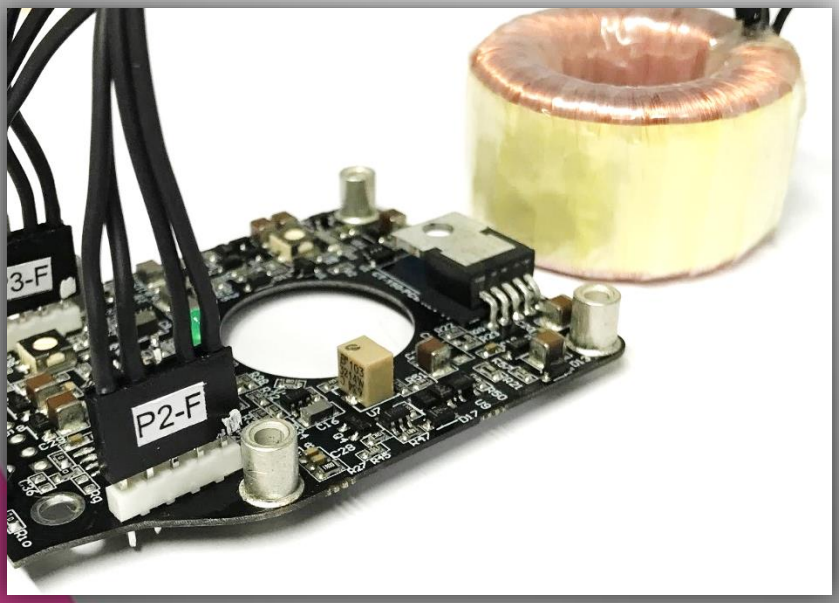
PRECISION CURRENT TRANSDUCERS

DC Current Transducer

CT-150-OEM

CAENels
Gear for Science

User's Manual



Rev. 1.0 – November 2017

CAEN ELS s.r.l.
Via Vetraia, 11
55049 Viareggio (LU) – Italy
Mail: info@caenels.com
Web: www.caenels.com

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Revision	Date	Comment
1.0	November 22th 2017	First Release

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

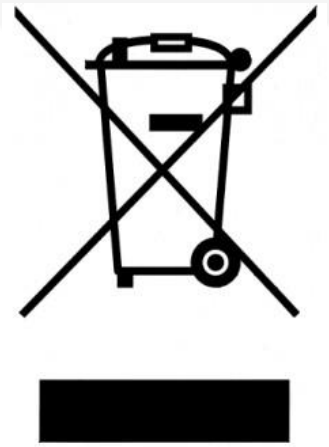
Do NOT open the boxes

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.



Read over the instruction manual carefully before using the instrument.
The following precautions should be strictly observed before using the CT-150-OEM DCCTs:

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 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 45°C
Operating Humidity	30% to 85% RH (non-condensing)
Storage Temperature	-10°C to 60°C
Storage Humidity	5% to 90% RH (non-condensing)

1. Introduction

This chapter describes the general characteristics and main features of the CT-150-OEM DC current transducer series.

1.1 CT-150-OEM Series 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 transducers CT-150-OEM have a transform ratio of 1:1500 between primary and secondary.

Output from the CT-150-OEM transducers is the standard secondary current output. Connections for power supply and output signals are available in a 7-pin through-hole strip.

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.

The 3D model of the CT-150-OEM is presented in **Figure 1**.

Figure 1: front view of a CT-150-OEM current transducer

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

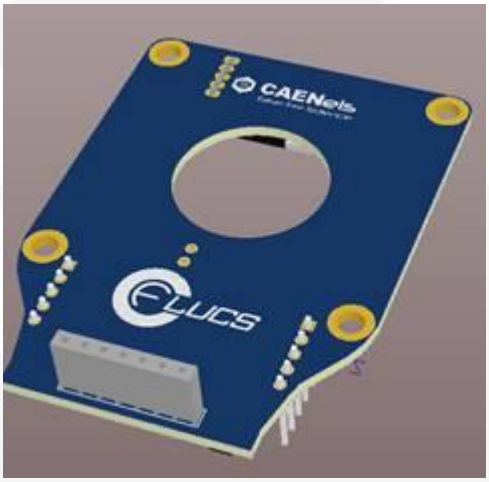


Figure 2: rear view of a CT-150-OEM current transducer

1.2 CT-150-OEM Model

The **CT-150-OEM** models have the following ordering code:

