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# **User Manual**

## **pSens3**

### **3 Phase Power meter & logger**

**PI184**  
**Version 0.16**

Revision History		
Version	Date	Improvement
0.1	22-Dec-2014	Initial version
0.2	17-Feb-2015	Full update
0.3	06-Mar-2015	Full update
0.4	13-Mar-2015	Full update
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## Contents

<b>1. Purpose</b> .....	<b>10</b>
<b>2. Intended Audience</b> .....	<b>10</b>
<b>3. Glossary</b> .....	<b>10</b>
<b>4. Safety Regulations</b> .....	<b>11</b>
4.1. Warning, caution and notes .....	11
4.2. General Safety Regulations .....	11
<b>5. Instrument Description</b> .....	<b>12</b>
5.1. Micro SD card .....	12
<b>6. Logging</b> .....	<b>14</b>
6.1. Sampling .....	14
6.2. Log time .....	14
6.3. Log data selection .....	14
6.4. Print options .....	17
6.5. Memory Erase .....	17
6.6. Date and Time Change .....	18
6.7. Phase Check .....	18
<b>7. Events</b> .....	<b>19</b>
7.1. Event description.....	19
7.1.1. Frequency variations .....	19
7.1.2. Magnitude variations .....	19
7.1.3. Rapid voltage changes .....	20
7.1.4. Flicker severity.....	20
7.1.5. Voltage dips .....	20
7.1.6. Voltage interruptions.....	20
7.1.7. Temporary overvoltage .....	20
7.1.8. Transient overvoltage.....	20
7.1.9. Voltage unbalance .....	20
7.1.10. Harmonic voltage.....	20
7.1.11. Current limit .....	20
7.1.12. Frequency drift .....	21
7.1.13. Vector jump.....	21
7.1.14. Neutral overvoltage.....	21
7.1.15. Operating state.....	21

7.1.16.	Harmonic current.....	21
7.1.17.	Time change .....	21
7.1.18.	Snapshot.....	21
7.2.	Event settings.....	21
<b>8.</b>	<b>Ethernet connection .....</b>	<b>24</b>
8.1.	pSens3 in a network connection.....	24
8.2.	pSens3 in a point to point connection.....	24
8.3.	Setting up an ip address by the use of WINS. ....	25
8.4.	Setting up an ip address by ARP and PING. ....	26
8.5.	Measurements Export.....	26
8.5.1.	Print options.....	27
<b>9.</b>	<b>Installation .....</b>	<b>28</b>
9.1.	Overview.....	28
9.2.	Connections.....	29
9.3.	Power .....	30
9.4.	Coils.....	30
<b>10.</b>	<b>IO .....</b>	<b>32</b>
10.1.	Digital Output .....	32
10.1.1.	Sink .....	32
10.1.2.	Source .....	33
10.2.	Digital Input.....	33
10.2.1.	Active Pulse Input (Voltage) .....	33
10.2.2.	Passive Pulse Input (Source) .....	33
10.2.3.	Input Processing.....	34
10.3.	Analog Output.....	35
10.4.	Analog Input .....	36
10.4.1.	Current .....	36
10.4.2.	Voltage .....	36
10.5.	Log Values.....	36
10.6.	Modbus Registers.....	37
10.6.1.	State Register .....	37
10.6.2.	Pulse Counter .....	37
10.7.	Settings .....	37
10.7.1.	Type .....	37
10.7.2.	Weight.....	39
10.8.	Timer .....	40

---

10.8.1.	Pattern file .....	40
10.8.2.	Website.....	40
<b>11.</b>	<b>Modbus .....</b>	<b>41</b>
11.1.	Modbus Registers and Coils.....	41
11.1.1.	Protocol functions .....	41
11.1.2.	Register order for 32 bit values.....	41
11.1.3.	Measurement Registers .....	42
11.1.4.	IO registers .....	43
11.1.5.	Event Flag Coils .....	43
11.1.6.	Event Setting Registers .....	44
11.1.7.	System Registers .....	44
11.1.8.	Event Value Registers.....	45
11.2.	Modbus Settings .....	45
11.3.	Modbus TCP .....	46
11.4.	Modbus RTU.....	46
11.5.	Modbus Gateway .....	46
11.6.	Modbus TCP and RTU .....	46
<b>12.</b>	<b>Command interface .....</b>	<b>47</b>
12.1.	Interface Description.....	47
12.1.1.	Command overview.....	47
12.1.2.	Print options .....	48
12.2.	Command Description .....	48
12.2.1.	Command 11 – Read password.....	48
12.2.2.	Command 12 – Check password .....	49
12.2.3.	Command 13 – Give new password.....	49
12.2.4.	Command 14 – Read software version .....	49
12.2.5.	Command 15 – Read serial number.....	49
12.2.6.	Command 16 – Configuration .....	49
12.2.7.	Command 21 – Read/write time.....	49
12.2.7.1.	Read time .....	49
12.2.7.2.	Write time .....	50
12.2.8.	Command 22 – Read/write IP address.....	50
12.2.8.1.	Read IP address .....	50
12.2.8.2.	Write IP address .....	50
12.2.9.	Command 31 – Read/write settings.....	50
12.2.9.1.	Read settings .....	50

---

12.2.9.2.	Write settings .....	51
12.2.10.	Command 32 – Read/write log interval.....	51
12.2.10.1.	Read log interval .....	51
12.2.10.2.	Write log interval.....	51
12.2.11.	Command 34 – Read actual measurements .....	52
12.2.12.	Command 35 – Read total energy .....	53
12.2.13.	Command 36 – Read event counters.....	53
12.2.14.	Command 37 – Read/write event settings .....	53
12.2.14.1.	Read event settings.....	53
12.2.14.2.	Write event settings .....	53
12.2.15.	Command 3B – Memory erase .....	53
12.2.16.	Command 3C – Set default event settings .....	54
12.2.17.	Command 3D – Reset total energy.....	54
12.2.18.	Command 3E – Read total negative energy .....	54
12.2.19.	Command 3F – Read/write IO settings .....	54
12.2.19.1.	Read IO settings .....	54
12.2.19.2.	Write IO settings.....	55
12.2.20.	Command 3G – Read/write current transformer setting .....	55
12.2.20.1.	Read current transformer settings .....	55
12.2.20.2.	Write current transformer settings.....	55
12.2.21.	Command 3H – Read/write IO output values .....	55
12.2.21.1.	Read IO output values.....	55
12.2.21.2.	Write IO output values .....	55
12.2.22.	Command 3I – Print options .....	56
12.2.22.1.	Read print options.....	56
12.2.22.2.	Write print options .....	56
12.2.23.	Command 51 – Read interval logs.....	56
12.2.24.	Command 52 – Read events .....	57
12.2.25.	Command 53 – Read waveform .....	58
12.2.26.	Command 54 – Read selected interval logs.....	59
12.2.27.	Command 55 – Read selected interval logs for selected time .....	59
12.2.28.	Command 56 – Read events for selected time .....	60
12.2.29.	Command 57 – Read second power logs .....	60
12.2.30.	Command 58 – Read second power logs for selected time.....	60
12.2.31.	Command 59 – Read minute logs.....	60
12.2.32.	Command 5A – Read minute logs for selected time.....	60



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12.2.33.	Command 5B – Read day logs.....	61
12.2.34.	Command 5C – Read selected day logs.....	61
12.2.35.	Command 5D – Read selected day logs for selected time.....	61
12.2.36.	Command 5E – Read selected minute logs for selected time .....	61
12.2.37.	Command 5F – Make and read snapshot .....	62
12.2.38.	Command 5G – Read selected second logs for selected time.....	62
12.2.39.	Command 5H – Read 100ms logs for selected time .....	62
12.2.40.	Command 61 – Read system log .....	62
12.2.41.	Command 62 – Reset system log .....	62
12.2.42.	Command 64 – Read parameters .....	63
12.2.43.	Command 65 – Read current sensor information .....	63
12.2.44.	Command 67 – Read status information .....	63
<b>13.</b>	<b>Specifications .....</b>	<b>64</b>
<b>14.</b>	<b>Reported problems .....</b>	<b>66</b>
14.1.	Direct connection without network.....	66
	<b>List of figures .....</b>	<b>67</b>
	<b>List of Tables .....</b>	<b>68</b>

## 1. Purpose

This document describes the user manual and the functional specifications of the pSens3 power meter. The pSens3 is identified by Project-ID PI184.

## 2. Intended Audience

The intended audience is generally anybody who wants to familiarize with and use the pSens3 power meter.

## 3. Glossary

VAC	Volts AC
mA	milli-Ampere, $1\text{mA} = 10^{-3}\text{A}$
Arms	Ampere root-mean-square
Hz	Hertz, $1\text{Hz} = 1/\text{second}$
MB	mega byte, $1\text{MB} = 10^6$ bytes
Wh	Watt-hour, 1Wh energy corresponds to 1 Watt during 1 hour = 3600J

## 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 PARTICLE, FLUID OR GAS.**

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

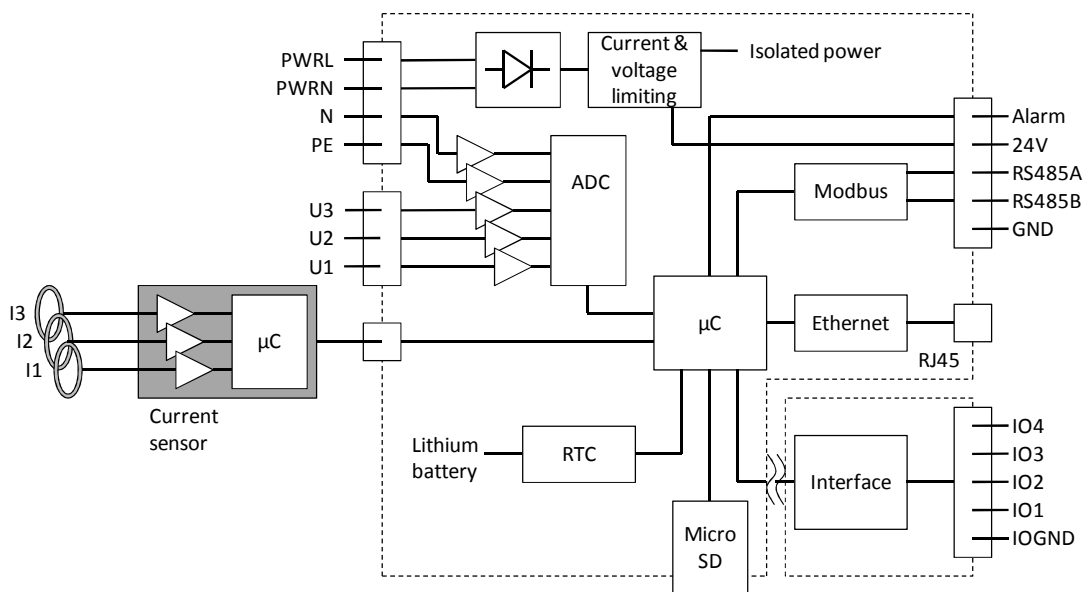
**CAUTION: The maximum input voltages must not be exceeded.**

## 5. Instrument Description

The pSens3 is a compact and advanced mains analyzer. It measures voltage, current and power on 3 supply lines and the voltage on a neutral wire. Temperature and mains frequency are measured as well. For the currents, an external current sensor is required. All measurements are logged on a MicroSD card.

The pSens3 detects and logs mains events such as voltage interruptions, frequency deviations, harmonics, flicker, etc. For short events the waveform is stored.

The pSens3 has an Ethernet connection. The module takes its supply directly from the mains.



**Figure 5-1 Schematic**

The schematic above shows the main parts of the pSens3.

The pSens3 takes its power from the lines PWRL and PWRN or from a separate 24V DC supply. The power consumption is only 2W when Ethernet is not active and 2.5W when Ethernet is active. The IO interface can consume extra power.

The RTC has a lithium battery, guaranteeing that the correct time is maintained when power is off.

An alarm output is included and an RS485 connection.

The interface is fully isolated. It has 4 independently configurable pins.

### 5.1. Micro SD card

The pSens3 contains a Micro SD card to hold its log data.

There are several prerequisites for the card:

- The minimum required disk size is 4GB.
- The card should be formatted to FAT32 with a 32K cluster size.
- The card has to contain a folder labeled "DATA". The pSens3 will only use this folder.

The following DOS commands perform a correct formatting (the example is for a disk with label E:):

```
format E: /FS:FAT32 /V:pSens3 /A:32K  
MKDIR E:DATA
```

**NOTE:** Never remove the Micro SD card from the pSens3. Removing the card can result in unknown behavior.

## 6. Logging

### 6.1. Sampling

The pSens3 samples the input voltages and currents at 10280Hz. This is enough to make frequently analysis up to the 100<sup>th</sup> harmonic.

Events are generated when a disturbance/error on the mains voltage is higher than the configurable limits. For several types of events, the raw samples are stored to view the waveform at the event occurrence, and this with a resolution of 100 micro seconds.

### 6.2. Log time

To get high resolution data, keep the data base limited and to advance read out, 5 data bases are used. A fine log data base, stores the power with a granularity of 100ms, during the last 7 days. Measurements older than a week are erased. If required, you should read them out earlier. The intermediate data base stores all data every minute during 40 days. The interval and hour data bases store this for a whole year, while the daily data is kept for the last 10 years. Logging stops at the end of this century i.e. the end of 2099.

An easy to interpret web page shows the logs in a graphical and numeric way. With a simple click on a numeric value, you can get more detailed information.

