

# HIOKI

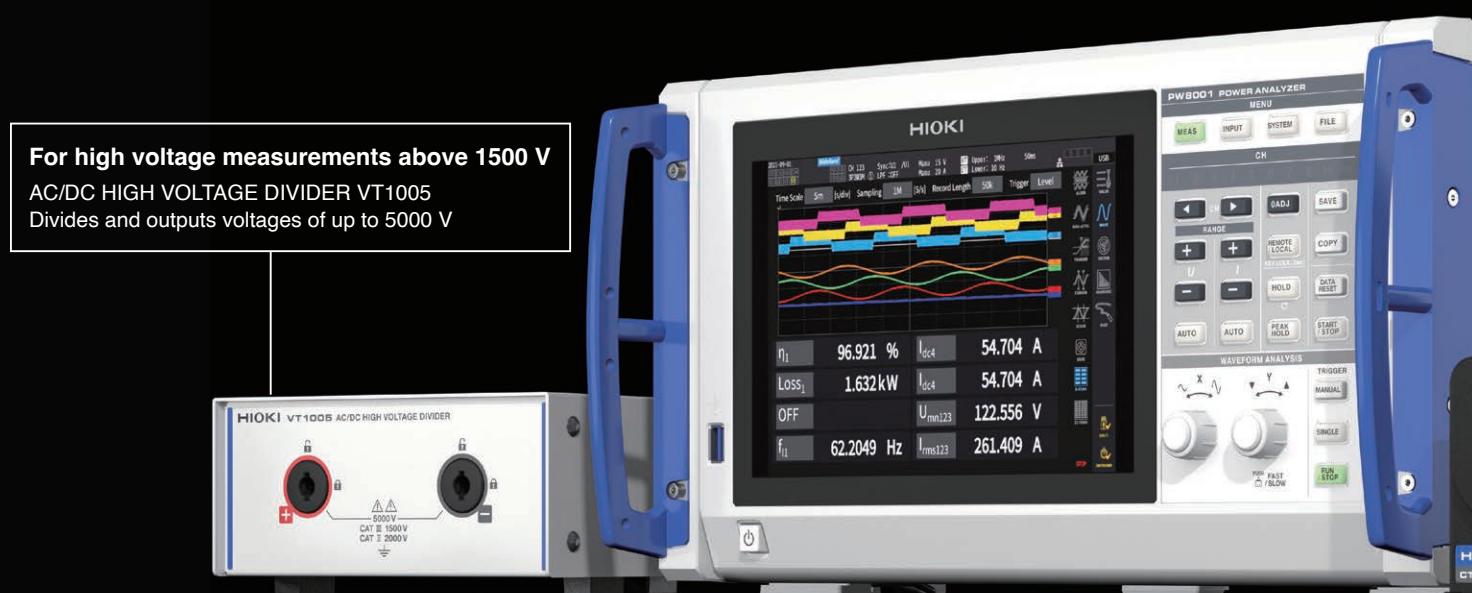
## POWER ANALYZER Series



# High-precision Power Analysis Through Sensing Technology

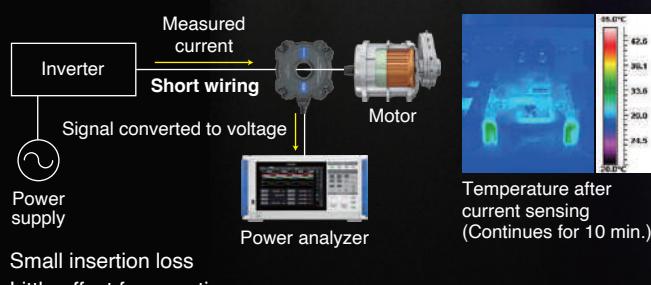
## Superior affinity between power analyzers and current sensors

Hioki develops both power analyzers and current sensors. Advanced sensing technology is a prerequisite for accurate power analysis. Given the high affinity between current sensors and power analyzers, precise power analysis is possible.

