



UP-2210R/P

UP-2210R/P Hardware installation and configuration manual
English version 23.0

Introduction

An increasing number of non-linear loads, such as computers, office equipment and frequency converters are currently being connected to the public electricity distribution network. Electrical equipment of this type affects the power quality in the network in a negative way and is frequently more sensitive to disturbances than older equipment. It has never been more important to measure and monitor power quality in the electricity distribution network in order to detect disturbances before serious and costly faults occur.

PQ Secure is the result of targeted efforts by Unipower and our customers to create an advanced, user-friendly and reliable power quality monitoring system.

In order to simplify the use of your PQ Secure system we have divided the documentation into separate manuals:

| | |
|---|--|
| <i>PQ Secure SQL user and software installation manual</i> | Describes the installation procedures for the PQ Secure system software. Instructions for configuration and use of the system. |
| <i>PQ Secure Light user and software installation manual</i> | Describes the installation and use of the PQ Secure Light software mainly used together with portable meters. |
| <i>Hardware installation and configuration manual</i> | Describes hardware installation of the meters, communications equipment etc. Instructions for configuration and use of the hardware. |
| <i>Technical manuals</i> | Technical data for the meters |



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1 SAFETY INFORMATION

This section contains basic safety instructions relating to this product. These instructions are always applicable unless expressly stated otherwise. Read through all the information before starting work on the product. The product can be referred to as *Instrument*, *Measuring Device* or *Measuring Instrument* or *Meter*.



Only authorized and well-informed personnel must use the instrument, because normal use of the instrument involves dangerous high voltages, which can cause death or serious injury. Only trained Unipower personnel may carry out any intervention in the instrument.

1.1 Installation conditions

Make sure the area in which you plan to install the meter is clean, dry and dust-free. Follow these recommendations to maintain a safe working environment and to avoid accidents:

- Avoid installing and handling the instrument if there is a risk of *thunderstorms*, as these can cause injury or damage.
- Ensure that the installation site has *no uninsulated* wires and *standing water* near the measuring device.
- The instrument case must *never be dismantled* under any circumstances.
- Make sure that *no loose or hanging items*, e.g. chains, bracelets, etc., can cause problems during installation.
- Use gloves and a helmet if there is a risk you might come into *contact* with live components.
- Follow the applicable electrical rules at the installation site.
- Never work on electrical installations on your own.

1.2 Installing the instrument

The following conditions must be met in order to achieve the best measurement results, to avoid installation errors and to minimize the risk of accidents:

- Always connect the transducers to the inputs of the measuring device before turning on the power.
- Never connect/disconnect the transducers while the measuring device is live.
- Make sure that the measuring device is always connected to protective earth before measuring transducers are installed and during the measuring process.
- Use the measuring device within the electrical ratings indicated on the transducers or on the case of the measuring device.

1.3 Power supply

Use a "clean" and regulated power source, free of surges and line noise. If a suitable DC voltage source is available this is preferred choice. If there is no station/internal battery backup, Unipower recommends that you connect the instrument to an external UPS type battery source in order to prevent power failure disturbances.

Always protect the power supply with a two amp 2A fuse in each conductor (phase and neutral).

1.4 Product end of life

At end of life, the product must be disposed of in accordance with the relevant national laws relating to electronic waste handling.

The product contains lithium batteries, which must be handled correctly, in order to prevent environmental pollution/damage. Rest of product is standard electronic components and treated as per relevant national laws. Contact your local authority for advice.

2 UNDERTAKING AND WARRANTY

Unipower undertakes to comply with the requisite legislation and recommendations relating to marketing and product liability.

2.1 Liability

Unipower AB reserves the right to make changes to the instrument or in the instrument specification as described in this manual without notice. Unipower AB encourages customers to obtain the latest version of all documentation before making a purchase.

In the absence of a written agreement with the other party, Unipower AB does not accept liability in respect of customers' failure to observe clauses and copyrights of Unipower and its suppliers, and third-party products of systems or applications. Unipower AB cannot be held liable for circumstances in which license agreements expire for systems or applications installed in the customer's property. In addition, Unipower AB or its suppliers cannot be held liable for direct or indirect faults that occur when our products are installed or used.

Unipower AB cannot be held liable for material damage or personal injury arising during the use of our products if such damage/injury has been caused by a failure to observe guidelines and health and safety rules.

2.2 Warranties

Unipower AB warrants the absence of material or manufacturing faults during the warranty period. The warranty is limited to one year from the date of delivery inclusive. The warranty does not apply if:

- the product fault is caused by the customer's incorrect handling
- the product has been used beyond the intended area of application
- the product has been opened by the customer or by a third party
- the purchaser or a third party has attempted to repair, or made modifications to, the item

In the event of a claim for repair under the warranty, Unipower AB is entitled to choose whether to repair or to replace the product. The purchaser's claim under the warranty must be made in writing to Unipower AB before the warranty expires. Items must not be returned without Unipower's prior written authorization.

If the purchaser claims that the product is not in accordance with Unipower's product specification, full details of the claimed infringement must be submitted. Compensation will not be provided until the fault has been documented and approved by the manufacturer. Apart from the warranty

obligations above, Unipower AB is not bound by other warranties or obligations unless these have been agreed between the parties or are imposed by law.

2.3 Patent

Unipower AB's products are covered by one or more of the following patents/patent applications:

Swedish Pat. No. SE525331

Chinese Pat. No ZL200380109063.0

European Pat. No. EP1581816

German Pat. No EP11341

U.K. Pat. No 1581816

French Pat. No EP11341

US Pat. No US 7,640,118 B2

3 COMPONENTS OF THE PQ SECURE SYSTEM

PQ Secure system is a collective name for a permanently installed measuring system for the continuous monitoring of power quality in the electricity network. It consists of three parts - the measuring device, communication equipment and a computer for storing the measured data. A PQ Secure system can have the following configuration:

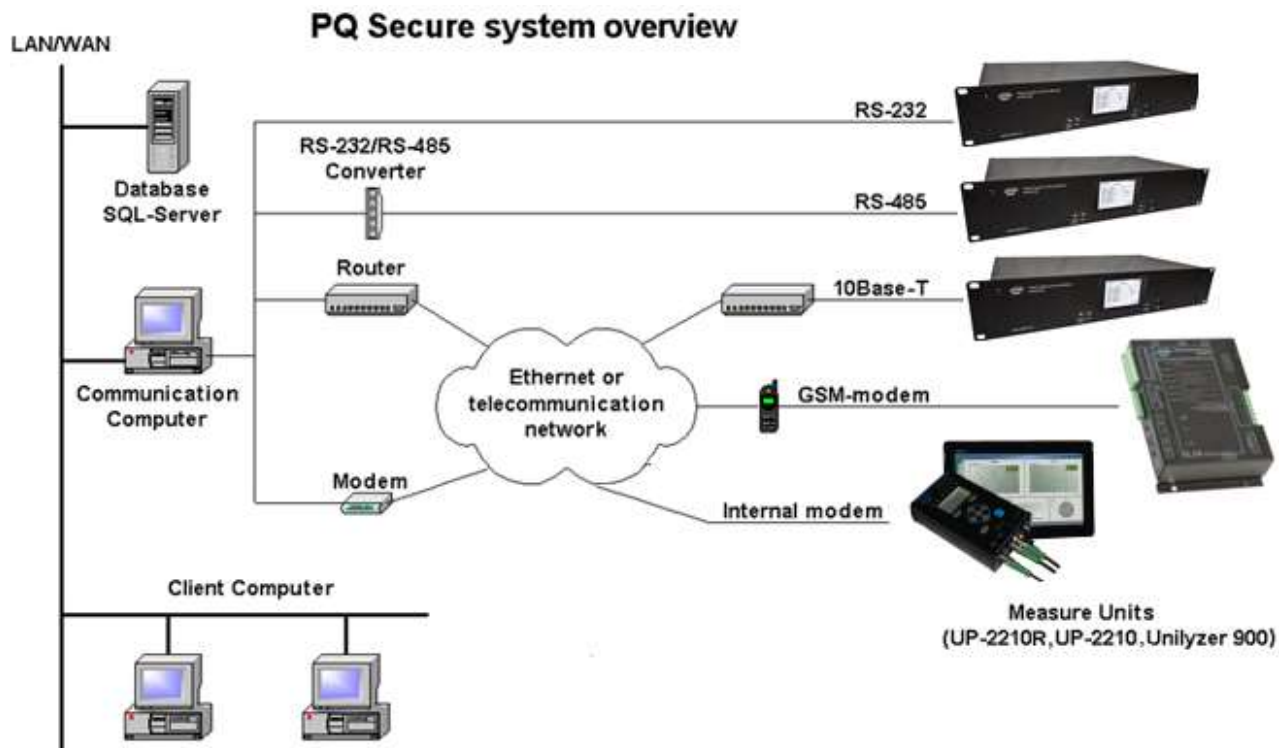


Figure 1

PQ Secure is a highly advanced and fully automated power quality monitoring and control system - easy to configure and use. After the system and all its meters are installed, any necessary configuration changes can be made directly from the office, without the need to go to the installation sites.

3.1 Measuring device

The measuring device UP-2210 is an advanced, 3-phase power quality and disturbance analyser designed for permanent installation. There are different models, UP-2210 wall mount and UP-2210R/P rack/panel mount.



UP-2210 Rack and panel mount



UP-2210 wall mount

Figure 2

3.2 Communication

All measured data is automatically transferred from the meter to the server. There are several options for communication between the meters and the computer centre. The meters may be equipped with RS-232, RS-485, built-in modems and dual Ethernet ports. This means that communication is possible using a range of media, such as a standard telephone lines, signal cables, GSM phones, local computer networks, etc. Different meters can use different communication options within the same system, creating a highly flexible communication solution. The dual Ethernet ports makes it possible to connect to two completely independent networks. Note that for security reasons the ports are isolated and there is no function that can transfer data between the two networks. Both ports support TCP/IP and UDP/IP but cannot be connected to the same network. ETH1 has the top priority and is the only port supporting NTP and SmartCom. Modbus uses TCP/IP but only allows one connection at a time.

There is no function making it possible to transfer data between the two ports.

3.3 Portable meter Unilyzer 900 / Unilyzer 900c

The meters Unilyzer 9900/900c are portable power quality and disturbance analysers. They can also be integrated in a PQ Secure system together with permanently installed meters.



Figure 3

3.4 Software

The PQ Secure system consists mainly of four programs performing different functions. The system is built around a Microsoft SQL server, which stores all information about the system as well as the measure data. The client computers and communication computers later use this information when they contact the measuring devices and when they perform analyses.

| | |
|----------------------------|---|
| PQ Secure | Main program of the system. Used to present measure data from the SQL database, and to configure the system. |
| PQ Online | Used to present real-time values from the meters, and to configure the meters. |
| PQ Schedule | Manages communication with the meters and transfers their measure data to the SQL database. |
| PQSM | <i>PQ Secure System Manager.</i> Server software, which handles periodic reports, limit calculations, alarms, PQ Ports etc. |
| PQ Secure DB Wizard | Only used when the PQ Secure database is being installed and updated. |
| UniLauncher | Software/service used to automatically connect to meters. |

Microsoft SQL Server is also needed for the operation of the system, this software is purchased separately.

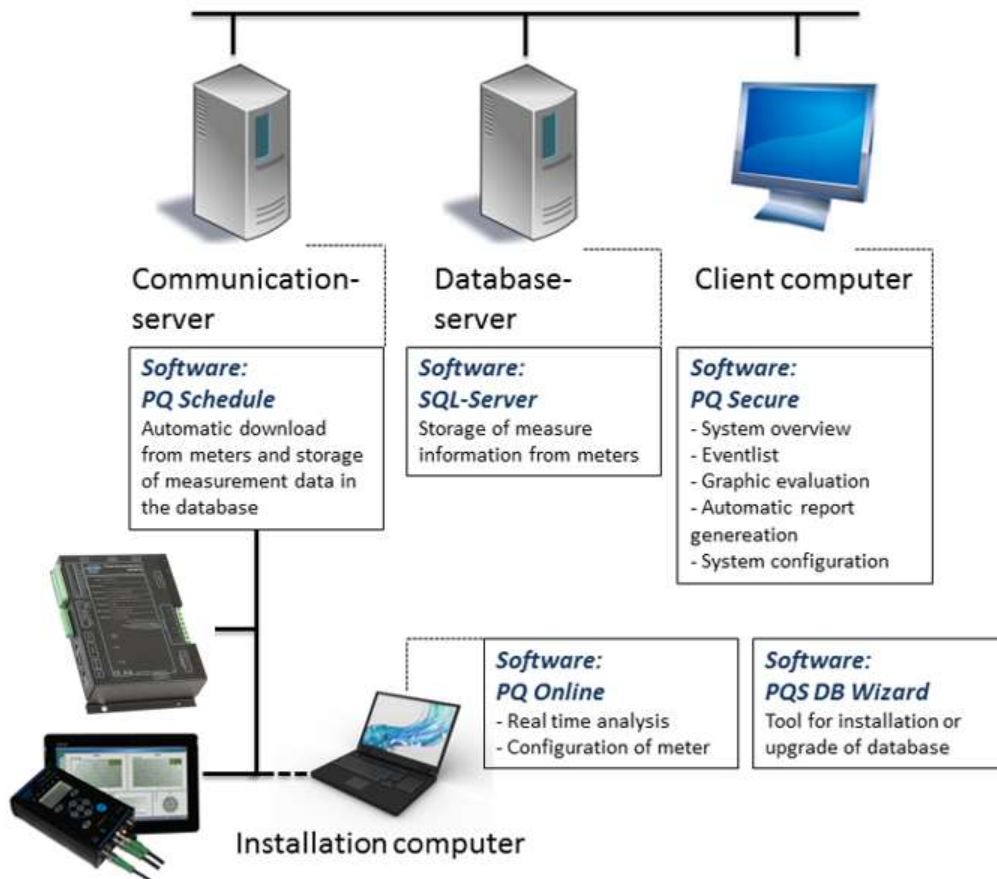


Figure 4

3.4.1 Server performance

The required server performance depends on which PQ Secure application is being used. Unipower or our representatives can help you with choosing the right computer/server solution.

Data growth in the database is approximate 29 MB to 75 MB per Meter per year (MY) depending on configuration. With standard configuration 45 MB/MM is a good average. This includes all data, both statistical and events.

When dimensioning a server for a system, use this figure to estimate hard disk requirements. Assume a server lifetime 4-5 years.

| Meter | 1 year | 5 years | Storage volume |
|------------|--------|---------|----------------|
| 1 Meter | 0,32 | 1,6 | GB |
| 10 Meters | 3,21 | 16,05 | GB |
| 20 Meters | 6,42 | 32,10 | GB |
| 50 Meters | 16,05 | 80,25 | GB |
| 100 Meters | 32,10 | 160,50 | GB |

4 INSTALLING PERMANENT METER UP-2210R/P

The installation process involves fitting the measuring device in an existing equipment cabinet or similar meter at the selected installation site. This includes the connection to existing instrument transformers and the chosen communication equipment. The connection to the instrument transformers must **only** be made by qualified electrical installers or equivalent personnel to prevent injury during installation. We recommend making the connections to the measure core and only in exceptional cases directly to the relay cores.

4.1 Location and fitting

UP-2210R is designed to be installed in standard 19" rack. UP-2210P is designed to be installed in a panel.



Figure 5



Figure 6

The picture above shows a few UP-2210R installed in typical a substation (130/10 kV).

The UP-2210R can be used with all standard connection options and can measure both line-to-neutral and line-to-line voltages.

The picture also shows a sub-station display that is used for real-time monitoring and configuration of all the units in the sub-station.

Note: If the meters are used with external/internal modem, keep in mind that phone lines are easily affected by lightning. Modems usually don't have lightning protection. Unipower recommends that external lightning protection is installed between the phone line and modem in exposed locations, in order to protect the meter from damages caused by lightning.

4.2 Installation diagram

The UP-2210R meter can be mounted on a rack/panel. For mounting dimensions, refer to the drawing below.

It is important to install the meter as close as possible to the measured object. When installing the unit, also bear in mind the type of communication facility you will be using, for example close to the window for a GSM modem, near a telephone outlet for an external modem, etc.

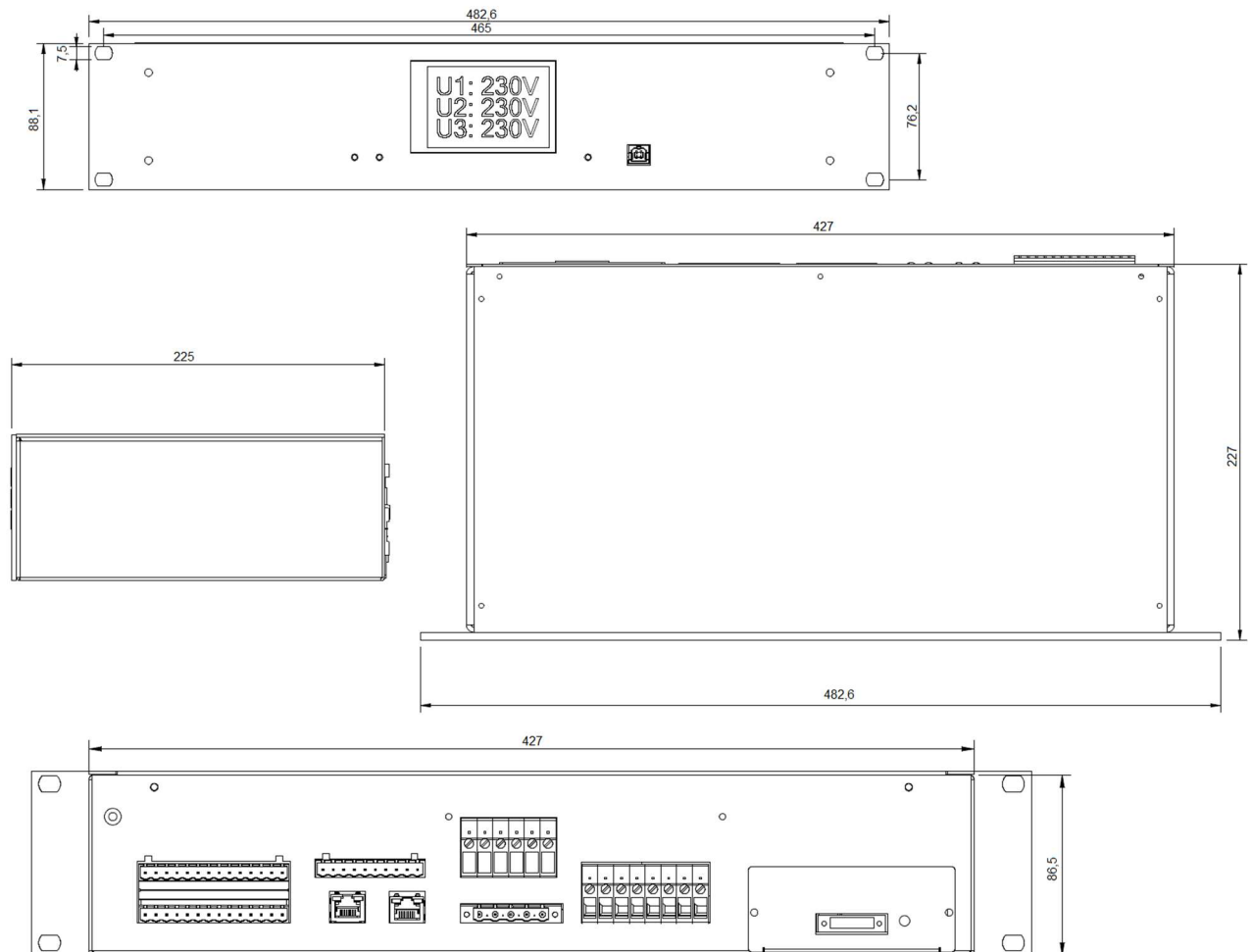


Figure 7

4.3 Connection points

There are several connection points on the UP-2210R/P for connecting to the measured object and for communication links. The connections are described below:

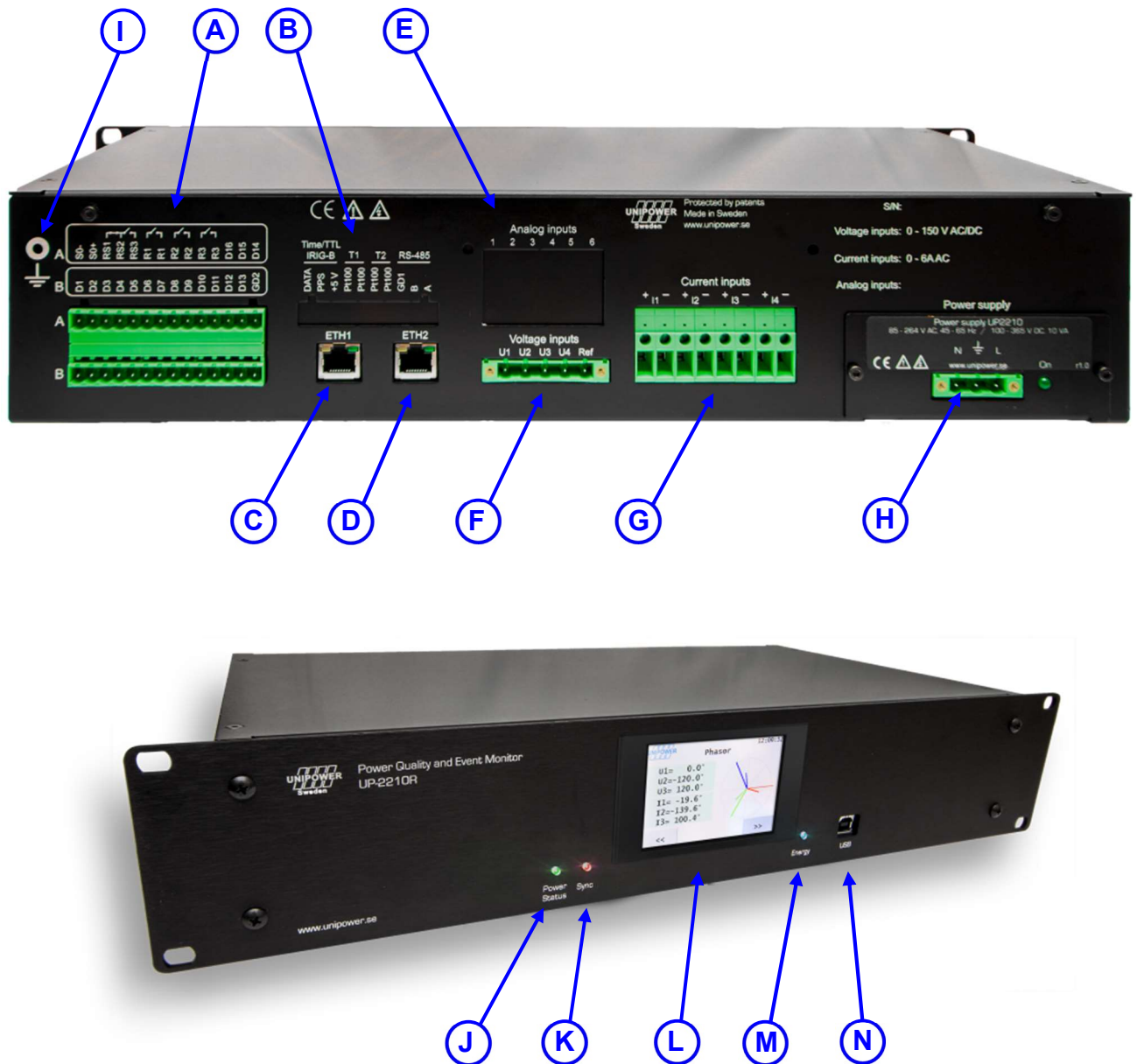


Figure 8

- A. Digital outputs.** Optional. The digital outputs are relays, which can be used for alarms and for controlling other equipment. The meter can also be programmed to activate the digital outputs under certain conditions, for example when a transient of a certain level is recorded. The digital outputs are configured using the PQ Online program.

Digital inputs. Optional. The digital inputs are galvanically isolated with a common for each group of 16 inputs. The digital inputs are used for a range of applications, providing completely new monitoring opportunities. The UP-2210 can for example be used as a fault meter. You have the option of capturing various types of power quality events, for example switch connections, relay status, etc. The digital inputs can also be used for monitoring other

events, for example when the door of a particular station is opened or closed, the temperature, status, etc. The digital inputs are easily configured using the PQ Online program.

S0 interface. 1 opto isolated S0 output for energy pulses.

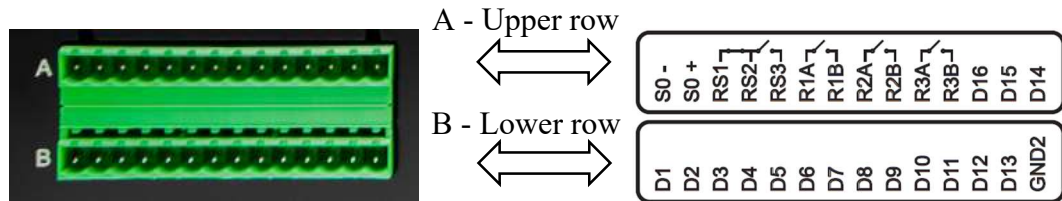


Figure 9

B. Time/TTL IRIG-B interface. Optional.

Temperature inputs. 2 Pt-100 sensor inputs. Optional.

RS-485 interface. Optional.

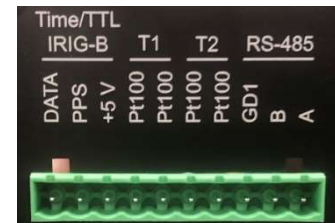


Figure 10

C. RJ-45 connection for 10/100-BaseT Ethernet communication, which is available as an option.

D. RJ-45 connection for secondary, independent 10/100-BaseT Ethernet communication, which is available as an option.

E. Optional extra analogue inputs. In the picture the SENSE card is installed. This card adds three extra voltage inputs that can be used for voltage calibration between high bandwidth voltage transducer like Capacitive Tap, PQ Sensor, RCVD and accurate PT like CVT, MVT.



F. 4 isolated voltage inputs + reference (the range is stated on the label). The voltage inputs are designed for the direct measurement of line-to-neutral voltages in low voltage networks as well as for connection to potential transformers (PT) secondary circuit in high voltage networks. Remember to connect the polarities correctly, because incorrect polarity will shift the voltage signal 180°, affecting power calculations, unbalance and other parameters. Connect the voltage channels in accordance with the wiring diagrams later in this manual. Local installation regulation must always be considered. For stranded cables we recommend fitting with an adapter.

G. 4 isolated current channels (the range is stated on the label). The current channels are designed for direct connection to the existing current transformer (CT) secondary side. It is important to connect the current channels with the correct polarity; otherwise power, unbalance and other parameters will be incorrect. Connect the current channels in accordance with the wiring diagrams shown later in this manual. Local installation regulation must always be considered. For stranded cables we recommend fitting with an adapter.

H. Connection for Power Supply. Power supply is user replaceable on site. If a suitable DC voltage source is available this is a preferred choice. If there is no station/internal battery backup, Unipower recommends that you connect the instrument to an external UPS type battery source in order to prevent power failure disturbances. Protect the feeding cable with a 2A fuse. Local installation regulation must always be considered. For stranded cables we recommend fitting with an adapter. If an AC supply is used, the phase is connected to L input and the neutral conductor is connected to the negative input, N on the UP-2210 meter.

Always ensure that the UP-2210 unit is grounded (earthed), using the input marked with the ground symbol.

- I. Ground terminal. Always connect this point to protective earth.
- J. Power/status LED. Green indicates power on and all ok. Red indicates failing UST (Unit Self Test). Contact your Unipower representative if you see red colour.
- K. Sync LED. When blinking it indicates that time/clock is synchronised with GPS.
- L. Colour touch screen.
- M. Energy LED. Blinks corresponding to measured, consumed energy. Depending on meter constant.
- N. USB interface. Used for local connection to laptop/computer for configuration, data download, service or real-time values.

Note: When connecting to CT or PT existing ones are preferably used. For new installations we recommend same type/class as being used in metering circuits.

4.4 Connection alternatives

In the electric grid there are multiple configurations of instrument transformers (PT= Potential Transformer, CT= Current Transformer). The UP-2210 meters support all standard 1-phase and 3-phase connections. The meter is configured using PQ Online, where all the common connections methods with their respective wiring diagrams available and a graphical explanation. Here it is also possible to set the transformer ratios as constants.

4.4.1 3 phase with 4 wire measurement with direct voltage and 3 CT's

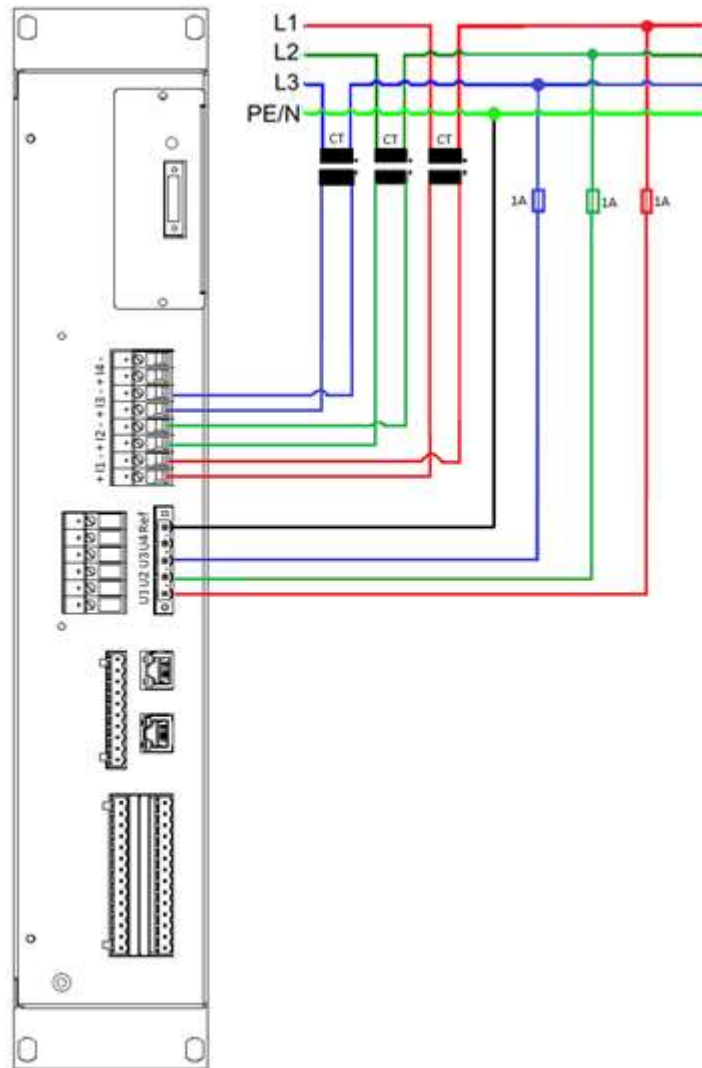


Figure 9

The above wiring diagram is used for 3-phase measurement in low voltage networks. The voltage channel of the unit is connected directly to the electricity network for measuring line-to-neutral voltage (230 V) and therefore do not require an instrument transformer (PT). The current channels are connected to existing instrument transformers, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with a suitable fuse in each conductor. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 | I1+ = | L1 CT+ |
| U2 = | L2 | I1- = | L1 CT- |
| U3 = | L3 | I2+ = | L2 CT+ |
| Ref = | N (Neutral) | I2- = | L2 CT- |
| | | I3+ = | L3 CT+ |
| | | I3- = | L3 CT- |

4.4.2 3 phase with 4 wire measurement with direct voltage and 2 CT's

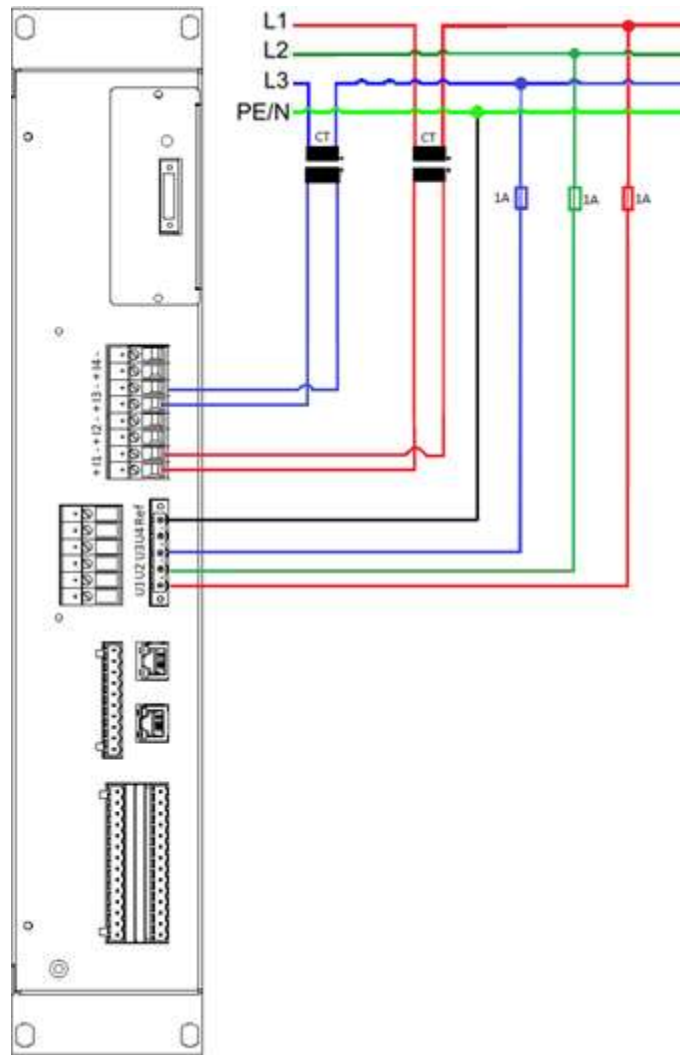


Figure 10

The above wiring diagram is used for 3-phase measurement in low voltage networks. The voltage channel of the unit is connected directly to the electricity network for measuring line-to-neutral voltage (230 V) and therefore do not require an instrument transformer (PT). The current channels are connected to existing instrument transformers, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with suitable fuse in each conductor. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 | I1+ = | L1 CT+ |
| U2 = | L2 | I1- = | L1 CT- |
| U3 = | L3 | I3+ = | L3 CT+ |
| Ref = | N (Neutral) | I3- = | L3 CT- |

4.4.3 3 phase with 4 wire measurement with 3 CT's and 3 PT's

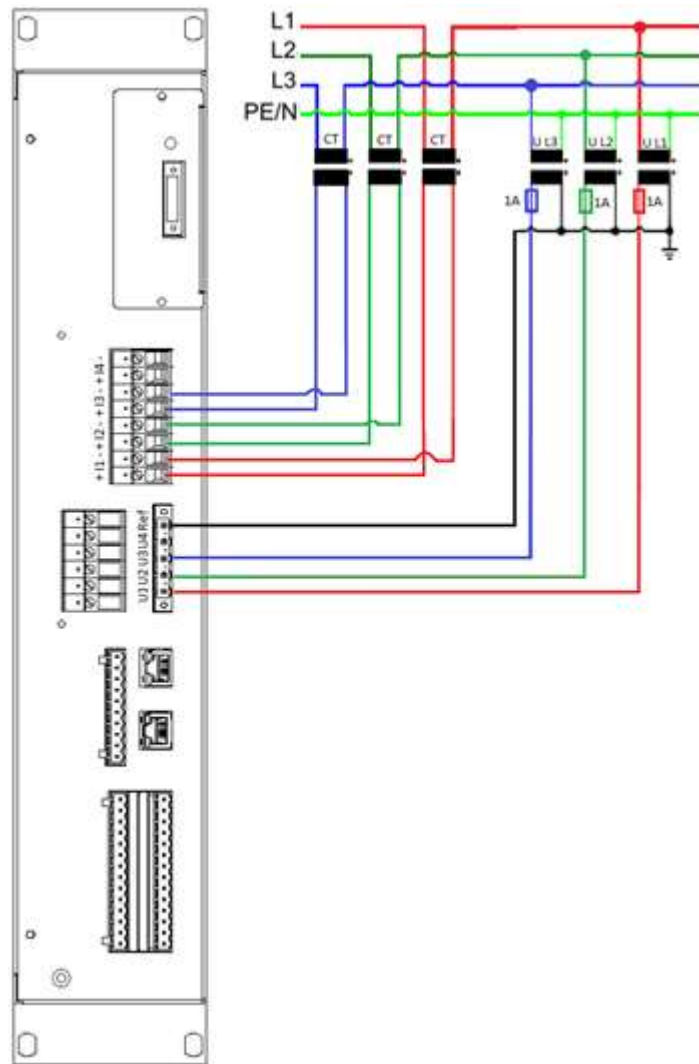


Figure 11

The above wiring diagram is used for three-phase measurement in public distribution networks with 3 CT's and 3 PT's. The voltage channels of the unit are connected to PT's (normally 63 V AC secondary), for supplying line-to-earth voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------------|--------------|------------------|
| U1 = | L1 PT+ | I1+ = | L1 CT+ |
| U2 = | L2 PT+ | I1- = | L1 CT- |
| U3 = | L3 PT+ | I2+ = | L2 CT+ |
| Ref = | L1 PT-, L2 PT-, L3 PT- | I2- = | L2 CT- |
| | | I3+ = | L3 CT+ |
| | | I3- = | L3 CT- |

