CM3286
CM3286-01

AC CLAMP POWER METER

HIOKI

Instruction Manual

EN

Oct. 2018 Revised edition 2
CM3286A961-02 18-10H

60050313 2

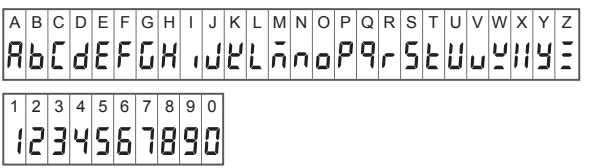
Contents

Introduction

Thank you for purchasing the Hioki CM3286/CM3286-01 AC Clamp Power Meter. To obtain maximum performance from the instrument over the long term, be sure to read this manual carefully and keep it handy for future reference.

This clamp power meter provides functionality for measuring AC current, voltage, power, and frequency as well as for detecting phase.
The CM3286-01 also provides **Bluetooth**® communications functionality, allowing measurement data to be monitored and logged from a smartphone or tablet.

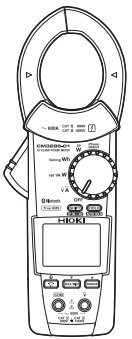
The instrument screen displays the alphanumeric characters as follows.



Package contents

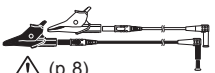
When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your authorized Hioki distributor or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

☐ Model CM3286 or CM3286-01
AC Clamp Power Meter



Accessories

☐ Model L9257 Connection Cord
(Model L4930 Connection Cable Set (1.2 m)
+ Model L4935 Alligator Clip Set)
CAT IV 600 V/ CAT III 1000 V/ CAT II 1000 V



⚠ (p.8)

☐ Model C0203 Carrying Case

☐ LR03 Alkaline battery ×2

☐ Instruction Manual

☐ Precautions Concerning Use of Equipment
That Emits Radio Waves
(only for the CM3286-01)

Precautions during shipment

Handle it carefully so that it is not damaged due to a vibration or shock.

Trademarks

- Bluetooth® is a registered trademark of Bluetooth SIG, Inc.(USA). The trademark is used by HIOKI E.E. CORPORATION under license.
- Android and Google Play are trademarks of Google, Inc.
- IOS is a registered trademark of Cisco in the U.S. and other countries.
- iPhone, iPad, iPad mini, iPad Pro, and iPod Touch are trademarks of Apple Inc.

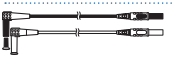
Accuracy

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

f.s. (maximum display value or range)	The maximum displayable value. This is usually the name of the currently selected range.
rdg. (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.

Options (sold separately)

L9207-10 Test Lead *1 ⚠



L4930 Connection Cable Set *2
⚠ (1.2 m)

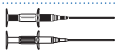
L4931 Extension Cable Set *2 ⚠
(1.5 m, with the coupling connector)

(⚠ : See p.8)

L4933 Contact Pin Set *6,*8

L4934 Small Alligator Clip Set *5,*8

L4935 Alligator Clip Set *2 ⚠



9243 Grabber Clip *3

L4936 Bus Bar Clip Set *4

L4937 Magnetic Adapter Set *3
9804 Magnetic Adapter *3

L4932 Test Pin Set *1

L4938 Test Pin Set *7

L4939 Breaker Pin Set *4

*1: CAT IV 600 V/ CAT III 1000 V/ CAT II 1000 V
*2: CAT IV 600 V/ CAT III 1000 V
*3: CAT III 1000 V
*4: CAT III 600 V
*5: CAT III 300 V/ CAT II 600 V

*6: 30 V AC/ 60 V DC
*7: CAT III 600 V/ CAT II 600 V
*8: Can also be connected to the tip of the L4932.

9290-10
Clamp On Adapter *4

Safety Notes

This instrument is designed to conform to IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, using the instrument in a way not described in this manual may negate the provided safety features.
Before using the instrument, be certain to carefully read the following safety notes.

⚠DANGER

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 an electric shock, a heat generation, a fire, and an arc flash due to short-circuit. Individuals using an electrical measuring instrument for the first time should be supervised by a technician who has experience in electrical measurement.

⚠WARNING

Protective gear

This instrument is measured on a live line. To prevent an electric shock, use appropriate protective insulation and adhere to applicable laws and regulations.

Notation

In this document, the risk seriousness and the hazard levels are classified as follows.

⚠DANGER	Indicates an imminently hazardous situation that will result in death or serious injury to the operator.	**IMPORTANT**	Indicates information related to the operation of the instrument or maintenance tasks with which the operators must be fully familiar.
⚠WARNING	Indicates a potentially hazardous situation that may result in death or serious injury to the operator.		Indicates prohibited actions.
⚠CAUTION	Indicates a potentially hazardous situation that may result in minor or moderate injury to the operator or damage to the instrument or malfunction.		Indicates the action which must be performed.

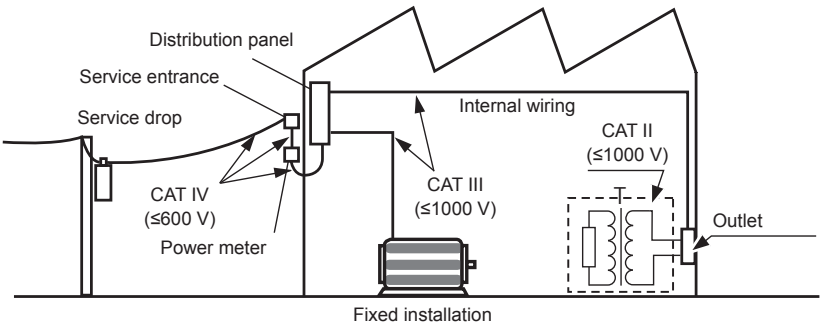
Symbols affixed to the instrument

	Indicates cautions and hazards. When the symbol is printed on the instrument, refer to a corresponding topic in the Instruction Manual.		Indicates AC (Alternating Current).
	Indicates that dangerous voltage may be present at this terminal.		Indicates DC (Direct Current).
	Indicates that the instrument may be connected to or disconnected from a live conductor.		Indicates a grounding terminal.
	Indicates a instrument that has been protected throughout by double insulation or reinforced insulation.		Indicates the Waste Electrical and Electronic Equipment Directive (WEEE Directive) in EU member states.
	Indicates that the product incorporates Bluetooth® wireless technology.		Indicates that the product conforms to regulations set out by the EU Directive.
FCC ID	Indicates the ID number of the wireless module certified by the U.S. Federal Communications Commission (FCC).	**IC**	Indicates the identification number of a wireless module approved by Industry Canada (IC).

Measurement categories

⚠DANGER

To prevent an electric shock, do not exceed the lower of the ratings shown on the instrument and connecting cords.

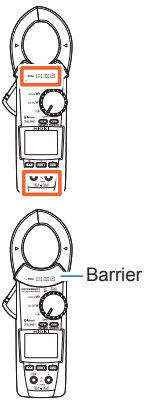


Usage Notes

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

⚠ DANGER

- **Do not use the instrument with circuits that exceed its ratings or specifications. Doing so may damage the instrument or cause it to become hot, resulting in bodily injury.**
- **The instrument must not be used to measure current in high-voltage lines (1000 V or more). Attempting to do so could cause a short-circuit or accident resulting in injury or death. Also, do not perform measurement around a bare conductor.**
- **To prevent an electric shock, do not touch any areas beyond the barrier while the instrument is in use.**



⚠ DANGER

- **Do not short-circuit two wires to be measured by bringing the clip or jaw tip of the connecting cords into contact with them. Arcs or such grave accidents are likely to occur.**
- **To prevent an electric shock, be careful to avoid shorting live lines with the connecting cords tip.**
- **To prevent a short-circuit or an electric shock, do not touch the metal part of the connecting cords tip.**
- **The maximum measurement current varies with the frequency, and the current that can be measured continuously is limited. Operating the instrument at less than this limitation is referred to as derating. Do not measure currents in excess of the derating curve. Doing so may result in instrument damage or malfunction, a fire, or a burn due to sensor heating.**

- **It is recommended to make measurements on the secondary side of the distribution panel. Making measurements on the primary side of the panel, where currents are higher, poses a higher risk of instrument or equipment damage in the event of a short-circuit.**

⚠ WARNING

- **Installing the instrument in inappropriate locations may cause a malfunction of instrument or may give rise to an accident. Avoid the following locations.**
  - **Exposed to direct sunlight or high temperature**
  - **Exposed to corrosive or combustible gases**
  - **Exposed to a strong electromagnetic field or electrostatic charge**
  - **Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)**
  - **Susceptible to vibration**
  - **Exposed to water, oil, chemicals, or solvents**
  - **Exposed to high humidity or condensation**
  - **Exposed to high quantities of dust particles**
- **Although this instrument is designed to resist the ingress of dust and dripping water, it is not entirely waterproof or dustproof. Therefore, to prevent an electric shock, do not use it in a wet or dusty environment.**
- **Battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.**

⚠WARNING

- **Use only the specified connection cords. Use of any connection cord not specified by our company does not allow safe measurements.**
- **To prevent an electric shock, set the rotary switch to the OFF position, disconnect all connection cords, and remove the instrument from the measurement object before replacing the batteries.**
- **To prevent instrument damage or an electric shock, use only the screw for securing the battery cover in place that is originally installed. If you have lost a screw or find that a screw is damaged, please contact your authorized Hioki distributor or reseller for replacement.**
- **Options may include connection cords which uses sleeves. To prevent a short-circuit accident, be sure to use the connection cords with the sleeves attached when performing measurements in the CAT III or CAT IV measurement categories. (See "Measurement categories" (p. 8))**
- **If the sleeves are inadvertently removed during measurement, stop the measurement.**

⚠ CAUTION

- To avoid damage to the instrument, protect it from physical shock when transporting and handling it. Be especially careful to avoid physical shock due to dropping it.
- Do not place foreign objects between jaws or insert foreign objects into the gaps of the sensor head. Doing so may worsen the performances of the sensor or interfere with clamping action.

- Poor performance or damage from battery leakage could result. Observe the cautions listed below.
  - Do no mix old and new batteries, or different types of batteries.
  - Be careful to observe the battery polarity during installation.
  - Do not use batteries after their recommended expiry date.
  - Do not leave depleted batteries inside the instrument.
  - Replace batteries only with the specified type.
- Keep the jaw closed when not in use, to avoid accumulating dust or dirt on the facing core surfaces, which could interfere with clamp performance.
- The cord is hardened in freezing temperature. Do not bend or pull it to avoid tearing its shield or cutting cord.

IMPORTANT

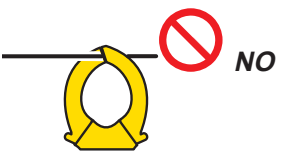
Inverter secondary-side waveforms and waveforms that include a large noise component may not be measured accurately.

Current measurement precautions

Do not touch.

Do not clamp around two wires.

Do not pinch wire between jaws.

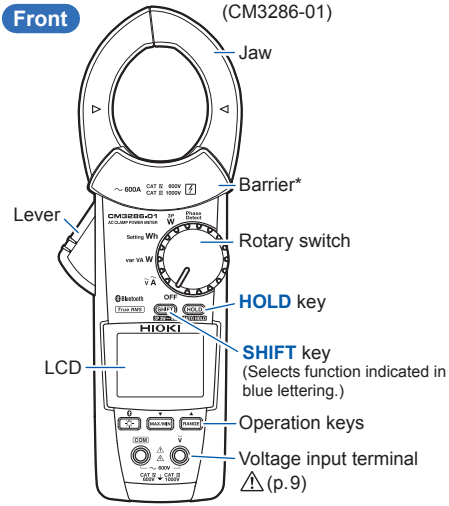


Do not input excessively high currents or voltages.