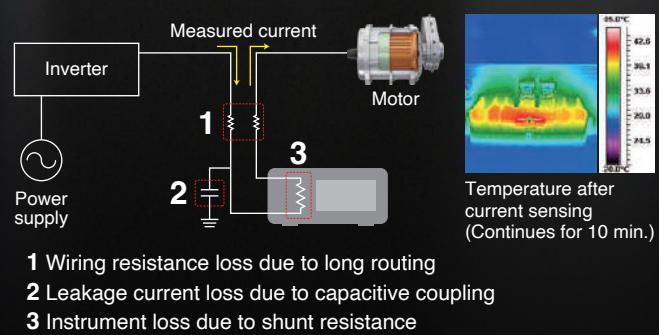


**The current sensor method is an approach to making measurements that closely resemble the actual operating environment**

### Measurement example using the current sensor method

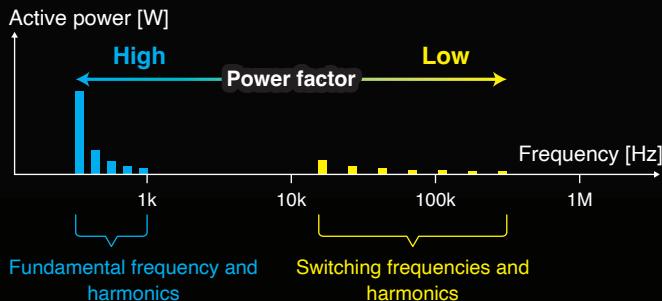


### Measurement example using the direct wiring method



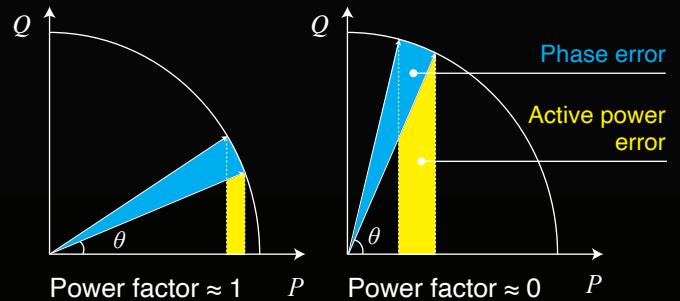
## Important points in evaluating high-efficiency inverters

When evaluating the power conversion efficiency of an inverter, the inverter's input and output power are measured, and its efficiency is calculated. PWM (pulse width modulated) inverter output, which has been widely used in recent years, contains the fundamental and its harmonic, the switching frequencies, and its harmonic component. Since switching frequencies are high, current sensors that can measure over a wide bandwidth are needed for the measurement process.



Active power spectrogram for an inverter's output power.

**The ability to measure low-powerfactor, high-frequency components is essential.**



At low power factors, phase error has a significant effect on power error.

**Phase accuracy of current sensor is important.**



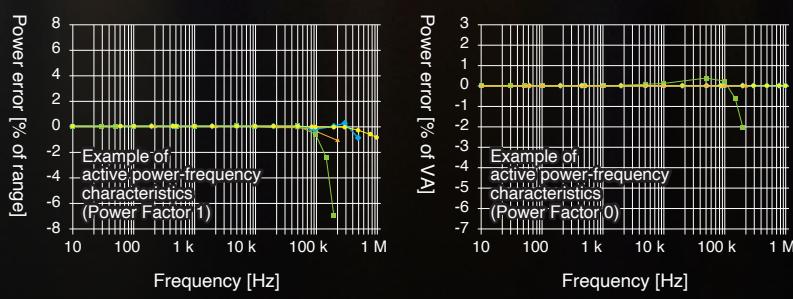
### For high current measurements above 2000 A

#### SENSOR UNIT CT9557

The current sensor output is added and output

Accurately measures large currents up to 8000 A (4 wires)

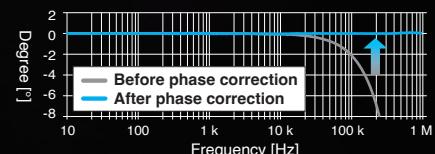
## Current sensor with defined phase accuracy can accurately measure power



- PW8001+U7005 (1500 V/50 A range)
- ◆ PW8001+U7001 (1500 V/50 A range)

