PTS 400.3 PLUS
Modular three-phase Portable Test System
Operation Manual

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1. Safety

The following symbol appears on the product and in the operation manual with the meaning:

Caution! Please consult the operation manual before using the instrument.
Failure to follow or carry out instructions preceded by this symbol may result in personal injury or damage of the device and the installation.

General precautions for use

To prevent electric shock:

- **This product has to be only used by qualified personnel practicing applicable safety precautions.**
- **Use caution during installation and use of this product; high voltages and currents may be present in circuit under test.**
- **Local safety regulations must be observed.**

1.1 Safety Guidelines

The information in this chapter is intended to protect you and the devices but cannot cover all possible safety aspects.

In any case, the local safety regulations must be observed!

Death or serious injury may result if proper precautions are not taken. Property damage can occur if the appropriate precautionary measure is not taken. An undesirable result or condition may occur if the corresponding note is ignored.

In cases where two or more levels of danger apply, only the most severe level warning is used. For the personal safety of the installation and operating personnel, please observe and follow the safety instructions in this chapter of the manual!

1.1.1 Safety

This technical file contains detailed descriptions to safely and properly install, connect, commission, and monitor the product.

- Read this technical document carefully to familiarize yourself with the product.
- This technical document is part of the product.
- Read and pay special attention to the safety instructions in this chapter.
- Observe the warnings in this technical document to avoid dangers arising from the operation.
- The product is manufactured according to the state of the art. Nevertheless, dangers to life and limb of the user or impairments of the product and other material assets may occur due to functional use.

1.1.2 Warning Symbols

1.1.2.1 General Warning Sign

The "General warning symbol" indicates that special instructions apply in this chapter.

1.1.2.2 Warning of electrical voltage

The "Warning of electrical voltage" indicates dangerous voltages in this area

1.1.3 Intended Use

This device is especially appropriate for test laboratories to perform compliance, acceptance or type test of electricity meters and different types of power, energy and power quality measurement devices.

1.1.4 Basic safety instructions

To prevent accidents, breakdowns, accidents and environmental damage, the person responsible for the transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

1.1.4.1 Personal protective equipment

Loosely worn or unsuitable clothing increases the risk of danger for getting caught on protruding parts. This poses a danger to life and limb.

- Have all the necessary equipment ready and wear the personal protective equipment required for the job, such as helmet, protective work shoes, etc. Also observe the section "Personal protective equipment".
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces and other jewelry.

1.1.4.2 Workspace

Messy and unlit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure the work area is well lit.
- Comply with applicable accident prevention legislation in the country.

1.1.4.3 Explosion protection

Highly flammable or explosive gases, vapors and dusts can lead to severe explosions and fire.

- Do not operate the product in potentially explosive atmospheres.

1.1.4.4 Safety information

Warning labels and safety labels are an important part of the security concept.

- Observe all safety labels on the product.
- Keep all safety labels on the product complete and legible.
- Replace damaged or obsolete safety markings.

1.1.4.5 Environmental conditions

To ensure reliable and safe operation, the product must be operated under the ambient conditions specified in the technical data only.

- Observe specified operating conditions and site installation requirements.

1.1.4.6 Changes and conversions

Unauthorized or improper modifications of the product may result in personal injury, property damage or malfunction.

- Modify the product only after consultation of EMH Energie-Messtechnik GmbH or MTE Meter Test Equipment AG.

1.1.4.7 Spare Parts

Spare parts not approved by EMH Energie-Messtechnik GmbH, or MTE Meter Test Equipment AG can lead to personal injury and property damage to the product.

- Use only replacement parts approved by the manufacturer.
- Contact EMH Energie-Messtechnik GmbH or MTE Meter Test Equipment AG.

1.1.5 Qualification of the staff

The person responsible for installation, commissioning, operation, maintenance and inspection must ensure adequate qualification of the personnel.

1.1.5.1 Electrician

The qualified electrician has knowledge and experience as well as knowledge of the relevant standards and regulations due to their professional training. In addition, the electrician has the following skills:

- The electrician independently identifies possible dangers and can avoid them.
- The electrician can carry out work on electrical installations.
- The electrician is specially trained for the working environment in which he works.
- The electrician must comply with the provisions of the applicable accident prevention legislation.

1.1.5.2 Electrically and mechanical trained persons

A person trained in electrical and mechanical engineering is instructed by a qualified electrician or mechanic about the tasks assigned to him and possible dangers of improper behavior, as well as protective devices and protective measures. The person trained in electrical and mechanical engineering works exclusively under the direction and supervision of a qualified electrician and mechanic.

1.1.5.3 Operator

The operator uses and operates the product within the scope of this technical document. He is informed and trained about the special tasks and the possible dangers of improper behavior.

1.1.6 Personal protective equipment

At work, personal protective equipment is required to minimize health hazards.

- Always wear the necessary protective equipment during work.
- Never wear damaged protective equipment.
- Follow instructions in the work area for personal protective equipment.

1.1.6.1 Basic protective equipment

	**Protective clothing** Close-fitting work clothing with low tear resistance, with tight sleeves. It is mainly used for protection from being caught by protruding parts.
	**Safety shoes** To protect against heavy falling parts and slipping on slippery surfaces.

1.1.6.2 Special protective equipment for special ambient conditions

	**Safety goggles** To protect the eyes from flying parts and liquid splashes.
	**Face Shield** To protect the face from flying parts and liquid splashes or other dangerous substances.
	**Helmet** To protect against falling and flying parts and materials.
	**Ear protection** To protect against hearing damage.

	**Protective gloves** For protection against mechanical, thermal and electrical hazards.

1.1.7 IT security

Observe the following recommendations for the safe operation of the product.

- Make sure that only authorized persons have access to the device.
- Use the device only within an electronic security perimeter (ESP).
- Make sure that the device is operated only by trained personnel who are sensitized to IT security.

2. Introduction

2.1 General

PTS 400.3 PLUS Three-phase, fully automatic test system with class 0.02% reference standard and integrated three-phase current and voltage source available in two versions. For many years, electricity utility companies have realized the importance of performing measurements and tests, on-site, at the metering installation. MTE continually supplies and develops new and improved products that reduces and simplifies the on-site efforts. MTE's latest meter test equipment with enhanced functionality and high measurement accuracy does not only determine the accuracy of meters, but also provides additional information relating to the conditions at the respective mains points.

2.2 Module

2.2.1 PRS 600.3 Portable Reference Standard / Power Quality Analyzer

The reference standard of the modular system is based on the well-known digital measurement value retrieval, fast analogue-digital conversion and calculation of the values using fast signal processors. As opposed to the past, reference standards are not only used as standards for meter testing in a stationary meter test installation, but predominantly in the field for the measurement of all main parameters.

The PRS 600.3 is a combination of a three-phase Portable Reference Standard of class 0.02% and an IEC 61000-4-30 Class A Compatible Power Quality Analyzer with 3 voltage and 3 current channels. The device is equipped with two 8.4" colours TFT VGA displays based on touch screen operation. The Reference Standard is used to test single and three phase meters, instrument transformers and installations on site.

The Power Quality Analyzer is used to resolve disputes at contractual applications, for statistical surveys, including EN 50160 reporting, and for online troubleshooting of different kind of power quality problems.

The unit can be used with various types of clamp-on CTs and current and voltage sensors. Therefore, it is possible to easily and accurately test both CT/PT and direct connected meters.

Advantages

- Two instruments in one compact case
- Two large 8.4" (640 x 480 pixels) colour TFT VGA displays with graphical user interface
- Data transfer and communication via 2 x USB (Type A and B) or 1 x ETHERNET
- Data storage on removable Compact Flash memory card
- Independent sets of UCT clamp-on CTs allow service, calibration or later purchase of clamp-on CTs without factory return of the device.

Measurement Inputs

- 3 voltage inputs U1, U2, U3
- 3 direct current inputs I1, I2, I3
- 2 universal UCT clamp-on CT current inputs for I1, I2, I3

REFERENCE STANDARD - Functions

- Meter testing of pulse outputs (LED/disc mark/S0) and registers of active, reactive, apparent 1- or 3-phase, 3- or 4-wire energy meters with 3 pulse inputs and 3 pulse outputs
- Measurement of electrical parameters (UI φ, PQS, f, PF) including vector diagram, harmonic analysis and wave form display.
- Instrument transformer testing (CT/PT burden, CT/PT ratio)

POWER QUALITY ANALYZER - Functions

- Dips / Swells / Interruptions
- Harmonics / Interharmonics / Signal voltages
- Voltage unbalance
- Flicker
- Transient capture $\geq$ 100μs (26.7 kHz)

Options

- Software CALegration
- GPS Time Synchronisation (integrated, order with instrument)
- Set of 3 UCT 120.3 clamp-on CT 120A (active error compensated)
- Set of 3 UCT 1000.3 clamp-on CT 1000A
- Set of 3 flexible UCT LEM.3 current probes FLEX 3000 (30/300/3000A)
- UCT AMP-LiteWire 3-phase adapter set for AmpLiteWire
- Primary current sensor AmpLiteWire 2000 A
- UCT VOLT-LiteWire 3-phase adapter set for VoltLiteWire
- Primary voltage sensor VoltLiteWire 40 kV

In order to meet these requirements, the PRS 600.3 offers the following main functions:

- Simultaneous testing of up to three meters or registers of a multi-functional meter
- Internal memory for measurement results and customer data
- Vector diagram, harmonics spectrum, waveform and rotary field display for analysis of the mains conditions
- Active, reactive and apparent energy measurement in three-wire or four-wire circuits with integrated error measurement and pulse output for energy
- Voltage measurement
- Current measurement, direct and with current transformer clamps up to 3000 A or hot sticks
- Active, reactive and apparent power measurement per phase and sum of all phases
- Phase angle, power factor and frequency measurement
- Burden measurement and ratio test of PTs and CTs
- Measuring of current, voltage and power transducers

2.2.2 PPS 400.3 Portable Power Source

The PPS 400.3, portable power source may be used as enhancement of the reference standard PRS 600.3 as well as independently. Following the different demands of the customers, this source is available in two versions, for the supply of transformer meters with a maximum current up to 12 A as well as wider range source up to 120 A.

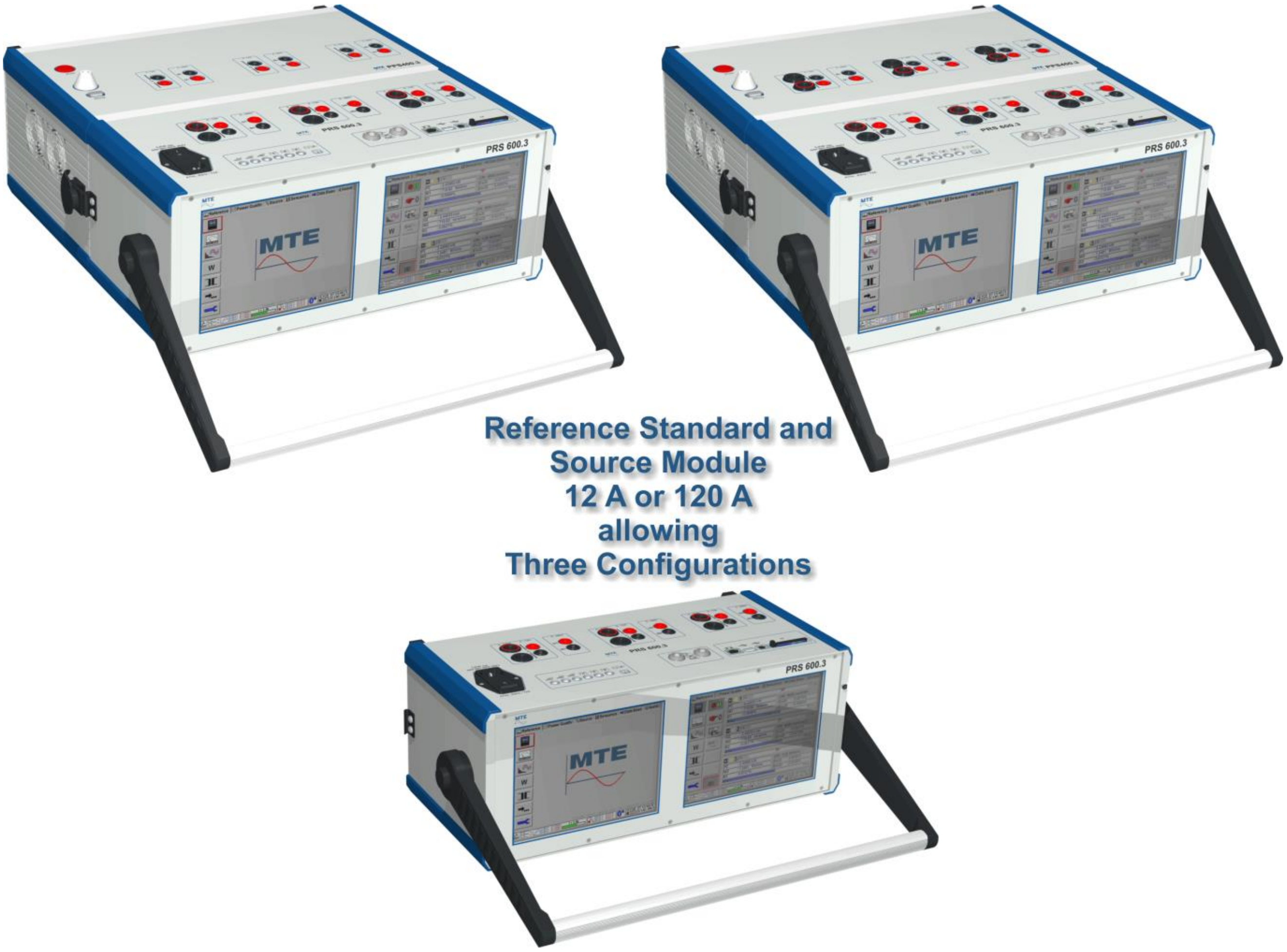
The source is designed to generate any network independent of its supply voltage, e.g. 3-phase 4-wire Y or Δ, 3-phase 3-wire, 1-phase 2-wire or others. Generation of harmonics in both voltage and current circuits as well as ripple control signals are optionally available.

The source module may be connected to the reference meter with little effort. The control software automatically recognises the module. It may therefore immediately be put into operation, and automatic measurement of a load curve of the meter may begin.

Controlling the source is carried out either by use of the PRS 600.3 or via RS 232 C.
The PPS 400.3 source is developed such as to be fully operational without the reference meter.

2.3 PTS 400.3 PLUS Portable Test System

The PTS 400.3 PLUS system consists of a reference standard PRS 600.3 of class 0.02% and a programmable power source PPS 400.3, which is available in two versions of up to 12 A or 120 A.



The PRS 600.3 serves as a control module for controlling the PPS 400.3 power source. Both modules are easily assembled and controlled. The PRS 600.3 module automatically recognizes the module it is connected to, therefore a reference meter PRS 600.3 may be simply and quickly upgraded with a source PPS 400.3 thereby producing a one-position portable test system. Operation of the system may begin immediately after connecting both modules.

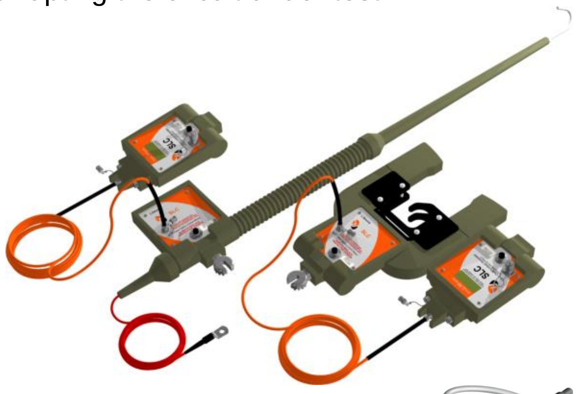
The PPS 400.3 power source if used without the control module can be controlled and test values retrieved via the serial interface RS 232 C. It is therefore possible to easily apply modules unchanged into stationary test systems.

2.4 Communication and operation

The Portable Reference Standard PRS 600.3 can be operated on a stand-alone basis or together with the Portable Power Source PPS 400.3 which is in this application controlled via blue-tooth.

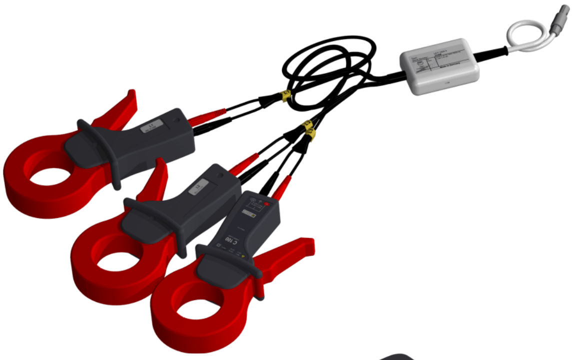
2.5 Extended functionalities

The PTS 400.3 PLUS allows to use several clamp-on CTs in the range of 100 A up to 3000 A or sensors for voltage and current measurements on high voltage potential. The clamp-on CTs and high voltage sensors are “clamped” around conductors to perform non-contact / intrusive measurements without interrupting the circuit under test.



AmpLiteWire and VoltLiteWire sensors for voltage and current measurements on high voltage potential up to 40 KV and currents up to 2000 A

Error compensated clip-on CTs UCT 120.3 for measurements in the range 0.1 A ... 120 A with a maximum error of 0.2 %



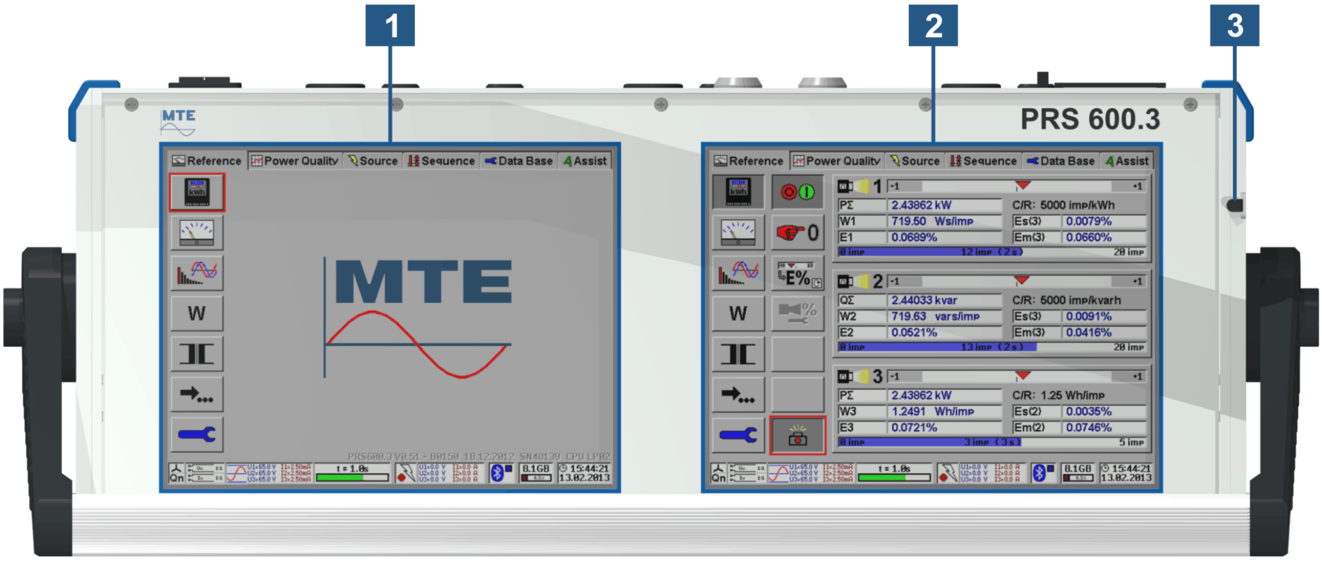
Clip-on CTs UCT 1000.3 for measurements in the range of 1 A up to 1000 A

Flexible current sensors UCT LEM.3 FLEX 3000 for current up to 30 / 300 / 3000 A

3. Connectors and control elements

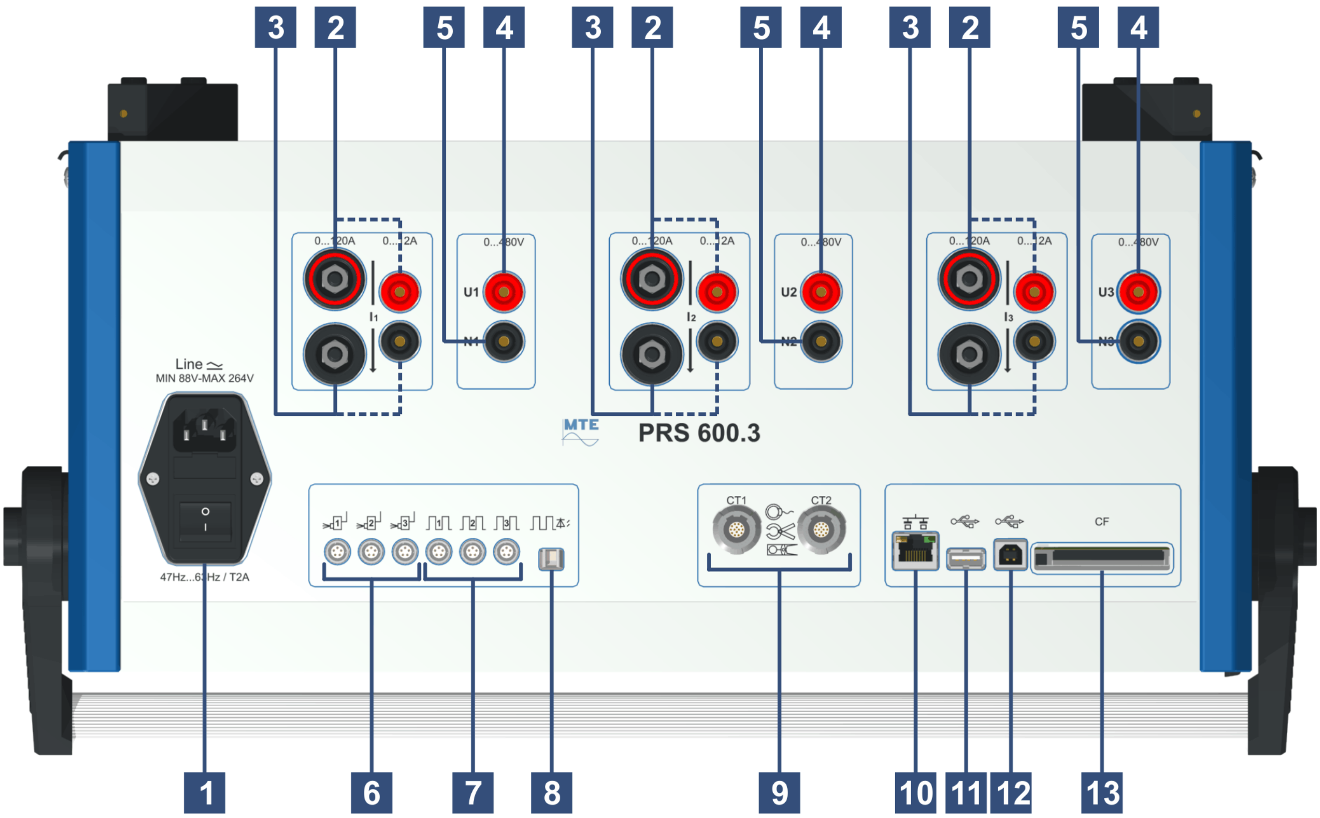
3.1 Connectors and control elements

Front view

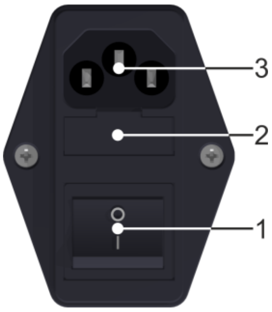


[1] **Left 8.4” color TFT VGA display (640 x 480 pixels) with touch screen**
[2] **Right 8.4” color TFT VGA display (640 x 480 pixels) with touch screen**
[3] **Pen for touch screen operation**

Top view



[1] Supply voltage connection, mains switch, fuses



1 ⇨ Mains switch
2 ⇨ Fuse 1 x 2 A / 250 V slow blow (below the cover)
3 ⇨ Supply voltage connection:
MIN 88 … MAX 264 VAC, 47 … 63 Hz

[2] Current-Inputs I1, I2, I3
There are two separate inputs for 12 A and 120 A
--- laboratory cables $I_{max.}$ 12 A (standard), Type: 4 mm insulated socket
— high current cables $I_{max.}$ 120 A (option), Type: 6 mm high current connector

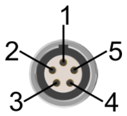
[3] Current-outputs I1*, I2*, I3*
There are two separate outputs for 12 A and 120 A
--- laboratory cables $I_{max.}$ 12 A (standard), Type: 4 mm insulated socket
— high current cables $I_{max.}$ 120 A (option), Type: 6 mm high current connector

[4] Phase connections for 3 voltage U1, U2, U3
Type: 4 mm insulated sockets

[5] Neutral connections for 3 voltage N1, N2, N3
Type: 4 mm insulated sockets

[6] Impulse inputs 1, 2, 3
The three impulse inputs 1, 2 and 3 can each be used for scanning heads (e.g. the SH 2003) and can also be used to connect to retransmitting contacts of the device being tested.

Type: Lemo socket, 5 pole



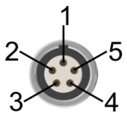
Pin 1 ⇨ +11 ... 13V (I<60mA) (supply of scanning head)
Pin 2 ⇨ f_{in} max. 100 Hz (slow input, anti-bounce)
Pin 3 ⇨ f_{in} max. 200 kHz (fast input)
Pin 4 ⇨ GND
Pin 5 ⇨ screen

[7] Impulse outputs 1, 2, 3
The default setting for the mean frequencies of the three impulse outputs are:

Output 1	Proportional to total active power PΣ
Output 2	Proportional to total reactive power QΣ
Output 3	Proportional to total apparent power SΣ

These impulse outputs can be reconfigured by commands over the serial interface.

Type: Lemo socket, 5 pole



Pin 1 ⇨ +11 ... 13 V (I<60mA)
Pin 2 ⇨ not used
Pin 3 ⇨ f_{out} max. 60kHz (1:1)
Pin 4 ⇨ GND
Pin 5 ⇨ screen

[8] Fiber optical impulse output to connect to error evaluation system SMM400

[9] CT1, CT2 connection for clamp-on current transformers and current sensors

- Set of 3 UCT120.3 clamp-on CT 120A (active error compensated, Standard accessory)
- Set of 3 UCT 10.3 clamp-on CT 10A (OPTION)
- Set of 3 UCT 1000.3 clamp-on CT 1000A (OPTION)
- Set of 3 UCT LEM.3 flexible current probes FLEX 3000 (30/300/3000A) (OPTION)
- Primary current sensor AmpLiteWire 2000A (OPTION)
- Primary voltage sensor VoltLiteWire 40kV (OPTION)

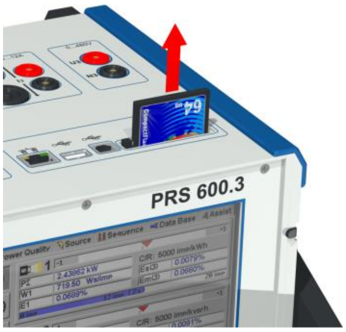
Connector type: 14 pole dedicated Redel socket, suitable for new MTE clamp-on current transformers and current sensors with voltage outputs and serial communication interface.

[10] **Ethernet connection**
Connector type: 8 position 8 contact (8P8C) Registered Jack RJ45, used for connection to an Ethernet network

[11] **Universal Serial Bus (USB) connection**
Connector type: Type A USB connector, used for connection of external keyboard and mouse

[12] **Universal Serial Bus (USB) connection**
Connector type: Type B USB connector, used for communication with PC

[13] **Compact flash card**
Removable compact flash (CF) memory card for storage of measurement data, administrative data and instrument settings.



Push on button to eject the CF card and then pull out the card.

When reinserting the card, regard the correct orientation. The side near the eject button has a thick guideway, the opposite side a thin guideway.

Warning! Do not remove the CF card, if the card is actually accessed, indicated with a red background of the CF status indication on the display. Not following this procedure may lead to corrupted files and loss of data.

The safest procedure is to switch off the PRS 600.3 before removing or inserting the CF card.

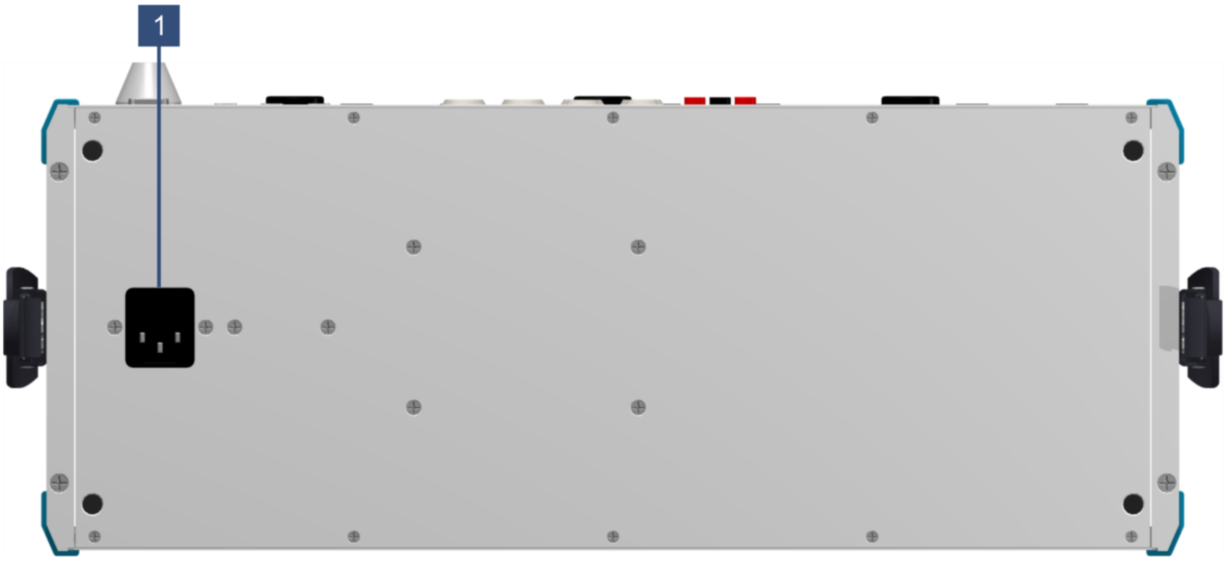
Back view

[1] **Supply voltage connection to portable power source PPS 400.3**

3.2 PPS 400.3 connectors and control elements

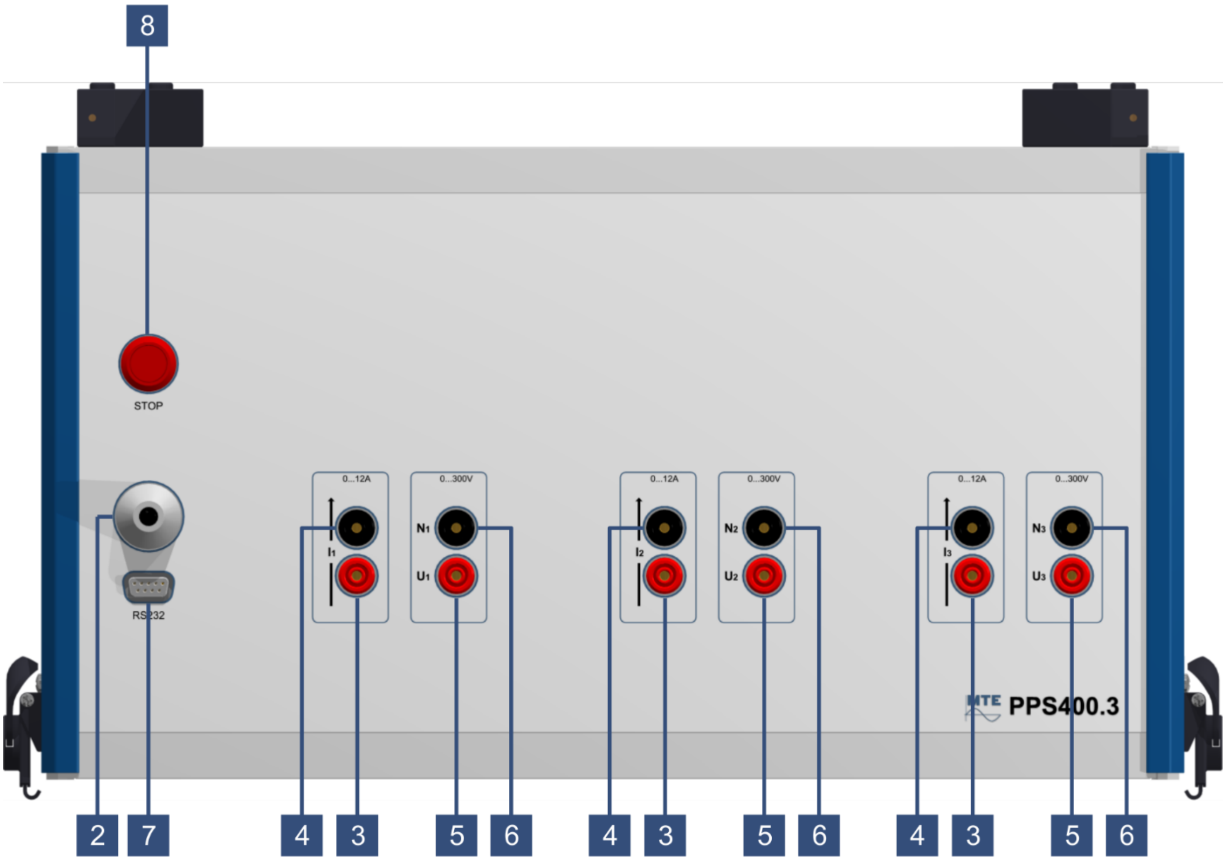
3.2.1 PPS 400.3-12A

Front view



[1] **Supply voltage connection**
Range: 86 … 264 VAC, 47 … 63 Hz
Fuses: 2 x 4 A / 250 V slow blow (below the cover)

Top View



[2] **Blue tooth antenna for wireless communication**

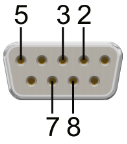
[3] **Current-outputs I1, I2, I3 (red)**
Type: 4 mm insulated sockets

[4] **Current-back wire I1, I2, I3 (black)**
Type: 4 mm insulated sockets

[5] **Phase connections for 3 voltage U1, U2, U3**
Type: 4 mm insulated sockets

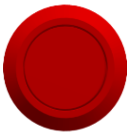
[6] **Neutral connections for 3 voltage U1, U2, U3**
Type: 4 mm insulated sockets

[7] **RS232 Serial Line Interfaces**
Connection: 9 pole SUB-D connector



Pin 2 ⇨ TxD
Pin 3 ⇨ RxD
Pin 5 ⇨ GND
Pin 7 ⇨ CTS
Pin 8 ⇨ RTS

[8] **Interrupt button**



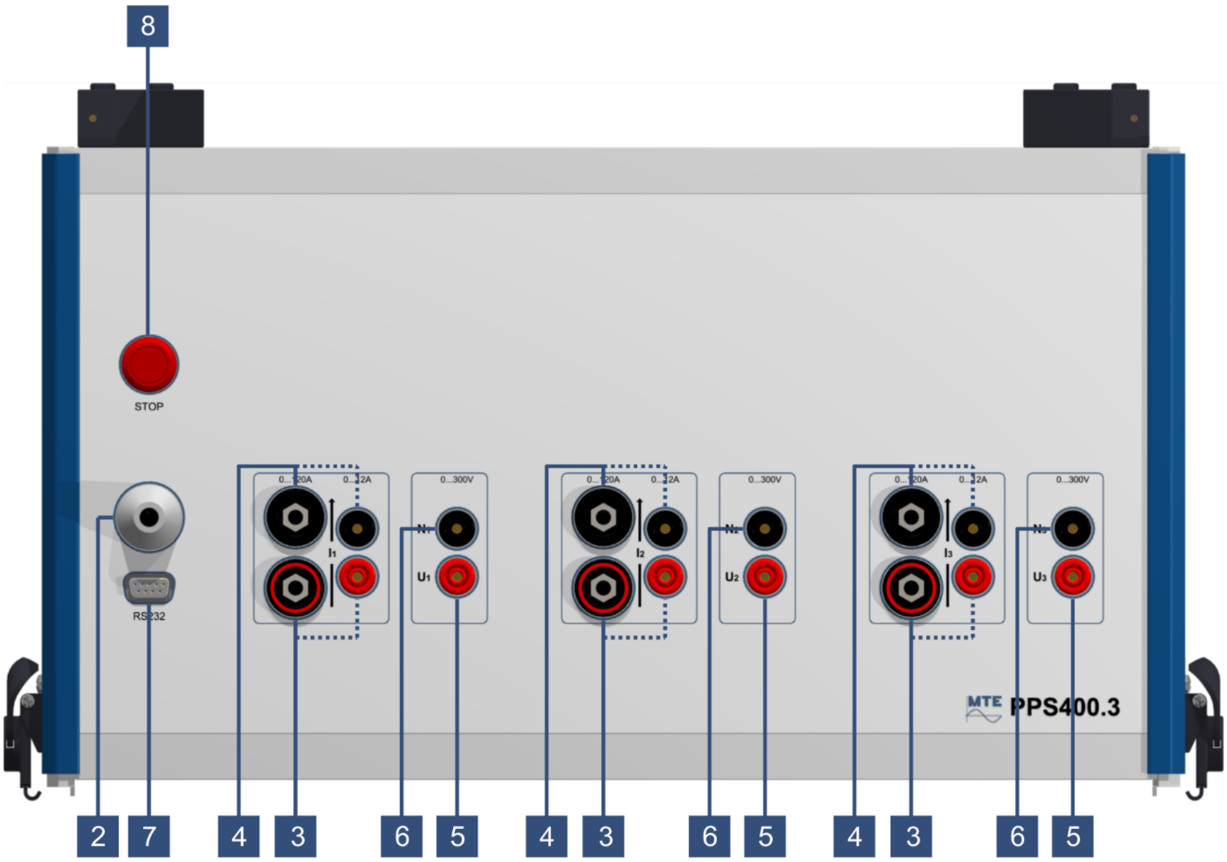
STOP

3.2.2 PPS 400.3-120A

Front view

[1] **Supply voltage connection**

Top View



[2] **Blue tooth antenna for wireless communication**

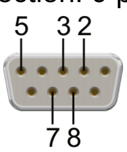
[3] **Current-outputs I1, I2, I3 (red)**
There are two separate outputs for 12 A and 120 A
--- laboratory cables **Imax.** 12 A (standard), Type: 4 mm insulated socket
— high current cables **Imax.** 120 A (option), Type: 6 mm high current connector

[4] **Current-back wire I1, I2, I3 (black)**
--- laboratory cables **Imax.** 12 A (standard), Type: 4 mm insulated socket
— high current cables **Imax.** 120 A (option), Type: 6 mm high current connector
(The sockets and connectors for 12A and 120A are connected internally for each phase)

[5] **Phase connections for 3 voltage U1, U2, U3**
Type: 4 mm insulated sockets

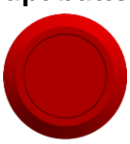
[6] **Neutral connections for 3 voltage N1, N2, N3**
Type: 4 mm insulated sockets

[7] **RS232 Serial Line Interfaces**
Connection: 9 pole SUB-D connector



Pin 2 ⇨ TxD
Pin 3 ⇨ RxD
Pin 5 ⇨ GND
Pin 7 ⇨ CTS
Pin 8 ⇨ RTS

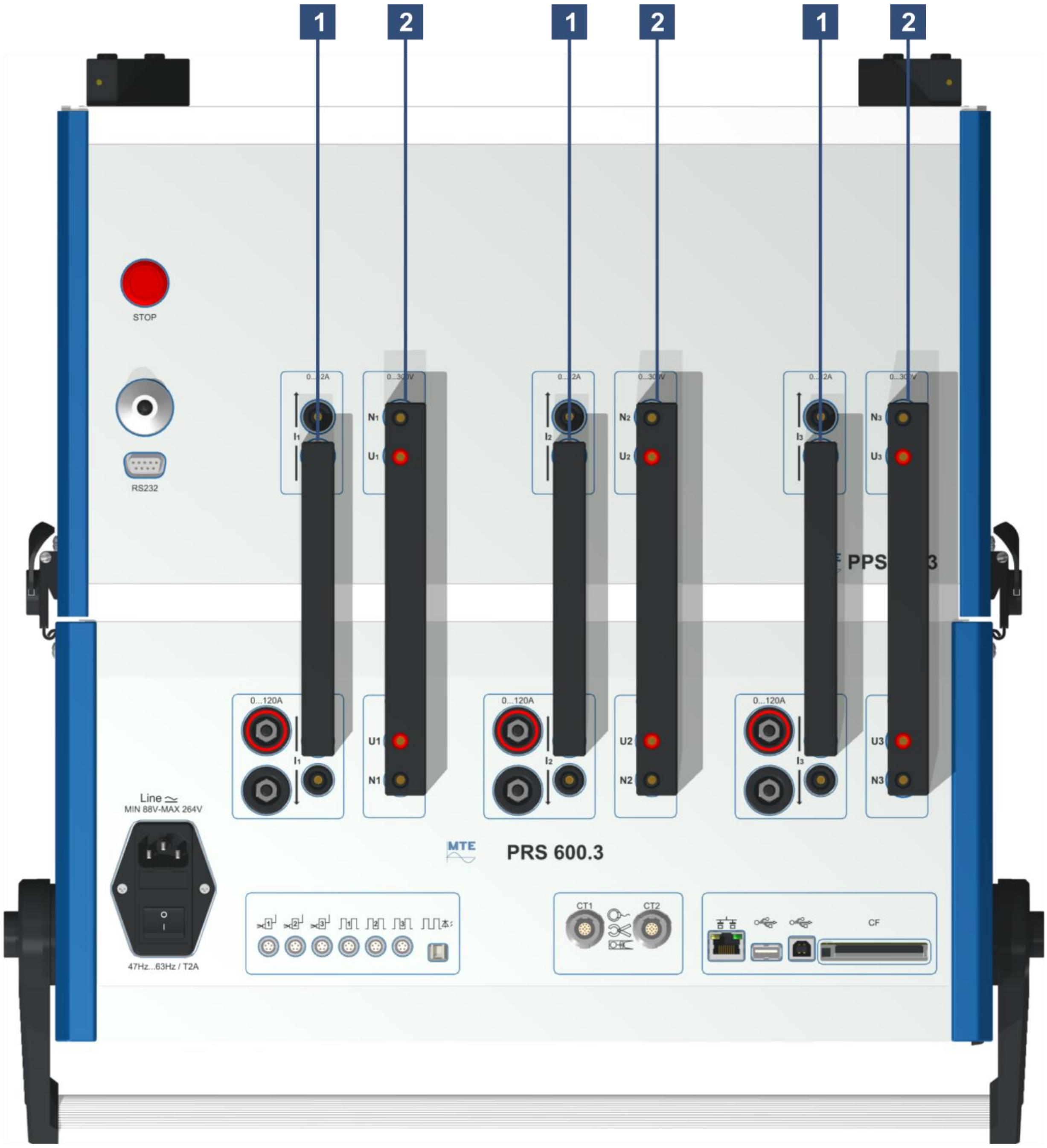
[8] **Interrupt button**



STOP

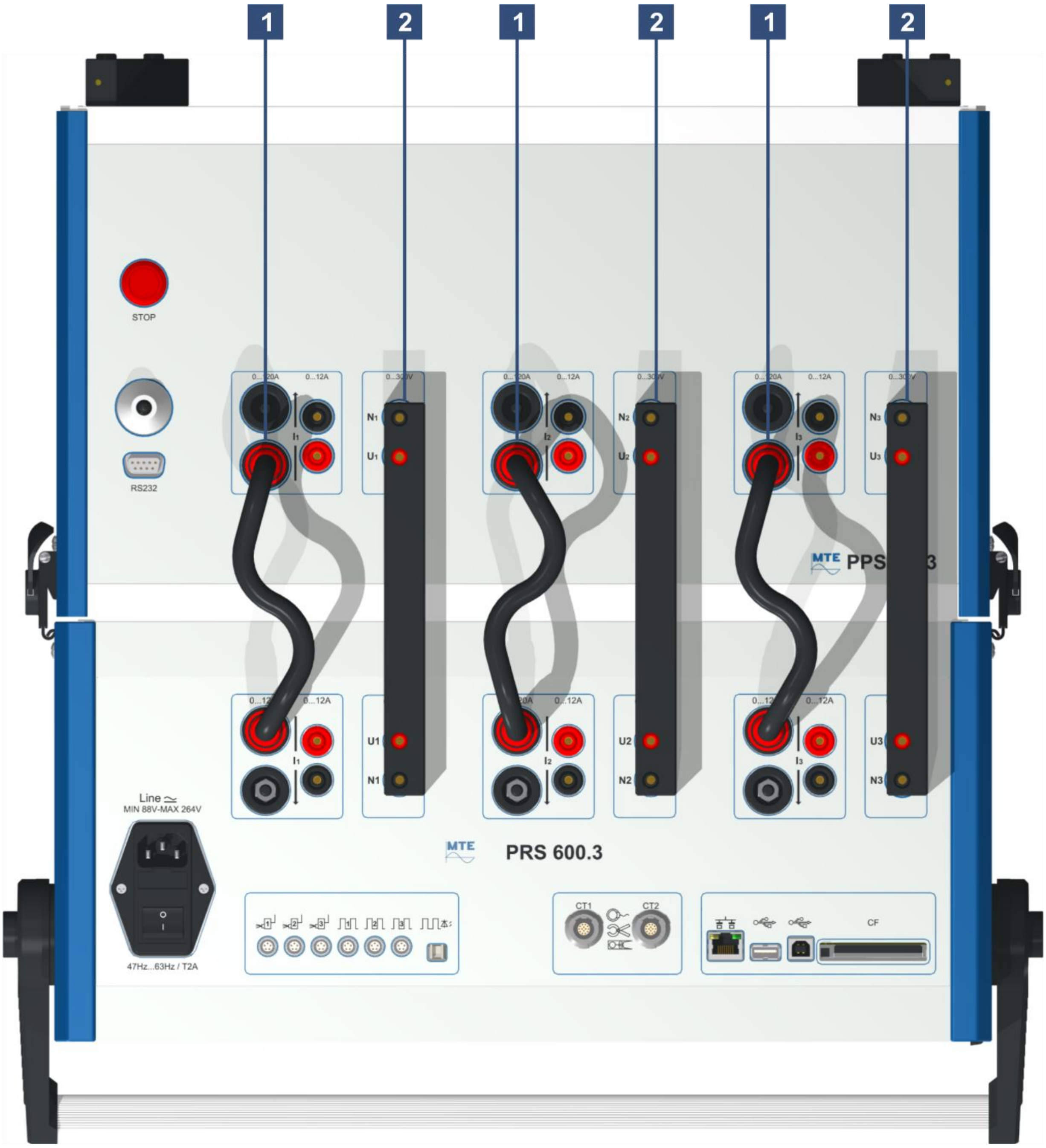
3.3 PTS 400.3 PLUS interconnections between PRS 600.3 and PPS 400.3

Interconnection between PRS 600.3 and PPS 400.3-12 A



[1] **Current bridge between PRS 600.3 and PPS 400.3-12 A**
[2] **Voltage bridge between PRS 600.3 and PPS 400.3-12 A**

Interconnection between PRS 600.3 and PPS 400.3-120 A



[1] High current bridge between PRS 600.3 and PPS 400.3-120 A

[2] Voltage bridge between PRS 600.3 and PPS 400.3-120 A

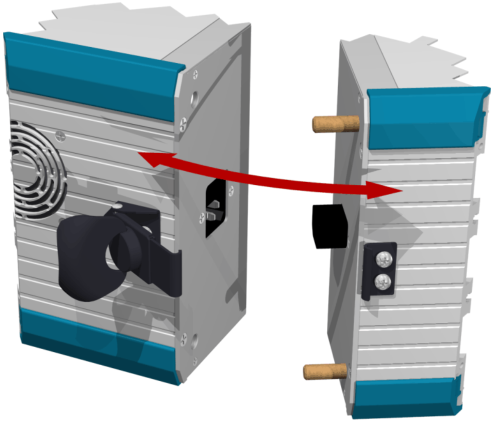
3.3.1 How to separate the two modules

In order to separate the individual modules, the following steps are to be made at the laterally appropriate locks.

As the first step fold up the latch

Turn the latch around its own axis and the connection of the modules will be released

Turn the whole lock a little bit away from the modules



Now the modules are separated and can be removed from each other

4. Operation principles

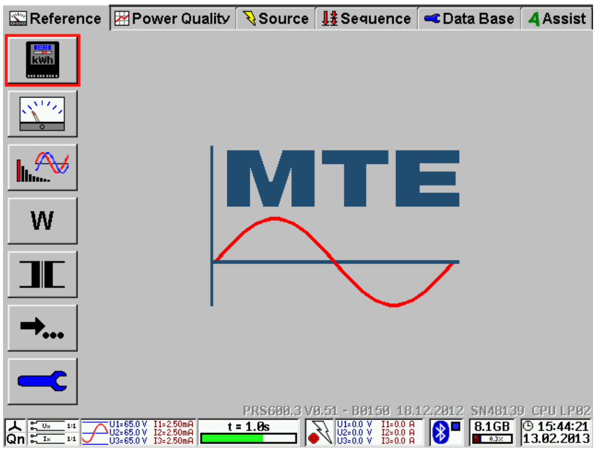
Before operating carefully read the safety precautions in chapter [0].

The following section deals with manual operation of the PRS 600.3 and PPS 400.3. Operation of the instrument via serial interface commands is explained in a separate operation manual.

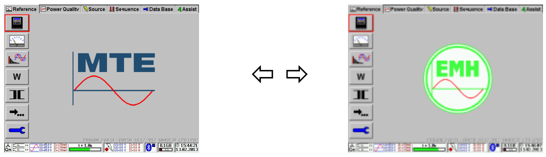
4.1 Display and control elements

4.1.1 Display

After start-up, the left and right display with touch screen show the same content. Both displays have the same functionality and can at the same time or alternatively be used to operate the instrument. If e.g. a PPS 400.3 source module is controlled via Bluetooth, one display can be used to control the source and the other to control the reference standard.



After start up the **Reference Menu Card (MC)** is displayed in the form of a register card with the Logo cycling between MTE and EMH.



The various selectable functions of the menu are shown at the left-hand side of the display in the form of **Functional Buttons (FB)** with graphical indication of the function.
At the bottom status information is displayed.

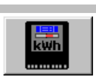
	**Menu Card (MC)**

The function (Reference) is indicated in the menu card. This MC includes all operating functions of the built-in reference standard. The MC Data Base, which includes basic settings of the instrument, is always active.

MC status

Active MC
The function (Reference) is indicated in the menu card.
The MC's Reference and Data Base are always active.

Inactive MC
The menu card Test Assist (option) is 'grayed out' and cannot be accessed.

	**Functional Button (FB)**

The functional buttons are used to call sub menus or functions or to enter data or select settings. The function is indicated in graphical from on the button directly. Further description can be found in section [4.1.3 / 4.1.4].

Menu Cards (MC) and Functional Buttons (FB) of main menu
A detailed description of the listed functions and sub menus can be found in the chapters indicated in brackets [ ].

Reference	**Reference standard**

- Error measurement [8.2]
- Measurement [8.3]
- Wave form analysis [8.4]
- Energy measurement and register test [8.5]
- Transformer tests [8.6]
- Special functions [8.7]
- Reference meter settings [8.1]

Power Quality	**Power Quality Analysis**

- Power Quality Online Measurement
- Power Quality Recording
- Power Quality Analysis

The power quality analysis functions are described in the PRS 600.3 operation manual.

Source	**Portable Power Source**

- Load point and network definition, execution [7.2]
- Harmonics [7.3]
- RCS Ripple Control Signals [7.4]
- Adjustment of load point with regulators for U, I, φUI [7.6]
- Adjustment of load point with configurable regulators for U, I, f, φUI, φUU [7.7]
- System parameters [7.1]

Sequence	**Sequence** with source control via Bluetooth (option)

Automatic or step by step test run [9.2]

Edit automatic test sequence [9.1]

Data Base	**Data base**

Administrative data [6.4]

Meter data [6.5]

Transformer data [6.6]

Load Point data [6.7]

View of results [6.2]

Lock keyboard with password

Basic settings of the instrument [5]

The look of the main menus is changing as soon as a sub menu is called. The sub menu contains a second column of FB's and is displayed in the window on the right side of the two FB columns.

PRS600.3 V0.51 - B0150 18.12.2012 SN48139 CPU LP02	**Version information**

In the main menu at the bottom above the status indications type and version information is displayed.

PRS 600.3	Type of unit
V0.501	Firmware version
B0150	Build code of the firmware
18.12.2012	Date of the firmware
SN48139	Serial number of the unit
CPU LP02	Hardware version

This information may be required during contact with MTE in the event of a problem.

Status information / Tool-tip

Status information

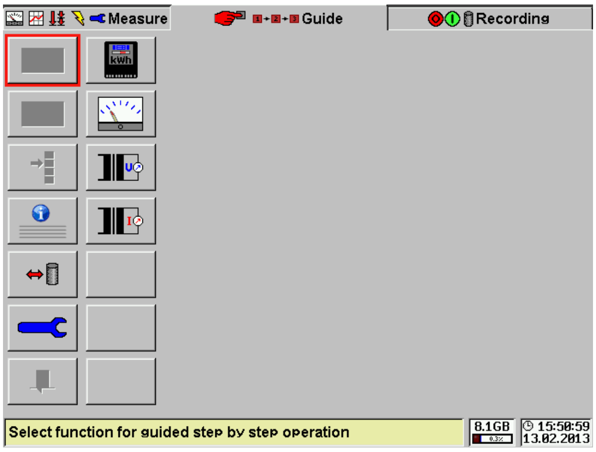
Most of the time status information of the system is displayed. For a detailed description see [4.2].

Tool-tip

Each time a new FB is selected a help text is displayed in a so-called tool-tip window. The time the window is shown is configurable between OFF, 0.5 .. 10s. For configuration and display of tool-tips in other languages see [5].

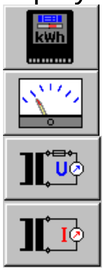
Test Assist mode (option)

The Test Assist mode is activated. Other menu cards are shown.



Guided operation

Step by step instructions for:

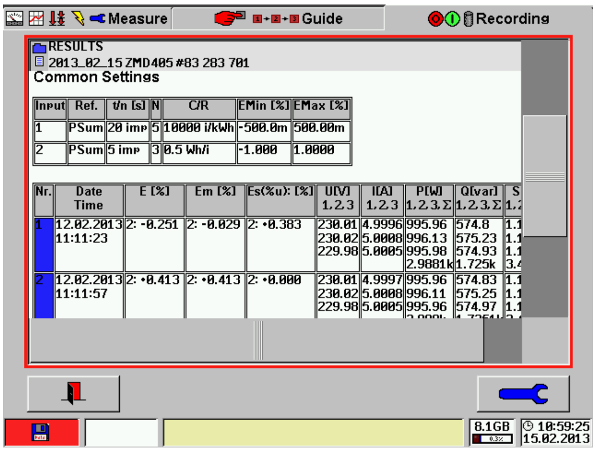


Meter testing

Installation check

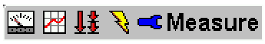
PT burden and ratio test

CT burden and ratio test



Recording

Control of recording and visualization of the results in table form.
One display can be used to show a summary result view of the results recorded with the test function active on the other display.



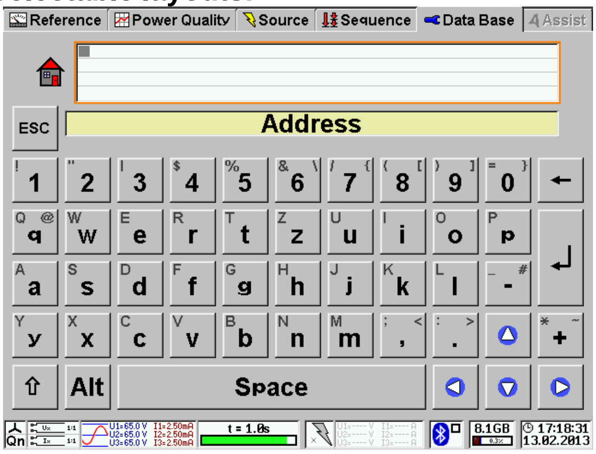
Back to **Manual operation** mode

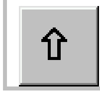
The functions of Test Assist are described in a separate operation manual.

4.1.2 Virtual keyboard

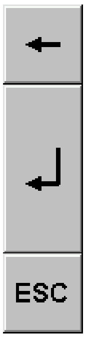
The PRS 600.3 has no keypad. Any operation can be done by the touch screen of the two displays. For data input (numbers or text) a virtual keyboard is displayed.
(Optionally an external mouse or keyboard can be connected via USB).

Selectable layouts:





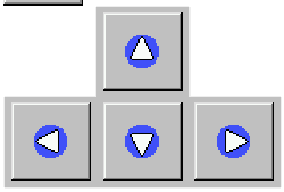
Lower case letters / numbers (default)



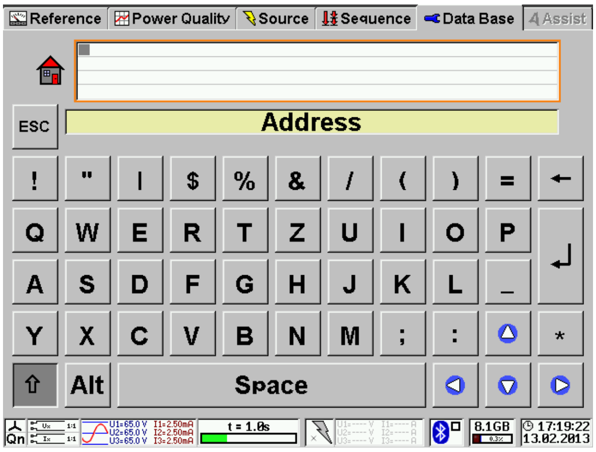
Delete one character to the left

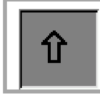
Enter to accept input of data and back to the calling menu

Escape to cancel input of data and keep old entries.

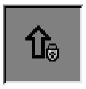


Cursor keys to navigate within input fields and used to make selections.

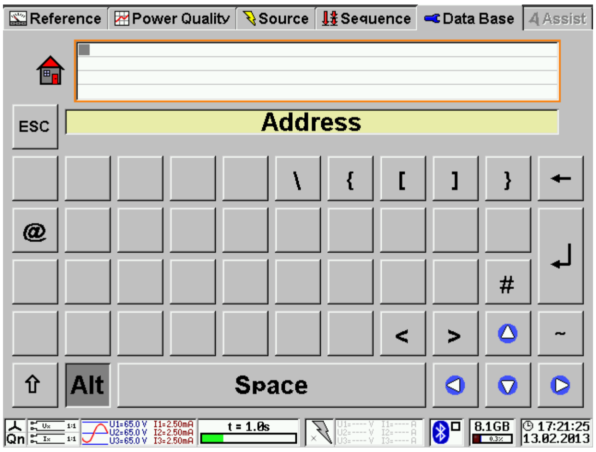


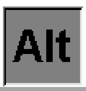


Upper case letters



Locked upper case letters
Press twice on Shift key





Special characters

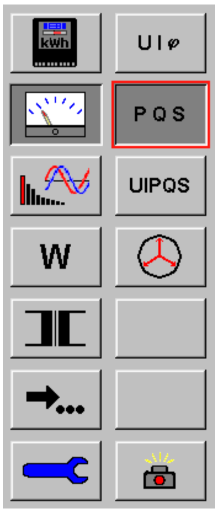
Details to the use of the virtual keyboard at data input see [4.3].

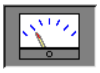
4.1.3 Functional Buttons (FB)

The rectangular fields shown in the display are simulating keys with different functions and settings. Because the function of the keys is variable, and the function is indicated on the key itself depending on the menu selected, they are called **Functional Buttons**, further in the manual abbreviated with **FB**.
These keys together with the graphical symbols displayed on them, allow fast and easy operation of the instrument.

Different types of functional buttons

Call of sub menu

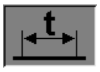




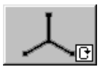
The pressed FB in the first column indicates that the measurement sub menu is active. The FB's in the second column are changing. They belong to the activated sub menu

The pressed FB in the second column indicates that the PQS display is active.

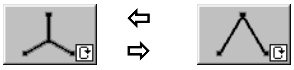
The FB's of the sub menu can directly be selected by touching them or by moving the red frame to the desired FB with the cursor keys of an external keyboard (option).



Pressed functional button
A key shown as depressed indicates that the function is in active state, e.g. input of time base.



Selection with cyclic mode and status indication in the FB
Cyclic mode function is indicated in the lower right corner of the FB with the sign
Consecutive key presses cycle between the possible states. The actual state is indicated in the FB itself.
E.g. the connection mode FB has two states. Each key press changes between these two states. A cyclic change between two states is also called toggle mode.



Disabled key
If a key is disabled, it is shown 'grayed out'. The function is blocked. The corresponding FB is not selectable and executable.

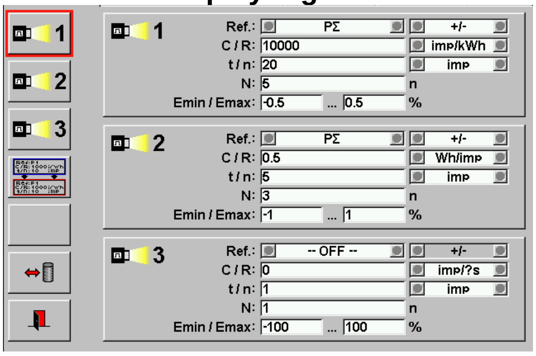
Blank key
A blank key can be selected, but has no function. Blank keys are reserved for future applications.

Exit of sub menu
The next higher menu or the calling menu is displayed.

4.1.4 Basic applications of Cursor and Enter keys and Functional Buttons (FB)

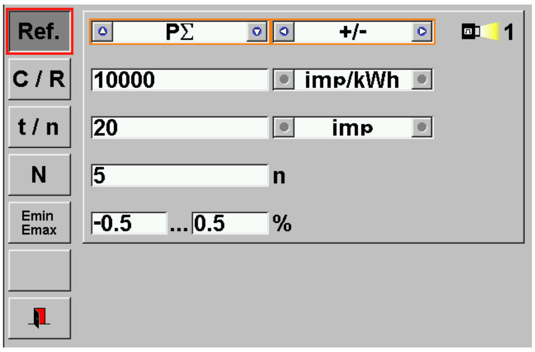
Selection of functional button, display region or display field with touch screen. Numerical input and selection out of predefined settings with touch screen and/or virtual keyboard.

Selection of display regions



Select display region

Either press the red framed FB or press into the display region.

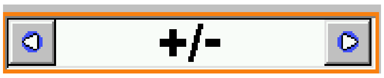


Select fields inside the region

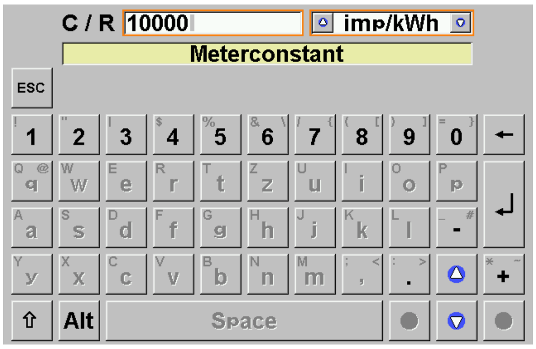
Either press the red framed FB or press into the corresponding field.

Selection out of predefined settings with cursor keys

Change values by pressing up/down cursor keys (cyclical mode)



Change values by pressing left/right cursor key (cyclical mode)



Numerical data input with virtual keyboard

In this example:

Change numerical value by entering desired number with the virtual keyboard.

Change unit value by pressing up/down cursor keys.

Press Enter button to save the new value and to return to previous menu.

4.1.5 External keyboard or mouse (option)

An external USB keyboard or USB mouse can be connected to the PRS 600.3 type A USB connector and be used to operate the instrument and to make alphanumerical inputs.

External keyboard

Touch the left or right display to make it active for keyboard control. A red selection frame is shown on the active display. The inactive display shows a grey selection frame

Special key functions

Keys	Function
Ctrl + ⇦ or ⇨	Change between menu cards
⇦, ⇨, ⇧, ⇩	Move red selection frame between FBs, fields or check boxes
Enter	Activate, terminate sub menu, function or input.
Esc	Leave submenus, terminate inputs
Tab	Select FBs top down, first column, second column
F1	Select **Reference** menu card
F2	Select **Power Quality** menu card
F3	Select **Source** menu card
F4	Select **Sequence** menu card
F5	Select **Data Base** menu card
F6	Select **Assist** menu card - **Guide**
F7	Select **Assist** menu card - **Recording**

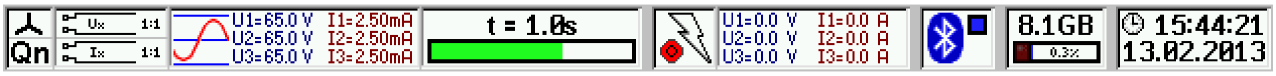
External mouse

A red mouse cursor is shown on the display and can be moved between left and right display to any position. Both displays can be operated directly.

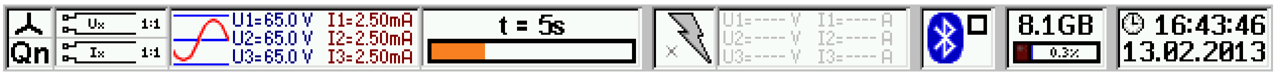
The operation of the left mouse key works like a touch operation.

4.2 Status indications

At the bottom of the display different status indications of the instrument are visible.
Bluetooth ON, source control active



Bluetooth OFF, source control inactive, PQ time base active



Connection mode and reactive mode

Connection mode

- 4-wire mode
- 3-wire mode

Reactive mode

- Qn Natural (n) mode (90° phase shifters used)
- Qx Artificial or cross-connected (x) (phase - phase voltages with 90° phase shift used)

Voltage and current measurement inputs

Voltage input type

- Direct voltage inputs
- Hotstick voltage input

Current input type

- Direct current inputs 120A
- Direct current inputs 12A
- Current clamps 100A
- Current clamps 1000A
- FLEX 3000 / 30A
- FLEX 3000 / 300A
- FLEX 3000 / 3000A
- Hotstick current input

Transformer factors

Status of activation of transformer factors for voltage inputs (upper symbol) and current inputs (lower symbol).

1:1 **Transformer factors disabled**
The ratio is 1. All values are indicated as measured.

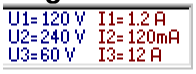
Transformer factors enabled
The displayed load values and energies and the ranges indicated in the status section are multiplied with the ratios defined at reference meter settings [8.1].

Selection and indication of voltage and current ranges

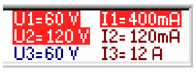
Type

- Automatic range selection
- Manual range selection

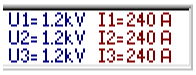
Range indication



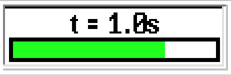
Normal display
The actual selected end of range value is indicated for each phase to neutral voltage (U1, U2, U3) and each phase current (I1, I2, I3).



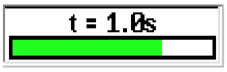
Range overflow
The range indication of inputs, which are overloaded are blinking between red and normal and a repeating beep can be heard.
The overload indications disappear as soon as normal conditions are reached again.



Transformer factors activated
The internal selected end of range values 120V and 12A are multiplied with the defined transformer factors (e.g. voltage 1kV:100V = 10, current 100A:5A = 20).

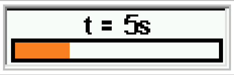


Time base of reference standard

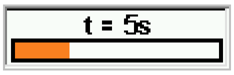


Internal time base interval
The set time base is indicated. The bar graph shows the actual elapsed time of the running interval.

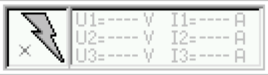
External control of time base interval
The time base interval is defined by impulses at impulse input 1. The time in brackets indicates the time between the last two impulses at input 1. The Indicated bar graph of the next period is based on this value.



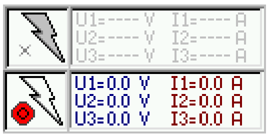
Time base of PQ analyzer



Internal time base interval
The set basic time base for PQ online measurement is shown. The bar graph shows the actual elapsed time of the running interval.



Status of source control



Source control inactive

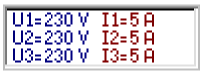
Source control active

Source ON / OFF status

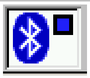
Source OFF indicated with red OFF button and white flash symbol

Source switch on / switch off active indicated with sandglass and yellow blinking flash symbol. The set values are ramped up or down.

Source On indicated with green ON button and yellow flash

	**Actual set voltage and current values of the source**

Indication of the actual set values for each voltage output (phase - neutral voltage) and each current output of the source. The values indicated here are switched on, when the start button is operated.

	**Blue tooth wireless communication status**

Indication of PRS 600.3 blue tooth module status and status indications for communication to device.

PRS 600.3 blue tooth module status

 Black indicates blue tooth module is recognized

 Orange indicates initialization / configuration of blue tooth module is running

 Blue indicates blue tooth module is configured and ready for communication with devices 1 and 2

 Green indicates blue tooth module is searching for active blue tooth devices. Only visible during search of devices in blue tooth connection setup.

Device communication status

- White indicates idle, no communication attempt
- Purple indicates searching for communication is active
- Blue indicates communication is running
- Red indicates no communication possible to configured device after three attempts.

  Note: There are no further attempts to communicate until the supply is switched off/on or until the reconnect function [5.3.2] is called.

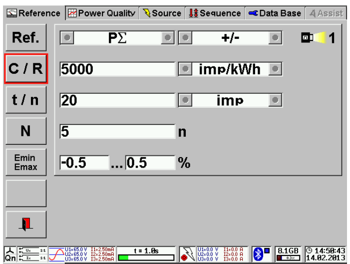
4.3 Input of data

The input of data is achieved using the virtual keyboard or by using an external keyboard (option).

4.3.1 Numerical inputs

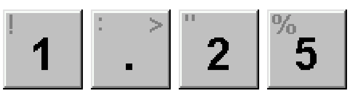
E.g. meter constant of device under test.

Input of numbers

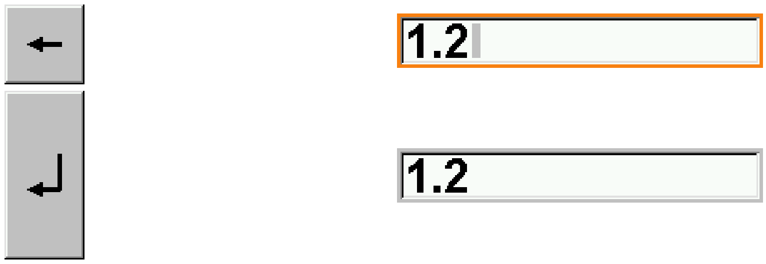


Display of actual meter constant. Touching the **FB** C/R or the input field (5000) activates the input.

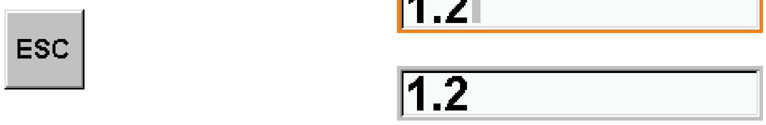
The virtual keyboard for numerical inputs is displayed. The old value is displayed in a red frame followed by a grey cursor sign.



Enter the desired value by touching the virtual keyboard. The first entered digit replaces the previous value.

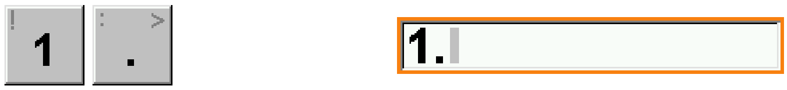


Incorrectly entered inputs can be cleared with the **Delete** key, digit by digit.
The input is completed by pressing the **Enter** key. The red frame and the grey cursor sign disappear and the new value is saved.

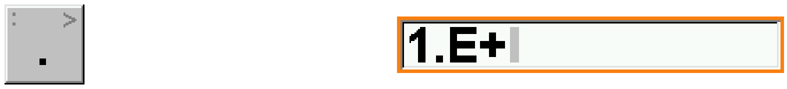


If an input should be activated by mistake, the input function can be aborted by pressing the **Escape** key.
In this case the original value is retained.

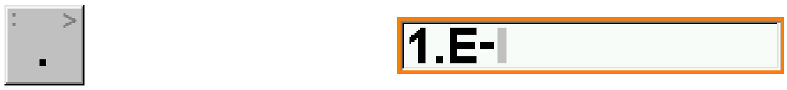
Input of numbers with exponent



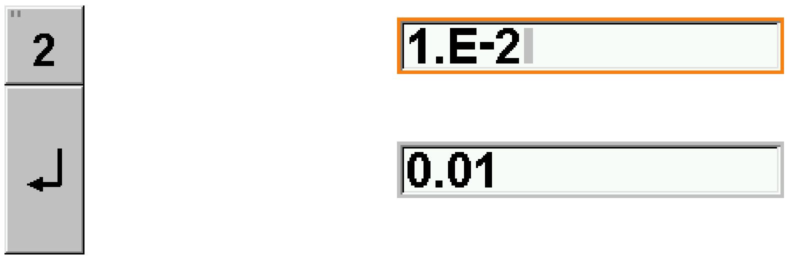
Decimal point:
If immediately after a number has been entered, the point key is depressed, a decimal point is inserted



Positive exponent:
If the point key is operated a second time immediately after a decimal point has been entered, an **E+** is inserted for a positive exponent.

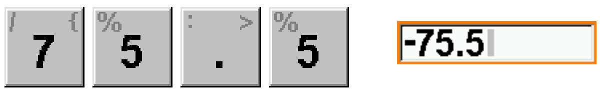


Negative exponent:
If the point key is pressed again after the **E+** is displayed**,** an **E-** is inserted for a negative exponent.



The input is completed by pressing the enter key. The red frame and the grey cursor sign disappear and the new value is saved.

Input of minus sign
E.g. input of phase angle settings.

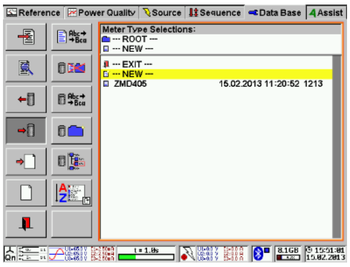


Minus sign with point key: If at start of input the decimal point key is depressed twice a minus sign is inserted.
If the point key is operated a third time a normal decimal point is inserted.

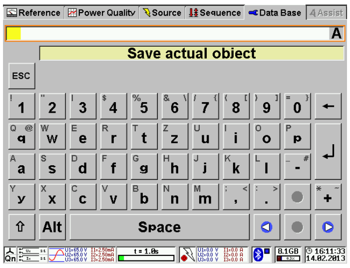
4.3.2 Alphanumerical line input

The virtual keyboard for alphanumerical inputs is displayed, if a line input of numbers and/or text is required.
The input can also be made with an external keyboard (option) connected to the USB type A connector.

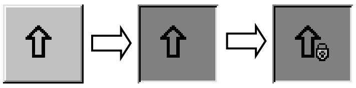
Example: Input of meter type name

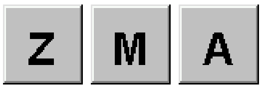


Activate input
Touching the yellow line ---NEW--- activates the input of the meter type name.

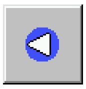


The virtual keyboard for alphanumerical inputs is displayed. An empty input field with a yellow cursor sign is displayed on top.
An A at the end of the line indicates that this is an alphanumerical input.

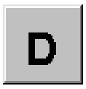




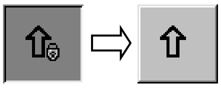
Input of characters
Input several capital letters
Touch the shift key twice to lock input of capital letters. Enter several capital letters. The yellow cursor key is moved to the right



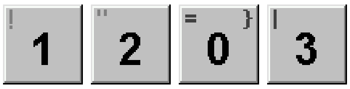
Move cursor to the left
Move the cursor over the character A by operating the left cursor key once.

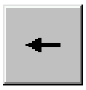


Insert character
The character is inserted at the position before the cursor.

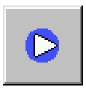


Change back to input of lower case letters and numbers
Touch the locked shift key once.

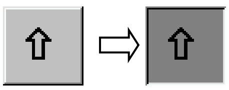




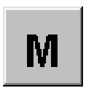
Delete character
Touch the delete key to delete one character left to the cursor

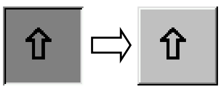


Move cursor to the right
Operating the right cursor key moves the cursor one position to the right. Further cursor key operations move the cursor to the end of the line.

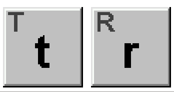


Change to capital letters
Touch the shift key once to activate capital letters

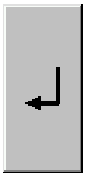


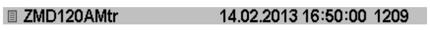


After the input of one capital letter, the input is automatically changed back to lower case letters.



Input lower case letters
This is the default input format.



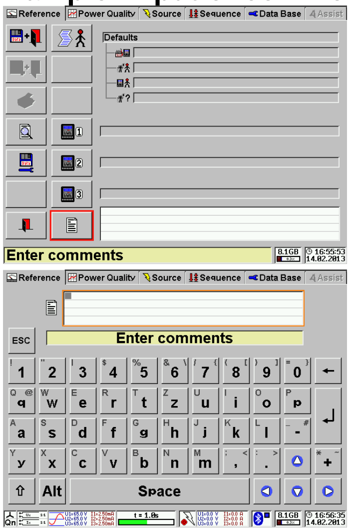


Terminate input
Press the enter key to terminate the input. The virtual keyboard disappears.

4.3.3 Alphanumerical field input

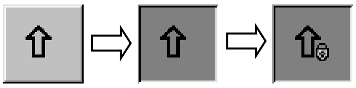
The virtual keyboard for alphanumerical inputs is displayed, if a field input of numbers and/or text is required.
The input can also be made with an external keyboard (option) connected to the USB type A connector.

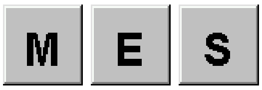
Example: Input of comment



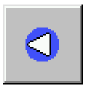
Activate input
Touch the FB comment to activate the input of text and numbers.

The virtual keyboard for alphanumerical inputs is displayed. The input field for comments is shown on top with a grey cursor on the first line in the left upper corner. New text is always inserted at the actual position of the grey cursor.

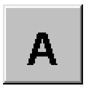




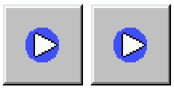
Input several capital letters
Touch the shift key twice to lock input of capital letters (caps lock active). Enter several capital letters. The grey cursor key is moved to the right



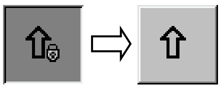
Move cursor to the left
Move the cursor over the character S by operating the left cursor key once.

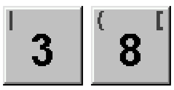


Insert character
The character is inserted at the position before the cursor.

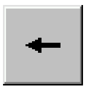


Move cursor to the right
Press the right cursor key twice moves the cursor two positions to the right.

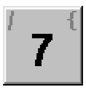




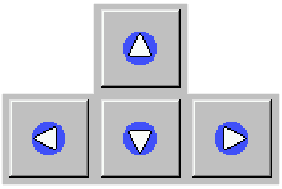
Change back to input of lower case letters and numbers
Touch the locked shift key once to change back to lower case letters and enter numbers directly.



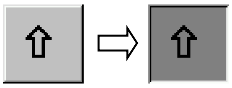
Delete character
Touch the delete key to delete one character left to the cursor



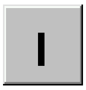
Enter correct number

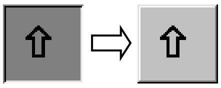


Move the cursor to other line
Touch the new position directly or use the up/down and left/right cursor keys to move the cursor to the new position, the beginning of the third line.

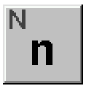


Change to capital letters
Touch the shift key once to activate capital letters

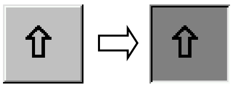




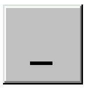
After the input of one capital letter, the layout is automatically changed back to lower case letters.

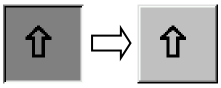


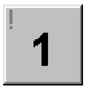
Input lower case letters
This is the default input format.

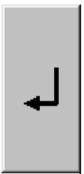


Change to capital letters again to access the underline sign.
Touch the shift key once to activate capital letters
After the input of the underline sign, the layout is automatically changed back to lower case letters.

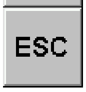






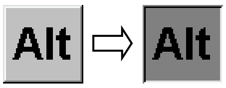


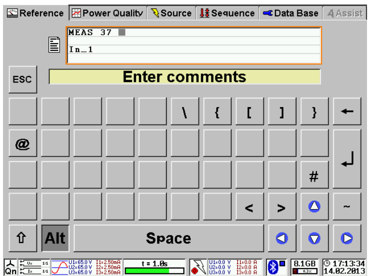
Terminate input
Press the enter key to accept and terminate the input. The virtual keyboard disappears.



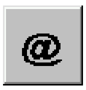
Cancel Input
Touch the **Escape** key to cancel the input function.
The original data is retained.

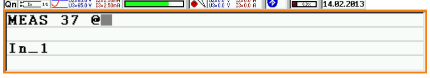
Input of special signs

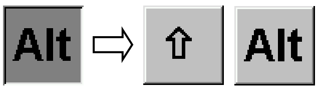




Touch the Alt key to activate the layout with special signs.

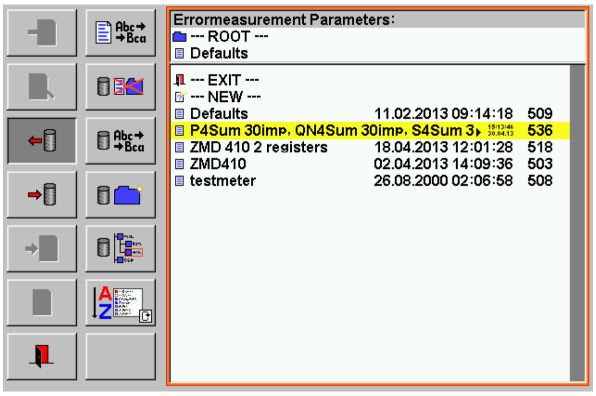






After the input of one special sign, the layout is automatically changed back to lower case letters.

4.4 Load / save settings



Load / save settings menu

The function can be called from different menus to load or save parameters (e.g. error measurement parameters).

The data base file selection menu is called and parameters can be loaded from a file or saved to a file on the compact flash card. The FB's of data base menu, which are not used, are displayed "grayed out" and not accessible.

The file defaults is loaded at power on. Desired default settings can be saved under this name.

Note: The files are only available and the default parameters are only loaded, if a compact flash card is inserted.

Indications / settings

Defaults 11.02.2013 09:14:18 509
P4Sum 30imp, QN4Sum 30imp, S4Sum 3 15:13:46 30.04.13 536

Indications

P4Sum 30imp, QN4Sum 30imp, S4Sum 3

File name
The file name is shown beside the blue file symbol.

11.02.2013 09:14:18
15:13:46 30.04.13

Date and time
Date and time when file was saved is shown. Depending of length of file name either in big letters or with arrow and small letters.

509
536

File size
The file size is shown in byte.

Load actual object

Activate **Load Actual Object** by pressing the FB

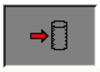
--- EXIT ---
--- NEW ---
Defaults 11.02.2013 09:14:18 509
P4Sum 30imp, QN4Sum 30imp, S4Sum 3 15:13:46 30.04.13 536
ZMD 410 2 registers 18.04.2013 12:01:28 518
ZMD410 02.04.2013 14:09:36 503
testmeter 26.08.2000 02:06:58 508

Select / load settings
Press on desired object and settings will be automatically loaded.

--- EXIT ---
Defaults

Cancel load settings
Press on EXIT to cancel the load function. The actual settings remain unchanged.

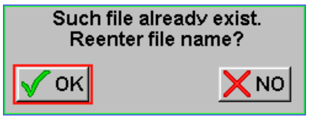
Save actual object



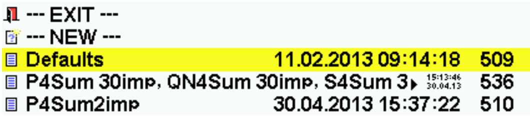
Activate **save actual object** by pressing the FB

Select / save as new settings
Press on **NEW** to activate input of new name

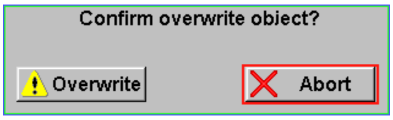
Define name
Define a name using the virtual keyboard and press enter to save the entry.



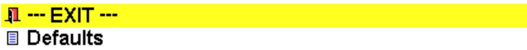
Reenter file name
The proposed file name already exists.
OK: Entry field for define name appears again.
NO: Cancel save function.



Select / save as defaults
Press on **Defaults** and confirm or abort the action.



Confirm to overwrite
Overwrite: Overwrite Defaults with new settings. At next power on these settings will be loaded as default.
Abort: Cancel save function. The actual defaults settings remain unchanged.



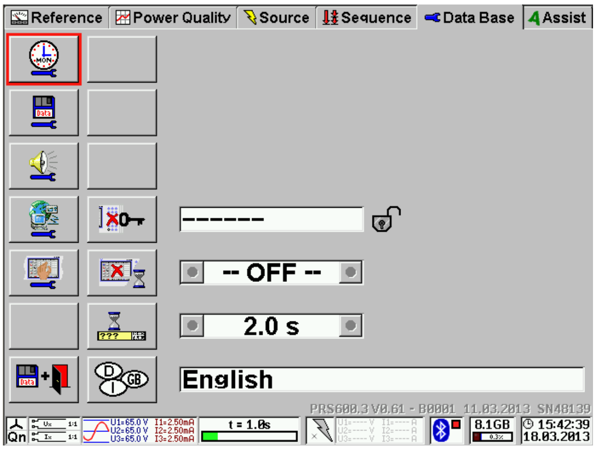
Cancel save settings
Press on **EXIT** to cancel the save function.

Exit, back to calling menu

Delete file / rename file / create folder / browse folder / change sorting order

Description of these functions see [6.1]

5. Data Base Basic settings of the instrument



Basic settings of the instrument menu

1st column:

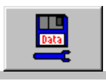
- Clock setup (time and date)
- Save parameter setup
- Beeper setup
- Communication setup (Ethernet, Bluetooth, Modem)
- Screen calibration
- Exit and save

2nd column:

- Set keyboard unlock password
- Set LCD switch off timeout
- Set Tool-Tip timeout
- Select language

Indications / settings

	Call **clock setup** menu [5.1].

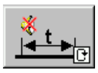
	Call **save parameters setup** menu [5.2].

	**Beeper setup**

The beep function is active when the loudspeaker sign is not crossed out. Press the button to change the status (cyclical mode).

 Beep for each touch on the touch screen (Status: active)

 Beep for each keystroke on external keyboard (Status: inactive)

 Beep each time the time base starts (Status: inactive)

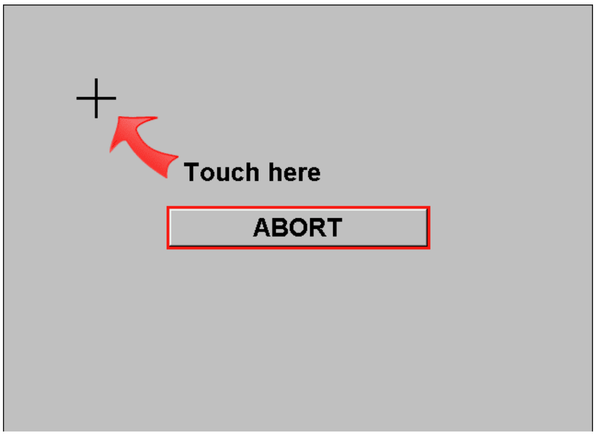
 Beep each time a new error value will be displayed (Status: inactive)

 **Exit** and accept settings, back to calling menu.

	Call **communication setup** menu [5.3]

	**Screen Calibration**

Both Screens on the PRS 600.3 can be calibrated by touching the indicated cross lines (+).



Following sequence will be displayed and needs to be touched:

- Left upper corner
- Right lower corner
- Right upper corner
- Left lower corner

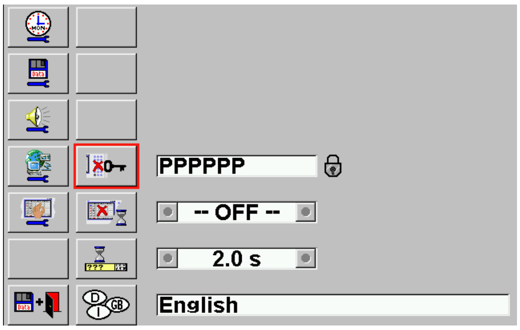
There is the possibility to abort the calibration by pressing the **ABORT** button and return to the call menu.

After successful calibration press the **Calibration OK** button and automatically return to Call menu.

Set keyboard unlock password

The keyboard can be locked in the data base main menu. This prevents e.g. unwanted manipulations during longtime power quality recording sessions.

To set an unlock password press the **Set keyboard unlock password** FB

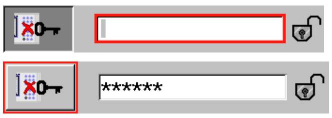


Enter the unlock password with the virtual keyboard and press enter.

Password definition

No password defined

Note: The key lock FB in the data base menu is blocked, if no password is defined.



Enter a new password

Enter a numerical password with 1 up to 17 digits. Correction of the password is possible by reentering a new password as long as the enter button is not pressed.

Attention! Memorize the password carefully, before leaving the basic setting menu. If you are not sure, what you have defined, enter 0 to reset the password function before leaving the menu.

Password is defined

The old password needs to be entered, before changes can be made. Stars are indicated and the lock is shown open, if the password was correct entered and accepted.

Reset the password

Enter 0 to reset the password function. The key lock function is disabled.

Screen saver

The display can be switched off for protection and energy saving after a selected time interval. This can be useful during long duration power quality recording sessions. The display is switched on again by any key operation and the interval is restarted.

5 min	Use the up/down cursor keys to select between: 1, 5, 15, 30, 60 min or OFF (cyclical mode)
-- OFF --	The screen saver function is switched off. The display is permanently on.

Tool-Tip timeout

1.0 s	The Tool-Tip timeout can be selected from 0.5s to 10s. The Tool-Tip text will be displayed in the status line for the defined time.
-- OFF --	The Tool-Tip description will not appear in the status line.
Start / Stop loadpoint execution	The Tool-Tip will be displayed during the defined time in the status line of the screen and explains the function of the FB.

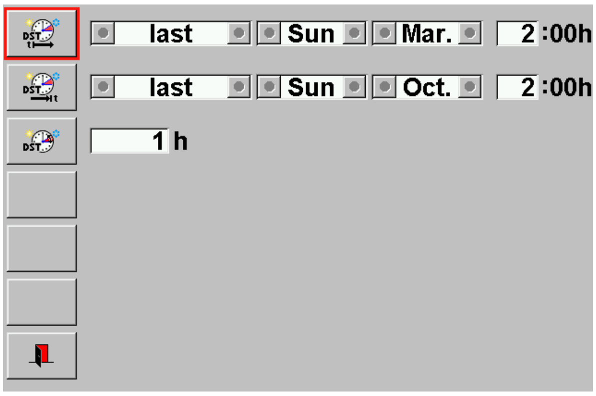
Call **Language selection** menu [5.4].

Load different languages for tool tips, menu and units from the directory **Languages**

Save and exit the menu

5.1 Clock setup (time and date)

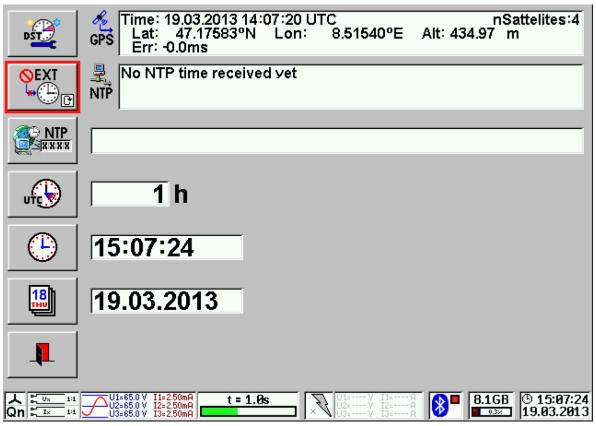
5.1.1 Daylight saving time



Daylight saving time setup

- Enter the begin of daylight saving time
- Enter the end of daylight saving time
- Enter time offset of daylight saving time

5.1.2 Manual clock setup



Manual clock setup

The status indication in the right lower corner shows a clock symbol. The clock used as time stamp for recordings is based on the internal Real Time Clock (RTC).

The correct clock time and the date must be manually entered by the user.

Note: Time and date can be reset, if the instrument was not used for longer time. Check the settings before use.

Time

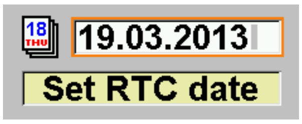
The clock is stopped and the actual time is displayed.

Enter the new time in the format **hh:mm:ss**. The separator (:) will be generated automatically.

h: hour, m: minute, s: second

The clock restarts with the entered time when the enter key is pressed to terminate the input.

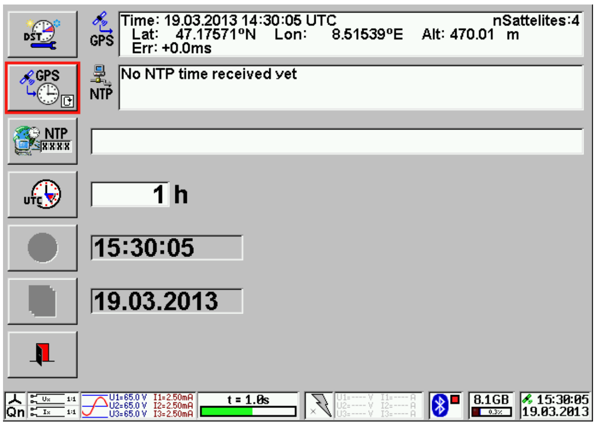
Date



Enter the date in the format **dd.mm.yyyy**. The separator (.) will be generated automatically.

d: day, m: month, y: year

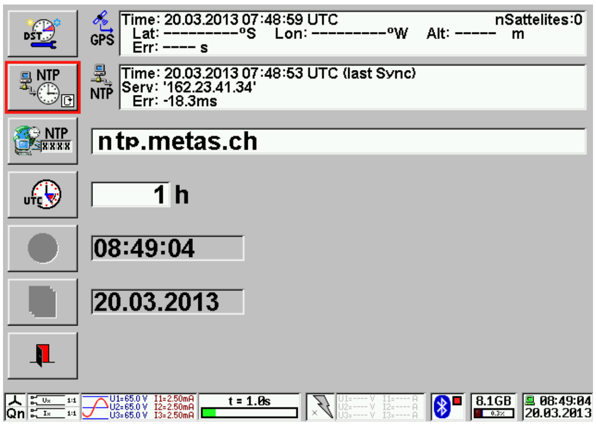
5.1.3 GPS time synchronization



GPS time synchronization
The internal clock and date are synchronized to the exact **U**niversal **T**ime **C**oordinated **UTC** transmitted by the satellites of the **G**lobal **P**ositioning **S**ystem **GPS**.
The status indication in the right lower corner shows a satellite symbol.
The time synchronization is successful, if three or more satellites are received and the satellite symbol in the status becomes permanently green. Additionally, also the coordinates (latitude, longitude) and the altitude of the actual position are indicated.

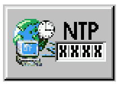
 Enter time shift of local time to UTC time.

5.1.4 NTP time synchronization



NTP time synchronization
NTP (**N**etwork **T**ime **P**rotocol) is a protocol designed to synchronize the clocks of computers over a network.
The status indication in the right lower corner shows a computer symbol.

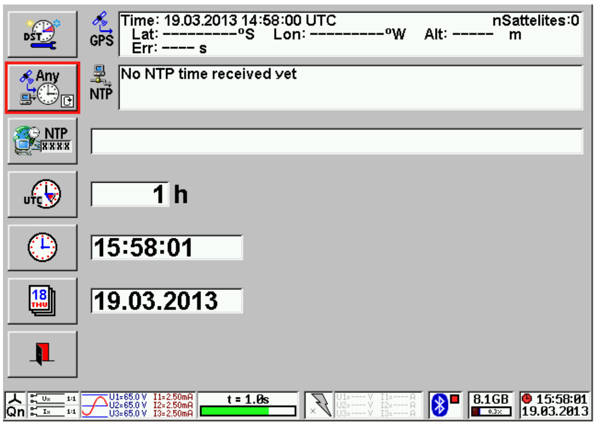
Note: An internet connection must be established in order to use this feature.
For the setup of a Ethernet communication refer to chapter [5.3.1].



Press the NTP button and enter the NTP server address, name or list using the virtual keyboard.

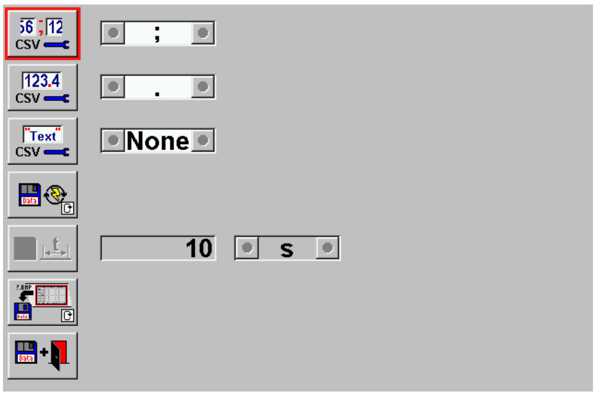
The time synchronization is successful, if it is displayed as in the example shown.

5.1.5 Any time mode



Any time mode
In this mode time synchronization happens randomly between GPS and NTP - whatever is available.
The status indication for the **Any time mode** in the right lower corner shows a red clock symbol. Once a GPS or NTP signal is received the status indication will change accordingly.

5.2 Save parameter setup



Save parameter setup menu

The following settings are displayed

- Test Assist function (set cell separator)
- Test Assist function (set value separator)
- Test Assist function (set text group)
- save mode
- time for save interval not selected
- set image save mode

Set save mode

Toggle mode between the three save modes.

The results will be saved one time. The FB interval with the according input field is 'grayed out'

The results will be saved at the defined interval time. This mode will be used for load analysis.

5 — Input of number between 1 and 99999

s — Select s, min or hr

h: hour, m: minute, s: second

The results will be saved on every new event (e.g. during error measurement - every new result corresponds to a new event). The FB interval with the according input field is 'grayed out'

Indication of active save mode

The camera key is shown depressed

<-> 8.1GB — The CF card status indication is periodically changing between disk symbol and size indication.

To stop the periodical saving the camera key must be pressed once again.

Set image save mode

If activated, an image of the display at time of pressing the camera FB can be saved together with the actual result data set.

Toggle mode between.

Save display image

The whole display content is saved

Save results image

The result window of the display is saved

No image

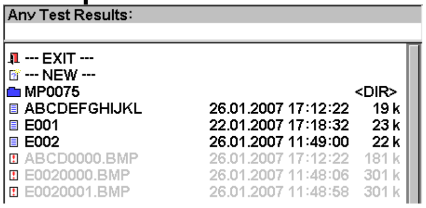
The image save function is disabled.

The images are saved in the same directory as the result file in the format:

<4 char name><4 digit number>.BMP

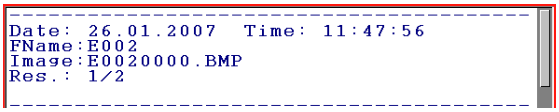
<4 char name>	First 4 characters of the result file name
<4 digit number>	Automatically incremented number starting at 0000
.BMP	Windows BMP Bitmap File Format

Example



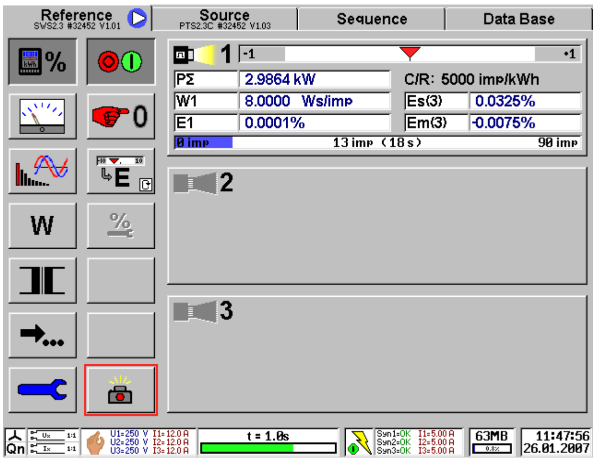
Result directory

Result files and image files are stored in the same directory. The grey shown image files *.BMP cannot be viewed on the instrument itself with the result preview function.
If a result file is deleted, then also all linked image files are deleted.



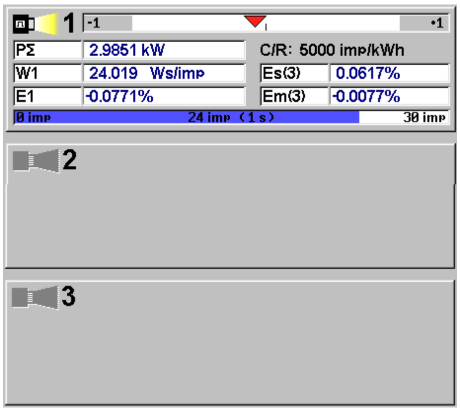
Header of results at print preview

The link between result file (E002) and image file (E0020000.BMP) is shown.



