

PW3336

PW3336-01

PW3336-02

PW3336-03

PW3337

PW3337-01

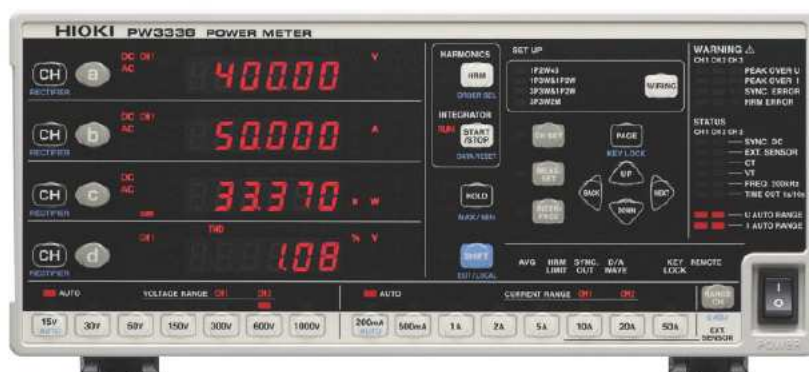
PW3337-02

PW3337-03

HIOKI

Instruction Manual

POWER METER



Be sure to read this manual before using the instrument.

Safety information

► p.3



When using the instrument for the first time

Names and Functions of Parts ► p.13

Measurement Preparations ► p.27



Troubleshooting

Maintenance and Service ► p.177

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Introduction

Thank you for purchasing the Hioki Model PW3336, PW3336-01, PW3336-02, PW3336-03, PW3337, PW3337-01, PW3337-02, PW3337-03 Power Meter. To obtain maximum performance from the instrument software, please read this manual first, and keep it handy for future reference.

The following documents are provided with this instrument. Refer to them as appropriate for your application.

1	Measurement Guide	Offers an introduction to the instrument's basic measuring method for first time users.
2	Instruction Manual (This document)	Contains explanation and instructions regarding the instrument's operating method and functions.

PW3336	PW3336-01	PW3336-02	PW3336-03	Show the model that is equipped with each function as the icon.
PW3337	PW3337-01	PW3337-02	PW3337-03	

The models are classified according to the number of the input channels and the factory-installed options as follows.

● : Installed — : Not installed

Model	Number of input channels	Factory-installed options	
		GP-IB	D/A output
PW3336	2	—	—
PW3336-01	2	●	—
PW3336-02	2	—	●
PW3336-03	2	●	●
PW3337	3	—	—
PW3337-01	3	●	—
PW3337-02	3	—	●
PW3337-03	3	●	●

The instrument can measure relatively high current with the use of HIOKI Clamp on Sensors (clamp sensors), which are option, or current sensors. Hereafter, those sensors are collectively referred to as "current sensors". Please read the instruction manuals of each sensor for details before using.

The current sensors are classified as either "TYPE1" or "TYPE2" according to the output specifications.

Using a TYPE2 current sensor requires Model CT9555 series Sensor Unit, which is option. Please refer to the instruction manual of Model CT9555 series for details.

Trademark

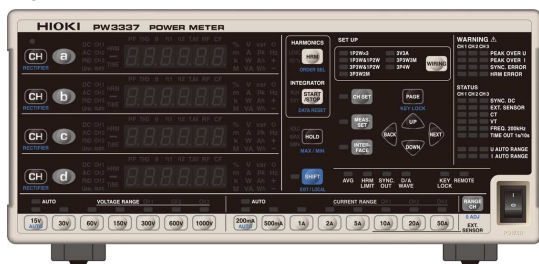
Microsoft and Internet Explorer are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

Confirming Package Contents

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

Confirm that these contents are provided.

e.g.) PW3337



- ☐ PW3336, PW3336-01, PW3336-02, PW3336-03, PW3337, PW3337-01, PW3337-02, PW3337-03 Power Meter
- ☐ Instruction manual
- ☐ Measurement guide
- ☐ Power cord
- ☐ Voltage and current input terminal safety cover
PW3336, -01, -02, -03..... 4
PW3337, -01, -02, -03..... 6
- ☐ Safety cover installation screws (M3 ×6 mm)
PW3336, -01, -02, -03..... 8
PW3337, -01, -02, -03..... 12

Options

Communications and control options

- ☐ Model 9637 RS-232C Cable (1.8 m, 9pin-9pin, crossover cable)
- ☐ Model 9638 RS-232C Cable (1.8 m, 25pin-9pin, crossover cable)
- ☐ Model 9642 LAN Cable (5 m, Supplied with Cross-Over Adapter)
- ☐ Model 9151-02 GP-IB Connector Cable (2 m)
- ☐ Model 9165 Connection Cord (1.5 m, metal BNC to metal BNC, not CE marked, for the synchronized measurements)

Current sensor options

- ☐ Model 9661 Clamp on Sensor (500 A AC)
- ☐ Model 9669 Clamp on Sensor (1000 A AC)
- ☐ Model 9660 Clamp on Sensor (100 A AC)
- ☐ Model CT9667 Flexible Clamp on Sensor (500 A/5000 A AC)
- ☐ Model CT6862-05 AC/DC Current Sensor (50 A AC/DC)
- ☐ Model CT6863-05 AC/DC Current Sensor (200 A AC/DC)
- ☐ Model 9709-05 AC/DC Current Sensor (500 A AC/DC)
- ☐ Model CT6865-05 AC/DC Current Sensor (1000 A AC/DC)
- ☐ Model CT6841-05 AC/DC Current Probe (20 A AC/DC)
- ☐ Model CT6843-05 AC/DC Current Probe (200 A AC/DC)
- ☐ Model CT6844-05 AC/DC Current Probe (500 A AC/DC)
- ☐ Model CT6845-05 AC/DC Current Probe (500 A AC/DC)
- ☐ Model CT6846-05 AC/DC Current Probe (1000 A AC/DC)
- ☐ Model 9272-05 Clamp on Sensor (20 A/200 A AC/DC)
- ☐ Model CT9555 Sensor Unit
- ☐ Model CT9556 Sensor Unit
- ☐ Model CT9557 Sensor Unit
- ☐ Model L9217 Connection Cord

Safety Information



DANGER

This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument.

Using the instrument in a way not described in this manual may negate the provided safety features.

- Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.
- Mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use.



WARNING

With regard to the electricity supply, there are risks of electric shock, heat generation, fire, and arc discharge due to short circuits. If persons unfamiliar with electricity measuring instruments are to use the instrument, another person familiar with such instruments must supervise operations.

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

Safety Symbols

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

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

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

Symbols for Various Standards

	WEEE marking: This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).
	This symbol indicates that the product conforms to regulations set out by the EU Directive.

Notation

	Indicates the prohibited action.
(p.)	Indicates the location of reference information.
*	Indicates that descriptive information is provided below.
SET (Bold character)	Names of settings, buttons, and other screen elements are enclosed in brackets.

The screen of this instrument displays characters in the following manner.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	b	C	d	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0

Accuracy

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

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

Measurement categories

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

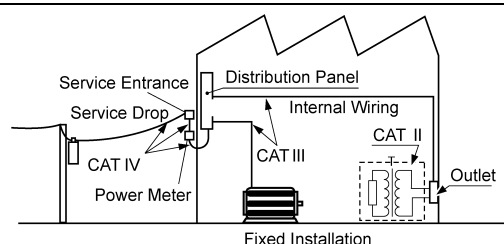


DANGER

- Using a measuring 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.
- Using a measuring instrument without categories in an environment designated with the CAT II to CAT IV category could result in a severe accident, and must be carefully avoided.

This instrument conforms to the safety requirements for CAT II 1000 V, CAT III 600 V measuring instruments.

CAT II	When directly measuring the electrical outlet receptacles of the primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)
CAT III	When measuring the primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.
CAT IV	When measuring the circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



Operating Precautions



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

Before Use

- Before using the instrument for the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.
- Before using the instrument, make sure that the insulation on the connection cable is undamaged and that no bare conductors are improperly exposed. Using the instrument in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.

Instrument Installation

Operating temperature and humidity: 0°C to 40°C (32°F to 104°F) at 80% RH or less (non-condensating)
Temperature and humidity range for guaranteed accuracy: 23°C±5°C (73°F±9°F), 80%RH or less

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



Exposed to direct sunlight
Exposed to high temperature



In the presence of corrosive or explosive gases



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



Exposed to strong electromagnetic fields
Near electromagnetic radiators



Exposed to high levels of particulate dust



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



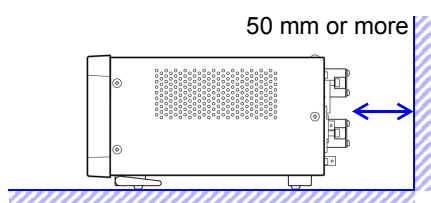
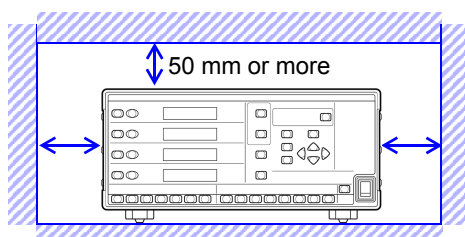
Subject to vibration



CAUTION

- **Ventilation holes for heat radiation are provided on the side and rear panels of the instrument. Leave sufficient space around the ventilation holes and install the instrument with the holes unobstructed. Installation of the instrument with the ventilation holes obstructed may cause a malfunction or fire.**
- **Do not place another PW3336 or measuring instrument or other heat-generating device underneath or on top of this instrument. Doing so may damage the instrument or cause burns or fire.**
-
-

To prevent overheating, be sure to leave the specified clearances around the unit.



- Unplugging the power cord kills power to the instrument. Be sure to provide enough unobstructed space to unplug the power cord immediately in an emergency.
- The instrument can be used with the stands flipped out. (p.21)
- To mount the instrument in a rack, refer to "Appendix 3 Rack Mounting" (p. A11)

Handling the Instrument

DANGER

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

WARNING

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

CAUTION

- To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- After use, always turn OFF the power.
- Do not allow any conductive foreign objects to enter through the vents. Doing so may cause damage to the instrument.

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

Handling the Cables

DANGER

- The maximum input voltage is 1000 V DC/AC and the maximum input current to the current direct input terminals is 70 A DC/AC. Attempting to measure a voltage or current in excess of each of the maximum inputs could destroy the instrument and result in personal injury or death.
- The maximum rated voltage between input terminals and the ground is as follows;
(CAT II) 1000 V DC, 1000 V AC
(CAT III) 600 V DC, 600 V AC
Attempting to measure voltages exceeding this level with respect to ground could damage the instrument and result in personal injury.
- The external current sensor input terminals are not insulated. The terminals are exclusive to the optional current sensors. Attempting to input a voltage or current other than the output from the optional clamp sensors into the external current sensor terminals could destroy the instrument and result in personal injury or death.
- When using the optional current sensors, do not measure a current in excess of the current rating. This could destroy the instrument, the current sensor, or both. Also this could result in personal injury or death.
- This instrument should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.
- To avoid electrical accidents, confirm that all terminals are secure. The increased resistance of loose connections can lead to overheating and fire.
(Tightening torque of the input terminals: 3 N·m)

⚠ WARNING

Observe the following to avoid electric shock and short circuits.

- Turn off the power to lines to be measured before making connections to terminals to be measured and turning on the instrument.
- Be sure to connect the voltage input and current input terminals correctly. An incorrect connection could damage or short circuit this instrument.
- When connecting wires to the voltage input terminals, be careful to avoid shorting between one terminal and another with the wires.
- Since the screws of the terminals could be loosened, do not move the cables connected to the terminals more than necessary.
- Do not tie the cables connected to the input terminals in a bundle with the power supply cord, the communication cables, the external I/O cables, or the current sensor cables. This may cause damage.

⚠ CAUTION

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

Before Connecting

⚠ WARNING

- Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.
- To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord provided only to a 3-contact (two-conductor + ground) outlet.
[See:](#) Connection Methods : 2.3 Connecting the Power Cord (p.34)
- Use only the designated power cord with this instrument. Use of other power cords may cause fire.
- Avoid using an uninterruptible power supply (UPS) or DC/AC inverter with rectangular wave or pseudo-sine-wave output to power the instrument. Doing so may damage the instrument.

When connecting cables to the input terminals, the communication connectors, or the external I/O terminals, observe the following to avoid electric shock and short circuits.

- Always turn off the power to the instrument and any device to be connected before making connections.
- Be careful to avoid exceeding the ratings of the input terminals or external control terminals.
- During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Use the screws to secure the communication connectors.

Input and Measurement

DANGER

- The maximum input voltage is 1000 V DC/AC and the maximum input current to the current direct input terminals is 70 A DC/AC.
Attempting to measure a voltage or current in excess of each of the maximum inputs could destroy the instrument and result in personal injury or death.
- The maximum rated voltage between input terminals and the ground is as follows;
(CAT II) 1000 V DC, 1000 V AC
(CAT III) 600 V DC, 600 V AC
Attempting to measure voltages exceeding this level with respect to ground could damage the instrument and result in personal injury.
- The external current sensor input terminals are not insulated. The terminals are exclusive to the optional current sensors. Attempting to input a voltage or current other than the output from the optional clamp sensors into the terminals could destroy the instrument and result in personal injury or death.
- To avoid the danger of electric shock, do not input a signal in excess of the ratings to the external I/O terminals.
- This instrument should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.

WARNING

When connecting

Observe the following to avoid electric shock and short circuits.

- Turn off the power to lines to be measured before making connections to input terminals and turning on the instrument.
- When making connections, do not mix up the voltage input terminals (U) and the current input terminals (I). In particular, do not input a voltage into the current input terminals (between I and $\pm$). Using the instrument with a faulty wiring will damage the instrument or cause injury.
- Be careful to avoid shorting between the voltage input terminals with the wires.

When abnormalities such as smoke, unusual noise, or unusual odor are observed

Stop the measurement immediately, and observe the following procedure. Using the instrument in such a abnormal condition could cause death or injury.

1. Turn off the power switch of the instrument.
2. Disconnect the power cord from the outlet.
3. Turn off the power to the line to be measured.
Remove the measurement cables.
4. Contact your dealer or Hioki representative.

⚠ CAUTION

- For safety reasons, disconnect the power cord when the instrument is not used and before connecting it to a device to be tested.
- To avoid damage to the instrument, do not input the voltage to the output terminals. Also do not short between any terminals.
- When the instrument is turned off, do not apply voltage or current to the instrument. Doing so may damage the instrument.
- Do not connect or disconnect connection cords from the current sensor or CT9555 series Sensor Unit while the instrument is turned on. Doing so may damage the instrument, current sensor, or CT9555 series Sensor Unit.
- Do not input current to the current sensor when it is not connected to the instrument or when the instrument and CT9555 series Sensor Unit are turned off. Doing so may damage the current sensor, instrument, or CT9555 series Sensor Unit.

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

To measure accurately

- Warm up the instrument for more than 30 minutes before use.
- To maintain sufficient measurement accuracy of the instrument, be sure to help heat radiation. e.g.) Keeping away the instrument from a heat, leaving sufficient clearances around the instrument, installing cooling fans to the rack in which the instrument is mounted, or other measures.
- The recommended calibration interval of the instrument is one year.
- The warranty period of the instrument is three years.

Overview

Chapter 1

1.1 Product Overview

The PW3336/ PW3337 is a power meter with power measurement capabilities for the full range of electrical equipment, from single-phase devices such as battery-driven devices and household electronics to industrial-use and three-phase electrical equipment.

The instrument provides coverage from DC to inverter frequencies with support for voltages up to 1000 V and direct-input currents of up to 65 A. It can also measure currents of up to 5000 A using an optional current sensor.

1.2 Features

■ Support for all power lines

- **PW3336** **PW3336-01** **PW3336-02** **PW3336-03** : These instruments provide two channels each of voltage input and current input.
- **PW3337** **PW3337-01** **PW3337-02** **PW3337-03** : These instruments provide three channels each of voltage input and current input.
- Since all channels are isolated, the instrument can simultaneously measure multiple circuits.
- It supports measurement lines from single-phase to 3-phase/4-wire.
- With 3-phase/3-wire measurement lines, the instrument can measure either voltage between lines (3V3A) or phase voltage (3P3W3M) using vector calculations simply by switching its line setting (input terminal connections remain the same).

■ Guaranteed accuracy up to 65 A with direct input

- Accuracy is guaranteed for currents of up to 65 A with direct input.
- (The maximum input current is 70 A, ± 100 Apeak.)
- An optional current sensor can be used to measure currents in excess of 65 A. (p.102)

■ High-accuracy, wide-band performance

- The instrument delivers a high fundamental accuracy of $\pm 0.15\%$ rdg. (at less than 50% of range, $\pm 0.1\%$ rdg. $\pm 0.05\%$ f.s.).
- Over a wide band from DC and 0.1 Hz to 100 kHz, the instrument covers not only the fundamental frequency band for inverter-driven equipment, but also the carrier frequency band.
- Power factor effects are low at $\pm 0.1\%$ f.s. (with a internal circuit voltage/current phase difference of $\pm 0.0573^\circ$), allowing high-accuracy measurement of active power during low power-factor operation, for example during no-load testing of transformers and motors.

■ Standard harmonic measurement function complying with IEC 61000-4-7:2002 (p.71)

- The instrument can perform harmonic measurement in compliance with the IEC 61000-4-7:2002 international standard on harmonic measurement methods.
- You can set an upper limit for the analyzed order from the 1st to 50th order according to the harmonic measurement standard in use.

■ Extensive measurement functionality, standard

- Since processing for functions such as AC+DC (RMS), AC+DC U_{mn} (voltage average value rectified RMS equivalent), DC (DC component), AC (AC component), FND (fundamental wave component), and harmonic measurement as well as integration measurement can be performed internally and in parallel, it is possible to obtain simultaneous measured values simply by switching the display.
- Since the measurement range and other parameters can be set independently for each channel, it is possible to measure input-output efficiency for inverters and other power supply devices. (p.78)

■ High-speed D/A output to capture harsh load variations (p.88)

PW3336-02 PW3336-03 PW3337-02 PW3337-03

- The active power level can be output for each cycle for the voltage or current assigned to the synchronization source.
- Variations over extended periods of time can be recorded by using the instrument in conjunction with equipment such as a recorder or data logger using level output (updated every 200 ms) for each channel's voltage, current, and active power as well as associated sum values and three user-selected parameters.
- Safe, insulated waveforms can be observed using waveform output (equivalent to a sampling rate of approximately 87.5 kHz) for each channel's instantaneous voltage, instantaneous current, and instantaneous power.

■ Building a system with 3 interfaces (p.117)

- You can control the instrument or capture data from it using a computer by using the standard RS-232C or LAN interface. (You can also communicate with a computer over USB by using a commercially available USB serial conversion cable.)
- The instrument also provides a GP-IB interface, an essential capability when building such systems.
(PW3336-01 PW3336-03 PW3337-01 PW3337-03)

■ Synchronized control function with support for measurement of even more channels (p.81)

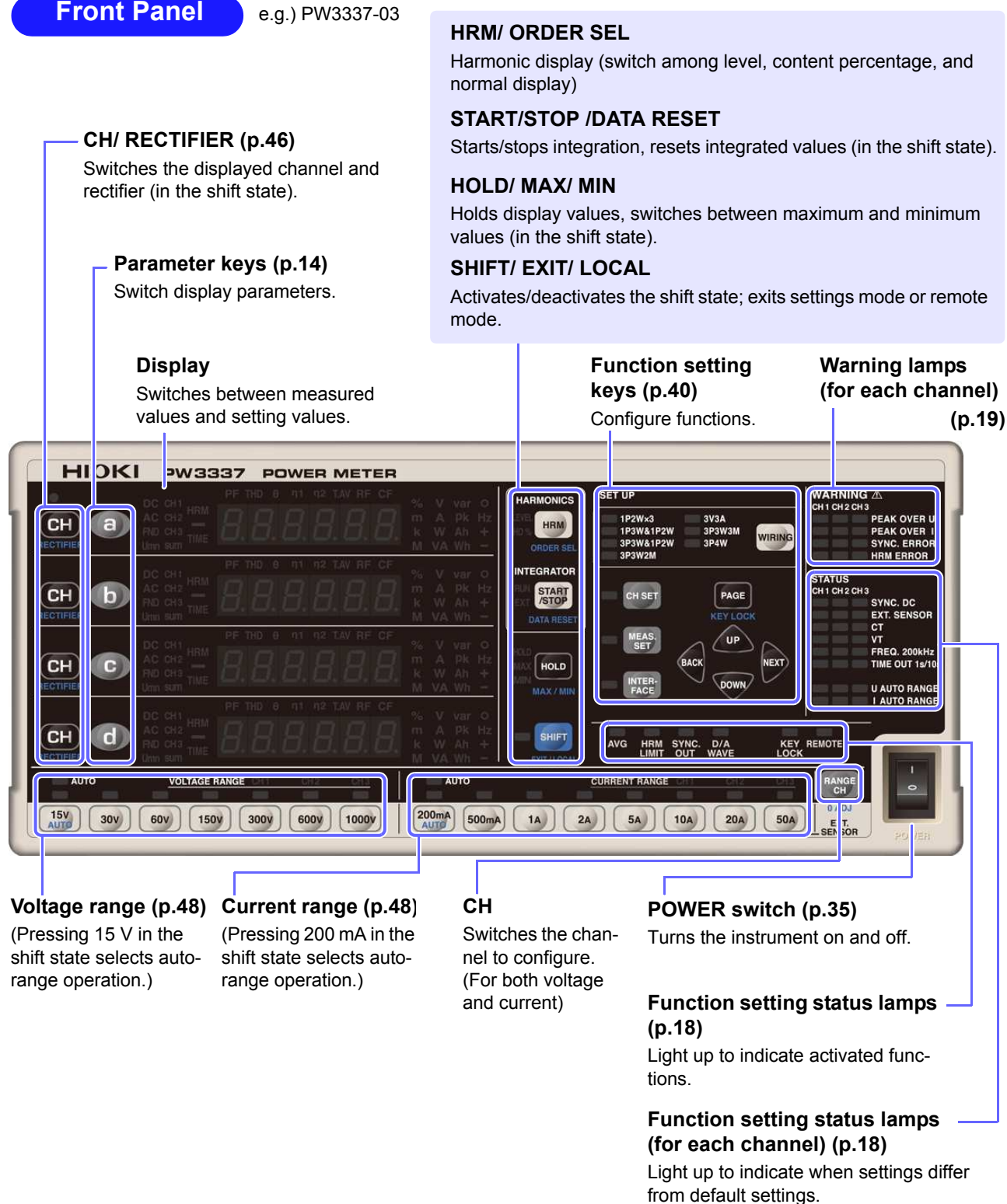
- Simultaneous measurement can be performed by connecting two instruments with an optional BNC cable.
- Calculations, display updates, data updates, integration control, display hold timing, zero-adjustment, and key lock operation of the instrument set as the slave (IN setting) are matched to the master instrument (OUT setting).

1.3 Names and Functions of Parts



Front Panel

e.g.) PW3337-03



The shift state is automatically canceled after Approx. 10 seconds. When the **RECTIFIER** key or a parameter key is pressed, the shift state is canceled after Approx. 2 seconds.

Display parameters

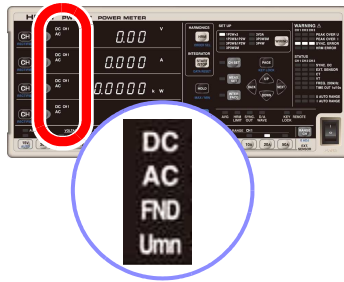


Pressing **a** on the first row, **b** on the second row, **c** on the third row, or **d** on the fourth row of the measured value display switches the display parameter, causing the selected display parameter to light up.

V	Voltage (U)
A	Current(I)
W	Active power (P)
VA	Apparent power (S)
Var	Reactive power (Q)
PF	Power factor (λ)
°	Phase angle (ϕ)
V Hz	Voltage frequency (f)
A Hz	Current frequency (f)
Ah +	Positive current integration
Ah -	Negative current integration
Ah	Current integration sum
Wh +	Positive active power integration
Wh -	Negative active power integration
Wh	Active power integration sum
TIME	Integration time
V pk	Voltage waveform peak value (Upk)
A pk	Current waveform peak value (Ipk)
$\eta 1$ %	Efficiency (η)
$\eta 2$ %	Efficiency (η)

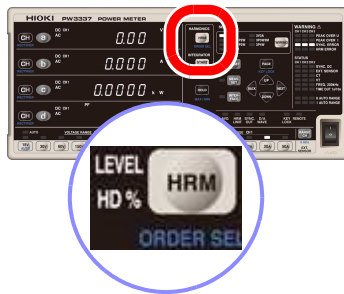
CF V	Voltage crest factor (Ucf)
CF A	Current crest factor (Icf)
T.AV A	Time average current (T.AV I)
T.AV W	Time average active power (T.AV P)
RF V %	Voltage ripple rate(Urf)
RF A %	Current ripple rate(Irf)
THD V %	Total harmonic voltage distortion (Uthd)
THD A %	Total harmonic current distortion (Ithd)
θ V ° CH1 CH2	Inter-channel voltage fundamental wave phase difference (θ_{U2-1})
θ V ° CH1 CH3	Inter-channel voltage fundamental wave phase difference (θ_{U3-1})
θ A ° CH1 CH2	Inter-channel current fundamental wave phase difference (θ_{I2-1})
θ A ° CH1 CH3	Inter-channel current fundamental wave phase difference (θ_{I3-1})
HRM V LEVEL	Harmonic voltage RMS value (Uk)
HRM A LEVEL	Harmonic current RMS value (Ik)
HRM W LEVEL	Harmonic active power (Pk)
HRM V % HD%	Harmonic voltage content percentage (UHDk)
HRM A % HD%	Harmonic current content percentage (IHDk)
HRM W % HD%	Harmonic active power content percentage (PHDk)

Rectifier indicator lamps (p.47)



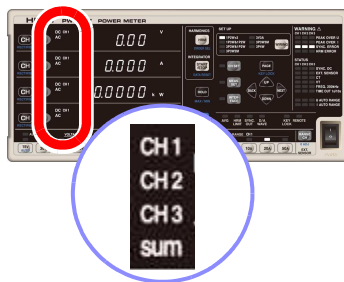
DC AC	When using the AC+DC rectifier, both the DC and AC lamps light up.
DC AC Umn	When using the AC+DC Umn rectifier, the DC, AC, and Umn lamps light up.
DC	Lights up when using the DC rectifier.
AC	Lights up when using the AC rectifier.
FND	Lights up when using the FND rectifier.

Harmonic measurement (HARMONICS) lamps (p.71)



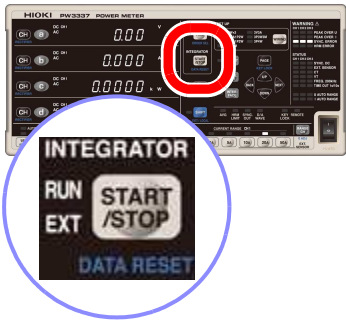
LEVEL	Lights up when the instrument is displaying a harmonic component level (harmonic voltage RMS value, harmonic current RMS value, or harmonic active power).
HD%	Lights up when the instrument is displaying a harmonic content percentage (harmonic voltage content percentage, harmonic current content percentage, or harmonic active power content percentage).

CH1, CH2, CH3, and sum lamps



CH1	Lights up when the instrument is displaying the CH1 measured value for the selected display parameter.
CH2	Lights up when the instrument is displaying the CH2 measured value for the selected display parameter.
CH3	Lights up when the instrument is displaying the CH3 measured value for the selected display parameter.
sum	Lights up when the instrument is displaying the measured value for the sum of the selected display parameters when using a wiring mode other than 1P2W.

Integration (INTEGRATOR) status indicator lamps (p.62)



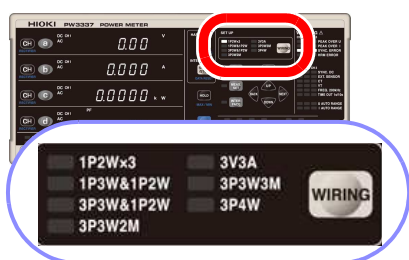
RUN	Indicates the status of integration based on START/STOP key operation or communications. RUN lamp on: Integration active RUN lamp flashing: Integration stopped RUN lamp off: Integration reset
RUN EXT	Indicates the status of integration based on external control. RUN lamp on, EXT lamp on: Integration active RUN lamp flashing, EXT lamp on: Integration stopped RUN lamp and EXT lamp off: Integration reset

Hold (HOLD) status indicator lamp (p.108)



HOLD	Lights up when display hold is activated by pressing the HOLD key. To cancel display hold: Pressing the HOLD key once more causes the display hold state to be canceled and the HOLD lamp to be turned off.
MAX	When the HOLD, MAX, and MIN lamps are all off, pressing the SHIFT key and then the HOLD key causes the maximum value to be held and the MAX lamp to light up.
MIN	Pressing the HOLD key while the MAX lamp is lit up (indicating that the maximum value is being held) causes the minimum value to be held and the MIN lamp to light up. Pressing the HOLD key while the MIN lamp is lit up (indicating that the minimum value is being held) causes the minimum value hold to be canceled, returning to the normal measured value display.

Wiring (WIRING) mode indicator lamps (p.40)



These lamps light up when the following wiring modes are selected:

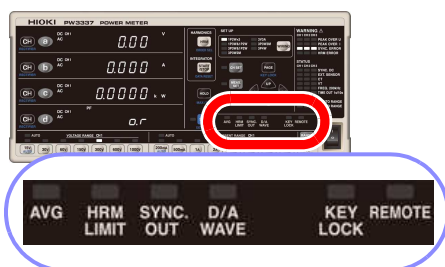
PW3336 PW3336-01 PW3336-02 PW3336-03

1P2W×2	1-phase/2-wire × 2 circuits (CH1 and CH2 are 1-phase/2-wire.)
1P3W	1-phase/3-wire
3P3W	3-phase/3-wire, active power measurement using the two-power-meter method
3P3W2M	3-phase/3-wire, active power measurement using the two-power-meter method (Displays line voltage and phase current, which are not measured, using vector calculations.)

PW3337 PW3337-01 PW3337-02 PW3337-03

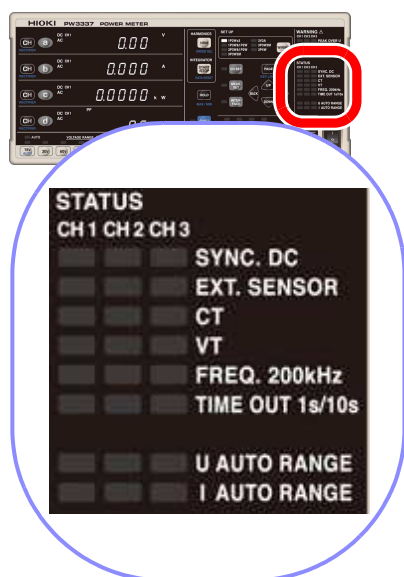
1P2W×3	1-phase/2-wire × 3 circuits (CH1, CH2, and CH3 are 1-phase/2-wire)
1P3W&1P2W	1-phase/3-wire & 1-phase/2-wire (CH1 and CH2 are 1-phase/3-wire, Active power is measured by 2-power measurement method, and CH3 is 1-phase/2-wire.)
3P3W&1P2W	3-phase/3-wire & 1-phase/2-wire (CH1 and CH2 are 3-phase/3-wire, and CH3 is 1-phase/2-wire.)
3P3W2M	3-phase/3-wire, active power measurement using the two-power-meter method (Displays wire voltage and phase current, which are not measured, using vector calculations.)
3V3A	3-phase/3-wire, active power measurement using the two-power-meter method (Actually measures and displays all wire voltages and phase currents.)
3P3W3M	3-phase/3-wire (Converts and displays wire voltages and phase voltages using vector calculations with 3V3A wiring.)
3P4W	3-phase/4-wire

Setting status indicator lamps



These lamps indicate the instrument's overall setting status. They light up when the corresponding function is ON.

AVG	Lights up when the number of averaging iterations is set to a value other than the default value of 1.(p.57)
HRM LIMIT	Lights up when the harmonic analysis order upper limit is set to a value other than the default value of 50.(p.71)
SYNC. OUT	Lights up when the synchronized measurement I/O setting is set to OUT (Master). Flashes with external synchronized signal input when set to IN (Slave). Turns off when set to OFF.(p.81)
D/A WAVE	PW3336-02 PW3336-03 PW3337-02 PW3337-03 Lights up when the D/A output setting is set to waveform/high-speed active power level output (the default setting is level output). (p.88)
KEY LOCK	Lights up when key operation is disabled. (p.111)
REMOTE	Lights up when the instrument is in remote operation mode. (p.134)



These lamps indicate the setting status for each channel. Function lamps light up when set to a value other than the default setting.

SYNC. DC	Lights up when the synchronization source is set to DC (the default setting is each channel's voltage: U1, U2, and U3). (p.51)
EXT. SENSOR	Lights up when the current input method setting is set to TYPE1 or TYPE2 (current sensor input) (the default setting is OFF [current value direct input]). (p.42)
CT	Lights up when the CT ratio setting is set to a value other than the default setting of 1. (p.59)
VT	Lights up when the VT ratio setting is set to a value other than the default setting of 1. (p.59)
FREQ. 200kHz	Lights up when the zero-cross and frequency measurement filter setting is set to 100 Hz, 5 kHz, or 200 kHz (the default setting is 500 Hz). (p.53)
TIME OUT 1s/10s	Lights up when the synchronization detection timeout is set to 1 sec. or 10 sec. (the default setting is 0.1 sec.). (p.55)
U AUTO RANGE	Lights up when the voltage measurement range is set to auto range (the default setting is auto range OFF). (p.48)
I AUTO RANGE	Lights up when the current measurement range is set to auto range (the default setting is auto range OFF). (p.48)



CAUTION When the VT and CT lamps are lit up, note that voltage and current inputs differ from the displayed measured values.

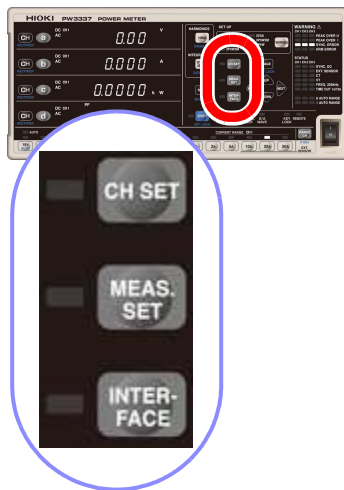
Warning (WARNING) indicator lamps



These lamps indicate channel warnings. When the following warning lamps and error lamps are lit up, they indicate a hazardous state or inability to perform measurement accurately:

PEAK OVER U	Lights up when an overvoltage input warning occurs, indicating that the input voltage peak value has exceeded ± 1500 V or $\pm 600\%$ of the voltage measurement range.
PEAK OVER I	Lights up when an overcurrent input warning occurs, indicating that the input current peak value has exceeded ± 100 A or $\pm 600\%$ of the current measurement range.
SYNC. ERROR	Lights up when a synchronization error occurs, indicating that synchronization cannot be detected.
HRM ERROR	Lights up when a harmonic measurement synchronization error occurs, indicating that the harmonic measurement synchronization frequency range was exceeded.

Setting screen indicator lamps



These lamps light up in response to settings on the following setting screens:

CH SET	Channel settings • Synchronization source • Current input method • CT ratio • VT ratio • Zero-cross and frequency measurement filter • Synchronization detection timeout
MEAS. SET	Shared settings that apply to all channels • Integration time • Number of averaging iterations • Harmonic analysis upper limit order • Synchronized measurement I/O (master, slave) • D/A output PW3336-02 PW3336-03 PW3337-02 PW3337-03
INTERFACE	Interface settings • RS-232C • GP-IB PW3336-01 PW3336-03 PW3337-01 PW3337-03 • LAN

Rear

e.g.) PW3337-03

D/A Output terminal* ⚠
(D/A OUTPUT)

PW3336-02 PW3336-03

PW3337-02 PW3337-03

The voltages listed below are output from each terminal. (p.88)

MAC address of the LAN

Power Inlet ⚠
(p.34)

Manufacturer's Serial No.
Model name number
Shows the serial number.
Do not remove this label, as it is required for product support.

External synchronization terminal
Connect a cable for synchronized measurement. (p.81)

GP-IB connector

PW3336-01 PW3336-03
PW3337-01 PW3337-03

Connect a communications cable when using the GP-IB interface. (p.131)

Voltage input terminal (U) ⚠
Input voltage signals. (p.28)

Current input terminal (I) ⚠
Input current signals. (p.28)

External control terminal ⚠
(EXT. CONTROL)
Input signals from an integration external control function. (p.85)

External current sensor input terminal ⚠
(CURRENT SENSOR)
Connect current sensors. (p.102)

RS-232C connector
Connect a communications cable when using the RS-232C interface. (p.118)

LAN connector
Connect a communications cable when using the LAN interface. (p.122)

***D/A OUTPUT terminals**

The following voltages are output from each terminal.

Level output: Level (analog) output is updated at an interval of approximately 200 ms.

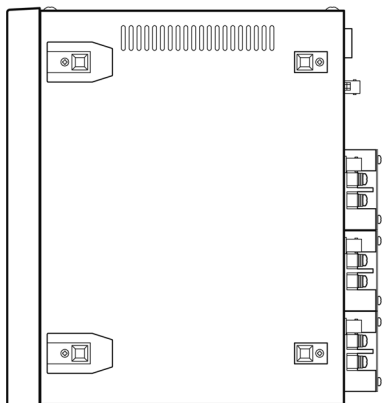
Instantaneous waveform output: The input waveform as sampled at a frequency of approximately 87.5 kHz is output.

High-speed active power level output: The active power for every cycle for the voltage or current set as the synchronization source is output.

U1/u1, U2/u2, U3/u3	Generates voltage level output or instantaneous voltage waveform output (set to one or the other) for each channel.
I1/i1, I2/i2, I3/i3	Generates current level output or instantaneous current waveform output (set to one or the other) for each channel.
P1/p1, P2/p2, P3/p3	Generates active power level output or instantaneous power waveform output (set to one or the other) for each channel. (P3/p3 is generated by PW3337-02 PW3337-03 only.)
Psum/Hi-Psum	Generates active power sum level output or high-speed level output (set to one or the other) for wiring modes other than 1P2W.
Hi-P1, Hi-P2, Hi-P3	Generates active power high-speed level output for each channel. (Hi-P3 is generated by PW3337-02 PW3337-03 only.)
DA1, DA2, DA3	Generates level output for three of the following parameters for each channel and as a sum (sum value) as selected by the user: Voltage, current, active power, apparent power, reactive power, power factor, phase angle, voltage total distortion, current total distortion, voltage crest factor, current crest factor, voltage ripple rate, current ripple rate, voltage frequency, current frequency, efficiency, current integration, and active power integration

Key processing is embedded in the instrument for production and verification purposes. For example, this processing includes transitioning to an adjustment mode. If key operation causes a message or indication that is not described in this manual to be displayed, immediately cycle the instrument's power.

Bottom panel

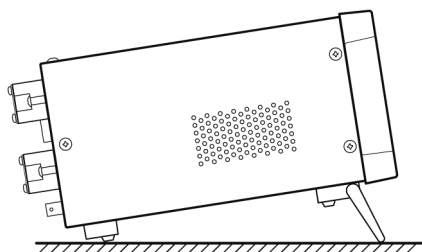


This instrument can be rack mounted.

See: Appendix 3 Rack Mounting(p. A11)

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

Left side



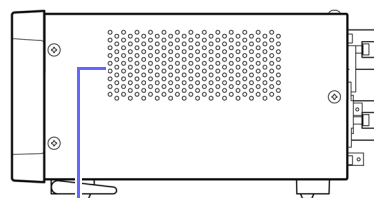
When using the stands

Open the stands until they clicks into place. Be sure to use both stands.

When folding up the stands

Fold up the stands until they click into place.

Right side



Vents

Keep clear of obstructions.



CAUTION

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

1.4 Measurement Workflow

1 Install the instrument, connect wires and cords, and turn on the instrument.

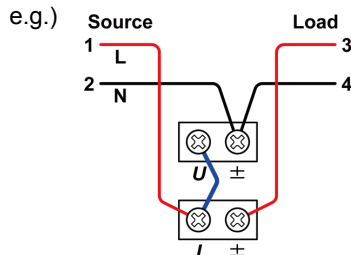
Installing the Instrument (p.5)

CHECKS

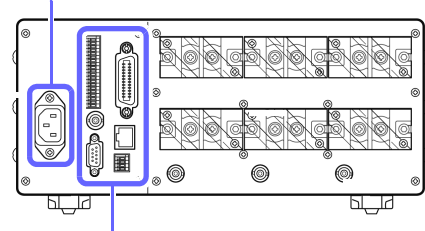
- Are the wires from the measurement targets shut off?
- Is the instrument turned off, and has the power cord been disconnected?

Connecting Wires and Cords

Connect the measurement lines to the instrument and then connect the power cord to the instrument.
Connect wires. (p.28)



Connect the power cord. (p.34)



CHECKS

- Is the instrument connected on the secondary side of the circuit breaker?
 - Does the circuit being used exceed 1000 V?
 - Does the voltage or current being measured exceed 1000 V or 70 A, respectively?
If so, use VT and CT.
 - Are appropriate types of wire being used to connect to the voltage and current input terminals?
Use solderless terminals that cover wiring with insulation. When using solderless terminals with exposed metallic parts, use wire with adequate dielectric strength and current capacity.
 - Has the wiring been shorted?
 - Are the input terminals loose?
 - Have wires been connected properly?
- Using D/A output (p.88)
 - Using synchronized control to conduct measurements with 2 instruments simultaneously (p.81)
 - Using external control to control integration (p.62)
 - Sending and receiving data with the RS-232C, LAN, and GP-IB interfaces (p.117)

When using one or more current sensors, see "3.9 Using a Current Sensor" (p.102).

Turning on the instrument (p.35)

Before turning on the instrument, verify that the wires have been connected properly one more time. After displaying the initial screen, the instrument will display input values under the current settings.

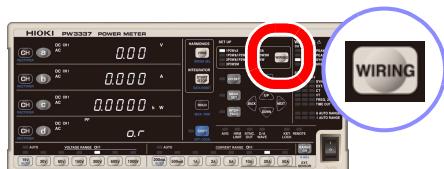
Allow the instrument to warm up for at least 30 minutes.

Perform zero-adjustment.

To fulfill the instrument's accuracy specifications, be sure to perform zero-adjustment for the voltage and current measured values.

2 Configure instrument settings. (These settings can also be changed during measurement.)

Selecting the wiring mode (p.40)



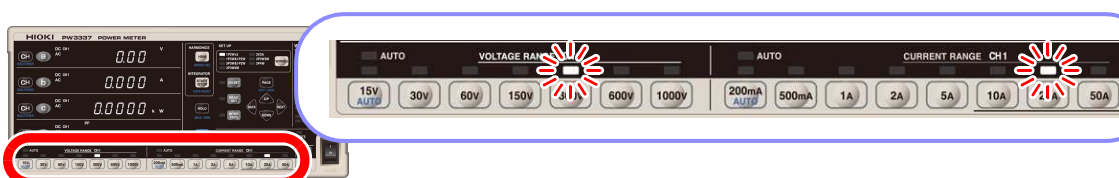
Setting the current input method (p.42)



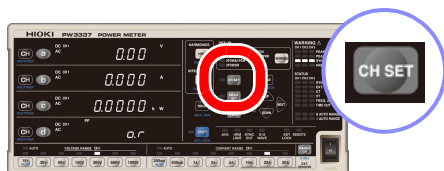
Selecting display parameters (p.44)



Selecting voltage and current ranges (p.48)



Setting the synchronization source (p.51)



Selecting rectifiers (p.47)



Configure the following settings as necessary:

■ **Setting the frequency measurement range**

[See:](#) "3.2.6 Setting the Frequency Measurement Range" (p.53)

■ **Addressing display value variation: Displaying average measured values**

[See:](#) "3.2.8 Displaying Measured Values as an Average (AVG: Averaging)" (p.57)

■ **Measuring voltages in excess of 1000 V: Using VT (PT) to make measurements**

[See:](#) "3.2.9 Setting the VT and CT Ratio" (p.59)

■ **Measuring currents in excess of 65 A: Using CT to make measurements**

[See:](#) "3.2.9 Setting the VT and CT Ratio" (p.59)

■ **When you wish to perform integration**

[See:](#) "3.3 Integration" (p.62)

■ **When you wish to measure harmonics**

[See:](#) "3.4 Viewing Harmonic Measured Values" (p.71)

■ **When you wish to measure efficiency**

[See:](#) "3.5 Measuring Efficiency" (p.78)

■ **When you wish to use the display hold, maximum value hold, and minimum value hold functions**

[See:](#) "3.10.1 Fixing Display Values (Display Hold)" (p.108)

"3.10.2 Displaying Peak, Minimum, and Maximum Values (Maximum Value Hold)" (p.109)

■ **When you wish to use D/A output**

PW3336-02

PW3336-03

PW3337-02

PW3337-03

[See:](#) "Examples of analog output"(p.98)

■ **When you wish to use the RS-232C interface**

[See:](#) "Setting the RS-232C communications speed"(p.119)

■ **When you wish to use the LAN interface**

[See:](#) "Setting the LAN's IP address"(p.123)

■ **When you wish to use the GP-IB interface**

PW3336-01

PW3336-03

PW3337-01

PW3337-03

[See:](#) "Setting the GP-IB address"(p.133)

■ **When you wish to perform synchronized measurement with multiple instruments**

[See:](#) "3.6 Performing Synchronized Measurement with Multiple Instruments (Multiple-instrument Synchronized Measurement)" (p.81)

3 Start measurement.

Activating power to the measurement lines

Measuring and outputting data

The instrument will display the measured values.

You can change the voltage and current range as well as display parameters during measurement.
Example:



■ When you wish to hold display values (p.108)

Press **HOLD**.

■ Displaying maximum and minimum values (p.109)

Press **HOLD** while holding down **SHIFT**.

4 Stop measurement.

Turning off the instrument

After disconnecting the cords from the object under measurement, turn off the instrument.

See: "2.4 Turning On the Instrument" (p.35)

About measured values

- The instrument's apparent power (S), reactive power (Q), power factor (λ), and phase angle (ϕ) are calculated based on the measured voltage (U), current (I), and active power (P). For the actual equations used, see "5.5 Calculation Formulas Specifications" (p.161). Values displayed by the instrument may differ from values displayed by measuring instruments that use different operating principles or equations.
- Display values are forcibly set to zero for voltage and current when the input is less than 0.5% of the measurement range and for the voltage peak value and current peak value when the input is less than 0.3% of the peak range (this is known as zero-suppression).
- Measured values may include an error component in measurements in which a terminal-to-ground voltage with a high frequency is input.
- Display values may exhibit variation in applications in which the frequencies of the voltage and current being measured differ.
- Measured values may include an error component when the instrument is used near a strong magnetic field such as that generated by a transformer or high-current path, a strong electric field generated by a radio or similar device, or a high-frequency magnetic field generated by a high-frequency current.

Measurement Preparations

Chapter 2

2.1 Installation and Connection Procedures

Please read "Operating Precautions" (p.5) carefully before installing or connecting the instrument.

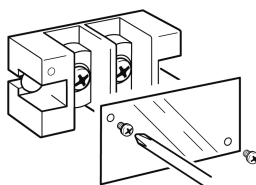
1

Install the instrument
(p.5)



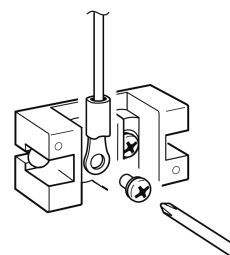
2

Remove the safety
covers.



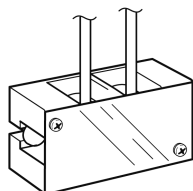
3

Connect the connection
cables to the voltage input
terminals and current input
terminals. (p.28)



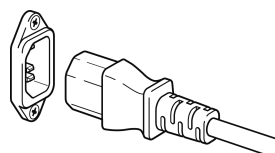
4

Reattach the safety
covers.



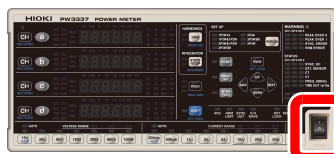
5

Connect the power cord.
(p.34)



6

Turn the power on
(p.35)



7

Activate power to the
measurement lines.

Configure the following settings as desired:

- 1: When you wish to use D/A output (p.88)
- 2: When you wish to perform synchronized measurement (p.81)
- 3: When you wish to use the RS-232C interface (p.118)
- 4: When you wish to use the GP-IB interface (p.131)
- 5: When you wish to use the LAN interface (p.122)
- 6: When you wish to use external control (p.85)
- 7: When you wish to use an external current sensor (p.102)

After use, deactivate power
to the measurement lines,
disconnect cables, and
turn off the instrument.

2.2 Connecting the Measurement Lines



Please read "Handling the Cables" (p.6) carefully before installing, connecting the instrument, or connecting the measurement LINES.



WARNING Verify that power to the measurement lines has been cut off before connecting the instrument to them.

To ensure accurate measurement

- When measuring power, the polarity of the voltage and current affects readings, so it is essential to connect the instrument to the measurement lines properly. Accurate measurement will not be possible if these connections are not made properly.
- Keep power supply wiring away from the instrument so that it is not affected by external magnetic fields.

If the object under measurement's voltage and current levels exceed the instrument's measurement range

You can then read primary-side input values directly by setting the VT ratio and CT ratio on the instrument.

See: "3.2.9 Setting the VT and CT Ratio"(p.59)



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

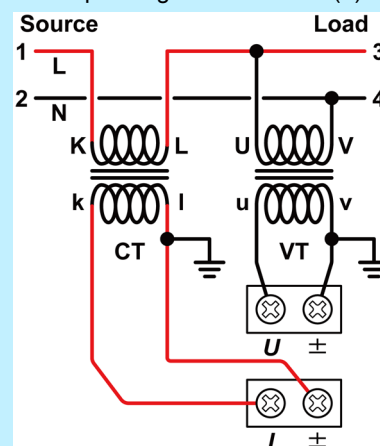


- When using an external VT (PT): Do not short the secondary side. Applying a voltage to the primary side while the secondary side is shorted will cause a large current to flow to the secondary side, causing it to burn up and resulting in a fire.
- When using an external CT: Do not leave the secondary side open. Allowing a current to flow to the primary side while the secondary side is open will cause a high voltage to occur on the secondary side, which is extremely dangerous.

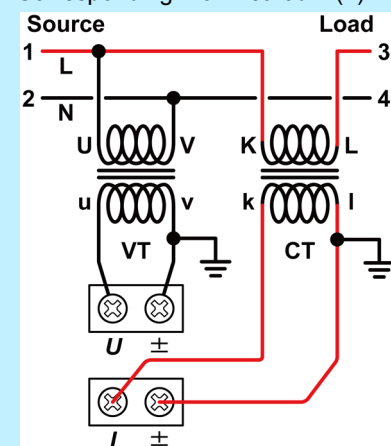
- Phase differences between an external VT (PT) and CT can introduce a large error component into power measurements. To ensure accurate power measurement, use a VT (PT) and CT with a small phase error in the frequency band of the circuit being used.
- To ensure safe operation, always ground the secondary side of the VT (PT) and CT (see figure below)

e.g.) 1P2W

Corresponding with Method 1 (1)



Corresponding with Method 2 (1)



Wire materials (Voltage input terminal, Current input terminal)**WARNING**

To avoid electric shock or a short-circuit at the input terminals, use solderless terminals that cover wiring with insulation.

