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ENERGY MANAGEMENT

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User Manual

pSens

3 Phase Power meter & logger

PI012
Version 0.13

Revision History		
Version	**Date**	**Improvement**
0.01	02-November-2009	Initial version
0.02	03-November-2009	Overall revision
0.03	09-November-2009	(7.1.17) Added event parameter description (8.3) Added command interface description
0.04	01-February-2010	(7) Added log parameter description
0.05	12-February-2010	Memory size increased from 2MB to 8MB (6.2.3) Added table with log variables (6.2.4) Removed current gain setting, autoranging is used (8.3) Added commands 22, 38, 39 and 54 Renamed Pulse interval to Pulse weight (6.2, 8.3.8.2, 8.3.9.2) Added note on memory erase Figures: replaced GNDE by PE, added current direction (8, 8.1) Changed Serial number, removed IPA procedure
0.06	11-March-2010	(9.3) Updated coil connection figure (6.2.3) Added remark about time stamp (8.3) Added commands 55, 56 and 61 to 64
0.07	01-April-2010	(8.3) Added commands 3A and 3B (8.2.14.1) "z" is printed after the last line (6.2/6.3) Updated remarks on memory erase
0.08	03-May-2010	(7.2) Changed default setting for Harmonic Voltage (8.2) Added command 3C (5) Schematic updated, new varistor configuration
0.09	09-June-2010	(8.2) Added command 3D
0.10	05-November-2010	(6.2.3) Bit 23 is used for total power
0.11	21-February-2011	(8.2.8) Corrected description for bit 1 (9.2) Added table for different distribution systems
0.12	03-March-2011	(8.2.8) Added extra setting for net configuration
0.13	11-March-2011	(8.2.8) Changed settings for net configuration

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

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

Contents

1. Purpose

This document describes the user manual and the functional specifications of the PSens power meter. The PSens is identified by Project-ID PI021.

2. Intended Audience

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

3. Glossary

VAC	Volts AC
mA	milli-Ampere, 1mA = 10^{-3}A
Arms	Ampere root-mean-square
Hz	Hertz, 1Hz = 1/second
MB	mega byte, 1MB = 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 VAST PARTICLE, FLUID OR GAS.

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

CAUTION: The maximum input voltages must not be exceeded.

5. Instrument Description

The PSens 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.
All measurements can be logged in an internal memory. The memory has a size of 8MB.

The PSens detects mains events such as voltage interruptions, frequency deviations, harmonics, flicker, etc. These events are logged as well. For short events the waveform is stored.

The PSens has an Ethernet connection and a CAN bus connection. The module takes its supply directly from the mains.

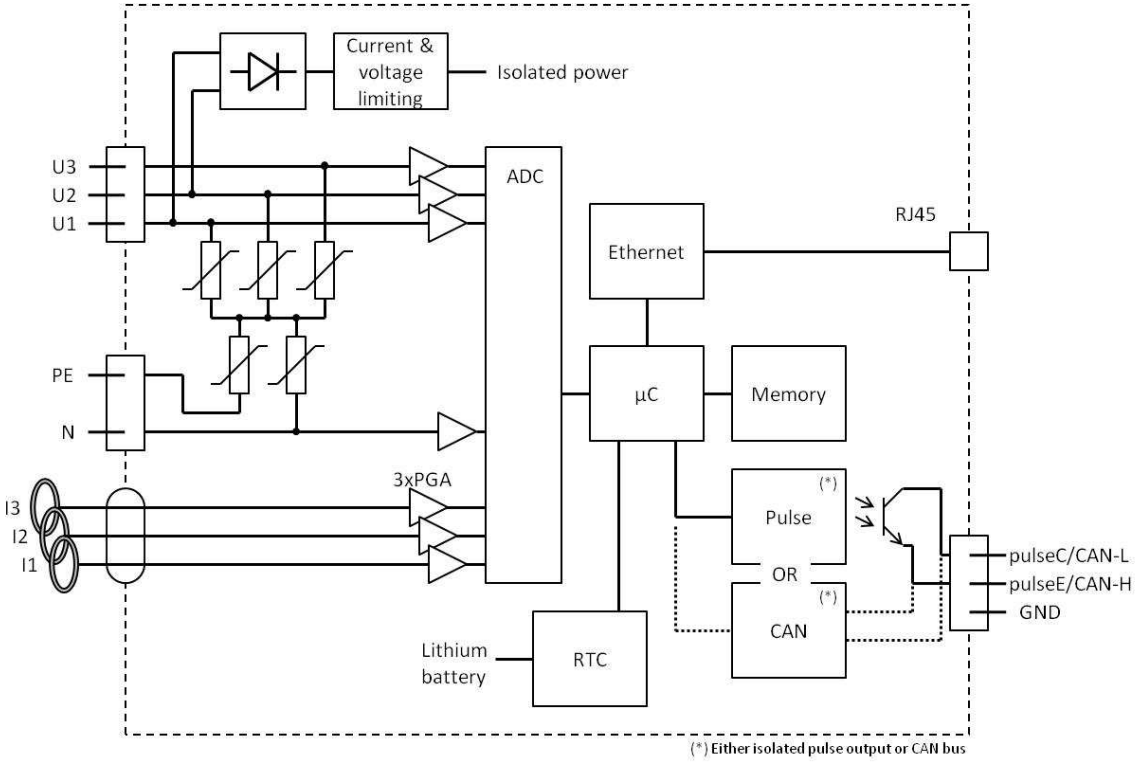


Figure 5-1 Schematic

The schematic above shows the main parts of the PSens.