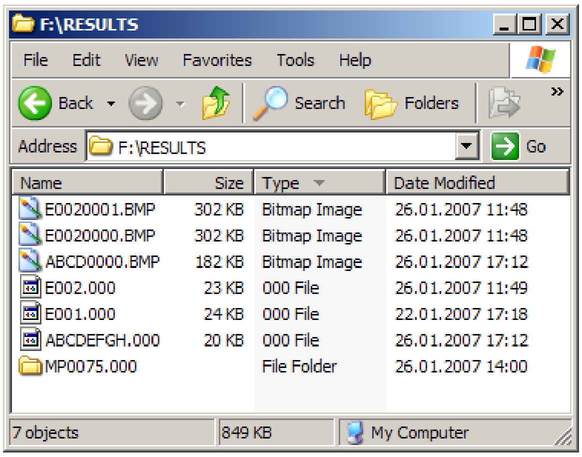
Display image

The full display is saved (size 302 kB).
The image E0020000.BMP was captured together with the results (same time and date in status as in header of results).



Result image

Only the result section of the display is saved (size 182 kB).

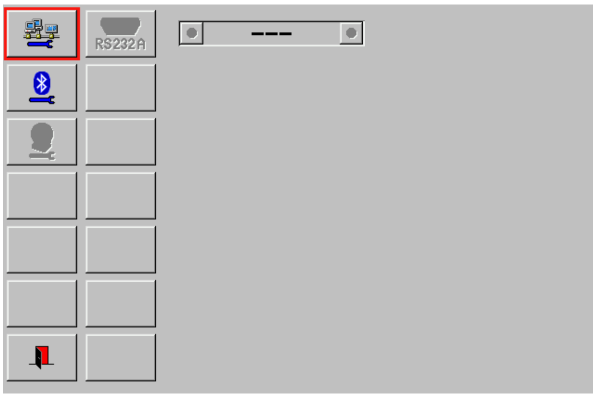


Directories on CF card

The images are stored in the directory **RESULTS**.
The images can directly be accessed by the PC with a CF card reader. The images can be copied or moved to any directory on the PC and can be used for documentation of the measurements (e.g. inserted in a word document).

	**Save and exit** the menu

5.3 Communication Setup



Communication setup menu
Content of the communication setup menu:

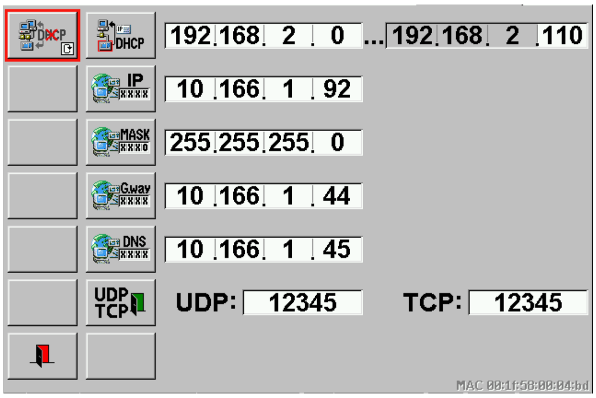
- Ethernet setup
- Bluetooth setup
- Modem setup (not available on PRS 600.3)
- RS 232 setup (not available on PRS 600.3)
- Exit, back to menu basic settings

5.3.1 Ethernet Setup

DHCP management

Toggle mode between:

- DHCP activated - PRS 600.3 receives IP address
- DHCP activated - PRS 600.3 provides IP address
- DHCP not activated - Used to enter a fixed IP address



Ethernet network setup menu
Press on corresponding FB to activate the input of the address part. Enter the required values with the virtual keyboard. and press the enter key to terminate the input.

- Set the DHCP server address range
- **I**nternet **P**rotocol (**IP**) address
- MASK address
- Gateway address
- **D**omain **N**ame **S**ystem (**DNS**) address
- **U**ser **D**atagram **P**rotocol (**UDP**) and **T**ransfer **C**ontrol **P**rotocol (**TCP**) Port numbers
- Exit, back to menu basic settings

The network communication with the PRS 600.3 happens via an Ethernet or USB connection. This section describes the three different modes the unit can be configured for establishing a connection.

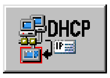
Caution! Please get in contact with your system administrator before connecting the PRS 600.3 to a computer network!
Choosing the wrong connection mode may cause network problems.

Basics
The PRS 600.3 needs an address. This address has to be entered later in Calegration. The address consists of two parts:

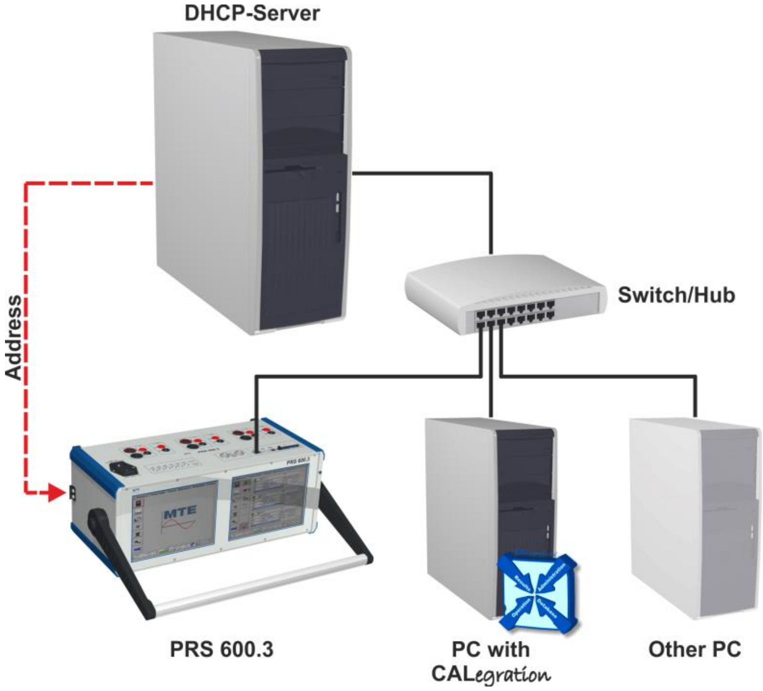
- Internet-Protocol-Address (IP-Address)
- User-Datagram-Protocol-Port Number (UDP-Port Number)

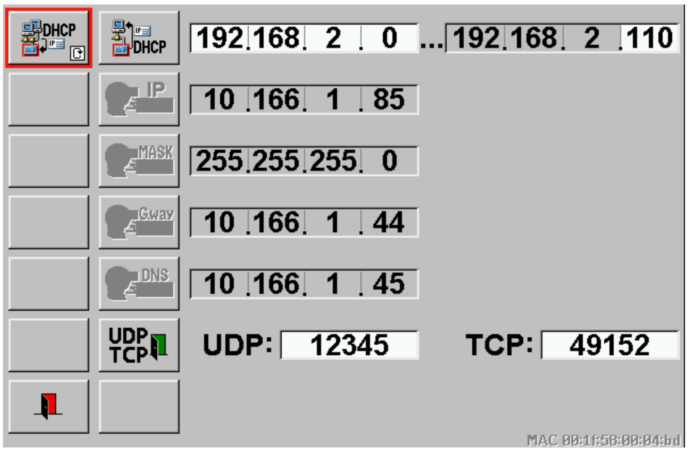
5.3.1.1 Ethernet Connection possibilities of the PRS 600.3

There are three possible communication principles / definitions:

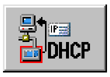
(a) 

The PRS 600.3 is receiving the IP-address automatically from a DHCP Server.
Recommended principle to integrate the PRS 600.3 in an existing network.



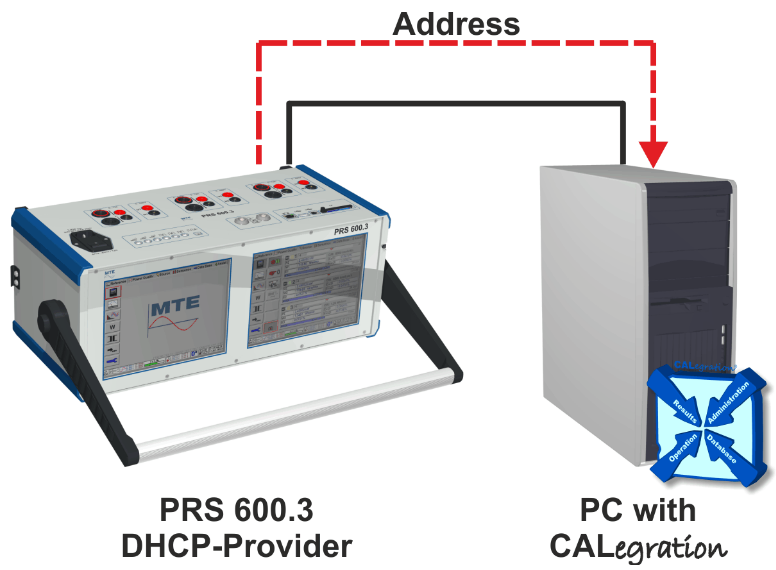


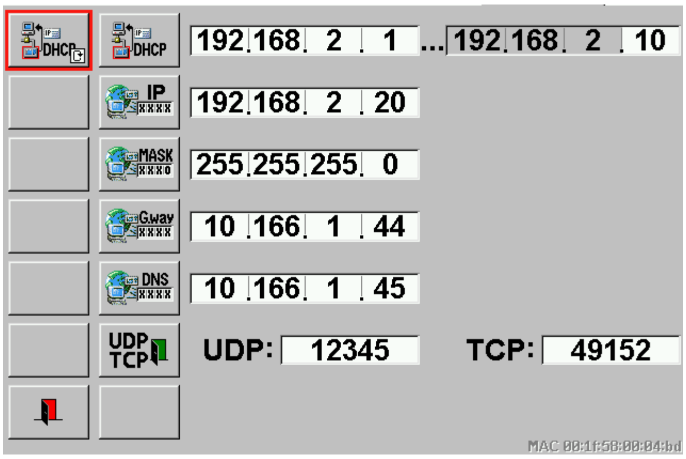
No other settings are needed in this mode except of the UDP/TCP definition.

(b) 

The PRS 600.3 is acting as DHCP Server and provides the IP-address for a PC/Notebook.

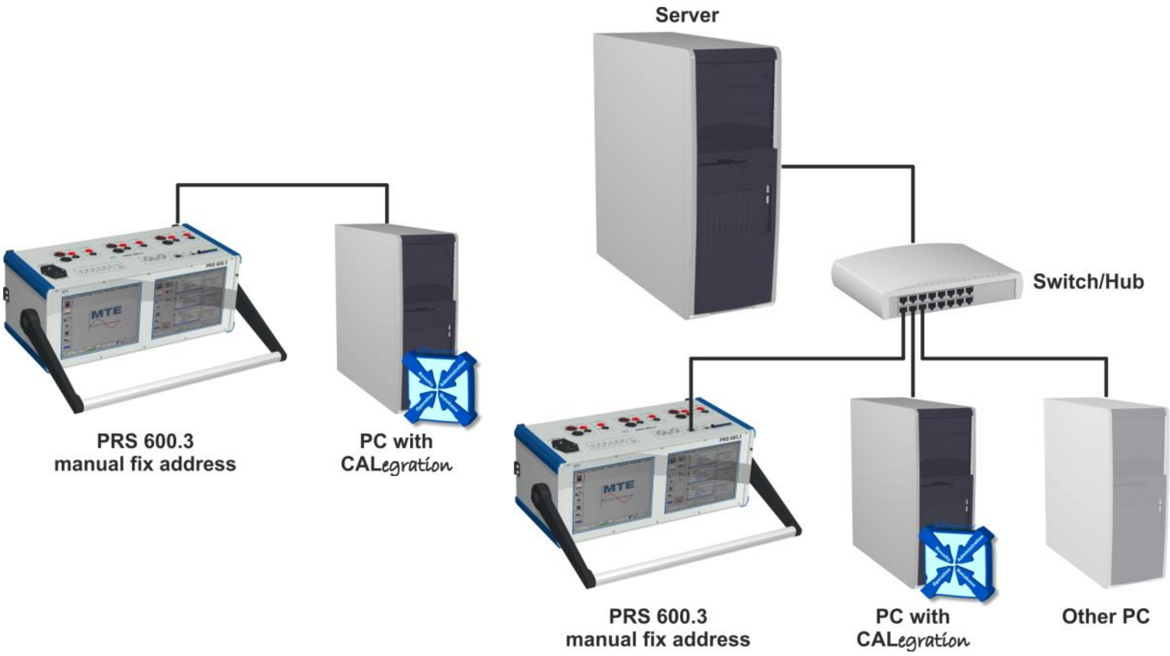
The PRS 600.3 can handle up to 10 addresses. The PRS 600.3’s own address, mask and gateway has to be set manually (see below c).
In below example the PRS 600.3's own IP address must be within the 192.168.2.x range, but should be outside of the range which the DHCP server is providing (192.168.2.1 - 192.168.2.10).
Recommended principle for a point – point communication between PC and PRS 600.3.

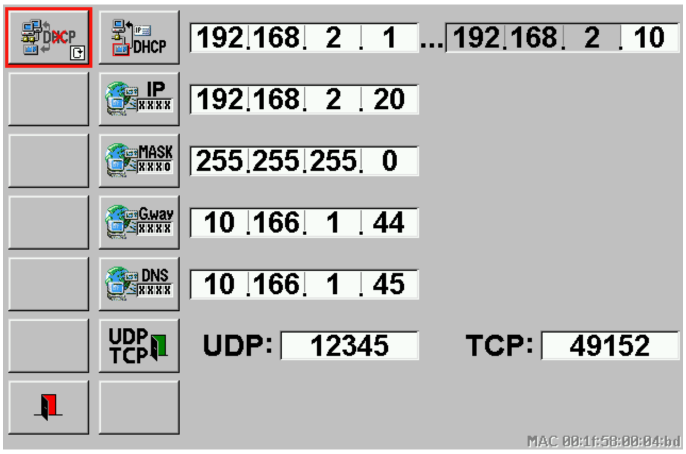


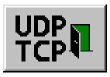


(c) 

The PRS 600.3 has a manually configured IP-address, Mask and Gateway
The PC needs an already assigned IP-address.
In below example the PC must have an IP address in the 192.168.2.x range except the PRS 600.3's own address (192.168.2.20).
Recommended only for users with good knowledge of the network.

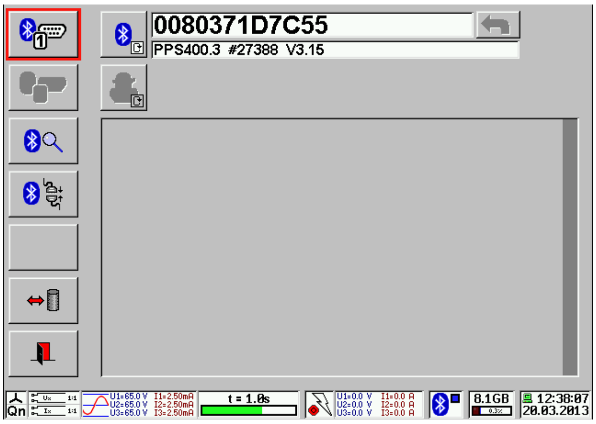






A User Datagram Protocol (UDP) or a Transfer Control Protocol (TCP) number (also called port number) is necessary in all three modes.
The three examples show the communication with UDP port number 12345.
For communication with TCP there are two ports available. The port 23 (=Telnet) and a second port, which can be entered in the setup.

5.3.2 Bluetooth configuration



Bluetooth configuration menu
This menu contains the following functions and settings:

- Defined bluetooth address
- Identification code of the device
- Table with available bluetooth devices
- Edit bluetooth device
- Search for device
- Reconnect device
- Load/save bluetooth settings
- Exit
- Status indication

We recommend switching on first the power supply of the power source and the reference meter. The PRS600.3 then will easily detect other Bluetooth devices. The communication to the defined Bluetooth device will be checked automatically. When the first call failed, the PRS600.3 will try to get the communication a second and third time before turning the status to ‘communication failed’. See status indication [4.2]

Setup bluetooth device

Typically, the bluetooth device is the power source PPS 400.3. Bluetooth devices have each a unique bluetooth address. The bluetooth devices can be selected from the table by clicking on it or the specific address can be set manually by typing it with the virtual keyboard.
We recommend starting with search devices first for getting all available bluetooth devices.

Selecting device from table

Select the table with the available bluetooth devices

01: ?	0080371B85A6	PPS400.4 #26552
02: ?	00803719D1BB	PPS400.3
03: ?	0080371B85A5	PRS400.3 #26522
04: ?	00803719D1BC	PRS400.3.3 #26528

Display of table with the available bluetooth devices. The desired device can be selected by pressing on it.

Typing it with the virtual keyboard

00803719D1BC

Input of hex number 0...F for the bluetooth address is possible. For entering numbers A...F activate the shift key. For entering numbers 0...9 deactivate the shift key.

PRS400.3 #26528 V1.03

Display of received identification code of the bluetooth device

Setup search for devices

The search for active bluetooth devices starts. Therefore, the actual connected devices will be disconnected. The fields for the identification codes will turn gray. During the search the green symbol will appear and the FB’s will be grayed out.

Status indication green: indicates that the PRS600.3 bluetooth module searches for available devices. The search can run during seconds up to minutes.

01: ? 0080371B85A6 PPS400.4 #26552 02: ? 00803719D1BB PPS400.3 03: ? 0080371B85A5 PRS400.3 #26522 04: ? 00803719D1BC PRS400.3.3 #26528	The available bluetooth devices will be shown in the table. The predefined bluetooth devices will be automatically connected when possible.
	Status indication (purple rectangle): shows that the bluetooth module is searching for communication to the defined bluetooth devices.
	Status indication (blue rectangle): shows successful communication with the bluetooth device.
0080371B85A5 PRS400.3 #26522 V1.03	The successfully connected device will be shown with the received identification code.

Reconnect devices

The PRS 600.3 tries to reconnect the bluetooth devices. When the first call failed, the PRS 600.3 is trying to establish the communication up to three times before turning the bluetooth device status to ‘communication failed’. The status indication changes three times between white and purple. If the reconnection fails, the bluetooth device status will turn to red.

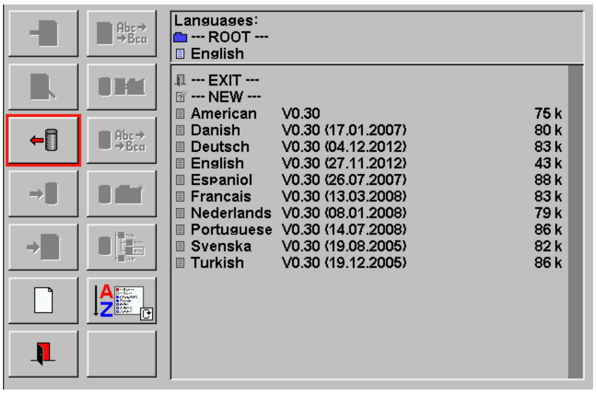
0080371B85A6	The indication before pushing the FB shows that the device is not connected. The field is grayed out.
0080371B85A5 PRS400.3 #26522 V1.03	The lost communication to the device with the defined address will be reconnected. The reconnected device will be displayed with the received identification code. The status indication of the source will change from grayed out to active.

Load/save settings from/to directory **Bluetooth settings**

Status indication

Description of status indication in chapter [4.2]

5.4 Language Selection



Language selection menu
The available languages for tool tips and menu texts are displayed in this menu.

There are two possibilities to load new language files to the instrument:

- Download of a new language file **<language>.txt** from a PC with the download tool.
- Copy the new language file **<language>. LNG** on a PC directly to the compact flash card directory **LANGUAGE.DB**.

For use of standard FB for data base handling see chapter 6.

Select language file

One of the shown languages can be selected by pressing on the corresponding name.
The selected language will be activated immediately.

American The selected language is indicated in the menu Parameter.

Reset to default language

The language file <English> will be loaded.

English The language English is indicated in the menu Parameter.

Exit and accept settings, back to calling menu.

5.5 Installation and configuration of Universal Serial Bus USB

This chapter describes the installation of the USB driver on the PC and how the Software CALegration needs to be configured to use the USB interface.
The first time the PRS 600.3 is connected to a PC with the USB cable, the installation of a driver is asked.

5.5.1 USB drivers for EMH / MTE devices

If the software CALegration is delivered together with the device, the USB drivers can be found in a subfolder **USB driver,** or they can be downloaded from the internet in the support section of our homepage.

https://www.mte.ch/support	> USB DRIVERS USB driver for all our MTE devices.	**USB driver** ftdi emh_cdc.cat EMH_CDC.inf

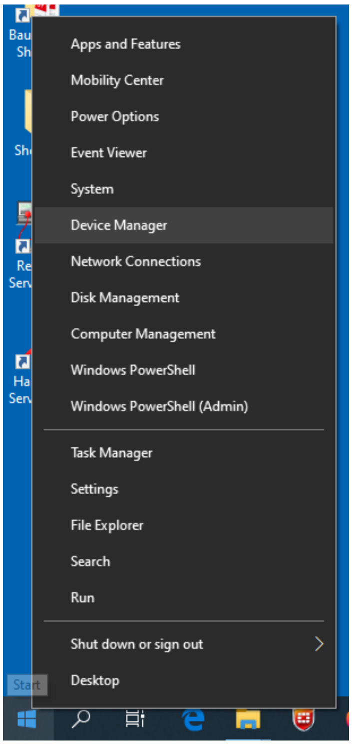
5.5.2 Installation of USB driver in Windows 10

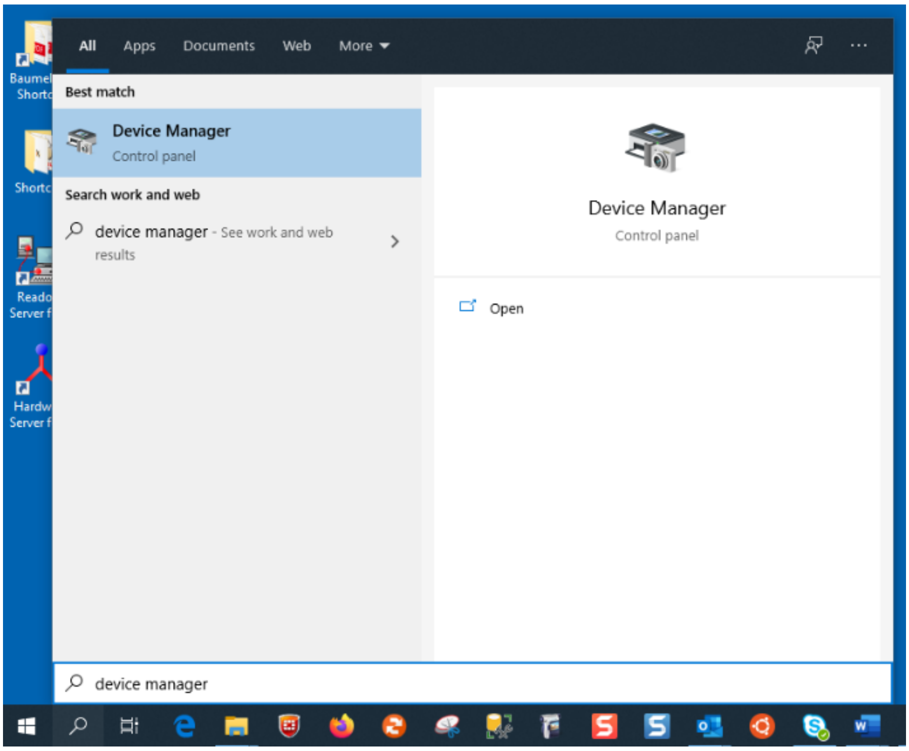
1 Connect the PRS 600.3 to a free USB port of the PC

The PC may automatically install a standard serial driver.
Should you directly be asked for a driver, select the path **usb driver** of the CALegration installation files or the path of the downloaded usb drivers from the internet.

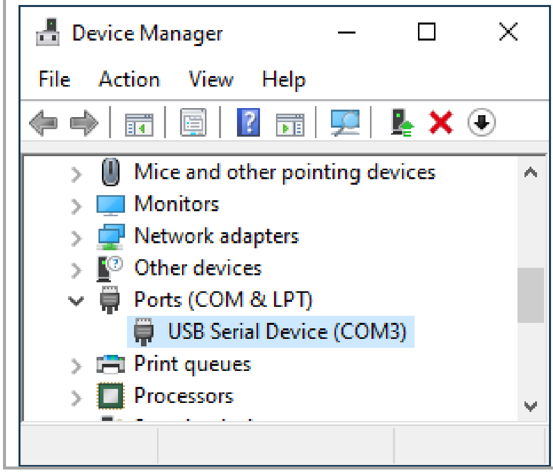
2 Open Device Manager

For manual installation of the drivers click the **windows start button** in the left lower corner with the **right mouse key** and select **Device Manager** with the **left mouse key** or click on search and enter device manager to find and activate the Device Manager.

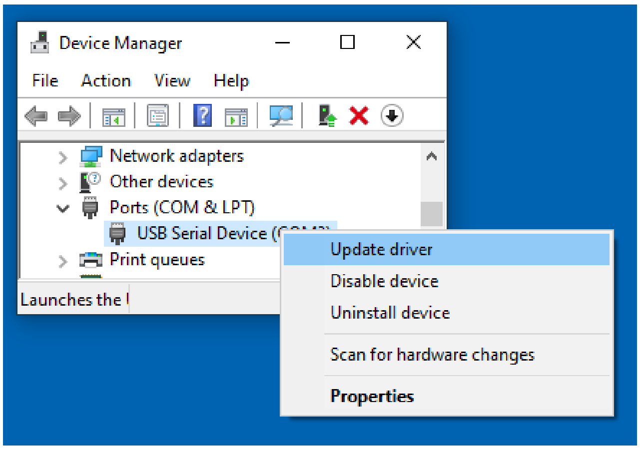




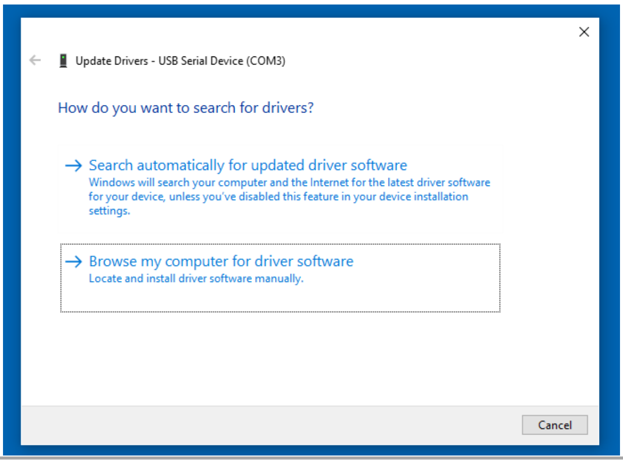
3 Open Ports (COM & LPT)



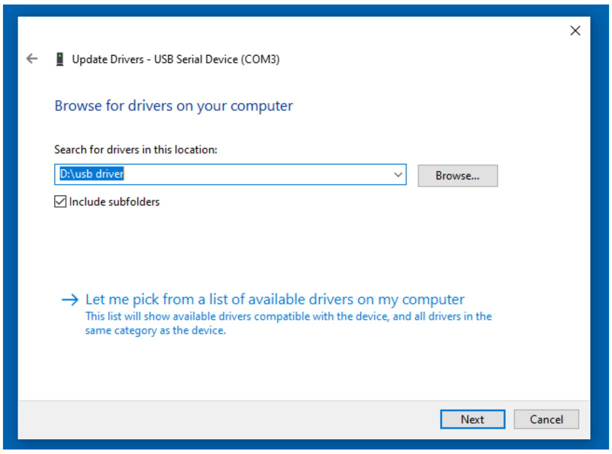
4 Right click USB Serial Device and select Update driver



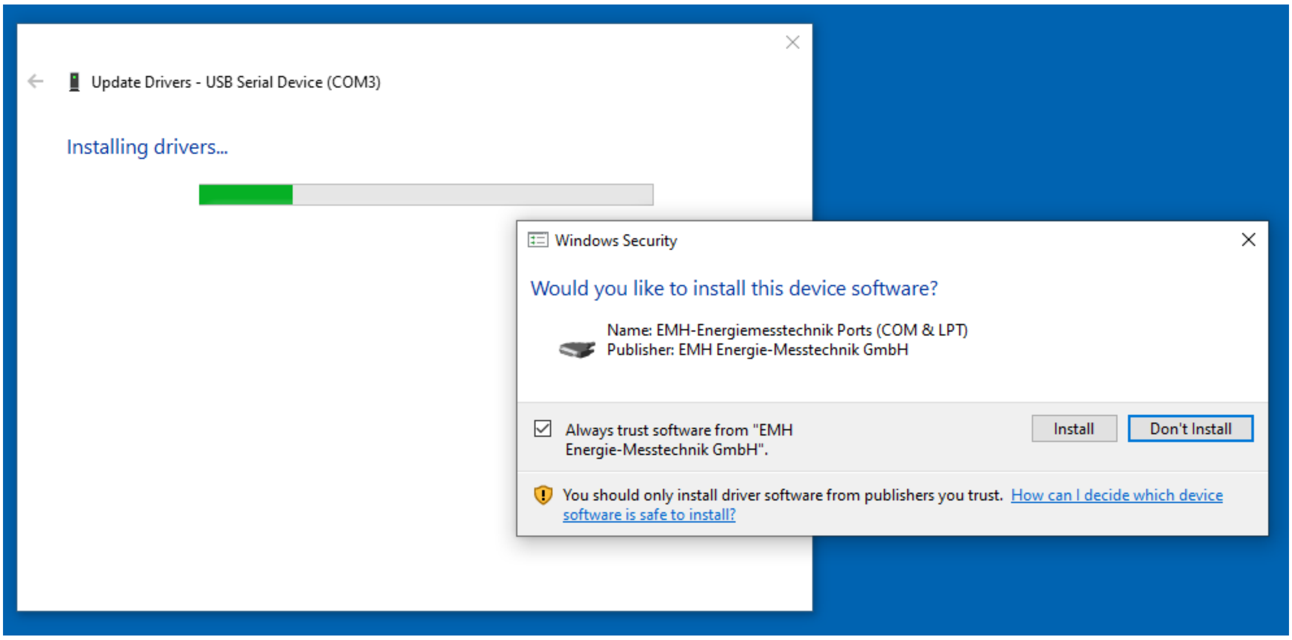
5 Select Browse my Computer for driver software



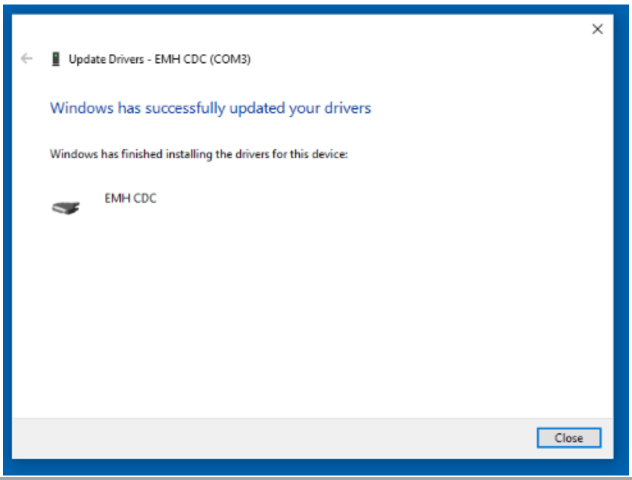
6 Select Browse and select the folder, where the driver is located



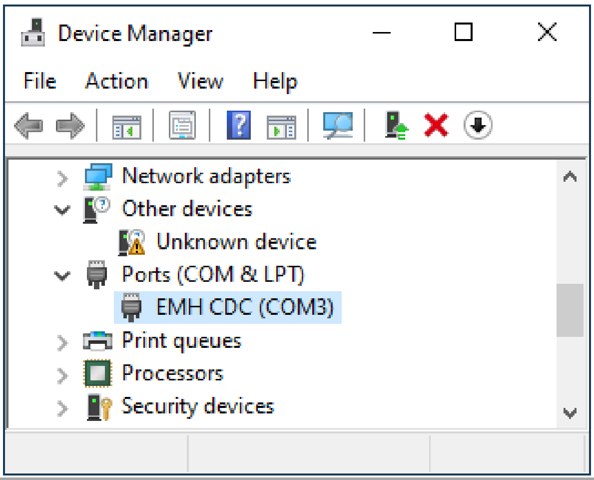
7 Select Install



8 **After a successful installation the following screen is shown.**



9 **Device Manager shows EMH CDC (COMx)**



Alternative Installation in Windows 7:

1. Copy the Driver file "EMH_CDC.inf" directly into following directory on your computer:

C:\Windows\inf

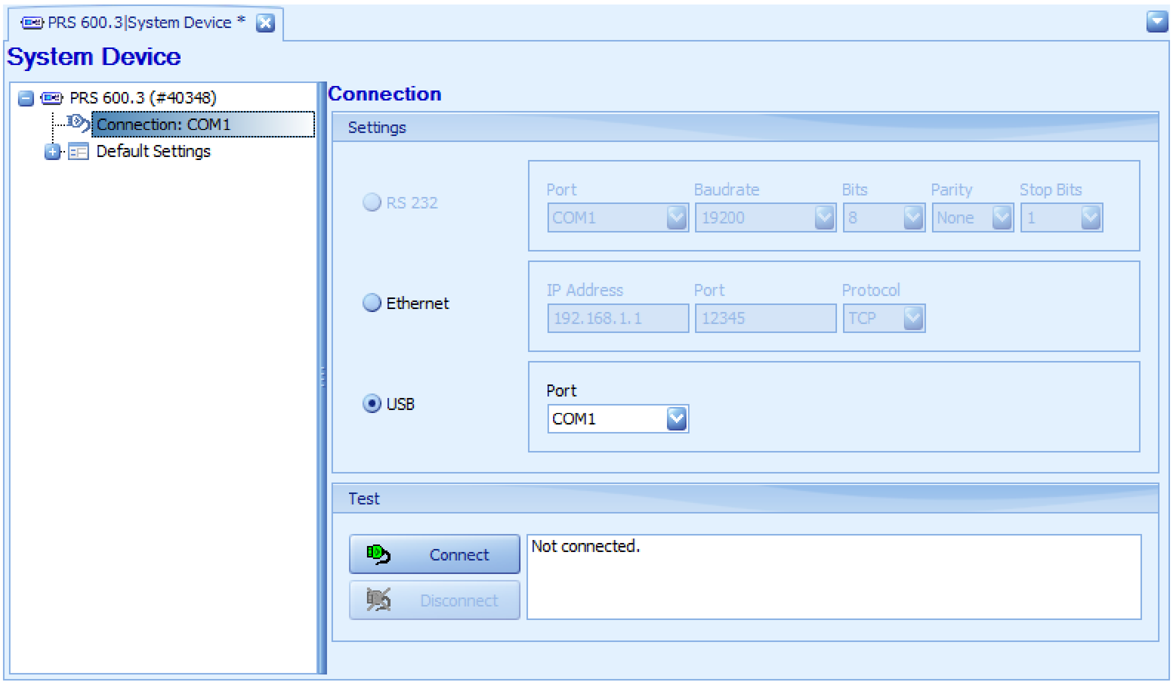
(USB driver file (EMH_CDC.inf) can be found on CALegration installation USB Memory Stick in folder "usb driver" or directly on the CF Card of the PRS 600.3).

2. Connect PRS 600.3 to a free USB port on your computer.

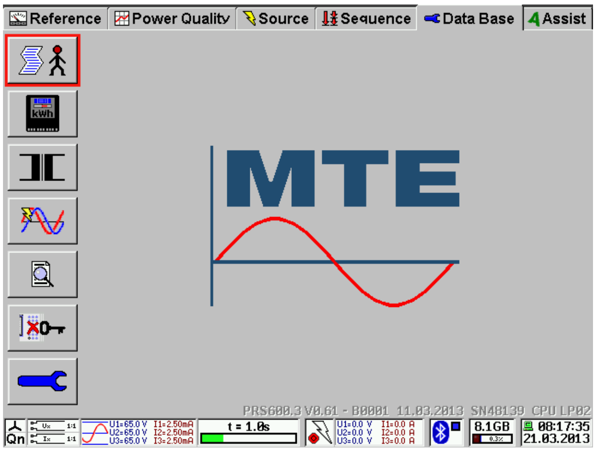
3. Windows is searching for the USB driver file and will install it automatically. After successful installation, a beep from the PRS 600.3 is hearable.

5.5.3 CALegration settings

Select the USB COM-port in the CALegration System Device connection settings. CALegration is only showing the COM-ports where the driver mentioned above is installed for.



6. Data Base Test results and administrative data



Data Base menu card

The data base menu gives access to all administrative data sets (ADS) and test results data sets (TDS), which are saved on the compact flash card.

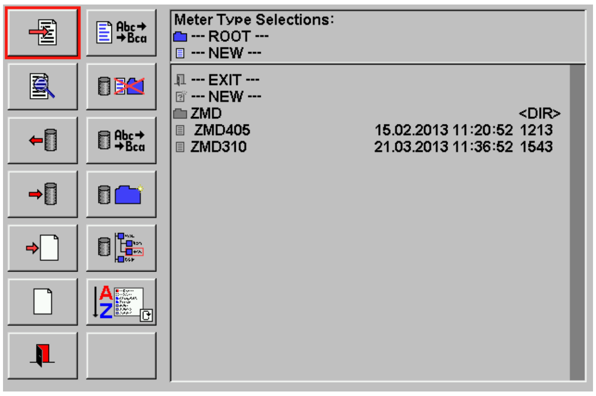
Parts of the data base can either be entered or modified manually with the internal virtual keyboard, an external keyboard or can be loaded into the unit with the software CALegration. Data transfer from PC to the compact flash card can be done via interface or directly with an adapter for the compact flash card connected to the PC.

Access to parts of the data base is possible from different menu cards and sub menus.

Indications / settings

	Call **Administrative data** menu [6.4]
	Call **Meter data** menu [6.5]
	Call **Transformer data** menu [6.6]
	Call **Loadpoint Data** menu [6.7]
	Call **View test results** menu [6.2]
	Lock the keyboard with password
	Basic settings of the instrument see chapter [5]

6.1 Data Base functions



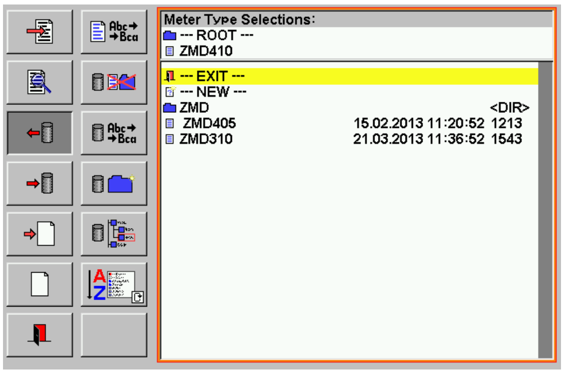
Data base file selection menu

The window on the right side shows a directory (e.g. Meter Type Selections) with subfolders and object files. There exist several object file types for the different parts of the data base.
The two FB columns at the left side show all the available data base functions, which can be applied on the object files.
The object file selection menu can be called from different MCs and different locations. If some FB's are not used at a call of the object file selection menu, they are shown "grayed out" and are not accessible in this case.

Indications / settings

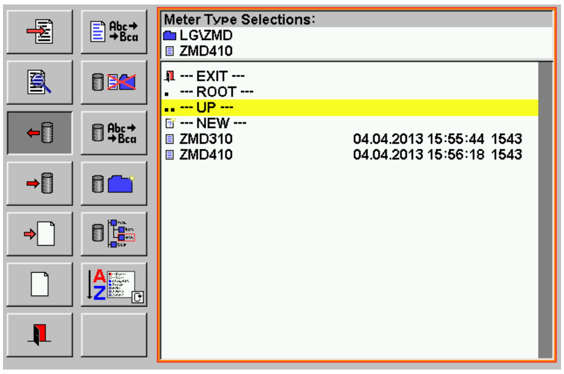
Basic file handling functions

Common functions for the listed FB's (example shown for load object file)



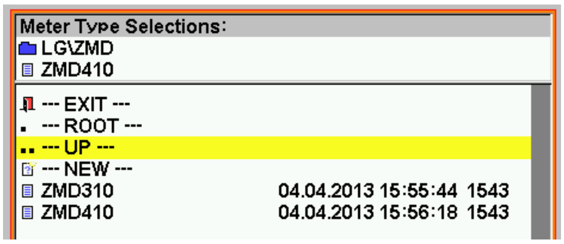
Activate function

Select and activate FB by pressing on it. The FB is shown depressed. A red frame surrounds the file window and a yellow selection line is shown.



Activate subfolder / select file

Select the corresponding subfolder by pressing on it. The path with root directory (Meter Type Selections:) and subfolders (LG\ZMD) is shown in the header.
Select the desired file by pressing on it. (e.g. ZMD410 for load or ---NEW--- for save).
Higher folder levels can also be selected with --- UP --- or --- ROOT ---, see description under browse.
Note: Direct selection of folders is not working for delete and rename. Here the browse function must be used.

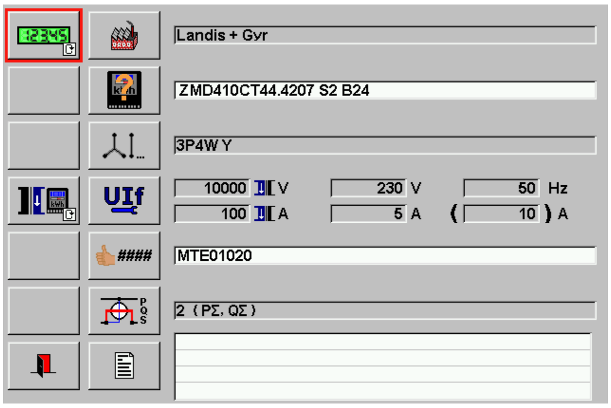


Cancel function

Press EXIT to cancel the function.

Edit actual object

The editor menu of the object file type indicated in the root directory (e.g. Meter Type Selections) is displayed.



Actual meter type dataset
The actual content of the object can be viewed and changed directly. The content of the entry fields depend on the forgoing actions. If an object was loaded before, the content of this object file is shown. If reset object to defaults or create / edit new object was called before, the fields are empty. Some fields can directly be changed (e.g. Approval Number: MTE01020), other fields contain links to sub menus (e.g manufacturer: Landis + Gyr) or show object file names of linked object files.

Exit, back to file selection menu.

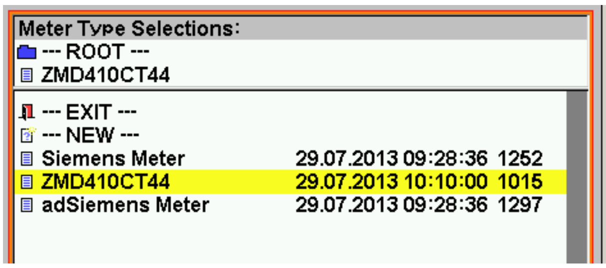
Note: To keep the changes, they must be saved after leaving the menu, otherwise they will be lost at next power off.

View actual object

The content of the actual object dataset of the file type indicated in the root directory (e.g. Meter Type Selections) is displayed.

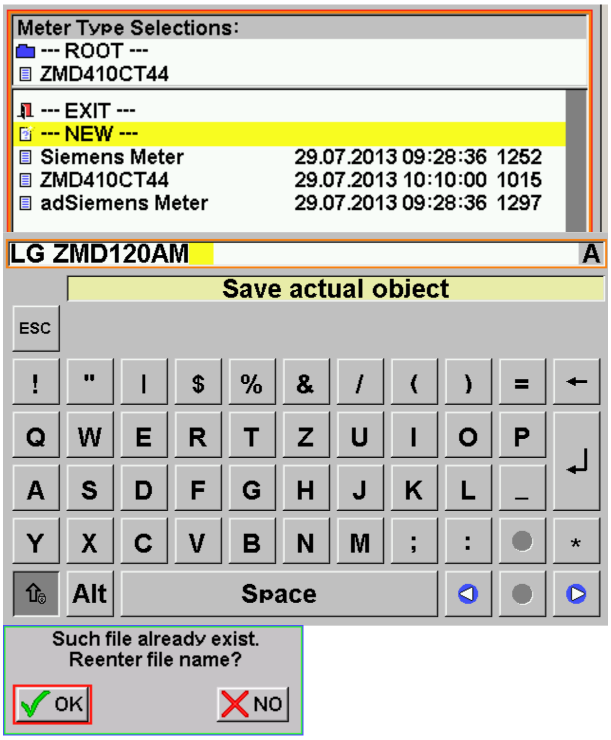
View actual meter type
The data of the actual object is displayed. This function gives a good overview over the actual object dataset, because all data, also the data of the linked submenus and object files, is shown at once.

Load object file



Load object file
Load file by pressing on corresponding name in the list. The file is loaded and the editor of the actual object dataset is shown (see description for edit actual object).

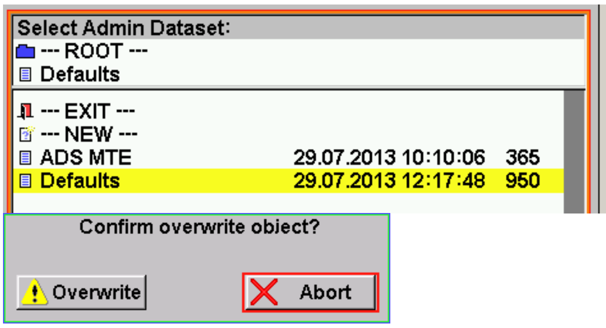
Save object file



Save as new file
Press on ---NEW--- to save dataset as new file.

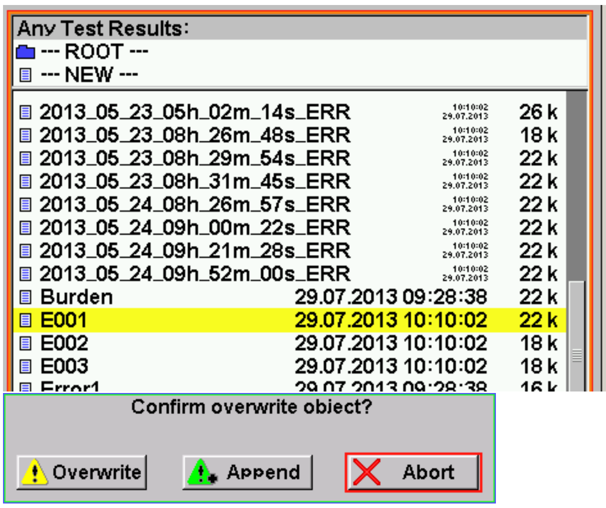
Enter / change name
The input of a name is required.
The name can be entered/changed with the virtual keyboard. [4.3].
Press the Enter key to terminate the save function.

Warning file exists, re-enter name?
OK: Re-enter different file name and press Enter key to terminate.
NO: The rename function is cancelled.



Save as defaults
Select file named Defaults in root directory (e.g. Admin Dataset). A confirmation is required, because an existing file will be overwritten.

Confirm overwriting
Overwrite: Overwrite Defaults with new settings. At next power on these settings will be loaded as default. The save function is terminated.
Abort: Cancel save function. The actual defaults settings remain unchanged.

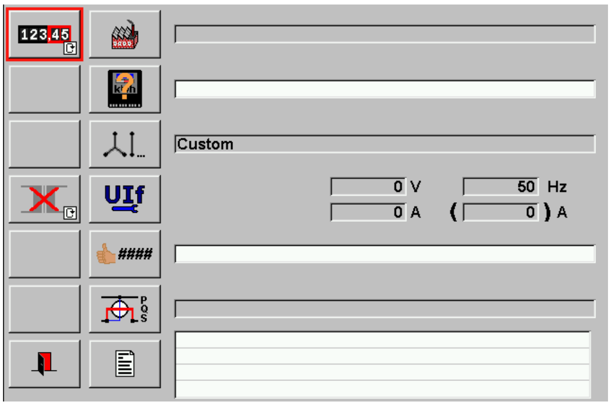


Save to existing result file
With this function several measurement data sets can be saved in the same result file.

Confirm overwriting / append
Overwrite: The old measurement data set will be overwritten with the new data set.
Append: The new measurement data set will be appended to the existing file. This option is only available at measurement result files.
Abort: Cancel save function.

Create / edit new object

The empty editor menu of the object file type indicated in the root directory (e.g. Meter Type Selections) is displayed.



Actual meter type dataset - empty
The input fields are empty or reset to default values.
Enter new dataset as desired. See description of different actual object datasets for the meaning of the listed entry fields.

Exit, back to file selection menu.

Save the values entered at the actual object dataset to a file in the data base (optional)

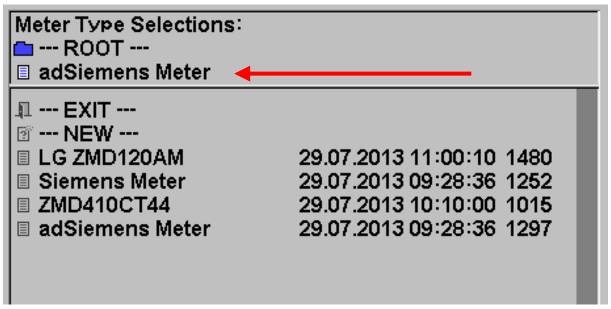
Note: If the entries are not saved, they will be lost at power off.

Reset actual object to defaults

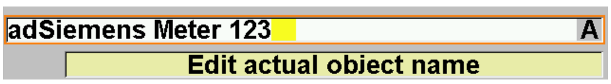
The actual object dataset is cleared. All entry fields and links to submenus and other object files are empty.

Edit actual object name

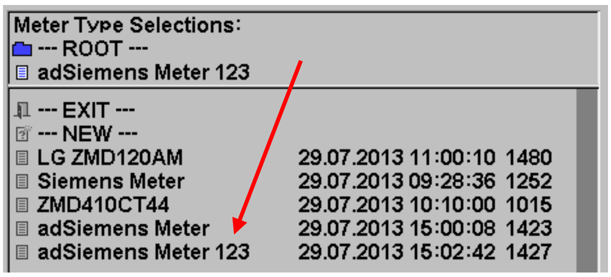
This function is similar to a "Save as" function (file can be saved under a new name and original file will remain the same).
For simple renaming a file refer to the "Rename object file or folder" function.



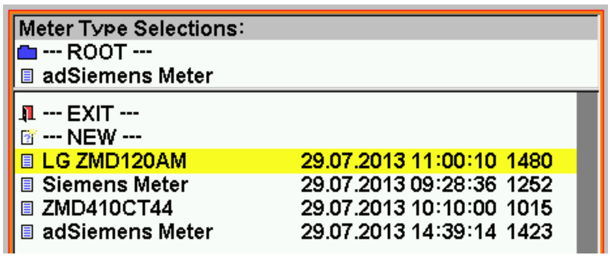
The name of the actual loaded object can be edited by pressing on the FB (in this example the adSiemens Meter is the actual loaded object).



Edit the object name by using the virtual keyboard and press Enter to terminate.
The edited file must be saved and will then be displayed in the list (adSiemens Meter 123).
The original file remains in the list.



Delete object file or folder

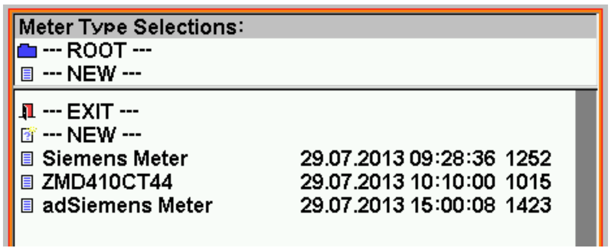


Delete object file

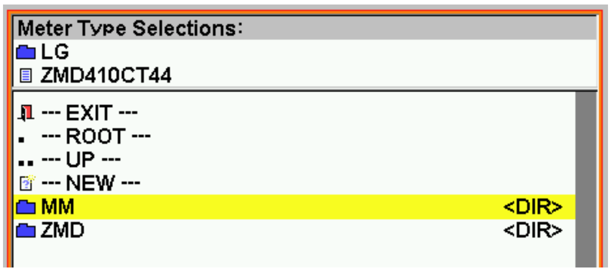
Select the corresponding file to be deleted.
A confirmation is requested.

Confirm delete file

NO: The delete function is cancelled.



OK: The file is deleted and the delete function is terminated.

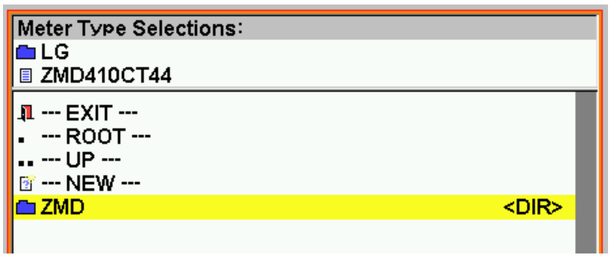


Delete folder

Select the corresponding folder to be deleted.
A confirmation is requested.

Confirm delete folder

NO: The delete function is canceled.

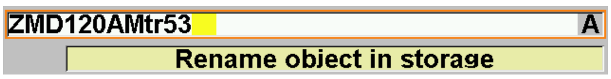


OK: The folder and all its content (files and subfolders) are deleted.
The function is terminated.

Rename object file or folder

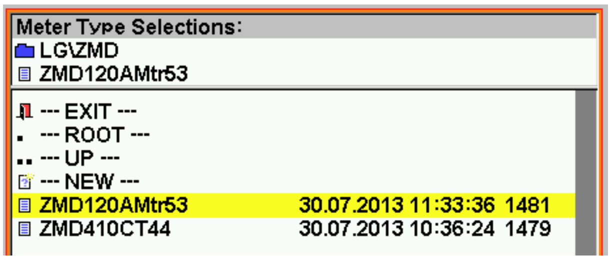
Activate rename

Select file to be renamed by pressing on the name.

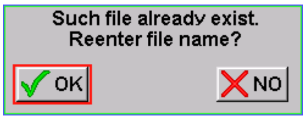


Change name

Change name with the virtual keyboard.

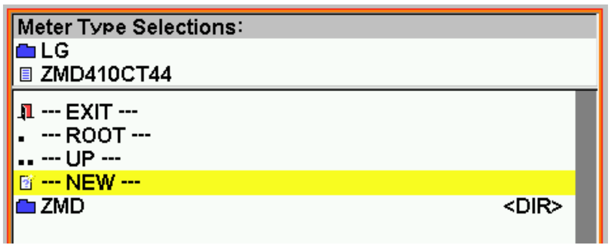


Terminate rename
Press Enter on the virtual keyboard to terminate the function.
If the name was not changed a warning appears.



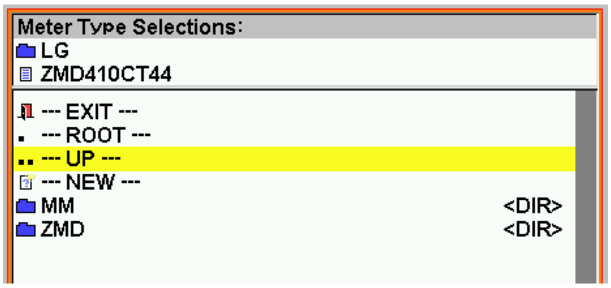
Warning file exists, reenter name?
OK: Reenter different file name and press Enter again to terminate.
NO: The rename function is cancelled.

Create new folder/subfolder

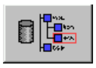


Select / activate new
Select line ---NEW--- in the root directory or sub directory where the new folder/subfolder shall be created, and enter the name with the virtual keyboard.

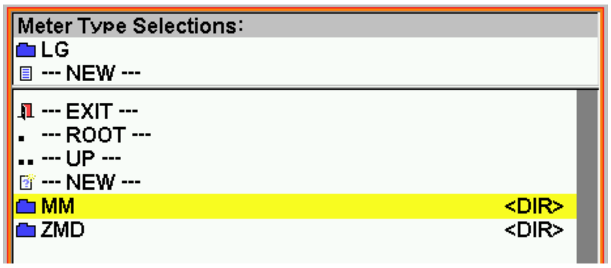
Enter folder name
Enter name of folder (MM) with the virtual keyboard.



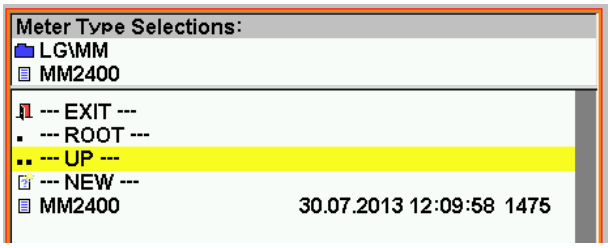
Terminate function
Press Enter on the virtual keyboard and new folder is created (MM). The function is terminated.



Browse folders/subfolders



Select folder
Select folder (MM) in actual path (LG) by pressing on name.



Change to subfolder
The subfolder content is shown. The second header line shows the new path (LG\MM).

Change to upper folder
Select --- UP --- to change to next higher level.

Change to root directory
Select --- ROOT --- to change to the root directory (e.g. Meter Type Selections)

Terminate browse
Pressing on any line with a file name or --- NEW --- or --- EXIT --- terminates the browse function.

	**Change sorting order**

Push on the FB to cyclically change between the 7 different sorting orders:

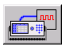
	Sort directories followed by files ascending according names.
	Sort files followed by directories descending according names.
	Sort files and directories ascending according creation dates
	Sort files and directories descending according creation dates
	Sort files ascending according file size
	Sort files descending according file size
	No sorting

	**Exit, back to calling menu**

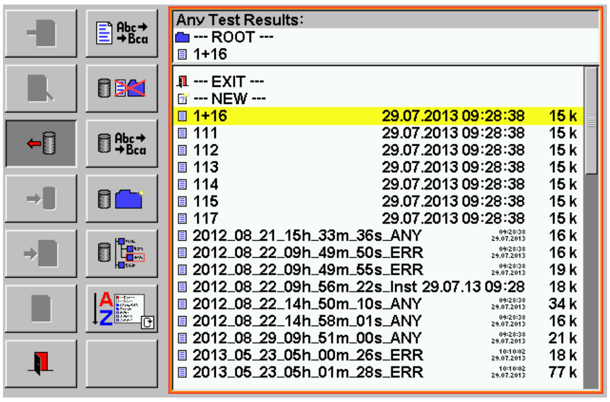
6.2  View of saved test results and measurement information

View results menu

 Call **Any Test Results** directory

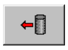
 Call **FRef Test Results** directory

Following some examples of viewing the results saved in the **Any Test Results** directory are shown. The results of the other directory **FRef Test Results** can be viewed in the same way.

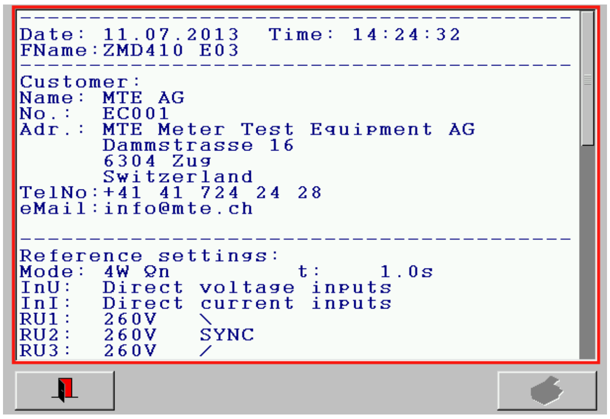


Any Test Results directory

All standard result files saved on the compact flash card are listed in this directory. The result files contain the combined results data with test results data (TDS) and administrative data (ADS).

 **Select / load** a result file

The view results menu is called

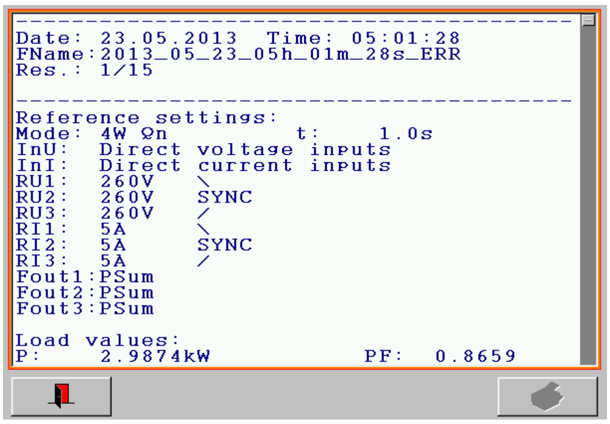


View results menu

The results are shown in a simple text format. This allows a compact fast overview of the ADS and TDS data saved in a result file
The first line shows date and time of saving. The second line shows the result file name.

Scroll up and down with the scroll bar on the right side to view further content.

Exit by pressing on 



Result file with several data sets

In a result file with several data sets saved in continuous mode or with the append function the actual shown result dataset 1 of total 15 (1/15) is indicated as third header line.

Scroll up and down with the scroll bar on the right side to view all datasets.

6.3 Data Base structure

Stored measuring data [Result] contains two major parts:

- Administrative Dataset (ADS) [Result (Administration)]
- Test Results Dataset (TDS) [Result (Measurement)]

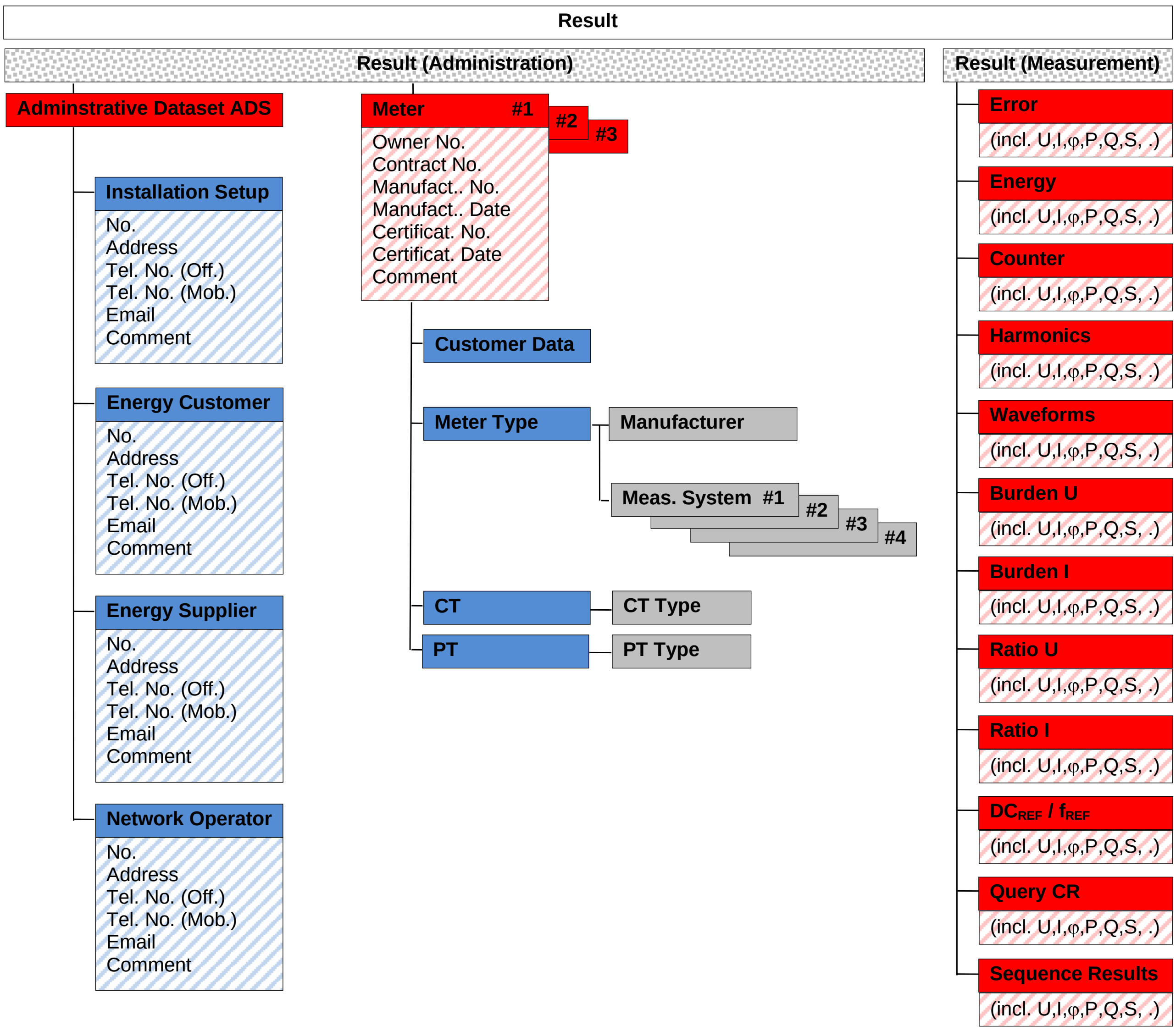
The ADS contains the main parts:

- Administrative dataset
- Meter dataset [Meter #1 to #3]

The TDS contains the parts:

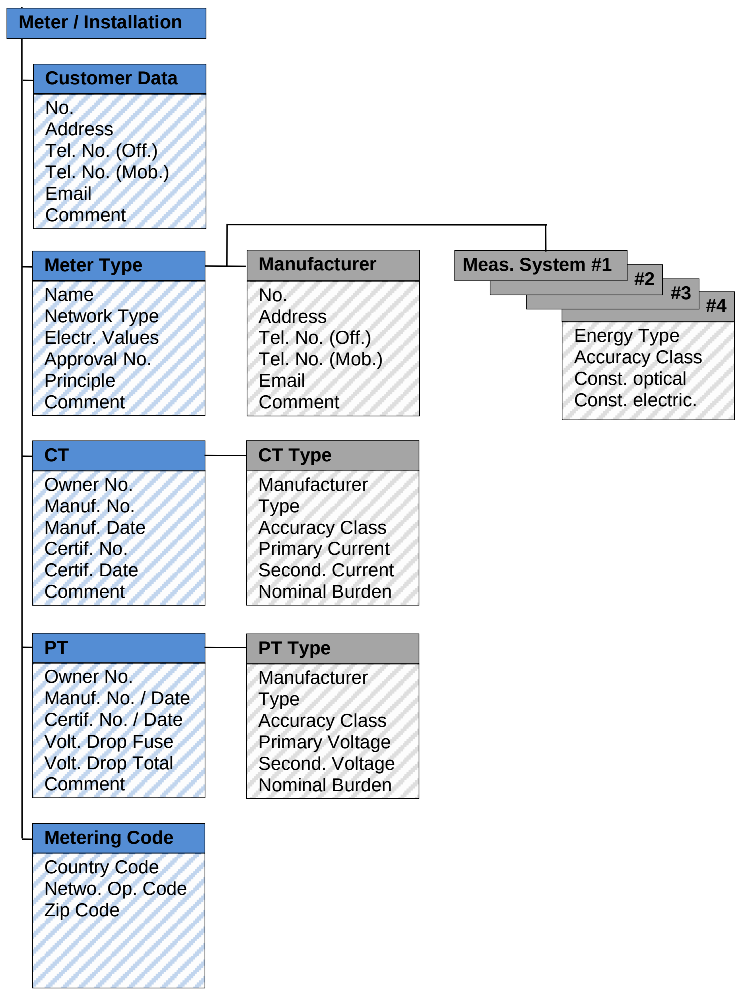
- Results of the different measuring functions [Error] to [Query CR]
- Sequence results [Sequence Results]

Database structure

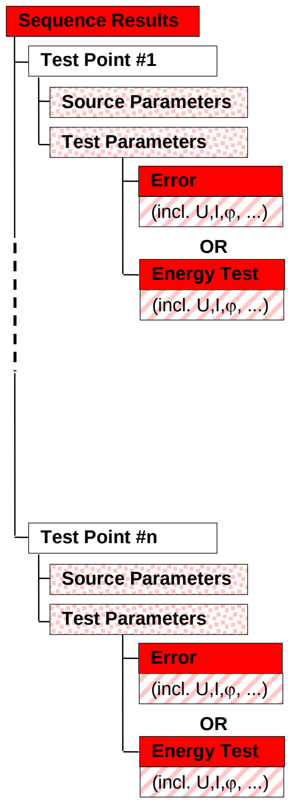


Detail structure

Meter / Installation



Sequence results



6.4 Administrative data

Administrative data menu

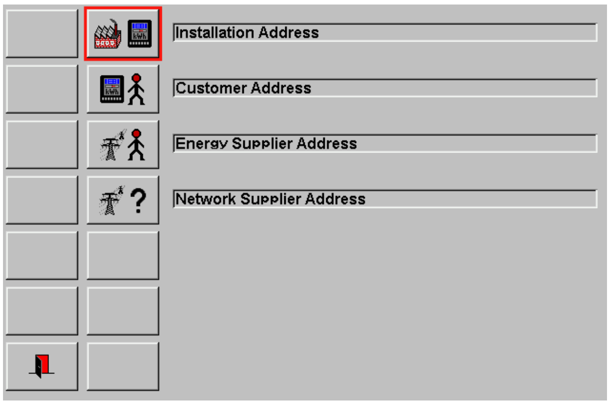
Administrative dataset (ADS)

Address data

An ADS object can be linked to a test result data set (TDS) and be saved together with the results as a result file.

6.4.1 Edit admin dataset (ADS)

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual admin dataset (ADS)

The file names of the actual loaded data base elements are shown at:

Installation address

Customer address

Energy Supplier address

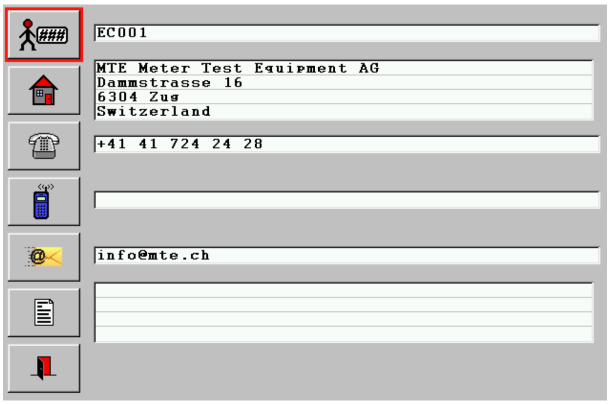
Network Operator address

Enter to load or modify objects [6.4.2]

Exit, back to calling menu

6.4.2 Edit address data

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual customer dataset

Enter or modify with virtual keyboard or external keyboard:

Customer number

Customer address

Phone number

Mobile phone number

E-mail address

Comment to customer dataset

Exit, back to file selection menu.

6.5 Meter data

Meter data menu

- Meter type dataset
- Meter dataset

Indications / settings

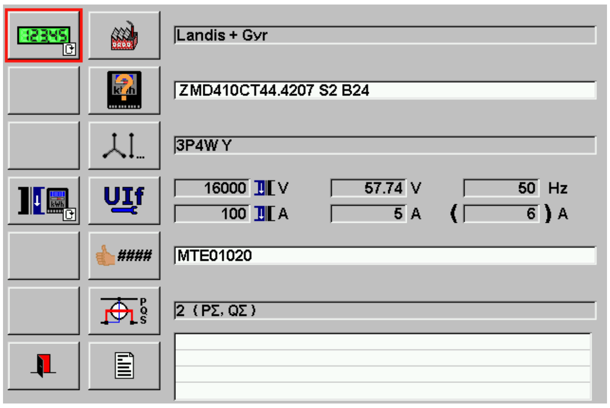
	Load / edit object files

The file selection menu [6.1] is called and an object file directory is displayed:

FB	Directory	Description
	Meter Type Selections	[6.5.1]
	Meter Selections	[6.5.2]

6.5.1 Meter type dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual meter type dataset

- Meter principle
- Manufacturer
- Meter type
- Meter network type
- Meter connection type
- Electrical values
- Approval Number
- Measure system setup
- Comments

Indications / settings

Meter principle

Electronic meter

Ferraris meter

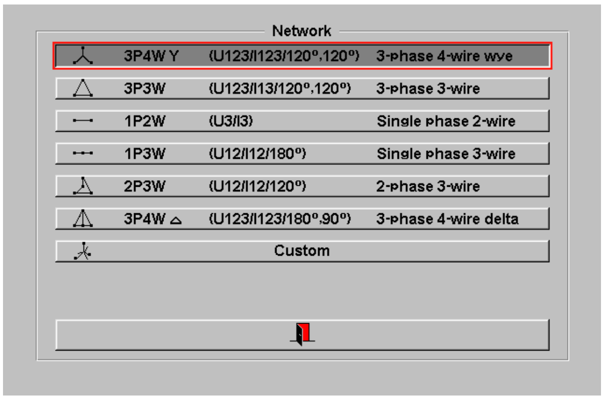
Manufacturer

Load manufacturer data from database.

Meter type

Enter name of meter type.

Meter network type



Network type selection menu
Select desired network type. The selected network is shown pressed. Press on exit door to leave the selection menu.

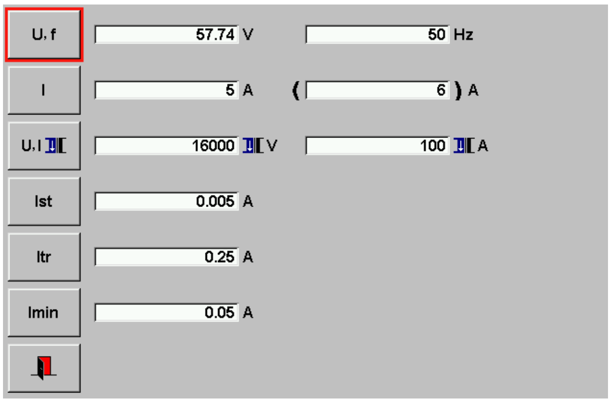
Meter connection type

Direct connection

Transformer operated related to primary.

Transformer operated related to secondary.

Electrical values



U, f	Nominal voltage / frequency
I	Basic current, max current
U, I	Primary voltage / current
Ist	Starting current Ist
Itr	Transitional current Itr
Imin	Minimum current Imin
	Exit screen

U, f

Nominal voltage
Enter nominal voltage as indicated on the meter or the specification.
U (phase - neutral) or U (phase - phase) must be entered depending on meter connection type.
Nominal frequency
Enter nominal frequency as indicated on the meter or the specification.

I

Basic current
Enter basic current Ib at direct connected meters or nominal current In at transformer connected meters, as indicated on the meter or specification.
Maximum current
Enter maximum current as indicated on the meter or the specification.

U, I

Primary nominal voltage
Enter primary nominal voltage as indicated on voltage transformer or the specification.
Primary nominal current
Enter primary nominal current as indicated on current transformer or the specification.

Ist

Starting Current
Enter the starting current Ist according to EN 50470-1 standard.
Typically, 2-6% of Itr for CT connected meters and 4-5% of Itr for direct connected meters.

Itr

Transitional Current
Enter the transitional current Itr according to EN 50470-1 standard.
Typically, 5% of In for CT connected meters and 10% of In for direct connected meters.

Imin

Minimum Current
Enter the minimum current Imin according to EN 50470-1 standard.
Typically, 20-40% of Itr for CT connected meters and 30-50% of Itr for direct connected meters.

Exit the screen.

Approval number

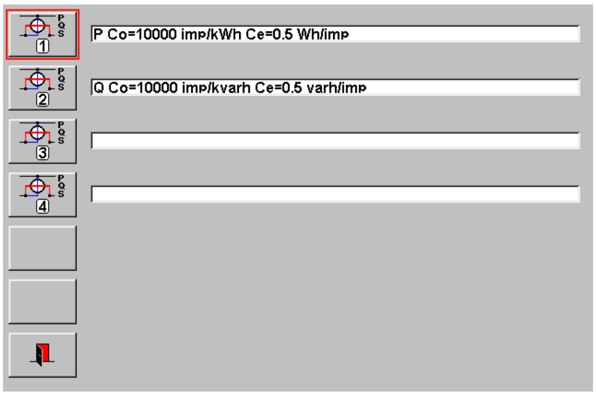
Approval number
Any alphanumerical approval identification, defined by customer, country of manufacturer, based on accepted type tests

Call **Measure systems setup** menu [6.5.1.1]

Enter Comments

Exit, back to calling menu

6.5.1.1 Measure systems setup



Measure systems setup menu
Up to four measure systems can be defined for one meter type.
The names of the actual loaded data base object files are shown at:

.. Measure system 1 .. 4

Indications / settings

.. **Load / edit object files**

The file selection menu [6.1] is called with the object file directory:

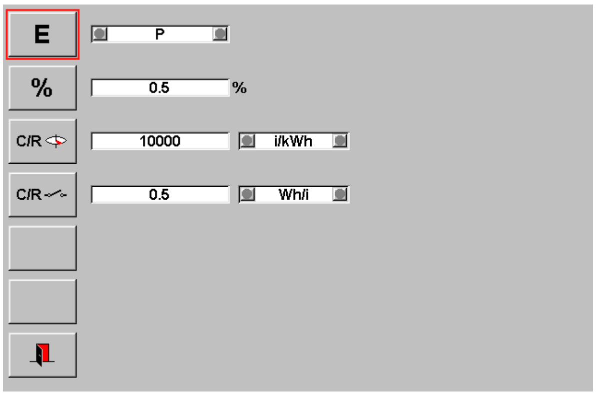
Measure System Selection

For description of actual measure system dataset see [6.5.1.2]

Exit, save actual settings, back to calling menu

6.5.1.2 Measure system dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual measure system dataset
Enter or modify directly with virtual or external keyboard:

E	Measuring system type
%	Accuracy class
C/R	Meter constant and unit of disc mark / LED
C/R	Meter constant and unit of electrical output

Indications / settings

E [P]	**Energy type**

Select energy type with up/down cursor keys (cyclical mode):

PΣ	Active energy import / export
QΣ	Reactive energy import / export
SΣ	Apparent energy import / export
I^2Σ	I^2-hours (used at transformer loss meters, copper and leakage loss)
U^2Σ	U^2-hours (used at transformer loss meters, iron and core loss)

% [0.5] %	**Accuracy class**

Enter accuracy class of measuring system in percentage (%) as indicated on meter or specifications.

C/R [10000] [i/kWh]	**Meter constant of disc mark /LED impulse output**
C/R [0.5] [Wh/i]	**Meter constant of electrical impulse output**

Constant value
Enter constant value for disc mark (1 revolution (r) = 1 impulse (i)) or LED impulse output or electrical impulse output as indicated on the meter or specifications.

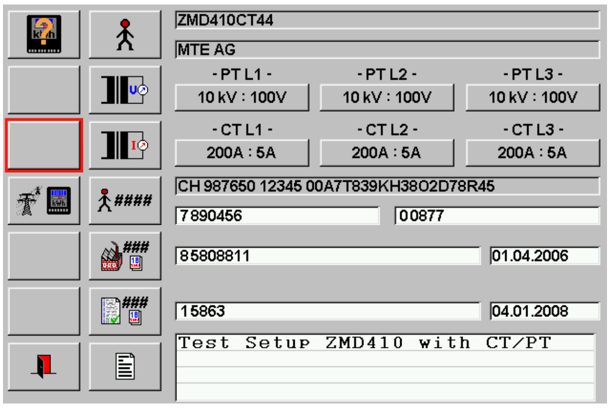
Unit
Available units depending on selected energy type

	P..	Q..	S..	U^2	I^2
i/k..h	i/kWh	i/kvarh	i/kVAh	i/kWh	i/kWh
i/..h	i/Wh	i/varh	i/VAh	i/Wh	i/Wh
i/..s	i/Ws	i/vars	i/VAs	i/Ws	i/Ws
k..h/i	kWh/i	kvarh/i	kVAh/i	kWh/i	kWh/i
..h/i	Wh/i	varh/i	VAh/i	Wh/i	Wh/i
..s/i	Ws/i	vars/i	VAs/i	Ws/i	Ws/i

	Exit, save actual settings, back to calling menu

6.5.2 Meter dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual meter dataset

Following object files can be loaded. The file names of the actual loaded object files are shown at:

- Meter type
- Customer Address
- Voltage transformers PT1 .. PT3
- Current transformers CT1 .. CT3
- Metering code

Enter or modify directly with virtual or external keyboard:

- Owner number / Contract number
- Manufacturer number / Date
- Certification number / Date
- Comment to meter dataset

Indications / settings

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:

Meter Type Selections

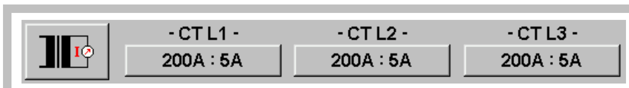
For description of actual meter type dataset see [6.5.1]

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:

Select Customer Address

For description of generally create and edit addresses see [6.4.2]

	**Load / edit object files**

Up to three current and / or voltage transformers can be linked to the phases 1 to 3 of a meter. In this way, a whole substation setup can be defined.

Example for loading of CT

Press the button below CT L1 (200A : 5A). The file selection menu [6.1] is called and an object file directory is displayed.

Select / load file from directory. The object file loaded at phase 1 is automatically copied to phases 2 and 3.

Select fields of phases 2 and 3 to individually load other settings for these phases.

The number of active input fields is depending on the connection mode defined in the loaded meter type. E.g. at 3-wire mode only 2 input fields are active.

FB	Directory	Description
	CT Selections	[6.6.2]
	PT Selections	[6.6.4]

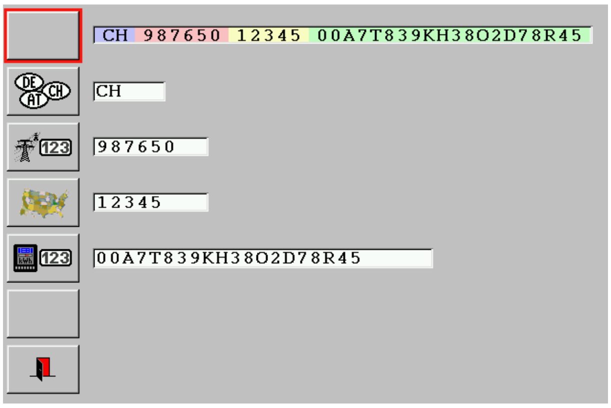
Load / enter metering code

The file selection menu [6.1] is called with the object file directory:

Metering code Selections

Call **Load object file** to load a saved metering code. The meter data set menu is displayed again and the loaded metering code is displayed.

Call **edit actual object** or **create new object** to call the actual meter code dataset menu.



Actual meter code dataset
Enter or modify directly with virtual or external keyboard:

- Country code
- Network operator code
- ZIP code
- Metering code
- Exit, back to calling menu

Exit file selection menu, back to meter dataset menu. The entered metering code is displayed.

Exit, save actual settings, back to calling menu

6.6 Transformer data

Transformer data menu
Object files for current CT and potential PT types and CT / PT transformers can be loaded. The file names of the actual loaded object files are shown at:

- Current transformer CT type dataset
- Current transformer CT dataset
- Potential transformer PT type dataset
- Potential transformer PT dataset

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
CT Type Selections
For description of actual current transformer CT type see [6.6.1]

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
CT Selections
For description of actual current transformer CT dataset see [6.6.2]

	Load / edit object file

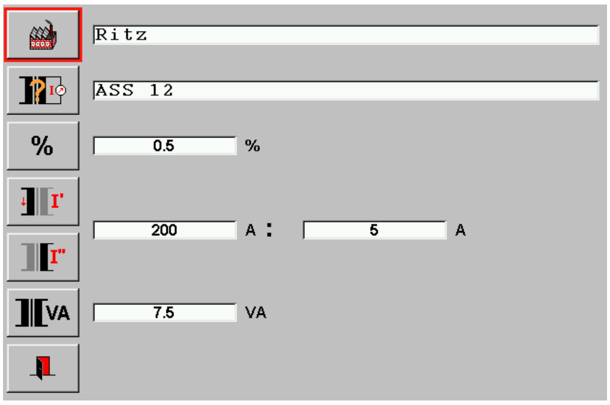
The file selection menu [6.1] is called with the object file directory:
PT Type Selections
For description of actual potential transformer PT type dataset see [6.6.3]

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
PT Selections
For description of actual potential transformer PT dataset see [6.6.4]

6.6.1 Current transformer CT type dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.

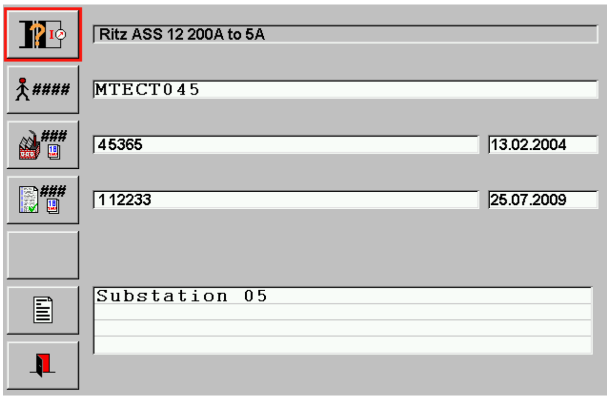


Actual CT type dataset menu
Enter or modify directly with virtual or external keyboard:

- Manufacturer
- Current transformer CT type
- Accuracy class
- Primary current
- Secondary current
- Nominal burden
- Exit, back to calling menu

6.6.2 Current transformer CT dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual CT dataset
Object files for current transformer CT's and current transformer CT types can be loaded. The file names of the actual loaded object files are shown at:

- Current transformer CT type

Enter or modify directly with virtual or external keyboard:

- Owner number
- Manufacturer number / Date
- Certification number / Date
- Comment to CT dataset
- Exit, back to calling menu

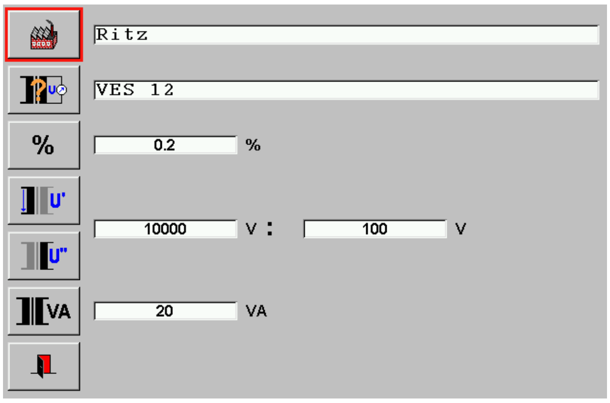
Indications / settings

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
CT Type Selections
For description of actual current CT type dataset see [6.6.1]

6.6.3 Potential transformer PT type dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.

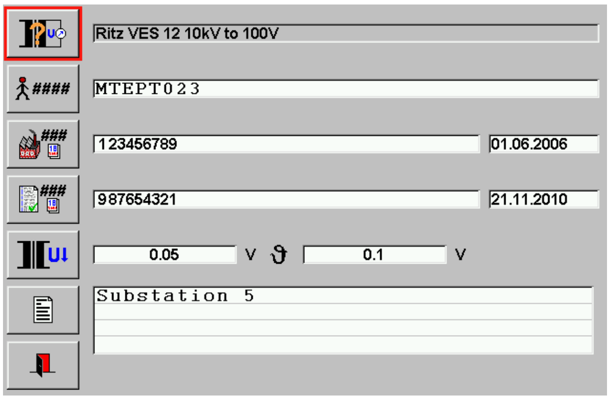


Actual PT type dataset
Enter or modify directly with keypad or external keyboard for:

- Manufacturer
- Potential transformer PT type dataset
- Accuracy class
- Primary voltage
- Secondary voltage
- Nominal burden
- Exit, back to calling menu

6.6.4 Potential transformer PT dataset

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual PT dataset
Object files for potential transformer PT's and potential transformer PT types can be loaded. The file names of the actual loaded object files are shown at:

- Potential transformer PT type

Enter or modify directly with keypad or external keyboard for:

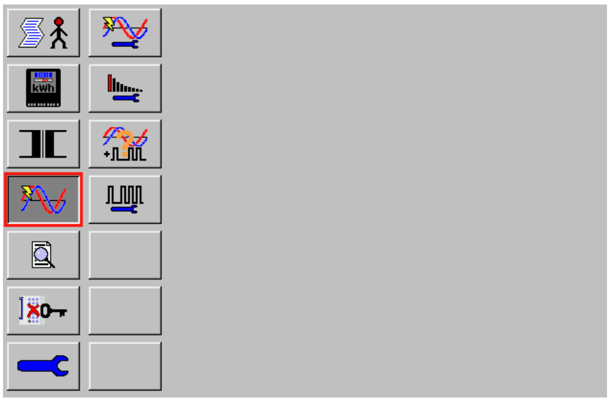
- Owner number
- Manufacturer number / Date
- Certification number / Date
- Voltage drop fuse / voltage drop total
- Comment to CT dataset
- Exit, back to calling menu

Indications / settings

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
PT Type Selections
For description of actual potential PT type dataset see [6.6.3]

6.7 Load point data



Load point data menu
Object files for load point data can be loaded. The file names of the actual loaded object files are shown at:

- Load point dataset
- Harmonics
- RCS Ripple Control telegram type dataset
- RCS Ripple Control Sequence dataset

6.7.1 Load point dataset

Indications / settings

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
Load point Selections
For description of Load point dataset see [7.2.1]

6.7.2 Harmonics dataset

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
Harmonics Selections
For description of Harmonics dataset see [7.3.1]

6.7.3 Ripple control RCS telegram type dataset

	Load / edit object file

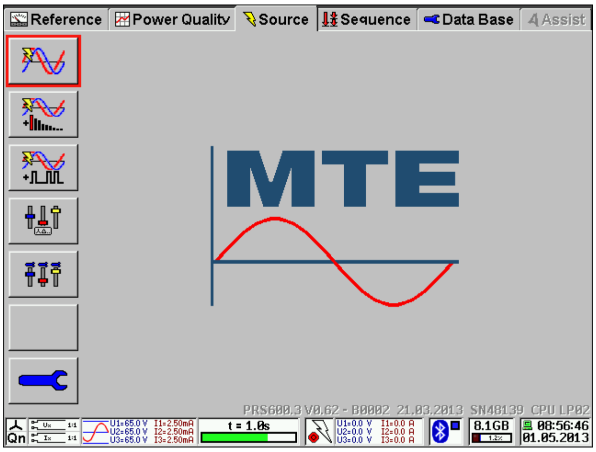
The file selection menu [6.1] is called with the object file directory:
RSC Param Selections
For description of RCS Ripple Control parameter type dataset see [7.4.2]

6.7.4 Ripple control RC Sequence dataset

	Load / edit object file

The file selection menu [6.1] is called with the object file directory:
RCS Telegram Selections
For description of RC Sequence Telegrams dataset see [7.4.1]

7. Source Portable Power Source



Power Source menu card
This menu card contains the following menus and functions:

- Name of menu card
- Load Points menu
- Harmonics menu
- Ripple Control menu
- Slider Screen
- Slider Screen User-defined
- Power Source Setup menu
- Status line

The Name, Serial Number and Firmware Version of the Power Source can be found in the Bluetooth setup (see chapter [5.3.2])

Warning!
There might be dangerous voltages and currents at the terminals of the power source after switching it ON. Regard the local safety precautions before working with the device.

Call **Load Point** menu [7.2]

The menu allows the handling and definition of the load points with the setting of all possible parameters.

Call **Harmonics** menu [7.3]

The menu allows the handling and definition of harmonics with the setting of all possible parameters.

Call **Ripple Control** menu [7.4]

The menu allows the handling and definition of ripple control telegrams with the setting of all possible parameters.

Call **Slider Screen** menu [7.6]

The menu allows to manually adjust load points with regulators for Voltage, Current and Phaseangle.

Call **User-defined Slider Screen** menu [7.7]

The menu allows to manually adjust load points with regulators for 3 user defined values at once. Choose from Voltage, Current, Phaseangle, Baseangle and Frequency or disable the slider.

Call **Power Source Setup** menu [7.1]

The menu allows to configure basic power source settings such as maximum values of voltage and current and as well as current outputs configuration. These settings can be saved and recalled in this menu.

The parameters menu is reserved to MTE service staff. The display of the parameters will be useful for the user to give detailed information to the service staff.

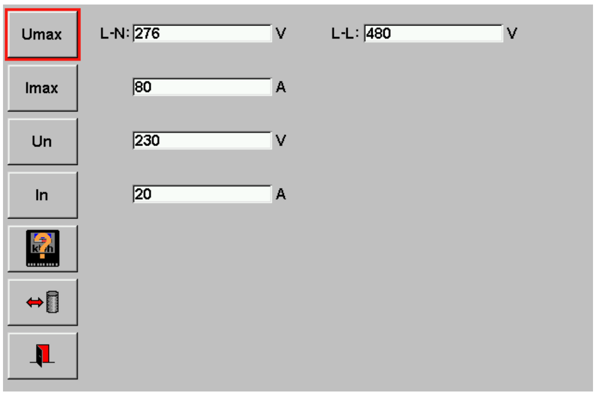
Warning!
The power source will also work without compact flash card. The database is saved on the compact flash card and therefore will be no access to the database without compact flash card. The initial settings UIφf will be 0. At least UIφf must be set and the settings Umax Imax must be checked before operation.

7.1 Power Source Setup

Power source setup menu
This menu contains the following menus and functions:

- Umax Imax menu
- Current output selection
- Power source system parameters menu
- Load/save source selections menu

7.1.1 Setup of Umax and Imax and nominal values Un and In



Umax Imax menu
This menu contains the following menus and functions:

- Edit UmaxLN and UmaxLL
- Edit Imax
- Edit Un
- Edit In
- Call meter types menu
- Load/save Umax Imax settings menu

Umax **Maximum voltage Umax**

The amplitude of the output voltage will be limited either to the setting UmaxLN or UmaxLL depending on the selected network type. It can prevent damages of reference meter and meter under test.

L-N: 276 V

The phase to neutral maximum voltage UmaxLN can be set in the range 0V...300V.

L-L: 480 V

The phase to phase maximum voltage UmaxLL can be set in the range 0V...600V.

Note: The phase to phase maximum voltage is recommended to be limited to <UmaxLN> x √3 in a 3P4W network or to <UmaxLN> x 2 in a 1P3W network.

Imax	**Maximum current Imax**

The amplitude of the output current will be limited to the setting Imax. It can prevent damages of reference meter and meter under test.

80 A

The maximum phase current Imax can be set in the range 0A...120A.

Un	**Nominal voltage Un**

230 V

The nominal voltage Un can be set without any range but will be limited by the maximum settings of Umax.

In	**Nominal current In**

20 A

The nominal current In can be set without any range, but will be limited to <Imax>. Therefore, the basis current Ib or nominal current In of the defined meter will be taken.

	Load Meter Type settings from directory **Meter Type Selections** [6.5.1]

The parameter Un, In, Imax will be loaded from selected meter type.

	Load/save settings from/to directory **Source Limits** [4.4]

The settings UmaxLN, UmaxLL, Imax, Un and In can be loaded or saved.

	Exit and accept settings, back to calling menu.

7.1.2 Setup current output

	Select **Current output**

The FB current output will either connect or separate the red 12A output of the power source with the red 120A output of the power source in the current range 0A...12.0000A. The black 12A output of the power source is always connected to the black 120A output of the power source.

Connect currents 0A...12A to 12A sockets.
Connect currents 12.0001A...120A to 120A current connectors.

Warning!
Connect the 120A cables to the 120A current connectors.
Remove the 12A cables and the 12A current bridges from the 12A sockets.
Set the direct current inputs for the PRS 600.3 in reference meter setup menu to **Direct current inputs 120A**.

Current output range 0A...12.0000A
Red 12A socket and red 120A current connector is **connected** if current output has been switched on at least one time.

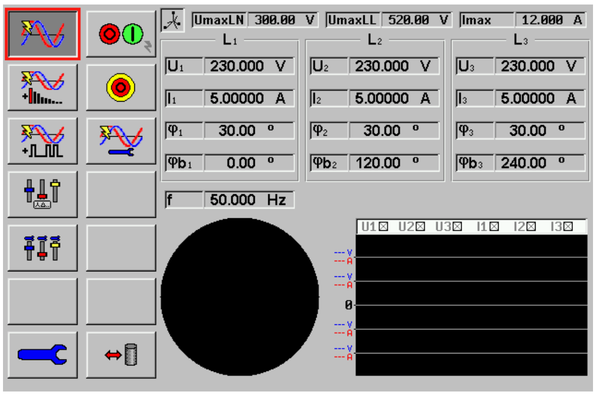
Current output range 12.0001A...120A
Red 12A socket and red 120A current connector are **separated**.

Call **Power source system parameters** menu

Load/save settings from/to directory **Source Selections**

Exit and accept settings, back to calling menu.

7.2 Load point definition



Load point menu
This menu contains the following menus and functions additional to the power source menu:

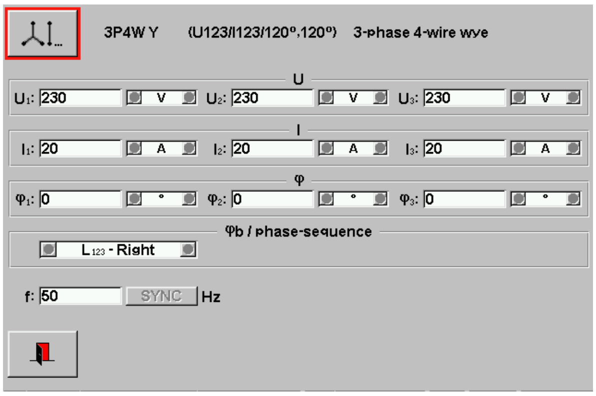
- Start/Stop load point
- Fast Stop load point
- UIφf menu
- Display of network selection
- Load/save menu
- Display of UmaxImax settings
- Display of UIφf settings
- Vector diagram monitor
- Waveform monitor

Start/Stop power source and **Fast Stop** power source [7.5]

Call **Edit Load point UIφf** menu [7.2.1]

Load/save settings from/to directory **Load Point Selections**

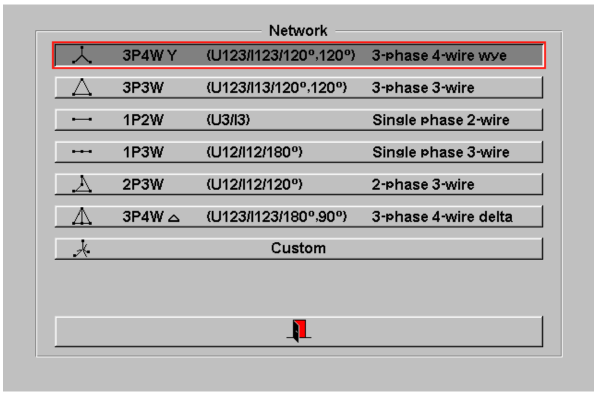
7.2.1 Edit load point



Edit load point menu
This menu contains the following submenus and functions:

- Network selection menu
- Edit voltage U or U1, U2, U3
- Edit phase current I1, I2, I3
- Edit phase angle current to voltage φ1, φ2, φ3
- Phase sequence selection
- Edit frequency

Network selection



Network selection menu
This menu contains the following functions:

- The predefined network types are displayed
- One Network Type can be selected

3P4W Y (U123/I123/120°,120°) 3-phase 4-wire wye — Select a network type.

Exit and accept selection, back to calling menu.

Edit phase to neutral voltage U1, U2, U3

Changing only the setting of voltage U_1 will cause an automatic setting of U_2 and U_3 with the set value of U_1.

V — The value for the phase to neutral voltage can be set between 0V...300V. The voltage will be limited to <UmaxLN>.

%Un — The value for the phase to neutral voltage can be set in % of voltage Un. The phase to neutral voltage will be limited to UmaxLN.

Edit voltage U

The voltage will be limited either to <UmaxLN> or <UmaxLL>.

V — The value for the voltage can be set between 0V...600V.

%Un — The value for the voltage can be set in % of voltage Un.

Warning!
The voltage **U** can be either the phase-phase voltage or the phase-neutral voltage. See table **Settings of voltage U depending on network type [7.2.2]**

I1 20 A — Edit phase current I1, I2, I3

Changing only the setting of current I_1 will cause an automatic setting of I_2 and I_3 with the set value of I_1.

A	The value for the current can be set between 0A...12A or 0A...120A. The current will be limited to <Imax>.
%In	The value for the current can be set in % of current In.
%Imax	The value for the current can be set between 0%...100% Imax.

φ1 0 ° — Edit phase angle between I and U

The value of the angle between current and voltage can be set in degree, cosLA, cosLE, sinLA or sinLE. The unit can be selected also with the up/down cursor keys.

Unit	Input range	Input steps	Calculation of angle φ
°	-360°...+360°	1°	
cosLA	-1...+1	-1, -0.866, -0.5, .0.25, 0, +0.25, +0.5, +0.866, +1	φ = acos (x)
cosLE	-1...+1	-1, -0.866, -0.5, .0.25, 0, +0.25, +0.5, +0.866, +1	φ = - acos (x)
sinLA	-1...+1	-1, -0.866, -0.5, .0.25, 0, +0.25, +0.5, +0.866, +1	φ = asin (x)
sinLE	-1...+1	-1, -0.866, -0.5, .0.25, 0, +0.25, +0.5, +0.866, +1	φ = 180° - asin (x)

L123 - Right — Edit phase sequence

The settings for the phase sequence can be selected from the list or set with the keypad.

L123 - Right	The phases in the order L_1, L_2, L_3.
L132 - Left	The phases in the order L_1, L_3, L_2.
φb2 120 °	The phase angle φb1, φb2, φb3 can be set in the range 0°...+360° (applicable only in a custom defined network)

f: 50 Hz — Edit frequency

The frequency of the fundamental wave can be set in the range 45Hz...400Hz.

Exit and accept settings, back to calling menu.

7.2.2 Additional information to the network types

Settings of voltage U depending on network type

Warning!
Check the settings for the voltage. Dangerous high voltage can destroy your meter under test!

The input field will be selected automatically depending on the selected network type. The input fields for the settings of voltage can be related to the phase-phase voltage U_{LL} or the phase-neutral voltage U_{LN}.

	3P4WY	3P3W	1P2W	1P3W	2P3W	3P4WΔ	Custom
Settings input in **Load point UIφf menu**							
U_{LN}	X		X		X		X
U_{LL}		X		X		X	
U		100V	230V	240V	120V	240V	
U1	230V						240V
U2	230V				120V		240V
U3	230V						240V
Settings of source in **load point menu**							
U1	230V	57.7V	0V	120V	120V	120V	240V
U2	230V	57.7V	0V	120V	120V	120V	240V
U3	230V	57.7V	230V	0V	0V	207V	240V

Settings for 1P2W mode

Warning!
In this mode voltage output U_3 and current output I_3 will be used.