(Screws for voltage input terminals and current input terminals: M6)

**CAUTION**

To avoid electric shock, use wiring with adequate dielectric strength and current capacity.

Connecting the measurement lines

Please read "Handling the Instrument" (p.6) carefully before connecting the instrument to the measurement lines.

⚠ WARNING

- Verify that power to the measurement lines has been cut off before connecting the instrument to them.
- To avoid electric shock or a short-circuit at the input terminals, use solderless terminals that cover wiring with insulation.
- To prevent instrument damage or electric shock, use only the screws (M6×12 mm) for securing the voltage input terminals and current input terminals in place and the screws (M3×6 mm) for securing the safety cover in place that shipped with the product. If you loose any screw or find that any screws are damaged, please contact your Hioki distributor for a replacement.

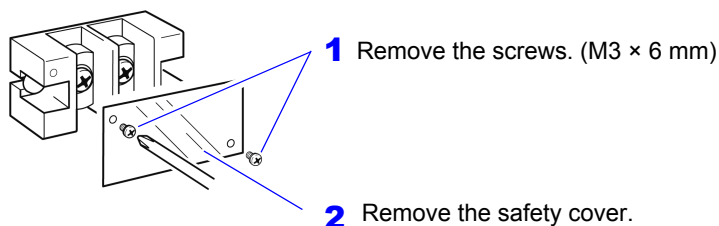
Safety covers

- The safety covers play a protective role by preventing contact with the terminals. Always attach the covers before using the instrument.
- Verify that no voltage is being applied to the measurement lines before attaching or removing the safety covers.

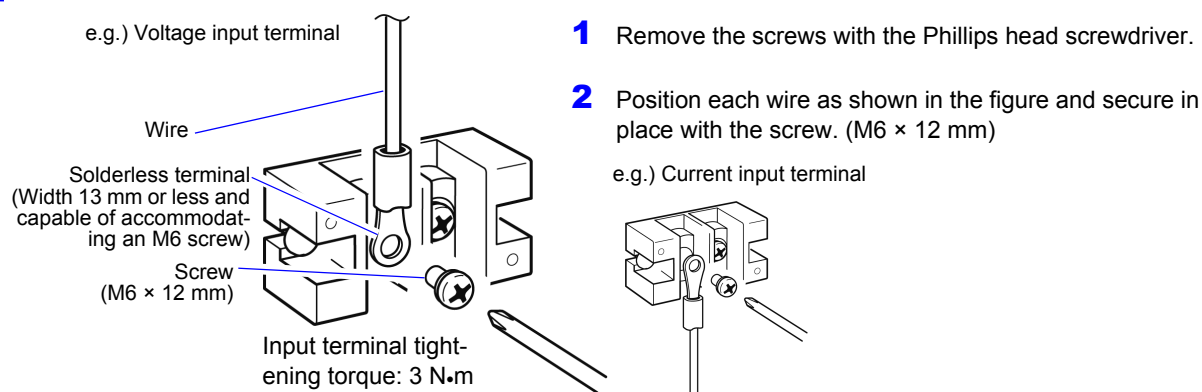
Connect cables to the instrument's voltage and current input terminals.

You will need: A Phillips head screwdriver with a No. 3 tip

1 Remove the safety covers from the voltage input terminals and current input terminals.

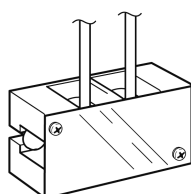


2 Connect the cables to the voltage input terminals and current input terminals.



- Use solderless terminals with a width of 13 mm or less.
- Tighten screws securely.

3 Attach the safety covers.



Attach each cover securely.

4 Connect the instrument to the measurement lines. (Example: 1P2W connection)

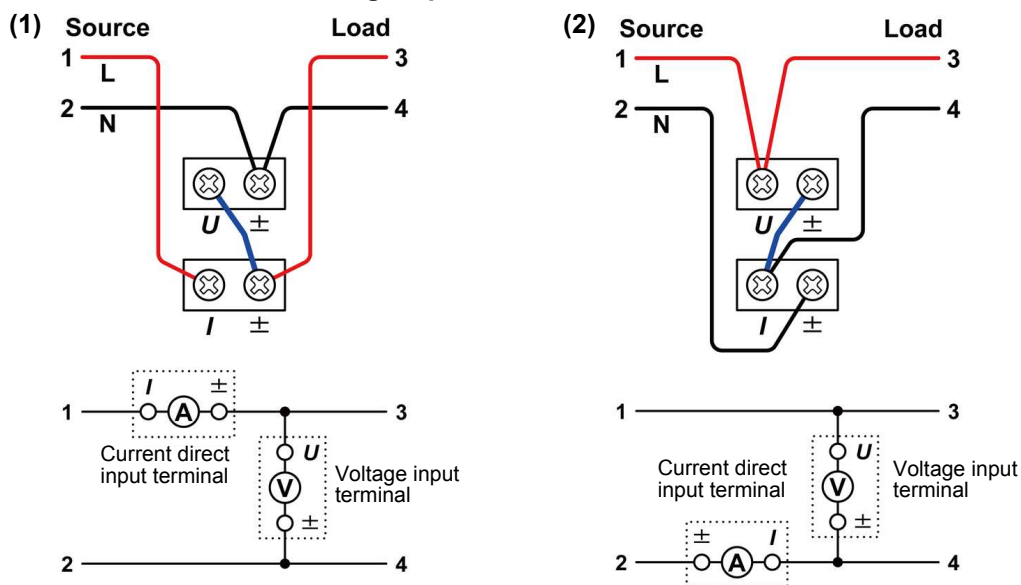
There are three types of connection methods:

1 When measuring measurement lines that are within the maximum input range, connect the instrument to the measurement lines directly.

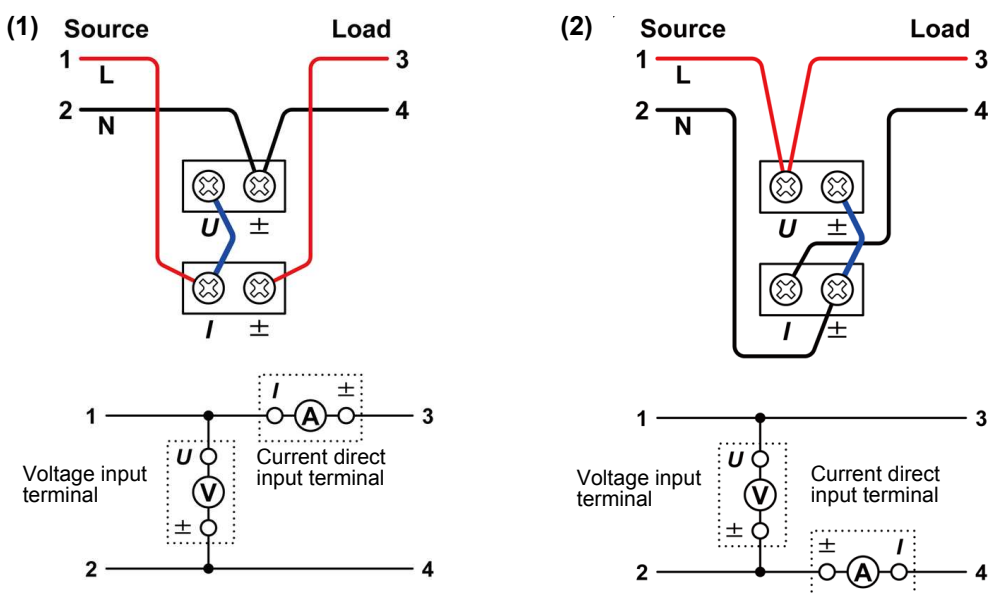
(For wiring modes other than 1P2W, see "Wiring diagrams for direct input (connections to instrument's terminal block)" (p.168) in "5.6 Wiring Specifications".)

Referring to "Selecting the connection method (Example: 1P2W connection)" (p.33), select the connection method with the lower power meter loss.

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



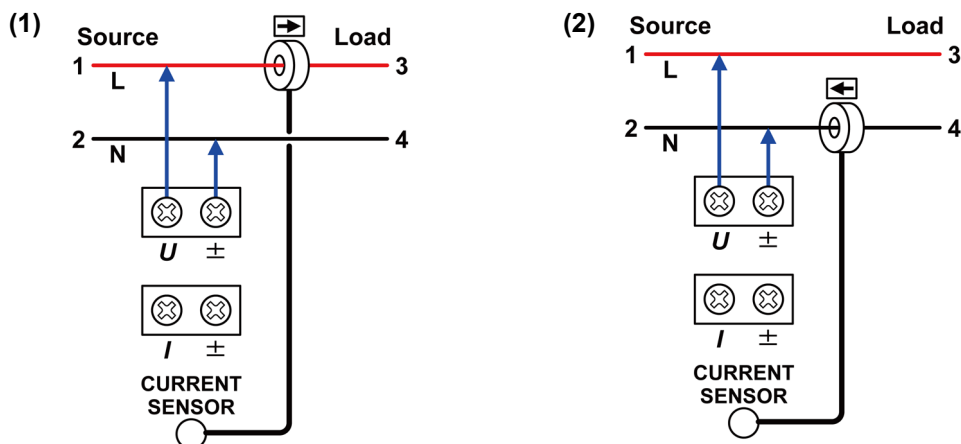
Method 2: Connect the current input terminals to the load side.



- When the instrument is affected by common-mode voltage, the error can be reduced by connecting the ammeter as shown in (2) under Method 1 and (2) under Method 2.
- If leaving the connections in place after measurement is complete, be sure to conduct a pre-measurement inspection (p.39) before making the next measurement. Such an inspection will enable you to prevent electric shock and measurement errors caused by breaks in cables, short-circuits, instrument failures, and other issues.

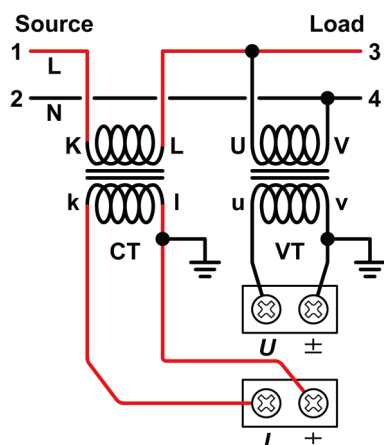
- 2** When measuring measurement lines that exceed the maximum input current Connect the instrument using a current sensor.

(For wiring modes other than 1P2W, see "Wiring diagrams when using an external current sensor" (p.173) in "5.6 Wiring Specifications".)

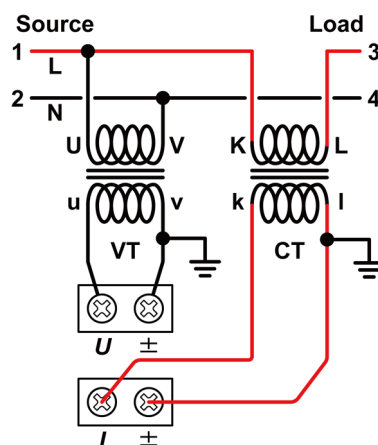


- 3** When measuring measurement lines that exceed the maximum input, connect the instrument using a VT (PT) and CT.

Corresponding with Method 1 (1)



Corresponding with Method 2 (1)



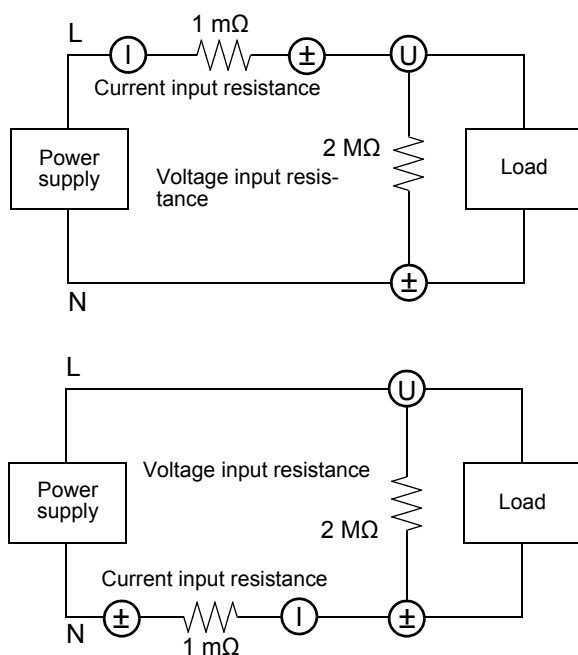
Selecting the connection method (Example: 1P2W connection)

Depending on the input level, the power meter's instrument loss may affect measured values. Select the connection method below with the lower loss.

Method 1

Connect the voltage input terminals to the load side.

$$\text{Loss} = (\text{Input voltage [V]})^2 \div 2 \text{ [M}\Omega\text{]}$$

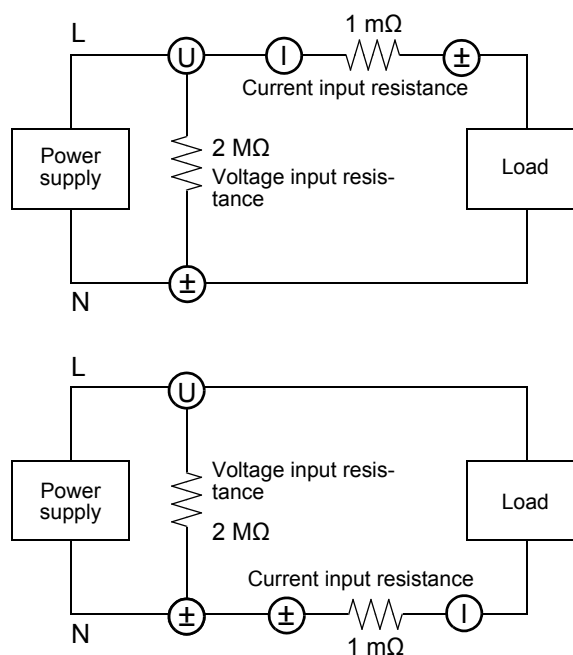


Power measurement includes loss from the voltage input terminals' input resistance.

Method 2

Connect the current input terminal to the load side.

$$\text{Loss} = (\text{Input current [A]})^2 \times 1 \text{ [m}\Omega\text{]}$$



Power measurement includes loss from the current input terminals' input resistance.

Example:

When measuring 12 V, 65 A

$$\text{Method 1: Loss} = (12 \text{ [V]})^2 \div 2 \text{ [M}\Omega\text{]} = 0.000072 \text{ [W]}$$

$$\text{Method 2: Loss} = (65 \text{ [A]})^2 \times 1 \text{ [m}\Omega\text{]} = 4.225 \text{ [W]}$$

Method 1 is characterized by lower loss and therefore allows more accurate measurement.

When measuring 1000 V, 10 mA

$$\text{Method 1: Loss} = (1000 \text{ [V]})^2 \div 2 \text{ [M}\Omega\text{]} = 0.5 \text{ [W]}$$

$$\text{Method 2: Loss} = (10 \text{ [mA]})^2 \times 1 \text{ [m}\Omega\text{]} = 0.0000001 \text{ [W]}$$

Method 2 is characterized by lower loss and therefore allows more accurate measurement.

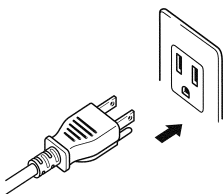
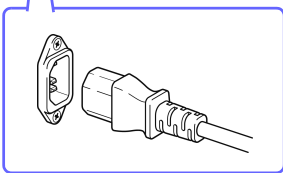
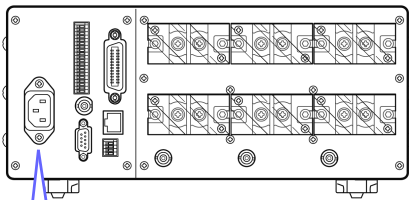
2.3 Connecting the Power Cord



WARNING

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

Rear



Turn off the power before disconnecting the power cord.

- 1** Check that the instrument's power switch is turned off.
- 2** Connect a power cord that matches the line voltage to the power inlet on the instrument.
- 3** Plug the other end of the power cord into an outlet.

2.4 Turning On the Instrument



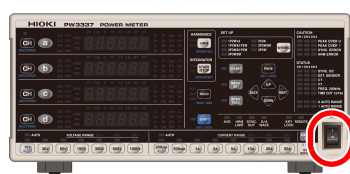
WARNING

Check the following once more before turning on the instrument:

- Are the instrument and peripheral equipment connected properly?
- Are any wires shorted between the voltage input terminals?
If so, an electric shock or short-circuit may result.

Turn the POWER switch on (|).

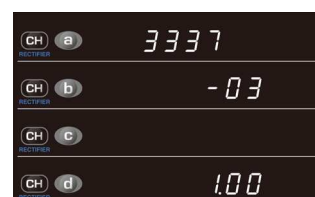
When the instrument is turned on, it will start a self-test. During the self-test, all indicators will light up, and then the model and version number will be displayed. Finally, hardware and saved data will be checked.



| : Power ON

Do not press any keys during the self-test.

Self-test (example: PW3337-03)



The product model and version number are displayed.

No errors

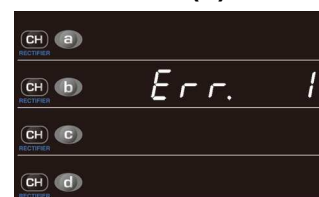


Display during zero-adjustment



Normal display (Measurement screen)

Error(s)



Any errors are displayed.

See: "6.2 Error Indication"(p.179)

- The current settings when the instrument was last turned off will be restored when it is turned on (backup function).
- If you're using the instrument for the first time, the default settings will be used. (p.112)
- To ensure high-precision measurement, allow the instrument to warm up for at least 30 minutes after turning it on.

2.5 Performing Zero-adjustment

Zero-adjustment (offset adjustment) is performed for voltage and current measured values after the instrument has warmed up for approximately 30 minutes in order to ensure that its measurement accuracy specifications are satisfied. Zero-adjustment consists of degaussing (DEMAG) its internal current input unit and performing offset adjustment for the voltage and current internal circuitry.

Although the zero-adjustment function operates automatically when the instrument is turned on, it should always be performed before starting measurement after the instrument has warmed up.

- Perform zero adjustment when there is no input to the instrument, for example after deactivating power to measurement lines. If zero-adjustment is performed while there is input to the instrument, the process will not complete normally, and you will be unable to make accurate measurements.
- Optional current sensors are not degaussed. Degauss current sensors as described in the instruction manual that came with each current sensor before performing the instrument's zero-adjustment process.

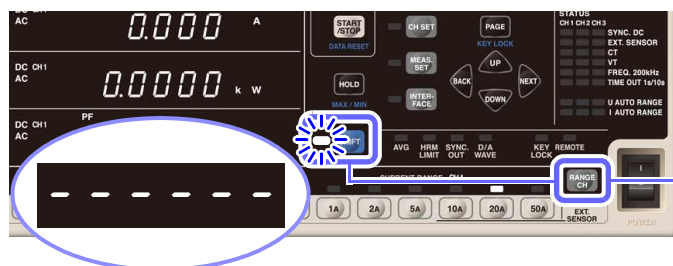
Zero-adjustment adjusts offsets within the following ranges:

Voltage circuitry: $\pm 10\%$ of the measurement range

Current direct input circuitry: $\pm 10\%$ of the measurement range

External current sensor input circuitry: $\pm 10\%$ of the measurement range

Operating time: Approx. 40 sec. (No measured values are displayed during zero-adjustment.)



- 1 Deactivate power to measurement lines and ensure that no input is being supplied to the instrument.
- 2 Press **SHIFT** to place the instrument in the shift state and then press **RANGE CH**.
- 3 Zero-adjustment will be performed, and the display will show **[- - - -]** for approximately 40 sec.

Once zero-adjustment is complete, the instrument will change to the normal measured value display and be ready for measurement.

- Zero-adjustment is performed for all channels, regardless of wiring mode or current input method.
- Settings cannot be changed, and integration cannot be started, during zero-adjustment.
- Zero-adjustment cannot be performed while integration is being performed or during display hold or maximum value/minimum value hold operation.
- To enable high-precision measurement, it is recommended to perform zero-adjustment at an ambient temperature that falls within the range specified in the specifications.
- Perform the zero-adjustment process with no input. The instrument will display **[Err.18]** if input is present when performing zero-adjustment. If this occurs, remove the input and then repeat the zero-adjustment process.
- It may be impossible to completely degauss the instrument's current input unit if current input in excess of the maximum input current is flowing to its current direct input terminals. In this case, perform zero-adjustment multiple times or cycle the instrument's power.

2.6 Activating Power to the Measurement Lines

Before activating power to the measurement lines



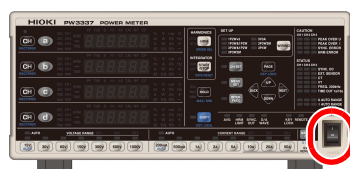
CAUTION

Before activating power to the measurement lines, turn on the instrument and verify that no errors are displayed.

If any measurement target lines are live before the instrument is turned on, the instrument may be damaged, or an error may be displayed when it is turned on.

See: "2.4 Turning On the Instrument"(p.35), "6.2 Error Indication"(p.179)

2.7 Turning Off the Instrument



○ : Power OFF

Once measurement is complete, turn off the instrument and disconnect any connection cables and other wiring.

Turn the **POWER** switch off (○).

Disconnect any connection cables and other wiring.

When power is turned on again, the display appears with the settings that existed when power was last turned off.

If leaving the connections in place after measurement is complete, be sure to conduct a pre-measurement inspection (p.39) before making the next measurement. Such an inspection will enable you to prevent electric shock and measurement errors caused by breaks in cables, short-circuits, instrument failures, and other issues.

Configuration and Measurement

Chapter 3

Please read **Operating Precautions (p.5)** carefully before using the instrument.
For more information about the measurement process, see "1.4 Measurement Workflow" (p.22).

3.1 Pre-Measurement Inspection

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

1 Peripheral Device Inspection

When using connection cables

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

Metal Exposed?
Screws are loose.

If there is any damage or the screws are loose, there is a risk of electric shock or short-circuit. Do not use the instrument. Replace the probe or cable with an undamaged equivalent. Securely retighten screws.

No Metal Exposed
Screws are tight.

2 Instrument Inspection

Is there any damage to the instrument?

Yes

If damage is evident, request repairs.

No

Turn on the instrument.

Is self-test information (model, version number) displayed?

No

There may be a break in the power cord, or there may be internal damage to the instrument. If the instrument is damaged, have it repaired.

Yes

Is the Measurement screen displayed after the self-test completes?

An error indication occurs (ERR)

The instrument may be damaged internally. Request repairs.
See: "6.2 Error Indication" (p.179)

Yes

Inspection complete

Allow the instrument to warm up for at least 30 minutes after turning it on.

Perform zero-adjustment.

Supply power to the measurement target.

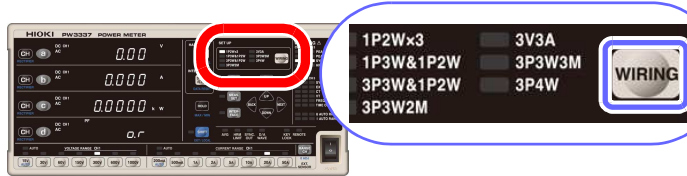
No measured value is displayed.
Measured value error

There may be a break in a connection cable or internal damage to the instrument, or the instrument may have been connected improperly. Stop supplying power to the measurement target immediately and repeat the inspection. If there is no problem with the wiring, have the instrument repaired.

3.2 Configuring Settings

3.2.1 Selecting the Wiring Mode

This section describes how to select the wiring mode according to the line being measured.



The wiring mode cycles through the values described below each time

WIRING is pressed.

In the shift state, the wiring mode cycles through the values in reverse order. The shift state is canceled approx. 2 seconds after pressing **WIRING**.

Display order

PW3336 PW3336-01 PW3336-02 PW3336-03
1P2W×2 → **1P3W** → **3P3W** → **3P3W2M** ...

PW3337 PW3337-01 PW3337-02 PW3337-03
1P2W×3 → **1P3W&1P2W** → **3P3W&1P2W** → **3P3W2M** → **3V3A** → **3P3W3M** → **3P4W** ...

Measurement characteristics

PW3336 PW3336-01 PW3336-02 PW3336-03 : Measurements are performed using the instrument's CH1 and CH2.

1P2W×2	Can be used to measure two 1-phase/2-wire circuits (default setting). Can be used to measure the efficiency given by the CH2 active power relative to the CH1 active power, or the efficiency given by the CH1 active power relative to the CH2 active power.
1P3W	Can be used to measure one 1-phase/3-wire circuit.
3P3W	Can be used to measure one 3-phase/3-wire circuit. Active power is measured by 2-power measurement method.
3P3W2M	Can be used to measure one 3-phase/3-wire circuit. Active power is measured by 2-power measurement method. The line voltage and phase current, which are not actually measured, are calculated using vector computation internally and displayed as the CH3 voltage and current.

PW3337 PW3337-01 PW3337-02 PW3337-03 : Measurements are performed using the instrument's CH1, CH2, and CH3.

1P2W×3	Can be used to measure three 1-phase/2-wire circuits (default setting). Can be used to measure the efficiency given by the CH3 active power relative to the CH1 active power, or the efficiency given by the CH1 active power relative to the CH3 active power.
1P3W&1P2W	Can be used to measure a total of two circuits: one 1-phase/3-wire circuit with CH1 and CH2, and one 1-phase/2-wire circuit with CH3. Can be used to measure the efficiency given by the CH3 active power relative to the sum of the CH1 and CH2 active power, or the efficiency given by the sum of the CH1 and CH2 active power relative to the CH3 active power.
3P3W&1P2W	Can be used to measure a total of two circuits: one 3-phase/3-wire circuit with CH1 and CH2, and one 1-phase/2-wire circuit with CH3. For one 3-phase/3-wire circuit, active power is measured by 2-power measurement method. Can be used to measure the efficiency given by the CH3 active power relative to the sum of the CH1 and CH2 active power, or the efficiency as given by the sum of the CH1 and CH2 active power relative to the CH3 active power.
3P3W2M	Can be used to measure one 3-phase/3-wire circuit. Active power is measured by 2-power measurement method. The line voltage and phase current, which are not measured with the 3P3W wiring mode, are calculated using vector computation internally and displayed as the CH3 voltage and current.

3V3A	Can be used to measure one 3-phase/3-wire circuit. Active power is measured by 2-power measurement method. The line voltage and phase current, which are not measured with the 3P3W wiring mode, are actually connected to CH3, measured, and displayed.
3P3W3M	Can be used to measure one 3-phase/3-wire circuit. Using the 3V3A connection as-is, the measured line voltage (Δ) is converted to the phase voltage (Y) by means of vector computation and displayed.
3P4W	Can be used to measure one 3-phase/4-wire circuit.

- When using a wiring mode other than 1P2W, parameters that can be set for individual channels (for example, measurement range) will be standardized using the CH1 settings.
- The wiring mode cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.

3.2.2 Selecting the Current Input Method

This section describes how to select the current input method. The instrument can perform measurement using the current input methods listed below. The default setting is the current direct input method (setting: OFF).



WARNING

- The external current sensor input terminals are not isolated. You must connect an optional current sensor in order to use them.
- Inputting a voltage other than output from an optional current sensor or inputting a primary-side voltage may damage the instrument or cause electric shock, a short-circuit, or bodily injury.



CAUTION

When using external current sensor input, disconnect all wiring from the current direct input terminals. Similarly, when using the current direct input terminals, disconnect all wiring from the external current sensor inputs.

The current input method serves to switch the input signals to the instrument's internal circuitry. Improperly configuring the current input method will make it impossible to make accurate measurements.

■ Current direct input method

- Connect wires and input current directly to the current direct input terminals.
- The input terminals are isolated.
- The maximum input current is 70 A, ± 100 Apeak.

■ External current sensor input method (p.102)

- Connect optional current sensors (voltage output) to the external current sensor input terminals to measure current.
- The input terminals are not isolated. Isolation is accomplished by the connected current sensors.
- The maximum input voltage for the external current sensor input terminals is 5 V, ± 7.1 Vpeak.
- TYPE1 and TYPE2 input is supported, depending on the current sensor specifications.

TYPE1 current sensors (p.104)

- 9661 Clamp on Sensor (rated current: 500 A AC)
- 9669 Clamp on Sensor (rated current: 1000 A AC)
- 9660 Clamp on Sensor (rated current: 100 A AC)
- CT9667 Flexible Clamp on Sensor (rated current: 500 A/5000 A AC range switchable)

TYPE2 current sensors (p.104)

Requires optional CT9555 series Sensor Unit and L9217 Connection Cord.

- CT6862-05 AC/DC Current Sensor (rated current: 50 A AC/DC)
- CT6863-05 AC/DC Current Sensor (rated current: 200 A AC/DC)
- 9709-05 AC/DC Current Sensor (rated current: 500 A AC/DC)
- CT6865-05 AC/DC Current Sensor (rated current: 1000 A AC/DC)
- CT6841-05 AC/DC Current Probe (rated current: 20 A AC/DC)
- CT6843-05 AC/DC Current Probe (rated current: 200 A AC/DC)
- CT6844-05 AC/DC Current Probe (rated current: 500 A AC/DC)
- CT6845-05 AC/DC Current Probe (rated current: 500 A AC/DC)
- CT6846-05 AC/DC Current Probe (rated current: 1000 A AC/DC)
- 9272-05 Clamp on Sensor (rated current: 20 A/200 A AC range switchable)

Example: When the PW3337 wiring mode is 1P2W×3



1 Press **CH SET**.



2 Press **PAGE** to display the settings screen shown to the left.

PW3336 PW3336-01 PW3336-02 PW3336-03 :

The screen varies depending on whether the wiring mode is 1P2W×2 or a mode other than 1P2W.

PW3337 PW3337-01 PW3337-02 PW3337-03 :

The screen varies depending on whether the wiring mode is 1P2W×3, 1P3W&1P2W and 3P3W&1P2W, 3P3W2M, or 3V3A and 3P3W3M and 3P4W.



3 Press **BACK** or **NEXT** to select the channel to set.

Areas **b**, **c**, and **d** on the display correspond to CH1, CH2, and CH3, respectively. The selected channel parameter will flash.



4 Press **UP** or **DOWN** to set the current input method.

Settings: **OFF** (direct input) → **TYPE1** (BNC terminal direct connection [using external sensors]) → **TYPE2** (connection via the CT9555 series and L9217 [using external sensors])

(When set to TYPE1 or TYPE2, the **EXT.SENSOR** lamp for the set channel will light up.)

5 Set the current input method for other channels as necessary.



6 Press **CH SET** to exit the settings.

The instrument will return to the normal measurement state.

- When using a wiring mode other than 1P2W, the current input method will be standardized using the CH1 settings.
- The current input method cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.

3.2.3 Selecting Display Content

This section describes how to select the information shown on the instrument's display.

- Selecting display parameters
- Selecting display channels
- Selecting rectifiers

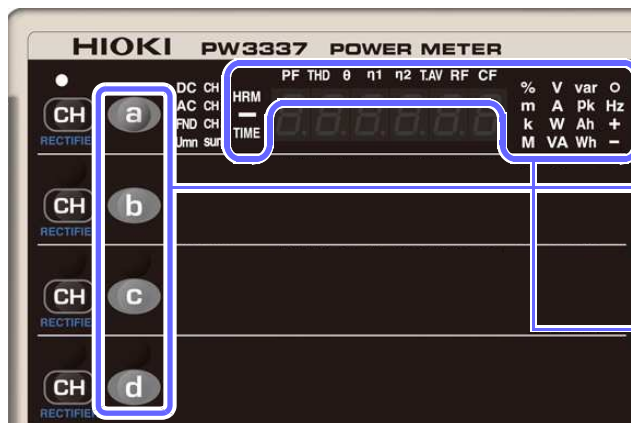
See: "Appendix 1 Detailed Specifications of Measurement Items (Display Items)" (p. A1)

Default settings

- a**: Voltage (V), CH1, AC+DC
- b**: Current (A), CH1, AC+DC
- c**: Active power (W), CH1, AC+DC
- d**: Power factor (PF), CH1, AC+DC

Selecting display parameters

This section describes how to select the parameters that are shown on the instrument's display.



Every time **a**, **b**, **c**, or **d** is pressed, the each relevant display is switched in the following order.

V → **A** → **W** → **VA** → **Vpk** → **Apk** → **VHz** → **AHz**
 → **var** → **Ah+** → **Ah-** → **Ah** → **Wh+** → **Wh-** → **Wh**
 → **°** → **PF** → **THD-V** → **THD-A** → **θ-V** → **θ-A** → **η1**
 → **η2** → **T.AV-A** → **T.AV-W** → **RF-V** → **RF-A** → **CF-V** → **CF-A** → **TIME** ...

In the shift state, the display parameters cycle through the values in reverse order. The shift state is canceled approx. 2 seconds after **a**, **b**, **c**, or **d** is released.

- The voltage and current are displayed from 0.5% to 140% of the range.
(When input is less than 0.5% of the range, zero-suppression forces a value of zero to be displayed.)
- Active power is displayed from 0% to 196% of the range.
(There is no zero-suppression function.)
- Some display parameters do not have measured values depending on the rectifier and wiring mode. In this case, the display will show [- - - -].

See: "Appendix 1 Detailed Specifications of Measurement Items (Display Items)" (p. A1)

If a warning lamp or “o.r.” is displayed



over-range

See: "3.11 When PEAK OVER, o.r, or the Unit Indicator Flashes" (p.114)

PEAK OVER

See: "3.11 When PEAK OVER, o.r, or the Unit Indicator Flashes" (p.114)

SYNC. ERROR

See: "3.2.6 Setting the Frequency Measurement Range" (p.53)

HRM ERROR

See: "3.4.4 About the HRM ERROR lamp" (p.77)

Display of integration elapsed time

From 0 sec. to 99 hr. 59 min. 59 sec.



From 100 hr. to 999 hr. 59 min.



From 1000 hr. to 9,999 hr. 59 min.



10,000 hr.

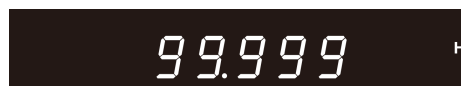


Display of frequency measurements

From 0.1000 Hz to 9.9999 Hz



From 10 Hz to 99.999 Hz



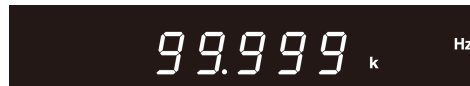
From 100 Hz to 999.99 Hz



From 1 kHz to 9.9999 kHz



From 10 kHz to 99.999 kHz



From 100 kHz to 220 kHz



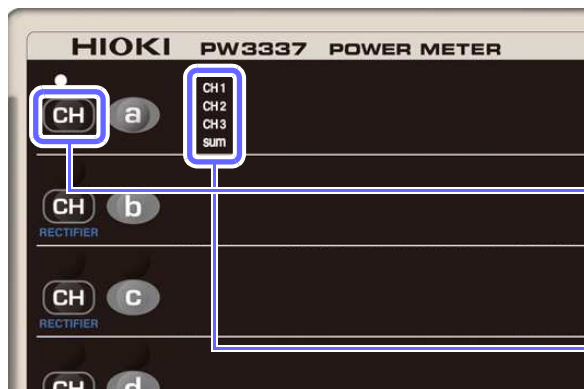
Because measured values become difficult to read near the point at which the display switches, the resolution is lowered by one digit.

Example: When changing from 1.0000 kHz to 999 Hz, values that would have been displayed as 999.00 Hz will be shown as 0.9990 kHz. When the frequency falls to 990 Hz or below, the display will switch to 990.00 Hz.

See: Specifications - Frequency measurement (p.143)

Selecting display channels

This section describes how to select the channels for which the selected parameters are displayed.



Default setting: CH1

Each time **CH** is pressed, the display will change as follows:

The indication “sum” refers to the sum for wiring modes other than 1P2W.

CH1 → **CH2** → **CH3** → **sum** ...

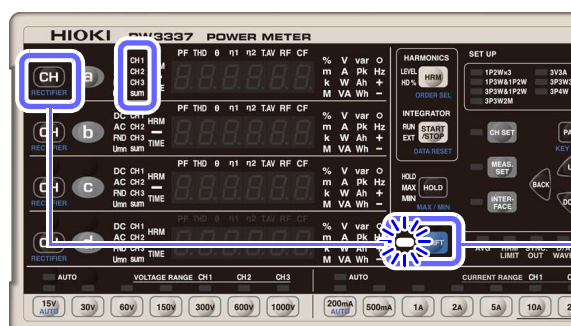
Some display parameters do not have measured values depending on the rectifier and wiring mode. In this case, the display will show [- - - -].

Selecting the rectifier

The instrument provides the five rectifiers listed below. Since data for all rectifiers is processed in parallel internally, the rectifier can be switched during measurement.

1. **DC AC** Displays true RMS values for all frequency bands that can be measured by the instrument for DC only, AC only, and mixed DC and AC voltage and current.
2. **DC AC**
Umn Displays mean value rectified RMS equivalents for all frequency bands that can be measured by the instrument for DC only, AC only, and mixed DC and AC voltage.
3. **DC** Displays simple average values (DC components only) for voltage and current. The calculated value (voltage DC value) × (current DC value) is displayed as the DC component for active power.
4. **AC** Displays calculated values given by the following equation as RMS values for the AC component only for voltage and current:

$$\sqrt{(AC+DC \text{ value})^2 - (DC \text{ value})^2}$$
 The calculated value given by (active power AC+DC value) - (active power DC value) is displayed as the active power value for the AC component only.
5. **FND** Extracts and displays the fundamental wave component only using harmonic measurement.



Default setting: AC+DC

Each time **CH** is pressed after pressing **SHIFT** to activate the shift state, the display will change as follows:

AC+DC → **AC+DC Umn** → **DC** → **AC** → **FND** ...

The shift state is canceled 2 seconds after **CH** is released.

- When the DC rectifier is selected, the voltage (U) and current (I) polarity will also be displayed (as a simple average).
- When the AC+DC or AC rectifier is selected, the voltage and current display values will always be positive.
- Some display parameters do not have measured values depending on the rectifier and wiring mode. In this case, the display will show [- - - -].

3.2.4 Selecting the Voltage and Current Ranges

**DANGER**

When input exceeds 1000 V, ± 1500 V_{peak}, or 70 A, ± 100 A_{peak}

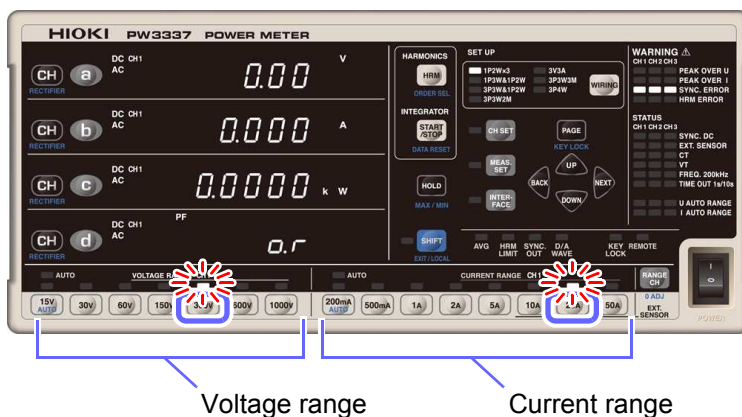
The maximum input voltage and maximum input current are 1000 V, ± 1500 V_{peak}, and 70 A, ± 100 A_{peak}. If the maximum input voltage or maximum input current is exceeded, immediately halt measurement, deactivate power to the measurement lines, and disconnect the cables from the instrument. Continuing measurement with maximum input exceeded will damage the instrument and cause bodily injury.

**CAUTION**

Do not input a voltage or current in excess of each measurement range. Doing so will damage the instrument.

Selecting the desired range

Press the range key to select the desired range. The lamp for the selected range key will light up, and the display value will change to reflect the selected range.



Default settings: 300 V voltage
20 A current
CH1

- When using a wiring mode other than 1P2W, the voltage and current ranges will be standardized using the CH1 settings.
- Allow the following amount of time to elapse before reading measured values after changing the range:
 - When the frequency of input set to the synchronization source is 10 Hz or greater
Approx. 0.6 s
 - When the frequency of input set to the synchronization source is less than 10 Hz
See: "3.2.7 Setting the Timeout" (p.55)
- Channels for which the range has changed will use the invalid data display [- - - -] until the data is updated.
- When measuring frequencies of 10 Hz or less, it is necessary to set the timeout to a value other than 0.1 sec.
See: "3.2.7 Setting the Timeout" (p.55)
- When using external current sensor input as the current input method, only the 10 A, 20 A, and 50 A keys are valid for selecting the current range. Pressing another range key will cause TYPE1 or TYPE2, indicating the type of external current sensor, to be displayed, and the range will not be changed.
- Ranges cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.

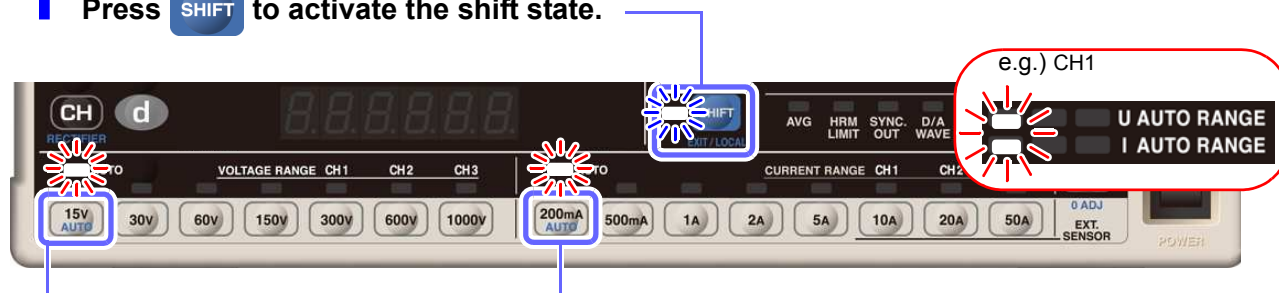
Automatically setting the range (auto-range operation)

Selecting auto-range operation causes the range to be switched automatically according to the measured value. This feature is convenient when you do not know the range.

■ Setting auto-range operation

See: Auto-range operation (p.50)

- 1 Press **SHIFT** to activate the shift state.



- 2 Press **15V AUTO** (to set the voltage range) or **200mA AUTO** (to set the current range).

- 3 The **AUTO** lamp and the lamp for the range being measured will light up.

You can check the auto-range setting for individual channels with the **STATUS**, **U AUTO RANGE** lamp and **I AUTO RANGE** lamp.

■ Canceling auto-range operation

Press any range key or **SHIFT** again and then press **15V AUTO** (voltage range) or **200mA AUTO** (current range).

- When the measurement range is set to auto-range operation, the output rate for analog and waveform output will vary with the range. When measuring lines for which measured values fluctuate excessively, exercise care so as not to mistake range conversions. It is recommended to use a fixed range for this type of measurement.
- Voltage and current are displayed from 0.5% to 140% of the range.
- Active power is displayed from 0% to 196% of the range.
- Display range values have an error of ± 1 dgt. due to calculation precision.
- When integration is started, auto-range operation will be canceled, and the range at that point will be fixed.
- The range will not change during display hold or maximum value/minimum value hold operation.

Auto-range operation

During auto-range operation, the range is switched as described below:

Range increased	Range decreased
- When the measured value exceeds 130% of the range - When the PEAK OVER lamp lights up	When the measured value is less than 15% of the range (The range will not be decreased when the value would exceed the peak value for the next lower range.)

The voltage and current display range is 0.5% to 140% of the range.

When the measured value is less than 0.5% of the range, the zero-suppression function forces the value to be displayed as zero.

When **Err. 12** or **Err. 16** is displayed

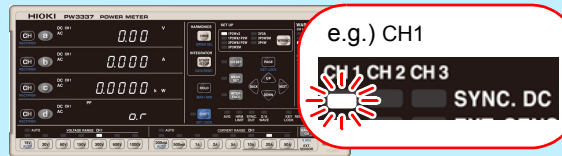
These errors indicate that the instrument was unable to switch ranges. Take the following action to address the error:

Error display	Status	Solution and reference for more information
Err. 12	During integration operation (RUN lamp lit up or flashing)	The range cannot be switched until the integrated value is reset (so that the RUN lamp turns off). See: Canceling integration (resetting integrated values) (p.65)
Err. 16	During display hold operation or maximum value/minimum value hold operation (HOLD , MIN , or MAX lamp lit up)	The range cannot be switched until this operation is canceled (so that the HOLD , MIN , or MAX lamp turns off). See: Canceling the display hold state (p.108) Returning to the instantaneous value display (p.109)

- When performing measurement using multiple channels, for example as with the 1P3W or 3P3W wiring modes, the range will be increased when any of the range increase conditions are satisfied.
- The range will be decreased when all of the range decrease conditions are satisfied.

3.2.5 Setting the Synchronization Source (SYNC)

This section describes how to set the synchronization source used to determine the cycle (between zero-cross events) that will be used as the basis for calculations. You can select from the following parameters for each connection: U1, U2, U3, I1, I2, I3, DC (fixed at 200 ms)



When the synchronization source is set to DC, the **SYNC. DC** lamp for the set channel will light up. When set to the voltage U or current I, the **SYNC. DC** lamp will not light up.



1 Press **CH SET**.



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

PW3336 PW3336-01 PW3336-02 PW3336-03 :

The screen varies depending on whether the wiring mode is 1P2W×2 or a mode other than 1P2W.

PW3337 PW3337-01 PW3337-02 PW3337-03 :

The screen varies depending on whether the wiring mode is 1P2W×3, 1P3W&1P2W and 3P3W&1P2W, 3P3W2M, or 3V3A and 3P3W3M and 3P4W.



3 Press **BACK** or **NEXT** to select the channel to set.

Areas **b**, **c**, and **d** on the display correspond to CH1, CH2, and CH3, respectively. The selected channel parameter will flash.



4 Press **UP** or **DOWN** to set the synchronization source.

Settings: **U1** → **I1** → **U2** → **I2** → **U3** → **I3** → **DC** ...

(Setting the source to DC will cause the **SYNC. DC** lamp for the set channel to light up.)

5 Set the synchronization sources for the other channels as necessary.



6 Press **CH SET** to exit the settings.

The instrument will revert to the normal measurement state.

- When using a wiring mode other than 1P2W, the synchronization source will be standardized using the CH1 settings.
 - Setting the synchronization source to DC when using AC input will cause display values to fluctuate, preventing accurate measurement. Set the synchronization source to a value other than DC when using AC input.
 - The voltage and current for each channel will use the same synchronization source as set.
 - Input for the parameters selected as synchronization sources must be at least 1% of the range.
 - When the **SYNC. ERROR** lamp is lit up, accurate measurement cannot be performed.
 - Even when the **SYNC. ERROR** lamp is not lit up, accurate measurement cannot be performed if the synchronization source input signal is in any of the following states:
 1. When a signal with a frequency higher than the frequency measurement range (zero-crossing filter) is being input
 2. When a measured voltage or current of an AC component of an input signal is less than 1% of each relevant range.
 3. When a measured voltage or current of an AC component of an input signal is greater than 130% of each relevant range.
 4. When a signal with a frequency component within the frequency measurement range (zero-crossing filter) other than the measurement signal's fundamental wave frequency is superposed

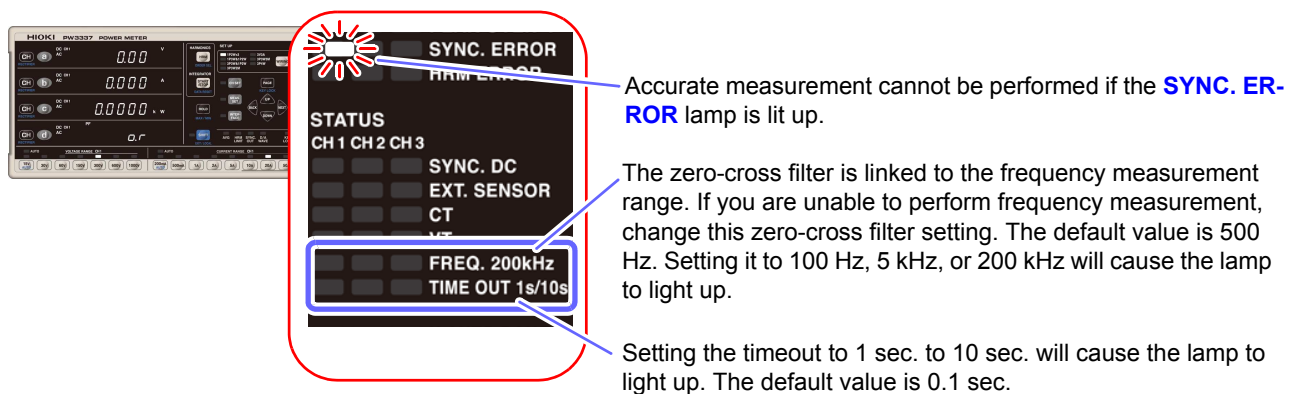
Example: When the frequency measurement range (zero-crossing filter) is 500 Hz, if a signal for which zero-crosses occur at a frequency of less than 500 Hz (a modulation signal, noise, etc.) is input on top of a 50 Hz input signal
 - The synchronization source cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.
 - When using a timeout setting other than 0.1 sec. (1 sec. or 10 sec.) for channels with the 1P2W×2 or 1P2W×3, 1P3W&1P2W, and 3P3W&1P2W wiring modes, set the synchronization source to the voltage or current for a channel whose timeout has been set to 1 sec. or 10 sec.
- Example: If the CH1 and CH3 timeout setting is 0.1 sec. and the CH2 timeout is 10 sec. while using the 1P2W×3 wiring mode, set the CH2 synchronization source to U2 or I2.

3.2.6 Setting the Frequency Measurement Range

When the synchronization source is set to voltage (U) or current (I), the **SYNC. ERROR** lamp will light up if the synchronization signal cannot be acquired. When the **SYNC. ERROR** lamp is lit up, the instrument will not be able to perform accurate measurement.

The instrument incorporates 100 Hz, 500 Hz, 5 kHz, and 200 kHz low-pass filters for use in switching the cut-off frequency (i.e., as a zero-crossing filter). These filters also vary with the frequency measurement range. If the **SYNC. ERROR** lamp lights up, change this zero-cross filter setting.

Additionally, accurate measurement also cannot be performed when using input of a low frequency of less than 10 Hz (with a repeating period of greater than 0.1 sec.) because each input cycle will exceed the instrument's calculation processing interval (causing a timeout). The **SYNC. ERROR** lamp will also light up at this time. In this case, set the instrument's timeout setting to 1 sec. (for an input frequency of less than 10 Hz) or 10 sec. (for an input frequency of less than 1 Hz).

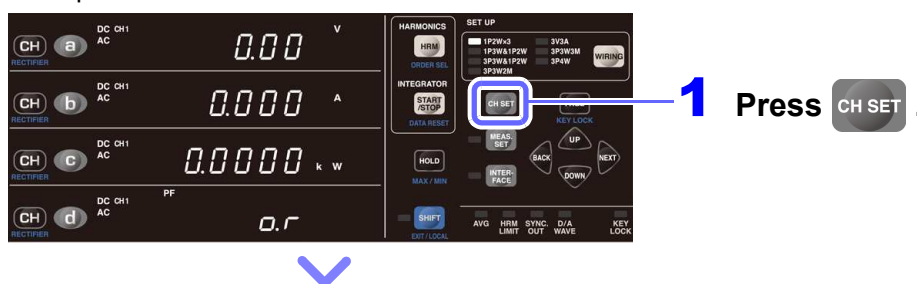


Zero-cross filter setting	Description
100 Hz *	Use this setting primarily when measuring standard AC power supply equipment (50 Hz, 60 Hz) and when using the fundamental wave (100 Hz or less) on the secondary side of an inverter as the synchronization signal. FREQ. 200kHz lamp on
500 Hz	Use this setting primarily when measuring standard AC power supply equipment (50 Hz, 60 Hz, 400 Hz) and when using the fundamental wave on the secondary side of an inverter as the synchronization signal. (Default setting) FREQ. 200kHz lamp off
5 kHz *	Use this setting when using frequency input in excess of 500 Hz as the synchronization signal. FREQ. 200kHz lamp on
200 kHz	Use this setting when using frequency input in excess of 5 kHz as the synchronization signal. FREQ. 200kHz lamp on

* Setting the frequency measurement range to 100 Hz or 5 kHz requires that the firmware with the version number 1.10 or later be installed.

