HIOKI

CT6904
CT6904-01

AC/DC CURRENT SENSOR

Instruction Manual

EN

Sept. 2018 Revised edition 1
CT6904A961-01 18-09H

6005146911

HIOKI

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Edited and published by HIOKI E.E. CORPORATION
Printed in Japan

Warranty

Warranty malfunctions occurring under conditions of normal use in conformity with the Instruction Manual and Product Precautionary Markings will be repaired free of charge. This warranty is valid for a period of three (3) years from the date of purchase. Please contact the distributor from which you purchased the product for further information on warranty provisions.

Introduction

Thank you for purchasing the Hioki CT6904, CT6904-01 AC/DC Current Sensor. To obtain maximum performance from the device, please read this manual first, and keep it handy for future reference.

Be sure to also read the accompanying “Operating Precautions” before use.

Troubleshooting

If the device seems to be malfunctioning, contact your authorized Hioki distributor or reseller.

⚠ DANGER

- **If the cable melts, metal parts could be exposed, posing a hazard. Keep the cable away from sources of heat.**
- **Connect the device to only the secondary side of a distribution panel. Even if a short-circuit occurs on the secondary side of the distribution panel, the distribution panel will interrupt a short-circuit current. Do not connect it to the primary side of the distribution panel because an unrestricted current flow could damage the device and facilities if a short-circuit occurs.**
- **Do not place the device on an unstable table or an inclined place. Dropping or knocking down the device can cause injury or damage to the device.**

- **Do not flow any current through the lines to be measured with the device turned off. This could result in damage to the device.**
- **Do not place the cable in contact with the measured line. Any contact can cause the device to malfunction and lead to a short-circuit or an electric shock.**

⚠ CAUTION

- To prevent cable damage, do not step on cables or pinch them between other objects. Do not bend or pull on cables at their base.

- The cable is hardened in freezing temperatures. Do not bend or pull it to avoid tearing its shield or cutting cable.
- When the power to lines to be measured is turned on or off, a current flowing through the lines can exceed considerably the maximum allowable current of the device. This could result in damage to the device. Make sure that there is not any over-current.

Overview

This current sensor has a Hioki ME15W output connector.
The sensor has the adequate frequency characteristics and temperature characteristics for not only current measurement but also high-accuracy power measurement.

Specifications

Accuracy

f.s.: Maximum display value or scale length (The rated measurement current)
rdg.: Reading value (The value currently being measured and indicated on the measuring instrument)

General Specifications

Operating environment	Indoor use, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity	−10°C to 50°C (14°F to 122°F) 80% RH or less (no condensation)
Storage temperature and humidity	−20°C to 60°C (−4°F to 140°F) 80% RH or less (no condensation)
Dustproofness and waterproofness	IP20 (EN 60529) *1
Standards	Safety: EN 61010 EMC: EN 61326
Dielectric strength	7.4 kV AC (sensed current: 1 mA) 50 Hz/60 Hz for 1 minute, between through window and cable output terminal
Power supply	Supplied from PW6001, PW3390, or CT9555 Rated supply voltage: ±11.5 V to ±12.5 V (Tracking) Maximum rated current: ±400 mA (500 A/55 Hz measurement, ±12 V power supply)
Maximum rated power	7 VA (500 A/55 Hz measurement, ±12 V power supply)
Interface	Dedicated interface (ME15W)
Dimensions	Approx. 139W × 120H × 52D mm (5.47″W × 4.72″H × 2.05″D) (excluding protrusions and the cable)
Output cable length	CT6904: Approx. 3 m (including relay box) CT6904-01 (with 10 m output cable): Approx. 10 m (including relay box)
Mounting hole diameter	ϕ5.2 mm (M5 screw, recommended tightening torque: 1.5 N•m to 2.0 N•m)
Mass	CT6904: Approx.1 kg (35.3 oz.) CT6904-01 (with 10 m output cable): Approx. 1.3 kg (45.9 oz.)
Product warranty period	3 years
Accessories	• Instruction Manual • Operating Precautions (0990A907) • Carrying case • Colored labels (for channel identification)
Option	Mounting hardware (special-order product)

*1: The protection rating for the enclosure of this device (based on EN60529) is IP20.
2: Protected against access to hazardous parts with fingers. The equipment inside the enclosure is protected against entry by solid foreign objects larger than 12.5 mm in diameter.
0: The equipment inside the enclosure is not protected against the harmful effects of water.

