Research

Technical Manual

iSens3

AC current sensor

Analog and pulse output

Project ID PJ190
Version 0.0

Synopsis

This Technical Manual describes the Hard-and Software specifications, Install and Commissioning of the CAN Input Output Module

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Revision History		
Document Version	**Date**	**Improvement**
0.0	5-nov-2018	Initial version
0.1	14 dec-2018	Cable length changed from 2,5m to 5m

Limited Warranty and disclaimer

Anerma Research products are guaranteed to be free of defects in workmanship or materials. Any product that proves to be defective will be replaced or repaired at the discretion of Anerma Research.

LIMITATION
This limited warranty only covers conditions resulting from normal use of products. Anerma Research's warranty shall not apply to the following products: products or parts repaired, altered or modified by other than Anerma Research or an authorized repair representative, failure to follow proper installation, operation or maintenance instructions and damage resulting from improper storage conditions.

Contents

1. Purpose

This document describes the user manual and the functional specifications of the iSens3 AC current sensor. The iSens3 is identified by Project-ID PJ190.

2. Intended Audience

The intended audience is generally anybody who wants to familiarize with and use the iSens3 sensor.

3. Glossary

AC	Alternating current
CF	Crest Factor = Peek_current/RMS_current
DC	Direct current
GND	Ground
Hz	Hertz
IDEP/CN8	Combined Nomenclature code
mA	milli Ampère
ppm	Parts pro million; 1ppm=0,0001%=1/1000000
PWR	power
true RMS	true Root Mean Square, Urms = sqrt(mean(U²))

4. Safety Regulations

4.1. Warning, caution and notes

Warnings, cautions and notes within this manual will be used as follows:

WARNING: Used to denote a danger to personnel of serious injury and/or death. The warning will be preceded by the caption WARNING and the detail of any warning will be in bold and uppercase.

CAUTION: Used to denote a possibility of damage to material or equipment but not a danger to personnel. The caution will be preceded by the caption CAUTION and the detail of any caution will be in bold and lowercase.

NOTE: used to draw attention to information that is extraneous to the immediate subject of the text. A note will be preceded by the caption NOTE and the detail will be in italics.

All warnings, cautions and notes will precede the relevant sections of the text.

4.2. General Safety Regulations

WARNING: THIS DEVICE IS NOT DESIGNED FOR AND THEREFORE NOT INTENDED FOR USE IN ANY ENVIRONMENT WHERE HUMAN LIFE DEPENDS DIRECTLY ON THE USE OF PROVEN RELIABILITY AND FAILSAFE TECHNIQUES AND COMPONENTS.

WARNING: THIS DEVICE MUST ONLY BE OPERATED IN ENVIRONMENTS LIMITED TO THE SPECIFIED TEMPERATURE AND HUMIDITY CONDITIONS.

WARNING: THIS DEVICE IS NOT PROTECTED AGAINST ANY CORROSION FROM ANY TOXICAL VAST PARTICLE, FLUID OR GAS.

WARNING: THIS DEVICE MUST NOT BE USED IN NUCLEAR PLANTS OR IN ANY EXPLOSIVE ENVIRONMENT.

CAUTION: The maximum input voltages must not be exceeded.

5. Instrument Description

The iSens3, 4..20mA AC current sensor measures AC currents up to 1600A true-rms on a single phase power cable.
The sensor has 2 outputs:
- The analog output is proportional to measured input and ranges from 4 mA to 20 mA.
- The pulse output generates a pulse frequency proportional to the current. This allows for a simple power meter by using a pulse counter attached to the pulse output. The pulse outputs of up to 3 iSens3 sensors can be connected together. Our private hard and software assures that there is no overlap between the pulses of different sensors.

Full range capacity and pulse rate are customer designed and should be mentioned at ordering.

The sensor has an indication LED. This blinks when the iSens3 is powered. The rate at which it blinks is proportional to the output current.

Power on time until valid output is 1.2 seconds.
Each sensor has a unique serial number and is delivered with a calibration certificate and report.

The following figure shows the module dimensions. The area/diameter of the loop formed by the measurement coil (light gray on the figure) is 65mmφ.