4.4.4 3 phase with 4 Wire measurement with 2 CT's and 3 PT's

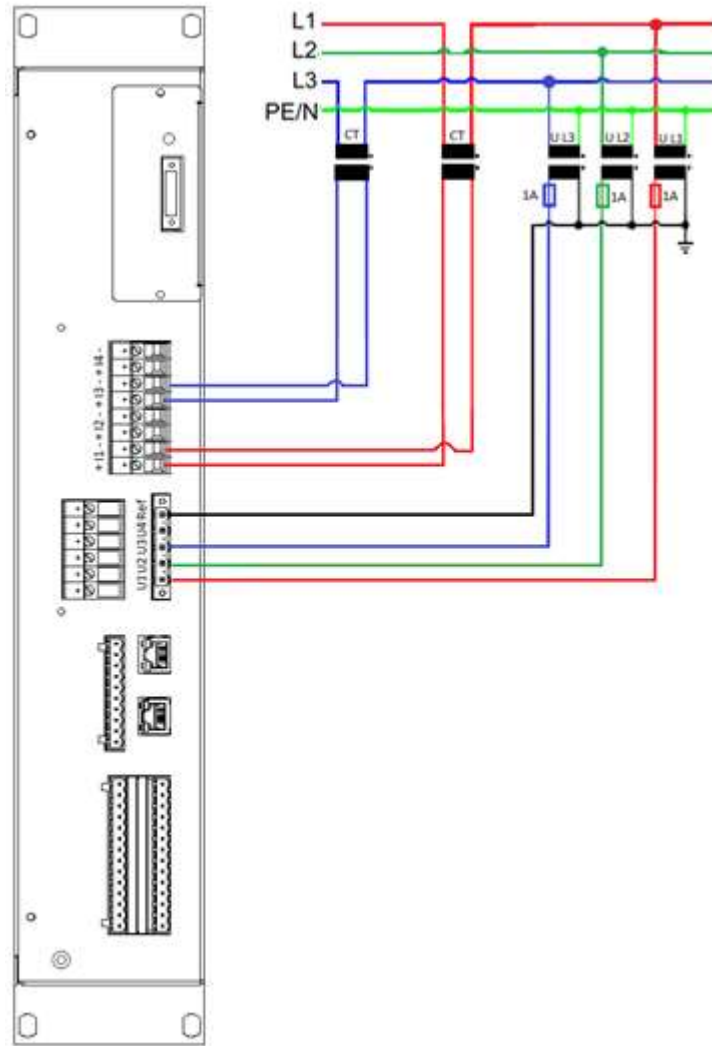


Figure 12

The above wiring diagram is used for three-phase measurement in in public distribution networks with 2 CT's and 3 PT's. The voltage channels of the unit are connected to PT's (normally 63 V AC secondary to earth), for supplying line-to-line voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------------|--------------|------------------|
| U1 = | L1 PT+ | I1+ = | L1 CT+ |
| U2 = | L2 PT+ | I1- = | L1 CT- |
| U3 = | L3 PT+ | I2+ = | L2 CT+ |
| Ref = | L1 PT-, L2 PT-, L3 PT- | I2- = | L2 CT- |

4.4.5 3 phase with 4 wire measurement with 3 CT's and 2 PT's

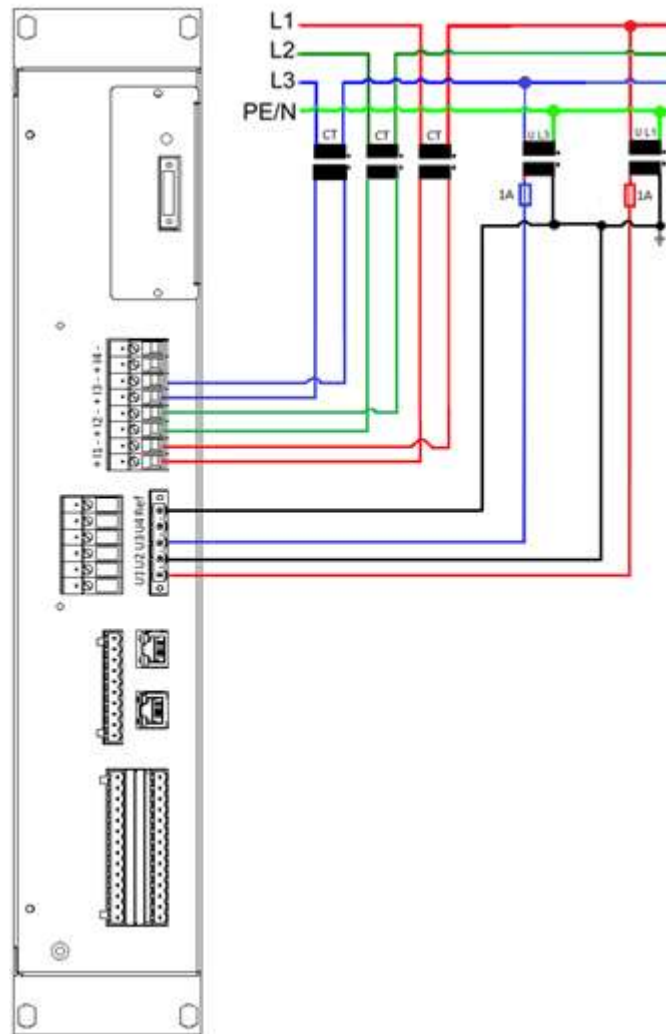


Figure 13

The above wiring diagram is used for three-phase measurement in in public distribution networks with 3 CT's and 2 PT's. The voltage channels of the unit are connected to PT's (normally 63 V AC secondary to earth), for supplying line-to-line voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 PT+ | I1+ = | L1 CT+ |
| U2 = | L1 PT-, L3 PT- | I1- = | L1 CT- |
| U3 = | L3 PT+ | I2+ = | L2 CT+ |
| Ref = | L1 PT-, L3 PT- | I2- = | L2 CT- |
| | | I3+ = | L3 CT+ |
| | | I3- = | L3 CT- |

4.4.6 3-phase 4 wire measurement with 2 CT's and 2 PT's

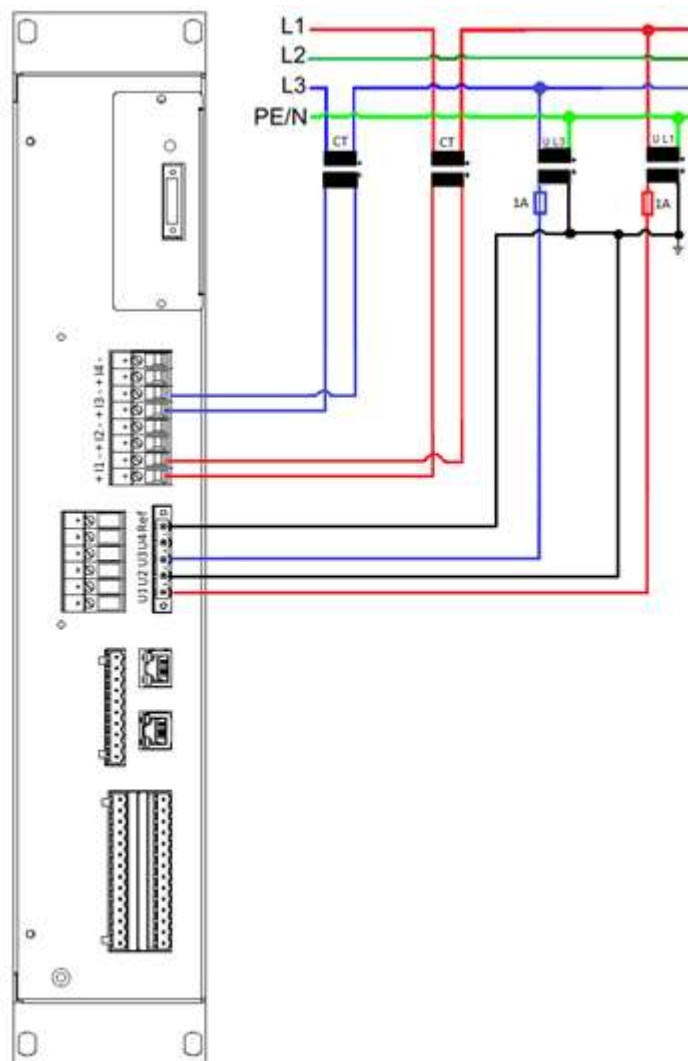


Figure 14

The above wiring diagram is used for three-phase measurement in public distribution networks with 2 CT's and 2 PT's. The voltage channels of the unit are connected to PT's (normally 63 V AC secondary to earth), for supplying line-to-line voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 PT+ | I1+ = | L1 CT+ |
| U2 = | L1 PT-, L3 PT- | I1- = | L1 CT- |
| U3 = | L3 PT+ | I3+ = | L3 CT+ |
| Ref = | L1 PT-, L3 PT- | I3- = | L3 CT- |

4.4.7 1-phase measurement with direct voltage and one CT (Line-to-neutral voltage)

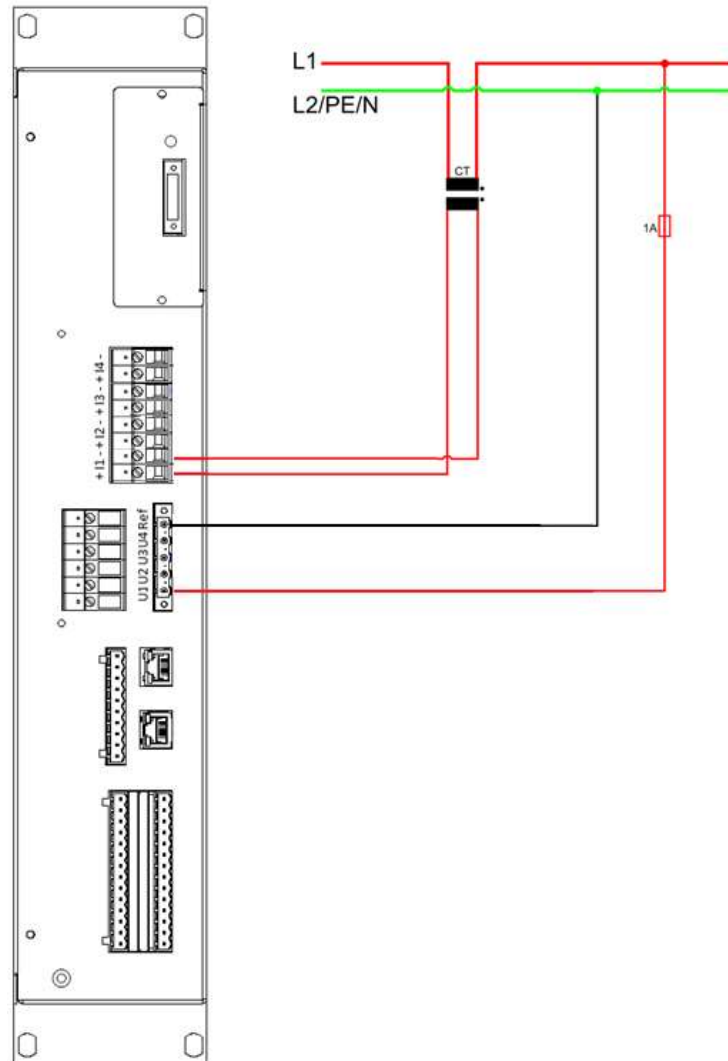


Figure 15

The above wiring diagram is used for single-phase measurement in low voltage networks. The voltage channel of the unit is connected directly to the public distribution networks for measuring line-to-neutral voltage (230 V) and therefore do not require an instrument transformer (PT). However, the current channel is connected to existing instrument transformer, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with a suitable fuse in each conductor (red conductor). The connection for this type of measurement is as follows:

| | | | |
|--------------|------------------|--------------|------------------|
| Channel: | Measured object: | Channel: | Measured object: |
| U1 = | L1 | I1+ = | L1 CT+ |
| Ref = | (Neutral) | I1- = | L1 CT- |

4.4.8 1-phase measurement with one PT and one CT

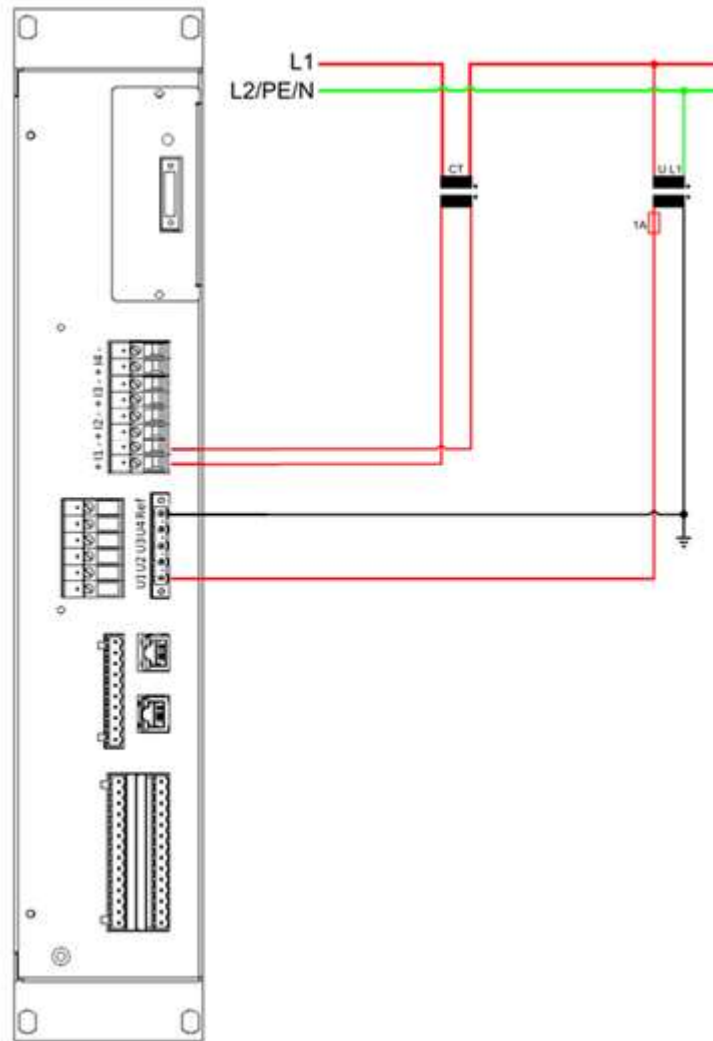


Figure 16

The above wiring diagram is used for single-phase measurement in public distribution networks with one CT and one PT. The voltage channel of the unit is connected to PT for measuring line-to-neutral voltage. The current channel is connected to existing instrument transformer, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with a suitable fuse in each conductor. The connection for this type of measurement is as follows:

| | | | |
|------------|--------------------|------------|------------------|
| Channel: | Measured object: | Channel: | Measured object: |
| U1 | = L1 PT+ | I1+ | = L1 CT+ |
| Ref | = L1 PT-(Grounded) | I1- | = L1 CT- |

4.4.9 HV 3-phase measurement with 2 CT's and 2 PT's (Line-to-line voltages)

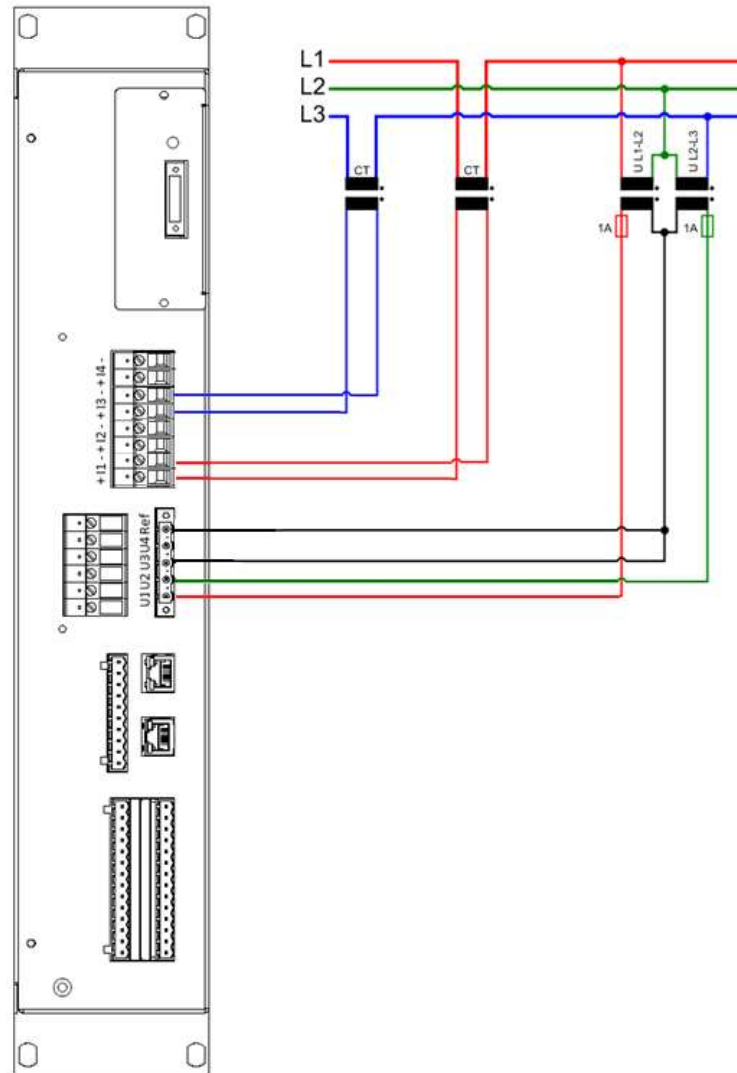


Figure 17

The above wiring diagram is used for three-phase measurement in public distribution networks with 2 CT's and 2 PT's. The voltage channels of the unit are connected to PT's for measuring line-to-line. The current channels are connected to CT's. Two channels are measured while the third current and voltage values are calculated from the measured channels. **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|------------|------------------------|------------|------------------|
| U1 | = L1-L2 PT+ | I1+ | = L1 CT+ |
| U2 | = L2-L3 PT- | I1- | = L1 CT- |
| Ref | = L1-L2 PT-, L2-L3 PT+ | I3+ | = L3 CT+ |
| | | I3- | = L3 CT- |

Note: If this method is used, the meter will automatically calculate the third line-to-line voltage (U_{L3-L1}) and the current I_2 . This configuration is normally used in medium voltage networks.

Note: In this configuration the constants for U1-U3 must be the same. Also the constants for I1-I3 must be the same. This is because the missing U_2/I_2 is calculated by the instrument.

4.4.10 HV 3-phase measurement with 3 CT's and 2 PT's (Line-to-line voltages)

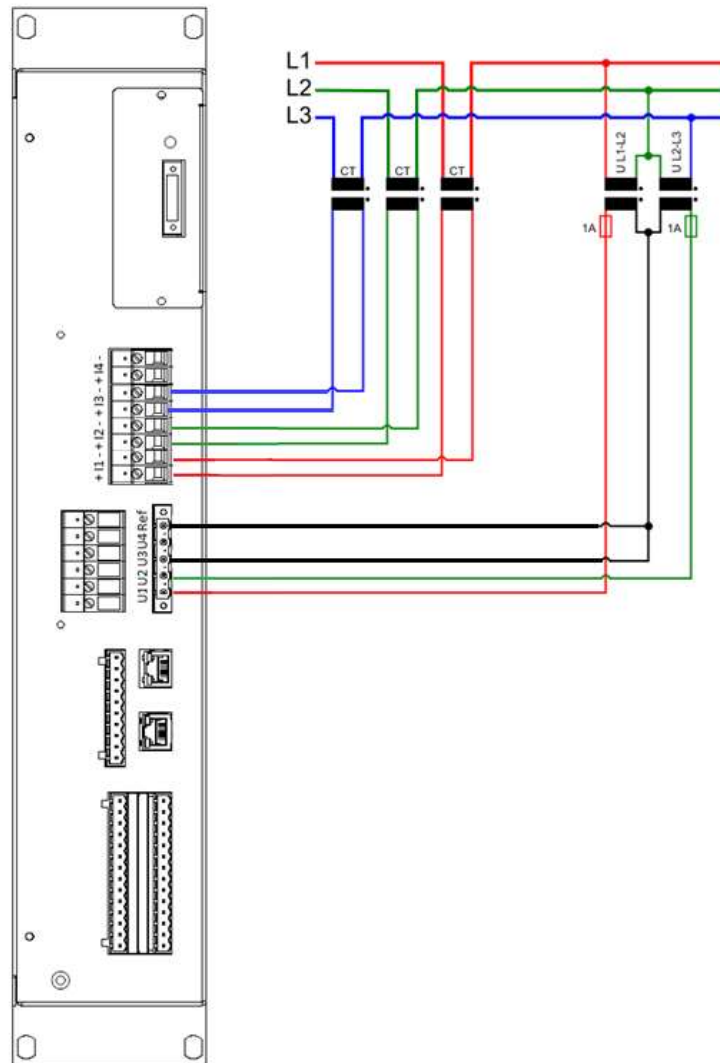


Figure 18

The above wiring diagram is used for three-phase measurement in public distribution networks with 3 CT's and 2 PT's. The voltage channels of the unit are connected to PT's (normally 110 V AC secondary), for supplying line-to-line voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). Two voltage channels are measured and the third is calculated in the measuring device. **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|------------|------------------------|------------|------------------|
| U1 | = L1-L2 PT+ | I1+ | = L1 CT+ |
| U2 | = L2-L3 PT- | I1- | = L1 CT- |
| Ref | = L1-L2 PT-, L2-L3 PT+ | I2+ | = L2 CT+ |
| | | I2- | = L2 CT- |
| | | I3+ | = L3 CT+ |
| | | I3- | = L3 CT- |

Note: If this method is used, the meter will automatically calculate the third line-to-line voltage (U_{L3-L1}). This configuration is normally used in medium voltage networks.

4.4.11 HV 3-phase measurement with 2 CT's and 3 PT's (Line-to-line voltages)

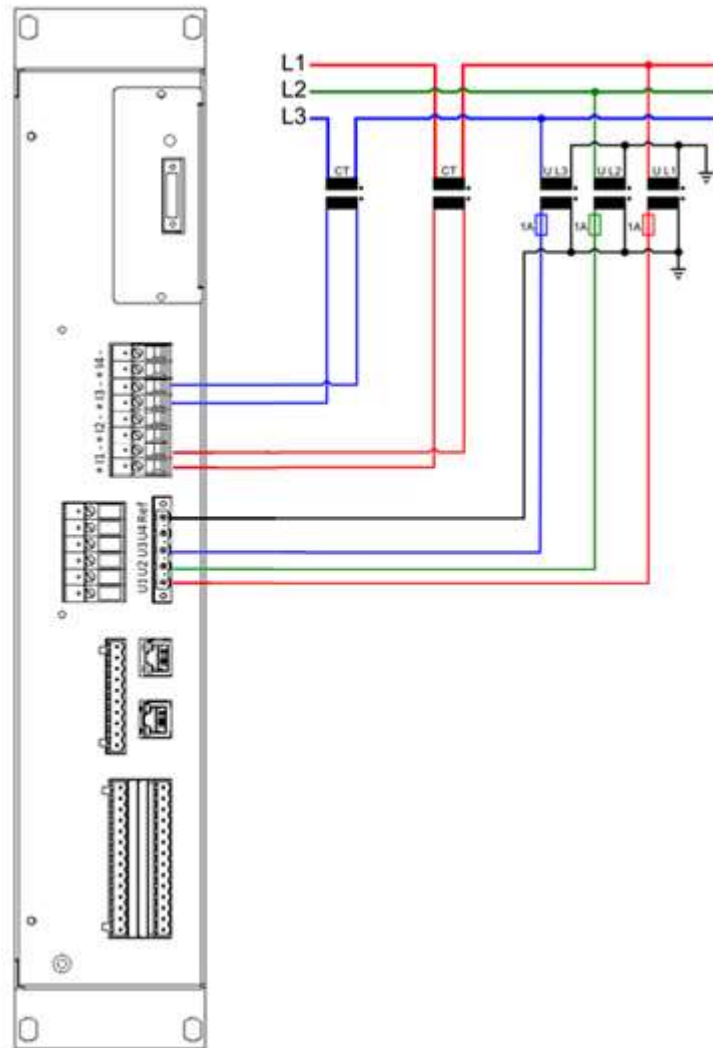


Figure 19

The above wiring diagram is used for three-phase measurement in in public distribution networks with 2 CT's and 3 PT's. The voltage channels of the unit are connected to the PT's (normally 63 V AC secondary to earth), for supplying line-to-line voltages, and current channels are connected to the CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. Two current channels are measured and the third is calculated by the measuring device. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel | Measured object: |
|------------|--------------------------|------------|------------------|
| U1 | = L1 PT+ | I1+ | = L1 CT+ |
| U2 | = L2 PT+ | I1- | = L1 CT- |
| U3 | = L3 PT+ | I3+ | = L3 CT+ |
| Ref | = L1 PT-, L2 PT-, L3 PT- | I3- | = L3 CT- |

Note: If this method is used, the meter will automatically calculate the current I2. This configuration is normally used in medium voltage networks.

4.4.12 HV 3-phase measurement with 3 CT's and 3 PT's (Line-to-line voltages)

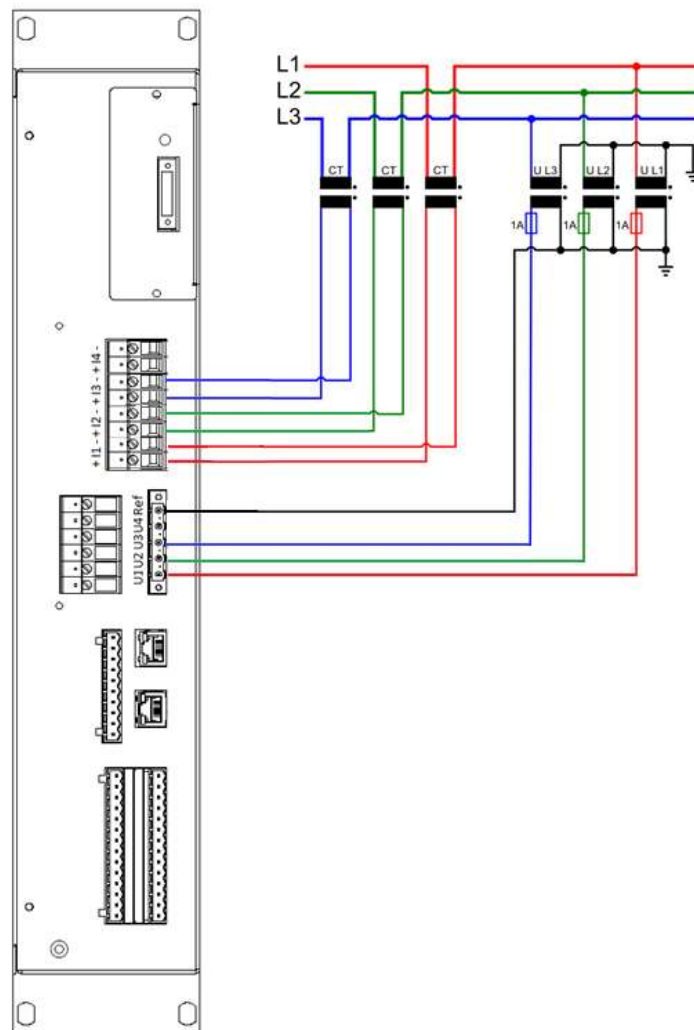


Figure 20

The above wiring diagram is used for three-phase measurement in public distribution networks with 3 CT's and 3 PT's. The voltage channels of the unit are connected to PT's (normally 63 V AC secondary to earth), for supplying line-to-line voltages, and current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel | Measured object: |
|------------|--------------------------|------------|------------------|
| U1 | = L1 PT+ | I1+ | = L1 CT+ |
| U2 | = L2 PT+ | I1- | = L1 CT- |
| U3 | = L3 PT+ | I2+ | = L2 CT+ |
| Ref | = L1 PT-, L2 PT-, L3 PT- | I2- | = L2 CT- |
| | | I3+ | = L3 CT+ |
| | | I3- | = L3 CT- |

Note: This configuration is normally used in medium voltage networks.

4.4.13 3-phase measurement with direct voltage, 2 CT's (Line-to-neutral)

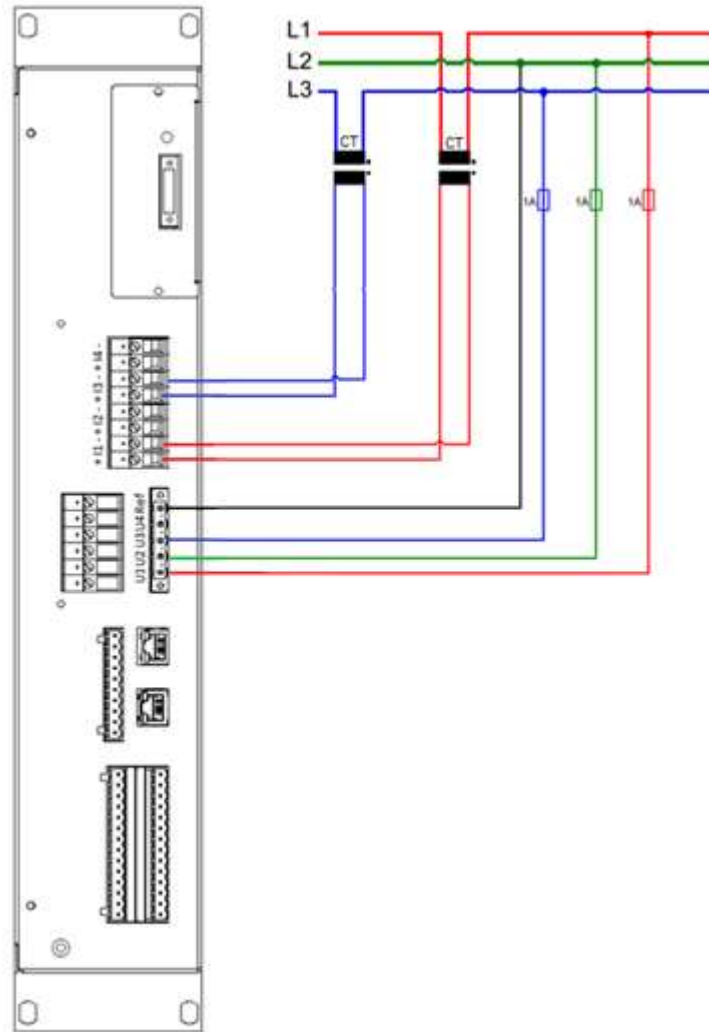


Figure 21

The above wiring diagram is used for 3-phase measurement in low voltage networks. The voltage channel of the unit is connected directly to the electricity network for measuring line-to-neutral voltage (230 V) and therefore do not require an instrument transformer (PT). The current channels are connected to existing instrument transformers, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with a suitable fuse in each conductor. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 | I1+ = | L1 CT+ |
| U2 = | L2 | I1- = | L1 CT- |
| U3 = | L3 | I3+ = | L3 CT+ |
| Ref = | L2 (Neutral) | I3- = | L3 CT- |

4.4.14 3-phase measurement with direct voltage, 3 CT's and neutral (Line-to-neutral voltages)

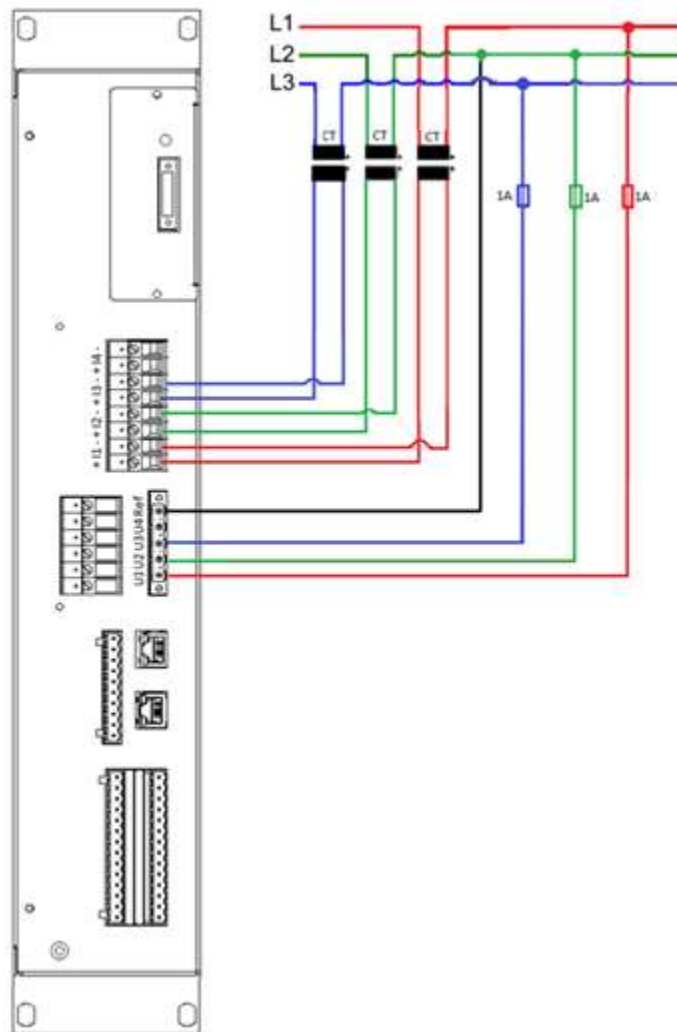


Figure 22

The above wiring diagram is used for 3-phase measurement in low voltage networks. The voltage channel of the unit is connected directly to the electricity network for measuring line-to-neutral voltage (230 V) and therefore do not require an instrument transformer (PT). The current channels are connected to existing instrument transformers, allowing the measurement of high currents, e.g. directly from the secondary side of a power transformer. **Always** protect the voltage inputs with a suitable fuse in each conductor. The connection for this type of measurement is as follows:

| Channel: | Measured object: | Channel: | Measured object: |
|------------|------------------|------------|------------------|
| U1 | = L1 | I1+ | = L1 CT+ |
| U2 | = L2 | I1- | = L1 CT- |
| U3 | = L3 | I2+ | = L2 CT+ |
| Ref | = L2 (Neutral) | I2- | = L2 CT- |
| | | I3+ | = L3 CT+ |
| | | I3- | = L3 CT- |

4.4.15 Split Phase 2CT 2PT

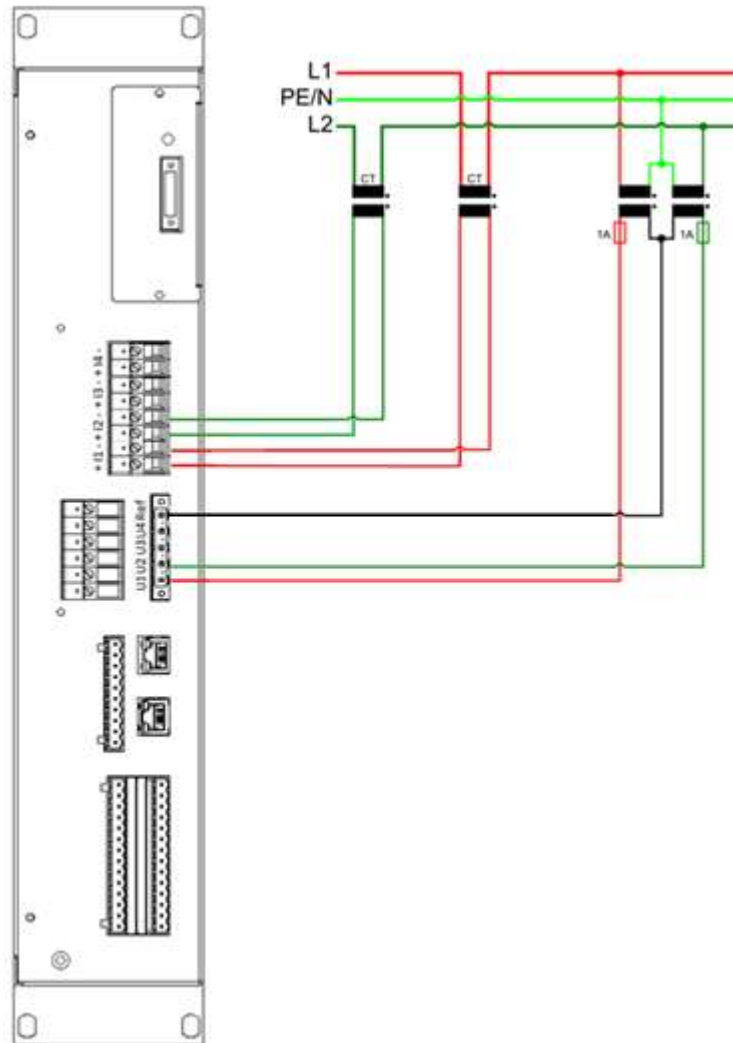


Figure 23

The above wiring diagram is used for

| | | | |
|--------------|------------------|--------------|------------------|
| Channel: | Measured object: | Channel: | Measured object: |
| U1 = | L1 | I1+ = | CT+ |
| Ref = | (Neutral) | I1- = | CT- |