Settings of phase sequence depending on network type

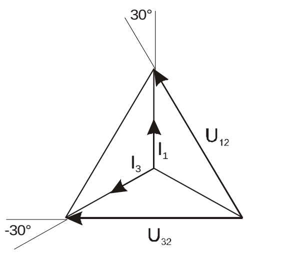
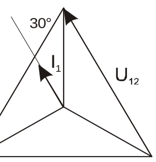
	3P4WY	3P3W	1P2W	1P3W	2P3W	3P4WΔ	Custom
Settings input in **Load point UIφf menu**							
φb	L123	L123	-	-	L123	L123	
φb1							10°
φb2							185°
φb3							355°
Settings of source in **load point menu**							
φb1	0°	0°	0°	0°	0°	0°	10°
φb2	120°	120°	0°	180°	120°	180°	185°
φb3	240°	240°	0°	0°	240°	270°	355°

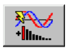
Settings for 1-phase 3P3W mode

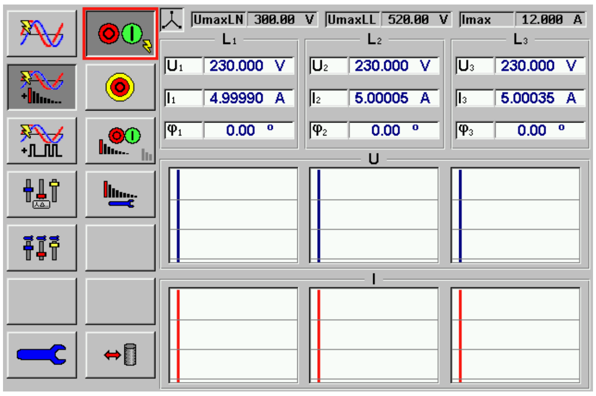
Operational mode for testing 3-phase 3-wire electricity meters

Devices under test should be connected using phases L1, L2, L3

The settings for currents and the phase angle between voltages and currents are set via the **Load point UIφf** menu. The current path L2 is switched off. The L1 and L3 current paths may also be switched off manually.

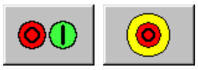
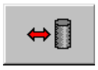
	All phases	**Phase L1**	**Phase L3**
I-phase	1 - 3	1 - -	- - 3
Settings input in **Load point UIφf menu**			
I1	5A	5A	0A
I3	5A	0A	5A
φ	0°	0°	0°
Settings of source in **load point menu**			
φ1	0°	330°	0°
φ2	0°	0°	0°
φ3	0°	0°	30°
Vector diagram			
$φU_{12}I_1$	30°	0°	-
$φU_{32}I_3$	330°	-	0°
Explanation	In the balanced 3-wire mode a phase angle setting of φ = 0° causes a 30° shift between current and voltage path of the Aron circuitry.	In the unbalanced, single sided 3-wire mode the system operates as in the 1-phase mode. Therefore, the current and the associated voltage are in phase if the setting is φ = 0°.	In the unbalanced, single sided 3-wire mode the system operates as in the 1-phase mode. Therefore, the current and the associated voltage are in phase if the setting is φ = 0

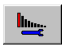
7.3  Harmonics

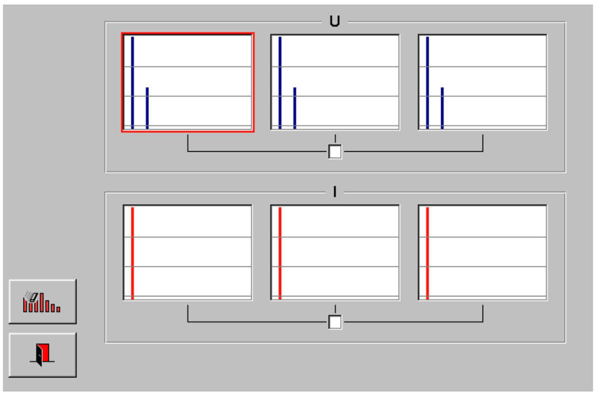


Harmonics menu
This menu contains the following menus and functions additional to the power source menu:

- Display of voltage harmonics settings L1, L2, L3
- Display of current harmonics settings L1, L2, L3
- Start/Stop harmonics
- Edit Harmonics menu
- Load/save harmonic settings menu

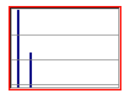
	**Start/Stop** power source and **Fast Stop** power source
	**Start/Stop harmonics**
	Call **Edit Harmonics** menu
	Load/save settings from/to directory **Harmonics Selections**

7.3.1  Setup of Harmonics

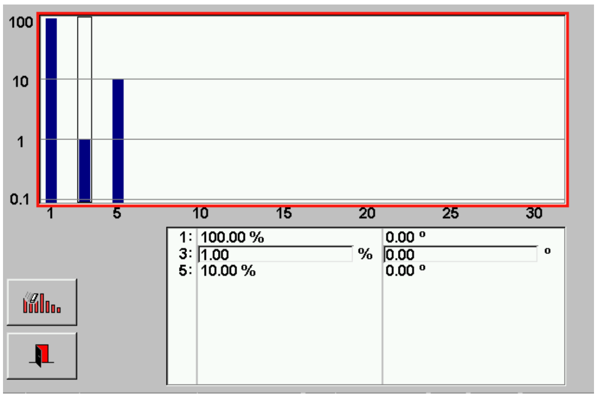


Edit harmonics menu
This menu contains the following functions:

- Edit function for phase selective setting of voltage harmonics
- Edit function for phase selective setting of current harmonics
- Checkbox for setting all voltage harmonics together
- Checkbox for setting all current harmonics together
- Reset all harmonics



Edit harmonics



Edit harmonics

- Up to 15 harmonics can be defined
- The sum of all harmonics is limited to 40%, from 2nd...6th the maximum amplitude is 40% and from 7th...31st 10%
- The maximum amplitude is limited for each harmonic separately
- The phase angle of each harmonic can be varied
- Selection of 2nd...31st harmonic
- Reset all harmonics function
- Exit

Range 1%...40%, these values can be set in steps of 1%.

Angle range -180°...+180°, values can be set in steps of 10°.

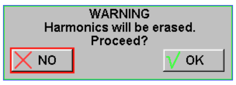
Exit and accept settings, back to calling menu.

Selection of all 3 phases

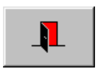
The mark in the checkbox indicates that the settings of phase 1 will also be active for phase 2 and phase 3.

Reset Harmonics

All harmonics will be set to 0%.

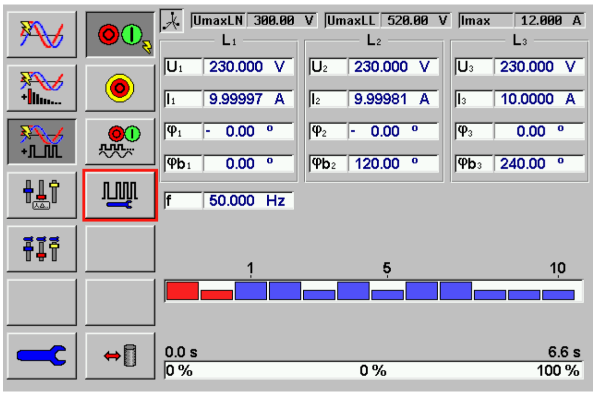


Before erasing the harmonic settings, the security question will appear. Choosing OK will erase the current settings.



Exit and accept settings, back to calling menu.

7.4 RCS Ripple Control Signals



Ripple Control menu

This menu contains the following menus and functions additional to the power source menu:

- Display of ripple control status
- Display of ripple control telegram
- Start/Stop ripple control
- Ripple control setup menu
- Load/save ripple control settings menu

Start/Stop and **Fast Stop** [7.5]

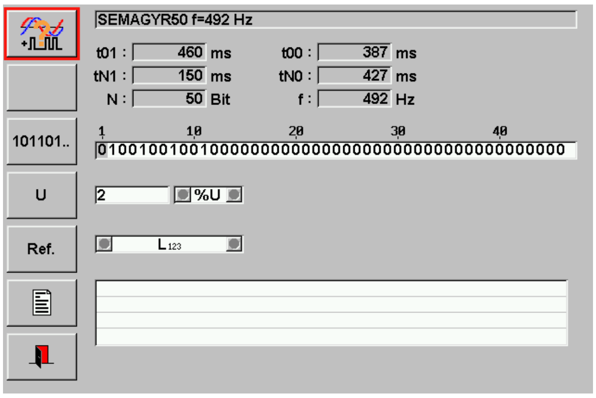
Start/Stop RCS signal [7.5.7]

Edit **RCS telegram** [7.4.1]

Load/save settings from/to directory **RCS Telegram Selections**

The RCS telegram settings will be loaded or saved.

7.4.1 Setup of RCS telegram

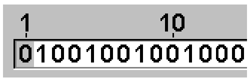


Ripple Control telegram menu
This menu contains the following menus and functions additional to the power source menu:

- Select/edit Ripple control telegram type
- Edit Ripple control telegram
- Edit Signal amplitude
- Edit Ripple control phases
- Edit Comments
- Exit

Select/edit telegram type settings from/to directory **RCS Param Selections** [7.4.2]

101101.. **Edit Telegram**

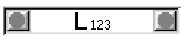


Input of the steering impulses (address bits and impulse bits). The input field contains N impulse places.(e.g. N=50 for Semagyr, N=10 for Decabit)

U **Edit Ripple control signal amplitude**

Input of the signal amplitude either in %U or in V.

Ref. **Edit Ripple control phases**



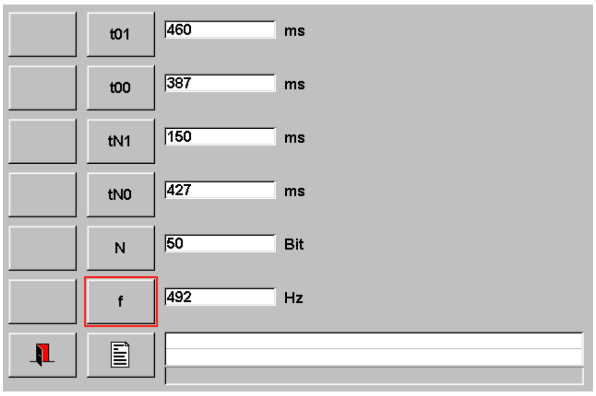
The ripple control signal will be generated for the selected phases.

Edit Comment

Input of a text with up to 128 characters.

Exit and accept settings, back to calling menu.

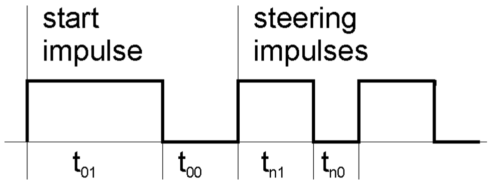
7.4.2 Setup of RCS telegram type



Edit RCS telegram type menu

This menu contains the following functions:

- Edit telegram structure with the parameter t00, t01, tN0, tN1
- Edit ripple control steering impulse places N.
- Edit of ripple control frequency f.
- Edit comments



t_{01}	Time of start impulse
t_{00}	Pause time between start and first steering impulse n1
t_{n1}	Time of steering impulse
t_{n0}	Pause time between steering impulses

t01 — Edit start impulse

460 ms — Input of the start impulse time in ms.

t00 — Edit start impulse pause

387 ms — Input of start impulse pause time in ms.

tN1 — Edit steering impulse

150 ms — Input of the steering impulse time in ms.

tN0 — Edit steering impulse pause

427 ms — Input of steering impulse pause time in ms.

N — Edit number of steering impulses

50 Bit — Input of the number of steering impulses according the defined telegram type in the range of 0...256.

f	**Edit ripple control frequency**

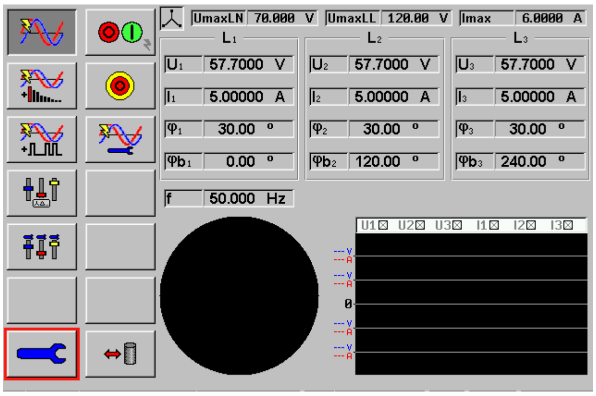
492 Hz — Input of the ripple control frequency in Hz.

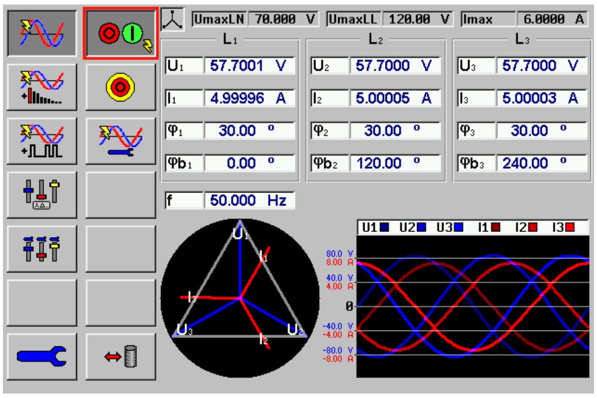
	Edit comments

COMMENTS — Input of text with up to 64 characters.

	Exit and accept settings, back to calling menu.

7.5 Execute load point

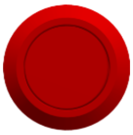




Warning!
Check all connections in the test circuit.
Check the settings UmaxImax.
Check the settings UIφf.
Check if the interrupt button on the top of the power source PPS 400.3 is free accessible.

Interrupt button on PPS 400.3

Warning!
Use the interrupt button on the power source PPS 400.3 in case of emergency, push down the button when needed.



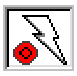
STOP

The interrupt button on the power source PPS 400.3 will interrupt the supply to the PPS 400.3. The output signals will be stopped immediately. After releasing the interrupt button the PPS 400.3 wil be supplied with power again. The output signals of the power source are still switched off after releasing the interrupt button.

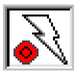
	Fast Stop

The output signals of the power source will be stopped immediately by pushing the FB **Fast Stop**.

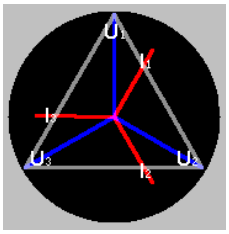
7.5.1  Functional button (FB) Start/Stop power source

Status of FB	Status of power source	Description
		**Power Source turned OFF** The FB Start/Stop is light grey and marked with a black flash. The power source can be started pushing the FB Start/Stop. The output signals will be raised in a ramp to the set value.
		**Power Source turned ON** The Start/Stop key is dark grey and marked with a yellow flash. The power source can be stopped pushing the FB Start/Stop. The output signals will be decreased in a ramp.
		**Settings of the Power Source changing** The values UIφf or Umax Imax of the power source have been changed and the FB Start/Stop button needs to be pressed that the changes will become active. During the time of changing the settings the FB Start/Stop is dark and marked with a red blinking flash.
		**Turn ON/OFF procedure of the Power Source** During the turn-on/-off procedure the FB Start/Stop is completely greyed out and a red flash is blinking

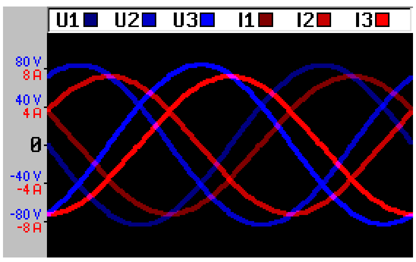
7.5.2 Indication Status of power source

Indication	Status of power source	Description
	OFF	The symbol with red button and white flash is shown. The power source is switched off.
	ramp up/down	The symbol with grey sandglass and yellow blinking flash is shown. The power source is on. The power source ramp up or down voltage and current or the power source is switching off (Fast Stop).
	ON	The symbol with green button with yellow flash is shown. The power source is on. Output voltage and current are stable.

7.5.3 Vector diagram and waveforms



The vector diagram shows the actual voltage vectors and current vectors.

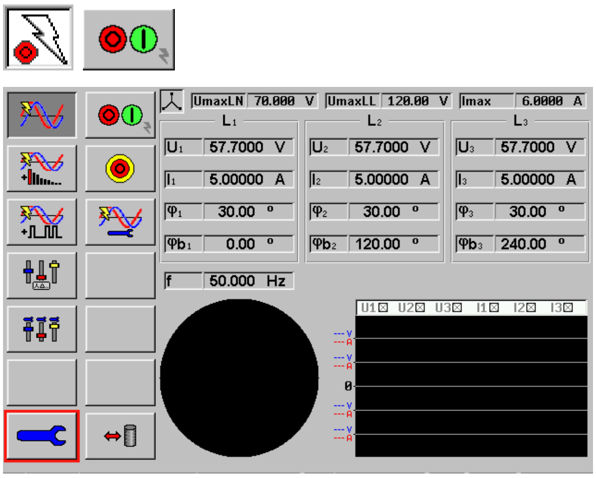


The waveform monitor shows the actual voltage wave forms and current waveforms. The scale will automatically be set according the amplitude of the signals. One period of the signal will be displayed.

7.5.4 Switch ON/OFF sequence

1	Check measuring setup and settings

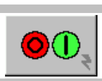
Warning!
Check all connections in the test circuit.
Check the settings UmaxImax.
Check the settings UIφf.

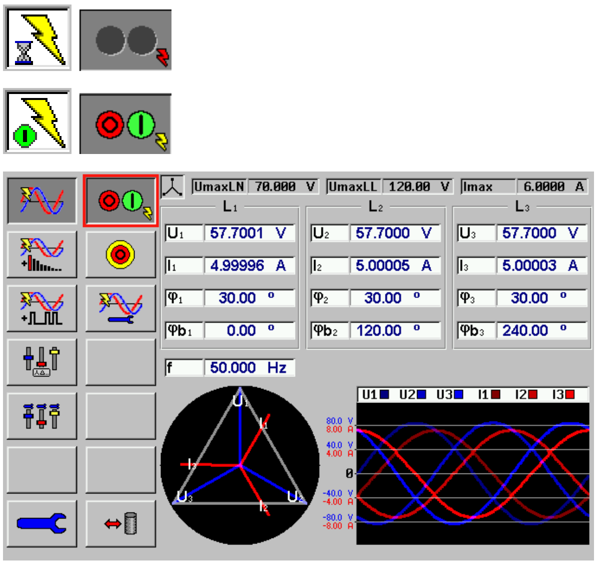


Status indication when the power source is switched OFF

The power source is switched off

- The settings are all greyed out.
- Vector diagram monitor is dark
- Wave form monitor is dark
- Power source indication is OFF

2		Switch ON power source



Status indication during ramping up voltage and current to the set value.

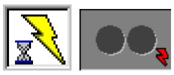
Status indication when the power source is switched ON

The power source is switched on.

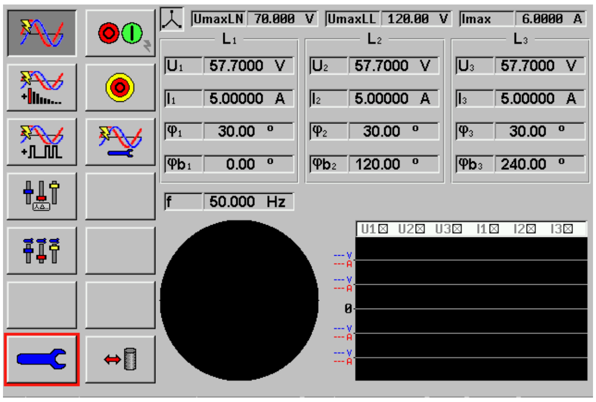
- Voltage and current are stable.
- The measured values will be displayed instead of settings.
- Vector diagram monitor is ON.
- Waveform monitor is ON.
- Power source indication is ON.

3	Run test

4a  Switch off the power source

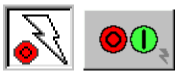


Status indication when ramping down voltage and current.



The power source is switched off

- The settings are all greyed out.
- Vector diagram monitor is dark
- Wave form monitor is dark
- Power source indication is OFF



Status indication when the power source is switched OFF

4b  Fast switch off the power source

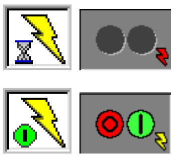
The power source will be stopped immediately without ramping down the output signals. The status indications will be identically as described in the switch off procedure with FB Start/Stop in step 4a.

7.5.5 Change settings of load point

1	Check measuring setup and settings

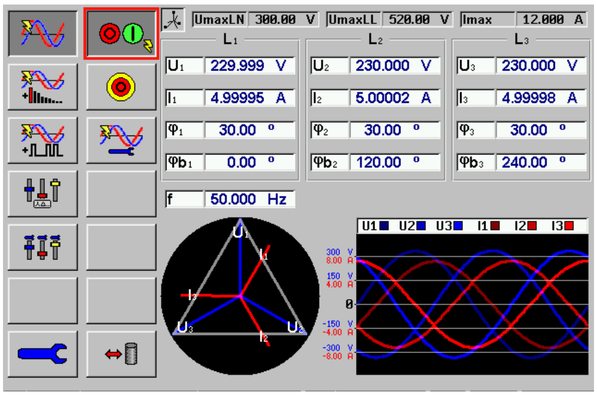
Warning!
Check all connections in the test circuit.
Check the settings UmaxImax.
Check the settings UIφf.

2	Switch ON power source



Status indication during ramping up voltage and current to the set value.

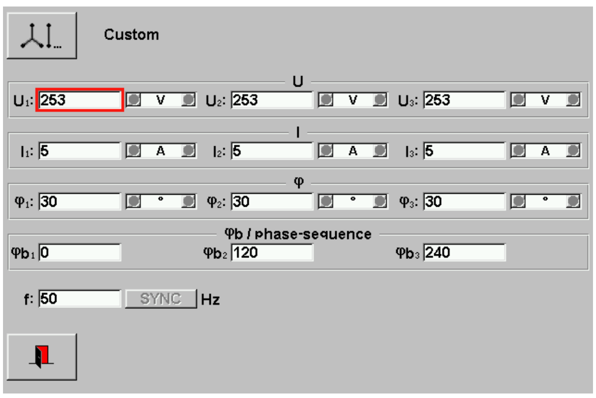
Status indication when the power source is switched ON



The measured values of voltage, current, phase angle, phase sequence and frequency are shown.

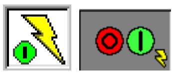
3	Call the UIφf menu

4	Change settings

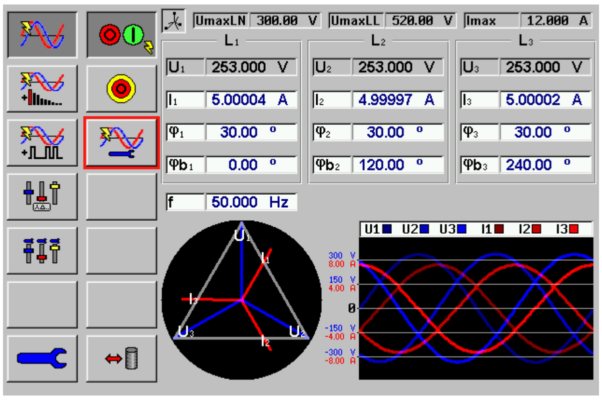


One or several values can be changed. In this example U_1 has been changed from 230V to 253V. Changing only the setting of voltage U_1 will cause an automatic setting of U_2 and U_3 with the set value of U_1.

5		**Exit** and accept settings, back to calling menu.



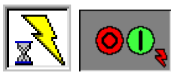
Power source is still switched ON.



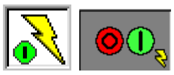
The changed settings U_1 - U_3 are greyed out.

This indicates that the new settings are not active at this time.

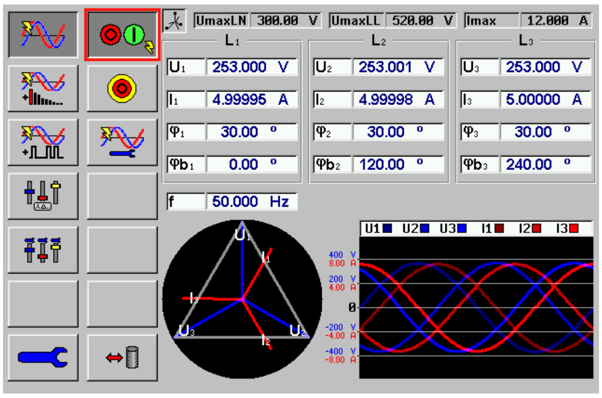
6		Switch on new settings



Status indication during ramping up or down voltage and current to the new set value.



The power source is running with the new settings.



The actual measured load point values are displayed.

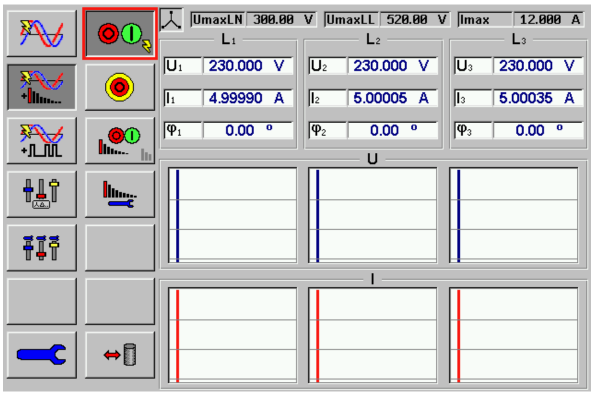
7.5.6 Switch Harmonics ON / OFF

1	Switch on power source first

Status indication during ramping up voltage and current to the set value.

Status indication when the power source is switched ON

2	Select harmonics menu



- Harmonics menu on
- Display the harmonic monitor

3	Define or select the harmonics

4	Switch on the selected harmonics

Indication harmonics on

5	**Run test**

6	Switch off harmonics

Indication harmonics switched off

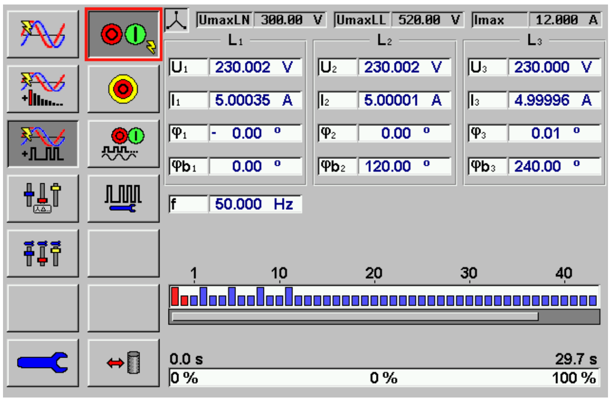
7.5.7 Switch RCS telegram ON / OFF

1 Switch on the power source first

Status indication during ramping up voltage and current to the set value.

Status indication when the power source is switched ON

2 Select the ripple control menu



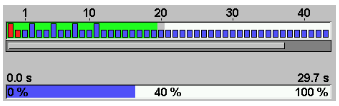
- Ripple control menu on
- Display with ripple control monitor

3 Define or select the ripple control signal

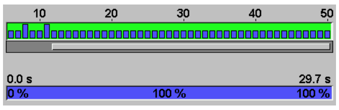
4 Switch on the selected ripple control signal

Indication that the ripple control telegram is switched on and will be prepared for execution. Needed time for preparation will be up to 1 minute.

Indication that the ripple control telegram is switched on and is in execution.



The ripple control telegram is in execution.



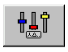
The total run time for the selected telegram can vary from several seconds up to several minutes.

5 Switch off ripple control signal (if necessary during execution)

Indication ripple control signal switched off

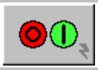
6 Switch off the power source

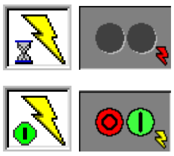
Indication power source switched off

7.6  Load point adjustment with regulators

1 Check measuring setup and settings

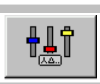
Warning!
Check all connections in the test circuit.
Check the settings UmaxImax.
Check the settings UIφf.

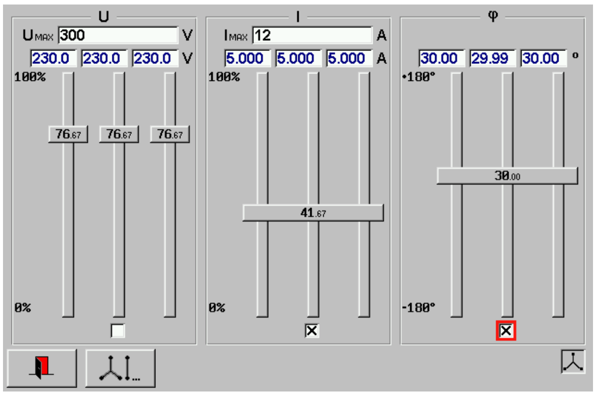
2  Switch on the power source first



Status indication during ramping up voltage and current to the set value.

Status indication when the power source is switched ON

3  Select the slider screen menu



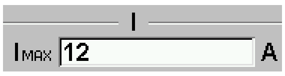
- In the case U_{max} or I_{max} is smaller than the actual voltage U1,2,3 or current I1,2,3 the output of the source will be limited to U_{max} and I_{max}.
- Changes will affect to the output immediately.

The actual measured values will be displayed.

4 Set full scale voltage U_{max}

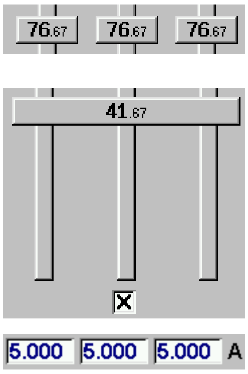
The full scale voltage can be set in the range 0V...Umax.

5 Set full scale current I_{max}



The full-scale current can be set in the range 0...Imax.

6	Set voltage U, current I and phase angle φ

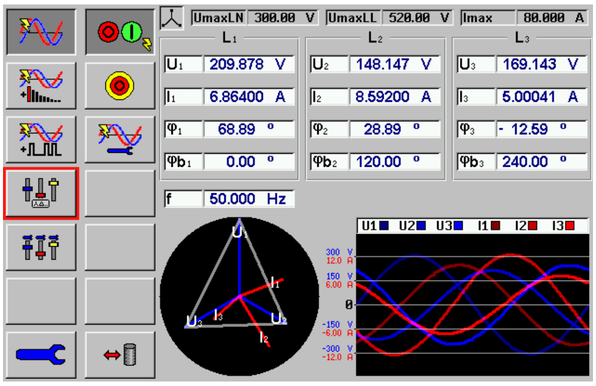


The slides show the settings in relation to the settings U_{max} and I_{max} in %. Each phase can be set individually.

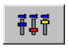
The slides show the settings in relation to the settings U_{max} and I_{max} in %. All phases can be linked together when the checkbox is marked.

The actual measured values will be displayed.

7		Exit the screen



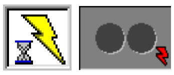
The settings are already active and the measured values are displayed.

7.7  User defined slider settings

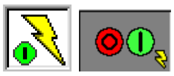
1	Check measuring setup and settings

Warning!
Check all connections in the test circuit.
Check the settings UmaxImax.
Check the settings UIφf.

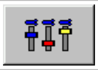
2		Switch on the power source first

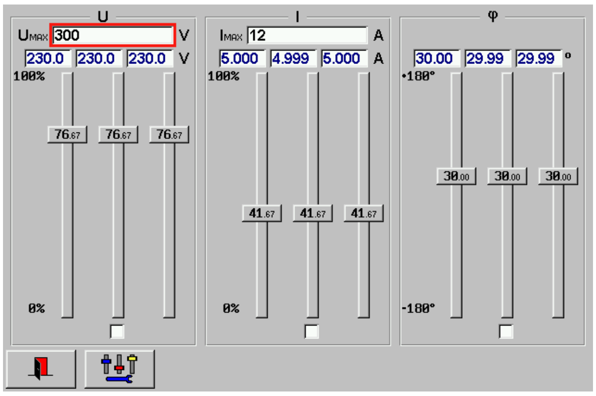


Status indication during ramping up voltage and current to the set value.

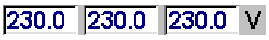


Status indication when the power source is switched ON

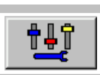
3  Select the user defined slider screen menu

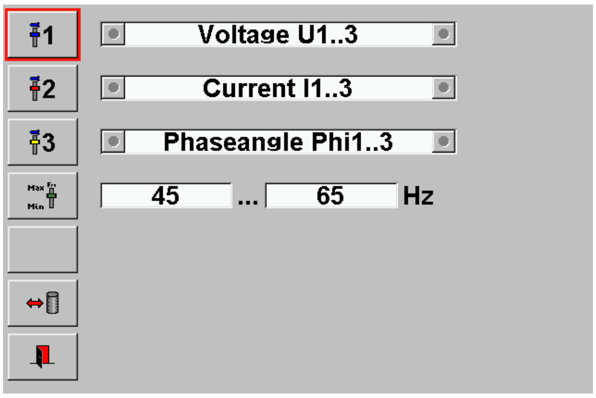


- In the case U_{max} or I_{max} is smaller than the actual voltage U1,2,3 or current I1,2,3 the output of the source will be limited to U_{max} and I_{max}.
- Changes will affect to the output immediately.



The actual measured values will be displayed.

4  Select the setup slider values menu



Following parameters can be chosen for Slider 1, 2 and 3:

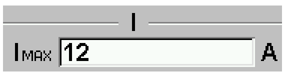
- Voltage U 1..3
- Current I 1..3
- Phase angle Phi 1..3
- Base angle U 1..3
- Frequency f
- Disabled

Select the frequency range (45 - 400 Hz).

5 Set full scale voltage U_{max}

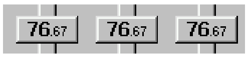
The full scale voltage can be set in the range 0V...Umax.

6 Set full scale current I_{max}

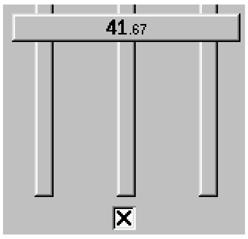


The full-scale current can be set in the range 0...Imax.

7	Set parameters defined in step 4



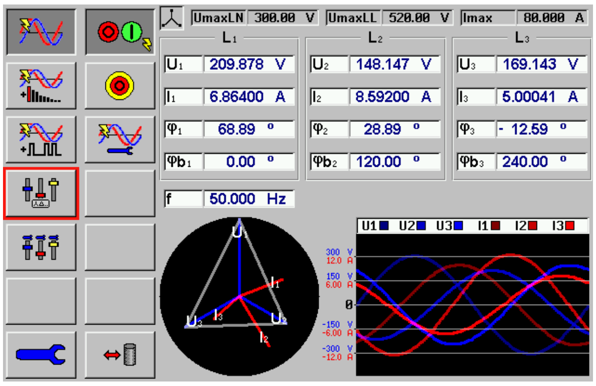
The slides show the settings in relation to the settings U_{max} and I_{max} in %. Each phase can be set individually.



The slides show the settings in relation to the settings U_{max} and I_{max} in %. All phases can be set together when the checkbox is marked.

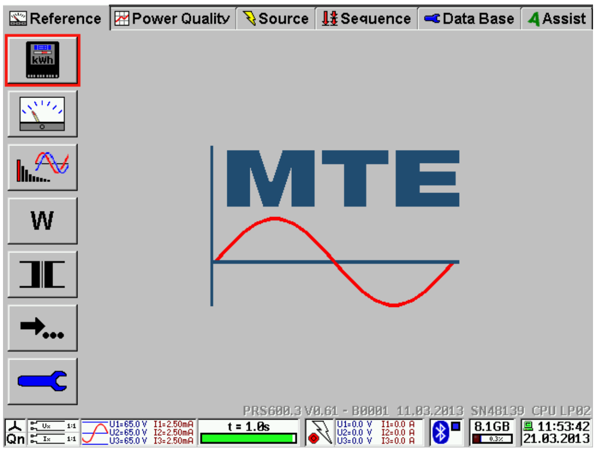
The actual measured values will be displayed.

7		Exit the screen



The settings are already active and the measured values are displayed.

8. Reference Reference meter



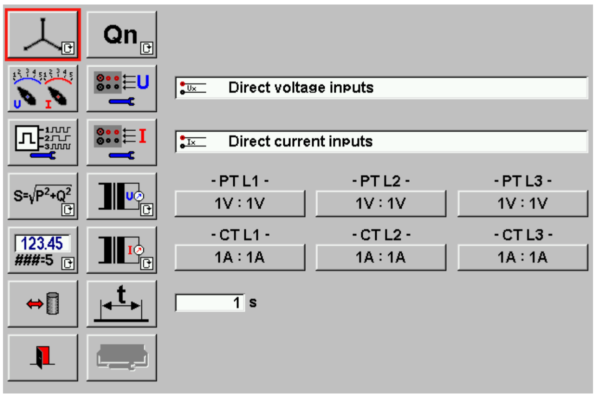
Reference meter menu card

This menu card contains the following menus and functions:

Reference — Name of the active menu card

- Error measurement [8.2]
- Measurement [8.3]
- Waveform analysis [8.4]
- Energy measurement and register test [8.5]
- Transformer tests [8.6]
- Special functions [8.7]
- Reference meter settings [8.1]

8.1 Reference meter settings



Reference meter settings menu

The following settings are displayed:

- Connection mode (4-wire or 3-wire)
- U / I range settings
- Frequency outputs
- Apparent power mode (applied calculation formula)
- Display resolution (5 or 6 digits)
- Load or save current parameters
- Exit of menu
- Reactive power mode (Qn or Qx)
- Selection of voltage measurement inputs
- Selection of current measurement inputs
- Voltage transformer (enable or disable)
- Current transformer (enable or disable)
- Time base
- Reference system parameters (not available at PTS 400.3 Plus)

Indications / settings

	Connection mode

4-wire mode

Operational mode for testing 3 phase 4 wire Y or ∆ meters.
Voltage connections: U1, U2, U3, UN
This mode can also be used to test 1 phase 2 wire, 1 phase 3 wire and 2 phase 3 wire meters.

3-wire mode

Operational mode for testing 3 phase 3 wire electricity meters.
Voltage connections: U1, U2, U3 (UN left open)

Call Range settings menu [8.1.1]

Call Definition of frequency outputs menu [8.1.2]

Apparent power mode

Selection of the formula used for the calculation of total apparent power ΣS.

Total apparent power calculation is based on total active power and total reactive power values. $\Sigma S = \sqrt{\Sigma P^2 + \Sigma Q^2}$

Total apparent power calculation is based on the effective values of voltages and currents. $\Sigma S = U\Sigma \cdot I\Sigma$

4-wire: $U\Sigma = \sqrt{U_1{}^2 + U_2{}^2 + U_3{}^2}$; $I\Sigma = \sqrt{I_1{}^2 + I_2{}^2 + I_3{}^2}$

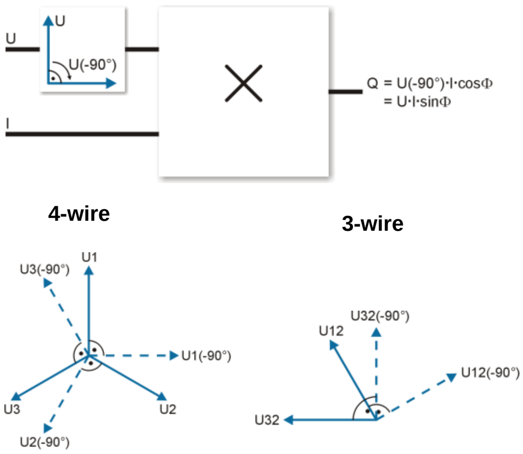
3-wire: $U\Sigma = \sqrt{U_{12}{}^2 + U_{32}{}^2}$; $I\Sigma = \sqrt{I_1{}^2 + I_3{}^2}$

Call **Load / save reference meter settings** menu [4.4]

Exit, back to calling menu

Reactive power mode

Natural (n) mode



This mode uses the time displacement method.

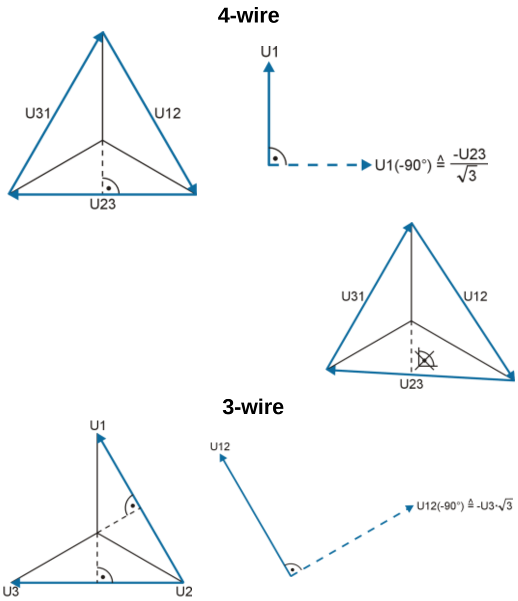
A -90° phase shifter is used in the voltage path before U and I are multiplied.

If U(-90°) is multiplied with I by an active power measuring system, the result is reactive power Q.

Q = U(-90°)·I·cosϕ = U·I·sinϕ

The maximum reactive power is reached, if the phase angle between current and voltage is 90° (sinϕ =1).

Qx Artificial or cross-connected (x) mode



This is a special mode applied at older precision 3 phase mechanical meters.

Opposite phase-phase or phase neutral voltages with -90° phase shift are used instead of 90° phase shifters.

This works only correct at a symmetrical 3 phase system.

If the voltage system is asymmetrical, the phase angle is not exactly 90°.

But because the same measuring principle is used at meter and reference, this has no influence on the error. You could say both are measuring the same way wrong and the influence of the asymmetry on the error can be excluded in this way.

Qf Fundamental (f) mode

This mode is considering fundamental components only.

$Qf = UH1 \cdot IH1 \cdot \sin\varphi H1$

$\Sigma Qf = Qf1 + Qf2 + Qf3$

It is applicable to meters designed according to IEC 62053-24 standard.

Qt Triangle (t) mode

This mode is the power triangle method or also known as non-active power method.

$$\Sigma Qt = \sqrt{\Sigma S^2 - \Sigma P^2}$$

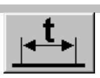
It is applicable to meters designed according to IEEE 1459 standard.

Call Selection of voltage measurement inputs menu [8.1.3]

Call Selection of current measurement inputs menu [8.1.4]

Call Voltage measuring transformer PT settings menu [8.1.5]

Call Current measuring transformer CT settings menu [8.1.6]



Time base

The time base defines the periodic timing interval for the measure and display of all calculated results. These include such values as U, I, P, Q, S, etc. It is also used in conjunction with harmonics analysis and vector diagram displays.

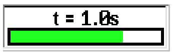
The interval for the update of the results on the display is defined in seconds (s).

Time base manually set

The time base interval can be set manually by the user.

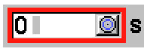
Input of time base interval in seconds (s).

Range: 0.1 … 999.9 s



Status indication of time base

The time base interval in seconds is displayed together with a bar graph, indicating the elapsed time of the active running measurement.



External time base

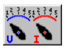
In the case of entering zero, the time base switches to

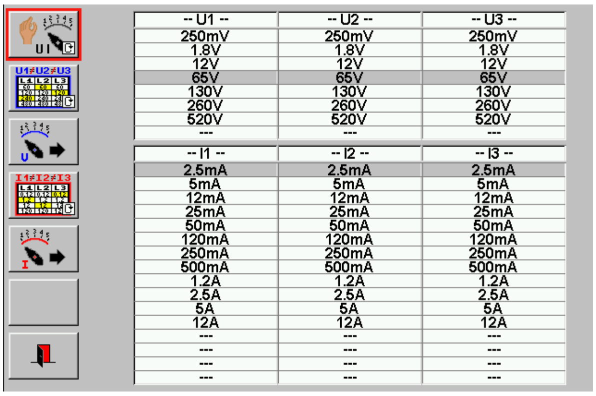
external time base.

By means of this function, an external pulse via pulse input socket 1 can be used to trigger the display of new results. This allows the display of the results to be synchronized with external instruments.

Status indication of external time base

The time base interval defined by the last two external impulses in seconds is displayed together with a bar graph, indicating the elapsed time of the active running measurement in relation to the previous time interval.

8.1.1  Selection of voltage and current range



Voltage and current range settings menu

The following settings are displayed:

Auto or manual range selection

Synchronization of voltage range selection

Common for all voltage phases

manual selection of voltage ranges individually per phase

Synchronization of current range selection

Common for all current phases

manual selection of current ranges individually per phase

The wide input dynamic range of voltage and current (several decades) is internally reduced to a smaller dynamic range in order to achieve the required accuracy. This is done by using multiple internal voltage and current sub-ranges.

Voltage Ranges

Input	End of Range values in [V] for voltage inputs						
direct	0.25	1.8	12	65	130	260	520
Hotstick U	40000						

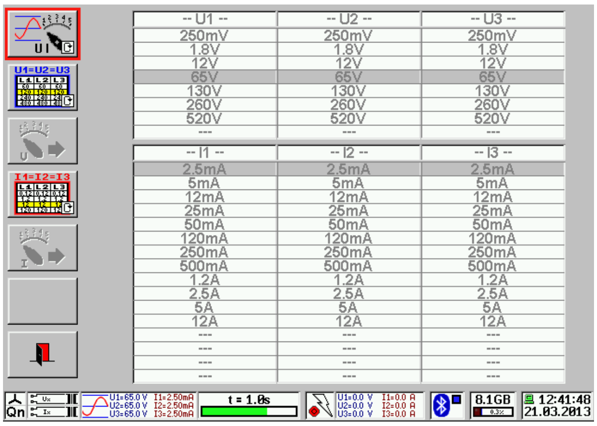
Current Ranges

Input	End of Range values in [A] for current inputs											
direct 12A	0.0025	0.005	0.012	0.025	0.05	0.12	0.25	0.5	1.2	2.5	5	12
direct 120A	0.025	0.05	0.12	0.25	0.5	1.2	2.5	5	12	25	50	120
UCT 120.3	0.12	1.2	12	120								
UCT 1000.3	1	10	100	1000								
FLEX 3000	30	300	3000									
Hotstick I	2000											

The range selection can be made either automatically or manually and either individually per phase or common to all phases.

	Auto or manual range selection

8.1.1.1 Auto range selection



Automatic range selection (default condition on start-up)

The soft key and the Symbol in the status line indicate that automatic range selection is active.

The keys for manual range selection are disabled.

For each phase voltage and phase current a table showing the range maximum values of all internal voltage and current ranges is displayed.

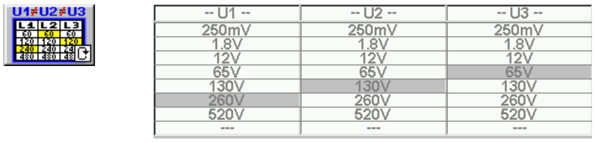
The actual selected ranges are marked

Status indication for automatic range selection

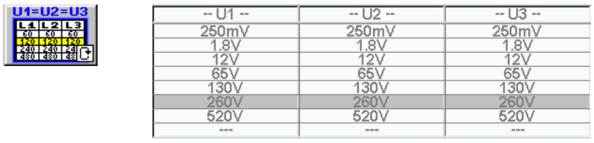
The Symbol indicates that automatic range selection is active.

The actual selected ranges of phase voltages and phase currents are shown.

Synchronization of voltage range selection

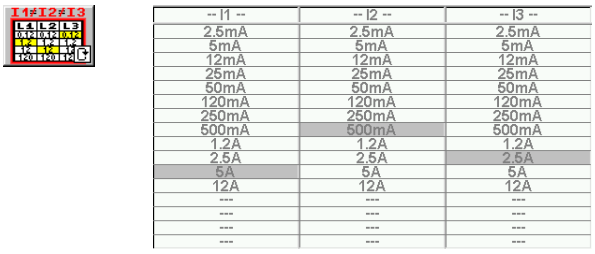


Individual voltage range selection (U1≠U2≠U3)
The range is selected individually for each phase.

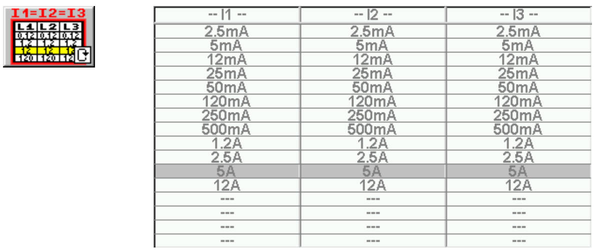


Common voltage range selection (U1=U2=U3)
The phase with the highest voltage defines the range for all phases.

Synchronization of current range selection

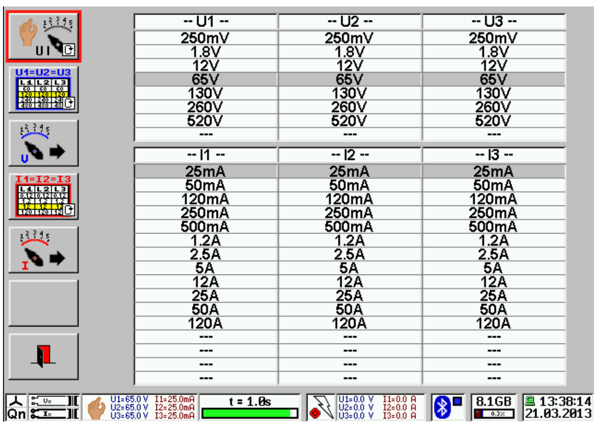


Individual current range selection (I1≠I2≠I3)
The range is selected individually for each phase.



Common current range selection (I1=I2=I3)
The phase with the highest current defines the range for all phases.

8.1.1.2  Manual range selection



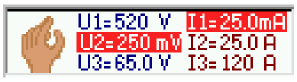
Manual range selection

The soft key and the Symbol in the status line indicate that manual range selection is active.

A table with the range maximum values for all internal voltage and current ranges is displayed for each phase voltage U1, U2, U3 and each phase current I1, I2, I3.
The actual selected ranges are marked.

Status indication for manual range selection

The Symbol indicates that manual range selection is active.
The actual selected ranges of phase voltages and phase currents are listed.



Status indication for manual range overflow

The Symbol  indicates that manual range selection is active.

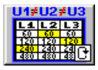
If any of the selected voltage or current ranges, shown in the status line, is too low, the manually selected range is flashing red.

The internal voltage and current ranges are changing at 110% of the step, to the higher or lower range

The main application of the manual range selection is to fix a maximum range, to prevent automatic range changes during a measurement. In the case of varying currents or voltages or a current or voltage near the upper limit of an internal range, it is better to fix the next higher range manually, to be sure that no range changes occur during the measurement.

Any range change occurring during an error measurement will invalidate that measurement.

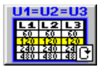
Synchronization of voltage range selection



-- U1 --	-- U2 --	-- U3 --
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	**65V**
130V	130V	130V
260V	**260V**	260V
520V	520V	520V
---	---	---

Individual voltage range selection (U1≠U2≠U3)

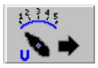
The range is selected individually for each phase.

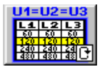


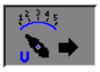
-- U1 --	-- U2 --	-- U3 --
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	65V
130V	130V	130V
260V	**260V**	**260V**
520V	520V	520V
---	---	---

Common voltage range selection (U1=U2=U3)

The phase with the highest voltage defines the range for all phases.







Manual selection of voltage ranges common for all phases

The range synchronization FB must indicate U1=U2=U3.

The pressed range FB indicates that voltage range selection is active.

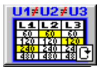
-- U1 --	**-- U2 --**	**-- U3 --**
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	65V
130V	130V	130V
260V	**260V**	**260V**
520V	520V	520V
---	---	---

Common selection active

A red frame is displayed. All phases U1, U2, U3 and the actual selected range are yellow highlighted.

-- U1 --	-- U2 --	-- U3 --
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	65V
130V	130V	130V
260V	**260V**	**260V**
520V	520V	520V
---	---	---

The last highlighted range is selected. The red frame and the yellow highlighting disappear.



Manual selection of voltage ranges individually per phase

The range synchronization FB must indicate U1≠U2≠U3.

The pressed range FB indicates that the voltage range selection is active.

-- U1 --	-- U2 --	**-- U3 --**
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	**65V**
130V	130V	130V
260V	**260V**	260V
520V	520V	520V
---	---	---

Selection for phase U1 active

A red frame is displayed. The actual selected phase and the actual selected ranges of all phases are yellow highlighted.

-- U1 --	-- U2 --	-- U3 --
250mV	250mV	250mV
1.8V	1.8V	1.8V
12V	12V	12V
65V	65V	**65V**
130V	130V	130V
260V	**260V**	260V
520V	520V	520V
---	---	---

The last highlighted ranges are accepted. The red frame and the yellow highlighting disappear.

Synchronization of current range selection

-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

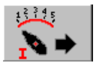
Individual current range selection (I1≠I2≠I3)

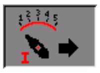
The range is selected individually for each phase.

-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

Common current range selection (I1=I2=I3)

The phase with the highest current defines the range for all phases.





Manual selection of current ranges common for all phases

The range synchronization soft key must indicate I1=I2=I3.

The pressed range FB indicates that current range selection is active.

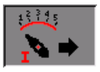
-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

Common selection active

A red frame is displayed. All phases I1, I2, I3 and the actual selected range are yellow highlighted.

-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

The last highlighted range is selected. The red frame and the yellow highlighting disappear.



Manual selection of current ranges individual per phase

The range synchronization soft key must indicate I1≠I2≠I3.

The pressed range FB indicates that current range selection is active.

-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

Selection for phase I1 active

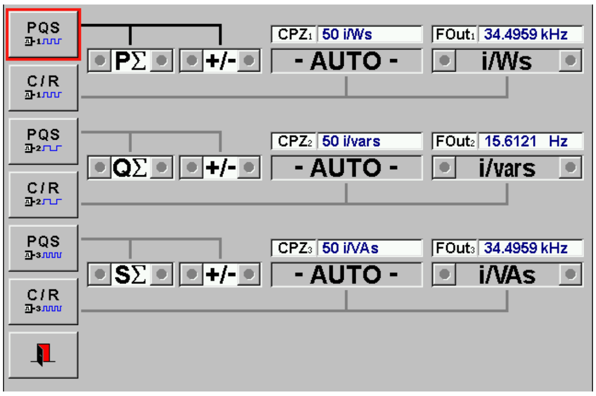
A red frame is displayed. The actual phase and the actual selected ranges of all phases are yellow highlighted.

-- I1 --	-- I2 --	-- I3 --
2.5mA	2.5mA	2.5mA
5mA	5mA	5mA
12mA	12mA	12mA
25mA	25mA	25mA
50mA	50mA	50mA
120mA	120mA	120mA
250mA	250mA	250mA
500mA	500mA	500mA
1.2A	1.2A	1.2A
2.5A	2.5A	2.5A
5A	5A	5A
12A	12A	12A
---	---	---
---	---	---
---	---	---
---	---	---

The last highlighted ranges are accepted. The red frame and the yellow highlighting disappear.

Exit, back to calling menu

8.1.2 Definition of frequency outputs



Frequency output
The PRS 600.3 has three individually configurable impulse output.
Total and single phase power values can be assigned to the impulse output.
The mean of the frequency of the output is proportional in each case to the mean of the chosen quantity.
Default setting: Output 1: Total active power
Output 2: Total reactive power
Output 3: Total apparent power

PQS | **Selection of reference value for the frequency output**

PΣ	QΣ	SΣ
P1	Q1	S1
P2	Q2	S2
P3	Q3	S3

Reference value
Selection of the source power for the frequency output
Total power or single power of active, reactive or apparent values can be assigned.

Direction

- +/- Positive and negative (all quadrants)
- \+ Positive only (consumption)
- \- Negative only (back feeding)

C/R | **Selection of the meter constant C / R for the frequency output.**

- AUTO -
Auto
The internal range dependent constant is active.

10000
Constant
Free selectable range independent meter constant
It should be noted that the constant must be selected in such a way that the maximum frequency of 46.8kHz is not exceeded in the desired operational ranges.

imp/kWh	imp/kvarh	imp/kVAh
imp/Wh	imp/varh	imp/VAh
imp/Ws	imp/vars	imp/VAs
kWh/imp	kvarh/imp	kVAh/imp
Wh/imp	Wh/imp	VAh/imp
Ws/imp	vars/imp	VAs/imp

Unit
Selection of the unit of the desired output.

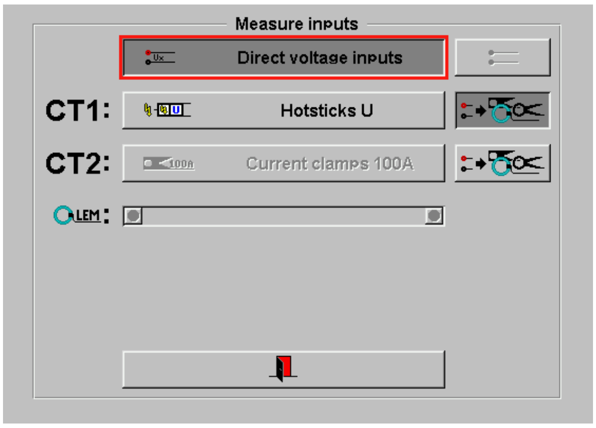
CPZ1 18.75 i/Ws
CPZ1
Shows the actual constant at the impulse output.

FOut1 40.0406 kHz
FOut1
Shows the actual frequency output at the impulse.

Exit, back to calling menu

8.1.3 Selection of voltage measurement inputs

This function serves to select the voltage input used, direct connected voltage or hotstick connected for high voltage measuring up to 40kV.



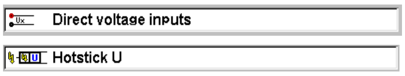
Selection of direct voltage measuring input

Selection of Hotstick voltage measuring input

Sensor detected but of wrong type

No sensor connected

Back to the main setup screen



Indication on the main setup screen

Depending on what voltage input is chosen, after pressing , on the main setup screen it shows the corresponding voltage input.

Status symbol indication for direct voltage measuring input.

Status symbol indication for hotstick voltage measuring input

	**Activation of automatic selection of active voltage input CT1 or CT2**

Manual selection

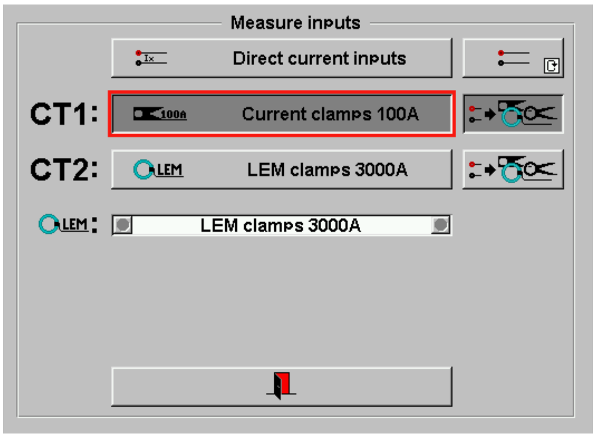
Use the up/down cursor to move the red selection frame to the recognized type of voltage sensor at CT1 and/or CT2 and press the enter key to activate the selected input. Actually only the high voltage sensor Hotstick U is supported (OPTION).

Automatic selection activated

As soon as a voltage sensor is plugged in and recognized, the voltage input is automatically changed to this input and this type of sensor.
There is no need to go to the setup menu to select the voltage measurement inputs. For further explanations to this function see 8.1.4.

8.1.4 Selection of current measurement inputs

This function serves to select the current input used, direct connection or different kinds of current clamps or hotstick for measuring up to 2000A connected and automatically recognized at universal sensor inputs CT1 or CT2.



One of the following inputs for current measurement can be selected.

Direct current inputs	Direct inputs 12A
Direct current inputs	Direct inputs 120A
Current clamps 100A	Current clamps 100A
Current clamps 1000A	Current clamps 1000A
LEM clamps 30A	FLEX 3000 / 30A
LEM clamps 300A	FLEX 3000 / 300A
LEM clamps 3000A	FLEX 3000 / 3000A
Hotstick I	Hotstick up to 2000A
- - -	No sensor connected
	Exit

The selection is common for all three phases

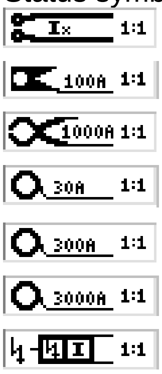
Indication on the main setup screen

Depending on what current input is chosen, after pressing ,
on the main setup screen it shows the corresponding current input and it's belonging status symbol.

Current input selection indication

Direct current inputs 120A
Current clamps 100A
Current clamps 1000A
LEM clamps 30A
LEM clamps 300A
LEM clamps 3000A
Hotstick I

Status symbol indication



Activation of direct current input 12A or 120A (cyclical mode)

12A direct current input active
12A current input can be selected if desired.

120A direct current input active
120A current input can be selected if desired.

Activation of automatic selection of active current input CT1 or CT2

Manual selection

Use the up/down cursor to move the red selection frame to the recognized type of current sensor at CT1 and/or CT2 and press the enter key to activate the selected input.

Automatic selection activated

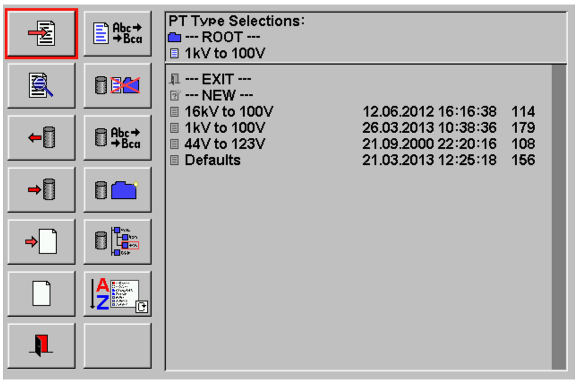
As soon as a current sensor is plugged in and recognized, the current input is automatically changed to this input and this type of sensor.
There is no need to go to the setup menu for selection of current measurement inputs.
E.g. if ‘direct current inputs’ was active before, the input is automatically changed to the current sensor plugged in (CT100A, CT1000A, FLEX 3000, Hotstick). If the sensor is unplugged, ‘direct current inputs’ is automatically selected again.
If automatic selection is activated at both inputs CT1 and CT2, the last plugged in sensor is automatically selected.
If the last plugged sensor is unplugged ‘direct current inputs’ is selected.
If the sensor at the other input is unplugged and plugged again, the input changes directly to this sensor.

Manual selection of the ‘direct current inputs’ or the other CT input is also possible, if one of the CT inputs is set to automatic selection.
If automatic selection is activated at both inputs, ‘direct current inputs’ cannot be selected, the input selection toggles between CT1 and CT2, if manually selected.
When leaving and recalling the measurement input selection menu after a manual selection, the automatic selection is reactivated.

Selection of FLEX 3000 (LEMflex) current range

Press on the selection field and use the up/down cursor keys on the virtual keyboard to select the same range 30A, 300A or 3000A as manually selected at the LEMflex or FLEX 3000 box. This range setting at the LEMflex or FLEX 3000 box cannot be automatically detected by the instrument.

8.1.5 Voltage measuring transformer PT settings



Database functions

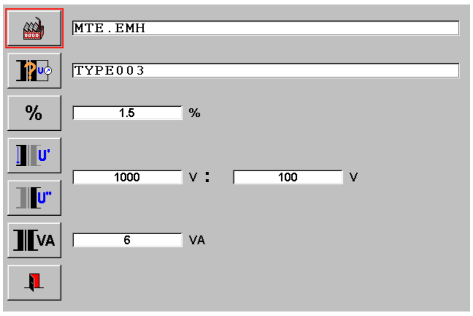
Edit actual object

Load object file from PT Type Selections:

Reset actual object to defaults

- PT L1 - - PT L2 - - PT L3 -

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual PT type dataset menu

Manufacturer

Potential transformer PT type

Accuracy class

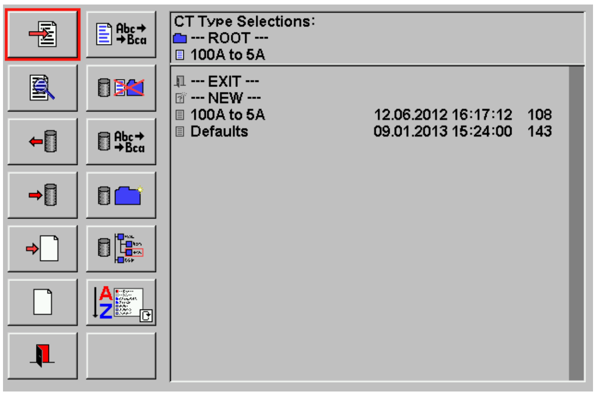
Primary voltage

Secondary voltage

Nominal burden

Exit, back to calling menu

8.1.6 Current measuring transformer CT settings



Database functions

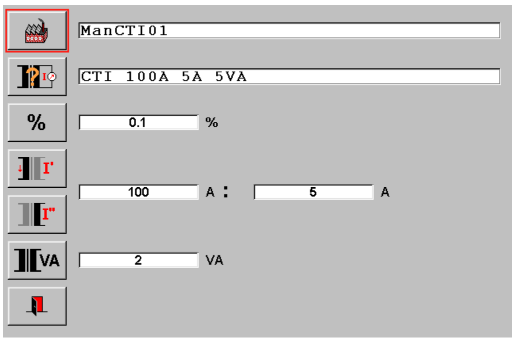
Edit actual object

Load object file from CT Type Selections:

Reset actual object to defaults

- CT L1 - - CT L2 - - CT L3 -

Call **edit actual object** or **load object file** or **create new object** at the file selection menu [6.1] to call the actual object menu.



Actual CT type dataset menu

Manufacturer

Current transformer CT type

Accuracy class

Primary current

Secondary current

Nominal burden

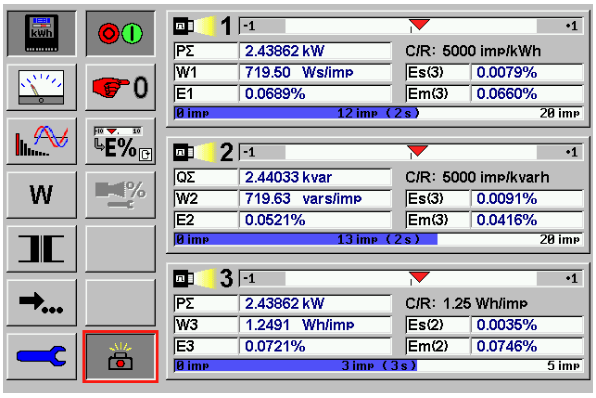
Exit, back to calling menu

8.2 Error measurement

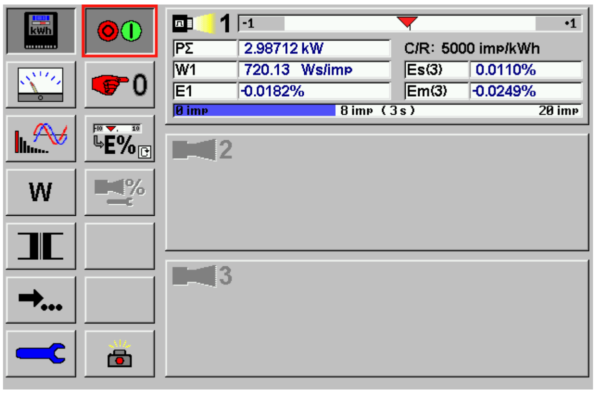
There are three independent impulse inputs which can be used for error measurements in accordance with the impulse comparison method for active, reactive and apparent energy.
The impulse inputs can be used with scanning heads, e.g. the SH 2003, with push buttons, or with impulse cables which are directly connected to the device under test.

Possible applications for three inputs

- Simultaneous test of active and reactive energy on a multi-purpose meter with two scanning heads connected to input 1 and input 2 for active and reactive power consumption plus simultaneous test of the electrical impulse output (retransmitting contact) with impulse cable connected to input 3.
- Simultaneous testing of three different meters with identical nominal values.

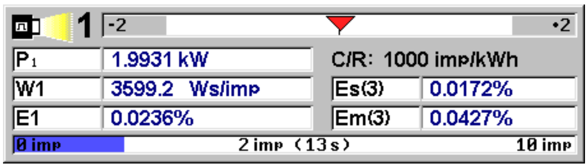


Error measurement menu
Example with 3 inputs active
The results and basic settings of the three error calculation units for the three impulse inputs are shown.
The settings for reference mode, meter constant, measuring period in Impulses (imp) or seconds (s) and number of results used for statistical calculations must be defined in the **setup of error measurement** menu [8.2.2].
The three error calculation units are completely independent (e.g. input 1 may be used to measure active energy, while input 2 measures reactive energy and input 3 measures active energy in positive direction only).

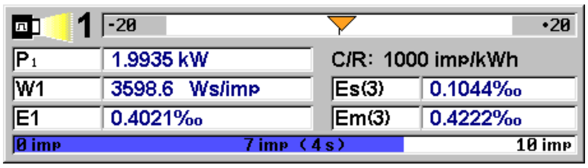


Example with 1 input active
The number of active inputs can be configured in the setup menu [8.2.2].

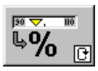
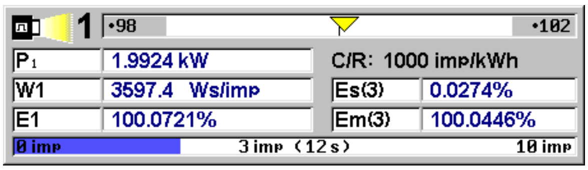
Error display mode (percentage, per mill, absolute)

Relative error in percentage
The displayed values are related to 0.
No error = 0%.

Relative error in per mill
The displayed values are related to 0.
No error = 0 ‰
1 % = 10 ‰

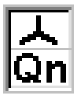
Absolute error
The displayed values are related to 100.
No error = 100%

The following description is based on the relative error display mode

PΣ	**Reference power / energy mode**

Actual mode PΣ is total active power / energy. The settings can be changed in the setup menu [8.2.2]

Linked definitions



The actual connection mode (e.g. 4-wire) and actual reactive mode (e.g. natural) can be seen in the status indication at the left lower corner of the display.
Both settings can be changed in the setup of reference standard menu [8.1].

C/R: 10k imp/kWh	**Constant of meter under test**

The value must previously be defined in the setup menu [8.2.2].

PΣ	1.7250 kW	**Actual sum power**

The power of the selected reference mode is indicated. The value is updated in the interval of the time base.

W1	720.30 Ws/imp	**Measured energy per impulse**

The energy per impulse is measured, which corresponds to the measured impulse input constant with unit Ws/imp.

E1	0.0014%	**Error of energy measurement of input 1**

The result will be updated in the interval defined by n, as soon as n impulses are counted at the input 1. The first measurement will require n+1 impulses, as the first impulse is used to start the measurement process.

Indications during first measurement

E1	. -	Waiting for first impulse to start
E1	--.--	Running the first time

Overflow indications

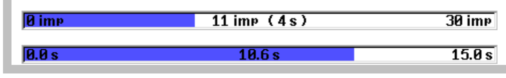
E3	E+	Indication of positive errors > +999.9999%
E2	-100.0000 %	Indication of negative errors > -100%

Es(3)	0.0046%	**Mean value Em(x) and standard deviation Es(x) of the error E1**
Em(3)	0.0036%	

The calculation is performed over the displayed number of results x in brackets Em(x). After restart of the measurement the value x will be counted up until N, the number of results defined in the setup menu, is reached. Successive calculations are performed over the last N results of E1.
With the setting N = 0 or 1 the value Em(1) = E1 and Es(1) = 0.000 is displayed. The statistic function is disabled and the error value displayed at Em(1) is equal to E1.

	**Graphical error indication with tolerance band**

The arrow indicates the error in graphical form in relation to a selectable tolerance band (e.g. Emin = -0.1%, Emax = +0.1%). The tolerance band can be changed in the setup menu [8.2.2].

	**Bar graph display of measuring period**

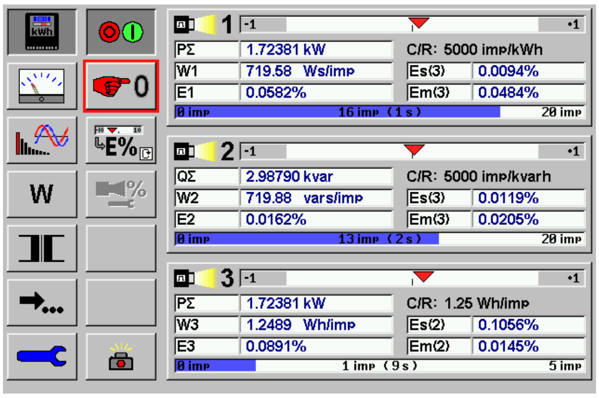
A bar graph indicates either the counted impulses with resting estimated measurement time in brackets or the elapsed time in s of the active measurement. At the right side the end value of t/n is displayed within the bar graph, either as impulses or seconds.

	**Start / Stop error measurement**

To start or stop an error measurement press the  key.

	**Restart of measurement**

Each key press causes a restart.



All error results and statistical calculations for mean value and standard deviation are reset.

Each of the three evaluation systems waits for the first impulse to start a new measurement.

The function is only active, if the start / stop soft key is pressed.

	Call **setup of error measurement** menu [8.2.2].

 During an error measurement, the **setup of error measurement** key is blocked. Stop the error measurement to activate the setup key.

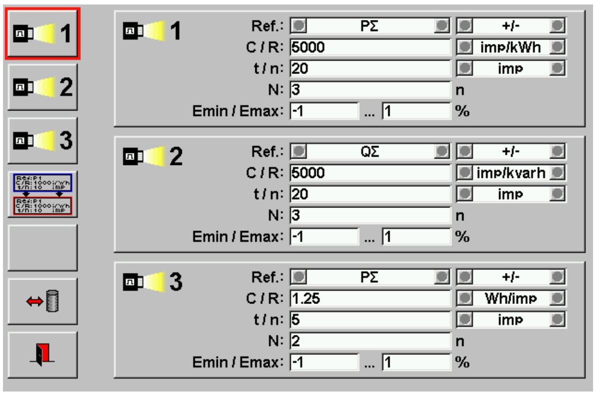
	Call **storage of test results** menu [10].

8.2.1 Measuring setup

Examples for measuring setups in different connection modes are described in chapter 17.
Special care must be taken with regards to the grounding of the measuring setup.
We recommend that only one connection of the measuring voltage neutral connector N is made to the protecting earth in the entire measuring setup. Normally this is done at the reference meter. However, if the output of the source used is already grounded, then this should be the only ground in the system. Loops caused by multiple ground connections must be avoided.

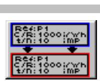
8.2.2  Setup of error measurement

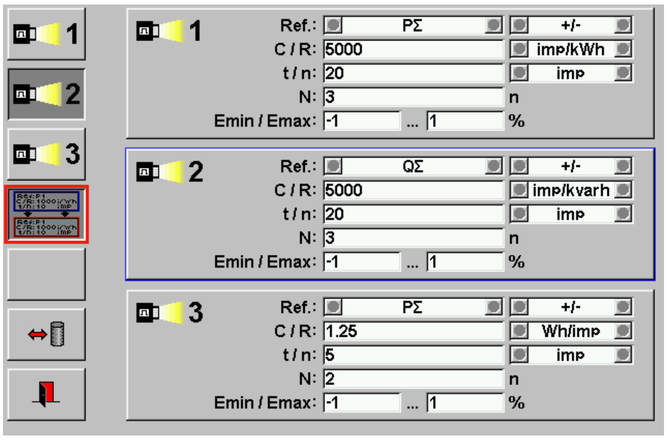
Here the data for the devices under test are entered, and the basic settings for the error measurement are defined.



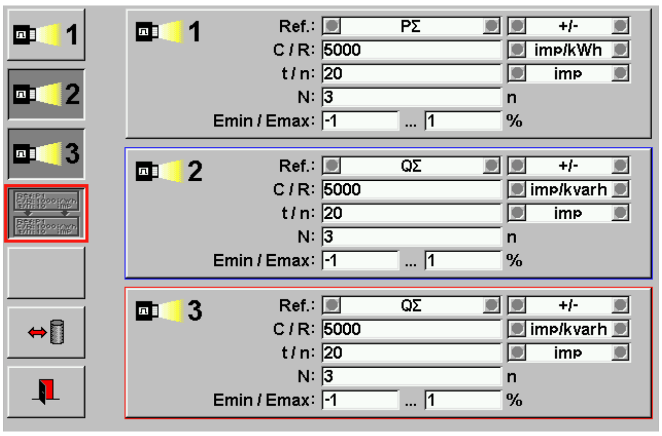
Setup of error measurement menu
In this menu, the following basic settings for error measurements can be made for input 1, 2 and 3.

- Reference energy mode (Ref)
- Meter constant of device under test (C/R)
- Measuring period (t/n)
- Number of test results used for mean value and standard deviation calculations(N)
- Tolerance band (Emin / Emax)

	**Parameters for scanning head 1, 2 and 3 [8.2.2.1]**
	**Copy parameters from input x to input y**



Activate copy function and input to be copied
Press on FB **Copy** and select the input to be copied either by pressing on the FB **Input** on the left side or by pressing directly into the corresponding region on the right side. The region to be copied is activated, if it becomes blue-framed.

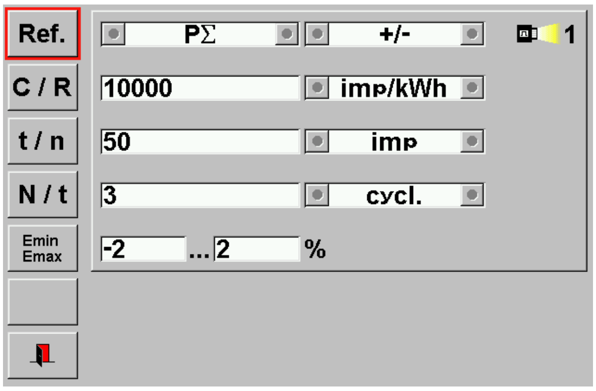


Paste function
Press either on the FB **Input** on the left side or directly into the corresponding region on the right side. During the paste process, the region is red-framed for a short moment.

⇔	Call **Load / save reference meter settings** [4.4]

	Exit, back to calling menu

8.2.2.1 1 Parameters for scanning heads



Setup of error measurement menu

- Reference energy mode (Ref)
- Meter constant of device under test (C/R)
- Measuring period (t/n)
- Number of test results used for mean value and standard deviation calculations (N)
- Tolerance band (Emin / Emax)

Ref. PΣ +/-	**Reference mode**

The following settings and inputs can be defined independently for each input.
All settings and inputs can be entered as desired.

PΣ P1 P2 P3 QΣ Q1 Q2 Q3 SΣ S1 S2 S3	Definition of **Reference mode** of the PRS 600.3 **for Error Measurement**. This should be the same reference mode as the device under test. One of these reference modes for error measurement can be selected.
-- OFF --	**-- OFF --** In **-- OFF --** mode the inputs are not activated
 +/- + -	**Direction** Positive and negative (all quadrants) Positive only (consumption) Negative only (back feeding)

C / R 10000 imp/kWh	**Constant of meter under test**

Numerical Input of the **constant of the device under test**. An input is also possible in exponential form for large values, e.g. during checking of reference standard meters. The value of the constant is always linked to the unit value, which is defined in the adjacent field (for numerical input see chapter 4.3.1).

Unit Depending on the measurement mode following units can be selected:
In most cases the units can be entered in the way familiar to the operator without conversion and just as it is printed on the nameplate of the meter.
In this case, 'Imp' stands for impulse. An impulse means the same as a disk rotation or the passing mark on a Ferraris meter, where 'Imp' is often replaced by 'r' for revolution.

	P	Q	S
Imp/k..h	Imp/kWh	Imp/kvarh	Imp/kVAh
Imp/..h	Imp/Wh	Imp/varh	Imp/VAh
Imp/..s	Imp/Ws	Imp/vars	Imp/VAs
k..h/Imp	kWh/Imp	kvarh/Imp	kVAh/Imp
..h/Imp	Wh/Imp	varh/Imp	VAh/Imp
..s/Imp	Ws/Imp	vars/Imp	VAs/Imp

Measuring period

Definition of the test time by number of impulses **imp** or seconds **sec.**
(for numerical input see chapter 4.3.1).

Number of impulses of device under test. The effective counted number is one more, because an additional start impulse is needed.

Test time in seconds. Based on the actual load and the constant of the meter under test (C/R) the system calculates itself the number of impulses to test. The resultant test time will only be approximate, because the test can only be carried out over an integer number of pulses.

Number of results for statistics

Input of the number of results **N** used for the calculation of mean value **Em(N)** and standard deviation **Es(N)** (for numerical input see chapter 4.3.1).

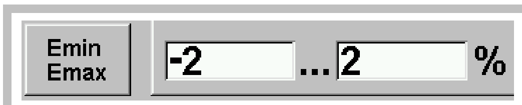
Em(N):
Es(N): The calculation is made over the last N measurements.

New measurement: If a new measurement is started, the calculation is made over the already available results, indicated with Es(n), where n = number of results since start of measurement (range: 1 .. N).

N = 1: The statistic function is disabled. The mean value Em(1) is equal to the displayed error Ex, x = 1, 2, and the standard deviation Es(1) is always zero.

Fixed number of results for statistics

Relative number of results for statistics within a fixed time. Based on the actual defined measuring periods the system always is considering complete measuring periods. Therefore, the actual measuring time is the defined time N/t + the completion of one measuring period t/n.



Error tolerance band

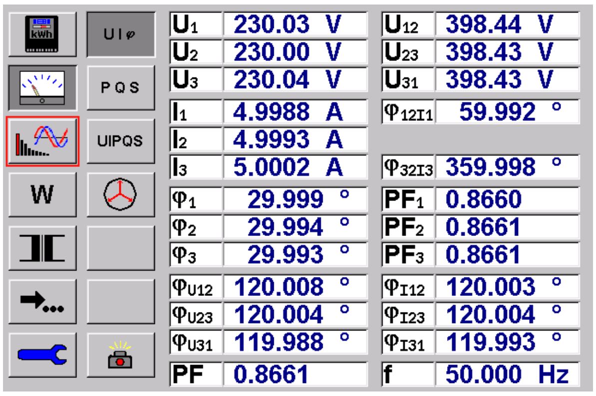
Emin / Emax Input of the lower and upper Error tolerance.
The tolerance range of the error bar graph can be changed individually for Emin and Emax by entering the value with the virtual keyboard.

8.3 Measurement

With the measurement function, load values and power values as well as vector diagrams can be measured and displayed.

8.3.1 UIφ values

4-wire mode

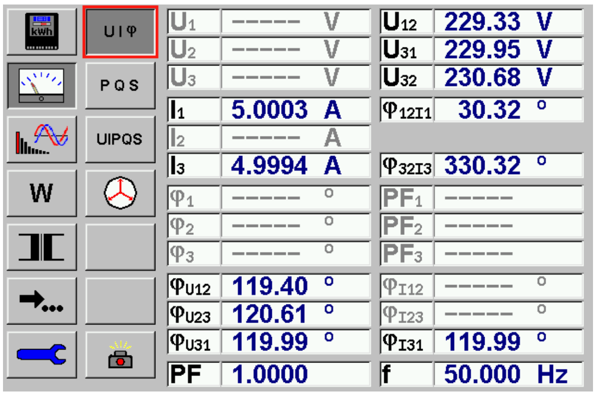


UIφ values

The display shows all relevant load values of a 4-wire or 3-wire network at the same time.

- Phase to neutral voltages (U_1, U_2, U_3)
- Phase to phase voltages (U_{12}, U_{23}, U_{31})
- Phase currents (I_1, I_2, I_3)
- Phase angles of phase-phase voltages to currents (φ_{12I1}, φ_{32I3})
- Phase angles of current to voltage (φ_1, φ_2, φ_3)
- Phase angles of voltage to voltage (φ_{U12}, φ_{U23}, φ_{U31})
- Phase angles of current to current (φ_{I12}, φ_{I23}, φ_{I31})
- Power factors per phase and sum, depending on connection mode (PF_1, PF_2, PF_3, PF)
- Frequency (f)

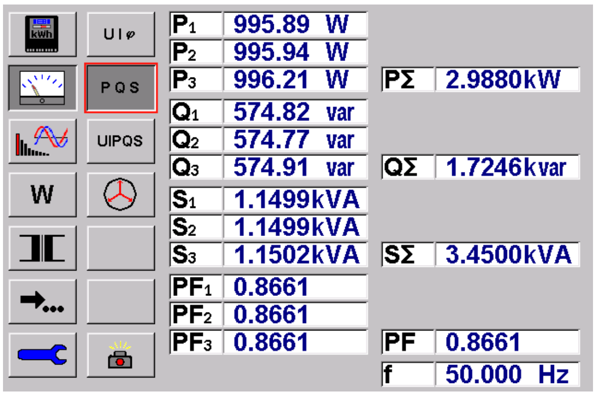
3-wire mode



The values not available in 3-wire mode are marked with: '------'.

8.3.2 PQS values

4-wire mode



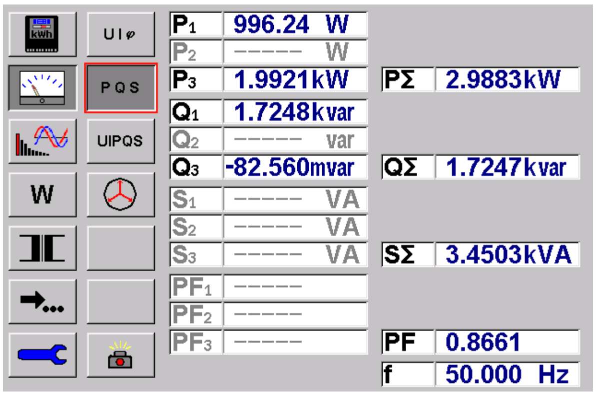
PQS values

The display shows all available power values of a 4-wire or 3-wire network at the same time:

- Active power per phase and sum (P_1, P_2, P_3, $P\Sigma$)
- Reactive power per phase and sum (Q_1, Q_2, Q_3, $Q\Sigma$)
- Apparent power per phase and sum (S_1, S_2, S_3, $S\Sigma$)
- Power factors per phase and sum (PF_1, PF_2, PF_3, PF)
- Frequency (f)

The values are updated at the interval of the time base.

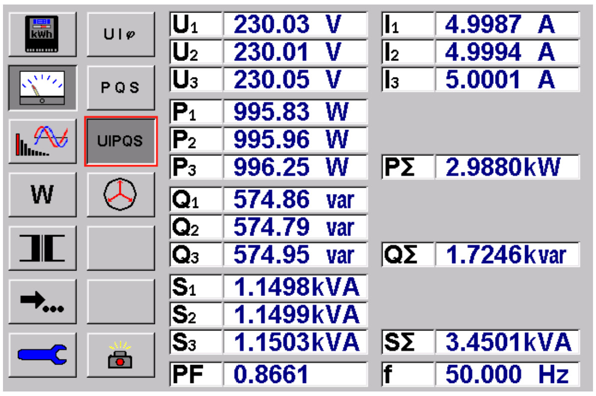
3-wire mode



The values not available in 3-wire mode are marked with: '------'.

8.3.3 UIPQS values

4-wire mode

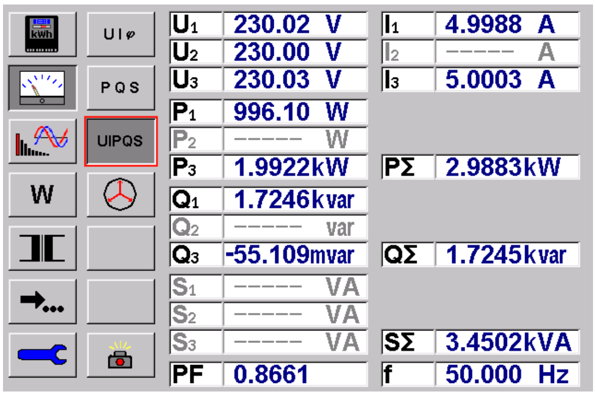


UIPQS values

The display shows all relevant load values of a 4-wire or 3-wire network at the same time.

- Phase to neutral voltages (U_1, U_2, U_3)
- Phase currents (I_1, I_2, I_3)
- Active power per phase and sum (P_1, P_2, P_3, $P\Sigma$)
- Reactive power per phase and sum (Q_1, Q_2, Q_3, $Q\Sigma$)
- Apparent power per phase and sum (S_1, S_2, S_3, $S\Sigma$)
- Power factor sum (PF)
- Frequency (f)

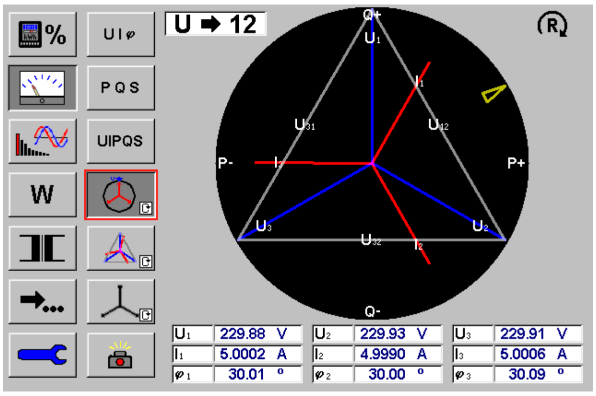
3-wire mode



The values not available in 3-wire mode are marked with: '------'.

8.3.4 Vector diagram

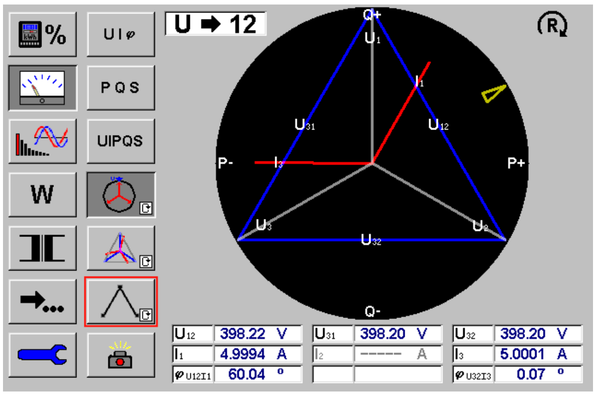
4-wire mode



Vector Diagram
The vector diagram of a 4-wire network with a phase shift of 30° between current and voltage and with correct field rotation (R) (clockwise sequence: L1, L2, L3) is shown.
The reference value for the vector diagram is U1, displayed at 12 o'clock. U ➜ 12.
The display is updated at the time base interval.

The field rotation changes to (L), (anticlockwise) if the phase sequence is L1, L3, L2.

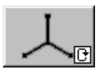
3-wire mode



The values not available in 3-wire mode are marked with: '------'.
The phase to phase voltages are indicated as connection lines between the phase to neutral voltages.
If there is no proper grounding in the measuring set-up, the inner 4-wire vector diagram may become asymmetrical in 3-wire mode,
The symmetry of the outside triangle and the values of the phase to phase voltages as displayed as **UIφ values** are not altered by this effect.
If N is connected to U2 in the network, the diagram is shifted to one side, because N is always displayed in the middle.

Reference for vector diagram
The reference phase voltage U or current I is defined here. All phase angles are displayed in relation to the reference value, which can have the direction 12 o' clock or 3 o' clock.

Repeated key pressure changes between (cyclic mode):
U-> 12h / I -> 12h / U -> 3h / I -> 3h
For U reference the values U1, U2, U3 and for I reference the values I1, I2, I3 are taken in this sequence. This means, if at U:12h the voltage U1 is missing, U2 will be taken as reference. In the case that no voltage is present but only current I3, this value will be the reference.
In the 3-wire vector diagram mode the calculated phase - neutral value U1, U2, U3 are taken as reference.

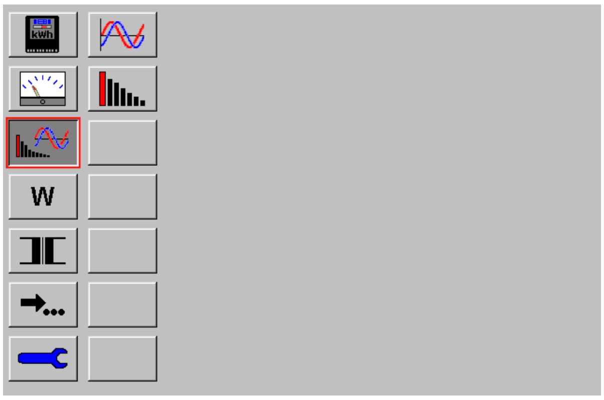
Indication 4-wire or 3-wire vector diagram
Switching between the display formats **4W** and **3W**

Change colors of vectors

The same color for all voltages (blue) and all currents (red)

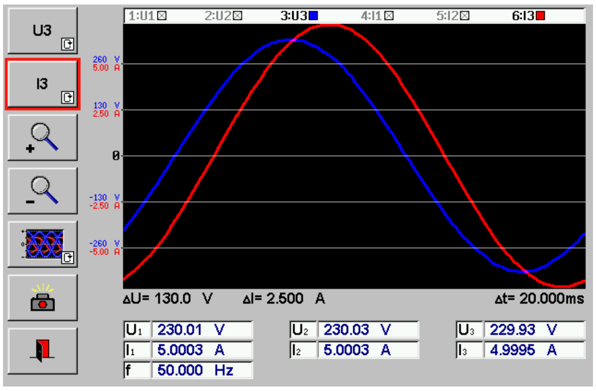
Different color for the phases: 1 (red), 2 (yellow), 3 (blue)

8.4 Wave form analysis

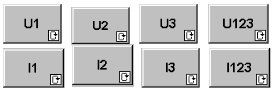


Waveform display menu [8.4.1]
Harmonic analysis menu [8.4.2]

8.4.1 Wave form display

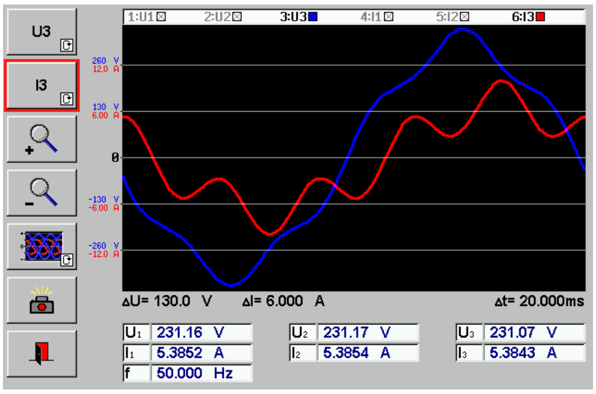


Oscilloscope
The oscilloscope can display one or a combination or all of the signals:



The display shows always one period of the signal, scaled in relation to the actual maximum range values.
At the bottom of the diagram the actual voltage step ΔU and current step ΔI of the vertical axis and the period of the signal Δt are displayed.
The step height depends on the selected ranges and the zoom level.

Phase 3 with 5th harmonic (10% U, 40% I)



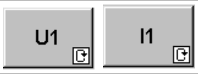
Without zoom the step height is half the end of range value.

The vertical axis is divided into three positive and three negative steps, with the actual values for voltage and current indicated beside the horizontal separation lines.

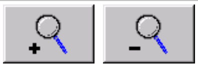
At the bottom the effective values of all signals and the measured frequency are displayed.

The numerical values are updated at the time base interval.

The signals U3, I3 with 5th harmonics displayed here correspond to the results of the analysis in chapter [8.4.2].

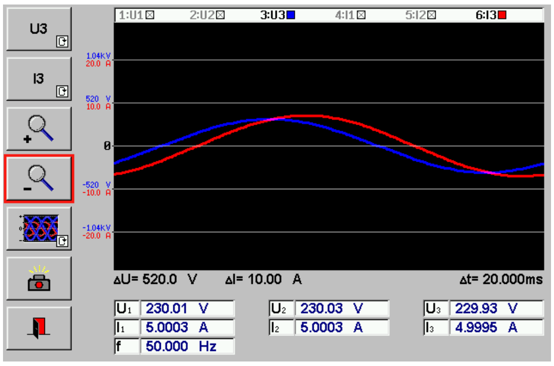
 Phase selection

Enable / disable display of all voltages U1..U3 or all currents I1..I3. Toggle between the display (cyclic mode).

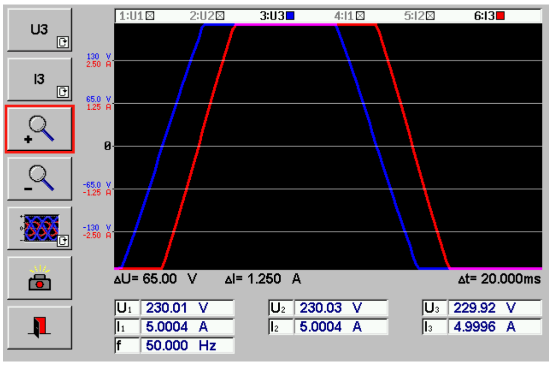
 Zoom in /out

The signal can be zoomed in / out over eight levels:
x 2 / x 4 / x 8 / x 20 / x 40 / x 80 / x 200 / x 400.
The step height beside the vertical axis is changed depending on the zoom level.
With the + /- zoom keys any one of these eight levels can be selected.

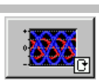
Small signal without zoom

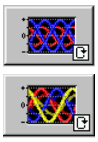


Zoom level 3 (x 8)



The status of the selection is indicated at the top of the diagram (e.g. U3, I3 activated).

 Change color of wave



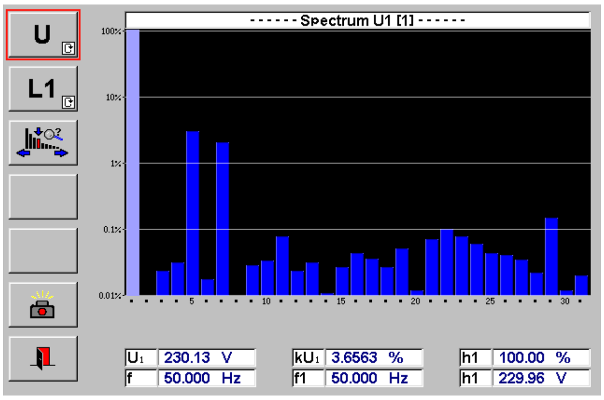
The same color for all voltages (blue) and all currents (red)

Different color for the phases: 1 (red), 2 (yellow), 3 (blue)

 Call **storage and printout of test results** menu [10].

 Exit, back to calling menu

8.4.2 Harmonic analysis



Harmonics

Harmonic analysis can be performed for one of the phases 1, 2, or 3 for:

- Phase to neutral voltage (U)
- Phase current (I)
- Active power (P)
- Reactive power (Q)
- Apparent power (S)

Harmonics of order number h1 (fundamental, always displayed as 100%) up to h31 are displayed using a logarithmic scale (0.01 / 0.1 / 1 / 10 / 100%).

U **Harmonic mode (U, I, P ;Q, S)**

Selection of mode for harmonic analysis

Consecutive key presses on the FB will select phase voltage U, phase current I, active power P, reactive power Q or apparent power S.

L1 **Harmonic phase (L1, L2 L3)**

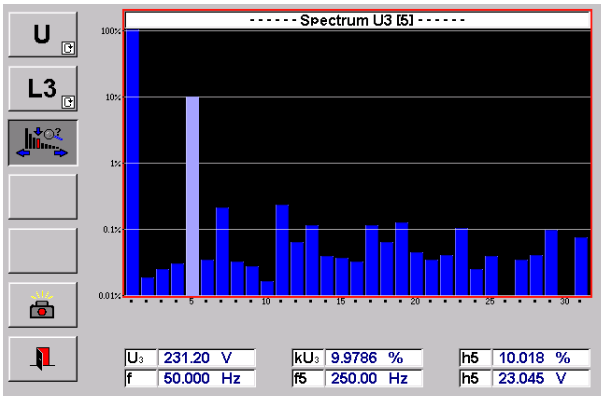
Selection of phase for harmonic analysis

Consecutive key presses on the **FB** will select the phase L1, phase L2 or phase L3
.
one of the signals in the table can then be selected for harmonic analysis:

	U	I	P	Q	S
L1	---U1---	---I1---	---P1---	---Q1---	---S1---
L2	---U2---	---I2---	---P2---	---Q2---	---S2---
L3	---U3---	---I3---	---P3---	---Q3---	---S3---

Harmonic analysis is always performed in 4-wire mode.

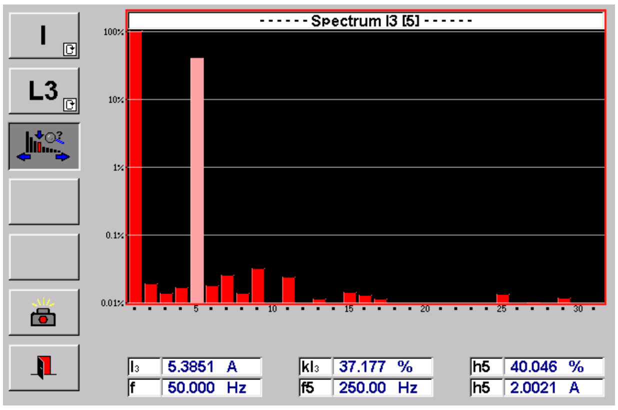
Analyze individual harmonic



A single harmonic hx (x = 1 … 31) can be selected by pressing on the desired signal bar.
The percentage value h5 10.018 % of the harmonic in relation to the fundamental waveform and the absolute value h5 23.045 V with the corresponding units (V, A, W, var, VA) as well as the selected harmonic frequency f5 250.00 Hz are displayed at the bottom.
The selected harmonic is highlighted in the graphical diagram.

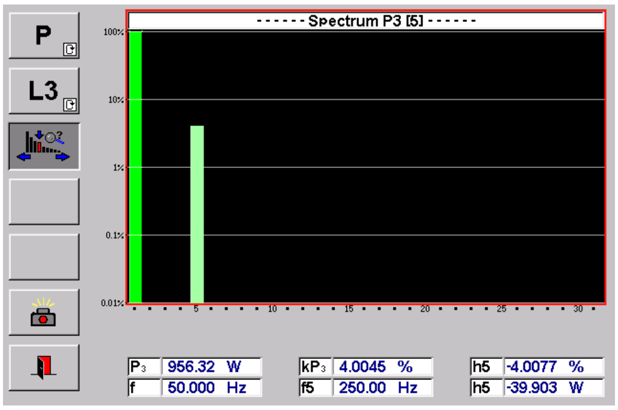
At the bottom are also displayed the effective value (U3) the fundamental frequency (f) and the total harmonic distortion (kU3) of the analyzed signal, updated at the time base interval.