The PSens takes its power from the lines U1 and U2. If either of those lines is not connected, the PSens will not operate. The power consumption is only 1.5mW when Ethernet is active. The minimum required phase voltage to operate is 70 VAC (120 VAC line voltage).

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

Instead off the CAN bus connection, an isolated pulse output can be implemented.

6. Logging

6.1. Sampling

The PSens samples the input voltages and currents at 32 samples/signal period. To do this, it tracks the frequency of the inputs and continuously updates its sampling rate accordingly.

At the same time, the PSens resamples the input voltages at 1kHz. These samples give a picture of the waveform. These waveforms are added to the last 160 events.

Events are generated when a disturbance of the mains voltage is higher than the configurable limits.

6.2. Settings

The PSens has a 8MB memory to store logs and events. This memory can hold 4000 events and 59000 upto 237000 depending on selected number of log variables. This is good for 1,5 months upto 6,5 year when logging every quarter hour.

The following settings control the logging.

All measures are AC except for these noted as DC.

6.2.1. Neuter selection

There are 2 possible settings:

- *Internal neuter calculation:* select this if you have only 3 line wires.
  The neuter voltage is calculated from the 3 phase voltages. The phase voltages used for calculations are the difference between the input line voltages and the calculated neuter voltage.
- *External neuter:* select this if you have 3 line wires and a neutre wire.
  The phase voltages used for calculations are the difference between the input line voltages and the neuter voltage.

6.2.2. Log Interval

Logs are stored after every interval. Average, minimum and maximum values are determined over the interval.
The interval is expressed in seconds and can range from 1 to 3600 seconds.

6.2.3. Log variables

The PSens calculates a set of measurements during each log interval.

Bit	Variables
0	L1 average rms voltage
1	L1 minimum rms voltage L1 maximum rms voltage

	L1 average rms voltage at base frequency L1 time when minimum is reached L1 time when maximum is reached L1 total harmonic voltage distortion
2	L2 average rms voltage
3	L2 minimum rms voltage L2 maximum rms voltage L2 average rms voltage at base frequency L2 time when minimum is reached L2 time when maximum is reached L2 total harmonic voltage distortion
4	L3 average rms voltage
5	L3 minimum rms voltage L3 maximum rms voltage L3 average rms voltage at base frequency L3 time when minimum is reached L3 time when maximum is reached L3 total harmonic voltage distortion
6	average of L1, L2 and L3 average rms voltage
7	*(reserved)*
8	L1 average rms current
9	L1 minimum rms current L1 maximum rms current L1 average rms current at base frequency L1 time when minimum is reached L1 time when maximum is reached L1 total harmonic current distortion
10	L2 average rms current
11	L2 minimum rms current L2 maximum rms current L2 average rms current at base frequency L2 time when minimum is reached L2 time when maximum is reached L2 total harmonic current distortion
12	L3 average rms current
13	L3 minimum rms current L3 maximum rms current L3 average rms current at base frequency L3 time when minimum is reached L3 time when maximum is reached L3 total harmonic current distortion
14	average of L1, L2 and L3 average rms current
15	*(reserved)*
16	L1 active power L1 reactive power
17	L1 active power at base frequency L1 reactive power at base frequency

	L1 power factor
18	L2 active power L2 reactive power
19	L2 active power at base frequency L2 reactive power at base frequency L2 power factor
20	L3 active power L3 reactive power
21	L3 active power at base frequency L3 reactive power at base frequency L3 power factor
22	average of L1, L2 and L3 active power average of L1, L2 and L3 reactive power
23	total active power of L1, L2 and L3 combined total reactive power of L1, L2 and L3 combined
24	number of samples frequency temperature log code
25	Neuter average rms voltage
26	Neuter minimum rms voltage Neuter maximum rms voltage
27..31	*(reserved)*

Table 6-1 Log variables

The user can choose between 3 subsets of measurements that are stored in memory:

- detailed:
  - all variables are logged
- normal:
  - for each line the average voltage, current, active power and reactive power are logged
  - the average neuter voltage is logged
- compact:
  - the same as normal but the average over the 3 lines is logged instead of each line separately

When using a log interval of 900s (1 quarter of an hour), the 8MB memory can hold 2474 days with compact records, 1546 days with normal records or 618 days with detailed records.

With every log a 1 byte log code is stored that indicates errors.

