibration	Reduces measurement value drift.	(p. 58)
BIN measurement function	Set variations of the upper limit and lower limit values and rank samples accordingly.	(p. 75)
Average function	Reduces fluctuation of the measurement value by performing an averaging process of the measurement values.	(p. 91)
Trigger delay	Provides a reliable measurement value even when taking a measurement immediately after connecting to a sample.	(p. 93)
Contact check function	Discerns whether or not the contact pin and sample are connected.	(p. 95)
Display	Turns the LED display ON/ OFF.	(p. 103)
Trigger synchronous output function	Apply the measurement signal only during measurement to reduce the generation of heat in the sample and decrease electrode wear.	(p. 104)
Key lock function	Disable key operations.	(p. 106)
Communication function	Control the unit from a PC.	(p. 131)
Panel save function	Save measurement conditions.	(p. 107)
Panel load function	Load saved measurement conditions	(p. 108)
Beep tone	Turns ON/ OFF the beep tone for judgment results and key operations.	(p. 112)
System reset	Resets device settings.	(p. 117)
Printing function	Print measurement values.	(p. 118)

Application Measurement

- Measurement using EXT I/O
  See 7.1 "About the EXT I/O Connector" (p. 123)
- Countermeasures Against Incorporation of External Noise
  See Appendix 1 "Countermeasures Against Incorporation of External Noise" (p. A1)
- Measurement of high impedance components
  See Appendix 2 "Measurement of High Impedance Components" (p. A3)
- Measurement of components in circuit networks
  See Appendix 3 "Measurement of In-circuit Components" (p. A4)

1.800.561.8187 www.itm.com information@itm.com

1.4 Names and Functions of Parts

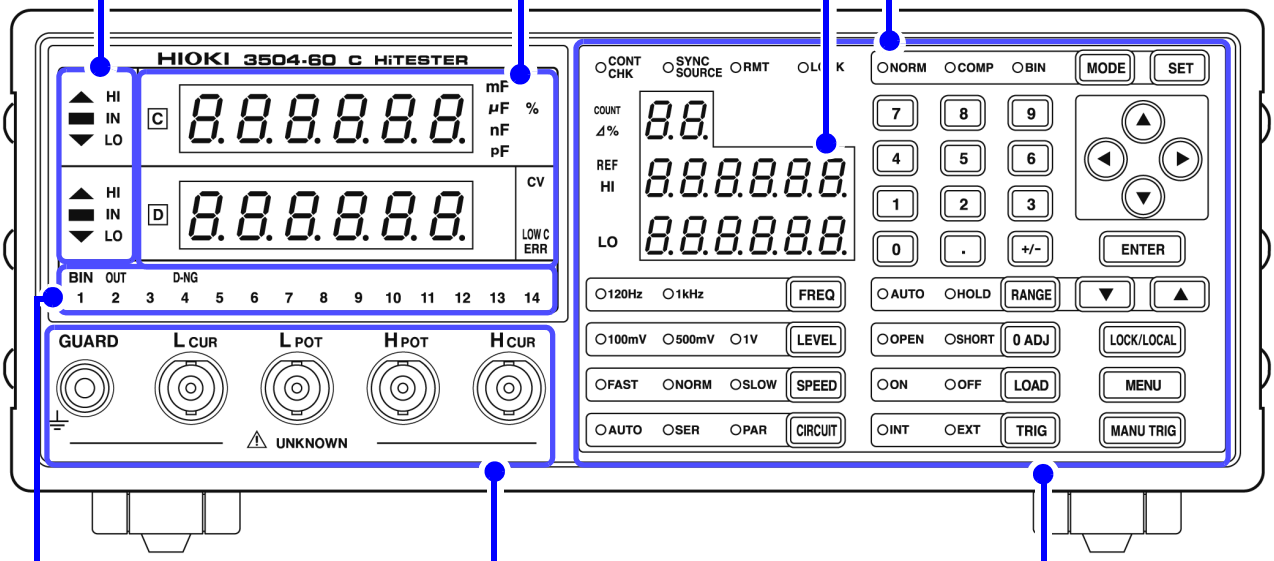
Front

SUB Display
Displays the limit values of BIN (Model 3504-50, 3504-60 only) and comparator.

Comparator Evaluation Result Display
Displays evaluation results in Comparator Mode.
See 5.1 "Comparator Function" (p. 61)

MAIN Display
Displays the measurement values of C and D.
Displays the MENU items.

Setting Condition Display
Displays current measurement conditions, presettings, and other information.
*BIN (Model 3504-50, 3504-60 only)



BIN Judgment Result Display (Model 3504-50, 3504-60 only)
Displays judgment results in BIN mode.
See 5.2 "BIN Measurement Function (Model 3504-50, 3504-60 only)" (p. 75)

Measurement Terminals
There are five measurement terminals:

H_{CUR}	Measurement-signal input terminal
H_{POT}	Detected voltage high terminal
L_{POT}	Detected voltage low terminal
L_{CUR}	Measurement current detected terminal
GUARD	Guard terminal

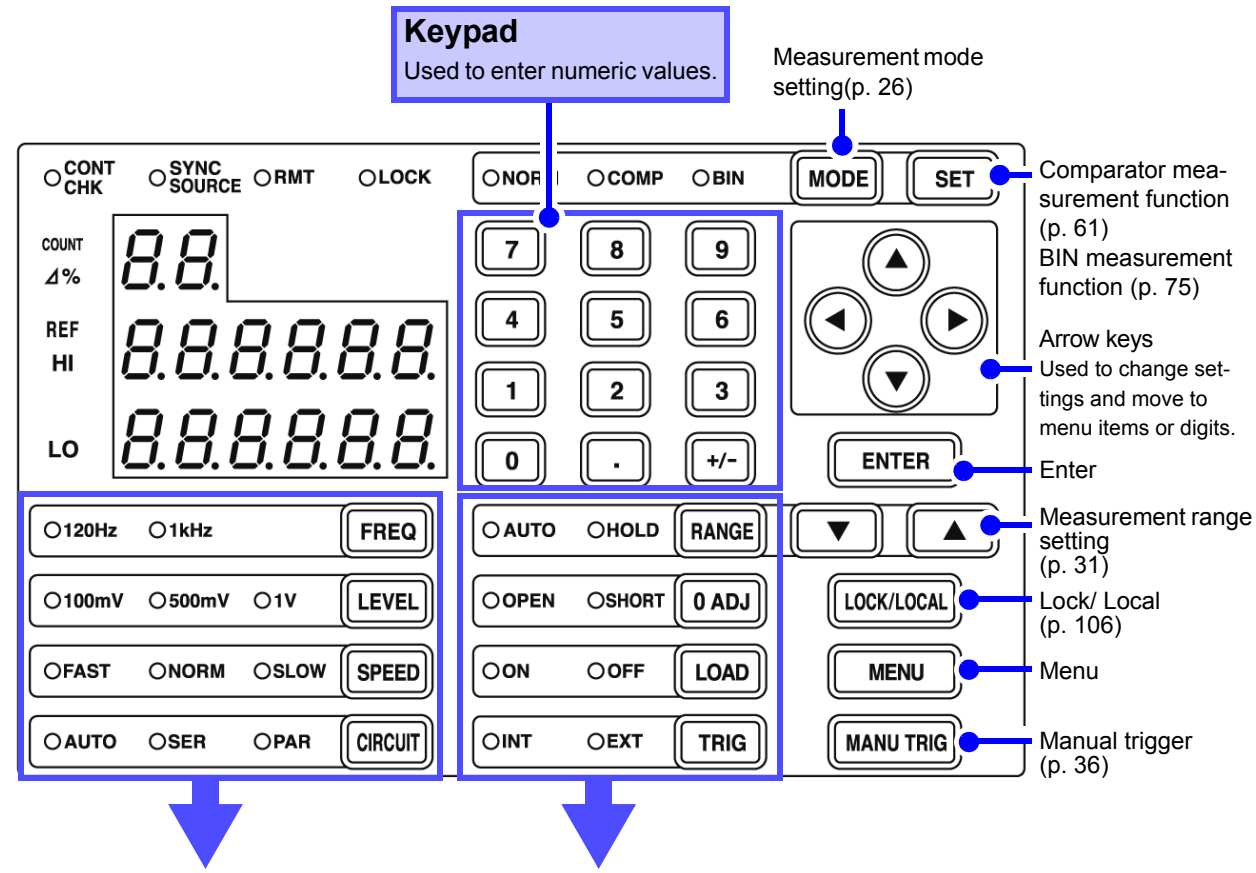
See 2.4 "Connecting the Probes and Fixtures" (p. 20)

Operating Panel
Use to set measurement conditions and to make other settings
See (p. 11)

NOTE The “CONT CHK” and the 100 mV of “LEVEL” in the SUB display portion will only show 3504-60.

1.800.561.8187 www.itm.com information@itm.com

Operating Panel



FREQ Measurement frequency setting (p. 26)

LEVEL Measurement signal level setting (p. 27)

SPEED Measurement speed setting (p. 28)

CIRCUIT Equivalent circuit mode (p. 29)

RANGE Measurement range setting (p. 31)

0 ADJ Open (short) circuit compensation (p. 37)

LOAD Load compensation setting (p. 47)

TRIG Trigger mode setting (p. 36)

Back

Power Switch
Turns the power on and off.

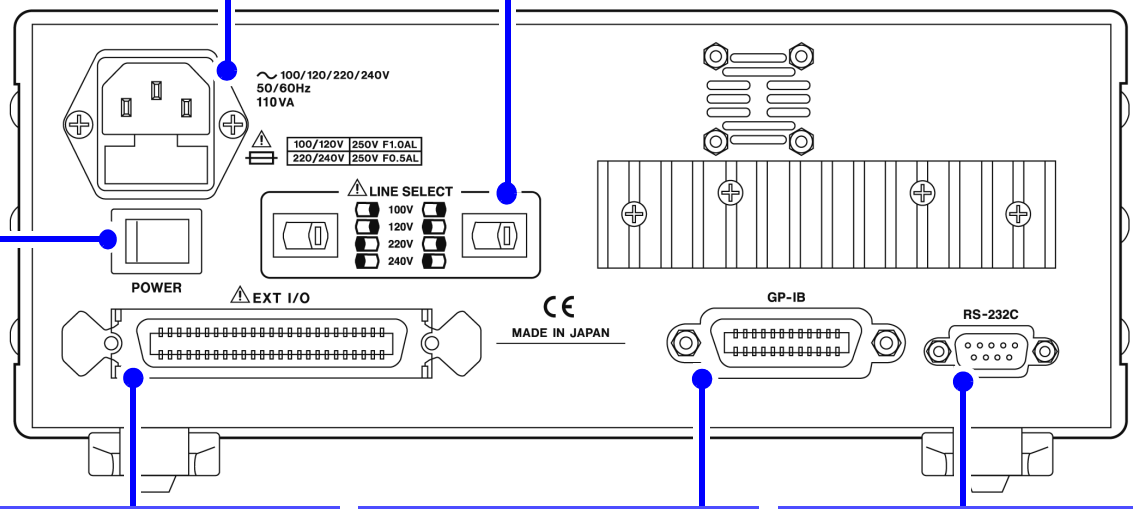
○ : Turns the power off.
| : Turns the power on.

See 2.5 "Turning the Power On and Off" (p. 21)

Power Inlet
Connect the supplied power cord

See 2.3 "Connecting the Power Cord" (p. 19)

Voltage Selectors
Changes the power voltage



EXT I/O Connector
Inputs external trigger signals and outputs comparator result signals and other signals. Supports connection to a sequencer.

See 7.1 "About the EXT I/O Connector" (p. 123)

GP-IB Connector
(Model 3504-50, 3504-60 only)
Connect a GP-IB cable.

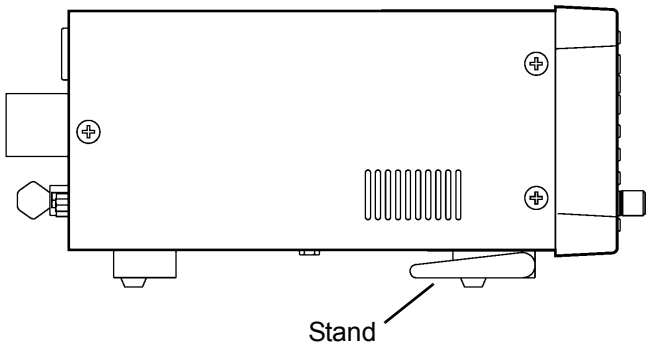
See Chapter 8 "Controlling the Unit from a PC" (p. 131)

RS-232C Connector
Connect an RS-232C cable.

See Chapter 8 "Controlling the Unit from a PC" (p. 131)

Side

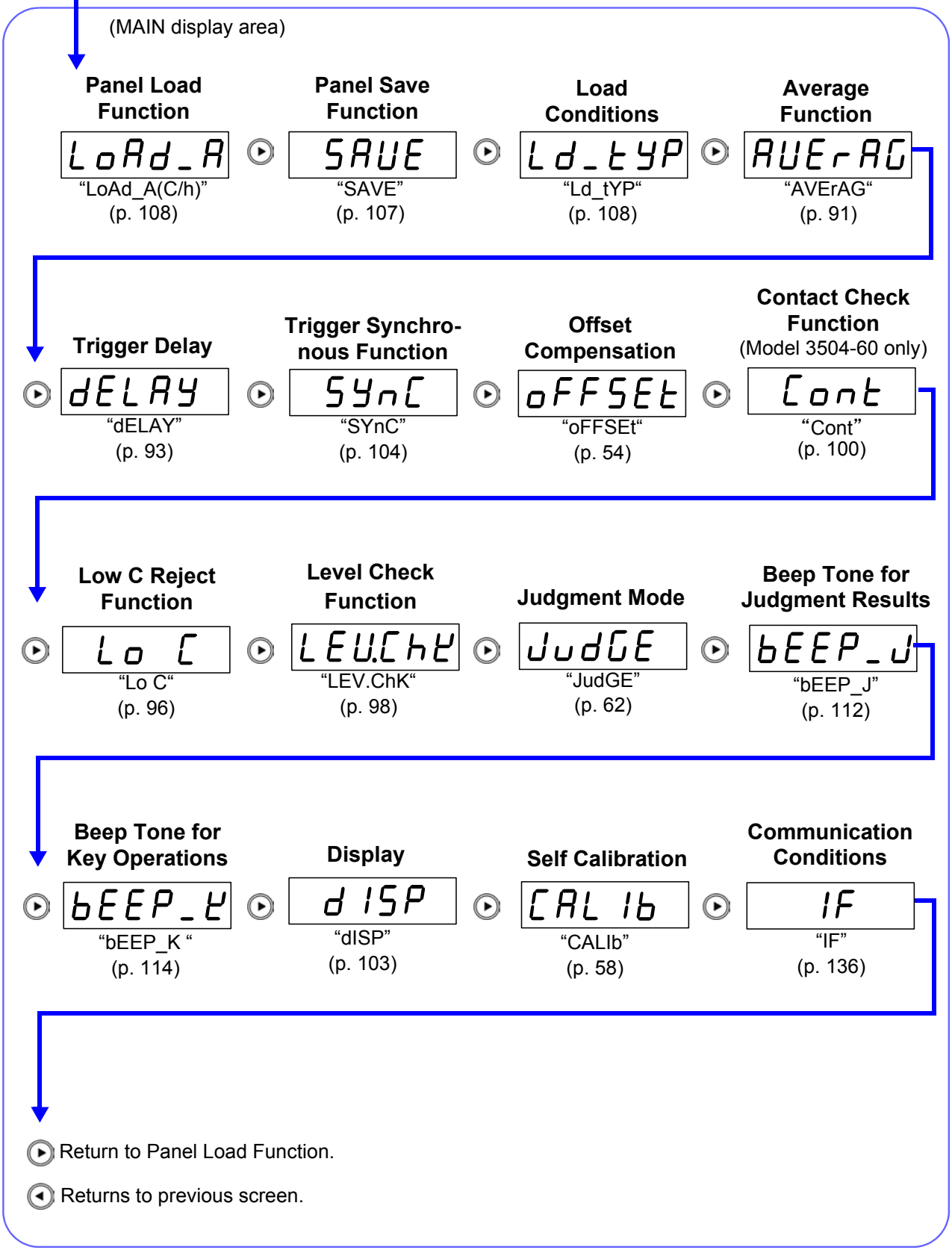
Right side



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

Menu display organization

MENU Displays menu screen



MAIN display area ERROR display

When the 3504-40, 3504-50 and 3504-60 C HiTesters detects a measurement abnormality, an error message is displayed in the MAIN display area.When a measurement error occurs, the device's condition is displayed in order of priority rank in the MAIN display area.When an error display occurs, the comparator and BIN measurement judgment results will be HI and OUTOF-BINS.

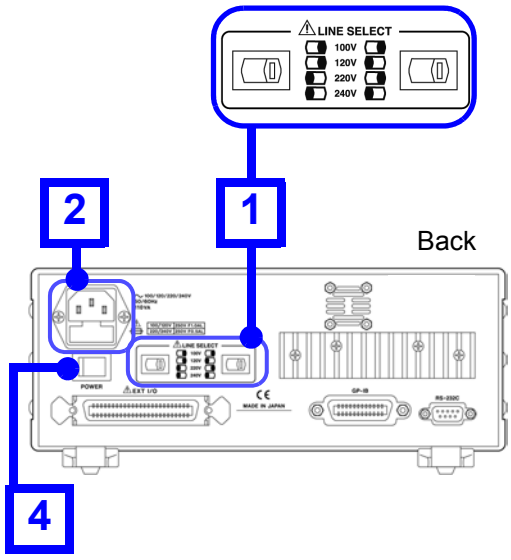
Priority rank	MAIN display	Error content	EXT I/O	Solution
–	Error	**OPEN compensation error** Displayed when the OPEN compensation value is less than 1 kΩ. **See** (p. 41)	–	• Put the measurement terminals in an open state. (Short circuit the H_{CUR} terminal to the H_{POT} terminal, and the L_{CUR} terminal to the L_{POT} terminal.) • Use the shielding process as a countermeasure against external noise. • Earth the device. • Check to see if the measurement cable is broken.
		SHORT compensation error Displayed when the SHORT compensation value is more than 1 kΩ **See** (p. 43)	–	• Short the measurement terminals. • Check to see if the measurement cable is broken.
		LOAD compensation error Displayed when the LOAD compensation value is outside of range. **See** (p. 49)	–	• Perform compensation again after setting to the appropriate range.
–	C i_oUEr D Error	**Output current abnormality** Displayed when low impedance elements were connected for more than 10 min. in range 7 or 8.	–	• Put the measurement terminals in an open state and then press ENTER. • In Range 7 and 8, do not leave low impedance elements (1 Ω or less) connected. It may result in damage on the main unit.
–	Normal measurement value	**ERR LED light on** Acquiring self calibration abnormal value **See** (p. 58)	ERR output Normal evaluation	• The device is acquiring an abnormal self calibration value. Reconnect the instrument to be tested correctly and carry out self-calibration again.

Priority rank	MAIN display	Error content	EXT I/O	Solution
High ↓ Low	t InE_E	**Sampling error** Displayed when the A/D conversion is not carried out normally.	ERR output, HI judgment, OUT judgment	• It is possible that the device is being affected by incoming noise. • Problem with the device. Submit it for repairs.
	Abnormal connection on the H side nC-hb nC-hA Abnormal connection on the L side nC-Lb nC-LA Abnormal connection on the H, L side nC-bb nC-bA	**Contact Abnormality** Displayed when the connection resistance between the measurement terminal and the object to be measured becomes large. **See** (p. 102)	ERR output, HI judgment, OUT judgment	• The measurement terminals may not be connected to the object being measured. Check the contact between the object being measured and the measurement terminals.
	CU_Lo	**Applied voltage abnormality** Displayed when the voltage between the measurement terminals is lower than the measured voltage.	ERR output, HI judgment, OUT judgment	• The H_{POT} and H_{CUR} terminals may be disconnected. Check the connection between the measurement sample and the terminals. • There may be a high contact resistance between the H_{CUR} and L_{CUR} terminals and the object being measured.
	Normal measurement value	**Low C Connector error** Displayed when the measured value is abnormally lower than the measurement range.	ERR output Normal evaluation	• The measurement terminals may not be connected to the object being measured. Check the contact between the object being measured and the measurement terminals.
	LEU_E	**Abnormal level detected** Displayed when the inspection level abnormality monitor value fluctuates. **See** (p. 99)	ERR output, HI judgment, OUT judgment	• hattering may have occurred. Check the connection between the measurement sample and the terminals. It is possible that the device is being affected by incoming noise. • Use the shielding process as a countermeasure agains

Measurement Preparations Chapter 2

Be sure to read "Operating Precautions" (p. 4) prior to setting up the unit.

2.1 Preparation Flowchart



1 Check the power voltage.
See 2.2 "Checking the Power Voltage" (p. 18)

2 Connect the power cord.
See 2.3 "Connecting the Power Cord" (p. 19)

3 Connect the probes or fixture (option) to the measurement terminals.
See 2.4 "Connecting the Probes and Fixtures" (p. 20)

4 Turn the power on.
See 2.5 "Turning the Power On and Off" (p. 21)

5 Connect the sample.

Unit Settings and Measurement

See Chapter 3 "Basic Measurement" (p. 23)
See Chapter 4 "Compensate for errors" (p. 37)
See Chapter 6 "Application Functions" (p. 91)

2.2 Checking the Power Voltage

⚠WARNING

- **Before turning the unit on, make sure the supply voltage matches that indicated on the its power connector. Connection to an improper supply voltage may damage the unit and present an electrical hazard.**
- **The power of the unit can be changed with the voltage selectors. To avoid an electric accident, use the unit with the voltage selectors set to a voltage value that matches the voltage to be used.**
- **Make sure the power is off when you change the voltage with the voltage selectors. Changing the power voltage when the power is on may result in damage to the unit or an electric accident.**
- **The maximum rated power is 110 VA.**
- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Using a non-specified fuse or shorting the fuse holder may cause a life-threatening hazard.**

  Fuse type: 100 V 120 V setting: 250 V F1.0AL ϕ20 mm x 5 mm dia
  220 V 240 V setting: 250 V F0.5AL ϕ20 mm x 5 mm dia

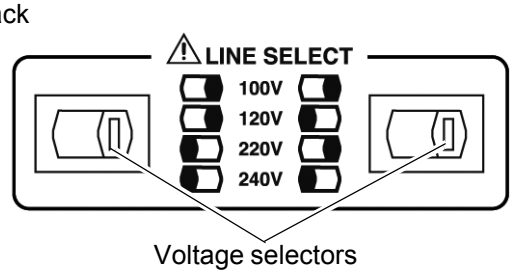
See 10.2 "Replacing the Power Fuse" (p. 265)

The power voltage specification of the unit is set as specified when the unit was ordered.
You can select from 100 V, 120 V, 220 V, and 240 V.

You can determine which voltage is set by checking the positions of the voltage selectors.
Refer to the diagram between the voltage selectors.

Voltage	Position of Left Voltage Selector	Position of Right Voltage Selector
100 V	(Right side)	(Right side)
120 V	(Right side)	(Left side)
220 V	(Left side)	(Right side)
240 V	(Left side)	(Left side)

Back



Voltage selectors

In the diagram, the voltage value is 100 V because both the left and right voltage selectors are set to the right side.

2.3 Connecting the Power Cord

⚠WARNING

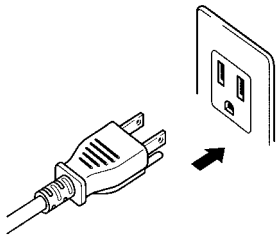
To avoid electrical accidents and to maintain the safety specifications of this unit, connect the power cord provide only to a 3-contact (two-conductor + ground) outlet.

⚠CAUTION

- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.
- Turn off the power before disconnecting the power cord.

Connection Procedure

1. Make sure the power switch of the unit is off.
2. Make sure the power voltage matches and connect the power cord to the power inlet with voltage selectors on the rear of the unit.
3. Insert the plug into the power outlet.



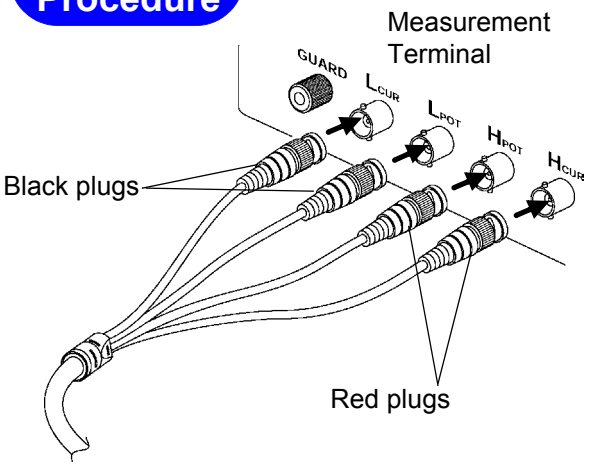
2.4 Connecting the Probes and Fixtures

⚠CAUTION

- Do not apply a voltage to the measurement terminals. 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 cable, can damage the connector.
- To avoid breaking the probes, do not bend or pull them.
- The ends of the probes are sharp. Be careful to avoid injury.
- Avoid stepping on or pinching cables, which could damage the cable insulation.
- A voltage of ±12 V is generated at the L_{CUR} terminal when the L_{POT} and L_{CUR} terminals are in an open state.

Connection Procedure

Example: Connecting a Model 9261 Test Fixture (Option)



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

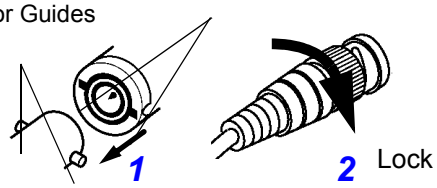
The unit has the following five measurement terminals.

H_{CUR} terminal	Terminal for applying measurement signals
H_{POT} terminal	Voltage detection HIGH terminal
L_{POT} terminal	Voltage detection LOW terminal
L_{CUR} terminal	Measurement current detection terminal
GUARD terminal	Connect this terminal to the case

Measurement Terminal Connections

3504-40, 3504-50, 3504-60 Measurement Terminal Connector Guides

9261 Test Fixture BNC Connector Grooves



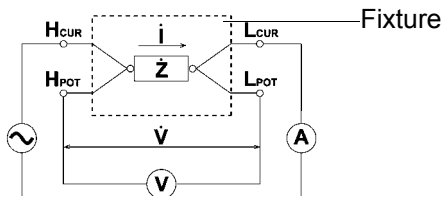
Align the grooves of the BNC connector with the connector guides of the connector of the unit and then insert the connector and rotate it clockwise until it locks into position.
To disconnect the connector, rotate it counterclockwise until it unlocks and then remove it.

For details such as the connection procedure for a fixture, refer to the corresponding instruction manual.

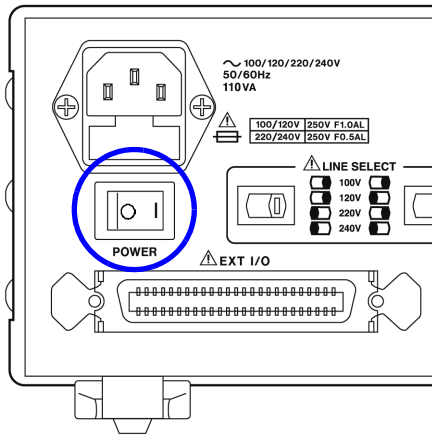
NOTE

- Use Hioki probes, fixtures (option), etc.
  See Appendix 6 "Options" (p. A8)
- If all four terminals are disconnected, a meaningless number may be displayed on the unit.

Measurement Terminal Configuration



2.5 Turning the Power On and Off



Power ON	|
Power OFF	○

Turning the power On

Set the power switch on the rear of the unit to ON (|).

All LEDs on the front panel light up.
The measurement conditions at startup are the same as the last time the power was turned off.

After turning the power on, wait 60 minutes for the unit to warm up before beginning measurement.

Turning the power Off

Set the power switch on the rear of the unit to OFF (○).

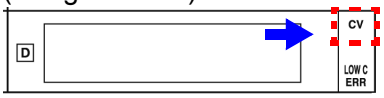
The measurement conditions are saved when the power is turned off.

Even if there is a power failure or other problem with the power, the unit will be in the measurement mode prior to the power failure after it recovers.

Basic Measurement Chapter 3

3.1 Pre-Operation Inspection

To ensure safe use of the unit, be sure to check the following inspection items prior to performing measurements.

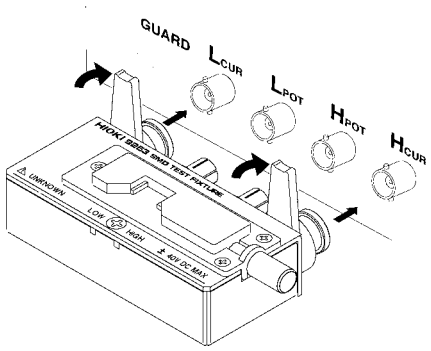
Items	Countermeasure	See:
Inspect the unit, probe, and fixture (Are there any damaged parts?)	If there is damage: Unit and fixture: Submit them for repairs. Probe: Replace it with a new one.	_____
Inspect the connection cord (Is the covering cracked or is any metal exposed?)	Do not use a damaged cord because doing so may result in electric shock. (Replace the cord with a new one.)	_____
Check the power supply voltage setting (Does the setting of the voltage selector on the rear of the unit match the power supply voltage to be used?)	Use of the unit outside the specified power supply voltage range may result in the unit being damaged or an electrical fault. Set the voltage selector in accordance with the power supply voltage to be used.	Setting the Voltage Selector: 2.2 "Checking the Power Voltage" (p. 18)
When the power is turned on, does the fan spin and do the "3504-40, 3504-50, 3504-60" and version number indications appear on the MAIN display area?	If the fan does not spin or the "3504-40, 3504-50, 3504-60" and version number indications are not displayed, the unit may be malfunctioning. Submit it for repairs.	_____
Does the CV LED light up when measurement is performed with the measurement terminals open while the probe and fixture are connected to the unit? (Range: AUTO) 	If the CV LED does not light up, the unit, probe, or fixture may be malfunctioning. Unit and fixture: Submit them for repairs. Probe: Replace it with a new one.	Connecting the Probe and Fixture: 2.4 "Connecting the Probes and Fixtures" (p. 20)
Are the measurement values indicated on the unit normal when measuring known samples such as standard capacitors?	If the measurement values are abnormal, check/perform the following. • Are the measurement conditions set appropriately? • Perform open circuit and short circuit compensation again. • Turn load compensation off. • Set an appropriate trigger delay time or wait time for trigger synchronous output function. If the measurement values are still abnormal after you have checked/performed the above, the unit, probe, or fixture may be malfunctioning. Unit and fixture: Submit them for repairs.	3.3 "Setting the Measurement Conditions" (p. 26) 4.1 "Open Circuit Compensation and Short Circuit Compensation" (p. 37) 4.2 "Load Compensation" (p. 47) 6.2 "Trigger Delay Setting" (p. 93) 6.5 "Trigger Synchronous Output Function" (p. 104) "Setting and Query of Wait Time for Trigger Synchronous Output Function" (p. 220)

3.2 Measurement Example

The following example shows a measurement operation using the 3504-40, 3504-50, 3504-60.

Example	The 9263 SMD Test Fixture is used for the measurement of multilayer ceramic capacitors.
Necessary tools	• 3504-40, 3504-50, 3504-60 • 9263 SMD Test Fixture • Sample to be measured: Multilayer ceramic capacitor
Measurement Conditions	See 2.

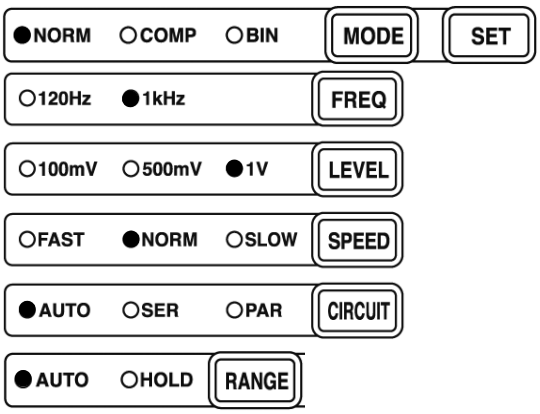
1 Connect the 9263 SMD Test Fixture (Option).



Connect the 9263 SMD Test Fixture to the measurement terminal.

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

2 Set the measurement conditions.



Using the keys on the operating panel, set the measurement conditions as shown at left.

MODE	Measurement mode..... NORM	(p. 26)
FREQ	Frequency..... 1 kHz	(p. 26)
LEVEL	Measurement signal level..... 1 V	(p. 27)
SPEED	Measurement speed..... NORM	(p. 28)
CIRCUIT	Equivalent-circuit mode .. AUTO	(p. 29)
RANGE	Measurement range..... AUTO	(p. 31)

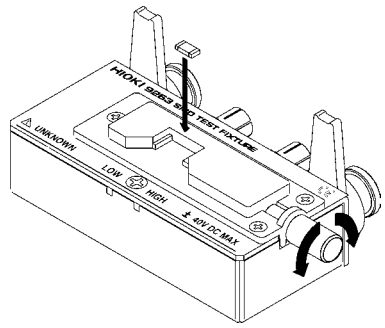
Make other settings as necessary.

See 4.1 "Open Circuit Compensation and Short Circuit Compensation" (p. 37)
See 4.2 "Load Compensation" (p. 47)
See 4.3 "Offset Compensation" (p. 54)
See 4.4 "Self Calibration" (p. 58)
See 6.1 "Setting the Average Function" (p. 91)
See 6.2 "Trigger Delay Setting" (p. 93)
See 3.3.7 "Trigger Signal" (p. 36)

The open circuit compensation, short circuit compensation, load circuit compensation and self calibration settings improve measurement accuracy.

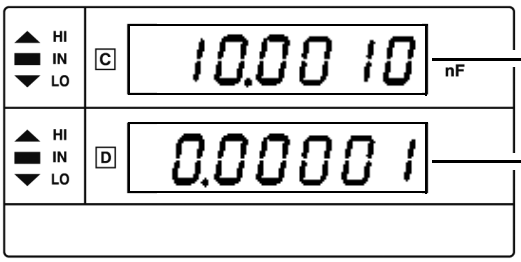
1.800.561.8187 www.itm.com information@itm.com

3 Connect the sample to be measured to the 9263 SMD Test Fixture.



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

4 Check the measurement results.



Capacitance

Dissipation Factor

The voltage monitor and the current monitor can be checked on the SUB display. (p. 115)

1.800.561.8187 www.itm.com information@itm.com

3.3 Setting the Measurement Conditions

3.3.1 Measurement Mode

Select a measurement mode.

Press MODE **to change the mode.**

Mode: **NORM**, **COMP**, **BIN**

The selected item is indicated by the lit LED lamp.

NORM	Select this when using normal measurement mode.
COMP	Select this when using comparator measurement mode. **See** 5.1 "Comparator Function" (p. 61)
BIN (Model 3504-50, 3504-60 only)	Select this when using BIN measurement mode. **See** 5.2 "BIN Measurement Function (Model 3504-50, 3504-60 only)" (p. 75)

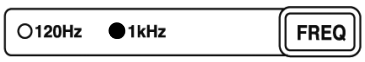
NOTE

The measurement conditions cannot be changed in comparator mode and BIN mode. Set them in normal measurement mode.

3.3.2 Measurement Frequency

Set the measurement frequency.
Set a frequency appropriate for the sample to be measured.

Press FREQ **to change the mode.**



Measurement frequency: **120 Hz**, **1 kHz**

The selected item is indicated by the lit LED lamp.

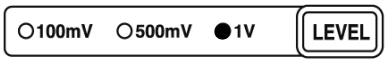
3.3.3 Measurement Signal Level

⚠CAUTION

A voltage of ±12 V is generated at the L_{CUR} terminal when the L_{POT} and L_{CUR} terminals are in an open state.

Set the measurement signal level.
Set a signal level appropriate for the sample to be measured.

Press LEVEL **to change the mode.**



Measurement signal level: **100 mV, 500 mV, 1 V**

The selected item is indicated by the lit LED lamp.

100 mV (Model 3504-60 only) **500 mV**	Constant-voltage measurement can be performed within the range of 0.94 pF up to 170 μF (1 kHz) or 9.4 pF up to 1.45 mF (120 Hz).
1 V	Constant-voltage measurement can be performed within the range of 0.94 pF up to 70 μF (1 kHz) or 9.4 pF up to 0.7 mF (120 Hz).

When the set voltage is applied to both sides of the sample, the CV indicator lights up. The CV indicator does not light up when the applied voltage is lower than the set voltage. In such a case, the EXT I/O outputs a $\overline{\text{ERR}}$ signal.

Range No.	120 Hz	1 kHz	Measurement Voltage Mode
1	200 pF	20 pF	Constant voltage mode
2	2 nF	200 pF	
3	20 nF	2 nF	
4	200 nF	20 nF	
5	2 μF	200 nF	
6	20 μF	2 μF	
7	200 μF	20 μF	
8	0.7 mF (when 1 V) 1.45 mF (when 500mV, 100 mV)	70 μF (when 1 V) 170 mF (when 500mV, 100 mV)	
9	2 mF	200 μF	Open terminal voltage mode Output resistance of 5 Ω
10	20 mF	2 mF	

NOTE

- In some samples, the value may vary depending on the measurement-signal level.
- Constant voltage measurement may not be possible if the value of the contact resistance between the measurement terminals and the sample is high. When this is the case, “CV_Lo ” appears on the MAIN display area, CV LED goes out, and a $\overline{\text{ERR}}$ signal is output from EXT I/O.
- When confirming the measurement signal level with a voltmeter, connect Hcur and Hpot, and Lcur and Lpot, to confirm the voltage between H and L. Turn the trigger synchronous output function OFF when doing so.

See 6.5 Trigger Synchronous Output Function (p.104)

1.800.561.8187 www.itm.com information@itm.com

3.3.4 Measurement Speed

Set the measurement speed.

Press SPEED **to change the mode.**

Measurement speed: **FAST**, **NORM**, **SLOW**

The selected item is indicated by the lit LED lamp.

FAST	Measures at high speed.
NORM	Measures at normal speed.
SLOW	Measures at low speed, but provides improved measurement accuracy.

The lower the measurement speed, the higher the measurement accuracy becomes.

Measurement speed

Measurement frequency	FAST	NORM	SLOW
120 Hz	10.0 ms	37.5 ms	146.0 ms
1 kHz	2.0 ms	5.5 ms	29.5 ms

(Allowance: ±5%±0.5 ms)

NOTE

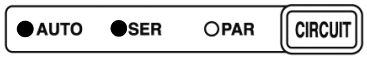
The measurement time varies depending on such factors as the open circuit, short circuit, and load compensation ON/OFF, self calibration and the comparator ON/ OFF.

See 7.4 "About Measurement Times" (p. 128)

3.3.5 Equivalent Circuit Mode

You may set an equivalent circuit mode (SER/ PAR).
Automatic selection is also possible.
See 3.3.5 "Equivalent Circuit Mode" (p. 29)

Press CIRCUIT **to change the mode.**



Equivalent circuit mode: **AUTO**, **SER**, **PAR**

The selected item is indicated by the lit LED lamp.

AUTO The series equivalent circuit mode or parallel equivalent circuit mode is automatically selected according to the measurement range.

Range No.	Automatically selected mode
6 to 10	Series equivalent circuit
1 to 5	Parallel equivalent circuit

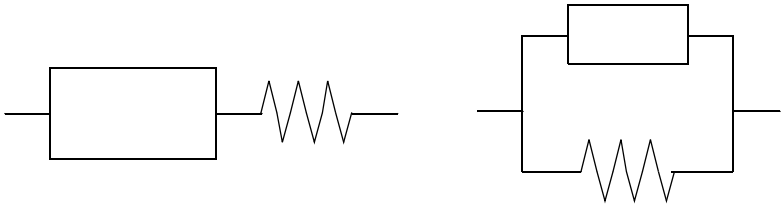
SER Series equivalent circuit mode

PAR Parallel equivalent circuit mode

1.800.561.8187 www.itm.com information@itm.com

Equivalent Circuit Mode

This unit measures a current that flows through the sample and a voltage applied between terminals of the measurement sample to calculate and obtain impedance Z and phase angle θ. Static capacitance can be obtained using Z and θ values.
A series-equivalent circuit mode calculates as though a captive component C and a resistive component were connected in series, or alternatively a parallel-equivalent circuit mode calculates as though connected in parallel. Because the operation is different between a series-equivalent circuit mode and a parallel-equivalent circuit mode, the appropriate equivalent circuit mode need be selected to reduce error margin.
See 9.3 "Measurement Parameters and Arithmetic Expressions" (p. 261)



Series-equivalent circuit Parallel-equivalent circuit

Normally, the series-equivalent circuit mode is used for a large capacitance (low-impedance components: approx. 100 Ω or less). While the parallel-equivalent circuit mode is used for a small capacitance (high-impedance components: approx. 10 kΩ or more). When you are not sure about selection of equivalent-circuit mode for the impedance such as between approx. 100 Ω to 10 kΩ), please call the parts maker.

1.800.561.8187 www.itm.com information@itm.com

3.3.6 Measurement Range

Select a measurement range. Automatic selection is also possible.

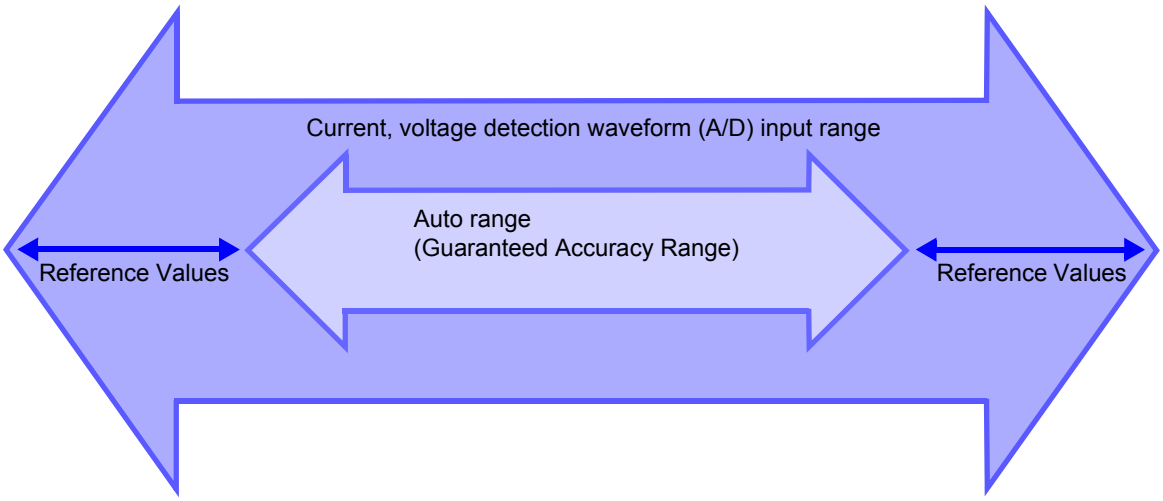
Press RANGE **to change the mode.**

Measurement Range: **AUTO**, **HOLD**

The selected item is indicated by the lit LED lamp.

AUTO (Auto range)	The optimal measurement range is selected automatically. This is useful for the measurement of unknown samples. However, measurement takes longer.
HOLD (Hold range)	The measurement range is fixed, and may only be altered manually. Take measurements in the same range regardless of the value of the sample. This is useful for high-speed measurement. Changing the range: ▼ ▲ When the range is changed, the decimal point and unit in the measurement value display area change. The range number is displayed in the SUB display area.

Measurement range



Measurement ranges and display ranges (Guaranteed Accuracy Range)

Range No.	Guaranteed Accuracy Range of C (when D ≤ 0.1)	
	120 Hz	1 kHz
1	009.400 pF to 200.000pF	00.9400 pF to 20.0000 pF
2	0.09400 nF to 2.00000nF	009.400 pF to 200.000 pF
3	00.9400 nF to 20.0000nF	0.09400 nF to 2.00000 nF
4	009.400 nF to 200.000nF	00.9400 nF to 20.0000 nF
5	0.09400 μF to 2.00000 μF	009.400 nF to 200.000 nF
6	00.9400 μF to 20.0000 μF	0.09400 μF to 2.00000 μF
7	009.400 μF to 200.000 μF	00.9400 μF to 20.0000 μF
8	0.09400 mF to 0.70000 mF (when 1 V) 1.45000 mF (when 500 mV, 100 mV)	009.400 μF to 070.000 μF (when 1 V) 170.000 μF (when 500 mV, 100 mV)
9	0.13500 mF to 2.00000 mF	016.000 μF to 200.000 μF
10	01.3500 mF to 20.0000 mF	0.16000 mF to 2.00000 mF

Display range

	C display range	D display range	Note
Normal measurement, comparator and BIN measurement (count setting)	-199999 to 999999	-199999 to 199999	When the C measurement value falls below -199999, the MAIN screen display will freeze at -199999.
comparator and BIN measurement (Δ%setting)	-99999 to 99999	-199999 to 199999	

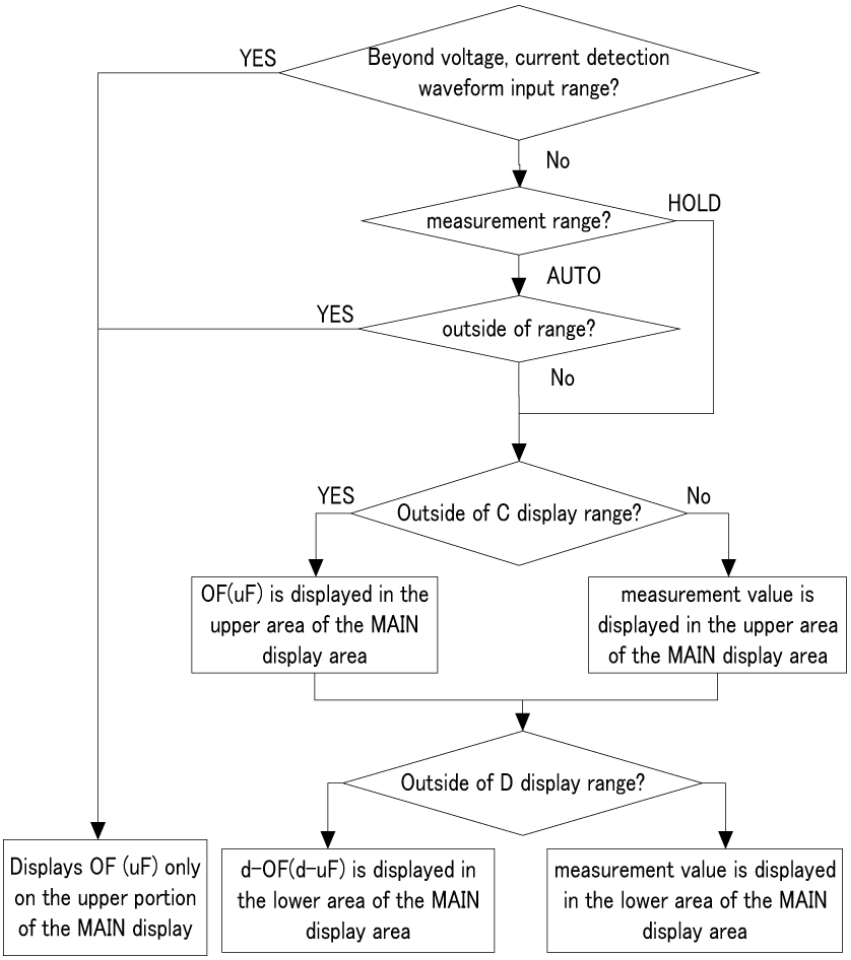
NOTE

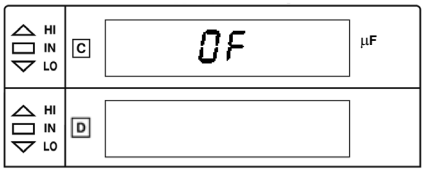
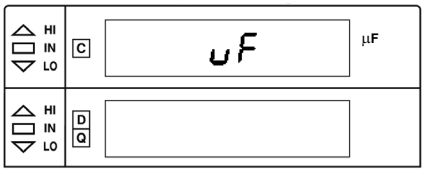
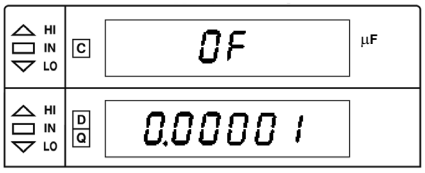
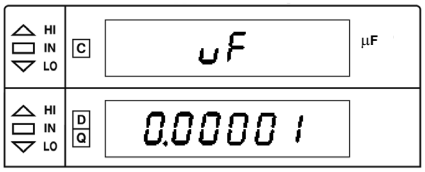
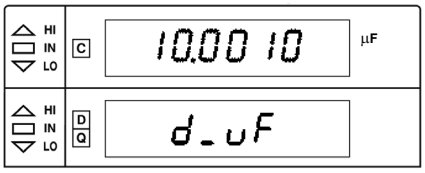
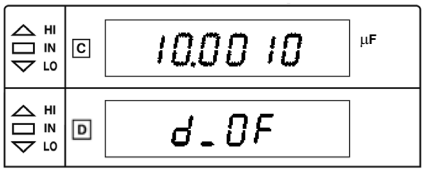
- If the measurement values displayed on the unit are outside of the guaranteed accuracy range, the HOLD LED flashes.
- For errors other than measurement value outside of range errors, refer to "MAIN display area ERROR display" (p. 14).
- When the measurement is out of the range or the display range, an error message will be displayed on the MAIN display following the flow chart below.
- A negative measurement value may be displayed.
  Factors which may cause this include the following:
  - Measuring inductance that is in the opposite phase.
  - The OPEN compensation value is not accurately taken.
  - LOAD compensation enabled.
  - Offset compensation is enabled.

  The lowest display value in both the MAIN and SUB displays is "-199999". If the measurement value is lower than this, "-199999" will be shown in the MAIN display and "d-UF" will be shown in the SUB display.
- In Range 7 and 8, do not connect low impedance elements (1 Ω or less) such as static capacities higher than the certified guaranteed range for long periods of time. It may result in damage on the main unit.
  When a low impedance element is connected for more than 10 minutes, an “i-ovEr Error” will flash on the MAIN display, which will automatically enable the trigger simultaneous function and terminate the measurement.
  To clear the error, open the measurement terminals and then press ENTER.
  However, there may be cases when an error message is not displayed depending on the connected state between the measurement terminals. For this reason, in Range 7 and 8, do not connect low impedance elements for 10 min. or more.
- An under flow or CV-Lo (applied voltage abnormality) may be obtained, depending on the balance condition of the internal circuit when the measurement terminal is opened.
- When the signal level is 100 mV (only for 3504-60), ranges 1 and 2 are beyond the certified guaranteed range regardless of the measurement frequency.

1.800.561.8187 www.itm.com information@itm.com

OF, UF Evaluation Flow Chart



MAIN display	Cause
	HOLD setting: When the current detection waveform is beyond the input range AUTO setting: Current detection waveform is beyond the input range + When the measurement value is higher than the upper limit of the auto range
	HOLD setting: When the voltage detection waveform is beyond the input range AUTO setting: Voltage detection waveform is beyond the input range + When the measurement value is smaller than the lower limit of the auto range
 or 	When the C display range is exceeded
 or 	When the D display range is exceeded

3.3.7 Trigger Signal

The internal trigger or the external trigger can be set.

Press TRIG **to change the mode.**

Trigger signal: **INT**, **EXT**

INT (Internal trigger mode)	• Continuous measurement is performed while automatically generating an internal trigger signal. • The INT LED flashes.
EXT (External trigger mode)	• A trigger signal is input from the outside either manually or automatically. • The EXT LED lights up. • Manual setting: Press MANU TRIG to perform measurement once. • Measurement is performed with a trigger from the EXT I/O connector TRIG terminal.

When inputting the trigger signal through the interface

Measurement starts when a "∗TRG" command is received through the interface.

See For details on inputting the trigger signal through the interface, refer to "Sampling Request" (p. 177) of 8.9, "Message Reference".

When inputting the trigger signal through the EXT I/O connector

When a negative-logic pulse signal is input to TRIG (pin 1) of the EXT I/O connector on the rear panel, one measurement operation is performed.

See 7.1 "About the EXT I/O Connector" (p. 123)

1.800.561.8187 www.itm.com information@itm.com

Chapter 4 Compensate for errors

4.1 Open Circuit Compensation and Short Circuit Compensation

Open circuit compensation and short circuit compensation enable you to reduce the effect of impedance remaining in parts such as the probe or fixture and improve measurement accuracy.
There are two ways of performing open circuit compensation and short circuit compensation.

- **All Compensation**
  Compensates at measurement conditions set at Command: CORRection :OPEN(SHORt):POINt (Frequencies: 1 kHz, 120 Hz, Signal levels: 100 mV (Model 3504-60 only), 500 mV, 1 V's optional point).
  This can be performed from the front panel or via a PC.
  See "Setting and Query of Open Circuit Compensation Function" (p. 197) and "Setting and Query of Short Circuit Compensation Function" (p. 202) of "8.9, "Message Reference".

  All Compensation Example
  For example, when the adjustment points are set to all frequencies and signal level 1V. (:CORRection:OPEN:POINt 36, :CORRection:SHORt:POINt 36), when all compensation is executed, adjustments will be carried out according to the measurement conditions marked [Yes] below.

Measurement level \ Measurement frequency	120 Hz	1 kHz
100 mV (3504-60 only)	No	No
500 mV	No	No
1 V	Yes	Yes

- **Spot Compensation**
  This performs compensation at the frequency currently set. Perform this from a PC through the interface.
  See "Setting and Query of Open Circuit Compensation Function" (p. 197) and "Setting and Query of Short Circuit Compensation Function" (p. 202) of "8.9, "Message Reference".

1.800.561.8187 www.itm.com information@itm.com

NOTE

- The measurement accuracy values defined in the specifications are for when open circuit compensation and short circuit compensation are performed.
- Be sure to perform compensation again after replacing the probe or fixture. You will be unable to obtain correct values if measurement is performed in the compensation state prior to replacement.
- The open circuit compensation range of impedance is 1 kΩ or more. However, if the values are not sufficiently high compared to the impedance of the sample, the measurement errors will be larger and measurement may become no longer possible.
- The short circuit compensation range of impedance is less than 1 kΩ. However, if the values are not sufficiently low compared to the impedance of the sample, the measurement errors will be larger and measurement may become no longer possible.
- The compensation value is saved at varying values depending on the measured frequency and signal level settings.
  If these settings are changed and a measurement value has not been taken with the changed measurement conditions, open circuit compensation and short circuit compensation will be turned OFF.
- If there is an abnormality in the compensation value, measurement value error will increase. The measurement value may be displayed as a negative number.

1.800.561.8187 www.itm.com information@itm.com

Take the open circuit compensation and short circuit compensation values

1. In normal measurement mode, press [0 ADJ].

OPEN ○SHORT [0 ADJ]
(Flash)

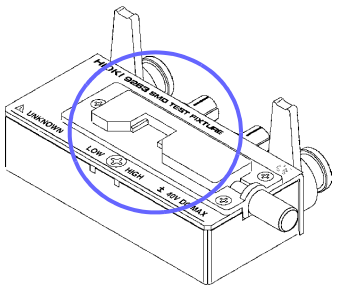
(MAIN display area)

oPEn
AdJuSt — Flash

NOTE

If you do not want to perform open circuit compensation, press [0 ADJ] to proceed to configuring the short circuit compensation settings. (The SHORT LED flashes and the "Short AdJuSt" indication is displayed and the "AdJuSt" indication flashes in the MAIN display area.) Proceed to Step 5.

2. Open the space between the HIGH and LOW terminals of the probe or fixture connected to the measurement terminals to match the width of the object being measured. (Connect Hc and Hp. Also connect Lc and Lp.)
(Example)



3. Use ◀ or ▶ to select setting the open circuit menu item.

Pressing ▲ or ▼ causes the display to change in the following manner.

