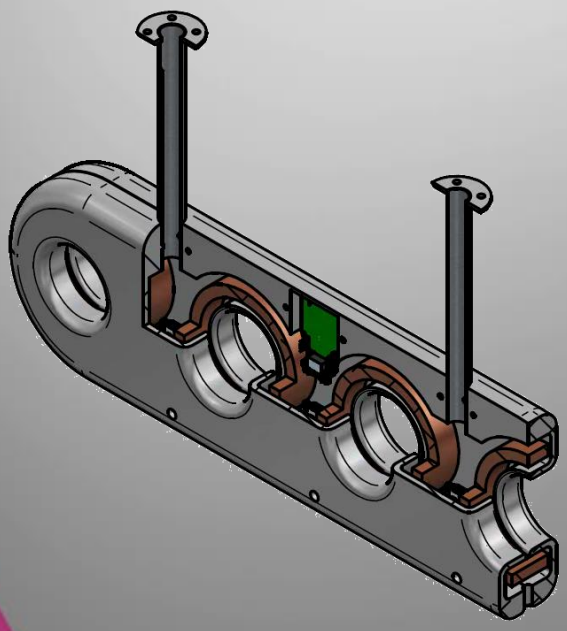
PRECISION CURRENT TRANSDUCERS

# DC Current Transducers

## 4XCT-100-C-HP

CAENels
Gear for Science

# User's Manual




Rev. 1.0 – February 2017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# Table Of Contents

| Revision | Date | Comment |
|---|---|---|
| 1.0 | February 13th 2017 | Document created |

## Safety information - Warnings

CAEN ELS will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

**Please read carefully the manual before operating any part of the instrument**

# WARNING

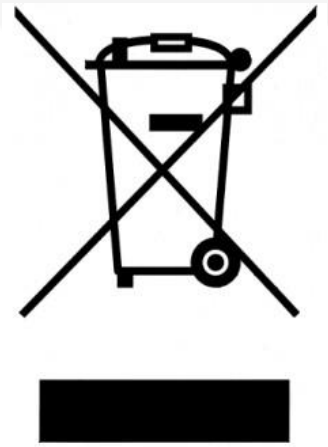
# Do NOT open the boxes

**CAEN ELS s.r.l. declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly this User's Manual before any kind of operation.**

CAEN ELS s.r.l. reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

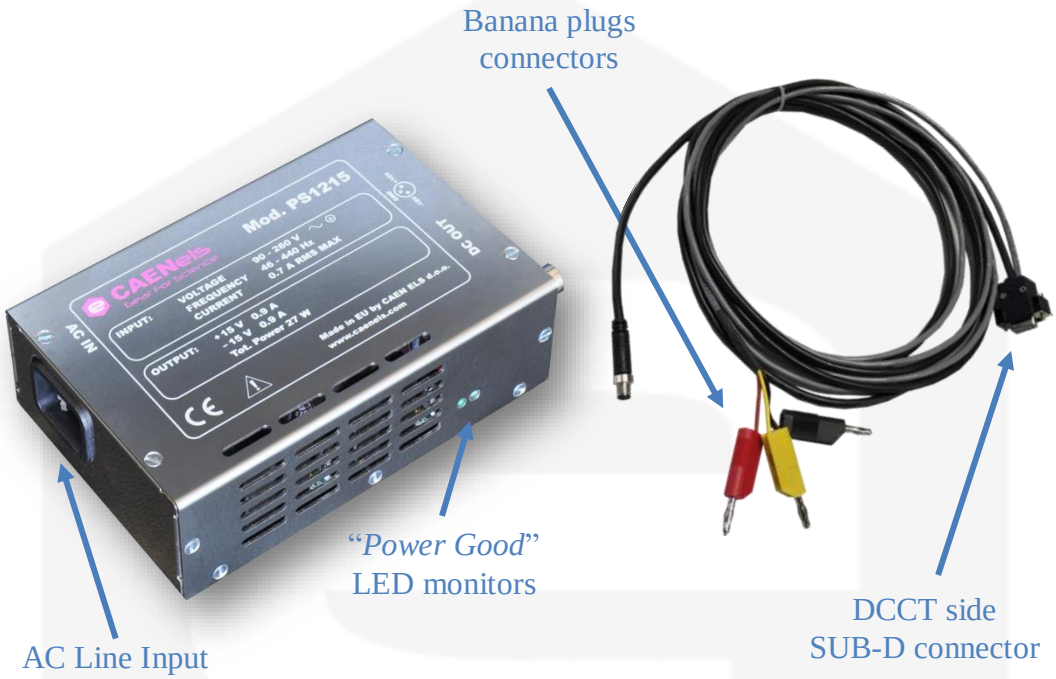
**Disposal of the Product**

The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.