See "2.4 Turning On the Instrument" (p.35) on how to check the installed firmware version number.

Example: 1P2W×3





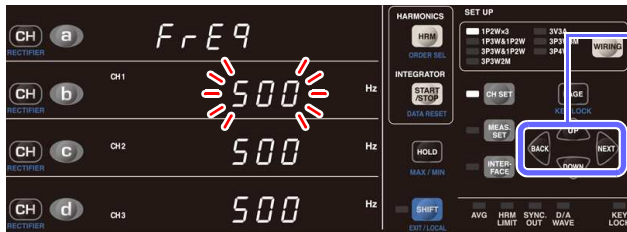
2 Press **PAGE** to display the setting screen shown to the left.

PW3336 PW3336-01 PW3336-02 PW3336-03 :

The screen varies depending on whether the wiring mode is 1P2W×2 or a mode other than 1P2W.

PW3337 PW3337-01 PW3337-02 PW3337-03 :

The screen varies depending on whether the wiring mode is 1P2W×3, 1P3W&1P2W and 3P3W&1P2W, 3P3W2M, or 3V3A and 3P3W3M and 3P4W.



3 Press **BACK** or **NEXT** to select the channel to set.

Areas **b**, **c**, and **d** on the display correspond to CH1, CH2, and CH3, respectively. The selected channel parameter will flash.



4 Press **UP** or **DOWN** to set the zero-cross filter (100 Hz/ 500 Hz/ 5 kHz/ 200 kHz).

Settings: **500Hz**→**200kHz**→**100Hz**→**5kHz** ...

5 Set the zero-cross filter for other channels as necessary.



6 Press **CH SET** to exit the settings.

The instrument will revert to the normal measurement state.

- When using a wiring mode other than 1P2W, the frequency range will be standardized using the CH1 settings.
- When measuring an AC signal with a frequency lower than 500 Hz, it is recommended to set the frequency measurement range (zero-crossing filter) to 100 Hz or 500 Hz to reduce the noise component at 500 Hz and higher. Select the frequency measurement range depending on frequencies of signals to be measured.
- Frequency measurement accuracy is guaranteed for sine wave input that is at least 20% of the frequency measurement source's measurement range. The instrument may not be able to perform frequency measurement accurately for other inputs (when the measurement signal is distorted, when there is a superposed noise component, etc.).
- The frequency measurement range cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.
- If a frequency of a signal to be measured is above the selected frequency measurement range, the instrument may not be able to perform frequency measurement accurately. Change the frequency measurement range to an appropriate one.
(Example) If a signal with a frequency above 500 Hz is input into the instrument with the frequency measurement range that is set to 500 Hz, change the range to 5 kHz or higher.

3.2.7 Setting the Timeout

Setting	Description
0.1 sec.	Use this setting when the frequency of the input set as the synchronization source is 10 Hz or higher. (Default setting) TIME OUT 1s/10s lamp off
1 sec.	Use this setting when the frequency of the input set as the synchronization source is less than 10 Hz. TIME OUT 1s/10s lamp on
10 sec.	Use this setting when the frequency of the input set as the synchronization source is less than 1 Hz. TIME OUT 1s/10s lamp on

Example: 1P2W×3



1 Press **CH SET**.



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

PW3336 PW3336-01 PW3336-02 PW3336-03 :

The screen varies depending on whether the wiring mode is 1P2W×2 or a mode other than 1P2W.

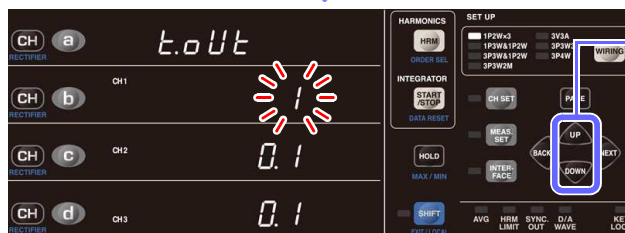
PW3337 PW3337-01 PW3337-02 PW3337-03 :

The screen varies depending on whether the wiring mode is 1P2W×3, 1P3W&1P2W and 3P3W&1P2W, 3P3W2M, or 3V3A and 3P3W3M and 3P4W.



3 Press **BACK** or **NEXT** to select the channel to set.

Areas **b**, **c**, and **d** on the display correspond to CH1, CH2, and CH3, respectively. The selected channel parameter will flash.



4 Press **UP** or **DOWN** to set the timeout (0.1 sec., 1 sec., or 10 sec.).

Settings: **0.1** → **1** → **10** ...

5 Set the timeout for other channels as necessary.



6 Press **CH SET** to exit the settings.

The instrument will revert to the normal measurement state.

- When using a wiring mode other than 1P2W, the timeout setting will be standardized using the CH1 setting.
- When using a timeout setting other than 0.1 sec. (1 sec. or 10 sec.) for channels with the 1P2W×2 or 1P2W×3, 1P3W&1P2W, and 3P3W&1P2W wiring modes, set the synchronization source to the voltage or current for a channel whose timeout has been set to 1 sec. or 10 sec.
Example: If the CH1 and CH3 timeout setting is 0.1 sec. and the CH2 timeout is 10 sec. while using the 1P2W×3 wiring mode, set the CH2 synchronization source to U2 or I2.
- When the frequency of the input to the set synchronization source is less than 5 Hz, the data update (display update) timing will vary with the frequency of the input to the synchronization source.
Example: If the frequency of the input to the synchronization source is 0.8 Hz, the data (display) will be updated every $1/0.8 = 1.25$ sec.
- If the **SYNC. ERROR** lamp lights up when the timeout has been set to a value other than 0.1 sec., the display will be updated once every time the timeout set time elapses.
- The timeout cannot be changed while integration is being performed or during display hold or maximum value/minimum value hold operation.
- The instrument is equipped with the high-pass filters to avoid influences from DC components of input signals during detecting cycles.
The characteristics (time constant) of high-pass filters are switched with the settings of timeout.
If the range is changed, or an input voltage or current including a DC component rapidly changes, it will take a time until a measured value becomes stable.
Please wait and read the measured value after the following time. The required time varies depending on the timeout setting.
 - When the timeout is set to 0.1 s: approximately 0.6 sec
 - When the timeout is set to 1 s: approximately 10 sec
 - When the timeout is set to 10 s: approximately 40 sec

3.2.8 Displaying Measured Values as an Average (AVG: Averaging)

In averaging operation, the number of averaging iterations for measured values is set, and averaged data is displayed. Used when measured values fluctuate, causing excessive variation in the display, this setting provides a way to reduce variation in display values.

The instrument uses simple averaging to average measured values. The display update interval varies with the number of averaging iterations setting.

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

Xk: Measured value every 200 ms (instrument display update rate)
n: Number of averaging iterations

Number of averaging iterations and display update interval

Number of averaging iterations	1 (OFF)	2	5	10	25	50	100
Display update interval	200 msec.	400 msec.	1 sec.	2 sec.	5 sec.	10 sec.	20 sec.

Parameters that are averaged

The five parameters of voltage, current, active power, apparent power, and reactive power are averaged, while the power factor and phase angle are calculated from averaged data.

Parameters that are not averaged

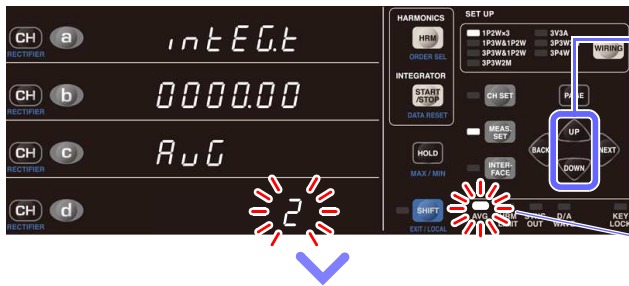
Voltage frequency, current frequency, current integration, active power integration, integration time, voltage waveform peak value, current waveform peak value, efficiency, voltage crest factor, current crest factor, time average current, time average active power, voltage ripple rate, current ripple rate, all harmonic measurement parameters

Example: Set the number of average iterations to 2

1 Press **MEAS. SET**.

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

3 Press **BACK** or **NEXT** until the number in the **d** area flashes.



- 4 Press **UP** or **DOWN** and set the number in the **d** area to 2. The number 2 will flash, and the **AVG** lamp will light up.

When the setting is changed to a value other than the default setting of 1, the **AVG** lamp will light up.



- 5 Press **MEAS. SET** to exit the settings.

The instrument will revert to the normal measurement state.

- Averaging will restart when there is a change that affects measured values, for example in the wiring mode, range, integration reset, or number of averaging iterations. Since no average value exists immediately after the start of averaging, the invalid data display [- - - -] will be shown. During this period of time, the **AVG** lamp will flash.
- If the instantaneous value changes to [o.r] while average values are being displayed, the display will change to [o.r].
- The unit may flash during measurement.
See: "3.11.3 When the Unit Indicator Flashes" (p.116)
- Averaging processing is performed for voltage, current, active power, apparent power, and reactive power.
- The power factor and phase angle are calculated from the averaged active power and apparent power.

If the number of average iterations does not flash

This indicates that the number of averaging iterations cannot be changed.

After pressing **MEAS. SET** to exit the setting, perform the following procedure:

Status	Solution and reference for more information
During integration operation (RUN lamp lit up or flashing)	Averaging cannot be changed until the integrated value is reset (so that the RUN lamp turns off). See: Canceling integration (resetting integrated values) (p.65)
During display hold operation or maximum value/minimum value hold operation (HOLD , MIN , or MAX lamp lit up)	Averaging cannot be changed until this operation is canceled (so that the HOLD lamp turns off). See: Canceling the display hold state (p.108) Returning to the instantaneous value display (p.109)

3.2.9 Setting the VT and CT Ratio

When inputting a voltage in excess of the instrument's maximum input voltage of 1000 V or a current in excess of its maximum input current of 70 A, use an external VT (PT) or CT, respectively. This section describes how to set the ratio (VT ratio or CT ratio) when using an external VT or CT. Even when using an external current sensor, it is necessary to set the CT ratio.

The VT and CT ratios can be set separately for each wiring mode.

By setting the VT and CT ratios, you can read primary-side current and voltage input values directly.



CAUTION

Exercise caution if the VT or CT lamp lights up as this state indicates that a voltage or current that differs from the indicated measured value is being input.

VT ratio setting range

0.1 to 0.9, 1.0 to 9.9, 10.0 to 99.9, 100.0 to 999.9, (1000)

(If the VT ratio display changes to 0.0, 00.0, 000.0, the instrument internally multiplies measured values by a VT ratio of 1000.

CT ratio setting range

0.001 to 0.009, 0.010 to 0.099, 0.100 to 0.999, 1.000 to 9.999, 10.00 to 99.99, 100.0 to 999.9 (1000)

(If the CT ratio display changes to 0.0, 00.0, 000.0, the instrument internally multiplies measured values by a CT ratio of 1000.

If the VT or CT ratio does not flash

This indicates that the VT or CT ratio cannot be changed.

After pressing **CH SET** to exit the setting, perform the following procedure:

Status	Solution and reference for more information
During integration operation (RUN lamp lit up or flashing)	The VT and CT ratios cannot be changed until the integrated value is reset (so that the RUN lamp turns off). See: Canceling integration (resetting integrated values) (p.65)
During display hold operation or maximum value/minimum value hold operation (HOLD , MIN , or MAX lamp lit up)	The VT and CT ratios cannot be changed until this operation is canceled (so that the HOLD lamp turns off). See: Canceling the display hold state (p.108) Returning to the instantaneous value display (p.109)

When using a wiring mode other than 1P2W, the CT and CT ratios will be standardized using the CH1 setting.

Setting the VT ratio



1 Press **CH SET**.



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



3 Press **BACK** or **NEXT** until the first digit of the VT ratio for the channel you wish to set flashes.



4 Press **UP** or **DOWN** to set the VT ratio.

To change digits:

Press **BACK** or **NEXT** until the digit you wish to set flashes and then set the digit.

To set the VT ratio for another channel:

Return to Step 3.



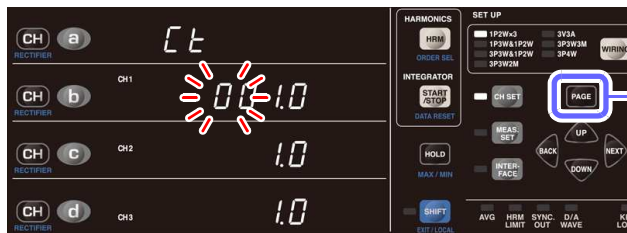
5 Press **CH SET** to exit the settings.

The instrument will revert to the normal measurement state.

Setting the CT ratio



1 Press **CH SET**.



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



3 Press **BACK** or **NEXT** until the first digit of the CT ratio for the channel you wish to set flashes.

To move the decimal point:

Press **BACK** or **NEXT** until the decimal point flashes, and press **UP** or **DOWN** to exit the setting.



4 Press **UP** or **DOWN** to set the CT ratio.

To change digits:

Press **BACK** or **NEXT** until the digit you wish to set flashes and then set the digit.

To set the VT ratio for another channel:

Return to Step 3.



5 Press **CH SET** to exit the settings.

The instrument will revert to the normal measurement state.

3.3 Integration

The instrument performs integration for the current and active power in the positive direction (Ah+, Wh+), in the negative direction (Ah-, Wh-), and as sums (Ah, Wh) simultaneously for all channels and can display the integrated value for each. Integration can be started and stopped, and the integrated value can be reset, using either the instrument's keys or the external control function. Additionally, by setting the integration time, it is possible to perform timer integration in 1-minute units from 1 minute to 10,000 hours (approximately 417 days). Furthermore, it is also possible to measure the time average current and time average active power as calculated from the integrated value at that point in time and the integration elapsed time while integration is being performed.

The effective measurement range for integration is the effective measurement range for current or active power, and values up to the maximum effective peak voltage or maximum effective peak current (until the **PEAK OVER U** or **PEAK OVER I** lamp lights up) are integrated as valid data.

Maximum effective peak voltage: $\pm 600\%$ of the voltage range (up to ± 1500 V_{peak} for the 300 V, 600 V, and 1000 V ranges)

Maximum effective peak current: $\pm 600\%$ of the current range (up to ± 100 A_{peak} for the 20 A and 50 A ranges)

Example: When performing DC current integration using the 1 A range, the current display value (A) will change to [o.r] when 1.4 A is exceeded, but the effective measurement range for current integration (Ah) extends from ± 10 mA (1% of the 1 A range) to ± 6 A, so the values will be integrated as valid data.

Display parameters and descriptions related to integration

Display parameter	Description
Ah +	Positive current integrated value
Ah -	Negative current integrated value
Ah	Sum of current integrated values
Wh +	Positive active power integrated value
Wh -	Negative active power integrated value
Wh	Sum of active power integrated values
TIME	Integration elapsed time
T.AV A	Time average current (obtained by dividing the sum of current integrated values by the integration elapsed time)
T.AV W	Time average active power (obtained by dividing the sum of active power integrated values by the integration elapsed time)

Displaying the rectifier and integrated values

Internally, the following integrated values are all integrated simultaneously, regardless of the rectifier. Consequently, integrated value data with simultaneity can be obtained simply by switching the display parameter.

Current (Ah+, Ah-, Ah)

Rectifier	Integration operation and display
AC+DC AC+DC Umn	The results of integrating current RMS value data (display values) once every display update interval (200 ms) are displayed as integrated values.
DC	The results of integrating sampled instantaneous data separately by polarity are displayed as integrated values.
AC FND	[- - - -] (no integrated data) is shown.

Active power (Wh +, Wh -, Wh)

Rectifier	Integration operation and display
AC+DC AC+DC Umn	The results of integrating active power values calculated once for every cycle of the selected synchronization source separately by polarity are displayed as integrated values. This rectifier is used to integrate active power values of cyclic waveforms.
DC	The results of integrating sampled instantaneous data separately by polarity are displayed as integrated values. This rectifier is used to integrate active power values of non-cyclic waveforms such as a DC or others. (When a waveform to be measured includes both a DC and an AC component, the integrated value will not be an integration of only a DC component.)
AC FND	[- - - -] (no integrated data) is shown.

Wiring mode and displayed integrated values

PW3336 PW3336-01 PW3336-02 PW3336-03

● : Installed? - : Not installed

Wiring mode	Rectifier	Channel	Ah+	Ah-	Ah	Wh+	Wh-	Wh
1P2W×2	AC+DC AC+DC Umn	1, 2	-	-	●	●	●	●
		sum	-	-	-	-	-	-
	DC	1, 2	●	●	●	●	●	●
		sum	-	-	-	-	-	-
1P3W	AC+DC AC+DC Umn	1, 2	-	-	●	●	●	●
		sum	-	-	-	●	●	●
	DC	1, 2	●	●	●	●	●	●
		sum	-	-	-	-	-	-
3P3W	AC+DC AC+DC Umn	1, 2	-	-	●	-	-	-
		sum	-	-	-	●	●	●
	DC	1, 2, sum	-	-	-	-	-	-
3P3W2M	AC+DC AC+DC Umn	1, 2, 3	-	-	●	-	-	-
		sum	-	-	-	●	●	●
	DC	1, 2, 3, sum	-	-	-	-	-	-

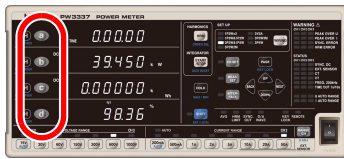
PW3337 PW3337-01 PW3337-02 PW3337-03

● : Installed? - : Not installed

Wiring mode	Rectifier	Channel	Ah+	Ah-	Ah	Wh+	Wh-	Wh
1P2W×3	AC+DC AC+DC Umn	1, 2, 3	-	-	●	●	●	●
		sum	-	-	-	-	-	-
	DC	1, 2, 3	●	●	●	●	●	●
		sum	-	-	-	-	-	-
1P3W&1P2W	AC+DC AC+DC Umn	1, 2	-	-	●	●	●	●
		sum	-	-	-	●	●	●
		3	-	-	●	●	●	●
	DC	1, 2, 3	●	●	●	●	●	●
		sum	-	-	-	-	-	-
3P3W&1P2W	AC+DC AC+DC Umn	1, 2	-	-	●	-	-	-
		sum	-	-	-	●	●	●
		3	-	-	●	●	●	●
	DC	1, 2, sum	-	-	-	-	-	-
		3	●	●	●	●	●	●
3P3W2M 3V3A	AC+DC AC+DC Umn	1, 2, 3	-	-	●	-	-	-
		sum	-	-	-	●	●	●
	DC	1, 2, 3, sum	-	-	-	-	-	-
3P3W3M 3P4W	AC+DC AC+DC Umn	1, 2, 3	-	-	●	●	●	●
		sum	-	-	-	●	●	●
	DC	1, 2, 3, sum	-	-	-	-	-	-

The display will indicate invalid data [- - - -] for combinations for which no integrated value exists.

Display method



Press **a** through **d** to select the display parameter.

See: "3.2.3 Selecting Display Content" (p.44)

Method for starting and stopping integration and resetting integrated values

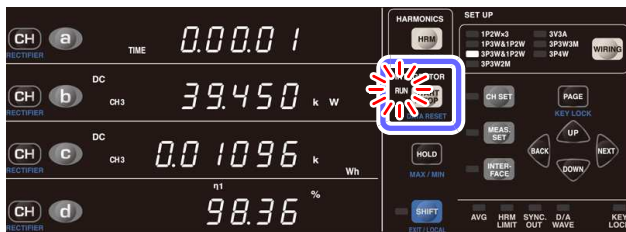
The following four methods are used to start and stop integration and reset integrated values:

- Using **START/STOP**
- Using **communications** (see the Communications Command Instruction Manual)
- Using **external control** (p.85)
- Using **synchronized control** (p.81)

This section describes use of **START/STOP**.

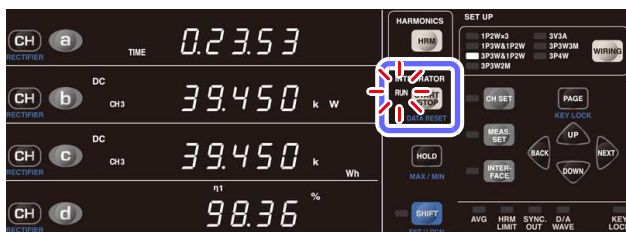
For more information about integration using communications, external control, or synchronized control, refer to each section indicated above.

Starting integration



- 1 Verify that the instrument is in the integration reset state (**RUN** and **EXT** lamps off).
- 2 Press **START/STOP**.
- 3 Integration will start, and the **RUN** lamp will light up.

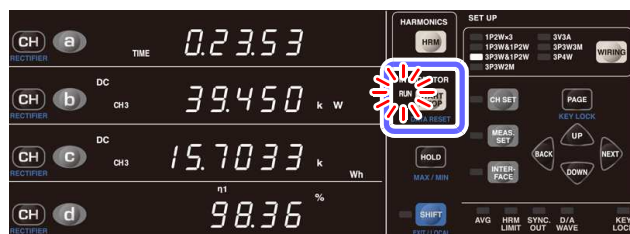
Stopping integration



- 1 Press **START/STOP** while the **RUN** lamp is lit up (indicating that the instrument is performing integration).
- 2 Integration will stop, and the **RUN** lamp will flash.

Starting integration while adding to previous integrated values (additional integration)

Pressing **START/STOP** while the **RUN** lamp is flashing (indicating that integration is stopped) causes integration to start while adding to previous integrated values.

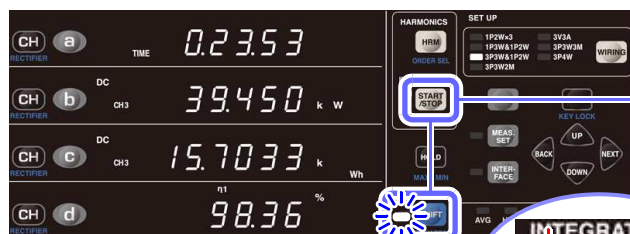


- 1 Press **START/STOP** while the **RUN** lamp is flashing.
- 2 Additional integration will start, and the **RUN** lamp will light up.

As long as the integrated values are not reset, integration will be repeated using the previous state.

Canceling integration (resetting integrated values)

Settings cannot be changed while integration is being performed (while the **RUN** lamp is lit up or flashing). To cancel integration, use the following procedure. When integration is canceled, measurement results up to that point will be reset.



- 1 Press **START/STOP** to stop integration.
- 2 Integration will stop, and the **RUN** lamp will flash.



- 3 Press **SHIFT** to place the instrument in the shift state and then press **START/STOP**.
- 4 Integration will be reset, and the **RUN** lamp will turn off.

Performing integration after setting an integration time (timer integration)

You can perform integration for a certain period of time by setting the integration time. The instrument allows the integration time to be set in 1-minute increments from 1 minute to 10,000 hours.



Example integration time setting displays

Integration time	Setting display
1 min.	0000.01
59 min.	0000.59
1 hr. 8 min.	0001.08
9,999 hr. 59 min.	9999.59
10,000 hr.	0000.00 (Default setting)



1 Press **MEAS. SET**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **BACK** or **NEXT** to select the digit of the time you wish to set, which will start flashing.



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

Setting range: 0 to 9,999.59

(When the setting display indicates 0000.00, integration will be performed until 10,000 hours has elapsed.)



5 Press **MEAS. SET** to exit the settings.

The instrument will return to the normal measurement state.

If the integration time does not flash

This indicates that the integration time cannot be changed. Take the following action to address the issue:

Status	Solution and reference for more information
During integration operation (RUN lamp lit up or flashing)	The integration time cannot be changed until the integrated value is reset (so that the RUN lamp turns off). See: Canceling integration (resetting integrated values) (p.65)
During display hold operation or maximum value/minimum value hold operation (HOLD , MIN , or MAX lamp lit up)	The integration time cannot be changed until this operation is canceled (so that the HOLD lamp turns off). See: Canceling the display hold state (p.108) Returning to the instantaneous value display (p.109)

Integration precautions

- (1) When integration starts, the voltage and current auto-range setting will be canceled, and measurement will be fixed to the range in effect when integration started. Set the range so that the **PEAK OVER U** (overvoltage input alarm) lamp and **PEAK OVER I** (overcurrent input alarm) lamp do not light up during integration.
If the **PEAK OVER U** lamp or **PEAK OVER I** lamp lights up during integration, the integrated value will not be accurate. In this case, the Ah or Wh unit will flash until integrated values are reset (DATA RESET).
(Even if the current or active power measured value is [o.r] [over-range], measured values falling within the range such that the **PEAK OVER U** and **PEAK OVER I** lamps do not light up will be integrated.)
- (2) Equipment constraints due to the integrating meter
Some parameters cannot be set or changed in the integration state (when the **RUN** lamp is lit up) or in the integration stopped state (when the **RUN** lamp is flashing). If a change is not supported, [Err.12] will be displayed for approximately 1 second.
See: Constraints during integration operation (p.145)
- (3) If an integrated value reaches 999,999 MWh, or if the integration elapsed time reaches 10,000 hours, integration will stop, and you will not be able to restart it. ([Err.14] will be displayed for approximately 1 second.) In this case, restart integration after pressing the **SHIFT** key followed by the **START/STOP** (DATA RESET) key to reset integrated values (causing the **RUN** lamp to turn off).
See: Canceling integration (resetting integrated values) (p.65)
- (4) Maximum value and minimum value measurement will also restart when integration starts. If an integration reset is performed, maximum value and minimum value measurement will also restart. Averaging will also restart when integration is reset.
- (5) When a system reset is performed, integration operation will stop, and the instrument will revert to its factory settings.
See: "3.10.4 Initializing the Instrument (System Reset)" (p.112)
- (6) If the power goes out during integration, integration will stop when power is restored.
- (7) If the timeout is set to 10 seconds and a signal of 1 Hz or less is input, a single measurement may take about 10 seconds.
- (8) Before starting integration synchronized measurement, reset integrated values on both the master and slave. To perform a reset that is synchronized to the master, it is necessary for integration operation on the slave to be in the stopped or reset state.
- (9) Starting integration without first performing a reset results in additional integration.
- (10) Synchronization- and external control-based integration cannot be mixed on the slave. Always terminate external control and reset integration when performing synchronization-based integration.
- (11) When the slave's integration time setting is shorter than the master's integration time setting, stop timing cannot be synchronized since the slave's integration will stop first.
- (12) When performing synchronized measurement, once integration start/stop is performed on the slave, it may not be possible to synchronize operation, even if the same operation is performed on the master.
- (13) When performing integrated measurement using synchronized control, a difference of up to 0.7 sec. per hour may occur between the master's integration elapsed time display value (TIME) and the slave's integration elapsed time display value.

- When performing integration for an extended period of time, it is recommended to back up the instrument with an uninterruptible power supply (UPS). The instrument's maximum rated power is 40 VA or less. Ensure that you use a UPS with adequate capacity. When using a UPS to power the instrument, do not use a unit that produces rectangular wave or pseudo-sine wave output. Doing so may damage the instrument.
- After power is restored, measured values may be offset for reasons related to the instrument's internal circuitry. In this case, perform zero-adjustment after eliminating all input to the instrument, for example by deactivating power to measurement lines.
- Continuing to input voltage or current signals after an outage has caused the instrument to lose power may damage the instrument.

3.3.1 Integrated Value Display Format

The following tables describe the format of integrated values after they have been reset. When the number of digits in an integrated value increases, the number of digits in the format will also increase. Similarly, when the number of digits in an integrated value decreases, the number of digits in the format will also decrease.

No fewer digits may be used than in the format in the integration reset state.

Current integration format

Current range	200 mA, 500 mA	1 A, 2 A, 5 A	10 A, 20 A, 50 A
Reset value	00.0000 mAh	000.000 mAh	0.00000 Ah

Power integration format (1P2W, 150 V range)

Current range	200 mA, 500 mA	1 A, 2 A, 5 A	10 A, 20 A, 50 A
Voltage range			
150 V	0.00000 Wh	00.0000 Wh	000.000 Wh

Approach to integration reset values

One-tenth of the value of the display format for the current range or active power range is used as the integrated value format at reset.

	Display format	Integrated value format	Reset value
3 W range	3.0000 W	300.000 mWh	000.000 mWh
9 kW range	9.0000 kW	900.000 Wh	000.000 Wh

Even when a VT ratio and CT ratio are set, 1/10 of the corresponding display format is used as the integrated value format.

	Display format	Integrated value format	Reset value
600 W range 15 V × 10 (VT) × 200 mA × 20 (CT)	600.00 W	60.0000 Wh	00.0000 Wh

3.4 Viewing Harmonic Measured Values

The instrument displays the results of harmonic analysis for each channel's voltage, current, and active power. Since all calculation processing is performed in parallel internally, you can obtain harmonic measured values with simultaneity with other measured values simply by switching display parameters.

Additionally, when the synchronization frequency is 45 Hz to 66 Hz, the instrument can perform harmonic measurement that complies with IEC 61000-4-7:2002.

3.4.1 Setting the Synchronization Source

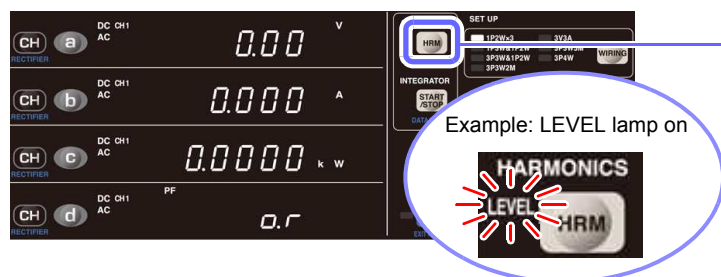
Set the synchronization source for the harmonic measurement to be performed with the instrument as described in "3.2.5 Setting the Synchronization Source (SYNC)" (p.51). The source can be set separately for each wiring mode.

3.4.2 Method for Displaying Harmonic Measurement Parameters

The following table summarizes the instrument's harmonic measurement parameters and corresponding display methods:

Display mode	Normal display LEVEL lamp off HD% lamp off	Harmonic level display LEVEL lamp on HD% lamp off	Harmonic content percentage display LEVEL lamp off HD% lamp on
Measurement items	- Total harmonic voltage distortion - Total harmonic current distortion - Fundamental wave voltage RMS value - Harmonic current RMS value - Fundamental wave active power - Fundamental wave apparent power - Fundamental wave reactive power - Fundamental wave power factor - Fundamental wave voltage/current phase difference - Inter-channel voltage fundamental wave phase difference - Inter-channel current fundamental wave phase difference	- Harmonic voltage RMS value - Harmonic current RMS value - Harmonic active power 0th to 50th order	- Harmonic voltage content percentage - Harmonic current content percentage - Harmonic active power content percentage 0th to 50th order

Switching display modes



1 Press **HARM**.

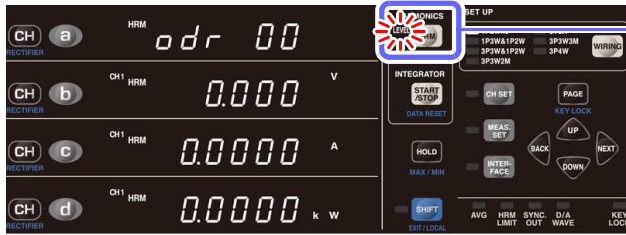
2 You can check the display mode based on the **LEVEL** lamp and **HD%** lamp state.

	LEVEL lamp	HD% lamp
Normal display	Off	Off
Harmonic level display	On	Off
Harmonic content percentage display	Off	On

The following two harmonic display methods are available:

Displaying components for the same order as the display parameter (default state)

Example: If [odr 1] or similar is shown in area a on the display while displaying harmonics



- 1 Press **HRM** to display **LEVEL**.
- 2 Press **UP** or **DOWN** to change the order.

The component for the order that is specified in the area a will be shown for areas b, c, and d on the display.

Settings: **0 to 50**

Allocating components for different orders to areas a, b, c, and d on the display



- 1 Press **HRM** after pressing **SHIFT** to place the instrument in the shift state.
- 2 Press **UP** or **DOWN** to change the order.

If all display areas indicate [--], the "display the same order component" setting will be used.

Settings: **0 to 50** → -- → **0 to 50**

To move areas a, b, c, or d on the display :

Press **BACK** or **NEXT** to select the display area you wish to set so that it flashes and then set as desired.

- 3 Press **HRM** or **SHIFT** to exit the Order Setting screen.



By allocating different orders to areas a through d on the display and then setting all the areas to the same measurement parameter, you can observe changes in each order.

Parameters shown with normal display parameters

Total harmonic voltage distortion (**THD V %**), total harmonic current distortion (**THD A %**)

Example: THD V%



Press **a** through **d** to display **THD V %** or **THD A %** in the display area.

Parameters shown as fundamental wave parameters (displayed as RECTIFIER FND)

Fundamental wave voltage (**FND V**), fundamental wave current (**FND A**), fundamental wave active power (**FND W**), fundamental wave apparent power (**FND VA**), fundamental wave reactive power (**FND var**), fundamental wave power factor (**FND PF**), fundamental voltage/current phase difference (**FND °**), inter-channel voltage fundamental wave phase difference (**FND θ V °**), inter-channel current fundamental wave phase difference (**FND θ A °**)

Example: FND V



1 Press **SHIFT** to place the instrument in the shift state and then press **CH** to display **FND**.

2 Press **a** through **d** to change the display parameter.

Measurement parameters displayed using harmonic analysis (harmonic level, content percentage, rectifier FND [fundamental wave component]) are not averaged by the averaging function.

Parameters shown as harmonic level (LEVEL)

Harmonic voltage RMS value (**HRM V**), harmonic current RMS value (**HRM A**), harmonic active power (**HRM W**)



- 1 Press **HRM** to display **LEVEL**.
- 2 Press **a**, **UP**, or **DOWN** to change the harmonic order.

After pressing **a** or **UP**:

01 (1st order: fundamental wave component) → **02** (2nd order) → ... → **49** (49th order) → **50** (50th order) → **00** (0th order: DC component) → **01**

After pressing **CH** or **DOWN**:

01 → **00** → **50** → **49** → ... → **02** → **01**

- 3 The harmonic level will be displayed in areas **b** through **d** on the display.

(Default display)

Display area b: CH1 harmonic voltage RMS value

Display area c: CH1 harmonic current RMS value

Display area d: Harmonic active power

- 4 Press **CH** to change the channel being shown.
- 5 Press **b** through **d** to change the display parameter.

■ Parameters displayed as harmonic content percentage (HD %)

Harmonic voltage content percentage (HRM V %), harmonic current content percentage (HRM A %), harmonic active power content percentage (HRM W %)

Display method



- 1 Press **HRM** to display **HD %**.
- 2 Press **a**, **UP**, or **DOWN** to change the harmonic order.

After pressing **a** or **UP**:

01 (1st order: fundamental wave component) → **02** (2nd order) → ... → **49** (49th order) → **50** (50th order) → **00** (0th order: DC component) → **01**

After pressing **CH** or **DOWN**:

01 → **00** → **50** → **49** → ... → **02** → **01**

- 3 The harmonic content percentage will be displayed in areas **b** through **d** on the display.

(Default display)

Display area b: CH1 harmonic voltage content percentage

Display area c: CH1 harmonic current content percentage

Display area d: Harmonic active power content percentage

- 4 Press **CH** to change the channel being shown.
- 5 Press **b** through **d** to change the display parameter.

■ Parameters that can be downloaded with communications functionality

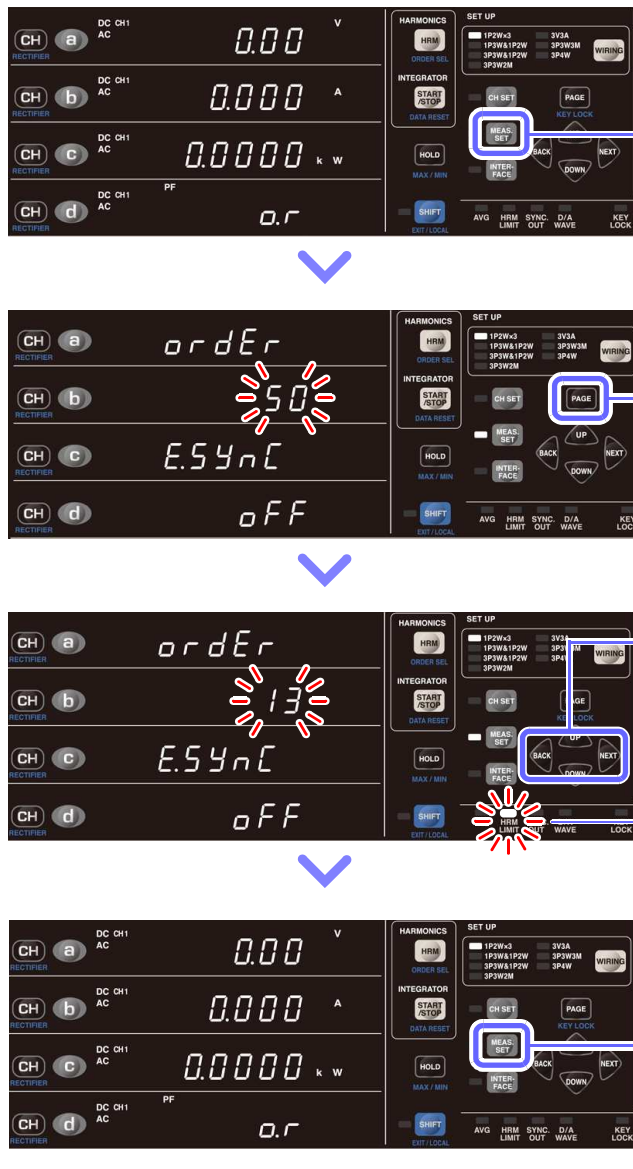
Harmonic voltage phase angle, harmonic current phase angle, harmonic voltage/current phase difference

These parameters cannot be displayed. They can only be downloaded using communications functionality. (See the Communications Command Instruction Manual.)

3.4.3 Setting the Analysis Order Upper Limit

The instrument allows you to set an upper limit value for the harmonic analysis order. One example of how this setting can be used is to set a limit on the uppermost order during total harmonic distortion (THD) measurement. The setting applies to all channels.

Example: To set the harmonic analysis order upper limit value to 13



1 Press **MEAS. SET**.

2 Press **PAGE** to display the settings screen shown to the left.

3 Press **UP** or **DOWN** to set the upper limit value for analysis.

The **HRM LIMIT** lamp will light up if you set a value other than 50.

4 Press **MEAS. SET** to exit the settings.

The instrument will return to the normal measurement state.

The harmonic level and content percentage displays will include data up to the 50th order, even if the upper limit is set to a value other than 50.

If the upper limit does not flash

Failure of the value to flash indicates that the upper limit value cannot be changed. Take the following action to address the issue:

Status	Solution and reference for more information
During integration operation (RUN lamp lit up or flashing)	The upper limit value cannot be changed until the integrated value is reset (so that the RUN lamp turns off). See: Canceling integration (resetting integrated values) (p.65)
During display hold operation or maximum value/minimum value hold operation (HOLD , MIN , or MAX lamp lit up)	The upper limit value cannot be changed until this operation is canceled (so that the HOLD , MIN , or MAX lamp turns off). See: Canceling the display hold state (p.108) Returning to the instantaneous value display (p.109)

3.4.4 About the HRM ERROR lamp

The HRM ERROR lamp lights up to indicate that the synchronization frequency range has been exceeded when unable to synchronize during harmonic measurement.



Accurate harmonic measurement cannot be performed while the **HRM ERROR** lamp is lit up.

The HRM ERROR lamp lights up when the instrument is unable to perform harmonic analysis due to the frequency range being exceeded, noise, or for other reasons. The invalid data display [- - - -] will be shown at this time.

3.5 Measuring Efficiency

The instrument can calculate the ratio of active power values for different wires and display the result as the efficiency η [%]. This function can be used to measure the efficiency across inputs and outputs of devices such as power supply equipment and inverters.

This section details the wiring modes for which efficiency can be measured as well as the calculation formulas used.



When performing synchronized measurement using two instruments, efficiency cannot be measured between the two instruments. Efficiency can only be measured on a single instrument between the wires listed below.

PW3336 PW3336-01 PW3336-02 PW3336-03

Wiring mode	Efficiency calculation formula	Description
1P2W×2	$\eta_1 = P_2 / P_1 \times 100$ [%]	The ratio of the CH2 (1-phase/2-wire) active power to the CH1 (1-phase/2-wire) active power
	$\eta_2 = P_1 / P_2 \times 100$ [%]	The ratio of the CH1 (1-phase/2-wire) active power to the CH2 (1-phase/2-wire) active power

PW3337 PW3337-01 PW3337-02 PW3337-03

Wiring mode	Efficiency calculation formula	Description
1P2W×3	$\eta_1 = P_3 / P_1 \times 100$ [%]	The ratio of the CH3 (1-phase/2-wire) active power to the CH1 (1-phase/2-wire) active power
	$\eta_2 = P_1 / P_3 \times 100$ [%]	The ratio of the CH1 (1-phase/2-wire) active power to the CH3 (1-phase/2-wire) active power
1P3W&1P2W	$\eta_1 = P_3 / P_{sum} \times 100$ [%]	The ratio of the CH3 (1-phase/2-wire) active power to the sum of the CH1 and CH2 (1-phase/2-wire) active power
	$\eta_2 = P_{sum} / P_3 \times 100$ [%]	The ratio of the sum of the CH1 and CH2 (1-phase/3-wire) active power to the CH3 (1-phase/2-wire) active power
3P3W&1P2W	$\eta_1 = P_3 / P_{sum} \times 100$ [%]	The ratio of the CH3 (1-phase/2-wire) active power to the sum of the CH1 and CH2 (3-phase/3-wire) active power
	$\eta_2 = P_{sum} / P_3 \times 100$ [%]	The ratio of the sum of the CH1 and CH2 (3-phase/3-wire) active power to the CH3 (1-phase/2-wire) active power

- Efficiency values η_1 and η_2 are calculated from the (absolute values of the) active power values with the **AC+DC** rectifier.
- The display range is 0.00 [%] to 200.00 [%]. Results that exceed this range will trigger the over-range display [**o.r**].
- If the active power value being used as the numerator or denominator in the calculation equation is [**o.r**], or the active power value being used as the denominator is 0, the efficiency will be displayed as [**o.r**].
- The invalid data display [- - - -] will be shown for wiring modes for which efficiency measurement is not performed, for example 3V3A, 3P3W3M, 3P4W, etc.

Examples of efficiency measurement

The following provides examples of efficiency measurement. Before making actual measurements, connect and configure the instrument as described in "Chapter 2 Measurement Preparations" (p.27).

When making actual measurements, select how to connect the measurement target to the instrument based on its voltage and current so as to minimize the effects of instrument loss. (p.30)

Measuring the input and output efficiency of a switching power supply

PW3336 PW3336-01 PW3336-02 PW3336-03

In this example, we will measure the input and output efficiency of a switching power supply with 1-phase/2-wire AC input and a single DC output circuit. The input side of the power supply will be input to CH1 of the instrument, and the output side of the power supply will be input to CH2 of the instrument. The 1P2W×2 wiring mode will be used.



1 Press **WIRING** and set the wiring mode to **[1P2W×2]**.

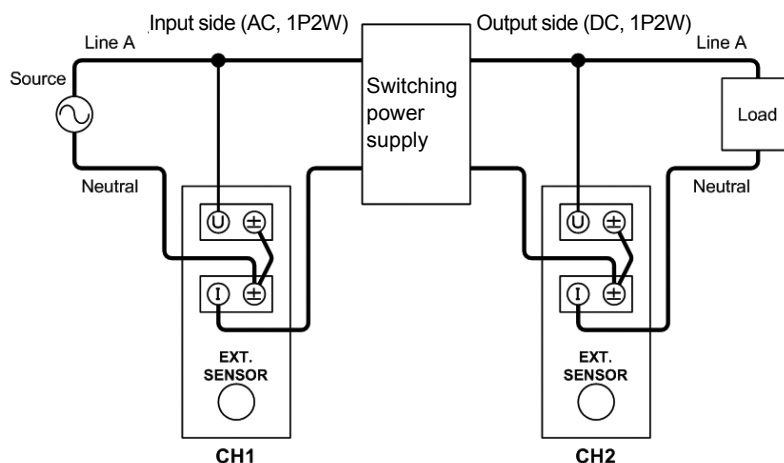
In this case, the switching power supply's input and output efficiency can be calculated as $\eta_1 (=|P_2|/|P_1| \times 100 [\%])$, so set the display parameter to η_1 .



2 Press **a** or **CH** to display **[CH2] [W]** (P2) for **[ACDC]** in area a on the display.

Press **b** or **CH** to display **[CH1] [W]** (P1) for **[ACDC]** in area b on the display.

Press **c** to display **[η1]** in area c on the display.



Measuring the input-output efficiency of a DC-to-AC (3-phase/3-wire) inverter

PW3337

PW3337-01

PW3337-02

PW3337-03

In this example, we will measure the input-output efficiency (energy conversion efficiency) of a 3-phase/3-wire inverter with DC input and AC output. The input side of the inverter will be input to CH3 of the instrument, and the output side will be input to CH1 and CH2 of the instrument.



1 Press **WIRING** and set the wiring mode to **[3P3W&1P2W]**.

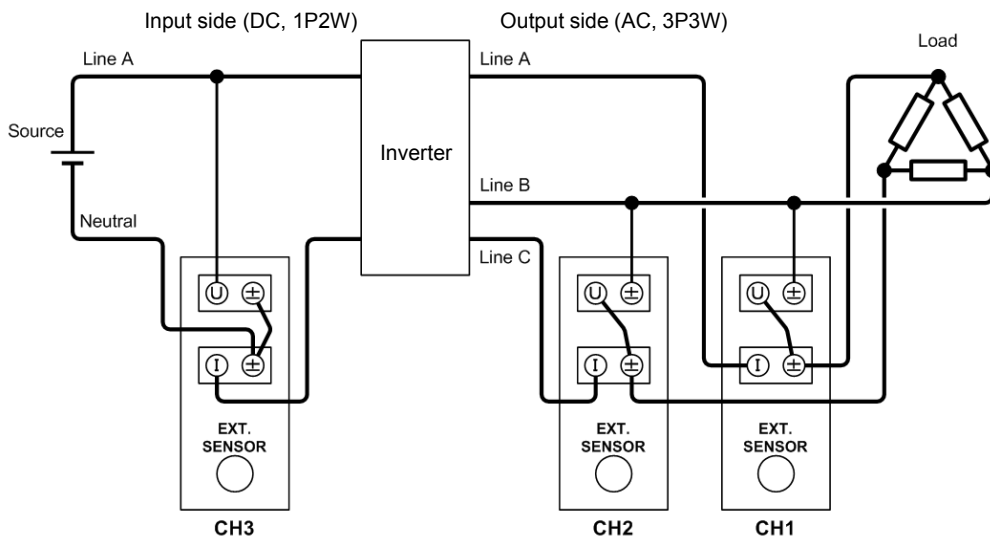
In this case, the switching power supply's input and output efficiency can be calculated as $\eta_2 (= |P_{sum}| / |P_3| \times 100 [\%])$, so set the display parameter to η_2 .



2 Press **a** or **CH** to display **[sum]** **[W]** (P_{sum}) for **[ACDC]** in area a on the display.

Press **b** or **CH** to display **[CH3]** **[W]** (P_3) for **[ACDC]** in area b on the display.

Press **c** to display **[η_2]** in area c on the display.



3.6 Performing Synchronized Measurement with Multiple Instruments (Multiple-instrument Synchronized Measurement)

You can perform synchronized measurement by connecting multiple (up to eight: one master and up to seven slaves) instruments (PW3336/PW3337) with optional 9165 Connection Cord (BNC cable).

This functionality can be used to perform simultaneous measurement of multiple circuits by operating only the instrument (PW3336/PW3337) set up as the master (instrument setting of OUT) and thereby controlling the instrument (PW3336/PW3337) set up as the slave (instrument setting of IN).

The instrument (PW3336/PW3337) set up as the slave will match the timing of the instrument (PW3336/PW3337) set up as the master for the following operations:

- Internal calculations
- Display updates
- Data updates
- Integration start, stop, and reset
- Display hold
- Zero-adjustment
- Key lock

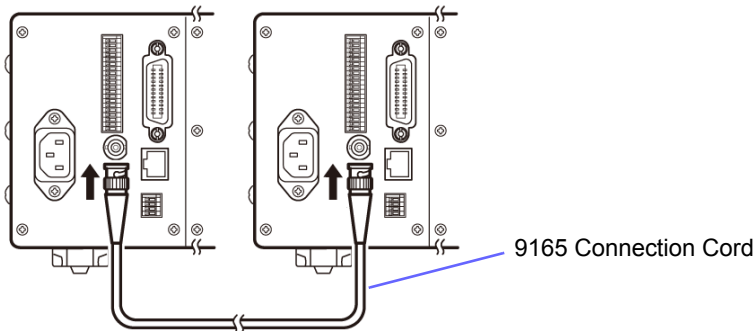
CAUTION

- To avoid damaging the instruments, do not connect or disconnect cables while the instruments are turned on.
- Use a common ground for instruments (PW3336/PW3337) that are performing simultaneous measurement. If different grounding is used, a potential difference will occur between the master ground and the slave ground. Connecting the connection cable (for synchronization) while there is such a difference may result in malfunction or damage.
- Dedicated signals are used in synchronized measurement. Do not input signals other than those designed for synchronized measurement. Doing so may result in malfunction or damage.

Connecting 2 instruments (PW3336/PW3337) with a synchronization cable

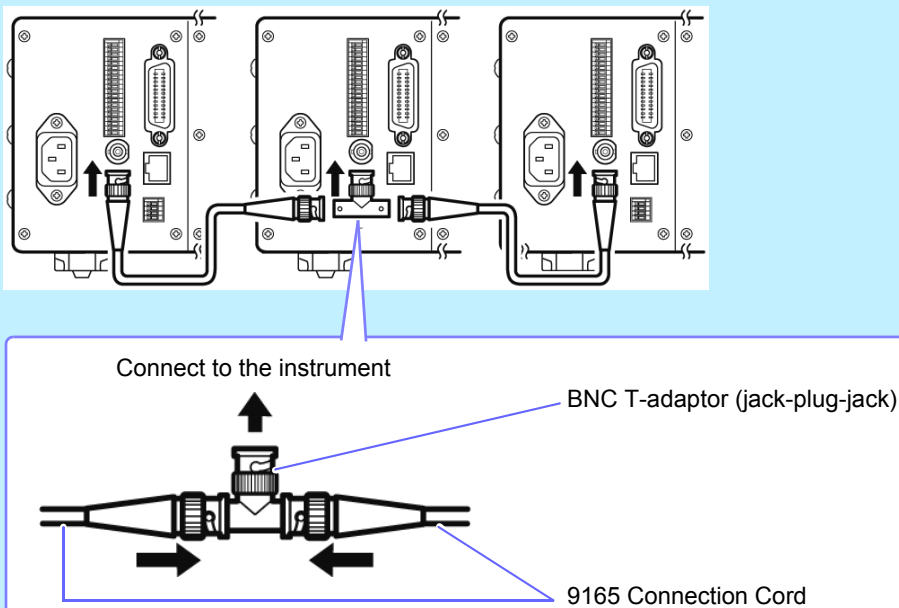
You will need: Two instruments, one 9165 Connection Cord

- 1** Verify that both instruments (PW3336/PW3337) have been turned off.
- 2** Connect the instruments' EXT SYNC terminals with the 9165 Connection Cord.



