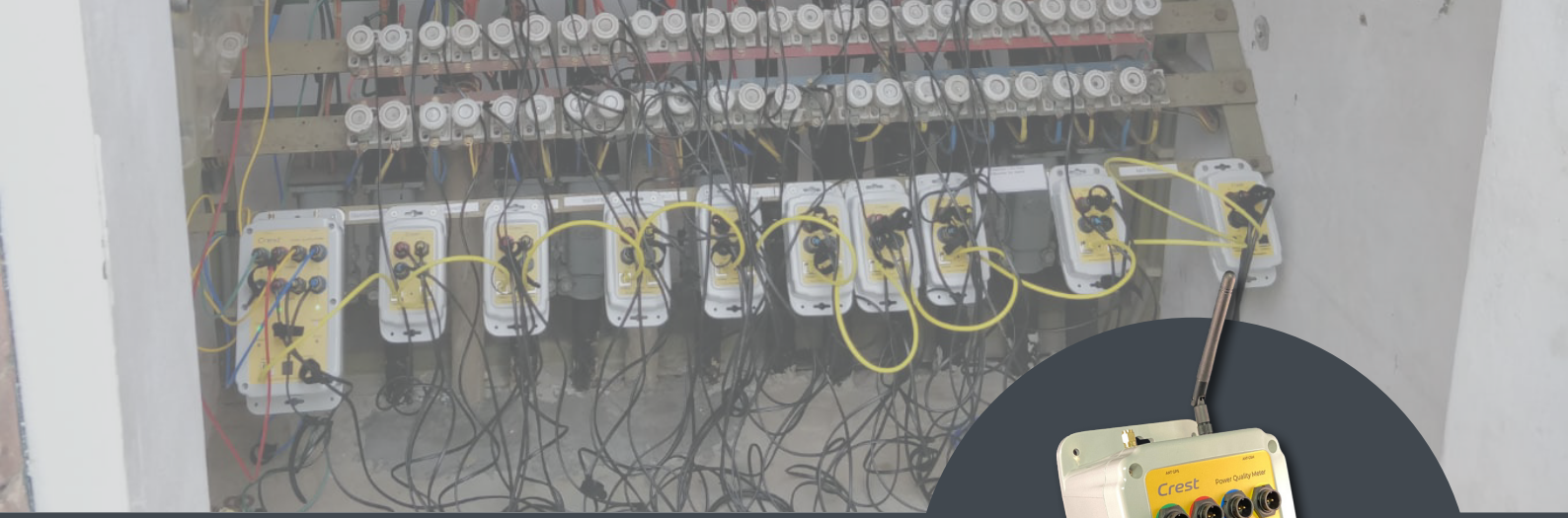


IoT Power Quality Meter

It is becoming increasingly important to know more about the power flow and quality in low voltage distribution grids. Due to the increasing DES (distributed energy sources), charging of EV (electric vehicles) and the general electrification more insight is needed to keep the grid stable and reliable and to detect bottlenecks at an early stage.

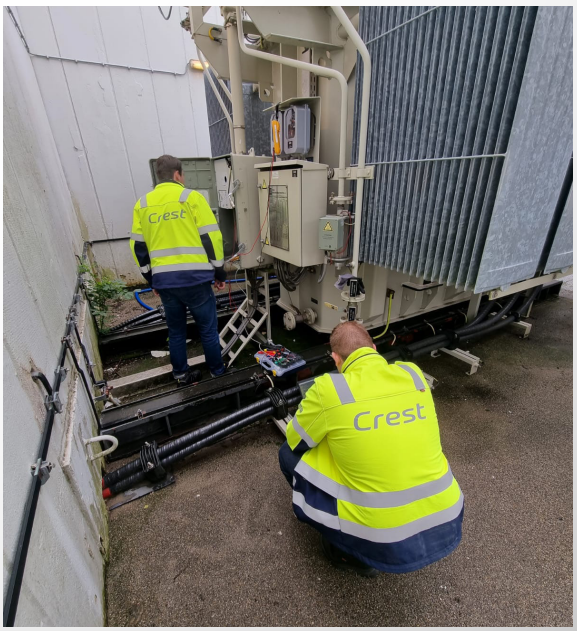
By increasing the locations where measurements are taken, the power flow could be better mapped, this will greatly increase insight in the grid. One of the main benefits of this insight could be that more renewable energy sources could be connected to the present low voltage grid and congestion can be prevented. This is mainly dependent on the loading of components.

