

HIOKI

Instruction Manual

3331

POWER HiTESTER

HIOKI E. E. CORPORATION

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Introduction

Thank you for purchasing this HIOKI "3331 POWER HiTESTER."
To get the maximum performance from the unit, please read this manual
first, and keep this at hand.

Inspection

When the unit is delivered, check and make sure that it has not been damaged in transit. In particular, check the accessories, panel switches, and connectors. If the unit is damaged, or fails to operate according to the specifications, contact your dealer or HIOKI representative.

■ Standard accessories

Instruction Manual	1
Power cord	1
Connector (DB-25P-N)	1
(Japan Aviation Electronics Industry, Limited or equivalent)	
(Shell DB19678-2)	

■ Shipment

If the 3331 unit is to be shipped or transported, the original packing should preferably be used. If this is not available, employ the following procedure.

1. Procure a packing case somewhat larger than the unit, such as a cardboard box.
2. Wrap the unit in plastic sheeting.
3. Pack the unit wrapped in this cushioning material into the box, pack in the accessories, add more cushioning to fill the box tightly, and then seal it with adhesive tape. If required, secure the case with shipping twine.

NOTE

When reusing the original for the unit, use cushioning to secure the unit so the unit will not move around in the box.

Safety Notes

This Instruction Manual provides information and warnings essential for operating this equipment in a safe manner and for maintaining it in safe operating condition. Before using this equipment, be sure to carefully read the following safety notes.

DANGER

This equipment is designed according to IEC 61010 Safety Standards, and has been tested for safety prior to shipment. During high voltage measurement, incorrect measurement procedures could result in injury or death, as well as damage to the equipment. Please read this manual carefully and be sure that you understand its contents before using the equipment. The manufacturer disclaims all responsibility for any accident or injury except that resulting due to defect in its product.

Safety symbols

	<ul style="list-style-type: none"> ▪ This symbol is affixed to locations on the equipment where the operator should consult corresponding topics in this manual (which are also marked with the  symbol) before using relevant functions of the equipment. ▪ In the manual, this mark indicates explanations which it is particularly important that the user read before using the equipment.
	Indicates a grounding terminal.
	Indicates AC (Alternating Current).

The following symbols are used in this Instruction Manual to indicate the relative importance of cautions and warnings.

	Indicates that incorrect operation presents extreme danger of accident resulting in death or serious injury to the user.
	Indicates that incorrect operation presents significant danger of accident resulting in death or serious injury to the user.
	Indicates that incorrect operation presents possibility of injury to the user or damage to the equipment.
	Denotes items of advice related to performance of the equipment or to its correct operation.

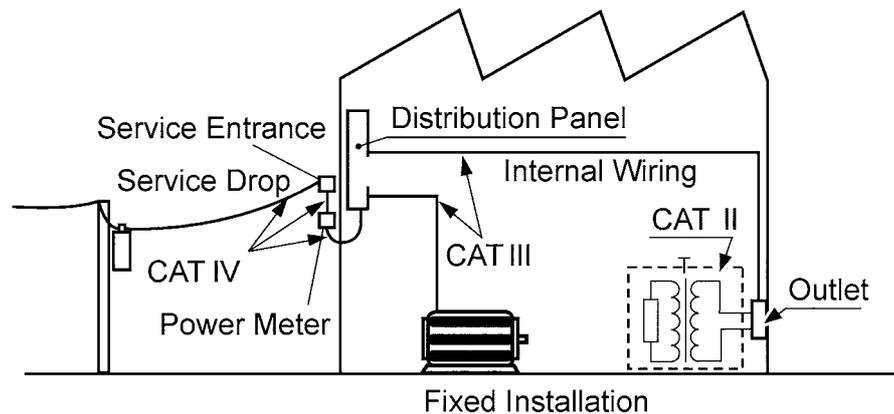
■ Measurement categories

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 device (distribution panel).

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



Notes on Use

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.

DANGER

- This unit cannot be used on voltage lines of 600 Vrms. If the voltage exceeds 600 VAC, there will be a short-circuit accident or electrocution accident will result.
 - The maximum input voltage and current are 600 Vrms, 60 Arms. Do not exceed the maximum input voltage and current. Doing so can damage the unit or cause a serious accident.
 - The maximum rated voltage between input terminals and ground is 600 Vrms. Attempting to measure voltages exceeding 600 Vrms with respect to ground could damage the instrument and result in personal injury.
 - Always connect the powermeter input to the secondary side of the breaker. On the secondary side of a breaker, even if the lines are shorted the breaker can trip and prevent an accident. On the primary side, however, the current capacity may be large, and in the event of a short-circuit there may be a serious accident.
-
-

WARNING

- Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit. If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.
 - In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting the direct connection voltage and current cables to the terminals.
 - Be sure to connect the voltage input terminals or current input terminals correctly. Measurement which is attempted with the wiring connected incorrectly may cause damage to the unit or a short-circuit.
 - Since the power switch is of a micro gap construction, always use near an outlet. When not in use and when connecting a device to be measured, make sure that the power cord is unplugged, or any other means so that the unit is cut off from the power.
 - The unit is constructed so as to be connected to a ground line via a three-core power cord that is supplied with the unit. In order to avoid electric shock, connect the unit to a properly grounded (3-pin) outlet using the power cord provided.
 - Do not remove the case of the unit. There are components inside carrying high voltages or becoming hot, and this could cause an electric shock accident.
 - Do not use the unit where it may be exposed to corrosive or explosive gases. The unit may be damaged, or explosion may occur.
-
-

⚠ CAUTION

-
- Before measurement, check the position of the measurement range. The unit may be damaged if voltage or current at levels in excess of the measurement limit is applied for a long time.
 - To avoid damage to the unit, do not short the output terminal and do not input voltage to the output terminal.
 - Do not store or use the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
 - This unit is designed for indoor use and can be safely used at temperatures ranging from 0°C to 40°C.
 - To avoid damage to the unit, do not subject the equipment to vibrations or shocks during transport or handling. Be especially careful to avoid dropping the equipment.
 - Should the unit emit smoke, or a strange smell or strange sound, immediately stop testing operations, power the unit off, and remove the power cord from the outlet, shut off the circuit being tested, disconnect the unit, and consult your HIOKI representative. Continued use of the unit could lead to fire or electric shock accidents.
 - Do not insert foreign objects through the ventilation holes. Particularly if metallic, liquid, or combustible substances get inside the case, this may lead to fire or electric shock, or to malfunction.
 - Do not use the unit near any device which generates strong electromagnetic radiation or near a static electrical charge, as these may cause errors.
 - To prevent electric shock, do not allow the unit to become wet and do not use the unit when your hands are wet.
 - This unit is not constructed to be waterproof or dustproof, so do not use it in a very dusty environment or in one where it will get wet.
 - Do not place the unit on an unstable stand, or in an uneven location. It may fall to the ground, or fall over, and either of these events may lead to malfunction or accident.
 - Avoid treading on or pinching the cable so as not to damage the cable sheaths.
 - Keep the cables well away from heat, to prevent the possibility of melting the insulation.
 - For long-term storage, remove the power cord.
 - Do not use the unit near any device which generates strong electromagnetic radiation or near a static electrical charge, as these may cause errors.
 - The recommended calibration interval for this instrument is six months.
-

NOTE

- This unit uses the two-power method for measuring a three-phase line. For this reason, if there is a leakage current from the line being measured, or in a four-wire three-phase system, accurate measurement is not possible.
- This unit is electrically configured specifically for AC currents. Thus signals with elements of DC currents (such as all-wave rectifier) cannot be measured.
- For accurate measurement, allow the unit to warm up for more than half an hour before starting operation.
- Note that limits are specified for the range in which voltage and current level accuracies are guaranteed.
- The values for apparent power (S), reactive power (Q), power factor () and phase angle () produced by this unit are computed from the measured voltage (U), current (I), and active power (P), using the expressions given in the specifications. The values given may be different from those measured with an instrument of different operating principles or using different calculation expressions.
- This machine's integration value is derived from the measured values of the electrical current and electrical power and calculated by the software. The integration value may be different from other instruments that have differing response times, sample rate or calculation expressions.
- Accurate measurement may be impossible in locations subject to strong external magnetic fields, such as transformers and high-current conductors, or in locations subject to strong external electric fields, such as radio transmission equipment.
- Due to the internal circuitry, when measuring objects that contain certain specific wave lengths, the indicated value of power may periodically shift and not settle down. (Specifically, this occurs when measuring distorted waves containing a large amount of high frequency waves which are the even number multiple of 2.44 kHz.)
- When the input is less than 0.1% of the measurement range, the indication is forcibly set to zero.
- The 3331 has a frequency measurement function, but this may produce unexpected results on a waveform which is severely distorted.
- When a maximum rated voltage to earth of high frequency is applied (as for example when measuring the secondary side of an inverter), errors may occur in the measured values.
- To ensure the accuracy of measurement be careful not to let the unit overheat. (Keep away from sources of heat, and provide sufficient ventilation space around the unit, or when rack-mounted provide a cooling fan.)
- 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.

Chapter 1

Overview

1.1 Product Overview

The 3331 POWER HiTESTER is a power tester for AC three-phase three-wire and single-phase, which is suitable for measuring the three phase products and three phase power line.

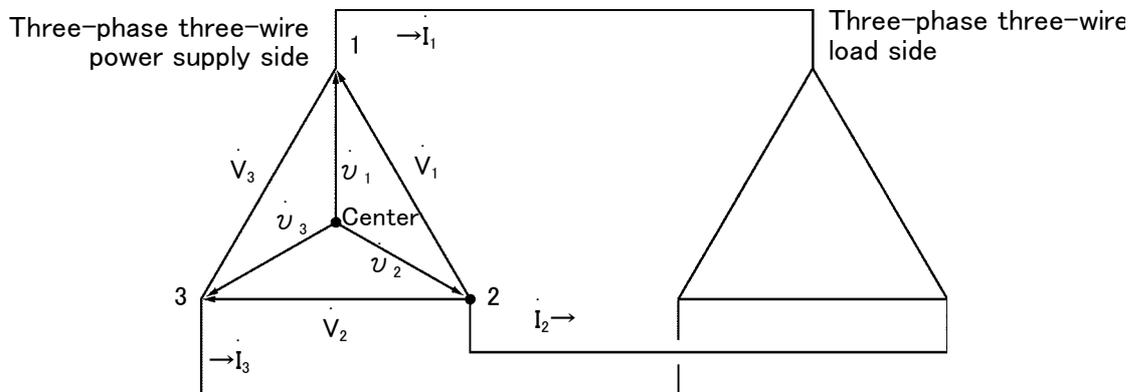
With this one unit, it is possible to measure voltage, current, active power, apparent power, reactive power, the power factor, phase angle, frequency and integrated value.

By using the peak-hold function, the peak value of the current waveform during powering on can be measured.

1.2 Features

- (1) Meets the safety requirements of IEC61010
- (2) Wide broad band from 10 Hz to 100 kHz.
- (3) In reactive power, power factor, and phase indication, it is possible to recognize the phase is lead or lag.
- (4) The current range is wide. (from 0.5 A to 50 A)
- (5) Analog output for voltage, current, and active power is provided. (3 3W)
- (6) Monitor output (waveform output) for voltage and current is provided. (3 3W)
- (7) It is possible to measure the plus, minus, total current, power integrations, and current integrations simultaneously.
- (8) The terminals for voltage and current measurements are insulated.
- (9) All measurement data has synchronism.
- (10) By using the GP-IB Interface and the RS-232C Interface, it is possible to print out this unit's controls and data.
- (11) This unit will convert either voltage, current, effective power, apparent power, reactive power, power factor, phase angle, frequency, integration value, and current peak value into ± 5 V f.s. direct voltage and output from the D/A output terminal.
- (12) Small-sized and light weight
- (13) With the 50 A range, large currents can be accurately measured.
- (14) With two voltage inputs and two current inputs, all currents and voltages of a three-phase line can be measured.
- (15) The peak value of a current waveform is measured.
- (16) The delay time from an input to an analog output is about 0.2 seconds.
- (17) With the response setting at "SLOW" (about 1.6 seconds), stable measurement is possible at 10 Hz and above.

1.3 Principles of the Two-Power Method of Power Measurement and V_3 and I_3 Measurement



Schematic circuit of a three-phase three-wire line

The above figure shows a schematic circuit of a three-phase three-wire line. In the figure, \dot{V}_1 , \dot{V}_2 , and \dot{V}_3 are vectors representing the inter-line voltages, \dot{I}_1 , \dot{I}_2 , and \dot{I}_3 are vectors representing the (phase) line currents, and \dot{v}_1 , \dot{v}_2 , and \dot{v}_3 are vectors representing the voltage of each of the phases. The power (P) of a three-phase system is normally found as the sum of the powers of the three phases.

$$P = \dot{v}_1 \dot{I}_1 + \dot{v}_2 \dot{I}_2 + \dot{v}_3 \dot{I}_3 \dots\dots\dots (1)$$

However, a three-phases three-wire system has no center point, and it is not possible directly to measure the power of each phase; moreover, even given a center point, three power meters are required simultaneously. For these reasons, usually the two-power method (two voltages, two currents) is used, measuring inter-line voltages.

This can be derived by the following expressions.

Measuring \dot{V}_1 , \dot{V}_2 , \dot{I}_1 , and \dot{I}_2 with power meters, the following holds:

$$\begin{aligned} P &= \dot{V}_1 \dot{I}_1 + \dot{V}_2 \dot{I}_3 \quad (\dot{V}_1 = \dot{v}_1 - \dot{v}_2, \dot{V}_2 = \dot{v}_3 - \dot{v}_1) \\ &= (\dot{v}_1 - \dot{v}_2) \dot{I}_1 + (\dot{v}_3 - \dot{v}_1) \dot{I}_3 \\ &= \dot{v}_1 \dot{I}_1 + \dot{v}_2 (-\dot{I}_3 - \dot{I}_1) + \dot{v}_3 \dot{I}_3 \quad (\text{with closed circuit } \dot{I}_1 + \dot{I}_2 + \dot{I}_3 = 0) \\ &= \dot{v}_1 \dot{I}_1 + \dot{v}_2 \dot{I}_2 + \dot{v}_3 \dot{I}_3 \dots\dots\dots (2) \end{aligned}$$

Since here expressions (1) and (2) are the same, it follows that the three-phase power can be measured by the two-power method.

This requires no special conditions, other than that the circuit is closed (that is, there are no leakage currents), and can therefore be used to find the three-phase power whether the circuit is balanced or unbalanced.

This unit uses the two-power method of power measurement.

Additionally, since the voltage and current vectors each sum to zero, and therefore the following are obtained by the internal circuit:

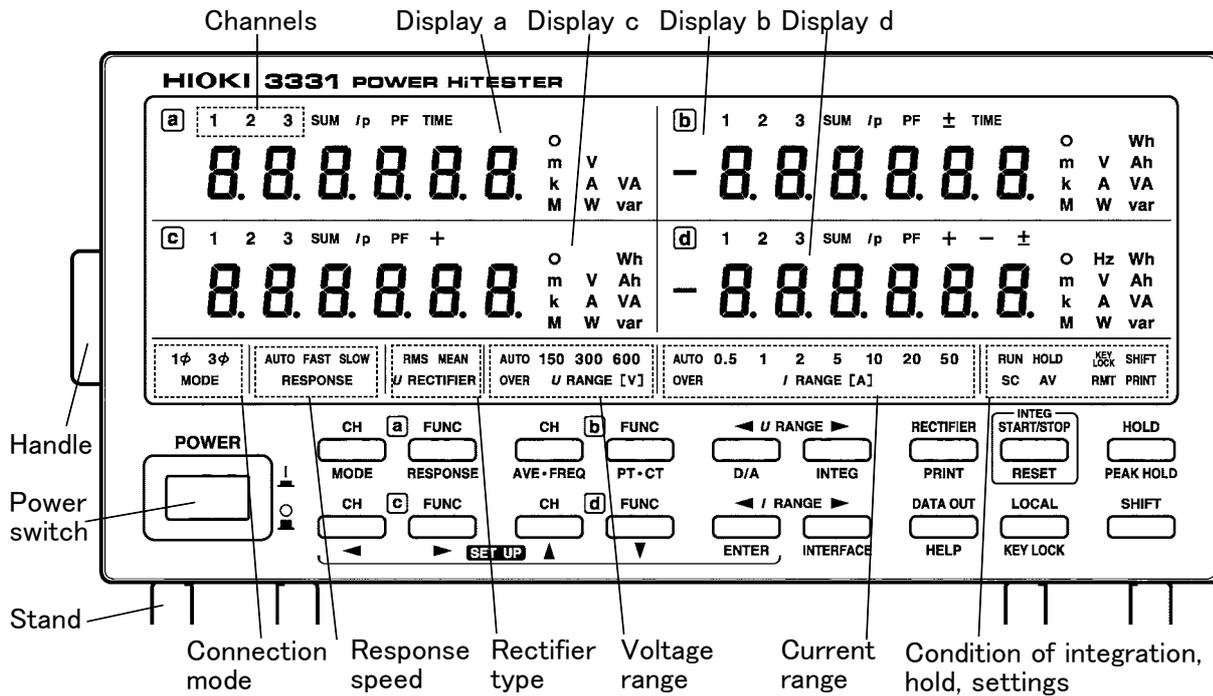
$$\begin{aligned} |\dot{V}_3| &= |\dot{V}_1 - \dot{V}_2| \\ |\dot{I}_2| &= |-\dot{I}_1 - \dot{I}_3| \end{aligned}$$

Thus yielding the third voltage and current values. Again, V_3 and I_2 can be measured regardless of whether or not there is distortion present.

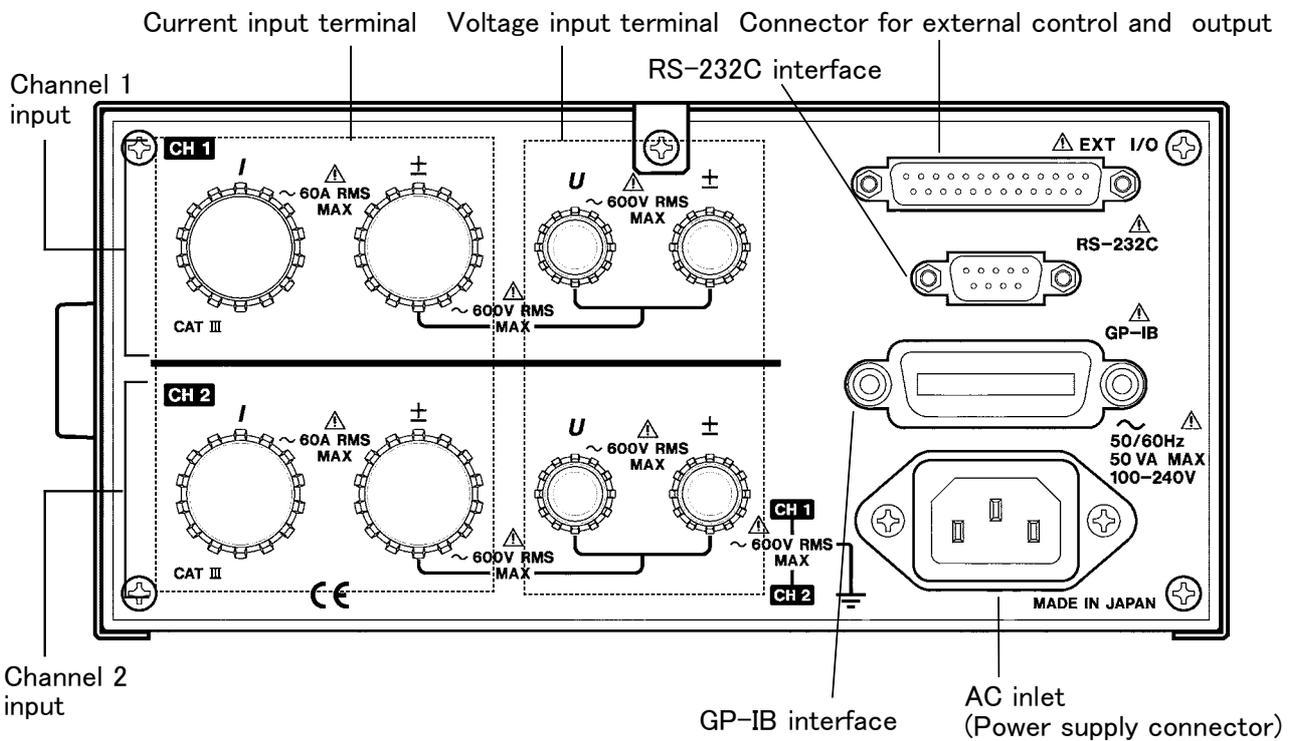
NOTE

Since with this unit I_3 is input to channel 2, on the display the current value shown for channel 2 is I_3 , and the current value shown for channel 3 is I_2 .

1.4 Identification of Controls and Indicators



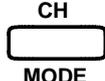
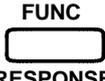
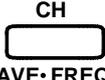
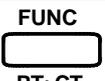
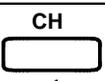
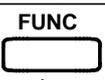
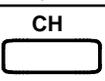
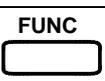
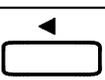
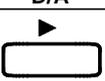
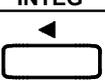
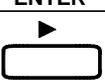
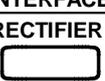
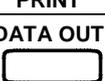
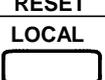
Front Panel



Rear Panel

1.5 Explanation for Keys

To get the lower key indications, press the **SHIFT** key first.

Key	Notation in this manual	Operations	Section
a 	CHa	Changes the display channel on the display a.	3.4
	MODE	Enter the connecting mode (1 /3).	3.1
	FUNCa	Changes the display item on the display a.	3.4
	RESPONSE	Switches the response speed (FAST/SLOW).	3.2
b 	CHb	Changes the display channel on the display b.	3.4
	AVE·FREQ	Sets the averaging count and frequency.	4.4, 4.5
	FUNCb	Changes the display item on the display b.	3.4
	PT·CT	Sets the PT and CT ratios.	4.7
c 	CHc	Changes the display channel on the display c.	3.4
	←	Moves the cursor to the left.	4
	FUNCc	Changes the display item on the display c.	3.4
	→	Moves the cursor to the right.	4
d 	CHd	Changes the display channel on the display d.	3.4
		Increases the setting value.	4
	FUNCd	Changes the display item on the display d.	3.4
		Decreases the setting value.	4
U 	← U	Decreases the voltage range.	3.5
	D/A	Sets the D/A output item.	4.6
	→ U	Increase the voltage range.	3.5
	INTEG	Sets the integration time.	4.3
I 	← I	Decreases the current range.	3.5
	ENTER	Enter the setting value.	4
	→ I	Increases the current range.	3.5
	INTERFACE	Sets the GP-IB and RS-232C.	4.9
	RECTIFIER	Switches the rectifier type (RMS/MEAN)	3.3
	PRINT	Sets the printer interval and output item.	4.8
	DATA OUT	Outputs the measured value on the printer.	8.2, 8.7
	HELP	Outputs the setting values on the printer.	
	START/STOP	Stops or starts the integration operation.	4.3.3
	RESET	Resets the integration value.	4.3.3
	LOCAL	Releases the remote state via interface.	8.2
	KEY LOCK	Sets the key lock state.	6.5

<p style="text-align: center;">HOLD</p>  <p style="text-align: center;">PEAK HOLD</p>	<p style="text-align: center;">HOLD</p> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">PEAK HOLD</p>	<p>Holds the display value.</p> <hr style="border-top: 1px dashed black;"/> <p>Holds the peak value and maximum value.</p>	3.6
<p style="text-align: center;">SHIFT</p> 	<p style="text-align: center;">SHIFT</p>	<p>Validates the lower indicated function key. (indicator is lit)</p>	2 to 6

Key operations during self-test when powering on

SHIFT RESET: system reset is performed after self-test

SHIFT ENTER: enter mode for changing the clock frequency of power calculation circuit after self-test.

: Press and then in order.

1.6 Display Reference

Indications	Meaning
Numbers	Measurement value
1, 2, 3, SUM	Indicates channel displayed.
m, k, M	Indicates the prefix of unit.
V, A, W, VA, var, PF, Ip, Hz, Ah, +Wh, -Wh, ± Wh, TIME	Indicates the unit and display item. Voltage, current, active power, apparent power, reactive power, power factor, phase angle, current peak frequency, integration power, positive integration power, negative integration power, total integration power, integration elapsed time
1, 3	Indicates connecting mode.
AUTO, FAST, SLOW	Indicates response time.
RMS, MEAN	Indicates the rectifier type (RMS: true rms value, MEAN: average rectifier effectiveness value conversion)
AUTO, 150, 300, 600	Indicates the voltage range (AUTO: auto-ranging on)
AUTO, 0.5,50	Indicates the current range (AUTO: auto-ranging on)
RUN	Indicator is lit during integration operating, flashes when it stops, goes off when it is reset.
SC	Indicator is lit when the PT ratio or CT ratio is other than 1.
AV	Indicator is lit excluding when the number of times of averaging are set to OFF (1)
HOLD	Indicates HOLD status. The indicator is flashing in the peak hold.
KEY LOCK	Indicates key lock status.
SHIFT	Indicates SHIFT status
RMT	The unit is in remote control state.
PRINT	Indicator is lit when the interface is in printer mode, or when GP-IB is communicating and outputting data.
—, — (left side of display c)	When displaying Hz, indicates on the left side of display c. "—": 50 kHz range, "—": 500 Hz range
OVER	Indicates the input's peak value has exceeded the range by 6 times.
o.r	Indicates the value exceeds the display range. (o.r) = out of range
V, A, W (flashing)	Indicates that there was the value which is out of range during averaging.
Wh, Ah (flashing)	Indicates that there was the value which is out of range during integration.
S.Err	Indicates the PT or CT ratio was set so that the scaling result exceeds 99999M at 130% f.s. input. (scaling error)
- - - -	Indicates the invalid data because of changing frequency.

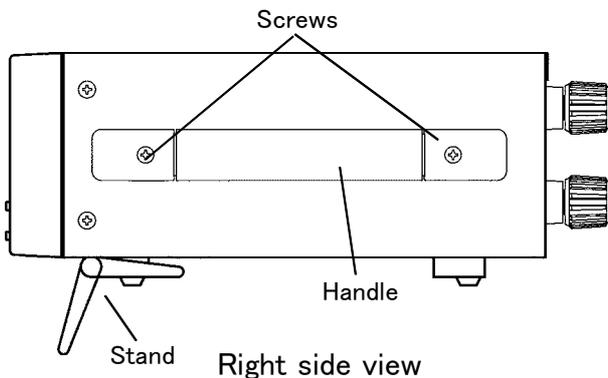
Setting indications	Meaning
AVERAGE	Average setting (number of times of average)
FREQ	Frequency setting (source, range)
D-A SELECT	D/A output setting (item)
INTEGRATE	Integration time setting
PRINT	Print out setting (time interval of printing, print item)
PT	PT (voltage transformer) ratio setting
CT	CT (current transformer) ratio setting
GP-IB	GP-IB (address, control mode) setting
RS232C	RS-232C setting (baud rate, data length, parity, stop bit, control mode)
P.FREQ CHANGE	Power computation circuit clock setting

Error indications	Meaning
Err.001	Backup error (press any key to deactivate, needs repair)
Err.101	ROM malfunction (cannot deactivate, needs repair)
Err.102	RAM malfunction (cannot deactivate, needs repair)
Err.103	RAM display malfunction (cannot deactivate, needs repair)
Err.104	Timer malfunction (cannot deactivate, needs repair)
Err.105	A/D,D/A converter malfunction (cannot deactivate, needs repair)
Err.011	Mix up of control by key and remote during integration (displayed approx. 1 second)
Err.012	A non-executable key was pressed during integration (RUN indicator lit/flashing) (displayed approx. 1 second)
Err.013	Integration was started while S. Err was displayed (displayed approx. 1 second)
Err.014	Integration was started when it was $\pm 999999M$ (displayed approx. 1 second)
Err.015	Data was reset during integration (displayed approx. 1 second)
Err.016	A invalid key was pressed during HOLD (HOLD indicator lit/flashing) (displayed approx. 1 second)
Err.017	A invalid key was pressed during display settings (displayed approx. 1 second)
Err.021	Key was pressed when the printer mode is not set for the interface (displayed approx. 1 second)
Err.022	There is no room in the printer output memory (displayed approx. 1 second)
Err.023	The interface cannot be communicated.
Err.CH	A CH key was pressed when the channel cannot be changed because of the connection mode (displayed approx. 1 second) Example: Attempting to display W1 in three-phase mode.

Other indications	Meaning
1P	Item is valid in single-phase connection mode. (Setting)
3P	Item is valid in three-phase connection mode. (Setting)
1P.3P	Item is valid in single-phase, three-phase connection mode. (Setting)
Error	This item is not set. (Setting)
E.Ctrl	In integration time setting, this indicates operation under external control.
data output	Data is sent to printer after recovery from power failure.
RESET 3331	Resets the 3331

1.7 Handle and Stand Operations

Removing the handle and stand



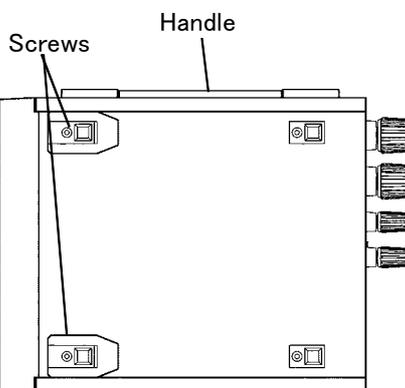
If the handle or feet are not required when the unit is rack-mounted, remove the fixing screws as shown in the figure on the left.

1. Remove the screws fixing on the handle.
2. Remove the screws on the four feet (two feet with stands)

NOTE

Carefully store removed handles, feet, and screws for use in locations other than the rack.

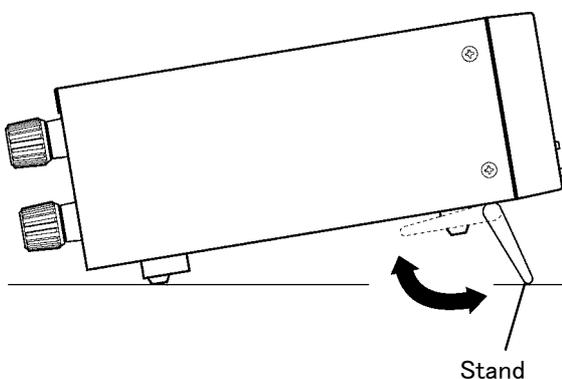
For the making rack mounting fittings, see Chapter 10, "Rack Mounting."



CAUTION

Be sure not to bear down too hard on the top of the unit when it is tilted upwards. Doing so may damage the stand.

Stand operation



The stands move in the direction indicated by the arrow.

When raising or closing the stands, move them to where you hear them click into place.

NOTE

When raising the stands, be sure to raise both the left and right stand together.



Chapter 2

Preparation for Measurement

2.1 Before Measurement

⚠ DANGER

- Do not exceed the maximum input voltage and current. Doing so can damage the unit or cause a serious accident.
- The maximum rated voltage between input terminals and ground is 600 Vrms. Attempting to measure voltages exceeding 600 Vrms with respect to ground could damage the instrument and result in personal injury.
- Always connect the powermeter input to the secondary side of the breaker. On the secondary side of a breaker, even if the lines are shorted the breaker can trip and prevent an accident. On the primary side, however, the current capacity may be large, and in the event of a short-circuit there may be a serious accident.
- To avoid electric shock accidents, do not touch the input terminals of the unit on live lines, which is exposed.

⚠ WARNING

- In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting the direct connection voltage and current cables to the terminals.
- Be sure to connect the voltage input terminals or current input terminals correctly. Measurement which is attempted with the wiring connected incorrectly may cause damage to the unit or a short-circuit.
- If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.
- Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit.
- The unit is constructed so as to be connected to a ground line via a three-core power cord that is supplied with the unit. In order to avoid electric shock, connect the unit to a properly grounded (3-pin) outlet using the power cord provided.

⚠ WARNING

- When using an external voltage transformer, do not leave the secondary side short-circuited. If a voltage is applied to the primary while the secondary is short-circuited, a high current will flow through the secondary, which could lead to fire or malfunction.
- When using an external current transformer, do not leave the secondary side open-circuit. If a current flows through the primary while the secondary is open-circuit, this can generate a high voltage on the secondary, which is extremely dangerous.

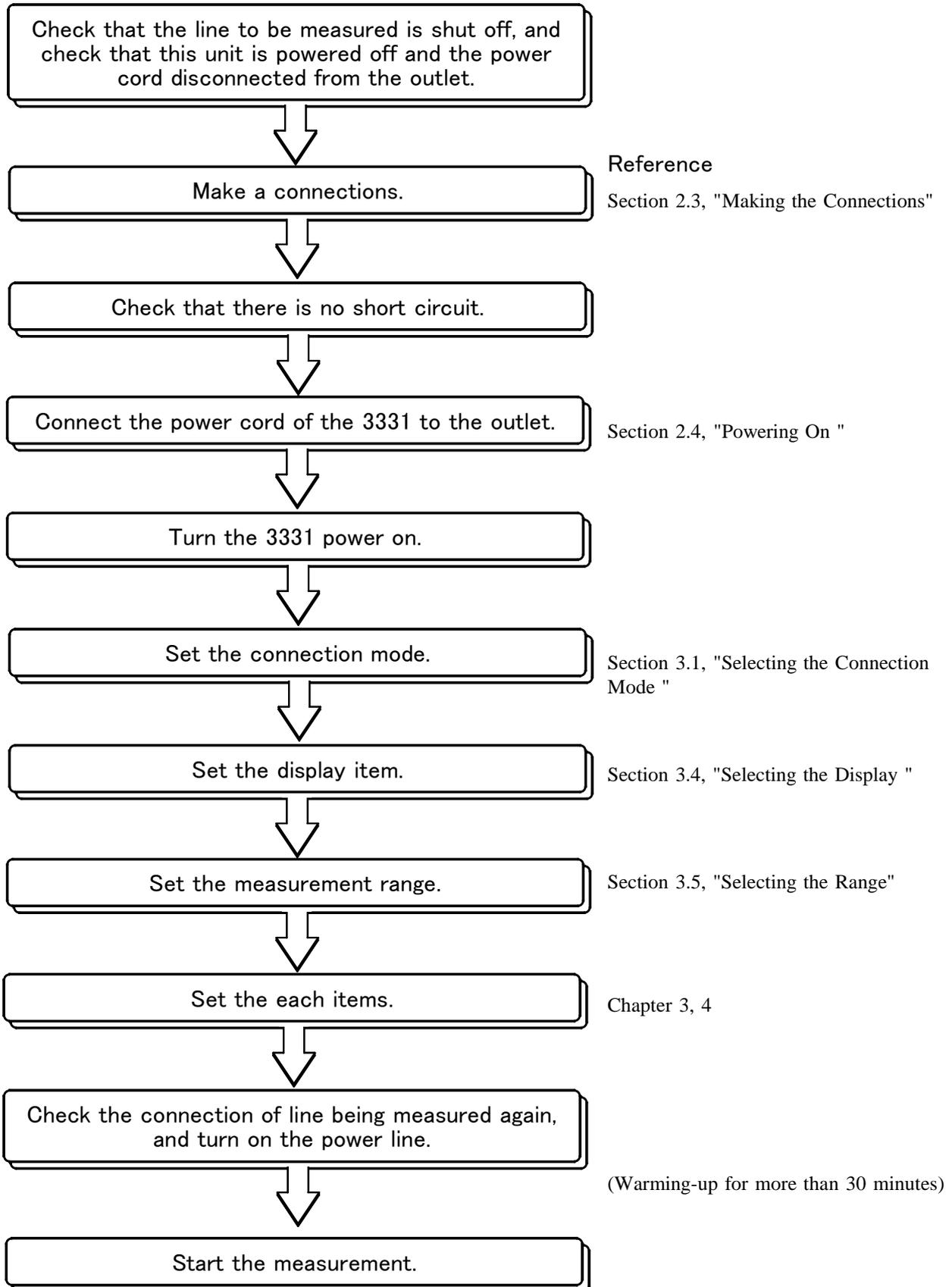
⚠ CAUTION

- To avoid electric shock, the wiring which is used for making the connections to the current input terminals should have sufficient current carrying capacity and insulation.
- This unit is designed for indoor use and can be safely used at temperatures ranging from 0°C to 40°C.
- Do not store or use the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
- This unit is not constructed to be waterproof or dustproof, so do not use it in a very dusty environment or in one where it will get wet.
- Do not use the unit near any device which generates strong electromagnetic radiation or near a static electrical charge, as these may cause errors.
- To prevent electric shock, do not allow the unit to become wet and do not use the unit when your hands are wet.

NOTE

- This unit uses the two-power method for measuring a three-phase line. For this reason, if there is a leakage current from the line being measured, or in a four-wire three-phase system, accurate measurement is not possible.
- This unit is electrically configured specifically for AC currents. Thus signals with elements of DC currents (such as all-wave rectifier) cannot be measured.
- Because the polarity of the voltage and current will affect electrical measurement, be sure the wiring is connected correctly.
- If the voltage and current of the device being measured exceeds the measurement range of this unit, please use an outside-connected PT, or CT. The measurement value can be directly read if the scaling function is used.
- When using an outside connected trans (PT, CT), the phase differences of those may cause differences in the electrical measurement. If a precise electrical measurement is necessary, use a PT or CT that has only a small phase difference from the wiring's wave length area that is to be used.
- Make sure that the wiring of the electric wires are separated from this unit, so that there is no effect on this unit from an outside magnetic field.

2.2 Simple Use





2.3 Making the Connections

2.3.1 Direct Connections

⚠ DANGER

- Always connect the power meter to the secondary side of a breaker.
 - On the secondary side of a breaker, even if the lines are shorted the breaker can trip and prevent an accident. On the primary side, however, the current capacity may be large, and in the event of a short-circuit there may be a serious accident.
 - Shut off the line power supply before connecting the voltage cable and current cable.
 - If the voltage cables should be detached and touch the two wires, a shorting accident or electric shock may result.
 - The maximum input voltage and current are 600 VAC, 60 A. Do not measure an input in excess of these limits, as the resulting heat buildup may damage the unit or cause a short-circuit accident.
 - Once the connections are made, do not touch the input terminals of the voltage and current transformers. There are exposed live parts, and a danger of electric shock or serious accident.
 - Check that the terminals are tightened securely. If the connections should become detached, there is a danger of a short-circuit or electric shock accident. Additionally, if the connections are not properly tightened, the contact resistance increases, which may lead to the generation of heat, or fire.
-
-

⚠ WARNING

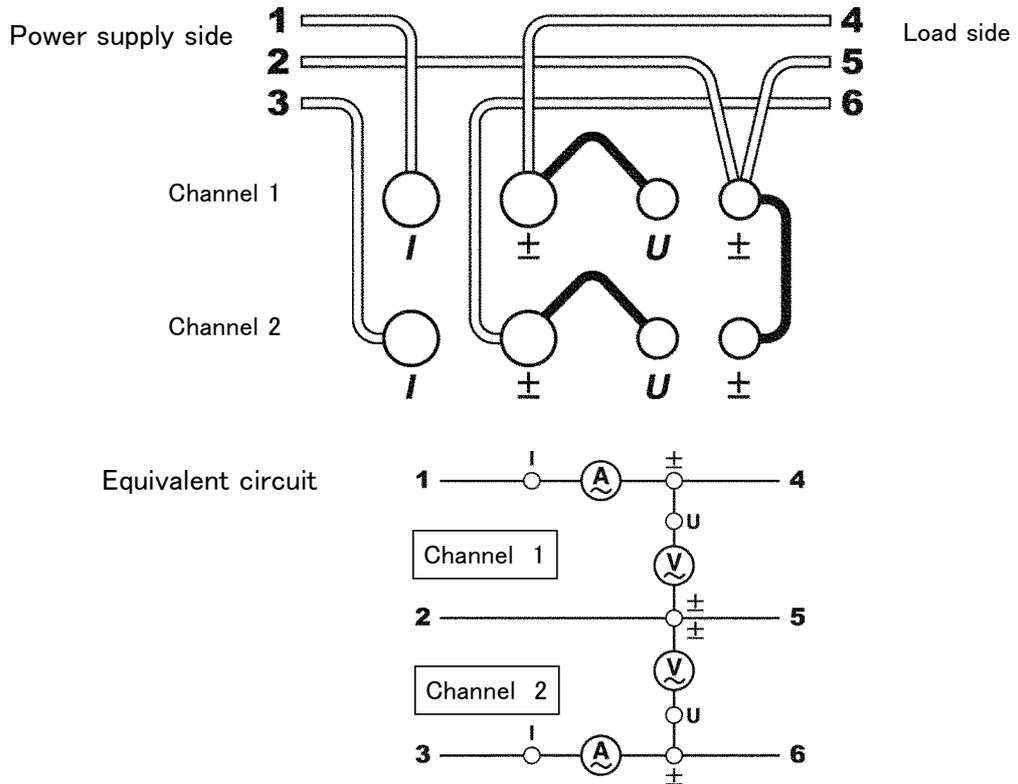
- In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting the direct connection voltage and current cables to the terminals.
 - Be sure to connect the voltage input terminals or current input terminals correctly. Measurement which is attempted with the wiring connected incorrectly may cause damage to the unit or a short-circuit.
 - Do not short circuit between voltage input terminals, when making a connection. If not, a shorting accident or electric shock may result.
 - To prevent accidental electrocution or short-circuits, make connections to the voltage and current input terminals using only insulated wire that is terminated with pressure-fitted terminals. (The voltage and current input terminals have an M6 axial diameter.)
 - Before switching on power for the line to be measured, check that the connections and the wiring are not shorting between the voltage input terminals. If there is a short circuit, an electrical shock and/or short circuit accident will occur.
-
-

⚠ CAUTION

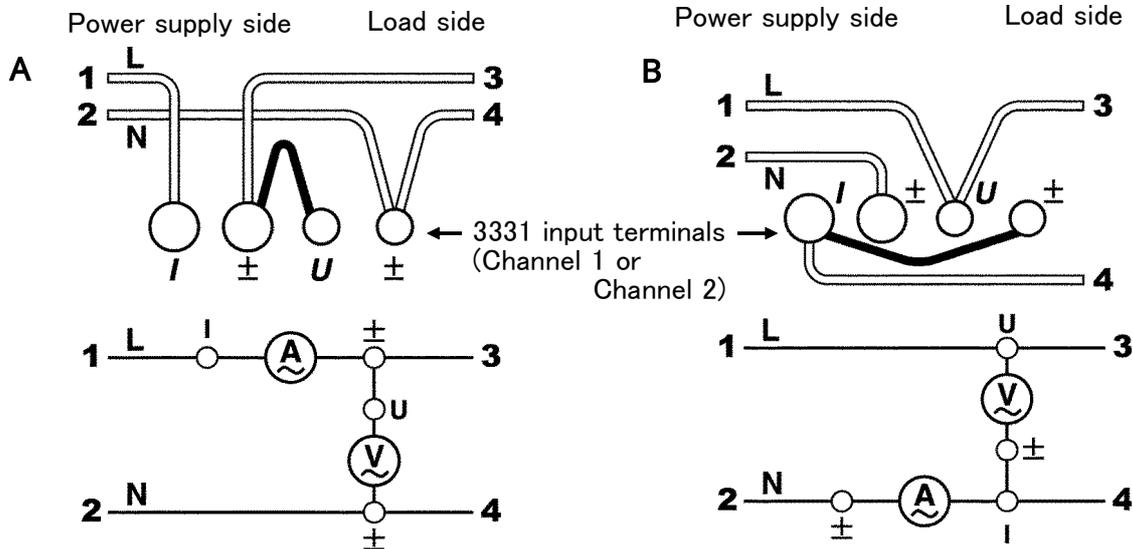
To avoid electric shock, the wiring which is used for making the connections to the current input terminals should have sufficient current carrying capacity and insulation.



single-phase three-wire or three-phase three-wire



single-phase two-wire



NOTE

- Depending on the input level, power meter losses may affect measured values. Refer to Section 2.3.3 for how to make connections that minimize power meter losses.
- If the instrument is affected by common mode voltage, connect an ammeter as shown as B to reduce the error.
- When measuring a single-phase two-wire system, set the wiring connection mode to 1 . (Refer to Section 3.1 "Selecting the Connection Mode".) However, all settings, such as the range, PT, and CT, of the CH1 and CH2 are common.



