3504-40 3504-50 3504-60 C HITESTER



Instruction Manual





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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.

Latest edition of insruction manual

The contents of this manual are subject to change, for example as a result of product improvements or changes to specifications. The latest edition can be downloaded from Hioki's website.

The latest edition can be downloaded from Hioki's website https://www.hioki.com/global/support/download



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.

This unit 3504-40 C HiTester 3504-50 C HiTester 3504-60 C HiTester 3504-60 C HiTester Instruction Manual	Confirm that these contents are provided.	
Spare fuse for power supply (according to voltage specification) 1 100 V, 120 V setting: 250 VF 1.0 AL5 x 20 mm dia	□ 3504-40 C HiTester 3504-50 C HiTester 3504-60 C HiTester	 Instruction Manual

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)

Trademarks

Microsoft, Windows and Visual Basic are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

Safety Information

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



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

<u> AWARNING</u>	Indicates that incorrect operation presents a significant haz- ard that could result in serious injury or death to the user.
<u> ACAUTION</u>	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

\bigcirc	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.



Fixed Installation

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.

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°C to 40°C, 80%RH or less, no condensation

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

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





light Exposed to high temperature

Exposed to direct sun-

Exposed to liquids Exposed to high humidity or condensa-



Exposed to high levels of particulate dust



In the presence of corrosive or explosive gases

Exposed to strong electromagnetic fields Near electromagnetic radiators



Subject to vibration

Installing

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



• Vents must not be obstructed.





- 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



Before connection and powering on

• 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 Outline Description (alternative Description (alternative)) (alternative)

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.



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

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 multilayer 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 μ F 500 mV, 100 mV (Model 3504-60 only): to 170 μ F 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.

1.3 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.

Application Functions

Function	Description	Reference Section
Open and Short circuit compensation	Eliminates measurement errors due to residual imped- ance.	(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 perform- ing 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
- 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)

1.4 Names and Functions of Parts



NOTE

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











<u>A</u>CAUTION

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



MAIN display area ERROR display When the 3504-40, 3504-50 and 3504-60 C HiTesters detects a measurement abnormality, an error message is dis-played 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
		OPEN compensation error Displayed when the OPEN compensation value is less than 1 k Ω . 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.
_	- Error	$\begin{array}{l} \textbf{SHORT compensation error}\\ \text{Displayed when the SHORT}\\ \text{compensation value is more}\\ \text{than 1 } k\Omega\\ \textbf{See} \ (p. 43) \end{array}$	_	•	Short the measurement terminals. Check to see if the measurement cable is broken.
		LOAD compensation error Displayed when the LOAD com- pensation value is outside of range. See (p. 49)	_	•	Perform compensation again after setting to the appropriate range.
_	© i_oUEr D Error	Output current abnormality Displayed when low imped- ance elements were con- nected for more than 2 min. in range 7 or 8.	_	•	Put the measurement terminals in an open state and then press $\boxed{\text{ENTER}}$. 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 evalua- tion	•	The device is acquiring an abnormal self cali- bration value. Reconnect the instrument to be tested correctly and carry out self-calibration again.

1.4 Names and Functions of Parts

Priority rank	MAIN display	Error content	EXT I/O		Solution
High	E INE_E	Sampling error Displayed when the A/D conversion is not carried out normally.	ERR output, HI judgment, 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 $\boxed{n [- h b]}$ $\boxed{n [- h A]}$ Abnormal connection on the L side $\boxed{n [- L b]}$ $\boxed{n [- L A]}$ Abnormal connection on the H, L side $\boxed{n [- b b]}$ $\boxed{n [- b A]}$	Contact Abnormality Displayed when the connection resistance between the mea- surement terminal and the ob- ject to be measured becomes large. See (p. 102)	ERR output, HI judgment, OUT judgment	•	The measurement terminals may not be con- nected to the object being measured. Check the contact between the object being measured and the measurement terminals.
	[U_Lo	Applied voltage abnormality Displayed when the voltage be- tween the measurement termi- nals 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 evalua- tion	•	The measurement terminals may not be con- nected to the object being measured. Check the contact between the object being measured and the measurement terminals.
Low	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 measure- ment 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



2.2 Checking the Power Voltage



- 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	(I) (Left side)	(Right side)
240 V	(D) (Left side)	(]) (Left side)



Voltage selectors

2.3 Connecting the Power Cord



Connecting the Probes and Fixtures

/!\CAUTION

Connection

Black plugs

- 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.

Example: Connecting a Model 9261 Test Fixture (Option)

- 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.

Procedure Connect the red plugs to the H_{CUR} terminal and Measurement H_{POT} terminal and the black plugs to the L_{CUR} Terminal terminal and L_{POT} terminal. The unit has the following five measurement terminals. H_{CUR} terminal Terminal for applying measurement signals Voltage detection HIGH terminal H_{POT} terminal L_{POT} terminal Voltage detection LOW terminal L_{CUR} terminal Measurement current detection terminal GUARD terminal Connect this terminal to the case Red plugs

Measurement Terminal Connections



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)

Lock

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



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(O).

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 sup- ply 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 ap- pear 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 malfunction- ing. 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 indi- cated 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. Probe: Replace it with a new one. 	 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)

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.

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.

Set the measurement conditions.

	OCOMP	OBIN	MODE	SET
0120Hz	●1kHz		FREQ	
0100mV	○500mV	●1V	LEVEL	
OFAST	●NORM	OSLOW	SPEED	
• AUTO	OSER	OPAR		
• AUTO	OHOLD	RANGE		

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

MODE	Measurement mode NORM	(p. 26)
FREQ	Frequency1 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.

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.



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

3.3 Setting the Measurement Conditions

3.3.1 Measurement Mode

Select a measurement mode.

	NORM	ОСОМР	OBIN	MODE	SET))
--	------	-------	------	------	-------	---

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.



O120Hz ●1kHz FREQ

Measurement frequency: 120 Hz, 1 kHz

The selected item is indicated by the lit LED lamp.

3.3.3 Measurement Signal Level



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.



O100mV O500mV ●1V [LEVEL]

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 μ F (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 μ F (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 ERR signal.

Range No.	120 Hz	1 kHz	Measurement Voltage Mode
1	200 pF	20 pF	
2	2 nF	200 pF	
3	20 nF	2 nF	
4	200 nF	20 nF	Constant voltage
5	2 µF	200 nF	mode
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
10	20 mF	2 mF	Output resistance of 5 Ω

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 <u>case</u>, "CV_Lo " appears on the MAIN display area, CV LED goes out, and a 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)

3.3.4 Measurement Speed

Set the measurement speed.

Press SPEED to change the mode.				•	
	● FAST	ONORM	OSLOW	SPEED	

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)



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	o chang	e the mode.
• AUTO	●SER	OPAR	CIRCUIT

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				

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 parallelequivalent circuit mode calculates as though connected in parallel. Because the operation is different between a series-equivalent circuit mode and a parallelequivalent 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 k Ω or more). When you are not sure about selection of equivalent-circuit mode for the impedance such as between approx. 100 Ω to 10 k Ω), please call the parts maker.
3.3.6 Measurement Range

Select a measurement range. Automatic selection is also possible.



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	Guaranteed Accuracy Range of C (when $D \le 0.1$)		
No.	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 $(\Delta\%$ setting)	-99999 to 99999	-199999 to 199999	



- 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 2 minutes, an "iovEr 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

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 2 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.



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
	1

3.3.7 Trigger Signal

The internal trigger or the external trigger can be set.



Trigger signal: INT, EXT

INT (Internal trigger mode)	 Continuous measurement is performed while automati- cally 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)

Compensate for errors

Chapter 4

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 frequency level		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".

4.1 Open Circuit Compensation and Short Circuit Compensation

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 k Ω 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 k Ω . 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.

Take the open circuit compensation and short circuit compensation values



NOTE

If you do not want to perform open circuit compensation, press [OADJ] 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.

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.

2.

Use (\bullet) or (\bullet) to select setting the open circuit menu item.

Pressing (\land) or (\neg) 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.



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)

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



Key or communication command in :CORRection:OPEN (SHORt):POINt 36

When adjustment value is acquired from (:CORRection :OPEN(SHORt)ALL)

Measurement frequency level		1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	Х	×
1 V	•	•

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

Measurement frequency Measurement level		1 kHz	
0.1 V (Model 3504-60 only)	×	×	
0.5 V	×	×	
1 V	r	r	
	L		

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

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

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

Measurement frequency level	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_r: adjustment value invali X: no adjustment valu		
Measurement frequency Measurement level		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 frequency level		1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	×	×
1 V	r	×
	L	

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 frequency Measurement		1 kHz	
0.1 V (Model 3504-60 only)	×	×	
0.5 V	×	×	
1 V	r	r	
	L		

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

Measurement frequency Measurement level		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 frequency Measurement level	120 Hz	1 kHz	
0.1 V (Model 3504-60 only)	×	×	
0.5 V	•	٠	
1 V	×	×	

4.1 Open Circuit Compensation and Short Circuit Compensation



End of Compensation:

When compensation ends, the state becomes as follows.





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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 [IADJ] 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.)

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.





- 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 **DADJ** 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.



NOTE



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 OADJ 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 _



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)





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.

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"

When	select	the	"oFF

OOPEN ╈SHORT 0 ADJ (Off) (Flash)

●OPEN ★SHORT 0 ADJ (Light up) (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 **OADJ** if not setting the open circuit compensation ON or OFF. The device enters short circuit compensation setting. (Proceed to Step 4.)

Press or view of 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)





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.



4.

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 "oFF"

When select the "on"



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 **[IADJ]** if not setting the short circuit compensation ON or OFF. The unit returns to normal measurement mode.

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.



• 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 $\leftarrow \rightarrow$ 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._

2.



The state becomes as follows.



(MAIN display area)



Use \bigcirc or \bigcirc 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.



Select "AdJuSt" and press ENTER .

Incorporate the load compensation value.

H ON	O OFF	LOAD
(Flash)		

End of Compensation:

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



(MAIN display area)



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].

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_r: adjustment value invalid X: no adjustment value

		·· ···j-·····
Measurement frequency level	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 frequency level	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 Measurement level	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)

× × –
x x
r r
>

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

Measurement Measurement level		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 (:COR-Rection:LOAD ON) at 120 Hz, level 0.5 V $\,$

120 Hz	1 kHz	
×	×	
•	×	
×	×	
	120 Hz × • ×	120 Hz 1 kHz × × • × × × × × × ×

Example of enabling/disabling setting for load circuit compensation values

Factory default condition

•: adjustment value valid_r: adjustment value invalid X: no adjustment value

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

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

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

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

Measurement frequency level	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 (:COR-Rection:LOAD ON) after measurement conditions have been changed to 120 Hz and level 1 V

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

NOTE

Setting Reference Value

0		
1.	In normal measur	ement mode, press LOAD.
	The state becomes a	as follows.
	(Flash)	
	(MAIN display area)	
	LoRd	
	SEE	— Flash
2.	Use 🕢 or 🕟 to	o select setting the load circuit compensation
	menu item.	
	Pressing () or (causes the display to change in the following manner.
		"SEt"
	SEE	Set the standard value at the currently set measure-
		ment frequency.
		"oFF"
		Disable load circuit compensation value at the enabled frequency.
		"on"
	on	Enable all load circuit compensation value at all dis-
		abled frequencies.
	RdJuSE	"AdJuSt"
		Delete the disabled load circuit compensation values, acquire the load circuit compensation value at the cur-
		rently set measurement frequency and enable the load circuit compensation value.
3.	Select "SEt" and	Press Enter.
	(SUB display area)	
		OLOCK





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



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 $\dots (\widehat{\bullet})$ and $(\widehat{\bullet})$

(SUB display area)



NOTE

- If you do not want to change the reference value of C, press 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)

	OSURCE ORMT OLOCK	_
COUNT	Н	
REF		
	100.000	
	0.00020-	- Reference value of D

The unit returns to the state of Step 2.



- If there is no need to change the reference value of D, press 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.

Setting Load Circuit Compensation ON/ OFF



The state of the load compensation LED becomes as follows.

When select the "on" When select the "oFF"



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



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)



(SUB display area)



Press () v to enable or disable offset compensation.

3.

The display switches between "on" and "oFF" each time (\blacktriangle) (\checkmark) 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)



OLOCK

(SUB display area)

OCHK



 L
 Offset compensation value mantissa part

 E - 00
 Offset compensation value index

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	\bigcirc
Change the number () and	



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. 6. Press ENTER to confirm the mantissa part of the C offset compensation value.

The state becomes as follows.





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 ()

<u>8.</u>

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.

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.

\leftarrow : The same as th	e left
-------------------------------	--------

Operation command to the device Measurement speed, self calibration		Measurement (no request for calibration)	Measurement (request for cali- bration)	Changes in mea- surement condi- tions (frequency, level, range)	Measurement (no request for calibration)	Measurement (request for cali- bration)
OFF	Default value	\leftarrow	\leftarrow	\leftarrow	\leftarrow	\leftarrow
MANUAL	Default value	\leftarrow	Revision	Default value	\leftarrow	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.

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.



3.

Use () or () to select the "CALIb" menu item.

(MAIN display area)



(Self calibration settings screen)

Use () and () to select a setting item.

Pressing () or () causes the display to change in the following manner $_{\circ}$



"oFF"

Adjust using the factory default self calibration value.

"MAnu"

<u>When</u> 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 (∆%) 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 (∆%) Setting)	The first parameter (C) displays the result of the calculation: (measurement value - reference value)		
	reference value × 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.

Setting Judgment Mode_

First, set the judgment mode. (Select the count value setting and the deviation percent ($\Delta\%$) 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.



Use () or () to select the "JudGE" menu item.

(MAIN display area)



(Judgment mode setting screen)



Use \bigcirc or \bigcirc to select a setting item.

Pressing () or () causes the display to change in the following manner.



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.



The unit returns to normal measurement mode.

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



MeasurementMake settings using the upper limit and lower limitmethod 1values (count setting).(To make settings using a reference value and the upper limit and lower limit)

(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.

ONORM COMP OBIN	(MODE) (SET
(Light up)	

2. Press SET.

З.

4.