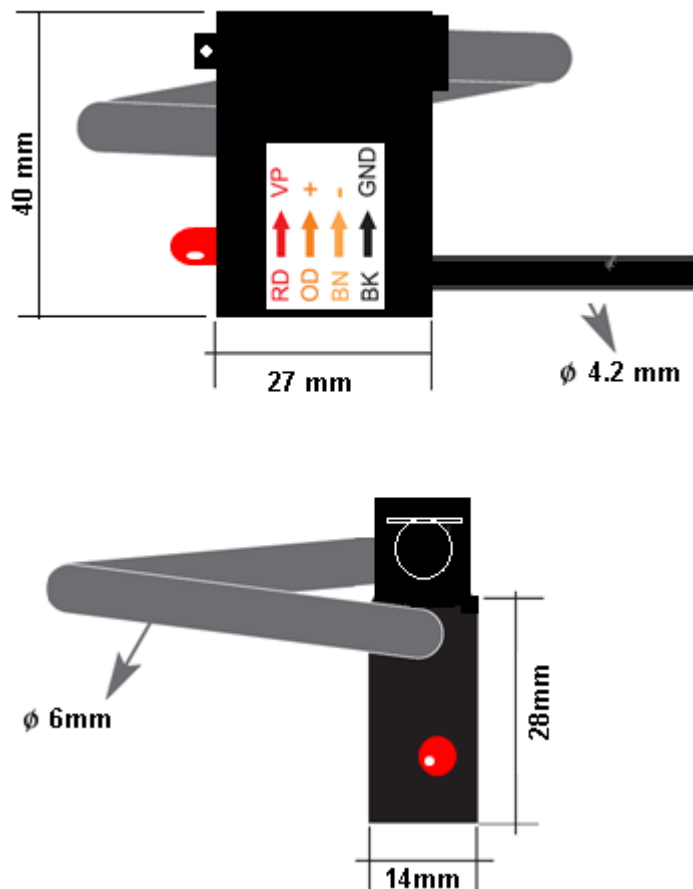**Figure 5-1 Global view of the sensor**

The hole (ϕ1.5mm) in the plug can be used to seal the device.

There is a irregularity in the loop between the 2 coil ends in the housing, due to the non-alignment of the 2 coil ends. If the sensor is mounted with an angle in respect to the power cable, this rotation results in an error. The iSens3 contains a unique circuit that compensates for this error, so there is no additional error due to the mounting.