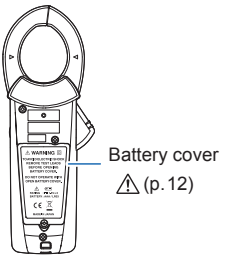
NO (Flashes red)

Part Names

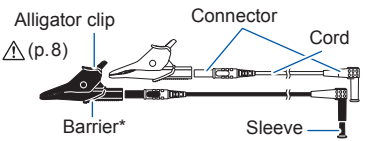
Front



Rear



L9257 Connection Cord

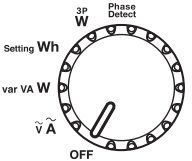


* Do not touch any areas beyond the barrier while the instrument is in use.

Operation keys

Key	Short press		Long press (1 sec.)	
HOLD HOLD	Activates/cancels manual hold operation	p.48	Activates/cancels automatic hold operation	p.48
	Start/stop integration, clears the integrated energy value (during energy measurement)	p.41		
	Switches the setting (when setting meter constants)	p.46		
	Switches from the connection display to the measurement display (during 3-phase power measurement)	p.22		
SHIFT SHIFT	Switches the information shown on the measurement display	p.24	Switches between 3-phase/3-wire and 3-phase/4-wire measurement during 3-phase power measurement (setting is not stored)	p.34 p.35
RANGE RANGE	Switches ranges	p.51	High speed count up (when setting meter constants)	–
	Count up (when setting meter constants)	p.46		
MAX/MIN MAX/MIN	Displays and switches MAX/MIN/AVG value	p.52	Cancels the display of MAX/MIN/AVG value	p.52
	Count down (when setting meter constants)	p.46	High speed count down (when setting meter constants)	–
☼	Toggles the display backlight on and off	p.55	Enables/disables external communications (Bluetooth®) (only for CM3286-01, setting is stored)	p.59

Rotary switch



When functions other than **OFF** is selected, the instrument turns on.
Select the desired function.

Phase Detect	"Phase Detection [Phase Detect]" (p. 38)
3P W	• "AC 3-phase measurement (3P3W, balanced) [3PW]" (p. 31) • "AC 3-phase measurement (3P3W, unbalanced) [3PW]" (p. 32) • "AC 3-phase measurement (3P4W, balanced) [3PW]" (p. 34) • "AC 3-phase measurement (3P4W, unbalanced) [3PW]" (p. 35)
Setting Wh	• "Single-phase Active Energy Measurement (Integrated Measurement) [Setting Wh]" (p. 40) • "Single-phase Energy Meter Comparison Function [Setting Wh]" (p. 42)
var VA W	• "AC single-phase measurement (1P2W) [var VA W]" (p. 29) • "AC single-phase measurement (1P3W) [var VA W]" (p. 30)
V A	"Current/Voltage Measurement (Frequency) [V A]" (p.28)
OFF	Turns off the instrument.

Power-on Option Table (buzzer sound, resetting the instrument to the factory settings, etc.)

+  Turn on the power while pressing the operation key.
(Turn the rotary switch from OFF.)

Setting	See	Operating instruction	Factory setting	Setting retained?
Switching the auto power save (APS) function (p.55)	–	HOLD + 	ON	–
Displaying product information or displaying all indicators (Display varies depending on the position of the rotary switch.)	–	SHIFT +  3PW: Serial number Wh: Model number W: Version of software Besides the above: Displays all indicators	–	–
Switching between balanced and unbalanced operation (during AC 3-phase power measurement)	p.32 p.35	RANGE +  3PW	–	–
Buzzer sound (ON/OFF)	–	MAX/MIN + 	ON	Yes
Switching the auto backlight off function (p.55)	–	☼ + 	ON	Yes

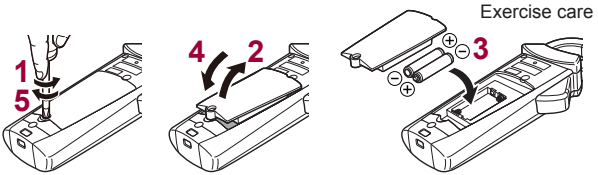
Setting	See	Operating instruction	Factory setting	Setting retained?
Selecting the CT ratio	**p.56**	MAX/MIN + RANGE + 	1/1	Yes
Reset to the factory setting	**–**	 + RANGE +	–	–

Insert / Replace Batteries

	Fully charged.
	As the battery charge diminishes, black charge bars disappear, one by one, from the left of the battery indicator.
	The battery voltage is low. Replace the batteries as soon as possible. The instrument may lose power when the backlight turns on, when a buzzer sounds, etc.
 (Flashes)	The battery is exhausted. Replace with new batteries.

Required items: No. 2 Phillips screwdriver and LR03 Alkaline battery ×2
Recommended screw tightening torque: 0.7 N·m

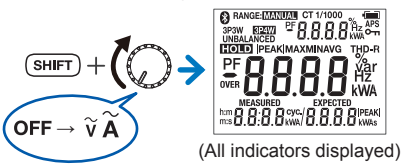
Exercise care to orient batteries properly.



Inspection Before Measurement

Verify that the instrument operates normally to ensure that no damage occured during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.

Check item	
☐ The battery cover is closed and its screw has been securely tightened.	☐ There is no damage to the connection cords insulation, and neither the white sheathing nor metal conductor inside the wire are exposed.
☐ There is no foreign matter on the voltage input terminals. (p. 15)	☐ The instrument is neither damaged nor cracked.
☐ The battery voltage (p. 20) is sufficient.	☐ No indicators are missing.



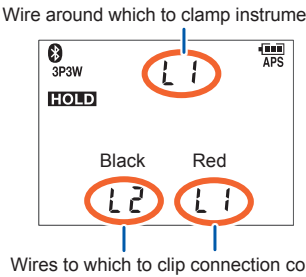
(All indicators displayed)

Screen / Basic Operation

Setting the rotary switch to a position other than **OFF** causes the instrument to turn on and the screen to activate. e.g.: During balanced 3-phase 3-wire active power measurement

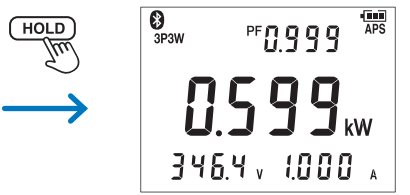
Connection display

Displays the connection locations for 3-phase power measurement and phase detection. Connects the wire.



Measurement display

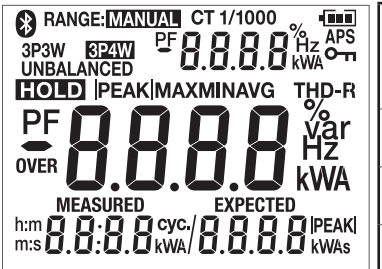
Displays the measured value.



IMPORTANT

If measured with a wrong wire connection, a correct value does not appear.

Screen display



(All indicators displayed)

"Error display" (p. 67)
"Warning display" (p. 67)

*The key lock feature may be activated according to the usage state of the application software.

Bluetooth®	Appearing: Bluetooth® communications function enabled Flashing: Bluetooth® communications active (only for CM3286-01)
3P3W, 3P4W	Connection type (not shown during single-phase measurement)
UNBALANCED	Unbalanced mode operation (not shown during balanced mode operation)
RANGE:MANUAL	Manual range operation (not shown during auto-range operation)
CT 1/1000	CT ratio (not shown during 1/1)
HOLD	Measured value held
APS	Auto power-off enabled
OVER	Current RMS value or voltage RMS value exceeded range
Key	Key lock enabled*

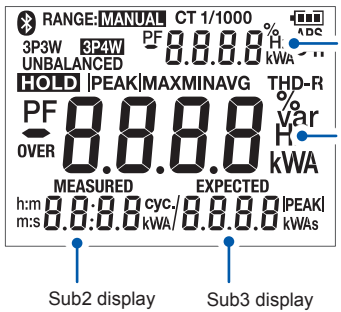
Switching the information shown on the measurement display

Able to switch using the **SHIFT** key (Excluding the Setting **Wh** and Phase Detect functions).

How to use this chart:

(Sub1 display) $FREQ_U$	
(Main display) I_{RMS}	
(Sub2 display) –	(Sub3 display) $I_{[PEAK]}$

Rotary switch	Current ← SHIFT → Voltage			
Current (frequency)	$FREQ_I$		$FREQ_U$	
Voltage (frequency)	I_{RMS}		U_{RMS}	
~ V A ~	–	$I_{[PEAK]}$	–	$U_{[PEAK]}$



$FREQ_I$: Current frequency
$FREQ_U$: Voltage frequency
I_{RMS}: Current RMS value
U_{RMS}: Voltage RMS value
$I_{[PEAK]}$: Current peak value
$U_{[PEAK]}$: Voltage peak value

Rotary switch		Active power → Apparent power → Reactive power → Power factor → Zero-cross phase angle (Main display) ← SHIFT									
Voltage/Power factor var VA W		PF		PF		PF		P		P	
		P		S		Q		PF		ϕ	
		U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}
3P W	Balance mode*1	PF *2		PF *2		PF *2		P_{3P}		P_{3P}	
		P_{3P}		S_{3P}		Q_{3P}		PF_{3P} *2		ϕ_{3P} *2	
		U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}	U_{RMS}	I_{RMS}
	Unbalance mode*3	P_3		S_3		Q_3		PF_3		ϕ_3	
		$P_1+P_2+P_3$		$S_1+S_2+S_3$		$Q_1+Q_2+Q_3$		$\frac{P_1+P_2+P_3}{S_1+S_2+S_3}$		–	
		P_1	P_2	S_1	S_2	Q_1	Q_2	PF_1	PF_2	ϕ_1	ϕ_2

P : Single-phase active power
S : Single-phase apparent power
Q : Single-phase reactive power
PF : Power factor
ϕ_1 : Zero-cross phase angle 1

P_1 : Active power 1
S_1 : Apparent power 1
Q_1 : Reactive power 1
PF_1 : Power factor 1
ϕ_2 : Zero-cross phase angle 2

P_2 : Active power 2
S_2 : Apparent power 2
Q_2 : Reactive power 2
PF_2 : Power factor 2
ϕ_3 : Zero-cross phase angle 3

P_3 : Active power 3
S_3 : Apparent power 3
Q_3 : Reactive power 3
PF_3 : Power factor 3

P_{3P}: Balanced 3-phase active power

S_{3P}: Balanced 3-phase apparent power

Q_{3P}: Balanced 3-phase reactive power

PF_{3P}: Balanced 3-phase power factor

ϕ: Zero-cross phase angle

$P_1+P_2+P_3$: Unbalanced 3-phase active power

$S_1+S_2+S_3$: Unbalanced 3-phase apparent power

$Q_1+Q_2+Q_3$: Unbalanced 3-phase reactive power

$\dfrac{P_1+P_2+P_3}{S_1+S_2+S_3}$: Unbalanced 3-phase power factor

ϕ_{3P}: 3-phase zero-cross phase angle

Notes(*) for table

*1 Value of the measured phase will be calculated and displayed.

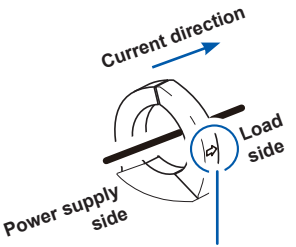
*2 Different calculation methods are used for 3-phase/3-wire and 3-phase/4-wire circuits. For more information, see the list of equations.

*3 Only 3-phase active power (P_1+P_2), active power 1 (P_1), and active power 2 (P_2) are measured for 3-phase/3-wire circuits.

–	
P_1+P_2	
P_1	P_2

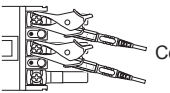
Connecting the Clamp and Clips

Clamp



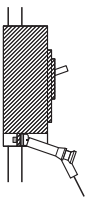
Align the current direction mark with the direction of the current.

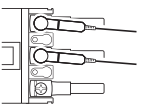
Clip (Alligator)



Connect to metal part.

Clip (Magnetic adapter)





Connect to metal part.

(If unable to connect the magnetic adapter so that it sits perpendicular to the terminal due to the weight of the voltage cord, connect it at an angle so as to balance it against the weight of the cord.)

