HIOKI

Instruction Manual

3334
3334-01

AC/DC POWER HiTESTER

HIOKI E. E. CORPORATION

September 2014 Revised edition 5 3334A981-05 14-09H

600200285

Contents

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

Chapter 1 Overview _____ 7

1.1 Product Overview and Features 7
1.2 Names and Functions of Parts 8
1.3 Measurement Work Flow 12

Chapter 2 Measurement Preparations _____ 15

2.1 Installation & Connection Procedures 15
2.2 Connecting a Connection Cable 16
2.3 Connecting the Power Cord 21
2.4 Turning the Power On and Off 21

Chapter 3 Settings and Measurements _____ 23

3.1 Pre-Operation Inspection 23
3.2 Setup Procedure 24
3.2.1 Selecting an item to be displayed 24
3.2.2 Selecting Voltage and Current Range 26
3.2.3 Selecting the rectifier type 29
3.2.4 Displaying average measurement values (AVG: average) 30
3.2.5 Setting the VT or CT ratio 32
3.3 Integration 35
3.3.1 Setting integration time 35
3.3.2 Integration Operation 36
3.3.3 Notes on Integration 39
3.3.4 Display Format of Integration Value 40
3.4 Analog Output and Waveform Output 41
3.4.1 Analog output 42
3.4.2 Waveform output 46

3.5 Other functions 47
3.5.1 Display hold (Hold) 47
3.5.2 Peak value and Maximum value hold (Peak Hold) 48
3.5.3 Disables key operations (key lock) 49
3.5.4 Initializing (system reset) 50
3.6 When PEAK OVER, o.r and units flash 52
3.6.1 When the PEAK OVER U and PEAK OVER I LEDs go on 52
3.6.2 When o.r (over-range) appears 52
3.6.3 When the unit flashes 53

Chapter 4
RS-232C/ GP-IB Interface 55

4.1 Overview 55
4.2 Connect a cable to the RS-232C connector or GP-IB connector 58
4.3 Enter a GP-IB address (3334-01 only) 60
4.4 Communication Methods 61
4.4.1 Message Format 62
4.4.2 Output Queue and Input Buffer 66
4.4.3 Status Byte Register 67
4.4.4 Event Registers 69
4.4.5 Initialization Items 74
4.4.6 Command Execution Time 75
4.5 Message List 76
4.5.1 Standard Commands 76
4.5.2 Device-Specific Commands 77
4.6 Message Reference 81
4.6.1 Standard Commands 82
4.6.2 Device-Specific Commands 87
4.6.3 Valid Command According to Condition (Standard Command) 108
4.6.4 Valid Commands According to Condition (Specific Command) 109
4.7 Troubleshooting (Communications) 111
4.8 Device Compliance Statement 113

Chapter 5
Specifications 117

5.1 General Specifications 117
5.2 Basic Specifications 118
5.3 Functions 121

Chapter 6
Maintenance and Service ____ 125

6.1 Troubleshooting 125
6.2 Error Indication 127
6.3 Cleaning 127

Chapter 7
Rack Mounting ____ 129

7.1 Installation Procedure 129
7.2 Dimensional Diagram 131

Index ____ Index1

Contents

Introduction

Thank you for purchasing the Hioki Model 3334, 3334-01 AC/DC Power HiTester. To obtain maximum performance from the instrument, please read this manual carefully, and keep it handy for future reference.

In this document, the “instrument” means the Model 3334 or 3334-01 AC/DC Power HiTester.

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.

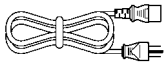
Confirm that these contents are provided.

☐ **This instrument: Model 3334 or 3334-01 Power HiTester**
(3334-01: Model with GP-IB interface)

Accessories

☐ **Instruction Manual..... 1**

☐ **Power Cord..... 1**



Options

Interface Connection Cables

- Model 9637 RS-232C Cable (1.8 m, 9-pin to 9-pin, Cross cable)
- Model 9638 RS-232C Cable (1.8 m, 9-pin to 25-pin, Cross cable)

(3334-01 only)

- Model 9151-02 GP-IB Connector Cable (2 m)
- Model 9151-04 GP-IB Connector Cable (4 m)

Other

- Model 9266-01 Outlet Code
- A number 3 Phillips screwdriver

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 product 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 a grounding terminal.
	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.
(⇒ p.)	Indicates the location of reference information.
	Indicates quick references for operation and remedies for troubleshooting.
*	Indicates that descriptive information is provided below.
SET (Bold)	Bold alphanumeric characters in this manual indicate key labels.

Accuracy

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

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

Measurement categories

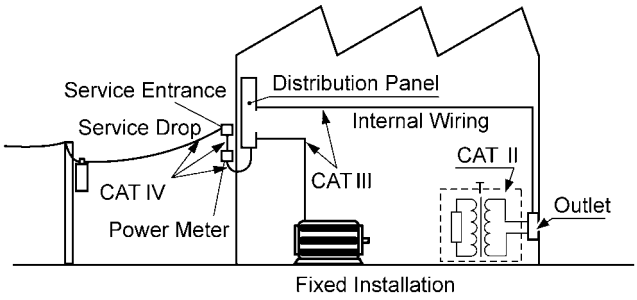
This instrument complies with CAT III safety requirements.
To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, and called measurement categories.

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

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

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

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



Operating Precautions

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

Before Use

- 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.
- Before using the instrument, make sure that the insulation on the connection cable is undamaged and that no bare conductors are exposed. A damaged product could cause an electric shock or short circuits and should be replaced with an undamaged product.

Instrument Installation

Operating temperature and humidity: 0 to 40°C at 80% RH or less (non-condensating)

Temperature and humidity range for guaranteed accuracy: 23±5°C, 80%RH or less

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

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

Exposed to liquids
Exposed to high humidity or condensation

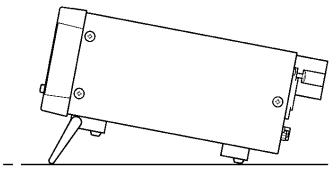
Exposed to strong electromagnetic fields
Near electromagnetic radiators

Exposed to high levels of particulate dust

Subject to vibration

Installation

- Do not install the instrument with any side except the bottom facing down.
- Do not install the product on an unstable or unlevel surface



Use the instrument with the stand extended.
See "How to use the stand" (⇒ p.11)

DANGER

To prevent electric shocks and personal injury, do not directly touch the exposed metallic parts of the input terminals and other wiring materials when the measurement lines connected to the input terminals at the rear panel of the instrument are live lines. In addition, do not allow them to touch or come near metallic parts.

NOTE

lTo meet the measurement accuracy, ensure the surrounding temperature of the instrument does not exceed 23±5°C by keeping it away from heat sources.

Handling the Instrument

DANGER

To avoid electric shock, do not remove the instrument's case. The internal components of the instrument carry high voltages and may become very hot during operation.

WARNING

- **Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.**
- **Never modify the instrument. Only Hioki service engineers should disassemble or repair the instrument. Failure to observe these precautions may result in fire, electric shock, or injury.**

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.

NOTE

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

Handling the cables

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.

Before Connecting

WARNING

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

See Connection procedure:"2.3 Connecting the Power Cord"(⇒ p.21)

Input and Measurement Precautions

DANGER

- **The maximum input voltage and current is 300 V, 30 A. Attempting to measure voltage and current in excess of the maximum input could destroy the instrument and result in personal injury or death.**
- **The maximum rated voltage between input terminals and ground is 300 V. Attempting to measure voltages exceeding 300V with respect to ground could damage the instrument and result in personal injury.**
- **This product should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.**

WARNING

When connecting wires,

Observe the following to avoid electric shock and short circuits.

- **Turn off the power to lines to be measured before making connections to terminals to be measured and turning on the instrument.**
- **Be sure to connect the voltage input and current input terminals correctly. An incorrect connection could damage or short circuit this instrument.**
- **Make sure no connecting wires are routed so they short circuit input voltage terminals.**

When the instrument gives off smoke, a strange odor or makes a strange noise,

Stop measuring immediately. Then perform the following procedure. Continued use under these conditions could result in fire and electric shock.

1. Turn the instrument power switch off.

2. Disconnect the power cord from the wall outlet.

3. Turn off the line to be measured and remove any connections.

4. Contact your dealer (agent) or nearest sales office.

CAUTION

- For safety reasons, disconnect the power cord when the instrument is not used and before connecting it to a device to be tested.
- To avoid damage to the instrument, do not short circuit or apply an input voltage to output terminals.

NOTE

- Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.

To ensure measurements are accurate,

- Warm up the instrument 3 minutes or more before use.
- Pay attention to heat dissipation to maintain accurate measurements.
  Example: Keep the instrument away from heat sources, make sure there is enough free space around the instrument and install a fan when the unit is mounted in a rack.
- The instrument should be calibrated once a year.

Overview Chapter 1

1.1 Product Overview and Features

The 3334 and 3334-01 AC/DC Power HiTesters are single-phase wattmeters suited to measurements of household electrical appliances and battery powered devices. One unit enables measurements of voltage, current, active power, apparent power, power factor, frequency, current integration, active power integration, peak voltage value and peak current value. All measurement data is simultaneously displayed. The instrument complies with IEC61010-1 safety standard and guarantees a basic accuracy of ±0.1%rdg. ±0.1%f.s. for a period of one year. It guarantees a basic accuracy of ±0.1%rdg. ±0.2%f.s. for a period of three years.

Perform the following operations

- Check the power consumption and current of an electrical appliance
- Integrate current and active power
- Import measurement data into the controller
- Connect a DMM or recorder to watch analog output or waveform output.

Display voltage, current, active power, apparent power, power factor, frequency, current integration, active power integration, peak voltage value and peak current value

The instrument can simultaneously display up to four measurements. The user can switch to display the desired value during measurement. Input data is displayed within 0.4 s.

See: "3.2.1 Selecting an item to be displayed"(⇒ p.24)

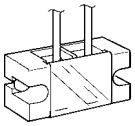
Voltage and current input terminals with protective cover attached

The instrument can handle inputs of up to 300 V, 30 A.

See: "2.2 Connecting a Connection Cable"(⇒ p.16)

The protective cover prevents personnel from inadvertently touching the terminals.

The voltage input terminals are insulated from the current input terminals.

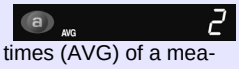


Set an external VT (PT) CT ratio

When the voltage or current exceeds the maximum rated input for this instrument, use an external VT (PT) or CT device and set the VT or CT ratio to read measurement values directly.

See: "2.2 Connecting a Connection Cable"(⇒ p.16), "3.2.5 Setting the VT or CT ratio"(⇒ p.32)

Display averages for measurements that fluctuate substantially



Set the average times (AVG) of a measurement value to display an average value.

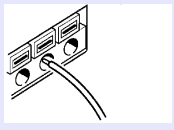
See: "3.2.4 Displaying average measurement values (AVG: average)"(⇒ p.30)

Level output of measurement values (Analog output)

The level of a specified parameter (voltage, current, active power, and one of current integration, active power integration, apparent power or power factor) can be converted to ±2 V f.s. DC at the analog output terminal. This output is isolated from voltage and current inputs. From this terminal, long-term measurement changes can be recorded by combining with DMMs, recorders, data loggers and other devices.

See: "3.4.1 Analog output"(⇒ p.42)

Waveform output



Instantaneous voltage, current and power waveforms can be converted to ±1 V f.s. at the waveform output terminal. This output is isolated from voltage and current inputs. From this terminal, measured input waveforms can be observed with an oscilloscope.

See: "3.4.2 Waveform output"(⇒ p.46)

Connect this instrument to a controller with standard RS-232C capability for data acquisition and remote control

This instrument can be connected to a controller with the RS-232C or GP-IB (3334-01 only) interface to enable control of the device and acquisition of measurement data.

See: "4.2 Connect a cable to the RS-232C connector or GP-IB connector"(⇒ p.58)

1.2 Names and Functions of Parts

Front Panel

Operating Keys (⇒ p.10)

PEAK OVER LED

PEAK OVER U (voltage over-range warning)
Lights when the input peak voltage value exceeds ±425 V or ±300% of the voltage range.

PEAK OVER I (current over-range warning)
Lights when the input peak current value exceeds ±54.0 A or ±300% of the current range.

See "3.6 When PEAK OVER, o.r and units flash"(⇒ p.52)

Setting screen LED

SET
Lights when the Setting screen is displayed (after pressing the **SET** key)

Integrator LED

INTEGRATOR
Lights: Integration execution state
Flashes: Integration stopped state
Goes out: Integration reset state

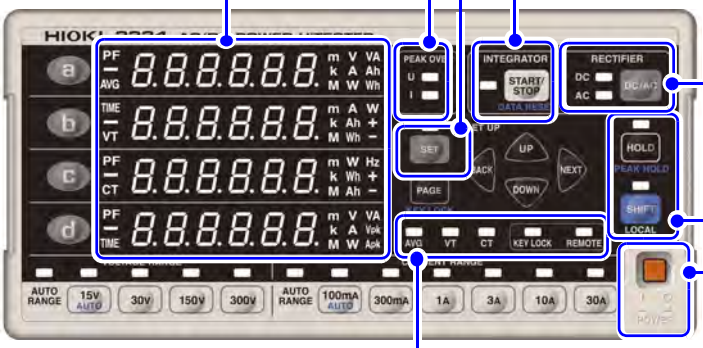
Rectifier LED

RECTIFIER AC+DC
DC and AC LED light when the rectifier type is AC+DC.

RECTIFIER DC
DC LED lights when the rectifier type is DC.

RECTIFIER AC
AC LED lights when the rectifier type is AC.

Display (LED)(⇒ p.9)
Screen Display



Status LED

Lights when any of the following items is set to something other than 1 (default value).

AVG	Sets average times(⇒ p.30)
VT	Sets VT ratio(⇒ p.32)
CT	Sets CT ratio(⇒ p.32)

Operating key LEDs

KEY LOCK **Lights when operating keys are invalid (in key lock state).**
To cancel lock:
Hold down the **SHIFT** key and press the **PAGE (KEY LOCK)*** key(⇒ p.49)

REMOTE Lights when this instrument is controlled via an interface (in remote control state).
The operating keys are disabled in this state.
To cancel remote control:
Press the **SHIFT (LOCAL)*** key.

***PAGE (KEY LOCK), SHIFT (LOCAL)**
As shown above, use of the functions indicated below the operating keys (key legends in blue or LOCAL) are given in parentheses.

POWER Switch

Turns the instrument on and off (⇒ p.21)
(| : Power On ○ : Power Off)

Operating key LEDs

HOLD (PEAK HOLD) Lights when the **HOLD** key is pressed to lock a display value (in display hold state).
To cancel display hold:
Press the **HOLD** key again. (⇒ p.47)

Flashes when the **SHIFT** key is pressed and then the **HOLD** key is pressed to lock a peak value and a maximum value (in peak hold state).
To cancel peak value hold:
Press the **SHIFT** key again, and then press the **HOLD** key. (⇒ p.48)

SHIFT Lights when the **SHIFT** key is depressed and the functions in blue under the keys are available.
To cancel the SHIFT function:
Press the **SHIFT** key again.

Display

Setting items

Lights setting item selected using the **a**, **b**, **c** or **d** keys or BACK NEXT after opening the setting screen with the **SET** key.

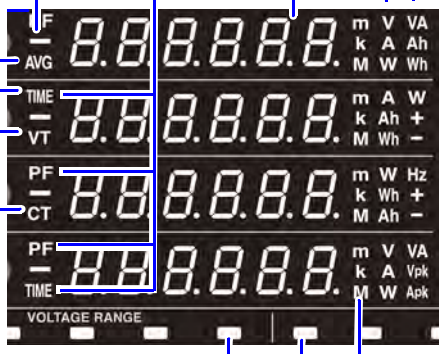
AVG	Sets average times(⇒ p.30)
VT	Sets VT ratio(⇒ p.32)
CT	Sets CT ratio(⇒ p.32)
	3334-01 only GP-IB address setting (⇒ p.60)

Press **PAGE** key to switch setting items.

TIME	Sets integration time (⇒ p.35)
	Sets D/A output item (⇒ p.43)

Minus sign

Measurement value



Selected voltage and current range lights(⇒ p.26)

m:10^{-3}
k: 10^{3}
M:10^{6}

Display items(⇒ p.24)

Display item selected using the **a**, **b**, **c** or **d** keys lights.

V	Voltage (*U*)
A	Current (*I*)
W	Active power (*P*)
VA	Apparent power (*S*)
PF	Power ratio (λ)
Hz	Frequency
Ah+	Positive current integration
Ah-	Negative current integration
Ah	Total current integration
Wh+	Positive active power integration
Wh-	Negative active power integration
Wh	Total active power integration
Vpk	Peak voltage value
Apk	Peak current value
TIME	Integration time

The **a**, **b**, **c** and **d** keys select different items

SET

Setting screen

PAGE

Measurement screen

Other indications

Error indication

See "6.2 Error Indication"(⇒ p.127)

over-range

See "3.6 When PEAK OVER, o.r and units flash"(⇒ p.52)

Flashing unit
Indicates that an averaged value (o.r.) is included

See "3.6 When PEAK OVER, o.r and units flash"(⇒ p.52)

Operation Keys

Selecting display items or setting items.

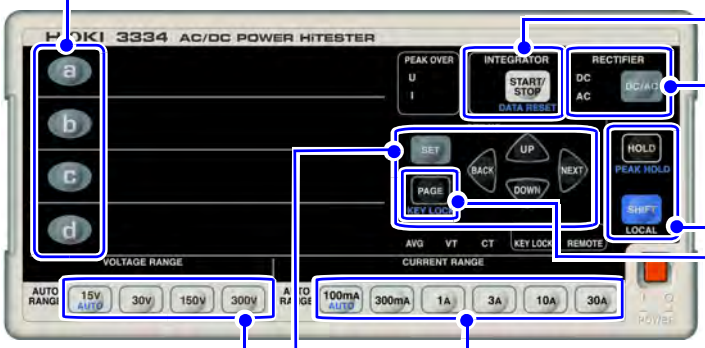
Display area	Voltage V	Current A	Active power W	Apparent power VA	Power factor PF	Frequency Hz	Positive current integration Ah+	Negative current integration Ah-	Total current integration Ah
a	●	●	●	●	●	–	–	–	●
b	–	●	●	–	–	–	●	●	●
c	–	–	●	–	●	●	●	●	●
d	●	●	●	●	●	–	–	–	–

Display area	Positive active power integration Wh+	Negative active power integration Wh-	Total active power integration Wh	Peak voltage value Vpk	Peak current value Apk	Integration time TIME
a	–	–	●	–	–	–
b	●	●	●	–	–	●
c	●	●	●	–	–	–
d	–	–	–	●	●	●

●: Available, –: Not Available

In the measurement screen (normal display)
Select display items (V, A, W, VA, PF, Hz, Ah, Ah+, Ah-, Wh, Wh+, Wh-, Vpk, Apk and TIME) to be displayed in display areas a, b, c and d. The items that can be displayed depend on the display area

In the setting screen
Press the **SET** key to open the setting screen and select setting items. (Or use the **NEXT** key, **BACK** key to select setting items.)



Integration

START/ STOP Starts or stops integration.
To reset the integration value (DATA RESET):
Hold down the **SHIFT** key and press this key to use this function.

Selecting rectifier type

DC/AC Changes the rectifier type.
Default setting: AC+DC
Sequentially selects DC, AC and AC+DC with repeated presses.

Making settings in the setting screen

SET Opens the setting screen.
Press again to exit the screen.

BACK Moves to the previous setting position.

NEXT Moves to the next setting position.

UP Changes set values and increments numeric values

DOWN Changes set values and decrements numeric values.

PAGE Changes the Setting screen page.

Changes voltage and current range

Lights selected range.

15V (AUTO) Sets the voltage range to auto-range.
Hold down the **SHIFT** key and press this key to use this function.

15V to 300V Sets respective range.

100mA (AUTO) Sets the current range to auto-range.
Hold down the **SHIFT** key and press this key to use this function.

100mA to 30A Sets respective range.

Measurement range

See "Effective measurement range" (⇒ p.120)

SHIFT Makes available the function printed in blue below the keys.

Holding display values, peak values and maximum values

HOLD Holds display values. (display hold state)
To cancel the display HOLD function:
Press the **HOLD** key again.

HOLD (PEAK HOLD) Holds peak values and maximum values. (peak hold state)
Hold down the **SHIFT** key and press this key to use this function.
To cancel the peak HOLD function:
Press the **SHIFT** key again, and press the **HOLD** key.

Enabling and disabling operating keys

PAGE (KEY LOCK) Disables operating keys. (KEY LOCK state)
Hold down the **SHIFT** key and press this key to use this function.
To cancel the KEY LOCK function:
Hold down the **SHIFT** key again and press this key to cancel this function.

SHIFT (LOCAL) Cancels a remote control state engaged via an interface.
Press the **SHIFT(LOCAL)** key once to set the instrument to local status.

NOTE This instrument includes a key processing program used in production and for checking (for example, to invoke a mode for making adjustments). Should a key operation open a screen not described in this manual, immediately shut down the instrument and power it up again.

Rear Panel

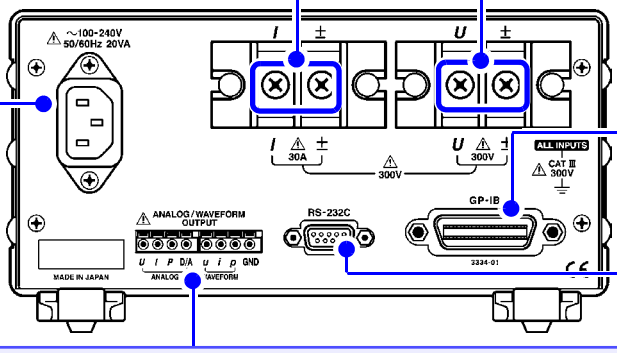
The 3334-01 is illustrated below.
The 3334-01 model comes with a GP-IB interface.
Except for the GP-IB connector, the 3334 and 3334-01 are identical

Protective cover
The instrument should be used with a protective cover to prevent personnel from inadvertently touching the terminals.
Make sure that no voltage is applied to a line to be measured before installing and removing the protective cover. (⇒ p.16)

Current input terminal (I)
Connect a current output to this input. (⇒ p.16)

Voltage input terminal (U)
Connect a voltage output to this input. (⇒ p.16)

Power Inlet
Connect the supplied power cord here (⇒ p.21)



GP-IB connector
(3334-01 only)
Connect a GP-IB interface communication cable .(⇒ p.58)

RS-232C connector
Connect an RS-232C interface communication cable. (⇒ p.58)

ANALOG/WAVEFORM OUTPUT terminal
Outputs the following voltage values from the connected terminal. (⇒ p.41)

ANALOG

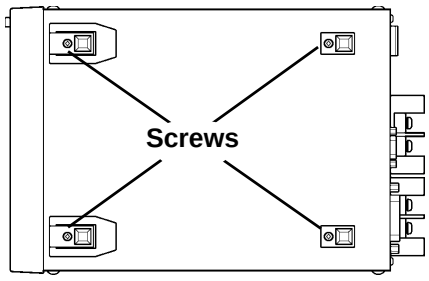
U	Analog output for voltage.
I	Analog output for current.
P	Analog output for active power.
D/A	Analog output of either current integration, active power integration, apparent power or power factor. (⇒ p.43)

WAVEFORM

u	Waveform output for instantaneous voltage.
i	Waveform output for instantaneous current.
p	Waveform output for instantaneous power.
GND	Ground terminal

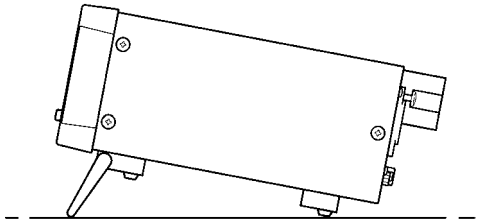
Bottom Panel

Stand



Foot

How to use the stand



This instrument can be rack mounted.
See "Chapter 7 Rack Mounting"(⇒ p.129)

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

⚠CAUTION

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

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

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

1.3 Measurement Work Flow

1 Installation, Connection and Turning the Power On

Installation

See (⇒ p.4)

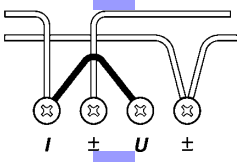
Check!

- ☐ Confirm whether the line to be measured is turned off.
- ☐ Confirm whether the instrument is turned off and the power cord is disconnected.

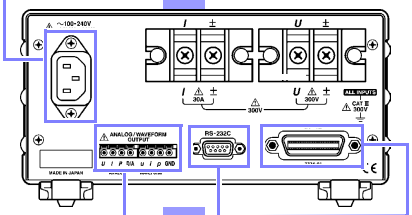
Connections

Connect a cable to the line to be measured and connect the power cord of the instrument

See Connection cable (⇒ p.16)



See Power cord (⇒ p.21)



See Using analog output (⇒ p.42) or waveform output (⇒ p.46)

See Communications via RS-232C or GP-IB interface (⇒ p.55)

Check!

- ☐ Confirm whether the instrument is connected to the secondary side of the breaker.
- ☐ Confirm that the voltage in the wiring does not exceed 300 V.
- ☐ Confirm that the voltage to be measured will not exceed 300 V, and current will not exceed 30 A.
  ⇒If the voltage is exceeded use VT or CT.
- ☐ Confirm that the wiring connected to the voltage and current input terminals is made of an appropriate material
  ⇒Use crimp contacts (terminal screw: M6) with insulating coating Also make sure that the materials used have sufficient withstand voltage and current capacity.
- ☐ Confirm that the wiring is not short-circuited
- ☐ Confirm that the input terminals are not loose
- ☐ Confirm that no connection mistakes have been made

Turn the power on

Before powering up, make one more check to confirm that all connections are correct

See (⇒ p.21)

(Warm up the instrument for at least 3 minutes.)

When the initial screen appears, input values are displayed according to current settings.

2 Make Instrument Settings (settings can be changed during measuring)

Select an item to be displayed

See (⇒ p.24)

Default setting:
a: V
b: A
c: W
d: PF

Select items to be displayed by a, b, c and d

Select up to four items of voltage (V), current (A), active power (W), apparent power (VA) or power factor (PF), frequency (Hz), current integration (Ah), active power integration (Wh), peak voltage value (Vpk) and peak current value (Apk) or Integration time (TIME).

Select voltage and current range

See (⇒ p.26)

Initial setting: 300V
: 30 A

Select a voltage range between 15 V to 300 V.
Select a current range between 100 mA to 30 A.

Press the SHIFT key, and then press the 15V(AUTO) key or 100mA(AUTO) key when the range is not known. The range is automatically changed. (Auto range)

Select the rectifier type

See (⇒ p.29)

Make the following settings when required.

When the displayed value fluctuates, display an average value.

Set the display average times

See (⇒ p.30)

When the voltage exceeds 300 V, select VT (PT) to measure.

Set the VT ratio

See (⇒ p.32)

When the voltage exceeds 30 A, select CT to measure

Set the CT ratio

See (⇒ p.32)

When integrating

Set the integration time

See (⇒ p.35)

When utilizing analog output

Select a D/A output item

See (⇒ p.43)

Using the GP-IB interface (3334-01 only)

Enter a GP-IB address

See (⇒ p.60)

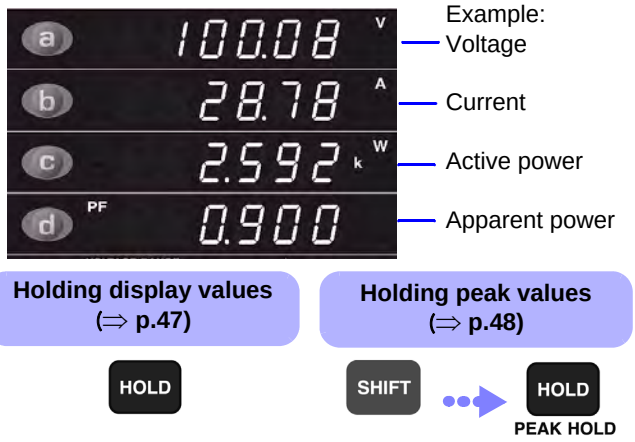
3 Starting measurements

Turning on the power to a line to be measured

Measuring and outputting

The measured values appear

The voltage range, current range and items to be displayed can be changed also during measurements



Holding display values (⇒ p.47)

HOLD

Holding peak values (⇒ p.48)

SHIFT → HOLD

PEAK HOLD

4 Ending measurements

Turn the power off

See (⇒ p.21)

Disconnect all cables from the device under test before turning the power off

Regarding measurement values

- Apparent power (*S*) and power factor (λ) displayed by this instrument are values calculated from measured voltage (*U*), current (*I*) and active power (*P*). For information on the calculation method used, refer to"5.2 Basic Specifications"(⇒ p.120).A measuring instrument using a different operating principle or a different calculation method may therefore produce different values.
- Voltage and current values that are less than 0.5% of their measurement ranges, and peak voltage and peak current values that are less than 0.3% of their peak ranges, are suppressed (forced to display as zero).
- Deviations may occur in the measurement of high-frequency common mode voltages
- This instrument is designed to handle DC and frequencies between 45 Hz to 5 kHz, and cannot measure frequencies outside this range.
- Measureable peak voltage and current values are for DC input and AC input between 45 Hz and 1 kHz. DC peak values and AC values at frequencies outside of the range 45 Hz to 1 kHz cannot be measured correctly.
- The displayed values of voltage and current measurements at different frequencies may be scattered.