4.4.16 SP 2CT DV

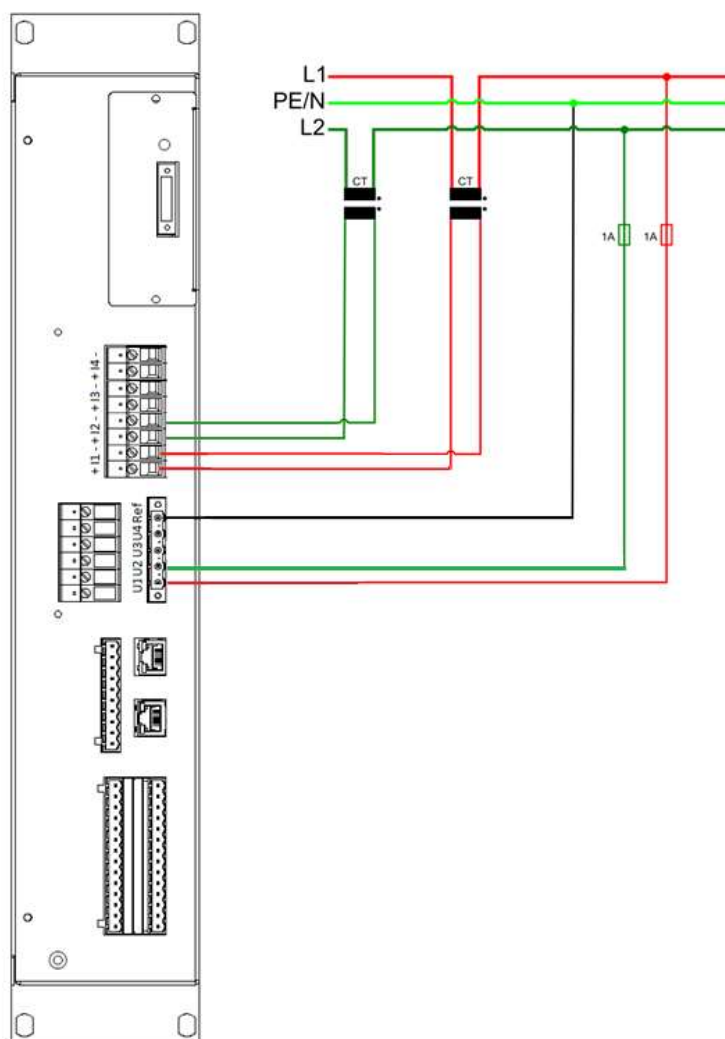
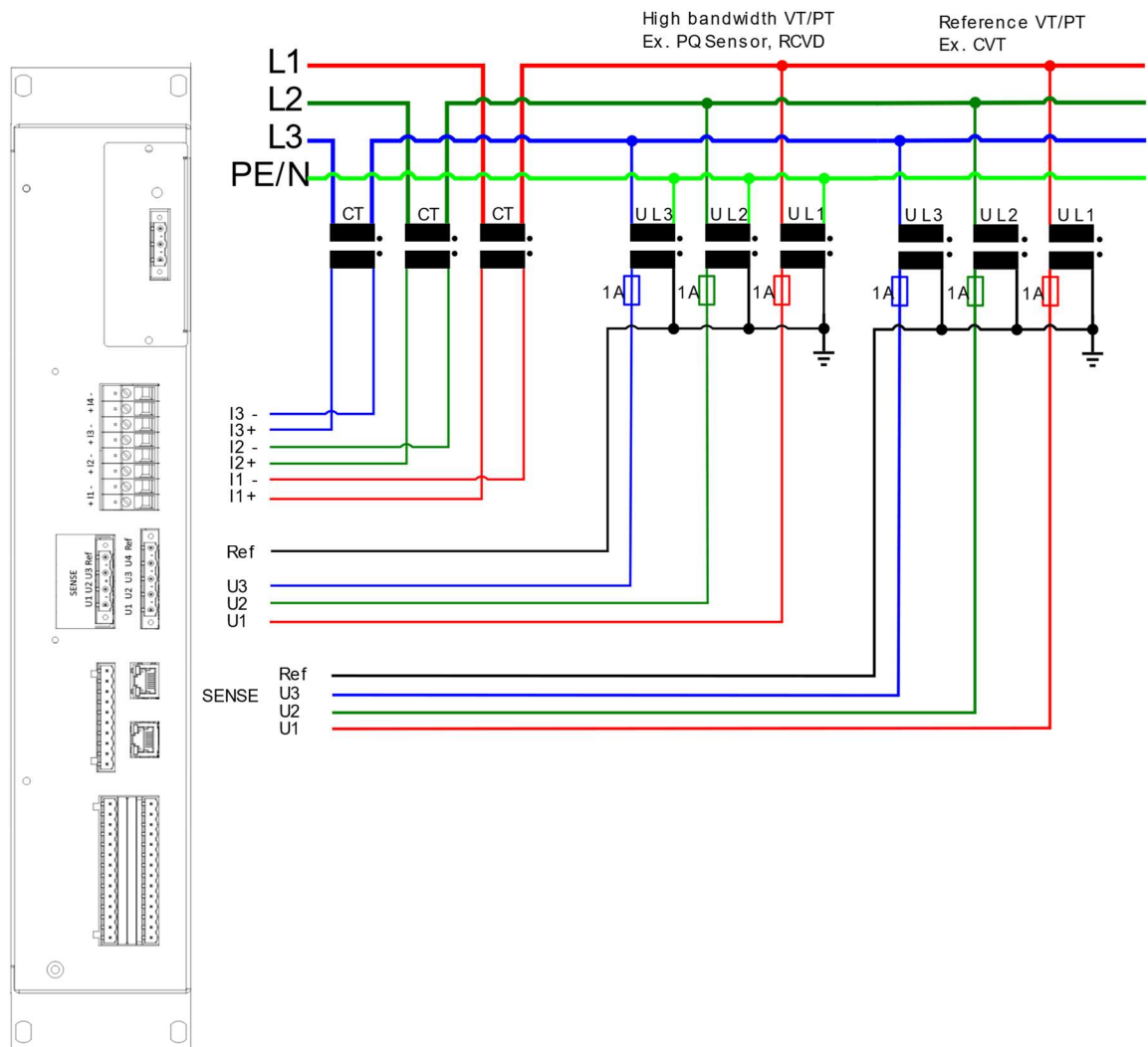


Figure 24

The above wiring diagram is used for

| Channel: | Measured object: | Channel: | Measured object: |
|--------------|------------------|--------------|------------------|
| U1 = | L1 | I1+ = | CT+ |
| Ref = | (Neutral) | I1- = | CT- |

4.4.17 Connecting SENSE voltage inputs

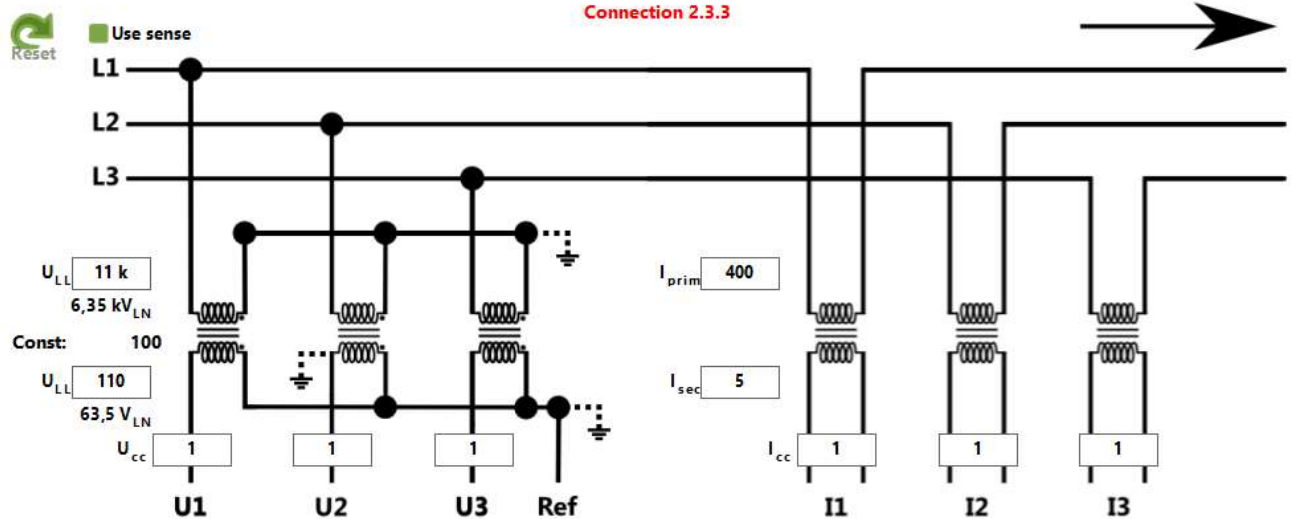


The above wiring diagram is used for three-phase measurement in public distribution networks with 3 CT's and 3 PT's together with SENSE calibration. The voltage channels of the unit are connected to high bandwidth PT's (around 65 V AC secondary to earth).

The SENSE voltage inputs are connected to the reference voltage VT/PT. When the SENSE measurement is activated for the meter the standard voltage inputs are calibrated phase by phase to the corresponding SENSE reference voltage inputs. Typical examples of high bandwidth PTs are RCVD, PQ Sensor and capacitive divider. For the reference voltage any accurate PT can be used such as MVT or CVT.

Current channels are connected to CT's (normally 1 - 5 A AC secondary). **Always** protect the voltage inputs with a suitable fuse in each conductor on the secondary side of the PT.

To activate the SENSE calibration the checkbox called "Use sense" must be checked. See picture below.



When using SENSE calibration, the configuration for the VT/PT apply to the SENSE inputs. In the example above the voltage ratio should be set to the reference VT/PT for example the CVT and not the high bandwidth VT/PT. The ratio for the high bandwidth VT/PT should not be used in the configuration.

4.4.18 HV/MV Earth fault monitoring via channel U4

In high impedance grounded MV networks the voltage in the transformer's ground point is of interest to study. Earth faults and emerging earth faults can be detected by analyzing the *ground point voltage*.

If there is an available connection to the ground point voltage (like in Figure 25) we recommend connecting it to channel U4.

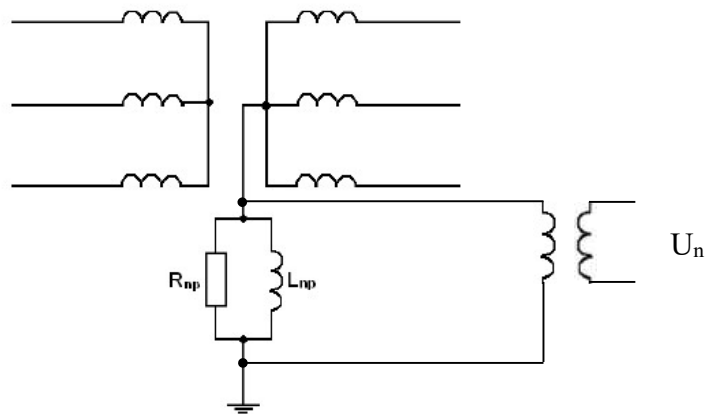


Figure 25

4.5 Vector graph for correct connection

To check and certify a correct connection of the measuring device you can use the program PQ Online. In PQ Online, under “Real time Analysis” a tab called “Vector”. This tool is a good controller to verify that you have plugged in phases correctly and turned the ammeters in the right direction. If a correct connection is done the voltage phases should be separated with 120 degrees, with the first phase (the read phase) pointing to the right in the graph. See Figure 26.

The currents are generally leading the voltages. This may vary in different systems. How far ahead the currents are can vary in different systems.

If e.g. the blue current phase is pointing downwards you have probably turned the ammeter the wrong way, try changing direction on it and the problem should be fixed.

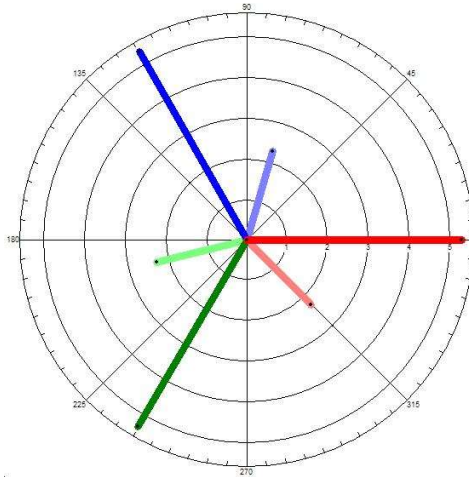


Figure 26

4.6 Recommended practices

Below, recommendations are given for a number of common network situations.

4.6.1 Impedance grounded 3-wire systems

Typical examples: MV distribution networks in a 3-phase, 3-wire network without neutral conductor impedance grounding (Petersen coil with/without resistor) is common. Figure 27 shows the secondary side of the transformer and the grounding impedance.

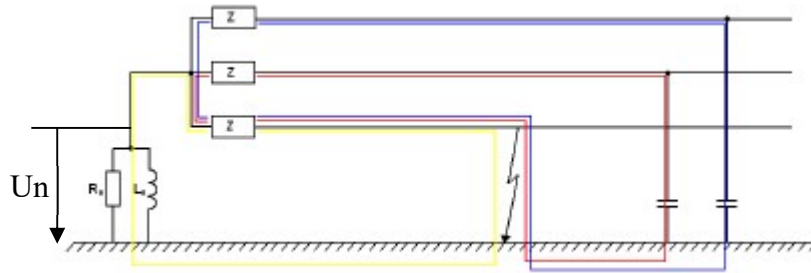


Figure 27

When an earth fault occurs the transformer neutral point voltage U_n rises. Measuring this voltage is a good indicator of earth faults and can be used to track them.

Connect your UP-2210 to measure **line-to-line voltages U1-U3** and phase currents **I1-I3** according to one of the sections 4.4.3, 4.4.4, 4.4.5, and 4.4.6 depending on how many PT/CT there are. Connect channel **U4** to measure the transformer neutral point voltage U_n . Channel **I4** is normally not used. Connect it to ground.

4.6.2 Effectively (directly) grounded 3-wire systems

Typical examples: HV distribution and transmission networks.

HV networks are 3-phase, 3-wire networks without neutral conductor. Direct grounding is common here.

Connect your UP-2210 to measure **line-line voltages U1-U3** and phase currents **I1-I3** according to one of the sections 4.4.9, 4.4.10, 4.4.11 and 4.4.12 depending on how many PT/CT there are.

Channels **U4** and **I4** are normally not used. Connect them to ground.

4.6.3 Isolated (ungrounded) 3-wire systems

Typical examples: Industrial MV networks.

In a 3-phase, 3-wire network without neutral conductor it is also common to isolate the network and leave it ungrounded.

Connect your UP-2210 to measure **line-line voltages U1-U3** and phase currents **I1-I3** according to one of the sections 4.4.9, 4.4.10, 4.4.11 and 4.4.12 depending on how many PT/CT there are.

Channels **U4** and **I4** are normally not used. Connect them to ground.

4.6.4 Low voltage 4- or 5-wire systems

In a 4-wire network with neutral conductor or 5-wire network with neutral and ground connectors phase (line-neutral) voltages should be measured.

Connect your UP-2210 to measure **line-neutral voltages U1-U3** and phase currents **I1-I3** according to section 4.4.8.

Connect channel **I4** to measure the neutral current.

Channel **U4** could be used to measure the voltage between neutral and ground. If it is not used, connect it to ground.

4.6.5 Alternative connection option for MV/HV 3-wire systems

From a *Power Quality point of view* **line-to-line** voltages should always be measured (see sections 4.6.1, 4.6.2 and 4.6.3). This is in accordance with existing Power Quality standards like EN 50160. As an alternative, from a disturbance point of view, you could choose to measure **line-to-ground** voltages instead. With this configuration you can see earth faults per phase. This configuration is mainly a tool for analysing disturbances.

Connect your UP-2210 to measure **line-to-neutral voltages U1-U3** and phase currents **I1-I3** according to section 4.4.8.

If the system is impedance grounded, connect channel **U4** to measure the transformer neutral point voltage U_n .

Channel **I4** is normally not used. Connect it to ground.

4.7 Digital inputs and outputs

The UP-2210R can be equipped with 16 digital inputs and 3 relay outputs. They can be used to record external events to the PQ Secure system or send signals to other equipment in case of a sag/swell or transient. These inputs/outputs are used in a similar way if the meter is used as a fault recorder. The configuration of the digital inputs/outputs is made via the PQ Online program. For more information about this, please see the “*PQ Secure SQL User and software installation manual*”. These functions are optional modules.

4.7.1 Connection of digital inputs

By connecting a signal voltage to the UP-2210R's digital inputs from external equipment (e.g. circuit breaker, harmonics filter), events can be registered, and recordings can be triggered as a result of change in the digital signal.

The UP-2210R is activated on positive flanks, which means that the trig takes place when the signal changes from a zero value to the upper limit. If you have signals with normally high values, active, you can via the configuration in PQ Online invert the signal to trigger events when the signal drops to zero.

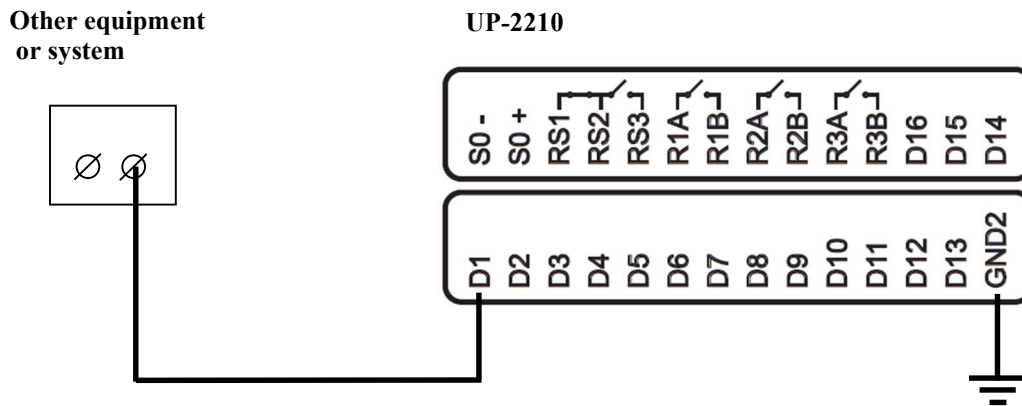


Figure 28

4.7.2 Connection of digital outputs

By connecting the UP-2210R digital outputs to another external equipment or system, the UP-2210R can send a digital HIGH signal in the event of a disturbance (transient or sag/swell). Outputs are activated when the meter detects a disturbance and close the built-in relay.

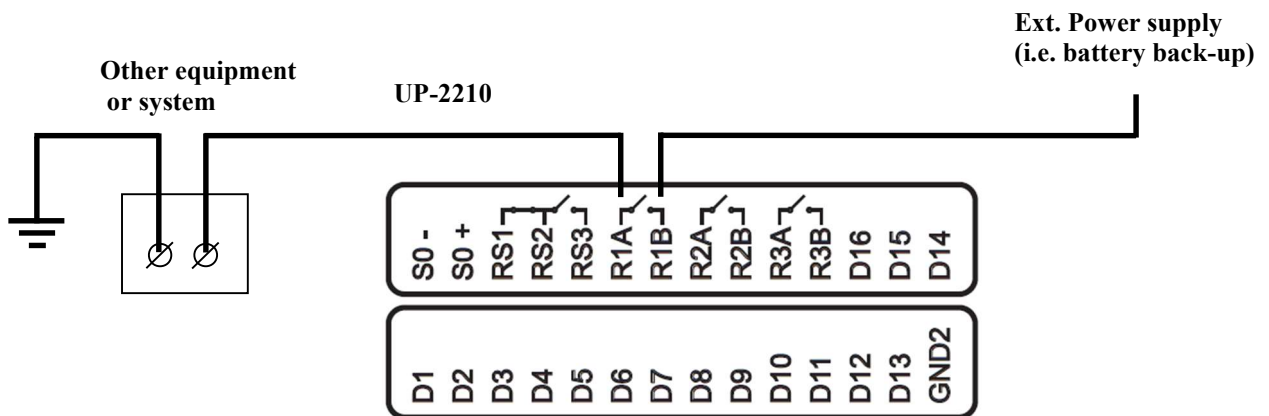
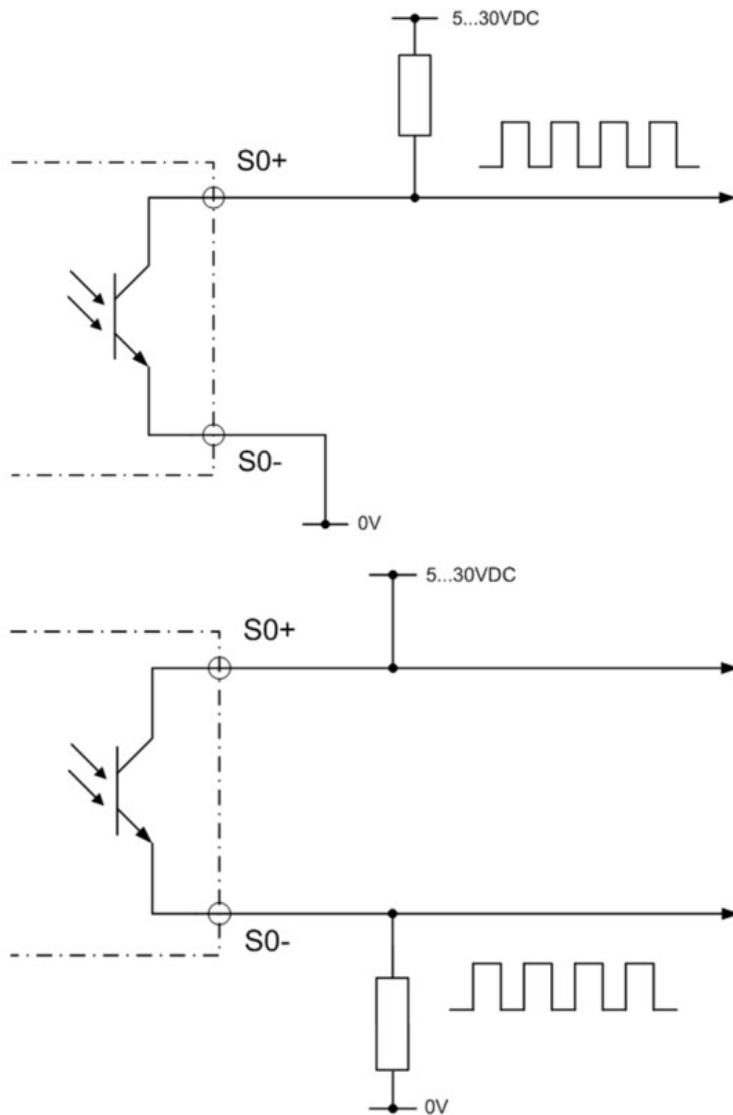


Figure 29

4.7.3 Energy pulses S0 interface

The S0 interface (DIN 43864) is an optical, open collector output to register energy pulses. It can be connected either way described by the below pictures:



The number of pulses per kWh of energy measured by the meter is stated on the front of the meter. Default value is 1000 pulses/kWh. The yellow energy LED on the meter front panel will also blink with the same rate.

4.8 Replaceable power supply and Micro SD card

The power supply and the Micro SD card of the unit are replaceable parts. If any of these are in need of a replacement, first disconnect the power connector then unscrew the two screws on the power supply part and gently pull it out.

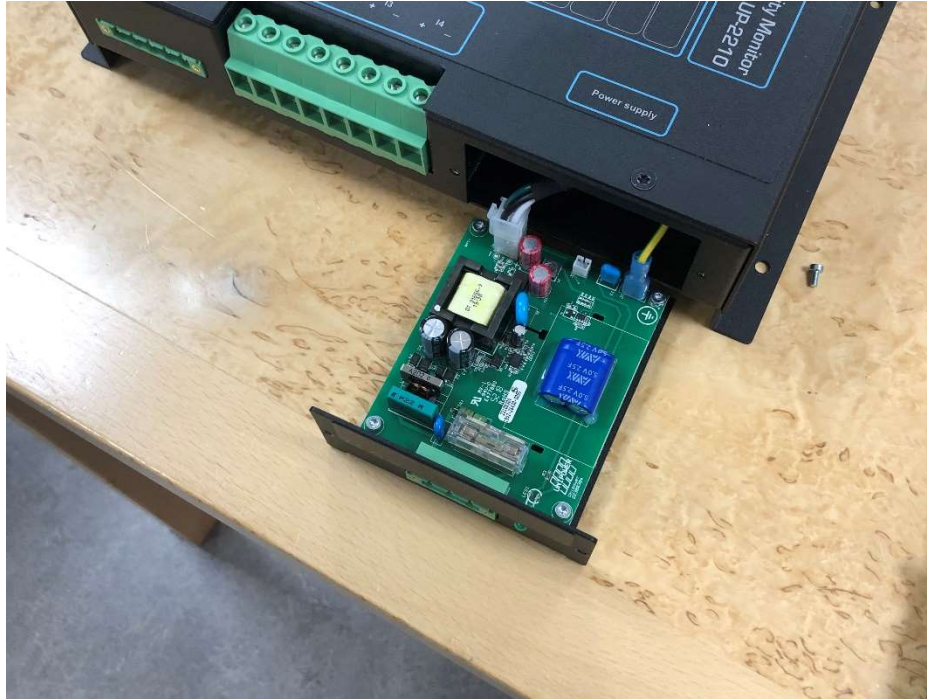


Figure 30

To replace the power supply unit, unplug the cords and plug them into the new unit and then put the piece back into the meter and tighten the screws.



To replace the Micro SD card, look inside the unit on the motherboard and find the existing Micro SD card, click on it to get it out and replace it with the new one, then mount the power supply unit back into the meter.

5 Substation display

There is an optional substation display unit that can be installed in a panel and serve a number of (up to 20) meters.



Figure 31

From the substation display realtime values can be viewed and meter configuration can be done. For physical installation measures please see separate document.

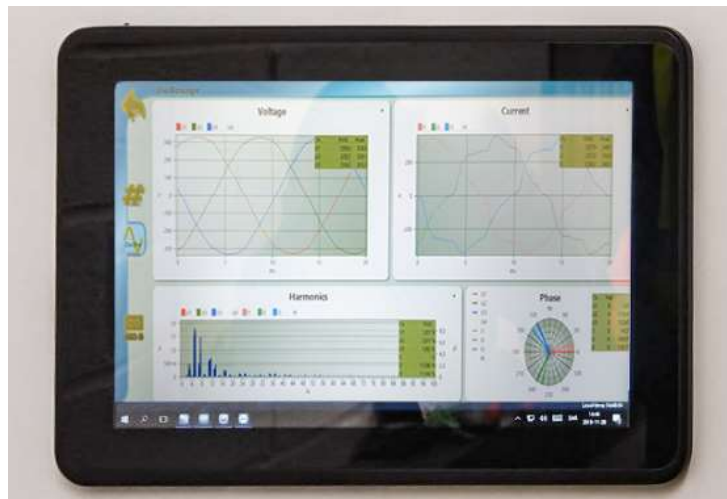


Figure 32

In the substation display PQ Online 3 is installed (see section 9.3) and configured for autostart operation.

5.1 PQ Online substation display configuration

1. Create a connection using either Ethernet or USB.

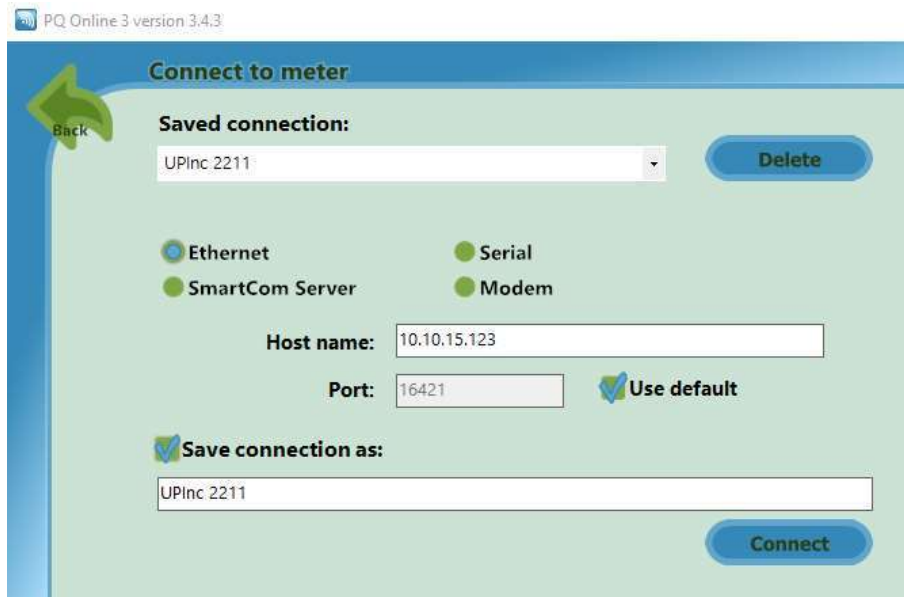


Figure 33

2. Repeat for each meter in the substation.
3. Launch the *Panel display setup*

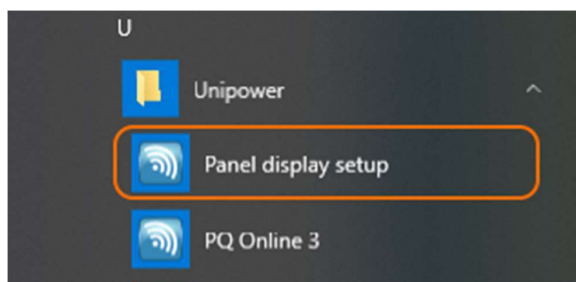


Figure 34

4. Select the previously saved configuration from the Connection drop down list and select which starting view to show when PQ Online 3 opens.

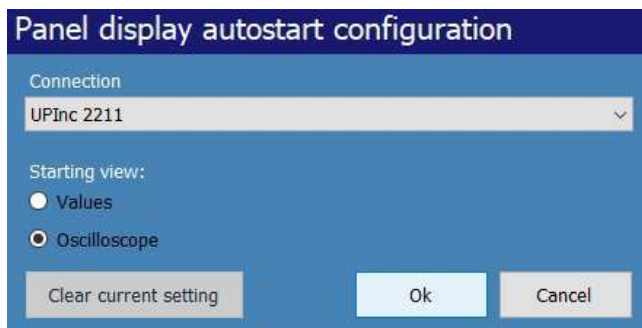


Figure 35

6 Display

On the front side of the UP-2210R there is a colour touch display that can show voltage and current values in real-time. Several parameters can be shown, such as, Voltage values, current values, harmonics, flicker, power frequency etc. In Figure 36 a vector diagram for voltages currents are shown. The values are also shown on the left side of the display.

You can browse through different pages to the left and right by touching the next/previous buttons at the bottom of the screen.

Note that it is not possible to change any settings in the instrument via the display. This is due to safety precautions. Only authorized personnel should be able to make changes.



Figure 36

7 INSTALLING COMMUNICATION EQUIPMENT

The communication between the SQL server and the measuring device can be implemented in a number of ways. This section covers the various options, including the brands recommended and sold by Unipower. The meter have standard interfaces and are not restricted to particular brands, but if you use other brands, please refer to the relevant user guides.

For details of how PQ Online works, see the user manual for PQ Secure.

7.1 Ethernet

The meter use 10/100Base-T (10/100 Mbps) for Ethernet communication. If a higher speed is being used in the network you can connect a 1000BaseT/100BaseT-switch or converter between the network and the UP-2210R. The UP-2210R has a standard RJ-45 connector and is connected to the network using a standard patch cable. The meter must be given a unique IP-address. Consult with your network administrator, which IP-address you can use.

If the meter is behind a firewall in the network, it is necessary to configure the firewall to open **UDP-port 16421** to be able to access the meter from outside the firewall.

If using a switch with supervision note that the meter is restarting the communication hardware every 10-15 minutes to ensure that the communication works. During the restart the LINK is lost for a short time. This is normal and should not trig any alarms.

For more information about PQ Online, please see the “PQ Secure SQL User and software installation manual”.

7.2 Wireless GSM/3G router

A wireless GSM/3G router is a good way to access meters remotely via the existing wireless networks. There are many wireless routers available, check with your Unipower representative for recommendations of tested solutions that work. The protocol used depends on the wireless network (2G/3G) and technology the router uses. Commonly supported protocols are GPRS, EDGE, HSDPA and UTMS.

To use a router with a meter (UP-2210 or UP-2210R etc.) the following must be done:

- The SIM card used must have no PIN-code and it must have a public, static IP-address.
- The router must be set up to forward UDP traffic on port 16421 to the meter’s local IP-address on the inside LAN of the router. If multiple meters are connected to the same router you use different port numbers on the outside and route them to UDP 16421 on the inside to each meter’s local IP.
- Connect the meter to the router using a standard RJ-45 Ethernet patch cable. If multiple meters are used you may need to connect a standard Ethernet switch between the router and the meters.

Example of settings from a typical router:

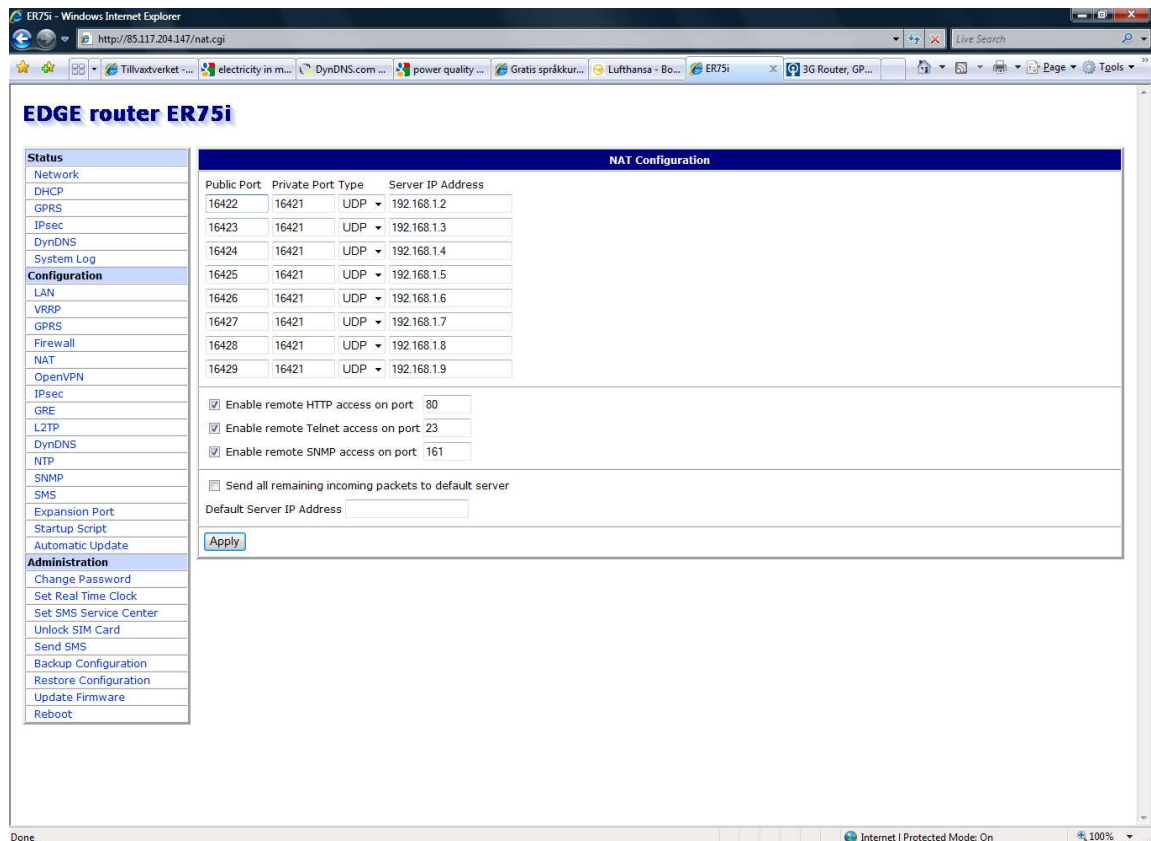
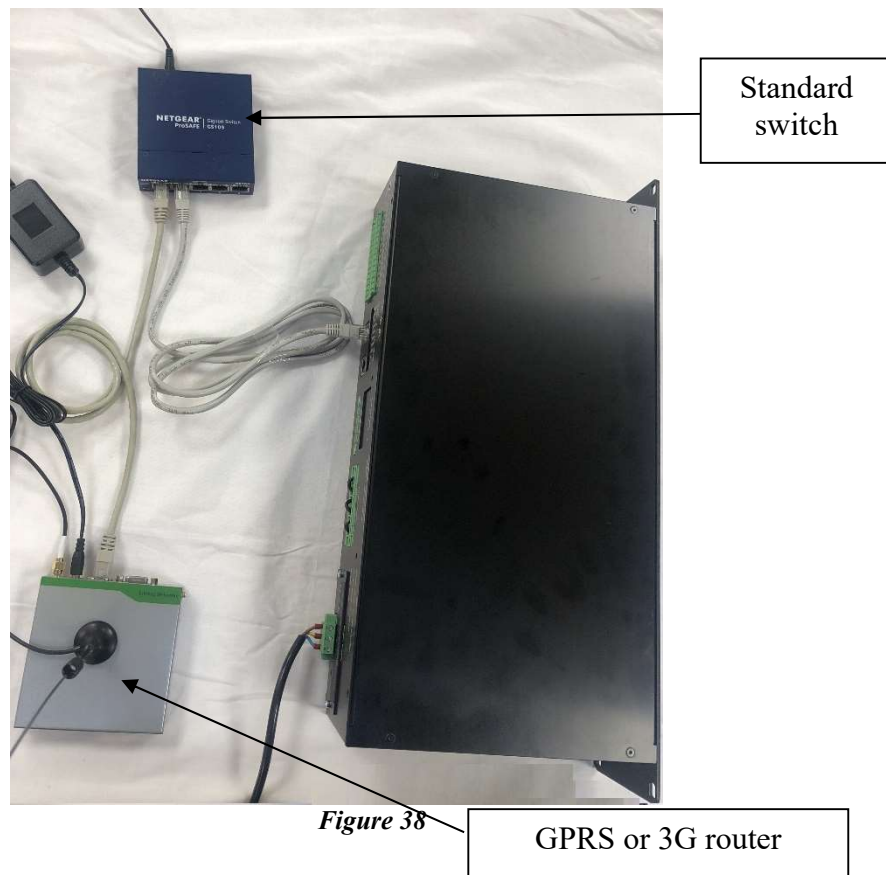


Figure 37

Note how UDP 16427 is routed to UDP 16421 IP 192.168.1.7. The meter given the IP 192.168.1.7 will respond to communication on UDP port 16427 to the router's (actually the SIM card's) public IP.

shows UP-2210R connected to a 3G router:



The standard switch is only needed when there are multiple meters that needs internet access.