Bit	**Description**
0	Internal supply dropped too low
1	Supply frequency could not be determined
2	Ethernet connection has failed
3	Current autoranging failed due to excessive current
4..7	*(reserved)*

Table 6-2 Logcode

Each log also contains a time stamp. This gives the beginning of the log interval.

When the logs are read from the PSens, the user can select which variables are printed. Selecting only the required parameters reduces the amount of data to be transferred.

6.2.4. Log Mode

There are 2 log modes:

- circular log: the logger keeps logging. When the logging memory is full, the oldest logs are overwritten by new ones.
- log until memory full: the logger stops logging when the memory is full.

6.2.5. Log Start Time

The log start time determines when the logger starts logging. If no start time is set, the logger starts immediately.

6.2.6. Pulse Weight

The pulse weight determines the pulse rate of the pulse output. It is expressed in Wh/pulse. The maximum pulse rate is 10Hz or 10 pulses/second.
When the pulse weight is set to zero, no pulses are sent.

6.3. Memory Erase

The logging memory can be erase either via the logging menu or via the command interface (commands 3A and 3B).
The memory is not erased atomatically.

7. Events

The PSens detects events on the supply. These are stored in the memory. For some events a 1s waveform of the line and neuter voltages is also stored. The waveform contains 1000 sample points. The 8MB memory can hold up to 4096 events and 160 waveforms

The events are:
- Frequency variations
- Magnitude variations
- Rapid voltage changes
- Flicker severity
- Voltage dips
- Voltage interruptions
- Temporary overvoltage
- Transient overvoltage
- Voltage unbalance
- Harmonic voltage
- Current limit
- Frequency drift
- Vector jump
- Neutral overvoltage
- Phase unbalance
- Harmonic current

The limits for all events are set at calibrations. They can be changed from the default values given here.

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

7.1. Event description

7.1.1. Frequency variations

The average supply frequency is checked every 10 minutes. Deviations of more than 2% from the nominal frequency are detected. This is the slow frequency deviation event.

7.1.2. Magnitude variations

The average supply voltage is checked every 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.

A waveform is stored for this event.

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 1s 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 are detected.

7.1.7. Temporary overvoltage

The 3 supply phases are checked. Overvoltage above 110% of the nominal supply voltage are detected.

7.1.8. Transient overvoltage

The 3 supply phases are checked. Overvoltage above 150% of the nominal supply voltage and less than 1s in duration are detected.

A waveform is stored for this event.

7.1.9. Voltage unbalance

The 3 supply phases are checked. Even order harmonic distortions of a voltage above 2% are detected.

7.1.10. Harmonic voltage

The 3 supply phases are checked. Total harmonic distortions of a voltage above 2% are detected. Harmonics are detected upto the 15^{th} 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.

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.

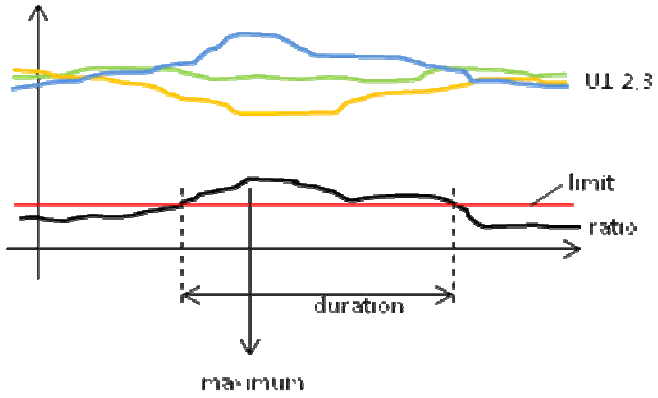
7.1.14. Neutral overvoltage

The neuter voltage is checked. A voltage above 20% of the nominal supply voltage is detected.

7.1.15. Phase unbalance

The 3 supply phases are compared. This detects voltage deviations between lines that are over 30% of the nominal supply voltage.

The figure below shows 3 voltages and their ratio. The event duration is the time that the ratio is above the limit. The maximum ratio is stored as well as the 3 voltages at the maximum.



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.

7.2. Event settings

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

Event	Setting 1	Setting 2	Setting 3
Frequency variations	period in seconds *default: 600s*	low limit in % of nominal freq. *default: 98%*	high limit in % of nominal freq. *default: 102%*
Magnitude variations	period in seconds	low limit in % of nominal volt.	high limit in % of nominal volt.

	default: 600s	*default: 90%*	*default: 110%*
Rapid voltage changes	limit in % of nominal volt. *default: 5%*	-	-
Flicker severity	period in seconds *default: 900s*	limit dimensionless *default: 1*	-
Voltage dips	limit in % of nominal volt. *default: 90%*	-	-
Voltage interruptions	limit in % of nominal volt. *default: 10%*	-	-
Temporary overvoltage	limit in % of nominal volt. *default: 110%*	-	-
Transient overvoltage	limit in % of nominal volt. *default: 150%*	-	-
Voltage unbalance	limit in % distortion *default: 2%*	-	-
Harmonic voltage	limit in % distortion *default: 8%*	-	-
Current limit	limit in Arms *default: 90% of current range*	-	-
Frequency drift	limit in Hz *default: 1Hz*	-	-
Vector jump	limit in ° *default: 30°*	-	-
Neutral overvoltage	limit in % of nominal volt. *default: 20%*	-	-
Phase unbalance	limit in % of nominal volt. *default: 30%*	-	-
Harmonic current	limit in % distortion *default: 2%*	-	-

Table 7-1 Event settings

7.3. Event log parameters

For each event up to 6 parameters are logged when the event occurs. These are shown in table 7-2. Unused parameters are 0.