6. Installation
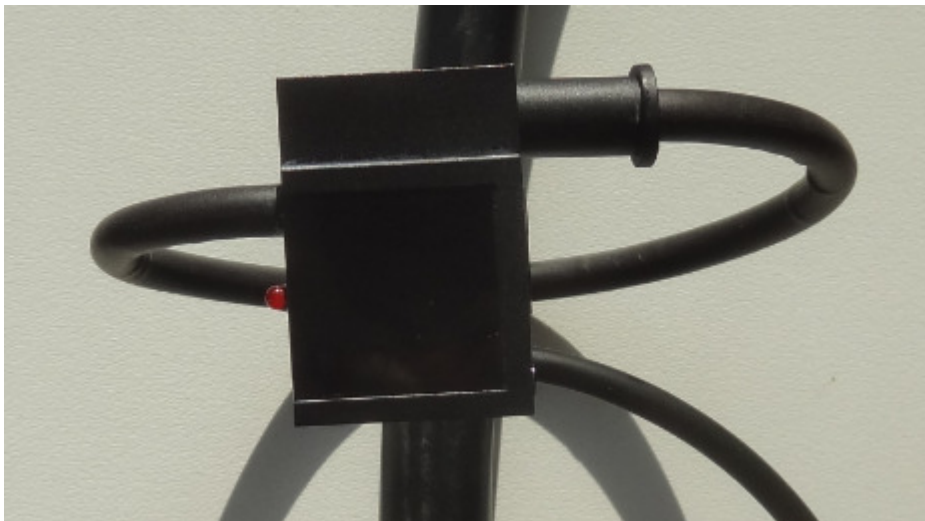
6.1. Connection to the cable

To install the iSens3 sensor, wrap the measurement coil round the single phase power cable (L1, L2, L3 or N). Then click the plug into the clamp. The coil has to make a **closed** loop around the power cable.
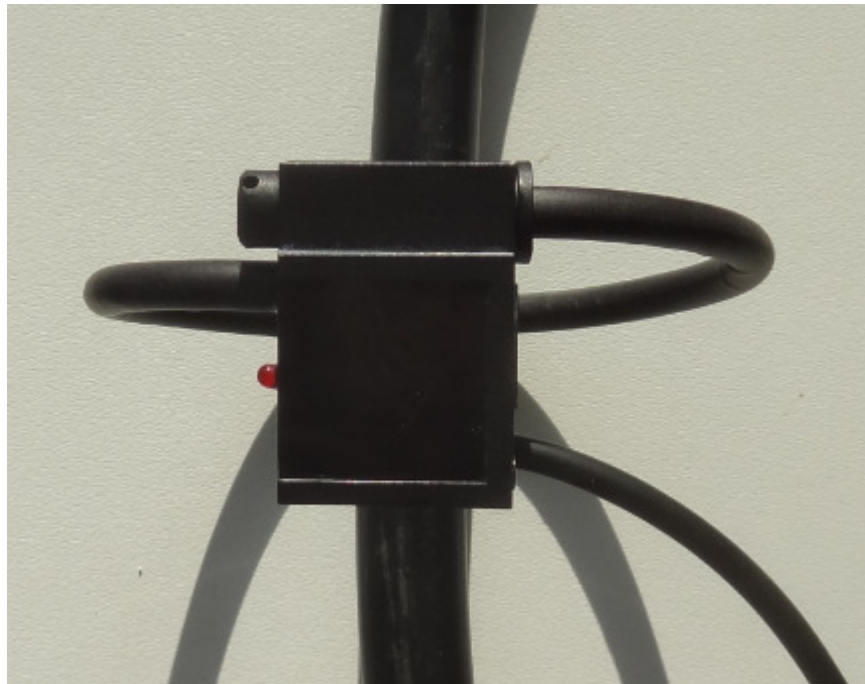
Figure 6-1 Correct sensor installation

The following figure illustrates a faulty installation.

Figure 6-2 Incorrect sensor installation

NOTE: *The sensor is not sensitive to power direction.*

NOTE: *Wrapping the power cable twice doubles the sensor's sensitivity. Use this feature to measure small currents.*

Figure 6-3 Sensitivity is 5 times higher if the power cable is wrapped around the coil 5 times

Note: The alignment of the sensor has no influence on the accuracy, due to the compensation circuit added in the iSens3. The predecessors, iSens and iSens2, don't have this compensation and should be aligned

WARNING: HIGH VOLTAGES ARE HAZARDOUS AND CAUSE AN IMMEDIATE RISK TO SERIOUS INJURY OR EVEN DEATH.

WARNING: BE VERY CAREFUL TO RESPECT ALL GENERAL AND LOCAL SAFETY PRECAUTIONS (E.G DISCONNECT POWER, WEAR SAFETY GLASSES, RUBBER GLOVES AND ADEQUATE CLOTHES, ETC)

6.2. Power-On/Off

The iSens3 sensor has no power on/off switch. Applying power to the sensor starts its internal power-up sequence. Switch the sensor off by removing its power supply.

The typical delay between applying power and valid output is about 1.2 seconds. The outputs can be erroneous during this delay period. After the delay the output is valid to within 1% of the full range.