### 6.3. Log data selection

All data can be exported in CSV (excel) or TXT format. The time interval, resolution and data are selectable. The next table shows the selectable data groups for export. Each log also contains a time stamp. This gives the beginning of the log interval.

Bit	Variables	Unit
0	L1 average rms voltage	Vrms
1	L1 minimum rms voltage L1 maximum rms voltage L1 average total harmonic voltage distortion	Vrms Vrms %
2	L2 average rms voltage	Vrms
3	L2 minimum rms voltage L2 maximum rms voltage L2 average total harmonic voltage distortion	Vrms Vrms %
4	L3 average rms voltage	Vrms
5	L3 minimum rms voltage L3 maximum rms voltage L3 average total harmonic voltage distortion	Vrms Vrms %
6..7	<i>(reserved)</i>	
8	L1 average rms current	Arms
9	L1 minimum rms current L1 maximum rms current L1 average total harmonic current distortion	Arms Arms %
10	L2 average rms current	Arms

11	L2 minimum rms current L2 maximum rms current L2 average total harmonic current distortion	Arms Arms %
12	L3 average rms current	Arms
13	L3 minimum rms current L3 maximum rms current L3 average total harmonic current distortion	Arms Arms %
14..15	<i>(reserved)</i>	
16	L1 average active power L1 average reactive power	W var
17	L1 average positive active power L1 average negative active power L1 average power factor	W W -
18	L2 average active power L2 average reactive power	W var
19	L2 average positive active power L2 average negative active power L2 average power factor	W W -
20	L3 average active power L3 average reactive power	W var
21	L3 average positive active power L3 average negative active power L3 average power factor	W W -
22	<i>(reserved)</i>	
23	total average active power (sum of L1, L2 and L3) total average reactive power (sum of L1, L2 and L3)	W var
24	number of samples frequency temperature log code	- Hz °C -
25	Neutral average rms voltage	Vrms
26	Neutral minimum rms voltage Neutral maximum rms voltage	Vrms Vrms
27	IO1 IO2 IO3 IO4	(*) (*) (*) (*)
28	total average positive active power (sum of L1, L2 and L3) total average negative active power (sum of L1, L2 and L3) total average reactive power (sum of L1, L2 and L3)	W W var
29..31	<i>(reserved)</i>	

(\*) The unit for the IO signals depends on the selected IO type: no unit for pulses, V for voltages and mA for currents.

#### Table 6-1 Log variables selection

The log code contains extra information about the log. It must be interpreted as a binary value.

Bit	Description
0..7	<i>(reserved)</i>
8	The log was not found in memory.

**Table 6-2 Log code**

The order of the printed data is fixed. It is given in the following table.

<b>Variables</b>	<b>Bit</b>
Time	-
number of samples frequency temperature log code	24
L1 average rms voltage	0
L1 minimum rms voltage L1 maximum rms voltage L1 average total harmonic voltage distortion	1
L1 average rms current	8
L1 minimum rms current L1 maximum rms current L1 average total harmonic current distortion	9
L1 average active power L1 average reactive power	16
L1 average positive active power L1 average negative active power L1 average power factor	17
L2 average rms voltage	2
L2 minimum rms voltage L2 maximum rms voltage L2 average total harmonic voltage distortion	3
L2 average rms current	10
L2 minimum rms current L2 maximum rms current L2 average total harmonic current distortion	11
L2 average active power L2 average reactive power	18
L2 average positive active power L2 average negative active power L2 average power factor	19
L3 average rms voltage	4
L3 minimum rms voltage L3 maximum rms voltage L3 average total harmonic voltage distortion	5
L3 average rms current	12
L3 minimum rms current L3 maximum rms current L3 average total harmonic current distortion	13
L3 average active power L3 average reactive power	20
L3 average positive active power L3 average negative active power L3 average power factor	21
total average active power (sum of L1, L2 and L3) total average reactive power (sum of L1, L2 and L3)	23
Neutral average rms voltage	25



Neutral minimum rms voltage Neutral maximum rms voltage	26
total average positive active power (sum of L1, L2 and L3) total average negative active power (sum of L1, L2 and L3) total average reactive power (sum of L1, L2 and L3)	28
IO1 IO2 IO3 IO4	27

**Table 6-3 Log variables printing order**

## 6.4. Print options

There are several options that determine how the log data is printed.

Option	Description
Decimal point	This is either . or ,
Log delimiter	This is either a TAB character or ; When printing to a .CSV file, the log delimiter is fixed to ;
Dummy lines	This option affects how the pSens3 handles logs that don't exist. <b>Enabled:</b> When a specific log is not found, a dummy line is printed with all values set to zero. The advantage of this is that the user knows exactly how many lines will be printed. <b>Disabled:</b> When a specific log is not found, no dummy line is printed. The advantage is that no unnecessary data has to be transferred.
Dummy columns	This option affects how the pSens3 handles variables that are not selected. <b>Enabled:</b> An empty column is added for unselected logs. The advantage is that the amount of columns in a log is always equal, regardless of which logs are selected. <b>Disabled:</b> No empty column is added for unselected logs. The advantage is that no unnecessary data has to be transferred.
Summer-/wintertime indication	When this option is enabled, an extra column is added to the log directly after the column with the time value. This column holds a "W" if the time is wintertime and an "S" if the time is summertime.
IO dummy value	Since the IO type can be changed, older logs can contain IO data that does not match the current IO type. This option determines how the pSens3 handles these logs. <b>Empty:</b> If the IO type differs from the current setting, an empty column is printed. <b>0:</b> If the IO type differs from the current setting, a zero is printed.

**Table 6-4 Log print options**

## 6.5. Memory Erase

The user can erase the logs or the events separately. When erasing, the pSens3 stores the erase time. No actual data is removed, only older data is hidden. This means that logs older than the erase time are not lost. They are simply not readable by the module.

## ***6.6. Date and Time Change***

The pSens3 contains a high precision pretrimmed time clock, with temperature compensation. Time lead or lag is limited to 5 ppm or 12 seconds/month. A daily synchronization with a time server can further enhance clock precision.

## ***6.7. Phase Check***

The module has a web page showing the actual measurements. It performs a phase check for all supply phases.

This checks if the current is between 16° lead and 46° lag. If it is not, a warning is indicated in the measurements table.

The phase check is intended for phases that measure consumed power. The result is not valid for generated power, e.g. with solar panels.

If an warning is given for a phase that measuremes consumed power, check the direction of the current coils.

## 7. Events

An important function of the pSens3 is to keep irregularities of your power supply. If a machine exhibits a problem at a certain time, then you can check if there was an irregularity in the mains.

Detected events are stored in the memory. For several events a 1s waveform (=scope picture) of all voltages and currents is also stored. This with a depth of 10000 points or a resolution of 100 $\mu$ s. The memory holds up to 50 records for every event type, so that one events type never influences another.

The events are:

- 1) Frequency variations
- 2) Magnitude variations
- 3) Rapid voltage changes
- 4) Flicker severity
- 5) Voltage dips
- 6) Voltage interruptions
- 7) Temporary overvoltage
- 8) Transient overvoltage
- 9) Voltage unbalance
- 10) Harmonic voltage
- 11) Current limit
- 12) Frequency drift
- 13) Vector surge
- 14) Neutral overvoltage
- 15) Power on/off
- 16) Harmonic current
- 17) Time Change
- 18) Snapshot

The limits for all events presets to the EN50160 norm. Experts can change them if necessary.

Unless noted otherwise, an event log contains the start time, the duration and the event specific measurements.

### ***7.1. Event description***

In the next description, value's from the EN50160 norm are used. Note that they can be changed if necessary.

#### **7.1.1. Frequency variations**

The average supply frequency is checked over every interval (default=10 seconds). Deviations of more than 1% from the nominal frequency are detected. This is the slow frequency deviation event.

#### **7.1.2. Magnitude variations**

The average supply voltage is checked over every interval (default=10 minutes). Deviations of more than 10% from the nominal supply voltage are detected.

This is the slow voltage deviation event.

### **7.1.3. Rapid voltage changes**

The 3 supply phases are checked. Sudden voltage changes of more than 5% of the nominal supply voltage are detected.

### **7.1.4. Flicker severity**

The 3 supply phases are checked. The method used to calculate the flicker is an approximation of the standard method.

### **7.1.5. Voltage dips**

The 3 supply phases are checked. Voltage drops below 90% of the nominal supply voltage and less than 1 minute in duration are detected.  
A waveform is stored for this event.

### **7.1.6. Voltage interruptions**

The 3 supply phases are checked. Voltage drops below 10% of the nominal supply voltage and less than 3 minutes in duration are detected.  
A waveform is stored for this event.

### **7.1.7. Temporary overvoltage**

The 3 supply phases are checked. Overvoltage above 110% of the nominal supply voltage and less than 3 minutes in duration are detected.  
A waveform is stored for this event.

### **7.1.8. Transient overvoltage**

The 3 supply phases are checked. Overvoltage above 150% of the nominal supply voltage and less than 1 minute in duration are detected.  
A waveform is stored for this event.

### **7.1.9. Voltage unbalance**

The 3 supply phases are checked. Unbalance above 2% is detected.  
A waveform is stored for this event.

### **7.1.10. Harmonic voltage**

The 3 supply phases are checked. Total harmonic distortions of a voltage above 8% are detected. Harmonics are detected up to the 100<sup>th</sup> harmonic.  
A waveform is stored for this event.

### **7.1.11. Current limit**

The 3 supply phases are checked. Currents above maximum current range are detected.  
A waveform is stored for this event.

### 7.1.12. Frequency drift

The supply frequency is checked. Sudden frequency changes of more than 1Hz of the nominal supply voltage are detected.  
A waveform is stored for this event.

### 7.1.13. Vector jump

The 3 supply phases are checked. Jumps of the voltage angle of more than 30° are detected.  
A waveform is stored for this event.

### 7.1.14. Neutral overvoltage

The neutral voltage is checked. A voltage above 10% of the nominal supply voltage is detected.

### 7.1.15. Operating state

Several changes to the operating state are logged:

- reset;
- power off/on cycle, this logs the times and the cause as well;
- sensor connect/disconnect.

### 7.1.16. Harmonic current

The 3 supply phases are checked. Total harmonic distortions of a current above 2% are detected.  
A waveform is stored for this event.

### 7.1.17. Time change

Changes of the date and time of the internal clock are logged.

### 7.1.18. Snapshot

The user can take a snapshot of the actual voltages and currents.  
A waveform is stored for this event.

## 7.2. Event settings

Each event has between 1 and 3 settings. These are shown in table 7-1.

Nr	Event	Setting 1	Setting 2	Setting 3
1	Frequency variations	period in seconds <i>default: 10s</i>	low limit in % of nominal freq. <i>default: 99%</i>	high limit in % of nominal freq. <i>default: 101%</i>
2	Magnitude variations	period in seconds <i>default: 600s</i>	low limit in % of nominal volt.	high limit in % of nominal volt.

			<i>default: 90%</i>	<i>default: 110%</i>
<b>3</b>	<b>Rapid voltage changes</b>	limit in % of nominal volt. <i>default: 5%</i>	-	-
<b>4</b>	<b>Flicker severity</b>	period in seconds <i>default: 600s</i>	limit dimensionless x10 <i>default: 10</i>	-
<b>5</b>	<b>Voltage dips</b>	limit in % of nominal volt. <i>default: 90%</i>	-	-
<b>6</b>	<b>Voltage interruptions</b>	limit in % of nominal volt. <i>default: 10%</i>	-	-
<b>7</b>	<b>Temporary overvoltage</b>	limit in % of nominal volt. <i>default: 110%</i>	-	-
<b>8</b>	<b>Transient overvoltage</b>	limit in % of nominal volt. <i>default: 150%</i>	-	-
<b>9</b>	<b>Voltage unbalance</b>	limit in % distortion <i>default: 2%</i>	-	-
<b>10</b>	<b>Harmonic voltage</b>	limit in % distortion <i>default: 8%</i>	-	-
<b>11</b>	<b>Current limit</b>	limit in Arms <i>default: 3000Arms</i>	-	-
<b>12</b>	<b>Frequency drift</b>	limit in mHz <i>default: 1000mHz</i>	-	-
<b>13</b>	<b>Vector jump</b>	limit in ° <i>default: 30°</i>	-	-
<b>14</b>	<b>Neutral overvoltage</b>	limit in % of nominal volt. <i>default: 10%</i>	-	-
<b>15</b>	<b>Operating state</b>	-	-	-
<b>16</b>	<b>Harmonic current</b>	limit in % distortion <i>default: 100%</i>	-	-

17	Time change	-	-	-
18	Snapshot	-	-	-

**Table 7-1 Event settings**

## 8. Ethernet connection

The Ethernet speed is optimized for 100Mb, but the pSens3 can be used with very old 10Mb hubs and with the 100/10Mb or 1Gb/100/10Mb switches (sometimes still hub named).

Each pSens3 has a MAC address 00-E0-82-Cn-nn-nn where n-nn-nn is a unique HEX number. The serial number is A82Cnnnnn, i.e. an 'A' followed by the last 4 bytes of the MAC address. This serial number is also the default network name.

### ***8.1. pSens3 in a network connection.***

After a power up or reset or every minute the pSens3 tries to discover a DHCP server. Once he find the server, he registers for one day, and gets the following information from the DHCP server:

- His private IP-address
- The network mask
- The router address
- The WINS server address
- The DNS server address
- The NTP server address
- The domain name
- The maximum registration time

These settings will override those in the pSens3.

In the next step, if there is a WINS server, the pSens3 registries his name and IP address at the WINS server. Normally your DNS server copies the WINS date.

After the maximum registration time or at least every day the pSens3 will redo the whole discover and registration procedure.