2.3.2 When Using PT or CT

⚠ DANGER

- Once the connections are made, do not touch the input terminals of the voltage and current transformers. There are exposed live parts, and a danger of electric shock or serious accident.
- Check that the terminals are tightened securely. If the connections should become detached, there is a danger of a short-circuit or electric shock accident. Additionally, if the connections are not properly tightened, the contact resistance increases, which may lead to the generation of heat, or fire.

⚠ WARNING

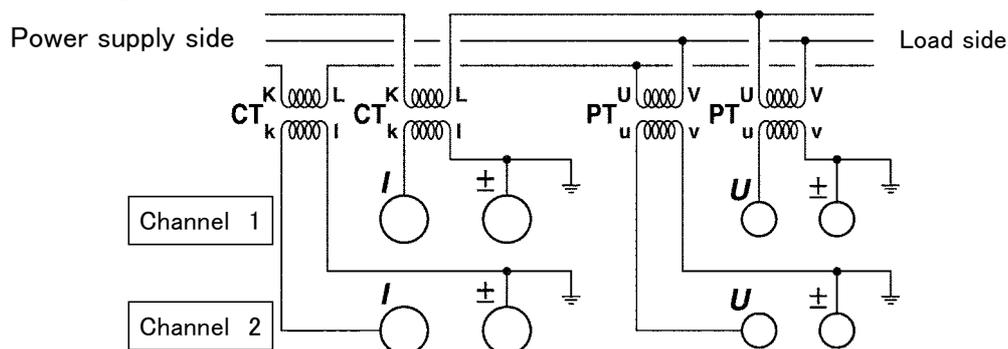
- When using an external voltage transformer, do not leave the secondary side short-circuited. If a voltage is applied to the primary while the secondary is short-circuited, a high current will flow through the secondary, which could lead to fire or malfunction.
- When using an external current transformer, do not leave the secondary side open-circuit. If a current flows through the primary while the secondary is open-circuit, this can generate a high voltage on the secondary, which is extremely dangerous.
- Before switching on power for the line to be measured, check that the connections and the wiring are not shorting between the voltage input terminals. If there is a short circuit, an electrical shock and or short circuit accident will occur.
- To prevent accidental electrocution or short-circuits, make connections to the voltage and current input terminals using only insulated wire that is terminated with pressure-fitted terminals. (The voltage and current input terminals have an M6 axial diameter.)

⚠ CAUTION

To avoid electric shock, the wiring which is used for making the connections to the current input terminals should have sufficient current carrying capacity and insulation.

NOTE

- By setting the PT ratio and the CT ratio, it is possible to directly read the first side of the PT and CT. For details, refer to Section 4.7, "Setting the PT and CT Ratios."
- The secondary side of the PT or CT must be grounded for safety. (Since most previously attached PT and CT's are already grounded, please check before grounding.)
- When using an outside connected trans (PT,CT), the phase differences of those may cause differences in the electrical measurement. If a precise electrical measurement is necessary, use a PT or CT that has only a small phase difference from the wiring's wave length area that is to be used.
- Depending on the input level, power meter losses may affect measured values. Refer to Section 2.3.3 for how to make connections that minimize power meter losses.



2.3.3 Notes on Connection Methods

The power meter can be connected either using the method shown below in Fig.1, with the voltage measurement terminal connected on the load side, or as shown in Fig.2, with the current measurement terminal connected on the load side.

As shown in Fig.1, when the voltage measurement terminal is connected on the load side, the power measurement includes a loss due to the inclusion of the voltage measurement input resistance.

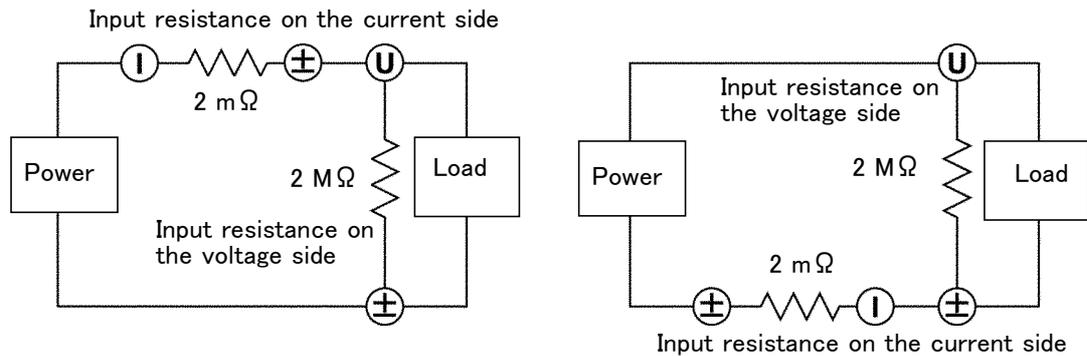


Fig.1 Voltage Measurement Terminal Connected on the Load Side

On the other hand, as shown in Fig 2, when the current measurement terminal is connected on the load side, the power measurement includes a loss due to the inclusion of the current measurement input resistance.

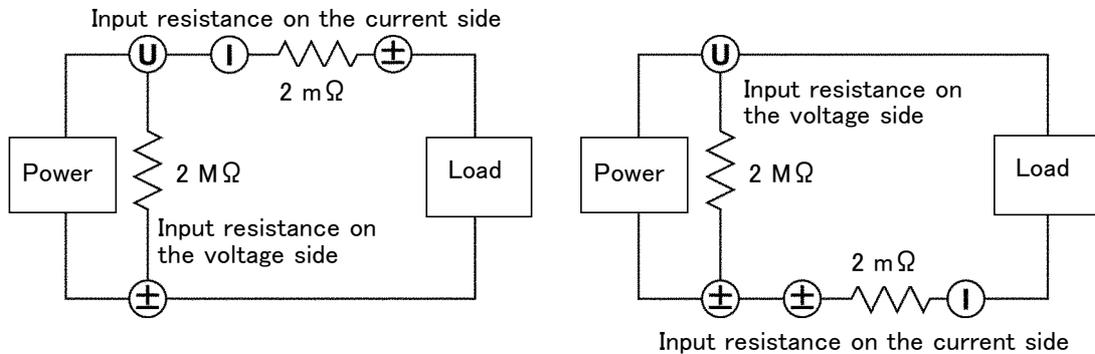


Fig.2 Current Measurement Terminal Connected on the Load Side

The method of connection should be shown so as to minimize the loss; which connection is better depends on the relative magnitude of the current and voltage. For example, measuring 600 V, 20 A supply:

$$\text{Fig.1 } \text{loss} = (600 \text{ [V]})^2 \div 2 \text{ [M } \Omega] = 0.18 \text{ [VA]}$$

$$\text{Fig.2 } \text{loss} = (20 \text{ [A]})^2 \times 2 \text{ [m } \Omega] = 0.8 \text{ [VA]}$$

In this case, therefore, the connection shown in Fig.1 should be used.

Next consider the case of measuring 600 V, 1 A system:

$$\text{Fig.1 } \text{loss} = (600 \text{ [V]})^2 \div 2 \text{ [M } \Omega] = 0.18 \text{ [VA]}$$

$$\text{Fig.2 } \text{loss} = (1 \text{ [A]})^2 \times 2 \text{ [m } \Omega] = 0.002 \text{ [VA]}$$

In this case, the connection shown in Fig 2 allows more accurate measurement.

2.4 Powering On

⚠ WARNING

- Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the AC power inlet of the unit.
- If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.
- The unit is constructed so as to be connected to a ground line via a three-core power cord that is supplied with the unit.
- The power switch has a microgap construction, and it is therefore essential to use it close to a power outlet. When the unit is not in use, and while making connections to the circuit being tested, isolate the unit electrically from the power supply, for example by removing the power cord plug from the outlet.

⚠ CAUTION

- When the power is turned off, do not apply voltage or current to the voltage input terminals and the current input terminals. Doing so may damage the unit.
- Should the unit emit smoke, or a strange smell or strange sound, immediately stop testing operations, power the unit off, and remove the power cord from the outlet, shut off the circuit being tested, disconnect the unit, and consult your HIOKI representative. Continued use of the unit could lead to fire or electric shock accidents.

NOTE

Before measuring, please perform a warm-up at least for 30 minutes after the power is turned on.

1. Make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel. (power supply voltage 100 V to 240 V)
2. Confirm the power switch on the front panel is OFF.
3. Connect the power cord supplied to AC inlet on the rear panel.
4. Plug the power cord into a properly grounded (3-pin) outlet that has a safety grounded terminal.
5. Turn the power switch on.
6. All Indicators on the front panel are displayed and the self testing start. Refer to Section 2.5, "Self Test" for details. This test ends about for 10 seconds.

2.5 Self Test

Indications in self test shifts as follows:

- (1) All indicators illuminate
- (2) Displays
 - a: Model
 - b: Software version number

3331		100	
MODE	RESPONSE	U RECIPIER	I RANGE [A]

- (3) Setting conditions of the GP-IB address and RS-232C

GP Ib			
1			
MODE	RESPONSE	U RECIPIER	I RANGE [A]

r5232C			
9600		Bn 1Ca	
MODE	RESPONSE	U RECIPIER	I RANGE [A]

- (4) After self checking, error number is displayed if an unusual matter is founded.
- (5) Returns to normal measurement state.

NOTE

- For the error indications, refer to Section 6.3, "Error Indications."
- Settings at powering on become previous condition. (Backup function)
However, this function does not work when internal lithium battery is used up. In this case, the error is indicated after self-test.

Err.001

- The battery would run down after six years. Please contact your nearest service representative for battery change.
- Don't press the keys unnecessarily during self testing.
- If the **SHIFT** key is pressed and then the **RESET** key is pressed during the self-test, the unit will reset the system. (Refer to Section 6.2, "System Resetting.")

r5232C			
9600		Bn 1Ca	
MODE	RESPONSE	U RECIPIER	I RANGE [A]

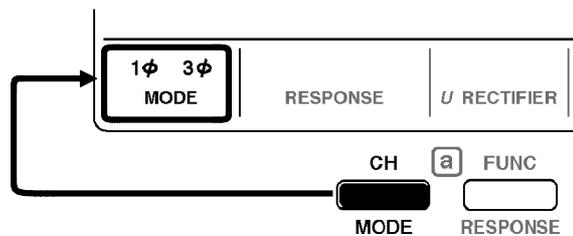
Chapter 3

Basic Operation

3

3.1 Selecting the Connection Mode

Depending on the type of line, set the connection mode to 1 (single-phase) or 3 (three-phase three-wire). This affects the method of calculation and the display items.



Pressing the **SHIFT** **MODE** key switches mode; 1 3W and 3 3W.

NOTE

- The display item can be changed in connecting mode.
- If the display does not support the changed connection mode, forcibly change the display channel.
- During integrating (the RUN indicator is lit or flashing), the connecting mode cannot be changed ("Err.012").
- After stopping integration by pressing the **START/STOP** key, press the **SHIFT** **RESET** key to reset the integration (the RUN indicator goes off). The mode can be changed.
- During holding displays or peak value (the HOLD indicator is lit or flashing), the connecting mode cannot be changed ("Err 016"). Press the **HOLD** key or **SHIFT** **HOLD** keys to release the hold state (the HOLD indicator goes off) to change the mode.
- When the mode is changed, read the measurement value after the condition of internal circuit is stable (for 5 seconds or more).
- When measuring a single-phase two-wire system, set the wiring connection mode to 1 . The power values for each channel can be displayed. However, all settings, such as the range, PT, and CT, of the CH1 and CH2 are common.

Display item		Channels	
		1 ϕ	3 ϕ
Voltage	V	1, 2	1, 2, 3, SUM
Current	A	1, 2	1, 2, 3, SUM
Active power	W	1, 2, SUM	SUM
Apparent power	VA	1, 2, SUM	SUM
Reactive power	var	1, 2, SUM	SUM
Power factor	PF	1, 2, SUM	SUM
Phase angle	°	1, 2, SUM	SUM
Current peak	I_p	1, 2	1, 2, 3
Frequency	Hz	1, 2	1, 2
Integration current	Ah	1, 2	1, 2, 3
Integration power +Wh/-Wh/±Wh		1, 2, SUM	SUM

NOTE

- In three-phase mode, the active power values for each channel are derived from the inter-line voltages and line currents, and have no independent significance as results. For this reason, some items are not shown for all channels.
- For a single-phase three-wire connection, channel 3 goes out of range when the channel 1 and channel 2 inputs are 65% f.s. Since an out-of-range input affects other measurement values, this unit cannot perform measurement on channel 3 in the single-phase mode.
- In the single-phase three-wire mode, the U3 and I3 analog outputs and monitor outputs are always 0 V.
- The SUM values for voltage and current show average values for channels 1, 2, and 3. For other items, the SUM values are the overall totals for one or three phases.

3.2 Changing the Response Setting

To enable stable measurements in the low frequency range, there are two response settings available.

FAST (response time: about 0.2 seconds)

This allows stable measurement for a constant input of at least 45 Hz, but at frequencies below 45 Hz the measured value fluctuates. When power transients or fluctuations occur, they are followed.

SLOW (response time: about 1.6 seconds)

This allows stable measurement down to 10 Hz, but sudden fluctuations cannot be followed.

Pressing the **SHIFT** **RESPONSE** keys changes display as follows.

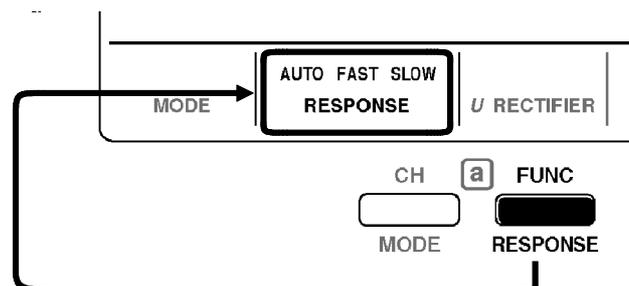


With the **AUTO** selection, the **FAST** response is used when the frequency is 45 Hz or above, and the **SLOW** response otherwise.

When the frequency indication is "o.r" or "-----", the previous response setting is maintained.

NOTE

It is not possible to change the response setting in the display hold or peak hold mode (with the **HOLD** indicator lit or flashed, "Err.016" is displayed). Press the **HOLD** key or **SHIFT** **HOLD** keys to end the hold mode (so that the **HOLD** indicator goes off), to make a change possible. However, with the **AUTO** selection, the measurement is continued switching the response setting, even if in the display hold mode.



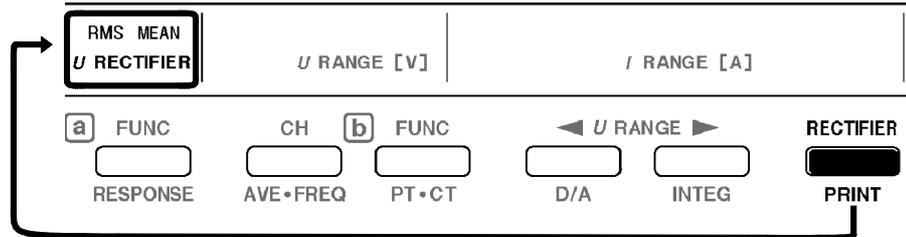
3.3 Selecting the Rectifier Type

- (1) For voltage measurement this unit has two rectifier circuits. Before measurement, select the following type.

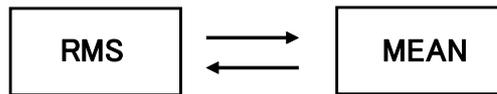
RMS Measure true RMS value

MEAN Measure average rectifier effective value converted for voltage, true RMS value for current

- (2) The rectifier type selected displays on rectifier display.



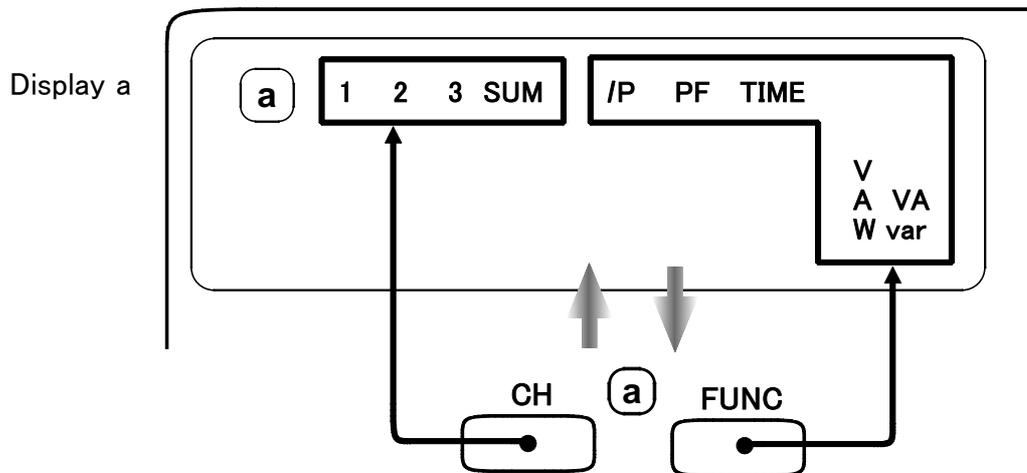
- (3) Pressing the **RECTIFIER** key changes the rectifier type. Select suitable rectifier type repeating these operation.



NOTE

- For sine wave less than 200 Hz, both "average rectifier effective value converted (MEAN)" and "real effective value (RMS)" indicate correct effective value. However, only "real effective value" indicates correct value for the input which include distorted wave.
- With the MEAN setting, a 500 Hz filter is automatically applied to the voltage measurement. This filter eliminates the carrier frequency of an inverter, allowing measurement close to the fundamental frequency. The power computation circuit, however, uses the input as is, so that there is no difference between MEAN and RMS. Moreover, for MEAN, the accuracy is not specified at frequencies of 200 Hz and above.
- During integrating (with RUN lit or flashed), the rectifier type cannot be changed ("Err.012"). Before changing the rectifier type, press the **RESET** key to reset the integration (RUN goes off).
- During holding the displays (with HOLD lit or flashed), the rectifier type cannot be changed ("Err.016"). Before changing the rectifier type, press the **HOLD** key to release the hold state (HOLD goes off).
- When the rectifier type is changed, read the measurement value after the condition of internal circuit is stable (for 5 seconds or more).

3.4 Selecting the Display



CH key Selects channel (1, 2, 3, SUM)
FUNC key Selects function (V, A, W, VA...)

Displays	Function
a	V, A, W, VA, var, PF, \angle , Ip, TIME
b	V, A, W, VA, var, PF, \angle , Ip, Ah, \pm Wh
c	V, A, W, VA, var, PF, \angle , Ip, Ah, +Wh
d	V, A, W, VA, var, PF, \angle , Ip, Hz, Ah, +Wh, -Wh, \pm Wh

V	Voltage	Hz	Frequency
A	Current	Ah	Integration power
W	Active power	+Wh	Positive integration power
VA	Apparent power	-Wh	Negative integration power
var	Reactive power	\pmWh	Total integration power
PF	Power factor	TIME	Integration elapsed time
\angle	Phase angle		
Ip	Current peak frequency		

Example of key operation

When displaying integration elapsed time on display a, SUM of active power on display b, positive integration power on display c, SUM of apparent power on display d:

1. Press **FUNC a** to light "TIME" on display a.
2. Press **FUNC b** to light "W" on display b.
3. Press **CH b** to light "SUM" on display b.
4. Press **FUNC c** to light "+Wh" on display c.
5. Press **CH c** to light "SUM" on display c.
6. Press **FUNC d** to light "VA" on display d.
7. Press **CH d** to light "SUM" on display d.

NOTE

The channels to be displayed vary depending on the function, therefore the data for channel in each function are saved. Before changing the channel, set the function to change the display.

The channels to be displayed in connecting mode are as follows.

Channels		1 φ 3W		3 φ 3W		Channels		1 φ 3W		3 φ 3W	
		Display item						Display item			
Voltage	V	1, 2		1, 2, 3, SUM		Phase angle	○	1, 2, SUM		SUM	
Current	A	1, 2		1, 2, 3, SUM		Current peak	I _p	1, 2		1, 2, 3	
Active power	W	1, 2, SUM		SUM		Frequency	Hz	1, 2		1, 2	
Apparent power	VA	1, 2, SUM		SUM		Integration current	Ah	1, 2		1, 2, 3	
Reactive power	var	1, 2, SUM		SUM		Integration power +Wh/-Wh/±Wh		1, 2, SUM		SUM	
Power factor	PF	1, 2, SUM		SUM		Integration elapsed	TIME	—		—	

Err.CH

O.r

- If the CH key is pressed when the item which the channel cannot be changed is displayed, for example; W and VA in 3 mode), "Err.CH" is displayed on the display corresponding to the key (for a second)
- Changing the frequency channel (Hz) changes automatically setting of frequency source.
- Changing the item saves measurement items of frequency.
- The voltage, current, and effective power channels display up to 130% of range. Values in excess of that amount will result in display of "o.r.", indicating out of range. The display will show o.r. for the results of calculations made using data that is out of range.
- In three-phase mode, the active power values for each channel are derived from the inter-line voltages and line currents, and have no independent significance as results. For this reason, some items are not shown for all channels.

When "TIME" is selected on display a, the following integration elapsed time is displayed.



From 0 minute to 999 hours and 59 minutes



From 1000 hours to 9999 hours and 59 minutes



From 1000 hours to 9999 hours and 59 minutes



1000 hours

For the frequency display, the frequency measurement range is displayed as follows;

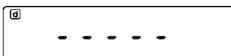


500 Hz range



50 kHz range

NOTE



- Under setting condition, constants or condition is displayed on the display.
- If the electrical current phase is leading compared to the voltage phase, the displays for reactive power, power factor, and phase angle will show a "-" for polarity.
- If the frequency item or range is changed, "-----" appears until the measurement is completed.
- If the frequency measurement channel is changed by using the CHd key in the hold state (HOLD indicator lit or flashing), the data is held after frequency measurement once.

3.5 Selecting the Range

⚠ DANGER

The maximum input voltage and current are 600 Vrms, 60 Arms. If the display value exceeds 600 V or 60 A, immediately stop measurement, cut the power to the line being measured.

If measurement is continued exceeding the maximum input, the unit will be damaged and cause a serious accident.

3

(1) Setting limits

Voltage range: 150/300/600 V

Current range: 0.5/1/2/5/10/20/50 A

Active power, reactive power and apparent power ranges: combination with voltage and current range. See Section 11.2

Current peak range: six times of current range

Active input limit (accuracy assuring limit) : 1% to 120% for range. (1% to 100% only in 600 V range) (for current peak value, 1% to 100% for range or 90 A peak value)

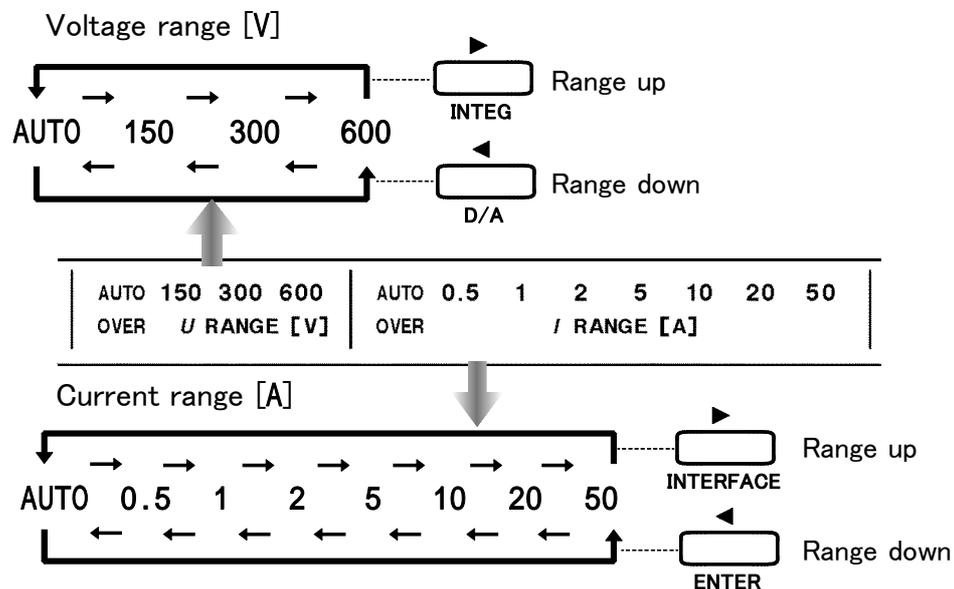
Indication limit: 130% for range (for voltage, current, active power), 110 % for range (for current peak) In case of over this limit, following mark is displayed (this means out of range).

O.r

NOTE

- During integration (the RUN indicator is lit or flashing), the range cannot be changed ("Err.012" is displayed). Before changing the range, press the **RESET** key to reset the integration value (the RUN indicator goes off).
- During holding the displays (the HOLD indicator is lit or flashed) the range cannot be changed ("Err.016" is displayed). Before changing the range, pressing the **HOLD** key or **SHIFT HOLD** keys to release the hold state (the HOLD indicator goes off).

(2) Settings



(3) Auto-ranging function

"AUTO" means auto-ranging function.

Shift level for auto-ranging function shows as follows;

When the measured value for any channel exceeds 110% for range: range up

When "OVER" illuminates: range up

When the measured value for all channels is less than full scale of 30%:
range down

To release auto-ranging function, press the ◀ or ▶ key once.

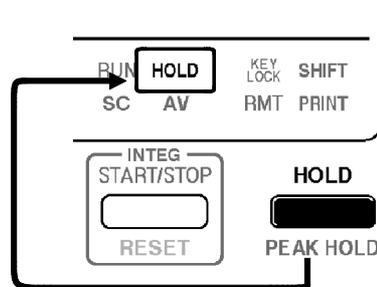
NOTE

- For single-phase, the decision is made for channels 1 and 2. For three-phase, the decision is made for channels 1, 2, and 3.
- In auto-ranging function sometimes range goes on up and down according to distortion of input wave or size of measuring value. In this case, release auto-ranging function and select range manually.
- The OVER indicator is lit when peak value of voltage input and current input waveform are over six times for range. In this case, internal circuit works abnormally. Select the range not to lit the OVER indicator.
- Even if it is either voltage or current, when massive input that will display out of range (o.r.) is applied, sometimes other measuring values become abnormal. Be sure to select ranges for voltage and/or current that will not be out of range or lit the OVER indicator.
- Apparent power shows out of range (o.r) when either voltage or current shows same display.
- Reactive power, power factor and phase angle shows out of range (o.r.) when either active power and apparent power shows same display.
- Power factor and phase angle shows out of range (o.r.) when apparent power is 0.
- If the function's crest factor is exceeded (OVER is lit), the indicated data is not correct.
- After changing range, wait until the internal circuitry settles (5 seconds) before reading the measurement value.

3.6 Holding the Display

Press the **HOLD** key, the HOLD indicator is lit and preserve all measuring value at that point. (Hold state)

Press the **HOLD** key again, this indicator goes off, and return normal measuring condition.



3.6.1 Restrictions During the Hold Status

- Shifting of connecting mode, response, range and rectifier type are not allowed. ("Err.016" is displayed.)
- Even if the auto-ranging is set for voltage, current, or frequency the range cannot be changed. The range is fixed when the range is held. If the HOLD state is released, auto-ranging function restarts.
- The following settings cannot be changed, which are explained in Chapter 4, "Settings and Operations". ("Err.017" is displayed.)

Pressing the **HOLD** key to release the hold state (the HOLD indicator goes off) changes setting.

Item	Display
Selecting number of averaging	AVERAG
Selecting frequency measurement source and range	FREQ
Selecting D/A output items	d-A SELECT
Selecting integrate time	intEGt
Setting PT ratio	Pt
Setting CT ratio	Ct

NOTE

When the measurement channel of the frequency is changed by using the **CHd** key, the data is held after the frequency measurement is carried out once.

3.6.2 Current Waveform Peak Hold Function and Maximum Value Measurement

These enable incoming current transients and maximum value of measurement items to be measured.

- (1) Press the **SHIFT** **HOLD** keys to start the peak hold function. While the peak hold function is activated the HOLD indicator flashes.
- (2) Press the **SHIFT** **HOLD** keys again to return to the normal display. (the HOLD indicator goes off.)
- (3) While the peak hold function is activated, pressing the **HOLD** key resets the peak value to the present instantaneous value.
- (4) The peak value of the current waveform is shown as Ip.
- (5) While the peak hold function is activated, for other measurement items the unit shows the maximum value since the peak hold function was activated. Pressing the **HOLD** key also resets these maximum values to the present instantaneous values.

NOTE

- The displayed peak value or maximum value is not necessarily measurements at the same time.
- For all items, the absolute values are compared.
- When the averaging function is used, the maximum value is taken from the averaged values, but the peak value is taken from the original values before averaging.
- Pressing the **SHIFT** **HOLD** keys while the hold function is active (HOLD indicator lit) switches to the peak hold function.
- Power factor or phase angle "o.r" indications are treated as a power factor of zero or phase angle of zero. (As minimum values) A frequency "o.r" indication or "-----" indication is treated as a frequency of 0 Hz. (As minimum value) For other items, an "o.r" indication is treated as a maximum value.
- The integration value is update during peak hold.

3.6.3 Restrictions During the Peak Hold Status

- Shifting of connecting mode, response, range and rectifier type are not allowed. ("Err.016" is displayed.)
- Even if the auto-ranging is set for voltage, current, or frequency the range cannot be changed. The range is fixed when the range is held. If the HOLD state is released, auto-ranging function restarts.
- The following settings cannot be changed. ("Err.017" is displayed.)

Press the **SHIFT PEAKHOLD** key to release the hold state (the HOLD indicator goes off) the settings can be changed.

Item	Display
Selecting number of averaging	AVERAG
Selecting frequency measurement source and range	FREQ
Selecting D/A output items	d-A SELECT
Selecting integrate time and items	intEGt
Setting PT ratio	Pt
Setting CT ratio	Ct

NOTE

When the measurement channel of the frequency is changed by using the **CHd** key, the data is held after the frequency measurement is carried out once.

Chapter 4

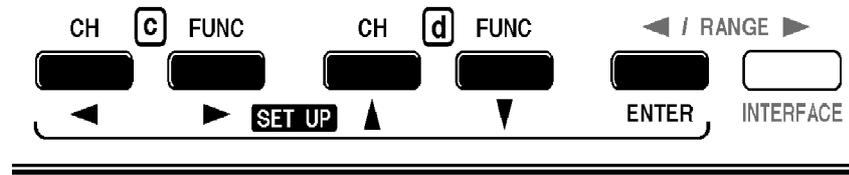
Settings and Operations

4

4.1 Setting Items

Items	Key	Display	Section
Setting the integrate time	INTEG	intEGt	4.3
Selecting the number of averaging	AVE·FREQ	AuErRG	4.4
Selecting frequency measurement source and range	AVE·FREQ	FREQ	4.5
Selecting the D/A output items	D/A	d-R SELEct	4.6
Setting the PT (voltage transformer) ratio	PT·CT	Pt	4.7
Setting the CT (current transformer) ratio	PT·CT	Ct	4.7
Selecting the printing interval time and printing items for GP-IB listen only printer or RS-232C printer	PRINT	Print	4.8
Setting the GP-IB address	INTERFACE	GPib	4.9
Setting the RS-232C	INTERFACE	r5232C	

4.2 Operating Setup Keys

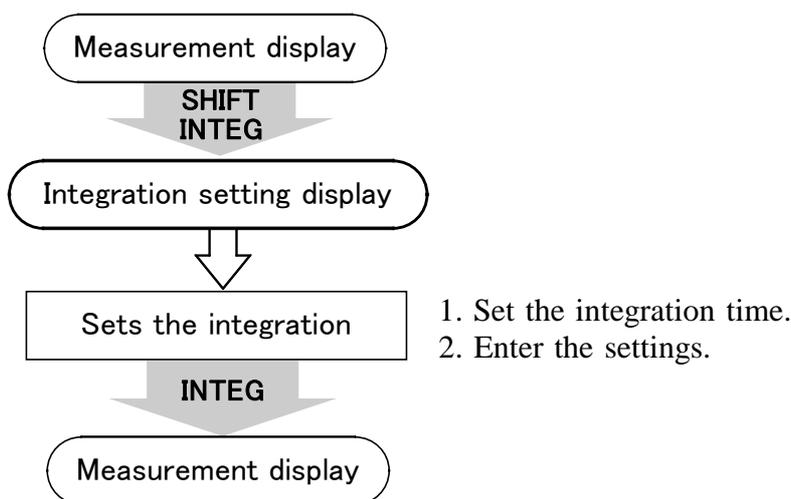


"Setup key" means every key (▶, ◀, ▲, ▼, and **ENTER**) shown with blue letters in the figure above. These keys work as "Setup key" when setting the display (the SHIFT indicator is lit). While the SHIFT indicator is turned off, this function does not work. However, those key work as the function shown with black letters above them.

4.3 Setting the Integration

This sets integration time. When integrating, some limitations arise for this unit. In this section, the settings and the integrating method will be explained.

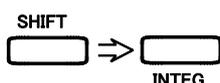
4.3.1 Flowchart



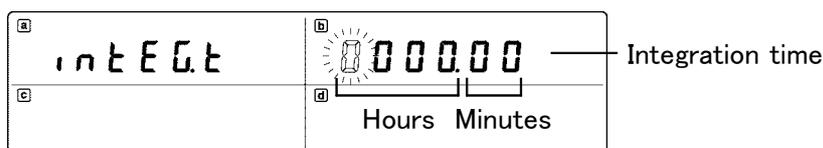
4

4.3.2 Integration Setting Method

(1) Enter the integration setting state.



1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **INTEG** key.



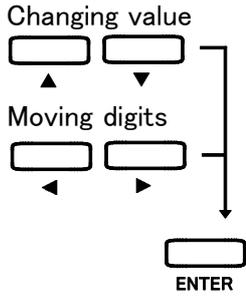
NOTE

If there is no flashing indication displayed the settings cannot be changed (during HOLD or RUN indicator lit or flashing). In this case, return to the measurement state by pressing the **INTEG** key, and set again after the integration value is reset or hold state is released.

To reset the integration, use the **START/STOP** key to stop integration (RUN indicator is flashing) and press **SHIFT RESET**. (Integration value is reset when the RUN indicator is off).

To release the hold state, press the **HOLD** key when the HOLD indicator is lit, and press **SHIFT PEAKHOLD** when the HOLD indicator is flashing. (HOLD state is released when the HOLD indicator is off).

(2) Set the integration.



1. To select the integration time, press the **▲** or **▼** or **SETUP** key to change the value.
Pressing **◀** or **▶** **SETUP** key moves flashing digit.
2. The setting range of integrate time is 1 minute to 10000 hours.
To set 10000 hours, set values to zero in all digits (0000.00).
3. Press the **ENTER** key. The flashing will stop and the setting will be decided.
Unless this operation is done, the internal setting cannot be changed.
If the settings need to be changed again, press either the **◀**, **▶**, **▲**, **▼**, or **SETUP** keys and the flashing points will reappear.

(3) Move to the measurement display.

Press the **INTEG** key. The **SHIFT** indicator will turn off.

Supplement

Display:

intEGr

Other keys operations in Integration Setting mode
(**SHIFT** indicator is lit):

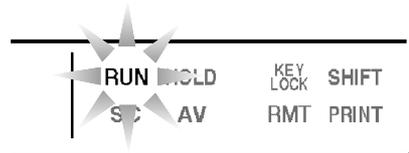
Key	Key operation
AVE·FREQ PT·CT D/A PRINT INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output.
If not, "Err.021" is displayed for 1 second.

4.3.3 Integration Operation

(1) Understanding the integrating state.

- Integration execution state: **RUN** indicator lit.
- Integration stopped state: **RUN** indicator flashing
- Integration reset state: **RUN** indicator off.



(2) The limitations of this unit due to integration.

During integration execution state (**RUN** indicator lit) and when in integration stopped state (**RUN** indicator flashing), the connecting mode, voltage range, current range, rectifier type, **PT** ratio, and **CT** ratio cannot be changed. ("Err.012" or "Err.017" is displayed for a second.)

(3) Integration operation

- To start the integration after the previous integration value is reset: Press the **SHIFT RESET** key (RUN indicator off), and then press **START/STOP** key (RUN indicator is lit). The integration will start.
- To add to the previous integration value. Press the **START/STOP** key.
- To stop forcibly the operating integration: Press the **START/STOP** key. The RUN indicator is flashing and the integration operation will stop.
- To reset the integration value: Press the **SHIFT RESET** key, and the RUN indicator is turned off. The integration value will be reset.

(4) Integration stop (RUN indicator flashing)

- Reaches integrating time.
- Press the **START/STOP** key while the RUN indicator is lit. (RUN indicator will be flashing).
- When integrate time reaches 10000 hours.
- When integrate value reaches ± 999999 MAh (MWh).

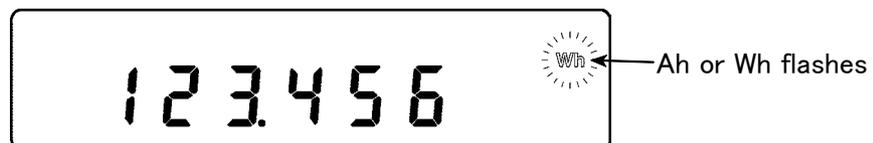
(5) Integration reset

Press the **SHIFT RESET** key while the RUN indicator is flashing (RUN indicator will be turned off).

4.3.4 Notes on Integration

- (1) When starting integration, auto range setting of voltage and current is canceled and the range at starting point is fixed. It is necessary to set the range so that it will not be out of range during integrating. If the input of current or active power for channels exceeds 130% of range during integration, the value for the channel is integrated as input of 130%f.s.

The Ah or Wh unit indication flashes to indicate that an out-of-range value has occurred. This continues flashing until the integration value is reset.



- (2) The following settings cannot be changed during integration (RUN indicator lit) or integration stop (RUN indicator flashing), (Err.012 is displayed).

Items	RUN indicator	
	Lit	Flashing
Connection mode	—	—
Response	●	●
Rectifier type	—	—
Voltage and current range	—	—
Averaging time	●	●
Frequency range and source	●	●
PT ratio, CT ratio	—	—
D/A output item	●	●
Integration time	—	—
Print time and item	—	●
Interface settings	—	●

●: changeable —: can not change
 ("Err.012" or "Err.017" is displayed for a second.)

When integrated by external control, the displays will be as follows and the setting cannot be changed.

^a integ.t	^b 0000.00
^c	^d E.C t r L

To change the setting for the integration value reset, return the measurement display with the **INTEG** key and press the **SHIFT RESET** key.

- (3) While the RUN indicator for integration is lit, resetting is out of order (Err.015 is displayed). Resetting must be done after stopping integration (interface and external control).
- (4) On starting and stopping integration key operating (and :INTEG:STATE START command of interface) and external control are unable to mix ("Err.011" is displayed).
- (5) When using external control, the integrate time which is set according to Section 4.3.2, "Integration Setting Method" is invalid. After all, integration stops in following cases.
- Stopped by external control signals.
 - When the integrate time achieves 10000 hours.
 - When the integrate value achieves ± 999999 MAh (MWh).
- (6) During displaying "S. Err", integrating cannot start ("Err.013" is displayed). In this case, change PT ratio and CT ratio. Refer to Section 4.7, "Setting the PT and CT Ratios".

- (7) When the integrate value achieves ± 999999 MAh (MWh) or when the integrate time achieves 10000 hours, integrating cannot restart. ("Err.014" is displayed).
In this case, press the **SHIFT** **RESET** keys to reset integrating data. (RUN indicator off)
- (8) When the GP-IB setting is "Pr." (printer mode), and a GP-IB listen-only printer is connected, at the same time that integration values start to be sent to the printer, measurement values can be printed at regular intervals. If, however, communications are lost because of any fault, "Err. 023" is displayed. Refer to Section 4.8, "Setting the Printer Output."
- (9) When using the RS-232C interface, set the unit to printer mode and connect RS-232C printer, measuring value are able to print according to every certain interval simultaneously as starting integration. Refer to Section 4.8, "Setting the Printer Output." If, however, communications are lost because of any fault, "Err. 023" is displayed.
- (10) When doing system resetting, integrating is stopped and the equipment is reset to initial condition. For system resetting refer to Section 6.2, "System Resetting."
- (11) When the power is cut off during integrating, integration starts again after returned. If the interface is Pr. (printer) mode, the data, integrate elapsed time, and comment "POWER FAILURE" are printed out.

4.3.5 Display Format of Integrating Value

The integration reset format is shown in Table 1 and 2.

Digits of integrate 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 Constitution of Current Integration Range

Range [A]	500.0 m	1	2	5	10	20	50
Reset value [Ah]	000.000 m	0.00000			00.0000		

Table 2 Constitution of Power Integration Range

Unit: Wh

U [V] \ I [A]	500.0 m	1	2	5	10	20	50
150	00.0000	000.000	000.000	000.000	0.00000 k	0.00000 k	0.00000 k
300	000.000	000.000	000.000	0.00000 k	0.00000 k	0.00000 k	0.00000 k
600	000.000	000.000	0.00000 k	0.00000 k	0.00000 k	00.0000 k	00.0000 k

Integration resetting value

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

Range	Display format	Integrating value format	Reset value
30 W	30.00 W	30.0000 Wh	00.0000 Wh
1.5 kW	1.500 kW	1.50000 kWh	0.00000 kWh

Also in scaling display format applies to integrating value format.

Range	Display format	Integrating value format	Reset value
150 W \times 5(CT)	750.0 W	750.000 Wh	000.000 Wh

NOTE

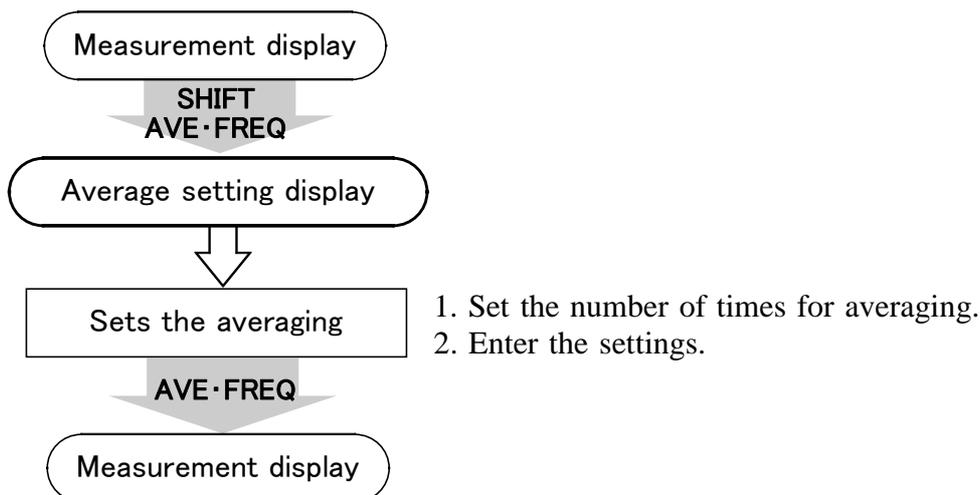
The W_{SUM} range is double that of the nominally specified range for each channel. However, upon reset, the display format uses the same digits as W1 and W2.