Event	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
Frequency variations	measured frequency [mHz]	ratio of measured to nominal frequency [%]	0	0	0	0
Magnitude variations	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 changes	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 dips	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 interruptions	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	maximum even order distortion for line 1 [%]	maximum even order distortion for line 2 [%]	maximum even order distortion for line 3 [%]	duration [ms]	0	0
Harmonic voltage	maximum total	maximum total	maximum total	duration [ms]	0	0

	distortion for line 1 [%]	distortion for line 2 [%]	distortion for line 3 [%]			
Current limit	integral of current above limit for line 1 [dArms*s]	integral of current above limit for line 2 [dArms*s]	integral of current above limit for line 3 [dArms*s]	duration [ms]	0	0
Frequency drift	frequency before change [mHz]	frequency after change [mHz]	0	0	0	0
Vector jump	vector jump for line 1 [°]	vector jump for line 2 [°]	vector jump for line 3 [°]	0	0	0
Neutral overvoltage	highest neuter voltage [dVrms]	duration [ms]	0	0	0	0
Phase unbalance	maximum ratio between voltages on all lines [%]	voltage on line 1 at maximum ratio [dVrms]	voltage on line 2 at maximum ratio [dVrms]	voltage on line 3 at maximum ratio [dVrms]	duration [ms]	0
Harmonic current	maximum total distortion for line 1 [%]	maximum total distortion for line 2 [%]	maximum total distortion for line 3 [%]	duration [ms]	0	0

Table 7-2 Event parameters

8. Ethernet connection

The ethernet speed is set fixed to 100Mb, so the device can not communicate with very old 10Mb only hubs. Use 100/10Mb or 1Gb/100/10Mb hubs or switches.

Each PSens has a MAC address 00-E0-82-CE-nn-nn where nn-nn is a unique number. The serial number is A82CEnnnn, i.e. an 'A' followed by the last 4 bytes of the MAC address.

The procedure to set the IP address for the PSens is described in
AppNote ACF4-007 Setting Clients IPA.docx.

8.1. User menu

When connected, the PSens user menu appears:

```
PSens main menu
================
      Time      : 09/11/2009 09:19:58
      Serial nr : A002
      Software  : 0.0.1.21
      Hardware  : 0.0.0.4  (Pulse output, 400 Arms, 8 MB flash)

1 : Print last measurements
2 : Print 100ms waveform
L : Logging & settings menu
V : View logs, events, waveforms
@ : change IP address
X : Command interface (press Q to quit)

<CR> : Repeat this screen

PSens main menu: Type your choice:
```

Print last measurements shows the frequency, voltage amplitudes & angles and current amplitudes & angles.

Print 100ms waveform prints the phase and neuter voltages of the last 100ms, sampled at 1kHz, i.e. 1 sample/ms.

Logging & settings menu starts a separate menu where all the logging and event settings can be set.

View logs, events, waveforms starts a separate menu where all the logs can be viewed as well as the memory consumption.

To change the IP address, type @ followed by an IPA address, including the dots, e.g. @11.22.33.44

The command interface is an interface with a dedicated protocol for writing the settings and reading the measurements.

8.2. Command interface

The command interface can be accessed via the main menu. This section describes the commands that can be used in this interface.

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 PSens 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 PSens 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 given for 1 hour, the command interface is terminated.

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

Command	**Description**
11	Read password *(free)*
12	Check password *(free)*
13	Give new password
14	Read software version *(free)*
15	Read serial number *(free)*
21	Read/write time
22	Read/write IP address
31	Read/write settings
32	Read/write log interval
33	Read/write pulse weight
34	Read actual measurements
35	Read total energy
36	Read event counters
37	Read/write event settings
38	Read/write log variable setting
39	Read/write log start time
3A	Erase memory – fast
3B	Erase memory
3C	Set default event settings
3D	Reset total energy
51	Read logs
52	Read logged events
53	Read logged waveforms

54	Read selected logs
55	Read selected logs for selected time
56	Read logged events for selected time
61	Read system log
62	Reset system log
63	Read log memory page
64	Read parameters

Table 8-1 Commands

8.2.1. Command 11 – Read password

Input : 11 p?g?f?
Output : 11 ******

The input has 1 parameter: the string p?g?f?.
The output has 1 parameter, this is the 6-character password.

8.2.2. Command 12 – Check password

Input : 12 p1g2f3
Output : 12 p1g2f3

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

8.2.3. 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.

8.2.4. 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.