If you have access to the WINS server than you can see the used IP address and connect to the pSens3.

Normally we use the name or serial number "A82Cnnnnn" of the pSens3. Your PC will ask the translation of this name to an IP-address to the WINS or DNS server. Or in absence of these servers the pSens3 respond to a WINS name resolution broadcast of your PC.

[HTTP://A82Cnnnnn](http://A82Cnnnnn) is the URL to surf to the pSens3, do not type a WWW in this URL.

### ***8.2. pSens3 in a point to point connection.***

This paragraph describes how to connect to the pSens3 with a direct connection PC-pSens3. The pSens3 supports auto MDX, which means that you can use both, a standard Ethernet patch cable or a cross cable, the auto MDX function switches cable pairs if necessary.

- 1) Use the default ip-address = 169.254.1.1 to connect. This address can be changed in the settings:network http page. If it is impossible to connect, an action could be an IP reset.  
Push on the reset button until the I/O2 LED blinks fast, and release then. This action resets the IP address to 169.254.1.1
- 2) Connect to pSens3's serial number "A82Cnnnnn". Name resolution is done by your PC with a WINS broadcast. This works only if your PC has an IP address in the range of 169.254.1.2 to 169.254.255.255



- 3) Temporally change of the IP address of your pSens3 using WINS. This method can also be used in a network, and works only if your PC supports WINS broadcasts (Linux don't).  
The pSens3 recognizes a connection with a name formed by his serial number and the last 16 bits (=2 bytes) of the new IP address. See §8.3.
- 4) Temporally change of the IP address of your pSens3 using ARP and PING. With ARP we enter the pSens3's IP address, a ping with an exact length of 1 will set temporally this address in the pSens3. See §8.4.

### ***8.3. Setting up an ip address by the use of WINS.***

The fastest and easiest way to give the pSens3 an IP address is done by surfing to it by using a special URL. This method uses a WINS broadcast packet and is not supplied in Linux. Another disadvantage of WINS is that windows will not send out a repeated WINS packet within one hour. This can be advanced by given the DOS command : nbtstat -R A82Cnnnnn  
Note that this address is lost on the next device reset or power off/on cycle.

Go to the settings:network to save this address permanently.

Take these steps to set the IP address:

1 – Get a free IP address from your network administrator.

2 - Check if the IP address is not already in use.

The IP address supplied by the network manager must be checked first,  
Ping to this IP address.

Ping must return a time out, if you are not sure if the pSens3 has already this address, then pull out the network connector from the client for this test.

If you receive a reply from this IP address, report this to your network manager and ask for a free IP address.

3 - Set temporally the IP address of the client.

URL = [HTTP://A82CnnnnnCCCDDD](http://A82CnnnnnCCCDDD)

A82Cnnnnn : serial number of the pSens3

CCCDDD : last 2 bytes of the IP address. Add leading zero's up to 2 times 3 digits.

001 <= CCC <= 254 and its best that CCC equals to the 3<sup>th</sup> byte of your PC's IP.

001 <= DDD <= 254 (do not use 000 or 255)

The format of the free IP address is always AAA.BBB.CCC.DDD where the first bytes should be the same as your PC's address.

For a class B network: AAA.BBB should be the same as the first 2 bytes of your PC's IP address. And CCC.DDD is the client specific part.

Surf to [HTTP://A82CnnnnnCCCDDD](http://A82CnnnnnCCCDDD) to set up the IP address and get the home page.

Examples:

[HTTP://A82Cnnnnn006009](http://A82Cnnnnn006009) : change the device IP address to AAA.BBB.6.9 + home)

[HTTP://A82Cnnnnn239001](http://A82Cnnnnn239001) : change the device IP address to AAA.BBB.239.1 + home)

NOT allowed:

[HTTP://A82Cnnnnn000000](http://A82Cnnnnn000000) (reserved for IP broadcast)

[HTTP://A82Cnnnnn255255](http://A82Cnnnnn255255) (reserved for IP broadcast)

[HTTP://A82Cnnnnn900900](http://A82Cnnnnn900900) (> 255 is not allowed)

[HTTP://A82Cnnnnn045](http://A82Cnnnnn045) (wrong format, should be 6 digits)

[HTTP://A82Cnnnnn00A00B](http://A82Cnnnnn00A00B) (no digits)

Note1: The given IP address is placed in RAM (=volatile memory) of the pSens3.

Change in the settings:network to keep it permanently.

Note2: Mostly it's necessary to switch off the non used networks.

Note3: Windows can only do this configuration, once in an hour, for the given IP-address.  
When there goes something wrong you should use another IP-address, or restart your computer.

Possible advanced commands if you have administrator rights on your PC:

- ARP -a : display the ARP table
  - ARP -d : delete the ARP table (\*)
  - nbtstat -c : show the network bios table (-c must be in lower case)
  - nbtstat -R A82Cnnnnn : resend a WINS packet (\*) (-R must be in upper case)
  - ipconfig /renew
- (\*) Windows7 and up, in user mode, doesn't accepts some commands

### 8.4. Setting up an ip address by ARP and PING.

This alternative can be used by persons who are familiar with DOS. In the first step one fills up the ARP table with the pSens3's MAC- and wanted IP address. The second step is a ping with exact 5 bytes of data.

```
ARP -s 192.168.2.201 00-E0-82-Cn-nn-nn
PING -n 1 -l 5 192.168.2.201
192.168.2.201 = pSens3's IP address
00-E0-82-Cn-nn-nn = mac address pSens3
```

Note that this address is lost on the next device reset or power off/on cycle. Go to the settings:network to save this address permanently.

### 8.5. Measurements Export

The log data can be exported in CSV format. The link name determines the data that is printed. The name is either fixed (/EXPORT.CSV) or contains a set of fields that select the data.

The fixed link /EXPORT.CSV prints the full data per minute for the last 4 hours, with dummy columns added.

The link name with selection fields is

```
/EXPORT_YYMMDDHHMMSS_R_LLLLLLLL_MMMMMMMMMM_E.CSV.
```

Field	Description
YYMMDDhhmmss	start time in wintertime: year+month+day+hour+minutes+seconds
R	resolution B=100ms S=seconds M=minutes Q=log intervals D=days
LLLLLLLL	length of the output: this is the amount of data lines This is a decimal value consisting of exactly 8 characters.
MMMMMMMM	Mask that selects which data to print (see section 6.3). This is a hexadecimal value consisting of exactly 8 characters.
E	Flag to select dummy columns (see section 6.4). E=1 : enabled E=0 : disabled

**Table 8-1 Export link name fields**

**Example 1**

To print the full data for the first day of 2014 in 15 minute intervals:

```
/EXPORT_140101000000_Q_00000096_FFFFFFFF_1.CSV
```

140101000000 = January 1<sup>st</sup>, 2014 at 0h0m0s

Q = 15 minute intervals

00000096 = print 96 intervals, this is 1 day

FFFFFFF = all bits of the mask are on, so the full data set is printed

1 = include a ";" for empty columns, there are none in this example

**Example 2**

To print the voltage for line 1 for today from 10h00 to 11h00 in minutes and leave out all other columns:

```
/EXPORT_140415090000_M_00000060_00000001_0.CSV
```

140415090000 = today, starting at 10h00, note that the time is given in wintertime

M = data per minute

00000060 = print 60 minutes = 1 hour

00000001 = print only the voltage for line 1

0 = all other columns are left out

**8.5.1. Print options**

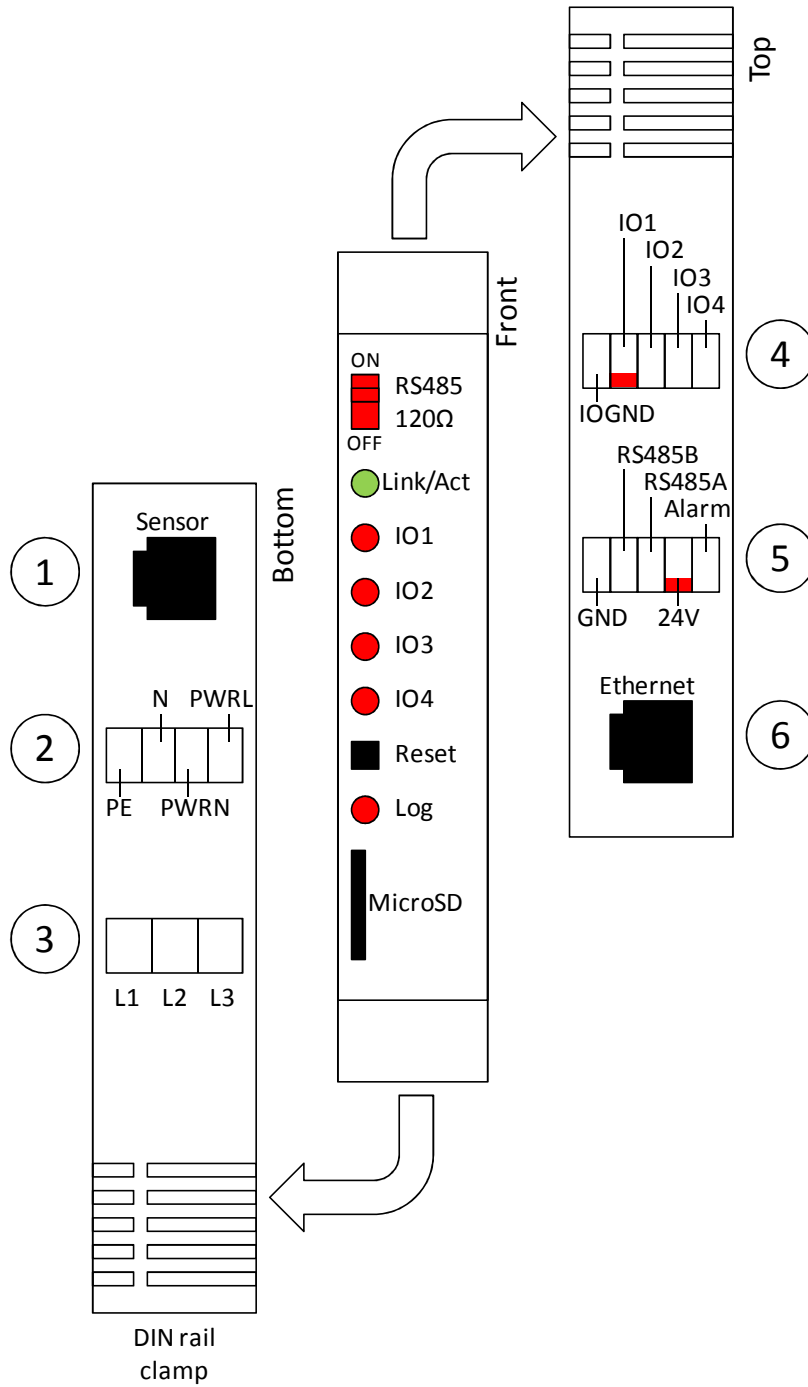
All print options are fixed, except for the dummy columns. The values are shown in the following table.

Option	Description
Decimal point	.
Log delimiter	TAB
Dummy lines	disabled
Dummy columns	Enabled for fixed link /EXPORT.CSV Set by the link name for a link name with selection fields
Summer-/wintertime indication	disabled
IO Dummy value	empty column

**Table 8-2 Log print options**

## 9. Installation

### 9.1. Overview



**Figure 9-1 Front, top and bottom views**

At the front, the pSens3 has a switch for the RS485 termination, 6 LEDs, a reset button and a slot for the MicroSD card.

	Description
<b>RS485 switch</b>	This switch enables/disables an internal 120Ω termination on the RS485 port.
<b>Link</b>	The LED is on if the pSens3 is connected to a network. The LED blinks when there is data transfer on the network.
<b>IO1..4</b>	The LED indicates the state of the IO pin.
<b>Reset</b>	The reset button can only be pressed with a small pin. A paper clip is perfect. A short press resets the pSens3.
<b>Log</b>	The log LED blinks every second to show activity.

**Table 9-1 Front switch, LEDs and reset button**

At the top and bottom side there are 6 connectors, numbered as indicated by the circles in Fig. 9-1.

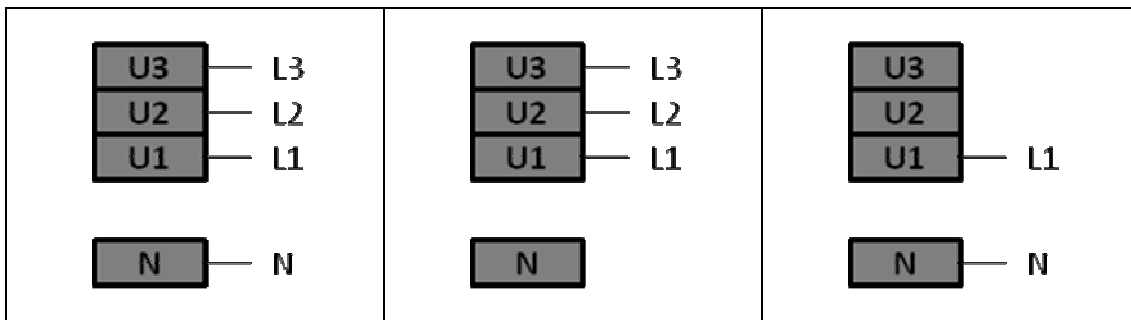
Connector	Description
<b>1</b>	Current sensor
<b>2</b>	Neutral, Earth (PE), AC supply L&N
<b>3</b>	Phase voltages U1,U2,U3
<b>4</b>	Isolated IO pins
<b>5</b>	Alarm, DC supply, modbus
<b>6</b>	Ethernet

**Table 9-2 Top and bottom connectors**

## 9.2. Connections

The power meter can be used with different distribution systems. The required connections for U1, U2, U3 and N are shown in the following table.