- 3** Turn on the two instruments (PW3336/PW3337). (The order in which the instruments are turned on does not matter.)

- When performing synchronized measurement with more than three instruments, connect the instrument in parallel using a BNC adaptor such as a BNC T-adaptor (jack-plug-jack).



- During synchronized measurement, control signals are sent using the 9165 Connection Cord. Never disconnect the connection cable during synchronized measurement. Doing so will prevent these signals from being properly supplied.

Configuring synchronized measurement

You can set the master and slave by configuring the synchronized control input and output settings.

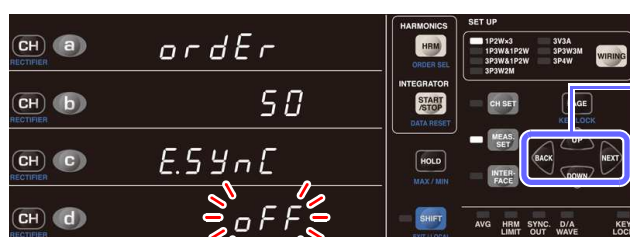
OFF	Turns off the synchronized control function. The EXT SYNC terminal setting is [IN], but input signals are ignored. This is the default state. External synchronized operation is not performed. The SYNC.OUT lamp is off.
IN	Sets the instrument as the slave. The EXT SYNC terminal is set to [IN], and dedicated synchronization signals can be input. Synchronization signals will be received from the BNC terminal, and processing will be performed accordingly. When synchronization signals are received from an external source, the SYNC.OUT lamp will flash.
OUT	Sets the instrument as the master. The EXT SYNC terminal will be set to [OUT], and dedicated synchronization signals will be output. Synchronization signals will be output from the BNC terminal. The SYNC.OUT lamp will light up.



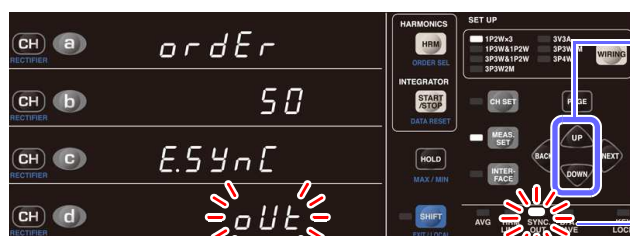
1 Press **MEAS. SET**.



2 Press **PAGE** to display the settings screen to the left.



3 Press **BACK** or **NEXT** to select the synchronized control I/O setting.



4 Press **UP** or **DOWN** to configure the synchronized control I/O setting.

Setting: **oFF** → **oUt** → **in** ...

The **SYNC.OUT** lamp will light up when set to **oUt**.



5 Press **MEAS. SET** to exit the settings.

The instrument will return to the normal measurement state.

- When drawing external synchronization from two or more instruments, be sure to set only one as the oUt power meter. Use of two or more oUt instruments may cause damage or malfunction.
- When an instrument is set to oUt, the synchronization signal is output from the BNC terminal according to the internal processing timing (200 ms).
- When an instrument is set to in, it will wait for the synchronization signal from the power meter set to oUt. If no synchronization signal is received before 210 ms or more elapses, the instrument will display [Err.20].

See: "6.2 Error Indication" (p.179)

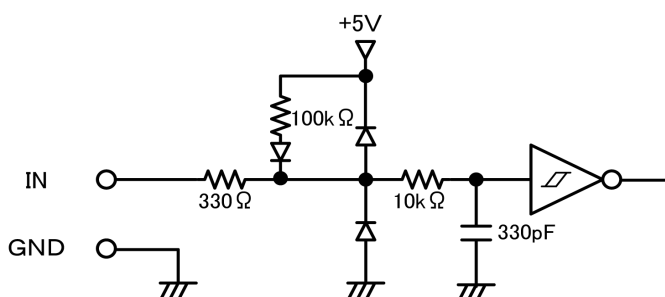
Synchronized operations

Internal calculations	The slave matches the master's timing.
Display updates	
Data updates	
Integration start/stop and reset	Integration starts, stops, and is reset at the same timing as the master on the slave by means of START and STOP key operation on the master.
Display hold	When the HOLD key is pressed on the master, the master and slave both enter the hold state. To cancel the display hold state, press the HOLD key again.
Zero Adjustment	Zero-adjustment is performed on the slave in synchronization with zero-adjustment on the master.
Key-lock	When the key lock is activated on the master, it is also activated on the slave. When the key lock is canceled on the master, it is also canceled on the slave.

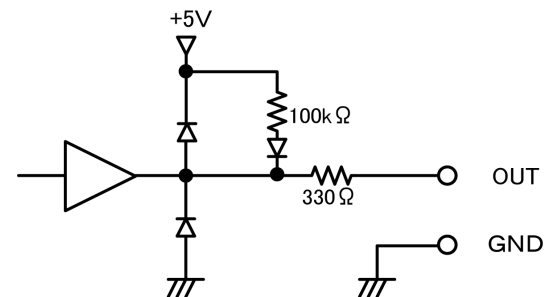
- Before starting integration synchronized measurement, reset integrated values on both the master and slave. To perform a reset that is synchronized to the master, it is necessary for integration operation on the slave to be in the stopped or reset state.
- Starting integration without first performing a reset results in additional integration.
- If the number of averaging iterations settings on the master and slave differ, display updates will not be synchronized.
- Synchronization- and external control-based integration cannot be mixed on the slave. Always terminate external control and reset integration when performing synchronization-based integration.
- When the slave's integration time setting is shorter than the master's integration time setting, stop timing cannot be synchronized since the slave's integration will stop first.
- When performing synchronized measurement, once integration start/stop, display hold, zero-adjustment, or key lock operation is performed on the slave, it may not be possible to synchronize operation, even if the same operation is performed on the master.
- When performing integrated measurement using synchronized control, a difference of up to 0.7 sec. per hour may occur between the master's integration elapsed time display value (TIME) and the slave's integration elapsed time display value.

EXT SYNC terminal internal circuitry

Synchronized control terminal input



Synchronized control terminal output

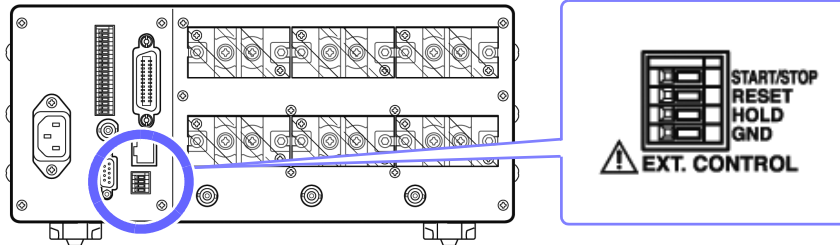


3.7 External Control



External control uses the EXT. CONTROL terminals.

External control terminals and description of control



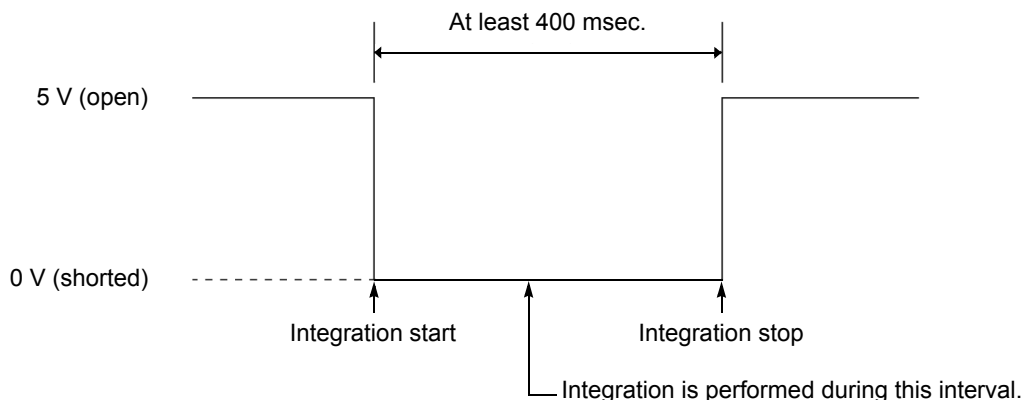
Terminal name	Description
START/STOP	Starts/stops integration. When a high (5 V or open) or low (0 V or shorted) signal is input to this terminal, integration starts. When the signal changes from low to high, integration stops.
RESET	Resets integrated values. When this terminal is set to low for at least 200 ms, integrated values are reset during that period.
HOLD	Holds the display when this terminal changes from high to low. The display hold is canceled when the terminal changes from low to high.
GND	Connect to the external device's GND terminal.

3.7.1 External control terminal

The external control terminals are input terminals for controlling the instrument by means of either 0/5 V logic signals or short/open contact signals.

External control signals are detected using the intervals illustrated in the following timing diagrams, but there may be a delay in the display depending on the input signal frequency, synchronization signal, timeout, and other settings.

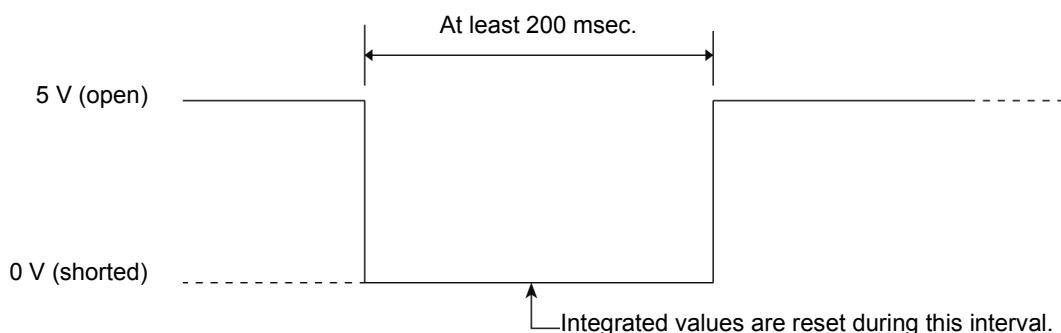
Integration start/stop (START/STOP terminal)



- When integration is started with external control, it can only be stopped by external control. The integration set time is ignored. If you attempt to stop integration with **START/STOP**, [Err.11] will be displayed.
- A delay (data update interval) of up to 200 msec. will occur between input of the integration start signal and the actual start of integration.
- The **EXT** lamp will light up while integration triggered by external control is being performed.

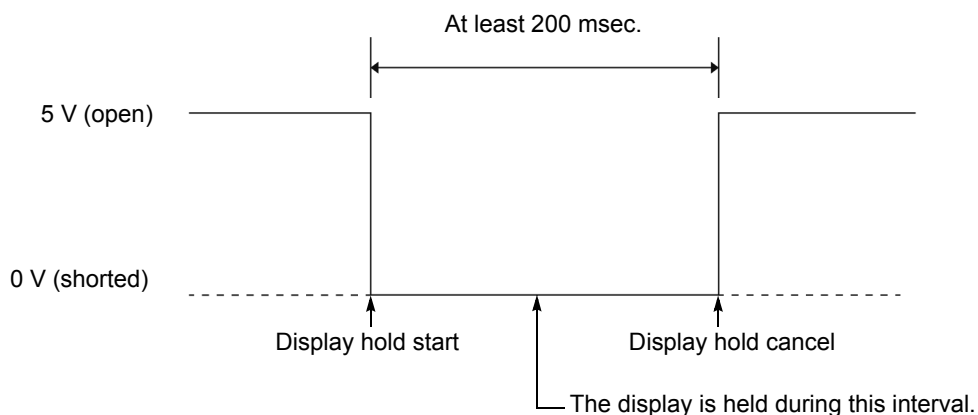


Integrated value reset (RESET terminal)



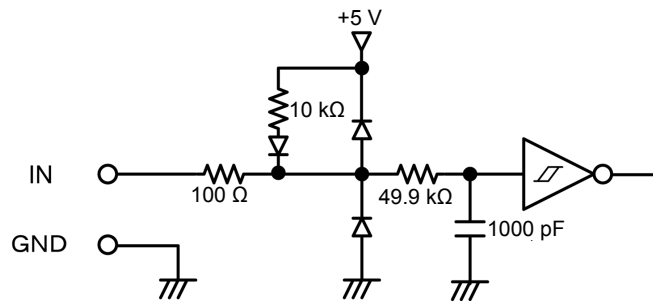
- While integration is being performed (while the **RUN** lamp is lit up), integrated values cannot be reset. Attempting to do so will cause [Err.15] to be displayed.
- A delay (data update interval) of up to 200 msec. will occur between input of the integration reset signal and the actual integration reset.

Display hold (HOLD terminal)



A delay (data update interval) of up to 200 msec. will occur between input of the hold signal and the actual hold.

External control terminal internal circuit schematic



Connecting wires to the external control terminals

Before connecting wires to the terminals, see *Handling the Instrument* (p.6).



CAUTION To avoid an electrical accident, use the specified wire type.

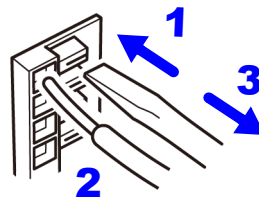
Connect the wires to the terminals for the parameter you wish to control. Connect the GND terminal on the instrument's external control terminals to the Lo (0 V) side of the contact signal or logic signal.

See: " External control terminals and description of control" (p.85)

- 1** Press down on the terminal button using a tool, such as a flat head screwdriver.
- 2** While the button is depressed, insert the wire into the electric wire connection hole.
- 3** Release the button.
The electric wire is locked in place.

To remove the wire:

Hold the button while pulling the wire out.



3.8 Using D/A Output



PW3336-02

PW3336-03

PW3337-02

PW3337-03

The PW3336-02, PW3336-03, PW3337-02, and PW3337-03 generate voltage output in response to input from the D/A OUTPUT terminals.

Analog (level) output

Converts the instrument's measured values into signal levels and outputs them as a DC voltage. The output voltage is updated in response to display updates (data updates). It is possible to record fluctuations over extended periods of time by combining this functionality with a data logger or recorder.

Waveform output

Samples the voltage and current input to the instrument at approximately 87.5 kHz, performs D/A conversion, and outputs them as an instantaneous voltage waveform, instantaneous current waveform, and instantaneous power waveform. It is possible to observe equipment rush current and instantaneous power waveforms by combining this functionality with an oscilloscope or other instrument.

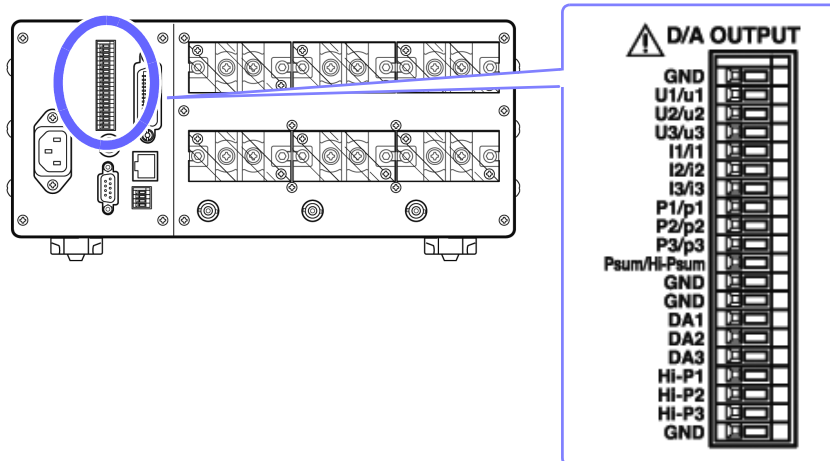
High-speed active power level output

Calculates the active power every cycle for the voltage or current set as the synchronization source, converts the resulting values to signal levels, and outputs them as a DC voltage. It is possible to observe power consumption and other properties for abruptly fluctuating loads one wave at a time by combining this functionality with a recorder or other instrument.

When the frequency of input to the set synchronization source is less than 5 Hz, the output update rate for analog output and high-speed active power level output varies with the frequency of the input to the synchronization source.

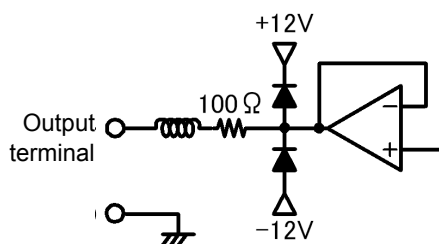
Example: If the frequency of input to the synchronization source is 0.8 Hz, the output update rate will be $1/0.8 = 1.25$ sec.

Output terminals and description of output



Terminal name	Description
U1/u1	CH1 voltage level output / instantaneous voltage waveform output (selected with settings)
U2/u2	CH2 voltage level output / instantaneous voltage waveform output (selected with settings)
U3/u3	CH3 voltage level output / instantaneous voltage waveform output (selected with settings)
I1/i1	CH1 current level output / instantaneous current waveform output (selected with settings)
I2/i2	CH2 current level output / instantaneous current waveform output (selected with settings)
I3/i3	CH3 current level output / instantaneous current waveform output (selected with settings)
P1/p1	CH1 active power level output / instantaneous power waveform output (selected with settings)
P2/p2	CH2 active power level output / instantaneous power waveform output (selected with settings)
P3/p3	CH3 active power level output / instantaneous power waveform output (selected with settings)
Psum/Hi-Psum	Active power sum level output / high-speed active power sum level output (selected with settings)
DA1	Level output for selected parameter
DA2	Level output for selected parameter
DA3	Level output for selected parameter
Hi-P1	CH1 high-speed active power level output (fixed output)
Hi-P2	CH2 high-speed active power level output (fixed output)
Hi-P3	CH3 high-speed active power level output (fixed output)
GND	GND

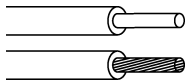
Output circuits



The output impedance of each output terminal is approximately 100 Ω. When connecting a recorder, DMM, or other instrument, use a device with high input impedance (1 MΩ or greater).

A maximum voltage of approximately ± 12 V may be output from D/A output terminals.

Required item:



Wires

Recommended cables Single strand diameter: ϕ 0.65 mm (AWG22)

Multi-strand: 0.32 mm² (AWG22)

Strand diameter: At least ϕ 0.12 mm or greater

Usable cables Single strand diameter: ϕ 0.32 mm to ϕ 0.65 mm (AWG28 to AWG22)

Multi-strand: 0.08 mm² to 0.32 mm² (AWG28 to AWG22)

Strand diameter: At least ϕ 0.12 mm or greater

Standard insulation stripping length : 9 mm



Flathead screwdriver

Shaft diameter: ϕ 3 mm

tip width: 2.6 mm

Connect wires to the terminals for the measured value you wish to output. Connect the instrument's GND terminal to the GND terminal of the data logger, recorder, or other output device.

Connecting wires to D/A output terminals

Before connecting wires to the terminals, see Before Connecting (p.7).



- To avoid damaging the instrument, do not input voltage to the output terminals or short the terminals.
- To avoid an electrical accident, use the specified wire type.

Connect wires to the terminals for the measured value you wish to output. Connect the instrument's GND terminal to the GND terminal of the data logger, recorder, or other output device.

1 Press down on the terminal button using a tool, such as a flat head screwdriver.

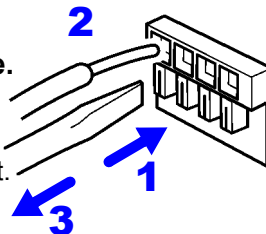
2 While the button is depressed, insert the wire into the electric wire connection hole.

3 Release the button.

The electric wire is locked in place.

To remove the wire:

Hold the button while pulling the wire out.



4 After connecting the wires, voltage output will be generated when power is connected to the measurement line.

3.8.1 Analog Level Output, Waveform Output, and High-speed Active Power Level Output

The instrument provides dedicated terminals for analog level output/waveform output for voltage, current, and active power as well as active power sum level output/high-speed active power sum level output.

There are also terminals for high-speed active power level output (fixed output) for each channel as well as active power sum level output and high-speed active power sum level output.

Terminals can be switched between analog output and waveform output and between active power sum level output and high-speed active power sum level output on the Settings screen. Additionally, the rectifier can be set for analog output.

When output is set to **Std.** (analog output), the rectifier can be selected.

Output voltages

Level output, high-speed level output: ± 2 V DC for $\pm 100\%$ of the range

Waveform output: 1 V f.s. for 100% of the range

Terminal	Std. (level output)	FASt (waveform output, high-speed output)
U1/u1	U1 CH1 voltage	u1 CH1 instantaneous voltage waveform
U2/u2	U2 CH2 voltage	u2 CH2 instantaneous voltage waveform
U3/u3	U3 CH3 voltage	u3 CH3 instantaneous voltage waveform
I1/i1	I1 CH1 current	i1 CH1 instantaneous current waveform
I2/i2	I2 CH2 current	i2 CH2 instantaneous current waveform
I3/i3	I3 CH3 current	i3 CH3 instantaneous current waveform
P1/p1	P1 CH1 active power	p1 CH1 instantaneous power waveform
P2/p2	P2 CH2 active power	p2 CH2 instantaneous power waveform
P3/p3	P3 CH3 active power	p3 CH3 instantaneous power waveform
Psum/Hi-Psum	Psum active power sum	HiPsum high-speed active power sum
Hi-P1	CH1 high-speed active power (fixed)	-
Hi-P2	CH2 high-speed active power (fixed)	-
Hi-P3	CH3 high-speed active power (fixed)	-

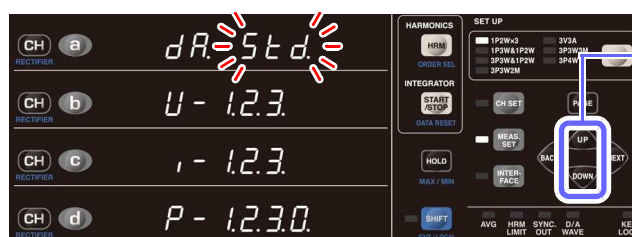
Switching between analog output and waveform output



1 Press **MEAS. SET**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **UP** or **DOWN** to change the output method.

Std.: Standard output (analog output)

FAST: Fast output (waveform output)



4 Press **MEAS. SET** to exit the settings.

The instrument will return to the normal measurement state.

Setting the rectifier for analog output



1 Press **MEAS. SET**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **UP** or **DOWN** to select Std.



4 Press **BACK** or **NEXT** to select the channel for which you wish to set the rectifier.

Settings: **U1** → **2** → **3** → **I1** → **2** → **3** → **P1** → **2** → **3** → **0**...

(U: voltage; I: current; P: power; 1, 2, 3: channel number; 0: sum)



5 Press **UP** or **DOWN** to set the rectifier. The rectifier lamp will light up to reflect the setting location.

Settings: **AC+DC** → **AC+DC Umn** → **DC** → **AC** → **FND**...



6 Press **MEAS. SET** to exit the settings.

The instrument will return to the normal measurement state.

- The rectifier cannot be changed when using the FAST setting (waveform output). (The cursor cannot be moved.)
- Output of 0 V will be generated for channels without data, if a rectifier is selected, or if a change in the settings causes the measured value to be shown as invalid data [-----].
- Never supply input to an output terminal. Doing so may damage the instrument.

Active power high-speed analog output terminals

The instrument's Hi-P1, Hi-P2 and Hi-P3 terminals continuously output the active power level in 1-wave units. These terminals can be used to observe variations in active power that track input.

3.8.2 D/A Output



The instrument provides three analog output terminals (D/A output) for which the output parameter can be selected.

See: "Appendix 2 Detailed Specifications of Output" (p. A5)

Selectable output parameters and output voltages

You can select three of the following parameters. (Any channel or sum can be selected for each.)

Voltage, current, active power, apparent power, reactive power, time average current, time average active power	± 2 V DC for $\pm 100\%$ of the range
Power factor	± 2 V DC for ± 0.0000 or 0 V DC for ± 1.0000
Phase angle, inter-channel voltage fundamental wave phase difference, inter-channel current fundamental wave phase difference	0 V DC for 0.00° , ± 2 V DC for $\pm 180.00^\circ$
Voltage ripple rate, current ripple rate, total harmonic voltage distortion, total harmonic current distortion	± 2 V DC at 100.00%
Voltage crest factor, current crest factor	± 2 V DC at 10.000
Frequency (varies with measured value)	± 2 V DC per 100 Hz from 0.1000 Hz to 300.00 Hz ± 2 V DC per 10 kHz from 300.01 Hz to 30.000 kHz ± 2 V DC per 100 kHz from 30.001 kHz to 220.00 kHz
Efficiency	± 2 V DC at 200.00%
Current integration, active power integration	± 5 V DC at (range) $\times$ (integration set time)

Setting D/A output parameters



1 Press **MEAS. SET**.



2 Press **PAGE** to display the settings screen shown to the left.

3 Press **BACK** or **NEXT** to select the rectifier, channel, parameter, and display area.



4 Press **UP** or **DOWN** to set the parameter you wish to output.

The flashing unit symbol will indicate the parameter selected for D/A output. (Default setting: **VA**)

Rectifier settings: **AC+DC** → **AC+DC Umn** → **DC** → **AC** → **FND...**

Lo will be displayed for parameters that cannot be output due to the wiring mode. (0 V fixed output)



5 Press **MEAS. SET** to exit the settings.

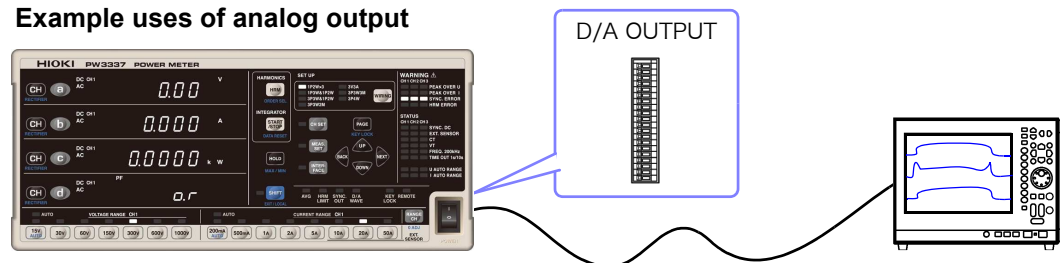
The instrument will return to the normal measurement state.

- By default, VA1 (CH1 VA) is assigned to D/A output channel 1 (D/A1), VA2 is assigned to D/A2, and VA3 is assigned to D/A3.
- For more information about D/A output, see the D/A output specifications in the product specifications.
See: "Chapter 5 Specifications" (p.135)
- Analog is generated for instantaneous values even when display hold or averaging operation is being performed.
- Analog output cannot be generated for voltage peak values, current peak values, or harmonic orders.
- The rectifier can be selected on the Settings screen even for parameters for which there is no need to specify a rectifier. In this case, the rectifier setting will be ignored by the instrument's internal processing. For example, efficiency, inter-channel phase difference, crest factor, ripple rate, distortion, etc.
- The channel can be selected on the Settings screen even for parameters for which there is no need to specify a channel (efficiency). In this case, the channel setting will be ignored by the instrument's internal processing.
- Concerning inter-channel phase differences, to generate D/A output for the CH1 and CH2 phase difference, set to CH1. To generate D/A output for the CH1 and CH3 phase difference, set to CH2.
- Output of 0 V will be generated for channels without data, if a rectifier is selected, or if a change in the settings causes the measured value to be shown as invalid data [-----].

Example uses

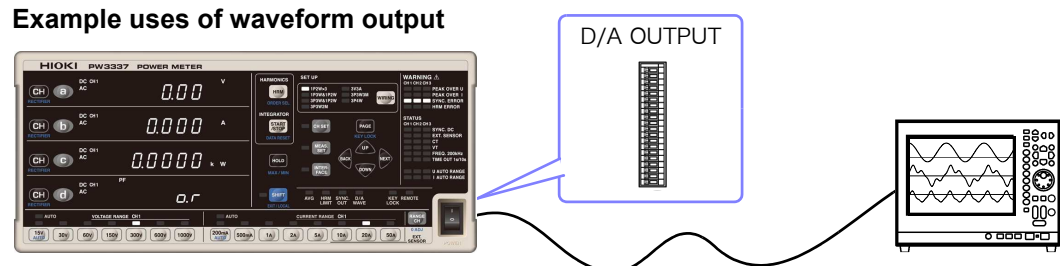
D/A output can be used in combination with a data logger or recorder. For more information about the output voltage, output resistance, response time, and output update rate, see "Chapter 5 Specifications" (p.135).

Example uses of analog output



- When using a VT ratio or CT ratio, output voltages are determined by multiplying the range by the VT ratio or CT ratio.
- When the measurement range is set to auto-range operation, the output rate for analog output, D/A output, and high-speed level output will also change with changes in the range. When measuring lines characterized by abrupt changes in measured values, exercise care not to mistake the range conversion. It is recommended to use a fixed range in measurement applications such as this.
- The response time for the instrument's analog output and D/A output is 0.6 s. (when the timeout is set to 0.1 s)
With measurement lines that change faster than the output response time, note that the output voltage may contain an error component.
When the timeout is set to other than 0.1 s, refer to "3.2.7 Setting the Timeout" (p.55).
- Analog output and D/A output generate output consisting of instantaneous values that are measured every 200 ms. High-speed active power level output is updated once every period of the input that is set as the synchronization source. Consequently, analog output will change even in the display hold state and during averaging processing.
- Output of 0 V is generated while displaying invalid data.

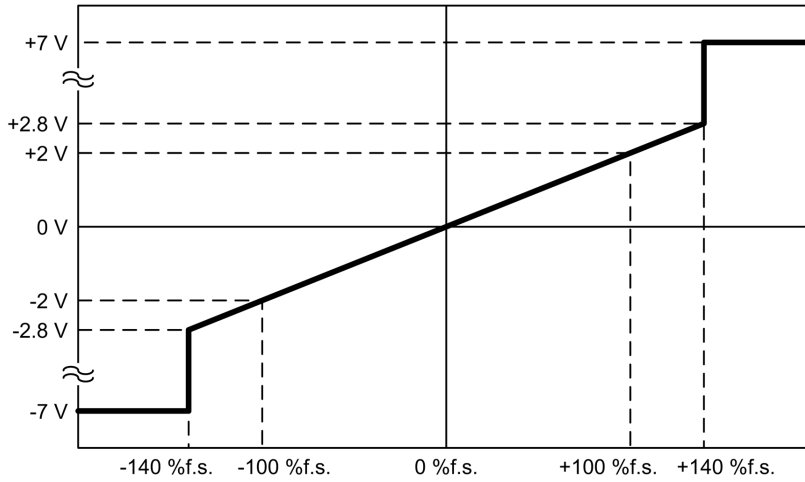
Example uses of waveform output



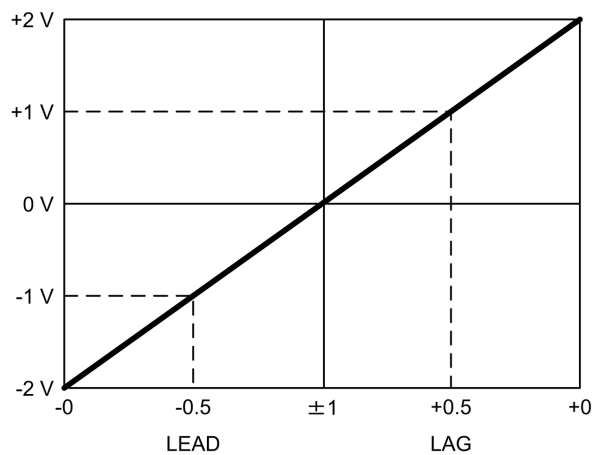
- When using a VT ratio or CT ratio, the value obtained by multiplying the range by the VT ratio or CT ratio serves as the 1 V RMS value.
- When the measurement range is set to auto-range operation, the output rate for waveform output will also change with changes in the range. When measuring lines characterized by abrupt changes in measured values, exercise care not to mistake the range conversion. It is recommended to use a fixed range in measurement applications such as this.
- Waveform output will change even in the display hold state and during averaging processing.

Examples of analog output

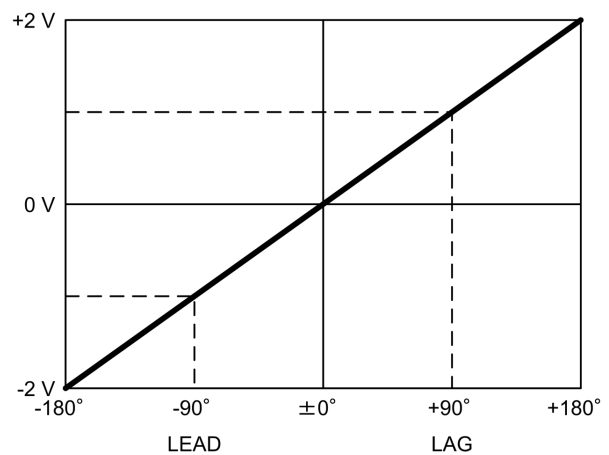
Voltage, current, active power, apparent power, reactive power, time average current, time active power



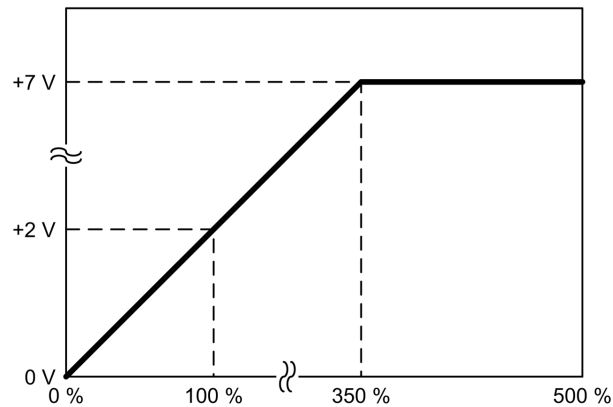
Power factor



Phase angle

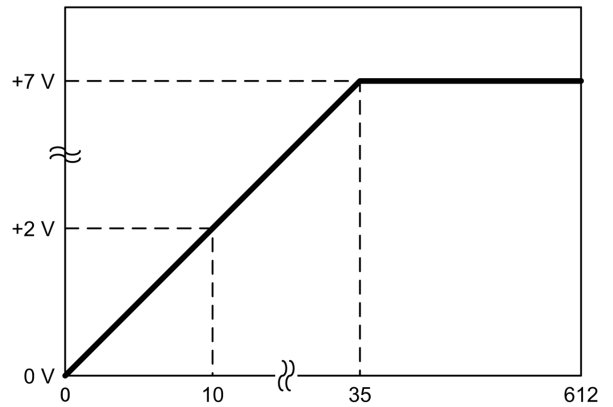


Voltage ripple rate, current ripple rate, total harmonic voltage distortion, total harmonic current distortion



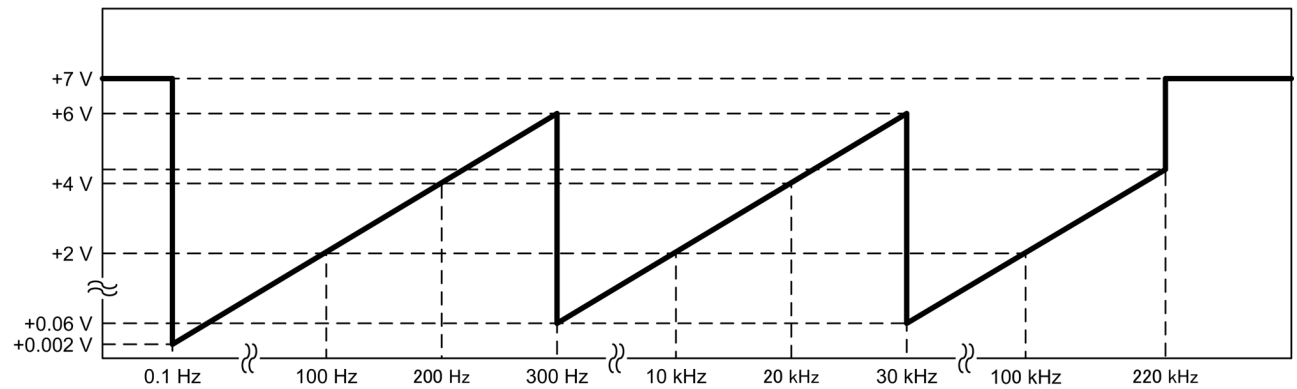
Although the voltage ripple rate, current ripple rate, total harmonic voltage distortion, and total harmonic current distortion are displayed up to 500.00%, analog output is limited to +7 V at 350%. Voltages in excess of that value are not output.

Voltage crest factor, current crest factor

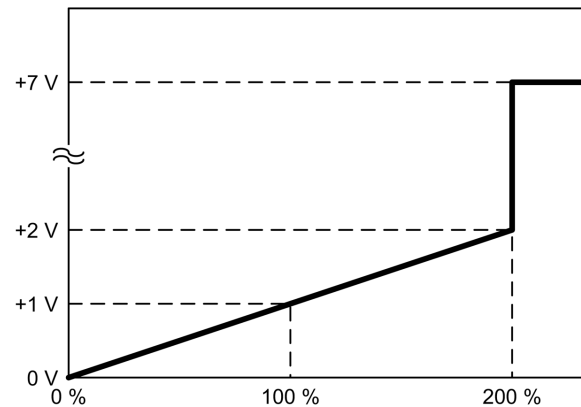


Although the voltage crest factor and current crest factor are displayed up to 612.00, analog output is limited to +7 V at 35. Voltages in excess of that value are not output.

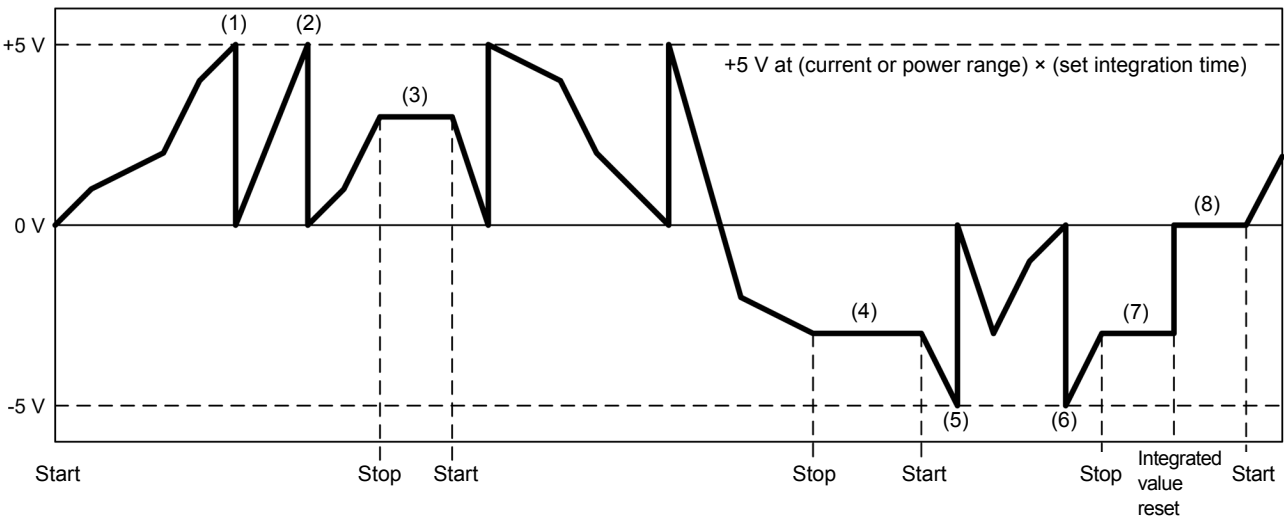
Frequency



Efficiency



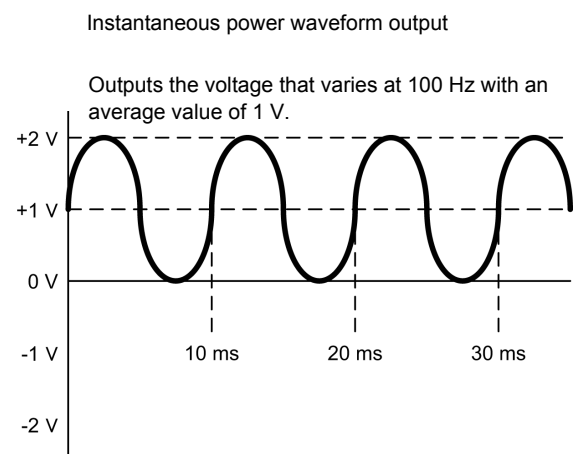
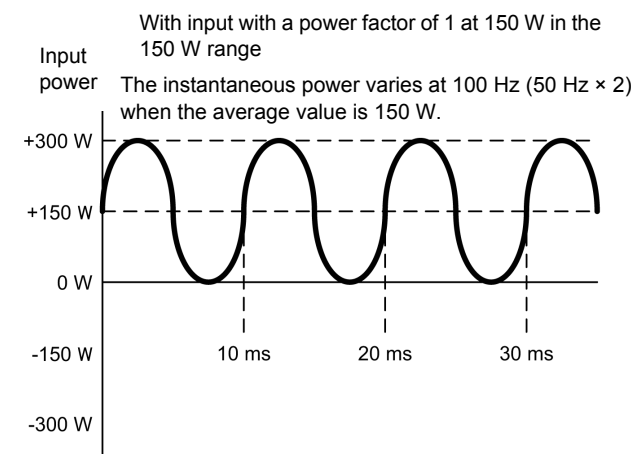
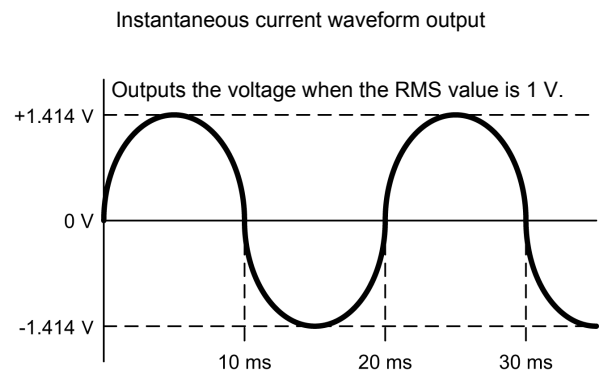
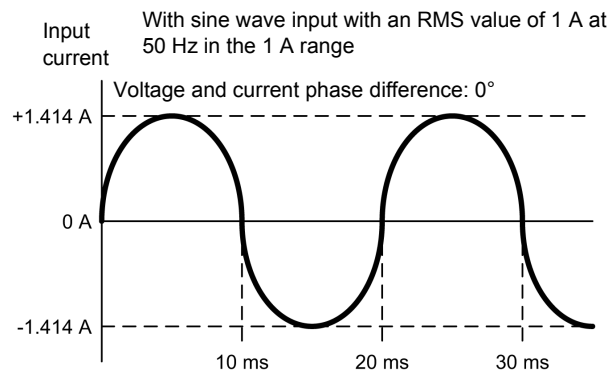
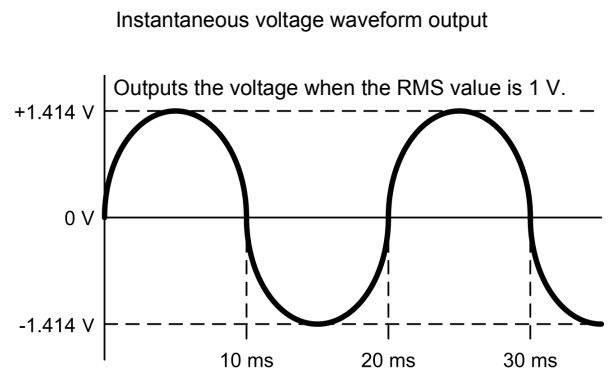
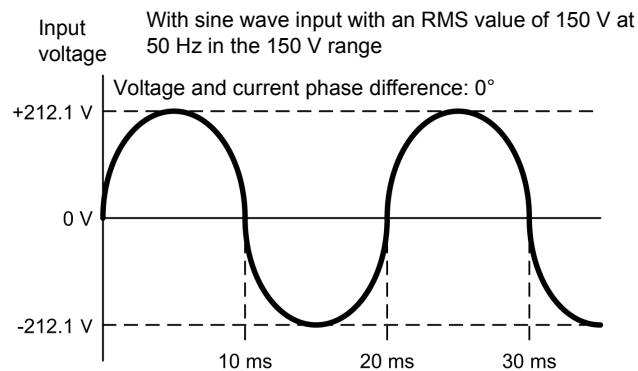
Current integration, active power integration



(1), (2), (5), (6)	Integrated value analog output of +5 V is generated when the integrated value is a multiple of (current or power range) × (set integration time). For example, with the 150 W range when the integration time is set to 24 hr.: +5 V is reached at 3.5 kW (150 W × 24 hr.), 7.2 kW (150 W × 24 hr. × 2), ... Similarly, -5 V is reached at multiples of -3.6 kW. When the analog output voltage exceeds ±5 V, it changes to 0 V, and then voltage output continues according to the integrated value from 0 V.
(3), (4)	When integration stops, the output voltage at that point in time is held. When integration is started in that state, the voltage continues to change from the held output voltage.
(7)	When integration stops, the output voltage at that point in time is held. When integrated values are reset in that state, the output voltage changes to 0 V.
(8)	When integration is started, the voltage changes from 0 V according to the integrated value and is output.

The default setting for the integration time is 10,000 hours (displayed as 0000.00). Consequently, +5 V output will not be generated unless 10,000 hours has elapsed, even if current or power range full-scale input is received. When using integrated value analog output, check the integration time setting before proceeding.

Example waveform output



3.9 Using a Current Sensor

An optional current sensor can be used to measure currents in excess of the instrument's current effective measurement range maximum of 65 A. By setting the instrument's CT ratio based on the rating of the current sensor being used, you can read the measured current value directly.

**DANGER**

The external current sensor input terminals are not isolated (secondary potential). Never connect any input other than isolated input from an optional current sensor to the terminals. Doing so may result in a short-circuit accident or electric shock.

The instrument can use the current sensors listed below. For detailed specifications for current sensors or the CT9555 series Sensor Unit as well as information about how to use the sensors, see the included instruction manual.

■ Current sensors (TYPE1) that are connected directly to the instrument's external current sensor input terminals (current sensor terminals)

The following current sensors are referred to as "TYPE1" current sensors:

- Model 9661 Clamp on Sensor (rated current: 500 A AC)
- Model 9669 Clamp on Sensor (rated current: 1000 A AC)
- Model 9660 Clamp on Sensor (rated current: 100 A AC)
- Model CT9667 Flexible Clamp on Sensor (rated current: 500 A/5000 A AC)

■ Current sensors (TYPE2) that are connected to the instrument's external current sensor input terminals (current sensor terminals) using the CT9555 series Sensor Unit and L9217 Connection Cord

The following current sensors are referred to as "TYPE2" current sensors:

- Model CT6862-05 AC/DC Current Sensor (rated current: 50 A AC/DC)
- Model CT6863-05 AC/DC Current Sensor (rated current: 200 A AC/DC)
- Model 9709-05 AC/DC Current Sensor (rated current: 500 A AC/DC)
- Model CT6865-05 AC/DC Current Sensor (rated current: 1000 A AC/DC)
- Model CT6841-05 AC/DC Current Probe (rated current: 20 A AC/DC)
- Model CT6843-05 AC/DC Current Probe (rated current: 200 A AC/DC)
- Model CT6844-05 AC/DC Current Probe (rated current: 500 A AC/DC)
- Model CT6845-05 AC/DC Current Probe (rated current: 500 A AC/DC)
- Model CT6846-05 AC/DC Current Probe (rated current: 1000 A AC/DC)
- Model 9272-05 Clamp on Sensor (rated current: 20 A/200 A AC range switchable)

Before connecting a current sensor

Please read Operating Precautions (p.5) carefully before connecting a current sensor to the instrument.

DANGER

When the clamp sensor is opened, do not short-circuit two wires to be measured by bringing the metal part of the clamp into contact with them, and do not use over bare conductors.

CAUTION

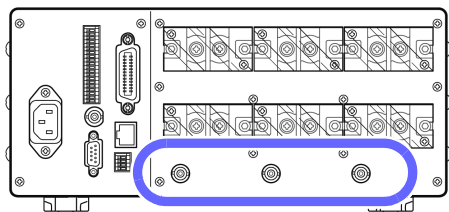
- Do not connect or disconnect connection cords from the current sensor or CT9555 series Sensor Unit while the instrument is turned on. Doing so may damage the instrument, current sensor, or CT9555 series Sensor Unit.
- Do not input current to the current sensor when it is not connected to the instrument or when the instrument and CT9555 series Sensor Unit are turned off. Doing so may damage the current sensor, instrument, or CT9555 series Sensor Unit.
- When connecting a current sensor to the instrument or CT9555 series, disconnect the current sensor from the target measurement line and verify that no current is being input.
- When disconnecting the current sensor or CT9555 series from the instrument, be sure to do so by gripping the BNC connector and pulling after disengaging the lock. Pulling on the connector without disengaging the lock or pulling on the cord may damage the connector.
- Avoid stepping on or pinching cables, which could damage the cable insulation.
- When using the CT9555 series, use the L9217 Connection Cord (which is made of plastic). Using a metal BNC cable may damage the instrument's external current sensor input terminals (which are made of plastic) or the instrument.
- Be careful to avoid dropping the current sensors or otherwise subjecting them to mechanical shock, which could damage the mating surfaces of the core and adversely affect measurement.
- Do not place the current sensor's core tips around foreign objects or insert foreign objects into the core slits. Doing so may degrade current sensor performance or prevent it from opening and closing properly.
- When not using a current sensor, place the clamp in the closed position. Storing the sensor with the clamp in the open position may allow dirt or dust to accumulate on the mating core surfaces, which could interfere with clamping action.
- When using external current sensor input, disconnect any lines from the current direct input terminals. When using the current direct input terminals, disconnect any lines from the external current sensor inputs.

- When using a wiring mode other than 1P2W, the current sensor type, CT ratio, and range will be standardized using the CH1 settings.
- The instrument's settings can be used to switch between current direct input terminals (maximum input current of 70 A, ± 100 Apeak) and external current sensor input terminals. Current signals input to input terminals that are not set as enabled are ignored.
- The instrument's CT ratio is set based on the current sensor type and rating. If the CT ratio is set improperly, it will be impossible to conduct accurate measurement.
- The measurement accuracy when using a current sensor is obtained by adding the instrument's external current sensor input measurement accuracy and the current sensor's measurement accuracy.
- Depending on the current sensor being used, the instrument's accuracy defined range may be narrower than the current sensor's frequency band.

Connecting a TYPE1 current sensor

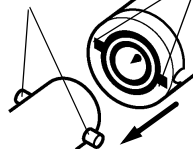
Connect the current sensor directly to one of the instrument's external current sensor input terminals.

- 1 Connect the clamp sensor's BNC connector to a current input terminal.
Align the groove on the BNC connector with the connector guides on the instrument and insert.



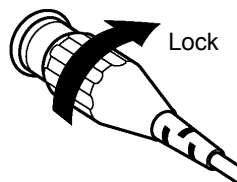
Connector guides on the instrument's current input terminals

Connector groove on the clamp sensor



- 2 Turn clockwise to lock.