Input / Output / Measurement Specifications

1. Basic specifications

Rated current	500 A AC/DC
Measurable conductor diameter	ϕ32 mm or less
Maximum input current	Within derating shown in Figure 1 However, a current of up to ±1000 A peak (design value) is allowable for up to 20 ms.
Output voltage	4 mV/A
Maximum rated voltage to earth	1000 V (Measurement category III) Anticipated transient overvoltage: 8000 V
Output resistance	50 Ω ±10 Ω
Input impedance	2.5 mΩ typical (100 kHz)
Linearity*1, *2	±10 ppm typical (23°C)
Offset voltage*2	±10 ppm typical (23°C, no input)

*1: Measuring the output voltage while cycling the input current (DC) from +500 A → 0 A → −500 A → 0 A → +500 A at an interval of 100 A. Defined as the difference between the regression line calculated from the above measurements and the measurement points.
*2: Defined as a percentage of the rated current.

2. Accuracy specifications

Conditions of guaranteed accuracy	Guaranteed accuracy period: 1 year Guaranteed accuracy period after adjustment made by Hioki: 1 year Accuracy guarantee for temperature and humidity: 23°C±5°C (73°F±9°F), 80% RH or less Warm-up time: at least 30 min Input waveform: Sine wave, Connection: measuring instrument with an input resistance of 0.9 MΩ to 1.1 MΩ 0 V relative to ground, no external magnetic field, conductor in center position

Measurement accuracy

Frequency	Amplitude	Phase
DC	±0.025% rdg.±0.007% f.s.	–
DC < f < 16 Hz	±0.2% rdg.±0.02% f.s.	±0.1°
16 Hz ≤ f < 45 Hz	±0.1% rdg.±0.02% f.s.	±0.1°
45 Hz ≤ f ≤ 65 Hz	±0.02% rdg.±0.007% f.s.	±0.08°
65 Hz < f ≤ 850 Hz	±0.05% rdg.±0.007% f.s.	±0.12°
850 Hz < f ≤ 1 kHz	±0.1% rdg.±0.01% f.s.	±0.4°
1 kHz < f ≤ 5 kHz	±0.4% rdg.±0.02% f.s.	±0.4°
5 kHz < f ≤ 10 kHz	±0.4% rdg.±0.02% f.s.	±(0.08×f)°
10 kHz < f ≤ 50 kHz	±1% rdg.±0.02% f.s.	±(0.08×f)°
50 kHz < f ≤ 100 kHz	±1% rdg.±0.05% f.s.	±(0.08×f)°
100 kHz < f ≤ 300 kHz	±2% rdg.±0.05% f.s.	±(0.08×f)°
300 kHz < f ≤ 1 MHz	±5% rdg.±0.05% f.s.	±(0.08×f)°
Frequency range	4 MHz (±3 dB Typical)	–

- Unit for f in accuracy calculations: kHz
- Amplitude accuracy and phase accuracy are defined for currents of less than or equal to the rated value for the frequency derating shown in Figure 1 for continuous input at an ambient temperature of 50°C. However, design values are given for DC < f < 10 Hz.
- For the CT6904-01 (with an output cable length of 10 m), add ±(0.015 × f)% rdg. for 50 kHz < f ≤ 1 MHz. CT6904-01 has a frequency band of 2 MHz (±3 dB typical).

Output noise	300 µV rms or less (≤1 MHz)
Effect of temperature	Within the range of -10°C to 18°C or 28°C to 50°C Amplitude sensitivity: ±0.005% rdg./°C Offset voltage: ±0.005% f.s./°C Phase: ±0.01°/°C
Effect of magnetization	5 mA or less (input equivalent, after 500 A DC is input)
Common mode rejection ratio (CMRR)	140 dB or more (50 Hz/60 Hz) 120 dB or more (100 kHz) (Effect on output voltage/common-mode voltage)
Effect of conductor position	±0.01% rdg. or less (input current: 100 A with 50 Hz/60 Hz) ±0.2% rdg. or less (input current: 10 A with 100 kHz) When using wire with an outer diameter of 10 mm
Effect of radiated radio-frequency electromagnetic field	0.5% f.s. or less at 10 V/m
Effect of conducted radio-frequency electromagnetic field	0.2% f.s. or less at 10 V
Effect of external magnetic field	±50 mA or less (input equivalent, under a magnetic field of 400 A/m DC or 400 A/m with 60 Hz)