Three-phase with neutral	Three-phase without neutral	Single-phase



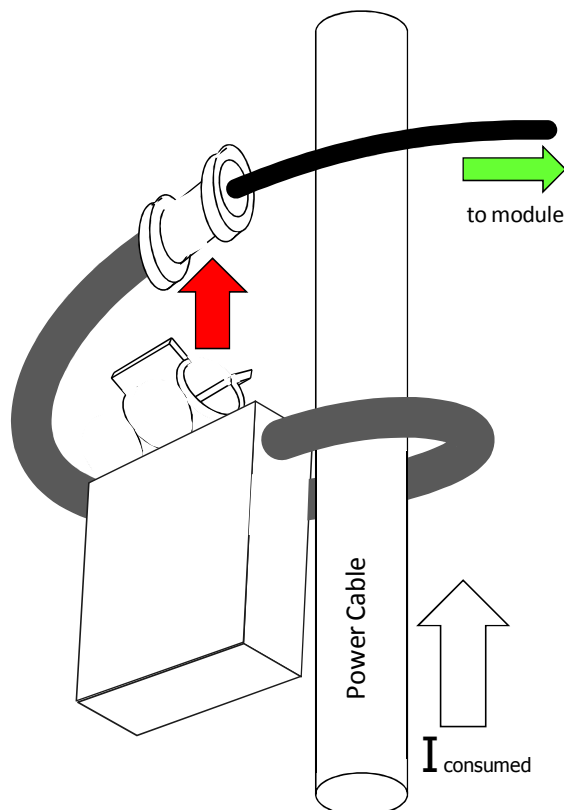
**Table 9-3 Connections for different distribution systems**

### 9.3. Power

The pSens3 can be powered by either a AC supply (connector 2) or a 12-28V DC supply (connector 5). The AC supply requires 230VAC.

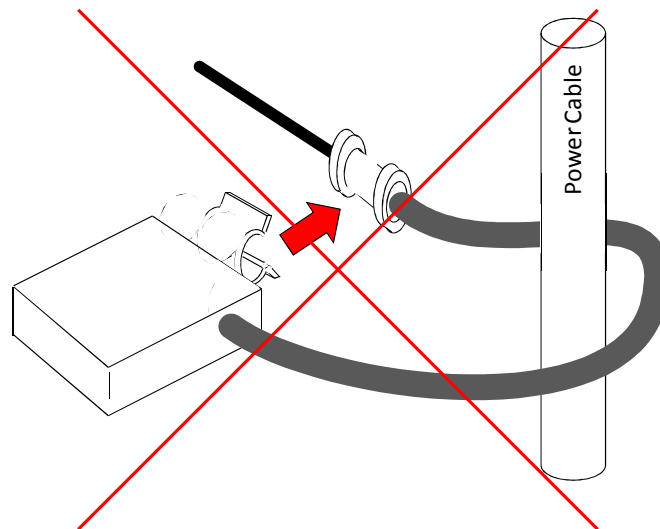
### 9.4. Coils

To install a current sensor, wrap the measurement coil round the single phase power cable. Click the free end (with box) into the clamp holder on the coil cable. The coil has to make a **closed** loop around the power cable.



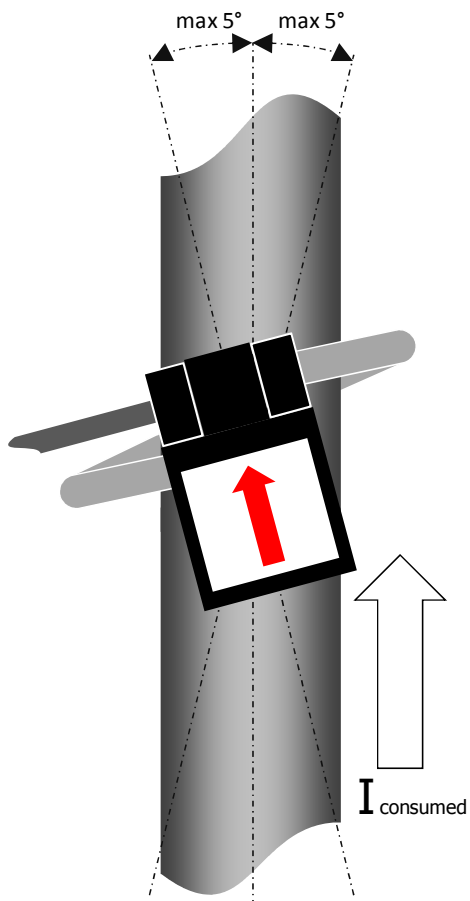
**Figure 9-2 Correct coil connection**

The following figure illustrates a faulty installation.



**Figure 9-3 Incorrect coil connection**

The sensor has to be properly aligned to the cable, as shown in the following figure.



**Figure 9-4 Correct coil alignment**

## 10. IO

The pSens3 has an IO section that is galvanically isolated from the rest of the system. This contains an IO ground and 4 IO pins. The functionality for each pin can be set separately. The IO connector is galvanically isolated from the rest of the meter.

### 10.1. Digital Output

When a pin is set to digital output, it has several functions.

Function	Description
Modbus controlled	The output can only be set/cleared via modbus. The output is updated every 5ms.
Consumed energy pulse	The output sends an amount of pulses that is proportional to the consumed energy. The user has to set the weight of the pulse, expressed in Wh/pulse. Each pulse is 50ms long and has minimum 50ms delay following the pulse. Every second maximum 10 pulses can be sent.
Generated energy pulse	Same as above, except the amount of pulses that is proportional to the generated energy.
Timer	The output can be programmed to activate/deactivate at requested times. The time resolution is 1s.

**Table 10-1 Digital output functions**

There are 2 different configurations for a digital output: sink and source.

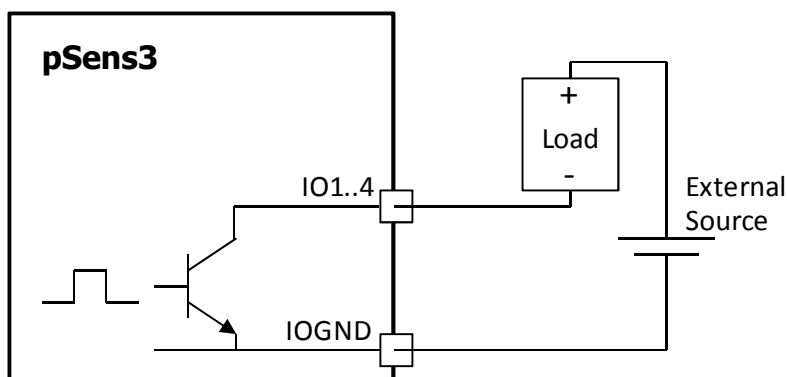
#### 10.1.1. Sink

This configuration requires an external source and load.

When active, an NPN transistor in the pSens3 pulls the output low. The emitter of the transistor is tied to IOGND.

This current can't driver inductive loads nor relays. Otherwise it can be used to drive an opto-relays.

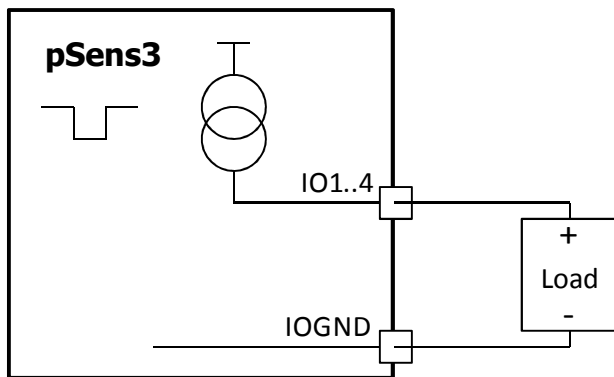
**NOTE:** The current is limited to 21mA. This current is guarded, if it rises above 21mA it is deactivated for 5 seconds.





**Figure 10-1 Digital sink output configuration****10.1.2. Source**

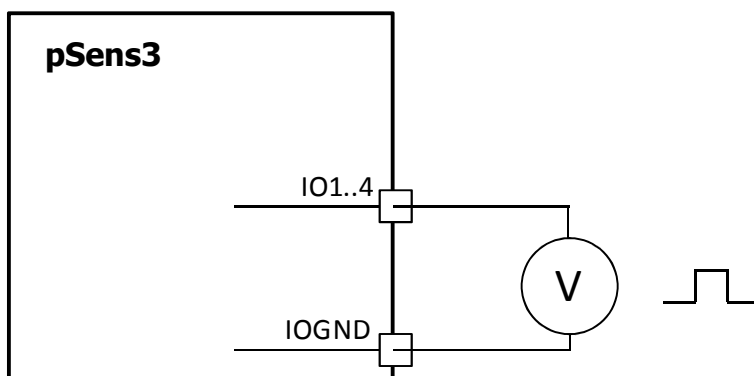
This configuration sources a current to a load. The load is tied to IOGND. The current can be set to 1mA, 2mA, 5mA, 10mA or 20mA. When active, the current is sourced to the load.

**Figure 10-2 Digital source output configuration****10.2. Digital Input**

When an IO pin is configured as digital input, the pSens3 counts the input pulses on the pin. The input can be either active or passive.

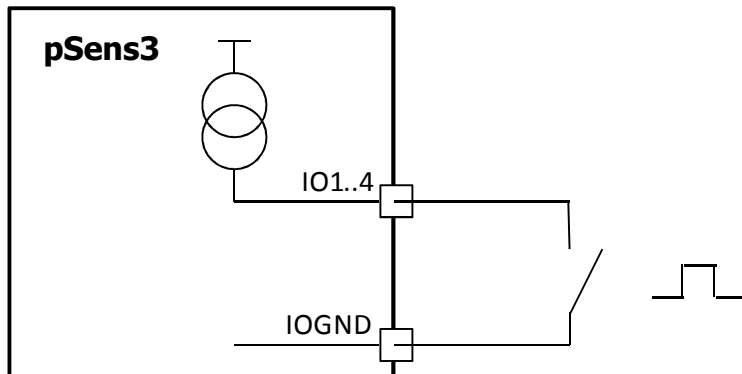
**10.2.1. Active Pulse Input (Voltage)**

The input is driven by a voltage source. The input is active high.

**Figure 10-3 Digital voltage input configuration****10.2.2. Passive Pulse Input (Source)**

The pSens3 sources a current. This can be set to 1mA, 2mA, 5mA, 10mA or 20mA. The input is active low.

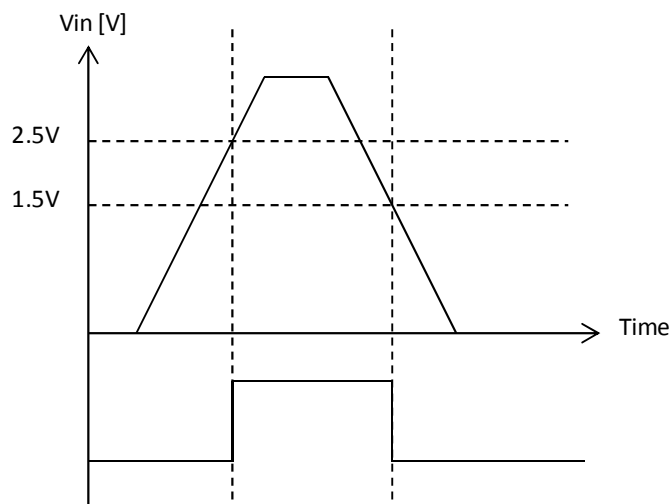
An external switch pulls the pin low in active state.



**Figure 10-4 Digital source input configuration**

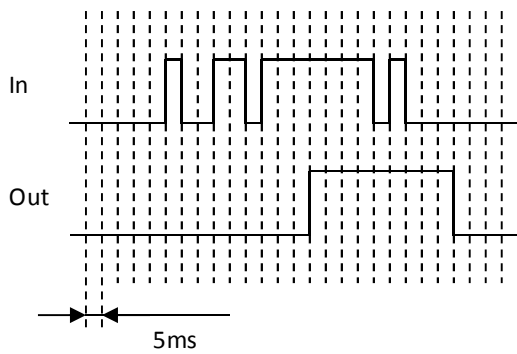
### 10.2.3. Input Processing

For a digital input, the pin voltage is measured. A high level is detected when the voltage rises above 2.5V. A low level is detected when the voltage drops below 1.5V. For voltages in between 1.5V and 2.5V, the level does not change.



**Figure 10-5 Digital input threshold levels**

The input level is sampled at 5ms intervals. The resulting samples are debounced. The input has to remain stable for 3 consecutive samples before the detected level changes. The figure below shows the input and output of debouncing. Peaks of only a or 2 samples are filtered out.



**Figure 10-6 Digital input debouncing**

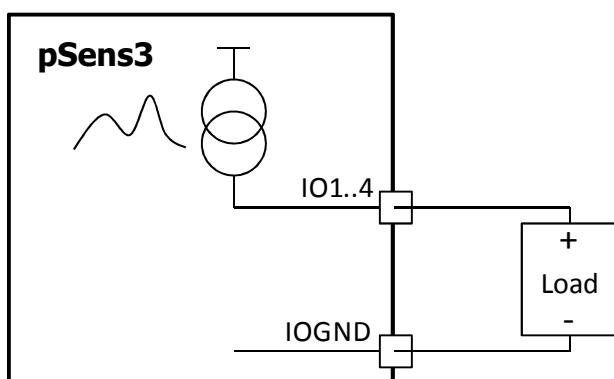
### 10.3. Analog Output

When configured as analog output, the pSens3 sends a current in the range 0 to 20mA. This current can't driver inductive loads nor relais.

