PQA 8000

CAMILLE BAUER

USER MANUAL

V1.9.4

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1 Introduction

This manual contains important tips on how to use the Camille Bauer instruments safely, properly and efficiently. Its purpose to help you to avoid danger, repair costs, and down time as well as to help maintain reliability and life of the instruments.

The PQA8000 is a Power Quality measurement instrument combining powerful energy measurement and power quality analyzer functions with the latest technology. It can be used for power measurement applications with its high sampling rates, high-resolution ADC and high accuracy. The conformity of the device according to international standards enables the user to generate reliable and accurate reports for various applications.

The LCD touch screen, that is also readable under sunlight, proves to be very comfortable for mobile measurement tasks. In combination with the internal battery pack the PQA8000 operates up to 3 hours without any external power source.

The PQA8000 offers multi-device synchronization due to a highly accurate GPS clock (available as option) and supports PMU functionality. Equipped with USB 3.0, Ethernet (GBit), telecommunication modem, Wi-Fi and Bluetooth, the PQA8000 enables remote configuration and multi-device monitoring.

Additionally, isolated RS-485 and CAN 2.0B ports are provided for connecting optional sensors e.g. pyranometer, weather and temperature sensors for PV applications. Isolated digital inputs and outputs can control external devices. The TEDS function enables effortless configuration of sensors of current sensors as all datasheet information are stored on a EEPROM.

Main Features

- 18bit / 1MS/s (PQA8000H) or 24 bits / 144 kS/s sampling rate (PQA8000)
- +/- 1600 V Voltage range
- 4 Voltage Input, 4, 6 or 8 Current Sensor Input
- Additional Low Voltage Analog Input, RS-485, CAN2.0B, DIO option
- GPS synchronization module inside
- AC power source inlet and 100Wh battery inside (including charger)
- Powerful x64-Intel-CPU, up to 8GB Memory

- High speed, high capacity SSD (2 x 256GB max.)
- Sunlight readable multi-touch screen LCD and HDMI port for external monitor
- Small and light case with rubber protection
- Versatile Power Quality software including analyzer, data storing, reporting

2 Safety Information

2.1 General Safety

- Carefully read this manual before using the instrument.
- Use the instrument according to these instructions only.
- Use the instruments only under environmental conditions described in the technical data.
- Personnel assigned to use the instrument must have read this reference manual and fully understood the instructions herein.
- The instruments may only be operated by trained personnel. Any maloperation can result in damage to property or persons.
- The input voltage shall not exceed the values rated in the technical data. With this product, only use the power cable delivered or defined for the host country.
- There is no guarantee if you exceed the values for your safety.
- The power supply must be within the limits given in the technical data.
- Always make a visual inspection of used equipment such as leads and clamps before use.
- Use fuses (500mA) if you connect the instrument directly to voltage where no fuse is available or high short circuit power is given.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- When connecting to the banana plug sockets, only use cables with 4mm/0.16” safety banana connectors and plastic housing. Always insert plugs completely.
- DO NOT insert objects into sockets or ventilation slots.
- DO NOT open the instrument or remove any of its housing components. Don’t carry out any modifications, extensions or adaptions at the instrument. If instrument is opened by the customer, all guarantees are invalidated.
- DO NOT use the system if equipment covers or shields are removed.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already lower level may damage your system.
- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatize the system unpowered to room temperature.
- Maintenance must be executed by qualified staff only.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to Camille Bauer Metrawatt sales and service office for service and repair to ensure that safety features are maintained.
- This manual is to be supplemented by existing national safety standards for accident prevention and environmental protection.
- The instructions provided in this manual and the associated software and hardware manuals are considered part of the rules governing proper usage.
- Observe local laws when using the instrument.
- The use of measuring devices under CAT II, III or IV conditions can be dangerous! Under these conditions, only appropriately trained / tested / informed about safety precautions may take measurements (for safety categories see also technical reference manual). If a measuring device, a cable or an accessory of a lower category or voltage is used, this lower category / voltage applies to the entire group (device + cable + accessories)

For working on equipment under voltage use the guidelines given in EN50110.