AdJuSt
oFF
on

"AdJuSt"
Delete invalid open adjustment values, after acquiring open adjustment values only with measurement conditions set at :CORRection:OPEN:POINt (Initial value: all measurement conditions), the open adjustment values will be enabled.
See "Setting and Query of Open Compensation Points" (p. 201)

"oFF"
Disable open adjustment values at enabled measurement values (frequency, level)

"on"
Enable all disabled open adjustment values.

NOTE

- When performing compensation, the placement of things like the probe and the distances between terminals must be as similar as possible to the state when performing measurement.
- If compensation is being affected by external noise, use the shielding process.

See Appendix 2 "Measurement of High Impedance Components" (p. A3)

1.800.561.8187 www.itm.com information@itm.com

4.1 Open Circuit Compensation and Short Circuit Compensation

- Example of setting for enabling/disabling open (short) adjustment functions

Example of enabling/disabling acquisition of open (short) circuit compensation values

Factory default condition

●: adjustment value valid △: adjustment value invalid
×: no adjustment value

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	×	×

Key or communication command in :CORRection:OPEN (SHORt):POINt 36
When adjustment value is acquired from (:CORRection :OPEN(SHORt)ALL)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	●

When adjustment value is disabled from key or communication command (:CORRection:OPEN(SHORt) OFF)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	△	△

When adjustment value is enabled from key or communication command (:CORRection:OPEN(SHORt) RETurn

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	●

Key or communication command in :CORRection :OPEN(SHORt):POINt 18
When adjustment value is acquired from (:CORRection :OPEN(SHORt)ALL)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	●	●
1 V	×	×

Example of enabling/disabling setting of open (short) circuit compensation values

Factory default condition

●: adjustment value valid △: adjustment value invalid
×: no adjustment value

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	×	×

Measurement frequency: when adjustment value is set from communication command (:CORRection:OPEN (SHORt):DATA) at 120 Hz, level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	△	×

Measurement frequency: when adjustment value is set from communication command (:CORRection:OPEN (SHORt):DATA) after measurement conditions have been changed to 1 kHz, level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	△	△

When adjustment value is enabled from key or communication command (:CORRection:OPEN(SHORt) RETurn)

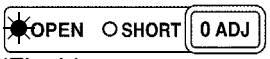
Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	●

Key or communication command in :CORRection :OPEN(SHORt):POINt 18
When adjustment value is acquired from (:CORRection :OPEN(SHORt)ALL)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	●	●
1 V	×	×

4. **Select "AdJuSt" and press [ENTER].**

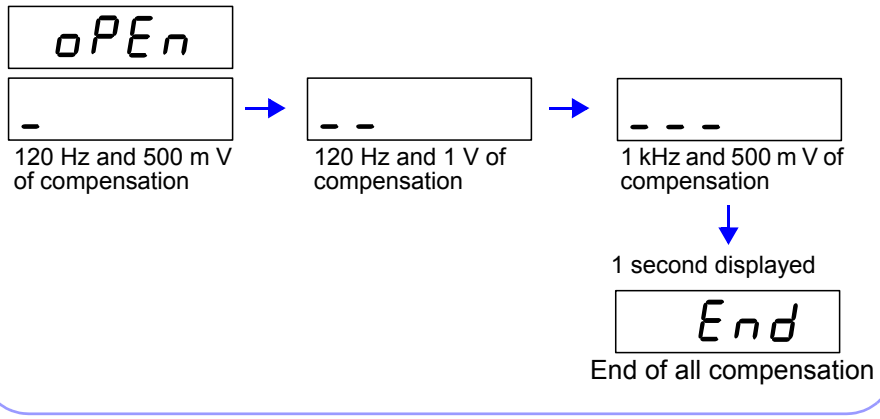
Incorporate the open circuit compensation values. (ALL Compensation)



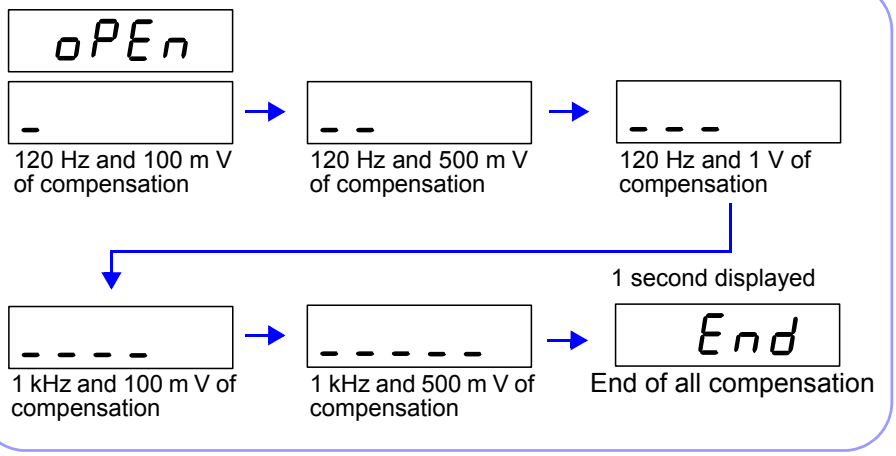
(Flash)

(MAIN display area)

3504-40, 3504-50



3504-60

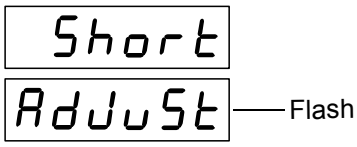


End of Compensation:

When compensation ends, the state becomes as follows.

(Light up) (Flash)

(MAIN display area)



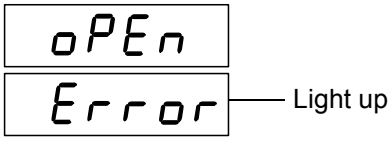
Compensation Error:

If a compensation error occurs, a warning beep will sound and the state becomes as follows.

The measurement frequency at which the error occurred can be ascertained from the underbar display.

See "MAIN display area ERROR display" (p. 14)

(MAIN display area)



Compensation stops.

What if there is an error?

- Are the measurement terminals open? Open the measurement terminals and then perform compensation again. (To set the measurement terminals open, short the H_{CUR} terminal to the H_{POT} terminal, and the L_{CUR} terminal to the L_{POT} terminal.)
- If there is a compensation error even when the measurement terminals are open, external noise may be affecting compensation or the unit, probe, or fixture may be malfunctioning. Use the shielding process, submit the unit or fixture for repairs, or replace the probe with a new one. (The probe cannot be repaired.)

See Appendix 2 "Measurement of High Impedance Components" (p. A3)

If [0 ADJ] is pressed, the unit enters short circuit compensation incorporate mode. (Proceed to Step5) (The settings for open circuit compensation remain the same as last time.)

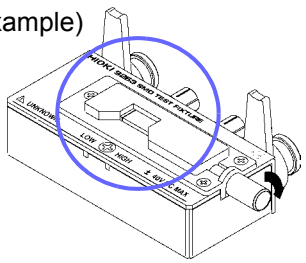
NOTE

When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
ex. Servo Motor, switching power source, high-voltage cable and etc.

5. Use a shorting bar to create a short circuit state between the HIGH terminal and LOW terminal of the probe or fixture connected to the measurement terminals.

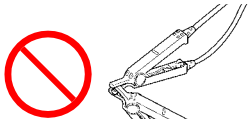
Use a shorting bar with as low an impedance as possible.

(Example)



NOTE

- When performing compensation, the placement of things like the probe and fixture and the distances between terminals must be as similar as possible to the state when performing measurement.
- If you do not want to perform short circuit compensation, press [0 ADJ] to return to normal measurement mode.
- When using 4-TERMINAL PROBE 9140, please pinch the short wire with both clips. A short circuit state can not be created by pinching clip each other.



1.800.561.8187 www.itm.com information@itm.com

6. **Use ▲ or ▼ to select setting the short circuit menu item.**

7. **Select "AdJuSt" and press ENTER.**

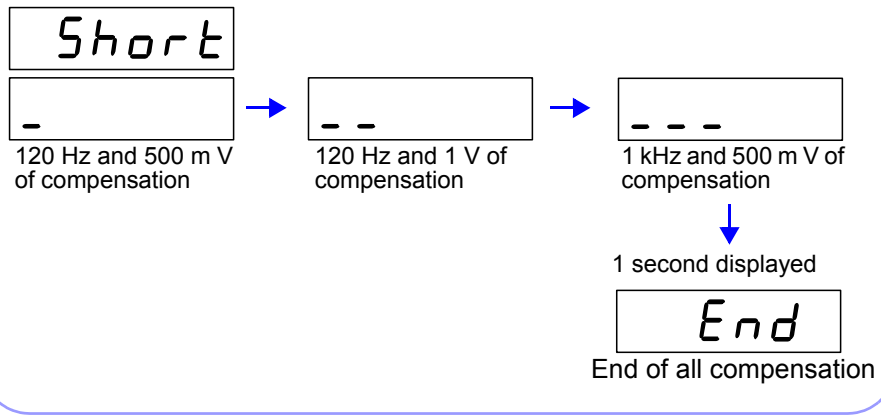
Incorporate the short circuit compensation values. (ALL Compensation)

● OPEN ✳ SHORT 0 ADJ

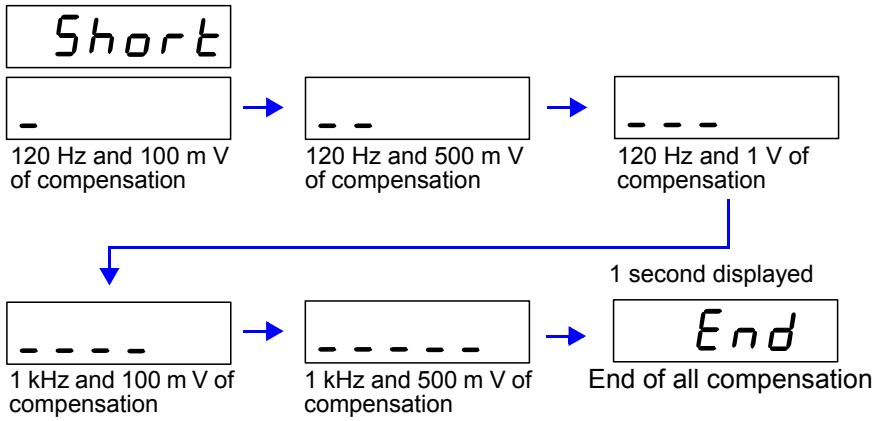
(Light up) (Flash)

(MAIN display area)

3504-40, 3504-50



3504-60



End of Compensation:

When compensation ends, the state becomes as follows.

● OPEN ● SHORT 0 ADJ

(Light up) (Light up)

The unit returns to normal measurement mode.

Compensation Error:

If a compensation error occurs, a warning beep will sound and the state becomes as follows.
The measurement frequency at which the error occurred can be ascertained from the underbar display.
See "MAIN display area ERROR display" (p. 14)

(MAIN display area)

Compensation stops.

What if there is an error?

- If 0 ADJ is pressed, the unit returns to normal measurement mode. (The settings for short circuit compensation remain the same as last time.)
- Are the measurement terminals in a short circuit state? Short circuit the measurement terminals and then perform compensation again.
- If there is a compensation error even when the measurement terminals are short circuited, the unit, probe, or fixture may be malfunctioning. Use the shielding process, submit the unit or fixture for repairs, or replace the probe with a new one. (The probe cannot be repaired.)

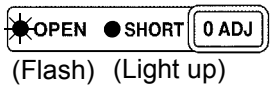
NOTE

When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
ex. Servo Motor, switching power source, high-voltage cable and etc.

Setting Open Circuit and Short Circuit Compensation ON/ OFF

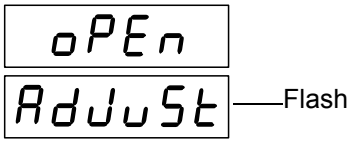
1. In normal measurement mode, press [0 ADJ].

The state becomes as follows.

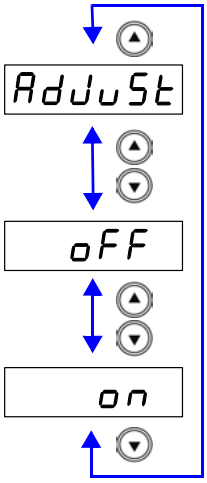


(Flash) (Light up)

(MAIN display area)



Pressing ▲ or ▼ causes the display to change in the following manner.



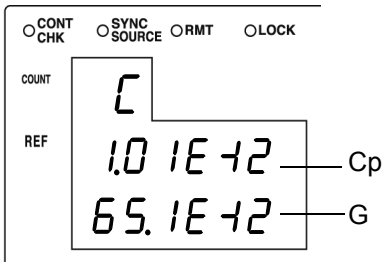
"AdJuSt"
Delete invalid open adjustment values, after acquiring open adjustment values only with measurement conditions set at :CORRection:OPEN:POINt (Initial value: all measurement conditions), the open adjustment values will be enabled.
See "Setting and Query of Open Compensation Points" (p. 201)

"oFF"
Disable open adjustment values at enabled measurement values (frequency, level)

"on"
Enable all disabled open adjustment values.

2. Press ▲ or ▼ to set the open circuit compensation ON or OFF.

When open circuit compensation is in the ON state the open circuit compensation value will be displayed (as "Cp, G") in the SUB display area.
(SUB display area)



NOTE

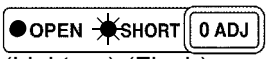
Pressing [FREQ] and [LEVEL] on the control panel and changing measurement conditions while the open circuit compensation values are being displayed will cause the compensation value relative to the set measurement conditions to be displayed.

1.800.561.8187 www.itm.com information@itm.com

3. Press [ENTER] to confirm the open circuit compensation ON or OFF.

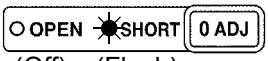
The state of the open circuit compensation LED becomes as follows and the device enters the short circuit compensation setting mode.

When select the “on”



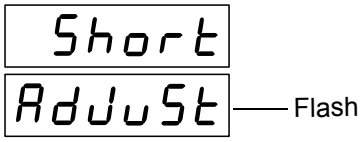
(Light up) (Flash)

When select the “oFF”



(Off) (Flash)

(MAIN display area)



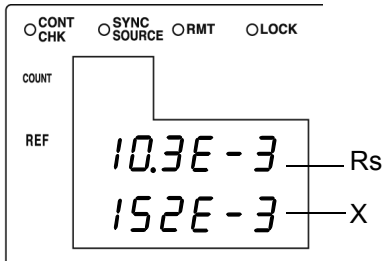
NOTE

- Open adjustment value will not be enabled even if “on” is selected before the acquisition or setting of the open circuit compensation value.
  See (⇒ p.40)
- Press [0 ADJ] if not setting the open circuit compensation ON or OFF.
  The device enters short circuit compensation setting.
  (Proceed to Step 4.)

4. Press ▲ or ▼ to set the short circuit compensation ON or OFF.

When short circuit compensation is in the ON state the open circuit compensation value will be displayed (as "Rs, X") in the SUB display area.

(SUB display area)



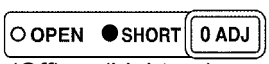
NOTE

Pressing [FREQ] and [LEVEL] on the control panel and changing measurement conditions while the open circuit compensation values are being displayed will cause the compensation value relative to the set measurement conditions to be displayed.

5. Press [ENTER] to confirm the short circuit compensation ON or OFF.

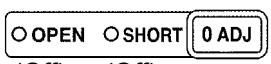
Short circuit compensation is set to OFF and the state becomes as follows.

When select the “on”



(Off) (Light up)

When select the “oFF”



(Off) (Off)

NOTE

- Short circuit compensation value will not be enabled even if “on” is selected before the acquisition or setting of the short circuit compensation value.
  See (⇒ p.40)
- Press [0 ADJ] if not setting the short circuit compensation ON or OFF.
  The unit returns to normal measurement mode.

1.800.561.8187 www.itm.com information@itm.com

4.2 Load Compensation

Load compensation allows for the calculation of the load compensation rate by measuring a standard sample with known measurement values and compensating the measurement values.
With this function, when using multiple Model 3504-40, 3504-50, 3504-60 units, the measurement errors of individual Model 3504-40, 3504-50, 3504-60 units can be reduced and a single measurement value produced. Alternately, the measurement values of the Model 3504-40, 3504-50, 3504-60 can be matched to those of a reference device.
The load compensation rate (load compensation value) is determined by first calculating the impedance Z and phase angle θ from the reference values of the measurement conditions, C, and D and the actual measurement values and then using the following formula for the calculation.

Z compensation rate = (Z reference value)/ (Z actual value)
θ compensation rate = (θ reference value) – (θ actual value)

For the actual values of Z and θ, compensation is performed using the above load compensation rate and then C and D are calculated from Z and θ after compensation.

NOTE

- The conditions that are currently set (level, range, self calibration) are used as the measurement conditions for load compensation.
  However, the load circuit compensation values will be separated according to the measurement frequencies.
  Changing the measurement conditions while load compensation in enabled results in load compensation being disabled. (When this happens, the OFF LED of LOAD flashes.)
  If, however, the measurement conditions are returned to what they were during load compensation, then load compensation is resumed.
  (The ON LED of LOAD lights up.)
  For example, in the measurement frequencies shown in “Yes” in the table below, the load compensation function is still enabled even when the measurement value is changed to 120 Hz ←→ 1 kHz after the load compensation value has been acquired.
  When the level, range, or self calibration is changed, the load circuit compensation function becomes disabled.

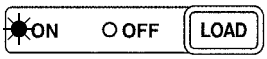
Measurement frequency	120 Hz	1 kHz
load compensation	Yes	Yes

- The enabling/ disabling of load circuit compensation will not change even if the self calibration setting is changed between AUTO and MANU. The load circuit compensation will disable when you change OFF ←→ MANU, AUTO.
- When open circuit compensation and short circuit compensation are enabled, load compensation performs compensation for Z and θ after open circuit compensation and short circuit compensation are finished.
  During the reading of open circuit compensation and short circuit compensation, setting, enabling/disabling of the circuit compensation value, and setting of all circuit compensation acquisition points, when the level is the same as the measurement signal level for load circuit compensation acquisition (setting) and the open circuit compensation and short circuit compensation value is changed, the load circuit compensation value will be adjusted by the most current open/short circuit compensation value and the load circuit compensation coefficient will be re-calculated.

Take the load compensation rate.

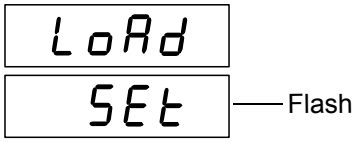
1. In normal measurement mode, press [LOAD].

The state becomes as follows.



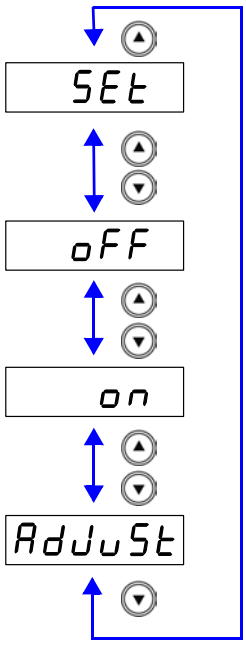
(Flash)

(MAIN display area)



2. Use ◀ or ▶ to select setting the load circuit compensation menu item.

Pressing ▲ or ▼ causes the display to change in the following manner.



"SEt"
Set the standard value at the currently set measurement frequency.

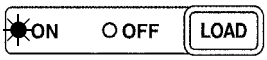
"oFF"
Disable load circuit compensation value at the enabled frequency.

"on"
Enable all load circuit compensation value at all disabled frequencies.

"AdJuSt"
Delete the disabled load circuit compensation values, acquire the load circuit compensation value at the currently set measurement frequency and enable the load circuit compensation value.

3. Select "AdJuSt" and press [ENTER].

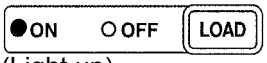
Incorporate the load compensation value.



(Flash)

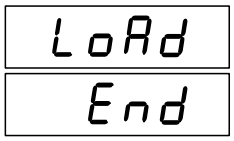
End of Compensation:

If compensation is completed normally, a beep tone sounds once and the condition becomes as follows.



(Light up)

(MAIN display area)



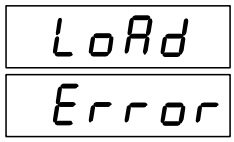
1 second light

The unit returns to normal measurement mode.

Compensation Error:

If a compensation error occurs, a warning beep will sound and the state becomes as follows.

(MAIN display area)



Compensation stops.

What if there is an error?

- If the value is outside the measurement range (under flow or over flow) a compensation error is generated. Set an appropriate range and then perform compensation again.
- To return to normal measurement mode, press LOAD.

NOTE Example of setting for enabling/disabling load circuit compensation functions

Example of enabling/disabling the acquisition of load circuit compensation values

Factory default condition

●: adjustment value valid △: adjustment value invalid
×: no adjustment value

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	×	×

Measurement frequency: when circuit compensation value is acquired from key or communication command (:CORRection:LOAD ON) at 120 Hz, level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	×

Measurement frequency: when circuit compensation value is acquired from (:CORRection:LOAD ON) after measurement conditions have been changed to 1 kHz, level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	●

When the circuit compensation value is disabled from key or communication command :CORRection:LOAD OFF)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	△	△

When the circuit compensation value is enabled from key or communication command (:CORRection:LOAD RETurn)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	●

Measurement frequency: when circuit compensation value is acquired from key or communication command (:CORRection:LOAD ON) at 120 Hz, level 0.5 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	●	×
1 V	×	×

Example of enabling/disabling setting for load circuit compensation values

Factory default condition

●: adjustment value valid △: adjustment value invalid
×: no adjustment value

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	×	×

Measurement frequency: when circuit compensation value is set from communication command (:CORRection:LOAD :DATA) at 120 Hz, level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	△	×

Measurement frequency: when circuit compensation value is set from communication command (:CORRection:LOAD :DATA) at 120 Hz, level 0.5 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	△	×
1 V	×	×

Measurement frequency: when circuit compensation value is set from communication command (:CORRection:LOAD :DATA) after measurement conditions have been changed to 1 kHz and level 1V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	△	×
1 V	×	△

When circuit compensation value is enabled from key or communication command (:CORRection:LOAD RETurn)

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	●	×
1 V	×	●

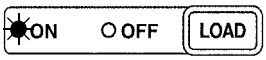
Measurement frequency: when circuit compensation value is acquired from key or communication command (:CORRection:LOAD ON) after measurement conditions have been changed to 120 Hz and level 1 V

Measurement level \ Measurement frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	●	×

Setting Reference Value

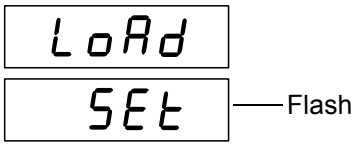
1. In normal measurement mode, press [LOAD].

The state becomes as follows.



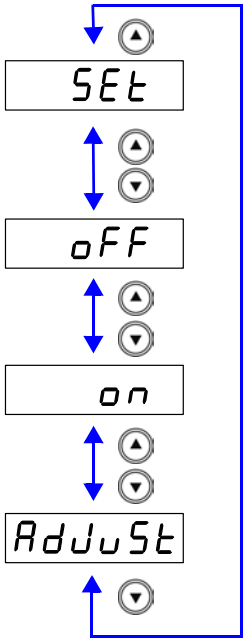
(Flash)

(MAIN display area)



2. Use ◀ or ▶ to select setting the load circuit compensation menu item.

Pressing ▲ or ▼ causes the display to change in the following manner.



"SEt"
Set the standard value at the currently set measurement frequency.

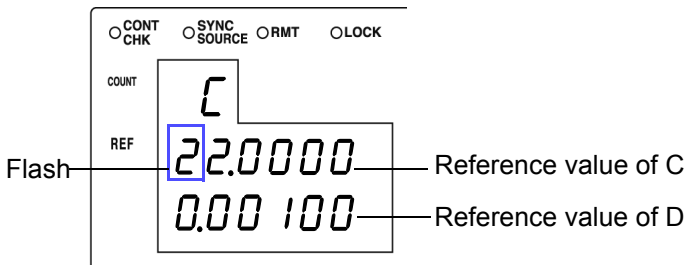
"oFF"
Disable load circuit compensation value at the enabled frequency.

"on"
Enable all load circuit compensation value at all disabled frequencies.

"AdJuSt"
Delete the disabled load circuit compensation values, acquire the load circuit compensation value at the currently set measurement frequency and enable the load circuit compensation value.

3. Select "SEt" and press [ENTER].

(SUB display area)



NOTE

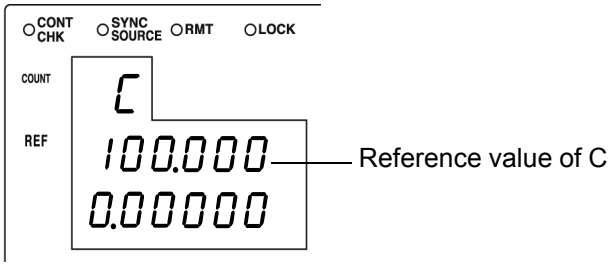
If you want to exit the reference value input screen and return to load compensation setting screen, press [LOAD].

1.800.561.8187 www.itm.com information@itm.com

4. Use the numeric keypad or arrow keys to enter a reference value for C and then press [ENTER].

(If you enter a number, each digit moves one place to the right.)
Settable Range: -199999 to 999999 (excluding 0)
Move to the digit..... ◀ and ▶
Change the number ... ▲ and ▼

(SUB display area)



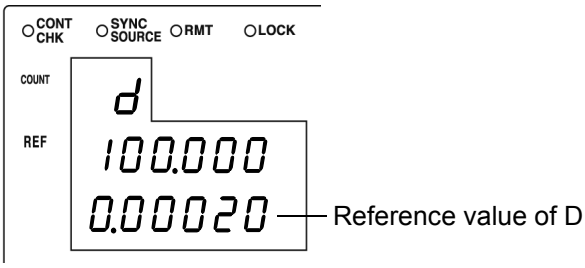
NOTE

- If you do not want to change the reference value of C, press [ENTER] without changing the number. The reference value input screen for D is displayed.
- Set count values for the reference values. The reference values at the time of shipment are 100000 for C and 0 for D.

5. Use the numeric keypad or arrow keys to enter a reference value for D and then press [ENTER].

(If you enter a number, each digit moves one place to the right.)
Settable Range: -199999 to 199999
Move to the digit..... ◀ and ▶
Change the number ... ▲ and ▼

(SUB display area)



The unit returns to the state of Step 2.

NOTE

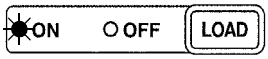
- If there is no need to change the reference value of D, press [ENTER] without changing the number.
- If you want to exit the reference value input screen and return to load compensation setting screen, press [LOAD].
- Recalculates the load compensation rate if the reference value is changed while LOAD compensation is enabled.
- Reference values are separated by measurement frequencies into separate data. The reference value is set based on the current measurement frequency.

1.800.561.8187 www.itm.com information@itm.com

Setting Load Circuit Compensation ON/ OFF

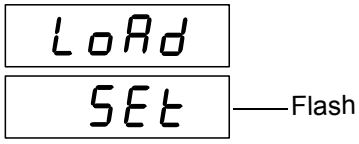
1. In normal measurement mode, press [LOAD].

The state becomes as follows.



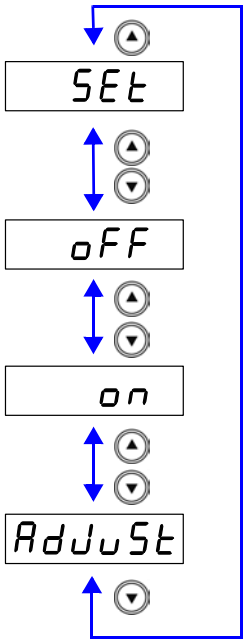
(Flash)

(MAIN display area)



2. Press ▲ ▼ to turn the load circuit compensation ON or OFF.

Pressing ▲ or ▼ causes the display to change in the following manner.



"SEt"
Set the standard value at the currently set measurement frequency.

"oFF"
Disable load circuit compensation value at the enabled frequency.

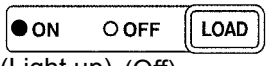
"on"
Enable all load circuit compensation value at all disabled frequencies.

"AdJuSt"
Delete the disabled load circuit compensation values, acquire the load circuit compensation value at the currently set measurement frequency and enable the load circuit compensation value.

3. Press [ENTER] to confirm the load circuit compensation ON or OFF.

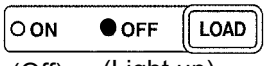
The state of the load compensation LED becomes as follows.

When select the "on"



(Light up) (Off)

When select the "oFF"



(Off) (Light up)

NOTE

- Load circuit compensation coefficient will not be enabled even if "on" is selected before the acquisition or setting of the load circuit compensation coefficient.
- Press [LOAD] if not turning load compensation ON or OFF.
  The unit returns to normal measurement mode.

4.3 Offset Compensation

Compensates for discrepancy from the correct value by subtracting an optional input value from measurement results. This function can compensate for the discrepancy found when measuring a fixed sample, or enable interchangeability of measuring instruments when measuring a single sample.

Performing offset compensation

1. **In normal measurement mode, press MENU.**

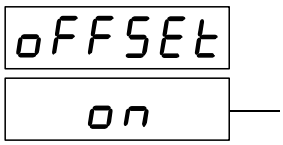
   The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
   (Refer to "Menu display organization" (p. 13) for menu order)

   This setting cannot be changed in comparator mode and BIN mode.

2. **Use ◀ or ▶ to select the “oFFSEt” menu item.**

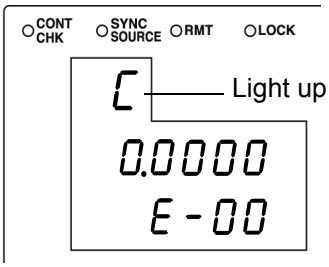
   The state becomes as follows.

   (MAIN display area)

   (Offset compensation setting screen)

   (SUB display area)

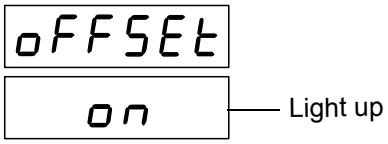
3. Press ▲ ▼ to enable or disable offset compensation.

The display switches between “on” and “oFF” each time ▲ ▼ is pressed.

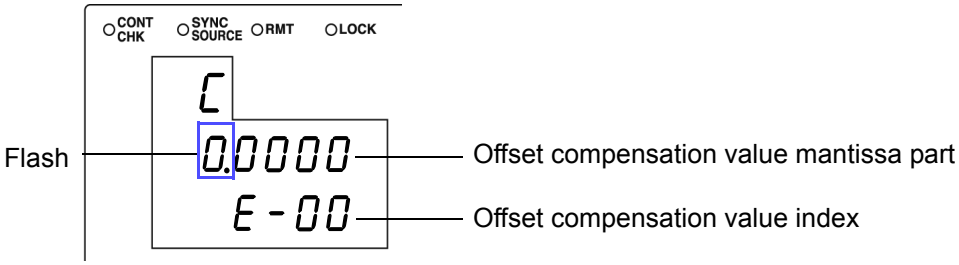
4. Press ENTER to confirm offset compensation as enabled or disabled.

When “on” is selected, the state becomes as follow.

(MAIN display area)



(SUB display area)



The following will be displayed on the upper portion of the MAIN display when “oFF” is selected.

- 3504-40, 3504-50.....“Low C“ (Low C reject function setting screen)
- 3504-60.....“Cont“ (Contact check function setting screen)

5. Input the mantissa part of the C offset compensation value using the arrow keys or the numeric keypad.

(If you enter a number, each digit moves one place to the right.)

Settable Range (Mantissa part) : ±(0.0000 to 9999.9)

Move to the digit..... ◀ and ▶

Change the number ... ▲ and ▼

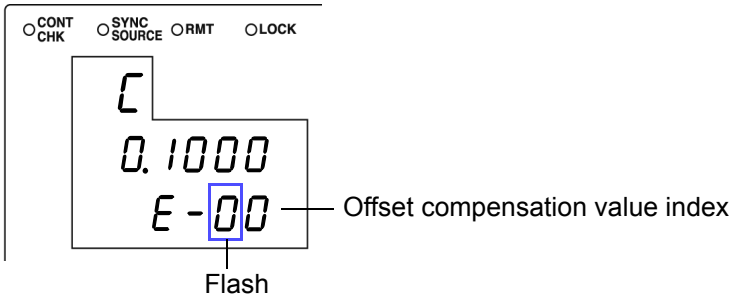
NOTE

The smallest resolution of the C offset compensation value is 1.0E-18. If you attempt to set it to a smaller value, the value will be set to "0".
Furthermore, if you attempt to make a setting lower than the lowest setting value it will be set at the lowest setting value, and if you attempt to make a setting higher than the highest setting value it will be set at the highest setting value.

1.800.561.8187 www.itm.com information@itm.com

6. **Press ENTER to confirm the mantissa part of the C offset compensation value.**
The state becomes as follows.

(SUB display area)

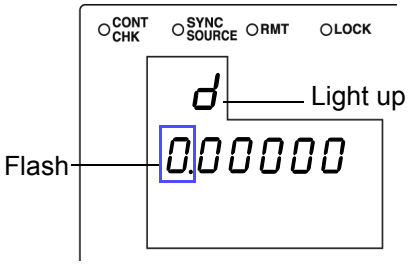


7. **Input the C offset compensation value index with the arrow keys or the numeric keypad.**
(If you enter a number, each digit moves one place to the right.)

Settable Range : -99.9E-3 to 99.9E-3 (Input the absolute value)
Smallest resolution : 1.0E-18
Move to the digit..... and
Change the number ... and

8. **Press ENTER to confirm the C offset compensation value index.**
The state becomes as follows.

(SUB display area)



9. **Input the D offset compensation value with the arrow keys or the numeric keypad.**
(If you enter a number, each digit moves one place to the right.)

Settable Range of D : -1.99999 to 1.99999
Move to the digit..... and
Change the number ... and

10. **Press ENTER to confirm the D offset compensation value.**
The following will be displayed on the upper portion of the MAIN display when “oFF” is selected.
- 3504-40, 3504-50.....“Low C“ (Low C reject function setting screen)
- 3504-60.....“Cont“ (Contact check function setting screen)

NOTE
- At time of shipment, the C and D offset compensation values are set to "0".
- The C and D offset compensation values are both divided into separate data depending on the measurement frequency (120 Hz, 1 kHz).Set the offset compensation value for the presently set measurement frequency.

11. **Press MENU.**
The unit returns to normal measurement mode.

1.800.561.8187 www.itm.com information@itm.com

4.4 Self Calibration

In Model 3504-40, 3504-50, 3504-60, drifts in the measurement values can be reduced by executing self calibration. Self calibration will acquire the value needed to adjust the relative error between the current detection circuit and voltage detection circuit and adjust the drifts of the detection circuits numerically.

Self calibration has the following modes.

- **OFF**
  Adjust using the default self calibration value.
- **MANUAL**
  When there is a request to start self calibration from EXT I/O, the self calibration value will be acquired and the measurement value adjusted.
  However, when the measurement conditions (frequency, level, range) are changed, the self calibration value will return to the factory default value.
  When there is a request to start from communication, the self calibration value will be acquired and measurement value adjusted at the point when the first measurement is carried out after the start request.
  The measurement value will be adjusted using the most current self calibration value.
- **AUTO**
  The self calibration value is acquired and measurement value adjusted every time a measurement is carried out.

←: The same as the left

Operation command to the device / Measurement speed, self calibration	Supply power	Measurement (no request for calibration)	Measurement (request for calibration)	Changes in measurement conditions (frequency, level, range)	Measurement (no request for calibration)	Measurement (request for calibration)
OFF	Default value	←	←	←	←	←
MANUAL	Default value	←	Revision	Default value	←	Revision
AUTO	Default value	Revision	Revision	Revision	Revision	Revision

NOTE

- Always connect to the object to be measured and set the measurement conditions (frequency, level, range) for the evaluation before acquiring the self calibration value. When the measurement conditions (frequency, level, range) are changed, the current self calibration value will be disabled automatically and returned to the factory default value.
- If the interval between taking the self calibration value and the next measurement becomes long, drift will occur between the time the self calibration value was obtained and the current circuit conditions, reducing the effectiveness of self calibration. Please make the interval after taking the self calibration value as short as possible.
  Take a new self calibration value after measuring if the ambient temperature has changed by more than 2°C.
- This device requires one hour of warm up time after it is turned on.
  The circuit error is different from after warm up so always acquire the self calibration value after warm up.
- When acquiring the self calibration value, the analog measurement time (INDEX) and measurement end time (EOM) become longer.
  See 7.4 "About Measurement Times" (p. 128)
- When an abnormal self calibration value is acquired when the instrument to be tested is not connected or self calibration is conducted in a noise environment, ERR will light up. When this happens, connect the instrument to be tested correctly, or carry out measures to reduce noise then try self calibration again to deactivate ERR.

1.800.561.8187 www.itm.com information@itm.com

Performing Self Calibration

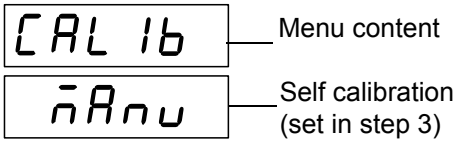
1. In normal measurement mode, press [MENU].

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

2. Use ◀ or ▶ to select the "CALIb" menu item.

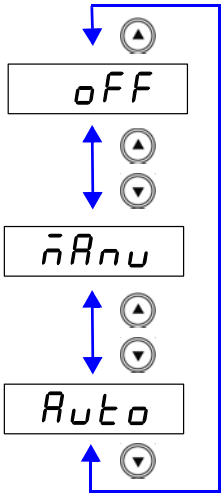
(MAIN display area)



(Self calibration settings screen)

3. Use ▲ and ▼ to select a setting item.

Pressing ▲ or ▼ causes the display to change in the following manner。



"**oFF**"
Adjust using the factory default self calibration value.

"**MAnu**"
When inputting the trigger from EXT I/O and when the CALIB signal line is at LOW, the self calibration value will be calculated and adjusted during measurement.
Or when communication command (:CALibration:ADJust) is executed, self calibration value will be calculated and adjusted at the point of the first measurement after a request for start.

"**Auto**"
Self calibration value will be calculated and adjusted during each measurement.

4. Press [ENTER].

The Self calibration setting is confirmed.
After confirmation, "IF" (Communication conditions setting screen) is displayed at the top of the MAIN display area.

The Self calibration setting is not confirmed unless [ENTER] is pressed.

5. Press [MENU].

Judging measurement results

Chapter 5

5.1 Comparator Function

This function enables you to set the upper limit and lower limit values for each of C and D, and then indicates the judgment result with HI, IN, or LO in the comparator judgment result display area.
The judgment result enables you to determine whether the sample has passed or failed.

The corresponding signal is also output from the EXT I/O connector on the rear of the unit.
There are two judgment modes for comparator measurement: the count value setting and deviation percent (Δ%) setting.

- **Count Value Setting**
  Set count values for the upper limit and lower limit values of the measurement parameters.

- **Deviation Percent (Δ%) Setting**
  Enter reference values and then set percentages corresponding to the reference values as the upper limit and lower limit values. The differences from reference values (C: Δ%, D: Δ) are displayed as the measurement values.

If the power is turned off while the unit is in comparator measurement mode, the unit will be in comparator measurement mode when the unit is turned back on again.

Select judgment mode and set judgment conditions.
- Judgment mode settings (p. 62)
- Judgment conditions settings (p. 63)
- Count Value Setting (p. 64)
- Deviation Percent (Δ%) Setting (p. 67)

Measurement results display

Judgment mode	Measurement Results
Count (Count Value Setting)	Displays the measurement value.
d-PEr (Deviation Percent (Δ%) Setting)	The first parameter (C) displays the result of the calculation: $\frac{\text{(measurement value - reference value)}}{\lvert\text{reference value}\rvert} \times 100$ The second parameter (D) displays the result of the calculation: (measurement value - reference value)

NOTE

- Set the upper limit and lower limit values of any parameter that does not require a comparator judgment to be made to OFF so that judgment will not be performed.
- Set the upper limit and lower limit values of any parameter (C,D) that does not require a comparator judgment to be made to OFF so that judgment will not be performed.
- The measurement conditions for normal measurement mode are inherited as is for the measurement conditions when the comparator is executed. However, the AUTO range is automatically set to the HOLD range.

1.800.561.8187 www.itm.com information@itm.com

Setting Judgment Mode

First, set the judgment mode. (Select the count value setting and the deviation percent (Δ%) setting.)
The judgment modes are the same for both the comparator and BIN.

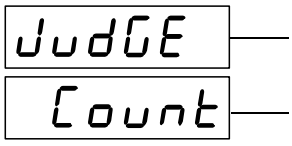
1. In normal measurement mode, press [MENU].

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

2. Use ◀ or ▶ to select the "JudGE" menu item.

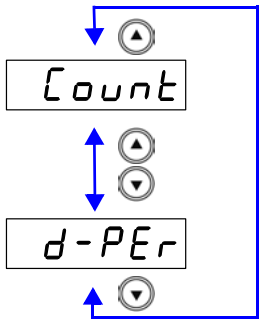
(MAIN display area)



(Judgment mode setting screen)

3. Use ▲ or ▼ to select a setting item.

Pressing ▲ or ▼ causes the display to change in the following manner.



"Count"
Count setting

"d-PEr"
Deviation percent (Δ%) setting

4. Press [ENTER].

The judgment mode is confirmed.
After confirmation, "bEEP_J"(Beep setting screen for judgment result) is displayed at the top of the MAIN display area.

The judgment mode is not confirmed unless [ENTER] is pressed.

5. Press [MENU].

The unit returns to normal measurement mode.

Setting the Upper Limit and Lower Limit Values for the ComparatorSetting Workflow

1	Normal measurement mode	MODE	Switch to comparator measurement mode. The range is automatically set to HOLD.
2	Comparator measurement mode	SET	Switch to the setting mode for the upper limit and lower limit values.
3	C setting	ENTER	Confirm C. Move to the next setting.
4	Reference value setting for C (Only for the Δ% setting)	• Numeric keypad • Arrow keys ENTER	Set the reference value for C.
5	Upper limit and lower limit value settings for C	• Numeric keypad • Arrow keys ENTER • Numeric keypad • Arrow keys ENTER	Set the upper limit value for C. Confirm the upper limit value. Set the lower limit value for C. Confirm the lower limit value.
6	D setting	ENTER	Select D. Confirm D.
7	Reference value setting for D (Only for the Δ% setting)	• Numeric keypad • Arrow keys ENTER	Set the reference value for D. Move to the next setting.
8	Upper limit and lower limit value settings for D	• Numeric keypad • Arrow keys ENTER • Numeric keypad • Arrow keys ENTER	Set the upper limit value for D. Confirm the upper limit value. Set the lower limit value for D. Confirm the lower limit value.
9	Comparator measurement mode	SET	Switch to comparator measurement mode.

Measurement method 1

Make settings using the upper limit and lower limit values (count setting).

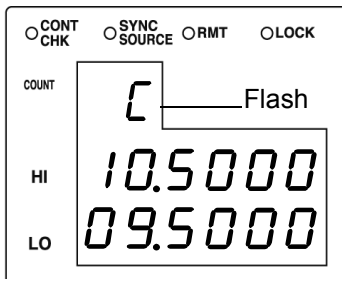
(To make settings using a reference value and the upper limit and lower limit values refer to "Measurement method 2" (p. 82))

1. Press [MODE] to light up COMP and enter comparator measurement mode.

(Light up)

2. Press [SET].

(SUB display area)

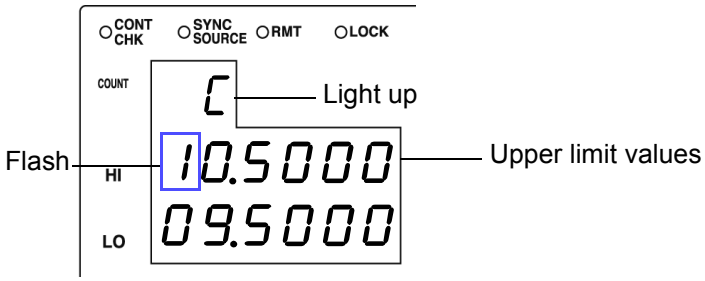


To make settings from an optional setting mode, press ▲ ▼ while "C" or "d" is flashing to select the setting mode, then press [ENTER].

Setting modes : C upper limit and lower limit values ←→ D upper limit and lower limit values ←→ C upper limit and lower limit values…

3. Press [ENTER] to enter "C" upper limit value setting mode.

(SUB display area)



4. Input the C upper limit value using the arrow keys or the numeric keypad.

Settable Range : OFF, -199999 to 999999 (When setting to "OFF" (p.72))

Move to the digit..... ◄ and ►

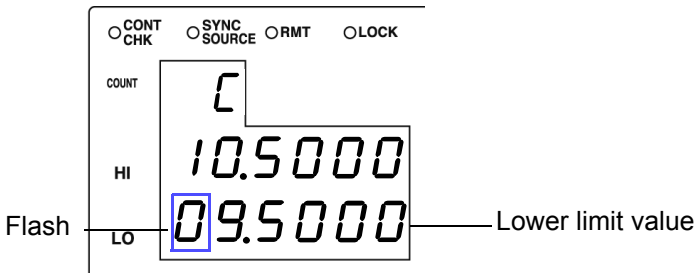
Change the number .. ▲ and ▼

Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to " - - - - - - " (OFF).

5. **Press ENTER to confirm the C upper limit value.**
Enter C lower limit value setting mode.

(SUB display area)



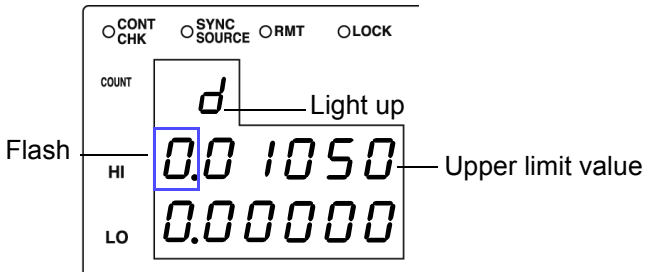
6. **In the same way input the C lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

7. **Press ENTER to set the C lower limit value.**

8. **Press ENTER to enter the D upper limit value setting mode.**

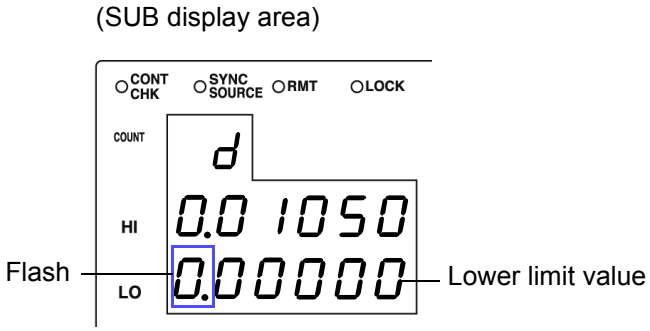
(SUB display area)



9. **Input the D upper limit value using the arrow keys or the numeric keypad.**
Settable Range: OFF, -199999 to 199999 (When setting to "OFF" (p. 72))
Move to the digit..... and
Change the number ... and
Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to " - - - - - - " (OFF).

10. **Press ENTER to set the D upper limit value.**
Enter the D lower limit value setting mode.

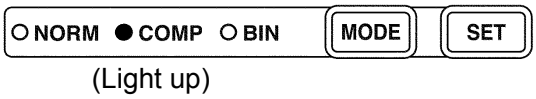


11. **In the same way input the D lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

12. **Press ENTER to set the D lower limit value.**

13. **Press SET.**
The unit switches to the comparator measurement mode.



The comparator measurement result is displayed in the MAIN display area.

See "Comparator Measurement Results" (p. 73)

NOTE

- The upper and lower limit values set during count setting become displayed count values independent of measurement conditions. If the range settings are changed, the absolute values which define the count values are changed.
  For example, if the range is currently set at 200 nF this would mean that C count value of 50000 = 50E-9, D count value 100 = 0.00100.
- Set the comparator measurement mode measurement conditions while in normal measurement mode.
  See 3.3 "Setting the Measurement Conditions" (p. 26)
- The large/small judgment for the upper limit and lower limit values is not performed. An error is not generated if the upper limit and lower limit values are set in reverse, but the judgment cannot be performed properly.
- Refer to "Judgement results display" (p. 73) regarding comparator judgment results.
- After settings are complete, ▲ ▼ can be used to toggle the judgment range display to confirm the judgment range.

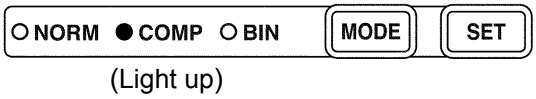
1.800.561.8187 www.itm.com information@itm.com

Measurement method 2

Make settings using a reference value and the upper limit and lower limit values (Δ% setting)

(To make settings using a reference value and the upper limit and lower limit values refer to "Measurement method 1" (p. 64))

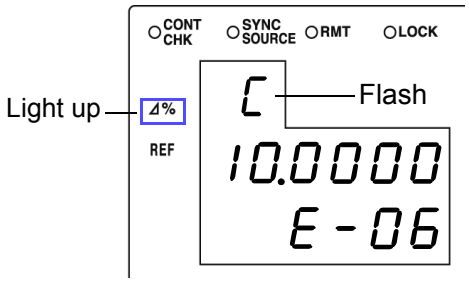
1. Press MODE to light up COMP and enter comparator measurement mode.



(Light up)

2. Press SET.

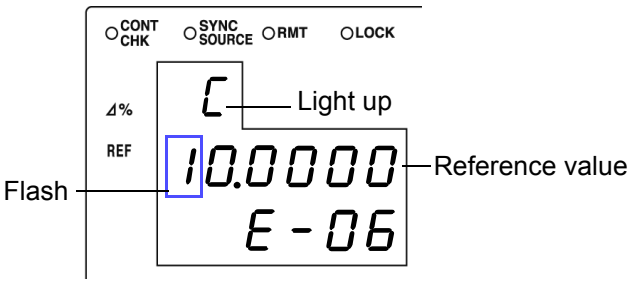
(SUB display area)



To make settings from an optional setting mode, press ▲ ▼ while "C" or "d" is flashing to select the setting mode, then press ENTER.
Setting modes: C reference value ←→C upper limit and lower limit values ←→ D reference value ←→D upper limit and lower limit values ←→ C reference value...

3. Press ENTER to enter "C" reference value setting mode.

(SUB display area)



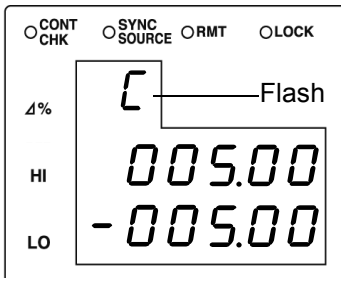
4. Enter the C reference value using the arrow keys or the numeric keypad.

(If you enter a number, each digit moves one place to the right.)
Settable Range : -199999 to 999999 (The Δ% setting cannot be set to "0")
Move to the digit..... ◄ and ►
Change the number ... ▲ and ▼
Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

Set a count value for the reference value.
At time of shipment, it is set to " 100000 ".

5. **Press ENTER to confirm the C reference value.**

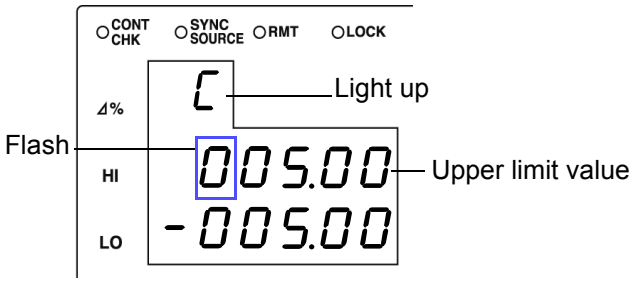
(SUB display area)



The reference value entered this time is not confirmed unless ENTER is pressed. The reference value used last time becomes valid.

6. **Press ENTER to enter the C upper limit value setting mode.**

(SUB display area)



7. **Enter the C upper limit value using the arrow keys or the numeric keypad.**

Settable Range

- OFF, -999.99 to 999.99 (When setting to "OFF"(p.72))

Move to the digit..... ◄ and ►

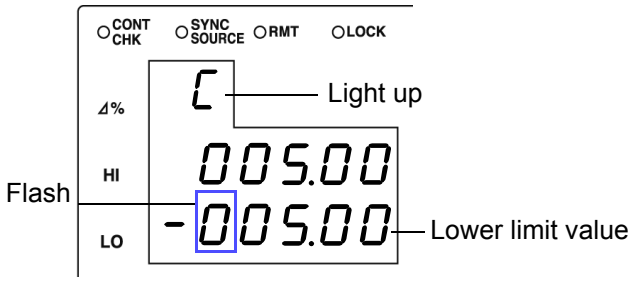
Change the number .. ▲ and ▼

Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to " - - - - - - " (OFF).

8. **Press ENTER to confirm the C upper limit value.**
Enter the C lower limit value setting mode.

(SUB display area)

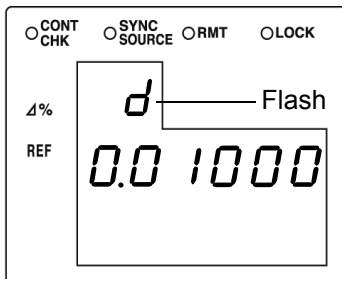


9. **Enter the C lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

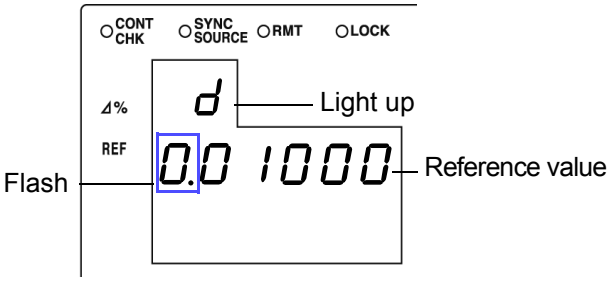
10. **Press ENTER to confirm the C lower limit value.**

(SUB display area)



11. **Press ENTER to enter the D reference value setting mode.**

(SUB display area)



12. **Enter the D reference value using the arrow keys or the numeric keypad.**
Settable Range: -199999 to 199999
Move to the digit..... ◀ and ▶
Change the number .. ▲ and ▼

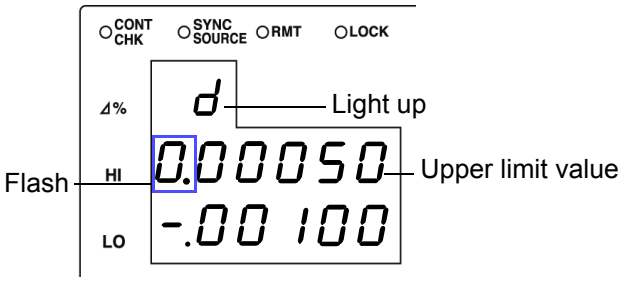
The reference value is set using the count value. At time of shipment it is set to ”0”.

13. **Press ENTER to confirm the D reference value.**

The reference value entered this time is not confirmed unless ENTER is pressed. The reference value used last time becomes valid.

14. **Press ENTER to enter the D upper limit value setting mode.**

(SUB display area)



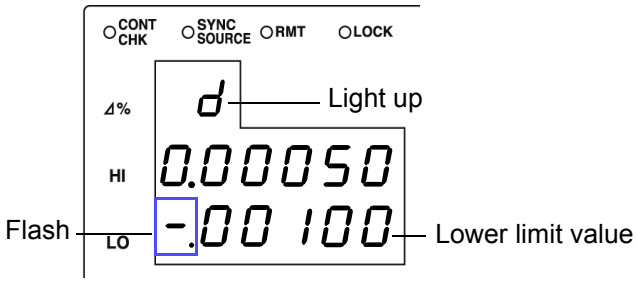
15. **Enter the D upper limit value using the arrow keys or the numeric keypad.**
Settable Range: OFF, -199999 to 199999 (When setting to "OFF" (p.72))
Move to the digit..... ◀ and ▶
Change the number .. ▲ and ▼
Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to ” - - - - - - ” (OFF).

