HIOKI

CT9691,CT9692,CT9693

CLAMP ON AC/DC SENSOR

Instruction Manual

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The Declaration of Conformity for instruments that comply to CE mark requirements may be downloaded from the HIOKI website.

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 one (1) year 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 CT9691, CT9692, CT9693 Clamp on AC/DC Sensor. To obtain maximum performance from the device, please read this manual first, and keep it handy for future reference.

Initial Inspection

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

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.
- Pack the device so that it will not sustain damage during shipping, and include a description of existing damage. We do not take any responsibility for damage incurred during shipping.
- When disposing of the unit, do so in accordance with all applicable local regulations.

Safety

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.

⚠WARNING
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. 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.
⚡	Indicates that the instrument may be connected to or disconnected from a live circuit.

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

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

Symbols for Various Standards

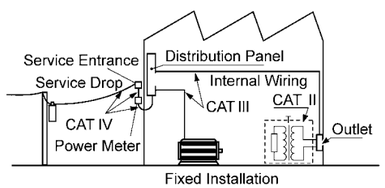
	WEEE marking: This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).
CE	This symbol indicates that the device conforms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

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.

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.



Operating Precautions

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

Instrument Installation

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

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

Exposed to strong electromagnetic fields
Near electromagnetic radiators

Operating temperature and humidity range: 0°C to 40°C (32 to 104°F), 80% RH or less; no condensation
Storage temperature range: -10°C to 50°C (14°F to 122°F), 80% RH or less; no condensation

⚠DANGER

- **Attempting to do so could cause a short circuit or accident resulting in injury or death.**
- **To avoid electric shock, do not remove the device's case. The internal components of the device carry high voltages and may become very hot during operation.**
- **To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots and a safety helmet.**

⚠WARNING
To avoid damaging the sensor, do not input a current in excess of the maximum input range. The maximum input range varies with the frequency of the measurement current. Note that continuously inputting a high frequency will cause the clamp sensor to generate heat.

⚠CAUTION

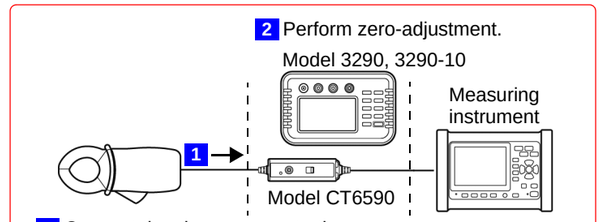
- The tips of the clamp sensor are extremely delicate. Exercise care in handling the sensor as deformation of the clamp sensor or damage to the clamp surface caused by dropping the sensor or bumping it into other objects may prevent accurate measurement.
- Keep the clamp jaws and core slits free from foreign objects, which could interfere with clamping action.
- 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.
- Measurements are degraded by dirt on the mating surfaces of the clamp on sensor, so keep the surfaces clean by gently wiping with a soft cloth.

Preliminary Checks

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

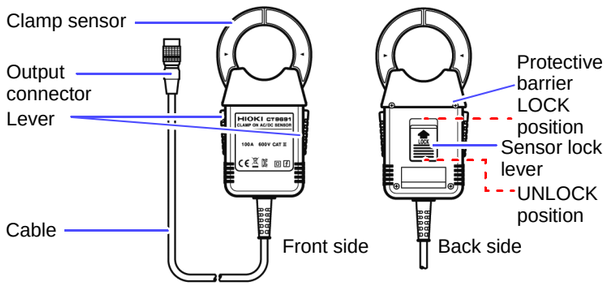
Overview

The CT9691, CT9692, and CT9693 Clamp on AC/DC Sensors are designed to be used with the 3290 and 3290-10 Clamp on AC/DC HiTesters or the CT6590 Sensor Unit (collectively, "instruments").
The 3290 and 3290-10 automatically detect the sensor when it is connected and set the range accordingly. This combination of equipment can be used to measure DC, AC, and AC+DC current in live lines.

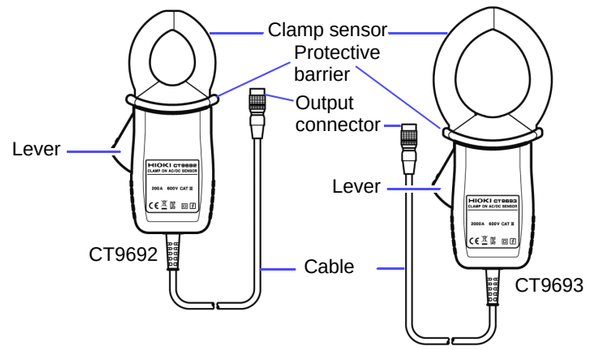


Parts Names

CT9691 Clamp On AC/DC Sensor



CT9692, CT9693 Clamp On AC/DC Sensor



Pre-Operation Inspection

Perform the following inspection before starting measurement:

No.	Inspection step (Continue inspection if OK.)	Corrective action (Perform when unit fails inspection.)
1	Is the clamp cracked or damaged?	If there is any damage, electric shock may result. Discontinue use and have the sensor repaired.
2	Is the cable insulation torn?	
3	Is there a broken connection involving the connector or sensor base?	You will not be able to perform proper measurement. Cease use and contact your dealer.