Always follow the 5 golden safety rules:

1. Always switch off.

Meaning that the electrical installation must be disconnected from live parts on all poles. Block all poles of the power source for every part of the operation. Switchgear of home or factory, low voltage switch mode, the power of the machine control switch should be cut off. The power supply circuit to be supplied to the electric appliance such as lamps and motors should be cut off. If you remove the low-voltage rapid fuse, you should wear bracers, a helmet, and front shields. If there is a capacitor, the residual charge must be discharged using appropriate tools.

2. Secure against reconnection.

Reliably prevent an accidental re-connection of an installation where work is in progress. This is achieved for example by just replacing the unscrewed fuses in the low-voltage system by lockable lock-out devices. Appropriate warning signs should be posted for viewing on the operating device (switch handle, instrument actuator, control device, circuit breaker, etc.). It should also be posted to closed electrical operating areas or locked switch cabinets. The contents of the warning cover should warn you that you don't manipulate the switch. In addition, provide a name for the workplace location and supervisor. The power-off device should be locked to a mechanical device. All keys must be kept in a safe place. If it is operated with the control voltage of the energy or controller, such as springs, compressed air, it must take measures to prevent the release or operation of energy.

3. Verify that the installation is dead

Use a suitable measuring / test equipment such as a voltage detector to verify on all poles that the installation is dead. Check the correct function of the voltage detector prior to using it.

4. Carry out earthing and short-circuiting.

An important point of the five safety rules is earthing and short-circuiting at the workplace. This measure ensures a voltage-free state for the duration of the work, also with regard to influencing voltages, atmospheric overvoltage or accidental restarting. Earthing and short-circuit areas should be visible at the workplace. Important: The relevant parts must be earthed before they are short-circuited!

5. Provide protection against adjacent live parts

According to the five safety rules, adjacent parts are parts located in the vicinity zone. If parts of an electrical installation in the vicinity zone of the work location cannot be disconnected, additional precautions must be taken before work starts. In this case use insulating protective shutters or covering material as protection against accidental contact. The hazard area should be marked for clarity.

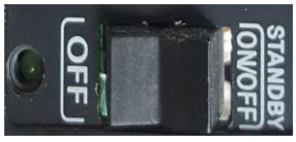
2.2 Battery Handling

Lithium-Ion rechargeable batteries require routine maintenance and care in their use and handling. Do not leave batteries unused for extended periods of time, either in the product or in storage. When a battery has been unused for 3 months, check the charge status and charge or dispose of the battery as appropriate.

Please especially consider the following points for storing the device:

- Charge the battery more than 50% of capacity before storage.
- Charge the battery more than 50% of capacity at least once every three months.
- Store the battery at temperatures between 5 °C and 20 °C (41 °F and 68 °F).
- The battery self-discharges during storage. Higher temperatures (above 20 °C or 68 °F) reduce the battery storage life.

If you will not use the instrument for longer time, always switch the Power button to OFF (bottom position). This enables the maximal power saving mode and will protect your battery of being over-discharged. Over-discharge of Li-Ion batteries has huge influence on their lifetime.



Position	Function
Right	Start (push switch)
Middle	ON after start or standby (returns to this position after push)
Left	OFF (MAX. power saving mode, useful for long term device storage)

If you start instrument after over-discharge or you didn't use it for a long time, the instrument may take several minutes to start up (even if fans are active). The integrated PC will start operation not before battery charge level will reach nominal operating conditions.

2.3 Warranty

The warranty for the instrument is 2 years – usual operating conditions preconditioned.

2.4 Recycling

- This is an electronic instrument and must be recycled according to the WEEE – directive. Do not throw away.
- More information see: http://ec.europa.eu/environment/waste/weee/index_en.htm
- Dispose of the test set in accordance with the legal environmental regulations in the country.

2.5 CE Conformity

- This instrument is compliant with the CE - requirements.
- **EMC Directive 2014/30/EU**
- **Test Procedure:**
  - EN 55011: 2009 + A1:2010(Group 1), Class A
  - EN 61326-1: 2013
  - EN 61000-3-2: 2014
  - EN 61000-3-3: 2013
- **EMI (EN55011):**
  - Conducted Emission (CE)
  - Radiated Emission (RE)
- **EMS (EN61000-4-2 ~ 11):**
  - Electrostatic discharge (ESD: EN61000-4-2)
  - Radiated RF immunity (RS: EN61000-4-3)
  - Electrical Fast Transient/BURST (EFT: EN61000-4-4)
  - Surge (Surge: EN61000-4-5)
  - Conducted RF immunity (CS: EN61000-4-6)
  - Voltage dip/interruption (DIP: EN61000-4-8/11)
- **Safety: EN 61010-1: 2010**