Product Code	Model	Description
WCT150OEMAAA	CT-150 OEM	150 A Primary Current , 7-pin PCB connector

2. Installation and Operation

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

2.1 Mechanical Considerations

For the CT-150-OEM current transducer, positive/negative current directions are hereafter presented:

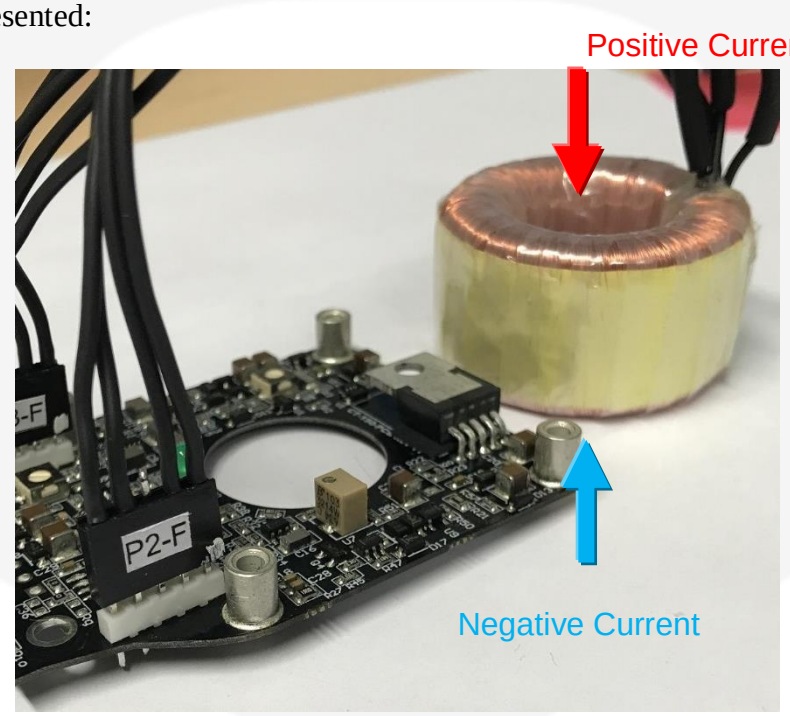


Figure 3: Positive/negative current directions

The primary conductor hole diameter Ø in all models is rated at 21 mm.

2.1.1 Pinout

The CT-150-OEM series models have 7-pin through-hole connections. The standard pin numbering to refer to is herein presented in **Figure 4**.

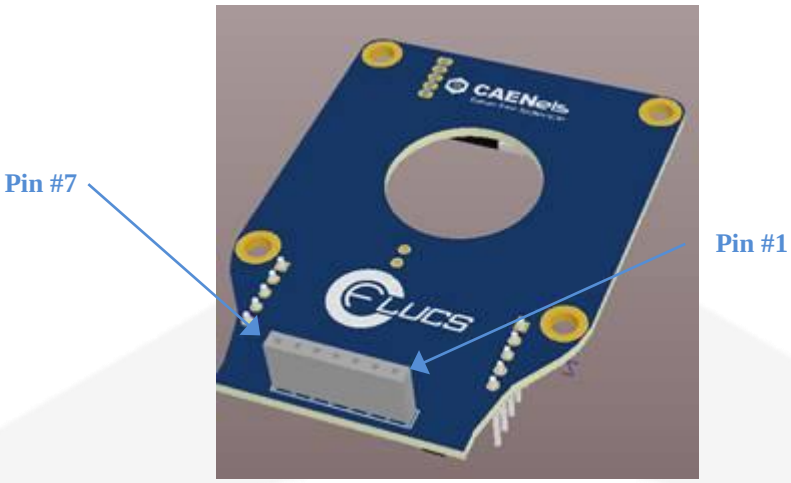


Figure 4: Connections pin numbering

The pinout is presented in **Table 1**.

Pin #	CT-150-OEM
1	GND
2	-15V
3	+15V
4	Status +
5	Status -
6	I_S
7	I_S return

Table 1: CT-150-OEM versions pinout

2.2 Mounting

For mounting purposes, four holes are present as indicated in the following **Figure 5**.