Measurement Procedures

⚠DANGER

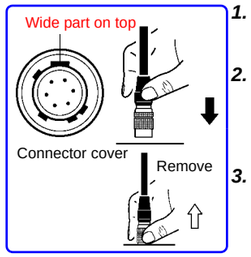
- **To avoid electric shock, do not touch the portion beyond the protective barrier during use.**
- **The maximum rated voltage is 600 V AC/DC. Attempting to measure voltages exceeding 600 V with respect to ground could damage the device and result in personal injury.**

⚠CAUTION

- The continuous maximum input range is based on the rise in temperature that occurs due to self-heating during measurement. Do not input a current in excess of this range. Doing so may damage the sensor. (The continuous maximum input range varies with the sensor and the frequency of the measurement current. Refer to the frequency derating characteristics graph in the “Specifications” section.)
- When removing the output connector, always grip the metal part of the connector. Pulling on the connector with excessive force may damage the connector.

For more information about instrument operation and settings, see the instrument’s instruction manual.

1 Connect the sensor to the instrument.

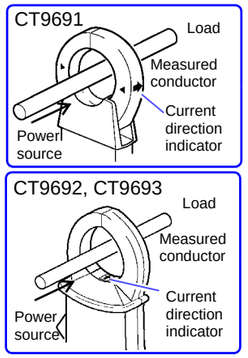


1. **If the included connector cover is attached to the clamp sensor’s output connector, slide it up the cable.**
2. **Gripping the <u>black part of the connector</u>, insert it into the jack.**
   Orient the connector so the wide part is facing up and insert it until you hear it click into place.
3. **Return the connector cover.**
   When removing the connector, slide the connector cover toward the cable and pull on the <u>metal part of the connector</u>.

2 Perform zero-adjustment. (DC measurement)

Correct zero output under no-input conditions.

3 Connect the sensor to the measurement target.



1. **Open the clamp sensor, align the current direction mark with the direction of the current in the wire, and close the clamp with the wire roughly centered in the clamp.**
   If the phase is not an issue during AC measurement, the direction of current flow in the wire relative to the current direction mark may be ignored.
2. **When using the CT9691 sensor, set the lock lever on the back of the sensor to the “LOCK” position.**
   Locking the sensor ensures that it will not open during measurement. If the sensor opens even slightly during measurement, the measured value will decrease, and the accuracy of the reading will not be guaranteed.

4 Remove the sensor after measurement is complete.

NOTE

- When a conductor to be measured is placed in the center of the clamp core, measurement is performed the most accurately, with no effect of the conductor position.
- Attach the clamp around only one conductor. Single-phase (2-wire) or three-phase (3-wire) cables clamped together will not produce any reading.

- To measure low current levels, multiple windings may be used to increase relative sensitivity (10 windings multiplies the measured current by a factor of 10). However, in this case, the windings should be made radially, with a diameter of at least 20 cm
- The reading may show a measurement greater than the actual value due to magnetic-field interference. The amount of interference varies depending on the sensor. For details, see “External magnetic-field interference” in Specifications.