2.6 RoHS

- This product is compliant with the RoHS - Directive.
- For further information see: http://ec.europa.eu/environment /waste/rohs_eee/index_en.htm

3 Hardware

The PQA8000 is an All-in-one Power Quality Analyzer having the most practicable measurement and computer interface, enabling measurements and analysis as soon as sensors and cables are connected. Foer further functions like GPS synchronization or data communication like RS-485, CAN2.0B and DIO, additional cable set are available.

3.1 Instrument

There are 4 banana connector sets for High Voltage measurement and four or six plastic LEMO connectors for Current Inputs on the top plate. Furthermore, one DSUB15 connector for low voltage signal measurement, one DSUB9 connector for RS-485 communication and another DSUB9 connector for digital input and output.

On the right side of the case are three fans for internal heat controlling.

Sunlight readable multi-touch LCD on the front side.

Device support and handle are on the rear side mounted. In addition, you can operate the touch screen with a touch pen located on the top of the back.

On the left side of the case are the computer interface, GPS antenna connector, battery indicator LED, power on/off switch and AC power inlet.

3.2 Power ON/OFF Switch

The Power ON/OFF switch is located on the left side on the bottom and has the following three functions, depending on its position.

Position	Function
Top	Start (push switch)
Middle	ON after start or standby (returns to this position after push)
Bottom	OFF (MAX. power saving mode, useful for long term device storage)

3.3 Connector Pins

The majority of connector pins for measurements are located on the top side.
4 banana connectors for voltage measurement are on the left, 6 LEMO connectors for current measurement sensors are on the right side. DSUB15 for additional low voltage analog signal input, DSUB9 for RS-485, CAN2.0 and DIO are located on the left side. The status LED on the upper right side shows the current device/measurement status.

3.3.1 Voltage Inputs

The device has banana connectors on its top side for measuring 4 Voltage input signals up to 1600V. All the channels are differential inputs and isolated channel by channel and channel by ground. This allows any kind of measurement (inverter measurements, mixed AC/DC measurements or mixed frequency measurements 50Hz/16.7Hz).

Pin	Signal
Red	U+ (L)
Black	U- (N)

The voltage inputs supports DC and AC measurement. Please refer to the *"Camille Bauer Technical Reference Manual"* for detailed information.

Depending on the hardware the channels are assigned to different Analog Input (AI) channels.

AI Channel	Name
AI0	V1
AI1	V2
AI2	V3
AI3	VN

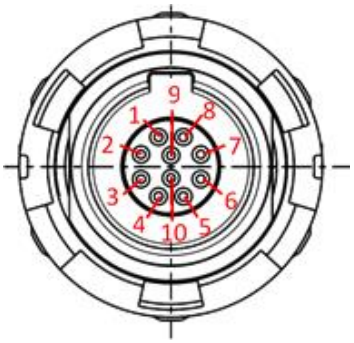
3.3.2 Current Inputs

For current measurement via sensors, 6 LEMO connectors are placed on the right top side of the device.

These input connectors support many different kinds of sensors including TEDS - sensors. Please refer to the *"Technical Reference Manual"* for detailed information.

10pin LEMO connector

Current sensors like Clamps, Rogowski-coils and other current sensors can be connected using the following pin assignment.



Pin	Signal	PQA8000H
1	Signal+	Signal +
2	Signal-	Signal- / GND
3	FGND	FGND
4	NC	Rogowski +
5	TEDS	TEDS
6	GND	GND
7	+3.3V	Isolation GND
8	+12V	Isolation +9V
9	+15V	+15V
10	-15V	-15V

Depending on the hardware the channels are assigned to different AI channels.

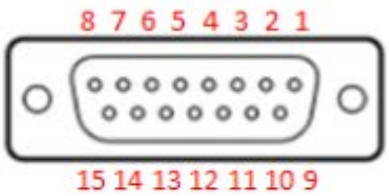
AI Channel	Name
AI4	I1
AI5	I2
AI6	I3
AI7	IN
AI8	IPE

3.3.3 Additional Low Voltage Signal Input

DSUB-15 female connector for additional Low Voltage signal measurement

The DSUB-15 connector allows connection of additional input signals. It offers three additional analog inputs, power supply of +12V, TEDS function and I2C serial interface.