With the help of cellular connected power quality meters with additional sensors, such as temperature sensors, components (like cables and transformers) can be remotely monitored.

The data obtained is used to gain insight into the load on the components. This allows for better forecasting of maintenance, problems can be prevented and the lifespan of the installation is guaranteed.

Crest Sensors provides a complete solution from mobile measurements to full distribution automation.

- Remote monitoring
- Distribution automation
- Realtime PQ sensor
- 4G LTE-M cellular connectivity
- Modular system through Modbus
- Measure up to 11 three phase feeders
- Connect up to 20 IO modules
- Secure data (SSL encryption)
- Firmware updates over the air (FOTA)
- Permanent or mobile use
- Fast installation
- Plug & play
- Low-cost



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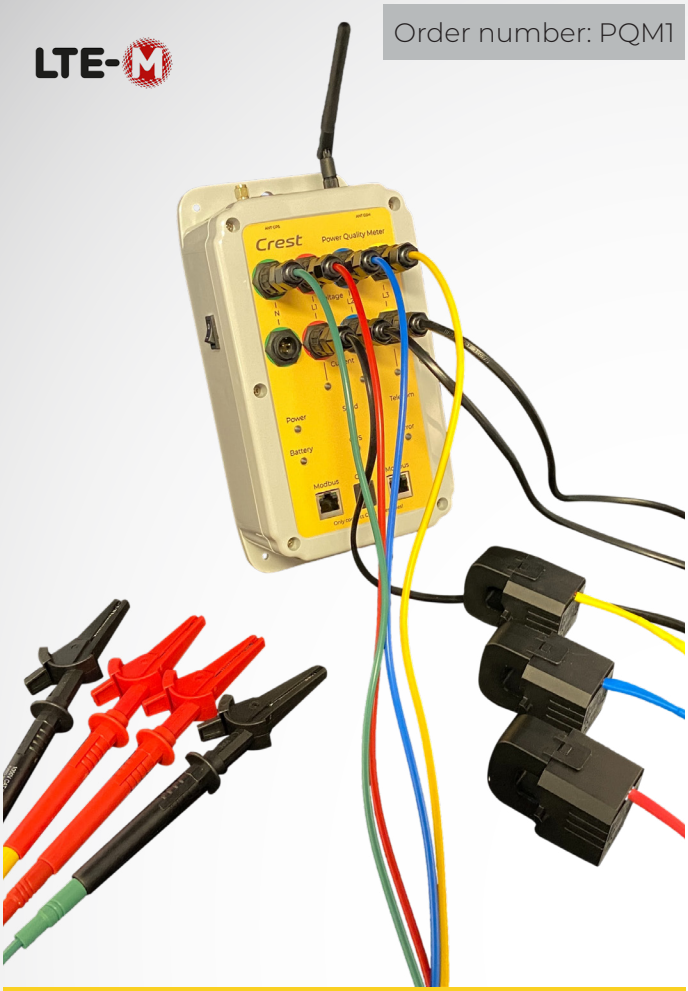
LTE-M

Order number: PQM1



Main module

The main module is the heart and brain of the power quality measurement system and is a measurement unit itself. Each configuration requires at least the main module. It contains the processor, power supply and telecom router. It is also a Modbus master.

By means of bayonet connectors voltage clamps and current transformers or rogowski coils can be connected to measure three phase voltage and current. Both connectors have a different number of pins so it cannot be connected incorrectly. You can see from the LEDs whether the phase voltage is present and within the limits. The other LEDs show telecom status, module status and errors.

Designed in cooperation with Stedin Netbeheer

STEDIN.NET

Power quality expansion

Since not every substation has the same layout, the system is easily adaptable to fit almost all situations. The amount of power quality expansion modules can vary between 0 and 10, which contributes to the flexibility. The main module senses the amount of connected expansion modules and automatically adapts accordingly.