# PS1215 – Power Supply Recommendations

We strongly recommend using this product with the CAEN ELS PS1215 power supply, which has been especially deigned in order to obtain low-noise operation and it is suited for DCCT measurement system where switching power supplies could corrupt measuring accuracy, precision and noise.




The power supply is available in two different versions, one to be used with the current-output DCCTs and one with the voltage-output ones (the PS1212I is shown in the previous image):

| Product Code | Description |
|---|---|
| **WPS1215VXAAA** | **PS1215V** - AC/DC Single Output - Dual Voltage ±15V Low Noise Power Supply - 27W max - 3m cable with DB-9 and BNC (**Voltage** Output) |
| **WPS1215IXAAA** | **PS1215I** - AC/DC Single Output - Dual Voltage ±15V Low Noise Power Supply - 27W max - 3m cable with DB-9 and banana plugs (**Current** Output) |

For more information or further details please refer to the PS1215 User's Manual.

Read over the instruction manual carefully before using the instrument.
The following precautions should be strictly observed before using the CT-100-C-HP.

**WARNING**

- Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in this manual.
- Do not use the device if it is damaged. Before you use the device, inspect the instrument for possible cracks or breaks before each use.
- Do not operate the device around explosives gas, vapor or dust.
- Always use the device with the cables provided.
- Turn off the device before establishing any connection.
- Do not operate the device with the cover removed or loosened.
- Do not install substitute parts or perform any unauthorized modification to the product.
- Return the product to the manufacturer for service and repair to ensure that safety features are maintained

**CAUTION**

- This instrument is designed for indoor use and in area with low condensation.

The following table shows the general environmental requirements for a correct operation of the instrument:

| Environmental Conditions | Requirements |
|---|---|
| Operating Temperature | 0°C to 50°C |
| Operating Humidity | Designed to be sunk in mineral oil – or in synthetic oil |
| Storage Temperature | -10°C to 60°C |

# 1. Introduction

This chapter describes the general characteristics and main features of the CT-100-C-HP DC current transducer.

## 1.1 CT-100-C-HP Overview

The (O-FLUx Current Sensor) family is based on a closed loop technology that allows accurate and precise monitoring of DC and AC currents with high bandwidth.

The internal conductive casing guarantees higher noise immunity and reduces undesired noise pick-up from external sources. The transducers CT-100-C-HP has a transform ratio of 1:1000 between primary and secondary. External plastic casing guarantees galvanic isolation between the primary and the secondary circuits in order to allow current measurements at a different potential and it simplifies interfacing when using the ,as the feedback element of current regulated power supplies.

Output from the CT-100-C-HP transducers is in form of current analog signal. Connections for power supply and output signals are available upon use of the provided DB-9 connector.

Main characteristics of the entire family are negligible temperature coefficient, excellent linearity and extremely low noise.

DC current transformers and transducers represent the ideal replacement for systems where Hall-effect sensors or shunt resistors are used as current sensing elements and better performances are needed.

Main application fields for these current transducers are precise and extremely stable regulated power supplies and power inverters.

Due to the excellent characteristics, the O-FLUCS transformers can be used in a variety of calibration, acceptance testing and quality control applications in the industrial and automotive fields.

Front view of a CT-100-C-HP current transducer is presented in **Figure 1**.