Current/Voltage Measurement (Frequency) [ṽ Ã]

1 ṽ Ã

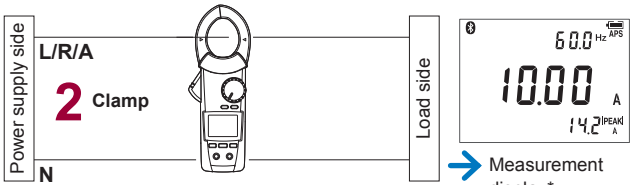
* SHIFT

"Switching the information shown on the measurement display" (p. 24)

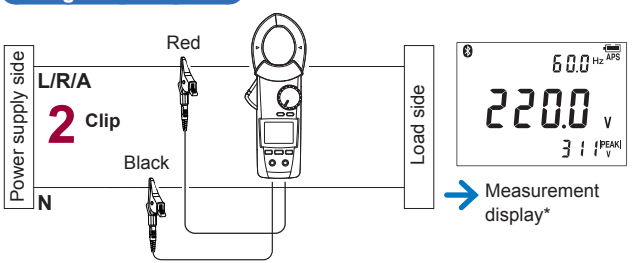
If the screen turns red: "Warning display" (p. 67)

The frequency display flashes when frequency exceeds 999.9 Hz.

Current measurement

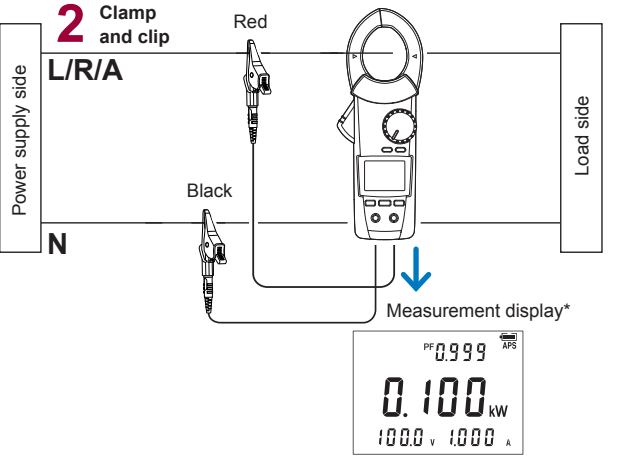


Voltage measurement



Power Measurement (Power/Power Factor)

AC single-phase measurement (1P2W) [var VA W]

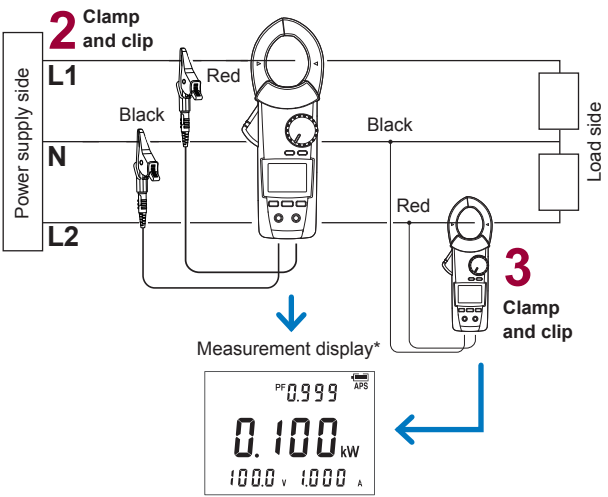


* 

"Switching the information shown on the measurement display" (p. 24)

If the screen turns red: "Warning display" (p. 67)

AC single-phase measurement (1P3W) [var VA W]



* SHIFT

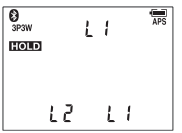
"Switching the information shown on the measurement display" (p. 24)

If the screen turns red: "Warning display" (p. 67)

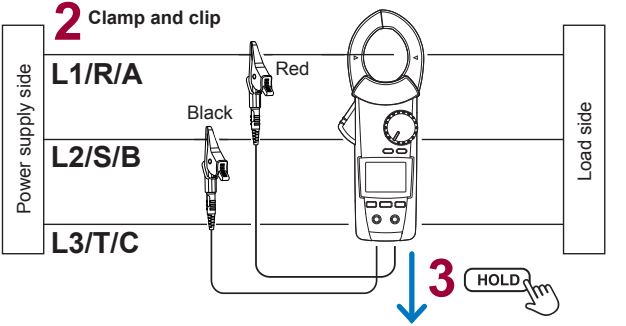
AC 3-phase measurement (3P3W, balanced) [3PW]

1 3P W

Connection display (p.22)



2 Clamp and clip



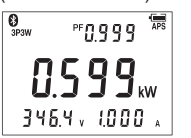
3 HOLD

* SHIFT

"Switching the information shown on the measurement display" (p. 24)

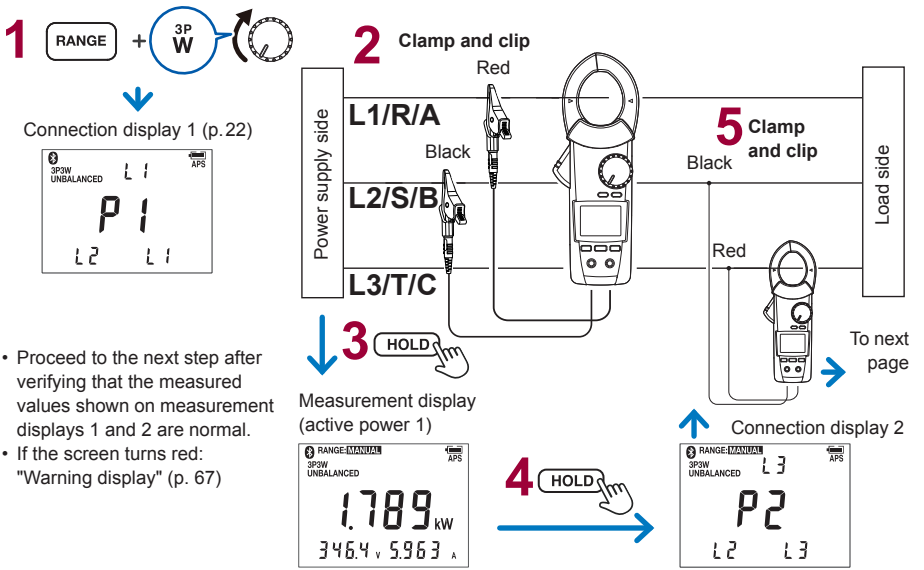
If the screen turns red: "Warning display" (p. 67)

Measurement display (calculation result)*

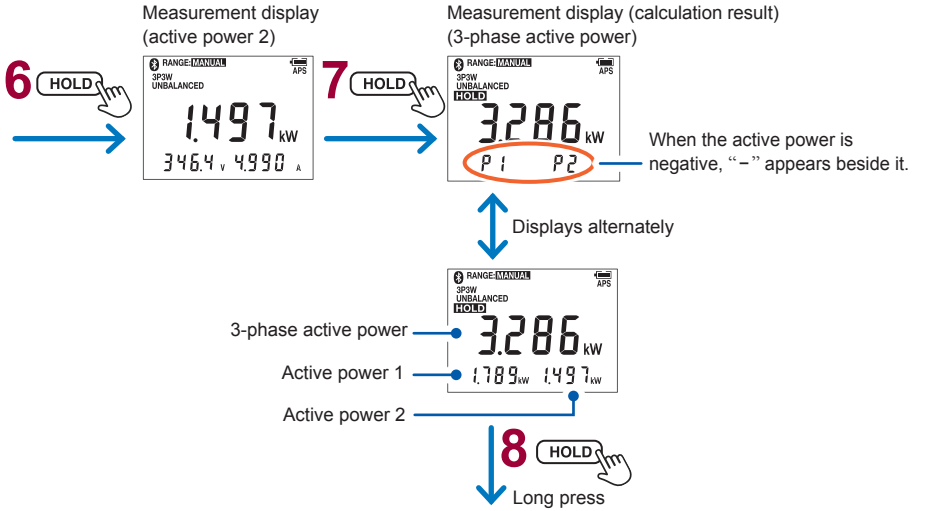


When the balanced 3-phase 3-wire zero-cross phase angle is less than −90° or exceeds 90°, the measured value appears "----".

AC 3-phase measurement (3P3W, unbalanced) [3PW]

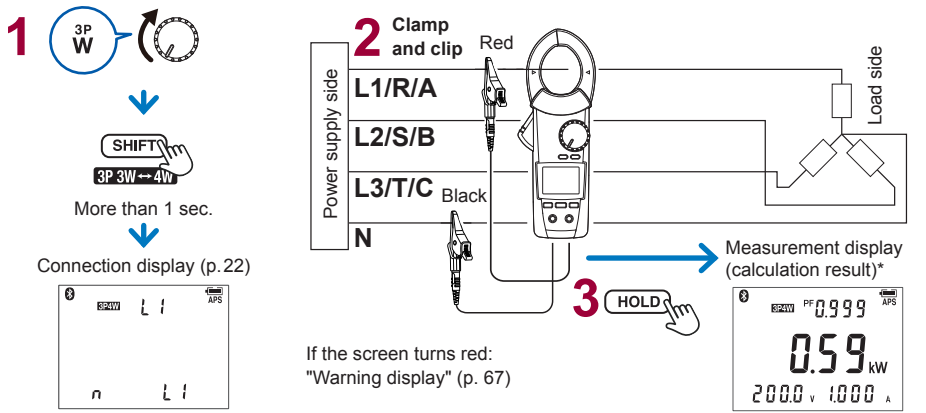


- Proceed to the next step after verifying that the measured values shown on measurement displays 1 and 2 are normal.
- If the screen turns red: "Warning display" (p. 67)



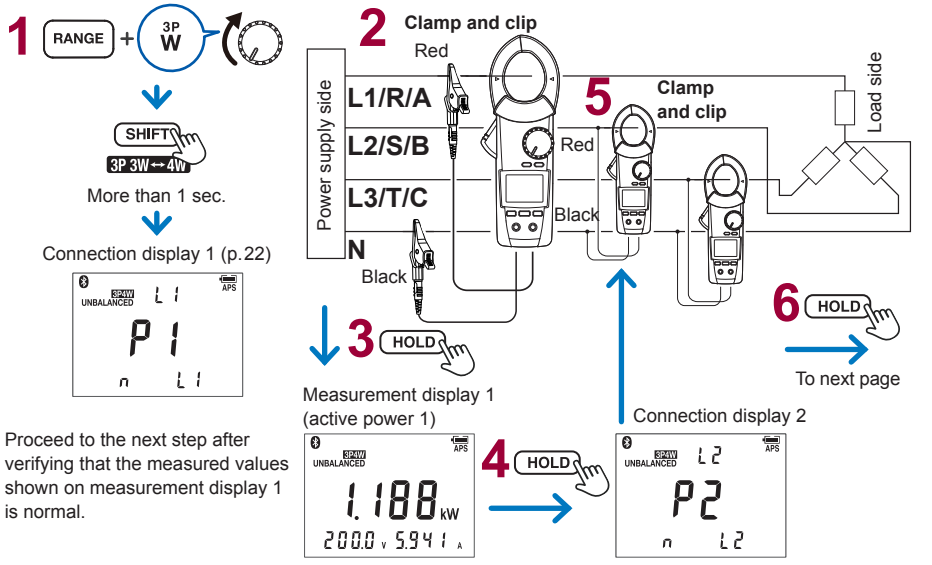
The measured value is cleared and returns to the initial connection display.

AC 3-phase measurement (3P4W, balanced) [3PW]

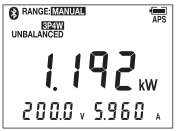


* SHIFT "Switching the information shown on the measurement display" (p. 24)

AC 3-phase measurement (3P4W, unbalanced) [3PW]

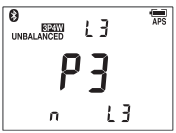


Measurement display 2
(active power 2)



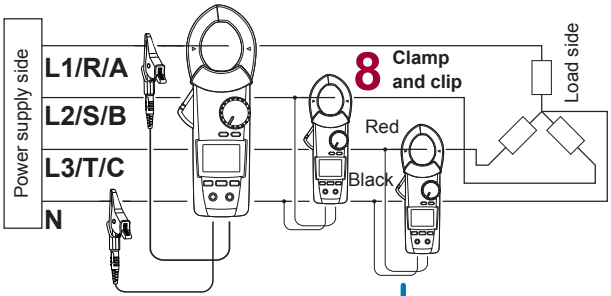
7 HOLD

Connection display 3



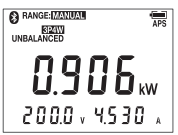
To **8**

Proceed to the next step after verifying that the measured values shown on measurement displays 2 and 3 are normal.