4.4 Setting the Number of Averaging

When dealing with input that changes greatly, an average measurement value is displayed.

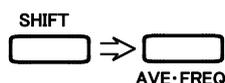
This unit does measurement averaging by the number of settings.

4.4.1 Flowchart

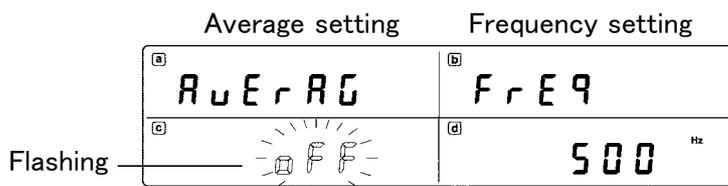


4.4.2 Average Setting Method

(1) Enter the average setting state.



1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **AVE·FREQ** key.

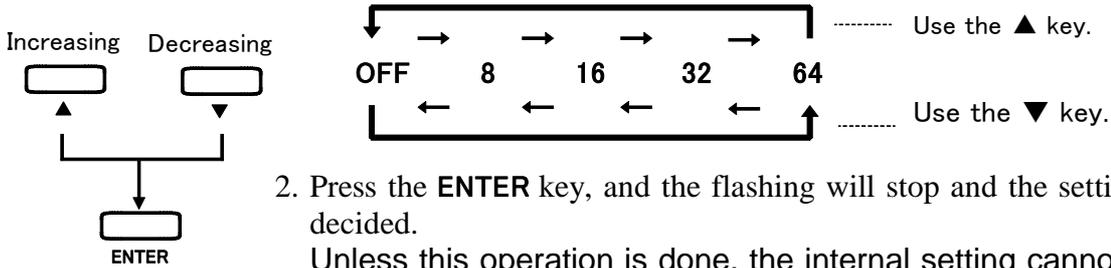


NOTE

If there is no flashing indication displayed the settings cannot be changed (the HOLD indicator lit or flashing). In this case, return to the measurement state by the **AVE·FREQ** key and release the HOLD state by the **HOLD** key or **SHIFT PEAKHOLD** key (the HOLD indicator off). Then set again from step 1.

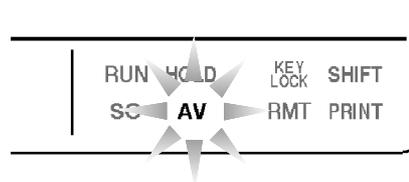
(2) Set the number of times for averaging.

1. When the indication on display c is flashing, the setting of the number of times averaged can be changed the following way, by using the **SETUP** keys.



2. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.
At this time, if the averaging times are anything but OFF, the AV (average) indicator is lit.



To change the settings again, press the ◀, ▶, or key and flashing indication appears.

(3) Move on to the measurement display.

Press the **AVE·FREQ** key and the **SHIFT** indicator will turn off.



NOTE

If the input of voltage, current or active power for channels exceeds 130% of range during averaging, the value for the channel is averaged and calculated as input of 130% f.s.

At that time, "o.r" is displayed. While an averaged value which includes an out-of-range value is being displayed, the unit indication flashes to indicate this fact.

Supplement

Display:

A U E R A G

Other keys operations in Averaging Setting mode (SHIFT indicator is lit):

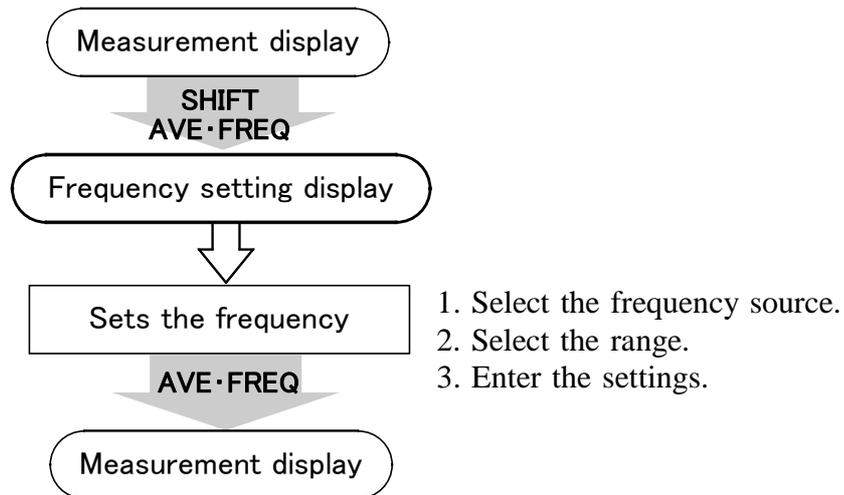
Key	Key operation
PT·CT D/A INTEG PRINT INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output. If not, "Err.021" is displayed for 1 second.

4.5 Setting the Frequency

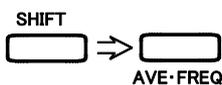
This sets the item to measure the frequency and the frequency range. Any frequency higher than the set range will be filtered out by an internal filter, so a stable frequency measurement can be made.

4.5.1 Flowchart

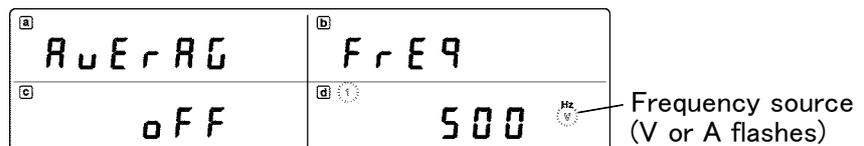


4.5.2 Frequency Setting Method

(1) Enter the frequency setting state.



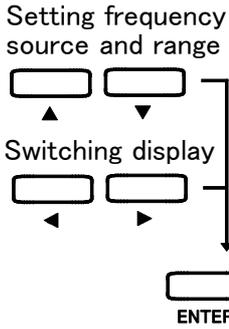
1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **AVE·FREQ** key. The averaging count is flashing.
3. Press the **▶ SETUP** key, and the frequency source is flashing.



NOTE

If there is no flashing indication displayed the settings cannot be changed (during HOLD indicator lit or flashing). In this case, return to the measurement state by pressing the **AVE·FREQ** key and release the HOLD state by pressing the **HOLD** key or **SHIFT PEAKHOLD** keys (the HOLD indicator off). Then set again from step 1.

(2) Set the frequency.



1. To select the frequency source, press the or key while the indication of V1, V2, A1, or A2 on display d is flashing.
2. To select the frequency range, press the key and the setting display (500 Hz, 50 kHz, or AUTO) on display d flashes. Press the or key to set the range.
3. Pressing the or key moves flashing point.
4. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.

If the settings need to be changed again, press either the , , , , or **SETUP** keys and the flashing points will reappear.

(3) Move onto the measurement display.

Press the **AVE·FREQ** key.

Supplement

Display:
F r E Q

Other keys operations in Frequency Setting mode (SHIFT indicator is lit):

Key	Key operation
PT·CT D/A INTEG PRINT INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output. If not, "Err.021" is displayed for 1 second.

NOTE

When the frequency range is set to "AUTO", and if the frequency exceeds 500 Hz, the range is set to 50 kHz, or if the frequency is less than 400 Hz, the range is set to 500 Hz. If the range is not decided, "----Hz" is displayed.

4.6 Setting the D/A Output

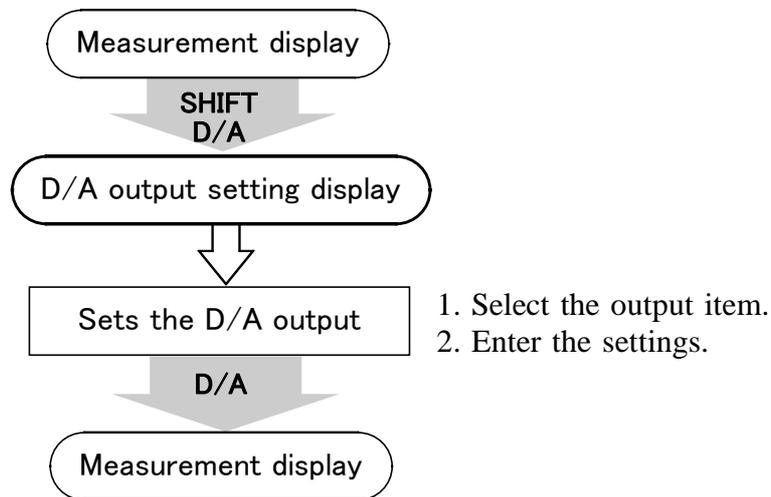
⚠ CAUTION

To avoid damage to this unit, do not shorten the D/A output terminal or input voltage.

Select the D/A output item.

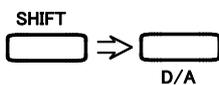
This function will change one of the measurement items (voltage, current active power, apparent power, reactive power, power factor, phase angle, current peak, frequency, current integration value or voltage integration value) out of the measured value reached by the calculation expression, into analog waveform.

4.6.1 Flowchart

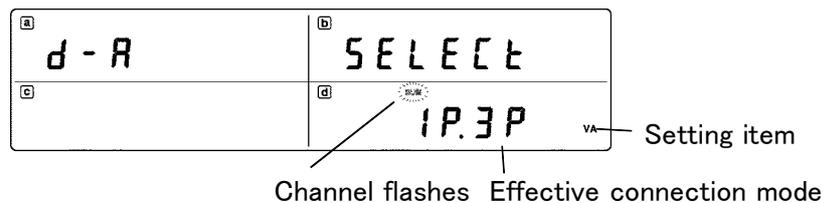


4.6.2 D/A Output Setting Method

(1) Enter the D/A output setting state.



1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **D/A** key.

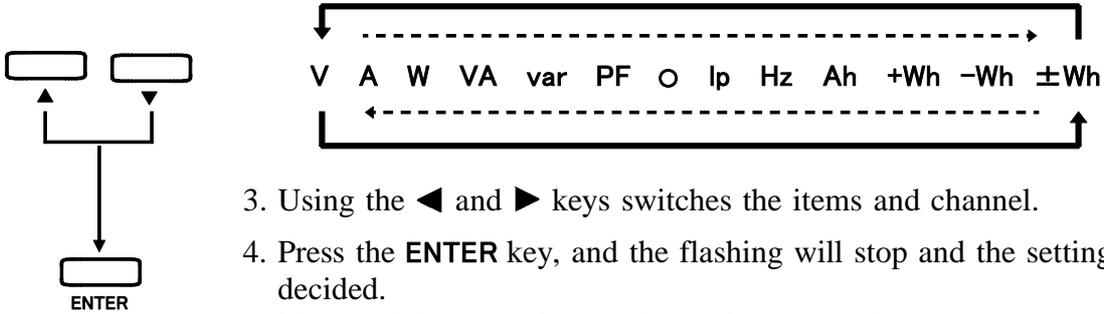


NOTE

If there is no flashing indication displayed the settings cannot be changed. In this case, return to the measurement state by the **D/A** key and release the **HOLD** state by the **HOLD** key or **SHIFT PEAKHOLD** keys. Then set again from step 1.

(2) Set the D/A output.

1. If the channel number on display d is flashing set channel 1 to SUM.
2. The measured data output from D/A is displayed as unit symbols on display d. When the indication on display d is flashing, the units can be changed the following way, by using the **SETUP** keys.



3. Using the ◀ and ▶ keys switches the items and channel.
4. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.
 If the settings need to be changed again, press either the ◀, ▶, , keys and the flashing points will reappear.

(3) Move onto the measurement display.

Press the **D/A** key.

Supplement

Display:
 d - R

Other keys operations in Averaging Setting mode (SHIFT indicator is lit):

Key	Key operation
AVE·FREQ PT·CT INTEG PRINT INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output. If not, "Err.021" is displayed for 1 second.

For D/A output example, refer to Figure 1 to 6.

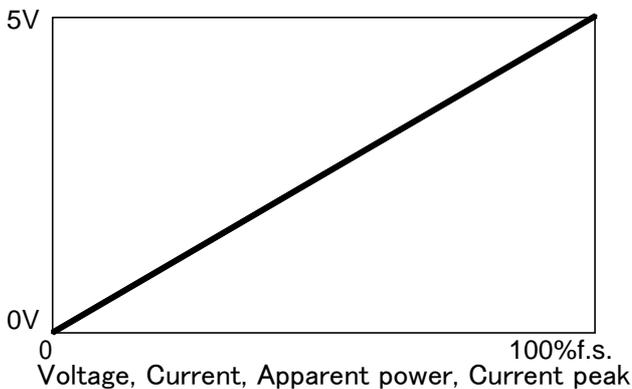


Figure 1 D/A Output of Apparent Power

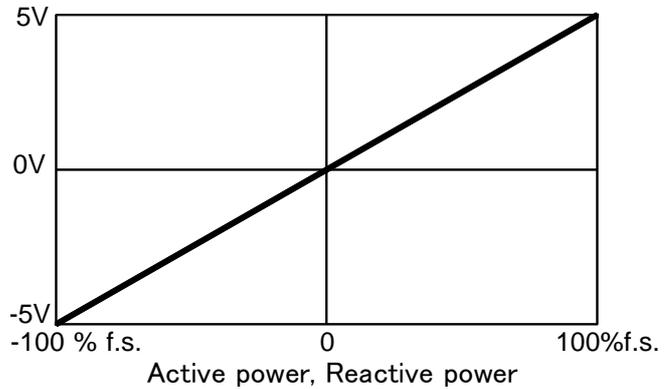


Figure 2 D/A Output of Reactive Power

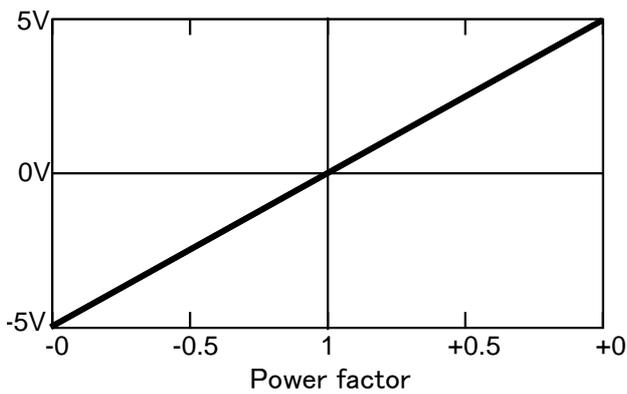


Figure 3 D/A Output of Power Factor

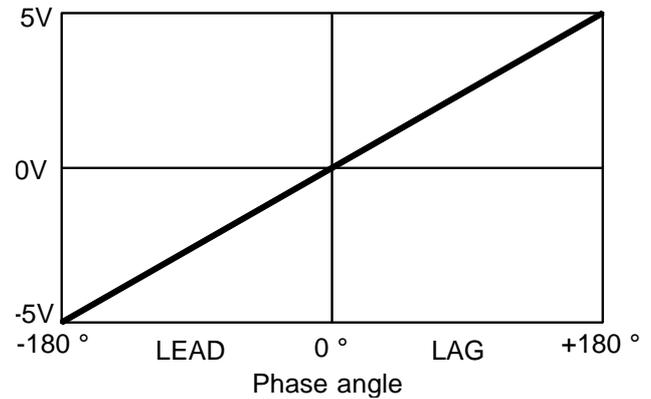


Figure 4 D/A Output of Phase Angle

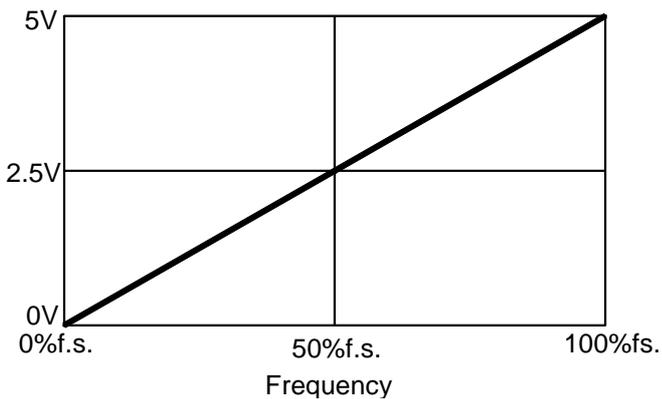


Figure 5 D/A Output of Frequency

Lower than 0.8% f.s. becomes out of range.
(Approx. 6.5 V)

- In 500 Hz range, 500 Hz is 100%
- In 50 kHz range, 50 kHz is 100%
- During "-----Hz" display, the output of the previous display is maintained.

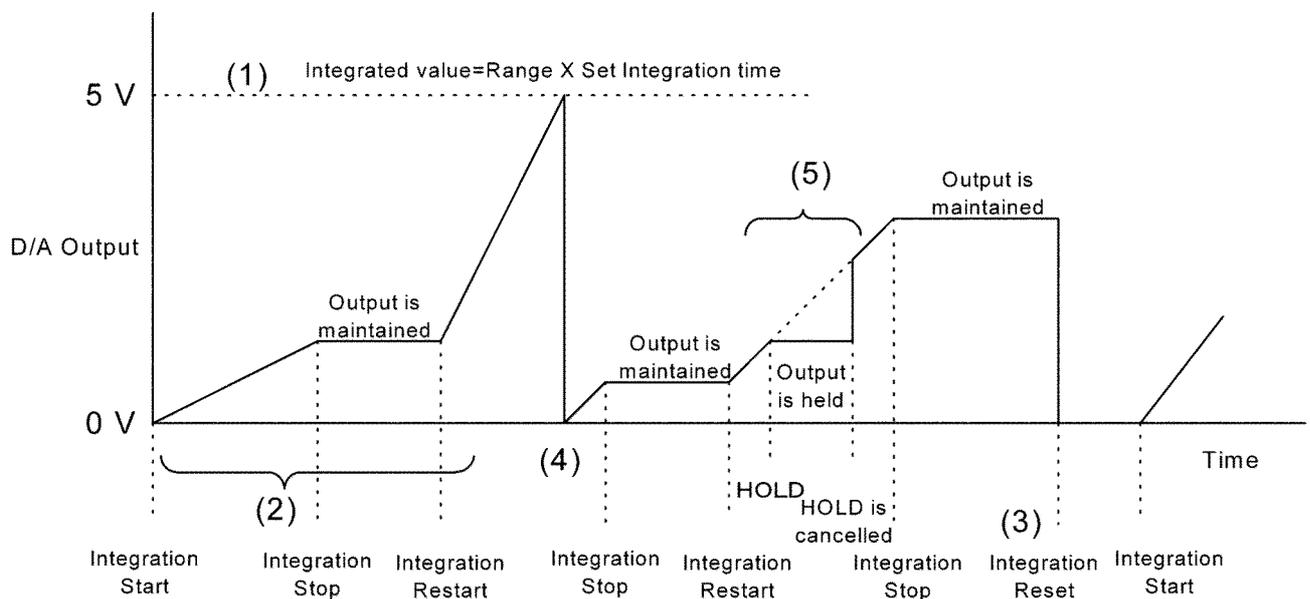


Figure 6 D/A Output of Integration (Example for active power integration)

- (1) When the integrated value equals a multiple of "the measurement range multiplied by the set integration time", the D/A output of the integration value becomes 5 V. For example, if the measurement range is 300 W and the integration time is set to 24 hours, when the integrated value is 7.2 kWh (300 x 24), 14.4 kWh (300 x 24 x 2), 21.6 kWh (300 x 24 x 3)... its the D/A output will be 5 V (when it is a multiple of -7.2 kWh, the D/A output will be -5 V).

- (2) When integration has started, D/A output begins to change. When integration has stopped, the last D/A output is maintained. When integration has restarted, D/A output begins to change again.
- (3) When the integration value is reset, D/A output returns to 0V.
- (4) When the integration value exceeds ± 5 V, D/A output returns to 0V and then begins to change again.
- (5) If the displayed value is held (by the HOLD function) during integration, the D/A output will be held, too. When the display HOLD is cancelled, D/A output begins to change again according to integration value.

NOTE

- Maximum output is 130% (± 6.5 V) of range.
- In the case of plus out of range, about 6.5 V are outputted, for minus out of range, about -6.5 V are outputted.
- During holding or averaging, the value displayed is outputted.
- D/A exchanging rate is about five times/second. There is a filter in the output circuit, and the response time is about 0.5 seconds.
- When integrating by external control, the set range \times integrate time will be 5 V.f.s.
- Depending on the connection mode, there are settings for which D/A output is not possible.

There are also values which are basically not measured. In the D/A output setting screen, to make this decision, the following indications appear in the display section d.

- 1P displays only 1 3W mode (0 V output in 3 mode)
- 3P displays only 3 3W mode (0 V output in 1 mode)
- 1P,3P displays both 1 3W and 3 3W mode
- Error no measurement

Measurement items are as follows.

Output items	Display c
W1, W2, VA1, VA2, var1, var2, PF1, PF2, O1, O2, +Wh1, +Wh2, -Wh1, -Wh2, \pm Wh1, \pm Wh2	1P (1 only)
V3, V _{SUM} , A3, A _{SUM} , Ah3, Ip3	3P (3 only)
V1, V2, A1, A2, W _{SUM} , VA _{SUM} , var _{SUM} , PF _{SUM} , O _{SUM} , Hz1, Ah1, Ah2, +Wh _{SUM} , -Wh _{SUM} , \pm Wh _{SUM} , Ip1, Ip2	1P,3P (Both 1 and 3)
W3, VA3, var3, PF3, O3, Hz2, Hz3, Hz _{SUM} , Ah _{SUM} , +Wh3, -Wh3, \pm Wh3	Error (no measurement)

For D/A output of the frequency value, set the output item to "Hz1".

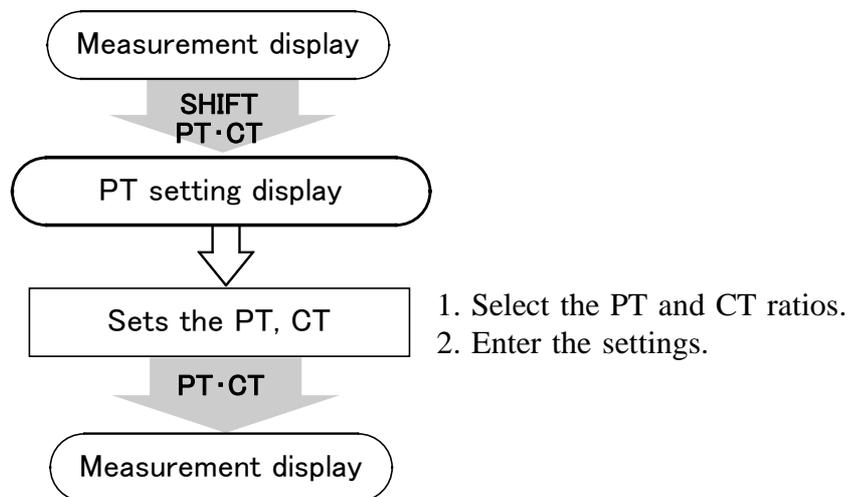
If the item of error display is decided by pressing **ENTER** key, the setting is forcibly changed to the channel which can be output.

4.7 Setting the PT (Voltage Transformer) and CT (Current Transformer) Ratios

When the secondary side of the PT is connected, by setting the PT ratio, it is possible to directly read the primary side of the PT.

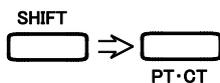
When the secondary side of the CT is connected, by setting the CT ratio, it is possible to directly read the primary side of the CT.

4.7.1 Flowchart



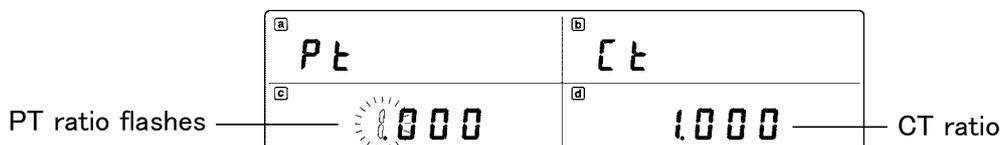
4.7.2 PT and CT Ratios Setting

(1) Enter the PT and CT ratios setting state.



1. Press the **SHIFT** key and the SHIFT indicator is lit.

2. Press the **PT·CT** key.

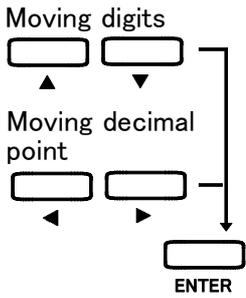


NOTE

If there is no flashing indication displayed the settings cannot be changed (during HOLD or RUN lit or flashing). In this case, return to the measurement state by pressing the **PT·CT** key, and set again after the integration value is reset or hold state is released.

To reset the integration, use the **START/STOP** key to stop integration (RUN indicator is flashing) and press **SHIFT RESET**. (Integration value is reset when the RUN indicator is turned off).

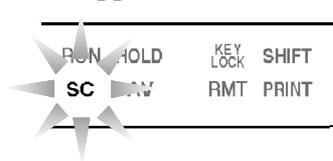
To release the hold state, press the **HOLD** key when the HOLD indicator is lit, and press **SHIFT PEAKHOLD** when the HOLD indicator is flashing. (HOLD state is released when the HOLD indicator is turned off).



(2) Set the PT and CT ratios.

1. Using the **▲** or **▼** **SETUP** key, set the PT ratio on display c and CT ratio on display d when the value is flashing.
2. To move the flashing digit, press the **◀** or **▶** key. To move the flashing decimal point, use the **◀** or **▶** key,
3. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed. At this time, if the PT or CT is other than 1, the SC (scaling) indicator is lit. If the settings need to be changed again, press either the **◀**, **▶**, **▲**, **▼** keys and the flashing points will reappear.



(3) Move onto the measurement display.

Press the **PT•CT** key.

NOTE

- Setting limits of PT and CT ratios are 0.001 to 9999.
- If the value is set to 0, such as "0.000", it is forcibly set to 1.000 when pressing the **ENTER** key.
- If the value exceeds 99999M at 130%f.s. input, the following indication will be displayed. (Means scaling error)

S.E r r

- When the active and apparent power become scaling error, the reactive power, power factor, phase angle and power integration value are also scaling error. However, when becomes out of range, "o.r" is displayed.

Supplement

Display:
P t . C t

Other keys operations in PT and CT Ratios Setting mode (SHIFT indicator is lit):

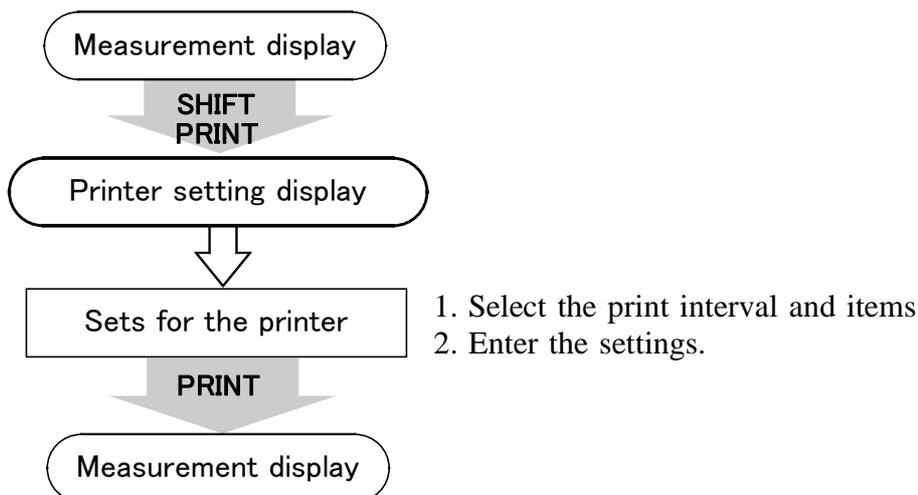
Key	Key operation
AVE•FREQ D/A INTEG PRINT INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output. If not, "Err.021" is displayed for 1 second.

4.8 Setting the Printer Output

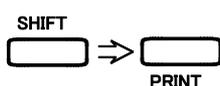
When the interface setting is "Pr." mode, it is possible to print data using a standard printer connected through the GP-IB or RS-232C interface. This section describes how to set the printing interval and the items to be printed.

4.8.1 Flowchart

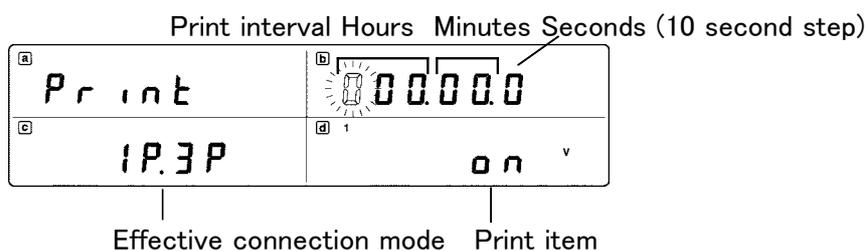


4.8.2 Printer Output Setting Method

(1) Enter the printer setting state.



1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **PRINT** key.



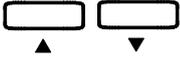
NOTE

If there is no flashing indication displayed the settings cannot be changed (RUN indicator lit).

In this case, return to the measurement state by pressing the **PRINT** key and press **START/STOP** key to stop integration. Then set again from step 1. (RUN indicator flashing)

(2) Set the print interval and print item.

Setting the value

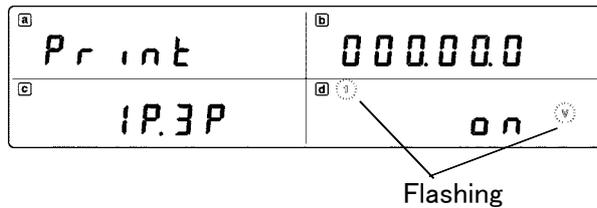


Moving digit



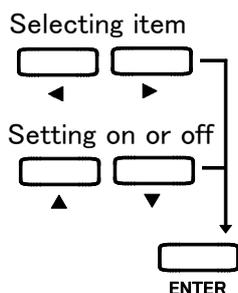
NOTE

1. To move the flashing point, press the ◀ or ▶ **SETUP** key.
 2. To set the value on the flashing digit, press the **ENTER** key.
- The smallest unit of setting limit is 10 seconds and biggest is 100 hours. If the setting exceeds this limit, it is forcibly set to 100 by pressing the **ENTER** key.
 - When this setting is used, data is printed by the printer at the same time as the start of integration.
 - When it is 000.00.0, the unit will not print at the same time as integration.
 - If the number of printed items is large, printing may not be possible within the specified printing interval. In this case, make the printing interval longer, or reduce the number of items.
3. If in the seconds column and the ▶ key is pressed, or in the left hand column of the hour columns and ◀ key is pressed, the display will change to the setting of the print item.



Pressing the ▶ key moves flashing point according to the following cycle.
Pressing the ◀ key moves reversely.

	Displays				Meaning	
	0 0 0.	→	0 0.	→	0	Time
V	V1	→	V2	→	V3 → V _{SUM}	Voltage
A	A1	→	A2	→	A3 → A _{SUM}	Current
W	W1	→	W2	→	W _{SUM}	Active power
VA	VA1	→	VA2	→	VA _{SUM}	Apparent power
var	var1	→	var2	→	var _{SUM}	Reactive power
PF	PF1	→	PF2	→	PF _{SUM}	Power factor
○	○1	→	○2	→	○ _{SUM}	Phase angle
Ip	Ip1	→	Ip2	→	Ip3	Current peak
Hz	Hz					Frequency
Ah	Ah1	→	Ah2	→	Ah3	Current integration
+Wh	+Wh1	→	+Wh2	→	+Wh _{SUM}	Positive power integration
-Wh	-Wh1	→	-Wh2	→	-Wh _{SUM}	Negative power integration
±Wh	±Wh1	→	±Wh2	→	±Wh _{SUM}	Total power integration
	TIME					Integration time



4. Select the item to be printed by using the ◀ or ▶ key. At this time, unit symbol and channel on display b and d are flashing to indicates the item. "on" shown on display d means that the item is printed. "oFF" shown on display d means that the item is not printed.

5. By pressing the ▲ or ▼ key, on or off setting can be changed. Repeat this procedure and select "ON" or "OFF" for every items.

6. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.

If the settings need to be changed again, press either the ◀, ▶, ▲, ▼ keys and the flashing points will reappear.

NOTE

- Depending on the connection mode, there are settings for which printer output is not possible. In the printer setting screen, to make this decision, the following indications appear in the display section c.

1P displays only 1 mode.

3P displays only 3 mode

1P,3P displays both 1 and 3 mode.

Measurement items are as follows.

Output items	Display c
W1, W2, VA1, VA2, var1, var2, PF1, PF2, O1, O2, +Wh1, +Wh2, -Wh1, -Wh2, ±Wh1, ±Wh2	1P (1 only)
V3, V _{SUM} , A3, A _{SUM} , Ah3, Ip3	3P (3 only)
V1, V2, A1, A2, W _{SUM} , VA _{SUM} , var _{SUM} , PF _{SUM} , O _{SUM} , Hz1, Ah1, Ah2, +Wh _{SUM} , -Wh _{SUM} , ±Wh _{SUM} , Ip1, Ip2, TIME	1P,3P (Both 1 and 3)

When the item for 3P in 1 3W mode or for 1P in 3 mode is selected, the item is not output on the printer.

- If all items are set to OFF, the displaying fourth item is printed.

(3) Moves onto the measurement display.

Press the **PRINT** key. The SHIFT indicator is turned off.

Supplement

Display:

Print

Other keys operations in Printer Setting mode (SHIFT indicator is lit):

Key	Key operation
AVE·FREQ PT·CT D/A INTEG INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output. If not, "Err.021" is displayed for 1 second.

4.8.3 Connecting to the Printer

(1) Printer for the GP-IB

1. Set the printer to listen only.
2. For details on the setting method of the 3331, refer to Section 4.9, "Setting the Interface."
3. Connect the 3331 to the printer by using the GP-IB cable.

(2) Printer for the RS-232C

1. Match the settings of the printer and the 3331. (Baud rate, data length, stopbit, and parity)
2. For details on the setting method of the 3331, refer to Section 4.9, "Setting the Interface."
3. Connect the 3331 to the printer by using the RS-232C cable.

NOTE

- Depending on the printer, either the pin 2 or the pin 3 is the receiver pin. If the pin 2 is the receiver pin, use a straight cable. If the pin 3 is the receiver pin, use a cross cable. For the cross cable, use the type indicated in Section 8.1.2, "RS-232C Interface", example for RS-232C cable connections.
- For interface cables, use screws to secure the cable. Also, always use shielded cables for the cable to be used.

(3) Setting the 3331

Set to Pr. mode on the 3331. (Refer to Section 4.9, "Setting the Interface".)

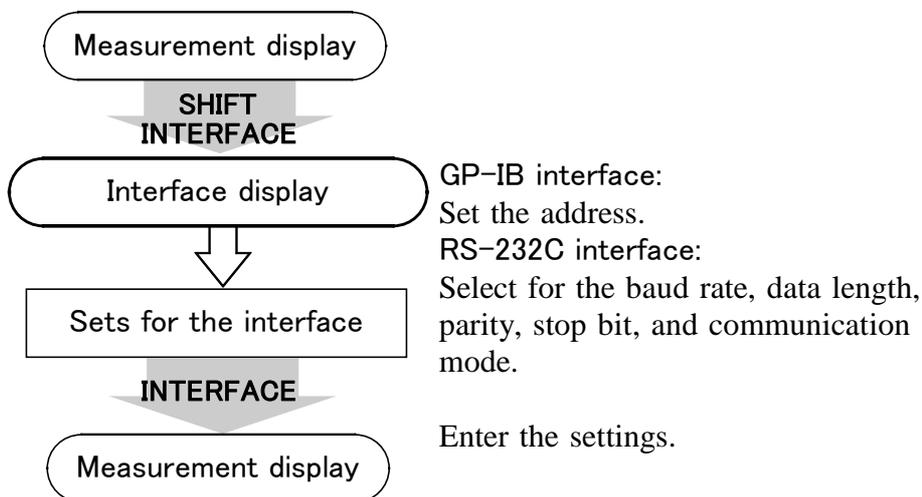
(4) Printing sample

Refer to Section 8.7, "Printer Output Function."

4.9 Setting the Interface

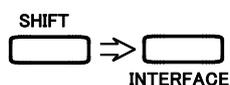
Sets the communication condition for GP-IB interface or RS-232C interface.

4.9.1 Flowchart



4.9.2 Interface Setting

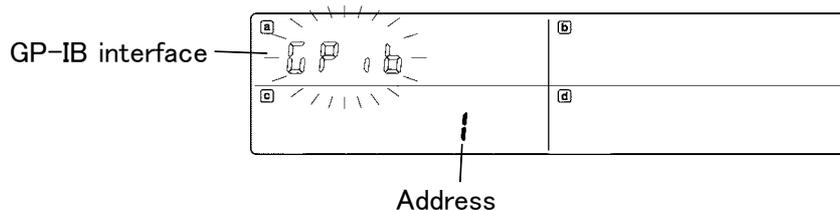
(1) Enter the interface setting state.



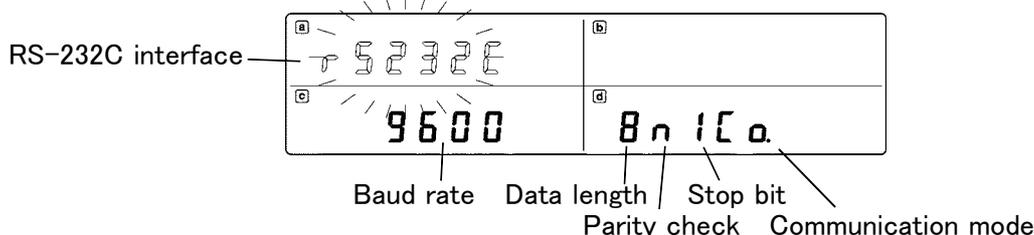
1. Press the **SHIFT** key and the SHIFT indicator is lit.

2. Press the **INTERFACE** key.

• GP-IB interface setting



• RS-232C interface setting



NOTE

If there is no flashing indication displayed the settings cannot be changed (RUN indicator lit).

In this case, return to the measurement state by pressing the **INTERFACE** key and press **START/STOP** key to stop integration. Then set again from step 1. (RUN indicator flashing)

(2) Select the interface

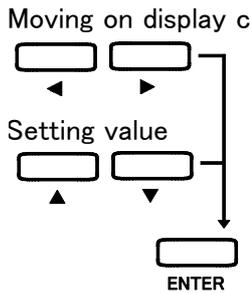
During flashing on display a, press the or key to select.

GP IB ↔ r 5 2 3 2 C

The display for GP-IB, the address setting is displayed on display c.
The display for RS-232C, the settings of data length, parity, stop bit, and communication mode on display d.

(3) Set the interface.

GP-IB INTERFACE

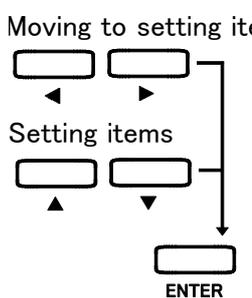


1. During flashing on display a, move the flashing to display c (address or Pr mode) by using the ◀ or ▶ key.
2. Change the settings with the ▲ or ▼ key. The address can be set between 0 and 30. The previous display of "0" or the next display of "30" is Pr. (printer mode).
3. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.

If the settings need to be changed again, press either the ◀, ▶, ▲, ▼ keys and the flashing points will reappear.

RS-232C INTERFACE



1. Using the ◀ or ▶ key, move the flashing point to the setting item.
2. Select the flashing baud rate (1200, 2400, 4800, or 9600 bps) on display c with the ▲ or ▼ key.
3. Select the flashing data length (7 or 8 bit) on display d with the ▲ or ▼ key.
4. Select the flashing parity (n :none/ o: odd/ E:even) on the 2nd character from the left end) on display c with the ▲ or ▼ key.
5. Select the flashing stop bit (1 or 2 bit on the 3rd character from the left end) on display d with the ▲ or ▼ key.
6. Using the ◀ or ▶ key, select the flashing communication mode (Pr.: print mode/ Co.:control mode (character on the right)) on display d.
7. Press the **ENTER** key, and the flashing will stop and the setting will be decided.

Unless this operation is done, the internal setting cannot be changed.

If the settings need to be changed again, press either the ◀, ▶, ▲, ▼ keys and the flashing points will reappear.

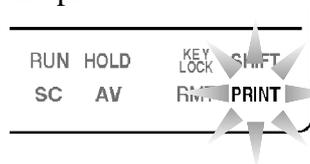
(4) Move to the measurement display.

Press the **INTERFACE** key. (SHIFT indicator off)

NOTE

Printer mode (Pr.) and Control mode (Co.)

- When in Pr mode (PRINT indicator is lit), data such as interval print and manual print are output to the printer.



- When in Co. mode, only control by the controller is possible through the interface.

Supplement

Other keys operations in GP-IB and RS-232C setting mode (SHIFT indicator is lit):

Display:
 0 P 1 b
 r 5 2 3 2 C

Key	Key operation
AVE·FREQ PT·CT D/A INTEG INTERFACE	Moves to each setting screen.
*HELP	Sends the setting data to the printer.
SHIFT	Displays "Err.017". (for 1 second)

*: When the interface is in Pr mode, the data is output.
 If not, "Err.021" is displayed for 1 second.

Chapter 5

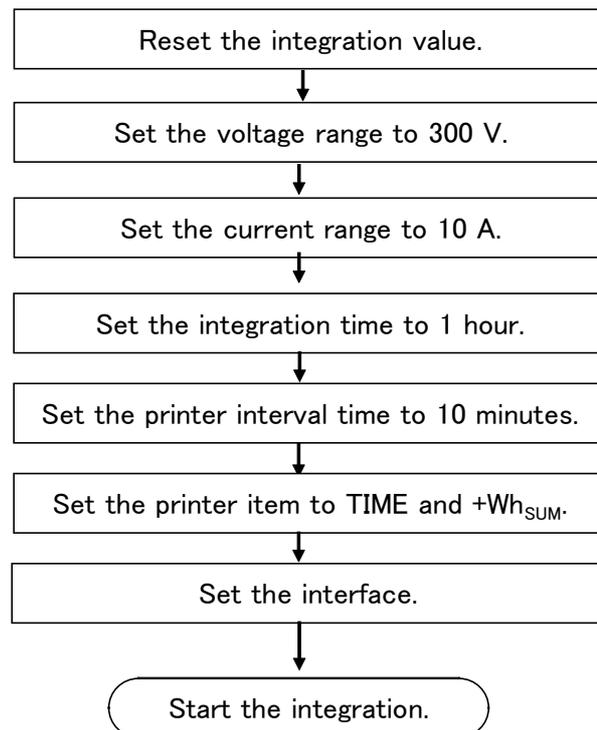
Setting and Measurement

Example

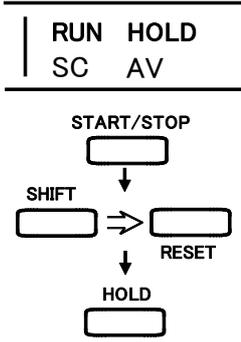
5

5.1 Electrical Power Integration and Printer Output Examples

Will integrate electrical power of 200 V, 10 A max. for 1 hour. Every ten minutes, the integration time and $+Wh_{SUM}$ will be printed.

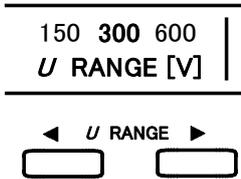


- (1) Reset the integration value. (The RUN and HOLD indicators should be turned off.)



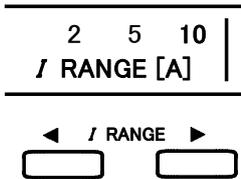
1. When the RUN indicator is lit, press the **START/STOP** key to stop integration. The RUN indicator is flashing.
2. Press the **SHIFT**→**RESET** keys to reset the integration value. The RUN indicator is turned off
3. Press the **HOLD** key to turn off the HOLD indicator when the HOLD indicator is lit.
4. When the HOLD indicator is flashing, press the **SHIFT**→**HOLD** keys to turn off the HOLD indicator.