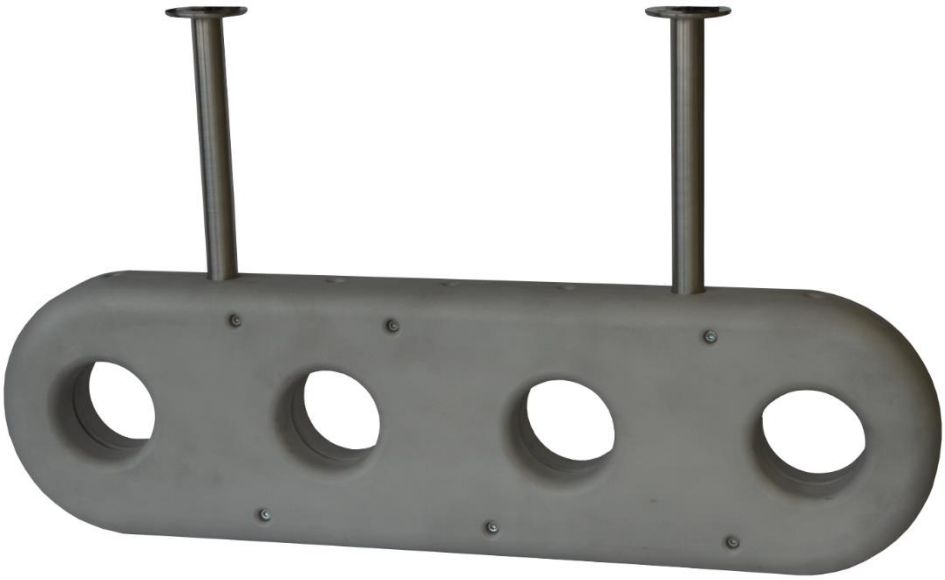


**Figure 1:** front view of a CT-100-C-HP current transducer

Internal view of the same current transducer is presented in **Figure 2**.

**Figure 2:** internal view of a CT-100-C-HP current transducer

# 2. Installation and Operation

General considerations and description of pinout and functionalities are herein presented.

## 2.1 Mechanical Considerations

Each version of the CT-100-C-HP current transducer presents embossed "arrows" on the plastic part of the casing that indicates the verse of positive primary current measurement. This arrow can be seen in **Figure 3** :

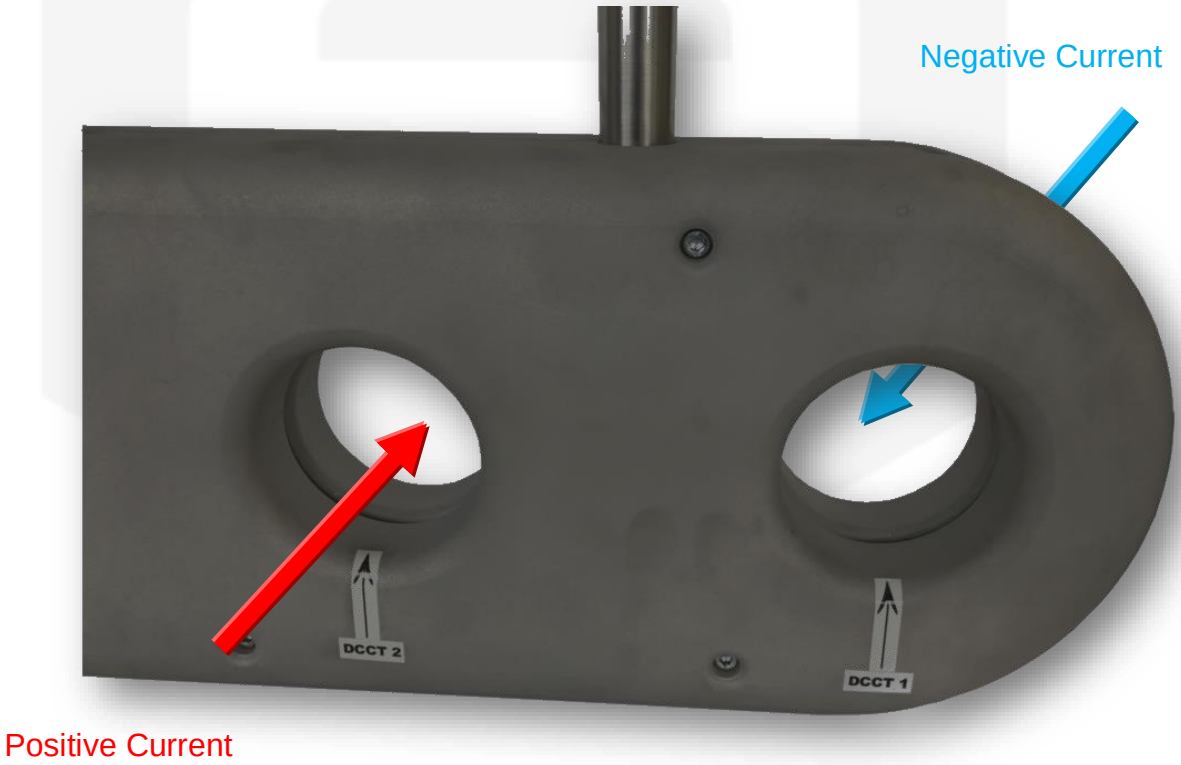



**Figure 3:** embossed arrows indicating the verse of positive primary current

The primary conductor hole diameter Ø in all models is rated at 75 mm.

