

# HIOKI 9709, 9709-10 9709-05 AC/DC CURRENT SENSOR

## Instruction Manual EN

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# HIOKI



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### 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 Model 9709, 9709-10 or 9709-05 AC/DC Current Sensor. To obtain maximum performance from the device, please read this manual first, and keep it handy for future reference.

### Usage with Other Hioki Products

The Model 9709 (-10), (-05) is used in connection with a dedicated instrument (Hioki). See "Specifications" for details.

### Inspection

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

## Overview

The Model 9709 (-05) is a feed-through current sensor designed to measure AC/DC currents up to 500 A with high precision. Featuring good frequency characteristics (amplitude & phase) and good temperature characteristics (sensitivity & offset), the sensor is also suitable for high-precision power measurements. The Model 9709-10 is a current sensor that supports even higher-accuracy power measurement when used in combination with the Model 3390-10 Power Analyzer.

## Safety Information

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

### ⚠ DANGER

This device is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the device. However, using the device in a way not described in this manual may negate the provided safety features. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from device defects.

### Safety Symbol

	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the device. The ⚠ symbol printed on the device indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
	Indicates a double-insulated device.

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

	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
	Indicates that incorrect operation presents a possibility of injury to the user or damage to the device.
	Indicates advisory items related to performance or correct operation of the device.

### Symbols for Various Standards

	Indicates the Waste Electrical and Electronic Equipment Directive (WEEE Directive) in EU member states.
	Indicates that the product conforms to regulations set out by the EU Directive.

### Other Symbol

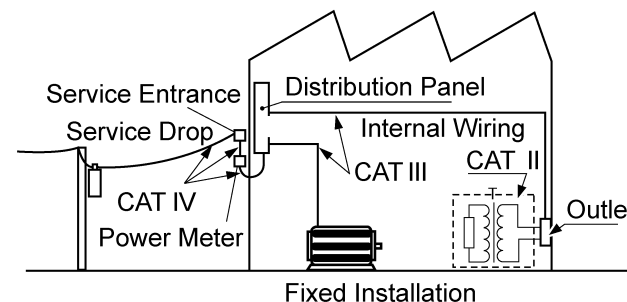
	Indicates a prohibited action.
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### Measurement categories

This device complies with CAT III safety requirements. To ensure safe operation of measurement devices, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, and called measurement categories. These are defined as follows.

- CAT II: Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)  
CAT II covers directly measuring electrical outlet receptacles.
- CAT III: Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.

CAT IV: The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



Using a measurement device in an environment designated with a higher-numbered category than that for which the device is rated could result in a severe accident, and must be carefully avoided. Use of a measurement instrument that is not CAT-rated in CAT II to CAT IV measurement applications could result in a severe accident, and must be carefully avoided.

### Instrument Installation

Operating temperature and humidity : 0 to 50° C, 80%RH or less (non-condensation)

Avoid the following locations that could cause an accident or damage to the instrument.	
	Exposed to direct sunlight Exposed to high temperature
	In the presence of corrosive or explosive gases
	Exposed to water, oil, other chemicals, or solvents Exposed to high humidity or condensation
	Exposed to strong electromagnetic fields Near electromagnetic radiators
	Exposed to high levels of particulate dust
	Near induction heating systems (e.g., high-frequency induction heating systems and IH cooking utensils)
	Subject to vibration

## Operating Precautions

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

### Preliminary Checks

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

### ⚠ DANGER

- This device should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.
- The maximum rated voltage between input terminals and ground is 1000 V DC/AC. Attempting to measure voltages exceeding 1000 V with respect to ground could damage the device and result in personal injury.