There are several possible functions.

Function	Description
Modbus controlled	The output current can only be set via modbus. The output is updated every 5ms.
Consumed power	The output current is proportional to the consumed power. The user has to set the weight of the output, expressed in W for 20mA.
Generated power	Same as above, except the amount indicates the generated power.
Current source	The output current is fixed.

**Table 10-2 Analog output functions**



**Figure 10-7 Analog output configuration**

## 10.4. Analog Input

### 10.4.1. Current

The pSens3 measures the input current in  $\mu\text{A}$ . The range is 0..20mA.

**NOTE:** The current is limited to 21mA. An electronic fuse will open the circuit on an overcurrent during 5 seconds. A check will be done every 5 seconds and the fuse closes again once the current is lower than 21mA.

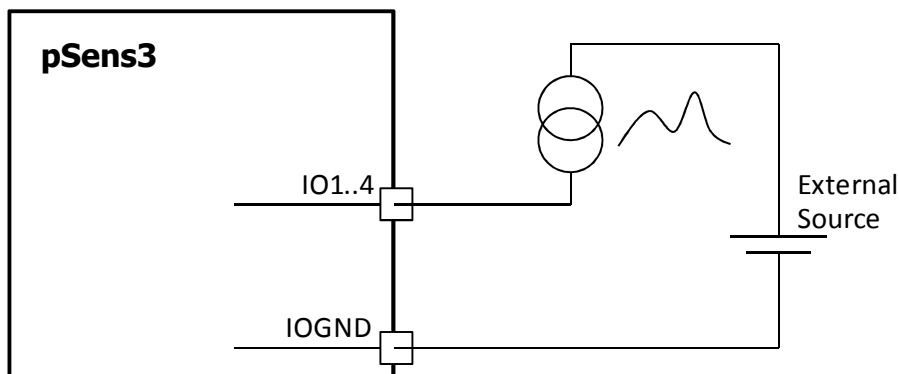


Figure 10-8 Analog current input configuration

### 10.4.2. Voltage

The pSens3 measures the input voltage in mV. The range can be set to either 0..10V or 0..30V.

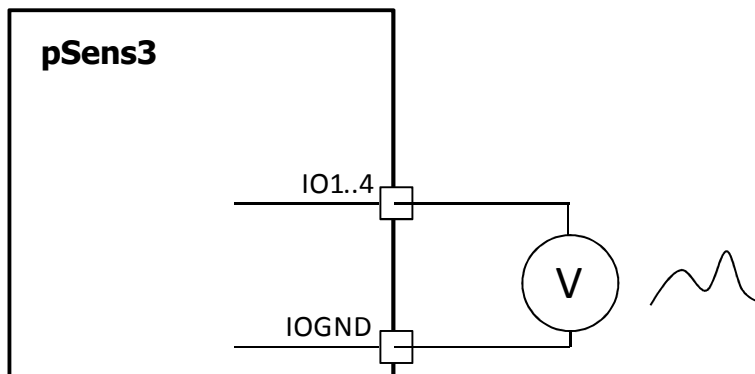


Figure 10-9 Analog voltage input configuration

## 10.5. Log Values

The logged value depends on the setting. When the setting changes in the middle of a log period, the logged value is zero.

Function	Logged value
Digital output – modbus	output pattern

controlled	This is stored with 40ms accuracy. Only the second logs contain this value.
Digital output – pulse function	sent pulse count
Digital input	received pulse count
Analog output	average current
Analog input - current	average current
Analog input - voltage	average voltage

**Table 10-3 IO log values**

## **10.6. Modbus Registers**

Each IO can be accessed over modbus through 2 registers: a state register and a pulse counter. All registers contain unsigned 16 bit integers.

### **10.6.1. State Register**

The state register indicates the actual value of the IO. For IOs that are set to modbus control, these registers can be written to change the output state.

For digital IO, the state register indicates the actual value of the pin. A zero indicates an inactive IO, a non-zero value indicates an active IO.

For analog IO, the state register holds the actual measured value. The unit is mV for voltage input. The unit is  $\mu$ A for current output or input.

### **10.6.2. Pulse Counter**

For all digital IOs, the pulse counter contains the total amount of pulses counted. For analog IOs, this register is 0. The pulse counter registers cannot be written to.

The counter is a 16 bit counter that overflows at 65536.

#### **Example 1**

The pulse counter register for a digital input contains the value 65500. An hour later, the register contains the value 10. The amount of pulses counted in this hour can be calculated with the following formula:

$$(10-65500) \text{ modulo } 65536.$$

## **10.7. Settings**

Each IO pin has 2 settings that completely control its functionality: a type setting and a weight setting. These settings are described in this section.

### **10.7.1. Type**

The type setting is a 32 bit variable.

When the IO functionality is set through the web interface, the bit settings are transparent to the user. Not all settings are possible. Check the configurations described in the beginning of this section.

Bit	Description
0..7	<i>reserved</i>
8..15	<b>function</b> 0: modbus controlled 1: pulse for consumed energy ( <i>only for digital outputs</i> ) 2: pulse for generated energy ( <i>only for digital outputs</i> ) 3: current proportional to consumed power ( <i>only for analog outputs</i> ) 4: current proportional to generated power ( <i>only for analog outputs</i> ) 5: timer ( <i>only for digital outputs</i> ) 6: current source ( <i>only for analog outputs</i> ) 7..255: <i>reserved</i>
16..17	<b>timer control</b> ( <i>only for timer function</i> ) 0: auto 1: on 2: off 3: -
18..21	<i>reserved</i>
22..25	<b>current</b> ( <i>only for source configuration</i> ) 0: 1mA 1: 2mA 2: 5mA 3: 10mA 4: 20mA 5..15: <i>reserved</i>
26..29	<b>configuration</b> 0: sink 1: source 2: <i>reserved</i> 3: 0..20mA 4: 0..10V 5: 0..30V 6..15: <i>reserved</i>
30	<b>direction</b> 0: input 1: output
31	<b>type</b> 0: digital 1: analog

**Table 10-4 IO type settings**

The full settings values for the different IO types are given in the table below.

IO Type, direction & configuration	Value
Disabled	0x00000000
Digital output – Sink	0x40000000
Digital output – Source	0x44000000
Digital input – Active (Voltage)	0x10000000 (*)
Digital input – Passive (Source)	0x04000000
Analog output	0xCC000000
Analog input – Current	0x8C000000
Analog input – Voltage 0..10V	0x90000000

Analog input – Voltage 0..30V	0x94000000
-------------------------------	------------

(\*) For active inputs, the measurement range is set to 0..10V. Higher input voltages are allowed.

**Table 10-5 IO settings – Type, direction & configuration**

Source current setting	Value
1mA	+ 0x00000000
2mA	+ 0x00400000
5mA	+ 0x00800000
10mA	+ 0x00C00000
20mA	+ 0x01000000

**Table 10-6 IO settings – Digital output source current**

Digital output function	Value
Modbus controlled	+ 0x00000000
Consumed energy pulse	+ 0x00000100
Generated energy pulse	+ 0x00000200
Timer	+ 0x00000500

**Table 10-7 IO settings – Digital output function**

Analog output function	Value
Modbus controlled	+ 0x00000000
Consumed power	+ 0x00000300
Generated power	+ 0x00000400
Current source	+ 0x00000600

**Table 10-8 IO settings – Analog output function**

Digital output timer	Value
Auto	+ 0x00000000
On	+ 0x00010000
Off	+ 0x00020000

**Table 10-9 IO settings – Analog output function**

### 10.7.2. Weight

The weight setting is only required when a pin is set as output (digital or analog). The use of the weight setting depends on the function of the output.

For digital pulse outputs, it gives the weight of a pulse in Wh/pulse.

For analog outputs proportional to power, it gives the value in Watt that corresponds to 20mA, i.e. full range output.

For a current source, it gives the value of the fixed output current.

#### **Example 1**

A digital output is set to pulse for consumed energy. The weight is set to 10.E3. For every 10000Wh or 10 kWh of consumed energy that is measured, the pSens3 will send out 1 pulse.

#### **Example 2**

An analog output is set to current proportional to generated power. The weight is set to 100.E3. If the device measures 100kW of generated power, the output sources 20mA. If the device measures 10kW of generated power, the output sources 2mA.

## 10.8. Timer

Digital outputs can be set as a timer function. This allows the user to set a timer pattern to enable/disable the outputs at selected times.

The timer pattern is stored in a file IOTIMER.TXT on the SD card. The pattern file is only loaded at poweron. If no pattern file is included, the timer outputs are disabled.

When any IO is set as a timer, the module website will include a link to a timer page.

### 10.8.1. Pattern file

Every line in the file contains fields separated by tabs: time and state.

The time format is DD/MM/YYYY hh:mm:ss, in summertime.

The state is a string of bits: the first bit is for IO1 etc.. A bit is included for every IO, also those that are not set as timer. "0" means the IO is disabled and "1" means it is enabled. Comments can be included in the file by starting the line with "(".

**NOTE:** The pattern is limited to 100 lines.

#### **Example**

An example file is given below. IO1 is enabled at 10h00 and disabled again at 10h05. IO2 is never enabled. IO3 and IO4 are enabled at 10h10 and disabled again at 10h20.

```
( IO timer pattern
16/04/2015 10:00:00      1000
16/04/2015 10:05:00      0000
16/04/2015 10:10:00      0011
16/04/2015 10:20:00      0000
```

**Figure 10-10** Timer pattern file example

### 10.8.2. Website

This timer page includes 2 tables.

The first table allows for any timer IO to be set to **auto**, **on** or **off**.

Selecting **auto** means that its state is defined by the selected timer pattern. Selecting **on** enables the output, regardless of the pattern. Selecting **off** disables the output.

The second table shows the contents of the pattern file. Lines that are no longer used have a grey background. The table indicates which line is currently in use.

Lines can be added to the table and removed from it. The pattern can be saved here or loaded from a file.



## 11. Modbus

### 11.1. Modbus Registers and Coils

The following is an overview of the available modbus register address ranges.

Range	Contents	Data size & type
2..110	Measurements	32 bit, floating point
120..126	Measurements	32 bit, floating point
200..217	Event flags	1 bit
300..340	Event settings	32 bit, integer
400..406	System	16 bit, integer
410..416	System	32 bit, integer
500..510	Event values	32 bit, floating point
600..603	IO outputs	16 bit, integer

**Table 11-1 Modbus register address ranges**

#### 11.1.1. Protocol functions

For reading 16 and 32 bit values, modbus supports the commands "Read Holding Registers" (0x03) and "Read Input Registers" (0x04) .

When addressing registers, the command contains the address minus 1, for instance registers 2..110 are addressed as 1..109.

For writing 16 bit values, modbus supports command "Write Single Register" (0x06). This is only accepted for the analog outputs.

For reading 1 bit values, modbus supports the commands "Read Coils" (0x01) and "Read Discrete Inputs" (0x02). When addressing coils, the command contains the adres minus 1, for instance coils 200..216 are addressed as 199..215.

For writing 1 bit values, command "Write Single Coil" (0x05) is used. This is only accepted for the digital outputs.

#### 11.1.2. Register order for 32 bit values

All 32 bit values are available in 2 ranges The values in both ranges are the same, but the order of the registers is switched. The example below uses the value 230.1e0, which in hexadecimal notation is 0x4366199A.

- **Range 2..110:** the 2 MSBs are in the first register and the 2 LSBs in the second register. The order is 0x4366 – 0x199A. This follows the modbus standard big-endian convention.
- **Range 1002..1110:** the 2 LSBs are in the first register and the 2 MSBs in the second register. The order is 0x199A – 0x4366. This range is included because some systems assume a different byte order.