### 2.1.1 Pinout

The CT-100-C-HP models have a standard D-sub 9-pin connector (i.e. "DE-9" or, commonly referred to as "DB-9"). The standard pin numbering to refer to is herein presented in **Figure 4**.

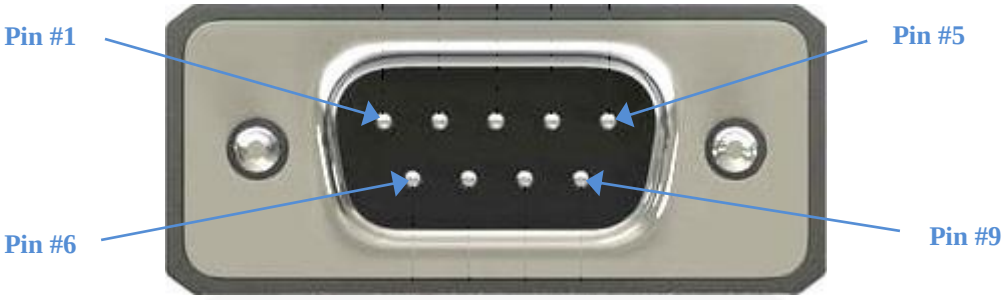



**Figure 4:** D-sub 9 connector pin numbering

The pinout for the "C" version is presented in **Table 1**.

| Pin # | CT-100-C-HP |
|---|---|
| 1 | $I_S$ return |
| 2 | *nc* |
| 3 | Status - |
| 4 | GND |
| 5 | -15V |
| 6 | $I_S$ |
| 7 | *nc* |
| 8 | Status + |
| 9 | +15V |

**Table 1:** CT-100-C-HP pinout

Please note that pins not internally connected on the specific model are indicated in **Table 1** as *nc = not connected*. Please DO NOT connect these pins.

## 2.2 Primary Current Path

A non-symmetrical layout of the primary current return path may degrade the accuracy and the noise of the current transducer. A cross section of the transducer plastic case illustrates what happens if the primary current is not equally distributed over the perimeter of the current transducer head.

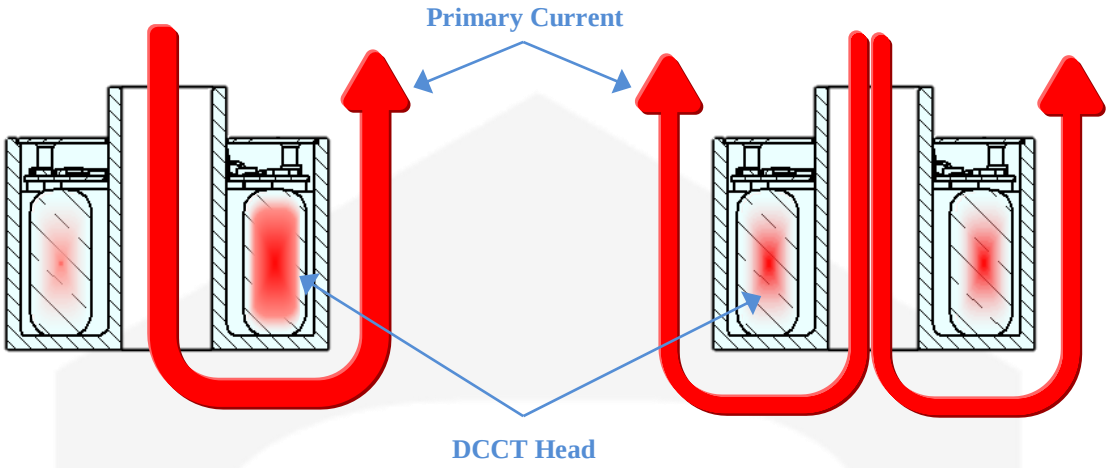



**Figure 5:** Primary current path; non-recommended layout (left) and recommended layout (right)

**Figure 5** (left) shows what happens if the primary current is routed over one side of the DCCT head: the Magnetic flux density is higher in the area between the "U" path.

If the current path return is split in two or more paths over the DCCT Head, the magnetic flux density is more homogenous over the perimeter and the resulting measurement will be more accurate. If the split return path is not possible, it is preferable to keep the retuning cable as far as possible from the DCCT Head.

## 2.3 Secondary-side Signals

The signals on the "secondary" side of the CT-100-C-HP are found on pins #1, #6 of the DB-9 connector.