- ▲ PW4001 (1500 V/50 A range)
- PW3390 (150 V/50 A range)

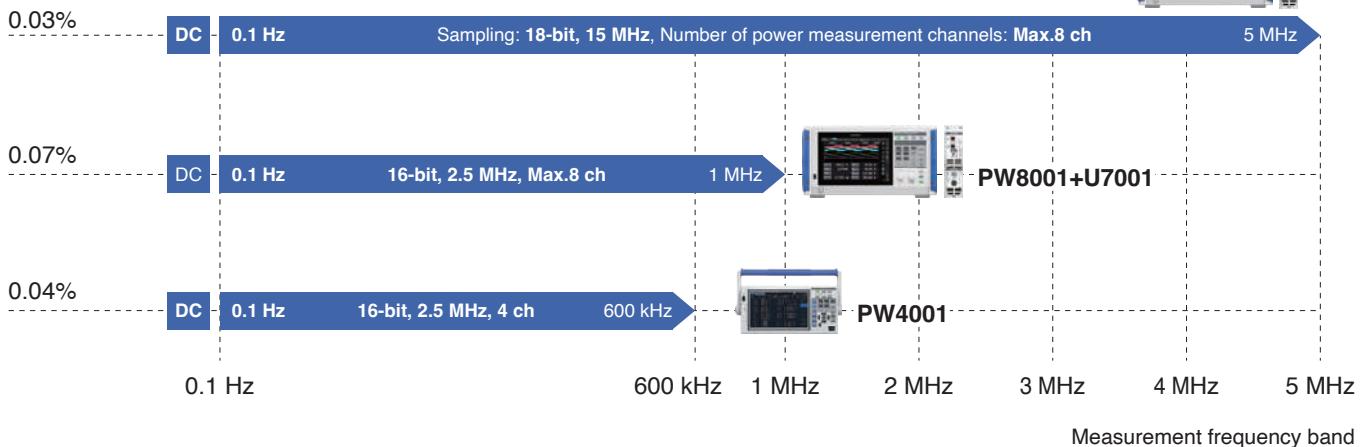
HIOKI specifies the phase accuracy of current sensors for more accurate power measurement. By correcting the phase characteristics of the current sensor with a power analyzer, low power factor power can be accurately measured down to higher frequencies.



Example of the phase correction for the CT6904A AC/DC current sensor

## Power analyzer lineup

Basic accuracy for 50/60 Hz active power

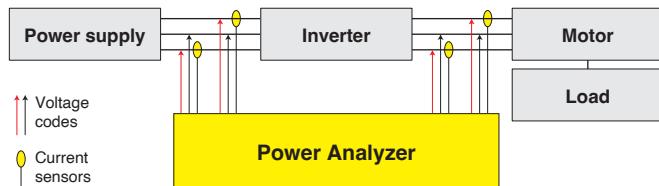


## Applications

### Power conversion efficiency evaluation of inverters



Measure input and output power for power conversion devices like inverters and calculate efficiency and loss.



#### Detect power conversion efficiency and loss

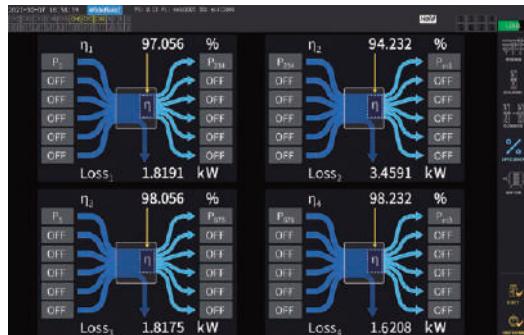
##### Number of power measurement channels

PW8001	Up to 8 channels (specified at time of purchase)
PW4001	4 ch

##### Efficiency and loss calculations

PW8001	Max.4 each for efficiency and loss (with Auto mode)
PW4001	Max.4 each for efficiency and loss (with Auto mode)

The PW8001's Auto mode automatically switches calculation formulas depending on the direction of power flow.