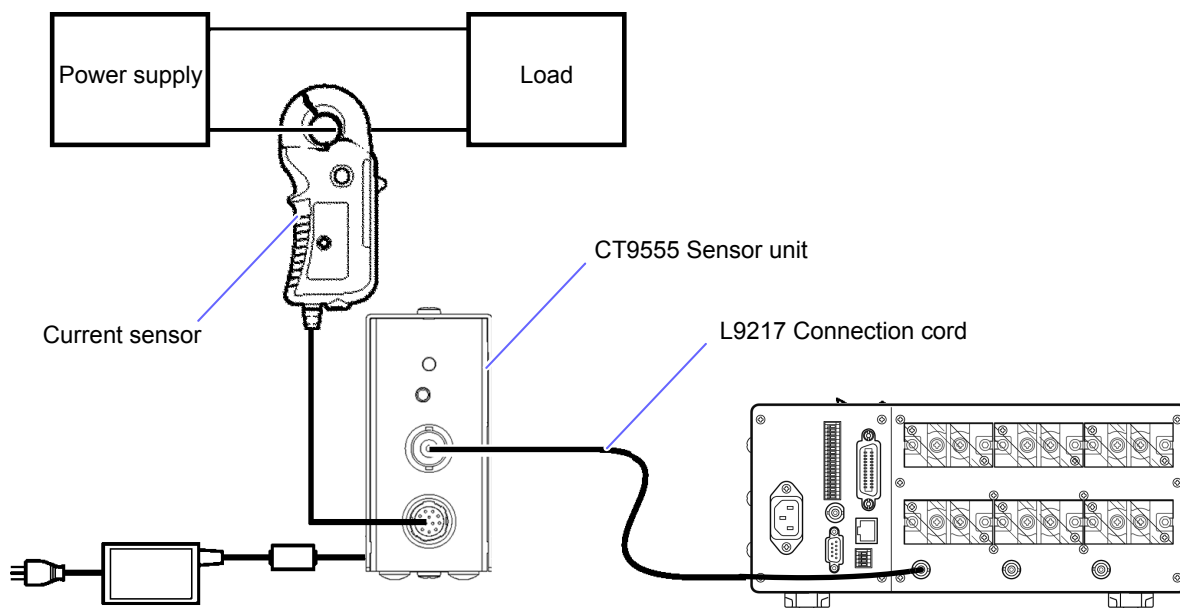
To remove the connector, turn it counterclockwise to disengage the lock and then pull out.



Connecting a TYPE2 current sensor

Use the CT9555 series Sensor Unit and L9217 Connection Cord to input current sensor output to the instrument.

(Example connection)

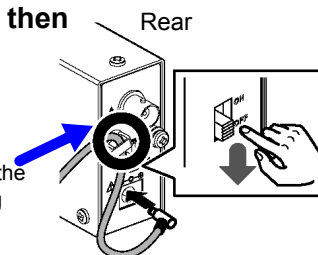


- 1 Verify that the instrument's power cord as well as the power cord for the AC adapter that came with the Sensor unit are unplugged.

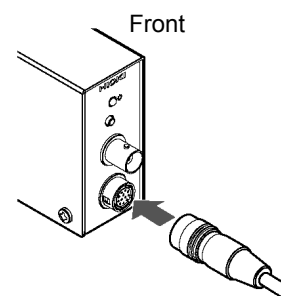
2 Verify that the instrument and Sensor unit power switches are turned off.

3 Connect the AC adapter that came with the Sensor unit and then connect the power cord to the AC adapter.

Pass the AC adapter cord through the locking clamp to keep it from being pulled out.



4 Connect the TYPE2 current sensor you will use to the CT9555 series' sensor connector.

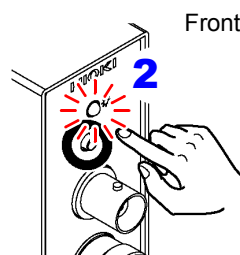
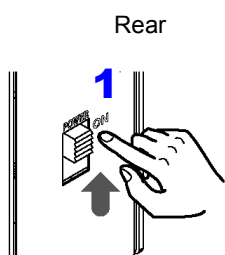


5 Connect the CT9555 series' output terminal and one of the instrument's external current sensor input terminals with the L9217 Connection Cord.

6 Make connections to the instrument's voltage input terminals.

7 Connect the power cords to the instrument and the AC adapter that came with the CT9555 series and plug each of them into a wall outlet.

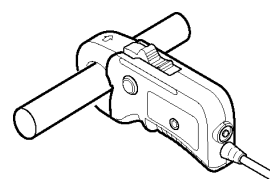
8 Turn on the instrument's power switch and verify that the display shows the Measurement screen. Then turn on the CT9555 series' power switch and verify that the current monitor lights up.



If using the AC/DC Current Probe, press the CT9555's DEMAG switch to perform degaussing operation.

9 Configure the instrument's settings.

10 Apply the current sensor to the wire being measured and perform measurement.



When using the AC/DC Current Probe, perform zero-adjustment for the current sensor.

1. Set the instrument to the 10 A range noted on the panel.
2. Set the display parameter to A and the rectifier to DC.
3. Turn the zero-adjustment knob (0ADJ) on the AC/DC Current Probe so that the display reads 0 A.

Setting external current sensor input

This section describes how to set the type of current sensor being used, the instrument's CT ratio, and the measurement range. These settings can be configured separately for each wiring mode.

See: "3.2.2 Selecting the Current Input Method" (p.42)

"3.2.9 Setting the VT and CT Ratio" (p.59)



CAUTION The instrument cannot automatically detect or set the current sensor type or CT ratio. When using a current sensor, you must manually set the current sensor type and CT ratio. If you replace the sensor with another unit that has a different rating, you must reconfigure the current sensor type and the instrument's CT ratio.

- When the current sensor type is set to "Off," input from the current direct input terminals is enabled, and external current sensor input is ignored.
- The panel displays the current measurement ranges when using external current sensor input as 10 A, 20 A, and 50 A. When the auto-range setting is enabled, auto-range operation will use the 10 A, 20 A, and 50 A ranges.
- When using the 9660 Clamp on Sensor, only the 100 A range (shown as the 10 A range on the instrument's panel) can be used.
- When using a wiring mode other than 1P2W that combines multiple channels, the combined channels will be forced to use the same current sensor type, CT ratio, and range. At this time, other channel settings will be changed to reflect the settings in use by the channel with the smallest value.

Current sensor types and instrument CT ratio settings

Current sensor	Current sensor rating	TYPE	CT ratio
9661 Clamp on Sensor	500 A AC	1	10
9669 Clamp on Sensor	1000 A AC	1	20
9660 Clamp on Sensor	100 A AC	1	10
CT9667 Flexible Clamp on Sensor	500A /5000A AC	1	10/100
CT6862-05 AC/DC Current Sensor	50 A AC/DC	2	1 (OFF)
CT6863-05 AC/DC Current Sensor	200 A AC/DC	2	4
CT6865-05 AC/DC Current Sensor	1000 A AC/DC	2	20
9709-05 AC/DC Current Sensor	500 A AC/DC	2	10
CT6841-05 AC/DC Current Probe	20 A AC/DC	2	0.4
CT6843-05 AC/DC Current Probe	200 A AC/DC	2	4
CT6844-05 AC/DC Current Probe	500 A AC/DC	2	10
CT6845-05 AC/DC Current Probe	500 A AC/DC	2	10
CT6846-05 AC/DC Current Probe	1000 A AC/DC	2	20
9272-05 Clamp on Sensor	20A /200A AC	2	0.4/4

When the measurement target's current exceeds the optional current sensor's rating

Use an external CT.

Using an external CT



DANGER

If energized components are exposed when connecting the current sensor, exercise care not to touch them or the CT. Doing so may result in electric shock, bodily injury, or a short-circuit accident.



WARNING

When using an external CT, avoid open-circuiting the secondary winding. If current flows through the primary when the secondary is open, high voltage across the secondary could present a dangerous hazard.

- The external CT's phase different could introduce a significant error component into power measurement. For more accurate power measurement, use a CT with a small phase error in the frequency band used by the circuit.
- When using an external CT, ground the CT's secondary negative terminal to ensure safety.

Usage example

Measured current	7,800 A (7.8 kA)
Current sensor	9669 Clamp on Sensor (rated current: 1000 A AC)
External CT	10:1

Configure the instrument as follows:

Current sensor type: TYPE1

CT ratio: 200 (current sensor's CT ratio of 20) × (external CT's CT ratio of 10)

Current measurement range: 10 kA (shown as 50 A range on the instrument's panel)

The current measured value (display value) on the instrument will be [7,800 kA].

3.10 Other Functions

3.10.1 Fixing Display Values (Display Hold)

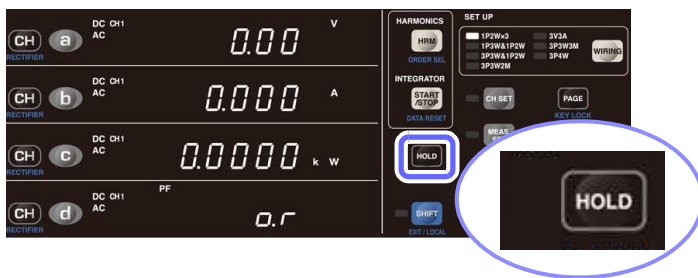
You can hold the display of all measured values by pressing the **HOLD** key (placing the instrument in the display hold state).

Activating display hold



- 1 Press **HOLD**.
- 2 The display of measured values will be fixed when **HOLD** is pressed, and the **HOLD** lamp will light up.

Canceling the display hold state



- 1 Press **HOLD** while the instrument is in the display hold state.
- 2 The instrument will revert to the normal measurement state, and the **HOLD** lamp will turn off.

The following operations are not available when in the display hold state:

- Range switching
The instrument will display [Err.16] if any range key is pressed. (p.179)
Similarly, the range will not change during auto-ranging operation. The range will be fixed to the range at the time the **HOLD** key was pressed.
- The flashing cursor cannot be moved to parameters that cannot be changed while in the hold state.
- To change a setting, press the **HOLD** key to cancel the display hold state (so that the **HOLD** lamp turns off).

The display hold will be unavailable in the following condition:

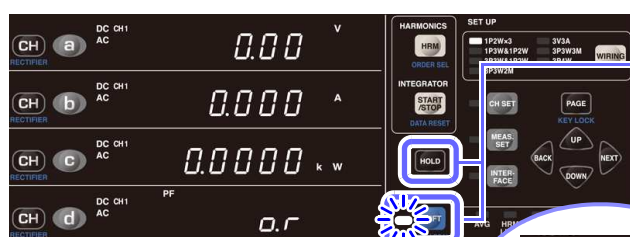
- During the **AVG** lamp is blinking
The display hold will become available when the **AVG** lamp that has been blinking lights up, which means that an average data is determined. Measurement values that are not supposed to be averaged such as a peak value will not be subject to the display hold until an average data is determined.
- Immediately after the setting such as the range is changed (while [----] is shown on the display)
The display hold will become available when a measurement value appears on the display on which [----] has been shown.

3.10.2 Displaying Peak, Minimum, and Maximum Values (Maximum Value Hold)

The instrument continuously measures instantaneous, maximum, and minimum values. The display can be switched to these values with the **HOLD** key.

- You can measure waveform peak values, for example device rush current (peak value hold).
- You can measure minimum values for measurement parameters (minimum value hold).
- You can measure maximum values for measurement parameters (maximum value hold).

Displaying maximum values



- 1 Press **SHIFT** to place the instrument in the shift state and then press **HOLD**.
- 2 The **MAX** lamp will turn on, and the display will switch to the maximum value display.

Displaying minimum values



- 1 Press **HOLD** while the instrument is displaying maximum values.
- 2 The **MIN** lamp will turn on, the display will switch to the minimum value display.

Returning to the instantaneous value display

Press **HOLD** while displaying minimum values (while the **MIN** lamp is lit up) to return to the instantaneous value display.

Clearing maximum and minimum values

Pressing **SHIFT** and **START/STOP** (**DATA RESET**) will clear the maximum and minimum values and restart their measurement. Maximum and minimum values are also cleared, and their measurement restarted, at the start of integration.

- The following operations are not available when in the maximum value or minimum value hold state:
 - Range switching
The instrument will display [Err.16] if any range key is pressed. (p.179)
Similarly, the range will not change during auto-range operation. The range will be fixed to the range at the time the HOLD key was pressed.
 - Setting changes (integration time, number of averaging iterations, VT/CT ratios, etc.)
The setting parameter will light up on the Settings screen, and you will not be able to change it.
 - The flashing cursor cannot be moved to parameters that cannot be changed while in the hold state.
- To change a setting, press  to return to the instantaneous value display.
- For parameters other than waveform peak values, the maximum and minimum values are compared using the absolute values of measured values. For waveform peak values, the maximum value for the waveform is shown as the maximum value, and the minimum value of the waveform is shown as the minimum value.
- For integration times, integrated values, and time average values, no maximum values or minimum values are determined. For integration times and integrated values, instantaneous values are directly displayed. For time averages, [- - - -] is displayed.

3.10.3 Disabling Control Keys (Key Lock)

Control keys can be disabled (by placing the instrument in the key lock state) to prevent inadvertent operation during measurement.

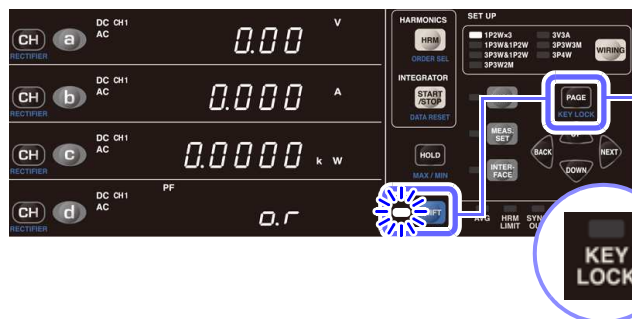
Enabling the key lock state

The instrument will not accept key lock input while the KEY LOCK lamp is lit up.



- 1 Press **SHIFT** to place the instrument in the shift state and then press **PAGE**.
- 2 The instrument will enter the key lock state, and the **KEY LOCK** lamp will light up.

Canceling the key lock state



- 1 Press **SHIFT** to place the instrument in the shift state and then press **PAGE**.
- 2 The control keys will be enabled, and the **KEY LOCK** lamp will turn off.

- When there are communications over one of the instrument's interfaces while in the key lock state, the **KEY LOCK** lamp will flash, and the instrument will enter the remote state (the **REMOTE** lamp will light up).
- While in the remote state, keys are disabled.
- To enable use of the control keys, press **SHIFT** to cancel the remote state.
See: "4.5 Canceling the Remote State (Activating the Local State)" (p.134)

3.10.4 Initializing the Instrument (System Reset)

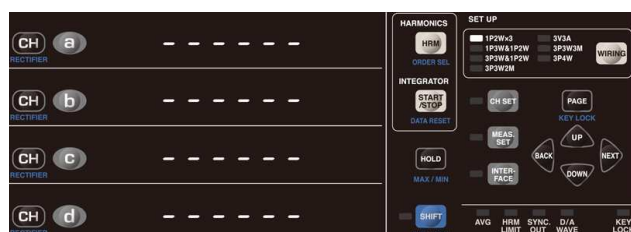
This section describes how to initialize the instrument's settings. Initializing the instrument (performing a system reset) reverts settings to their default values at the time the device was shipped from the factory. The system reset should be performed while the self-test is in progress after turning on the instrument (before the display changes to the normal display).

- Disconnect any voltage or current input from the instrument before performing the reset.
- The RS-232C communications speed, GP-IB address, and LAN-related settings will not be initialized.

Example: PW3337-03



- 1 Turn on the instrument.
- 2 While the product model and version are being displayed, press **SHIFT** and then **START/STOP**.
(The SHIFT lamp will not light up.)



- 3 Perform zero-adjustment as you would during normal operation.
If the system reset is being performed, the display will appear as shown below after the completion of zero-adjustment.



- 4 The System Reset screen will be displayed, and settings will be reverted to their default values when the instrument was shipped from the factory.

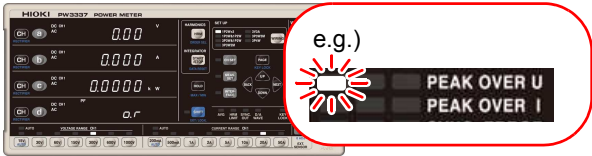
Factory Settings

Parameter		Setting	
Display area a		AC+DC CH1 V	
Display area b		AC+DC CH1 A	
Display area c		AC+DC CH1 W	
Display area d		AC+DC CH1 PF	
Voltage range		300 V range (auto-range off)	
Current range		20 A range (auto-range off)	
Wiring mode		1P2W	
Synchronization source		CH1: U1; CH2: U2; CH3; U3	
Current input		All direct input for CH1 to CH3 (off)	
VT ratio		1 (OFF) CH1 to CH3: 1 (OFF)	
CT ratio		1 (OFF) CH1 to CH3 1 (OFF)	
Frequency range		CH1 to CH3: 500 Hz	
Timeout		CH1 to CH3: 0.1 sec.	
Integration time		0000.00 (10,000 hr.)	
Number of averaging iterations (AVG)		1 (OFF)	
Harmonic analysis upper limit order		50th	
External synchronization function		OFF	
D/A output		U, I, P terminals: Level output DA1: S1; DA2: S2; DA3: S3	
PW3336-02	PW3336-03	PW3337-02	PW3337-03
Integration		Reset state	
Display hold		OFF	
Maximum value/minimum value display		OFF	
Key-lock		OFF	
LAN-related settings	IP address	192.168.1.1	
	Subnet mask	255.255.255.0	
	Default gateway	0.0.0.0	
RS-related settings	RS communications speed	38,400 bps	
GP-IB address		1	
PW3336-01	PW3336-03	PW3337-01	PW3337-03

Default LAN, RS-232C, and GP-IB settings are shown. These settings will not be initialized when a system reset is performed.

3.11 When PEAK OVER, o.r, or the Unit Indicator Flashes

3.11.1 If the PEAK OVER U or PEAK OVER I Lamp Lights Up

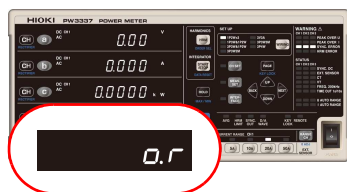


These lamps will light up if the voltage input or current input waveform peak value exceeds the figures listed below. At this time, the displayed data is not accurate.

- Voltage input waveform peak value: $\pm 600\%$ of the voltage range
When using the 300 V, 600 V, or 1000 V range, ± 1500 Vpeak
- Current input waveform peak value: $\pm 600\%$ of the current range
When using the 20 A or 50 A range, ± 100 Apeak

Error display	Status	Solution
PEAK OVER U	When greater than or equal to ± 1500 Vpeak	Stop measurement immediately, deactivate power to measurement lines, and disconnect wires.
	When less than ± 1500 Vpeak	The internal circuit is not operating properly. Switch to a range for which the PEAK OVER U lamp does not light up. See: "3.2.4 Selecting the Voltage and Current Ranges" (p.48)
PEAK OVER I	When greater than or equal to ± 100 Apeak	Stop measurement immediately, deactivate power to measurement lines, and disconnect wires.
	When less than ± 100 Apeak	The internal circuit is not operating properly. Switch to a range for which the PEAK OVER I lamp does not light up. See: "3.2.4 Selecting the Voltage and Current Ranges" (p.48)

3.11.2 When o.r (over-range) Is Displayed



This indication is displayed when the voltage or current exceeds 140% of the range. When using the voltage 1000 V range, it is displayed when 1060.5 V is exceeded.

For active power, [o.r] is not displayed until the 196% of the power range is exceeded, even if the voltage or current reading is shown as [o.r]. The [o.r] indication is displayed for parameters calculated using [o.r] data.

The [o.r] indicator is displayed under the following conditions:

Apparent power	When [o.r] is displayed for either the voltage or current
Reactive power	When [o.r] is displayed for the voltage, current, or active power
Power factor	- When [o.r] is displayed for either the voltage or current - When the apparent power is 0
Phase angle	When [o.r] is displayed for the power factor
Frequency measurement	When the reading falls outside the measurement range of 0.1 Hz to 220 kHz
Voltage waveform peak value	When the reading exceeds 102% of the voltage peak range
Current waveform peak value	When the reading exceeds 102% of the current peak range
Efficiency	- When [o.r] is displayed for the active power value used as the numerator or denominator in the calculation - When the active power value used as the denominator in the calculation is 0
Voltage crest factor	- When [o.r] is displayed for the voltage waveform peak value - When [o.r] is displayed for the voltage, or the voltage is 0
Current crest factor	- When [o.r] is displayed for the current waveform peak value - When [o.r] is displayed for the current, or the voltage is 0
Voltage ripple rate	- When [o.r] is displayed for the voltage waveform peak value - When [o.r] is displayed for the voltage, or the voltage is 0
Current ripple rate	- When [o.r] is displayed for the current waveform peak value - When [o.r] is displayed for the current, or the current is 0

Status	Solution
When [o.r] is displayed for the voltage	Switch to a range that does not result in an over-range condition. When [o.r] has been displayed while using the 1000 V range, stop measurement immediately, deactivate power to measurement lines, and disconnect wires. See: "3.2.4 Selecting the Voltage and Current Ranges" (p.48)
When [o.r] is displayed for the current	Switch to a range that does not result in an over-range condition. When [o.r] has been displayed while using the 50 A range, stop measurement immediately, deactivate power to measurement lines, and disconnect wires. See: "3.2.4 Selecting the Voltage and Current Ranges" (p.48)

3.11.3 When the Unit Indicator Flashes



Status	Solution
The unit indicator flashes during averaging processing	The average value being displayed contains [o.r] data. If no [o.r] data is present during averaging processing, the unit indicator will not flash. When [o.r] is displayed, internal data for which the voltage or current exceeded 140% of the range, or the active power exceeded 196% of the range, will be used as-is in calculating the average value.
The integrated value or time average value unit indicator flashes	Reset integrated values, change the range, and repeat integration. If no PEAK OVER condition occurs during integration, the indicator will not flash. See: "3.3 Integration" (p.62)

Connection to a PC

Chapter 4

You can use the instrument's standard LAN interface to connect it to a computer, which can then control it remotely. Additionally, you can also control the instrument with communications commands using the LAN, RS-232C, or GP-IB (optional feature) interface or transfer measurement data to a computer with a dedicated application*. To use communications features, you must first configure the instrument's communications settings.

For more information about how to control the instrument using communications commands, see the Communications Command Instruction Manual*.

***The latest version can be downloaded from our web site.**

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

■ RS-232C connections and settings (p.118)

- You can control the instrument using communications commands (see the Communications Command Instruction Manual).

■ LAN connections and settings (p.122)

- You can control the instrument remotely with an Internet browser. (p.129)
- You can control the instrument using communications commands (see the Communications Command Instruction Manual).
- You can control the instrument by creating a program and connecting to its communications command port via TCP.

■ GP-IB connections and settings (p.131)

PW3336-01

PW3336-03

PW3337-01

PW3337-03

- You can control the instrument with communications commands (see the Communications Command Instruction Manual).

4.1 RS-232C Settings and Connection
(Before Using Command Communications)

This section describes how to control the instrument using its RS-232C interface.

Items to verify before configuring settings and connecting to the instrument

 **WARNING**

- Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.
- To avoid damage to the instrument, do not short-circuit the terminal and do not input voltage to the terminal.
- Be sure to connect the cable to the target device’s RS-232C connector. Connecting the cable to a connector with different electrical specifications may cause electric shock or equipment damage.

 **CAUTION**

After connecting, always tighten the connector screws. If the connector is not secured, operation may fail to meet specifications, and damage could result.

Caution

Use the LAN, RS-232C, or GP-IB interface. Using multiple interfaces simultaneously may cause the instrument to malfunction, for example by interrupting communications.

Specifications

RS-232C

Communication Method	Full duplex Start-stop synchronization		
Communication Speed	9600bps/38400bps		
Data Bits	8 bits		
Parity	None		
Stop bit	1bits		
Message terminator (delimiter)	During Receiving : LF During Sending : CR+LF (can be switched to LF)		
Flow control	None		
Electrical Specifications	Input voltage level	5 to 15 V	: ON
		-15 to -5 V	: OFF
	Output voltage level	+5 V or greater	: ON
		-5 V or less	: OFF
Connector	Pin configuration of the interface connector (Male 9-pin D-sub #4-40 attaching screws) The I/O connector is a DTE (Data Terminal Equipment) configuration. Recommended cable: • 9637 RS-232C Cable (for a computer) • 9638 RS-232C Cable (for a D-sub 25-pin connector) See: Connecting the RS-232C Cable (p.120), Connecting the cable to the GP-IB connector (p.132) Note: When using a USB-serial converter to connect the instrument to a computer, you may need a gender converter and a straight-cross converter.		

Code used: ASCII code

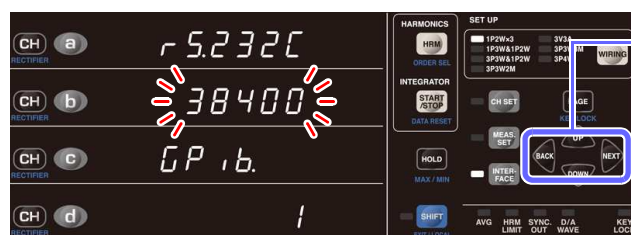
Setting the RS-232C communications speed



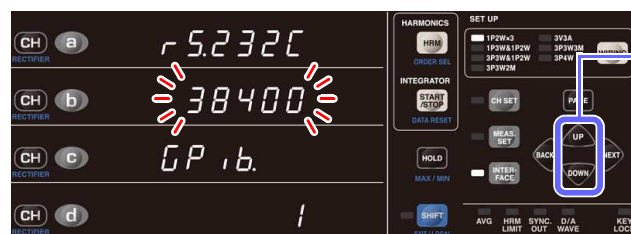
1 Press **INTER-FACE**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Until the number in **b** flashes, press **BACK** or **NEXT** to select RS-232C.



4 Press **UP** or **DOWN** to select the communications speed.
Settings: 38400 → 9600...

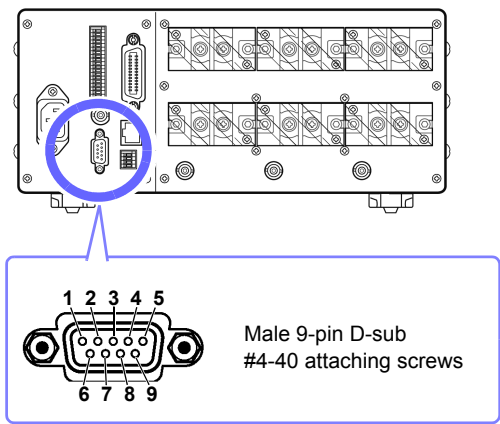


5 Press **INTER-FACE** to exit the settings.

The instrument will return to the normal measurement state.

Connecting the RS-232C Cable

Recommended cable: Model 9638 RS-232C Cable (9pin-25pin/1.8m crossover cable)



1 Connect the RS-232C cable to the instrument's RS-232C connector.

Be sure to secure it in place with the screws.

2 Set the controller's communications protocol so that it is the same as the instrument's settings.

Configure the controller's settings as follows:

- Start-stop synchronization
- Communication Speed: 9,600 bps/38,400 bps (Use the same setting as the instrument.)
- Stop bit: 1 bits
- Data Bits: 8 bits
- Parity: None
- Flow control: None

- When connecting the instrument to a controller (DTE), use a cross cable that satisfies the specifications of the instrument's connector and the controller's connector.
- When using a USB-serial cable, you may need a gender converter and a straight-cross converter. Obtain models that satisfy the specifications for the instrument's connector and the USB-serial cable's connector.

The I/O connector is a DTE (Data Terminal Equipment) configuration.
Pin number 2, 3, 5, 7, and 8 are used in the instrument. The other pins are not used.

Pin No.	Interchange circuit name		CCITT circuit No.	EIA abbreviation	JIS abbreviation	Common abbreviation
1	Data/channel receive carrier detection	Carrier Detect	109	CF	CD	DCD
2	Received data	Receive Data	104	BB	RD	RxD
3	Transmitted data	Send Data	103	BA	SD	TxD
4	Data terminal ready	Data Terminal Ready	108/2	CD	ER	DTR
5	Signal ground	Signal Ground	102	AB	SG	GND
6	Data set ready	DATA Set Ready	107	CC	DR	DSR
7	Request to send	Request to Send	105	CA	RS	RTS
8	Clear to send	Clear to Send	106	CB	CS	CTS
9	Ring indicator	Ring Indicator	125	CE	CI	RI

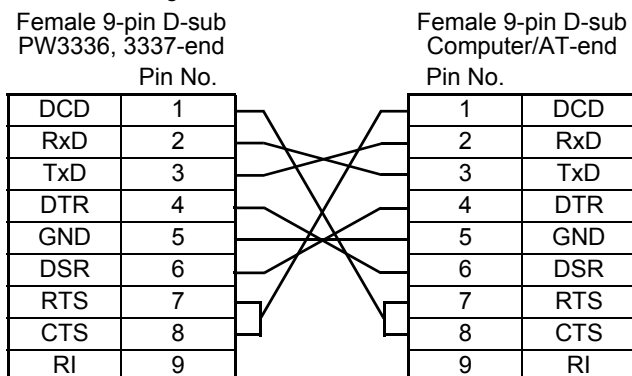
4.1 RS-232C Settings and Connection (Before Using Command Communications)

Computer

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

Recommended cable: Model 9637 RS-232C Cable (1.8 m, 9pin-9pin, crossover cable)

Crossover Wiring



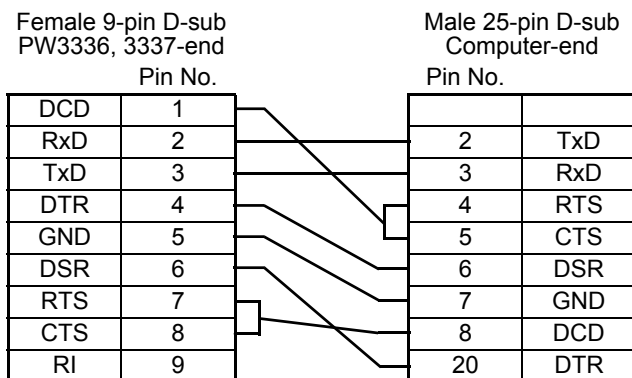
Device with D-sub 25-pin connector

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

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

Recommended cable: Model 9638 RS-232C Cable (1.8m, 25pin-9pin, crossover cable)

Crossover Wiring



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

4.2 LAN Settings and Connection
(Before Using Command Communications)

Before you can control the instrument remotely with an Internet browser on a computer or use command communications, you must configure the instrument’s LAN settings and connect it to the computer with a LAN cable.

Caution
Use the LAN, RS-232C, or GP-IB interface. Using multiple interfaces simultaneously may cause the instrument to malfunction, for example by interrupting communications.

Items to verify before configuring settings and connecting to the instrument

- Always make LAN settings before connecting to the network. If you change settings while connected to the network, IP addresses may overlap or invalid address data may flow over the network.
- The instrument does not support networks on which the IP address is automatically acquired using DHCP.

IP address	Identifies each device connected on a network. Each network device must be set to a unique address. The instrument supports IP version 4, with IP addresses indicated as four decimal octets, e.g., "192.168.0.1".
Subnet mask	This setting is for separating the IP address into the network address that indicates the network and the host address that indicates the instrument. On this instrument, the subnet mask is represented as four decimal numbers separated by "." such as "255.255.255.0."
Default Gateway	When the computer and instrument are on different but overlapping networks (subnets), this IP address specifies the device to serve as the gateway between the networks. If the computer and instrument are connected one-to-one, no gateway is used, and the instrument's default setting "0.0.0.0" can be kept as is.

When Connecting the instrument to an Existing Network

The following items must be assigned in advance by your network administrator. Be sure that there is no conflict with other devices.

IP address.

Subnet mask.

Default Gateway.

Connecting multiple instruments to a single computer using a hub

When building a local network with no outside connection, the following private IP addresses are recommended. Example settings: When creating a network with a network address of 192.168.1.0/24

IP address Computer:192.168.1.1

Instrument: Assign in order: 192.168.1.2, 192.168.1.3, 192.168.1.4, ...

Subnet mask 255.255.255.0

Default Gateway. 0.0.0.0

Connecting one instrument to a single computer using the 9642 LAN Cable

The 9642 LAN Cable can be used with its supplied connection adapter to connect one instrument to one computer, in which case the IP address is freely settable. Use the recommended private IP addresses.

IP address Computer: 192.168.1.1

Instrument: 192.168.1.2 (Set to a different IP address than the computer.)

Subnet mask 255.255.255.0

Default Gateway. 0.0.0.0

Setting the LAN's IP address

Before using the LAN, set the LAN's IP address.



1 Press **INTER-FACE**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **BACK** or **NEXT** to move among the address's four numbers.



4 Press **UP** or **DOWN** to set the IP address.

Setting range: 000 to 255



5 Press **INTER-FACE** to exit the settings.



6 The screen shown to the left will be displayed while the LAN is initialized.

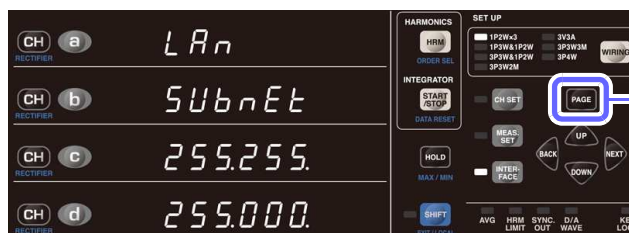
The instrument will return to the normal measurement state.

Setting the LAN's subnet mask

Before using the LAN, set the LAN's subnet mask.



1 Press **INTER-FACE**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **BACK** or **NEXT** to move among the address's four numbers.



4 Press **UP** or **DOWN** to set the subnet mask.

Setting range: **000** to **255**



5 Press **INTER-FACE** to exit the settings.



6 The screen shown to the left will be displayed while the LAN is initialized.

The instrument will return to the normal measurement state.

Setting the LAN's default gateway

Before using the LAN, set the LAN's default gateway.



1 Press **INTER-FACE**.



2 Press **PAGE** to display the settings screen shown to the left.



3 Press **BACK** or **NEXT** to move among the address's four numbers.



4 Press **UP** or **DOWN** to set the default gateway.

Setting range: **000** to **255**



5 Press **INTER-FACE** to exit the settings.



6 The screen shown to the left will be displayed while the LAN is initialized.

The instrument will return to the normal measurement state.

Displaying the LAN's MAC address

You can check the instrument's MAC address.

The MAC address cannot be changed.



1 Press **INTERFACE**.



2 Press **PAGE** to display the settings screen shown to the left.
The MAC address will be displayed.



3 Press **INTERFACE**.

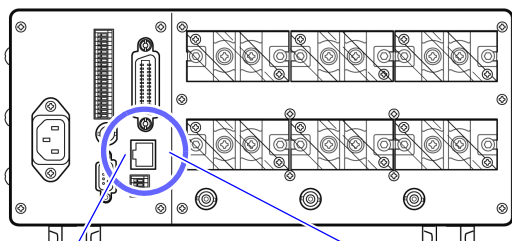
The instrument will return to the normal measurement state.

Connecting the instrument to a computer with a LAN cable

Connect the instrument and PC with a LAN cable.

There are two ways to accomplish this connection:

- Connect the instrument to an existing network.
- Connect the instrument to a single PC (p.128)



Orange LED

Lights up when the communications speed is 100 Mbps and turns off when the communications speed is 10 Mbps.

Green LED

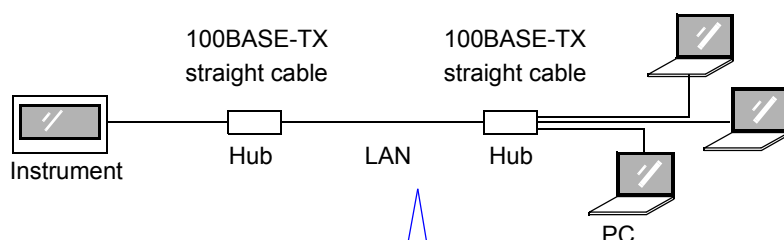
Lights up when a link is established and flashes when communications are in progress.

1 Connect a LAN cable (that is compatible with 100BASE-TX) to the 100BASE-TX connector on the right side of the instrument.

2 Connect the LAN cable to the PC.

If the green LED fails to light up when the instrument is connected to a LAN, there may be an issue with the instrument, the target device, or the connection cable.

Connecting the Instrument to a Network



You can monitor and control the instrument from a PC by connecting the instrument to a hub with LAN cable (100BASE-TX cable).

Instrument's 100Base-TX connector

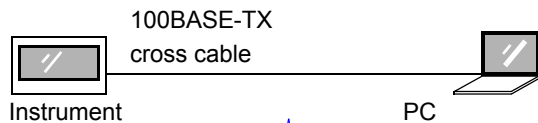


Model 9642 LAN Cable

Connect to hub

Connection cable: Use one of the following.

- 100BASE-TX straight-through cable (maximum length 100 m, commercially available) (10BASE-T cable may also be used for 10BASE communications)
- Model 9642 LAN cable (option)

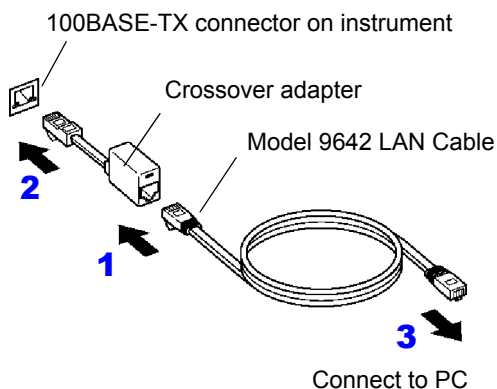
Making 1:1 Connections Between the Instrument and a PC

You can monitor and control the instrument from a PC by connecting the instrument to the PC with LAN cable (100BASE-TX cable)

Connecting with the 9642 LAN Cable and crossover adapter (supplied)

Connection cable: Use one of the following.

- 100BASE-TX crossover cable (maximum length 100 m)
- 100BASE-TX straight-through cable with crossover adapter (maximum length 100 m)
- 9642 LAN cable (option, supplied with crossover adapter)



- 1** Connect the 9642 LAN Cable to the supplied crossover adapter.
- 2** Connect the crossover adapter to the 100BASE-TX connector on the instrument.
- 3** Connect the 9642 LAN Cable to the 100BASE-TX connector on the PC.

This completes the process of connecting the instrument and PC.

4.3 Operating the Instrument from a PC's Browser

You can operate from the instrument using a PC Web browser such as Internet Explorer®. It is recommended to use IE (Internet Explorer®) Version 9 or later.

Connecting and configuring the LAN port

See: 4.2 LAN Settings and Connection (Before Using Command Communications) (p.122)

The home screen will be displayed when you connect.



Operating the instrument remotely

Selecting [Remote] on the menu displays the Remote Operation screen. The screen shown on the instrument will be shown as-is in the browser window.

The buttons on the control panel correspond to the buttons on the instrument. You can also operate the instrument remotely by clicking the screen with the mouse (the same key operation as the instrument).

You can save a PNG-format screenshot by clicking the [Screen copy] button.

You can also zoom in and out on most browsers by using CTRL + "+" to zoom in, CTRL + "-" to zoom out, and CTRL + "0" to select normal size.

You can select how often the screen is updated (update speeds are about 0.3 sec [High], 1 sec [Normal], and 10 sec [Low]).

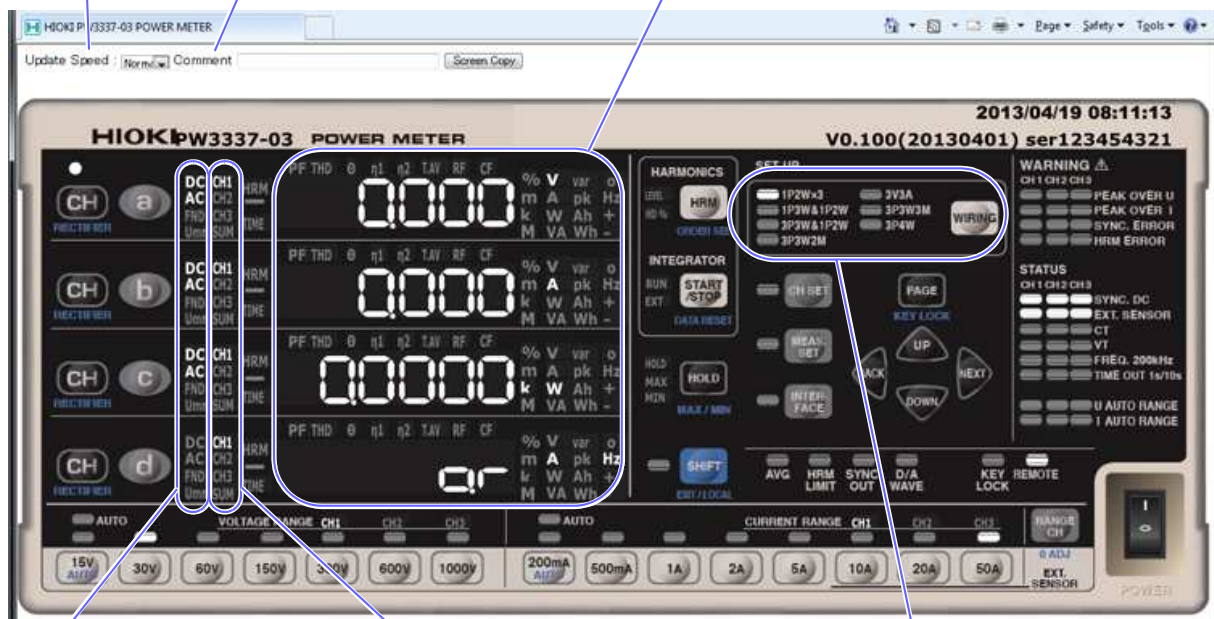
You can display a comment at the top right of the screen by entering it in this field. Supported with Internet Explorer® ver. 9 and later.

Changing display parameters

You can change display parameters by clicking on the display parameters (V, A, W, VA, etc.) in the measured value display area. You can select **pk**, **Hz**, **THD**, **θ**, **T.AV**, **RF**, and **CF** by using the computer's **shift** key.

Example: To display the current or voltage peak value
Click **pk** while holding down the computer's **shift** key.
→The current peak value will be displayed.

Click **pk** (do not press the computer's **shift** key).
→The voltage peak value will be displayed.



Changing the rectifier

You can change the displayed rectifier by clicking on the rectifier part (**DC**, **AC**, **FND**, **Umn**) of the measured value display area. You can also select **ACDC** by holding down the computer's shift key while you click the rectifier part of the display.

Changing display channels

You can change display channels by clicking the **CH1** to **CH3** part of the measured value display area.

Changing the wiring mode

You can change the wiring mode by clicking on the wiring mode display area.

Instrument keys + shift key

You can place the instrument in the shift state by holding down the computer's shift key while you click on keys on the screen with your mouse.

Example: Auto-range settings (voltage range)

You can set auto-range operation by clicking the **15V AUTO** voltage range while holding down the computer's shift key.

4.4 GP-IB Interface Settings and Connection (Before Using Command Communications)

PW3336-01

PW3336-03

PW3337-01

PW3337-03

This section describes how to control the instrument using its GP-IB interface.

Items to verify before configuring settings and connecting to the instrument

WARNING

- Turn off all devices before connecting or disconnecting interface connectors. Failure to do so may result in electric shock.
- To avoid equipment damage, do not short-circuit the connector or input a voltage.
- Be sure to connect the cable to the target device's GP-IB connector. Connecting the cable to a connector with different electrical specifications may cause electric shock or equipment damage.

CAUTION

After connecting, be sure to tighten the connector screws. If the connector is not secured, operation may fail to meet specifications, and damage could result.

Caution

Use the LAN, RS-232C, or GP-IB interface. Using multiple interfaces simultaneously may cause the instrument to malfunction, for example by interrupting communications.

GP-IB

- Commands common to IEEE-488-2 1987 (requirement) can be used.
- The instrument complies with the following standard. (Compliance standard: IEEE-488.1 1987^{*1})
- The instrument has been designed with reference to the following standard. (Reference standard: IEEE-488.2 1987^{*2})

If the output queue becomes full, a query error will result, and the output queue will be cleared. Consequently, the instrument does not support the output queue clearing and query error output requirements in the deadlocked state^{*3} as defined by IEEE 488.2.

^{*1} ANSI/IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation

^{*2} ANSI/IEEE Standard 488.2-1987, IEEE Standard Codes, Formats, Protocols, and Common Commands

^{*3} Deadlocked state: A state in which processing cannot be continued because the input buffer or output buffer is full.

Specifications

GP-IB

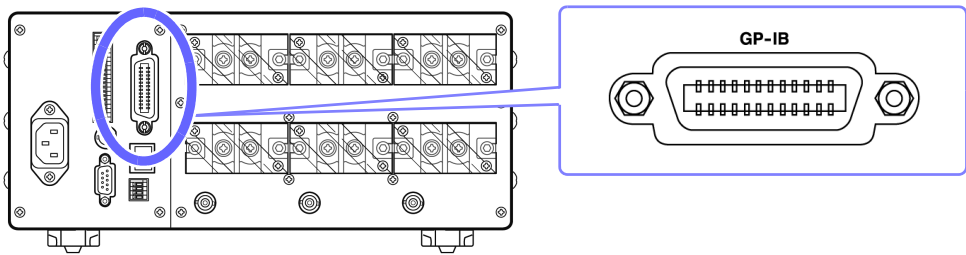
SH1	Supports all source handshake functions.
AH1	Supports all acceptor handshake functions.
T6	Supports standard talker functions.Supports serial poll functions.Talk only mode is not supported.Supports the talker cancel function by MLA (My Listen Address).
L4	Supports standard listener functions.Listener only mode is not supported.Supports the listener cancel function by MTA (My Talk Address).
SR1	Supports all service request functions.
RL1	Supports all remote/local functions.
PP0	Parallel poll functions are not supported.
DC1	Supports all device clear functions.
DT1	Supports all device trigger functions.
C0	Controller functions are not supported.

Code used: ASCII code

Connecting the cable to the GP-IB connector

- PW3336-01
- PW3336-03
- PW3337-01
- PW3337-03

Connect the GP-IB cable to the GP-IB connector.
Recommended cable: Model 9151-02 GP-IB connection cable (2 m)



Setting the GP-IB address PW3336-01 PW3336-03 PW3337-01 PW3337-03

Before using the GP-IB interface, you must set the GP-IB address.

1 Press **INTER-FACE**.

2 Press **PAGE** to display the settings screen shown to the left.

3 Press **BACK** or **NEXT** to select GP-IB.

4 Press **UP** or **DOWN** to set the GP-IB address.
Setting range: **00** to **30**

5 Press **INTER-FACE** to exit the settings.

The instrument will return to the normal measurement state.

4.5 Canceling the Remote State (Activating the Local State)

During communications, **REMOTE** lamp is lit to indicate the remote control state.

Control keys are disabled, with the exception of **SHIFT**.

If the remote state is activated while the instrument is displaying the Settings screen, it will automatically switch to the measurement display.

SHIFT key (**SHIFT**) is disabled if the GP-IB controller has put the instrument into the local lock out state (LLO: Local Lock Out).

In this case, run the GTL command of the interface function, or reboot the instrument. Then it returns to the local state.

Canceling the remote state

To switch the instrument from the remote state (with the **REMOTE** lamp lit up) to the local state (with panel operation enabled), press **SHIFT**.

The **REMOTE** lamp will turn off, and use of control keys will be enabled.



1 Press **SHIFT**.

2 The **REMOTE** lamp will turn off, enabling use of control keys.

Specifications

Chapter 5

5.1 Environmental and Safety Specifications

Operating environment	Indoors, altitude up to 2000 m (6562ft.), pollution degree 2
Operating temperature and humidity	0 to 40°C (32 to 104°F), 80% RH or less (no condensating)
Storage temperature and humidity	-10 to 50°C (14 to 122°F), 80% RH or less (no condensating)
Dielectric strength	4,290 Vrms AC (current sensitivity: 1 mA) Between voltage input terminals and (case, interface, and output terminals) Between current direct input terminals and (case, interface, and output terminals) Between voltage input terminals and current direct input terminals
Maximum rated voltage to earth	Voltage input terminal, Current direct input terminal Measurement category III 600 V (anticipated transient overvoltage: 6000 V) Measurement category II 1000 V (anticipated transient overvoltage: 6000 V)
Maximum input voltage	Between voltage input terminals U and $\pm$: 1000 V, $\pm$ 1500 Vpeak Between external current sensor input BNC terminal Hi and Lo: 5 V, $\pm$ 7.1 Vpeak
Maximum input current	Between current direct input terminals I and $\pm$: 70 A, $\pm$ 100 Apeak
Dust-proof,water-proof	IP20(EN60529)
Standards	Safety EN61010 EMC EN61326 Class A

5.2 General Specifications

Input specifications

PW3336 series

Measurement line type

Single-phase 2-wire(1P2W), Single-phase 3-wire (1P3W),
Three-phase 3-wire(3P3W, 3P3W2M)

Wiring (WIRING)	CH1	CH2
1P2W×2	1P2W	1P2W
1P3W	1P3W	
3P3W	3P3W	
3P3W2M	3P3W2M	

PW3337 series

Measurement line type

Single-phase 2-wire (1P2W), Single-phase 3-wire (1P3W),
Three-phase 3-wire (3P3W, 3P3W2M, 3V3A, 3P3W3M), Three-phase 4-wire(3P4W)

Wiring (WIRING)	CH1	CH2	CH3
1P2W×3	1P2W	1P2W	1P2W
1P3W&1P2W	1P3W		1P2W
3P3W&1P2W	3P3W		1P2W
3P3W2M	3P3W2M		
3V3A	3V3A		
3P3W3M	3P3W3M		
3P4W	3P4W		

Input methods

Voltage

Current

Isolated input, resistance voltage division method

Isolated input, DCCT method

Isolated input from current sensors

Input resistance (50/60 Hz)

Voltage input terminal : 2 MΩ±0.04 MΩ

Current direct input terminal : 1 mΩ or less

External current sensor input terminal : 300 kΩ±30 kΩ

Voltage measurement ranges

AUTO/ 15 V/ 30 V/ 60 V/ 150 V/ 300 V/ 600 V/ 1000 V (set for each wiring mode)

Current measurement ranges

AUTO/ 200 mA/ 500 mA/ 1 A/ 2 A/ 5 A/ 10 A/ 20 A/ 50 A (set for each wiring mode)

For more information about external current sensor input, see the external current sensor input specifications (Current Sensor) (p.151).

Power ranges For wiring modes other than 1P2W, sum power range (power ranges for individual channels are the same as for 1P2W).