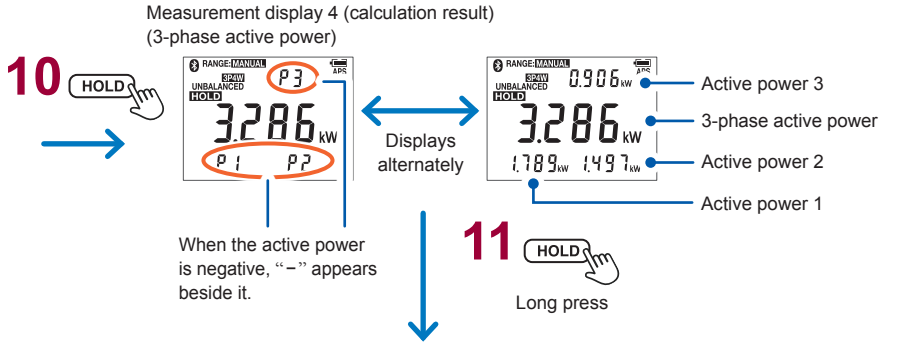


9 HOLD

Measurement display 3
(active power 3)



To next page

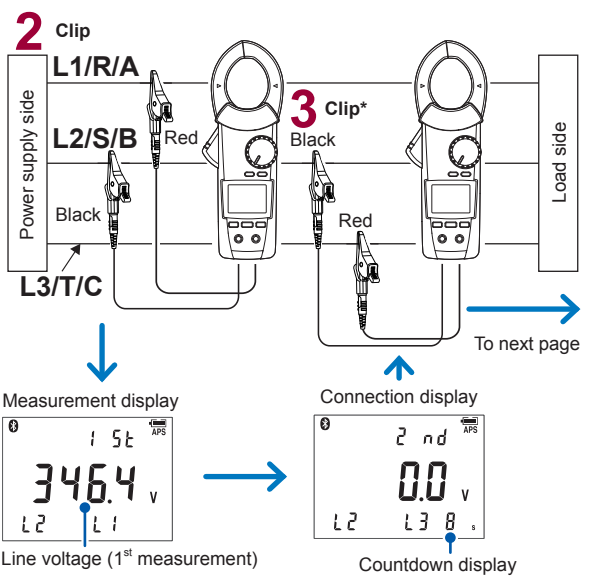


- You can switch the information shown on the final measurement display with the **SHIFT** key. See "Switching the information shown on the measurement display" (p. 24)
- If the screen turns red: "Warning display" (p. 67)

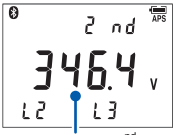
Phase Detection [Phase Detect]

- The instrument will display "– – – –" if open phase is detected or if it is unable to make a measurement.
- When the input is unstable, the second connection display will not show up.

* If not clipped within 10 seconds, it is unable to make a measurement.



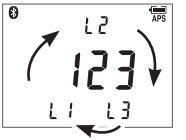
Measurement display



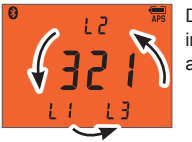
Line voltage (2nd measurement)

Display of results

Normal phase



Reverse phase

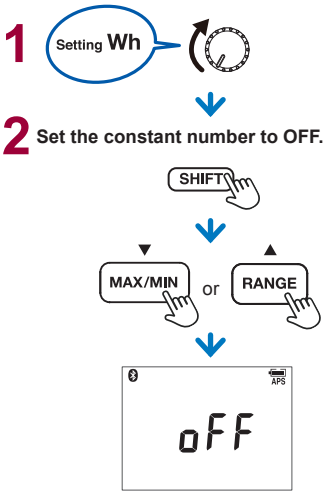


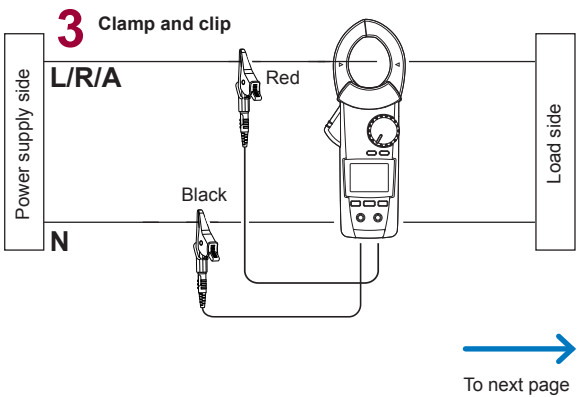
(Lights red)

Display appears in the order of the arrow.

Goes back to the first display when the **HOLD** key is pressed.

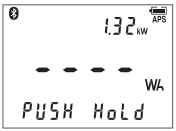
Single-phase Active Energy Measurement (Integrated Measurement) [Setting Wh]



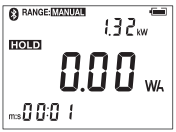


To next page

4 **Set the instrument to power integration mode.**

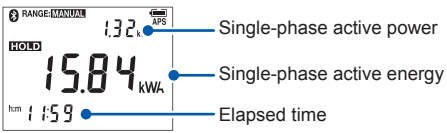


5 **Start integration.**



- Range is fixed when integration starts. Change the range before starting to integrate a large power quantity or for an extended period of time.
- Only the positive (consumption) active power is added. Negative (generation) active power is not added.

6 **Stop integration.**



- When the **HOLD** key is pressed during integration stop, the integrated energy clears and returns to the display shown in Step 4.
- The measured values are automatically stored just before the instrument turns off due to low battery voltage. Next time the instrument is turned on, the saved values will be displayed. (The measured values can be cleared by pressing the **HOLD** key.)

Single-phase Energy Meter Comparison Function [Setting Wh]

This function allows you to compare the actual energy value (measured value) from an energy meter with the theoretical value.

There are two ways to start and stop integration:
- Start/stop at 1 cycle based on the energy meter's instrument constant: 1-cycle mode
- Start/stop based on a fixed amount of energy as measured by the energy meter: Fixed energy mode

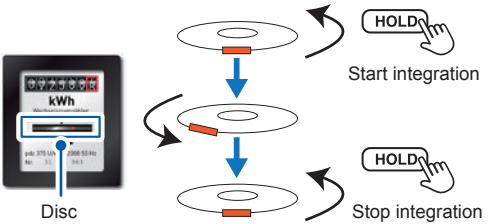
IMPORTANT

Energy may not be calculated properly in the following circumstances:
- If the power line of the measurement object, instrument connection, or meter constant (for the watt-hour meter) is set incorrectly.
- If integration is not started and stopped as described above.
- If the instrument is being used outside its operating temperature and humidity range.
- If the instrument is being used in close proximity to a device that emits powerful electromagnetic radiation or a device that carries an electrical charge.
- If the instrument is being used in close proximity to a device that emits a strong magnetic field, for example a transformer, high-current circuit, or wireless device.

1-cycle mode

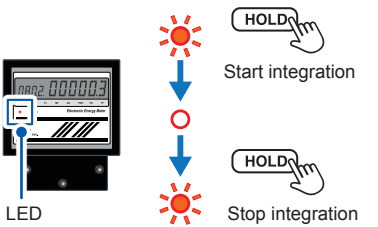
Mechanical meter

Once the disc has completed one revolution



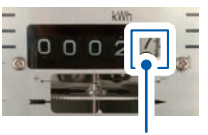
Electronic meter

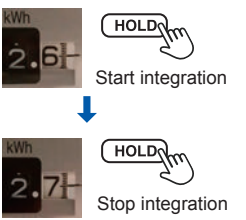
When the LED flashes once



Fixed energy mode

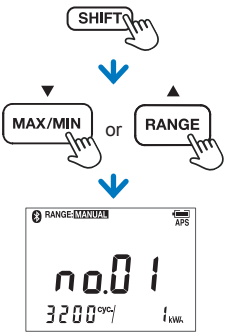
e.g.: With the fixed energy set to 0.1 kWh



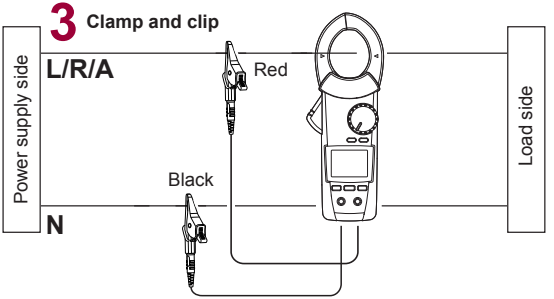


1 Setting **Wh**

2 **Select the constant number or fixed energy*.**



3 **Clamp and clip**



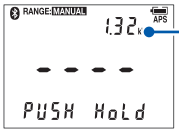
To next page

* Select fixed energy mode if the energy meter's disc rotates, or if its LED flashes, quickly.

The constant can be changed.
"Watt-hour meter constants default setting value" (p. 47)
"Setting the desired meter constant" (p. 46)

4 **Set the instrument to power integration mode.**

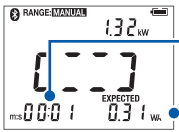
SHIFT



Single-phase active power (measured value)

5 **Start integration.**

HOLD



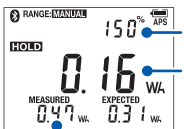
Elapsed time

Energy (theoretical value)

- Only the positive (consumption) active power is added. Negative (generation) active power is not added.
- Range is fixed when integration starts. Change the range before starting to integrate a large power quantity or for an extended period of time.

6 **Stop integration.**

HOLD



Energy ratio (Measured value/theoretical value)

Energy difference (Measured value − theoretical value)

Energy (Measured value)

When the **HOLD** key is pressed during integration stop, the integrated energy clears and returns to the display shown in Step 4.

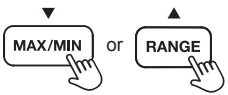
Setting the desired meter constant

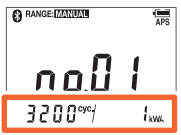
Set after conducting the procedures 1 and 2 of "Single-phase Energy Meter Comparison Function [Setting Wh]" (p. 42)

1 **Select the portion you wish to change.**

The selected portion will flash.

2 **Change the value.**





Set the value shown on the meter.

The set value will be stored.

- Press the **SHIFT** key to go back to the measurement display.
- The changed final value will be the setting value.
- "Watt-hour meter constants default setting value" (p. 47)

Watt-hour meter constants default setting value

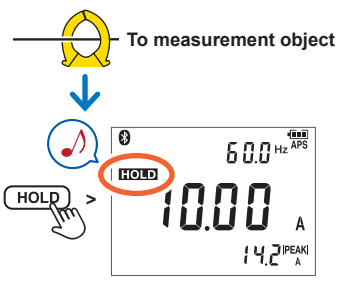
No.01 to No.10: 1-cycle mode
0.10 kWh to 0.01 kWh: Fixed energy mode

SET No.	Setting value	Changing the setting value Enable: ✓ Disable: –	SET No.	Setting value	Changing the setting value Enable: ✓ Disable: –
oFF	None (single-phase energy measurement)	✓	**07**	300 cyc./1 kWh	✓
01	3200 cyc./1 kWh	✓	**08**	250 cyc./1 kWh	✓
02	1600 cyc./1 kWh	✓	**09**	150 cyc./1 kWh	✓
03	1200 cyc./1 kWh	✓	**10**	125 cyc./1 kWh	✓
04	1000 cyc./1 kWh	✓	**0.10 kWh**	0.10 kWh	–
05	600 cyc./1 kWh	✓	**0.05 kWh**	0.05 kWh	–
06	500 cyc./1 kWh	✓	**0.01 kWh**	0.01 kWh	–

Updated settings are stored by the instrument.