Accuracy for active power*	DC	50 Hz/60 Hz	10 kHz
PW8001+U7005	$\pm(0.02\% + 0.03\%)$	$\pm(0.01\% + 0.02\%)$	$\pm(0.05\% + 0.05\%)$
PW8001+U7001	$\pm(0.02\% + 0.05\%)$	$\pm(0.02\% + 0.05\%)$	$\pm(0.2\% + 0.05\%)$
PW4001	$\pm(0.03\% + 0.01\%)$	$\pm(0.03\% + 0.01\%)$	$\pm(0.2\% + 0.05\%)$

\* $\pm(\% \text{ of reading} + \% \text{ of range})$

#### Harmonics measurement

	Synchronization frequency range	Maximum analysis order
PW8001+U7005	0.1 Hz to 1.5 MHz	500th
PW8001+U7001	0.1 Hz to 1 MHz	500th
PW4001	0.1 Hz to 600 kHz	500th

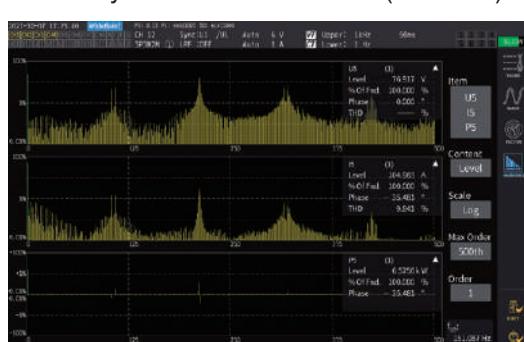
The instrument can perform harmonic analysis for each channel's voltage, current, and active power and display the results. The PW8001 and PW4001 can analyze harmonics for individual channels, and they can simultaneously measure harmonics in multiple circuits at different frequencies.

#### Common-mode rejection ratio (CMRR)

	50 Hz/60 Hz	100 kHz
PW8001+U7005	120 dB or greater	110 dB or greater
PW8001+U7001	100 dB or greater	80 dB typical
PW4001	80 dB or greater	-

When evaluating an equipment that produces noise, such as an inverter, it is essential to consider how effectively the device can withstand noise.

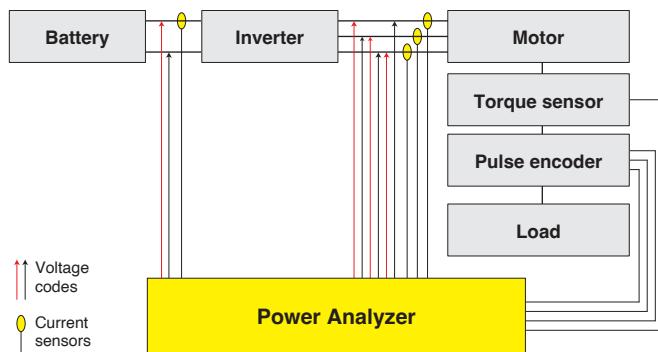
Harmonic analysis of the 500th-order (PW8001)



## Evaluation of inverters and motors



Efficiency and loss can be calculated from the power on the input and output sides of inverters and motors. Torque meter and pulse encoder signals can be input to the power analyzer to simultaneously analyze and record the motor's torque, rotation speed, and mechanical output.



### Motor analysis

Number of motors that can be simultaneously analyzed

PW8001	Max. 4 motors
PW4001	Max. 2 motors

Input signals from a torque meter and pulse encoder to analyze motor torque, speed, rotational direction, and electrical angle.

user-defined calculations (used when calculating motor parameters)

PW8001	Up to 20 equations can be set
PW4001	Up to 20 equations can be set

Set calculation formulas as desired and display the results in real time. Calculate Ld and Lq motor parameters from electrical angle measurements.

Correction of torque meter measurement error

PW8001	Zero correction, nonlinear correction*, friction correction*
PW4001	Zero correction, nonlinear correction*, friction correction*

\*Enter the calibration values and points for compensating the sensor's error to calibrate the torque meter's value.