Current/Wiring/Voltage		15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
200.00 mA	1P2W	3.0000	6.0000	12.000	30.000	60.000	120.00	200.00
	Other than 1P2W, 3P4W	6.0000	12.000	24.000	60.000	120.00	240.00	400.00
	3P4W	9.0000	18.000	36.000	90.000	180.00	360.00	600.00
500.00 mA	1P2W	7.5000	15.000	30.000	75.000	150.00	300.00	500.00
	Other than 1P2W, 3P4W	15.000	30.000	60.000	150.00	300.00	600.00	1.0000 k
	3P4W	22.500	45.000	90.000	225.00	450.00	900.00	1.5000 k
1.0000 A	1P2W	15.000	30.000	60.000	150.00	300.00	600.00	1.0000 k
	Other than 1P2W, 3P4W	30.000	60.000	120.00	300.00	600.00	1.2000 k	2.0000 k
	3P4W	45.000	90.000	180.00	450.00	900.00	1.8000 k	3.0000 k
2.0000 A	1P2W	30.000	60.000	120.00	300.00	600.00	1.2000 k	2.0000 k
	Other than 1P2W, 3P4W	60.000	120.00	240.00	600.00	1.2000 k	2.4000 k	4.0000 k
	3P4W	90.000	180.00	360.00	900.00	1.8000 k	3.6000 k	6.0000 k
5.0000 A	1P2W	75.000	150.00	300.00	750.00	1.5000 k	3.0000 k	5.0000 k
	Other than 1P2W, 3P4W	150.00	300.00	600.00	1.5000 k	3.0000 k	6.0000 k	10.000 k
	3P4W	225.00	450.00	900.00	2.2500 k	4.5000 k	9.0000 k	15.000 k
10.000 A	1P2W	150.00	300.00	600.00	1.5000 k	3.0000 k	6.0000 k	10.000 k
	Other than 1P2W, 3P4W	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	20.000 k
	3P4W	450.00	900.00	1.8000 k	4.5000 k	9.0000 k	18.000 k	30.000 k
20.000 A	1P2W	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	20.000 k
	Other than 1P2W, 3P4W	600.00	1.2000 k	2.4000 k	6.0000 k	12.000 k	24.000 k	40.000 k
	3P4W	900.00	1.8000 k	3.6000 k	9.0000 k	18.000 k	36.000 k	60.000 k
50.000 A	1P2W	750.00	1.5000 k	3.0000 k	7.5000 k	15.000 k	30.000 k	50.000 k
	Other than 1P2W, 3P4W	1.5000 k	3.0000 k	6.0000 k	15.000 k	30.000 k	60.000 k	100.00 k
	3P4W	2.2500 k	4.5000 k	9.0000 k	22.500 k	45.000 k	90.000 k	150.00 k

Units: W (active power), VA (apparent power), var (reactive power)

Basic Specifications

Rated supply voltage	100 VAC to 240 VAC (Voltage fluctuations of $\pm 10\%$ from the rated supply voltage are taken into account.) Anticipated transient overvoltage: 2500 V
Rated power supply frequency	50/60 Hz
Maximum rated power	40 VA or less
Dimensions	Approx. 305 (W) $\times$ 132 (H) $\times$ 256 (D) mm (12.01"W $\times$ 5.20"H $\times$ 10.08"D) (excluding protrusions)
Mass	PW3336 series Approx. 5.2 kg (183.4 oz.) PW3337 series Approx. 5.6 kg (197.5 oz.)
Product warranty period	3 years Connector, cable, etc.: Not covered by the warranty

Display Specifications

Display	7-segment LED
Number of display parameters	4
Display resolution	Other than integrated values: 99999 count Integrated values: 999999 count
Display update rate	200 ms $\pm$ 50 ms (approx. 5 updates per sec.) to 20 s (varies with number of averaging iterations setting)

External interface specifications**RS-232C interface (standard equipment)**

Connector	D-sub 9-pin connector × 1
Communication method	Full duplex, Start-stop synchronization Stop bits: 1 (fixed) Data length : 8 (fixed) Parity: None Remote control by controller (REMOTE lamp will light up.) Cancellation of remote operation with LOCAL key (REMOTE lamp will turn off.) Hardware handshake function
Communication Speed	9600bps/38400bps

LAN interface (standard equipment)

Connector	RJ-45 connector × 1
Electrical Specifications	Compliant with IEEE802.3
Transmission Method	10Base-T/100Base-TX (automatic detection)
Protocol	TCP/IP
Functions	HTTP server (remote operation, firmware updates) Dedicated ports (command control, data transfer) Remote control by controller (REMOTE lamp will light up.) Cancellation of remote operation with LOCAL key (REMOTE lamp will turn off.)

GP-IB interface PW3336-01/-03, PW3337-01/-03, specify at time of order)

Method	IEEE488.1 1987 compliant; in reference to IEEE488.2 1987 Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0 Remote control by controller (REMOTE lamp will light up.) Cancellation of remote operation with LOCAL key (REMOTE lamp will turn off.)
Address	00 to 30

Accessory and Option Specifications

Accessories	Voltage and current input terminal safety cover PW3336, -01, -02, -03 4 PW3337, -01, -02, -03 6 Safety cover installation screws (M3×6 mm) PW3336, -01, -02, -03 8 PW3337, -01, -02, -03 12 Instruction manual 1 Measurement guide 1 Power cord 1
Options	Communications and control options Model 9637 RS-232C Cable (1.8 m, 9pin-9pin, crossover cable) Model 9638 RS-232C Cable (1.8 m, 25pin-9pin, crossover cable) Model 9642 LAN Cable (5 m, Supplied with Cross-Over Adapter) Model 9151-02 GP-IB Connector Cable (2 m) Model 9165 Connection Cord (1.5 m, metal BNC to metal BNC, not CE marked, for the synchronized measurements) Current sensor options See external current sensor input specifications (CURRENT SENSOR) (p.151).

5.3 Measurement specifications

Basic Measurement Specifications

Measurement method	Simultaneous voltage and current digital sampling, zero-cross simultaneous calculation		
Sampling frequency	Approx. 700 kHz		
A/D converter resolution	16-bit		
Frequency bands	DC, 0.1 Hz to 100 kHz (Reference value of 0.1 Hz ≤ f < 10 Hz)		
Synchronization sources (SYNC)	U1, U2, U3, I1, I2, I3, DC (fixed at 200 ms) Can be set separately for each wiring mode. When the source input AC measured value is less than 1% f.s., operation and accuracy are not defined. When synchronization cannot be detected, the SYNC ERROR lamp will light up. Operation and accuracy are not defined at that time. When the synchronization source is DC, accuracy is not defined for input with a cycle that is not divisible by 200 ms. Synchronization timeout setting: 0.1 sec. / 1 sec. / 10 sec. (linked to measurement lower limit frequency setting)		
Measurement items	Voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, current integration, active power integration, integration time, voltage waveform peak value, current waveform peak value, efficiency, voltage crest factor, current crest factor, time average current, time average active power, voltage ripple rate, current ripple rate Harmonic parameters Harmonic voltage RMS value, harmonic current RMS value, harmonic active power, total harmonic voltage distortion, total harmonic current distortion, fundamental wave voltage, fundamental wave current, fundamental wave active power, fundamental wave apparent power, fundamental wave reactive power, fundamental wave power factor (displacement power factor), fundamental wave voltage current phase difference, inter-channel voltage fundamental wave phase difference, inter-channel current fundamental wave phase difference, harmonic voltage content percentage, harmonic current content percentage The following parameters can be downloaded as data with communications but not displayed: Harmonic voltage phase angle, harmonic current phase angle, harmonic voltage current phase difference		
Rectifiers	AC+DC	AC+DC measurement	Display of true RMS values for both voltage and current
	AC+DC Umn	AC+DC measurement	Display of average value rectified RMS converted values for voltage and true RMS values for current
	DC	DC measurement	Display of simple averages for both voltage and current Display of values calculated by (voltage DC value) × (current DC value) for active power
	AC	AC measurement	Display of values calculated by $\sqrt{(AC+DC \text{ value})^2 - (DC \text{ value})^2}$ for both voltage and current Display of values calculated by (AC+DC value) - (DC value) for active power
	FND	Extraction and display of the fundamental wave component from harmonic measurement	
Zero-Crossing Filter	100 Hz/ 500 Hz/ 5 kHz/ 200 kHz (linked to frequency measurement range) 100 Hz: 0.1 Hz to 100 Hz 500 Hz: 0.1 Hz to 500 Hz 5 kHz: 0.1 Hz to 5 kHz 200 kHz: 0.1 Hz to 200 kHz The zero-cross filter lower limit setting is linked to the synchronization timeout setting. 10 Hz/ 1 Hz/ 0.1 Hz		

Measurement accuracy

Voltage

Frequency(f)	Input < 50% f.s.	50% f.s. ≤ Input < 100% f.s.	100% f.s. ≤ Input
DC	±0.1%rdg.±0.1%f.s.	±0.1%rdg.±0.1%f.s.	±0.2%rdg.
0.1 Hz ≤ f < 16 Hz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
16 Hz ≤ f < 45 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
45 Hz ≤ f ≤ 66 Hz	±0.1%rdg.±0.05%f.s.	±0.15%rdg.	±0.15%rdg.
66 Hz < f ≤ 500 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
500 Hz < f ≤ 10 kHz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
10 kHz < f ≤ 50 kHz	±0.5%rdg.±0.3%f.s.	±0.8%rdg.	±0.8%rdg.
50 kHz < f ≤ 100 kHz	±2.1%rdg.±0.3%f.s.	±2.4%rdg.	±2.4%rdg.

Current (direct input)

Frequency(f)	Input < 50% f.s.	50% f.s. ≤ Input < 100% f.s.	100% f.s. ≤ Input
DC	±0.1%rdg.±0.1%f.s.	±0.1%rdg.±0.1%f.s.	±0.2%rdg.
0.1 Hz ≤ f < 16 Hz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
16 Hz ≤ f < 45 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
45 Hz ≤ f ≤ 66 Hz	±0.1%rdg.±0.05%f.s.	±0.15%rdg.	±0.15%rdg.
66 Hz < f ≤ 500 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
500 Hz < f ≤ 1 kHz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
1 kHz < f ≤ 10 kHz	±(0.03+0.07×F)%rdg.±0.2%f.s.	±(0.23+0.07×F)%rdg.	±(0.23+0.07×F)%rdg.
10 kHz < f ≤ 100 kHz	±(0.3+0.04×F)%rdg.±0.3%f.s.	±(0.6+0.04×F)%rdg.	±(0.6+0.04×F)%rdg.

Active power

Frequency(f)	Input < 50% f.s.	50% f.s. ≤ Input < 100% f.s.	100% f.s. ≤ Input
DC	±0.1%rdg.±0.1%f.s.	±0.1%rdg.±0.1%f.s.	±0.2%rdg.
0.1 Hz ≤ f < 16 Hz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
16 Hz ≤ f < 45 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
45 Hz ≤ f ≤ 66 Hz	±0.1%rdg.±0.05%f.s.	±0.15%rdg.	±0.15%rdg.
66 Hz < f ≤ 500 Hz	±0.1%rdg.±0.1%f.s.	±0.2%rdg.	±0.2%rdg.
500 Hz < f ≤ 1 kHz	±0.1%rdg.±0.2%f.s.	±0.3%rdg.	±0.3%rdg.
1 kHz < f ≤ 10 kHz	±(0.03+0.07×F)%rdg.±0.2%f.s.	±(0.23+0.07×F)%rdg.	±(0.23+0.07×F)%rdg.
10 kHz < f ≤ 50 kHz	±(0.07×F)%rdg.±0.3%f.s.	±(0.3+0.07×F)%rdg.	±(0.3+0.07×F)%rdg.
50 kHz < f ≤ 100 kHz	±(0.6+0.07×F)%rdg.±0.3%f.s.	±(0.9+0.07×F)%rdg.	±(0.9+0.07×F)%rdg.

- Values for f.s. depend on measurement ranges.
- "F" in the tables refers to the frequency in kHz.
- Add ±1 mA to DC measurement accuracy for current.
- Add (±1 mA) × (voltage read value) to DC measurement accuracy for active power.
- When using the 200 mA or 500 mA range, add ±0.1% rdg. to current and active power for which 1 kHz < f ≤ 10 kHz.
- Values for voltage, current, and active power for which 0.1 Hz ≤ f < 10 Hz are for reference only.
- Values for voltage, current, and active power in excess of 220 V or 20 A for which 10 Hz ≤ f < 16 Hz are for reference only.
- Values for current and active power in excess of 20 A for which 500 Hz < f ≤ 50 kHz are for reference only.
- Values for current and active power in excess of 15 A for which 50 kHz < f ≤ 100 kHz are for reference only.
- Values for voltage and active power in excess of 750 V for which 30 kHz < f ≤ 100 kHz are for reference only.

Effective measuring range

Voltage: 1% to 130% of range (1000 V range, up to 1000 V)
 Current: 1% to 130% of range
 Active power: 0% to 169% of range (when using 1000 V range, up to 130%)
 However, defined when voltage and current fall within the effective measurement range.
 Other parameters: Valid within the voltage, current, and active power effective measurement range.

Maximum effective peak voltage	±600% of each voltage range However, for 300 V, 600 V, and 1000 V ranges, ±1500 V _{peak}
Maximum effective peak current	±600% of each current range However, for 20 A range and 50 A range, ±100 A _{peak}
Guaranteed accuracy period	1 year
Conditions of guaranteed accuracy	Temperature and humidity for guaranteed accuracy: 23°C ±5°C, 80% RH or less Warm-up time: 30 minutes Input: Sine wave input, power factor of 1, voltage to earth of 0 V, after zero-adjustment; within range in which the fundamental wave satisfies synchronization source conditions
Temperature coefficient	±0.03% f.s. per °C or less
Power factor effects	±0.1% f.s. or less (45 to 66 Hz, at power factor = 0) Internal circuitry voltage/current phase difference: ±0.0573°
Effect of common mode voltage	±0.02% f.s. or less (600 V, 50/60 Hz, applied between input terminals and enclosure)
Magnetic field interference	400 A/m, DC and 50/60 Hz magnetic field Voltage ±1.5% f.s. or less Current ±1.5% f.s. or ±10 mA, whichever is greater, or less Active power ±3.0% f.s. or (voltage influence quantity) × (±10 mA), whichever is greater, or less
Magnetization effect	±10 mA equivalent or less (after inputting 100 A DC to the current direct input terminals)
Adjacent channel input effect	±10 mA equivalent or less (when inputting 50 A to adjacent channel)

Voltage Measurement Specifications (U: Displayed as V on panel display)

Measurement types	Rectifiers: AC+DC, DC, AC, FND, AC+DC U _{mn}
Effective measuring range	1% to 130% of range; however, up to ±1500 V peak value and 1000 V RMS value
Display range	0.5% to 140% of range (zero-suppression when less than 0.5%)
Polarity	Displayed when using DC rectifier
Over-range display	Displays [o.r] (over-range) when input exceeds ±140% of the range or ±1060.5 V.
Peak exceeded warning	The PEAK OVER U (U1 to U3) lamp will light up for any channel for which the input voltage peak value exceeds ±1500 V or ±600% of the range.

Current Measurement Specifications (I: Displayed as A on panel display)

Measurement types	Rectifiers: AC+DC, DC, AC, FND, AC+DC I _{mn}
Effective measuring range	1% to 130% of range
Display range	0.5% to 140% of range (zero-suppression when less than 0.5%)
Polarity	Displayed when using DC rectifier
Over-range display	Displays [o.r] when input exceeds ±140% of the range.
Peak exceeded warning	The PEAK OVER I (I1 to I3) lamp will light up for any channel for which the input current peak value exceeds ±100 A or ±600% of the range.

Active Power Measurement Specifications (P: Displayed as W on panel display)

Measurement types	Rectifiers: AC+DC, DC, AC, FND, AC+DC Umn
Effective measuring range	0% to 169% of the range However, defined when the voltage and current fall within the effective measurement range.
Display range	0% to 196% of the range (no zero-suppression)
Polarity	Positive: Power consumption (no polarity display); negative: generation or regenerated power
Over-range display	Displays [o.r] when input exceeds $\pm 196\%$ of the range.

Apparent Power Measurement Specifications (S: Displayed as VA on panel display)

Measurement types	Rectifiers: AC+DC, AC, FND, AC+DC Umn
Effective measuring range	As per voltage and current effective measurement ranges.
Display range	0% to 196% of the range (no zero-suppression) When using the AC+DC or AC rectifier, displays S as P when $ P > S$.
Over-range display	Displays [o.r] when displaying [o.r] for either voltage or current.
Invalid data display	Displays [- - - -] when using the DC rectifier.

Reactive Power Measurement Specifications (Q: Displayed as var on panel display)

Measurement types	Rectifiers: AC+DC, AC, FND, AC+DC Umn
Effective measuring range	As per voltage, current, and active power effective measurement ranges.
Display range	0% to 196% of the range (no zero-suppression)
Polarity	Polarity is assigned according to the lead/lag relationship of the voltage waveform rising edge and the current waveform rising edge. +: When current lags voltage (no polarity display) -: When current leads voltage
Polarity effective range	With the AC+DC, AC, or AC+DC Umn rectifier: Sine-wave input equivalent to at least 20% of the measurement range, frequency of 10 Hz to 20 kHz, phase difference of $\pm(1^\circ$ to $179^\circ)$
Over-range display	Displays [o.r] when displaying [o.r] for the voltage, current, or active power.
Invalid data display	Displays [- - - -] when using the DC rectifier.

Power Factor Measurement Specifications (λ : Displayed as PF on panel display)

Measurement types	Rectifiers: AC+DC, AC, FND, AC+DC Umn
Effective measuring range	As per voltage, current, and active power effective measurement ranges
Display range	± 0.0000 to ± 1.0000
Polarity	Polarity is assigned according to the lead/lag relationship of the voltage waveform rising edge and the current waveform rising edge. +: When current lags voltage (no polarity display) -: When current leads voltage
Polarity effective range	With the AC+DC, AC, or AC+DC Umn rectifier: Sine-wave input equivalent to at least 20% of the measurement range, frequency of 10 Hz to 20 kHz, phase difference of $\pm(1^\circ$ to $179^\circ)$
Over-range display	Displays [o.r] when displaying [o.r] for the voltage or current, or when the displayed apparent power is 0.
Invalid data display	Displays [- - - -] when using the DC rectifier.

Phase Angle Measurement Specifications (ϕ : Displayed as ° on panel display)

Measurement types	Rectifiers: AC, FND
Effective measuring range	As per voltage, current, and active power effective measurement ranges
Display range	+180.00 to -180.00
Polarity	Polarity is assigned according to the lead/lag relationship of the voltage waveform rising edge and the current waveform rising edge. +: When current lags voltage (no polarity display) -: When current leads voltage
Polarity effective range	With the AC rectifier: Sine-wave input equivalent to at least 20% of the measurement range, frequency of 10 Hz to 20 kHz, phase difference of $\pm(1^\circ$ to $179^\circ)$
Over-range display	Displays [o.r] when displaying [o.r] for the power factor.
Invalid data display	Displays [- - - -] when using the AC+DC, AC+DC Umn, or DC rectifier.

**Frequency Measurement Specifications
(f: Displayed as V Hz or A Hz on panel display)**

Number of measurement channels	6
Measurement method	Calculated from input waveform period (reciprocal method)
Measurement ranges	100 Hz/ 500 Hz/ 5 kHz/ 200 kHz (linked to zero-cross filter) (The measurement ranges of 100 Hz and 5 kHz will be added to the firmware with the version number 1.10)
Measurement accuracy	$\pm 0.1\%$ rdg. ± 1 dgt. (0°C to 40°C)
Effective measuring range	0.1 Hz to 100 kHz For sine wave input that is at least 20% of the measurement source's measurement range Measurement lower limit frequency setting: 0.1 sec. / 1 sec. / 10 sec. (linked to synchronization timeout setting)
Display format	0.1000 Hz to 9.9999 Hz, 9.900 Hz to 99.999 Hz, 99.00 Hz to 999.99 Hz, 0.9900 kHz to 9.9999 kHz, 9.900 kHz to 99.999 kHz, 99.00 kHz to 220.00 kHz
Over-range display	Displays [o.r] when input falls outside the measurement range.
Invalid data display	Displays [- - - -] when using the DC rectifier.

Integration Measurement Specifications

Measurement items	Simultaneous integration of the following 6 parameters for each channel (total of 18 parameters): Sum of current integrated values (displayed as Ah on panel display) Positive current integrated value (displayed as Ah+ on panel display) Negative current integrated value (displayed as Ah- on panel display) Sum of active power integrated values (displayed as Wh on panel display) Positive active power integrated value (displayed as Wh+ on panel display) Negative active power integrated value (displayed as Wh- on panel display)
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Measurement types	Rectifiers: AC+DC, AC+DC Umn Current: Displays the result of integrating current RMS value data (display values) once every display update interval (approx. 200 ms) as an integrated value. Active power: Displays the result of integrating active power values by polarity calculated once every cycle for the selected synchronization source as integrated values. Rectifier: DC Displays the result of integrating instantaneous data obtained by sampling both current and active power by polarity as integrated values (these values are not integrated values for the DC component when active power contains both DC and AC components)		
Integration time	1 min. to 10,000 hr., settable in 1 min. blocks Default value: 10,000 hr. (0000.00 display)		
Integration time accuracy	±100 ppm ±1 dgt. (0°C to 40°C)		
Integration measurement accuracy	(Current or active power measurement accuracy) + (±0.01% rdg. ±1 dgt.)		
Effective measuring range	Until PEAK OVER U or PEAK OVER I occurs		
Display resolution	999999 (6 digits + decimal point)		
Peak exceeded warning	If a PEAK OVER U or PEAK OVER I event occurs during integration operation, the unit (Ah, Ah+, Ah-, Wh, Wh+, Wh-) will flash.		
Invalid data display	Displays [- - - -] when using the AC or FND rectifier.		
Integration status display	During integration operation	RUN lamp lit up (during external control operation, EXT lamp lit up)	
	When stopped	RUN lamp flashing (during external control operation, EXT lamp lit up)	
	Integrated value reset	RUN lamp off (during external control operation, EXT lamp off)	
Functions	Stopping integration based on integration time setting (timer) Stopping/starting integration and resetting integrated values based on external control Displaying the integration elapsed time (displayed as TIME on panel display) Additional integration by repeatedly starting/stopping integration Backing up integrated values and the integration elapsed time during power outages Stopping integration when power returns		
External control	Input signal level: 0 to 5 V (high-speed CMOS level) or shorted [Lo]/open [Hi]		
	Functions	External control signal	External control terminal
	Start	Hi → Lo	START/STOP
	Stop	Lo → Hi	
	Reset	Lo interval of at least 200 ms	RESET

Constraints	During integration operation and while integration is stopped, the following operational constraints apply until integrated values are reset:	
	●: Setting and changes allowed -: Setting and changes not allowed	
	Item	During integration operation or while integration is stopped
	Measurement range	- (Fixed to range when integration was started.)
	Current input method switching	-
	Wiring	-
	Frequency measurement range (Zero-Crossing Filter)	-
	Timeout	-
	Integration time	-
	Synchronization source	-
	Zero Adjustment	- (Can be adjusted while integration is stopped.)
	D/A output parameters	●
	Number of averaging iterations	-
	VT ratio	-
	CT ratio	-
	RS-232C transfer speed	●
	GP-IB address	●
	LAN	●
	Harmonic analysis order upper limit value	-

Voltage Waveform Peak Value Measurement Specifications (Upk: Displayed as V pk on panel display)

Measurement method	Measures the voltage waveform's peak value (for both positive and negative polarity) based on sampled instantaneous voltage values.						
Range configuration							
Voltage range	15 V	30 V	60 V	150 V	300 V	600 V	1000 V
Voltage peak range	90.000 V	180.00 V	360.00 V	900.00 V	1.8000 kV	3.6000 kV	6.0000 kV
Measurement accuracy	±2.0% f.s. at DC and when 10 Hz ≤ f ≤ 1 kHz (f.s.: voltage peak range). Provided as reference value when 0.1 Hz ≤ f < 10 Hz and when in excess of 1 kHz.						
Effective measuring range	±5% to ±100% of voltage peak range (up to ±1500 V)						
Display range	±0.3% to ±102% of voltage peak range (values less than ±0.3% are subject to zero-suppression)						
Over-range display	Displays [o.r] when input exceeds ±102% of the voltage peak range.						
Invalid data display	Upksum is displayed as [- - - -].						

Current Waveform Peak Value Measurement Specifications (I_{pk}: Displayed as A pk on panel display)

Measurement method	Measures the current waveform's peak value (for both positive and negative polarity) based on sampled instantaneous current values.							
Range configuration								
Current range	200 mA	500 mA	1 A	2 A	5 A	10 A	20 A	50 A
Current peak range	1.2000 A	3.0000 A	6.0000 A	12.000 A	30.000 A	60.000 A	120.00 A	300.00 A
Measurement accuracy	±2.0% f.s. at DC and when $10\text{ Hz} \leq f \leq 1\text{ kHz}$ (f.s.: current peak range). Provided as reference value when $0.1\text{ Hz} \leq f < 10\text{ Hz}$ and when in excess of 1 kHz.							
Effective measuring range	±5% to ±100% of current peak range (up to ±100 A)							
Display range	±0.3% to ±102% of current peak range (values less than ±0.3% are subject to zero-suppression)							
Over-range display	Displays [o.r] when input exceeds ±102% of the current peak range.							
Invalid data display	Ipksum is displayed as [- - - -].							

Efficiency Measurement Specifications (η: Displayed as η1 % or η2 % on display panel)

Measurement method	Calculates the efficiency η [%] from the ratio of active power values for channels and wires.				
Wiring modes and calculation equations	Calculated based on the AC+DC rectifier active power.				
	PW3336, PW3336-01, PW3336-02, PW3336-03				
	Wiring (WIRING)	CH1	CH2	Calculation formulas	
	1P2W×2	1P2W	1P2W	$\eta 1=100\times P2 / P1 $ $\eta 2=100\times P1 / P2 $	
	1P3W	1P3W		-	
	3P3W	3P3W		-	
	3P3W2M	3P3W2M		-	
	PW3337, PW3337-01, PW3337-02, PW3337-03				
	Wiring (WIRING)	CH1	CH2	CH3	Calculation formulas
	1P2W×3	1P2W	1P2W	1P2W	$\eta 1=100\times P3 / P1 $ $\eta 2=100\times P1 / P3 $
	1P3W&1P2W	1P3W		1P2W	$\eta 1=100\times P3 / Psum $ $\eta 2=100\times Psum / P3 $
	3P3W&1P2W	3P3W		1P2W	
3P3W2M	3P3W2M			-	
3V3A	3V3A			-	
3P3W3M	3P3W3M			-	
3P4W	3P4W			-	
Effective measuring range	As per the active power effective measurement range.				
Display range	0.00[%] to 200.00[%]				
Over-range display	Displays [o.r] when displaying [o.r] for the active power value being used as either the numerator or denominator in the equation. Displays [o.r] when the active power value being used as the denominator in the equation is 0.				
Invalid data display	Displays [- - - -] for wiring modes for which efficiency is not measured.				

Voltage Crest Factor Measurement Specifications (Ucf: Displayed as CF V on panel display)

Measurement method	Calculates values from display values once each display update interval for voltage and voltage waveform peak values.
Effective measuring range	As per voltage and voltage waveform peak value effective measurement ranges.
Display range	1.0000 to 612.00 (no polarity)
Over-range display	Displays [o.r] when displaying [o.r] for the voltage waveform peak value and when the display voltage is [o.r] or 0.
Invalid data display	Ucfsum is displayed as [- - - -].

Current Crest Factor Measurement Specifications (Icf: Displayed as CF A on panel display)

Measurement method	Calculates values from display values once each display update interval for current and current waveform peak values.
Effective measuring range	As per current and current waveform peak value effective measurement ranges.
Display range	1.0000 to 612.00 (no polarity)
Over-range display	Displays [o.r] when displaying [o.r] for the current waveform peak value and when the display current is [o.r] or 0.
Invalid data display	Icfsum is displayed as [- - - -].

Time Average Current Measurement Specifications (T.AV I: Displayed as T.AV A on panel display)

Measurement method	Calculates the average by dividing the current integrated value by the integration time.
Measurement accuracy	(Current measurement accuracy) + ($\pm 0.01\%$ rdg. ± 1 dgt.)
Effective measuring range	As per the current integration effective measurement range.
Display range	0% to 612% of the range (no [o.r] display)
Polarity	Has polarity when using the DC rectifier.
Peak exceeded warning	The unit (A) will flash when the integrated value contains data that triggers a PEAK OVER I warning.
Invalid data display	Displays [- - - -] when using the AC or FND rectifier.

Time Average Active Power Measurement Specifications (T.AV P: Displayed as T.AV W on panel display)

Measurement method	Calculates the average by dividing the active power integrated value by the integration time.
Measurement accuracy	(Active power measurement accuracy) + ($\pm 0.01\%$ dg. ± 1 dgt.)
Effective measuring range	As per the active power integration effective measurement range.
Display range	0% to 3,745.4% of the range (no [o.r] display)
Polarity	Yes
Peak exceeded warning	The unit (W) will flash when the integrated value contains data that triggers a PEAK OVER U or PEAK OVER I warning.
Invalid data display	Displays [- - - -] when using the AC or FND rectifier.

Voltage Ripple Rate Measurement Specifications (Urf: Displayed as RF V % on panel display)

Measurement method	Calculates the AC component (peak to peak [peak width]) as a proportion of the voltage DC component.
Effective measuring range	As per voltage and voltage waveform peak value effective measurement ranges.
Display range	0.00[%] to 500.00[%]
Polarity	None
Over-range display	Displays [o.r] when displaying [o.r] for the voltage waveform peak value and when the voltage is [o.r] or 0.
Invalid data display	Urfsum is displayed as [- - - -].

Current Ripple Rate Measurement Specifications (Irf: Displayed as RF A % on panel display)

Measurement method	Calculates the AC component (peak to peak [peak width]) as a proportion of the current DC component.
Effective measuring range	As per current and current waveform peak value effective measurement ranges.
Display range	0.00[%] to 500.00[%]
Polarity	None
Over-range display	Displays [o.r] when displaying [o.r] for the current waveform peak value and when the current is [o.r] or 0.
Invalid data display	Irfsum is displayed as [- - - -].

Harmonic Measurement Specifications

Measurement method	Zero-cross simultaneous calculation method (separate windows by channel according to the wiring mode) Uniform thinning between zero-cross events after processing with a digital antialiasing filter Interpolation calculations (Lagrange interpolation) When the synchronization frequency falls within the 45 Hz to 66 Hz range IEC 61000-4-7:2002 compliant Gaps and overlaps may occur if the measurement frequency is not 50 Hz or 60 Hz. When the synchronization frequency falls outside the 45 Hz to 66 Hz range No gaps or overlap will occur.
Synchronization source	Conforms to synchronization source (SYNC) for the basic measurement specifications.
Measurement channels	3
Measurement items	Harmonic voltage RMS value, harmonic voltage content percentage, harmonic voltage phase angle, harmonic current RMS value, harmonic current content percentage, harmonic current phase angle, harmonic active power, harmonic active power content percentage, harmonic voltage/current phase difference, total harmonic voltage distortion, total harmonic current distortion, fundamental wave voltage, fundamental wave current, fundamental wave active power, fundamental wave apparent power, fundamental wave reactive power, fundamental wave power factor, fundamental wave voltage current phase difference, inter-channel voltage fundamental wave phase difference, inter-channel current fundamental wave phase difference The following parameters can be downloaded as data with communications but not displayed: Harmonic voltage phase angle, harmonic current phase angle, harmonic voltage current phase difference
FFT processing word length	32 bits
Number of FFT points	4,096 points

Window function	Rectangular																		
Analysis window width	<table> <tr> <th>Frequency (f)</th><th>Window width</th></tr> <tr> <td>$45 \text{ Hz} \leq f < 56 \text{ Hz}$</td><td>178.57 ms to 222.22 ms (10 cycles)</td></tr> <tr> <td>$56 \text{ Hz} \leq f < 66 \text{ Hz}$</td><td>181.82 ms to 214.29 ms (12 cycles)</td></tr> <tr> <td>Frequencies other than the above</td><td>185.92 ms to 214.08 ms</td></tr> </table>	Frequency (f)	Window width	$45 \text{ Hz} \leq f < 56 \text{ Hz}$	178.57 ms to 222.22 ms (10 cycles)	$56 \text{ Hz} \leq f < 66 \text{ Hz}$	181.82 ms to 214.29 ms (12 cycles)	Frequencies other than the above	185.92 ms to 214.08 ms										
Frequency (f)	Window width																		
$45 \text{ Hz} \leq f < 56 \text{ Hz}$	178.57 ms to 222.22 ms (10 cycles)																		
$56 \text{ Hz} \leq f < 66 \text{ Hz}$	181.82 ms to 214.29 ms (12 cycles)																		
Frequencies other than the above	185.92 ms to 214.08 ms																		
Data update rate	Depends on window width.																		
Maximum analysis order	Synchronization frequency range: 10 Hz to 640 Hz <table> <tr> <th>Synchronization frequency (f) range</th><th>Analysis order</th></tr> <tr> <td>$10 \text{ Hz} \leq f < 45 \text{ Hz}$</td><td>50th</td></tr> <tr> <td>$45 \text{ Hz} \leq f < 56 \text{ Hz}$</td><td>50th</td></tr> <tr> <td>$56 \text{ Hz} \leq f \leq 66 \text{ Hz}$</td><td>50th</td></tr> <tr> <td>$66 \text{ Hz} < f \leq 100 \text{ Hz}$</td><td>50th</td></tr> <tr> <td>$100 \text{ Hz} < f \leq 200 \text{ Hz}$</td><td>40th</td></tr> <tr> <td>$200 \text{ Hz} < f \leq 300 \text{ Hz}$</td><td>25th</td></tr> <tr> <td>$300 \text{ Hz} < f \leq 500 \text{ Hz}$</td><td>15th</td></tr> <tr> <td>$500 \text{ Hz} < f \leq 640 \text{ Hz}$</td><td>11th</td></tr> </table>	Synchronization frequency (f) range	Analysis order	$10 \text{ Hz} \leq f < 45 \text{ Hz}$	50th	$45 \text{ Hz} \leq f < 56 \text{ Hz}$	50th	$56 \text{ Hz} \leq f \leq 66 \text{ Hz}$	50th	$66 \text{ Hz} < f \leq 100 \text{ Hz}$	50th	$100 \text{ Hz} < f \leq 200 \text{ Hz}$	40th	$200 \text{ Hz} < f \leq 300 \text{ Hz}$	25th	$300 \text{ Hz} < f \leq 500 \text{ Hz}$	15th	$500 \text{ Hz} < f \leq 640 \text{ Hz}$	11th
Synchronization frequency (f) range	Analysis order																		
$10 \text{ Hz} \leq f < 45 \text{ Hz}$	50th																		
$45 \text{ Hz} \leq f < 56 \text{ Hz}$	50th																		
$56 \text{ Hz} \leq f \leq 66 \text{ Hz}$	50th																		
$66 \text{ Hz} < f \leq 100 \text{ Hz}$	50th																		
$100 \text{ Hz} < f \leq 200 \text{ Hz}$	40th																		
$200 \text{ Hz} < f \leq 300 \text{ Hz}$	25th																		
$300 \text{ Hz} < f \leq 500 \text{ Hz}$	15th																		
$500 \text{ Hz} < f \leq 640 \text{ Hz}$	11th																		
Analysis order upper limit setting	2nd to 50th																		
Measurement accuracy	f.s.: Measurement range <table> <tr> <th>Frequency (f)</th><th>Voltage, Current, Active power</th></tr> <tr> <td>DC</td><td>$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$</td></tr> <tr> <td>$10 \text{ Hz} \leq f < 30 \text{ Hz}$</td><td>$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$</td></tr> <tr> <td>$30 \text{ Hz} \leq f \leq 400 \text{ Hz}$</td><td>$\pm 0.3\% \text{rdg.} \pm 0.1\% \text{f.s.}$</td></tr> <tr> <td>$400 \text{ Hz} < f \leq 1 \text{ kHz}$</td><td>$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$</td></tr> <tr> <td>$1 \text{ kHz} < f \leq 5 \text{ kHz}$</td><td>$\pm 1.0\% \text{rdg.} \pm 0.5\% \text{f.s.}$</td></tr> <tr> <td>$5 \text{ kHz} < f \leq 8 \text{ kHz}$</td><td>$\pm 4.0\% \text{rdg.} \pm 1.0\% \text{f.s.}$</td></tr> </table> For DC, add $\pm 1 \text{ mA}$ to current and $(\pm 1 \text{ mA}) \times (\text{voltage read value})$ to active power.	Frequency (f)	Voltage, Current, Active power	DC	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$10 \text{ Hz} \leq f < 30 \text{ Hz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$30 \text{ Hz} \leq f \leq 400 \text{ Hz}$	$\pm 0.3\% \text{rdg.} \pm 0.1\% \text{f.s.}$	$400 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$1 \text{ kHz} < f \leq 5 \text{ kHz}$	$\pm 1.0\% \text{rdg.} \pm 0.5\% \text{f.s.}$	$5 \text{ kHz} < f \leq 8 \text{ kHz}$	$\pm 4.0\% \text{rdg.} \pm 1.0\% \text{f.s.}$				
Frequency (f)	Voltage, Current, Active power																		
DC	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$																		
$10 \text{ Hz} \leq f < 30 \text{ Hz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$																		
$30 \text{ Hz} \leq f \leq 400 \text{ Hz}$	$\pm 0.3\% \text{rdg.} \pm 0.1\% \text{f.s.}$																		
$400 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$																		
$1 \text{ kHz} < f \leq 5 \text{ kHz}$	$\pm 1.0\% \text{rdg.} \pm 0.5\% \text{f.s.}$																		
$5 \text{ kHz} < f \leq 8 \text{ kHz}$	$\pm 4.0\% \text{rdg.} \pm 1.0\% \text{f.s.}$																		

D/A Output Specifications (PW3336-02/-03 and PW3337-02/-03 when D/A output specified at time of order)

Number of output channels	16
Configuration	16-bit D/A converter (polarity + 15 bits)
Output parameters	U1 to U3 (voltage level) or u1 to u3 (instantaneous voltage waveform) (switchable) I1 to I3 (current level) or i1 to i3 (instantaneous current waveform) (switchable) P1 to P3 (active power level) or p1 to p3 (instantaneous power waveform) (switchable) Psum (active power level) or Hi-Psum (high-speed active power level) (switchable) Psum and Hi-Psum output is not available (0 V) when using the 1P2W wiring mode. P12 is output when using 1P3W, 3P3W, or 3P3W2M, or 3V3A and P123 is output when using 3P3W3M, or 3P4W. D/A1 to D/A3 Select any 3 from channel or sum value for voltage, current, active power, apparent power, reactive power, power factor, phase angle, total harmonic voltage/current distortion, inter-channel voltage/current fundamental wave phase difference, voltage/current crest factor, time average current/active power, voltage/current ripple rate, frequency, efficiency, current integration, active power integration (harmonic output is not available for individual orders). Hi-P1 to Hi-P3 and Hi-Psum (high-speed active power level): Fixed to AC+DC For level outputs other than Hi-P1, Hi-P2, Hi-P3, or Hi-Psum, select AC+DC, AC+DC Umn, DC, AC, or FND.
Output accuracy	f.s.: Relative to the output voltage rated value for each output parameter Level output: (Output parameter measurement accuracy) + ($\pm 0.2\%$ f.s.) High-speed active power level output: (Output parameter measurement accuracy) + ($\pm 0.2\%$ f.s.) Instantaneous waveform output: (Output parameter measurement accuracy) + ($\pm 1.0\%$ f.s.) Instantaneous voltage, instantaneous current: RMS value level Instantaneous power: Average value level
Output frequency band	Instantaneous waveform output, high-speed active power level output At DC or 10 Hz to 5 kHz, accuracy is as defined above.
Conditions of guaranteed accuracy	Temperature and humidity for guaranteed accuracy: $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 9^{\circ}\text{F}$), 80%RH or less Warm-up time: 30 minutes, after zero-adjustment
Output voltage	Level output Voltage, current, active power, apparent power, reactive power, time average current/active power: ± 2 V DC for $\pm 100\%$ of range Power factor: ± 2 V DC at ± 0.0000, 0 V DC at ± 1.0000 Phase angle, inter-channel voltage/current fundamental wave phase difference : 0 V DC at 0.00°, ± 2 V DC at $\pm 180.00^{\circ}$ Voltage/current ripple rate, total harmonic voltage/current distortion: + 2 V DC at 100.00% Voltage/current crest factor: + 2 V DC at 10.000 Frequency: Varies with measured value. + 2 V DC per 100 Hz from 0.1000 Hz to 300.00 Hz + 2 V DC per 10 kHz from 300.01 Hz to 30.000 kHz + 2 V DC per 100 kHz from 30.001 kHz to 220.00 kHz Efficiency: + 2 V DC at 200.00% Current integration, active power integration: ± 5 V DC at (range) $\times$ (integration set time) Waveform output: 1 V f.s. relative to 100% of range Error output: Level output of ± 7 V DC is generated when the output parameter display is [o.r] or when the PEAK OVER U or PEAK OVER I indicator lights up. Waveform output and high-speed active power level output is generated up to approx. ± 7 V DC. When that value is exceeded, the waveform is clipped. Output of 0 V is generated for [- - - -] (invalid data display).
Maximum output voltage	Approx. ± 12 V DC
Output update rate	Level output: Fixed at 200 ms ± 50 ms (approx. 5 times per sec.) Update rate is unrelated to number of averaging iterations setting and display hold operation. Waveform output: Approx. 11.4 μs (approx. 87.5 kHz) High-speed active power level output: Updated once every cycle for the input waveform set as the synchronization source.

Response time	Level output: 0.6 sec. or less (when the input changes abruptly from 0% to 90%, or from 100% to 10%, the time required in order to satisfy the accuracy range with a synchronization timeout setting of 0.1 s) Waveform output: 0.2 ms or less High-speed active power level output: 1 cycle
Temperature coefficient	$\pm 0.05\%$ f.s./°C or less
Output resistance	100 Ω $\pm 5 \Omega$

External Current Sensor Input Specifications (CURRENT SENSOR)

Terminal	Isolated BNC terminals, 1 for each channel
Input method	Isolated input from a voltage-output external current sensor (instrument's external current sensor input terminals are not isolated)
Current sensor type switching	OFF/ TYPE1/ TYPE2 When set to off, input from the external current sensor input terminal is ignored.
Current sensor options	Supported current sensors TYPE1/ 9661 Clamp on Sensor (rating: 500 A AC) 9669 Clamp on Sensor (rating: 1000 A AC) 9660 Clamp on Sensor (rating: 100 A AC) CT9667 Flexible Clamp on Sensor (rating: 500 A/5000 A AC) TYPE2 CT9555 Sensor Unit CT9556 Sensor Unit CT9557 Sensor Unit L9217 Connection Cord 9272-05 Clamp on Sensor (rating: 20 A/200 A AC) CT6841-05 AC/DC Current Probe (rating: 20 A AC/DC) CT6843-05 AC/DC Current Probe (rating: 200 A AC/DC) CT6844-05 AC/DC Current Probe (rating: 500 A AC/DC) CT6845-05 AC/DC Current Probe (rating: 500 A AC/DC) CT6846-05 AC/DC Current Probe (rating: 1000 A AC/DC) 9709-05 AC/DC Current Sensor (rating: 500 A AC/DC) CT6862-05 AC/DC Current Sensor (rating: 50 A AC/DC) CT6863-05 AC/DC Current Sensor (rating: 200 A AC/DC) CT6865-05 AC/DC Current Sensor (rating: 1000 A AC/DC)
Temperature coefficient	Voltage: $\pm 0.03\%$ f.s./°C Current, active power: $\pm 0.08\%$ f.s./°C (instrument temperature coefficient; f.s.: instrument measurement range) Add current sensor temperature coefficient to above.
Power factor effects	Instrument: $\pm 0.15\%$ f.s. or less (45 Hz to 66 Hz with power factor = 0) Internal circuit voltage/current phase difference: $\pm 0.0859^\circ$ Add the current sensor phase accuracy to the internal circuit voltage/current phase difference noted above.
Current peak value measurement accuracy	(External current sensor input instrument accuracy) + ($\pm 2.0\%$ f.s.) (f.s.: current peak range) Add the current sensor accuracy to the above.
Current measurement range	Auto/ 10 A/ 20 A/ 50 A (range noted on panel) User-selectable for each wiring mode. Can be read directly by manually setting the CT ratio.
Power range configuration	Can be set separately for each wiring mode. For wiring modes other than 1P2W, sum power range (power ranges for individual channels are the same as 1P2W)

5.3 Measurement specifications

When using a current sensor with a rating of 20 A (with the CT ratio set to 0.4)
9272-05 (20 A): TYPE2; CT6841-05: TYPE2

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	4.0000 A	1P2W	60.000	120.00	240.00	600.00	1.2000 k	2.4000 k	4.0000 k
		Other than 1P2W or 3P4W	120.00	240.00	480.00	1.2000 k	2.4000 k	4.8000 k	8.0000 k
		3P4W	180.00	360.00	720.00	1.8000 k	3.6000 k	7.2000 k	12.000 k
20 A	8.0000 A	1P2W	120.00	240.00	480.00	1.2000 k	2.4000 k	4.8000 k	8.0000 k
		Other than 1P2W or 3P4W	240.00	480.00	960.00	2.4000 k	4.8000 k	9.6000 k	16.000 k
		3P4W	360.00	720.00	1.4400 k	3.6000 k	7.2000 k	14.400 k	24.000 k
50 A	20.000 A	1P2W	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	20.000 k
		Other than 1P2W or 3P4W	600.00	1.2000 k	2.4000 k	6.0000 k	12.000 k	24.000 k	40.000 k
		3P4W	900.00	1.8000 k	3.6000 k	9.0000 k	18.000 k	36.000 k	60.000 k

Units: W (active power), VA (apparent power), var (reactive power)

When using a current sensor with a rating of 50 A (with the CT ratio set to 1 [off])
CT6862-05: TYPE2

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	10.000 A	1P2W	150.00	300.00	600.00	1.5000 k	3.0000 k	6.0000 k	10.000 k
		Other than 1P2W or 3P4W	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	20.000 k
		3P4W	450.00	900.00	1.8000 k	4.5000 k	9.0000 k	18.000 k	30.000 k
20 A	20.000 A	1P2W	300.00	600.00	1.2000 k	3.0000 k	6.0000 k	12.000 k	20.000 k
		Other than 1P2W or 3P4W	600.00	1.2000 k	2.4000 k	6.0000 k	12.000 k	24.000 k	40.000 k
		3P4W	900.00	1.8000 k	3.6000 k	9.0000 k	18.000 k	36.000 k	60.000 k
50 A	50.000 A	1P2W	750.00	1.5000 k	3.0000 k	7.5000 k	15.000 k	30.000 k	50.000 k
		Other than 1P2W or 3P4W	1.5000 k	3.0000 k	6.0000 k	15.000 k	30.000 k	60.000 k	100.00 k
		3P4W	2.2500 k	4.5000 k	9.0000 k	22.500 k	45.000 k	90.000 k	150.00 k

Units: W (active power), VA (apparent power), var (reactive power)

When using a current sensor with a rating of 200 A (with the CT ratio set to 4)
9272-05 (200 A): TYPE2; CT6843-05: TYPE2; CT6863-05: TYPE2

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	40.000 A	1P2W	600.00	1.2000 k	2.4000 k	6.0000 k	12.000 k	24.000 k	40.000 k
		Other than 1P2W or 3P4W	1.2000 k	2.4000 k	4.8000 k	12.000 k	24.000 k	48.000 k	80.000 k
		3P4W	1.8000 k	3.6000 k	7.2000 k	18.000 k	36.000 k	72.000 k	120.00 k
20 A	80.000 A	1P2W	1.2000 k	2.4000 k	4.8000 k	12.000 k	24.000 k	48.000 k	80.000 k
		Other than 1P2W or 3P4W	2.4000 k	4.8000 k	9.6000 k	24.000 k	48.000 k	96.000 k	160.00 k
		3P4W	3.6000 k	7.2000 k	14.400 k	36.000 k	72.000 k	144.00 k	240.00 k
50 A	200.00 A	1P2W	3.0000 k	6.0000 k	12.000 k	30.000 k	60.000 k	120.00 k	200.00 k
		Other than 1P2W or 3P4W	6.0000 k	12.000 k	24.000 k	60.000 k	120.00 k	240.00 k	400.00 k
		3P4W	9.0000 k	18.000 k	36.000 k	90.000 k	180.00 k	360.00 k	600.00 k

Units: W (active power), VA (apparent power), var (reactive power)

When using a current sensor with a rating of 500 A (with the CT ratio set to 10)
9661: TYPE1; CT9667 (500 A): TYPE1; 9709-05: TYPE2; CT6844-05: TYPE2; CT6845-05: TYPE2

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	100.00 A	1P2W	1.5000 k	3.0000 k	6.0000 k	15.000 k	30.000 k	60.000 k	100.00 k
		Other than 1P2W or 3P4W	3.0000 k	6.0000 k	12.000 k	30.000 k	60.000 k	120.00 k	200.00 k
		3P4W	4.5000 k	9.0000 k	18.000 k	45.000 k	90.000 k	180.00 k	300.00 k
20 A	200.00 A	1P2W	3.0000 k	6.0000 k	12.000 k	30.000 k	60.000 k	120.00 k	200.00 k
		Other than 1P2W or 3P4W	6.0000 k	12.000 k	24.000 k	60.000 k	120.00 k	240.00 k	400.00 k
		3P4W	9.0000 k	18.000 k	36.000 k	90.000 k	180.00 k	360.00 k	600.00 k
50 A	500.00 A	1P2W	7.5000 k	15.000 k	30.000 k	75.000 k	150.00 k	300.00 k	500.00 k
		Other than 1P2W or 3P4W	15.000 k	30.000 k	60.000 k	150.00 k	300.00 k	600.00 k	1.0000 M
		3P4W	22.500 k	45.000 k	90.000 k	225.00 k	450.00 k	900.00 k	1.5000 M

Units: W (active power), VA (apparent power), var (reactive power)

When using a current sensor with a rating of 1000 A (with the CT ratio set to 20)
9669: TYPE1; CT6846-05: TYPE2 ; CT6865-05: TYPE2

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	200.00 A	1P2W	3.0000 k	6.0000 k	12.000 k	30.000 k	60.000 k	120.00 k	200.00 k
		Other than 1P2W or 3P4W	6.0000 k	12.000 k	24.000 k	60.000 k	120.00 k	240.00 k	400.00 k
		3P4W	9.0000 k	18.000 k	36.000 k	90.000 k	180.00 k	360.00 k	600.00 k
20 A	400.00 A	1P2W	6.0000 k	12.000 k	24.000 k	60.000 k	120.00 k	240.00 k	400.00 k
		Other than 1P2W or 3P4W	12.000 k	24.000 k	48.000 k	120.00 k	240.00 k	480.00 k	800.00 k
		3P4W	18.000 k	36.000 k	72.000 k	180.00 k	360.00 k	720.00 k	1.2000 M
50 A	1.0000 kA	1P2W	15.000 k	30.000 k	60.000 k	150.00 k	300.00 k	600.00 k	1.0000 M
		Other than 1P2W or 3P4W	30.000 k	60.000 k	120.00 k	300.00 k	600.00 k	1.2000 M	2.0000 M
		3P4W	45.000 k	90.000 k	180.00 k	450.00 k	900.00 k	1.8000 M	3.0000 M

Units: W (active power), VA (apparent power), var (reactive power)

5.3 Measurement specifications

When using a current sensor with a rating of 5000 A (with the CT ratio set to 100)
CT9667 (5000 A): TYPE1

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	1.0000 kA	1P2W	15.000 k	30.000 k	60.000 k	150.00 k	300.00 k	600.00 k	1.0000 M
		Other than 1P2W or 3P4W	30.000 k	60.000 k	120.00 k	300.00 k	600.00 k	1.2000 M	2.0000 M
		3P4W	45.000 k	90.000 k	180.00 k	450.00 k	900.00 k	1.8000 M	3.0000 M
20 A	2.0000 kA	1P2W	30.000 k	60.000 k	120.00 k	300.00 k	600.00 k	1.2000 M	2.0000 M
		Other than 1P2W or 3P4W	60.000 k	120.00 k	240.00 k	600.00 k	1.2000 M	2.4000 M	4.0000 M
		3P4W	90.000 k	180.00 k	360.00 k	900.00 k	1.8000 M	3.6000 M	6.0000 M
50 A	5.0000 kA	1P2W	75.000 k	150.00 k	300.00 k	750.00 k	1.5000 M	3.0000 M	5.0000 M
		Other than 1P2W or 3P4W	150.00 k	300.00 k	600.00 k	1.5000 M	3.0000 M	6.0000 M	10.000 M
		3P4W	225.00 k	450.00 k	900.00 k	2.2500 M	4.5000 M	9.0000 M	15.000 M

Units: W (active power), VA (apparent power), var (reactive power)

When using the 9660 (TYPE1) (rated current: 100 A; with the CT ratio set to 10)

			Voltage range						
Range noted on panel	Current range	Wiring	15.000 V	30.000 V	60.000 V	150.00 V	300.00 V	600.00 V	1.0000 kV
10 A	100.00A	1P2W	1.5000 k	3.0000 k	6.0000 k	15.000 k	30.000 k	60.000 k	100.00 k
		Other than 1P2W or 3P4W	3.0000 k	6.0000 k	12.000 k	30.000 k	60.000 k	120.00 k	200.00 k
		3P4W	4.5000 k	9.0000 k	18.000 k	45.000 k	90.000 k	180.00 k	300.00 k

Units: W (active power), VA (apparent power), var (reactive power)

Measurement accuracy

External current sensor input instrument measurement accuracy only
When input is less than 50% of the range

Frequency(f)	Voltage	Current, Active power
DC	$\pm 0.1\% \text{rdg} \pm 0.1\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.6\% \text{f.s.}$
$0.1 \text{ Hz} \leq f < 16 \text{ Hz}$	$\pm 0.1\% \text{rdg} \pm 0.2\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.2\% \text{f.s.}$
$16 \text{ Hz} \leq f < 45 \text{ Hz}$	$\pm 0.1\% \text{rdg} \pm 0.1\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.2\% \text{f.s.}$
$45 \text{ Hz} \leq f \leq 66 \text{ Hz}$	$\pm 0.1\% \text{rdg} \pm 0.05\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.1\% \text{f.s.}$
$66 \text{ Hz} < f \leq 500 \text{ Hz}$	$\pm 0.1\% \text{rdg} \pm 0.1\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.2\% \text{f.s.}$
$500 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.1\% \text{rdg} \pm 0.2\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.3\% \text{f.s.}$
$1 \text{ kHz} < f \leq 10 \text{ kHz}$	$\pm 0.1\% \text{rdg} \pm 0.2\% \text{f.s.}$	$\pm 5.0\% \text{f.s.}$
$10 \text{ kHz} < f \leq 50 \text{ kHz}$	$\pm 0.5\% \text{rdg} \pm 0.3\% \text{f.s.}$	-
$50 \text{ kHz} < f \leq 100 \text{ kHz}$	$\pm 2.1\% \text{rdg} \pm 0.3\% \text{f.s.}$	-

When input is 50% or more of the range but less than 100%

Frequency(f)	Voltage	Current, Active power
DC	$\pm 0.1\% \text{rdg} \pm 0.1\% \text{f.s.}$	$\pm 0.2\% \text{rdg} \pm 0.6\% \text{f.s.}$
$0.1 \text{ Hz} \leq f < 16 \text{ Hz}$	$\pm 0.3\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$16 \text{ Hz} \leq f < 45 \text{ Hz}$	$\pm 0.2\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$45 \text{ Hz} \leq f \leq 66 \text{ Hz}$	$\pm 0.15\% \text{rdg.}$	$\pm 0.3\% \text{rdg.}$
$66 \text{ Hz} < f \leq 500 \text{ Hz}$	$\pm 0.2\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$500 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.3\% \text{rdg.}$	$\pm 0.5\% \text{rdg.}$
$1 \text{ kHz} < f \leq 10 \text{ kHz}$	$\pm 0.3\% \text{rdg.}$	$\pm 5.0\% \text{rdg.}$
$10 \text{ kHz} < f \leq 50 \text{ kHz}$	$\pm 0.8\% \text{rdg.}$	-
$50 \text{ kHz} < f \leq 100 \text{ kHz}$	$\pm 2.4\% \text{rdg.}$	-

When input is 100% or more of the range

Frequency(f)	Voltage	Current, Active power
DC	$\pm 0.2\% \text{rdg.}$	$\pm 0.8\% \text{rdg.}$
$0.1 \text{ Hz} \leq f < 16 \text{ Hz}$	$\pm 0.3\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$16 \text{ Hz} \leq f < 45 \text{ Hz}$	$\pm 0.2\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$45 \text{ Hz} \leq f \leq 66 \text{ Hz}$	$\pm 0.15\% \text{rdg.}$	$\pm 0.3\% \text{rdg.}$
$66 \text{ Hz} < f \leq 500 \text{ Hz}$	$\pm 0.2\% \text{rdg.}$	$\pm 0.4\% \text{rdg.}$
$500 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.3\% \text{rdg.}$	$\pm 0.5\% \text{rdg.}$
$1 \text{ kHz} < f \leq 10 \text{ kHz}$	$\pm 0.3\% \text{rdg.}$	$\pm 5.0\% \text{rdg.}$
$10 \text{ kHz} < f \leq 50 \text{ kHz}$	$\pm 0.8\% \text{rdg.}$	-
$50 \text{ kHz} < f \leq 100 \text{ kHz}$	$\pm 2.4\% \text{rdg.}$	-

f.s.: Each measurement range

To obtain the current or active power accuracy, add the current sensor's accuracy to the above current and active power accuracy figures.