(SUB display area)



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

(SUB display area)

	ССОЛТ		OLOCK	
	COUNT	<u>ــــــ</u>	Light u	D
Flash-	н	10.50	00	Upper limit values
	LO	09.50	00	

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 ...... \bigcirc and \bigcirc
```

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).





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...... \bigcirc and \bigcirc

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.

(SUB display area)



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.

ONORM COMP OBIN	
(Light up)	

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.
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.







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) CONT OSUBCE ORMT OLOCK 4% HI 005.00

005.00

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

LO

• 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.

ENTER to enter the D reference value setting mode.

(SUB display area)

Press



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

Settable Range: -199999 to 199999
Move to the digit \bigcirc and \bigcirc
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) $O_{CHK}^{CONT} O_{SOURCE}^{SYNC} ORMT OLOCK}$ A% D Light up HI 0.00050 Upper limit value L0 -.00100

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 \ldots and \bigcirc

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.

ONORM ●COMP OBIN	MODE SET
(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.

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

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.





The unit switches to comparator measurement mode.

ONORM ●COMP OBIN	SET
(Light up)	

Canceling Comparator Measurement Mode

In comparator measurement mode, press MODE twice.

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

• NORM	О сом р	OBIN	SET
	\		

(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.

Upper limit value settings Upper limit value Lower limit value

Measurement value judgment

When the measurement value is larger than the upper limit value

When the measurement value is within the range of the upper limit and lower limit values

When the measurement value is smaller than the lower limit value

Measurement value judgment



When the measurement value is above the measurement range (OVER FLOW)



Lower limit

Measurement

Upper limit

range



When the measurement value is below the measurement range (UNDER FLOW)

Judgment order	Judgement results	Meaning	Solution
	The HI LED lights up.	Measurement error	See "MAIN display area ERROR display" (p. 14)
1	The HI LED lights up.	The measurement value is above the high limit value range in the current range.	Switch to an appropriate range.
	The LO LED lights up.	The measurement value is below the low limit value range in the current range.	See 3.3.6 "Measurement Range" (p. 31)
2	.	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 Judg-	• Output the judgment result for each of C and D (LO/IN/HI) and the AND
ment Results	results for both judgment results (only when both parameters are IN) from
	EXT I/O.
	See 7.1 "About the EXT I/O Connector" (n. 123)

- 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" • "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 (∆%) 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 (∆%) Setting)	The first parameter (C) displays the result of the calculation: (measurement value - reference value) reference value × 100 The second parameter (D) displays the result of the calculation: (measurement value - reference value)	



- 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.

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

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.



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.





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.



The unit returns to normal measurement mode.

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



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Make settings using the upper limit and lower limit values Measurement method 1 (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.



ENTER Press 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 \ldots (\bullet) and (\bullet)

Change the number .. (\blacktriangle) and (\bigtriangledown)

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 <u>ENTER</u> 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).



Press ENTER to confirm the BIN1 lower limit value.

(SUB display area)





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)



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



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.



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.

MeasurementMake 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 val-

(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.





(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 \bigcirc and \bigcirc

Change the number .. () and ()

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



(SUB display area)



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



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.

is

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8. Press **ENTER** to confirm the BIN1 upper limit value.

Enter the BIN1 lower limit value setting mode.





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)

ОСОК	OSYNC SOURCE	RMT OLOCK
⊿%	d	—— Flash
REF	0.0	000

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



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

Settable range: -1999999 to 199	995
Move to the digit	Þ

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 <u>ENTER</u> 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).

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17. Press ENTER to confirm the D upper limit value.

Enter the D lower limit value setting mode.



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.

ONORM	ОСОМР	● BIN	MODE	SET
		(Light up)		

See "Performing BIN Measurement" (p. 88)



• 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?
 - 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

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. ○NORM ○COMP ●BIN MODE SET

OCOMP	BIN	
	(Light up)	

Canceling BIN Measurement Mode

In	BIN	m	easuren	nent mo	de, press	MODE.
[• NOF	١M	ОСОМР	OBIN	MODE	SET

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

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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 ∆% setting) ← → BIN 1 to 14 upper limit and lower limit values ← → D reference value (for the ∆% 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.





Outputting Judgment Results

- Output the judgment result for BIN (BIN1 to 14, OUT OF BINS, and D-NG) from EXT I/O.
 Son 7.1 "About the EXT I/O Connector" (n. 122)
 - 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 cur- rent 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" • "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

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.



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 \bigcirc \bigcirc to enable or disable the average function.

It will toggle "on" and "oFF" each time () () is pressed.



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 the middle row of the SUB display area.

5. When "on" is selected.

Enter the number of measurements to average using \bigcirc \bigcirc 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.



Use () or () to select the "dELAY" menu item.

(MAIN display area)



(Trigger delay setting screen)

(SUB display area / "on" setting)





It will toggle "on" and "oFF" each time (A) () is pressed.



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.

5. When "on" is selected. Enter the delay time using (h) (\bullet) 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 \ldots and \bigcirc 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. ENTER is not pressed the delay time setting will not be set. lf 7. Press MENU The unit returns to normal measurement mode. NOTE 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.

Measurement timing chart

When the trigger synchronization function is off



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.

 Δ % = (effective value - reference value) / |reference value| ×100

If the $\Delta\%$ 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 (a) (b) 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....... (c) and (c) Change the number... (c) and (c)

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

"LEV.ChK" (Measurement level monitoring function setting screen) will be displayed in the MAIN display area.





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.

⊲ □ ⊳ ⊔ С D Low C lights up LOW C

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)

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 (A) () 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

LEU_E 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>6666666.
 - 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)



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.)

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.

З.

Use () or () to select the "Cont" menu item.

(MAIN display area)



(Contact check function setting screen)

Use \bigcirc and \bigcirc 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.



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.

	OSYNC SOURCE ○RMT	OLOCK
COUNT		

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



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	
n[-hb	Connection abnormality before H side measurement	
n[-hR	Connection abnormality after H side measurement	
n[-1b]	Connection abnormality before L side measurement	
n[-LR	Connection abnormality after L side measurement	
n[-bb	Connection abnormality before H, L side measurement	
n[-bR	Connection abnormality after H, L side measurement	

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

- 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)

Measurement results

Output

NOTE

- During contact check, the INDEX (signal after the end of the analog measurement) will continue to be emitted.
- During a two-terminal (short $\rm H_{CUR}$ and $\rm H_{POT}$, short $\rm L_{CUR}$ and $\rm L_{POT})$ 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.
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

Setting the display to OFF can speed up the time to the next measurement and save energy.



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)



Use () or () to select the "dISP" menu item.

(MAIN display area)



(Display setting screen)

З.

Press () () to turn the display ON or OFF.

It will toggle "on" and "oFF" each time () () is pressed.



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.



ENTER is not pressed the display setting will not be saved.



Press MENU

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



- 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.

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

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)



(Trigger synchronous output function setting screen)

Press $\textcircled{\baselineskip}$ $\textcircled{\baselineskip}$ to enable or disable the Trigger synchronous output function.

It will toggle "on" and "oFF" each time () () is pressed.

4. Press ENTER

3.

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.



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.

When the trigger synchronization function is on



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.





- All the keys except (MANUTRIG) 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.





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 \mathbf{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.)

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 b to select the "Ld_tYP" menu item. (MAIN display area)



(Load condition setting screen)

3.

Use () and () to select a setting item.

Pressing (h) or (n) 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.

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.



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.

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6.8 Load the Measurement Conditions (Panel Load Function)

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)



(Panel load screen)

There are 3 types of panel load screens.





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
[orr	LoRd_C

3. Use the numeric keypad or (a) and (c) 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.



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.



- 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 CALIb signal to Lo level in the response times (time from TRIG (LOW) to INDEX (High) based on the load conditions in the "MANUAL"self calibration setting.

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

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 \bigcirc or \bigcirc to select the "bEEP_J" menu item.

(MAIN display area)



(Beep tone setting screen for judgment results)

3. Press \bigcirc \bigcirc to enable or disable the beep tone setting details function.

Pressing \bigcirc or \bigcirc 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.



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.



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

Use () or () to select the "bEEP_K" menu item.

(MAIN display area)



(Beep tone setting screen for key operations)

3. Press \bigcirc \bigcirc 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.



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 (a) (\mathbf{v}) keys.

The display items will change accordingly as shown below.



116 6.10 Switching the displayed item (SUB display)

NOTE

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

Range display	Units			
ī	m (10 ⁻³)			
U	μ (10 ⁻⁶)			
n	n (10 ⁻⁹)			
Р	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.



Turn the power back on while holding down [ENTER], and then let go



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)



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



"no" A system reset is not performed.



"vES" A system reset is performed.



ENTER to confirm the setting. Press

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)



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.

6.12 Printing Function

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



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 (discontinued)
- 9443-01 AC adapter (for Japan) (discontinued) 9443-02 AC adapter (for EU) (discontinued)
- 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.



- 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'



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	Return			
5	Setting command	Enable	Disable		
6			OFF		
7	Print density (set to 100%)	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		ON	
6	International	ON	
7	characters	ON	
8		ON	

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			OFF	
6	Baud rate	ON		
7	(Set to 19200 bps)	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

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 (discontinued) 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.



Turn on the power of the 3504-40, 3504-50, 3504-60 unit.



З.

Turn on the power of the 9442 Printer.



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.

6.12.3 Printing

If MANUTRIG is pressed when an external trigger is set, the measurement values are output to the printer after measurement finishes.

If MANUTRIG 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

СР	100.052n	F	HI D	0.00050	ΗI
СР	100.047n	F	IN D	0.00045	IN

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

СР	100.016n	F	D	0.00042	BIN1
СР	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	TRIG	26	IN	LD0	
2	IN	LD1	27	IN	LD2	
3	IN	LD3	28	IN	LD4	
4	IN	LD5	29	IN	LD6	
5	IN	LD-VALID	30	OUT	BIN1, C-HI	
6	OUT	BIN2, C-IN	31	OUT	BIN3, C-LO	
7	OUT	BIN4, D-HI	32	OUT	BIN5, D-IN	
8	OUT	BIN6, D-LO	33	OUT	BIN7, AND	
9	OUT	BIN8	34	OUT	BIN9	
10	OUT	BIN10	35	OUT	BIN11	
11	OUT	BIN12	36	OUT	BIN13	
12	OUT	UT BIN14 37 OUT		OUT	OUT OF BINS	
13	OUT	INDEX	38	OUT	EOM	
14	OUT	CV-ERR	8 39 OUT		D-NG	
15	IN	CALIB	40	-	Unused	
16 to 20	IN	EXT DCV	41 to 45	OUT	INT DCV	
21 to 25	IN	EXT COM	EXT COM 46 to 50 OUT		INT COM	

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

EXT I/O Connector Signal Lines

TRIG	If a negative le ment begins a								single measure- e).
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	0: (HIGH: 5 to 24 V)
