SM7810
SM7810-20

HIOKI

Instruction Manual

SUPER MΩ HiTESTER

EN

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Introduction

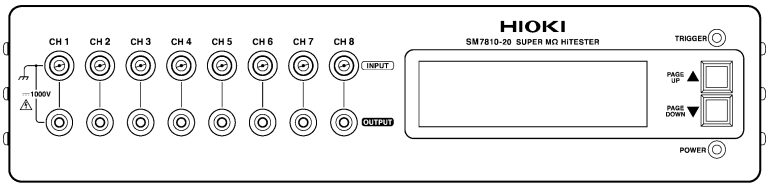
Thank you for purchasing the HIOKI Model SM7810, SM7810-20 Super MΩ HiTester. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

Confirming Package Contents

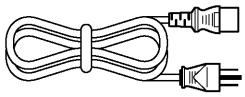
When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

Confirm that these contents are provided.

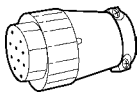
☐ Model SM7810, SM7810-20 Super MΩ HiTester (1)
(Model SM7810 Rated supply voltage: 100 VAC, 110 VAC)
(Model SM7810-20 Rated supply voltage: 220 VAC)



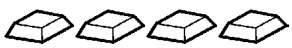
☐ Power cord (1)



☐ Voltage input connector (1)

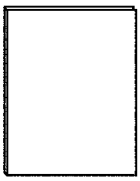


☐ Rubber feet (4)



☐ Spare fuse (1)
(built into inlet)

☐ Instruction manual (1)



Options

☐ Model 9637 RS-232C Cable (9pin-9pin/Cross/1.8m)
☐ Model 9638 RS-232C Cable (9pin-25pin/Cross/1.8m)
☐ Model 9151-02 GP-IB Connector Cable (2 m)

Safety Information

DANGER

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

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

Safety Symbols

	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument. The ⚠ symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
	Indicates that dangerous voltage may be present at this terminal.
	Indicates a fuse.
	Indicates a grounding terminal.
	Indicates a ground terminal connected to the chassis of the system.
	Indicates DC (Direct Current).
	Indicates AC (Alternating Current).
	Indicates the ON side of the power switch.
	Indicates the OFF side of the power switch.

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

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

Other symbols

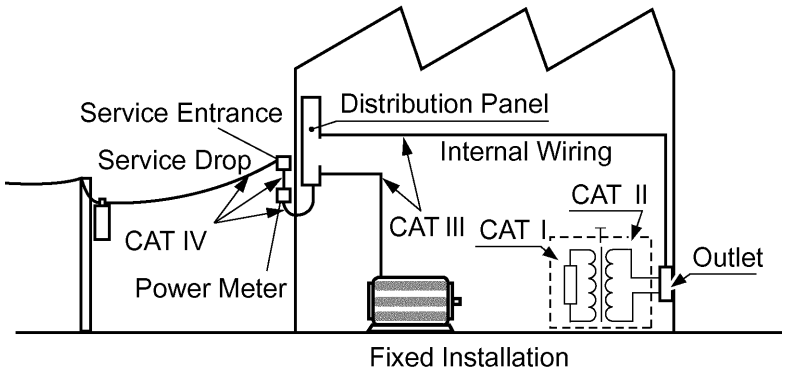
	Indicates a prohibited action.
*	Indicates that descriptive information is provided below.
PAGE UP (Bold characters)	Bold characters within the text indicate operating key labels.
(p. #)	Indicates the location of reference information.

Measurement categories (Overvoltage categories)

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

CAT I	Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.
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.



Operating Precautions

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

Preliminary Checks

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

Instrument Installation

Operating temperature and humidity:
0 to 40°C at 80%RH or less (non-condensing)
Temperature and humidity range for guaranteed accuracy:
23±5°C, 80%RH or less (non-condensing)

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

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

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

Exposed to strong electromagnetic fields
Near electromagnetic radiators

Exposed to high levels of particulate dust

Near electromagnetic radiators (e.g., high-frequency induction heating systems and IH cooking utensils)

Subject to vibration

⚠CAUTION

Do not slant the instrument or place it on top of an uneven surface. Dropping or knocking down the instrument can cause injury or damage to the instrument.

Handling the Instrument

WARNING

- **Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.**
- **Touching any of the high-voltage points inside the instrument is very dangerous. Do not attempt to modify, disassemble or repair the instrument; as fire, electric shock and injury could result.**

CAUTION

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

Handling the Cords

DANGER

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

CAUTION

- Avoid stepping on or pinching cables, which could damage the cable insulation.
- To avoid breaking the cables, do not bend or pull them.
- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

NOTE

Use only the specified connection cables. Using a non-specified cable may result in incorrect measurements due to poor connection or other reasons.

Before Connecting

WARNING

- **Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.**
- **To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord only to a 3-contact (two-conductor + ground) outlet.**

Input and Measurement Precautions

DANGER

- **The maximum input voltage and maximum rated voltage to earth are 1000 VDC. If their voltages are exceeded, this instrument will be damaged and personal injury will result. Therefore, do not input signals in excess of these values.**
- **To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximum to the voltage input terminal.**

To ensure measurements are accurate,

- Warm up the instrument 60 minutes or more before use.
- The instrument should be calibrated once a year.

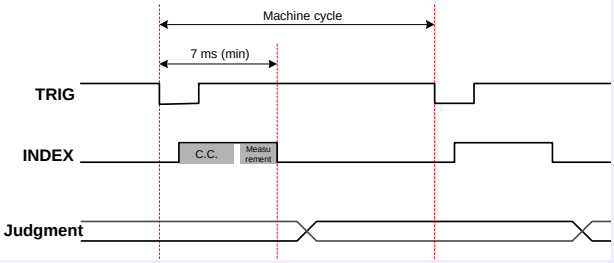
Overview Chapter 1

1.1 Product Overview and Features

The instrument is an 8-channel, high-sensitivity ammeter for use in measuring insulation resistance. It can perform insulation measurement of target objects such as electrical insulators with high resistance values, measuring all 8 channels simultaneously at high speed. The instrument is designed for use in applications such as automatic insulation testing, particularly of capacitors.
This insulation measuring instrument requires an external measurement power source to be provided by the operator. HIOKI offers a recommended power source (Model SM7860 series Power Source Unit).

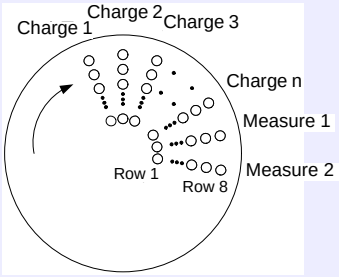
High-speed insulation resistance measurement

The instrument is a high-sensitivity ammeter for use in insulation resistance measurement applications. The time from trigger activation to index output is as little as 7 ms.



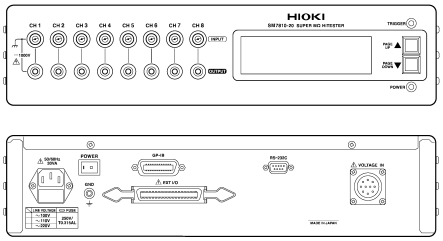
8-channel simultaneous measurement

The instrument can measure 8 channels simultaneously, boosting production volume. This capability improves on previous HIOKI instruments, which offered 4 channels.



Compatibility with high-capacity capacitors

Range: 100 pA to 1 mA
The instrument features an expanded current measurement range to accommodate increasingly high-capacity MLCCs, making possible more accurate pass/fail judgments.

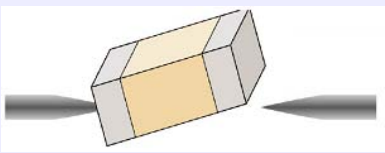


Interface communications

The instrument can be connected to a control device and controlled via either its GP-IB or RS-232C interface. Measurement data can also be downloaded.

Contact check for improved reliability

The instrument can check for poor contact with the object under measurement using the capacitance detection method, and the results of this check can be output from the instrument.



Easy integration into automated testing systems

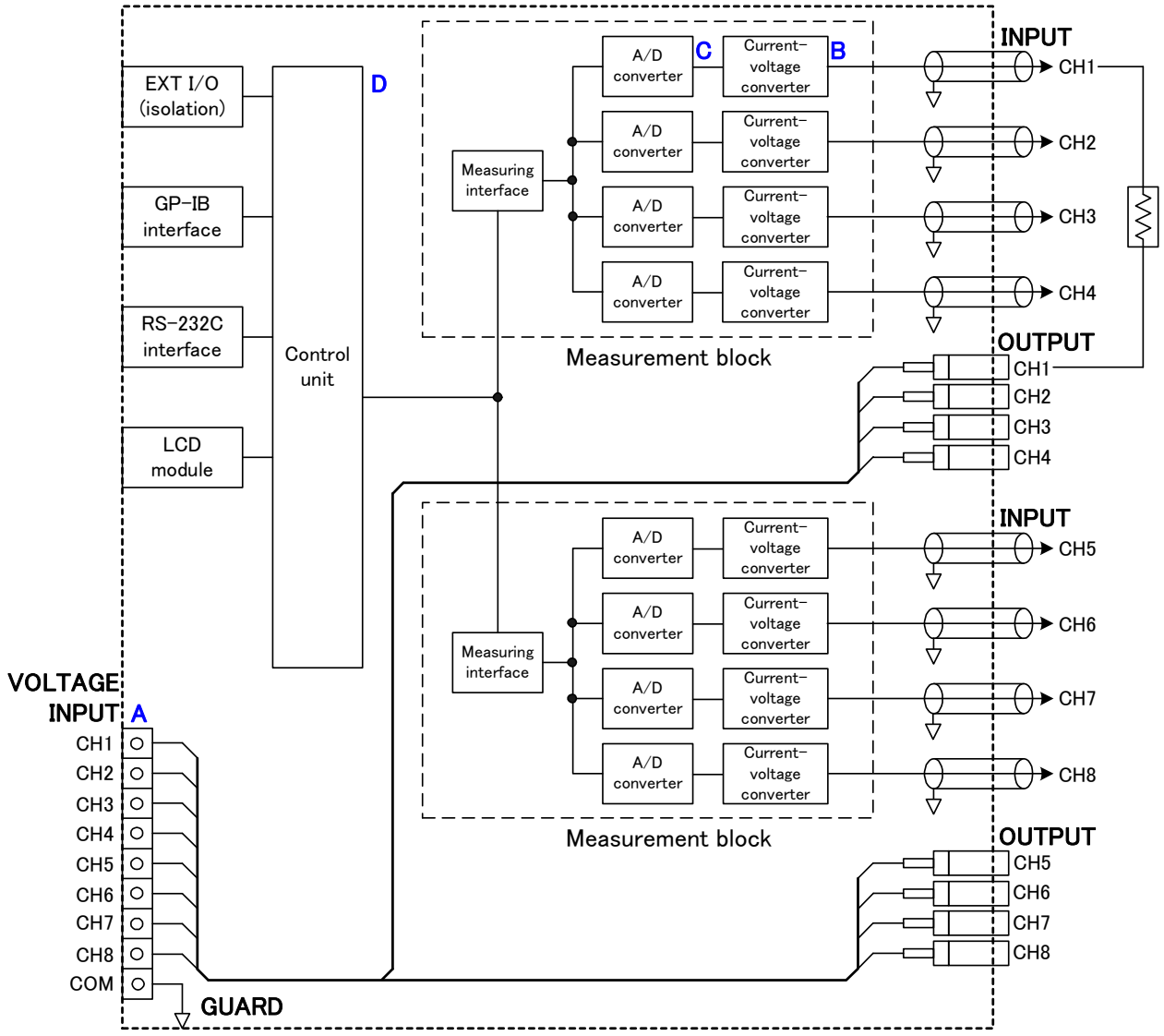
The instrument features a standard external I/O interface, allowing contact check results and comparison judgment results to be downloaded to other devices. Additionally, external I/O can be used to easily change target objects, making it easy to integrate the instrument into an automated testing system.

Operating Principles and Block Diagram

The instrument is an 8-channel, high-sensitivity ammeter for use in measuring insulation resistance. After connecting the dedicated external power source to the voltage input terminal (A) and applying voltage to the object under measurement from the voltage output terminals (OUTPUT), current is measured at the current input terminals (INPUT). The resistance value is then calculated from the measured current values and the set measurement voltage values.

The measurement block performs current/voltage conversion using charge measurement type current-voltage converters (B) that integrate input current values and A/D converters (C). This method allows precise measurement of minute currents by using long integration times.

Having been converted into digital data, measurement block output is sent to the control block (D) memory. The control block (D) performs arithmetic processing on measurement data that has been input to its memory and sends output to the instrument's LCD screen and interfaces.



1.2 Names and Functions of Parts

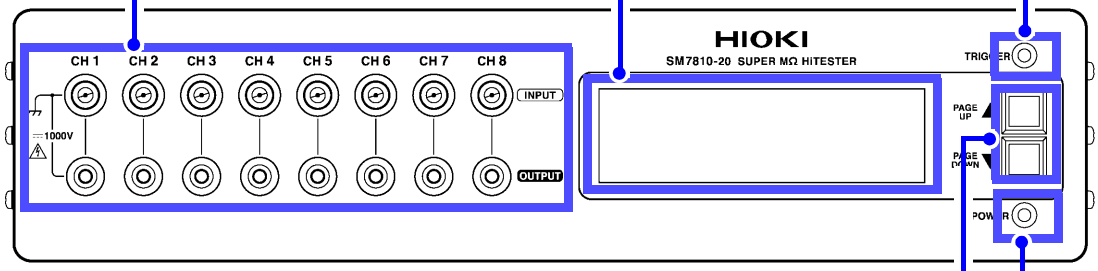
Front Panel

Measurement terminals
- INPUT: Current input terminals
- OUTPUT: Voltage output terminals

The instrument's 8 channels can be measured simultaneously.

LCD screen
The instrument's interface consists of three display pages, including measured values, contact check results, and operating conditions.
"1.3 Screen Layout" (p.10).

Trigger indicator
Lights up when the trigger signal is on.



Scroll keys (PAGE UP▲/ PAGE DOWN▼)
Used to scroll through the display pages.
"1.3 Screen Layout" (p.10)
The scroll keys are also used to set the GP-IB address. (p.23)

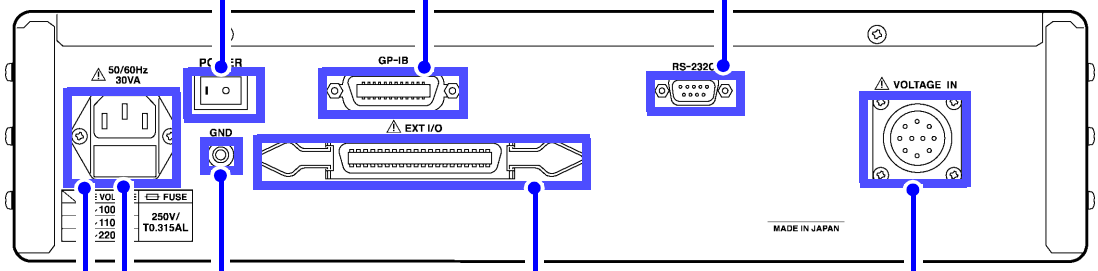
Power indicator
Lights up when the instrument is on.