7. Connection

7.1. Wiring diagram
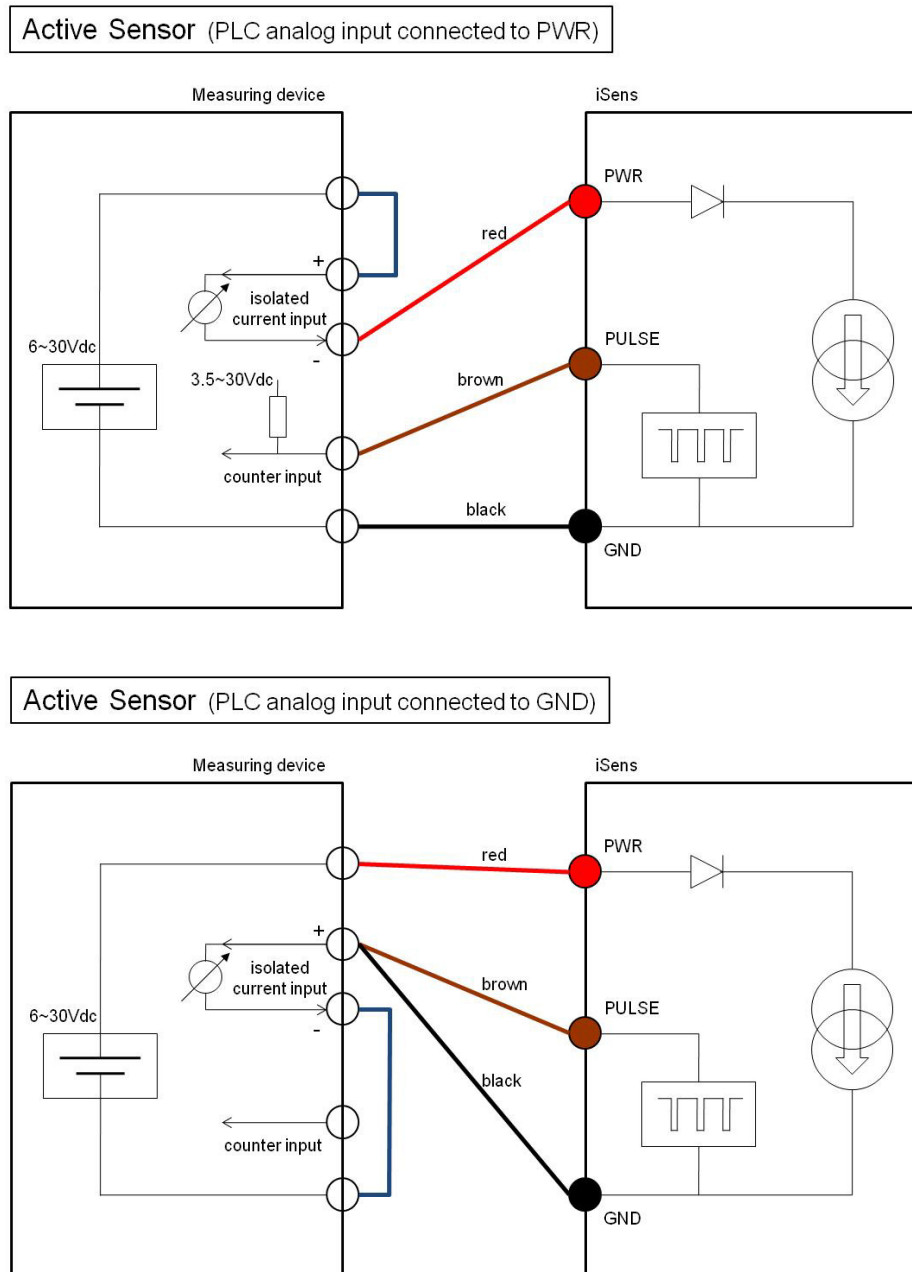
The next figures show the wiring for the iSens3.

Figure 7-1 Sensor wiring

The iSens3 sensor has 3 wires. Two of these are used for the supply. The third is a pulse output. The sensor has 2 outputs: a 4 to 20mA current output and a pulse output.

The output of 4 to 20mA flows in the supply lines. The current can be measured either in the power line or the ground line. When the pulse output is used, the ground line is not suited because it carries extra current from the pulse output.

The pulse output requires a pull-up resistor. It can be connected to a counter input. The pulse output generates some extra current consumption.

When the pulse output is not used, connect it directly to GND or through a pull-up resistor to a supply. **Never** connect it directly to the supply, the supply will then be shorted to GND whenever a pulse is sent.