	Panel 2	0	0	0	0	0	1	0	1 : (LOW: 0 to 0.9 V)
	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	
LD-VALID	Inputs a nega panel <u>num</u> ber After TRIG inp	is reco	gnized	l as va	lid.				that the selected ted.
С-НІ, <mark>С-І</mark> , <mark>С-LO</mark>	Outputs the c first paramete					lt for th	ne me	asuren	nent value of the
D-HI, D-IN, D-LO	Outputs the c second param		-	-			ne me	asuren	nent value of the
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 judgr only).	nent re	esults	for BIN	N mea	sureme	ent (M	odel 3	504-50, 3450-60
INDEX	This is the ana the trailing edg	-			-	-	ter this	signal	is set to ON (from
EOM	This is the end	d of me	easurer	nent si	gnal.				
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 intern	al +5 \	/ DC a	nd inte	rnal C	OM of	the un	it.	
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". After TRIG input, maintain a Low level until INDEX is outputted.								

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

<u> </u>	 power supply EXT DCV and EX apply a voltage that exceeds +2 Connect a device with an output drive the circuit. Signal lines are insulated to sto use protective grounding for the may be damaged. +5 V DC is output between the insulated to sto use protective grounding for the may be damaged. 	hat can be connected to the external DC (T COM terminals is 5 to 24 V DC. Do not 4 V DC. Doing so may damage the device. t capacitance of at least 200 mA in order to p interference between signals. Be sure to connected device. Otherwise the insulation internal DC power supply INT DVC and INT pacity is 100 mA. Do not connect a circuit to an external device.
NOTE	current of more than 30 mA is	current of the output signal is 30 mA. When a required, connect, for example, a transistor rrent amplification and run on an external
Circuit Configuration	photocoupler. When using the EXT I/O, connect a	r than the power signal line are isolated by a 5-24 V DC power in EXT DCV-EXT COM. m an external device, connect INT DCV and OM.
Pull-up resistor 3.3 kΩ (1/4 W)		Internal DC power supply (5 V)* ⊸ INT DCV External DC power supply (5 to 24 V)* ⊸ EXT DCV
		→ BIN1, C-HI
Current-limiting resistor 3.3 k Ω (1/4 W)		 → TRIG → LD0 to LD6 _ External DC power supply (COM)* EXT COM [¬] Internal DC power supply (COM)*
	The ground is connected to the case	INT COM Ising an internal DC power supply voltage

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 k Ω 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	Output Signal (Internal Pull-up Resistor of 3.3 k Ω)			
Power	High Level	Low Level (Output Current)(10 mA)(30 mA)		
Source	Thigh Level			
5	5			
12	12	0.9 V	1.1 V	
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_{II} 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

Symbol	Description		Approximate Time
T1	TRIG width (LOW)	: Trigger signal minimum time	100 μs
T2	From TRIG (LOW) to INDEX (HIGH)	: Time from trigger to circuit response	250 μs *1
Т3	INDEX width (HIGH)	: Mini <u>mum c</u> huck time, switching chuck with INDEX (LOW) is possible	1 ms *2
T4	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.



 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 EOM output may cause measurement error.

To prevent this, it is possible to set the comparator and delay time for BIN evaluation result 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 TRIG, LOW \rightarrow 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 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 ←→ 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)

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 (\overline{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		
			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		
measurement rrequency	FAST (ms) NORM (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		
measurement requerty	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 kHz	2 ms	2 ms + 3 ms

End of Measurement Signal

The output time (T4) for an end of measurement signal (\overline{EOM}) can be obtained by the following equation. T4 = A(1 or 2) + B + C + D

EOM

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		
measurement requertey	FAST (ms)	NORM (ms)	SLOW (ms)
120 Hz	10.0	37.5	146.0
1 kHz	2.0	5.5	29.5

(Allowable tolerance: $\pm 5\% \pm 0.5$ ms)

(2)_Request for self calibration

Measurement Frequency	Measurement Speed		
medourement requertoy	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 INDEX output.

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.





- To avoid equipment failure, do not disconnect the communications cable while communications are in progress.
- Use a common ground for both theinstrument and the computer. Using different ground circuits will result in a potential difference between the instrument's ground and the computer's ground. If the communications cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.
- Before connecting or disconnecting any communications cable, always turn off the instrument and the computer. Failure to do so could result in equipment malfunction or damage.
- After connecting the communications cable, tighten the screws on the connector securely. Failure to secure the connector could result in equipment malfunction or damage.

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 (discontinued) to the unit.

See 6.12 "Printing Function" (p. 118)



- 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

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 (Delim- iter)	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	When using hardware (RTS/CTS control):
Receiving	 When the data in the receive buffer exceeds <u>85%</u> of the buffer, <u>CA(RTS) is set to</u> <u>OFF</u> 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 <u>CA(RTS) is set to ON</u> and the controller is notified that there is sufficient remaining space in the buffer
	when the amount of data becomes less than <u>25%</u> . When using software (XON/XOFF control): When the data in the receive buffer exceeds <u>75%</u> of the buffer, <u>XOFF(13H) is</u> <u>sent</u> 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 <u>XON(11H) is sent</u> and
	the controller is notified that there is sufficient remaining space in the buffer when the amount of data becomes less than <u>25%</u> .



Control during
SendingWhen 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.			
Т6	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

8.3 Connection and Setting Procedures

8.3.1 Connecting the RS-232C Cable / GP-IB Cable

<u> MWARNING</u>

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.

<u> ACAUTION</u>

After connecting the cable, be sure to secure the connector in place by tightening the screws.

RS-232C Connector Pin Configuration





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 Abbrevia- tion	JIS Abbrevia- tion	Common Abbrevia- tion
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	СВ	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)

8.3.2 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 (discontinued) 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 \bigcirc or \bigcirc to select one of the above items.

Pressing (or (switches the display.





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.

- **5.** Use \bigcirc or \bigcirc 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.
 - 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 v to set a baud rate (9600, 19200) and then press
 - 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 (

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 LICK/LOCAL when you want to return to the normal state (local state). The RMT LED goes out.

	OCONT OSYNC ORMT OLOCK ONORM OCOMP OBIN MODE SET
8.8.8. ^{mF} [%]	COUNT 8.8. 7 8 9 A
8.8.8.	HI 8.8.8.8.8.8.8. HI 2 3 B.8.8.8.8.8.8. D . ++- ENTER
3 9 10 11 12 13 14	
HPOT HCUR	O100mV O500mV O1V LEVEL OOPEN OSHORT 0 ADJ
	OFAST ONORM OSLOW SPEED OON OOFF LOAD MENU
WN	OAUTO OSER OPAR CIRCUIT OINT OEXT TRIG MANUTRIG

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.





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 Separator Data Section

• 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 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)

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.

RS-232C

- LF
- CR+LF
- EOI
- LF with EOI

- 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



- 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 explana-tions 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

8.6 Things to Know before Beginning Communication

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

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.



- The power is turned on
- The device is cleared*
- There is a query error
 * The device is initialized



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.



Keep the length of one command under 10 kB.

8.6.3 About the Status Byte Register



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.



Standard Event Register Information

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.



For RS-232C, bit 4 (MAV message available) of the status byte register is not set.

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	This becomes 1 when a service request is sent.
MSS	This indicates logical OR of other bits of the status byte register.
Bit 5	Standard event summary (logical OR) bit
ESB	This indicates the logical OR of a standard event status register.
Bit 4	Message available
MAV	This indicates there is a message in the output queue.
Bit 3	Event summary (logical OR) bit 3
ESB3	This indicates the logical OR of event status register 3.
Bit 2	Event summary (logical OR) bit 2
ESB2	This indicates the logical OR of event status register 2.
Bit 1	Event summary (logical OR) bit 1
ESB1	This indicates the logical OR of event status register 1.
Bit 0	Event summary (logical OR) bit 01
ESB0	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) PON Bit 7 Power on flag This becomes "1" when the power is turned on or the unit recovers from a power failure. URQ Bit 6 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 DDE Bit 3 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

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 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 St	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 Sta	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 Stat	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 Sta	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		

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)

bit4 bit3 bit2 bit1 bit0 Event Status Register 0 (ESR0) MAV ESB3 ESB2 ESB1 ESB0 bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 COF MOF MUF REF LER IDX EOM CEM ↓ ↓ ↓ ↓ ↓ ↓ ↓ Logical & & & & & & & & OR ♠ 1 ♠ ♠ ♠ ⋪ 1 bit5 bit0 bit7 bit6 bit4 bit3 bit2 bit1 REF COF LER MOF MUF IDX EOM CEM Event Status Enable Register 0 (ESER0) Event Status Register 1 (ESR1) bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 FHI NOC AND SLO SIN SHI FLO FIN ╈ & & & & & & & & Logical 1 ⋪ ♠ ⋪ ♠ ♠ Î OR bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 AND SLO SIN SHI FLO FIN FHI NOC Event Status Enable Register 1 (ESER1) Event Status Register 2 (ESR2) bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 BIN8 BIN7 BIN6 BIN5 BIN4 BIN3 BIN2 BIN1 ↓ ╈ ╈ 4 & & & & & & & & Logical ♠ ♠ ♠ ⋪ ♠ f ↑ ⋪ OR bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 BIN8 BIN7 BIN6 BIN5 BIN4 BIN3 BIN2 BIN1 Event Status Enable Register 2 (ESER2) Event Status Register 3 (ESR3) bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0 DNG OUT BIN14 BIN13 BIN12 BIN11 BIN10 BIN9 ↓ & & & & & & & & Logical ♠ ♠ ♠ ⋪ ♠ ♠ ♠ OR bit4 bit3 bit2 bit7 bit6 bit5 bit1 bit0 BIN14 BIN13 BIN12 BIN11 BIN10 BIN9 DNG OUT Event Status Enable Register 3 (ESER3)

Status Byte Register (STB)

Reading and Writing of Each Register

	r	
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		
SDC	Selected Device Clear	Clears the input buffer and output queue.	
GET	Group Execute Trigger	When there is an external trigger, performs the sam- pling process once.	

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.

Command	Data Section	Explanation	Error	Refer- ence 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 9999999 (NR1)</upper></lower></bin></upper </lower </bin>	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. 				

Command	Data Section	Data Section Explanation		Refer- ence Page	
:BIN:FLIMit:COUNt?	<bin number=""> = Numer- ic Value from 1 to 14 (NR1)</bin>	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)</upper></lower></bin></upper </lower </bin>	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:FLIMit:DEViation? SIN:FLIMit:DEViation? CBIN Number> = Numer- ic Value from 1 to 14 (NR1) Query of upper limit and lower limit values 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)</reference>	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)</upper></lower></upper></lower>	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)</upper></lower></upper></lower>	Setting of upper limit and lower limit values of second parameter for BIN function in devia- tion 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)</reference>	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. 					

Command	Data Section	Explanation	Error	Refer- ence Page	
:BIN:SLIMit:REFerence?		Query of reference values of second parame- ter for BIN function in deviation percent mode		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 Re		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 cir- cuit mode	*1, 2	189	
Contact Check Fun	ction (Only for M	/lodel 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	on				
: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 -1999999 to 9999999 (NR1)</upper></lower>	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 measure-ment. *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. 					

Command	Data Section Explanation		Error	Refer- ence 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	
·DEViation <lower limit="" value="">, lower limit value</lower>		Setting of reference value and upper limit and lower limit values of first parameter for com- parator 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 com- parator 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)</upper></lower>	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)</upper></lower></reference></upper></lower></reference>	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 S	hort Circuit Com	npensation			
: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. 					
	e the count setting is co		a is ex	ecuted	

Command	nmand Data Section Explanation		Error	Refer- ence Page
:CORRection:OPEN?		Query of open circuit compensation function	*1, 2	197
:CORRection:OPEN:DATA <compensation val<br="">1>,<compensation ues 2> <compensation value<br=""><compensation value<br="">= -99.9999E9 to 99.9999E9 (NR3)</compensation></compensation></compensation </compensation>		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		202
:CORRection:SHORt:DATA	<pre><compensation 1="" values="">,<compensation 2="" ues="" val-=""> <compensation 1="" values="">,<compensation 2="" values=""> = -99.9999E9 to 99.9999E9 (NR3)</compensation></compensation></compensation></compensation></pre>	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	า			
: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. 				

Command	Data Section	Explanation	Error	Refer- ence Page	
:CORRection:LOAD?		Query of load compensation function	*1, 2	206	
:CORRection:LOAD:DATA	<compensation value<br="">1>,<compensation val-<br="">ue 2> Differs depending on for- warding format</compensation></compensation>	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 compensa- tion values	*2, 3	209	
:CORRection:LOAD:DATA :FORMat?		Query of output format for load compensation values	*1, 2	209	
:CORRection:LOAD :REFerence	<reference 1="" value="">, <reference 2="" value=""> <reference 1="" value=""> = Numeric Value from -199999 to 9999999 (NR1) (excluding 0) <reference 2="" value=""> = Numeric Value from -199999 to 1999999 (NR1)</reference></reference></reference></reference>	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	on				
: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	<pre><compensation 1="" value="">, <compensation 2="" value=""> <compensation 1="" value=""> = -99.9E-3 to 99.9E-3 (NR3), <compensation 2="" value=""> = -1.99999 to 1.99999 (NR2)</compensation></compensation></compensation></compensation></pre>	Setting of offset compensation values	*2, 3	211	
:CORRection:OFFSet:DATA?		Query of offset compensation values	*1, 2	211	