- (2) Set the voltage range to 300 V.



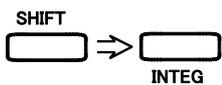
Using the ◀U or ▶U key, move the flashing to 300 (300 V).

- (3) Set the current range to 10 A.

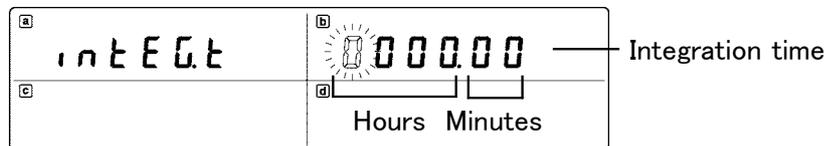


Using the ◀I or ▶I key, move the flashing to 10 (10 A).

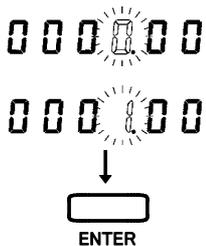
- (4) Set the integration time to 1 hour.



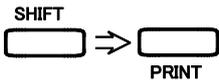
1. Press the **SHIFT** key to lit the SHIFT indicator.
2. Press the **INTEG** key to display settings of integration time. The value in the left end of the display b is flashing.



b

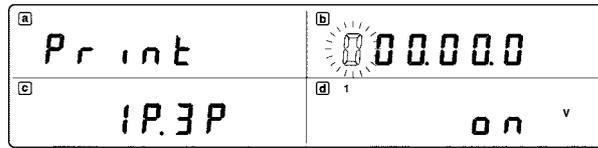


3. Press the ▶ key 3 times and the 4th column (a digit for hour) is flashing. (Pressing the ◀ key moves the flashing point in the reverse way.)
4. Press the ◀ key once to set to "1".
5. Press **ENTER** key to enter "0001.00" (no flashing).



(5) Set the print interval time to 10 minutes.

1. Press the **PRINT** key during displaying integration setting (If the display is returned to the measurement display, press **SHIFT**→ **PRINT**.)



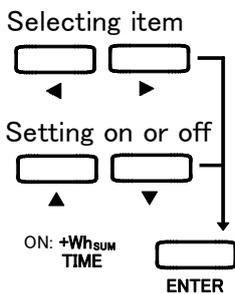
(b)



2. Press the **▶** key 3 times, and the flashing moves to the column of 10 minutes. (Pressing the **◀** key moves the flashing point in the reverse way.)
3. Press the **1** key once to set to "1".

(6) Set the print item of the printer to TIME and +Wh.

1. Press the **▶** key 3 times, and "V" is flashing.
2. Press the **◀** or **▶** key to set to "OFF".
3. Press the **▶** key to change the item, and then set to ON or OFF by using the **◀** or **▶** key. Set to ON for +Wh_{SUM} and TIME only. (Pressing **◀** key moves the item in the reverse way.)
4. Press the **ENTER** key, the setting of print interval (10 minutes) and print item (+Wh, TIME) will be decided.



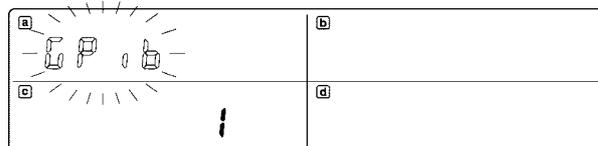
(7) Set the interface.

Press the **INTERFACE** key during printer setting display.

(If the display is returned to the measurement display, press the **SHIFT** key and then press the **INTERFACE** key.)

When flashing on display a, set GP-IB and RS-232C by using the **◀** or **▶** key.

Using the GP-IB interface



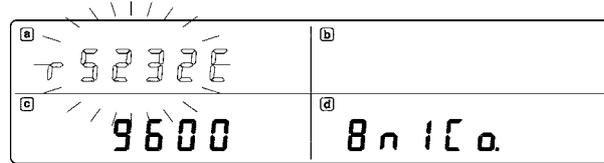
(b)



1. Using the **◀** or **▶** key, move the flashing to address.
2. Press the **◀** or **▶** key to set to "Pr".

Using the RS-232C interface

Setting example: baud rate: 9600, data length: 8, parity: no, stop bit: 1



1. Using the ► key, move the flashing point to display c.
2. Set the baud rate to "9600" on display c, using the or key.
3. Using the ► key, move the flashing point to display d.
4. Set the data length to "8" on display d, using the or key.
5. Press the ► key once to move the flashing point to the right.
6. Set the parity to "n", using the or key.
7. Press the ► key once to move the flashing point to the right.
8. Set the stopbit to "1", using the or key.
9. Press the ► key once to move the flashing point to the right.
10. Set the parity to "Pr", using the or key.
11. Press the **ENTER** key and the setting will be decided.

(8) Integration start

1. Press the **INTERFACE** key to return the measurement display.
2. Press the **START/STOP** key.
3. The RUN indicator is lit and the integration starts. "INTEGRATOR START" is printed on the printer. Integration will print the measurement value every ten minutes, and will stop 1 hour later. (RUN indicator will flash, and "INTEGRATOR STOP" will be printed by the printer)

```

INTEGRATOR START  ————— Start integration

0000:00:00
INTEGRATOR
TOTAL TIME      0000:00:00 ——— Integration value from the
                    WH                               integration start.
(±) 0.0000k
INTERVAL TIME   0000:00:00 ——— Integration value from the
                    WH                               previous to this time print output.
(±) 0.0000k

0000:10:00
INTEGRATOR
TOTAL TIME      0000:10:00
                    WH
(±) 0.6691k
INTERVAL TIME   0000:10:00
                    WH
(±) 0.6691k
.
.
.
0000:00:00
INTEGRATOR
TOTAL TIME      0000:00:00
                    WH
(±) 4.0157k
INTERVAL TIME   0000:10:00
                    WH
(±) 0.6694k

INTEGRATOR STOP  ————— Stop integration

```

- To continue integration

When resetting the data and restarting, press the **SHIFT→RESET** key and then press the **START/STOP** key.

When adding data and integrating, press **START/STOP** key once.

- To stop operating

Press the **START/STOP** key once. The RUN indicator will flash and "INTEGRATOR STOP" will be printed out.

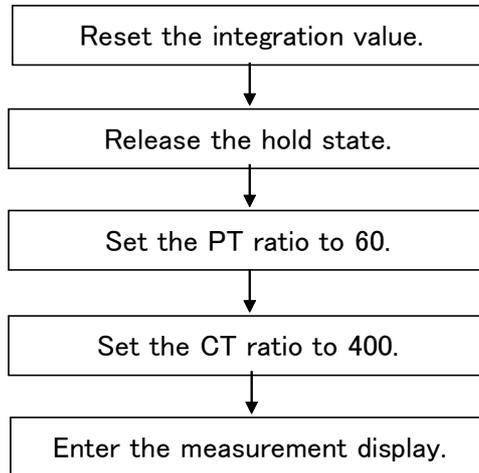
5.2 PT and CT Setting

(Examples of Changing the Digits and Moving the Decimal Point)

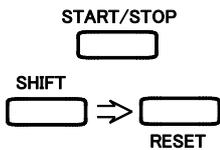
Explains when using the following PT and CT:

PT: primary side 6,600 V secondary 110 V (PT ratio $6,600 \div 110=60$)

CT: primary side 2,000 A secondary 5 A (CT ratio $2,000 \div 5=400$)

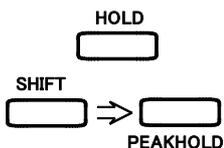


(1) Resets the integration value.



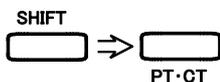
1. When the RUN indicator is lit, press the **START/STOP** key to stop integration.
2. When the RUN indicator is flashing, press the **SHIFT→RESET** key to reset the integration value (the RUN indicator is turned off).

(2) Release the hold state.

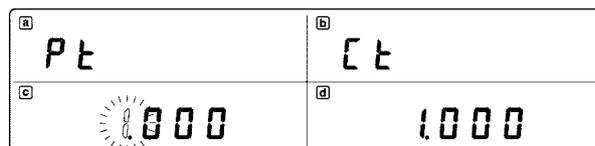


1. When the HOLD indicator is lit, press the **HOLD** key to turn off.
2. When the HOLD indicator is flashing, press the **SHIFT→PEAKHOLD** keys to turn off.

(3) Set the PT ratio to 60.



1. Press the **SHIFT** key and the SHIFT indicator is lit.
2. Press the **PT·CT** key to make a setting condition. Displays in this case become as follows;



The most significant digit flashes

When PT ratio except 1 is already set that value is displayed.

If the most significant digit is not flashing, the holding display state or integration data is not reset. At this time press the **PT·CT** key and return to normal condition, and then repeat from step 1.

3. Set the PT ratio.

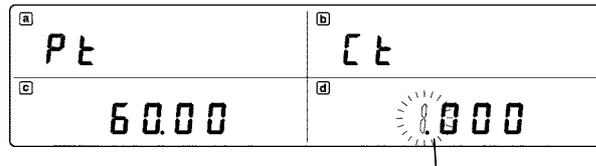
To change the numerical value
Press the or key 5 times to set to "6".

To change the flashing to decimal point
Press the key 4 times.

To move the decimal point
Press the key once or press the key 3 times to set to "60.00".

(4) Set the CT ratio to 400.

1. Press the key once, the flashing point moves to the top of the CT ratio.



The most significant digit flashes

2. Set the CT ratio.

To change the numerical value
Press the key 3 times to set to "4".

To change the flashing to decimal point
Press the key 4 times.

To move the decimal point
Press the or key twice to set to "400.0".

3. Press the **ENTER** key to decide the settings ("SC" indicator lit)

NOTE

If you switch to a different setting display or return to the normal measurement state while this is flashing, the PT and CT ratios remain at their previous settings.

(5) Move onto the measurement display.

1. Press the **PT·CT** key, and the SHIFT indicator will turn off. The SC indicator (scaling) is lit.
2. The range setting corresponds to the secondary side of the voltage and current transformers. For example, with the 150 V, 5 A ranges, the ranges (resolution) of the scaled voltage, current, active power, and other values is as follows.

Voltage	9.0000 kV	$150 \text{ V} \times 60$
Current	2.0000 kA	$5 \text{ A} \times 400$
Active power	18.000 MW (CH1, 2) 36.000 MW (SUM)	$(150 \text{ V} \times 5 \text{ A} \times 60 \times 400) \times 2$ (SUM)
Apparent power	18.000 MVA (CH1, 2) 36.000 MVA (SUM)	$(150 \text{ V} \times 5 \text{ A} \times 60 \times 400) \times 2$ (SUM)
Reactive power	18.000 Mvar (CH1, 2) 36.000 Mvar (SUM)	$(150 \text{ V} \times 5 \text{ A} \times 60 \times 400) \times 2$ (SUM)
Current integration	0.00000 kAh	(On starting integration)
Power integration	0.0000 MWh	(On starting integration)

Chapter 6

Other Functions

6.1 When Power Fails

- (1) If a power failure occurs during integration, the integration restart (continues) after the power is restored.
- (2) When the GP-IB or RS-232C interface is in "Pr." mode, and if the power failed while integration was in progress, the measurement data at the time of power failure is printed, together with the integration elapsed time and a message "POWER FAILURE."
- (3) During the above power failure processing, the display appears as follows.

a d A t A	b o U t P U t
c	d

6.2 System Resetting

To carry out a system reset, power on the unit, and hold down the **SHIFT → RESET** keys during the self test.

This returns all of the settings to their initial values. (These are the same as the settings when the unit is initially shipped from the factory.)

The integration elapsed time and integration value are also reset.

Items		Settings
Display a		Voltage ch1
Display b		Current ch1
Display c		Active power SUM
Display d		Power factor SUM
Connecting mode		3 ϕ
Response		Auto
Voltage range		Auto-range
Current range		Auto-range
Rectifier type		RMS
Frequency range		Auto-range
Frequency measurement source		Voltage CH1
Integrate time		10000:00 (10,000 hours)
PT ratio		1.000
CT ratio		1.000
D/A output items		Apparent power SUM
The number of averaging		OFF (No averaging)
GP-IB address		1
RS-232C (GP-IB: interface for communication)	Baud rate	9600 bps
	Data length	8 bits
	Parity bits	none
	Stop bits	1 bit
	Communication mode	Co.
Hold		OFF (continuous display)
Printing items		All items
Print interval time		00:00:00 (interval printing: OFF)

[A] r E S E t		[B] 3 3 3 1	
[C]		[D]	
MODE	RESPONSE	V RECTIFIER	V RANGE [V]
			I RANGE [A]

6.3 Error Indications

When there is something wrong for self testing at the power turning on or operates wrong key in integrating or holding the display, error indications are displayed.

E r r . 0 0 1

 Error number

Error Indication List

Error number	Errors	Pages
001	Backup error (*1, *2, *3)	Requires repair
101	ROM error (*3)	Requires repair
102	RAM error (*3)	Requires repair
103	I/O port error(*3)	Requires repair
104	Interrupt handler fault (*3)	Requires repair
105	A/D and D/A converter error (*3)	Requires repair
011	(Integration) Key operation and external control used together	38, 76
012	(Integration) Invalid key press during integration operation	21, 24, 27, 36, 38
013	(Integration) Integration started while scaling error has	38
014	(Integration) Restarted from maximum integration count or occurred integration elapsed time	39
015	(Integration) Integration reset carried out during integration	38, 76
016	Invalid key is pressed during display hold	21, 23, 24, 29, 31
017	Invalid key is pressed during setting	29, 31, 36, 38
021	(Interface) Data out or help operation is carried out while it is not in Pr. mode or when interface is not installed	163, 173, 174
022	(Interface) No space left in internal data buffer	164, 169
023	(Interface) Invalid communication	39
CH	CH key is pressed in connection mode, which channel can not be changed.	26

***1 Err.001 (backup error)**

Pressing any key frees the display and returns to the normal measurement state. The 3331, however, undergoes a system reset. (Refer to Section 6.2 "System Resetting".)

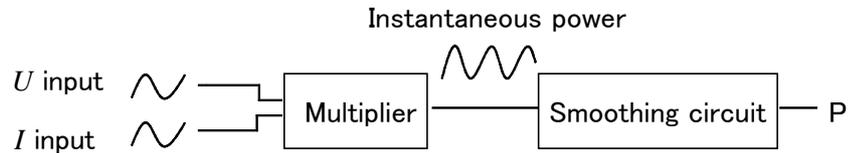
***2 Error.001 occurs when backup data stored in RAM is corrupted, which can result from a depleted internal lithium backup battery, external noise ingress or loss of power while changing settings. Please contact your nearest service representative for battery change. The battery would run down after six years.**

***3 Err.101 to 105, 001**

Indicate internal problems with the 3331. If these error indications appear, the unit requires repair.

6.4 Changing the Power Calculation Circuit Clock Frequency

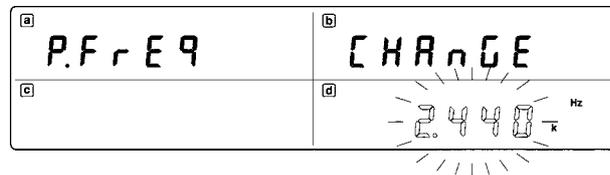
Power measurement is carried out by direct input of the voltage and current waveforms to a multiplier, where an instantaneous power waveform is created. This is then passed through a smoothing circuit.



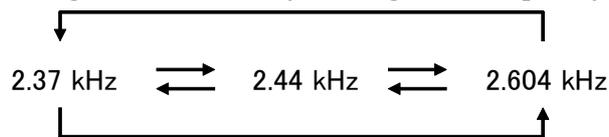
To eliminate the multiplier offset, this unit is designed to allow stable measurement of input voltages and currents chopped at a frequency of 2.44 kHz.

However, if the input waveform includes a component with a frequency which is an integral multiple of 2.44 kHz, the indicated power value may fluctuate periodically. In this case, use the following procedure to change the frequency (the clock frequency of the power measurement circuit).

1. Turn the power on.
2. Press the **SHIFT** **ENTER** keys during self testing.
3. After self testing, the current frequency is displayed.



4. By pressing the **←** or **→** keys change the frequency.



5. Press the **ENTER** key to enter the setting and the normal measurement mode is returned.

NOTE

- This setting is saved in backup memory. It is not changed, even by a system reset.
- If a backup error occurs, this is reset to 2.44 kHz. This is also the factory default setting.
- While this display is shown, control via the interface is not possible.

6.5 Key Lock State

While measurement values are displayed, pressing the **SHIFT** **KEYLOCK** keys locks the panel, so that keys other than the **SHIFT** **KEYLOCK** keys are disabled. (The **KEYLOCK** indicator lights.)

To release the key lock state (to turn off the **KEYLOCK** indicator)

1. Press the **SHIFT** **KEYLOCK** keys again.
2. By using the controller, set the 3331 to remote condition.

This does not inhibit the input of external control signals.



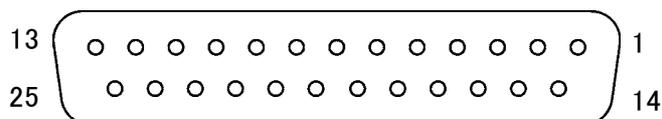
Chapter 7

External Control Terminal and Output Terminal

7.1 Connector Pin Assignment

CAUTION

This connector is not for the RS-232C interface. Do not connect to the personal computer. The unit may be damaged.



Acceptable connector (Cable side) (Standard accessory)

Pin No.		Meaning	
1		GND for analog output, waveform output, D/A output	(A.GND)
2	Output	Analog output of voltage (CH1)	(U1)
3	Output	Analog output of voltage (CH2)	(U2)
4	Output	Analog output of voltage (CH3)	(U3)
5	Output	Analog output of current (CH1)	(I1)
6	Output	Analog output of current (CH2)	(I2)
7	Output	Analog output of current (CH3)	(I3)
8	Output	Analog output of active power (CH1)	(P1)
9	Output	Analog output of active power (CH2)	(P2)
10	Output	Analog output of active power (SUM)	(P _{SUM})
11		GND for analog output, waveform output, D/A output	(A.GND)
12	Input	Request for print output	(PRINT)
13		GND for START/STOP, RESET, PRINT	(D.GND)
14		GND for analog output, waveform output, D/A output	(A.GND)
15	Output	Waveform output of voltage (CH1)	(U1m)

16	Output	Waveform output of voltage (CH2)	(U2m)
17	Output	Waveform output of voltage (CH3)	(U3m)
18	Output	Waveform output of current (CH1)	(I1m)
19	Output	Waveform output of current (CH2)	(I2m)
20	Output	Waveform output of current (CH3)	(I3m)
21	Output	D/A output	(D/A OUT)
22		GND for analog output, waveform output, D/A output	(A.GND)
23	Input	Start/stop integration	(START/STOP)
24	Input	Reset integration	(RESET)
25		GND for START/STOP, RESET, PRINT	(D.GND)

7.2 Output Terminal

⚠ CAUTION

To avoid damage to this unit, do not shorten the output terminal or input voltage.

(1) Analog output (U , I , P terminals)

Outputs ± 5 V DC f.s. direct voltage for range.

Outputs simultaneously for voltage ($U1$, $U2$, $U3$), current ($I1$, $I2$, $I3$) and active power ($P1$, $P2$, P_{SUM}).

(2) Monitor output (U_m , I_m terminals)

Waveform output 1 V f.s. for range.

Outputs simultaneously for voltage ($U1m$, $U2m$, $U3m$), current ($I1m$, $I2m$, $I3m$).

(3) D/A output (D/A OUT terminal)

Refer to Section 4.6, "Setting the D/A Output".

NOTE

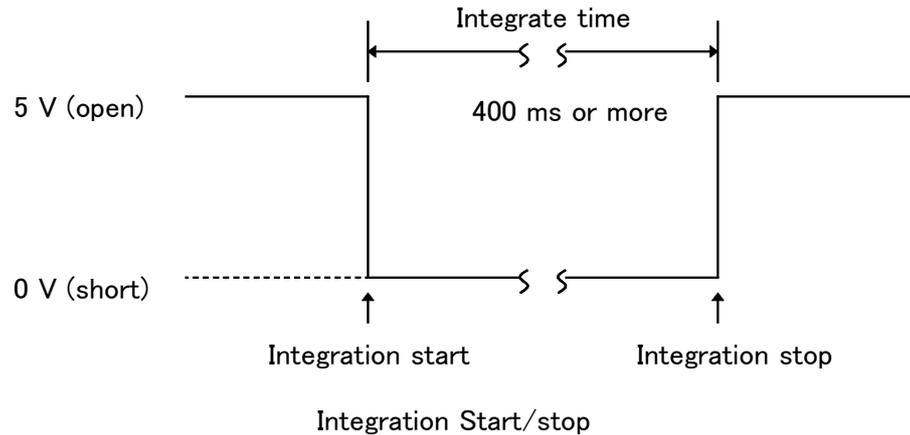
- Output resistance of output terminals is about 100 Ω .
- Always use the A.GND terminal (pin 1, 11, 14, 22) for the common of output terminal.
- Analog output and D/A output voltage is ± 5 VDC f.s. for each range. If scaling or (PT, CT ratio) are being used, the value reached by multiplying the range times scaling value becomes ± 5 VDC.
- When using the measuring range as auto ranging, analog output rate changes as range changing. Be careful of making mistake for range conversion when recording on the such line measuring value changes hard. In such measurement we advice you to measure in fixed ranging.
- The analog output response time is about 0.2 seconds (FAST), about 1.6 seconds (SLOW). Note that if there are fluctuations on the line being measured which happen faster than the response time of the unit, errors in the output voltage may occur.
When the response is FAST, analog output below 45 Hz includes ripple, and cannot be used as a correct wave form.
- Always use shielded cables for output and for external control.
- In 1 mode, the output of $U3$, $I3$, $U3m$, $I3m$ is 0 V.

7.3 External Control Terminal

The external control terminals accept a 0/5 V logic signal or a relay contact short/open signal to control the unit.

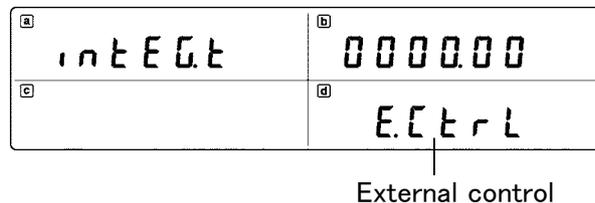
For details of the settings, refer to Sections 4.9, "Setting the Interface", Section 4.3, "Setting the Integration", and Section 4.8, "Setting the Printer Output".

(1) Integration start and stop (START/STOP terminal)

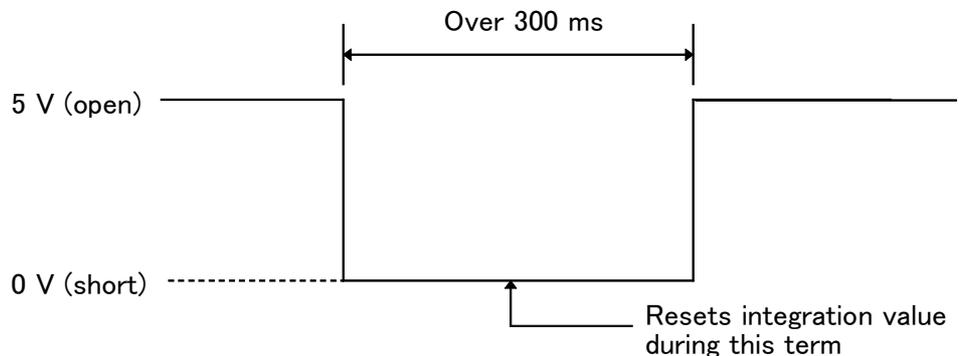


NOTE

If integration is started by external control, the integration set time is ignored and can only be stopped by external control. If it is attempted to stop integration by pressing the **START/STOP** key, "Err.011" is displayed. Integration's setting display will be the following way below.



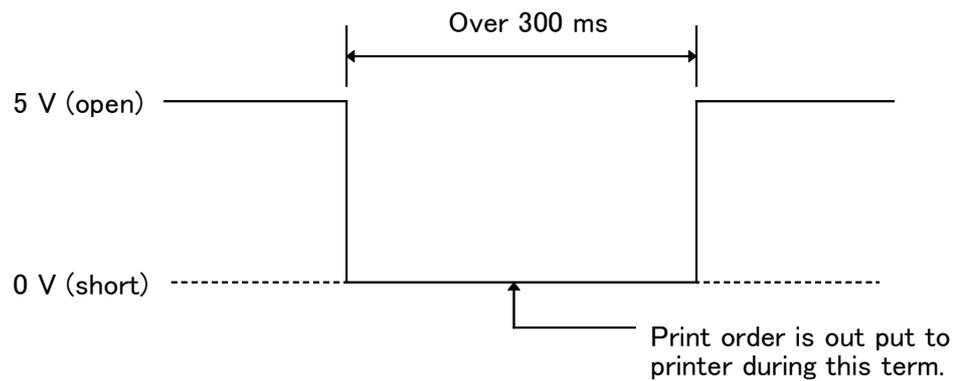
(2) Reset integration



NOTE

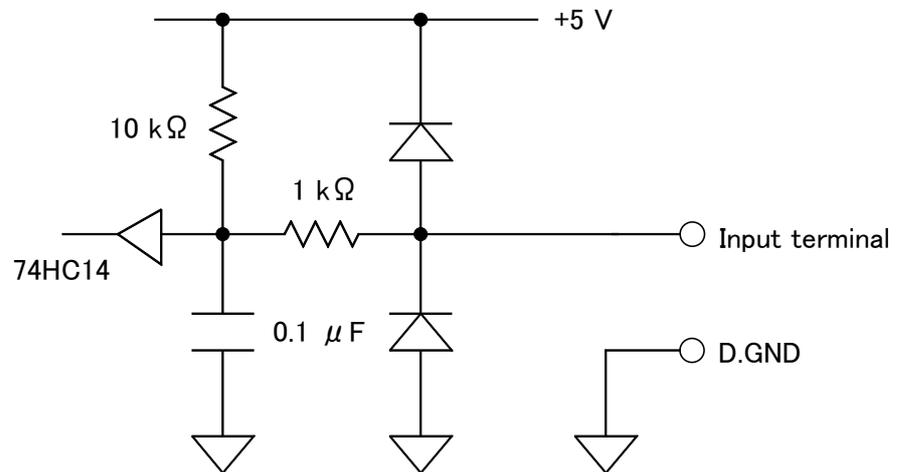
During integration operating (RUN indicator lit), "Err.015" is displayed and it is not possible to reset integration.

(3) Data output (Manual printing) (PRINT terminal)



Data Output

(4) Internal circuit of the external control terminal



Internal Circuit

NOTE

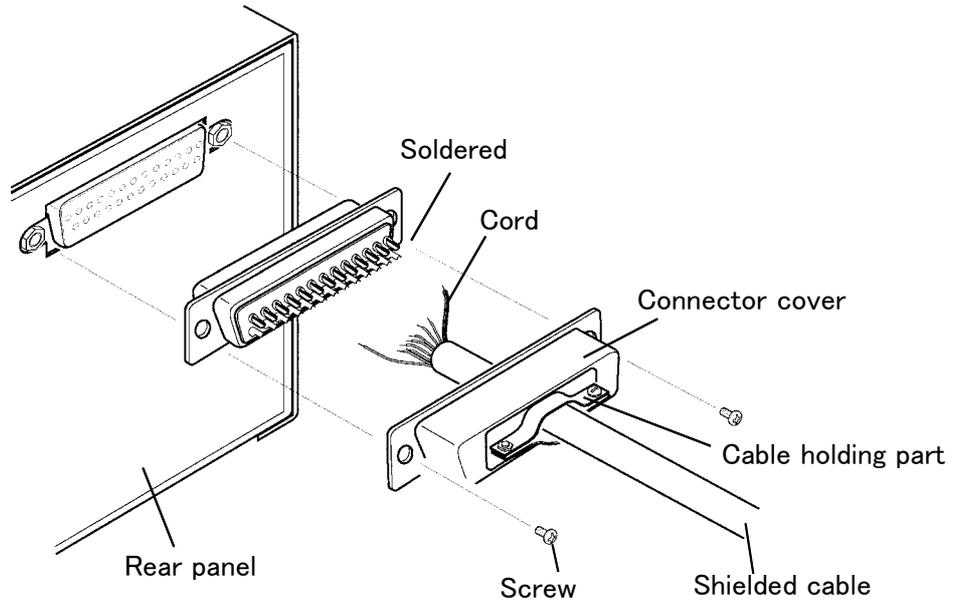
Always use the D.GND terminal (pin 13, 25) for the common of external control terminal.

7.4 Making the Connections

CAUTION

To avoid damage to this unit, do not shorten the output terminal or input voltage.

When connecting the external control terminal or output terminal, use the supplied connector (DB-25P-N, DB19678-2 Japan Aviation Electronics Industry, Limited) or equivalent.

**NOTE**

- Make sure the cord is soldered tightly.
- To prevent the connector from being detached, be sure to fasten the supplied screws (M2.6 × 6) with the connector cover.
- When plugging and unplugging, always hold the connector cover.
- Always use shielded cables for output and for external control.
- If the shield of the cable is not grounded, connect it to the connector cover or cable holding part described in the figure above.

Chapter 8

GP-IB·RS-232C Interface

8.1 Specifications

8.1.1 GP-IB Interface

Compliance standard: IEEE-488.1 1987

Reference standard: IEEE-488.2 1987

NOTE

- On the 3331, if the output queue becomes full, it is cleared and a query error is generated. This does not correspond to the clearing of the output queue and the outputting of a query error in the deadlock state as stipulated in IEEE 488.2. (A deadlock state occurs when both the input buffer and the output queue are full, and processing cannot continue normally.)
- This unit does not fully conform to IEEE488.2, and to the extent possible should be used only for indicated reference data. Also, take care to ensure that each command does not result in overflows of the input buffer and output queue.

Interface Functions Provided

SH1	All source handshake functions
AH1	All acceptor handshake functions
T5	Basic talk functions, Serial poll function Talk-only mode is provided. The talker cancellation function with MLA (My Listen Address) is provided.
L4	Basic listener functions Listen-only mode is not provided. The listener cancellation function with MTA (My Talk Address) is provided.
SR1	All service request functions
RL1	All remote/local functions
PP0	Parallel polling is not provided.
DC1	All device clear functions
DT1	All device trigger functions
C0	The controller function is not provided.

ASCII codes are used.

8.1.2 RS-232C Interface

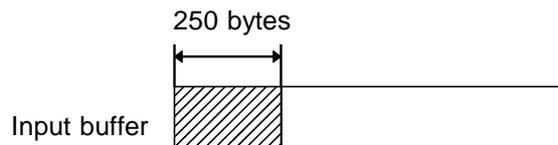
Transfer system	Start-stop synchronization
Baud rate	1200, 2400, 4800, 9600 bps
Data length	7 or 8 bits
Parity	Even, odd or none
Stop bits	1 or 2 bits

XON/XOFF Can be transmitted and received. (Set with the RS232c:HANDshake command)

An XOFF (13 H) code is transmitted when the input buffer is 3/4 full (750 bytes).



An XON (11H) code is transmitted when the input buffer is 1/4 full (250 bytes).

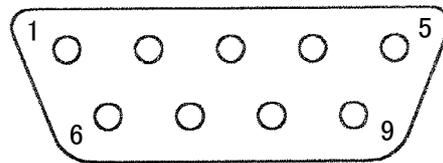


Hardware handshake	Can be transmitted and received. (RS232c: HANDshake command)
Execution confirmation messages	After analyzing and executing one line of data (data up to the terminator) from the controller, a numeric data value (ASCII) is returned. The next of terminator, 001th program cord. (RS232c: Set with the ANSWer command) Transmitted data from the 3331 000: no error nnn: error detected in item nnn of the received program code In the case of a query command, the transmission is appended after the response message.
Electrical characteristics	
Input voltage levels	+5 V to +15 V: ON, -15 V to -5 V: OFF
Output voltage levels (load impedance 3 to 7 k Ω)	+5 V to +9 V : ON, -9 V to -5 V: OFF

If XON/XOFF or Hardware handshake is used to set with RS232c:HANDshake command, the length of a command should be less than 750 bytes.

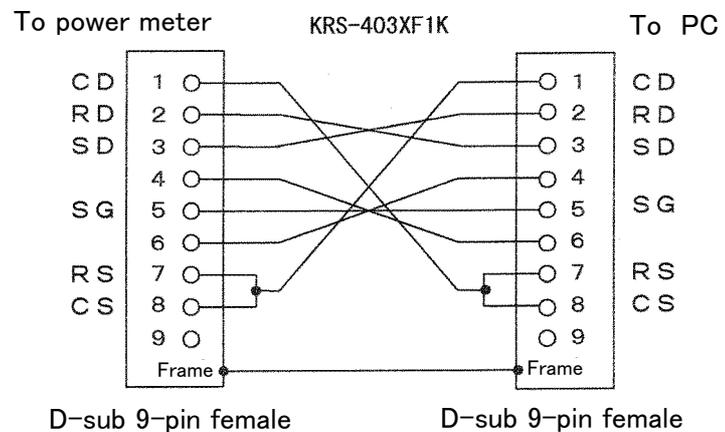
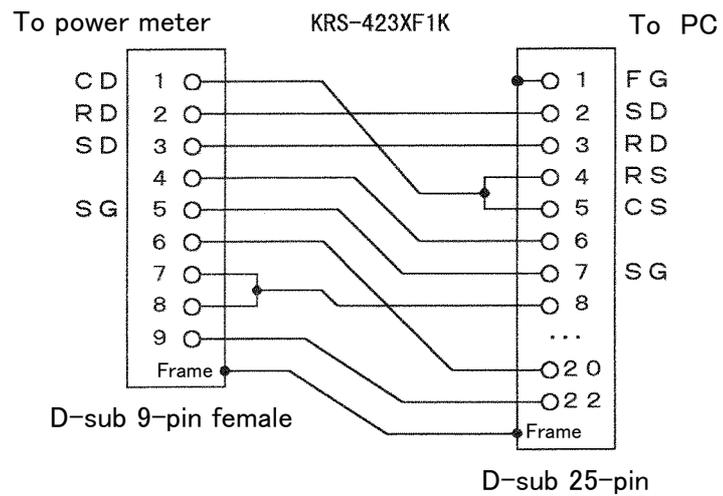
Connector specification

Pin No	EIA symbol	JIS symbol	Common symbol	Function
1	CF	CD	DCD	Data channel detection
2	BB	RD	RxD	Reception data
3	BA	SD	TxD	Transmission data
4	CD	ER	DTR	Data terminal ready
5	AB	SG	GND	Signal ground
6	CC	DR	DSR	Data set ready
7	CA	RS	RTS	Ready to send
8	CB	CS	CTS	Clear to send
9	CE	CI	RI	Call indicator

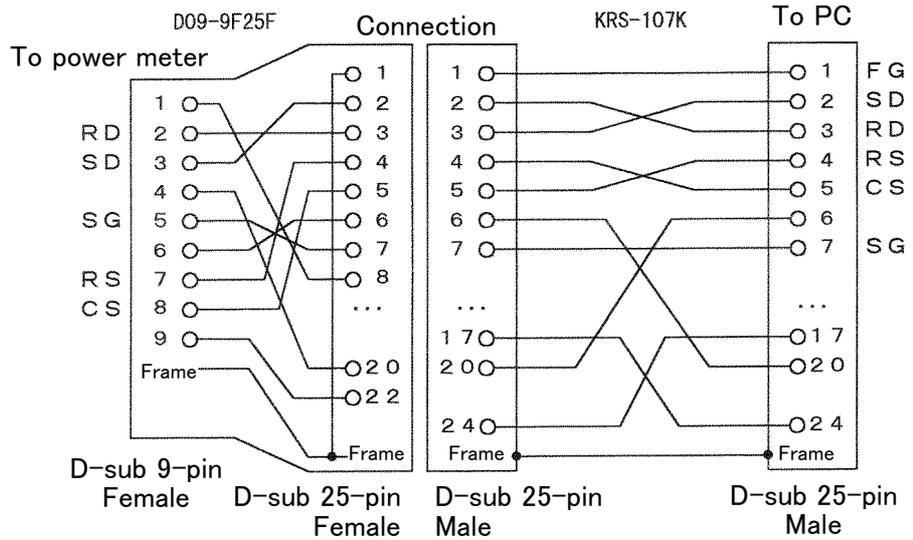


RS-232C Connector Pin Assignments

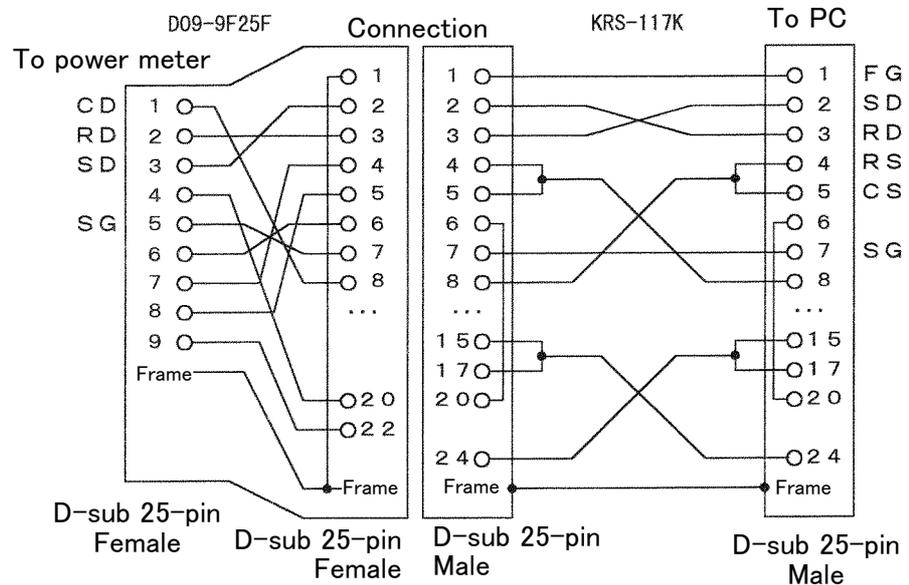
DOS/V PC
Handshake OFF, X



PC-9801 PC
Handshake: HARD



DOS/V, PC-9801 PC
Handshake: OFF, X



RS-232C Cable

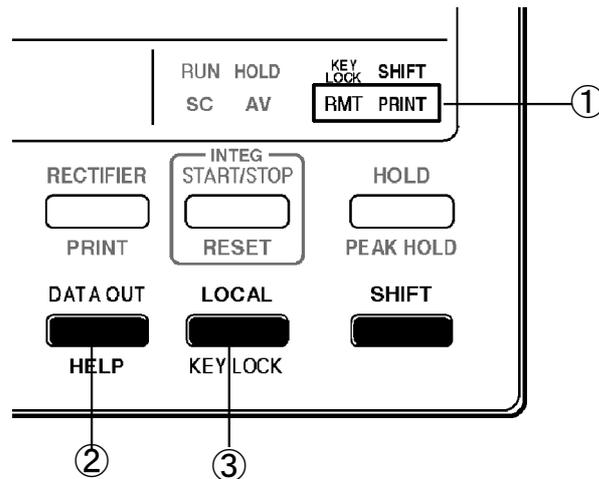
Connecting example of Sanwa Supply's RS-232C Cables (reverse)

Connecting to the personal computer	Handshake	
	OFF, X	HARD
DOS/V	KRS-423XF1K KRS-403XF1K	KRS-107K in combination with the D09-9F25F Adapter
NEC PC-9801	KRS-117K in combination with the D09-9F25F Adapter	KRS-107K in combination with the D09-9F25F Adapter

*: Hioki's RS-232C cables can also be used when handshaking is OFF or XON/XOFF.

- 9637 RS-232C CABLE (1.8 m, 9-pin to 9-pin)
- 9638 RS-232C CABLE (1.8 m, 9-pin to 25-pin)

8.2 Identification of Controls and Indicators



① Interface status display

When using the GP-IB interface

These indicators show the GP-IB control state:

RMT: Remote

PRINT: Talker (printer mode Pr.)

When using the RS-232C interface

These indicators show the RS-232C control state:

RMT: Remote

PRINT: Printer mode Pr.

② PRINT OUT/HELP key

When using GP-IB or RS-232C in talk only mode, measuring value or setting state can output with this key.

③ LOCAL key

- Press this key to release the remote state of the GP-IB or RS-232C interface and to resume the local state. However, the **LOCAL** key is disabled if the unit into the local lock out state.
- Pressing this key in local state resets data of the GP-IB and RS-232C interfaces.

NOTE

- If communication is done by a controller, GP-IB and RS-232C will enter remote state and will not accept key input. In order to input by key, release the remote state by pressing the **LOCAL** key.
- If the remote mode is set in the key lock state, the lock state is released.

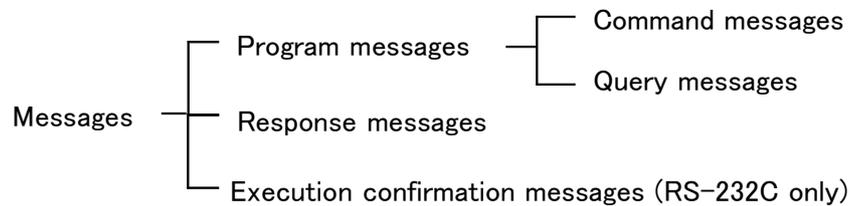
8.3 Interface Outline

8.3.1 Features

- (1) In the HOLD state, single-shot measurement is possible.
 - (2) IEEE 488.2-1987 standard (essential) commands can be used.
 - (3) This unit can output manual, time interval and help output using the printer mode.
-

8.3.2 Messages

Data received or sent by the interface is called a message. The following are the message types:



Of these, program messages are those received by the unit from the controller, while response messages are those sent from the unit to the controller.

(1) Program messages

Program messages can be divided into either command messages or query messages.

Command messages are orders for control of the unit, such as for making settings or for reset or the like.

Query messages are orders for responses relating to results of operation, results of measurement, or the state of device settings.

(2) Response messages

After a query message has been received, a response message is produced the moment that its syntax has been checked. It is also possible to change the message unit separator of response messages from the semicolon ";" to the comma "," when headers are off, using the command "TRANsmit:SEParator". Initially this separator is set to the semicolon ";". A space is represented by "_" in this manual.

Headers on	"V_+101.02E+0;A_+10.200E+0"
Headers off	"+101.02E+0;+10.200E+0"
Headers off	"+101.02E+0,+10.200E+0"

(3) Execution confirmation message

Execution confirmation message is the numeric data (ASCII) created by analyzing and executing one line of data (data up to the terminator) from the controller. This numeric data is returned to the controller. The controller and this unit are synchronized by means of this data.

(Refer to Section 8.1.2, "RS-232C Interface".)

8.3.3 Command Syntax

The names of commands for the 3331 are as far as possible mnemonic. Furthermore, all commands have a long form, and an abbreviated short form. In command references in this manual, the short form is written in upper case letters, and then this is continued in lower case letters so as to constitute the long form. Either of these forms will be accepted during operation, but intermediate forms will not be accepted. Further, during operation both lower case letters and upper case letters will be accepted without distinction.

DISPLAY	}	Accepted
DISPlay		
DISP		
DISPL	}	Error
DIS		

Response messages generated by the 3331 are in long form and in upper case letters.

8.3.4 Headers

Whether or not headers are prefixed to response messages is set by the "HEADer" command. It is essential to prefix headers to program messages.

(1) Command program headers

There are three types of command: simple commands, compound commands, and standard commands.

① Simple command header

This header is a sequence of letters and digits.

HEADer

② Compound command header

This header is made up from a plurality of simple command type headers marked off by colons.