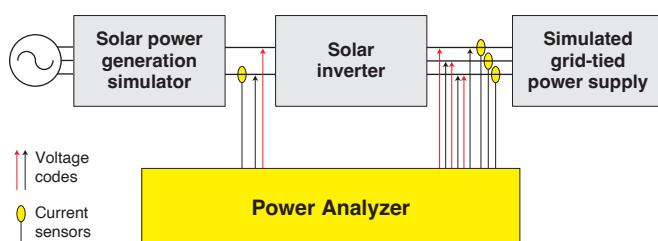
### CAN or CAN FD communication

PW8001	Measured data can be converted to CAN format and output (output function)
PW4001	•Measured data can be converted to CAN format and output (output function) •CAN data and measured data can be saved simultaneously (input function)

## Solar inverter efficiency measurements



Measure a solar inverter's input and output power and calculate efficiency and loss. Evaluate power generation systems that require measuring high voltages and multiple circuits, such as a multi-string solar inverter.



### Maximum input voltage

PW8001+U7005	1000 V AC/DC, $\pm 2000$ V peak
PW8001+U7001	1000 V AC, 1500 V DC, $\pm 2000$ V peak
PW4001	1000 V AC, 1500 V DC, $\pm 2000$ V peak

Use the VT1005 (option) to measure voltages of up to 5000 V with a power analyzer.

### IEC standard compliant harmonic and flicker measurement

	IEC harmonics measurement	IEC Flicker Measurement
PW8001	Yes	Yes
PW4001	-	-

Measure harmonics in compliance with the IEC 61000-4-7 standard and flicker in compliance with the IEC 61000-4-15 standard.

### Multi-string solar inverters evaluation

Optical link interface

PW8001	Analysis of up to 16 channels
PW4001	-

Connect two power analyzers with the optical link interface to aggregate and analyze measured data on one instrument.