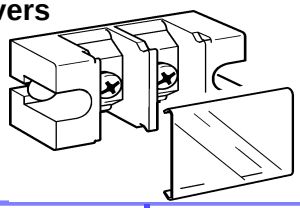
Measurement Preparations Chapter 2

2.1 Installation & Connection Procedures

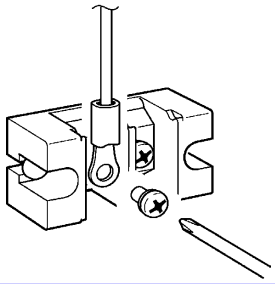
Be sure to read the "Operating Precautions" (⇒ p.4) before installing and connecting this instrument.

1 **Install this instrument (⇒ p.4)**

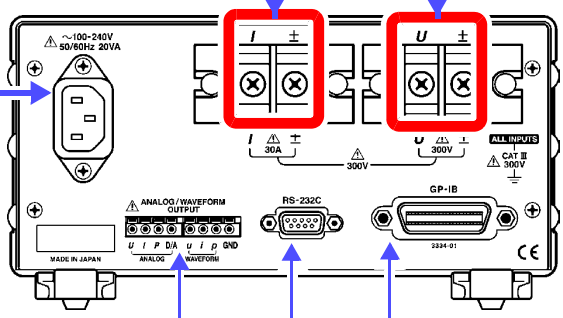
2 **Remove the protective covers**



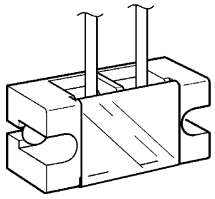
3 **Connect connection cables to the voltage and current input terminals. (⇒ p.16)**



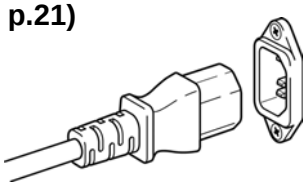
Rear panel



4 **Attach the protective covers**



5 **Connect the power cord (⇒ p.21)**



Using an interface

Connect a connection cable to the RS-232C or GP-IB connector (3334-01) (⇒ p.58)

Using analog output or waveform output

Connect a cable to the ANALOG/WAVEFORM OUTPUT terminal (⇒ p.41)

6 **Turn the power on (⇒ p.21)**

7 **Turn on the power to the line to be measured**

When finished measuring, disconnect the cables from the measurement object(s), and turn the power off.

2.2 Connecting a Connection Cable

Please read the following before making connections

DANGER

- **The maximum input voltage and current is 300 V, 30 A.**
  Attempting to measure voltage in excess of the maximum input could destroy the instrument and result in personal injury or death.
- **The maximum rated voltage between input terminals and ground is 300V.**
  Attempting to measure voltages exceeding 300V with respect to ground could damage the instrument and result in personal injury.
- **This instrument should only be connected to the secondary side of a breaker**
  So the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.
- **Confirm that no terminal is loose.**
  A connection that becomes disconnected could cause a short circuit or electrical shock. A loose connection will increase the insulation resistance resulting in heat generation, burn damages or fire.
  (Use a torque of 3Nm to secure the input terminals.)

WARNING

Observe the following to avoid electric shock and short circuits.

- **Turn off the power to lines to be measured before making connections to terminals to be measured and before turning on the instrument**
- **Be sure to connect the voltage input and current input terminals correctly. An incorrect connection could damage or short circuit this instrument**
- **Make sure no connecting wires are routed so they short circuit input voltage terminals**
- **Do not move cables around unnecessarily as terminals may become loose.**

Before turning on the power to the line to be measured

CAUTION

Turn on this instrument before turning on the power to the line to be measured. Confirm that no errors are indicated and then turn on the power to the line to be measured.
Powering up the line to be measured before this instrument is turned on may damage the instrument or generate an error when it is powered up

See "2.4 Turning the Power On and Off"(⇒ p.21), "6.2 Error Indication"(⇒ p.127)

Using an external VT (PT) or CT device

Use an external VT (PT) or CT device to for measurements of a device under test whose voltage exceeds the measurement range of this device. By setting the VT or CT ratio, you can directly read primary side input values

See "3.2.5 Setting the VT or CT ratio"(⇒ p.32)

DANGER

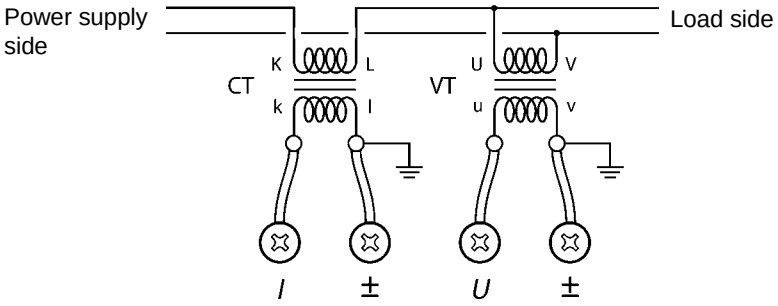
To prevent electrical shock and personnel injury, do not touch any input terminals on the VT (PT), CT or the instrument when they are in operation.

WARNING

- **Do not short circuit the secondary side when using an external VT (PT) device**
  Applying a voltage to the primary side when the secondary side is short-circuited will result in the generation of a high current on the secondary side that could lead to burn damages and fire.
- **Do not open the secondary side when using an external CT device.**
  Applying current to the primary side when open will generate high current in the secondary side and could pose serious danger

NOTE

- Note that a phase difference in the external VT (PT) or CT device may cause substantial deviations in current measurements.
  Use a VT (PT) or CT device with a minimal phase difference in the frequency bandwidth to ensure accurate measurement results.
- For reasons of safety, connect the secondary side of a VT (PT) and CT device to ground. (See figure below.)



For other safety precautions, refer to "Operating Precautions" (⇒ p.4)

For accurate measurements:

NOTE

- Since polarity is an important factor in power measurements, make sure that voltage and current inputs are correctly connected. The instrument will not yield accurate measurement results when incorrectly connected.
- Make sure that power lines are routed away from the instrument as the external electromagnetic fields they produce could have a negative effect on operation.

Wiring material (for voltage and current input terminals)

WARNING

To avoid electric shock and short-circuit accidents, use only solderless terminals whose wires are properly insulated.
(Screws for voltage and current input connectors: M6)

CAUTION

To prevent electrical shock, make sure that the materials used have sufficient withstand voltage and current capacity.

Connecting procedure

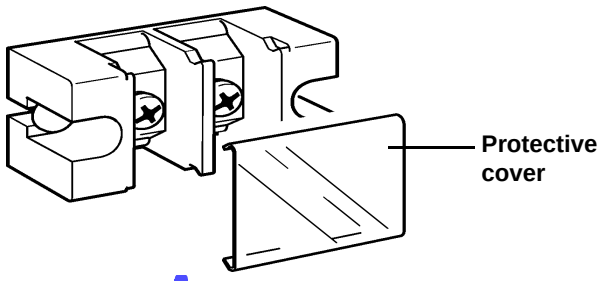
Please read the Section, "Please read the following before making connections" (⇒ p.16).

Make sure that the power to a line to be measured is turned off before making connections.

Tools required: a number 3 Phillips screwdriver (optional) or a Phillips screwdriver that has a no. 3 size bit

1. Connect cables to the voltage and current input terminals.

Remove the protective covers

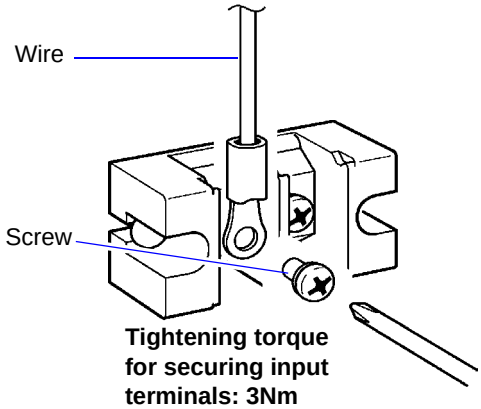


Connect the cables to the input terminals.

Use solderless terminals with a width of 13 mm or less.

Tighten the screws properly

Be sure to use the screws provided with the input terminals to connect the cables. Use of other screws may damage the connector threads, and it may cause of preventing attachment and disconnection of wires.



Tightening torque for securing input terminals: 3Nm

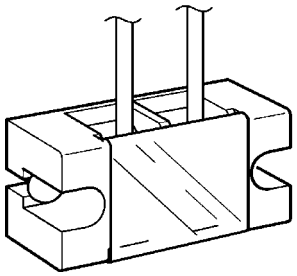
1 Use a Phillips screwdriver to remove the screw.

2 Secure the screw as shown in the wiring diagram.

WARNING

To avoid electric shock and short-circuit accidents, use only insulated terminals.
(Screws for voltage and current input connectors: M6)

Attach the protective cover



Attach the cover properly.

2. Connect to the lines to be measured

Use one of the following two methods to make a connection.

When the voltage or current for the line being measured is within the maximum rated input for this instrument

Connect the device to the instrument for direct measurement.

1

When the voltage or current for the line being measured exceeds the maximum rated input for this instrument

Connect a VT (PT) or CT device.

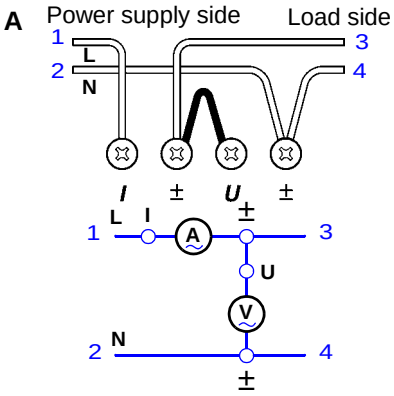
2

1 Connect to the lines to be measured

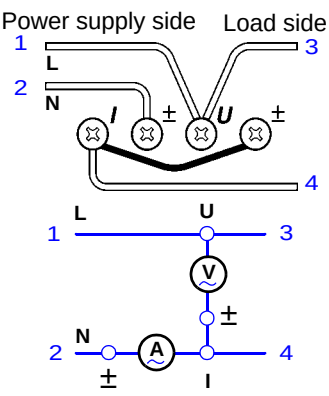
Refer to "Selecting connection method" (⇒ p.20) to select a connection method to minimize wattmeter loss.

Method 1: Connect the voltage input terminals to the load side

A

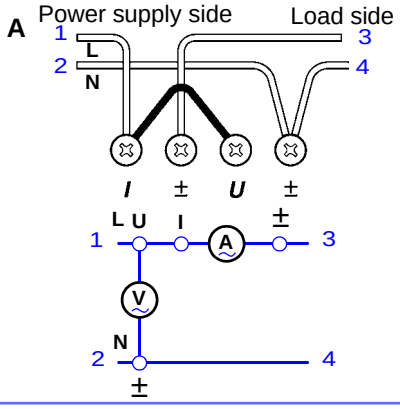


B

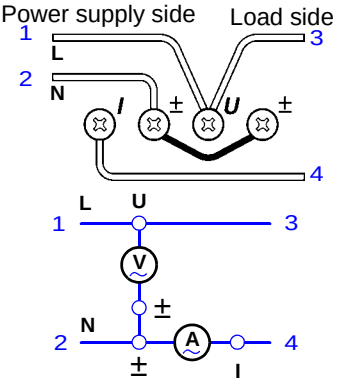


Method 2: Connect the current input terminals to the load side

A



B



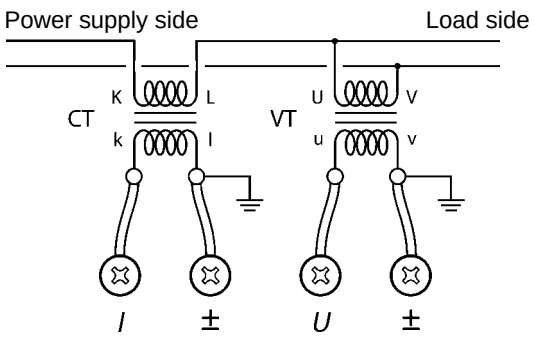
NOTE

If the instrument is affected by common mode voltage, connect an ammeter as shown at B to reduce the error.

NOTE

If the connection will be maintained after measurement, perform an inspection (⇒ p.23) before conducting the next measurement. Such an inspection will help prevent electric shock and measurement errors from disconnected cables, short circuits and instrument failure.

2 Connect a VT (PT) or CT device

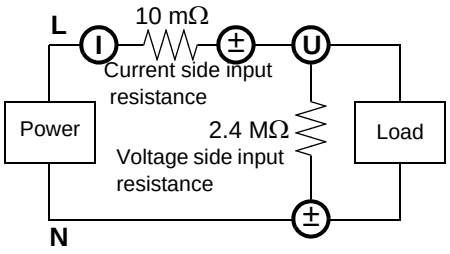


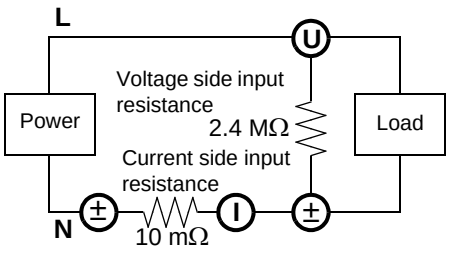
Selecting connection method

Instrument loss in the wattmeter may affect the measurement value depending on the input level.
Then use method 2 to minimize loss.

Method 1
Connect the voltage input terminal to the load side.

Loss = (input voltage [V])^2/2.4 [MΩ]

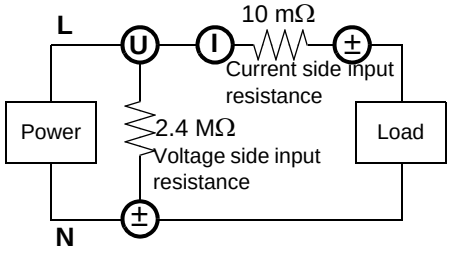


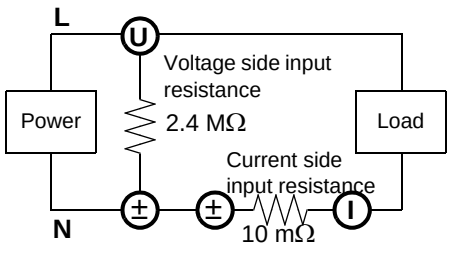


Make a power measurement that includes the loss resulting from the input resistance in the voltage input terminals.

Method 2
Connect the current input terminal to the load side.

Loss = (input current [A]) ^{2}x10 [mΩ]





Make a power measurement that includes the loss resulting from the input resistance in the current input terminals.

Example:
When measuring 100 V, 20 A

Method 1: loss = (100 [V])^2/2.4 [MΩ] = 0.0042 [VA]
Method 2: loss = (20 [A])^{2}x10 [mΩ] = 4 [VA]

Method 1 involves less loss and provides a more accurate measurement.

When measuring 100 V, 50 mA

Method 1: loss = (100 [V])^2 /2.4 [MΩ] = 0.0042 [VA]
Method 2: loss = (50 [mA])^2 x10 [mΩ] = 0.000025 [VA]

Method 2 involves less loss and provides a more accurate measurement.

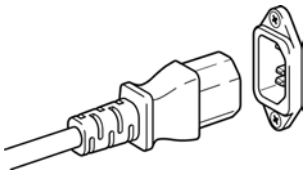
2.3 Connecting the Power Cord

⚠WARNING

- **Before turning the instrument on, make sure the supply voltage matches that indicated on the its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.**
  Rated power supply voltage (100V AC to 240 V AC), rated power supply frequency (50/60 Hz)
  (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.)
- **To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord provided only to a 3-contact (two-conductor + ground) outlet.**

Connection procedure

Rear panel



1. Verify that the instrument's power switch 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.

Turn off the power before disconnecting the power cord.

2.4 Turning the Power On and Off

⚠WARNING

Check the following again before turning on the power.

- **Confirm that the instrument and all peripheral equipment are correctly connected.**
- **Confirm that no wires are short-circuiting the voltage input terminals.**
  A short circuit could lead to electric shock and short circuits.

⚠CAUTION

Turn on the instrument and make sure no errors are indicated before turning on the power to lines to be measured.
Powering up the line to be measured before this instrument is turned on may damage the instrument or generate an error when it is powered up.

Turning Power On

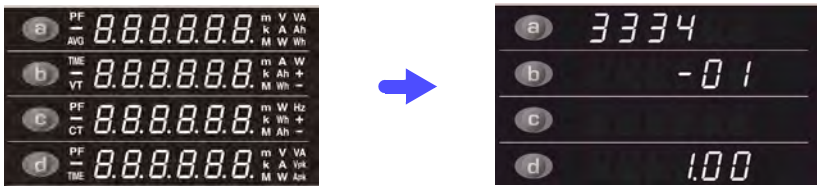
Power On |

Turn the **POWER** switch on (|).

After Power-On

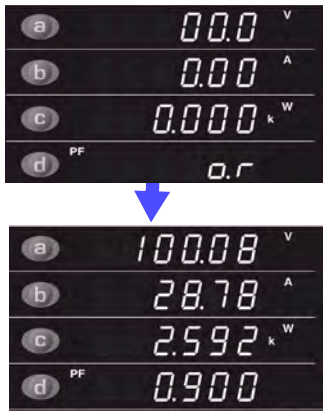
A self-test (instrument diagnostic routine) is performed.
The self-test lights all LEDs and checks model name, version and saved data.

Self-test



Model no. “3334-01” (or “3334”) and version no. appear

OK



Normal display (measurement screen)

Error

Indicates an error.

See "6.2 Error Indication"(⇒ p.127)

NOTE

Do not press an operating key during the self-test.

When the power is turned on, the same setting as when the power was last turned off appears (backup function). When powered up for the first time, the default settings appear(⇒ p.50)

Before Starting Measurement

To obtain precise measurements, provide about 3 minutes warm-up after turning power on.

Turning Power Off

Power Off ○

Turn the POWER switch off (○).
When power is turned on again, the display appears with the settings that existed when power was last turned off.

Settings and Measurements Chapter 3

For information on measurement work flow, refer to "1.3 Measurement Work Flow"(⇒ p.12)

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

When using connection cables

Is the insulation of the connection cable to be used damaged, or is bare metal exposed? Is the input terminal screw loose?

Metal Exposed Screw Is Loose → **Do not use if damage or short-circuited, or the screw is loose as you could receive an electric shock. Replace the damaged items. Tighten the screw properly.**

No Metal Exposed Screw Is Properly Tightened.

2 Instrument Inspection

Is damage to the instrument evident?

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

No

Turn on the power

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

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

Yes

Does the measurement screen appear after the self-test?

An error indication occurs (Err) → **The instrument may be damaged internally. Request repairs.**

See "6.2 Error Indication"(⇒ p.127)

Yes

End of inspection

Turn on the DUT.

No measurement value appears Measurement values are incorrect → **Connected cables may be short-circuited, incorrectly connected or an internal instrument failure may have occurred. Immediately turn the power off and re-inspect. If the wiring is correct, turn the instrument in for repair.**

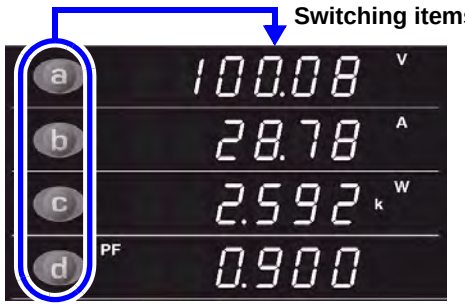
Allow the instrument to warm up for 3 minutes or more after powering up before use.

3.2 Setup Procedure

3.2.1 Selecting an item to be displayed

Use the **a**, **b**, **c** and **d** keys to select items for display areas a, b, c and d.
The items change with each press of the key.

Press the key (a, b, c or d) to select item to be displayed.



Default setting:
Display area a: Voltage (V)
Display area b: Current (A)
Display area c: Active power (W)
Display area d: Power factor (PF)

Display sequence

a: V → A → W → VA → Ah → Wh → PF

b: A → Ah+ → Ah- → Ah → Wh+ → Wh- → Wh → W → TIME

c: W → Wh+ → Wh- → Wh → Ah+ → Ah- → Ah → Hz → PF

d: PF → TIME → V → A → W → VA → Vpk → Apk

Display items

Display area	Voltage V	Current A	Active power W	Apparent power VA	Power factor PF	Frequency Hz	Positive current integration Ah+	Negative current integration Ah-	Total current integration Ah
a	●	●	●	●	●	–	–	–	●
b	–	●	●	–	–	–	●	●	●
c	–	–	●	–	●	●	●	●	●
d	●	●	●	●	●	–	–	–	–

Display area	Positive active power integration Wh+	Negative active power integration Wh-	Total active power integration Wh	Peak voltage value Vpk	Peak current value Apk	Integration time TIME
a	–	–	●	–	–	–
b	●	●	●	–	–	●
c	●	●	●	–	–	–
d	–	–	–	●	●	●

●: Available, –: Not Available

NOTE Voltage and current are displayed up to 105% of the range.
Active power is displayed up to 110.25% of the range.

When the PEAK OVER LED or o.r. goes on

See "3.6 When PEAK OVER, o.r and units flash"(⇒ p.52)

The integrate elapsed time is displayed as follows;

From 0 minute to 99 hours, 59 minutes and 59 seconds

From 100 to 999 hours and 59 minutes

From 1000 to 9999 hours and 59 minutes

10000 hours

The frequency measurement is displayed as follows;

From 45 to 99.999 Hz

From 100 to 999.99 Hz

From 1 to 5 kHz

3.2.2 Selecting Voltage and Current Range

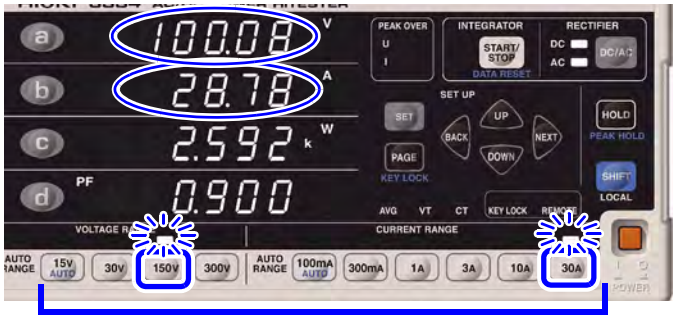
DANGER

When the input exceeds 300 V or 30 A,
Maximum input voltage and maximum input current are 300 V and 30 A, respectively.
When the maximum input voltage or current is exceeded, terminate measurements as soon as possible, turn off the measurement line and disconnect all connections.
Continuing measurements while maximum input voltage and maximum input current are exceeded will damage the instrument and could lead to injuries.

Selecting a range

Press a range key.

The LED for the selected range key lights and measurement values for the selected range appear.



setting: voltage 300 V
: current 30 A

Wait (one second or more) until the internal circuit has stabilized after changing a range before reading measurements.

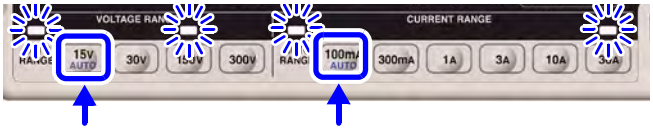
See "Effective measurement range and display range" (⇒ p.27)

CAUTION

Note that the instrument may be damaged if the applied voltage or current exceeds the measurement range.

Selecting auto-range

Use auto-range when the range is not known.



Press SHIFT and then press 15V AUTO, auto-range voltage measurement is enabled.

Press SHIFT and then press 100mA AUTO, auto-range current measurement is enabled.

When auto-ranging is enabled, the AUTO RANGE LED is lit along with a measuring range LED.

See "Auto-range" (⇒ p.28)

To cancel auto-range:

Press any range key, or press SHIFT again and then press 15V AUTO (voltage range) or 100mA AUTO (current range).

NOTE When the measurement range is set to auto-range, analog output or waveform output changes the output rate according to changes in range. In measuring a line whose measurement value fluctuates wildly, take care not to mistake the range conversion.
It is recommended that a fixed range be used for such measurements.

Effective measurement range and display range

Voltage / Current	**15-V range** 0.150 to 15.000 V (0.075 to 15.750 V)	**30-V range** 0.30 to 30.00 V (0.15 to 31.50 V)	**150-V range** 1.50 to 150.00 V (0.75 to 157.50 V)	**300-V range** 3.0 to 300.0 V (1.5 to 315.0 V)
100-mA range 1.00 to 100.00 mA (0.50 to 105.00 mA)	1.5-W range 0.0000 to 1.5000 W (0.0000 to 1.6538 W)	3-W range 0.000 to 3.000 W (0.000 to 3.308 W)	15-W range 0.000 to 15.000 W (0.000 to 16.538 W)	30-W range 0.00 to 30.00 W (0.00 to 33.08 W)
300-mA range 3.0 to 300.0 mA (1.5 to 315.0 mA)	4.5-W range 0.000 to 4.500 W (0.000 to 4.961 W)	9-W range 0.000 to 9.000 W (0.000 to 9.923 W)	45-W range 0.00 to 45.00 W (0.00 to 49.61 W)	90-W range 0.00 to 90.00 W (0.00 to 99.23 W)
1-A range 0.0100 to 1.0000 A (0.0050 to 1.0500 A)	15-W range 0.000 to 15.000 W (0.000 to 16.538 W)	30-W range 0.00 to 30.00 W (0.00 to 33.08 W)	150-W range 0.00 to 150.00 W (0.00 to 165.38 W)	300-W range 0.0 to 300.0 W (0.0 to 330.8 W)
3-A range 0.030 to 3.000 A (0.015 to 3.150 A)	45-W range 0.00 to 45.00 W (0.00 to 49.61 W)	90-W range 0.00 to 90.00 W (0.00 to 99.23 W)	450-W range 0.0 to 450.0 W (0.0 to 496.1 W)	900-W range 0.0 to 900.0 W (0.0 to 992.3 W)
10-A range 0.100 to 10.000 A (0.050 to 10.500 A)	150-W range 0.00 to 150.00 W (0.00 to 165.38 W)	300-W range 0.0 to 300.0 W (0.0 to 330.8 W)	1.5-kW range 0.0000 to 1.5000 kW (0.0000 to 1.6538 kW)	3-kW range 0.000 to 3.000 kW (0.000 to 3.308 kW)
30-A range 0.30 to 30.00 A (0.15 to 31.50 A)	450-W range 0.0 to 450.0 W (0.0 to 496.1 W)	900-W range 0.0 to 900.0 W (0.0 to 992.3 W)	4.5-kW range 0.000 to 4.500 kW (0.000 to 4.961 kW)	9-kW range 0.000 to 9.000 kW (0.000 to 9.923 kW)

- ( ): Display range
- Substitute VA for the W units in the table to obtain the apparent power values.

See "5.2 Basic Specifications"(⇒ p.118)

NOTE
- Voltage and current are displayed up to 105% of the range.
- Active power is displayed up to 110.25% of the range.
- Numerical values in the displayed range are subject to a ±1 dgt. error due to calculation accuracy.

4-digit and 5-digit indication

The number of digits in the indications shown by this instrument depends on the numeric value in the most significant digit of the full-scale value.

When the most significant digit is: 1 — 5-digit indication
Something other than 1 — 4-digit indication

Example: **In the 30-A range:**
30.00 A is a 4-digit indication since the figure in the most significant digit of the full-scale value is "3".
In the 15-W range:
15.000 W is a 5-digit indication since the figure in the most significant digit of the full-scale value is "1".
VT ratio 10 at 150-V range, CT ratio 30 at 3-A range (in 135-kW range)
135.00 kW is a 5-digit indication since the figure in the most significant digit of the full-scale value is "1".

NOTE When the average times is set to a value other than 1 (OFF), voltage, current, active power, apparent power and power factor are indicated in 5 digits.

See "3.2.4 Displaying average measurement values (AVG: average)"(⇒ p.30)

Peak voltage value range configuration, effective measurement range and display range

Voltage range	Voltage peak range	Effective measurement range	Display range
15 V	45 V	±2.3 Vpk to ±45.0 Vpk	0.0 Vpk to ±45.9 Vpk
30 V	90 V	±4.5 Vpk to ±90.0 Vpk	±0.3 Vpk to ±91.8 Vpk
150 V	450 V	±23 Vpk to ±425 Vpk	0 Vpk to ±459 Vpk
300 V	900 V	±45 Vpk to ±425 Vpk	±3 Vpk to ±918 Vpk

Peak current value range configuration, effective measurement range and display range

Current range	Current peak range	Effective measurement range	Display range
100 mA	300 mA	±15 mApk to ±300 mApk	0 mApk to ±306 mApk
300 mA	900 mA	±45 mApk to ±900 mApk	±3 mApk to ±918 mApk
1 A	3 A	±0.15 Apk to ±3.00 Apk	0.00 Apk to ±3.06 Apk
3 A	9 A	±0.45 Apk to ±9.00 Apk	±0.03 Apk to ±9.18 Apk
10 A	30 A	±1.5 Apk to ±30.0 Apk	0.0 Apk to ±30.6 Apk
30 A	90 A	±4.5 Apk to ±54.0 Apk	±0.3 Apk to ±91.8 Apk

NOTE

Numerical values in the displayed range are subject to a ±1 dgt. error due to calculation accuracy.

3-digit and 4-digit indication

The number of digits of peak voltage and peak current values displayed on this instrument depends on the numerical value of the most-significant full-scale digit, as follows:

When the most significant digit is: 1 — 4-digit indication
Something other than 1 — 3-digit indication

Example: In the 9 A peak range (3 A current range):
9.00 Apk is a 3-digit indication since the figure in the most significant digit of the full-scale value is "9".
VT ratio 2 at 900 V peak range (300-V voltage range) (in 1.8-kV range)
1.800 kW is a 4-digit indication since the figure in the most significant digit of the full-scale value is "1".

Auto-range

In auto-range, ranges are switched as described below.