The expansion modules are connected and powered by the main module by the use of a single UTP cable. This reduces the amount of cables across the substation.

Every power quality expansion module can measure the current (harmonics), power factor and total harmonic distortion of one three phase feeder. The current in the neutral conductor is calculated in the sensor or can be measured using an extra current transformer or rogowski.

Modbus

Order number: PQS1

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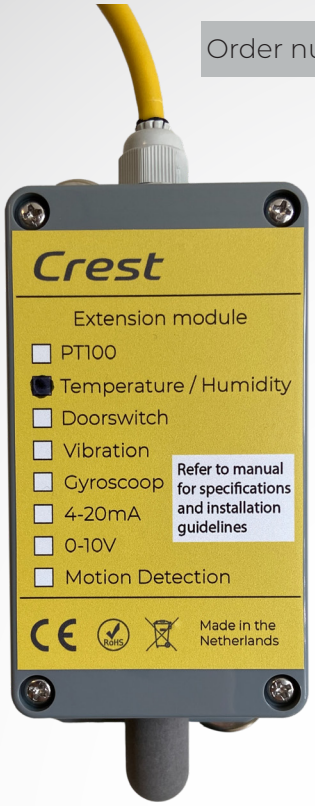
Order number: PQT1



Indoor climate expansion

Temperature and humidity have a direct influence on the lifetime of electronic components such as switchgear. It is therefore very important that these are kept within limits. The indoor climate expansion module can be used to monitor this. This module can be mounted on the wall inside a station and can be connected with a UTP cable to the main module.

PT100 expansion

PT100 sensors are the industry standard for measuring temperature. The PT100 expansion module has one PT100(0) input and sends the average temperature over the time-sent interval to the main module.

The PT100 can be utilized for measuring the temperature of different materials and liquids. A purpose is the measurement of the transformer top oil temperature. This temperature can then be real-time compared with the loading of the transformer.

Order number: PQT2

Other expansions

The possibilities for this system are endless, we have the resources to design and manufacture custom expansion modules to fit your specific needs. For example: vibration sensors and flood sensors.

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Specifications

Function	Range	Resolution	Accuracy	Main Module	Expansion Module
AC-Voltage[4]	0 - 275 V	0.01 V	1 %	✓	
AC-Voltage Harmonics[2]	0 - 399 %	0.01 V	5 %	✓	
THD Voltage	0 - 399 %	0.01 %	5 %	✓	
Frequency[4]	45 - 65 Hz	0.01 Hz	0.01 Hz	✓	
Voltage Phase Angle[3]	-180 - 180°	0.1 °	3 %	✓	
AC-Current[4]	[1]	[1]	[1]	✓	✓
AC-Current Harmonics[2]	0 - 399 %	0.01 %	5 %	✓	✓
THD Current	0 - 399 %	0.01 %	5 %	✓	✓
Phase Angle[3]	-180 - 180°	0.1 °	3 %	✓	✓
Power Factor[3]	-1 - 1	0.01	2 %	✓	✓
Active Power	[1]	[1]	[1]	✓	✓
Reactive Power	[1]	[1]	[1]	✓	✓
Apparent Power	[1]	[1]	[1]	✓	✓

[1] Dependant on CT/ Rogowski coil (contact for more information)
[2] Standard up to the 15^{th} order, optionally to the 32^{th} order
[3] Sampling frequency of 256 kHz
[4] Sampling frequency of 8 kHz

Measure Sent Interval	Number of Measurements	Time Between Measurement
30 seconds	10	3 seconds
1 minute	20	3 seconds
2 minutes	40	3 seconds
5 minutes	50	6 seconds
10 minutes	50	12 seconds
12 minutes	40	18 seconds
15 minutes	50	18 seconds

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Connectivity

UTP Class 6

The system is designed to meet the needs and requirements of a contemporary distribution automation system. Different types of peripheral equipment can therefore be connected and accessed. The main module is the heart and brain of the system. The main module contains the processor, the power supply and the telecom router. The main module can read and / or control peripherals via Modbus. It can be connected to power quality extensions, IO extensions or existing Modbus equipment.