## Power analyzer lineup

Model	PW8001+U7005	PW8001+U7001	PW4001
Applications	For measurement of SiC and GaN inverters and reactor/transformer loss	For measurement of high-efficiency IGBT inverters and solar inverters	For portability and high accuracy
Basic accuracy	Basic accuracy for 50/60 Hz power* <sup>1</sup> Accuracy for DC power* <sup>1</sup> Accuracy for 10 kHz power* <sup>1</sup> Accuracy for 50 kHz power* <sup>1</sup>	$\pm(0.01\% + 0.02\%)$ $\pm(0.02\% + 0.03\%)$ $\pm(0.05\% + 0.05\%)$ $\pm(0.15\% + 0.05\%)$	$\pm(0.02\% + 0.05\%)$ $\pm(0.02\% + 0.05\%)$ $\pm(0.2\% + 0.05\%)$ $\pm(0.4\% + 0.1\%)$
Measurement frequency band	DC, 0.1 Hz to 5 MHz	DC, 0.1 Hz to 1 MHz	DC, 0.1 Hz to 600kHz
Number of power measurement channels	1 to 8 channels, specify U7001 or U7005 when placing an order (mixed available)		
Voltage, current ADC sampling	18-bit, 15 MHz	16-bit, 2.5 MHz	16-bit, 2.5 MHz
Voltage range	6 V, 15 V, 30 V, 60 V, 150 V, 300 V, 600 V, 1500 V		
Current range	40 mA to 2000 A* <sup>2</sup>	<b>probe1:</b> 40 mA to 2000 A* <sup>2</sup> <b>probe2:</b> 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V	40 mA to 8000 A* <sup>2</sup>
Data update rate	1 ms, 10 ms, 50 ms, 200 ms		
Common-mode rejection ratio (CMRR)	50/60 Hz: 120 dB or greater 100 kHz: 110 dB or greater	50/60 Hz: 100 dB or greater 100 kHz: 80 dB typical	50 Hz/60 Hz: 80 dB or greater
Temperature coefficient	0.01%/ $^{\circ}$ C		
Voltage input method	Photoisolated input, resistor voltage division	Isolated input, resistor voltage division	Isolated input, resistor voltage division
Current input method	Isolated input from current sensor		
Current input	External current sensor input	Yes (ME15W)	Yes (ME15W)
	Power supplied to external current sensor	Yes	
	Current sensor phase shift calculation	Yes (auto)	
Voltage input	Maximum input voltage	1000 V, $\pm$ 2000 V peak	1000 V AC, 1500 V DC, $\pm$ 2000 V peak
	Maximum rated line-to-ground voltage	600 V CAT III 1000 V CAT II	600 V AC/1000 V DC CAT III 1000 V AC/1500 V DC CAT II
Analysis/calculation	Efficiency and loss calculations	Yes (Max.4 each for efficiency and loss, auto* <sup>3</sup> )	Yes (Max.4 each for efficiency and loss)
	Motor analysis Number of channels Input format	Yes* <sup>4</sup> Max. 4 motors Analog DC, frequency, pulse	Yes* <sup>4</sup> Maximum 2 motors Analog DC, frequency, pulse
	Torque meter correction	Zero correction, nonlinear correction, friction correction	
	Harmonics measurement Max. analysis order Synchronization frequency range	Yes (8, for each channel) 500th 0.1 Hz to 1.5 MHz	Yes (8, for each channel) 500th 0.1 Hz to 1 MHz
	IEC harmonics measurement	Yes	-
	IEC flicker measurement	Yes	-
	FFT spectrum analysis	Yes (DC to 4 MHz)	Yes (DC to 1 MHz)
	User-defined calculations	Yes	Yes
	Delta conversion	Yes ( $\Delta$ -Y, Y- $\Delta$ )	Yes ( $\Delta$ -Y, Y- $\Delta$ )
	D/A output	Yes* <sup>4</sup> 20 ch (waveform output, analog output)	Yes* <sup>4</sup> 16ch (waveform output, analog output)
Display	Display	10.1" WVGA TFT color LCD	10.1" WVGA TFT color LCD
	Touch screen	Yes	Yes
Interface	External storage media	USB 3.0	USB 3.0
	LAN (100BASE-TX, 1000BASE-T)	Yes	Yes
	GP-IB	Yes	-
	RS-232C	Yes (maximum 115,200 bps)	-
	External control	Yes	Yes
	Synchronization of multiple instruments	Yes (up to 4 instruments)	Yes (up to 8 instruments)
	Optical link	Yes* <sup>4</sup>	-
	CAN or CAN FD	Yes * <sup>4</sup>	Yes
	Dimensions, weight (WxHxD)	430 mm $\times$ 221 mm $\times$ 361 mm (16.93 in. $\times$ 8.70 in. $\times$ 14.21 in.), 14 kg (493.84 oz.)	
		361 mm $\times$ 176 mm $\times$ 135 mm (14.21 in. $\times$ 6.93 in. $\times$ 5.31 in.) 4.6 kg (162.26 oz.)	

\*1:  $\pm$ (% of reading + % of range) \*2: 6 ranges, based on sensor \*3: The position of terms set on the input and output sides is switched depending on the sign of the measured values.

\*4: Sold separately

## Model No. (Order code)

### PW8001

Model	Number of channels	Motor analysis	Waveform and D/A output	CAN or CAN FD interface	Optical link interface
PW8001-01	1 to 8 channels, specify U7001 or U7005 when placing an order (mixed available)	-	-	-	-
PW8001-02		-	Yes	-	-
PW8001-03		-	-	Yes	-
PW8001-04		-	-	-	Yes
PW8001-05		-	Yes	-	Yes
PW8001-06		-	-	Yes	Yes
PW8001-11		Yes	-	-	-
PW8001-12		Yes	Yes	-	-
PW8001-13		Yes	-	Yes	-
PW8001-14		Yes	-	-	Yes
PW8001-15	U7001	Yes	Yes	-	Yes
PW8001-16		Yes	-	Yes	Yes

### PW4001

Model	Number of channels	Motor analysis	Waveform and D/A output	CAN or CAN FD interface	DC power supply operation
PW4001-01	4 ch	-	-	Yes	-
PW4001-02	4 ch	-	Yes	Yes	-
PW4001-03	4 ch	Yes	-	Yes	-
PW4001-04	4 ch	-	-	Yes	Yes
PW4001-05	4 ch	Yes	Yes	Yes	Yes

Scan for more details on each product.