E.g. Harmonics of current of phase 3



The signal consists of a fundamental of 5A and a 5th harmonic with 40% of the fundamental (2 A).
The effective value (I3) is the square root of the sum of all harmonics squared. Because the 5th harmonic is much bigger than the rest, the other harmonics can be neglected.
The effective value is approximately:
$I3 = \sqrt{(h1^2 + h5^2)} = \sqrt{(5^2 + 2^2)}$
I3 = 5.385 A

E.g. Harmonics of active power of phase 3

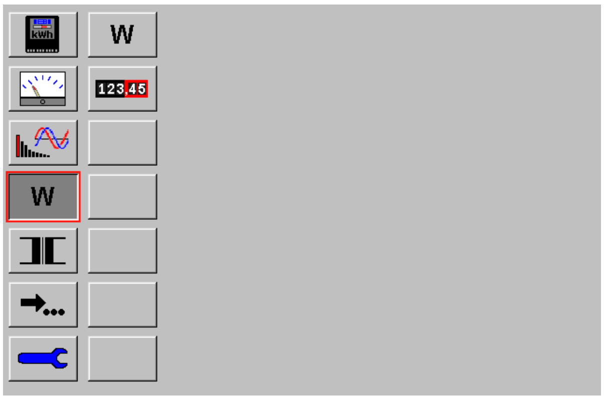


The active power value is based on a voltage signal 230V with 10% of 5th harmonic and a current signal 5A with 40% of 5th harmonic.
These are typical signals used for type tests.
The phase shift from current to voltage of the fundamental wave forms is approximately +30°.
The resulting 5th harmonic of power is 4.0 %. The absolute value of h5 is negative, because the phase shift between the 5th harmonic of current and voltage is approximately 150°.

	Call **storage of test results** menu [10].

	**Exit, back to calling menu**

8.5 W Energy measurement and register test

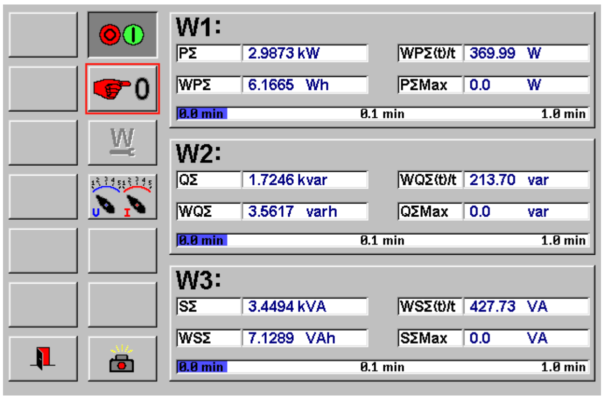


W Energy measurement

123.45 Register test

8.5.1 W Energy measurement

This function serves to do simple energy measurements in one of the available power modes with manual start and stop.



Start energy measurement

Reset and restart energy measurement

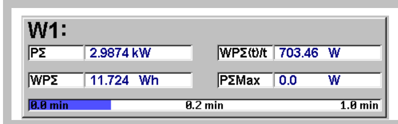
Setup energy measurement menu [8.5.1.1]

Voltage and current range settings menu [8.1.1]

W	Call **Setup energy measurement** menu [8.5.1.1]

	Call **Range settings** menu [8.1.1]

Display of values

	**Display for one energy measurement**

PΣ 2.9874 kW	**Actual power**

The actual power of the selected energy mode is displayed.

WPΣ 11.724 Wh	**Actual Σ energy**

The actual Σ-energy of the selected mode is displayed. The energy is counted up, starting at zero, displayed with the selected unit.

WPΣ(t)/t 703.46 W	**Actual Σ power per measure period**

Actual Σ-power of the selected mode is displayed. The value shows the energy counted since start of period (WPΣ/t) divided by the maximum period (t).

PΣMax 0.0 W	**Maximum value**

When the first measuring period is finished, power value is shown. At the end of the next measuring period, the new power value is displayed. The value, however, only varies if the new power value is larger than all preceding ones.

0.0 min 0.2 min 1.0 min	**Time bar graph for measuring period**

A time bar graph shows the progression of the measuring period.
The next measuring period starts automatically.

	Start Energy measurement

Start the energy measurement after definitions are made in
Setup Energy measurement. W menu [8.5.1.1]

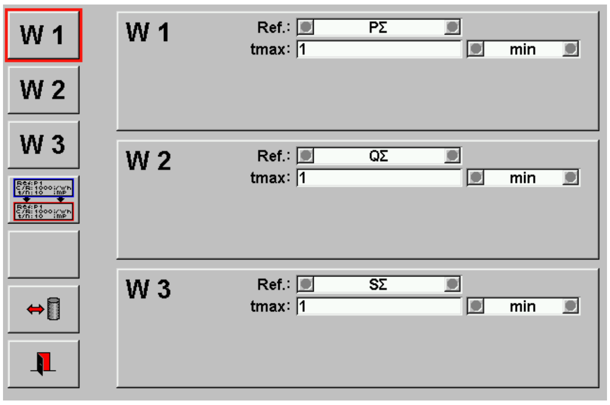
0	**Restart Energy measurement**

With the FB 0 the counting registers are reset to zero. Counting restarts automatically.

	Call **storage and printout of test results** menu [10].

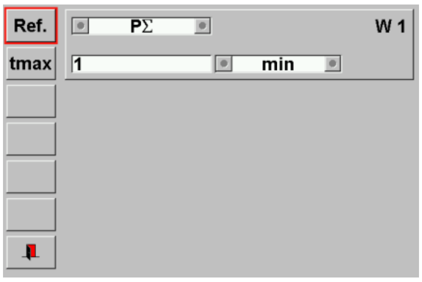
	Exit, back to calling menu

8.5.1.1 W Setup Energy measurement



W 1	Parameters for input 1
W 2	Parameters for input 2
W 3	Parameters for input 3
	Copy parameters from input x (1,2,3) to input y (1,2,3**)**
	Load/save settings [4.4]

W 1 W 2 W 3	**Parameters for input 1, 2, 3**



Selection of the source power for the energy measurement.
Enter of time period for maximum registration.

Ref.	**Selection of the source power for energy measurement**

Total power or single power of active, reactive or apparent values can be assigned to any of the three energy registers.

QΣ	SΣ	PΣ
Q_1	S_1	P_1
Q_2	S_2	P_2
Q_3	S_3	P_3

tmax	**Maximum time period**

15 min

For the maximum measurement, the user is asked for a measuring period. Time base can be entered in seconds, minutes or hours.

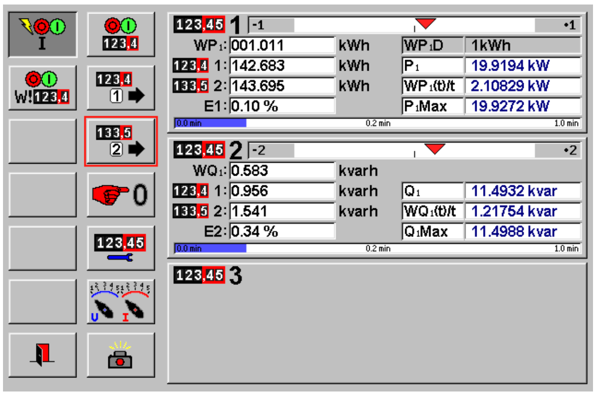
	Copy parameters from input x (1,2,3) to input y (1,2,3) menu [8.2.2]

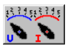
	Load/save settings from/to directory [4.4]

	Exit, back to calling menu

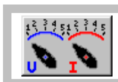
8.5.2  Register test

The register or counter test function is used to test the correct indication of the registers on mechanical or electronic meters.

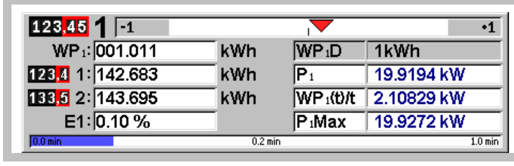


	Switch power source on/off (I, U or U+I)
	Start or stop automatic register test
	Start or stop energy measurement
	Enter start reading of register
	Enter end reading of register
	Reset register test
	Setup Register Test menu [8.5.2.1]
	Range settings menu [8.1.1]

	Call **Setup Register Test** menu [8.5.2.1]

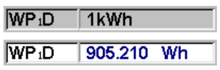
	Call **Range settings** menu [8.1.1]

Indications / Entries

	**Indications for one energy register**

	**Tolerance band**

Predefined upper and lower tolerances with graphical indicated error.

	**Predefined energy for register test**

The grey marked field shows the predefined energy in the **Setup register test** menu [8.5.2.1].After starting the register test, the energy is counting down to zero.

	**Actual power**

The actual power of the selected energy mode is displayed.

	**Actual power per measuring period**

Actual power of the selected mode is displayed. The value shows the energy counted since start of period (WP1(t)) divided by the maximum period (t).

	**Maximum value**

When the first measuring period is finished, power values are also shown in the field P1Max. The next measuring period starts automatically. At the end of the next measuring period, the new power values are displayed. The value, however, only varies if the new power value is larger than all preceding ones.

WP_1: 001.011 kWh	**Actual energy**

Actual passed energy. The energy is counting up until the register test is stopped.
The number of digits after decimal point is defined by the entry of the start reading.

123.4 1: 142.683 kWh	**Start reading of register**

Any start value can be defined for the register.
The way the value is entered (number of digits after decimal point) is used as register format for the actual energy indication and the input of the end reading and defines the resolution of the error calculation.

133.5 2: 143.695 kWh	**End reading of register**

Entering of the end reading, when the register test has finished or during the test to enter the expected end reading before the register test has finished.

E1: 0.10 %	**Register Error**

The register error is calculated based on the measured energy (WP1) and the entered start (1:) and end (2:) readings.

Note: The digits entered after decimal point at the start reading define the resolution for the error calculation. E.g. the format 0.001 kWh at a dosage energy of 1 kWh gives a resolution of the error of ± 0.1%.
The real measured energy WP_1 is relevant for the error calculation, not the predefined value WP_1D. WP_1 normally is a little bit higher than the predefined value WP1D, because energy is also measured during the source is switched off with a ramp.

0.0 min 0.2 min 1.0 min	**Time bar graph for maximum measuring period**

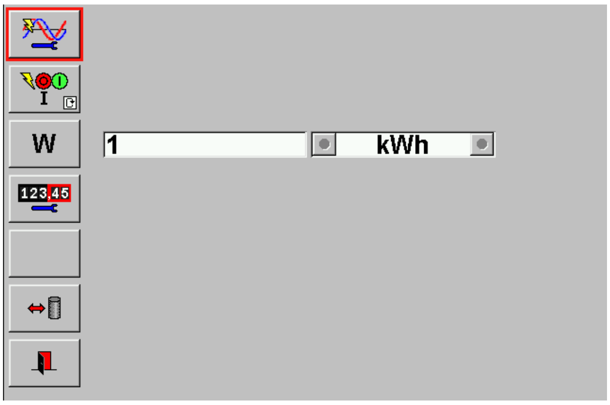
A time bar graph shows the progression of the measuring period.
The next measuring period starts automatically.
This time is only used for Maximum demand test.

Test setup
Before start of the test, the meter under test (MUT) must be connected. Examples for measuring set-ups in different connection and operating modes can be found in chapter [17].

Configuration
Check / change basic settings and configurations for register test in setup menu [8.5.2.1]

Step by step instruction
See test procedures for automatic register test [8.5.2.2] or manual register test [8.5.2.3], [8.5.2.4].

8.5.2.1 Setup Register test



Select a loadpoint from the database

Status selection (ON or OFF) of the voltage and current after the test

W Energy (W) for dosage

Setup registers for register test

Select loadpoint for auto dosage

Define the load point in the same way as in the source setup menu or load previously defined saved load point settings.
Note: To speed up the register test it is recommended to operate the meter at maximum power (e.g. Imax and power factor PF1).

Source action during register test

Select the desired status of the voltage and current source, during the register test run.

I **Only current is switched ON/OFF during the test.**
The voltage is always on. The current is switched on/off for the dosage of the desired energy.
This is the most used mode for electronic meters. For reading out the register end values of electronic meters, voltage has to be switched on.

U **Only voltage is switched ON/OFF during the test.**
The current is always on. The voltage is switched on/off for the dosage of the desired energy.

U+I **Both, voltage and current are switched ON/OFF during the test.**
The source is completely off. Voltage and current are switched on/off for the dosage of the desired energy.
This mode can e.g. be used with electromechanical meters.

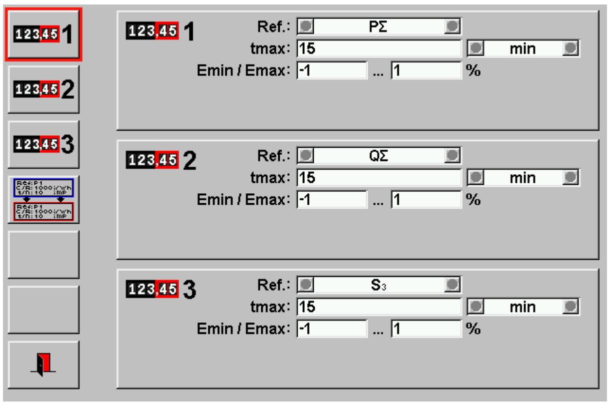
W Energy (W) for dosage

1 kWh **Enter the amount of Energy (W) for dosage**
If the predefined amount of energy is reached, the input of the end reading will be activated. The procedure is not automatic.

Ws Wh kWh MWh GWh — The unit depends on the chosen reference mode. These setting and input can be defined on input 1 only, valid for all three register tests.

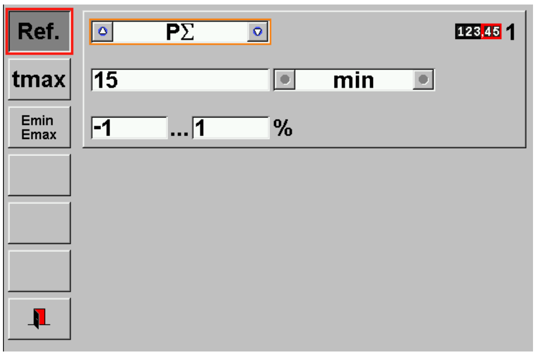
k?h — In case -- OFF -- is chosen, the unit is shown **x?x.**

Setup registers for register test



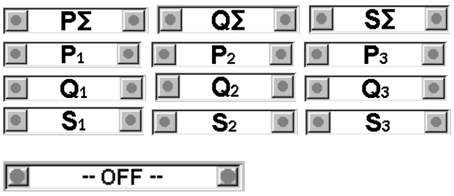
123,45 1	Select input for register 1
123,45 2	Select input for register 2
123,45 3	Select input for register 3
	Copy parameters
	Exit, back to calling menu

123,45 1 123,45 2 123,45 3 Settings for registers 1, 2, 3



Ref.	Select reference mode
tmax	Select maximum time period
Emin Emax	Select error tolerance band

Ref. Reference mode



These settings and inputs can be defined independently for each of the inputs 1, 2 or 3. All settings and inputs can be entered as desired.

Register test switched OFF, the corresponding field is blank in the register test main menu.

tmax Maximum time period

Time period for maximum demand test in minutes (e.g. typical value: 15 min).
This interval must be manually synchronized with the maximum demand period of the meter under test by starting the test with the interval start at the meter.

Hint: The maximum demand test is always running and cannot be switched off. If this is disturbing, a period of 60 min can be entered. In this case $WP_1(t)/t$ will indicate the energy counted up since start in Wh during 1h.

Error tolerance band

-1 ... 1 % — Entry of an upper and lower tolerance between ±0.0000... ±100 %.

Call **Copy parameters** from input x (1,2,3) to input y (1,2,3) menu [8.2.2]

Load/save settings from/to directory Counter Test Parameters: menu [4.4]

Exit, back to calling menu

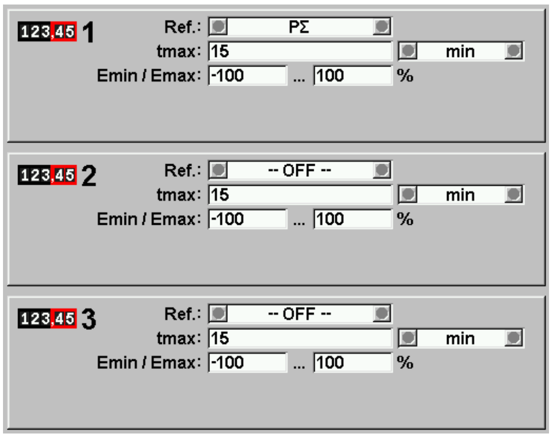
8.5.2.2 Procedure for automatic register test

The following procedure describes an automatic register test of one active energy register. The source is switched **automatically** on and off as required by the settings.

1 Call **Setup Register Test** menu [8.5.2.1]

Load predefined settings or check and adapt the actual settings

1.1



Configure register test 1

- Select reference power mode (Ref.) PΣ for register test 1 and select -- OFF -- for register tests 2,3.
- Enter desired maximum demand period (tmax), if a maximum demand test should be performed in parallel.
- Define tolerances (Emin/Emax) regarding the class of the meter under test.

1.2 Define the **load point** for the automatic register test (e.g. 230V, 100A, 0°).
Attention! During the test these settings are activated, not the actual settings in the source menu. Check that the load point settings are defined and suitable for your meter under test (e.g. I ≤ Imax).

1.3 Select source action mode **current switched on/off**.

1.4 Enter dosage energy (W), e.g. 100 Wh

1.5 Leave setup menu

2 **Reset register test**

The result of a previous test are reset to zero.

3 **Start automatic register test**

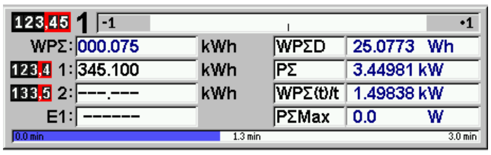
The FBs for source action and energy measurement are blocked and the voltage is switched on to power up the meter under test.

4	123.4 1: ----.-- kWh	**Enter register start reading**

The **input of the start reading** is automatically activated.
Enter the actual register reading as displayed on the meter under test with unit kWh.

5	↵	**Start of energy dosage**

By pressing the Enter key to accept the input of the start reading the current is switched on and the dosage runs automatically as defined.



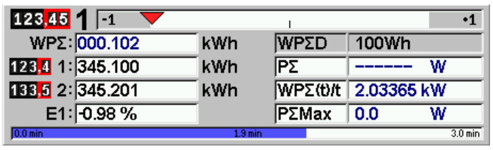
The dosage value WPΣD is counting down from initial value to zero.
The reference energy WPΣ is counting up with the resolution of the entered start reading.
If the programmed dosage value is reached, the current is switched off.

6	133.5 2: -.---- kWh	**Enter register end reading**

The **input of the end reading** is automatically activated.
Enter the actual register reading as displayed on the meter under test with unit kWh.

7	↵	**Calculation and indication of the register error**

By pressing the enter key to accept the input of the end reading the register test is finished.



The error (E1) of the register test is calculated and indicated based on the measured reference energy (WPΣ) and the entered start (1:) and end (2:) readings.

8		Call **storage of test results** menu [10].

The test result together with the actual load values are frozen at the moment the camera key is pressed and can be saved on the CF card for later analysis and reporting with the software CALegration.

Notes
In the same way, the test can also be performed for reactive energy or apparent energy only.
To repeat the same test restart with step 2.

Variations in the automatic procedure

1a, 4a, 6a	**Test of 2 or 3 registers at the same time**

1a The 2 or 3 required register tests must be defined in the setup (1a).
Note: The dosage energy is only defined at register test 1 and is valid for all three register tests. The test will stop for all three register tests, if the energy defined at register test 1 is reached. If active and reactive energy registers are tested at the same time, a suitable load point must be defined (PF ≠ 1) to get active and reactive energy dosage at the same time.

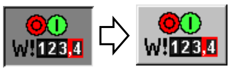
4a,6a During entry of start and end readings the input for all active registers is required one by one, before the next step is running.

4b, 6b **Change of start and end readings**

The start and end readings can be changed before, during and after the test.
This can be used to:

- Correct wrong entries
- Enter an expected end reading
- Test several registers of different meters one by one by entering the corresponding register readings.

5a **Stop automatic test**



Press the **automatic test button** to stop the automatic procedure. The buttons for source control and energy measurement are unblocked.

After stopping the energy measurement, the entry of the end reading must be activated manually. The error is calculated with the energy (WPΣ) counted since start of the test.

3c, 5c, 6c **Automatic test with reference standard only**

The register test is a guided energy measurement. There is no automatic dosage performed. The switch on/off of the load must be done manually by the user (e.g. by operating a load circuit breaker or by connecting and disconnecting a load or by manual operation of an external source).

The source action button is blocked all the time, because no source control is available.

3c Energy measurement of the reference standard is automatically started
The load status before the test, e.g. voltage on, must be manually controlled by the user.

5c Dosage is not starting automatically. The user must activate the load, e.g. operate a circuit breaker or switch on a current with an external source manually. As soon as a load is there, the predefined energy is counting down.

6c The energy measurement is stopped, when the predefined energy is reached and the input of the end reading is activated. The user must stop the load manually at the same time, when the input of the end reading is activated to assure, that the reference standard and the meter under test are counting the same amount of energy.

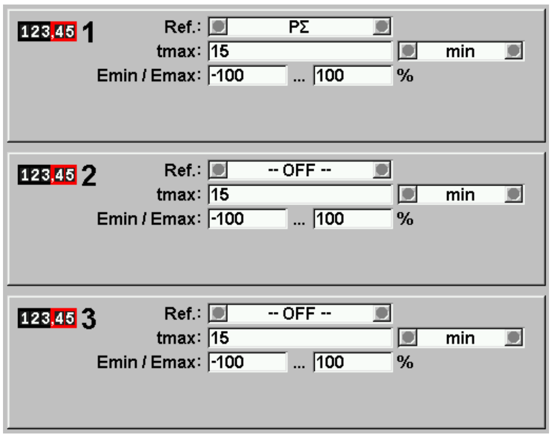
8.5.2.3 Procedure for manual register test

The following procedure describes a manual register test of one active energy register. The source and the energy measurement are controlled **manually** by the user.

1	Call **Setup Register Test** menu [8.5.2.1]

Load predefined settings or check and adapt the actual settings

1.1



Configure register test 1

- Select reference power mode (Ref.) PΣ for register test 1 and select -- OFF -- for register tests 2,3.
- Enter desired maximum demand period (tmax), if a maximum demand test should be performed in parallel.
- Define tolerances (Emin/Emax) regarding the class of the meter under test.

1.2 Define the **load point** for the automatic register test (e.g. 230V, 100A, 0°).
Attention! If the source action button is pressed, these settings are activated, not the actual settings in the source menu. Check that the load point settings are defined and suitable for your meter under test (e.g. I ≤ Imax).

1.3 Select source action mode **current switched on/off**.

1.4 Leave setup menu

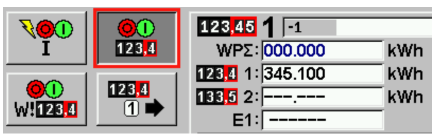
2	**Reset register test**

The result of a previous test are reset to zero.

3	**Enter start reading**

Enter the actual register reading as displayed on the meter under test with unit kWh and press the Enter key.

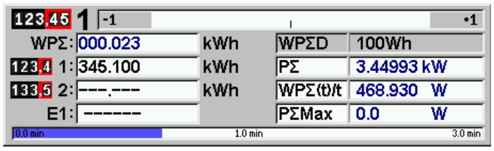
4	**Start energy measurement**



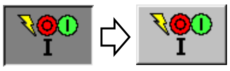
The energy measurement of the reference meter is enabled and the energy will be counted and shown at WPΣ as soon as a load is present.

5	**Switch power source on**

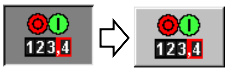
The current is switched on and the energy dosage is running until it is stopped manually.



The reference energy WPΣ is counting up with the resolution of the entered start reading.
The dosage value WPΣD is shown grey and remains unchanged, because this value is not regarded in the manual mode.

6		**Switch power source off**

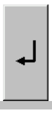
The current is switched off. Wait with the next step until the source is completely switched off.

7		**Stop energy measurement**

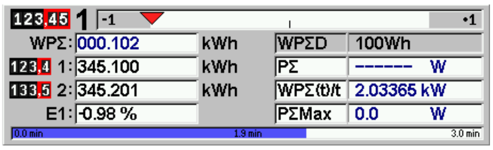
The energy measurement of the reference is stopped.

8	133.5 2: -.---- kWh	**Enter register end reading**

The **input of the end reading** is automatically activated.
Enter the actual register reading as displayed on the meter under test with unit kWh.

9		**Calculation and indication of the register error**

By pressing the Enter key to accept the input of the end reading the register test is finished.



The error (E1) of the register test is calculated and indicated based on the measured reference energy (WPΣ) and the entered start (1:) and end (2:) readings.

8		Call **storage of test results** menu [10].

The test result together with the actual load values are frozen at the moment the camera key is pressed and can be saved on the CF card for later analysis and reporting with the software CALegration.

Notes
In the same way, the test can also be performed for reactive energy or apparent energy only.
To repeat the same test restart with step 2.

Attention! The source remains in the last state, if you leave the register test menu. Voltage and/or current can still be switched on depending on the actual source action settings.
Check the actual state in the source menu card and switch off the source manually, if this is required.

1a, 3a, 8a	**Test of 2 or 3 registers at the same time**

1a The 2 or 3 required register tests must be defined in the setup (1a).
Note: If active and reactive energy registers are tested at the same time, a suitable load point must be defined (PF ≠ 1) to get active and reactive energy dosage at the same time.

3a,8a During entry of start and end readings the input for all active registers is required one by one, before the next step is running.

3b, 8b	**Change of start and end readings**

The start and end readings can be changed before, during and after the test.
This can be used to:

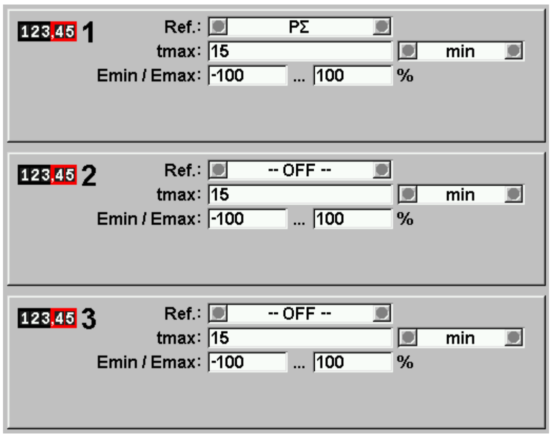
- Correct wrong entries
- Enter an expected end reading
- Test several registers of different meters one by one by entering the corresponding register readings.

8.5.2.4 Procedure for manual register test with reference meter only

The following procedure describes a manual register test of one active energy register. The energy measurement of the reference standard and the test load must be controlled **manually** by the user.

1	Call **Setup Register Test** menu [8.5.2.1]

Load predefined settings or check and adapt the actual settings



Configure register test 1

- Select reference power mode (Ref.) PΣ for register test 1 and select -- OFF -- for register tests 2,3.
- Enter desired maximum demand period (tmax), if a maximum demand test should be performed in parallel.
- Define tolerances (Emin/Emax) regarding the class of the meter under test.

The definition of the load point and the source action mode is not necessary, because no source is controlled from the reference meter.

Leave setup menu

2	Call **Range settings** menu [8.1.1]

Set manual range selection and select voltage and current ranges next higher to the maximum values of current and voltage reached during the test.
This is to prevent additional errors introduced through the automatic range switching of the reference standard during switch on/off procedure of the load.

Note: It is recommended to use automatic range selection only, if the peak values of voltage and current reached during the test are not known and if the test duration is long compared to the switch on/off procedure, where this influence can be neglected (e.g. long duration test on site with customer load).

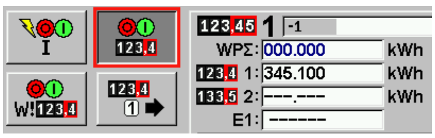
3	**Reset register test**

The result of a previous test are reset to zero.

4	**Enter start reading**

Enter the actual register reading as displayed on the meter under test with unit kWh and press the Enter key.

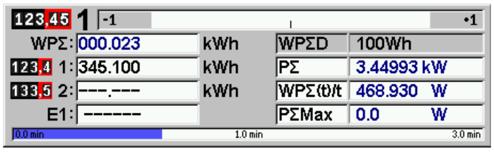
5	**Start energy measurement**



The energy measurement of the reference meter is enabled and the energy will be counted and shown at WPΣ as soon as a load is present.

6 Switch on the load

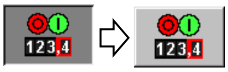
Manually switch on an external source or switch on a circuit breaker or connect a load to dose some energy.



The reference energy WPΣ is counting up with the resolution of the entered start reading.
The dosage value WPΣD is shown grey and remains unchanged, because this value is not regarded in the manual mode.

7 Switch off the load

The current is switched off. Wait with the next step until the source is completely switched off.

8  Stop energy measurement

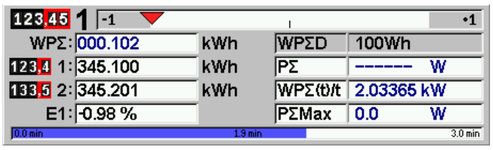
The energy measurement of the reference is stopped.

9  Enter register end reading

The **input of the end reading** is automatically activated.
Enter the actual register reading as displayed on the meter under test with unit kWh.

10  Calculation and indication of the register error

By pressing the Enter key to accept the input of the end reading the register test is finished.



The error (E1) of the register test is calculated and indicated based on the measured reference energy (WPΣ) and the entered start (1:) and end (2:) readings.

Notes

In the same way, the test can also be performed for reactive energy or apparent energy only.
To repeat the same test restart with step 2.

Variations in the manual procedure

1a, 4a, 9a Test of 2 or 3 registers at the same time

1a The 2 or 3 required register tests must be defined in the setup (1a).
Note: If active and reactive energy registers are tested at the same time, a suitable load point must be defined (PF ≠ 1) to get active and reactive energy dosage at the same time.

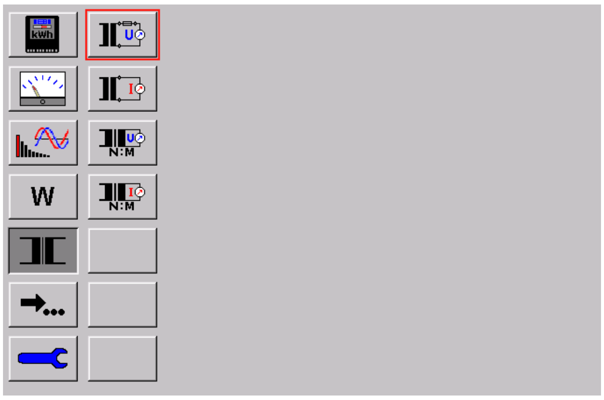
4a,9a During entry of start and end readings the input for all active registers is required one by one, before the next step is running.

4b, 9b **Change of start and end readings**

The start and end readings can be changed before, during and after the test.
This can be used to:

- Correct wrong entries
- Enter an expected end reading
  E.g. if the load cannot be controlled, a start reading a little bit higher than the actual reading of the meter register can be entered, and the register test can be started by starting the energy measurement, if this reading is reached at the meter under test. Then an end reading can be entered and the test can be stopped by stopping the energy measurement, if the end reading is reached at the meter under test. In this way no load control is necessary. This method could be applied for onsite tests with customer load, which cannot be influenced.
- Test several registers of different meters one by one by entering the corresponding register readings.

8.6 Instrument Transformer Testing




PT burden measurement


CT burden measurement


PT ratio measurement (function only available if VoltLiteWire 40 kV sensor is detected)


CT ratio measurement (function only available if at least one clamp-on CT is detected)

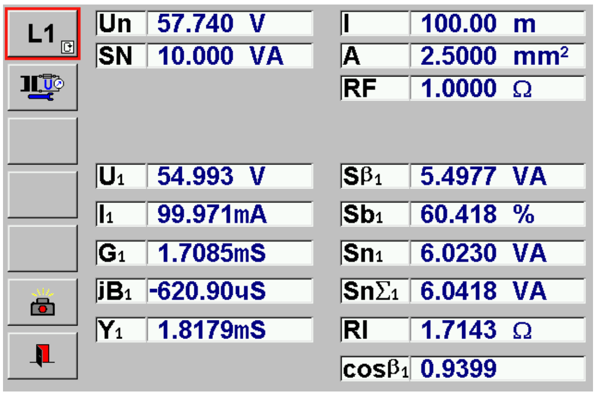
8.6.1 Potential Transformer (PT) burden measurement

The rated secondary voltage (Un) and rated burden (SN) of the potential instrument transformer (PT) must be entered. These values can normally be found on the nameplate of the transformer.
Optionally the influence of the wires between secondary side of the transformer and the measuring point can be regarded by entering resistance of fuse and junctions (RF), length (l) and cross section (A) of the wire.
The instrument measures the burden current (I), the actual secondary voltage (U) and the burden factor (cos).
As main result the ratio (Sb) of total rated operating burden (SnΣ) to rated burden (SN) is calculated and indicated in %.
Regarding the international standard IEC 60044-2 the Sb value should be in the range:

$$25\,\%\ SN \le Sb \le 100\,\%\ SN$$

After the exchange of a mechanical meter with an electronic meter in a substation the burden of the voltage measurement transformer is often too low and measures must be taken to raise the burden to be in the admissible range again.

For the necessary connections between transformer and instrument see the connection example in chapter [17.2.10].



PT burden measurement menu

The measurement starts immediately and is continuously running with the actual parameter settings shown in the upper part of the display. The measured and calculated results are updated in the interval of the time base.

L1 — Assign results to phase L1, L2 or L3 (Test phase by phase with U1, I1)

Settings for PT burden measurement

Call **storage of test results** menu [10].

Exit, back to calling menu

Indications / settings

Parameter settings

Un 57.740 V SN 10.000 VA	**Voltage transformer parameters** Rated secondary voltage (UN) and rated burden (SN) of voltage transformer
I 100.00 m A 2.5000 mm² RF 1.0000 Ω	**Influence parameters** (optional) Parameters to regard the influence of the length (l) and cross section (A) of the wire and of junctions and fuses (RF) between test point and transformer secondary side on the total burden.

Results

U1 54.993 V I1 99.971mA	**Secondary voltage:** The actual measured secondary voltage of the voltage transformer **Burden current:** The actual measured current into the burden of the voltage transformer
Sβ1 5.4977 VA	**Measured burden** The real burden with actual load condition. This value cannot be directly compared to the rated nominal burden (SN). Therefore, this value has not high importance.

Measured burden
$S\beta 1 = U1 \cdot I1$

Sb1 60.418 %

Operating burden ratio

The ratio between calculated total rated operating burden to the entered rated burden is indicated in %.

The value should be in the range: **25 % SN ≤ Sb ≤ 100 % SN**

If the value is not in the admissible range measures can be taken on site to adjust the burden and the effect can immediately be checked.

Operating burden ratio in %
$Sb = \frac{Sn\Sigma}{SN} \cdot 100 [\%]$

cosβ1 0.9399

Burden factor

Ratio of real part (G) to admittance (Y). The value is calculated based on the measured values U and I.

Burden factor	Phase angle of burden
$\cos\beta = \frac{G}{Y}$	$\beta = \cos^{-1}\left(\frac{G}{Y}\right) = \tan^{-1}\left(\frac{B}{G}\right)$

Sn1 6.0230 VA

Rated operating burden

Burden related to the rated voltage, calculated with the measured admittance (Y) and the entered rated voltage (UN). This value can directly be compared with the rated burden specified by the manufacturer (SN). Because the calculation of SN is based on the admittance (Y), the measurement is independent of the actual secondary voltage (U). The secondary voltage (U) can be different from the rated value (UN). The result remains the same.

Rated operating burden
$Sn = UN^2 \cdot Y = UN^2 \cdot \frac{I}{U}$

SnΣ1 6.0418 VA

Rl 1.7143 Ω

Total rated operating burden

Resistance of wire, fuse and junctions

Burden related to the rated voltage with regard of voltage drops between secondary connections of the voltage transformer and the measuring point of the secondary voltage (U).

The voltage drop is calculated with the optional entries for length (l) of wire from measuring point to transformer and back and cross section (A) of the wire. The entered value RF for fuse and junctions will be regarded additionally.

Total rated burden	Resistance of wire, fuse and junctions
$Sn\Sigma = UN^2 \cdot \left(Y + \frac{1}{Rl}\right)$	$Rl = \rho \cdot \frac{l}{A} + RF$

If RF, A and l are zero: SnΣ = Sn

G1 1.7085mS

jB1 -620.90uS

Y1 1.8179mS

Conductance (real part of Y)

Susceptance (imaginary part of Y)

Admittance Y

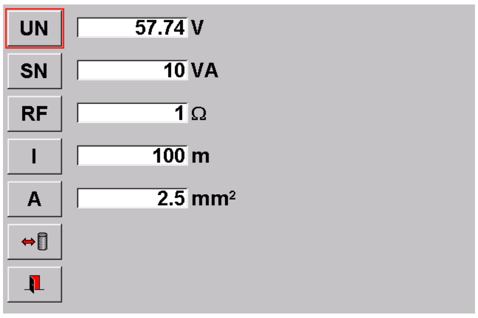
The admittance (Y) and its real part (G) and imaginary part (jB) are calculated based on the measured values U and I.

Admittance	Complex Admittance
$Y = \frac{I}{U} = \sqrt{G^2 + B^2}$	$\overline{Y} = \frac{\dot{I}}{\underline{U}} = G + jB$

L1 L2 L3	**Assign results to phase L1, L2, L3**

Select L1, L2, L3 to assign the measured results (U1, I1) to the corresponding phase (cyclical mode).
The calculated results are indicated with the index of the selected phase. This function can be used to test a 3-phase meter phase by phase and save the results.

	Parameter settings for PT burden measurement



To perform the measurement, the nominal values of the potential transformer (PT) must be entered:

UN	Rated secondary voltage in **V**
SN	Rated burden in **VA**

This information can be found on the name plate or the calibration certificate of the transformer.

	Load/save settings
	Exit, back to calling menu

If the voltage cannot be measured directly at the secondary side of the voltage transformer, the influence of the wires between measuring point and transformer and the influence of fuses and junctions to the total burden can be regarded by entering values at l, A and RF. The entries are regarded for the calculation of **Rl** and **SnΣ**.

The entries l, A and RF are optional and should be set to zero, if not used.

RF	Resistance of fuses and junctions between measuring point and transformer in Ω.
l	Total length of conductor from measuring point to voltage transformer and back to measuring point in **m**.
A	Cross section of conductor between measuring point and voltage transformer in **mm²**.

Resistivity of copper (ρ)	Resistance Rl
$\rho = 17.857\left[\frac{m\Omega \cdot mm^2}{m}\right]$	$Rl = \rho \cdot \frac{l}{A} + RF$

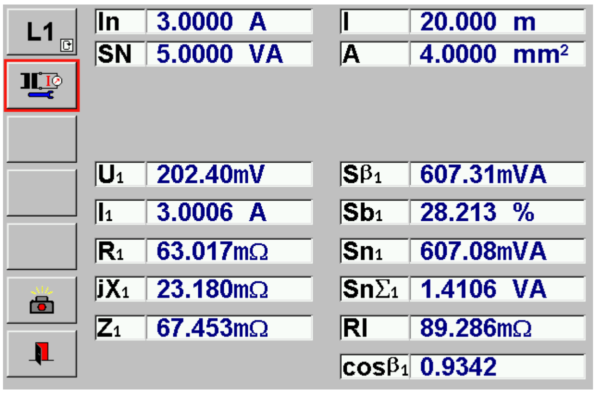
8.6.2 Current Transformer (CT) burden measurement

The rated secondary current (IN) and rated burden (SN) of the current instrument transformer must be entered.
Optionally the influence of the wires between secondary side of the transformer and the measuring point can be regarded by entering length (l) and cross section (A) of the wire.
The instrument measures the actual secondary current (I), the burden voltage (U) and the burden factor (cos).
As main result the ratio (Sb) of total rated operating burden (SnΣ) to rated burden (SN) is calculated and indicated in %.
Regarding the international standard IEC 60044-1 the Sb value should be in the range:

25 % SN ≤ Sb ≤ 100 % SN

After the exchange of a mechanical meter with an electronic meter in a substation the burden of the current measurement transformer is often too low and measures must be taken to raise the burden to be in the admissible range again.

For the necessary connections between transformer and instrument see the connection example in chapter [17.2.11].



CT burden measurement

The measurement starts immediately and is continuously running with the actual parameter settings shown in the upper part of the display. The measured and calculated results are updated in the interval of the time base.

- Assign results to phase L1, L2 or L3 (Test phase by phase with U1, I1)
- Settings for CT burden measurement
- Call **storage of test results** menu [10].
- Exit, back to calling menu

Indications / settings

Parameter settings

In 3.0000 A
SN 5.0000 VA

Current transformer parameters
Rated secondary current (IN) and rated burden (SN) of current transformer

l 20.000 m
A 4.0000 mm²

Influence parameters (optional)
Parameters to regard the influence of the length (l) and cross section (A) of the wire between test point and transformer secondary side on the total burden.

Results

U1 202.40mV

I1 3.0006 A

Burden voltage: The actual measured burden voltage of the current transformer.
Secondary current: The actual measured secondary current of the current transformer.

Sβ1 607.31mVA

Measured burden
The real burden with actual load condition. This value cannot be directly compared to the rated nominal burden (SN). Therefore, this value has not high importance.

Measured burden
$S\beta 1 = U1 \cdot I1$

Sb1 28.213 %

Operating burden ratio

The ratio between calculated total rated operating burden to the entered rated burden is indicated in %.

The value should be in the range: **25 % SN ≤ Sb ≤ 100 % SN**

If the value is not in the admissible range measures can be taken on site to adjust the burden and the effect can immediately be checked.

Operating burden ratio in %
$Sb = \frac{Sn\Sigma}{SN} \cdot 100\,[\%]$

$\cos\beta_1$	0.9342	**Burden factor** Ratio of real part (R) to impedance (Z). The value is calculated based on the measured values U and I.

Burden factor	Phase angle of burden
$\cos\beta = \frac{R}{Z}$	$\beta = \cos^{-1}\left(\frac{R}{Z}\right) = \tan^{-1}\left(\frac{X}{R}\right)$

Sn_1	607.08mVA	**Rated operating burden** Burden related to the rated current, calculated with the measured impedance (Z) and the entered rated current (IN). This value can directly be compared with the rated burden specified by the manufacturer (SN). Because the calculation of SN is based on the impedance (Z), the measurement is independent of the actual secondary current (I). The secondary current (I) can be different from the rated value (IN). The result remains the same.

Rated operating burden
$Sn = IN^2 \cdot Z = IN^2 \cdot \frac{U}{I}$

$Sn\Sigma_1$	1.4106 VA	**Total rated operating burden**
Rl	89.286mΩ	**Resistance of wire and junctions**

Burden related to the rated current with regard of voltage drops between secondary connections of the current transformer and the measuring point of the burden voltage (U).

The voltage drop is calculated with the optional entries for length (l) of wire from measuring point to transformer and back and cross section (A) of the wire.

Total rated operating burden	Resistance of wire
$Sn\Sigma = IN^2 \cdot (Z + Rl)$	$Rl = \rho \cdot \frac{l}{A}$

If A and l are zero: SnΣ = Sn

R_1	63.017mΩ	**Resistance (real part of Z)**
jX_1	23.180mΩ	**Reactance (imaginary part of Z)**
Z_1	67.453mΩ	**Impedance Z**

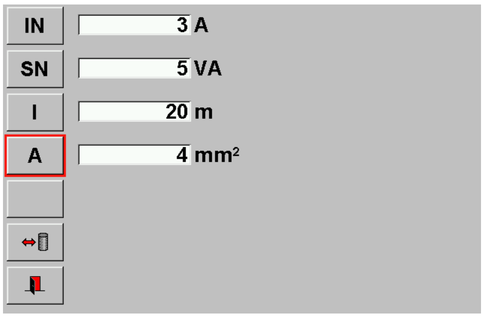
The impedance (Z) and its real part (R) and imaginary part (jX) are calculated based on the measured values U and I.

Impedance	Complex Impedance
$Z = \frac{U}{I} = \sqrt{R^2 + X^2}$	$\overline{Z} = \frac{\overline{U}}{I} = R + jX$

L1 L2 L3	**Assign results to phase L1, L2, L3**

Select L1, L2, L3 to assign the measured results (U1, I1) to the corresponding phase (cyclical mode).
The calculated results are indicated with the index of the selected phase. This function can be used to test a 3 phase meter phase by phase and save the results.

Parameter settings for burden measurement I



To perform the measurement, the nominal values of the current transformer (CT) must be entered:

- **IN** Rated secondary current in **A**
- **SN** Rated burden in **VA**

This information can be found on the name plate or the calibration certificate of the transformer.

- Load/save settings
- Exit, back to calling menu

If the burden voltage cannot be measured directly at the secondary side of the current transformer, the influence of the wires between measuring point and transformer and the influence of junctions to the total burden can be regarded by entering values at I, A. The entries are regarded for the calculation of **Rl** and **SnΣ**.

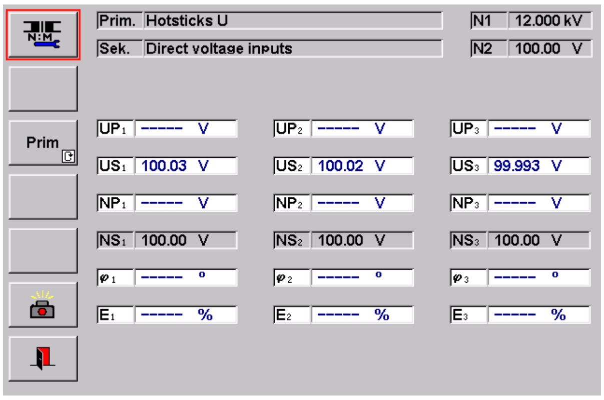
The entries I, A are optional and should be set to zero, if not used.

- **I** Total length of conductor from measuring point to current transformer and back to measuring point in **m**.
- **A** Cross section of conductor between measuring point and current transformer in **mm²**.

Resistivity of copper (ρ)	Resistance Rl
$\rho = 17.857 \left[\frac{m\Omega \cdot mm^2}{m}\right]$	$Rl = \rho \cdot \frac{l}{A}$

8.6.3 Voltage transformer (PT) ratio measurement

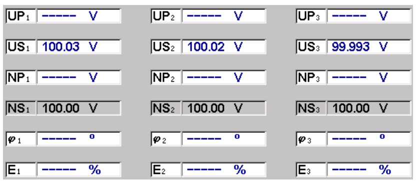
Voltage transformer ratio



Reference for voltage ratio calculation

- **Prim** / **Sec** Definition of the reference **NP** or **NS.**

Display of measured primary and secondary values
φ Phase angle in °
Error E of the measured ratio / nominal ratio in %.



Display of results

- Measured primary voltage **UP** and secondary voltage **US**.
- Calculated nominal values **NP** or **NS** based on ratio **UPrim/USec**, depending on the value that is defined as reference.
- **φ** Phase angle in °
- Error E of the measured ratio / nominal ratio in %

The results are updated in the interval of the time base T (e.g. 1s).

Nominal ratio

$r_n = NP_n/NS_n$

Measured ratio

$r = IP/IS = NP/NS$

Ratio error

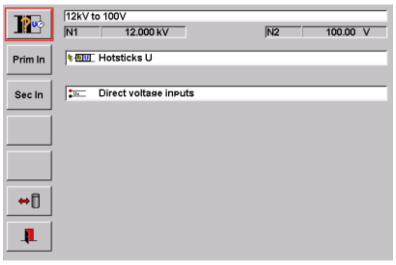
$E = [r/r_n - 1]*100$ [%]

Input of nominal ratio

To calculate the ratio error **E** the specified ratio of the transformers must be defined. This is done by input of primary nominal value **NP** and secondary nominal value **NS** or **nominal ratio** at **NP** with **NS = 1.**

The fields of the **reference** are grey marked and will be the base value for the calculation of NP or NS in the results display section.

Reference for voltage ratio calculation

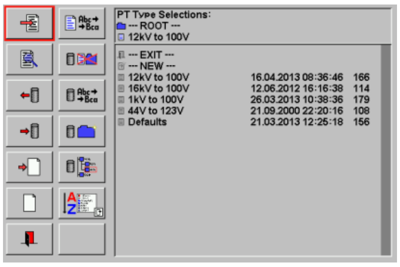


Select / Edit Voltage transformer data

Prim In — Settings for primary and secondary voltage inputs

Sec In

Voltage Transformer selection



Database PT Type

Taking an existing dataset from the directory.

Editing a PT type data set.

Prim In — Primary voltage measurement input

The definition is common for all three phases and must be different for primary and secondary input, otherwise the measurement is not started.

Definition of primary voltage input

Select the measurement mode, direct voltage input or Hotstick U, for the primary voltage **Up,** of the **primary input** on the voltage transformer.

Sec In — Secondary voltage measurement input

Definition of secondary current input

Select the measurement mode, direct voltage input or Hotstick U, for the primary voltage **Us,** of the **secondary input** on the voltage transformer.

Load/save settings from/to directory

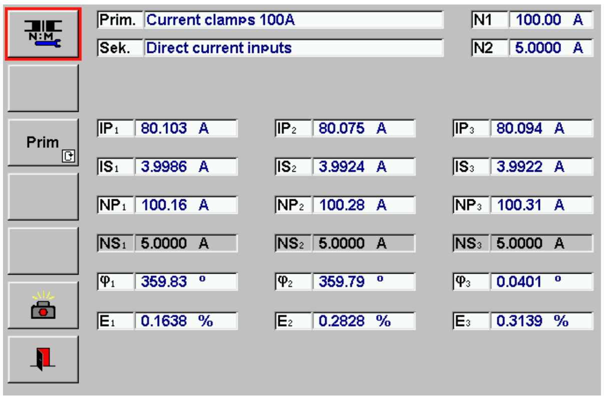
Exit, back to calling menu

	Call **storage of test results** menu [10].
	Exit, back to calling menu

8.6.4 Current transformer (CT) ratio measurement

This function is used to measure the transformer ratio of current transformers. Three current transformers can be measured at the same time, because the reference meter has six current input channels. The kind of current measurement, direct or with clamp-on current transformers, can be selected for primary and secondary input. Both primary and secondary current can be measured with current clamps. This makes it possible to test instrument transformers during normal measuring equipment operation without any shutdowns or safety disconnections.

	Current transformer ratio



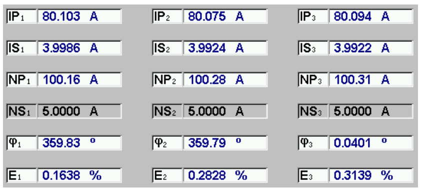
Reference for current ratio calculation

Definition of the reference

Display of measured primary and secondary values

φ Phase angle in °

Error Ex of the measured ratio / nominal ratio in %



Display of results

- Measured primary current **IP** and secondary current **IS**.
- Calculated nominal values **NP** or **NS** based on ratio **IPrim/ISec**, depending on the value that is defined as reference.
- **φ** Phase angle in °
- Error E of the measured ratio / nominal ratio in %

The results are updated in the interval of the time base T (e.g. 1s).

Input of nominal ratio

To calculate the ratio error **E** the specified ratio of the transformers must be defined. This is done by input of primary nominal value **NP** and secondary nominal value **NS** or **nominal ratio** at **NP** with **NS = 1.**

The fields of the **reference** are grey marked and will be the base value for the calculation of NP or NS in the results display section.

Nominal ratio

$r_n = NP_n/NS_n$

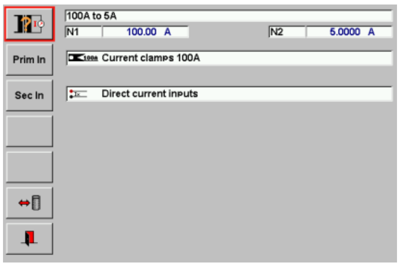
Measured ratio

r = IP/IS = NP/NS

Ratio error

$E = [r/r_n - 1]*100$ [%]

Reference for current ratio calculation

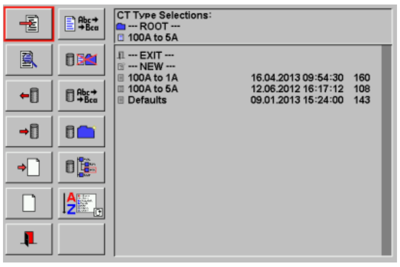


Select / Edit current transformer data

Prim In
Sec In

Settings for primary and secondary current inputs

Current Transformer selection



Database current transformer Type
Taking an existing dataset from the directory CT Type.

- Editing a CT type data set.

Prim In Primary current measurement input

The definition is common for all three phases and must be different for primary and secondary input, otherwise the measurement is not started.

Definition of primary current input
Select the measurement mode, direct current input or current clamps input, for the primary current **Ip,** of the **primary input** on the current transformers**.**

Sec In Secondary current measurement input

Definition of secondary current input
Select the measurement mode, direct current input or current clamps input, for the secondary current **Is,** of the **secondary input** on the current transformers.

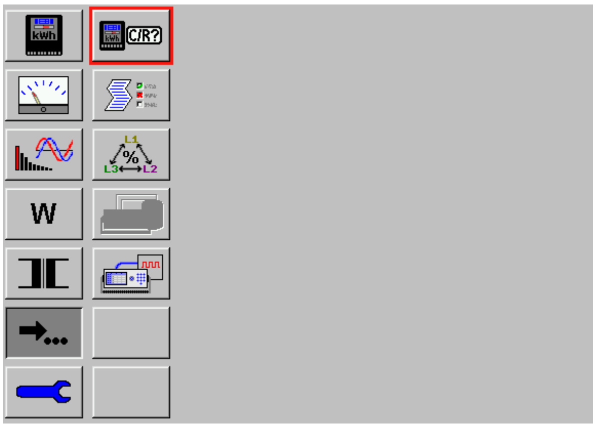
Load/save settings from/to directory

Exit, back to calling menu

Call **storage of test results** menu [10].

Exit, back to calling menu

8.7 Special functions



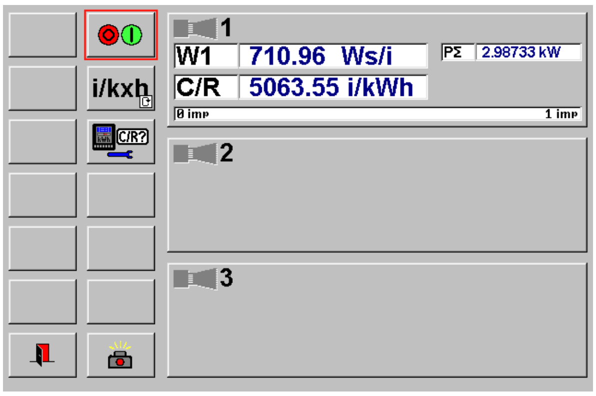
Special functions menu

- Measurement of meter constant [8.7.1]
- Attributive Test [8.7.2]
- Self-test [8.7.3]
- URef test (option) [8.7.4]
- fRef test [8.7.5]

8.7.1 Measurement of impulse constant

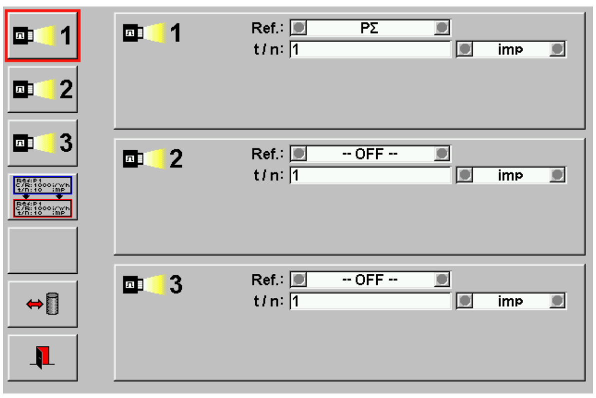
A predefined number of impulses (1 up to n) of a scanning head, hand switch or other impulse source is counted at the impulse input and compared with the energy measured by the internal reference standard from start impulse to impulse n. This reference energy is divided by the tested number of impulses to calculate the approximate impulse constant of the impulse source.

This function helps to find the correct meter constant for the error measurement, if the constant is not clearly indicated on the device under test (e.g. when testing transformer operated meters, where only the primary constant is indicated, but no CT and/or PT ratio or additional factors must be regarded or when testing reference standards, where the specification for the impulse output is missing).



Measurement of impulse constant
The function works in the same way as the error measurement (see also [8.2]).

- Start / Stop measurement
- i/kxh Change unit of constant (i/kxh, i/xh, i/xs, kxh/i, xh/i xs/i with x = W, var, VA)
- Call parameter setup menu
- Call storage and printout menu [10]
- Exit, back to calling menu



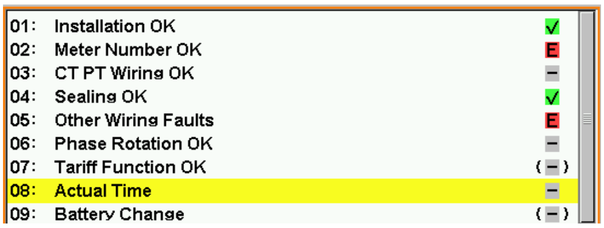
Parameters for measurement of impulse constant
Reference power (Ref.) and number of impulses to test (t/n) can be defined in the same manner as at error measurement (see also [8.2.2])

- Copy parameters from input x to input y
- Load/save settings from/to directory
- Exit, back to calling menu

8.7.2 Attributive Test

- Edit attributive test results
- Reset attributive test results
- Create / Edit attributes [8.7.2.1]
- Call storage menu [10]
- Exit, back to calling menu

Edit attributive test results

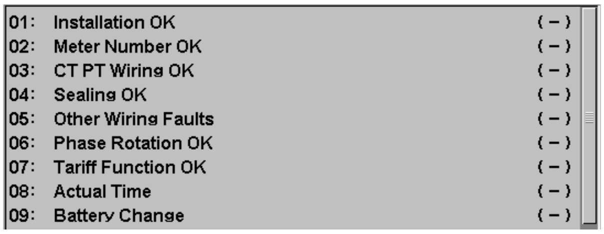


Results of attributive tests can be checked with following markings by touching the corresponding line (cyclical mode):

- √ Good
- E Bad
- – No check

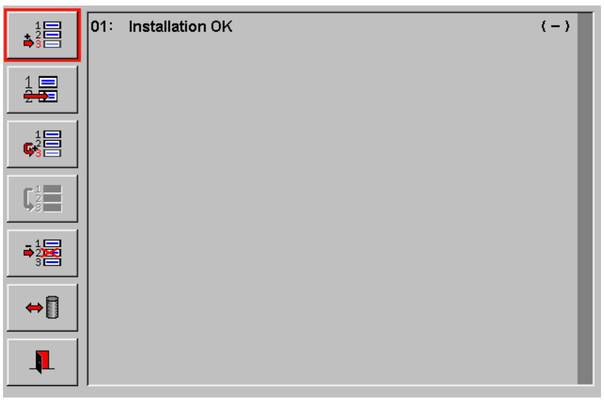
Save test results

Reset attributive test results



Reset all attributive test results to default value.

8.7.2.1 Create / Edit attributes



- Add attribute
- Edit attribute
- Copy attribute
- Move attribute
- Delete attribute
- Load/save settings from/to directory
- Exit, back to calling menu

Add attribute

Add attribute menu

Create/Edit attribute name

Edit attribute type (check or text)

Enter default value for attribute

Exit, back to calling menu

Create/Edit attribute name

Edit attribute type (cyclical mode)

Attribute type defined as check entry.

Attribute type defined as text entry.

Enter default value for attribute (cyclical mode)

A default value for the attribute can be defined among following selection:

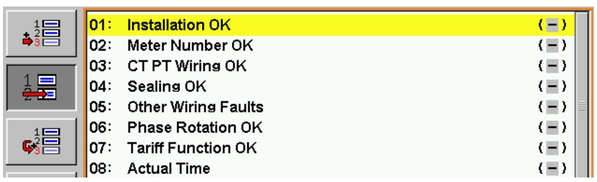
No check

Good result

Bad result

Empty or predefined text field (only available if attribute type is defined as text entry)

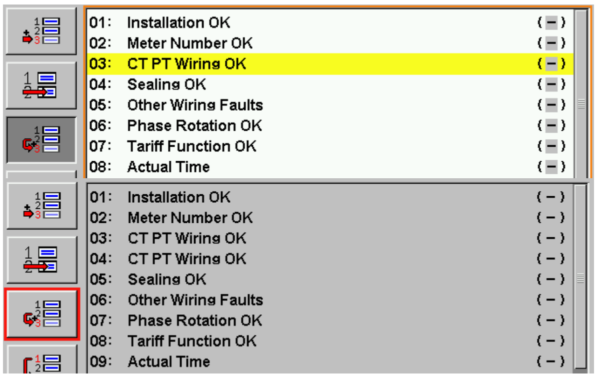
Edit attribute



Select the attribute to be edited by pressing on corresponding entry.

Further steps are analog to above procedure "Add attribute".

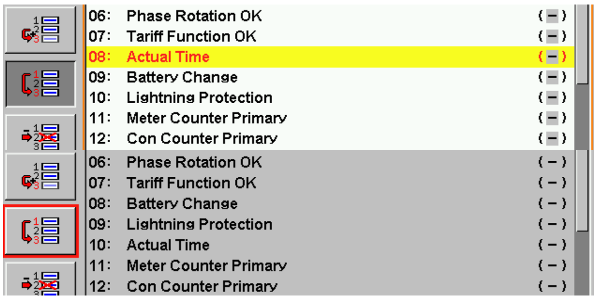
Copy attribute



Select the attribute to be copied by pressing on corresponding entry.

Attribute will be copied to next line adjacent to original entry.
All further entries are moved one step down.

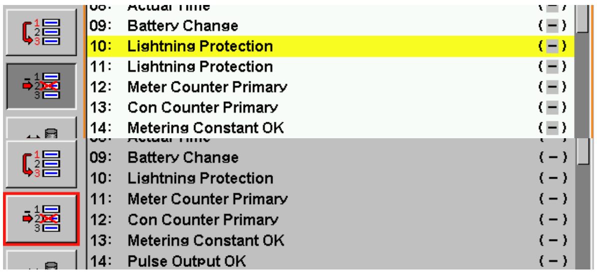
Move attribute



Select the attribute to be moved by pressing on corresponding entry.
Then press on desired position where the attribute needs to be moved to.

Attribute has been moved from position 8 to position 10.

Delete attribute

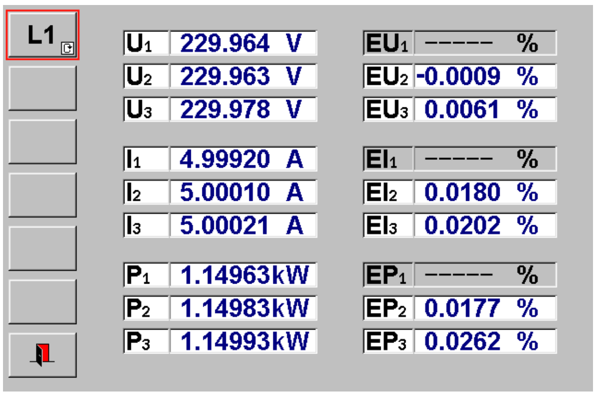


Select the attribute to be deleted by pressing on corresponding entry.

Attribute has been deleted and all further entries are moved one step up.

8.7.3 Self-test

Before start of the test connect the same voltage to all voltage inputs U1, U2, U3 and the same current in series through all current inputs I1, I2, I3.

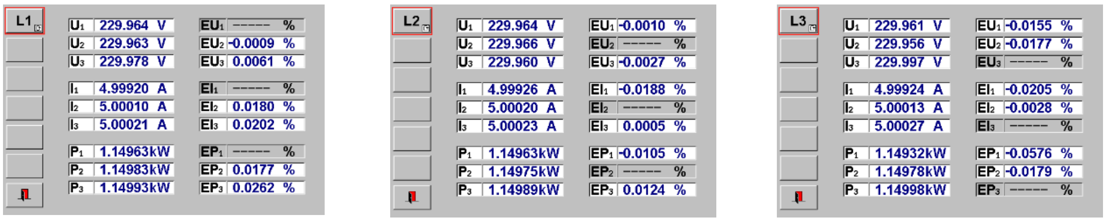


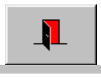
The self-test will measure the values of voltage U and current I at the sockets and show the results of voltage U, current I and active power P. The phase indicated on the FB is the reference phase.
The deviation between phases and reference will be shown:

- EU (error U in %)
- EI (error I in %)
- EP (error P in %)

Reference phase selection

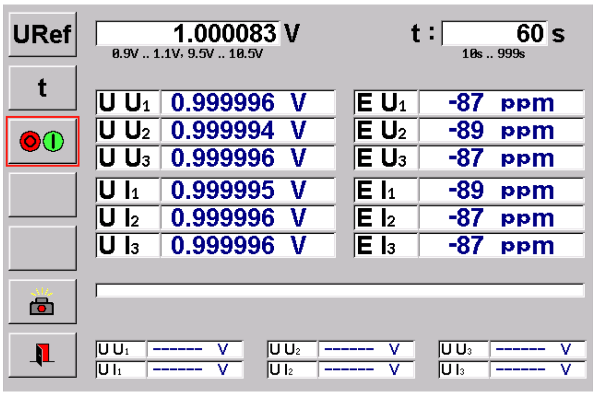
Toggle mode for reference phase selection

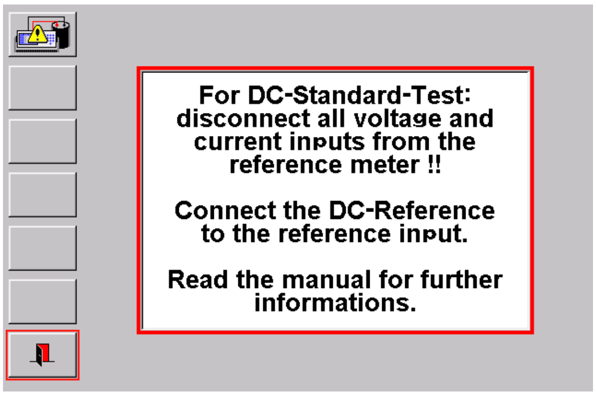




Exit, back to calling menu

8.7.4 URef test (option)





Verification against URef

The stability of the built-in DC-reference voltages and of the six Analog Digital Converter (ADC) channels can be verified by this test.

Two types of DC-standards can be connected to the PRS 600.3.

1V Range: 0.9 V ... 1.1 V

10V Range: 9.5 V ... 10.5 V

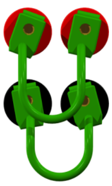
The output of a DC-voltage standard of either nominal 1V (0.9V … 1.1V) or 10V (9.5V … 10.5V) must be connected to the **NE** input, first with positive, then with negative polarity.

The time base changes to **t=URef test** and is synchronized to the internal self-calibration cycle of the ADC converters (approx. 4s).

1	Preparation

All cables connected to the voltage inputs U1, U2, U3 and current inputs I1, I2, I3 and all other cables, except the power supply cable must be removed before the connections for the URef test are made.
If the voltage and current inputs are not left open, the reference standard may be damaged.

The measuring set-up should be in accordance with the connection example shown in chapter [17].



Make short connections between red and black 2mm sockets at back of PRS 600.3.

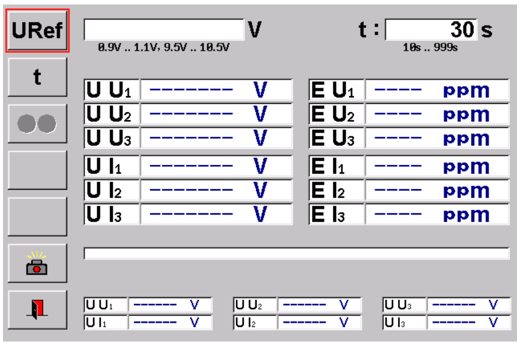
Use adapter cable supplied:

Yellow connector -> **Uout**
Black connector -> **COM**

Connect DC - Voltage Standard 1V or 10V for positive URef test to input **NE**.

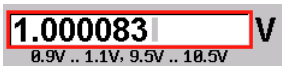
The outputs of the DC-voltage standard may have names other than Uout and COM. In this case consult the manufacturer’s DC-Voltage Standard user manual for connection instructions.

2		Start URef test (Weston element or NE-test)



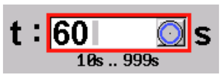
The display appears without results the first time after first start of test.

3	URef	Input of reference voltage URef

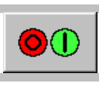


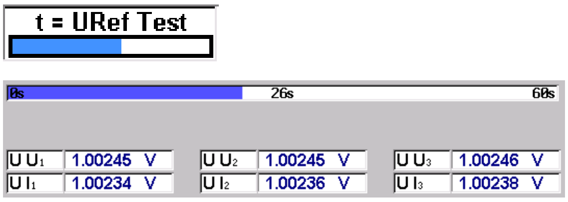
The nominal value or the value measured with a high precision DVM or the value in a calibration certificate of the DC-Voltage Standard must be entered at **URef**.

4	t	Input of duration of test



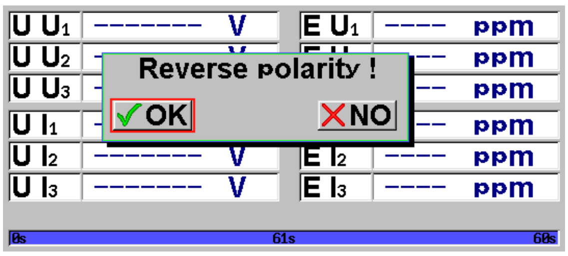
The measuring time must be in the range:
10 s ... 999 s

5		Start test with positive URef voltage (Weston element test)



Test with positive URef voltage is running.

The bar graph indicates the progress of the measurement.
The 6 measured positive voltages for U1, U2, U3, I1, I2, I3 are displayed.



Test with positive URef voltage is finished.
Warning to reverse polarity of DC - voltage standard appears.

OK: Start URef test with negative voltage
NO: Cancel URef test

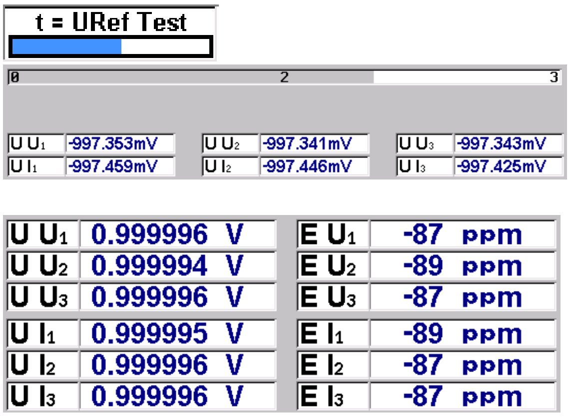
6	Reverse polarity

Connect DC - voltage standard for negative URef test to **NE**-input.

Yellow connector -> **COM**
Black connector -> **Uout**

or use the polarity switch of the DC - voltage standard if available.

7	√ OK	Start test with negativ URef voltage

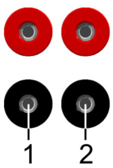


Test with negative URef voltage is running.

The bar graph indicates the progress of the measurement.
The 6 measured negative voltages for U1, U2, U3, I1, I2, and I3 are displayed.

The measured values of the 6 internal ADC - channels for U1, U2, U3, I1, I2, and I3 are displayed together with the calculated deviation from the entered value of URef in ppm.

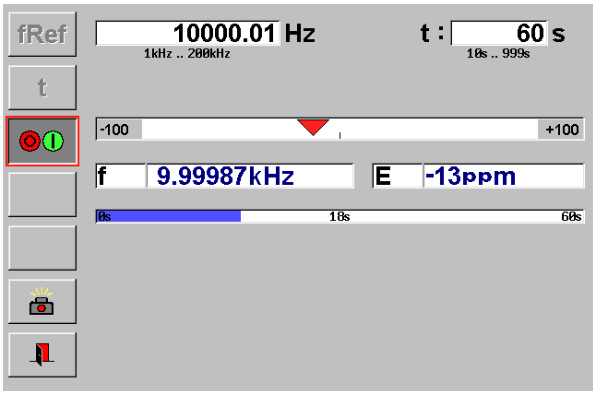
8		Call storage of test results menu
9		Exit, back to calling menu
10	Remove test circuits	



Disconnect DC - Voltage Standard from input NE

Remove short circuit connections between red and black 2mm sockets at back of PRS 600.3.

8.7.5 fRef test



Verification against fRef

The stability of the built-in time base can be verified by this test.

The output of a frequency standard must be connected to the impulse input 1.

Enter the exact test frequency value fRef and the test time t.

Frequency range: 1 kHz … 200 kHz

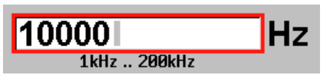
The measurement runs continuously. A bar graph indicates the progress of the measurement.

The deviation of the internal time base is indicated in ppm in graphical form and as a numerical value.

1	**Preparation**	

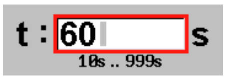
Disconnect all accessories and cables, except the power supply cable. Connect the output of the frequency standard with the impulse input 1. Any instructions given in the user manual of the Frequency standard should be followed.

2	**fRef**	Input of reference frequency



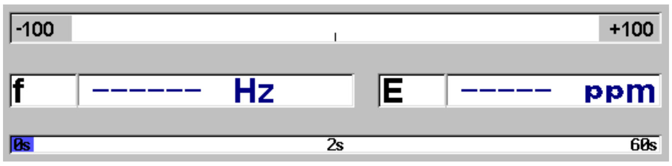
The frequency must be in the range:
1 kHz … 200 kHz

3	**t**	Input of duration of test

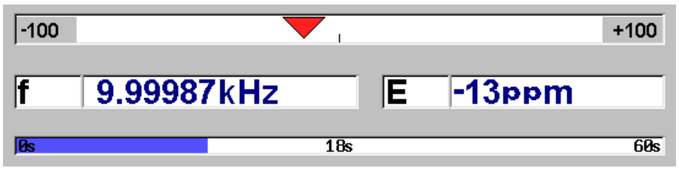


The measuring time must be in the range:
10 s ... 999 s

4		Start fRef test



Test starts



After the test duration, the deviation of the internal time base is indicated in ppm in graphical form and as a numerical value.

The measurement runs continuously.

5		Stop fRef test
6		Save test results
7		Exit, back to calling menu

9. Sequence Automatic test run with portable test system

Sequence menu card
The sequence menu allows to define test sequences for the two functions:

- Error measurement and
- Energy measurement (register test)

and to run them automatic or step by step on a portable test system.

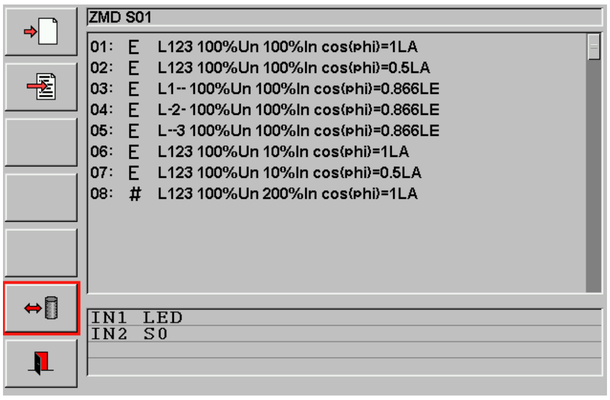
Note: The test sequence function can only be used for Portable Test Systems with both Reference Standard and Power Source integrated and active.

Indications / settings

	Run automatic or step by step test [9.2]

	Create / edit test sequence [9.1]

9.1 Create / edit test sequence



Basic menu
The three grey display areas shown top down:

- File name of actual test sequence
- Steps of actual test sequence
- Comment

At the first call all fields are empty.
Following functions can be executed in this menu:

Reset and edit test sequence

Edit actual test sequence

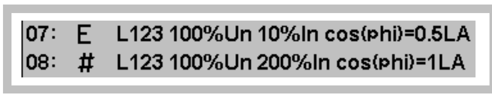
Load / save test sequence

Exit, back to calling menu

Indications / settings

	Call **test sequence editor** menu [9.1.1]

	Load / save test sequence from / to directory **Check Sequence Selections** [4.4]



Test step list

The test steps are numbered in the sequence they are executed.

Type

E Error measurement
Energy measurement (register test)

Test step name

The automatically generated name indicates the active current phases and the load point settings of the test step.

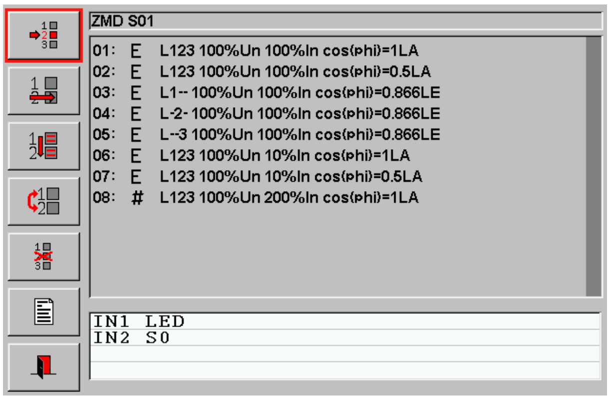
Voltage, current and phase angle settings

L--- 0 V 0 A φ = 0°	Test step with fixed settings for UIφ (empty step)
L123 100 %Un 200 %In cosφ = 1L	Percentage settings in relation to nominal values Un, In of meter type, phase angle defined with power factor

Activated current phases

L---	No phase active (empty step)
L123	All phases 1, 2, 3 active
L-2-	Only phase 2 active

9.1.1 Editor functions



Test sequence editor menu

The right side of the display looks like the basic menu [9.1], only the FB's on the left side are changed and the following functions are available:

- Insert new step
- Edit step
- Copy step
- Move step
- Delete step
- Enter comment
- Exit, back to basic menu

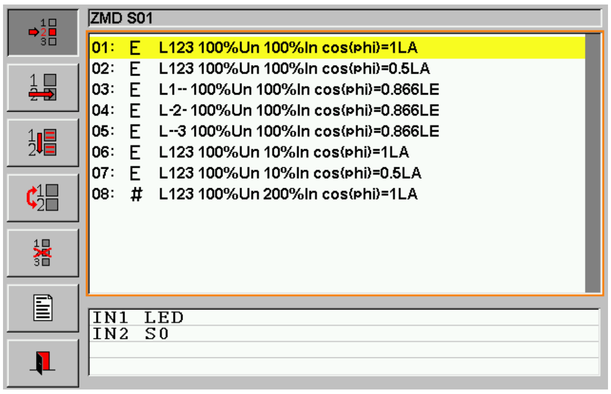
Indications / settings

Enter comment

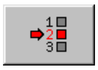
Comment menu
Any comment related to the test sequence can be entered. with the virtual or external keyboard

Basic editor functions

Common functions for the listed FB's (example shown for insert new step):



Activate function
Activate FB by pressing on it. The FB is shown depressed. A red frame surrounds the test step window and a yellow selection line is shown on position 1.



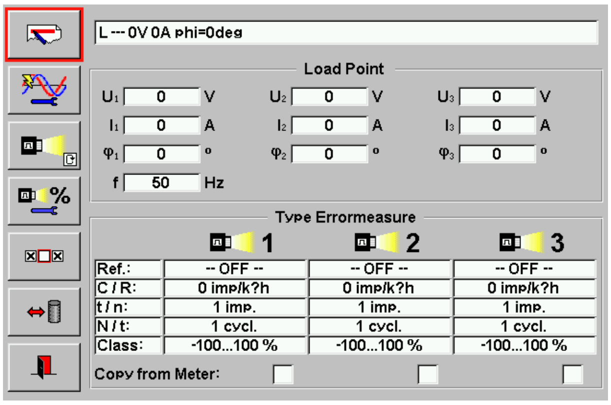
Cancel function
Press somewhere outside of the listing field to cancel the function. The FB is shown normal again.

Note: Move the yellow line with the cursor keys of an external keyboard up to the the first or down to the last step to cancel the function.

Insert new step

06: E L123 100 %Un 10 %In cosφ = 1L
07: E L123 100 %Un 10 %In cosφ = 0.5L
08: # L123 100 %Un 200 %In cosφ = 1L

Activate insert
Press on demanded step to call the editor.



Test step definition menu [9.1.2]
Select and define:

1		Type error **or**
		Type countertest **or**
		Type markposition
2		Load point setup [9.1.3]
3		Error setup [9.1.4] or
		Energy easurement setup [9.1.5] or
		Markposition setup
4		Copy from meter (optional)
5		Exit, back to editor menu

Alternative:

1		Load test point from database
5		Exit, back to editor menu

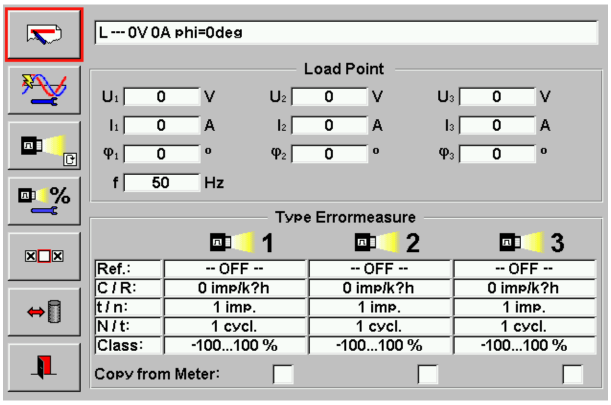
06: E L123 100 %Un 10 %In cosφ = 1L
07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L--- 0 V 0 A φ = 0°
09: # L123 100 %Un 200 %In cosφ = 1L

New step inserted
The new test step is inserted at the selected position (08). The old step at this position and all following steps are shifted +1.

Edit step

07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L--- 0 V 0 A φ = 0°
09: # L123 100 %Un 200 %In cosφ = 1L

Activate edit
Press on demanded step to call the editor.



Test step definition menu [9.1.2]
Change settings and name as desired.

Exit, back to editor menu and **terminate edit** function.

Copy step

06: E L123 100 %Un 10 %In cosφ = 1L
07: E L123 100 %Un 10 %In cosφ = 0.5L
08: # L123 100 %Un 200 %In cosφ = 1L

Activate copy
Press on demanded step to be copied.

06: E L123 100 %Un 10 %In cosφ = 1L
07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L123 100 %Un 10 %In cosφ = 0.5L
09: # L123 100 %Un 200 %In cosφ = 1L

Step copied
The selected step (07) is copied to position +1 (08). All following steps are shifted +1.

Move step

07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L123 100 %Un 10 %In cosφ = 0.5L
09: # L123 100 %Un 200 %In cosφ = 1L

Mark source position
Press on demanded step to be moved. The test step is marked red.

07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L123 100 %Un 10 %In cosφ = 0.5L
09: # L123 100 %Un 200 %In cosφ = 1L

07: E L123 100 %Un 10 %In cosφ = 0.5L
08: # L123 100 %Un 200 %In cosφ = 1L
09: E L123 100 %Un 10 %In cosφ = 0.5L

Move position
Press on target position to move the marked test step. It will be inserted at the target position and the other steps will be moved accordingly.

Delete step

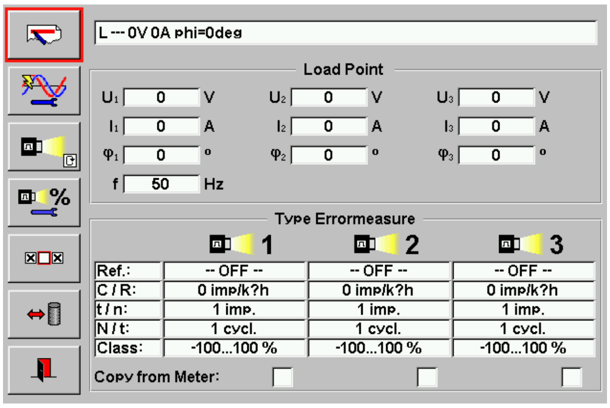
07: E L123 100 %Un 10 %In cosφ = 0.5L
08: E L--- 0 V 0 A φ = 0°
09: # L123 100 %Un 200 %In cosφ = 1L

Delete step
Press on demanded step to be deleted.

07: E L123 100 %Un 10 %In cosφ = 0.5L
08: # L123 100 %Un 200 %In cosφ = 1L

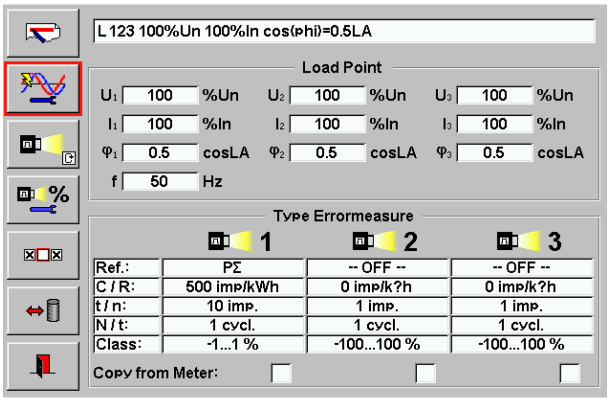
Step deleted
The following positions are shifted -1.

9.1.2 Test step definition



Test step definition menu - new step
The test step name, the load point settings, the error measurement parameters and the status of the copy from meter check boxes are shown.
Functions independent of test step type:

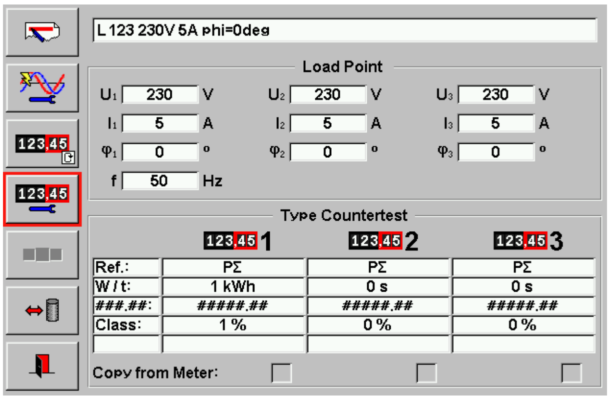
- Test step name
- Load point setup
- Set copy from meter flag
- Load/Save from/to database
- Exit, back to basic menu



Test step definition menu - Type Error
Functions and indications related to type error:

- Test step type - Error
- Error measurement setup

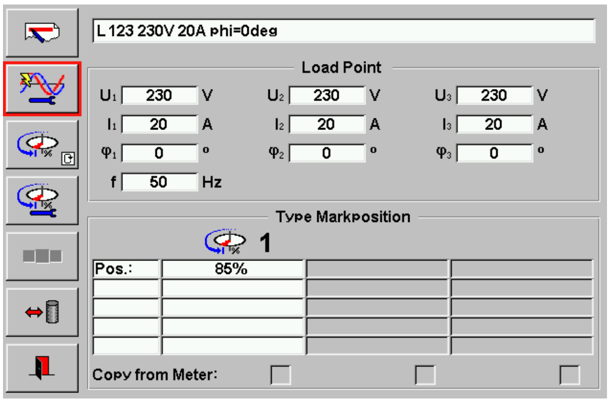
Type Error
In the lower part of the display the error measurement parameters are shown
Load Point
The load point parameters shown are defined in the form percentage of meter nominal values (%Un, %In) and the phase information as power factor (cosLA). In this form the test step can be used for different meter types with varying Un, In values. Applicable for all types.



Test step definition menu - Type Energy
Functions and indications related to type energy:

- Test step type - Energy
- Energy measurement setup

Type Energy
In the lower part of the display the energy measurement parameters are shown.
Load Point
The load point parameters shown are defined with fixed settings for voltage, current and phase angle with units V, A, Applicable for all types.



Test step definition menu - Type Mark Positioning
Functions and indications related to type mark positioning:

- Test step type – Mark positioning
- Mark positioning setup

Type Mark Positioning
In the lower part of the display the mark positioning parameter is shown.
Load Point
The load point parameters shown are defined with fixed settings for voltage, current and phase angle with units V, A, Applicable for all types.

Indications / settings

Test step name

The system automatically generates a test step name based on the load point setup. The given name can be changed or any other name can be defined.

Load point setup

The file selection menu is called [6.1].

Load settings
Select and load object file with predefined settings from directory **Load Points Selection**.

Edit settings
The **load point setup** menu is called [9.1.3]
Settings can be entered completely new or loaded settings can be modified.

Test step type

Type Error
Error measurement with 1, 2 or 3 inputs, used to count the impulses from the same meter (e.g. LED kWh, LED kvarh and impulse output Wh/i) or different meters.

Type Energy
Energy measurement (register test) with 1, 2 or 3 counter registers.

Type Mark Positioning
Positioning of the disc mark of mechanical meters in percentage of a full turn (e.g. 85%).

Call **error measurement setup** menu [9.1.4]

Call **energy measurement setup** menu [9.1.5]

Call **mark positioning setup** menu [9.1.6]

Set copy from meter flag

Change settings

Activate / Deactivate function
Press FB to activate or deactivate function. The function is activated or deactivated for all 3 inputs (cyclical mode).

Copy from Meter: ☒ ☒ ☒

Change status

Press on check boxes to change the status of the function for an individual input (cyclical mode).

Status of check box

Copy from meter active

The settings in the type error or type energy frame related to the input, where the checkbox is crossed, are copied from the meter, which is defined for this input during the test run.

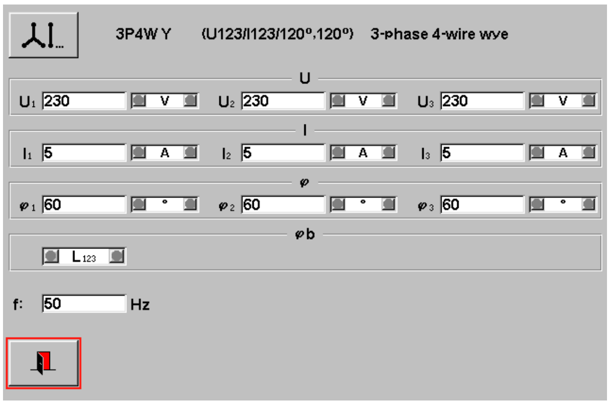
Note: The test duration (t/n) for type error (imp, s) or type energy (kWh, s) is not copied from the meter. The value must be defined in the test step (initial values: 1 imp, 0 s).

Copy from meter inactive

The settings for type error or type energy as defined in the test step and shown in the frame are used.

	Call **Load / Save settings** in Testpoint menu [4.4]

9.1.3 Load point setup



Load point setup menu

Network selection

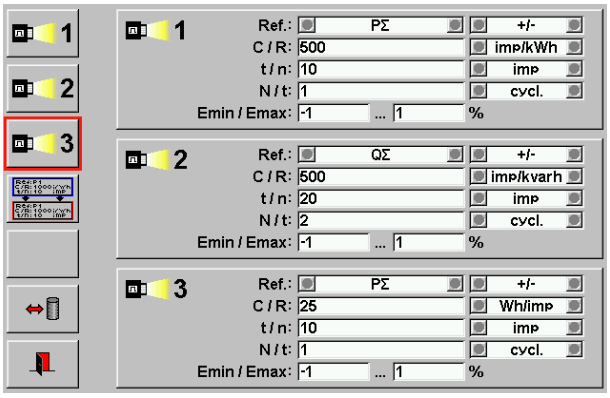
Settings for voltage (U1, U2, U3) current (I1, I2, I3), phase angle (φ1, φ2, φ3), phase angle between voltages (φb) or phase sequence (L123) and frequency can be modified or entered here. The input format is depending on the selected network type.

The settings can be made absolute with unit V, A, ° or relative as %Un, %In. The phase angle can be entered in ° or as power factor in the form cosφLA, cosφLE, sinφLA, sinφLE.

Exit back to calling menu

For a detailed description of load point settings and network selection see chapter [7.2.1].

9.1.4 Error measurement setup



Error measurement setup menu

Settings for reference power/energy mode (Ref.), meter constant (C/R), test duration (t/n) in impulses (imp) or seconds(sec), number of test repetitions (N) in cycles (cycl.) or seconds (sec) and error tolerance band (Emin / Emax) can be modified or entered here for inputs 1 to 3.

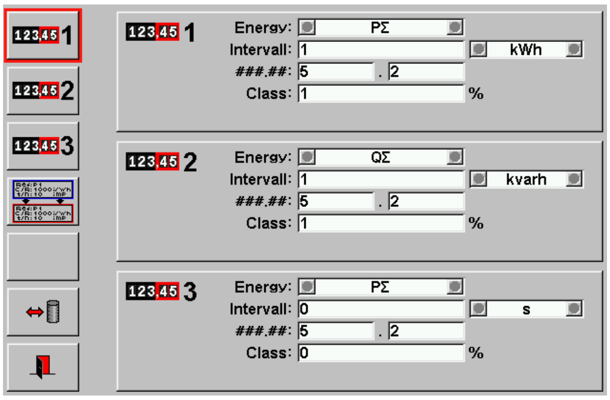
Load /save settings from / to object file in directory

Copy settings from input x to input y

Exit, back to calling menu

For a detailed description of error measurement settings see chapter [8.2.2].

9.1.5 Energy measurement setup

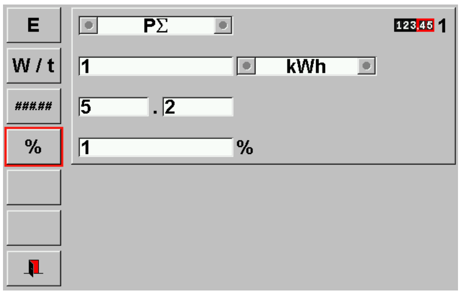


Energy measurement setup menu

1	Parameters for register 1
2	Parameters for register 2
3	Parameters for register 3
	Load /save settings from / to object file in directory **Counter Test Point Selections**
	Copy settings form input x to input y
	Exit, back to calling menu

Indications / settings

1 2 3	Set **parameters** for register 1, 2 and 3



Parameters for energy measurement setup

E	Energy type
W / t	Test interval
###.##	Register resolution
%	Accuracy class
	Exit, back to calling menu

E	**Energy type**

Select energy type with up / down cursors (cyclical mode):

PΣ	Active energy import / export
QΣ	Reactive energy import / export
SΣ	Apparent energy import / export
$I^{2\Sigma}$	I^2-hours (used at transformer loss meters, copper and leakage loss)
$U^{2\Sigma}$	U^2-hours (used at transformer loss meters, iron and core loss)

W / t	**Test Interval**

Value
Enter desired dosage interval for energy or time dosage.
Unit / mode
Select the appropriate unit with up down cursors (cyclical mode):

Unit	Mode
s, min, hr	Time dosage
Ws, Wh, kWh	Energy dosage

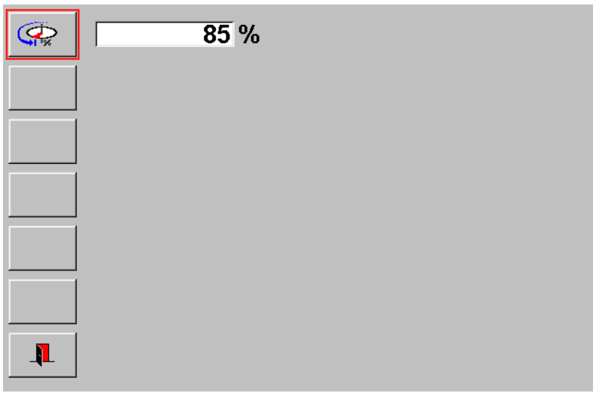
Register Resolution

Enter the register resolution in number of digits before and after the decimal point.

% Accuracy Class

Enter the accuracy class of measuring system in percentage (%) as indicated on meter or specifications. This value will be used for good / bad evaluation during the test run.

9.1.6 Mark positioning setup

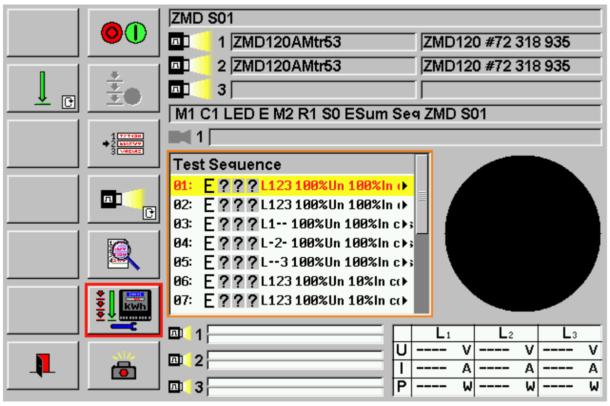


Mark positioning setup menu
Definition of stop position of disk mark in percentage of a full revolution.

Enter value in percentage.

Exit, back to calling menu

9.2 Run automatic or step by step test



Test run menu - test prepared
FB's for preparation of test run:

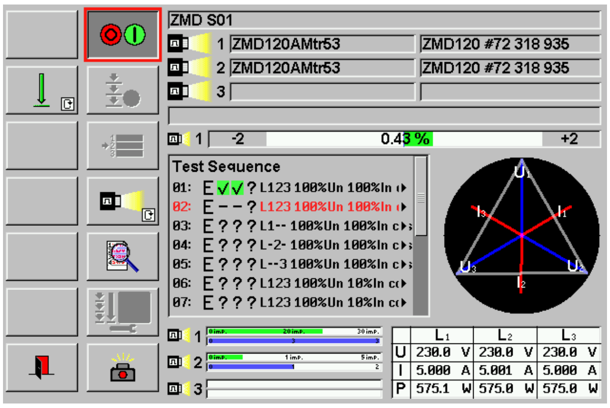
Select first test step

Test mode automatic or step by step

Test sequence and meters setup

Following display fields show the actual meter and sequence definition:

- Test sequence file name (ZMD S01)
- Meter type (ZMD120AMtr53) and meter (ZMD120 #72 318 935) file name for inputs 1 to 3, where meters are defined.
- Comment to test setup (abbreviated form)
- Window with test sequence steps



Test run menu - automatic test running

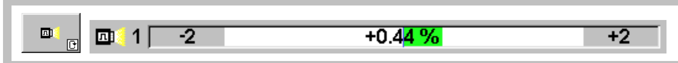
FB's for execution of test run:

- Start / Stop test run
- Select error Indication for input 1, 2 or 3
- View test step results
- Storage of test results

Following display fields and indications are active during test run:

- Error tolerance band above test step window
- Actual running step (red) with status indication for inputs 1 to 3 in test step window
- Two bar graphs for each input, showing the status of actual measurement and repetitions
- Load point status with vector diagram and table for voltage (U), current (I) and power (P) for phases L1, L2, L3 on the right side

Indications / settings



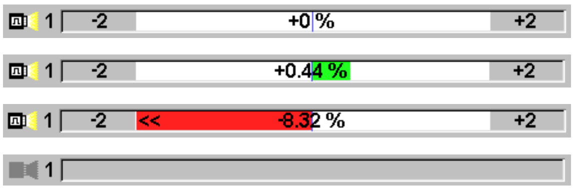
Graphical error indication with tolerance band

Selection of input

Change between indication for input 1, 2, 3 (cyclical mode)

The result of the last finished test run of the selected input is shown. The error is indicated numerical and graphically with a bar graph starting at the blue zero line, indicated in relation to the white tolerance band. Lower and upper limits are indicated in percentage.

Different error indications



No bar graph, new step, no result yet

Green bar graph, error within tolerance

Red bar graph, error out of tolerance

The Indication is inactive, when the test run is stopped (Start / Stop FB is out).

01: E √ √ ? L123 100 %Un 100
02: E – – ? L123 100 %Un 100

Indications in Test Sequence window

Actual test step

02: E – – ? L123 100 %Un 100   Test step position and step name are red marked

Test step type

E   Type Error

Type Energy (register test)

Test step status for measuring places 1, 2, 3

?   Not yet executed, no result or input not defined

–   Step running

√   Step finished, error within tolerance

E   Step finished, error out of tolerance

Status of actual running test step

For each measuring input, there is an individual status indication for the actual running test step.

Status of actual measurement
The actual counted impulses (38 imp.) of the running measurement and a green bar graph in relation to the programmed test duration t (50 imp.) are indicated.
The test duration can also be indicated in seconds (s). At test steps of type energy, no numerical values are indicated.

Status of repetitions
The actual status of the executed repetitions of the measurement (2) and a blue bar graph in relation to the programmed number of repetitions (5) are indicated.

Start / Stop test run

Start of a test run is only possible, if a test sequence with at least one test step is defined and if at least one meter is defined.

Test stopped

Source status

	Voltages and currents are switched off

Status of functions in both test modes

	Test sequence and meters setup can be changed
	First step can be defined

Test running

Source status

	Voltages or voltages and currents are switched on
	Currents are switched off / on between test steps

Note: The voltages are always on as long as the start / stop FB is depressed.

Status of functions in test mode automatic

	Test sequence and meters setup is not accessible
	Select first step is not accessible as long as test run is active

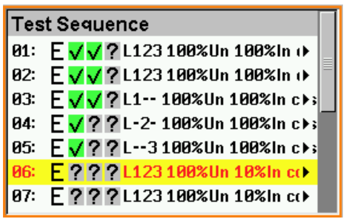
Status of functions in test mode step by step

	Test sequence and meters setup is not accessible
	Select first step is not accessible as long as test step is active
	Start next single step is not accessible as long as test step is active
	Start next single step is active between steps

Select first or next test step

The function is used to select the start test step in both test modes.
In test mode step by step the function is also used to define the next step.

Activate function
A red frame surrounds the test step window and a yellow selection line is shown on position 1



Select new position
Select desired start or next step by pressing on according line. The selected position is marked red.

Start step
The function is terminated and to start the test press the FB Start/Stop

Next step
The selected test step is automatically started and the function is locked as long as the test step is running.