8.2.5. Command 15 – Read serial number

Input : 15 ?
Output : 15 40962

The input has 1 parameter: a question mark.
The output has 1 parameter, the serial number in decimal format. 40962 corresponds to 0xA002.

8.2.6. Command 21 – Read/write time

8.2.6.1. 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 27th, 2009 13h51:54.

8.2.6.2. 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.

8.2.7. Command 22 – Read/write IP address

8.2.7.1. 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.

8.2.7.2. 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.

8.2.8. Command 31 – Read/write settings

8.2.8.1. 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 off the bits is shown in the table below. Value 2 corresponds to 50Hz, external neuter, circular buffer.

bit	description
0	**mains frequency** 0: 50Hz

	1: 60Hz
1	**neuter intern/extern** 0: extern: the neuter input is used 1: intern: the neuter is the average of L1, L2 and L3
2..4	[]
5..6	**logmode** 00: circular buffer 01: log until memory is full 10,11: *invalid*
7	[]
8..11	**phase voltage:** 0000: 230V 0001: 200V 0010: 220V 0011: 240V 0100: 100V 0101: 110V 0110: 115V 0111: 120V 1000: 127V 1001: 400V 1010..1111: *invalid*
12..15	**topology:** 0000: star (=three-phase with neuter) 0001: triangle (=three-phase without neuter) 0010: mono=single-phase 0011: double-phase 180° 0100..1111: *invalid*
16..31	[]

Table 8-2 Command 31 settings

Bits 8..15 are only used from software version 0.0.4.1 onwards. Software version 0.0.4.1 and later determine the neuter setting based on the topology (bits 12..15) and do not check bit 1.

The following examples show the settings for several net configurations. Note that the logmode 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 8-3 Command 31 examples

8.2.8.2. 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.

8.2.9. Command 32 – Read/write log interval

8.2.9.1. 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.

8.2.9.2. Write log interval

Input : 32 1500
Output : 32 1500

The input has 1 parameter, the log interval.
The output has 1 parameter, the log interval.

8.2.10. Command 33 – Read/write pulse weight

8.2.10.1. Read pulse weight

Input : 33 ?
Output : 33 100

The input has 1 parameter, a question mark.
The output has 1 parameter, the pulse weight. This is the energy in Wh corresponding to 1 pulse at the PSens pulse output. When the pulse output is 100, the PSens sends a pulse for every 100Wh that is measured.

8.2.10.2. Write pulse weight

Input : 33 100
Output : 33 100

The input has 1 parameter, the pulse weight.
The output has 1 parameter, the pulse weight.

8.2.11. Command 34 – Read actual measurements

Input : 34 ?
Output : 34 …

The input has 1 parameter, a question mark.
The output has 27 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

Table 8-4 Command 34 output parameters

8.2.12. 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. 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 $31*2^{32}$ + 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.

8.2.13. Command 36 – Read event counters

Input : 36 ?
Output : 36 …

The input has 1 parameter, a question mark.
The output has 16 parameters. These are counters for the 16 events. Each counter is a 1-byte value. When the count reaches 255, the counter stops.

8.2.14. Command 37 – Read/write event settings

8.2.14.1. Read event settings

Input : 37 ?
Output : 37 …

The input has 1 parameter, a question mark.
The output has 16 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.

8.2.14.2. 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, the enable flag and between 1 and 3 event settings.
The output returns the settings for the event specified in the input.

8.2.15. Command 38 – Read/write log variable setting

8.2.15.1. Read log variable setting

Input : 38 ?
Output : 38 2

The input has 1 parameter, a question mark.
The output has 1 parameter, the log variable setting. This is a number from 1 to 3 (1=compact, 2=normal, 3=detailed).

8.2.15.2. Write log variable setting

Input : 38 3
Output : 38 3

The input has 1 parameter, the log variable setting. Only numbers from 1 to 3 are allowed.
The output has 1 parameter, the log variable setting.

8.2.16. Command 39 – Read/write log start time

8.2.16.1. Read log start time

Input : 39 ?
Output : 39 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 27th, 2009 13h51:54.

8.2.16.2. Write log start time

Input : 39 091127 140000
Output : 39 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.

8.2.17. Command 3A – Fast memory erase

Input : 3A ?
Output : 3A …

The input has 1 parameter, a question mark.
The entire memory is erased in fast mode. The module detects which memory blocks have been written and erases only those blocks. The progress of the erase is printed. At the end a "z" is printed.

8.2.18. Command 3B – Memory erase

Input : 3B ?
Output : 3B …

The input has 1 parameter, a question mark.
The entire memory is erased. The progress of the erase is printed. At the end a "z" is printed.

8.2.19. 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.

8.2.20. 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.

8.2.21. Command 51 – Read 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.

8.2.22. Command 52 – Read events

Input : 52 YYMMDD
Output : 52 …

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

8.2.23. Command 53 – Read waveform

Input : 53 n
Output : 53 …

The input has 1 parameter, a number specifying the waveform.
The output has the following format: the first line is a header, 1023 data lines, a line with "z" to indicate the end.