PW8001



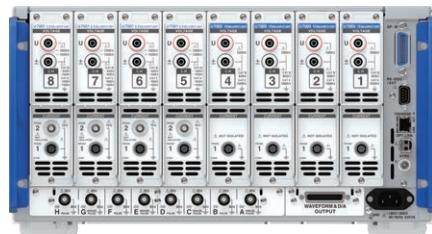
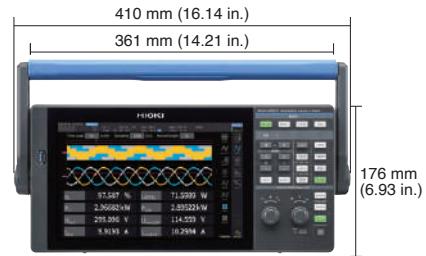
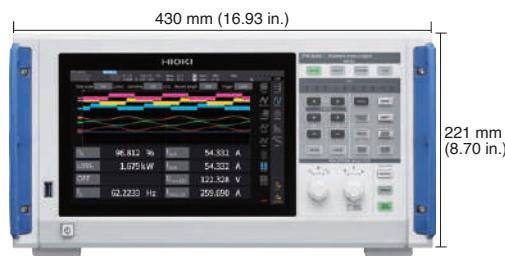
Current Sensors