Function Specifications

Connectable products

1. PW6001 Power Analyzer
Combined accuracy

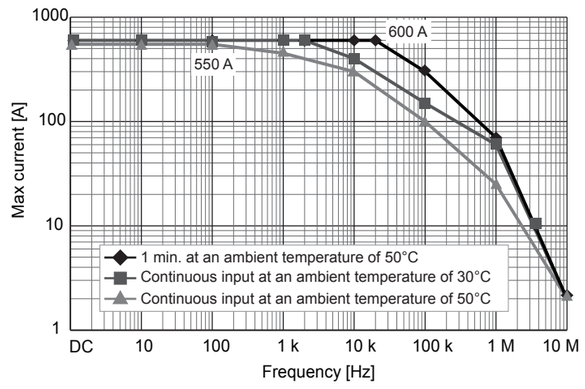
Frequency	Current	Power	Phase
DC	±0.045% rdg.±0.037% f.s. (f.s.: The measurement range set on the PW6001)	±0.045% rdg.±0.057% f.s. (f.s.: The measurement range set on the PW6001)	PW6001 accuracy + sensor accuracy
45 Hz≤f≤ 65 Hz	±0.04% rdg.±0.027% f.s. (f.s.: The measurement range set on the PW6001)	±0.04% rdg.±0.037% f.s. (f.s.: The measurement range set on the PW6001)	
DC, band other than 45 Hz≤ f≤ 65 Hz	PW6001 accuracy + sensor accuracy (Consider sensor rating for f.s. error.)	PW6001 accuracy + sensor accuracy (Consider sensor rating for f.s. error.)	

- For other measurement parameters, PW6001 accuracy + sensor accuracy (consider sensor rating for f.s. error).
- For the 10 A range or the 20 A range, add ±0.12% f.s. of the measurement range set on the PW6001.
- Additional components should be added to the accuracy depending on the power analyzer and sensor specifications.

2. PW3390 Power Analyzer
Combined accuracy
Power analyzer accuracy + sensor accuracy (consider sensor rating for f.s. error)
- Additional components should be added to the accuracy depending on the power analyzer and sensor specifications.

3. CT9555 Sensor Unit
Combined accuracy
Sensor accuracy × 1.5 (when the output coaxial cable is 1.6 m or less in length)
- For the CT6904-01 (with an output cable length of 10 m), the frequency band is 1 MHz (±3 dB typical).
- Additional components should be added to the accuracy depending on the connected device and sensor specifications.

Figure 1. Frequency Derating



When measuring current close to the derating, allow a cool-down time of at least 10 times the time for which the current was input.

Phase Correction Values

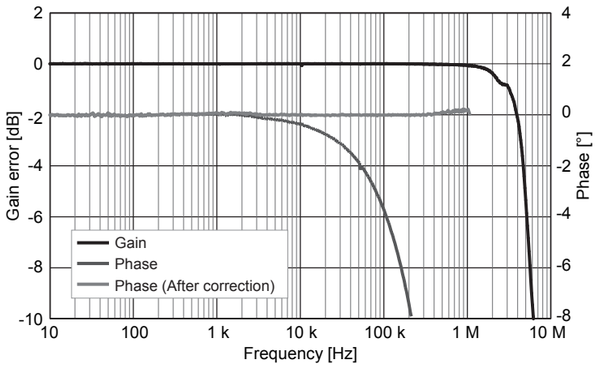
Enter the following correction values (characteristic values) when performing phase correction on the PW6001 or PW3390.

300kHz -9.82° (CT6904, CT6904-01 common)

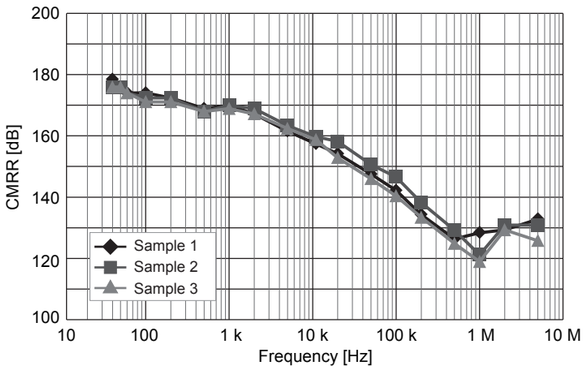
The 300 kHz phase measured value noted in the test report can be used as the phase correction value. In theory, using this value will allow more accurate measurement than is possible when using the representative value.