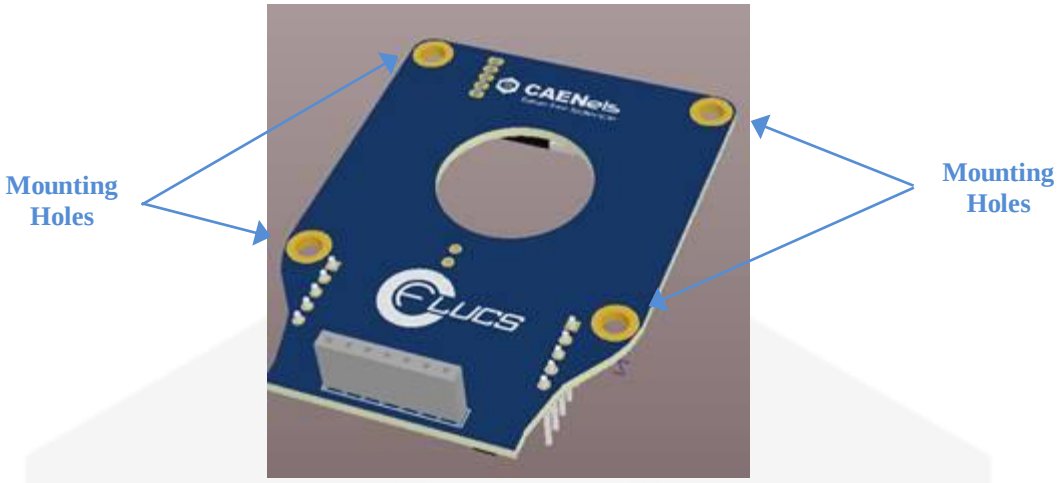


Figure 5: Mounting holes pattern

The diameter of these holes is of 3.7 mm.

2.3 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 toroid illustrates what happens if the primary current is not equally distributed over the perimeter of the current transducer head.

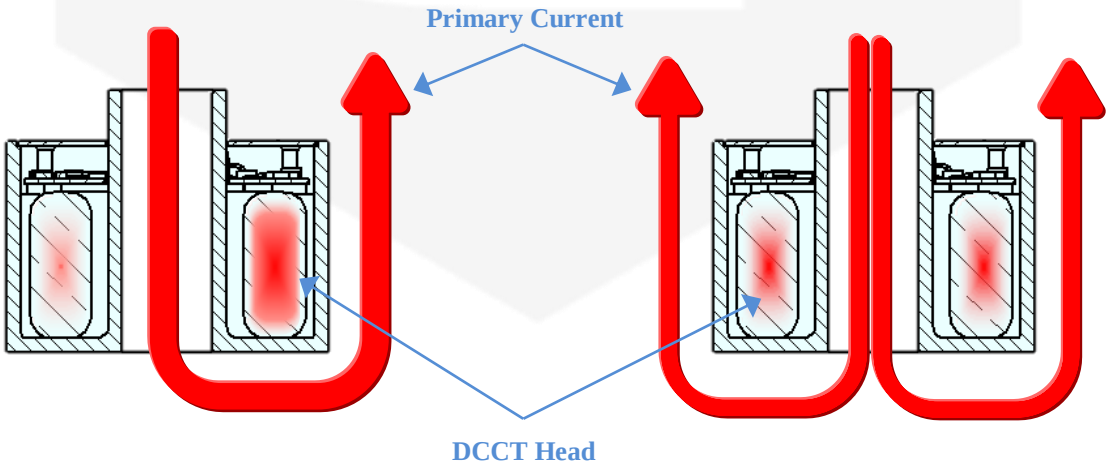


Figure 6: Primary current path; non-recommended layout (left) and recommended layout (right)

Figure 6 (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.

2.4 Full-Scale Current

Rated full-scale primary current can be easily changed by carrying out multiple turns on the primary conductor hole.

The full-scale current can then be scaled by a factor of *N*, with *N* = number of turns of the primary conductor around the hole.

As an example, in a CT-150 a primary current full-scale of 75A and of 50A respectively is obtained by connecting primary conductor as follows in **Figure 7**.