Low C Reject Funct	tion				
: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. 					

Command	Data Section	Explanation	Error	Refer- ence 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 TRIG signal enabled/disabled.	*2, 3	213		
:DISable:TRIGger?		Query to confirm the input TRIG signal en- abled or disabled.	*1, 2	213		
Display Function	on					
:DISPlay	ON/ OFF	Setting of display	*2, 3	213		
:DISPlay?	Query of display		*1, 2	213		
Confirmation o	f Communication Er	ror				
:ERRor? (RS-232C)		Query of RS-232C error	*1,2,7	214		
Event Register	S					
: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. 						
Note: Command errors are generated for all messages with a misspelling.						

Command	Data Section Explanation		Error	Refer- ence Page		
:ESR2?		Query of event status register 2	*1	218		
:ESR3?		Query of event status register 3	*1	218		
Measurement Freq	uency					
:FREQuency	120/ 1000 (NR1)	Setting of measurement frequency	*2, 3	219		
:FREQuency?		Query of measurement frequency	*1, 2	219		
Communication Ha	Indshake					
:HANDshake rs-2320	OFF/ X/ HARDware/ BOTH	Setting of RS-232C communication hand- shake	*2,3,7	219		
:HANDshake? [Rs-232C]		Query of RS-232C communication hand- shake	*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 $\overrightarrow{\text{EOM}}$ 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.						
*7 Execution Error Wh to C						
	le the count setting is co		a is exe	ecuted		

Command	Data Section	Explanation	Error	Refer- ence Page
Key Lock				
:KEYLock	ON/ OFF	Setting of key lock function	*2, 3	222
:KEYLock?		Query of key lock function	*1, 2	222
Measurement Sig	nal Level			
:LEVel	1/ 0.5/ <u>0.1</u> (NR2) Setting of measurement signal level * (only for Model 3504-60)		*2, 3	223
:LEVel?		Query of measurement signal level	*1, 2	223
Detected Level M	onitoring Functior	1		
:LEVel:CHECk	HECk 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		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 Measuren	nent			
: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.

Command	Data Section Explanation		Error	Refer- ence Page	
Measurement Val	ue Memory Fun	ction			
:MEMory?	No Data/ ALL	Query of measurement values saved to mem- ory by the measurement value memory func- tion	*1,2,6	231	
:MEMory:CLEar	Deleting data from memory of me 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 func- tion	*2, 3	233	
:MEMory:CONTrol?		Query of measurement value memory func- tion	*1, 2	233	
:MEMory:POINts	1 to 32000	Setting of memory size for measurement val- ue 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 Rai	nge				
: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. 					

Command	Data Section	Explanation	Error	Refer- ence 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 Sp	eed				
:SPEEd	FAST/ NORMal/ SLOW	Setting of measurement speed	*2, 3	238	
:SPEEd?		Query of measurement speed	*1, 2	238	
Trigger Synchro	nous Output Funct	ion			
: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 1="" time="">, <wait Time 2> <wait 1="" 2="" and="" time=""> Numeric Value from 0.001 to 9.999 (NR2)</wait></wait </wait>	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 Termina	ator				
: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. 					

Command Data Section		Explanation		Refer- ence 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</id>	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.

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 r: 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

Command Name	Normal Comparat Measurement Measurem Mode Mode		BIN Measurement Mode (Only for Models 3504-50, 3504-60)	Performing Compensation	Reference Page
:AVERaging	Yes	r	r	No	178
:AVERaging?	Yes	Yes	Yes	No	178
:AVERaging:STATe	Yes	r	r	No	178
:AVERaging:STATe?	Yes	Yes	Yes	No	178
:BEEPer:JUDGment	Yes	r	r	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

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	r	r	No	188
:CALibration?	Yes	Yes	Yes	No	188
:CALibration:ADJust	Yes	Yes	Yes	No	188
:CIRCuit	Yes	r	r	No	189
:CIRCuit?	Yes	Yes	Yes	No	189
:CIRCuit:AUTO	Yes	r	r	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	r	r	No	197
:CORRection:OPEN?	Yes	Yes	Yes	No	197

					,
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	r	r	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	r	r	No	202
:CORRection:SHORt?	Yes	Yes	Yes	No	202
:CORRection:SHORt:DATA	Yes	r	r	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	r	r	No	206
:CORRection:LOAD?	Yes	Yes	Yes	No	206
:CORRection:LOAD:DATA	Yes	r	r	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	r	r	No	210
:CORRection:LOAD:REFerence?	Yes	Yes	Yes	No	210
:CORRection:OFFSet	Yes	r	r	No	211
:CORRection:OFFSet?	Yes	Yes	Yes	No	211
:CORRection:OFFSet:DATA	Yes	r	r	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

[Normal	Comparator	BIN Measurement			
Command Name	Measurement Mode	Comparator Measurement Mode	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	r	r	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	r	r	No	222	
:JUDGment:MODE?	Yes	Yes	Yes	No	222	
:KEYLock	Yes	Yes	Yes	No	222	
:KEYLock?	Yes	Yes	Yes	No	222	
:LEVel	Yes	r	r	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	

Command Name	Normal Measurement Mode	Measurement Measurement		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	r	r	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	r	r	No	238
:SPEEd?	Yes	Yes	Yes	No	238
:SSOurce	Yes	r	r	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	r	r	No	241
:TRIGger:DELay?	Yes	Yes	Yes	No	241
:TRIGger:DELay:STATe	Yes	r	r	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.

	value or characte < <u>Numeric Value</u> (NR1) Inte (NR2) Fixe (NR3) Float	er parame >Numeric eger ed Point ating point mat includ character p	c Value Parameter
Indicates the content of the command.	Setting and	Query of	Measurement Signal Level
Describes the syntax of the ———— message.		Query	:LEVel <numeric value=""> :LEVel ? <numeric value=""></numeric></numeric>
Provides an explanation of the command data section or response data.			<numeric value="">=1/ 0.5/ 0.1 (only for Model 3504-60) (NR2) 1: 1 V, 0.5: 500 mV, 0.1: 100 mV</numeric>
Provides an explanation of	Explanation C	Command	Sets the measurement signal level. A numeric value in NRf format is accepted but non significant digits are rounded off so the numeric.
Shows an actual example of		Query	Returns the setting of the measurement sig- nal level as an NR2 numeric value.
using the command. This explanation is normally for when HEADER ON. (Ex-	Example C	Command	: LEVel 0.5 Sets the measurement signal level to 500 mV
cept for HEADER com- mand.)		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<="" th=""><th>e>,< Model Name>,40/ 50/ 60,<software version=""></software></th></maker>	e>,< Model Name>,40/ 50/ 60, <software version=""></software>
Example	HIOKI,3504,40,V1 HIOKI,3504,50,V1 HIOKI,3504,60,V1	.00 (Model 3504-50)

(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	<numer< th=""><th>ic Value></th><th></th><th></th><th></th><th></th><th></th></numer<>	ic Value>					
		<numer< th=""><th>ic Value></th><th>= 0 to 15</th><th>(NR1)</th><th></th><th></th><th></th></numer<>	ic Value>	= 0 to 15	(NR1)			
Explanation	Returns the No header					an NR1 r	numeric va	alue.
	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Unused	Unused	Unused	Unused	Interrupt error	I/O error	RAM error	ROM error
Example	Query Response	*TST? 2						

There is a RAM error (bit 1).

(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.
(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 Query Response	<pre>*ESE <numeric value=""> *ESE? <numeric value=""> <numeric value=""> = 0 to 255 (NR1)</numeric></numeric></numeric></pre>							
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			ER conter n 0 to 255		the ESE	command	l as an N	IR1
	128	64	32	16	8	4	2	1	
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	
	PON	URQ	CME	EXE	DDE	QYE	RQC	OPC	
Example	Command ★ESE 36 Sets bit 5 and bit 2 of SESER								
	Query	*ESE?							
	Response		36 (whe	n HEADER	ON)				
	•	E *ESE 36 (when HEADER ON) 36 (when HEADER OFF)							
		•		ESER are	ə 1.				

Reading and Clearing of Standard Event Status Register (SESR)

Syntax	Query *ESR?									
	Response	<numer< th=""><th colspan="8"><numeric value=""></numeric></th></numer<>	<numeric value=""></numeric>							
		<numer< th=""><th>ic Value></th><th>= 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th><th></th></numer<>	ic Value>	= 0 to 255	5 (NR1)					
Explanation	Returns the		content a	s an NR1	numeric	value fro	m 0 to 2	55, and th	ıen	
	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		
	PON	URQ	CME	EXE	DDE	QYE	RQC	OPC		
Example	Query	*ESR?								
	Response									
	Bit 5 of SE	SR is 1.								
Note	Bit 6 and I	oit 1 are no	ot used in	the unit.						

Reading and Writing of Service Request Enable Register (SRER)

Syntax	Command Query Response	*SRE? <numer< th=""><th>Numeric V ic Value> ic Value></th><th>√alue> = 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th></numer<>	Numeric V ic Value> ic Value>	√alue> = 0 to 255	5 (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	numeric The valu	value fror les of bit 6	n 0 to 255 ວິ and the ເ	i. unused bi	t (bit 7) ar	e always (l as an NR1 0.
	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Unused	Х	ESB	MAV	ESB3	ESB2	ESB1	ESB0
Example	Command	*SRE Sets bit		l of SRER	to 1.			
	Query Response		nen HEADE	n HEADER ER OFF) SRER are	,			

Reading of Status Byte Register

Syntax	Query Response	*STB? <numeri< th=""><th>c Value></th><th></th><th></th><th></th><th></th><th></th></numeri<>	c Value>					
Explanation	Returns the No header	e STB sett	ting conte		R1 numer	ic value fr	om 0 to 1:	27.
Example	128 bit 7 Unused Query Response	64 bit 6 MSS *STB? 8 Bit 3 of 5	32 bit 5 ESB	16 bit 4 MAV	8 bit 3 ESB3	4 bit 2 ESB2	2 bit 1 ESB1	1 bit 0 ESB0

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	Query	:AVERaging <numeric value=""> :AVERaging? <numeric value=""> = 1 to 256 (NR1)</numeric></numeric>
Explanation	Command	Set the number of measurements to average for the average mea- surement value. When the number of average measurements is set, the average func- tion 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 Response	: AVERaging? : 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 Query Response	:AVERaging:STATe <on off=""> :AVERaging:STATe? <on off=""></on></on>
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 Response	:AVERaging:STATe? :AVERaging:STATE ON (when HEADER ON) ON (when HEADER OFF) The average function is enabled.

Setting and Query of Comparator and BIN Judgment Beep Tone Setting

Syntax	Command	:BEEPer:JUDGment <character></character>
	Query	:BEEPer:JUDGment?
	Response	<character></character>
		<pre><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</character></pre>
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 Response	:BEEPer:JUDGment? :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	Query	:BEEPer:KEY <on off=""> :BEEPer:KEY? <on off=""></on></on>
		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 Response	:BEEPER:KEY? :BEEPER:KEY ON (when HEADER ON) ON (when HEADER OFF) The beep tone is set so that it plays.

Setting and Query of ON/ OFF Setting of BIN Measurement (Only for Models 3504-50, 3504-60)

Syntax	Query	:BIN <on off=""> :BIN ? <on off=""> ON : Starts BIN measurement OFF : Ends BIN measurement</on></on>
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 Query	:BIN:DISPIay <bin characters="" number=""> :BIN:DISPIay?</bin>
	Response	< <u>BIN Number/ Characters></u> = 1 to 14 (NR1)/ D/ CREFerence/ DREF- erence/ 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 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 Query Response	:BIN:FLIMit:COUNt <bin number="">,<lower limit="" value="">,<upper Limit Value> :BIN:FLIMit:COUNt? <bin number=""> <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)</upper></lower></bin></upper></lower></bin></bin></upper </lower></bin>
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 Response	:BIN:FLIMit:COUNt? 1 :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 Query Response	:BIN:FLIMit:DEViation <bin number="">,<lower limit<br="">Value>,<upper limit="" value=""> :BIN:FLIMit:DEViation? <bin number=""> <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)</upper></lower></bin></upper></lower></bin></bin></upper></lower></bin>
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 Response	:BIN:FLIMit:DEViation? 1 :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 Query Response	:BIN:FLIMit:REFerence <reference value=""> :BIN:FLIMit:REFerence? <reference value=""> = Numeric Value from -1999999 to 9999999 (excluding 0) (NR1)</reference></reference>
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 Response	:BIN:FLIMit:REFerence? :BIN:FLIMit:REFERENCE 150000 (when HEADER ON) 150000 (when HEADER OFF) 150000 is set for the reference value of the first parameter in devia- tion 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 Query Response	:BIN:SLIMit:COUNt <lower limit="" value="">,<upper limit="" value=""> :BIN: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)</upper></lower></upper></lower></upper></lower>
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 Response	:BIN:SLIMit:COUNt? :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.

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 Query Response	:BIN:SLIMit:DEViation <lower limit="" value="">,<upper limit="" value=""> :BIN:SLIMit:DEViation? <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)</upper></lower></upper></lower></upper></lower>
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 Response	<pre>:BIN:SLIMit:DEViation? :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.</pre>
Note		The measurement value for the second parameter in deviation per- cent mode is the result of the calculation (measurement value - refer- ence value).

Setting and Query of Reference Value of Second Parameter for BIN Function in Deviation Percent Mode (Only for Models 3504-50, 3504-60)

Syntax	Query	:BIN:SLIMit:REFerence <reference value=""> :BIN:SLIMit:REFerence? <reference value=""> = Numeric Value from -1999999 to 1999999 (NR1)</reference></reference>
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 Response	:BIN:SLIMit:REFerence? :BIN:SLIMit:REFERENCE 150000 (when HEADER ON) 150000 (when HEADER OFF) 150000 is set for the reference value of the second parameter in devi- ation 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 Self Calibration

Syntax	Command Query Response	:CALibration <character> :CALibration? <character> = OFF/ MANUal /AUTO</character></character>
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 Response	:CALibration? :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 com- mand 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	 Connect the object to be tested to the measurement terminal Set the measurement frequency, level and suitable range Carry out :CALibration:ADJust 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.

Setting and Query of Equivalent Circuit

ommand	:CIRCuit <character></character>
uery	:CIRCuit?
esponse	<character></character>
	< <u>Character></u> = SERial, PARallel SERial: Sets the equivalent circuit mode to series-equivalent circuit. PARallel: Sets equivalent circuit mode to parallel-equivalent circuit.
ommand	Sets the equivalent circuit mode.
•	Returns the setting of the current equivalent circuit mode as charac- ters.
ommand	:CIRCuit SERIAL Sets the equivalent circuit mode to series-equivalent circuit.
·	:CIRCuit? :CIRCUIT SERIAL (when HEADER ON) SERIAL (when HEADER OFF) The equivalent circuit mode is set to series-equivalent circuit.
	uery esponse ommand uery ommand

Automatic Setting and Query of Equivalent Circuit

Syntax	Command	:CIRCuit:AUTO <on off=""></on>
	Query	:CIRCuit:AUTO?
	Response	<on off=""></on>
		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.

Setting and Query of Contact Check Function

Syntax	Command	:CONTact:VERify <character></character>
	Query	:CONTact:VERify?
	Response	<character> = OFF/ BEFore/ AFTer/ BOTH</character>
		 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 Response	:CONTact:VERify? :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 trig- ger simultaneous output function will automatically turn to "ON".

Setting and Query of ON/ OFF Setting of Comparator Function

Syntax	Query	:COMParator <on off=""> :COMParator ? <on off=""></on></on>
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 Response	: COMParator? : 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></character>