Manual Hold / Auto Hold

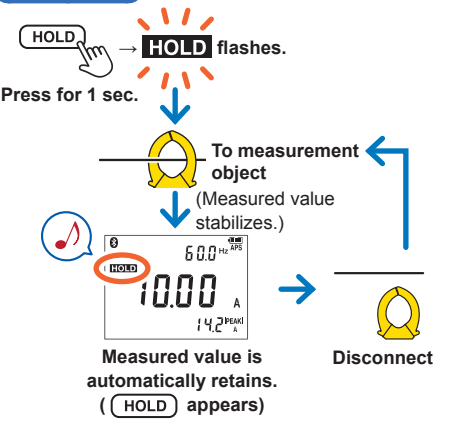
MANUAL HOLD



Measured value is retained.
(HOLD appears)

Pressing the **HOLD** key again cancels the measured value hold function.
(**HOLD** and HOLD disappears)

AUTO HOLD



Pressing the **HOLD** key for 1 second cancels the auto hold function. (**HOLD** and HOLD disappears)

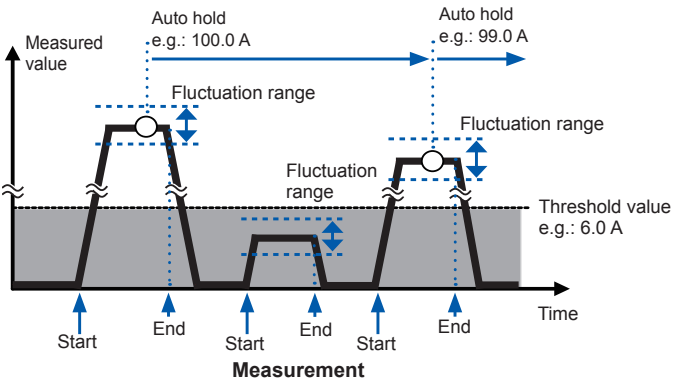
See the next page for auto hold conditions.

Auto hold conditions

Measured value is automatically retained when the following two conditions are satisfied:

- When the range over which the measured value is fluctuating stabilizes within the fluctuation range described in the table in the next page.
- When the measured value exceeds the threshold value described in the table in the next page.

O: Held value



If the measured value* (voltage, current, or active power) falls below the threshold value once and the two conditions are satisfied again after automatic retaining, the measured value at that point will retain automatically.

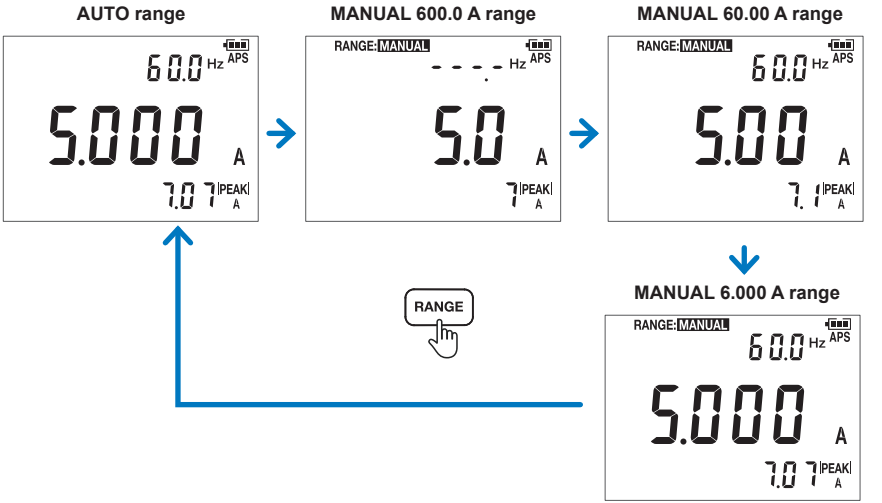
* Either the current RMS value or voltage RMS value for power.

Measurement function*	Fluctuation range	Threshold value
AC current	Current RMS value 6.000 A range: within 60 counts 60.00 A range: within 60 counts 600.0 A range: within 60 counts	Current RMS value 6.000 A range: 59 counts 60.00 A range: 59 counts 600.0 A range: 59 counts
AC voltage	Voltage RMS value within 120 counts	Voltage RMS value 799 counts
Single-phase power, balanced 3-phase power	Current and voltage RMS values satisfy above conditions, and active power is within 5 counts.	Current and voltage RMS values are within the above counts.

* No auto-hold function is available for single-phase active energy measurement.

Switching Ranges

e.g.: During current measurement



MAX/ MIN/ AVG

1  **To measurement object**

2 

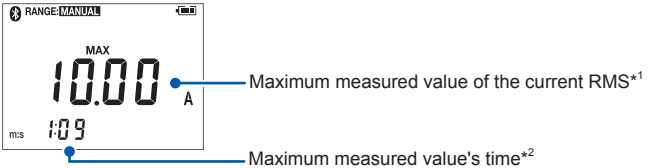
Present value → **MAX** → **MIN** → **AVG**

: To switch the main display.

(long press) or  (switching functions): MAX/MIN/AVG measurement function is cleared.

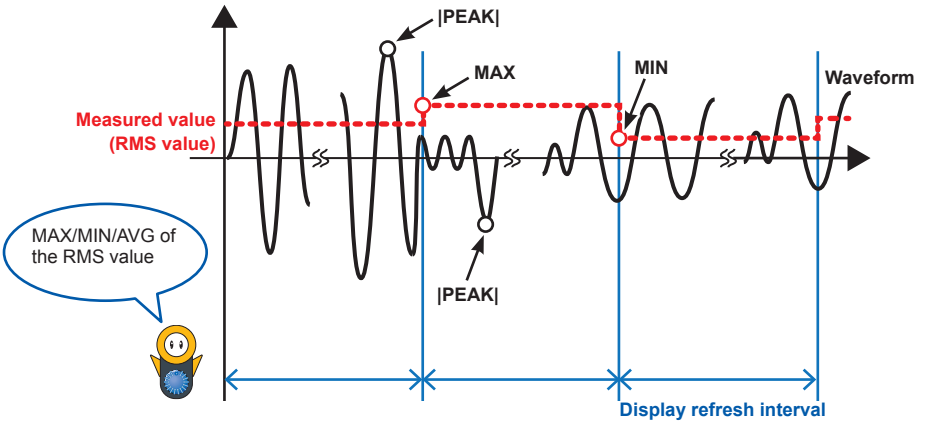
- Switches to manual range when it is auto range. (**RANGE:MANUAL** appears)
- The MAX/MIN/AVG measurement will be continued during hold function.
- The maximum, minimum, and average function cannot be used during Wh function and phase detect function operation.
- The maximum, minimum, and average values are automatically stored just before the instrument turns off due to low battery voltage. Next time the instrument is turned on, the saved values will be displayed. (The measured values can be cleared by pressing the **HOLD** key.)

e.g.: During current measurement



*1 The maximum, minimum, and average values for the main display's measured value is shown. (However, only the maximum and average values are shown during peak value measurement. Also, only the maximum and minimum values are shown during zero-cross phase angle measurement.)

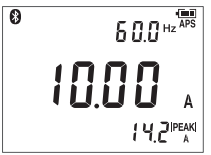
*2 Measured value's update time is displayed when maximum or minimum value is shown. Elapsed time from the start of maximum, minimum, and average function is displayed when present or average value is shown.



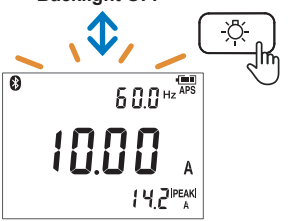
AVG: Average value after pressing the **MAX/MIN** key
MAX: Maximum value after pressing the **MAX/MIN** key
MIN: Minimum value after pressing the **MAX/MIN** key
|PEAK|: Maximum value of the absolute value of the waveform during the display update interval

Backlight / Auto Power Save (APS)

Backlight



Backlight OFF



Backlight ON

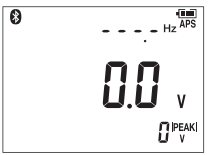
No operation for approx. 40 sec.: Backlight off

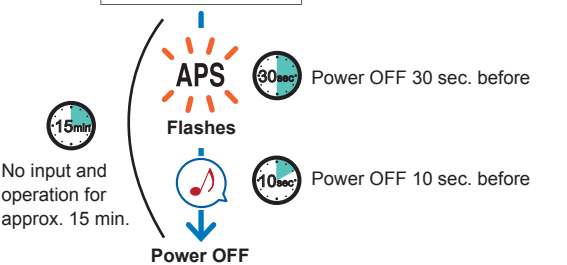
Switching the auto backlight off function: p. 18

Auto power save (APS)

(Ordinarily on)

Switching the function: p. 18



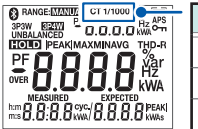


- Set the rotary switch to OFF when restarting the instrument after the APS function.
- The APS function is disabled while displaying the MAX/MIN/AVG value and during energy integration.
- Bluetooth® communications are treated as an operation for the purpose of the APS function.

Measurement Using the Clamp Adapter

A clamp adapter (sold separately) can be used to measure currents that are larger than the rated input current.

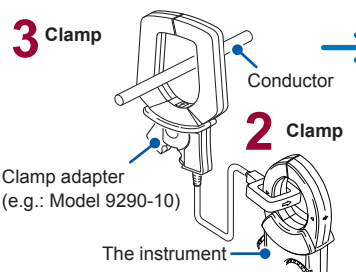
1 **Select the CT ratio.**



Rotary switch	CT ratio
A	1/1 (not shown)
W	1/10
Wh	1/100
3PW	1/1000

Set the CT ratio as appropriate for the clamp adapter.
(e.g.: For the 9290-10 Clamp on Adapter, **1/10**)

3 **Clamp**



4 **Perform measurement.**

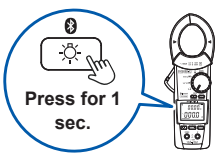
Bluetooth® Communications (only for CM3286-01)

The CM3286-01 is a clamp-style meter with Bluetooth® low energy support. When the Bluetooth® function is enabled, you can review measurement data and create measurement reports on mobile devices (iPhone, iPad, iPad Mini, iPad Pro, iPod Touch, and Android™ devices). For more information about this functionality, see the **Help** function in the application software GENNECT Cross.

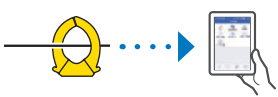
1 **Install the GENNECT Cross on your mobile device. (p.58)**

2 **Enable the Bluetooth® function on the CM3286-01. (p.59)**

3 **Launch the GENNECT Cross and pair it with the CM3286-01. (p.60)**



4 **Select the General Measurement, Logging (Recording), Waveform Graph, Electricity Theft Detection, or Harmonic Analysis function. (p.61)**



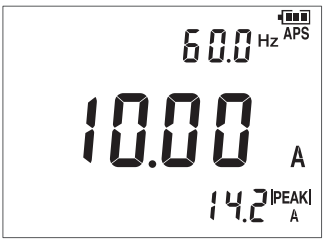
Installing the application software GENNECT Cross

Search for “GENNECT Cross” on the App Store from your iPhone, iPad or other Apple device, or on Google Play from your Android device. Then download and install the GENNECT Cross. You will need an Apple ID to download the app from the App Store, or a Google account to download the app from Google Play. For more information about how to register an account, contact the store at which you purchased your device.

- Because the CM3286-01 emit radio waves, use in a country or region where they have not been approved may be subject to fines or other penalties as a violation of applicable laws or regulations. For more information, see the attached “Precautions Concerning Use of Equipment That Emits Radio Waves” or go to our website.
- The CM3286-01 availability is limited to certain countries. For more information, contact your authorized Hioki distributor or reseller.
- Bluetooth® communications range varies greatly with distance from obstructions (walls, metal obstruction, etc.) as well as distance from the floor or ground. To ensure stable measurement, verify adequate signal strength.
- Although this application software is provided free of charge, downloading or use of the application software may incur Internet connection charges. Such charges are the sole responsibility of the user.
- This application software is not guaranteed to operate on all mobile devices.