Changes to a higher range	Changes to a lower range
• When the measurement value exceeds the range by 100% • When the PEAK OVER LED lights	When the measurement value is less than 25% of the range (less than 15% from 150-V range) (A change to a lower range is not made when a peak over occurs in the lower range.)

NOTE

- During integration (INTEGRATOR LED lights or flashes), the range cannot be changed until the integration value is reset (INTEGRATOR LED goes out). ("Err.5")
  See "To reset the integration value" (⇒ p.36)
- In display hold state (HOLD LED lights), the range cannot be changed until the display hold state is canceled (HOLD LED goes out). ("Err.5")
  See "Canceling Hold" (⇒ p.36)
- The voltage and current display range is within 0.5 to 105% of the range.
  At less than 0.5%, the zero process function forcibly sets the display to zero.

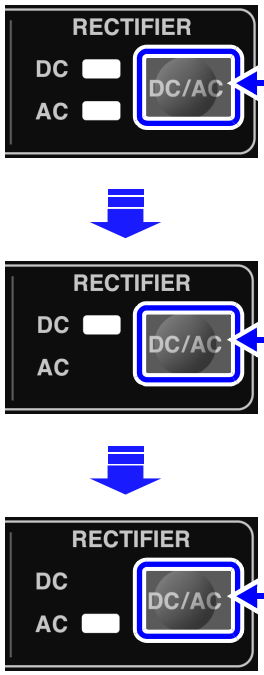
3.2.3 Selecting the rectifier type

For voltage measurement this instrument has three rectifier circuits. Before measurement, select the following type.

1. AC+DC: To measure only AC or true RMS value of combined DC and AC
2. DC : To measure only DC (simple average indication)
3. AC : To measure only AC and true RMS

Calculated by:

$$\sqrt{(\text{AC+DC Measured Value})^2 - (\text{DC Measured Value})^2}$$



Press DC/AC **to change the rectifier type.**
The DC rectifier is enabled.

The LED for the selected rectifier type lights.
(Default setting: AC+DC)

Press DC/AC **to change the rectifier type.**
The AC rectifier is enabled.

Select suitable rectifier type repeating these operation.

NOTE

- Default setting is AC+DC.
- When DC is selected, the polarities of voltage (*U*) and current (*I*) are indicated. (simple average indication)
  Polarity of the apparent power ($S=U \times I$) is also indicated.
- When AC+DC or AC is selected, the displayed values of voltage and current are always positive.
- During integration (INTEGRATOR LED lights or flashes), the rectifier type cannot be changed until the integration value is reset (INTEGRATOR LED goes out).("**Err.5**")
  See "To reset the integration value" (⇒ p.36)
- In display hold state or peak hold state (HOLD LED lights or flashes), the rectifier type cannot be changed until these are canceled (HOLD LED goes out). ("**Err.5**")
  See "Canceling Hold" (⇒ p.36)

3.2.4 Displaying average measurement values (AVG: average)

When the display fluctuates wildly, set the average times for the measurement value to display an average value. This minimizes fluctuations in displayed values. Measurement values are displayed as simple averages.

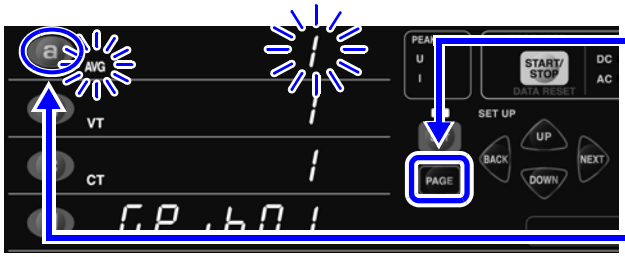
Measurement range:

1 (OFF), 2, 5, 10, 25, 50, 100

Display area a in the setting screen shows the average times.

Example: set the average times to "2"

1 **Press SET to open the setting screen.**



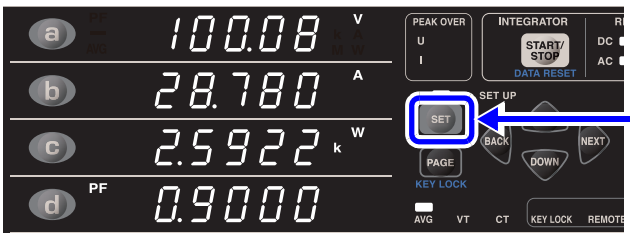
2 **Press PAGE to display the setting screen at the left.**

3 **Press a.**

AVG and the average times flash in display area a.
(Default setting: 1)

4 **Press UP or DOWN to set the average times (2).**

The AVG LED flashes when set to 2 or more.



5 **Press SET to exit the setting screen.**

The normal measurement screen appears.

This example shows the average value for two data items.

$$\text{Average value} = \frac{\sum_{k=1}^{n} Xk}{n}$$

Xk: measurement value every 200 ms
n: average times

Interval between display updates

Average times	1 (OFF)	2	5	10	25	50	100
Display update	200 ms	400 ms	1 s	2 s	5 s	10 s	20 s

Averaging starts over when the range is changed. The data displayed when averaging started remains on until the first average value appears.
The unit may flash during measurement.

See "3.6.3 When the unit flashes"(⇒ p.53)

Averaging is performed for voltage, current, active power and apparent power.
The power factor is calculated from the averaged effective and apparent power.

NOTE

- In display hold state or peak hold state (HOLD LED lights or flashes), the average times cannot be changed until these are canceled (HOLD LED goes out). ("**Err.5**")

  See "Canceling Hold" (⇒ p.36)

- When the average times is set to a value other than 1 (OFF), voltage, current, active power, apparent power and power factor are indicated in 5 digits.

  See "4-digit and 5-digit indication" (⇒ p.27)

3.2.5 Setting the VT or CT ratio

Use an external VT (PT) or CT device to measure voltage or current values that exceed the maximum rated input for this instrument.

See "Connect a VT (PT) or CT device" (⇒ p.19)

By setting the VT or CT ratio in the setting screen, you can directly read primary side input values.

- Measuring voltages exceeding 300 V:
  Connect an external VT (PT) and set the VT ratio.
- Measuring current exceeding 30 A:
  Connect an external CT and set the CT ratio.

Measurement range:

VT ratio ..1 (OFF), 2, 4, 10, 20, 30, 60, 100
CT ratio...1 (OFF), 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 25, 30, 40, 50, 60, 75, 80, 100, 200, 300, 500, 1000, 2000, 3000, 5000, 10000

Set the VT and CT ratios in display area b and c in the setting screen.

NOTE

- During integration (INTEGRATOR LED lights or flashes), the VT or CT ratio cannot be changed until the integration value is reset (INTEGRATOR LED goes out). ("**Err.5**")

  See "To reset the integration value" (⇒ p.36)
- In display hold state or peak hold state (HOLD LED lights or flashes), the VT or CT ratio cannot be changed until these are canceled (HOLD LED goes out). ("**Err.5**")

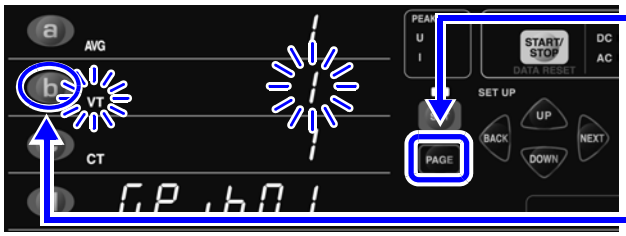
  See "Canceling Hold" (⇒ p.36)

Setting VT ratio (example: measuring a 600 V line)

Use an external VT (PT) and enter 10:1 (60 V) voltage ratio on this instrument:
Set the voltage range to "150 V" and the VT ratio to "10".
A voltage of 60 V is input to the instrument, but it displays an input value of 600 V.

1 **Press 150V to set the voltage range to "150 V".**

2 **Press SET to open the setting screen.**



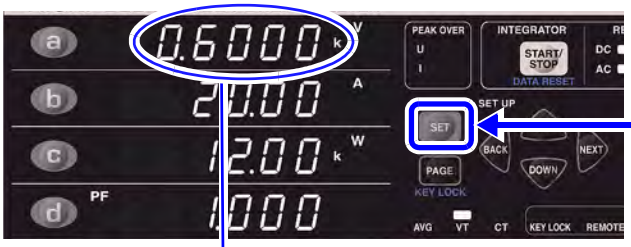
3 **Press PAGE to display the setting screen at the left.**

4 **Press b.**

VT and the VT ratio in display area b flashes. (Default setting: 1)

5 **Press UP or DOWN to set the VT ratio (10).**

The VT LED flashes when set to 2 or more.



6 **Press SET to exit the setting screen.**

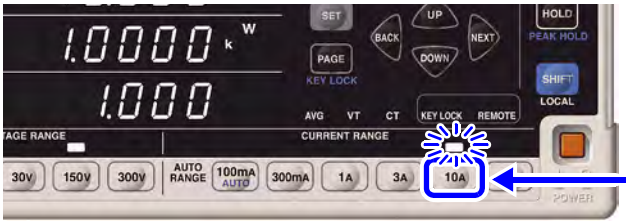
The normal measurement screen appears.

VT indicates the primary side voltage.

Setting a CT ratio (example: measuring a 100 A line)

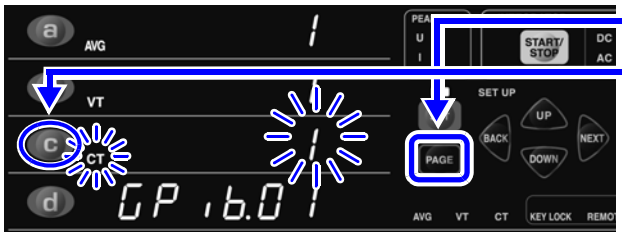
Use CT device and set a 10:1 (10 A) current ratio on this instrument:
Set the current range to "20 A" and the CT ratio to "10".
A current of 10 A is input to the instrument, but it displays an input value of 100 A.

See Range selection: "3.2.2 Selecting Voltage and Current Range"(⇒ p.26)



1 **Press 10A to set the current range to “10 A”.**

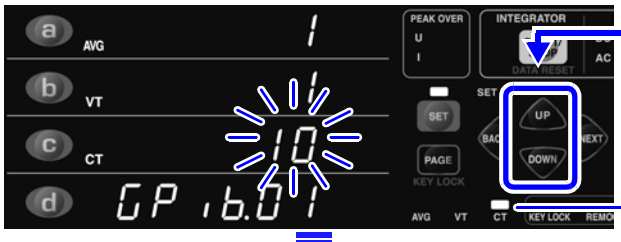
2 **Press SET to open the setting screen.**



3 **Press PAGE to display the setting screen at the left.**

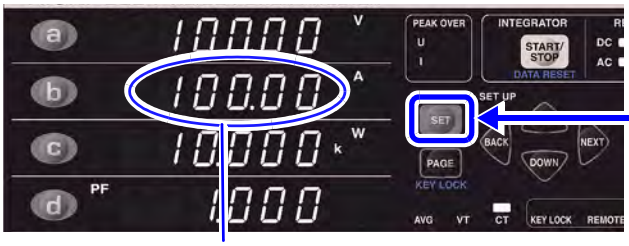
4 **Press C.**

CT and the CT ratio in display area c flashes. (Default setting: 1)



5 **Press UP or DOWN to set the CT ratio (10).**

The CT LED flashes when set to 2 or more.



6 **Press SET to exit the setting screen.**

The normal measurement screen appears.

CT indicates the primary side current.

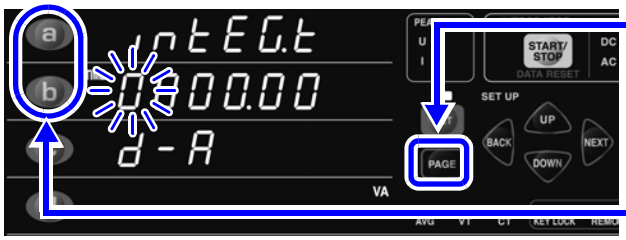
The VT and CT ratios are also used to multiply active power and apparent power.

3.3 Integration

This sets integration time. It is possible to integrate current and active power simultaneously. When starting integration, some limitations arise for this instrument. In this section, the integration time settings and the integrating method will be explained.

3.3.1 Setting integration time

1 **Press SET to open the setting screen.**



2 **Press PAGE to display the setting screen at the left.**

3 **When the D/A output setting item is flashing, press a or b.**

Integration time flashes.

0000 . 00
hours minutes

4 **Press BACK or NEXT to change the selected (flashing) time digit to be set.**

5 **Press UP or DOWN to set the integration time.**

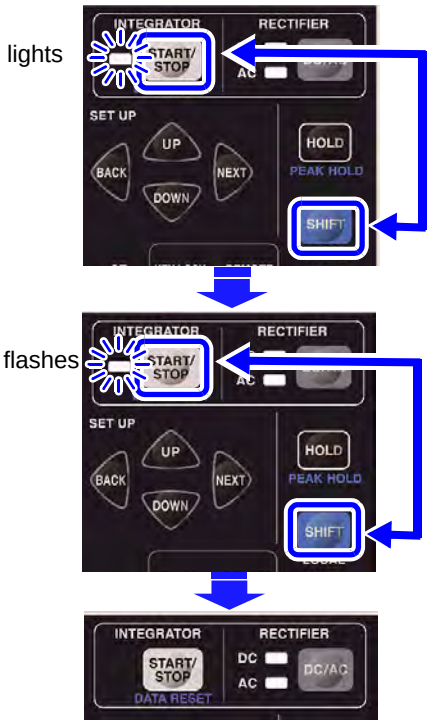
6 **Press SET to exit the setting screen.**

The normal measurement screen appears.

NOTE

If there is no flashing indication displayed the settings cannot be changed (during HOLD or INTEGRATOR LED lights or flashes). In this case, return to the measurement screen by pressing the **SET** key, and set again after the integration value is reset or hold state is canceled (DATA RESET).

To reset the integration value



1 **Press START/STOP, or press SHIFT and then press START/STOP (DATA RESET).**

INTEGRATOR LED flashes and the integration operation will stop.

2 **Press SHIFT and then press START/STOP (DATA RESET).**

INTEGRATOR LED goes out and the integration value is reset.

Canceling Hold

- Press the **HOLD** key when the HOLD LED lights.
- Press the **SHIFT** key and then press the **HOLD(PEAK HOLD)** key when the HOLD LED flashes.

The HOLD LED goes out when Hold is canceled.

3.3.2 Integration Operation

Integrating state

Integration execution state : INTEGRATOR LED lights
Integration stopped state : INTEGRATOR LED flashes
Integration reset state : INTEGRATOR LED goes out

The limitations of this instrument due to integration

Some settings are not available during integration (INTEGRATOR LED lights) and when integration is stopped (INTEGRATOR LED flashes). When the settings cannot be changed, "**Err.5**" is displayed for a second.

See "3.3.3 Notes on Integration"
"3. The limitations of this instrument due to integration"(⇒ p.39)

Integration operation

To start the integration

Press START/STOP **.**

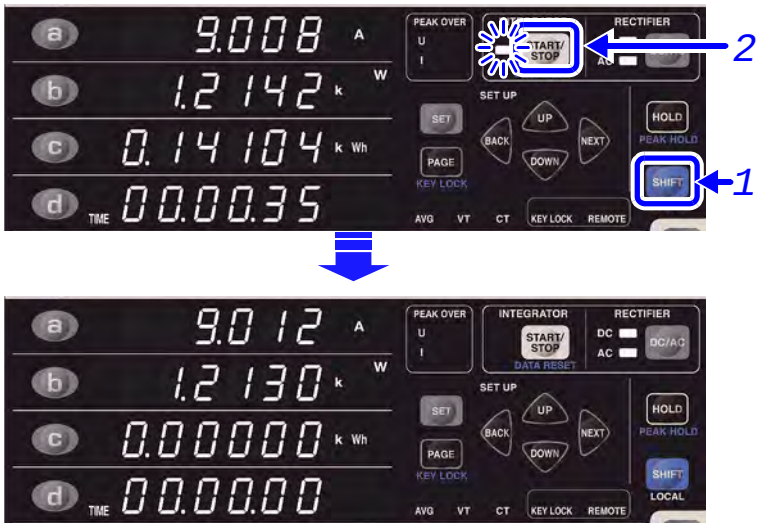
INTEGRATOR LED lights and the integration will start.

To stop forcibly the operating integration: (INTEGRATOR LED lights: Integration execution state)

Press START/STOP **again.**

INTEGRATOR LED flashes and the integration operation will stop.

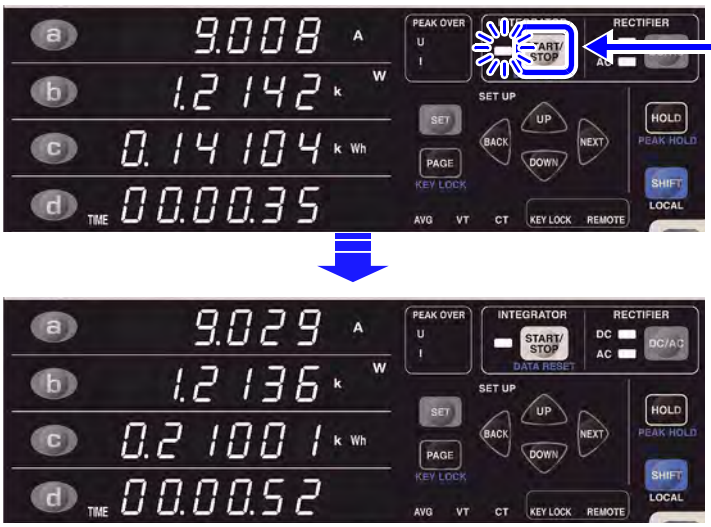
To reset the integration value: (INTEGRATOR LED flashes: Integration stopped state)



Press SHIFT **and then press** START/STOP (DATA RESET) **.**

INTEGRATOR LED goes out and the integration value is reset.

To add to the previous integration value:
(INTEGRATOR LED flashes: Integration stopped state)



Press START/ STOP **.**

The integration value is added to the previous integration value.

Integration stop

The integration operation will stop in the following circumstances:

- Reaches the set integration time.
- While the INTEGRATOR LED is lit, press the **START/STOP** key, or press the **SHIFT** key and then press the **START/STOP** key.
- When integration time reaches 10000 hours.
- When integration value reaches ±999999 MWh.

3.3.3 Notes on Integration

1. Current integration effective measurement range : ±1% to ±100% of current range
   Active power integration effective measurement range: 0% to ±100% of active power range

2. When starting integration, auto range setting of voltage and current is canceled and the range at integration starting point is fixed. It is necessary to set the range so that PEAK OVER U (voltage over-range warning) LED and PEAK OVER I (current over-range warning) LED will not light during integration.
   When the PEAK OVER U or PEAK OVER I LED is lit while integrating, the integration value is invalid. In this case, the Ah or Wh unit flashes. This continues flashing until the integration value is reset (DATA RESET).
   (Even when the current or active power measurement value is out of range ("**o.r**"), integration is performed for the measurement values for which the PEAK OVER U or PEAK OVER I LED is not lit.)

3. The limitations of this instrument due to integration
   The following settings cannot be changed in the integration execution state (INTEGRATOR LED lights) or the integration stopped state (INTEGRATOR LED flashes). When the settings cannot be changed, "**Err.5**" is displayed for a second.

●: changeable —: can not change

Items	integration execution state, Integration stopped state (INTEGRATOR LED lights or flashes)
Range select	—
Rectifier type select	—
Integration time setting and changing	—
D/A output item setting and changing	●
Averaging time setting and changing	●
VT ratio setting and changing	—
CT ratio setting and changing	—
GP-IB address setting and changing (3334-01 only)	●

4. When the integration value reaches ±999999 MWh, or when the integration time reaches 10000 hours, integrating cannot restart. ("**Err.6**" is displayed for a second).
   In this case, press the **SHIFT** key and then press the **START/STOP(DATA RESET)** key to reset integration value (INTEGRATOR LED goes out), and then restart.

5. When perform a system reset, integration stops and the instrument is reset to initial setting (factory default settings).

   See"3.5.4 Initializing (system reset)"(⇒ p.50)

6. When the power is cut off during integration, integration starts again after returned.

3.3.4 Display Format of Integration Value

The integration reset format is shown in Table 1 and 2. Digits of integration value and integrate range format carry up or down simultaneously.

NOTE The number of digits does not go below that when integration is reset.

Table 1: Format of current integration

Current range	100 mA, 300 mA	1 A, 3 A	10 A, 30 A
Reset value	000.000 mAh	0.00000 Ah	00.0000 Ah

Table 2: Format of active power integration

Current range / Voltage range	100 mA, 300 mA	1 A, 3 A	10 A, 30 A
15 V, 30 V	0.00000 Wh	00.0000 Wh	000.000 Wh
150 V, 300 V	00.0000 Wh	000.000 Wh	0.00000 kWh

Overview of integration reset value

Display format of current range and active power range applies to integration value format under reset condition.

Example:

	Display format	Integration value format	Reset value
1.5-W range	1.5000 W	1.50000 Wh	0.00000 Wh
9 kW-range	9.000 kW	9.00000 kWh	0.00000 kWh

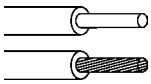
The display format when setting VT and CT ratios determines the integration value format.

Example:

	Display format	Integration value format	Reset value
300-W range 15 V×10(VT)×100 mA×20(CT)	300.0 W	300.000 Wh	000.000 Wh

3.4 Analog Output and Waveform Output

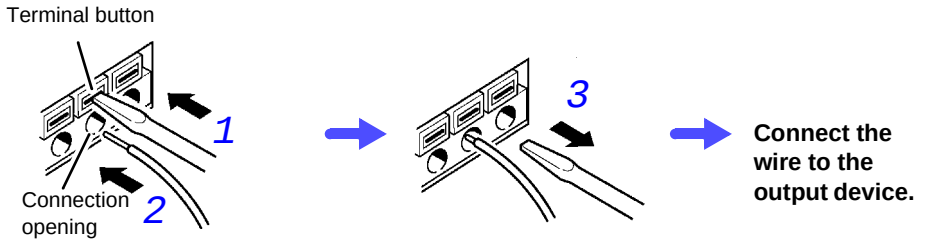
Wire materials that can be used for connection



Rated wire	Single wire 1.2 mm in diameter (AWG 16) Stranded wire 1.25 mm^2 (AWG 16), wire diameter 0.18 mm or more
Range of usable wire	Single wire 0.4 mm in diameter (AWG 26) to 1.2 mm (AWG 16) Stranded wire 0.3 mm^2 (AWG 22) to 1.25 mm^2 (AWG 16), wire diameter 0.18 mm or more
Standard length of removed wire section	11 mm
Recommended tools	Phillips screwdriver (3 mm shaft diameter, 2.6 mm blade width)

Connecting to the ANALOG/WAVEFORM Output Terminal

Connect one wire to the terminal corresponding to the measurement value to be output. Connect the GND terminal of this instrument to the GND terminal of a data logger or recorder to which the data is to be output.



Insert a straight-bladed screwdriver or similar tool into the opening to enable insertion of the wire.

Let go of the button. The wire is now secured.

Connect the wire to the output device.

When the power to the line to be measured is turned on after connection, the voltage is also output to the output device.

CAUTION

To avoid damage to the instrument, do not short circuit or apply an input voltage to output terminals.

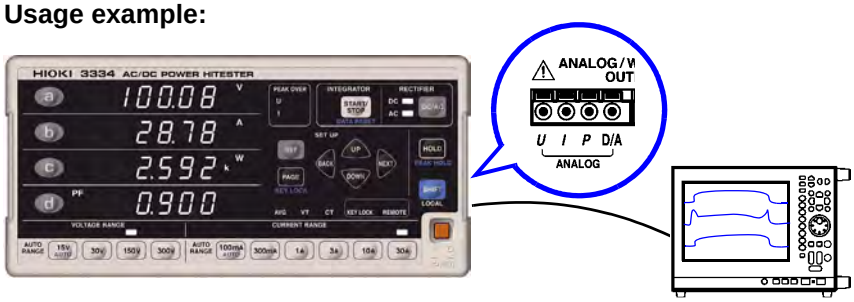
3.4.1 Analog output

The ANALOG OUTPUT terminal can output measurement values as a level converted voltage.
This output is isolated from voltage and current inputs.
A data logger or recorder can use this data.
Output items: following 4 items

- voltage
- current
- active power
- One of the following:
  current integration, active power integration, apparent power or power factor

See "Selecting the D/A output item" (⇒ p.43)

Usage example:



Analog output specifications

Output voltage	voltage, current, active power, apparent power : ±2 V DC for ±100% of range power factor : 0 V at 0.000, +2 V DC at 1.000 current integration, active power integration : ±2 V DC (range × set integration time)
Output resistance	100 Ω±5 Ω (±5%)
Response time	0.5 s or less
Output update rate	200 ms

NOTE

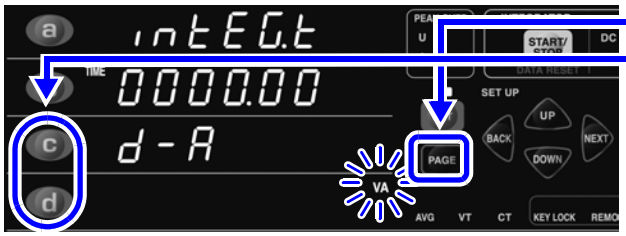
- When a VT or CT ratio is used, the range is multiplied by the VT ratio and CT ratio producing +2 V DC.
- When the measurement range is set to auto-range, the analog output changes the output rate according to changes in range. In measuring a line whose measurement value fluctuates wildly, take care not to mistake the range conversion.
  It is recommended that a fixed range be used for such measurements.
- The response time for the analog output of this instrument is 0.5 s.
- Note that a line that fluctuates faster than the output response time of the instrument will produce a deviation in the output voltage.
- The analog output outputs measured instantaneous values every 200 ms. Thus the analog output changes also in the display hold and during an averaging process.

Selecting the D/A output item

Select the D/A output item.
Choose one of the following four parameters for output:

- Current integration
- Active power integration
- Apparent power
- Power factor

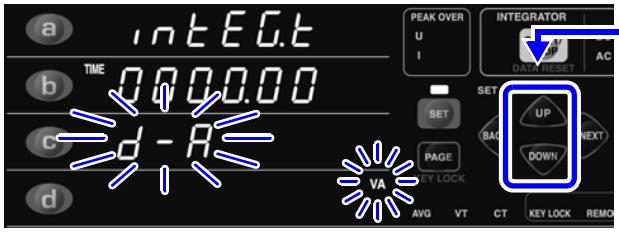
1 **Press SET to open the setting screen.**



2 **Press PAGE to display the setting screen at the left.**

3 **Press c or d.**

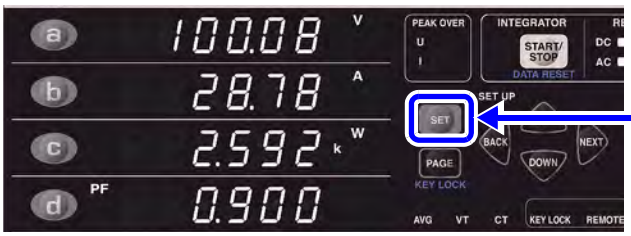
D/A output item flashes.
(Default setting: VA)



4 **Press UP or DOWN to set the output item.**

The flashing unit symbol indicates the selected D/A output item.

Pressing the **UP** key changes the flashing unit symbol as follows:
VA → PF → Ah- → Ah+ → Ah → Wh- → Wh+ → Wh
(Pressing the **DOWN** key changes the symbol in the reverse order.)



5 **Press SET to exit the setting screen.**

The normal measurement screen appears.

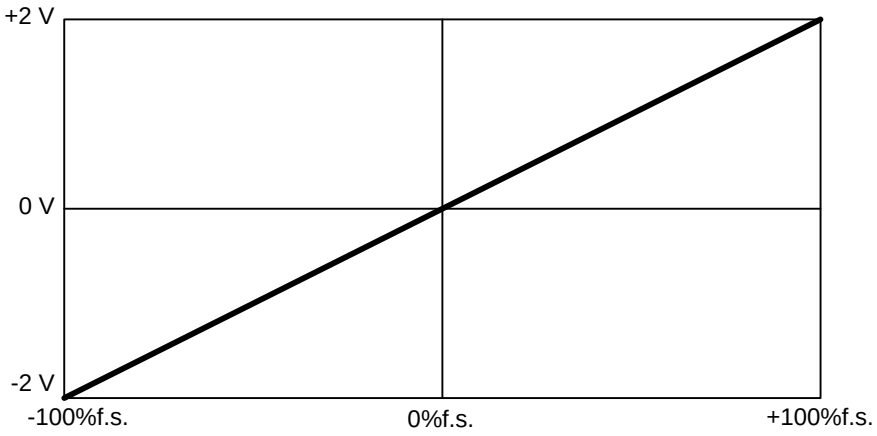
NOTE

- Default setting is apparent power (VA).
- Maximum output voltage
  Voltage, Current, Current integration, Active power integration
  : ±2.1 V (±105% of range)
  Active power, Apparent power : ±2.205 V (±110.25% of range)
  Power factor : +2.1 V
- Output update rate is about five times/s.
- Output timing is independent of the averaging timing (Average) setting, and Display Hold.