	Query	:COMParator:DISPlay?
	Response	<character> = C/ D/ CREFerence/ DREFerence/ OFF</character>
		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 refer- ence value to be displayed in the SUB display area during comparator measurement.
	Query	Returns the indication setting of the SUB display area during compar- ator 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 Response	: COMParator: DISPlay? : 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.

Setting and Query of Upper Limit and Lower Limit Values of First Parameter for Comparator Function in Count Value Mode

Syntax		:COMParator:FLIMit:COUNt <lower limit="" value="">,<upper limit="" value=""></upper></lower>
	Query Response	:COMParator:FLIMit:COUNt?
	Response	<lower limit="" value="">,<upper limit="" value=""></upper></lower>
		<lower limit="" value=""> = OFF/ Numeric Value from -199999 to 999999 (NR1) <upper limit="" value=""> = OFF/ Numeric Value from -199999 to 999999 (NR1)</upper></lower>
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 Response	:COMParator:FLIMit:COUNt? :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 Query	:COMParator:FLIMit:DEViation <reference value="">,<lower limit="" value="">,<upper limit="" value=""></upper></lower></reference>
	Response	:COMParator:FLIMit:DEViation?
	rteepenee	<reference value="">,<lower limit="" value="">,<upper limit="" value=""></upper></lower></reference>
		<reference value=""> = -199999 to 9999999 (excluding 0) (NR1)</reference>
		<lower limit="" value=""> = OFF/ Numerical Value from -999.99 to 999.99(NR2)</lower>
		<upper limit="" value=""> = OFF/ Numerical Value from -999.99 to 999.99 (NR2)</upper>
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 set- tings for the first parameter in deviation percent mode in order of ref- erence 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 Response	:COMParator:FLIMit:DEViation? :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.

Setting and Query of Upper Limit and Lower Limit Values of Second Parameter for Comparator Function in Count Value Mode

Syntax	Command Query	:COMParator:SLIMit:COUNt <lower limit="" value="">,<upper limit="" value=""></upper></lower>
	Response	:COMParator:SLIMit:COUNt? <lower limit="" value="">,<upper limit="" value=""></upper></lower>
		<lower limit="" value=""> = OFF/ Numeric Value from -199999 to 199999(NR1) <upper limit="" value=""> = OFF/ Numeric Value from -199999 to 199999(NR1)</upper></lower>
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 Response	:COMParator:SLIMit:COUNt? :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 Query	:COMParator:SLIMit:DEViation <reference value="">,<lower Limit Value>,<upper limit="" value=""></upper></lower </reference>
	Response	:COMParator:SLIMit:DEViation? <reference value="">,<lower limit="" value="">,<upper limit="" value=""></upper></lower></reference>
		<reference value=""> = -199999 to 199999(NR1)</reference>
		<lower limit="" value=""> = OFF/ Numeric Value from -199999 to 199999 (NR1)</lower>
		<upper limit="" value=""> = OFF/ Numeric Value from -199999 to 199999 (NR1)</upper>
Explanation Command	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 set- tings 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 Response	:COMParator:SLIMit:DEViation? :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 devia- tion percent mode.
Note		The measurement value for the second parameter in deviation per- cent mode is the result of the calculation (measurement value - refer- ence value).

Query of Compensation Values for Open Circuit and Short Circuit Compensation

Syntax Query Response		:CORRection:DATA? 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:</phase></residual>
		<rs> = OFF/Numeric Value (NR3),<x> = OFF/Numeric Value (NR3) Output parameter LSRS:</x></rs>
		<ls> = OFF/Numeric Value (NR3),<rs> = OFF/Numeric Value (NR3)</rs></ls>
		Output parameter for open circuit compensation values Output parameter ZPH:
		< <u>Residual Impedance> = OFF/Numeric Value (NR3),</u> < <u>Phase Angle> = OFF/Numeric Value (NR2)</u> Output parameter GB:
		<g> = OFF/Numeric Value (NR3), = OFF/Numeric Value (NR3) Output parameter CPG:</g>
		<cp> = OFF/Numeric Value (NR3),<g> = OFF/Numeric Value (NR3)</g></cp>
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 M Ω 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</character></character>	
	Query	:CORRection:OPEN?	
	,	<character>=ALL/ ON/ SPOT/ OFF</character>	
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 measure- ment values set at open circuit compensation reading set- ting 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 mea- surement conditions (frequency, level).	
		ON : The open circuit compensation function is enabled for the cur- rent 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 Response	: CORRection : OPEN? : CORRECTION : OPEN ALL (when HEADER ON) ALL (when HEADER OFF) The compensation function is enabled for all measurement conditions (frequency, level).	

Setting and Query of Open Circuit Compensation Function

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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.

: adjustmer	It value valid \times : n	o adjustment value)
frequency Measurement signal level	120 Hz	1 kHz	
0.1 V (Model 3504-60 only)	×	×	
0.5 V	•	×	
1 V	×	•	
	-		<u>.</u>

B. The following will occur when circuit compensation is disabled (execute :CORREction:OPEN OFF), or when able (abl) is pressed for 2 seconds or more.

r: adjustment	t value invalid $ imes$: n	o adjustment value
frequency Measurement signal level	120 Hz	1 kHz
0.1 V (Model 3504-60 only)	×	×
0.5 V	r	×
1 V	×	r

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)

: adjustmer	nt value valid $ imes$: n	o adjustment value	•
frequency Measurement signal level	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 1="" values="">, <compensation 2="" values=""></compensation></compensation>
	Query	:CORRection:OPEN:DATA?
	Response	<compensation 1="" values="">,<compensation 2="" values=""> <compensation 1="" values=""> = -99.9999E9 to 99.9999E9 (NR3) <compensation 2="" values=""> = -99.9999E9 to 99.9999E9 (NR3)</compensation></compensation></compensation></compensation>
Explanation	Command	Sets the open compensation value for current measurement condi- tions (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 set- ting.
		When the forwarding format is ZPH <compensation 1="" values=""> : Z (Z < 0 an execution error) <compensation 2="" values=""> : PH (PH<-180, PH > 180 an execution error)</compensation></compensation>
		When the forwarding format is GB <compensation 1="" values=""> : G <compensation 2="" values=""> : B</compensation></compensation>
		When the forwarding format is CPG <compensation 1="" values=""> : Cp <compensation 2="" values=""> : G</compensation></compensation>
		• 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.

Setting and Query of Output Parameter for Open Circuit Compensation Values

Syntax	Command Query	:CORRection:OPEN:DATA:FORMat <character> :CORRection:OPEN:DATA:FORMat?</character>
	Response	<character> = ZPH/ GB/ CPG</character>
Explanation	Command	Sets the forwarding format of open circuit compensation values.
	Query	Returns the setting of the forwarding format for open circuit compen- sation values.
Example	Command	:CORRection:OPEN:DATA:FORMat GB Sets the forwarding format of open circuit compensation values to be G and B.
	Query Response	:CORRection:OPEN:DATA:FORMat? :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	Query	:CORRec	:CORRection:OPEN:POINt <numeric value=""> :CORRection:OPEN:POINt?</numeric>					
	Response	<numeric \<="" th=""><th>/alue> = 1</th><th>l to 255 (N</th><th>IR1)</th><th></th><th></th><th></th></numeric>	/alue> = 1	l to 255 (N	IR1)			
Explanation	Command	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.			n:OPEN tion.			
	Query	Returns se values.	ttings of n	neasureme	ent conditi	ons for op	en compe	nsation
	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Unuse	d 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 Query	: CORREC Set to acquiconditions value (:CO value using : CORREC	ire open o in "Yes" be RRection: g key oper tion: C	compensa elow durin OPEN AL ation. OPEN : PC	tion value: g commar L) or acqu	s under th nd for oper iring open	ו compens compens	sation ation
	Response	: CORREC 36 (when Returns the	HEADER	OFF)		(when HE	ADER ON)
			ement frequ ment signa		120 Hz	100 kHz	:	
			100 mV		No	No	1	
			500 mV		No	No		
			1 V		Yes	Yes		
Note		When any open comp						

Setting and Query of Short Circuit Compensation Function

Syntax	Command	:CORRection:SHORt <character></character>
	Query	< <u>Character></u> = ALL/ ON/ OFF/ RETurn :CORRection:SHORt?
		<character> = ALL/ ON/ SPOT/ OFF</character>
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 measure- ment values set at short circuit compensation reading set- ting 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 measure- ment 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 (fre- quency, level) and enable the short circuit compensation function.
	Query Response	: CORRection : SHORt? : CORRECTION : SHORT ON (when HEADER ON) ON (when HEADER OFF) The short compensation function is enabled for the current measure- ment conditions (frequency, level).

Setting and Query of Short Compensation Values

Syntax	Command	:CORRection:SHORt:DATA <compensation values1="">, <compensation 2="" values=""></compensation></compensation>
	Query	:CORRection:SHORt:DATA?
	Response	<pre><compensation 1="" values="">,<compensation 2="" values=""> <compensation 1="" values=""> = -99.9999E9 to 99.9999E9 (NR3) <compensation 2="" values=""> = -99.9999E9 to 99.9999E9 (NR3)</compensation></compensation></compensation></compensation></pre>
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 cur- rent 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 1="" values=""> : Z (Z < 0 an execution error) <compensation 2="" values=""> : PH (PH<-180, PH>180 an execution error)</compensation></compensation>
		When the forwarding format is RSX <compensation 1="" values=""> : Rs <compensation 2="" values=""> : X</compensation></compensation>
		When the forwarding format is LSRS <compensation 1="" values=""> : Ls <compensation 2="" values=""> : Rs</compensation></compensation>
		• 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.

Setting and Query of Output Parameter for Short Circuit Compensation Values

Syntax	Command Query	:CORRection:SHORt:DATA:FORMat <character> :CORRection:SHORt:DATA:FORMat?</character>
	Response	<character> = ZPH/ RSX/ LSRS</character>
Explanation	Command	Sets the forwarding format of short circuit compensation values.
	Query	Returns the setting of the forwarding format for short circuit compen- sation values.
Example	Command	:CORRection:SHORt:DATA:FORMat RSX Sets the forwarding format of short circuit compensation values to be Rs and X.
	Query Response	:CORRECTION:SHORT:DATA:FORMat? :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.

Setting and Query of Short Compensation Points

Syntax	Command Query Response	:CORRection:SHORt:POINt <numeric value=""> :CORRection:SHORt:DATA:FORMat? <numeric value=""> = 1 to 255 (NR1)</numeric></numeric>						
	Response		/alue> = 1	to 255 (N	IRT)			
Explanation	Command Set measurement conditions for short compensation value acquisitie during command for short compensation value (:CORRection:SHO 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.			n:SHORt tion.				
	Query	Returns se values.	ttings of n	neasureme	ent conditi	ons for sh	ort compe	nsation
	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Unused	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 Query Response	: CORREC Set to acqu conditions value (:CO value using : CORREC	ire short o in "Yes" be RRection: g key oper stion:S	compensa elow durin SHORt AL ation. SHORt : P	tion values g commar .L) or acqu OINt?	s under the nd for shor uiring shor	t compens t compens	sation sation
	Response : CORRECTION : SHORt : POIN! 18 (when HEADER OFF) Returns the short compensation point							
			ement frequ ment signa	-	120 Hz	1 kHz		
			100 mV		No	No		
			500 mV		Yes	Yes		
			1 V		No	No		
Note		When any short comp						

Setting and Query of Load Compensation Function

Syntax	Command	:CORRection:LOAD <character></character>	
- ,		<character> = ON/ OFF/ RETurn</character>	
	Query	:CORRection:LOAD?	
	Ē	<character> = ON/ SPOT/ OFF</character>	
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 compensa- tion) 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 Response	:CORRECTION:LOAD? :CORRECTION:LOAD ON (when HEADER ON) ON (when HEADER OFF) The load compensation function is enabled for the current measure- ment conditions.	

Setting and Query of Load Compensation Values

Syntax	Command	:CORRection:LOAD:DATA <compensation 1="" values="">, <compensation 2="" values=""></compensation></compensation>
	Query Response	:CORRection:LOAD:DATA? <compensation 1="" values="">,<compensation 2="" values=""> For the load compensation value forwarding format COEFFICIENT and ZPH</compensation></compensation>
		<compensation 1="" values=""> = 1E-21 to 99.9999E9 (NR3) <compensation 2="" values=""> = -180 to 180 (NR2)</compensation></compensation>
		For the load compensation value forwarding format CD <compensation 1="" values=""> = -19.9999E-3 to 99.9999E-3 (NR3) (excluding -1E-21 to 1E-21) <compensation 2="" values=""> = -1.99999 to 1.999999 (NR2)</compensation></compensation>
Explanation	Command	
	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 1="" values=""> : Z_COEF <compensation 2="" values=""> : PH_COEF</compensation></compensation>
		When the forwarding format is ZPH <compensation 1="" values=""> : Z <compensation 2="" values=""> : PH</compensation></compensation>
		When the forwarding format is CD <compensation 1="" values=""> : C</compensation>
		 <compensation 2="" values=""> : D</compensation> 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 measure- ment 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.

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 Query	:CORRection:LOAD:DATA:FORMat <character> :CORRection:LOAD:DATA:FORMat?</character>
	Response	
		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 coeffi- cient.
	Query Response	:CORRECTION:LOAD:DATA:FORMat? :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 coeffi- cient.

Setting and Query of Reference Values for Load Compensation Function

Syntax	Command Query	:CORRection:LOAD:REFerence <reference 1="" value="">, <reference 2="" value=""></reference></reference>
	Response	:CORRection:LOAD:REFerence?
		<reference 1="" value=""> = Numeric Value from -199999 to 999999 (excluding 0) (NR1)</reference>
		<reference 2="" value=""> = Numeric Value from -199999 to 199999 (NR1)</reference>
Explanation	Command	Sets the reference values for the load compensation function. Set the standard values for the measurement frequencies when exe- cuting the command because the standard values will be saved according to the measurement frequencies. <reference 1="" value=""> indicates the reference value for C (capaci- tance) and <reference 2="" value=""> 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.</reference></reference>
	Query	Returns the reference value setting in the order of <reference 1="" value=""> and <reference 2="" value="">.</reference></reference>
Example	Command	:CORRection:LOAD:REFerence 250000,1000 Sets the reference values for the load compensation function to C = 250000 and D = 1000.
	Query Response	:CORRection:LOAD:REFerence? :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 (:CORRetion:LOAD:DATA).
Setting and Query of OFFSET Compensation Function

Syntax	Command Query Response	:CORRection:OFFSet <on off=""> :CORRection:OFFSet? <on off=""> ON :Enables the offset compensation function. OFF :Disables the offset compensation function.</on></on>
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 Response	:CORRection:OFFSet? :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 Query	:CORRection:OFFSet:DATA <c compensation="" offset="" value="">, <d compensation="" offset="" value=""> :CORRection:OFFSet:DATA?</d></c>
	Response	<c compensation="" offset="" value="">,<d compensation="" offset="" value=""> <c compensation="" offset="" value=""> = -99.9E -3 to 99.9E -3 <the compensation="" offset="" parameter="" second="" value=""> = -1.99999 to 1.99999 (NR2)</the></c></d></c>
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 Response	:CORRection:OFFSet:DATA? :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 off- set compensation value is set to 0.0001.