Characteristics (CT6904)

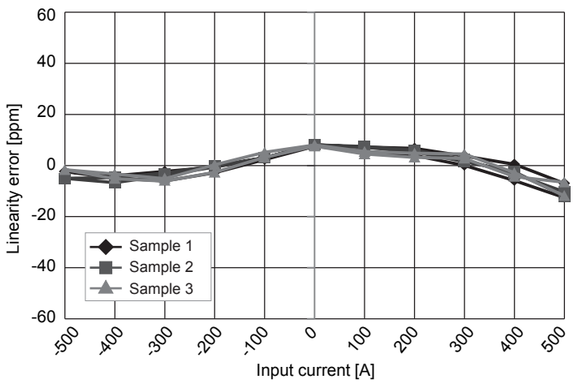
Frequency characteristics (Typical)



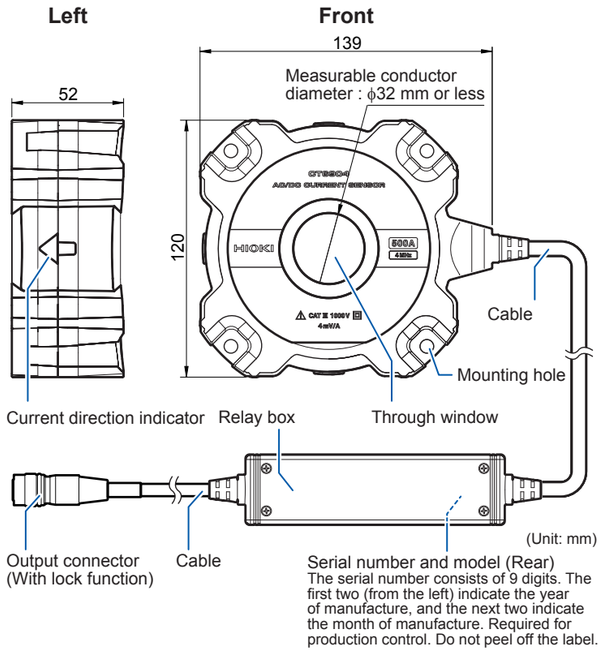
CMRR (Typical)



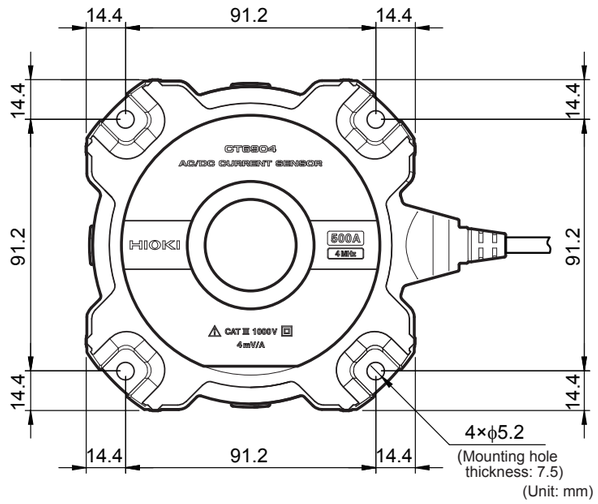
Linearity error (Typical)



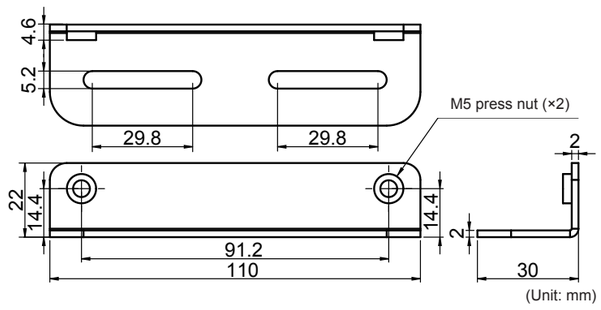
Part Names and Dimensions



Mounting hole dimensions



Mounting hardware dimensions (Option)



Example Installation/Mount

To facilitate high-precision measurement, the measured conductor must be as short as possible. Determine how to mount the device so that the measured conductor is as short as possible.