8.2.24. Command 54 – Read selected logs

Input : 54 YYMMDD mask
Output : 54 …

The input has 2 parameters, a date in YYMMDD 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 prointed.

The variables that can be printed are determined by the subset that was logged:
detailed records: 0x73F3F3F
normal records: 0x3151515
compact records: 0x3404040

Setting the mask to -1 (all bits 1) prints all the variables. This is equivalent to command 52.

8.2.25. Command 55 – Read selected logs for selected time

Input : 55 YYMMDD HHMMSS YYMMDD HHMMSS mask
Output : 55 …

The input has 5 parameters, a starttime in YYMMDD HHMMSS format, an endtime in YYMMDD HHMMSS format and a mask. The starttime and endtime 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.

8.2.26. Command 56 – Read events for selected time

Input : 56 YYMMDD HHMMSS YYMMDD HHMMSS
Output : 56 …

The input has 4 parameters, a starttime in YYMMDD HHMMSS format and an endtime in YYMMDD HHMMSS format. The starttime and endtime specify which events 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.

8.2.27. 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.

8.2.28. 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.

8.2.29. Command 63 – Read log memory page

Input : 63 1
Output : 63 …

The input has 1 parameter, the page number.
The output contains a memory dump of the selected page in the log memory. After the last line a "z" is printed.

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

8.2.30. Command 64 – Read parameters

Input : 64 ?
Output : 64 …

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

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

9. Installation

9.1. Overview

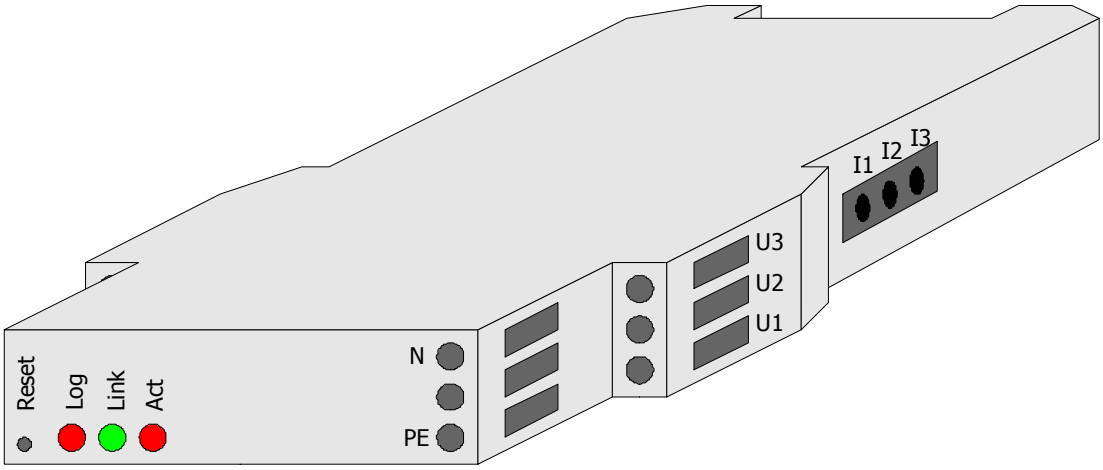


Figure 9-1 Front view

At the front, the PSens has a reset button and 3 LEDs: Log, Link, Network Activity.

At the right side, the PSens has connections for: neuter, earth (PE), phase voltages U1,U2,U3 and currents I1, I2, I3.

At the left side, the PSens has 4 connections: Ethernet, GND, and either pulseC & pulseE (pulse output) or CANL & CANH (CAN connection).

All the connections are shown on the expanded view.

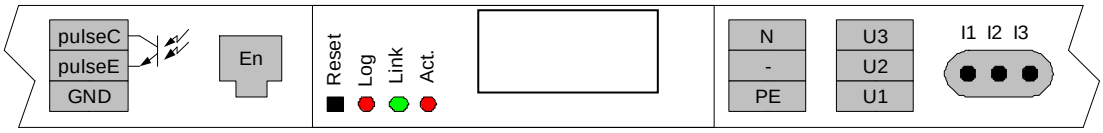


Figure 9-2 Expanded view

9.2. Connections

The next figure shows the connections for a supply net with 4 lines. The pulse output connection is shown as well.