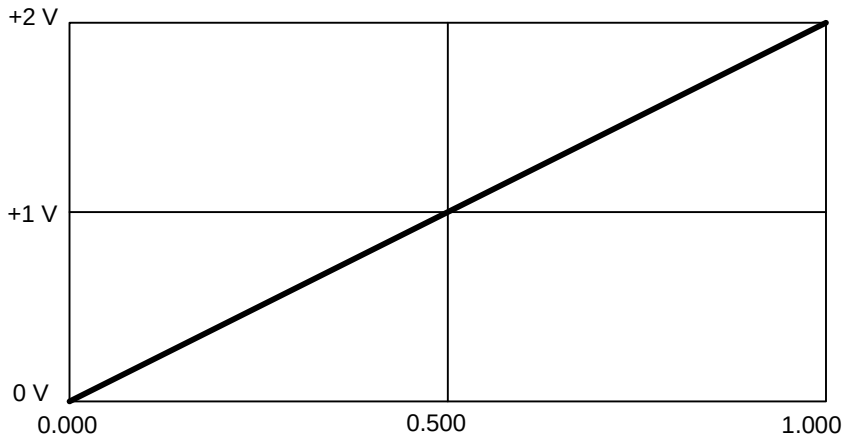
Example: Analog output

For analog output example, refer to figure below.

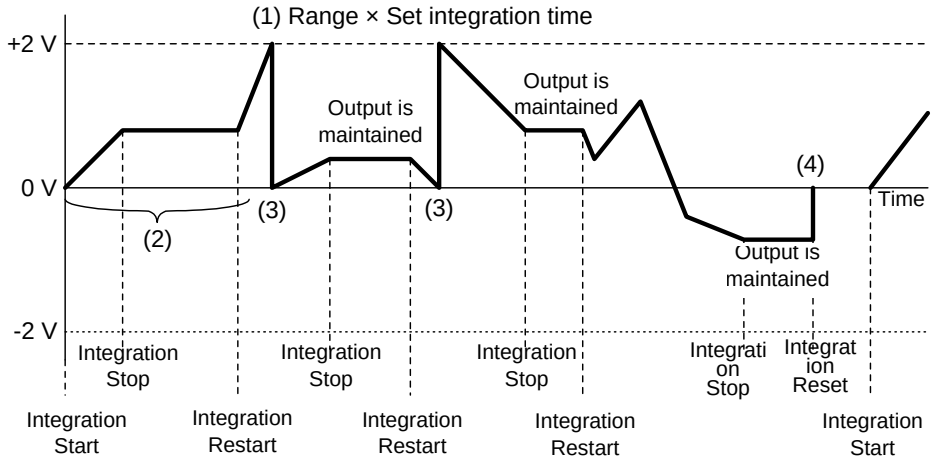
Voltage, Current, Active power, Apparent power



Power factor



Current integration, Active power integration



(1) When the integrated value equals a multiple of "the measurement range multiplied by the set integration time", the analog output of the integration value becomes ±2 V. For example, if the measurement range is 150 W and the integration time is set to 24 hours, when the integrated value is 3.6 kWh (150 W x 24 hours), 7.2 kWh (150 W x 24 hours x 2), 10.8 kWh (150 W x 24 hours x 3) ··· its the analog output will be +2 V. When it is a multiple of -3.6 kWh, the analog output will be -2 V.

(2) When integration has started, analog output voltage begins to change. When integration has stopped, the last analog output voltage is maintained. When integration has restarted, analog output voltage begins to change again.

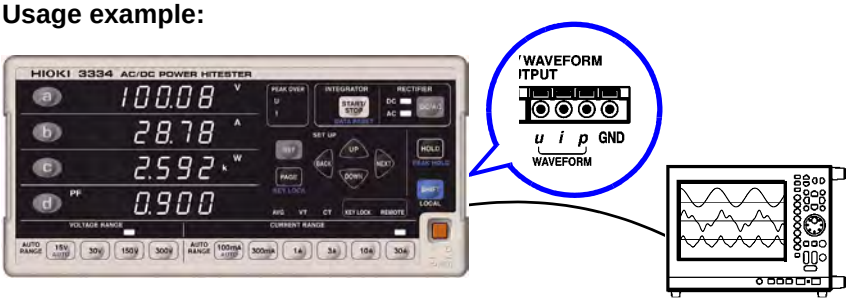
(3) When analog output voltage exceeds ±2 V, analog output voltage returns to 0 V and then begins to change again.

(4) When the integration value is reset, analog output voltage returns to 0 V.

3.4.2 Waveform output

The WAVEFORM OUTPUT terminal provides output of instantaneous voltage, current or power.
This output is isolated from voltage and current inputs.
From this terminal, measured input waveforms can be observed with an oscilloscope.

Usage example:



Waveform specifications

Output voltage	1 V f.s. for 100% of range
Output resistance	100 Ω±5 Ω (±5%)
Conversion interval	Approx. 13 μs

NOTE

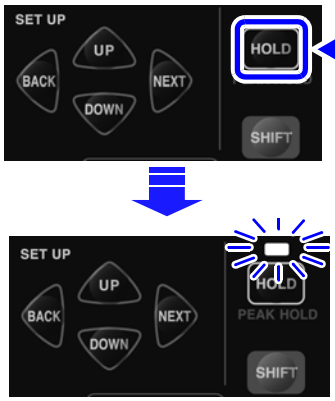
- When a VT or CT ratio is used, the range is multiplied by the VT ratio or CT ratio to provide a true RMS value of 1 V.
- When the measurement range is set to auto-range, the waveform output changes the output rate according to changes in range. In measuring a line whose measurement value fluctuates wildly, take care not to mistake the range conversion.
  It is recommended that a fixed range be used for such measurements.
- The waveform output changes also in the display hold and during an averaging process.

3.5 Other functions

3.5.1 Display hold (Hold)

Pressing the **HOLD** key makes it possible to hold all displayed measurement values (display hold state).

Invoking display hold state

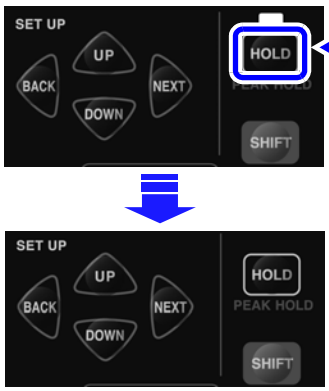


Press HOLD .

The HOLD LED lights.

Pressing the **HOLD** key holds displayed measurement values.

Canceling display hold state



Press HOLD again.

The HOLD LED goes out and the normal measurement screen reappears.

NOTE

The following operations are disabled in the hold state.

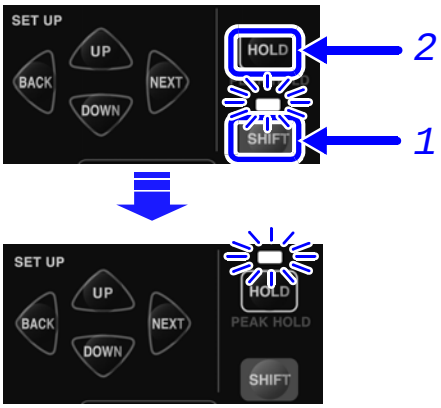
- Range switching
  Err.5 appears when a range key is pressed.
  Range changing is also disabled in auto-range mode. The **HOLD** key locks the current range.
- Changing settings (average times, VT and CT ratio setting)
  In the setting screen, set items light and cannot be changed.
- Rectifier type switching

To change ranges and settings, press the **HOLD** key to cancel the hold state (HOLD LED goes out).

3.5.2 Peak value and Maximum value hold (Peak Hold)

Peak waveform values such as device inrush current can be measured. (Peak value hold)
The maximum value of each measurement parameter is available. (maximum value hold)

Invoking peak hold state



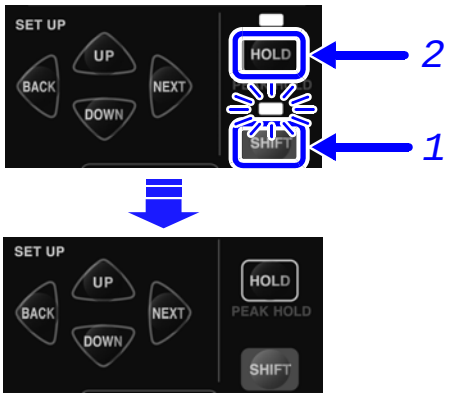
Press SHIFT **, and then press** HOLD (PEAK HOLD) **.**

The HOLD LED flashes and the Peak Hold function is enabled.

Clearing the peak hold value

Press the **HOLD** key while Peak Hold is enabled (HOLD LED flashes).
The display is updated with the instantaneous value at that moment, and the Peak Hold function is restarted.

Canceling peak hold state



Press SHIFT **again, and then press** HOLD (PEAK HOLD) **.**

The HOLD LED goes out and the normal measurement screen reappears.

NOTE

The following operations are disabled in the peak hold state.

- Range switching
  Err.5 appears when a range key is pressed.(⇒ p.127)
  Range changing is also disabled in auto-range mode. The **HOLD** key locks the voltage and current range.
- Changing settings (integration time, average times, VT and CT ratio setting)
  In the setting screen, set items light and cannot be changed.
- Rectifier type switching
- For all measurement parameters, “o.r” (over-range) is treated as the maximum value. To return to displaying an actual measurement value, clear the Peak Hold value.

To change settings, press the **SHIFT** key, and then press the **HOLD(PEAKHOLD)** key to cancel the peak hold state (HOLD LED goes out).

3.5.3 Disables key operations (key lock)

This function disables key operations (key lock state) to prevent inadvertent operation during measurement.

Invoking key lock state

1 **Press** SHIFT **.**
The SHIFT LED lights.

2 **Press** PAGE (KEY LOCK) **.**
The KEY LOCK LED lights.
Keys do not function when pressed.

Canceling key lock state

Press SHIFT again (the SHIFT LED lights) and press PAGE (KEY LOCK) .
The KEY LOCK LED goes out and operating key functions are again available.

NOTE

Communications via an interface in KEY LOCK state turns off the KEY LOCK LED and engages the remote state (REMOTE LED lights).
The remote state also prevents use of the operating keys.
To enable the operating keys, press the **SHIFT (LOCAL)** key to cancel the remote control state.

See "To cancel the Remote state (enter the local state))" (⇒ p.61)

3.5.4 Initializing (system reset)

Instrument functions can be returned to their factory defaults (system reset). Perform a system reset during the self-test (the interval until the normal screen appears) after powering up.

Note: On the 3334-01, the display appears as follows.

Turn on the power.

Self-test

Press the SHIFT key and then press START/STOP DATA RESET during a self-test.

System reset indication

All settings return to their factory defaults.

Factory default settings (initial setting: system reset)

Item	Settings
Display area a	Voltage (V)
Display area b	Current (A)
Display area c	Active power (W)
Display area d	Power factor (PF)
Voltage range	300-V range (Auto range OFF)
Current range	30-A range (Auto range OFF)
Rectifier type (RECTIFIER)	AC+DC
D/A output	Apparent power (VA)
VT ratio (VT)	1 (OFF)
CT ratio (CT)	1 (OFF)
Average times (AVG)	1 (OFF)
Display Hold	OFF
Peak hold	OFF
GP-IB address (3334-01 only)	1
Key lock	OFF
Integration time setting	10000 h (Setting screen: "0000.00")
Integration value	0 Wh, 0 Ah
Integration elapsed time	00 h 00 min 00 s (Displays: "0.00.00")

3.6 When PEAK OVER, o.r and units flash

3.6.1 When the PEAK OVER U and PEAK OVER I LEDs go on

The LEDs go on when the voltage input or the current input waveform peak value exceed the following value.

- The voltage input waveform peak value: when ±300% of any voltage range and ±425 V in a 300 V or 150-V range
- The current input waveform peak value: when ±300% of any current range and ±54.0 A in a 30-A range

When the displayed data is not accurate.

Remedy:

- **When the** PEAK OVER U **LED lights**
  When ±425 V is exceeded, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
  When the LED lights at a lower value, the internal circuit is not operating correctly. Switch over to a range that does not light the PEAK OVER U LED.
- **When the** PEAK OVER I **LED lights**
  When ±54.0 A is exceeded, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
  When the LED lights at a lower value, the internal circuit is not operating correctly. Switch over to a range that does not light the PEAK OVER I LED.
  See "3.2.2 Selecting Voltage and Current Range"(⇒ p.26)

3.6.2 When o.r (over-range) appears

This icon appears when a range is exceeded by 105%.
(For information on ranges: refer to "Effective measurement range" (⇒ p.121))
A calculation based on data that has generated an "o.r" will also produce an "o.r" display.

- When the voltage or current is "o.r", the apparent power, active power and power factor all become "o.r".
- When the apparent voltage is 0, the power factor becomes "o.r".
- However, a power factor that is "o.r" when apparent power is 0 will produce a normal value if the voltage and current inputs are made.

Remedy:

- **When the voltage is "o.r",**
  Switch to a range that is not over-range.
  When “o.r” is displayed with the 300-V range selected, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
- **When the current is "o.r",**
  Switch to a range that is not over-range.
  When “o.r” is displayed with the 30-A range selected, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
- "3.2.2 Selecting Voltage and Current Range"(⇒ p.26)

3.6.3 When the unit flashes

The unit may sometimes flash during an average operation. In some cases, the integration value unit indicator also flashes.
This indicates that the displayed average value contains "o.r".
Along with the integration value, PEAK OVER is indicated when this condition occurs during measurement.

When an over-range ("o.r") measurement occurs, averages are calculated using internal voltage and current data that exceeds 105% of their ranges, and active power and apparent power data that exceeds 110.25% of their ranges.

Remedy:

- The LED does not flash when "o.r" does not occur in the average period.
- It does not flash unless PEAK OVER occurred during integration.
- When the voltage flashes:
  Change the measurement range. If the 300-V range is already selected, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
- When the current, active power or apparent power LED flashes:
  Switch to a range that does not cause flashing. If the 30-A range is already selected, stop measuring as quickly as possible, turn off the power to the line being measured, and disconnect all connections.
  See "3.2.2 Selecting Voltage and Current Range"(⇒ p.26)
- When only the power factor flashes:
  This happens when the apparent power is 0 and is thought to be caused by load fluctuations. Flashing stops when the apparent power changes to something other than 0.
- When the integration value unit flashes:
  Reset the integration value, then change the range and restart integration.

3.6 When PEAK OVER, o.r and units flash

Chapter 4 RS-232C/ GP-IB Interface

The symbol shown below indicates that the following instructions are specific to the RS-232C or the GP-IB interface. Instructions without this symbol are for both the RS-232C and the GP-IB interface.
RS-232C : RS-232C only, or devices prepared for RS-232C
GP-IB : GP-IB only (3334-01), or devices prepared for GP-IB

4.1 Overview

This instrument can be controlled via the RS-232C and GP-IB.

GP-IB

- Complies with the following standard:Applicable standard IEEE 488.1-1987 *1
- This instrument is designed with reference to the following standard: Reference standard IEEE 488.2-1987*2
- If the output queue becomes full, a query error is generated and the output queue is cleared. Therefore, clearing the output queue and query error output from the deadlocked condition*3 as defined in IEEE 488.2 is not supported.

*1. ANSI/IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation
*2. ANSI/IEEE Standard 488.2-1987, IEEE Standard Codes, Formats, Protocols, and Common Commands
*3. The situation in which the input buffer and the output queue become full, so that processing cannot continue.

Before Use

1. **Connect to this connector.**

Always make use of the connector screws to affix the GP-IB or RS-232C connectors.

See "4.2 Connect a cable to the RS-232C connector or GP-IB connector"(⇒ p.58)

2. GP-IB

Enter a GP-IB address.

Enter a GP-IB address in the setting screen.

See "4.3 Enter a GP-IB address (3334-01 only)"(⇒ p.60)

RS-232C

Refer to the table below to set up the communication protocol of the controller so that these settings are identical to those of the instrument.

See "Setting up the communication protocol of the controller" (⇒ p.59)

The RS-232C interface

Specifications

Transfer method Communications Synchronization	 Full duplex Start-stop synchronization
Baud rate	9600 bps
Data length	8 bits
Parity	none
Stop bit	1 bit
Message terminator (delimiter)	Receiving: LF Transmitting: CR + LF (switchable to LF)
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 "4.2 Connect a cable to the RS-232C connector or GP-IB connector"(⇒ p.58)

Operating Code: ASCII codes

The GP-IB interface

Interface Functions

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

Operating Code: ASCII codes

NOTE

Precautions

Use an RS-232C or an GP-IB interface.
Simultaneous use of both interfaces may cause malfunctions such as communication interruptions.

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

WARNING

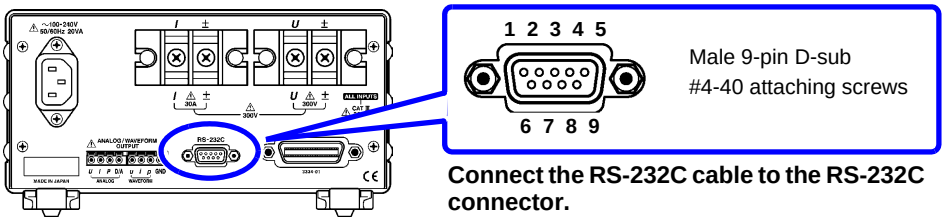
- **Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.**
- **To avoid damage to the product, do not short-circuit the terminal and do not input voltage to the terminal.**
- **Connect this instrument to the RS-232C or GP-IB connector on the device to be connected.**
  A connection to a connector with different electrical specifications may result in an electric shock or equipment damage hazard.

CAUTION

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

Connect to the RS-232C connector

RS-232C connector



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

To connect the instrument to a controller (DTE), use a crossover cable compatible with the connectors on both the instrument and the controller.

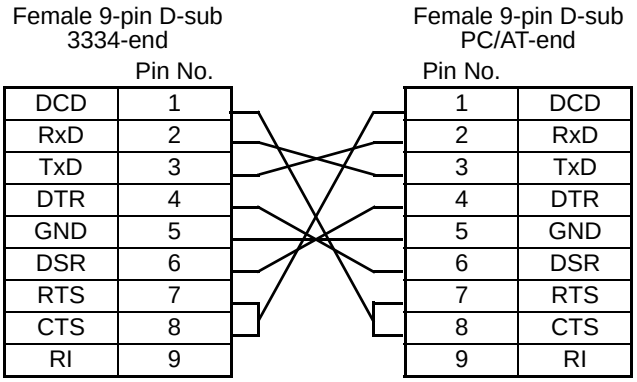
The I/O connector is a DTE (Data Terminal Equipment) configuration.
This instrument uses only pins 2, 3, 5, 7 and 8. The other pins are unconnected.

Pin No.	Mutual connection circuit name		CCITT	EIA	JIS	Signal Name
			Circuit No.	Code Addr.	Code Addr.	
1	Carrier Detect	Carrier Detect	109	CF	CD	DCD
2	Receive Data	Receive Data	104	BB	RD	RxD
3	Transmit Data	Send Data	103	BA	SD	TxD
4	Data Terminal Ready	Data Terminal Ready	108/2	CD	ER	DTR
5	Signal Ground	Signal Ground	102	AB	SG	GND
6	Data Set Ready	DATA Set Ready	107	CC	DR	DSR
7	Request to Send	Request to Send	105	CA	RS	RTS
8	Clear to Send	Clear to Send	106	CB	CS	CTS
9	Ring Indicator	Ring Indicator	125	CE	CI	RI

Connecting a controller with a 9-pin D-sub male port

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

Crossover Wiring



Recommended cable:

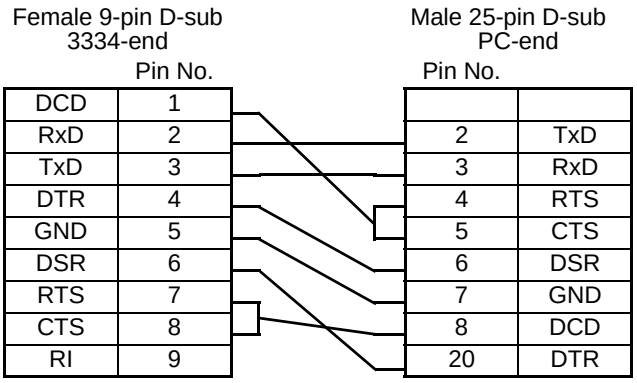
Hioki
Model 9637 RS-232C Cable (1.8 m)

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

Use a crossover cable with a female 9-pin D-sub and a male 25-pin D-sub connector.

As the figure shows, RTS and CTS pins are shorted together and crossed to DCD in the other connector.

Crossover Wiring



Recommended cable:

Hioki
Model 9638 RS-232C Cable (1.8 m)

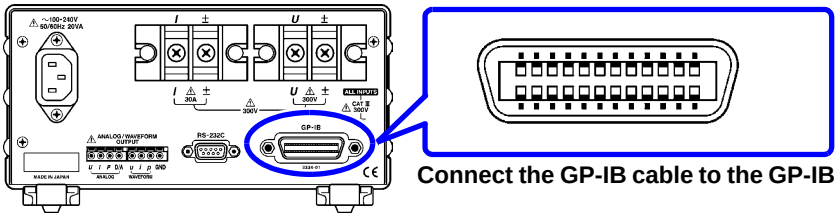
Note that the combination of a dual male 25-pin D-sub cable and a 9- to 25-pin adapter cannot be used.

Setting up the communication protocol of the controller

Be sure to make set up the controller as shown below.

- Asynchronous communication
- Transfer rate 9600 bps
- Stop bit: 1
- Data length 8
- Parity check: None

Connect to the GP-IB connector



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

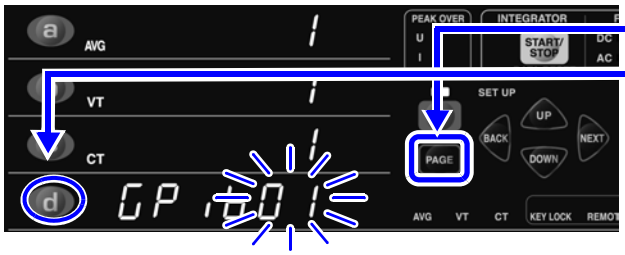
Recommended cable:
Model 9151-02 GP-IB Connector Cable (2 m)
Model 9151-04 GP-IB Connector Cable (4 m)

4.3 Enter a GP-IB address (3334-01 only)

Enter the GP-IB address in the setting screen before use of the GP-IB interface.

Settable range: 00 to 30

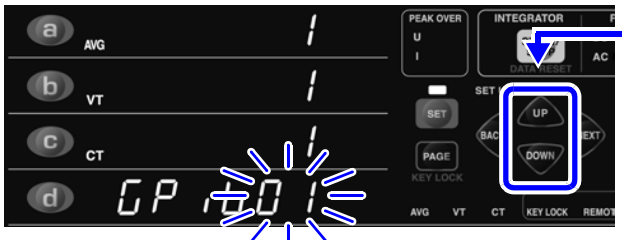
1 **Press SET to display the setting screen.**



2 **Press PAGE to display the setting screen at the left.**

3 **Press d.**

The address digits flash.



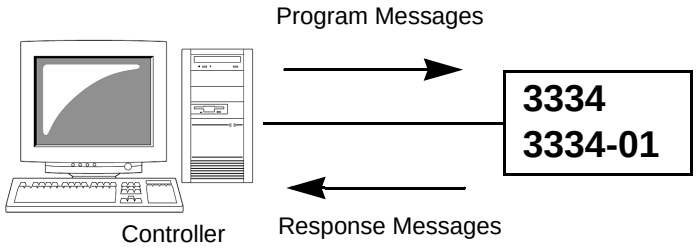
4 **Use UP or DOWN to enter the GP-IB address.**

5 **Press SET to exit the setting screen.**

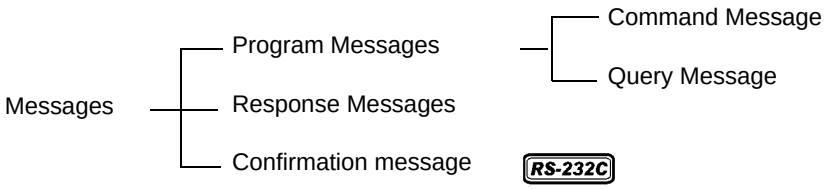
The normal measurement screen appears.

4.4 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.
RS-232C also provides messages that confirm operations to ensure that controller and instrument processing are synchronized.



Message types are further categorized as follows:



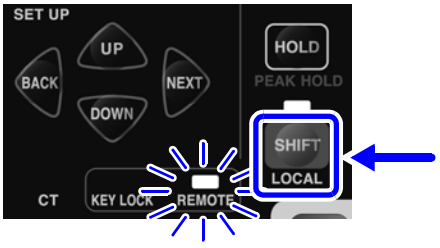
When issuing commands that contain data, make certain that the data is provided in the specified format.

NOTE During communications, REMOTE is lit to indicate the remote control state.
Pressing the key except the **SHIFT (LOCAL)** key has no effect.

When the remote control state is invoked and the instrument is in the setting screen, the measurement screen is displayed automatically
This key is disabled if the GP-IB controller has put the instrument into the local lock out state (LLO: Local Lock Out (⇒ p.73)). In this case, run the GTL command of the interface function, or reboot the instrument. Then it returns to the local state.

To cancel the Remote state (enter the local state))

Remote state



Press the SHIFT(LOCAL) key.
The REMOTE LED goes out.

4.4.1 Message Format

Program Messages

Program messages can be either Command Messages or Query Messages.

- Command Messages
  Instructions to control the instrument, such as to change settings or reset
  Example: instruction to set the measurement range
  :CURRENT:RANGE 0.1
  Header portion Space Data portion
- Query Messages
  Requests for responses relating to results of operation or measurement, or the state of instrument settings.
  Example:Command for inquiring current measurement range
  :CURRENT:RANGE?
  Header portion Question Mark

For details:
See "Headers" (⇒ p.63), "Separators" (⇒ p.64), "Data Formats" (⇒ p.64)

Response Messages

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

Header ON **:CURRENT:RANGE 0.1**
Header OFF **0.1**
(the current range is 100 mA)

At power-on, Header ON is selected.
If an error occurs when a query message is received, no response message is generated for that query.
There are also messages such as *TST? that do not have a header.

Confirmation Messages

RS-232C

A confirmation message is created from three-digit numeric data (ASCII code) after analyzing and running 1 line of data (data up to the terminator) from the controller.
This numeric data is returned to the controller. This data makes it possible to synchronize controller and instrument operations. (⇒ p.102)

Example: Confirmation massages

000:	Indicates the transferred command ended normally.
001:	The command at the beginning (first) of the program message was not correctly processed.
010:	The 10th command in the program message was not correctly processed.

NOTE

- When a confirmation message is specified, import it after sending the program message as the instrument will not otherwise properly synchronize with the controller. This message also works with GP-IB and must be received. Any query commands should be added at the end of a response message.
- A command that generates command errors, execution errors or device dependent errors is regarded as abnormal.

Command Syntax

Command names are chosen to mnemonically represent their function, and can be abbreviated. The full command name is called the "long form", and the abbreviated name is called the "short form".
The command references in this manual indicate the short form in upper-case letters, extended to the long form in lower case letters, although the commands are not case-sensitive in actual usage.

DISPLAY	OK (long form)
DISP	OK (short form)
DISPL	Error
DIS	Error

Response messages generated by the instrument are in long form and in upper case letters.

Headers

Headers must always be prefixed to program messages.

(1) Command Program Headers

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

- Headers for Simple Commands
  This header type is a sequence of letters and digits
  :ESE0 1
- Headers for Compound Commands
  These headers consist of multiple simple command type headers separated by colons ":"
  :CURRent:RANGe
- Headers for Standard Commands
  This header type begins with an asterisk "*****",
  indicating that it is a standard command defined by IEEE 488.2.
  ***RST**

(2) Query Program Header

These commands are used to interrogate the instrument about the results of operations, measured values and the current states of instrument settings.
As shown by the following examples, a query is formed by appending a question mark "**?**" after a program header.
***TST?**

Message Terminators

This instrument recognizes the following message terminators:

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

RS-232C
- LF
- CR+LF

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

GP-IB
- LF with EOI
- LF with CR and EOI (initial setting)

RS-232C
- LF
- CR+LF (initial setting)

See "Set and query the response message terminator" (⇒ p.107)

Separators

(1) Message Unit Separator

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

```
:CURRent:RANGe 0.1;:AVERaging 10
```

When messages are combined in this way and if one command contains an error, all subsequent messages up to the next terminator will be ignored.

(2) Header Separator

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

```
:CURRent:RANGe 0.1
```

(3) Data Separator

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

```
:MEASure? V,A
```

Data Formats

The instrument uses character data and decimal numeric data, depending on the command.

(1) Character Data

Character data always begins with an alphabetic character, and subsequent characters may be either alphabetic or numeric. Character data is not case-sensitive, although response messages from the instrument are only upper case.

```
:HOLD ON
```

(2) Decimal Numeric Data

Three formats are used for numeric data, identified as NR1, NR2 and NR3. Numeric values may be signed or unsigned. Unsigned numeric values are handled as positive values.

Values exceeding the precision handled by the instrument are rounded to the nearest valid digit.

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

The term "NRf format" includes all three of the above numeric decimal formats. The instrument accepts NRf format data.

The format of response data is specified for each command, and the data is sent in that format.

```
:AVERAGING 10
```

GP-IB

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

Compound Command Header Omission

When several commands having a common header are combined to form a compound command (e.g., **:CURRent:RANGe** and **:CURRent:AUTO**), if they are written together in sequence, the common portion (here, **:CURRent:**) can be omitted after its initial occurrence.
This common portion is called the "current path" (analogous to the path concept in controller file storage), and until it is cleared, the interpretation of subsequent commands presumes that they share the same common portion.
This usage of the current path is shown in the following example:

Full expression

```
:CURRent:RANGe 0.1;:CURRent:AUTO ON
```

Compacted expression

```
:CURRent:RANGe 0.1;AUTO ON
```

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

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

A colon ":" is not required at the start of the header of a Simple or Compound command. However, to avoid confusion with abbreviated forms and operating mistakes, we recommend always placing a colon at the start of a header.
In this instrument, the current path is as follows

```
:CURRent:, :DATAout:, :INTEGrate:, :RS232c:,
:SCALe:, :TRANsmit:, :VOLTage:
```

4.4.2 Output Queue and Input Buffer

Output Queue

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

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

The output queue capacity of the instrument is 1000 bytes. If response messages overflow the buffer, a query error is generated and the output queue is cleared.
Also, with GP-IB, if a new message is received while data remains in the output queue, the output queue is cleared and a query error is generated.