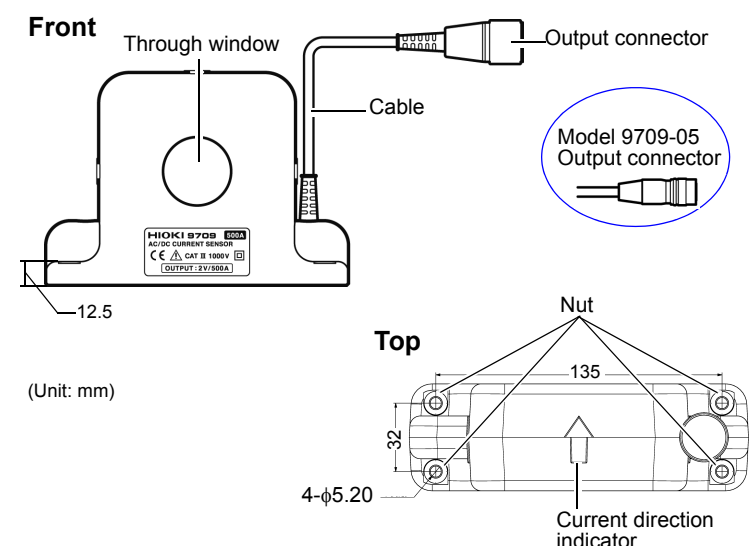
### ⚠ WARNING

- Before using the device, make sure that the insulation on the cable is undamaged and that no bare conductors are improperly exposed. Using the device in such conditions could cause an electric shock, so contact your dealer or Hioki representative for repair.
- In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting this device.
- Ensure that the input does not exceed the maximum input voltage or current to avoid device damage, short-circuiting and electric shock resulting from heat building.
- Avoid contact between the cable and the measured line in order to protect the cable from damage. Any contact can cause the device to malfunction and lead to short-circuits or electric shock.
- Do not use the device where it may be exposed to oil, chemicals, or solvents. Contact with these substances may cause cracking in the device, resulting in damage or electric shock.

### ⚠ CAUTION

- This device is not drip-proof. Water droplets on the connector may result in malfunctions.
- Do not slant the device or place it on top of an uneven surface. Dropping or knocking down the device can cause injury or damage to the device.
- Avoid stepping on or pinching cables, which could damage the cable insulation.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.
- To avoid damage to the device, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- 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.
- Do not apply any current through the lines to be measured with the device turned off. This could result in damage to the device.

## Names of Parts



# Specifications

## Accuracy

f.s.: maximum display value or scale length (Rated current)  
rdg.: reading value (The value currently being measured and indicated on the measuring instrument)

## About the 9709-10

The 9709-10 specifications are the same as the following 9709 specifications. For more information about specifications when used with the 3390-10, see the 3390-10 instruction manual.

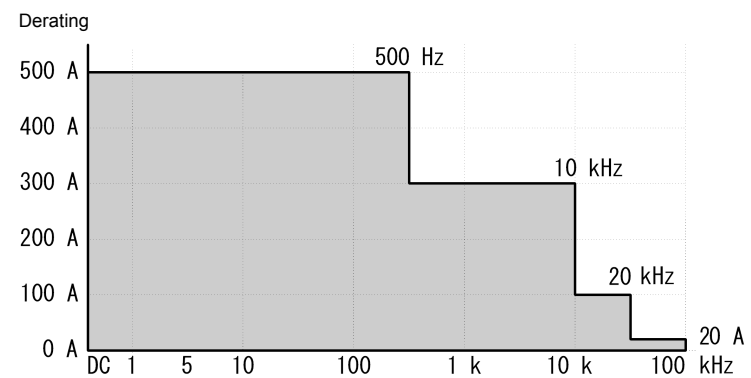
The specs except the output connector and options are the same as respectively those of the 9709, 9709-05 and 9709-10.