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

Enter the D lower limit value setting mode.

(SUB display area)



17. **In the same way, enter the D lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

18. **Press ENTER to confirm the D lower limit value.**

19. **Press SET.**

The unit switches to the comparator measurement mode.

(Light up)

The comparator measurement result is displayed in the MAIN display area.

See "Comparator Measurement Results" (p. 73)

NOTE

- The upper limit and lower limit values for the count setting and the reference value for the Δ% setting become display count values that are independent of the measurement conditions. If the measurement conditions differ, the absolute values that signify the count values change.
  For example, if the range is currently set at 200 nF this would mean that C count value of 50000 = 50E-9, D count value 100 = 0.00100.
- Set the comparator measurement mode measurement conditions while in normal measurement mode.
  See 3.3 "Setting the Measurement Conditions" (p. 26)
- The large/small judgment for the upper limit and lower limit values is not performed. An error is not generated if the upper limit and lower limit values are set in reverse, but the judgment cannot be performed properly.
- Refer to "Judgement results display" (p. 73) regarding comparator judgment results.
- After settings are complete, ▲ ▼ can be used to toggle the judgment range display to confirm the judgment range.

Setting the Upper Limit and Lower Limit Values to OFF

1. **When entering the upper limit and lower limit values, use ◀ to move left until the far left digit flashes and then press and hold ◀ for at least two seconds or use ▶ to move right until the far right digit flashes and then press and hold ▶ for at least two seconds.**

   The display changes to "– – – – – –" and OFF is set.

2. **Press ENTER to confirm the OFF setting.**

3. **Press SET.**

   The unit switches to comparator measurement mode.

(Light up)

Canceling Comparator Measurement Mode

In comparator measurement mode, press MODE twice.

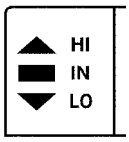
The measurement mode LEDs light in the order of COMP → BIN → NORM, and then the unit switches to normal measurement mode.

(Light up)

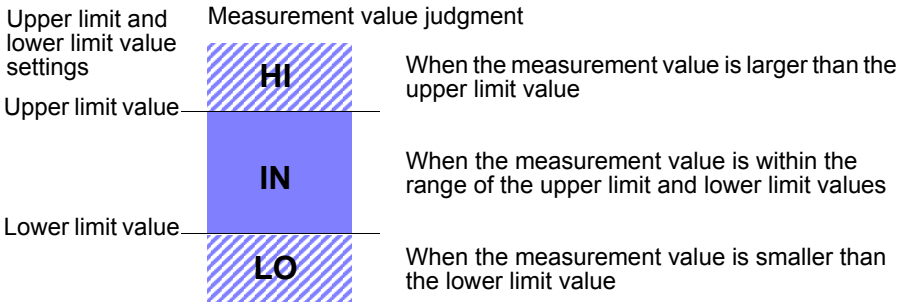
Comparator Measurement Results

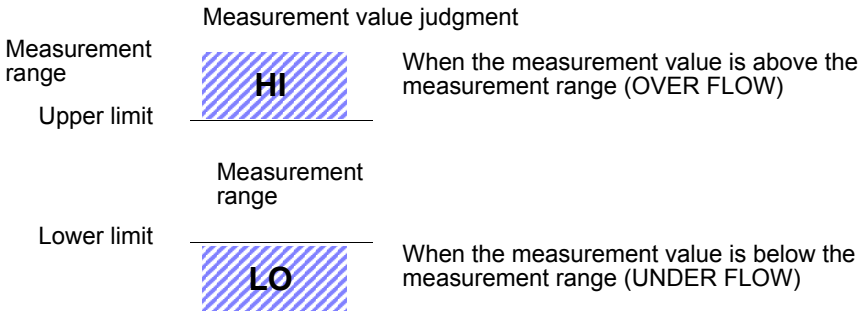
- The measurement conditions of comparator measurement mode use the measurement conditions of normal measurement. Set the comparator mode measurement conditions in normal measurement mode.
  See 3.3 "Setting the Measurement Conditions" (p. 26)
- The upper limit and lower limit value numbers are not checked for which is greater and smaller. Therefore please take care when setting them, as correct judgments cannot be made if they are set in the opposite order.

Judgement results display



Each of the judgment results for C and D is displayed in the comparator judgment result display area.
The comparator judgment is not performed for parameters with the upper limit and lower limit value set to OFF.





Judgment order	Judgement results	Meaning	Solution
1	The HI LED lights up.	Measurement error	See "MAIN display area ERROR display" (p. 14)
	The HI LED lights up.	The measurement value is above the high limit value range in the current range.	Switch to an appropriate range. See 3.3.6 "Measurement Range" (p. 31)
	The LO LED lights up.	The measurement value is below the low limit value range in the current range.	
2	The LO LED lights up.	The measurement value is lower than the lower limit value.	—
3	The HI LED lights up.	The measurement value is higher than the upper limit value.	
4	The IN LED lights up.	The measurement value is within the setting range.	

Outputting Judgment Results

- Output the judgment result for each of C and D (LO/IN/HI) and the AND results for both judgment results (only when both parameters are IN) from EXT I/O.
  See 7.1 "About the EXT I/O Connector" (p. 123)
- The comparator judgment results (IN/NG) can be differentiated by beep tones.
  See 6.9 "Setting Beep Tones" (p. 112)

- Except for the trigger setting, the measurement conditions cannot be changed in comparator measurement mode.

  Press MODE to switch to normal measurement mode and then change the measurement conditions.

Keys Enabled for Comparator Mode

Key	Function
MODE	Switches the measurement mode.
SET	Switches to the setting modes for the upper limit and lower limit values.
▲ ◀ ▶ ▼	Change to confirm the upper/ lower limit values, range, and voltage current monitor values.
TRIG	Switches the trigger setting to INT/EXT.
MANU TRIG	This key is only enabled when the trigger setting is EXT. One measurement is performed each time the key is pressed.
MENU	The following menu settings can be made. • “LoAd_A(C/h)” • “SAVE” • “Ld_tYP” • “Cont” • “Lo C” • “LEV.ChK” • “bEEP_K” • “dISP” • “IF” Settings other than the above listed can be made from normal measurement mode. Menu which cannot be set at the comparator measurement mode will display the current setting conditions in the lower portion of the MAIN display.
LOCK/LOCAL	Changes the keylock function and cancels the remote state.

5.2 BIN Measurement Function (Model 3504-50, 3504-60 only)

This function enables you to set up to 14 categories of upper limit and lower limit values for C and one category of upper limit and lower limit values for D, and indicates the judgment results in the BIN judgment result display area.
The corresponding signal is also output from the EXT I/O connector on the rear of the unit.

There are two judgment modes for BIN measurement: the count value setting and deviation percent (Δ%) setting

- **Count Value Setting**
  Set count values for the upper limit and lower limit values of the measurement parameter.

- **Deviation Percent (Δ%) Setting**
  Enter reference values and then set percentages corresponding to the reference values for the upper limit and lower limit values.

Select judgment mode and set judgment conditions.
- Judgment mode settings (p. 76)
- Judgment conditions settings (p. 77)
  Count Value Setting (p. 78)
  Deviation Percent (Δ%) Setting (p. 82)

Measurement results display

Judgment mode	Measurement Results
Count (Count Value Setting)	Displays the measurement value.
d-PEr (Deviation Percent (Δ%) Setting)	The first parameter (C) displays the result of the calculation: $\frac{\text{(measurement value - reference value)}}{\lvert\text{reference value}\rvert} \times 100$ The second parameter (D) displays the result of the calculation: (measurement value - reference value)

NOTE

- If the power is turned off while the unit is in BIN measurement mode, the unit will be in BIN measurement mode when the unit is turned back on again.
- Set the upper limit and lower limit values of any BIN number that does not require a BIN judgment to be made to OFF so that judgment will not be performed.
- The measurement conditions for normal measurement mode are inherited as is for the measurement conditions when the BIN is executed. However, the AUTO range is automatically set to the HOLD range.

1.800.561.8187 www.itm.com information@itm.com

Setting Judgment Mode

Set the judgment mode before setting the BIN judgment conditions.
(Select the count value setting, the deviation percent (Δ%) setting.)

The judgment mode is common to comparator measurement and BIN measurement.

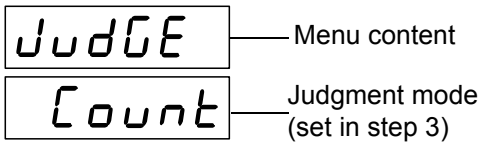
1. In normal measurement mode, press [MENU].

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

2. Use ◄ or ► to select the "JudGE" menu item.

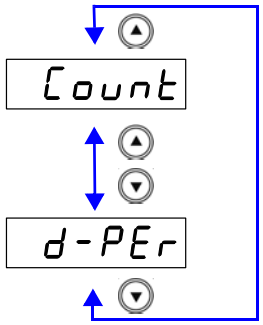
(MAIN display area)



(Judgment mode setting screen)

3. Use ▲ or ▼ to select a setting item.

Pressing ▲ or ▼ causes the display to change in the following manner.



"Count"
Count setting.

"d-PEr"
Deviation percent (Δ%) setting.

4. Press [ENTER].

The judgment mode is confirmed.
After confirmation, "bEEP_J"(Beep setting screen for judgment result) is displayed at the top of the MAIN display area.

The judgment mode is not confirmed unless [ENTER] is pressed.

5. Press [MENU].

The unit returns to normal measurement mode.

Setting the Upper Limit and Lower Limit Values for the BIN Setting Workflow

1 Normal measurement mode

MODE (Twice)

Switch to comparator measurement mode.

Switch to BIN measurement mode.
The range is automatically set to HOLD.

2 BIN measurement mode

SET

Switch to the setting mode for the upper limit and lower limit values.

3 Reference value setting for C
(Only for the Δ% setting)

ENTER

Confirm C.

• Numeric keypad
• Arrow keys

Set the reference value for C.

ENTER

Confirm the setting value.

4 Upper limit and lower limit value settings for BIN1 to BIN14

ENTER

Confirm BIN1.

• Numeric keypad
• Arrow keys

Set the upper limit value for BIN1.

ENTER

Confirm the upper limit value.

• Numeric keypad
• Arrow keys

Set the lower limit value for BIN1.

ENTER

Confirm the lower limit value.
Set BIN2 to BIN14 in the same manner.

5 Reference value setting for D
(Only for the Δ% setting)

ENTER

Confirm D.

• Numeric keypad
• Arrow keys

Set the reference value for D.

ENTER

Confirm the reference value.
Move to the next setting.

6 Upper limit and lower limit value settings for D

ENTER

Confirm D.

• Numeric keypad
• Arrow keys

Set the upper limit value for D.

ENTER

Confirm the upper limit value.

• Numeric keypad
• Arrow keys

Set the lower limit value for D.

ENTER

Confirm the lower limit value.
Move to the next setting.

7 BIN measurement mode

SET

Switch to BIN measurement mode.

1.800.561.8187 www.itm.com information@itm.com

Measurement method 1

Make settings using the upper limit and lower limit values (count setting).

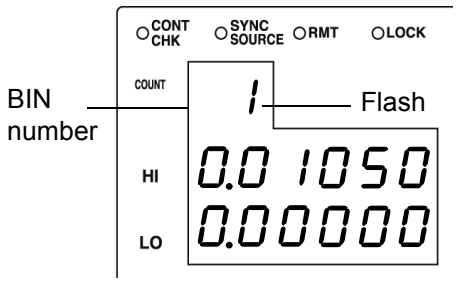
(To make settings using a reference value and the upper limit and lower limit values refer to "Measurement method 2" (p. 82))

1. **Use [MODE] to switch to the BIN measurement mode.**

(Light up)

2. **Press [SET].**

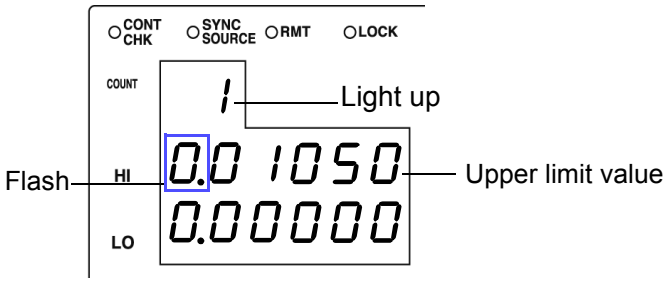
(SUB display area)



To make settings from an optional setting mode, press ▲ ▼ to select the setting mode while "1 to 14" is flashing, and then press [ENTER].
Setting modes: BIN1 to 14 upper and lower limit values ←→ D upper and lower limit values ←→ BIN1 to 14 upper and lower limit values...

3. **Press [ENTER] to enter the BIN1 upper limit value setting mode.**

(SUB display area)



4. **Use the numeric keypad or the arrow keys to enter an upper limit value for BIN1 and then press [ENTER].**

Settable Range: OFF, -199999 to 999999 (When setting to "OFF"(p. 87))

Move to the digit..... ◀ and ▶

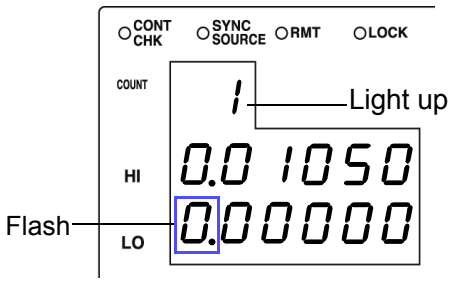
Change the number .. ▲ and ▼

Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to " - - - - - - " (OFF).

5. **Press ENTER to confirm the BIN1 upper limit value.**
Enter the BIN1 lower limit value setting mode.

(SUB display area)



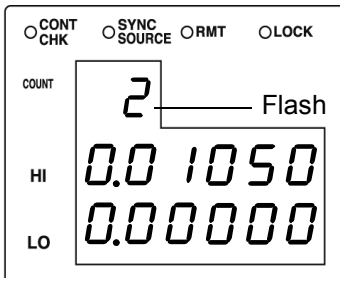
If ENTER is not pressed, the BIN upper limit and lower limit values just entered will not be set.
The previous BIN upper limit value and lower limit value will remain in effect.

6. **Enter the BIN1 lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

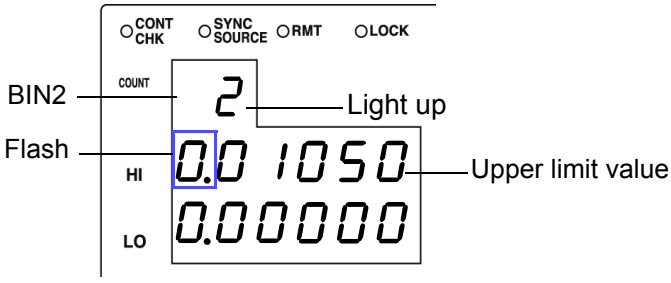
7. **Press ENTER to confirm the BIN1 lower limit value.**

(SUB display area)



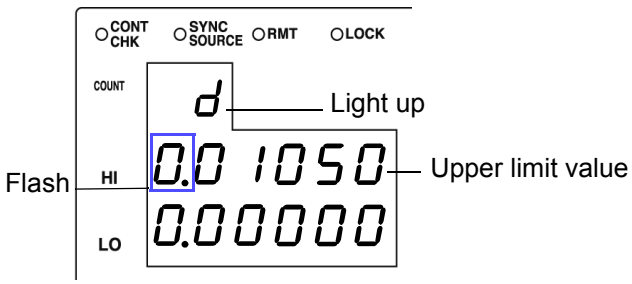
8. **Press ENTER to enter the BIN2 upper limit value setting mode.**
In the same way make settings for the BIN2 to 14 upper limit values and lower limit values.

(SUB display area)



9. **Press ENTER to enter the D upper limit value setting mode.**

(SUB display area)



10. **Enter the D upper limit value using the arrow keys or the numeric keypad.**

Settable Range: OFF, -199999 to 199999 (When setting to "OFF"(p. 87))

Move to the digit..... ◄ and ►

Change the number .. ▲ and ▼

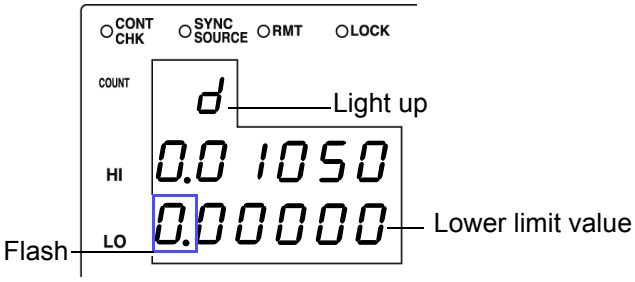
Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to " - - - - - - " (OFF).

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

Enter the D lower limit value setting mode.

(SUB display area)



12. **Enter the D lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

13. **Press ENTER to confirm the D lower limit value.**

14. **Press** [SET].

The unit switches to the BIN measurement mode.

(Light up)

See "Performing BIN Measurement" (p. 88)

NOTE

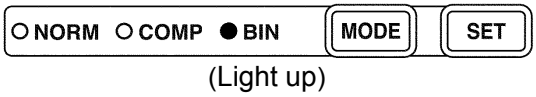
- The upper limit and lower limit values for the count setting become display count values that are independent of the measurement conditions. If the measurement conditions differ, the absolute values that signify the count values change.
  For example, if the range is currently set at 200 nF this would mean that C count value of 50000 = 50E-9 and D count value 100 = 0.00100.
- The measurement conditions for normal measurement mode are used for the BIN measurement mode. Set the measurement conditions to use for BIN measurement mode while the unit is in normal measurement mode.
- Check the following because judgment cannot be performed properly if the upper limit and lower limit values are set incorrectly.
  - Are the setting values within the display range of the measurement range?
  - Is the large/small relationship of the upper limit and lower limit values correct?
- After settings are complete, [▲] [▼] can be used to toggle the judgment range display to confirm the judgment range.

Measurement method 2

Make settings using the reference value upper limit and lower limit values (Δ% setting)

(To make settings using a reference value and the upper limit and lower limit values refer to "Measurement method 1" (p. 78))

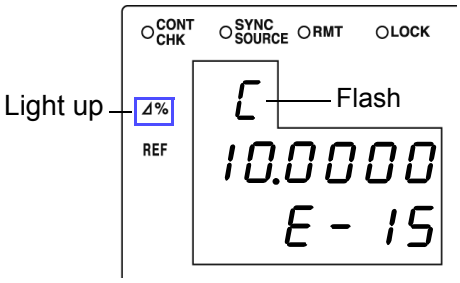
1. Press MODE to light up BIN and enter the BIN measurement mode.



(Light up)

2. Press SET.

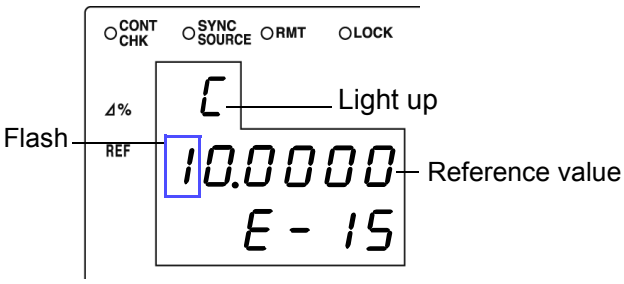
(SUB display area)



To make settings from an optional setting mode, press ▲ ▼ while "C" is flashing to select the setting mode, then press ENTER. Setting modes: C reference value ←→ BIN1 to 14 upper limit and lower limit values ←→ D reference value ←→ D upper limit and lower limit values ←→ C reference value....

3. Press ENTER to enter the C reference value setting mode.

(SUB display area)



4. Enter the C reference value using the arrow keys or the numeric keypad.

(If you enter a number, each digit moves one place to the right.)
Settable Range: -199999 to 999999 (Cannot be set to 0.)

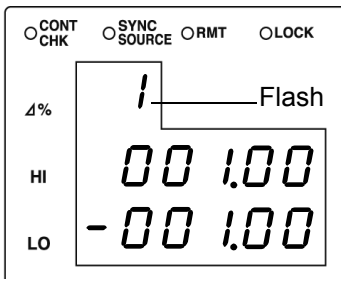
Move to the digit..... ◀ and ▶

Change the number .. ▲ and ▼

The reference value is set with the count value. At time of shipment it is set to ”100000”.

5. **Press ENTER to confirm the C reference value.**

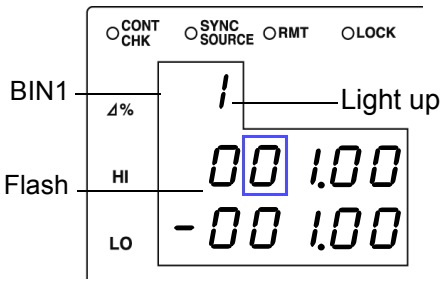
(SUB display area)



The reference value entered this time is not confirmed unless ENTER is pressed. The reference value used last time becomes valid.

6. **Press ENTER to enter the BIN1 upper limit value setting mode.**

(SUB display area)



7. **Enter the BIN1 upper limit value using the arrow keys or the numeric keypad.**

Settable Range

- OFF, –999.99 to 999.99 (When setting to "OFF"(p. 87))

Move to the digit..... ◄ and ►

Change the number ... ▲ and ▼

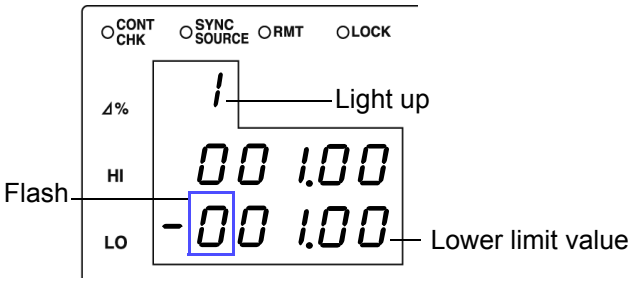
Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to ” - - - - - - ” (OFF).

ENTER Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

8. **Press ENTER to confirm the BIN1 upper limit value.**
Enter the BIN1 lower limit value setting mode.

(SUB display area)



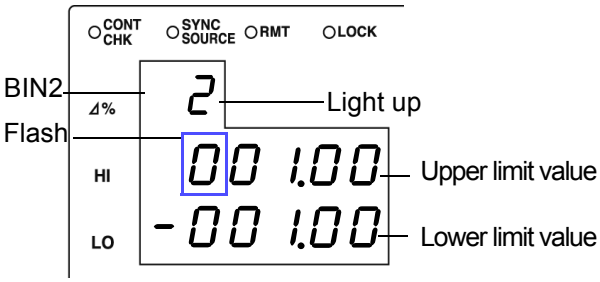
9. **Enter the BIN1 lower limit value in the same way using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

10. **Press ENTER to confirm the BIN1 lower limit value.**

11. **Press ENTER to enter the BIN2 upper limit value setting mode.**

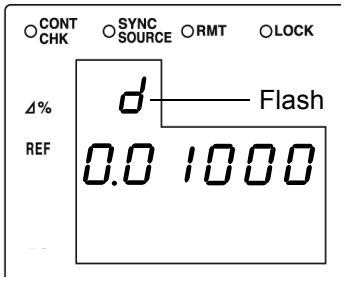
(SUB display area)



In the same way set all BIN upper limit and lower limit values.

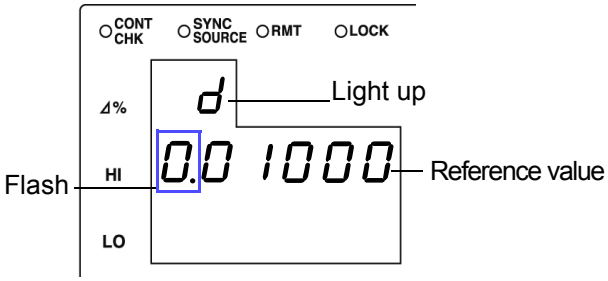
After all of the BIN upper limit and lower limit values have been set, the condition will become as follows.

(SUB display area)



12. **Press ENTER to enter the D reference value setting mode.**

(SUB display area)



13. **Enter the D reference value using the arrow keys or the numeric keypad.**

Settable range: -199999 to 199999

Move to the digit..... ◄ and ►

Change the number ... ▲ and ▼

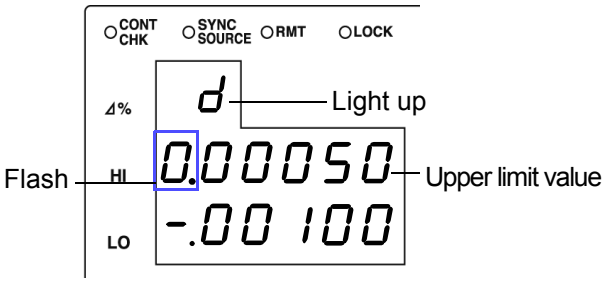
The reference value is set with the count value. At time of shipment it is set to ”0“.

14. **Press ENTER to confirm the D reference value.**

If ENTER is not pressed, the reference value just entered will not be set. The previous reference value will remain in effect.

15. **Press ENTER to enter the D upper limit value setting mode.**

(SUB display area)



16. **Enter the D upper limit value using the arrow keys or the numeric keypad.**

Settable range: OFF, -199999 to 199999 (When setting to "OFF"(p. 87))

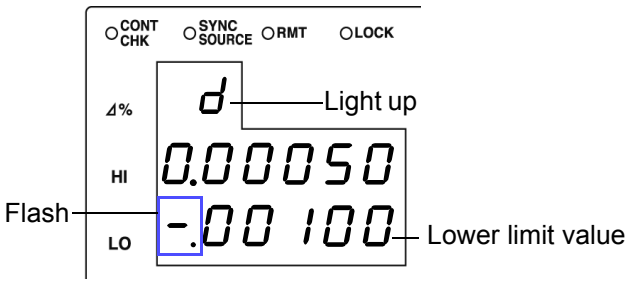
Move to the digit..... ◄ and ►

Change the number ... ▲ and ▼

Setting a value lower than the lower limit value will not produce an error, but accurate judgment will not be possible.

At time of shipment, it is set to ” - - - - - - ” (OFF).

17. **Press ENTER to confirm the D upper limit value.**
Enter the D lower limit value setting mode.
(SUB display area)



18. **In the same way enter the D lower limit value using the arrow keys or the numeric keypad.**

At time of shipment, it is set to " - - - - - - " (OFF).

19. **Press ENTER to confirm the D lower limit value.**

20. **Press SET.**

Enter the BIN measurement mode.

(Light up)

See "Performing BIN Measurement" (p. 88)

NOTE

- The reference value for the Δ setting and Δ% setting become display count values that are independent of the measurement conditions. If the measurement conditions differ, the absolute values that signify the count values change.
  For example, if the range is currently set at 100 pF this would mean that C count value of 50000 = 50E-9 and D count value 100 = 0.00100.
- The measurement conditions for normal measurement mode are used for the BIN measurement mode. Set the measurement conditions to use for BIN measurement mode while the unit is in normal measurement mode.
- When checking the upper/lower limit values, error judgment is not done.
- Check the following because judgment cannot be performed properly if the upper limit and lower limit values are set incorrectly.
  •Are the setting values within the display range of the measurement range?
  •Is the large/small relationship of the upper limit and lower limit values correct?
- After settings are complete, ▲ ▼ can be used to toggle the judgment range display to confirm the judgment range.

Setting the Upper Limit and Lower Limit Values to OFF

1. **When entering the upper limit and lower limit values, use ◀ to move left until the far left digit flashes and then press and hold ◀ for at least two seconds or use ▶ to move right until the far right digit flashes and then press and hold ▶ for at least two seconds.**

   The display changes to "– – – – – –" and OFF is set.

2. **Press ENTER to confirm the OFF setting.**

3. **Press SET.**
   Enter the BIN measurement mode.

(Light up)

Canceling BIN Measurement Mode

In BIN measurement mode, press MODE.

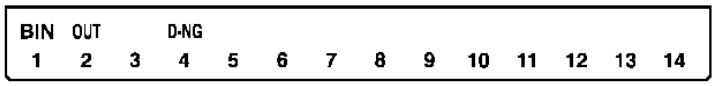
The measurement mode LEDs light in the order of BIN → NORM, and then the unit switches to normal measurement mode.

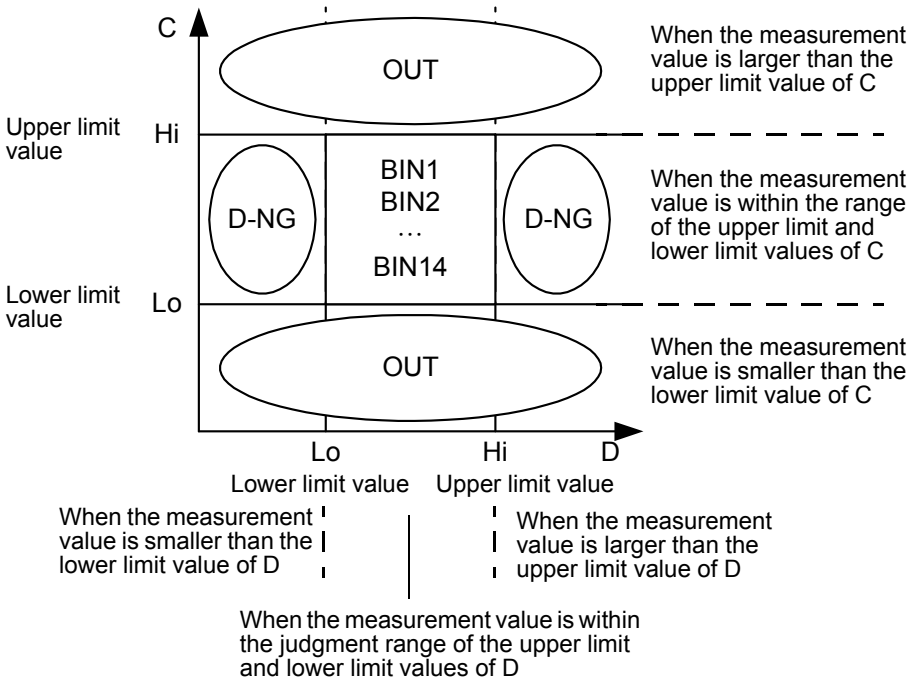
Performing BIN Measurement

- Starting with the lowest, checks to see if BIN numbers are within the set upper limit and lower limit value range and displays as a judgment result the first BIN number that is in range.
- Except for the trigger setting, the measurement conditions cannot be changed in BIN measurement mode. Press MODE to switch to normal measurement mode and then change the measurement conditions.
- Press ▲ ▼ to toggle the information shown in the SUB display area.
  C reference value (for the Δ% setting) ←→ BIN 1 to 14 upper limit and lower limit values ←→ D reference value (for the Δ% setting) ←→ D upper limit and lower limit values ←→ display OFF ←→ C reference value...
- If the upper limit and lower limit values of C and D have not been set, OUT will be displayed in the BIN judgment result display area. The measurement range will automatically become HOLD.

Judgement results display

Each of the judgment results is displayed in the BIN judgment result display area.

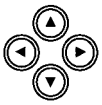




Outputting Judgment Results

- Output the judgment result for BIN (BIN1 to 14, OUT OF BINS, and D-NG) from EXT I/O.
  See 7.1 "About the EXT I/O Connector" (p. 123)
- The BIN judgment results (IN/NG) can be differentiated by beep tones.
  See 6.9 "Setting Beep Tones" (p. 112)

Keys Enabled for Comparator Mode

Key	Function
MODE	Switches the measurement mode.
SET	Switches to the setting modes for the upper limit and lower limit values.
	Change to confirm the upper limit value, range, voltage current monitor values.
TRIG	Switches the trigger setting to INT/EXT.
MANU TRIG	This key is only enabled when the trigger setting is EXT. One measurement is performed each time the key is pressed.
MENU	The following menu settings can be made. • “LoAd_A(C/h)” • “SAVE” • “Ld_tYP” • “Cont” • “Lo C” • “LEV.ChK” • “bEEP_K” • “dISP” • “IF” Settings other than the above listed can be made from normal measurement mode. Menu which cannot be set at the comparator measurement mode will display the current setting conditions in the lower portion of the MAIN display.
LOCK/LOCAL	Changes the keylock function and cancels the remote state.

Application Functions Chapter 6

6.1 Setting the Average Function

The average function performs an averaging process on the measurement values. With the use of this function you can reduce measurement value fluctuations even in environments with a lot of noise.

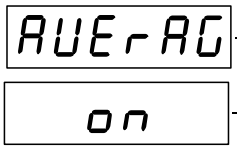
1. In normal measurement mode, press [MENU].

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

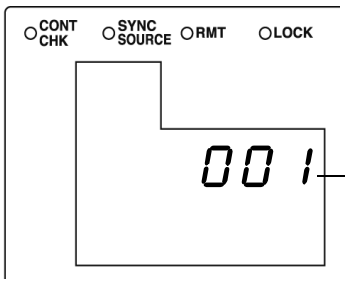
2. Use ◀ or ▶ to select the "AVErAG" menu item.

(MAIN display area)



(Setting screen for the number of measurements to be averaged)

(SUB display area)



3. Press ◀ ▶ to enable or disable the average function.

It will toggle "on" and "oFF" each time ◀ ▶ is pressed.

4. Press [ENTER] to enable or disable the average function.

When "oFF" is selected, the averaging process is not performed. "SYnC" (Trigger synchronous output function setting screen) will be shown in the MAIN display area.
When "on" is selected, the number of measurements to be averaged will flash in

1.800.561.8187 www.itm.com information@itm.com

5. **When "on" is selected**.
Enter the number of measurements to average using ▲ ▼ or the numeric keypad.
When entering using the numeric keypad, the value is entered one digit at a time from right to left.
Settable range : 1 to 256
Change the number… ▲ and ▼

6. **Press ENTER.**
The number of measurements to average will be set.
Once it is set, “dELAY” (Trigger delay setting screen) is shown in the MAIN display area.

If ENTER is not pressed, the number of measurements to average will not be set.

7. **Press MENU.**
The unit returns to normal measurement mode.

6.2 Trigger Delay Setting

This sets the delay time between when the trigger is detected and measuring begins. With the use of this function even if measurement is commenced immediately after connecting to a sample a reliable measurement value can be attained.

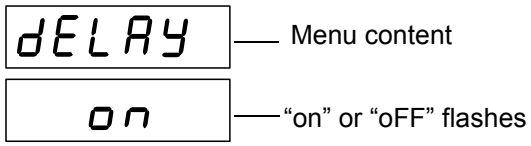
1. In normal measurement mode, press [MENU].

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

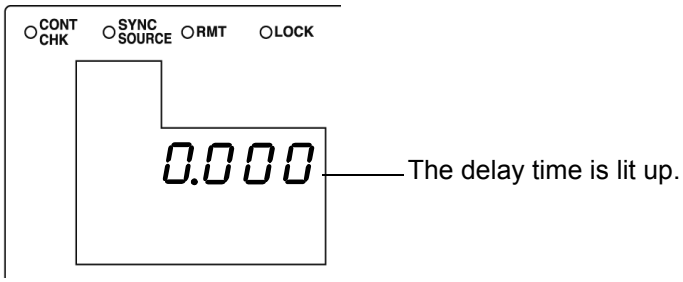
2. Use ◀ or ▶ to select the "dELAY" menu item.

(MAIN display area)



(Trigger delay setting screen)

(SUB display area / "on" setting)



3. Press ▲ ▼ to enable or disable the trigger delay.

It will toggle "on" and "oFF" each time ▲ ▼ is pressed.

4. Press [ENTER] to enable or disable trigger delay.

When "oFF" is selected, "SYnC" (Trigger synchronous output function setting screen) appears in the MAIN display area.
When "on" is selected, the leftmost LED which displays the delay time will flash in the middle row of the SUB display area.

1.800.561.8187 www.itm.com information@itm.com

5. **When "on" is selected.**

Enter the delay time using ▲ ▼ or the numeric keypad.
(If you enter a number, each digit moves one place to the right.)
Settable range : 0.000 to 9.999(s)
Move to the digit..... ◀ and ▶
Change the number... ▲ and ▼

6. **Press ENTER to confirm the delay time setting.**
"SYnC" (Trigger synchronous output function setting screen) will be shown in the MAIN display area.

If ENTER is not pressed the delay time setting will not be set.

7. **Press MENU.**
The unit returns to normal measurement mode.

6.3 Evaluate Contact Check Function

The contact check evaluation function has the following three components.

- **Exclude abnormally low measurement results (Low C reject function)** (p. 96)
  As for the measurement on 2-terminal connection, if C measurement value is abnormally small, it detects the measurement result as an error.
  It can discern whether or not the contact pin and the sample are in contact with one another.
  If a relative percentage the full scale of the currently selected range is set as a limit value, this function detects it as a contact error if the reading is lower than the limit value. For example, if 1% is set for a 200 nF range, measurement values lower than 2 nF will be detected as contact errors. This judgment is based on the measurement value after OPEN, SHORT and LOAD compensation.

  During a contact error the measurement value and comparator as well as BIN judgment results will be made normally. If the measurement value after offset compensation is smaller than the limit value, there will not be a contact error.

- **Exclude chattering during contact (measurement level monitoring function)** (p. 98)
  By monitoring the amount of fluctuation in the effective voltage value (Vmoni) and effective current value (Imoni), detects chattering and other waveform abnormalities resulting from the contact pin and sample in connection.
  The judgment method is as follows: During analog measurement the Vmoni and Imoni are operated several times. The first operated Vmoni and Imoni are treated as the reference values and the Δ% value is calculated relative to the subsequently operated Vmoni and Imoni using the following equation.

  $\Delta\% = (\text{effective value} - \text{reference value}) \ / \ |\text{reference value}| \times 100$

  If the Δ% value is greater than the set limit value it is detected as a contact error.

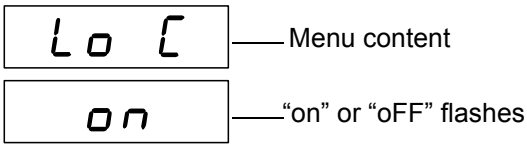
- **Detect connection problems between the respective terminals (H_{CUR}, H_{POT}, L_{POT}, L_{CUR}) and the object to be tested (contact check function (only for 3504-60))** (p. 100)
  Able to detect connection problems between the respective terminals (H_{CUR}, H_{POT}, L_{POT}, L_{CUR}) and the object to be tested in all 4 terminal measurements.

6.3.1 Setting the Low C Reject Function

1. **Press MENU.**
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

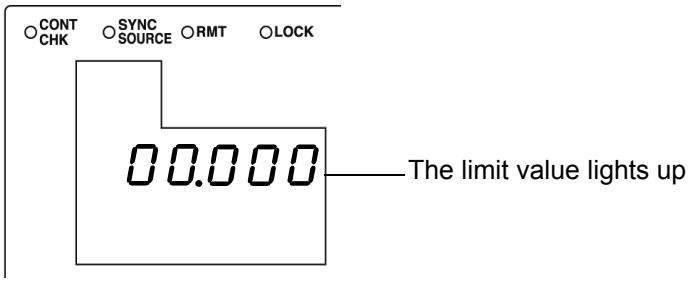
2. **Use ◀ or ▶ to select the "Lo C" menu item.**

(MAIN display area)



(Low C reject function setting screen)

(SUB display area / "on" setting)



3. **Press ▲ ▼ to enable or disable the Low C reject function.**
It will toggle "on" and "oFF" each time ▲ ▼ is pressed.

4. **Press ENTER to confirm the Low C reject function as enabled or disabled.**
When "oFF" is selected, "LEV.ChK" (Measurement level monitoring function setting screen) will be displayed in the MAIN display area.
When "on" is selected, the leftmost LED showing the limit value in the middle row of the SUB display area will flash.

5. **When "on" is selected.**
Enter the limit value using ▲ ▼ or the numeric keypad.
(If you enter a number, each digit moves one place to the right.)
Settable range : 0.000 to 10.000(%)
Move to the digit..... ◀ and ▶
Change the number... ▲ and ▼

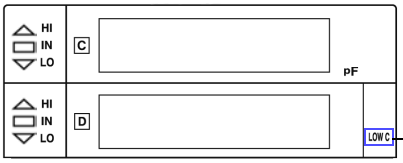
6. **Press ENTER to confirm the limit value.**
"LEV.ChK" (Measurement level monitoring function setting screen) will be displayed in the MAIN display area.

If ENTER is not pressed the Low C reject function settings will not be saved.

7. **Press MENU.**
The unit returns to the measurement mode before the menu contents were displayed.

Measurement results display

Shows Low C contact error on the right side of the D measurement value in the MAIN display.



Output Measurement results

- The <measurement status> of the response data to the "MEASure?" measure value command outputs "5".

See "Query of Measurement Data" (p. 226)

- Outputs to BIT7 of the event status register ESR1.

See "Setting and Query of Event Status Enable Register 1 (ESER1)" (p. 215)

- Outputs Low C contact error from EXT I/O.

See 7.1 "About the EXT I/O Connector" (p. 123)

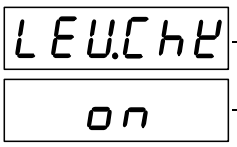
1.800.561.8187 www.itm.com information@itm.com

6.3.2 Measurement Level Monitoring Function Settings

1. **Press MENU.**
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

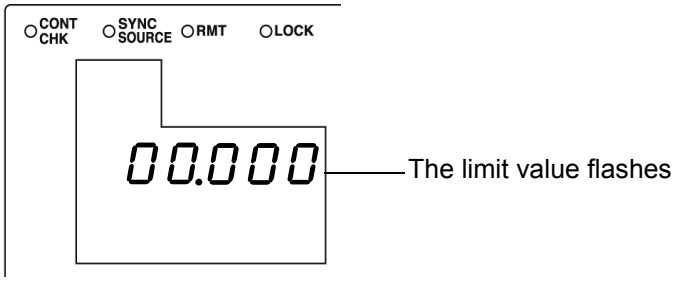
2. **Use ◀ or ▶ to select the "LEV.ChK" menu item.**

(MAIN display area)



(Measurement level monitoring function setting screen)

(SUB display area / "on" setting)



3. **Press ▲ ▼ to enable or disable the measurement level monitoring function.**
It will toggle "on" and "oFF" each time ▲ ▼ is pressed.

4. **Press ENTER to confirm the measurement level monitoring function as on or off.**
When "oFF" is selected, "JudGE" (Judgment mode setting screen) will be displayed in the MAIN display area.
When "on" is selected, the leftmost LED showing the limit value in the middle row of the SUB display area will flash.

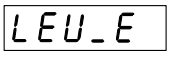
5. **When "on" is selected.**
Enter the limit value using ▲ ▼ or the numeric keypad.
(If you enter a number, each digit moves one place to the right.)
Settable range: 0.01 to 100.00 (%)
Move to the digit..... ◀ and ▶
Change the number... ▲ and ▼

6. **Press ENTER to confirm the limit value.**
"JudGE"(Judgment mode setting screen) will be displayed in the MAIN display area.

If ENTER is not pressed, the measurement level monitoring function settings will not be saved.

7. **Press MENU.**
The unit returns to the measurement mode it was in prior to the menu items being displayed.

Measurement results display



will be displayed in the MAIN display area.
See "MAIN display area ERROR display" (p. 14)

Output Measurement results

- The response data to the ":MEASure?" measure value command is output thusly: <measurement status> 4, <C measurement value>666666E+66, and <D measurement value>666666.
  See "Query of Measurement Data" (p. 226)
- Outputs to BIT5 of event status register ESR0.
  See "Setting and Query of Event Status Enable Register 1 (ESER1)" (p. 215)
- Outputs detected level abnormalities from EXT I/O.
  See 7.1 "About the EXT I/O Connector" (p. 123)

NOTE

Even in the case of normal contact, error output may occur due to the influence of external noise. (It is possible to judge external noise.)

1.800.561.8187 www.itm.com information@itm.com

6.3.3 Contact Check Function Settings (Model 3504-60 only)

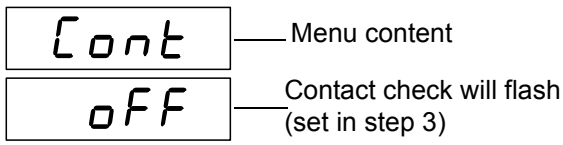
Function to detect connection problems between the respective terminals (H_{CUR}, H_{POT}, L_{POT}, L_{CUR}) and the object to be tested in all 4 terminal measurements.

1. **Press** MENU.

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

2. **Use ◀ or ▶ to select the "Cont" menu item.**

(MAIN display area)



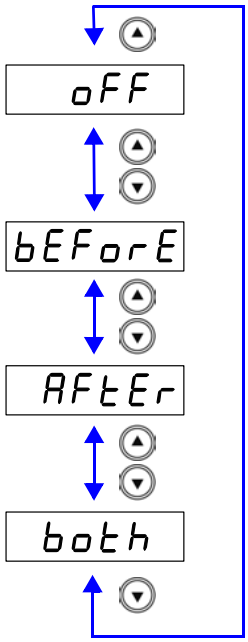
Menu content

Contact check will flash (set in step 3)

(Contact check function setting screen)

3. **Use ▲ and ▼ to select a setting item.**

Pressing ▲ or ▼ causes the display to change in the following manner.



"**oFF**"
Disable contact check function.

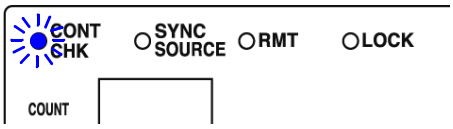
"**bEForE**"
Carry out contact check before measuring the test object.

"**AFtEr**"
Carry out contact check after measuring the test object.

"**both**"
Carry out contact check before and after measuring the test object.

4. **Press** [ENTER].
The contact check function setting is set.

The LED of the contact check will not light up when the contact check function is set to “oFF”. In all other settings, the LED will light up.



Once set, ”Low C” (Low C reject function setting screen) will be displayed in the upper part of the MAIN display area.

The contact check setting cannot be confirmed without pressing [ENTER].

5. **Press** [MENU].
The unit returns to the measurement mode it was in prior to the menu items being displayed.

Measurement results display

When a connection problem is detected, the following will be displayed on the MAIN display.

MAIN display area	Error content
nC-hb	Connection abnormality before H side measurement
nC-hA	Connection abnormality after H side measurement
nC-Lb	Connection abnormality before L side measurement
nC-LA	Connection abnormality after L side measurement
nC-bb	Connection abnormality before H, L side measurement
nC-bA	Connection abnormality after H, L side measurement

See "MAIN display area ERROR display" (p. 14)

Output Measurement results

- Refer to the command :MEASure? (p. 226) for acquiring measurement values.
- Outputs to BIT7 of event status register ESR1.
  See "Query of Event Status Register 1" (p. 218)
- Outputs detected level abnormalities from EXT I/O.
  See 7.1 "About the EXT I/O Connector" (p. 123)

NOTE

- During contact check, the $\overline{\text{INDEX}}$ (signal after the end of the analog measurement) will continue to be emitted.
- During a two-terminal (short H_{CUR} and H_{POT}, short L_{CUR} and L_{POT}) measurement, connection problems cannot be detected. Use the Low C reject function.
- When the contact check function is set to “bEForE” or “both”, the trigger simultaneous output function will automatically set to “ON” (the LED of the “SYNC SOURCE” will light up in the SUB display). Setting for the trigger simultaneous output function cannot be changed.
- There may be the cases when the contact check increases the measurement errors and display differences depending on the measurement sample. In order to reduce these errors, please set an appropriate trigger delay time or wait time for trigger synchronous output function.

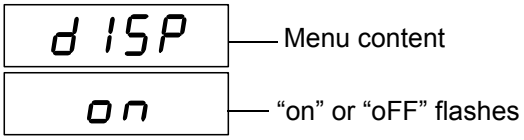
1.800.561.8187 www.itm.com information@itm.com

6.4 Setting the Display ON/ OFF

It various circumstances, such as use with a production line, EXT I/O or interfaces, displaying the measurement may be unnecessary.
Setting the display to OFF can speed up the time to the next measurement and save energy.

1. **Press [MENU].**
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

2. **Use ◀ or ▶ to select the "dISP" menu item.**
(MAIN display area)



(Display setting screen)

3. **Press ▲ ▼ to turn the display ON or OFF.**
It will toggle "on" and "oFF" each time ▲ ▼ is pressed.

4. **Press [ENTER].**
The display setting is set.
Once set, "CALIb" (Self calibration settings screen) will be displayed in the upper part of the MAIN display area.

If [ENTER] is not pressed the display setting will not be saved.

5. **Press [MENU].**
The unit returns to the measurement mode it was in prior to the menu items being displayed.

NOTE

- If the display is set to OFF during measurement mode, the LED display will go out approximately 10 seconds after the key was last pressed. When it is out, pressing a key will cause it to light up again.
- When the display is off, the measurement mode LED will remain lit to confirm that the unit's power is on.

1.800.561.8187 www.itm.com information@itm.com

6.5 Trigger Synchronous Output Function

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

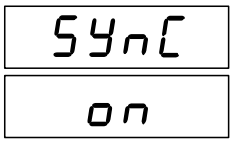
1. **In normal measurement mode, press [MENU].**

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

This setting cannot be changed in comparator mode and BIN mode.

2. **Use ◀ or ▶ to select the "SYnC" menu item.**

(MAIN display area)



Menu content

"on" or "oFF" flashes

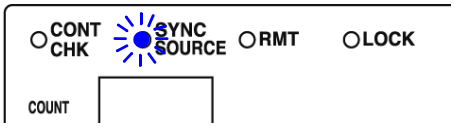
(Trigger synchronous output function setting screen)

3. **Press ▲ ▼ to enable or disable the Trigger synchronous output function.**

It will toggle "on" and "oFF" each time ▲ ▼ is pressed.

4. **Press [ENTER].**

The trigger synchronous output function setting is confirmed.
When the trigger synchronous output function is set, the "SYNC SOURCE LED" lights up.



After confirmation, "OFFSEt" (Offset settings screen) is displayed at the top of the MAIN display area.

The trigger synchronous output function setting is not confirmed unless [ENTER] is pressed.

5. **Press** MENU.
The unit returns to normal measurement mode.

NOTE

- Only use this function within the constant voltage measurement range. If it used outside the constant voltage measurement range, accurate values will not be displayed.
See 3.3.3 "Measurement Signal Level" (p. 27)
- When the trigger synchronous output function is set to ON, there is a measurement time delay because the unit enters a wait time which spans from when the measurement signal is output to when measurement starts.
- The wait time can be set from a PC.

See "Setting and Query of Wait Time for Trigger Synchronous Output Function" (p. 239)

Wait time default setting

Measurement Frequency	Range 1 to 8	Range 9, 10
120 Hz	10 ms	10 ms + 40 ms
1 kHz	2 ms	2 ms + 3 ms

As for Range 9 and 10, when 120 Hz, 40 ms will be added to the wait time of Range 1 to 8, when 1 kHz, 3 ms will be added to the wait time.
Set the optimal wait time for the DUT (device under test).
A wait time that is too short may increase measurement errors and display differences.

See 7.3 "About Input and Output Signals" (p. 126)

- When the contact check function is set to “bEForE” or “both”, the trigger simultaneous output function will automatically set to “ON” (the LED of the “SYNC SOURCE” will light up in the SUB display). Setting for the trigger simultaneous output function cannot be changed.

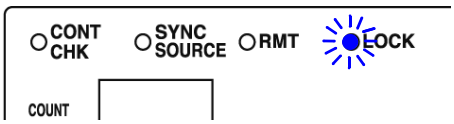
6.6 Disable Key Control (Keylock Function)

If the keylock function is set, the keys on the front panel are disabled. This function enables you to protect your setup.

Setting the Keylock

Press and hold LOCK/LOCAL **for at least two seconds.**

The LOCK LED of the SUB display area lights up.



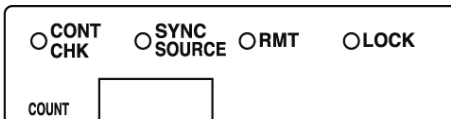
NOTE

- All the keys except MANU TRIG are locked.
- The following tasks can still be performed when the keylock is set.
  In the case of external triggers: Manual triggering is possible.
  In the case of internal triggers: When the interface is a printer, the measurement values can be output to the printer.
- The keylock can be set in normal measurement mode, comparator measurement mode, and BIN measurement mode (Model 3504-50, 3504-60 only).

Canceling the Keylock

Press and hold LOCK/LOCAL **for at least two seconds.**

The LOCK LED goes out and the keylock function is canceled.



NOTE

Turning off the power does not cancel the keylock function.

6.7 Save the Measurement Conditions (Panel Save Function)

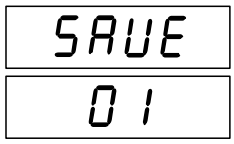
- The current measurement conditions can be saved to internal memory. Up to 99 panels (99 sets) of measurement conditions can be saved.
- When the panel save function is used, the measurement mode and all of the measurement conditions are saved. The saved values include comparator and BIN (Model 3504-50, 3504-60 only) upper limit and lower limit values and the open circuit, short circuit, and load compensation values.
- Use the panel load function to load saved measurement conditions.
  See 6.8 "Load the Measurement Conditions (Panel Load Function)" (p. 108)

Saving Panels

1. **Press MENU.**
   The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
   (Refer to "Menu display organization" (p. 13) for menu order)

2. **Use ◀ or ▶ to select the "SAVE" menu item.**
   When the saved panel number is selected, a word with a **u** in it in front of the panel number will light up.

   (MAIN display area)

   — Menu content
   — The panel numbere flashes
   (At the time of shipment: "01")
   (If all panels have not been saved, the "u 01" indication is displayed.)

   (Panel save function setting screen)

3. **Use the numeric keypad or ▲ and ▼ to select the panel number to save.**
   The numbers 01 to 99 can be set.
   Panel numbers already in use flash. To overwrite a panel number, select the panel number to overwrite.

4. **Press ENTER to save the measurement conditions.**
   The unit returns to the measurement mode it was in prior to the menu items being displayed.

NOTE

- The panel is not saved unless ENTER is pressed.
- The lifespan of the backup battery for internal memory is approximately six years under normal use.
- Measurement conditions can no longer be saved after the life of the battery runs out. When this happens, submit a request for the battery to be replaced by our repair service personnel. (A fee will be charged.)

1.800.561.8187 www.itm.com information@itm.com

6.8 Load the Measurement Conditions (Panel Load Function)

The saved measurement values and compensation values can be loaded from internal memory.

First, set the load condition.
There are the following three load conditions.

- **All**
  The measurement conditions (frequency, level, range, upper limit and lower limit values, etc.) and the open circuit, short circuit, load circuit, and offset compensation values.

- **Compensation values**
  The open circuit, short circuit, load circuit, offset compensation values and self calibration setting.

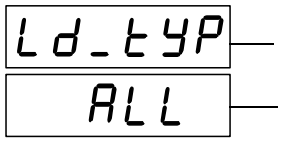
- **Measurement conditions**
  The measurement conditions (frequency, level, range, upper limit and lower limit values, etc.).

1. Press MENU.

The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

2. Use ◀ or ▶ to select the "Ld_tYP" menu item.

(MAIN display area)



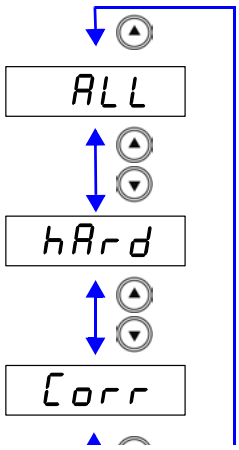
Menu content

Judgment mode (set in step 3)

(Load condition setting screen)

3. Use ▲ and ▼ to select a setting item.

Pressing ▲ or ▼ causes the display to change in the following manner.



"ALL"
Loads the measurement conditions (frequency, level, range, upper limit and lower limit values, etc.) and the open circuit, short circuit, and load compensation values.