Specifications

	CT9691 sensor	CT9692 sensor	CT9693 sensor
Rated primary current	AC/DC100 A	AC/DC200 A	AC/DC2000 A
Output voltage	AC/DC1 V/100 A	AC/DC2 V/200 A	AC/DC2 V/2000 A
Maximum input range (RMS value)	100 A continuous *1	200 A continuous *1	2000 A continuous *1
Maximum peak current value	150 A_{peak}	300 A_{peak}	2840 A_{peak}
Accuracy guarantee for temperature and humidity	23°C ± 5°C (73°F±9°F), 80%RH or less, no condensation		
Guaranteed accuracy period	1 year (Opening and closing of the sensor: 10,000 times)		
Frequency band	DC to 10 kHz (-3dB)	DC to 20 kHz (-3dB)	DC to 15 kHz (-3dB)
Effect of conductor position	Within ±1.0% at 80 A (55 Hz)	Within ±0.5%	Within ±0.7%
External magnetic-field interference	0.5 A equivalent or less*2	0.7 A equivalent or less*2	2.0 A equivalent or less*2
Temperature characteristics	0 to 40°C range: 0.1 x accuracy specifications/°C 32°F to 104°F range: 0.18 x accuracy specifications/°F		
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less; no condensation		
Storage temperature and humidity range	-10°C to 50°C (14°F to 122°F), 80% RH or less; no condensation		
Location for use	Indoor, pollution degree 2, altitude up to 2000 m (6566 feet)		
Maximum rated voltage to earth	AC/DC 600 V		
Dielectric strength	5.55 kV AC for 1 minute (sensor - case, sensor - circuit)		
Maximum rated power	50 mVA		
Measurable conductor diameter	ϕ35 mm (1.38") or less	ϕ33 mm (1.30") or less	ϕ55 mm (2.17") or less
Dimensions	Approx. 53W x 129H x 18D mm Approx. 2.09"W x 5.08"H x 0.71"D	Approx. 62W x 167H x 35D mm Approx. 2.44"W x 6.57"H x 1.38"D	Approx. 62W x 196H x 35D mm Approx. 2.44"W x 7.72"H x 1.38"D
Mass	Approx. 230 g (8.1 oz.)	Approx. 410 g (14.5 oz.)	Approx. 500 g (17.6 oz.)
Cable length	Approx. 2 m (6.6 feet)		
Accessories	Instruction manual (Japanese/ English/ Chinese) x 1		
Applicable standards	Safety EN61010, EMC EN61326 Measurement categories III (Anticipated Transient Overvoltage: 6000 V) Pollution Degree 2		

*1: Derating according to frequency
*2: In an external electromagnetic field of 400 A/m

CT9691 sensor accuracy

Frequency		DC	DC < f ≤ 66 (Hz)	66 < f ≤ 500 (Hz)
Continuous input	I ≤ 80 (A)	±1.0%rdg. ± 0.5 mV	±1.0%rdg. ± 0.5 mV	±2.0%rdg. ± 0.5 mV
	80 < I ≤ 100 (A)			±2.5%rdg. ± 0.5 mV
Peak input	$\lvert I_{peak}\rvert \le 110$ (A_{peak})	±1.0%rdg. ± 2 mV	±1.0%rdg. ± 2 mV	±2.0%rdg. ± 2 mV
	110 < $\lvert I_{peak}\rvert \le$ 150 (A_{peak})			±2.5%rdg. ± 2 mV
Phase		-	±1.8deg.	Not defined.

CT9692 sensor accuracy

Frequency		DC	DC < f ≤ 66 (Hz)	66 < f ≤ 1k (Hz)
Continuous input	I ≤ 200 (A)	±1.0%rdg. ± 0.5 mV	±1.0%rdg. ± 0.5 mV	±2.0%rdg. ± 0.5 mV
Peak input	$\lvert I_{peak}\rvert \le 300$ (A_{peak})	±1.0%rdg. ± 2 mV	±1.0%rdg. ± 2 mV	±2.0%rdg. ± 2 mV
Phase		-	±1.8deg.	Not defined.

CT9693 sensor accuracy

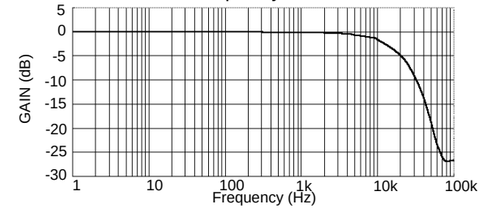
Frequency		DC	45 ≤ f ≤ 66 (Hz)	DC < f < 45, 66 < f ≤ 1k (Hz)
Continuous input	I ≤ 1800 (A)	±1.5%rdg. ± 0.5 mV	±1.0%rdg. ±0.5 mV	±2.0%rdg. ±0.5 mV
	1800 < I≤ 2000 (A)		±2.0%rdg. ±0.5 mV	Not defined.

CT9693 sensor accuracy

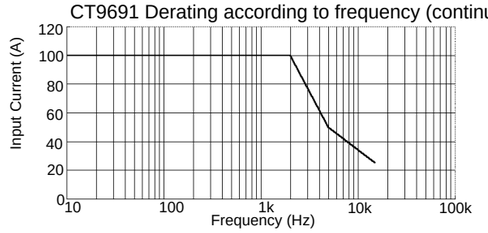
Peak input	$\lvert I_{peak}\rvert \le 2300$ (A_{peak})	±1.5%rdg. ±2 mV	±1.0%rdg. ± 2 mV	±2.0%rdg. ±2 mV
	2300 < $\lvert I_{peak}\rvert \le$ 2840 (A_{peak})	±6.0%rdg. ±2 mV	±6.0%rdg. ± 2 mV	Not defined.
Phase		-	±1.8deg.	DC < f < 45 Hz: ±1.8deg. 66 < f ≤ 1k (Hz): Not defined.