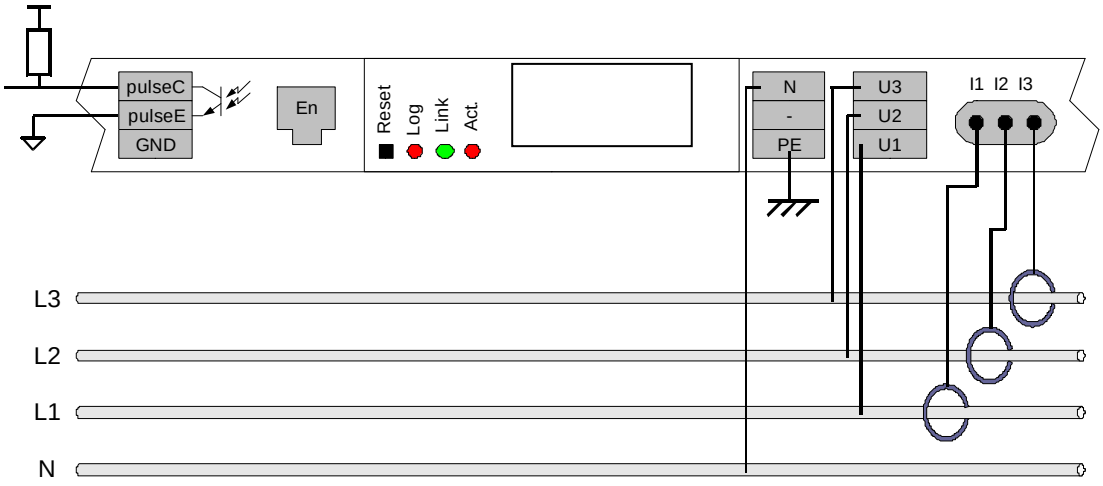


Figure 9-3 Installation

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. The required neutral selection is shown in the last line of the table. This is described in section 6.2.1. This setting is accessible through the command interface (section 8.2.8) or through the Logging&Settings menu in the user menu (section 8.1).

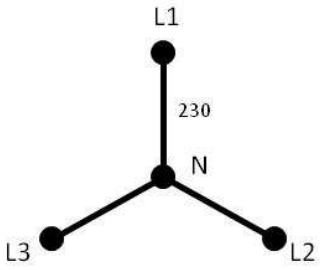
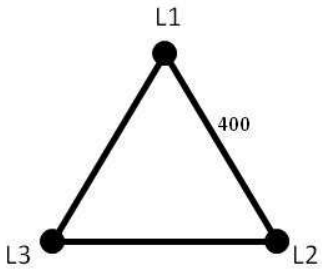
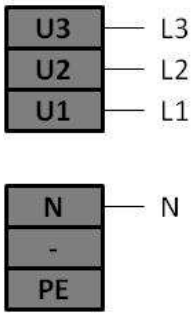
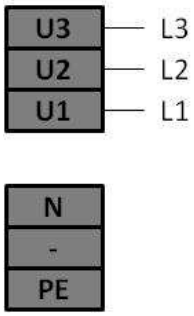
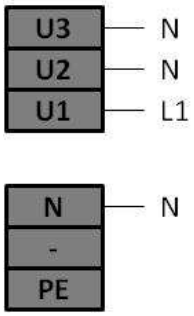
Three-phase with neutral	**Three-phase without neutral**	**Single-phase**
		
		
neutral setting: external	neutral setting: internal	neutral setting: external

Table 9-1 Connections for different distribution systems

9.3. 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.

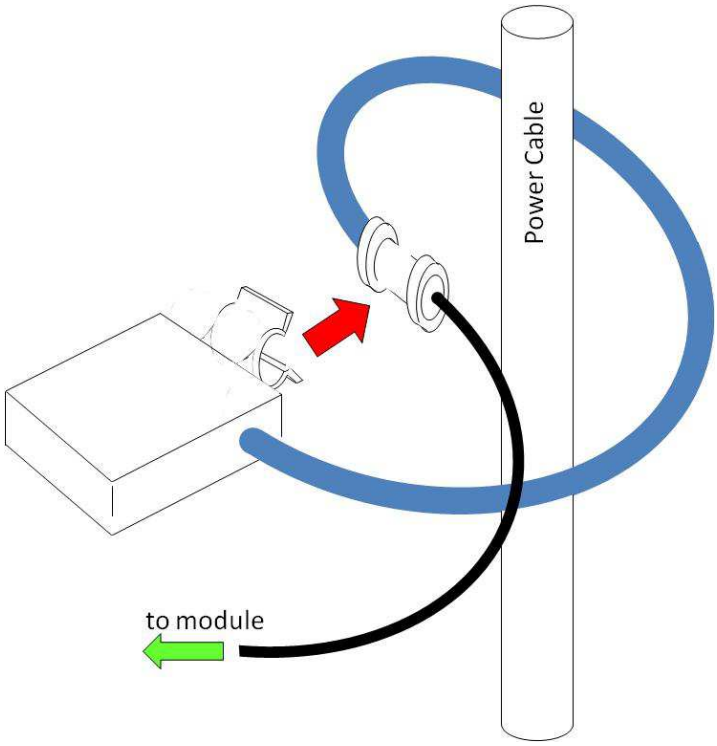


Figure 9-4 Correct coil connection

The following figure illustrates a faulty installation.