"hArd"
Loads the measurement conditions (frequency, level, range, upper limit and lower limit values, etc.).

"Corr"
Loads the open circuit, short circuit, and load compensation values

1.800.561.8187 www.itm.com information@itm.com

4. **Press** [ENTER].

The load condition setting is confirmed.
The “AVErAG” (Setting screen for the number of measurements to be averaged) indication is displayed in the MAIN display area.

The load condition setting is not confirmed unless [ENTER] is pressed.

5. **Press** [MENU].

The unit returns to the measurement mode it was in prior to the menu items being displayed.

NOTE

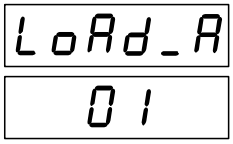
When the load condition is set to “circuit compensation value” (Corr), the device will read the circuit compensation value and setting for the self calibration when carrying out the panel load.
To automatically acquire the self calibration value from EXT I/O every time panel load is carried out, set the self calibration to “AUTO” when saving the measurement conditions, and set the panel load to “MANUAL” after carrying out panel load.

Loading Panels

1. **Press MENU.**
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

2. **Use ◀ or ▶ to select the "LoAd_A ("LoAd_C", "LoAd_h")" menu item.**

(MAIN display area)



Menu content

The panel numbere flashes

(Panel load screen)

There are 3 types of panel load screens.

LoAd_A	Loads the measurement conditions and the open circuit, short circuit, and load compensation values.
LoAd_h	Loads the measurement conditions.
LoAd_C	Loads the open circuit, short circuit, and load compensation values.

NOTE The panel load screen that is displayed differs depending on the load condition set in 6.8 "Load the Measurement Conditions (Panel Load Function)" (p. 108). (Refer to the following table.)

Load Condition Setting	Panel Screen Displayed
ALL	LoAd_A
hArd	LoAd_h
Corr	LoAd_C

3. Use the numeric keypad or ▲ and ▼ to select the panel number to load.

The number is entered at the bottom of the MAIN display area.

NOTE

- Only saved numbers can be set. If a number that was not saved with the numeric keypad is set, the set number flashes and then changes to the nearest saved number after one second elapses.
- At the time of shipment, when the unit has been reset, or at any other time when there are no measurement conditions saved, "– –" is displayed at the bottom of the MAIN display area.
- Each time a panel number is changed, the SUB display area for the measurement conditions of that panel number flashes.

4. Press ENTER to load the measurement conditions.

When the load condition is set to ALL (measurement conditions and compensation values) or hArd (measurement conditions), the unit switches to the saved measurement mode.
When the load condition is set to Corr (compensation values), the unit returns to the measurement mode it was in prior to the menu items being displayed.

NOTE

- The panel is not loaded unless ENTER is pressed.
- After panel load is carried out, the self calibration value can be acquired by setting the $\overline{\text{CALIb}}$ signal to Lo level in the response times (time from $\overline{\text{TRIG}}$ (LOW) to $\overline{\text{INDEX}}$ (High) based on the load conditions in the "MANUAL"self calibration setting.

Load Condition	wait time* (ms)
ALL measurement conditions	350
compensation value	0.5

*Response time in"ALL" and "measurement conditions" will vary according to the time setting for the measurement speed.
The values in the table above obtained when the measurement speed is at SLOW. During "circuit compensation value", the response time will not vary according to measurement conditions.

6.9 Setting Beep Tones

Setting the Beep Tone for Judgment Results of Comparator and BIN (Model 3504-50, 3504-60 only)

Any of following three settings is possible for the beep tone.

- A beep tone is not played.
- A beep tone plays when there is an IN judgment (AND) for both C and D during comparator measurement and a judgment corresponding to a BIN number during BIN measurement.
- A beep tone plays when there is a HI or LO judgment during comparator measurement and an OUT OF BINS or D-NG judgment during BIN measurement.

Setting the Beep Tone for Key Operations (p. 114)

6.9.1 Setting the Beep Tone for Judgment Results of Comparator and BIN

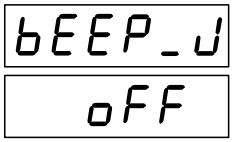
1. **In normal measurement mode, press** MENU.

   The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
   (Refer to "Menu display organization" (p. 13) for menu order)

   This setting cannot be changed in comparator mode and BIN mode.

2. **Use ◀ or ▶ to select the "bEEP_J" menu item.**

   (MAIN display area)

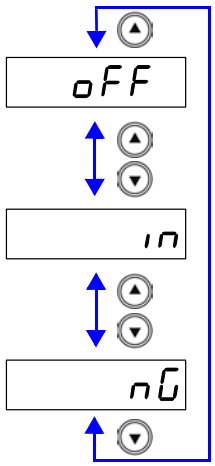
   Menu content

   "oFF", "nG" or "in" flashse.

   (Beep tone setting screen for judgment results)

3. Press ▲ ▼ to enable or disable the beep tone setting details function.

Pressing ▲ or ▼ causes the display to change in the following manner.



"OFF"
No beep sound regardless of the evaluation result.

"nG"
A beep tone plays when there is a HI or LO judgment during comparator measurement and an OUT OF BINS or D-NG judgment during BIN measurement.

"in"
A beep tone plays when there is an IN judgment (AND) for both C and D during comparator measurement and a judgment corresponding to a BIN number during BIN measurement.

4. Press [ENTER].

The beep tone setting for judgment results is set.
Once set, "bEEP_K" (Beep tone setting screen for key operations) will be displayed in the upper part of the MAIN display area.

The beep tone setting for judgment results is not confirmed unless [ENTER] is pressed.

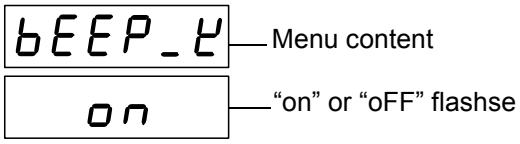
5. Press [MENU].

The unit returns to normal measurement mode.

6.9.2 Setting the Beep Tone for Key Operations

1. **Press** MENU.
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

2. **Use ◀ or ▶ to select the "bEEP_K" menu item.**
(MAIN display area)



(Beep tone setting screen for key operations)

3. **Press ▲ ▼ to enable or disable the beep tone output.**
It will toggle “on” and “oFF” each time ▲ ▼ is pressed.

4. **Press** ENTER.
The beep tone setting for key operations is confirmed.
Once set, "disp" (Display setting screen) will be displayed in the upper part of the MAIN display area.
The beep tone setting for key operations is not confirmed unless ENTER is pressed.

5. **Press** MENU.

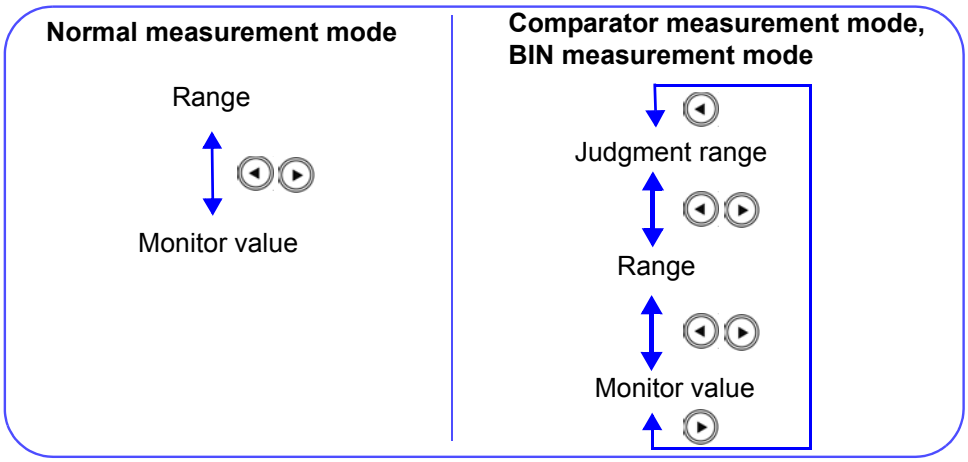
The unit returns to the measurement mode it was in prior to the menu items being displayed.

6.10 Switching the displayed item (SUB display)

The item displayed in the SUB display area can be switched.

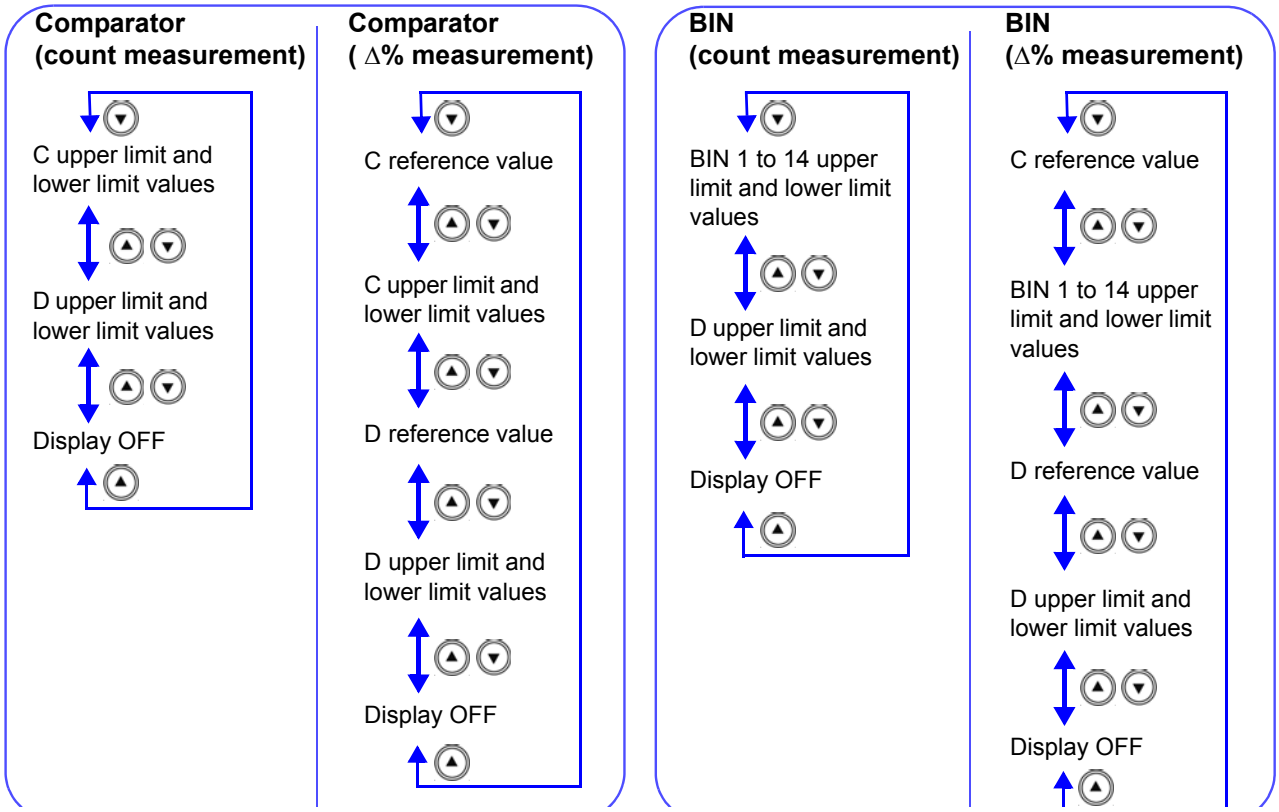
- Range number (for normal measurement only)
- Monitor value (Voltage between the terminals and the current flowing in the object being measured)
- Judgement range (for comparator and BIN measurement only)

Press ◀ ▶ during measurement (normal measurement, Comparator measurement or BIN measurement) to select the item displayed in the SUB display area.



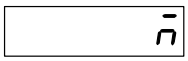
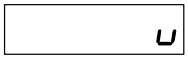
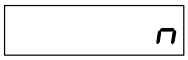
NOTE

- When the measurement condition is changed, the monitor value will not be displayed before any measurement is carried out.
- The judgment range for comparator measurement and BIN measurement can be switched using the ▲ ▼ keys.
  The display items will change accordingly as shown below.



NOTE

- The units during range display will appear as shown below.

Range display	Units
	m (10^{-3})
	μ (10^{-6})
	n (10^{-9})
	p (10^{-12})

6.11 Performing a System Reset

System reset resets the system to the factory default state, except for the settings below.

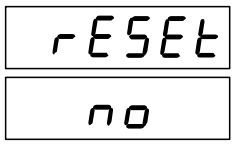
- Open, short, load, offset compensation
- Keylock function
- Panel save

1. Turn the power of the unit off.

2. Turn the power back on while holding down [ENTER], and then let go of [ENTER] when the version information is displayed.

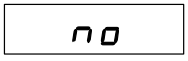
The version information is displayed for approximately 1.5 seconds after all LEDs light up. Then, the system reset setting is displayed.

(MAIN display area)

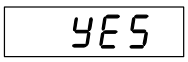


—System reset setting item

3. Use the arrow keys to set system reset while the indication is displayed.



"no"
A system reset is not performed.



"yES"
A system reset is performed.

4. Press [ENTER] to confirm the setting.

If you execute a system reset, the measurement conditions are reset and the system is placed in the normal measurement mode.

See Appendix 7 "Initial Settings Table" (p. 11)

NOTE

The settings of the RS-232C interface in the 3504-40, 3504-50, 3504-60 unit are initialized to 9600 bps for the baud rate and CR+LF for the terminator.

1.800.561.8187 www.itm.com information@itm.com

6.12 Printing Function

The optional 9442 Printer and 9444 Connection Cable can be used to print measurement values.

WARNING

To avoid electric shock, turn off the power to all devices before plugging or unplugging any cables or peripherals.

6.12.1 Preparation Prior to Connecting the Printer

Things to Prepare

- 9442 Printer
- 9443-01 AC adapter (for Japan)
  9443-02 AC adapter (for EU)
- 1196 Recording Paper
- 9444 Connection Cable (for connecting this unit and the printer)

9442 Printer Setup

The settings of the software DIP SW need to be changed to use the 9442 Printer with this unit.

NOTE

- For details on handling the printer, be sure to careful read the instruction manual supplied with the printer.
- Use 1196 Recording Paper (thermal paper; 10 rolls per set) or the equivalent as the printer paper.

Procedure

1. Turn off power of the 9442 Printer.
2. Turn the power back on while holding down the ON LINE switch, and then let go of the switch when printing starts.

   The current settings are printed.
   The following is printed at the end of the printout.

   ```
   Continue? :Push 'On-line SW'
   Write?    :Push 'Paper feed SW'
   ```

3. Press the ON LINE switch to change the settings.
   “Dip SW-1” is printed and the printer enters the configuration state for the software DIP SW1.

4. Set the switches numbered 1 to 8 of DIP SW1 to either ON or OFF in accordance with the table below.

Press the **ON LINE** switch once to set a switch to ON and the **FEED** switch once to set a switch to OFF.

You can confirm the input result that is printed each time a switch is pressed. If a setting is configured incorrectly, repeat the procedure from Step 1 (p. 118).

is the setting to use with this unit.

Software DIP SW1 Settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Input method setting	Parallel	Serial
2	Print speed	Fast	Slow
3	Auto loading	Enable	Disable
4	CR function	Carriage return	Return
5	Setting command	Enable	Disable
6	Print density (set to 100%)		OFF
7		ON	
8		ON	

After you finish configuring the switch numbered 8, the following is printed again.

```
Continue? :Push 'On-line SW'
Write?    :Push 'Paper feed SW'
```

5. Press the ON LINE switch again so that the printer enters the configuration state and configure each of the settings for DIP SW2 and DIP SW3 as shown in the table below.

Software DIP SW2 Settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Print mode	Normal print (40 digits)	Reduced print (80 digits)
2	User-defined character backup	Enable	Disable
3	Character type	Normal characters	Special characters
4	Zero font	0	Ø
5	International characters	ON	
6		ON	
7		ON	
8		ON	

1.800.561.8187 www.itm.com information@itm.com

Software DIP SW3 Settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Data bit length	8 bits	7 bits
2	Use parity	No	Yes
3	Parity setting	Odd	Even
4	Control flow	H/W BUSY	XON/XOFF
5	Baud rate (Set to 19200 bps)		OFF
6		ON	
7		ON	
8			OFF

6. After you finish configuring the switch numbered 8 of DIP SW3, press either the ON LINE switch or the FEED switch to complete the setup.

The following is printed.

```
Dip SW setting complete!!
```

6.12.2 Connection Procedure

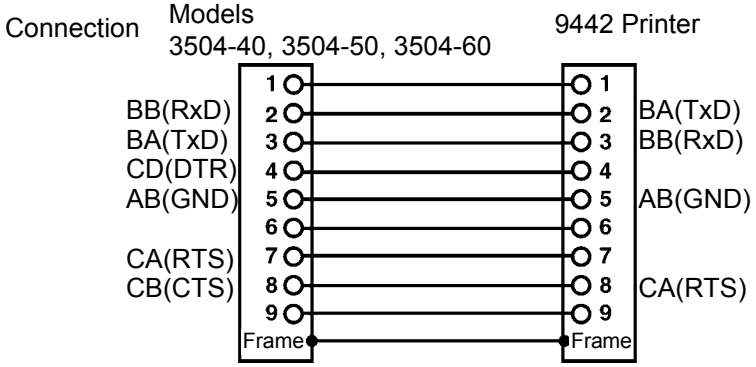
WARNING

To avoid electric shock, be sure to turn off the power of the printer and unit before you connect or disconnect a cable.

Connect the 9442 Printer to the RS-232C connector of the unit.
Configure the printer and unit beforehand.
See 8.3.2 "Setting the Interface Communication Conditions" (p. 136)

Procedure

1. Turn off the power of the 3504-40, 3504-50, 3504-60 unit and the 9442 Printer.
2. Connect the 9444 Connection Cable to the unit and the printer.



3. Turn on the power of the 3504-40, 3504-50, 3504-60 unit.
4. Turn on the power of the 9442 Printer.

NOTE

Turn on the power of the 3504-40, 3504-50, 3504-60 unit before you turn on the power of the 9442 Printer. If the 9442 Printer is on when you turn on the 3503 unit, undefined values may be sent from the 3504-40, 3504-50, 3504-60 unit because of BA(TxD) being unstable.

1.800.561.8187 www.itm.com information@itm.com

6.12.3 Printing

If [MANU TRIG] is pressed when an external trigger is set, the measurement values are output to the printer after measurement finishes.

If [MANU TRIG] is pressed when an internal trigger is set, the measurement values up until the time when the key is pressed are output to the printer.

1. Example when performing normal measurement

```
CP 100.034n F   |D  0.00041
CP 100.029n F   |D  0.00038
```

2. Example when performing comparator measurement

```
CP 100.052n F    HI|D  0.00050      HI
CP 100.047n F    IN|D  0.00045      IN
```

3. Example when performing BIN measurement (Model 3504-50, 3504-60 only)

```
CP 100.016n F   |D  0.00042       BIN1
CP 100.023n F   |D  0.00036       OUTB
```

Connecting a PC instead of the 9442 Printer enables you to receive the measurement values on the PC.
Set the RS-232C communication conditions on the PC as shown below.

- Bits per second: 19200
- Data bits: 8
- Parity: None
- Stop bits: 1

NOTE

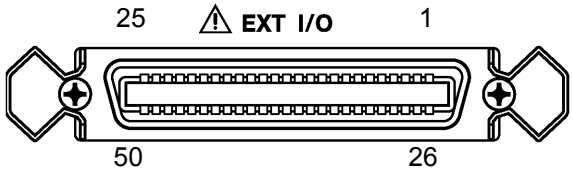
Flow control is automatically set to Hardware (RTS/CTS control) if the interface used with the 3504-40, 3504-50, 3504-60 unit is a printer.

EXT I/O Chapter 7

7.1 About the EXT I/O Connector

The EXT I/O connector includes the following functions.
- Output signal for comparator result
- Output signal for BIN result (Model 3504-50, 3504-60 only)
- Output end of measurement signal (EOM)
- Output analog end of measurement signal (INDEX)
- Input external trigger signal
- Select the panel number to load

Connector Used DDK 57RE-40500-730B (D29)
Applicable Connector DDK 57-30500



EXT I/O Connector Terminal

PIN No.	I/O	Signal Line Name	PIN No.	I/O	Signal Line Name
1	IN	$\overline{\text{TRIG}}$	26	IN	$\overline{\text{LD0}}$
2	IN	$\overline{\text{LD1}}$	27	IN	$\overline{\text{LD2}}$
3	IN	$\overline{\text{LD3}}$	28	IN	$\overline{\text{LD4}}$
4	IN	$\overline{\text{LD5}}$	29	IN	$\overline{\text{LD6}}$
5	IN	$\overline{\text{LD-VALID}}$	30	OUT	$\overline{\text{BIN1}}$, $\overline{\text{C-HI}}$
6	OUT	$\overline{\text{BIN2}}$, $\overline{\text{C-IN}}$	31	OUT	$\overline{\text{BIN3}}$, $\overline{\text{C-LO}}$
7	OUT	$\overline{\text{BIN4}}$, $\overline{\text{D-HI}}$	32	OUT	$\overline{\text{BIN5}}$, $\overline{\text{D-IN}}$
8	OUT	$\overline{\text{BIN6}}$, $\overline{\text{D-LO}}$	33	OUT	$\overline{\text{BIN7}}$, $\overline{\text{AND}}$
9	OUT	$\overline{\text{BIN8}}$	34	OUT	$\overline{\text{BIN9}}$
10	OUT	$\overline{\text{BIN10}}$	35	OUT	$\overline{\text{BIN11}}$
11	OUT	$\overline{\text{BIN12}}$	36	OUT	$\overline{\text{BIN13}}$
12	OUT	$\overline{\text{BIN14}}$	37	OUT	$\overline{\text{OUT OF BINS}}$
13	OUT	$\overline{\text{INDEX}}$	38	OUT	$\overline{\text{EOM}}$
14	OUT	$\overline{\text{CV-ERR}}$	39	OUT	$\overline{\text{D-NG}}$
15	IN	$\overline{\text{CALIB}}$	40	-	Unused
16 to 20	IN	EXT DCV	41 to 45	OUT	INT DCV
21 to 25	IN	EXT COM	46 to 50	OUT	INT COM

*The output of BIN results is only for Model 3504-50, 3504-60.

1.800.561.8187 www.itm.com information@itm.com

EXT I/O Connector Signal Lines

NOTE All input and output signals other than the power signal are negative logic.

TRIG

If a negative logic signal is input in external trigger mode, a single measurement begins at the corresponding Low level (100 μs or more).

NOTE This is not valid during analog measurement (during output of INDEX signal), even if a TRIG signal is input.

LD0 to LD6

Selects the number of the panel to load.
If a trigger signal is input in external trigger mode, the selected panel is loaded and used for measurement.

Panel Number	LD6	LD5	LD4	LD3	LD2	LD1	LD0
Panel 1	0	0	0	0	0	0	1
Panel 2	0	0	0	0	0	1	0
Panel 4	0	0	0	0	1	0	0
Panel 8	0	0	0	1	0	0	0
Panel 16	0	0	1	0	0	0	0
Panel 32	0	1	0	0	0	0	0
Panel 64	1	0	0	0	0	0	0
Panel 99	1	1	0	0	0	1	1

0 : (HIGH: 5 to 24 V)
1 : (LOW: 0 to 0.9 V)

LD-VALID

Inputs a negative logic signal from an external device so that the selected panel number is recognized as valid.
After TRIG input, maintain a Low level until INDEX is outputted.

C-HI, C-IN, C-LO

Outputs the comparator judgment result for the measurement value of the first parameter (MAIN PARAMETER).

D-HI, D-IN, D-LO

Outputs the comparator judgment result for the measurement value of the second parameter (SUB PARAMETER).

AND

Outputs a result if the judgment result AND is obtained for the measurement value of the first parameter and the measurement value of the second parameter. Outputs a result if both judgments results are IN or if one of either the first or second parameters was not judged but the judgment result of the judged parameter is IN.

BIN1 to BIN14 OUT OF BINS, D-NG

Outputs judgment results for BIN measurement (Model 3504-50, 3450-60 only).

INDEX

This is the analog end of measurement signal. After this signal is set to ON (from the trailing edge), the sample can be changed.

EOM

This is the end of measurement signal.

EXT DCV, EXT COM

This terminal supplies power from an external device. It enables an isolated connection to be established between the unit and an external device. The range of power voltages that can be connected is 5 to 24 V DC.

INT DCV, INT COM

Outputs internal +5 V DC and internal COM of the unit.

ERR

When the voltages on both ends of the object to be tested are lower than the set voltage, error will be shown in the case when the Low C reject limit range is exceeded, and there is a detection level abnormality and contact error.

CALIB

When the CALIB signal is at Low level after the TRIG signal confirmation, the self calibration value will be acquired. This can be used only when the self calibration setting is at “MANUAL”.

1.800.561.8187 www.itm.com information@itm.com

7.2 Circuit Configuration and Connections of the EXT I/O Connector

⚠CAUTION

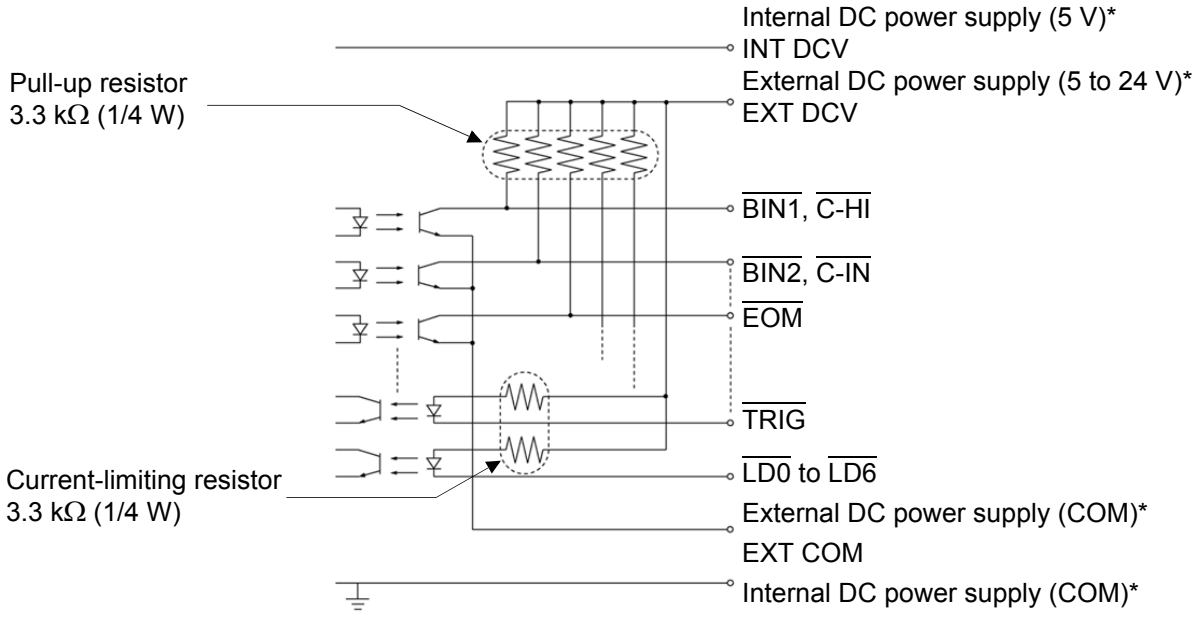
- The range of power voltages that can be connected to the external DC power supply EXT DCV and EXT COM terminals is 5 to 24 V DC. Do not apply a voltage that exceeds +24 V DC. Doing so may damage the device. Connect a device with an output capacitance of at least 200 mA in order to drive the circuit.
- Signal lines are insulated to stop interference between signals. Be sure to use protective grounding for the connected device. Otherwise the insulation may be damaged.
- +5 V DC is output between the internal DC power supply INT DVC and INT COM. The maximum current capacity is 100 mA. Do not connect a circuit that consumes 100 mA or more to an external device.

NOTE

- INT COM is connected to the case.
- The maximum low level output current of the output signal is 30 mA. When a current of more than 30 mA is required, connect, for example, a transistor circuit, which is capable of current amplification and run on an external power source, to the external device.

Circuit Configuration

All input and output signal lines other than the power signal line are isolated by a photocoupler.
When using the EXT I/O, connect a 5-24 V DC power in EXT DCV-EXT COM.
When power cannot be supplied from an external device, connect INT DCV and EXT DCV, and INT COM and EXT COM.



* A connection is possible when using an internal DC power supply voltage of 5 V.

7.3 About Input and Output Signals

Electrical Characteristics of Output Signals

The output signals are photocoupler open collector output. Inside the unit, a 3.3 kΩ pull-up resistor is used to connect to the external DC power source (EXT DCV).

Relation Between External DC Power Source Voltage and Output Signal Voltage/Current

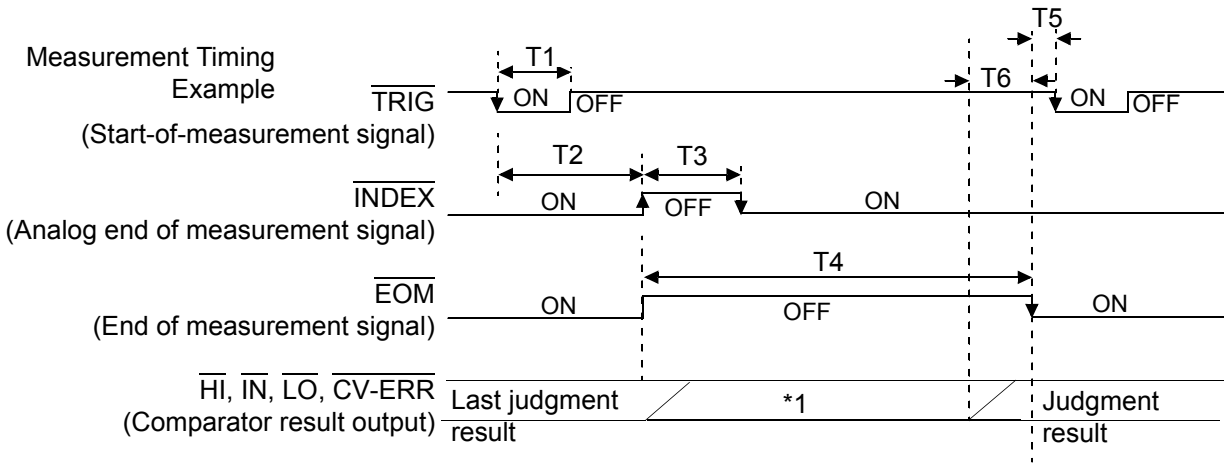
External DC Power Source	Output Signal (Internal Pull-up Resistor of 3.3 kΩ)		
	High Level	Low Level (Output Current)	
		(10 mA)	(30 mA)
5	5	0.9 V	1.1 V
12	12		
24	24		

It is not possible to directly connect a circuit that has a maximum input voltage V_{IL} of 0.8 V or more. Add a transistor and buffer circuit capable of driving so that the V_{IL} becomes less than 0.8 V.

Timing of Input Signals

Set the judgment conditions with the comparator and input a trigger signal from EXT I/O in that state. (The trigger setting is set to external trigger.)

If you press MANU TRIG, the judgment result is output from the EXT I/O comparator result output signal line.



NOTE

You can use a communication command to select whether the judgment results for comparator measurement and BIN measurement are reset when the start-of-measurement signal is input or updated when measurement ends.

See "Setting and Query of Output of Judgment Result Signal Line in EXT I/O" (p. 221)

*1 Reset at the same time as TRIG: HIGH
Not reset at the same time as TRIG: LOW

1.800.561.8187 www.itm.com information@itm.com

Symbol	Description		Approximate Time
T1	$\overline{\text{TRIG}}$ width (LOW)	: Trigger signal minimum time	100 μs
T2	From $\overline{\text{TRIG}}$ (LOW) to $\overline{\text{INDEX}}$ (HIGH)	: Time from trigger to circuit response	250 μs *1
T3	$\overline{\text{INDEX}}$ width (HIGH)	: Minimum chuck time, switching chuck with $\overline{\text{INDEX}}$ (LOW) is possible	1 ms *2
T4	$\overline{\text{EOM}}$ width (HIGH)	: Measurement time	2.0 ms *2
T5	From $\overline{\text{EOM}}$ width (LOW) to TRIG (LOW): Minimum time from end of measurement to next trigger		0 s
T6	From Comparator, BIN Judgement Result to $\overline{\text{EOM}}$ (LOW): Setting value for Display Time		85 μs *3

*1: When the panel number is being loaded by the panel load function, the response times become approximately 0.5 ms (loading compensation values) and approximately 350 ms (ALL, loading measurement conditions).
When the trigger delay is enabled, the pre-set wait time will be activated.

*2: These reference values are when the measurement frequency is 1 kHz, the measurement speed is FAST, and the range is HOLD.
When the trigger synchronous output function is enabled, wait times are included. (The wait times at the time of shipment are approximately 2 ms [1 kHz] and 10 ms [120 Hz] and can be changed from a PC.)
When “i-ovEr Error” is shown, the trigger simultaneous function will be automatically enabled.

*3: There is an approximate error of 160 μs in the delay time between evaluation result ←→ EOM output with respect to the setting value.

NOTE

- As the speed for the Comparator and the acceleration (LOW → HI) of the BIN Evaluation Results (Pins 6 to 12, 30 to 37, 39) depends on the circuit structure connected to the EXT I/O, using Comparator, BIN evaluation result level immediately after $\overline{\text{EOM}}$ output may cause measurement error.
  To prevent this, it is possible to set the comparator and delay time for BIN evaluation result $\overline{\text{EOM}}$ Period from Command. In addition, when the Command setting for evaluation result signal line in EXT I/O (:IO:RESult:RESet) is enabled (ON) and forcibly moved to HIGH level simultaneously with $\overline{\text{TRIG}}$, LOW → HIGH transfer will not occur when evaluation result is outputted immediately after measurement has finished. As a result, it is possible to set the delay time for the Evaluation Result $\overline{\text{EOM}}$ Period to a minimum. However, take note that the evaluation result confirmation range is valid until the following triggers are accepted.
- During measurement, a trigger input from EXT/ IO or communicating by interface may lead to the results for the comparator and delay time for BIN judgement result ←→ $\overline{\text{EOM}}$ varying widely. As far as possible, try not to control from external sources when carrying out measurement.

See "Setting and Query of Delay time for Judgement Result Output and EOM Output Period in EXT I/O" (p. 220)
"Setting and Query of Output of Judgment Result Signal Line in EXT I/O" (p. 221)

1.800.561.8187 www.itm.com information@itm.com

7.4 About Measurement Times

Measurement times differ depending on the measurement conditions. Refer to the following values.

NOTE

- All of the values are reference values. Note that they may differ depending on the conditions of use.
- A wait of 350 ms is included when the frequency, level, and range change.

Analog Measurement Signal

INDEX

The output time (T3) for an analog measurement signal (INDEX) can be obtained by the following equation.

T3 = (1 or 2) + 3

(HOLD range contact check: OFF, trigger simultaneous output function: disabled)

1. No request for self calibration

Measurement Frequency	Measurement Speed		
	FAST (ms)	NORM (ms)	SLOW (ms)
120 Hz	8.3	33.3	133.3
1 kHz	1	4	24

(Allowable tolerance: ±5%±0.3 ms)

2. Request for self calibration

Measurement Frequency	Measurement Speed		
	FAST (ms)	NORM (ms)	SLOW (ms)
120 Hz	24.1	41	141
1 kHz	3.7	5.7	26.9

3. Contact check evaluation time (Only for 3504-60)

Calculation times differ depending on the execution of the contact checks.

Measurement Frequency	Measurement Speed		
	BEFORE (ms)	AFTER (ms)	BOTH (ms)
120 Hz	15.0 *	5.0	20.0 *
1 kHz	7.0 *	5.0	12.0 *

* When the contact check setting is at “bEForE”, “both” the analog measurement time will be delayed because automatically after contact check, the measurement will start only after the wait time for the trigger simultaneous output function has been activated.
The above values are the initial values of the wait time settings. They are for reference only. The actual value will be 5.0 ms + wait time of the trigger simultaneous output function.
A wait time for trigger synchronous output function will be decided according to the following table.
As for Range 9 and 10, when 120 Hz, 40 ms will be added to the wait time of Range 1 to 8, when 1 KHz, 3 ms will be added to the wait time.

Wait time default setting

Measurement Frequency	Range 1 to 8	Range 9, 10
120 Hz	10 ms	10 ms + 40 ms

1.800.561.8187 www.itm.com information@itm.com

End of Measurement Signal

$\overline{\text{EOM}}$

The output time (**T4**) for an end of measurement signal ($\overline{\text{EOM}}$) can be obtained by the following equation.

T4 = A(1 or 2) + B + C + D

A Measurement time during normal measurement mode, no open/short circuit compensation, HOLD range (contact check: OFF, trigger simultaneous output function: disabled)

(1) No request for self calibration

Measurement Frequency	Measurement Speed		
	FAST (ms)	NORM (ms)	SLOW (ms)
120 Hz	10.0	37.5	146.0
1 kHz	2.0	5.5	29.5

(Allowable tolerance: ±5%±0.5 ms)

(2) Request for self calibration

Measurement Frequency	Measurement Speed		
	FAST (ms)	NORM (ms)	SLOW (ms)
120 Hz	25.8	43.2	148.2
1 kHz	4.8	7	30

B The calculation time differs depending on whether or not there is open circuit, short circuit, or load compensation

Open Circuit, Short Circuit and load Circuit Compensation	(ms)
No	0.0
Yes	Max. 0.4 Each

C The calculation time differs if comparator is executed.

Measurement Mode	(ms)
Normal measurement mode	0.0
Comparator Measurement Mode	MAX 0.4

D The calculation time differs if BIN is executed. (Only for 3504-50, 3504-60)

Measurement Mode	(ms)
Normal measurement mode	0.0
BIN Measurement Mode	MAX 0.4

NOTE

The output time for an analog measurement signal ($\overline{\text{INDEX}}$) will be delayed by the execution of the contact check. Accordingly the output time for an end of measurement signal ($\overline{\text{EOM}}$) will be delayed by the increase of delay time of $\overline{\text{INDEX}}$ output.

1.800.561.8187 www.itm.com information@itm.com

Controlling the Unit from a PC Chapter 8

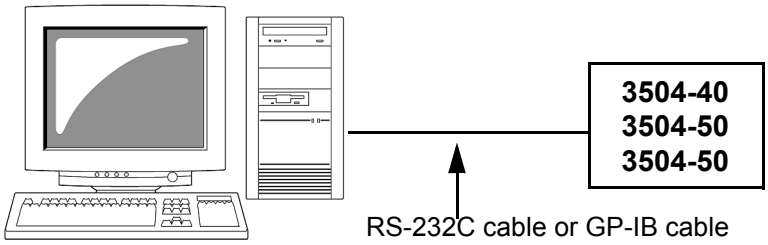
About Marks

The following marks are used in this section to indicate whether a description applies to each of GP-IB and RS-232C. If no specific mark is shown, the description applies to both.

GP-IB :	Only for GP-IB (Only for Models 3504-50, 3504-60)
RS-232C :	Only for RS-232C

8.1 Outline and Features

You can connect a PC to the unit via the GP-IB interface or RS-232C interface and control the unit from the PC.



- All functions other than the power switch can be controlled.
- The buzzer tone can be switched on and off.
- The system can be reset.

RS-232C

Measurement results can be printed if you connect an optional 9442 Printer to the unit.
See 6.12 "Printing Function" (p. 118)

GP-IB

- Use of the common commands of IEEE-488-2 1987 (required) is possible.
- This function is compliant with the following standard. : IEEE-488.1 1987
- This function was designed in reference to the following standard: IEEE-488.2 1987

1.800.561.8187 www.itm.com information@itm.com

8.2 Specifications

8.2.1 RS-232C Specifications

Transmission Method	Communication method: Full duplex Synchronous method: Start-stop synchronization
Transmission Speed	9600 bps, 19200 bps
Data Bits	8 bits
Parity	None
Stop Bits	1 bit
Message Terminator (Delimiter)	CR+LF, CR
Flow Control	Hardware (RTS/CTS control), software (XON/XOFF control) **See** "Handshake (About Buffer Flow Control)" (p. 132)
Electrical Specifications	Input voltage level 5 to 15 V ON -15 to -5 V OFF Output voltage level 5 to 9 V ON -9 to -5 V OFF

NOTE

If a PC is used to read data from the Models 3504-40, 3504-50, 3504-60 unit immediately after the power of the Models 3504-40, 3504-50, 3504-60 unit is turned on, undefined values may be read because of BA(TxD) being unstable. After turning the power on, wait at least six seconds before starting to read data.

Handshake (About Buffer Flow Control)

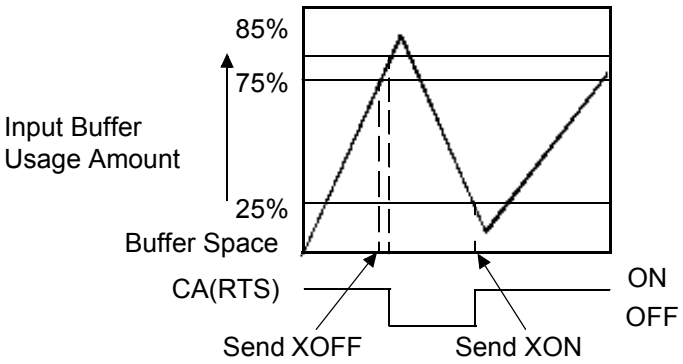
RS-232C

Control during Receiving

When using hardware (RTS/CTS control):
When the data in the receive buffer exceeds 85% of the buffer, CA(RTS) is set to OFF and the controller is notified that there is not much space remaining in the buffer.
Processing of the data in the buffer continues, and then CA(RTS) is set to ON and the controller is notified that there is sufficient remaining space in the buffer when the amount of data becomes less than 25%.

When using software (XON/XOFF control):
When the data in the receive buffer exceeds 75% of the buffer, XOFF(13H) is sent and the controller is notified that there is not much space remaining in the buffer.
Processing of the data in the buffer continues, and then XON(11H) is sent and the controller is notified that there is sufficient remaining space in the buffer when the amount of data becomes less than 25%.

1.800.561.8187 www.itm.com information@itm.com



Control during Sending

When using hardware (RTS/CTS control):
When CB(CTS) is confirmed to be OFF, the sending of data is halted. When it is confirmed to be ON, the sending of data is resumed.

When using software (XON/XOFF control):
When XOFF is received, the sending of data is halted. When XON is received, the sending of data is resumed.

8.2.2 GP-IB Specifications (Only for Models 3504-50, 3504-60)

Interface Functions

SH1	Supports all source handshake functions.
AH1	Supports all acceptor handshake functions.
T6	Supports standard talker functions. Supports serial poll functions. Talk only mode is not supported. Supports the talker cancel function by MLA (My Listen Address).
L4	Supports standard listener functions. Listener only mode is not supported. Supports the listener cancel function by MTA (My Talk Address).
SR1	Supports all service request functions.
RL1	Supports all remote/local functions
PP0	Parallel poll functions are not supported.
DC1	Supports all device clear functions.
DT1	Supports all device trigger functions.
C0	Controller functions are not supported.

Code used: ASCII code

1.800.561.8187 www.itm.com information@itm.com

8.3 Connection and Setting Procedures

8.3.1 Connecting the RS-232C Cable / GP-IB Cable

⚠WARNING

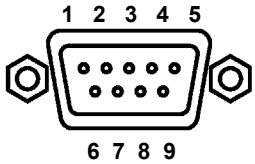
- **Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.**
- **To avoid damage to the unit, do not short-circuit the terminal and do not input voltage to the terminal.**

⚠CAUTION

After connecting the cable, be sure to secure the connector in place by tightening the screws.

RS-232C Connector Pin Configuration

RS-232C



D-sub 9-pin male
#4-40 fixing screws

Connect the RS-232C cable.

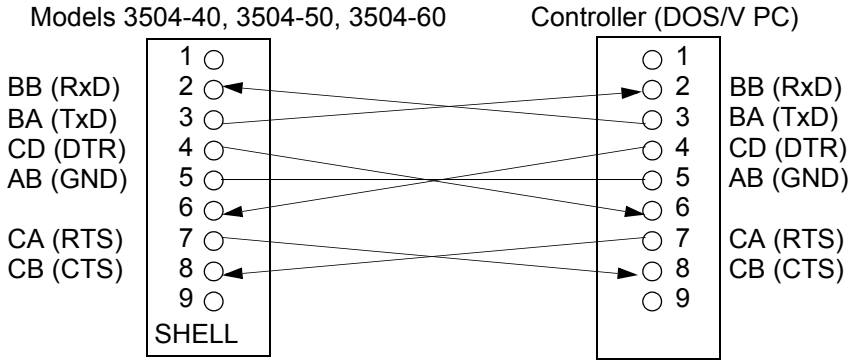
When connecting the controller (DTE), prepare a cross cable that meets the specifications of the connector of the unit and the connector of the controller

The input/output connector complies with the terminal (DTE) specifications.

Connector (D-sub) Pin No.	Interchange Circuit Name	CCITT Circuit No.	EIA Abbreviation	JIS Abbreviation	Common Abbreviation
1	Unused				
2	Received Data	104	BB	RD	RxD
3	Transmitted Data	103	BA	SD	TxD
4	Data Terminal Ready	108/2	CD	ER	DTR
5	Signal Ground	102	AB	SG	GND
6	Unused				
7	Request to Send	105	CA	RS	RTS
8	Clear to Send	106	CB	CS	CTS
9	Unused				

Example: Connecting to a DOS/V PC

Specification: D-sub 9-pin female and female connector, reverse connection

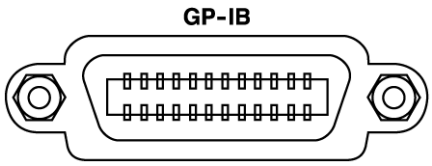


NOTE

Hardware control will not work properly if you use a cable that has CA(RTS) and CB(CTS) short-circuited.

GP-IB Connector Pin Configuration (Only for Models 3504-50, 3504-60)

GP-IB



Connect the GP-IB cable.

Recommended Cables
9151-02 GP-IB Connector Cable (2 m)
9151-04 GP-IB Connector Cable (4 m)

8

8.3.2 Setting the Interface Communication Conditions

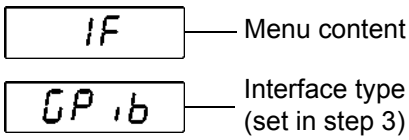
This section describes how to set the communication conditions for the interface used by the Models 3504-40, 3504-50, 3504-60 unit.
A GP-IB interface (only for Models 3504-50, 3504-60), RS-232C interface, and 9442 Printer can be set.

Setting Procedure for Communication Conditions

1. **Press MENU.**
The upper part of the MAIN display area displays the menu contents and the lower part displays the setting information.
(Refer to "Menu display organization" (p. 13) for menu order)

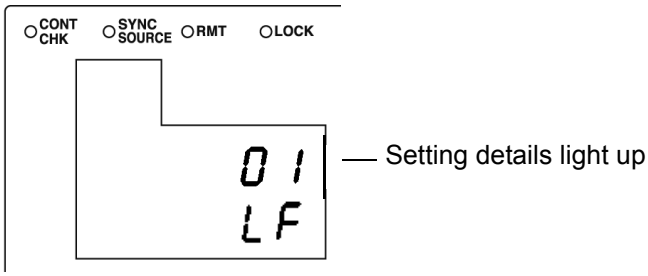
2. **Use ◀ or ▶ to select the "IF.GPib(rS/Prnt)" menu item.**

(MAIN display area)



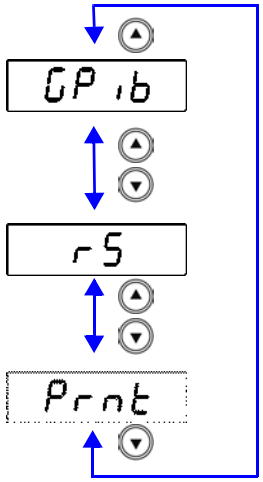
(Communication condition setting screen)

(SUB display area)



3. Use ▲ or ▼ to select one of the above items.

Pressing ▲ or ▼ switches the display.



"GPib"
For using the GP-IB interface (only for Models 3504-50, 3504-60)

"rS"
For using the RS-232C interface

"Prnt"
For using the 9442 Printer

4. Press ENTER to set the interface type is confirmed.

NOTE

Selecting "Print" completes the setup because there are no advanced setting items for this interface. After you complete the setup, "LoAd_A(C/h)"(Panel load screen) is displayed at the top of the MAIN display area.

8

5. Use ▲ or ▼ to select a setting item.

- **If "IF.GPib" was selected (for using the GP-IB interface) (only for Models 3504-50, 3504-60):**

1. Use the numeric keypad or ▲ and ▼ to set an address (0 to 30) and then press ENTER to confirm the address.
2. Use ▲ or ▼ to set the terminator.
   "LF"..... :LF with EOI
   "CrLF".... :CR+LF with EOI
   (Pressing ▲ or ▼ switches between "LF"←→"CrLF".)

- **If "IF. rS" was selected (for using the RS-232C interface):**

1. Use ▲ or ▼ to set a baud rate (9600, 19200) and then press ENTER to confirm the baud rate.
2. Use ▲ or ▼ to set the terminator.
   "Cr"..... :CR
   "CrLF".... :CR+LF
   (Pressing ▲ or ▼ switches between "Cr"←→"CrLF".)

6. Press ENTER to confirm the terminator.

After confirmation, "LoAd_A(C/h)" (Panel load screen) is displayed at the top of the MAIN display area.

The interface communication conditions are not confirmed unless ENTER is pressed.

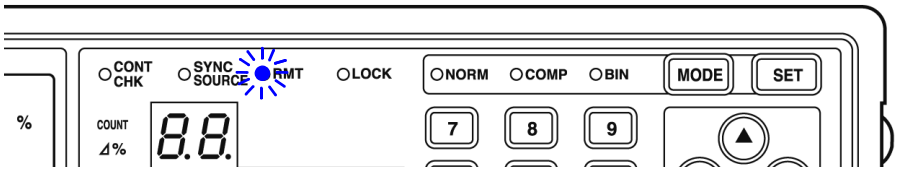
7. Press MENU.

The unit returns to the measurement mode it was in prior to the menu items being displayed.

8.4 Remote Function

When a connection is established to the interface and communication begins, the Models 3504-40, 3504-50, 3504-60 unit enters remote mode (remote control state) and the RMT LED lights up.

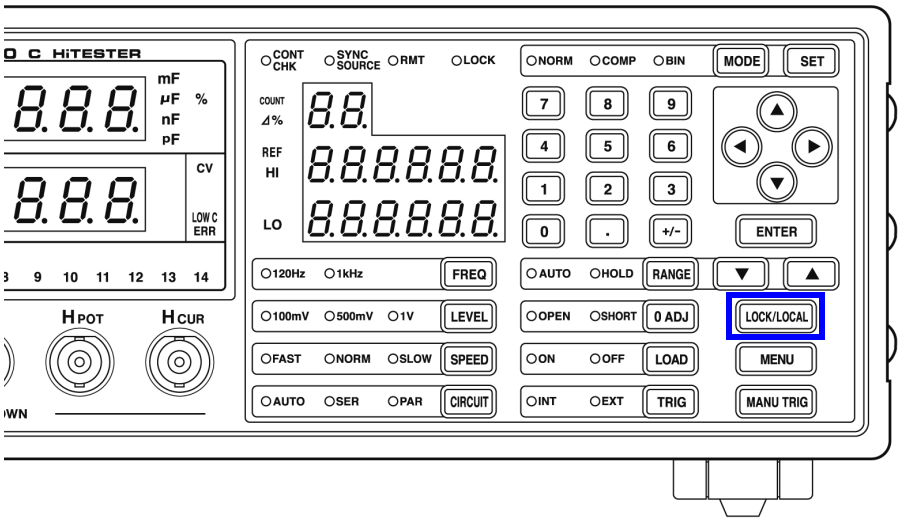
See Connecting to the interface: 8.3 "Connection and Setting Procedures" (p. 134)
See Starting communication: 8.5 "Communication Procedure" (p. 140)



The keys at the top of the front panel are disabled.

Canceling Remote Mode

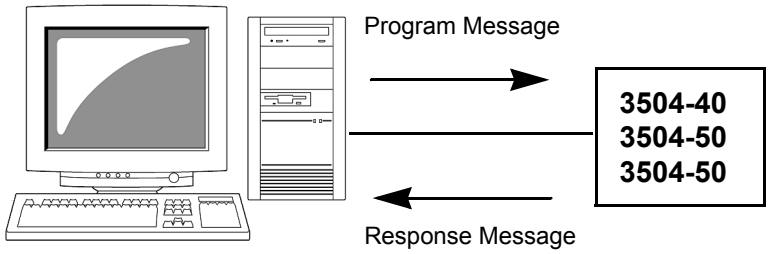
Press LOCK/LOCAL when you want to return to the normal state (local state).
The RMT LED goes out.



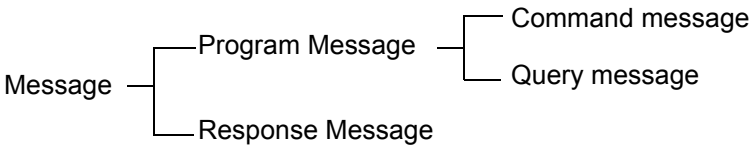
8

8.5 Communication Procedure

You can control the unit by sending messages from a PC to the unit via the interface
Program messages (p. 141) are sent from the PC to the unit and response messages(p. 141) are sent from the unit to the PC.



Messages are classified as follows.



NOTE

The term "command" appearing in the following explanations has the same meaning as "program message."

8.6 Things to Know before Beginning Communication

8.6.1 About Message Formats

Program Messages

Program messages can be divided into command messages and query messages.

- Command Message
  A command for controlling the unit such as an instruction to configure a setting or reset the settings of the device.

  Example `:FREQUENCY 1000` (instruction for setting the frequency)

  Header: `:FREQUENCY` Separator: ` ` Data Section: `1000`

- Query Message
  A command for finding out the results of operations, results of measurements, or the current configuration state of the device.

  Example `:FREQUENCY?` (instruction for finding out the set frequency)

  Header: `:FREQUENCY` Question Mark: `?`

See For details: Header (p. 142), Separator (p. 143), Data Section (p. 144)

Response Message

A response message is created after the syntax of a received query message has been checked. The "HEADer" command can be used to select whether there is a header.

Header ON `:FREQUENCY 1000`
Header OFF `1000`
(The current frequency is 1 kHz.)

The header is set to OFF when the power is turned on.
If some sort of error was generated when a query message was received, a response message is not created for the query message.
See About errors: (p. 155)

1.800.561.8187 www.itm.com information@itm.com

Command Syntax

Command names are selected for functions to be executed in a language that is as easy as possible to understand, and command names can also be shortened. The unshortened form of a command name is known as the "long form" and the shortened form of a command name is know as the "short form." In this manual, uppercase characters are used for the short form part and lowercase characters are used for the remaining part. However, either uppercase or lowercase characters are acceptable.

FREQuency	OK (long form)
FREQ	OK ((short form)
FREQu	Error
FRE	Error

For response messages returned from the unit, uppercase characters and the long form are used.

Header

The header indicates what is to be controlled. Program messages must have a header.

(1) Command Program Headers

There are three types of headers: simple command, compound command, and common command.

- Simple Command Header
  Simple command headers contain a single word beginning with an alphabetic character.
  :HEADer

- Compound Command Header
  Compound command headers contain multiple simple command headers separated by colons (**:**).
  :BEEPer:KEY

- Common Command Header
  Common command headers begin with an asterisk (*****) to indicate the commands are common commands.
- (As specified in IEEE488.2)
  ***RST**

(2) Query Program Header

This is used for finding out the results of operations performed in response to device commands, the results of measurements, or the current configuration state of the device. A program header is identified as a query if a question mark (**?**) is added at the end as shown in the example below.