"Peak input" is only available in conjunction with 3290 or 3290-10.
For more information about the combination accuracy with the instrument, see the instrument’s instruction manual.
Amplitude accuracy design value is DC < f < 5 Hz. Phase accuracy design value is DC < f < 10 Hz.
rdg. : The value currently being measured and indicated on the measuring device.

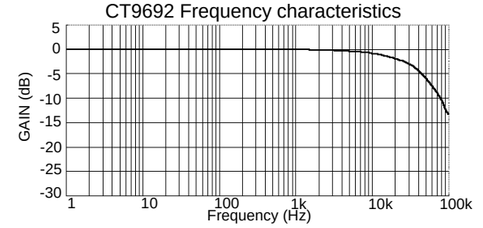
CT9691 Frequency characteristics



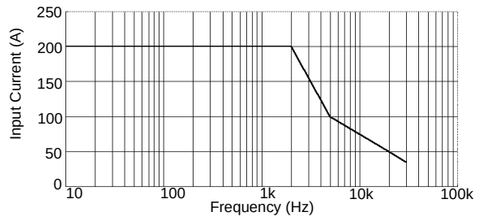
CT9691 Derating according to frequency (continuous)



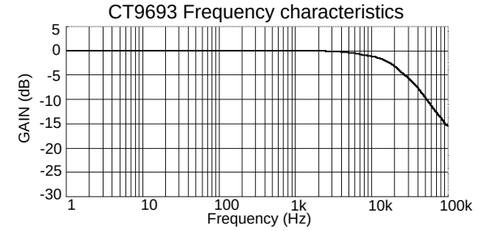
CT9692 Frequency characteristics



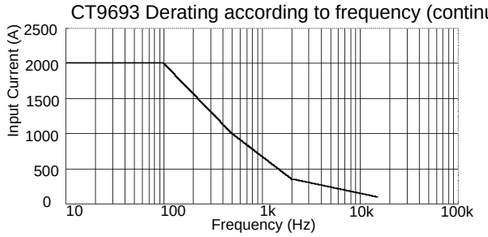
CT9692 Derating according to frequency (continuous)



CT9693 Frequency characteristics



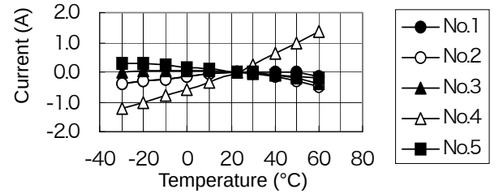
CT9693 Derating according to frequency (continuous)



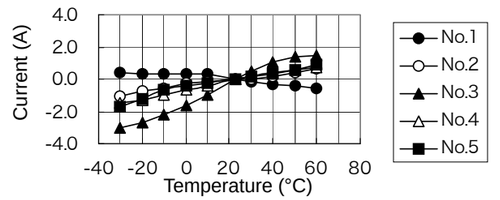
Zero-point Temperature Characteristics

Hall elements are subject to individual variation, and it is not possible to specify the magnitude or tendency of that variation. When using the sensor in an operating environment characterized by large temperature variations, it is recommended to assess variation in the zero point under no-input conditions. Zero-point variation affects DC by not AC mode operation. Reference examples are provided below to illustrate zero-point variation (23°C reference) relative to temperature variations for each sensor. (There is also a significant level of variation in characteristics among individual products.) The clamp sensor operating temperature range is 0°C to 40°C. (See below for example characteristics.)

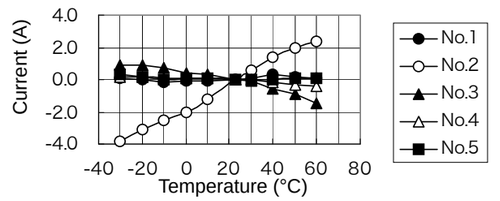
CT9691: Zero-point variation caused by temperature



CT9692: Zero-point variation caused by temperature



CT9693: Zero-point variation caused by temperature



Temperature Characteristics of Sensor Sensitivity

The clamp sensor’s detection circuitry uses Hall elements. Since Hall elements exhibit temporal drift as well as ambient temperature-dependent drift, the sensor’s internal circuitry performs temperature correction. Reference examples are provided below to illustrate sensitivity variation (23°C reference) relative to temperature for each sensor. (There is also a slight level of variation in characteristics among individual products.)

Sensor sensitivity variation caused by temperature