The third analog input (AI-2) of the DSUB-15 connector is multiplexed with the 6th LEMO input for current measurement. So you just should either use the 6th current input or AI-2 of the DSUB-15 connector. This connector is often used for connection of additional signals like pyranometer, weather sensor, temperature sensor, any process signal or I2C serial data.



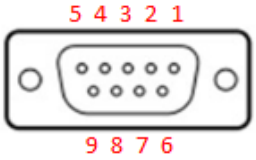
Depending on the hardware the channels are assigned to different AI channels.

Pin	Signal	Description
1	GND	Ground
2	AI-0	
3	AI-1	
4	AI-2	MUXed with 6 LEMO
5	NC	
6	GND	Power ground
7	+ 12V	+12V power source
8	I2C_SDA	I2C serial data
9	AI+0	
10	AI+1	
11	AI+2	MUXed with 6 LEMO
12	NC	
13	GND	Power ground
14	TEDS+	TEDS signal(Sensor CAL)
15	I2C_CLK	I2C Clock

3.3.4 Digital Input / Output

DSUB-9 Female connector for digital input and output

The digital input is isolated and can measure up to +50 VDC with programmable Schmitt trigger levels. Digital output is also isolated using a PhotoMOS relay.

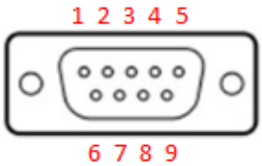


Pin	Signal	Description
1	DO0	Isolated digital output 0
2	DO1	Isolated digital output 1
3	+12V	+12V power source
4	DI0	Isolated digital input 0
5	DI1	Isolated digital input 1
6	DO0_COM	Return path for output 0
7	DO1_COM	Return path for output 1
8	GND	Power ground (for +12V power)
9	DI_GND	Isolated digital input ground

3.3.5 Communication Ports

DSUB-9 Male connector for CAN 2.0B and RS-485 communication

This interfaces can be used for additional sensor connection (pyranometer, weather, temperature etc.). All data are fully synchronized to the analoge input data (voltage, current, additional AI). It offers +12VDC for power supply (if needed).



Pin	Signal	Description
1	RS-485_0B	RS-485 B(+)
2	485_GND	GND for RS-485
3	+12V	+12V power source
4	CANL0	CAN low
5	CAN_GND	GND for CAN2.0B
6	RS-485_0A	RS-485 A(-)
7	NC	Not Connected
8	GND	Power ground
9	CANH0	CAN high

3.3.6 Computer Interface

The Computer interfaces are located on the left top side

One 1GB Ethernet interface, two USB3.0, one USB2.0 interfaces and one HDMI port for an external monitor.

HDMI Port	
Pin	Signal
1	TMDS data2+
2	TMDS data2 shield
3	TMDS data 2-
4	TMDS data 1+
5	TMDS data1 shield
6	TMDS data 1-
7	TMDS data 0+
8	TMDS data0 shield
9	TMDS data 0-
10	TMDS clock +
11	TMDS clock shield
12	TMDS clock -
13	CEC
14	NC
15	DDC clock
16	DDC data
17	GND
18	+ 5V
19	Plug detected

2 x USB 3.0	
Pin	Signal
1	VCC
2	Data-
3	Data+
4	GND
5	SSRX-
6	SSRX+
7	GND Drain
8	SSTX-
9	SSTX+

USB 2.0	
Pin	Signal
1	VCC
2	Data-
3	Data+
4	GND

1 GB LAN	
Pin	**Signal**
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DC+
5	BI_DC-
6	BI_DB-
7	BI_DD+
8	BI_DD-

3.3.7 Antenna and Battery indicator LED

The SMA jack connector is prepared for external GPS antennas having a SMA plug type connector, and supports passive and active antennas.

The GPS LED indicates the GPS status, if it is locked or not.
WLAN Antenna: internal patch antenna is used.
Telecommunication modem antenna (option): can be installed inside.

The GPS antenna should be connected before the measurement software is started.