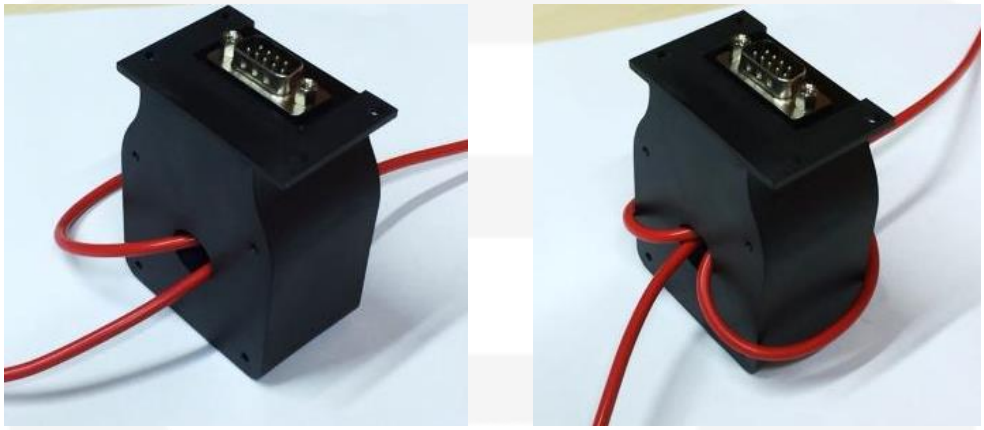


Figure 7: Primary full-scale current of 75A (left) and of 50A (right) in CT-150

Do not apply rated full-scale primary current (150A for CT-150) when carrying out multiple turns on primary conductor hole.

2.5 Pinout signals

The signals on the 7-position strip need to respect some specifications which are hereafter discussed.

2.5.1 Power Supply

Supply voltages for the CT-150-OEM series have to be fed to pin #3 (+15V) and to pin #2 (-15V); both these voltages are referred to pin #1 (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.

2.5.2 Secondary Current

On the CT-150-OEM series the secondary current output $\mathbf{I_S}$, scaled by the current transformation ratio 1:1500 is fed to pin #6. Current return pin is found on pin #7.

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.

2.5.3 STATUS Signal

A STATUS signal, obtained from the outputs of an optocoupler phototransistor (**Status+** and **Status-**, pins #4 and #5 respectively) 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 green LED is also present on the front side of the PCB indicating the correct operation of the device.

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:

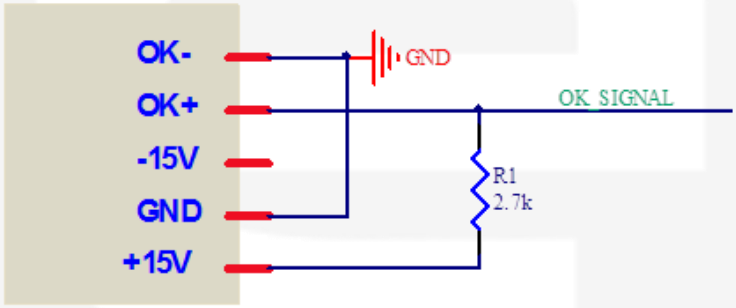


Figure 8: OUT OK signals connections using the +15V and the GND pins

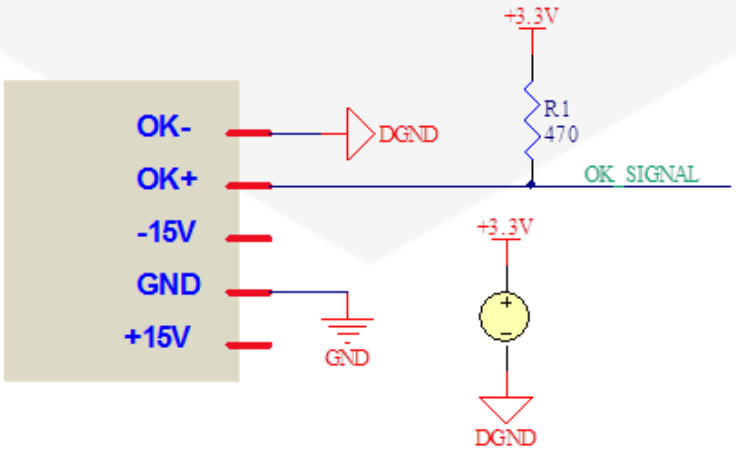


Figure 9: OUT OK signals connections as digital interfacing to +3.3V

Note that the connection scheme presented in **Figure 8** is referred to the GND potential and the OK_SIGNAL is at low level (<0.4V) if the device is correctly working while it is at high level (>14.5V) when the transducer is not.