Test mode

Automatic test run
The test runs fully automatic for error measurement test steps from selected start test step until the last test step in the sequence and then stops.
If there are energy measurement test steps within the sequence, the sequence stops and waits for user input of start or end readings. When the input is finished, the sequence runs automatic again.

Step by step test run
The selected test step runs. When the step is finished, the current is switched off, but the voltage remains on. The next step is selected. The user must manually select the next single step or any other step with following buttons:

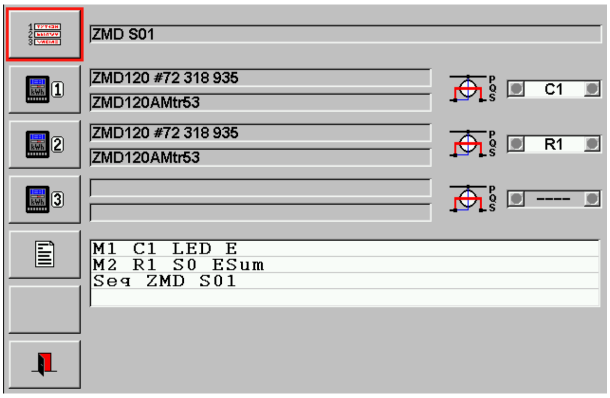
	Start next single step (next single step automatically starts)
	Select and start any step (step will automatically start after selecting)

Call **test sequence and meters setup** menu [9.2.1]

Call **view test step results** menu [9.2.2]

Call **storage of test results** menu [10]

9.2.1 Test sequence and meters setup



Test sequence and meters setup menu

The file names of the actual loaded data base elements are shown at:

- Test sequence
- Meter and meter type of input 1
- Meter and meter type of input 2
- Meter and meter type of input 3

Make individual definitions by calling the FB's:

- Load / edit test sequence and meters individual

Enter or modify directly with virtual or external keyboard:

- Comment to setup
- Exit, back to calling menu

Indications / settings

Load / edit meters for measuring inputs 1, 2, 3

The three measuring inputs can be assigned to three impulse outputs, defined with a meter constant.

The file selection menu [6.1] is called with the object file directory:

Meter Selections

There are two possibilities to assign the meters to the inputs:

Load meter file from data base
Three different meters or the same meter one, two or three times can be loaded with different impulse outputs, measuring systems and counters selected.
Restriction: The meters must have the same Imax and network type. If this is not the case, the entries are shown red and the exit is blocked. See also error handling [9.6].

Edit actual meter dataset
Select sub menus and activate edit actual object until the meter menu is displayed. Enter directly the data for meter and meter type. It is not necessary to fill out all the fields. See also descriptions of create/edit meter dataset in chapter [6.5]

Load / edit test sequence

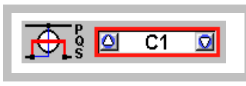
The file selection menu [6.1] is called with the object file directory:

Check Sequence Selections

There are two possibilities to define the actual test sequence:

Load test sequence file from data base
Test sequences previously defined by the test sequence editor and stored in the data base can be loaded.

Edit actual test sequence
Select sub menus and activate edit actual object until the sequence editor is displayed [9.1.1]. Define test steps directly.



Select impulse output to test

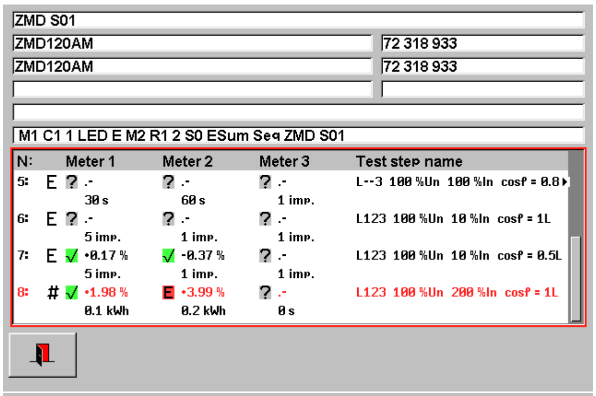
Select one of the up to 8 meter constants, based on the two constant types and up to four measuring systems (x = 1,2,3,4), defined in the meter type linked to the loaded meter. This selection is necessary if the copy from meter function is activated in the test sequence. In this case the meter constant for the measurement is taken from the meter type of the loaded meter regarding the selection.

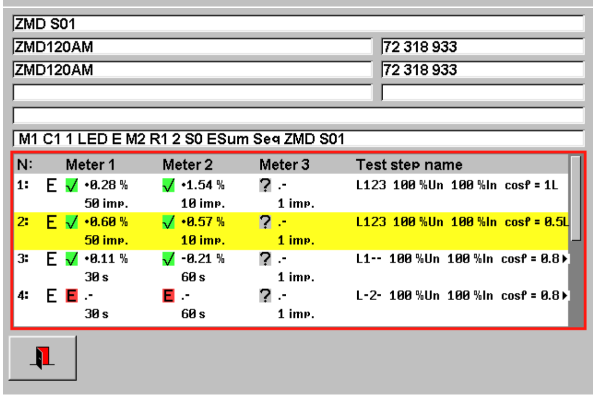
---- **No constant defined**
The field cannot be selected. This is the case if no constant or even no meter type is defined in a reduced setup.

C1 **Optical constant (Co)** of measuring system 1 defined.

R1 **Electrical constant (Ce)** of measuring system 1 defined.

9.2.2  View test step results





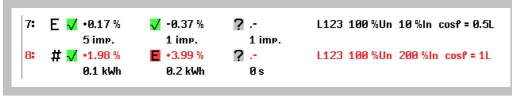
View test step results menu
In the upper part of the display test sequence, definitions for inputs 1 to 3 with meter name and serial number are shown.
The window in the lower part shows the test step list with additional information to the test step:

- Error measurement status and results for meters (inputs) 1 to 3 on first line of test step
- Test duration settings (imp, s, kWh) for meters (inputs) 1 to 3 on second line of test step

View test step results menu - scroll mode
If not all test steps are visible within the window, they can be scrolled.
Use the scroll bar on the right side or the up/down cursors on an external keyboard.

 Exit, back to calling menu

Indications / settings



Results and status indications in test step window

Additional to the status indications, shown in the test sequence window of the test run menu, status of measurement, error results, test duration and more details of test step name are shown here.
The status indications are shown for each meter (input) individual

Measurement status / error result

.-	Step Not yet executed or not defined at step not selected
.-	Waiting for start impulse at actual step
--.-- %	First measurement of N measurements running, no error result available yet
•1.98 %	Last measured error result of selected test step. The value is updated during test runs with several repetitions (N>1).
•0.17 %	Last measured error result of not selected, finished test step.

Test duration (t/n) defined for test step and input

50 imp.	Test type error with test mode imp, 50 impulses tested
30 s	Test type error with test mode time, 30 s tested
0.1 kWh	Test type energy with test mode energy in kWh, 0.1 kWh dosage

9.3 Preparation of test run

9.3.1 Work with individual meters and test sequences of data base

1		Load meter file for input 1 from data base

The meter and the meter type object file name are indicated in the two fields. Impulse output selection becomes accessible.

2	C1	Select impulse output of meter 1 to test

Select one of the meter constants Cx, Rx (C = Co: optical constant, R = Ce: electrical constant) of the up to four measuring systems (x = 1,2,3,4) defined in the meter type linked to the loaded meter.
For test sequences, where the copy from meter flag is set at least one meter constant (e.g. C1) must be defined to run test steps or type error.
For test sequences with fix error measurement parameters and copy from meter flag not set, the impulse output must not be selected.

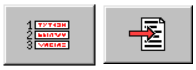
3		Repeat steps 1 to 3 for input 2 (optional)
4		Repeat steps 1 to 3 for input 3 (optional)
5		Load test sequence file from data base

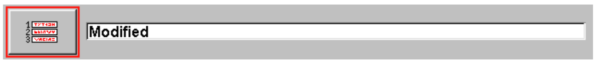
9.3.2 Work with direct entries for meter and test sequence

The example shows a minimum directly entered meter and test sequence definition to enable a test run with input 1.

1		Input minimum meter settings for input 1

Select sub menus and activate edit actual object until the meter menu is displayed. Make at least one input (e.g. serial number). Go back with several exit FB's until setup menu is displayed again with entries Modified at meter and meter type file name.

2		Define a test sequence with one test step directly

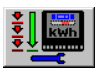


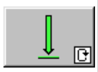
Select sub menus and activate edit actual object until the test sequence editor is displayed. Insert a new step and define fix load point settings for voltage, current and phase angle and fix parameters for error or energy measurement of input 1. The copy from meter flag must be empty.
Go back with several exit FB's until setup menu is displayed again with entry Modified at test sequence file name.

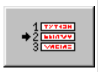
9.4 Test run examples

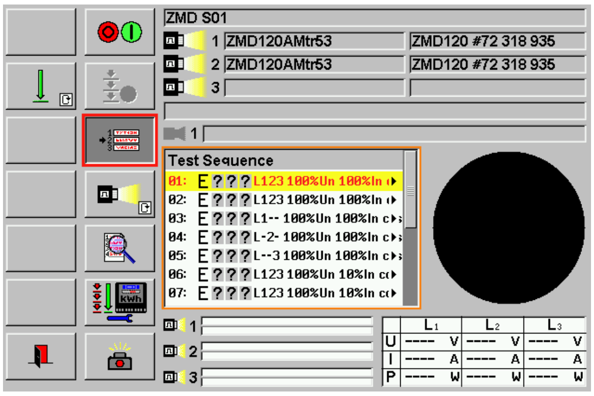
9.4.1 Automatic test run

The test is running full automatic if the test sequence contains only test steps of type error.
The test is running half automatic, if test steps of type energy are included, see [9.4.3].

1		Prepare test run, see [9.3]

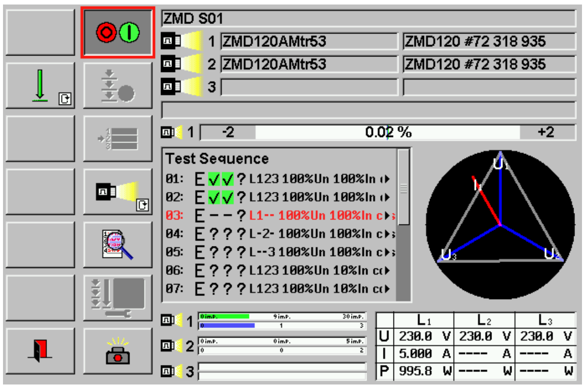
2		Select test mode automatic

3		Select start test step (default position 01)

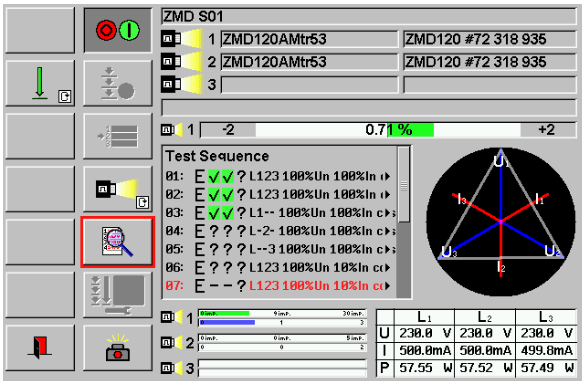


Select any start step with the yellow selection line. The default start step is 01.
The selected start step becomes red.
The sequence will run automatically form start step until the last step in the sequence

4 Start test run



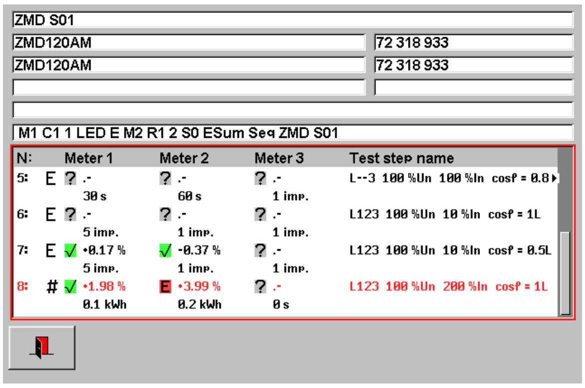
The example shows a running test sequence with total 8 steps. Steps 01 and 02 are already finished and the results are OK. Step 03 is actual running. It is a single phase measurement with only current of phase 1 switched on (L1--).



The example shows the same test sequence at a later state with step 07 running.
Steps 01 to 03 are already finished with results OK.
Step 07 was chosen as new start step and the measurement was restarted at step 07.

The test run stops automatically after last test step

5 Track test step results with result view function

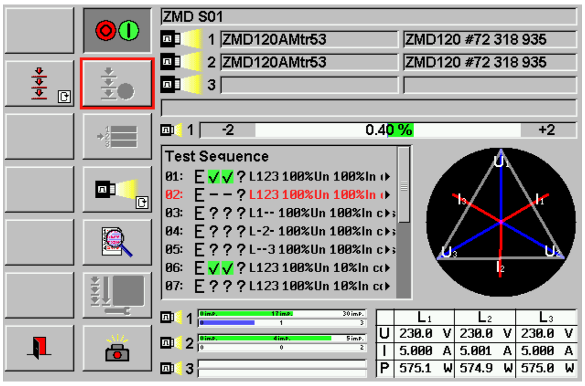


More detailed information to the status and settings of the test steps can be seen in the view test steps results menu.
The errors of the last measurement are shown for the different steps of meters 1 to 3 (input 1 to 3).

6 Call **storage of results** menu to save results [10]

9.4.2 Step by step test run

1	Prepare test run, see [9.3]
2	Select test mode step by step
3	Select start test step (default position 01)
4	Start test run



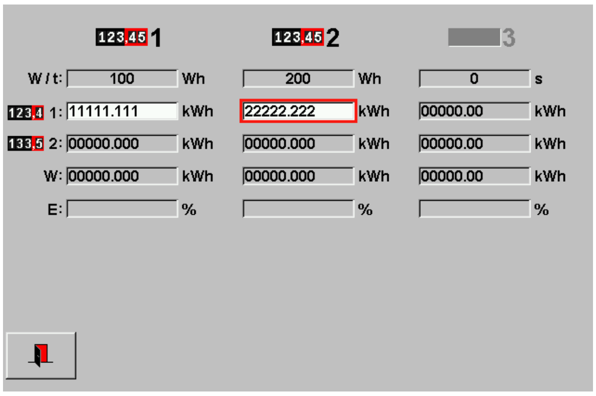
The example shows a step by step test run with point 06 and 01 finished. The step 02 is automatically selected as next step. The user can start step 02 by pushing the start next single step button (as done in the example) or select any other step by pressing twice on desired step.
Note: Between the steps the voltages remain always on.

5	Track test step results with result view function
6a	Start next single test step (continues automatically without restarting)
6b	Select any next test step (press twice on desired step to continue test at corresponding step)
7	Stop test run manually
8	Call **storage of results** menu to save results [10]

9.4.3 Test run with test steps of type energy

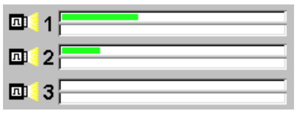
An automatic test run doesn't run fully automatic. It will be stopped at each test step of type energy to enter start and end readings.

1	Enter start readings for defined counters



At the begin of a energy type test step the voltage is switched on and the system waits for the input of start readings by the user.
In this example two counters are defined for the measuring inputs 1 and 2. Input 3 is not defined and therefore grayed out. The counter format (digits before / after decimal point) is taken from the meter type.
Select entry fields and enter start readings of the defined counters.
If two counters have different test durations (W/t) defined (e.g. 100 Wh, 200 Wh), the smallest value (100 Wh) will be taken as reference

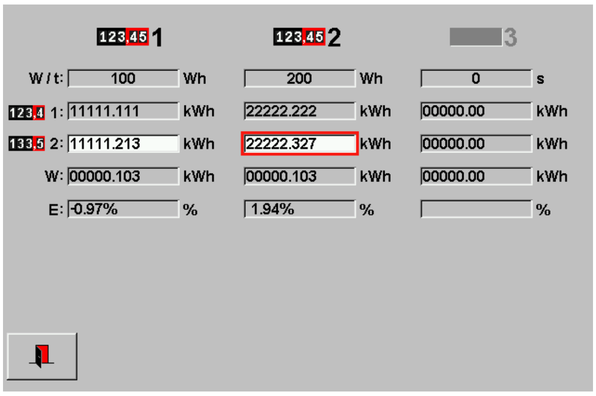
Select exit to terminate the input and to start the energy dosage.



Status indications during test

The green bar graph shows the already dosed amount of the defined dosage energy.
Example for different test duration:
The bar graph of input 2 is shown with half length, because the programmed value (200 Wh) is double the value of input 1 (100 Wh).
The test stops, when the bar graph at input 1 reaches the end.

2	Enter end readings for defined counters



After automatic stop the system waits for user inputs of the end readings.
Select entry fields and enter end readings of the defined counters.
The counter error (E) is calculated and displayed.
The second last line shows the energy (W), which was really dosed and taken as reference for the error calculation.

9.4.4 Functions to change / interrupt / restart the test run

Change test mode within test run

The test mode can be changed at any time within an active test run.
As soon as the actual test step is finished, the new test mode is used for the next step.
E.g. changing from automatic to step by step test mode can be used for a well-defined mean stop of an automatic test run. The test run stops, when the actual test step is finished. The voltages are not switched off. Single steps can now be tested or a new start step can be defined and the automatic test run can be restarted by changing back to automatic test mode.

Interrupt active test run

An active test run can be stopped at any time. The already measured step results remain in the temporary storage as long as no new test sequence is loaded or as long as the test step is not repeated.
Note: The source is completely switched off. During test of electronic meters it may not be advisable to interrupt the test in this way.

Restart stopped test run

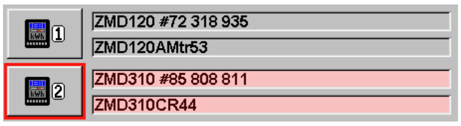
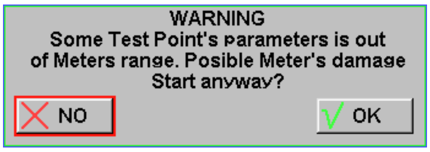
The test run will go on with the selected test mode starting at the marked test step.
If an automatic test was interrupted, optional a new start step can be selected before the start / stop button is pressed (e.g. to repeat an already finished part of a test sequence or to omit some test steps).

9.5 Useful functions available during test run

The other menu cards are not locked during the test run is active.
The following functions can be called at any time during the test run without influencing the measurement results.

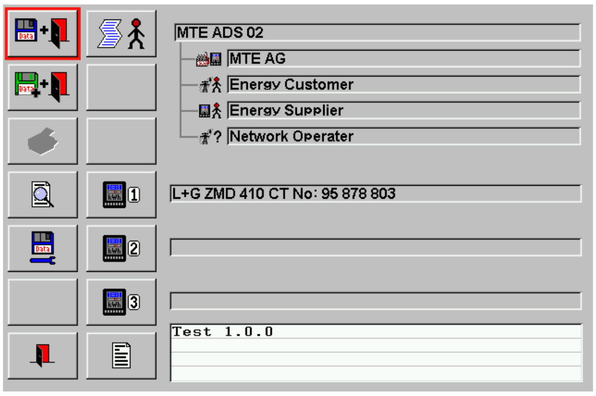
Function call	Description
	View detailed test step results in storage of results preview
Source	Track test step settings with Source Load point menu
Reference	Track test step settings with Reference measurement functions
Data Base	Work parallel in data base (e.g. to enter or change ADS of customer)

9.6 Error handling

Indication / effect	Error reason	Solution
 Test run start / stop is locked	No valid meter and / or test sequence is defined or communication to units is not ok.	Define missing part in meters and test sequence setup. Check communication status.
  Exit of menu is locked	Two meters with different Imax values or different network types are defined.	Test each meter individually with two separate test runs.
	Warning during test run if test step parameters are in conflict with meter parameters, e.g. if test current of test step is higher than maximum current (Imax) defined in meter type.	Select **NO** and change test step parameters or load other test sequence which works fine with the settings of the loaded meter. Select **YES** only, if you are sure that the meters connected are not damaged under this conditions.

10. Storage of test results

In this menu measured results, a so called Testresult Data Set (TDS) can be combined with a freely configurable Administrative Data Set (ADS) to one combined result dataset. In this way, the link between measured results and measuring identification (customer address, tested meters and comment) can be made.
It is up to the user, how many ADS information he likes to define and to link to the TDS. The ADS information can be entered directly with the edit function of the data base or can be loaded full or partially from the data base.
It is recommended to define full ADS datasets for customers or measuring places with the optional software CALegration, installed on a PC.
As preparation for tests in the field the predefined ADS datasets or parts of it can then be uploaded from CALegration software into the instrument, either over a communication interface or by direct transfer on the compact flash card.



Storage of test results menu

The combined result dataset (TDS + ADS) can be:

- saved to new file
- appended to file with last saved data set
- printed (not available at PRS 600.3)
- previewed

The right side shows the file names of the actual loaded ADS and its components:

Administrative dataset (ADS) consisting of following datasets:

- Installation setup
- Energy customer
- Energy Supplier
- Network Operator

Meter dataset for input 1

Meter dataset for input 2

Meter dataset for input 3

Indications / settings

	Save new or append results and go back to calling menu [10.2]
	Print data (not available at PRS 600.3, use print function of software CALegration)
	Preview of results in printout format
	Call **save parameters settings** menu [5.2] to define settings for:

Save mode (single / continuous) see description in chapter [10.2.1]

Load / edit / reset object files

The **file selection menu** [6.1] is called and an object file directory is displayed.

Load object file
Select and load a predefined object file from the shown directory.

Edit actual object
Edit the actual dataset, which can be empty or contain the previously loaded data. All data can directly be entered. If another dataset is called in the editor menu, call the edit actual object function again, until you can enter the data directly.

Reset actual object to defaults
The dataset is reset; the file name field is cleared. No data of this type is linked with the result data.

Exit, back to calling menu
Use the exit FB to come back to the storage of results menu. Several exit steps may be necessary to come back.

A detailed description of the listed datasets can be found in the chapters listed below.

FB	Directory	Description
	Administrative Dataset	[6.4.2]
	Meter datasets for input 1-3	[6.5.2]

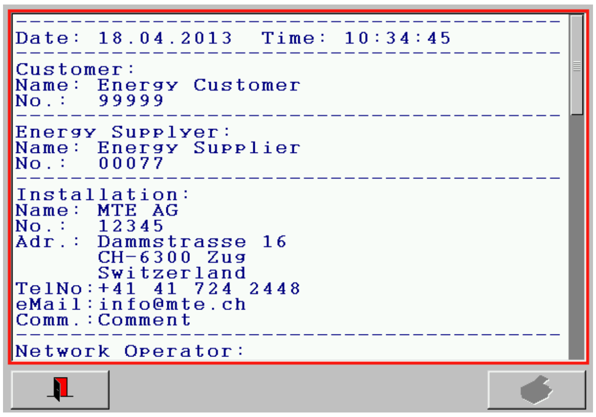
Comment

If a complete ADS dataset is loaded, the ADS comment is displayed here.
Enter or modify comment with the virtual or external keyboard.
This field can also be used for simple measurement documentation, if the complete ADS and the ADS parts are not used and reset to defaults.

Exit, back to calling menu

10.1 Preview of results

The preview function can be used to view the results before saving. With this function a fast overview over the complete results data with measured results (TDS) and the linked administrative data (ADS) is possible.



Preview of results menu
The combined results (TDS + ADS) are shown in the preview

Scroll up / down by using the scroll bar on the right side, or use cursor keys on an external keyboard.

Exit menu by pressing the exit key.

Print button (not available at PTS 400.3 Plus)

Note: If the results are transferred to CALegration, they will have another look, adapted to the CALegration user interface.

10.2 Save results

The actual combined results of measured results (TDS) and administrative data (ADS) are saved on the compact flash card.

10.2.1 Save mode configuration

	Call **save parameters settings** menu [5.2] to define the **save mode**:

Single
One measurement result dataset (TDS) is saved

Continuous
The measurement result datasets (TDS) are saved continuously at the defined time interval in s, min, h.

On new event
The measurement result datasets (TDS) are saved every time a new result is created.

10.2.2 Save single measurement

1	Run measurement

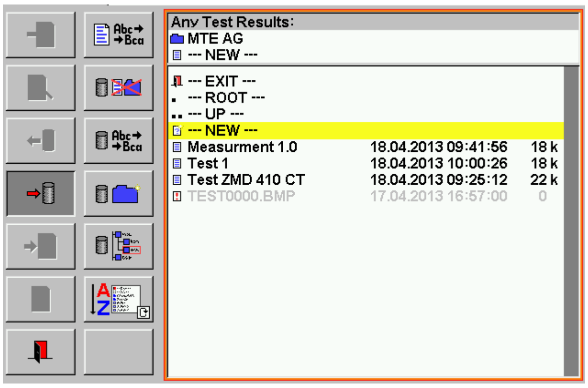
2	Call storage of results menu

3	Load / edit administrative data (optional)

4	Preview results (optional)

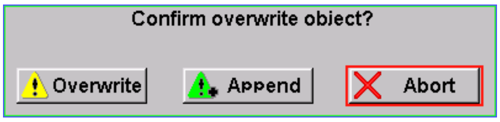
5a	**Call save results and exit** to create or select a new file

The **file selection menu** [6.1] is called with the directory **Any Test Results** displayed.



Save as new file

1		Call save actual object
2	--- NEW ---	Select line new in directory
3	LAB	Enter name for result file
4	LAB	Press enter to terminate save
5		Back to measurement menu



Save to existing file
Confirm overwriting file or append new results dataset to existing file.
With **Append** several measurements can be saved in the same file and be transferred to CALegration by readout of just one result file.

5b	**Call append results and exit** to save directly to the last selected file.

With this function, several measurements can be added to the same file (e.g. all measurements of one customer).

The FB is only enabled, if a file was created/selected before and a data set saved already regarding point 5a.

10.2.3 Save continuous measurements

1	Call storage of results menu

2	Load / edit administrative data (optional)

3	Call save results and exit to define a result file

The file selection menu [6.1] is called with the directory Any Test Results displayed.

Create result file, as described under save single measurement step 5.

The continuous storage mode is automatically started, when the file selection menu is left with the exit door FB. The calling measurement menu is displayed again.

Status indications

The camera FB is shown depressed during continuous saving is active.

The compact flash status indication changes periodically to the save continuous symbol.

3	Run measurement

The measurement results are cyclically saved according to the defined saving mode (event or time interval).

4	Select camera FB and press enter to stop continuous saving.

The data saving is stopped.

Status indications

The camera FB is shown normal again.

The save continuous symbol disappears and the normal compact flash status indication is displayed again.

5	Call storage of results menu and preview results (optional)

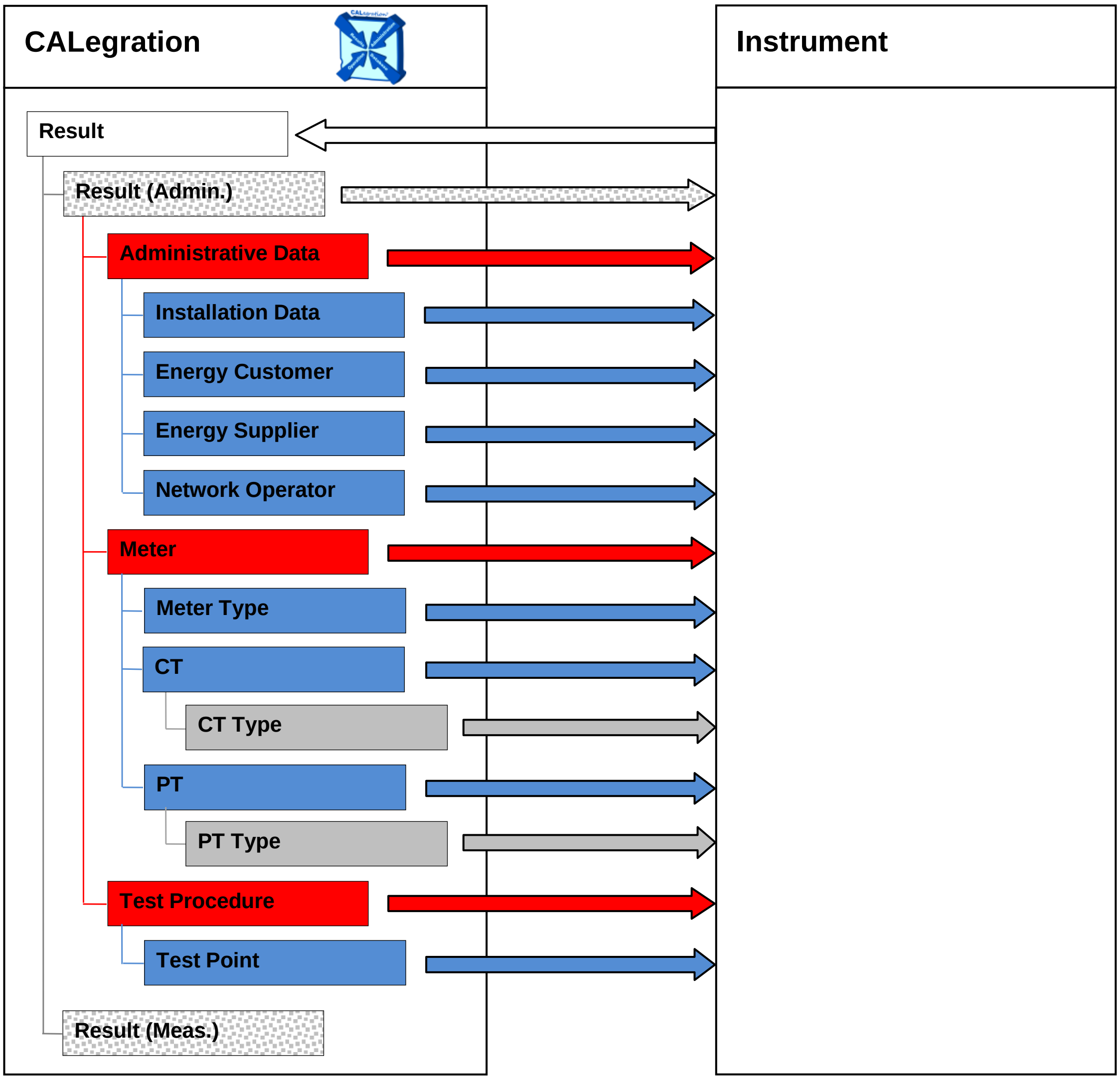
The last saved measurement results are shown. With the preview function, only one of the saved result sets can be viewed. To see all the saved results the data must be transferred to CALegration.

6	Exit, back to calling measurement menu

10.3 Data transfer to PC

10.3.1 Software for data transfer (option)

With the optional CALegration software administrative data (ADS), Meter data and Test Procedures can be transferred from the CALegration software to the instrument by using the Preload Control function in CALegration (refer to CALegration operation manual for additional information). For further evaluation of the results and reporting of the measurements any saved results on the instrument can be transferred to the CALegration software by using the Read-Out Control function in CALegration. The results are displayed on the PC in a user-friendly windows environment (refer to CALegration operation manual for additional information).



Linked sub-level elements always will be transferred together with higher level elements, but must be saved individually on the instrument for further use.
All sub-level elements can also be transferred individually from CALegration to the instrument.

10.3.2 Data transfer with compact flash (CF) card

The data can be transferred directly between instrument and a PC with software CALegration installed by using a flash card adapter at PC side, e.g. compact flash to USB adapter (refer to CALegration operation manual for additional information).

Warning!
Do not remove the CF card, if the card is actually accessed, indicated with a red background of the CF status indication. Not following this procedure may lead to corrupted files and loss of data. The safest procedure is to switch off the power supply before removing or inserting the CF card.

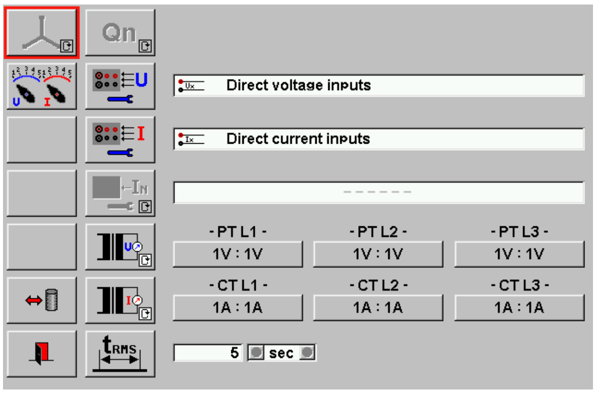
10.3.3 Interface for data transfer

The data can be transferred by using either the USB or the Ethernet interface. Configuration for the connections must be made in the CALegration software.

11. Basic settings and functions for Power Quality measurement

11.1 Setup of inputs U, I and recording time base for online measurements

Only the setup of the recording time base t_{RMS} is different. The rest of the available settings is the same as described under reference meter settings [8.1].



The following settings are displayed:

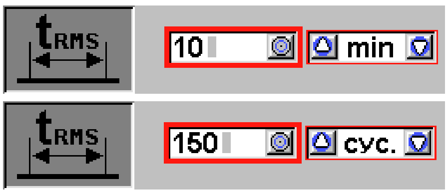
- Connection mode 4-wire (selection only available, if used as reference standard)
- Setting of internal voltage and current ranges [8.1.1]
- Load or save current parameters
- Exit of menu
- Reactive power mode natural Qn (selection only available, if used as reference standard)
- Selection of voltage inputs [8.1.3]
- Selection of current inputs [8.1.4]
- Selection of IN/IE measurement inputs (not available for PRS 600.3)
- Voltage transformer settings [8.1.5]
- Current transformer settings [8.1.6]
- Recording time base (PQ online only)

Indications / settings

t_{RMS}	**Recording time base for PQ online measurements**

This input is only accessible and used at PQ online measurements to define the basic measurement time interval for the PQ parameters.

Press the FB to activate the input.

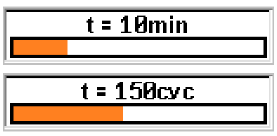


Enter the value with the virtual keyboard

Range: **1 … 9999**

Use the up/down cursor keys to select the unit (cyclical mode):

s	Second
min	Minute
hr	Hour
cyc.	Cycles of fundamental frequency

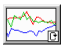


Status indication of time base

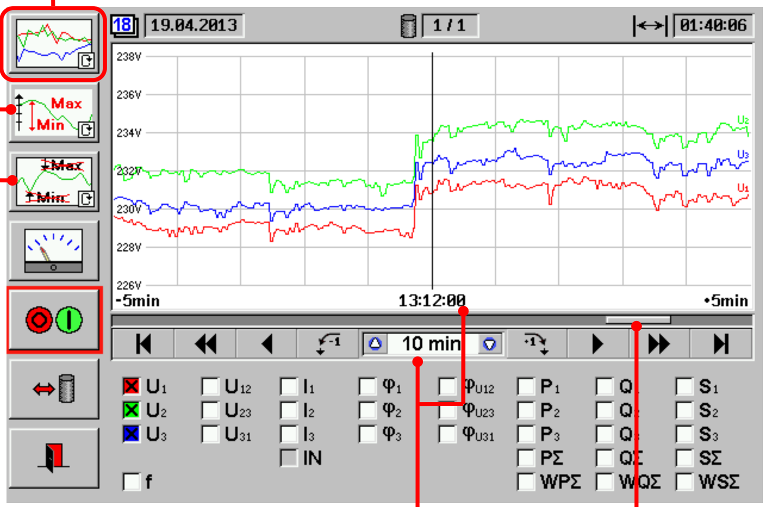
The time base interval with time unit or in cycles is displayed together with a bar graph, indicating the elapsed time of the actual running measurement interval.

Note: The recording time base defined here is not regarded for the frequency, which is always recorded with 10s intervals regarding the standard IEC 61000-4-30. It is also not regarded at magnitude values recorded with events, transients and mains signaling, where a fix 1s interval is used.

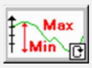
11.2 Different views of results

11.2.1  Graph view

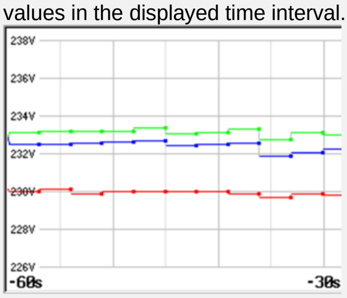
Graph view

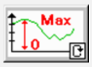


Vertical scale

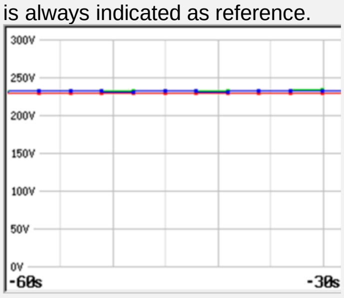


Automatic scaling with regard of minimum **Min** and maximum **Max** values in the displayed time interval.

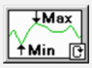




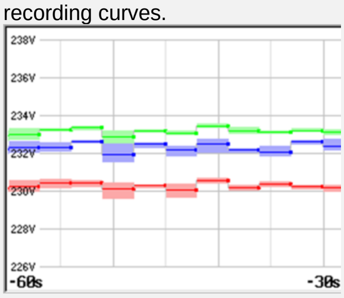
Automatic scaling with regard of maximum value **Max**. The zero line **0** is always indicated as reference.



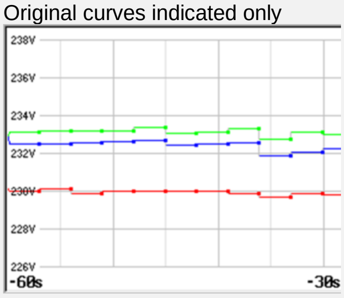
Minimum / Maximum values



Indication ON
Minimum **Min** and maximum **Max** values for each recording interval, evaluated at intervals of 1/5 of the recording interval, are shown as envelope color band around the recording curves.



Indication OFF
Original curves indicated only



Horizontal scale – Time interval

The selected time interval corresponds to the horizontal scale shown in the graph window. The time within the window is indicated relative to a **time stamp**, which includes the **clock time (13:12:00)** below a vertical **cursor line** and the **date (19.04.2013)** above the upper left corner.
E.g. 10 m: 13:12:00 ± 5 m (13:07:00 .. 13:17:00).
Changing the time interval allows to zoom in or out in a recording to see details or an overview of the results.
The **time/division: 1 min**, indicated with vertical lines, varies with the value of the interval (1/10, 1/12, 1/6 of the interval etc.).

Position of the time interval in the recording

E.g. length and position of interval 10 min within total recording of 1 h 40 min 6 s (01:40:06), whole length of the bar graph.

11.2.2 Table view

Table view

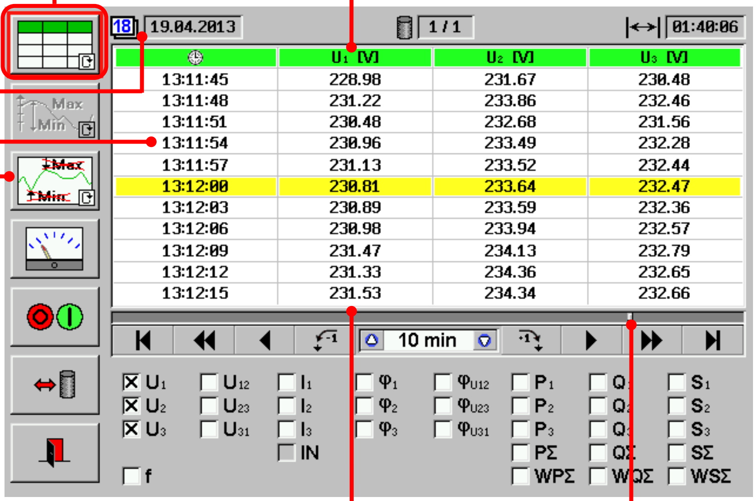
Selected value with [unit]

Date of recording

in format **DD.MM.YYYY** with
DD: Day
MM: Month
YYYY: Year
The date belongs to the **clock time** marked with the yellow row.

Recording clock time

in format **hh:mm:ss** with:
hh: hours
mm: minutes
ss: seconds



⏲	U1 [V]	U2 [V]	U3 [V]
13:11:45	228.98	231.67	230.48
13:11:48	231.22	233.86	232.46
13:11:51	230.48	232.68	231.56
13:11:54	230.96	233.49	232.28
13:11:57	231.13	233.52	232.44
13:12:00	230.81	233.64	232.47
13:12:03	230.89	233.59	232.36
13:12:06	230.98	233.94	232.57
13:12:09	231.47	234.13	232.79
13:12:12	231.33	234.36	232.65
13:12:15	231.53	234.34	232.66

Minimum / Maximum values

Indication ON
Minimum **Min** and maximum **Max** values for each recording interval, evaluated at intervals of 1/5 of the recording interval, are shown in brackets.

⏲	U1 [V]
12:14:45	231.36 [231.3 .. 231.5]
12:14:48	231.28 [231 .. 231.5]
12:14:51	231.38 [231.2 .. 231.5]
12:14:54	231.47 [231.3 .. 231.6]
12:14:57	231.45 [231.4 .. 231.6]
12:15:00	231.62 [231.4 .. 231.7]
12:15:03	231.7 [231.6 .. 231.8]
12:15:06	231.64 [231.6 .. 231.7]
12:15:09	231.76 [231.5 .. 231.9]
12:15:12	231.76 [231.7 .. 231.8]
12:15:15	231.68 [231.6 .. 231.8]

Indication OFF
Original values indicated only

⏲	U1 [V]
12:14:45	231.36
12:14:48	231.28
12:14:51	231.38
12:14:54	231.47
12:14:57	231.45
12:15:00	231.62
12:15:03	231.7
12:15:06	231.64
12:15:09	231.76
12:15:12	231.76
12:15:15	231.68

Numerical results

A column contains 11 numerical consecutive results with basic recording time interval (e.g. t = 3 s)

Position of table in total recording

The bar graph indicates the time span of the table section (30 s) and the position of the table section in relation to the total recording time (full bar graph = 01:40:06).
Note: The time interval (10 min) indicated in the time control section has no meaning for the table view.

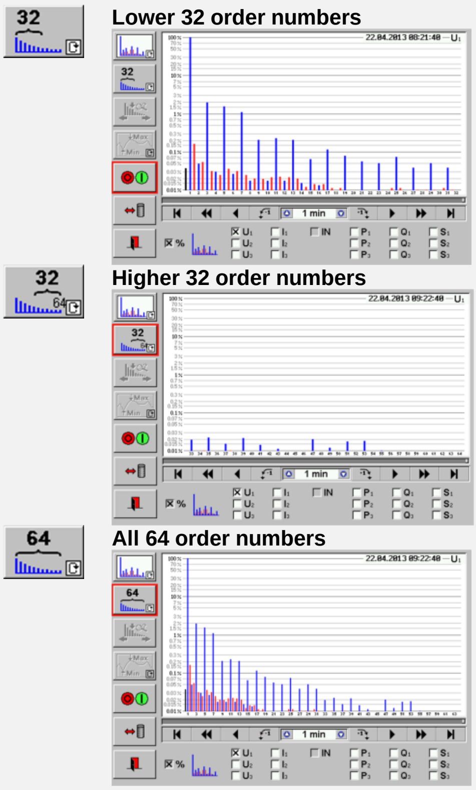
11.2.3 Histogram view

Display range of Harmonics / Interharmonics

Lower 32 order numbers

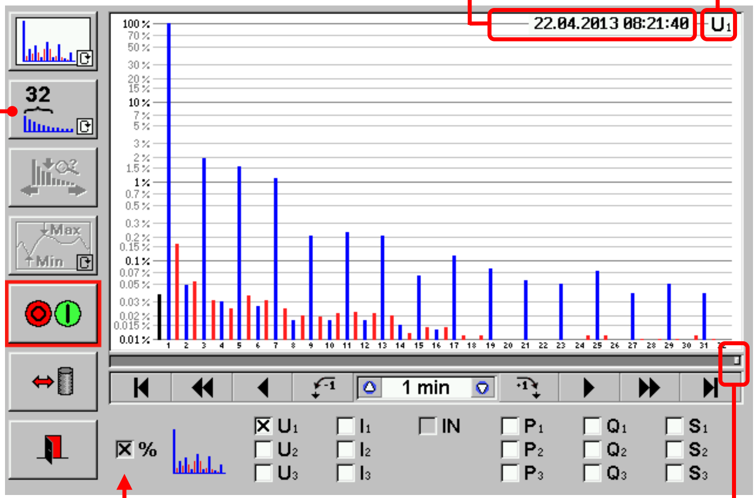
Higher 32 order numbers

All 64 order numbers



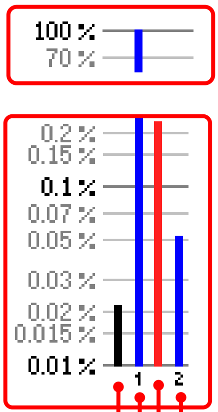
Date and clock time

Value



Vertical scale in % of fundamental

The harmonics / interharmonics are indicated with a logarithmic scale in percentage of the fundamental (H1), which is always 100%.



Position of histogram in total recording

The bar graph indicates the length of the recording interval (3 s) and the position of the histogram in relation to the total recording time (full bar graph).
Note: The time interval (1 m) indicates the time step applied to select the next histogram backward / forward, when the buttons ◀ / ▶ are used.

DC component

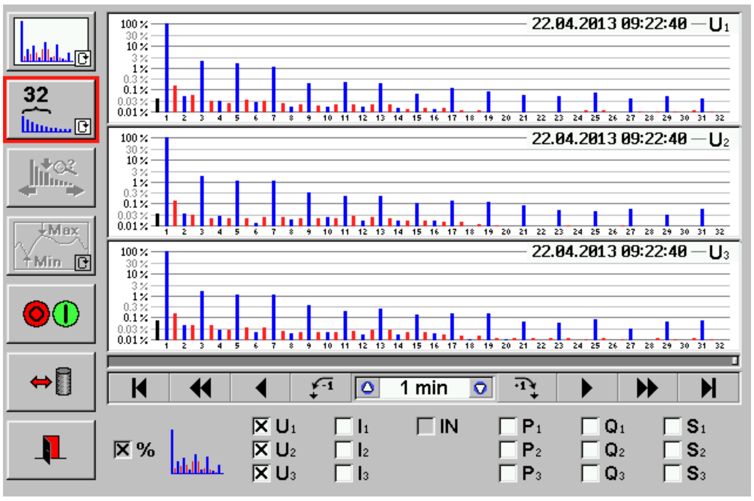
2nd Harmonic (H2)

Fundamental (H1)

Interharmonic 1-2 (IHG 1-2)

Display of several histograms

Up to three histograms are displayed at the same time, if several checkboxes are activated.
Any combination of 2 or 3signals can be displayed (e.g. all phase neutral voltages U1, U2, U3).
Note: If more than three checkboxes are active, the left and upper checkboxes have priority.



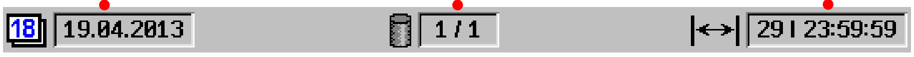
11.3 Overview of recording and navigation within the recording

Overview of the recording

Date **dd.mm.yyyy**, with d: day, m: month, y: year, of time stamp in graph or marked row in table.

Recording block x of n blocks **x / n**

Total recording time **d I hh:mm:ss**, with d:day h: hour, m: minute, s: second

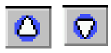


Navigation within the recording

The bar graph background shows the total recording time

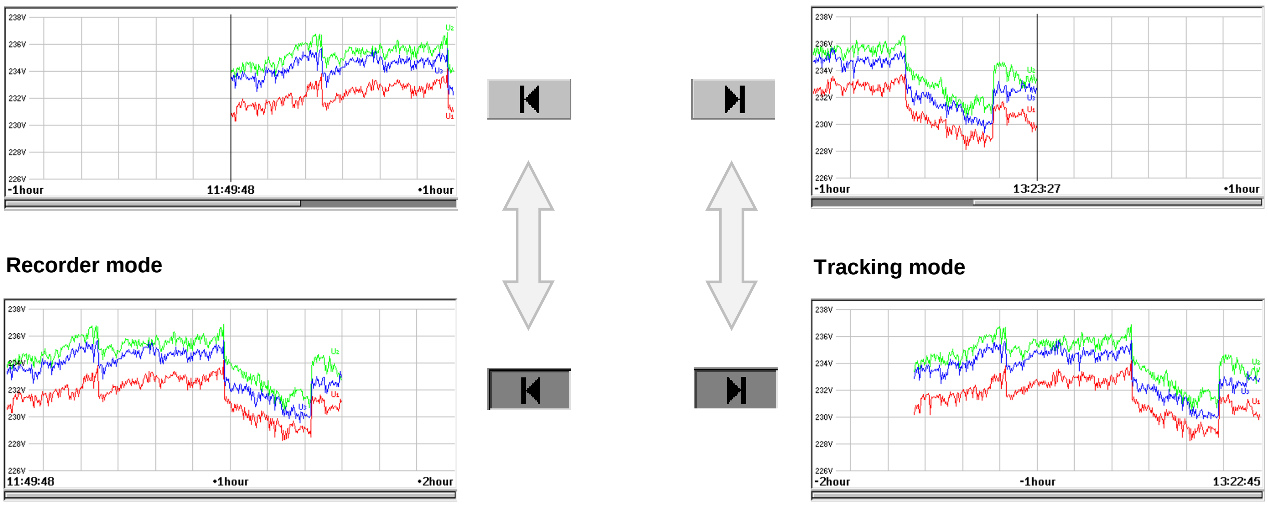
Size and position of selected time interval (e.g. 10 m) in recording

actual time interval - can be changed with up/down cursors



Start of recording, clock time in center

End of recording, clock time in center



graph / table / bar graph	**Jump to start**	⏮	**Jump to end**	⏭
1 time interval 1 table (11 rows) 2 time intervals	**fast backward**	⏪	**fast forward**	⏩
1 time division 1 result row 1 time interval	**backward**	◀	**forward**	▶
graph / table / bar graph	**1 result / 1 event backward**	-1	**1 result / 1 event forward**	+1

Change to next higher time interval to zoom out for better overview

Change to next lower time interval to zoom in for more details

The following predefined time intervals can be selected:

Milliseconds	100, 200, 500 ms
Seconds	1, 2, 5, 10, 20, 30 s
Minutes	1, 2, 5, 10, 20, 30 m
Hours	1, 2, 5, 10, 24 h

Recorder mode

The clock time on the left side indicates the start clock time of the recording. If the window interval is bigger than the total recording duration, the curve is continuously written to the right.

The zoom reference for the window time interval is at the left side.

Start of recording, clock time in the center

The zoom reference for the window time interval is in the center.

Details at the start of the recording can be analyzed in this mode by zooming in and out by varying the time interval.

Tracking mode

The clock time on the right side indicates the time of the end of the recording and is permanently updated. The recorded curves are continuously moved to the left.

The zoom reference for the window time interval is at the right side.

End of recording, clock time in the center

The zoom reference for the window time interval is in the center.

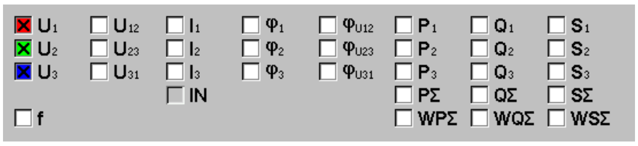
Details at the end of the recording can be analyzed in this mode by zooming in and out by varying the time interval. The clock time remains, if this mode is activated. A running recording is written from the middle to the right.

12. Power Quality Parameters

12.1 VARIATIONS or CONTINUOUS DISTURBANCES

Magnitude

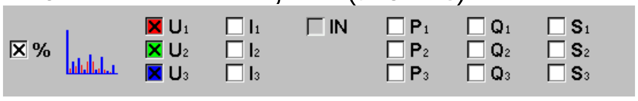
Voltage (U) **Current (I)**
Frequency (f) **Phase angle (φ)**
Power (PQS) **Energy (W)**



X_{AVG} **X_{MIN}, X_{MAX}** ($t_{RMS} \geq 1s$)

Harmonics / Interharmonics

Voltage (U) **Current (I)**
Power (PQS)



DC, H 1 .. H 64 **IHG 1-2 .. IHG 63-64**

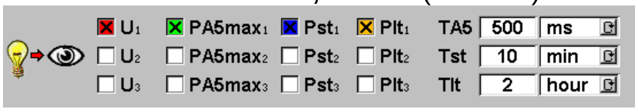
Total Harmonic Distortion

Voltage (U) **Current (I)**
Power (PQS)

THD_{AVG} **THD_{MIN}, THD_{MAX}** ($t_{RMS} \geq 1s$)

Flicker

Voltage (U)



U_{AVG} **PA5max** **Pst** **Plt**

Unbalance

Voltage (U)

U0/U1 **U2/U1**

Mains Signaling

Voltage (U)

U_{AVG} **Usig** **fsig**

The values of the different **P**ower **Q**uality **PQ** parameters are gapless recorded and evaluated regarding the standard IEC 61000-4-30 class A.

The recording can be configured with intervals synchronous to the signal (number of cycles of the fundamental) or synchronous to clock time (time interval with unit s, min, h).

The clock time can be synchronized with the precise **U**niversal **T**ime **C**oordinated **UTC**, which is transmitted by the GPS satellites (option).

The typical recording and aggregation intervals regarding IEC 61000-4-30, like: 10(12) and 150(180) cycles at 50(60) Hz or 10s, 10min, 2h are supported, but other intervals can also be configured.

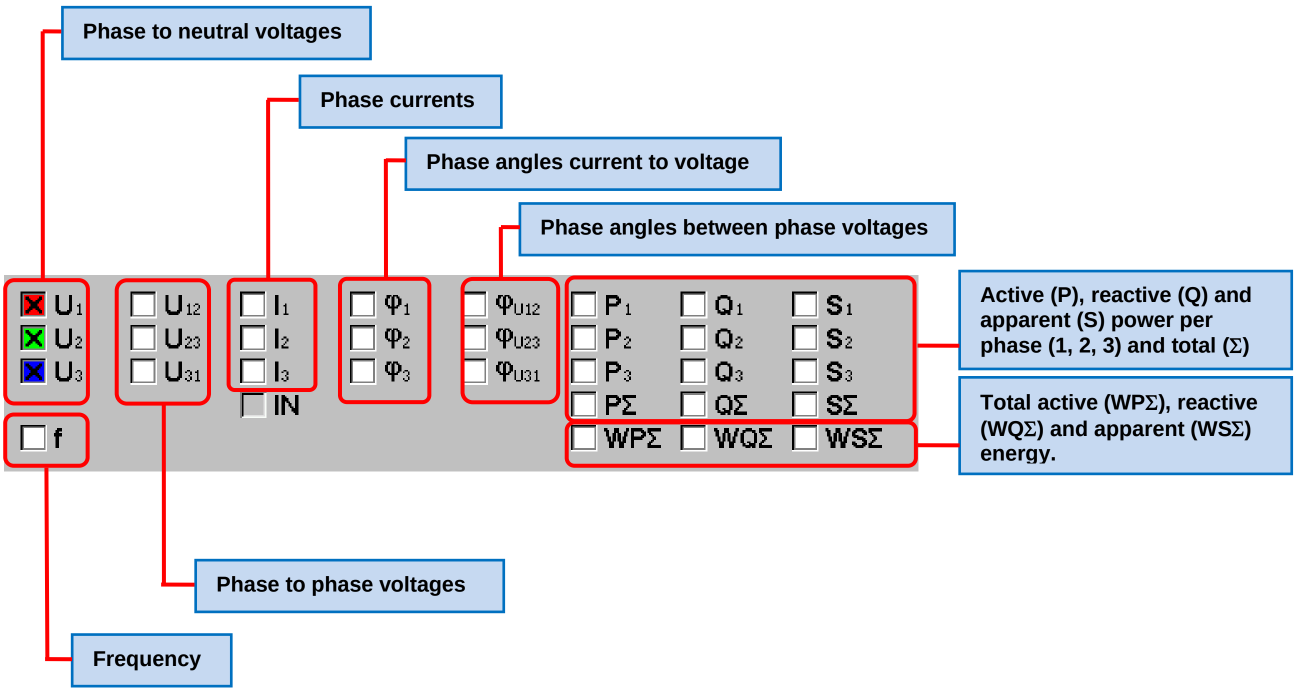
12.1.1 Magnitude UIφfPQS

The root mean square (rms) values of voltage and current and the mean values for the other quantities are recorded in the configured aggregation intervals, exception power frequency (f), which is always recorded with interval 10s.

Additional to the standardized recording of the voltage values and power frequency also current, phase angles, power and energy values can be recorded with high precision and simultaneously.

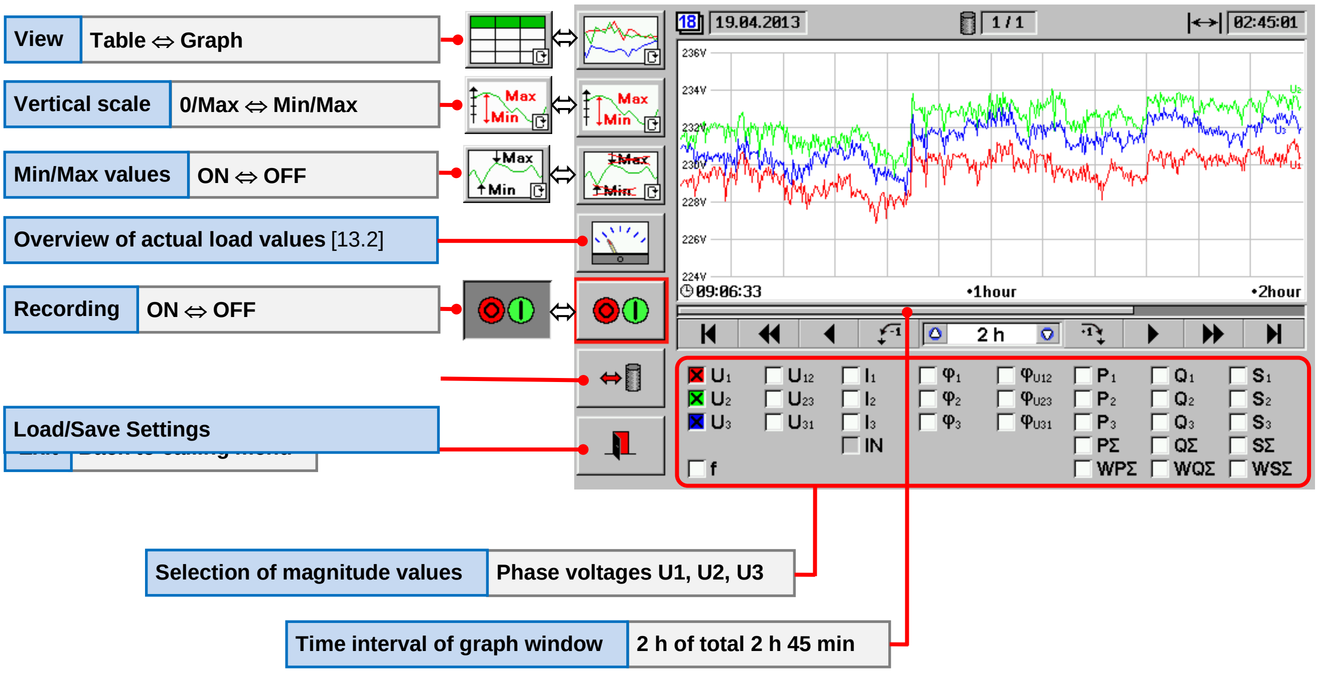
This allows further application of the instrument for precise load profiling or energy analysis.

The magnitude (rms or mean value) of the values listed with checkboxes can be analyzed individual or in any combination from the single result up to a 24h overview of the recording.



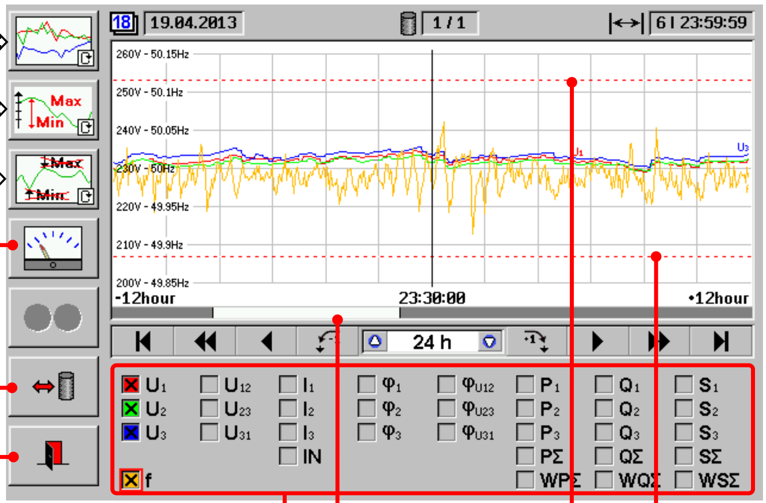
Magnitude UIφfPQS graph view

Example: PQ online analysis of phase to neutral voltages U1, U2, U3



Example: Analysis of recorded phase to neutral voltages U1, U2, U3 and frequency of 1 week

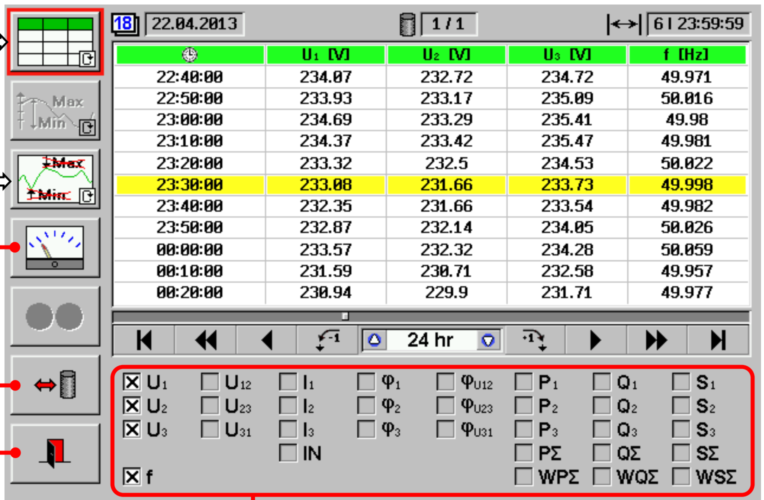
View	**Table ⇔ Graph**
Vertical scale	**0/Max ⇔ Min/Max**
Min/Max values	**ON ⇔ OFF**
Overview of actual load values [13.2]	
Load/Save Settings	
Exit	**Back to calling menu**



Selection of magnitude values	**Phase voltages U1, U2, U3 and frequency f**
Time interval of graph window	**24 h of total 7 days**
Evaluation limits	**Upper and lower limit for voltage (230V ± 10 %) regarding EN 50160**

UIφf PQS Magnitude UIφfPQS table view

View	**Graph ⇔ Table**
Min/Max values	**ON ⇔ OFF**
Overview of actual load values [13.2]	
Load/Save Settings	
Exit	**Back to calling menu**

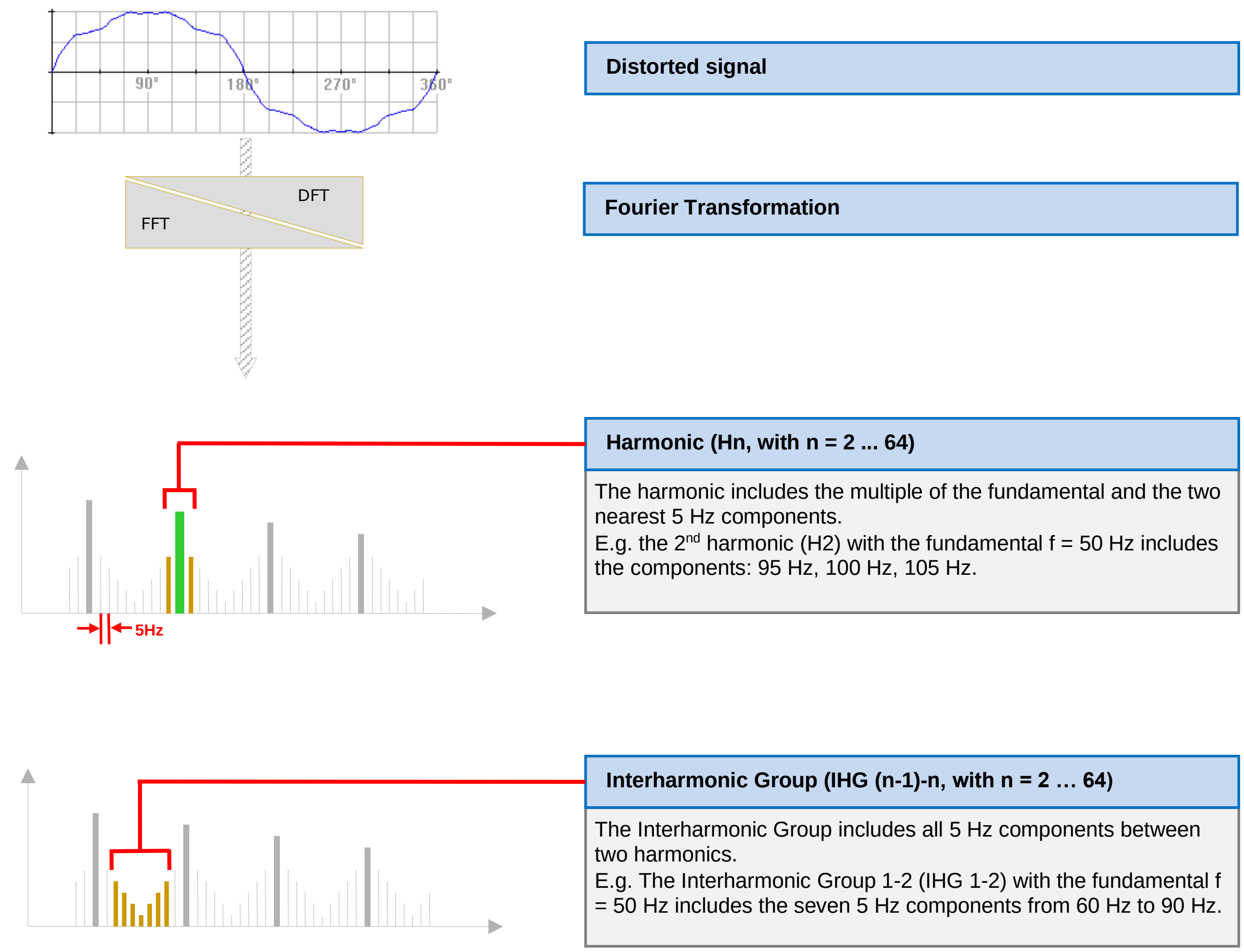


	U1 [V]	U2 [V]	U3 [V]	f [Hz]
22:40:00	234.07	232.72	234.72	49.971
22:50:00	233.93	233.17	235.09	50.016
23:00:00	234.69	233.29	235.41	49.98
23:10:00	234.37	233.42	235.47	49.981
23:20:00	233.32	232.5	234.53	50.022
23:30:00	233.08	231.66	233.73	49.998
23:40:00	232.35	231.66	233.54	49.982
23:50:00	232.87	232.14	234.05	50.026
00:00:00	233.57	232.32	234.28	50.059
00:10:00	231.59	230.71	232.58	49.957
00:20:00	230.94	229.9	231.71	49.977

Selection of magnitude values	**Phase voltages U1, U2, U3 and frequency**

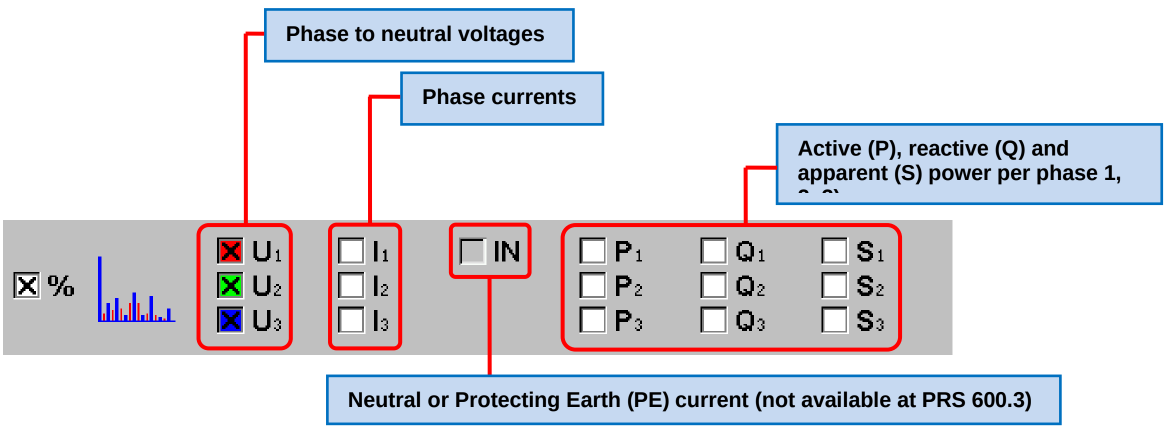
12.1.2 Harmonics and Interharmonics

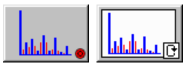
The Harmonics and Interharmonics up to the 64th order are analysed at the same time, based on gapless 10/12 cycle intervals at 50/60 Hz (approx. 200 ms), which leads to a frequency resolution of 5 Hz.



Selectable Values

The values listed with checkboxes can be analyzed individual or in any combination.

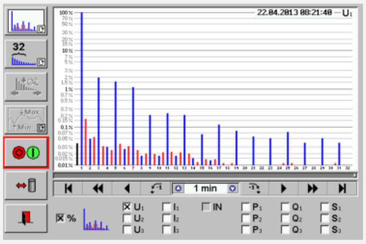




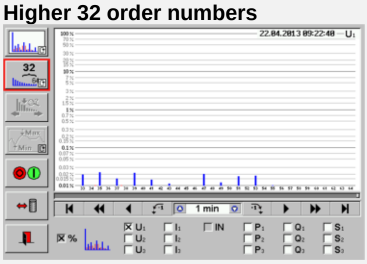
Harmonics / Interharmonics histogram view

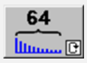
Display range of Harmonics / Interharmonics

Lower 32 order numbers

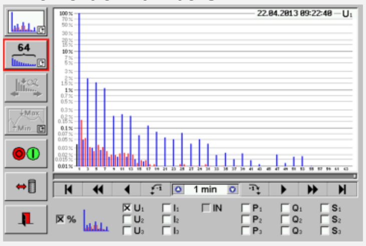


Higher 32 order numbers



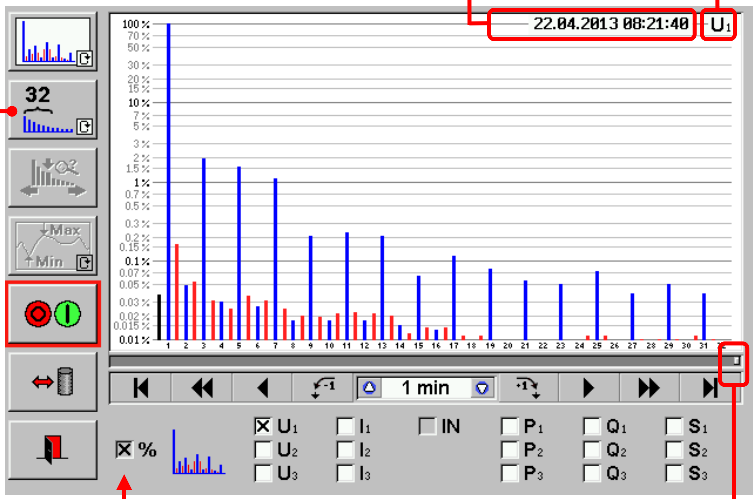


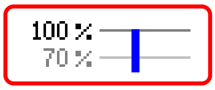
All 64 order numbers



Date and clock time

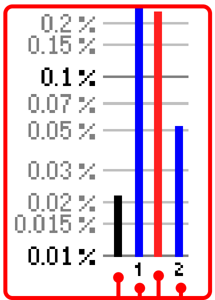
Value





Vertical scale in % of fundamental

The harmonics / interharmonics are indicated with a logarithmic scale in percentage of the fundamental (H1), which is always 100%.



Position of histogram in total recording

The bar graph indicates the length of the recording interval (3 s) and the position of the histogram in relation to the total recording time (full bar graph).
Note: The time interval (1 m) indicates the time step applied to select the next histogram backward / forward, when the keys ◀ / ▶ are used.

DC component

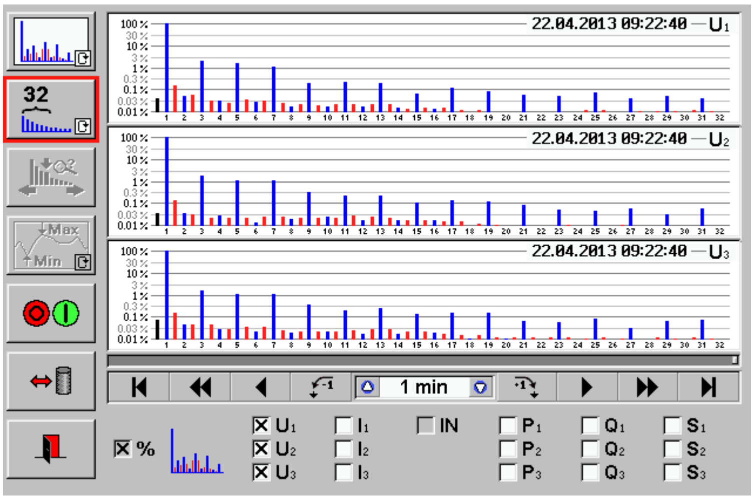
2nd Harmonic (H2)

Fundamental (H1)

Interharmonic 1-2 (IHG 1-2)

Display of several histograms

Up to three histograms are displayed at the same time, if several checkboxes are activated.
Any combination of 2 or 3signals can be displayed (e.g. all phase neutral voltages U1, U2, U3).
Note: If more than three checkboxes are active, the left and upper checkboxes have priority.



Harmonics / Interharmonics graph view

Example: Analysis of recorded Harmonics / Interharmonics of voltages U1, U2, U3 of 1 week

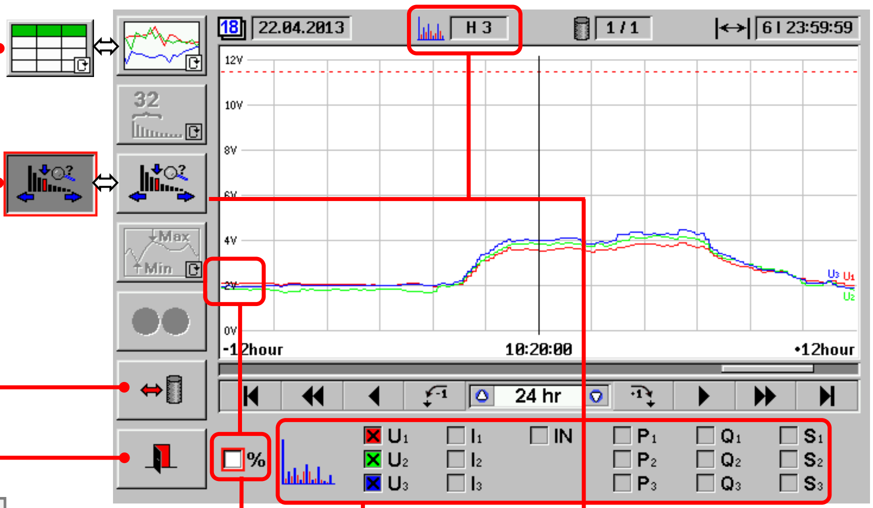
View	Table ⇔ Graph

Component selection	ON ⇔ OFF

Load/Save Settings

Exit	Back to calling menu

Indication type	Absolute value



Selection of values to analyse	Phase voltages U1, U2, U3

Select component to analyse

The details of one of the components:
- DC (DC)
- Fundamental (H1)
- Interharmonic (IHG 1-2 ... IHG 63-64)
- Harmonic (H2 … H64)

are shown over time for the selected magnitude values (e.g. 3rd harmonic (H3) of voltages U1, U2, U3).

Harmonics / Interharmonics table view

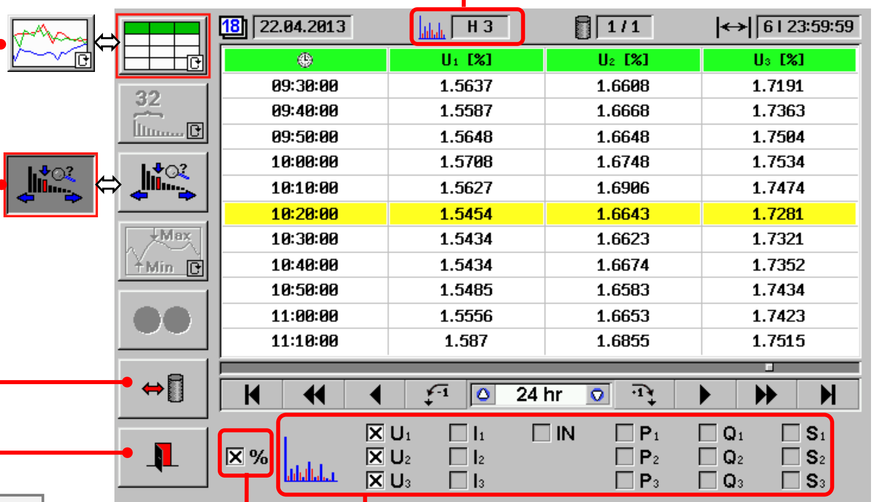
Analysed component	3rd harmonic (H3)

View	Graph ⇔ Table

Component selection	ON ⇔ OFF

Load/Save Settings

Exit	Back to calling menu



	U1 [%]	U2 [%]	U3 [%]
09:30:00	1.5637	1.6608	1.7191
09:40:00	1.5587	1.6668	1.7363
09:50:00	1.5648	1.6648	1.7504
10:00:00	1.5708	1.6748	1.7534
10:10:00	1.5627	1.6906	1.7474
10:20:00	1.5454	1.6643	1.7281
10:30:00	1.5434	1.6623	1.7321
10:40:00	1.5434	1.6674	1.7352
10:50:00	1.5485	1.6583	1.7434
11:00:00	1.5556	1.6653	1.7423
11:10:00	1.587	1.6855	1.7515

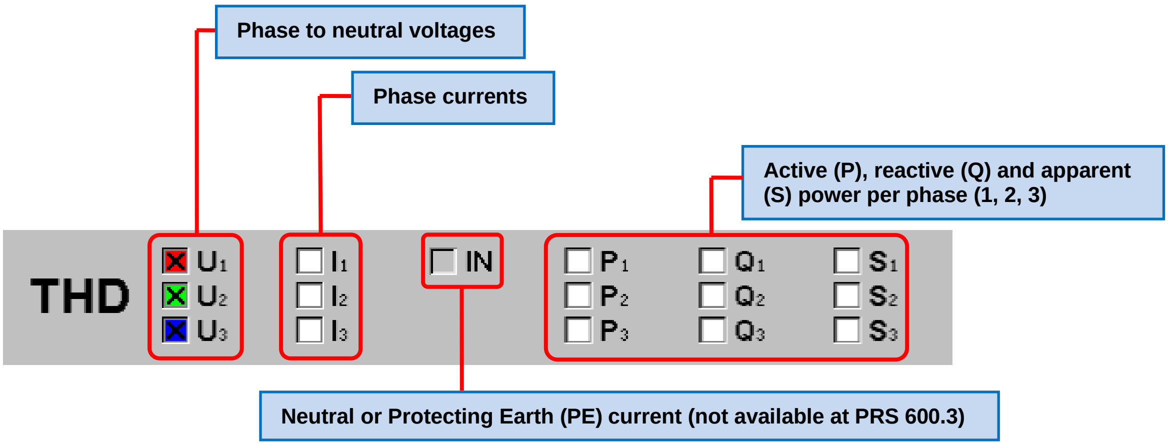
Indication type	Percentage of fundamental

Selection of values to analyse	Phase voltages U1, U2, U3

12.1.3 THD Total Harmonic Distortion

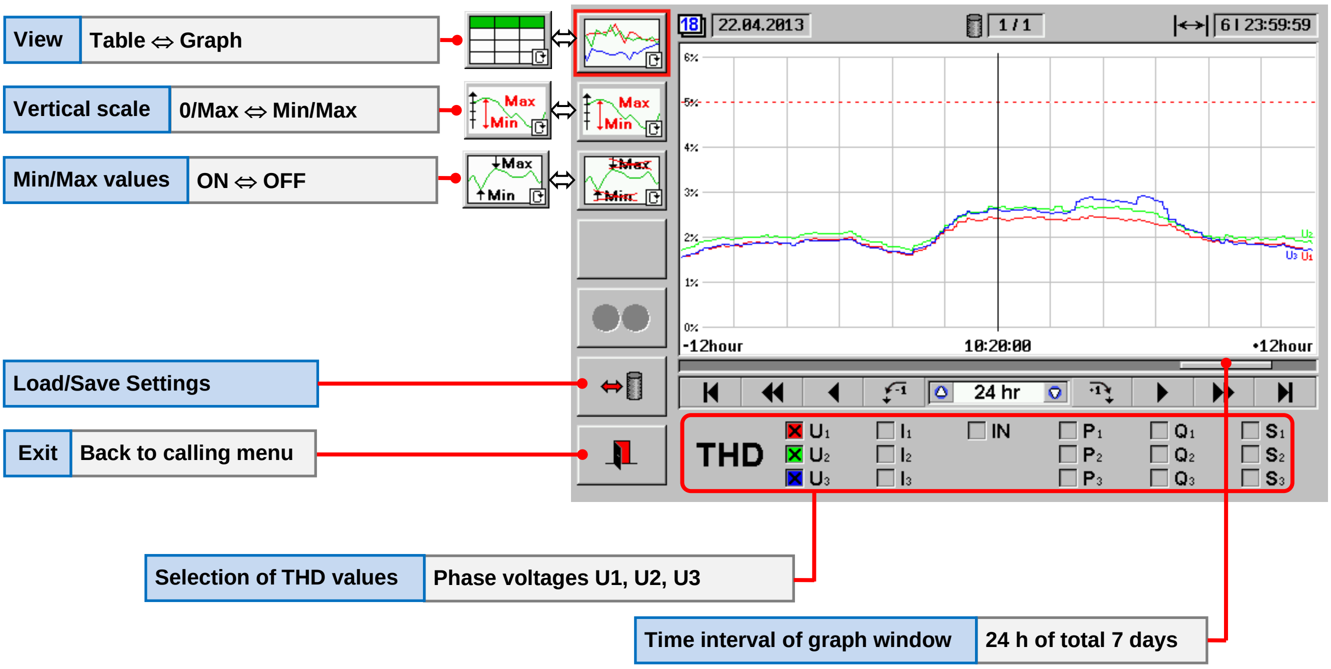
Selectable Values

The Total Harmonic Distortion (THD) of the values listed with checkboxes can be analyzed individual or in any combination.



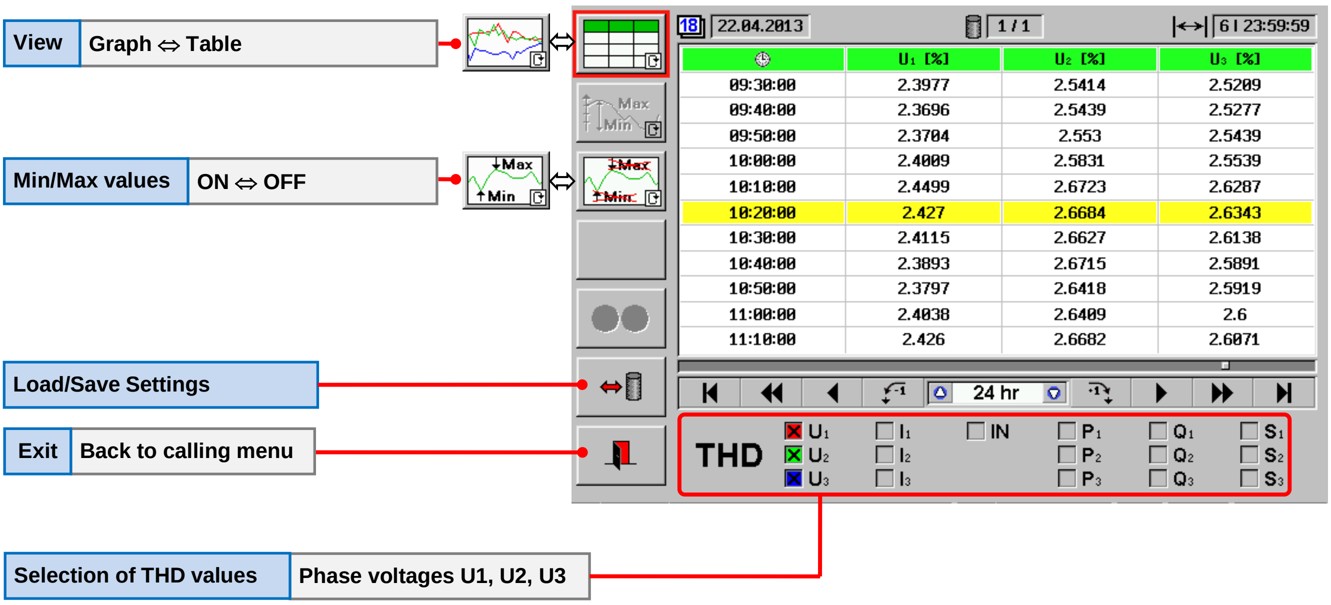
Total Harmonic Distortion graph view

Example: Analysis of recorded THD values of voltages U1, U2, U3 over 1 week



Total Harmonic Distortion table view

Example: Analysis of recorded THD values of voltages U1, U2, U3 over 1 week



	U1 [%]	U2 [%]	U3 [%]
09:30:00	2.3977	2.5414	2.5209
09:40:00	2.3696	2.5439	2.5277
09:50:00	2.3704	2.553	2.5439
10:00:00	2.4009	2.5831	2.5539
10:10:00	2.4499	2.6723	2.6287
10:20:00	2.427	2.6684	2.6343
10:30:00	2.4115	2.6627	2.6138
10:40:00	2.3893	2.6715	2.5891
10:50:00	2.3797	2.6418	2.5919
11:00:00	2.4038	2.6409	2.6
11:10:00	2.426	2.6682	2.6071

12.1.4 Flicker

The luminance variation of a light source, caused by relatively small (ΔU/U: 0.2 … 3.5 %), low frequency (f: 0.01 … 40 Hz) voltage variations is called flicker.

The human perception and reaction to flicker of long duration (several minutes up to hours) is very subjective and can cause discomfort, headache, up to an epileptic attack.

Flicker is therefore an important power quality problem since the beginning of electricity generation.

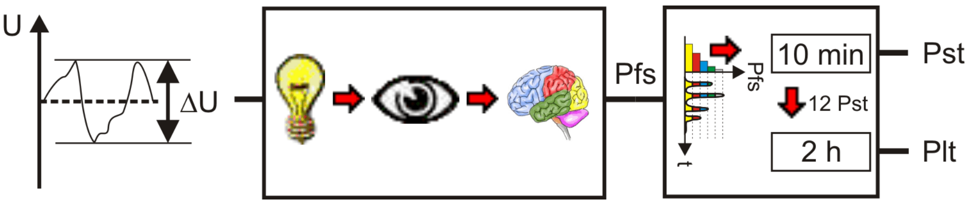
It is a very complex task to measure this human perception of flicker correctly.

To get objective, comparable flicker results, based on measurements of the voltage variations, the measurement and statistical evaluation of the perception of flicker was modeled in the standard IEC 61000-4-15 based on a 60 W filament light bulb (60W, 230V at 50 Hz or 60W, 120V at 60 Hz).

The flicker measurement is realized regarding the standard IEC 61000-4-15, which is a statistical evaluation of the human reaction to flicker based on the reaction of a 60W lamp to voltage variations and the reaction of the human eye and brain to the luminance variation of this lamp. This allows the objective evaluation of flicker based on measurements of the voltage fluctuations.

IEC 61000-4-15 Flickermeter

The perception limit, where 50% of the people find the light fluctuations disturbing, is defined as perception level **P = 1**. The flicker perceptibility or flicker severity is indicated in perception units.



A model of the lamp – eye – brain response defines the relation between voltage variations and instantaneous flicker sensation Pfs, followed by a statistically evaluation of the Pfs signal over a 10 min interval. The main outputs are:

Flicker Perceptibility (P):

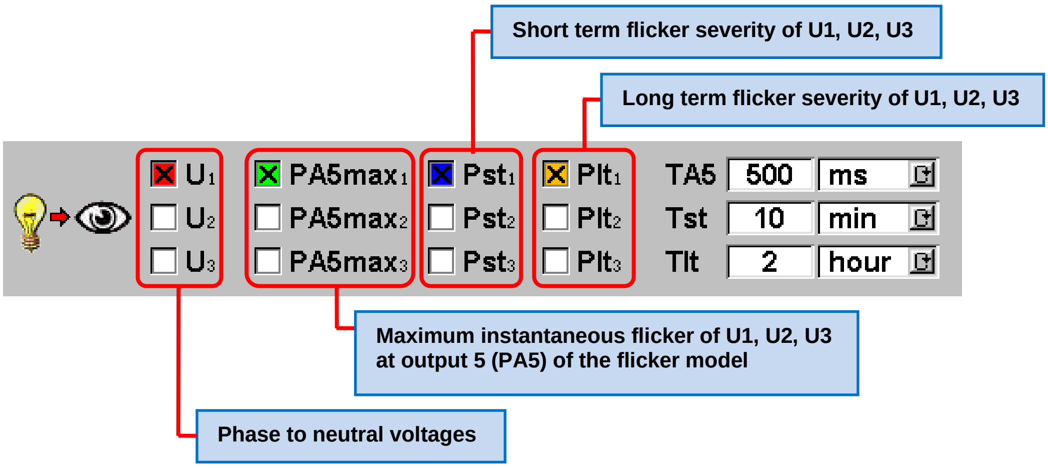
Pst **s**hort **t**erm flicker severity (10 min)

Plt **l**ong **t**erm flicker severity (2 h),
calculated from 12 Pst values (cubic mean value)

E.g. EN50160 requires during 95% of a week: Pst < 1, Plt < 0.65.

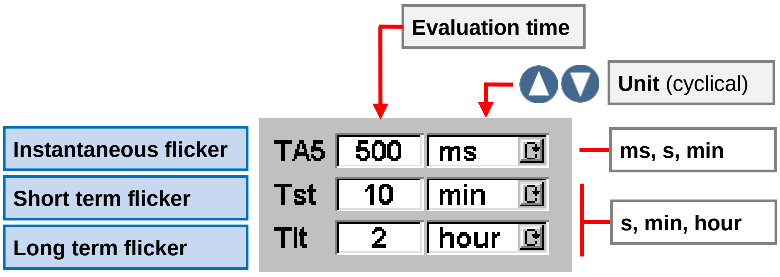
Selectable values

The values listed with check boxes can be analyzed individual or in any combination.



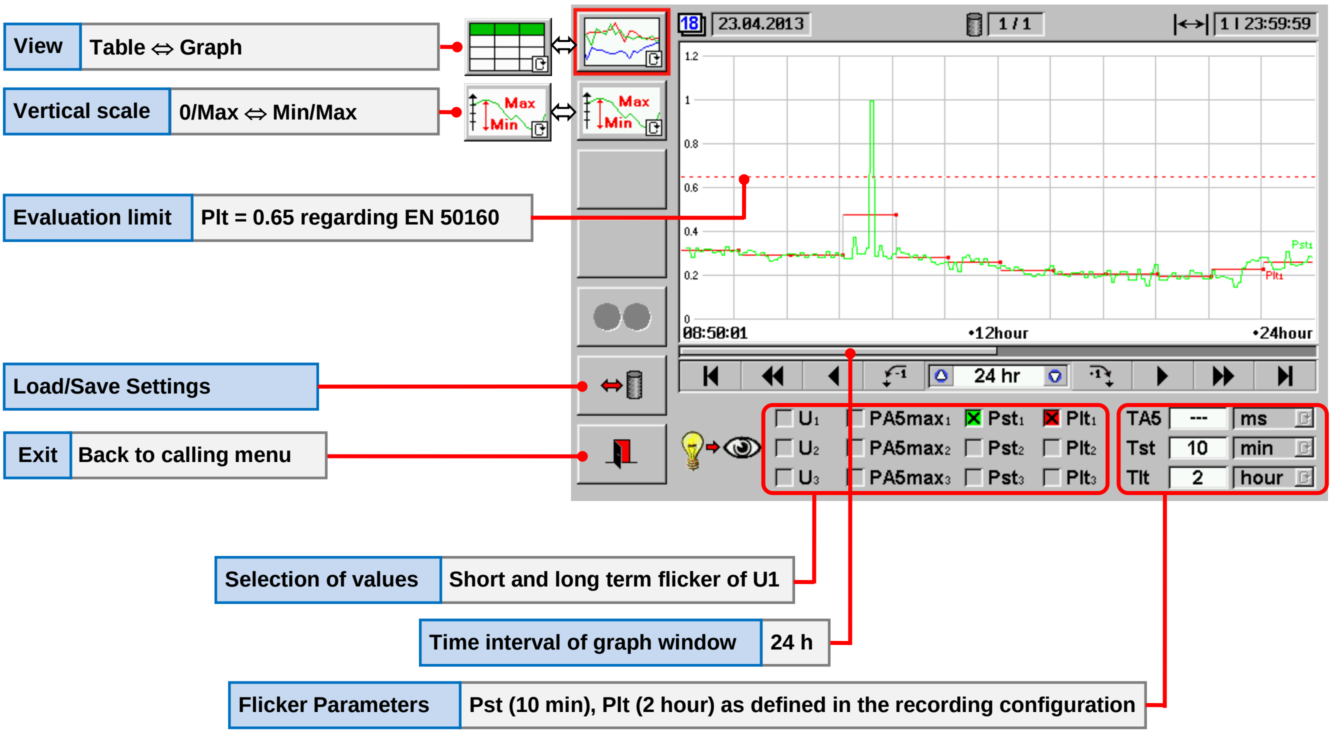
Flicker parameters

The time parameters for the instantaneous (TA5), short term (Tst) and long term (Tlt) flicker evaluation can be programmed directly (PQ online only).

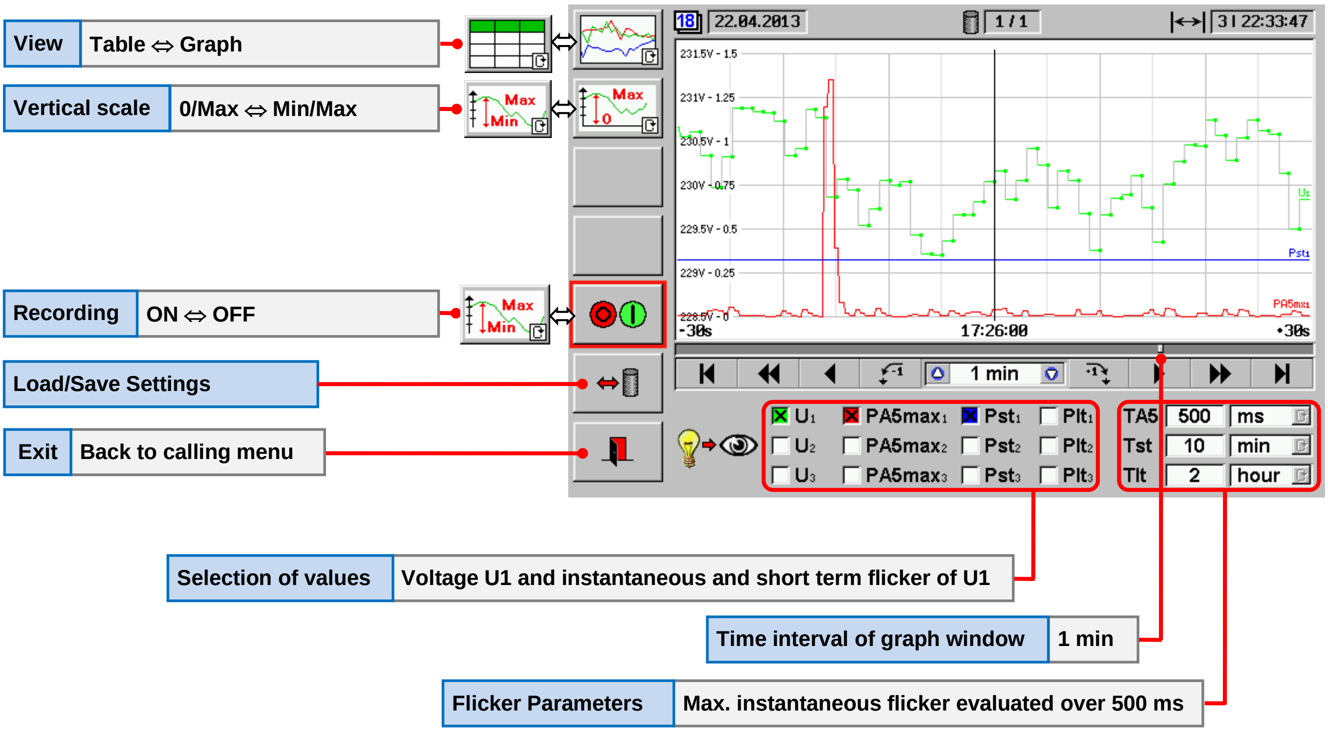


Flicker graph view

Example1: Analysis of recorded short and long term flicker of phase 1

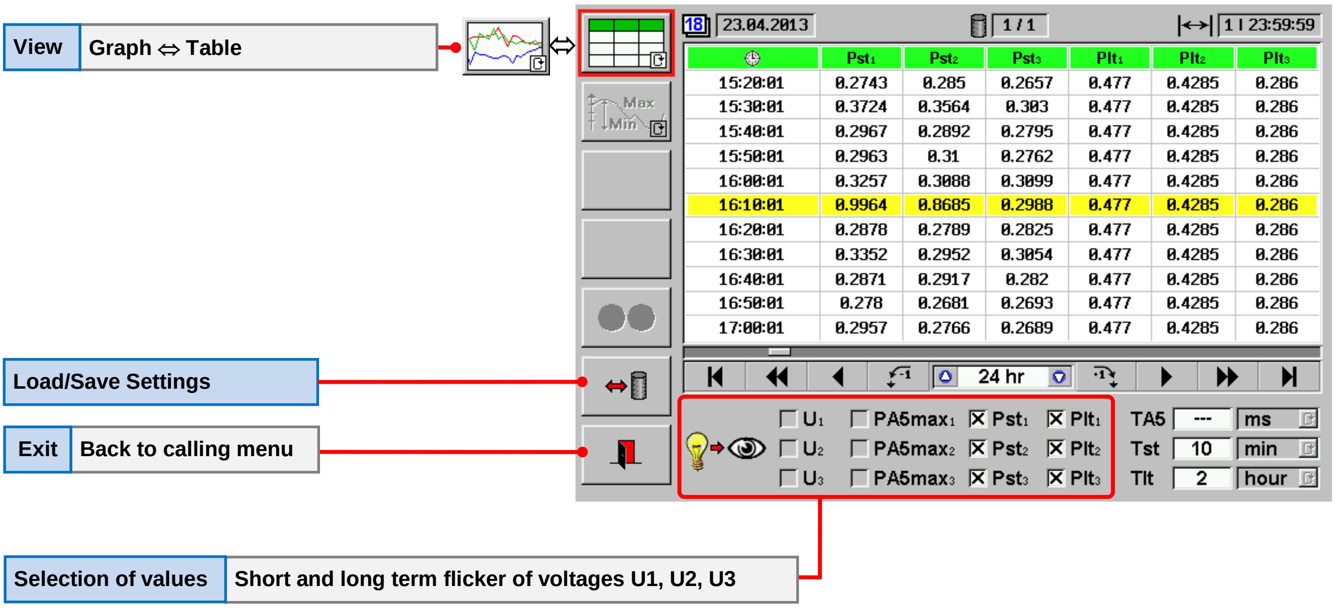


Example2: PQ online detail view of voltage and instantaneous flicker of phase 1



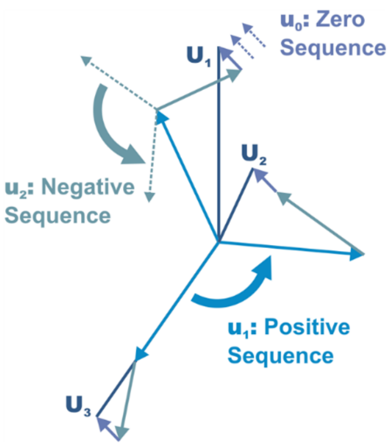
Flicker table view

Example 1: Analysis of recorded short and long term flicker of phases 1, 2, 3.



12.1.5 Unbalance

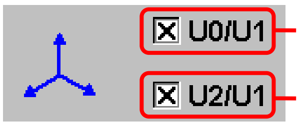
The voltage unbalance is only relevant in 3 phase systems and is caused by unequal impedances and asymmetrical loads. It causes problems mainly in distribution networks and e.g. can reduce the power and shorten the lifetime of motors and transformers.



The unbalance is analysed with help of the system of symmetrical components, which breaks down an unbalanced system in three balanced systems:

- Positive sequence (u_1)
- Negative sequence (u_2)
- Zero sequence (u_0)

The unbalance is indicated in relation to the positive sequence component (u_1).



Zero sequence unbalance [%]

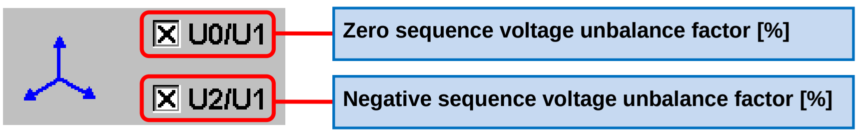
Negative sequence unbalance [%]

At a balanced 3 phase system the phase angles between the voltages are 120° and the voltage values are equal. For a perfectly balanced system therefore both zero and negative sequence unbalance are zero.

The negative sequence unbalance (U2/U1) is more important.