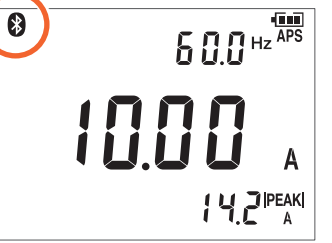
Turning on the Bluetooth® function

Bluetooth® function OFF

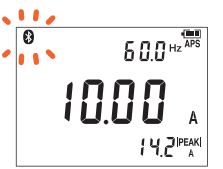


Press for 1 sec.

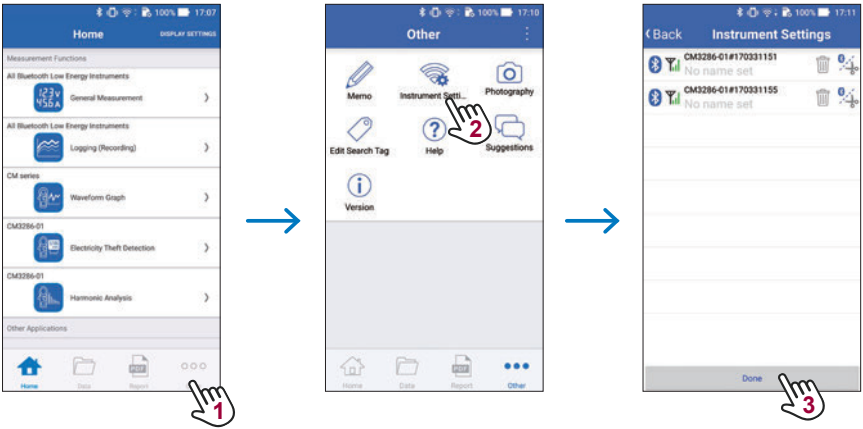
Bluetooth® function ON



icon will flash when the instrument is connected to a mobile device.



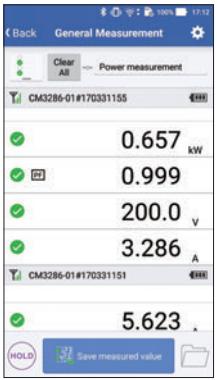
Pairing the app with the CM3286-01



- When the app is launched for the first time (before being paired with any instrument), the **Instrument Settings** screen will be displayed.
- While the mobile device is displaying the **Instrument Settings** screen, simply move it close to a CM3286-01 to automatically pair it with the instrument (the app can be paired with up to 8 instruments).
- Allow about 5 to 30 seconds for the instrument to pair with the app after being turned on. If the instrument fails to pair within 1 minute, relaunch GENNECT Cross and cycle the instrument's power.

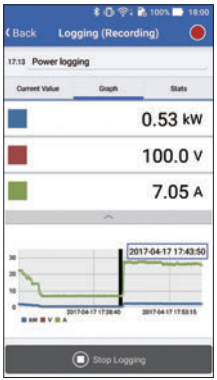
Making measurements with the Bluetooth® function

Select the **General Measurement**, **Logging (Recording)**, **Waveform Graph**, **Electricity Theft Detection**, or **Harmonic Analysis** function on the **Home** screen. For more information about each function, see the **Help** function in the GENNECT Cross.



General Measurement

Saves measured values from multiple channels.

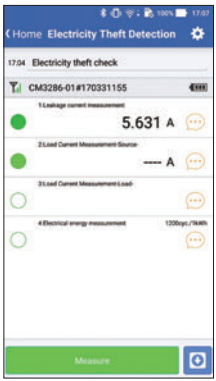


Logging (Recording)

Simple logging (up to 24 hours)

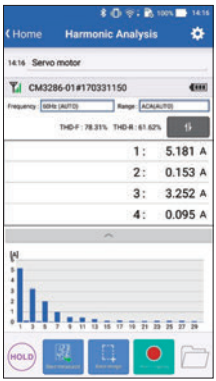
Waveform Graph

Simple oscilloscope (voltage/current)



Electricity Theft Detection

Creates a result report by measuring current and energy.



Harmonic Analysis

Analyzes levels, content percentages, and total distortion (voltage, current).

Repairs, Inspections, and Cleaning

⚠WARNING

Customers are not allowed to modify, disassemble, or repair the instrument. Doing so may cause a fire, an electric shock, or a injury..

Cleaning

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent.
- Measurements are degraded by dirt on the mating surfaces of the jaw, so keep the surfaces clean by gently wiping with a soft, dry cloth.
- Wipe the LCD gently with a soft, dry cloth.

Disposal

Handle and dispose of the instrument and batteries in accordance with local regulations.

Precautions during shipment

Be sure to observe the following precautions:

- To avoid damage to the instrument, remove the batteries, accessories, and options from the instrument. Moreover, be sure to pack in a double carton. Damage that occurs during transportation is not covered by the warranty.
- When sending the instrument for repair, be sure to include details of the problem.

Calibrations

The calibration period varies depending on the status of the instrument or installation environment. We recommend that the calibration period be determined in accordance with the status of the instrument or installation environment. Please contact your Hioki distributor to have your instrument periodically calibrated.

Troubleshooting

If damage is suspected, check the following before contacting your authorized Hioki distributor or reseller.

Symptom	Verification and/or Solution
• The instrument is indicating an abnormal measured value for current.	• Is the measured current value too small for the instrument's measurement range? Wrap the wire around the jaw one or more times. Each additional wrap of the wire will increase the measured value, so that wrapping it once yields a measured value that is twice the actual value and wrapping it twice yields a measured value that is three times the actual value.
	• Are the tips of the jaw open?
	• Is the jaw damaged? If the sensor is damaged or cracked, it will not be able to measure current accurately. Send the instrument for repair.
• When readings from the instrument are compared with those of another clamp-on current meter, the measured values differ.	• The instrument cannot accurately measure waveforms that contain a component that falls outside the frequency characteristics range.
	• Since the instrument performs true RMS measurement, it can accurately measure distorted waveforms. When measuring a distorted waveform, the measured value will differ from a clamp-on current meter that uses the averaging method.

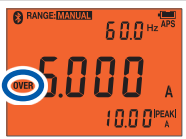
Symptom	Verification and/or Solution
• The current value is larger than expected. • A current value is displayed even though there is no input.	• The instrument cannot perform measurement accurately in the presence of a strong magnetic field from a source such as a nearby transformer or high-current circuit or in the presence of a strong electric field from a source such as a wireless device.
• A sound is being emitted by the instrument's jaw.	• The jaw may emit sound when measuring AC currents in excess of approx. 500 A, however, there is no effect on the measurement.
• The measured value does not appear. • No measured value is displayed, even when the connection cords are shorted.	• Insert the connection cords all the way. • Use the proper measurement method. If no measured value is displayed after attempting the above two solutions, the instrument may be broken. Have the instrument repaired.

Error display

Error display	Description		Solution
Err 001	**ROM error**	Program	Repair is necessary. Please contact your authorized Hioki distributor or reseller.
Err 002	**ROM error**	Adjustment data	
Err 005	**ADC error**	Hardware malfunction	
Err 008	**Bluetooth® error**	Hardware malfunction (only for CM3286-01)	

Warning display

Display		Buzzer	Cause	Solution
	Flashes red	–	Measurement resulted in a negative active power value.	The instrument may not be connected properly. Reconnect the instrument to the circuit being measured.

Display		Buzzer	Cause	Solution
 e.g.: for current measurement	Flashes red	Intermittent sound	A current or voltage exceeding the maximum input was input to the instrument.	Stop measurement immediately as the current or voltage cannot be measured by the instrument. For current measurement, the optional 9290-10 can be used to measure currents of up to 1000 A AC. When manual range is 6 A and 60 A range, this warning display will not appear.
 e.g.: for current measurement	Lights red	–	A current or voltage exceeding the range was input while using a manual range.	Change the measurement range or select the AUTO range.

Display		Buzzer	Cause	Solution
	Lights red	Intermittent sound	Phase detection indicated reverse phase.	

Specifications

General Specifications

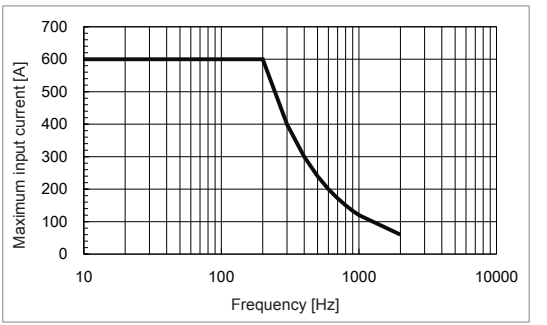
Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)	
Operating temperature and humidity	Temperature	−25°C (−13°F) to 65°C (149°F)
	Humidity	−25°C (−13°F) or higher but less than 40°C (104°F): 80% RH or less 40°C (104°F) or higher but less than 45°C (113°F): 60% RH or less 45°C (113°F) to 65°C (149°F): 50% RH or less (no condensation)
Storage temperature and humidity	Temperature	−25°C (−13°F) to 65°C (149°F)
	Humidity	−25°C (−13°F) or higher but less than 40°C (104°F): 80% RH or less 40°C (104°F) or higher but less than 45°C (113°F): 60% RH or less 45°C (113°F) to 65°C (149°F): 50% RH or less (no condensation) Remove batteries before storing the instrument.
Dustproof and waterproof	Grip except lever: IP54 (EN 60529) Jaw, barrier, lever: IP50 (EN 60529)	

Standards (other than wireless communications functionality)	Safety: EN 61010 EMC: EN 61326
Power supply	LR03 alkaline battery ×2 Rated supply voltage: 1.5 V DC ×2 Maximum rated power: 550 mVA
Continuous operating time	Approx. 25 hours (Backlight display off, Bluetooth® communication off, at 23°C, as a referential) Approx. 18 hours (Backlight display off, Bluetooth® communication on, at 23°C, as a referential)
Interface (only for CM3286-01)	Bluetooth® 4.0LE (Bluetooth®)
Dimensions	Approx. 82W × 241H × 37D mm (3.23″W × 9.49″H × 1.46″D)
Jaw dimensions	Approx. 79W × 20D mm (3.11″W × 0.79″D)
Maximum measurable conductor diameter	46 mm (1.81″)
Mass	Approx. 450 g (15.9 oz.) (including batteries)
Product warranty period	3 years
Accessories	See p.2
Options	See p.4

Input/Output/Measurement Specifications

Basic Specifications

Measurement items	AC current RMS value/AC current peak value (no polarity)/AC current frequency AC voltage RMS value/AC voltage peak value (no polarity)/AC voltage frequency Single-phase active power/Single-phase apparent power/Single-phase reactive power/Single-phase power factor/Single-phase zero-cross phase angle Balanced 3-phase active power/Balanced 3-phase reactive power/Balanced 3-phase apparent power/Balanced 3-phase power factor/Balanced 3-phase zero-cross phase angle Single-phase active energy (only positive values added)/Phase detection
Maximum input current	See the frequency derating characteristics (p.74). (up to 200 Hz, 600 A or less; above 200 Hz, 120000 A･Hz or less)
Maximum measuring voltage	600 V AC
Maximum rated voltage to earth **Maximum rated voltage to terminal**	600 V AC (Measurement category IV) 1000 V AC (Measurement category III) Anticipated transient overvoltage 8000 V
Measurement method	True RMS measurement with digital sampling
Measurement terminal	COM terminal and V terminal
Input impedance	1 MΩ or greater

Display update interval	2 times/sec.
Response time	1 sec.
Crest factor	3 or less for current 6 A and 60 A range 1.6 or less for current 600 A range and voltage 600 V range
Zero-display range	• Voltage and current RMS values: 29 counts or less • If they fall within the zero-display range, current (voltage) peak values and active/apparent/reactive power values are shown as zero, while current (voltage) frequency, power factor, and zero-cross phase values are shown as "– – – –." • A value of 0 is used in single-phase active energy calculations.
Frequency derating characteristics	

Accuracy Specifications

Conditions of guaranteed accuracy	Guaranteed accuracy period: 1 year Guaranteed accuracy period after adjustment made by Hioki: 1 year Guaranteed accuracy for temperature and humidity: 23°C±5°C (73°F±9°F), 80% RH or less (no condensation) Number of jaw open/close cycles: 10000 times or less
Input conditions for guaranteed accuracy	Sine wave input
Effects of external magnetic fields	DC/AC 60 Hz, with a 400 A/m external magnetic field: 0.10 A or less
Effects of conductor position	At all positions around the jaw's center-point reference: within ±0.5% (100 A input, f ≤100 Hz)
Temperature coefficient	Add "measurement accuracy × 0.1/°C" (excluding 23°C±5°C (73°F±9°F)).
Effects of sensor phase	±1° (50 Hz to 60 Hz)

See "Accuracy Table" (p. 79)

Harmonic Measurement Specifications (only for CM3286-01)

All operations are performed by the GENNECT Cross application software. The following specifications apply only to use of the GENNECT Cross's harmonic analysis functionality. Perform sampling of data by instrument and harmonic analysis calculations by GENNECT Cross.