Optionally, the system can be expanded with a 24V back-up battery. With this back-up battery, the system can continue to do its work for a certain time when the phase voltages fail. It depends on the size of the battery how long this is. This can vary from hours to days. The purpose of this is to be able to immediately send an error report in the event of a malfunction or failure and to continue reading and / or controlling the peripheral equipment until the malfunction or failure has been resolved.

As standard, the main module is equipped with 4G LTE-M. LTE-M is part of the new 5G standard, which guarantees connection reliability for the coming years. Thanks to the SSL encryption, sensor data (uplinks), commands to the module (downlinks) and firmware updates over the air (FOTA) are encrypted and meet the latest security standards. However, there may be a desire to connect an external interchangeable telecom router to the main module. This is possible via the communication port. Uplinks, downlinks and FOTA are possible to and from the user's end application without the intervention of a secondary application.

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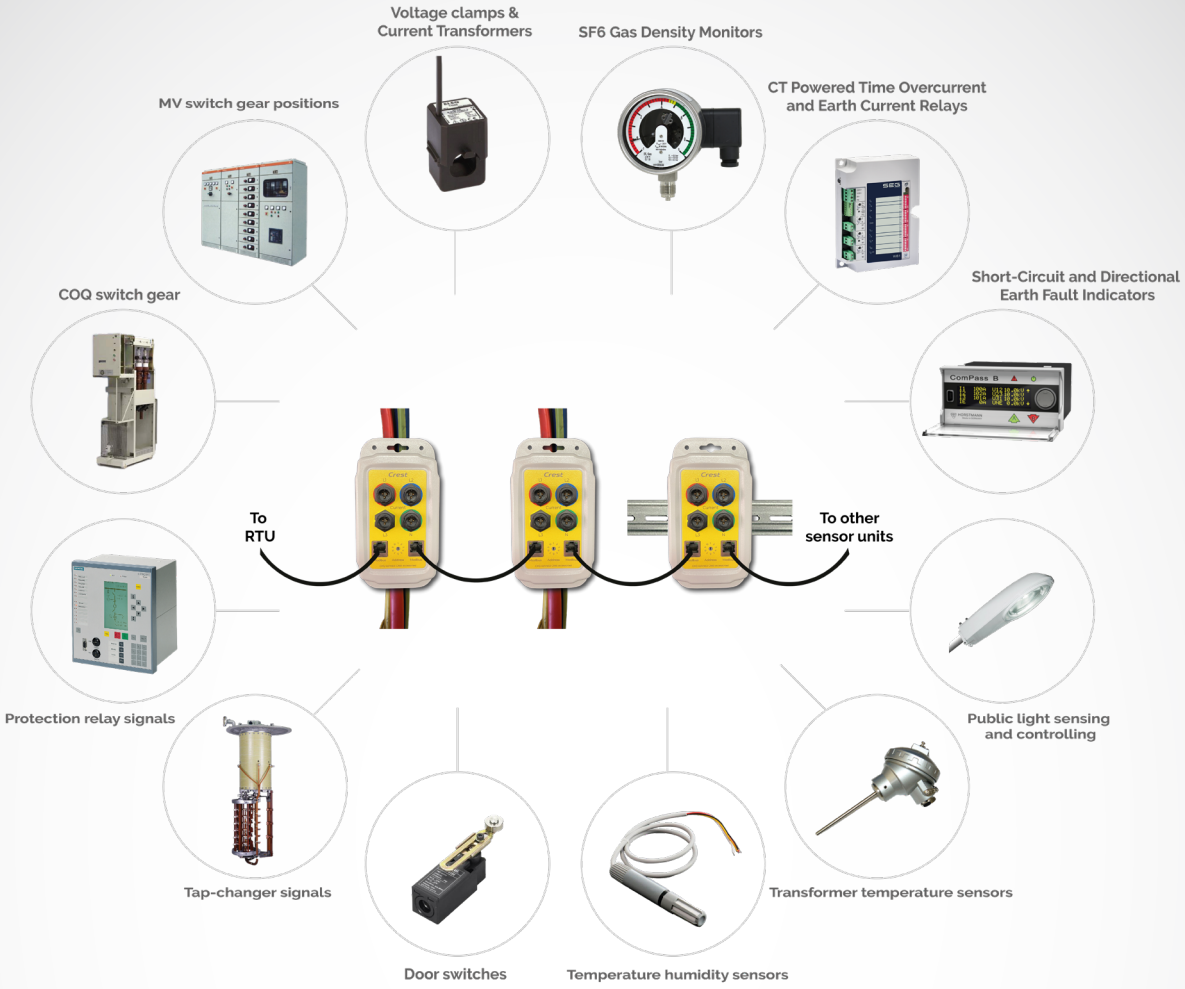
Modularity