:FREQuency?

Message Terminator

A message terminator indicates the end of a command.
The unit accepts the following as message terminators.

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

RS-232C
- CR
- CR+LF

NOTE The Models 3504-40, 3504-50, 3504-60 unit analyzes a message after it has confirmed the message terminator.

Depending on the interface setting, the following can be selected as terminators of response messages.

GP-IB
- LF with EOI (initial state)
- CR and EOI with LF

RS-232C
- CR
- CR and LF (initial state)

Separator

(1) Message Unit Separator (Semicolon)

Semicolons are used as separators when executing compound messages. Linking multiple messages by semicolons (`;`) enables a single line to be used to describe a compound command.

```
:RANGe:AUTO ON;:BEEPer:KEY ON;*IDN?
```

If a command error occurs when messages are described in succession, the messages from the error to the terminator are not executed.

Example) If `:RAN:AUTO ON;:BEEPer:KEY ON;*IDN?` is executed and `:RAN:AUTO` is a command error, `:BEEPer:KEY ON;*IDN?` following the error will also not be executed

Command processing is continued for an execution error or a query error

See For details on errors: 8.6.4 "About Event Registers" (p. 149), and the error explanations in 8.7"Message List"; (Pages 154 to 166)

(2) Message Unit Separator (Space)

A space is used as a separator to differentiate the header and data section. Add a space ( ) between the header and data section.

```
:LEVel 0.5
```

(3) Message Unit Separator (Comma)

When a message has multiple data sections, a comma is used as a separator to differentiate data sections. Add a comma (`,`) between data sections.

```
:COMParator:FLIMit:COUNt 112345,123456
```


1.800.561.8187 www.itm.com information@itm.com

Data Section

A data section indicates the content of a command. In the unit, character data and decimal numeric data are used for data sections, and use differs depending on the command.

(1) Character Data

Character data begins with an alphanumeric character and consists of alphabetic characters and numbers. Both uppercase and lowercase characters are acceptable, but uppercase characters are always used for response messages from the unit.

```
:TRIGger INTernal
```

(2) Decimal Numeric Data

There are three numeric data formats: NR1, NR2, and NR3. Both signed numeric and unsigned numeric values are acceptable for each of these formats. Unsigned numeric values are treated as positive numeric values.
Furthermore, if the accuracy of numeric values exceeds that capable of being handled by the unit, the numeric values are rounded off.

- NR1Integer data (Example: +12, -23, 34)
- NR2Fixed-point data (Example:+1.23, -23.45, 3.456)
- NR3Floating-point representation exponent data (Example:+1.0E-2, -2.3E+4)

The format that includes all three of the above types is referred to as the NRf format. The NRf format is accepted by the unit

For response data, the format is specified separately for each command and the data is sent in that format.

```
:RANGe 6
:LEVel 0.5
```

NOTE For commands with data, make every effort to enter the data in the specified format.

Omitting Compound Command Headers

When compound commands contain common initial parts (example: **:BEEPer:KEY**, **:BEEPer:JUDGment**), the common initial part (example: **:BEEPer:**) can be omitted just for subsequent commands.
The common initial part is known as the "current path," and until cleared, the current paths of subsequent commands are determined to have been omitted when analysis is performed.
The following shows an example of the procedure for using current paths.

Normal expression

```
:BEEPer:KEY ON;:BEEPer:JUDGment NG
```

Expression with current path omitted

```
:BEEPer:KEY ON;JUDGment NG
```

This becomes the current path and can be omitted from subsequent commands.

The current path is cleared when the power is turned on, the interface type is changed, the device is cleared* (only for GP-IB), or upon detection of a colon (:) at the beginning of a command or a message terminator.
Common command messages can be executed regardless of the current path. Furthermore, the current path is not affected.
A colon does not need to be added to the beginning of simple and compound command headers. However, Hioki recommends adding a colon to the beginning of these headers to prevent them from being mixed up with headers that have omissions and to prevent an incorrect operation from being performed.

* Device Initialization

1.800.561.8187 www.itm.com information@itm.com

8.6.2 About the Output Queue and Input Buffer

Output Queue

The output queue is the area in the unit where response messages are stored. Stored response messages are cleared once they are read by the controller of the PC. The output queue is also cleared at the following times.

GP-IB

- The power is turned on
- The device is cleared*
- There is a query error

* The device is initialized

RS-232C

- The power is turned on

The output queue of the unit is 10 kB. If a response message exceeds this size, a query error is generated and the output buffer is cleared.
For GP-IB, the output queue is cleared and a query error is generated if a new message is received when there is data in the output queue.

Input Buffer

The input buffer is the area in the unit where received data is stored. The input buffer is 10 kB. If data exceeding 10 kB was sent and the input buffer becomes full, the GP-IB interface bus enters a wait state until free space becomes available. RS-232C cannot receive data that exceeds 10 kB.

NOTE

Keep the length of one command under 10 kB.

1.800.561.8187 www.itm.com information@itm.com

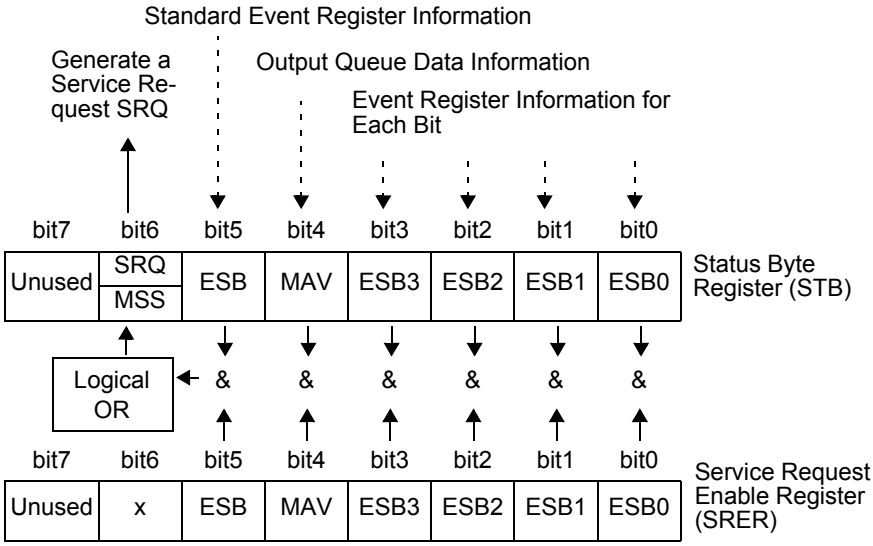
8.6.3 About the Status Byte Register

RS-232C

RS-232 reads the status bytes to find out the status of the unit.

GP-IB

The unit adopts the IEEE488.2 defined status model for parts related to the serial polling performed by the service request function. A trigger for generating a service request is called an event.



Conceptual Diagram of Generation of Service Request

The event register and output queue information is set in the status byte register. The service request enable register can be used to further select required items from this information. If the selected information is set, bit 6 (MMS master summary status bit) of the status byte register is set and an SRQ (service request) message is generated and used to generate a service request.

NOTE

For RS-232C, bit 4 (MAV message available) of the status byte register is not set.

8

Status Byte Register (STB)

A status byte register is an 8-bit register output from the unit to the controller during serial polling. If even one of the status byte register bits enabled by the service request enable register changes from "0" to "1," the MSS bit becomes 1. At the same time, the SRQ bit also becomes "1" and a service request is generated.

The SRQ bit is always synchronized with the service request and only read and simultaneously cleared upon being serial polled. The MSS bit is only read by an **"*STB?"** query and is not cleared until the event is cleared by a command such as a "***CLS**" command.

Bit 7	Unused
Bit 6 SRQ MSS	This becomes 1 when a service request is sent. This indicates logical OR of other bits of the status byte register.
Bit 5 ESB	Standard event summary (logical OR) bit This indicates the logical OR of a standard event status register.
Bit 4 MAV	Message available This indicates there is a message in the output queue.
Bit 3 ESB3	Event summary (logical OR) bit 3 This indicates the logical OR of event status register 3.
Bit 2 ESB2	Event summary (logical OR) bit 2 This indicates the logical OR of event status register 2.
Bit 1 ESB1	Event summary (logical OR) bit 1 This indicates the logical OR of event status register 1.
Bit 0 ESB0	Event summary (logical OR) bit 01 This indicates the logical OR of event status register 0.

Service Request Enable Register (SRER)

When the service request enable register is used to set each of the bits to "1," the corresponding bits are enabled in the status byte register.

8.6.4 About Event Registers

Standard Event Status Register (SESR)

A standard event status register is an 8-bit register.

If even one of the standard status byte register bits enabled by the standard event status enable register becomes “1,” bit 5 (ESB) of the status byte register becomes 1.
See "Standard Event Status Enable Register (SESER)" (p. 150)

The content of the standard event register is cleared at the following times.

- The "***CLS"** command is executed.
- An event register query is executed (***ESR?**)
- The power is turned on again.

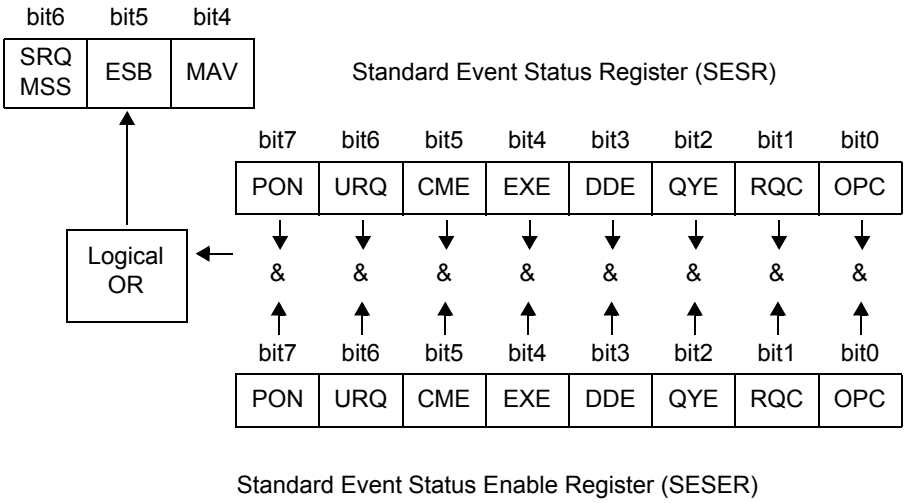
Standard Event Status Register (SESR)		
Bit 7	PON	Power on flag This becomes “1” when the power is turned on or the unit recovers from a power failure.
Bit 6	URQ	User request Unused
Bit 5	CME	Command error (Commands up until the message terminator are ignored.) This becomes "1" when there is an error with the syntax or meaning of a received command. • When there is an error in the program header • When the number of data items differs from that specified • When the data format differs from that specified • When a command not in the unit is received
Bit 4	EXE	Execution error This becomes "1" when a received command cannot be executed for some reason. • When the specified data is outside the setting range • When the specified data cannot be set • When the command cannot be executed because another function is being used
Bit 3	DDE	Device dependent error This becomes "1" when a command cannot be executed for a reason other than a command error, query error, or execution error. • When the command cannot be executed because there is an internal anomaly • When data valid for open circuit, short circuit, or load compensation cannot be incorporated • When the "i-ovEr Error" indication flashes in the MAIN display area
Bit 2	QYE	Query error (Clears the output queue.) This becomes "1" when a query error is detected by the controller of the output queue. • When an attempt was made to read the output queue while it was empty (only for GP-IB) • When there is an output queue overflow • When data in the output queue is lost
Bit 1	RQC	Request control Unused
Bit 0	OPC	End of operations This becomes "1" when the operation complete "*OPC" command is executed. • When operations for all messages up until the "*OPC" command have ended

1.800.561.8187 www.itm.com information@itm.com

Standard Event Status Enable Register (SESER)

When the standard event status enable register is used to set each of the bits to "1," the corresponding bits are enabled in the standard event status register.

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



Unique Event Status Registers (ESR0, ESR1, ESR2, ESR3)

Four event status registers have been provided for managing events in the unit. An event status register is an 8-bit register.

If even one of the event status register bits enabled by the event status enable register becomes "1," the corresponding bit becomes as follows.

- When event status register 0: Bit 0 (ESB0) of the status byte register becomes "1"
- When event status register 1: bit 1 (ESB1) becomes "1"
- When event status register 2: bit 2 (ESB2) becomes "1"
- When event status register 3: bit 3 (ESB3) becomes "1"

The content of event status register 0, 1, 2, and 3 is cleared at the following times.

- The "**`*CLS`**" command is executed.
- An event status register query is executed (**`:ESR0?,:ESR1?,:ESR2?,:ESR3?`**)
- The power is turned on again.

Event Status Register 0 (ESR0)		
Bit 7	REF	Non-guaranteed accuracy bit
Bit 6	COF	CV operation error bit
Bit 5	LER	Measurement level error bit
Bit 4	MOF	First parameter over range bit
Bit 3	MUF	First parameter under range bit
Bit 2	IDX	Data incorporation end bit
Bit 1	EOM	End of measurement bit
Bit 0	CEM	End of compensation data measurement bit

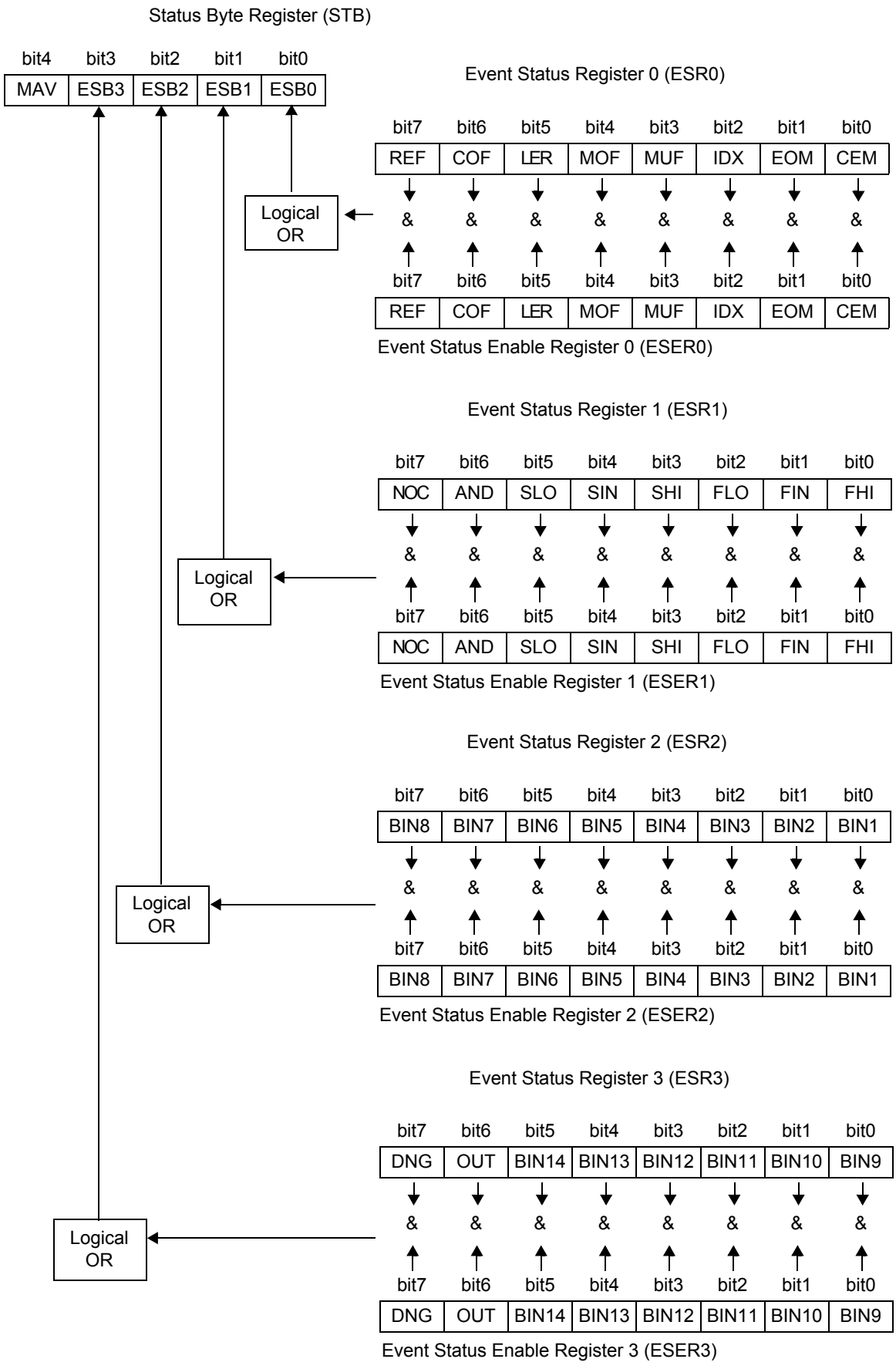
Event Status Register 1 (ESR1)		
Bit 7	NOC	Contact error bit or outside range of Low C reject limit
Bit 6	AND	Comparison result logical AND (AND of bit 1 and bit 4)
Bit 5	SLO	Below lower limit value of second parameter
Bit 4	SIN	Within range of second parameter
Bit 3	SHI	Above upper limit of second parameter
Bit 2	FLO	Below lower limit value of first parameter
Bit 1	FIN	Within range of first parameter
Bit 0	FHI	Above upper limit of first parameter

Event Status Register 2 (ESR2)		
Bit 7	BIN8	Within range of BIN 8
Bit 6	BIN7	Within range of BIN 7
Bit 5	BIN6	Within range of BIN 6
Bit 4	BIN5	Within range of BIN 5
Bit 3	BIN4	Within range of BIN 4
Bit 2	BIN3	Within range of BIN 3
Bit 1	BIN2	Within range of BIN 2
Bit 0	BIN1	Within range of BIN 1

Event Status Register 3 (ESR3)		
Bit 7	DNG	Outside range of second parameter
Bit 6	OUT	Outside range of BIN
Bit 5	BIN14	Within range of BIN 14
Bit 4	BIN13	Within range of BIN 13
Bit 3	BIN12	Within range of BIN 12
Bit 2	BIN11	Within range of BIN 11
Bit 1	BIN10	Within range of BIN 10
Bit 0	BIN9	Within range of BIN 9

1.800.561.8187 www.itm.com information@itm.com

Event Status Register 0 (ESR0), 1 (ESR1), 2 (ESR2), and 3 (ESR3) and Event Status Enable Register 0 (ESER0), 1 (ESER1), 2 (ESER2), and 3 (ESER3)



Reading and Writing of Each Register

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
Event Status Register 2	:ESR2?	–
Event Status Enable Register 2	:ESE2?	:ESE2
Event Status Register 3	:ESR3?	–
Event Status Enable Register 3	:ESE3?	:ESE3

GP-IB Command (Only for Models 3504-50, 3504-60)

The following commands can be used by interface functions.

Command	Description	
GTL	Go To Local	Cancels the remote state and switches to the local state.
LLO	Local Lock Out	Disables all keys including LOCK/LOCAL.
DCL	Device CLear	Clears the input buffer and output queue.
SDC	Selected Device Clear	
GET	Group Execute Trigger	When there is an external trigger, performs the sampling process once.

1.800.561.8187 www.itm.com information@itm.com

8.7 Message List

Common Commands

Command	Data Section	Explanation	Error	Reference Page
*CLS		Clearing of the event register	*1, 3	175
*ESE	Numeric values 0 to 255 (NR1)	Setting of the standard event status enable register	*3, 5	175
*ESE?		Query of standard event status enable register	*1, 2, 3	175
*ESR?		Query of standard event status register	*1, 2	176
*IDN?		Query of device ID	*1, 2, 3	173
*OPC		SRQ request when operation ends	*1	174
*OPC?		Query of operation end	*1, 2	174
*RST	————————	Initialization of device	*1, 3	173
*SRE	Numeric values 0 to 255 (NR1)	Setting of service request enable register	*3, 5	176
*SRE?		Query of service request enable register	*1, 2, 3	176
*STB?		Query of status byte register	*1, 2, 3	177
*TRG	————————	Performing of sampling once	*1, 3, 4	177
*TST?		Query of self test and results	*1, 2, 3	173
*WAI	————————	Wait	*1	174

Error Explanations (An error is generated when a message is executed in the following cases)
*1 Command Error ___ When there is data after a command or query
*2 Query Error _____ When a response message exceeds 10 kB
*3 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*4 Execution Error ____ When this command is executed while there is an internal trigger.
*5 Execution Error ____When set to other than the specified character data or numeric data.
Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
Average Function				
:AVERageing	1 to 256 (NR1)	Setting of the number of measurements to average	*2, 3	178
:AVERaging?		Query of the number of measurements to average	*1, 2	178
:AVERageing:STATe	ON/ OFF	Setting of average function	*2, 3	178
:AVERageing:STATe?		Query of average function	*1, 2	178
Beep Tone				
:BEEPer:JUDGment	IN/ NG/ OFF	Setting of comparator and BIN measurement beep tone	*2, 3	179
:BEEPer:JUDGment?		Query of comparator and BIN measurement beep tone	*1, 2	179
:BEEPer:KEY	ON/ OFF	Setting of key input beep tone	*2, 3	179
:BEEPer:KEY?		Query of key input beep tone	*1, 2	179
BIN Function (Only for Models 3504-50, 3504-60)				
:BIN	ON/ OFF	ON/ OFF setting of BIN measurement	*2, 3	180
:BIN?		ON/ OFF query of BIN measurement	*1, 2	180
:BIN:DISPlay	Numeric value from 1 to 14 (NR1)/ D/ CREFerence / DRFFer-ence/ OFF	Setting of the SUB display area indication during BIN measurement	*2,3,8	181
:BIN:DISPlay?		Query of the SUB display area indication during BIN measurement	*1, 2	181
:BIN:FLIMit:COUNt	<BIN Number>, <Lower Limit Value>, <Upper Limit Value> <BIN Number> = Numeric Value from 1 to 14 (NR1) <Lower Limit Value>, <Upper Limit Value> = OFF/ Numeric Value from -199999 to 999999 (NR1)	Setting of upper limit and lower limit values of first parameter for BIN function in count value mode	*2, 3	182

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:BIN:FLIMit:COUNt?	<BIN Number> = Numeric Value from 1 to 14 (NR1)	Query of upper limit and lower limit values of first parameter for BIN function in count value mode	*1,2,3	182
:BIN:FLIMit:DEViation	<BIN Number>, <Lower Limit Value>, <Upper Limit Value> <BIN Number> = Numeric Value from 1 to 14 (NR1) <Lower Limit Value>, <Upper Limit Value> =OFF/ Numeric Value from -999.99 to 999.99 (NR2)	Setting of upper limit and lower limit values of first parameter for BIN function in deviation percent mode	*2, 3	183
:BIN:FLIMit:DEViation?	<BIN Number> = Numeric Value from 1 to 14 (NR1)	Query of upper limit and lower limit values of first parameter for BIN function in deviation percent mode	*1,2,3	183
:BIN:FLIMit:REFerence	<Reference Value> = Numeric Value from -199999 to 999999 (excluding 0) (NR1)	Setting of reference values of first parameter for BIN function in deviation percent mode	*2, 3	184
:BIN:FLIMit:REFerence?		Query of reference values of first parameter for BIN function in deviation percent mode	*1, 2	184
:BIN:SLIMit:COUNt	<Lower Limit Value>, <Upper Limit Value> <Lower Limit Value>, <Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)	Setting of upper limit and lower limit values of second parameter for BIN function in count value mode	*2, 3	185
:BIN:SLIMit:COUNt?		Query of upper limit and lower limit values of second parameter for BIN function in count value mode	*1, 2	185
:BIN:SLIMit:DEViation	<Lower Limit Value>, <Upper Limit Value> <Lower Limit Value>, <Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)	Setting of upper limit and lower limit values of second parameter for BIN function in deviation percent mode	*2, 3	186
:BIN:SLIMit:DEViation?		Query of upper limit and lower limit values of second parameter for BIN function in deviation percent mode	*1, 2	186
:BIN:SLIMit:REFerence	<Reference Value> = Numeric Value from 0 to 199999 (NR1)	Setting of reference values of second parameter for BIN function in deviation percent mode	*2, 3	187

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____When a number that has not been saved is specified.
*5 Execution Error ____When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____When not even one measurement value is saved to memory.
*7 Execution Error ____When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:BIN:SLIMit:REFerence?		Query of reference values of second parameter for BIN function in deviation percent mode	*1, 2	187
Self Calibraiton				
:CALibration	OFF/ MANUal/ AUTO	Setting of self calibration function	*2, 3	188
:CALibration?		Query of self calibration function	*1, 2	188
:CALibration:ADJust		Request for start of self calibration	*2	188
Equivalent Circuit				
:CIRCuit	SERial/ PARallel	Setting of equivalent circuit mode	*2, 3	189
:CIRCuit?		Query of equivalent circuit mode	*1, 2	189
:CIRCuit:AUTO	ON/ OFF	Automatic setting of equivalent circuit mode	*2, 3	189
:CIRCuit:AUTO?		Query of automatic setting of equivalent circuit mode	*1, 2	189
Contact Check Function (Only for Model 3504-60)				
:CONTact:VERify	OFF/ BEFore/ AFTer / BOTH	Setting of setting of contact check function	*2, 3	190
:CONTact:VERify?		Query of equivalent contact check function	*1, 2	190
Comparator Function				
:COMParator	ON/ OFF	ON/ OFF setting of comparator function	*2, 3	190
:COMParator?		ON/ OFF query of comparator function	*1, 2	190
:COMParator:DISPlay	C/ D/ CREFerence/ DREFerence/ OFF	Setting of the SUB display area indication during comparator measurement	*2,3,8	191
:COMParator:DISPlay?		Query of the SUB display area indication during comparator measurement	*1, 2	191
:COMParator:FLIMit:COUNt	<Lower Limit Value>, <Upper Limit Value> OFF/ Numeric Value from -199999 to 999999 (NR1)	Setting of upper limit and lower limit values of first parameter for comparator function in count value mode	*2, 3	192

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:COMParator:FLIMit:COUNt?		Query of upper limit and lower limit values of first parameter for comparator function in count value mode	*1, 2	192
:COMParator:FLIMit :DEViation	<Reference Value>, <Lower Limit Value>, <Upper Limit Value> <Reference Value> = Numeric Value from -199999 to 999999 (excluding 0) (NR1) <Lower Limit Value>, <Upper Limit Value> = OFF/Numeric Value from -999.99 to 999.99 (NR2)	Setting of reference value and upper limit and lower limit values of first parameter for comparator function in deviation percent mode	*2, 3	193
:COMParator:FLIMit :DEViation?		Query of reference value and upper limit and lower limit values of first parameter for comparator function in deviation percent mode	*1, 2	193
:COMParator:SLIMit:COUNt	<Lower Limit Value>, <Upper Limit Value> OFF/Numeric Value from -199999 to 199999 (NR1)	Setting of upper limit and lower limit values of second parameter for comparator function in count value mode	*2, 3	194
:COMParator:SLIMit:COUNt?		Query of upper limit and lower limit values of second parameter for comparator function in count value mode	*1, 2	194
:COMParator:SLIMit :DEViation	<Reference Value>, <Lower Limit Value>, <Upper Limit Value> <Reference Value> = Numeric Value from -199999 to 199999 (NR1) <Lower Limit Value>, <Upper Limit Value> = OFF/Numeric Value from -199999 to 199999 (NR1)	Setting of reference value and upper limit and lower limit values of second parameter for comparator function in deviation percent mode	*2, 3	195
:COMParator:SLIMit :DEViation?		Query of reference value and upper limit and lower limit values of second parameter for comparator function in deviation percent mode	*1, 2	195
Open Circuit and Short Circuit Compensation				
:CORRection:DATA?		Query of compensation values for open circuit and short circuit compensation	*1, 2	196
:CORRection:OPEN	ALL/ ON/ OFF/ RETurn	Setting of open circuit compensation function	*2, 3	197

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____When a number that has not been saved is specified.
*5 Execution Error ____When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____When not even one measurement value is saved to memory.
*7 Execution Error ____When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:CORRection:OPEN?		Query of open circuit compensation function	*1, 2	197
:CORRection:OPEN:DATA	<compensation values 1>,<compensation values 2> <compensation values 1>, <compensation values 2> = -99.9999E9 to 99.9999E9 (NR3)	Setting of open circuit compensation values	*1, 2	199
:CORRection:OPEN:DATA?		Query of open circuit compensation values	*1, 2	199
:CORRection:OPEN:DATA :FORMat	ZPH/ GB/ CPG	Setting of output parameter for open circuit compensation values	*2, 3	200
:CORRection:OPEN:DATA :FORMat?		Query of output parameter for open circuit compensation values	*1, 2	200
:CORRection:OPEN:POINt	1 to 255 (NR1)	Setting of open circuit compensation reading	*2, 3	201
:CORRection:OPEN:POINt?		Query of open circuit compensation reading	*1, 2	201
:CORRection:SHORt	ALL/ ON/ OFF/ RETurn	Setting of short circuit compensation function	*2, 3	202
:CORRection:SHORt?		Query of short circuit compensation function	*1, 2	202
:CORRection:SHORt:DATA	<compensation values 1>,<compensation values 2> <compensation values 1>,<compensation values 2> = -99.9999E9 to 99.9999E9 (NR3)	Setting of short circuit compensation values	*2, 3	203
:CORRection:SHORt:DATA?		Query of short circuit compensation values	*1, 2	203
:CORRection:SHORt:DATA :FORMat	ZPH/ RSX/ LSRS	Setting of output parameter for short circuit compensation values	*2, 3	204
:CORRection:SHORt:DATA :FORMat?		Query of output parameter for short circuit compensation values	*1, 2	204
:CORRection:SHORt:POINt	1 to 255 (NR1)	Setting of short circuit compensation reading	*2, 3	205
:CORRection:SHORt:POINt?		Query of short circuit compensation reading	*1, 2	205
Load Compensation				
:CORRection:LOAD	ON/ OFF/ RETurn	Setting of load compensation function	*2, 3	206

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:CORRection:LOAD?		Query of load compensation function	*1, 2	206
:CORRection:LOAD:DATA	<compensation value 1>,<compensation value 2> Differs depending on forwarding format	Setting of load compensation values	*1, 2	207
:CORRection:LOAD:DATA?		Query of load compensation values	*1, 2	207
:CORRection:LOAD:DATA :FORMat	COEFficient/ ZPH/ CD	Setting of output format for load compensation values	*2, 3	209
:CORRection:LOAD:DATA :FORMat?		Query of output format for load compensation values	*1, 2	209
:CORRection:LOAD :REFerence	<Reference Value 1>, <Reference Value 2> <Reference Value 1> = Numeric Value from -199999 to 999999 (NR1) (excluding 0) <Reference Value 2> = Numeric Value from -199999 to 199999 (NR1)	Setting of load compensation function reference value	*2, 3	210
:CORRection:LOAD :REFerence?		Query of load compensation function reference value	*1, 2	210
Offset Compensation				
:CORRection:OFFSet	ON/ OFF	Setting of offset compensation function	*2, 3	211
:CORRection:OFFSet?		Query of offset compensation function	*1, 2	211
:CORRection:OFFSet:DATA	<compensation value 1>, <compensation value 2> <compensation value 1> = -99.9E-3 to 99.9E-3 (NR3), <compensation value 2> = -1.99999 to 1.99999 (NR2)	Setting of offset compensation values	*2, 3	211
:CORRection:OFFSet:DATA?		Query of offset compensation values	*1, 2	211
Low C Reject Function				
:CREJect	ON/ OFF	Setting of Low C reject function	*2, 3	212
:CREJect?		Query of Low C reject function	*1, 2	212

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____When a number that has not been saved is specified.
*5 Execution Error ____When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____When not even one measurement value is saved to memory.
*7 Execution Error ____When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:CREJect:LIMit	0.000 to 10.000 (NR2)	Setting of Low C reject function limit value	*2, 3	212
:CREJect:LIMit?		Query of Low C reject function limit value	*1, 2	212
EXT I/O input				
:DISable:TRIGger	ON/ OFF	Setting of the input $\overline{\text{TRIG}}$ signal enabled/disabled.	*2, 3	213
:DISable:TRIGger?		Query to confirm the input $\overline{\text{TRIG}}$ signal enabled or disabled.	*1, 2	213
Display Function				
:DISPlay	ON/ OFF	Setting of display	*2, 3	213
:DISPlay?		Query of display	*1, 2	213
Confirmation of Communication Error				
:ERRor? RS-232C		Query of RS-232C error	*1,2,7	214
Event Registers				
:ESE0	Numeric Value from 0 to 255 (NR1)	Setting of event status enable register 0	*2, 3	214
:ESE0?		Query of event status enable register 0	*1, 2	214
:ESE1	Numeric Value from 0 to 255 (NR1)	Setting of event status enable register 1	*2, 3	215
:ESE1?		Query of event status enable register 1	*1, 2	215
:ESE2	Numeric Value from 0 to 255 (NR1)	Setting of event status enable register 2	*2, 3	216
:ESE2?		Query of event status enable register 2	*1, 2	216
:ESE3	Numeric Value from 0 to 255 (NR1)	Setting of event status enable register 3	*2, 3	217
:ESE3?		Query of event status enable register 3	*1, 2	217
:ESR0?		Query of event status register 0	*1	217
:ESR1?		Query of event status register 1	*1	218

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:ESR2?		Query of event status register 2	*1	218
:ESR3?		Query of event status register 3	*1	218
Measurement Frequency				
:FREQuency	120/ 1000 (NR1)	Setting of measurement frequency	*2, 3	219
:FREQuency?		Query of measurement frequency	*1, 2	219
Communication Handshake				
:HANDshake RS-232C	OFF/ X/ HARDware/ BOTH	Setting of RS-232C communication handshake	*2,3,7	219
:HANDshake? RS-232C		Query of RS-232C communication handshake	*1,2,7	219
Header				
:HEADer	ON/ OFF	Setting of header for response messages	*2, 3	220
:HEADer?		Query of header for response messages	*1, 2	220
EXT I/O Output				
:IO:OUTPut:DELay	ON/ OFF	Setting of delay time for judgement result output and EOM output period in EXT I/O	*2, 3	220
:IO:OUTPut:DELay?		Query of delay time for judgement result Output and EOM output period in EXT I/O	*1, 2	220
:IO:RESult:RESet	ON/ OFF	Setting of output of judgment result signal line in EXT I/O	*2, 3	221
:IO:RESult:RESet?		Query of output of judgment result signal line in EXT I/O	*1, 2	221
Judgment Mode				
:JUDGment:MODE	COUNt/ DEViation	Setting of judgment mode of comparator and BIN functions	*2, 3	222
:JUDGment:MODE?		Query of judgment mode of comparator and BIN functions	*1, 2	222

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
Key Lock				
:KEYLock	ON/ OFF	Setting of key lock function	*2, 3	222
:KEYLock?		Query of key lock function	*1, 2	222
Measurement Signal Level				
:LEVel	1/ 0.5/ 0.1 (NR2) (only for Model 3504-60)	Setting of measurement signal level	*2, 3	223
:LEVel?		Query of measurement signal level	*1, 2	223
Detected Level Monitoring Function				
:LEVel:CHECk	ON/ OFF	Setting of detected level monitoring function	*2, 3	223
:LEVel:CHECk?		Query of detected level monitoring function	*1, 2	223
:LEVel:CHECk:LIMit	0.01 to 100.00	Setting of judging threshold for detected level abnormality	*2, 3	224
:LEVel:CHECk:LIMit?		Query of judging threshold for detected level abnormality	*1, 2	224
Panel Load				
:LOAD	1 to 99 (NR1)	Loading of specified panel number	*2,3,4	224
:LOAD:TYPE	ALL/ CORRection/ HARDware	Setting of load method	*2, 3	225
:LOAD:TYPE?		Query of load method	*1, 2	225
Normal Measurement				
:MEASure?		Query of measurement data	*1, 2	226
:MEASure:VALid	1 to 255 (NR1)	Setting of effective data for measurement value acquisition query	*2, 3	230
:MEASure:VALid?		Query of effective data for measurement value acquisition query	*1, 2	230

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
Measurement Value Memory Function				
:MEMory?	No Data/ ALL	Query of measurement values saved to memory by the measurement value memory function	*1,2,6	231
:MEMory:CLEar		Deleting data from memory of measurement value memory function	*2	232
:MEMory:COUNt?		Query of number of measurement values saved to memory by the measurement value memory function	*1, 2	232
:MEMory:CONTrol	ON/ IN/ OFF	Setting of measurement value memory function	*2, 3	233
:MEMory:CONTrol?		Query of measurement value memory function	*1, 2	233
:MEMory:POINts	1 to 32000	Setting of memory size for measurement value memory function	*2, 3	234
:MEMory:POINts?		Query of memory size for measurement value memory function	*1, 2	234
Monitor				
:MONItor?		Query of voltage and current monitor levels	*1, 2	234
:MONItor:DISPlay	ON/ OFF	Setting of voltage and current monitor value display	*2, 3	235
:MONItor:DISPlay?		Query of voltage and current monitor value display	*1, 2	235
Initialize Device				
:PRESet		Initialize Device	*2	235
Measurement Range				
:RANGe	1 to 10 (NR1)	Setting of measurement range	*2, 3	236
:RANGe?		Query of measurement range	*1, 2	236
:RANGe:AUTO	ON/ OFF	Automatic setting of measurement range	*2,3,5	237

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:RANGe:AUTO?		Query of automatic setting of measurement range	*1, 2	237
Panel Save				
:SAVE	1 to 99 (NR1)	Saving of specified panel number	*2, 3	237
:SAVE?	1 to 99 (NR1)	Query of saving of specified panel number	*1,2,3	237
:SAVE:CLEar	ALL/ 1 to 99	Clear specified panel number		238
Measurement Speed				
:SPEEd	FAST/ NORMal/ SLOW	Setting of measurement speed	*2, 3	238
:SPEEd?		Query of measurement speed	*1, 2	238
Trigger Synchronous Output Function				
:SSOurce	ON/ OFF	Setting of trigger synchronous output function	*2, 3	239
:SSOurce?		Query of trigger synchronous output function	*1, 2	239
:SSOurce:WAIT	<Wait Time 1>, <Wait Time 2> <Wait Time 1 and 2> Numeric Value from 0.001 to 9.999 (NR2)	Setting of wait time for trigger synchronous output function	*2, 3	239
:SSOurce:WAIT?		Query of wait time for trigger synchronous output function	*1, 2	239
Message Terminator				
:TRANsmit:TERMinator	Numeric Value from 0 to 255 (NR1)	Setting of the terminator of a response message	*2, 3	240
:TRANsmit:TERMinator?		Query of the terminator of a response message	*1, 2	240
Trigger				
:TRIGger	INTernal/ EXTernal	Setting of trigger	*2, 3	241
:TRIGger?		Query of trigger	*1, 2	241
:TRIGger:DELay	0 to 9.999	Setting of trigger delay time	*2, 3	241

Error Explanations (An error is generated when a message is executed in the following cases)

*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____ When a number that has not been saved is specified.
*5 Execution Error ____ When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____ When not even one measurement value is saved to memory.
*7 Execution Error ____ When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____ When a command to display a reference value in the SUB display area is executed while the count setting is configured.

Note: Command errors are generated for all messages with a misspelling.

1.800.561.8187 www.itm.com information@itm.com

Unique Commands

Command	Data Section	Explanation	Error	Reference Page
:TRIGger:DELay?		Query of trigger delay time	*1, 2	241
:TRIGger:DELay:STATe	ON/ OFF	Setting of trigger delay function	*2, 3	242
:TRIGger:DELay:STATe?		Query of trigger delay function	*1, 2	242
User ID				
:USER:IDENtity	<ID> = User ID Code	Setting of user ID	*2, 3	242
:USER:IDENtity?		Query of user ID	*1, 2	242

Error Explanations (An error is generated when a message is executed in the following cases)
*1 Query Error _____ When a response message exceeds 10 kB
*2 Execution Error ____ When a command is executed while open circuit, short circuit, or load compensation
*3 Execution Error ____ When set to other than the specified character data or numeric data.
*4 Execution Error ____When a number that has not been saved is specified.
*5 Execution Error ____When a command is executed during comparator measurement or BIN measurement.
*6 Execution Error ____When not even one measurement value is saved to memory.
*7 Execution Error ____When there is an RS-232C specific command or query while the interface type is set to GP-IB.
*8 Execution Error ____When a command to display a reference value in the SUB display area is executed while the count setting is configured.
Note: Command errors are generated for all messages with a misspelling.

8.8 Ability to Use Commands by State

The ability to use commands depends on the state of the unit; for example, whether the unit is in a measurement mode or performing compensation. Refer to the following table.

8.8.1 Common Commands

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
*CLS	Yes	Yes	Yes	No	175
*ESE	Yes	Yes	Yes	No	175
*ESE?	Yes	Yes	Yes	No	175
*ESR?	Yes	Yes	Yes	Yes	176
*IDN?	Yes	Yes	Yes	No	173
*OPC	Yes	Yes	Yes	Yes	174
*OPC?	Yes	Yes	Yes	Yes	174
*RST	Yes	Yes	Yes	No	173
*SRE	Yes	Yes	Yes	No	176
*SRE?	Yes	Yes	Yes	No	176
*STB?	Yes	Yes	Yes	No	177
*TRG	Yes	Yes	Yes	No	177
*TST?	Yes	Yes	Yes	No	173
*WAI	Yes	Yes	Yes	Yes	174

8.8.2 Unique Commands

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable
*Only for Models 3504-50, 3504-60

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:AVERaging	Yes	△	△	No	178
:AVERaging?	Yes	Yes	Yes	No	178
:AVERaging:STATe	Yes	△	△	No	178
:AVERaging:STATe?	Yes	Yes	Yes	No	178
:BEEPer:JUDGment	Yes	△	△	No	179
:BEEPer:JUDGment?	Yes	Yes	Yes	No	179
:BEEPer:KEY	Yes	Yes	Yes	No	179
:BEEPer:KEY?	Yes	Yes	Yes	No	179
:BIN *	Yes	Yes	Yes	No	180

1.800.561.8187 www.itm.com information@itm.com

8.8 Ability to Use Commands by State

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable
*Only for Models 3504-50, 3504-60

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:BIN? *	Yes	Yes	Yes	No	180
:BIN:DISPlay *	Yes	Yes	Yes	No	181
:BIN:DISPlay? *	Yes	Yes	Yes	No	181
:BIN:FLIMit:COUNt *	Yes	Yes	Yes	No	182
:BIN:FLIMit:COUNt? *	Yes	Yes	Yes	No	182
:BIN:FLIMit:DEViation *	Yes	Yes	Yes	No	183
:BIN:FLIMit:DEViation? *	Yes	Yes	Yes	No	183
:BIN:FLIMit:REFerence *	Yes	Yes	Yes	No	184
:BIN:FLIMit:REFerence? *	Yes	Yes	Yes	No	184
:BIN:SLIMit:COUNt *	Yes	Yes	Yes	No	185
:BIN:SLIMit:COUNt? *	Yes	Yes	Yes	No	185
:BIN:SLIMit:DEViation *	Yes	Yes	Yes	No	186
:BIN:SLIMit:DEViation? *	Yes	Yes	Yes	No	186
:BIN:SLIMit:REFerence *	Yes	Yes	Yes	No	187
:BIN:SLIMit:REFerence?*	Yes	Yes	Yes	No	187
:CALibration	Yes	△	△	No	188
:CALibration?	Yes	Yes	Yes	No	188
:CALibration:ADJust	Yes	Yes	Yes	No	188
:CIRCuit	Yes	△	△	No	189
:CIRCuit?	Yes	Yes	Yes	No	189
:CIRCuit:AUTO	Yes	△	△	No	189
:CIRCuit:AUTO?	Yes	Yes	Yes	No	189
:CONTact:VERify	Yes	Yes	Yes	No	190
:CONTact:VERify?	Yes	Yes	Yes	No	190
:COMParator	Yes	Yes	Yes	No	190
:COMParator?	Yes	Yes	Yes	No	190
:COMParator:DISPlay	Yes	Yes	Yes	No	191
:COMParator:DISPlay?	Yes	Yes	Yes	No	191
:COMParator:FLIMit:COUNt	Yes	Yes	Yes	No	192
:COMParator:FLIMit:COUNt?	Yes	Yes	Yes	No	192
:COMParator:FLIMit:DEViation	Yes	Yes	Yes	No	193
:COMParator:FLIMit:DEViation?	Yes	Yes	Yes	No	193
:COMParator:SLIMit:COUNt	Yes	Yes	Yes	No	194
:COMParator:SLIMit:COUNt?	Yes	Yes	Yes	No	194
:COMParator:SLIMit:DEViation	Yes	Yes	Yes	No	195
:COMParator:SLIMit:DEViation?	Yes	Yes	Yes	No	195
:CORRection:DATA?	Yes	Yes	Yes	No	196
:CORRection:OPEN	Yes	△	△	No	197
:CORRection:OPEN?	Yes	Yes	Yes	No	197

1.800.561.8187 www.itm.com information@itm.com

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable
*Only for Models 3504-50, 3504-60

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:CORRection:OPEN:DATA	Yes	△	△	No	199
:CORRection:OPEN:DATA?	Yes	Yes	Yes	No	199
:CORRection:OPEN:DATA:FORMat	Yes	Yes	Yes	No	200
:CORRection:OPEN:DATA:FORMat?	Yes	Yes	Yes	No	200
:CORRection:OPEN:DATA:POINt	Yes	Yes	Yes	No	201
:CORRection:OPEN:DATA:POINt?	Yes	Yes	Yes	No	201
:CORRection:SHORt	Yes	△	△	No	202
:CORRection:SHORt?	Yes	Yes	Yes	No	202
:CORRection:SHORt:DATA	Yes	△	△	No	202
:CORRection:SHORt:DATA?	Yes	Yes	Yes	No	203
:CORRection:SHORt:DATA:FORMat	Yes	Yes	Yes	No	204
:CORRection:SHORt:DATA:FORMat?	Yes	Yes	Yes	No	204
:CORRection:SHORt:DATA:POINt	Yes	Yes	Yes	No	205
:CORRection:SHORt:DATA:POINt?	Yes	Yes	Yes	No	205
:CORRection:LOAD	Yes	△	△	No	206
:CORRection:LOAD?	Yes	Yes	Yes	No	206
:CORRection:LOAD:DATA	Yes	△	△	No	207
:CORRection:LOAD:DATA?	Yes	Yes	Yes	No	207
:CORRection:LOAD:DATA:FORMat	Yes	Yes	Yes	No	209
:CORRection:LOAD:DATA:FORMat?	Yes	Yes	Yes	No	209
:CORRection:LOAD:REFerence	Yes	△	△	No	210
:CORRection:LOAD:REFerence?	Yes	Yes	Yes	No	210
:CORRection:OFFSet	Yes	△	△	No	211
:CORRection:OFFSet?	Yes	Yes	Yes	No	211
:CORRection:OFFSet:DATA	Yes	△	△	No	211
:CORRection:OFFSet:DATA?	Yes	Yes	Yes	No	211
:CREJect	Yes	Yes	Yes	No	212
:CREJect?	Yes	Yes	Yes	No	212
:CREJect:LIMit	Yes	Yes	Yes	No	212
:CREJect:LIMit?	Yes	Yes	Yes	No	212
:DISable:TRIGger	Yes	Yes	Yes	No	213
:DISable:TRIGger?	Yes	Yes	Yes	No	213
:DISPlay	Yes	Yes	Yes	No	213
:DISPlay?	Yes	Yes	Yes	No	213
:ERRor?	Yes	Yes	Yes	No	214
:ESE0	Yes	Yes	Yes	No	214
:ESE0?	Yes	Yes	Yes	No	214
:ESE1	Yes	Yes	Yes	No	215
:ESE1?	Yes	Yes	Yes	No	215

1.800.561.8187 www.itm.com information@itm.com

8.8 Ability to Use Commands by State

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable
*Only for Models 3504-50, 3504-60

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:ESE2	Yes	Yes	Yes	No	216
:ESE2?	Yes	Yes	Yes	No	216
:ESE3	Yes	Yes	Yes	No	217
:ESE3?	Yes	Yes	Yes	No	217
:ESR0?	Yes	Yes	Yes	Yes	217
:ESR1?	Yes	Yes	Yes	Yes	218
:ESR2?	Yes	Yes	Yes	Yes	218
:ESR3?	Yes	Yes	Yes	Yes	218
:FREQuency	Yes	△	△	No	219
:FREQuency?	Yes	Yes	Yes	No	219
:HANDshake	Yes	Yes	Yes	No	219
:HANDshake?	Yes	Yes	Yes	No	219
:HEADer	Yes	Yes	Yes	No	220
:HEADer?	Yes	Yes	Yes	No	220
:IO:OUTPut:DELay	Yes	Yes	Yes	No	220
:IO:OUTPut:DELay?	Yes	Yes	Yes	No	220
:IO:RESult:RESet	Yes	Yes	Yes	No	221
:IO:RESult:RESet?	Yes	Yes	Yes	No	221
:JUDGment:MODE	Yes	△	△	No	222
:JUDGment:MODE?	Yes	Yes	Yes	No	222
:KEYLock	Yes	Yes	Yes	No	222
:KEYLock?	Yes	Yes	Yes	No	222
:LEVel	Yes	△	△	No	223
:LEVel?	Yes	Yes	Yes	No	223
:LEVel:CHECk	Yes	Yes	Yes	No	223
:LEVel:CHECk?	Yes	Yes	Yes	No	223
:LEVel:CHECk:LIMit	Yes	Yes	Yes	No	224
:LEVel:CHECk:LIMit?	Yes	Yes	Yes	No	224
:LOAD	Yes	Yes	Yes	No	224
:LOAD:TYPE	Yes	Yes	Yes	No	225
:LOAD:TYPE?	Yes	Yes	Yes	No	225
:MEASure?	Yes	Yes	Yes	No	226
:MEASure:VALid	Yes	Yes	Yes	No	230
:MEASure:VALid?	Yes	Yes	Yes	No	230
:MEMory?	Yes	Yes	Yes	No	231
:MEMory:CLEar	Yes	Yes	Yes	No	232
:MEMory:COUNt?	Yes	Yes	Yes	No	232
:MEMory:CONTrol	Yes	Yes	Yes	No	233
:MEMory:CONTrol?	Yes	Yes	Yes	No	233

1.800.561.8187 www.itm.com information@itm.com

Yes: Available △: Only for commands available (Key unavailable) No: Unavailable
*Only for Models 3504-50, 3504-60

Command Name	Normal Measurement Mode	Comparator Measurement Mode	BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:MEMory:POINts	Yes	Yes	Yes	No	234
:MEMory:POINts?	Yes	Yes	Yes	No	234
:MONItor?	Yes	Yes	Yes	No	234
:MONItor:DISPlay	Yes	Yes	Yes	No	235
:MONItor:DISPlay?	Yes	Yes	Yes	No	235
:PRESet	Yes	Yes	Yes	No	235
:RANGe	Yes	△	△	No	236
:RANGe?	Yes	Yes	Yes	No	236
:RANGe:AUTO	Yes	No	No	No	237
:RANGe:AUTO?	Yes	Yes	Yes	No	237
:SAVE:CLEar	Yes	Yes	Yes	No	238
:SAVE	Yes	Yes	Yes	No	237
:SAVE?	Yes	Yes	Yes	No	237
:SPEEd	Yes	△	△	No	238
:SPEEd?	Yes	Yes	Yes	No	238
:SSOurce	Yes	△	△	No	239
:SSOurce?	Yes	Yes	Yes	No	239
:SSOurce:WAIT	Yes	Yes	Yes	No	239
:SSOurce:WAIT?	Yes	Yes	Yes	No	239
:TRANsmit:TERMinator	Yes	Yes	Yes	No	240
:TRANsmit:TERMinator?	Yes	Yes	Yes	No	240
:TRIGger	Yes	Yes	Yes	No	241
:TRIGger?	Yes	Yes	Yes	No	241
:TRIGger:DELay	Yes	△	△	No	241
:TRIGger:DELay?	Yes	Yes	Yes	No	241
:TRIGger:DELay:STATe	Yes	△	△	No	242
:TRIGger:DELay:STATe?	Yes	Yes	Yes	No	242
:USER:IDENtity	Yes	Yes	Yes	No	242
:USER:IDENtity?	Yes	Yes	Yes	No	242

8.9 Message Reference

Refer to the following on how to read this section.

This indicates whether the command message format has a numeric value or character parameter.
<Numeric Value>**Numeric Value Parameter**
(NR1) Integer
(NR2) Fixed Point
(NR3) Floating point
(NRf) Format including all of NR1, NR2, and NR3
<Character> Character parameter
<Content to input>

Indicates the content of the command.

Describes the syntax of the message.

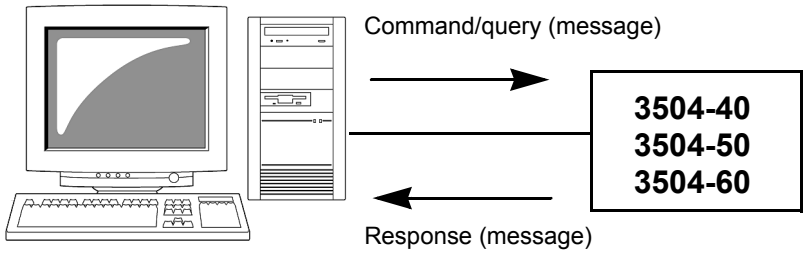
Provides an explanation of the command data section or response data.

Provides an explanation of the message

Shows an actual example of using the command.
This explanation is normally for when HEADER ON. (Except for HEADER command.)

Setting and Query of Measurement Signal Level

Syntax	Command	:LEVel <Numeric Value>	
	Query	:LEVel ?	
	Response	<Numeric Value>	
		<Numeric Value>=1/ 0.5/ 0.1 (only for Model 3504-60) (NR2) 1: 1 V, 0.5: 500 mV, 0.1: 100 mV	
Explanation	Command	Sets the measurement signal level. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.	
	Query	Returns the setting of the measurement signal level as an NR2 numeric value.	
Example	Command	`:LEVel 0.5`	Sets the measurement signal level to 500 mV
	Query	`:LEVEL?` `:LEVEL 0.5` (when HEADER ON) `0.5` (when HEADER OFF)	The measurement signal level is set to 500 mV.



8.9.1 Common Commands

(1) System Data Commands

Query of Device ID (Identification Code)

Syntax
Query ***IDN?**
Response <Maker Name>,< Model Name>,40/ 50/ 60,<Software Version>

Example
HIOKI,3504,40,V1.00 (Model 3504-40)
HIOKI,3504,50,V1.00 (Model 3504-50)
HIOKI,3504,60,V1.00 (Model 3504-60)

(2) Internal Operation Commands

Initialization of Device

Syntax
Command ***RST**

Explanation
Initializes the unit. (This is the same as performing a system reset. However, the interface setting and user ID setting are excluded.)
See Appendix 7 "Initial Settings Table" (p. A11)

Query of Self Test Execution and Results

Syntax
Query ***TST?**
Response <Numeric Value>

<Numeric Value> = 0 to 15 (NR1)

Explanation
Returns the results of the self check of the unit as an NR1 numeric value.
No header is added to the response message.

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	Interrupt error	I/O error	RAM error	ROM error

Example
Query ***TST?**
Response **2**
There is a RAM error (bit 1).

8

(3) Synchronization Commands

Setting of OPC of SESR after All Executed Operations End

Syntax Command ***OPC**

Explanation Sets the OPC (bit 0) of SESR (standard event status register) when processing ends for sent commands prior to the *OPC command.

Example

```
A;B;*OPC;C
```

Sets OPC of SESR after processing ends for commands A and B.

Response of 1 of ASCII after All Executed Operations End

Syntax Query ***OPC?**
Response 1

Explanation Responds with 1 of ASCII when processing ends for sent commands prior to the *OPC command.

Continuing Execution of Commands after Command Processing Ends

Syntax Command ***WAI**

Example

```
A;B;*WAI;C
```

Executes ***WAI** and then the C command after processing ends for commands A and B.