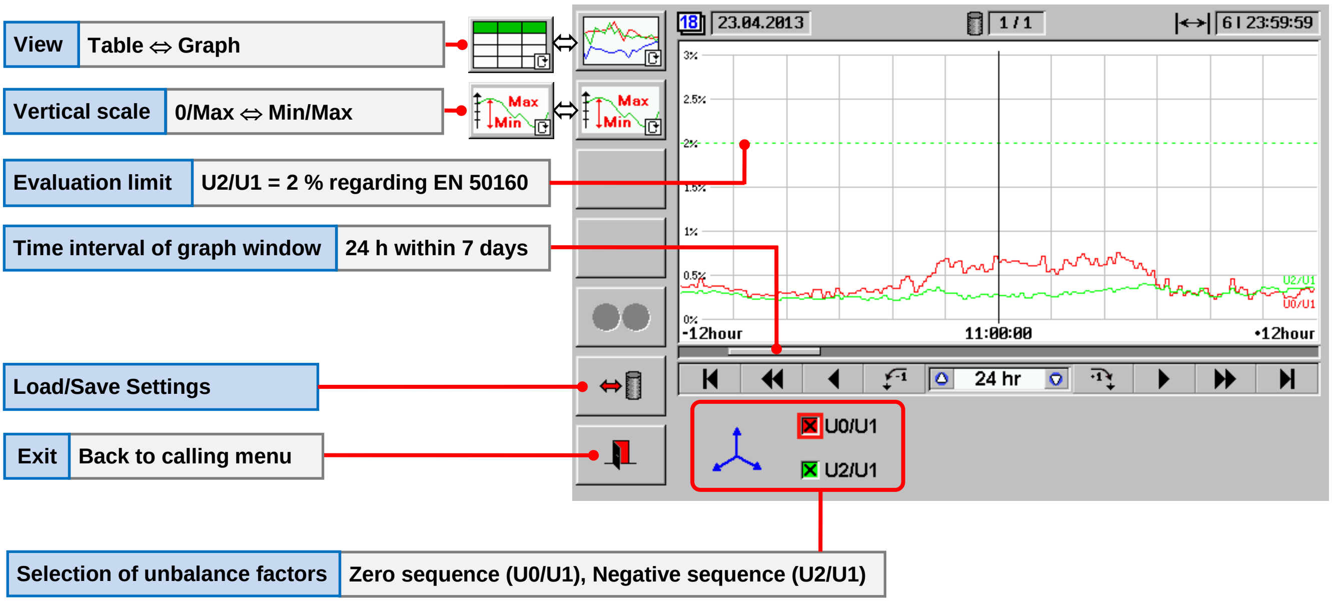
Typical limit for negative sequence unbalance regarding EN 50160: U2/U1 ≤ 2 %

Selectable Values



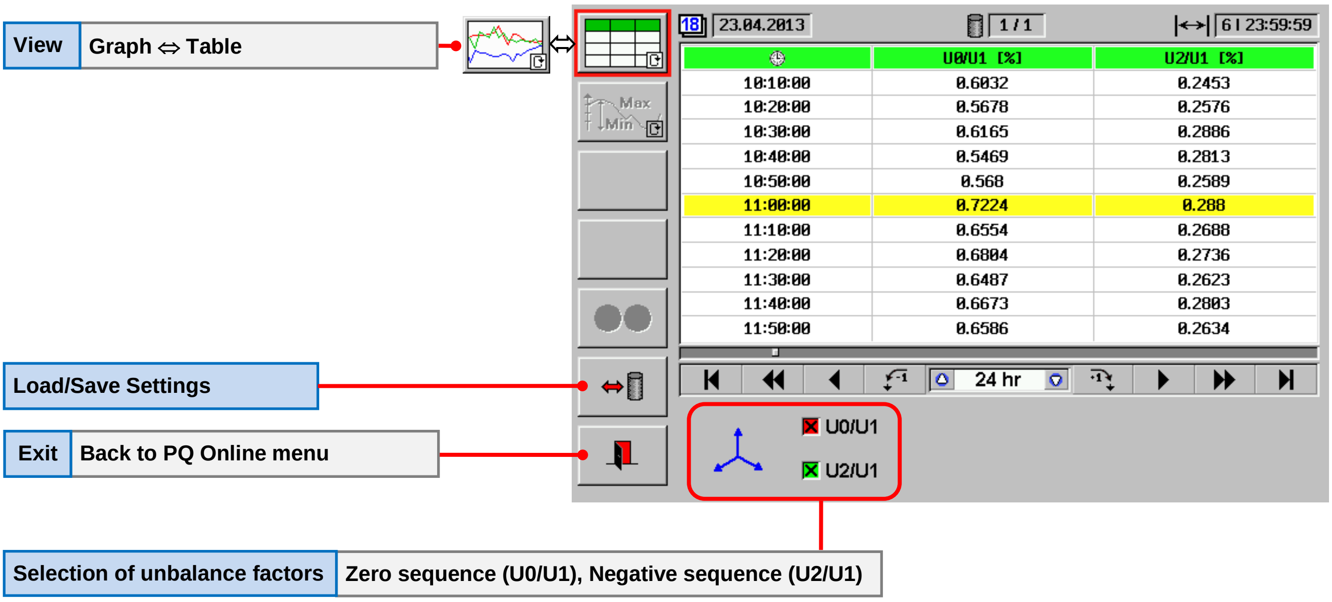
Unbalance graph view

Example: Analysis of recorded unbalance of 1 week



Unbalance table view

Example: Analysis of recorded unbalance of 1 week



	U0/U1 [%]	U2/U1 [%]
10:10:00	0.6032	0.2453
10:20:00	0.5678	0.2576
10:30:00	0.6165	0.2886
10:40:00	0.5469	0.2813
10:50:00	0.568	0.2589
11:00:00	0.7224	0.288
11:10:00	0.6554	0.2688
11:20:00	0.6804	0.2736
11:30:00	0.6487	0.2623
11:40:00	0.6673	0.2803
11:50:00	0.6586	0.2634

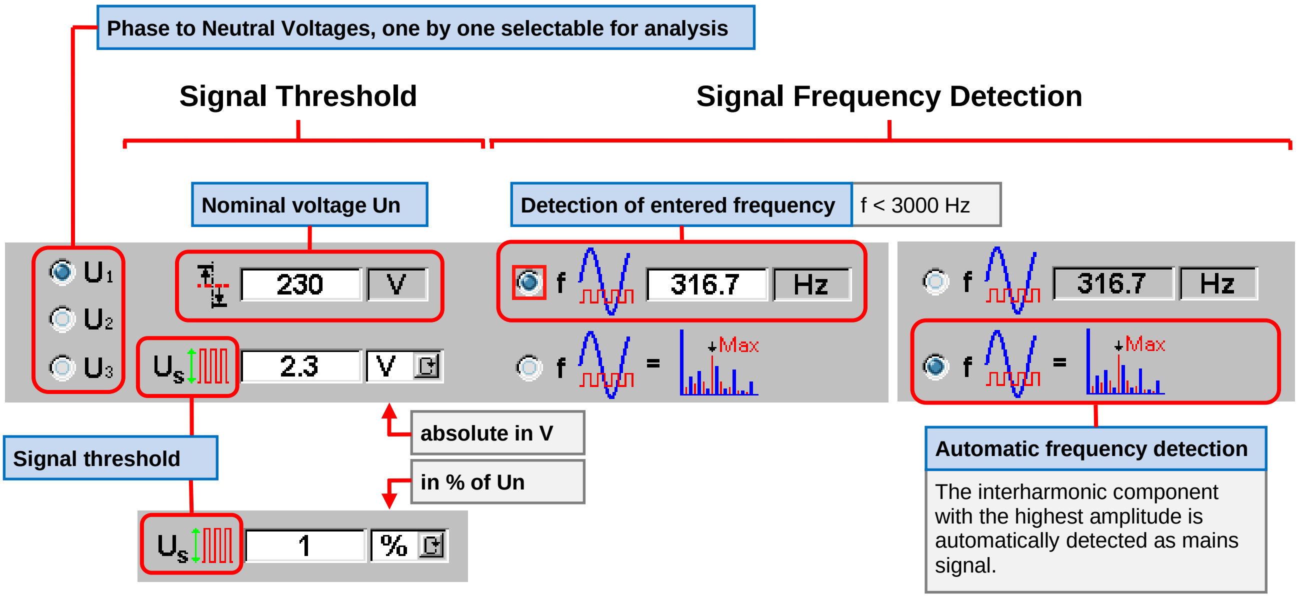
12.1.6 Mains Signaling

Low frequency control signals up to 3 kHz are coupled into the supply voltage system to control the load (e.g. remote switch on/off of the street lightning).

Other name used for Mains Signaling is Ripple Control (RC).

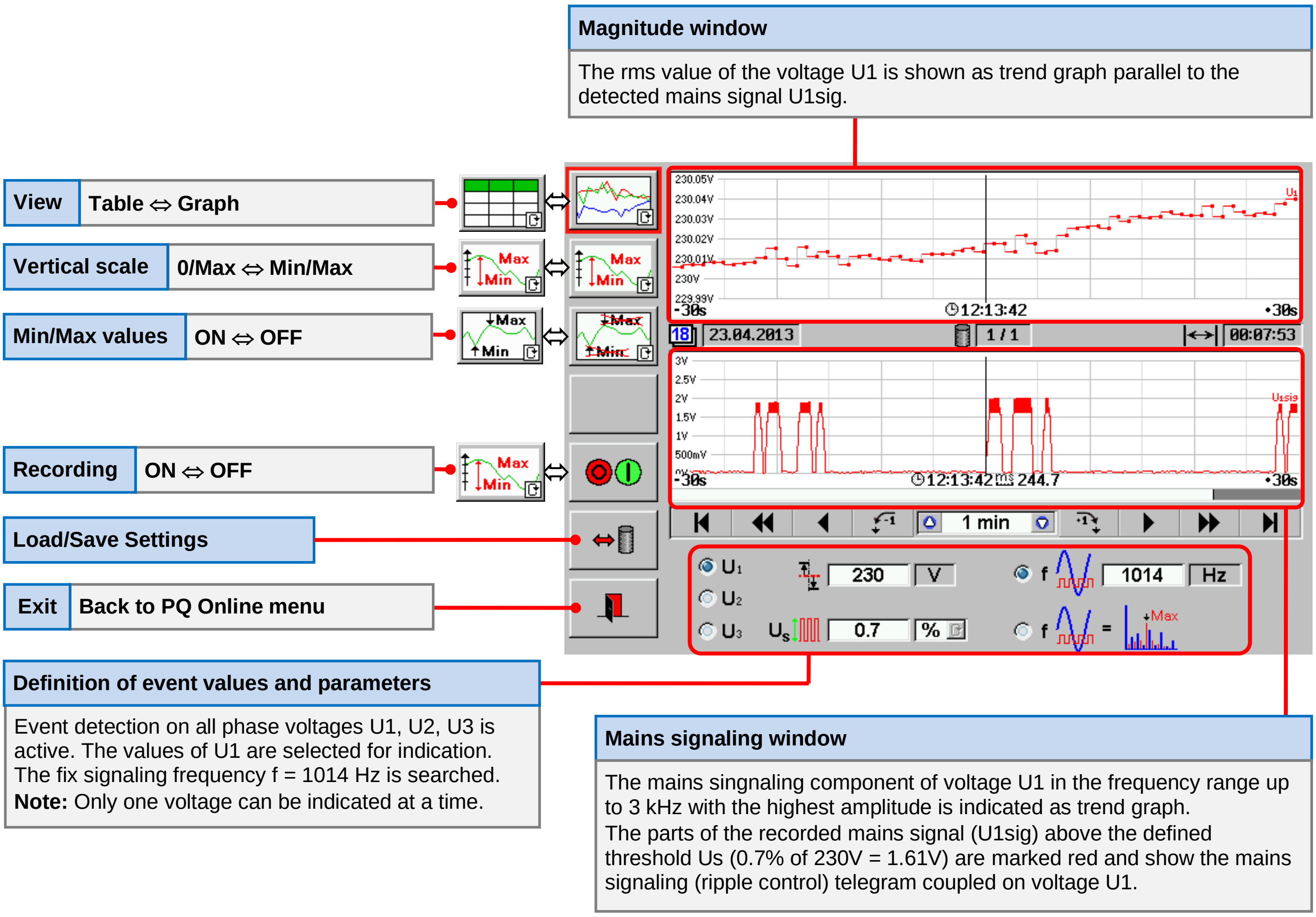
Selectable Values and Signal Parameters

One of the voltages U1, U2, U3 can be selected for analysis. The nominal voltage, the signal detection threshold and the signal frequency detection mode can be defined with parameters.



Mains signaling graph view

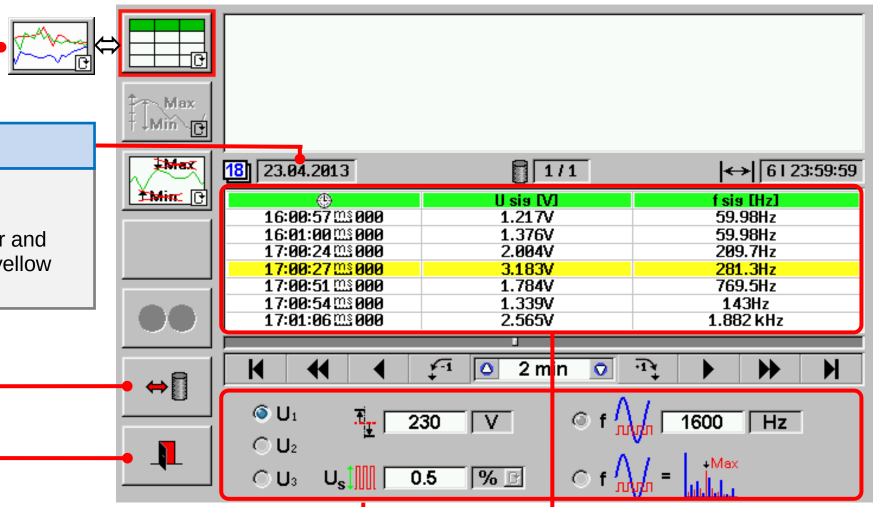
Example: PQ online analysis of mains signaling voltages of voltage U1



Mains signaling table view

Example: Analysis of recorded mains signaling values on voltage U1 of 1 week

View	Graph ⇔ Table



Date of recording
The date is indicated in the form **DD.MM.YYYY**, with **DD:** day, **MM:** month, **YYYY:** year and belongs to the time stamp in the yellow marked row.

Load/Save Settings

Exit	Back to calling menu

Voltage selection and definition of parameters
The indication of the mains signaling values of U1 is selected. The recording configuration was: - Nominal voltage: Un = 230V - Threshold for the signaling voltage: Us = 0.5 % Un, - Automatic detection of signaling frequency (fMax). **Note:** Only one voltage can be analyzed at a time.

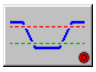
Mains signaling table

A list of all the mains signaling values, which have surpassed the threshold (0.5 % of 230V = 1.15V) is shown for voltage U1.

16:00:57ms000	Time stamp in the format **HH:MM:SS**ms**XXX** with: **HH:** Hours, **MM:** Minutes, **SS:** Seconds, **XXX:** Milliseconds.
U1sig [V]	RMS value of detected mains signaling component on U1 of the intervals, where the threshold (0.5 % of 230V = 1.15V) is surpassed.
f1max [Hz]	Detected frequency of U1sig

12.2 EVENTS or DISCRETE DISTURBANCES

These parameters are only recorded, if trigger conditions are fulfilled (values above or below a set threshold).

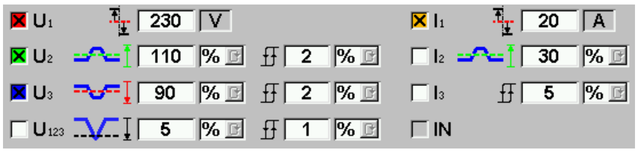


Events

Voltage (U)	Current (I)
- Swell	- Inrush current
- Dip	
- Interrupt	

GRAPHICAL RESULTS

- Trend graph U, I (interval: 1s)
- Signature curve (RMS ½)
- Waveform (9 cycles) at start/end



U123 Three phase voltage events

EVENT TABLE

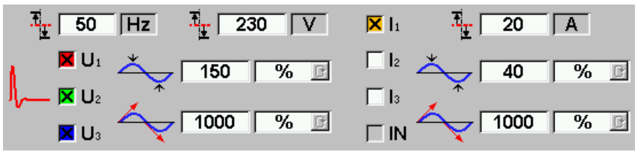
- Time stamp
- Duration
- Residual or peak value (RMS ½)

Transients

Voltage (U)	Current (I)

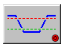
GRAPHICAL RESULTS

- Trend graph U, I (interval: 1s)
- Waveform (1 cycle)



EVENT TABLE

- Time stamp
- Duration
- Peak value
- Gradient

12.2.1  Events (Dip, Swell, Interrupt, Inrush)

Sudden big load changes or errors in the supply network can cause events like voltage dip, short time overvoltage (swell), interrupt or high inrush current. Such events can cause malfunctions and failures at the devices, motors or control systems connected to the supply network. Therefore, the detection and evaluation of these events is a very important task of power quality analysis.

The event detection is based on RMS ½ evaluation of the voltage and current signals regarding IEC 61000-4-30 with the requested results: duration and RMS ½ residual or peak value. Additional the PRS 600.3 records also the precise time stamp of the start of the event, the signature based on the RMS ½ values and the wave form of the signal at start and end of the event.

The detection starts at the crossing of definable trigger levels for dip, swell, interrupt and inrush current. The trigger levels are RMS values, which can be defined in % of definable reference values for U and I or absolute in V or A.

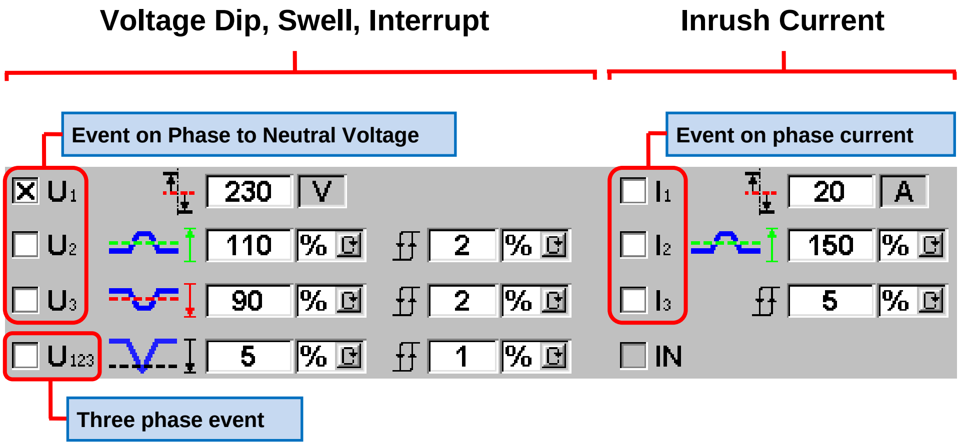
A hysteresis can be defined for each trigger level. The trigger level is raised or lowered a little bit by the magnitude of the hysteresis, as soon as the level is surpassed. This prevents, that small signal changes, which are going below the trigger level short after start of the event, are not detected as the end of the event.

At PQ online these values can be defined directly in the corresponding submenu of the PRS 600.3.

At recording mode these values are defined in the recording and analysis profile, which offers additional detection and evaluation possibilities. Two trigger levels and two event duration categories can be defined individual per type of event and per phase. This results in 4 combinations of trigger level and even duration, for which the number of admissible events per observation period can be defined.

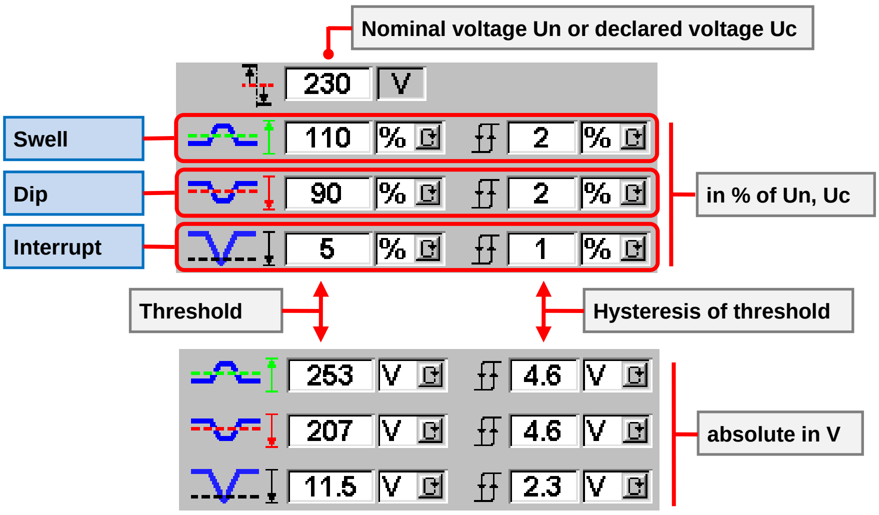
Selectable Values

Events of the values listed with checkboxes can be analysed individual or in any combination.

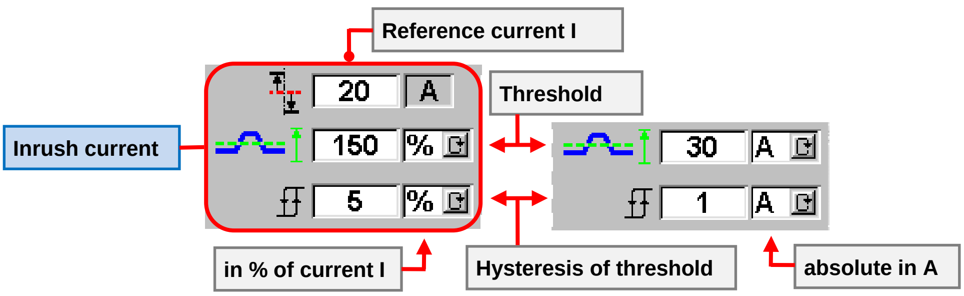


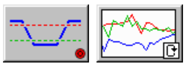
The trigger levels for the detection of the different events can be set with parameters.

Voltage Parameters



Current Parameters





Event graph view

Example: PQ online analysis of short interrupt at phase to neutral voltage U1

Magnitude window

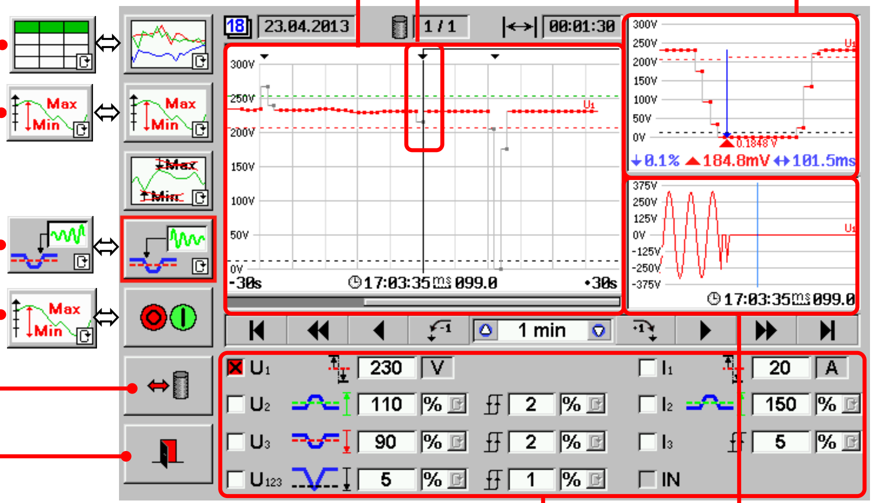
The magnitude or rms values of voltages and currents with selected check boxes are shown as trend graph together with the thresholds for the event detection (dashed lines).
All detected events are marked with black arrows at the top.
Recording interval: 1s
Note: Because of the long interval (1s) compared to the short interrupt time (0.1s), the event is shown as small dip not as interrupt in the magnitude window.

Event window

The event marked with the black line in the magnitude window is shown in detail (signature of the event).
Recording interval: Urms½ (1 cycle, started at each zero crossing of the signal, overlapping, e.g. 10 ms at 50 Hz).
Event parameters

Length	**101.5 ms**
Residual Value	**0.1%** of Un = 230 V
	184.8 mV

View	**Table ⇔ Graph**
Vertical scale	**Min/Max ⇔ 0/Max**
Wave form	**End ⇔ Start**
Recording	**ON ⇔ OFF**
Load/Save Settings	
Exit	**Back to calling menu**

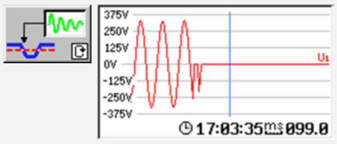


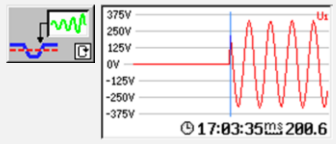
Definition of event values and parameters

Indication of events on phase voltage U1 is selected only.
Note: The input of the parameters (reference values of U and I, threshold, hysteresis) is only available at PQ online.

Wave form window

The wave form details at start and end of the event are shown (9 cycles of the fundamental).





Event table view

Example: PQ online analysis of phase to neutral voltage U1

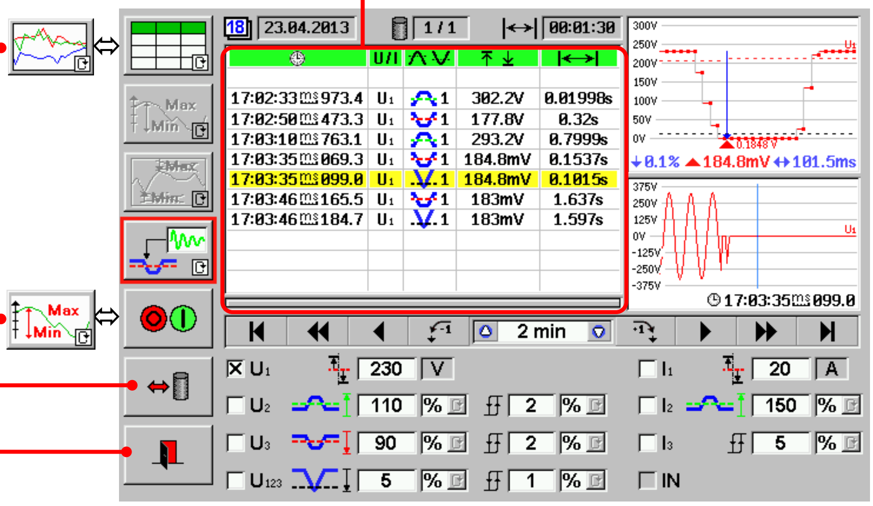
Event Table

A list of all recorded events is shown. The selected event is marked yellow.

Event Parameters

- **Event time stamp:** Start time stamp at crossing of threshold in format **HH:MM:SS**ms**XXX.X** with **HH:** Hours, **MM:** Minutes, **SS:** Seconds, **XXX.X:** Milliseconds.
- **U/I Quantity:** Voltage U1, U2, U3, U123(three phase event) or current I1, I2, I3, IN
- **Event type:** 1 Swell, 1 Dip, 1 Interrupt. The number indicates the level, which was surpassed (1 or 2). At PQ online there is only one level (1) available.
- **Peak/residual value:** Highest or lowest Urms½ value reached during the event. Peak Value at Swell, Residual Value at Dip or Interrupt.
- **Length:** Time between start time stamp at crossing of threshold and end time stamp at crossing of threshold ± hysteresis.

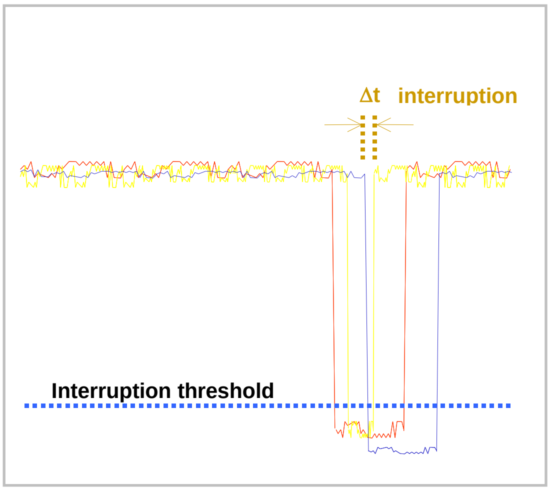
View	**Graph ⇔ Table**
Recording	**ON ⇔ OFF**
Load/Save Settings	
Exit	**Back to PQ Online menu**



Three phase Events (U_{123})

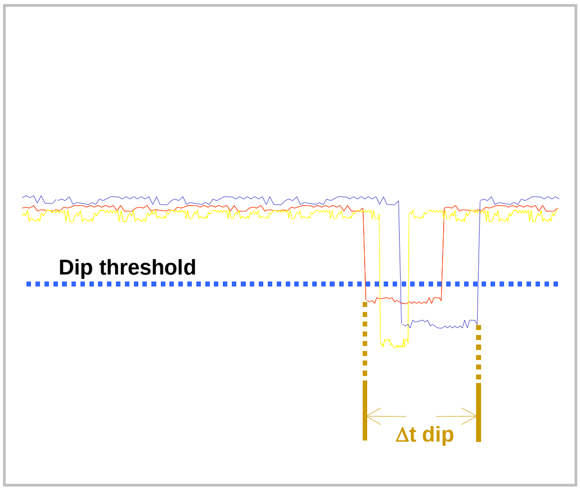
Example: Three phase Interrupt

A three phase interrupt is finished, as soon as **ONE** voltage is higher than the threshold + hysteresis level.



Example: Three phase Dip

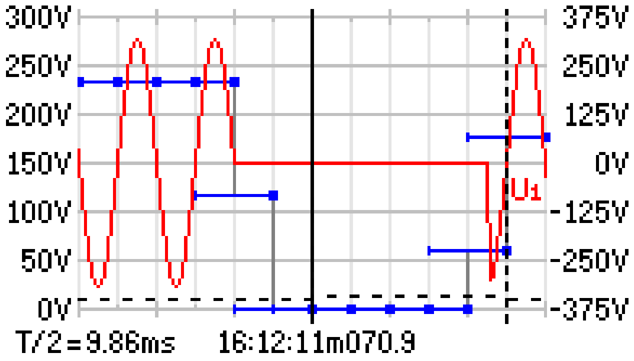
A three phase dip is finished, as soon as **ALL** voltages are higher than the threshold + hysteresis level.



Event recording with Urms½ values

Example: Short interrupt

The Urms½ values are calculated over 1 cycle of the fundamental of the signal. This is the minimum possible rms calculation interval. Every ½ cycle a new calculation is started. Therefore, the intervals are overlapping by ½ cycle.



The blue curve shows the overlapping Urms½ intervals. The dot at the end of the interval marks the time stamp belonging to this interval.

The red wave form shows a fast interrupt of 3 ¼ cycles. The blue Urms½ values are crossing the dashed interrupt threshold delayed by 1 cycle.

Because of the rms calculation, the detection of an interrupt is always delayed and quantised by ½ cycles of the fundamental (T/2).

The detection of the end of the interrupt is also delayed by ¼ cycle. The detected interrupt time in this case is 2 ½ cycles instead of the real 3 ¼ cycles.

12.2.2 Transients

Transients are fast voltage or current changes of short duration (<10 ms), which can happen at load changes (peaks, damped oscillation, notches, inrush currents) or lightning (peak values) etc.

The PRS 600.3 detects transient voltages and currents of a duration ≥ 100µs (sampling rate: 22.7 kHz) and saves the parameters: start time stamp, duration, peak value, gradient and the wave form of the transient during one period of the fundamental.

The height of the detectable peak values is defined by the used voltage and current inputs and the configuration of the internal ranges.

The detection starts at the crossing of definable peak values, indicated in % of a reference value for U or I or absolute in V or A.

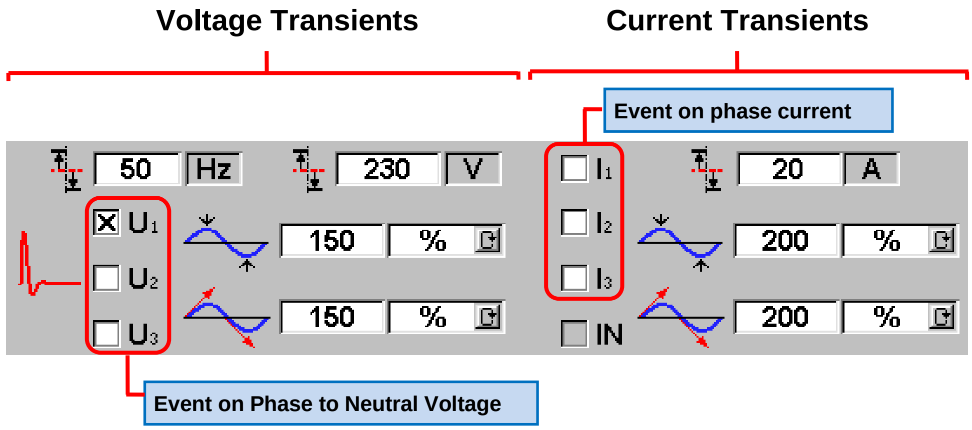
At PQ online additionally the gradient (steepness) of the signal at zero crossing can be defined as trigger parameter in % of reference or absolute in V/ms or A/ms. This allows e.g. the detection of short notches on the signal.

At PQ online these values can be defined directly in the corresponding submenu of the PRS 600.3.

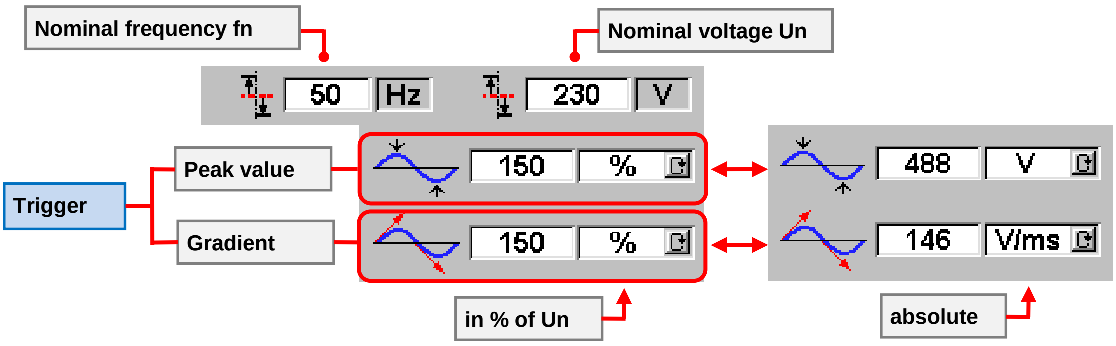
At recording mode, these values are defined in the recording and analysis profile, which offers additional detection and evaluation possibilities. Two trigger levels and two event duration categories can be defined individual per type of event and per phase. This results in 4 combinations of trigger level and event duration, for which the number of admissible events per observation period can be defined.

Selectable Values

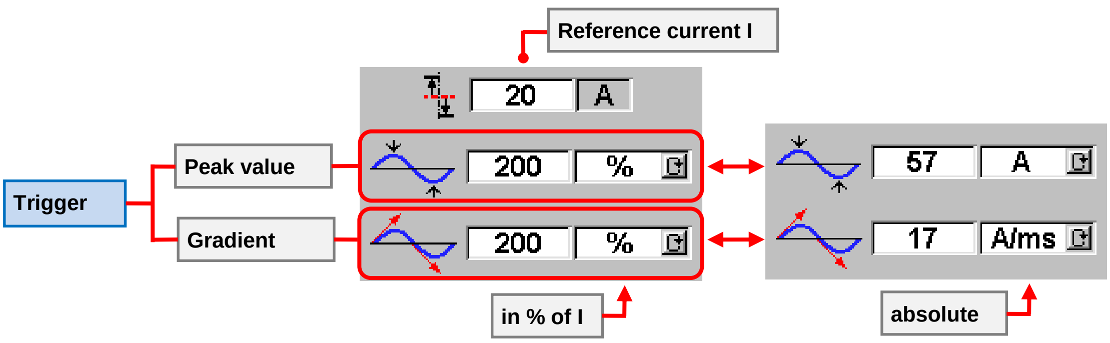
Transients of the values listed with checkboxes can be analysed individual or in any combination.



Voltage Parameters



Current Parameters



Transients graph view

Magnitude window

The magnitude or rms values of voltages and currents with selected check boxes are shown as trend graph.
All detected transients are marked with black arrows at the top.
Recording interval: 1s

Wave form window

The window shows details of the transient event marked with the black line in the magnitude window.
One period of the fundamental is shown. The transient part of the wave form is marked green and the peak value **287.5 V** and the wave form amplitude peak value 312.8 V are indicated.

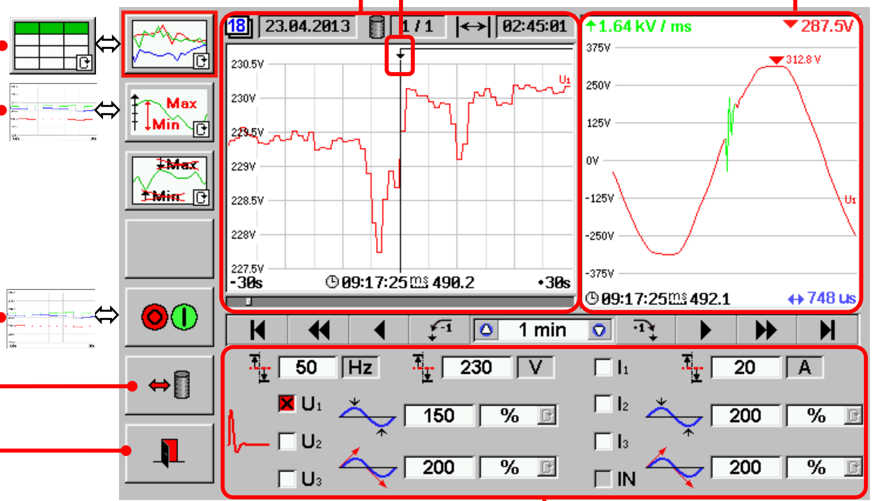
Event parameters

Slope	**1.64 kV/ms**
Peak value	**287.5 V**
Length	**748 µs**

View	**Table ⇔ Graph**
Vertical scale	**0/Max ⇔ Min/Max**
Recording	**ON ⇔ OFF**

Load/Save Settings

Exit	**Back to calling menu**



Definition of event values and parameters

Indication of events on phase voltage U1 is selected only.
Note: The input of the parameters (reference values of f, U and I, threshold, gradient) is only available at PQ online.

Transients table view

Event Table

A list of all recorded events is shown. The selected event is marked yellow.

Event Parameters

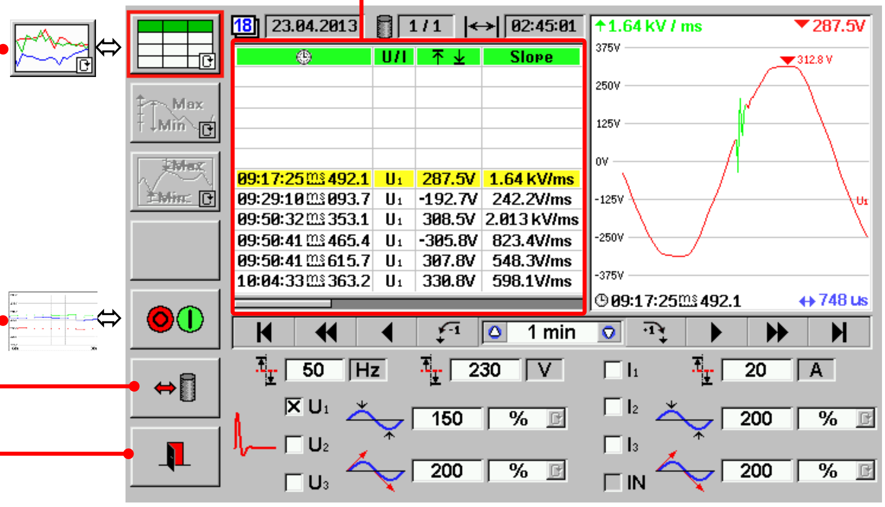
Event time stamp: Start time stamp at crossing of threshold in format **HH:MM:SS**m**XXX.X** with:**HH:** Hours, **MM:** Minutes, **SS:** Seconds, **XXX.X:** Milliseconds.
U/I **Quantity:** Voltage U1, U2, U3 or current I1, I2, I3, IN
Positive / negative peak value: Highest positive or negative value reached during the event.
Slope **Slope** of the green marked transient part of the wave form.

View	**Graph ⇔ Table**

Recording	**ON ⇔ OFF**

Load/Save Settings

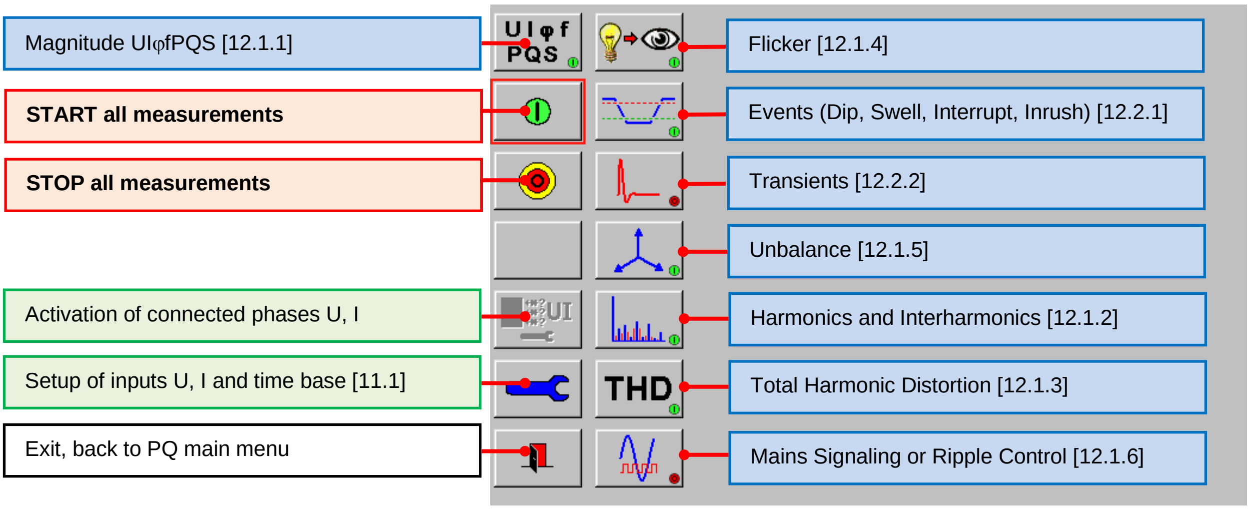
Exit	**Back to calling menu**



13. Power Quality Online Measurement

Simple to configure and operate direct parallel recording and analysis at a common recording interval (t_{RMS}). This allows a quick on site analysis for troubleshooting of customer complaints and fault localization.

PQ Online main menu



One, a selection or all of the listed PQ parameters can be recorded at the same time and analysed with trend graph, table or histogram view.

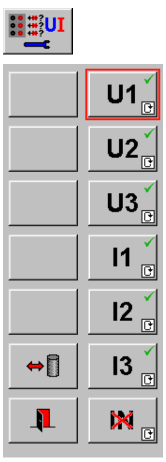
All available values and settings are always visible at the graphical user interface and selections and settings can directly be changed.

13.1 Preparation of online measurements

1 Make measuring setup regarding installation to check

- Connect accessories (e.g. clamp-on CT’s) to the instrument.
- Connect the supply cable and switch on the PRS 600.3.
- Make voltage and current connections between instrument and installation.

2 Activate the connected voltage and current phases



Call the menu for the activation of connected phases U, I

Activate connected phases

Enable [√] / disable [X] the available voltage and current phases by pressing on the corresponding buttons (cyclical mode).

or

Load / save a configuration

Different configurations (e.g. voltages only, phase 1 (U1, I1) only etc.) can be saved and recalled later.

3 Check / change settings of U, I input and the time base trms

Call menu setup of inputs U, I and time base [11.1].

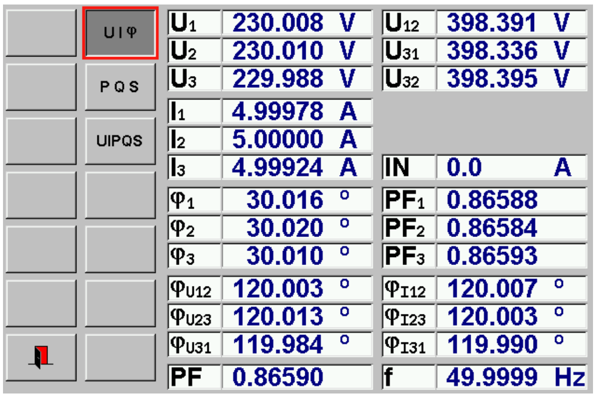
- Select the current input (direct or type of clamp-on CT), which shall be used for the measurement of I1, I2, I3.
- Manually select voltage and current ranges.
  Note: The ranges will be fixed during recording. Therefore, the end of range values should be higher than the max. reached voltage and current values during recording.
- Setup and activate transformer factors for voltage and current transformers, if used (optional)
- Define the time base of the recording, the basic recording time interval (trms) in cycles of the fundamental (cyc) or in seconds (sec), minutes (min) or hours (hr).

13.2 Overview of actual load values UIφfPQS

Call the magnitude menu and then the measurement menu.

The submenu shows the actual measured load values.
The values are updated in the basic recording time interval trms, which is different from the time base used at 'Reference'.
These indications may help to define the correct settings for the voltage and current ranges in the menu for the setup of the inputs U, I [11.1].

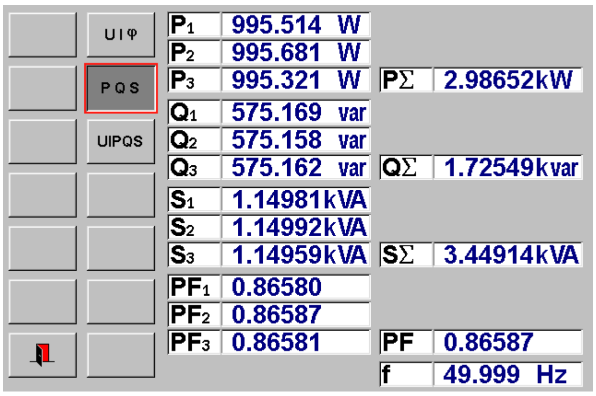
13.2.1 UIφ values



The display shows all relevant load values of a 4-wire network at the same time.

- Phase to neutral voltages (U_1, U_2, U_3)
- Phase to phase voltages (U_{12}, U_{23}, U_{31})
- Phase currents (I_1, I_2, I_3)
- Neutral of earth current (IN) (not available at PRS 600.3)
- Phase angles current to voltage (φ_1, φ_2, φ_3)
- Phase angles voltage to voltage (φ_{U12}, φ_{U23}, φ_{U31})
- Phase angles current to current (φ_{I12}, φ_{I23}, φ_{I31})
- Power factors per phase and sum, depending on connection mode (PF_1, PF_2, PF_3, PF)
- Frequency (f)

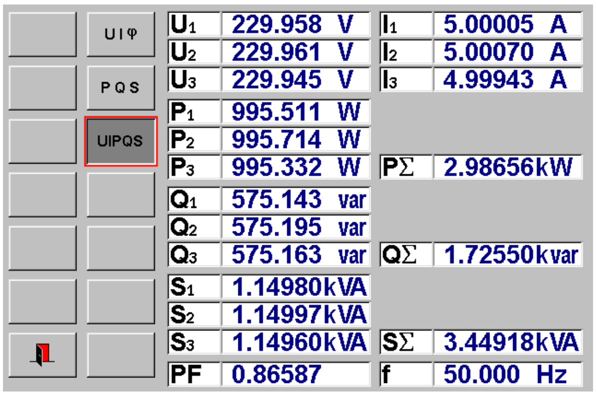
13.2.2 PQS values



The display shows all available power values of a 4-wire network at the same time:

- Active power per phase and sum (P_1, P_2, P_3, PΣ)
- Reactive power per phase and sum (Q_1, Q_2, Q_3, QΣ)
- Apparent power per phase and sum (S_1, S_2, S_3, SΣ)
- Power factors per phase and sum (PF_1, PF_2, PF_3, PF)
- Frequency (f)

13.2.3 UIPQS values



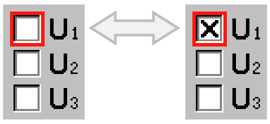
The display shows all relevant load values of a 4-wire network at the same time.

- Phase to neutral voltages (U_1, U_2, U_3)
- Phase currents (I_1, I_2, I_3)
- Active power per phase and sum (P_1, P_2, P_3, $P\Sigma$)
- Reactive power per phase and sum (Q_1, Q_2, Q_3, $Q\Sigma$)
- Apparent power per phase and sum (S_1, S_2, S_3, $S\Sigma$)
- Power factor sum (PF)
- Frequency (f)

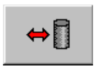
13.3 Run a Power Quality Online Measurement

1 Select values to analyse and define parameters for events and signaling

Go to the parameter submenus, where you plan to measure and analyse values.



Select values / enter parameters
Select the values to analyse by pressing on the corresponding checkboxes which will enable **[x]** / disable **[ ]** analysis of the selected value.
Enter parameters with virtual keyboard, where necessary
or

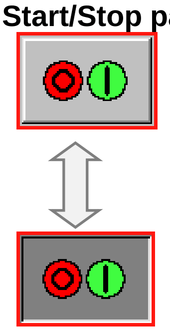


Load / save configuration
Select the load / save function to load or save a configuration of values and parameter settings.

2 Start / stop online recording

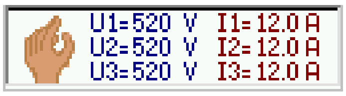
The online recording can be started and stopped individually in each parameter submenu or common for all parameters in the PQ online main menu.

Start/Stop parameters individual



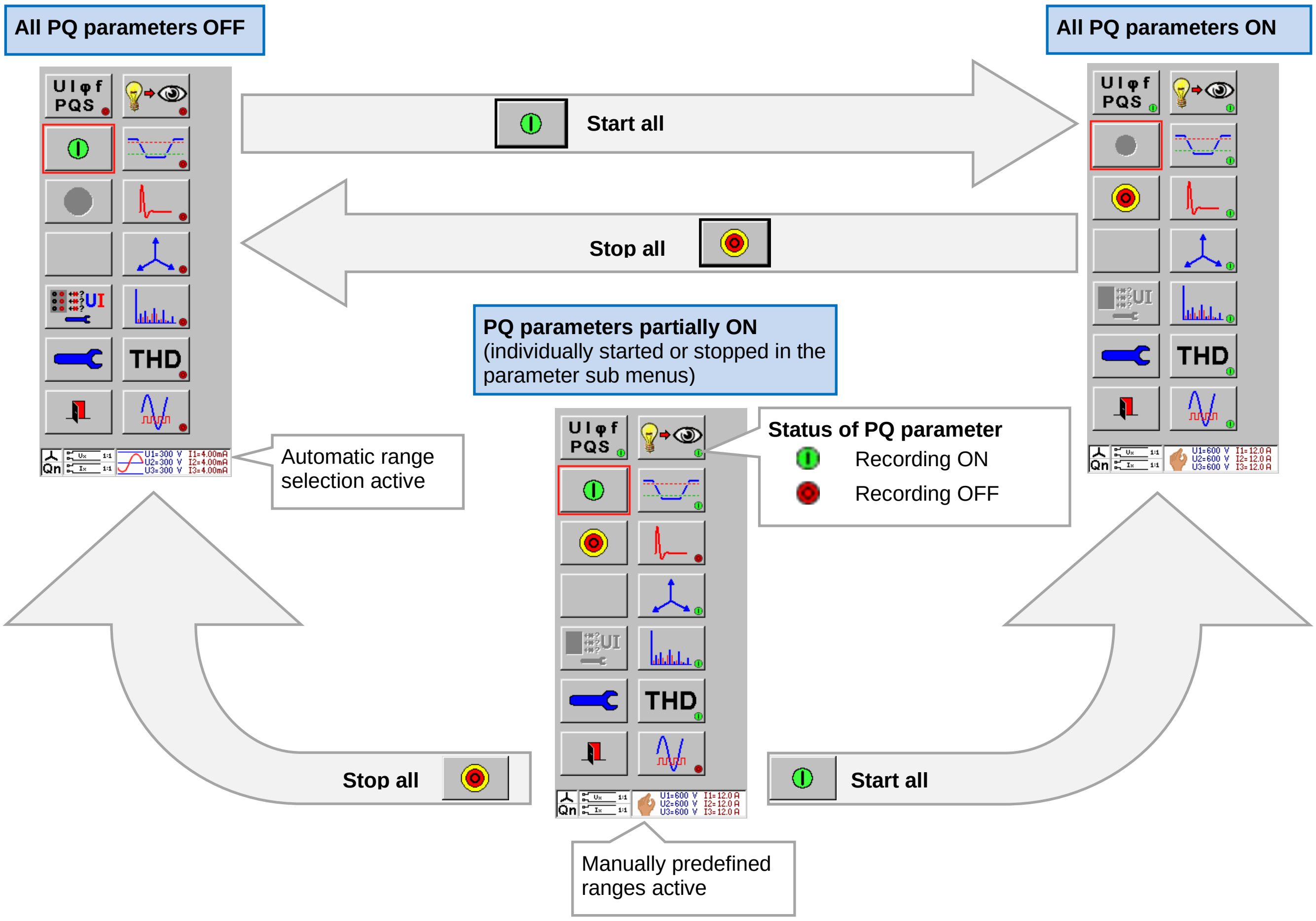
Recording OFF
The Start/Stop button is out and if no other recording is active, the automatic range selection is active.

Start / Stop recording



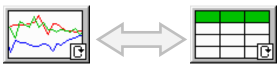
Recording ON
The online recording is active with the basic time interval. The Start/Stop button is shown depressed.
The manual range selection is active with the predefined current and voltage ranges.

Start/Stop measurement of all parameters
Select the PQ online main menu and press the start or stop button depending on the actual state and desired action.

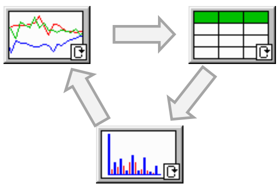


3 Analyse values of the different PQ parameters with different views and over the time

Select view of results



Select between graph or table view
(at all parameters, except harmonics)



Select between graph, table or histogram view at harmonics
(cyclical mode)

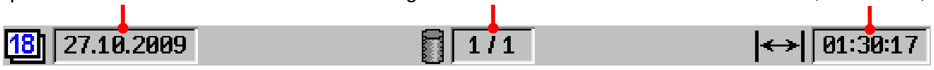
The selection can be changed at any time during recording or at stopped recording.

Navigation within the recording

Date **dd.mm.yyyy**, with d: day, m: month, y: year, of time stamp in graph or marked row in table.

Recording block x of n blocks **x / n**

Total recording time **hh:mm:ss**, with h: hour, m: minute, s: second



Size and position of selected time interval (e.g. 10 m) in recording

The bar graph background shows the total recording time

Start of recording clock time in center / **Recorder mode**

End of recording clock time in center / **Tracking mode**

Jump to start — **Jump to end**

1 time interval / 1 table (11 rows) / 2 time intervals — **fast backward** — **fast forward**

1 time division / 1 result row / 1 time interval — **backward** — **forward**

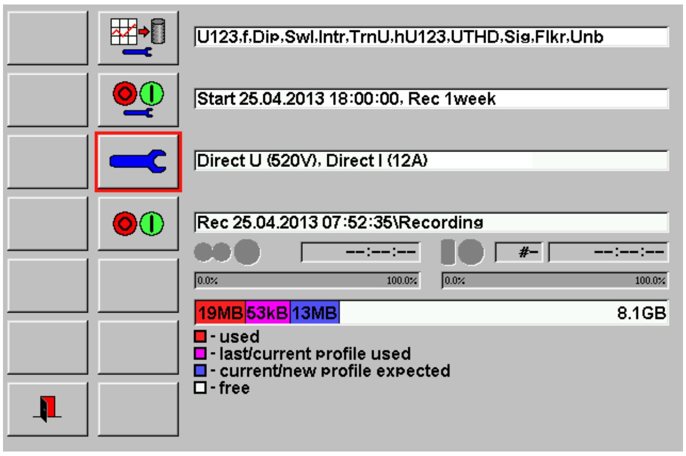
1 result / 1 event backward — **1 result / 1 event forward**

Bigger time interval (zoom out / overview) — **Smaller time interval (zoom in / details)**

14. Power Quality Recording

The recording function supports long time recording on the Compact Flash (CF) card with a very high flexibility regarding recording and analysis configurations. The basic recording intervals are freely configurable for each parameter and each phase in number of cycles (1 cycle = 20ms at 50Hz or 16.67ms at 60Hz) or with a time interval with unit s, min, h.

This includes the intervals required regarding IEC 61000-4-30, like the basic recording time intervals: 10(12) cycles (U, I), 10 s (f) and the aggregation intervals: 150(180) cycles for 50(60) Hz, 10min, 2h.



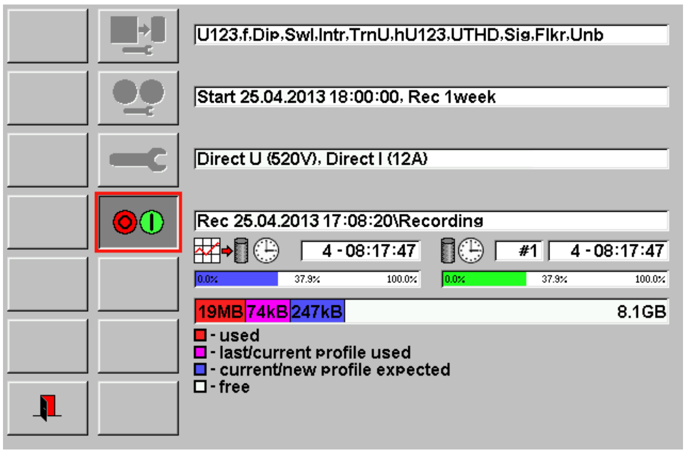
For a fast preparation of a recording session predefined setups can be loaded or directly be defined:

Recording / analysis profile (e.g. EN50160)

Recording options start options, recording time, recording in one or several recording time blocks

Setup of inputs U, I like voltage and current inputs used, transformer factors, internal range settings [11.1].

Start/Stop of recording



After start of the recording the progress is indicated with:

Rest of programmed recording duration

Rest of actual recording block duration (for 1 block the same as the recording duration)

The actual allocation of the CF card (used, free memory) and the expected memory usage for the selected profile and recording duration are indicated.

The already recorded values can be analyzed in parallel with the analysis function.

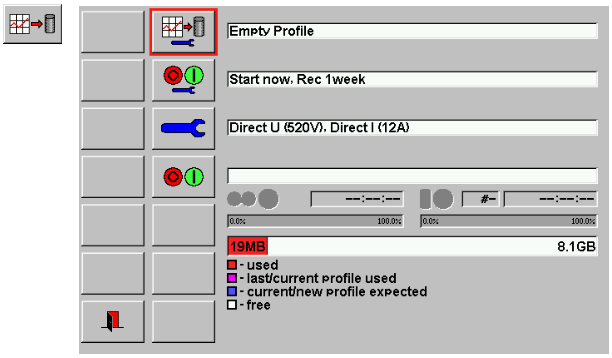
14.1 Run a Power Quality recording

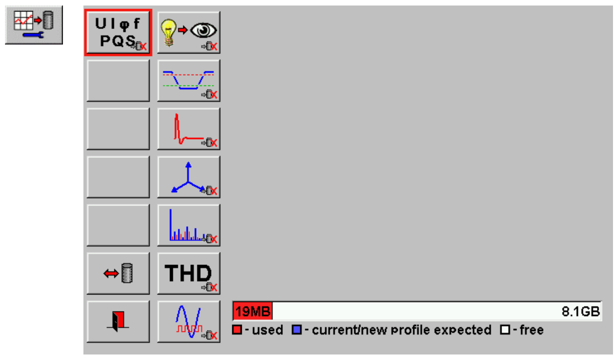
1 Make measuring setup regarding installation to check

- Connect accessories (e.g. clamp-on CT's, communication interfaces) to the instrument.
- Connect the supply cable and switch on the PRS 600.3.
- Make voltage and current connections between instrument and installation.

Example: Connect voltages U1, U2, U3, N only to analyze a 3-phase 4-wire network regarding the standard EN 50160.

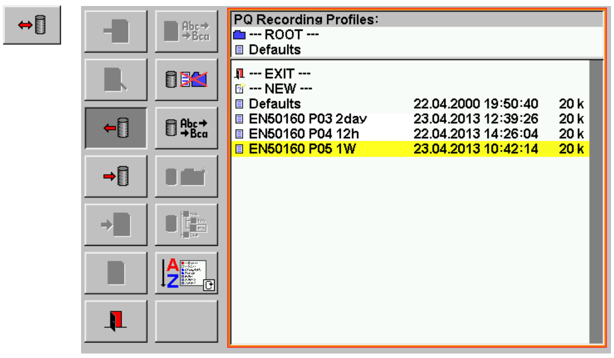
2 Go to the recording menu and then to the setup of recording and analysis profiles [14.2]

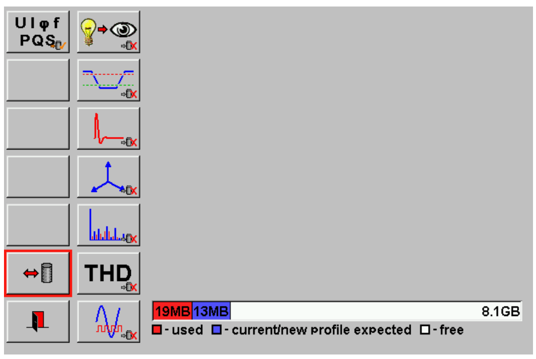




Define the recording and analysis settings of the different PQ parameters and phases directly or load a predefined profile.

Example: Load recording and analysis profile for evaluation of the supply voltage regarding standard EN 50160 for 1 week (e.g. EN 50160 P05 1W)



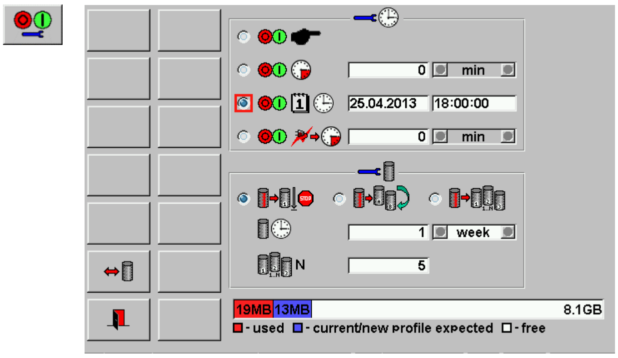


The expected memory usage of the loaded profile is indicated with a blue bar (13 MB).

3 Go to the setup of recording options [14.3]

Define the recording start options and the recording duration and time block configuration directly or load predefined settings.

Example: Start at exact date and time, record 1 week in 1 block and then stop.

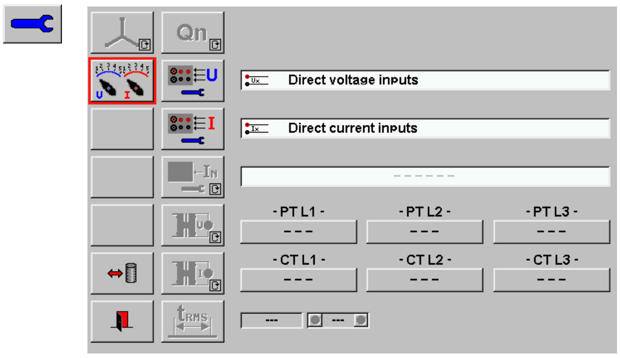


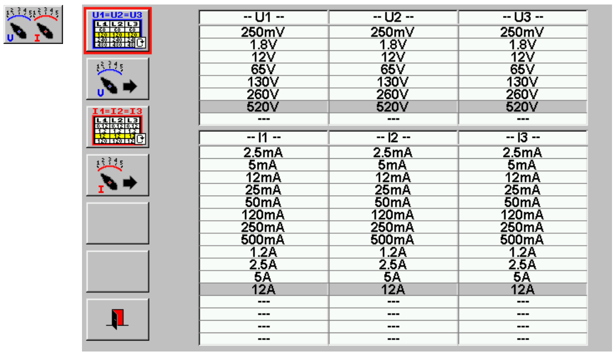
4 Setup of voltage and current inputs [14.4]

- Select the current input (direct or type of clamp-on CT), which shall be used for I1, I2, I3 measurement.
- Manually select voltage and current ranges.
  Note: The ranges will be fixed during recording. Therefore, the end of range values should be higher than the max. reached voltage and current values during recording.
- Setup and activate transformer factors for voltage and current transformers (optional)

Example: Direct voltage inputs used, internal voltage range 520V selected.

Note: The settings for the current inputs and current ranges do not matter for this example, because only voltages are measured.





5 Check time and date

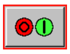
All recordings are saved with a time stamp with the actual date and time as indicated in the status field in the lower right corner.

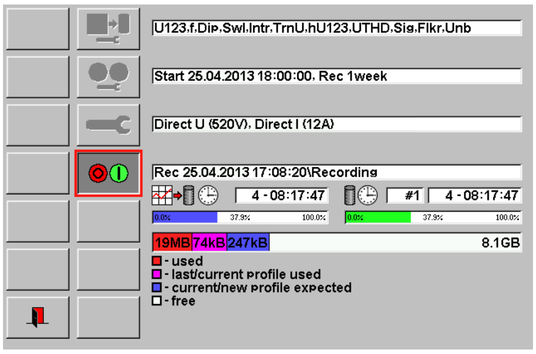
Check time and date settings and change if necessary at **Data Base / Setup / Clock setup** [5.1].

6 Start recording

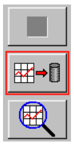
Press the start/stop button to initialize the recording regarding the defined recording options.

Example: The recording starts at the defined date and time and runs for 1 week



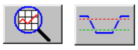


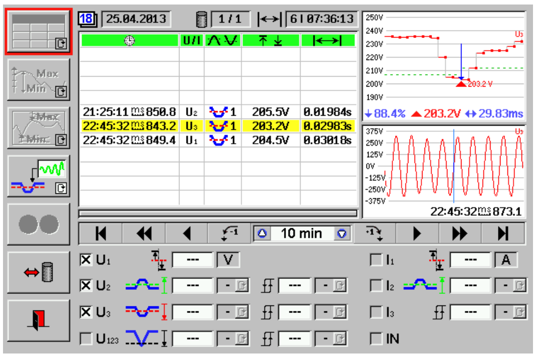
7 Follow a running recording with the analysis function [15] (optional)



The PQ online measurement is locked during a running recording, but the analysis function is available and works parallel to the recording.

Example: Analysis of events (dip, swell, interrupt) with the event table.





8 Stop of recording

The recording can be stopped at any time by pressing the start/stop button.

The automatically stop of the recording depends on the programmed recording options.

Example: The recording will stop automatically after 1 week of recording.

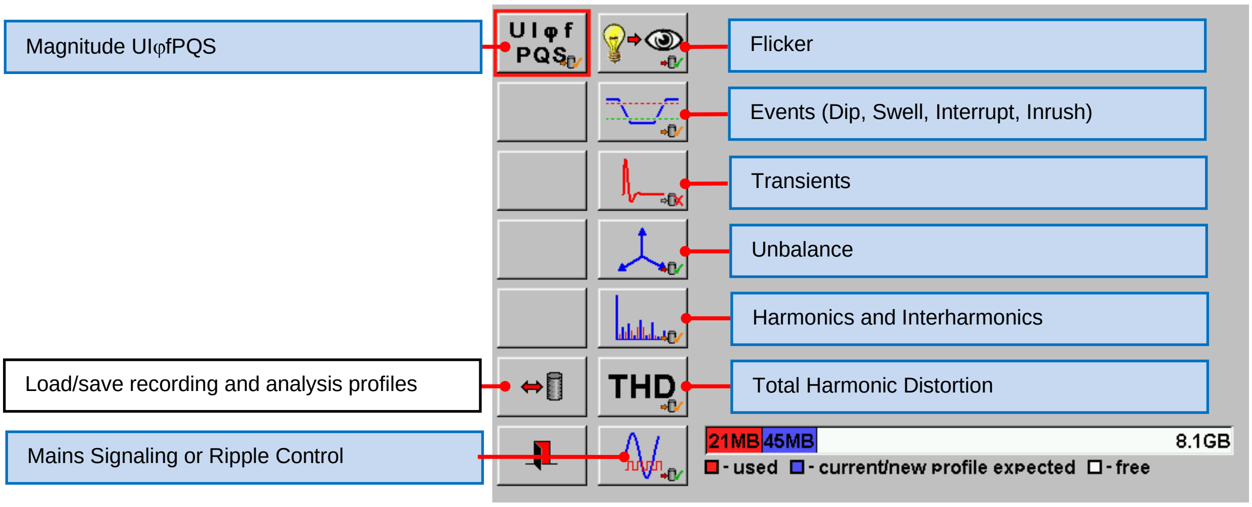
14.2 Setup of Recording and Analysis Profile

The recording and analysis settings for the different PQ parameters shown with functional buttons on the left side can be changed directly by operating the corresponding button.

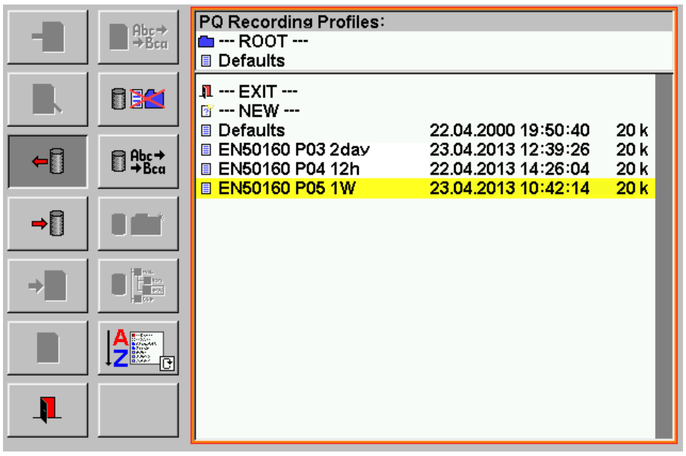
The different PQ parameters can be setup individual for each value and each phase, so maximum flexibility is given.

The settings of all parameters together can be saved as a configuration or a predefined configuration can be loaded and be modified if required.

The used space on the CF card and the expected storage capacity for the actual profile are indicated with a bar graph at the bottom.



Load/save PQ recording and analysis profile



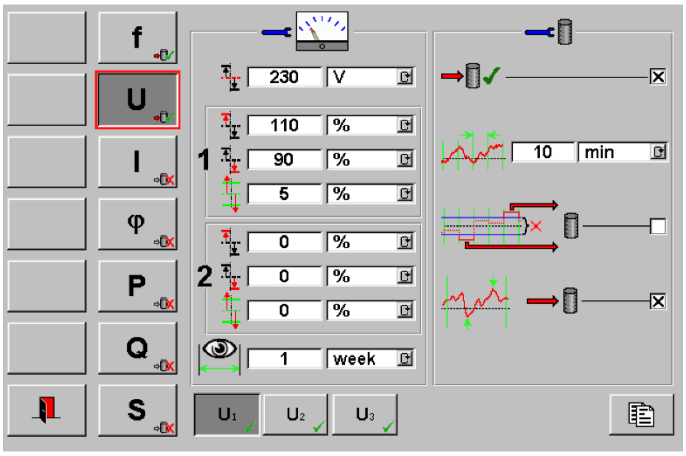
The recording and analysis settings of all parameters and phases can be saved as a configuration in a common file on the CF card and recalled at any time.

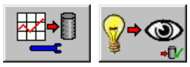
In this way profiles for e.g. the compliance verification with the standard **EN 50160** for different observation periods can be predefined and saved and later be recalled.

Examples for direct change of parameter settings

Magnitude UIφfPQS

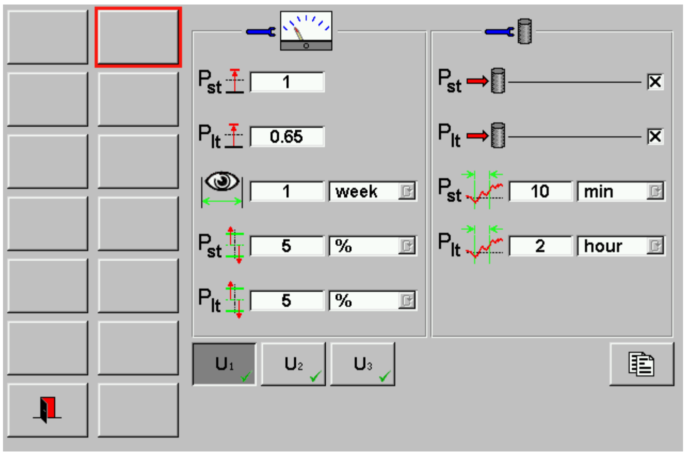
Example: Magnitude U1



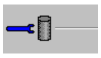


Flicker

Example: Flicker U1



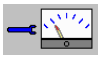
A recording and analysis profile contains different sub menus for the configuration of the different parameters and phases. Each with two sections for the configuration of:



Recording

Individual configuration for each value and each phase:

- Enable recording
- Recording interval
- Out of tolerance values recorded
- Min/Max values recorded

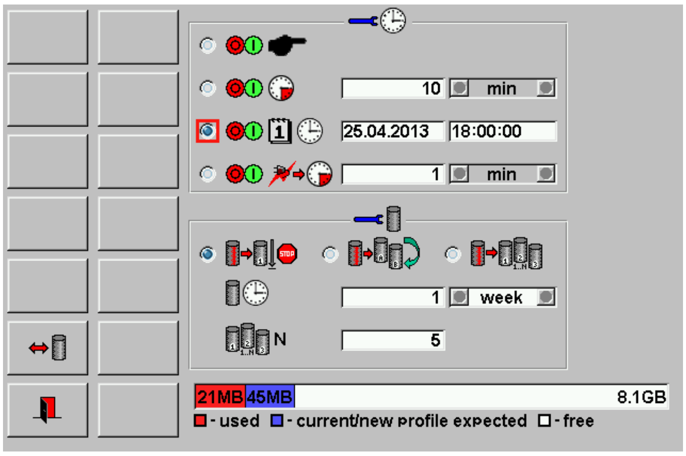


Analysis

- Definition of nominal values with upper/lower limits in % of nominal value (e.g. U1) or absolute limit values (e.g. Pst, Plt).
- Free configurable observation period with unit min, h, day, week for each parameter and phase (e.g. 1 week).
- Free configurable percentage or numbers of out of tolerance values allowed during observation period (e.g. up to 5% out of tolerance during 1 week allowed)

Not only the PQ compliance verification regarding EN 50160 is supported, but also the compliance verification regarding modified standards or company own regulations or specially agreed contracts with customers.

14.3 Setup of Recording Options



Recording Options

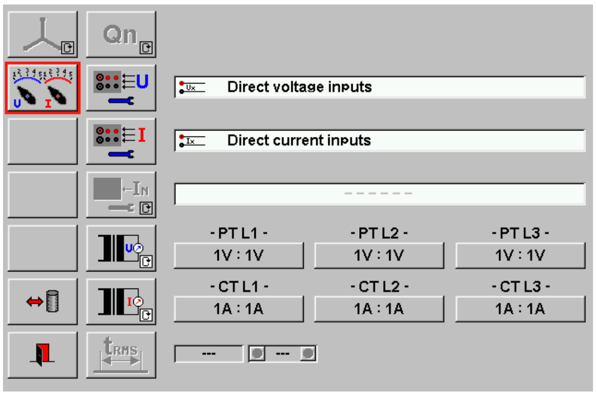
Recording start

- Immediate at pressing of start button
- Delayed (e.g. 10 min)
- At exact date and time
- Delayed after power-on (e.g. 1 min)

Recording time blocks configuration

- Time block interval (e.g. T = 1 week)
- Recording in one block of T. Stop of recording, if memory is full.
- Recording swapping between two blocks A, B in interval T.
- Recording with N blocks of interval T.

14.4 Setup of Voltage and Current Inputs



The following settings are displayed:

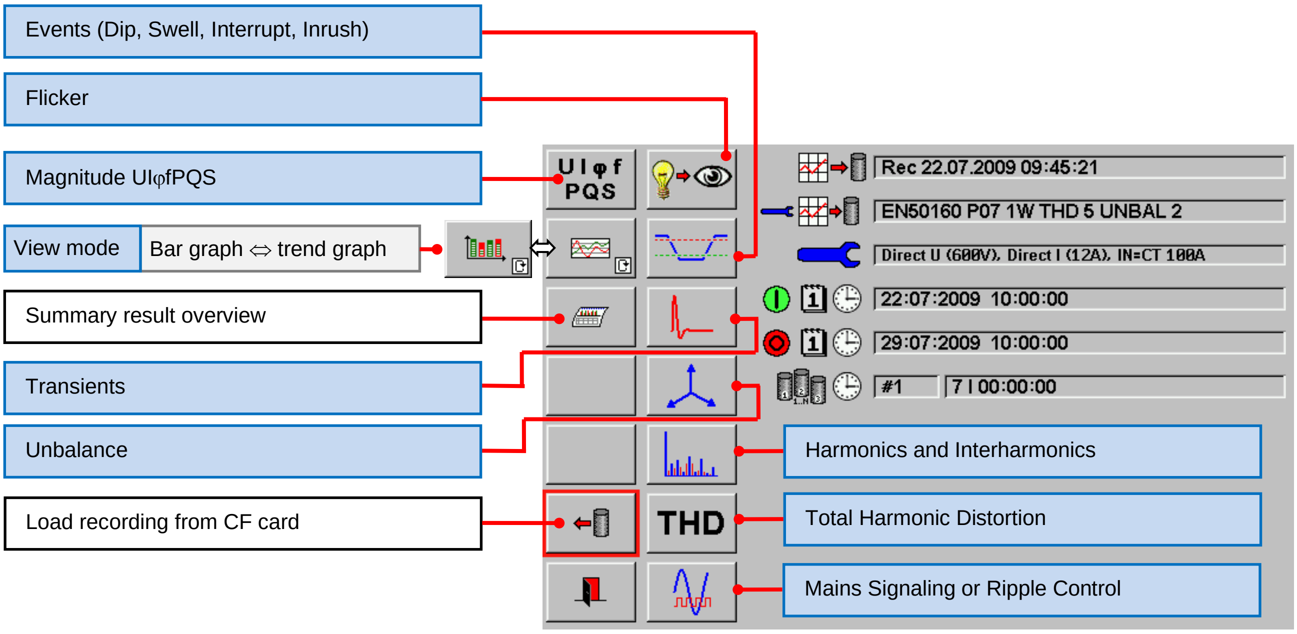
- Connection mode 4-wire (selection only available, if used as reference standard)
- Setting of internal voltage and current ranges
- Load or save current parameters
- Exit of menu
- Reactive power mode natural Qn (selection only available, if used as reference standard)
- Selection of voltage measurement inputs
- Selection of current measurement inputs
- Selection of IN/IE measurement inputs (not available at PRS 600.3)
- Voltage transformer settings
- Current transformer settings
- Recording time base (PQ online only)

For a detailed description of the different settings see chapter 11.1.

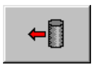
15. Power Quality Analysis

Recordings can be loaded from the compact flash (CF) card and all recorded parameters can be analysed with trend graph, table and histogram view as at online measurement.

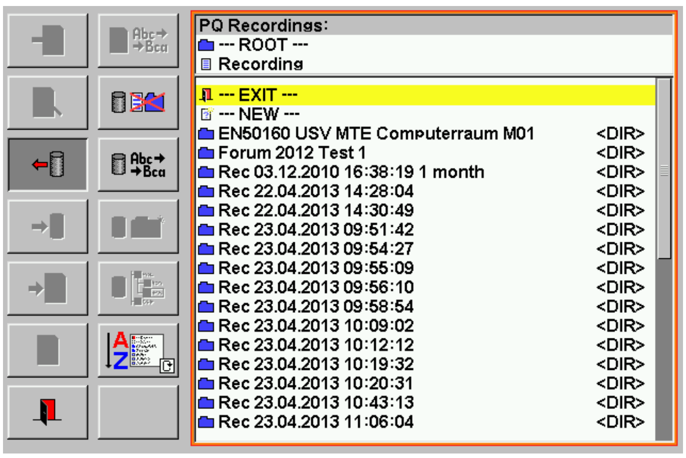
Additional statistical evaluations related to an observation period (e.g. 1 h, 1 day, 1 week etc) can be performed with bar graph view and a summary result overview.



The analysis functions work in parallel to a running recording in similar way as the online measurement. For details see also chapters 11.2, 11.3 and 12.



Load a finished recording from CF card for analysis



Each recording including several files is saved in a separate folder, which is automatically named with date and time at operation of the start button:

Rec <date> <time>

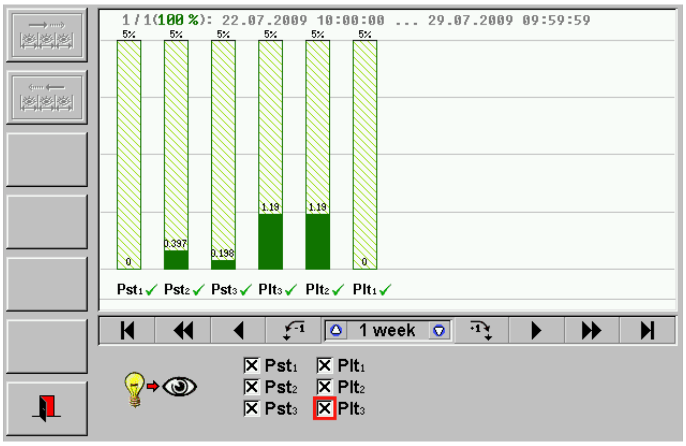
The recordings can be deleted, renamed or sorted (e.g. last recording first).

The recordings can also be transferred to a PC via interface (Ethernet or USB) or directly with a CF card reader for further analysis and reporting with the software CALegration.

15.1 Bar graph view

The bar graph view allows a statistical evaluation of recorded parameters in comparison to defined limits during an observation interval (e.g. 1 day, 1 week, 1 month, 1 year).

Example: Short and long term flicker of voltages U1, U2, U3 evaluated over 1 week



Compliance verification of individual parameters against the individual out of tolerance limit.

E.g. The short term flicker Pst and the long term flicker Plt are OK, if the defined limits Pst ≤ 1 and Plt ≤ 0.65 have not been surpassed for more than 5 % of the time of the observation period of 1 week.

This is the same as 95 % of the time within the tolerance during 1 week.

The limit of allowed tolerance surpassing can be indicated in % of the observation interval (e.g. 5 %) or in number of events allowed during the observation interval.

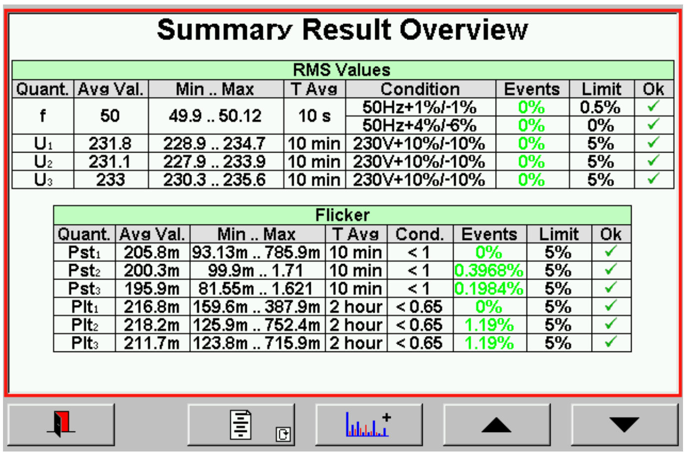
If the surpassing of a parameter is out of the set limit (e.g. > 5 %), the bar graph will be marked red.

15.2 Summary Result Overview

A statistical evaluation over the loaded recording is performed. This needs some time.

At the end an overview of the results with parameters marked OK or not OK regarding the configured recording and analysis parameters and set limits is indicated with several tables.

This overview supports the compliance verification with the standard **EN 50160**, but can also be configured for compliance verification with other standards or company own regulations



Summary Result Overview

RMS Values							
Quant.	Avg Val.	Min .. Max	T Avg	Condition	Events	Limit	Ok
f	50	49.9 .. 50.12	10 s	50Hz+1%/-1%	0%	0.5%	✓
				50Hz+4%/-6%	0%	0%	✓
U_1	231.8	228.9 .. 234.7	10 min	230V+10%/-10%	0%	5%	✓
U_2	231.1	227.9 .. 233.9	10 min	230V+10%/-10%	0%	5%	✓
U_3	233	230.3 .. 235.6	10 min	230V+10%/-10%	0%	5%	✓

Flicker							
Quant.	Avg Val.	Min .. Max	T Avg	Cond.	Events	Limit	Ok
Pst_1	205.8m	93.13m .. 785.9m	10 min	< 1	0%	5%	✓
Pst_2	200.3m	99.9m .. 1.71	10 min	< 1	0.3968%	5%	✓
Pst_3	195.9m	81.55m .. 1.621	10 min	< 1	0.1984%	5%	✓
Plt_1	216.8m	159.6m .. 387.9m	2 hour	< 0.65	0%	5%	✓
Plt_2	218.2m	125.9m .. 752.4m	2 hour	< 0.65	1.19%	5%	✓
Plt_3	211.7m	123.8m .. 715.9m	2 hour	< 0.65	1.19%	5%	✓

Up cursor to navigate between different tables.

Down cursor to navigate between different tables.

Button to switch on/off details of harmonics.

Change text alignment (left, center or right alignment)

Exit of menu

16. Verification of accuracy of PRS 600.3

The reference standard used for the calibration of the PRS 600.3 should be of a higher class (class 0.01).

If a reference standard of the same class 0.02 is used, the own errors regarding the actual calibration certificate of the standard and calculated uncertainty must be regarded.

To check the correct functioning of the instrument it is enough to verify active energy measurement in 3 phase 4 wire mode.

16.1 Preparation

Test setup

Example test setups for calibration of the PRS 600.3 with a 3-phase or a single-phase reference standard and a 3-phase or a single-phase source can be found in chapter [17.2.22].

The AC power source (SRC), the reference standard (REF) and the error evaluation unit (EEU) are shown as function blocks. At modern reference standards, normally the blocks REF and EEU are combined in one instrument.

Follow the instructions in the operation manuals of the used instruments for the blocks SRC, REF, EEU and adapt the connections where necessary.

Note: The voltage neutral bridge cable to connect the black sockets of U1, U2, U3 must be placed during all energy measurements (single phase and three phase).

Precautions to minimize the influences of the test setup

- Ground the voltage circuit at exactly one point (connect N to PE), preferably at the Reference standard.
- Take the supply of the instruments from the same point (e.g. the same distribution socket).
- Use well defined wiring (route cables of same phase together, twist cables)
- Keep ambient conditions stable (temperature, humidity etc.)
- Let the instruments warm-up before use (at least 1 hour).
- Use a measuring frequency either synchronized to line frequency (50 / 60 Hz) or explicitly different (e.g. 53 / 63 Hz).
- Use a power source with good stability and signal quality (pure sinus wave form)

Connection of PRS 600.3 Impulse Output to Impulse Input of error evaluation unit

To perform the energy comparison method one of the impulse outputs (LEMO 5-pole: Pin 3 = Impulse signal (5V), Pin 4 = GND) must be connected to the impulse input of the error evaluation unit or directly to the reference standard, if the error evaluation unit is integrated in the reference standard.

An adapter cable LEMO 5-pole to BNC socket and a standard BNC to BNC cable to connect directly to reference standards with BNC inputs can be ordered at MTE.

- Adapter cable LEMO 5-pole to BNC socket (H1K Z00 9B0 670 101)
- BNC impulse cable 2m (H0K 51R G58 U02 020)

Some reference standards, which use low ohm pull-up resistors at their impulse inputs (e.g. Radian standards), are not working directly with the impulse output of the PRS 600.3, which is equipped with a 1k series resistor to protect the output.

To drive this type of inputs with low ohm pull-up resistors a level adaptation with a NPN transistor switching to ground must be used. Such an adapter can be ordered at MTE:

- Level adaptation MTE devices Radian devices (H 2 2431 0755)

General information needed to process requests/orders for impulse adapters/cables

A) Impulse cables between own instruments (EMH / MTE / EDI / HEG / L&G)

- Instrument types, impulse connectors and impulse direction
  (Instrument A. Output x to Instrument B. Input y)
- Divider factor (10:1, 100:1, 1000:1), if divider function is needed

B) Impulse cables with foreign instruments involved

- Exact instrument type
- Detailed technical specification of input/output of foreign instrument (signals, supply)
- Connector type and Pin assignment

Based on this information MTE/EMH will check, whether a simple cable or a cable with built-in adapter is needed and then offer the cable.

Special impulse cables / adapters are not on stock. They are manufactured upon order

16.2 Recommended test points for active energy 4-wire measurements

It is recommended to check minimum one load point within each internal voltage and current range at power factors PF = 1, PF = 0.5 (+60°), PF = 0.5 (300°) for phase L1, L2, L3 and 3 phase L1-L2-L3.

The influences of voltage, current and frequency variations on each other are very small. Therefore, the current (load curve), voltage and frequency dependency can be tested separately.

The following definition of test points as used in the factory calibration certificate can be taken as reference.

If the customer needs direct traceability for special load points (U, I values as used in later daily work), additional connection and measurement modes, these additional test points should be agreed and defined between customer and testing laboratory.

Table 1-1: 3-phase 4-wire active energy measurements with direct current inputs 12A

Load Curve and Voltage Dependency (f = 53 Hz)

	Un [V]	65	130	260	520
In [A]	I[A] \ U[V]	60	120	240	480
0.0025	0.002			•	
0.005	0.004			•	
0.012	0.01			•	
0.025	0.02			•	
0.05	0.04			•	
0.12	0.1	•	•	•	•
0.25	0.2			•	
0.5	0.4			•	
1.2	1.0			•	
2.5	2.0			•	
5	4.0			•	
12	10.0			•	

Frequency Dependency

f [Hz]	U = 240 V I = 1 A
45	•
50	•
55	•
60	•
65	•

- Each mark represents 3 load points at PF=1(0°), PF=0.5(60°), PF=0.5(300°),
  each with 4 error results of energy measurements single phase at L1, L2, L3 and three-phase L1-L2-L3 (Total 12 results).

Table 1-2: 3-phase 4-wire active energy measurements with direct current inputs 120A

Load Curve and Voltage Dependency (f = 53 Hz)

	Un [V]	65	130	260	520
In [A]	I[A] \ U[V]	60	120	240	480
0.025	0.02			•	
0.05	0.04			•	
0.12	0.1			•	
0.25	0.2			•	
0.5	0.4			•	
1.2	1	•	•	•	•
2.5	2			•	
5	4			•	
12	10			•	
25	20			•	
50	40			•	
120	100			•	

Frequency Dependency

f [Hz]	U = 240 V I = 1 A
45	•
50	•
55	•
60	•
65	•

- Each mark represents 3 load points at PF=1(0°), PF=0.5(60°), PF=0.5(300°), each with 4 error results of energy measurements single phase at L1, L2, L3 and three-phase L1-L2-L3 (Total 12 results).

Table 1-3: 3-phase 4-wire active energy measurements with Current Clamps 100A

Load Curve and Voltage Dependency (f = 53 Hz)

	Un [V]	65	130	260	520
In [A]	I[A] \ U[V]	60	120	240	480
0.1	0.05			•	
1	0.5			•	
10	5	•	•	•	•
100	50			•	

Frequency Dependency

f [Hz]	U = 240 V I = 1 A
45	•
50	•
55	•
60	•
65	•

- Each mark represents 3 load points at PF=1(0°), PF=0.5(60°), PF=0.5(300°), each with 4 error results of energy measurements single phase at L1, L2, L3 and three-phase L1-L2-L3 (Total 12 results).

16.3 Meter constants of impulse outputs

The following tables are showing the meter constant depending on used current input and internal voltage range, current range.

Table 2-1: Direct current input 12A

Base constant: cpz_0 = 9000 [imp/Wh], CPZ_0 = 2.5 [imp/Ws]

Range dependent constant of PRS 600.3: **$cpz = cpz_0 * \alpha * \beta$ [imp/Wh]**

$CPZ = CPZ_0 * \alpha * \beta$ [imp/Ws]

cpz [imp/Wh] CPZ [imp/Ws]	Un[V] (β)			
In [A] (α)	65 (8)	130 (4)	260 (2)	520 (1)
0.0025 (4'800)	345'600'000 96'000	172'800'000 48'000	86'400'000 24'000	43'200'000 12'000
0.005 (2'400)	172'800'000 48'000	86'400'000 24'000	43'200'000 12'000	21'600'000 6'000
0.012 (1'000)	72'000'000 20'000	36'000'000 10'000	18'000'000 5'000	9'000'000 2'500
0.025 (480)	34'560'000 9'600	17'280'000 4'800	8'640'000 2'400	4'320'000 1'200
0.05 (240)	17'280'000 4'800	8'640'000 2'400	4'320'000 1'200	2'160'000 600
0.12 (100)	7'200'000 2'000	3'600'000 1'000	1'800'000 500	900'000 250
0.25 (48)	3'456'000 960	1'728'000 480	864'000 240	432'000 120
0.5 (24)	1'728'000 480	864'000 240	432'000 120	216'000 60
1.2 (10)	720'000 200	360'000 100	180'000 50	90'000 25
2.5 (4.8)	344'000 96	172'800 48	86'400 24	43'200 12
5 (2.4)	172'800 48	86'400 24	43'200 12	21'600 6
12 (1)	72'000 20	36'000 10	18'000 5	9'000 2.5

Mean frequency at the impulse output: **f = CPZ * PΣ**, with **CPZ = cpz/3600** [imp/Ws]

Maximum frequency (reached at Un, In): fmax = 46.8 kHz

The actual constants **CPZx** [imp/Ws] and the mean frequency **FOutx**, **x = 1,2,3** of the three impulse outputs are indicated at the PRS 600.3 in the Reference / setup / impulse output menu.

Note: If a **range independent constant C/R** is programmed by the user, he must take care, that the resulting frequency fout stays below 46.8 kHz.