Operating Environment	Indoors, Pollution degree 2, altitude up to 2000 m (6562-ft.)				
Operating temperature and humidity	0°C to 50°C (32°F to 122°F), 80%RH or less (non-condensation)				
Storage temperature and humidity	-10°C to 60°C (14°F to 140°F), 80%RH or less (non-condensation)				
Maximum rated voltage to earth	1000 V AC/DC (50 Hz/60 Hz), Overvoltage Category III, anticipated transient overvoltage 8000 V				
Applicable standards	Safety : EN61010 EMC : EN61326				
Product warranty period	3 years				
Rated current	500 A AC/DC				
Output voltage	2 V/500 A				
Maximum input current	700 A rms (1000 A peak, 50 Hz/60 Hz, continuity), within a derating				
Output resistance	50 Ω ( ± 5%)				
Temperature and humidity range of guaranteed accuracy	23 ± 5°C (73 ± 9°F), 80%RH or less				
Period of guaranteed accuracy	6 months				
Guaranteed accuracy period from adjustment made by Hioki	6 months				
Warming-up time	after auto-balancing, after 10 minutes				
Accuracy	Sine wave input, conductor in center position, using with Model 9555-10, Not including each effect Measuring instrument having 1 MΩ or higher input resistance. Amplitude accuracy (Within a derating, DC < f < 5 Hz (design values)) Phase accuracy (Within a derating, DC < f < 10 Hz (design values))				
Frequency	DC	Amplitude	± 0.05% rdg. ± 0.01% f.s.	Phase	Not specified
	DC < f < 45 Hz	± 0.2% rdg. ± 0.02% f.s.		± 0.3°	
	45 Hz ≤ f ≤ 66 Hz	± 0.05% rdg. ± 0.01% f.s.		± 0.2°	
	66 Hz < f ≤ 500 Hz	± 0.2% rdg. ± 0.02% f.s.		± 0.5°	
	500 Hz < f ≤ 5 kHz	± 0.5% rdg. ± 0.05% f.s.		± 0.5°	
	5 kHz < f ≤ 10 kHz	± 2.0% rdg. ± 0.10% f.s.		± 2.0°	
	10 kHz < f ≤ 20 kHz	± 5.0% rdg. ± 0.10% f.s.		± 5.0°	
	20 kHz < f ≤ 100 kHz	± 30% rdg. ± 0.10% f.s.		± 30°	
Temperature coefficient	Amplitude sensitivity : ± 0.01% rdg./°C or less Offset voltage : ± 0.005% f.s./°C or less				
Effect of conductor position	± 0.05% rdg. or less (at 100 A DC input, using with the wire 10 mm diameter)				
Effect of external electromagnetic field	50 mA or less (In a 60 Hz or DC magnetic field of 400 A/m)				
Effect of magnetic	20 mA or less (after 500 A DC input)				
Effect of radiated radio-frequency electromagnetic field	2% f.s. at 3 V/m				
Effect of conducted radio-frequency electromagnetic field	0.2% f.s. at 3 V				
Measurable conductor diameter	φ36 mm (1.42" ) or less				
Supply voltage	± 11 V to ± 15 V (Tracking)				
Power supply capacity	± 300 mA or less (500 A/55 Hz measurement, with ± 12 V power supply)				
Rated power	5 VA or less (500 A/55 Hz measurement, with ± 12 V power supply)				
Dimensions and Mass	Approx. 160W × 112H × 50D mm, Approx. 850 g (Approx. 6.30" W × 4.41" H × 1.97" D, Approx. 30.0 oz.) (excluding protrusions, cable)				
Cable length	Approx. 3 m				

Output connector	9709, 9709-10: Hioki PL23 (Male) 9709-05 : Hioki ME15W (Male)														
Accessories	Instruction manual (Japanese/ English) ×1, Mark band×6 (3sets)														
Attachable connection devices and conditions															
Options	<table border="1"> <tr> <td rowspan="4">9709 9709-10</td> <td>CT9900</td> <td>Conversion Cable</td> </tr> <tr> <td>CT9903</td> <td>Extension Cable</td> </tr> <tr> <td>9318</td> <td>Conversion Cable</td> </tr> <tr> <td>9705</td> <td>Conversion Cable</td> </tr> <tr> <td rowspan="2">9709-05</td> <td>CT9901</td> <td>Conversion Cable</td> </tr> <tr> <td>CT9902</td> <td>Extension Cable</td> </tr> </table>	9709 9709-10	CT9900	Conversion Cable	CT9903	Extension Cable	9318	Conversion Cable	9705	Conversion Cable	9709-05	CT9901	Conversion Cable	CT9902	Extension Cable
9709 9709-10	CT9900		Conversion Cable												
	CT9903		Extension Cable												
	9318		Conversion Cable												
	9705	Conversion Cable													
9709-05	CT9901	Conversion Cable													
	CT9902	Extension Cable													

Combined accuracy and conditions		
Combined accuracy = Accuracy of 9709 (-05) + Accuracy of combined product (Power factor: 1)		
Combined product	Required option	
	9709, 9709-10	9709-05
CT9555, CT9556, CT9557 Sensor Unit <sup>*1</sup>	CT9900	—
PW3390 Power Analyzer	CT9900	—
PW6001 Power Analyzer	CT9900	—
9602 AC/DC Clamp Input Unit <sup>*2</sup>	—	CT9901
3334-10 AC/DC Power Hitster	—	CT9901
8940 F/V Unit <sup>*3</sup>	9705+9318	CT9901+9705+9318
8971 Current Unit <sup>*3</sup>	9318	CT9901+9318
9555-10 Sensor Unit	—	CT9901
3390, 3390-10 Power Analyzer	—	CT9901

\*1: Add the sensor unit output accuracy to the combined accuracy when one of the addition functions, that is, RMS output or TOTAL OUTPUT, is used.  
\*2: Add ± 0.1% rdg. to the combined accuracy.  
\*3: The sensor recognition methods vary according to the Memory HiCorder settings (refer to the manuals of Memory HiCorder to be connected).



# Measurement Procedure

## WARNING

**In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting this device.**

## CAUTION

- To prevent damage to the connected instrument and sensor, never connect or disconnect a sensor while the power is on.
- When the connected instrument's power is turned off, do not apply current to the sensor. Doing so may damage the device.
- When disconnecting the output connector, be sure to release the lock before pulling off the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable, can damage the connector.