Setting and Query of Low C Reject Function

Syntax	Command Query Response	:CREJect <on off=""> :CREJect? <on off=""> ON ilf the measurement value is abnormally low, it is detected as an error. OFF :Even if the measurement value is abnormally low it is not con- sidered an error.</on></on>
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 Response	: CREJect? : 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 Query Response	:CREJect:LIMit <numeric value=""> :CREJect:LIMit? <numeric value=""> = 0.000 to 10.000 (NR2)</numeric></numeric>
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 Response	:CREJect:LIMit? :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 Query Response	:DISable:TRIGger <on off=""> :DISable:TRIGger? <on off=""></on></on>
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 Response	:DISable:TRIGger? :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 Query Response	:DISPlay <on off=""> :DISPlay? <on off=""> ON The display is always lit. OFF The display remains off as long as there is no key control.</on></on>
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 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 Response	:ERRor <numer< th=""><th>? ic Value></th><th></th><th></th><th></th><th></th><th></th></numer<>	? ic Value>					
		1 Pa 2 Fr	o (
Explanation	Query	numeric	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 Response	: ERRO 4 An overr	r? un error v	vas gener	ated.			

Setting and Query of Event Status Enable Register 0 (ESER0)

Syntax	Command Query Response	:ESE0? <numeri< th=""><th>c Value></th><th>Value> = 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th><th></th></numeri<>	c Value>	Value> = 0 to 255	5 (NR1)				
Explanation	Command	A numer are roun	ets the mask pattern of the ESER0 to a numeric value from 0 to 255. numeric value in NRf format is accepted but non significant digits re rounded off so the numeric. ne initial value (when the power is turned on) is 0.						
	Query	Returns	the ESEF	R0 content	as an NF	R1 numeri	c value.		
	128 bit 7 REF	64 bit 6 COF	32 bit 5 LER	16 bit 4 MOF	8 bit 3 MUF	4 bit 2 IDX	2 bit 1 EOM	1 bit 0 CEM	
Example	Command Query Response	:ESE0 :ESE0 20 (wh	4 and bit 2 ? 20 (when HEADE	2 of ESER nen HEADE ER OFF) ESER0 are	ER ON)				

Setting and Query of Event Status Enable Register 1 (ESER1)

Syntax	Command	:ESE1 <	Numeric	Value>					
	Query	:ESE1?							
	Response	<numeri< th=""><th>c Value></th><th></th><th></th><th></th><th></th><th></th><th></th></numeri<>	c Value>						
		<numeri< th=""><th>c Value></th><th>= 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th><th></th></numeri<>	c Value>	= 0 to 255	5 (NR1)				
Explanation	Command	Commar from 0 to		e mask p	attern of	the ESEF	R1 to a n	umeric va	lue
				n NRf for the nume		cepted bu	ıt non sigi	nificant dię	gits
		The initia	al value (v	vhen the p	ower is tu	irned on)	is 0.		
	Query	Returns	the ESEF	R1 content	as an NF	1 numeri	c 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	
	NOC	AND	SLO	SIN	SHI	FLO	FIN	FHI	
Example	Command	:ESE1	64						
		Sets bit 6	6 of ESEF	R1.					
	Query	:ESE1	?						
	Response	:ESE1	<mark>64</mark> (wł	nen HEADE	ER ON)				
		<mark>64</mark> (wh	en HEADE	R OFF)					
		•	SER1 is	,					

Setting and Query of Event Status Enable Register 2 (ESER2)

Syntax	Command Query Response	:ESE2? <numer< th=""><th></th><th></th><th>5 (NR1)</th><th></th><th></th><th></th><th></th></numer<>			5 (NR1)				
Explanation	Command	A numer rounded	•	n NRf form numeric.	nat is acce	epted but i	non signific	rom 0 to 2 cant digits	
	Query	Returns	the ESER	R2 content	t as an NF	R1 numeri	c value.		
	128 bit 7 BIN8	64 bit 6 BIN7	32 bit 5 BIN6	16 bit 4 BIN5	8 bit 3 BIN4	4 bit 2 BIN3	2 bit 1 BIN2	1 bit 0 BIN1	
Example	Command	:ESE2	_						
	Query Response	:ESE2 :ESE2 1 (whe	0 of ESEF ? 1 (whe n HEADEF ESER2 is	n HEADEF R OFF)	R ON)				
Note		There is	no BIN fu	inction for	the Mode	el 3504-40).		

Setting and Query of Event Status Enable Register 3 (ESER3)

Syntax	Command Query Response	:ESE3?		Value>					
		<numer< th=""><th>ic Value></th><th>= 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th><th></th></numer<>	ic Value>	= 0 to 255	5 (NR1)				
Explanation	Command	A nume are roun	ric value i ded off so		mat is ac eric.	cepted bu	ıt non sig	om 0 to 25 nificant dig	
	Query	Returns	the ESEF	R3 content	as an NF	R1 numeri	c value.		
	128 bit 7 DNG	64 bit 6 OUT	32 bit 5 BIN14	16 bit 4 BIN13	8 bit 3 BIN12	4 bit 2 BIN11	2 bit 1 BIN10	1 bit 0 BIN9	
Example	Command	:ESE3	64						
	Query Response	Sets bit	6 of ESEF ?	R3. nen HEADE	ER ON)				
		<mark>64</mark> (wł	nen HEADE	ER OFF)					
		BILOOIE	ESER3 is	set to T.					
Note		There is	no BIN fu	Inction for	the Mode	el 3504-40).		

Query of Event Status Register 0

Syntax	Query Response	:ESR0? <numeri< th=""><th>c Value></th><th></th><th></th><th></th><th></th><th></th></numeri<>	c Value>					
		<numeri< th=""><th>c Value></th><th>= 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th></numeri<>	c Value>	= 0 to 255	5 (NR1)			
Explanation	Query	numeric	data from	0 to 255		SR0) sett clears tha nessage.	•	nt as NR1
	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	Query Response	:ESR0' 4	?					

Bit 2 of ESR0 is 1.

Query of Event Status Register 1

Syntax	Query Response	:ESR1? <numer< th=""><th>) ic Value></th><th></th><th></th><th></th><th></th><th></th></numer<>) ic Value>					
		<numer< th=""><th>ic Value></th><th>= 0 to 255</th><th>5 (NR1)</th><th></th><th></th><th></th></numer<>	ic Value>	= 0 to 255	5 (NR1)			
Explanation	Query	numeric	data from		and then	clears tha		nt as NR1
	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 Response	: ESR1 82 Bit 6, bit	-	t 1 of ESR	1 are 1.			

Query of Event Status Register 2

_								
Syntax	Query Response	:ESR2? <numer< th=""><th>ic Value></th><th></th><th></th><th></th><th></th><th></th></numer<>	ic Value>					
		<numer< th=""><th>c Value></th><th>= 0 to 258</th><th>5 (NR1)</th><th></th><th></th><th></th></numer<>	c Value>	= 0 to 258	5 (NR1)			
Explanation	Query	numeric No head	data from er is adde	0 to 255 d to the r	gister 2 (E and then esponse r always re	clears tha nessage.	-	nt as NR1
	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 Response	: ESR2 1 Bit 0 of E	? ESR2 is 1					

Query of Event Status Register 3

		<u> </u>						
Syntax	Query Response	:ESR3? <numer< th=""><th>∙ ic Value></th><th></th><th></th><th></th><th></th><th></th></numer<>	∙ ic Value>					
		<numer< th=""><th>ic Value></th><th>= 0 to 25</th><th>5 (NR1)</th><th></th><th></th><th></th></numer<>	ic Value>	= 0 to 25	5 (NR1)			
Explanation	Query	numeric No heac	data from ler is adde		and then esponse i	clears tha nessage.	ing conter t content.	nt as NR1
	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 Response	: ESR3 64 Bit 6 of I	? ESR3 is 1					

Setting and Query of Measurement Frequency

		• •
Syntax	Command	:FREQuency <numeric value=""></numeric>
	Query	:FREQuency?
	Response	<numeric value=""></numeric>
		<numeric value=""> = 120/ 1000 (NR1)</numeric>
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></character>
	Query	:HANDshake?
	Response	<character> = X/ HARDware/ BOTH/ OFF</character>
		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.

Setting and Query of Header for Response Messages

Syntax	Command Query Response	:HEADer <on off=""> :HEADer? <on off=""></on></on>
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	Query	:IO:OUTPut:DELay <numeric value=""> :IO:OUTPut:DELay? <numeric value=""> = 0 to 0.9999 (NR1)</numeric></numeric>
Explanation	Command	Sets delay time comparator and the BIN judgement result $\leftrightarrow \rightarrow \overline{\text{EOM}}$ 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 $\leftrightarrow \overline{\text{EOM}}$ period as charaters.
Example	Command	: IO:OUTPut:DELay 0.0005 Sets delay time comparator and the BIN judgement result $\leftrightarrow \overline{\text{EOM}}$ period to 500 µs.
	Query Response	: IO: OUTPut: DELay? :IO: OUTPUT: DELay 0.0005 (when HEADER ON) 0.0005 (when HEADER OFF) Delay time comparator and the BIN judgement result $\leftrightarrow \rightarrow \overline{\text{EOM}}$ period set at 500 µs.
Note		There is an approximate error of 160 μ s in the delay time entered for comparator and the BIN judgement result $\leftrightarrow \rightarrow$ 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.

Setting and Query of Output of Judgment Result Signal Line in EXT I/O

Syntax	Command	:IO:RESult:RESet <character></character>
- ,	Query Response	:IO:RESult:RESet? <character> = ON/ OFF</character>
		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 judg- ment results OUT-OF-BINS, D-NG, BIN1 to BIN14 for BIN measure- ment, 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 Response	: IO:RESult:RESet? :IO:RESULT:RESET OFF (when HEADER ON) OFF (when HEADER OFF) The judgment results are set to be updated when judgment ends.

Setting and Query of Judgment Mode for Comparator and BIN Functions

Syntax	Command Query Response	:JUDGment:MODE <character> :JUDGment:MODE? <character> = COUNt/ DEViation</character></character>
		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 Response	: JUDGment: MODE? : 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 Query	:KEYLock <on off=""> :KEYLock?</on>
	Response	<on off=""></on>
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 Response	: KEYLOCK? : 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=""></numeric>
	Query	:LEVel?
	Response	<numeric value=""></numeric>
		< <u>Numeric Value></u> = 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 Response	:LEVel? :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 Query	:LEVel:CHECk <on off=""> :LEVel:CHECk?</on>
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 Query Response	:LEVel:CHECk ON Enables the measurement level monitoring function. :LEVel:CHECk? :LEVEL:CHECK ON (when HEADER ON) ON (when HEADER OFF) The measurement level monitoring function is set to ON.

Setting and Query of Threshold for Judging Abnormal Measurement Level

Syntax	Command Query	:LEVel:CHECk:LIMit <numeric value=""> :LEVel:CHECk:LIMit?</numeric>
		<numeric value=""> = 0.01 to 100.00 (NR2)</numeric>
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
	Query Response	are rounded off so the numeric. :LEVel:CHECk:LIMit? :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

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Syntax	Command	:LOAD <numeric value=""></numeric>
		<numeric value=""> = 1 to 99 (NR1)</numeric>
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.

Setting and Query of Load Method

Syntax	Command	:LOAD:TYPE <character></character>		
-	Query	:LOAD:TYPE?		
		<character> = ALL/ CORRection/ HARDware</character>		
		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 Response	: LOAD : TYPE ? : 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.		

Query of Measurement Data

Syntax	Query Response	 :MEASure? During normal measurement <measurement (nr1)="" status="">,C <measurement (nr3)="" value="">, D <measurement (nr2)="" value="">,<panel (nr1)="" load="" number=""></panel></measurement></measurement></measurement>
		<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 error (before measurement) 13 L side contact check error (before measurement) 12 H 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</measurement>
		 During comparator measurement <measurement status(nr1)="">,<comparison and="" logical="" result="">,</comparison></measurement> <measurement (nr3)="" c="" of="" value="">,<comparison c="" of="" result="">,</comparison></measurement> <measurement (nr2)="" d="" of="" value="">,<comparison d="" of="" result="">,</comparison></measurement> <panel (nr1)="" load="" number=""></panel>
		 <comparison and="" logical="" result=""> = 0/1</comparison> 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.
		<pre><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)</comparison></pre>
Syntax	Query Response	 During BIN measurement <bin result="">, <measurement (nr3)="" c="" of="" value="">, <measurement (nr2)="" d="" of="" value="">, <panel (nr1)="" load="" number=""></panel></measurement></measurement></bin>
		Sin Result> = -1, -2, 1 to 14 1 to 14 BIN No1 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

settings of the unit were changed, the measurement values obtained when the previous settings were configured are returned.

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, compari- son 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 com- parison 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	Query Response Query	 During normal measurement, when the second parameter is D. :MEASure? 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. :LOAD 5
	Response Query Response	<pre>:MEASure? 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. :BIN ON :MEASure? 0,1,CP 1.23456E-06,D 0.01234,0 (when HEADER ON) 0,1,1.23456E-06,0.01234,0 (when HEADER OFF)</pre>
Note		 Indicates that the measurement value is within the set BIN1 range. 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.

Query of Measurement Data

• The following values are returned in the case of abnormal measurement.

	:MEASure? :MEMory? response result							
Pri- ority rank		Measure- ment Status	Comparator result logical product	BIN resul	C measurement value	C COMP result	D measure- ment value	D COMP result
Llianh	Time out	9	0	-1	44444E+44	1	44444	1
High	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	Measure- ment 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	Measure- ment value	Standard judgment
	Outside of C display range (comparator and BIN measurement $(\Delta\% \text{ setting}))$	3/-3	0	-1	999999E+99/ -999999E+99	1/-1	Measure- ment 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	Measure- ment 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						
Prior- ity rank	Measurement abnormality	ERR (pin 14)	BIN1 to BIN13	OUT OF BINS (pin 37)	D-NG (pin 39)	Comparator Output (Output pin)	Panel display
High	Time out	LOW	ні	LOW	ні	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	H, L side contact check errors (after measurement)	LOW	ні	LOW	ні	<u>С-НІ</u> (pin 30) D-НІ (pin 7)	
	L side contact check error (after measure- ment)	LOW	н	LOW	ні	<u>С-НІ</u> (pin 30) D-НІ (pin 7)	
	H side contact check error (after measure- ment)	LOW	ні	LOW	ні	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	H, L side contact check errors (before measure- ment)	LOW	н	LOW	н	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	L side contact check error (before mea- surement)	LOW	н	LOW	н	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	H side contact check error (before mea- surement)	LOW	н	LOW	ні	<u>С-Н</u> І (pin 30) D-НІ (pin 7)	
	Fixed voltage abnor- mality (CV error)	LOW	н	LOW	н	<u>С-НІ</u> (pin 30) D-НІ (pin 7)	CV light will go off
	Over range	НІ	ні	LOW	ні	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	Under range	н	н	LOW	н	C-LOW (pin 31) D-LOW (pin 8)	
	Outside of Low C reject limit range	LOW	LOW/ HI	LOW / HI	LOW/ HI	Standard judgment	Ê
	Abnormal level detected	LOW	н	LOW	н	<u>C-HI</u> (pin 30) D-HI (pin 7)	
	Outside of C display range (normal measure- ment + comparator and BIN measure- ment (count setting)) *1	ні	ні	LOW	н	C: C-HI (pin 30) D: Standard judgment	
	Outside of C display range (comparator and BIN measurement (Δ% setting))	ні	ні	LOW	НІ	C: C-HI (pin 30) or C-LOW (pin 31) D: Standard judgment	$ \begin{array}{c c} & & & \\ \hline & & \\ \hline & & \\ \hline \\ \hline$
	Outside of D display range	н	н	LOW/ HI	LOW/ HI	C: Standard judgment D: D-HI (pin 7) or D-LOW (pin 8)	$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$
	Outside of guaran- teed accuracy range	н	LOW/ HI	LOW/ HI	LOW/ HI	Standard judgment	⊕** ■ 1000 10 ** ⊕** ■ 000000 1 **
Low	No measurements are made when the power supply is turned on	ні	НІ	HI	НІ	No output	

Setting of Valid Data For Measurement Data Query (:MEASure)

E	Syn cplanat	Query Respo	onse <nume nand Sets th query o Return</nume 	Sure:VALid <n Sure:VALid? eric Value> = 0 to the measurement f (:MEASure?). is the measurement (:MEASure?) as f</n 	255 (NR value resu	1) ult returned by 1 esult returned b	oy measure	ement data
	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Unused	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
	Query Response	 performed, the C measurement value and D measurement value will be returned. :MEASure:VALid? :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.

Query of Measurement Values Saved to Memory by the Measurement Value Memory Function