7.3 RS-485

RS-485 is a serial communication that can be used together with some meters. It is similar to the common RS-232 but works with larger distances. Another advantage is that you can connect multiple meters to the same RS-485 cable (multi drop). This is useful in large sub-stations where you want to connect several meters to the same modem.

RS-485 communication can be direct from the computer (using a signal converter) to the meter via a twisted pair cable, but over a distance of less than 1 km. It may also be necessary to terminate (jumper) the contacts (A to B) on the UP-2210 with a $120\ \Omega$ resistor to improve the communication conditions. In this case, the resistor is only connected in the last unit.

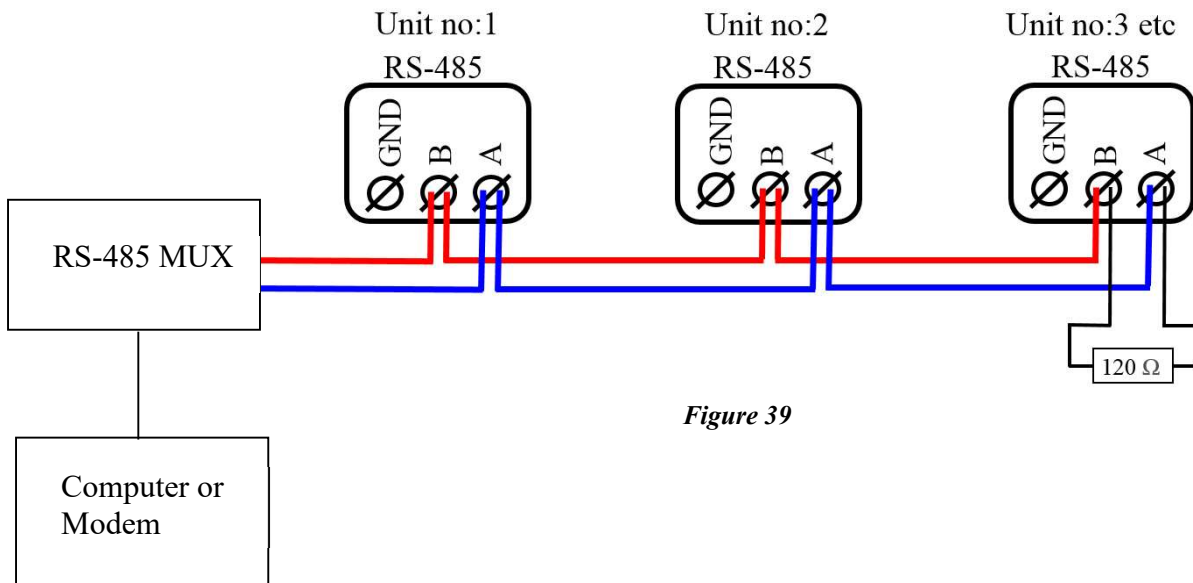


Figure 39

7.4 Using multiple meters with Westermo GDW-11 GSM/GPRS-modem and RS-485

The Westermo GDW-11 is an example of an industry GSM/GPRS modem with both RS-485. The RS-485 is an easy solution if you want to connect one or several meters to one wireless modem/SIM card. Always choose an *industry class* modem rather than office equipment when building communications solutions for your meters in substations. The environment is normally quite different from an office, both regarding physical environmental factors such as temperature and EMC.

The figure below shows a meter connected to the modem using RS-485 (there are extra connectors on the RS-485 cable for multiple meter connection).

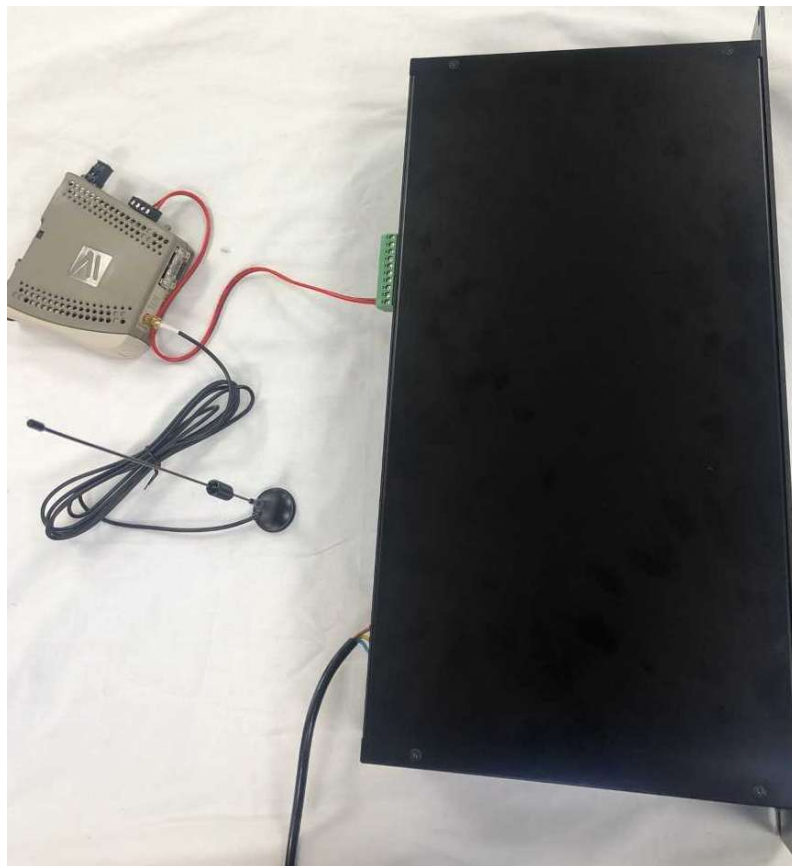


Figure 40 - GDW-11 GSM/GPRS modem with RS-485 connection to a meter

Use the recommended factory setting in the modem for use with RS-485.

See below:

DIP-switch settings

DIP-switches under the lid on top of the unit

Before DIP-switch settings:



Warning! Do not open connected unit

Hazardous voltages may occur within this unit when connected to a power supply.

Warning!

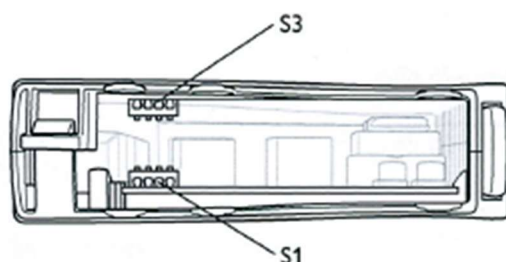
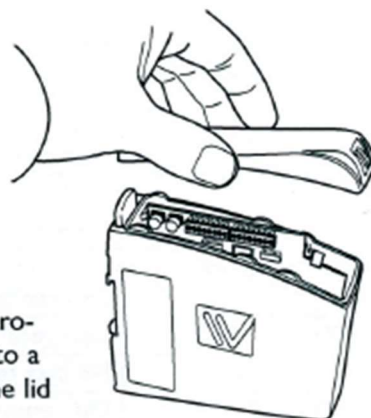
Prevent damage to internal electronics from electrostatic discharges (ESD) by discharging your body to a grounding point (e.g. use of wrist strap), before the lid on top of the unit is removed.



To activate DIP-switches Advanced mode needs to be enabled.

NOTE DIP-switch alterations are only effective after a power on or after a software reset command (AT+CFUN=1).

A setting configured by any other method during normal operation, overrides the DIP-switch setting. However, at power up, the DIP-switch settings have precedence over the setting configured by any other method.



S1 Selection of DTE interface, only in GDW-11 485



RS-232 interface



RS-422/485 interface
4-wire full duplex



RS-485 interface
2-wire half duplex

S2 DIP-switch

RS-422/485 termination, only in GDW-11 485



No termination



Termination of R in 4-wire connection



Termination of both T and R in 2-wire connection



Termination of both T and R in 4-wire connection

S3 Selection of data rate, only in GDW-11 485



1200 bit/s



19.2 kbit/s



2400 bit/s



38.4 kbit/s



4800 bit/s



57.6 kbit/s



9600 bit/s



115.2 kbit/s

Factory settings GDW-11



S1

Factory settings GDW-11 485



S1



S2



S3

If you want to use the modem with RS-232 communication, change S1-4 from on to **off**. Power the modem off-on to make changes active.

7.5 Modbus

Modbus in the unit can communicate via RS232, RS485 or TCP/IP

The modbus address is 10dec for every UP2210.

The values from the UP2210 can be received using command 3 dec (read holding register).

7.5.1 Binary registers 16 bit signed

The binary registers applies for all UP2210 U901/U902 year model 2010 and later.

To read voltage U1, the modbus command should be 0A,03,00,0A,00,01,A5,73 and the response will be 0A,03,02,08,FF,5A,05 for 230.3V
 $8 \times 256 + 255 \rightarrow 2303$.

RMS Voltage

| Reg | Name | Unit | Scale | Range | Comment |
|-----|-----------------|------|-------|----------|---------|
| 10 | Voltage phase 1 | V | 0.1 | 0-3276.8 | |
| 11 | Voltage phase 2 | V | 0.1 | 0-3276.8 | |
| 12 | Voltage phase 3 | V | 0.1 | 0-3276.8 | |
| 13 | Voltage 4 | V | 0.1 | 0-3276.8 | |

RMS Current

| Reg | Name | Unit | Scale | Range | Comment |
|-----|-----------------|------|-------|----------|---------|
| 30 | Current phase 1 | A | 0.1 | 0-3276.8 | |
| 31 | Current phase 2 | A | 0.1 | 0-3276.8 | |
| 32 | Current phase 3 | A | 0.1 | 0-3276.8 | |
| 33 | Current 4 | A | 0.1 | 0-3276.8 | |

Active Power

| Reg | Name | Unit | Scale | Range | Comment |
|-----|----------------------|------|-------|----------|---------|
| 40 | Active power phase 1 | W | 0.1 | 0-3276.8 | |
| 41 | Active power phase 2 | W | 0.1 | 0-3276.8 | |
| 42 | Active power phase 3 | W | 0.1 | 0-3276.8 | |
| 43 | Active power tot 1-3 | W | 0.1 | 0-3276.8 | |

Reactive Power

| Reg | Name | Unit | Scale | Range | Comment |
|-----|------------------------|------|-------|----------|---------|
| 44 | Reactive power phase 1 | VAr | 0.1 | 0-3276.8 | |
| 45 | Reactive power phase 2 | VAr | 0.1 | 0-3276.8 | |
| 46 | Reactive power phase 3 | VAr | 0.1 | 0-3276.8 | |
| 47 | Reactive power tot 1-3 | VAr | 0.1 | 0-3276.8 | |

Apparent Power

| Reg | Name | Unit | Scale | Range | Comment |
|-----|------------------------|------|-------|----------|---------|
| 48 | Apparent power phase 1 | VA | 0.1 | 0-3276.8 | |
| 49 | Apparent power phase 2 | VA | 0.1 | 0-3276.8 | |
| 50 | Apparent power phase 3 | VA | 0.1 | 0-3276.8 | |
| 51 | Apparent power tot 1-3 | VA | 0.1 | 0-3276.8 | |

Power Factor

| Reg | Name | Unit | Scale | Range | Comment |
|-----|------------------------|------|-------|-------|---------|
| 60 | Apparent power phase 1 | | 0.01 | 0-1.0 | |
| 61 | Apparent power phase 2 | | 0.01 | 0-1.0 | |
| 62 | Apparent power phase 3 | | 0.01 | 0-1.0 | |
| 63 | Apparent power tot 1-3 | | 0.01 | 0-1.0 | |

Displacement factor

| Reg | Name | Unit | Scale | Range | Comment |
|-----|-----------------------------|------|-------|-------|---------|
| 64 | Displacement factor phase 1 | | 0.01 | 0-1.0 | |
| 65 | Displacement factor phase 2 | | 0.01 | 0-1.0 | |

| | | | | | |
|----|-----------------------------|--|------|-------|--|
| 66 | Displacement factor phase 3 | | 0.01 | 0-1.0 | |
| 67 | Displacement factor tot 1-3 | | 0.01 | 0-1.0 | |

Digital inputs

| Reg | Name | Unit | Scale | Range | Comment |
|------|----------------------|------|-------|-------|---------|
| 1000 | 0-15 digital inputs | | | | |
| 1001 | 16-32 digital inputs | | | | |

7.5.2 Floating-Point registers

The floating point registers applies for all UP2210 U901/U902 year model 2011 and later.

To read voltage U1, the modbus command should be [14][03][08][00][00][02][C4][AE] and the response will be [14][03][04][47][F1][20][00][E2][75] for 123456.000

The float format is “Float inverse”. Byte order [4][3][2][1] (“byte swap” and a “word swap”)

The Importance of Byte Order

Modbus itself does not define a floating point data type but it is widely accepted that it implements 32-bit floating point data using the IEEE-754 standard. However, the IEEE standard has no clear cut definition of byte order of the data payload. Therefore the most important consideration when dealing with 32-bit data is that data is addressed in the proper order.

For example, the number 123456.00 as defined in the IEEE 754 standard for single-precision 32-bit floating point numbers appears as follows:

| Decimal | Hexadecimal Value | | | | ± | Exponent | Significant |
|-----------|-------------------|----|----|----|---|----------|---------------------------|
| 123456.00 | A | B | C | D | | | |
| | 00 | 20 | F1 | 47 | 0 | 10001111 | 1.11100010010000000000000 |

The effects of various byte orderings are significant. For example, ordering the 4 bytes of data that represent 123456.00 in a “B A D C” sequence in known as a “byte swap”. When interpreted as an IEEE 744 floating point data type, the result is quite different:

| Decimal | Hexadecimal Value | | | | ± | Exponent | Significant |
|---------------------------|-------------------|----|----|----|---|----------|--------------------------|
| | B | A | D | C | | | |
| -9.85402689122801930E+029 | 20 | 00 | 47 | F1 | 1 | 11100010 | 1.1000111000000000100000 |

Ordering the same bytes in a “C D A B” sequence is known as a “word swap”. Again, the results differ drastically from the original value of 123456.00:

| Decimal | Hexadecimal Value | | | | ± | Exponent | Significant |
|---------------------------|-------------------|----|----|----|---|----------|--------------------------|
| | C | D | A | B | | | |
| +1.66858251394509650E-019 | F1 | 47 | 00 | 20 | 0 | 01000000 | 1.0000000100011111110001 |

Furthermore, both a “byte swap” and a “word swap” would essentially reverse the sequence of the bytes altogether to produce yet another result:

| Decimal | Hexadecimal Value | | | | ± | Exponent | Significant |
|---------------------|-------------------|----|----|----|---|----------|---------------------------|
| | D | C | B | A | | | |
| +1.257363081x2E-127 | 47 | F1 | 20 | 00 | 0 | 00000000 | 1.01000001111000101000110 |

Clearly, when using network protocols such as Modbus, strict attention must be paid to how bytes of memory are ordered when they are transmitted, also known as the ‘byte order’.

RMS Voltage

| Reg | Name | Unit | Comment |
|------|------------------|------|---------|
| 2048 | Voltage phase 1 | V | |
| 2050 | Voltage phase 2 | V | |
| 2052 | Voltage phase 3 | V | |
| 2054 | Voltage 4 | V | |
| 2056 | Main Voltage 12 | V | |
| 2058 | Main Voltage U23 | V | |
| 2060 | Main Voltage 31 | V | |
| 2062 | Voltage sum 1-3 | V | |

RMS Current

| Reg | Name | Unit | Comment |
|------|-----------------|------|---------|
| 2088 | Current phase 1 | A | |
| 2090 | Current phase 2 | A | |
| 2092 | Current phase 3 | A | |
| 2094 | Current 4 | A | |
| 2096 | Current sum 1-4 | A | |

Active Power

| Reg | Name | Unit | Comment |
|------|----------------------|------|---------|
| 2128 | Active power phase 1 | W | |
| 2130 | Active power phase 2 | W | |
| 2132 | Active power phase 3 | W | |
| 2134 | Active power tot 1-3 | W | |

Reactive Power

| Reg | Name | Unit | Comment |
|------|------------------------|------|---------|
| 2136 | Reactive power phase 1 | VAr | |
| 2138 | Reactive power phase 2 | VAr | |
| 2140 | Reactive power phase 3 | VAr | |
| 2142 | Reactive power tot 1-3 | VAr | |

Apparent Power

| Reg | Name | Unit | Comment |
|------|------------------------|------|---------|
| 2144 | Apparent power phase 1 | VA | |
| 2146 | Apparent power phase 2 | VA | |
| 2148 | Apparent power phase 3 | VA | |
| 2150 | Apparent power tot 1-3 | VA | |

Power Factor

| Reg | Name | Unit | Comment |
|------|----------------------|------|---------|
| 2168 | Power factor phase 1 | VA | |
| 2170 | Power factor phase 2 | VA | |
| 2172 | Power factor phase 3 | VA | |
| 2174 | Power factor tot 1-3 | VA | |

Displacement factor

| Reg | Name | Unit | Comment |
|------|-----------------------------|------|---------|
| 2176 | Displacement factor phase 1 | VA | |
| 2178 | Displacement factor phase 2 | VA | |
| 2180 | Displacement factor phase 3 | VA | |
| 2182 | Displacement factor tot 1-3 | VA | |

Voltage unbalance

| Reg | Name | Unit | Comment |
|------|--------------------------------------|------|---------|
| 2448 | Negative sequence/ Positive sequence | % | |
| 2450 | Positive sequence | V | |
| 2452 | Negative sequence | V | |
| 2454 | Zero sequence | V | |

Current unbalance

| Reg | Name | Unit | Comment |
|------|--------------------------------------|------|---------|
| 2456 | Negative sequence/ Positive sequence | % | |
| 2458 | Positive sequence | A | |
| 2460 | Negative sequence | A | |
| 2462 | Zero sequence | A | |

Frequency

| Reg | Name | Unit | Comment |
|------|-----------|------|---------|
| 2478 | Frequency | Hz | |

Flicker

| Reg | Name | Unit | Comment |
|------|---------------------|------|---------|
| 2488 | Flicker Ifl phase 1 | A | |
| 2490 | Flicker Ifl phase 2 | A | |
| 2492 | Flicker Ifl phase 3 | A | |
| 2494 | Flicker Pst phase 1 | A | |
| 2496 | Flicker Pst phase 2 | A | |
| 2498 | Flicker Pst phase 3 | A | |
| 2500 | Flicker Plt phase 1 | A | |
| 2502 | Flicker Plt phase 2 | A | |
| 2504 | Flicker Plt phase 3 | A | |

Voltage harmonic THD

| Reg | Name | Unit | Comment |
|------|---------------------|------|-----------------|
| 2508 | THD Voltage phase 1 | % | THD fundamental |
| 2510 | THD Voltage phase 2 | % | |
| 2512 | THD Voltage phase 3 | % | |
| 2514 | THD Voltage U4 | % | |

Voltage harmonic TDD

| Reg | Name | Unit | Comment |
|------|---------------------|------|-------------|
| 2516 | TDD Voltage phase 1 | % | TDD nominal |
| 2518 | TDD Voltage phase 2 | % | |
| 2520 | TDD Voltage phase 3 | % | |
| 2522 | TDD Voltage U4 | % | |

Current harmonic THD

| Reg | Name | Unit | Comment |
|------|---------------------|------|-----------------|
| 2524 | THD Current phase 1 | % | THD fundamental |
| 2526 | THD Current phase 2 | % | |
| 2528 | THD Current phase 3 | % | |
| 2530 | THD Current I4 | % | |

Current harmonic TDD

| Reg | Name | Unit | Comment |
|------|---------------------|------|-----------------|
| 2532 | TDD Current phase 1 | % | TDD fundamental |
| 2534 | TDD Current phase 2 | % | |
| 2536 | TDD Current phase 3 | % | |
| 2538 | TDD Current U4 | % | |

Transformer K-Factor

| Reg | Name | Unit | Comment |
|------|------------------------------|------|-----------------|
| 2540 | Transformer K Factor phase 1 | % | THD fundamental |
| 2542 | Transformer K Factor phase 2 | % | |
| 2544 | Transformer K Factor phase 3 | % | |
| 2546 | Transformer K Factor I4 | % | |

Individual Voltage harmonics

| Reg | Name | Unit | Comment |
|-----------|--------------------------|------|---------------------------|
| 2648-2746 | Voltage harmonic phase 1 | V | 2648-> Fund, 2650->H2 ... |
| 2748-2846 | Voltage harmonic phase 2 | V | |
| 2848-2946 | Voltage harmonic phase 3 | V | |
| 2948-3046 | Voltage harmonic U4 | V | |

Individual Current harmonics

| Reg | Name | Unit | Comment |
|-----------|--------------------------|------|---------------------------|
| 3048-3146 | Current harmonic phase 1 | A | 3048-> Fund, 3050->H2 ... |
| 3148-3246 | Current harmonic phase 2 | A | |
| 3248-3346 | Current harmonic phase 3 | A | |
| 3348-3446 | Current harmonic I4 | A | |

Individual Voltage Phase Angle

| Reg | Name | Unit | Comment |
|-----------|--------------------------|--------|---|
| 3448-3546 | Voltage harmonic phase 1 | Degree | 3448-> Fund phase, 2450->H2 phase ... |
| 3548-3646 | Voltage harmonic phase 2 | Degree | +180 degree in relation to U1 fundamental |
| 3648-3746 | Voltage harmonic phase 3 | Degree | |
| 3748-3846 | Voltage harmonic U4 | Degree | |

Individual Current Phase Angle

| Reg | Name | Unit | Comment |
|-----------|--------------------------|--------|---|
| 3848-3946 | Current harmonic phase 1 | Degree | 3848-> Fund phae, 3850->H2 phase ... |
| 3948-4046 | Current harmonic phase 2 | Degree | +180 degree in relation to U1 fundamental |
| 4048-4146 | Current harmonic phase 3 | Degree | |
| 4148-4246 | Current harmonic I4 | Degree | |

Individual Voltage Inter Harmonic

| Reg | Name | Unit | Comment |
|-----------|--------------------------|------|---------------------------------|
| 4248-4346 | Voltage harmonic phase 1 | V | 4248-> IH25Hz, 4250->IH75Hz ... |
| 4348-4446 | Voltage harmonic phase 2 | V | |
| 4448-4546 | Voltage harmonic phase 3 | V | |
| 4548-4646 | Voltage harmonic U4 | V | |

Individual Current Inter Harmonic

| Reg | Name | Unit | Comment |
|-----------|--------------------------|------|---------------------------------|
| 4648-4746 | Current harmonic phase 1 | A | 4648-> IH25Hz, 4650->IH75Hz ... |
| 4748-4846 | Current harmonic phase 2 | A | |
| 4848-4946 | Current harmonic phase 3 | A | |
| 4948-5046 | Current harmonic I4 | A | |

8 GPS CLOCK SYNCHRONISATION MODULE

In many measurement applications it is important to have very accurate timing of the measurement. This is required since the measurement algorithm demands it and/or that the installation site is remote and no periodic communication with clock synchronization can be done. A very effective way to achieve this is to synchronize the instruments internal clock with the atomic clocks of the global positioning system (GPS) satellites.

With accurate real-time clock synchronization, the comparison between events such as sags/swells or transients between different sites in the electrical network can be made with high accuracy, even if the distance between the sites is large.

The GPS clock synchronization module can be used with the Unipower UP-2210. In order for the synchronization to work, the units must be equipped with the appropriate software as well as the necessary peripheral hardware.

Below is a mechanical drawing of the optional GPS unit delivered by Unipower.

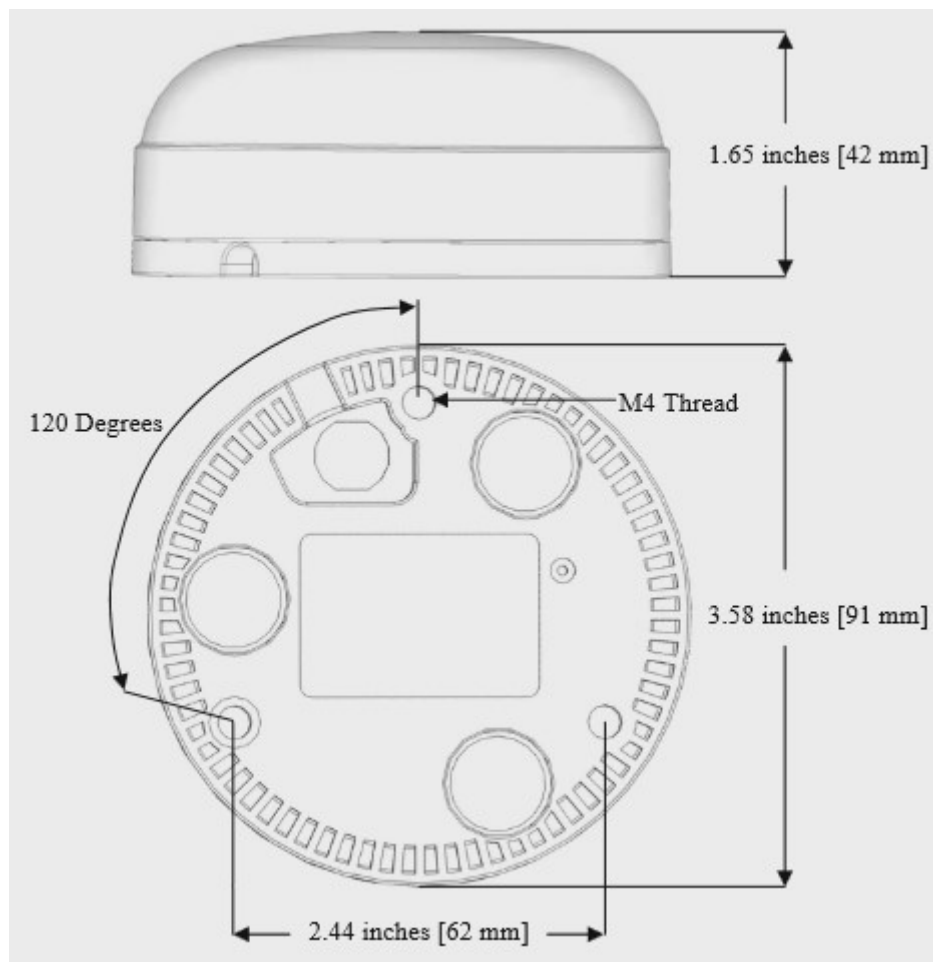


Figure 41

This chapter covers the use of the GPS synchronization module with the UP-2210 family of instruments.

8.1 INSTALLATION

The GPS adapter connects to the UP-2210 via the Time/TTL input. The following sections will describe the connection method in detail.

8.1.1 GPS communication configuration

Connect to the unit with PQ Online and go to the Tools-Status Tab. Select the appropriate connection method for the GPS (Time/TTL), and set the baud rate according to the baud rate configured in the GPS (default values are normally 19200, but can also be 4800). Then press Apply.

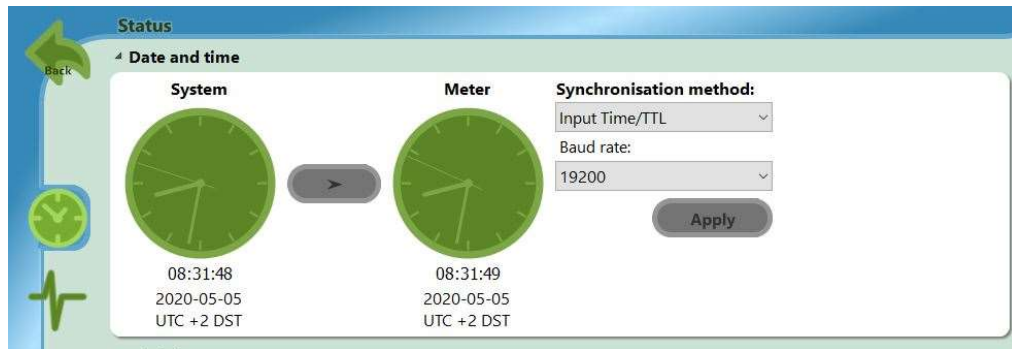


Figure 42 - GPS configuration

This is all that is needed to configure the UP2210 to use GPS synchronization. If everything is connected correctly and the GPS finds enough satellites, the “Sync” led on the UP2210 will start to flash rapidly (0.05s On and 0.9s Off).

8.2 IRIG-B

The UP2210R supports time synchronization via IRIG-B connections. To use IRIG-B, connect the time synchronization instrument to the Data port and the GND port as shown in Figure 43. **Error! Reference source not found..** Then connect to the unit with PQ Online and choose IRIG-B for synchronization method and choose the baud rate configured in the synchronization instrument. Then press Apply. (see 8.1.1).

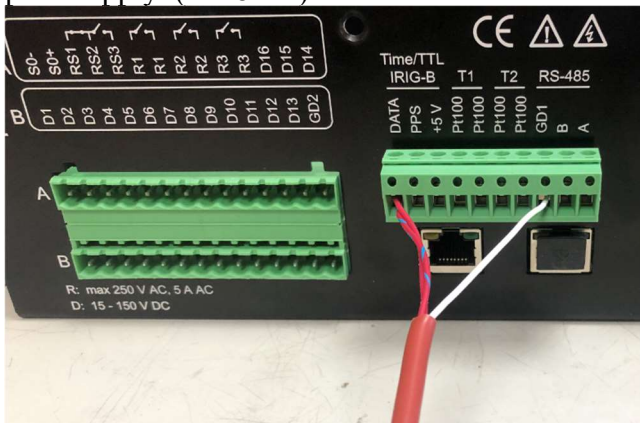


Figure 43

8.3 Useful information regarding GPS

When in GPS mode (i.e. the GPS sends valid information to the meter) the meter will not accept time setting information from either manual operation by PQ Online or automatic setting by PQ Schedule.

If the GPS can't send reliable time information to the meter (it loses contact with satellites, for instance) the meter will wait for 1 hour before starting to accept time setting from other sources, like PQ Schedule. You can study the *RTC Sync* event in the event list and see if the meter has been synchronized by the GPS or by PQ Schedule.















| | | | | | |
|---|-------------------------|------------------|----------|----------------------------------|----|
|  | 2012-04-12 13:10:16.000 | JA test 22103170 | RTC Sync | 4631/15544/4631/15544/20000/1 | 10 |
|  | 2012-04-12 12:46:31.000 | JA test 22103170 | RTC Sync | 3206/15544/3206/15544/20000/1 | 10 |
|  | 2012-04-12 12:22:46.000 | JA test 22103170 | RTC Sync | 1781/15544/1781/15544/20000/1 | 10 |
|  | 2012-04-12 11:59:01.000 | JA test 22103170 | RTC Sync | 356/15544/356/15544/20000/1 | 10 |
|  | 2012-04-12 11:35:31.000 | JA test 22103170 | RTC Sync | 64482/15543/64482/15543/20000/1 | 10 |
|  | 2012-04-12 11:25:01.000 | JA test 22103170 | RTC Sync | 63852/15543/63852/15543/0/1 | 10 |
|  | 2012-04-12 11:11:46.000 | JA test 22103170 | RTC Sync | 63057/15543/63057/15543/20000/1 | 10 |
|  | 2012-04-12 10:59:43.000 | JA test 22103170 | RTC Sync | 62337/15543/62335/15543/30000/1 | 10 |
|  | 2012-04-12 10:30:05.000 | JA test 22103170 | RTC Sync | 60559/15543/60557/15543/760000/0 | 10 |
|  | 2012-04-12 09:30:07.000 | JA test 22103170 | RTC Sync | 56960/15543/56959/15543/280000/0 | 10 |
|  | 2012-04-12 08:30:08.000 | JA test 22103170 | RTC Sync | 53361/15543/53360/15543/170000/0 | 10 |
|  | 2012-04-12 07:30:00.000 | JA test 22103170 | RTC Sync | 49753/15543/49752/15543/310000/0 | 10 |
|  | 2012-04-12 06:29:58.000 | JA test 22103170 | RTC Sync | 46152/15543/46150/15543/650000/0 | 10 |
|  | 2012-04-12 05:30:08.000 | JA test 22103170 | RTC Sync | 42561/15543/42560/15543/530000/0 | 10 |

Figure 44 - RTC sync information event

The last digit indicates the source of time synchronization. "0" means PQ Schedule or manually by PQ Online. "1" means by GPS.

If there is a communication error between the GPS and the meter there are several protective mechanisms in the software that prevent incorrect time from setting the meter. Each time, for instance, is verified twice before setting.

When the clock is set in the meter and the deviation is greater than 1 minute, an event will be generated (*clock deviation*). This event could also be connected to a visual and/or email alarm.

The Clock Sync event, that can also be seen in the event list, only informs you that PQ Schedule has tried to synchronize.

8.4 GPS Connection instruction for UP2210R

This chapter describes the connection procedure for connecting a Garmin GPS16x-LVS to one or more UP2210R measurement instruments.

To perform this installation, you will need:

- A Garmin GPS16x-LVS antenna. Unipower article no: 22-4042.
- A UP2210R with the 22-4052 module installed.
- 4 wire signal/connection cable (for several UP2210R to the same GPS)
- The appropriate tools (Flat head screwdriver, cable stripper tool etc.)

Optionally if you are going to cascade several UP2210R meters to the same GPS you will need additional connection cable.

1. Look at the RJ45 connector at the end of the cable connected to the GPS and identify in which order the cables inside is connected from left to right. **In this case** the cables are in the following order:
 1→Red
 2→Black
 3→Yellow

4→Blue
5→White
6→Grey
7→Green
8→Purple

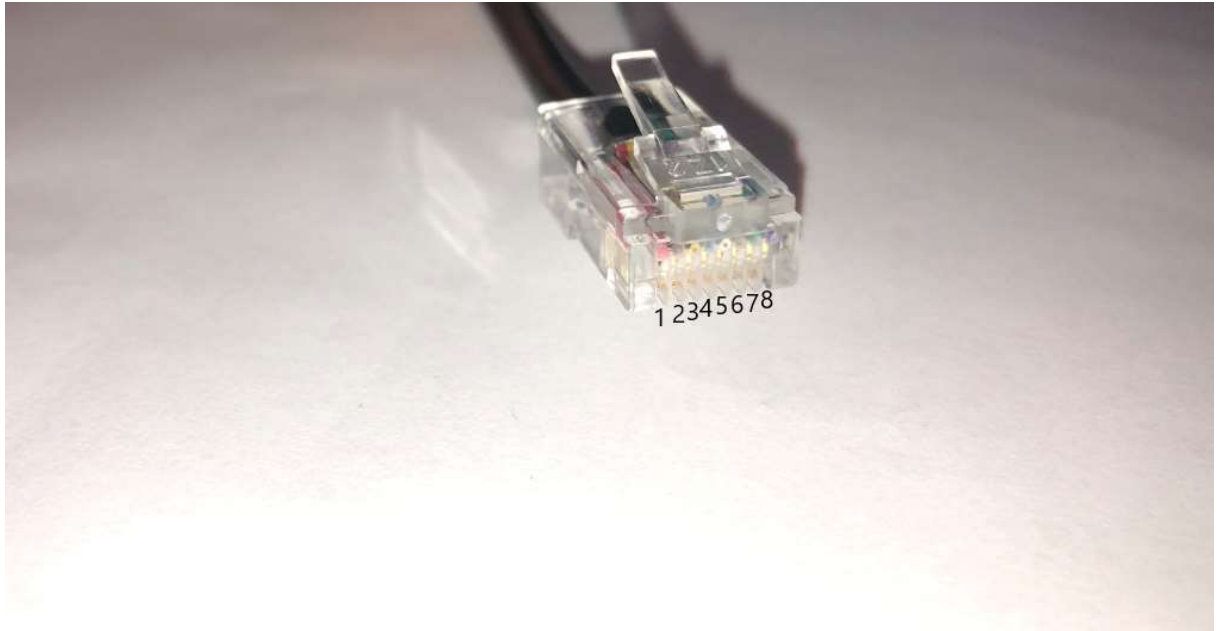


Figure 45-RJ45 connector

2. When you have identified the cables and noted them, cut of the RJ45 connector from the cable.



Figure 46-RJ45 connector separated

3. Strip approximately 30mm from your cable. Keep the individual cables identified as number 1,2,3,5 and 6. Cut the rest of.