In the configuration presented in **Figure 9**, 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.

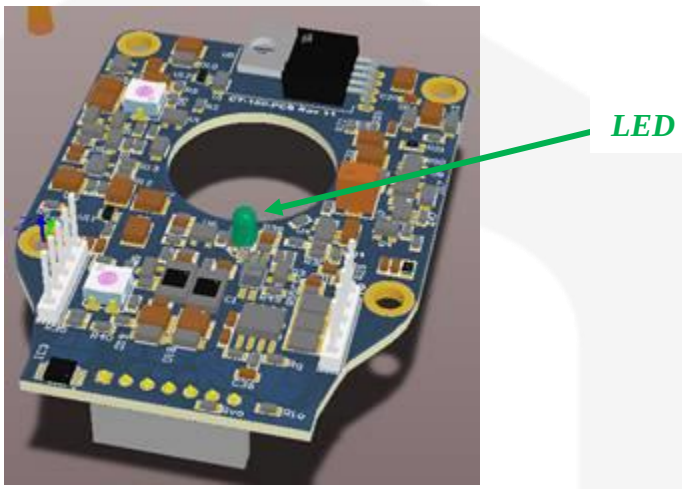


Figure 10: STATUS – OUT OK indications

The OUT OK green light is on whenever the device is correctly working and regulating secondary output current – i.e. zero flux is established and secondary circuit is closed on the shunt resistor.

3. Technical Specifications

Technical Specifications for current transducers of the CT-100/CT-150 Series (both current and voltage output versions) are herein presented.

Technical Specifications	*CT-150-OEM*
Current Transformation Ratio - N	1:1500
Maximum DC Primary Current - $I_{P(DC)}$	±150 A
Maximum RMS Primary Current - $I_{P(RMS)}$	106 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 (±3 dB) – typ. BW	> 300 kHz
Equivalent Input Noise (@Bandwidth) *	< 1 ppm/FS @ 200Hz < 10 ppm/FS @ 50 kHz
Maximum Output Current ("V"-version)	±15 mA
Temperature Coefficient - TC	< 0.5 ppm/°C typ. < 2 ppm/°C ("V"-version)
Non-Linearity	< 5 ppm < 15 ppm ("V"-version)
Induction into Primary (0-100 kHz) typ.	50 µV (RMS)
Offset (with factory calibration) *	< 10 ppm/FS
Protection Signal	OK Status
Supply Voltage (± 6%)	±15 V
Current Consumption	50 mA + I_S
Secondary Coil Resistance - R_{SEC}	34 Ω
Accuracy (typ.) *	< 50 ppm / FS
Connections	7-pin strip TH type ("P"-model)
Operating Temperature Range	0°C – 50°C

Primary Conductor Hole Diameter - Ø	**21 mm**
Maximum Weight	**250 g**

Table 2: Technical Specification

3.1 Equivalent Input Noise

The typical equivalent input noise of the CT-100/CT-150 transducers is hereafter presented as a function of the measuring bandwidth.

CT-150-OEM Typical Equivalent Input Noise

Bandwidth	*CT-150*
200 Hz	1.6
1 kHz	3.7
10 kHz	6.3
50 kHz	6.8

Table 3: Equivalent Input Noise (typical values)