### 11.1.3. Measurement Registers

Name	Register	Description	Phase	Units
Ptot	2	Real Energy	Total	kWh
P L1	4	Real Energy	L1	kWh
P L2	6	Real Energy	L2	kWh
P L3	8	Real Energy	L3	kWh
Qtot	10	Reactive Energy	Total	kvarh
Q L1	12	Reactive Energy	L1	kvarh
Q L2	14	Reactive Energy	L2	kvarh
Q L3	16	Reactive Energy	L3	kvarh
u(L1)	18	Voltage	L1-L2	V
u(L2)	20	Voltage	L2-L3	V
u(L3)	22	Voltage	L3-L1	V
un(L1)	24	Voltage	L1-N	V
un(L2)	26	Voltage	L2-N	V
un(L3)	28	Voltage	L3-N	V
i(L1)	30	Current	L1	A
i(L2)	32	Current	L2	A
i(L3)	34	Current	L3	A
p(L1)	36	Real Power	L1	kW
p(L2)	38	Real Power	L2	kW
p(L3)	40	Real Power	L3	kW
q(L1)	42	Reactive Power	L1	kvar
q(L2)	44	Reactive Power	L2	kvar
q(L3)	46	Reactive Power	L3	kvar
s(L1)	48	Apparent Power	L1	kVA
s(L2)	50	Apparent Power	L2	kVA
s(L3)	52	Apparent Power	L3	kVA
PF tot	54	Power Factor	Total	-
PF(L1)	56	Power Factor	L1	-
PF(L2)	58	Power Factor	L2	-
PF(L3)	60	Power Factor	L3	-
Hdu(L1)	62	Voltage Distortion	L1-N; THD	%
Hdu(L2)	64	Voltage Distortion	L2-N; THD	%
Hdu(L3)	66	Voltage Distortion	L3-N; THD	%
Hdi(L1)	68	Current Distortion	L1; THD	%
Hdi(L2)	70	Current Distortion	L2; THD	%
Hdi(L3)	72	Current Distortion	L3; THD	%
Temp	74	Temperature		°C
Freq	76	Frequency		Hz
P+tot	78	Positive Real Energy	Total	kWh
P+ L1	80	Positive Real Energy	L1	kWh
P+ L2	82	Positive Real Energy	L2	kWh
P+ L3	84	Positive Real Energy	L3	kWh
P-tot	86	Negative Real Energy	Total	kWh
P- L1	88	Negative Real Energy	L1	kWh
P- L2	90	Negative Real Energy	L2	kWh
P- L3	92	Negative Real Energy	L3	kWh
Q+tot	94	Positive Reactive Energy	Total	kvarh
Q+ L1	96	Positive Reactive Energy	L1	kvarh
Q+ L2	98	Positive Reactive Energy	L2	kvarh

Q+ L3	100	Positive Reactive Energy	L3	kvarh
Q-tot	102	Negative Reactive Energy	Total	kvarh
Q- L1	104	Negative Reactive Energy	L1	kvarh
Q- L2	106	Negative Reactive Energy	L2	kvarh
Q- L3	108	Negative Reactive Energy	L3	kvarh
u(N)	110	Voltage	N	volt

**Table 11-2 Modbus measurement registers (part 1)**

Name	Register	Description	Phase	Units
i tot	120	Current	Total	amp
p tot	122	Real Power	Total	kW
q tot	124	Reactive Power	Total	kvar
s tot	126	Apparent Power	Total	kVA

**Table 11-3 Modbus measurement registers (part 2)**

### 11.1.4. IO registers

The following registers allow the user to read IO values. All are 16 bit unsigned integers. The state registers can also be written for IOs set to modbus control. See section 10.6 for a description of the contents.

Name	Register
IO1 state	600
IO2 state	601
IO3 state	602
IO4 state	603
IO1 pulse counter	604
IO2 pulse counter	605
IO3 pulse counter	606
IO4 pulse counter	607

**Table 11-4 Modbus IO registers**

### 11.1.5. Event Flag Coils

Every event has a single flag. When the event starts, the pSens3 sets the flag. The flag is cleared when the event ends.

The user can set a minimum activity time, the flag will remain high for at least this time. A setup register for this value is included after the event settings. Its value is expressed in milliseconds.

Name	Coil
Event1 flag	200
Event2 flag	201
Event3 flag	202
Event4 flag	203
Event5 flag	204
Event6 flag	205
Event7 flag	206
Event8 flag	207
Event9 flag	208

Event10 flag	209
Event11 flag	210
Event12 flag	211
Event13 flag	212
Event14 flag	213
Event15 flag	214
Event16 flag	215
Event17 flag	216

**Table 11-5 Modbus event coils****11.1.6. Event Setting Registers**

Name	Register
Event1 period	300
Event1 low limit	302
Event1 high limit	304
Event2 period	306
Event2 low limit	308
Event2 high limit	310
Event3 limit	312
Event4 period	314
Event4 limit	316
Event5 limit	318
Event6 limit	320
Event7 limit	322
Event8 limit	324
Event9 limit	326
Event10 limit	328
Event11 limit	330
Event12 limit	332
Event13 limit	334
Event14 limit	336
Event16 limit	338
Event halflife time	340

**Table 11-6 Modbus event registers****11.1.7. System Registers**

Name	Register	Type
Short serial number (*)	400	16 bit integer
Year	401	16 bit integer
Month	402	16 bit integer
Day	403	16 bit integer
Hour	404	16 bit integer
Minute	405	16 bit integer
Second	406	16 bit integer
Boot software version	410	32 bit integer
System software version	412	32 bit integer
Application software version	414	32 bit integer
Serial number	416	32 bit integer

(\*) This register contains only the lowest 16 bits of the serial number. It is included to remain compatible with the previous module version. The full 32-bit serial number is available in register 416.

**Table 11-7 Modbus system registers**

### 11.1.8. Event Value Registers

Name	Register
Flicker L1 (Pst)	500
Flicker L2 (Pst)	502
Flicker L3 (Pst)	504
Flicker L1 (Plt)	506
Flicker L2 (Plt)	508
Flicker L3 (Plt)	510

**Table 11-8 Modbus event value registers**

Pst is the short term flicker value for the last flicker period. Plt is the long term flicker value, this is the cubic mean value over the last 12 periods.

## 11.2. Modbus Settings

The setup has to be performed via HTML.

Parameter	Description
Interface	This selects which modbus protocol is used: <ul style="list-style-type: none"> <li>- none</li> <li>- Modbus TCP (Ethernet)</li> <li>- Modbus RTU (RS485)</li> <li>- Modbus Gateway</li> <li>- Modbus TCP and RTU</li> </ul>
TCP Address	This single byte value selects the bus address for the TCP connection. Allowed values are 0..255.
RTU Address	This single byte value selects the bus address for the RTU connection. Allowed values are 0..255.
Baudrate	This selects the RS485 baudrate. Allowed values are 9600, 19200, 38400, 57600 and 115200.
Parity	This selects the RS485 parity: none, odd, even.
Stopbits	This selects the number of stopbits: 1 or 2.
Port number	This selects the port number for modbus over TCP/IP. The default value is 502. Other values are allowed
TCP delay	This parameter is only used when the pSens3 is used as a modbus gateway. This is a time in milliseconds, allowed values are 0..3600000.
RS485 timeout	This parameter is only used when the pSens3 is used as a modbus gateway. This is a time in milliseconds, allowed values are 0..3600000.
Event flag activity time	When an event occurs, a flag is set that can be read over modbus. The duration of an event can be very short. This parameter sets the minimum time that the flag will remain set. This is a time in milliseconds, allowed values are 0..3600000.

**Table 11-9 Modbus parameters**

The following sections describe the different modbus interfaces. The required parameters are described.

### **11.3. Modbus TCP**

When the pSens3 is used as a Modbus server over TCP/IP, the modbus TCP specification suggests to use address 255 and port number 502. Other values are possible.

This modbus interface can be used on devices that do not have an RS485 connection.

### **11.4. Modbus RTU**

When the pSens3 is used as a Modbus server over RS485, only the serial line parameters are required.

### **11.5. Modbus Gateway**

When the pSens3 is used as a Modbus Gateway, all parameters are required. The modbus TCP specification suggests to use port number 502. Other values are possible.

If the modbus gateway receives a request over TCP/IP with an address byte that matches its own bus address, it will act as modbus server. This way, a device can be both gateway and server at the same time. All requests with a different address byte are sent to the RS485 bus.

This modbus interface can be used on devices that do not have an RS485 connection. Since it cannot pass on request to the RS485 bus, it will respond with an exception code 0xA "Gateway path unavailable".

The TCP delay is a time in milliseconds. After the gateway sends a request to the RS485 bus, it will check the RS485 line for a response. During the TCP delay, it will not check for new requests on the TCP/IP input. After the delay is over, the gateway is ready to receive new request via the TCP/IP input. It will keep checking the RS485 line.

If it receives a new request via TCP/IP, it will start handling that request and no longer look at the RS485 line.

By setting the TCP delay to 0, this functionality is disabled. The gateway will start checking both RS485 and TCP/IP immediately after sending a command to the RS485 bus.

The RS485 timeout is the time during which the gateway waits for a response over the RS485 line. If no response is received within this time, it sends an exception code 0xB "Gateway target device failed to respond" to the master. When the timeout is set to 0, the gateway keeps checking the RS485 line until it receives a response, or until it receives a new request over TCP/IP.

### **11.6. Modbus TCP and RTU**

When the pSens3 is used as a modbus server over both TCP/IP and RS485, it uses 2 separate addresses for each connection.

## 12. Command interface

### 12.1. Interface Description

The command interface is available on port 1027. It allows computer control and read-out of the pSens3.

Each command consists of a 2-digit number followed by a set of parameters, all separated by either spaces or tabs. The command is terminated by a carriage return.

The pSens3 returns the 2-digit number followed by a set of values, all separated by tabs. The result is terminated by a carriage return.

If the command or its parameters are incorrect, the pSens3 returns the 2-digit number followed by a tab and a question mark.

Most commands are protected by a 6-character password. Giving the correct password (command 12) enables all commands. The password has a time-out of 1 hour. After that time the password has to be given again or the commands are disabled. When the command interface is terminated, the password becomes invalid.

If no commands are received during 1 hour, the command interface is terminated (closed).

#### 12.1.1. Command overview

The table below lists the possible commands. Commands indicated as “free” are not password protected.

Command	Description
11	Read password ( <i>free</i> )
12	Check password ( <i>free</i> )
13	Give new password
14	Read software version ( <i>free</i> )
15	Read serial number ( <i>free</i> )
16	Read hardware configuration ( <i>free</i> )
21	Read/write time
22	Read/write IP address
31	Read/write settings
32	Read/write log interval
34	Read actual measurements
35	Read total energy
36	Read event counters
37	Read/write event settings
3B	Memory erase
3C	Set default event settings
3D	Reset total energy

3E	Read total negative energy
3F	Read/write IO settings
3G	Read/write current transformer setting
3H	Read/write IO output values
3I	Print options
51	Read interval logs
52	Read logged events
53	Read logged waveforms
54	Read selected interval logs
55	Read selected interval logs for selected time
56	Read logged events for selected time
57	Read second power logs
58	Read second power logs for selected time
59	Read minute logs
5A	Read minute logs for selected time
5B	Read day logs
5C	Read selected day logs
5D	Read selected day logs for selected time
5E	Read selected minute logs for selected time
5F	Make and read snapshot
5G	Read selected second logs for selected time
5H	Read subsecond logs for selected time
61	Read system log
62	Reset system log
64	Read parameters
65	Read current sensor info
67	Read status info

**Table 12-1 Commands**

### 12.1.2. Print options

When data is printed in the command interface, the print options as set by command 3I are used. These print options only affect the commando interface.

The language is fixed to English. This makes sure that the names of the events remain the same.

## 12.2. Command Description

### 12.2.1. Command 11 – Read password

Input : 11 ...  
Output : 11 ...

This command can be used in case the password is lost. It requires a secret factory password.



The input has 1 parameter: the factory password.  
The output has 1 parameter, this is the 6-character password.

### 12.2.2. Command 12 – Check password

Input : 12 p1g2f3  
Output : 12 p1g2f3

The input has 1 parameter: the password (*p1g2f3* in this example).  
The output contains the same parameter if the password is correct, otherwise it contains a question mark.

### 12.2.3. Command 13 – Give new password

Input : 13 newpas  
Output : 13 newpas

The input has 1 parameter: the new password. Only 6-character strings are allowed.  
The output has 1 parameter, this is the new password.

### 12.2.4. Command 14 – Read software version

Input : 14 ?  
Output : 14 270

The input has 1 parameter: a question mark.  
The output has 1 parameter, the software version in decimal format. 270 corresponds to 0x10E, i.e. version 0.0.1.14.

### 12.2.5. Command 15 – Read serial number

Input : 15 ?  
Output : 15 960512

The input has 1 parameter: a question mark.  
The output has 1 parameter, the serial number in decimal format. 960512 corresponds to 0xEA800.

### 12.2.6. Command 16 – Configuration

Input : 16 ?  
Output : 16 5.4.0.0

The input has 1 parameter: a question mark.  
The output has 1 parameter, the hardware configuration.

### 12.2.7. Command 21 – Read/write time

#### 12.2.7.1. Read time

Input : 21 ?  
Output : 21 091127 135154

The input has 1 parameter: a question mark.

The output has 2 parameters, the date and the time in the format YYMMDD hhmmss. The output 091127 135154 corresponds to November 27<sup>th</sup>, 2009 13h51:54.

### **12.2.7.2. Write time**

Input : 21 091127 140000

Output : 21 091127 140000

The input has 2 parameters: the date and time in the format described above.

The output has 2 parameters, the date and the time.

## **12.2.8. Command 22 – Read/write IP address**

### **12.2.8.1. Read IP address**

Input : 22 ?

Output : 22 11.22.33.44

The input has 1 parameter: a question mark.

The output has 1 parameter: the IP address.

### **12.2.8.2. Write IP address**

Input : 22 11.22.33.45

Output : 22 11.22.33.45

The input has 1 parameter: the IP address.

The output has 1 parameter: the IP address.

## **12.2.9. Command 31 – Read/write settings**

### **12.2.9.1. Read settings**

Input : 31 ?

Output : 31 2

The input has 1 parameter, a question mark.

The output has 1 parameter, the settings value. This is 32-bit value in decimal format. The meaning of the bits is shown in the table below. Value 0 corresponds to 50Hz 230/400V star net.

Bit	Description
0	<b>mains frequency</b> 0: 50Hz 1: 60Hz
1..7	□
8..11	<b>phase/line voltage:</b> 0000: 230/400V 0001: 200/350V 0010: 220/380V

	0011: 240/420V 0100: 100/175V 0101: 110/190V 0110: 115/200V 0111: 120/210V 1000: 127/220V 1001: 400/690V 1010: 130/230V 1011..1111: <i>invalid</i>
12..15	<b>topology:</b> 0000: star (=three-phase with neutral) 0001: triangle (=three-phase without neutral) 0010: mono=single-phase 0011: double-phase 180° 0100..1111: <i>invalid</i>
16..31	[]

**Table 12-2 Command 31 settings**

The following examples show the settings for several net configurations. Note that the log mode bits (5..6) are not set here.