CT9557



VT1005



PW8001-15  
Four U7001 units installed  
Four U7005 units installed



PW4001

# Current sensor lineup

Model	Appearance	Rated current	Maximum peak current	Frequency range	Amplitude accuracy 50 Hz/60 Hz	Diameter of measurable conductors	Cable length	Automatic phase correction <sup>1</sup>	Operating temperature
<b>Pass-through types</b>									
CT6862-05		50 Arms	±141 A peak	DC to 1 MHz	±0.05 % rdg ±0.01 % f.s.	φ 24 mm (0.94 in.)	3 m (9.84 ft.)	-	-30°C to 85°C -22°F to 185°F
CT6872		50 Arms	±200 A peak	DC to 10 MHz	±0.03 % rdg ±0.007 % f.s.	φ 24 mm (0.94 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6872-01		50 Arms	±200 A peak		±0.03 % rdg ±0.007 % f.s.	10 m (32.81 ft)			-40°C to 85°C -40°F to 185°F
CT6863-05		200 Arms	±565 A peak	DC to 500 kHz	±0.05 % rdg ±0.01 % f.s.	φ 24 mm (0.94 in.)	3 m (9.84 ft.)	-	-30°C to 85°C -22°F to 185°F
CT6873		200 Arms	±350 A peak <sup>2</sup>	DC to 10 MHz	±0.03 % rdg ±0.007 % f.s.	φ 24 mm (0.94 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6873-01		200 Arms	±350 A peak <sup>2</sup>		±0.03 % rdg ±0.007 % f.s.	10 m (32.81 ft)			-40°C to 85°C -40°F to 185°F
CT6875A		500 Arms	±1500 A peak <sup>2</sup>	DC to 2 MHz DC to 1.5 MHz	0.04 % rdg ±0.008 % f.s.	φ 36 mm (1.42 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6875A-1		500 Arms	±1000 A peak <sup>2</sup>		±0.02 % rdg ±0.007 % f.s.	φ 32 mm (1.26 in.)	3 m (9.84 ft.)		-10°C to 50°C 14°F to 122°F
CT6904A		500 Arms	±1000 A peak <sup>2</sup>	DC to 4 MHz DC to 2 MHz	±0.025 % rdg ±0.009 % f.s.	φ 32 mm (1.26 in.)	10 m (32.81 ft)	Yes	-10°C to 50°C 14°F to 122°F
CT6904A-1		800 Arms	±1200 A peak <sup>2</sup>		±0.025 % rdg ±0.009 % f.s.	φ 36 mm (1.42 in.)	3 m (9.84 ft.)		-10°C to 50°C 14°F to 122°F
CT6904A-2		800 Arms	±1200 A peak <sup>2</sup>	DC to 4 MHz DC to 2 MHz	0.04 % rdg ±0.008 % f.s.	φ 36 mm (1.42 in.)	10 m (32.81 ft)	Yes	-40°C to 85°C -40°F to 185°F
CT6904A-3		1000 Arms	±1800 A peak <sup>2</sup>		0.04 % rdg ±0.008 % f.s.	φ 80 mm (3.15 in.)	3 m (9.84 ft.)		-40°C to 85°C -40°F to 185°F
CT6877A		2000 Arms	±3200 A peak <sup>2</sup>	DC to 1 MHz	0.04 % rdg ±0.008 % f.s.	φ 80 mm (3.15 in.)	10 m (32.81 ft)	Yes	-40°C to 85°C -40°F to 185°F
CT6877A-1									-40°C to 85°C -40°F to 185°F
<b>Clamp types</b>									
CT6830		2 Arms	±4.3 A peak	DC to 100 kHz	±0.3 % rdg ±0.05 % f.s.	φ 5 mm (0.20 in.)	4 m, 20 cm <sup>4</sup> (13.12 ft., 7.87 in.)	Yes	-40°C to 85°C (-40°F to 185°F)
CT6831		20 Arms	±43 A peak	DC to 100 kHz	±0.3 % rdg ±0.01 % f.s.	φ 5 mm (0.20 in.)	4 m, 20 cm <sup>4</sup> (13.12 ft., 7.87 in.)	Yes	-40°C to 85°C (-40°F to 185°F)
CT6833		200 Arms	±600 A peak	DC ~ 50 kHz	±0.07 % rdg ±0.007 % f.s.	φ 20 mm (0.79 in.)	5 m (16.40 ft.) 10 m (32.81 ft.)	Yes	-40 °C ~ 85 °C (-40°F to 185°F)
CT6833-01									
CT6834		500 Arms	±800 A peak	DC ~ 50 kHz	±0.07 % rdg ±0.007 % f.s.	φ 20 mm (0.79 in.)	5 m (16.40 ft.) 10 m (32.81 ft.)	Yes	-40 °C ~ 85 °C (-40°F to 185°F)
CT6834-01									
9272-05		20 Arms, 200 Arms	±71 Apeak, ±430 Apeak	1 Hz to 100 kHz	±0.3 % rdg ±0.01 % f.s.	φ 46 mm (1.81 in.)	3 m (9.84 ft.)	-	0°C to 50°C 32°F to 122°F
CT6841A		20 Arms	±60 A peak <sup>2</sup>	DC to 2 MHz	±0.2 % rdg ±0.01 % f.s.	φ 20 mm (0.79 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6843A		200 Arms	±600 A peak <sup>2</sup>	DC to 700 kHz	±0.2 % rdg ±0.01 % f.s.	φ 20 mm (0.79 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6844A		500 Arms	±800 A peak <sup>2</sup>	DC to 500 kHz	±0.2 % rdg ±0.01 % f.s.	φ 20 mm (0.79 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6845A		500 Arms	±1500 A peak <sup>2</sup>	DC to 200 kHz	±0.2 % rdg ±0.01 % f.s.	φ 50 mm (1.97 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
CT6846A		1000 Arms	±1900 A peak <sup>2</sup>	DC to 100 kHz	±0.2 % rdg ±0.01 % f.s.	φ 50 mm (1.97 in.)	3 m (9.84 ft.)	Yes	-40°C to 85°C -40°F to 185°F
<b>Direct-wired types</b>									
PW9100A-3 <sup>3</sup>		50 Arms	±200 A peak <sup>2</sup>	DC to 3.5 MHz	±0.02 % rdg ±0.005 % f.s.	M6 screw terminals	3 ch	Yes	0°C to 40°C 32°F to 104°F
PW9100A-4 <sup>3</sup>		50 Arms	±200 A peak <sup>2</sup>	DC to 3.5 MHz	±0.02 % rdg ±0.005 % f.s.	M6 screw terminals	4 ch	Yes	0°C to 40°C 32°F to 104°F

\*1: When using PW8001 \*2: Within 20 ms and 40°C (104°F) or less \*3: Special specification PW9100A with a rated current of 5A can also be ordered.

\*4: Between sensor to multiplexer, Between multiplexer to output connector

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