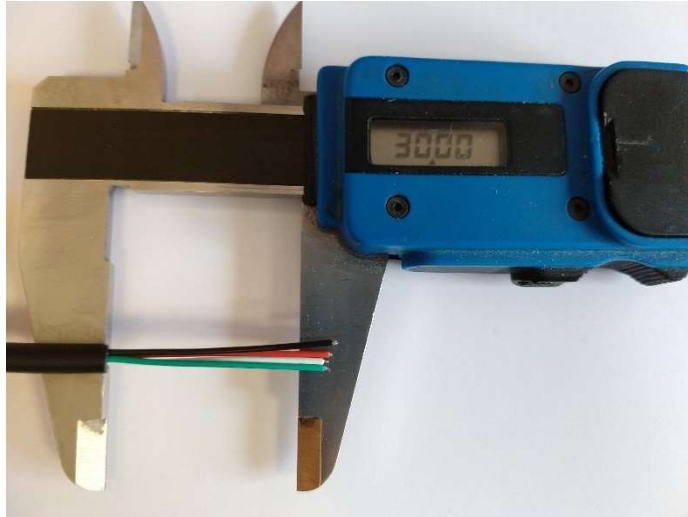


Figure 47 - Strip 30mm

4. Strip each individual cable (it is highly recommended to use cable ferrules) and connect each cable to the pluggable terminal block that was supplied with the instrument. The order of connection is (Seen from the right, please also see Figure 48 for reference)
 1. DATA - Identified cable 5 (White **in this case**)
 2. PPS - Identified cable 6 (Grey **in this case**)
 3. + 5 V - Identified cable 1 (Red **in this case**)
 4. Not used
 5. Not used
 6. Not used
 7. Not used
 8. GD 1 - Identified cables 2 and 3 (Black and Yellow **in this case**)
 9. Not used
 10. Not used

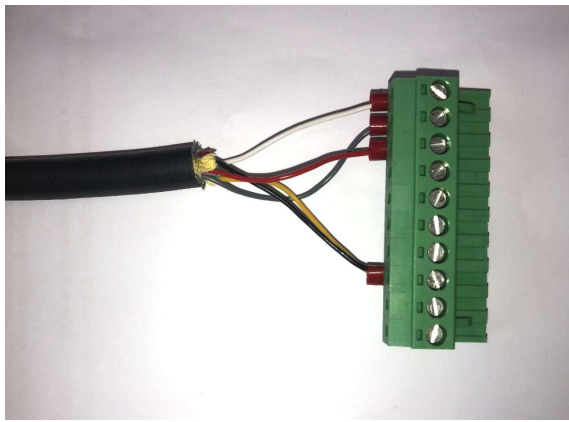


Figure 48 - Cables connected to the terminal block.

5. Plug the terminal block back to the instrument.
6. Configure the instrument to use GPS Aux according to the installation manual.

8.5 Attaching several UP2210R to the same GPS.

It is easy to attach several adjacent instruments to the same GPS. Use suitable installation cable and connect the green, white and black wires in the terminal plug to each terminal in parallel. See figure below.

IMPORTANT: The Red (+5V) Cable should only be connected to the first instrument!

| Main meter GPS | Meters 2 | Meters 3 |
|----------------|--------------|--------------|
| 1. DATA | 1 DATA | 1 DATA |
| 2. PPS | 2. PPS | 2. PPS |
| 3. + 5 V | 3. + 5 V | 3. + 5 V |
| 4. Not used | 4. Not used | 4. Not used |
| 5. Not used | 5. Not used | 5. Not used |
| 6. Not used | 6. Not used | 6. Not used |
| 7. Not used | 7. Not used | 7. Not used |
| 8. GD 1 | 8. GD1 | 8. GD1 |
| 9. Not used | 9. Not used | 9. Not used |
| 10. Not used | 10. Not used | 10. Not used |

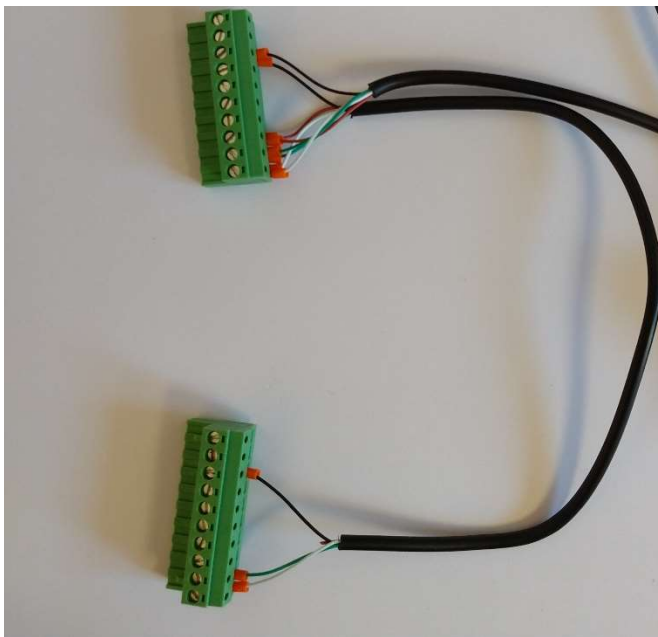


Figure 49 - Cable connection for two instruments sharing the same GPS.

This method is only applicable to adjacent instruments (within a couple of meters)!
The recommended maximum cable length (including any additional meters connected in parallel) is 35m.

9 Installing Software

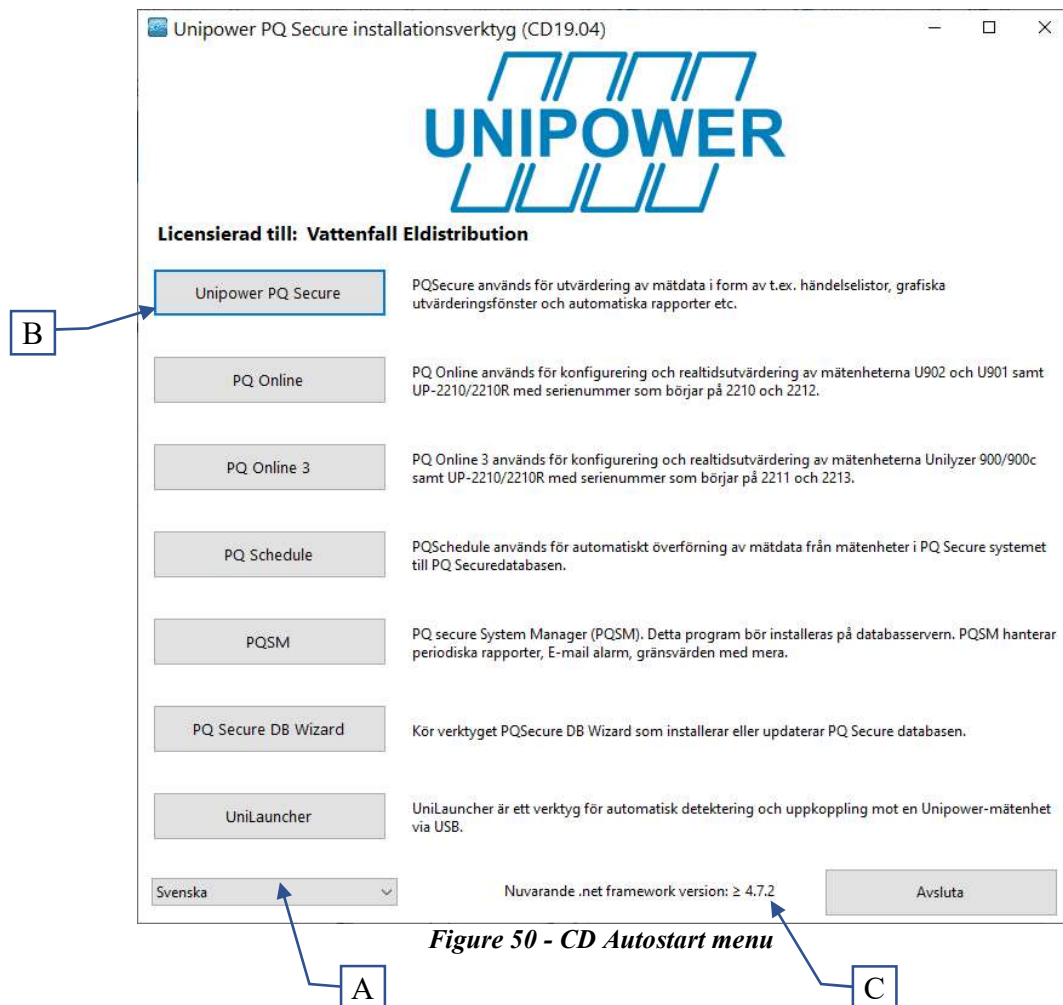
All programs that form part of the PQ Secure system can be found on the supplied installation CD.

9.1 Installation procedure

Depending on the architecture of the PQ Secure the different programs should be installed on different computers. Please see “PQ Secure SQL User and software installation manual” for more detailed information about the different parts of the system.

9.2 Installation program

Insert the PQ Secure installation CD and the program will start automatically. In the program window you can select language (of menu and applications), manuals and brochures in pdf-format. Here you also find some service packs and software tools that can simplify the installation and commissioning of the PQ Secure system.



Using the installation program:

- Choose suitable Language for the installation process and for the program you want to install.
- Choose the Software to be installed. The text to the right provides a brief explanation of what the application is used for. When installing, start from the top and work yourself down.
- Tells you the version of the installed Microsoft .NET Framework.

9.3 Installing PQ Online

PQ Online should be installed in the *Communications Computer* and, if needed, in those Client Computers that should have direct access to the meters.

Start by closing all running programs. Insert the PQ Secure Installation CD and wait for the Installation program to open (See Figure 50). In the appearing window, choose “**PQ Online**”. An installation wizard guides you through the installation process, and usually there is no need to make any changes so you can simply accept the recommended settings.

Check that the installation path is correct. We recommend: **C:\Program Files\Unipower\PQ Online**

If the installation doesn't start automatically, click on the Windows **Start** button and select *Run*. Use the Browse button to open the file "*Setup.exe*" in the **PQOnline\Disk1** folder, and click on **OK**.

9.4 Installing PQ Online 3

PQ Online 3 can be installed in the communications computer as well as in client computers that needs to connect directly to the meters.

9.4.1 Additional command line parameters

FORCELOGIN=YES

If authentication with the PQ Secure system is required to control permissions when communicating with the hardware, PQ Online 3 must be installed using the command line argument "FORCELOGIN=YES"

i.e. PQOnline 3 Setup 3.7.1 FORCELOGIN=YES. This will make PQ Online 3 add an additional authentication step before being able to connect to a measuring device.

FORCEENCRYPTION=YES

If encrypted communication between the client and the PQ Secure system is required when communicating, PQ Online 3 must be installed using the command line argument "FORCEENCRYPTION=YES"

i.e. "PQ Online 3 Setup 3.7.1" FORCEENCRYPTION=YES

if both of the above functions are required, you can combine these:

"PQ Online 3 Setup 3.7.1" FORCELOGIN=YES FORCEENCRYPTION=YES

9.5 Installing UniLauncher


UniLauncher is a utility application that helps you to connect to your Unipower meters via USB. When you connect the USB cable UniLauncher will automatically connect with the meter and launch PQ Online.

Start by closing all running programs. Insert the PQ Secure Installation CD and wait for

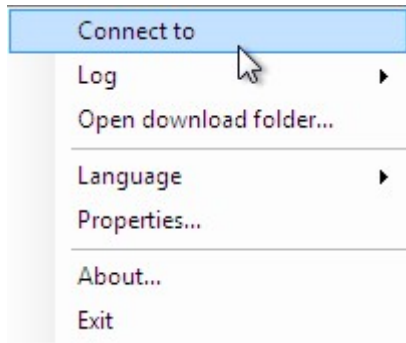
the Installation program to open. Select “**UniLauncher**” and complete the installation wizard.

Usually there is no need to make any changes, so you can simply accept the recommended settings.

If the installation doesn’t start automatically, click on the Windows **Start** button and select *Run*. Use the Browse button to open the file “*UniLauncherSetup.msi*” in the \UniLauncher cd folder, and click on **OK**.

After installation the icon  should be seen in the system tray bottom right on the screen.

You can right-click on it to access the menu:



The settings can be found under *Properties*:

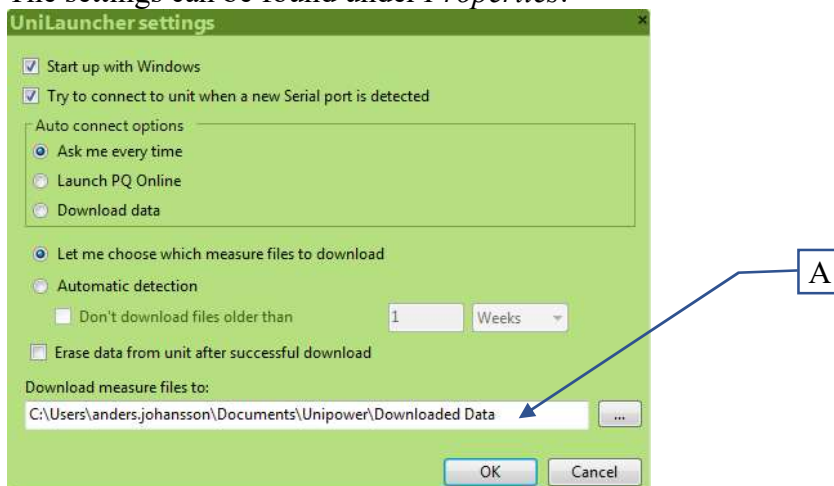


Figure 51

We recommend the above default settings.

The path to the folder in Figure 51A is the location where data will be automatically downloaded by UniLauncher.

To use UniLauncher, first connect the USB cable to the meter. Then connect it to the PC. After a few seconds you should see a message that the meter is being connected and then a menu like in . You can choose to start PQ Online (for configuration or realtime analysis) or you could select download to transfer data. This is very practical and convenient.

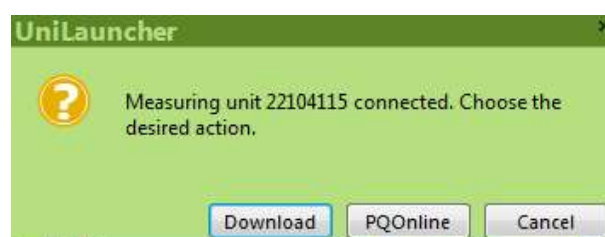


Figure 52 – Connecting the USB cable

The very first time you connect your meter to the PC the system needs to install some drivers. Be patient and wait (*don't pull out the USB cable and retry to fast! It could take 30-60 seconds to do the installation*)

10 PQ ONLINE

PQ Online is mainly used for configuring the measuring devices UP-2210R, UP-2210 and Unilyzer 900/900C, but is also used as a communication program between the measure site and the office. In that case, PQ Online is used for the manual polling of measure data or for real-time analysis.

10.1 Main window

When starting PQ Online you will be met with the main window.

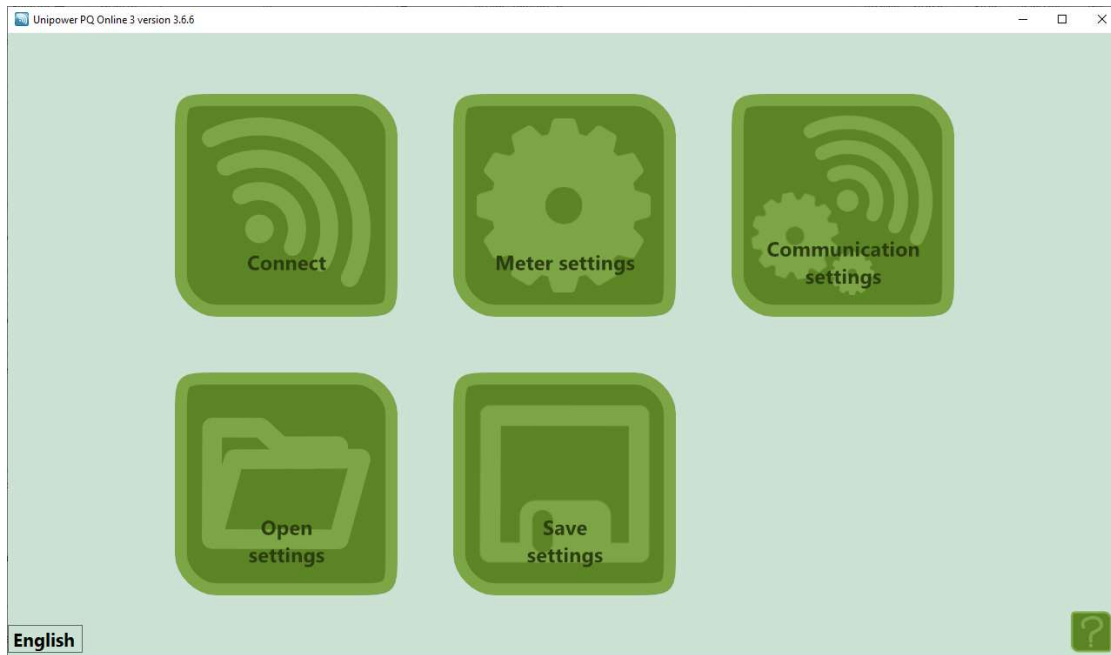


Figure 53

The buttons have the following functionality when the program is initially started.

- Connect, allows you to connect to a meter. (section 10.2)
- Meter settings, measurement parameters. (section 10.3, **Error! Reference source not found.**)
- Communication settings, communication settings such as IP address.
- Open settings, opens meter settings from file.
- Save settings, saves meter settings to file.

Meter settings can be edited without being connected to a meter so that they can be saved to file. You can change the language of PQ Online by clicking on the language in the bottom left corner.

After connecting to a meter, the main window changes to the following.

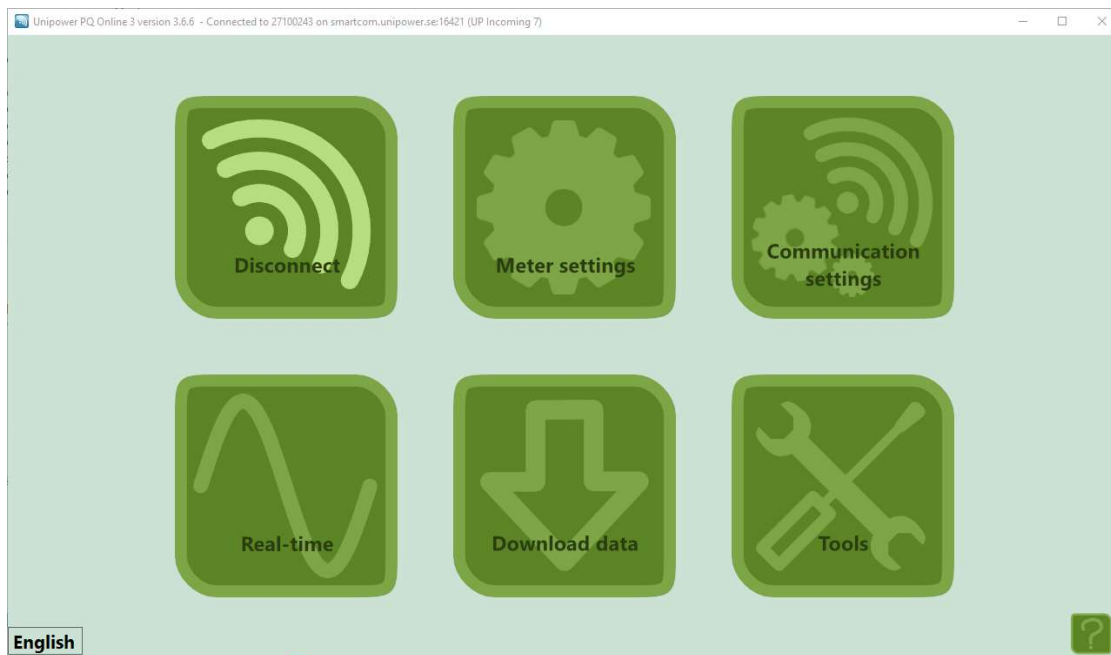


Figure 54

While connected to a meter, the following changes occur

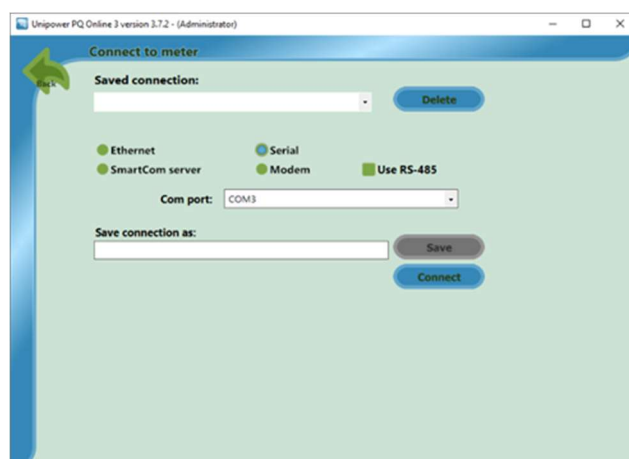
- Realtime, shows real time measurement data (section **Error! Reference source not found.**).
- Download data, allows for manual download of stored data.
- Tools, contains various settings such as time synchronization.
- Disconnect replaces connect.

10.2 Connect



When you have started the program and pressed “Connect” a connect to meter dialogue will automatically appear. Here you select the communication method chosen for connecting the computer with the meter.

You can contact a meter in three different ways:



Serial (USB)

Here you specify the COM port the meter is connected to.

Figure 55

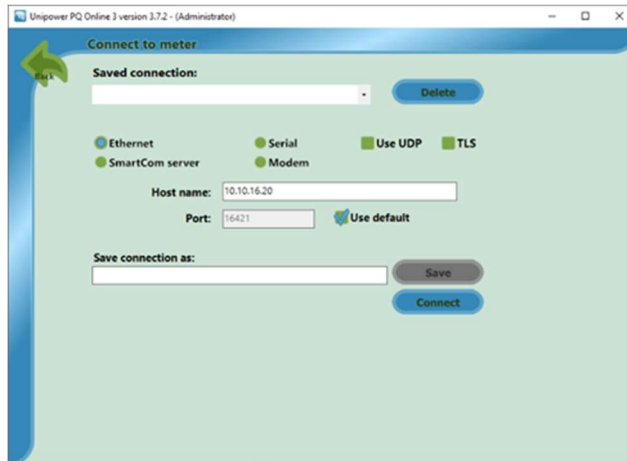


Figure 56

Ethernet

Here you must specify the meters IP address that the unit has been configured with. It is possible to select different ports in order to route different meters on one IP address. The default port is 16421. TLS is described in [10.6.7 TLS Encryption](#)

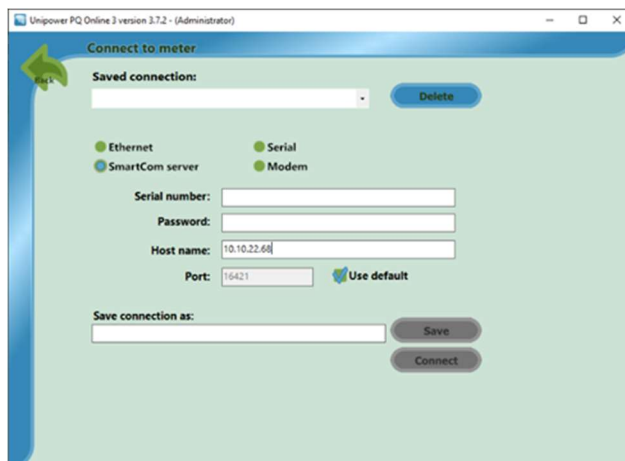


Figure 57

SmartCom Server

Here you specify the meters Serial number, Password and Host name.

Select the appropriate alternative and click the **Connect** button. The status window enables you to follow the communication process.

10.3 Meter settings

The section **Unit configuration** is used for checking and editing the configuration of the meter. The configuration contains information about how the meter is connected to the measure site, the reference levels on the voltage and current, and the storage intervals for PQ parameters.

At the bottom of the page you may choose to start or stop the measurement. The meter will then begin or end measuring with the current settings. This name of this setting is stated on the top of the page.

In the bottom right corner you may choose to “change settings”. This allows you to reconfigure the current setting or create new configuration for the meter.

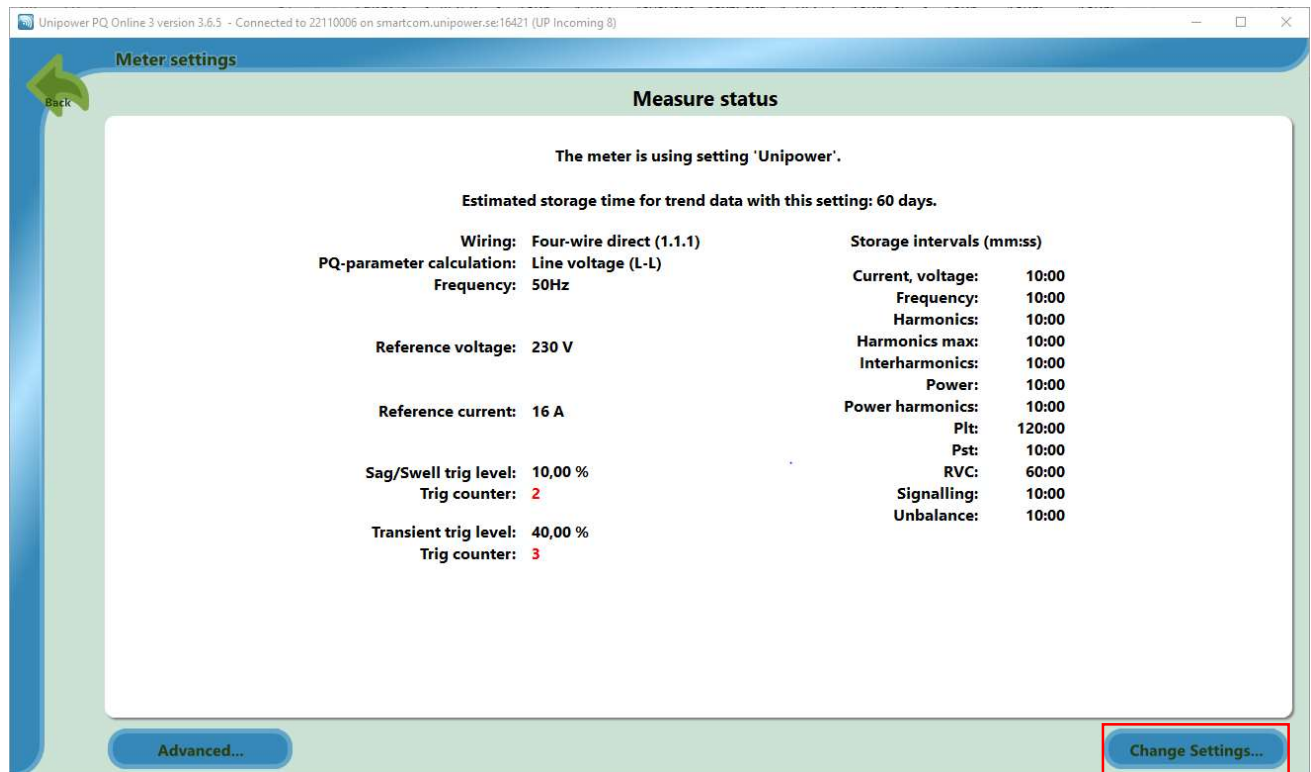
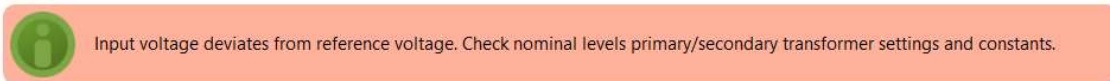


Figure 58

If for example the voltage on the meter inputs deviates from the reference voltage a warning sign is shown in the bottom of the window.



10.4 Change settings using the configuration wizard

In order to change or create a new configuration, access the “change settings” section under measurement settings tab (see section **Error! Reference source not found.**).

Configuring the settings is done by the following steps:

- Select either to create new settings, modify the current settings or get settings from file see Figure 59 below.
- Set the wiring, constants and nominal levels (section 10.4.2). If you use the currently active settings or load from a file these will default to the settings in the meter or file.
- Set reference and trig levels (Figure 63Figure 63).

- Review the configuration (section 10.4.3).
- Save the configuration to the meter (section **Error! Reference source not found.**).

These steps are described in detail below.

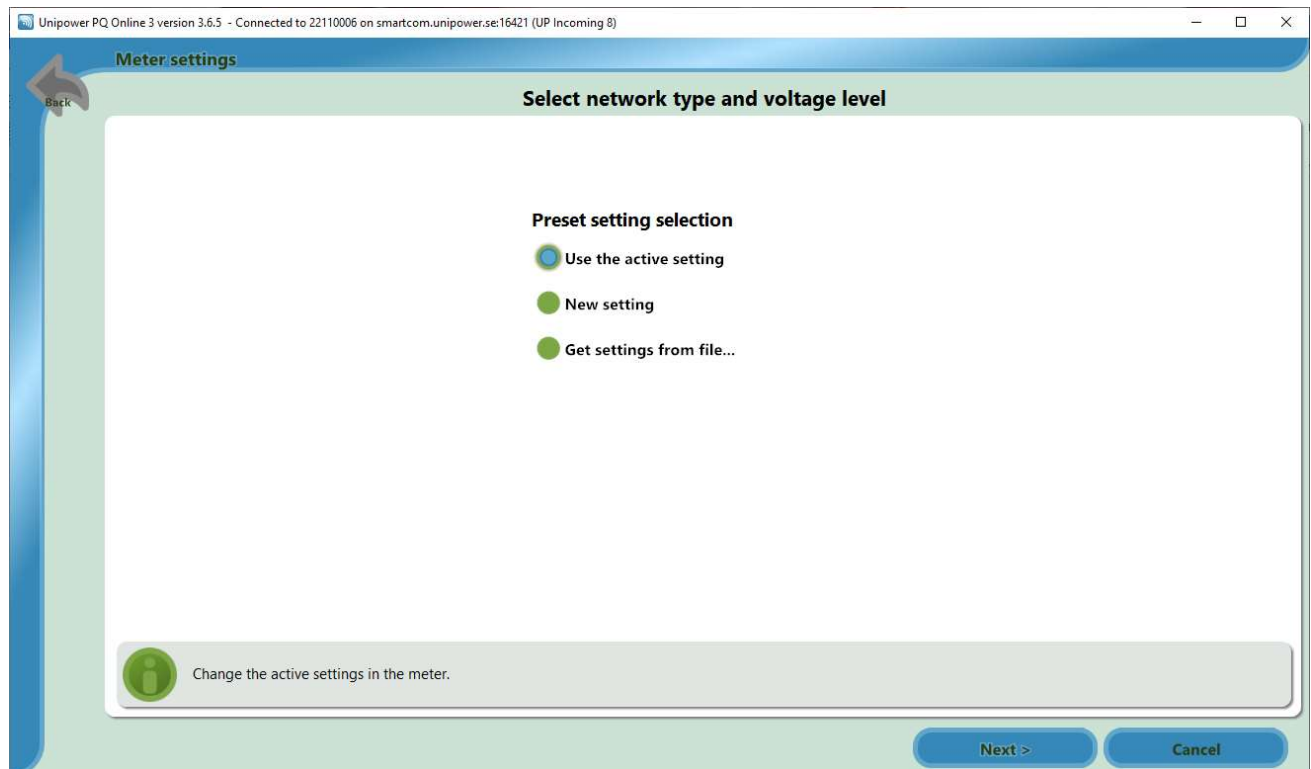


Figure 59

It is also possible to create a configuration and save it to file without connecting a meter in case you wish to send a configuration. Simply start PQ Online and click Measurement Settings -> Change settings -> New Settings. Configure the template and save it to your computer.

Note: choosing the template EN50160LV/MV/HV provides a norm compliant power quality measurement setting. (see 10.4.1)

10.4.1 EN50160 templates

When the software has been installed the installer places three preconfigured measure templates under *C:\Program Files (x86)\Unipower\PQ Online 3\Templates*

These templates are compatible with the standard EN50160 and comes in three different voltage levels: Low voltage, Medium voltage and High voltage. Choosing the measurement template for the appropriate voltage level provides a norm compliant power quality measurement.

These measurement templates come with pre-set transformer ratios and nominal levels. The transformer configuration, ratios and nominal levels need to be checked and adjusted to match the actual values of the installation.

The presets are as follows:

EN50160LV: $U_{LL} = 400V$ $I_{Nom} = 16$ No transformer ratios

EN50160MV: $U_{LL} = 11kV$ $I_{Nom} = 400$ Voltage transformer ratio: 11kV/110V Current transformer ratio: 400A/5A

EN50160HV: $U_{LL} = 130kV$ $I_{Nom} = 400$ Voltage transformer ratio: 130kV/110V Current transformer ratio: 400A/5A

10.4.2 Creating a new configuration template

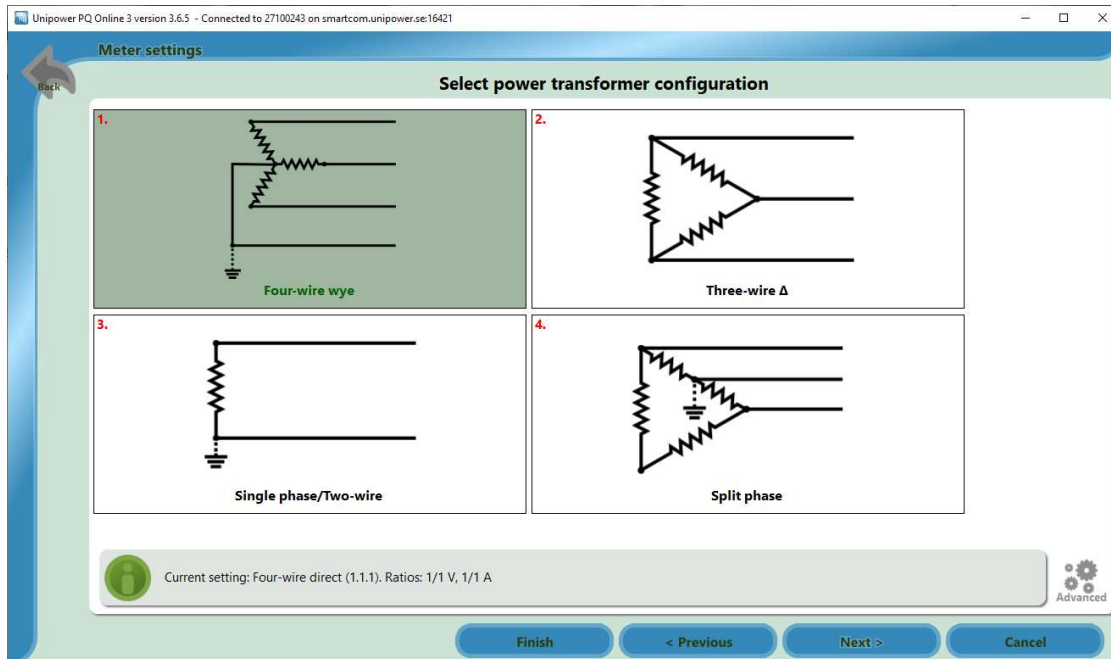


Figure 60

Begin with choosing the transformer configuration that fits your system. If possible Unipower always recommends measuring on a four-wire wye configuration. Note that the previously selected configuration is marked with a dark background color, in the above Case four-wire wye.