Syntax	Query Response	 :MEMory? <character></character> <character> = No Data/ ALL</character> When there is no data section <first in="" item="" memory=""><message terminator=""><second in="" item="" memory=""><message terminator=""><nth in="" item="" memory=""> <message terminator=""></message></nth></message></second></message></first> n indicates a number up to 32,000. When the characters of the data section are ALL <first in="" item="" memory=""><comma(,)><second in="" item="" memory=""></second></comma(,)></first> <comma(,)><nth in="" item="" memory=""><message terminator=""></message></nth></comma(,)>
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? 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		 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. 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.

Deleting Data from Memory of Measurement Value Memory Function

Syntax	Command	:MEMory:CLEar
Explanation	Command	Deletes all measurement values saved to memory by the measure- ment 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>
		<numeric value=""> = 0 to 32,000 (NR1)</numeric>
Explanation	Query	Returns the number of data items saved to memory by the measure- ment 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.

Setting and Query of Measurement Value Memory Function ON/ OFF

Syntax	Command Query Response	:MEMory:CONTrol <on in="" off=""> :MEMory:CONTrol? <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 mea- surements. OFF : Measurement values not saved in memory.</on></on>
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 Query Response	:MEMory:CONTrol ON Sets so that the measurement value is saved each time a measurement is made. :MEMory:CONTrol? :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.

Setting and Query of Measurement Value Memory Function Memory Size

Syntax	Command Query Response	:MEMory:POINts <numeric value=""> :MEMory:POINts? <numeric value=""> = 1 to 32,000 (NR1)</numeric></numeric>
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 Query Response	:MEMory: POINts 200 Sets the memory size to 200. :MEMory: POINts? :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 Response	: MONItor? <voltage monitor="" value(nr3)="">,<current monitor="" value(nr3)=""></current></voltage>
Explanation	Query	Returns the measurement signal monitor values in the order of volt- age monitor value and current monitor value.
Example	Query Response	: MONItor? 9.56789E-01,7.34567E-05 The voltage monitor value and current monitor value are set to 0.956789 V and 73.4567 μA.

Setting and Query of Voltage and Current Monitor Levels Display

Syntax	Command Query Response	:MONItor:DISPlay <on off=""> :MONItor:DISPlay? <on off=""> ON :Displays measurement signal monitor level in the SUB display area.</on></on>
		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 Query Response	:MONItor:DISPlay ON Set the measurement signal monitor level to be displayed. :MONItor:DISPlay? 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)

Setting and Query of Measurement Range

0 1		J
Syntax	Command	:RANGe <numeric value=""></numeric>
	Query	:RANGe?
	Response	<numeric value=""></numeric>
		<numeric value=""> = 1 to 10 (NR1)</numeric>
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 com- mand 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 auto- matically 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 Response	: RANGe? : RANGE 5 (when HEADER ON) 5 (when HEADER OFF) The measurement range is set to 5 (200 nF) (when 1 kHz).

Note

Numerical Value	Measurement Frequency			
(Range Number)	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		

Automatic Setting and Query of Measurement Range

Syntax	Query	:RANGe:AUTO <on off=""> :RANGe:AUTO? <on off=""> ON Changes the measurement range automatically.</on></on>
		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 Response	:RANGe : AUTO? :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.></no.>
-	Query	:SAVE? <no.></no.>
	Response	0/ 1
		<no.>1 to 99 (NR1)</no.>
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 num- ber, 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 Response	: SAVE? 3 1 Measurement conditions are saved to Panel No. 3.

Clearing the Specified Panel Number

Syntax	Command	:SAVE:CLEar <all numeric="" value=""> <all numeric="" value=""> = ALL/ 1 to 70 (NR1)</all></all>
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></character>
	Query	:SPEEd?
	Response	<character></character>
		<character> = FAST/ NORMal/ SLOW</character>
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 Response	: SPEEd? : 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

5	<u> </u>	
Syntax	Command	:SSOurce <on off=""></on>
	Query	:SSOurce?
	Response	<on off=""></on>
		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 Response	: SSOurce? : 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 trig- ger simultaneous output function setting cannot be changed.

Setting and Query of Wait Time for Trigger Synchronous Output Function

U I		
Syntax	Command	:SSOurce:WAIT <wait 1="" time="">, <wait 2="" time=""></wait></wait>
	Query	:SSOurce:WAIT?
	Response	<wait 1,="" 2="" time=""> = 0.001 to 9.999 (NR2)</wait>
		<wait 1="" time=""> : Sets the wait time for a measurement frequency of 120 Hz.</wait>
		<wait 2="" time=""> : Sets the wait time for a measurement frequency of 1 kHz.</wait>
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	
		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.

Setting and Query of Terminator of Response Message

Syntax	Command	:TRANsmit:TERMinator <numeric value=""> <numeric value=""> = 0 to 255 (NR1)</numeric></numeric>
	Query	:TRANsmit:TERMinator?
	Response	<numeric value=""> = 0/ 1 (NR1)</numeric>
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 Response	: TRANsmit: TERMinator? : TRANSMIT: TERMINATOR 0 (when HEADER ON) 0 (when HEADER OFF)
		Rs-232C : The terminator is set to CR+LF.
		(only for Models 3504-50, 3504-60)

Setting and Query of Trigger Mode

U		
Syntax	Command	:TRIGger <character></character>
	Query	:TRIGger?
	Response	<character></character>
		< <u>Character></u> = 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	Query	:TRIGger:DELay <off numeric="" value=""> :TRIGger:DELay? <off numeric="" value=""> = OFF/ 0 to 9.999 (NR2)</off></off>
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 Response	:TRIGGER:DELay? :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.

Setting and Query of Trigger Delay Function

Syntax	Command Query Response	:TRIGger:DELay:STATe <on off=""> :TRIGger:DELay:STATe? <on off=""></on></on>
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></id>
	Query	:USER:IDENtity?
	Response	<id></id>
		<id> = User ID Code (Example: AB-1234) A to Z, a to z, 0 to 9, and - (hyphen)</id>
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 Response	:USER:IDENtity? :USER:IDENTITY AB-1234 (when HEADER ON) AB-1234 (when HEADER OFF) The user ID is set to AB-1234.

Response Format of Queries for Returning Values 8.9.3

Measurement Values

C(Capacitance)<NR3>

$\frac{(-)\Box \Box \Box \Box \Box \Box}{1} \frac{\Box}{2} \frac{\Box \Box}{3}$	 Sign part: The only sign added is the minus sign (-) when the value is negative Mantissa part: 6 digit numeric value + decimal point Exponent part: 2 digit numeric value
D (Dissipation Fact	or) <nr2></nr2>
$\frac{(-)}{1} \frac{\square \square \square \square \square \square}{2}$	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>

(-)0.00000E± <u>00</u>		E±□□	1: Sign part: The only sign added is the minus sign (-) when the value is negative
1	2	3	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

(-)□.□□□□□
(-)000000
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>

(-)	
(-)	

(-) 0.000

- 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>

1 3

2

- - 2
- 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: Sign part: The only sign added is the minus sign (-) when the value is negative
- 2: Numeric value with 5 digits after the decimal point

Offset For Compensation Values _____

C offset compensation value				
$\frac{(-)\Box \Box \Box \Box \Box \Box \Box}{1} \frac{E \pm \Box \Box}{2} \frac{E \pm \Box \Box}{3}$	 Sign part: The only sign added is the minus sign (-) when the value is negative Mantissa part: 6 digit numeric value + decimal point Exponent part: 2 digit numeric value 			
• D offset compensa	tion value			
$\frac{(-)\Box.\Box\Box\Box\Box}{1}$	 Sign part: The only sign added is the minus sign (-) when the value is negative 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>

(-)0000000	1: Sign part: The only sign added is the minus sign (-)
$\frac{1}{1}$ 2	when the value is negative
Ι Ζ	2: Numeric value part: 6 digit numeric value

Δ % Mode

(-) 🗆 🗆 🗆 🗆 🗆	1: Sign part: The only sign added is the minus sign (-)
$\frac{(1)}{1}$ 2	when the value is negative
(First parameter: C <nr2>)</nr2>	2: Numeric value part: Numeric value with 2 digits afte
(the decimal point
(-)	1: Sign part: The only sign added is the minus sign
1 2	(-) when the value is negative
(Second parameter: D <nr1< td=""><td>>)²: Numeric value part: 6 digit numeric value</td></nr1<>	>) 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

Initialization Method Item	Upon Pow- er On	*RST Command	*CLS Command
Device-specific functions (range, etc.)	×	•	×
Output queue	•	×	×
Input buffer	•	×	×
Status byte register	•	×	• *2
Event register	• *3	×	٠
Enable register	•	×	×
Current path	•	×	×
Header ON/ OFF	•	•	×

GP-IB

(Only for Models 3504-50, 3504-60)

Initialization Method Item	Upon Pow- er 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.

8.11 Creating Programs

This section describes an example of how to use the Windows[®] development language Visual Basic[®] 2005 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.

8.11.1 Creation Procedure

This section describes the procedure for using Visual ${\rm Basic}^{\circledast}$ 2005 to create programs.

NOTE

Depending on the environment of the PC and Visual Basic[®] 2005, the procedure may differ slightly from the one described here. For a detailed explanation on how to use Visual Basic[®] 2005, refer to the instruction manual or Help of Visual Basic[®] 2005.



Startup Visual Basic[®] 2005, select [Windows Application] from [File] - [New Project] (a), and click the "OK" button (b).



. 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 Visual Basic[®] 2005 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.

1	Wind	lowsApplication1 -	Microsoft Visu	al Basic 2005 E	xpress Edil	tion				
F	le I	Edit View Projec	t Build Debu	g Data Tool	s Window	Community	/ Help			
	7 🗋	j 🔃 • 🛃 🎒	X 🖻 🛍 🗄) 🗏 😫 🐇) = (21 =	► II II	SI 🗊 🛓 😽	🚰 🐋 🛠 遏 💂		
79	F	orm1.vb Form1.v	b [Design]						Solution Explorer	• + × 🛃
	4	Form1				-	Declarations)	🔓 🔂 🙍 🗉 💷	Sol
Toolbox	-	Public Class	Form1				-,		WindowsApplication1	Solution Explorer
									My Project	<u>P</u>
		End Class								orer
										Properties
										ertie
										[<u>``</u>

8.11.2 Sample Programs

232C communic conditions, read program will be 8.11.1 "Creation Button created t Button created t When the [Begi 3504-60 takes 1 data.csv] file. When the [Quit	a sample program which uses Visual Basic [®] 2005 to enact RS- tation, set the Models 3504-40, 3504-50, 3504-60 measurement measurement results and then save them to file. The sample written in the following manner. Procedure" (p. 246) description Write using sample program o begin measuremen
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 Syst Dim recvstr As String Dim i As Integer	em.Object, ByVal e As System.EventArgs) Handles Button1.Click
Try Button1.Enabled = False	'Disable buttons during communication
Button2.Enabled = False Dim sp As New SerialPort("COM1", 9600 sp.NewLine = vbCrLf sp.ReadTimeout = 2000 sp.Open() SendSetting(sp)	, Parity.None, 8, StopBits.One) 'Communication port setting(b) 'Terminator setting
FileOpen(1, "data.csv", OpenMode.Outpu For i = 1 To 10	'Models 3504-40, 3504-50, 3504-60 settings it) 'Create text file to be saved(e)
sp.WriteLine("*TRG;:MEAS?")	'Begin measurement and read measurement results command(f)
recvstr = sp.ReadLine() WriteLine(1, recvstr) Next i	'Read measurement results 'Write to file
FileClose(1)	'Close file
sp.Close() Button1.Enabled = True Button2.Enabled = True	'Close port
Catch ex As Exception MessageBox.Show(ex.Message, "Error", End Try	MessageBoxButtons.OK, MessageBoxIcon.Error)
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") sp.WriteLine(":TRIG EXT")	'Measurement frequency : 1 MHz 'Trigger : external trigger
End Try	MessageBoxButtons.OK, MessageBoxIcon.Error)
End Sub 'Close program when Button2 is pressed	
Private Sub Button2_Click(ByVal sender As Syst Me.Dispose()	em.Object, ByVal e As System.EventArgs) Handles Button2.Click
End Sub End Class	
LIIU UIASS	

- (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.

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 **RS-232C** or **GP-IB** 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. [CP-IB] See "Message Terminator" (p. 143) 			
The keys do not work after using RS-232C/GP-IB for communica- tion.	 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. [CPUE] 			
The program stops when attempt- ing to read data in INPUT.	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).	 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 dif- fers from the indications on the panel.	 The indications when the controller performs the read may some- times not match because the response message is created when the unit receives the query. 			

Symptom	Cause/Solution
Service requests are sometimes not generated.	 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).	 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.

8.13 Device Document Requirements (Only for Models 3504-50, 3504-60)

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).
 Oueries that return multiple response message units

Queries that return multiple response message units	
:BIN:FLIMit:COUNt?	5
:BIN:FLIMit:DEViation?	5
:BIN:SLIMit:COUNt?	5
:BIN:SLIMit:DEViation?	5
:COMParator:FLIMit:COUNt?2	2
:COMParator:FLIMit:DEViation?3	5
:COMParator:SLIMit:COUNt?2	2
:COMParator:SLIMit:DEViation?3	5
:CORRection:DATA?4	
:CORRection:LOAD:DATA?2	
:CORRection:LOAD:REFerence?2	
:CORRection:OFFSet:DATA?2	
:CORRection:OPEN:DATA?2	2
:CORRection:SHORt:DATA?2	
:MEASure?	j
:MEMory?1 to 32000	
:SSOurce:WAIT?2	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.

8.13 Device Document Requirements (Only for Models 3504-50, 3504-60)

(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. (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? guery

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.

Specifications

Chapter 9

9.1 Basic Specifications

Product Specifications

Measurement items	C (capacitance), D (dissipation factor $tan\delta$)		
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, 1V 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 1.999999 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, measure- ment speed: FAST) * The measurement speed differs depending on the measurement fre- quency 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 com- pensating the measurement values is possible		
Offset circuit compensation	Set value cannot be subtracted from the measurement value		

9.1 Basic Specifications

Product Specifications

Self Calibration	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 ad- justed. 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.				
Average	1 to 256 (necessary)				
Triggerdelay	0 to 9.999s (0.001s resolution)				
Contact Check Function (only for Model 3504-60)	Threshold value for contact check abnorm	ality			
		Range 1 to 8	Range 9, 10		
	Hc terminal connection resistance + Hp terminal connection resistance	Approx.500 Ω	Approx.100 Ω		
	Lc terminal connection resistance + Lp terminal connection resistance	Approx.500 Ω	Approx.100 Ω		
	Result output during contact check abnormality EXT I/O outputerror signal output (same signal line as CV error signal) LED displayerror shown in MAIN display See (p. 14)				
Low C Reject Function	 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 standardCan be set to 0.001% to 10.000% (0.001% resolution) of the full case of the range. 				
	Error outputLED lights up, as w		ut from EXT I/O.		
Measurement Level Monitoring Function	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 standard0.01% to 100.00% (0.01% resolution) of the refer- ence value Error output $LEU-E$ output in the main display area as				
	Error output LEU_E output in the main display area, as well as error output from EXT I/O				
Trigger Synchronous Output Function	Applying a measurement signal only during measurement is possible				