The system can be used for simple power quality measurements on one field to full distribution automation where all outgoing fields and peripheral components in a low / mid voltage distribution station have to be read. To make this possible with one system, it must be modular. A Modbus interface was therefore chosen, which gives the system limitless possibilities. Up to 10 additional power quality expansion modules can be connected. This enables the system to measure 11 outgoing LS fields. In addition, up to 20 IO (input & output) expansion modules can be connected. With this, various signals such as PT100(0) signals, pulse signals, 0-10V / 4-20mA signals, NO / NC signals, door contact signals and much more can be read. This makes it possible to access all kinds of peripheral equipment such as tap changers, MV switchgear, public lighting, transformer temperature, indoor climate and malfunction indicators. Because the IO expansion module can be attached near the peripherals, there is no need to lay huge amounts of cables, only one UTP cable. The system can also be easily expanded later on without making any changes to the existing configuration. For example, a distribution automation can take place in phases, with new modules being connected to Modbus each time. This makes the system flexible and never too big or too small, resulting in a exactly right priced system.

Use case MS / LS compact stations Joulz: main module + PT100 expansion + indoor climate expansion. By means of this combination the transformer load can be measured. The PT100 is used to measure the top oil temperature.

Joulz

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Current measurement

Current transformer
- Up to 1000A
- 1 / 5A output
- 1000VRMS CATIII

Order number: CT1A / CT5A

Rogowski coil
- Up to 2000A
- 100 / 333mV output
- 1000VRMS CATIII

Order number: RC1A

Connector 3 Pin
- IP67
- Bayonet
- Plug & Play

Voltage measurement

Crocodile clamp
- 2A fused
- mobile use
- 1000VRMS CATIII

Order number: CC2A

Rail clamp
- 10A fused
- mobile / permanent use
- 1000VRMS CATIII

Order number: RC1A

Connector 2 Pin
- IP67
- Bayonet
- Plug & Play

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Mobile installation

The system can be used as a mobile measurement device. All the modules and extra materials fit in two cases as shown in the image below. The power quality system is built in such a way that it could be mounted very quickly, reducing the installation time and so the time inside a substation. The modules could be fitted with magnets to facilitate a fast snap on mount on a metal surface. This contributes to the safety of the personnel working in the field.

The fused crocodile clamps are often used for the mobile setup of the system, but the fused rail clamps are also a possibility to connect the three phases and neutral to the main module. All connections are color coded to make installation clear and easy.

The current is measured by split-core current transformers or rogowski coils.