### 2.3.1 Power Supply

Supply voltages for the CT-100-C-HP have to be fed to pin #9 (+15V) and to pin #5 (-15V) of the D-sub 9-pin connector; both these voltages are referred to pin #4 (GND) and have a rated tolerance of ±6% on the nominal values.

Maximum current that can be drawn from each one of these supply voltages is of 150 mA.

### 2.3.2 Secondary Current

On the CT-100-C-HP the secondary current output **Is**, scaled by the current transformation ratio 1:1000, is fed to pin #6 . Current return pin is found on pin #1.

Maximum secondary current is rated at ±100 mA and an external shunt resistor, which can be placed close to the user's desired measuring circuit, is needed in order to convert the current signal to voltage.

### 2.3.3 STATUS Signal

A STATUS signal, obtained from the outputs of an optocoupler phototransistor (**Status+** and **Status-**, pins #8 and #3) is present. Please note that the OK- signal is not internally connected to the ground potential and can be connected to an external reference potential.

A pull-up resistor is needed (between the OK+ and some supply voltage referred to the OK- potential) in order to correctly obtain the correct signaling.

Two examples on how to connect the OK+ and OK- signals are hereafter presented in **Figure 6**:

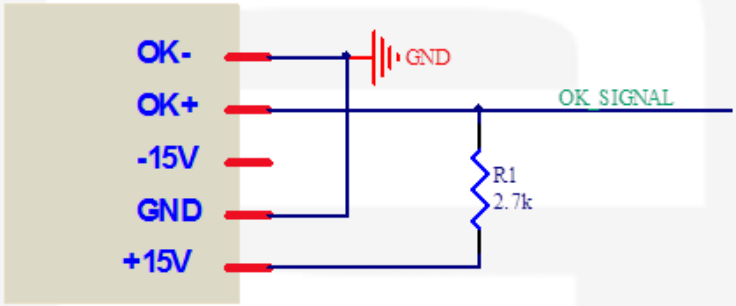



**Figure 6:** OUT OK signals connections using the +15V and the GND pins

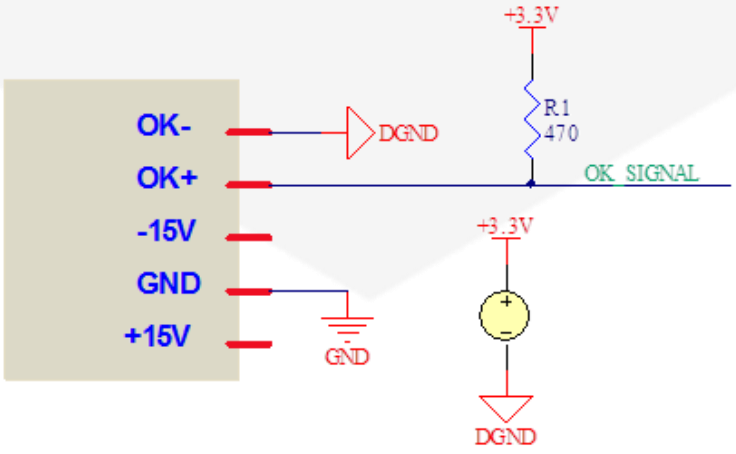



**Figure 7:** OUT OK signals connections as digital interfacing to +3.3V

Note that the connection scheme presented in **Figure 6** is referred to the GND potential and the OK_SIGNAL is at low level (<0.4V) if the CT-100-C-HP transducer is correctly working while it is at high level (>14.5V) when the transducer is not.

In the configuration presented in **Figure 7**, the current transducer can be easily interfaced to a digital microcontroller, a Digital Signal Processor or an FPGA, supplied by a +3.3V voltage source.

Please note that the +3.3V supply and the OK_SIGNAL is referred to DGND potential, which can be the same or different from the GND potential on which the CT device is supplied from. The OK_SIGNAL is found to be at low level (<0.4V) when the transducer is correctly working and at high-level (>3V) when not.