The effective measurement range and frequency characteristics conform to the current sensor's specifications.

Values for voltage, current, and active power for which $0.1 \text{ Hz} \leq f < 10 \text{ Hz}$ are for reference only.

Values for voltage in excess of 220 V and active power for which $10 \text{ Hz} \leq f < 16 \text{ Hz}$ are for reference only.

Values for voltage in excess of 750 V for which $30 \text{ kHz} < f \leq 100 \text{ kHz}$ are for reference only.

When using the AC/DC Current Probe, add $\pm 2 \text{ mV}$ to the AC/DC Current Probe accuracy after performing the AC/DC Current Probe zero-adjustment using the 10 A range noted on the panel.

Harmonic measurement accuracy

External current sensor input instrument measurement accuracy only

Frequency (f)	Voltage	Current, Active power
DC	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$\pm 0.6\% \text{rdg.} \pm 0.8\% \text{f.s.}$
$10 \text{ Hz} \leq f < 30 \text{ Hz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$\pm 0.6\% \text{rdg.} \pm 0.4\% \text{f.s.}$
$30 \text{ Hz} \leq f \leq 400 \text{ Hz}$	$\pm 0.3\% \text{rdg.} \pm 0.1\% \text{f.s.}$	$\pm 0.5\% \text{rdg.} \pm 0.3\% \text{f.s.}$
$400 \text{ Hz} < f \leq 1 \text{ kHz}$	$\pm 0.4\% \text{rdg.} \pm 0.2\% \text{f.s.}$	$\pm 0.6\% \text{rdg.} \pm 0.5\% \text{f.s.}$
$1 \text{ kHz} < f \leq 5 \text{ kHz}$	$\pm 1.0\% \text{rdg.} \pm 0.5\% \text{f.s.}$	$\pm 1.0\% \text{rdg.} \pm 5.5\% \text{f.s.}$
$5 \text{ kHz} < f \leq 8 \text{ kHz}$	$\pm 4.0\% \text{rdg.} \pm 1.0\% \text{f.s.}$	$\pm 2.0\% \text{rdg.} \pm 6.0\% \text{f.s.}$

f.s.: Each measurement range

To obtain the current or active power accuracy, add the current sensor's accuracy to the above current and active power accuracy figures.

When using the AC/DC Current Probe, add $\pm 2 \text{ mV}$ to the AC/DC Current Probe accuracy after performing the AC/DC Current Probe zero-adjustment using the 10 A range noted on the panel.

5.4 Functional Specifications

Auto-range (AUTO)

Functions	Automatically changes the voltage and current range for each wiring mode according to the input.
Operation	Pressing the SHIFT key and then the AUTO key turns on the auto-range function (causing the AUTO lamp to light up). Pressing the SHIFT key and then the AUTO key again turns the auto-range function off, as does pressing any range key (causing the AUTO lamp to turn off). Range up: The range is increased when input exceeds 130% of the range or when the peak is exceeded. Range down: The range is decreased when input falls below 15% of the range. However, the range is not decreased when the peak is exceeded at the lower range.

Averaging (AVG)

Functions	Averages the voltage, current, active power, apparent power, and reactive power. The power factor and phase angle are calculated from averaged data. Measured values other than peak values, efficiency, frequency, integrated values, T.AV, crest factor, ripple rate, total harmonic distortion, and harmonics are averaged.							
Method	Simple averaging							
Number of averaging iterations and display update interval	Number of averaging iterations	1(OFF)	2	5	10	25	50	100
	Display update interval	200 ms	400 ms	1 s	2 s	5 s	10 s	20 s
Display	The AVG lamp will light up when the number of averaging iterations is set to a value other than 1 (off). From the start of averaging until the first average value is displayed, the AVG lamp will flash, and all measured values will be shown as [- - - -] (invalid data).							
Over-range warning	When the data being averaged includes an [o.r] value, the corresponding unit will flash.							
Operation	Start of averaging 1. Averaging starts after zero-adjustment operation is complete (when turning on the instrument or after zero-adjustment operation). 2. Averaging restarts when the DATA RESET key is pressed (including via external control). 3. Averaging restarts when settings related to measured values are changed, including the number of averaging iterations, wiring mode, and range.							

Scaling (VT, CT)

Functions	Applies user-defined VT and CT ratio settings to measured values. These settings can be configured separately for each wiring mode.							
VT ratio setting range	OFF (1.0) 0.1 to 0.9, 1.0 to 9.9, 10.0 to 99.9, 100.0 to 999.9, 1000. (setting: 0)							
CT ratio setting range	OFF (1.0) 0.001 to 0.009, 0.010 to 0.099, 0.100 to 0.999, 1.000 to 9.999, 10.00 to 99.99, 100.0 to 999.9, 1000. (setting: 0)							
Display	The VT lamp will turn on when the VT ratio is set to any value other than 1 (off). The CT lamp will turn on when the CT ratio is set to any value other than 1 (off).							
Error warnings	The display will show S.Err (scaling error) when the VT ratio or CT ratio setting causes the full-scale value for active power, apparent power, or reactive power to exceed 99,999 M.							

Hold functions**Hold (HOLD)**

Functions	Stops display updates for all measured values and fixes the display values at that point in time. Measurement data acquired by communications is also fixed at that point in time. Peak exceeded and other warning lamps will still light up. Internal calculations (including integration and integration elapsed time) will continue. Analog output and waveform output are not held.																																							
Operation	Pressing the HOLD key turns on the hold function (and causes the HOLD lamp to light up). Pressing the HOLD key again turns off the hold function (causing the HOLD lamp to turn off).																																							
Backup	Yes (when the instrument is turned back on, display of the initial data will be held)																																							
Constraints	During hold operation, the following operational constraints apply: ●: Setting and changes allowed -/: Setting and changes not allowed																																							
	<table><tr><th>Item</th><th>During hold operation</th></tr><tr><td>Measurement range</td><td>- (Fixed to the range when the hold function was turned on.)</td></tr><tr><td>Current input method switching</td><td>-</td></tr><tr><td>Wiring</td><td>-</td></tr><tr><td>Frequency measurement range (zero-crossing filter)</td><td>-</td></tr><tr><td>Timeout</td><td>-</td></tr><tr><td>Integration time</td><td>-</td></tr><tr><td>Synchronization source</td><td>-</td></tr><tr><td>Zero-adjustment</td><td>-</td></tr><tr><td>Maximum value/minimum value hold</td><td>●</td></tr><tr><td>Display parameters</td><td>●</td></tr><tr><td>D/A output parameters</td><td>●</td></tr><tr><td>Number of averaging iterations</td><td>-</td></tr><tr><td>VT ratio</td><td>-</td></tr><tr><td>CT ratio</td><td>-</td></tr><tr><td>RS-232C transfer speed</td><td>●</td></tr><tr><td>GP-IB address</td><td>●</td></tr><tr><td>LAN</td><td>●</td></tr><tr><td>Harmonic analysis order upper limit</td><td>-</td></tr></table>		Item	During hold operation	Measurement range	- (Fixed to the range when the hold function was turned on.)	Current input method switching	-	Wiring	-	Frequency measurement range (zero-crossing filter)	-	Timeout	-	Integration time	-	Synchronization source	-	Zero-adjustment	-	Maximum value/minimum value hold	●	Display parameters	●	D/A output parameters	●	Number of averaging iterations	-	VT ratio	-	CT ratio	-	RS-232C transfer speed	●	GP-IB address	●	LAN	●	Harmonic analysis order upper limit	-
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RS-232C transfer speed	●																																							
GP-IB address	●																																							
LAN	●																																							
Harmonic analysis order upper limit	-																																							
External control	Input signal level 0 to 5 V (high-speed CMOS level) or shorted (low)/open (high)																																							
	<table><tr><th>Functions</th><th>External control signal</th><th>External control terminal</th></tr><tr><td>Hold on</td><td>Hi → Lo</td><td>HOLD</td></tr><tr><td>Hold off (canceled)</td><td>Lo → Hi</td><td>HOLD</td></tr></table>		Functions	External control signal	External control terminal	Hold on	Hi → Lo	HOLD	Hold off (canceled)	Lo → Hi	HOLD																													
Functions	External control signal	External control terminal																																						
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Hold off (canceled)	Lo → Hi	HOLD																																						

Maximum value/minimum value hold (MAX/MIN HOLD)

Functions	Detects maximum and minimum measured values (except integration, integration elapsed time, and time average values) as well as maximum and minimum values for the voltage and current waveform peak and holds them on the display. For data with polarity, display of the maximum value and minimum value for the data's absolute values is held (so that both positive and negative polarity values are shown). Peak exceeded and other warning lamps will still light up. Internal calculations (including integration and integration elapsed time) will continue. Analog output and waveform output are not held.
Operation	Clearing and start of maximum value/minimum value detection 1. Internal data is cleared and detection restarts after zero-adjustment operation is complete (when turning on the instrument or after zero-adjustment operation). 2. Internal data is cleared and detection restarts when the DATA RESET key is pressed (including via external control). 3. Internal data is cleared and detection restarts when integration is started. 4. Detection restarts when settings related to measured values are changed, including wiring mode and range. Changing the display Pressing the MAX/MIN key cycles the display as follows: Maximum value → minimum value → instantaneous value (causing the MAX and MIN lamp to light up as appropriate).
Backup	Yes (detection restarts when the instrument is turned back on)

Constraints

During maximum value and minimum value hold operation, the following operational constraints apply:

●: Setting and changes allowed -: Setting and changes not allowed

Item	During maximum value/minimum value hold operation
Measurement range	- (Fixed to the range when the maximum value/minimum value hold function was turned on.)
Current input method switching	-
Wiring	-
Frequency measurement range (zero-crossing filter)	-
Timeout	-
Integration time	-
Synchronization source	-
Zero Adjustment	-
Hold	-
Display parameters	●
D/A output parameters	●
Number of averaging iterations	-
VT ratio	-
CT ratio	-
RS-232C transfer speed	●
GP-IB address	●
LAN	●
Harmonic analysis order upper limit	-

Zero Adjustment (0 ADJ)

Functions	Degausses the current input unit DCCT and then zeroes out the voltage and current input offset.
Compensation range	Voltage: $\pm 10\%$ f.s. or less Current direct input: $\pm 10\%$ f.s. or less External current sensor input: $\pm 10\%$ f.s. or less
Compensation operation time	Approx. 40 sec.
Method	1. Zero-adjustment is performed for current alone when the instrument is turned on (zero-adjustment is not performed for voltage when the instrument is turned on). 2. Press the 0 ADJ key.
Constraints	Zero-adjustment is performed for all channels, regardless of the wiring mode or current input method. No measured values are displayed during zero-adjustment. Integration cannot be started during zero-adjustment. Zero-adjustment cannot be performed during integration. Zero-adjustment cannot be performed during display hold or maximum value or minimum value hold operation. Settings cannot be changed during zero-adjustment. After zero-adjustment completes, the maximum value, minimum value, and average value are cleared, and associated processing is restarted.

Synchronized control

Functions	The timing of calculations; display updates; data updates; integration start, stop, and reset events; display hold operation; key lock operation; and zero-adjustment operation for the slave PW3336/PW3337 is synchronized with the master PW3336/PW3337. An error will be displayed if unable to perform synchronized control (and the display will continue until the error is cleared).
Terminal	BNC terminal $\times 1$ (non-isolated)
Terminal name	EXT SYNC
I/O settings	OFF/ IN/ OUT OFF Synchronized control function off (signals input to the EXT SYNC terminal are ignored) IN: The EXT SYNC terminal is set to input, and a dedicated synchronization signal can be input (slave). The SYNC OUT lamp will flash when a synchronization signal is received. OUT: The EXT SYNC terminal is set to output, and a dedicated synchronization signal can be output (master). The SYNC OUT lamp will light up when the terminal is set to OUT.
I/O signal levels	High level: +5 V; low level: 0 V (high-speed CMOS level)
Number of units for which synchronized control can be performed	1 master, 7 slaves (total of 8 units)

Key-lock (KEY LOCK)

Functions	Disables key input in the measurement state, except for the SHIFT key and KEYLOCK key.
Operation	Pressing the SHIFT key and then the KEYLOCK key enables the key lock function (causing the KEYLOCK lamp to light up).
Constraints	The key lock state will be canceled when the instrument is placed in the RMT state by communications.
Backup	Yes (when the instrument is turned back on, it will still be in the key lock state)

Backup

Functions	Backs up settings and integration data if the instrument is turned off and if a power out-age occurs.
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System Reset

Functions	Initializes the instrument’s settings.
Operation	The system will be reset if the SHIFT key and then the RESET key are pressed when turning on the instrument.
Constraints	Communications-related settings (communications speed, address, and LAN-related settings) are not initialized.

5.5 Calculation Formulas Specifications

Basic measurement parameter calculation formulas

(1) Voltage basic calculation formulas

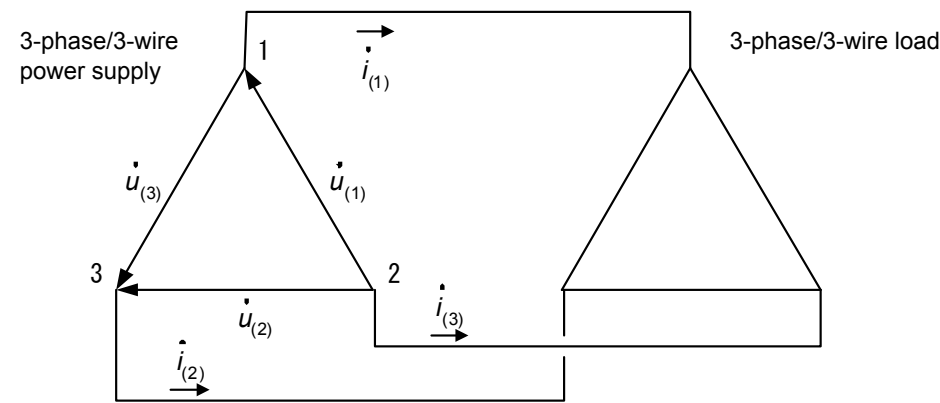
Item (RECTIFIER)	Calculation formulas
RMS value (AC+DC)	$U_{(i)} = \sqrt{\frac{1}{M} \sum_{s=0}^{M-1} (u_{(i)s})^2}$
Average value rectification RMS value converted value (AC+DC U_{mn})	$U_{mn(i)} = \frac{\pi}{2\sqrt{2}} \frac{1}{M} \sum_{s=0}^{M-1} u_{(i)s} $
Simple average value (DC)	$U_{DC(i)} = \frac{1}{M} \sum_{s=0}^{M-1} u_{(i)s}$
AC component RMS values (AC)	$U_{AC(i)} = \sqrt{(U_{(i)})^2 - (U_{DC(i)})^2}$
Fundamental wave component RMS values (FND)	$U_{1(i)}$ from harmonic calculation formula
Waveform peak value	$U_{pk(i)} = \begin{cases} U_{pk+}(i) : u_{(i)s} & \text{Maximum value from M values} \\ U_{pk-}(i) : u_{(i)s} & \text{Minimum value from M values} \end{cases}$ Displays the maximum absolute value from the above with its polarity.
Total harmonic distortion	$U_{thd(i)}$ from harmonic calculation formula
Ripple rate	$U_{rr(i)} = \frac{ (U_{pk+}(i) - U_{pk-}(i)) }{2 \times U_{DC(i)} } \times 100$
Crest factor	$U_{cf(i)} = \left \frac{U_{pk(i)}}{U_{(i)}} \right $
(i): Measurement channel; M: Number of samples between synchronized timing points; s: Sample point number	

Voltage channel and sum value calculation formula

Wiring	1P2W	1P3W	3P3W	3P3W2M	3V3A	3P3W3M	3P4W
	All channels	Sum values					
See note.	Basic calculation formula $U_{(i)}$	$U_{sum} = \frac{1}{2}(U_{(1)} + U_{(2)})$		$U_{sum} = \frac{1}{3}(U_{(1)} + U_{(2)} + U_{(3)})$			
Note: Above applies to RMS values (AC+DC). For average value rectification RMS values (AC+DC U_{mn}), simple average values (DC), AC component RMS values (AC), and fundamental wave component RMS values (FND), replace $U_{(i)}$ with $U_{mn(i)}$, $U_{DC(i)}$, $U_{AC(i)}$, and $U_{1(i)}$.							

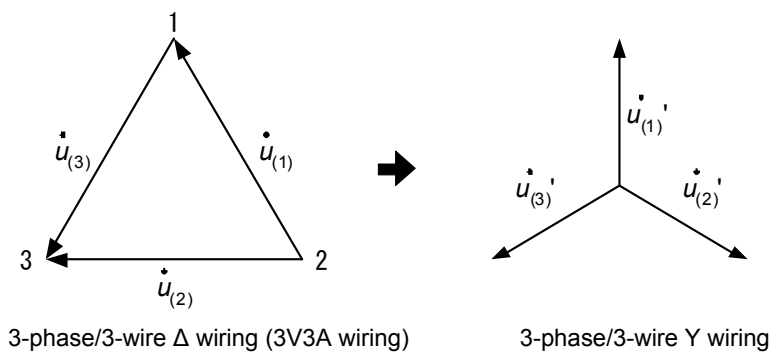
5.5 Calculation Formulas Specifications

1. Vector calculations for 3P3W2M



3P3W2M Calculation formulas for 3 channels calculations using vector calculation	$\dot{u}_{(3)} = \dot{u}_{(2)} - \dot{u}_{(1)}$
	$\dot{i}_{(3)} = -\dot{i}_{(1)} - \dot{i}_{(2)}$

2. Vector calculations for 3P3W3M



3P3W3M Calculation formulas for phase voltage calculation using vector calculation (Voltage used in other calculations)	$\dot{u}_{(1)'} = \frac{1}{3}(\dot{u}_{(1)} - \dot{u}_{(3)})$
	$\dot{u}_{(2)'} = -\frac{1}{3}(\dot{u}_{(1)} + \dot{u}_{(2)})$
	$\dot{u}_{(3)'} = \frac{1}{3}(\dot{u}_{(2)} + \dot{u}_{(3)})$

However, to align with current channels, $\dot{u}_{3'}$ and $\dot{u}_{2'}$ are displayed as U_2 and U_3 , respectively.

(2) Current basic calculation formulas

Item (RECTIFIER)	Calculation formulas
RMS value (AC+DC)	$I_{(i)} = \sqrt{\frac{1}{M} \sum_{s=0}^{M-1} (i_{(i)s})^2}$
Simple average value (DC)	$I_{DC(i)} = \frac{1}{M} \sum_{s=0}^{M-1} i_{(i)s}$
AC component RMS value (AC)	$I_{AC(i)} = \sqrt{(I_{(i)})^2 - (I_{DC(i)})^2}$
Fundamental wave component RMS value (FND)	$I_{1(i)}$ from harmonic calculation formula
Waveform peak value	$I_{pk(i)} = \begin{cases} I_{pk} + (i) : i(i)s & \text{Maximum value from M values} \\ I_{pk} - (i) : i(i)s & \text{Minimum value from M values} \end{cases}$ Displays the maximum absolute value from the above with its polarity.
Total harmonic distortion	$I_{thd(i)}$ from harmonic calculation formula
Ripple rate	$I_{rr(i)} = \frac{ (I_{pk+(i)} - I_{pk-(i)}) }{2 \times I_{DC(i)} } \times 100$
Crest factor	$I_{cf(i)} = \frac{ I_{pk(i)} }{ I_{(i)} }$
(i): Measurement channel; M: Number of samples between synchronization timing points; s: Sample point number	

Current channel and sum value calculation formulas

Wiring	1P2W	1P3W	3P3W	3P3W2M	3V3A	3P3W3M	3P4W
	All channels	Sum values					
See note.	Basic calculation formula $I_{(i)}$	$I_{sum} = \frac{1}{2}(I_{(1)} + I_{(2)})$		$I_{sum} = \frac{1}{3}(I_{(1)} + I_{(2)} + I_{(3)})$			
Note: Above applies to RMS values (AC+DC). For simple average values (DC), AC component RMS values (AC), and fundamental wave component RMS values (FND), replace $I_{(i)}$ with $I_{DC(i)}$, $I_{AC(i)}$, and $I_{1(i)}$.							

(3) Power calculation formulas

Item (RECTIFIER)	Calculation formulas
Active power (AC+DC, AC+DC Umn)	$P_{(i)} = \frac{1}{M} \sum_{s=0}^{M-1} (u_{(i)s} \times i_{(i)s})$
Active power simple average value (DC)	$P_{DC(i)} = U_{DC(i)} \times I_{DC(i)}$
Active power AC component (AC)	$P_{AC(i)} = P_{(i)} - P_{DC(i)}$
Fundamental wave active power (FND)	$P_{1(i)}$ from harmonic calculation formula
Apparent power (AC+DC, AC, AC+DC Umn)	$S_{(i)} = U_{(i)} \times I_{(i)}$ Calculated values from the respective rectifiers are used for $U_{(i)}$ and $I_{(i)}$. (For AC+DC Umn, the AC+DC value is used for current.)
Fundamental wave apparent power (FND)	$S_{1(i)}$ from harmonic calculation formula
Reactive power (AC+DC, AC, AC+DC Umn)	$Q_{(i)} = si_{(i)} \sqrt{S_{(i)}^2 - P_{(i)}^2}$ Calculated values from the respective rectifiers are used for $P_{(i)}$ and $S_{(i)}$.
Fundamental wave reactive power (FND)	$Q_{1(i)}$ from harmonic calculation formula
Power factor (AC+DC, AC, AC+DC Umn)	$\lambda_{(i)} = si_{(i)} \left \frac{P_{(i)}}{S_{(i)}} \right $ Calculated values from the respective rectifiers are used for $P_{(i)}$ and $S_{(i)}$.
Fundamental wave power factor (FND)	$\lambda_{1(i)}$ value from harmonic calculation formula
Phase angle (AC)	When $P_{AC(i)} \geq 0$ $\varphi_{(i)} = si_{(i)} \cos^{-1} \left \lambda_{(i)} \right \quad (0^\circ \text{ to } \pm 90^\circ)$ When $P_{AC(i)} < 0$ $\varphi_{(i)} = si_{(i)} \left 180 - \cos^{-1} \left \lambda_{(i)} \right \right \quad (\pm 90^\circ \text{ to } \pm 180^\circ)$ Calculated values from the respective rectifiers are used for $\lambda_{(i)}$.
Fundamental wave voltage current phase difference (FND)	$\varphi_{1(i)}$ from harmonic calculation formula
(i): Measurement channel; M: Number of samples between synchronized timing points; s: Number of sample points; $si_{(i)}$: Polarity symbol, acquired based on voltage waveform and current waveform lead and lag for each measurement channel Symbol [None]: Current lags voltage (LAG). Symbol [-]: Current leads voltage (LEAD).	

Power channel and sum value calculation formulas

Wiring	1P2W	1P3W	3P3W	3P3W2M	3V3A	3P3W3M	3P4W
Item	All channels	Sum values					
Active power	Basic calculation formula $P_{(i)}$	$P_{sum} = P_{(1)} + P_{(2)}$				$P_{sum} = P_{(1)} + P_{(2)} + P_{(3)}$	

Item \ Wiring		Apparent power	Reactive power
All channels	1P2W	Basic calculation formula $S_{(i)}$	Basic calculation formula $Q_{(i)}$
Sum values	1P3W	$S_{sum} = S_{(1)} + S_{(2)}$	$Q_{sum} = Q_{(1)} + Q_{(2)}$
	3P3W	$S_{sum} = \frac{\sqrt{3}}{2} (S_{(1)} + S_{(2)})$	
	3P3W2M	$S_{sum} = \frac{\sqrt{3}}{3} (S_{(1)} + S_{(2)} + S_{(3)})$	
	3V3A		
	3P3W3M	$S_{sum} = S_{(1)} + S_{(2)} + S_{(3)}$	$Q_{sum} = Q_{(1)} + Q_{(2)} + Q_{(3)}$
	3P4W		

Wiring		Item	Power factor	Phase angle
All channels	1P2W		Basic calculation formula $\lambda_{(i)}$	Basic calculation formula $\Phi_{(i)}$
Sum values	1P3W		$\lambda_{sum} = si_{sum} \left \frac{P_{sum}}{S_{sum}} \right $	When $P_{sum} \geq 0$ $\varphi_{sum} = si_{sum} \cos^{-1} \lambda_{sum}$ (0° to ±90°) When $P_{sum} < 0$ $\varphi_{sum} = si_{sum} \left 180 - \cos^{-1} \lambda_{sum} \right$ (±90° to ±180°)
	3P3W			
	3P3W2M			
	3V3A			
	3P3W3M			
	3P4W			
The polarity symbol si_{sum} is acquired from the Q_{sum} symbol.				

(4) Harmonic measurement parameter calculation formulas

Item	Calculation formulas
Harmonic voltage	$U_{k(i)} = \sqrt{(U_{kr(i)})^2 + (U_{ki(i)})^2}$
Harmonic voltage content percentage	$U_{HDk(i)} = \frac{U_{k(i)}}{U_{1(i)}} \times 100$
Harmonic voltage phase angle	$\theta_{U_{k(i)}} = \tan^{-1} \left(\frac{U_{kr(i)}}{-U_{ki(i)}} \right)$
Total harmonic voltage distortion	$U_{thd(i)} = \frac{\sqrt{\sum_{k=2}^K (U_{k(i)})^2}}{U_{1(i)}} \times 100$
Inter-channel voltage fundamental wave phase difference	Phase difference of channel 2 relative to channel 1: $\theta_{U_{2-1}} = \theta_{U_{1(2)}} - \theta_{U_{1(1)}}$ Phase difference of channel 3 relative to channel 1: $\theta_{U_{3-1}} = \theta_{U_{1(3)}} - \theta_{U_{1(1)}}$
Harmonic current	$I_{k(i)} = \sqrt{(I_{kr(i)})^2 + (I_{ki(i)})^2}$
Harmonic current content percentage	$I_{HDk(i)} = \frac{I_{k(i)}}{I_{1(i)}} \times 100$
Harmonic current phase angle	$\theta_{I_{k(i)}} = \tan^{-1} \left(\frac{I_{kr(i)}}{-I_{ki(i)}} \right)$
Total harmonic current distortion	$I_{thd(i)} = \frac{\sqrt{\sum_{k=2}^K (I_{k(i)})^2}}{I_{1(i)}} \times 100$
Inter-channel current fundamental wave phase difference	Phase difference of channel 2 relative to channel 1: $\theta_{I_{2-1}} = \theta_{I_{1(2)}} - \theta_{I_{1(1)}}$ Phase difference of channel 3 relative to channel 1: $\theta_{I_{3-1}} = \theta_{I_{1(3)}} - \theta_{I_{1(1)}}$
Harmonic active power	$P_{k(i)} = U_{kr(i)} \times I_{kr(i)} + U_{ki(i)} \times I_{ki(i)}$
Harmonic active power content percentage	$P_{HDk(i)} = \frac{P_{k(i)}}{P_{1(i)}} \times 100$
Fundamental wave voltage current phase difference	$\varphi_{1(i)} = (\theta_{I_{1(i)}} - \theta_{U_{1(i)}}) \times (-1)$
Fundamental wave apparent power	$S_{1(i)} = U_{1(i)} \times I_{1(i)}$
Fundamental wave reactive power	$Q_{1(i)} = (U_{1r(i)} \times I_{1i(i)} - U_{1i(i)} \times I_{1r(i)}) \times (-1)$

Item	Calculation formulas
Fundamental wave power factor	$\lambda_{1(i)} = \text{sic} \cos \varphi_{1(i)} $
Voltage and current calculated using their respective vector calculations are used for CH3 in 3P3W2M connections and all channels in 3P3W3M connections. (i): Measurement channel; k: Analysis order; K: Maximum analysis order; r: Real part after FFT; i: Imaginary part after FFT; sic: Polarity symbol, assigned based on the fundamental wave reactive power $Q_{1(i)}$ polarity Symbol [None]: Current lags voltage (LAG). Symbol [-]: Current leads voltage (LEAD).	

Power channel and sum value calculation formulas

Wiring	1P2W	1P3W	3P3W	3P3W2M	3V3A	3P3W3M	3P4W
Item	All channels	Sum values					
Active power	Basic calculation formulas $P_{k(i)}$	$P_{ksum} = P_{k(1)} + P_{k(2)}$				$P_{ksum} = P_{k(1)} + P_{k(2)} + P_{k(3)}$	

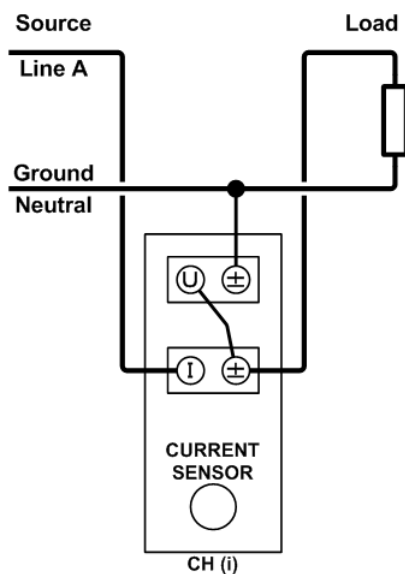
Wiring	Item	Fundamental wave apparent power	Fundamental wave reactive power
All channels	1P2W	Basic calculation formula $S_{1(i)}$	Basic calculation formula $Q_{1(i)}$
Sum values	1P3W	$S_{1sum} = \sqrt{P_{1sum}^2 + Q_{1sum}^2}$	$Q_{1sum} = Q_{1(1)} + Q_{1(2)}$
	3P3W		
	3P3W2M		
	3V3A		
	3P3W3M		$Q_{1sum} = Q_{1(1)} + Q_{1(2)} + Q_{1(3)}$
	3P4W		

Item		Fundamental wave power factor	Fundamental wave voltage current phase difference
All channels	1P2W	Basic calculation formula $\lambda_{1(i)}$	Basic calculation formula $\varphi_{1(i)}$
Sum values	1P3W	$\lambda_{1sum} = s_{i sum} \cos \varphi_{1sum} $	$\varphi_{1sum} = \tan^{-1}(\frac{Q_{1sum}}{P_{1sum}})$
	3P3W		
	3P3W2M		
	3V3A		
	3P3W3M		
	3P4W		
The polarity symbol $s_{i sum}$ is acquired from the Q_{sum} symbol.			

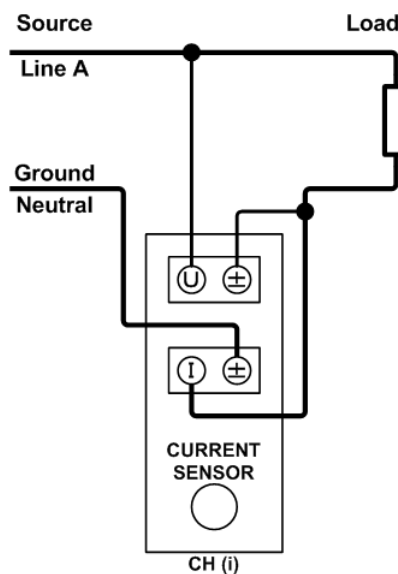
5.6 Wiring Specifications

Wiring diagrams for direct input (connections to instrument's terminal block)

(1) 1-phase/2-wire (1P2W)

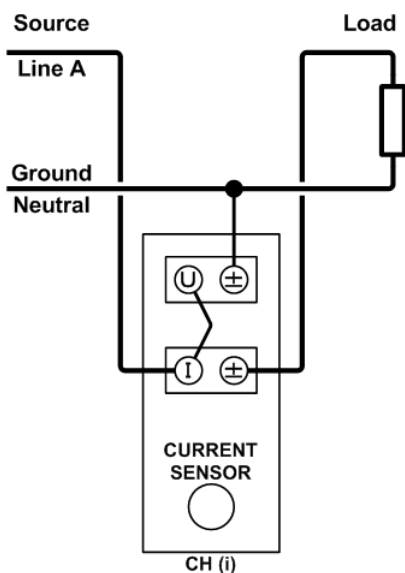


Method 1-(1)

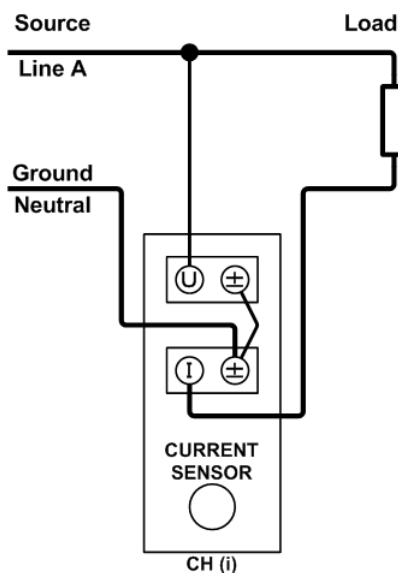


Method 1-(2)

Connect the voltage input terminals to the load side. (p.31)



Method 2-(1)

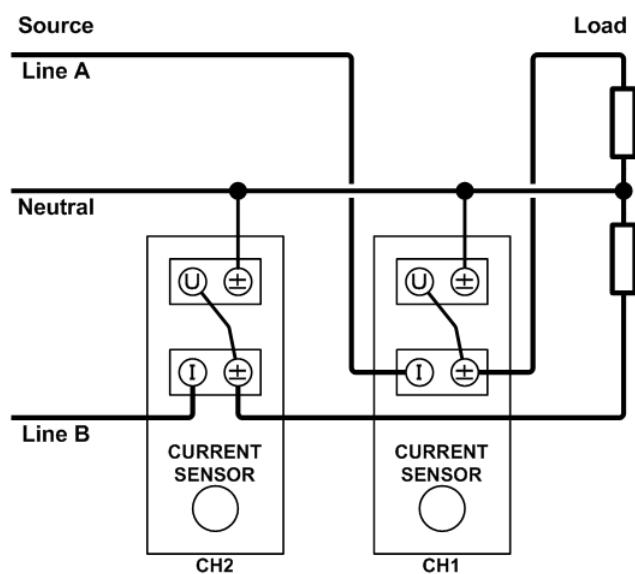


Method 2-(2)

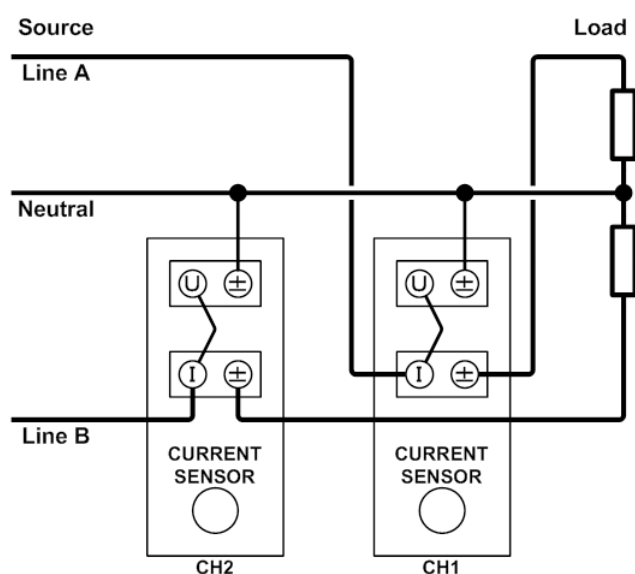
Connect the current input terminals to the load side. (p.31)

CH (i): Measurement channel;(1, 2, 3)

(2) 1-phase/3-wire(1P3W)

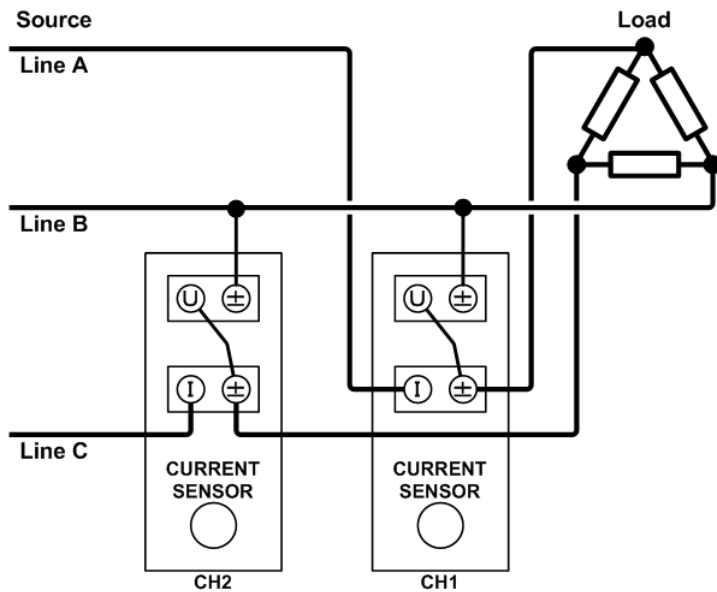


Method 1: Connect the voltage input terminals to the load side. (p.31)

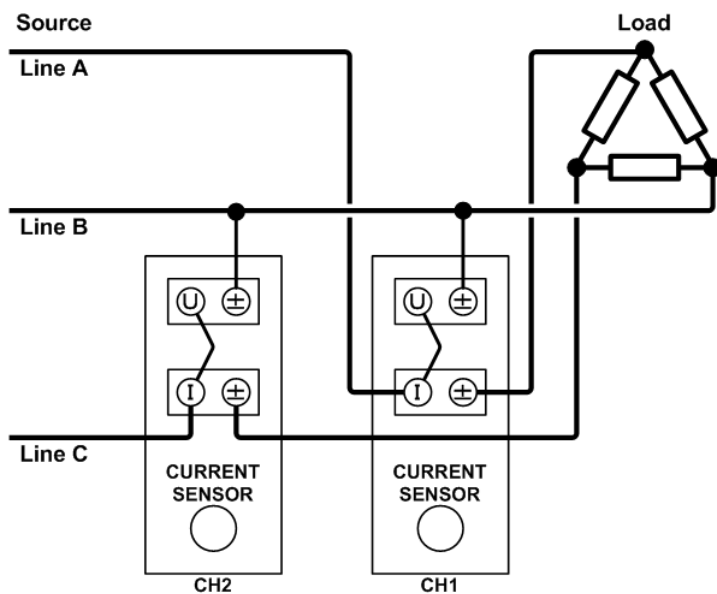


Method 2: Connect the current input terminals to the load side. (p.31)

(3) 3-phase/3-wire (3P3W, 3P3W2M)

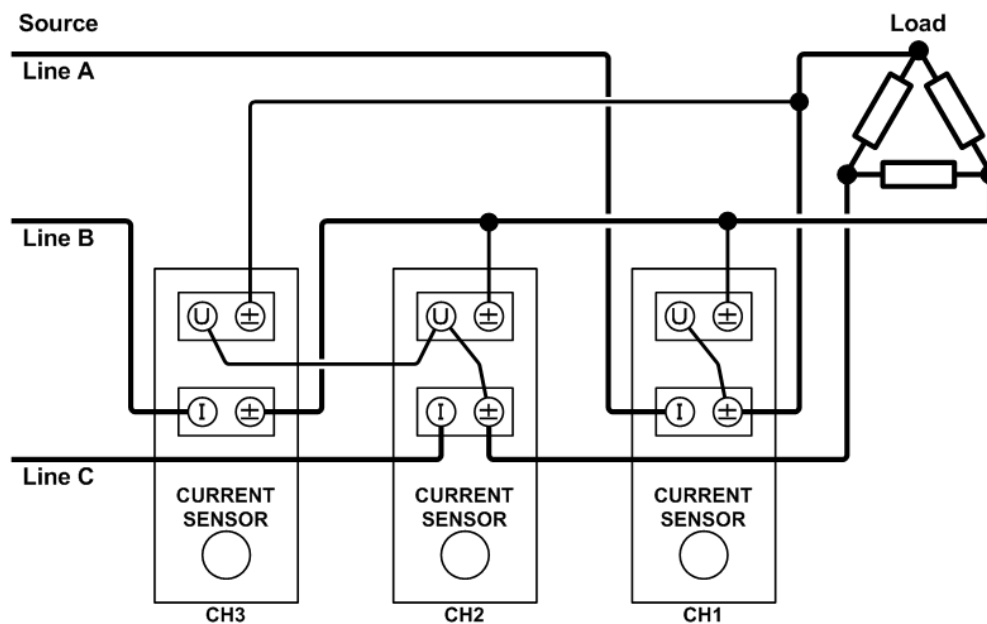


Method 1: Connect the voltage input terminals to the load side. (p.31)

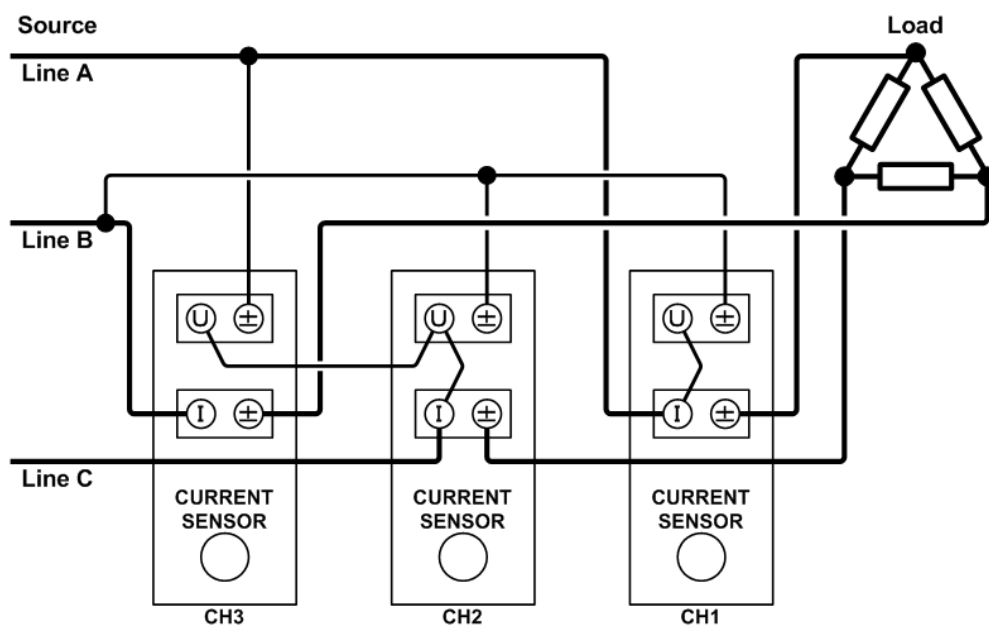


Method 2: Connect the current input terminals to the load side. (p.31)

(4) 3-phase/3-wire (3V3A, 3P3W3M)

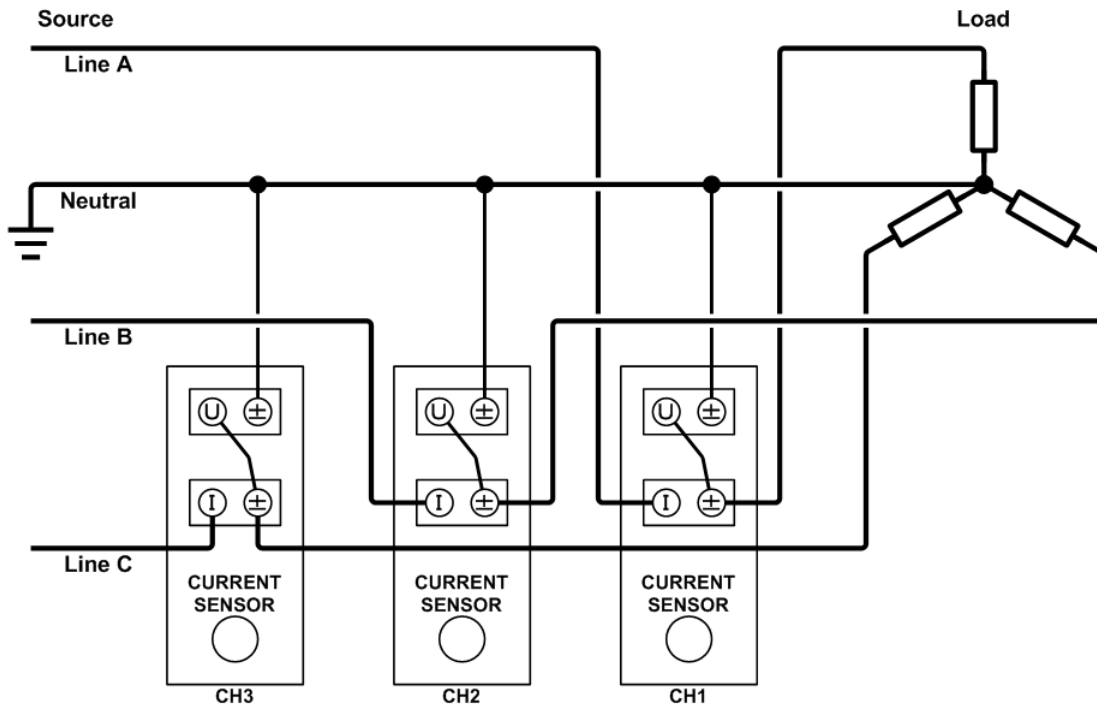


Method 1: Connect the voltage input terminals to the load side. (p.31)