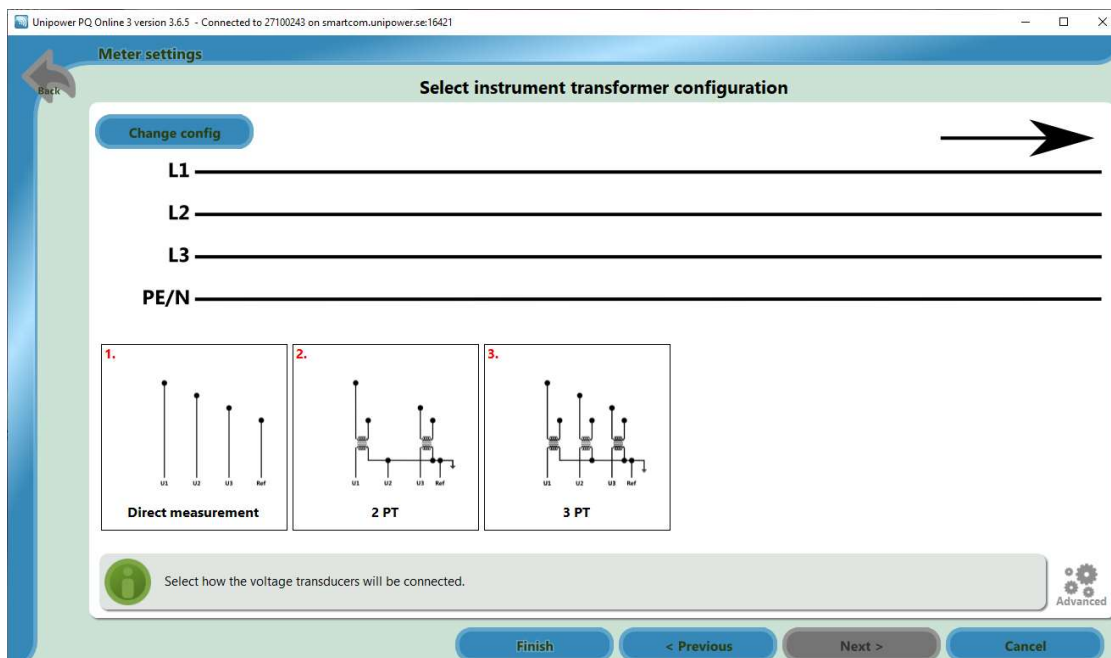


Figure 61

After you have set the system configuration you will be prompted to configure the wiring. You will first set how many PT:s you are measuring over or if it is a direct measurement. After you have set the voltage transformers you set the current transformers in the same way.

Note that each alternative has an associated number shown, this can be used to unambiguously identify the connection method of a meter, in Figure 62 you can see the Connection being specified in red as 1.3.3 this corresponds to option 1 for power transformer configuration (four-wire wye), option 3 for PT configuration (3 PT) and option 3 for CT configuration (3 CT)

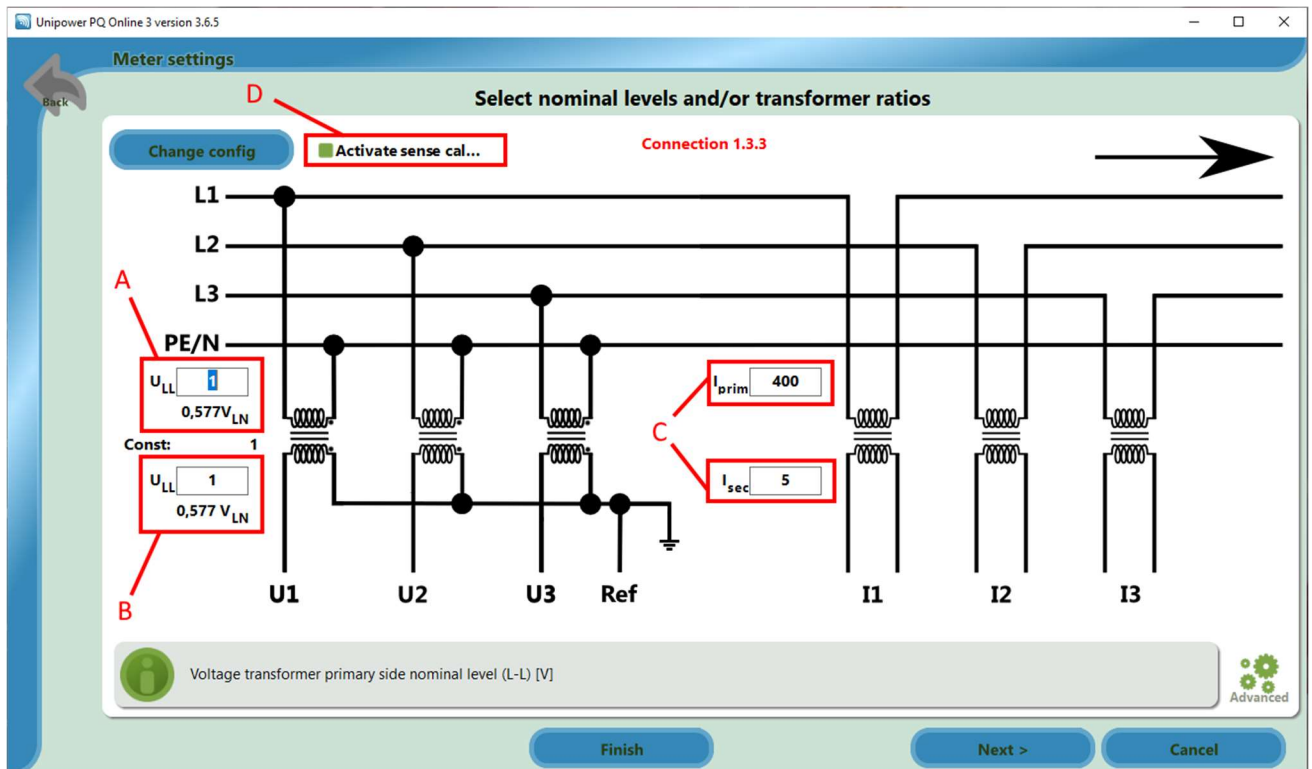


Figure 62

When you have set the wiring of the system you must set the transformer ratios and nominal levels. The nominal levels are automatically set to the values you put on the primary side of the transformer (A). Set the voltage on the secondary side of the transformer, this is the voltage that is the output of the instrument transformer (B). Then proceed to set the same for the current transformer (C). The checkbox (D) to activate sense calibration is only available for meters with the sense option.

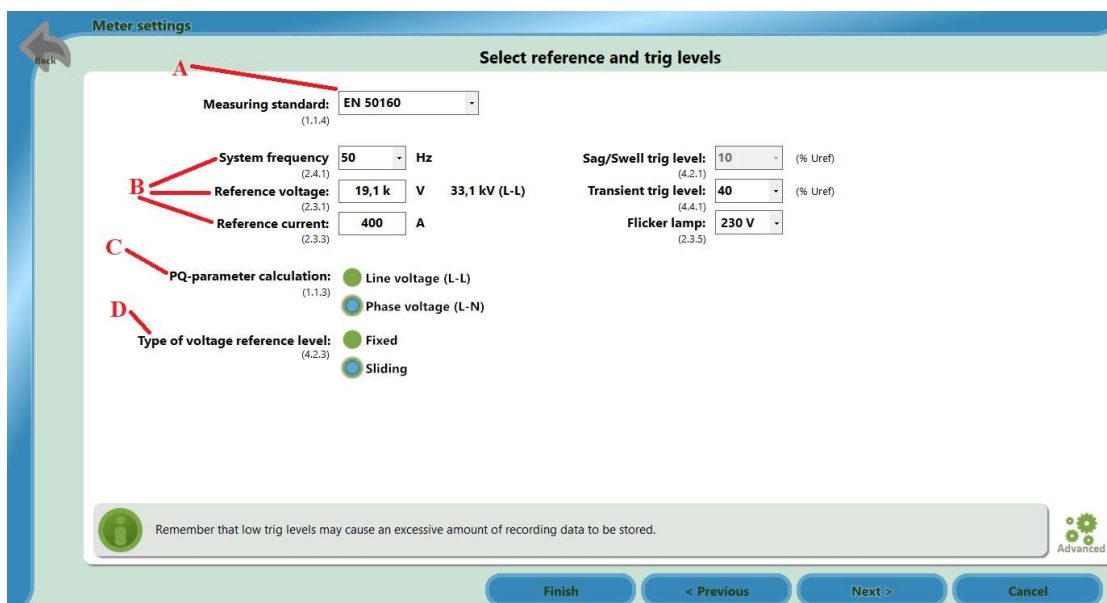


Figure 63

- In the following window choose a Measurement standard(A).Choosing the EN 50160 setting will set and lock some key values to be compliant with EN 50160.
- Then proceed and fill in the system frequency, reference voltage and current(B).
- Choose if you wish to calculate the PQ Parameters (harmonics, unbalance etc.) on phase-neutral or phase-phase voltage (B). International norms require that for HV networks L-L voltages shall be considered and for LV networks where there is a neutral or ground conductor L-N voltages shall be considered for power quality. For troubleshooting purposes both perspectives could be considered depending on the application.
- Set the voltage reference level to either Fixed or Sliding. If you are measuring over a high/medium voltage network the reference level should be set to **sliding** and while measuring over a low voltage network the voltage level should be set to **fixed**. For further explanation of sliding reference see section **Error! Reference source not found.**
- Continue to set the trig-levels and flicker measurement level. The flicker level measurement should be set to the voltage-level in your lamp socket.

Note! Calculating PQ Parameters on phase-to-phase voltage is not the same as measuring over phase-to-phase voltage.

10.4.3 Review configuration

Review the configuration before saving it and begin measurement. Make sure that all parameters are correct according to the system measured.

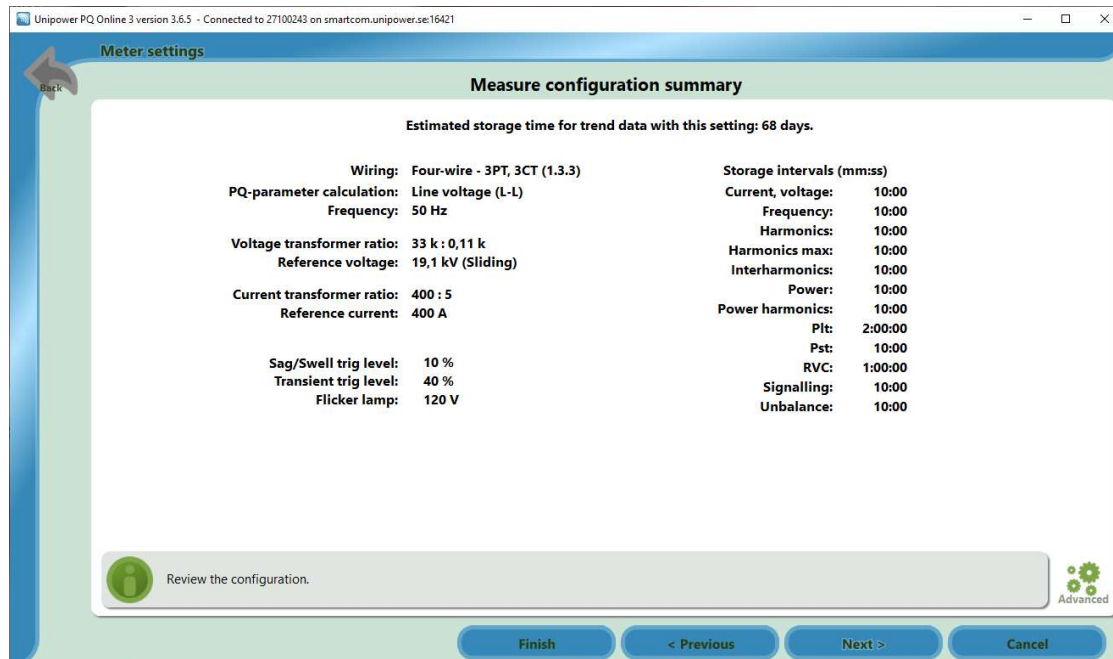


Figure 64

10.4.4 Store settings

The last step in the wizard has you chose how to store the configuration.

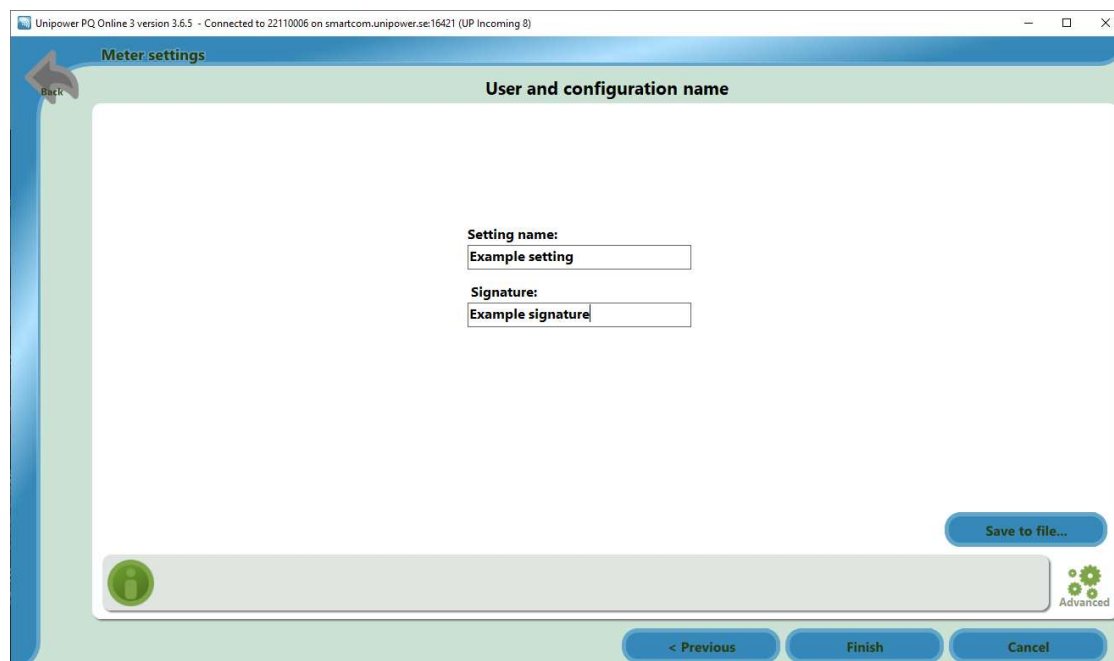


Figure 65

When storing the configuration make sure to use a descriptive name for the configuration such as the name of the substation and transformer. Make sure to check that the signature is correct. You can also save the finalized configuration to a file for later use. Once you press Finish the configuration will be stored in the meter.

10.4.5 Advanced settings

In advanced settings you have five overall setting icons.

1. General settings
2. Measure site properties
3. Storage intervals
4. Disturbance
5. Slowsan settings
6. Digital in
7. Digital out

These are described below.

General settings (1)

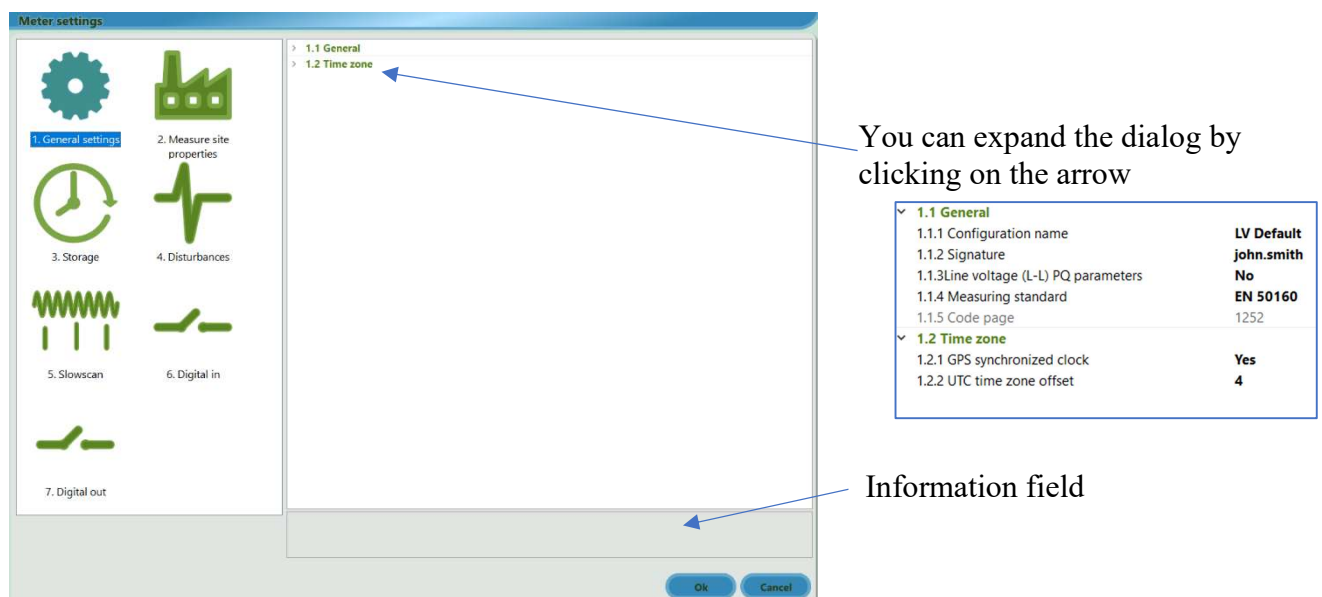


Figure 66

General settings are measurement settings for the meter. If you want to edit a value, highlight the row by clicking on it and edit the value.

In the selected description information field there is information about the actual highlighted row.

Measure site properties (2)

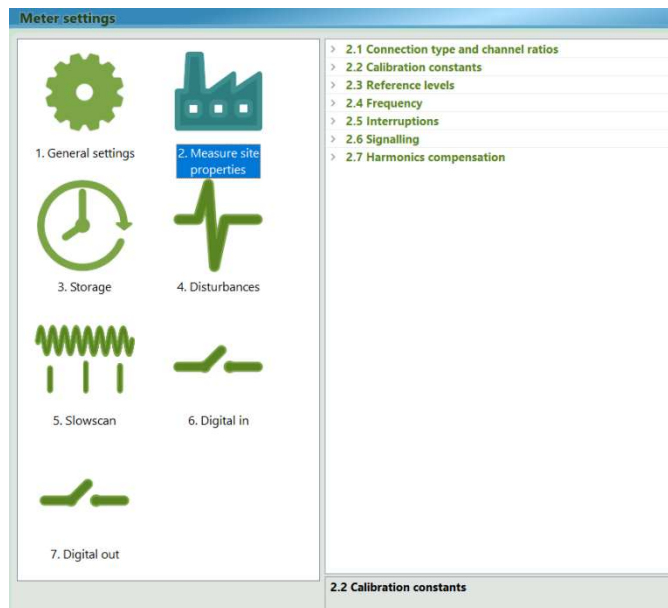


Figure 67

In measure site settings you have several settings. You can also here highlight a row and get information about the setting and edit the value.

Signalling (2.6)

Signaling is communications signals that are transmitted over the power distribution network. They behave like inter-harmonic frequencies and can cause malfunctions in other equipment.

You can set up an event trigger to capture these events. Enter the signaling frequency (Ripple frequency) that you want to monitor, e.g. 1070 Hz. Then enter the detection threshold in percent of the nominal voltage. The events are shown in the event viewer in PQ Secure. Or as an event line in any graph. See separate manual for PQ Secure.

tion 19.0.10 - Unipower Intern

| Time ↑ | Location | Type of event | Value | Comment |
|-------------------------|--------------------|--------------------|----------------------|---|
| 2017-05-14 06:41:27.703 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/19840ms/2%/2,29%, 2,38%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 06:42:03.203 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22120ms/2%/2,34%, 2,42%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 06:43:03.283 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/37400ms/2%/2,33%, 2,41%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 06:43:56.060 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22410ms/2%/2,33%, 2,41%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 07:09:45.427 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/19580ms/2%/2,32%, 2,40%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 07:10:20.540 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22460ms/2%/2,25%, 2,35%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 07:11:20.917 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/37510ms/2%/2,34%, 2,42%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 07:12:13.697 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22300ms/2%/2,25%, 2,32%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 08:37:12.860 | , signalling event | 11kV Station Fibre | Three phase RVC | 11,00kV/365,4V (3,32%)/6,479V (0,06%)/1,20s |
| 2017-05-14 08:37:12.860 | , signalling event | 11kV Station Fibre | Rapid voltage change | 3/11,00kV/365,4V (3,32%)/-6,479V (-0,06%) |
| 2017-05-14 09:09:43.810 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/18790ms/2%/2,36%, 2,43%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:10:18.940 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22240ms/2%/2,30%, 2,38%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:11:19.133 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/37450ms/2%/2,32%, 2,39%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:12:11.913 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22450ms/2%/2,34%, 2,41%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:39:45.853 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/17990ms/2%/2,35%, 2,43%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:40:21.017 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22440ms/2%/2,36%, 2,44%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:41:21.340 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/37610ms/2%/2,36%, 2,44%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 09:42:14.273 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/22360ms/2%/2,34%, 2,42%, 0,00%/0,00%, 0,00%, 0,00% |
| 2017-05-14 10:00:44.957 | , signalling event | 11kV Station Fibre | Signalling | 11000/1042Hz/17960ms/2%/2,36%, 2,43%, 0,00%/0,00%, 0,00%, 0,00% |

Figure 68

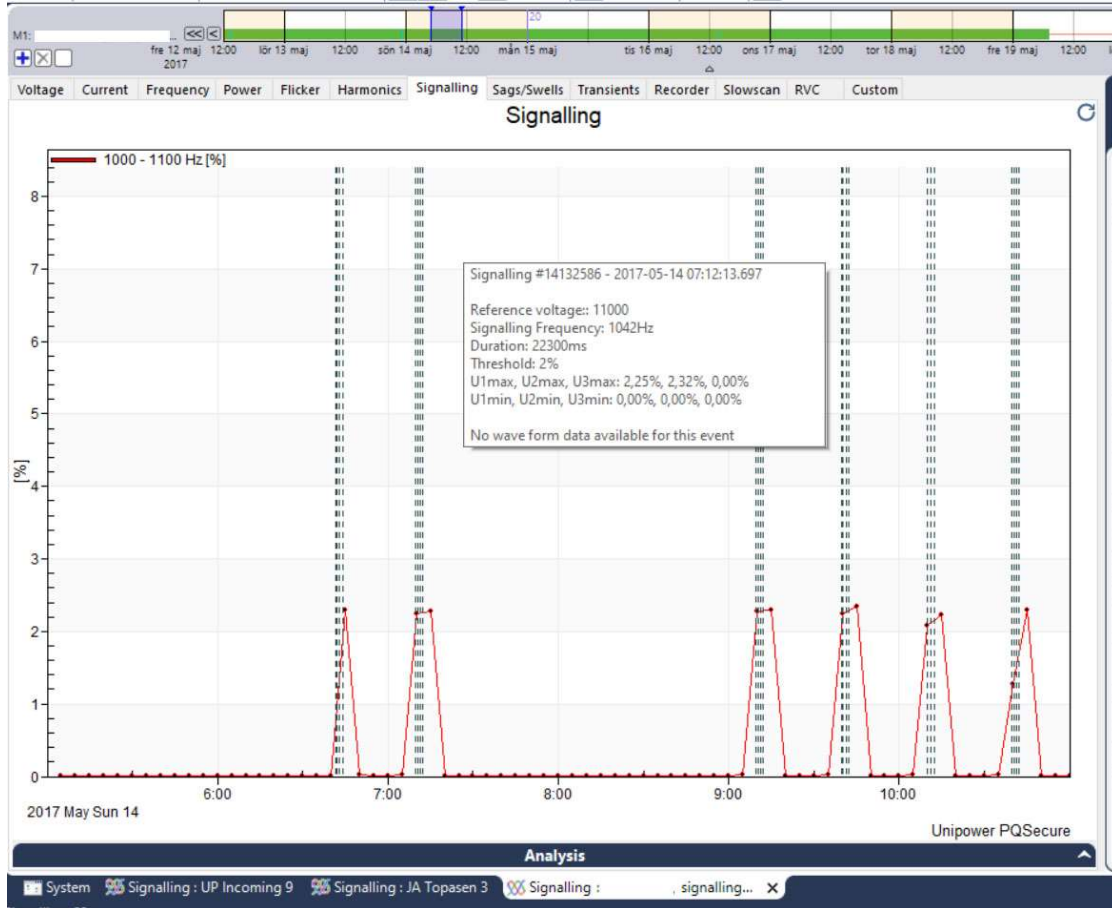


Figure 69

Detection threshold (2.6.1)

Here you set a value (% of nominal voltage) to be the trig condition. If the signaling value exceed this set value an event will be created which can be shown in the event viewer.

Ripple frequency (2.6.2)

Here you set the signaling frequency to monitor.

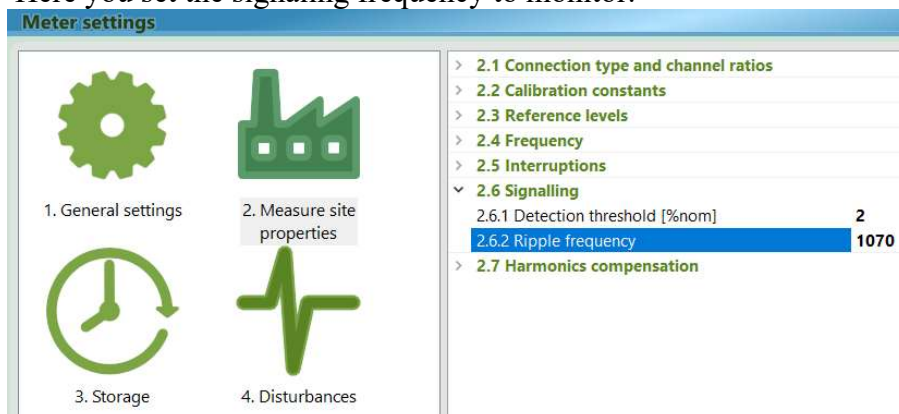


Figure 70

Storage intervals (3)

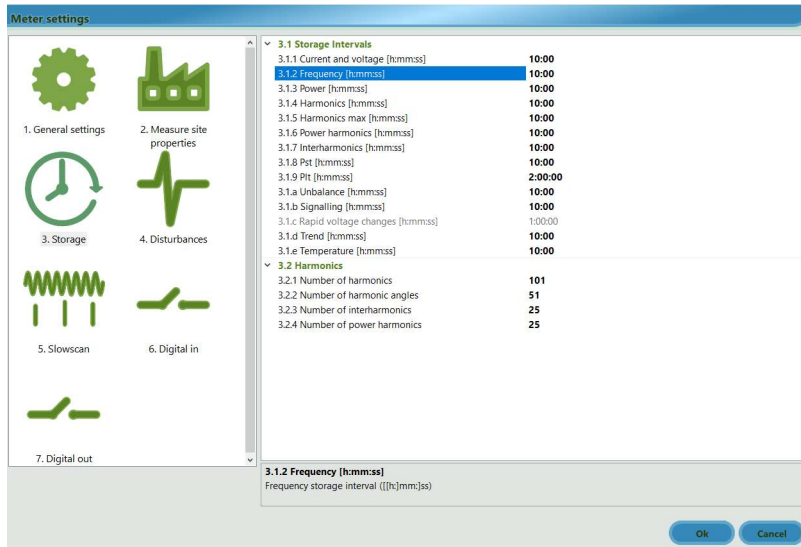


Figure 71

In storage interval you set the intervals how often values will be stored to the memory.

Disturbances (4)

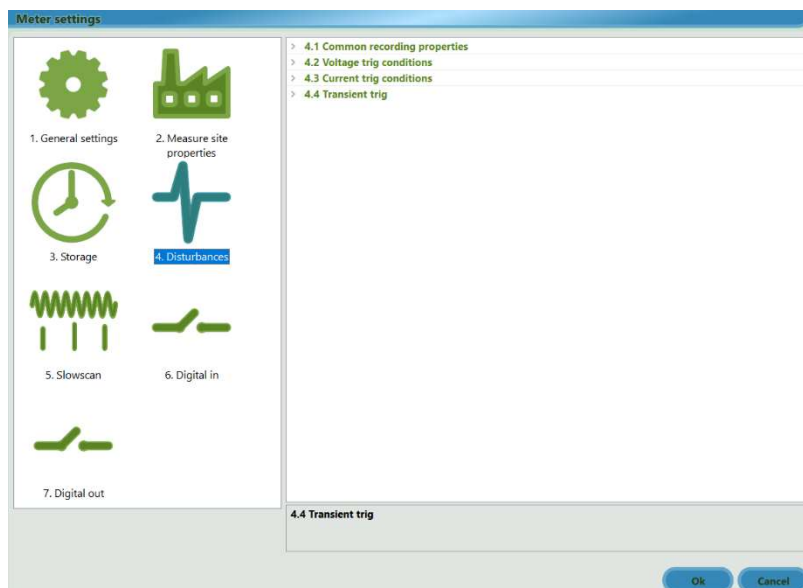


Figure 72

In disturbances you set values for disturbances such as sags/swells and transients.

Sags/Swells events

The recorder can do a high-speed recording to allow detailed analysis of, for instance, a sag/swell event. The storage time is the total recording length and is set so that the event you want to capture is covered. A typical sag in the power distribution network is less than 1 second. The pre trig is a short time that allows study of the time just before the event starts, the maximum pre trig is 10 seconds with waveform enabled and 10 seconds with only RMS recording.

If waveform is not enabled, you will lose the ability to see disturbances in line-line/line-neutral voltage. In **waveform** mode the meter stores sample points in the selected rate. In **RMS** mode only the RMS1/2-values are stored, every half cycle. The RMS recording takes much less memory space and allows for storing more events. With the auto stop function you can also save memory. In this mode, if the event goes back to normal condition before the total storage time has passed the recording stops and memory space is saved. An extra delay (post trig) before the stop is added.

| 4.1 Common recording properties | |
|---------------------------------|----------|
| 4.1.1 Recording type | Waveform |
| 4.1.2 Samples per cycle | 64 |
| 4.1.3 Recording duration [ms] | 2500 |
| 4.1.4 Pre trig duration [ms] | 500 |
| 4.1.5 Post trig duration [ms] | 500 |
| 4.1.6 Use autostop | No |

Recording type

Decides whether recording should be stored as waveform or RMS

Samples per cycle

Samples per cycle. This value controls the sampling frequency for waveform recording.

Recording duration [ms]

Max recording duration. Including pre trig and eventual post trig.

Pre trig duration [ms]

Decides for how long before the actual trig occurs data should be saved.

Post trig duration [ms]

Recording duration after the measured values has returned to normal state. Only used when auto stop is enabled.

Use autostop

Enabling autostop will automatically stop the recording when the status has returned to normal state.

To start (trig) the recording there are a number of different triggering methods.

Example of sag event:

According to IEC 61000-4-30 standard: a sag/dip begins when the voltage on one or more channels is below the trig threshold (level) and ends when the voltage on all measured channels is equal to or above the dip threshold plus the hysteresis voltage.

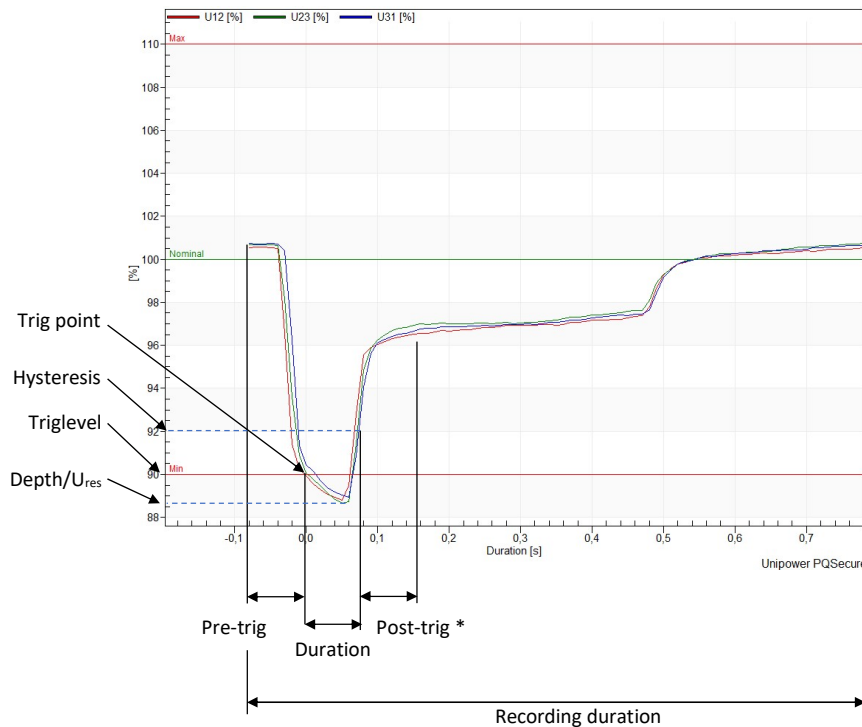


Figure 73

*) Post-trig is only used with auto-stop function. Recording duration is then = pre-trig + duration + post-trig

Voltage triggers (4.2)

| | |
|---|----------|
| 4.2 Voltage trig conditions | |
| 4.2.1 U1 - U3 trigs at deviation [% Uref] | 10 |
| 4.2.2 Hysteresis [% Uref] | 2 |
| 4.2.3 Use sliding reference | No |
| 4.2.4 U4 trig level [V] | Disabled |
| 4.2.5 Voltage sum trig level [V] | Disabled |
| 4.2.6 RVC Threshold [%nom] | 0 |
| 4.2.7 RVC Hysteresis [%nom] | 0 |

4.2.1 U1 - U3 trigs at deviation [% Uref]

The value at which a sag or swell is registered and a recording is started. 0 = Disabled

4.2.2 Hysteresis [% Uref]

Trig end value = (trig level - hysteresis). Example: trig value 10%, hysteresis 2%. Trig end value=ref ±(10-2=8%)

4.2.3 Use sliding reference

If enabled, the reference level will be following the actual voltage, instead of remaining at a fixed level.

4.2.4 U4 trig level [V]

The value at which a sag or swell is registered and a recording is started. 0 = Disabled

4.2.5 Voltage sum trig level [V]

A recording will begin at this voltage sum level. 0 = Disabled

4.2.6 RVC Threshold [%nom]

The value at which a rapid voltage change is registered.

4.2.7 RVC Hysteresis [%nom]

Trig end value = (trig level - hysteresis). Example: trig value 3%, hysteresis 1.5%. Trig end value=ref ±(3-1.5=1.5%)

a) U1-U3 trigs at deviation [% Uref] (4.2.1)

A voltage sag (or swell) recording begins when the voltage one of the phases U1-U3 passes the Uref value +/- the trig level as in Figure 73. The recording will have the timing as described above.

The *duration* of the sag/swell event is calculated to the point where the voltage of all phases U1-U3 is back within the trig level + the **hysteresis** value as in Figure 73 in accordance to IEC 61000-4-30 Class A.

The purpose of the hysteresis level is to avoid recording secondary events that occur directly following an important sag/swell. The meter also calculates the *depth* of the sag/swell as the lowest (sag) or highest (swell) voltage value during the event. This value is expressed as the residual voltage level in accordance to IEC 61000-4-30 Class A.

If the nominal level in the system is changing, for example in high voltage networks, you can use a **sliding reference** nominal level (see Figure 73). The recorder will calculate the average value of the reference voltage channel (U1) according to the norm IEC 61000-4-30 and create its own reference level. The value of the sliding reference level will be shown along with each sag/swell.

Normally, if sliding reference is not active, the fixed reference value is used as the nominal voltage.

b) U4 trig level [V] (4.2.4)

If the voltage on channel U4 is higher or lower than the reference value +/- the trig level a sag/swell recording starts.

c) Voltage sum trig level [V] (4.2.5)

This trig gives you the possibility to trig on earth faults. Normally the voltage sum $U1+U2+U3=0$. If this is not the case you probably have an earth fault and this trigger starts a recording.

Current triggers (4.3)

| | |
|--|-----------------|
| 4.3 Current trig conditions | |
| 4.3.1 I1-I3 Trig level [A] | Disabled |
| 4.3.2 Hysteresis [A] | 0 |
| 4.3.3 I4 Trig level [A] | Disabled |
| 4.3.4 Earth fault trig level [A] | Disabled |
| 4.3.5 Earth fault reference level type | Fixed reference |

4.3.1 I1-I3 Trig level [A]

The current at which a recording will start. 0 = Disabled

4.3.2 Hysteresis [A]

Trig end value = (trig level - hysteresis). Example: trig value 10A, hysteresis 1A. Trig end value = $10 - 1 = 9A$

4.3.3 I4 Trig level [A]

The current at which a recording will start. 0 = Disabled

4.3.4 Earth fault trig level [A]

A recording will begin at this earth fault current level. 0 = Disabled

4.3.5 Earth fault reference level type

Current sum reference calculation method

a) I1-I3 high trigger (4.3.1)

Whenever one of the current phases I1-I3 exceeds the trig level a sag/swell recording starts as described above. For current you also have the possibility to specify Hysteresis (4.3.2). Compare with Figure 73. Hysteresis is specified as a current value and is added to the trig level. By specifying a hysteresis level you avoid recording secondary events that occur directly following an important current trig event.

b) I4 trig level [A] (4.3.3)

If the current on I4 exceeds the trig level a sag/swell recording is started.

c) Earth fault trig level [A] (4.3.4)

This trig gives you the possibility to trig on earth faults. Earth faults are detected by calculating the sum of the currents. Normally the current sum $I1+I2+I3+I4=0$. If this is not the case you probably have an earth fault and this trigger starts a recording.