Rear Panel

POWER switch
Turns the instrument on and off. (p.15)
| : Power On
○: Power Off

GP-IB connector
Connect to a computer when using the GP-IB interface.
(p.21)

RS-232C connector
Connect to a computer when using the RS-232C interface.
(p.21)



GND terminal
Serves as the ground terminal. The GND terminal is connected to the instrument's enclosure. It is used when shielding measurement cables.

EXT I/O connector
The external I/O connector can be used to control the instrument.
(p.41)

Voltage input terminal
Supplies the measurement power source. Connect the included voltage input connector.

Power inlet
Connect the supplied power cord here. (p.12)

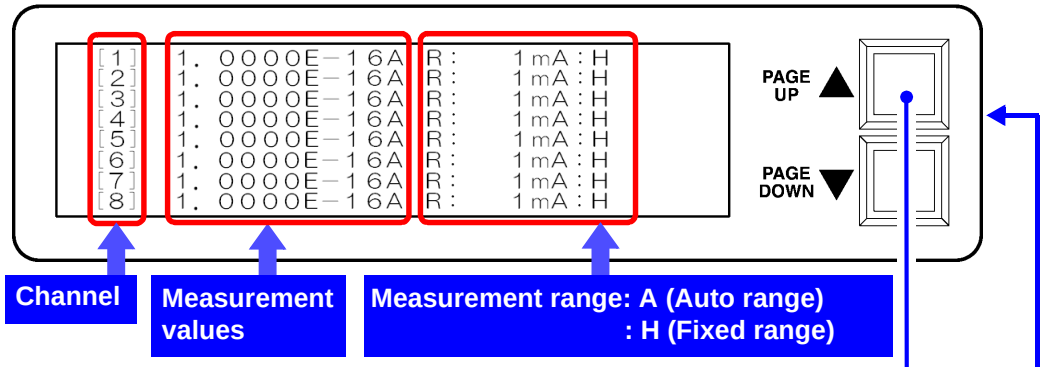
Fuse holder
Allows the fuse to be replaced.
(p.60)

1.3 Screen Layout

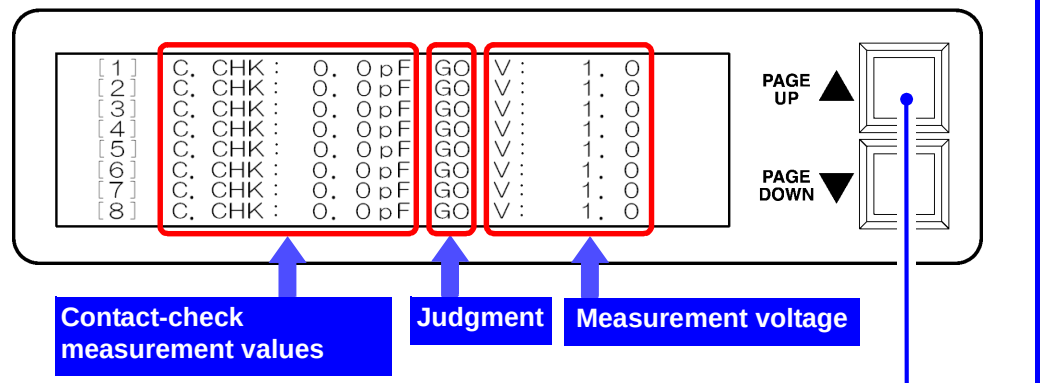
The LCD screen consists of three display pages. When the instrument is turned on, page 1 is shown. The scroll keys on the front of the instrument (**PAGE UP▲**/ **PAGE DOWN▼**) are used to scroll among the display pages, which can also be selected directly by sending the "**PAG**" command from the GP-IB or RS-232C interface.

See: Message List "PAG" (p.38)

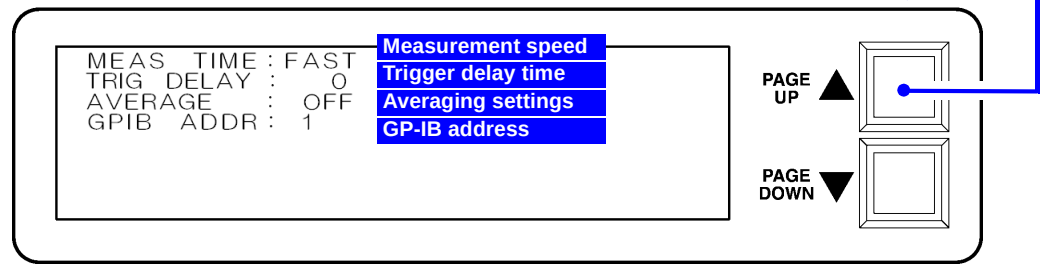
■ **Screen P1: Measured value display**



■ **Screen P2: Contact check results display**



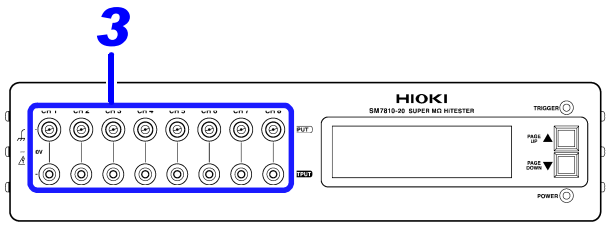
■ **Screen P3: Operating condition display**



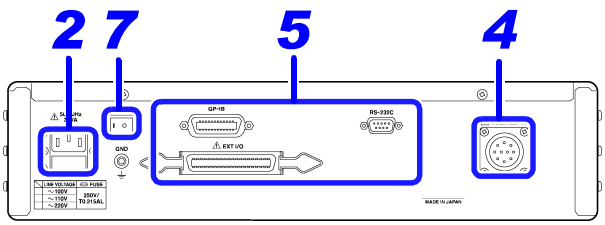
Measurement Preparations Chapter 2

2.1 Installation & Connection Procedures

Be sure to read the "Operating Precautions" (p.4) before installing and connecting this instrument.



Front Panel



Rear Panel

1 Install this instrument (p.4)

2 Connect the power cord (p.12)

3 Connect measurement cables (p.13)

4 Connect the instrument to the measurement line (p.14)

5 Connect the external interface
(as needed)

- Using the GP-IB or RS-232C interface (p.19)
- Using the EXT I/O (p.41)

6 Be sure to complete the pre-operation inspection (p.17) before starting measurement

7 Turn the power on (p.15)

8 Make instrument settings (p.18) (via the external interface)

9 Connect to the test sample

Activate the measurement power source

Make measurements

When finished measuring, turn the power off (p.15)

2.2 Connecting the Power Cord

⚠WARNING

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

⚠CAUTION

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

Turn off the power before disconnecting the power cord.

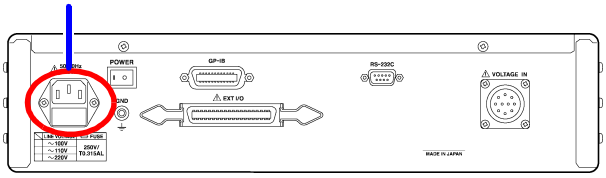
Connection Methods

1 **Confirm that the instrument is turned off.**

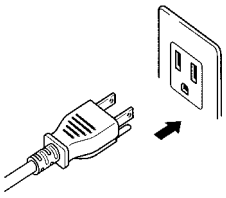
2 **Confirm that the mains supply voltage matches the instrument, and connect the power cord to the power inlet on the instrument.**

3 **Plug the power cord into the mains outlet.**

Power inlet



Rear Panel



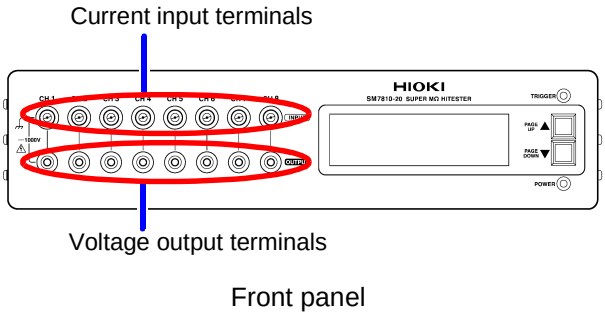
2.3 Connecting the Measurement Cables

CAUTION To avoid damage to the instrument, do not apply voltage to measurement terminals.

Connection Methods

1 **Connect the measurement cables to each channel's current input terminal.**

2 **Connect the voltage output cables to each channel's voltage output terminal.**



Front panel

NOTE

- The current input terminals incorporate a two-tiered design with both center and outer conductors. The center conductors are connected to measurement input, while the outer conductors are connected to guard signals.
- Because the instrument performs high-sensitivity current measurement, noise occurring on the measurement cables may prevent measured values from stabilizing. Use low-noise shielded measurement cables that meet HIOKI's specifications.

For more information about measurement cables and voltage output cables, please contact your dealer or HIOKI representative.

2.4 Connecting the Measurement Power Source

DANGER **To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximum to the voltage input terminal.**

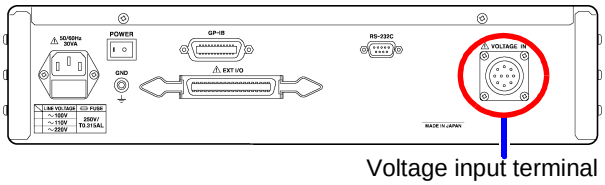
WARNING **Do not input voltage to the voltage input terminal before connecting measurement cables and voltage output cables. Doing so may result in injury.**

CAUTION When the power is turned off, do not apply voltage to the voltage input terminals. Doing so may damage the instrument.

Connection Methods

1 **Confirm that the instrument is turned off.**

2 **Connect the included voltage input connector to the voltage input terminal on the rear of the instrument.**



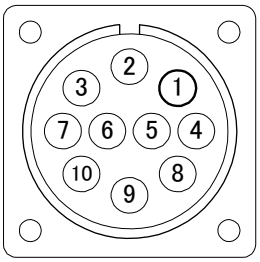
Voltage input terminal

Rear Panel

NOTE This insulation measuring instrument requires an external measurement power source provided by the operator. HIOKI offers a recommended power source (Model SM7860 series Power Source Unit).

Specifications

Voltage input pin assignments



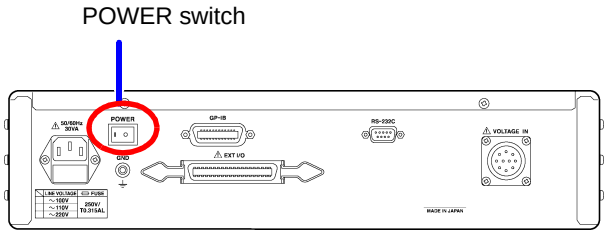
(View of terminal on instrument)

Pin No.	Channel
1	CH1
2	CH2
3	CH3
4	CH4
5	CH5
6	CH6
7	CH7
8	CH8
9	NC
10	COM

2.5 Turning the Power On and Off

WARNING

Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.



Rear Panel

Turning Power On

Turn the POWER switch on (|).

The power indicator and LCD screen on the front of the instrument will light up.

When the power is turned on, the same setting as when the power was last turned off appears (backup function).
When powered up for the first time, the instrument will be configured with its default settings. However, the LCD screen is not backed up.

Before Starting Measurement

To obtain precise measurements, provide about 60 minutes warm-up after turning power on.

Turning Power Off

Before turning the instrument off, turn off measurement power source output.

Turn the POWER switch off (○).

NOTE

If a power outage (e.g., breaker trip) occurs when the instrument is on, it will automatically turn on again when power is restored.

2.5 Turning the Power On and Off

Chapter 3 Setting Measurement Conditions

3.1 Pre-Operation Inspection

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

1 Peripheral Device Inspection

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

Metal Exposed → Do not use a damaged cord because doing so may result in electric shock. (Replace the cord with a new one.)

No Metal Exposed

2 Instrument Inspection

Is damage to the instrument evident?

Yes → If damage is evident, request repairs.

No

Does the supply voltage of your power source match the supply voltage indicated above the power source inlet on the rear of the instrument?

No → Use of a supply voltage outside the specified range may damage the instrument or cause electric shock. Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector.

Yes

When turning power on

Do the “HIOKI”, “SM7810” and version number indications appear on the display area?

No → The power cord may be damaged, or the instrument may be damaged internally.
Request repairs.

Yes

Inspection complete

3.2 Setting Measurement Conditions

This section describes how to set measurement conditions according to the manner in which the instrument is to be used. Settings are configured via either of the instrument's external interfaces:
See: GP-IB/RS-232C Interface (p.19)

The instrument cannot be configured directly in a standalone manner. For more detailed setting specifications, see "6.3 Functions" (p.51).

Setting function	Description of operation and settings	For more information
Measurement value indication	Selects the displayed value. [Resistance * / Current] * Resistance is calculated from the set measurement voltage and current value.	(p.33)
Measurement speed	Selects the measurement speed. [FAST / MED (medium) / SLOW / SLOW2]	(p.33)
Current measurement range	Switches the current measurement range. [HOLD/ AUTO] Selects the current measurement range. [100 pA/ 1 nA/ 10 nA/ 100 nA/ 1 µA/ 10 µA/ 100 µA/ 1 mA]	(p.34)
Trigger delay time	Fix time between inputting trigger signal and starting measurement. 0 ms to 9999 ms (1 ms resolution)	(p.34)
Averaging	Configures averaging of measured values. OFF (No averaging) / ON (Required setting number of times for averaging) / AUTO (Number of times for averaging is automatically determined)] Number of times (in case "ON" setting): 1 to 255	(p.34)
Power source frequency	Selects the power source frequency. [50/60 Hz]	(p.34)
Measurement voltage	Sets the measurement voltage. Setup ranges: 0.1 to 1000.0 V (0.1 V resolution)	(p.35)
Fixture capacitance open correction function	Measures the capacitance value with the fixture in the open state. The fixture capacitance open correction function can be used to increase measurement precision by decreasing the effects of residual inductance of the fixture (including probes) and other components.	(p.37) (p.43)
Contact-check	Judges whether the object under measurement is connected by performing capacitance measurement with a high-frequency signal and evaluating the difference between that reading and the reading obtained when the system is in the open state. [OFF/ ON] Judgment GO: Capacitance measured value > judgment reference value * NG: Judgment reference value * ≥ capacitance measured value * Judgment reference value = Fixture capacitance + (object under measurement capacitance setting / 2)	(p.36) (p.43)
Measured value comparison/ judgment function	Compares the measured value and reference value to make a PASS/FAIL judgment. [OFF/ ON] Judgment HI : Measured value > upper limit setting IN : Upper limit setting ≥ measured value ≥ lower limit setting LO: Lower limit setting > measured value	(p.37) (p.46)
Fixture resistance open correction function	Measures the current of the fixture in the open state and corrects measured values. [OFF/ ON]	(p.37) (p.43)
LCD display mode	Turns the LCD display on and off. [OFF/ ON]	(p.38)

Communication (GP-IB/RS-232C Interface) Chapter 4

The symbol shown below indicates that the following instructions are specific to the RS-232C or the GP-IB interface. Instructions without these symbols are for both the RS-232C and the GP-IB interface.