Current Frequency:1 kHz when in internal trigger state

- When the *WAI command was not used
  (Send)
  ```
  :FREQuency 120;:MEASure?
  ```
  In this case, it is not certain which frequency measurement value will be sent in response to the :MEASure? query.
- When the *WAI command was used
  (Send)
  ```
  :FREQuency 120;*WAI;:MEASure?
  ```
  In this case, the 120 Hz frequency measurement value is sent in response to the :MEASure? query.

Note Unique commands other than the ":MEASure?" query use sequential commands. Therefore, the *WAI command is only effective for the ":MEASure?" query.

1.800.561.8187 www.itm.com information@itm.com

(4) Status and Event Control Commands

Clearing of Status Byte Register and Related Queues (Except Output Queue)

Syntax

Command ***CLS**

Explanation

Clears the content of the event registers (SESR, ESR0, ESR1, ESR2, ESR3).

Note

RS-232C The output queue is not affected

GP-IB The output queue and the MAV (bit 4) of each type of enable register status byte are not affected.

Reading and Writing of Standard Event Status Enable Register (SESER)

Syntax

Command ***ESE** <Numeric Value>

Query ***ESE?**

Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the mask pattern of the SESER to a numeric value from 0 to 255.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
The initial value (when the power is turned on) is 0.

Query Returns the SESER content set by the ESE command as an NR1 numeric value from 0 to 255.

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

Example

Command ***ESE 36**

Sets bit 5 and bit 2 of SESER

Query ***ESE?**

Response ***ESE 36** (when HEADER ON)

36 (when HEADER OFF)

Bit 5 and bit 2 of SESER are 1.

1.800.561.8187 www.itm.com information@itm.com

Reading and Clearing of Standard Event Status Register (SESR)

Syntax

Query ***ESR?**

Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Returns the SESR content as an NR1 numeric value from 0 to 255, and then clears that content.

No header is added to the response message.

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

Example

Query ***ESR?**

Response **32**

Bit 5 of SESR is 1.

Note

Bit 6 and bit 1 are not used in the unit.

Reading and Writing of Service Request Enable Register (SRER)

Syntax

Command ***SRE** <Numeric Value>

Query ***SRE?**

Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the mask pattern of the SRER to a numeric value from 0 to 255. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

The values of bit 6 and the unused bit (bit 7) are ignored.
The value is initialized to 0 when the power is turned on.

Query Returns the SRER content set by the *SRE command as an NR1 numeric value from 0 to 255.

The values of bit 6 and the unused bit (bit 7) are always 0.

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	X	ESB	MAV	ESB3	ESB2	ESB1	ESB0

Example

Command ***SRE 34**

Sets bit 5 and bit 1 of SRER to 1.

Query ***SRE?**

Response ***SRE 34** (when HEADER ON)

34 (when HEADER OFF)

Bit 5 and bit 1 of SRER are 1.

Reading of Status Byte Register

Syntax

Query ***STB?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Returns the STB setting content as a NR1 numeric value from 0 to 127.
No header is added to the response message.

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	MSS	ESB	MAV	ESB3	ESB2	ESB1	ESB0

Example

Query ***STB?**
Response **8**
Bit 3 of STB is 1.

Sampling Request

Syntax

Command ***TRG**

Explanation

Performs sampling once when there is an external trigger.

Example

```
:TRIGger EXTernal;*TRG;:MEASure?
```

8.9.2 Unique Commands

Setting and Query of the number of measurements to Average

Syntax

Command **:AVERaging** <Numeric Value>
Query **:AVERaging?**
Response <Numeric Value> = 1 to 256 (NR1)

Explanation

Command: Set the number of measurements to average for the average measurement value.
When the number of average measurements is set, the average function will not be automatically set to ON.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric value can be handled.

Query: Returns the setting of the number of measurements to average as NR1 numeric value.

Example

Command
```
:AVERaging 32
```
Set the number of measurements to average to 32.

Query
```
:AVERaging?
```
Response
```
:AVERaging 32
```
(when HEADER ON)
```
32
```
(when HEADER OFF)
The number of measurements to average is set at 32.

Note

The command receives 1, but the response returns OFF.

Setting and Query of Average

Syntax

Command **:AVERaging:STATe** <ON/ OFF>
Query **:AVERaging:STATe?**
Response <ON/ OFF>

Explanation

Command: Sets the ON/ OFF setting of average function.

Query: Returns ON or OFF for the setting of average function.

Example

Command
```
:AVERaging:STATe ON
```
Enables the average function.

Query
```
:AVERaging:STATe?
```
Response
```
:AVERaging:STATE ON
```
(when HEADER ON)
```
ON
```
(when HEADER OFF)
The average function is enabled.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Comparator and BIN Judgment Beep Tone Setting

Syntax

Command **:BEEPer:JUDGment** <Character>

Query **:BEEPer:JUDGment?**

Response <Character>

<Character> = IN/ NG/ OFF
IN : Set so that the beep tone plays when the value is within the range
NG : Set so that the beep tone plays when the value is outside the range
OFF : Mute

Explanation

Command Sets the comparator and BIN judgment beep tone.

Query Returns the setting of the comparator and BIN judgment beep tone as characters.

Example

Command **:BEEPer:JUDGment NG**
Sets the beep tone so that it plays when the value is outside the range

Query **:BEEPer:JUDGment?**

Response **:BEEPER:JUDGMENT NG** (when HEADER ON)
NG (when HEADER OFF)
The beep tone is set so that it plays when the value is outside the range.

Setting and Query of Key Input Beep Tone

Syntax

Command **:BEEPer:KEY** <ON/ OFF>

Query **:BEEPer:KEY?**

Response <ON/ OFF>

ON : Set so that the beep tone plays
OFF : Set so that the beep tone does not play

Explanation

Command Sets the beep tone for key input of the unit.

Query Returns the beep tone setting of key input of the unit as ON or OFF

Example

Command **:BEEPer:KEY ON**
Sets the beep tone so that it plays

Query **:BEEPer:KEY?**

Response **:BEEPER:KEY ON** (when HEADER ON)
ON (when HEADER OFF)
The beep tone is set so that it plays.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of ON/ OFF Setting of BIN Measurement (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN** <ON/ OFF>
Query **:BIN ?**
Response <ON/ OFF>

ON : Starts BIN measurement
OFF : Ends BIN measurement

Explanation

Command: Sets the BIN measurement function to ON/ OFF.
If the ":BIN ON" command is sent during comparator measurement, comparator measurement ends automatically and BIN measurement starts.

Query: Returns ON or OFF for the setting of the BIN measurement function.

Example

Command **:BIN ON**
Sets the BIN measurement function to ON.

Query **:BIN?**
Response **:BIN ON** (when HEADER ON)
ON (when HEADER OFF)
The BIN measurement function is set to ON.

Setting and Query of SUB Display Indication during BIN Measurement (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:DISPlay** <BIN Number/ Characters>

Query **:BIN:DISPlay?**

Response <BIN Number/ Characters> = 1 to 14 (NR1)/ D/ CREFerence/ DREFerence/ OFF

BIN Number : Sets the upper limit and lower limit values of the BIN number to be displayed in the SUB display area.

D : Sets the upper limit and lower limit values of D to be displayed in the SUB display area.

CREFerence: Sets the reference value of C to be displayed in the SUB display area.

DREFerence: Sets the reference value of D to be displayed in the SUB display area

OFF : Sets nothing to be displayed in the SUB display area.

Explanation

Command Sets the set upper limit and lower limit values or the reference value to be displayed in the SUB display area during BIN measurement. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query Returns the indication setting of the SUB display area during BIN measurement as characters.

Example

Command
```
:BIN:DISPlay 1
```
Sets the upper limit and lower limit values of BIN1 to be displayed during BIN measurement.

Query
```
:BIN:DISPlay?
```
Response
```
:BIN:DISPLAY 1
```
(when HEADER ON)
```
1
```
(when HEADER OFF)
The upper limit and lower limit values of BIN1 are set to be displayed during BIN measurement.

Note

If an attempt is made to set the indication setting to CREFerence or DEFerence when the judgment mode is count value mode, an execution error is generated.

Setting and Query of Upper Limit and Lower Limit Values of First Parameter for BIN Function in Count Value Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:FLIMit:COUNt** <BIN Number>,<Lower Limit Value>,<Upper Limit Value>

Query **:BIN:FLIMit:COUNt?** <BIN Number>

Response <BIN Number>,<Lower Limit Value>,<Upper Limit Value>

<BIN Number> = 1 to 14 (NR1)

<Lower Limit Value> = OFF/ Numeric Value from -199999 to 999999 (NR1)

<Upper Limit Value> = OFF/ Numeric Value from -199999 to 999999 (NR1)

Explanation

Command CommandSets the upper limit and lower limit values of the first parameter in count value mode of the specified BIN number.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric value can be handled.

Query Returns the upper limit and lower limit value settings for the first parameter in count value mode of the specified BIN number in order of BIN number, lower limit value, and upper limit value.

Example

Command `:BIN:FLIMit:COUNt 1,100000,150000`
Sets 100000 for the lower limit value and 150000 for the upper limit value of the first parameter in count value mode of BIN1.

Query `:BIN:FLIMit:COUNt? 1`

Response `:BIN:FLIMit:COUNT 1,100000,150000` (when HEADER ON)

`1,100000,150000` (when HEADER OFF)

100000 is set for the lower limit value and 150000 is set for the upper limit value of the first parameter in count value mode of BIN1.

Setting and Query of Upper Limit and Lower Limit Values of First Parameter for BIN Function in Deviation Percent Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:FLIMit:DEViation** <BIN Number>,<Lower Limit Value>,<Upper Limit Value>

Query **:BIN:FLIMit:DEViation?** <BIN Number>

Response <BIN Number>,<Lower Limit Value>,<Upper Limit Value>

<BIN Number> = 1 to 14 (NR1)

<Lower Limit Value> = OFF/ Numeric Value from -999.99 to 999.99 (NR2)

<Upper Limit Value> = OFF/ Numeric Value from -999.99 to 999.99 (NR2)

Explanation

Command: Sets the upper limit and lower limit values of the first parameter in deviation percent mode of the specified BIN number.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric value can be handled.

Query: Returns the upper limit and lower limit value settings for the first parameter in deviation percent mode of the specified BIN number in order of BIN number, lower limit value, and upper limit value.

Example

Command
```
:BIN:FLIMit:DEViation 1,-10.0,10.0
```
Sets -10 for the lower limit value and 10 for the upper limit value of the first parameter in deviation percent mode of BIN1.

Query
```
:BIN:FLIMit:DEViation? 1
```
Response
```
:BIN:FLIMit:DEVIATION 1,-10.000,10.000
```
(when HEADER ON)
```
1,-10.000,10.000
```
(when HEADER OFF)
-10% is set for the lower limit value and 10% is set for the upper limit value of the first parameter in deviation percent mode of BIN1.

Setting and Query of Reference Value of First Parameter for BIN Function in Deviation Percent Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:FLIMit:REFerence** <Reference Value>
Query **:BIN:FLIMit:REFerence?**
Response <Reference Value> = Numeric Value from -199999 to 999999 (excluding 0) (NR1)

Explanation

Command: Sets the reference value of the first parameter in deviation percent mode. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric value can be handled.

Query: Returns the reference value set for the first parameter in deviation percent mode

Example

Command
```
:BIN:FLIMit:REFerence 150000
```
Sets 150000 for the reference value of the first parameter in deviation percent mode.

Query
```
:BIN:FLIMit:REFerence?
```
Response
```
:BIN:FLIMit:REFERENCE 150000
```
(when HEADER ON)
```
150000
```
(when HEADER OFF)
150000 is set for the reference value of the first parameter in deviation percent mode.

Note

The upper limit and lower limit values for count value mode and the upper limit and lower limit values for deviation percent mode of the unit are stored separately.

Setting and Query of Upper Limit and Lower Limit Values of Second Parameter for BIN Function in Count Value Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:SLIMit:COUNt** <Lower Limit Value>,<Upper Limit Value>
Query **:BIN:SLIMit:COUNt?**
Response <Lower Limit Value>,<Upper Limit Value>
<Lower Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)
<Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)

Explanation

Command: Sets the upper limit and lower limit values of the second parameter in count value mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric value can be handled.

Query: Returns the upper limit and lower limit value settings for the second parameter in count value mode in order of lower limit value and upper limit value.

Example

Command
```
:BIN:SLIMit:COUNt 100000,150000
```
Sets 100000 for the lower limit value and 150000 for the upper limit value of the second parameter in count value mode.

Query
```
:BIN:SLIMit:COUNt?
```
Response
```
:BIN:SLIMit:COUNT 100000,150000
```
(when HEADER ON)
```
100000,150000
```
(when HEADER OFF)
100000 is set for the lower limit value and 150000 is set for the upper limit value of the second parameter in count value mode.

8

Setting and Query of Upper Limit and Lower Limit Values of Second Parameter for BIN Function in Deviation Percent Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:SLIMit:DEViation** <Lower Limit Value>,<Upper Limit Value>

Query **:BIN:SLIMit:DEViation?**

Response <Lower Limit Value>,<Upper Limit Value>

<Lower Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)

<Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)

Explanation

Command: Sets the upper limit and lower limit values of the second parameter in deviation percent mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the upper limit and lower limit value settings for the second parameter in deviation percent mode in order of lower limit value and upper limit value.

Example

Command
```
:BIN:SLIMit:DEViation -10,10
```
Sets -10 for the lower limit value and 10 for the upper limit value of the second parameter in deviation percent mode.

Query
```
:BIN:SLIMit:DEViation?
```
Response
```
:BIN:SLIMit:DEVIATION -10,10
```
(when HEADER ON)
```
-10,10
```
(when HEADER OFF)
-10 is set for the lower limit value and 10 is set for the upper limit value of the second parameter in deviation percent mode.

Note

The measurement value for the second parameter in deviation percent mode is the result of the calculation (measurement value - reference value).

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Reference Value of Second Parameter for BIN Function in Deviation Percent Mode (Only for Models 3504-50, 3504-60)

Syntax

Command **:BIN:SLIMit:REFerence** <Reference Value>
Query **:BIN:SLIMit:REFerence?**
Response <Reference Value> = Numeric Value from -199999 to 199999 (NR1)

Explanation

Command: Sets the reference value of the second parameter in deviation percent mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the reference value set for the second parameter in deviation percent mode.

Example

Command
```
:BIN:SLIMit:REFerence 150000
```
Sets 150000 for the reference value of the second parameter in deviation percent mode.

Query
```
:BIN:SLIMit:REFerence?
```
Response
```
:BIN:SLIMit:REFERENCE 150000
```
(when HEADER ON)
```
150000
```
(when HEADER OFF)
150000 is set for the reference value of the second parameter in deviation percent mode.

Note

The upper limit and lower limit values for count value mode and the upper limit and lower limit values for deviation percent mode of the unit are stored separately.

8

Setting and Query of Self Calibration

Syntax

Command **:CALibration** <Character>
Query **:CALibration?**
Response <Character> = OFF/ MANUal /AUTO

Explanation

Command Sets the self calibration function.
OFF : Adjust using factory default self calibration value.
MANUal : When there is a request to start from EXT I/O during measurement start, the self calibration value will be acquired and adjusted.
AUTO : Self calibration value will be acquired and adjusted for each measurement.

Query Returns the self calibration function settings as letters.

Example

Command **:CALibration MANUal**
When there is a request to start the acquisition of the self calibration value, setting to acquire the self calibration value will be carried out.

Query **:CALibration?**
Response **:CALIBRATION MANUal** (when HEADER ON)
MANUal (when HEADER OFF)
Set to acquire the self calibration value when there is a request to start the acquisition of the self calibration value.

Request for Start of Self Calibration

Syntax

Command **:CALibration:ADJust**

Explanation

Command Request for start of self calibration.
Self calibration value will be acquired during measurement after command handling.
To acquire a suitable self calibration value, connect the object to be tested firmly to the measurement terminal, and activate the trigger for the object to be tested after setting the measurement frequency, level and range.

Example

Command
1. Connect the object to be tested to the measurement terminal
2. Set the measurement frequency, level and suitable range
3. Carry out :CALibration:ADJust
4. Activate the trigger (the order of 1-3 can be changed)

Note

- Start request is only accepted when the self calibration function is set to “MANUAL”. An error will show for settings other than “MANUAL”.
- When there is a start request from :CALibration:ADJust, self calibration will start in the measurement after the request.
- Please take a new self calibration value if the ambient temperature has changed by more than 2°C.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Equivalent Circuit

Syntax

Command **:CIRCuit** <Character>

Query **:CIRCuit?**

Response <Character>

<Character> = SERial, PARallel
SERial: Sets the equivalent circuit mode to series-equivalent circuit.
PARallel: Sets equivalent circuit mode to parallel-equivalent circuit.

Explanation

Command Sets the equivalent circuit mode.

Query Returns the setting of the current equivalent circuit mode as characters.

Example

Command `:CIRCuit SERIAL`
Sets the equivalent circuit mode to series-equivalent circuit.

Query `:CIRCuit?`

Response `:CIRCUIT SERIAL` (when HEADER ON)
`SERIAL` (when HEADER OFF)
The equivalent circuit mode is set to series-equivalent circuit.

Automatic Setting and Query of Equivalent Circuit

Syntax

Command **:CIRCuit:AUTO** <ON/ OFF>

Query **:CIRCuit:AUTO?**

Response <ON/ OFF>

ON : Switching is performed automatically.
OFF : Switching is not performed automatically.

Explanation

Command Sets equivalent circuit mode to be switched automatically.

Query Returns ON or OFF for the automatic setting of equivalent circuit mode.

Example

Command `:CIRCuit:AUTO ON`
Sets equivalent circuit mode to be switched automatically.

Query `:CIRCuit:AUTO?`

Response `:CIRCUIT:AUTO ON` (when HEADER ON)
`ON` (when HEADER OFF)
Equivalent circuit mode is set to be switched automatically.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Contact Check Function

Syntax

Command **:CONTact:VERify** <Character>

Query **:CONTact:VERify?**

Response <Character> = OFF/ BEFore/ AFTer/ BOTH

OFF : Contact check will not be carried out.
FRONt : Carry out contact check before measurement.
BACK : Carry out contact check after measurement.
BOTH : Carry out contact check before measurement and after measurement.

Explanation

Command Set the contact check function.

Query Return setting for contact check function using words.

Example

Command `:CONTact:VERify AFTer`
Set to carry out the contact check after measurement.

Query `:CONTact:VERify?`

Response `:CONTACT:VERIFY AFTER` (when HEADER ON)
`AFTER` (when HEADER OFF)
Set to carry out contact check after measurement.

Note

When the contact check function is set to “bEForE” or “both, the trigger simultaneous output function will automatically turn to “ON”.

Setting and Query of ON/ OFF Setting of Comparator Function

Syntax

Command **:COMParator** <ON/ OFF>

Query **:COMParator ?**

Response <ON/ OFF>

Explanation

Command Sets the ON/ OFF setting of the comparator function.

Query Returns ON or OFF for the setting of the comparator function.

Example

Command `:COMParator ON`
Sets the comparator function to ON.

Query `:COMParator?`

Response `:COMPARATOR ON` (when HEADER ON)
`ON` (when HEADER OFF)
The comparator function is set to ON.

Setting and Query of SUB Display Indication during Comparator Measurement

Syntax

Command **:COMParator:DISPlay** <Character>

Query **:COMParator:DISPlay?**

Response <Character> = C/ D/ CREFerence/ DREFerence/ OFF

C : Sets the upper limit and lower limit values of C to be displayed in the SUB display area.

D : Sets the upper limit and lower limit values of D to be displayed in the SUB display area.

CREFerence: Sets the reference value of C to be displayed in the SUB display area.

DREFerence: Sets the reference value of D to be displayed in the SUB display area.

OFF : Sets nothing to be displayed in the SUB display area.

Explanation

Command CommandSets the set upper limit and lower limit values or the reference value to be displayed in the SUB display area during comparator measurement.

Query Returns the indication setting of the SUB display area during comparator measurement as characters.

Example

Command
```
:COMParator:DISPlay C
```
Sets the upper limit and lower limit values of C to be displayed during comparator measurement.

Query
```
:COMParator:DISPlay?
```
Response
```
:COMPARATOR:DISPLAY C
```
(when HEADER ON)

```
C
```
(when HEADER OFF)

The upper limit and lower limit values of C are set to be displayed during comparator measurement.

Note

If an attempt is made to set the indication setting to CREFerence or DEFerence when the judgment mode is count value mode, an execution error is generated.

8

Setting and Query of Upper Limit and Lower Limit Values of First Parameter for Comparator Function in Count Value Mode

Syntax

Command **:COMParator:FLIMit:COUNt** <Lower Limit Value>,<Upper Limit Value>

Query

Response **:COMParator:FLIMit:COUNt?**
<Lower Limit Value>,<Upper Limit Value>

<Lower Limit Value> = OFF/ Numeric Value from -199999 to 999999 (NR1)
<Upper Limit Value> = OFF/ Numeric Value from -199999 to 999999 (NR1)

Explanation

Command: Sets the upper limit and lower limit values of the first parameter for the comparator function in count value mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns data for the upper limit and lower limit value settings of the first parameter for the comparator function in order of lower limit value and upper limit value.

Example

Command
```
:COMParator:FLIMit:COUNt 112345,123456
```
Sets 112345 for the lower limit value and 123456 for the upper limit value of the first parameter in count value mode.

Query
```
:COMParator:FLIMit:COUNt?
```
Response
```
:COMPARATOR:FLIMIT:COUNT 112345, 123456
```
(when HEADER ON)
```
112345,123456
```
(when HEADER OFF)
112345 is set for the lower limit value and 123456 is set for the upper limit value of the first parameter in count value mode.

Setting and Query of Reference Value and Upper Limit and Lower Limit Values of First Parameter for Comparator Function in Deviation Percent Mode

Syntax

Command: **:COMParator:FLIMit:DEViation** <Reference Value>,<Lower Limit Value>,<Upper Limit Value>

Query Response: **:COMParator:FLIMit:DEViation?** <Reference Value>,<Lower Limit Value>,<Upper Limit Value>

<Reference Value> = -199999 to 999999 (excluding 0) (NR1)

<Lower Limit Value> = OFF/ Numerical Value from -999.99 to 999.99(NR2)

<Upper Limit Value> = OFF/ Numerical Value from -999.99 to 999.99 (NR2)

Explanation

Command: Sets the reference value and upper limit and lower limit values of the first parameter in deviation percent mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the reference value and upper limit and lower limit value settings for the first parameter in deviation percent mode in order of reference value, lower limit value, and upper limit value.

Example

Command:
```
:COMParator:FLIMit:DEViation 250000,-5.0,5.0
```
Sets 250000 for the reference value, -5% for the lower limit value, and 5% for the upper limit value of the first parameter in deviation percent mode.

Query:
```
:COMParator:FLIMit:DEViation?
```
Response:
```
:COMPARATOR:FLIMit:DEVIATION 250000,-5.0000,5.0000
```
(when HEADER ON)
```
250000,-5.0000,5.0000
```
(when HEADER OFF)
250000 is set for the reference value, -5% is set for the lower limit value, and 5% is set for the upper limit value of the first parameter in deviation percent mode.

8

Setting and Query of Upper Limit and Lower Limit Values of Second Parameter for Comparator Function in Count Value Mode

Syntax

Command **:COMParator:SLIMit:COUNt** <Lower Limit Value>,<Upper Limit Value>

Query

Response **:COMParator:SLIMit:COUNt?**
<Lower Limit Value>,<Upper Limit Value>

<Lower Limit Value> = OFF/ Numeric Value from -199999 to 199999(NR1)

<Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999(NR1)

Explanation

Command: Sets the upper limit and lower limit values of the second parameter for the comparator function in count value mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns data for the upper limit and lower limit value settings of the second parameter for the comparator function in order of lower limit value and upper limit value.

Example

Command
```
:COMParator:SLIMit:COUNt 112345,123456
```
Sets 112345 for the lower limit value and 123456 for the upper limit value of the second parameter in count value mode.

Query
```
:COMParator:SLIMit:COUNt?
```
Response
```
:COMPARATOR:SLIMIT:COUNT 112345,123456
```
(when HEADER ON)
```
112345,123456
```
(when HEADER OFF)
112345 is set for the lower limit value and 123456 is set for the upper limit value of the second parameter in count value mode.

Setting and Query of Reference Value and Upper Limit and Lower Limit Values of Second Parameter for Comparator Function in Deviation Percent Mode

Syntax

Command: **:COMParator:SLIMit:DEViation** <Reference Value>,<Lower Limit Value>,<Upper Limit Value>

Query Response: **:COMParator:SLIMit:DEViation?** <Reference Value>,<Lower Limit Value>,<Upper Limit Value>

<Reference Value> = -199999 to 199999(NR1)

<Lower Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)

<Upper Limit Value> = OFF/ Numeric Value from -199999 to 199999 (NR1)

Explanation

Command: Sets the reference value and upper limit and lower limit values of the second parameter in deviation percent mode.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the reference value and upper limit and lower limit value settings for the second parameter in deviation percent mode in order of reference value, lower limit value, and upper limit value.

Example

Command:
```
:COMParator:SLIMit:DEViation 2000,-5,5
```
Sets 2000 for the reference value, -5 for the lower limit value, and 5 for the upper limit value of the second parameter in deviation percent mode.

Query:
```
:COMParator:SLIMit:DEViation?
```
Response:
```
:COMPARATOR:SLIMit:DEVIATION 2000,-5,5
```
(when HEADER ON)
```
2000,-5,5
```
(when HEADER OFF)
2000 is set for the reference value, -5 is set for the lower limit value, and 5 is set for the upper limit value of the second parameter in deviation percent mode.

Note

The measurement value for the second parameter in deviation percent mode is the result of the calculation (measurement value - reference value).

8

Query of Compensation Values for Open Circuit and Short Circuit Compensation

Syntax

Query: **:CORRection:DATA?**

Response:

Output parameter for short circuit compensation values
Output parameter ZPH:

<Residual Impedance> = OFF/Numeric Value (NR3),
<Phase Angle> = OFF/Numeric Value (NR2)
Output parameter RSX:

<Rs> = OFF/Numeric Value (NR3),<X> = OFF/Numeric Value (NR3)
Output parameter LSRS:

<Ls> = OFF/Numeric Value (NR3),<Rs> = OFF/Numeric Value (NR3)

Output parameter for open circuit compensation values
Output parameter ZPH:

<Residual Impedance> = OFF/Numeric Value (NR3),
<Phase Angle> = OFF/Numeric Value (NR2)
Output parameter GB:

<G> = OFF/Numeric Value (NR3),<B> = OFF/Numeric Value (NR3)
Output parameter CPG:

<Cp> = OFF/Numeric Value (NR3),<G> = OFF/Numeric Value (NR3)

Explanation

Query

Returns the compensation values for open circuit and short circuit compensation in the current measurement conditions (frequency, level) as characters or a numeric value.
If compensation is set to OFF or the spot compensation frequency and measurement frequency differ, OFF is returned.

Example

Query: `:CORRection:DATA?`

Response: `RS OFF,X OFF,Z 247.456E+06,PHASE -21.583` (when HEADER ON)

`OFF,OFF,247,456E+06,-21.583` (when HEADER OFF)

The compensation values in the current conditions are OFF for short circuit compensation and 247.456 MΩ and -21.583° for the open circuit compensation values.

Setting and Query of Open Circuit Compensation Function

Syntax

Command **:CORRection:OPEN** <Character>
<Character>ALL/ ON/ OFF/ RETurn

Query **:CORRection:OPEN?**

<Character>=ALL/ ON/ SPOT/ OFF

Explanation

Command Sets the open circuit compensation function.
If ALL or ON is set, open circuit compensation value begins to be incorporated and then open circuit compensation is enabled after incorporation ends.

ALL : Delete disabled open circuit compensation value, acquire open circuit compensation value according to the measurement values set at open circuit compensation reading setting command (:CORRection:OPEN:POINt) and enable the open circuit compensation function.

ON : Delete disabled open circuit compensation value, acquire open circuit compensation value at the current measurement conditions (frequency, level) and enable the open circuit compensation function.

OFF : Disable open circuit compensation value at the enabled measurement conditions (frequency, level).

RETurn: Enable all disabled open circuit compensation values.

Query Returns the setting of the open circuit compensation function as characters.

ALL : The open circuit compensation function is enabled for all measurement conditions (frequency, level).

ON : The open circuit compensation function is enabled for the current measurement conditions (frequency, level).

SPOT: The open circuit compensation function is enabled for other than the current measurement conditions (frequency, level).

OFF : The open circuit compensation function is disabled.

Example

Command **:CORRection:OPEN ALL**
Delete disabled open circuit compensation value, acquire open circuit compensation value according to the measurement values set at :CORRection:OPEN:POINt and enable the open circuit compensation function.

Query **:CORRection:OPEN?**

Response **:CORRECTION:OPEN ALL** (when HEADER ON)
ALL (when HEADER OFF)
The compensation function is enabled for all measurement conditions (frequency, level).

8

Setting and Query of Open Circuit Compensation Function

Note

About Recovering Compensation Values

When the :CORRection:OPEN RETurn is carried out, disabled open circuit compensation values can be retrieved, but when open circuit compensation is carried out again after the circuit compensation values are disabled, the pre-disabled open values cannot be retrieved. Refer to the following examples.

Example of a retrievable circuit compensation value.

A. When open circuit compensation is carried out under the points in the figure below.

●: adjustment value valid ×: no adjustment value

Measurement signal level \ frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	●	×
1 V	×	●

B. The following will occur when circuit compensation is disabled (execute :CORREction:OPEN OFF), or when [0 ADJ] is pressed for 2 seconds or more.

△: adjustment value invalid ×: no adjustment value

Measurement signal level \ frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	△	×
1 V	×	△

C. When CORRection:OPEN RETurn is executed, setting before circuit compensation disabled will return.

Example of a non-retrievable circuit compensation value.

a. When open circuit compensation is carried out at whichever point from B. (the following shows an example when :CORRection :OPEN ON is carried out in 1 kHz, level: 0.5)

●: adjustment value valid ×: no adjustment value

Measurement signal level \ frequency	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	●
1 V	×	×

b. When CORRection:OPEN RETurn is executed in a., the device will remain in a. condition (in order to retrieve a new circuit compensation value)

Setting and Query of Open Compensation Values

Syntax

Command **:CORRection:OPEN:DATA** <Compensation values 1>, <Compensation values 2>

Query **:CORRection:OPEN:DATA?**

Response <Compensation values 1>,<Compensation values 2>
<Compensation values 1> = -99.9999E9 to 99.9999E9 (NR3)
<Compensation values 2> = -99.9999E9 to 99.9999E9 (NR3)

Explanation

Command Sets the open compensation value for current measurement conditions (frequency, level).
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query Returns as a numeric value the open compensation value for current measurement conditions (frequency, level).

Note

- The forwarding format for making settings and reading data with this command follows the :CORRection:OPEN:DATA:FORMat setting.

  When the forwarding format is ZPH
  <Compensation values 1> : Z (Z < 0 an execution error)
  <Compensation values 2> : PH (PH < -180, PH > 180 an execution error)

  When the forwarding format is GB
  <Compensation values 1> : G
  <Compensation values 2> : B

  When the forwarding format is CPG
  <Compensation values 1> : Cp
  <Compensation values 2> : G

- When the compensation value is-1E-21 to 1E-21 the setting value will be 0.

Example

Command
```
:CORRection:OPEN:DATA:FORMat GB
:CORRection:OPEN:DATA -1.56789E-11,8.91234E-11
```
When the forwarding format setting is GB, the open compensation value for the current measurement conditions will be set to **-1.56789E-11,8.91234E-11** (G,B).

Query
```
:CORRection:OPEN:DATA?
:CORRECTION:OPEN:DATA -1.56789E-11,8.91234E-11
```
(when HEADER ON)
When the forwarding format setting is GB, the open compensation value for the current measurement conditions is set to **-1.56789E-11,8.91234E-11** (G,B).

Note

- If the value forwarded to this device when converted to G and B is outside of the -99.9999E9 to 99.9999E9 range an execution error will occur.

8

Setting and Query of Output Parameter for Open Circuit Compensation Values

Syntax

Command **:CORRection:OPEN:DATA:FORMat** <Character>
Query **:CORRection:OPEN:DATA:FORMat?**
Response <Character> = ZPH/ GB/ CPG

Explanation

Command Sets the forwarding format of open circuit compensation values.

Query Returns the setting of the forwarding format for open circuit compensation values.

Example

Command `:CORRection:OPEN:DATA:FORMat GB`
Sets the forwarding format of open circuit compensation values to be G and B.

Query `:CORRection:OPEN:DATA:FORMat?`
Response `:CORRECTION:OPEN:DATA:FORMAT GB` (when HEADER ON)
`GB` (when HEADER OFF)
The forwarding format of open circuit compensation values are set to be G and B.

Setting and Query of Open Compensation Points

Syntax

Command **:CORRection:OPEN:POINt** <Numeric Value>
Query **:CORRection:OPEN:POINt?**
Response <Numeric Value> = 1 to 255 (NR1)

Explanation

Command Set measurement conditions for open compensation value acquisition during command for open compensation value (:CORRection:OPEN ALL) or acquiring open compensation value using key operation.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
Unused bit (bit6, bit 7) values will be disregarded.
In 3504-40 and 3504-50, bit0 and bit3 values are ignored.

Query Returns settings of measurement conditions for open compensation values.

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	1 kHz, 1 V	1 kHz, 0.5 V	1 kHz, 0.1 V	120 Hz, 1 V	120 Hz, 0.5 V	120 Hz, 0.1 V

Example

Command **:CORRection:OPEN:POINt 36**
Set to acquire open compensation values under the measurement conditions in “Yes” below during command for open compensation value (:CORRection:OPEN ALL) or acquiring open compensation value using key operation.

Query **:CORRection:OPEN:POINt?**
Response **:CORRECTION:OPEN:POINT 36** (when HEADER ON)
36 (when HEADER OFF)
Returns the open compensation points.

Measurement frequency / Measurement signal level	120 Hz	100 kHz
100 mV	No	No
500 mV	No	No
1 V	Yes	Yes

Note

When any setting of the open compensation points is changed, all open compensation values prior to the change will be disabled.

8

Setting and Query of Short Circuit Compensation Function

Syntax

Command **:CORRection:SHORt** <Character>

<Character> = ALL/ ON/ OFF/ RETurn

Query **:CORRection:SHORt?**

<Character> = ALL/ ON/ SPOT/ OFF

Explanation

Command

Sets the short circuit compensation function.
If ALL or ON is set, short circuit compensation value begins to be incorporated and then short circuit compensation is enabled after incorporation ends.

ALL : Delete disabled short circuit compensation value, acquire short circuit compensation value according to the measurement values set at short circuit compensation reading setting command (:CORRection:SHORt:POINt) and enable the short circuit compensation function.

ON : Delete disabled short circuit compensation value, acquire short circuit compensation value at the current measurement conditions (frequency, level) and enable the short circuit compensation function.

OFF : Disable short circuit compensation value at the enabled measurement conditions (frequency, level).

RETurn: Enable all disabled short circuit compensation values.

Query

Returns the setting of the short circuit compensation function as characters.

ALL : The short compensation function is enabled for all measurement conditions (frequency, level).

ON : The short compensation function is enabled for the current measurement conditions (frequency, level).

SPOT: The short compensation function is enabled for other than the current measurement conditions (frequency, level).

OFF : The short compensation function is disabled.

Example

Command **:CORRection:SHORt ON**

Delete disabled short circuit compensation value, acquire short circuit compensation value at the current measurement conditions (frequency, level) and enable the short circuit compensation function.

Query **:CORRection:SHORt?**

Response **:CORRECTION:SHORT ON** (when HEADER ON)

ON (when HEADER OFF)

The short compensation function is enabled for the current measurement conditions (frequency, level).

Setting and Query of Short Compensation Values

Syntax

Command **:CORRection:SHORt:DATA** <Compensation values1>, <Compensation values 2>

Query **:CORRection:SHORt:DATA?**

Response <Compensation values 1>,<Compensation values 2>
<Compensation values 1> = -99.9999E9 to 99.9999E9 (NR3)
<Compensation values 2> = -99.9999E9 to 99.9999E9 (NR3)

Explanation

Command Sets the short compensation value for current measurement settings (frequency, level).
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query Returns as a numerical value the short compensation value for current measurement settings (frequency, level).

Note

- The forwarding format for making settings and reading data with this command follows the :CORRection:SHORT:DATA:FORMat setting.

  When the forwarding format is ZPH
  <Compensation values 1> : Z (Z < 0 an execution error)
  <Compensation values 2> : PH (PH < -180, PH > 180 an execution error)

  When the forwarding format is RSX
  <Compensation values 1> : Rs
  <Compensation values 2> : X

  When the forwarding format is LSRS
  <Compensation values 1> : Ls
  <Compensation values 2> : Rs

- When the compensation value is-1E-21 to 1E-21 the setting value will be 0.

Example

Command
```
:CORRection:SHORt:DATA:FORMat RSX
:CORRection:SHORt:DATA 5.67891E-03,3.34564E-05
```
When the forwarding format setting is RSX, the open compensation value for the current measurement conditions will be set to **5.67891E-03,3.34564E-05** (Rs,X).

Query
```
:CORRection:SHORt:DATA?
:CORRection:SHORt:DATA 5.67891E-03,3.34564E-05
```
(when HEADER ON)
5.67891E-03,3.34564E-05 (when HEADER OFF)
When the forwarding format setting is RSX, the open compensation value for the current measurement conditions is set to **5.67891E-03,3.34564E-05** (Rs,X).

Note

- If the value forwarded to this device when converted to R and X is outside of the -99.9999E9 to 99.9999E9 range an execution error will occur.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Output Parameter for Short Circuit Compensation Values

Syntax

Command **:CORRection:SHORt:DATA:FORMat** <Character>
Query **:CORRection:SHORt:DATA:FORMat?**
Response <Character> = ZPH/ RSX/ LSRS

Explanation

Command Sets the forwarding format of short circuit compensation values.

Query Returns the setting of the forwarding format for short circuit compensation values.

Example

Command **:CORRection:SHORt:DATA:FORMat RSX**
Sets the forwarding format of short circuit compensation values to be Rs and X.

Query **:CORRection:SHORt:DATA:FORMat?**
Response **:CORRECTION:SHORT:DATA:FORMAT RSX** (when HEADER ON)
RSX (when HEADER OFF)
The forwarding format of short circuit compensation values are set to be Rs and X.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Short Compensation Points

Syntax

Command **:CORRection:SHORt:POINt** <Numeric Value>
Query **:CORRection:SHORt:DATA:FORMat?**
Response <Numeric Value> = 1 to 255 (NR1)

Explanation

Command Set measurement conditions for short compensation value acquisition during command for short compensation value (:CORRection:SHORt ALL) or acquiring short compensation value using key operation.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
Unused bit (bit6, bit 7) values will be disregarded.
In 3504-40 and 3504-50, bit0 and bit3 values are ignored.

Query Returns settings of measurement conditions for short compensation values.

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	1 kHz, 1 V	1 kHz, 0.5 V	1 kHz, 0.1 V	120 Hz, 1 V	120 Hz, 0.5 V	120 Hz, 0.1 V

Example

Command **:CORRection:SHORt:POINt 18**
Set to acquire short compensation values under the measurement conditions in “Yes” below during command for short compensation value (:CORRection:SHORt ALL) or acquiring short compensation value using key operation.

Query **:CORRection:SHORt:POINt?**
Response **:CORRECTION:SHORt:POINT 18** (when HEADER ON)
18 (when HEADER OFF)
Returns the short compensation points.

Measurement frequency / Measurement signal level	120 Hz	1 kHz
100 mV	No	No
500 mV	Yes	Yes
1 V	No	No

Note

When any setting of the short compensation points is changed, all short compensation values prior to the change will be disabled.

8

Setting and Query of Load Compensation Function

Syntax

Command **:CORRection:LOAD** <Character>
<Character> = ON/ OFF/ RETurn

Query **:CORRection:LOAD?**
<Character> = ON/ SPOT/ OFF

Explanation

Command Sets the load compensation function.
If ON is set, load compensation data begins to be incorporated based on the current measurement conditions (frequency, level, range, self calibration, open circuit compensation, short circuit compensation) and reference values for load compensation conditions. After incorporating of the data ends properly, load compensation is enabled. If it does not end properly, the load compensation data remains the same as last time.

ON : Delete disabled load circuit compensation value, acquire load circuit compensation value at the current measurement conditions and enable the load circuit compensation function.

OFF : Disable the load circuit compensation value at the enabled measurement frequency.

RETurn: Enable all disabled load circuit compensation values.

Query Returns the setting of the load compensation function as characters.

ON : The load compensation function is enabled for the current measurement conditions.

SPOT: The load compensation function is enabled for other than the current measurement conditions.

OFF : The load compensation function is disabled.

Example

Command
```
:CORRection:LOAD ON
```
Delete disabled load circuit compensation value, acquire load circuit compensation value at the current measurement conditions and enable the load circuit compensation function.

Query
```
:CORRection:LOAD?
```
Response
```
:CORRECTION:LOAD ON
```
(when HEADER ON)
```
ON
```
(when HEADER OFF)
The load compensation function is enabled for the current measurement conditions.

Setting and Query of Load Compensation Values

Syntax

Command **:CORRection:LOAD:DATA** <Compensation values 1>, <Compensation values 2>

Query **:CORRection:LOAD:DATA?**

Response <Compensation values 1>,<Compensation values 2>
For the load compensation value forwarding format COEFFICIENT and ZPH
<Compensation values 1> = 1E-21 to 99.9999E9 (NR3)
<Compensation values 2> = -180 to 180 (NR2)
For the load compensation value forwarding format CD
<Compensation values 1> = -19.9999E-3 to 99.9999E-3 (NR3) (excluding -1E-21 to 1E-21)
<Compensation values 2> = -1.99999 to 1.99999 (NR2)

Explanation

Command: Sets the load compensation value for the current measurement conditions (frequency, level, range, self calibration, equivalent circuit mode, open compensation, short compensation).
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the load compensation value for the current measurement conditions (frequency, level, range, self calibration, equivalent circuit mode, open compensation, short compensation).

Note

- The forwarding format for making settings and reading data with this command follows the :CORRection:LOAD:DATA:FORMat setting.

  When the forwarding format is COEFFICIENT
  <Compensation values 1> : Z_COEF
  <Compensation values 2> : PH_COEF

  When the forwarding format is ZPH
  <Compensation values 1> : Z
  <Compensation values 2> : PH

  When the forwarding format is CD
  <Compensation values 1> : C
  <Compensation values 2> : D
- When the forwarding format is CD, the setting value, Cp or Cs, which is set depending on the current equivalent mode, will be converted into the actual Z and θ measurement values.
  Z compensation rate = (Z reference value)/ (Z actual value)
  θ compensation rate = (θ reference value) - (θ actual value)
  Using the above formula and the changed actual Z and θ measurement values, the compensation rates will be calculated.
  Query will return the data for the current measurement mode after converting the actual Z and θ measurement values into Cp or Cs.
- When the compensation value is -1E-21~1E-21 the setting value will be 0.
- When the value transferred to the device is converted to Z, an error will occur when the range is beyond Z:1E-21-99.9999E9.

8

Setting and Query of Load Compensation Values

Example

Command

```
:CORRection:LOAD:DATA:FORMat COEFficient
:CORRection:LOAD:DATA 1.02453,0.16346
```

When the forwarding format setting is **COEFFICIENT**, set the load compensation value for current measurement settings to **1.02453,0.16346** (Z_COEF,PH_COEF).

Query

```
:CORRection:LOAD:DATA?
:CORRection:LOAD:DATA 1.02453E+00,0.16346E+00
```

(when HEADER ON)

```
1.02453E +00,0.16346E +00
```

(when HEADER OFF)

When the forwarding format setting is **COEFFICIENT**, the load compensation value for current measurement settings is set to **1.02453,0.16346** (Z_COEF,PH_COEF).

Setting and Query of Output Format for Load Compensation Values

Syntax

Command **:CORRection:LOAD:DATA:FORMat** <Character>
Query **:CORRection:LOAD:DATA:FORMat?**
Response <Character> = COEFficient/ ZPH/ CD

COEFficient: The impedance compensation coefficient and phase compensation coefficient.

ZPH : The actual measurement values for the impedance and phase.

CD : The actual measurement values for C and D.

Explanation

Command Sets the forwarding format of load compensation values.

Query Returns the setting of the forwarding format for load compensation values.

Example

Command `:CORRection:LOAD:DATA:FORMat COEFficient`
Sets the forwarding format of load compensation values to be the impedance compensation coefficient and phase compensation coefficient.

Query `:CORRection:LOAD:DATA:FORMat?`
Response `:CORRECTION:LOAD:DATA:FORMAT COEFFICIENT` (when HEADER ON)
`COEFFICIENT` (when HEADER OFF)
The forwarding format of load compensation values are set to be the impedance compensation coefficient and phase compensation coefficient.

8

Setting and Query of Reference Values for Load Compensation Function

Syntax

Command: **:CORRection:LOAD:REFerence** <Reference Value 1>, <Reference Value 2>

Query

Response: **:CORRection:LOAD:REFerence?**

<Reference Value 1> = Numeric Value from -199999 to 999999 (excluding 0) (NR1)

<Reference Value 2> = Numeric Value from -199999 to 199999 (NR1)

Explanation

Command

Sets the reference values for the load compensation function.
Set the standard values for the measurement frequencies when executing the command because the standard values will be saved according to the measurement frequencies.
<Reference Value 1> indicates the reference value for C (capacitance) and <Reference Value 2> indicates the reference value for D (dissipation factor).
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query

Returns the reference value setting in the order of <Reference Value 1> and <Reference Value 2>.

Example

Command

```
:CORRection:LOAD:REFerence 250000,1000
```

Sets the reference values for the load compensation function to C = 250000 and D = 1000.

Query

```
:CORRection:LOAD:REFerence?
```

Response

```
:CORRECTION:LOAD:REFERENCE  250000,1000
```

(when HEADER ON)

```
250000,1000
```

(when HEADER OFF)

The reference values for the load compensation function are set to C = 250000 and D = 1000.

Note

- If the reference value is changed while load compensation is enabled, the compensation factor needed to perform load compensation will be recalculated.
- The absolute value which defines the count value differs depending on the setting range settings used when taking the load compensation value or setting the load compensation value (:CORRection:LOAD:DATA).

Setting and Query of OFFSET Compensation Function

Syntax

Command **:CORRection:OFFSet** <ON/ OFF>

Query **:CORRection:OFFSet?**

Response <ON/ OFF>
ON :Enables the offset compensation function.
OFF :Disables the offset compensation function.

Explanation

Command Set the offset compensation function to ON or OFF.

Query Return the offset compensation function as ON or OFF.

Example

Command `:CORRection:OFFSet ON`
Enables the offset function.

Query `:CORRection:OFFSet?`

Response `:CORRECTION:OFFSET ON` (when HEADER ON)
`ON` (when HEADER OFF)
The offset compensation function is enabled.

Setting and Query of OFFSET Compensation Values

Syntax

Command **:CORRection:OFFSet:DATA** <C offset compensation value>, <D offset compensation value>

Query **:CORRection:OFFSet:DATA?**

Response <C offset compensation value>,<D offset compensation value>
<C offset compensation value> = -99.9E -3 to 99.9E -3
<The second parameter offset compensation value> = -1.99999 to 1.99999 (NR2)

Explanation

Command Sets the offset compensation value.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query The offset compensation value settings are returned in the order of C offset compensation value (NR3 numerical value), and D offset compensation value (NR2 numerical value).

Example

Command `:CORRection:OFFSet:DATA 1.00000E-12,0.0001`
Sets the C offset compensation value to 1.00000E-12 and the D offset compensation value to 0.0001.

Query `:CORRection:OFFSet:DATA?`

Response `:CORRECTION:OFFSET:DATA 1.00000E-12,0.0001`
(when HEADER ON)
`1.00000E-12,0.0001` (when HEADER OFF)
The C offset compensation value is set to 1.00000E-12, and the D offset compensation value is set to 0.0001.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Low C Reject Function

Syntax

Command **:CREJect** <ON/ OFF>
Query **:CREJect?**
Response <ON/ OFF>
ON :If the measurement value is abnormally low, it is detected as an error.
OFF :Even if the measurement value is abnormally low it is not considered an error.

Explanation

Command Enables or disables Low C reject function.

Query Returns the Low C reject function setting as ON or OFF.

Example

Command `:CREJect ON`
Enables the Low C reject function.

Query `:CREJect?`
Response `:CREJECT ON` (when HEADER ON)
`ON` (when HEADER OFF)
The Low C reject function is enabled.

Setting and Query of Low C Reject Function Limit Value

Syntax

Command **:CREJect:LIMit** <Numeric Value>
Query **:CREJect:LIMit?**
Response <Numeric Value> = 0.000 to 10.000 (NR2)

Explanation

Command Sets the Low C reject function limit value.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query Returns the Low C reject function limit value setting.

Example

Command `:CREJect:LIMit 1.000`
Set the Low C reject function limit value to 1%. If the measurement value C is lower than 1% relative to the measurement range, a Low C contact error will be detected.

Query `:CREJect:LIMit?`
Response `:CREJECT:LIMIT 1.000` (when HEADER ON)
`1.000` (when HEADER OFF)
The Low C reject function limit value is set to 1%.

Setting and Query of the input $\overline{\text{TRIG}}$ signal enabled or disabled when measuring

Syntax

Command **:DISable:TRIGger** <ON/ OFF>
Query **:DISable:TRIGger?**
Response <ON/ OFF>

Explanation

Command: Sets the input trigger signal in EXT I/O enabled/disabled when measuring.

Query: Returns whether the input trigger signal in EXT I/O is set to ON or OFF when measuring.

Example

Command
```
:DISable:TRIGger ON
```
Sets to reject the input trigger signal in EXT I/O when measuring.

Query
```
:DISable:TRIGger?
```
Response
```
:DISABLE:TRIGGER ON
```
(when HEADER ON)
```
ON
```
(when HEADER OFF)
Set to reject the input trigger signal in EXT I/O when measuring.

Setting and Query of Display

Syntax

Command **:DISPlay** <ON/ OFF>
Query **:DISPlay?**
Response <ON/ OFF>
ON The display is always lit.
OFF The display remains off as long as there is no key control.

Explanation

Command: Turns the display ON/ OFF.

Query: Returns whether the display is ON or OFF.

Example

Command
```
:DISPlay ON
```
Makes the display always be lit up.

Query
```
:DISPlay?
```
Response
```
:DISPLAY ON
```
(when HEADER ON)
```
ON
```
(when HEADER OFF)
The display is set to always be lit up.

Query of RS-232C Communication Error

Syntax

Query **:ERRor?**
Response <Numeric Value>

<Numeric Value> = 0 to 7 (NR1)
1 Parity error (error in data)
2 Framing error (data read incorrectly)
4 Overrun error (loss of data)

Explanation

Query Returns the RS-232C communication error register content as NR1 numeric data from 0 to 7 and then clears that content.
No header is added to the response message.

					4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	Unused	Unused	Unused	Unused	Overrun error	Framing error	Parity error

Example

Query **:ERRor?**
Response **4**
An overrun error was generated.

Setting and Query of Event Status Enable Register 0 (ESER0)

Syntax

Command **:ESE0** <Numeric Value>
Query **:ESE0?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the mask pattern of the ESER0 to a numeric value from 0 to 255.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
The initial value (when the power is turned on) is 0.

Query Returns the ESER0 content as an NR1 numeric value.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
REF	COF	LER	MOF	MUF	IDX	EOM	CEM

Example

Command **:ESE0 20**
Sets bit 4 and bit 2 of ESER0.
Query **:ESE0?**
Response **:ESE0 20** (when HEADER ON)
20 (when HEADER OFF)
Bit 4 and bit 2 of ESER0 are set to 1.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Event Status Enable Register 1 (ESER1)

Syntax

Command **:ESE1** <Numeric Value>
Query **:ESE1?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command CommandSets the mask pattern of the ESER1 to a numeric value from 0 to 255.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
The initial value (when the power is turned on) is 0.

Query Returns the ESER1 content as an NR1 numeric value.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
NOC	AND	SLO	SIN	SHI	FLO	FIN	FHI

Example

Command **:ESE1 64**
Sets bit 6 of ESER1.
Query **:ESE1?**
Response **:ESE1 64** (when HEADER ON)
64 (when HEADER OFF)
Bit 6 of ESER1 is set to 1.

8

Setting and Query of Event Status Enable Register 2 (ESER2)

Syntax

Command **:ESE2** <Numeric Value>
Query **:ESE2?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the mask pattern of the ESER2 to a numeric value from 0 to 255.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
The initial value (when the power is turned on) is 0.

Query Returns the ESER2 content as an NR1 numeric value.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
BIN8	BIN7	BIN6	BIN5	BIN4	BIN3	BIN2	BIN1

Example

Command `:ESE2 1`
Sets bit 0 of ESER2.
Query `:ESE2?`
Response `:ESE2 1` (when HEADER ON)
`1` (when HEADER OFF)
Bit 0 of ESER2 is set to 1.

Note

There is no BIN function for the Model 3504-40.

Setting and Query of Event Status Enable Register 3 (ESER3)

Syntax

Command **:ESE3** <Numeric Value>
Query **:ESE3?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the mask pattern of the ESER3 to a numeric value from 0 to 255.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
The initial value (when the power is turned on) is 0.

Query Returns the ESER3 content as an NR1 numeric value.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
DNG	OUT	BIN14	BIN13	BIN12	BIN11	BIN10	BIN9

Example

Command **:ESE3 64**
Sets bit 6 of ESER3.
Query **:ESE3?**
Response **:ESE3 64** (when HEADER ON)
64 (when HEADER OFF)
Bit 6 of ESER3 is set to 1.

Note

There is no BIN function for the Model 3504-40.

Query of Event Status Register 0

Syntax

Query **:ESR0?**
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Query Returns the event status register 0 (ESR0) setting content as NR1 numeric data from 0 to 255 and then clears that content.
No header is added to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
REF	COF	LER	MOF	MUF	IDX	EOM	CEM

Example

Query **:ESR0?**
Response **4**
Bit 2 of ESR0 is 1.

Query of Event Status Register 1

Syntax

Query :ESR1?
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Query Returns the event status register 1 (ESR1) setting content as NR1 numeric data from 0 to 255 and then clears that content.
No header is added to the response message.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
NOC	AND	SLO	SIN	SHI	FLO	FIN	FHI

Example

Query `:ESR1?`
Response `82`
Bit 6, bit 4, and bit 1 of ESR1 are 1.

Query of Event Status Register 2

Syntax

Query :ESR2?
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Query Returns the event status register 2 (ESR2) setting content as NR1 numeric data from 0 to 255 and then clears that content.
No header is added to the response message.
For the Model 3504-40, 0 is always returned.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
BIN8	BIN7	BIN6	BIN5	BIN4	BIN3	BIN2	BIN1

Example

Query `:ESR2?`
Response `1`
Bit 0 of ESR2 is 1.

Query of Event Status Register 3

Syntax

Query :ESR3?
Response <Numeric Value>

<Numeric Value> = 0 to 255 (NR1)

Explanation

Query Returns the event status register 3 (ESR3) setting content as NR1 numeric data from 0 to 255 and then clears that content.
No header is added to the response message.
For the Model 3504-40, 0 is always returned.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DNG	OUT	BIN14	BIN13	BIN12	BIN11	BIN10	BIN9

Example

Query `:ESR3?`
Response `64`
Bit 6 of ESR3 is 1.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Measurement Frequency

Syntax

Command **:FREQuency** <Numeric Value>
Query **:FREQuency?**
Response <Numeric Value>

<Numeric Value> = 120/ 1000 (NR1)

Explanation

Command: Sets the measurement frequency.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the setting of the current measurement frequency as an NR1 numeric value.