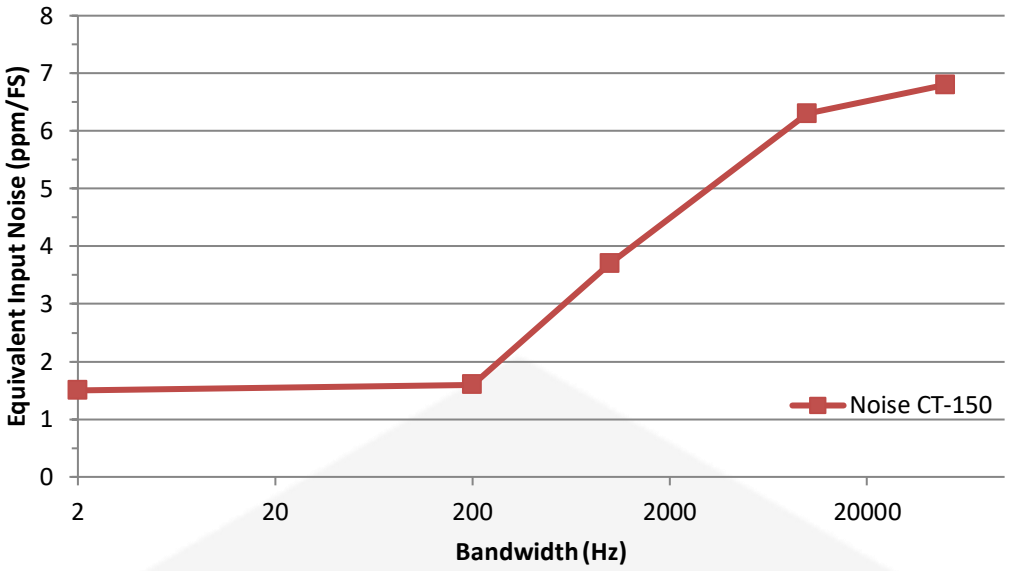


Figure 11: Equivalent Input Noise graph (typical values)