GP-IB : GP-IB only

RS-232C : RS-232C only

Before Use

- Always make use of the connector screws to affix the GP-IB or RS-232C connectors.
- When issuing commands that contain data, make certain that the data is provided in the specified format.

Wiring Diagram (p.21)
Connect the Instrument and Controller with a GP-IB or RS-232C Interface Cable

Communications Protocol Settings
GP-IB **Enter a GP-IB address. (p.23)**
RS-232C **Set the instrument to the same communications protocol as the controller**
Send the "RMT" command. (p.23)

4.1 Overview and Features

The instrument provides standard communication functionality in the form of GP-IB and RS-232C interfaces, both of which can be used to control the instrument remotely and to transfer data.

GP-IB
- This instrument is designed with reference to the following standard:
  Reference standard IEEE 488.1-1987

4.2 Specifications

NOTE

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

GP-IB Specifications

Electrical machinery specifications: IEEE std. 488.1-1987 compliant
Address setting : Can be set to talker/listener addresses 1 to 30.

Interface Functions GP-IB

SH1	All Source Handshake functions	●
AH1	All Acceptor Handshake functions	●
T6	Basic talker functions	●
	Serial poll function	●
	Talk-only mode	–
	The talker cancel function with MLA (My Listen Address)	●
L4	Basic listener functions	●
	Listen-only mode	–
	The listener cancel function with MTA (My Talk Address)	●
SR1	All Service Request functions	●
RL1	All Remote/Local functions	●
PP0	Parallel Poll function	–
DC1	All Device Clear functions	●
DT1	All Device Trigger functions	●
C0	Controller functions	–
E2	Tri-state output	

Operating Code: ASCII codes

RS-232C Specifications

RS-232C

Transfer method	Communications: Full duplex Synchronization: Start-stop synchronization		
Baud rate	38400 bps		
Data length	8 bits		
Parity	none		
Stop bit	1 bit		
Flow control	none		
Electrical specification	Input voltage levels	5 to 15 V	: ON
		-15 to -5 V	: OFF
	Output voltage levels	+5 V or more	: ON
		-5 V or less	: OFF
Connector	RS-232C Interface Connector Pinout (Male 9-pin D-sub, with #4-40 attachment screws) The I/O connector is a DTE (Data Terminal Equipment) configuration Recommended cables: • Model 9637 RS-232C Cable • Model 9638 RS-232C Cable See: "4.3 Connect a cable to the GP-IB connector or RS-232C connector" (p.21)		

Operating Code: ASCII codes

4.3 Connect a cable to the GP-IB connector or RS-232C connector

WARNING

- **Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.**
- **Failure to fasten the connectors properly may result is sub-specification performance or damage to the equipment.**

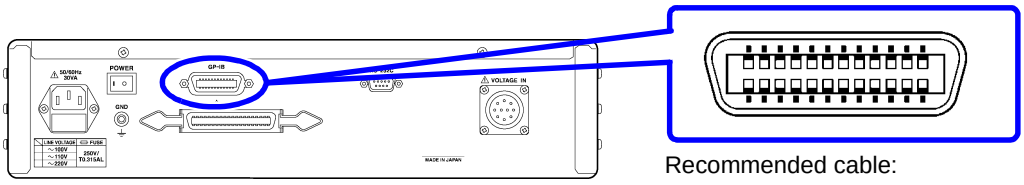
CAUTION

To avoid damage to the instrument, do not short-circuit the terminal and do not input voltage to the terminal.

Using the GP-IB Interface

GP-IB

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



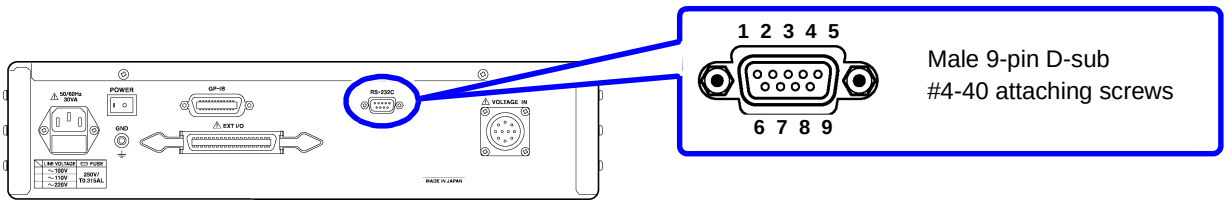
Rear Panel

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

Using the RS-232C Interface

RS-232C

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



Male 9-pin D-sub
#4-40 attaching screws

Rear Panel

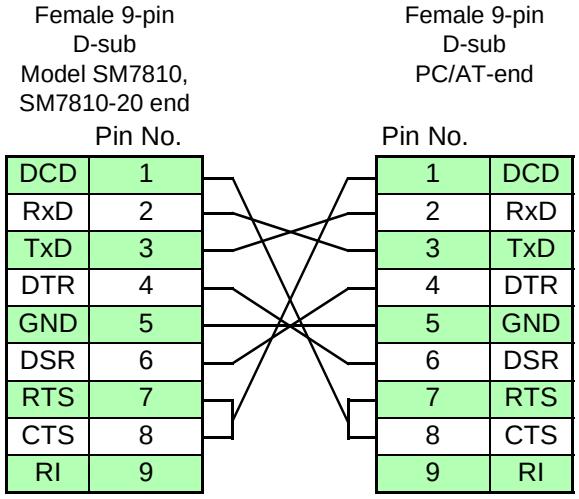
Pin No.	Signal Name	Code Addr.		Mutual connection circuit name	Remarks
		EIA	JIS		
1	DCD	CF	CD	Carrier Detect	Not used
2	RXD	BB	RD	Receive Data	
3	TXD	BA	SD	Transmit Data	
4	DTR	CD	ER	Data Terminal Ready	Not used
5	GND	AB	SG	Signal Ground	
6	DSR	CC	DR	Data Set Ready	Not used
7	RTS	CA	RS	Request to Send	Not used
8	CTS	CB	CS	Clear to Send	Not used
9	RI	CE	CI	Ring Indicator	Not used

4.3 Connect a cable to the GP-IB connector or RS-232C connector

When connecting the instrument to a computer

Use a **crossover cable** with **female 9-pin D-sub** connectors.

Crossover Wiring



Recommended cable:

HIOKI
Model 9637 RS-232C
Cable (1.8 m)

4.4 Configuring the Communications Protocol

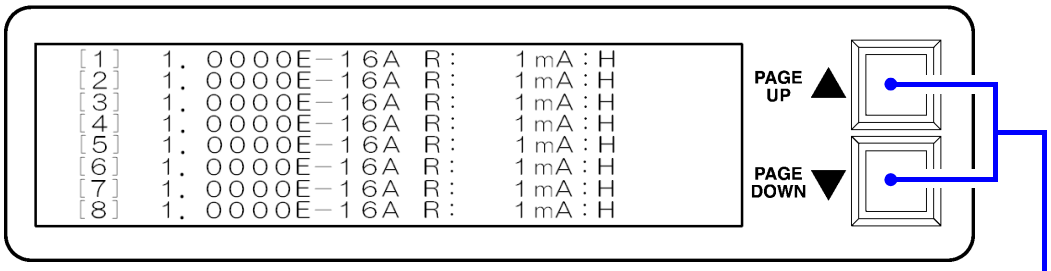
Configuring GP-IB Interface Communications

GP-IB

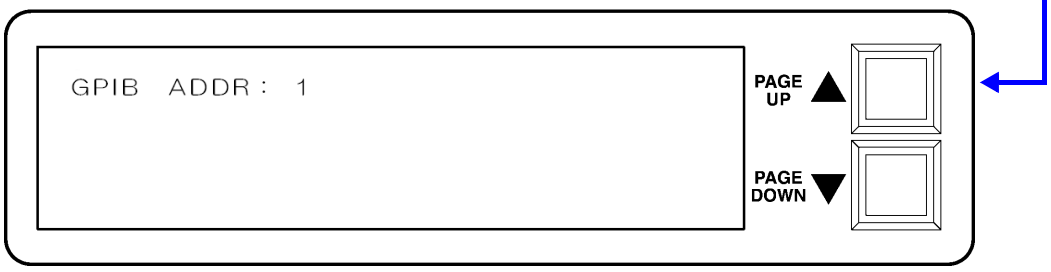
Setting the address

1 **Press and hold the scroll keys (PAGE UP▲/PAGE DOWN▼) on the front of the instrument for about 7 seconds. (The address can be set from the P1, P2, or P3 screen.)**

■ **Screen P1: Measured value display**



2 **Using the scroll keys (PAGE UP▲/PAGE DOWN▼), set the desired address. (Valid setting range: 1 to 30)**



3 **When finished making the setting, turn off the instrument.**

4 **Turn on the instrument.**

The instrument will revert to the initial screen, and the GP-IB address will be set to the selected address.

Configuring RS-232C Interface Communications

RS-232C

Communication conditions

Baud rate	38400 bps
Parity	none
Stop bit	1 bit
Data	8 bits
Flow control	none

Remote switching requests

Send the "**RMT**" command from the RS-232C interface.

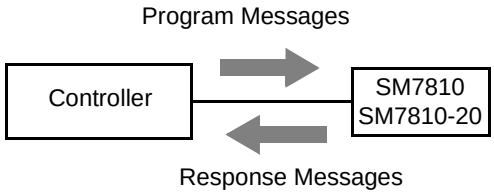
NOTE

RS-232C interface communications will not be available until the "**RMT**" command is sent.

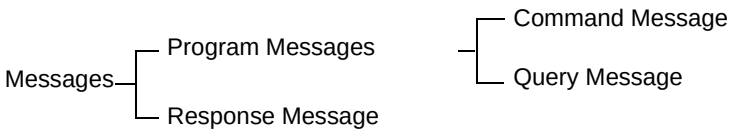
4.5 Communication Methods

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

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



Message types are further categorized as follows



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

Program Messages

1. Command Messages and Query Messages

(1) Command Messages

Commands that control the instrument, for example to configure settings or reset the device.

(2) Query Messages

Requests for responses relating to results of operation or measurement, or the state of instrument settings.
Query commands end with a question (**?**) mark.

2. Message delimiter (terminator)

This instrument recognizes the following input message delimiters:
CR+LR with EOI
LF with EOI
CR with EOI
EOI
CR+LF
LF

Response Messages

1. Response Messages

When a query message is received, its syntax is checked and a response message is generated.

2. Message delimiter (terminator)

The following three response message delimiters can be specified with the "**DLM**" command:
LF (initial setting)
CR+LF
EOI

3. Measurement data format

The data format returned by the "**MTG**" and "**RDT?**" commands can be set to any of the following three types by command:

(1) Basic format

Data is returned in channel order.
Fields are separated by a data separator (**,**).

1,±d.ddddE±dd,d,d,2,±d.ddddE±dd,d,d,
a b c d a b c d

3,±d.ddddE±dd,d,d,4,±d.ddddE±dd,d,d,
a b c d a b c d

5,±d.ddddE±dd,d,d,6,±d.ddddE±dd,d,d,
a b c d a b c d

7,±d.ddddE±dd,d,d,8,±d.ddddE±dd,d,d
a b c d a b c d

LF <EOI>
e

a. Channel number
The channel number is set as a 1-byte number from 1 to 8.

b. Measured value
The measured value is set as an 11-byte exponent.

±d.ddddE±dd	**d**: Number

NOTE When the range is exceeded, all numbers in the output data are set to 9 (for resistance measurements) or 0 (for current measurements).

9.9999E+99	Resistance measurement
+0.0000E+00	Current measurement

c. Status
The contact check and range exceeded results are set as numbers from 0 to 4. The results are allocated to bits 0 to 2 of the status, and their logical sum is output.
Bit 0: 0 (fixed)
Bit 1: Contact check error (automatic execution result)
Bit 2: Range exceeded

NOTE A status of 0 indicates normal operation.

d. Comparison result
When comparative measurement is on, this field is set to the result (0 to 2).
0: High (The measured value was greater than the upper limit reference value.)
1: IN (The measured value fell within the range defined by the upper and lower limits.)
2: LOW (The measured value was less than the lower limit reference value.)

NOTE When comparative measurement is off, comparison results (d) are not added to the output data.

e. Delimiter
The output message delimiter can be specified with the "**DLM**" command.

(2) Measured value only

The status (c) and comparison results (d) are not added to the output data. Otherwise, this format is the same as the basic format.

(3) Comparison results only

The measured value (b) and status data (d) are not added to the output data. Otherwise, this format is the same as the basic format.

Separators

1. Message Unit Separator

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

2. Header Separator

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

3. Data Separator

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

Data Formats

Query messages use the formats outlined in Table 1. The format is selected according to the command.

Table 1: Response Messages and Parameter Data Types

Data type	Description	Example	Notes
NR1	Integer	0, 1, 2, 3, etc.	Parameter settings, etc.
NR2	Fixed-point decimal number	+12.345, 400.0, etc.	Primarily settings
NR3	Floating-point decimal number	+1.234±50, etc.	Primarily settings and measured values
ASCII	ASCII string	XXXXXXXXXXXXXXX	Primarily hardware IDs

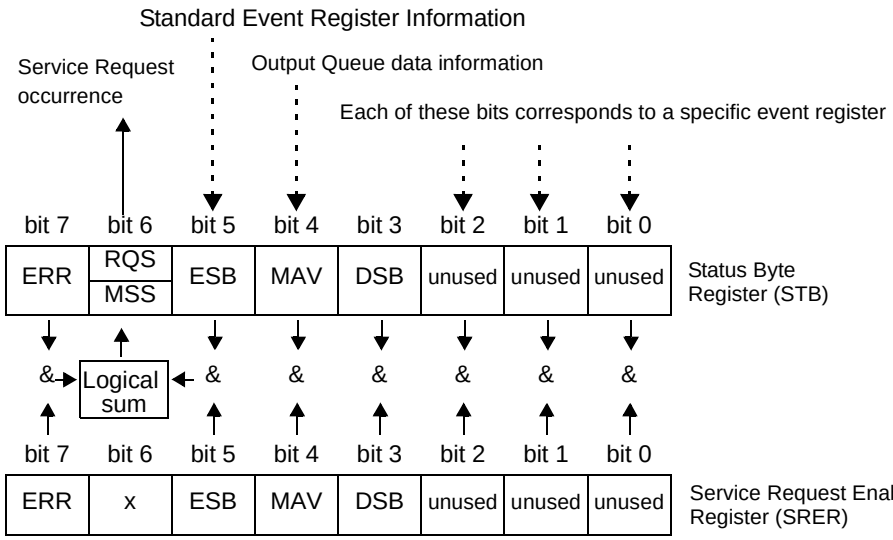
Status Byte Register

RS-232C

RS-232C reads the status bytes to find out the status of the instrument.