Input Buffer

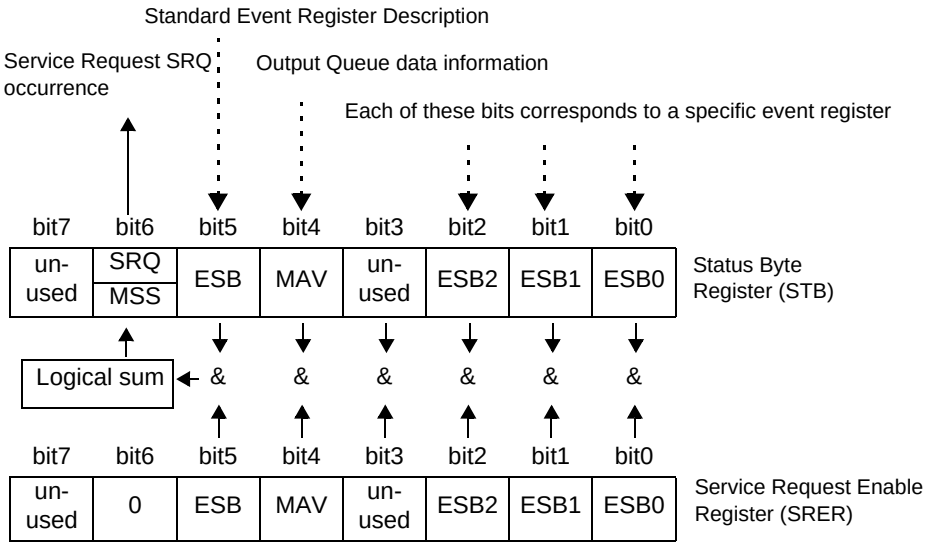
The output queue capacity of the instrument is 500 bytes. When the input buffer receives data that exceeds 500 bytes and becomes full, the GP-IB interface buss waits until buffer space becomes available.
RS-232C does not receive data that exceeds 500 bytes. For example, if it receives 520 bytes from the controller, the 20 bytes from the 501st byte are not received.

NOTE Ensure that the no command ever exceeds 500 bytes.

4.4.3 Status Byte Register

GP-IB

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



Overview of Service Request Occurrence

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

NOTE

SRQ (Service Request) is a GP-IB only function.
However, STB (Status Byte Register) data uses the ***STB?** command, RS-232C can also access this information.

RS-232C

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

Status Byte Register (STB)

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

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

Bit 7		unused
Bit 6	**SRQ**	Set to 1 when a service request is dispatched.
	MSS	This is the logical sum of the other bits of the Status Byte Register.
Bit 5	**ESB**	Standard Event Status (logical sum) bit This is logical sum of the Standard Event Status Register.
Bit 4	**MAV**	Message available Indicates that a message is present in the output queue.
Bit 3		unused
Bit 2	**ESB2**	Event Status (logical sum) bit 2 This is the logical sum of Event Status Register 2.
Bit 1	**ESB1**	Event Status (logical sum) bit 1 This is the logical sum of Event Status Register 1.
Bit 0	**ESB0**	Event Status (logical sum) bit 0 This is the logical sum of Event Status Register 0.

Service Request Enable Register (SRER)

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

4.4.4 Event Registers

Standard Event Status Register (SESR)

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

See "Standard Event Status Register (SESR) and Standard Event Status Enable Register (SESER)" (⇒ p.70)

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

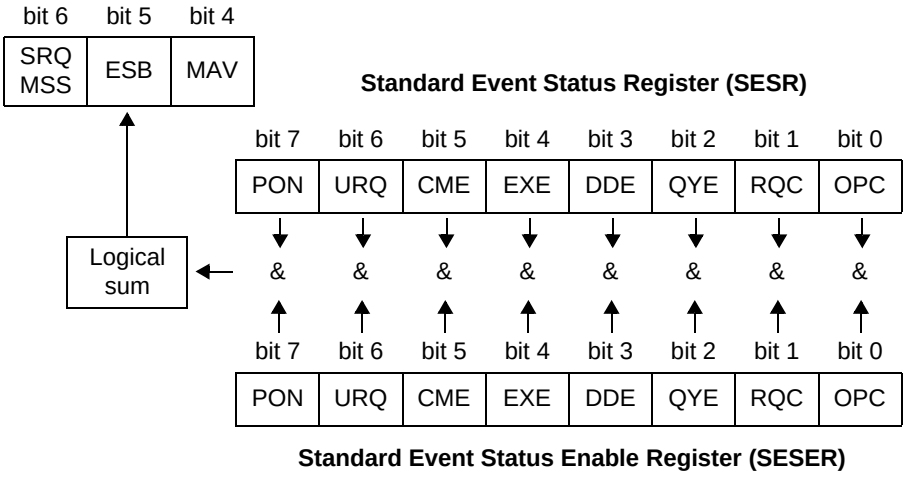
- When a ***CLS** command is executed
- When an event register query (***ESR?**) is executed
- When the instrument is powered on

Bit 7	PON	Power-On Flag Set to 1 when the power is turned on, or upon recovery from an outage.
Bit 6	URQ	User Request unused
Bit 5	CME	Command error. (The command to the message terminator is ignored.) This bit is set to 1 when a received command contains a syntactic or semantic error: • Program header error • Incorrect number of data parameters • Invalid parameter format • Received a command not supported by the instrument
Bit 4	EXE	Execution Error This bit is set to 1 when a received command cannot be executed for some reason. • The specified data value is outside of the set range • The specified setting data cannot be set (Invalid data format)
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. • Execution is impossible due to an internal instrument fault (Error indication) • The received command cannot be executed during a limited operation (Integration or Hold) • A value outside the range is read in using the "MEASure?" command when "o.r" is on.
Bit 2	QYE	Query Error (the output queue is cleared) This bit is set to "1" when an abnormality occurs in processing an 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 the controller sends the next command before reading data from the output queue (GP-IB only) • When a *IDN? query is followed by a query in the same line
Bit 1	RQC	Controller privilege request 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-Specific Event Status Registers (ESR0, ESR1 and ESR2)

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

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

- For Event Status Register 0, bit 0 (ESB0) of the Status Byte Register (STB) is set to 1.
- For Event Status Register 1, bit 1 (ESB1) of the Status Byte Register (STB) is set to 1.
- For Event Status Register 2, bit 2 (ESB2) of the Status Byte Register (STB) is set to 1.

Event Status Registers 0, 1 or 2 are cleared in the following situations:

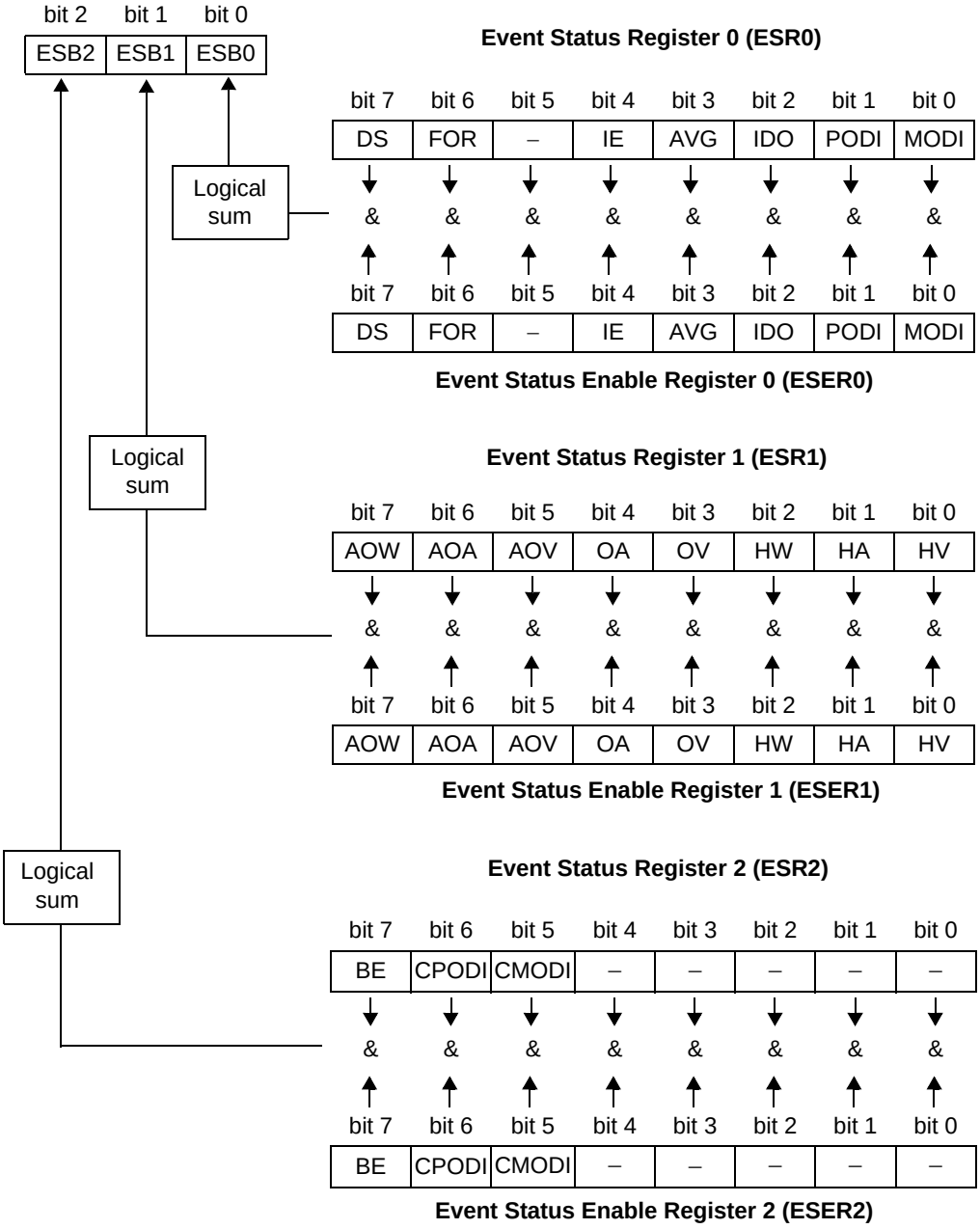
- When a ***CLS** command is executed
- When an Event Status Register query (:ESR0?, :ESR1? or :ESR2?) is executed
- When the instrument is powered on

Event Status Register 0 (ESR0)		
Bit 7	DS	Data update
Bit 6	FOR	Frequency o.r
Bit 5	–	Held at 0
Bit 4	IE	Integation end
Bit 3	AVG	The averaged data display has been updated, or the averaging time has elapsed during Display Hold.
Bit 2	IDO	Integration value is ±999999M
Bit 1	PODI	The positive power integration value (including voltage or current peak over)
Bit 0	MODI	The negative power integration value (including voltage or current peak over)

Event Status Register 1 (ESR1)		
Bit 7	AOW	The average power value (including “o.r”)
Bit 6	AOA	The average current value (including “o.r”)
Bit 5	AOV	The average voltage value (including “o.r”)
Bit 4	OA	OVER-A current peak over
Bit 3	OV	OVER-V v peak over
Bit 2	HW	HIGH-W Power “o.r”
Bit 1	HA	HIGH-A Current “o.r”
Bit 0	HV	HIGH-V Voltage “o.r”

Event Status Register 2 (ESR2)		
Bit 7	BE	The setting and integration value could not be written to backup memory.
Bit 6	CPODI	The positive current integration value (including current peak over)
Bit 5	CMODI	The negative current integration value (including current peak over)
Bit 4	–	Held at 0
Bit 3	–	Held at 0
Bit 2	–	Held at 0
Bit 1	–	Held at 0
Bit 0	–	Held at 0

Event Status Registers 0 (ESR0), 1 (ESR1) and 2 (ESR2), and Event Status Enable Registers 0 (ESER0), 1 (ESER1) and 2 (ESER2)



Register Reading and Writing

Register	Read	Write
Status Byte Register	*STB?	–
Service Request Enable Register	*SRE?	*SRE
Standard Event Status Register	*ESR?	–
Standard Event Status Enable Register	*ESE?	*ESE
Event Status Register 0	:ESR0?	–
Event Status Enable Register 0	:ESE0?	:ESE0
Event Status Register 1	:ESR1?	–
Event Status Enable Register 1	:ESE1?	:ESE1
Event Status Register 2	:ESR2?	–
Event Status Enable Register 2	:ESE2?	:ESE2

GP-IB Commands

The following commands can be used for performing interface functions.

Com-mand	Description	
GTL	Go To Local	Cancels the Remote state and enters the Local state.
LLO	Local Lock Out	Disables all keys, including the **LOCAL** key.
DCL	Device CLear	Clears the input buffer and the output queue.
SDC	Selected Device Clear	Clears the input buffer and the output queue.
GET	Group Execute Trigger	When the display values or the peak values are held, processes one sample.

4.4.5 Initialization Items

●: initialized/ –: not initialized

Item \ Initialization method	Power on	Key reset (⇒ p.50)	*RST command	Device clear (GP-IB only)	*CLS command	Initial setting
GP-IB address	–	●	–	–	–	1
RS-232C setting (fixed)	–	–	–	–	–	–
Device specific functions (ranges etc.)	–	●	●	–	–	(⇒ p.51)
Output queue	●	●	–	●	–	–
Input buffer	●	●	–	●	–	–
Status byte register	●	●	–	– *1	●*2	–
Event register	●*3	●	–	–	●	–
Enable register	●	●	–	–	–	0
Current path	●	●	–	●	–	–
Headers on/off	●	●	●	–	–	ON
Output items	●	●	●	–	–	All items output
Response message terminator	●	●	–	–	–	CR+LF
Response message separator	●	●	●	–	–	;

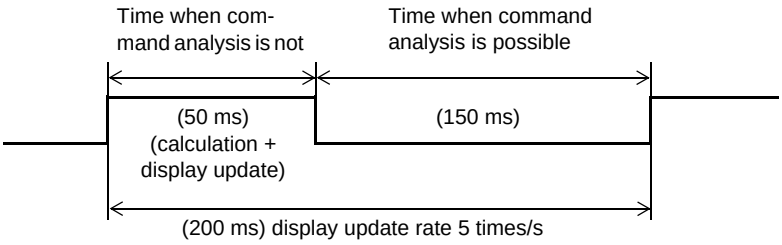
*1. Only the MAV bit (bit 4) is cleared.
*2. All bits except the MAV bit are cleared.
*3. Except the PON bit (bit 7).

4.4.6 Command Execution Time

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

NOTE

- Due to internal processing, there may be a maximum time lag of 50 ms between command reception and analysis in this instrument.
- When an analysis cannot be completed in the time allotted for internal processing, data display is delayed.
- All commands are sequential commands.
- In communications with the controller, time must be added for data transmission.
- GP-IB transfer time depends on the controller.
  The time for RS-232C transfers involving a total of 10 bits (the start bit is 1, data length is 8, no parity, stop bit is 1) is shown below.
  9600 bps: approximately 960 characters/s
- Wait until measurements stabilize after a change before using a setting command.



Command	Execution time
*RST	200 ms or less
∗TRG (including GET) ∗WAI :MEASure? :HOLD :PEAKhold	When measurement values appear: 200 ms or less No indication: wait for a measurement value to appear
:INTEGrate:STATe	250 ms or less
:CURRent:RANGe :VOLTage:RANGe :INTEGrate:TIME :SCALe:CT :SCALe:VT	50 ms or less
*TST?	6 s
Commands other than those above	20 ms or less

4.5 Message List

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

4.5.1 Standard Commands

Command	Data Formats (Response data if a Query)	Description	Error	Ref page
∗CLS		Clears the event registers and the Status Byte Register.	*1	84
∗ESE	0 to 255 (NR1)	Sets the contents of the Standard Event Status Enable Register.	*3, *5	85
∗ESE?	0 to 255 (NR1)	Queries the Standard Event Status Enable Register.	*2, *5	85
∗ESR?	0 to 255 (NR1)	Queries the Standard Event Status Register.	*2	85
∗IDN?	<Manufacturer's name>,<Model name>,<Serial number>,<Software version>	Queries the Device ID.	*2, *5	82
∗OPC	————————		*1, *5	84
∗OPC?	1	Queries execution completion.	*2, *5	84
∗RST	————————	Initializes the device.	*1	83
∗SRE	0 to 255 (NR1)	Sets the Service Request Enable Register.	*3, *5	86
∗SRE?	0 to 255 (NR1)	Queries the contents of the Service Request Enable Register.	*2, *5	86
∗STB?	0 to 119 (NR1)	Queries the Status Byte Register.	*2	86
∗TRG	————————	Executes one sampling.	*1, *4, *5	86
∗TST?	0 to 4 (NR1)	Initiates a self-test and queries the result.	*2	83
∗WAI	————————	Wait for operations to finish.	*1, *5	84

Error description (an error occurs when executing messages in the following cases):

*1 Command Error.....When data is present after the command

*2 Query Error.....When the response message exceeds 1000 bytes, or when a query follows ∗IDN?.

*3 Execution Error.....When invalid character or numeric data is present

*4 Device dependent Error.....When this command is executed at times other than in the hold state

*5 Device dependent Error.....When the self-test generates an error

NOTE:

- A misspelled message and the presence of data after a query always produce a command error.
- < > = contents of the data portion.
  Numeric data values are indicated by format as (NR1), (NR2) and (NR3), representing integer, fixed-point and floating point decimal data values respectively, or as (NRf), representing any of these formats.
- In GP-IB, Event Status Enable Register and ∗SRE can be set to enable SRQ interrupts to the controller.
- When each query ends in some kind of error, no response message is created for the query.

4.5.2 Device-Specific Commands

Command	Data Contents ( ) = response data	Description	Error	Ref page
Event registers				
:ESE0	0 to 255	Sets Event Status Enable Register 0.	*3, *5	87
:ESE0?	(0 to 255)	Queries Event Status Enable Register 0.	*2, *5	87
:ESR0?	(0 to 255)	Queries Event Status Register 0.	*2, *5	88
:ESE1	0 to 255	Sets Event Status Enable Register 1.	*3, *5	87
:ESE1?	(0 to 255)	Queries Event Status Enable Register 1.	*2, *5	87
:ESR1?	(0 to 255)	Queries Event Status Register 1.	*2, *5	88
:ESE2	0 to 255	Sets Event Status Enable Register 2.	*3, *5	88
:ESE2?	(0 to 255)	Queries Event Status Enable Register 2.	*2, *5	88
:ESR2?	(0 to 255)	Queries Event Status Register 2.	*2, *5	88
Rectifier type				
:RECTifier	ACDC/ DC/ AC	Sets rectifier type	*3, *4 *5, *6	89
:RECTifier?	ACDC/ DC/ AC	Queries rectifier type	*2, *5	89
Voltage range				
:VOLTage?		Queries voltage setting	*2, *5	90
:VOLTage:AUTO	ON/ OFF	Sets voltage auto-range	*3, *4 *5, *6	90
:VOLTage:AUTO?	(ON/ OFF)	Queries voltage auto-range	*2, *5	90
:VOLTage:RANGe	<Voltage range (NR1)>	Sets voltage range	*3, *4 *5, *6	91
:VOLTage:RANGe?	(<Voltage range (NR1)>)	Queries voltage range	*2, *5	91
Current range				
:CURRent?		Queries current setting	*2, *5	92
:CURRent:AUTO	ON/ OFF	Sets current auto-range	*3, *4 *5, *6	92
:CURRent:AUTO?	(ON/ OFF)	Queries current auto-range	*2, *5	92
:CURRent:RANGe	<Current range(NR2)>	Sets current range	*3, *4 *5, *6	93
:CURRent:RANGe?	(<Current range(NR2)>)	Queries current range	*2, *5	93

Error description (an error occurs when executing messages in the following cases):

*1 Command Error..... When data is present after the command
*2 Query Error ..... When the response message exceeds 1000 bytes, or when a query follows ∗IDN?
*3 Execution Error ..... When invalid character or numeric data is present
*4 Device dependent Error .... When this command is executed in the hold state (HOLD LED lights or flashes)
*5 Device dependent Error .... When the self-test generates an error
*6 Device dependent Error .... When this command is executed during integrating (INTEGRATOR LED lights or flashes)

For information on other errors, refer to the notes attached to each command.

NOTE:

- A misspelled message and the presence of data after a query always produce a command error. (except :MEASure?)
- < > = contents of the data portion.
  [Numeric data values are indicated by format as (NR1), (NR2) and (NR3), representing integer, fixed-point and floating point decimal data values respectively, or as (NRf), representing any of these formats]
- In GP-IB, Event Status Enable Register and ∗SRE can be set to enable SRQ interrupts to the controller.
- When each query ends in some kind of error, no response message is created for the query.

4.5 Message List

Command	Data Contents ( ) = response data	Description	Error	Ref page
Integration				
:INTEGrate?		Queries integration time and integration condition	*2, *5	94
:INTEGrate:STATe	<Integration condition> <Integration condition> = START/ STOP/ RESET	Sets the condition of the integrate operation	*3, *5	95
:INTEGrate:STATe?		Queries integration condition	*2, *5	95
:INTEGrate:TIME	<hours(NR1)>,<minutes(NR1)>	Sets integration time	*3, *5, *6	95
:INTEGrate:TIME?		Queries integration time	*2, *5	95
Analog output items				
:AOUT	<output item> <output item> = VA/ PF/ PAH/ MAH/ AH/ PWH/ MWH/ WH	Sets analog output item	*3, *5	94
:AOUT?		Queries analog output item	*2, *5	94
Average times (average)				
:AVERaging	1/ 2/ 5/ 10/ 25/ 50/ 100 (NR1)	Sets average times	*3, *4, *5	89
:AVERaging?	(1/ 2/ 5/ 10/ 25/ 50/ 100)	Queries average times	*2, *5	89
VT (PT)/CT ratio				
:SCALe?	(<VT ratio>;<CT ratio>)	Queries VT (PT) and CT ratio settings	*2, *5	104
:SCALe:VT (:SCALe:PT)	1/ 2/ 4/ 10/ 20/ 30/ 60/ 100 (NR1)	Sets VT (PT) ratio	*3, *4 *5, *6	104
:SCALe:VT? (:SCALe:PT?)	(<VT(PT) ratio(NR1)>)	Queries VT (PT) ratio	*2, *5	104
:SCALe:CT	1/ 2/ 3/ 4/ 5/ 6/ 8/ 10/ 12/ 15/ 16/ 20/ 24/ 25/ 30/ 40/ 50/ 60/ 75/ 80/ 100/ 200/ 300/ 500/ 1000/ 2000/ 3000/ 5000/ 10000 (NR1)	Sets CT ratio	*3, *4 *5, *6	105
:SCALe:CT?	(<CT ratio(NR1)>)	Queries CT ratio	*2, *5	105

Error description (an error occurs when executing messages in the following cases):

*1 Command Error.....When data is present after the command

*2 Query Error.....When the response message exceeds 1000 bytes, or when a query follows ∗IDN?

*3 Execution Error.....When invalid character or numeric data is present

*4 Device dependent Error.....When this command is executed in the hold state (HOLD LED lights or flashes)

*5 Device dependent Error.....When the self-test generates an error

*6 Device dependent Error.....When this command is executed during integrating (INTEGRATOR LED lights or flashes)

For information on other errors, refer to the notes attached to each command.

NOTE:

- A misspelled message and the presence of data after a query always produce a command error. (except :MEASure?)
- < > = contents of the data portion.
  [Numeric data values are indicated by format as (NR1), (NR2) and (NR3), representing integer, fixed-point and floating point decimal data values respectively, or as (NRf), representing any of these formats]
- In GP-IB, Event Status Enable Register and ∗SRE can be set to enable SRQ interrupts to the controller.
- When each query ends in some kind of error, no response message is created for the query.

Command	Data Contents ( ) = response data	Description	Error	Ref page
Display items				
:DISPlay	<Display area a>, <Display area b>, <Display area c>, <Display area d> <Display area a> = V/ A/ W/ VA/ PF/ AH/ WH <Display area b> = A/ W/ PWH/ MWH/ WH/ PAH/ MAH/ AH/ TIME <Display area c> = W/ PF/ FREQ/ PWH/ MWH/ WH/ PAH/ MAH/ AH <Display area d> = V/ A/ W/ VA/ PF/ VPK/ APK/ TIME	Sets display item	*3, *5	96
:DISPlay?		Queries display item	*2, *5	96
Hold				
:HOLD	ON/OFF	Sets display hold ON or OFF	*3, *5	97
:HOLD?		Queries whether or not the display is currently held	*2, *5	97
:PEAKhold	ON/OFF	Enables or disables the peak value hold function	*3, *5	97
:PEAKhold?		Queries whether or not the display of peak value is currently held	*2, *5	97
Header				
:HEADer	ON/OFF	Sets header	*3, *5	96
:HEADer?		Queries the header	*2, *5	96
Measurement data				
:MEASure?	<Item 1>, ••• <Item 15> V/ A/ W/ VA/ PF/FREQ/ PAH/ MAH/ AH/ PWH/ MWH/WH/ VPK/ APK/ TIME (A total of fifteen items can, but need not, be set.)	Queries set measurement data	*2, *3 *5	98
:DATAout:ITEM	<Item 1 (NR1)>, <Item 2 (NR1)>	Sets ":MEASure?" output item	*3, *5	100
:DATAout:ITEM?		Queries ":MEASure?" output item	*2, *5	100

Error description (an error occurs when executing messages in the following cases):

*1 Command Error..... When data is present after the command
*2 Query Error ..... When the response message exceeds 1000 bytes, or when a query follows ∗IDN?
*3 Execution Error ..... When invalid character or numeric data is present
*4 Device dependent Error .... When this command is executed in the hold state (HOLD LED lights or flashes)
*5 Device dependent Error .... When the self-test generates an error
*6 Device dependent Error .... When this command is executed during integrating (INTEGRATOR LED lights or flashes)

For information on other errors, refer to the notes attached to each command.

NOTE:

- A misspelled message and the presence of data after a query always produce a command error. (except :MEASure?)
- < > = contents of the data portion.
  [Numeric data values are indicated by format as (NR1), (NR2) and (NR3), representing integer, fixed-point and floating point decimal data values respectively, or as (NRf), representing any of these formats]
- In GP-IB, Event Status Enable Register and ∗SRE can be set to enable SRQ interrupts to the controller.
- When each query ends in some kind of error, no response message is created for the query.

4.5 Message List

Command	Data Contents ( ) = response data	Description	Error	Ref page
RS-232C	RS-232C			
:RS232c?		Queries RS-232C settings	*2	101
:RS232c:ANSWer	ON/ OFF	Sets confirmation message	*3	102
:RS232c:ANSWer?		Queries confirmation message	*2	102
:RS232c:ERRor?		Queries RS-232C communication error	*2	103
:RS232c:HANDshake	HARD/ OFF	Sets RS-232C communication handshake	*3	103
:RS232c:HANDshake?		Queries RS-232C communication handshake	*2	103
Separator, terminator				
:TRANsmit:SEParator	0/ 1 (NR1)	Sets message unit and separator	*3, *5	106
:TRANsmit:SEParator?	(0/ 1)	Queries message unit and separator	*2, *5	106
:TRANsmit:TERMinator	0/ 1 (NR1)	Set message and terminator	*3	107
:TRANsmit:TERMinator?	(0/ 1)	Queries message and terminator	*2, *5	107

Error description (an error occurs when executing messages in the following cases):

*1 Command Error.....When data is present after the command

*2 Query Error.....When the response message exceeds 1000 bytes, or when a query follows ∗IDN?

*3 Execution Error.....When invalid character or numeric data is present

*4 Device dependent Error.....When this command is executed in the hold state (HOLD LED lights or flashes)

*5 Device dependent Error.....When the self-test generates an error

*6 Device dependent Error.....When this command is executed during integrating (INTEGRATOR LED lights or flashes)

For information on other errors, refer to the notes attached to each command.

NOTE:

- A misspelled message and the presence of data after a query always produce a command error. (except :MEASure?)
- < > = contents of the data portion.
  [Numeric data values are indicated by format as (NR1), (NR2) and (NR3), representing integer, fixed-point and floating point decimal data values respectively, or as (NRf), representing any of these formats]
- In GP-IB, Event Status Enable Register and ∗SRE can be set to enable SRQ interrupts to the controller.
- When each query ends in some kind of error, no response message is created for the query.

4.6 Message Reference

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

Numeric Parameters:

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

Shows the command description.

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

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

Syntax

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

Describes the message.

Description

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

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

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

Shows an example of an actual command application.
(Normally described with HEADER ON, (except the HEADER command itself).)

Example

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

4.6.1 Standard Commands

Messages specific to the RS-232C or GP-IB interface are identified by their corresponding symbols.

(1) System Data Command

Queries device ID.

Syntax

Query `*IDN?`

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

Example

Response `HIOKI,3334,00,V1.00`

The Device ID is HIOKI, 3334, Model code 00 (standard model), software version 1.00.

Note

- The response message has no header.
- In the model code, 00 denotes the standard model (3334) while 01 the model with GP-IB support (3334-01).
- "*IDN?" is the last query message of the program messages. Thus a subsequent query on the same line will generate a query error and no response message is output.