Settings (hex)	Setting (dec)	Net Configuration
0x00000000	0	50Hz, 230V phase voltage, star
0x00001000	4096	50Hz, 400V line voltage, triangle
0x00002000	8192	50Hz, 230V phase voltage, mono
0x00000900	2304	50Hz, 400V phase voltage, star
0x00001900	6400	50Hz, 690V line voltage, triangle
0x00002900	10496	50Hz, 400V phase voltage, mono

**Table 12-3 Command 31 examples**

### 12.2.9.2. Write settings

Input : 31 2  
Output : 31 2

The input has 1 parameter, the settings value in decimal format.  
The output has 1 parameter, the settings value.

### 12.2.10. Command 32 – Read/write log interval

#### 12.2.10.1. Read log interval

Input : 32 ?  
Output : 32 1500

The input has 1 parameter, a question mark.  
The output has 1 parameter, the log interval in the format hhmmss. The output 1500 corresponds to 15 minutes.

#### 12.2.10.2. Write log interval

Input : 32 1500

Output : 32    1500

The input has 1 parameter, the log interval. The only values that are allowed are 1000 and 1500.

The output has 1 parameter, the log interval.

### 12.2.11. Command 34 – Read actual measurements

Input : 34    ?

Output : 34    ...

The input has 1 parameter, a question mark.

The output has 31 parameters. These are the version number and the actual measurements.

The order of the measurements and their units are shown in the table below.

1	Version number (decimal)
2	U1 in dVrms
3	U2 in dVrms
4	U3 in dVrms
5	U12 in dVrms
6	U23 in dVrms
7	U31 in dVrms
8	I1 in dArms
9	I2 in dArms
10	I3 in dArms
11	P1 in W
12	P2 in W
13	P3 in W
14	Q1 in W
15	Q2 in W
16	Q3 in W
17	PF1 *100
18	PF2 *100
19	PF3 *100
20	Distortion U1 in %
21	Distortion U2 in %
22	Distortion U3 in %
23	Distortion I1 in %
24	Distortion I2 in %
25	Distortion I3 in %
26	Temperature in °C
27	Frequency in mHz
28	IO1
29	IO2
30	IO3
31	IO4

**Table 12-4 Command 34 output parameters**

For the IO's, the printed value depends on the settings. For digital IOs, the value is the pulsecount for the active interval. For analog IOs, the value is in uA for current values and mV for voltage values.

### 12.2.12. Command 35 – Read total energy

Input : 35 ?  
Output : 35 31 22785736

The input has 1 parameter, a question mark.

The output has 2 parameters. The total energy is a 64-bit value and is expressed in Joule. It is the sum of positive and negative energy. The negative total energy can be obtained separately with command 3E, the positive total energy cannot be obtained separately.

The 64-bit value is sent as 2 decimal numbers, the first represents the highest 32 bits, the second the lowest 32 bits. The output 31 22785736 corresponds to  $31 \cdot 2^{32} + 22785736$ , i.e. 133.1668 GJ.

Both numbers are signed, meaning that values from  $2^{31}$  to  $2^{32}-1$  are shown as negative values.

### 12.2.13. Command 36 – Read event counters

Input : 36 ?  
Output : 36 ...

The input has 1 parameter, a question mark.

The output has 18 parameters. These are counters for the each events. Each counter is a 1-byte value given the amount of stored events.

### 12.2.14. Command 37 – Read/write event settings

#### 12.2.14.1. Read event settings

Input : 37 ?  
Output : 37 ...

The input has 1 parameter, a question mark.

The output has 17 lines, 1 for each event. Each line contains up to 5 parameters: the event number, the enable flag (0=disabled, <>0 is enabled) and between 1 and 3 settings. The number of settings depends on the event as discussed in section 7.2. After the last line a "z" is printed.

#### 12.2.14.2. Write event settings

Input : 37 1 -1 600 98 102  
Output : 37 1 -1 600 98 102

The input has 3 to 5 parameters, the event number, and the enable flag and between 1 and 3 event settings.

The output returns the settings for the event specified in the input.

### 12.2.15. Command 3B – Memory erase

Input : 3B ?  
Output : 3B ...

The input has 1 parameter, a question mark.

The entire memory is erased (see section 6.5). A "z" is printed to indicate the end of the erase.

### 12.2.16. Command 3C – Set default event settings

Input : 3C ?  
Output : 3C ...

The input has 1 parameter, a question mark.

The output contains the event settings for all events. At the end a "z" is printed.

### 12.2.17. Command 3D – Reset total energy

Input : 3D ?  
Output : 3D 0 0

The input has 1 parameter, a question mark.

The output has 2 parameters that are zero. This is the new total energy.

### 12.2.18. Command 3E – Read total negative energy

Input : 3E ?  
Output : 3E -1 22785736

The input has 1 parameter, a question mark.

The output has 2 parameters. The total negative energy is a 64-bit value and is expressed in Joule. The 64-bit value is sent as 2 decimal numbers, the first represents the highest 32 bits, the second the lowest 32 bits.

Both numbers are signed, meaning that values from  $2^{31}$  to  $2^{32}-1$  are shown as negative values.

### 12.2.19. Command 3F – Read/write IO settings

#### 12.2.19.1. Read IO settings

Input : 3F ?  
Output : 3F 1 1073742080 10 Out1  
 2 1073742336 10 Out2  
 3 0 0  
 4 0 0

The input has 1 parameter, a question mark.

The output has 4 lines, 1 for each IO. Each line contains 4 parameters: the IO number, the IO setting, the IO weight and the IO name. After the last line a "z" is printed. The IO setting is a 32-bit value printed in decimal format. These settings are described in detail in section 10.7.

In this example, IO1 is set to  $1073742080 = 0x40000100$  which is a digital sink output proportional to consumed energy. IO2 is set to  $1073742336 = 0x40000200$  which is a digital sink output proportional to generated energy. The weight for both is 10Wh per pulse.

**12.2.19.2. Write IO settings**

Input : 3F 1 ... ..  
Output : 3F ...

The input has 4 parameters: the IO number, the IO type, the IO weight and the IO name. The name is a string of maximum 15 chars. Longer strings are truncated. The output returns the settings for the IO specified in the input.

**12.2.20. Command 3G – Read/write current transformer setting****12.2.20.1. Read current transformer settings**

Input : 3F ?  
Output : 3F

The input has 1 parameter, a question mark.  
The output has 1 parameter.

**12.2.20.2. Write current transformer settings**

Input : 3F 100  
Output : 3F 100

The input has 1 parameter: the new current transformer setting. The output returns the new settings value.

**12.2.21. Command 3H – Read/write IO output values****12.2.21.1. Read IO output values**

Input : 3H ?  
Output : 3H 0 0 0 0

The input has 1 parameter, a question mark.  
The output has 4 parameters, 1 for each IO.  
For IOs set to input, the returned value is 0.  
For digital outputs, the value is zero for an inactive output or non-zero for an active output.  
For analog outputs, the value is the current in uA in the range 0 to 20000.

**12.2.21.2. Write IO output values**

Input : 3H 1 0 10000 0  
Output : 3H 1 0 10000 0

The input has 4 parameters: 1 for each IO. It returns the new values.  
In this example:

- IO1 is a digital output: it is set to active
- IO2 is a digital output: it is set to inactive
- IO3 is an analog output: it is set to 10mA
- IO4 is not an output, its value is left at zero since it is not used.

## 12.2.22. Command 3I – Print options

### 12.2.22.1. Read print options

Input : 3I ?  
Output : 3I 0

The input has 1 parameter: a question mark.

The output has 1 parameter: the print options. This is a 32-bit value printed in decimal format. The meaning of the bits is shown in the table below. These print options only affect the commando interface.

Bit	Description
0	<b>Decimal point</b> 0: . 1: ,
1	<b>Delimiter</b> 0: TAB 1: ;
2	<b>Dummy lines</b> 0: disable 1: enable
3	<b>Dummy columns</b> 0: disable 1: enable
4	<b>Summer-/wintertime indication</b> 0: disable 1: enable
5	<b>Dummy IO values</b> 0: empty column 1: zero
6..31	[]

**Table 12-5 Command 3I settings**

### 12.2.22.2. Write print options

Input : 3I 4  
Output : 3I 4

The input has 1 parameter: the print options.

The output has 1 parameter: the print options.

## 12.2.23. Command 51 – Read interval logs

Input : 51 YYMMDD  
Output : 51 ...

The input has 1 parameter, a date in YYMMDD format. This specifies the date for which the logs are read. By setting DD to 00, the logs for a month are read.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.



### 12.2.24. Command 52 – Read events

Input : 52    YMMDD

Output : 52    ...

The input has 1 parameter, a date in YMMDD format. This specifies the date for which the events are read. By setting DD to 00, the events for a month are read.

The first line of the output is a header. Then a line for every event follows. Each line contains the time of the event, the event type, an index for the waveform and 6 parameters. After the last line a "z" is printed.

If no waveform is stored for the event, the waveform index is 0.

The 6 parameters depend on the type of event. These are given in the next table.

Event	Parameter 1	Parameter 2	Parameter 3
	Parameter 4	Parameter 5	Parameter 6
Frequency variation	measured frequency [mHz]	ratio of measured to nominal frequency [%]	0
	0	0	0
Magnitude variation	measured voltage on line 1 [dVrms]	measured voltage on line 2 [dVrms]	measured voltage on line 3 [dVrms]
	ratio of maximum measured voltage to nominal voltage [%]	0	0
Rapid voltage change	voltage change on line 1 [dVrms]	voltage change on line 2 [dVrms]	voltage change on line 3 [dVrms]
	0	0	0
Flicker severity	long-term flicker on line 1 [-/10]	long-term flicker on line 2 [-/10]	long-term flicker on line 3 [-/10]
	0	0	0
Voltage dip	lowest ratio measured to nominal voltage for line 1 [%]	lowest ratio measured to nominal voltage for line 1 [%]	lowest ratio measured to nominal voltage for line 1 [%]
	duration [ms]	0	0
Voltage interruption	lowest voltage on line 1 [dVrms]	lowest voltage on line 2 [dVrms]	lowest voltage on line 3 [dVrms]
	duration [ms]	0	0
Temporary overvoltage	highest ratio measured to nominal voltage for line 1 [%]	highest ratio measured to nominal voltage for line 1 [%]	highest ratio measured to nominal voltage for line 1 [%]
	duration [ms]	0	0
Transient overvoltage	integral of overvoltage for line 1 [dVrms*s]	integral of overvoltage for line 2 [dVrms*s]	integral of overvoltage for line 3 [dVrms*s]
	duration [ms]	0	0
Voltage unbalance	measured voltage on line 1 at maximum unbalance [dVrms]	measured voltage on line 2 at maximum unbalance [dVrms]	measured voltage on line 3 at maximum unbalance [dVrms]
	duration [ms]	maximum unbalance [%]	0

<b>Harmonic voltage</b>	maximum total distortion for line 1 [%]	maximum total distortion for line 2 [%]	maximum total distortion for line 3 [%]
	duration [ms]	0	0
<b>Current limit</b>	integral of current squared for line 1 [Arms <sup>2</sup> *s]	integral of current squared for line 2 [Arms <sup>2</sup> *s]	integral of current squared for line 3 [Arms <sup>2</sup> *s]
	duration [ms]	0	0
<b>Frequency drift</b>	frequency before change [mHz]	frequency after change [mHz]	0
	0	0	0
<b>Vector jump</b>	vector jump for line 1 [°]	vector jump for line 2 [°]	vector jump for line 3 [°]
	0	0	0
<b>Neutral overvoltage</b>	highest neutral voltage [dVrms]	duration [ms]	0
	0	0	0
<b>Operating state</b>	(see table 12-7)	(see table 12-7)	(see table 12-7)
	0	0	0
<b>Harmonic current</b>	maximum total distortion for line 1 [%]	maximum total distortion for line 2 [%]	maximum total distortion for line 3 [%]
	duration [ms]	0	0
<b>Time change</b>	time difference [s]	0	0
	0	0	0
<b>Snapshot</b>	0	0	0
	0	0	0

**Table 12-6 Event read parameters**

For the operating state event, only the first 3 parameters are used. Their values are described in the table below.

	Parameter 1	Parameter 2	Parameter 3
<b>Power off/on cycle</b>	0	0	poweroff duration [s]
<b>Reset</b>	0	2	0
<b>Sensor disconnect</b>	1	0	0
<b>Sensor connect</b>	1	1	sensor serial number
<b>Calibration</b>	2	0	0
<b>Factory reset</b>	3	0	0

**Table 12-7 Operating state read parameters**

### 12.2.25. Command 53 – Read waveform

```

Input  : 53   n
Output : 53   1000  10280
          Starttime: 10/06/2015 15:42:51
          U1   U2   U3   I1   I2   I3
          -23.8 -321.0 198.4 98.0 -167.3 64.1
          -15.4 -319.4 191.8 101.0 -166.2 58.8

```

-8.6	-318.9	183.6	104.9	-165.8	54.1
-0.6	-317.3	176.3	109.2	-164.1	50.0
6.2	-315.5	164.0	112.7	-162.7	45.0
13.7	-313.3	155.2	115.6	-161.7	39.1
20.9	-310.7	148.7	118.7	-160.3	33.4
27.5	-308.5	137.1	122.0	-158.6	28.7

The input has 1 parameter, a number specifying the waveform. This number can be obtained from command 52 or 56.

The output has 3 header lines and a number of data lines. After the last data line, a line with "z" is printed to indicate the end.

The first line contains 2 numbers: the first is the total duration of the waveform in ms, the second is the amount of data lines.