E.g. to test the full range up to 120A, 260V the range independent constant must be:

cpz ≤ 1'800 [imp/Wh] or with unit Wh/imp: cpz ≥ 0.0005555 [Wh/imp]
Above annotation is also applying for table 2-2 and 2-3

Table 2-2: Direct current input 120A

Base constant: cpz_0 = 900 [imp/Wh], CPZ_0 = 0.25 [imp/Ws]

Range dependent constant of PRS 600.3: **cpz = cpz_0*α*β [imp/Wh], CPZ = CPZ_0*α*β [imp/Ws]**

cpz [imp/Wh] CPZ [imp/Ws]	Un[V] (β)			
In [A] (α)	65 (8)	130 (4)	260 (2)	520 (1)
0.025 (4'800)	34'560'000 9'600	17'280'000 4'800	8'640'000 2'400	4'320'000 1'200
0.05 (2'400)	17'280'000 4'800	8'640'000 2'400	4'320'000 1'200	2'160'000 600
0.12 (1'000)	7'200'000 2'000	3'600'000 1'000	1'800'000 500	900'000 250
0.25 (480)	3'456'000 960	1'728'000 480	864'000 240	432'000 120
0.5 (240)	1'728'000 480	864'000 240	432'000 120	216'000 60
1.2 (100)	720'000 200	360'000 100	180'000 50	90'000 25
2.5 (48)	345'600 96	172'800 48	86'400 24	43'200 12
5 (24)	172'800 48	86'400 24	43'200 12	21'600 6
12 (10)	72'000 20	36'000 10	18'000 5	9'000 2.5
25 (4.8)	34'560 9.6	17'280 4.8	8'640 2.4	4'320 1.2
50 (2.4)	17'280 4.8	8'640 2.4	4'320 1.2	2'160 0.6
120 (1)	7'200 20	3'600 10	1'800 0.5	900 0.25

Table 2-3: Current clamp-on CT 100A

Base constant: cpz_0 = 1'080 [imp/Wh], CPZ_0 = 0.3 [imp/Ws]

Range dependent constant of PRS 600.3: **$cpz = cpz_0 * \alpha * \beta$ [imp/Wh], $CPZ = CPZ_0 * \alpha * \beta$ [imp/Ws]**

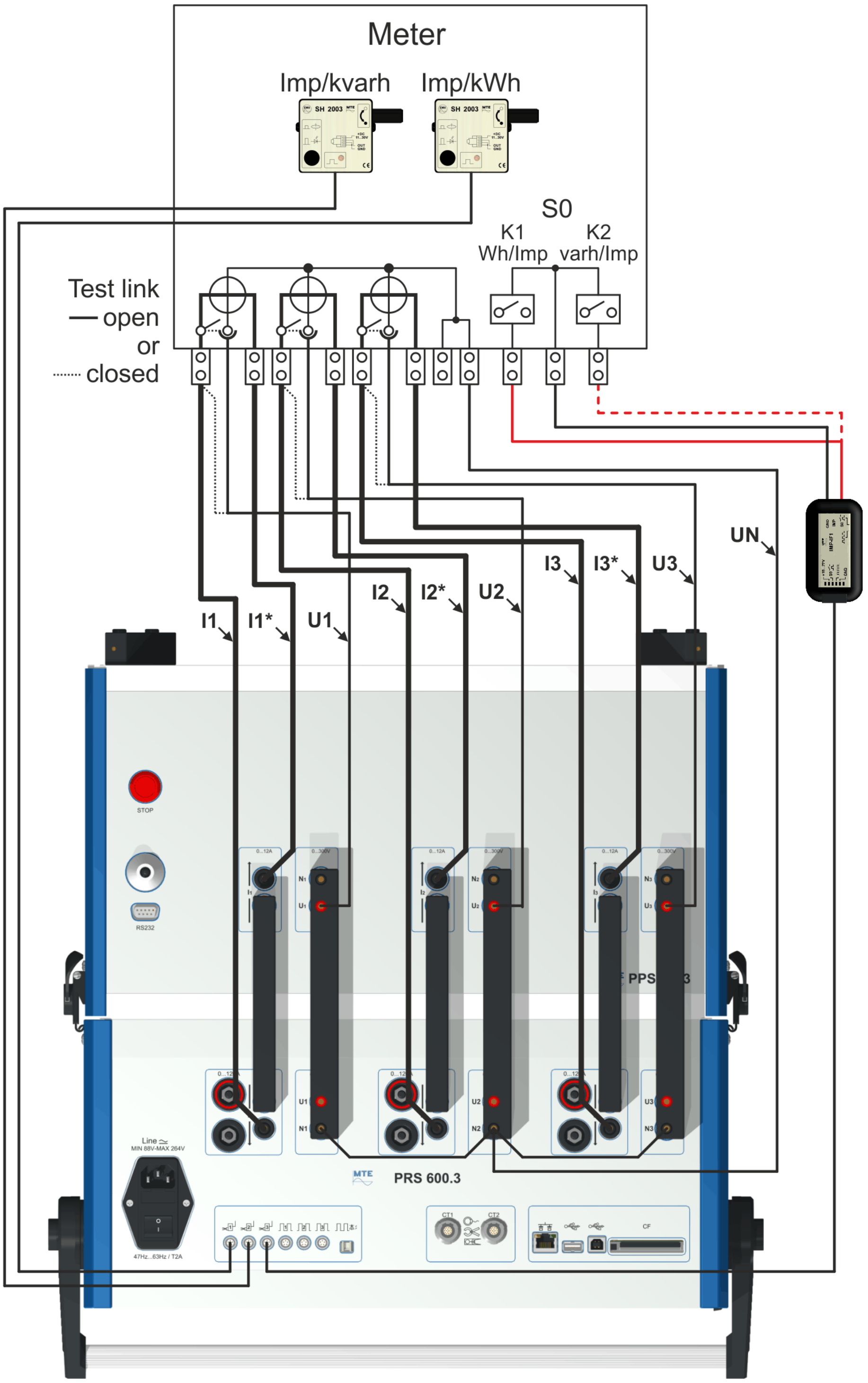
cpz [imp/Wh] CPZ [imp/Ws]	Un[V] (β)			
In [A] (α)	65 (8)	130 (4)	260 (2)	520 (1)
0.1 (1'000)	8'640'000 2'400	4'320'000 1'200	2'160'000 600	1'080'000 300
1 (100)	864'000 240	432'000 120	216'000 60	108'000 30
10 (10)	86'400 24	43'200 12	21'600 6	10'800 3
100 (1)	8'640 2.4	4'320 1.2	2'160 0.6	1'080 0.3

17. Connection examples

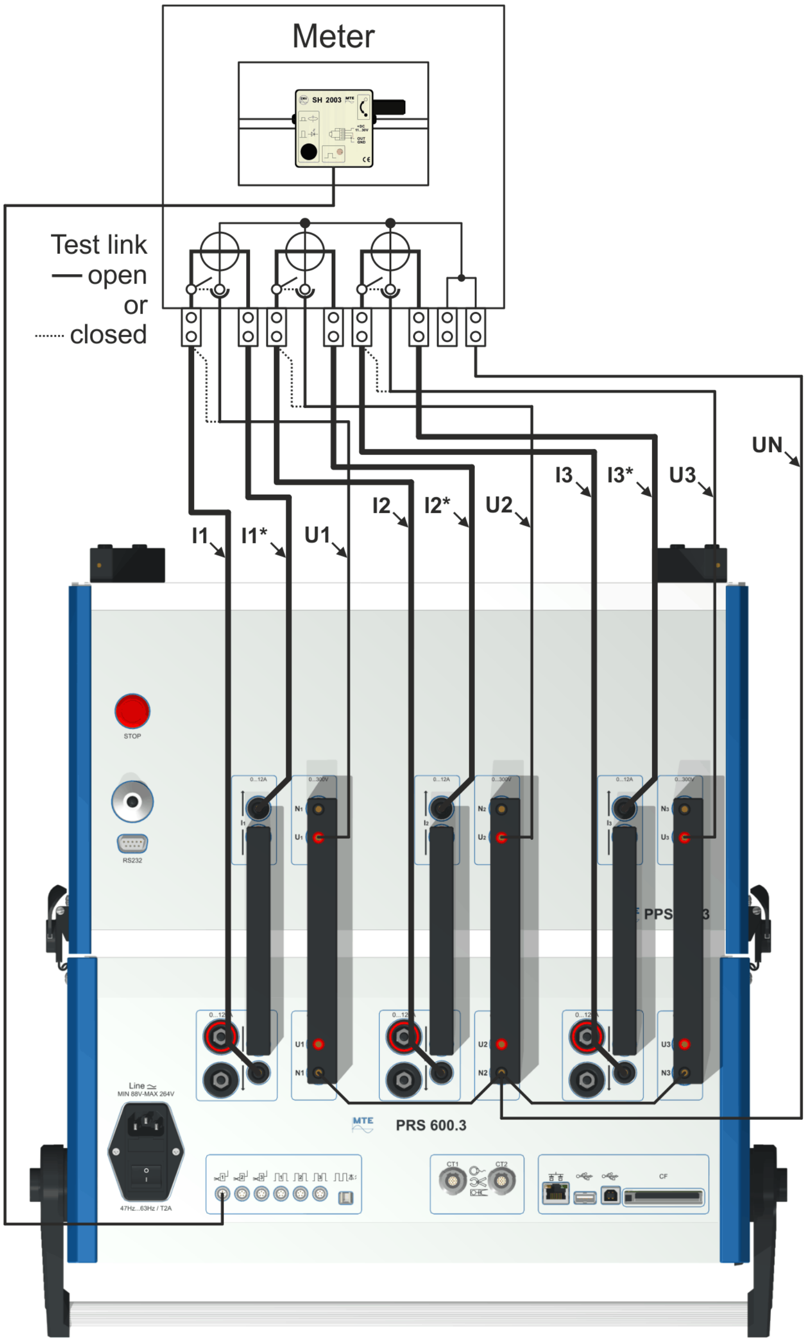
17.1 PTS 400.3 PLUS connection examples

17.1.1 Testing of a direct connected 4-wire meter up to 12A

Complex electronic meter



Simple mechanical meter

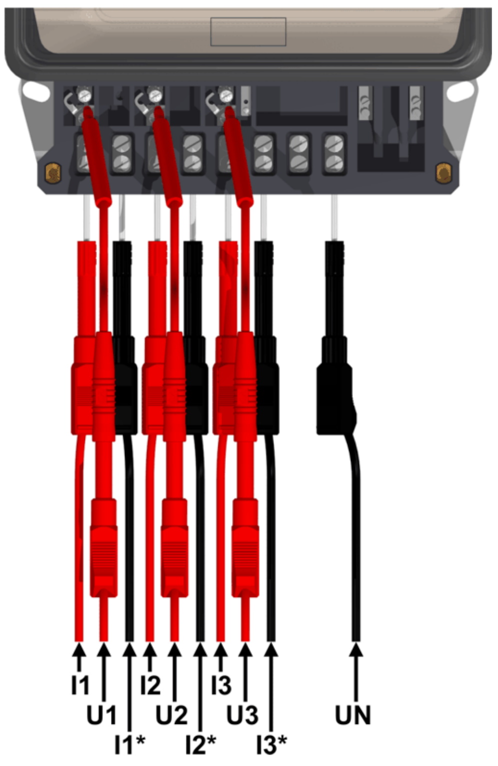


Connections to meter under test (example for IEC-type meter)

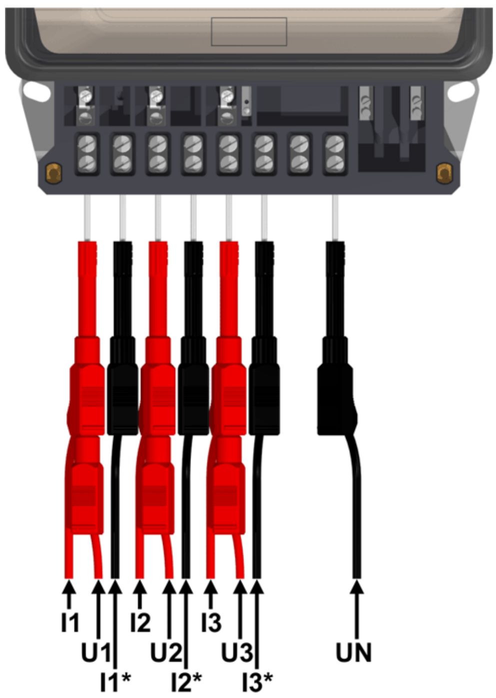
Adapter pins

Direct connected
4-wire meter
Uninstalled on site or in laboratory
Maximum test current 12 A

Test links open

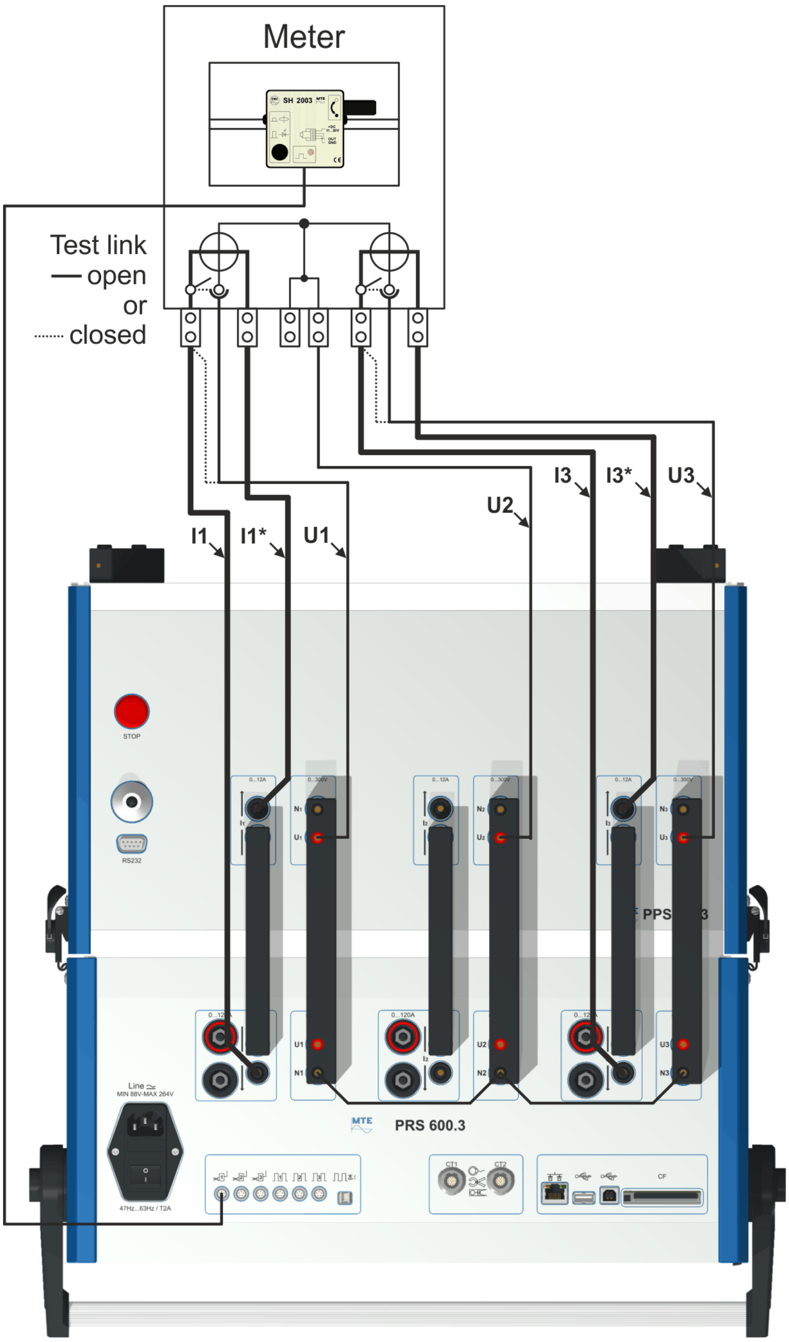


Test links closed



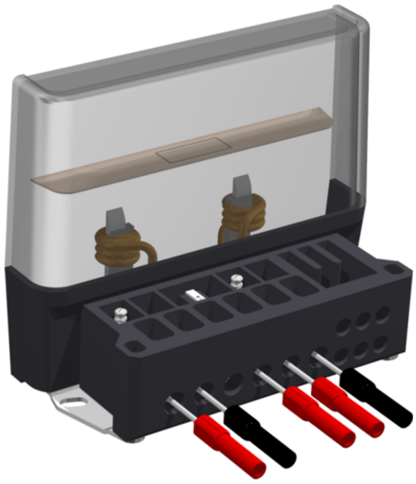
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.1.2 Testing of a direct connected 3-wire meter up to 12A



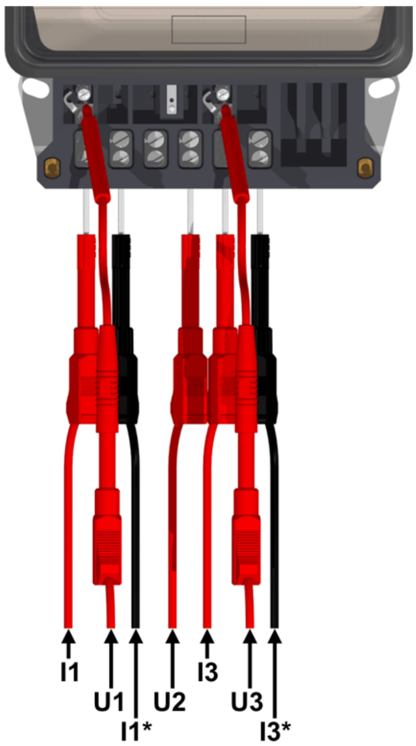
Connections to meter under test (example for IEC-type meter)

Adapter pins

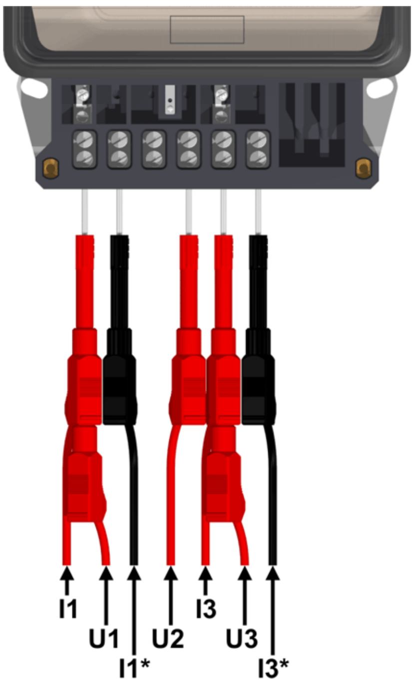


Direct connected
3-wire meter
Uninstalled on site or in laboratory
Maximum test current 12 A

Test links open

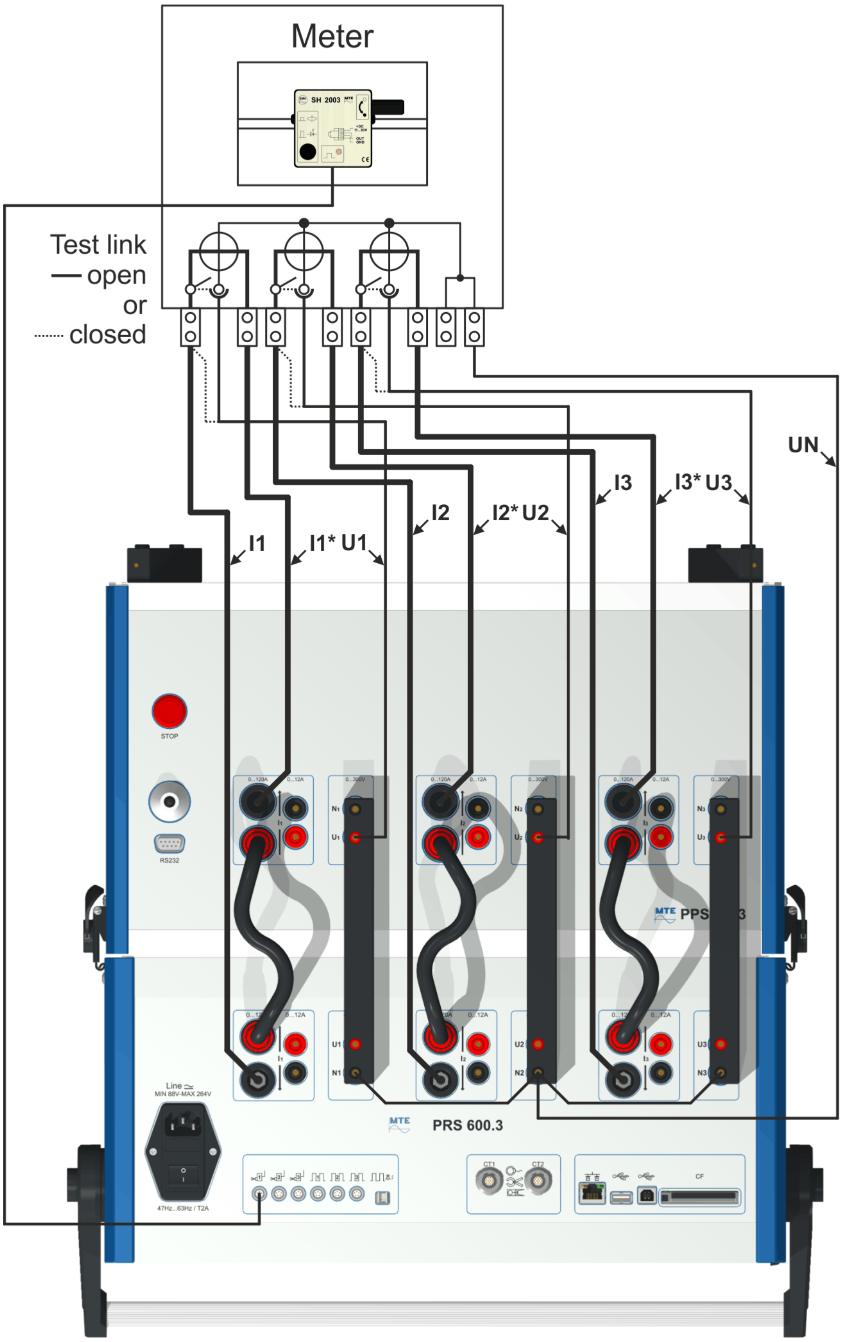


Test links closed



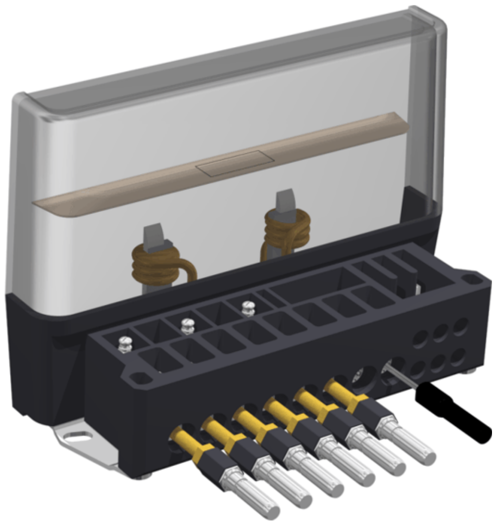
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.1.3 Testing of a direct connected 4-wire meter up to 120A



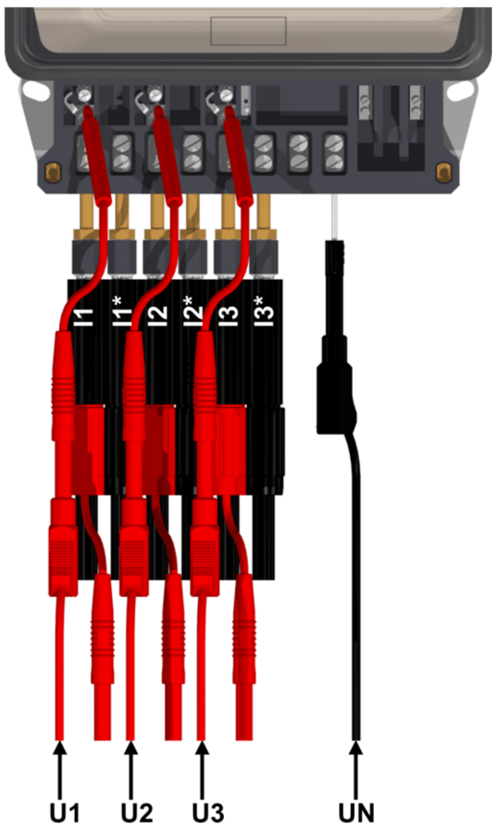
Connections to meter under test (example for IEC-type meter)

Adapter pins

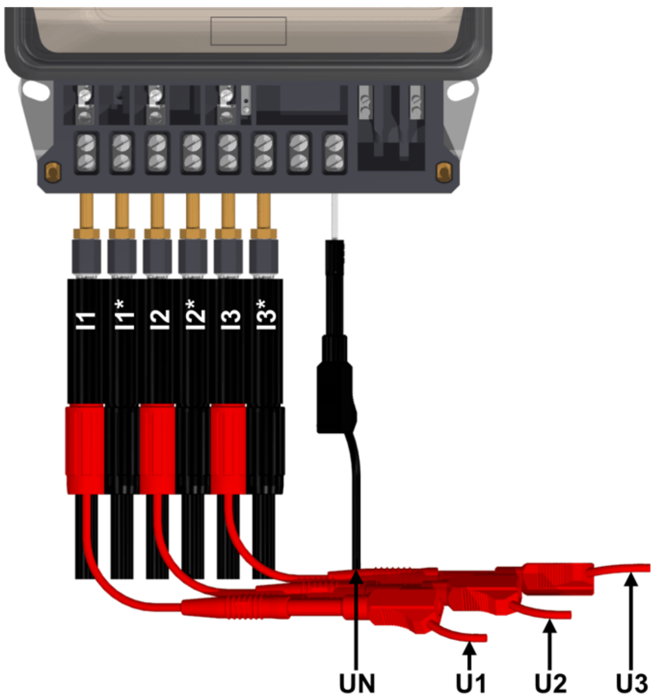


Direct connected
4-wire meter
Uninstalled on site or in laboratory
Maximum test current 120 A

Test links open

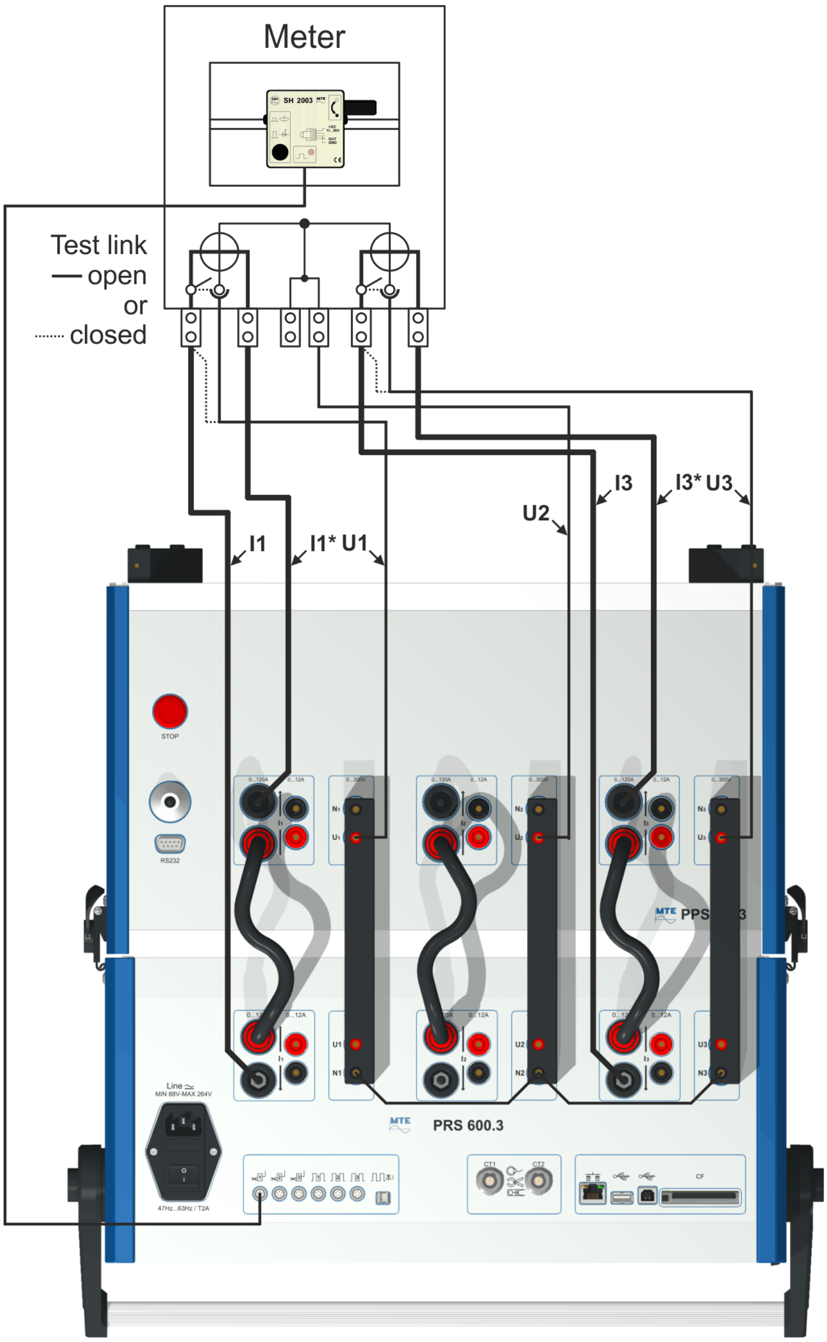


Test links closed



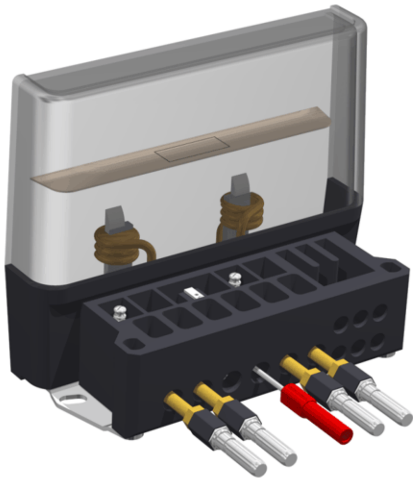
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.1.4 Testing of a direct connected 3-wire meter up to 120A



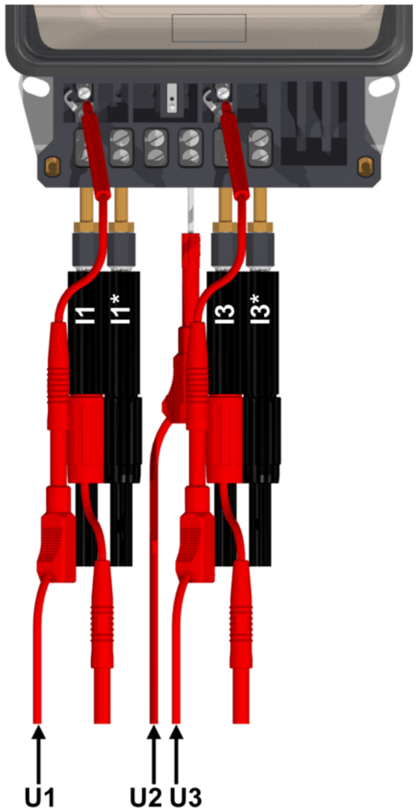
Connections to meter under test (example for IEC-type meter)

Adapter pins

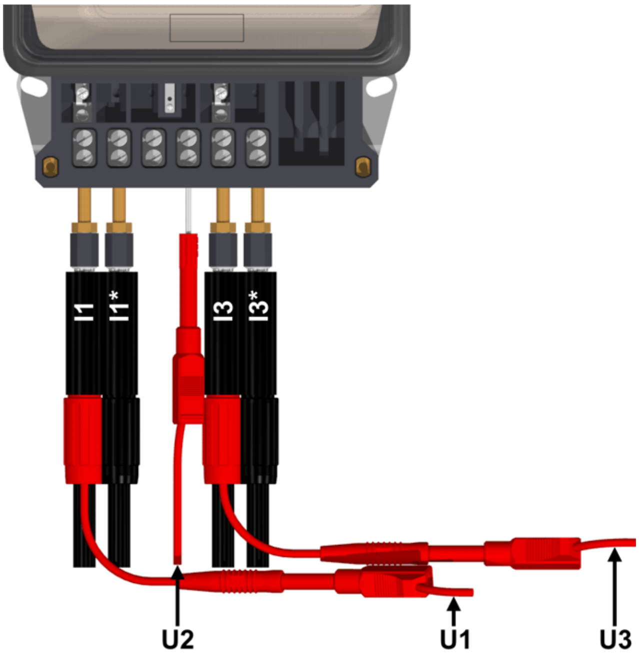


Direct connected
3-wire meter
Uninstalled on site or in laboratory
Maximum test current 120 A

Test links open

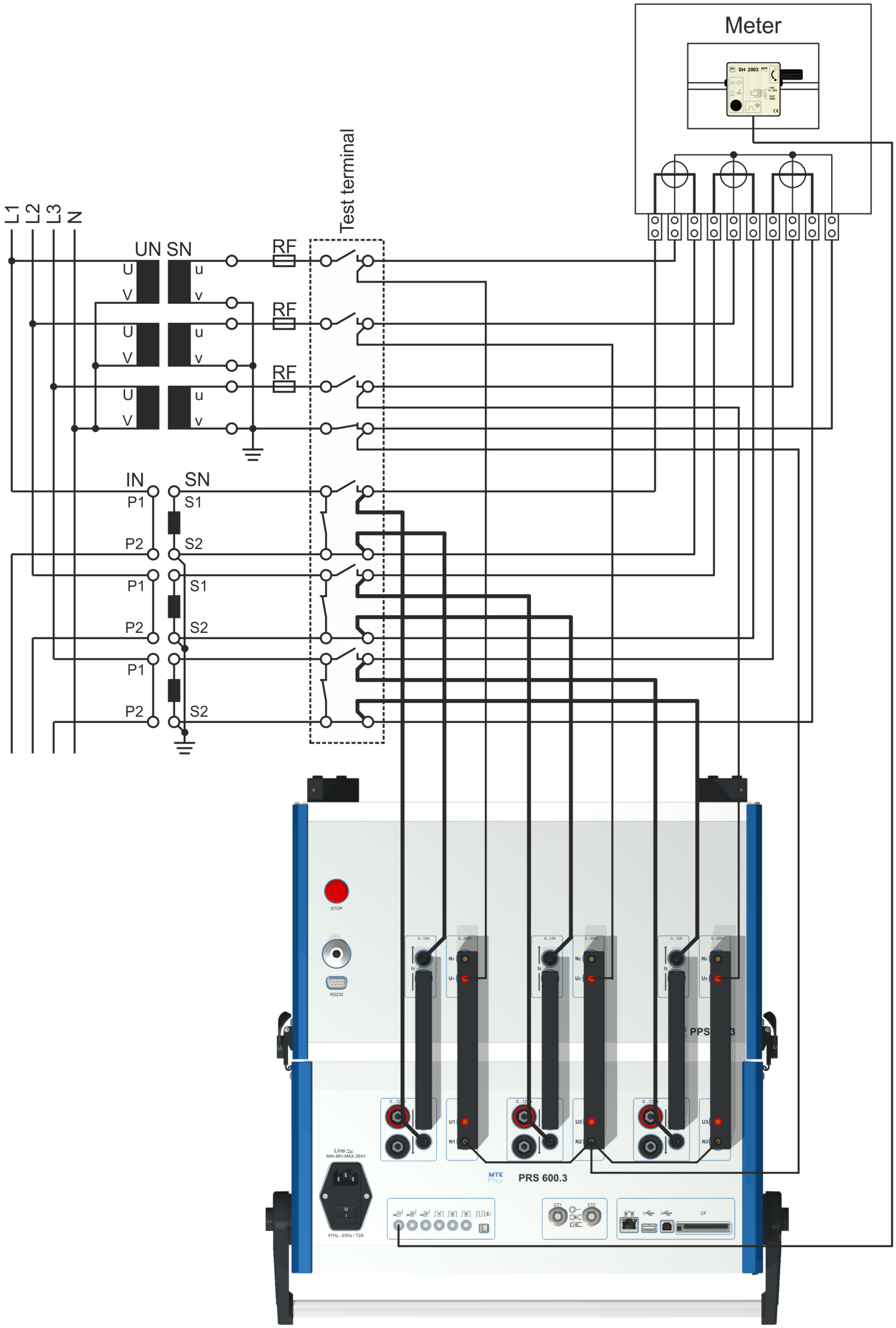


Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.1.5 Testing of an installed transformer connected 4-wire meter up to 12A



Connections to test terminals

Use the delivered adapter pins and cables or if available special adapters and cables delivered with the test terminals for the connections to the PTS 400.3 PLUS.

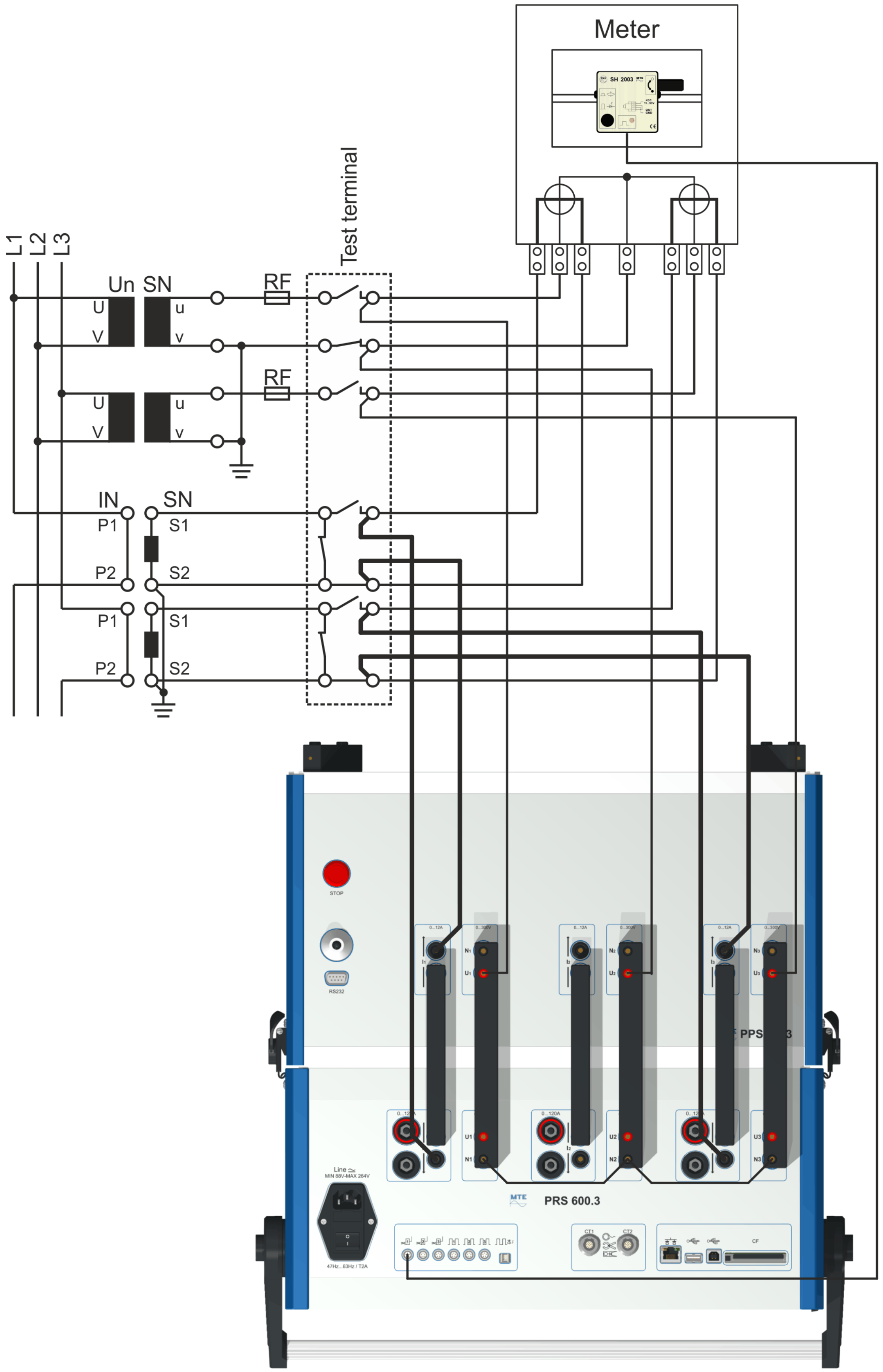
Attention! The current transformers must be short connected on the secondary side during the time the current connections to the meter are changed to the PTS 400.3 PLUS.

The voltage paths from voltage transformers to the meter must be interrupted, before making the connections between test terminals and PTS 400.3 PLUS voltage outputs.

Regard the instructions for the use of the installed test terminals and observe local safety regulations.

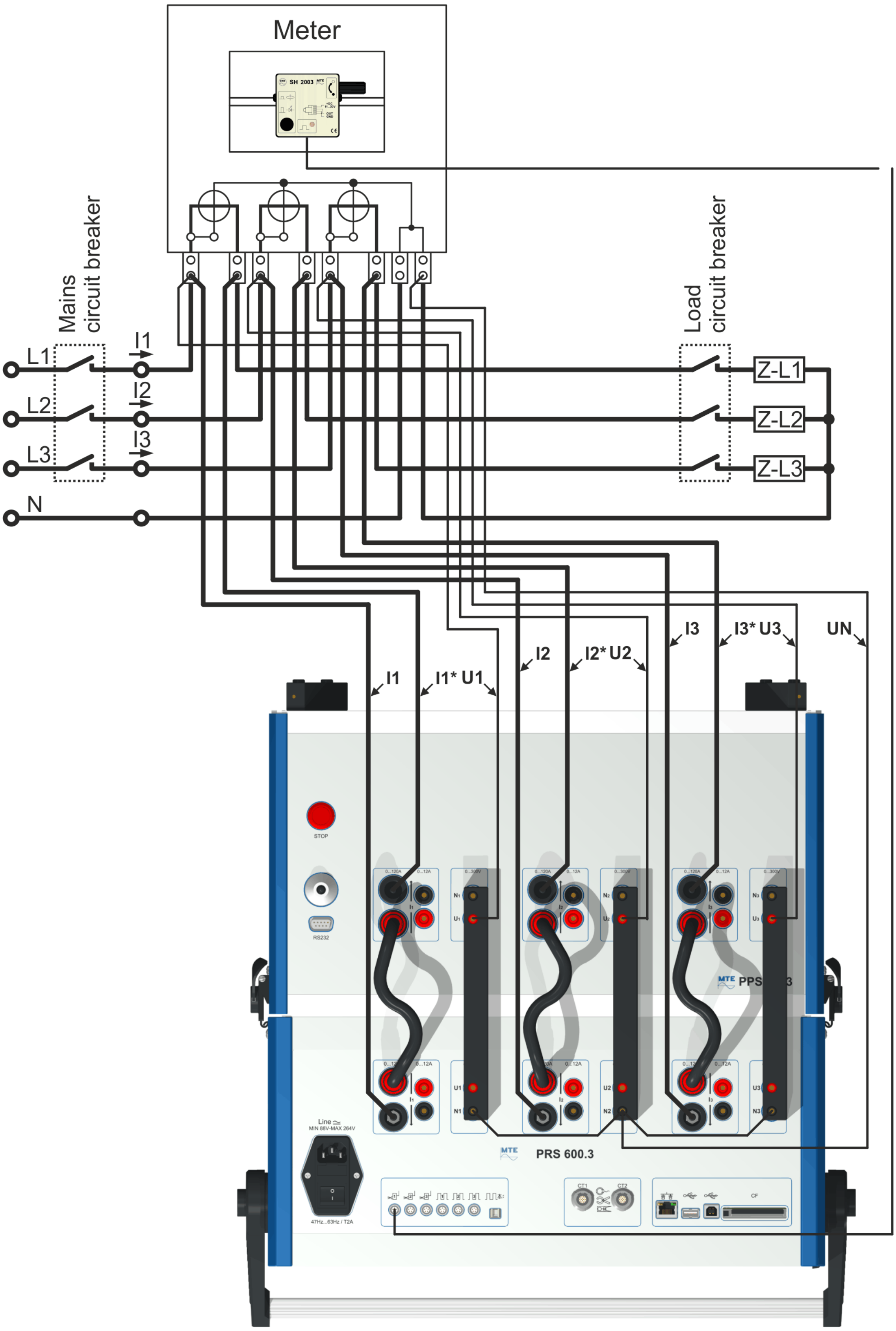
Warning! The current path on secondary side of an active current transformer must always remain closed. Dangerous high voltages can occur and the current transformer and the instrument can be damaged, if the current path is opened during measurements.

17.1.6 Testing of an installed transformer connected 3-wire meter up to 12A



Connections to test terminals (see explanations in chapter 17.1.5)

17.1.7 Testing of an installed direct connected 4-wire meter up to 120A

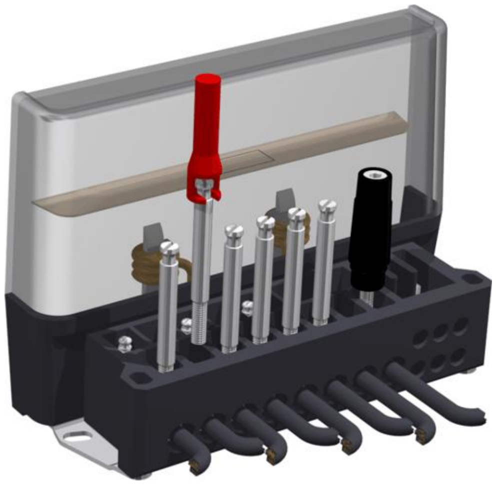


Connections to meter under test (example for IEC-type meter)

Attention! The meter must be disconnected from mains and load during the time the tests are performed and during the connections to the PTS 400.3 PLUS are made or released. Switch off mains and load circuit breakers.

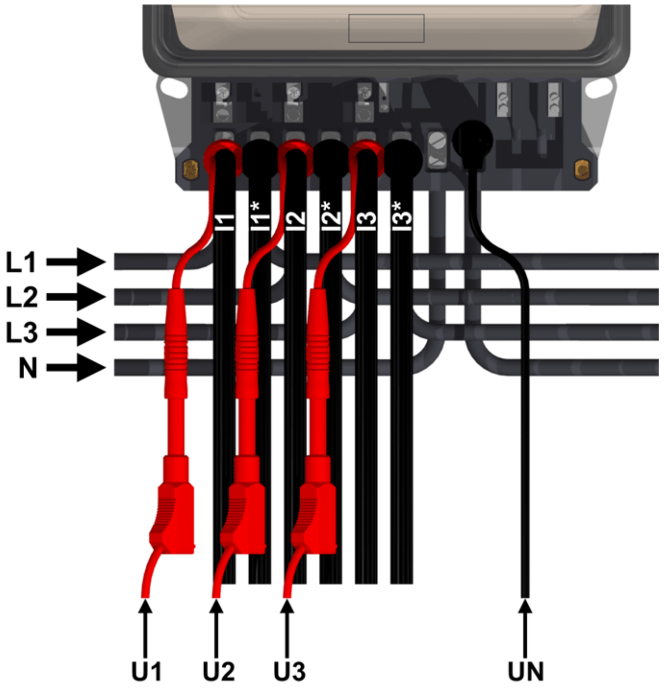
Observe local safety regulations.

Adapter pins



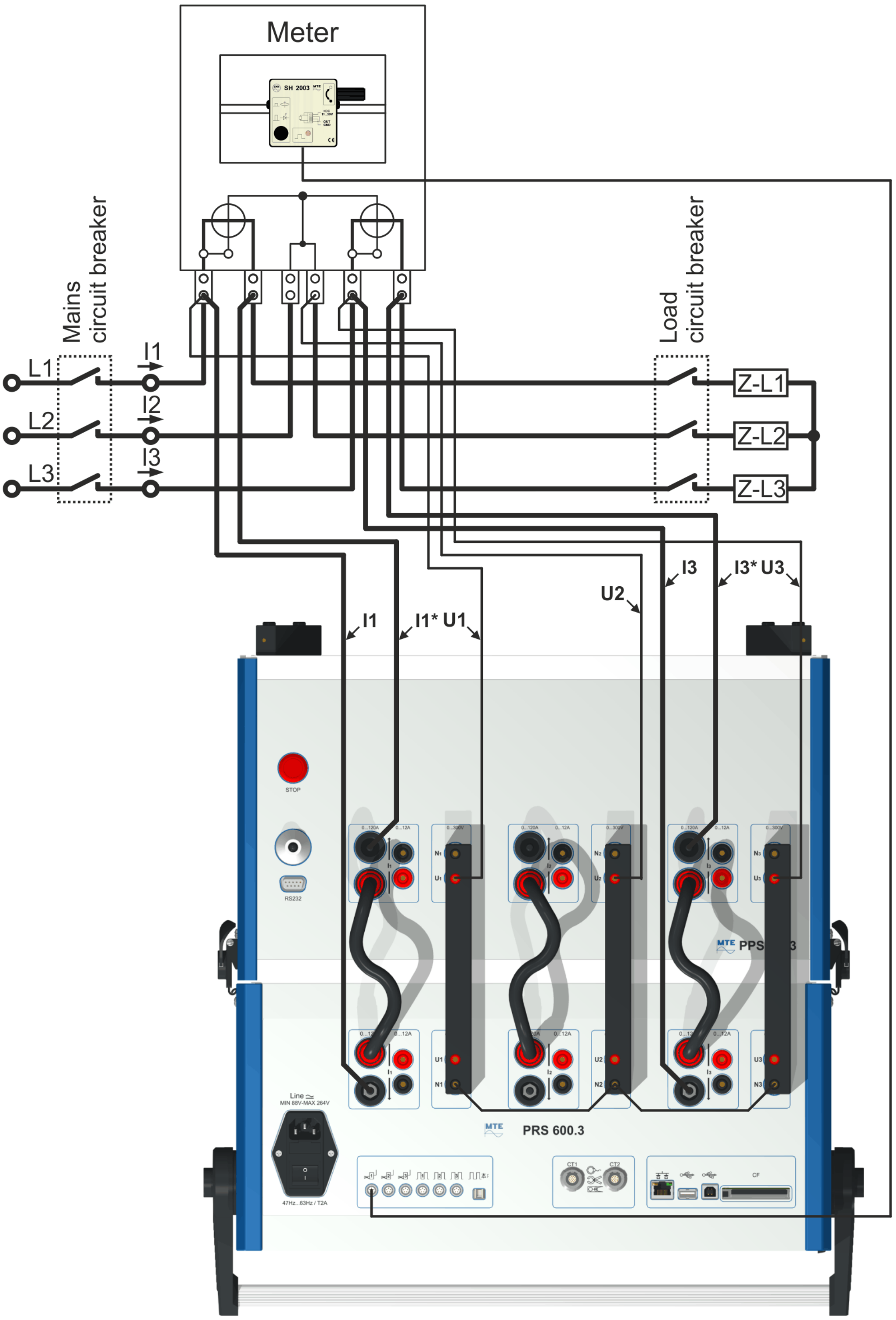
Direct connected
4-wire meter
Installed on site
Maximum test current 120 A

Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.1.8 Testing of an installed direct connected 3-wire meter up to 120A

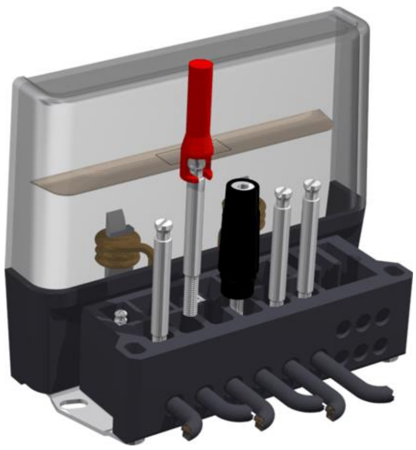


Connections to meter under test (example for IEC-type meter)

Attention! The meter must be disconnected from mains and load during the time the tests are performed and during the connections to the PTS 400.3 PLUS are made or released. Switch off mains and load circuit breakers.

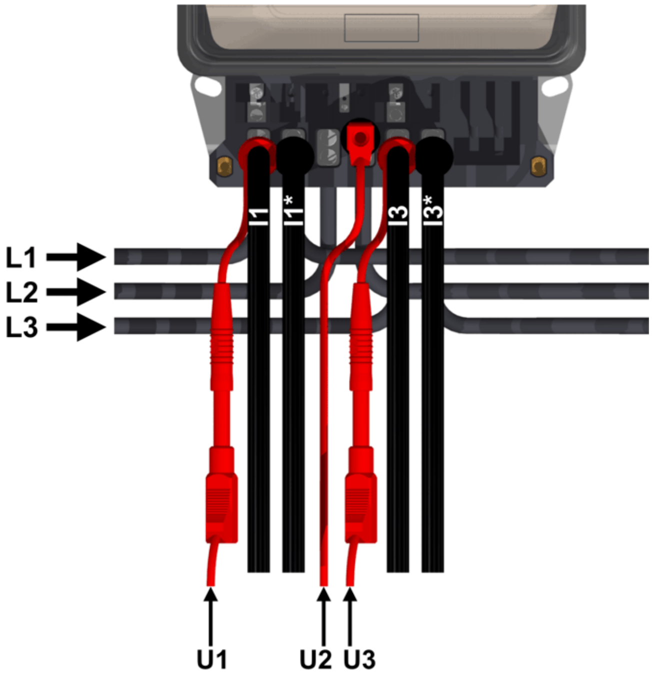
Regard the instructions for the use of the installed test terminals and observe local safety regulations.

Adapter pins



Direct connected
3-wire meter
Installed on site
Maximum test current 120 A

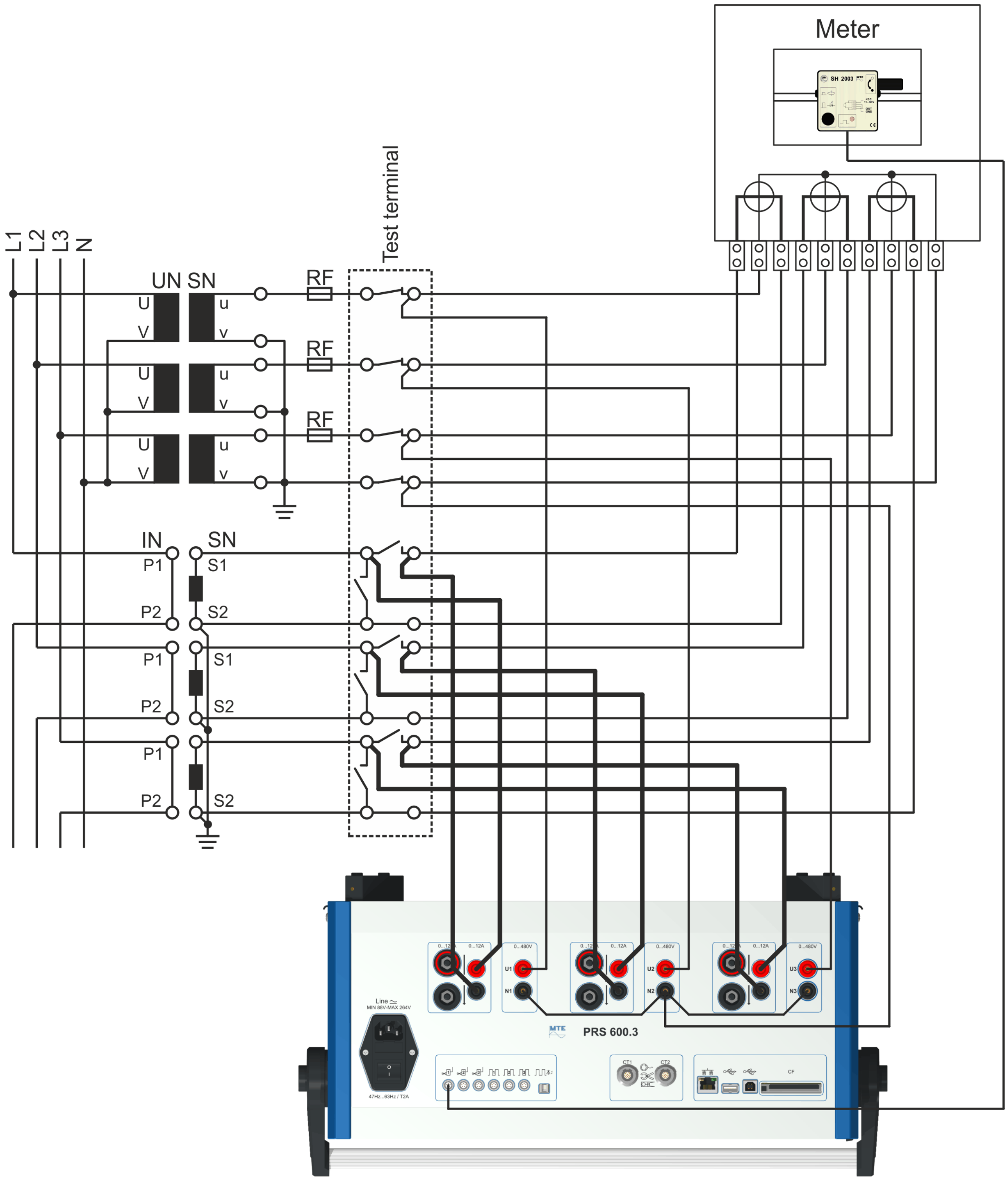
Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2 PRS 600.3 connection examples

17.2.1 Testing of an installed transformer connected 4-wire meter



Connections to test terminals

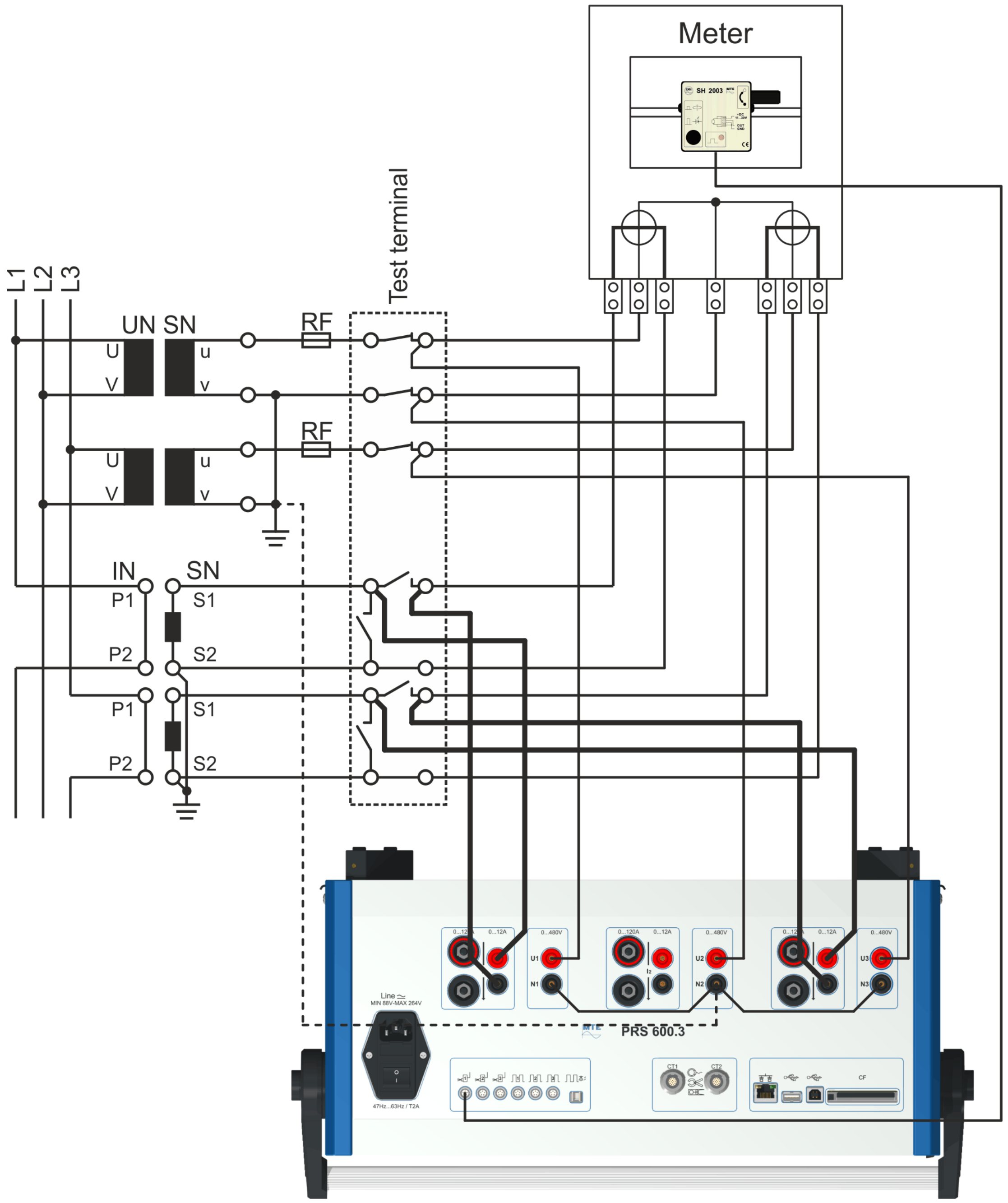
Use the delivered adapter pins and cables or if available special adapters and cables delivered with the test terminals for the connections to the PRS 600.3.

Attention! The current transformers must be short connected on the secondary side during the time the current paths to the meter are opened and the connections to the PRS 600.3 are made or released.

Regard the instructions for the use of the installed test terminals and observe local safety regulations.

Warning! The current path on secondary side of an active current transformer must always remain closed. Dangerous high voltages can occur and the current transformer and the instrument can be damaged, if the current path is opened during measurements.

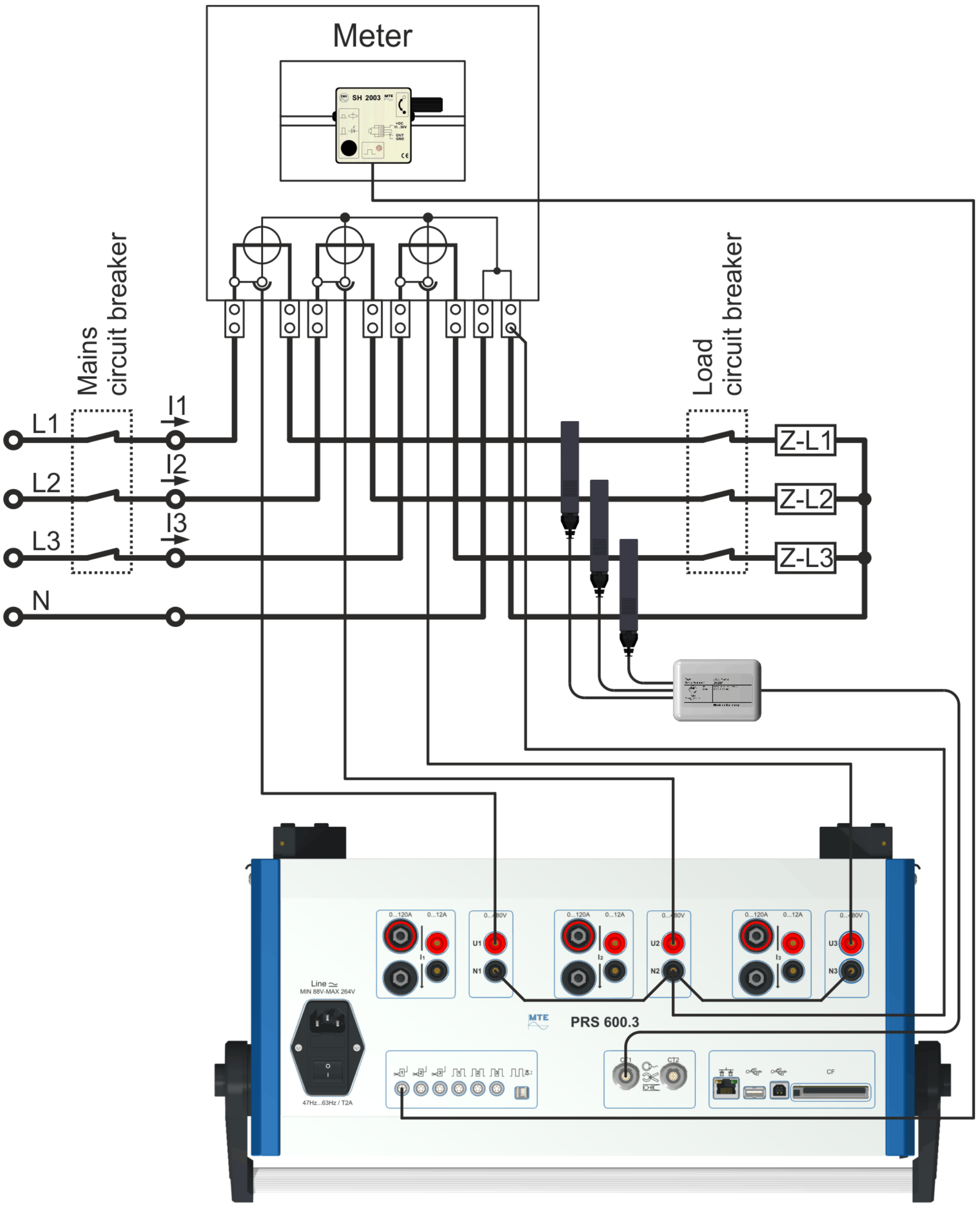
17.2.2 Testing of an installed transformer connected 3-wire meter



Connections to test terminals (see explanations in chapter 17.2.1)

---- Optional connection to protected earth (PE)

17.2.3 Testing of an installed direct connected 4-wire meter with clamp-on CT (120A)



Connections to meter under test (example for IEC-type meter)

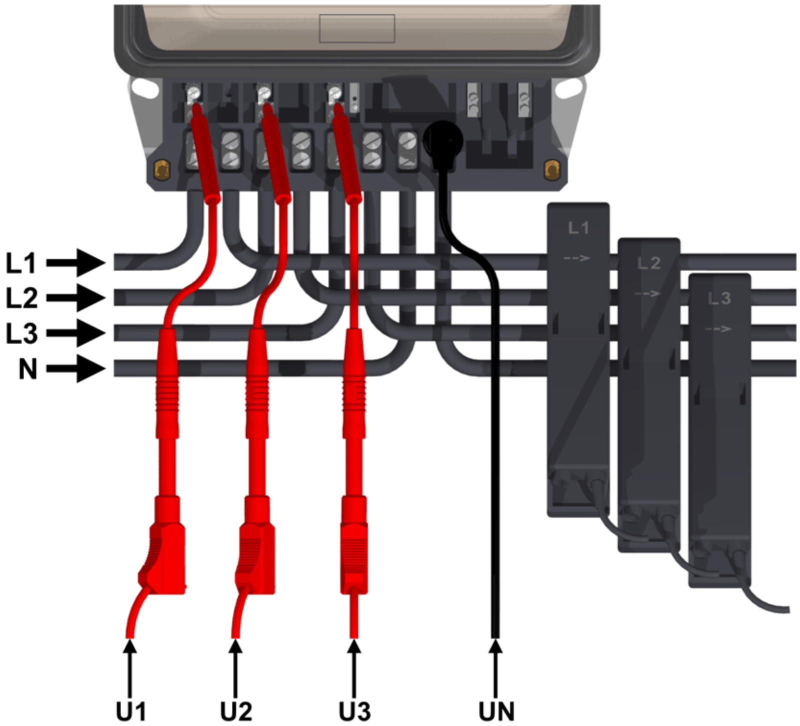
Attention! For safety reasons, whenever possible, switch off the mains circuit breaker during meter manipulations to fix the adapter pins and omega clips for the voltage connections.

Regard the instructions for the use of the installed test terminals and observe local safety regulations.

Adapter pins

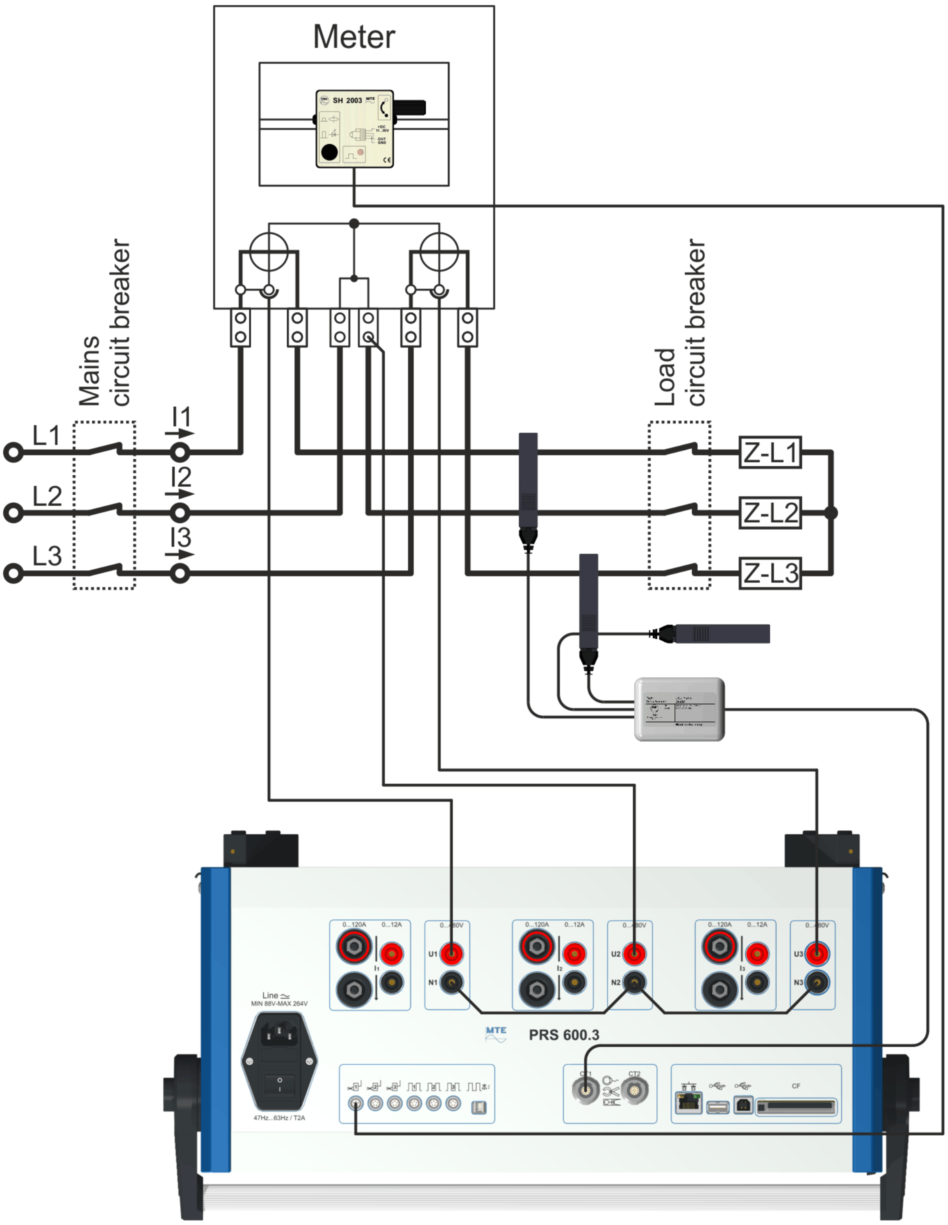
Direct connected
4-wire meter
Installed on site
Maximum test current 120 A

Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.4 Testing of an installed direct connected 3-wire meter with clamp-on CT (120A)

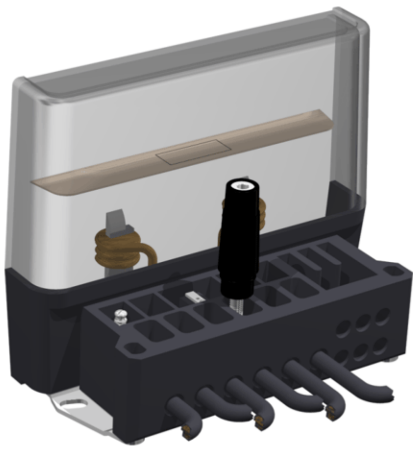


Connections to meter under test (example for IEC-type meter)

Attention! For safety reasons, whenever possible, switch off the mains circuit breaker during meter manipulations to fix the adapter pins and omega clips for the voltage connections.

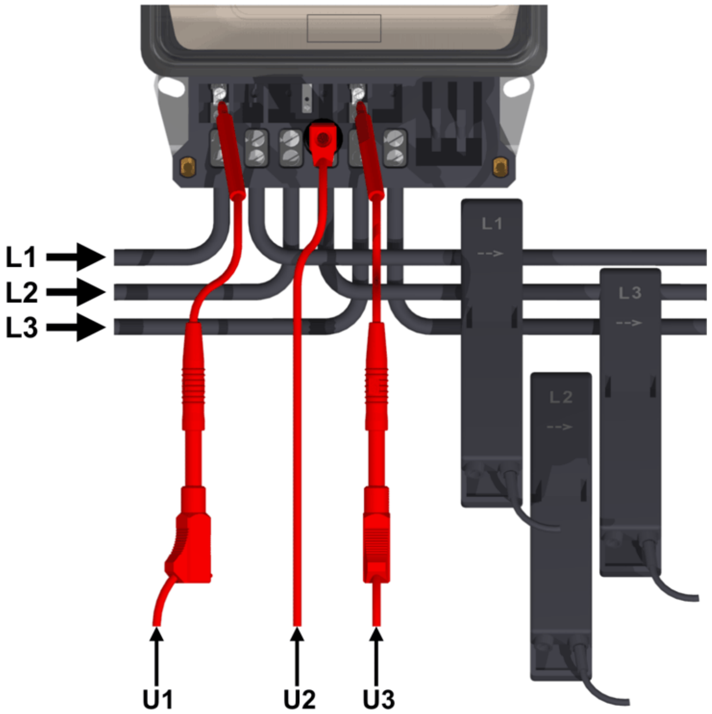
Regard the instructions for the use of the installed test terminals and observe local safety regulations.

Adapter pins



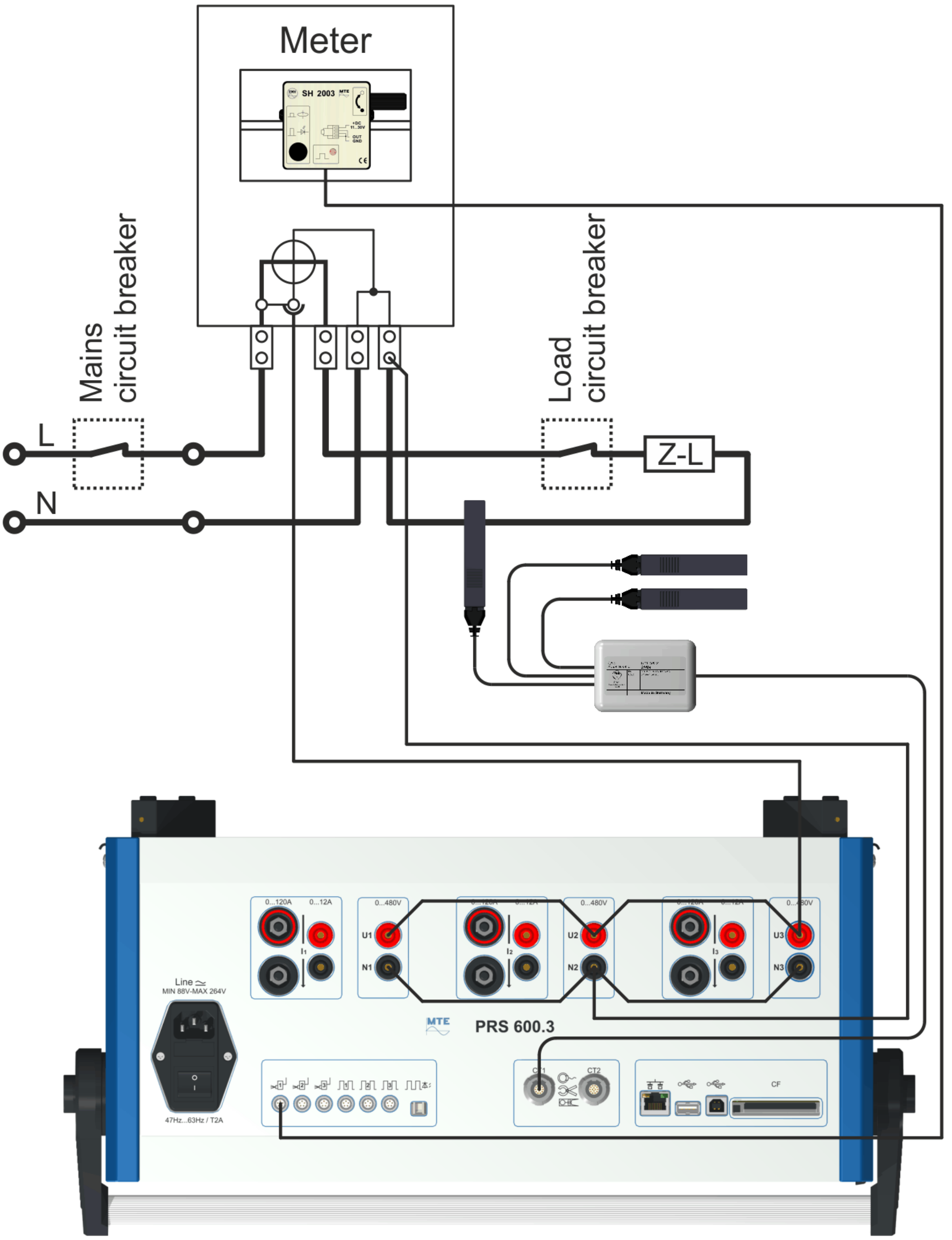
Direct connected
3-wire meter
Installed on site
Maximum test current 120 A

Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.5 Testing of an installed direct connected 2-wire meter with clamp-on CT (120A)

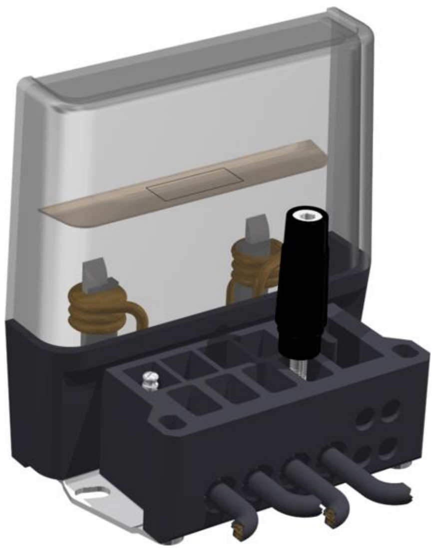


Connections to meter under test (example for IEC-type meter)

Attention! For safety reasons, whenever possible, switch off the mains circuit breaker during meter manipulations to fix the adapter pins and omega clips for the voltage connections.

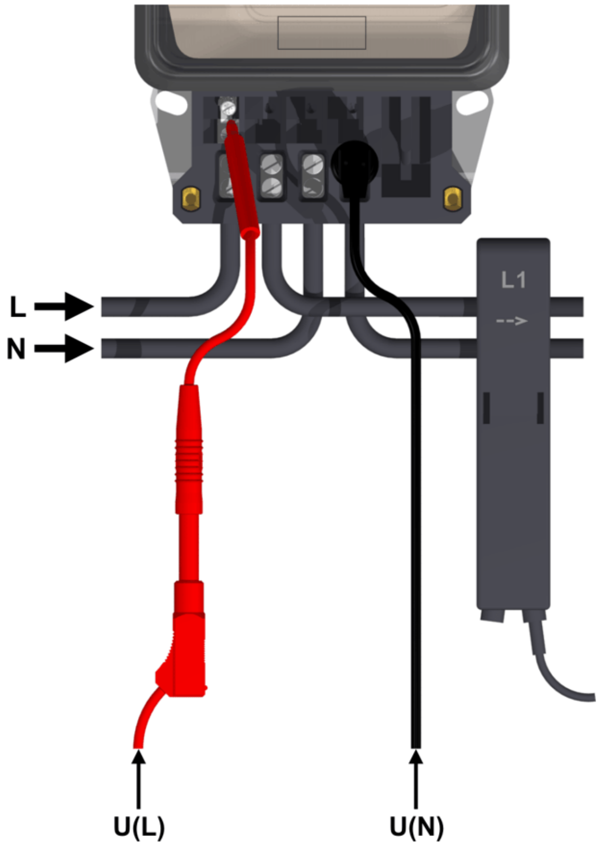
Regard the instructions for the use of the installed test terminals and observe local safety regulations.

Adapter pins



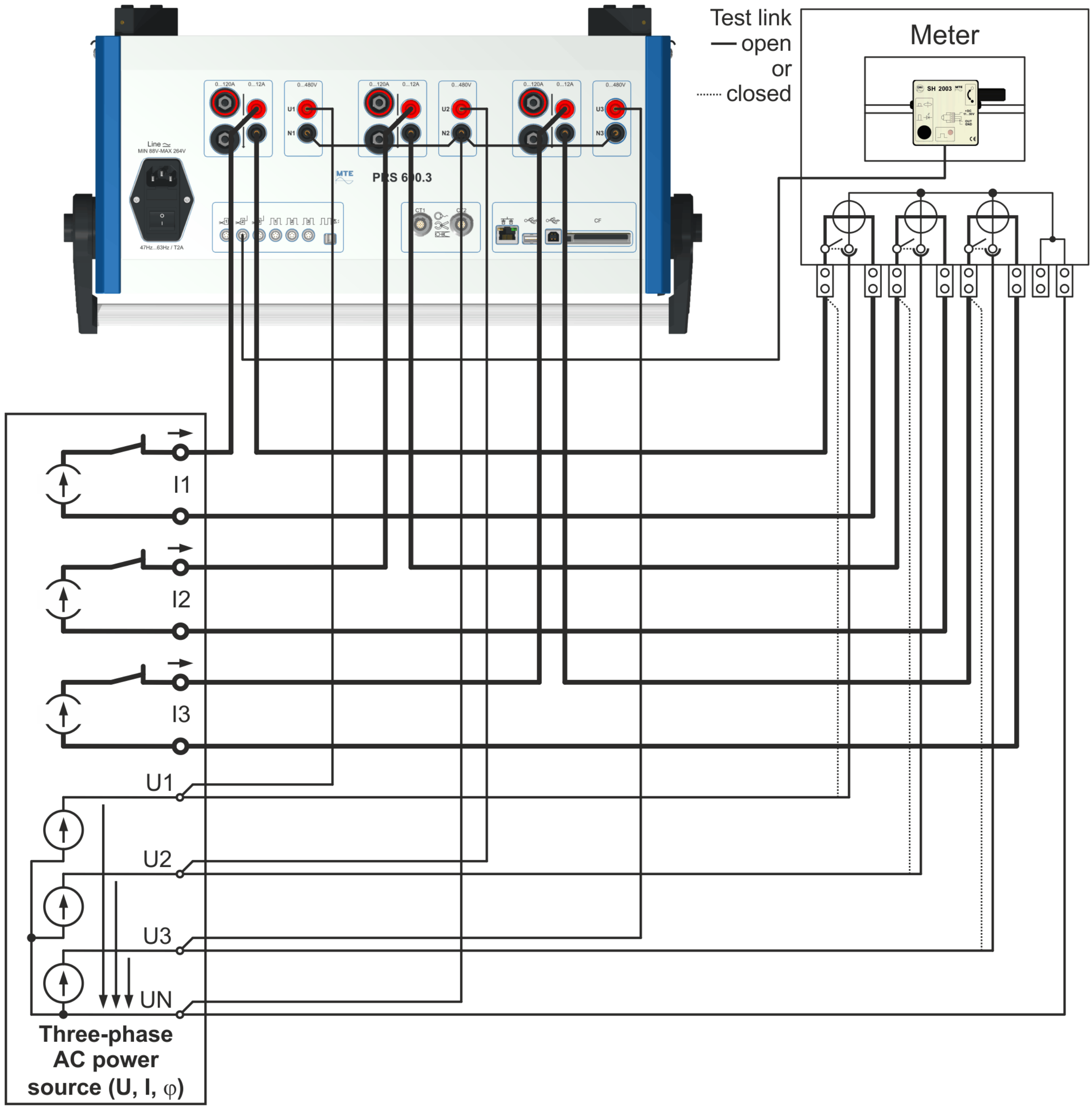
Direct connected
2-wire meter
Installed on site
Maximum test current 120 A

Test links closed



For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.6 Testing of a direct connected 4-wire meter up to 12A with source

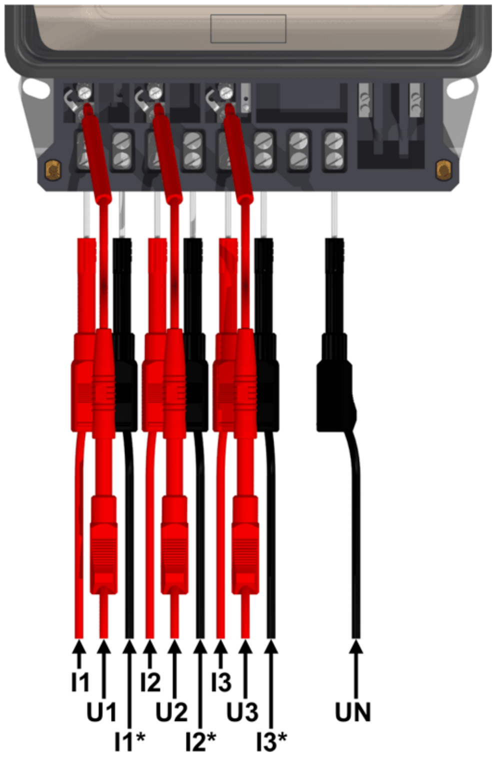


Connections to meter under test (example for IEC-type meter)

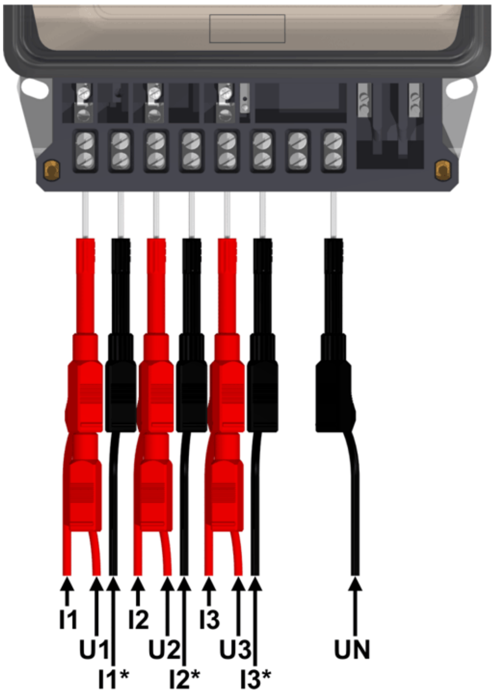
Adapter pins

Direct connected
4-wire meter
Uninstalled on site or in laboratory
Maximum test current 12 A

Test links open

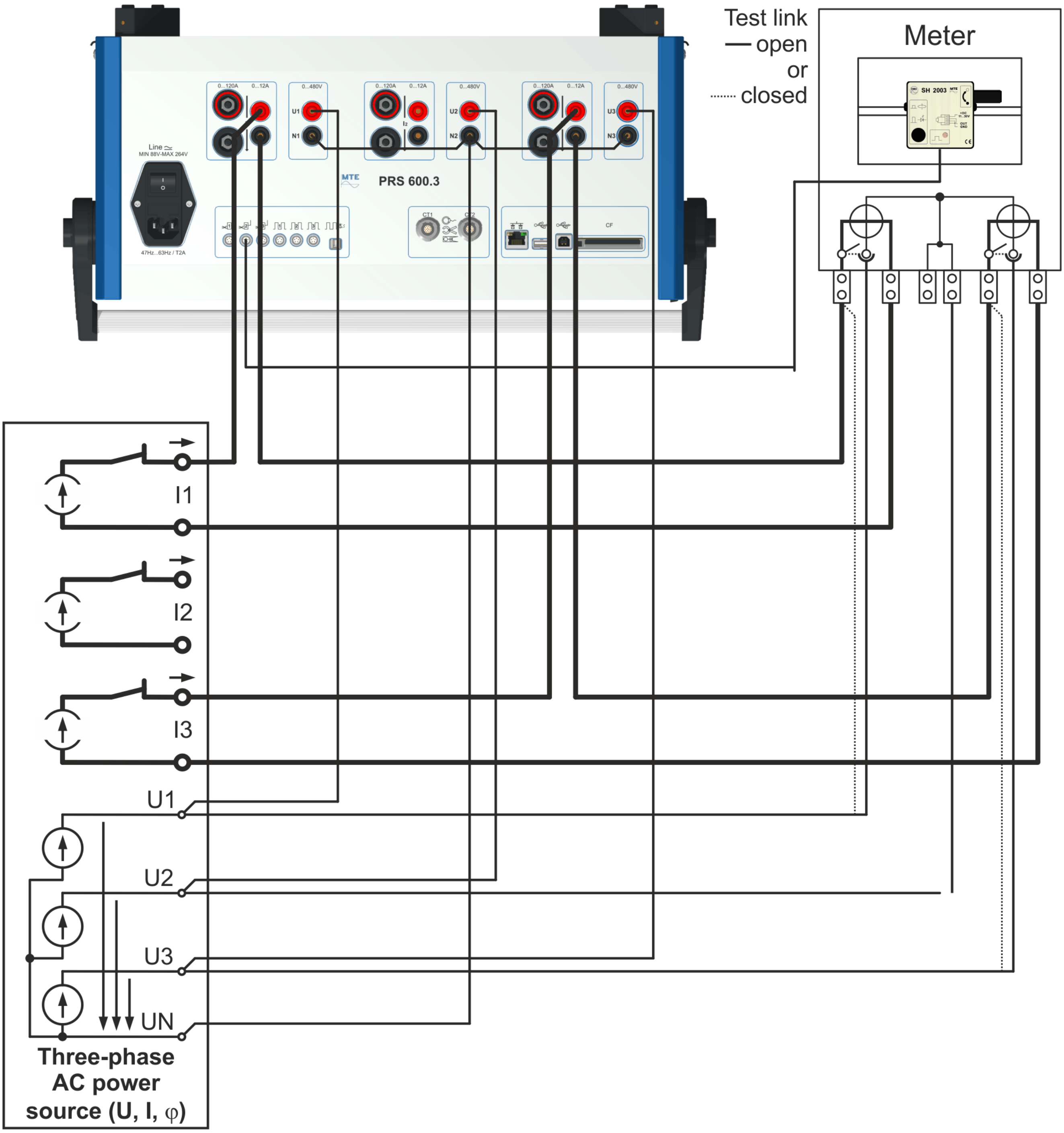


Test links closed



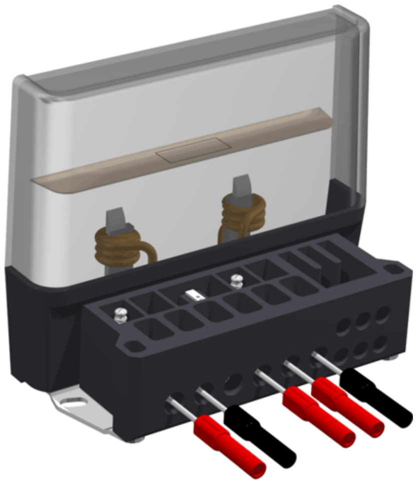
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.7 Testing of a direct connected 3-wire meter up to 12A with source



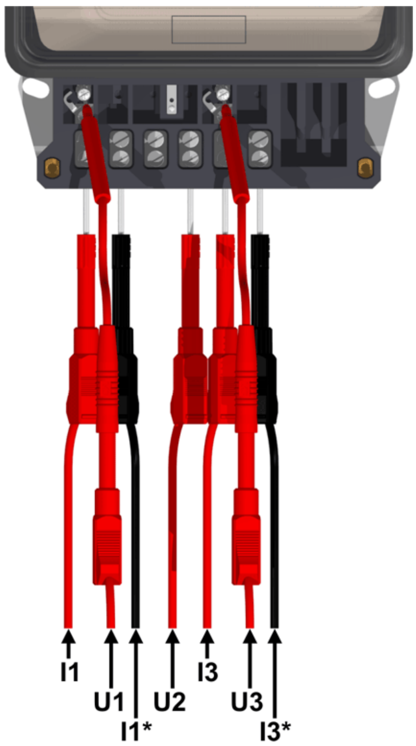
Connections to meter under test (example for IEC-type meter)

Adapter pins

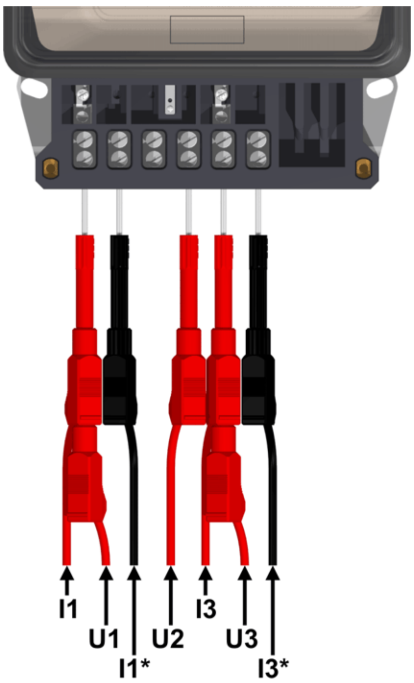


Direct connected
3-wire meter
Uninstalled on site or in laboratory
Maximum test current 12 A

Test links open

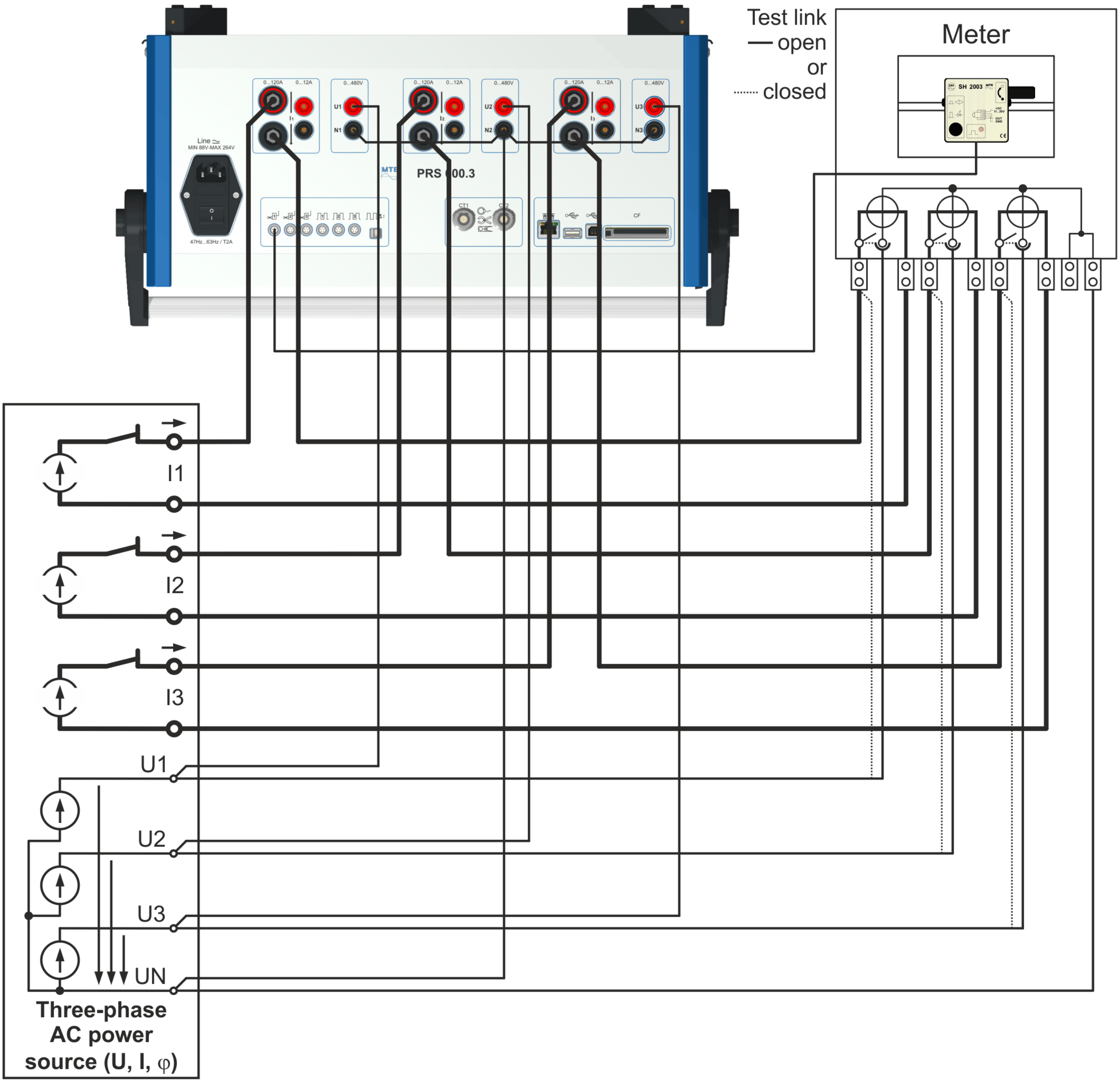


Test links closed



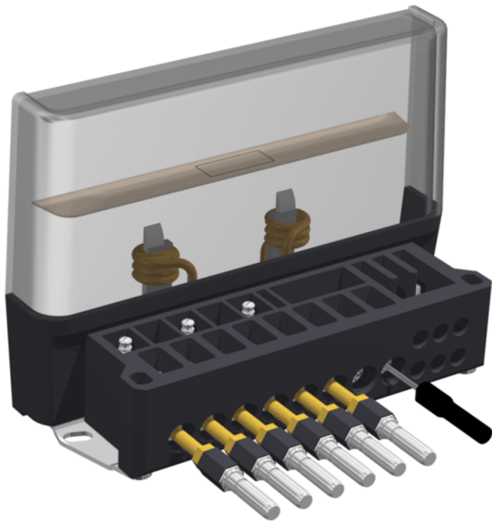
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.8 Testing of a direct connected 4-wire meter up to 120A with source



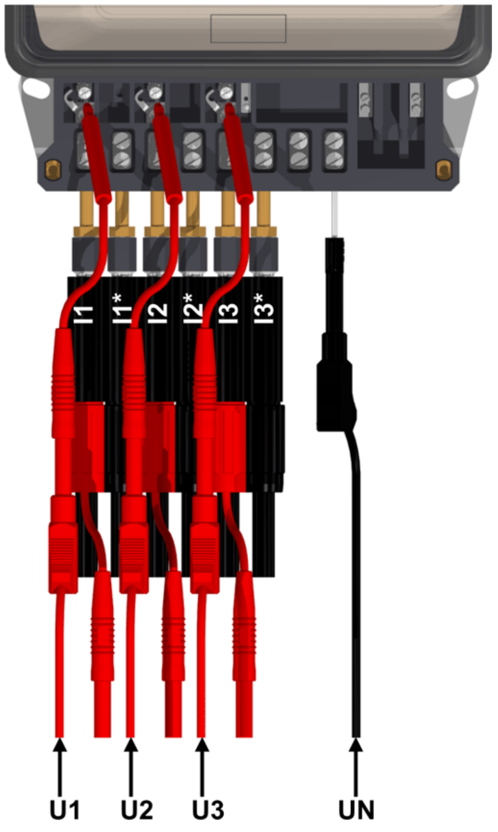
Connections to meter under test (example for IEC-type meter)

Adapter pins

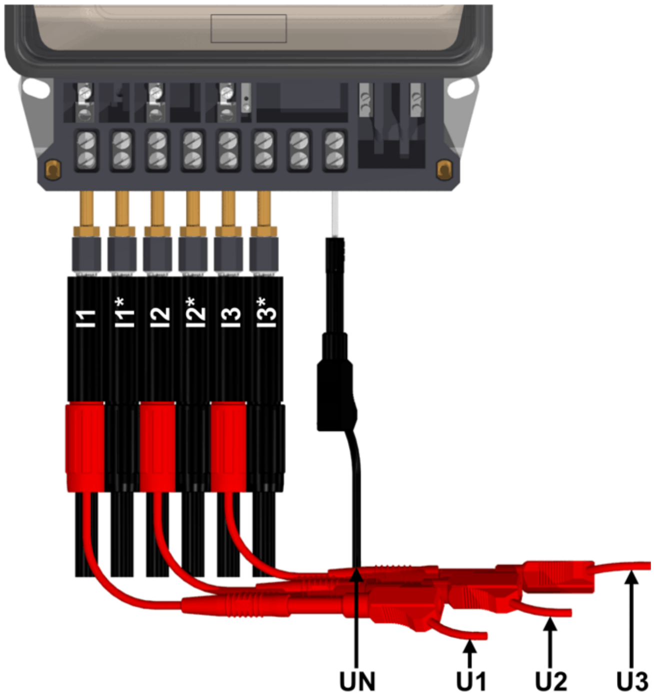


Direct connected
4-wire meter
Uninstalled on site or in laboratory
Maximum test current 120 A

Test links open

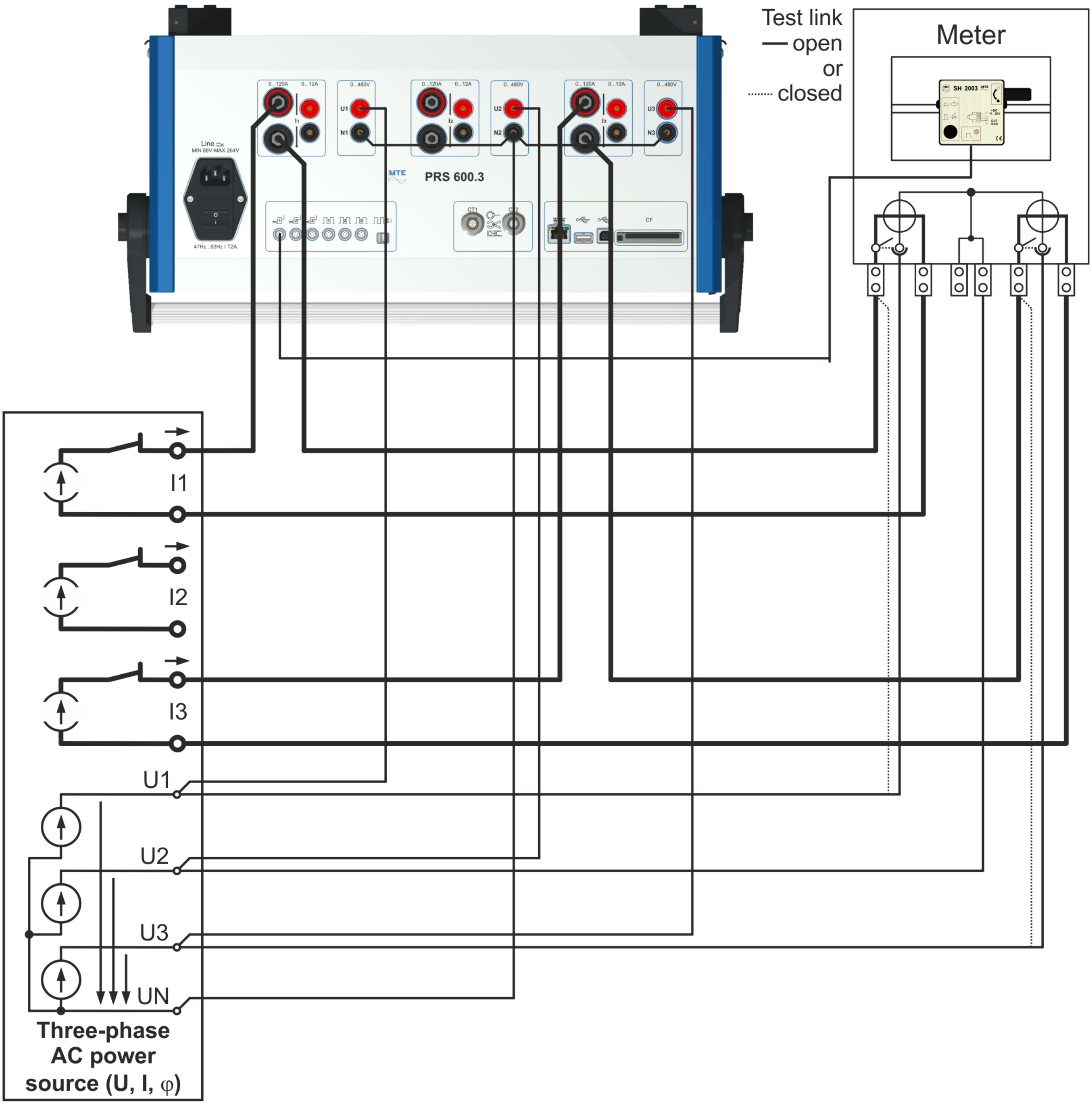


Test links closed



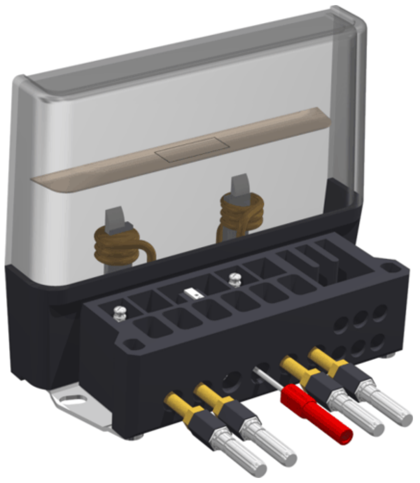
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.9 Testing of a direct connected 3-wire meter up to 120A with source



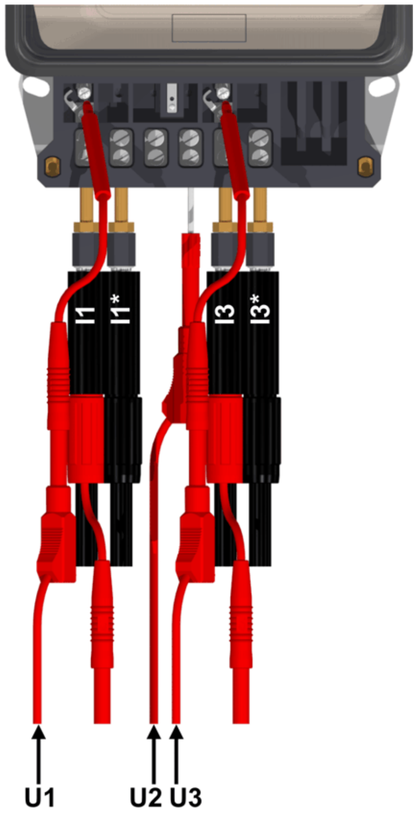
Connections to meter under test (example for IEC-type meter)

Adapter pins

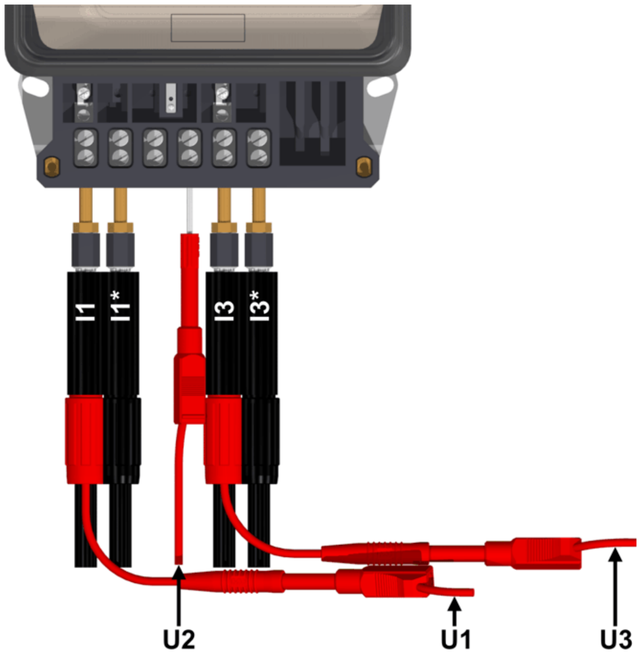


Direct connected
3-wire meter
Uninstalled on site or in laboratory
Maximum test current 120 A

Test links open



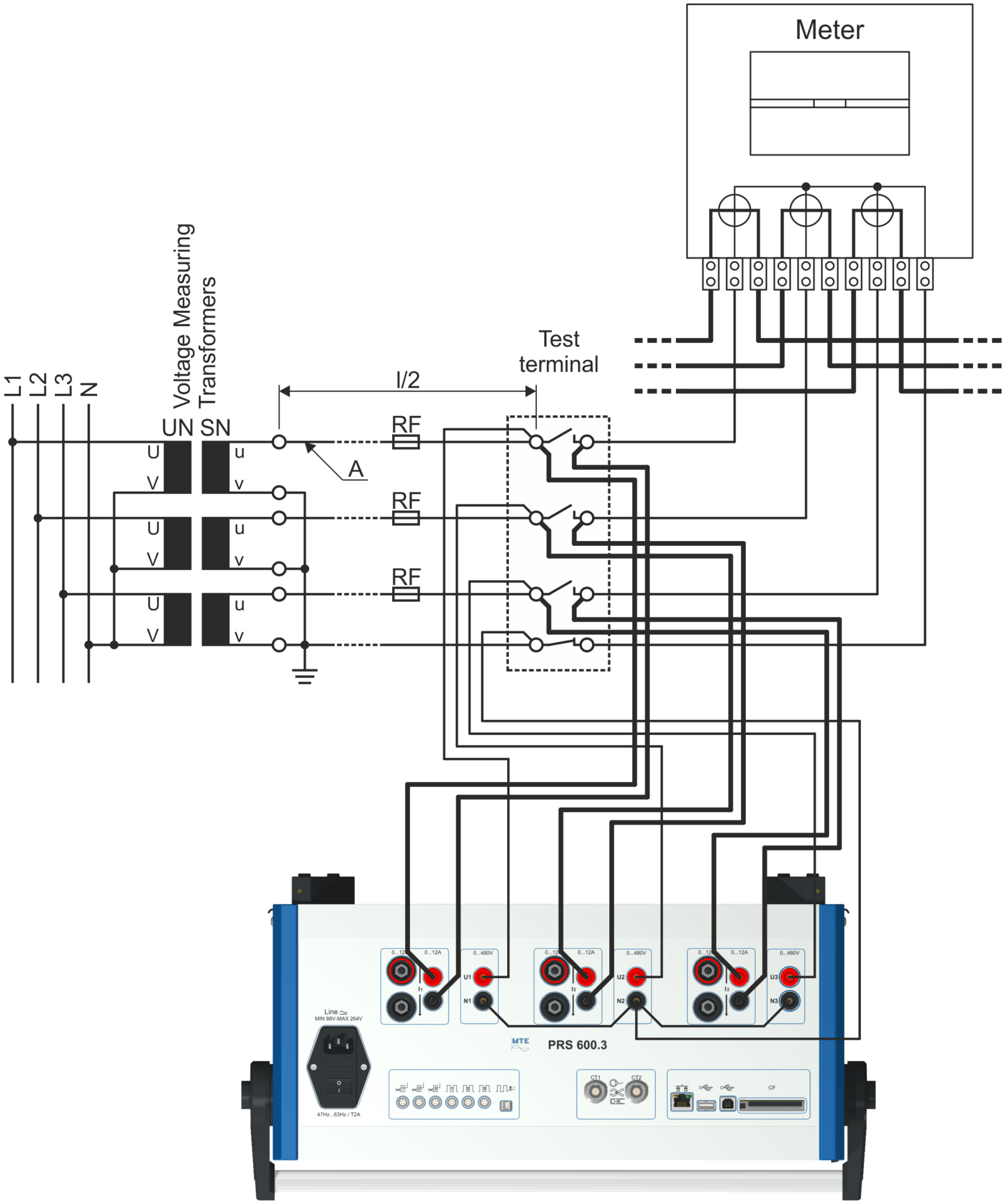
Test links closed



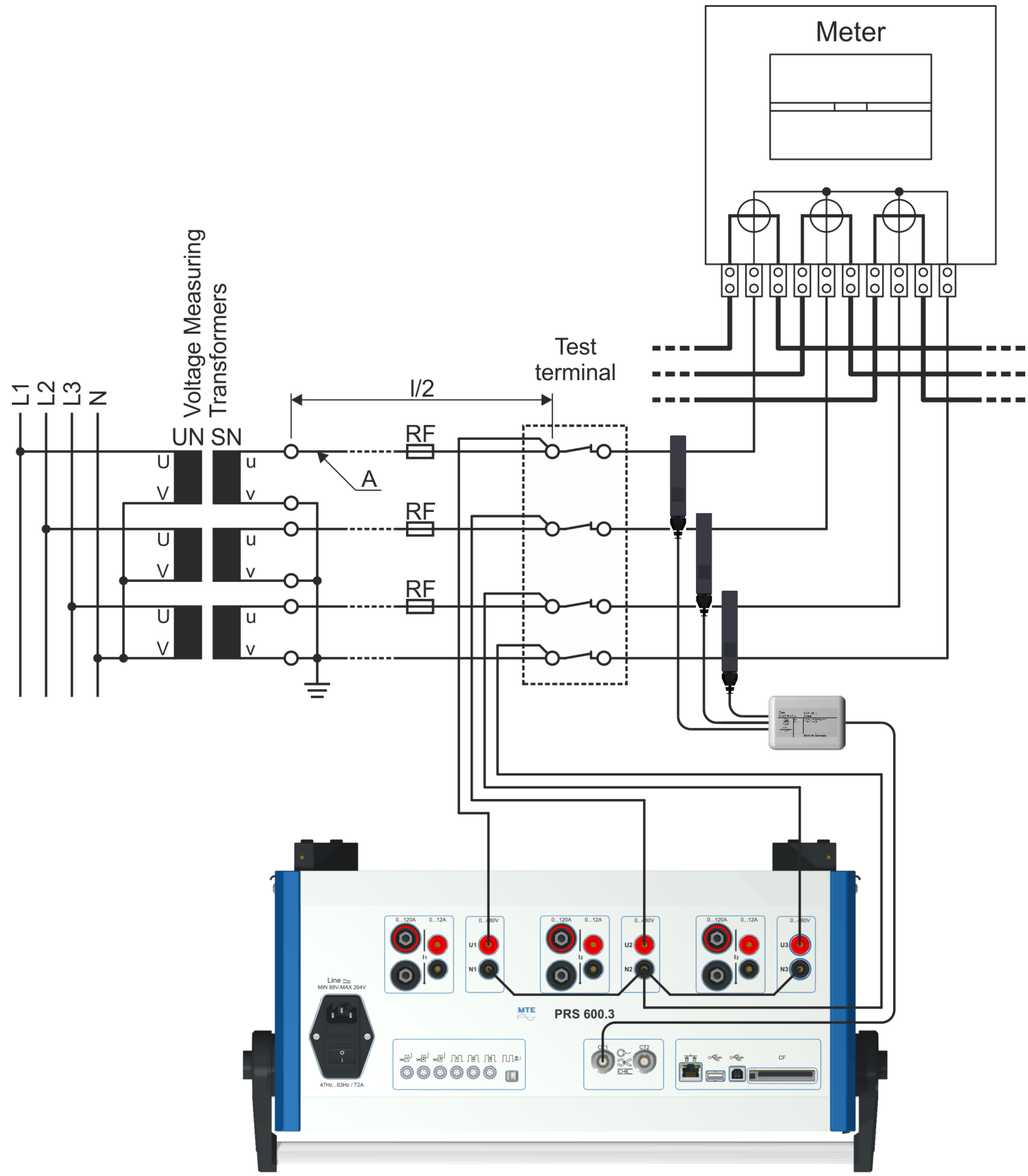
For other type of meters (ANSI Form S, Form A; British Standard BS etc.) consult the documentation delivered by the manufacturer and adapt the connections to the meter regarding your needs.