(2) Internal Operation Command

Initialize Device (system reset)

Syntax

Command: ***RST**

Description

Command: Resets instrument settings to factory defaults.
Default setting: "4.4.5 Initialization Items"(⇒ p.74)

Note

- The GP-IB address is not initialized.
- Communication handshake, confirmation message and response message terminator settings are not initialized.
- This command runs also in the event of a system error.

Execute Self-Test and Query the Result

Syntax

Query: ***TST?**

Response: <0 to 4 (NR1)>
0: No Errors
1: ROM Error
2: RAM Error
3: Control circuit Error
4: Backup data Error

Description

Perform instrument self-test and return the result as numerical value 0 to 4.

Example

Query: ***TST?**

Response: **1**

A ROM error occurred.

Note

- A header is not added to the response message.
- Device dependent error/ If this command is executed during integrating (INTEGRATOR LED lights) and hold state (HOLD LED lights or flashes).
- This query runs also in the event of a system error.

(3) Synchronization Commands

Set the OPC bit of SESR When Finished All Pending Operations

Syntax Command `*OPC`

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

Example `:MEAS?;*OPC`

The OPC bit of the SESR is set after commands MEAS? have finished processing.

Set 1 in the output queue after completing all running operations

Syntax Query `*OPC?`

Response `1`

Description .When the command (of transferred commands) prior to the *OPC command has finished processing, “1” is stored in the output queue.

Example `:MEAS?;*OPC?`

"1" is stored in the output queue after MEAS? data has been created.

Note A header is not added to the response message.

Wait until display update finishes before executing the next command.

Syntax Command `*WAI`

Description No commands after *WAI are run until the next display update completes.

Example `:MEAS? V,A,W;*WAI;:MEAS? V,A,W`

Data is imported at each display update.

Note

- If this command is executed in the hold state, the displayed data will not change.
- If this command is executed during range switching over, no displays change.
- The longest possible wait period is 200 ms.

(4) Status and Event Control Commands

Clear the Status Byte Resisters and Event Resisters

Syntax Command `*CLS`

Description Clears the event registers. Also clears the bit of the Status Byte Register corresponding to event resisters.(SESR, ESR0, ESR1, ESR2, RS232c:ERRor)

Note

- The output queue, the various enable registers and MAV bit 4 of the Status Byte Register are unaffected.
- This command runs also in the event of a system error.

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

Syntax

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

Description

Command: The SESER mask is set to the numerical value 0 to 255. The initial value (at power-on) is 0. (⇒ p.69)
The numerical value can be in NRf format, but any digits after the decimal point will be rounded.
Since the 3334 does not use URQ (bit6) and RQC (bit 1), these events do not occur even when they are set to 1.

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

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

Example

Command ***ESE 36**
Sets bits 5 and 2 of SESER.

Query ***ESE?**
Response ***ESE 36** (Headers: ON)
36 (Headers: OFF)

Read and Clear the Standard Event Status Register (SESR)

Syntax

Query ***ESR?**
Response <0 to 255 (NR1)>

Description

Returns the contents of the SESR as an NR1 value from 0 to 255, then clears register contents.
A header is not added to the response message. (⇒ p.69)

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

Example

32
Bit 5 of the SESR was set to 1.
The command error occurs.

Note

- This query runs also in the event of a system error.

Write and Read the Service Request Enable Register (SRER)

Syntax

Command: **∗SRE** <0 to 255 (NR1)>

Query: **∗SRE?**

Response: <0 to 255 (NR1)>

Description

Command: The SRER mask is set to the numerical value 0 to255.
The numerical value can be in NRf format, but any digits after the decimal point will be rounded.
Bits 3, 6 and 7 are ignored.
The data is initialized to zero at power-on. (⇒ p.68)

Query: The contents of the SRER, as set by the ∗SRE command, are returned as an NR1 value (0 to 255).

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	unused	ESB	MAV	unused	ESE2	ESE1	ESE0

Example

Command: ***SRE 33**
Set SRER bits 0 and 5 to 1.

Query: ***SRE?**

Response: ***SRE 33** (Headers: ON)
33 (Headers: OFF)
SRER bits 0 and 5 have been set to 1.

Read the Status Byte and MSS Bit

Syntax

Query: **∗STB?**

Response: <0 to 119 (NR1)>

Description

The contents of the STB are returned as an NR1 value (0 to 119).
A header is not added to the response message. (⇒ p.68)

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	MSS	ESB	MAV	unused	ESE2	ESE1	ESE0

Example

Query: ***STB?**

Response: **16**
STB bit 4 has been set to 1.

Note

- Bit 6 is the MSS bit.
- Even if service requests are cleared by serial polling, the MSS bit is not cleared.
- This command runs also in the event of a system error.

Request a Sample

Syntax

Command: **∗TRG**

Description

Performs one measurement when the display values or peak values are held.

Example

```
:HOLD ON;*TRG;:MEAS?
```

4.6.2 Device-Specific Commands

(1) Event Status Register

Read and Write Device-Specific Event Status Enable Registers ESER0, ESER1 and ESER2

ESER0

Syntax

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

Description

Command

Sets the mask pattern in Event Status Enable Register 0 (ESER0) for the Event Status Register.(⇒ p.70)

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Bits 3 and 5 are ignored.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
DS	FOR	unused	IE	AVG	IDO	PODI	MODI

Example

Command `:ESE0 4`

Set SRER0 bit 2 to 1.

Query `:ESE0?`
Response `:ESE0 4` (Headers: ON)
`4` (Headers: OFF)

Note

Data initializes to zero at power-on.

ESER1

Syntax

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

Description

Command

Sets the mask pattern in Event Status Enable Register 1 (ESER1) for the Event Status Register.(⇒ p.70)

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
AOW	AOA	AOV	OA	OV	HW	HA	HV

Example

Command `:ESE1 24`

Set ESER1 bits 3 and 4 to 1.

Query `:ESE1?`
Response `:ESE1 24` (Headers: ON)
`24` (Headers: OFF)

Note

- Data initializes to zero at power-on.

ESER2

Read and Write Device-Specific Event Status Enable Registers ESER0, ESER1 and ESER2

Syntax

Command **:ESE2** <0 to 255 (NR1)>

Query **:ESE2?**

Response <0 to 255 (NR1)>

Description

Command Sets the mask pattern in Event Status Enable Register 2 (ESER2) for the Event Status Register.(⇒ p.70)

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Bits 0 to 4 are ignored.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
BE	CPODI	CMODI	unused	unused	unused	unused	unused

Example

Command **:ESE2 96**

Set ESER2 bits 5 and 6 to 1.

Query **:ESE2?**

Response **:ESE2 96** (Headers: ON)

96 (Headers: OFF)

Note

Data initializes to zero at power-on.

Read Device-Specific Event Status Registers ESR0, ESR1 and ESR2

Syntax

Query **:ESR0?**
:ESR1?
:ESR2?

Response <0 to 255 (NR1)>

Description

Query Returns event status register content as a numerical value in the NR1 format.

A header is not added to the response message.

Note

- Executing ESR0? clears the contents of ESR0.
- Executing ESR1? clears the contents of ESR1.
- Executing ESR2? clears the contents of ESR2.

(2) Rectifier type

Sets and queries rectifier type

Syntax

Command **:RECTifier** <Rectifier type>
Query **:RECTifier?**
Response <Rectifier type (NR1)>
<Rectifier type (NR1)> = ACDC/ DC/ AC

Description

Command: Sets the rectifier type.

Query: Returns rectifier type as character data.

Example

Command **:RECT ACDC**
Sets the rectifier type to AC/DC.

Query **:RECT?**
Response **:RECTIFIER ACDC** (Headers: ON)
ACDC (Headers: OFF)

(3) Average times (average)

Sets and queries average times

Syntax

Command **:AVERaging** <Average times (NR1)>
Query **:AVERaging?**
Response <Average times (NR1)>
<Average times (NR1)> = 1/ 2/ 5/ 10/ 25/ 50/ 100

Description

Command: Sets the display average times
The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Query: Returns display average times as a numerical value in NR1 format.

Example

Command **:AVER 10**
The count for averaging is set to 10.

Query **:AVER?**
Response **:AVERAGING 10** (Headers: ON)
10 (Headers: OFF)

Note

- Averaging starts over when the range is changed.
  See Acquiring the averaged data (⇒ p.112)

(4) Voltage range

Query the Voltage Range and Auto-Range Setting

Syntax

Query `:VOLTage?`

Response <Voltage range(NR1)>;<Auto-range ON/OFF>

Description

Query Returns the voltage range as a numerical value in NR1 format and the auto-range as ON or OFF.

Example

Query `:VOLT?`

Response `:VOLTAGE:RANGE 15;AUTO ON` (Headers: ON)

`15;ON` (Headers: OFF)

Voltage measurement is in auto-range mode in 15-V range.

Note

The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)

Set and Query the Voltage Auto-Range Setting

Syntax

Command `:VOLTage:AUTO` <ON/ OFF>

Query `:VOLTage:AUTO?`

Response <ON/ OFF>

ON: measures voltage in the auto-range.

OFF: ends voltage auto-range operation.

Description

Command Enables and disables the voltage auto-range.

Query Returns the ON/OFF setting of the voltage auto-range setting as ON or OFF.

Example

Command `:VOLT:AUTO ON`

The voltage auto-range is set to ON.

Query `:VOLT:AUTO?`

Response `:VOLTAGE:AUTO ON` (Headers: ON)

`ON` (Headers: OFF)

Note

Specifying a different range with the VOLTage:RANGe command disables auto-range operation.

Set and Query the Voltage Range Setting

Syntax

Command **:VOLTage:RANGe** <Voltage range (NR1)>
Query **:VOLTage:RANGe?**
Response <Voltage range (NR1)>
<Voltage range (NR1)> = 15/ 30/ 150/ 300

Description

Command: Sets the voltage range. (The unit is volt (V))
The numerical value can be in NRf format, but any digits after the decimal point will be rounded.
The instrument uses <voltage range> to select the optimum range for measurement. However, it goes to the next higher range when measurements are 100% f.s. of the range.

Query: Queries the voltage range setting.
Returns the voltage range as a numerical value in NR1 format.

Example

Command **:VOLT:RANG 15**
The 15-V range is set.

Query **:VOLT:RANG?**
Response **:VOLTAGE:RANGE 15** (Headers: ON)
15 (Headers: OFF)

Note

- Do not add a unit to the measurement range.
- Wait until the internal circuit has stabilized after changing a range before reading measurements.
- Setting a range disables auto-range.
- A set negative value is processed as an absolute value.
- A change in the range when average times is set to something other than 1, restarts averaging.
  See Acquiring the averaged data (⇒ p.112)
- If a value other than <Voltage range (NR1)> is specified, the specified value is set to a range which can be measured. If, however, the range full scale value is exceeded, then the next higher range is set.

(5) Current range

Query the Current Range and Auto-Range Setting

Syntax

Query `:CURRent?`

Response <Current range(NR2)>;<Auto-range ON/OFF>

Description

Query Returns the current range as a numerical value in NR2 format and the auto-range as ON or OFF.

Example

Query `:CURR?`

Response `:CURRENT:RANGE 0.1;AUTO ON` (Headers: ON)
`0.1;ON` (Headers: OFF)
Current measurement is in auto-range mode in 100-mA range.

Note

- The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)

Set and Query the Current Auto-Range Setting

Syntax

Command `:CURRent:AUTO` <ON/ OFF>

Query `:CURRent:AUTO?`

Response <ON/ OFF>
ON: measures current in the auto-range.
OFF: ends current auto-range operation.

Description

Command Enables and disables the current auto-range.

Query Returns the ON/OFF setting of the current auto-range setting as ON or OFF.

Example

Command `:CURR:AUTO ON`
The current auto-range is set to ON.

Query `:CURR:AUTO?`

Response `:CURRENT:AUTO ON` (Headers: ON)
`ON` (Headers: OFF)

Note

Specifying a different range with the CURRent:RANGe command disables auto-range operation.

Set and Query the Current Range Setting

Syntax

Command **:CURRent:RANGe** <Current range (NR2)>
Query **:CURRent:RANGe?**
Response <Current range (NR2)>
<Current range (NR2)> = 0.1/ 0.3/ 1.0/ 3.0/ 10.0/ 30.0

Description

Command: Sets the current range. (The unit is ampere (A))
The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place. (Valid digits: 4 digits)
The instrument uses <current range> to select the optimum range for measurement. However, it goes to the next higher range when measurements are 100% f.s. of the range.

Query: Queries the current range setting.
Returns the current range as a numerical value in NR2 format.

Example

Command **:CURR:RANG 0.1**
The 0.1-A range (100-mA range) is set.

Query **:CURR:RANG?**
Response **:CURRENT:RANGE 0.1** (Headers: ON)
0.1 (Headers: OFF)

Note

- Do not add a unit to the measurement range.
- Wait until the internal circuit has stabilized after changing a range before reading measurements.
- Setting a range disables auto-range.
- A set negative value is processed as an absolute value.
- A change in the range when average times is set to something other than 1, restarts averaging.
  See Acquiring the averaged data (⇒ p.112)
- If a value other than <Current range (NR2)> is specified, the specified value is set to a range which can be measured. If, however, the range full scale value is exceeded, then the next higher range is set.

(6) Analog output

Set and Query Analog output item

Syntax

Command: **:AOUT** <output item>

Query: **:AOUT?**

Response: <output item>

<output item> = VA/ PF/ PAH/ MAH/ AH/ PWH/ MWH/ WH

VA : apparent power (also S)
PF : power factor
PAH : positive current integration (also PIH)
MAH : negative current integration, (also MIH)
AH : total current integration (also IH)
PWH : positive power integration (also PWP or PINTEG)
MWH: negative power integration, (also MWP or MINTEG)
WH : total power integration (also WP or INTEG)

Description

Command: Sets the analog output item.

Query: Returns the analog output item as character data.

Example

Command: **:AOUT VA**

The analog output item is set to apparent power.

Query: **:AOUT?**

Response: **:AOUT VA** (Headers: ON)

VA (Headers: OFF)

(7) Integration

Queries the integration time and the integration condition

Syntax

Query: **:INTEGrate?**

Response: <0000 to 9999 (NR1)>,<00 to 59 (NR1)>;<integration condition>

Description

Query: Queries the integration time (hours, minutes) and the condition of the integration operation and returns them as a numerical value and character data.

Example

Query: **:INTEG?**

Response: **:INTEGRATE:TIME 0100,00;STATE START**

(Headers: ON)

0100,00;START (Headers: OFF)

Note

The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)

Set and Query the integration condition

Syntax

Command **:INTEGrate:STATe** <integration condition>
Query **:INTEGrate:STATe?**
Response <integration condition>
<integration condition> = START/ STOP/ RESET

Description

Command: Sets the condition of the integration operation.

Query: Returns the condition of the integration operation as character data.

Example

Command **:INTEG:STAT START**
The integration will start.

Query **:INTEG:STAT?**
Response **:INTEGRATE:STATE START** (Headers: ON)
START (Headers: OFF)

Note

- Device dependent error/ according to the INTEGRATOR LED. (Refer to the table below)
- Device dependent error/
  When the integration time reached 10000 hours.
  When the START command is executed with the integration value is ±999999M.

State of 3334 / Command	INTEGRATOR LED off	Key input (command)	
		INTEGRATOR LED lights	INTEGRATOR LED flashes
START	●	–	●
STOP	–	●	–
RESET	●	–	●

●: The command is executed.
–: A device dependent error is generated.

Set and Query the integration time

Syntax

Command **:INTEGrate:TIME** <0 to 9999 (NR1)>,<0 to 59 (NR1)>
Query **:INTEGrate:TIME?**
Response <0000 to 9999 (NR1)>,<00 to 59 (NR1)>

Description

Command: Sets the integration time (hours, minutes) respectively. Setting limit is from 1 minute to 9999 hours 59 minutes (1 minute step). Specifying 0 hours, 0 minutes sets this setting to 10000 hours.
The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.

Query: Returns the integration time (hours, minutes) as NR1 numerical data.

Example

Command **:INTEG:TIME 100,20**
Sets the integration time to 100 hours, 20 minutes.

Query **:INTEG:TIME?**
Response **:INTEGRATE:TIME 0100,20** (Headers: ON)
0100,20 (Headers: OFF)

(8) Display items

Set and Query the Display Items

Syntax

Command: **:DISPlay** <Display a>,<Display b>,<Display c>,<Display d>

Query: **:DISPlay?**

Response: <Display a>,<Display b>,<Display c>,<Display d>

<Display a> = V/ A/ W/ VA/ PF/ AH/ WH
<Display b> =A/ W/ PWH/ MWH/ WH/ PAH/ MAH/ AH/ TIME
<Display c> = W/ PF/ FREQ/ PWH/ MWH/ WH/ PAH/ MAH/ AH
<Display d> = V/ A/ W/ VA/ PF/ VPK/ APK/ TIME
V: voltage (also U), A: current (also I), W: active power (also P),
VA: apparent power (also S), PF: power factor,
AH: total current integration (also IH),
WH: total power integration (also WP or INTEG),
PWH: positive power integration (also PWP or PINTEG),
PAH: positive current integration (also PIH),
MAH: negative current integration (also MIH),
MWH: negative power integration (also MWP or MINTEG),
TIME: integration time, FREQ: frequency,
VPK: voltage waveform peak (also UP),
APK: current waveform peak (also IP)

Description

Command: Sets items in display areas a, b, c and d.

Query: Returns the displayed parameters as character data.

Example

Command: **:DISP V,A,W,TIME**

The voltage appears in display area a, current in display area b, active power in display area c and integration time in display area d.

Query: **:DISP?**

Response: **:DISPLAY V,A,W,TIME** (Headers: ON)
V,A,W,TIME (Headers: OFF)

(9) Header

Enables/disables and queries headers for the response message

Syntax

Command: **:HEADer** <ON/ OFF>

Query: **:HEADer?**

Response: <ON/ OFF>
ON: Headers are prefixed to response messages.
OFF: No header is affixed to the response message.

Description

Command: Sets whether or not the instrument will prefix headers to its response messages.
When the power is turned on, the data is initially set to ON.

Query: Returns the setting of headers for the response messages as ON or OFF.

Example

Command: **:HEAD ON**

Headers are prefixed to response messages.

Query: **:HEAD?**

Response: **:HEADER ON** (Headers: ON)
OFF (Headers: OFF)

(10)Hold

Set and query display hold

Syntax

Command **:HOLD** <ON/ OFF>

Query **:HOLD?**

Response <ON/ OFF>
ON: holds displayed value (display hold state)
OFF: cancels held display value.

Description

Command Sets display hold (ON) and cancels (OFF) display hold.

Query Returns the setting of display hold as ON or OFF.

Example

Command **:HOLD ON**
Holds displayed values

Query **:HOLD?**

Response **:HOLD ON** (Headers: ON)
ON (Headers: OFF)
Displayed data is held.

Note

Device dependent error/ During peak hold (HOLD LED flashes)

Set and query peak hold

Syntax

Command **:PEAKhold** <ON/ OFF/ RESET>

Query **:PEAKhold?**

Response <ON/ OFF>
ON: displays peak hold value (peak hold state)
OFF: displays instantaneous value.

Description

Command Sets peak value hold (ON) and cancels (OFF) peak value.
Clears the peak value and restarts (RESET)

Query Returns the setting of peak value hold as ON or OFF.

Example

Command **:PEAK ON**
Holds peak values

Query **:PEAK?**

Response **:PEAKHOLD ON** (Headers: ON)
ON (Headers: OFF)
Peak value is held.

Note

- Device dependent error/ During display hold (HOLD LED lights)
- Peak hold is always enabled in the 3334.
  PEAKhold ON displays this internal data. To clear the peak hold value, execute PEAKhold RESET.

(11)Measurement data

Queries measured data

Syntax

Query

```
:MEASure? <Measurement item 1>,…,<Measurement item 15>
```

(Up to 15 items)

Response

<Measurement item 1> <Measurement value>;…;

<Measurement item 15> <Measurement value>

<Measurement item> = V/ A/ W/ VA/ PF/ FREQ/ PAH/ MAH/ AH/ PWH/ MWH/ WH/ VPK/ APK/ TIME

V: voltage (also U), A: current (also I), W: active power (also P),
VA: apparent power (also S), PF: power factor, FREQ: frequency,
PAH: positive current integration (also PIH),
MAH: negative current integration (also MIH),
AH: total current integration (also IH),
PWH: positive power integration (also PWP or PINTEG),
MWH: negative power integration (also MWP or MINTEG),
WH: total power integration (also WP or INTEG),
VPK: voltage waveform peak (also UP),
APK: current waveform peak (also IP),
TIME: integration time

Output format

Header portion	Data portion
V, A, W, VA, PF, FREQ, VPK, APK	Numerical data in NR3 format (10 fixed characters) 3-digit display data: ±00ddddE±e (dddd: 4 numerical value items including decimal point, e: index 0, 3, 6) 4-digit display data: ±0dddddE±e (ddddd: 5 numerical value items including decimal point, e: index 0, 3, 6) 5-digit display data: ±ddddddE±e (dddddd: 6 numerical value items including decimal point, e: index 0, 3, 6)
PAH, MAH, AH, PWH, MWH, WH	Numerical data in NR3 format (11 fixed characters) ±dddddddE±e (ddddddd: 7 numerical value items including decimal point, e: index 0, 3, 6)
TIME	Numerical data in NR1 format (11 fixed characters) hhhhh, mm, ss (hours, minutes, seconds)

Error data

Header / Error	V, A, W, VA, PF, FREQ, VPK, APK	AH, PAH, MAH, PWH, MWH, WH
over-range	±999.99E+9	No syntax

Description

Query

Queries measurement values of measure items and returns them as character data or a numerical value.

Set character strings are used as a header. However, U, I, P, S ,etc. are replaced with V, A, W, VA ,etc.. The data is output in the order specified by the <measurement item>.

Queries measured data

Example

Query `:MEAS? V,A,W`

Response `V +150.00E+0;A +020.00E+0;W +03.000E+3`
(Headers: ON)
`+150.00E+0;+020.00E+0;+03.000E+3` (Headers: OFF)

Note

- If measurement item is not specified, produces the measured value set by ":DATAout:ITEM" command. In this case, the output data sequence is V, A, W, VA, PF, VPK, APK, FREQ, PAH, MAH, AH, PWH, MWH, WH, TIME. (The OFF setting is not output.)
  If all measurement items are set to OFF, the measured values of the displays a, b, c, and d are produced.
- When this query ends in any error other than out-of-range, no response message is created for this query.
- The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)
- An "o.r", or "-o.r" indication appears as "+999.99E+9" or "-999.99E+9".
- When the display is blank such as when ranges are switched, a response message cannot be created until measurement data appears. Therefore it is recommended that a fixed range be used.
  See "No response to the MEASure? command." (⇒ p.112)

Set and query ":MEASure?" output items

Syntax

Command **:DATAout:ITEM** <output item 1 (NR1)>,<output item 2 (NR1)>

Query **:DATAout:ITEM?**

Response <output item 1 (NR1)>,<output item 2 (NR1)>

Description

Command

The ":MEASure?" output item is set to the numerical value 0 to 255.

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

If no parameters are specified to the :MEASure? command, the items specified here are used to supply the measurement values.

If the bit which has no item is selected, no error occur.

Query

Returns the ":MEASure?" output item as an NR1 numerical value from 0 to 255.

	128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
output item 1	FREQ	APK	PF	unused	VA	W	A	V
output item 2	VPK	MAH	PAH	AH	TIME	MWH	PWH	WH

V: voltage, A: current, W: active power, VA: apparent power,
PF: power factor, FREQ: frequency, WH: total power integration,
PWH: positive power integration, MWH: negative power integration,
TIME: integration time, AH: total current integration,
PAH: positive current integration,
MAH: negative current integration,
VPK: voltage waveform peak, APK: current waveform peak

Example

Command **:DATA:ITEM 255,128**

Set V, A, W, VA, PF, VPK, APK and FREQ for ":MEASure?" output items.

Query **:DATA:ITEM?**

Response **:DATAOUT:ITEM 255,128** (Headers: ON)

255,128 (Headers: OFF)

Note

- If all measurement items are set to OFF, the measured values of the displays a, b, c, and d are produced.
- Unused bits are ignored.

(12)RS-232C

Query RS-232C

RS-232C

Syntax

Query
:RS232c?

Response
:RS232C:HANDSHAKE <HARD/OFF>;ANSWER <ON/ OFF>

<HARD/OFF> ;<ON/ OFF>

<HARD/OFF>
HARD: hardware handshake

OFF: no hardware handshake

<ON/ OFF>
ON: outputs a confirmation message.

OFF: does not output a confirmation message.

Description

Query
Returns current RS-232C communication handshake setting and confirmation message setting as character data.

Example

Query
:RS232?

Response
:RS232C:HANDSHAKE OFF;ANSWER OFF (Headers: ON)
OFF;OFF (Headers: OFF)

Note

- This query runs also in the event of a system error.
- The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)
- Queries are available also in GP-IB.

Sets and queries a confirmation message

RS-232C

Syntax

Command: **:RS232c:ANSWer** <ON/ OFF>

Query: **:RS232c:ANSWer?**

Response: <ON/ OFF>
ON: outputs a confirmation message(⇒ p.62)
OFF: does not output a confirmation message.

Description

Command: Determines whether or not a confirmation message is to be output.
This command runs also in the event of a system error.

Query: Returns ON or OFF to a confirmation message setting.

Example

Command

```
PRINT #1,":RS232:ANSW ON"      [Result] (comment)
INPUT #1,A$
PRINT A$                       000(OK)
PRINT #1,"CUR:RANG 10.0"
INPUT #1,A$
PRINT A$                       001("CUR:RANG" is an
                               error)
PRINT #1,"CURR:RANG?"
INPUT #1,A$
PRINT A$                       :CURRENT:RANGE
                               30.0;000
                                      (Query data is OK)
                               Confirmation messages
```

Note

- These command and query run also in the event of a system error.
- When set to ON, operation may become unstable if the message is not received.
- This command is used for synchronizing with the controller in RS-232C, but can be used also in GP-IB. However, be sure to import this message.

Queries RS-232C communication error data

RS-232C

Syntax

Query: **:RS232c:ERRor?**

Response: <Communication error data (NR1)>

<Communication error data (NR1)> = 0 to 6

Description

Query

Returns RS-232C communication error data as NR1 numerical data and clears the contents.

The *CLS command sets the communication error data to 0.

A header is not added to the response message.

Bit 2: overrun error (data loss)

Bit 1: framing error (incorrect data read)

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	unused	unused	unused	unused	Overrun	Framing	unused

Example

Query: **:RS232:ERR?**

Response: **4**

An overrun error has occurred.

Note

- This query runs also in the event of a system error.
- Queries are available also in GP-IB.

Set and query RS-232C communication handshake

RS-232C

Syntax

Command: **:RS232c:HANDshake** <HARD/ OFF>

Query: **:RS232c:HANDshake?**

Response: <HARD/ OFF>

HARD: hardware handshake (using RTS/CTS)

OFF: no hardware handshake

Description

Command

Sets a communication handshake

This command runs also in the event of a system error.

When HARD is set, the screen stops when the content of the input buffer exceeds 375 bytes. The screen is restored when input buffer content goes below 125 bytes. In the 3334, processing of commands reduces buffer space. However, communications are not restored until buffer content goes below 125 bytes. The **SHIFT(LOCAL)** key allows the user to reset the handshake to resolve situations like this.

To prevent communications from stopping, command length should be less than 125 bytes and never exceed 375 bytes.

Query

Returns the contents of a communication handshake as character data.

Example

Command: **:RS232:HAND HARD**

Sets a hardware handshake (HARD).

Query: **:RS232:HAND?**

Response: **:RS232C:HANDSHAKE HARD** (Headers: ON)

HARD (Headers: OFF)

Note

- These command and query run also in the event of a system error.
- Setup and queries are available also in GP-IB.

(13)VT and CT ratio

Queries VT (PT) and CT ratio

Syntax

Query `:SCALe?`

Response <VT ratio (NR1)>;<CT ratio (NR1)>

<VT ratio (NR1)> = 1/ 2/ 4/ 10/ 20/ 30/ 60/ 100

<CT ratio (NR1)> = 1/ 2/ 3/ 4/ 5/ 6/ 8/ 10/ 12/ 15/ 16/ 20/ 24/ 25/ 30/ 40/ 50/ 60/ 75/ 80/ 100/ 200/ 300/ 500/ 1000/ 2000/ 3000/ 5000/ 10000

Description

Query Returns current VT and CT ratios as NR1 numerical data.

Example

Query `:SCAL?`

Response `:SCALE:VT 2;CT 3`

2 is set as the VT (PT) ratio and 3 is set as the CT ratio.

Note

- The :TRANsmit:SEParator command makes it possible to change the message unit separator from a semicolon (;) to a comma (,). (⇒ p.106)

Set and query VT (PT) ratio

Syntax

Command `:SCALe:VT` <VT ratio (NR1)> (also :SCALe:PT?)

Query `:SCALe:VT ?` (also :SCALe:PT?)

Response <VT ratio (NR1)>

<VT ratio (NR1)> = 1/ 2/ 4/ 10/ 20/ 30/ 60/ 100

Description

Command Sets a VT (PT) ratio

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Query Returns the VT (PT) ratio setting as an NR1 value.

Example

Command `:SCAL:VT 10`

Sets a VT (PT) ratio of 10.

Query `:SCAL:VT?`

Response `:SCALE:VT 10` (Headers: ON)

`10` (Headers: OFF)

Note

A change in VT ratio when average times is set to something other than 1, restarts averaging.