# 3. Technical Specifications

Technical Specifications for current transducers of the CT-100-C-HP are herein presented.

| *Technical Specifications* | *CT-100-C-HP* |
|---|---|
| Current Transformation Ratio - N | 1:1000 |
| Maximum DC Primary Current - $I_{P(DC)}$ | ±100 A |
| Maximum RMS Primary Current - $I_{P(RMS)}$ | 71 A |
| Current Polarity | Bipolar |
| Maximum DC Secondary Current - $I_{S(DC)}$ | ±100 mA |
| Maximum RMS Secondary Current - $I_{S(RMS)}$ | 71 mA |
| External Shunt Resistor Value - $R_S$ | 0...40 Ω |
| Small Signal Bandwidth (±1 dB) – typ. BW | > 200 kHz |
| Maximum dI/dt | 100 A/µs |
| Response time | < 1 µs |
| Typical Equivalent Input Noise | 100 ppm/FS @50 kHz |
| Temperature Coefficient - TC | < 0.5 ppm/°C |
| Non-Linearity | < 5 ppm |
| Offset (with factory calibration) * | < 100 ppm/FS |
| Protection Signal | OK Status |
| Supply Voltage (± 6%) | ±15 V |
| Current Consumption | 50 mA + $I_S$ |
| Secondary Coil Resistance - $R_{SEC}$ | 43 Ω |
| Accuracy (typ.) * | < 30 ppm / FS<br>< 0.25% / FS ("V" - version) |
| Connections | D-sub 9 connector ("C"-model)<br>7-pin strip TH type ("P"-model) |

| | |
|---|---|
| **Operating Temperature Range** | **0°C – 50°C** |
| **Mechanical (Outer) Dimensions** | **700 x 200 x 70 mm + 198 mm mounting pipe** |
| **Primary Conductor Hole Diameter - Ø** | **75 mm** |
| **Maximum Weight** | **18 Kg** |

* These specifications are guaranteed only when the CT sensor is used with the dedicated CAEN ELS PS1215 power supply

**Table 2:** Technical Specification

## 3.1 External Shunt Resistor

The maximum value of the external shunt resistor that can be connected on the $I_S$ output pin is shown hereafter in the following chart.

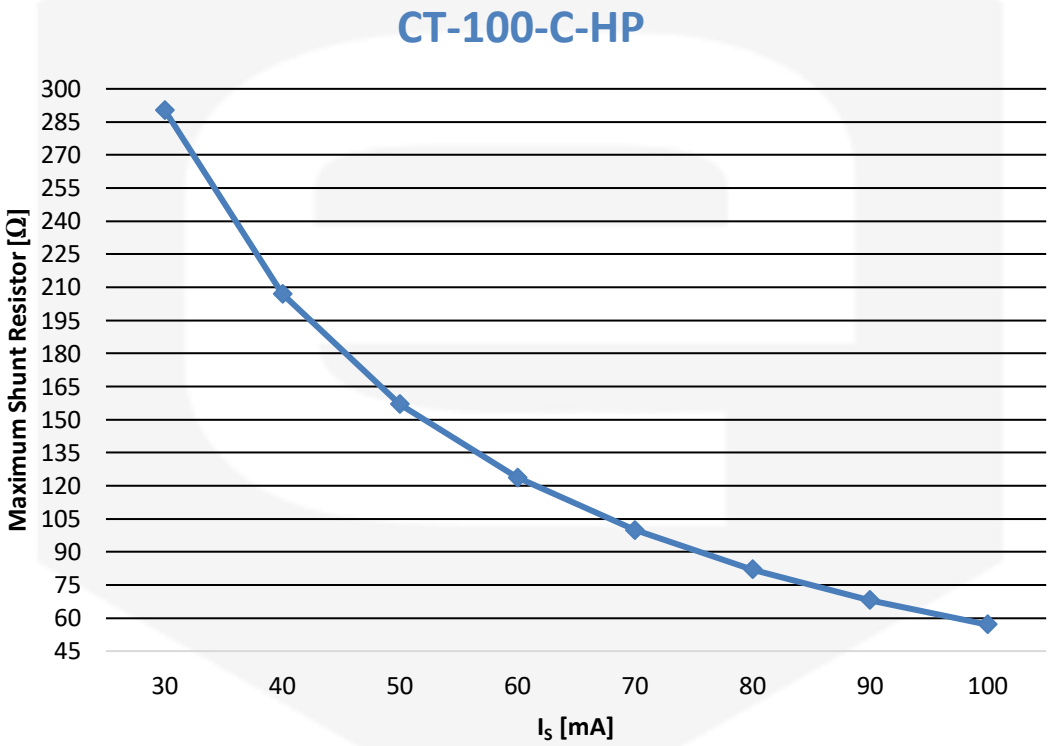



**Figure 8:** CT-100-C-HP maximum external shunt resistor

# 4. Mechanical Dimensions

The mechanical dimensions of the CT-100-C-HP are hereafter presented (all dimensions are in **mm**).