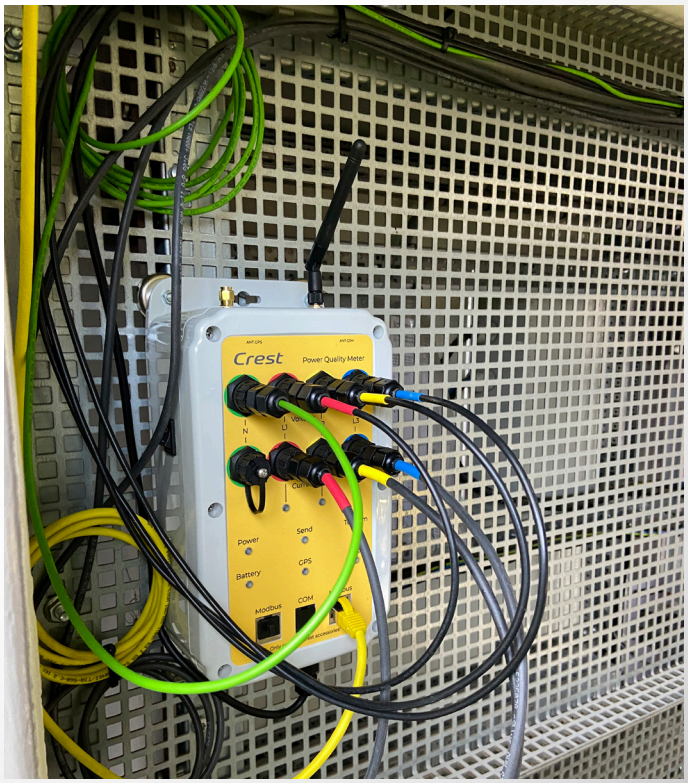
Order number: RK1A

Permanent installation

The system can also be installed permanently for continuous monitoring purposes. The connection material can be supplied with other cable lengths on request. The rogowski coils can also be supplied with various diameters.

If signal strength is a problem, an external outdoor antenna for 4G LTE-M and GPS reception can be supplied.

Crest Sensors offers 24/7 support for installation or problems.



Order number: DK1A

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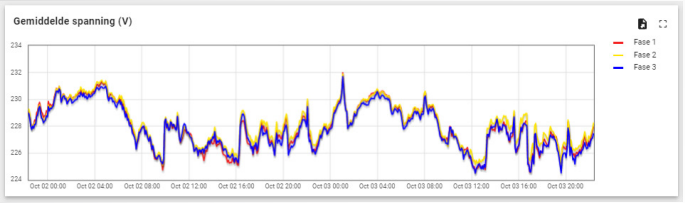
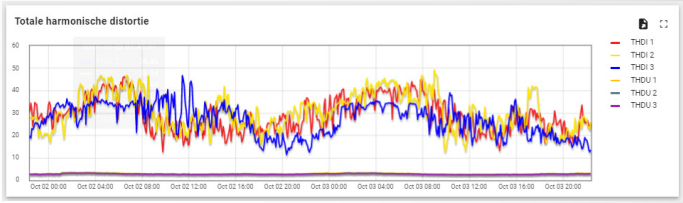
Data