VOLTage:RANGe

③ Standard command header

This header begins with an asterisk, and continues with a standard command stipulated by IEEE 488.2.

*RST

(2) Query program headers

These are for commands used for interrogating the unit about the results of operations, about measured values, or about the current states of settings for the unit. As shown by the following examples, they can be recognized as queries by a question mark appearing after the program header. The structure of the header is identical to that of a command program header, with "?" always being affixed to the last command. There are queries possible in each of the three previously described types of command form.

```
SCALE?
SCALE:PT?
```

8.3.5 Message Terminators

The 3331 recognizes,

- (1) linefeed character (LF; GP-IB and RS-232C),
 - (2) EOI signal (GP-IB only),
 - (3) LF with EOI (GP-IB only),
- as message terminators.

To terminate a response message, the 3331 always provides the appropriate EOI signal, and also sends a terminating character sequence. By the use of the "TRANsmit:TERMinator" command either of the following can be selected as response message terminator sequence:

GP-IB	RS-232C
LF with EOI (linefeed only)	LF (linefeed only)
CR + LF with EOI (carriage return plus linefeed)	CR + LF (carriage return plus linefeed)

The initial setting is in the column above.

A detailed explanation of the "TRANsmit:TERMinator" command is given in Section 8.4.2, "Commands Specific to the 3331."

8.3.6 Separators

(1) Message unit separator

A semicolon ";" is used as a message unit separator when it is desired to set out several messages on a single line.

```
**RST[ ]:SCALE:CT_4[ ]:AVERaging_64"
```

(2) Header separator

In a message which has a header and data, a space (represented by "_" in the examples) is used as the header separator to separate the header from the data.

```
":VOLTage:AUTO[ ]ON" (actually, "_" is not displayed.)
```

(3) Data separator

If a message has several data items, commas are required as data separators for separating these data items from one another.

```
":MEASure?_V1[ ],A1[ ],W1[ ],W0"
```

8.3.7 Data Formats

The 3331 uses character string data and decimal numeric data, and the type used varies according to the command in question.

(1) Character data

Character string data must always begin with an alphabetic character, and the following characters can be either alphabetic characters or numerals. Although in character data either upper case letters or lower case letters are accepted, response messages output by the 3331 are always in upper case letters.

```
" :DISPlay_ V1, A1, WO, FREQ "
```

(2) Decimal data

The numeric data values are all represented in decimal, in three formats identified as NR1, NR2 and NR3, and each of these can appear as either a signed number or an unsigned number. Unsigned numbers are taken as positive.

Further, if the accuracy of a numerical value exceeds the range with which the 3331 can deal, it is rounded off. (5 and above is rounded up; 4 and below is rounded down).

NR1 format: integer data (+12, -23, 34)

NR2 format: fixed point numbers (+1.23, -23.45, 3.456)

NR3 format: floating point numbers (+1.E-2, -2.3E+4)

The term "NRf format" includes all these three formats.

When the 3331 is receiving it accepts NRf format.

All of the following examples set the voltage range to 150 V:

```
" :VOLTage:RANGe_150 "
```

```
" :VOLTage:RANGe_150.002 "
```

```
" :VOLTage:RANGe_1.495E2 "
```

When it is sending response messages it utilizes whichever one of the formats NR1 to NR3 is indicated in the particular command.

This unit does not fully conform to IEEE488.2, and to the extent possible should be used only for indicated reference data. Also, take care to ensure that each command does not result in overflows of the input buffer and output queue.

8.3.8 Abbreviation of Compound Commands

When several compound commands have a common head portion, for example :SCAL:PT and :SCAL:CT, then, when and only when writing them directly following on from one another, this common portion (:SCAL: in this example) can be omitted from each command. This common portion is called "the current path", by analogy with the general concept of the current directory in the directory structure of UNIX or MS-DOS, and until it is cleared the analysis of following commands is performed by deeming them to be preceded by the current path which has been curtailed in the interests of brevity. This manner of using the current path is shown in the following example:

Normal expression

```
":SCALE:CT_2;:SCALE:PT_10;:SCALE:CT?"
```

Abbreviated expression:

```
":SCALE: CT_2;PT_10;CT?"
```

↑—This becomes the current path, and can be curtailed from the following commands.

The current path is cleared when the power is turned on, when a system reset is performed by key input, when a colon ":" appears at the start of a command, and when a message terminator is detected.

Messages of standard command form can be executed without relation to the current path. Further, they have no effect upon the current path.

It is not necessary to prefix a colon ":" at the start of headers of simple commands and compound commands. However, in order to prevent confusion with abbreviated forms and mistakes in operation, it is recommended practice always to prefix ":" to headers.

With the 3331, there are eight possible current paths:

```
":VOLTage:"
```

```
":CURRent:"
```

```
":SCALE:"
```

```
":TRANsmi t:"
```

```
":FREQuency:"
```

```
":INTEGrate:"
```

```
":DATAout:"
```

```
":RS232c:"
```

8.3.9 Output Queue

Response messages accumulate in the output queue and are read out as data and cleared by the controller. The output queue is also cleared in the following circumstances:

- When a device clear is issued.
- When the power is turned off and turned on again.
- When the unit is reset by a key press.
- When a query error is generated.

The 3331 has an output queue of 1000 bytes capacity. If the response messages overflow this limit of 1000 bytes, a query error is generated, and the output queue is cleared. Further, if a new message is received while the output queue still contains data, the output queue is cleared, and a query error is generated.

8.3.10 Input Buffer

The 3331 has an input buffer of 1000 bytes capacity.

Messages which are received are put into this buffer and executed in order. If the data accumulated in this buffer exceeds 300 bytes the buffer becomes full, and until a space again becomes available in the buffer the GP-IB interface bus goes into the waiting state.

NOTE

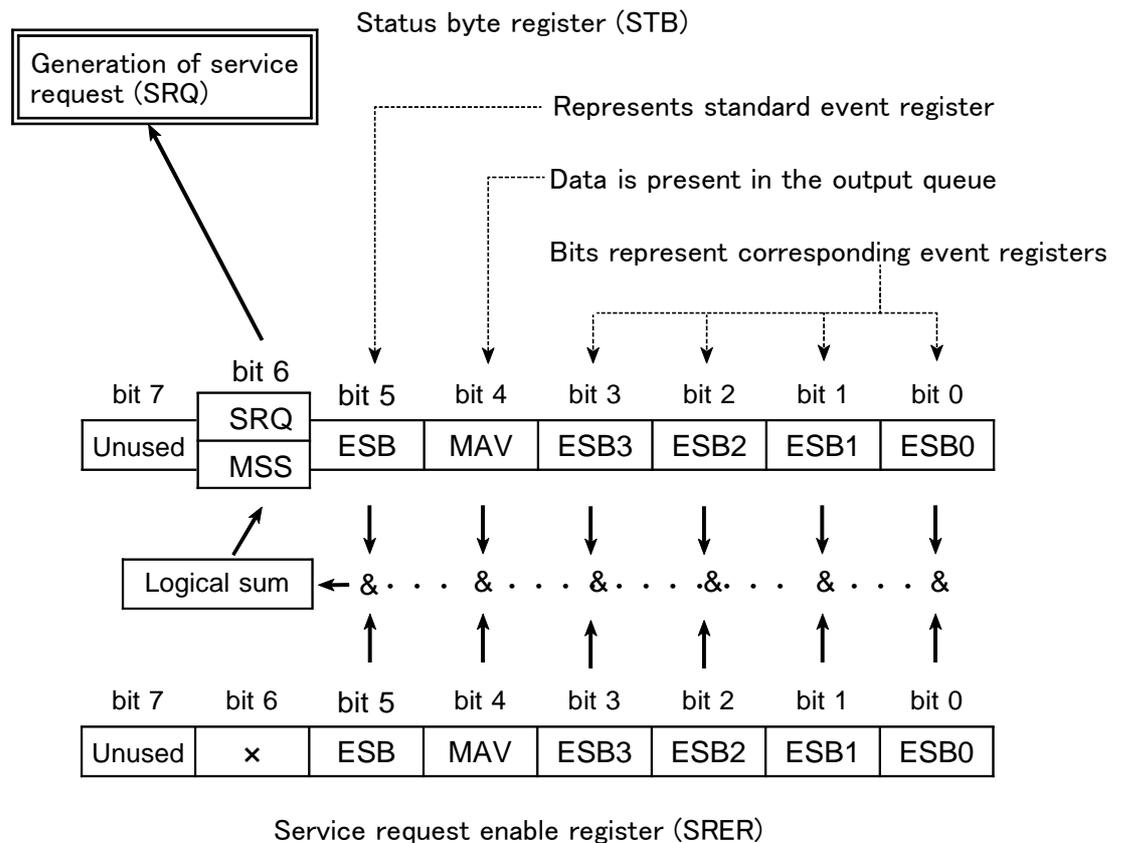
- Ensure that the length of a single command does not exceed 1,000 bytes.
- When using XON/XOFF or hardware handshaking with the RS-232C interface, limit the length of a single command to 750 bytes.

8.3.11 Status Model

In its implementation of the serial polling function using service requests, the 3331 employs the status model specified by IEEE 488.2.

The term "event" refers to any phenomenon which generates a service request.

Generation of service requests

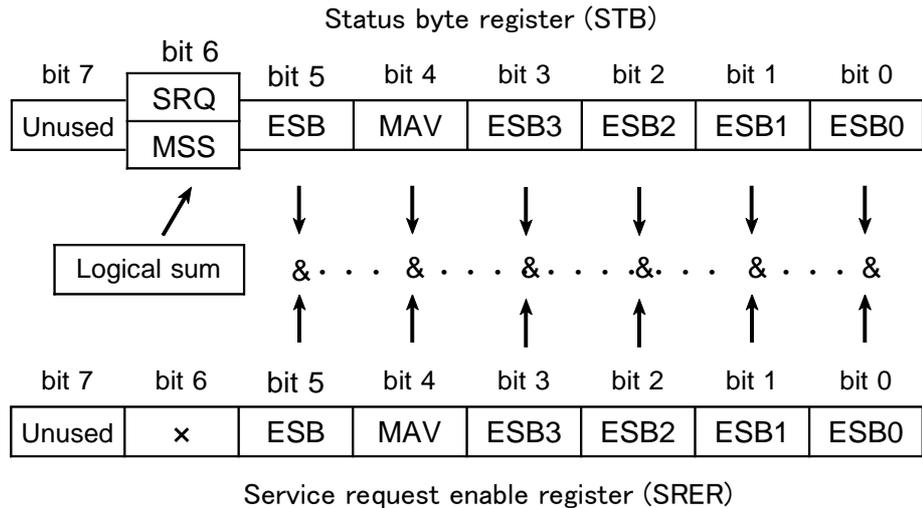


The status byte register holds information relating to the event registers and the output queue. It is further possible to use the service request enable register as a mask to select the items required. If any of the bits selected by the mask becomes 1, bit 6 (the master summary status or MSS bit) is also set to 1, an SRQ message is generated, and this generates a service request.

8.3.12 Status Byte Register

(1) Status byte register (STB)

The status byte register is an 8-bit register whose contents are output from the 3331 to the controller, when serial polling is being performed. If even only one bit in the status byte register has changed from 0 to 1 (provided that it is a bit which has been set in the service request enable register as a bit which can be used), then the MSS bit is set to 1. Simultaneously with this the SRQ bit is set to 1, and a service request is generated.



The SRQ bit is synchronized with service requests, and is read out and simultaneously cleared when serial polling is being performed. Although the MSS bit is only read out on a "*STB?" query, on a "*CLS" command for example it is not cleared until the event is cleared.

Status byte register bit assignments

Bit 7	Unused.
Bit 6 SRQ	Set to 1 when a service request is dispatched.
MSS	Logical sum of the other bits of the status byte register
Bit 5 ESB	Standard event summary (logical sum) bit Shows a logical sum of the standard event status register.
Bit 4 MAV	Message available. Indicates that there is at least one message in the output queue.
Bit 3 ESB3	Event summary (logical sum) bit3 Shows a logical sum of the standard event status register 3.
Bit 2 ESB2	Event summary (logical sum) bit2 Shows a logical sum of the standard event status register 2.
Bit 1 ESB1	Event summary bit 1 Bitwise logical sum of event status register 1
Bit 0 ESB0	Event summary bit 0 Bitwise logical sum of event status register 0

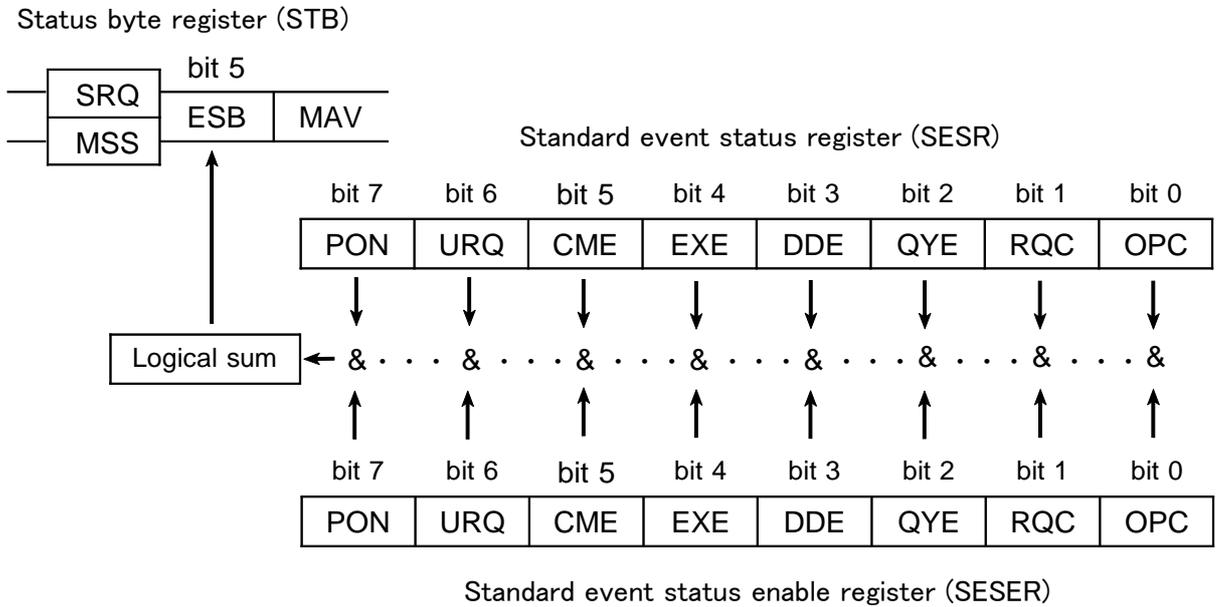
(2) Service request enable register (SRER)

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.

8.3.13 Event Registers

(1) 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.



The standard event status register is cleared in the following three situations:

- When a "*CLS" command is received.
- When an "*ESR?" query is received.
- When the unit is powered on.

(2) Standard event status enable register (SESER)

Setting any bit of the standard event status enable register to 1 enables the corresponding bit of the standard event status register to be accessed.

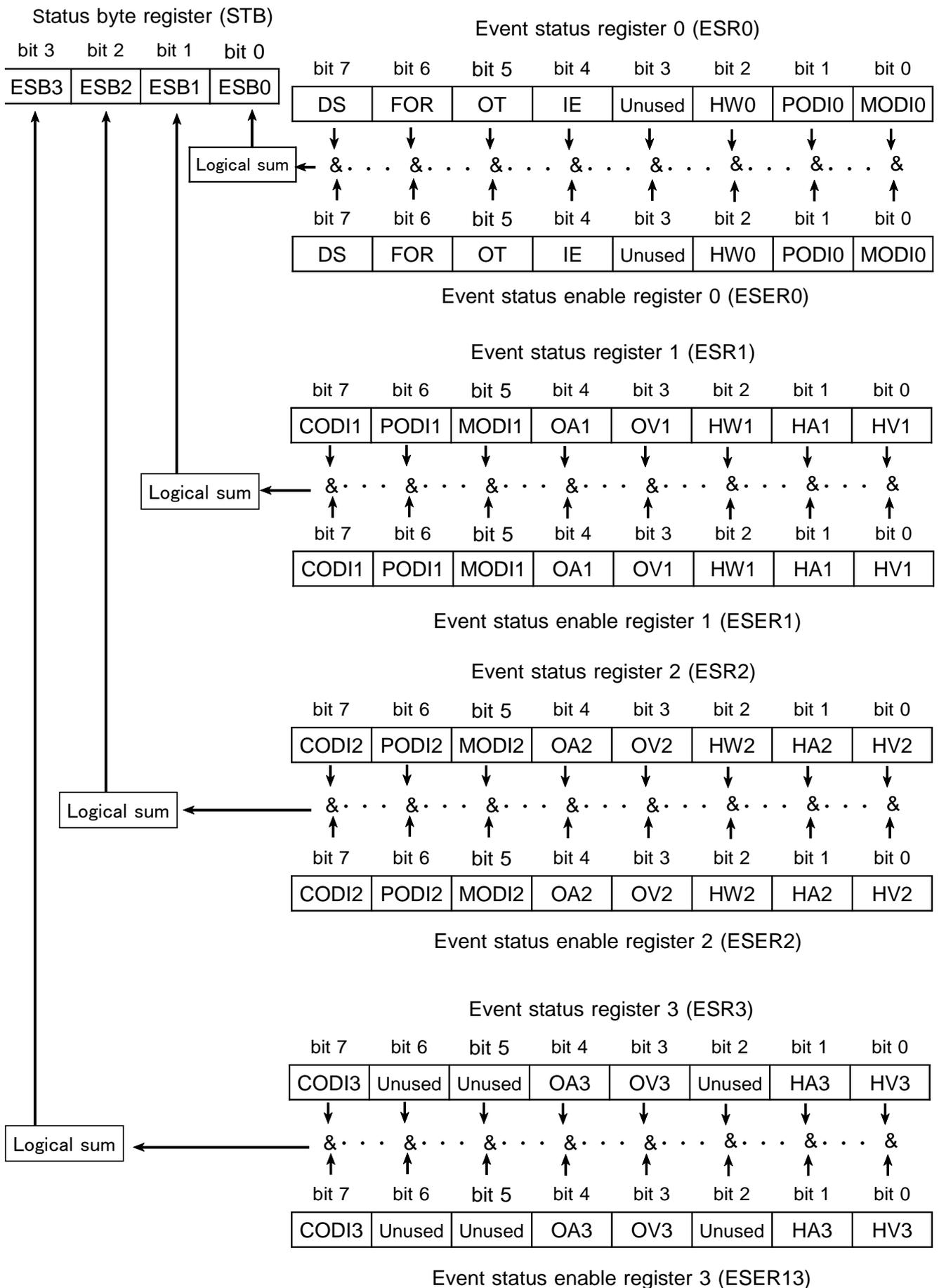
Standard event status register (SESR) bit assignments

Bit 7 PON	Power on flag. When the power is turned on, or on recovery from a power cut, this bit is set to 1.
Bit 6 URQ	User request. Not used by the 3331.
Bit 5 CME	Command error. When a command which has been received contains a syntactic or semantic error, this bit is set to 1. <ul style="list-style-type: none"> • There is a mistake in a program header. • The number of data parameters is wrong. • The format of the parameters is wrong.
Bit 4 EXE	Execution error. When for some reason a command which has been received cannot be executed, this bit is set to 1. <ul style="list-style-type: none"> • The designated data value is outside the set range. • The designated data value is not acceptable.
Bit 3 DDE	Device dependent error. When a command cannot be executed due to some cause other than a command error, a query error, or an execution error, this bit is set to 1. <ul style="list-style-type: none"> • Execution is impossible due to an abnormality inside the 3331. • Execution is impossible because some other function is being performed (during holding and integrating). • If input out of range, or scaling overflow has occurred, when the "MEASure?" command has read this out-of-range value.
Bit 2 QYE	Query error. This bit is set to 1 when a query error is detected by the output queue control. <ul style="list-style-type: none"> • When an attempt has been made to read the output queue when it is empty. • When the data overflows the output queue. • When data in the output queue has been lost. • When on the same line, a query occurs after an "*IDN?" query.
Bit 1 RQC	Request for controller authority. Not used by the 3331.
Bit 0 OPC	Operation terminated. This bit is set to 1 when an "*OPC" command is executed, when the operation of all the messages up to the "*OPC" command has been completed.

(3) Event status registers specific to the 3331 (ESR0, ESR1, ESR2, ESR3)

Four 8-bit event status registers are provided for managing events on the 3331. If any bit in one of these event status registers is set to 1 (after masking by the corresponding event status enable register), the following happens:

- For event status register 0, bit 0 of the status byte register (ESB0) is set to 1.
- For event status register 1, bit 1 of the status byte register (ESB1) is set to 1.
- For event status register 2, bit 2 of the status byte register (ESB2) is set to 1.
- For event status register 3, bit 3 of the status byte register (ESB3) is set to 1.



Event status registers 0 to 3 are cleared in the following three situations:

When a "*CLS" command is received.

When an "ESR0?" query (for event status register 0) or

"ESR1?" query (for event status register 1), "ESR2?" query (for event status register 2), "ESR3?" query (for event status register 3) are received.

When the unit is powered on.

Event status register 0 (ESR0)

Event status enable register 0 (ESER0)

(Event register for unit and W_{SUM})

Bit 7 DS	Data Set	Sets at every time the measuring value is replaced.
Bit 6 FOR	Frequency Out of Range	Sets when frequency becomes o.r.
Bit 5 OT	Output Time	Sets when achieved output time during integrating. Sets when integrating has been started and stopped. Not set when output time is 0000:00:00.
Bit 4 IE	Integrate End	Sets when integrating has been stopped.
Bit 3 Unused		
Bit 2 IDO	HIGH-Wsum	W_{SUM} becomes o.r.
Bit 1 PODI	Plus Over Data Integrate	Sets when the plus over data (o.r) is added to the positive power value of W_{SUM} .
Bit 0 MODI	Minus Over Data Integrate	Sets when the minus over data (-o.r) is added to the negative power value of W_{SUM} .

Event status register 1 (ESR1)

Event status enable register 1 (ESER1)

(Event register for channel 1)

Bit 7 CODI1	Current Over Data Integrate	Sets when the over data (o.r) is added to the current integration value for channel 1.
Bit 6 PODI1	Plus Over Data Integrate	Sets when the over data (o.r) is added to the positive power integration value for channel 1.
Bit 5 MODI1	Minus Over Data Integrate	Sets when the over data (-o.r) is added to the negative power integration value for channel 1.
Bit 4 OA1	OVER-A1	Peak value of current input for channel 1 is out of range
Bit 3 OV1	OVER-V1	Peak value of voltage input for channel 1 is out of range
Bit 2 HW1	HIGH-W1	Voltage input for channel 1 is out of range
Bit 1 HA1	HIGH-A1	Current input for channel 1 is out of range
Bit 0 HV1	HIGH-V1	Voltage input for channel 1 is out of range

Event status register 2 (ESR2)
 Event status enable register 2 (ESER2)
 (Event register for channel 2)

Bit 7 CODI2	Current Over Data Integrate	Sets when the over data (o.r) is added to the current integration value for channel 2.
Bit 6 PODI2	Plus Over Data Integrate	Sets when the over data (o.r) is added to the positive power integration value for channel 2.
Bit 5 MODI2	Minus Over Data Integrate	Sets when the over data (-o.r) is added to the negative power integration value for channel 2.
Bit 4 OA2	OVER-A2	Peak value of current input for channel 2 is out of range
Bit 3 OV2	OVER-V2	Peak value of voltage input for channel 2 is out of range
Bit 2 HW2	HIGH-W2	Voltage input for channel 2 is out of range
Bit 1 HA2	HIGH-A2	Current input for channel 2 is out of range
Bit 0 HV2	HIGH-V2	Voltage input for channel 2 is out of range

Event status register 2 (ESR3)
 Event status enable register 3 (ESER3)
 (Event register for channel 3)

Bit 7 CODI3	Current Over Data Integrate	Sets when the over data (o.r) is added to the current integration value for channel 3.
Bit 6 Unused		
Bit 5 Unused		
Bit 4 OA3	OVER-A3	Peak value of current input for channel 3 is out of range
Bit 3 OV3	OVER-V3	Peak value of voltage input for channel 3 is out of range
Bit 2 Unused		
Bit 1 HA2	HIGH-A3	Current input for channel 3 is out of range
Bit 0 HV2	HIGH-V3	Voltage input for channel 3 is out of range

Set when the display has been renewed.

Summary of commands for writing and reading each of the registers

Register	Read	Write
Status byte register	*STB?	—
Service request enable register	*SRE?	*SRE
Standard event status register	*ESR?	—
Standard event status enable register	*ESE?	*ESE
Event status register 0	:ESR0?	—
Event status enable register 0	:ESE0?	ESE0
Event status register 1	:ESR1?	—
Event status enable register 1	:ESE1?	ESE1
Event status register 2	:ESR2?	—
Event status enable register 2	:ESE2?	ESE2
Event status register 3	:ESR3?	—
Event status enable register 3	:ESE3?	ESE3

NOTE

All registers are not backed up by battery.
The data must be set each time the unit is switched on.

8.3.14 GP-IB Commands

The following commands are used for performing interface functions:

Command	Function
GTL	Go To Local The remote state is canceled, and the system goes into the local state.
LLO	Local Lock Out All keys, including the LOCAL key, become inoperable.
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 During the hold condition, performs single-shot sampling processing.

8.4 Command Reference

:Command
 Indicates functions of message reference

Syntax : Indicates the command syntax. ("_" in the syntax indicates a space.)

< > : Indicates the data format or character data for a command that includes data.

Function : Describes the function of the command.

Response : Indicated only for commands for which a response message is returned.

Example : Shows a simple example illustrating the usage of the command. All transmissions are indicated in "short form."

Transmission : A command that is sent by the controller
 Response : Data that is received by the controller

Note : Describes points that require special attention when using the command.

Error : Indicates the what kinds of errors might occur. Note that misspellings are a type of error that applies to all commands, and are therefore not explicitly mentioned.

Data formats indicated in this manual

1, 2, 3: channel, 0: SUM
 (): can be also used

A: display items (see table ►)

Data format indicated as <A>

NR1: integer
 NR2: fixed point number
 NR3: floating point number
 NRf : includes all three formats

The settings by the following commands are not backed up by the batteries. When powering on, the settings are reset. It is necessary to set again.

Command	Reset data
*ESE, ESE0, ESE1, ESE2, ESE3, *SRE	0
HEADer	ON
RS232C:ANSWer	OFF
RS232C:HANDshake	OFF
TRANsmit:SEParator	0 (;)
TRANsmit:TERMinator	0 (LF)

Voltage	V1, V2, V3, V0 / (U1,U2,U3,U0)
Current	A1, A2, A3, A0 / (I1,I2,I3,I0)
Effective power	W1, W2, W0 / (P1,P2,P0)
Apparent power	VA1, VA2, VA0 / (S1,S2,S0)
Reactive power	VAR1, VAR2, VAR0 / (Q1,Q2,Q0)
Power factor	PF1, PF2, PF0
Phase angle	DEG1, DEG2, DEG0
Frequency	FFRQ
Integration current	AH1, AH2, AH3 / (IH1, IH2, IH3)
Positive integration power	PWH1, PWH2, PWH0 (PINTEG)/ PWP1, PWP2, PWP0
Negative integration power	MWH1, MWH2, MWH0 (MINTEG) / MWP1, MWP2, MWPO
Total integration power	WH1, WH2, WHO (INTEG) / WP1, WP2, WPO
Current peak	IP1, IP2, IP3
Integration time	TIME

NOTE

This unit does not fully conform to IEEE488.2, and to the extent possible should be used only for indicated reference data. Also, ensure that the length of a single command does not exceed 1,000 bytes. (When using XON/XOFF or hardware handshaking with the RS-232C interface, limit the length of a single command to 750 bytes.)

8.4.1 Standard Commands

*CLS

- Clears the status byte register and the event registers.

Syntax *CLS

Function This instruction clears the event registers and the bits of the status byte register associated with that register (SESR, ESR0, ESR1, ESR2, ESR3, RS232C:ERRor).

Note This has no effect upon the output queue, the various enable registers, or bit 4 (the MAV bit) of the status byte register.

Error This command is executed even in the event of a system error.

*ESE

- Sets the standard event status enable register. (Refer to Section 8.3.13.)

Syntax *ESE_<NR1>

<NR1> 0 to 255

Function

- This instruction sets the standard event status enable register (SESER) to a bit pattern which is used to mask the standard event status register (SESR).
- The decimal fraction is rounded (rounding up a final 5).

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

Standard Event Status Enable Register (SESER)

Note When the power is turned on, and when a reset has taken place upon key input, the data is reinitialized to 0.

Errors

- Execution error/ If the setting data is outside of the range.
- Command error/ If the setting data is not in NRf format.
- System error/ This command is not executed. A device dependent error occurs.

Example Transmission "*ESE 36"
Bits 2 and 5 of SESER are set to 1.

*ESE?

- Reads the standard event status enable register (SESER). (Refer to Section 8.3.13.)

Syntax	*ESE?
Function	The contents of SESER as set by the *ESE command are returned as an NR1 integral value in the range 0 to 255.
Note	If any error occurs, no response message to this query is produced.
Response syntax	Headers: ON "*ESE <0-255>" Headers: OFF "<0-255>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This command is not executed. A device dependent error occurs.
Example	Transmission "*ESE?" Response Headers: ON "*ESE 36" Headers: OFF "36"

*ESR?

- Reads out the contents of the standard event status register (SESR). (Refer to Section 8.3.13.)

Syntax	*ESR?																								
Function	The contents of the standard event status register SESR are returned as a value in NR1 format between 0 and 255 and cleared.																								
	<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">128</td> <td style="text-align: center;">64</td> <td style="text-align: center;">32</td> <td style="text-align: center;">16</td> <td style="text-align: center;">8</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">bit 7</td> <td style="text-align: center;">bit 6</td> <td style="text-align: center;">bit 5</td> <td style="text-align: center;">bit 4</td> <td style="text-align: center;">bit 3</td> <td style="text-align: center;">bit 2</td> <td style="text-align: center;">bit 1</td> <td style="text-align: center;">bit 0</td> </tr> <tr> <td style="text-align: center;">PON</td> <td style="text-align: center;">URQ</td> <td style="text-align: center;">CME</td> <td style="text-align: center;">EXE</td> <td style="text-align: center;">DDE</td> <td style="text-align: center;">QYE</td> <td style="text-align: center;">RQC</td> <td style="text-align: center;">OPC</td> </tr> </table>	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
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																		
	Standard Event Status Register (SESR)																								

Notes	<ul style="list-style-type: none"> • No header is affixed to the response message. • If any error occurs, no response message to this query is produced. • Even in the event of a system error, this query is executed.
Response syntax	Headers: ON/OFF "<0-255>"
Error	Query error/ If the response message is longer than 1000 bytes.
Example	Transmission "*ESR?" Response "32"

*IDN?

- Queries manufacturer's name, model name, and software version.

Syntax *IDN?

Function The response consists of the name of the manufacturer of the unit, the model name, and the software version.

- Notes**
- The "*IDN?" query is the last query message in the program messages. Accordingly, if another query is detected after this query, a query error is generated, and no response message after the "*IDN?" query is produced.
 - No header is affixed to the response message.
 - If any error occurs, no response message to this query is produced.

Response syntax

Headers: ON/OFF "HIOKI,3331,0,V1.00"

First field	Manufacturer's name
Second field	Model name
Third field	Not used - always "0"
Fourth field	Software version

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This command is not executed. A device dependent error occurs.

Example

Transmission	"*IDN?"
Response	"HIOKI,3331,0,V1.00"

*OPC

- After all action has been completed during execution, performs an SRQ request.

Syntax *OPC

Function When a number of commands are written on one line, the *OPC command sets bit 0 (the OPC bit) of the standard event status register (SESR) to 1 at the instant the previous commands have been completed.

Error System error/ This command is not executed. A device dependent error occurs.

Example

Transmission	"*RST;MEAS?;*OPC;DISP V1,A1,W1,VA1"
--------------	-------------------------------------

When the entire action of the commands *RST and MEAS? has been completed, the OPC bit is set to 1.

*OPC?

- Queries whether or not all action has been completed during execution.

Syntax *OPC?

Function The same as the *OPC command, except in that, at the instant that the previous commands have been completed, instead of bit 0 (the OPC bit) of the standard event status register (SESR) being set to 1, the response message "1" is returned.

- Notes**
- With this query, if any error occurs, no response message is produced.
 - No header is affixed to the response message.

Response syntax Headers: ON/OFF "1"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This command is not executed. A device dependent error occurs.

*RST

- Performs device initial setting.

Syntax *RST

Function Resets the 3331 unit. The parameters which are reset, the values to which they are reset, and those items which are not affected by this command, are listed below.

Parameters which are reset, and their new values:	
• Connecting mode	3
• Display	V1, A1, W _{SUM} , PF _{SUM}
• Rectifier type	RMS
• Voltage range	Auto ranging
• Current range	Auto ranging
• Frequency source, range	V1, auto ranging
• PT ratio, CT ratio	1.000, 1.000
• Number of averaging	OFF
• INTEG time	10000:00
• Output interval	00:00:00
• Output items	all items
• D/A output	V _A _{SUM}
• HOLD	OFF
• Header	ON
• Data separator	semicolon ";"

- Function** Items which are not reset.
- Interface functions
 - GP-IB device address
 - RS-232C setting
 - The output queue
 - The input buffer
 - The terminator for query messages
 - The various event registers (SESR, ESR0, ESR1, ESR2, ESR3)
 - The various enable registers (SRER, SESER, ESER0, ESER1, ESER2, ESER3)

Note When executes this command under integration, it stops by force and its data are reset.

Error Backup error (001 backup error)/ This command is executed.
Other system errors/ This command is not executed. A device dependent error occurs.

*SRE

■ Sets the service request enable register (SRER). (Refer to Section 8.3.12.)

Syntax *SRE_<NR1>

<NR1> 0 to 255

- Function**
- Sets the service request enable register (SRER) to a pattern is used to mask the status byte register (STB).
 - The decimal fraction is rounded (rounding up a final 5).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	×	ESB	MAV	ESB3	ESB2	ESB1	ESB0

Service Request Enable Register (SRER)

- Notes**
- The unused bits and bit 6 are disregarded.
 - When the power is turned on, and when a reset has taken place upon key input, the data is reinitialized to 0.

- Errors**
- Execution error/ If the setting data is outside of the range.
 - Command error/ If the setting data is not in NRf format.
 - System error/ This command is not executed. A device dependent error occurs.

Example Transmission "*SRE 34"
Bits 1 and 5 of SRER are set to 1.

*SRE?

- Reads the service request enable register (SRER). (Refer to Section 8.3.12.)

Syntax *SRE?

Function Returns the value of the service request enable register (SRER) as a numerical data value in NR1 format (0 to 63).

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON "*SRE_<0-63>"
 Headers: OFF "<0-63>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	"*SRE?"
Response	
Headers: ON	"*SRE 34"
Headers: OFF	"34"

*STB?

- Queries the status byte register. (Refer to Section 8.3.12.)

Syntax *STB?

Function Returns the set contents of the status byte register (STB) as a numerical data value in NR1 format (0 to 127).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	MSS	ESB	MAV	ESB3	ESB2	ESB1	ESB0

Status Byte Register (STB)

- Notes**
- Bit 6 is the MSS bit.
 - Even if service requests are cleared by serial polling, the MSS bit is not cleared.
 - No header is affixed to the response message.
 - With this query, if any error occurs, no response message is produced.
 - Even if a system error occurs, this query is executed.

Response syntax Headers: ON/OFF "<0-127>"

Error Query error/ If the response message is longer than 1000 bytes.

Example

Transmission	"*STB?"
Response	"32"

Some event has been generated in the standard event status register (SESR).

*TRG

- Request for sampling (single-shot sampling).

Syntax *TRG

Function If the system is currently in the hold state, performs sampling once.

- Errors**
- Device dependent error/ If the system is not in the hold state.
 - System error/ This command is not executed. A device dependent error occurs.

Example

Transmission	":HOLD ON::MEAS? A1;*TRG::MEAS? A1"
Response	"A1 +20.120E+0;A1 +20.240E+0"

*TST?

- Requests execution of, and queries the result of, the self test.

Syntax *TST?

Function Causes the 3331 to perform the self test, and returns the result thereof as a numerical data value in NR1 format. The value of the result has the following meaning:

0	Normal
1	Backup error
101	ROM error
102	RAM error
103	Display RAM error
104	Timer error
105	A/D and D/A converter error

- Notes**
- No header is affixed to the response message.
 - With this query, if any error occurs, no response message is produced.
 - Even in the event of a system error, this query is still executed.
 - A backup error (only) can be cleared with the *RST command.

Response syntax Headers: ON/OFF "<0/1/101/102/103/104/105>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - Device dependent error/ If this command is executed during RUN indicator lit or HOLD indicator lit/flashing.

Example

Transmission	"*TST?"
Response	"0"

The result is OK.

*WAI

- Waits until sampling is fully completed.

Syntax *WAI

Function If this command is executed during continuous display, it will not wait until sampling is completed.

- Notes**
- If this command is executed during the hold condition, the displayed data will not change.
 - If this command is executed during range switching over, the system will remain in the waiting state until the measured data are displayed.

Error System error/ This command is not executed. A device dependent error occurs.

Example

Transmission	":HOLD OFF::MEAS? V1:*WAI::MEAS? V1"
Response	"V1 +100.01E+0;V1 +101.02E+0"

8.4.2 Commands Specific to the 3331

AOUT

■ Sets the items of D/A output.

Syntax AOUT_<A>

<A> V1, V3, V3, V0, (U1,U3,U3,U0)
 A1, A2, A3, A0, (I1,I2,I3,I0)
 W1, W2, W0, (P1,P2,P0)
 VA1, VA2, VA0, (S1,S2,S0)
 VAR1, VAR2, VAR0, (Q1,Q2,Q0)
 PF1, PF2, PF0
 DEG1, DEG2, DEG0
 FFRQ
 AH1, AH2, AH3, (IH1, IH2, IH3)
 PWH1, PWH2, PWH0, (PWP1, PWP2, PWP0/ PINTEG)
 MWH1, MWH2, MWH0, (MWP1, MWP2, MWP0/ MINTEG)
 WH1, WH2, WH0, (WP1, WP2, WP0/ INTEG)
 (1, 2, 3: channel, 0: SUM, (): can be also used.)

Function Sets the items of D/A output.

- Errors**
- Execution error/ If the setting data is other than character data <A>
 - Command error/ If the setting data is not character data.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state
(HOLD indicator lit or flashing)
 - When selected items cannot be specified in this connection mode
(The item is set.)

Example Transmission ":AOUT VA1"
 The items of D/A output are set to VA1.

AOUT?

- Queries which the items of D/A output is to be performed

Syntax	AOUT?	
Function	Returns the D/A output items as character data <A>.	
Note	With this query, if any errors occurs, no response message is produced.	
Response syntax	Headers: ON	":AOUT_<A>"
	Headers: OFF	"<A>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs. 	
Example	Transmission	":AOUT?"
	Response	
	Headers: ON	":AOUT VA1"
	Headers: OFF	"VA1"

AVERaging

- Sets the number of measurements over which the averaging calculation is to be performed.

Syntax	AVERaging_<NR1>	
<NR1>	1, 8, 16, 32, 64	
Function	<ul style="list-style-type: none"> • Sets the number of measurements over which the averaging calculation is to be performed. • <NR1> can be received in NRf format, but the decimal fraction is rounded (rounding up a final 5). 	
Notes	<ul style="list-style-type: none"> • When the averaging count is set, the measurement is restarted. • The AV indicator lights with setting other than 1, and it goes off with setting of 1. 	
Errors	<ul style="list-style-type: none"> • Execution error/ If the setting data is other than listed above. • Command error/ If the setting data is not in NRf format. • Device dependent error/ <ul style="list-style-type: none"> In the event of a system error If this command is executed in the hold state (HOLD indicator lit or flashing) 	
Example	Transmission	":AVER 15.5"
	The averaging count is set to 16.	
		":AVER 15.4"
	An execution error is generated. (This numerical value is rounded to 15, according to the above described rounding process, and this causes the error).	

AVERaging?

- Queries the number of measurements over which the averaging calculation is to be performed.

Syntax AVERaging?

Function Returns the current setting of the number of measurements over which the averaging calculation is to be performed, as a numerical value in NR1 format.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	"AVERAGING_<1/8/16/32/64>"
Headers: OFF	"<1/8/16/32/64>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":AVER?"
Response	
Headers: ON	"AVERAGING 16"
Headers: OFF	"16"

CURRent?

- Queries the present setting for the current (amperage) range.

Syntax CURRent?

Function Returns the presently set current range as a numerical value in NR2 format, and also returns whether current auto-ranging is presently taking place or not as ON or OFF.

- Notes**
- With this query, if any error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

Headers: ON	":CURRENT:RANGE_<NR2>;AUTO_<NR2>"
Headers: OFF	"<NR2>;<NR2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":CURR?"
Response	
Headers: ON	":CURRENT:RANGE 0.5;AUTO ON"
Headers: OFF	"0.5;ON"

CURRent:AUTO

- Turns the current (amperage) auto range setting on and off.

Syntax CURRent:AUTO_<ON/OFF>

Function Turns current auto ranging ON or OFF.

- Errors**
- Execution error/ If the setting data is other than character data above.
 - Command error/ If the setting data is not character data.
 - Device dependent error/
 - In the event of a system error.
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (the RUN indicator lit or flashing).

Example Transmission ":CURR:AUTO ON"
 Current auto range setting is turned on.

CURRent:AUTO?

- Queries whether or not current auto ranging is enabled.

Syntax CURRent:AUTO?

Function Returns as "ON" or "OFF" character data whether or not current (amperage) auto ranging is presently enabled.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":CURRENT:AUTO_<ON/OFF>"
 Headers: OFF "<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":CURR:AUTO?"
 Response
 Headers: ON ":CURRENT:AUTO ON"
 Headers: OFF "ON"

CURRent:RANGe

- Sets the current (amperage) range.

Syntax CURRent:RANGe_<NR2>

<NR2> 0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 50.0

- Function**
- Sets the current (amperage) range. The units are amps (A).
 - <NR2> can be accepted in NRf format, but its effective value will be obtained by rounding off the sixth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

- Notes**
- If an invalid value 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.
 - A unit (A) should not be set to data portion.
 - After changing range, wait at least 5 seconds for the internal circuit to stabilize before taking readings.

- Errors**
- Execution error/ If the setting exceeds maximum range or it is negative value.
 - Command error/ If the setting data is not in NRf format
 - Device dependent error/
 - In the event of a system error.
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit or flashing)

Example

Transmission ":CURR:RANG 0.500004"
 Sets to 0.5 A range by rounding off.

 ":CURR:RANG 0.500005"
 Sets to 1 A range by rounding off.

CURRent:RANGe?

- Queries the current (amperage) range.

Syntax	CURRent:RANGe?
Function	Returns the presently set current (amperage) range as a numerical value in NR2 format.
Note	With this query, if any error occurs, no response message is produced.
Response syntax	Headers: ON ":CURRENT:RANGE_<NR2>" Headers: OFF "<NR2>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs.
Example	Transmission ":CURR:RANG?" Response Headers: ON ":CURRENT:RANGE 0.5" Headers: OFF "0.5"

DATAout?

- Queries the printer output.

Syntax	DATAout?
Function	<ul style="list-style-type: none"> • Returns the printer output items as six NR1 values, and the interval setting as three NR1 values. • The interval setting is returned as hours, minutes and seconds.
Notes	<ul style="list-style-type: none"> • With this query, if any error occurs, no response message is produced. • By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
Response syntax	Headers: ON ":DATAOUT:ITEM_<NR1 (six items)>,<hours>,<minutes>,<seconds>" Headers: OFF "<NR1,(six items)>,<hours>,<minutes>,<seconds>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs.
Example	Transmission ":DATA?" Response Headers: ON ":DATAOUT:ITEM 255,255, 131,255,127,119;TIME 010,10,10" Headers: OFF "255,255,131,255,127,119;010,10,10"

DATAout:ITEM

- Sets printer output item (:MEAS? output item).