On high voltage systems you don't have a neutral conductor and normally don't use channel I4. In this case, select 0 as constant on channel I4 and this trigger will work as intended anyway.

d) Earth fault reference level type (4.3.5)

With setting fixed reference the earth fault trig compares the actual current to 0 Amps and trigs when current is higher than the trig level (c). With setting sliding reference the earth fault trig compares the actual current to a sliding mean current value and trigs when difference is larger than the trig level (c). This is useful if there is an offset (starting) value for the current sum and you want to trig on small deviations from this level. The offset could be because of current unbalance. The sliding reference is a mean value calculated over 1 minute.

Transient triggers (4.4)

Transients are sub-cycle events that are captured on sample level rather than rms values, like sags/swells.

| | |
|---|-----------------|
| 4.4 Transient trig | |
| 4.4.1 U1-U3 switching transient trig at deviation [%Uref] | 40 |
| 4.4.2 Fast transient max trig level [V] | Disabled |
| 4.4.3 Fast Transient RoC trig level [V] | Disabled |
| 4.4.4 Ultra transient max trig level [V] | Disabled |
| 4.4.5 Ultra transient RoC trig level [V] | Disabled |
| 4.4.7 Allow Fast Crosstrigging | No |
| 4.4.8 Allow Ultra Crosstrigging | No |
| 4.4.9 Current transient trig level [A] | Disabled |

| | |
|--|--|
| 4.4.1 U1-U3 switching transient trig at deviation [%Uref] | |
| Transient deviation trig level. 0 = Disabled | |
| 4.4.2 Fast transient max trig level [V] | |
| 0 -> Disabled | |
| 4.4.3 Fast Transient RoC trig level [V] | |
| Max deviation in V over the last 128 μ s (0 -> Disabled) | |
| 4.4.4 Ultra transient max trig level [V] | |
| 0 -> Disabled | |
| 4.4.5 Ultra transient RoC trig level [V] | |
| Max deviation in V over the last 20 μ s (0 -> Disabled) | |
| 4.4.7 Allow Fast Crosstrigging | |
| Allow crosstriggin a switching transient based on a fast transient | |
| 4.4.8 Allow Ultra Crosstrigging | |
| Allow crosstriggin a switching transient based on an ultra transient | |
| 4.4.9 Current transient trig level [A] | |
| Current transient max trig level | |

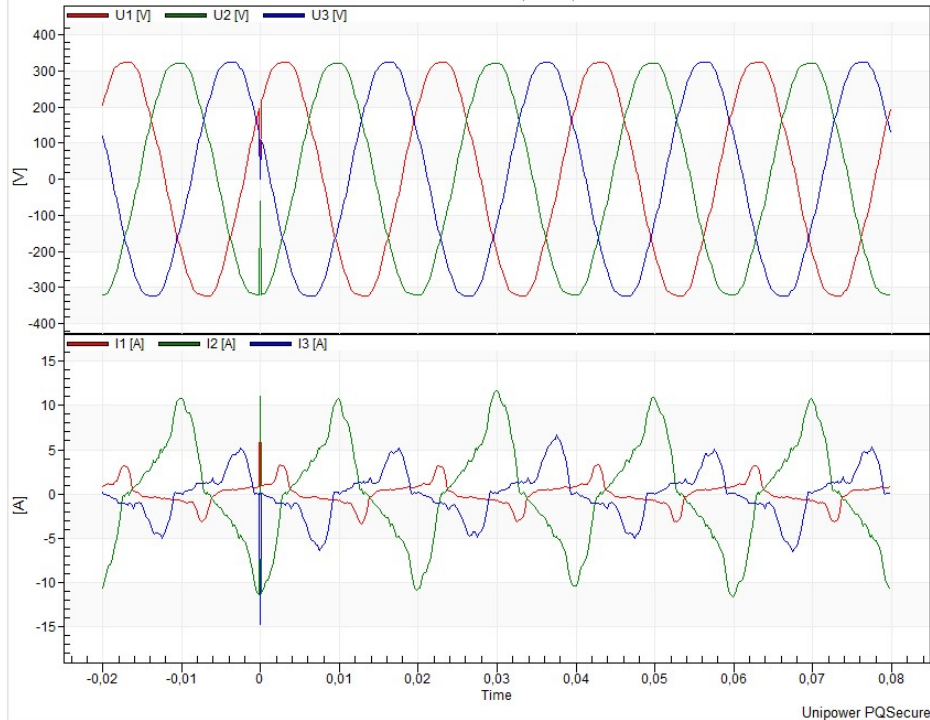
a) Switching transients

Switching transients are the most common ones in the power system. They have a duration in the magnitude of ca 1/256 cycle or ca 57 us @ 50 Hz.

The waveform is compared sample by sample to the previous waveform and whenever there is a deviation between the voltage value in a sample point there is a trig. The trig level is set in % of the reference voltage. 40% Uref is a good starting point but you may have to adjust this level if measuring in the LV network or in an industry where there are more disturbances.

The transient recording is 1 cycle pre-trig and 4 cycles post-trig (a total of 5 recorded cycles).

Example of switching transient:



b) Fast transients

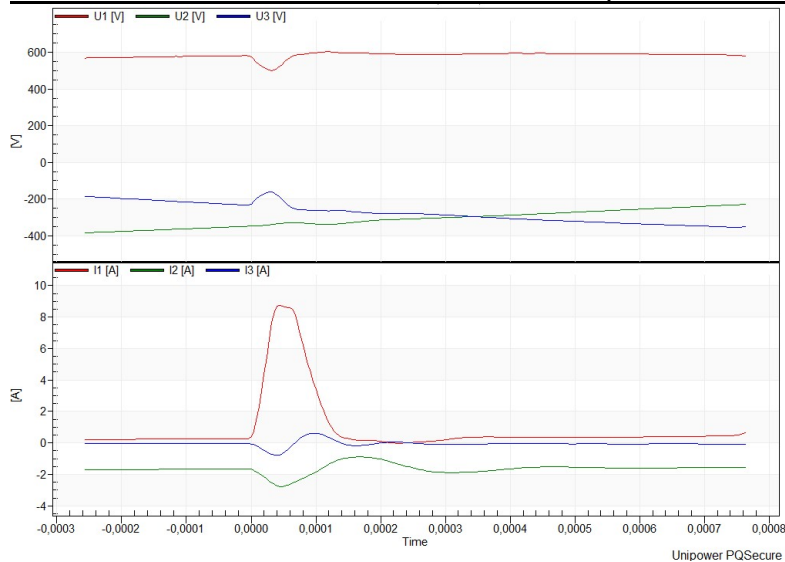
Fast transients have a duration in the magnitude of ca 4 us (1/5000 cycle @ 50 Hz or 1/4200 cycle @ 60 Hz)

A fast transient is captured if:

- i) Max level exceeds the 4.4.2 trig level setting in Volts. Remember that the in the normal case the max value = voltage RMS * $\sqrt{2}$. On 230V LV network peak value is $230 * \sqrt{2} = \pm 326$ V. Max level should be set to 400 V or more. You need to experiment with trig levels depending on situation.
- ii) If the deviation in Volts between each sample point and the 128 us previous sample point exceeds the 4.4.3 trig level setting in Volts. This is a rate of change (RoC) trig. A good starting value could be 50% of Uref. You need to experiment with trig levels depending on situation.

A fast transient is recorded during 1000 us with a 250 us pre-trig.

Example of a fast transient:



c) Ultra-fast transients

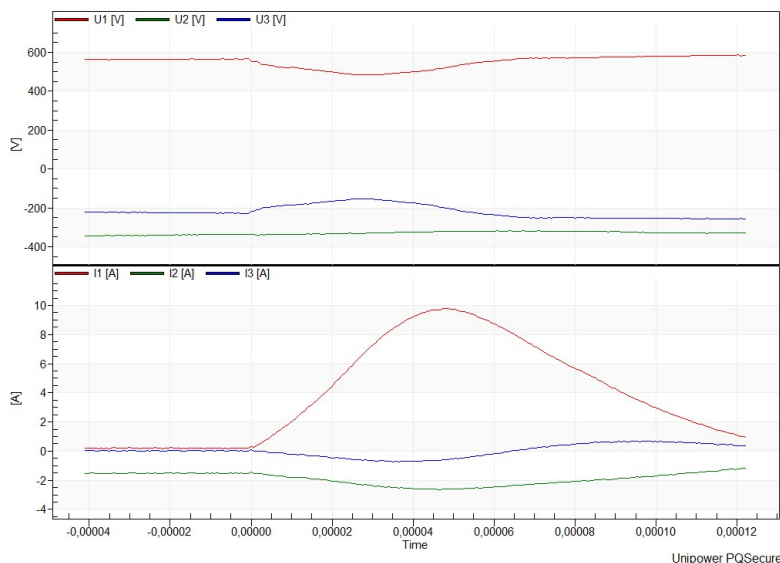
Ultra-fast transients have a duration in the magnitude of ca 650 ns (1/31000 cycle @ 50 Hz or 1/26000 cycle @ 60 Hz)

An ultra-fast transient is captured if:

- i) Max level exceeds the 4.4.4 trig level setting in Volts. Remember that the in the normal case the max value = voltage RMS * $\sqrt{2}$. On 230V LV network peak value is $230 * \sqrt{2} = \pm 326$ V. Max level should be set to 400 V or more.
You need to experiment with trig levels depending on situation.
- ii) If the deviation in Volts between each sample point and the 20 us previous sample point exceeds the 4.4.5 trig level setting in Volts. This is a rate of change (RoC) trig.
A good starting value could be 50% of Uref.
You need to experiment with trig levels depending on situation.

An ultra-fast transient is recorded during 160 us with a 40 us pre-trig.

Example of an ultra-fast transient:



Slowscan Settings (5)

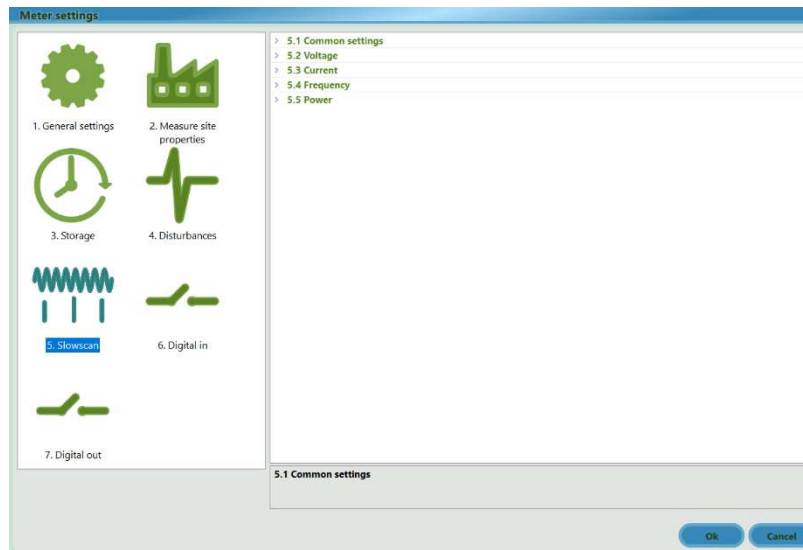


Figure 74

Slowscan is an optional module. Slowscan recording is often used to verify longer disturbances in the electrical network. The type of disturbance could be caused by instability or other major events that influence the network.

During a slowscan recording the RMS values of the parameters are stored with a resolution of 10-100 samples per second.

Since the resolution is lower a longer recording can be made. Maximum pre trig is 30 seconds and maximum recording length (including pre trig) is 300 seconds. For typical grid operations Unipower recommends a configuration of 10 seconds pre trig, 120 seconds post trig. Note that appropriate settings might take some trial and error before you find optimal storage length for your system. If you wish you can configure the meter to automatically stop recording when values are within the limits again.

Common settings (5.1)

| | |
|--------------------------------------|----|
| 5.1 Common settings | |
| 5.1.1 Number of stored values/second | 10 |
| 5.1.2 Recording duration [s] | 60 |
| 5.1.3 Pre trig duration [s] | 10 |
| 5.1.4 Use autostop | No |

5.1.1 Number of stored values/second

Number of values per second that will be stored.

Recording duration [s]

The total recording length including pre trig time. If auto stop is active this will be the total maximum length. [s].

Pre trig duration [s]

The time before the registered trig occurs for which information will be stored [s].

Use autostop

Enabling autostop will automatically stop the recording when the status has returned to normal state.

Voltage triggers (5.2)

| | |
|---|----------|
| ▼ 5.2 Voltage | |
| 5.2.1 U1 - U3 trigs at deviation [% Uref] | Disabled |
| 5.2.2 Hysteresis [% Uref] | 2 |
| 5.2.3 Use sliding reference | No |

U1 - U3 trigs at deviation [% Uref]

Maximum voltage deviation before a recording starts [% Uref].

Use sliding reference

If enabled, the reference level will be following the actual voltage, instead of remaining at a fixed level.

Current triggers (5.3)

| | |
|---|----------|
| ▼ 5.3 Current | |
| 5.3.1 Trig at current rate of change [kA/s] | Disabled |

5.3.1 Trig at current rate of change [kA/s]

Storing 10 times/s and the change dI is 2A between two samples -> $dI/dt = 2A \cdot 10 = 0,02 \text{ kA/s}$

Frequency triggers (5.4)

| | |
|---|----------|
| ▼ 5.4 Frequency | |
| 5.4.1 Maximum frequency deviation | Disabled |
| 5.4.2 Trig at Frequency rate of change [Hz/s] | Disabled |

Maximum frequency deviation

Maximum frequency deviation before a recording starts [%Fnom].

Power triggers (5.5)

| | |
|-------------------------------------|----------|
| ▼ 5.5 Power | |
| 5.5.1 Trig level for P-RoC [MW/s] | Disabled |
| 5.5.2 Trig level for Q-RoC [MVar/s] | Disabled |

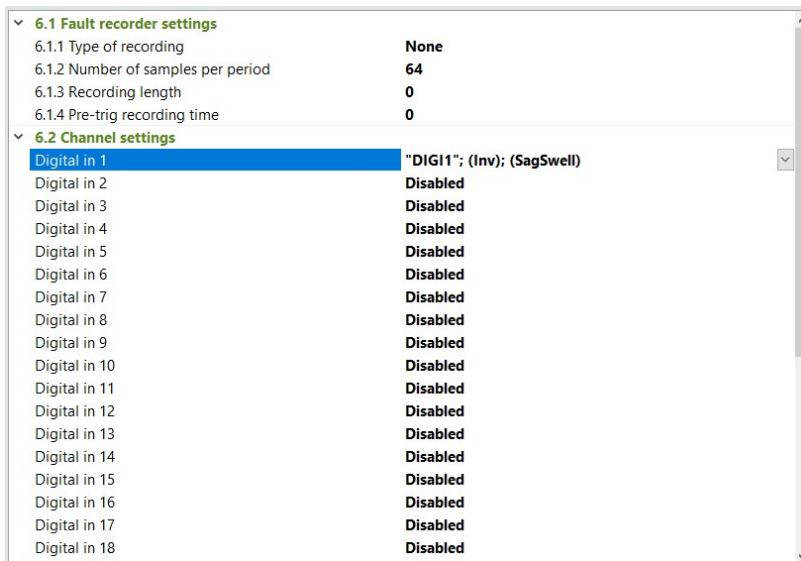
Trig at Frequency rate of change [Hz/s]

Maximum Frequency rate of change that is allowed before a recording starts [Hz/s].

For power parameters the trigger is set on the rate of change (RoC). The system stores 5 values per second. If the change dP is 20 kW between two values, then dP/dt (rate of change) is $20 \text{ kW} \cdot 5 = 0,1 \text{ MW/s}$. Use the setting 0,1 MW/s.

Reactive power Q works in a similar way.

Digital inputs (6)



| 6.1 Fault recorder settings | |
|------------------------------------|------|
| 6.1.1 Type of recording | None |
| 6.1.2 Number of samples per period | 64 |
| 6.1.3 Recording length | 0 |
| 6.1.4 Pre-trig recording time | 0 |

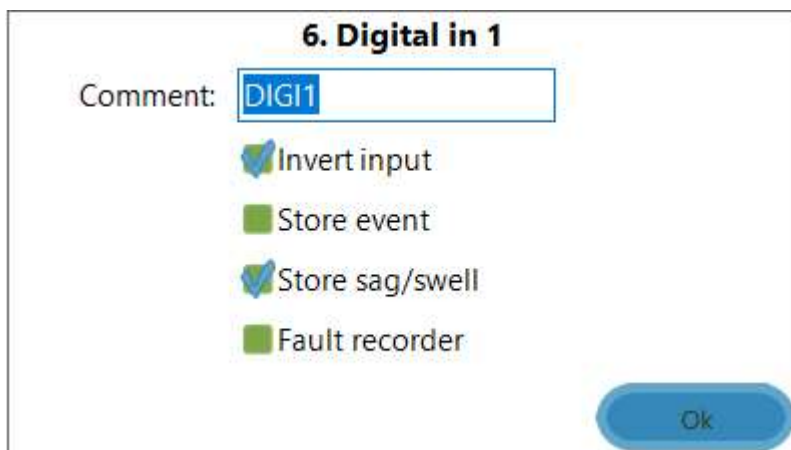
| 6.2 Channel settings | |
|----------------------|----------------------------|
| Digital in 1 | "DIGI1"; (Inv); (SagSwell) |
| Digital in 2 | Disabled |
| Digital in 3 | Disabled |
| Digital in 4 | Disabled |
| Digital in 5 | Disabled |
| Digital in 6 | Disabled |
| Digital in 7 | Disabled |
| Digital in 8 | Disabled |
| Digital in 9 | Disabled |
| Digital in 10 | Disabled |
| Digital in 11 | Disabled |
| Digital in 12 | Disabled |
| Digital in 13 | Disabled |
| Digital in 14 | Disabled |
| Digital in 15 | Disabled |
| Digital in 16 | Disabled |
| Digital in 17 | Disabled |
| Digital in 18 | Disabled |

Digital inputs allows external signals to trig different things in the meter. For physical connections see section 4.7.1)

Each digital input can be configured for different actions as seen in 6.2:

Basic options is to store an event. The comment is a text added to the event and will be seen when evaluating the event in PQ Secure.

Alternatively you can trig a sag/swell recording as defined in 4.1 (see section 10.4.5).



6. Digital in 1

Comment:

☒ Invert input

☐ Store event

☒ Store sag/swell

☐ Fault recorder

Ok

Fault recorder (6.1) (optional)

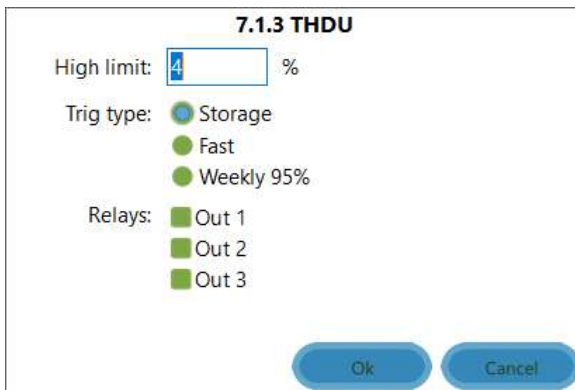
The digital input can trig a fault recording. The recording properties are set in 6.1 (see above).

PQ Control / Digital outputs (7)

The PQ Control module is a way to trig the digital outputs on the meter as a result from PQ events.

Power Quality events (7.1)

Each trigger (like Pst, subharmonics, unbalance etc.) can be set in three different modes_



7.1.3 THDU

High limit: %

Trig type: ☒ Storage
☐ Fast
☐ Weekly 95%

Relays: ☐ Out 1
☐ Out 2
☐ Out 3

Ok Cancel

- Storage mode. The 10-minute values from the statistical memory are used for comparison. When a value exceeds the limit(s) there is a trig on the selected output.
- Fast mode. Fast realtime values are used.
- Weekly 95%. Statistical values are accumulated during 1 week and the 95% value is deducted from that. This is how most PQ norms and grid codes work.

Disturbances (7.2)

Different events like sag/swells and transients can also trig the digital outputs.

PT Voltage lost is a special condition indicating a problem with the PT/VT voltage circuit.

7.2 Disturbances

| | |
|-------------------------|----------|
| 7.2.1 PT Voltage lost | Inactive |
| 7.2.2 Sag/Swell, relays | Inactive |
| 7.2.3 Transient, relays | Inactive |

Weekly 95% settings (7.3)

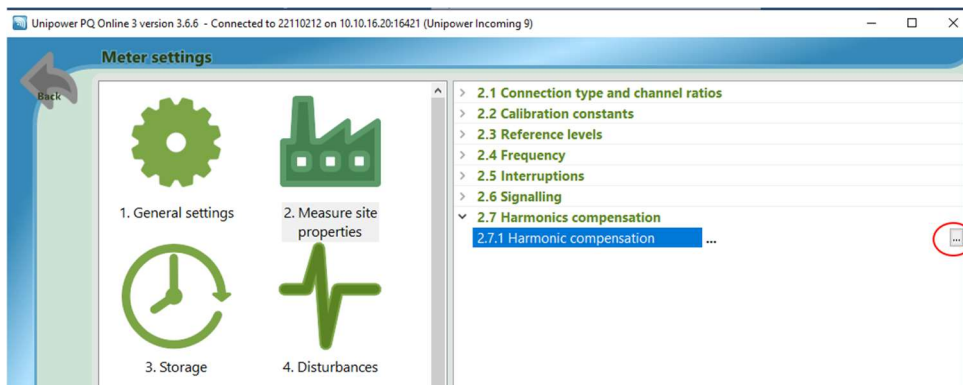
This controls how the weekly values are calculated. The values are used in 7.1 above.

Harmonics (7.4)

In the same way as in section 7.1, individual harmonics can also have their own limits and trig digital outputs.

10.5 Harmonic bandwidth extension HBE (option)

The harmonic bandwidth extension is used for Voltage Transformer frequency correction. The compensation is done for each harmonic component, both amplitude and phase angle error. The compensation is done in PQ Online, in the advanced meter configuration window (2.7.1). Press the three dots.



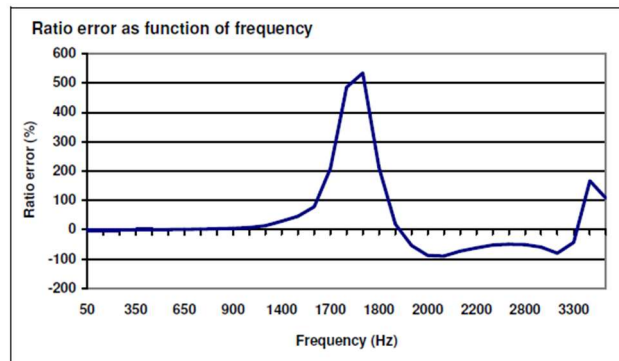
| Harmonic | U1 Amplitude | U1 Phase | U2 Amplitude | U2 Phase | U3 Amplitude | U3 Phase | U4 Amplitude | U4 |
|----------|--------------|----------|--------------|----------|--------------|----------|--------------|----|
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 3 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 4 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 5 | 1,05 | +10 | 1 | 0 | 1 | 0 | 1 | |
| 6 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 7 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 8 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 9 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 10 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 11 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 12 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 13 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 14 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 15 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |

To remove all compensation, you can press the button “Reset to default”. This will set all amplitude compensation to 1.0 and all phase angles to 0°. The amplitude compensation range can be set to between 0.0 and 10.0 and the phase angle compensation is between -180° to +180°.

Parameters that will be influenced by the harmonic compensation parameters are:
Harmonic Amplitude, Harmonic Phase, THD values, Voltage Unbalance, Current Unbalance, K-factor.

Text information can be copied from Excel into the Harmonic compensation sheet.

The picture below shows an amplitude/frequency graph of a magnetic 130kV voltage transformer. In this case the amplitude compensation for harmonic 35 (1750Hz) can be set to 0.2 to eliminate the majority of the PT error.



10.6 Real-time



The real time values accessible from PQ Online are a useful tool when ensuring correct installation and configuration.

Make a habit of always checking installation and configuration through real time analysis before starting a measurement!

In order to investigate the real time values of the measure site click the **real-time** button in the home screen of PQ Online.



Figure 75

10.6.1 Values tab

The first of the real time tabs accessible is the values tab. In this tab you may access numeric values and plots of basic electric power parameters.

When investigating values before a measurement, focus on the quantity of each parameter. Make sure that all parameters are within plausible levels.

- Check the voltage, current and frequency levels*
- Check active, reactive and apparent power levels and polarity
- Plot a graph over some of the parameters
- Move on to the oscilloscope tab

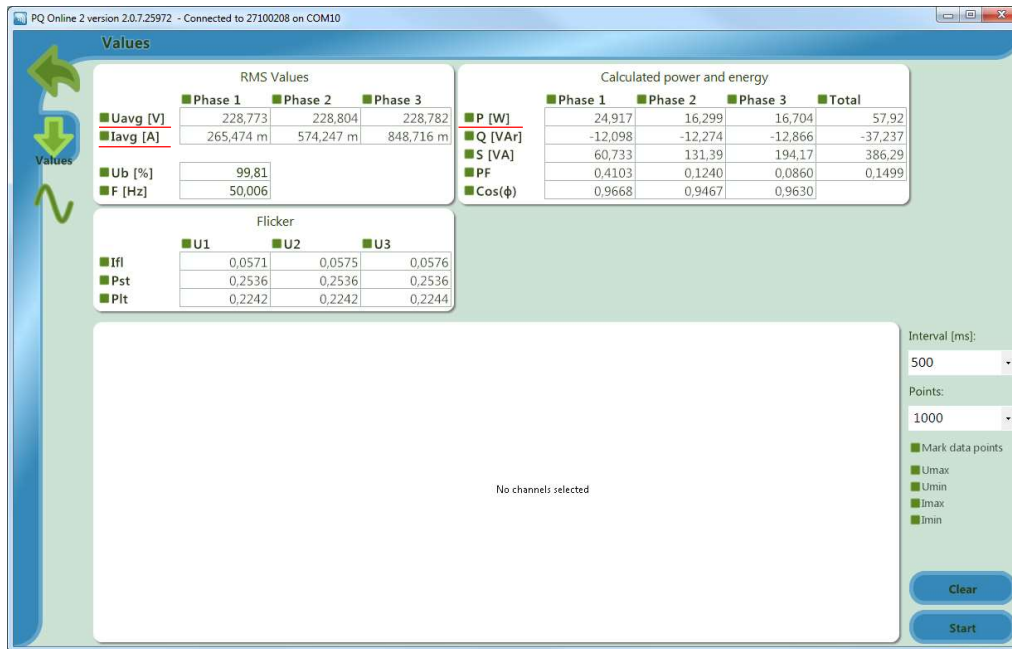


Figure 76

Plotting PQ parameters in a trend graph gives a brief overview of the power quality at the measure site. And can be a good way of quickly oversee the electrical network in the local measurement area.

Note that real time measurements may never replace logging of data under a longer period.

* * If the voltage or current has faulty RMS values, check the constants under the wiring tab in the configuration (see section 10.3)

**If the power quantities are presented with wrong polarity (for example + instead of -) revise the direction of the current clamps, alternatively change the calibration constant to a negative.

10.6.2 Trend graph

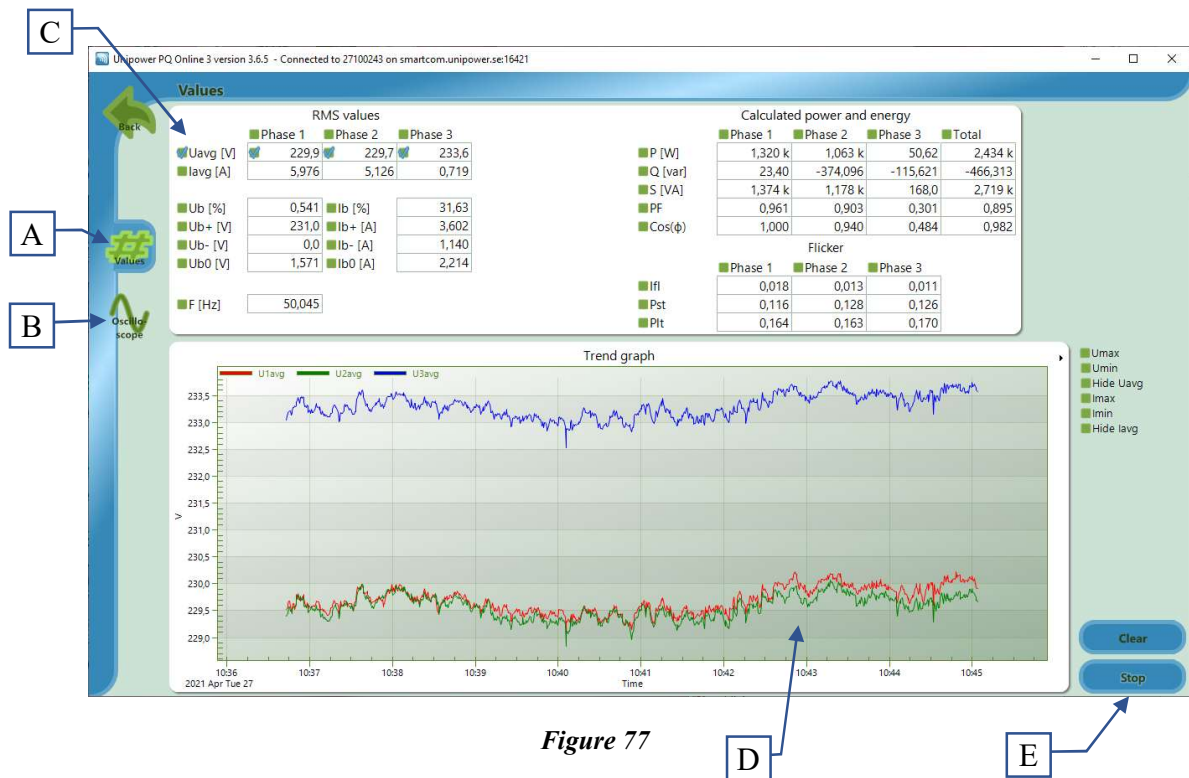


Figure 77

PQ Online includes a real-time function allowing you to contact a meter in order to study the measured power quality parameters in real time. The dialogue contains two tabs **A** and **B**, each with a different way of presenting the information. This function is also very useful for verifying that the meter has been installed correctly before starting the actual measurement.

You can also click the start button **E** to show the variation of the selected **C** power quality parameters over time. The purpose of the trend monitor is to give a quick overview of the power quality without having to download data. If you wish to see more parameters or view events that occurred further in the past, downloading is necessary.

By clicking on the Y axis of the graph you can manually lock the max and min values of the axis so that it is not automatically scaled.

☒ Lock axis

Max:

Min:

Ref:

Figure 78

Right clicking on the graph brings up the context menu with multiple options to adjust the graph, specifically note the Interval and History size options.

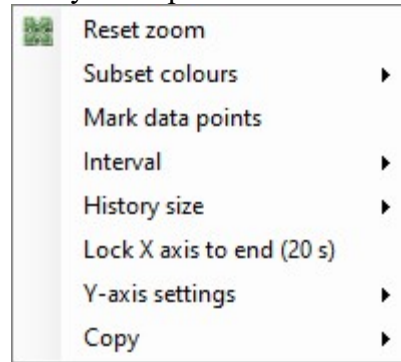


Figure 79

- Reset zoom: Undoes all zoom actions performed on the graph.
- Subset colors: Allows you to change the colors used in the graph.
- Mark data points: Turns on or off marks for individual data points in the graph.
- Interval: Specifies the interval between each datapoint in the graph, adjustable between 100ms and 5s.
- History size: Specifies the maximum number of datapoints in the history of the graph, adjustable between 30 and 2000 points.
- Lock X axis to end: changes the size of the viewing windows without affecting the size of the history while always showing the latest data the length of the window is configurable up to the length of the total data.
- Copy: Copies either the graph data or the graph image to the clipboard.

10.6.3 Oscilloscope tab

If you press the Oscilloscope tab **B**, following window appears.
This tab shows the waveform of the measured voltage and current.

- To plot the graphs, vectors or bars click the desired PQ parameter (marked in red below)
- Check that the phase angle between phases are between -90° and 90° (in the first and fourth quadrant) *
- If the phase angles seem to mismatch check the direction of the arrow on the current clamps. The arrow should always point in the direction of the load.
- To maximize one of the windows, press the top right maximize symbol in each window.
- If the graphs show correct connection and configuration proceed to start the measurement.



Figure 80

*The phase angle should always be between -90° and 90° (phase angle $< \pm 90^\circ$) if the meter is measuring over a load, respectively the phase angles should be more than 90° and -90° (phase angle $> \pm 90^\circ$) if the meter is measuring over production of energy

Communication settings

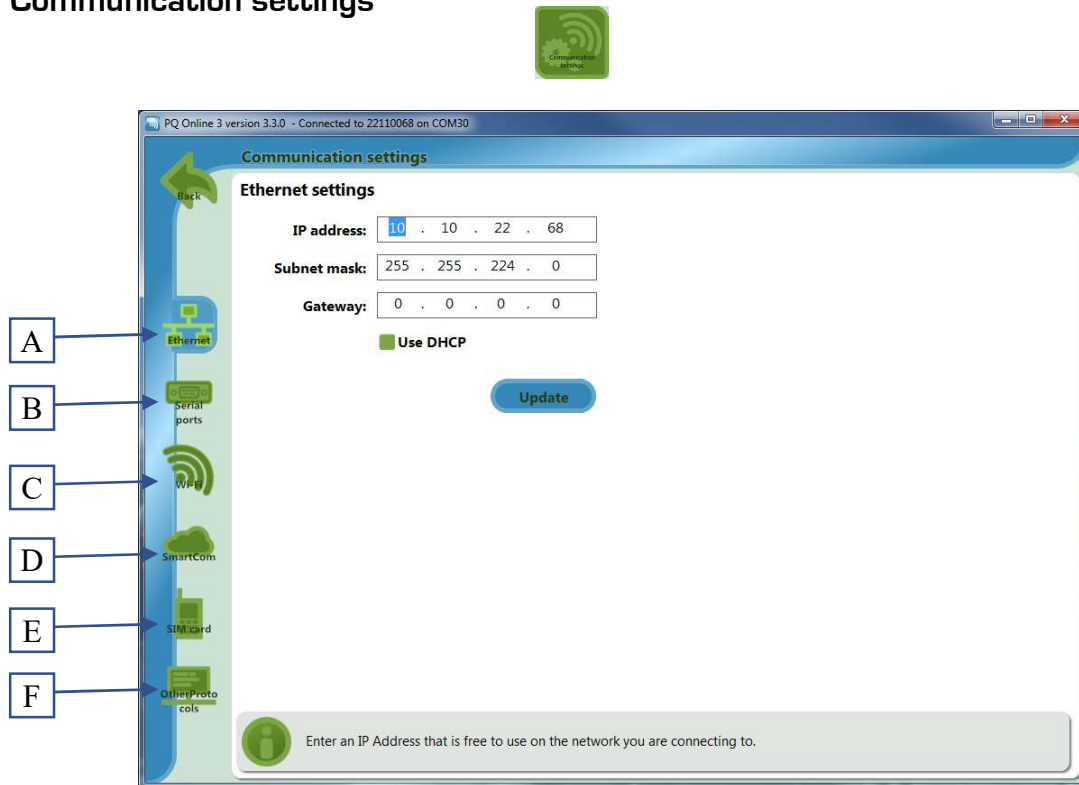


Figure 81

In communication settings there are several settings tabs depending on communication type.

- A, Settings for Ethernet
- B, Settings for Serial ports
- C, Settings for Wi-Fi
- D, Settings for SmartCom
- E, Settings for SIM card
- F, Settings for Other Protocols

10.6.4 Ethernet

Typical settings for connection to LAN is shown below. You must use a unique, fixed ip address (ask your IT department for one).

Ethernet settings

IP address: 10 . 10 . 16 . 20

Subnet mask: 255 . 255 . 255 . 0

Gateway: 10 . 10 . 16 . 103

☒ Use DHCP

Update

Figure 82 Ethernet settings

Gateway is not necessary for local access. If you need to access the meter beyond a router (or gateway) you need to set the gateway address. The IT department can help you with the gateway address. DHCP is not used in most installations. **If the meter has two ethernet ports make sure that the ip addresses are on different nets!**

10.6.5 DHCP and SmartCom

If you use Unipower SmartCom communications you must activate DHCP. The meter will then automatically ask the system for an ip address and get one.

Convenient, but **works only with SmartCom**. If you use DHCP you no longer know what ip the meter gets and you can't connect in the traditional way.