Example

Command
```
:FREQuency 1000
```
Sets the measurement frequency to 1 kHz.

Query
```
:FREQuency?
```
Response
```
:FREQUENCY 1000
```
(when HEADER ON)
```
1000
```
(when HEADER OFF)
The measurement frequency is set to 1 kHz.

Setting and Query of RS-232C Communication Handshake

Syntax

Command **:HANDshake** <Character>
Query **:HANDshake?**
Response <Character> = X/ HARDware/ BOTH/ OFF

X : Software handshake
HARDware: Hardware handshake
BOTH: Software handshake + hardware handshake
OFF : No handshake

Explanation

Command: Sets the communication handshake.

Query: Returns the setting of the communication handshake as characters.

Example

Command
```
:HANDshake X
```
Sets the communication handshake to software handshake.

Query
```
:HANDshake?
```
Response
```
:HANDshake X
```
(when HEADER ON)
```
X
```
(when HEADER OFF)
The communication handshake is set to software handshake.

8

Setting and Query of Header for Response Messages

Syntax

Command **:HEADer** <ON/ OFF>
Query **:HEADer?**
Response <ON/ OFF>

Explanation

Command: Sets whether there is a header for response messages.
This is initialized to OFF when the power is turned on.

Query: Returns ON or OFF for the header setting of response messages.

Example

Command: `:HEADer ON`
Sets a header to be added to response messages.

Query: `:HEADer?`
Response: `:HEADER ON` (when HEADER ON)
`OFF` (when HEADER OFF)
A header is set to be added to response messages.

Setting and Query of Delay time for Judgement Result Output and $\overline{\text{EOM}}$ Output Period in EXT I/O

Syntax

Command **:IO:OUTPut:DELay** <Numeric Value>
Query **:IO:OUTPut:DELay?**
Response <Numeric Value> = 0 to 0.9999 (NR1)

Explanation

Command: Sets delay time comparator and the BIN judgement result ←→ $\overline{\text{EOM}}$ period.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the setting of delay time comparator and the BIN judgement result ←→ $\overline{\text{EOM}}$ period as charaters.

Example

Command: `:IO:OUTPut:DELay 0.0005`
Sets delay time comparator and the BIN judgement result ←→ $\overline{\text{EOM}}$ period to 500 μs.

Query: `:IO:OUTPut:DELay?`
Response: `:IO:OUTPUT:DELay 0.0005` (when HEADER ON)
`0.0005` (when HEADER OFF)
Delay time comparator and the BIN judgement result ←→ $\overline{\text{EOM}}$ period set at 500 μs.

Note

There is an approximate error of 160 μs in the delay time entered for comparator and the BIN judgement result ←→ $\overline{\text{EOM}}$ period for the setting value.
As the delay time will vary greatly when activating the trigger from EXT I/O during measurement, or when communicating during interface, as far as possible, try not to control externally during measurement.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Output of Judgment Result Signal Line in EXT I/O

Syntax

Command **:IO:RESult:RESet** <Character>

Query **:IO:RESult:RESet?**

Response <Character> = ON/ OFF

ON : Resets the judgment results when the start-of-measurement signal (trigger signal) is input.

OFF : Updates the measurement results when measurement ends.

Explanation

Command Sets whether to reset the judgment result signal line in EXT I/O.

Query Returns the setting of whether to reset the judgment result signal line in EXT I/O.

Note

The judgment result signal line indicates judgment results for C or D-HI, C or D-IN, and C or D-LO for comparator measurement and judgment results OUT-OF-BINS, D-NG, BIN1 to BIN14 for BIN measurement, and error (CV error, Low C error, level detected error, contact error).

See 7.1 "About the EXT I/O Connector" (p. 123)

Example

Command `:IO:RESult:RESet OFF`

Sets the judgment results to be updated when measurement ends.

Query `:IO:RESult:RESet?`

Response `:IO:RESULT:RESET OFF` (when HEADER ON)

`OFF` (when HEADER OFF)

The judgment results are set to be updated when judgment ends.

8

Setting and Query of Judgment Mode for Comparator and BIN Functions

Syntax

Command **:JUDGment:MODE** <Character>
Query **:JUDGment:MODE?**
Response <Character> = COUNt/ DEViation
COUNt: Count value mode
DEViation: Deviation percent (Δ%) mode

Explanation

Command Selects the judgment mode.

Query Returns the judgment mode as characters.

Example

Command **:JUDGment:MODE COUNt**
Selects count value mode.

Query **:JUDGment:MODE?**
Response **:JUDGMENT:MODE COUNT** (when HEADER ON)
COUNT (when HEADER OFF)
The judgment mode is set to count value mode.

Setting and Query of Key Lock Function

Syntax

Command **:KEYLock** <ON/ OFF>
Query **:KEYLock?**
Response <ON/ OFF>

Explanation

Command Sets the key lock function to ON/ OFF.

Query Returns ON or OFF for the setting of the key lock function.

Example

Command **:KEYLock ON**
Sets the key lock function to ON.

Query **:KEYLock?**
Response **:KEYLOCK ON** (when HEADER ON)
ON (when HEADER OFF)
The key lock function is set to ON.

Setting and Query of Measurement Signal Level

Syntax

Command **:LEVel** <Numeric Value>
Query **:LEVel?**
Response <Numeric Value>

<Numeric Value> = 1/ 0.5/ 0.1(only for Model 3504-60) (NR2)
1: 1 V, 0.5: 500 mV, 0.1: 100mV

Explanation

Command: Sets the measurement signal level.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the setting of the measurement signal level as an NR2 numeric value.

Example

Command `:LEVel 0.5`
Sets the measurement signal level to 500 mV.

Query `:LEVel?`
Response `:LEVEL 0.5` (when HEADER ON)
`0.5` (when HEADER OFF)
The measurement signal level is set to 500 mV.

Setting and Query of Measurement Level Monitoring Function

Syntax

Command **:LEVel:CHECk** <ON/ OFF>
Query **:LEVel:CHECk?**

Explanation

Command: Set whether or not to judge the amount of change of the voltage and current monitor levels

Query: Returns the measurement level monitoring function setting as ON or OFF.

Example

Command `:LEVel:CHECk ON`
Enables the measurement level monitoring function.
Query `:LEVel:CHECk?`
Response `:LEVEL:CHECK ON` (when HEADER ON)
ON (when HEADER OFF)
The measurement level monitoring function is set to ON.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Threshold for Judging Abnormal Measurement Level

Syntax

Command **:LEVel:CHECk:LIMit** <Numeric Value>
Query **:LEVel:CHECk:LIMit?**

<Numeric Value> = 0.01 to 100.00 (NR2)

Explanation

Command: Sets the threshold for detecting abnormal measurement level.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the threshold for abnormal measurement level as an NR2 numerical value.

Example

Command: `:LEVel:CHECk:LIMit 5.00`
Sets the threshold for judging abnormal measurement level to 5%.
During a measurement if the amount of change of the monitor values (voltage monitor value, current monitor value) exceeds ±5% it is detected as an outside of limit range error.
A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: `:LEVel:CHECk:LIMit?`

Response: `:LEVEL:CHECK:LIMIT 5.00` (when HEADER ON)
5 (when HEADER OFF)
The threshold for judging abnormal measurement level is set to 5%.

Loading of Specified Panel Number

Syntax

Command **:LOAD** <Numeric Value>

<Numeric Value> = 1 to 99 (NR1)

Explanation

Command: Loads the specified panel number.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.

Example

Command: `:LOAD 2`
Loads panel number 2.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Load Method

Syntax

Command **:LOAD:TYPE** <Character>

Query **:LOAD:TYPE?**

<Character> = ALL/ CORRection/ HARDware

ALL : Sets the device settings and compensation values to be loaded.

CORRection: Sets the compensation values to be loaded.

HARDware: Sets the device settings to be loaded.

Explanation

Command Sets the load method.

Query Returns the setting of the load method as characters.

Example

Command **:LOAD:TYPE CORRection**

Sets only the data of the compensation values to be loaded at load time.

Query **:LOAD:TYPE?**

Response **:LOAD:TYPE CORRECTION** (when HEADER ON)

CORRECTION (when HEADER OFF)

Only the data of the compensation values are set to be loaded at load time.

8

Query of Measurement Data

Syntax

Query: **:MEASure?**

Response

- During normal measurement

<Measurement Status (NR1)>,C <Measurement Value (NR3)>, D <Measurement Value (NR2)>,<Panel Load Number (NR1)>

<Measurement Status>	
0	Normal
9	Time out error
17	H, L side contact check errors (after measurement)
16	L side contact check error (after measurement)
15	H side contact check error (after measurement)
14	H, L side contact check errors (before measurement)
13	L side contact check error (before measurement)
12	H side contact check error (before measurement)
6	Fixed voltage abnormality (CV error)
7	Over range
-7	Under range
5	Outside of Low C reject limit range
4	Abnormal level detected
-3	Outside of C display range (UNDER)
3	Outside of C display range (OVER)
2	Outside of guaranteed accuracy range
1	No measurements are made when the power supply is turned on

- During comparator measurement

<Measurement Status(NR1)>,<Comparison Result Logical AND>, <Measurement Value of C (NR3)>,<Comparison Result of C>, <Measurement Value of D (NR2)>,<Comparison Result of D >, <Panel Load Number (NR1)>

<Comparison Result Logical AND> = 0/ 1	
0	When one of C and D is LO or HI or both parameters were not judged
1	When the judgment results for both C and D are IN (within the range) or if one of the parameters was not judged but the judgment result of the judged one is IN.

<Comparison Result> = 0/ 1/ -1/ 2	
0	IN
1	HI
-1	LO
2	Not judged (when the upper limit and lower limit values are OFF)

Syntax

Query

Response

- During BIN measurement

<BIN Result>, <Measurement Value of C (NR3)>, <Measurement Value of D (NR2)>, <Panel Load Number (NR1)>

<BIN Result> = -1, -2, 1 to 14	
1 to 14	BIN No.
-1	OUT OF BINS
-2	DNG

However, if not even one measurement has been performed since the settings of the unit were changed, the measurement values obtained when the previous settings were configured are returned.

1.800.561.8187 www.itm.com information@itm.com

Query of Measurement Data

Note

- If panel load has not been performed, or if measurement conditions have been changed after panel load has been performed, the panel load number will return 0.

Explanation

Query

- Normal measurement
  Returns the measurement status, measurement values, and panel load number.
- Comparator measurement
  Returns the measurement status, measurement values, comparison result of the comparator, and panel load number.
  However, if not even one measurement has been performed since the measurement mode was changed, 2 is returned for the comparison results of both C and D.
- BIN measurement
  Returns the measurement status, the measurement values, BIN measurement result, and panel load number.
  However, if not even one measurement has been performed since the measurement mode was changed, OUT OF BINS is returned for the BIN measurement result.

Example

- During normal measurement, when the second parameter is D.

Query
```
:MEASure?
```
Response
```
0,CP 1.23456E-06,D 0.12345,0
```
(when HEADER ON)
```
0,1.23456E-06,0.12345,0
```
(when HEADER OFF)

- Comparator measurement, the second parameter is D, when panel number 5 is loaded.

Query
```
:LOAD 5
:MEASure?
```
Response
```
0,0,CP 1.23456E-06,0,D 0.12345,-1,5
```
(when HEADER ON)
```
0,0,1.23456E-06,0,0.12345,-1,5
```
(when HEADER OFF)
Indicates that the judgment result for C is IN and the judgment result for D is LO.

- During BIN measurement, when the second parameter is D.

Query
```
:BIN ON
:MEASure?
```
Response
```
0,1,CP 1.23456E-06,D 0.01234,0
```
(when HEADER ON)
```
0,1,1.23456E-06,0.01234,0
```
(when HEADER OFF)
Indicates that the measurement value is within the set BIN1 range.

Note

- The header of C returns CS when the equivalent circuit is a series-equivalent circuit and CP when the equivalent circuit is a parallel-equivalent circuit.

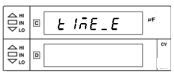
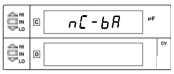
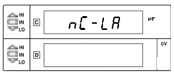
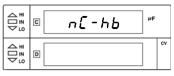
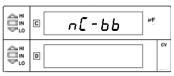
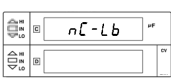
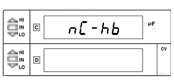
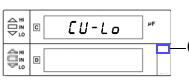
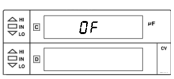
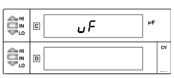
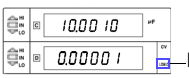
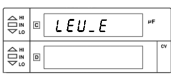
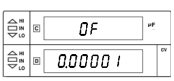
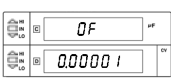
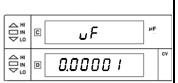
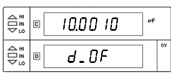
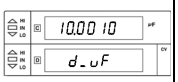
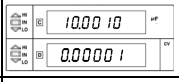
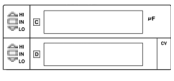
8

Query of Measurement Data

- The following values are returned in the case of abnormal measurement.

:MEASure? :MEMory? response result								
Priority rank	Measurement abnormality	Measurement Status	Comparator result logical product	BIN resul	C measurement value	C COMP result	D measurement value	D COMP result
High	Time out	9	0	-1	444444E+44	1	444444	1
	H, L side contact check errors (after measurement)	17	0	-1	555555E+55	1	555555	1
	L side contact check error (after measurement)	16	0	-1	555555E+55	1	555555	1
	H side contact check error (after measurement)	15	0	-1	555555E+55	1	555555	1
	H, L side contact check errors (before measurement)	14	0	-1	555555E+55	1	555555	1
	L side contact check error (before measurement)	13	0	-1	555555E+55	1	555555	1
	H side contact check error (before measurement)	12	0	-1	555555E+55	1	555555	1
	Fixed voltage abnormality (CV error)	6	0	-1	777777E+77	1	777777	1
	Over range	7	0	-1	999999E+99	1	999999	1
	Under range	-7	0	-1	-999999E+99	-1	-999999	-1
	Outside of Low C reject limit range	5	Standard judgment	Standard judgment	Measurement value	Standard judgment	Measurement value	Standard judgment
	Abnormal level detected	4	0	-1	666666E+66	1	666666	1
	Outside of C display range (normal measurement + comparator and BIN measurement (count setting)) *1	3	0	-1	999999E+99	1	Measurement value	Standard judgment
	Outside of C display range (comparator and BIN measurement (Δ% setting))	3/-3	0	-1	999999E+99/ -999999E+99	1/-1	Measurement value	Standard judgment
	Outside of D display range	0	0	-1/-2	Measurement value	Standard judgment	999999/ -999999	1/-1
	Outside of guaranteed accuracy range	2	Standard judgment	Standard judgment	Measurement value	Standard judgment	Measurement value	Standard judgment
Low	No measurements are made when the power supply is turned on	1	0	-1	888888E+88	2	888888	2

*1: When the C measurement value falls below -199999, the display will freeze at -199999.

EXT I/O output							
Priority rank	Measurement abnormality	$\overline{\text{ERR}}$ (pin 14)	$\overline{\text{BIN1}}$ to $\overline{\text{BIN13}}$	$\overline{\text{OUT OF BINS}}$ (pin 37)	$\overline{\text{D-NG}}$ (pin 39)	Comparator Output (Output pin)	Panel display
High	Time out	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	H, L side contact check errors (after measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	L side contact check error (after measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	H side contact check error (after measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	H, L side contact check errors (before measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	L side contact check error (before measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	H side contact check error (before measurement)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	Fixed voltage abnormality (CV error)	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	 CV light will go off
	Over range	HI	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	Under range	HI	HI	LOW	HI	$\overline{\text{C-LOW}}$ (pin 31) $\overline{\text{D-LOW}}$ (pin 8)	
	Outside of Low C reject limit range	LOW	LOW/ HI	LOW / HI	LOW/ HI	Standard judgment	 Low C lights up
	Abnormal level detected	LOW	HI	LOW	HI	$\overline{\text{C-HI}}$ (pin 30) $\overline{\text{D-HI}}$ (pin 7)	
	Outside of C display range (normal measurement + comparator and BIN measurement (count setting)) *1	HI	HI	LOW	HI	C: $\overline{\text{C-HI}}$ (pin 30) D: Standard judgment	
	Outside of C display range (comparator and BIN measurement (Δ% setting))	HI	HI	LOW	HI	C: $\overline{\text{C-HI}}$ (pin 30) or $\overline{\text{C-LOW}}$ (pin 31) D: Standard judgment	 or 
	Outside of D display range	HI	HI	LOW/ HI	LOW/ HI	C: Standard judgment D: $\overline{\text{D-HI}}$ (pin 7) or $\overline{\text{D-LOW}}$ (pin 8)	 or 
	Outside of guaranteed accuracy range	HI	LOW/ HI	LOW/ HI	LOW/ HI	Standard judgment	
Low	No measurements are made when the power supply is turned on	HI	HI	HI	HI	No output	

Setting of Valid Data For Measurement Data Query (:MEASure)

Syntax

Command **:MEASure:VALid** <Numeric Value>
Query **:MEASure:VALid?**
Response <Numeric Value> = 0 to 255 (NR1)

Explanation

Command Sets the measurement value result returned by measurement data query (:MEASure?).
Query Returns the measurement value result returned by measurement data query (:MEASure?) as NR1 numerical value data between 0 and 255.

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	Measurement Status	Comparator result logical product, or BIN result	C measurement value	C COMP result	D measurement value	D COMP result	Panel load number

Example

Command **:MEASure:VALid 20**
Set the unit so that when the measurement data query (:MEASure) is performed, the C measurement value and D measurement value will be returned.
Query **:MEASure:VALid?**
Response **:MEASure:VALid 20** (when HEADER ON)
20 (when HEADER OFF)
The unit is set to return the C measurement value and D measurement value when the measurement data query (:MEASure) is performed.

1.800.561.8187 www.itm.com information@itm.com

Query of Measurement Values Saved to Memory by the Measurement Value Memory Function

Syntax

Query **:MEMory?** <Character>

Response <Character> = No Data/ ALL

- When there is no data section
  <First Item in Memory><Message Terminator><Second Item in Memory><Message Terminator>...<nth Item in Memory> <Message Terminator>
  n indicates a number up to 32,000.
- When the characters of the data section are ALL
  <First Item in Memory><Comma(,)><Second Item in Memory><Comma(,)>...<nth Item in Memory><Message Terminator>

Explanation

Query

- Returns all of the most recent measurement values saved to memory by the measurement value memory function.
- The measurement results for a maximum of 32,000 most recent measurements are saved to memory.
  When command :MEMory? is carried out, the memory contents will be cleared. Before retrieving memory content, use command :MEMory:CLEar to delete the memory contents.
- The format of items in memory is the same as that of the response data of the :MEASure? query. For details on the format, refer to the explanation of the :MEASure? query (p. 226).
- A memory terminator is inserted between each memory item when :MEMory? and a comma (,) is inserted between each memory item when :MEMory? ALL.
- The number of data items currently saved to memory can be confirmed with the :MEMory:COUNt? query.
- If the trigger setting is set to internal trigger, the number of data items obtained with the :MEMory:COUNt? query and the n value may differ. Set the trigger setting to external trigger before using the :MEMory:COUNt? query.

Example

GP-IB When :MEMory? is executed, only the first item in memory is returned with the first receive operation (specified talker). To obtain all measurement values saved to memory, perform the receive operation a number of times equal to the number of data items saved to memory or send :MEMory? ALL and then perform the receive operation once.

RS-232C The only difference between :MEMory? and :MEMory? ALL is whether data is separated by a message terminator or comma (,).
When :MEMory? is executed, there is no need to perform the receive operation a number of times equal to the number of data items saved to memory in order to obtain all measurement values.

8

Deleting Data from Memory of Measurement Value Memory Function

Syntax Command **:MEMory:CLEar**

Explanation Command Deletes all measurement values saved to memory by the measurement value memory function.
If this command is sent, subsequent measurement values are saved from the beginning of memory.

Example Command `:MEMory:CLEar`
Deletes all measurement values saved to memory.

Query of Number of Measurement Values Saved to Memory by the Measurement Value Memory Function

Syntax Query **:MEMory:COUNt?**
Response <Numeric Value>

<Numeric Value> = 0 to 32,000 (NR1)

Explanation Query Returns the number of data items saved to memory by the measurement value memory function as an NR1 numeric value.
No header is added to the response message.

Example Query `:MEMory:COUNt?`
Response `1`
Indicates that one measurement value is saved to memory.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Measurement Value Memory Function ON/ OFF

Syntax

Command **:MEMory:CONTrol** <ON/ IN/ OFF>

Query **:MEMory:CONTrol?**

Response <ON/ IN/ OFF>

ON : Save measurement values in memory.

IN : Only measurement values whose parameters are evaluated as good in the comparator and BIN function will be saved in memory. (value will not be saved even if 1 comparator result is Hi or Lo, or when the BIN result is OUT-OF-BINS or D-NG). Saves measurement values in memory under normal measurements.

OFF : Measurement values not saved in memory.

Explanation

Command Sets the measurement value memory function.
When the setting is changed all saved measurement values are erased.

Query Returns the setting of the measurement value memory function as characters.

Example

Command **:MEMory:CONTrol ON**
Sets so that the measurement value is saved each time a measurement is made.

Query **:MEMory:CONTrol?**

Response **:MEMORY:CONTROL ON** (when HEADER ON)
ON (when HEADER OFF)
The device is set to save the measurement value each time a measurement is made.

8

Setting and Query of Measurement Value Memory Function Memory Size

Syntax

Command **:MEMory:POINts** <Numeric Value>
Query **:MEMory:POINts?**
Response <Numeric Value> = 1 to 32,000 (NR1)

Explanation

Command: Sets the memory size (the number of measurements to save).When the setting is changed all saved measurement values are erased. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.

Query: Returns the memory size as an NR1 numerical value.

Example

Command
```
:MEMory:POINts 200
```
Sets the memory size to 200.

Query
```
:MEMory:POINts?
```
Response
```
:MEMORY:POINTS 200
```
(when HEADER ON)
```
200
```
(when HEADER OFF)
The memory size is set to 200.

Query of Voltage and Current Monitor Values

Syntax

Query **:MONItor?**
Response <Voltage Monitor Value(NR3)>,<Current Monitor Value(NR3)>

Explanation

Query: Returns the measurement signal monitor values in the order of voltage monitor value and current monitor value.

Example

Query
```
:MONItor?
```
Response
```
9.56789E-01,7.34567E-05
```
The voltage monitor value and current monitor value are set to 0.956789 V and 73.4567 μA.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Voltage and Current Monitor Levels Display

Syntax

Command **:MONItor:DISPlay** <ON/ OFF>
Query **:MONItor:DISPlay?**
Response <ON/ OFF>
ON :Displays measurement signal monitor level in the SUB display area.
OFF :Does not display the measurement signal monitor level in the SUB display area.

Explanation

Command Sets the measurement signal monitor level display to ON or OFF.

Query Returns the measurement signal monitor level display as ON or OFF.

Example

Command `:MONItor:DISPlay ON`
Set the measurement signal monitor level to be displayed.
Query `:MONItor:DISPlay?`
Response `MONITOR:DISPLAY ON` (when HEADER ON)
`ON` (when HEADER OFF)
The measurement signal monitor level is set to be displayed.

Initializing the Unit

Syntax

Command **:PRESet**

Explanation

Command Resets the unit to its original initialized state.
This initialized state differs from that when resetting with the ∗RST command.
See Appendix 7 "Initial Settings Table" (p. A11)

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Measurement Range

Syntax

Command **:RANGe** <Numeric Value>
Query **:RANGe?**
Response <Numeric Value>

<Numeric Value> = 1 to 10 (NR1)

Explanation

Command: Sets the measurement range.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.
If this command is executed, the setting of the :RANGe:AUTO command is automatically changed to OFF.
If this command is executed when the setting of the equivalent circuit is set to AUTO, the setting (SER/PAR) of the equivalent circuit is automatically changed to the optimal setting.

Query: Returns the setting of the measurement range as an NR1 value from 1 to 10.

Example

Command **:RANGe 5**
Sets the measurement range to 5 (200 nF) (when 1 kHz).

Query **:RANGe?**
Response **:RANGE 5** (when HEADER ON)
5 (when HEADER OFF)
The measurement range is set to 5 (200 nF) (when 1 kHz).

Note

Numerical Value (Range Number)	Measurement Frequency	
	120Hz	1kHz
1	200 pF	20 pF
2	2 nF	200 pF
3	20 nF	2 nF
4	200 nF	20 nF
5	2 μF	200 nF
6	20 μF	2 μF
7	200 μF	20 μF
8	0.7 mF (when 1 V), 1.45 mF (when 500 mV, 100 mV)	70 μF (when 1 V), 170 μF (when 500 mV, 100 mV)
9	2 mF	200 μF
10	20 mF	2 mF

1.800.561.8187 www.itm.com information@itm.com

Automatic Setting and Query of Measurement Range

Syntax

Command **:RANGe:AUTO** <ON/ OFF>
Query **:RANGe:AUTO?**
Response <ON/ OFF>

ON Changes the measurement range automatically.
OFF Does not change the measurement range automatically.

Explanation

Command: Sets the measurement range to be changed automatically.

Query: Returns ON or OFF for the automatic setting of the measurement range.

Example

Command **:RANGe:AUTO ON**
Sets the measurement range to be changed automatically.

Query **:RANGe:AUTO?**
Response **:RANGE:AUTO ON** (when HEADER ON)
ON (when HEADER OFF)
The measurement range is set to be changed automatically.

Query and Saving of Specified Panel Number

Syntax

Command **:SAVE** <No.>
Query **:SAVE?** <No.>
Response 0/ 1

<No.> 1 to 99 (NR1)

Explanation

Command: Specifies the panel number and saves the measurement conditions.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.

Query: Returns 1 if measurement conditions are saved for the specified number, and 0 if no measurement conditions are saved.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.
No header is added to the response message.

Example

Command **:SAVE 3**
Saves the measurement conditions to Panel No. 3.

Query **:SAVE? 3**
Response **1**
Measurement conditions are saved to Panel No. 3.

1.800.561.8187 www.itm.com information@itm.com

Clearing the Specified Panel Number

Syntax
Command **:SAVE:CLEar** <ALL/ Numeric Value>
<ALL/ Numeric Value> = ALL/ 1 to 70 (NR1)

Explanation
Command Erases the saved panel data.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.

Example
Command `:SAVE:CLEar 5`
Erases the saved data of panel No. 5.

Setting and Query of Measurement Speed

Syntax
Command **:SPEEd** <Character>
Query **:SPEEd?**
Response <Character>
<Character> = FAST/ NORMal/ SLOW

Explanation
Command Sets the measurement speed.
Query Returns the setting of the measurement speed as characters.

Example
Command `:SPEEd NORMal`
Sets the measurement speed to normal speed.

Query `:SPEEd?`
Response `:SPEED NORMAL` (when HEADER ON)
`NORMAL` (when HEADER OFF)
The measurement speed is set to normal speed.

Setting and Query of Trigger Synchronous Output Function

Syntax

Command **:SSOurce** <ON/ OFF>

Query **:SSOurce?**

Response <ON/ OFF>

ON : Enables the trigger synchronous output function.
OFF : Disables the trigger synchronous output function.

Explanation

Command: Enables/disables the trigger synchronous output function.

Query: Returns ON or OFF for the current setting of the trigger synchronous output function.

Example

Command
```
:SSOurce ON
```
Enables the trigger synchronous output function.

Query
```
:SSOurce?
```
Response
```
:SSOURCE ON
```
(when HEADER ON)
```
ON
```
(when HEADER OFF)
The trigger synchronous output function is enabled.

Note

When the contact check function is set to “bEForE” or “both”, the trigger simultaneous output function setting cannot be changed.

Setting and Query of Wait Time for Trigger Synchronous Output Function

Syntax

Command **:SSOurce:WAIT** <Wait Time 1>, <Wait Time 2>

Query **:SSOurce:WAIT?**

Response <Wait Time 1, 2> = 0.001 to 9.999 (NR2)

<Wait Time 1> : Sets the wait time for a measurement frequency of 120 Hz.
<Wait Time 2> : Sets the wait time for a measurement frequency of 1 kHz.

Explanation

Command: Sets the wait time from after the triggered output of the measurement signal to the start of measurement.

Query: Returns the setting of the wait time for the trigger synchronous output function as a numeric value.

Example

Command
```
:SSOurce:WAIT 0.500,0.250
```
Sets the wait time from after the trigger to the start of measurement to 500 ms for 120 Hz and 250 ms for 1 kHz.

Query
```
:SSOurce:WAIT?
```
Response
```
:SSOURCE:WAIT 0.500,0.250
```
(when HEADER ON)
```
0.500, 0.250
```
(when HEADER OFF)
The wait time from after the trigger to the start of measurement is set to 500 ms for 120 Hz and 250 ms for 1 kHz.

Note

- When the wait time is short, measurement errors may increase.
- As for Range 9, 10, when 120 Hz, 40ms will be added to the setting wait time and when 1 kHz, 3 ms will be added to the wait time.

1.800.561.8187 www.itm.com information@itm.com

Setting and Query of Terminator of Response Message

Syntax

Command **:TRANsmit:TERMinator** <Numeric Value>
<Numeric Value> = 0 to 255 (NR1)

Query **:TRANsmit:TERMinator?**

Response <Numeric Value> = 0/ 1 (NR1)

Explanation

Command Sets the terminator of the response message.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.

- When RS-232C
  CR+LF : when 0
  CR : when 1 to 255
- When GP-IB (only for Models 3504-50, 3504-60)
  LF+EOI : when 0
  CR+LF+EOI : when 1 to 255

Query Returns the setting of the terminator of the response message as NR1 numeric data of 0 and 1.

- When RS- 232C
  CR+LF : when 0
  CR : when 1
- When GP-IB (only for Models 3504-50, 3504-60)
  LF+EOI : when 0
  CR+LF+EOI : when 1

Example

Command `:TRANsmit:TERMinator 0`

- RS- 232C
  Sets the terminator to CR+LF.
- GP-IB (only for Models 3504-50, 3504-60)
  Sets the terminator to LF+EOI.

Query `:TRANsmit:TERMinator?`

Response `:TRANSMIT:TERMINATOR 0` (when HEADER ON)
`0` (when HEADER OFF)

RS-232C : The terminator is set to CR+LF.

GP-IB : The terminator is set to LF+EOI.
(only for Models 3504-50, 3504-60)

Setting and Query of Trigger Mode

Syntax

Command **:TRIGger** <Character>
Query **:TRIGger?**
Response <Character>

<Character> = INTernal/ EXTernal
INTernal: Internal trigger
EXTernal: External trigger

Explanation

Command: Sets the trigger mode.

Query: Returns the setting of the trigger mode as characters.

Example

Command
```
:TRIGger INTernal
```
Sets the trigger mode to internal trigger.

Query
```
:TRIGger?
```
Response
```
:TRIGGER INTERNAL
```
(when HEADER ON)
```
INTERNAL
```
(when HEADER OFF)
The trigger mode is set to internal trigger.

Setting and Query of Trigger Delay Time

Syntax

Command **:TRIGger:DELay** <OFF/ Numeric Value>
Query **:TRIGger:DELay?**
Response <OFF/ Numeric Value> = OFF/ 0 to 9.999 (NR2)

Explanation

Command: Sets the trigger delay time.
When the trigger delay time is set, the trigger delay function will not be automatically set to ON.
A numeric value in NRf format is accepted but decimals are rounded off so the numeric value can be handled.

Query: Returns the trigger delay time as a NR2 numerical value.

Example

Command
```
:TRIGger:DELay 0.1
```
Sets so that measurement will commence 100 ms after the trigger.

Query
```
:TRIGger:DELay?
```
Response
```
:TRIGGER:DELAY 0.1
```
(when HEADER ON)
```
0.1
```
(when HEADER OFF)
Measurement is set to commence 100 ms after the trigger.

Note

A command of OFF is accepted, but the setting will become 0, and an 0 response will be returned.

8

Setting and Query of Trigger Delay Function

Syntax

Command **:TRIGger:DELay:STATe** <ON/ OFF>
Query **:TRIGger:DELay:STATe?**
Response <ON/ OFF>

Explanation

Command Sets the trigger delay function ON/ OFF.

Query Returns whether the trigger delay function is set to ON or OFF.

Example

Command `:TRIGger:DELay:STATe ON`
Enables the trigger delay function

Query `:TRIGger:DELay:STATe?`
`:TRIGGER:DELAY:STATE ON` (when HEADER ON)
`ON` (when HEADER OFF)
The trigger delay function is set to ON.

Setting and Query of User ID

Syntax

Command **:USER:IDENtity** <ID>
Query **:USER:IDENtity?**
Response <ID>

<ID> = User ID Code (Example: AB-1234)
A to Z, a to z, 0 to 9, and - (hyphen)

Explanation

Command Allows you to set an ID code for the user.
The ID code is backed up in the same manner as the settings of the unit.
If more than 12 characters are entered, only the first 12 characters are valid.
The user ID code is cleared when the system is reset.

Query Returns the setting of the ID as characters or numeric values.

Example

Command `:USER:IDEN AB-1234`
Stores AB-1234 as the user ID.

Query `:USER:IDENtity?`
Response `:USER:IDENTITY AB-1234` (when HEADER ON)
`AB-1234` (when HEADER OFF)
The user ID is set to AB-1234.

8.9.3 Response Format of Queries for Returning Values

Measurement Values

C(Capacitance)<NR3>

(-)□.□□□□□ E±□□
1 2 3

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Mantissa part: 6 digit numeric value + decimal point
3: Exponent part: 2 digit numeric value

D (Dissipation Factor) <NR2>

(-)□.□□□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
3: Exponent part: Numeric value with 5 digits after the decimal point

Compensation Values

Compensation Values for Open Circuit and Short Circuit Compensation

- **Residual Impedance (Z, G, B, Cp, Rs, X, Ls) <NR3>**

(-)□.□□□□□ E±□□
1 2 3

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Mantissa part: 6 digit numeric value + decimal point
3: Exponent part: 2 digit numeric value

- **Phase Angle <NR2>**

(-)□□□.□□□
(-)□□.□□□
(-)□.□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: Numeric value with 3 digits afte the decimal point

Compensation Values for Load Compensation <NR2>

- **Impedance Compensation Coefficient**

(-)□.□□□□□
(-)□□.□□□□
(-)□□□.□□□
(-)□□□□.□□
(-)□□□□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: 6 digit numeric value+ decimal point

- **Phase Compensation Values and Phase Angle <NR2>**

(-) □□□.□□□
(-) □□.□□□
(-) □.□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: Numeric value with 3 digits after the decimal point

- **Residual Impedance (Z, C) <NR3>**

(-)□.□□□□□ E±□□
1 2 3

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Mantissa part: 6 digit numeric value + decimal point
3: Exponent part: 2 digit numeric value

- **D (Dissipation Factor) <NR2>**

(-)□.□□□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative

1.800.561.8187 www.itm.com information@itm.com

Offset For Compensation Values

- **C offset compensation value**

(-)□.□□□□□ E±□□
1 2 3

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Mantissa part: 6 digit numeric value + decimal point
3: Exponent part: 2 digit numeric value

- **D offset compensation value**

(-)□.□□□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: Numeric value with 5 digits after the decimal point

Upper Limit and Lower Limit Values for BIN and COMP

COUNT Mode <NR1>

(-)□□□□□□
1 2

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: 6 digit numeric value

Δ% Mode

(-)□□□.□□
1 2
(First parameter: C<NR2>)

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: Numeric value with 2 digits afte the decimal point

(-)□□□□□□
1 2
(Second parameter: D<NR1>)

1: Sign part: The only sign added is the minus sign (-) when the value is negative
2: Numeric value part: 6 digit numeric value

Wait Time for Trigger Synchronous Output Function <NR2>

□.□□□

Numeric value with 3 digits after the decimal point

8.10 Initialized Items

Some items are initialized when, for example, the power is turned on. Refer to the table below.

RS-232C

Item \ Initialization Method	Upon Power On	*RST Command	*CLS Command
Device-specific functions (range, etc.)	×	●	×
Output queue	●	×	×
Input buffer	●	×	×
Status byte register	●	×	● *2
Event register	● *3	×	●
Enable register	●	×	×
Current path	●	×	×
Header ON/ OFF	●	●	×

GP-IB

(Only for Models 3504-50, 3504-60)

Item \ Initialization Method	Upon Power On	*RST Command	Clearing of Device*	*CLS Command
GP-IB address	×	×	×	×
Device-specific functions (range, etc.)	×	●	×	×
Output queue	●	×	●	×
Input buffer	●	×	●	×
Status byte register	●	×	× *1	● *2
Event register	● *3	×	×	●
Enable register	●	×	×	×
Current path	●	×	●	×
Header ON/ OFF	●	●	×	×

*1 Only the MAV bit (bit 4) is cleared.
*2 Other than the MAV bit is cleared.
*3 Excluding the PON bit (bit 7).

* This means to initialize the unit.

1.800.561.8187 www.itm.com information@itm.com

8.11 Creating Programs

This section describes an example of how to use the Windows development language Visual Basic2005 Express Edition to operate the 3504-40/ 3504-50/ 3504-60 unit from a PC via RS-232C, incorporate measurement values, and save measurement values to a file.

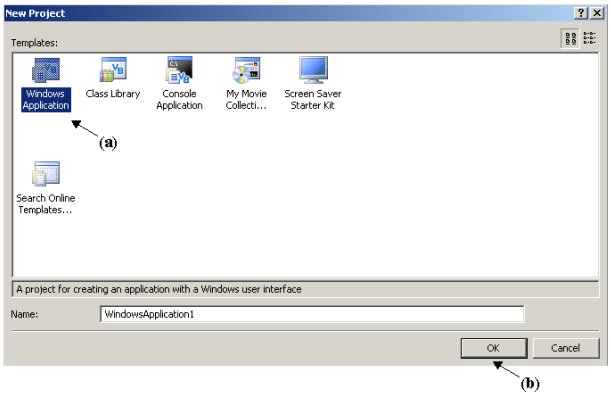
- Windows and Visual Basic2005 are registered trademarks of Microsoft Corporation.

8.11.1 Creation Procedure

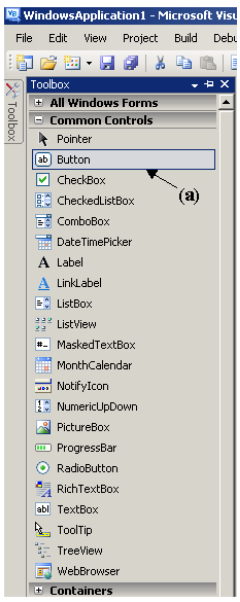
This section describes the procedure for using Visual Basic2005 to create programs. Visual Basic2005 is referred to as VB2005 hereafter.

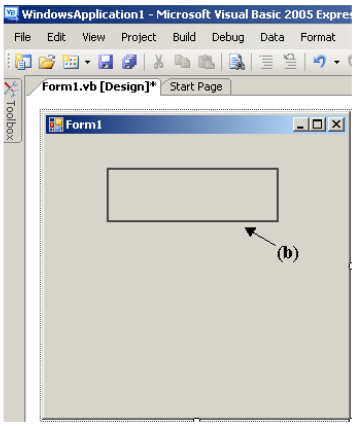
NOTE

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.

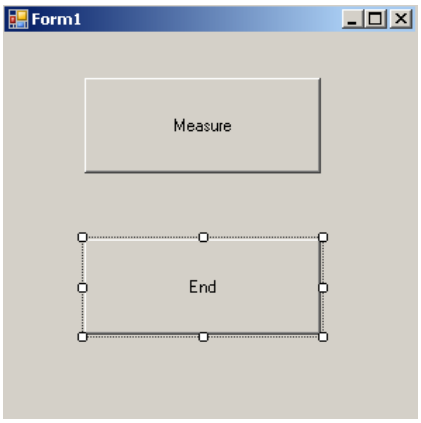


1. **Startup VB2005, select [Windows Application] from [File] - [New Project] (a), and click the "OK" button (b).**

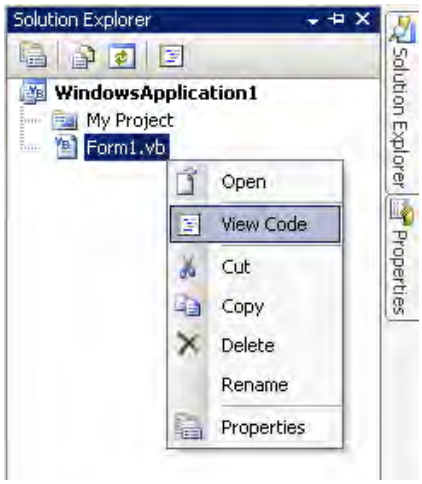




2. **Click on the common control [Button] icon (a), and then drag the mouse over the form layout window (b) to insert the button.**

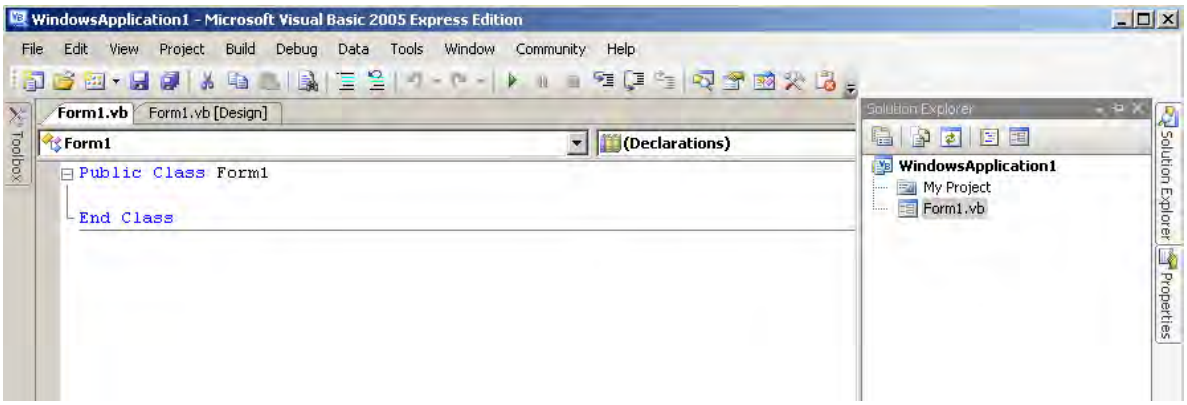


3. **Use the method in step 2 to create another button, and edit the text in the property window of each button to appear as in the diagram.**



4. **Right-click above [From1] 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 8.11.2 "Sample Programs" (p. 248), and execute the created program.