17.2.10 Burden measurement of voltage transformer

Example A: Secondary current measured direct

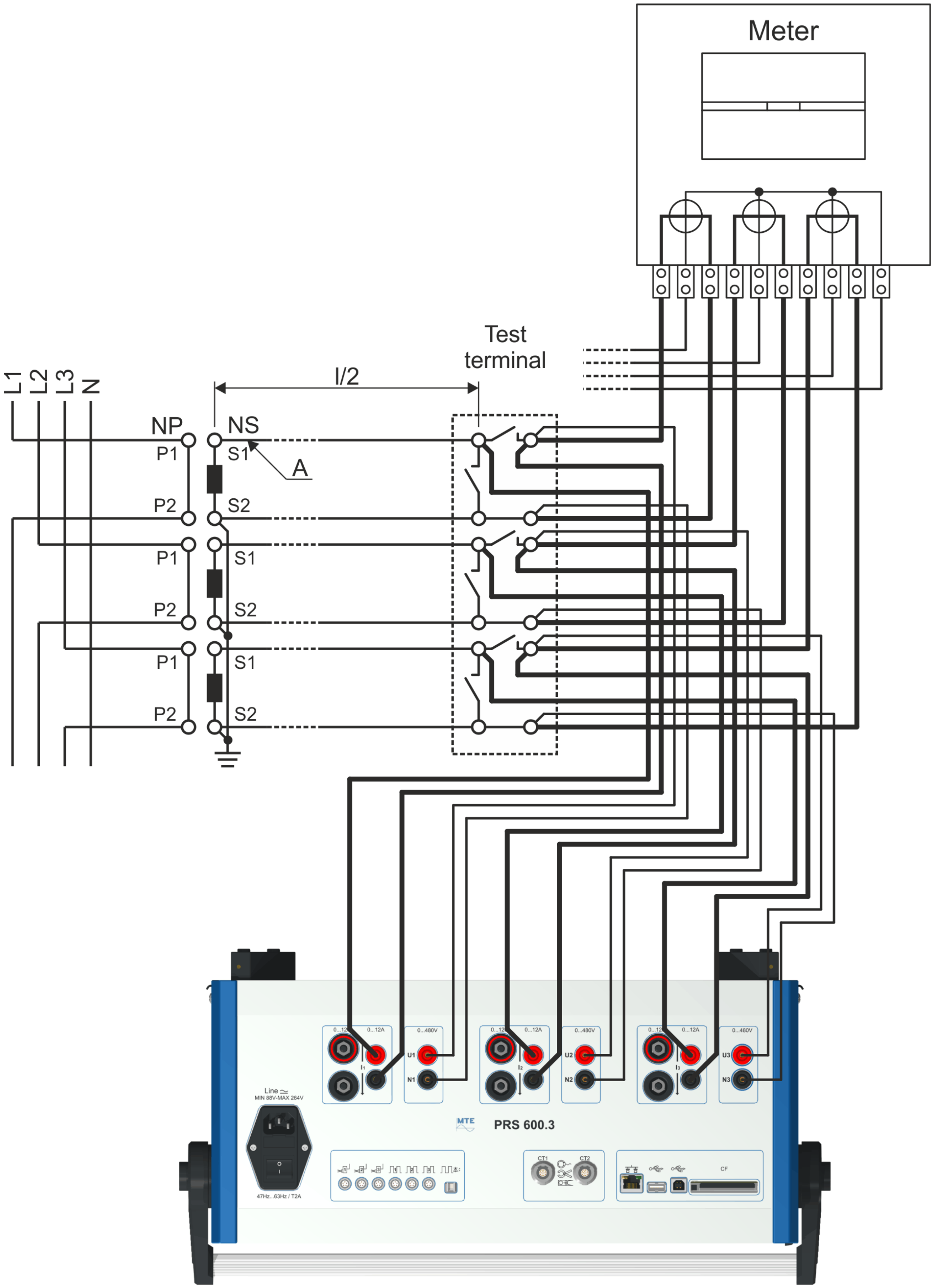


Example B: Secondary current measurement with clamp-on CTs

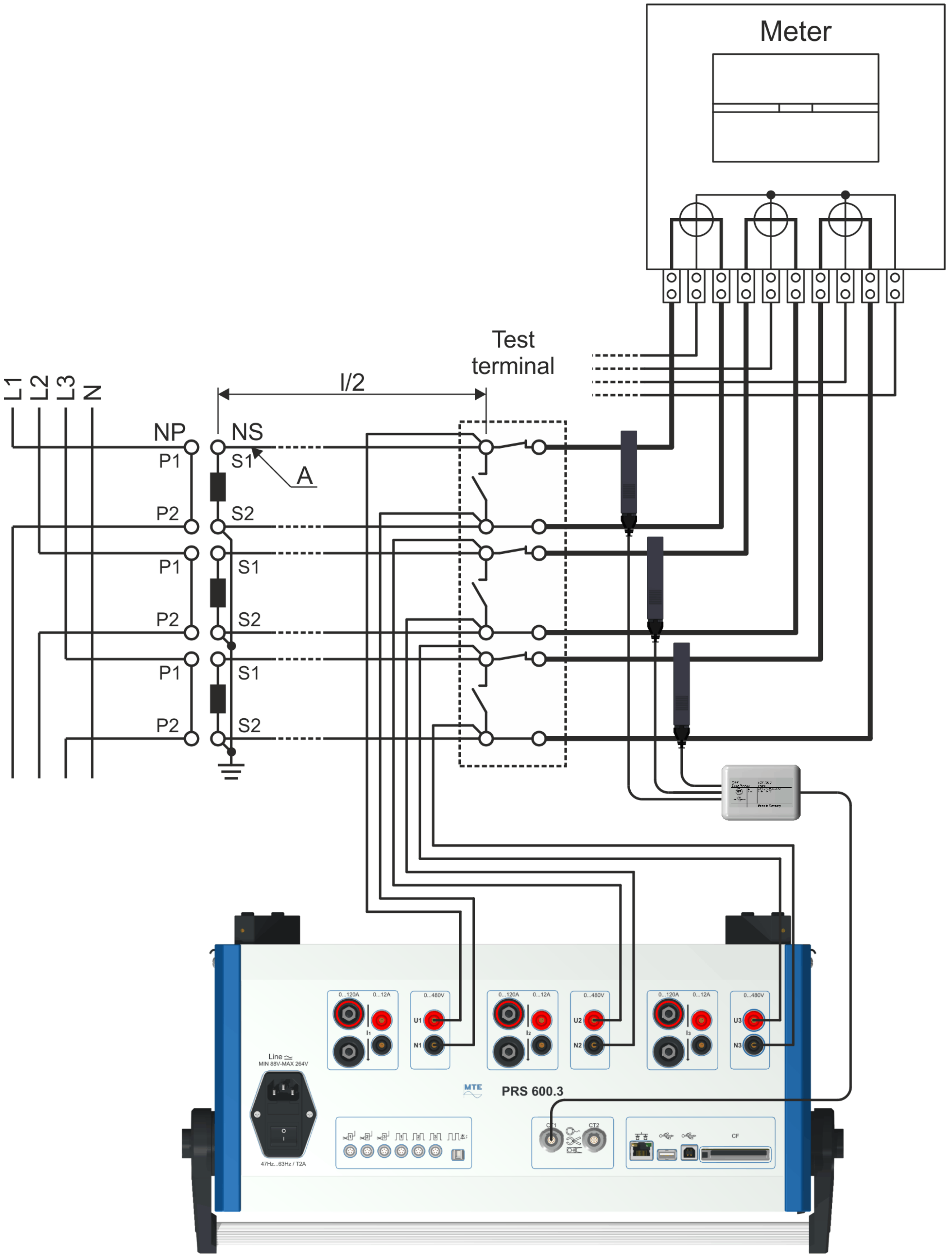


17.2.11 Burden measurement of current transformer

Example A: Secondary current measured direct

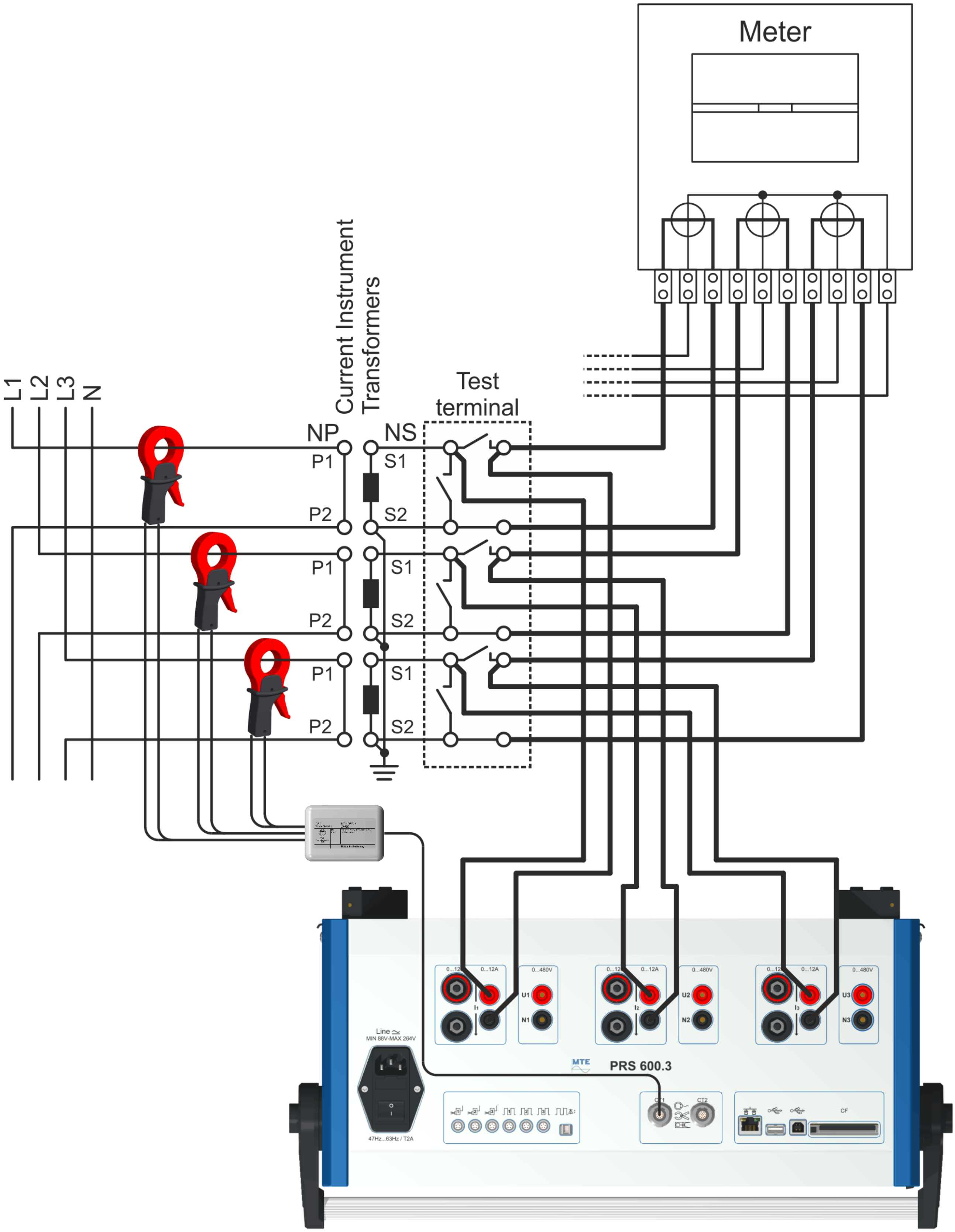


Example B: Secondary current measurement with clamp-on CTs

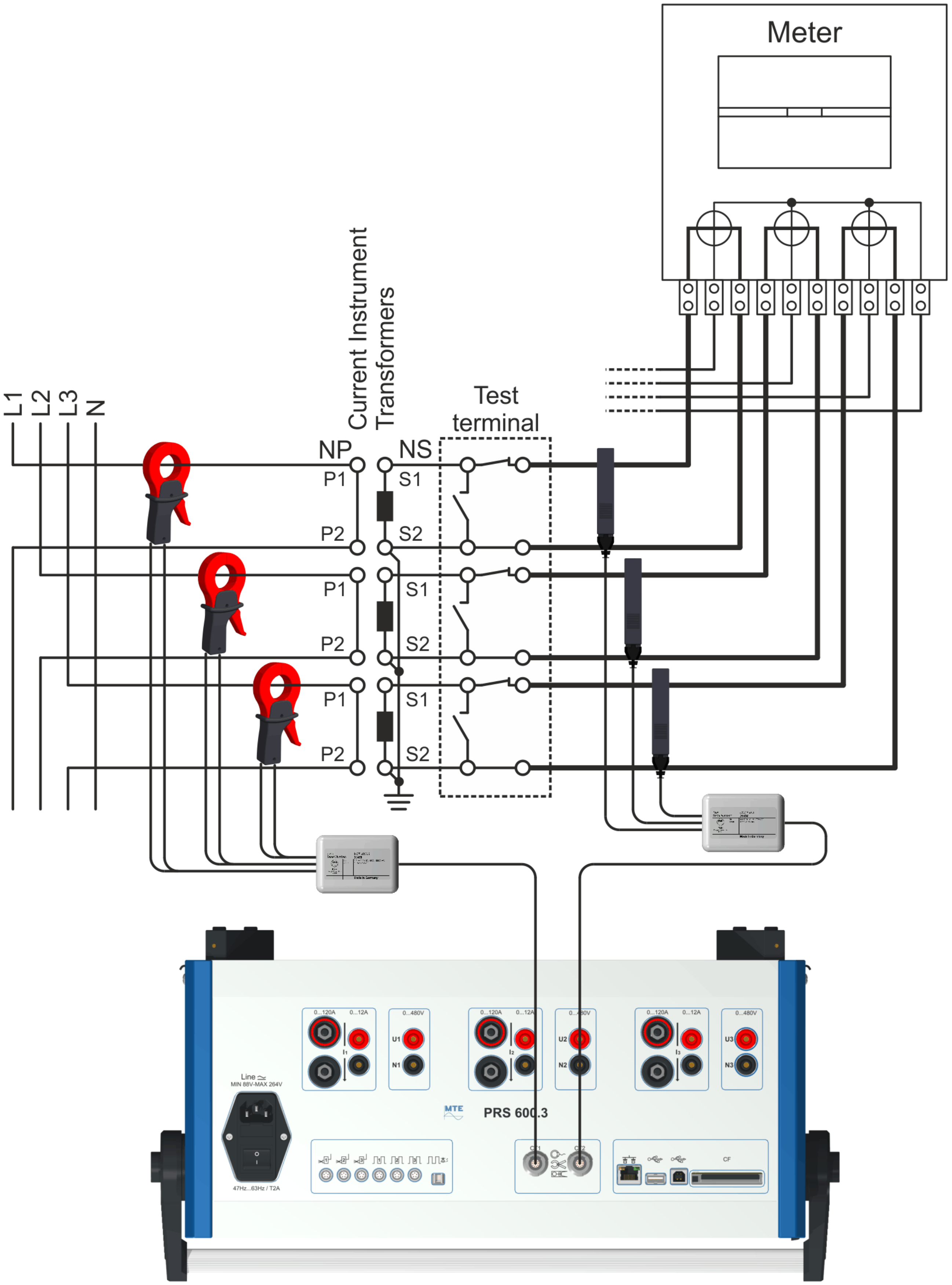


17.2.12 Transformer ratio measurement of current transformer

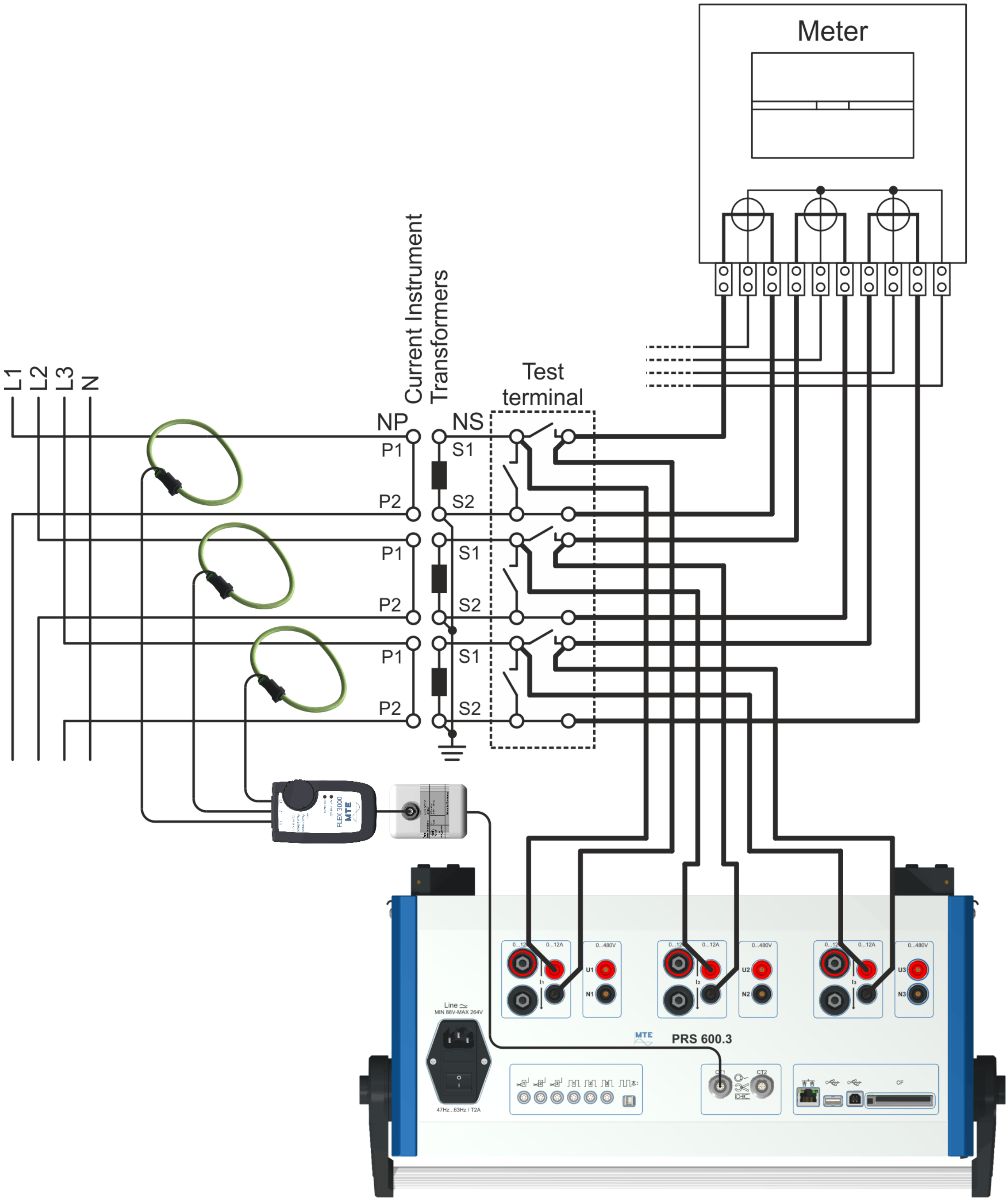
Example A: Primary current measured with clamp-on CTs (1000 A)
Secondary current measured direct (12 A)



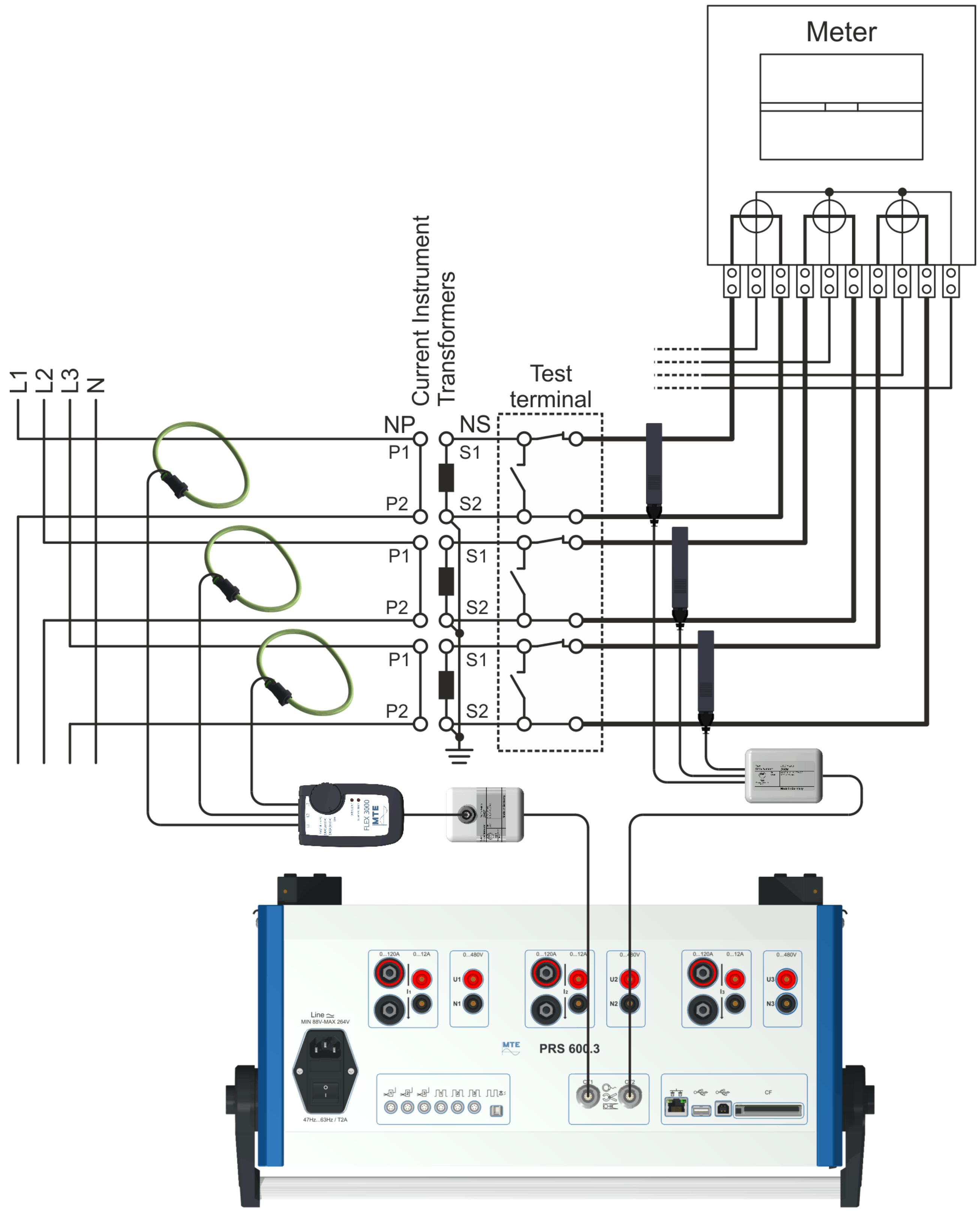
Example B: Primary current measured with clamp-on CTs (1000 A)
Secondary current measured with clamp-on CTs (120 A)



Example C: Primary current measured with clamp-on CTs (3000 A)
Secondary current measured direct (12 A)



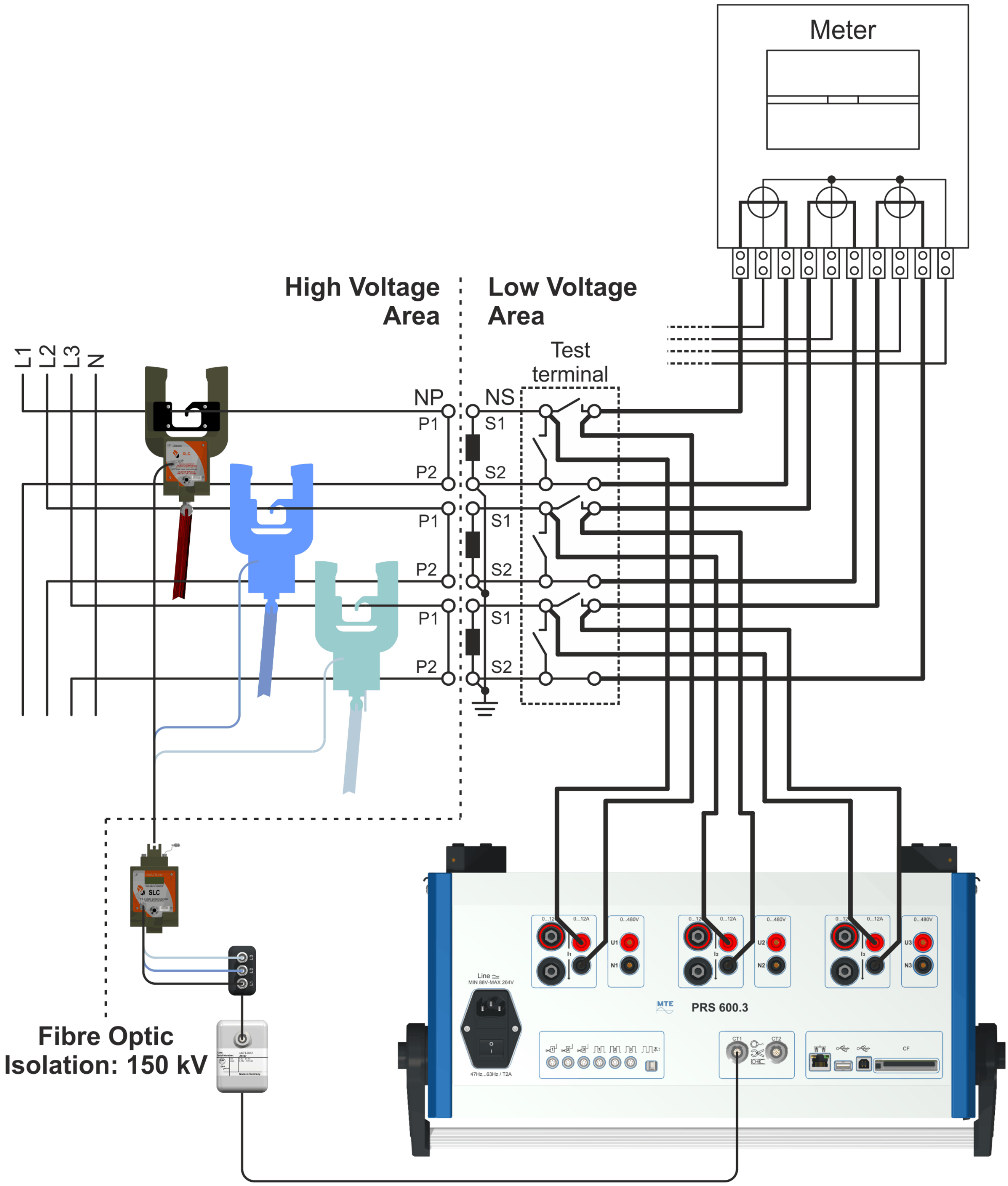
Example D: Primary current measured with clamp-on CTs (3000 A)
Secondary current measured with clamp-on CTs (120 A)



17.2.13 Ratio measurement of current transformer with AmpLiteWire 2000A

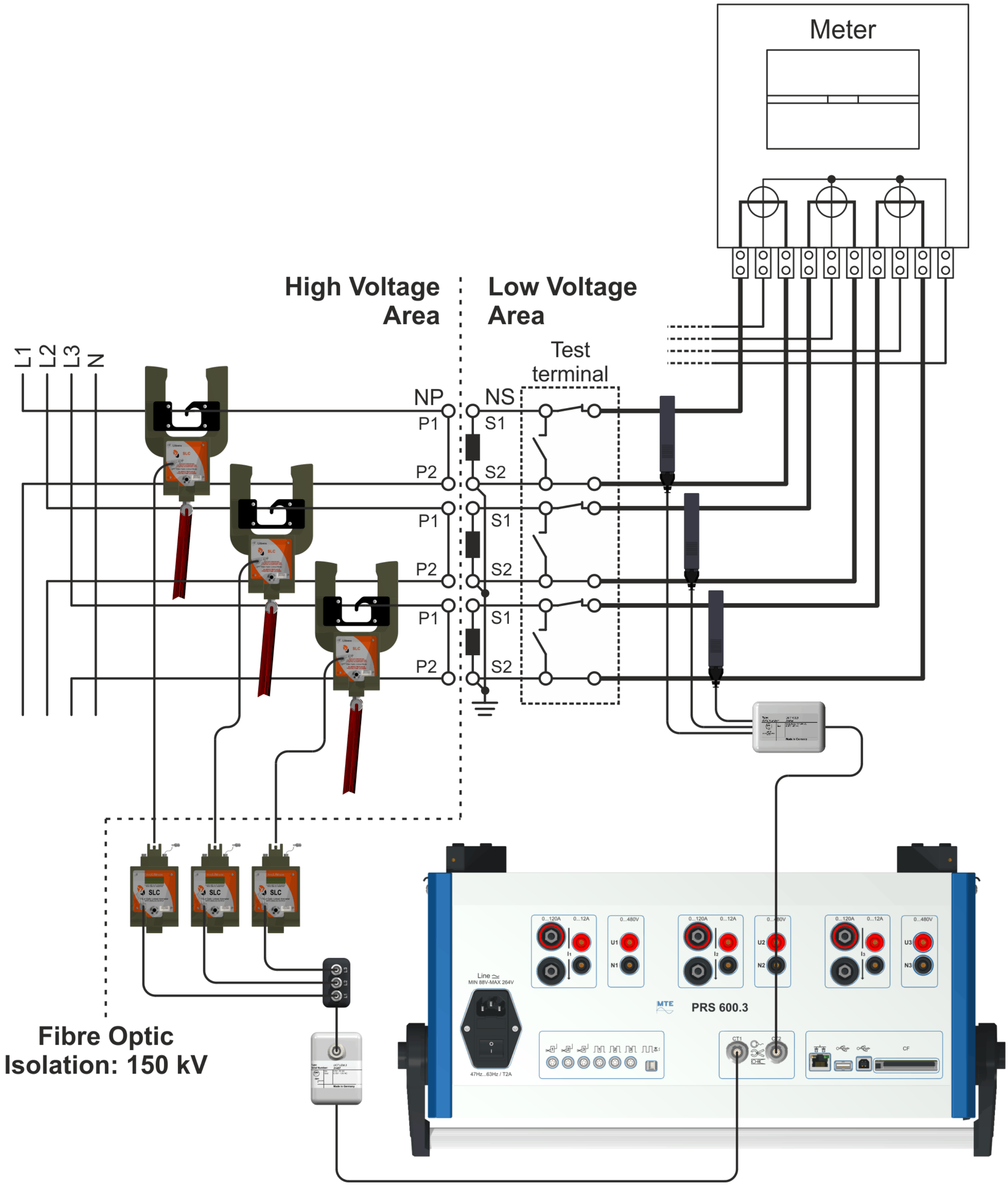
Example A: Secondary current measured direct

The connection example is shown for the test of the current instrument transformer of phase 1 of a 3-phase 4-wire installation. Check phases L2, L3 in the same way phase by phase (blue marked).



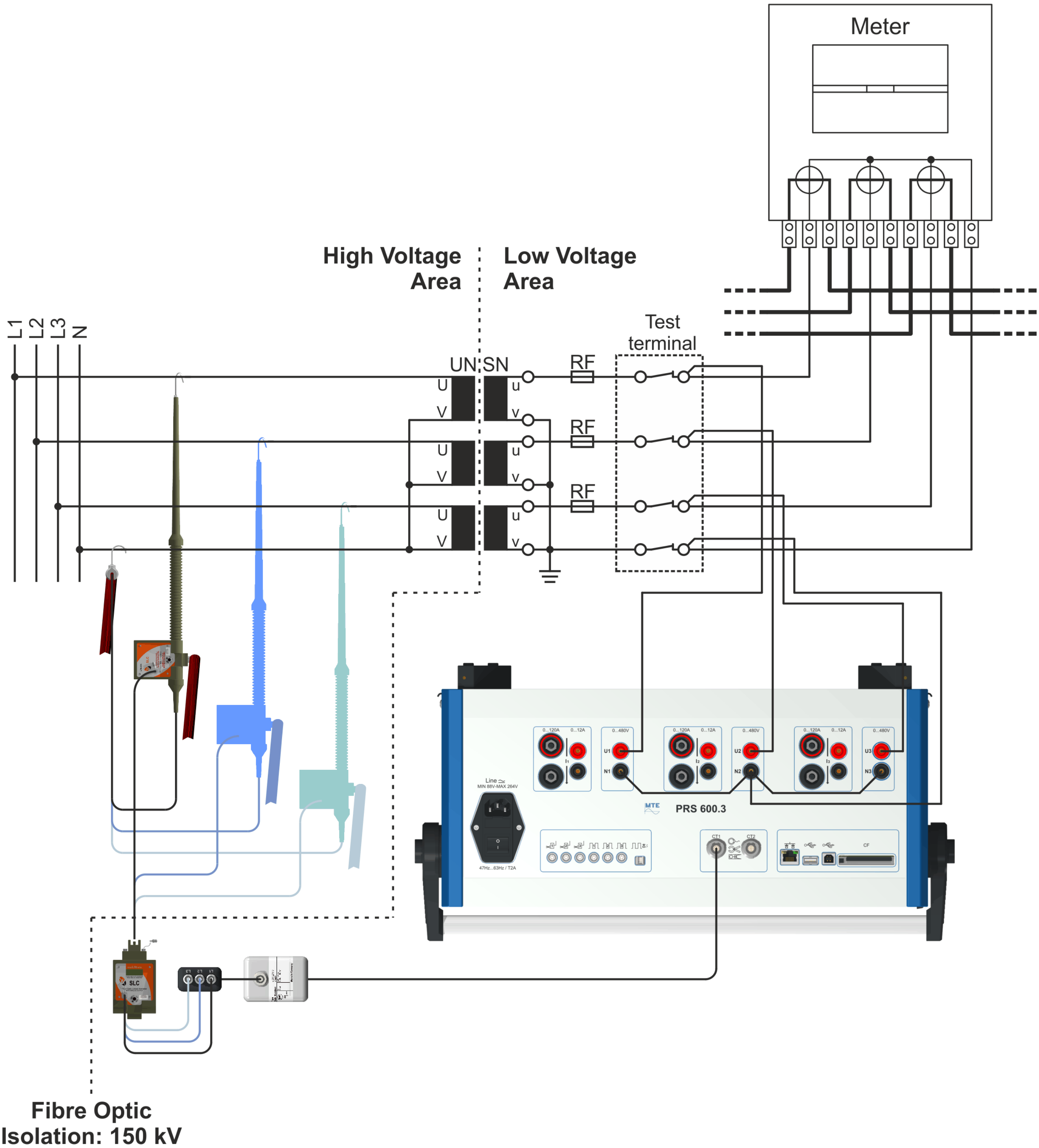
Attention! Regard the instructions for the use of the AmpLiteWire high voltage current sensor and observe local safety regulations for measurements on high voltage potential.

Example B: Three phase measurement, secondary current measurement with clamp-on CTs



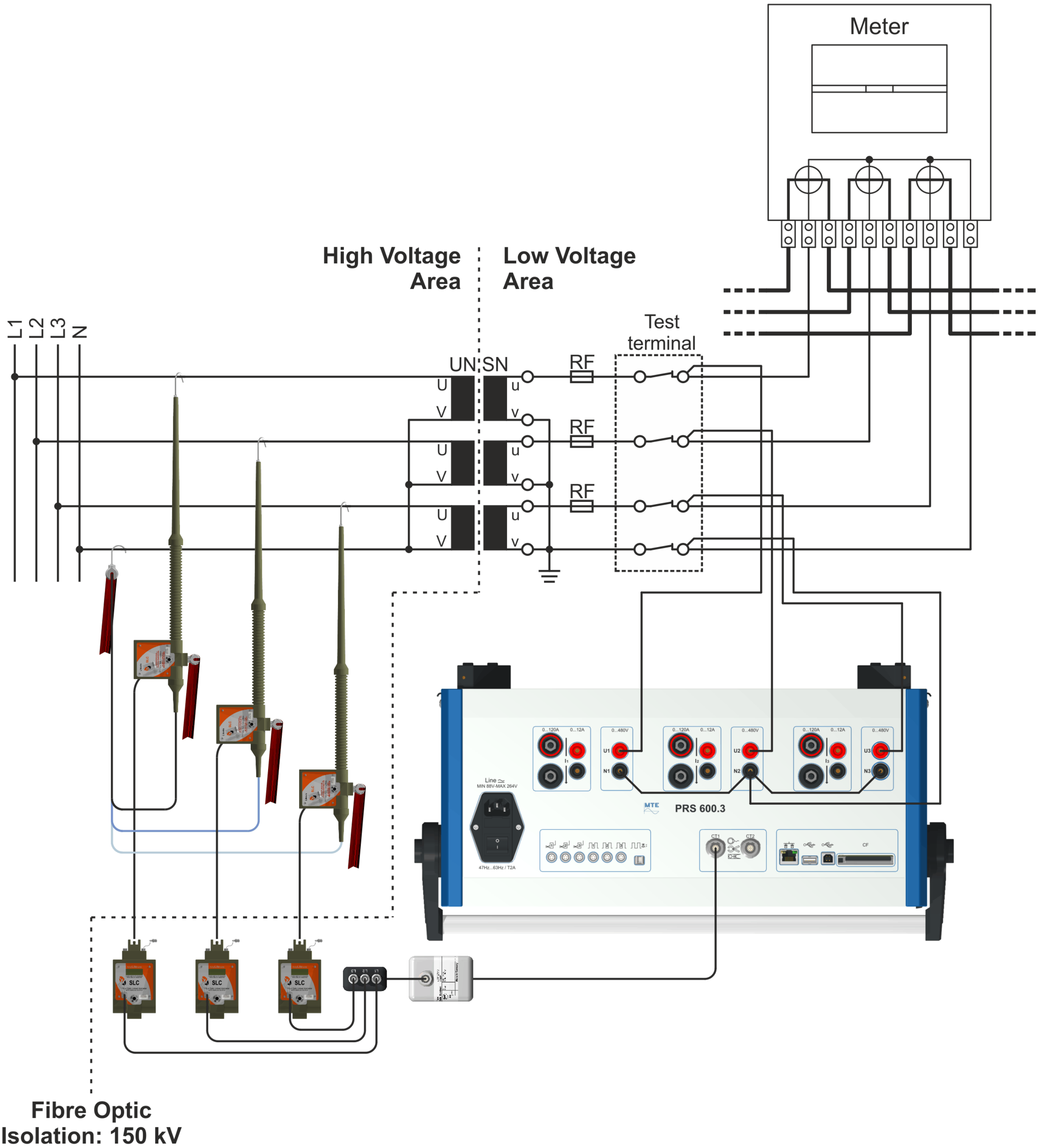
17.2.14 Ratio measurement of voltage transformer with VoltLiteWire 40kV

The connection example is shown for the test of the voltage instrument transformer of phase 1 of a 3-phase 4-wire installation. Check phases L2, L3 in the same way phase by phase (blue marked).

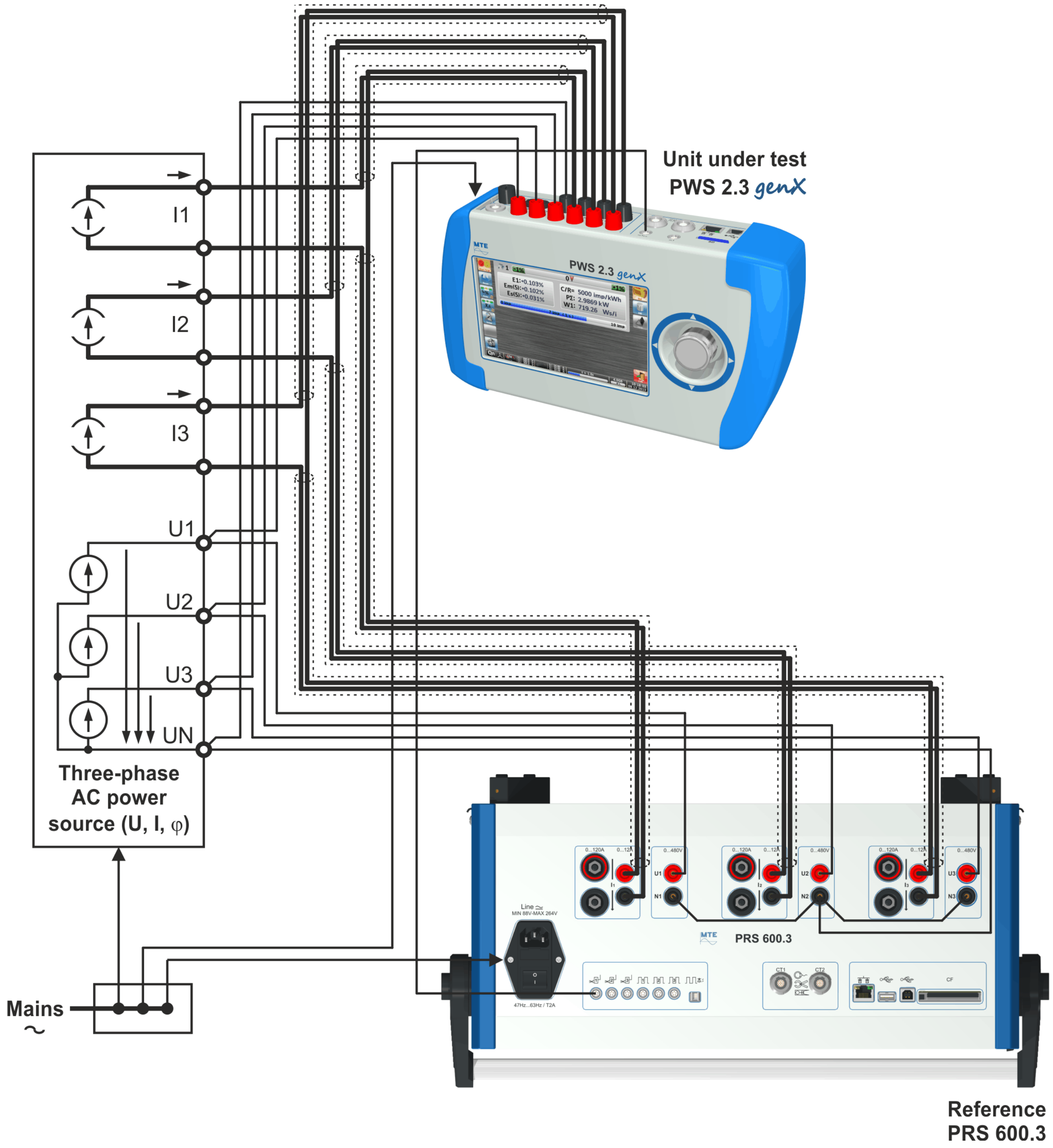


Attention! Regard the instructions for the use of the VoltLiteWire high voltage voltage sensor and observe local safety regulations for measurements on high voltage potential.

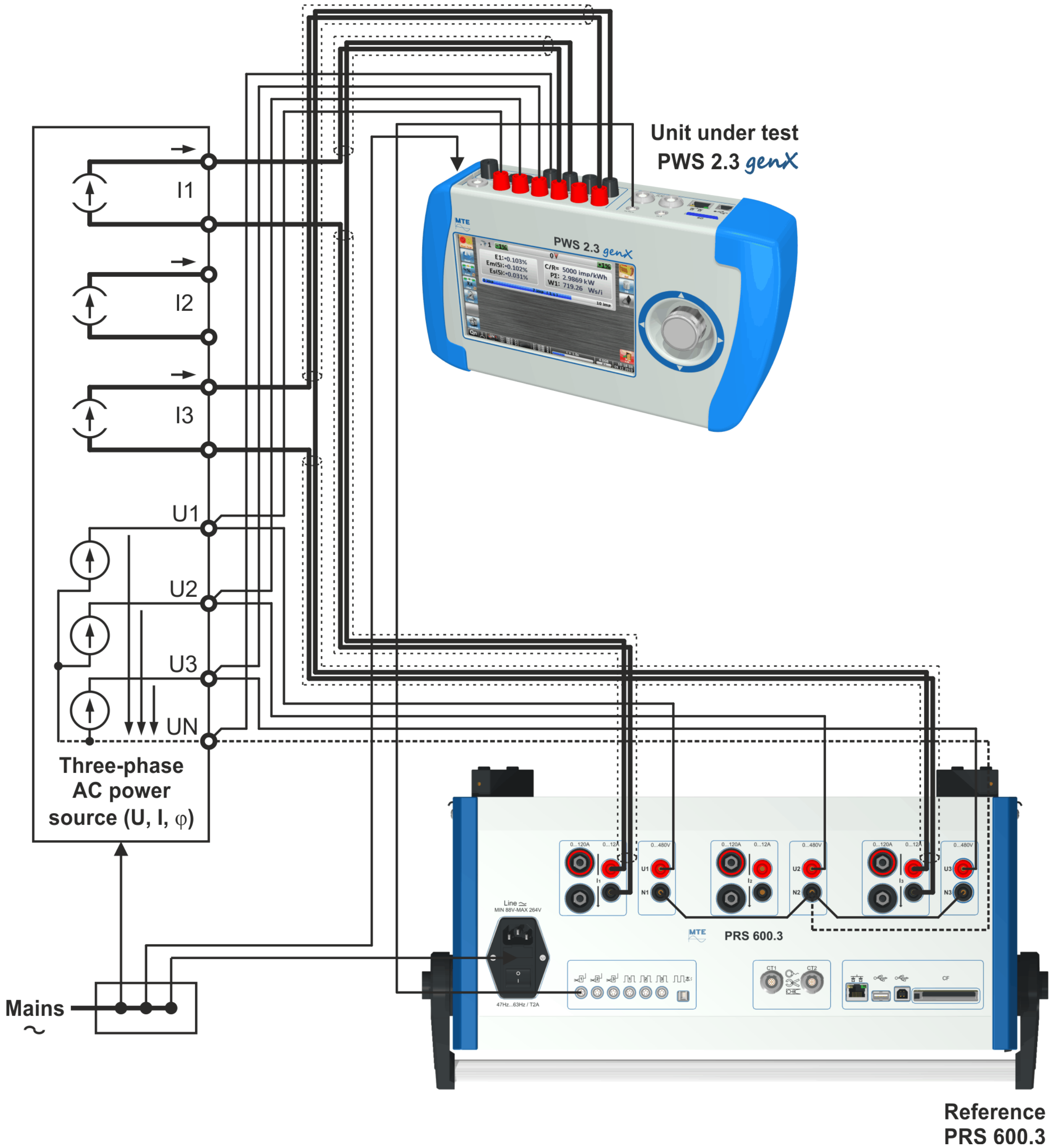
Example B: Three phase measurement



17.2.15 Testing of a 3-phase reference meter in 4-wire mode



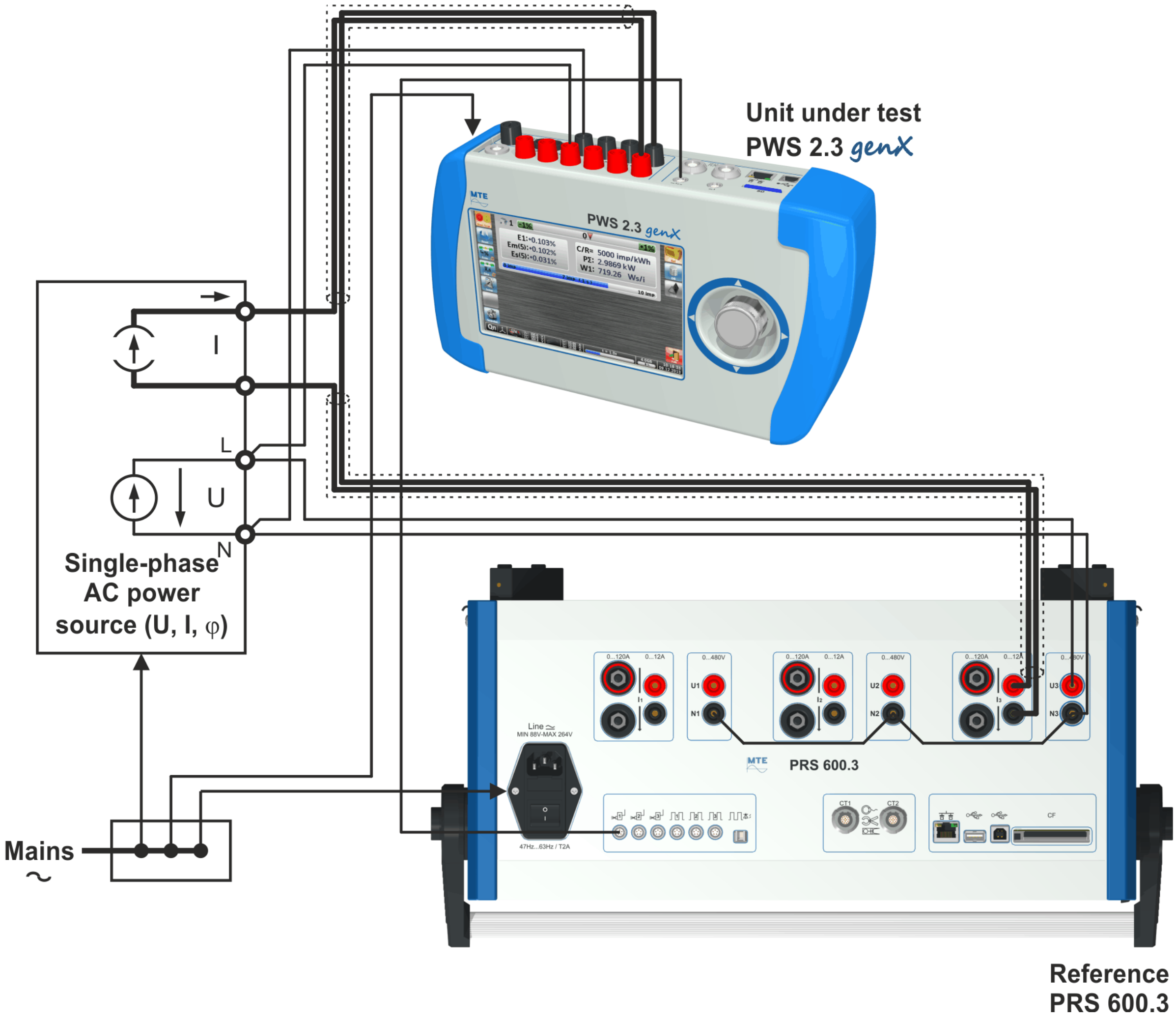
17.2.16 Testing of a 3-phase reference meter in 3-wire mode



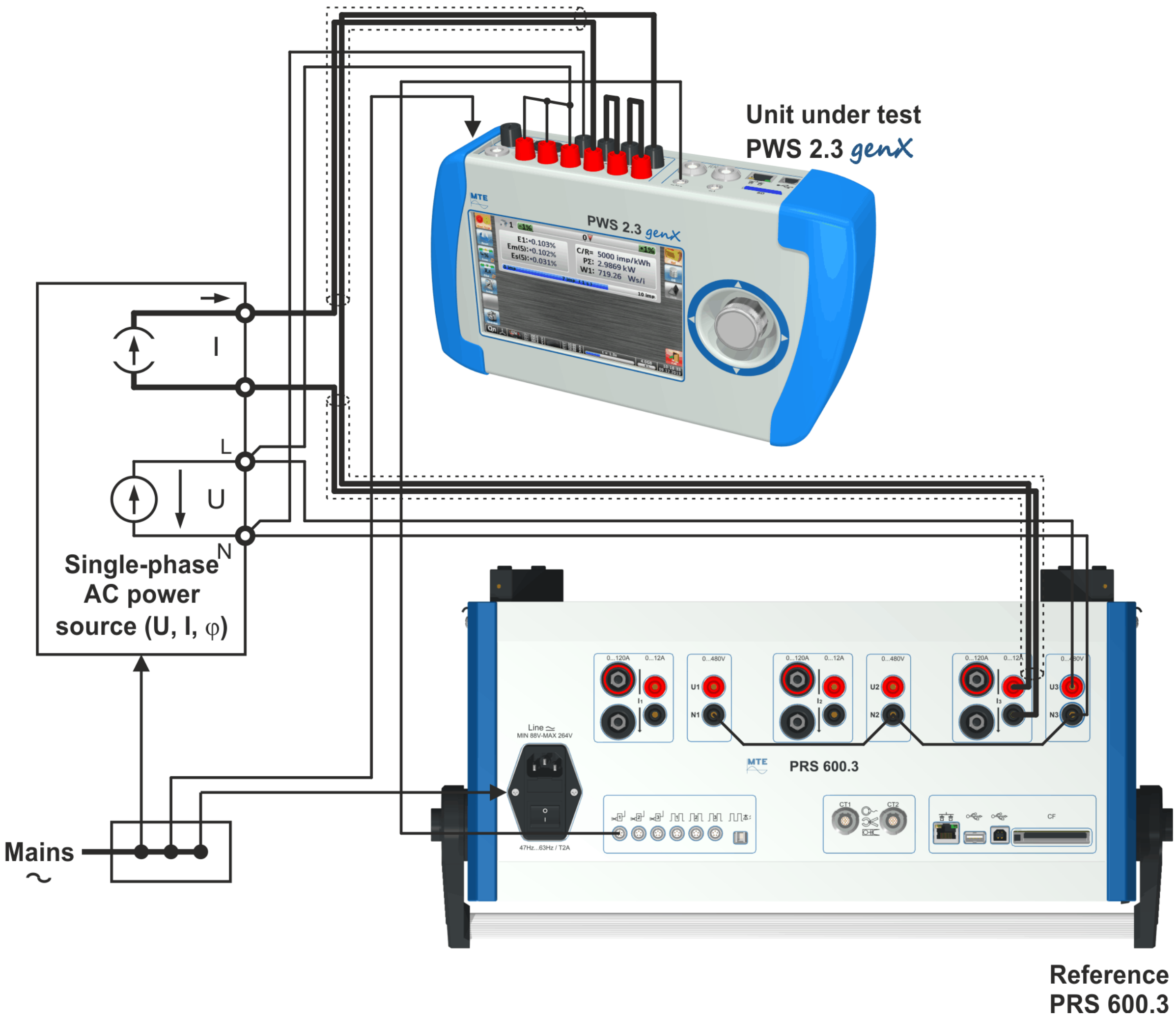
---- Optional connection to ground the source in measuring set-up, if the source is completely galvanically isolated (e.g. PPS 400.3)

17.2.17 Testing of a 3-phase reference meter with a single phase source

Single-phase connection

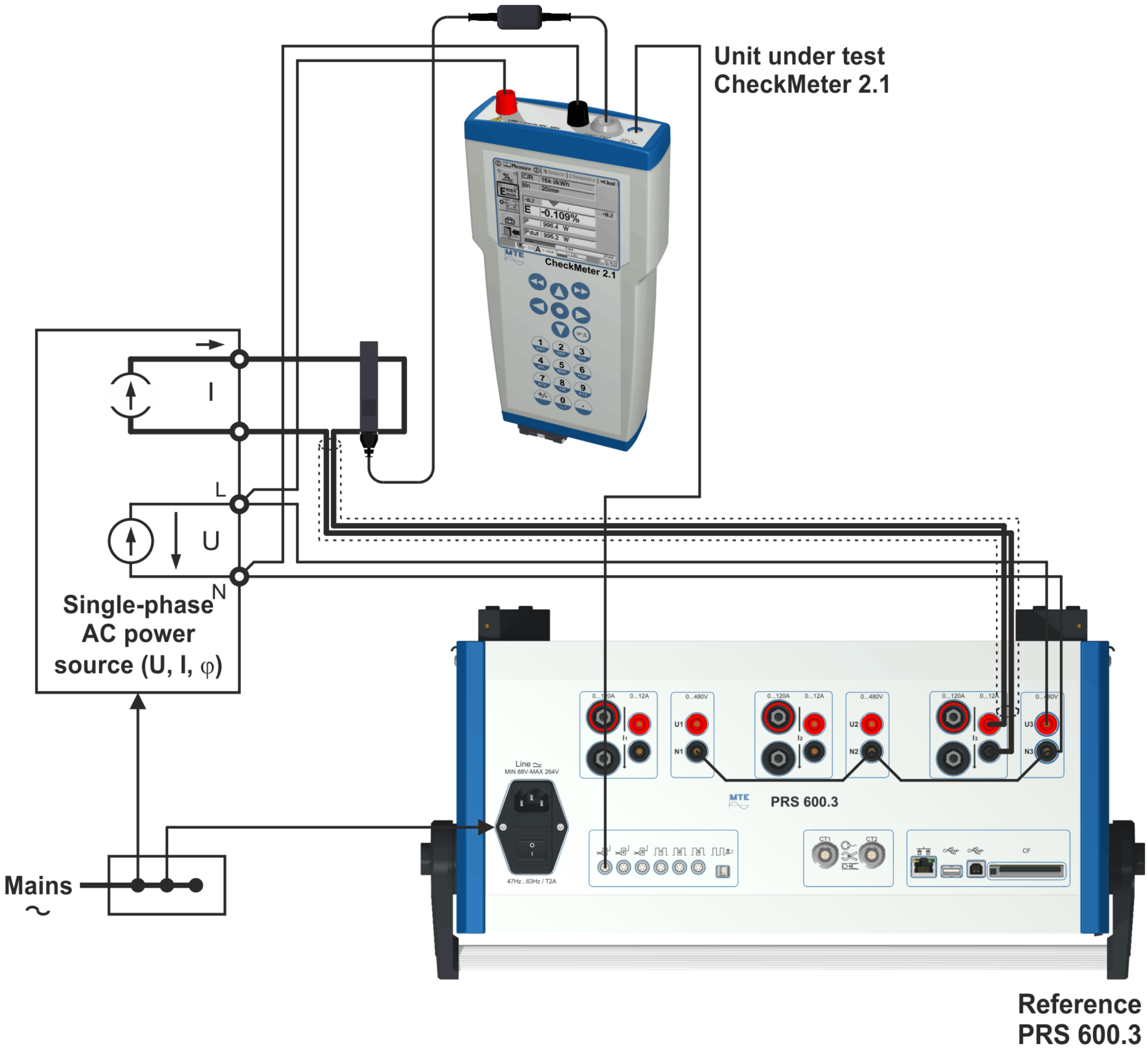


Series / parallel connection

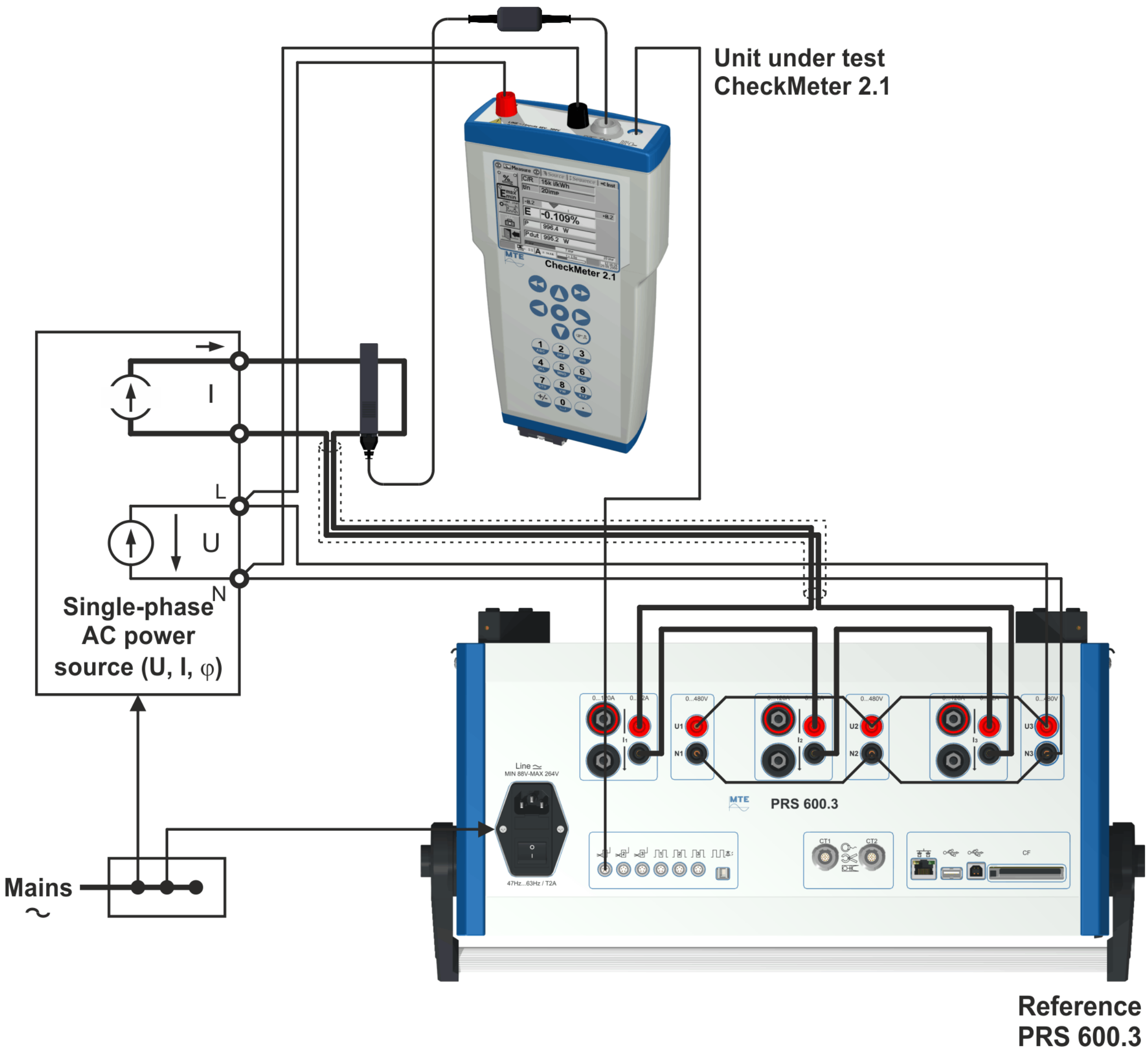


17.2.18 Testing of a single phase reference meter

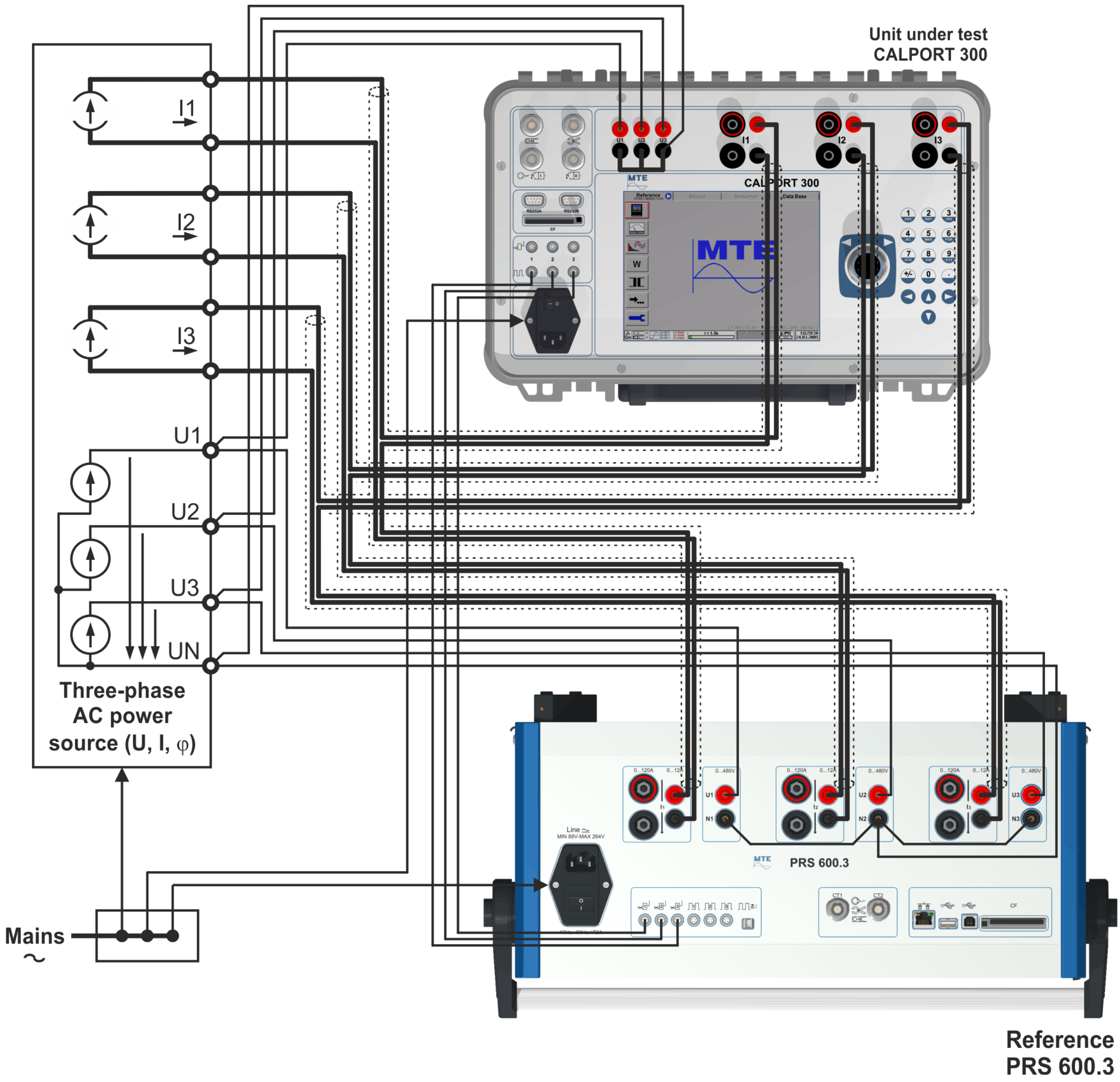
Single-phase connection



Series / parallel connection



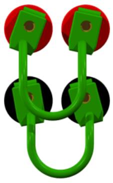
17.2.19 Testing of a reference meter with several impulse outputs

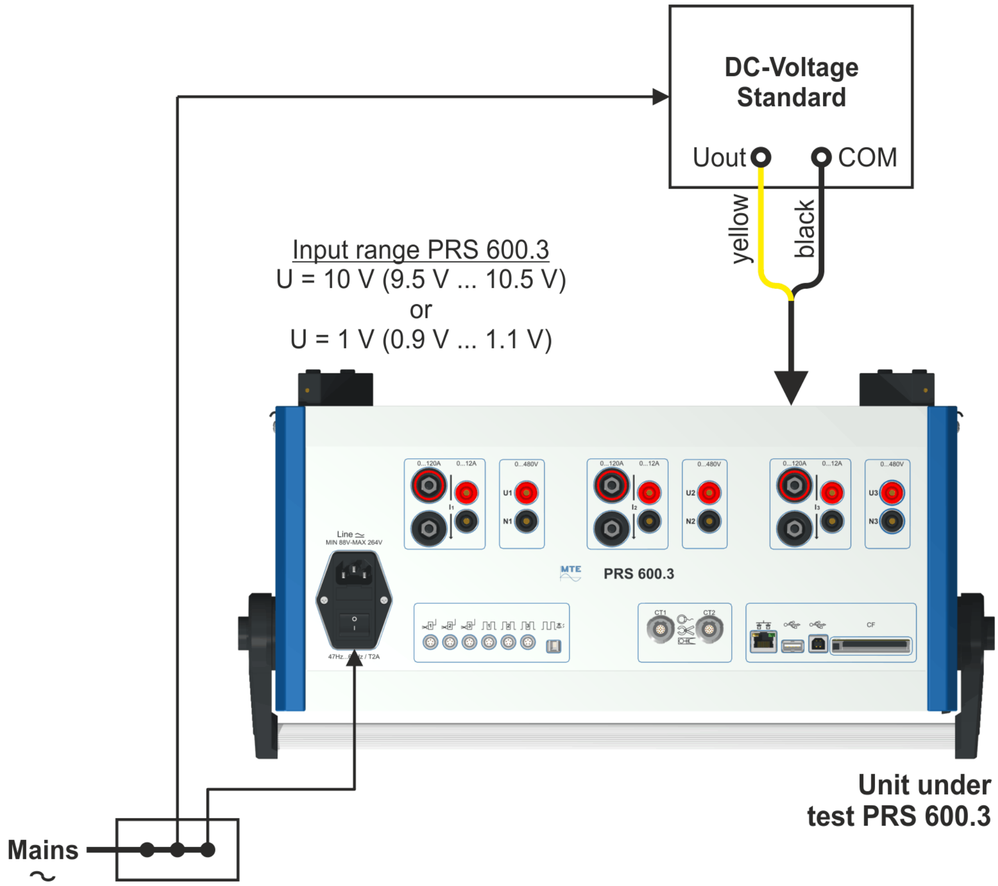


17.2.20 Verification of PRS 600.3 internal reference voltages against ext. DC-standard

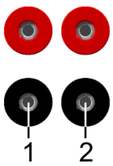
Remove all cables connected to the PRS 600.3, except the power supply cable, before starting the test

Make short circuit connections between the two red 2mm sockets and the two black 2mm sockets before starting the test



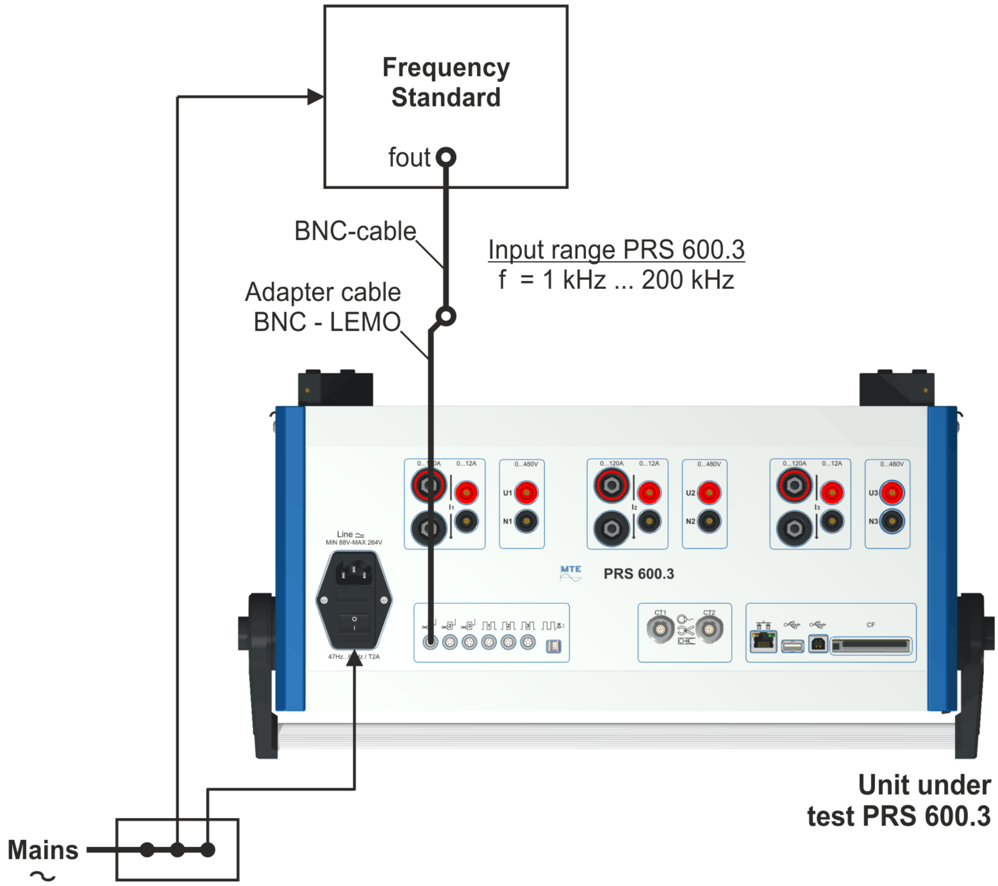


Remove the short circuit connections between the red and black 2mm sockets after finishing the test

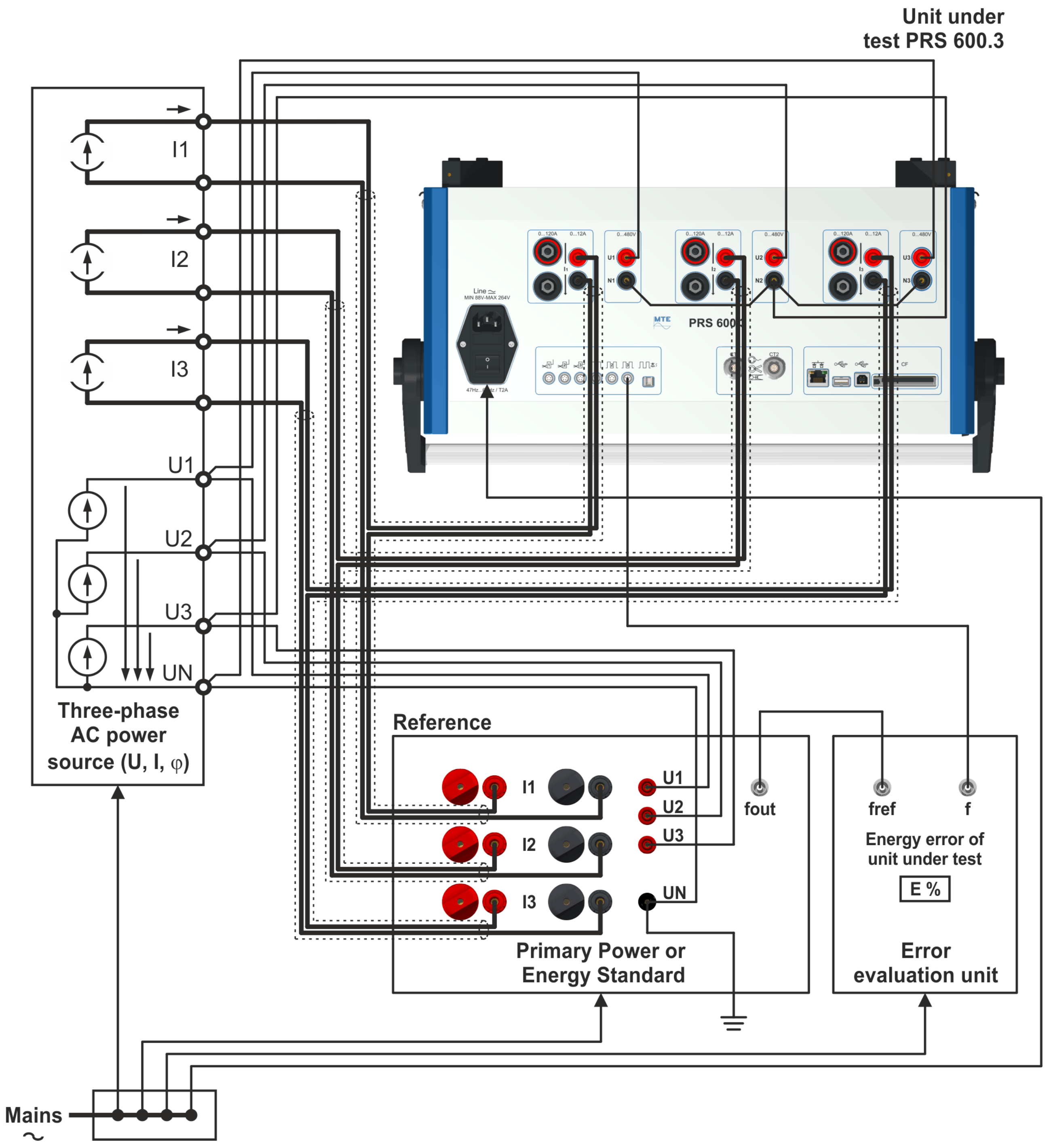


17.2.21 Verification of PRS 600.3 internal time base against ext. frequency standard

Remove all cables connected to the PRS 600.3, except the power supply cable, before starting the test



17.2.22 Verification of accuracy of PRS 600.3



18. Technical Details

18.1 PPS 400.3

18.1.1 Technical data

Model	Description	PPS 400.3-12 A	PPS 400.3-120 A
Supply voltage		88 V … 264 V, 45 … 65 Hz	
Power consumption		max. 300 VA	max. 500 VA
Housing		Metal, rubber protection	
Dimensions	Width x Height x Depth	520 x 195 x 280 mm	520 x 195 x 280 mm
Weight		15.2 kg	18.4 kg
Ambient temperature	Operating / Specified range	-10 °C … +50 °C / +10 °C … +40 °C	
Influence of auxiliary voltage on the measuring results		≤ 0.005 % at 10 % variation	
Frequency range		45 … 400 Hz	
Frequency resolution		0.01 Hz	
Phase angle range		-180°… +180°	
Phase angle resolution		0.01°	
Phase angle error		≤ 0.1°	

Voltage source			
Voltage range	Phase - Neutral	3 x 0 V … 3x 300 V / 520 V	
Internal ranges / Peak values	Range Peak voltage	Power / Peak current	
	150 V …300 V 467 V	50 VA / 0.26 A	
	75 V …150 V 233 V	50 VA / 0.52 A	
	30 V … 75 V 117 V	50 VA / 1.04 A	
Resolution	at the final range value	0.01 %	
Adjustment error	at the final range value	< 0.05 %	
Distortion factor	on linear Load	< 0.5 %	
Stability	Time base 5 s	better than 0.05 % / 2 min	
	Time base 150 s	better than 0.005 % / h	
Load regulation	0 % - 100 % Load	< 0.01 %	
Power factor of load		0.1 lead … 1 … 0 lag	
Efficiency		> 85 %	

Current source			
Current range		3 x 1 mA … 3 x 12 A	3 x 1 mA … 3 x 120 A
Internal ranges / Peak values	Range Peak current	Power / Peak voltage	Power / Peak voltage
	80 A …120 A 187 A	---	80 VA / 1.04 V
	12 A … 80 A 124 A	---	80 VA / 1.56 V
	1.2 A … 12 A 18.7 A	30 VA / 3.89 V	80 VA / 10.4 V
	120 mA…1.2 A 1.87 A	3 VA / 3.89 V	8 VA / 10.4 V
	12 mA ...120 mA 187 mA	0.3 VA / 3.89 V	0.8 VA / 10.4 V
	1 mA ... 12 mA18.7 mA	0.1 VA / 3.89 V	0.1 VA / 10.4 V
Resolution	at the final range value	0.01 %	
Adjustment error	at the final range value	< 0.05 %	

Distortion factor	on linear Load	< 0.5 %
Stability	Time base 5 s	better than 0.05 % / 2 min
Stability	Time base 150 s	better than 0.005 % / h
Load regulation	0 % - 100 % Load	< 0.01 %
Power factor of load		1 ... 0.1 lag
Efficiency		> 85 %

Generation of harmonics		
Fundamental frequency range		45 … 65 Hz
Amplitude	2. - 6. Harmonics	max. 40 %
	7. - 31. Harmonics	max. 10 %
Sum of all harmonics		max. 40 %
Sum of 7. - 31. harmonics		max. 10 %
Phase shift	Basic waveform / harmonic	0° ... 360°

Safety Requirements		
CE-certified		
Isolation protection		according EN 61010-1
Degree of protection		IP-40
Storage temperature		-20°C ... +55°C
Relative humidity		≤ 85 % at Ta ≤ 21°C
Relative humidity at 30 days / year		≤ 95 % at Ta ≤ 21°C

18.2 PRS 600.3

18.2.1 Calculation formulae

All calculations are based on 16 bit samples of the phase voltages u1, u2, u3 and of the phase currents i1, i2, i3. The 6 values are simultaneously sampled at a rate of 31.25 kHz. Every sample is corrected in amplitude and phase before further calculations are carried out. The correction parameters used have been determined during manufacture and are stored in the internal non-volatile memory.

Table 18-1 Definition of basic measured variables

			Indications on instrument				
Name	Mode	Value	⅄ Qn	L1	L2	L3	Σ
Current		Ix		I1	I2	I3	
Voltage phase-to-neutral		Ux		U1	U2	U3	
Voltage phase-to-phase		Uxy		U12	U23	U31	
Active power 4-wire	P4	P4x	⅄	P1	P2	P3	
Active power 3-wire	P3	P3x	∧	P1		P3	
Reactive power, artificial, 4-wire	K4	QK4x	⅄ Qx	Q1	Q2	Q3	
Reactive power, artificial, 3-wire	K3	QK3x	∧ Qx	Q1		Q3	
Reactive power, natural, 4-wire	N4	QN4x	⅄ Qn	Q1	Q2	Q3	
Reactive power, natural, 3-wire	N3	QN3x	∧ Qn	Q1		Q3	
Apparent power 4-wire	S4	S4x	⅄	S1	S2	S3	
Total active power 4-wire	P4	PΣ4	⅄				PΣ
Total active power 3-wire	P3	PΣ3	∧				PΣ
Total reactive power, artificial, 4-wire	K4	QKΣ4	⅄ Qx				QΣ
Total reactive power, artificial, 3-wire	K3	QKΣ3	∧ Qx				QΣ
Total reactive power, natural, 4-wire	N4	QNΣ4	⅄ Qn				QΣ
Total reactive power, natural, 3-wire	N3	QNΣ3	∧ Qn				QΣ
Total apparent power 4-wire	S4	SΣ4	⅄				SΣ
Total apparent power 3-wire	S3	SΣ3	∧				SΣ
Power factor per phase 4-wire			⅄	PF1	PF2	PF3	
Total power factor 4-wire / 3-wire							PF
Angle between current and voltage				φ1	φ2	φ3	
Angle between voltage and voltage				φU12	φU23	φU31	
Angle between current and current				φI12	φI23	φI31	
Frequency							f

			Indications on instrument				
Name	Mode	Value	Qn	L1	L2	L3	Σ
Distortion factor current		kIx		kI_1	kI_2	kI_3	
Distortion factor voltage		kUx		kU_1	KU_2	KU_3	
Distortion factor active power		kPx		kP_1	kP_2	kP_3	
Distortion factor reactive power		kQx		kQ_1	kQ_2	kQ_3	
Distortion factor apparent power		kSx		kS_1	kS_2	kS_3	
Harmonics of voltage hi (1)	P4	hUxi		U, hi	U, hi	U, hi	
Harmonics of current hi (1)	P4	hIxi		I, hi	I, hi	I, hi	
Harmonics of active power hi (1)	P4	hPxi		P, hi	P, hi	P, hi	
Harmonics of reactive power, artificial, hi (1)	K4	hQKxi	**Qx**	Q, hi	Q, hi	Q, hi	
Harmonics of reactive power, natural, hi (1)	N4	hQNxi	**Qn**	Q, hi	Q, hi	Q, hi	
Harmonics of apparent power hi (1)	S4	hSxi		S, hi	S, hi	S, hi	

Note
(1) i = 1 ... 31

Table 18-2 Calculation formulae

Value	Sample value x_n	RMS value / average value of one period Tm
U1 U2 U3	$u1_n$ $u2_n$ $u3_n$	$Ux = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} ux_n^{\,2}} \quad ; x = 1,2,3$
U12 U23 U31	$u12_n = u1_n - u2_n$ $u23_n = u2_n - u3_n$ $u31_n = u3_n - u1_n$	$Uxy = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} uxy_n^{\,2}} \quad ; x = 1,2,3 \quad ; y = 1,2,3$
I1 I2 I3	$i1_n$ $i2_n$ $i3_n$	$Ix = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} ix_n^{\,2}} \quad ; x = 1,2,3$
IN	$iN_n = i1_n + i2_n + i3_n$	$IN = \sqrt{\frac{1}{N} \cdot \sum_{n=1}^{N} iN_n^{\,2}}$
P41 P42 P43	$p41_n = u1_n \cdot i1_n$ $p42_n = u2_n \cdot i2_n$ $p43_n = u3_n \cdot i3_n$	$P4x = \frac{1}{N} \sum_{n=1}^{N} p4x_n \quad ; x = 1,2,3$
P31 P33	$p31_n = u12_n \cdot i1_n = (u1_n - u2_n) \cdot i1_n$ $p33_n = -u23_n \cdot i3_n = (u3_n - u2_n) \cdot i3_n$	$P3x = \frac{1}{N} \sum_{n=1}^{N} p3x_n \quad ; x = 1,3$
QK41 QK42 QK43	$qK41_n = \frac{1}{\sqrt{3}} \cdot (u2_n - u3_n) \cdot i1_n$ $qK42_n = \frac{1}{\sqrt{3}} \cdot (u3_n - u1_n) \cdot i2_n$ $qK43_n = \frac{1}{\sqrt{3}} \cdot (u1_n - u2_n) \cdot i3_n$	$QK4x = \frac{1}{N} \sum_{n=1}^{N} qK4x_n \quad ; x = 1,2,3$
QK31 **QK33**	$qK31_n = \sqrt{3} \cdot (-u3_n) \cdot i1_n$ $qK33_n = \sqrt{3} \cdot u1_n \cdot i3_n$	$QK3x = \frac{1}{N} \sum_{n=1}^{N} qK3x_n \quad ; x = 1,3$

Value	Sample value x_n	RMS value / average value of one period Tm
QN41 QN42 QN43	$qN41_n = \frac{2\pi}{N} \cdot u1\_90°_n \cdot i1_n$ $qN42_n = \frac{2\pi}{N} \cdot u2\_90°_n \cdot i2_n$ $qN43_n = \frac{2\pi}{N} \cdot u3\_90°_n \cdot i3_n$	$QN4x = \frac{1}{N}\sum_{n=1}^{N} qN4x_n \quad ;x = 1,2,3$
QN31 QN33	$qN31_n = \frac{2\pi}{N} \cdot u12\_90°_n \cdot i1_n$ $qN33_n = \frac{2\pi}{N} \cdot u32\_90°_n \cdot i3_n$	$QN3x = \frac{1}{N}\sum_{n=1}^{N} qN3x_n \quad ;x = 1,3$
S1 S2 S3		$S1 = U1 \cdot I1$ $S2 = U2 \cdot I2$ $S3 = U3 \cdot I3$
SΣ4		Apparent power mode: S=UΣ*IΣ $S\Sigma4 = \sqrt{U1^2 + U2^2 + U3^2} \cdot \sqrt{I1^2 + I2^2 + I3^2}$ Apparent power mode: S=sqrt(P^2+Q^2) $S\Sigma4 = \sqrt{P\Sigma4^2 + Qx\Sigma4^2} \qquad ;x = N,K$
SΣ3		Apparent power mode: S=UΣ*IΣ $S\Sigma3 = \sqrt{U12^2 + U32^2} \cdot \sqrt{I1^2 + I3^2}$ Apparent power mode: S=sqrt(P^2+Q^2) $S\Sigma3 = \sqrt{P\Sigma3^2 + Qx\Sigma3^2} \qquad ;x = N,K$
PΣ4		$P\Sigma4 = P41 + P42 + P43$
PΣ3		$P\Sigma3 = P31 + P33$
QKΣ4		$QK\Sigma4 = QK41 + QK42 + QK43$
QKΣ3		$QK\Sigma3 = QK31 + QK33$
QNΣ4		$QN\Sigma4 = QN41 + QN42 + QN43$
QNΣ3		$QN\Sigma3 = QN31 + QN33$
kU1 kU2 kU3 kI1 kI2 kI3 kP1 kP2 kP3 kQ1 kQ2 kQ3 kS1 kS2 kS3		$kx = \frac{\sqrt{\sum_{i=2}^{127} hx_i^2}}{\sqrt{\sum_{i=1}^{127} hx_i^2}} \cdot 100 = \sqrt{\frac{\sum_{i=2}^{127} hx_i^2}{1 + \sum_{i=2}^{127} hx_i^2}} \cdot 100 \quad [\%]$ $x = U1, U2, U3, I1, I2, I3, P1, P2, P3, Q1, Q2, Q3, S1, S2, S3$

Definitions

f : Signal frequency

Tm : Signal period

$$Tm = \frac{1}{f}$$

fs : Sampling frequency

N : Samples per signal period

$$N = abs\left(\frac{fs}{f}\right)$$

n : Index for sample

$n = 1...N$

$ux\_90°$: Phase-to-neutral voltage with phase displacement of 90°, with digital integrator calculated from sample values ux.

(Because of the integration this is $\frac{N}{2\pi}$ times larger than voltage ux)

$uxy\_90°$: Phase-to-phase voltage with phase displacement of 90°, with digital integrator calculated from sample values uxy.

(Because of the integration this is $\frac{N}{2\pi}$ times larger than voltage uxy)

hx_i : Harmonics content with index i in relation to the fundamental wave

$$hx_i = \frac{Hx_i}{Hx_1}$$

$i = 1...127$

x : RMS value, $x = U1, U2, U3, I1, I2, I3$

Hx_i : RMS value of the harmonic of x with index i

Hx_1 : Fundamental wave (first harmonic), $hx_1 = 1$

Display during harmonics analysis in percent of the fundamental wave:

$khx_i = 100 \cdot hx_i$ (%)

Time base function

The DSP software calculates an average of the RMS and average values over a period Tm using the defined time base (T = 0.2 ... 9999s). In this case, only complete measuring signal periods Tm are considered (T/Tm).

Example: in the case of 50 Hz with a measuring signal period Tm = 20 ms and a time base T = 1s, an average is calculated over 50 RMS values or average values for each period.

18.2.2 Technical data

General

Auxiliary supply:	88VACmin … 264 VACmax
Power consumption:	max. 85 VA
Housing:	Hard Plastic
Dimensions:	W 510 x H 182.5 x D 227.5 mm
Weight:	approx. 10 kg
Operation temperature:	-10 °C ... +50 °C
Storage temperature:	-20 °C ... +60 °C
Relative humidity:	≤ 85% at Ta ≤ 21°C
	≤ 95% at Ta ≤ 25°C, 30 days / year spread

Safety	CE certified
Isolation protection:	IEC 61010-1:2002
Measurement Category:	300V CAT IV, 600V CAT III
Degree of protection:	IP-40

Measurement Range

Measuring Quantity	Range	Input / Sensor
Voltage (phase - neutral)	5 V … 520 V	U1, U2, U3
	10 mV … 5 V	U1 (Burden)
Current	1 mA … 12 A	12 A (I1, I2, I3)
	10 mA … 120 A	120 A (I1, I2, I3)
	10 mA … 120 A	UCT 120.3
	100 mA … 1000 A	UCT 1000.3
	3 A … 3000 A	FLEX 3000
Primary current	30 A … 2000 A	AmpLiteWire 2000A
Primary voltage	500 V … 40 kV	VoltLiteWire 40kV

PORTABLE REFERENCE STANDARD
Measurement Accuracy

Voltage / Current		≤ ± E [%] [1 2 4 6]
Measuring Quantity	Range	**Cl. 0.02**
Voltage (U1, U2, U3, N)	30 V … 520 V	0.01
	5 V … 30 V	0.02
Current direct up to 12 A	60 mA … 12 A	0.01
	6 mA … 60 mA	0.02
	1 mA … 6 mA	0.02
Current direct up to 120 A	600 mA … 120 A	0.01
	60 mA … 600 mA	0.02
	10 mA … 60 mA	0.02

Current CT 120A UCT 120.3	100 mA … 120 A	0.2
	10 mA … 100 mA	0.2
Curr. CT 1000A UCT 1000.3	10 A … 1000 A	0.2
	1 A … 10 A	1.0
Current FLEX 3000 UCT LEM.3	300 A … 3000 A	
	30 A … 300 A	0.1 + E_M
	3 A … 30 A	
Burden Voltage (U1)	100 mV … 5 V	0.1
	10 mV … 100 mV	0.1
Current AmpLiteWire 2000A	300 A … 2000 A	0.1 + E_M
	30 A … 300 A	0.1 + E_M
Voltage VoltLiteWire 40kV	10 kV … 40 kV	0.1 + E_M
Drift / year		≤ ± E [%] [1,2,5,6]
Measuring Quantity	Range	
Voltage (U-N)	30 V ... 520 V	0.004
Current direct up to 12 A	60 mA ... 12 A	0.004
Current direct up to 120 A	600 mA ... 120 A	0.004

Power / Energy Voltage: 30 V… 520 V (U - N)		≤ ± E [%] [1,2,3,6]
Measuring quantity / Input I	Range	**Cl. 0.02**

Active (P), Apparent (S) and Reactive (Q) Power / Energy		
Direct 12 A (I1, I2, I3)	60 mA … 12 A	0.015
	6 mA … 60 mA	0.02
	1 mA … 6 mA	0.02
Direct 120 A (I1, I2, I3)	600 mA … 120 A	0.015
	60 mA … 600 mA	0.02
	10 mA … 60 mA	0.02
Current CT 120A UCT 120.3	100 mA … 120 A	0.2
	10 mA … 100 mA	1.0
Curr. CT 1000A UCT 1000.3	10 A … 1000 A	0.2
	1 A … 10 A	1.0
Drift / year		≤ ± E [%] [1,2,3,5,6]
Measuring Quantity	Range	
Power / Energy (PQS)	I direct	0.008

		≤ ± TC [%/°C] [3]
Temperature coefficient (TC):	Range	**Cl. 0.02**
	-10° C ... +15°C	0.0015
	+35° C ... +50°C	0.0015

Frequency / Phase Angle / Power Factor		≤ ± E
Measuring Quantity	Range	**Cl. 0.02**
Frequency (f)	40 Hz … 70 Hz	0.01 Hz
Phase Angle (φ)	0.00 °… 359.99°	0.01 °
Power Factor (PF)	-1.000… +1.000	0.0002

CT/PT Ratio	≤ ± E [%][1 2]
Ratio error E: Sum of errors of inputs used for primary (IP, UP) and secondary (IS, US) measurements.	$E_P + E_S$

CT/PT Burden	≤ ± E[%] [1 2]
Operating burden Sn: Sum of errors of inputs used for voltage (U) and current (I) measurement.	$E_U + E_I$

Notes

1 x.x: Related to the measuring value
x.x: Related to the measuring range final value (full scale, FS),
E(M) = FS/M * x.x (e.g. 0.1 at FS =10 mA, E(2mA) = 10/2 * 0.1 = 0.5 %)

2 Fundamental frequency in the range 45 … 66 Hz

3 S: x.x, P,Q: x.x / PF (related to apparent power), 3- and 4-wire networks

4 E_M: Accuracy specified by manufacturer of clamp-on CT or sensor

5 Value in brackets () valid for IN/IE input, used for PQ analysis

6 Valid in temperature range: +15°C … +35°C

3 Pulse Inputs / outputs

Input level:	4 … 12 VDC (24 VDC)
Input frequency:	max. 200 kHz
Supply:	12 VDC (I < 60 mA)
Output level:	5V
Pulse length:	≥ 10µs
Meter constant: Active, Reactive, Apparent [imp/Wh(varh,VAh)]	$C = C_0$ / (In * Un) C_0=56’160’000 [imp/Wh(varh,VAh)] The meter constant depends on the highest selected internal ranges In, Un. Example: Un = 520V, In = 120 A) C = 900 [imp/Wh(varh,VAh)]
Output frequency: (e.g. Output 1)	CPZ_1 =C / 3’600 [imp/Ws(vars, VAs)] f_0 =CPZ_1 * PΣ(QΣ, SΣ) f_{max} =CPZ_1 * **3** * Un * In =0.25 imp/Ws * **3** * 520V * 120A =46’800 [imp/s] Factor **3** for 3-phase system

POWER QUALITY ANALYZER

Voltage	
Inputs	3
Accuracy class	■ 0.1%
Dips / Swells / Interruptions	■ $U_{RMS\ ½}$
Harmonics	■ 2 … 64
Interharmonics	■ 1-2 … 63-64
Signal Voltages	■ fs < 3 kHz
Flicker P_{st}, P_{lt}	■ up to 40 Hz
Unbalance	■
Transients	● 0.8 kV / ≥ 100 µs (26.7 kHz)
EN 50160	●
Current	
Inputs	3
Accuracy class	■ 0.1%
Inrush	■
Harmonics	■ 2 … 64
Interharmonics	■ 1-2 … 63-64
Transients	● ≥ 100 µs (26.7 kHz)
Power	
Active (P) / Reactive (Q) / Apparent (S)	●
Harmonics P, Q, S	●
Power Factor	●
Energy	●
Communication	
USB	●
ETHERNET	●
Other functions	
Removable Compact Flash CF card memory	●
GPS time synchronization (integrated)	○

Notes

■ Function according IEC 61000-4-30 Class A

○ Option