Measurement conditions	Fundamental frequency 50 Hz/60 Hz
Measurement functionality	AC current/AC voltage (controlled by application software)
Analysis window width	1 cycle (50 Hz/60 Hz)
Window type	Rectangular
Number of data points analyzed	256
Orders analyzed	1st to 30th
Items analyzed	Harmonic level (RMS values for current harmonics [A], RMS values for voltage harmonics [V])
	Harmonic content percentage (content percentages for current harmonics [%], content percentages for voltage harmonics [%])
	Total harmonic distortion (THD-F and THD-R for current [%], THD-F and THD-R for voltage [%])

Range (maximum resolution)	AC current	600.0 A (0.1 A)	60.00 A (0.01 A)	6.000 A (0.001 A)
	AC voltage	600.0 V (0.1 V)		
Accuracy input range	Input of 1% of range or greater for each order			
Crest factor	3 or less for the 6 A and 60 A current ranges 1.6 or less for the 600 A current range and the 600 V voltage range			
Data refresh	5 s (reference value)			
Measurement accuracy	Harmonic level (RMS value)	Order	Accuracy	
		1 to 10	±5.0% rdg. ±10 dgt.	
		11 to 20	±10% rdg. ±10 dgt.	
		21 to 30	±20% rdg. ±10 dgt.	
	Harmonic content percentage	±1 dgt. for calculations performed using measured values		
	Total harmonic distortion	±1 dgt. for calculations performed using measured values		

External Interface (Bluetooth®) Specifications

Display function	Display of measured values on a iOS device or a Android device, using Bluetooth® communications.
Interface	Bluetooth® 4.0 LE
Antenna power	Maximum +0 dBm (1 mW)
Communications range	10 m (line of sight)
Communications profile	GATT (Generic Attribute Profile)
Supported devices	Android 4.3 or later, iOS 10 or later (only for Bluetooth® low energy models)

Application Software Specifications

Electricity theft detection function	Creates an result report by measuring current and energy in conjunction with the instrument.
Harmonic analysis function	The app analyzes current or voltage harmonics up to the 30th order and displays the results in graph form.
Others	See the GENNECT Cross specifications (data saving, logging (recording), waveform graph function)

Accuracy Table

(1) AC Current Measurement

The current RMS (I_{RMS}) and current peak value ($I_{|PEAK|}$) ranges will change at the same time.

Auto range threshold: Range up: Current RMS value greater than 6000 count
Range down: Current RMS value less than 540 count

AC current RMS (I_{RMS})	Range (Accuracy guarantee range)	Resolution	Accuracy		
		Display range	45 Hz ≤ f ≤ 66 Hz	66 Hz < f ≤ 500 Hz	500 Hz < f ≤ 1 kHz
	6.000 A (0.060 A to 6.000 A)	0.001 A	±1.3% rdg. ±3 dgt.	±2.0% rdg. ±5 dgt.	±5.0% rdg. ±5 dgt.
		0.000 A to 6.000 A			
	60.00 A (0.60 A to 60.00 A)	0.01 A	±1.0% rdg. ±3 dgt.	±1.5% rdg. ±5 dgt.	±3.0% rdg. ±5 dgt.
		0.00 A to 60.00 A			
	600.0 A (6.0 A to 600.0 A)	0.1 A			–
		0.0 A to 600.0 A			

Accuracy Table

AC current peak value (I_{PEAK}) Zero to Peak No polarity (absolute value of the maximum wave height during the display update interval)	Range (Accuracy guarantee range is specified in terms of current RMS values.)	Resolution	Accuracy		
		Display range	45 Hz ≤ f ≤ 66 Hz	66 Hz < f ≤ 500 Hz	500 Hz < f ≤ 1 kHz
	6.000 A (0.060 A to 6.000 A)	0.01 A	±3.0% rdg. ±5 dgt.		±5.0% rdg. ±5 dgt.
		0.00 A to 18.00 A			
	60.00 A (0.60 A to 60.00 A)	0.1 A	±2.5% rdg. ±5 dgt.		±4.0% rdg. ±5 dgt.
		0.0 A to 180.0 A			
	600.0 A (6.0 A to 600.0 A)	1 A			–
		0 A to 1000 A			
AC current frequency ($FREQ_I$)	Range (Accuracy guarantee range)	Resolution	Accuracy		
		Display range	Current frequency values are shown as "– – – –" when the current RMS value is less than 150 count. Current frequency values of less than 45.0 Hz are shown as "– – – –."		
	999.9 Hz (45.0 Hz to 999.9 Hz)	0.1 Hz	±0.3% rdg. ±3 dgt.		
		45.0 Hz to 999.9 Hz			

(2) AC Voltage Measurement

AC voltage RMS value (U_{RMS})	Range (Accuracy guarantee range)	Resolution	Accuracy		
		Display range	45 Hz ≤ f ≤ 66 Hz	66 Hz < f ≤ 500 Hz	500 Hz < f ≤ 1 kHz
	600 V (80.0 V to 600.0 V)	0.1 V	±0.7% rdg. ±3 dgt.	±1.0% rdg. ±5 dgt.	±3.0% rdg. ±5 dgt.
		0.0 V to 600.0 V			
AC voltage peak value ($U_{|PEAK|}$) Zero to Peak No polarity (absolute value of the maximum wave height during the display update interval)	**Range (Accuracy guarantee range is specified in terms of current RMS values.)**	**Resolution**	**Accuracy**		
		Display range	**45 Hz ≤ f ≤ 66 Hz**	**66 Hz < f ≤ 500 Hz**	**500 Hz < f ≤ 1 kHz**
	600 V (80.0 V to 600.0 V)	1 V	±2.5% rdg. ±5 dgt.		±4.0% rdg. ±5 dgt.
		0 V to 1000 V			

Accuracy Table

AC voltage frequency ($FREQ_U$)	Range (Accuracy guarantee range)	Resolution	Accuracy
		Maximum display	Voltage frequency values are shown as "– – – –" when the voltage RMS value is less than 150 count. Voltage frequency values of less than 45.0 Hz are shown as "– – – –."
	999.9 Hz (45.0 Hz to 999.9 Hz)	0.1 Hz	±0.3% rdg. ±3 dgt.
		999.9 Hz	

(3) Single-phase power measurement, balanced 3-phase/4-wire power measurement

Auto range threshold: Range up: Current RMS value greater than 6000 count
Range down: Current RMS value less than 540 count

Effective measuring range	Current RMS value (I_{RMS})	0.060 A to 600.0 A Value must fall within the current measurement range's guaranteed accuracy range.
	Voltage RMS value (U_{RMS})	80.0 V to 600.0 V
	Frequency	50 Hz/60 Hz

<table>
<tr><td rowspan="5">Single-phase active power/ Balanced 3-phase/4-wire active power ($PIP_{(3P4W)}$)</td><td colspan="3">Range configuration (minimum resolution)</td><td colspan="3">Current range</td></tr>
<tr><td colspan="3"></td><td>6.000 A</td><td>60.00 A</td><td>600.0 A</td></tr>
<tr><td rowspan="2">Voltage range</td><td rowspan="2">600.0 V</td><td>Single-phase</td><td>3.600 kW (0.001 kW)</td><td>36.00 kW (0.01 kW)</td><td>360.0 kW (0.1 kW)</td></tr>
<tr><td>3-Phase 4-Wire</td><td>10.80 kW (0.01 kW)</td><td>108.0 kW (0.1 kW)</td><td>1080 kW (1 kW)</td></tr>
<tr><td rowspan="2">Accuracy (Power factor =1)</td><td colspan="2">Single-phase</td><td>±2.0% rdg. ±7 dgt.</td><td colspan="2">±1.7% rdg. ±5 dgt.</td></tr>
<tr><td colspan="2">3-Phase 4-Wire</td><td>±2.0% rdg. ±3 dgt.</td><td colspan="2">±1.7% rdg. ±2 dgt.</td></tr>
<tr><td rowspan="2">Single-phase apparent power/ Balanced 3-phase/4-wire apparent power ($SIS_{(3P4W)}$)

Single-phase reactive power/ Balanced 3-phase/4-wire reactive power ($QIQ_{(3P4W)}$)</td><td>Accuracy</td><td colspan="5">±1 dgt. relative to calculation from measured values</td></tr>
<tr><td>Range configuration</td><td colspan="5">For the above active power range configuration, the unit [W] is replaced by [VA] for apparent power values. For reactive power values, the unit [W] is replaced by [var].</td></tr>
</table>

Single-phase power factor/ Balanced 3-phase/4-wire power factor (PF / $PF_{(3P4W)}$)	**Accuracy**	±1 dgt. relative to calculation from measured values	
	Range configuration	**Regeneration**	−1.000 to −0.001
		Consumption	0.000 to 1.000
Zero-cross phase angle (ϕ)*	**Accuracy**	±3°	
	Range configuration	**Lead**	−180.0° to −0.1°
		Lag	0.0° to 179.9°

* Value is calculated based on the measurement of the zero-cross phase difference for the voltage and current waveforms (positive [no sign] when the current lags the voltage and negative when the current leads the voltage).

(4) Balanced 3-phase/3-wire power measurement

Auto range threshold: Range up: Current RMS value greater than 6000 count
Range down: Current RMS value less than 540 count

Effective measuring range	**Current RMS value (I_{RMS})**	0.060 A to 600.0 A Value must fall within the current measurement range's guaranteed accuracy range.
	Voltage RMS value (U_{RMS})	80.0 V to 600.0 V
	Frequency	50 Hz/60 Hz

<table>
<tr><td rowspan="5">Balanced 3-phase/3-wire active power ($P_{(3P3W)}$)

Balanced 3-phase/3-wire apparent power ($S_{(3P3W)}$)</td><td>Accuracy</td><td colspan="4">±3.0% rdg. ±10 dgt. (Power factor =1)</td></tr>
<tr><td rowspan="4">Range configuration (minimum resolution)</td><td colspan="2" rowspan="2"></td><td colspan="3">Current range</td></tr>
<tr><td>6.000 A</td><td>60.00 A</td><td>600.0 A</td></tr>
<tr><td>Voltage range</td><td>600.0 V</td><td>7.200 kW
(0.001 kW)</td><td>72.00 kW
(0.01 kW)</td><td>720.0 kW
(0.1 kW)</td></tr>
<tr><td colspan="5">The unit [W] is replaced by [VA] for apparent power values.</td></tr>
<tr><td rowspan="2">Balanced 3-phase/3-wire reactive power ($Q_{(3P3W)}$)</td><td>Accuracy</td><td colspan="4">±1 dgt. relative to calculation from measured values</td></tr>
<tr><td>Range configuration</td><td colspan="4">For the above active power range configuration, the unit [W] is replaced by [var].</td></tr>
<tr><td rowspan="3">Balanced 3-phase/3-wire power factor ($PF_{(3P3W)}$)</td><td>Accuracy</td><td colspan="4">±3° ±2 dgt. (Calculated from the balanced 3-phase/3-wire zero-cross phase angle)</td></tr>
<tr><td rowspan="2">Range configuration</td><td>Regeneration</td><td colspan="3">−0.001</td></tr>
<tr><td>Consumption</td><td colspan="3">0.000 to 1.000</td></tr>
<tr><td rowspan="3">Balanced 3-phase/3-wire zero-cross phase angle ($\phi_{(3P3W)}$)*</td><td>Accuracy</td><td colspan="4">±3°</td></tr>
<tr><td rowspan="2">Range configuration</td><td>Lead</td><td colspan="3">−90.0° to −0.1°</td></tr>
<tr><td>Lag</td><td colspan="3">0.0° to 90.0°</td></tr>
</table>

Accuracy Table

* Value is calculated based on the measurement of the zero-cross phase difference for the voltage and current waveforms (positive [no sign] when the current lags the voltage and negative when the current leads the voltage).