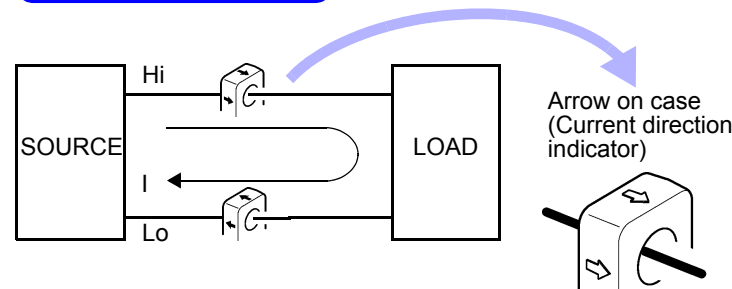
## NOTE

The sensor's signal output circuit is protected by a resistor (output resistor). A digital multimeter used for monitoring should have high input resistance (recommended minimum: 1 MΩ).

## Wiring

Make sure the direction of the arrow on the case matches the direction of the current flow, as shown in Figure 1. If they are oriented incorrectly, the output signal from the sensor will be reversed

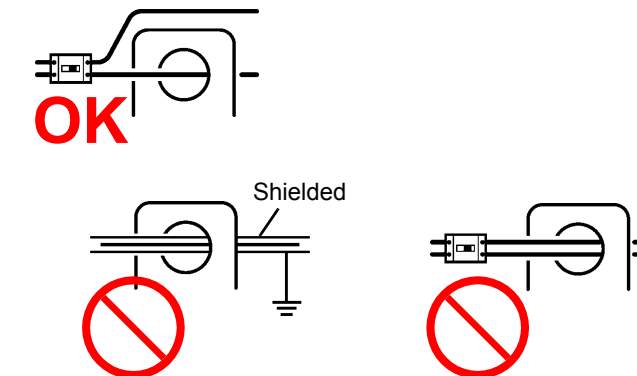
Figure 1. Wiring example



When the 9709 or 9709-10 is used with a wattmeter, follow the wiring instructions provided with the wattmeter.

## NOTE

- 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.

# Maintenance and Service

## WARNING

**Do not attempt to modify, disassemble or repair the device; as fire, electric shock and injury could result.**

- To clean the device, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- If the device seems to be malfunctioning, contact your dealer or Hioki representative. When returning the device for repair, pack the device so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.

# Options

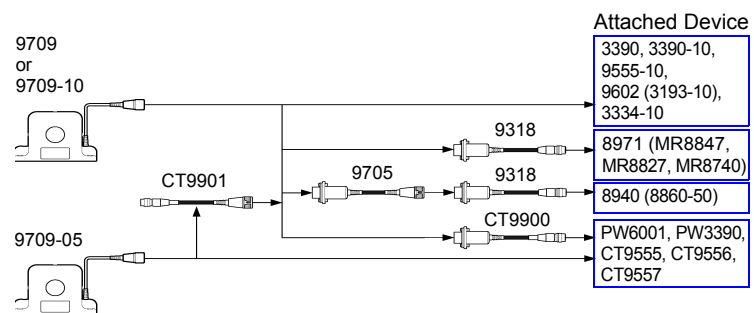
**9705 Conversion Cable<sup>\*1</sup>, 9318 Conversion Cable<sup>\*1</sup>, CT9900 Conversion Cable<sup>\*1</sup>, CT9901 Conversion Cable<sup>\*2</sup>**  
The Conversion Cable makes it possible to connect to and use with products that cannot be directly connected to the 9709, 9709-05 or 9709-10 (Refer to "Connection example").

**CT9902 Extension Cable<sup>\*2</sup>(5 m), CT9903 Extension Cable<sup>\*1</sup>(5 m)**

- Single sensor cable, 5 m extension (max. 10 m extension)
- Up to two extension cable is connectable. (If three or more extension cables are connected to the device, its performance is not guaranteed)
- Add the following values to each of the accuracy per cable:  
Amplitude accuracy: ±0.1% rdg. (DC ≤ f<sup>\*3</sup> ≤ 1 kHz)  
±0.5% rdg. (1 kHz < f<sup>\*3</sup>)  
Phase accuracy: ±(0.1 × f<sup>\*3</sup> kHz)<sup>°</sup> (1 kHz < f<sup>\*3</sup>)

\*1: For 9709, 9709-10, \*2: For 9709-05, \*3: frequency

# Connection example



Cannot be directly connected to any parenthesized models. A module is required. Refer to "Combined accuracy and conditions" specified in the specifications.