GP-IB

The instrument adopts the IEEE488.1-1987 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.



Overview of Service Request Occurrence

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

NOTE

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 RQS bit also becomes "1" and a service request is generated.

The RQS 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	ERR	Unrecoverable error
Bit 6	RQS MSS	Set to 1 when a service request is dispatched. This is the logical sum of the other bits of the Status Byte Register.
Bit 5	ESB	Standard Event Status (logical sum) bit This is logical sum of the Standard Event Status Register.
Bit 4	MAV	Message available Indicates that a message is present in the output queue.
Bit 3	DSB	Event Status (logical sum) bit This is the logical sum of Event Status Register.
Bit 2	–	unused
Bit 1	–	unused
Bit 0	–	unused

Service Request Enable Register (SRER)

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

Event Registers

Standard Event Status Register (SESR)

A standard event status register is an 8-bit register.

If any bit in the Standard Event Status Register is set to 1 (after masking by the Standard Event Status Enable Register), bit 5 (ESB) of the Status Byte Register is set to 1.
See: "Standard Event Status Enable Register (SESER)" (p.30)

The standard event register is cleared at the following times:

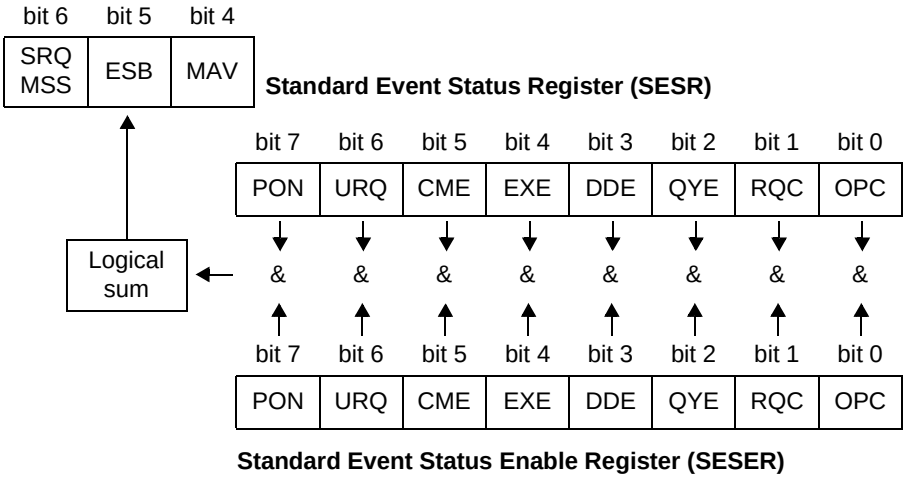
- When a "***CLS**" command is executed
- When an event register query (***ESR?**) is executed
- When the instrument is powered on

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

Standard Event Status Enable Register (SESER)

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

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



Device Event Status Registers (DESR)

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

When any bit in one of these event status registers enabled by its corresponding event status enable register is set to 1, bit (DSB) of the Status Byte Register is set to 1.

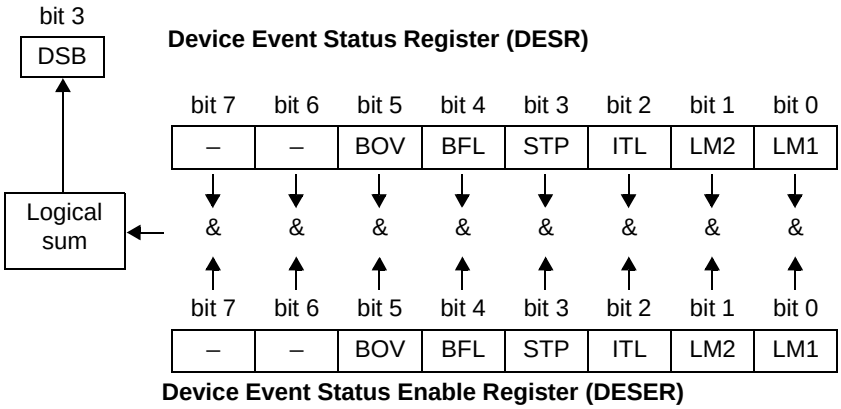
Device Event Status Registers are cleared in the following situations:

- When a "***CLS**" command is executed
- When an Event Status Register query (**DSR?**) is executed
- When the instrument is powered on

Bit 7	–	Unused
Bit 6	–	Unused
Bit 5	BOV	Reserved bit
Bit 4	BFL	Reserved bit
Bit 3	STP	Measured stop event
Bit 2	ITL	Reserved bit
Bit 1	LM2	Reserved bit
Bit 0	LM1	Reserved bit

Device Event Status Register (DESR) and Device Event Status Enable Register (DESER)

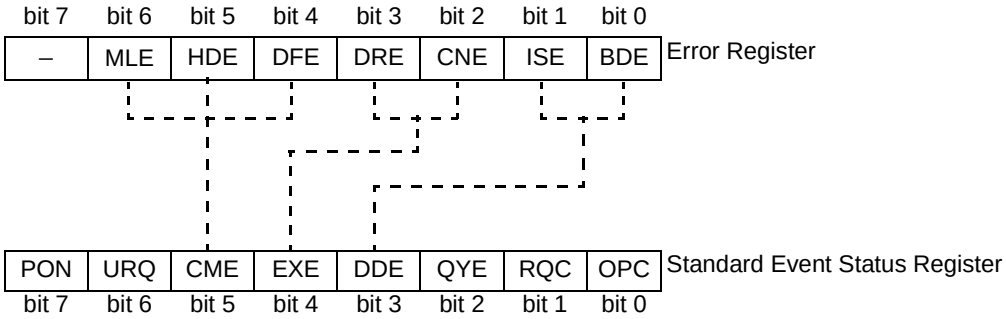
Status Byte Register (STB)



Error Registers

The Error Register, which consists of 8 bits, manages error information. The contents of this register are aggregated in the CME, EXE, DDE, and QYE bits of the Standard Event Status Register (no mask processing is performed).
Error register-related message are listed below.

***CLS**	Clears the following registers: • Status Byte Register • Standard Event Status Register • Device Event Status Register • Error Register
ERR?	Queries and clears the Error Register.



MLE: Message Length Error
DFE: Data Format Error
CNE: Can Not Execute
BDE: Environment Backup was Damaged (RAM)
HDE: Header Error
DRE: Data Range Error
ISE: Internal communication Error

Error Register structure

Bit No.	Name	Event/status indicated by set bit
Bit 7	–	Unused
Bit 6	MLE	Message Length Error Set when the message length exceeds the allowable range. The bit is reset after the register is read.
Bit 5	HDE	Message Header Error Set when an unrecognizable message header is received. The bit is reset after the register is read.
Bit 4	DFE	Data Format Error Set when the number of parameters exceeds the stipulated number or when there is an unrecognizable parameter. The bit is reset after the register is read.
Bit 3	DRE	Data Range Error Set when a parameter falls outside the stipulated range. The bit is reset after the register is read.
Bit 2	CNE	Unexecutable command Set when an unexecutable command is received. The bit is reset after the register is read.
Bit 1	ISE	Internal communication Error Set when an internal communication error occurs. The bit is reset after the register is read.
Bit 0	BDE	Environment Backup was Damaged Set when data stored in the instrument's backup RAM is corrupted. The bit is reset after the register is read.

4.6 Message List

RS-232C-only commands are indicated by RS-232C.

NOTE

When using the RS-232C interface to send commands, include a uniform wait time of 100 ms (excluding the following exceptions).
<Exceptions>
OCL command: Requires a wait time of 8 s.
MTG command: Although the instrument can respond to the next command in 2.7 ms, the following wait times are required depending on the measurement speed in order to allow the instrument to wait for the measurement results and obtain measured values:

	Measurement speed setting			
	FAST	MED	SLOW	SLOW2
Wait time	10 ms	30 ms	100 ms	400 ms

Command	Description	Formats
Communication conditions		
RMT	Remote switching request RS-232C	[Format] RMT
Delimiter		
DLM	Talker delimiter specification d1 (delimiter specification: 0 to 2) 0: LF<EOI> Default 1: CRLF<EOI> 2: <EOI> Note: This setting reverts to its default value when the instrument is powered on. A combination CR+LF is used as the RS-232C delimiter for both data transmission and reception.	[Format] DLM d1 d1: NR1 format
DLM?	Delimiter query The contents of responses are the same as the settings.	[Format] DLM? [Response] d1
Measurement value indication		
MOD	Measurement mode setting d1 (Mode: 0 to 1) 0: Resistance measurement mode 1: Current measurement mode	[Format] MOD d1 d1: NR1 format
MOD?	Measurement mode query The contents of responses are the same as the settings.	[Format] MOD? [Response] d1
Measurement speed		
SPL	Measurement speed setting d1 (Speed: FAST, MED, SLOW, SLOW2) Note: The current measurement ranges available for selection vary with the measurement speed. If the selected current range is no longer valid when the measurement speed changes, it will be automatically changed to the optimal current range. See:**RNG** command (p.34)	[Format] SPL d1 d1: String
SPL?	Measurement speed query (setting) The contents of responses are the same as the settings.	[Format] SPL? [Response] d1
Current channel		
CCH	Current channel setting CH (d1: 1 to 8) Note: Sets which channel to enable. This setting is only valid for the following commands: **RNG RNG? CMP CMP? OIR?**	[Format] CCH d1 d1: NR1 format
CCH?	Current channel query The contents of responses are the same as the settings.	[Format] CCH? [Response] d1

<table>
<tr><th>Command</th><th>Description</th><th>Formats</th></tr>
<tr><td colspan="3">Measurement ranges</td></tr>
<tr><td>RNG</td><td>Current measurement range setting
AUTO/HOLD selection and HOLD range setting
d1 (Selection: 0 to 1)
0: HOLD
1: AUTO
d2 (HOLD range: string)
Sets the current measurement range as a string. The current measurement ranges available for selection vary with the measurement speed setting. When using the AUTO range setting, d2 can be omitted.
<table><tr><td rowspan="2"></td><td colspan="4">Measurement speed setting</td></tr><tr><td>FAST</td><td>MED</td><td>SLOW</td><td>SLOW2</td></tr><tr><td rowspan="9">Available ranges</td><td>1 mA</td><td></td><td></td><td></td></tr><tr><td>100 uA</td><td>100 uA</td><td>100 uA</td><td></td></tr><tr><td>10 uA</td><td>10 uA</td><td>10 uA</td><td>10 uA</td></tr><tr><td>1 uA</td><td>1 uA</td><td>1 uA</td><td>1 uA</td></tr><tr><td>100 nA</td><td>100 nA</td><td>100 nA</td><td>100 nA</td></tr><tr><td>10 nA</td><td>10 nA</td><td>10 nA</td><td>10 nA</td></tr><tr><td>1 nA</td><td>1 nA</td><td>1 nA</td><td>1 nA</td></tr><tr><td></td><td>100 pA</td><td>100 pA</td><td>100 pA</td></tr></table>Note: Attempting to select an unavailable range will result in an execution error.
Note: In communications, use "u" (small letter "u") to refer to "µ" (microns) in settings.
Example: Input "10 uA" for the setting "10 µA."</td><td>[Format] RNG d1,d2
d1: NR1 format
d2: String</td></tr>
<tr><td>RNG?</td><td>Current measurement range query
The contents of responses are the same as the settings.</td><td>[Format] RNG?
[Response] d1,d2</td></tr>
<tr><td colspan="3">Trigger delay time</td></tr>
<tr><td>DLY</td><td>Trigger delay time (ms) setting
d1 (time: 0 to 9999)</td><td>[Format] DLY d1
d1: NR1 format</td></tr>
<tr><td>DLY?</td><td>Trigger delay time (ms) query
The contents of responses are the same as the settings.</td><td>[Format] DLY?
[Response] d1</td></tr>
<tr><td colspan="3">Averaging</td></tr>
<tr><td>AVE</td><td>Averaging setting
d1 (Selection: 0 to 2)
0: OFF (Disables averaging.)
1: ON (Enables count averaging.)
2: AUTO (Enables automatic averaging.)
d2 (Measurement count: 1 to 256; default value: 1)</td><td>[Format] AVE d1,d2
d1: NR1 format
d2: NR1 format</td></tr>
<tr><td>AVE?</td><td>Averaging query
The contents of responses are the same as the settings.</td><td>[Format] AVE?
[Response] d1,d2</td></tr>
<tr><td colspan="3">Power source frequency</td></tr>
<tr><td>FRQ</td><td>Power source frequency selection
d1 (Selection: 0 to 1)
0: 50 Hz
1: 60 Hz</td><td>[Format] FRQ d1
d1: NR1 format</td></tr>
<tr><td>FRQ?</td><td>Power line frequency query
The contents of responses are the same as the settings.</td><td>[Format] FRQ?
[Response] d1</td></tr>
</table>

Command	Description	Formats
Measurement voltage		
VM1	CH1 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM1 d1 d1: NR2 format
VM1?	CH1 measurement voltage query The contents of responses are the same as the settings.	[Format] VM1? [Response] d1
VM2	CH2 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM2 d1 d1: NR2 format
VM2?	CH2 measurement voltage query The contents of responses are the same as the settings.	[Format] VM2? [Response] d1
VM3	CH3 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM3 d1 d1: NR2 format
VM3?	CH3 measurement voltage query The contents of responses are the same as the settings.	[Format] VM3? [Response] d1
VM4	CH4 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM4 d1 d1: NR2 format
VM4?	CH4 measurement voltage query The contents of responses are the same as the settings.	[Format] VM4? [Response] d1
VM5	CH5 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM5 d1 d1: NR2 format
VM5?	CH5 measurement voltage query The contents of responses are the same as the settings.	[Format] VM5? [Response] d1
VM6	CH6 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM6 d1 d1: NR2 format
VM6?	CH6 measurement voltage query The contents of responses are the same as the settings.	[Format] VM6? [Response] d1
VM7	CH7 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM7 d1 d1: NR2 format
VM7?	CH7 measurement voltage query The contents of responses are the same as the settings.	[Format] VM7? [Response] d1
VM8	CH8 measurement voltage setting d1: 0.1 to 1000.0 V	[Format] VM8 d1 d1: NR2 format
VM8?	CH8 measurement voltage query The contents of responses are the same as the settings.	[Format] VM8? [Response] d1