(5) Single-phase active energy measurement (AC)

Effective measuring range	**Current RMS value (I_{RMS})**	0.060 A to 600.0 A Value must fall within the current measurement range's guaranteed accuracy range.
	Voltage RMS value (U_{RMS})	80.0 V to 600.0 V
	Frequency	50 Hz/60 Hz

<table>
<tr><td rowspan="8">Single-phase active energy (Wh)</td><td colspan="2">Measurement method</td><td>Positive active power values are added every 0.5 s.* A value of zero is added when the active power is negative.
* When stopping integration, the energy measured during the last 0.5 sec. is divided into 5 and added every 0.1 sec.</td></tr>
<tr><td>Range configuration</td><td>Display range</td><td rowspan="7">• After the single-phase active power range is selected, integration starts with a value of 0.00 Wh. Only auto-range operation is supported for active energy measurement. When values exceed 9999 count, the range is switched to the next higher range.
• The range is fixed to the active power range in use when integrated began.</td></tr>
<tr><td>99.99 Wh</td><td>0.00 Wh to 99.99 Wh</td></tr>
<tr><td>999.9 Wh</td><td>100.0 Wh to 999.9 Wh</td></tr>
<tr><td>9.999 kWh</td><td>1.000 kWh to 9.999 kWh</td></tr>
<tr><td>99.99 kWh</td><td>10.00 kWh to 99.99 kWh</td></tr>
<tr><td>999.9 kWh</td><td>100.0 kWh to 999.9 kWh</td></tr>
<tr><td>9999 kWh</td><td>1000 kWh to 9999 kWh</td></tr>
</table>

Integration time display	59:59 [min:sec]	The time is incremented by 1 s from 00:00 [min:sec]. When 59:59 [min:sec] is exceeded, the range is switched to the 48:00 [hour:min] range. During integration using the 48:00 [hour:min] range, the “:” display flashes every 0.5 s.
	48:00 [hour:min]	

(6) Phase detection

Detected voltage range	80 V AC to 600 V AC
Detection target frequency	50 Hz/60 Hz (sine wave)
Phase order detection*	Normal phase (Display: 123) Reverse phase (Display: 321) Open phase or unable to measure (Display: – – – –)

* After the second measurement display appears, and the second measurement value does not become stable over 10 seconds, it is unable to make a measurement.

Range configuration when setting a CT ratio

CT ratio	1/1 (default value)	1/10	1/100	1/1000	Remarks
Current RMS value	600.0 A	6000 A	–	–	CT ratio 1/1 Same accuracy specifications as 600.0 A.
	60.00 A	600.0 A	6000 A	–	CT ratio 1/1 Same accuracy specifications as 60.00 A.
	6.000 A	60.00 A	600.0 A	6000 A	CT ratio 1/1 Same accuracy specifications as 6.000 A.
Current peak value	1000 A	10.00 kA	–	–	CT ratio 1/1 Same accuracy specifications as 600.0 A.
	180.0 A	1800 A	18.00 kA	–	CT ratio 1/1 Same accuracy specifications as 60.00 A.
	18.00 A	180.0 A	1800 A	18.00 kA	CT ratio 1/1 Same accuracy specifications as 6.000 A.
Single-phase active power	360.0 kW	3600 kW	–	–	CT ratio 1/1 Same accuracy specifications as 360.0 kW.
	36.00 kW	360.0 kW	3600 kW	–	CT ratio 1/1 Same accuracy specifications as 36.00 kW.
	3.600 kW	36.00 kW	360.0 kW	3600 kW	CT ratio 1/1 Same accuracy specifications as 3.600 kW.

Accuracy Table

CT ratio	1/1 (default value)	1/10	1/100	1/1000	Remarks
Balanced 3-phase/3-wire active power	720.0 kW	7200 kW	–	–	CT ratio 1/1 Same accuracy specifications as 720.0 kW.
	72.00 kW	720.0 kW	7200 kW	–	CT ratio 1/1 Same accuracy specifications as 72.00 kW.
	7.200 kW	72.00 kW	720.0 kW	7200 kW	CT ratio 1/1 Same accuracy specifications as 7.200 kW.
Balanced 3-phase/4-wire active power	1080 kW	9999 kW*1	–	–	CT ratio 1/1 Same accuracy specifications as 1080 kW.
	108.0 kW	1080 kW	9999 kW*1	–	CT ratio 1/1 Same accuracy specifications as 108.0 kW.
	10.80 kW	108.0 kW	1080 kW	9999 kW*1	CT ratio 1/1 Same accuracy specifications as 10.80 kW.

- Add the accuracy of the appropriate CT.
- The unit is replaced as below for apparent power and reactive power, relative to the active power range.
  Apparent power: kVA
  Reactive power: kVAR

*1 Multiply the dgt. error indicated in the accuracy specifications noted in the “Remarks” column by 10.

Equations

(1) Single-phase power measurement

Apparent power	S	$U_{\mathrm{RMS}} \cdot I_{\mathrm{RMS}}$	• The active power P has no sign during consumption and a negative sign during generation. • Due to the effects of measurement error, S=|P| and Q=0 are used when S<|P|.
Reactive power	Q	$\sqrt{S^2 - P^2}$	
Power factor	PF	$\frac{P}{S}$	

(2) Balanced 3-phase/3-wire power measurement

Balanced 3-phase/3-wire zero-cross phase angle	$\phi_{(3P3W)}$	$\phi - 30°$	• The symbol ϕ represents the zero-cross phase angle of the voltage U_{12} and the current I_1. • The symbol S represents the apparent power of the line voltage U_{12} and the wire current I_1.
Balanced 3-phase/3-wire power factor	$PF_{(3P3W)}$	$\cos\left\{\phi_{(3P3W)}\right\}$	
Balanced 3-phase/3-wire active power	$P_{(3P3W)}$ [W]	$\sqrt{3} \cdot PF_{(3P3W)} \cdot S$	
Balanced 3-phase/3-wire apparent power	$S_{(3P3W)}$ [VA]	$\sqrt{3} \cdot S$	
Balanced 3-phase/3-wire reactive power	$Q_{(3P3W)}$ [var]	$\sqrt{S_{(3P3W)}^2 - P_{(3P3W)}^2}$	

(3) Balanced 3-phase/4-wire power measurement

Balanced 3-phase/4-wire active power	$P_{(3P4W)}$ [W]	$3 \cdot P$	• The symbol P represents the active power of the phase voltage U_1 and the wire current I_1. • The symbol S represents the apparent power of the phase voltage U_1 and the wire current I_1. • The symbol Q represents the reactive power of the phase voltage U_1 and the wire current I_1. • The active power P has no sign during consumption and a negative sign during generation. • Due to the effects of measurement error, S=|P| and Q=0 are used when S<|P|.
Balanced 3-phase/4-wire apparent power	$S_{(3P4W)}$ [VA]	$3 \cdot S$	
Balanced 3-phase/4-wire reactive power	$Q_{(3P4W)}$ [var]	$3 \cdot Q$	
Balanced 3-phase/4-wire power factor	$PF_{(3P4W)}$	$\frac{P_{(3P4W)}}{S_{(3P4W)}}$	

(4) Unbalanced 3-phase/3-wire power measurement

Unbalanced 3-phase/3-wire active power	$P_{(UB3P3W)}$ [W]	P_1+P_2	• The symbol P_1 represents the active power of the line voltage U_{21} and the wire current I_1. • The symbol P_2 represents the active power of the line voltage U_{23} and the wire current I_3. • The active power P has no sign during consumption and a negative sign during generation.

(5) Unbalanced 3-phase/4-wire power measurement

Unbalanced 3-phase/4-wire active power	$P_{(UB3P4W)}$ [W]	$P_1+P_2+P_3$	• The symbol P_1 represents the active power of the phase voltage U_1 and the wire current I_1. • The symbol P_2 represents the active power of the phase voltage U_2 and the wire current I_2. • The symbol P_3 represents the active power of the phase voltage U_3 and the wire current I_3. • The active power P has no sign during consumption and a negative sign during generation.
Unbalanced 3-phase/4-wire apparent power	$S_{(UB3P4W)}$ [VA]	$S_1+S_2+S_3$	• The symbol S_1 represents the apparent power of the phase voltage U_1 and the wire current I_1. • The symbol S_2 represents the apparent power of the phase voltage U_2 and the wire current I_2. • The symbol S_3 represents the apparent power of the phase voltage U_3 and the wire current I_3. • Due to the effects of measurement error, $S=\|P\|$ is used when $S<\|P\|$.

Unbalanced 3-phase/4-wire reactive power	$Q_{(UB3P4W)}$ [var]	$Q_1+Q_2+Q_3$	• The symbol Q_1 represents the reactive power of the phase voltage U_1 and the wire current I_1. • The symbol Q_2 represents the reactive power of the phase voltage U_2 and the wire current I_2. • The symbol Q_3 represents the reactive power of the phase voltage U_3 and the wire current I_3. • Due to the effects of measurement error, Q=0 is used when S<$\|P\|$.
Unbalanced 3-phase/4-wire power factor	$PF_{(UB3P4W)}$	$\frac{P_{(UB3P4W)}}{S_{(UB3P4W)}}$	–

(6) (Reference) Harmonic calculations

Calculated by GENNECT Cross

Harmonic current	RMS value [A]	–	$\sqrt{I_{kr}^2 + I_{ki}^2}$
	Harmonic content percentage for k th order [%]	–	$\frac{\sqrt{I_{kr}^2 + I_{ki}^2}}{\sqrt{I_{1r}^2 + I_{1i}^2}} \times 100[\%]$
	Total harmonic distortion [%]	*THD-F*	$\frac{\sqrt{\sum_{k=2}^{30}\left(I_{kr}^2 + I_{ki}^2\right)}}{\sqrt{I_{1r}^2 + I_{1i}^2}} \times 100[\%]$
		THD-R	$\frac{\sqrt{\sum_{k=2}^{30}\left(I_{kr}^2 + I_{ki}^2\right)}}{\sqrt{\sum_{n=1}^{256}(I'_n)^2}} \times 100[\%]$

Harmonic voltage	RMS value [V]	–	$\sqrt{U_{kr}^2 + U_{ki}^2}$
	Harmonic content percentage for k th order [%]	–	$\frac{\sqrt{U_{kr}^2 + U_{ki}^2}}{\sqrt{U_{1r}^2 + U_{1i}^2}} \times 100[\%]$
	Total harmonic distortion [%]	*THD-F*	$\frac{\sqrt{\sum_{k=2}^{30}\left(U_{kr}^2 + U_{ki}^2\right)}}{\sqrt{U_{1r}^2 + U_{1i}^2}} \times 100[\%]$
		THD-R	$\frac{\sqrt{\sum_{k=2}^{30}\left(U_{kr}^2 + U_{ki}^2\right)}}{\sqrt{\sum_{n=1}^{256}\left(U'_n\right)^2}} \times 100[\%]$

Index
k: Analyzed order
r: Post-FFT resistance component
i: Post-FFT reactance component
I': Current sampling value
U': Voltage sampling value

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
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18-07 EN-3

HIOKI

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