8.11.2 Sample Programs

Shown below is a sample program which uses VB2005 to enact RS-232C communication, set the Models 3504-40, 3504-50, 3504-60 measurement conditions, read measurement results and then save them to file. The sample program will be written in the following manner.
8.11.1 "Creation Procedure" (p. 246) description ..... Write using sample program
Button created to begin measuremen Button1
Button created to close application Button2
When the [Begin Measurement] is pressed, the Models 3504-40, 3504-50, 3504-60 takes 10 measurements and writes the measurement values to a [data.csv] file.
When the [Quit] 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 process 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 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                      '2 second time out ..... (d)
      sp.Open()                                  'Open port
      SendSetting(sp)                            'Models 3504-40, 3504-50, 3504-60 settings
      FileOpen(1, "data.csv", OpenMode.Output)   'Create text file to be saved ..... (e)
      For i = 1 To 10
        sp.WriteLine("*TRG;:MEAS?")              'Begin measurement and read measurement
                                                  results command ..... (f)
        recvstr = sp.ReadLine()                  'Read 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 measurement conditions
Private Sub SendSetting(ByVal sp As SerialPort)
    Try
      sp.WriteLine(":HEAD OFF")                  'Header : OFF
      sp.WriteLine(":LEV 0.5")                   'Signal level : 500 mV
      sp.WriteLine(":FREQ 1E6")                  'Measurement frequency : 1 MHz
      sp.WriteLine(":TRIG EXT")                  'Trigger : external trigger
    Catch ex As Exception
      MessageBox.Show(ex.Message, "Error", MessageBoxButtons.OK, MessageBoxIcon.Error)
    End Try
End Sub
‘Close 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
```

1.800.561.8187 www.itm.com information@itm.com

(a) This makes it so that during communication the [Begin Measurement] and [Close] buttons cannot be pressed.
(b) Matches the Models 3504-40, 3504-50, 3504-60 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: 1bit
(c) Sets CR + LF as the terminator indicating the end of the sending and receiving character string.
(d) Sets the reading operation time to 2 seconds.
(e) Opens the “data.csv” file. However, if a file with this name already exists, the previous “data.csv” will be deleted and a new file created.
(f) Sends the command to the Models 3504-40, 3504-50, 3504-60 to perform one measurement and return that measurement result to the computer.

1.800.561.8187 www.itm.com information@itm.com

8.12 Troubleshooting the Interface

If the interface is not working properly, check the following causes and solve the problem accordingly. In particular, if you are using a PC from the NEC PC-9801 series as the controller, refer to the following because there are some precautionary notes specific to that series.
* Causes and solutions without a mark are common to both RS-232C and GP-IB.

Symptom	Cause/Solution
RS-232C/GP-IB does not work at all.	• Is the cable connected properly? • Is the power of all connected devices turned on? • Is the correct cable being used? • Are the settings of the communication conditions correct? RS-232C • Is the address setting of the unit correct? GP-IB • Is the address identical to that of another device? GP-IB
Cannot perform RS-232C/GP-IB communication properly.	• Are the RS-232C settings (baud rate, data bit length, parity, and stop bits) of the Models 3504-40, 3504-50, 3504-60 unit and PC the same? RS-232C • Configure the message terminator (delimiter) of the controller properly. GP-IB See "Message Terminator" (p. 143)
The keys do not work after using RS-232C/GP-IB for communication.	• Press the LOCAL key on the panel of the unit to cancel the remote state. • Was the LLO (local lockout) command sent? • Send the GTL command to switch to the local state. GP-IB
The program stops when attempting to read data in INPUT. RS-232C	• Be sure to send a query each time before INPUT. • Did the sent query generate an error?
The GP-IB path is stopped when attempting to read data in INPUT @ (ENTER). GP-IB	• Be sure to send a query each time before INPUT @ (ENTER). • Did the sent query generate an error?
An operation is not performed even though the command was sent.	• Use *ESR? to view the content of the standard event status register and confirm the type of error. • Use *ERR? to check whether an RS-232C communication error was generated. RS-232C
The number of read data sections was insufficient (PC-9801).	• Try using LINE INPUT for data including a comma (,).
Only one response was returned despite sending multiple queries.	• Was an error generated? • Perform one read for each query sent. When you want them to be read in one go, use message separators and place the description on a single line.
The query response message differs from the indications on the panel.	• The indications when the controller performs the read may sometimes not match because the response message is created when the unit receives the query.

1.800.561.8187 www.itm.com information@itm.com

Symptom	Cause/Solution
Service requests are sometimes not generated. GP-IB	• Are the service request enable register and each event status enable register configured properly? • At the end of the SRQ process subroutine, use an ***CLS** command to clear all event registers. If the bits of an event are not cleared once, a service request will not be generated for the same event.
Service requests do not function properly (PC-9801). GP-IB	• When using N88BASIC, add the following four lines (command to set the SRQ flag of a PC-9801 to OFF) to the SRQ process subroutine DEF SEG=SEGPTR(7) A%=PEEK(&H9F3) A%=A% AND &HBF POKE &H9F3,A%
A beep tone is played if a *TRG command is sent.	• Is the trigger setting configured to internal trigger? • The ***TRG** command is only valid for the external trigger setting. The internal trigger setting generates an execution error.
The hardware handshake is not functioning properly. RS-232C	• Is a cable that has CA (RTS) and CB (CTS) shorted being used? Use a cross cable that does not have CA (RTS) and CB (CTS) shorted.

1.800.561.8187 www.itm.com information@itm.com

8.13 Device Document Requirements (Only for Models 3504-50, 3504-60) GP-IB

Standard implementation method related information based on the IEEE 488.2 standard

(1) Functionality of IEEE 488.1 interface function

This is included in 8.2.2 "GP-IB Specifications (Only for Models 3504-50, 3504-60)" (p. 133).

(2) Explanation of operation when the address is set to other than a value from 0 to 30.

Such a setting is not possible.

(3) Recognition of change to the address initially set by the user

The change to the address is recognized when the address is changed.

(4) Explanation of the device settings at power on

The status information is cleared. Other information is backed up. However, the header and response message terminator are initialized.

(5) Description of message exchange options

- Capacity and operation of input buffer
  This is included in8.6.2 "About the Output Queue and Input Buffer" (p. 146).
- Queries that return multiple response message units
  :BIN:FLIMit:COUNt? 3
  :BIN:FLIMit:DEViation? 3
  :BIN:SLIMit:COUNt? 3
  :BIN:SLIMit:DEViation? 3
  :COMParator:FLIMit:COUNt? 2
  :COMParator:FLIMit:DEViation? 3
  :COMParator:SLIMit:COUNt? 2
  :COMParator:SLIMit:DEViation? 3
  :CORRection:DATA?.....4
  :CORRection:LOAD:DATA? 2
  :CORRection:LOAD:REFerence? 2
  :CORRection:OFFSet:DATA? 2
  :CORRection:OPEN:DATA?.....2
  :CORRection:SHORt:DATA? 2
  :MEASure?..... 2, 3, 5
  :MEMory? .....1 to 32000
  :SSOurce:WAIT? 2
- Queries that result in the creation of a response once the syntax is checked
  All queries result in the creation of responses once the syntax is checked.
- Use/non use of queries that result in a response being created upon being read
  Queries that result in a response being created when they are read by the controller are not used.
- Use/non use of a coupling command
  There is no such command.

1.800.561.8187 www.itm.com information@itm.com

(6) List of the functional elements used for device-specific commands and explanation of whether to use compound command program headers

The following are used
- Program message
- Program message terminator
- Program message unit
- Program message unit separator
- Command message unit
- Query message unit
- Command program header
- Query program header
- Program data
- Character program data
- Decimal numeric program data
- Compound command program header

(7) Explanation of buffer capacity limits related to block data

Block data is not used

(8) List of program data elements used in <expression> and maximum nesting level for sub-expressions (including syntax rules assigned for <expression> by device)

Sub-expressions are not used. The program data elements used are character program data and decimal numeric program data.

(9) Explanation of response syntax for each query

The response syntax is included in 8.9 "Message Reference" (p. 172).

(10) Explanation of delay in sending messages between devices not following response message element rules

Messages are not sent between devices

(11) Explanation of block data response capacity

There is no block data response.

(12) List of the common commands and queries used

This is included in 8.7 "Message List" (p. 154).

(13) Explanation of the device state after the calibration command ends without a problem

The ∗CAL? command is not used

(14) Use/non use of the "∗DDT" command

In the case of a ∗DDT command being executed, the maximum block length used to define the trigger macro.
The ∗DDT command is not used.

1.800.561.8187 www.itm.com information@itm.com

(15) Use/non use of the macro command

In the case of the macro command being executed, the maximum macro label length, the maximum block length used to define the macro, and how to process reflection when extending the macro.
The macro command is not used.

(16) Explanation of queries related to the identification and response for the ∗IDN? query

These are defined in 8.9.1 "Common Commands" (p. 173).

(17) Capacity of the user data storage area protected by executing the ∗PUD command and ∗PUD? query

The ∗PUD command and ∗PUD? query are not used. Furthermore, there is no user data storage area.

(18) Explanation of resources when the ∗RDT command and ∗RDT? query are used

The ∗RDT command and ∗RDT? query are not used. Furthermore, there is no user data storage area.

(19) Explanation of effect of ∗RST, ∗LRN?, ∗RCL?, and ∗SAV

∗LAN?, ∗RCL?, and ∗SAV are not used. The ∗RST command returns the unit to the initial state.
(Refer to 8.9.1 "Common Commands" (p. 173), 8.10 "Initialized Items" (p. 245).)

(20) Explanation of the range of the self test executed by the ∗TST? query

This is included in the section on "∗TST?" (p. 173) in 8.9.1 "Common Commands".

(21) Explanation of additional structure for the status data used in the status report of the Device

This is included in 8.6.4 "About Event Registers" (p. 149).

(22) Explanation of whether each command is an overlap or sequential command

All commands except :MEASure?, :MEMory?, :CORRection:OPEN, :CORRection:SHORt, and :CORRection:LOAD are sequence commands.

(23) Explanation of criteria related to the function requested when an operation end message is generated as a response for a command

The operation end message is generated when the command is analyzed.

1.800.561.8187 www.itm.com information@itm.com

Specifications Chapter 9

9.1 Basic Specifications

Product Specifications

Measurement items	C (capacitance), D (dissipation factor tanδ)
Measurement Frequency	120 Hz, 1 kHz Frequency accuracy: ±0.01% or less
Measurement Signal Level	(1) Constant voltage mode: 100 mV (only for Model 3504-60), 500 mV, 1 V Measurement range CV1 V: to 70 μF range (measurement frequency: 1 kHz) CV1 V: to 0.7 mF range (measurement frequency: 120 Hz) Cv100 mV, CV500 mV: to 170 μF range (measurement frequency: 1 kHz) Cv100 mV,CV500 mV: to 1.45 mF range (measurement frequency: 120 Hz) Signal level accuracy of ±10% ± 5 mV (2) Open terminal voltage mode: 100 mV (only for Model 3504-60), 500 mV, 1 V Measurement range: other than above Output resistance: 5 Ω ±1 Ω Signal level accuracy: ±10% ± 5 mV
Guaranteed Accuracy Range	C : 0.9400 pF to 20.0000 mF D : 0.00001 to 0.10000 (0.10001 to 1.99999 are reference values)
Measurement Range	C : 009.400 pF to 20.0000 mF (120 Hz, 10 range) 00.9400 pF to 2.00000 mF (1 kHz, 10 range) Auto, manual (up, down)
Equivalent Circuit Mode	Series and parallel equivalent circuit modes Auto, manual
Measurement Time	Representative value: 2.0 ms (measurement frequency: 1 kHz, measurement speed: FAST) * The measurement speed differs depending on the measurement frequency and measurement speed.
Measurement Speed	FAST, NORMAL, SLOW
Trigger Function	Setting of internal trigger or external trigger is possible
Zero Compensation	Open circuit and short circuit compensation is possible
Load Compensation	Measuring the sample to be used as the standard sample and then compensating the measurement values is possible
Offset circuit compensation	Set value cannot be subtracted from the measurement value

Product Specifications

<table>
<tr><td>Self Calibration</td><td>Decrease the drift of the measurement value
OFF, MANUAL, AUTO
In MANUAL setting, when there is a request to start from EXT I/O during the TRG signal activation, self calibration value will be acquired and adjusted.
When there is a request to start from communication, self calibration will be acquired and adjusted in the measurement after the request for self calibration.</td></tr>
<tr><td>Average</td><td>1 to 256 (necessary)</td></tr>
<tr><td>Triggerdelay</td><td>0 to 9.999s (0.001s resolution)</td></tr>
<tr><td>Contact Check Function
(only for Model 3504-60)</td><td>Threshold value for contact check abnormality
<table>
<tr><th></th><th>Range 1 to 8</th><th>Range 9, 10</th></tr>
<tr><td>Hc terminal connection resistance +
Hp terminal connection resistance</td><td>Approx.500 Ω</td><td>Approx.100 Ω</td></tr>
<tr><td>Lc terminal connection resistance +
Lp terminal connection resistance</td><td>Approx.500 Ω</td><td>Approx.100 Ω</td></tr>
</table>
Result output during contact check abnormality
EXT I/O output ...error signal output (same signal line as CV error signal)
LED display.....error shown in MAIN display
See (p. 14)</td></tr>
<tr><td>Low C Reject Function</td><td>Detect contact abnormality (detects OPEN state of 2-terminal connection).
Output as a contact error if the measurement value is lower than the judgment standard.
Judgement standard ..Can be set to 0.001% to 10.000% (0.001% resolution) of the full case of the range.
Error output .....LED lights up, as well as error output from EXT I/O.</td></tr>
<tr><td>Measurement Level Monitoring Function</td><td>Detect contact abnormalities (detect chattering)
Takes the first waveform effective value (the first half of a waveform during FAST setting, otherwise the first waveform effective value) as a basis for comparison, and outputs a contact error if the fluctuation of the following waveform effective values exceeds the judgment standard.
Judgment standard ....0.01% to 100.00% (0.01% resolution) of the reference value
Error output ..... LEU_E output in the main display area, as well as error output from EXT I/O</td></tr>
<tr><td>Trigger Synchronous Output Function</td><td>Applying a measurement signal only during measurement is possible</td></tr>
<tr><td>Key Lock Function</td><td>The setting and canceling of this function by pressing a key on the front panel is possible</td></tr>
<tr><td>BIN Measurement (Only for Model 3504-50, 3504-60)</td><td>The setting of 14 categories for C and upper limit and lower limit values for D is possible (absolute value setting, Δ% setting)</td></tr>
<tr><td>Comparator</td><td>The setting of the upper limit and lower limit values of each of C and D is possible (absolute value setting, Δ% setting)</td></tr>
</table>

1.800.561.8187 www.itm.com information@itm.com

Product Specifications

Panel Save and Load	The saving of 99 sets of measurement conditions is possible The reading of any measurement condition (readable settings: ALL, compensation values only, and measurement conditions only) by pressing a key or sending a EXT I/O control signal is possible
Buzzer Tone	Setting the buzzer for comparator judgment results (IN or NG) to ON or OFF is possible
Printer Function	Printing measurement values is possible * The 9442 and 9444 options are required

Basic Specifications

Display Device	LED	
Operating Temperature and Humidity Ranges	0 to 40°C (32 to 104°F), 80% RH or less, no condensation	
Storage Temperature and Humidity Ranges	-10 to 55°C (14 to 131°F), 80% RH or less, no condensation	
Location of Use	Indoors, Pollution degree 2, Altitude up to 2000 m (6562-ft.)	
Rated Power Voltage	100, 120, 220, and 240 V AC are settable (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.)	
Rated Power Frequency	50/ 60 Hz	
Maximum Rated Apparent Power	110 VA	
Dimensions	Approx. 260 W x 100 H x 220 D mm (excluding protrusions) (10.24”W × 3.94”H × 8.66”D)	
Mass	Approx. 3.8 kg (134.0 oz.)	
Period of guaranteed accuracy	1 years	
Product warranty period	3 years	
Specification Compliance	EMC	EN61326 Class A EN61000-3-2 EN61000-3-3
	Safety	EN61010
Radiated Immunity Level	C: 6% rdg, D: 0.04 at 10 V/m	
Conducted Immunity Level	C: 0.2% rdg, D: 0.005 at 3 V	
Withstand Voltage	Between the power wire and ground wire: 1.62 kV AC for 60 seconds	
Backup Battery (Lithium Battery) Lifespan	Approx. 6 years	
Interfaces	EXT I/O (standard) RS-232C Interface (standard) GP-IB Interface (only for Model 3504-50, 3504-60)	

1.800.561.8187 www.itm.com information@itm.com

Basic Specifications

Standard Accessories	• 2 pin power cord with ground • Instruction manual • Spare fuse for power supply (Select from 100 to 120 V and 220 to 240 V in accordance with destination) For 100 to 120V: 250VF1.0AL ϕ5 x 20 mm For 220 to 240V: 250VF0.5AL ϕ5 x 20 mm
Options	Probes and Fixtures • Model 9140 4-Terminal Probe • Model 9143 Pincher Probe • Model 9261 Test Fixture • Model 9262 Test Fixture • Model 9263 SMD Test Fixture • Model 9677 SMD Test Fixture • Model 9699 SMD Test Fixture Printer Related • Model 9442 Printer • Model 9443-01 AC Adapter (for Japan) • Model 9443-02 AC Adapter (for EU) • Model 9444 Connection Cable (for the printer) • Model 1196 Recording Paper Cables • Model 9151-02 GP-IB Connector Cable • Model 9151-04 GP-IB Connector Cable

1.800.561.8187 www.itm.com information@itm.com

9.2 Accuracy

Basic Accuracy

Guaranteed accuracy for temperature and humidity ranges: 23±5°C, 80% RH or less (no condensation)
Warm-up time: 1 hour

Measurement Accuracy = Basic Accuracy × Measurement Signal Level Coefficient × Measurement Speed Coefficient × Cable Length Coefficient × Temperature Coefficient

Measurement signal level		100 mV	500 mV	1 V
	Coefficient	1.5	1	1

Measurement speed		FAST	NORMAL	SLOW
	Coefficient	1.5	1.0 (during 1 kHz 1V) 1.2 (besides 1 kHz 1V)	1

Cable length		0 m	1 m
	Coefficient	1	1.0 (during 1 kHz 1V) 1.5 (besides 1 kHz 1V)

Temperature*1		t = Operating temperature (°C)
	Coefficient	1 + 0.1 x | t-23 |

*1:The coefficient is 1 when the operating temperature (t) is 23±5°C.

Measurement Conditions

Measurement signal level: 1 V
Measurement speed: SLOW
Executing open circuit and short circuit compensation
Cable length: 0 m

C-D (CL: electrostatic capacitance [pF] of sample, , CH: electrostatic capacitance [mF] of sample) **when D ≤ 0.1**

Range No.	Frequency Parameter	Guaranteed Accuracy of 6 Months		Guaranteed Accuracy of 1 Year	
		120 Hz	1 kHz	120 Hz	1 kHz
1	C	±0.20%rdg.±300dgt.	±0.20%rdg.±300dgt.	±0.30%rdg.±450dgt.	±0.30%rdg.±450dgt.
	D	±0.0120±2/CL	±0.0120±0.25/CL	±0.0180±3/CL	±0.0180±0.375/CL
2	C	±0.20%rdg.±60dgt.	±0.20%rdg.±60dgt.	±0.30%rdg.±90dgt.	±0.30%rdg.±90dgt.
	D	±0.0020±2.2/CL	±0.0020±0.265/CL	±0.0030±3.3/CL	±0.0030±0.3975/CL
3	C	±0.16%rdg.±20dgt.	±0.14%rdg.±20dgt.	±0.24%rdg.±30dgt.	±0.21%rdg.±30dgt.
	D	±0.0036	±0.0036	±0.0054	±0.0054
4	C	±0.15%rdg.±15dgt.	±0.13%rdg.±15dgt.	±0.23%rdg.±23dgt.	±0.20%rdg.±23dgt.
	D	±0.0020	±0.0020	±0.0030	±0.0030
5	C	±0.15%rdg.±15dgt.	±0.13%rdg.±15dgt.	±0.23%rdg.±23dgt.	±0.20%rdg.±23dgt.
	D	±0.0016	±0.0016	±0.0024	±0.0024
6	C	±0.15%rdg.±15dgt.	±0.09%rdg.±10dgt.	±0.23%rdg.±23dgt.	±0.14%rdg.±15dgt.
	D	±0.0020	±0.0016	±0.0030	±0.0024
7	C	±0.25%rdg.±20dgt.	±0.13%rdg.±15dgt.	±0.38%rdg.±30dgt.	±0.20%rdg.±23dgt.
	D	±0.0035	±0.0030	±0.00525	±0.0045
8	C	±1.2%rdg.±50dgt.	±0.7%rdg.±40dgt.	±1.8%rdg.±75dgt.	±1.05%rdg.±60dgt.
	D	±0.0060	±0.0050	±0.0090	±0.0075

1.800.561.8187 www.itm.com information@itm.com

C-D (CL: electrostatic capacitance [pF] of sample, , CH: electrostatic capacitance [mF] of sample) **when D ≤ 0.1**

Range No.	Frequency Parameter	Guaranteed Accuracy of 6 Months		Guaranteed Accuracy of 1 Year	
		120 Hz	1 kHz	120 Hz	1 kHz
9	C	±1.2%rdg.±50dgt.	±0.7%rdg.±40dgt.	±1.8%rdg.±75dgt.	±1.05%rdg.±60dgt.
	D	±0.0060	±0.0050	±0.0090	±0.0075
10	C	±2.5%rdg.±50dgt.	±2.0%rdg.±40dgt.	±3.75%rdg.±75dgt.	±3.0%rdg.±60dgt.
	D	±0.0200±0.008xC_H	±0.0180±0.08xC_H	±0.0300±0.012xC_H	±0.0270±0.12xC_H

* Not certified guaranteed when range is No.1 and No. 2 for measurement signal level 100 mV.

Support for Range Numbers and Range Names

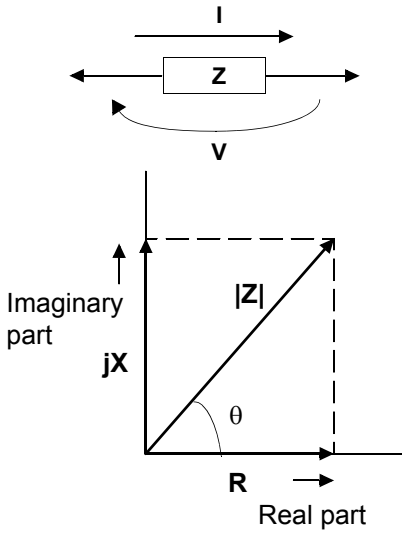
Yes: Available/ No: Unavailable

Parameter	C		CV Operation
Frequency Range No.	120 Hz	1 kHz	
1	200 pF	20 pF	Yes
2	2 nF	200 pF	Yes
3	20 nF	2 nF	Yes
4	200 nF	20 nF	Yes
5	2 μF	200 nF	Yes
6	20 μF	2 μF	Yes
7	200 μF	20 μF	Yes
8	0.7 mF (when 1 V) 1.45 mF (when 500 mV, 100 mV)	70 μF (when 1 V) 170 μF (when 500 mV, 100 mV)	Yes
9	2 mF	200 μF	No
10	20 mF	2 mF	No

NOTE When D>0.1, the measurement values are the reference values.

9.3 Measurement Parameters and Arithmetic Expressions

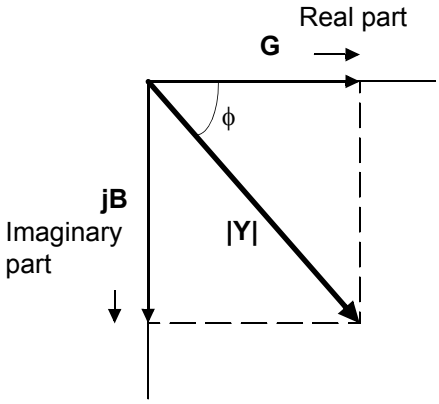
In general, impedance Z is used to evaluate the characteristics of, for example, circuit components.
Measure voltage and current vectors for circuit components relative to AC measurement frequency signals. The unit uses these values to obtain the impedance Z and phase difference θ. The following values can be obtained from impedance Z by rotating the impedance Z around the complex plane.



$$Z = R + jX = |Z|\angle\theta$$
$$\theta = \tan^{-1}\frac{X}{R}$$
$$|Z| = \sqrt{R^2 + X^2}$$

Z : Impedance (Ω)
θ : Phase angle (deg)
R : Resistance (Ω)
X : Reactance (Ω)
$|Z|$: Absolute value of impedance (Ω)

Furthermore, admittance Y that is the reciprocal of impedance Z can also be used depending on the characteristics of circuit components. As in the case of impedance Z, the following values can also be obtained from admittance Y by rotating the admittance Y around the complex plane



$$Y = G + jB = |Y|\angle\phi$$
$$\phi = \tan^{-1}\frac{B}{G}$$
$$|Y| = \sqrt{G^2 + B^2}$$

Y : Admittance (S)
ϕ : Phase angel (deg) = $-\theta$
G : Conductance (S)
B : Susceptance (S)
|Y| : Absolute value of admittance (S)

The unit calculates each of the elements using the following arithmetic expressions, based on a voltage V applied between terminals of the measurement sample, a current I that flows through the sample at that time, a phase angle θ between voltage V and current I, and an angle speed ω of the measurement frequency.

Item	Series Equivalent Circuit Mode	Parallel Equivalent Circuit Mode
Z	$\|Z\| = \frac{V}{I} (= \sqrt{R^2 + X^2})$	
C	$Cs = -\frac{1}{\omega \|Z\| \sin\theta}$	$Cp = \frac{\sin(-\theta)}{\omega \|Z\|}$
D	$D = \frac{\cos\theta}{\|\sin\theta\|}$	

Cs indicates the measurement item of C in the series equivalent circuit mode
Cp indicates the measurement item of C in the parallel equivalent circuit mode.

Maintenance and Service Chapter 10

10.1 Inspection, Repair, and Cleaning

To ensure safe use, periodically inspect the unit

⚠WARNING

Never modify the unit. Only Hioki service engineers should disassemble or repair the unit. Failure to observe these precautions may result in fire, electric shock, or injury.

⚠CAUTION

If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.

n any of the following cases, stop using the unit, disconnect the power cord, and contact your dealer or Hioki representative.

- The unit is clearly damaged.
- Measurement is not possible.
- The unit was stored for a prolonged period of time in a very hot and humid location or other unfavorable conditions.
- Rough transportation resulted in stress being applied.
- The unit has become wet with water or dirty with oil or dust.
- If the unit becomes wet with water or oil and dust enters inside, the risk of an electrical accident or fire will be greatly increased as a result of deterioration of the insulation.

In the following case, submit the unit to be repaired by our repair service personnel.

- Measurement conditions can no longer be saved.
  The unit contains a built-in backup lithium battery, which offers a service life of about six years. Measurement conditions can no longer be saved after the life of the battery runs out.

10

Transportation

NOTE

- Pack the unit so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.
- Use the original packing materials when transporting the unit, if possible.

Before Submitting the Unit for Repairs

Symptom	Check Item	Solution
No indications appear on the display when the power	Is the power cord disconnected?	Connect the power cord.
	Is the fuse blown?	Replace the fuse.

1.800.561.8187 www.itm.com information@itm.com

Symptom	Check Item	Solution
Key input is not possible.	Is the key lock set?	Cancel the key lock.
	Is the unit being remotely operated from an external device using GP-IB?	Switch GP-IB to local
	Is the unit being remotely operated from an external device using RS-232C?	Switch RS-232C to local.
"i-ovEr Error" appears in the MAIN display area.	Were large capacitance components and other low-impedance components measured at range 7,8 for a prolonged period?	Open the measurement terminal and press ENTER.
"CV-Lo" appears in the MAIN display area.	Are all the measurement terminals open?	Connect the probe or fixture to the unit.
	Is there a high contact resistance between the measurement terminal and sample?	Gently wipe the measurement terminals with a cloth.
	Is the cable of the probe or fixture disconnected?	Submit the fixture for repair. Replace the probe with a new one. (The probe cannot be repaired.)
The measurement values are abnormal when measuring known samples such as standard capacitors.	Are the measurement conditions of known samples same as the measurement conditions of this main unit?	Set the measurement conditions appropriately. **See** 3.3 "Setting the Measurement Conditions" (p. 26)
	Are the OPEN and SHORT compensations appropriate?	Re-perform the OPEN and SHORT compensation. **See** 4.1 "Open Circuit Compensation and Short Circuit Compensation" (p. 37)
	Is LOAD compensation enabled?	Turn LOAD compensation off. **See** 4.2 "Load Compensation" (p. 47)
	Does a wait time, which is from connecting the sample to starting measurement, fall short?	Set an appropriate trigger delay or wait time for trigger synchronous output function. **See** 6.2 "Trigger Delay Setting" (p. 93) 6.5 "Trigger Synchronous Output Function" (p. 104) "Setting and Query of Wait Time for Trigger Synchronous Output Function" (p. 239)
Do not know what the cause is.		Try resetting the system. **See** 6.11 "Performing a System Reset" (p. 117)

Cleaning

⚠CAUTION

To clean the unit, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.

1.800.561.8187 www.itm.com information@itm.com

10.2 Replacing the Power Fuse ⚠

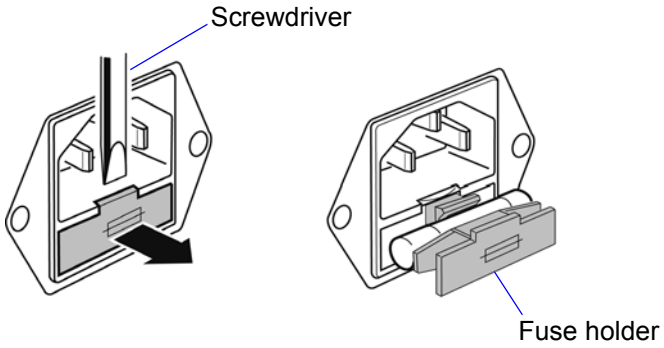
⚠WARNING

- **To avoid an electric accident, be sure to turn the power switch off and disconnect the power cord before replacing the fuse or switching the power voltage.**
  Afterwards, be sure to check that the power voltage set for the power switch with power selectors on the rear of the unit and the voltage to be used match before reconnecting the power cord.
- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Using a non-specified fuse or shorting the fuse holder may cause a life-threatening hazard.**
  Fuse type: 100 V 120 V setting: 250 V F1.0AL ϕ5 mm x 20 mm
  220 V 240 V setting: 250 V F0.5AL ϕ5 mm x 20 mm
- **Prior to shipment, the power voltage is set and the fuse designated for that power voltage is included (same applies for the spare fuse). If you want to set another power voltage, be sure to replace the fuse with one of the designated rating.**
- **If you want to use a power voltage other than one indicated, set the corresponding power voltage setting shown below.**
  Set the power voltage to 110 V →120 V/ 200V→220 V/230 V→240 V
  See 2.2 "Checking the Power Voltage" (p. 18)

Removing the Fuse Holder

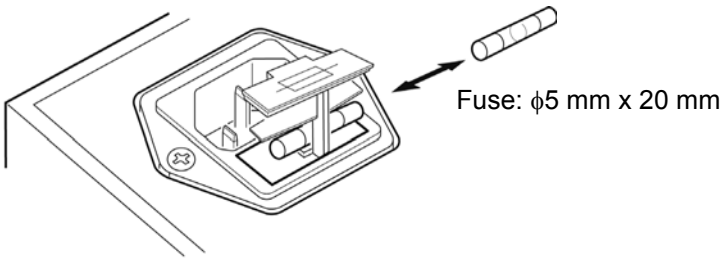
Tools to Prepare: Flat blade screwdriver

Rear panel of the unit



1. Turn off the power switch and disconnect the power cord.
2. Align the flat blade screwdriver with the fuse holder securing part of the power inlet and then remove the fuse holder by pushing the handle of the screwdriver toward the opposite side of the unit.

Replacing the Power Fuse



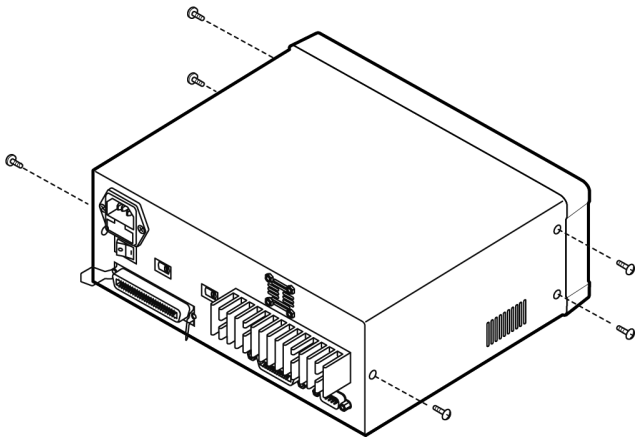
3. Replace the power fuse with a fuse of the designated rating.
4. Reinsert the fuse holder in the power inlet.

10.3 Discarding the Unit

The unit uses a lithium battery as power for storing measurement conditions.

WARNING

- **To avoidelectric shock, turn off the power switch and disconnect the power cord, probes, and fixtures before removing the lithium battery.**
- **When disposing of this unit, remove thelithium battery and dispose of battery and unit in accordance with local regulations.**
- **If the protective functions of the unit are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.**



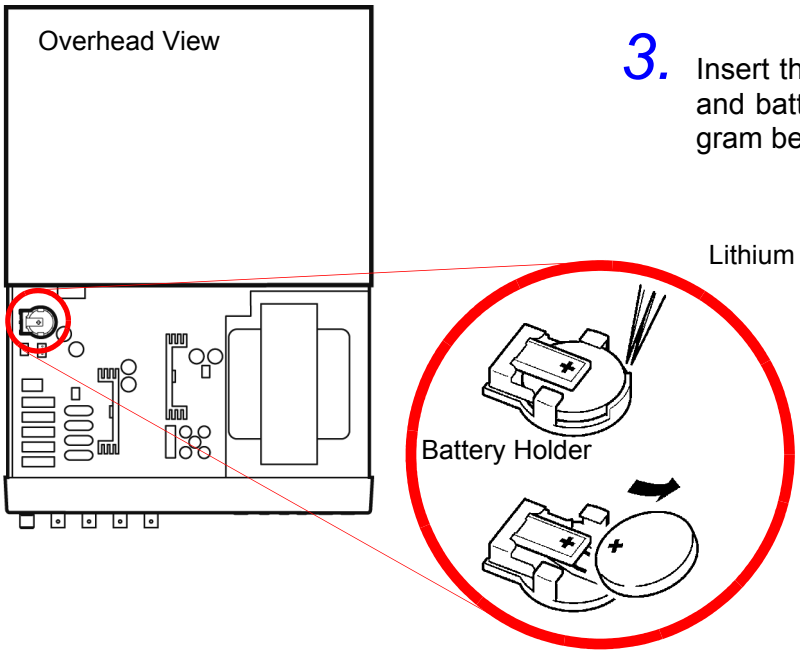
Tools to Prepare:

- One Phillips screwdriver
- Pair of tweezers

1. Remove the six screws from the sides of the unit.

2. Remove the case.

3. Insert the tweezers between the battery and battery holder as shown in the diagram below and lift up the battery.



NOTE

Take care not to short the + and -. Doing so may cause sparks.

CALIFORNIA, USA ONLY
This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Appendix

Appendix 1 Countermeasures Against Incorporation of External Noise

The unit is designed not to malfunction as a result of noise incorporated from the probes, fixture, and power line. However, extremely large levels of noise may still cause measurement errors and malfunctions.

Refer to the following examples of countermeasures against noise when the unit malfunctions, etc

Appendix 1.1 Countermeasures Against Incorporation of Noise from the Power Line

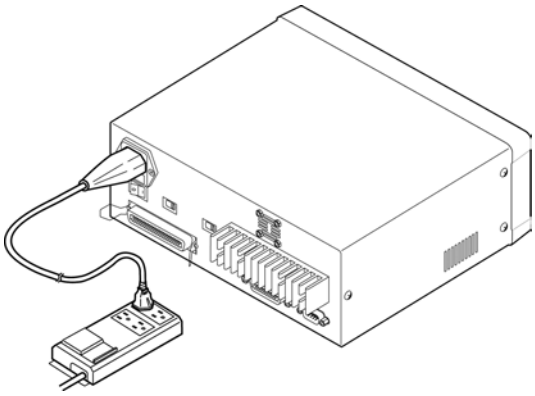
You can use the following countermeasures to reduce the effect of noise being incorporated from the power line.

Grounding Using a Protective Ground Wire

The unit is structured so that the ground wire of the power cable can be used as protective grounding for the unit. Protective grounding plays an important role in not only the prevention of electrical accidents but also the use of an internal filter to eliminate the incorporation of noise from the power line.
Use the supplied power cord.

Attaching a Noise Filter to the Power Line

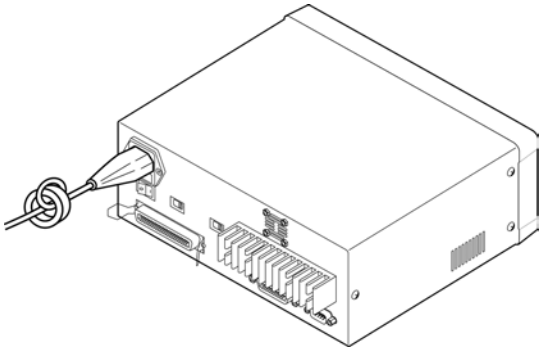
Connect a commercial plug-in noise filter to the power outlet and then connect the unit to the output of the noise filter in order to suppress the incorporation of noise from the power line.
Plug-in noise filters are commercially available from various specialist manufacturers.



1.800.561.8187 www.itm.com information@itm.com

Attaching an EMI Suppression Ferrite Core to the Power Cord

Pass the power cord through a commercially available EMI suppression ferrite core and secure the core as close as possible to the AC power inlet of the unit in order to suppress the incorporation of noise from the power line.
Suppression is even more effective if you also attach an EMI suppression ferrite core close to the power plug of the power source.
If a toroidal ferrite core or split ferrite core with a large enough internal diameter is used, the amount of noise suppression can be increased by passing the power cord through the core several times.
EMI ferrite cores and ferrite beads are commercially available from various specialist manufacturers.

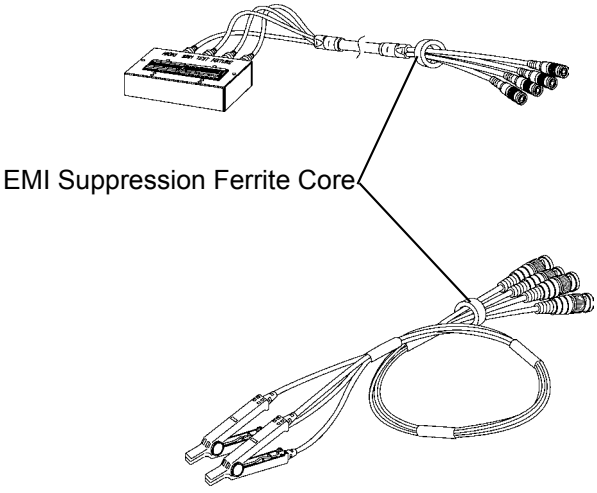


Appendix 1.2 Countermeasures Against Incorporation of Noise from the Input Line (Types of Probe)

You can use the following countermeasures to reduce the effect of noise being incorporated from, for example, a probe or fixture.

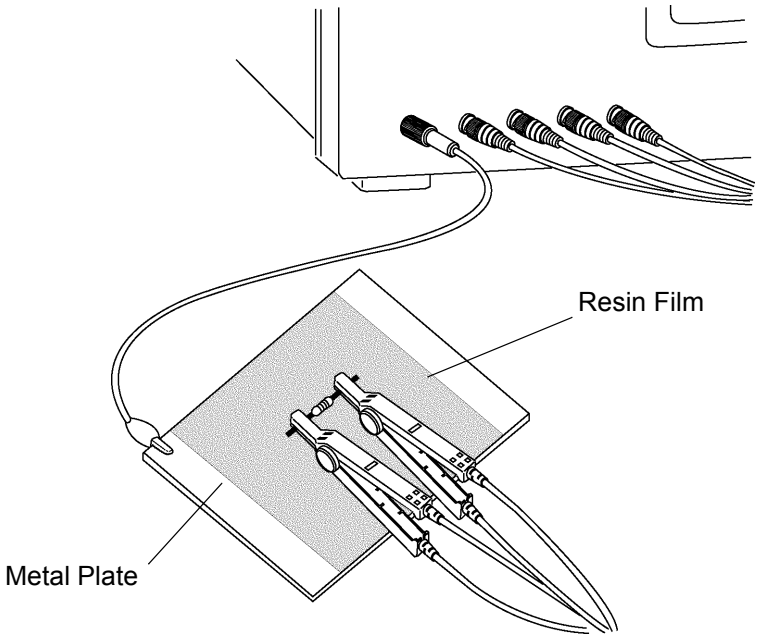
Attaching an EMI Suppression Ferrite Core to Commercial Cables

Noise from things like probes can be suppressed if you pass them through commercially available EMI suppression ferrite cores and secure the cores as close as possible to the measurement terminals. Furthermore, if large enough ferrite cores are used, the amount of noise suppression can be increased by passing things like probes through the cores several times in the same manner as with the power cord.



Appendix 2 Measurement of High Impedance Components

Since high impedance components (for example, capacitors of 1 μF or less) are susceptible to things like external induction noise, measurement values may become unstable. When this happens, stable measurement can be performed by measuring components on a metal plate connected to the GUARD terminal (shielding process).



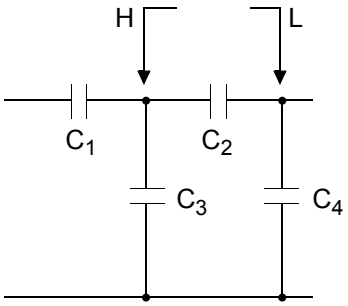
When measuring components on a metal plate, use, for example, resin film as insulation to ensure terminals and the like are not short-circuited.
Open circuit compensation is high impedance measurement, so be sure to use the shielding process. If it is not used, the compensation values may become unstable and affect the measurement values.

Appendix 3 Measurement of In-circuit Components

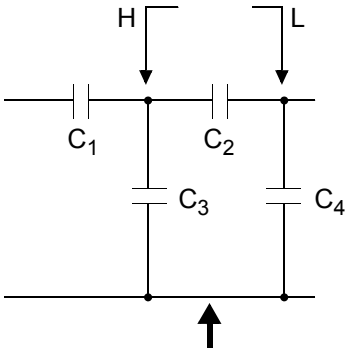
Measurement Using Guarding Technique

Measure an in-circuit component after providing guarding.

$$C = C2 + \frac{C3 \times C4}{C3 + C4}$$



When measuring the capacitance of capacitor C_2 as shown in the diagram, measure the parallel capacitance by adding up the value of the current that flows through capacitor C_2 and the values of the current that flows through capacitors C_3 and C_4, after the probes are connected to both sides of capacitor C2.

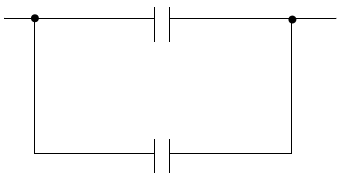


To guard terminal

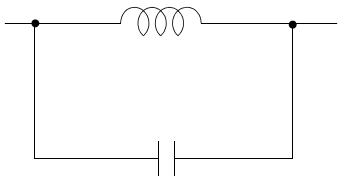
If you use a guard terminal as shown in the diagram, however, the current does not flow through capacitor C_4 and the current that flows through capacitor C_3 is absorbed by the guard terminal so that you can measure the capacitance of capacitor C_2.

NOTE

- However, if, for example, the capacitance of C_2 is less than that of C_3 ($C_2 << C_3$), this technique does not improve measurement precision.
- When two capacitors or a capacitor and a coil are connected in parallel as shown in the diagram, you cannot measure each component separately.



Two capacitors connected in parallel



A coil and a capacitor connected in parallel

Appendix 4 Mounting the Unit in a Rack

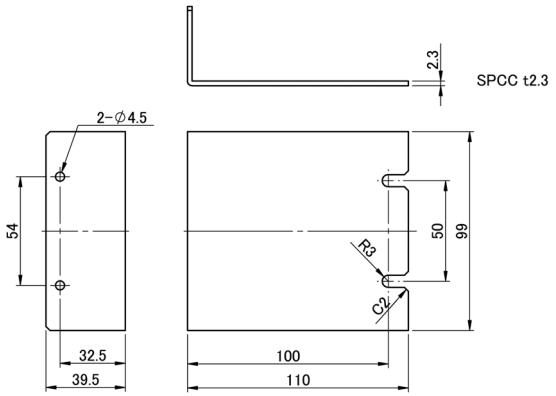
You can remove the screws on the sides of the unit and attach rack mounting brackets.

⚠WARNING

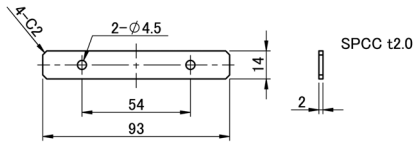
To avoid damage to the unit or an electrical accident, be sure to observe the following precautions on using screws.

- **Ensure that the screws used to attach the rack mounting brackets to the sides of the unit are not screwed into the unit more than 6 mm.**
- **If the rack mounting brackets are removed, be sure to use screws identical to the ones used originally.**
  (Support legs: M3 x 6 mm, side covers: M4 x 6 mm)

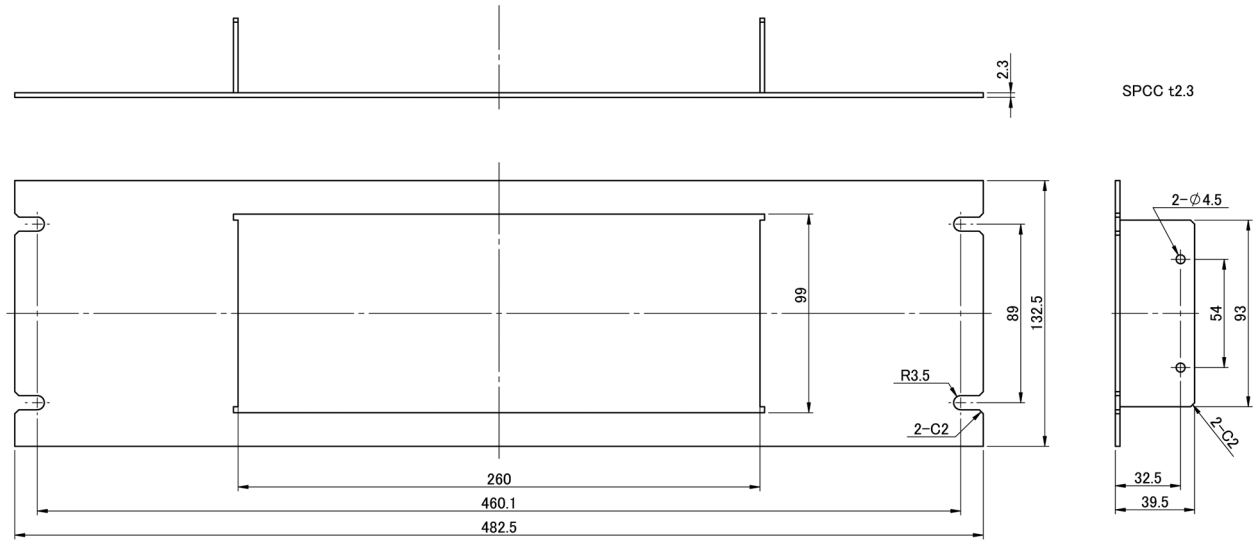
Reference Diagrams and Attachment Procedure for Rack Mounting Brackets



Rack Mounting Bracket (JIS)



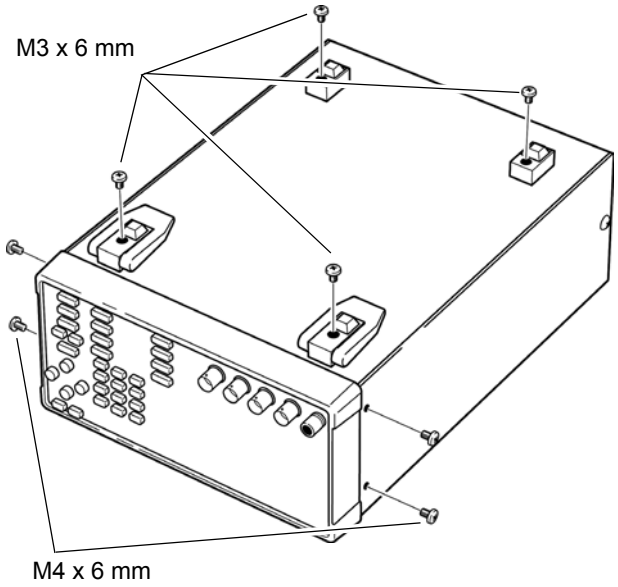
Spacers (Use 2)



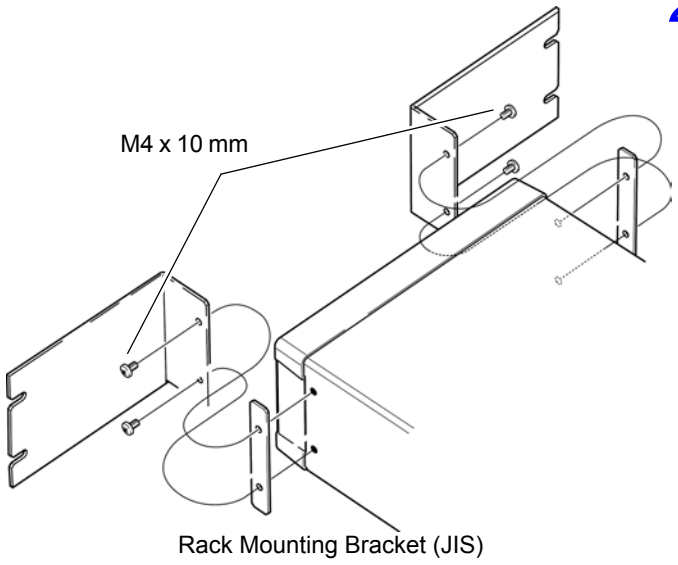
Rack Mounting Bracket (EIA)

Appendix

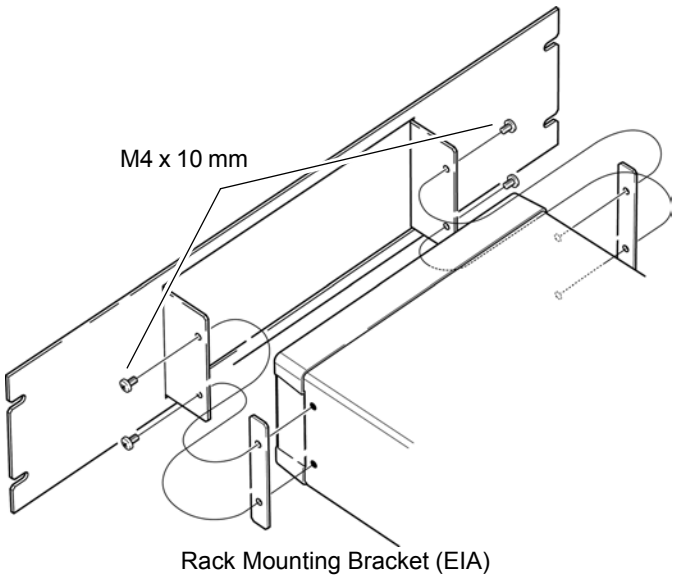
Appendix 4 Mounting the Unit in a Rack



1. Remove the support legs from the bottom of the unit and screws from the side covers (4 screws at the front).

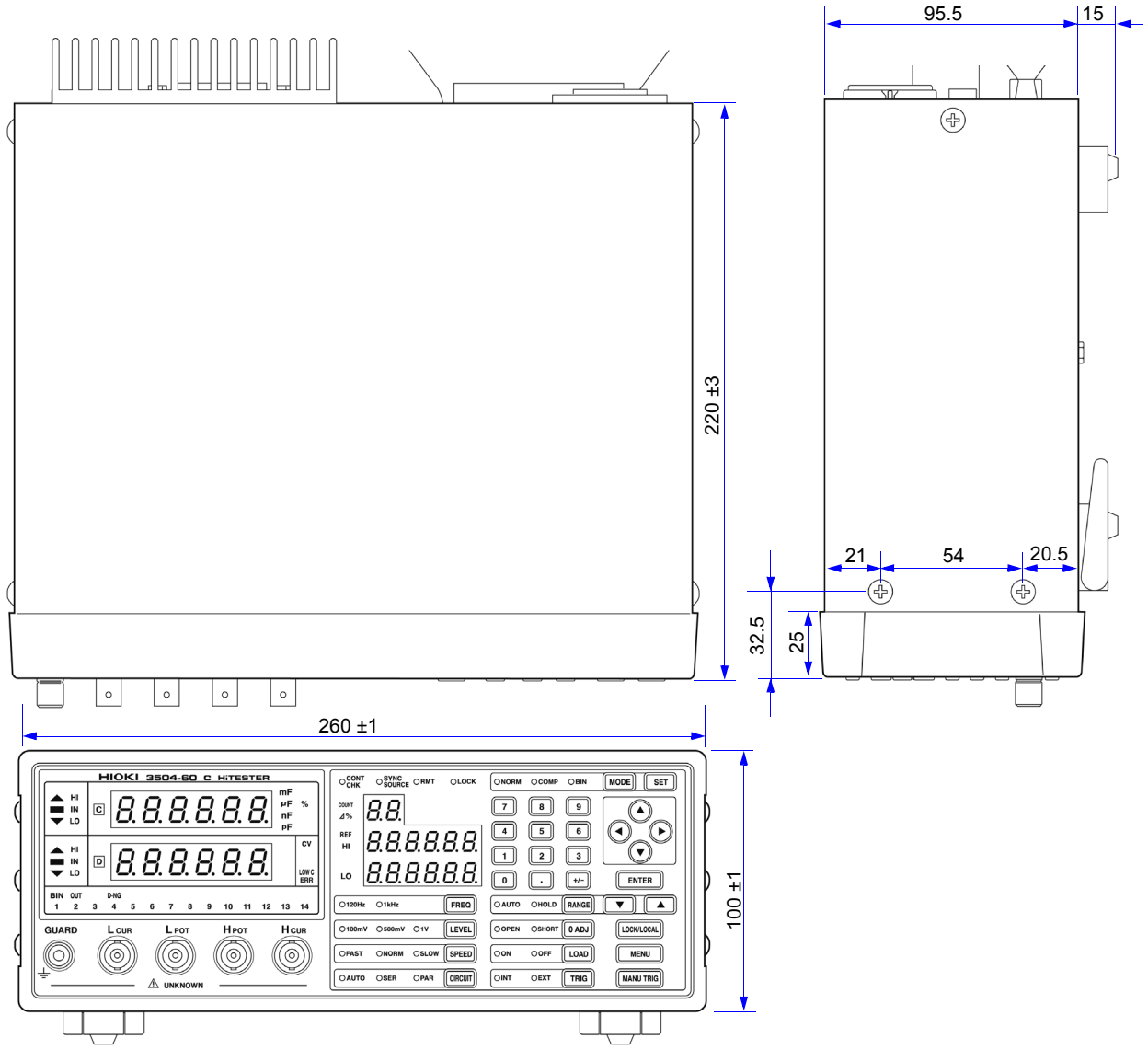


2. Insert spacers on both sides of the unit and attach the mounting brackets with M4 x 10 mm screws.



When mounting the unit in a rack, use, for example, a commercially available base for reinforcement

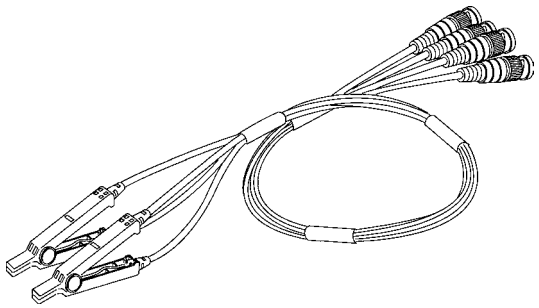
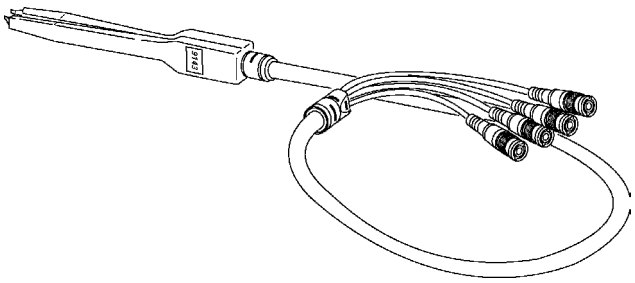
Appendix 5 External View



(Unit: mm)

Appendix 6 Options

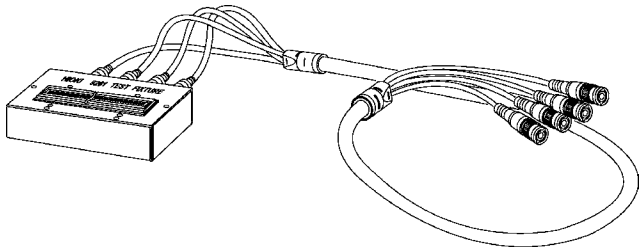
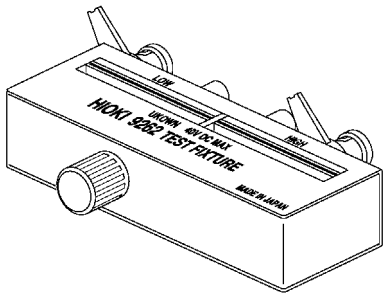
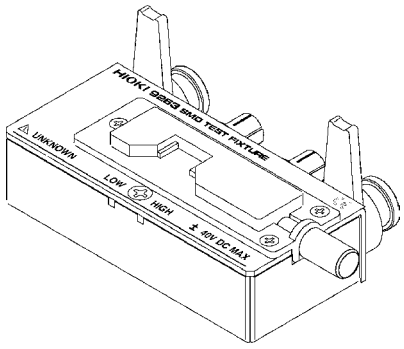
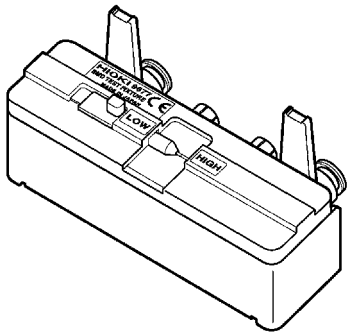
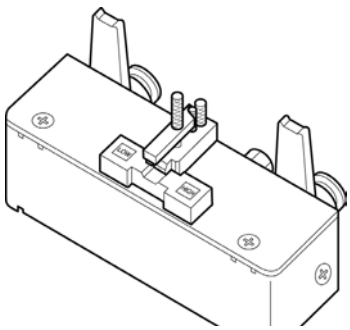
Probes

9140 4-Terminal Probe This is an alligator clip measurement probe. It is a versatile probe that can be clipped on wires ranging from relatively thin to thick.	
9143 Pincher Probe This pincher probe is convenient for measuring components such as chips. The impedance range that can be measured differs depending on the frequency.	

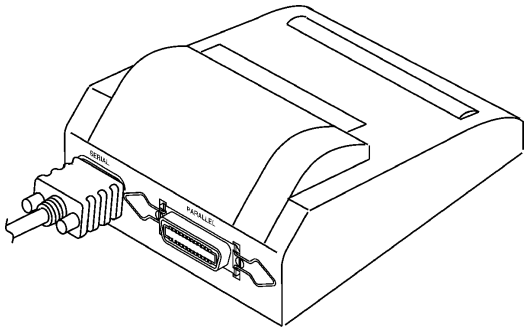
NOTE

- Try your best to ensure even force is applied when using a probe. Since the contact resistance varies depending on the contact pressure, uneven force may cause variations in values.
- Open and close by holding the clip part of the 9140. If you hold the cable when opening or closing the clip, too much stress may be added to the cable, causing it to break.

Fixtures

9261 Test Fixture It is relatively easy to attach and remove samples when you use this type of fixture.	
9262 Test Fixture	
9263 SMD Test Fixture This fixture is suitable for measuring components such as chips.	
9677 SMD Test Fixture	
9699 SMD Test Fixture	

Printer

9442 Printer Use this cable when using the synchronous measurement function • 9443-01 AC Adapter (when using the printer in Japan) • 9443-02 AC Adapter (when using the printer in the EU) • 9444 Connection Cable • 1196 Recording Paper	

Appendix 7 Initial Settings Table

Factory default settings are as follows.

Yes: Available/ ←: The same as the left/ No: Unavailable

Setting Items			Initial Setting	Operate from Front Panel	:PRE-Set	*RST	Return to Initial Settings when Power is Turned On	Save	Back Up
Measurement Signal	Frequency		1 kHz	←	←	←	No	Yes	Yes
	Signal Level		1 V	←	←	←	No	Yes	Yes
Measurement Range	Switch		AUTO	←	←	←	No	Yes	Yes
	Range		1	←	←	←	No	Yes	Yes
Equivalent Circuit Mode	Switch		AUTO	←	←	←	No	Yes	Yes
	Mode		Par(parallel)	←	←	←	No	Yes	Yes
Measurement Speed			NORM	←	←	←	No	Yes	Yes
Average	ON/ OFF		ON	←	←	←	No	Yes	Yes
	Number of Times		1	←	←	←	No	Yes	Yes
Trigger	Mode		Int(Internal)	←	←	←	No	Yes	Yes
	Delay	ON/ OFF	ON	←	←	←	No	Yes	Yes
		Time	0.0s	←	←	←	No	Yes	Yes
Trigger Synchronous Function	ON/ OFF		OFF	←	←	←	No	Yes	Yes
	Wait Time	120 Hz	10 ms	←	←	←	No	Yes	Yes
		1 MHz	2 ms	←	←	←	No	Yes	Yes
Open Circuit Compensation	Compensation Value	Compensation of G	0S	No Change	No Change	0S	No	Yes	Yes
		Compensation of B	0S	No Change	No Change	0S	No	Yes	Yes
	Parameter Type		ZPH	No Change	No Change	ZPH	No	Yes	Yes
	Open Compensation Conditions		All enabled	←	←	←	No	No	Yes
Short Circuit Compensation	Compensation Value	Compensation of R	0 Ω	No Change	No Change	0 Ω	No	Yes	Yes
		Compensation of X	0 Ω	No Change	No Change	0 Ω	No	Yes	Yes
	Parameter Type		ZPH	No Change	No Change	ZPH	No	Yes	Yes
	Short Compensation Conditions		All enabled	←	←	←	No	No	Yes
Load Circuit Compensation *1	Compensation Value	Impedance Coefficient	1	No Change	No Change	1	No	Yes	Yes
		Phase Coefficient	0	No Change	No Change	0	No	Yes	Yes
	Parameter Type		COEF	No Change	No Change	COEF	No	Yes	Yes
	Reference Value	Reference Value of C	100000	No Change	No Change	100000	No	Yes	Yes
		Reference Value of D	0	No Change	No Change	0	No	Yes	Yes
Offset Circuit Compensation	ON/OFF		OFF	No Change	No Change	OFF	No	Yes	Yes
	Compensation Value	Compensation Value of C	0	No Change	No Change	0	No	Yes	Yes
		Compensation Value of D	0	No Change	No Change	0	No	Yes	Yes

*1 Measurement conditions for initial values: Level: 1 V, Frequency: 2 kHz, Bias: OFF

Appendix

Yes: Available/ ←: The same as the left/ No: Unavailable

Setting Items			Initial Setting	Operate from Front Panel	:PRE-Set	*RST	Return to Initial Settings when Power is Turned On	Save	Back Up
Self Calibration	OFF/ MANU/ AUTO		OFF	←	←	←	No	Yes	Yes
Measurement Value Memory Function	Save ON/ OFF		ON	←	←	←	No	No	Yes
	Memory Size		1000	←	←	←	No	No	Yes
:MEASure:VALid			62	←	←	←	No	Yes	Yes
Judgment Mode			Count Judgment	←	←	←	No	Yes	Yes
Comparator Function	ON/ OFF		OFF	←	←	←	No	Yes	Yes
	Count Setting Value	Upper Limit Values	OFF	←	←	←	No	Yes	Yes
		Lower Limit Values	OFF	←	←	←	No	Yes	Yes
	Compensation Percent Setting Value	Upper Limit Values	OFF	←	←	←	No	Yes	Yes
		Lower Limit Values	OFF	←	←	←	No	Yes	Yes
		Reference Value of C	100000	←	←	←	No	Yes	Yes
		Reference Value of D	0	←	←	←	No	Yes	Yes
BIN Function	ON/ OFF		OFF	←	←	←	No	Yes	Yes
	Count Setting Value	Upper Limit Values	OFF	←	←	←	No	Yes	Yes
		Lower Limit Values	OFF	←	←	←	No	Yes	Yes
	Compensation Percent Setting Value	Upper Limit Values	OFF	←	←	←	No	Yes	Yes
		Lower Limit Values	OFF	←	←	←	No	Yes	Yes
		Reference Value of C	100000	←	←	←	No	Yes	Yes
		Reference Value of D	0	←	←	←	No	Yes	Yes
Contact Check Function	Evaluation		OFF	←	←	←	No	Yes	Yes
Low C Reject Function	ON/ OFF		OFF	←	←	←	No	Yes	Yes
	Limit Values		0.000%	←	←	←	No	Yes	Yes
Measurement Level Monitoring Function	ON/ OFF		OFF	←	←	←	No	Yes	Yes
	Limit Values		10.0%	←	←	←	No	Yes	Yes
Panel Save			Clear Contents	No Change	No Change	Clear Contents	No	-	Yes
Load Conditions			ALL	←	←	←	No	No	Yes
Display	ON/ OFF		ON	←	←	←	No	Yes	Yes
Voltage and Current Monitor Value	ON/ OFF		OFF	←	←	←	Yes	No	No
Keylock Function	ON/ OFF		OFF	No Change	No Change	OFF	No	Yes	Yes

Yes: Available/ ←: The same as the left/ No: Unavailable

Setting Items		Initial Setting	Operate from Front Panel	:PRE-Set	*RST	Return to Initial Settings when Power is Turned On	Save	Back Up
Setting Beep Tones	Key	ON	←	←	←	No	Yes	Yes
	Mode	OFF	←	←	←	No	Yes	Yes
Disabling trigger signal on EXT I/O	ON/ OFF	OFF	←	←	←	No	No	Yes
EXT I/O Judgment Results Reset	ON/ OFF	ON	←	←	←	No	Yes	Yes
EXT I/O output delay time	Delay time between evaluation result output ←→ EOM output	0.0	←	←	←	No	No	Yes
Setting Interface	Interface	GP-IB	←	No Change	No Change	No	No	Yes
	Address	1	←	No Change	No Change	No	No	Yes
	Terminator	LF with EOI	←	No Change	No Change	No	No	Yes
Header		OFF	←	←	←	Yes	No	No
Status Byte Register		0	No Change	No Change	No Change	Yes	No	No
Event Register		0	No Change	No Change	No Change	Yes	No	No
Enable Register		0	No Change	No Change	No Change	Yes	No	No

Index

A

Accuracy 259
Average Function 91

B

Beep tones 112
BIN Measurement 88
BIN measurement function 75

C

Cleaning 264
Command Syntax 142
Communication error 149, 154
Comparator Evaluation Result Display 10
Comparator function 61
Comparator Measurement 73
Contact Check Function 95

D

Discarding 266
Display ON/ OFF 103

E

ERROR display 14
EXT I/O
  Configuration 125
  Signal lines 124
  Timing of input signals 126
EXT I/O Connector 123
External View A7

G

GP-IB/RS-232C interface
  Creating RS-232C communication programs 246
  GP-IB command 153

H

Handshake (Flow control) 132
Header 142
High Impedance Component A3

I

In-circuit Components A4
Initialized items (Communication) 245
Input buffer 146
Inspection 263

J

Judgement results display 73, 88

K

Keylock Function 106

L

Load Compensation 47
Low C Reject Function 96

M

Measurement Level Monitoring Function 98
Measurement Parameters and Arithmetic Expressions 261
Measurement times 128
Measurement value display 10
Message terminator 143
Mounting the Unit in a Rack A5

N

Noise A1

O

Offset Compensation 54
Omitting compound command headers 145
Options A8
Output queue 146

P

Panel Load Function 108
Panel Save Function 107
Power cord 19
Power fuse 265
Power voltage 18
Printer
  Connection 121

1.800.561.8187 www.itm.com information@itm.com

Printing 122
Setup 118
Program Messages 141

R

Remote function 139
Repair 263
Response format 243

S

Self Calibration 58
Separator 143
SESER 150
SESR 149
Setting the interface 136
Shielding process A3
SRER 148
STB 148
System reset 117

T

Timing of Input Signals 126
Trigger 126
Trigger Delay 93
Trigger synchronous output function 104
Troubleshooting the interface 250

U

Unique event status registers
(ESR0, ESR1, ESR2, ESR3) 150

1.800.561.8187 www.itm.com information@itm.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
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   -2. Damage arising from measurement results provided by the product
   -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

HIOKI E.E. CORPORATION

18-07 EN-3

1.800.561.8187 www.itm.com information@itm.com