Command	Description	Formats
Contact-check		
CCM	Contact check automatic execution mode selection d1 (Selection: 0 to 1) 0: OFF 1: ON	[Format] CCM d1 d1: NR1 format
CCM?	Contact check automatic execution mode query The contents of responses are the same as the settings.	[Format] CCM? [Response] d1
WCP	Target object capacitance setting Target object capacitance used to perform contact checks and calculate the judgment reference value d1: CH1 (0.5 to 99.9) pF d2: CH2 (0.5 to 99.9) pF d3: CH3 (0.5 to 99.9) pF d4: CH4 (0.5 to 99.9) pF d5: CH5 (0.5 to 99.9) pF d6: CH6 (0.5 to 99.9) pF d7: CH7 (0.5 to 99.9) pF d8: CH8 (0.5 to 99.9) pF	[Format] WCP d1,d2,d3,d4, d5,d6,d7,d8 d1: NR2 format d2: NR2 format d3: NR2 format d4: NR2 format d5: NR2 format d6: NR2 format d7: NR2 format d8: NR2 format
WCP?	Target object capacitance query The contents of responses are the same as the settings.	[Format] WCP? [Response] d1,d2,d3,d4, d5,d6,d7,d8
CCK?	Returns the contact check results and capacitance as a response. [Format] d1 (Operation specification) 0: Returns the most recent contact check execution results and capacitance value without performing a contact check. 1: Performs a contact check and returns the results and capacitance. [Response] d1 (CH1 results: 0 to 1) d2 (CH1 capacitance: 0 to 99.9) d3 (CH2 results: 0 to 1) d4 (CH2 capacitance: 0 to 99.9) d5 (CH3 results: 0 to 1) d6 (CH3 capacitance: 0 to 99.9) d7 (CH4 results: 0 to 1) d8 (CH4 capacitance: 0 to 99.9) d9 (CH5 results: 0 to 1) d10 (CH5 capacitance: 0 to 99.9) d11 (CH6 results: 0 to 1) d12 (CH6 capacitance: 0 to 99.9) d13 (CH7 results: 0 to 1) d14 (CH7 capacitance: 0 to 99.9) d15 (CH8 results: 0 to 1) d16 (CH8 capacitance: 0 to 99.9) Results 0: NO1: GO Note: Omitted parameters are treated as 0.	[Format] CCK? d1 [Response] d1,d2,d3,d4,d5, d6,d7,d8,d9,d10, d11,d12,d13,d14, d15,d16 d1: NR1 format d2: NR2 format d3: NR1 format d4: NR2 format d5: NR1 format d6: NR2 format d7: NR1 format d8: NR2 format d9: NR1 format d10: NR2 format d11: NR1 format d12: NR2 format d13: NR1 format d14: NR2 format d15: NR1 format d16: NR2 format

Command	Description	Formats
OST?	Returns the fixture capacitance open correction value (fixture capacitance) as a response. [Format] d1 (operation specification) 0: Returns the capacitance without performing open correction. 1: Performs open correction and then returns the capacitance. If an error occurs, this command will return the value 999.9. [Response] d1 (CH1 fixture capacitance: 0 to 99.9) d2 (CH2 fixture capacitance: 0 to 99.9) d3 (CH3 fixture capacitance: 0 to 99.9) d4 (CH4 fixture capacitance: 0 to 99.9) d5 (CH5 fixture capacitance: 0 to 99.9) d6 (CH6 fixture capacitance: 0 to 99.9) d7 (CH7 fixture capacitance: 0 to 99.9) d8 (CH8 fixture capacitance: 0 to 99.9) Error: 999.9 Note: Open correction must be performed once before a contact check can be performed. Note: Omitted parameters are treated as 0.	[Format] OST? d1 d1: NR1 format [Response] d1,d2,d3,d4, d5,d6,d7,d8 d1: NR2 format d2: NR2 format d3: NR2 format d4: NR2 format d5: NR2 format d6: NR2 format d7: NR2 format d8: NR2 format
Measured value comparison and judgment function		
CMP	Comparative measurement mode setting d1 (Execute comparison: 0 to 1) 0: OFF 1: ON d1 (Mode: 0 to 2) 0: HI 1: IN 2: LO d3 (Upper limit comparison value) (-9.9999E+30 to 9.9999E+30) d4 (Lower limit comparison value) (-9.9999E+30 to 9.9999E+30) Note: Always set parameters so that d3 ≥ d4. Failure to do so will cause the current settings to be applied. Note: The d2, d3, and d4 parameters are valid even when comparison execution is set to OFF. (They will be saved as the current settings.)	[Format] CMP d1,d2,d3,d4 d1: NR1 format d2: NR1 format d3: NR3 format d4: NR3 format
CMP?	Comparative measurement mode query The contents of responses are the same as the settings.	[Format] CMP? [Response] d1,d2,d3,d4
Fixture resistance open correction function		
OCM	Fixture resistance open correction mode selection d1 (Selection: 0 to 1) 0: OFF (Disables use of correction value in measured value calculations.) 1: ON (Enables use of correction value in measured value calculations.)	[Format] OCM d1 d1: NR1 format
OCM?	Fixture resistance open correction mode query The contents of responses are the same as the settings.	[Format] OCM? [Response] d1
OCL	Performs fixture resistance open correction once and saves the correction value. d1 (Channel specification) 1 to 255: Specifies the channel for which to perform correction as the weight of bits 0 (channel 1) to 7 (channel 8).	[Format] OCL d1 d1: NR1 format
OIR?	Fixture resistance open value query The contents of responses are the same as the settings. Note: The value for the current channel is returned as a query. Note: The AD converted values for the instrument's internal ammeter's seven ranges are used as the return values. Note: A return value of 32768 indicates that correction was not performed due to an error.	[Format] OIR? [Response] d1,d2,d3,d4,d5, d6,d7 d1 to d7: NR1 format

Command	Description	Formats
LCD display		
LCD	LCD display mode setting d1 (Display mode: 0 to 1) 0: OFF Display OFF 1: ON Display ON	[Format] LCD d1 d1: NR1 format
LCD?	LCD display mode query The contents of responses are the same as the settings.	[Format] LCD? [Response] d1
PAG	LCD display page specification d1 (Page number: 0 to 2) 0: Displays measured value. 1: Displays contact check results. 2: Displays operation conditions.	[Format] PAG d1 d1: NR1 format
Measurement data		
RDT?	Measurement data query d1 (Format specification: 0 to 2) 0: Fundamental waveform 1: Measured value only 2: Comparison results only Note: When the comparative measurement function is OFF, no query is returned even if the **RTD? 2** command is executed. For more information about the response, see "Measurement data format" (p.25).	[Format] RDT? d1 [Response] d1: NR1 format
MTG	Manual trigger d1 (Format specification: 0 to 2 [may be omitted]) If omitted: No automatic data return 0: Fundamental waveform 1: Measured value only 2: Comparison results only For more information about the response, see "Measurement data format" (p.25).	[Format] MTG d1 d1: NR1 format

Command	Description	Formats
Others		
***RST**	Instrument initialization Initializes all settings to their factory values. Instrument operation will be stopped.	[Format] *RST
***IDN?**	Hardware ID query Returns the instrument's hardware ID as the response. d1 (HIOKI E.E. CORPORATION, SM7810, 0, 01.00)	[Format] *IDN? [Response] d1: String
***TRG**	Provides the same functionality as the GET message.	[Format] *TRG
***SAV**	Save environmental data d1 (Environmental data no.: 0 to 3)	[Format] *SAV d1 d1: NR1 format
***RCL**	Recall environmental data d1 (Environmental data no.: 0 to 3)	[Format] *RCL d1 d1: NR1 format
***CLS**	Clear status register	[Format] *CLS
***SRE**	Sets the service request enable register. d1 (0 to 255)	[Format] *SRE d1 d1: NR1 format
***SRE?**	Service request enable register query d1 (0 to 63, 128 to 191) Note: Bit 6 is not set by ***SRE**.	[Format] *SRE? [Response] d1: NR1 format
***STB?**	Status byte register query d1 (0 to 255)	[Format] *STB? [Response] d1: NR1 format
***ESE**	Sets the standard event status enable register. d1 (0 to 255)	[Format] *ESE d1 d1: NR1 format
***ESE?**	Standard event status enable register query The contents of responses are the same as the settings.	[Format] *ESE? [Response] d1: NR1 format
***ESR?**	Standard event status register query d1 (0 to 255) Note: Register contents are cleared when the response is output.	[Format] *ESR? [Response] d1: NR1 format
***OPC**	Sets the standard event status register's OPC bit after all ongoing operations have completed. This command is used to detect the completion of commands that involve time-consuming processing.	[Format] *OPC
***OPC?**	Returns the value 1 when all ongoing operations have completed. d1: 1	[Format] *OPC? [Response] d1: NR1 format
ERR?	Error information query d1 (Error information: 0 to 255) Note: Error information is cleared when the response is output.	[Format] ERR? [Response] d1: NR1 format
DSE	Sets the device event status enable register.	[Format] DSE d1 d1: NR1 format
DSE?	Device event status enable register query The contents of responses are the same as the settings.	[Format] DSE? [Response] d1
DSR?	Device event status register query d1 (0 to 255) Note: Register contents are cleared when the response is output.	[Format] DSR? [Response] d1: NR1 format

4.7 Listener Specification Precautions

Input buffer size

Multiple command messages can be transferred at once by joining them with message separators. Since the instrument provides an 128-byte input buffer, the instrument is unable to receive message strings in excess of 127 characters in length. In this case, the entire command will be ignored (discarded), and the Error Register's MLE (Message Length Error) bit will be set.

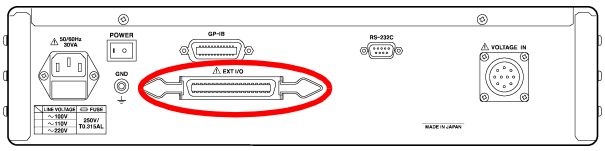
Reading from the output buffer

The output buffer uses a FIFO design, with older data being read first. Consequently, the read value may differ from the expected value under certain circumstances, for example if no response is acquired after issuing a query. Additionally, the output buffer is 511 bytes in size. If data in excess of 511 bytes is written to the buffer, it will be discarded, and the Error Register's QYE (Query Error) bit will be set.

Chapter 5 External Control

This chapter describes how to use the EXT I/O connector on the rear of the instrument to control the device.

Connect the instrument's EXT I/O connector to the signal output or input device.



Rear Panel

5.1 External Input/Output Connector and Signals

⚠WARNING

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

- **Always turn off the power to the instrument and to any devices to be connected before making connections.**
- **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Ensure that the cable is securely attached to the EXT I/O connector.**
- **Ensure that devices and systems to be connected to the EXT I/O connector are properly isolated.**

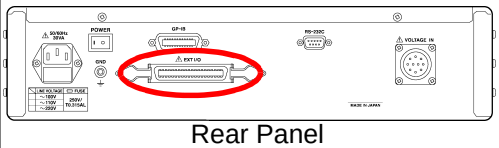
⚠CAUTION

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

- Do not apply voltage or current to the EXT I/O connector that exceeds their ratings.
- When driving relays, be sure to install diodes to absorb counter-electromotive force.

See: "Connector Type and Signal Pinouts" (p.42)

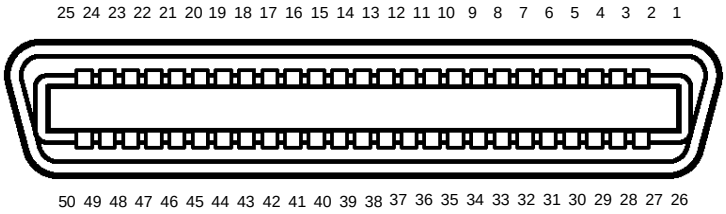
Connector Type and Signal Pinouts



Rear Panel

Connector

- 57RE-40500-730B (50-pin: DDK)



EXT I/O connector

Pin	Signal name	I/O
1	COM	-
2	EXT_DCV2(+24V)	IN
3	$\overline{\text{TRIG}}$	IN
4	$\overline{\text{C.CHECK}}$	IN
5	(Reserved)	-
6	(Reserved)	-
7	(Reserved)	-
8	$\overline{\text{ALARM}}$	OUT
9	$\overline{\text{EOM}}$	OUT
10	$\overline{\text{NO CONTACT1}}$	OUT
11	$\overline{\text{NO CONTACT3}}$	OUT
12	$\overline{\text{NO CONTACT5}}$	OUT
13	$\overline{\text{NO CONTACT7}}$	OUT
14	$\overline{\text{LO1}}$	OUT
15	$\overline{\text{LO3}}$	OUT
16	$\overline{\text{LO5}}$	OUT
17	$\overline{\text{LO7}}$	OUT
18	$\overline{\text{IN1}}$	OUT
19	$\overline{\text{IN3}}$	OUT
20	$\overline{\text{IN5}}$	OUT
21	$\overline{\text{IN7}}$	OUT
22	$\overline{\text{IN1}}$	OUT
23	$\overline{\text{HI3}}$	OUT
24	$\overline{\text{HI5}}$	OUT
25	$\overline{\text{HI7}}$	OUT

Pin	Signal name	I/O
26	COM	-
27	EXT_DCV2(+24V)	IN
28	$\overline{\text{OPEN\_IR}}$	IN
29	$\overline{\text{OPEN\_CX}}$	IN
30	(Reserved)	-
31	(Reserved)	-
32	(Reserved)	-
33	(Reserved)	-
34	$\overline{\text{INDEX}}$	OUT
35	$\overline{\text{NO CONTACT2}}$	OUT
36	$\overline{\text{NO CONTACT4}}$	OUT
37	$\overline{\text{NO CONTACT6}}$	OUT
38	$\overline{\text{NO CONTACT8}}$	OUT
39	$\overline{\text{LO2}}$	OUT
40	$\overline{\text{LO4}}$	OUT
41	$\overline{\text{LO6}}$	OUT
42	$\overline{\text{LO8}}$	OUT
43	$\overline{\text{IN2}}$	OUT
44	$\overline{\text{IN4}}$	OUT
45	$\overline{\text{IN6}}$	OUT
46	$\overline{\text{IN8}}$	OUT
47	$\overline{\text{HI2}}$	OUT
48	$\overline{\text{HI4}}$	OUT
49	$\overline{\text{HI6}}$	OUT
50	$\overline{\text{HI8}}$	OUT