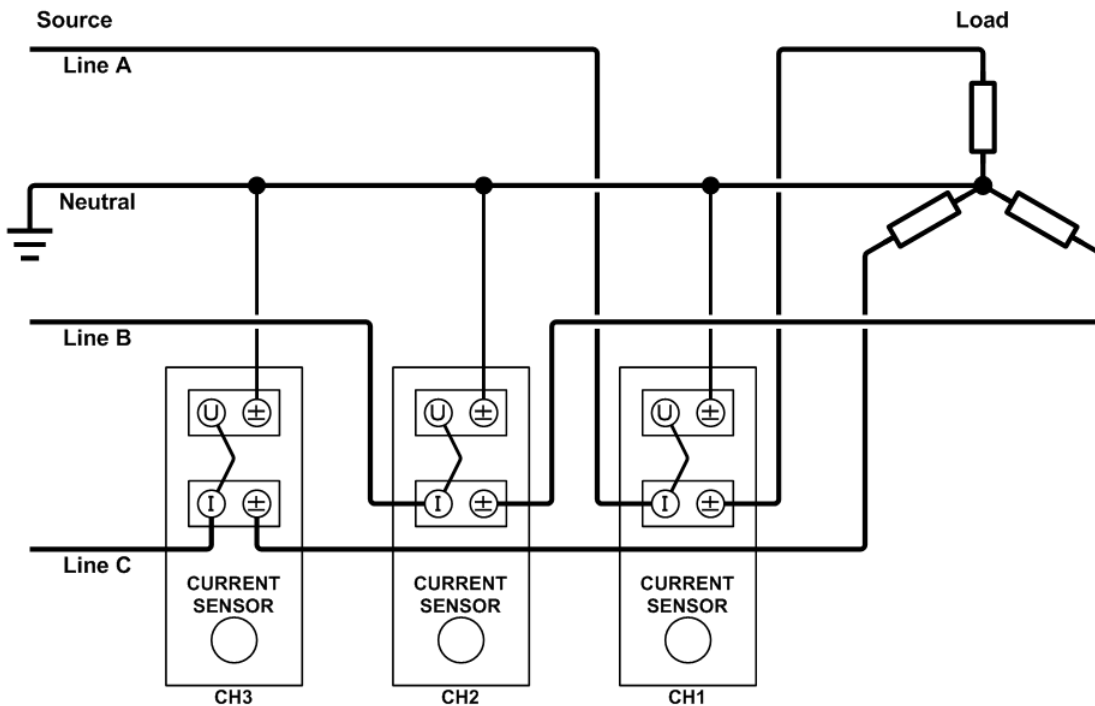


Method 2: Connect the current input terminals to the load side. (p.31)

(5) 3-phase/4-wire (3P4W)



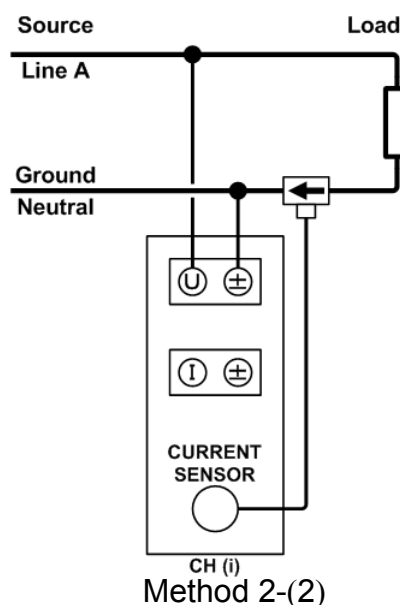
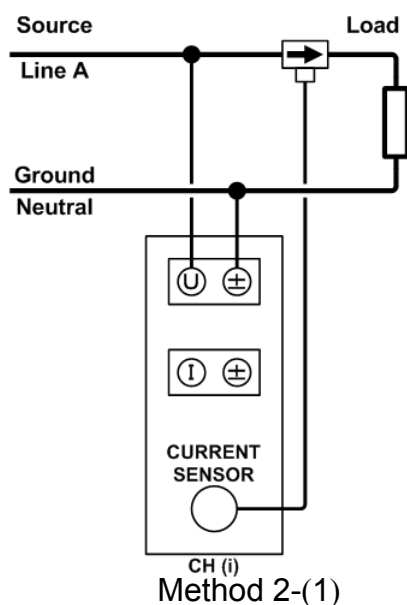
Method 1: Connect the voltage input terminals to the load side. (p.31)



Method 2: Connect the current input terminals to the load side. (p.31)

Wiring diagrams when using an external current sensor

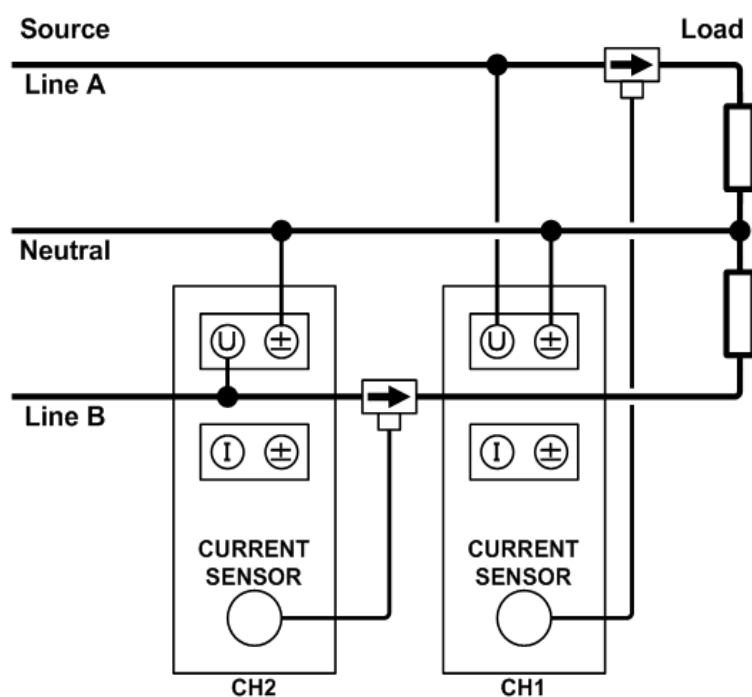
(1) 1-phase/2-wire(1P2W)



Connect the current input terminals to the load side. (p.31)

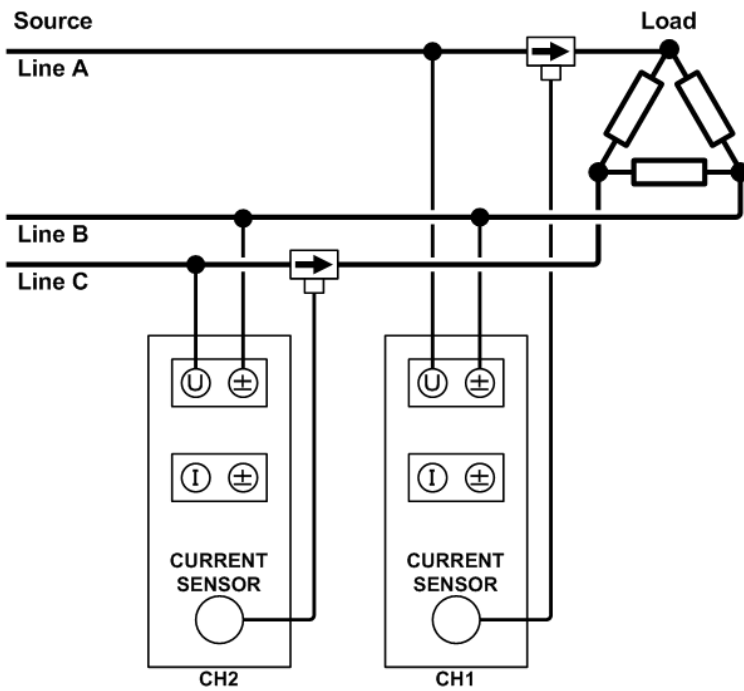
CH (i): Measurement channel;(1, 2, 3)

(2) 1-phase/3-wire(1P3W)

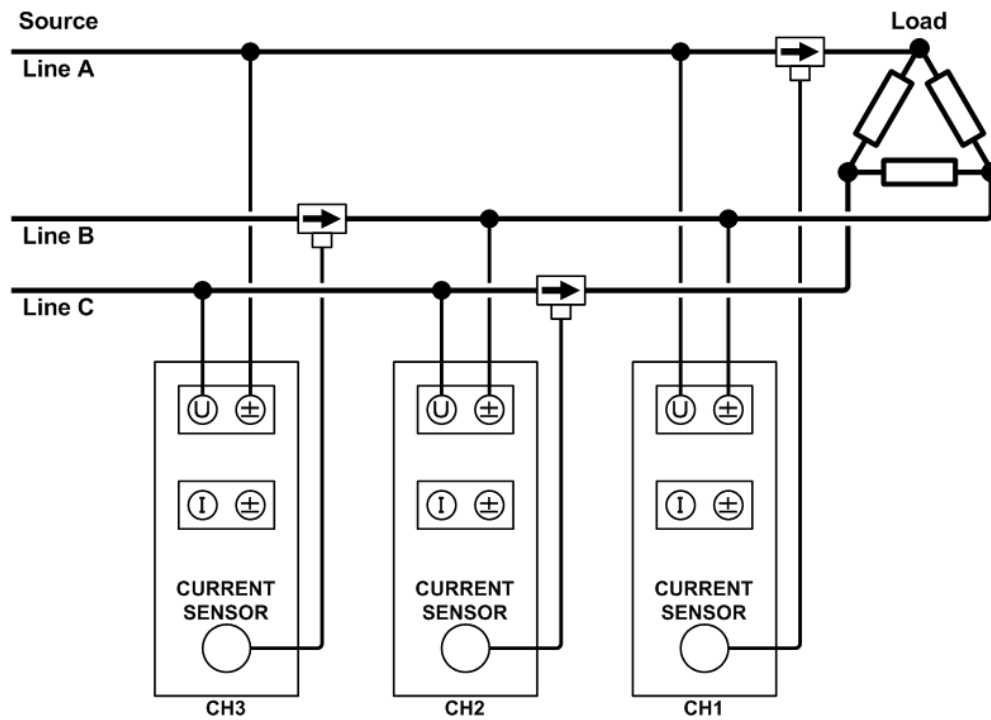


  :Current sensor

(3) 3-phase/3-wire(3P3W, 3P3W2M)

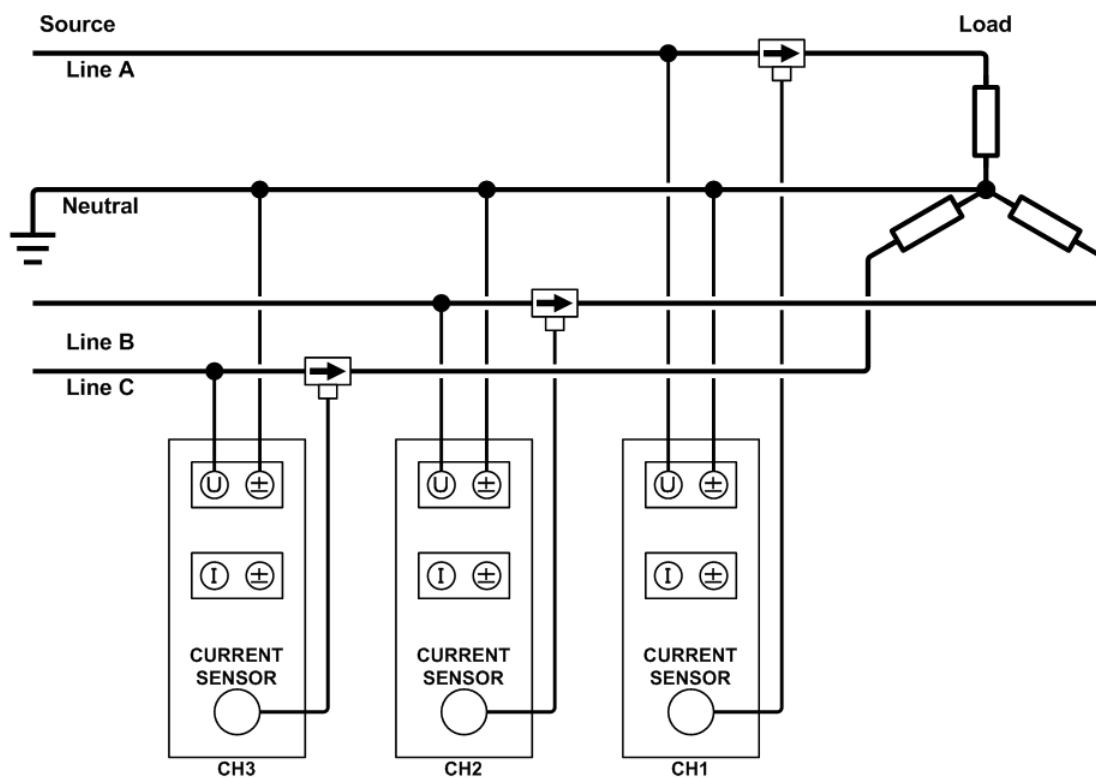


(4) 3-phase/3-wire (3V3A, 3P3W3M)



 :Current sensor

(5) 3-phase/4-wire (3P4W)



 :Current sensor

Maintenance and Service

Chapter 6

6.1 Troubleshooting

Inspection and Repair

For more information about error messages, see 6.2 Error Indication (p.179).



WARNING

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

- Regular calibration is required in order to maintain or verify the instrument's accuracy.
- If damage is suspected, check the Before having the instrument repaired (p.178) section before contacting your authorized Hioki distributor or reseller.
- The fuse is housed in the power unit of the instrument. If the power does not turn on, the fuse may be blown. If this occurs, a replacement or repair cannot be performed by customers. Please contact your authorized Hioki distributor or reseller.

Replaceable Parts and Operating Lifetimes

Properties of some parts used in the instrument may deteriorate after a long-term use.

The regular replacement of those parts is recommended to use the instrument properly for a long time.

For the replacement of the parts, please contact your authorized Hioki distributor or reseller.

The useful lives of the parts depend on the operating environment and frequency of use.

Operation cannot necessarily be guaranteed for the following recommended replacement period of each part.

Parts Name	Recommended Replacement Period	Note and Condition
Switching power supply	Approx. 10 years	After continuous use at 40°C The switching power supply will need to be replaced.
Relays	Approx. 10 years	When switching the range 500 times per hour The board with the component in question will need to be replaced.

Transporting the instrument

- Use the original packing materials when transporting the instrument, if possible.
- Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We do not take any responsibility for damage incurred during shipping.

Cleaning

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

Disposing of the instrument

Handle and dispose of the instrument in accordance with local regulations.

Before having the instrument repaired

Symptom	Check Item, or Cause	Remedy and Reference
The display does not appear when you turn the power on.	Has the power cord been disconnected from the instrument? Is it connected properly?	Verify that the power cord is connected properly. See: 2.3 Connecting the Power Cord (p.34)
Keys do not work.	Has the key lock been activated?	Cancel the key lock state. See: 3.10.3 Disabling Control Keys (Key Lock) (p.111)
	Is the REMOTE lamp lit up?	The instrument is being controlled by the controller. End control and cancel the remote state. See: 4.5 Canceling the Remote State (Activating the Local State) (p.134)

When no apparent cause can be established

Perform a system reset.

This will return all settings to their factory defaults.

See: 3.10.4 Initializing the Instrument (System Reset) (p.112)

6.2 Error Indication

The instrument will display an error if a malfunction is found during the self-test when the instrument is turned on or if it is unable to accept key input for some reason.

See: 3.10.4 Initializing the Instrument (System Reset) (p.112)



CAUTION

If the measurement lines are energized when the instrument is turned on, the instrument may be damaged or an error message may appear, so before energizing the lines, turn the instrument on and confirm that no error message is displayed.

Contact your authorized Hioki distributor or reseller if a repair should become necessary.

Error display	Description	Cause and Remedy
	ROM error	The instrument needs to be repaired. (Circuit failure)
	SDRAM error	
	Control circuit error	
	Buffer data error	Pressing any key will cause the instrument to switch to the measurement display after performing a system reset. If this error occurs frequently, the instrument will need to be repaired. The circuit used to save settings may be damaged.
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when key and external control are mixed during integration.
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when an invalid operation is attempted during integration. Example: Range switching
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when the user attempts to start integration while an S.Err event has occurred.
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when the user attempts to start integration after the integration limit (integration time, integrated value) has been reached.
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when a data reset is performed during integration.
	Invalid key input (displayed for approx. 1 sec.)	This error is displayed when an invalid operation is performed while the HOLD/MAX/MIN display is active.
	Degaussing/zero-adjustment failure (displayed for approx. 1 sec.)	This error is displayed when input exceeds the degaussing or zero-adjustment range. See: 2.5 Performing Zero-adjustment (p.36)
	Synchronization loss	This error is displayed when no external signal is received while the instrument has been set as the slave with the external synchronization function. See: 3.6 Performing Synchronized Measurement with Multiple Instruments (Multiple-instrument Synchronized Measurement) (p.81)

Error display	Description	Cause and Remedy
	Over-range	This error is displayed when the voltage or current exceeds 140% of the range (or 1060.5 V when using the 1000 V voltage range). See: 3.11.2 When o.r (over-range) Is Displayed (p.115) 3.2.4 Selecting the Voltage and Current Ranges (p.48)
	Scaling error	This error is displayed when the display range has been exceeded due to the VT ratio or CT ratio setting. Change the VT or CT ratio. See: 3.2.9 Setting the VT and CT Ratio (p.59)
	External current sensor input	This error is displayed when the a 200 mA to 5 A range key is pressed while using external current sensor input. See: 3.9 Using a Current Sensor (p.102)
		
	No measurement or measured value not ready	This error is displayed when switching the wiring mode, rectifier, or channel. When starting averaging, the [-----] display indicates the measured value when the first average value has been calculated.

Appendix

Appendix 1 Detailed Specifications of Measurement Items (Display Items)

PW3336, PW3336-01, PW3336-02, PW3336-03

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×2	1P3W	3P3W	3P3W2M	Display range
Voltage	V	ALL		1, 2	●	●	●	●	±0.5 to ±140% of voltage range
				3	–	–	–	●	
				sum	–	●	●	●	
Current	A	ALL		1, 2	●	●	●	●	±0.5 to ±140% of current range
				3	–	–	–	●	
				sum	–	●	●	●	
Active power	W	ALL		1, 2	●	●	–	–	0 to ±196% of power range
				3	–	–	–	–	
				sum	–	●	●	●	
Apparent power Reactive power	VA var	Except for DC		1, 2	●	●	–	–	0 to ±196% of power range
				3	–	–	–	–	
				sum	–	●	●	●	
		DC		1, 2, 3, sum	–	–	–	–	
Power factor	PF	Except for DC		1, 2	●	●	–	–	±0.0000 to ±1.0000
				3	–	–	–	–	
				sum	–	●	●	●	
		DC		1, 2, 3, sum	–	–	–	–	
Phase angle	°	AC, FND		1, 2	●	●	–	–	+180.00 to –180.00
				3	–	–	–	–	
				sum	–	●	●	●	
		AC+DC AC+DC Umn DC		1, 2, 3, sum	–	–	–	–	
Frequency	Voltage Current	V Hz A Hz	–	1, 2	●	●	●	●	0.1000 to 220.00k
				3	–	–	–	●	
				sum	–	–	–	–	
Current integration	Positive Negative	Ah + Ah -	DC	1, 2	●	●	–	–	±999999
				3, sum	–	–	–	–	
			Except for DC	1, 2, 3, sum	–	–	–	–	
	Total	Ah	AC+DC	1, 2	●	●	●	●	
			AC+DC	3	–	–	–	●	
			Umn	sum	–	–	–	–	
			DC	1, 2	●	●	–	–	
				3, sum	–	–	–	–	
			AC, FND	1, 2, 3, sum	–	–	–	–	

Appendix 1 Detailed Specifications of Measurement Items (Display Items)

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×2	1P3W	3P3W	3P3W2M	Display range
Active power integration	Positive Negative Total	Wh + Wh – Wh	AC+DC AC+DC Umn	1, 2	●	●	—	—	±999999
				3	—	—	—	—	
				sum	—	●	●	●	
			DC	1, 2	●	●	—	—	
				3, sum	—	—	—	—	
			AC, FND	1, 2, 3, sum	—	—	—	—	
Integration time		TIME	—	—	●	●	●	●	0000.00 to 9999.59
Waveform peak value	Voltage Current	V pk A pk	—	1, 2	●	●	●	●	±0.3 to ±102% of peak range
				3	—	—	—	●	
				sum	—	—	—	—	
Total harmonic distortion	Voltage Current	THD V % THD A %	—	1, 2	●	●	●	●	0.00 to 500.00
				3	—	—	—	●	
				sum	—	—	—	—	
Inter-channel fundamental wave phase difference	Voltage Current	θ V ° θ A °	FND	1-2	—	●	●	●	+180.00 to –180.00
				1-3	—	—	—	●	
				3, sum	—	—	—	—	
			AC+DC AC+DC Umn DC, AC	1-2 1-3 3, sum	— — —	— — —	— — —		
Efficiency		η1, η2	—	—	●	—	—	—	0.00 to 200.00
Time average current		T.AV A	AC+DC AC+DC Umn	1, 2	●	●	●	●	0 to 612% of current range
				3	—	—	—	●	
				sum	—	—	—	—	
			DC	1, 2	●	●	—	—	
				3, sum	—	—	—	—	
			AC, FND	1, 2, 3, sum	—	—	—	—	
Time average active power		T.AV W	AC+DC AC+DC Umn	1, 2	●	●	—	—	0 to ±3745.4% of power range
				3	—	—	—	—	
				sum	—	●	●	●	
			DC	1, 2	●	●	—	—	
				3, sum	—	—	—	—	
			AC, FND	1, 2, 3, sum	—	—	—	—	
Ripple rate	Voltage Current	RF V % RF A %	—	1, 2	●	●	●	●	0.00 to 500.00
				3	—	—	—	●	
				sum	—	—	—	—	
Crest factor	Voltage Current	CF V CF A	—	1, 2	●	●	●	●	1.0000 to 612.00
				3	—	—	—	●	
				sum	—	—	—	—	

Appendix 1 Detailed Specifications of Measurement Items (Display Items)

PW3337, PW3337-01, PW3337-02, PW3337-03

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Display range
Voltage	V	ALL		1, 2, 3	●	●	●	●	●	●	●	±0.5 to ±140% of voltage range
				sum	–	●	●	●	●	●	●	
Current	A	ALL		1, 2, 3	●	●	●	●	●	●	●	±0.5 to ±140% of current range
				sum	–	●	●	●	●	●	●	
Active power	W	ALL		1	●	●	–	–	–	●	●	0 to ±196% of power range
				2	●	●	–	–	–	●	●	
				3	●	●	●	–	–	●	●	
				sum	–	●	●	●	●	●	●	
Apparent power Reactive power	VA var	Except for DC		1	●	●	–	–	–	●	●	0 to ±196% of power range
				2	●	●	–	–	–	●	●	
				3	●	●	●	–	–	●	●	
				sum	–	●	●	●	●	●	●	
		DC		1, 2, 3, sum	–	–	–	–	–	–	–	
Power factor	PF	Except for DC		1	●	●	–	–	–	●	●	±0.0000 to ±1.0000
				2	●	●	–	–	–	●	●	
				3	●	●	●	–	–	●	●	
				sum	–	●	●	●	●	●	●	
		DC		1, 2, 3, sum	–	–	–	–	–	–	–	
Phase angle	°	AC, FND		1	●	●	–	–	–	●	●	+180.00 to –180.00
				2	●	●	–	–	–	●	●	
				3	●	●	●	–	–	●	●	
				sum	–	●	●	●	●	●	●	
		AC+DC AC+DC Umn DC		1, 2, 3, sum	–	–	–	–	–	–	–	
Frequency	Voltage Current	V Hz A Hz	–	1, 2, 3	●	●	●	●	●	●	●	0.1000 to 220.00k
				sum	–	–	–	–	–	–	–	
Current integration	Positive Negative	Ah + Ah -	DC	1	●	●	–	–	–	–	–	±999999
				2	●	●	–	–	–	–	–	
				3	●	●	●	–	–	–	–	
				sum	–	–	–	–	–	–	–	
	Total	Ah	Except for DC	1, 2, 3, sum	–	–	–	–	–	–	–	
			AC+DC AC+DC Umn	1, 2, 3	●	●	●	●	●	●	●	
				sum	–	–	–	–	–	–	–	
			DC	1	●	●	–	–	–	–	–	
				2	●	●	–	–	–	–	–	
				3	●	●	●	–	–	–	–	
				sum	–	–	–	–	–	–	–	
			AC, FND	1, 2, 3, sum	–	–	–	–	–	–	–	
Active power integration	Positive Negative Total	Wh + Wh – Wh	AC+DC AC+DC Umn	1	●	●	–	–	–	●	●	±999999
				2	●	●	–	–	–	●	●	
				3	●	●	●	–	–	●	●	
				sum	–	●	●	●	●	●	●	
			DC	1	●	●	–	–	–	–	–	
				2	●	●	–	–	–	–	–	
				3	●	●	●	–	–	–	–	
				sum	–	–	–	–	–	–	–	
			AC, FND	1, 2, 3, sum	–	–	–	–	–	–	–	

Appendix 1 Detailed Specifications of Measurement Items (Display Items)

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Display range
Integration time		TIME	—	—	●	●	●	●	●	●	●	0000.00 to 9999.59
Waveform peak value	Voltage Current	V pk A pk	—	1, 2, 3	●	●	●	●	●	●	●	±0.3 to ±102% of peak range
				sum	—	—	—	—	—	—	—	
Total harmonic distortion	Voltage Current	THD V % THD A %	—	1, 2, 3	●	●	●	●	●	●	●	0.00 to 500.00
				sum	—	—	—	—	—	—	—	
Inter-channel fundamental wave phase difference	Voltage Current	θ V ° θ A °	FND	1-2	—	●	●	●	●	●	●	+180.00 to –180.00
				1-3	—	—	—	●	●	●	●	
				3, sum	—	—	—	—	—	—	—	
			AC+DC AC+DC Umn DC, AC	1-2	—	—	—	—	—	—	—	
				1-3 3, sum	—	—	—	—	—	—	—	
Efficiency		η1, η2	—	—	●	●	●	—	—	—	—	0.00 to 200.00
Time average current		T.AV A	AC+DC AC+DC Umn	1, 2, 3	●	●	●	●	●	●	●	0 to 612% of current range
				sum	—	—	—	—	—	—	—	
			DC	1	●	●	—	—	—	—	—	
				2	●	●	—	—	—	—	—	
				3	●	●	●	—	—	—	—	
				sum	—	—	—	—	—	—	—	
AC, FND	1, 2, 3, sum	—	—	—	—	—	—	—	—			
	Time average active power		AC+DC AC+DC Umn	1	●	●	—	—	—	●	●	0 to ±3745.4% of power range
2				●	●	—	—	—	●	●		
3				●	●	●	—	—	●	●		
sum				—	●	●	●	●	●	●		
DC			1	●	●	—	—	—	—	—		
			2	●	●	—	—	—	—	—		
			3	●	●	●	—	—	—	—		
			sum	—	—	—	—	—	—	—		
AC, FND			1, 2, 3, sum	—	—	—	—	—	—	—	—	
			Ripple rate	Voltage Current	RF V % RF A %	—	1, 2, 3	●	●	●	●	
sum	—	—					—	—	—	—	—	
Crest factor	Voltage Current	CF V CF A	—	1, 2, 3	●	●	●	●	●	●	●	1.0000 to 612.00
				sum	—	—	—	—	—	—	—	

Appendix 2 Detailed Specifications of Output

Appendix 2.1 Detailed Specifications of Level Output

PW3336, PW3336-01, PW3336-02, PW3336-03

● : Installed – : Not installed

Measurement items	Output terminal	Rectifier	1P2W×2	1P3W	3P3W	3P3W2M	Rated output voltage
Voltage	U1	ALL	●	●	●	●	DC ±2 V
	U2		●	●	●	●	
	U3		0 V	0 V	0 V	●	
Current	I1	ALL	●	●	●	●	DC ±2 V
	I2		●	●	●	●	
	I3		0 V	0 V	0 V	●	
Active power	P1	ALL	●	●	0 V	0 V	DC ±2 V
	P2		●	●	0 V	0 V	
	P3		0 V	0 V	0 V	0 V	
	Psum		0 V	●	●	●	
Hi-speed active power	Hi-P1	AC+DC	●	●	●	●	DC ±2 V
	Hi-P2		●	●	●	●	
	Hi-P3		0 V	0 V	0 V	0 V	
	Hi-Psum		0 V	●	●	●	
	Hi-P1	Except for AC+DC	-	-	-	-	
	Hi-P2		-	-	-	-	
	Hi-P3		-	-	-	-	
	Hi-Psum		-	-	-	-	

PW3337, PW3337-01, PW3337-02, PW3337-03

● : Installed – : Not installed

Measurement items	Output terminal	Rectifier	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Rated output voltage
Voltage	U1	ALL	●	●	●	●	●	●	●	DC ±2 V
	U2		●	●	●	●	●	●	●	
	U3		●	●	●	●	●	●	●	
Current	I1	ALL	●	●	●	●	●	●	●	DC±2 V
	I2		●	●	●	●	●	●	●	
	I3		●	●	●	●	●	●	●	
Active power	P1	ALL	●	●	0 V	0 V	0 V	●	●	DC ±2 V
	P2		●	●	0 V	0 V	0 V	●	●	
	P3		●	●	●	0 V	0 V	●	●	
	Psum		0 V	●	●	●	●	●	●	
Hi-speed active power	Hi-P1	AC+DC	●	●	●	●	●	●	●	DC ±2 V
	Hi-P2		●	●	●	●	●	●	●	
	Hi-P3		●	●	●	0 V	0 V	●	●	
	Hi-Psum		0 V	●	●	●	●	●	●	
	Hi-P1	Except for AC+DC	-	-	-	-	-	-	-	
	Hi-P2		-	-	-	-	-	-	-	
	Hi-P3		-	-	-	-	-	-	-	
	Hi-Psum		-	-	-	-	-	-	-	

Appendix 2.2 Detailed Specifications of Waveform Output

PW3336, PW3336-01, PW3336-02, PW3336-03

● : Installed – : Not installed

Measurement items	Output terminal	Rectifier	1P2W×2	1P3W	3P3W	3P3W2M	Rated output voltage
Instantaneous voltage waveform	u1	-	●	●	●	●	1 V (RMS level)
	u2		●	●	●	●	
	u3		0 V	0 V	0 V	●	
Instantaneous current waveform	i1	-	●	●	●	●	1 V (RMS level)
	i2		●	●	●	●	
	i3		0 V	0 V	0 V	●	
Instantaneous power waveform	p1	-	●	●	●	●	1 V (Average level)
	p2		●	●	●	●	
	p3		0 V	0 V	0 V	0 V	

PW3337, PW3337-01, PW3337-02, PW3337-03

● : Installed – : Not installed

Measurement items	Output terminal	Rectifier	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Rated output voltage
Instantaneous voltage waveform	u1	-	●	●	●	●	●	●	●	1 V (RMS level)
	u2		●	●	●	●	●	●	●	
	u3		●	●	●	●	●	●	●	
Instantaneous current waveform	i1	-	●	●	●	●	●	●	●	1 V (RMS level)
	i2		●	●	●	●	●	●	●	
	i3		●	●	●	●	●	●	●	
Instantaneous power waveform	p1	-	●	●	●	●	●	●	●	1 V (Average level)
	p2		●	●	●	●	●	●	●	
	p3		●	●	●	0 V	0 V	●	●	

Appendix 2.3 Detailed Specifications of Selectable Items for D/A Output

PW3336, PW3336-01, PW3336-02, PW3336-03

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×2	1P3W	3P3W	3P3W2M	Rated output voltage	
Voltage	V	ALL		1, 2	●	●	●	●	DC ±2V	
				3	—	—	—	●		
				sum	—	●	●	●		
Current	A	ALL		1, 2	●	●	●	●	DC ±2V	
				3	—	—	—	●		
				sum	—	●	●	●		
Active power	W	ALL		1, 2	●	●	—	—	DC ±2V	
				3	—	—	—	—		
				sum	—	●	●	●		
Apparent power Reactive power Power factor	VA Var PF	Except for DC		1, 2	●	●	—	—	DC ±2V	
				3	—	—	—	—		
				sum	—	●	●	●		
		DC	1, 2, 3, sum	—	—	—	—			
Phase angle	°	AC, FND		1, 2	●	●	—	—	DC ±2V	
				3	—	—	—	—		
				sum	—	●	●	●		
		AC+DC AC+DC Umn DC	1, 2, 3, sum	—	—	—	—			
Frequency	Voltage Current	V Hz A Hz	— (Note 1)	1, 2	●	●	●	●	DC +2V	
				3	—	—	—	●		
				sum	—	—	—	—		
Current integration	Positive Negative	Ah + Ah -	DC	1, 2	●	●	—	—	DC ±5V	
				3, sum	—	—	—	—		
			Total	Ah	Except for DC	1, 2, 3, sum	—	—		—
	AC+DC AC+DC Umn	1, 2				●	●	●		●
		3				—	—	—		●
		DC			sum	—	—	—		—
	1, 2				●	●	—	—		
	3, sum				—	—	—	—		
	AC, FND				1, 2, 3, sum	—	—	—		—
Active power in- tegration	Positive Negative Total	Wh + Wh — Wh	AC+DC AC+DC Umn	1, 2	●	●	—	—	DC ±5V	
				3	—	—	—	—		
				sum	—	●	●	●		
			DC	1, 2	●	●	—	—		
				3, sum	—	—	—	—		
				AC, FND	1, 2, 3, sum	—	—	—		—
Integration time		TIME	—	—	—	—	—	—	—	
Waveform peak value	Voltage Current	V pk A pk	—	—	—	—	—	—	—	
Total harmonic distortion	Voltage Current	THD V % THD A %	— (Note 1)	1, 2	●	●	●	●	DC +2V	
				3	—	—	—	●		
				sum	—	—	—	—		
Inter-channel fundamental wave phase difference	Voltage Current	θ V ° θ A °	— (Note 1)	1 (1-2)	—	●	●	●	DC ±2V	
				2 (1-3)	—	—	—	●		
				3, sum	—	—	—	—		
Efficiency		η1, η2	— (Note 1)	ALL (Note 2)	●	—	—	—	—	

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×2	1P3W	3P3W	3P3W2M	Rated output voltage
Time average current		T.AV A	AC+DC AC+DC Umn	1, 2	●	●	●	●	DC ±2V
				3	–	–	–	●	
				sum	–	–	–	–	
			DC	1, 2	●	●	–	–	
				3, sum	–	–	–	–	
			AC, FND	1, 2, 3, sum	–	–	–	–	
Time average active power		T.AV W	AC+DC AC+DC Umn	1, 2	●	●	–	–	DC ±2V
				3	–	–	–	–	
				sum	–	●	●	●	
			DC	1, 2	●	●	–	–	
				3, sum	–	–	–	–	
			AC, FND	1, 2, 3, sum	–	–	–	–	
Ripple rate	Voltage Current	RF V % RF A %	– (Note 1)	1, 2	●	●	●	●	DC +2V
				3	–	–	–	●	
				sum	–	–	–	–	
Crest factor	Voltage Current	CF V CF A	– (Note 1)	1, 2	●	●	●	●	DC +2V
				3	–	–	–	●	
				sum	–	–	–	–	

PW3337, PW3337-01, PW3337-02, PW3337-03

● : Installed – : Not installed

Measurement items		Display	Rectifier	Channel	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Rated output voltage	
Voltage		V	ALL	1, 2, 3	●	●	●	●	●	●	●	DC ±2V	
				sum	—	●	●	●	●	●	●		
Current		A	ALL	1, 2, 3	●	●	●	●	●	●	●	DC ±2V	
				sum	—	●	●	●	●	●	●		
Active power		W	ALL	1	●	●	—	—	—	●	●	DC ±2V	
				2	●	●	—	—	—	●	●		
				3	●	●	●	—	—	●	●		
				sum	—	●	●	●	●	●	●		
Apparent power Reactive power Power factor		VA Var PF	Except for DC	1	●	●	—	—	—	●	●	DC ±2V	
				2	●	●	—	—	—	●	●		
				3	●	●	●	—	—	●	●		
				sum	—	●	●	●	●	●	●		
			DC	1, 2, 3, sum	—	—	—	—	—	—	—		
Phase angle		°	AC, FND	1	●	●	—	—	—	●	●	DC ±2V	
				2	●	●	—	—	—	●	●		
				3	●	●	●	—	—	●	●		
				sum	—	●	●	●	●	●	●		
			AC+DC AC+DC Umn DC	1, 2, 3, sum	—	—	—	—	—	—	—		
Frequency	Voltage Current	V Hz A Hz	— (Note 1)	1, 2, 3	●	●	●	●	●	●	●	DC +2V	
				sum	—	—	—	—	—	—	—		
Current integration		Positive Negative	Ah + Ah -	DC	1	●	●	—	—	—	—	DC ±5V	
					2	●	●	—	—	—	—		—
					3	●	●	●	—	—	—		—
					sum	—	—	—	—	—	—		—
		Total	Ah	AC+DC AC+DC Umn	1, 2, 3	●	●	●	●	●	●		●
					sum	—	—	—	—	—	—		—
				DC	1	●	●	—	—	—	—		—
					2	●	●	—	—	—	—		—
					3	●	●	●	—	—	—		—
					sum	—	—	—	—	—	—		—
AC, FND	1, 2, 3, sum	—	—	—	—	—	—	—					
Active power integration		Positive Negative Total	Wh + Wh – Wh	AC+DC AC+DC Umn	1	●	●	—	—	—	●	●	DC ±5V
					2	●	●	—	—	—	●	●	
					3	●	●	●	—	—	●	●	
					sum	—	●	●	●	●	●	●	
				DC	1	●	●	—	—	—	—	—	
					2	●	●	—	—	—	—	—	
					3	●	●	●	—	—	—	—	
					sum	—	—	—	—	—	—	—	
				AC, FND	1, 2, 3, sum	—	—	—	—	—	—	—	
Integration time		TIME	—	—	—	—	—	—	—	—	—		
Waveform peak value	Voltage Current	V pk A pk	—	—	—	—	—	—	—	—	—		
Total harmonic distortion	Voltage Current	THD V % THD A %	— (Note 1)	1, 2, 3	●	●	●	●	●	●	●	DC +2 V	
				sum	—	—	—	—	—	—	—		
Inter-channel fundamental wave phase difference	Voltage Current	θ V ° θ A °	— (Note 1)	1 (1-2)	—	●	●	●	●	●	●	DC ±2 V	
				2 (1-3)	—	—	—	●	●	●	●		
				3, sum	—	—	—	—	—	—	—		

A10

Appendix 2 Detailed Specifications of Output

● : Installed – : Not installed

Measurement items	Display	Rectifier	Channel	1P2W×3	1P3W & 1P2W	3P3W & 1P2W	3P3W2M	3V3A	3P3W3M	3P4W	Rated output voltage
Efficiency	η1, η2	– (Note 1)	ALL (Note 2)	●	●	●	–	–	–	–	–
Time average current	T.AV A	AC+DC	1, 2, 3	●	●	●	●	●	●	●	DC ±2 V
		AC+DC Umn	sum	–	–	–	–	–	–	–	
		DC	1	●	●	–	–	–	–	–	
			2	●	●	–	–	–	–	–	
			3	●	●	●	–	–	–	–	
			sum	–	–	–	–	–	–	–	
		AC, FND	1, 2, 3, sum	–	–	–	–	–	–	–	
Time average active power	T.AV W	AC+DC	1	●	●	–	–	–	●	●	DC ±2 V
		AC+DC	2	●	●	–	–	–	●	●	
		AC+DC Umn	3	●	●	●	–	–	●	●	
		DC	sum	–	●	●	●	●	●	●	
			1	●	●	–	–	–	–	–	
			2	●	●	–	–	–	–	–	
			3	●	●	●	–	–	–	–	
			sum	–	–	–	–	–	–	–	
		AC, FND	1, 2, 3, sum	–	–	–	–	–	–	–	
Ripple rate	Voltage Current	RF V %	–	1, 2, 3	●	●	●	●	●	●	DC +2 V
		RF A %	(Note 1)	sum	–	–	–	–	–	–	
Crest factor	Voltage Current	CF V	–	1, 2, 3	●	●	●	●	●	●	DC +2 V
		CF A	(Note 1)	sum	–	–	–	–	–	–	

Note1: The rectifier can be selected on the Settings screen even for parameters for which there is no need to specify a rectifier. In this case, the rectifier setting will be ignored by the instrument's internal processing.

Note2: The channel can be selected on the Settings screen even for parameters for which there is no need to specify a channel (efficiency). In this case, the channel setting will be ignored by the instrument's internal processing.

Appendix 3 Rack Mounting

By removing the screws on the sides, this instrument can be installed in a rack mounting plate.

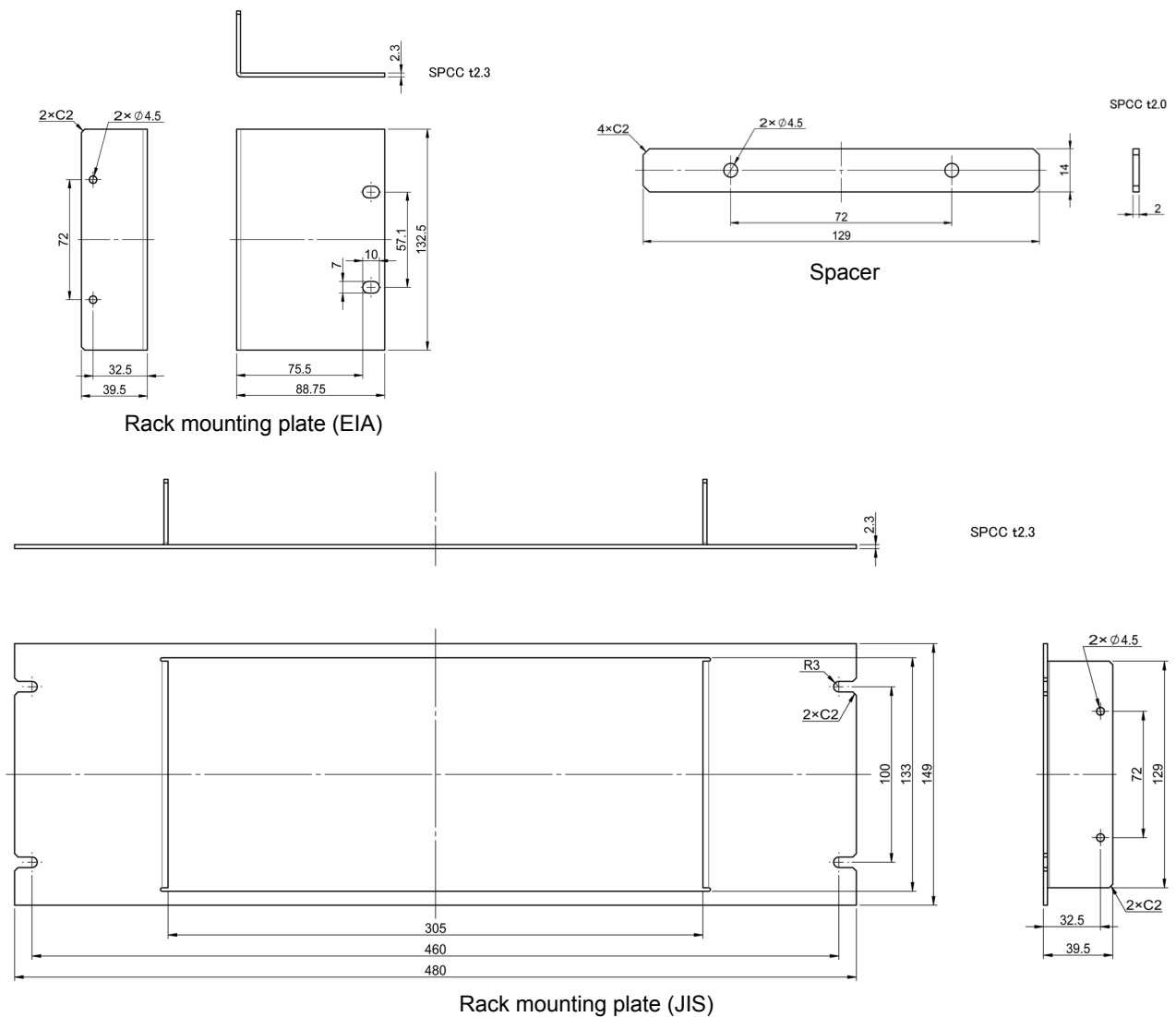


WARNING

Observe the following precautions regarding the mounting screws to avoid instrument damage and electric shock accidents.

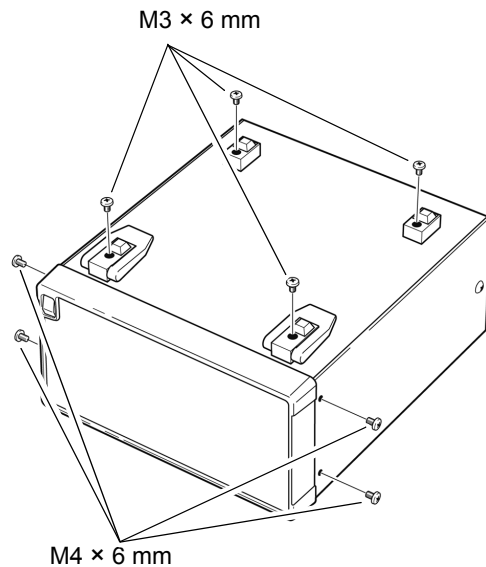
- When installing the Rack Mounting Plate, the screws must not intrude more than 6 mm into either side of the instrument.
- When removing the Rack Mounting Plate to return the instrument to stand-alone use, replace the same screws that were installed originally. (Feet: M3 × 6 mm, Sides: M4 × 6 mm)

Rack mounting plate template diagram



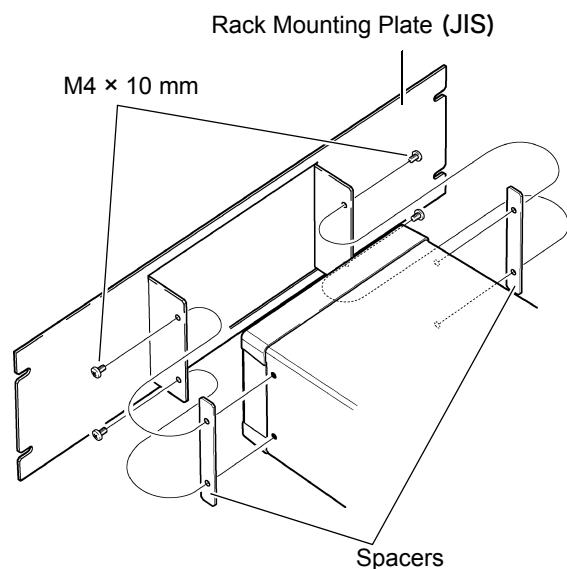
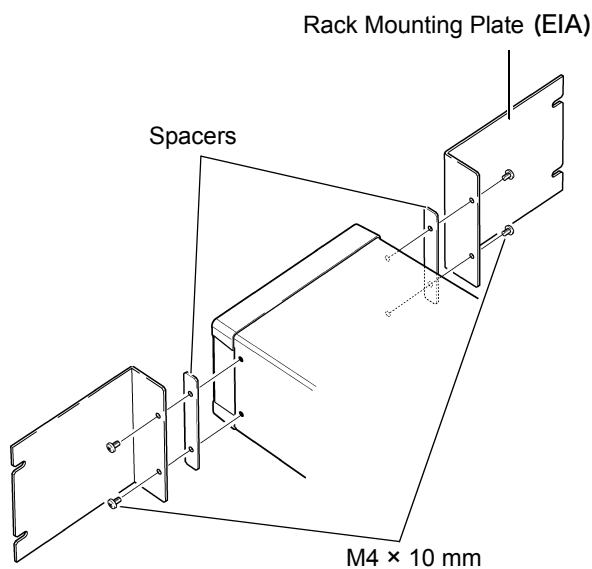
Installation procedure

- 1 Remove the feet from the bottom of the instrument, and the screws from the sides (four near the front).



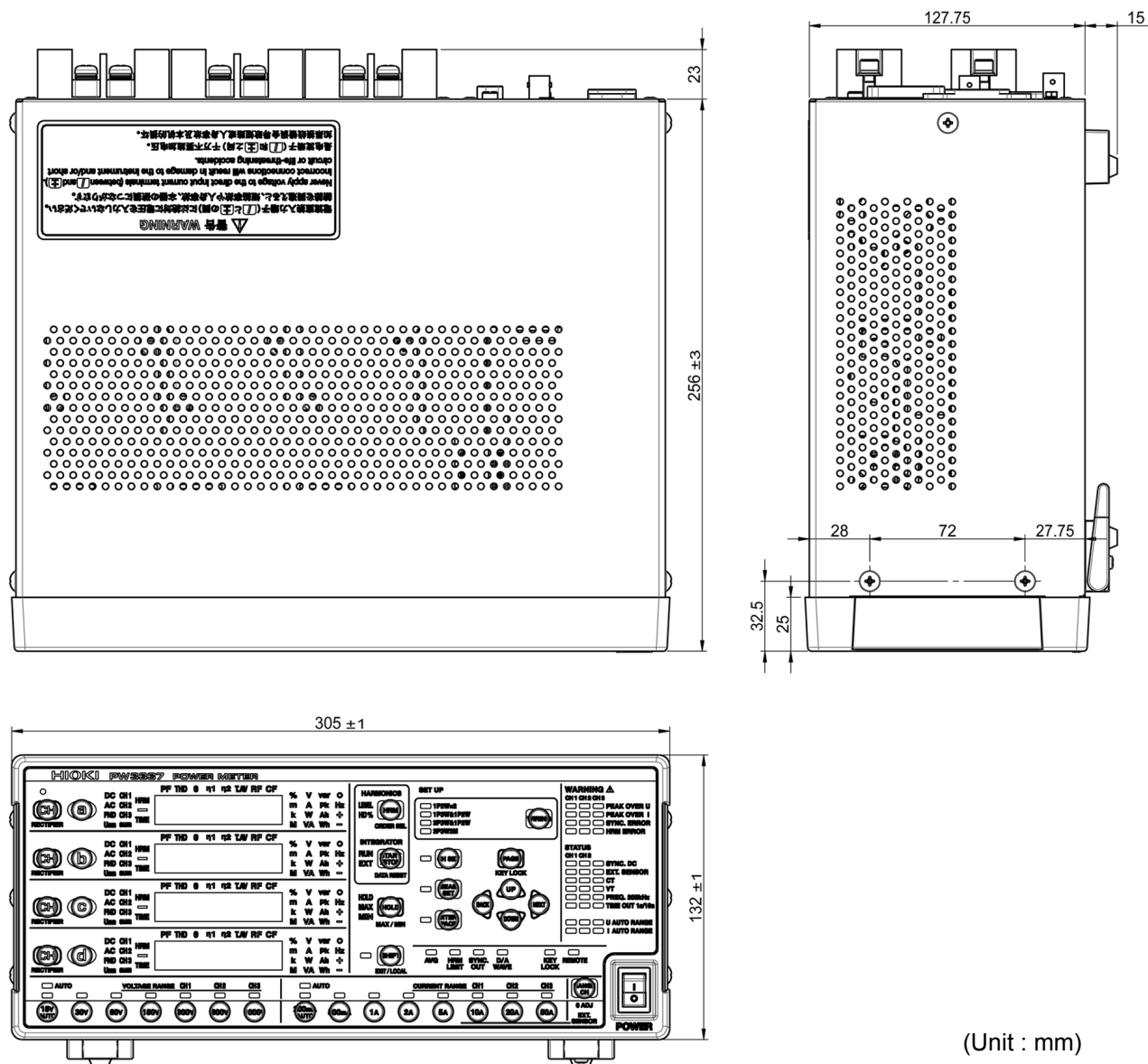
- 2 Installing the spacers on both sides of the instrument, affix the rack mounting plate with the M4 × 10 mm screws.

When installing into the rack, reinforce the installation with a commercially available support stand.



Appendix 4 Dimensional Diagram

e.g.) PW3337-03



(Unit : mm)

A14

Appendix 4 Dimensional Diagram

Index

Symbol

η 78

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Warranty Certificate

HIOKI

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

Customer name: _____

Customer address: _____

Important

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

This document certifies that the product has been inspected and verified to conform to Hioki's standards.

Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

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

HIOKI E.E. CORPORATION

<http://www.hioki.com>

18-07 EN-3

HIOKI

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