7.2. Terminals

Terminal	Color	Designation
GND	Black	Ground
PWR	Red	6 to 30 Vdc
PULSE	Brown	GND ≤ PULSE ≤ PWR Connect to a supply with a pull-up resistor

Table 7-1 Sensor terminals

8. Ordering

8.1. Ordering codes

The iSens3 sensor is available with different settings. These are shown in the table below.
On request, a 400Hz version can be produced. Cable length = 5m

Ordering code	Frequency	Current range	Pulses/Ah	Coil length	Power cable φ
-	Hz	Arms		mm	mm
iSens3B100	50/60	100	10	250	65
iSens3B200	50/60	200	10	250	65
iSens3B400	50/60	400	10	250	65
iSens3B800	50/60	800	10	250	65
iSens3C800	50/60	800	1	250	65
iSens3C1500	50/60	1500	1	250	65
iSens3C1600	50/60	1600	1	250	65

Table 8-1 Ordering codes

8.2. Configuration and evaluation tool

iSensConfig is a USB evaluation, configuration and programming device for the iSens3.
It consists of a standalone hardware module (no software on the PC is necessary). This tool has the following features:
- OLED display
- Rotary + enter switch to surf through the menus
- USB-B connector
- 3-pole Plug to connect the iSens3 (Plug = Phoenix MC 1,5/ 3-ST-3,5 – 1840379)

- Displays the measurement + trending for the last minute.
- Count the pulses + conversion to current and trending for the last minute.
- Configure the sensor for a different current range or pulse weight
- Update of the software of the iSens3
- Update of the software of the iSensConfig
- It is seen by the PC as an USB memory stick
- Battery (AA-cell) or USB powered

9. Technical Specifications

Specification	Unit	Min	Typ	Max	Conditions
Voltage (PWR to GND)	Vdc	6	-	30	(1) (2)
Pulse Supply Voltage	Vdc	3.5	-	30	(3) (4)
Power consumption	mA	4	-	20	
LED blink frequency	Hz		0.4		no current
			2		full range
Power-on delay until valid	s		1.2		output within 1%
Crest factor	-		2		
Measurement bandwidth	Hz		720		50/60Hz version
			3400		400Hz version (8)
Noise	% full scale		0.2	0.5	
Supply coefficient	ppm/V		160		(5)
Temperature coefficient	ppm/°C		100		(6)
Accuracy	% full scale	-1		1	(7)

(1) The sensor works with a supply down to 5Vdc. However, below 6Vdc the accuracy is about 1% worse for high output current.
(2) The sensor is loop powered, there is no need for a separate power supply.
(3) A pull-up resistor must be included between the PULSE output and the pulse supply voltage.
(4) The pulse supply voltage can be lowered to 3V. However the pulses will then be active only if the power consumption is below 10mA.
(5) The change of the output current, if the sensor voltage changes one Volt.
(6) The change of the output current, if the sensor temperature changes one degree Celcius.
(7) When mounted as shown in paragraph 6.1.
(8) Nonstandard option, can be produced on request.

Table 9-1 Electrical specs

Specification	Unit	Min	Typ	Max	Conditions
Current output	mA	4	-	20	
Current input range	Arms	100	-	1600	50Hz current
		20	-	400	400Hz current
Pulse rate	Hz	0	-	2.66	

Table 9-2 Output ranges

Specification	Value
Coil Length	250 mm
Allowed Power Cable Diameter	65 mm
Coil Diameter	6 mm
Coil Bend Radius	30 mm
Coil Plug Diameter	12 mm
Housing W x H x D	27 mm x 40 mm x 14 mm
Output Cable	5 m UL-LiYY, double insulation
Weight (Housing + Coil)	150gr
IDEP/CN8	8504.3129

Table 9-3 Mechanical specs

Specification	Value
Operational ambient temperature	-20 ºC to +70 ºC
Operational relative humidity	max 95%, non-condensing
Storage ambient temperature	-20 ºC to +70 ºC
Storage relative humidity	max 95%, non-condensing

Table 9-4 Environmental specs

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