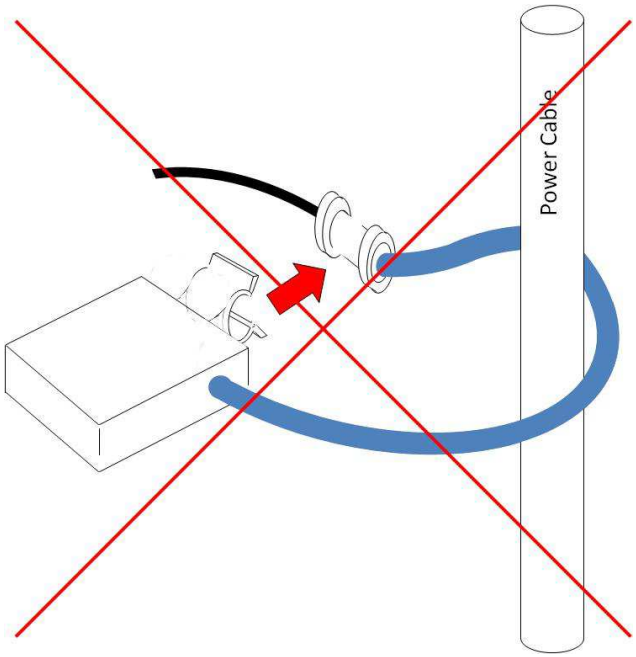


Figure 9-5 Incorrect coil connection

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

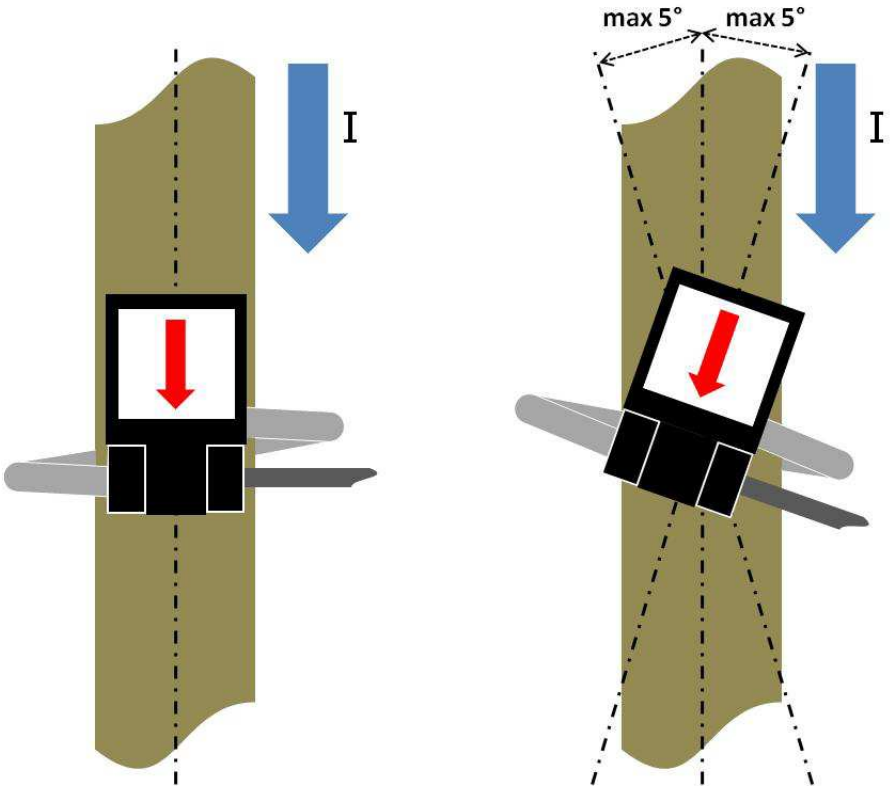


Figure 9-6 Correct coil alignment

10. Specifications

Specification	Units	Value
Minimum operating voltage *(1)*	VAC	70 (phase) 120 (line)
Maximum current	mA	30
Power consumption	W	0.5 (no Ethernet) 1.5 (100Mbit Ethernet)

(1) The power is taken from lines U1 & U2

Table 10-1 Power

Specification	Units	Value
Maximum allowed phase voltage	V	350 (continuous) 710 (peak for 20us)
Accuracy	%	±1

Table 10-2 Voltage inputs

Specification	Units	Value
Current range – 170mm coil	Arms	400 *(1)*
Current range – 250mm coil	Arms	1600 *(1)*
Current range – 350mm coil	Arms	3200 *(1)*
Resolution	Arms	0.1
Accuracy	%	±1

(2) At crest factor 2.5

Table 10-3 Current inputs

Specification	Units	Value
Maximum pulse rate	Hz	10
Maximum output current	mA	10
Maximum output voltage	V	30

Table 10-4 Pulse output

Specification	Units	Value
Size	MB	8
Log Time – compact	days	2474 *(1)*
Log Time – normal	days	1546 *(1)*
Log Time – detailed	days	618 *(1)*

(1) When logging every 15 minutes

Table 10-5 Memory

Specification	Units	Value
Housing W x H x D	mm	94 x 23 x 121
Coil Length	mm	170, 250, 350

Allowed Cable Diameter	mm	35, 65, 95
Coil Diameter	mm	7
Coil Bend Radius	mm	35
Output Cable	mm	3 m UL-LiYY, double insulation

Table 10-6 Mechanical

List of figures

List of Tables