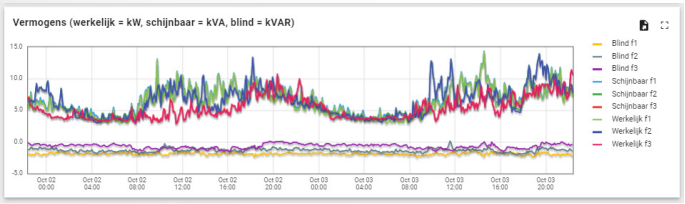
Phase / line voltage



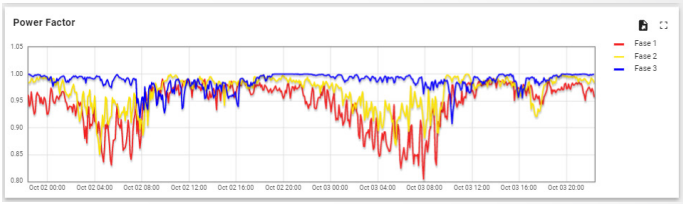
Total harmonic distortion



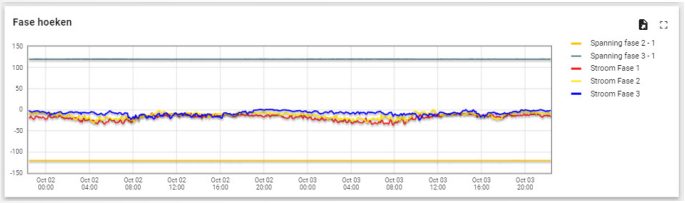
Power



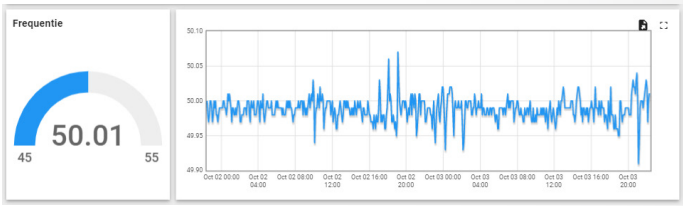
Power factor



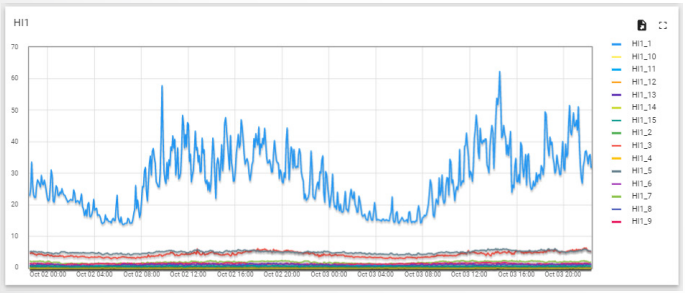
Phase angle



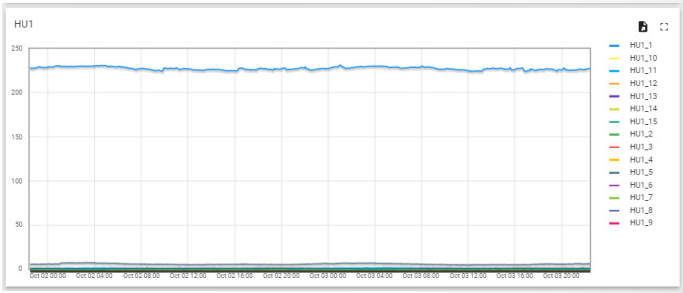
Frequency



Current harmonics



Voltage harmonics



Other data (uplink)

- GPS data
- timestamp (synchronised with NTP server)
- ID
- Battery voltage
- Signal quality
- Error codes
- Connection tries
- Hardware / Firmware version

Commands (downlink)

- Firmware update over the air (FOTA)
- Change measurment interval
- Change send interval
- Reset