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

Signal Descriptions

Input Signals

EXT_DCV2(+24V)	External power source input	
$\overline{\text{TRIG}}$	External trigger input signal	
$\overline{\text{C.CHECK}}$	Contact check input signal	(p.52)
$\overline{\text{OPEN\_IR}}$	Fixture resistance open correction execution signal	(p.53)
$\overline{\text{OPEN\_CX}}$	Fixture capacitance open correction execution signal	(p.52)

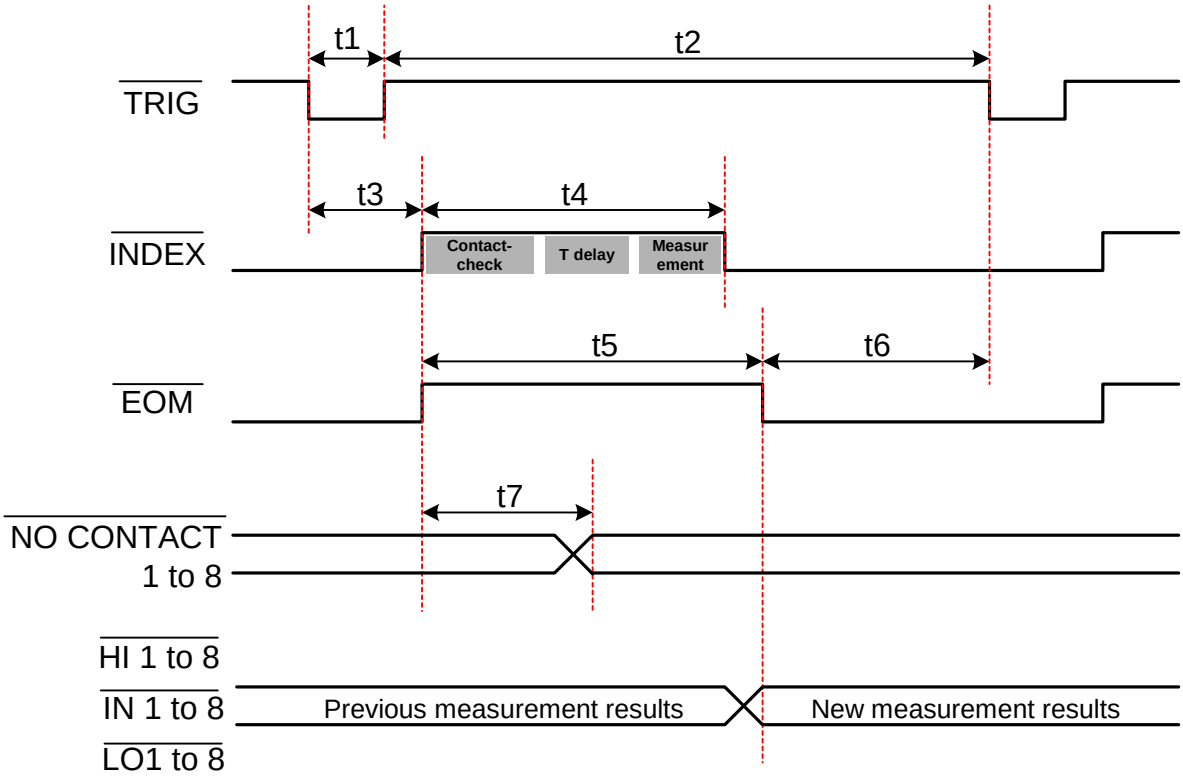
Output Signals

$\overline{\text{EOM}}$	This signal indicates the end of a measurement. Output data is acquired when this signal changes to low.	
$\overline{\text{INDEX}}$	This signal indicates that A/D conversion in the measurement circuit is complete. Sample switching is performed when this signal changes to low.	
$\overline{\text{NO CONTACT}}$	Contact check judgment results	(p.52)
$\overline{\text{LO}}$	Comparative measurement results (LOW)	(p.52)
$\overline{\text{IN}}$	Comparative measurement results (IN)	
$\overline{\text{HI}}$	Comparative measurement results (HIGH)	
$\overline{\text{ALARM}}$	Instrument malfunction	

5.2 Timing Chart

Each signal level indicates a corresponding voltage level.

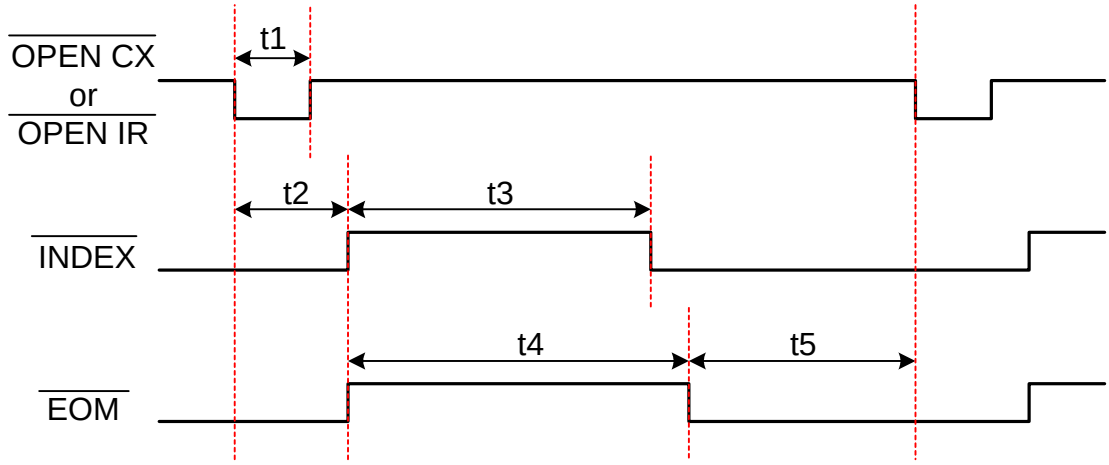
◆ **Normal measurement**



Timing Chart Interval Descriptions

Interval	Description	Duration
t1	Trigger pulse width (Low time)	100 µs or more
t2	Trigger OFF (Hi time)	100 µs or more
t3	$\overline{\text{INDEX}}$, $\overline{\text{EOM}}$ delay time	200 µs or less
t4	T index (Measurement time)	Within (set measurement time + T delay)
t5	T eom	Within (T index + 500 µs)
t6	Trigger setup time	Display ON : 30 ms or more Display OFF: 1 ms or more
t7	$\overline{\text{NO CONTACT}}$ delay time	3 ms or less

◆ **Fixture capacitance or fixture resistance open correction**

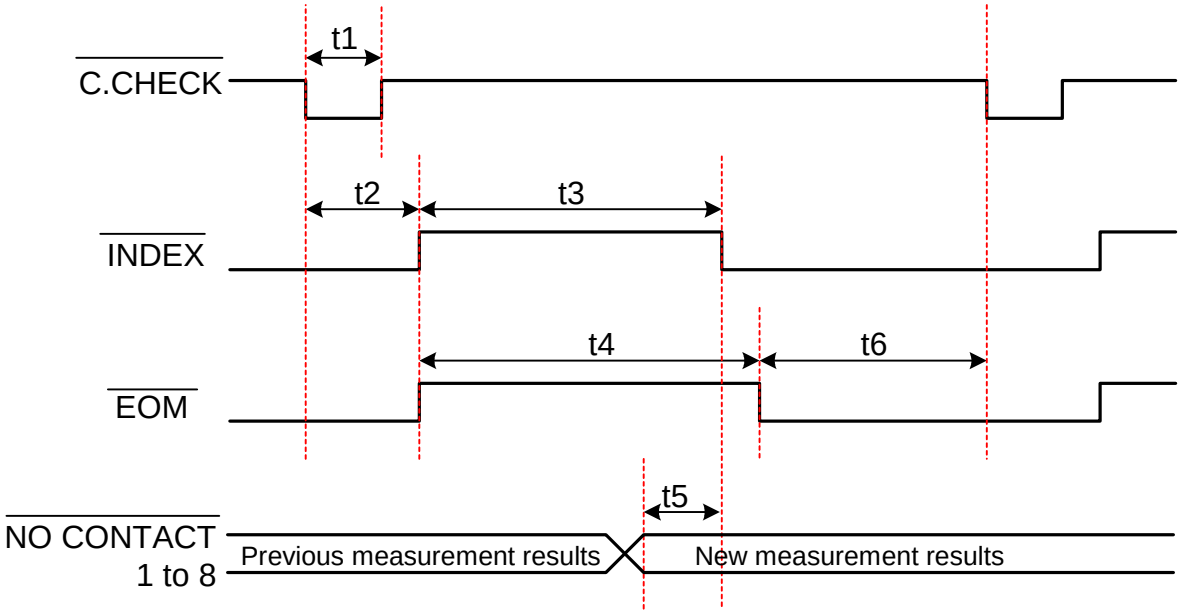


Timing Chart Interval Descriptions

Interval	Description	Duration
t1	Pulse width (Low time)	100 µs or more
t2	INDEX, EOM delay time	400 µs or less
t3	T index (Measurement time)	OPEN CX : 8 ms typ OPEN IR : 5 s typ
t4	T eom	OPEN CX : 10 ms typ OPEN IR : 5 s typ
t5	Trigger setup time	2 s or more

5.2 Timing Chart

◆ **Contact-check**

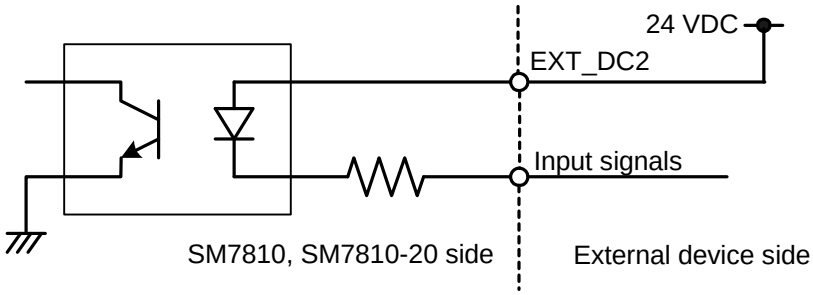


Timing Chart Interval Descriptions

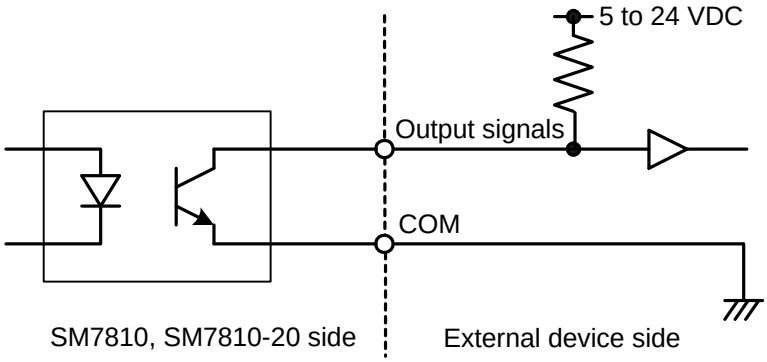
Interval	Description	Duration
t1	Pulse width (Low time)	100 µs or more
t2	$\overline{\text{INDEX}}$, $\overline{\text{EOM}}$ delay time	400 µs or less
t3	T index (Measurement time)	4 ms or less
t4	T eom	4 ms or less
t5	Judgment setup time	100 µs or more
t6	Input setup time	2 s or more

5.3 Internal Circuitry

Input Circuit



Output Circuit



Input Signals	Input type	Contact input via photocoupler (negative logic)
	Input voltage	LOW: 0 to 0.5 V, HIGH: 24 V±10%
Output Signals	Output type	Photocoupler-isolated output (negative logic)
	Output voltage/current	See following table:

Output Signals		Output voltage rating		Maximum output current	Circuit common
		LOW	HIGH		
Judgment signals	$\overline{\text{HI1}}$ to $\overline{\text{HI8}}$ $\overline{\text{IN1}}$ to $\overline{\text{IN8}}$ $\overline{\text{LO1}}$ to $\overline{\text{LO8}}$ $\overline{\text{NO CONTACT1}}$ to $\overline{\text{NO CONTACT8}}$	≤ 0.5 V	5 to 24 V	6 mA	COM
Control signals	$\overline{\text{ALARM}}$ $\overline{\text{INDEX}}$ $\overline{\text{EOM}}$	≤ 0.5 V	5 to 24 V	5 mA	COM

Chapter 6 Specifications

6.1 General Specifications

Operating environment	Indoors, Pollution degree 2, up to 2,000 m (6562-ft.) ASL
Operating temperature and humidity	0 to 40°C (32 to 104°F), 80%RH or less (non-condensing)
Storage temperature and humidity	-10 to 55°C (14 to 131°F), 80%RH or less (non-condensing)
Dielectric strength	1.69 kV AC for 15s, Cutoff current 10 mA, between all power terminals and protective ground, interfaces, and measurement terminals
Applicable Standard **Safety**	EN61010
Power source	Rated supply voltage Model SM7810 : 100 VAC, 110 VAC Model SM7810-20 : 220 VAC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account) Rated supply frequency: 50/60 Hz Anticipated transient overvoltage: 2,500 V
Maximum rated power	30 VA
Dimensions	Approx. 425W × 99H × 488D mm (16.73"W × 3.90"H × 19.21"D) (sans protrusions)
Mass	Approx. 10.5 kg (370.4 oz.)
Accessories	Power Cord.....1 Voltage input connector.....1 Spare fuse (built into inlet) (250 V T0.315AL ϕ5 mm × 20 mm Slo-Blo type).....1 Rubber feet.....4 Instruction manual 1
Options	Model 9637 RS-232C Cable (9pin-9pin/Cross/1.8m) Model 9638 RS-232C Cable (9pin-25pin/Cross/1.8m) Model 9151-02 GP-IB Connector Cable (2 m)
Product warranty period	3 years

6.2 Basic Specifications

Number of channels	8 (parallel and simultaneous measurement)
Measurement Method	Applies voltage to the measurement target and measures current.
Applied voltage	Supplied from an external power supply (Input to the voltage input connector on the rear panel.)
Input resistance of each current meter	1 kΩ ±10%
Input/Output terminals	Current input terminals (Front panel) :HIOKI proprietary input connector for IR meters Voltage output terminals (Front panel):Safety terminal (Red-colored) Voltage input terminals (Rear panel) :Special round connector Maximum input voltage:1000VDC (between each terminal) 1000VDC (between the ground and terminals)
Setup method and operation	GP-IB Interface RS-232C Interface EXT I/O (No setup available on the instrument front panel except settings for GP-IB address)
LED indicator	For “Power indication” and “Trigger indication”
LCD screen	3-page layout P1: For “measurement values” and “current measurement ranges” P2: For “Contact-check measurement values”, “Results of contact-check” and “Measurement voltage values” P3: For “Measurement speed”, “Trigger Delay”, “Averaging settings” and “GP-IB address”
Recommended power supply	HIOKI Model SM7860 series Power Source Unit

6.3 Functions

Measurement value indication

Function	Selects displayed value.
Default state	Resistance
Settings	Resistance * / Current *The resistance is calculated from the set measurement voltage and current value.