The second line contains the starttime. The third line contains the names for the columns. The data is printed in Volt for voltages and Ampère for currents.

There are 3 types of waveform:

- Waveform 1 second: There are 10280 data lines.
- Waveform 100 milliseconds: There are 1024 data lines. This waveform type is used for the events that check voltage and current distortion.
- Waveform current limit: The amount of data lines depends on the duration of the event. The timestep is 100ms. This waveform type is only used for the current limit event.

#### **Example 1:**

For a 1 second waveform, the first line contains: 1000 10280

This means the waveform has a total length of 1000ms. There are 10280 datalines. The timestep between datalines is  $1000\text{ms}/10280 = 97.276\mu\text{s}$ .

### **12.2.26. Command 54 – Read selected interval logs**

Input : 54 YMMDD mask

Output : 54 ...

The input has 2 parameters, a date in YMMDD format and a mask that selects which measurements are printed. The date specifies which the logs are read. By setting DD to 00, the logs for a month are read.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

The mask is a 32-bit value given in decimal format. The bits are described in table 6-1. Only the variables whose bit is 1 are printed. Variables whose bit is 0 are not printed.

Setting the mask to -1 (all bits 1) prints all the variables. This is equivalent to command 51.

### **12.2.27. Command 55 – Read selected interval logs for selected time**

Input : 55 YMMDD hhmmss YMMDD hhmmss mask

Output : 55 ...

The input has 5 parameters, a start time in YYMMDD hhmmss format, an end time in YYMMDD hhmmss format and a mask. The start time and end time specify which logs are read. The mask is used as described for command 54.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.28. Command 56 – Read events for selected time

Input : 56 YYMMDD hhmmss YYMMDD hhmmss

Output : 56 ...

The input has 4 parameters, a start time in YYMMDD hhmmss format and an end time in YYMMDD hhmmss format. The start time and end time specify which events are read. The mask is used as described for command 54.

The output is the same as for command 52.

### 12.2.29. Command 57 – Read second power logs

Input : 57 YYMMDD

Output : 57 ...

The input has 1 parameter, a date in YYMMDD format. This specifies the date for which the logs are read. By setting DD to 00, the logs for a month are read.

Only the total power for each line is printed.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.30. Command 58 – Read second power logs for selected time

Input : 58 YYMMDD hhmmss YYMMDD hhmmss

Output : 58 ...

The input has 4 parameters, a start time in YYMMDD hhmmss format and an end time in YYMMDD hhmmss format. The start time and end time specify which logs are read.

Only the total power for each line is printed.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.31. Command 59 – Read minute logs

Input : 59 YYMMDD

Output : 59 ...

The input has 1 parameter, a date in YYMMDD format. This specifies the date for which the logs are read. By setting DD to 00, the logs for a month are read.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.32. Command 5A – Read minute logs for selected time

Input : 5A YYMMDD hhmmss YYMMDD hhmmss

Output : 5A ...

The input has 4 parameters, a start time in YYYYMMDD hhmmss format and an end time in YYYYMMDD hhmmss format. The start time and end time specify which logs are read. The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.33. Command 5B – Read day logs

Input : 5B    YYYYMMDD  
Output : 5B    ...

The input has 1 parameter, a date in YYYYMMDD format. This specifies the date for which the logs are read. By setting DD to 00, the logs for a month are read. The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.34. Command 5C – Read selected day logs

Input : 5C    YYYYMMDD mask  
Output : 5C    ...

The input has 2 parameters, a date in YYYYMMDD format and a mask that selects which measurements are printed. The date specifies which the logs are read. By setting DD to 00, the logs for a month are read. The output has a line for every log. The first line is a header. After the last line a "z" is printed.

The mask is a 32-bit value given in decimal format. The bits are described in table 6-1. Only the variables whose bit is 1 are printed. Variables whose bit is 0 are not printed.

Setting the mask to -1 (all bits 1) prints all the variables. This is equivalent to command 5B.

### 12.2.35. Command 5D – Read selected day logs for selected time

Input : 5D    YYYYMMDD hhmmss YYYYMMDD hhmmss mask  
Output : 5D    ...

The input has 5 parameters, a start time in YYYYMMDD hhmmss format, an end time in YYYYMMDD hhmmss format and a mask. The start time and end time specify which logs are read. The mask is used as described for command 5C. The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.36. Command 5E – Read selected minute logs for selected time

Input : 5E    YYYYMMDD hhmmss YYYYMMDD hhmmss mask  
Output : 5E    ...

The input has 5 parameters, a start time in YYYYMMDD hhmmss format, an end time in YYYYMMDD hhmmss format and a mask. The start time and end time specify which logs are read. The mask is used as described for command 5C. The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.37. Command 5F – Make and read snapshot

Input : 5F ?  
Output : 5F ...

The input has 1 parameter, a question mark.

A waveform is taken of the actual voltage and current waveforms of the last second. This is printed.

The output is the same as for command 53.

### 12.2.38. Command 5G – Read selected second logs for selected time

Input : 5G YYMMDD hhmmss YYMMDD hhmmss mask  
Output : 5G ...

The input has 5 parameters, a start time in YYMMDD hhmmss format, an end time in YYMMDD hhmmss format and a mask. The start time and end time specify which logs are read. The mask is used as described for command 5C.

The output has a line for every log. The first line is a header. After the last line a "z" is printed.

### 12.2.39. Command 5H – Read 100ms logs for selected time

Input : 5H YYMMDD hhmmss YYMMDD hhmmss  
Output : 5H ...

The input has 4 parameters, a start time in YYMMDD hhmmss format and an end time in YYMMDD hhmmss format. The start time and end time specify which logs are read. The measurements included the active power for the 3 lines. No other data is available for the 100ms logs.

The output has a line for every log. The first line is a header. After the last line a "z" is printed. The time indication includes a decimal point and 1 extra digit after the seconds.

### 12.2.40. Command 61 – Read system log

Input : 61 ?  
Output : 61 ...

The input has 1 parameter, a question mark.

The output contains the system log. After the last line a "z" is printed.

**NOTE:** The system log contains operational information that is intended for diagnostic purposes by Idetron only.

### 12.2.41. Command 62 – Reset system log

Input : 62 ?  
Output : 62 reset

The input has 1 parameter, a question mark.

The output contains a line "reset" that confirms the reset of the system log.

---

**NOTE:** The system log contains operational information that is intended for diagnostic purposes by Idetron only.

### 12.2.42. Command 64 – Read parameters

Input : 64 ?  
Output : 64 ...

The input has 1 parameter, a question mark.  
The output contains a memory dump of the parameters. After the last line a "z" is printed.

**NOTE:** This command is intended for diagnostic purposes by Idetron only.

### 12.2.43. Command 65 – Read current sensor information

Input : 65 ?  
Output : 65 -1 1139045 17

The input has 1 parameter, a question mark.  
The output contains 3 parameters. The first value is a flag indicating if a current sensor was detected (-1=detected, 0=not detected). The second value is the sensor serial number. The third value is the sensor configuration number.

**NOTE:** This command is intended for diagnostic purposes by Idetron only.

### 12.2.44. Command 67 – Read status information

Input : 67 ?  
Output : 67 8

The input has 1 parameter, a question mark.  
The output contains a some text with information on the module status. After the last line a "z" is printed.

**NOTE:** This command is intended for diagnostic purposes by Idetron only.

## 13. Specifications

Specification meter power supply	Units	Value
Minimum operating voltage (1)	VAC	90 (50)
Maximum operating voltage (1)	VAC	280
Maximum current	mA	50
Power consumption	W	1.5 (no IO output & no no-break) 5.0

(1) The power is taken from lines PWRL & PWRN, once power-up at 90 volts, the pSens3 remains operational with a power down to 50Vac.

**Table 13-1 Meter power**

Specification AC voltage inputs	Units	Value
Maximum allowed phase voltage	V	0 to 710
Accuracy	%	±1

**Table 13-2 Voltage inputs**

Specification AC current inputs	Units	Value
Current range	Arms	(2)
Resolution	Arms	0.1
Accuracy	%	±1

(2) Depends on the used coil/transformer set. Currently current set starting from 0,5A full range upto 5000A full range are available.

**Table 13-3 Current inputs**

Specification galvanic isolated I/O	Units	Value
Digital input: minimum pulse width	ms	30
Digital input: minimum time between pulses	ms	30
Digital input: minimum level for low-to-high transition	V	2.5
Digital input: maximum level for high-to-low transition	V	1.5
Digital input: maximum pulse rate	Hz	16
Digital output: maximum pulse rate	Hz	10
Digital output: maximum sink current	mA	10
Maximum source current	mA	20
Maximum input voltage	V	30
IO supply voltage	V	15
IO Isolation voltage	kV	0,5

**Table 13-4 IO**

Specification power logger	Units	Value
Log Time – seconds (3)	days	7
Log Time – minutes	days	40
Log Time – intervals	years	1
Log Time – days	years	10



(3) The second logs include a finelog for every 100ms. This only contains active power positive and negative for every fase.

**Table 13-5 Log Memory**

Specification physical dimensions	Units	Value
Housing W x H x D	mm	94 x 23 x 121

**Table 13-6 Mechanical**

Specification coil sets 400A	Units	Value
Coil Type		Rogowsky
Coil Length	mm	200
Allowed Cable Diameter	mm	45
Coil Diameter	mm	7
Coil Bend Radius	mm	45
Current range	A	400
Crest factor at 400A		2
Output Cable	mm	2,5 m UL-LiYY, double insulation.

**Table 13-7 400A coil sets**

Specification coil sets 3000A	Units	Value
Coil Type		Rogowsky
Coil Length	mm	400
Allowed Cable Diameter	mm	105
Coil Diameter	mm	7
Coil Bend Radius	mm	45
Current range	A	3000
Crest factor at 3000A		2
Output Cable	mm	2,5 m UL-LiYY, double insulation.

**Table 13-8 3000A coil sets**

## 14. Reported problems

### 14.1. *Direct connection without network*

Problem: With a direct connection, PC – pSens3, it was impossible to establish a connection. See also paragraph 8.2.

A client performs the following actions:

- PC starts up with WLAN and pSens3 not connected.
- Once started, opens the browser and tries to connect to the pSens3. This did not work because there the pSens3 isn't connected.
- Connect pSens3 to PC
- Connection on name or 169.254.1.1 does not work
- Ping to 169.254.1.1 works.
- A power off/on cycle of the pSens3 does not change anything.
- After 1 to 2 minutes connection works on 169.254.1.1, and also on name.

Our reaction:

- Windows caches names and address translations for a while, sometimes you must be patient, or restart your PC.
- If your PC has received an IP address from the network and you disconnect it from the network to form a point to point connection to the pSens3, then it keeps this IP-address until you restart your computer (this is the same for the pSens3).
- A method that always works, is to connect PC to pSens3, power on pSens3 and at last power up your PC. With this sequence, the PC caches don't contain erroneous data.

## List of figures

Figure 5-1 Schematic.....	12
Figure 9-1 Front, top and bottom views .....	28
Figure 9-2 Correct coil connection .....	30
Figure 9-3 Incorrect coil connection.....	31
Figure 9-4 Correct coil alignment.....	31
Figure 10-1 Digital sink output configuration .....	33
Figure 10-2 Digital source output configuration .....	33
Figure 10-3 Digital voltage input configuration .....	33
Figure 10-4 Digital source input configuration .....	34
Figure 10-5 Digital input threshold levels .....	34
Figure 10-6 Digital input debouncing .....	35
Figure 10-7 Analog output configuration .....	35
Figure 10-8 Analog current input configuration.....	36
Figure 10-9 Analog voltage input configuration .....	36
Figure 10-10 Timer pattern file example .....	40

## List of Tables

Table 6-1 Log variables selection .....	15
Table 6-2 Log code .....	16
Table 6-3 Log variables printing order .....	17
Table 6-4 Log print options.....	17
Table 7-1 Event settings.....	23
Table 8-1 Export link name fields.....	26
Table 8-2 Log print options.....	27
Table 9-1 Front switch, LEDs and reset button.....	29
Table 9-2 Top and bottom connectors.....	29
Table 9-3 Connections for different distribution systems.....	30
Table 10-1 Digital output functions .....	32
Table 10-2 Analog output functions.....	35
Table 10-3 IO log values .....	37
Table 10-4 IO type settings .....	38
Table 10-5 IO settings – Type, direction & configuration .....	39
Table 10-6 IO settings – Digital output source current.....	39
Table 10-7 IO settings – Digital output function .....	39
Table 10-8 IO settings – Analog output function .....	39
Table 10-9 IO settings – Analog output function .....	39
Table 11-1 Modbus register address ranges.....	41
Table 11-2 Modbus measurement registers (part 1).....	43
Table 11-3 Modbus measurement registers (part 2).....	43
Table 11-4 Modbus IO registers.....	43
Table 11-5 Modbus event coils.....	44
Table 11-6 Modbus event registers .....	44
Table 11-7 Modbus system registers .....	45
Table 11-8 Modbus event value registers.....	45
Table 11-9 Modbus parameters .....	45
Table 12-1 Commands .....	48
Table 12-2 Command 31 settings.....	51
Table 12-3 Command 31 examples .....	51
Table 12-4 Command 34 output parameters.....	52
Table 12-5 Command 3I settings .....	56

Table 12-6 Event read parameters .....	58
Table 12-7 Operating state read parameters.....	58
Table 13-1 Meter power .....	64
Table 13-2 Voltage inputs.....	64
Table 13-3 Current inputs.....	64
Table 13-4 IO .....	64
Table 13-5 Log Memory.....	65
Table 13-6 Mechanical.....	65