See Acquiring the averaged data (⇒ p.112)

Set and query CT ratio

Syntax

Command `:SCALe:CT` <CT ratio (NR1)>

Query `:SCALe:CT?`

Response <CT ratio (NR1)>

<CT ratio (NR1)> = 1/ 2/ 3/ 4/ 5/ 6/ 8/ 10/ 12/ 15/ 16/ 20/ 24/ 25/ 30/ 40/ 50/ 60/ 75/ 80/ 100/ 200/ 300/ 500/ 1000/ 2000/ 3000/ 5000/ 10000

Description

Command: Sets a CT ratio.
The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Query: Returns the CT ratio setting as an NR1 value.

Example

Command `:SCAL:CT 2`
Sets a CT ratio of 2.

Query `:SCAL:CT?`
Response `:SCALE:CT 2` (Headers: ON)
`2` (Headers: OFF)

Note

A change in CT ratio when average times is set to something other than 1, restarts averaging.

See Acquiring the averaged data (⇒ p.112)

(14)Message

Set and query a message unit separator

Syntax

Command **:TRANsmit:SEParator** <0/ 1>

Query **:TRANsmit:SEParator?**

Response <0/ 1>

When header is set to OFF, the following message unit separator is set.

0: semicolon ";"

1: comma ","

Description

Command

Sets the message unit separator for the response message.

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

This command runs also in the event of a system error.

Query

Returns the message unit separator for the response message as 0 or 1.

Example

Command **:TRAN:SEP 0;:HEAD OFF;:MEAS? V,A** (specify ;)

Response **+0101.2E+0;+02.120E+0** (; is produced)

Command **:TRAN:SEP 1;:HEAD OFF;:MEAS? V,A** (specify ,)

Response **+0101.2E+0,+02.120E+0** (, is produced)

Command **:TRAN:SEP 0;:HEAD ON;:MEAS? V,A** (specify ;)

Response **V +0101.2E+0;A +02.120E+0** (; is produced)

Command **:TRAN:SEP 1;:HEAD ON;:MEAS? V,A** (specify ,)

Response **V +0101.2E+0;A +02.120E+0** (, is not produced)

When header is set to ON, a comma "," message unit separator setting is converted to a semicolon ";".

Query **:TRAN:SEP?**

Response **:TRANSMIT:SEPARATOR 1** (Headers: ON)

1 (Headers: OFF)

Note

Be sure to turn the header off when changing a message unit separator. (:HEAD OFF)

Set and query the response message terminator

Syntax

Command **:TRANsmit:TERMinator** <0/ 1>

Query **:TRANsmit:TERMinator?**

Response <0/ 1>

A terminator has the following format

	RS-232C	GP-IB
0:	LF	EOI with LF
1:	CR+LF	CR+EOI with LF

Description

Command: Sets a response message terminator.

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Query: Returns the response message terminator setting as 0 or 1.

Example

Command **:TRAN:TERM 0**

Sets the terminator to EOI with LF.

Query **:TRAN:TERM?**

Response **:TRANSMIT:TERMINATOR 1** (Headers: ON)

1 (Headers: OFF)

Note

This command runs also in the event of a system error. (However, the query is not run.)

4.6.3 Valid Command According to Condition (Standard Command)

Cont: Continue
●: can be executed / –: cannot be executed

Condition / Command	Integration reset		Integration START		Integration STOP		System error
	Cont	HOLD	Cont	HOLD	Cont	HOLD	
***CLS**	●	●	●	●	●	●	●
***ESE**	●	●	●	●	●	●	–
***ESE?**	●	●	●	●	●	●	–
***ESR?**	●	●	●	●	●	●	●
***IDN?**	●	●	●	●	●	●	–
***OPC**	●	●	●	●	●	●	–
***OPC?**	●	●	●	●	●	●	–
***RST**	●	●	●	●	●	●	●
***SRE**	●	●	●	●	●	●	–
***SRE?**	●	●	●	●	●	●	–
***STB?**	●	●	●	●	●	●	●
***TRG**	–	●	–	●	–	●	–
***TST?**	●	–	–	–	●	–	●
***WAI**	●	●	●	●	●	●	–

Explanations for conditions

Integration reset : Integration is stopped and integration time and value is reset (INTEGRATOR LED off)
Integration START : Integration is in progress (INTEGRATOR LED lights)
Integration STOP : Integration is stopped (INTEGRATOR LED flashes)
Continue : Display is being updated at the sampling (continuous display)
HOLD : Display is on hold (HOLD LED lights or flashes)
System error : Err.1 to 4 are displayed

4.6.4 Valid Commands According to Condition (Specific Command)

Cont: Continue / ●: can be executed / –: cannot be executed

Condition / Command	Integration reset		Integration START		Integration STOP		System error
	Cont	HOLD	Cont	HOLD	Cont	HOLD	
AOUT	●	●	●	●	●	●	–
AOUT?	●	●	●	●	●	●	–
AVERaging	●	–	●	–	●	–	–
AVERaging?	●	●	●	●	●	●	–
CURRent?	●	●	●	●	●	●	–
CURRent							
:AUTO	●	–	–	–	–	–	–
:AUTO?	●	●	●	●	●	●	–
:RANGe	●	–	–	–	–	–	–
:RANGe?	●	●	●	●	●	●	–
DATAout							
:ITEM	●	●	–	–	●	●	–
:ITEM?	●	●	●	●	●	●	–
DISPlay	●	●	●	●	●	●	–
DISPlay?	●	●	●	●	●	●	–
ESE0	●	●	●	●	●	●	–
ESE0?	●	●	●	●	●	●	–
ESE1	●	●	●	●	●	●	–
ESE1?	●	●	●	●	●	●	–
ESE2	●	●	●	●	●	●	–
ESE2?	●	●	●	●	●	●	–
ESR0?	●	●	●	●	●	●	–
ESR1?	●	●	●	●	●	●	–
ESR2?	●	●	●	●	●	●	–
HEADer	●	●	●	●	●	●	–
HEADer?	●	●	●	●	●	●	–
HOLD *1	●	●	●	●	●	●	–
HOLD?	●	●	●	●	●	●	–

*1: During peak value hold, the command is invalid.

Cont: Continue / ●: can be executed / –: cannot be executed

Command \ Condition	Integration reset		Integration START		Integration STOP		System error
	Cont	HOLD	Cont	HOLD	Cont	HOLD	
INTEGrate?	●	●	●	●	●	●	–
INTEGrate							
:STATe							
START	●	●	–	–	●	●	–
STOP	–	–	●	●	–	–	–
RESET	●	●	–	–	●	●	–
:STATe?	●	●	●	●	●	●	–
:TIME	●	–	–	–	–	–	–
:TIME?	●	●	●	●	●	●	–
MEASure?	●	●	●	●	●	●	–
PEAKhold	●	●*2	●	●*2	●	●*2	–
PEAKhold?	●	●	●	●	●	●	–
RECTifier	●	–	–	–	–	–	–
RECTifier?	●	●	●	●	●	●	–
RS232c? *3	●	●	●	●	●	●	●
RS232c							
:ANSWer *3	●	●	●	●	●	●	●
:ANSWer? *3	●	●	●	●	●	●	●
:ERRor? *3	●	●	●	●	●	●	●
:HANDshake *3	●	●	●	●	●	●	●
:HANDshake? *3	●	●	●	●	●	●	●
SCALe?	●	●	●	●	●	●	–
SCALe							
:CT	●	–	–	–	–	–	–
:CT?	●	●	●	●	●	●	–
:VT	●	–	–	–	–	–	–
:VT?	●	●	●	●	●	●	–
TRANsmit							
:SEParator	●	●	●	●	●	●	●
:SEParator?	●	●	●	●	●	●	–
:TERMinator	●	●	●	●	●	●	●
:TERMinator?	●	●	●	●	●	●	–
VOLTage?	●	●	●	●	●	●	–
VOLTage							
:AUTO	●	–	–	–	–	–	–
:AUTO?	●	●	●	●	●	●	–
:RANGe	●	–	–	–	–	–	–
:RANGe?	●	●	●	●	●	●	–

*2: During display hold, the command is invalid.
*3: Command for RS-232C.

4.7 Troubleshooting (Communications)

When the 3334 is malfunctioning, attempt checking and troubleshooting according to the instructions shown below.
The causes/treatments without marks (GP-IB / RS-232C) are common to both the RS-232C and GP-IB.

Symptom	Cause / Treatment
The RS-232C/ GP-IB has stopped working completely.	• Are the cables properly connected?(⇒ p.58) • Are all the devices powered on? • Are correct cables used? (⇒p.58 to 60) • Has the communication condition been correctly set? RS-232C (⇒ p.59) • Is the device address for the instrument set correctly? GP-IB (⇒ p.60) • Does some other device have the same device address? GP-IB
Communication failure with RS-232C/GP-IB.	• Do the instrument and controller have the same settings (baud rate, data length, parity, and stop bit)? RS-232C (⇒ p.59) • Ensure the message terminators (delimiters) for the controller are same as the instrument. GP-IB See "Message Terminators" (⇒ p.64)
After transmission on the RS-232C/ GP-IB bus, the keys on the instrument freeze up and have no effect.	• Press the SHIFT(LOCAL) key on the front panel of the instrument to release the remote state.(⇒ p.61) • Has a LLO (Local Lock-Out) command been transmitted? Transmit a GTL command to put the instrument into the local state. GP-IB
When attempting to read data using a BASIC INPUT statement, the RS-232C bus hangs. RS-232C	• Be sure to transmit one query before each INPUT statement. • Have any of these transmitted queries resulted in as error?
When attempting to read data using a HP-Basic ENTER statement, the GP-IB bus hangs. GP-IB	• Be sure to transmit one query before each ENTER statement. • Have any of these transmitted queries resulted in an error?
Although a command has been transmitted, nothing has happened.	• Using the *ESR? query, inspect the standard event status register, and check what type of error has occurred.⇒Check error content. (⇒ p.85) • Using the RS232c:ERRor? query, and check whether transmission error occurred on the RS-232C. RS-232C (⇒ p.103) • Set the RS232c:ANSWer to ON and check execution. RS-232C (⇒ p.102)
Sending several queries, produces only one response.	• Has an error occurred? • Send the queries one at a time, and read the responses individually. When you want to read them in all at once, try doing so by putting them all on one line separated by the message separator character. • Have you used the *IDN? query? The query command is not executed after *IDN?.
The response message to a query differs from the display on the front panel.	• Due to the response message being produced at the instant that the instrument receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.

4.7 Troubleshooting (Communications)

Symptom	Cause / Treatment
Sometimes service requests are not generated. GP-IB	• Have the service request enable register and the various event status enable registers been correctly set? (⇒p.85 to 88) • Clear all the event registers at the end of SRQ processing subroutines by using the *CLS command. If an event bit is not cleared, no service request will be generated for that event.(⇒ p.84)
Averaged data cannot be acquired.	A change in current range, average times, VT ratio and CT ratio restarts averaging process and indicates the instantaneous value measured when starting. To obtain an average value, wait for the first average process to end (See "Interval between display updates" (⇒ p.31) or monitor the ESR0? AVG flag described below. 1. Clear the event flag and wait for the first indication to appear after a change in range : CURR:RANG 1, ∗WAI; ∗CLS (example: when changing to the 1-mA range) To change to VT ratio range, change the :CURR:RANG command to the SCAL:VT command; to change to CT ratio, change to the SCAL:CT command; to change to average times, change to the AVER command. 2. Check that the AVG flag becomes 1 Use :ESR0? to read 0 into the event status register Repeat until the AVG flag (bit 3) becomes 1 3. Import data when the AVG flag becomes 1 :MEAS?
No response to the MEASure? command.	The MEASure? command does not generate a response message until display data is created when a flag is displayed to notify a change in range. In the 3334, a flag is displayed during a 0.6 s interval after a change in range and no response message is returned in this interval. In auto range operation, when ranges change irregularly and changes often involve multiple ranges, no response message may be returned during these changes. To prevent this, use a fixed range or monitor the ESR0? DS flag (bit 7) and obtain the data when the DS flag becomes 1. Example: 1. Clear the ∗CLS event register 2. Use :ESR0? to read 0 into the event status register Repeat until the DS flag (bit 7) becomes 1 3. Import data when the DS flag becomes 1 :MEAS?

4.8 Device Compliance Statement

GP-IB

Information on compliance to standards" based on the IEEE 488.2 standard

(1) IEEE 488.1 interface functions

See "The GP-IB interface" (⇒ p.57)

(2) Operation with a device address other than 0 through 30

A setting outside the 0 to 30 range cannot be made.

(3) Timing of changed device address recognition

A change of address is recognized immediately after changing.

(4) Device settings at power on

The status information is cleared, and all other items are preserved. However, the header on/off setting, and response message separator and terminator are all reinitialized.

(5) List of message exchange options

- Input buffer capacity and operation

  See "Input Buffer" (⇒ p.66)
- Queries to which multiple response message units are returned

  :VOLTage? 2
  :CURRent? 2
  :INTEGrate? 2
  :MEASure? ..... 1 to 15
  :SCALe? 2
  :RS232c? 2
- Queries producing responses as syntax checking is performed:
  All queries produce responses when syntax checking is performed.
- Whether any queries produce responses when read:
  There are no queries which produce response messages at the instant they are read in by the controller.
- Whether any commands are coupled:
  There are no relevant commands.

(6) Summary of functional elements for use when constructing device specific commands, and whether compound commands or program headers can be used:

The followings can be used

- Program message
- Program message terminator
- Program message unit
- Program message unit separator
- Command message unit
- Query message unit
- Command program header
- Query program header
- Program data
- Character program data
- Decimal program data
- Compound commands and program headers

(7) Buffer capacity limitations for block data

Block data is not used.

(8) Summary of program data elements used in expressions, and deepest nesting level allowable in sub-expressions, including syntax restrictions imposed by the device.

Sub-expressions are not used. Character data and decimal data are the only program data elements used.
(excluding **`*IDN?`**)

(9) Response syntax for queries

See "4.6 Message Reference"(⇒ p.81)

(10) Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages

There are no device to device messages.

(11) Response capacity for block data

Block data does not appear in responses.

(12) Summary of standard commands and queries used

See "4.5 Message List"(⇒ p.76)

(13) Device state after a calibration query has been completed without any problem

The "**`*CAL?`**" query is not used.

(14) Existence/nonexistence of "*DDT" command

The "**`*DDT`**" command is not used.

(15) Existence/nonexistence of macro command

Macros are not used.

(16) For queries related to identification, explanation of the response to the "*IDN?" query

See "4.6.1 Standard Commands"(⇒ p.82)

(17) Capacity of the user data storage area reserved for when the "*PUD" command and the "*PUD?" query are being executed

The "***PUD**" command and the "***PUD?**" query are not used.
Further, there is no user data storage area.

(18) Resources when the "*RDT" command and the "*RDT?" query are being used

The "***RDT**" command and the "***RDT?**" query are not used.
Further, there is no user data storage area.

(19) Conditions which are influenced when "*RST", "*LRN?", "*RCL?", and "*SAV" are used

"***LRN?**", "***RCL?**", and "***SAV**" are not used. The "***RST**" command returns the unit to its initial state.

See "4.6.1 Standard Commands"(⇒ p.83)
"4.4.5 Initialization Items"(⇒ p.74)

(20) Scope of the self-testing executed as a result of the "*TST?" query

See "4.6.1 Standard Commands"(⇒ p.82)

(21) Additional organization of the status data used in a device status report

See "4.4.4 Event Registers"(⇒ p.69)

(22) Whether commands are overlap or sequential type

All the commands are sequential commands.

(23) Criterion relating to the functions required at the instant that the termination message is produced, as a response to each command

Termination occurs when the command has been parsed.
The **:MEASure?** query will run only when there is no valid data available and run until valid data is created. The ***TRG** command ends processing when the measurement data is ready.

4.8 Device Compliance Statement

Specifications Chapter 5

Accuracy

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

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

5.1 General Specifications

Operating environment	Indoors, up to 2000 m (6562-ft.) ASL, Pollution degree 2
Operating temperature and humidity	0 to 40°C (32 to 104°F) 80% RH or less (non-condensating)
Storage temperature and humidity	-10 to 50°C (14 to 122°F) 80% RH or less (non-condensating)
Dielectric strength (50/60 Hz, for 15 seconds)	• 4.290 kVrms (Current sensitivity: 5 mA) Between voltage and current input terminals and the case, interface and output terminals Between voltage and current input terminals and the power supply • 2.570 kVrms (Current sensitivity: 1 mA) Between voltage input terminal and current input terminal • 1.690 kVrms (Current sensitivity: 10 mA) Between power supply and the case, interface and output terminals
Rated supply voltage	100 to 240 V AC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) Anticipated transient overvoltage 2500 V
Rated supply frequency	50/60 Hz
Maximum rated power	20 VA
Dimensions	Approx. 210W × 100H × 245D mm (8.27"W × 3.94"H × 9.65"D) (not including protrusions)
Mass	Approx. 2.5 kg (88.2 oz.)
Applicable Standards	Safety EN61010 EMC EN61326 Class A EN61000-3-2 EN61000-3-3
Accessories	• Instruction Manual ..... 1 • Power Cord 1
Options	• Model 9637 RS-232C Cable (1.8 m, 9-pin to 9-pin, Cross cable) • Model 9638 RS-232C Cable (1.8 m, 9-pin to 25-pin, Cross cable) • Model 9151-02 GP-IB Connector Cable (2 m) • Model 9151-04 GP-IB Connector Cable (4 m) **Others** • A number 3 Phillips screwdriver

5.2 Basic Specifications

Measurement line type	Single-phase 2-wire (AC, DC)
Input methods	Voltage Isolation input, resistance potential division method Current Isolation input, shunt input method
Measurement method	Simultaneous digital sampling of voltage and current Sampling frequency : Approx. 74.4 kHz A/D converter resolution : 16 bits
Rectifier type	True RMS indication : AC + DC measurement (RECTIFIER AC + DC) AC measurement (RECTIFIER AC) Simple average indication : DC measurement (RECTIFIER DC)
Input resistance (50/60 Hz)	Voltage 2.4 MΩ ±0.12 MΩ Current 10 mΩ or less
Maximum rated voltage to earth	300 V (50/60 Hz) Measurement category III (anticipated transient overvoltage 4000 V)
Maximum input voltage	300 V, ±425 Vpeak
Maximum input current	30 A, ±54.0 Apeak
Measurement items	Voltage, current, active power, apparent power, power factor, frequency, current integration, active power integration, voltage waveform peak, current input waveform peak
Display	LED Display
No. of displayed items	Four items
Screen update rate	200 ms±50 ms (approx. 5 times/s) to 20s (varies with average times setting)
Range configuration	

Current \ Voltage	15 V	30 V	150 V	300 V
100 mA	1.5 W	3 W	15 W	30 W
300 mA	4.5 W	9 W	45 W	90 W
1 A	15 W	30 W	150 W	300 W
3 A	45 W	90 W	450 W	900 W
10 A	150 W	300 W	1.5 kW	3 kW
30 A	450 W	900 W	4.5 kW	9 kW

Note 1: Substitute VA for the W units in the table above for information on apparent power.
Note 2: Auto-range
Up : Automatically changes to the next higher range when inputs exceed 100% of range or a peak over occurs
Down : Goes to a lower range when input is less than 25% (less than 15% from 150-V range) of current range
A change to a lower range is not made when a peak over occurs in the lower range.

Period of guaranteed accuracy	3 years (However, accuracy figures after 1 year and 3 years differ)

Measurement accuracy (1 year)

When input is less than 50% of range

Frequency (f)	Voltage, Current, Active power
DC	±0.1%rdg.±0.2%f.s.
45 Hz ≤ f ≤ 66 Hz	±0.1%rdg.±0.1%f.s.
66 Hz < f ≤ 1 kHz	±0.1%rdg.±0.2%f.s.
1 kHz < f ≤ 5 kHz	±3.0%f.s.

When input is 50 to 100% of range

Frequency (f)	Other than 30-A range Voltage, Current, Active power	30-A range Current, Active power	
		15 A ≤ Input ≤ 20 A	20 A < Input ≤ 30 A
DC	±0.1%rdg.±0.2%f.s.	±0.1%rdg.±0.2%f.s.	±0.1%rdg.±0.2%f.s.
45 Hz ≤ f ≤ 66 Hz	±0.2%rdg.	±0.2%rdg.	±0.2%rdg.
66 Hz < f ≤ 1 kHz	±0.3%rdg.	±0.3%rdg.	-----
1 kHz < f ≤ 5 kHz	±3.0%rdg.	±3.0%rdg.	-----

Add ±50 µA for DC current measurement accuracy
Add (±50 µA) × (voltage reading) for DC active power measurement accuracy

Measurement accuracy (3 year)

When input is less than 50% of range

Frequency (f)	Voltage, Current, Active power
DC	±0.1%rdg.±0.35%f.s.
45 Hz ≤ f ≤ 66 Hz	±0.1%rdg.±0.2%f.s.
66 Hz < f ≤ 1 kHz	±0.1%rdg.±0.35%f.s.
1 kHz < f ≤ 5 kHz	±4.5%f.s.

When input is 50 to 100% of range

Frequency (f)	Other than 30-A range Voltage, Current, Active power	30-A range Current, Active power	
		15 A ≤ Input ≤ 20 A	20 A < Input ≤ 30 A
DC	±0.1%rdg.±0.35%f.s.	±0.1%rdg.±0.35%f.s.	±0.1%rdg.±0.35%f.s.
45 Hz ≤ f ≤ 66 Hz	±0.3%rdg.	±0.3%rdg.	±0.3%rdg.
66 Hz < f ≤ 1 kHz	±0.45%rdg.	±0.45%rdg.	-----
1 kHz < f ≤ 5 kHz	±4.5%rdg.	±4.5%rdg.	-----

Add ±50 µA for DC current measurement accuracy
Add (±50 µA) × (voltage reading) for DC active power measurement accuracy

Conditions of Guaranteed Accuracy	• Temperature and humidity for guaranteed accuracy: 23±5°C, 80%RH or less • Warm-up time: 3 minutes • Input: Sine-wave input, Power factor = 1, Common mode voltage = 0 V
Temperature characteristic	±0.03%f.s./°C or less
Power factor influence	±0.4%rdg.or less (45 to 66 Hz, power factor = at 0.5)
Maximum effective peak voltage	±300% of each voltage range, but the 150-V range and 300-V range have a peak of ±425 V
Maximum effective peak current	±300% of each current range, but the 30-A range has a peak of ±54.0 A
Effect of common mode voltage	±0.1%f.s. or less (300 V, 50/60 Hz, when applied between an input terminal and the case)
Effect of external magnetic field	±1.5%f.s. or less (400 A/m DC, in a 50/60 Hz magnetic field)

Effective measurement range

Voltage, Current : 1 to 100% of range
Active power : 0 to 100% of range

( ): Display range

Current \ Voltage	**15-V range** 0.150 to 15.000 V (0.075 to 15.750 V)	**30-V range** 0.30 to 30.00 V (0.15 to 31.50 V)	**150-V range** 1.50 to 150.00 V (0.75 to 157.50 V)	**300-V range** 3.0 to 300.0 V (1.5 to 315.0 V)
100-mA range 1.00 to 100.00 mA (0.50 to 105.00 mA)	1.5-W range 0.0000 to 1.5000 W (0.0000 to 1.6538 W)	3-W range 0.000 to 3.000 W (0.000 to 3.308 W)	15-W range 0.000 to 15.000 W (0.000 to 16.538 W)	30-W range 0.00 to 30.00 W (0.00 to 33.08 W)
300-mA range 3.0 to 300.0 mA (1.5 to 315.0 mA)	4.5-W range 0.000 to 4.500 W (0.000 to 4.961 W)	9-W range 0.000 to 9.000 W (0.000 to 9.923 W)	45-W range 0.00 to 45.00 W (0.00 to 49.61 W)	90-W range 0.00 to 90.00 W (0.00 to 99.23 W)
1-A range 0.0100 to 1.0000 A (0.0050 to 1.0500 A)	15-W range 0.000 to 15.000 W (0.000 to 16.538 W)	30-W range 0.00 to 30.00 W (0.00 to 33.08 W)	150-W range 0.00 to 150.00 W (0.00 to 165.38 W)	300-W range 0.0 to 300.0 W (0.0 to 330.8 W)
3-A range 0.030 to 3.000 A (0.015 to 3.150 A)	45-W range 0.00 to 45.00 W (0.00 to 49.61 W)	90-W range 0.00 to 90.00 W (0.00 to 99.23 W)	450-W range 0.0 to 450.0 W (0.0 to 496.1 W)	900-W range 0.0 to 900.0 W (0.0 to 992.3 W)
10-A range 0.100 to 10.000 A (0.050 to 10.500 A)	150-W range 0.00 to 150.00 W (0.00 to 165.38 W)	300-W range 0.0 to 300.0 W (0.0 to 330.8 W)	1.5-kW range 0.0000 to 1.5000 kW (0.0000 to 1.6538 kW)	3-kW range 0.000 to 3.000 kW (0.000 to 3.308 kW)
30-A range 0.30 to 30.00 A (0.15 to 31.50 A)	450-W range 0.0 to 450.0 W (0.0 to 496.1 W)	900-W range 0.0 to 900.0 W (0.0 to 992.3 W)	4.5-kW range 0.000 to 4.500 kW (0.000 to 4.961 kW)	9-kW range 0.000 to 9.000 kW (0.000 to 9.923 kW)

Note 1: The effective measurement range of active power is valid when voltage and current are within their effective measurement ranges
Note 2: Other measurement items depend on the effective measurement ranges of voltage, current and active power
Note 3: Values of voltage and current less than 0.5% of their ranges are suppressed (forced to display as zero)
Note 4: Numerical values in the displayed range are subject to a ±1 dgt. error due to calculation accuracy.
Note 5: When the average times is set to a value other than 1 (OFF), voltage, current, active power, apparent power and power factor are indicated in 5 digits.
(Example: In the 45-W range; 45.00 W → 45.000 W)

Calculation method

Measurement item	Calculation method
Apparent power (S)	$S = U \times I$
Power factor (λ)	$\lambda = \lvert P/S \rvert$
Current integration	$\frac{\text{(Total } I \text{ from start of integration)}}{\text{(Number of values per hour)}}$
Active power integration	$\frac{\text{(Total } P \text{ from start of integration)}}{\text{(Number of values per hour)}}$

Note 1: U, I and P indicate the measured values for voltage, current and active power, respectively. None of the values have been rounded (deviation ±1 dgt.)
Note 2: The accuracy of values calculated from measurement values is ±1 dgt.
Note 3: When $|P| > S$, S values replace $|P|$. (Except when the RECTIFIER setting is DC)
Note 4: Even when I and P values are "o.r", integration is performed for measured values within the range for which "PEAK OVER U" and "PEAK OVER I" are not lit.

5.3 Functions

Note 1: Each numerical value in the specifications is subject to ±1 dgt. error due to calculation accuracy.
Note 2: When the average times is set to a value other than 1 (OFF), voltage, current, active power, apparent power and power factor are indicated in 5 digits.

Voltage measurement (Displays: V)

Total display area	±0.5% to ±105% of range (less than 0.5% is processed as 0) VT ratio enables indication of up to ±31.50 kV
Over-range indication	"o.r" (over-range) is indicated for inputs that exceed ±105% of the input range
Over-range warning	The PEAK OVER U LED lights when the input peak voltage value exceeds ±425 V or exceeds ±300% of the input range.
Threshold voltage for lamp lighting	150-V, 300-V range: ±425 V to ±433.5 V Other ranges: ±300% to ±302% of range

Current measurement (Displays: A)

Total display area	±0.5% to ±105% of range (less than 0.5% is processed as 0) CT ratio enables indication of up to ±315.0 kA
Over-range indication	"o.r" is indicated for inputs that exceed ±105% of the input range
Over-range warning	The PEAK OVER I LED lights when the input peak current value exceeds ±54.0 A or exceeds ±300% of the input range.
Threshold current for lamp lighting	30-A range: ±54.0 A to ±54.6 A Other ranges: ±300% to ±302% of range

Active power measurement (Displays: W)

Total display area	0% to ±110.25% of range The VT and CT ratios permit indication of up to ±9923 MW
Over-range indication	"o.r" is indicated for inputs that exceed ±110.25% of the input range

Apparent power measurement (Display: VA)

Total display area	0% to ±110.25% of range The VT and CT ratios permit indication of up to ±9923 MVA
Over-range indication	"o.r" is indicated when the voltage or current input exceeds the range.
Measurement accuracy	±1 dgt. for values calculated from measurement values

Power factor measurement (Display: PF)

Total display area	0.000 to 1.000 (No polarity)
Over-range indication	"o.r" is indicated when the voltage or current input exceeds the range. "o.r" is indicated for 0 apparent power
Measurement accuracy	±1 dgt. for values calculated from measurement values

Frequency measurement (Display: Hz)

Measurement method	Reverse calculation from the input waveform cycle (reciprocal method)
Measurement accuracy	±0.1%rdg.±1dgt. (0 to 40°C, sine-wave input)
Effective measurement range	10 to 100% of voltage, current range
Total display area	45.000 to 5.0000 kHz
Over-range indication	"o.r" is indicated when outside of the overall display area.