Measurement speed

Function	Selects the measurement speed.
Default state	SLOW2
Setups	FAST / MED (medium) / SLOW / SLOW2

Measurement ranges

Current	1 pA to 1 mA
Resistance	1×10^2 Ω to 1×10^{15} Ω

Current measurement range switching

Function	Selects the current measurement range.
Default state	AUTO, 10 µA
Setups	Functions : HOLD / AUTO Ranges : 100 pA / 1 nA / 10 nA / 100 nA / 1 µA / 10 µA / 100 µA / 1 mA

Trigger delay time

Function	Fix time between inputting trigger signal and starting measurement.
Default state	0 ms
Setup ranges	0 ms to 9999 ms (1 ms resolution)

Averaging

Function	Carry out averaging procedure of measurement values
Default state	ON, 1
Setups	OFF (No averaging) / ON (Required setting number of times for averaging) / AUTO (Number of times for averaging is automatically determined) Number of times (in case “ON” setting): 1 to 255
Averaging method	Moving average

Power source frequency

Function	Sets the power source frequency.
Default state	50 Hz
Setups	50 Hz / 60 Hz

Measurement voltage

Function	Sets the measurement voltage.
Default state	1.0 V
Setup ranges	0.1 to 1000.0 V (0.1 V resolution)

Fixture capacitance open correction function

Function	Measures the capacitance with the fixture in the open state (fixture capacitance). *This function must be executed before using the contact check function.
Default state	OFF

Contact-check

Function	Judges the contact state by comparing the measured capacitance to a reference value.
Method	Capacitance measurement using a high-frequency signal
Default state	OFF
Setups	OFF / ON
Target object capacitance setting range	0.5 pF to 99.9 pF (0.1 pF resolution)
Capacitance measurement range	(Fixture capacitance + target object capacitance) = 0.5 pF to 99.9 pF (0.1 pF resolution) *However, the target object capacitance must be greater than or equal to 1/10 of the fixture capacitance. *With a 1 m measurement cable.
Judgment	GO : Capacitance measured value > judgment reference value* NG : Judgment reference value* ≥ capacitance measured value *Judgment reference value = Fixture capacitance + (target object capacitance setting / 2)
Execution conditions	Fixture capacitance open correction must have been performed.
Capacitance measurement accuracy	±(20% of reading + 0.2 pF) *When using a measurement cable (1 m) and voltage output cable (1 m) after performing fixture capacitance open correction.

Measured value comparison and judgment function

Function	Compares the measured value and reference value to make a PASS/FAIL judgment.
Default state	OFF
Setups	OFF / ON
Judgment	HI : Measured value > upper limit setting IN : Upper limit setting ≥ measured value ≥ lower limit setting LO : Lower limit setting > measured value
Judgment reference value setting range	-9.9999E+30 to 9.9999E+30 *The reference value is a current value if the display setting is current, or a resistance value if the display setting is resistance.

Fixture resistance open correction function

Function	Measures the current of the fixture in the open state and corrects measured values.
Default state	OFF
Setups	OFF / ON

Backup Function

Function	Backups up certain items.
Backup Items	Environmental data (measurement speed, trigger delay time, measured value display settings, averaging settings, averaging count, measurement voltage setting, power source frequency, current range, current range switching setting, comparative measurement setting, comparative measurement upper and lower limits, contact check automatic execution, target object capacitance value, fixture capacitance open correction value, fixture resistance open correction setting, fixture resistance open correction value)

LCD display mode setting function

Function	Turns the LCD display on and off.
Default state	ON
Setups	OFF / ON

6.4 Measurement Specifications

Accuracy

Conditions of guaranteed accuracy	
Warm-up time	1 hour or more
Temperature and humidity range for guaranteed accuracy	23±5°C, 80%RH or less (non-condensing)
Averaging settings	OFF
Period of guaranteed accuracy	1 year

Accuracy

DC current measurement accuracy

Range	Measurement speed	Current accuracy ±(percent of reading)	Resistance accuracy ±(percent of reading)
100 pA	FAST	–	–
	MED	$5.0 + 15 \times 10^{-11} / Im^{*}$	$Ve^{*} + 100 \times Vofs^{*} / Vs^{*} + 5.0 + 15 \times 10^{-11} Rm^{*} / Vs$
	SLOW	$3.0 + 15 \times 10^{-11} / Im$	$Ve + 100 \times Vofs / Vs + 3.0 + 15 \times 10^{-11} Rm / Vs$
	SLOW2	$1.5 + 6 \times 10^{-11} / Im$	$Ve + 100 \times Vofs / Vs + 1.5 + 6 \times 10^{-11} Rm / Vs$
1 nA	FAST	$4.0 + 15 \times 10^{-10} / Im$	$Ve + 100 \times Vofs / Vs + 4.0 + 15 \times 10^{-10} Rm / Vs$
	MED	$3.0 + 6 \times 10^{-10} / Im$	$Ve + 100 \times Vofs / Vs + 3.0 + 6 \times 10^{-10} Rm / Vs$
	SLOW	$2.0 + 6 \times 10^{-10} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 6 \times 10^{-10} Rm / Vs$
	SLOW2	$0.6 + 6 \times 10^{-10} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 6 \times 10^{-10} Rm / Vs$
10 nA	FAST	$2.0 + 8 \times 10^{-9} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 8 \times 10^{-9} Rm / Vs$
	MED	$1.0 + 6 \times 10^{-9} / Im$	$Ve + 100 \times Vofs / Vs + 1.0 + 6 \times 10^{-9} Rm / Vs$
	SLOW	$0.6 + 6 \times 10^{-9} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 6 \times 10^{-9} Rm / Vs$
	SLOW2	$0.4 + 5 \times 10^{-9} / Im$	$Ve + 100 \times Vofs / Vs + 0.4 + 5 \times 10^{-9} Rm / Vs$
100 nA	FAST	$2.0 + 5 \times 10^{-8} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 5 \times 10^{-8} Rm / Vs$
	MED	$1.0 + 5 \times 10^{-8} / Im$	$Ve + 100 \times Vofs / Vs + 1.0 + 5 \times 10^{-8} Rm / Vs$
	SLOW	$0.6 + 5 \times 10^{-8} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 5 \times 10^{-8} Rm / Vs$
	SLOW2	$0.4 + 5 \times 10^{-8} / Im$	$Ve + 100 \times Vofs / Vs + 0.4 + 5 \times 10^{-8} Rm / Vs$
1 µA	FAST	$2.0 + 5 \times 10^{-7} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 5 \times 10^{-7} Rm / Vs$
	MED	$1.0 + 5 \times 10^{-7} / Im$	$Ve + 100 \times Vofs / Vs + 1.0 + 5 \times 10^{-7} Rm / Vs$
	SLOW	$0.6 + 5 \times 10^{-7} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 5 \times 10^{-7} Rm / Vs$
	SLOW2	$0.4 + 5 \times 10^{-7} / Im$	$Ve + 100 \times Vofs / Vs + 0.4 + 5 \times 10^{-7} Rm / Vs$
10 µA	FAST	$2.0 + 5 \times 10^{-6} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 5 \times 10^{-6} Rm / Vs$
	MED	$1.0 + 5 \times 10^{-6} / Im$	$Ve + 100 \times Vofs / Vs + 1.0 + 5 \times 10^{-6} Rm / Vs$
	SLOW	$0.6 + 5 \times 10^{-6} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 5 \times 10^{-6} Rm / Vs$
	SLOW2	$0.4 + 5 \times 10^{-6} / Im$	$Ve + 100 \times Vofs / Vs + 0.4 + 5 \times 10^{-6} Rm / Vs$
100 µA	FAST	$2.0 + 5 \times 10^{-5} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 5 \times 10^{-5} Rm / Vs$
	MED	$1.0 + 5 \times 10^{-5} / Im$	$Ve + 100 \times Vofs / Vs + 1.0 + 5 \times 10^{-5} Rm / Vs$
	SLOW	$0.6 + 5 \times 10^{-5} / Im$	$Ve + 100 \times Vofs / Vs + 0.6 + 5 \times 10^{-5} Rm / Vs$
	SLOW2	–	–
1 mA	FAST	$2.0 + 5 \times 10^{-4} / Im$	$Ve + 100 \times Vofs / Vs + 2.0 + 5 \times 10^{-4} Rm / Vs$
	MED	–	–
	SLOW	–	–
	SLOW2	–	–

* Im : Current measured value
* Rm : Resistance measured value
* Ve : External power source accuracy
* Vs : Voltage setting (The instrument setting and external power source setting must match.)
* Vofs : Offset voltage 0.1 V (Vs < 100 V), 0.5 V (Vs ≥ 100 V)
* - : Setting not available
Note: For 0 to 18 and 18 to 40C, add ±(1/10 measurement accuracy) /°C.

Voltage generation accuracy	Varies with SM7860 series specifications.

Measurement time

			Power Source Frequency			
			50 Hz		60 Hz	
Comparator	Contact -check	Measurement speed	INDEX [ms]	EOM [ms]	INDEX [ms]	EOM [ms]
OFF	OFF	FAST	4.4	INDEX + 0.1 ms	4.4	INDEX + 0.1 ms
		MED	24.0		21.0	
		SLOW	100.0		84.0	
		SLOW2	320.0		320.0	
ON	OFF	FAST	4.5	INDEX + 0.3 ms	4.5	INDEX + 0.3 ms
		MED	24.0		21.0	
		SLOW	100.0		84.0	
		SLOW2	320.0		320.0	
OFF	ON	FAST	6.7	INDEX + 0.1 ms	6.7	INDEX + 0.1 ms
		MED	26.0		23.0	
		SLOW	100.0		90.0	
		SLOW2	320.0		320.0	
ON	ON	FAST	6.8	INDEX + 0.3 ms	6.8	INDEX + 0.3 ms
		MED	26.0		23.0	
		SLOW	100.0		90.0	
		SLOW2	320.0		320.0	

Note: Values shown above are specified at their maximum.
Values on current measurement mode
Both "INDEX" and "EOM" values shall be added "+0.1 ms" on resistance measurement mode.
When the current measurement range is held.

6.5 Input / Output Functions (Interface for External Control)

GP-IB Interface

Data reception	
Settings	Environmental data (measured value display mode, measurement speed, measurement range, trigger delay time, averaging, power source frequency, measurement voltage, contact check execution mode, target object capacitance setting, LCD display mode, current channel setting)
Control	Measurement trigger, contact check execution, fixture capacitance open correction execution, fixture resistance open correction execution
Data transmission	
Setting responses	Environmental data (measured value display mode, measurement speed, measurement range, trigger delay time, averaging, power source frequency, measurement voltage, contact check execution mode, target object capacitance setting, fixture capacitance open correction value, fixture resistance open correction mode, LCD display mode, current channel setting)
Measured values and results	Measured value, comparative judgment results, contact check results, contact check measured value, fixture capacitance open correction value, fixture resistance open correction value

RS-232C Interface

Data reception	
Settings	Environmental data (measured value display mode, measurement speed, measurement range, trigger delay time, averaging, power source frequency, measurement voltage, contact check execution mode, target object capacitance setting, LCD display mode, current channel setting)
Control	Measurement trigger, contact check execution, fixture capacitance open correction execution, fixture resistance open correction execution
Data transmission	
Setting responses	Environmental data (measured value display mode, measurement speed, measurement range, trigger delay time, averaging, power source frequency, measurement voltage, contact check execution mode, target object capacitance setting, fixture capacitance open correction value, fixture resistance open correction mode, LCD display mode, current channel setting)
Measured values and results	Measured value, comparative judgment results, contact check results, contact check measured value, fixture capacitance open correction value, fixture resistance open correction value
Communication conditions	
Baud rate	38400bps
Parity	None
Stop bit	1 bit
Data	8 bit
Flow control	None

External I/O

Input/Output signals	
Input	
Signal types	Trigger (TRIGGER), fixture capacitance open correction execution (OPEN_CX), fixture resistance open correction execution (OPEN_IR), contact check execution (C.CHECK)
Input method	Photocoupler-isolated input
Electrical specification	LOW: 0.5 V or less HIGH: 24 V±10%
Output	
Signal types	Measured value comparative judgment results (Hi1 to Hi8, IN1 to IN8, LO1 to LO8), contact check judgment results (NO_CONTACT1 to NO_CONTACT8), error (ALARM), measurement calculation complete (EOM), analog measurement complete (INDEX)
Output method	Photocoupler-isolated output, open collector output
Electrical specification	LOW: 0.5 V or less HIGH: 5 to 24 V (depends on external power source voltage) Output current: 5 mA max.
Connector	57RE-40500-730B (50-pin: DDK)

Maintenance and Service Chapter 7

7.1 Troubleshooting

Inspection and Repair

WARNING **Touching any of the high-voltage points inside the instrument is very dangerous. Do not attempt to modify, disassemble or repair the instrument; as fire, electric shock and injury could result.**

NOTE If the instrument seems to be malfunctioning, confirm that the cables and fuse are not open circuited before contacting your dealer or Hioki representative.

Transporting

Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We do not take any responsibility for damage incurred during shipping.

Replaceable Parts and Operating Lifetimes

Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods.
For replacement parts, contact your dealer or Hioki representative.