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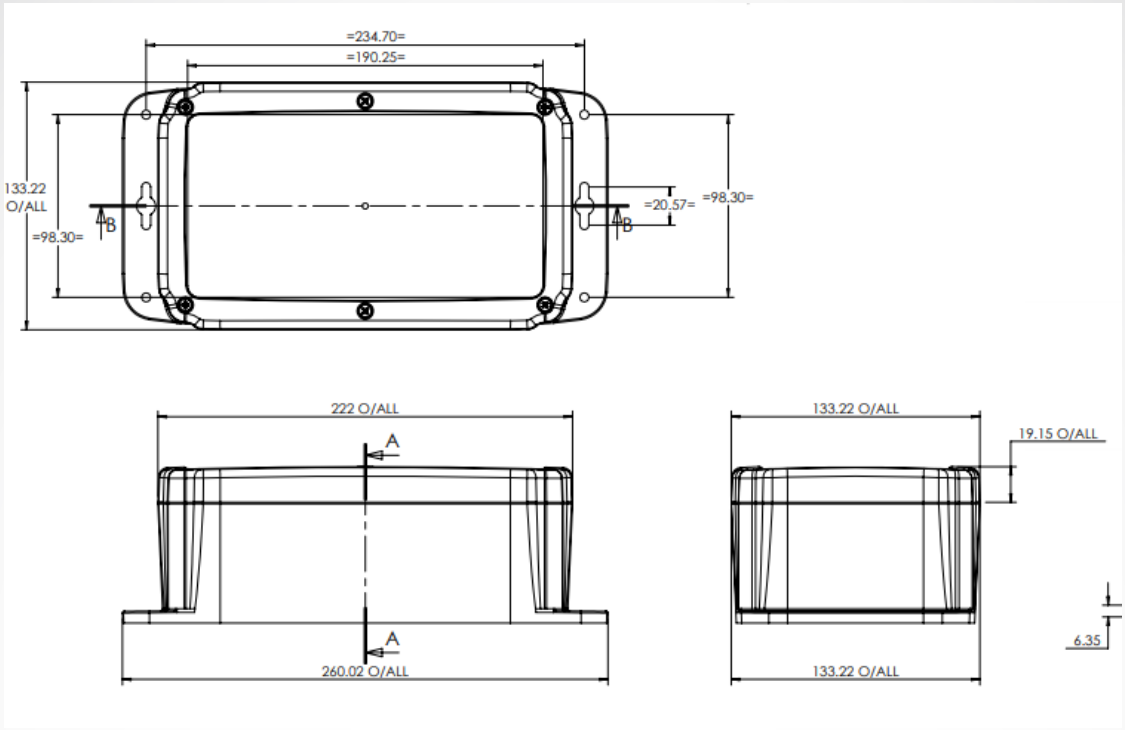
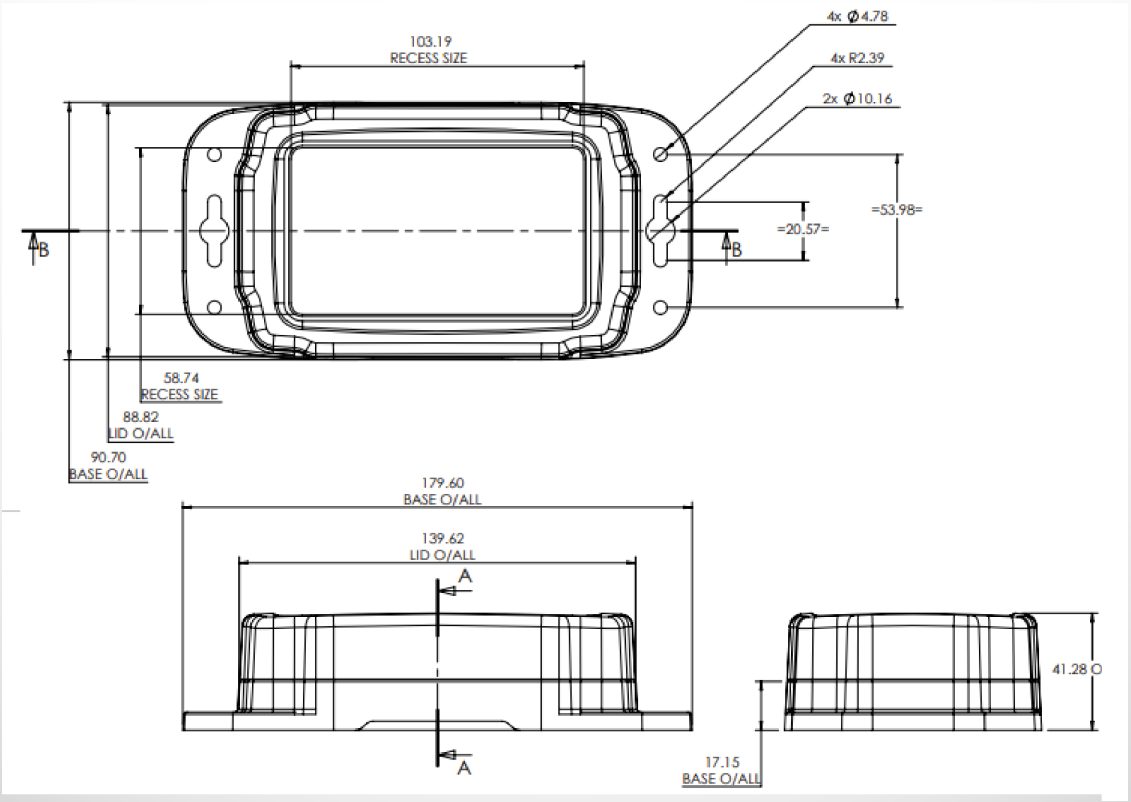
Dimensions main module



Dimensions power quality expansion



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