Peak voltage value measurement (Display: Vpk)

Measurement method	The peak voltage of the sampled instantaneous voltage value (both polarities) is measured
Range configuration	

Voltage range	15 V	30 V	150 V	300 V
Voltage peak range	45.0 V	90.0 V	450 V	900 V

Measurement accuracy	For DC and 45 Hz to 1 kHz, ±1.2% f.s. (f.s. is that of the voltage peak range)
Effective measurement range	±5 to ±100% of voltage peak range (up to ±425 V)
Total display area	±0.3 to ±102% of voltage peak range (less than ±0.3% is processed as 0) Depending on the VT ratio setting, up to ±91.8 kVpk can be displayed.
Over-range indication	"o.r" is indicated for inputs that exceed ±102% of voltage peak range

Peak current value measurement (Display: Apk)

Measurement method	The peak current of the sampled instantaneous current value (both polarities) is measured
Range configuration	

Current range	100 mA	300 mA	1 A	3 A	10 A	30 A
Current peak range	300 mA	900 mA	3.00 A	9.00 A	30.0 A	90.0 A

Measurement accuracy	For DC and 45 Hz to 1 kHz, ±1.2% f.s. (f.s. is that of the current peak range)
Effective measurement range	±5 to ±100% of current peak range (up to ±54.0 A)
Total display area	±0.3 to ±102% of current peak range (less than ±0.3% is processed as 0) Depending on the CT ratio setting, up to ±918 kApk can be displayed.
Over-range indication	"o.r" is indicated for inputs that exceed ±102% of current peak range

Current integration (Integration time: TIME)

Measurement method	Total current integration value (Display: Ah), Positive current integration value (Display: Ah+), Negative current integration value (Display: Ah-) Six items integrated simultaneously (Ah, Ah+, Ah-, Wh, Wh+, Wh-)
Measurement accuracy	Integration value: measurement accuracy of current ±1dgt. Integration time: ±100 ppm±1 s (0 to 40°C)
Effective measurement range	Effective measurement range of current
No. of displayed digits	Six digits
Integration time	1 min to 10000 h (1 min step)
Error alarm	The unit (Ah, Ah+, Ah-) flashes when "PEAK OVER I" occurs during integration.
Functions	Stop integration by timer, Display elapsed integration time, Additive integration by repeated Start/Stop, Resume integration upon recovery from power outages, Integration value and elapsed integration time are backed up during power outages, INTEGRATOR LED lights when integration is in process, it flashes when integration is stopped, and it goes out when integration is in the reset state.

Active power integration (Integration time: TIME)

Measurement method	Total active power integration value (Display: Wh), Positive active power integration value (Display: Wh+), Negative active power integration value (Display: Wh-) Six items integrated simultaneously (Ah, Ah+, Ah-, Wh, Wh+, Wh-)
Measurement accuracy	Integration value: measurement accuracy of active power ±1dgt. Integration time: ±100 ppm±1 s (0 to 40°C)
Effective measurement range	Effective measurement range of active power
No. of displayed digits	Six digits
Integration time	1 min to 10000 h (1 min step)
Error alarm	The unit (Wh, Wh+, Wh-) flashes when "PEAK OVER U" or "PEAK OVER I" occurs during integration.
Functions	Stop integration by timer, Display elapsed integration time, Additive integration by repeated Start/Stop, Resume integration upon recovery from power outages, Integration value and elapsed integration time are backed up during power outages, INTEGRATOR LED lights when integration is in process, it flashes when integration is stopped, and it goes out when integration is in the reset state.

Rectifier type changing

Rectifier type	AC+DC :For AC + DC measurements (true RMS display of voltage and current) DC :For DC measurements (simple average display of voltage and current) AC :For AC measurements (true RMS display of voltage and current) (Calculated by: $\sqrt{(\text{AC+DC Measured Value})^2 - (\text{DC Measured Value})^2}$)

Average (the AVG LED goes on when average times is something other than 1)

System	Simple average
Average times and display update rate interval	

Average times	1(OFF)	2	5	10	25	50	100
Interval between display updates	200 ms	400 ms	1 s	2 s	5 s	10 s	20 s

Number of digit indication for measurement value	When the average times is set to a value other than 1 (OFF), voltage, current, active power, apparent power and power factor are indicated in 5 digits. (Example: In the 45-W range; 45.00 W → 45.000 W)
Error alarm	The unit flashes when data used for calculating averages contain "o.r" data

VT/CT Ratio (the VT LED or CT LED lights when respective ratio is something other than 1)

VT ratio	1(OFF), 2, 4, 10, 20, 30, 60, 100
CT ratio	1(OFF), 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 25, 30, 40, 50, 60, 75, 80, 100, 200, 300, 500, 1000, 2000, 3000, 5000, 10000

Analog Output

Configuration	12bit D/A converter, 4channels
Output items	*U* : Voltage, *I* : Current, *P* : Active power D/A: Select an item from current integration, active power integration, apparent power, power factor
Output accuracy	(Measurement accuracy for each output) + (±0.5%f.s.) (23±5°C)
Temperature characteristic	±0.05%f.s./°C or less
Output voltage	Voltage, Current, Active power, Apparent power: ±2 Vf.s. DC at ±100% of range Power factor : 0 V at 0.000, +2 V DC at 1.000 Current integration, Active power integration: ±2 V DC (range × set integration time) (Outputs maximum output voltage when "o.r" is on or when "PEAK OVER U" and "PEAK OVER I" are lit.)
Maximum output voltage	Voltage, Current, Current integration, Active power integration : ±2.1 V DC (±105% of the measurement range) Active power, Apparent power : ±2.205 V DC (±110.25% of the measurement range) Power factor : +2.1 V DC
Output update rate	200 ms±50 ms (approx. 5 times/s) (fixed)
Response time	0.5 s or less (the time it takes for indication to stabilize within an accurate range for fluctuations of 0 → 90% and 100 → 10% of input range)
Output resistance	100 Ω±5 Ω

Waveform output

Configuration	12bit D/A converter, 3channels
Output items	u: Instantaneous voltage waveform i : Instantaneous current waveform p: Instantaneous power waveform
Output accuracy	(Measurement accuracy for each output) + (±1.0%f.s.) (23±5°C) Instantaneous voltage, Instantaneous current : True RMS level Instantaneous power : Average level
Temperature characteristic	±0.05%f.s./°C or less
Output voltage	1 Vf.s. at ±100% of range
Maximum output voltage	Approx. ±5 V
Conversion interval	Approx. 13 μs (= A/D conversion interval of input circuit)
Output resistance	100 Ω±5 Ω

External Interface

RS-232C Interface	Standard equipment • Asynchronous communication: Full duplex • Baud rate: 9600 bps (fixed) • Stop bit: 1 (fixed) • Data length: 8 (fixed) • Parity: none • Remote control from controller (REMOTE LED lights) • Use **SHIFT (LOCAL)** key to cancel remote state (REMOTE LED goes out)
GP-IB Interface	Specify when placing order (Model 3334-01) • Complies with IEEE 488.1 1987, refer to IEEE 488.2 1987 • Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0 • Remote control from controller (REMOTE LED lights) • Use **SHIFT (LOCAL)** key to cancel remote state (REMOTE LED goes out)

Other functions

Display hold	Disables display updates for all measurement values (HOLD LED lights)
Maximum value hold	Detects the maximum values of voltage, current, active power, apparent power, power factor, and frequency, and retains (holds) those values on the display. (HOLD LED flashes) Any measurement that exceeds the absolute value of the previous measurement is held on the display.
Peak value hold	Detects the maximum values of peak voltage value, peak current value, and then hold displays. (HOLD LED flashes) The largest positive or negative polarity value, or the absolute value, is held on the display
Key-lock	Disables all keys other than **SHIFT** and **KEY LOCK** (KEY LOCK LED lights) at measurement state.
Backup function	Backup the various settings and integration data. If there is a power failure during integration, the instrument will resume integration after the power is restored.
System reset	Returns all settings to factory defaults

Operations limited by instrument status

Changes to settings are limited by the hold state (display, maximum value, peak value) and integration. When hold and integration are both enabled, the “cannot change” condition has priority.

—: cannot change, ●: changeable

	Hold state	Integration is in process, Integration is stopped
Range changing	–	–
Rectifier type changing	–	–
Average (AVG)	–	●
VT ratio	–	–
CT ratio	–	–
Integration time	–	–
D/A output	●	●
GP-IB address	●	●

Maintenance and Service Chapter 6

6.1 Troubleshooting

Inspection and Repair

Refer to "6.2 Error Indication"(⇒ p.127) for error messages.

CAUTION

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

NOTE

- If damage is suspected, check the "Before returning for repair" (⇒ p.126) section before contacting your dealer or Hioki representative.

Transporting

Use the original packing materials when transporting the instrument, if possible.Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.

Replaceable Parts

Certain parts require replacement periodically and at the end of their useful life: (Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods)

Part	Remarks Life	Remarks
Electrolytic Capacitors	Approx. 10 years	The instrument contains many electrolytic capacitors. The useful life of electrolytic capacitors varies greatly according to the operating environment. In severe operating environments (40°C ambient temperature), degradation occurs in about ten years, so they should be replaced periodically.

The fuse is housed in the power unit of the instrument. If the power does not turn on, the fuse may be blown. If this occurs, a replacement or repair cannot be performed by customers. Please contact your dealer or Hioki representative.

Before returning for repair

Symptom	Check Item, or Cause	Remedy and Reference
The display does not appear when you turn the power on.	Is the power cord disconnected? Are connections made correctly?	Verify that the power cord is connected properly. **See** "2.3 Connecting the Power Cord"(⇒ p.21)
Keys do not work.	• Check whether the instrument is in the key lock state.	Cancel key lock status **See** "3.5.3 Disables key operations (key lock)"(⇒ p.49)
	• Check whether the REMOTE LED is on.	The instrument is controlled by a controller. End control and cancel remote control. **See** "Before Use" (⇒ p.4), "1.2 Names and Functions of Parts"(⇒ p.8)

When no apparent cause can be established

Perform a system reset.
This will return all settings to their factory defaults.

See "3.5.4 Initializing (system reset)"(⇒ p.50)

6.2 Error Indication

An error is displayed when a fault occurs during the power on self test, and when keys are non-responsive due to the operating state of the instrument.
Errors (4, 5 and 6) that occur as a result of key operations are display for only one second. Errors 1 through 4 that occur as a result of failure of the self test are displayed continuously. (A system reset can clear the error, but operation is not guaranteed.) "Initializing (system reset)" (⇒ p.50))

Error indication list

Error indication	Description	Remedy
	ROM error	Requires repair. (instrument circuit failure)
	RAM error	
	Control circuit error	
	Backup data error (When a setting is changed, it appears for about 1 s.)	
	Invalid key is pressed (Appears for about 1 s)	Key input is limited during integration or hold operation. This error is cleared when integration is reset or hold is canceled.
	Invalid key is pressed (Appears for about 1 s)	This error is displayed when attempting to resume integration after reaching 10000 hours or ±999999 MWh. This error is cleared when integration is reset.

Contact your dealer (agent) or local sales office if a repair should become necessary.

NOTE

Powering up the line to be measured before this instrument is turned on may damage the instrument or generate an error when it is powered up.
Be sure to turn on the instrument and check that no errors are indicated before turning on the power to lines to be measured.

6.3 Cleaning

NOTE

To clean the instrument and input modules, 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.

Rack Mounting Chapter 7

7.1 Installation Procedure

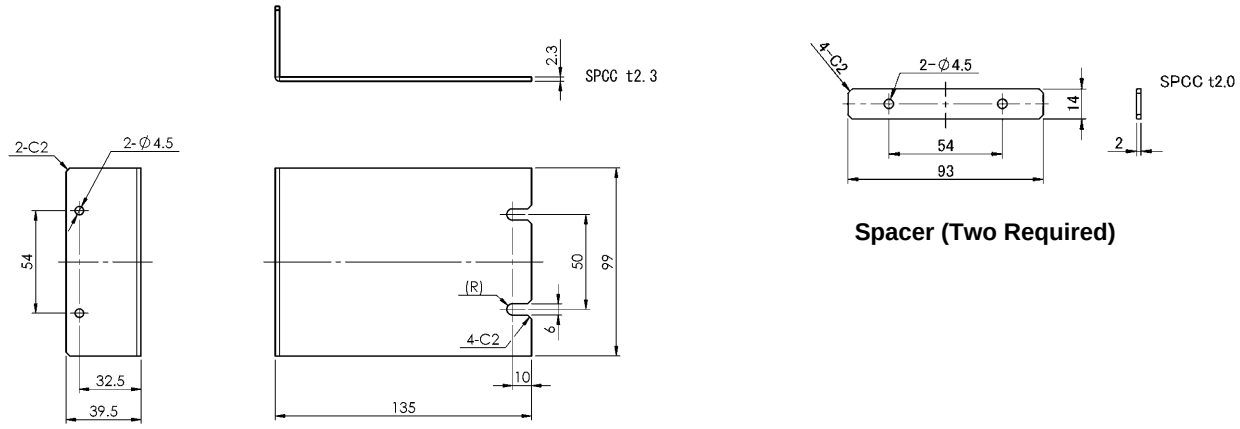
By removing the screws on the sides, this instrument can be installed in a rack mounting plate.

⚠WARNING

Observe the following precautions regarding the mounting screws to avoid instrument damage and electric shock accidents.

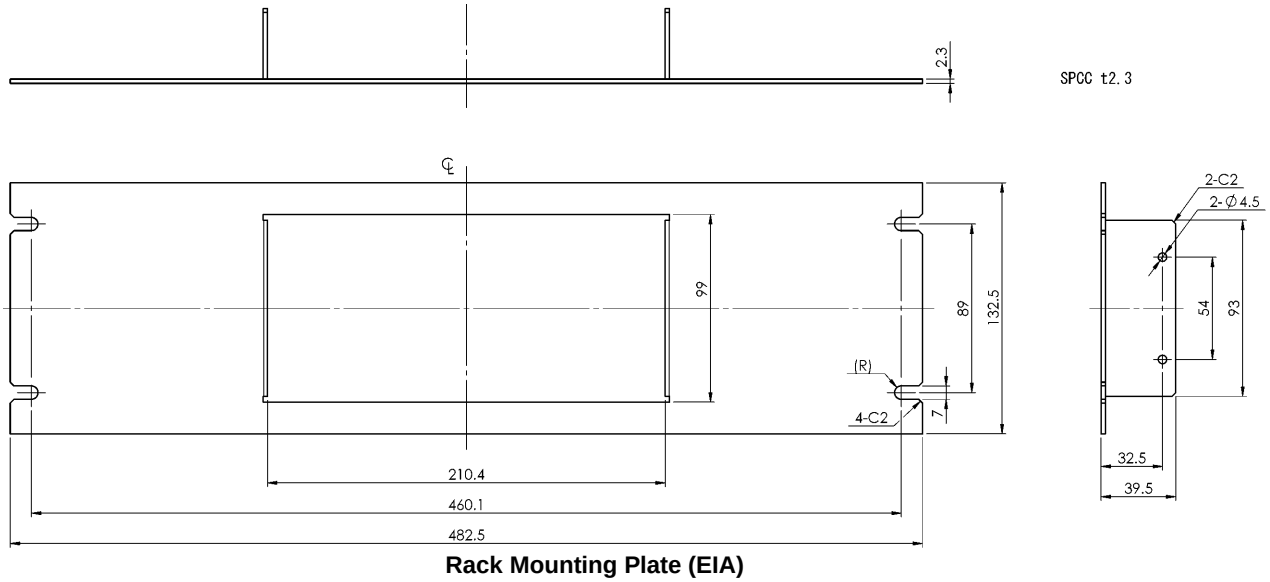
- **When installing the Rack Mounting Plate, the screws must not intrude more than 6 mm into either side of the instrument.**
- **When removing the Rack Mounting Plate to return the instrument to stand-alone use, replace the same screws that were installed originally. (Feet: M3 x 6 mm, Sides: M4 x 6 mm)**

Rack Mounting Plate Template Diagram



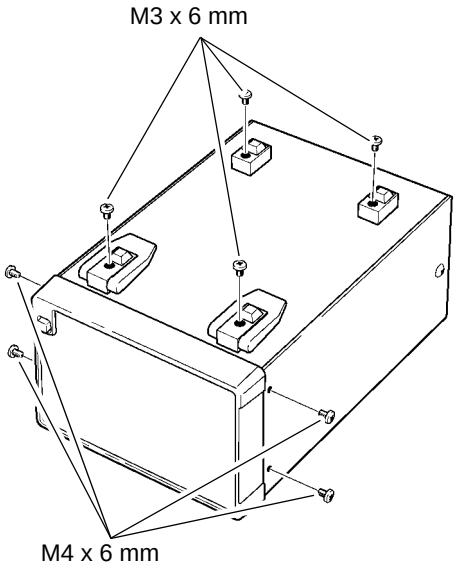
Rack Mounting Plate (JIS)

Spacer (Two Required)



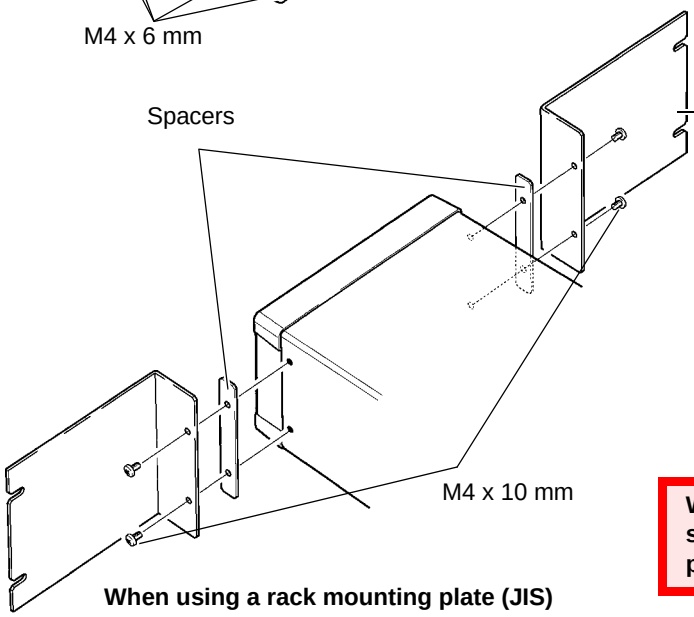
Rack Mounting Plate (EIA)

Installation Procedure



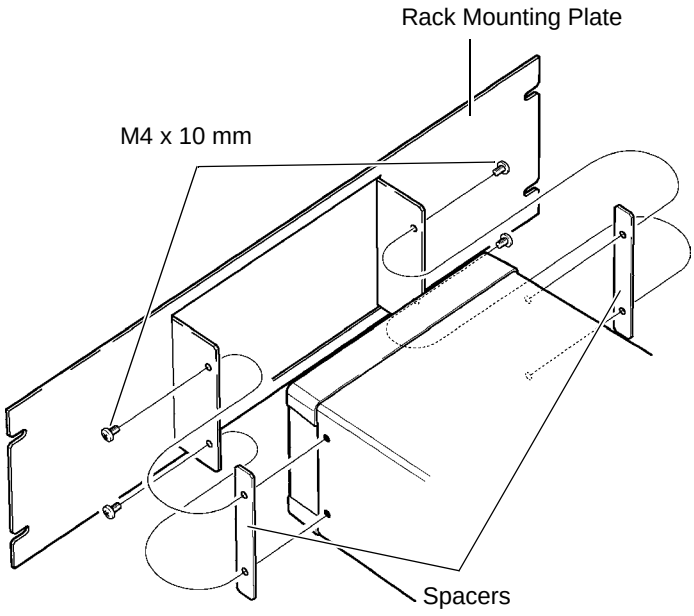
1. Remove the feet from the bottom of the instrument, and the screws from the sides (four near the front).

2. Installing the spacers on both sides of the instrument, affix the Rack Mounting Plate with the M4 x 10 mm screws.



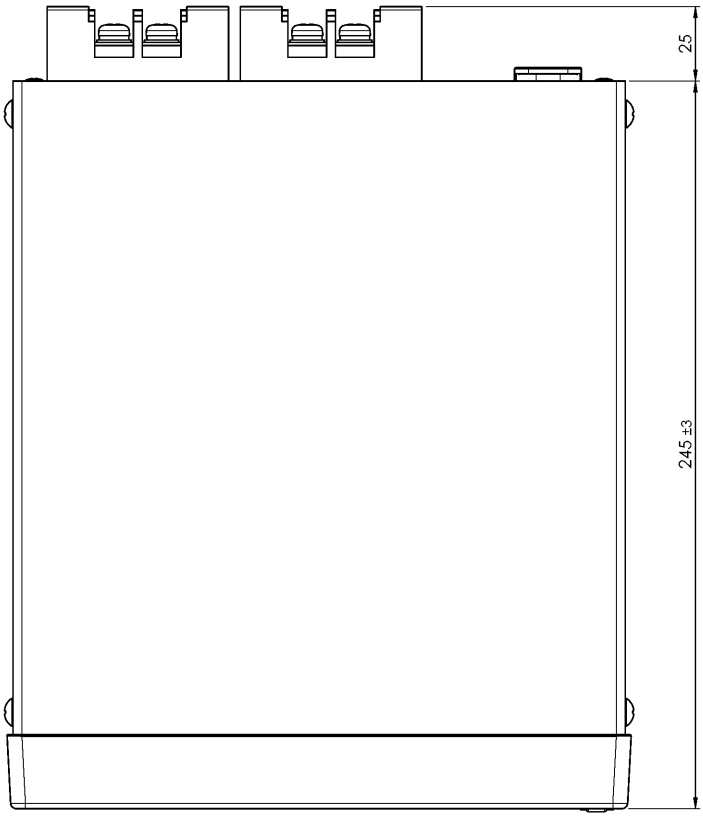
When using a rack mounting plate (JIS)

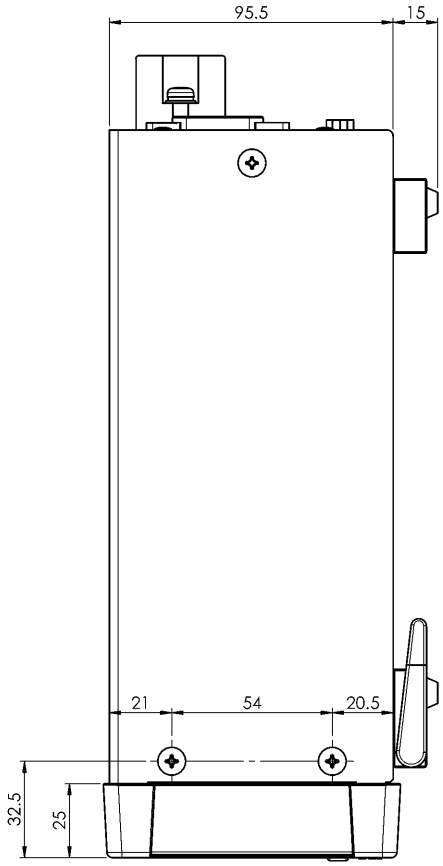
When installing into the rack, reinforce the installation with a commercially available support stand.

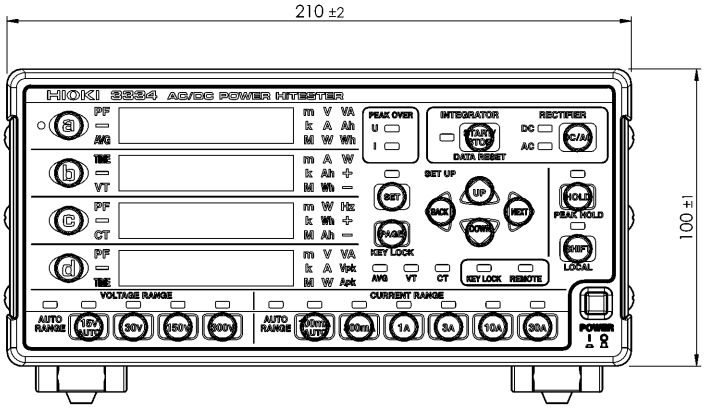


When using a rack mounting plate (EIA)

7.2 Dimensional Diagram







7.2 Dimensional Diagram

Index

A

Analog Output 41
ANALOG/WAVEFORM OUTPUT Terminal ..11, 41
Auto-Range 26, 28
Average 30
AVG 8, 30

B

Backup Function 22
Before Connecting 5

C

Command
  Device-Specific Commands 77, 87
  List 76
  Standard Commands 76, 82
Command Execution Time 75
Command Message 62
Command Syntax 63
Confirmation Messages 62
Connection 15
Connection Method 20
CT 17, 19
CT Ratio 32
Current Range 26

D

D/A Output 43
Damage 125
Data Formats 64
Device Clear 66
Device Compliance Statement 113
Device-Specific Commands 77, 87
Dimensional Diagram 131
Display 9
Display Hold 47
Display Items 9

E

Error Indication 127
Event Status Register
  Device-Specific 70
  Standard 69

F

Factory Default Settings 51
Fixed-point Data 65
Floating-Point Exponential Representation Data 65

G

GP-IB 55
GP-IB Address 60
GP-IB Connector 11, 60

H

Headers 62, 63
  Omission 65
HOLD 8, 47

I

IEEE 488.2 ..... 55, 65
Initialization Items 74
Initializing 50
Input Buffer 66
Instrument installation 4
Instrument Loss 20
Integer Data 65
Integration 35
Integration Time 35
Interface 55
Item to be Displayed 13, 24

K

KEY LOCK 8, 49

L

LOCAL 8, 61

M

Maximum Value 10, 48
Measurement Range 27
Measurement Work Flow 12
Message Terminators 64

N

NR1 65

Index

NR2 65
NR3 65
NRf 65

O

o.r 52
Operation Keys 10
Operation Overview 12
Output Queue 66

P

PEAK HOLD 8, 48
PEAK OVER 8, 52
Peak Value 10, 48
Power 21
Power Cord 15, 21
Power Inlet 21
POWER Switch 8, 22
Pre-Operation Inspection 23
Program Messages 62
Protective Cover 15, 18

Q

Query Error 55, 66
Query Message 62

R

Rack Mounting 129
Rectifier Type 29
Regarding Measurement Values 14
REMOTE 8, 61
Repair 125
Replaceable Parts 125
Response Messages 62
RS-232C 55
RS-232C Connector 11, 58

S

Self-Test 50
Separators 64
Setting Screen 9
Specifications 117
Stand 11
Standard Commands 76, 82, 76
Status Byte Register 67
System Reset 50

T

To Cancel the Remote State 61
Transporting 125
TRG 86

U

Unit Flashes 53

V

Voltage Range 13, 26
VT 17, 19
VT Ratio 32

W

Waveform Output 41, 46
Wiring Material 17

Warranty Certificate

Model	Serial No.	Warranty period One (1) year from date of purchase (___ / ___)

This product passed a rigorous inspection process at Hioki before being shipped.

In the unlikely event that you experience an issue during use, please contact the distributor from which you purchased the product, which will be repaired free of charge subject to the provisions of this Warranty Certificate. This warranty is valid for a period of one (1) year from the date of purchase. If the date of purchase is unknown, the warranty is considered valid for a period of one (1) year from the product's date of manufacture. Please present this Warranty Certificate when contacting the distributor.
Accuracy is guaranteed for the duration of the separately indicated guaranteed accuracy period.

1. Malfunctions occurring during the warranty period under conditions of normal use in conformity with the Instruction Manual, product labeling (including stamped markings), and other precautionary information will be repaired free of charge, up to the original purchase price. Hioki reserves the right to decline to offer repair, calibration, and other services for reasons that include, but are not limited to, passage of time since the product's manufacture, discontinuation of production of parts, or unforeseen circumstances.
2. Malfunctions that are determined by Hioki to have occurred under one or more of the following conditions are considered to be outside the scope of warranty coverage, even if the event in question occurs during the warranty period:
   a. Damage to objects under measurement or other secondary or tertiary damage caused by use of the product or its measurement results
   b. Malfunctions caused by improper handling or use of the product in a manner that does not conform with the provisions of the Instruction Manual
   c. Malfunctions or damage caused by repair, adjustment, or modification of the product by a company, organization, or individual not approved by Hioki
   d. Consumption of product parts, including as described in the Instruction Manual
   e. Malfunctions or damage caused by transport, dropping, or other handling of the product after purchase
   f. Changes in the product's appearance (scratches on its enclosure, etc.)
   g. Malfunctions or damage caused by fire, wind or flood damage, earthquakes, lightning, power supply anomalies (including voltage, frequency, etc.), war or civil disturbances, radioactive contamination, or other acts of God
   h. Damage caused by connecting the product to a network
   i. Failure to present this Warranty Certificate
   j. Failure to notify Hioki in advance if used in special embedded applications (space equipment, aviation equipment, nuclear power equipment, life-critical medical equipment or vehicle control equipment, etc.)
   k. Other malfunctions for which Hioki is not deemed to be responsible

*Requests
- Hioki is not able to reissue this Warranty Certificate, so please store it carefully.
- Please fill in the model, serial number, and date of purchase on this form.

13-09

HIOKI E.E. CORPORATION
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL: +81-268-28-0555
FAX: +81-268-28-0559

- Please visit our website at http://www.hioki.com for the following:
  - ■ Regional contact information
  - ■ The latest revisions of instruction manuals and manuals in other languages.
  - ■ Declarations of Conformity for instruments that comply with CE mark requirements.
- All reasonable care has been taken in the production of this manual, but if you find any points which are unclear or in error, please contact your supplier or the International Sales and Marketing Department at Hioki headquarters.
- In the interests of product development, the contents of this manual are subject to revision without prior notice.
-

HIOKI

HIOKI E.E. CORPORATION

Headquarters
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp
(International Sales and Marketing Department)

http://www.hioki.com/

HIOKI USA CORPORATION
E-mail: hioki@hiokiusa.com http://www.hiokiusa.com

HIOKI (Shanghai) Sales & Trading Co., Ltd.
E-mail: info@hioki.com.cn http://www.hioki.cn

HIOKI INDIA PRIVATE LIMITED
E-mail: hioki@hioki.in http://www.hioki.in

HIOKI SINGAPORE PTE. LTD.
E-mail: info@hioki.com.sg

1407

Edited and published by Hioki E.E. Corporation Printed in Japan