Recommended tightening conditions

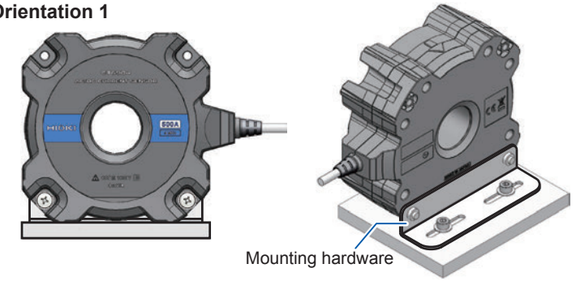
Nominal screw size: M5
Screw length: 20 mm or more
Tightening torque: 1.5 N•m to 2.0 N•m
Use a washer and lock washer

There are two ways to mount the sensor:

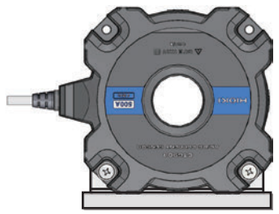
1. Using the mounting hardware

The sensor can be mounted in four orientations.

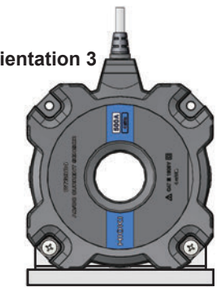
Orientation 1



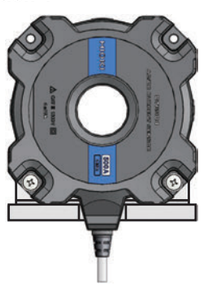
Orientation 2

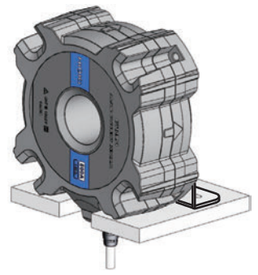


Orientation 3



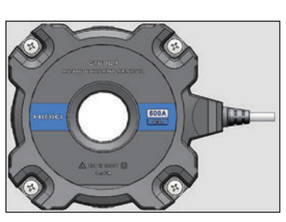
Orientation 4

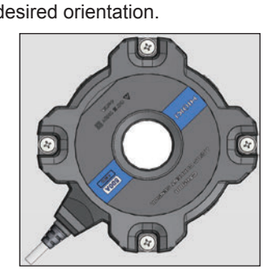




2. Mounting directly

The sensor can be mounted in the desired orientation.





Measurement Procedure

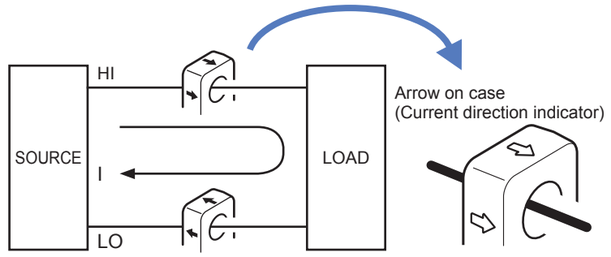
Inspection Before Use

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

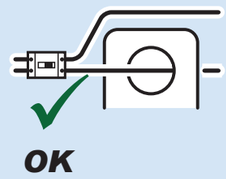
Check Items	Remedy
Is the device cracked or damaged?	If there is any damage, electric shock may result. Discontinue use and contact your authorized Hioki distributor or reseller.
Is the cable insulation torn?	
Is the cable broken at the base (of the connector or the sensor)?	Broken connections will make proper measurement impossible. Discontinue use and contact your authorized Hioki distributor or reseller.

Wiring

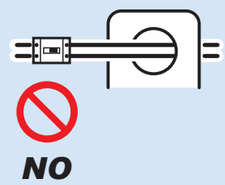
Make sure the direction of the arrow on the case matches the direction of the current flow, as shown in the figure below. If they are oriented incorrectly, the output signal from the sensor will be reversed. When using the device in combination with a power meter, conform to the power meter's wiring method.



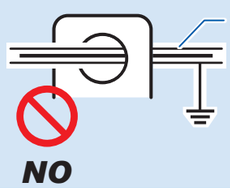
IMPORTANT



Make sure to pass only one conductor through.



Single-phase (2-wire) or three-phase (3-wire) cables conducted together will not produce any reading.



Ground-shielded conductors cannot be accurately measured.