When using SmartCom you must enter the SmartCom server address like below and activate the function:

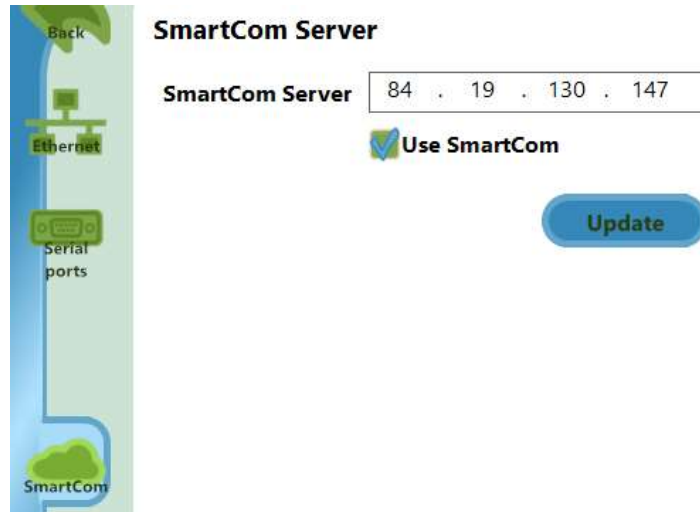


Figure 83 SmartCom settings

Now you can connect using SmartCom from PQ Online:

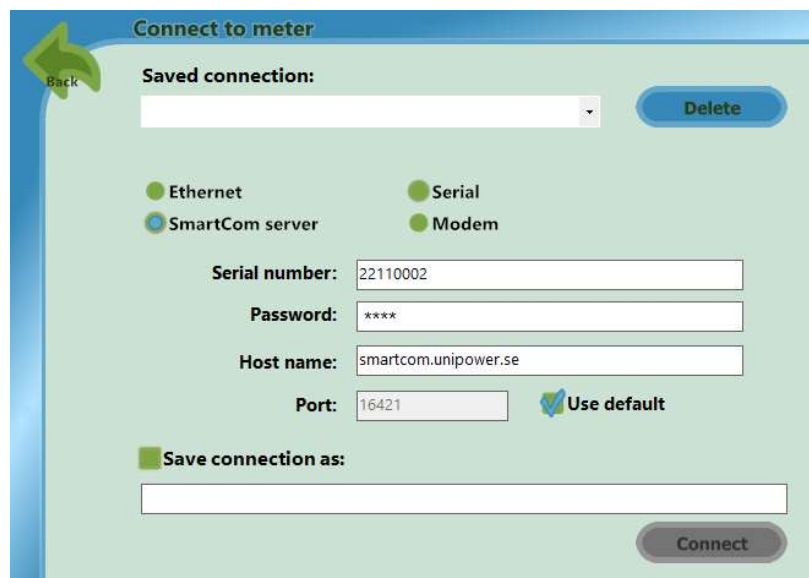


Figure 84 Connect using SmartCom

Note that SmartCom is a service provided by Unipower and you need to have a valid subscription of this before activating this function.

Contact your local representative for more information.

10.6.6 IEC 61850

Optional. The meter supports IEC 61850, see separate documentation.

10.6.7 TLS Encryption

If communication security is of a great concern, there is an option to enable TLS encryption. This is an optional feature which requires a license to enable. Furthermore, a certificate and a private key need to be uploaded to the measuring device. Such a certificate and a key can be generated using a tool like OpenSSL (downloadable from www.openssl.org). The only supported file format is “.PEM”.

The following Command Prompt example generates a certificate using OpenSSL:

```
C:\Program Files\OpenSSL-Win64\bin>openssl req -new -newkey ec -pkeyopt ec_paramgen_curve:prime256v1 -x509 -nodes -days 3650 -subj "/C=PQ" -out C:\whatever\outputdir\2210hardwarecert.pem -keyout C:\whatever\outputdir\2210hardwarekey.pem
```

The “2210hardwarecert.pem” and “2210hardwarekey.pem” files can then be uploaded to the meter using PQ Online under Communication Settings/Ethernet.

Tick the upload certificate checkbox and click “TLS Certificate...” and select “2210hardwarecert.pem”. Click “TLS private key...” and select “2210hardwarekey.pem” and click “Update” to install the certificate.

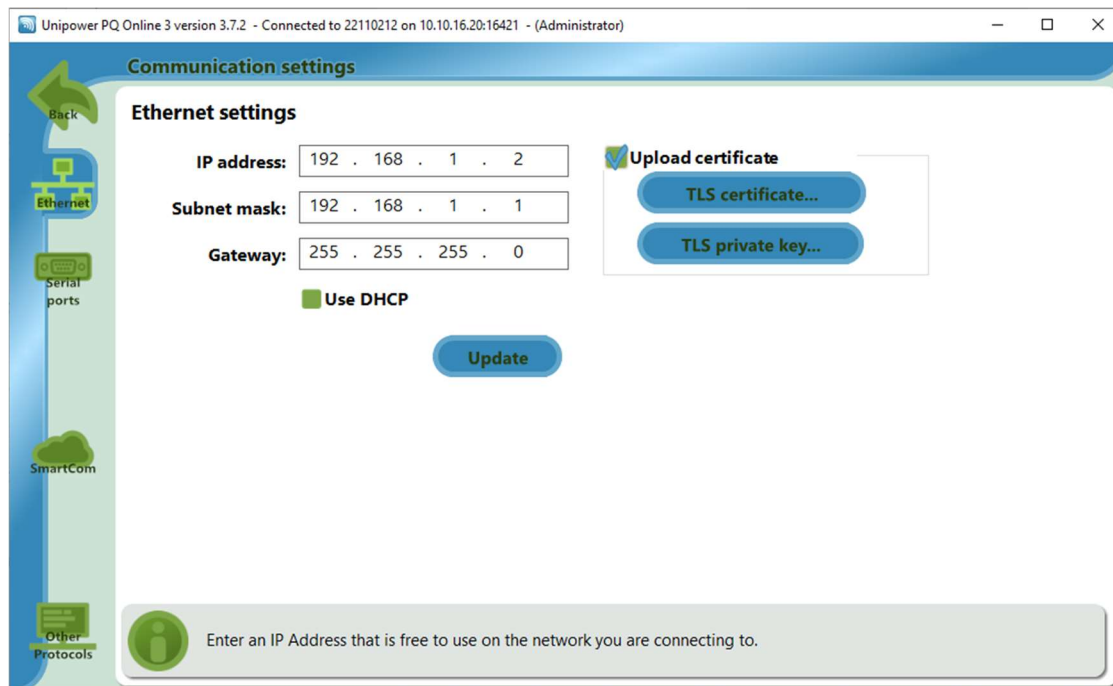


Figure 85

10.7 Download data

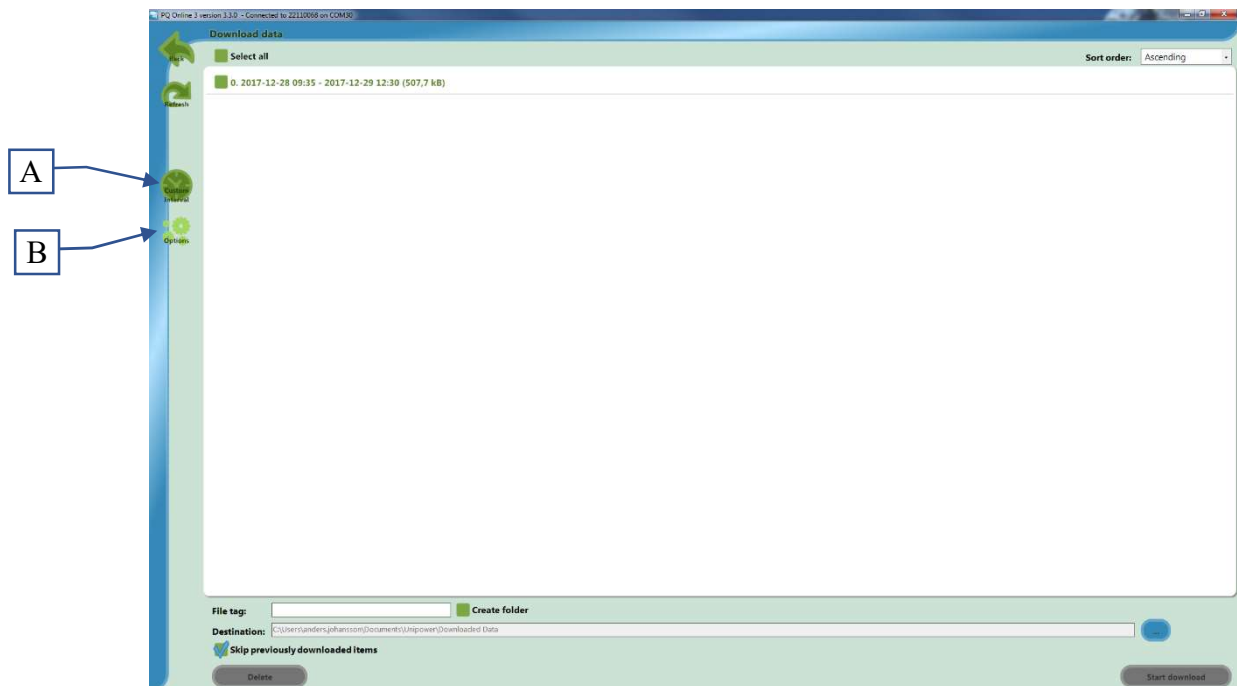


Figure 86

In Download data window you can select the file to be downloaded. Pressing Custom Interval tab **A** gives you opportunities to specify an interval from the file that you will download data.

In the Options tab you can setup file tag and destination folder for the downloaded file.

10.8 Tools

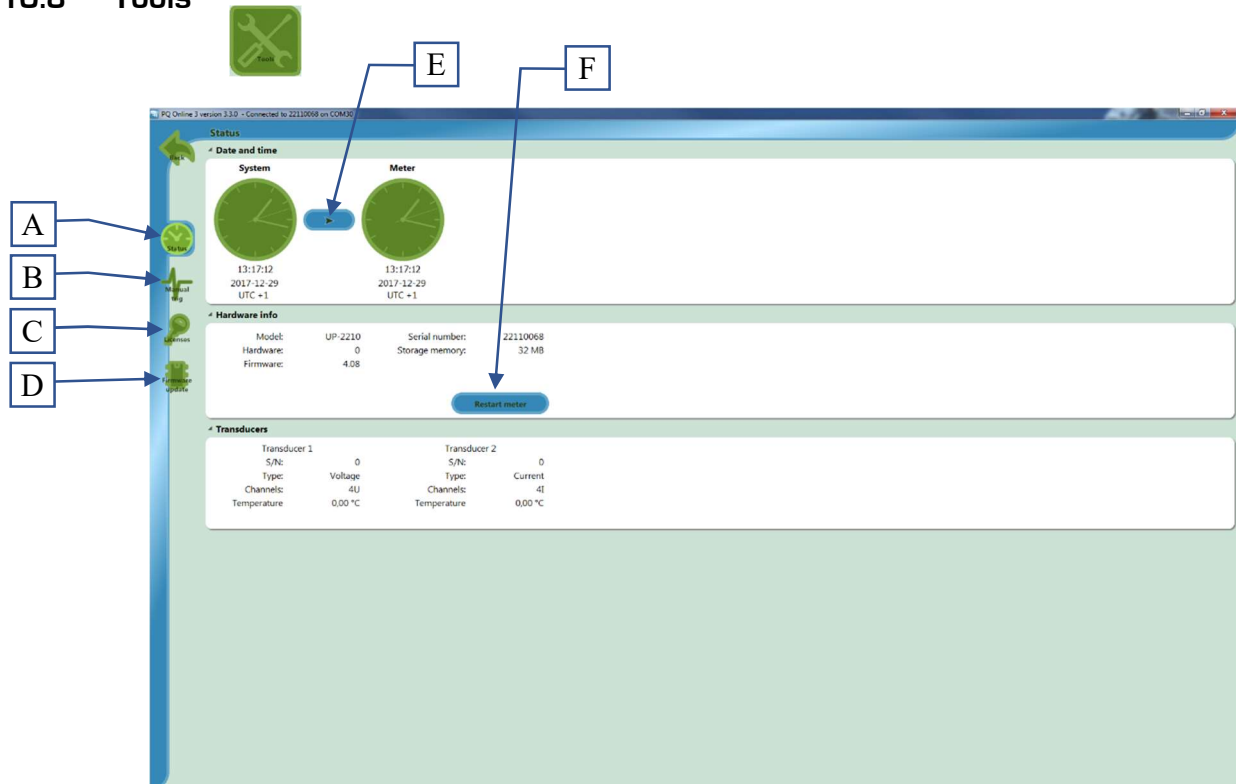


Figure 87

In Tools there are four tabs.

A, Status tab. In status tab you can see Date and time info for the meter, Hardware info and transducer info. You can set the time in meter to same time as in System by clicking on arrow **E**. You can restart the meter by pressing on restart meter button **F**.

B, Manual trig tab. Here you can manually trig a sag, transient or a slowscan.

C, License tab. In license tab you see the actual licenses for the meter.

D, Firmware tab. There is also a way to upgrade the firmware in the meter. Here you specify the file and firmware update code.

10.9 Language

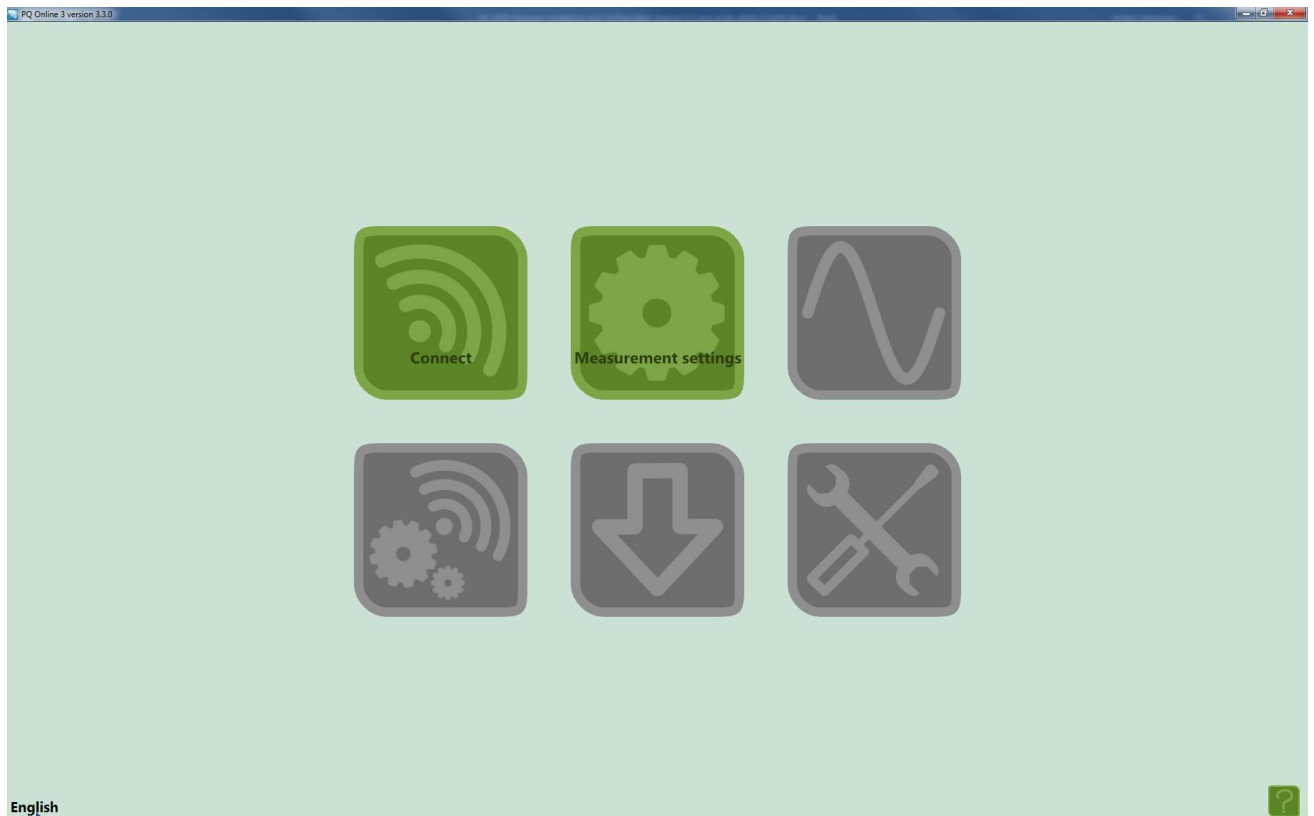


Figure 88

In the startup window for PQ Online you can set language by clicking on the actual language **A**. Choose the language you want from the dropdown list.

10.10 USB port

The meter UP-2210 is equipped with a USB port. This port doesn't need any settings. We recommend you install and use the *UniLauncher* software (see "PQ Secure SQL User and software installation manual"). Just connect the USB cable between meter and computer and UniLauncher will automatically connect PQ Online.

10.11 Upgrading meter firmware

The meter firmware controlling all the meter's functions is software upgradable. If you have a support agreement you have access to service upgrades of the meter firmware. Check further with your local representative on how to get files and upgrade codes.

This is how you do the upgrade.

1. Connect the meter to AC power. **Important! Do not run only on battery and do not interrupt power during the process. Your meter can be severely damaged!**
2. Start PQ Online and connect to the meter. Go to the Tools menu. Select the firmware update menu:

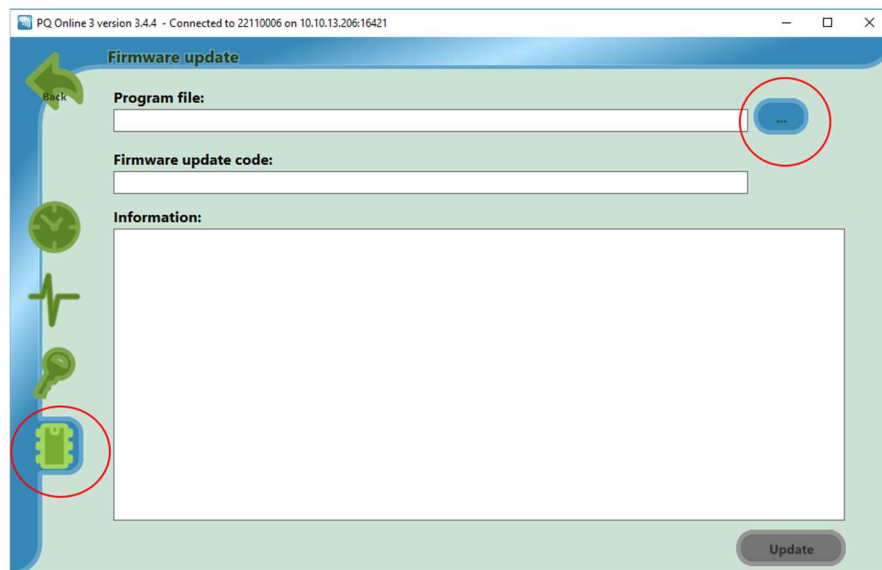


Figure 89

3. Browse to the firmware (program) file. **Important! Only try upgrade with certified and approved firmware files for your meter from Unipower! Your meter can be severely damaged!**

4. Enter the **update code** and press Update:

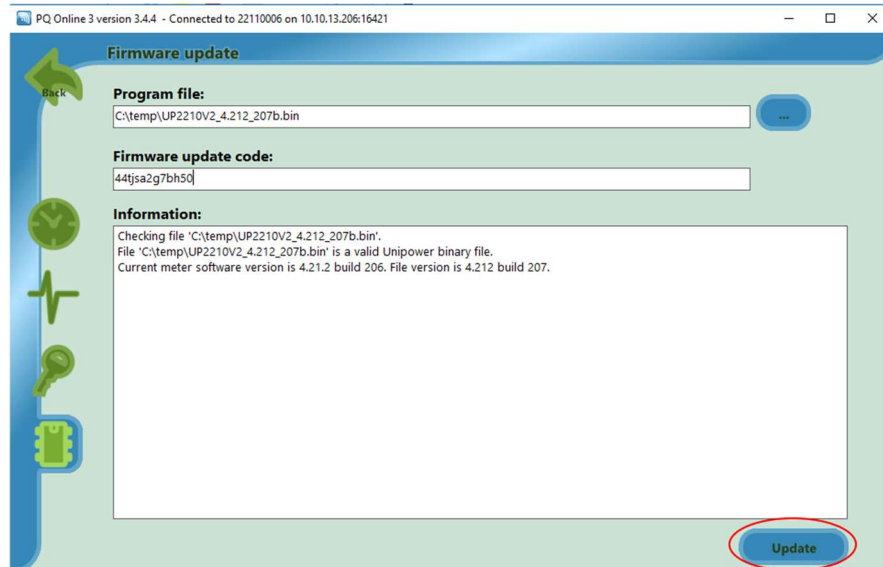


Figure 90

5. Let the process finish, it can take several minutes. Don't disconnect or unplug the meter during the update!

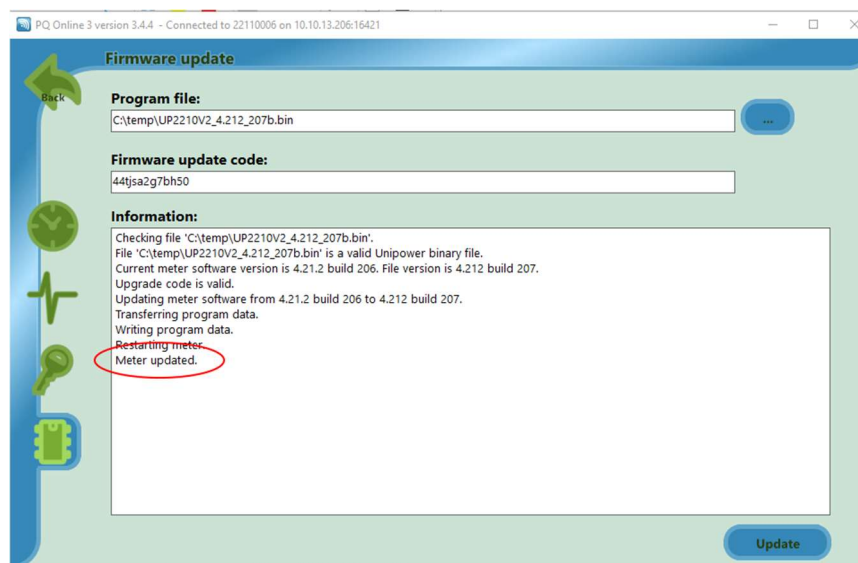


Figure 91

6. When the meter is ready the text “**Meter updated**” is written in the information window.
7. You can verify that the update was successful by checking the version in the Status window:

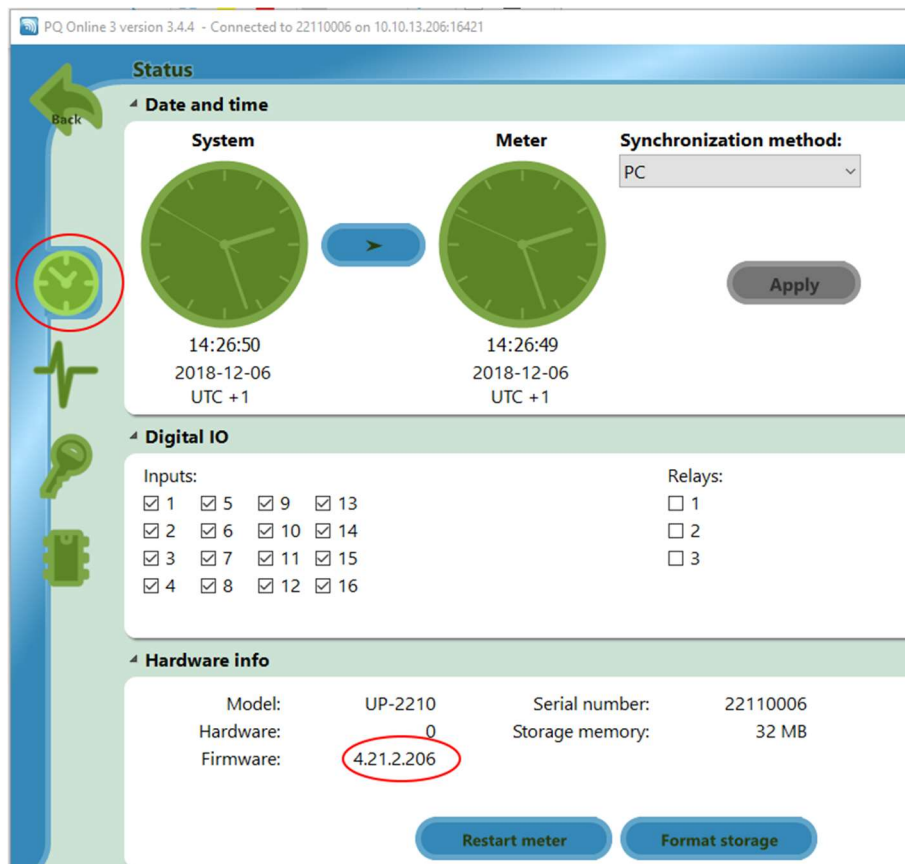


Figure 92

10.12 Adding meter options

Some meter options are “soft” and can be activated by a license code. Check further with your local representative on your meter’s capabilities and on how to get license codes.

To activate a soft meter option, go to the Tools menu, enter the license code and press **Add**. The option/license will appear in the window.

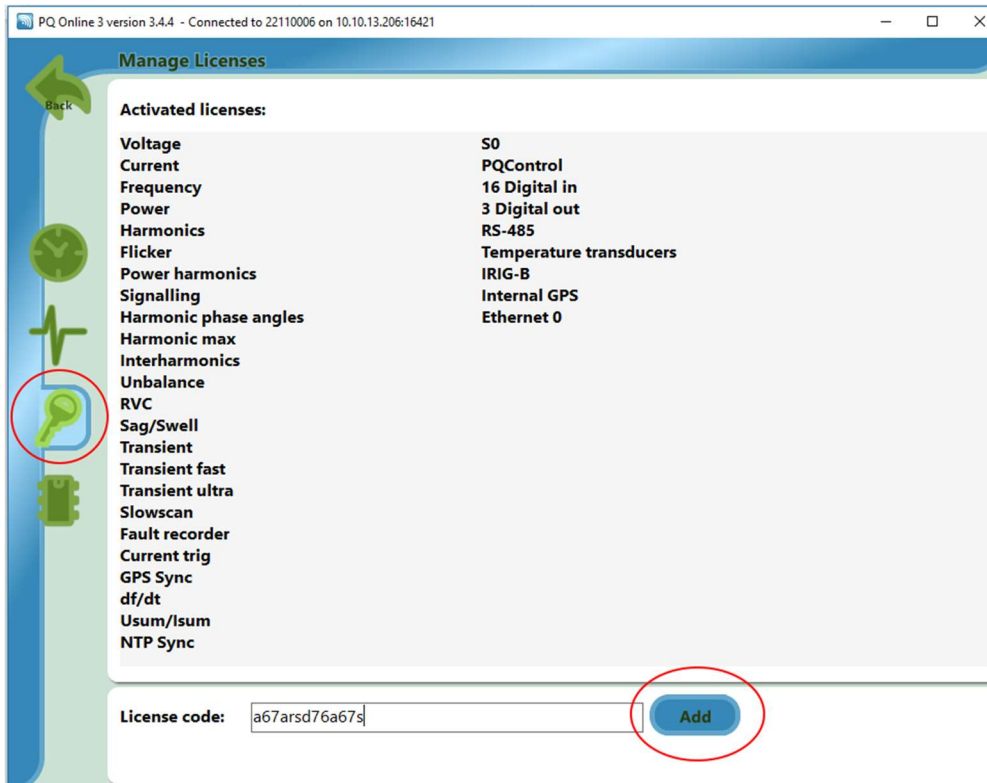


Figure 93

10.13 PQ Online login

If PQ Online has been installed with the command line parameter “FORCELOGIN=YES” an additional step is required before connecting to a meter.

First the database connection information must be entered so that PQ Online can connect to the PQ Secure database in order to determine which level of access the user will be given when running PQ Online.

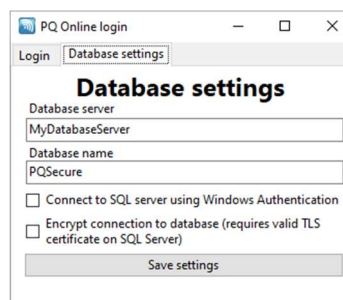


Figure 94

Secondly, enter your credentials and you can continue to run PQ Online as instructed in 10.1.

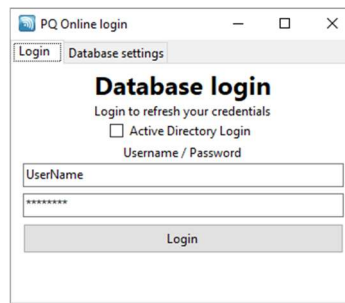


Figure 95

There are three levels of access determined by permissions in the PQ Secure system:

Administrator – Full access to all functionality in PQ Online.

Operator – Full access to everything in PQ Online except communication settings.

Observer – Access is restricted to viewing settings and real time data.

11 APPENDIX – COMISSIONING CHECKLISTS

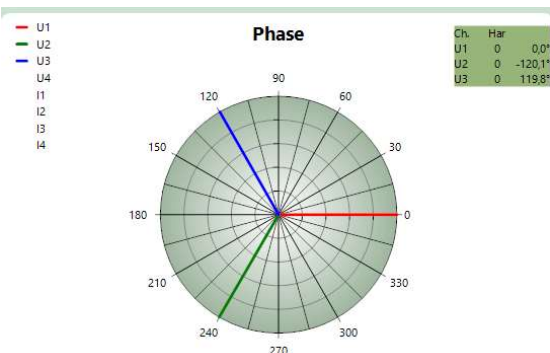
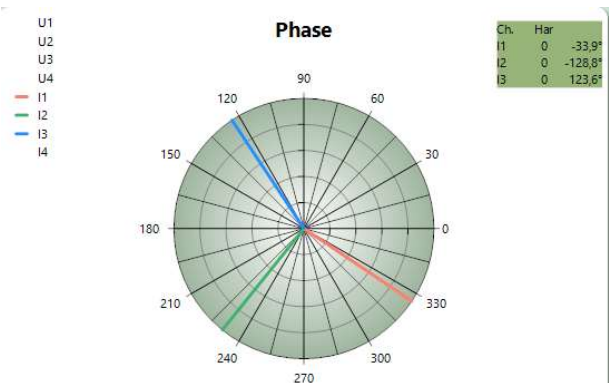
11.1 Meter Installation Checklist

Use this checklist when you install a new meter on site.

| 1 | Configuration of meter | OK | Comments |
|-----|--|--------------------------|----------|
| | PQ Secure system/meter owner contact information: Company: _____ Name: _____ E-mail: _____ Telephone: _____ | | |
| 1.0 | Installation date: _____ | | |
| 1.1 | Information about meter: Meter name: _____ Serial no: _____ Location: _____ Location label: _____ Line: _____ Bus bar: _____ Group: _____ Cabinet: _____ Voltage level (primary/secondary): _____ / _____ kV Supply voltage: _____ <input type="checkbox"/> AC <input type="checkbox"/> DC Supply voltage protection (UPS): <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> | |

| | | | |
|-------|---|--------------------------|--------------------------|
| 1.2 | <i>Installed communication equipment</i> | | |
| 1.2.1 | Ethernet Unit IP: _____ Gateway: _____ Subnet mask: _____ | <input type="checkbox"/> | |
| 1.2.2 | Modem <input type="checkbox"/> PSTN <input type="checkbox"/> ISDN <input type="checkbox"/> GSM Phone no: _____ | <input type="checkbox"/> | |
| 1.2.3 | GPRS/4G Modem Unit IP: _____ Port number (standard 16421): _____ | <input type="checkbox"/> | |
| | | | |
| 1.3 | Configuration 1) New <input type="checkbox"/> 2) From file <input type="checkbox"/> Name: _____ | | <input type="checkbox"/> |
| 1.3.1 | State type of wiring connection (with no. of PT/CT): 1) 4 wire <input type="checkbox"/> _PT_ CT <input type="checkbox"/> Direct measurement? 2) 3 wire Δ <input type="checkbox"/> _PT_ CT <input type="checkbox"/> Direct measurement? 3) Single phase <input type="checkbox"/> PT&CT <input type="checkbox"/> Direct measurement? 4) Split phase <input type="checkbox"/> PT&CT <input type="checkbox"/> Direct measurement? | | <input type="checkbox"/> |
| 1.3.2 | State selected configuration number in PQ Online: _____ | | <input type="checkbox"/> |
| 1.3.3 | Potential/voltage transformer (PT): 1)Primary side voltage _____kV 2)Secondary side voltage _____kV 3)Calibration constant (if any) _____ | | <input type="checkbox"/> |
| 1.3.4 | Current transformer (CT): 1)Primary side current _____A 2)Secondary side current _____A 3)Calibration constant (if any) _____ | | <input type="checkbox"/> |
| | | | |

| | | | |
|-------|--|--------------------------|--|
| 1.4 | <i>Reference and trig levels</i> | | |
| 1.4.1 | Select measuring standard (1.1.4) <input type="checkbox"/> EN50160 (recommended) <input type="checkbox"/> Custom | <input type="checkbox"/> | |
| 1.4.2 | System frequency (2.4.1) <input type="checkbox"/> 50Hz <input type="checkbox"/> 60Hz | <input type="checkbox"/> | |
| 1.4.3 | Reference voltage (2.3.1) _____ V (as measured by channel U1) Recommendation is given by configuration guide | <input type="checkbox"/> | |
| 1.4.4 | Reference current (2.3.3) _____ A (as measured by channel I1) Recommendation is given by configuration guide | <input type="checkbox"/> | |
| 1.4.5 | PQ parameter calculation (1.1.3): <input type="checkbox"/> Line-Line <input type="checkbox"/> Line-Neutral Recommendation: low voltage: L-N high voltage: L-L | <input type="checkbox"/> | |
| 1.4.6 | Type of voltage reference (4.2.3): <input type="checkbox"/> Fixed <input type="checkbox"/> Sliding Recommendation: low voltage: fixed high voltage: sliding | <input type="checkbox"/> | |
| 1.4.7 | Sag/swell trig level (4.2.1) <input type="checkbox"/> _____ % Recommended 10% | <input type="checkbox"/> | |
| 1.4.8 | Switching transient trig level (4.4.1) <input type="checkbox"/> _____ % Recommended 40% | <input type="checkbox"/> | |
| 1.4.9 | Flicker Lamp <input type="checkbox"/> 230V <input type="checkbox"/> 120V Recommendation: On HV select based on dependent LV network | <input type="checkbox"/> | |
| 1.5 | <i>Channel 4</i> | | |
| 1.5.1 | Is U4 used? YES _____ NO _____ If no skip next step. Channel U4 configured settings: (found in advanced section) U4 reference voltage (2.3.2) _____ V 0=channel disabled U4 sag trig level (4.2.4) _____ V If ground fault monitoring select ca 10% of nominal voltage. Note! Value is stated in Volts . | <input type="checkbox"/> | |
| 1.5.2 | Is I4 used? YES _____ NO _____ . If no skip next step. Channel I4 configured settings: (found in advanced section) I4 reference voltage (2.3.4) _____ A 0=channel disabled I4 sag trig level (4.3.3) _____ A If ground fault monitoring select ca 10% of nominal voltage. Note! Value is stated in Amps . | <input type="checkbox"/> | |
| 1.6 | Advanced settings (optional). Note! Changing the advanced settings may result in a non-normative measurements | | |
| 1.6.1 | Advanced settings (write down changed settings here): . | <input type="checkbox"/> | |

| | | | |
|----------|---|--------------------------|--|
| 1.7 | Last steps | | |
| 1.7.1 | Enter a setting name _____ Enter your signature_____ | <input type="checkbox"/> | |
| 1.7.2 | Save the configuration to a file (optional). | <input type="checkbox"/> | |
| 1.7.3 | Select Finish to store and activate the settings in the meter | <input type="checkbox"/> | |
| | | | |
| 2 | Check the connection/wiring | | |
| 2.1 | Check nearby equipment (if possible) to verify that measured values are reasonable and good. If not, go back and troubleshoot configuration and wiring. | <input type="checkbox"/> | |
| 2.2 | <p>Check vector diagram. The voltage phase sequence should be U1 red (0°) U2 green (-120°) U3 blue (+120°)</p>  | <input type="checkbox"/> | |
| 2.3 | <p>Check vector diagram. Each current should be within +/-90° from its corresponding voltage</p>  | <input type="checkbox"/> | |
| 2.4 | Check the real time waveform to ensure that voltage and current doesn't clip, which could indicate overload of instrument input. | <input type="checkbox"/> | |

| | | | |
|------|--|--------------------------|--|
| 2.5 | Check that PF is >0.7 on all phases as well as total | <input type="checkbox"/> | |
| 2.6 | Check that P is positive for each phase (if not measuring on a generator) | <input type="checkbox"/> | |
| 2.7 | Check that unbalance is low (high value means wrong phase sequence) | <input type="checkbox"/> | |
| 2.8 | Check measure status page and be sure the sag/swell and transient trig counters are not counting repeating events. This could indicate bad trigger settings. | <input type="checkbox"/> | |
| 2.9 | Erase all old data in the meter | <input type="checkbox"/> | |
| 2.10 | Set clock in meter (using PQ Online) | <input type="checkbox"/> | |

Date: ____ - ____ - ____

| | |
|---|----------------------|
| Installation performed by (signature): | Printed name: |
| Report received by (signature): | Printed name: |

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