Key Lock Function	The setting and canceling of this function by pressing a key on the front panel is possible				
BIN Measurement (Only for Model 3504-50, 3504-60)	The setting of 14 categories for C and upper limit and lower limit values for D is possible (absolute value setting, Δ % setting)				
Comparator	The setting of the upper limit and lower limit values of each of C and D is possible (absolute value setting, Δ % setting)				

Panel Save and Load	The saving of 99 sets of measurement conditions is possible The reading of any measurement condition (readable settings: ALL, com- pensation 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 (discontinued) and 9444 options are required

Product Specifications

Basic Specifications

Display Device	LED			
Operating Temperature and Humidity Ranges	0°C to 40°C (32°F to 104°F), 80% RH or less, no condensation			
Storage Temperature and Humidity Ranges	-10°C to 55°C (14°F 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 $\pm 10\%$ from the rated supply voltage are taken into account.)			
Rated Power Frequency	50 Hz/ 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.)			
Guaranteed accuracy	1 year			
Product warranty period	3 years			
Specification Compliance	EMC EN61326 Class A 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)			

9.1 Basic Specifications

Basic Specifications

Standard Accessories	 2 pin power cord with ground Instruction manual Spare fuse for power supply (Select from 100 V to 120 V and 220 V to 240 V in accordance with destination) For 100 V to 120V: 250VF1.0AL φ5 x 20 mm For 220 V to 240V: 250VF0.5AL φ5 x 20 mm
Options	 Probes and Fixtures Model 9140 4-Terminal Probe Model L2001 Pincher Probe Model 9143 Pincher Probe (discontinued) 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 (discontinued) Model 9443-01 AC Adapter (for Japan) (discontinued) Model 9443-02 AC Adapter (for EU) (discontinued) Model 9444 Connection Cable (for the printer) Model 1196 Recording Paper Cables Model 9151-02 GP-IB Connector Cable

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 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 capacita	nce [mF] of sample) when $D \le 0.1$
---	--------------------------------------

Rang	Frequen- cy Pa-			Guaranteed Accuracy of 1 Year		
e No.	rameter	120 Hz	1 kHz	120 Hz	1 kHz	
1	С	±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	С	±0.20%rdg.±60dgt.	±0.20%rdg.±60dgt.	±0.30%rdg.±90dgt.	±0.30%rdg.±90dgt.	
2	D	±0.0020±2.2/CL	±0.0020±0.265/CL	±0.0030±3.3/CL	±0.0030±0.3975/CL	
3	С	±0.16%rdg.±20dgt.	±0.14%rdg.±20dgt.	±0.24%rdg.±30dgt.	±0.21%rdg.±30dgt.	
5	D	±0.0036	±0.0036	±0.0054	±0.0054	
4	С	±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	С	±0.15%rdg.±15dgt.	±0.13%rdg.±15dgt.	±0.23%rdg.±23dgt.	±0.20%rdg.±23dgt.	
U	D	±0.0016	±0.0016	±0.0024	±0.0024	
6	С	±0.15%rdg.±15dgt.	±0.09%rdg.±10dgt.	±0.23%rdg.±23dgt.	±0.14%rdg.±15dgt.	
0	D	±0.0020	±0.0016	±0.0030	±0.0024	
7	С	±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	С	±1.2%rdg.±50dgt.	±0.7%rdg.±40dgt.	±1.8%rdg.±75dgt.	±1.05%rdg.±60dgt.	
0	D	±0.0060	±0.0050	±0.0090	±0.0075	

9.2 Accuracy

Rang	Frequen- cy Pa-	Guaranteed Accu	uracy of 6 Months	Guaranteed Accuracy of 1 Year			
e No.	rameter	120 Hz	1 kHz	120 Hz	1 kHz		
9	С	±1.2%rdg.±50dgt.	±0.7%rdg.±40dgt.	±1.8%rdg.±75dgt.	±1.05%rdg.±60dgt.		
3	D	±0.0060	±0.0050	±0.0090	±0.0075		
10	С	±2.5%rdg.±50dgt.	±2.0%rdg.±40dgt.	±3.75%rdg.±75dgt.	±3.0%rdg.±60dgt.		
10	D	±0.0200±0.008xC _H	±0.0180±0.08xC _H	±0.0300±0.012xC _H	±0.0270±0.12xC _H		

 $\textbf{C-D} (\text{CL: electrostatic capacitance [pF] of sample, , CH: electrostatic capacitance [mF] of sample)} \quad \textbf{when } \textbf{D} \leq \textbf{0.1}$

* 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	()	CV
Frequency Range No.	120 Hz	1 kHz	Operation
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



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.



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



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 Mod					
z	$ Z = \frac{V}{I} (= \sqrt{R^2 + X^2})$					
С	$Cs = -\frac{1}{\omega Z \sin \theta}$	$C\rho = \frac{\sin(-\theta)}{\omega Z }$				
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

CAUTION	If damage is suspected, check the "Troubleshooting" section before contact your dealer or Hioki representative.
	n any of the following cases, stop using the unit, disconnect the power co 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 hur 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 electrical accident or fire will be greatly increased as a result of deteriorat of the insulation.
	In the following case, submit the unit to be repaired by our repair service p sonnel.
	 Measurement conditions can no longer be saved. The unit contains a built-in backup lithium battery, which offers a service of about six years. Measurement conditions can no longer be saved a the life of the battery runs out.

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 ap-	Is the power cord disconnected?	Connect the power cord.
pear on the display when the power switch is turned on.	Is the fuse blown?	Replace the fuse.

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10.1 Inspection, Repair, and Cleaning

Symptom	Check Item	Solution
Key input is not pos-	Is the key lock set?	Cancel the key lock.
sible.	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" ap- pears in the MAIN display area.	Were large capacitance components and other low-impedance components mea- sured at range 7,8 for a prolonged period?	Open the measurement terminal and press ENTER .
"CV-Lo" appears in	Are all the measurement terminals open?	Connect the probe or fixture to the unit.
the MAIN display area.	Is there a high contact resistance between the measurement terminal and sample?	Gently wipe the measurement termi- nals with a cloth.
	Is the cable of the probe or fixture discon- nected?	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	Are the measurement conditions of known samples same as the measurement condi- tions of this main unit?	Set the measurement conditions appro- priately. See 3.3 "Setting the Measurement Condi- tions" (p. 26)
such as standard capacitors.	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	e cause is.	Try resetting the system. See 6.11 "Performing a System Reset" (p. 117)

Cleaning



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.

10.2 Replacing the Power Fuse



10.3 Discarding the Unit

The unit uses a lithium battery as power for storing measurement conditions.

<u>AWARNING</u>

- 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 the lithium 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.



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.



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 fer-

rite 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 μ F 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.

$$C = C_2 + \frac{C_3 \times C_4}{C_3 + C_4}$$



 C_2

 C_4

 C_3

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.

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 .

To guard terminal

 C_1



- However, if, for example, the capacitance of C₂ is less than that of C₃ (C₂<< C₃), 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.





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.

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 iden-

tical 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 (EIA)



M4 x 10 mm

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

The following options are available for the instrument. Contact your authorized Hioki distributor or reseller when ordering.

The options are subject to change. Visit our website for updated information.

Probes



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 compo- nents such as chips.	
9677 SMD Test Fixture	
9699 SMD Test Fixture	

Appendix 6 Options

Printer

9442 Printer (discontinued)

Use this cable when using the synchronous measurement function

- 9443-01 AC Adapter (discontinued) (when using the printer in Japan)
- 9443-02 AC Adapter (discontinued) (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 Ini- tial Settings when Power is Turned On	Sav	Back Up
Measurement	Frequency		1 kHz	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Signal	Signal Level		1 V	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Measurement	Switch		AUTO	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Range	Range		1	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Equivalent Circuit	Switch		AUTO	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Mode	Mode		Par(parallel)	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Measurement Spe	eed		NORM	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Average	ON/ OFF		ON	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Number of Times		1	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Trigger	Mode		Int(Internal)	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Delay	ON/ OFF	ON	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		Time	0.0s	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Trigger Synchro-	ON/ OFF		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
nous Function	Wait Time	120 Hz	10 ms	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		1 MHz	2 ms	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Open Circuit Compensation	Compensation Value	Compensa- tion of G	0S	No Change	No Change	0S	No	Yes	Yes
		Compensa- tion 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	\leftarrow	\leftarrow	\leftarrow	No	No	Yes
Short Circuit Compensation	Compensation Value	Compensa- tion of R	0 Ω	No Change	No Change	0 Ω	No	Yes	Yes
		Compensa- tion 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	\leftarrow	\leftarrow	\leftarrow	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	Compensa- tion Value of C	0	No Change	No Change	0	No	Yes	Yes
		Compensa- tion Value of D	0	No Change	No Change	0	No	Yes	Yes
4	conditions for initial		el levieli 4 V						

*1 Measurement conditions for initial value are signal level: 1 V, range: 6 and self calibration: OFF.

Setting Items			Initial Setting	Operate from Front Panel	:PRE- Set	*RST	Return to Ini- tial Settings when Power is Turned On	Sav e	Back Up
Self Calibration OFF/ MANU/ AUTO		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes	
Measurement	Save ON/ OFF		ON	\leftarrow	\leftarrow	\leftarrow	No	No	Yes
Value Memory Function	Memory Size		1000	\leftarrow	\leftarrow	\leftarrow	No	No	Yes
:MEASure:VALid			62	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Judgment Mode			Count Judgment	\leftarrow	\leftarrow	\downarrow	No	Yes	Yes
Comparator	ON/ OFF		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Function	Count Setting Value	Upper Limit Values	OFF	\leftarrow	\leftarrow	\downarrow	No	Yes	Yes
		Lower Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Compensation Per- cent Setting Value	Upper Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		Lower Limit Values	OFF	\leftarrow	Ļ	\downarrow	No	Yes	Yes
		Reference Value of C	100000	←	←	\leftarrow	No	Yes	Yes
		Reference Value of D	0	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
BIN Function	ON/ OFF		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Count Setting Value	Upper Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		Lower Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Compensation Per- cent Setting Value	Upper Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		Lower Limit Values	OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
		Reference Value of C	100000	\leftarrow	\leftarrow	\downarrow	No	Yes	Yes
		Reference Value of D	0	\leftarrow	\downarrow	\downarrow	No	Yes	Yes
Contact Check Function	Evaluation		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Low C Reject Function	ON/ OFF		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
	Limit Values		0.000%	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Measurement Level Monitoring	ON/ OFF		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Function	Limit Values		10.0%	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Panel Save		Clear Contents	No Change	No Change	Clear Con- tents	No	-	Yes	
Load Conditions		ALL	\leftarrow	\leftarrow	\leftarrow	No	No	Yes	
Display	ON/ OFF		ON	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Voltage and Current Monitor Value	ON/ OFF		OFF	~	~	\leftarrow	Yes	No	No
Keylock Function	ON/ OFF		OFF	No Change	No Change	OFF	No	Yes	Yes
Setting Beep	Кеу		ON	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
Tones	Mode		OFF	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes

Yes: Available/ $\leftarrow:$ The same as the left/ No: Unavailable

Setting Items		Initial Setting	Operate from Front Panel	:PRE- Set	*RST	Return to Ini- tial Settings when Power is Turned On	Sav e	Back Up
Disabling trigger signal on EXT I/O	ON/ OFF	OFF	\leftarrow	\leftarrow	\leftarrow	No	No	Yes
EXT I/O Judg- ment Results Reset	ON/ OFF	ON	\leftarrow	\leftarrow	\leftarrow	No	Yes	Yes
EXT I/O output delay time	Delay time between evaluation result output $\leftarrow \rightarrow$ EOM output	0.0	\leftarrow	\leftarrow	\leftarrow	No	No	Yes
Setting Interface	Interface	GP-IB	\leftarrow	No Change	No Change	No	No	Yes
	Address	1	\leftarrow	No Change	No Change	No	No	Yes
	Terminator	LF with EOI	\leftarrow	No Change	No Change	No	No	Yes
Header		OFF	\leftarrow	\leftarrow	\leftarrow	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

Yes: Available/ $\leftarrow:$ The same as the left/ <code>No: Unavailable</code>

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Warranty Certificate

Model	Serial number	Warranty period		
		Three (3) years from date of purchase (/)		
Customer name:				
Customer address:				
 Complete the certificate 	nformation you provide on this form will	ssued. and date of purchase, along with your name and only be used to provide repair service and information		
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.				
If the date of purchase is umanufacture (as indicated 2. If the product came with an 3. The accuracy of measured specifications. 4. In the event that the produ- workmanship or materials, 5. The following malfunctions replacement: -1. Malfunctions or damage -2. Malfunctions or damage -3. Malfunctions or damage -4. Malfunctions or damage on precautionary label	Inknown, the warranty period is defined by the first four digits of the serial num in AC adapter, the adapter is warrantied d values and other data generated by the ct or AC adapter malfunctions during in Hioki will repair or replace the product a and issues are not covered by the wa ge of consumables, parts with a defined ge of connectors, cables, etc. ge caused by shipment, dropping, reloc ge caused by inappropriate handling th ing on the product itself	d for one (1) year from the date of purchase. The product is guaranteed as described in the product is respective warranty period due to a defect of or AC adapter free of charge. Tranty and as such are not subject to free repair or d service life, etc. eation, etc., after purchase of the product at violates information found in the instruction manual or		
 -5. Malfunctions or damage recommended in the ir recommended in the ir recommended in the ir recommended in the involving voltage, frequence of the recommendation of t	je caused by a failure to perform maint istruction manual je caused by fire, storms or flooding, e uency, etc.), war or unrest, contaminat to the product's appearance (cosmetic damage for which Hioki is not responsi			
service such as repair or c -1. If the product has beer -2. If the product has beer	alibration: n repaired or modified by a company, e	nent for use in a special application (aerospace,		
 If you experience a loss ca Hioki will provide compens Secondary damage ar Damage arising from r 	aused by use of the product and Hioki of sation in an amount not to exceed the p ising from damage to a measured devi neasurement results provided by the p ther than the product that was sustained	determines that it is responsible for the underlying issue, burchase price, with the following exceptions: ce or component that was caused by use of the product		
	heir manufacture, products whose part	r other service for products for which a certain amount s have been discontinued, and products that cannot be		
		HIOKI E.E. CORPORATION		

http://www.hioki.com

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ΗΙΟΚΙ



www.hioki.com/

HEADQUARTERS 81 Koizumi Ueda, Nagano 386-1192 Japan



All regional contact information

HIOKI EUROPE GmbH Helfmann-Park 2 65760 Eschborn, Germany hioki@hioki.eu

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