Part	Life	Remarks
Electrolytic Capacitors	Approx. 10 years	
LCD backlight	Approx. 20,000 hours	
Relay	Approx. 1 million operations	

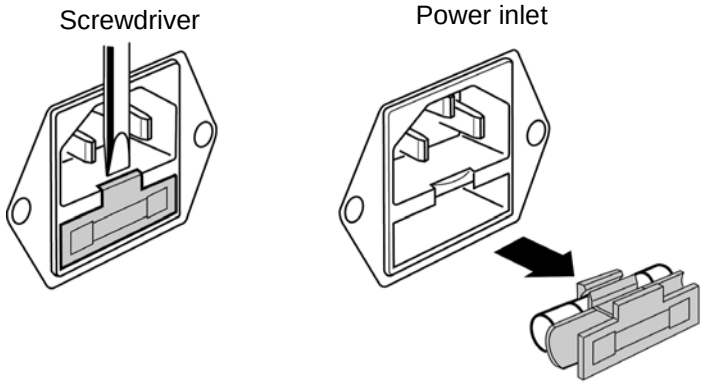
7.2 Replacing the Power Fuse

⚠WARNING

- **To avoid electric shock, turn off the power switch and disconnect the connection cables before replacing the fuse.**
- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Never use unspecified fuses and never use the instrument after the fuse holder has shorted. This will damage the instrument and cause injury.**
  Fuse type: 250 V T0.315AL ϕ5 mm × 20 mm, Slo-Blo type

Removing the Fuse Holder

Rear panel of the instrument

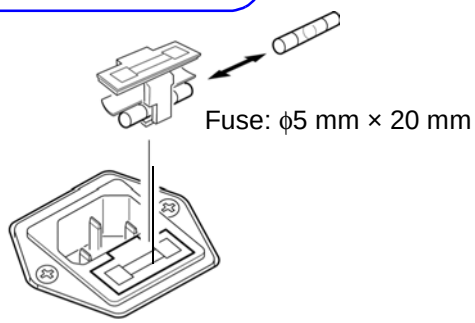


Tools to Prepare: Flat blade screwdriver

1 **Turn off the power switch and disconnect the power cord.**

2 **Align the flat blade screwdriver with the fuse holder securing part of the power inlet and then remove the fuse holder by pushing the handle of the screwdriver toward the opposite side of the unit.**

Replacing the Power Fuse



3 **Replace the power fuse with a fuse of the designated rating.**

4 **Reinsert the fuse holder in the power inlet.**

7.3 Error Displays

Error Display	Description	Remedy
ERROR:001 Call Service Center	Backup data corrupt	Please contact your dealer or Hioki representative.
ERROR:002 Call Service Center	Backup data write failure	Please contact your dealer or Hioki representative.
ERROR:006 Call Service Center	Measurement controller internal communication failure	Please contact your dealer or Hioki representative.

7.4 Cleaning

NOTE

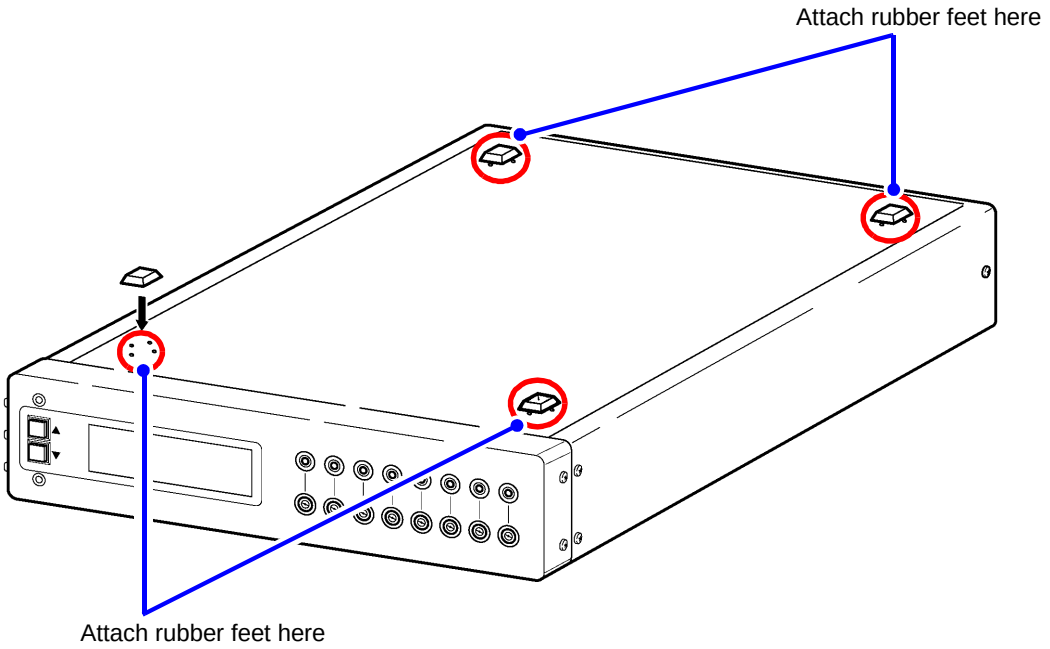
- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- Wipe the LCD gently with a soft, dry cloth.

Appendix

Appendix 1 Attaching Rubber Feet

The instrument ships with four rubber feet. Attach the rubber feet to the base of the instrument as necessary.

When attaching the rubber feet, refer to the following diagram for a rough indication of how the feet should be positioned.



Appendix 2 Rack Mounting

You can remove the screws on the sides of the instrument and attach rack mounting brackets.

⚠WARNING

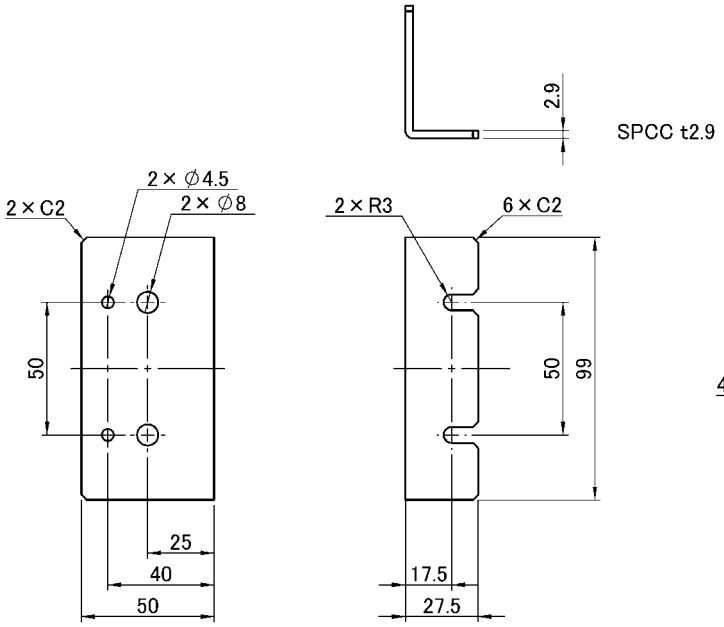
To avoid damage to the instrument or an electrical accident, be sure to observe the following precautions on using screws.

- **Ensure that the screws used to attach the rack mounting brackets to the sides of the instrument are not screwed into the instrument more than 10 mm.**
- **If the rack mounting brackets are removed, be sure to use screws identical to the ones used originally.**
  (M4 × 10 mm)

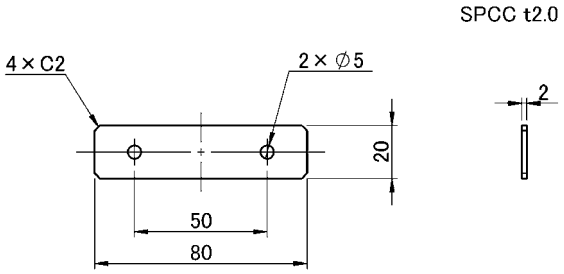
NOTE

When rack-mounting the instrument, place it on the shelf specified by the rack manufacturer or on a support angle. Mounting it on a rack using only the four front screws may damage the rack-mount bracket.

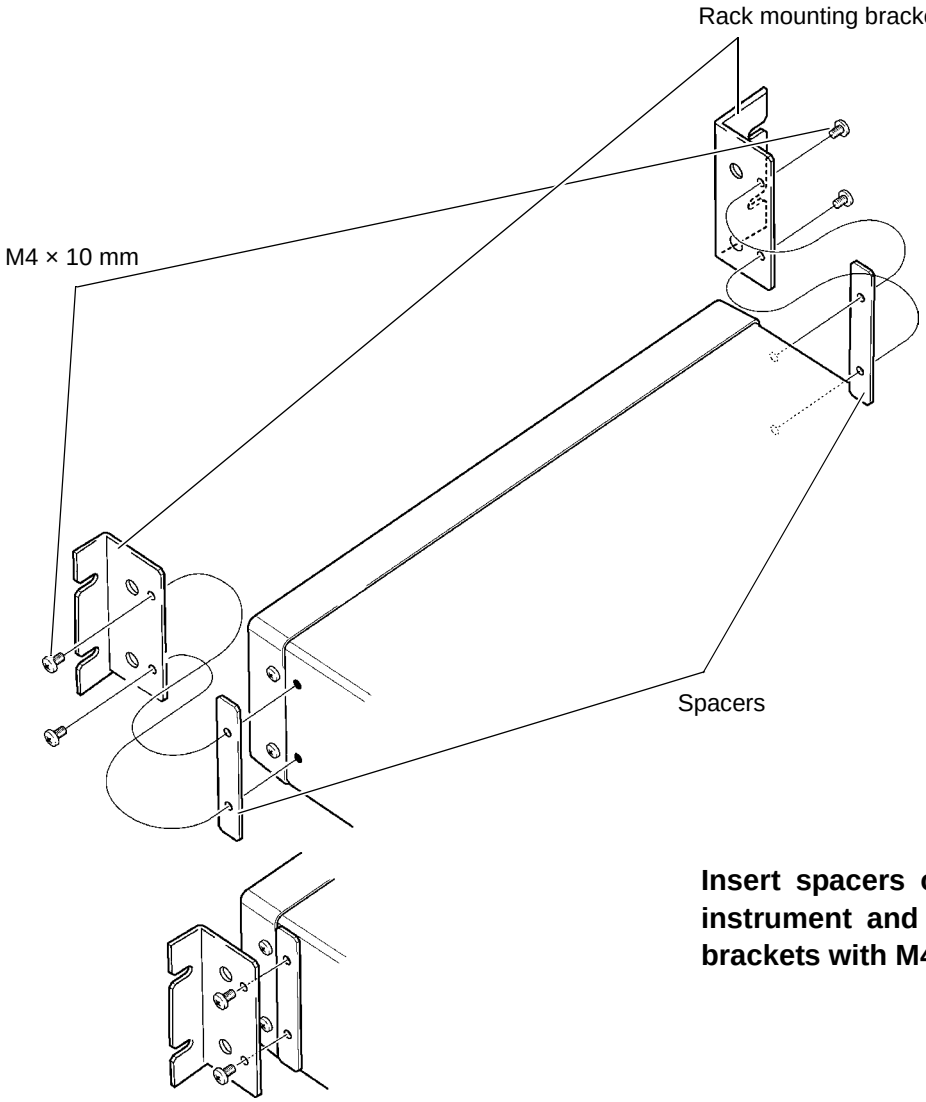
Reference Diagrams and Attachment Procedure for Rack Mounting Brackets



Rack Mounting Bracket (JIS)

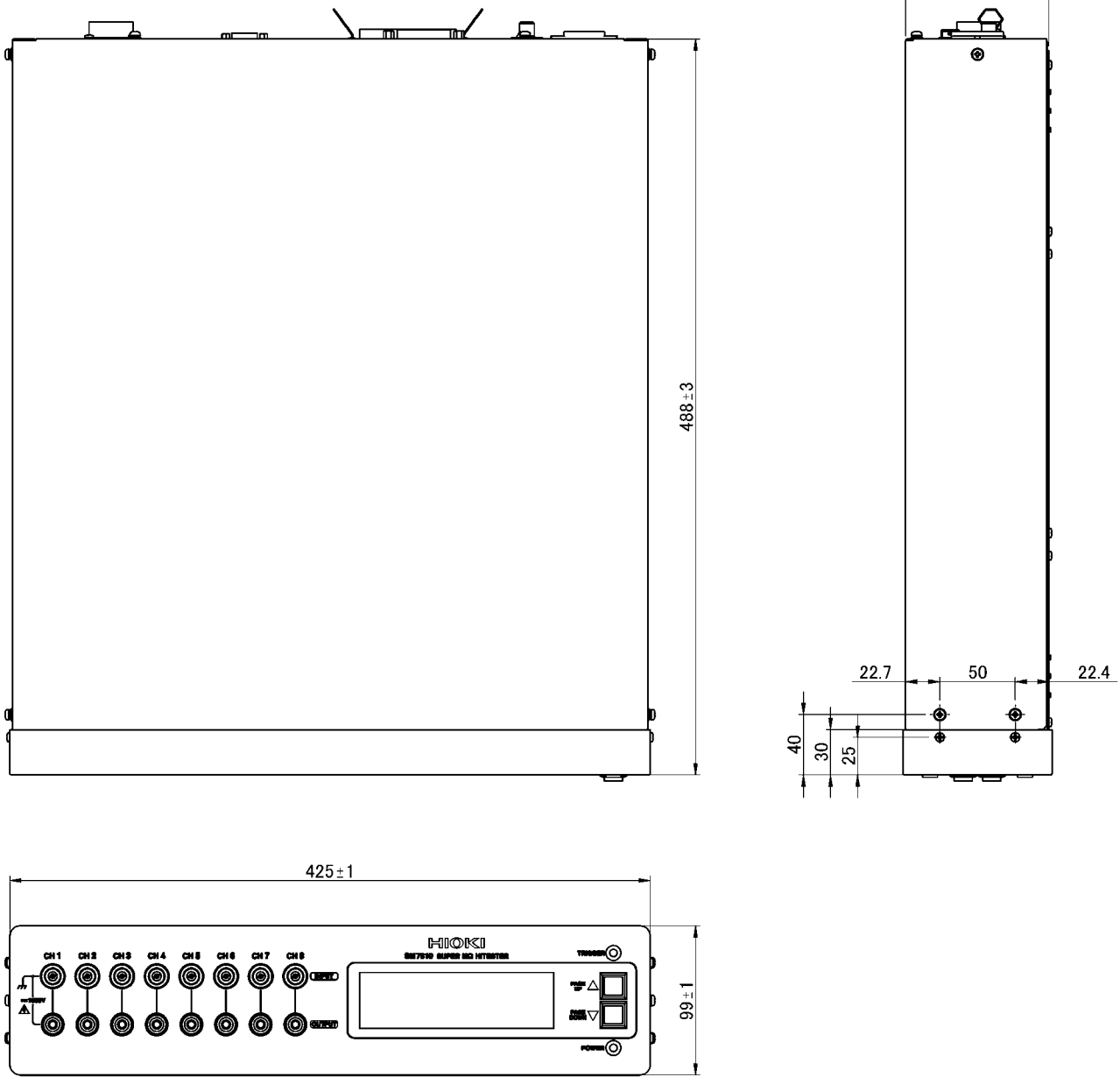


Spacers (Use 2)



Insert spacers on both sides of the instrument and attach the mounting brackets with M4 × 10 mm screws.

Appendix 3 External Dimensions



Memo

Memo

Warranty Certificate

HIOKI

Model	Serial number	Warranty period Three (3) years from date of purchase (___ / ___)

Customer name: _____

Customer address: _____

Important

- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.
Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

1. The product is guaranteed to operate properly during the warranty period (three [3] years from the date of purchase). If the date of purchase is unknown, the warranty period is defined as three (3) years from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warrantied for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
   -1. Malfunctions or damage of consumables, parts with a defined service life, etc.
   -2. Malfunctions or damage of connectors, cables, etc.
   -3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
   -4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
   -5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
   -6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
   -7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
   -8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   -2. Damage arising from measurement results provided by the product
   -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

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