Syntax DATAout:ITEM_<NR1>,<NR1>,<NR1>,<NR1>,<NR1>,<NR1>

<NR1> 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
1st data	IP1	DEG1	PF1	var1	VA1	W1	A1	V1
2st data	IP2	DEG2	PF2	var2	VA2	W2	A2	V2
3th data	IP3						A3	V3
4th data	FREQ	DEG0	PF0	var0	VA0	W0	A0	V0
5th data		AH3	AH2	AH1	TIME	± WH0	± WH2	± WH1
6th data		-WH0	-WH2	-WH1		+WH0	+WH2	+WH1

- Function**
- Sets the printer output items. The data set by bit corresponding to the items to be printed is transmitted.
 - 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.
 - <NR1> are accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).
 - When <NR1> are all 0, the display value is printed out. With the "MEASure?" command, display value is printed.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - Device dependent error/
 - In the event of a system error
 - When selected items cannot be specified in this connection mode. (The data is set)
 - When selected items cannot be specified in this connection mode (The bit for selected item is set.)

Example Transmission ":DATA:ITEM 255,0,0,0,0,0"
Set V1, A1, W1, VA1, var1, PF1, deg1 and IP1 for printer output items.

DATAout:ITEM?

- Queries the printer output item.

Syntax DATAout:ITEM?

Function Returns the settings of printer output items as a numerical value in NR1 format. This value is one of the set: 0 through 255.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":DATAOUT:ITEM_<NR1>...(six items)>"
Headers: OFF	"<NR1>,<NR1>,<NR1>,<NR1>,<NR1>,<NR1>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":DATA:ITEM?"
Response	
Headers: ON	":DATAOUT:ITEM 255,0,0,0,0,0"
Headers: OFF	"255,0,0,0,0,0"

DATAout:TIME

- Sets the printer output interval.

Syntax DATAout:TIME_<NR1>,<NR1>,<NR1>,<NR1>

<NR1>

First parameter	0 to 100 (hours)
Second parameter	0 to 59 (minutes)
Third parameter	0, 10, 20, 30, 40, 50 (seconds)

- Function**
- Sets the data output interval in hours, minutes and seconds. The setting range is from 10 seconds to 100 hours, in 10-second steps.
 - <NR1> are accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).
 - When the integration starts, bit 5 (OT) of ESR0 is set at every setting time.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - Device dependent error/ During integration (RUN indicator lit), in the event of a system error

Example

Transmission	":DATA:TIME 10,10,10"
--------------	-----------------------

Sets the printer output interval to 10 hours, 10 minutes and 10 seconds.

DATAout:TIME?

- Queries the printer output interval.

Syntax DATAout:TIME?

Function Returns the printer output interval as three NR1 values, in hours, minutes and seconds.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":DATAOUT:TIME_<hours>,<minutes>,<seconds>"
 Headers: OFF "<hours>,<minutes>,<seconds>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":DATA:TIME?"
 Response
 Headers: ON ":DATAOUT:TIME 010,10,10"
 Headers: OFF "010,10,10"

DISPlay

- Sets the items displayed.

Syntax DISPlay_<A>,<A>,<A>,<A>

<A> (Ref. Section 8.4)

First Display a	V1, V2, V3, V0, A1, A2, A3, A0, W1, W2, W0, VA1, VA2, VA0, VAR1, VAR2, VAR0, PF1, PF2, PF0, DEG1, DEG2, DEG0, IP1, IP2, IP3, TIME
Second Display b	V1, V2, V3, V0, A1, A2, A3, A0, W1, W2, W0, VA1, VA2, VA0, VAR1, VAR2, VAR0, PF1, PF2, PF0, DEG1, DEG2, DEG0, IP1, IP2, IP3, AH1, AH2, AH3, WH1, WH2, WH0
Third Display c	V1, V2, V3, V0, A1, A2, A3, A0, W1, W2, W0, VA1, VA2, VA0, VAR1, VAR2, VAR0, PF1, PF2, PF0, DEG1, DEG2, DEG0, IP1, IP2, IP3, AH1, AH2, AH3, PWH1, PWH2, PWH0
Fourth Display d	V1, V2, V3, V0, A1, A2, A3, A0, W1, W2, W0, VA1, VA2, VA0, VAR1, VAR2, VAR0, PF1, PF2, PF0, DEG1, DEG2, DEG0, IP1, IP2, IP3, AH1, AH2, AH3, PWH1, PWH2, PWH0, MWH1, MWH2, MWH0, WH1, WH2, WH0, FREQ1, FREQ2

If FREQ1 or FREQ2 is specified, the channel for frequency measurement can be changed.

Function Sets the items to be shown on display a, b, c, and d, and switches over the display.

- Notes**
- There should be four items of character data.
 - All <A> are respectively the items to be shown on display a, b, c, and d.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not character data.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":DISP V1,A1,W0,VA0"
 Displays respectively voltage on display a, current on display b, active power on display c, and apparent power on display d.

DISPlay?

- Queries the items displayed.

Syntax DISPlay?

Function Returns as <A> the presently set items which are being shown on display a, display b, display c, and display d.

- Note**
- With this query, if any error occurs, no response message is produced.
 - When the frequency was set on display d, "FREQ" is returned.

Response syntax

Headers: ON	":DISPLAY_<A>,<A>,<A>,<A>"
Headers: OFF	"<A>,<A>,<A>,<A>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":DISP?"
Response	
Headers: ON	":DISPLAY V1,A1,W0,VA0"
Headers: OFF	"V1,A1,W0,VA0"

ESE0

- Sets event status enable register 0 (Refer to Section 8.3.13.) (events relating to the unit status and W_{SUM})

Syntax ESE0_<NR1>

<NR1> 0 to 255

- Function**
- Sets event status enable register 0 (ESER0) to the bitmask for controlling access to events in event status register 0 (ESR0).
 - The decimal fraction is rounded (rounding up a final 5).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DS	FOR	OT	IE		HW0	PODIO	MODIO

Event Status Enable Register 0 (ESER0)

- Note** The data is initialized to 0 after the power has been switched on, or after a reset by key operation.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE0 4"
Bit 2 of ESER0 is set to 1.	

ESE0?

- Reads out event status enable register 0. (Event for unit settings and W_{SUM}) (Refer to Section 8.3.13.)

Syntax ESE0?

Function Returns the contents of event status enable register 0 as a numerical value in NR1 format. This value is one of the set: 0 through 255.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":ESE0_<0-255>"
Headers: OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE0?"
Response	
Headers: ON	":ESE0 4"
Headers: OFF	"4"

ESE1

- Sets event status enable register 1. (Event for channel 1) (Refer to Section 8.3.13.)

Syntax ESE1_<NR1>

<NR1> 0 to 255

- Function**
- Sets event status enable register 1 (ESER1) to the bitmask for controlling access to events in event status register 1 (ESR1).
 - The decimal fraction is rounded (rounding up a final 5).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
CODI1	PODI1	MODI1	OA1	OV1	HW1	HA1	HV1

Event Status Enable Register 1 (ESER1)

Note The data is initialized to 0 after the power has been switched on, or after a reset by key operation.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE1 24"
Bits 3 and 4 of ESER1 are set to 1.	

ESE1?

- Reads out event status enable register 1. (Event for channel 1)
(Refer to Section 8.3.13.)

Syntax ESE1?

Function Returns the value of event status enable register 1 as a numerical value in NR1 format (0 to 255).

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":ESE1_<0-255>"
Headers: OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE1?"
Response	
Headers: ON	":ESE1 24"
Headers: OFF	"24"

ESE2

- Sets event status enable register 1. (Event for channel 2)
(Refer to Section 8.3.13.)

Syntax ESE2_<NR1>

<NR1> 0 to 255

- Function**
- Sets event status enable register 2 (ESER2) to the bitmask for controlling access to events in event status register 2 (ESR2).
 - The decimal fraction is rounded (rounding up a final 5).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
CODI2	PODI2	MODI2	OA2	OV2	HW2	HA2	HV2

Event Status Enable Register 2 (ESER2)

Note Directly after the power has been switched on, or after a reset caused as a result of key operation, the value is initialized to 0.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE2 24"
Bits 3 and 4 of ESER2 are set to 1.	

ESE2?

- Reads out event status enable register 2. (Event for channel 2)
(Refer to Section 8.3.13.)

Syntax ESE2?

Function Returns the value of event status enable register 2 as a numerical value in NR1 format (0 to 255).

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":ESE2_<0-255>"
Headers: OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE2?"
Response	
Headers: ON	":ESE2 24"
Headers: OFF	"24"

ESE3

- Sets event status enable register 3. (Event for channel 3)
(Refer to Section 8.3.13.)

Syntax ESE3_<NR1>

<NR1> 0 to 255

- Function**
- Sets event status enable register 3 (ESER3) to the bitmask for controlling access to events in event status register 3 (ESR3).
 - The decimal fraction is rounded (rounding up a final 5).

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
CODI3			OA3	OV3		HA3	HV3

Event Status Enable Register 3 (ESER3)

Note The data is initialized to 0 after the power has been switched on, or after a reset by key operation.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE3 24"
--------------	------------

Bits 3 and 4 of ESER3 are set to 1.

ESE3?

- Reads out event status enable register 3. (Refer to Section 8.3.13.)

Syntax ESE3?

Function Returns the value of event status enable register 3 as a numerical value in NR1 format (0 to 255) and clears.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":ESE3_<0-255>"
Headers: OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESE3?"
Response	
Headers: ON	":ESE3 24"
Headers: OFF	"24"

ESR0?

- Reads out event status register 0. (Event for unit settings and W_{SUM}) (Refer to Section 8.3.13.)

Syntax ESR0?

Function Returns the value of event status register 0 (ESR0) as a numerical value in NR1 format, 0 to 255, and then clears event status register 0.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DS	FOR	OT	IE		HW0	PODIO	MODIO

Event Status Register 0 (ESR0)

- Notes**
- No header is prefixed to the response message.
 - With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON/OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":ESR0?"
Response	"16"

The integrating end (IE) flag is raised.

ESR1?

- Reads out event status register 1. (Event for channel 1)
(Refer to Section 8.3.13.)

Syntax ESR1?

Function Returns the value of event status register 1 (ESR1) as a numerical value in NR1 format, and then clears event status register 1. The numerical value is one of the set: 0 through 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
CODI1	PODI1	MODI1	OA1	OV1	HW1	HA1	HV1

Event Status Register 1 (ESR1)

- Note**
- No header is prefixed to the response message.
 - With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON/OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":ESR1?"
Response "24"

The peak voltage out of range flag (OV1) and peak current out of range flag (OA1) are raised.

ESR2?

- Reads out event status register 2. (Event for channel 2)
(Refer to Section 8.3.13.)

Syntax ESR2?

Function Returns the value of event status register 2 (ESR2) as a numerical value in NR1 format, and then clears event status register 1. The numerical value is one of the set: 0 through 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
CODI2	PODI2	MODI2	OA2	OV2	HW2	HA2	HV2

Event Status Register 2 (ESR2)

- Note**
- No header is prefixed to the response message.
 - With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON/OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":ESR2?"
Response "24"

The peak voltage out of range flag (OV2) and peak current out of range flag (OA2) are raised.

ESR3?

- Reads out event status register 3. (Event for channel 3) (Refer to Section 8.3.13.)

Syntax ESR3?

Function Returns the value of event status register 3 (ESR3) as a numerical value in NR1 format, and then clears event status register 3. The numerical value is one of the set: 0 through 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
CODI3			OA3	OV3		HA3	HV3

Event Status Register 3 (ESR3)

- Notes**
- No header is prefixed to the response message.
 - With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON/OFF "<0-255>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":ESR3?"
Response "24"

The peak voltage out of range flag (OV3) and peak current out of range flag (OA3) are raised.

FREQuency?

- Queries the frequency setting items.

Syntax FREQuency?

Function Returns the current setting of frequency measuring items as character data (A), frequency range as a numerical value in NR3 format and frequency auto ranging as "ON" or "OFF".

- Note**
- With this query, if any error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax Headers: ON ":FREQUENCY:SOURCE_<A>;RANGE_<NR3>;AUTO_ <ON/OFF>"
Headers: OFF "<A>;<NR3>;<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":FREQ?"
Response
Headers: ON ":FREQUENCY:SOURCE V1;RANGE +500.0E+0;AUTO ON"
Headers: OFF "V1;+500.0E+0;ON"

FREQUENCY:AUTO

- Sets the frequency auto range.

Syntax FREQUENCY:AUTO_<ON/OFF>

Function Sets the frequency auto range either ON or OFF.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not character data.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)

Example Transmission ":FREQ:AUTO ON"
 Frequency auto range setting is turned on.

FREQUENCY:AUTO?

- Queries the frequency auto range.

Syntax FREQUENCY:AUTO?

Function Returns as "ON" or "OFF" whether or not the frequency auto ranging is presently enabled.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":FREQUENCY:AUTO_<ON/OFF>"
 Headers: OFF "<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":FREQ:AUTO?"
 Response
 Headers: ON ":FREQUENCY:AUTO ON"
 Headers: OFF "ON"

FREQuency:RANGe

- Sets the frequency range.

Syntax FREQuency:RANGe_<NR3>

<NR3> +500.0E+0, +50.00E+3

- Function**
- Sets the frequency range. The units are hertz (Hz).
 - <NR3> can be accepted in NRf format, but its effective value will be obtained by rounding off the sixth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

- Notes**
- If an invalid value 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.
 - Units (Hz) cannot be set.

- Errors**
- Execution error/ If the setting exceeds maximum range or it is negative value.
 - Command error/ If the setting data is not in NRf format
 - Device dependent error/
In the event of a system error
If this command is executed in the hold state (HOLD indicator lit or flashing)

Example

Transmission ":FREQ:RANG +500.004E+0"
The range is set to 500 Hz by rounding off.

 ":FREQ:RANG +500.005E+0"
The range is set to 50 kHz by rounding off.

FREQuency:RANGe?

- Queries the frequency range.

Syntax FREQuency:RANGe?

Function Returns the presently set frequency range as a numerical value in NR3 format.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":FREQUENCY:RANGE_<NR3>"
Headers: OFF	"<NR3>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":FREQ:RANG?"
Response	
Headers: ON	":FREQUENCY:RANGE +500.0E+0"
Headers: OFF	"+500.0E+0"

FREQuency:SOURce

- Sets the frequency measuring items.

Syntax FREQuency:SOURce_<A>

<A> V1, V2, A1, A2 (V: voltage, A: current)

Function Sets the current frequency measuring items.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not character data.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)

Example Transmission ":FREQ:SOUR V1"
Sets the frequency measuring item to V1.

FREQuency:SOURce?

- Queries the frequency measuring items.

Syntax FREQuency:SOURce?

Function Returns the current setting of the frequency measuring item as V1, V2, A1 or A2.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":FREQUENCY:SOURCE_<V1/V2/A1/A2>"
Headers: OFF	"<V1/V2/A1/A2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":FREQ:SOUR?"
Response	
Headers: ON	":FREQUENCY:SOURCE V1"
Headers: OFF	"V1"

HEADer

- Turns response headers ON or OFF.

Syntax HEADer_<ON/OFF>

Function Sets whether or not the 3331 will prefix headers to its response messages.

Note In any case, responses to the queries *IDN?, *OPC?, *ESR?, *STB?, *TST?, ESR0?, ESR1?, ESR2?, ESR3? and RS232c:ERRor? are not prefixed with any headers.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not character data.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":HEAD OFF"

No headers will henceforward be prefixed to response messages.

HEADer?

- Queries whether or not headers on response messages are enabled.

Syntax HEADer?

Function Returns as "ON" or "OFF" whether or not headers on response messages are enabled.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":HEADER_ON"
Headers: OFF	":OFF"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":HEAD?"
Response	
Headers: ON	":HEADER ON"
Headers: OFF	":OFF"

INTEGrate?

- Queries the integrate setting items.

Syntax INTEGrate?

Function Returns the integration time as two values in NR1 format (hours and minutes respectively) and the condition of the integration operation as character data (START/STOP/RESET).

- Notes**
- With this query, if any error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

Headers: ON	":INTEGRATE:TIME<NR1>,<NR1>;STATE<START/STOP/RESET>"
Headers: OFF	"<NR1>,<NR1>;<START/STOP/RESET>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":INTEG?"
Response	
Headers: ON	":INTEGRATE:TIME 00100,0;STATE START"
Headers: OFF	"00100,0;START"

INTEGrate:STATe

- Set the integration condition.

Syntax INTEGrate:STATe_<START/ STOP/ RESET>

Function Sets the condition of the integrate operation (start, stop or reset).

- Errors**
- Device dependent error/ according to the "RUN" indicator.

Data portion	Off	Key input (GP-IB)		External control	
		Lit	Flashing	Lit	Flashing
START	●	—	●	—	—
STOP	—	●	—	—	—
RESET	●	—	●	—	●

: The command is executed. / - : A device dependent error is generated.

- System error/ This query is not executed. A device dependent error occurs.
- Depending on the external control, an error may occur during integration operation. (See Section, 8.5.4.)
- Device dependent error/
 - When the integration time reached 10000 hours
 - When the START command is executed with the integration value is 999999M

Example

Transmission	":INTEG:STAT START"
Starts integrating.	

INTEGrate:STATe?

- Queries the integration condition.

Syntax	INTEGrate:STATe?	
Function	Returns the condition of integrate operation (START/STOP/RESET) as a character data.	
Note	With this query, if any error occurs, no response message is produced.	
Response syntax	Headers: ON	":INTEGRATE:STATE_<START/STOP/RESET>"
	Headers: OFF	"<START/STOP/RESET>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs. 	
Example	Transmission	":INTEG:STAT?"
	Response	
	Headers: ON	":INTEGRATE:STATE START"
	Headers: OFF	"START"

INTEGrate:TIME

- Sets the integrate timer.

Syntax	INTEGrate:TIME_<NR1>,<NR1>	
<NR1>	First	0 to 10000
	Second	0 to 59
Function	<ul style="list-style-type: none"> • Sets the integration time in NR1 format as two values, hours and minutes respectively. Setting limit is from one minute to 10000 hours. • <NR1> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 5 and above being rounded up and 4 and below being rounded down. 	
Errors	<ul style="list-style-type: none"> • Execution error/ If the setting data is other than listed above. • Command error/ If the setting data is not in NRf format. • Device dependent error/ <ul style="list-style-type: none"> In the event of a system error During integrating (RUN indicator lit) 	
Example	Transmission	":INTEG:TIME 100,30"
	Sets the integrate timer to 100 hours and 30 minutes.	

INTEGrate:TIME?

- Queries the integrate timer.

Syntax INTEGrate:TIME?

Function Returns the hours of integrate timer as a numerical value in NR1 format and minutes in same format.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":INTEGRATE:TIME_<NR1>,<NR1>"
Headers: OFF	"<NR1>,<NR1>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":INTEG:TIME?"
Response	
Headers: ON	":INTEGRATE:TIME 00100,30"
Headers: OFF	"00100,30"

MEASure?

■ Queries measured data items.

Syntax MEASure?_ <A>,<A>,<A>,...

<A> Up to 40 items (See the explanation of data formats in Section 8.4)

- Function**
- Up to 40 items can be set.
 - Produces the measured value of the data item specified by <A>.
 - If <A> is not specified, produces the measured value set by ":DATAout:ITEM" command.
 - If all data items are set to OFF, the measured values of the displays a, b, c, and d are produced.

- Notes**
- With this query, if any error other than out-of-range, a scaling error, connection mode error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
 - If FREQ displays "-----", outputs previous value.
 - When selected items cannot be specified in this connection mode, the error value is output.
 - Due to the amount of time required for analysis when <A> is great, it may not be possible to maintain 200 ms display switching. When there are two or more data items, the amount of analysis time can be minimized by specifying each item in "DATA:ITEM" format.

Response syntax

Header portion	Data portion
V, A, W, VA, VAR, PF, DEG, FREQ, IP	Numerical data in NR3 format ±□□□□□□E±□ Mantissa : 5 digits with a decimal point Exponent : 1 digit
AH, PWH, MWH, WH	Numerical data in NR3 format ±□□□□□□E±□ Mantissa : 6 digits with a decimal point Exponent : 1 digit
TIME	Numerical data in NR1 and 3 format □□□□□,□□,□□ (hours, minutes, seconds)

Error	Data	V, A, W, VA, VAR, PF, DEG, FREQ, IP	AH, PWH, MWH, WH
Over range		±999.99E+9	No syntax
Scaling error		±888.88E+9	±8888.88E+9
Connection mode error		±777.77E+9	±7777.77.E+9

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - Execution error/ If this query is executed with character data other than above.
 - Device dependent error/
 - In the event of a system error
 - When it is out of range, when scaling error occurred, or
 - when the data of connection mode error is selected.

Example

Transmission	":MEAS? V1,A1,W0?"
Response	":V1 +150.00E+0;A1 +20.000E+0;W0 +3.0000E+3"
Headers: ON	":V1 +150.00E+0;A1 +20.000E+0;W0 +3.0000E+3"
Headers:OFF	"+150.00E+0;+20.000E+0;+3.0000E+3"

MODE

- Sets the connecting mode.

Syntax MODE_<NR1>

<NR1> 1, 2 (1: 1 , 2: 3)

- Function**
- Sets the connecting mode.
 - <NR1> can be accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example Transmission ":MODE 2"
Sets the connecting mode to 3 .

MODE?

- Queries the connecting mode.

Syntax MODE?

- Function** Returns the current setting mode as a numerical value in NR1 format (1 or 2).

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	"MODE_<1/2>"
Headers: OFF	"<1/2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	" :MODE?"
Response	
Headers: ON	" :MODE 2"
Headers:OFF	" 2"

RECTifier

■ Sets the rectifier type.

Syntax RECTifier_<NR1>

<NR1> 1, 2 (1: RMS, 2: MEAN)

Function

- Sets the rectifier type.
- <NR1> can be accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).

Note After changing the rectifier type, wait at least 5 seconds for the internal circuit to stabilize before taking readings.

Errors

- Execution error/ If the setting data is other than listed above.
- Command error/ If the setting data is not in NRf format.
- Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example Transmission ":RECT 1"
Sets the rectifier type to RMS.

RECTifier?

■ Queries the rectifier.

Syntax RECTifier?

Function Returns the presently set rectifier type as a numerical value in NR1 format (1 or 2).

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":RECTIFIER_<1/2>"
Headers: OFF "<1/2>"

Errors

- Query error/ If the response message is longer than 1000 bytes.
- System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":RECT?"
Response
Headers: ON ":RECTIFIER 1"
Headers: OFF "1"

RESPonse

- Sets the response speed.

Syntax RESPonse_<FAST/ SLOW/ AUTO>

Function Sets the response speed.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format.
 - Device dependent error/
 - In the event of a system error (the command is not executed).
 - If this command is executed in the hold state (HOLD indicator lit or flashing)

Example Transmission ":RESP AUTO"
Sets the response speed to automatic.

RESPonse?

- Queries the response speed.

Syntax Response?

Function Returns the current setting of response speed as FAST or SLOW.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":RESPONSE <FAST/SLOW/AUTO>"
 Headers: OFF "<FAST/SLOW/AUTO>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":RESP?"
 Response
 Headers: ON ":RESPONSE FAST"
 Headers: OFF "FAST"

RS232c? (Query for the RS-232C interface)

- Queries the setting for the RS-232C communications handshake.

Syntax RS232c?

Function Returns the current setting for the RS-232C communications handshake as X, HARD or OFF, the setting for execution confirmation message as ON or OFF .

- Notes**
- With this query, if any error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
 - Even if a system error occurs, this query is executed.

Response syntax

Headers: ON	":RS232C:HANDSHAKE_<X/HEAD/OFF>;ANSWER_<ON/OFF>"
Headers: OFF	"<X/HEAD/OFF>;<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - Execution error/ If this query is executed when using GP-IB interface

Example

Transmission	":RS232c?"
Response	
Headers: ON	":RS232C:HANDSHAKE OFF; ANSWER OFF"
Headers: OFF	"OFF;OFF"

RS232c:ANSWer (Command for the RS-232C interface)

- Sets whether or not the execution confirmation message

Syntax RS232c:ANSWer_<ON/ OFF>

Function • Sets the execution confirmation message either ON or OFF.
 • When set to ON, outputs the execution confirmation message (see Section 8.1.2).

Notes • Even if a system error occurs, this command is executed.
 • When set to ON, if this message is not accepted the operation may become unstable.

Errors • Execution error/
 If the setting data is other than listed above or when using GP-IB interface
 • Command error/ If the setting data is not character data.
 • System error/ This query is not executed. A device dependent error occurs.

Example PRINT #1,":RS232:ANSW ON" (Results)
 INPUT #1,A\$
 PRINT A\$ 000 OK
 PRINT #1,"V:RNG 100"
 INPUT #1,A\$
 PRINT A\$ 001 "V:RNG" is error
 PRINT #1,"VOLT:RANG?"
 INPUT #1,A\$
 PRINT A\$:VOLTAGE:RANGE 150;000 Query data is OK

RS232c:ANSWer? (Query for the RS-232C interface)

- Queries whether or not execution confirmation messages are enabled.

Syntax RS232c:ANSWer?

Function Returns the current setting for the execution confirmation messages as ON or OFF.

Notes • With this query, if any error occurs, no response message is produced.
 • Even if a system error occurs, this query is executed.

Response syntax Headers: ON ":RS232C:ANSWER_<ON/OFF>"
 Headers: OFF "<ON/OFF>"

Errors • Query error/ If the response message is longer than 1000 bytes.
 • Execution error/ If this query is executed when using GP-IB interface

Example Transmission ":RS232:ANSW?"
 Response
 Headers: ON ":RS232C:ANSWER OFF"
 Headers: OFF "OFF"

RS232c:ERRor? (Query for the RS-232C interface)

- Queries whether or not the RS-232C communications error information are enabled.

Syntax RS232c:ERRor?

Function Returns the RS-232C communications error information as a numerical data value in NR1 format taken from the set :0 to 7 and then clears.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	Unused	Unused	Unused	Unused	Overrun	framing	parity

- Overrun error
- Framing error
- Parity error

- Notes**
- With this query, if any error occurs, no response message is produced.
 - Even if a system error occurs, this query is executed.
 - The response message has no header.
 - This query clears the communications error information.

Response syntax Headers: ON/OFF "<0-7>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - Execution error/ If this query is executed when using GP-IB interface

Example Transmission ":RS232:ERR?"
 Response "4"
 An overrun error has occurred.

RS232c:HANDshake (Command for the RS-232C interface)

- Sets the RS-232C communications handshake

Syntax RS232c:HANDshake_<X/ HARD/ OFF>
 (X: software handshake, HARD: hardware handshake, OFF: no handshake)

Function Select the type of handshake.

- Note**
- Even if a system error occurs, this query is executed.
 - If "X" or "HARD" is selected, the length of a command should be less than 750 bytes.

- Errors**
- Execution error/ If the setting data is other than listed above or when using GP-IB interface
 - Command error/ If the setting data is not character data.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":RS232:HAND X"
 Sets to software handshake (XON/XOFF).

RS232c:HANDshake? (Command for the RS-232C interface)

- Queries the setting for the RS-232C communications handshake.

Syntax	RS232c:HANDshake?
Function	The value of the communications handshake is returned as character data (X, HARD or OFF).
Notes	<ul style="list-style-type: none"> • With this query, if any error occurs, no response message is produced. • Even if a system error occurs, this query is executed.
Response syntax	Headers: ON ":RS232C:HANDSHAKE_<X/HARD/OFF>" Headers: OFF "<X/HARD/OFF>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • Execution error/ If this query is executed when using GP-IB interface
Example	Transmission ":RS232:HAND?" Response Headers: ON ":RS232C:HANDSHAKE X" Headers: OFF "X"

SCALE?

- Queries the scaling factors being applied.

Syntax	SCALE?
Function	The current values of the PT ratio and CT ratio are returned as numerical values in NR2 numerical format.
Notes	<ul style="list-style-type: none"> • With this query, if any error occurs, no response message is produced. • By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
Response syntax	Headers: ON ":SCALE:PT_<NR2>;CT_<NR2>" Headers: OFF "<NR2>;<NR2>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs.
Example	Transmission ":SCAL?" Response Headers: ON ":SCALE:PT 2.000;CT 3.000" Headers: OFF "2.000;3.000"

SCALe:CT

- Sets the CT ratio.

Syntax SCALe:CT_<NR2>

<NR2> 0.001 to 9999.0

- Function**
- The current value of CT ratio is set.
 - <NR2> can be accepted in NRf format, but its effective value will be obtained by rounding off the fifth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example

Transmission ":SCAL:CT 2.0004"
 The CT ratio is set to 2.000 by rounding off.

 ":SCAL:CT 2.0005"
 The CT ratio is set to 2.001 by rounding off.

SCALe:CT?

- Queries the CT scaling item.

Syntax SCALe:CT?

- Function** The current value of CT ratio is returned as a numerical value in NR2 numerical format.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":SCALE:CT_<NR2>"
Headers: OFF	"<NR2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":SCAL:CT?"
Response	
Headers: ON	":SCALE:CT 2.000"
Headers: OFF	"2.000"

SCALe:PT

- Sets the PT ratio.

Syntax SCALe:PT_<NR2>

<NR2> 1.000 to 9999.0

- Function**
- The current value of PT ratio is set.
 - <NR2> can be accepted in NRf format, but its effective value will be obtained by rounding off the fifth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not in NRf format.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example

Transmission ":SCAL:PT 2.0004"
 The PT ratio is set to 2.000 by rounding off.

 ":SCAL:PT 2.0005"
 The PT ratio is set to 2.001 by rounding off.

SCALe:PT?

- Queries the PT scaling item.

Syntax SCALe:PT?

- Function** The current value of PT ratio is returned as a numerical value in NR2 numerical format.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":SCALE:PT_<NR2>"
Headers: OFF	"<NR2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":SCAL:PT?"
Response	
Headers: ON	":SCALE:PT 2.000"
Headers: OFF	"2.000"

TRANsmit:SEParator

- Sets the message unit separator for response messages.

Syntax TRANsmit:SEParator_<NR1>

<NR1> 0, 1

- Function**
- When the header is off, the data separator is set as follows:
 - If <NR1> = 0, the separator is set to semicolon ";".
 - If <NR1> = 1, the separator is set to comma ",".
 - <NR1> can be accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).

- Notes**
- Even if you set the command to the comma, message unit separator will appear as a semicolon when headers are on.
 - After <NR1> has been rounded as explained above, if it becomes a numerical value other than 0, the message unit separator is set to the comma.

- Errors**
- Command error/ If the setting data is not in NRf format
 - System error/ This command is executed.

Example	Transmission	":TRAN:SEP 0;;HEAD OFF;;MEAS? V1,A1"
	Response	" +101.20E+0;+2.1200E+0"
	Transmission	":TRAN:SEP 1;;HEAD OFF;;MEAS? V1,A1"
	Response	" +101.20E+0,+2.1200E+0"
	Transmission	":TRAN:SEP 0;;HEAD ON;;MEAS? V1,A1"
	Response	"V1 +101.20E+0;A +2.1200E+0"
	Transmission	":TRAN:SEP 1;;HEAD ON;;MEAS? V1,A1"
	Response	"V1 +101.20E+0;A +2.1200E+0"

TRANsmit:SEParator?

- Queries the message unit separator for response messages.

Syntax TRANsmit:SEParator?

- Function**
- The message unit separator for response messages is returned as 0 or 1.
 - The returned numerical value corresponds to the setting state of the data separator as follows:
 - If <NR1> = 0, the separator is a semicolon ";".
 - If <NR1> = 1, the separator is a comma ",".

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":TRANSMIT:SEPARATOR_<0/1>"
Headers: OFF	"<0/1>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":TRAN:SEP?"
Response	
Headers: ON	":TRANSMIT:SEPARATOR 1"
Headers: OFF	"1"

TRANsmit:TERMinator

- Sets the data terminator for response messages.

Syntax TRANsmit:TERMinator_<NR1>

<NR1> 0, 1

- Function**
- The data terminator for response messages is set as follows:
 - If <NR1> = 0, the terminator is set to LF + EOI (GP-IB) or LF (RS-232C).
 - If <NR1> = 1, the terminator is set to CR and LF + EOI (GP-IB) or CR and LF (RS-232C).
 - <NR1> can be accepted in NRf format, but the decimal fraction is rounded (rounding up a final 5).

- Notes**
- After <NR1> has been rounded as explained above, if it becomes a numerical value other than 0, the data terminator is set to CR and LF + EOI.
 - Even in the event of a system error, this command is executed.

Error Command error/ If the setting data is not in NRf format

Example

Transmission	":TRAN:TERM 0"
--------------	----------------

Sets the data terminator to "LF + EOI".

TRANsmit:TERMinator?

- Queries the data terminator for response messages.

Syntax TRANsmit:TERMinator?

- Function**
- The data terminator for response messages is returned as 0 or 1.
 - The returned numerical value corresponds to the setting state of the data terminator for response messages as follows:
 - If <NR1> = 0, the terminator is LF + EOI (GP-IB) or LF (RS-232C) signal.
 - If <NR1> = 1, the terminator is CR and LF + EOI (GP-IB) or CR and LF (RS-232C) signal.

Note With this query, if any error occurs, no response message is produced.

Response syntax

Headers: ON	":TRANSMIT:TERMINATOR <0/1>"
Headers: OFF	"<0/1>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":TRAN:TERM?"
Response	
Headers: ON	":TRANSMIT:TERMINATOR 1"
Headers: OFF	"1"

VOLTage?

- Queries the present setting for voltage range.

Syntax VOLTage?

- Function** Returns the presently set voltage range as a numerical value in NR1 format, and also returns whether voltage auto-ranging is presently taking place or not as "ON" or "OFF".

- Notes**
- With this query, if any error occurs, no response message is produced.
 - By using the ":TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

Headers: ON	":VOLTAGE:RANGE<NR1>;AUTO<ON/OFF>"
Headers: OFF	"<NR1>;<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":VOLT?"
Response	
Headers: ON	":VOLTAGE:RANGE 300;AUTO ON"
Headers: OFF	"300;ON"

VOLTage:AUTO

- Turns voltage auto ranging on and off.

Syntax VOLTage:AUTO_<ON/ OFF>

Function Turns voltage auto ranging ON or OFF.

- Errors**
- Execution error/ If the setting data is other than listed above.
 - Command error/ If the setting data is not character data.
 - Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example Transmission ":VOLT:AUTO ON"
Voltage auto range setting is turned on.

VOLTage:AUTO?

- Queries whether or not voltage auto ranging is enabled.

Syntax VOLTage:AUTO?

Function Returns whether or not voltage auto ranging is presently enabled as "ON" or "OFF".

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":VOLTAGE:AUTO_<ON/OFF>"
Headers: OFF "<ON/OFF>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example Transmission ":VOLT:AUTO?"
Response
Headers: ON ":VOLTAGE:AUTO ON"
Headers: OFF "ON"

VOLTage:RANGe

■ Sets the voltage range.

Syntax VOLTage:RANGe_<NR1>

<NR1> 150, 300, 600

Function

- Sets the voltage range. The units are volts (V).
- <NR1> can be accepted in NRf format, but its effective value will be obtained by rounding off the sixth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Notes

- If the value specified is not a valid range setting, the next largest range is selected.
- A unit (V) should not be set to data portion.
- After changing range, wait at least 5 seconds for the internal circuit to stabilize before taking readings.

Errors

- Execution error/ If the setting data is other than listed above.
- Command error/ If the setting data is not in NRf format.
- Device dependent error/
 - In the event of a system error
 - If this command is executed in the hold state (HOLD indicator lit or flashing)
 - During integrating (RUN indicator lit)

Example Transmission ":VOLT:RANG 300.004"
The range is set to 300 V by rounding off.

 ":VOLT:RANG 300.005"
The range is set to 600 V by rounding off.

VOLTage:RANGe?

- Queries the voltage range.

Syntax	VOLTage:RANGe?	
Function	Returns the presently set voltage range as a numerical value in NR1 format.	
Note	With this query, if any error occurs, no response message is produced.	
Response syntax	Headers: ON	":VOLTAGE:RANGE_<150/300/600>"
	Headers: OFF	"<150/300/600>"
Errors	<ul style="list-style-type: none"> • Query error/ If the response message is longer than 1000 bytes. • System error/ This query is not executed. A device dependent error occurs. 	
Example	Transmission	":VOLT:RANG?"
	Response	
	Headers: ON	":VOLTAGE:RANGE 300"
	Headers: OFF	"300"

WCLock

- Changes the power computation circuit clock.

Syntax	WCLock_<NR1>	
<NR1>	0, 1, 2 (0: 2.37 kHz, 1: 2.44 kHz, 2: 2.604 kHz)	
Function	<ul style="list-style-type: none"> • Sets the power computation circuit clock. • <NR1> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 5 and above being rounded up and 4 and below being rounded down. 	
Errors	<ul style="list-style-type: none"> • Execution error/ If the setting data is other than listed above. • Command error/ If the setting data is not in NRf format • System error/ This query is not executed. A device dependent error occurs. 	
Example	Transmission	":WCL 0"
	Sets the clock to 2.23 kHz.	

WCLock?

- Queries the power computation circuit clock.

Syntax WCLock?

Function The current setting of power computation circuit clock. is returned as a numerical value in NR1 format.

Note With this query, if any error occurs, no response message is produced.

Response syntax Headers: ON ":WLOCK_<0/1/2>"
Headers: OFF "<0/1/2>"

- Errors**
- Query error/ If the response message is longer than 1000 bytes.
 - System error/ This query is not executed. A device dependent error occurs.

Example

Transmission	":WCL?"
Response	
Headers: ON	":WLOCK 0"
Headers: OFF	"0"

8.5 Command Summary

8.5.1 Standard Commands

Command	Data format (): number of data items	Explanation	Page
*CLS		Clears STB and ESR.	98
*ESE	NR1 numerical data (1)	Sets bitmask for ESR.	98
*ESE?		Queries bitmask for ESR.	99
*ESR?		Queries ESR.	99
*IDN?		Queries device ID.	100
*OPC		Issues service request after execution completion.	100
*OPC?		Queries execution completion.	101
*RST		Device initialization.	101
*SRE	NR1 numerical data (1)	Sets bitmask for STB.	102
*SRE?		Queries bitmask for STB.	103
*STB?		Queries STB.	103
*TRG		Performs sampling once.	104
*TST?		Queries the result of the self-test.	104
*WAI		Waits until sampling is fully completed.	105

8.5.2 Commands Specific to the 3331

Command	Data format (): number of data items	Explanation	Ref. page
AOUT	Character data (1)	Sets D/A output items.	106
AOUT?		Queries D/A output items.	107
AVERaging	NR1 numerical data (1)	Sets averaging count.	107
AVERaging?		Queries averaging count.	108
CURRent?		Queries current settings.	108
CURRent			
:AUTO	Character data (1)	Sets current auto ranging.	109
:AUTO?		Queries current auto ranging.	109
:RANGe	NR2 numerical data (1)	Sets current range.	110
:RANGe?		Queries current range.	111
DATAout?		Queries printer output settings.	111
DATAout			
:ITEM	NR1 numerical data (6)	Sets printer output items.	112
:ITEM?		Queries printer output items.	113
:TIME	NR1 numerical data (3)	Sets printer output interval.	113
:TIME?		Queries printer output interval.	114
DISPlay	Character data (4)	Sets display items.	114
DISPlay?		Queries display items.	115
ESE0	NR1 numerical data (1)	Sets bitmask for ESR0.	115
ESE0?		Queries bitmask for ESR0.	116
ESE1	NR1 numerical data (1)	Sets bitmask for ESR1.	116
ESE1?		Queries bitmask for ESR1.	117
ESE2	NR1 numerical data (1)	Sets bitmask for ESR2.	117
ESE2?		Queries bitmask for ESR2.	118
ESE3	NR1 numerical data (1)	Sets bitmask for ESR3.	118
ESE3?		Queries bitmask for ESR3.	119
ESR0?		Queries ESR0.	119
ESR1?		Queries ESR1.	120
ESR2?		Queries ESR2.	121
ESR3?		Queries ESR3.	122

Command	Data format (): number of data items	Explanation	Ref. page
FREQ <u>u</u> ency?		Queries frequency settings.	122
FREQ <u>u</u> ency			
:AU <u>T</u> O	ON/OFF (1)	Sets frequency auto ranging.	123
:AU <u>T</u> O?		Queries frequency auto ranging.	123
:RA <u>N</u> Ge	NR3 numerical data (1)	Sets frequency range.	124
:RA <u>N</u> Ge?		Queries frequency range.	124
:SO <u>R</u> Ce	V1/V2/A1/A2 (1)	Sets frequency items.	125
:SO <u>R</u> Ce?		Queries frequency items.	125
HEA <u>D</u> er	ON/OFF (1)	Sets header.	126
HEA <u>D</u> er?		Queries header.	126
HOLD	ON/OFF (1)	Sets the hold state.	127
HOLD?		Queries the hold state.	127
INTE <u>G</u> rate?		Queries the settings of integrate meter.	128
INTE <u>G</u> rate			
:STA <u>T</u> e	START/STOP/RESET (1)	Sets the condition of integrate operation.	128
:STA <u>T</u> e?		Queries the condition of integrate operation.	129
:TI <u>M</u> E	NR1 numerical data (2)	Sets integrate time.	129
:TI <u>M</u> E?		Queries integrate time.	130
MEAS <u>U</u> re?	Character data (0 to 40)	Queries designated measuring data.	131
MO <u>D</u> E	NR1 numerical data (1)	Sets the connection mode.	132
MO <u>D</u> E?		Queries the connection mode.	132
PEAK <u>H</u> old	Character data (1)	Sets the peak hold.	133
PEAK <u>H</u> old?		Queries the peak hold.	133
RECT <u>I</u> fier	NR1 numerical data (1)	Sets rectifier type.	134
RECT <u>I</u> fier?		Queries rectifier type.	134
RESP <u>O</u> nse	Character data (1)	Sets the response speed.	135
RESP <u>O</u> nse?		Queries the response speed.	135

Command	Data format (number of data items)	Explanation	Page
RS232c?		Queries the RS-232C setting item.	136
RS232c			
:ANSWer	ON/OFF(1)	Sets the execution confirmation message.	137
:ANSWer?		Queries the execution confirmation message.	137
:ERRor?		Queries the RS-232C communications error.	138
:HANDshake	X/HARD/OFF(1)	Sets the RS-232C communications handshake.	138
:HANDshake?		Queries the RS-232C communications handshake.	139
SCALe?		Queries the setting of scaling.	139
SCALe			
:CT	NR2 numerical data (1)	Sets CT ratio.	140
:CT?		Queries CT ratio.	140
:PT	NR2 numerical data (1)	Sets PT ratio.	141
:PT?		Queries PT ratio.	141
TRANsmit			
:SEParator	NR1 numerical data (1)	Sets the separator.	142
:SEParator?		Queries the separator.	143
:TERMinator	NR1 numerical data (1)	Sets the terminator.	143
:TERMinator?		Queries the terminator.	144
VOLTage?		Queries voltage settings.	144
VOLTage			
:AUTO	ON/OFF(1)	Sets voltage auto ranging.	145
:AUTO?		Queries voltage auto ranging.	145
:RANGe	NR1 numerical data (1)	Sets voltage range.	146
:RANGe?		Queries voltage range.	147
WCLock	NR1 numerical data (1)	Changes the clock of power calculation circuit.	147
WCLock?		Queries the clock of power calculation circuit.	148

8.5.3 Valid Command According to Condition (Standard Command)

Condition Command	Integration reset		Key				External control				System error	
	Continue	HOLD	Integration RUN		Integration STOP		Integration RUN		Integration STOP			
			Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD		
*CLS	●	●	●	●	●	●	●	●	●	●	●	●
*ESE	●	●	●	●	●	●	●	●	●	●	●	—
*ESE?	●	●	●	●	●	●	●	●	●	●	●	—
*ESR?	●	●	●	●	●	●	●	●	●	●	●	●
*IDN?	●	●	●	●	●	●	●	●	●	●	●	—
*OPC	●	●	●	●	●	●	●	●	●	●	●	—
*OPC?	●	●	●	●	●	●	●	●	●	●	●	—
*RST	●	●	●	●	●	●	●	●	●	●	●	Partly
*SRE	●	●	●	●	●	●	●	●	●	●	●	—
*SRE?	●	●	●	●	●	●	●	●	●	●	●	—
*STB?	●	●	●	●	●	●	●	●	●	●	●	●
*TRG	—	●	—	●	—	●	—	●	—	●	—	—
*TST?	●	—	—	—	●	—	—	—	●	—	—	●
*WAI	●	●	●	●	●	●	●	●	●	●	●	—

●: can be executed

—: cannot be executed.