3.2 External Shunt Resistor

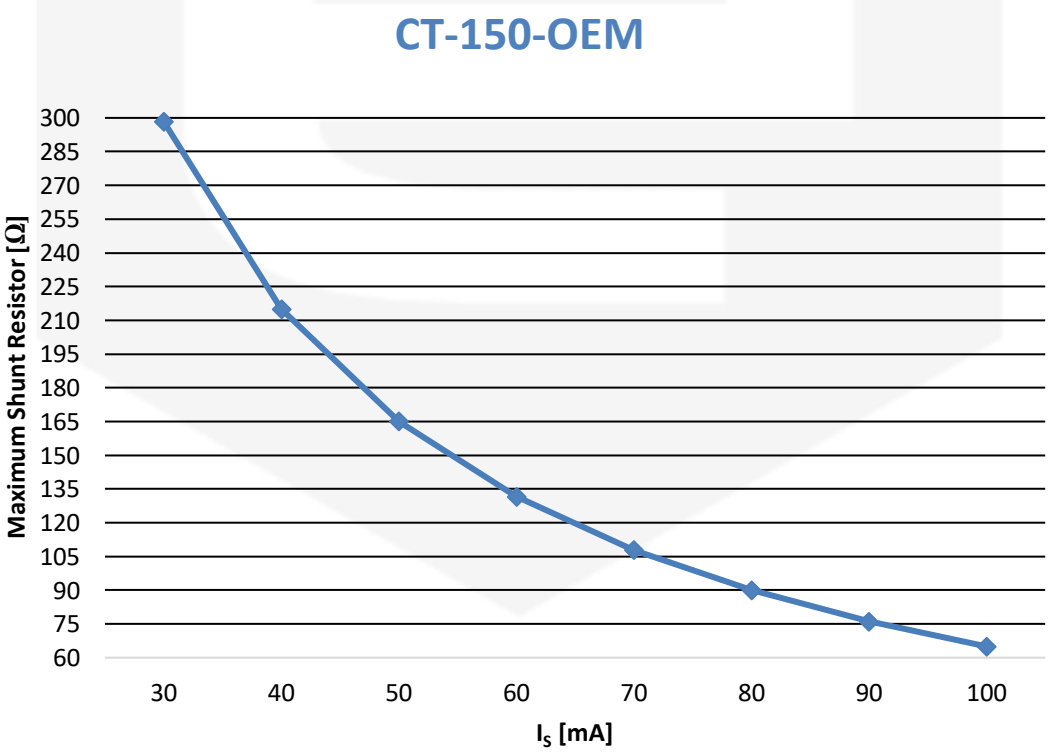
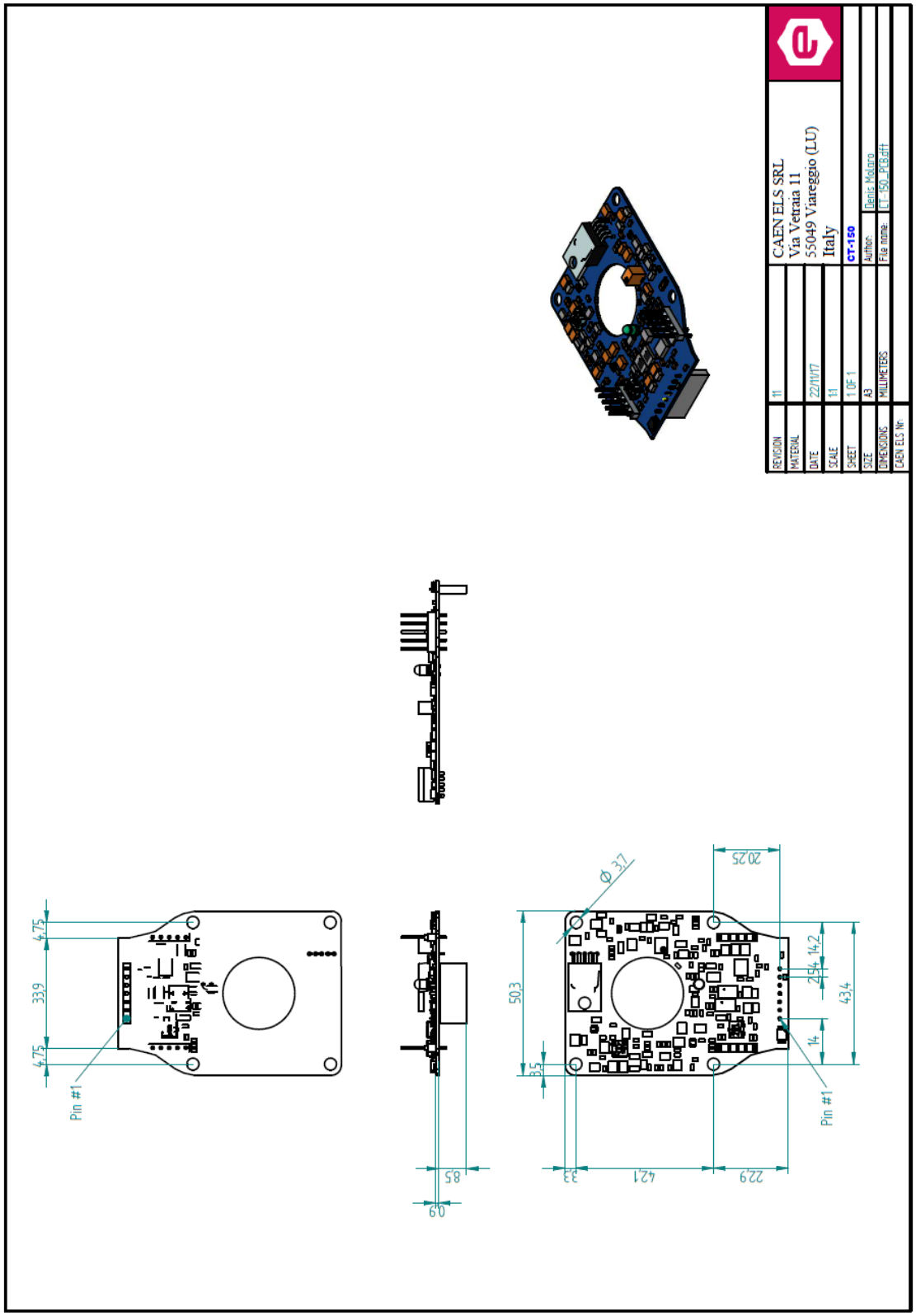
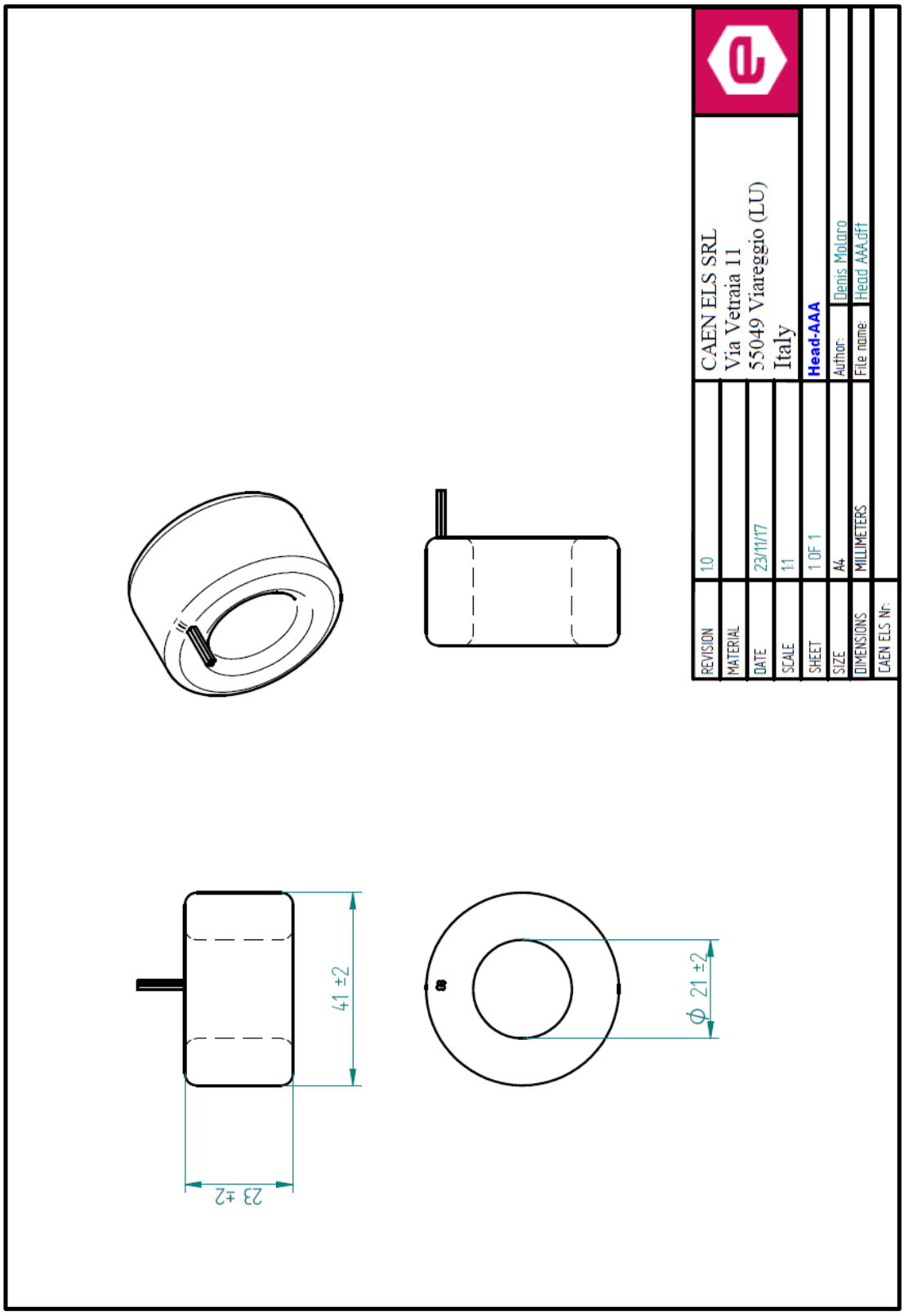


Figure 12: CT-150-OEM maximum external shunt resistor

4. Mechanical Dimensions

The mechanical dimensions of the CT-150-OEM Series DC Current Transducers are hereafter presented (all dimensions are in **mm**).

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55049 Viareggio (LU)
Italy
Head-AAA
REVISION 1.0
MATERIAL
DATE 23/11/17
SCALE 1:1
SHEET 1 OF 1
SIZE A4
DIMENSIONS MILLIMETERS
CAEN ELS Nr:
Author: Denis Molaro
File name: Head AAA.dft
41 ±2
23 ±2
Φ 21 ±2