Partly : in the event of backup error, the command can be executed. In other errors, a device dependent error is generated.

Explanations for conditions

Integration reset	Integration is stopped and integration time and value is reset (RUN lamp off)
Integration RUN	Integration is in progress (RUN lamp lit)
Integration STOP	Integration is stopped (RUN lamp flashing)
Continue	Display is being updated at the sampling (continuous display)
HOLD	Display is on hold (HOLD lamp lit or flashing)
System error	Err.001 or Err.101 to 105 is displayed
Key	Integration started by key operation or GP-IB command
External control	Integration started by external control signal (START/STOP)

8.5.4 Valid Commands According to Condition (Specific Command)

Cont: Continuous

Condition Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	
AOUT	●	—	●	—	●	—	●	—	●	—	—
AOUT?	●	●	●	●	●	●	●	●	●	●	—
AVERaging	●	—	●	—	●	—	●	—	●	—	—
AVERaging?	●	●	●	●	●	●	●	●	●	●	—
CURRent?	●	●	●	●	●	●	●	●	●	●	—
CURRent											
:AUTO	●	—	—	—	—	—	—	—	—	—	—
:AUTO?	●	●	●	●	●	●	●	●	●	●	—
:RANGe	●	—	—	—	—	—	—	—	—	—	—
:RANGe?	●	●	●	●	●	●	●	●	●	●	—
DATAout?	●	●	●	●	●	●	●	●	●	●	—
DATAout											
:ITEM	●	●	●	●	●	●	●	●	●	●	—
:ITEM?	●	●	●	●	●	●	●	●	●	●	—
:TIME	●	●	—	—	●	●	—	—	●	●	—
:TIME?	●	●	●	●	●	●	●	●	●	●	—
DISPlay	●	●	●	●	●	●	●	●	●	●	—
DISPlay?	●	●	●	●	●	●	●	●	●	●	—
ESE0	●	●	●	●	●	●	●	●	●	●	—
ESE0?	●	●	●	●	●	●	●	●	●	●	—
ESE1	●	●	●	●	●	●	●	●	●	●	—
ESE1?	●	●	●	●	●	●	●	●	●	●	—
ESE2	●	●	●	●	●	●	●	●	●	●	—
ESE2?	●	●	●	●	●	●	●	●	●	●	—
ESE3	●	●	●	●	●	●	●	●	●	●	—
ESE3?	●	●	●	●	●	●	●	●	●	●	—
ESR0?	●	●	●	●	●	●	●	●	●	●	—
ESR1?	●	●	●	●	●	●	●	●	●	●	—
ESR2?	●	●	●	●	●	●	●	●	●	●	—
ESR3?	●	●	●	●	●	●	●	●	●	●	—

Cont: Continuous

Condition Command	Integration reset		Key				External control				System error	
			Integration RUN		Integration STOP		Integration RUN		Integration STOP			
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD		
FREQuency?	●	●	●	●	●	●	●	●	●	●	●	—
FREQuency												
:AUtO	●	—	●	—	●	—	●	—	●	—	●	—
:AUtO?	●	●	●	●	●	●	●	●	●	●	●	—
:RANGe	●	—	●	—	●	—	●	—	●	—	●	—
:RANGe?	●	●	●	●	●	●	●	●	●	●	●	—
:SOURce	●	—	●	—	●	—	●	—	●	—	●	—
:SOURce?	●	●	●	●	●	●	●	●	●	●	●	—
HEADer	●	●	●	●	●	●	●	●	●	●	●	—
HEADer?	●	●	●	●	●	●	●	●	●	●	●	—
HOLD *1	●	●	●	●	●	●	●	●	●	●	●	—
HOLD?	●	●	●	●	●	●	●	●	●	●	●	—
INTEGrate?	●	●	●	●	●	●	●	●	●	●	●	—
INTEGrate												
:STATe												
START	●	●	—	—	●	●	—	—	—	—	—	—
STOP	—	—	●	●	—	—	—	—	—	—	—	—
RESET	●	●	—	—	●	●	—	—	●	●	—	—
:STATe?	●	●	●	●	●	●	●	●	●	●	●	—
:TIME	●	—	—	—	—	—	—	—	—	—	—	—
:TIME?	●	●	●	●	●	●	●	●	●	●	●	—
MEASure?	●	●	●	●	●	●	●	●	●	●	●	—
MODE	●	—	—	—	—	—	—	—	—	—	—	—
MODE?	●	●	●	●	●	●	●	●	●	●	●	—
PEAKhold *2	●	●	●	●	●	●	●	●	●	●	●	—
PEAKhold?	●	●	●	●	●	●	●	●	●	●	●	—
RECTifier	●	—	—	—	—	—	—	—	—	—	—	—
RECTifier?	●	●	●	●	●	●	●	●	●	●	●	—
RESPonse?	●	—	●	—	●	—	●	—	●	—	●	—
RESPonse	●	●	●	●	●	●	●	●	●	●	●	—

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

*2: During display hold, the command is invalid.

Condition Command	Integration reset		Key				External control				System error	
			Integration RUN		Integration STOP		Integration RUN		Integration STOP			
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD		
RS232c? *3	●	●	●	●	●	●	●	●	●	●	●	●
RS232c *3												
:ANSwer	●	●	●	●	●	●	●	●	●	●	●	●
:ANSwer?	●	●	●	●	●	●	●	●	●	●	●	●
:ERRor?	●	●	●	●	●	●	●	●	●	●	●	●
:HANDshake	●	●	●	●	●	●	●	●	●	●	●	●
:HANDshake?	●	●	●	●	●	●	●	●	●	●	●	●
SCALe?	●	●	●	●	●	●	●	●	●	●	●	—
SCALe												
:CT	●	—	—	—	—	—	—	—	—	—	—	—
:CT?	●	●	●	●	●	●	●	●	●	●	●	—
:PT	●	—	—	—	—	—	—	—	—	—	—	—
:PT?	●	●	●	●	●	●	●	●	●	●	●	—
TRANsmitt												
:SEPArator	●	●	●	●	●	●	●	●	●	●	●	●
:SEPArator?	●	●	●	●	●	●	●	●	●	●	●	—
:TERMinator	●	●	●	●	●	●	●	●	●	●	●	●
:TERMinator?	●	●	●	●	●	●	●	●	●	●	●	—
VOLTage?	●	●	●	●	●	●	●	●	●	●	●	—
VOLTage												
:AUTO	●	—	—	—	—	—	—	—	—	—	—	—
:AUTO?	●	●	●	●	●	●	●	●	●	●	●	—
:RANGe	●	—	—	—	—	—	—	—	—	—	—	—
:RANGe?	●	●	●	●	●	●	●	●	●	●	●	—
WCLock	●	●	●	●	●	●	●	●	●	●	●	—
WCLock?	●	●	●	●	●	●	●	●	●	●	●	—

*3: When using the GP-IB, the command is invalid.

8.5.5 Execution Time of GP-IB Interface Command

Execution time

Displays the analysis and dealing time of long form command.

However for commands with parameter data, the time is that for the case determined by the data format specified by the data item, and for queries the time is that with headers enabled.

NOTE

- In the 3331, there may be a maximum delay of 150 ms relating to internal processing from the time that a command is received until command analysis starts.
- If when the internal processing time has elapsed the command analysis is not yet completed, the display update is delayed.
- All commands are sequential.
- Communications with the controller require the data transmission time to be added. The GP-IB transmission time depends on the controller.
RS-232C: when the data length is start bit is 1, set to 8, parity is none, stop bit is 1 (total number of the data is 10).

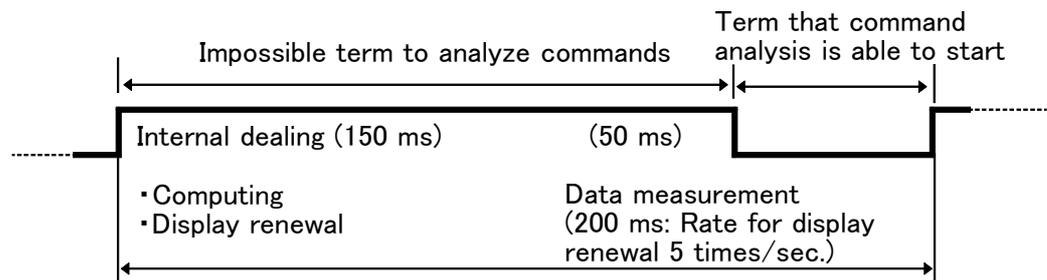
9600 bit/second 960 character/second

4800 bit/second 480 character/second

2400 bit/second 240 character/second

1200 bit/second 120 character/second

- For setting commands, allow a pause after changing a setting to allow measurement to stabilize.



Commands	Executing time
*RST	Within 250 ms
*TRG (include GFT) *WAI :MEASure?	When measurement values appear: 200 ms or less No indication: wait for a measurement value to appear
:INTEGrate:STATe	Within 250 ms
:CURRent:RANGe :SCALE:CT :VOLTage:RANGe :SCALE:PT :INTEGrate:TIME	Within 50 ms
*TST?	10 s
Commands other than in the table above	Within 20 ms

- The analysis time for the "MEAS?" command varies depending on the number of data specification items. Due to the amount of time required for analysis when the specified data is great, it may not be possible to maintain 200 ms display switching. When there are two or more data items, the amount of analysis time can be minimized by specifying each item in "DATA:ITEM" format.

8.5.6 Initialization

The following table shows which items are initialized and which not, under various conditions.

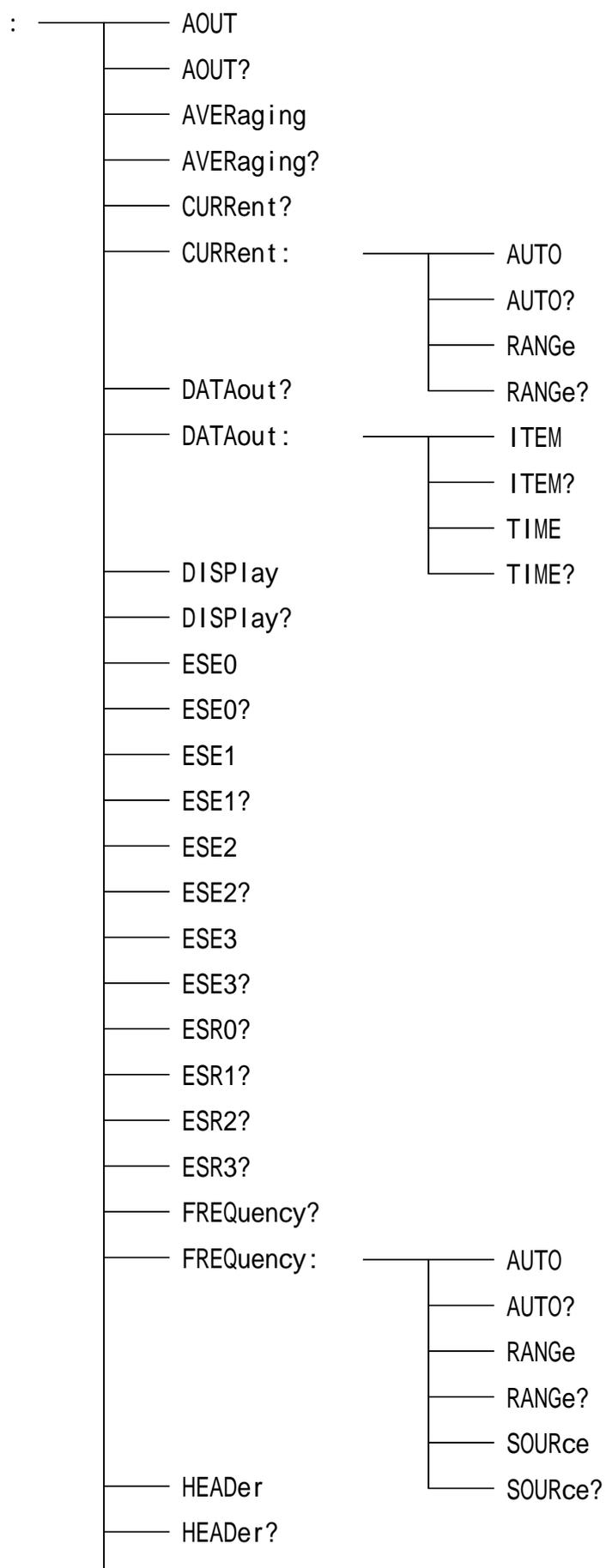
Item \ Initialize method	Power on	Keyboard reset	*RST command	Device clear	*CLS command
GP-IB device address	—	●	—	—	—
RS-232C setting	—	●	—	—	—
Device specific functions (ranges etc.)	—	●	●	—	—
Output queue	●	●	—	●	—
Input buffer	●	●	—	●	—
Status byte register	●	●	—	— *1	● *2
Event registers	● *3	●	—	—	●
Enable registers	●	●	—	—	—
Current path	●	●	—	●	—
Headers on/off	●	●	●	—	—
Terminator for response messages	●	●	—	—	—
Separator for response messages	●	●	●	—	—

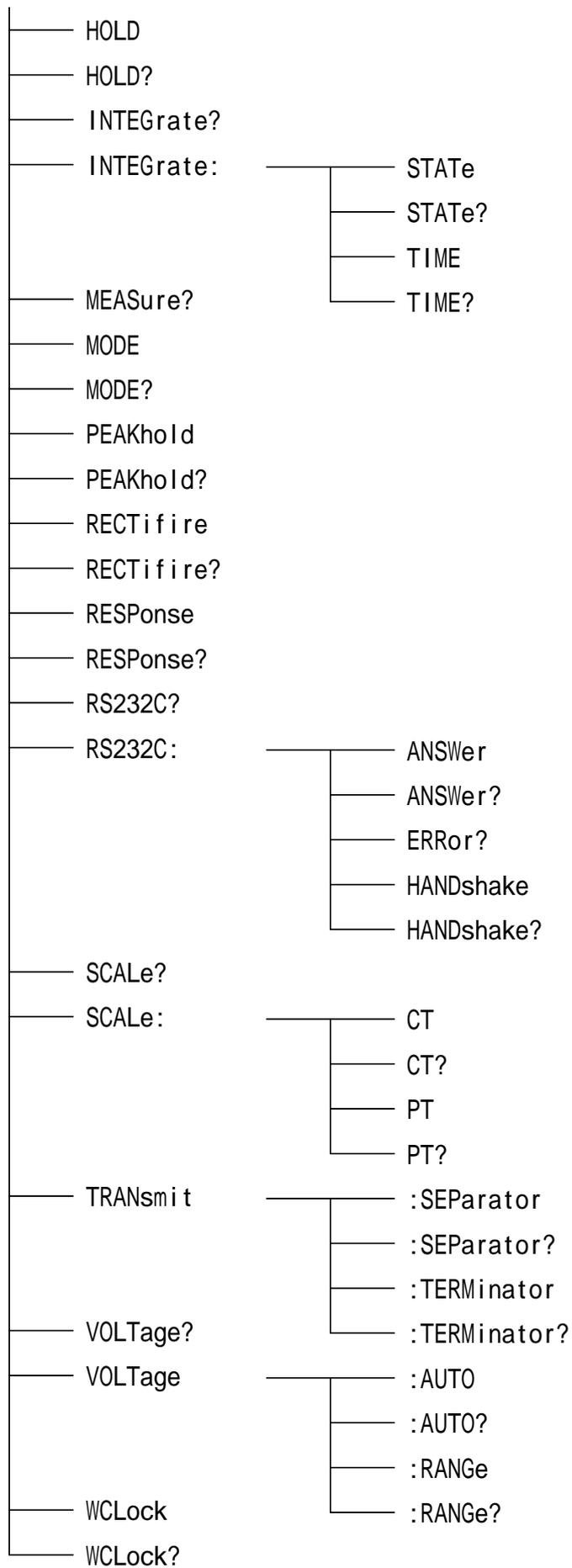
*1 Only the MAV bit (bit 4) is cleared.

*2 All bits except the MAV bit are cleared.

*3 Except the PON bit (bit 7).

8.5.7 Specific Command Tree





8.6 Sample Programs

As examples of interface, shows sample programs.

The contents of programs: Setting of range, scaling and rectifier type and displaying to get integrate elapsed time and integrate value at regular intervals (a minute at this point).

The sample programs of GP-IB and RS-232C are the same contents.

The sample programs of GP-IB are written in HP-BASIC (by Hewlett Packard) and of RS-232C are written in Quick BASIC (by Microsoft).

8.6.1 GP-IB

Setting condition	
Voltage	300 V range
Current	20 A range
PT ratio	1
CT ratio	1
Rectifier type	RMS
Integration time	1 hour
Data output interval	1 minute

Program list

```

10 'GP-IB SAMPLE PROGRAM
20 CLEAR 701
30 OUTPUT 701; "*RST"
40 OUTPUT 701; ":TRAN:TERM 1"
50 OUTPUT 701; ":VOLT:AUTO OFF;RANG 300"
60 OUTPUT 701; ":CURR:AUTO OFF;RANG 20"
70 OUTPUT 701; ":SCAL:PT 1;CT 1"
80 OUTPUT 701; ":RECT 1"
90 OUTPUT 701; ":MODE 2"
100 OUTPUT 701; ":INTEG:TIME 1,0"
110 OUTPUT 701; "*ESE 0"
120 OUTPUT 701; ":ESE0 32;:ESE1 0;:ESE2 0;:ESE3 0"
130 OUTPUT 701; ":DATA:TIME 0,1,0;ITEM 3,0,0,4,12,0"
140 OUTPUT 701; "*CLS"
150 OUTPUT 701; ":INTEG:STAT START"
160 OUTPUT 701; "*STB?"
170 ENTER 701;A$
180 IF A$ <> "1" THEN GOTO 160
190 OUTPUT 701; ":MEAS?"
200 ENTER 701;A$
210 PRINT A$
220 OUTPUT 701; ":INTEG:STAT?"
230 ENTER 701;A$
240 IF A$ = ":INTEGRATE:STATE STOP" THEN GOTO 270
250 OUTPUT 701; "*CLS"
260 GOTO 160
270 OUTPUT 701; ":INTEG:STAT RESET"
280 END

```

Program comments

```

20 Initialize the GP-IB interface
30 Initialize the 3331
40 Set delimiter to "CR+LF"
50 Set ranges to 300 V
60 Set ranges to 20 A
70 Set PT ratio to 1, CT ratio to 1
80 Set rectifier type to "RMS"
90 Set the connecting mode to 3
100 Set integration time to an hour
110 Invalidate ESE
120 Validate only bit 5 (OT) of ESE0
130 Set data output time to one minute, output
    item to (V1,A1,W0,WH0,TIME)
140 Clear event registers
150 Start integration
160 Query contents of status byte
170 Get contents of status byte
180 Branches to line 160 when "OT" flag is not
    raised
190 Query integrate value data for output item
200 Get data
210 Display data
220 Query integrate condition
230 Get integrate condition
240 Branches to line 270 when integration
    stops
250 Clear event registers
260 Branches to line 160
270 Reset integrate value
280 End of program

```

Execution results

```

V1 +199.92E+0;A1 +10.034E+0;W0 +4.0905E+3;WHO +0.00000E+3;TIME 00000,00,00
V1 +199.94E+0;A1 +10.005E+0;W0 +4.0141E+3;WHO +0.06716E+3;TIME 00000,01,00
V1 +199.93E+0;A1 +10.009E+0;W0 +4.0136E+3;WHO +0.13406E+3;TIME 00000,02,00
V1 +199.91E+0;A1 +10.006E+0;W0 +4.0138E+3;WHO +0.20096E+3;TIME 00000,03,00
V1 +199.93E+0;A1 +10.003E+0;W0 +4.0135E+3;WHO +0.26786E+3;TIME 00000,04,00
V1 +199.95E+0;A1 +10.006E+0;W0 +4.0132E+3;WHO +0.33453E+3;TIME 00000,05,00
-----
V1 +199.95E+0;A1 +10.005E+0;W0 +4.0145E+3;WHO +3.67710E+3;TIME 00000,55,00
V1 +199.98E+0;A1 +10.005E+0;W0 +4.0147E+3;WHO +3.74401E+3;TIME 00000,56,00
V1 +199.96E+0;A1 +10.002E+0;W0 +4.0143E+3;WHO +3.81091E+3;TIME 00000,57,00
V1 +199.94E+0;A1 +10.006E+0;W0 +4.0145E+3;WHO +3.87781E+3;TIME 00000,58,00
V1 +199.96E+0;A1 +10.005E+0;W0 +4.0146E+3;WHO +3.94472E+3;TIME 00000,59,00
V1 +199.95E+0;A1 +10.006E+0;W0 +4.0144E+3;WHO +4.01162E+3;TIME 00001,00,00

```

8.6.2 RS-232C

Program list

```

10 OPEN "COM1:9600,N,8,1,LF" FOR RANDOM AS #1
20 PRINT #1,"*RST"
30 PRINT #1,":TRAN:TERM 1"
40 PRINT #1,":VOLT:AUTO OFF;RANG 300"
50 PRINT #1,":CURR:AUTO OFF;RANG 20"
60 PRINT #1,":SCAL:PT 1;CT 1"
70 PRINT #1,":RECT 1"
80 PRINT #1,":MODE 2"
90 PRINT #1,":INTEG:TIME 1,0"
100 PRINT #1,"*ESE 0"
110 PRINT #1,":ESE0 32;:ESE1 0;:ESE2 0;:ESE3 0"
120 PRINT #1,":DATA:TIME 0,1,0;ITEM 3,0,0,4,12,0"
130 PRINT #1,"*CLS"
140 PRINT #1,":INTEG:STAT START"
150 PRINT #1,"*STB?"
160 LINE INPUT #1,A$
170 IF VAL(A$) <> 1 THEN GOTO 150
180 PRINT #1,":MEAS?"
190 LINE INPUT #1,A$
200 PRINT A$
210 PRINT #1,":INTEG:STAT?"
220 LINE INPUT #1,A$
230 IF INSTR(A$,"STOP")<>0 THEN 260
240 PRINT #1,"*CLS"
250 GOTO 150
260 PRINT #1,"INTEG:STAT RESET"
270 CLOSE #1
280 END

```

Program comments

```

10 Open the RS-232C circuit file
20 Initialize the 3331
30 Set delimiter to "CR+LF"
40 Set range to 300 V
50 Set range to 20 A
60 Set PT ratio to 1, CT ratio to 1
70 Set rectifier type to "RMS"
80 Set the connecting mode to 3
90 Set integration time to an hour
100 Invalidate ESE
110 Validate only bit 5 (OT) of ESE0
120 Set data output time to a minute, output item
to (V1,A1,W0,WHO,TIME)
130 Clear event registers
140 Start integration
150 Query contents of status byte
160 Get contents of status byte
170 Branches to line 150 when "OT" flag is not
raised
180 Query integrate value data for output item
190 Get data
200 Display data
210 Query integrate condition
220 Get integrate condition
230 Branches to line 260 when integration stops
240 Clear event registers
250 Branches to line 150
260 Reset integrate value
270 Close the RS-232C circuit file
280 End of program

```

8.7 Printer Output Function

8.7.1 Printer Mode Function

When the GP-IB or RS-232C interface is set to printer mode (Pr.), the measured value and settings can be printed by the listen only printer connected to the GP-IB or RS-232C interface.

For how to set this function, refer to Section 4.9, "Setting the Interface."

NOTE

- In Pr. mode, PRINT lamp is lit.
- If in Co. mode or address setting is made by GP-IB, it will not output to the printer
- Set the GP-IB printer to listen-only mode.
- For the RS-232C printer, match the communication terms (baud rate, data length, parity, stopbit) with 3331 unit. When changing the settings for 3331, refer to Section 4.9, "Setting the Interface"
- Depending on the RS-232C printer, either the pin 2 or the pin 3 is the receiver pin.
 - If the pin 2 is the receiver pin, use a straight cable.
 - If the pin 3 is the receiver pin, use a cross cable.
- Screw the interface cable in so it will not fall off. In addition always use shielded cables.
- Depending on processing performance of the printer, the printer may not be able to keep up with the set print interval. If this happens, increase the print interval or reduce the number of items being printed as explained in 4.8, "Setting the Printer."

8.7.2 Type of Printing

There are three types of printing for the 3331.

(1) Manual printing

Pressing the **DATA OUT** key can print measuring value at that point.

The 3331 is also able to print by external control. Refer to Chapter 7, "External Control Terminal and Output Terminal."

(2) Interval printing

Synchronized with integration on the 3331, printer output appears at the interval set using the procedure described in Section 4.8, "Setting the Printer Output."

(3) Help printing

Internal settings of the 3331 are printed by the **SHIFT** key, after illuminate SHIFT lamp by the **HELP** key.

NOTE

When the interface is in Co. mode, "Err.021" is displayed.

8.7.3 Selecting Printing Items and Setting Printing Interval Time

Refer to Section 4.8, "Setting the Printer Output."

When no printing items are selected, printer elapsed time and items which is displayed in display a, b, c, and d are printed.

In addition, if the print time interval is not set, interval printing is not done. If in Co. mode, output to the printer is not done.

8.7.4 Printer Output Buffer

Printer output buffer of the 3331 consists of 2000 bytes.

When buffer exceeds the capacity, "Err.022" is printed and data which are obtained after that become invalid.

8.7.5 Printing in Power Cut

When the power is cut off during interval printing, after returned from that state, integrate elapsed time and "*** POWER FAILURE ***" are printed and return to normal interval printing.

8.7.6 Printing Example

(1) Manual printing

① In 3 ϕ mode

```

MANUAL  HOLD
          V          A          IP[A]
CH1 >  199.77      10.003      14.19
CH2      199.64      9.996      14.11
CH3      199.36      10.006      14.14
SUM >  199.59      10.002
          W          VA          var
SUM      3.016k      3.458k      1.692k
          PF          DEG          FREQ
SUM      0.8722      29.28      60.000
INTEGRATOR
TOTAL TIME 00000:02:00 ----- Integration elapsed time
          AH          WH
CH1      0.3336      (+) > 0.1006k
CH2      0.3333      (-)      0.0000k
CH3      0.3338      (+-) 0.1006k
INTERVAL TIME 00000:01:00 ----- Interval time
          AH          WH
CH1      0.1668      (+) > 0.0503k
CH2      0.1666      (-)      0.0000k
CH3      0.1669      (+-) > 0.0503k

```

HOLD	During display hold
>	including out-of-range value in the average value or integration value
S.Err	Scaling error
PEAKHOLD	In peak hold mode
o.r	out-of-range

V	Voltage value	A	Current value
W	Active power value	VA	Apparent power value
var	Reactive power value	PF	Power factor
deg	Phase angle	FREQ	Frequency
IP	Current peak	AH	Current integration value
WH(+)	Integrate value of plus side		
WH(-)	Integrate value of minus side		
WH(+/-)	Integrate value add plus to minus.		

② In 1 ϕ mode

```

MANUAL
          V          A          IP[A]
CH1      199.75      10.003      14.12
CH2      199.56      9.994      14.06
          W          VA          var
CH1      2.004k      2.004k      0.000k
CH2      2.011k      2.011k      0.000k
SUM      4.015k      4.015k      0.000k
          PF          DEG          FREQ
CH1      1.0000      0.00      60.000
CH2      1.0000      0.00
SUM      1.0000      0.00
INTEGRATOR
TOTAL TIME 00000:00:00 ----- Integration elapsed time
          AH          WH(+)
CH1      0.0000      0.0000k
CH2      0.0000      0.0000k
SUM      0.0000k      0.0000k
          WH(-)          WH(±)
CH1      0.0000k      0.0000k
CH2      0.0000k      0.0000k
SUM      0.0000k      0.0000k
INTERVAL TIME 00000:00:00 ----- Interval time
          AH          WH(+)
CH1      0.0000      0.0000k
CH2      0.0000      0.0000k
SUM      0.0000k      0.0000k
          WH(-)          WH(±)
CH1      0.0000k      0.0000k
CH2      0.0000k      0.0000k
SUM      0.0000k      0.0000k

```

(2) Interval printing

```

INTEGRATOR START ----- Integration start
00000:00:00 ----- Print elapsed time
      V      A      IP[A]
CH1  199.73  10.006  14.12
CH2  199.59   9.997  14.08
CH3  199.37  10.012  14.14
SUM   199.56  10.005
      W      VA      var
SUM   3.016k  3.458k  1.692k
      PF      DEG     FREQ
SUM   0.8722  29.28  60.000
INTEGRATOR
TOTAL TIME 00000:00:00
      AH      WH
CH1  0.0000  (+)  0.0000k
CH2  0.0000  (-)  0.0000k
CH3  0.0000  (+-) 0.0000k
INTERVAL TIME 00000:00:00
      AH      WH
CH1  0.0000  (+)  0.0000k
CH2  0.0000  (-)  0.0000k
CH3  0.0000  (+-) 0.0000k
-----
INTEGRATOR
TOTAL TIME 00000:02:00
      AH      WH
CH1  0.3336  (+)  0.1006k
CH2  0.3333  (-)  0.0000k
CH3  0.3338  (+-) 0.1006k
INTERVAL TIME 00000:002:00
      AH      WH
CH1  0.3336  (+)  0.1006k
CH2  0.3333  (-)  0.0000k
CH3  0.3338  (+-) 0.1006k
INTEGRATOR STOP ----- Integration stop

```

(3) Help printing

① Help HIOKI 3331 Ver 1.00 ——— Type and version
 Mode 3P3W ——— Mode
 Range 150V(AUTO) 0.5A(AUTO) ——— Voltage and current range
 Rectifier RMS ——— Rectifier type
 Response FAST(AUTO) ——— Response
 PT ratio 1.000 ——— PT ratio
 CT ratio 1.000 ——— CT ratio
 Frequency Source : V1 ———
 Range : 500Hz(AUTO) ——— Frequency source and range
 Integrator Time : 10000:00:00 ——— Integrate items and time
 Print out Time : 000:00:00 ——— Print interval time
 D/A out VAsum ——— D/A output item
 Averaging OFF ——— Number of averaging
 Hold OFF
 Interface GP-IB ——— GP-IB

② Help HIOKI 3331 Ver 1.00
 Mode 3P3W
 Range 150V 0.5A
 Rectifier RMS
 Response FAST(AUTO)
 PT ratio 1.000
 CT ratio 1.000
 Frequency Source : V1
 Range : 50kHz(AUTO)
 Integrator Time : 10000:00:00 ——— External control
 EXT.Control
 Print out Time : 000:00:00
 D/A out VAsum
 Averaging OFF
 Hold OFF
 Interface RS232C Baud Rate 9600
 Data Bits 8
 Parity NONE
 Stop Bit 1

③ Help HIOKI 3331 Ver 1.00
 Mode 3P3W
 Range 600V(AUTO) 20.0A(AUTO)
 Rectifier RMS
 Response FAST(AUTO)
 PT ratio 1.000
 CT ratio 1.000
 Frequency Source : V1
 Range : 500Hz(AUTO)
 Integrator Time : 10000:00:00
 Print out Time : 000:00:00
 D/A out VAsum
 Averaging OFF
 Hold OFF
 Interface RS232C Baud Rate 9600 ——— RS-232C transfer speed
 Data Bits 8 ——— RS-232C data length
 Parity NONE ——— RS-232C parity
 Stop Bit 1 ——— RS-232C stop bit

Printing examples

(1) Interval printing and power cut printing

```

*** POWER FAILURE ***
00000:00:02
      V      A      IP[A]
CH1  199.96  10.006  14.16
CH2  199.97   9.999  14.09
CH3  199.29  10.014  14.16
SUM   199.74  10.006
      W      VA      var
SUM   3.0151k  3.4617k  1.7007k
      PF      DEG      FREQ
SUM   0.8710  29.42   60.000
INTEGRATOR
TOTAL TIME 00000:00:02
      AH      WH
CH1  0.0056  (+)  0.00168k
CH2  0.0056  (-)  0.00000k
CH3  0.0056  (+-) 0.00168k
INTERVAL TIME 00000:00:02
      AH      WH
CH1  0.0056  (+)  0.00168k
CH2  0.0056  (-)  0.00000k
CH3  0.0056  (+-) 0.00168k

```

Power cut comment

Data when power cut

(2) Display data printing

(In case of no printing items are selected, data on display is output.)

```

199.73 V1      10.008 A1
3.016kW0      1.0000 (PF0)

199.73 V1      199.57 V2
199.32 V3      133.21 V0

10.008 A1(IP)  9.998 A2(IP)
20.015 A3(IP)  55.019 Hz1

00000:01:00    0.0669kWH0(+/-)
0.0669kWH0(+) 0.0000kWH0(-)

 4.016kVA0     0.000kvar0
1.0000 (PF0)   0.00 (DEG0)

00000:01:00    0.1668 AH1
0.1666 AH2     0.3335 AH3

10.006 A1      9.997 A2
20.012 A3      4.016kW0

199.73 V1      199.73 V1
199.73 V1      199.73 V1

20.012 A3      0.000kvar0
0.00 (DEG0)    4.016kVA0

00000:00:00    1.0000 (PF0)
0.00 (DEG0)    0.771 VA0

```

(3) Printing when the printer output buffer is over

When the printer output buffer is over, Err 022 is displayed and printed.

```

MANUAL
      V      A      IP[A]
CH1  199.76  10.006  14.29
CH2  199.67   9.998  14.19
CH3  199.36  10.013  14.16
SUM  199.60  10.006
      W      VA      var
SUM   3.018k  3.459k  1.690k
      PF      DEG     FREQ
SUM   0.8725  29.25  60.000
INTEGRATOR
TOTAL TIME 00000:00:00
      AH      WH
CH1  0.0000  (+)  0.0000k
CH2  0.0000  (-)  0.0000k
CH3  0.0000  (+-) 0.0000k
INTERVAL TIME 00000:00

```

Err.022

Printer output buffer over error

```

MANUAL
      V      A      IP[A]
CH1  199.76  10.006  14.26
CH2  199.59   9.999  14.15
CH3  199.39  10.012  14.16
SUM  199.58  10.006
      W      VA      var
SUM   3.018k  3.459k  1.690k
      PF      DEG     FREQ
SUM   0.8725  29.25  60.000
INTEGRATOR
TOTAL TIME 00000:00:00
      AH      WH
CH1  0.0000  (+)  0.0000k
CH2  0.0000  (-)  0.0000k
CH3  0.0000  (+-) 0.0000k
INTERVAL TIME 00000:00:00

```

8.8 Device Compliance Statement

- (1) IEEE 488.1 interface functions
These are detailed in Section 8.1.1, "GP-IB Interface."
- (2) Operation with a device address other than 0 through 30
Address is unable to set other than 0 through 30.
- (3) Timing of changed device address recognition
A change of address is recognized by pressing ENTER key while address is on display.
- (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 unit separator and terminator are all reinitialized.
- (5) List of message exchange options
 - ① Input buffer capacity and operation:
These are detailed in Section 8.3.10 "Input Buffer."
 - ② Queries to which multiple response message units are returned:

CURREnt?	2	DATAout?	2
FREQuency?	3	INTEGrate?	3
MEASure?	1 to 40	SCALE?	2
VOLTage?	2	RS232c?	2
 - ③ Queries producing responses as syntax checking is performed:
On the 3331, all queries produce responses when syntax checking is performed.
 - ④ 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.
 - ⑤ Whether any commands are coupled:
There are no relevant commands.
- (6) Summary of functional elements for use when constructing device specific commands:
 - Program message
 - Program message unit
 - Command message unit
 - Command program header
 - Program data
 - Compound commands and program headers can be used.
 - Program message terminator
 - Program message unit separator
 - Query message unit
 - Query program header
 - Decimal program data
- (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.

-
- (9) Response syntax for queries
Response syntax is detailed in "Command Reference".
 - (10) Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages
It is possible to output with talk only function. Message format is described in Section 8.7.6, "Printing Example."
 - (11) Response capacity for block data
Block data does not appear in responses.
 - (12) Summary of standard commands and queries used
This appears in Section 8.5, "Command Summary."
 - (13) Device state after a calibration query has been completed without any problem
The "*CAL?" command is not used.
 - (14) Whether any "*DDT" commands are used:
The "*DDT" command is not used.
 - (15) Whether any macro commands are used:
Macros are not used.
 - (16) For queries related to identification, explanation of the response to the "*IDN?" query
This is detailed in "Command Reference".
 - (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.
 - (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 3331 to its initial state. (Refer to "Standard Commands", and "Initialization").
 - (20) Scope of the self-testing executed as a result of the "*TST?" query
This is detailed in "Standard Commands".
 - (21) Additional organization of the status data used in a device status report
This is detailed in "Event Registers".
 - (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, when and only when there is no effective data, terminates when effective data has been produced. The "*TRG" command terminates the moment that measured data has been obtained.

8.9 Notes on Interface

8.9.1 GP-IB Troubleshooting

If the GP-IB appears to be malfunctioning, refer to the information below before calling for servicing.

Symptom	Cause / Treatment
The GP-IB has stopped working completely.	Are the cables properly connected?
	Is the device address for the 3331 set correctly?
	Does some other device have the same device address?
	Are all the devices powered on?
After transmission on the GP-IB bus, the keys on the 3331 freeze up and have no effect.	Press the LOCAL key on the front panel of the 3331 to release the remote state.
	Has a LLO (Local Lock-Out) command been transmitted? Transmit a GTL command to put the 3331 into the local state.
When attempting to read data using a HP-Basic ENTER statement, the GP-IB bus hangs.	Be sure to transmit one query before each Basic 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.
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?
Sometimes service requests are not generated.	Have the service request enable register and the various event status enable registers been correctly set?
	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.
	If service requests may be generated by performing sampling processing twice or more successively, make sure that the SRQ processing subroutine can be completed within 200 ms.

Symptom	Cause / Treatment
The response message to a query differs from the display on the front panel of the 3331.	Due to the response message being produced at the instant that the 3331 receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.
Although the talk only has been set, printing has not work.	Has the printer been set to listen only?
	Except 3331 and printer, has any other equipments of controller or talk only been connected.
Although the printer mode has been set, printing has not work.	Has 3331 been set to listen only ?
	Has print interval time been set to 000:00:0? In this case, set interval time.
Pressing DATA OUT key or HELP key displays "Err 021".	Has GP-IB interface been equipped?
	Has the 3331 been set to Pr. mode?

8.9.2 RS-232C Troubleshooting

Symptom	Cause / Treatment
The RS-232C has stopped working completely.	Are the cables properly connected?
	Are all the devices powered on?
	Are the cables properly connected?
Transmission on the RS-232C is not taking place properly.	Is the controller message terminator set correctly? ("TRAN:TERM" command) (Refer to "Message Terminators")
	Is RS-232C (band rate, data length, parity, stop bits) set the same?
After transmission on the RS-232C, the keys on the 3331 freeze up and have no effect.	Press the LOCAL key on the front panel of the 3331 to release the remote state.
When attempting to read data using a Basic INPUT statement, the RS-232C hangs.	Be sure to transmit one query before each Basic INPUT 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.
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 response message to a query differs from the display on the front panel of the 3331.	Due to the response message being produced at the instant that the 3331 receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.
Although printer mode has been set, printing has not work.	Check the pin for "receive data" of RS-232C on the printer. For a printer with pin 2 for "receive data", use a "straight" cable, also for a printer with pin 3 for "receive data", "cross" cable.
Although the printer mode has been set, printing has not work.	Has the printer been set to listen only?
	Has print interval time (DATA OUT TIME) been set to 000:00:0? In this case, set interval time.
Pressing DATA OUT key or HELP key displays "Err 021".	Has RS-232C interface been equipped?
	Has the 3331 been set to printer mode?

Chapter 9

Maintenance and Service

9.1 Disposing

Disposing of the unit

The 3331 uses a lithium battery as the power source for the memory for backing up the settings. If you intend to dispose of the unit, you should first dismantle the unit, and remove the lithium battery.

Disposing of the batteries

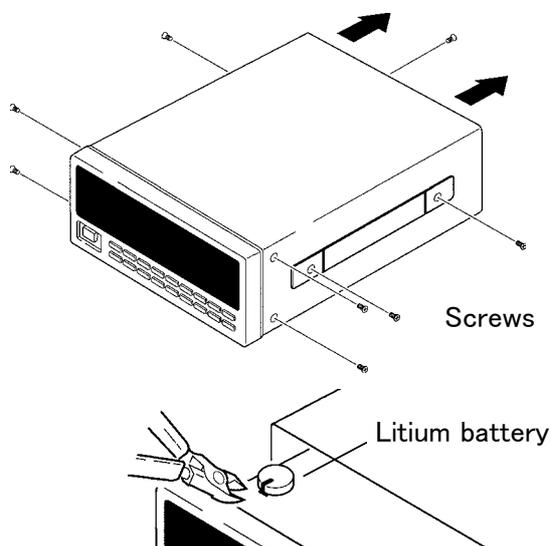
WARNING

- Do not short-circuit used batteries, disassemble them, or throw them in a fire. Doing so may cause the batteries to explode.
- Be sure to dispose of removed lithium batteries according to their type in the prescribed manner and in the proper location.

(1) Tools needed to dismantle the 3331

- Phillips screwdriver 1
- Instrument pliers 1

(2) How to dismantle the unit:



1. Remove the four retaining screws which hold on the upper case of the unit.
2. Remove the upper case by lifting it straight upwards off the unit.
3. Cut away the coin-shaped lithium battery wrenching it out with the radio pliers.
4. Dispose of the lithium battery according to the manner prescribed by the competent authorities in your locality.

CALIFORNIA, USA ONLY
 This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
 See www.dtsc.ca.gov/hazardouswaste/perchlorate

9.2 Cleaning and Storing of the Unit

■ Cleaning

⚠ CAUTION

Gently wipe dirt from the surface of the unit with a soft cloth moistened with a small amount of water or mild detergent. Do not try to clean the unit using cleaners containing organic solvents such as benzene, alcohol, acetone, ether, ketones, thinners, or gasoline. They may cause discoloration or damage.

■ Storing

⚠ CAUTION

-
- Do not store the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
 - This unit is not constructed to be waterproof or dustproof, so do not use it in a very dusty environment or in one where it will get wet.
 - If stored for a long period (over 6 months), the unit may no longer satisfy its specifications. When it is to be used, please ask for a recalibration of the unit.
-

■ Service

⚠ CAUTION

If the unit is not functioning properly, check the power cord wiring, and fuse blowing. If a problem is found, contact your dealer or HIOKI representative. Pack the unit carefully so that it will not be damaged during transport, and write a detailed description of the problem. HIOKI cannot bear any responsibility for damage that occurs during shipment.

Chapter 10

Rack Mounting

No special metal rack mounting fittings are supplied for the 3331. If the 3331 is to be rack-mounted, you should make a panel and support shelf with reference to the figures below.

10.1 Making Rack Mounting Fittings

(1) Fittings for EIA (19-inch) standard rack mounting

The figures show the construction of the panel, if the 3331 is to be fitted to a EIA standard rack.

Figure 1: Panel for single 3331 unit

Figure 2: Panel for two 3331 units

(2) Fittings for JIS standard rack mounting

The figures show the construction of the panel, if the 3331 is to be fitted to a JIS standard rack.

Figure 3: Panel for single 3331 unit

Figure 4: Panel for two 3331 units

(3) Fittings for two units coupling rack mounting

The figures show the construction of the panel, if the two units are to be fitted to a rack.

Two fittings are required for each units.

Figure 5: Panel for two units

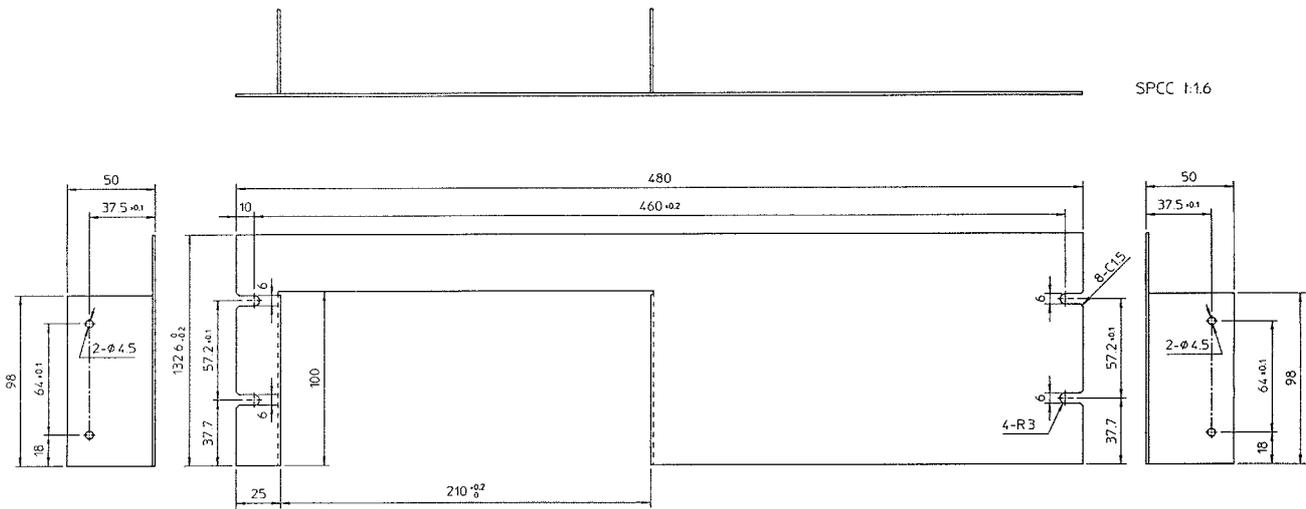


Figure 1 Panel for Single 3331 Unit (EIA)

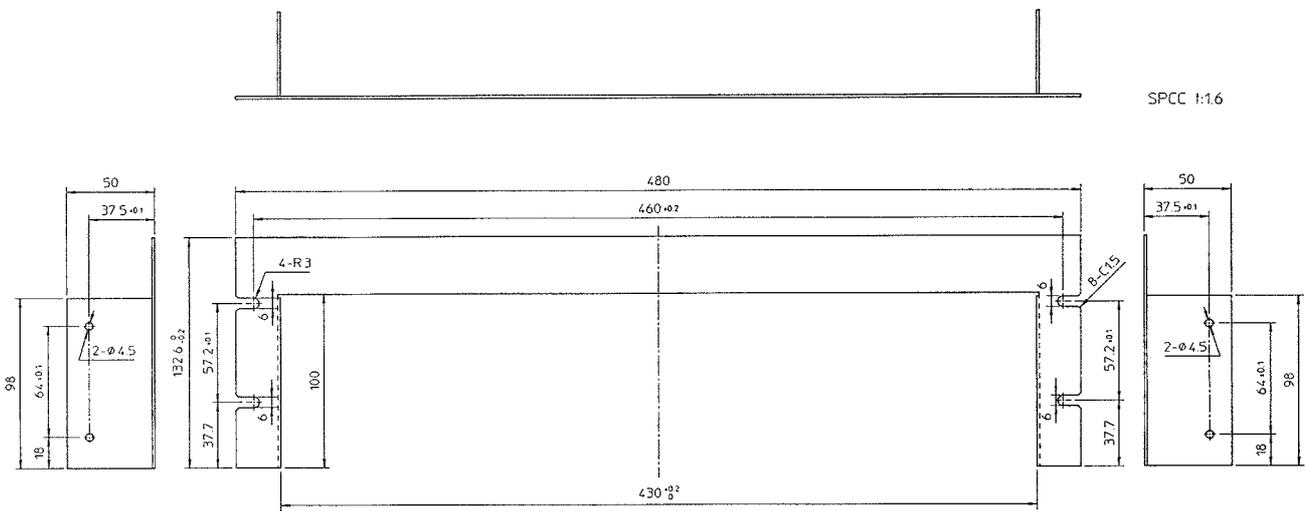


Figure 2 Panel for Two 3331 Units (EIA)

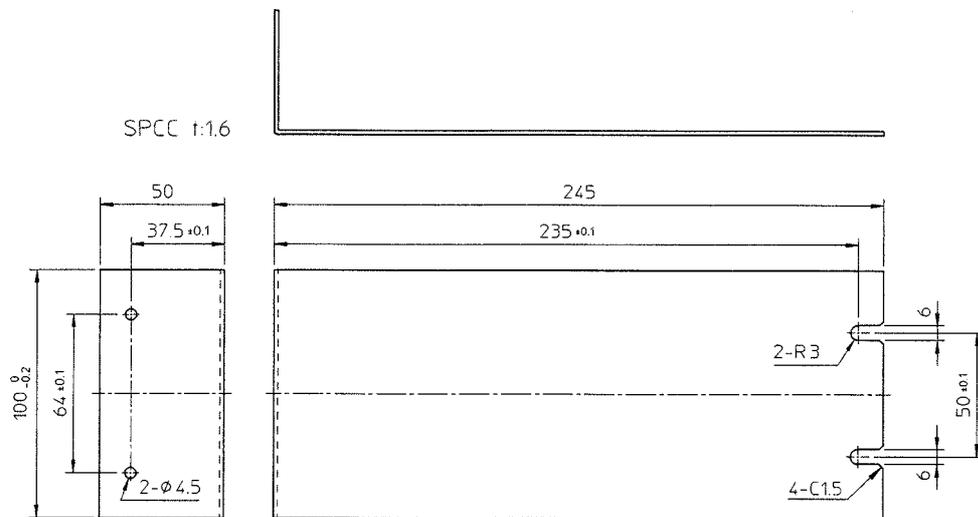


Figure 3 Panel (right side) for Single 3331 Units (JIS)

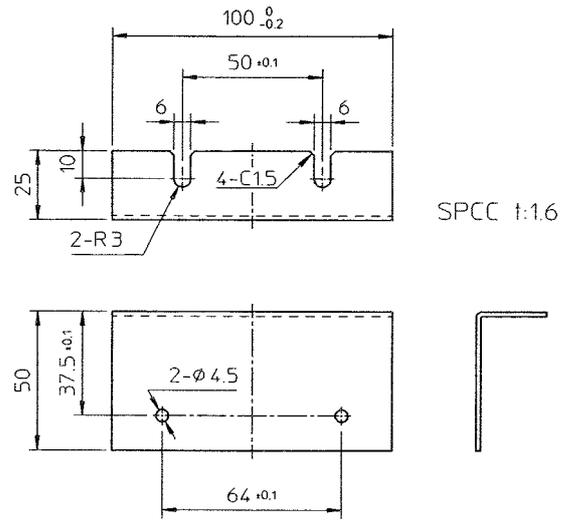


Figure 4 Panel for Two 3331 Units and Panel (left side) for Single unit (JIS)

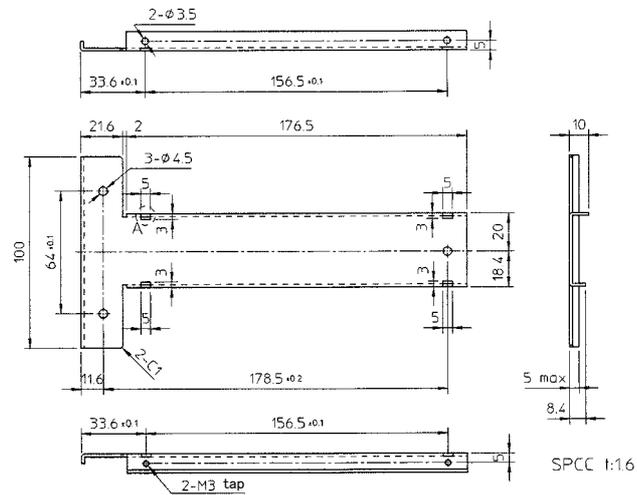
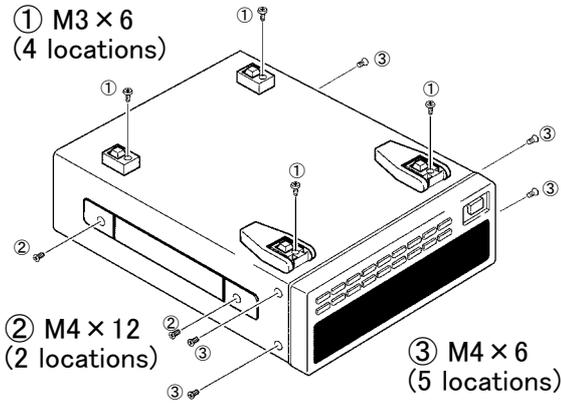


Figure 5 Panel for Two 3331 Units (two panels required)

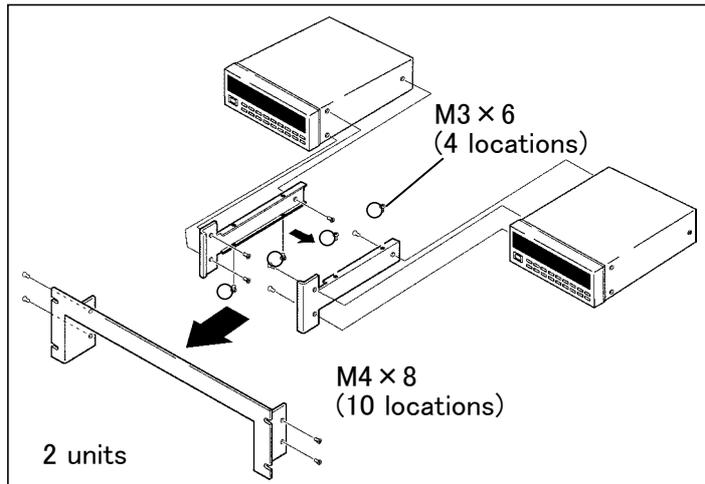
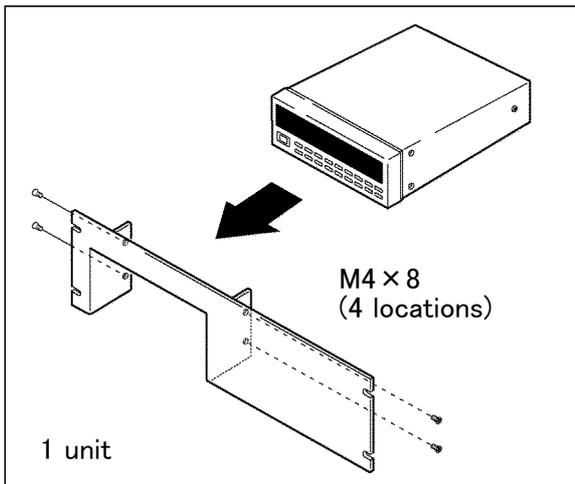
10.2 Installation Procedures

⚠ WARNING

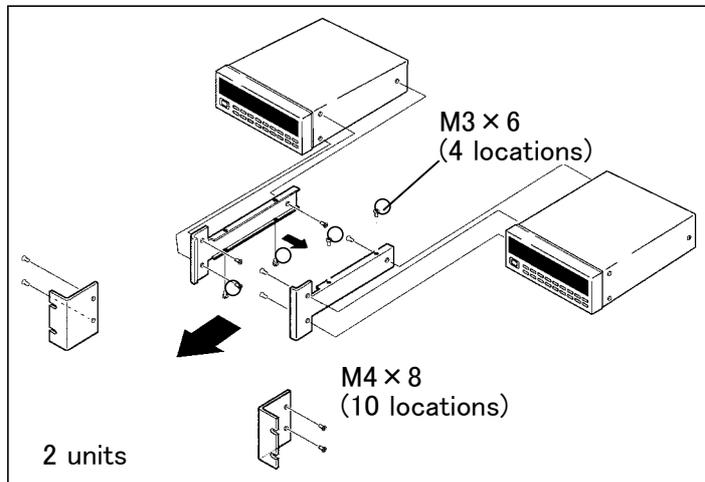
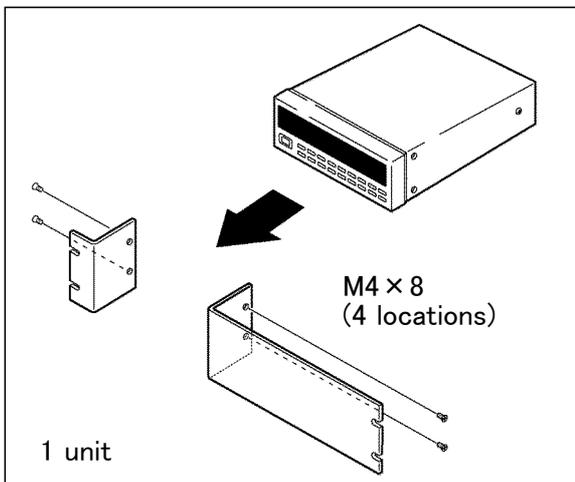
When installing the unit into the rack, or when installing handle or stand removed, use the specified screws. Using screws that are longer than specified will cause internal short circuits, resulting in destruction of the equipment and a possible electrocution hazard.



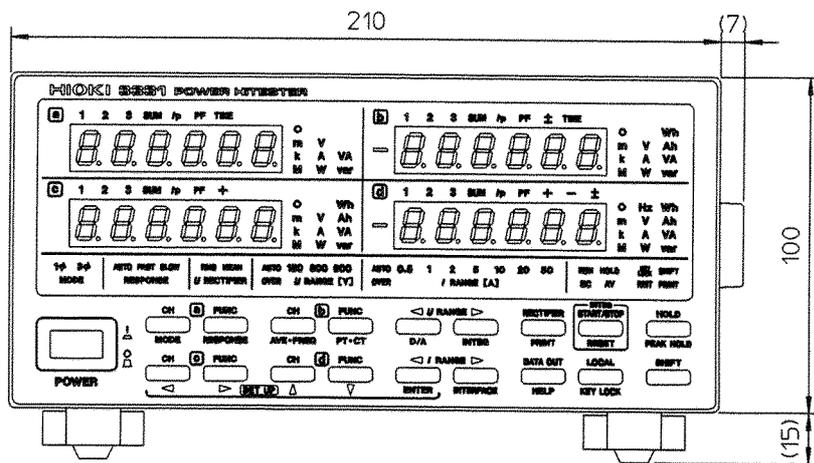
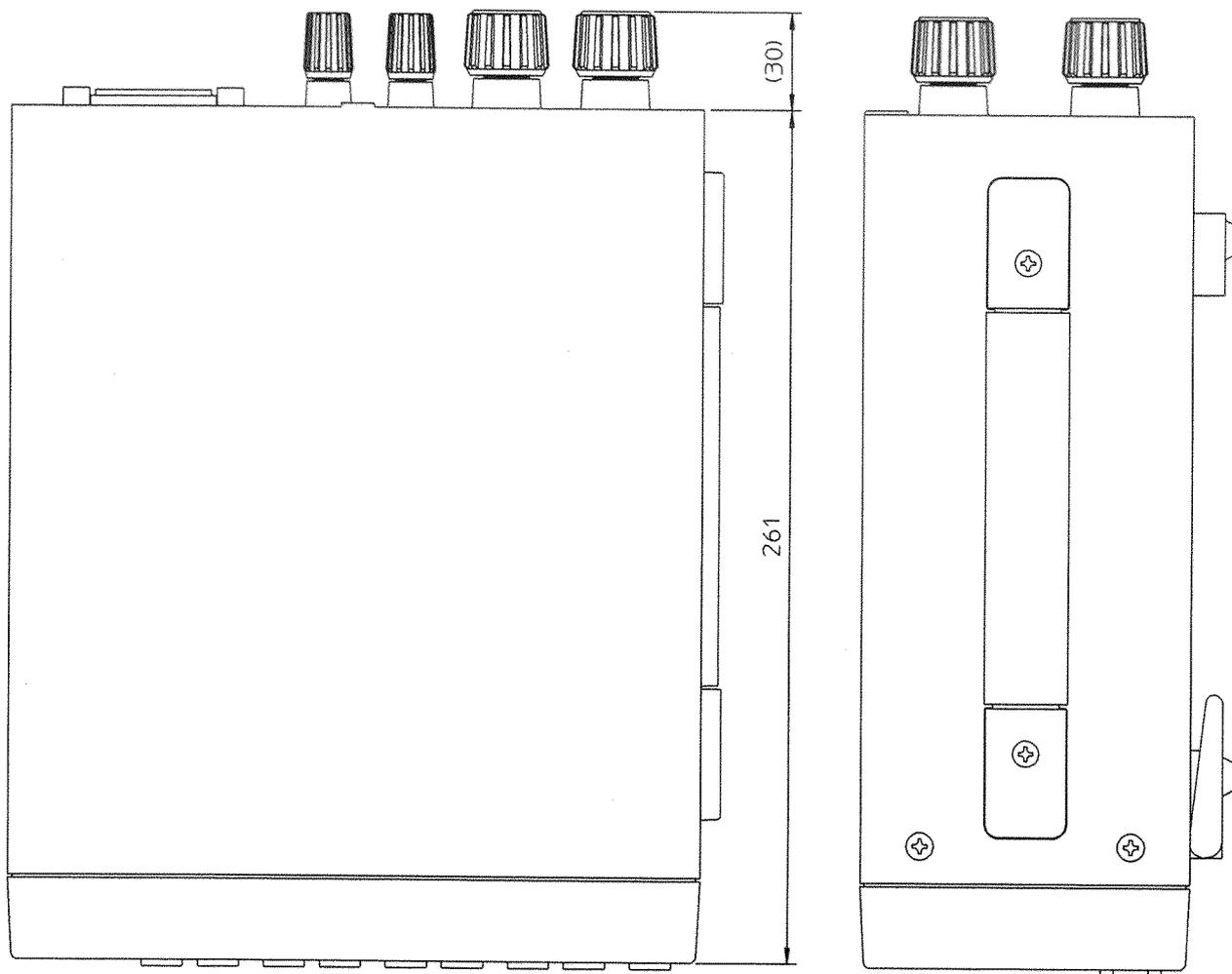
1. Referring to the illustration, remove the handle and screws from the unit.
2. Mount the unit(s) into the rack, using the appropriate rack mounting fixtures for the type of rack being used and the number of units being installed using M4 x 8 mm screws.
3. When joining two units together, align the joint fixtures with the sides of the units and fasten them at the four indicated locations at top and bottom using M3 x 6 mm screws.
4. When using rack mounting, reinforce the rack with commercial available support angles.



Rack Mounting (EIA)



Rack Mounting (JIS)



External Dimensions

10

Chapter 11

Specifications

11.1 General Specifications

Measure line	3 3W , 1 3W
Measurement Method	Analog processing, Digital display method (LED)
Location for use	Indoors, altitude up to 2000m (6562 feet)
Operating temperature and humidity ranges	0 to 40 (32°F to 104°F), 80% RH with no condensation
Storage temperature and humidity ranges	-10 to 50 (14°F to 122°F), 80% RH with no condensation
Accuracy assurance temperature and humidity ranges	23 ±3 (73°F ±5°F), 80% RH or less (Unless it is otherwise noted, it is set at this temperature/humidity standard.)
Maximum input voltage Maximum input current	Voltage: 600 V rms value, 1100 V peak value Current: 60 A rms value, 90 A peak value
Maximum rated voltage to earth	600 Vrms 50/60 Hz
Input resistance (50/60 Hz)	Voltage: 2 M ±10% Current: 2 m max.
Dielectric strength (50/60 Hz, for 1 minutes)	3.32 kVAC between voltage and current input terminals and case, interface, output and external control terminals, between voltage and current input terminals and power supply, between voltage input terminal and current input terminal, between each channels 1.39 kVAC between power supply and case
Insulation resistance	At least 100 M at 500 VDC Between voltage and current input terminals and case, interface, output and external control terminals, between voltage and current input terminals and power supply, between voltage input terminal and current input terminal, between each channels, between power supply and case
Rated power voltage (50/60 Hz)	100 to 240 VAC switchable (Voltage fluctuations of 10% from the rated supply voltage are taken into account.)
Rated power	50 VA max.

Dimensions	Approx. 210W × 100H × 261D mm (8.27"W × 3.93"H × 10.28"D) (excluding protrusions such as terminals, support legs, handle)	
Mass	Approx. 2.5 kg (88.2 oz.)	
Accessories	Instruction Manual	1
	Power cord	1
	Connector	1
Options	9442 PRINTER 9444 CONNECTION CABLE (for 9442) 1196 RECORDING PAPER (for 9442) 9443-02 AC ADAPTER (for EU) 9443-01 AC ADAPTER (for Japan) 9151-02 GP-IB CONNECTOR CABLE (2 m) (6.56 feet) 9151-04 GP-IB CONNECTOR CABLE (4 m) (13.12 feet)	
Standards applying	Safety	EN61010 Pollution Degree 2, Measurement Category (anticipated transient overvoltage 6000 V)
	EMC	EN61326, Class A EN61000-3-2 EN61000-3-3 Effect of radiated radio-frequency electromagnetic field: 10 V/m, within 6 V, 0.3 A Effect of conducted radio-frequency disturbances: at 3 V within 0.5 A

11.2 Standard Specifications

Measurement items	Refer to "Processing and calculation" table																																		
	Measurement line	<table border="1"> <thead> <tr> <th></th> <th>3 ϕ 3W</th> <th>1 ϕ 3W</th> </tr> </thead> <tbody> <tr> <td>Voltage</td> <td>U_1, U_2, U_3, U_{SUM}</td> <td>U_1, U_2</td> </tr> <tr> <td>Current</td> <td>I_1, I_2, I_3, I_{SUM}</td> <td>I_1, I_2</td> </tr> <tr> <td>Active power</td> <td>P_{SUM}</td> <td>P_1, P_2, P_{SUM}</td> </tr> <tr> <td>Apparent power</td> <td>S_{SUM}</td> <td>S_1, S_2, S_{SUM}</td> </tr> <tr> <td>Reactive power</td> <td>Q_{SUM}</td> <td>Q_1, Q_2, Q_{SUM}</td> </tr> <tr> <td>Power factor</td> <td>SUM</td> <td>1, 2, SUM</td> </tr> <tr> <td>Phase angle</td> <td>SUM</td> <td>1, 2, SUM</td> </tr> <tr> <td>Current peak</td> <td>I_{p1}, I_{p2}, I_{p3}</td> <td>I_{p1}, I_{p2}</td> </tr> <tr> <td>Frequency</td> <td>f</td> <td>f</td> </tr> <tr> <td>Integration</td> <td>I_1, I_2, I_3, P_{SUM}</td> <td>$I_1, I_2, P_1, P_2, P_{SUM}$</td> </tr> </tbody> </table>		3 ϕ 3W	1 ϕ 3W	Voltage	U_1, U_2, U_3, U_{SUM}	U_1, U_2	Current	I_1, I_2, I_3, I_{SUM}	I_1, I_2	Active power	P_{SUM}	P_1, P_2, P_{SUM}	Apparent power	S_{SUM}	S_1, S_2, S_{SUM}	Reactive power	Q_{SUM}	Q_1, Q_2, Q_{SUM}	Power factor	SUM	1, 2, SUM	Phase angle	SUM	1, 2, SUM	Current peak	I_{p1}, I_{p2}, I_{p3}	I_{p1}, I_{p2}	Frequency	f	f	Integration	I_1, I_2, I_3, P_{SUM}	$I_1, I_2, P_1, P_2, P_{SUM}$
		3 ϕ 3W	1 ϕ 3W																																
	Voltage	U_1, U_2, U_3, U_{SUM}	U_1, U_2																																
	Current	I_1, I_2, I_3, I_{SUM}	I_1, I_2																																
	Active power	P_{SUM}	P_1, P_2, P_{SUM}																																
	Apparent power	S_{SUM}	S_1, S_2, S_{SUM}																																
	Reactive power	Q_{SUM}	Q_1, Q_2, Q_{SUM}																																
	Power factor	SUM	1, 2, SUM																																
	Phase angle	SUM	1, 2, SUM																																
	Current peak	I_{p1}, I_{p2}, I_{p3}	I_{p1}, I_{p2}																																
Frequency	f	f																																	
Integration	I_1, I_2, I_3, P_{SUM}	$I_1, I_2, P_1, P_2, P_{SUM}$																																	
Display update rate	Approx. 200 ms (5 times/second)																																		
Number of display item	4 items																																		
Measurement range	Voltage	150/300/600 V, auto-range																																	
	Current	0.5/1/2/5/10/20/50 A/ auto-range																																	
	(auto-range)	1 : If either of channels 1 and 2 exceeds 110% f.s. or a out of range peak value is given, then the range is switched to the next higher setting. If both of channels 1 and 2 are less than 30% of the next lower range the range is switched down.																																	
	Power	3 : If either of channels 1,2 and 3 exceeds 110% f.s. or a out of range peak value is given, then the range is switched to the next higher setting. If both of channels 1,2 and 3 are less than 30% of the next lower range the range is switched down. automatically decided voltage range and current range (see Table 1)																																	
Frequency	500 Hz/50 kHz/ auto-range																																		
(auto-range)	"Up" for over 100% for range "Down" for under 0.8% for range																																		
Effective input range	Voltage, current, power	1 to 120% for range (1 to 100% for range, only 600 V range)																																	
	Frequency	0.8 to 100% for frequency range (with input of 10 to 130% for measurement range of voltage, current, and power)																																	
	Others	According to the effective input range of voltage, current, and power																																	
Power factor influence	$\pm 0.4\%$ rdg. max. (45 Hz to 66 Hz, power factor=0.5) $\pm 0.23\%$ f.s. max. (45 Hz to 66 Hz, power factor=0)																																		
Temperature coefficient	$\pm 0.04\%$ f.s./ max.																																		
External magnetic field influence	$\pm 1.5\%$ f.s. max. (in a magnetic field of 400 A/m, 50/60 Hz, channels 1 and 2 only)																																		
Influence of maximum rated voltage to earth	$\pm 0.05\%$ f.s. max. (apply 600Vrms, 50/60 Hz between input terminal and earth)																																		

Crest factor	Voltage	lower value of either (measurement range $\times 6$)/measurement value or 1100 V/measurement value
	Current	lower value of either (measurement range $\times 6$)/measurement value or 90 A/measurement value

Characteristics of voltage, current, and active power Measurement accuracy 23 \pm 3 (73° F \pm 5° F), 80% RH or less, sine wave, power factor = 1, warm-up time = 30 minutes
Guaranteed accuracy period: six months

Current input	Frequency	Active power	Voltage and current
20 A (max.)	10 Hz to 20 Hz *1	$\pm 1.0\%$ f.s.	$\pm 2.0\%$ f.s.
	20 Hz to 30 Hz *1	$\pm 0.5\%$ f.s.	$\pm 1.0\%$ f.s.
	30 Hz to 45 Hz *1	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.
	45 Hz to 66 Hz	$\pm 0.1\%$ rdg. $\pm 0.1\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.1\%$ f.s.
	66 Hz to 500 Hz	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s. *2
	500 Hz to 4 kHz	$\pm 0.3\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.2\%$ rdg. $\pm 0.3\%$ f.s. *2
	4 kHz to 8 kHz	$\pm 1.0\%$ f.s.	$\pm 1.0\%$ f.s. *2
	8 kHz to 20 kHz	$\pm 2.0\%$ f.s.	$\pm 2.0\%$ f.s. *2
	20 kHz to 50 kHz	$\pm 5.0\%$ f.s.	$\pm 5.0\%$ f.s. *2
50 kHz to 100 kHz	$\pm 15\%$ f.s. (10 A max.)	$\pm 15\%$ f.s. (10 A max.) *2	
20 A to 30 A	10 Hz to 20 Hz *1	$\pm 1.0\%$ f.s.	(current only) $\pm 2.0\%$ f.s.
	20 Hz to 30 Hz *1	$\pm 0.5\%$ f.s.	$\pm 1.0\%$ f.s.
	30 Hz to 45 Hz *1	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.
	45 Hz to 66 Hz	$\pm 0.1\%$ rdg. $\pm 0.1\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.1\%$ f.s.
	66 Hz to 500 Hz	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.1\%$ rdg. $\pm 0.2\%$ f.s. *2
	500 Hz to 1 kHz	$\pm 0.3\%$ rdg. $\pm 0.2\%$ f.s.	$\pm 0.2\%$ rdg. $\pm 0.3\%$ f.s. *2
	1 kHz to 10 kHz	$\pm 2.0\%$ f.s.	$\pm 2.0\%$ f.s. *2
30 A to 50 A	50/60 Hz	$\pm 0.2\%$ f.s.	$\pm 0.2\%$ f.s. (current only)

*1: The measurement accuracy when response time is SLOW

*2: When the rectifier type is U_{mean} (average rectifier rms value), the accuracy more than 200 Hz is not prescribed for voltage.

Analog output	Output voltage	5 VDC f.s. ($U_1, U_2, U_3, I_1, I_2, I_3, P_1, P_2, P_{\text{SUM}}$ output simultaneously, however, U_3, I_3 outputs 0 V in 1 measurement accuracy $\pm 0.2\%$ f.s. (45 Hz or less, when response time is SLOW)
	Output accuracy	
	Response time	(suddenly change to 0% to 90% and 100% to 10% for range)
	FAST SLOW	0.2 to 0.3 seconds for voltage, current, active power 1.6 to 2 seconds for voltage, current, active power
	Output resistance	100 $\pm 5\%$

Monitor output	Output voltage	1 VAC f.s. ($u_1, u_2, u_3, i_1, i_2, i_3$ output simultaneously)
	Output accuracy	measurement accuracy $\pm 0.1\%$ f.s. (rms value level)
	Output resistance	100 $\pm 5\%$

Frequency characteristics (Measurement accuracy) $\pm 0.1\%$ rdg. ± 1 dgt. (0 to 40 , 32° F to 104° F) , in sinewave input)

Characteristic of integrator (Measurement accuracy)	Integrated value	measurement accuracy of current and active power ± 1 dgt.
	Integration time	± 100 ppm ± 1 s (0 to 40 , 32° F to 104° F)

Table 1 Range Configuration Table
Range for each channel (1 ϕ 3W only)

unit:W

I [A] \ U [V]	500.00 m	1.0000	2.0000	5.0000	10.000	20.000	50.000
150.00	75.000	150.00	300.00	750.00	1.5000 k	3.0000 k	7.5000 k
300.00	150.00	300.00	600.00	1.5000 k	3.0000 k	6.0000 k	15.000 k
600.00	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	30.000 k

Range for SUM (each channel × 2)

unit:W

I [A] \ U [V]	500.00 m	1.0000	2.0000	5.0000	10.000	20.000	50.000
150.00	150.00	300.00	600.00	1.5000 k	3.0000 k	6.0000 k	15.000 k
300.00	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	30.000 k
600.00	600.00	1.2000 k	2.4000 k	6.0000 k	12.000 k	24.000 k	60.000 k

For apparent power, reactive power, replace the unit W with VA or var.

Processing and calculation

●: display / —:not display

Measurement item	Processing/ calculation	3 ϕ 3W	1 ϕ 3W
Voltage (U_1, U_2)	u_1 and u_2 converted to analog by RMS circuit and MEAN circuit	●	●
Voltage (U_3)	After vector calculation u_1+u_2 , u_1 and u_2 converted to analog by RMS circuit and MEAN circuit	●	—
Average voltage (U_{SUM})	$(U_1+U_2+U_3)/3$	●	—
Current (I_1, I_2)	i_1 and i_2 converted to analog by RMS circuit	●	●
Current (I_3)	After vector calculation i_1+i_2 , i_1 and i_2 converted to analog by RMS circuit	●	—
Average current (I_{SUM})	$(I_1+I_2+I_3)/3$	●	—
Peak current (I_p)	Waveform peak detect circuit of i_1, i_2, i_3 (for i_3 3 ϕ 3W only)	●	●
Active power (P_1, P_2)	$P_1=u_1i_1$ and $P_2=u_2i_2$ subject to analog processing by multiplier circuit	—	●
Active power (P_{SUM})	P_1+P_2	●	●
Apparent power (S_1, S_2)	$S_1=U_1 \times I_1, S_2=U_2 \times I_2$	—	●
Apparent power (S_3)	$S_3=U_3 \times I_3$	—	—
Apparent power (S_{SUM})	(1 ϕ) S_1+S_2 , (3 ϕ) $\sqrt{3}/3 \times (S_1+S_2+S_3)$	●	●
Reactive power (Q_1, Q_2)	$Q_1=s_1\sqrt{(U_1I_1)^2-P_1^2}, Q_2=s_2\sqrt{(U_2I_2)^2-P_2^2}$	—	●
Reactive power (Q_{SUM})	Q_1+Q_2	●	●
Power factor (λ_1, λ_2)	$\lambda_1=s_1 (P_1/S_1) , \lambda_2=s_2 (P_2/S_2) $	—	●
Power factor (λ_{SUM})	$s P_{SUM}/S_{SUM} $	●	●
Phase angle (ϕ_1, ϕ_2)	$\phi_1=s_1 \cos^{-1} \lambda_1 , \phi_2=s_2 \cos^{-1} \lambda_2 $	—	●
Phase angle (ϕ_{SUM})	$s \cos^{-1} \lambda_{SUM} $	●	●
Integration power	(Total P from start of integration)/(Number of values per hour)	●	●
Integration current	(Total I from start of integration)/(Number of values per hour)	●	●

1. u, i : instantaneous waveform of voltage and current
2. U, I, P : measurement values of voltage, current, and active power
(rounding error for display ± 1 dgt. is not included)
3. 1, 2, 3: channels
4. SUM: average value for channel (voltage, current), or total (other item)
5. s_1, s_2 : lead or lag of the phase for each channel
"-": when the current phase against voltage is lead
no sign: when the current phase against voltage is lag
6. s is polarity derived from $Q_{\text{SUM}} (=Q_1+Q_2)$ and indicates overall lead or lag.
7. Computing accuracy is ± 1 dgt. for the calculate value from measurement value on display. SUM is 3dgt. max.
8. The number of data for 1 hour = update display (5 time/second) \times seconds for hour (3600) = 18000
9. When $|P| > |S|$, S is value of $|P|$.
10. When the input for each channels of U, I , or P results in "o.r." (out of range), the item for "o.r." is calculated as input of 130% f.s

11.3 Function Specifications

(1) Voltage, Current, Active Power Measurement (Indicated as V, A, or W on the display)

Display limit	0.1% to 130% of the range (Displays ± 0.0000 m to ± 99999 M in scaling function. For "-" display, active power only)
Out of range display	Displays "o.r" (out of range) when the input exceeds 130% of the range.
Over input warning	When the peak value of voltage or current input waveform is more than 6 times of range, OVER lamp is lit.

(2) Apparent Power, Reactive Power Measurement (Indicated as VA or var on the display)

Display limit	0% to 169% of the range (Displays ± 0.0000 m to ± 99999 M in scaling function.)
Out of range display	If either the voltage or current is out of range, "o.r" will be displayed. For the reactive power, "o.r" will be also displayed when the active power is out of range.
Polarity display	Reactive power: When the current is leading(LEAD) compared to the voltage " - ", when it is lagging(LAG) no notation. Apparent power: no polarity

(3) Power Factor Measurement (Indicated as PF on the display)

Display limit	± 0.0000 to ± 1.0000
Out of range display	If either the voltage, current or active power is out of range, "o.r" will be displayed. When the apparent power is 0, "o.r" is displayed.
Polarity display	When the current is leading(LEAD) compared to the voltage " - ", when it is lagging(LAG) no notation.

(4) Phase Angle Measurement (Indicated as \circ on the display)

Display limit	+180.00 to -180.00
Out of range display	When the power factor is "o.r" indication, displays "o.r".
Polarity display	When the current is leading(LEAD) compared to the voltage " - ", when it is lagging(LAG) no notation.

(5) Integrator (Indicated as Ah or Wh, TIME (integration time) on the display)

Integration item	I , $\pm P$, $+P$, $-P$ integrated simultaneously The RUN lamp is lit during integration, flashing during stop, turned off when integration reset
Number of integration	5 times/second
Integration time	1 minutes to 10000 hours (1 minute step)
Display limit	0.00000 m to ± 999999 M
Effective input range	Same as the effective input limits of current and active power
Error warning	When an "o.r" is included in the integration value, the unit (Wh, Ah) will flash.
Synchronizing with other functions	Interval printing to the printer, start/stop and data reset of integration by outside control, and saving the integration value by backup batteries.
Power failure recovery	If there is a power failure during integration, the unit will resume integration after the power is restored.

(6) Frequency Measurement (Indicated as Hz on the display)

Measurement item	Select one of U_1 , U_2 , I_1 , I_2
Measurement range	500 Hz/50 kHz/auto-range
Display limit	0.8% to 100% for range (4.0000Hz to 500.00 Hz, 400.00 Hz to 50.000 kHz)
Out of range display	If out of display range, "o.r", out of range will be displayed.
Measurement Frequency	2 to 5 times/seconds

(7) Connection mode

3 ϕ	Three phase, three wire
1 ϕ	Single phase, three wire

(8) Rectifier type changing (only voltage, the true r.m.s. value is always displayed for current.)

RMS	True r.m.s. value
MEAN	Average rectifier effectiveness value indicator (filter 500 Hz)

(9) Response time

FAST	Response time of analog output: 0.2 to 0.3 seconds
SLOW	Response time of analog output: 1.6 to 2 seconds
AUTO	FAST at input at 45 Hz or more SLOW at input at less than 45 Hz (For the waveform which it is not possible to measure frequency, the previous setting will be hold.)

(10) Current waveform peak detection (displays "Ip")

Detect item	I_1, I_2, I_3 (1 : I_1, I_2 only)																
Detect accuracy	Measurement accuracy $\pm 1\%$ f.s.(current peak range) A full scale (f.s.) specified within the measurement accuracy range represents a current range. For example, when a current of 60Hz is input, the detection accuracy will be $\pm 0.1\%$ rdg, $\pm 0.1\%$ f.s. (current range) $\pm 1\%$ f.s. (current peak range).																
Current peak range	6 times of current range																
	<table border="1"> <tr> <td>Current range [A]</td> <td>0.5</td> <td>1</td> <td>2</td> <td>5</td> <td>10</td> <td>20</td> <td>50</td> </tr> <tr> <td>Current peak range [A]</td> <td>3.0000</td> <td>6.0000</td> <td>12.000</td> <td>30.000</td> <td>60.000</td> <td>120.00</td> <td>300.00</td> </tr> </table>	Current range [A]	0.5	1	2	5	10	20	50	Current peak range [A]	3.0000	6.0000	12.000	30.000	60.000	120.00	300.00
Current range [A]	0.5	1	2	5	10	20	50										
Current peak range [A]	3.0000	6.0000	12.000	30.000	60.000	120.00	300.00										
Effective input range	Lower value either 1% to 100% of current peak range or 90 A peak value																
Display range	0.1% to 110% of current peak range																

(11) Averaging (AV lamp is lit when sliding average and when the number of averaging is other than 1.)

Number of averaging	1 (off), 8, 16, 32, 64
Error display	When an "o.r" is included in the average data, the unit will flash.

(12) Scaling(If either the PT ratio or the CT ratio are anything besides 1, the SC lamp is lit.)

Setting range of PT ratio	0.001 to 9999
Setting range of CT ratio	0.001 to 9999
Error display	If because of the PT ratio and the CT ratio setting the f.s. value exceeds "99999M", "S.Err" will be displayed.

(13) D/A output (Polarity + 15 bits D/A converter 1 channel)

Output item	Selects one of the following; voltage, current, active power, apparent power, reactive power, power factor, phase angle, current peak, frequency, integration values for each channel, total integrated value
Maximum output voltage	± 6.5 VDC
Output level	Voltage, current, active power, apparent power, reactive power, current peak, frequency : ± 5 VDC (with \pm f.s.) Power factor: ± 5 VDC (with ± 0.0), 0 V (with ± 1.0) Phase angle: ± 5 VDC(with $\pm 180^\circ$) Integrator: ± 5 VDC (current or power range \times integration setting time) Display o.r: ± 6.5 VDC (during " \pm o.r" display)
Output update rate	Same as display update rate (approx. 5 times/seconds)
Output accuracy	Measurement accuracy $\pm 0.2\%$ f.s. (23 ± 3 , 73° F $\pm 5^\circ$ F) Current peak output accuracy detected accuracy $\pm 0.2\%$ f.s.(current peak range)
Temperature coefficient	$\pm 0.04\%$ f.s./ max.
Output resistance	100 $\pm 5\%$

(14) Display Hold

The updating of all measurement values are stopped (HOLD lamp is lit).

(15) Maximum Value and Current Peak Value Hold

Detects the maximum values of voltage, current, active power, apparent power, reactive power, power factor, phase angle, and frequency, and the current waveform peak value, and then hold displays. (HOLD lamp is flash)

(16) External Control

Control item	Start and stop of integrator, reset of integrated value, manual print
Input signal level	CMOS level (0 - 5 V)

(17) Changing Frequency of multiplier circuit for active power

Select from 2.37, 2.44, 2.604 kHz

(18) Key lock

During measurement, keys excluding SHIFT and KEYLOCK are not accepted. (KEYLOCK lamp lit)

(19) Battery backup

Backup item	Setting values in each functions, integrating status and integration value.
Backup time	6 years or more (23 °C (73° F) reference value)

(20) System reset

The units's settings are returned to the initial settings.

(21) Interface

GP-IB INTERFACE	Based on IEEE-488.1 1987 and refer to IEEE-488.2 1987 Interface function: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0 Remote control by controllers Data output to the listen-only printer (manual, interval, help) (PRINT lamp lit) It is possible to set the interval with unit in 10 seconds from 10 seconds to 100 hours. Remote release by LOCAL key (RMT lamp off)
RS-232C INTERFACE	Start-stop transmission Baud rate: 1200, 2400, 4800, 9600 bps Stop bits: 1 or 2 bits Data length: 7 or 8 bits Parity: even, odd, none Remote control by controllers (RMT lamp lit) Data output to the printer (manual, interval, help) (PRINT lamp lit) It is possible to set the interval with unit in 10 seconds from 10 seconds to 100 hours. Remote release by LOCAL key (RMT lamp off)

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HIOKI

DECLARATION OF CONFORMITY

Manufacturer's Name: HIOKI E.E. CORPORATION
Manufacturer's Address: 81 Koizumi, Ueda, Nagano 386-1192, Japan
Product Name: POWER HiTESTER
Model Number: 3331

The above mentioned product conforms to the following product specifications:

Safety: EN61010-1:2001
EMC: EN61326-1:2006
Class A equipment
Equipment intended for use in industrial locations
EN61000-3-2:2006+A1:2009+A2:2009
EN61000-3-3:2008

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC.

HIOKI E.E. CORPORATION



Atsushi Mizuno

Director of Quality Assurance

21 June 2011

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