Battery indicator LED

NO. of ON LED	Remaining battery
5	80~100%
4	60~80%
3	40~60%
2	20~40%
1	0~20%

3.3.8 Fan

Three Fans for internal heat control are located on the right side. Two fans input the cold air, while the third outputs the internal warm air. The speed of the fans is controlled depending on the internal temperature. Additionally, metal mesh filters out the external dust particles.

3.4 Status LED

The status LED is located on the upper right side of the upper plate.

LED Status	Description
Green	Standby for measurement
Green blinking	Measuring (and storing)

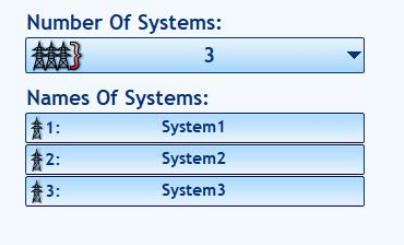
4 Software

The measurement software is included with the device, while additional report and management software can be installed as it may be necessary. For further information, we would like to refer to the software manual.

4.1 Start Measurement Software

After turning on the instrument, the Software will automatically be started. If not, the software can be started by the shortcut “ENA Measurement Software”

The number of systems can be configured at: „Setup“ – „Misc.“ – „Multisystem“.
If one system is selected, then automatically the 4U4I configuration will be active.
If two systems are selected then depending on the instrument version the 3U3I+1U1I config (PQA8000) or the 3U3I+3U3I config (PQA8000M, PQA8000P) will be applied..



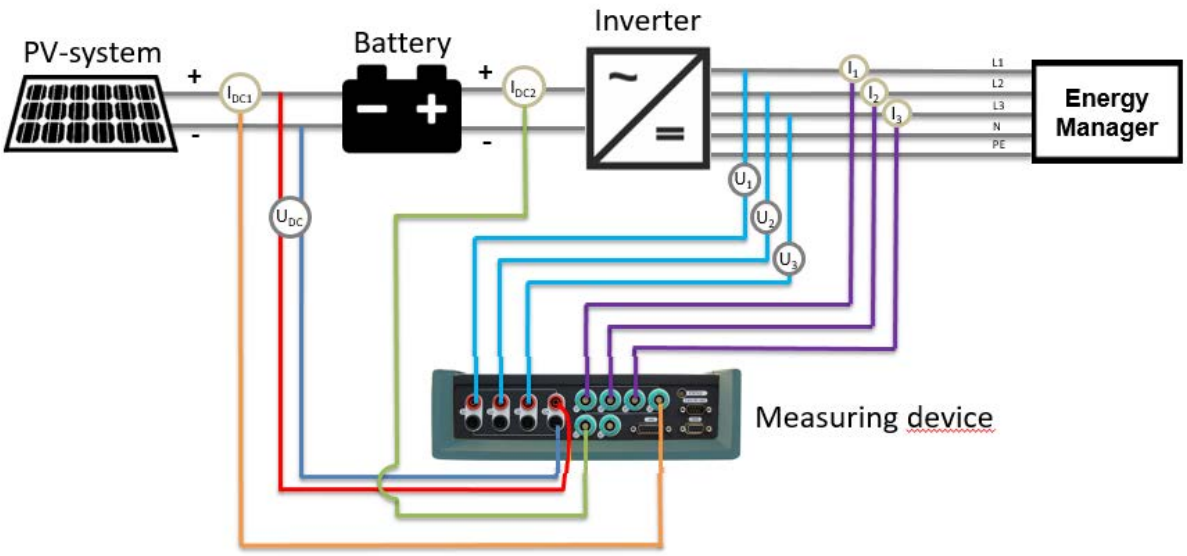
In the software you can switch between the systems with this button:

The button is either located on the bottom of the screen (Measurement mode) or on the left side (Configuration).

Note: The instrument always starts-up in the last used configuration (Sampling Rate, connection, range, language etc.)

Overview	Multisystem configuration
4U4I	Standard configuration with 4x Voltage and 4x Current measurement
3U3I + 1U1I	Configuration for two different power systems Example 1: 1x 3-Phase AC and 1x DC Example 2: 1x 3-Phase AC (50Hz) and 1x 1-Phase AC (16.7Hz)
3U3I + 3U3I	Configuration for two different power systems Example: 2x 3-Phase AC (same Voltage for both systems, I1,I2,I3 for System 1 I4,I5,I6 for System 2

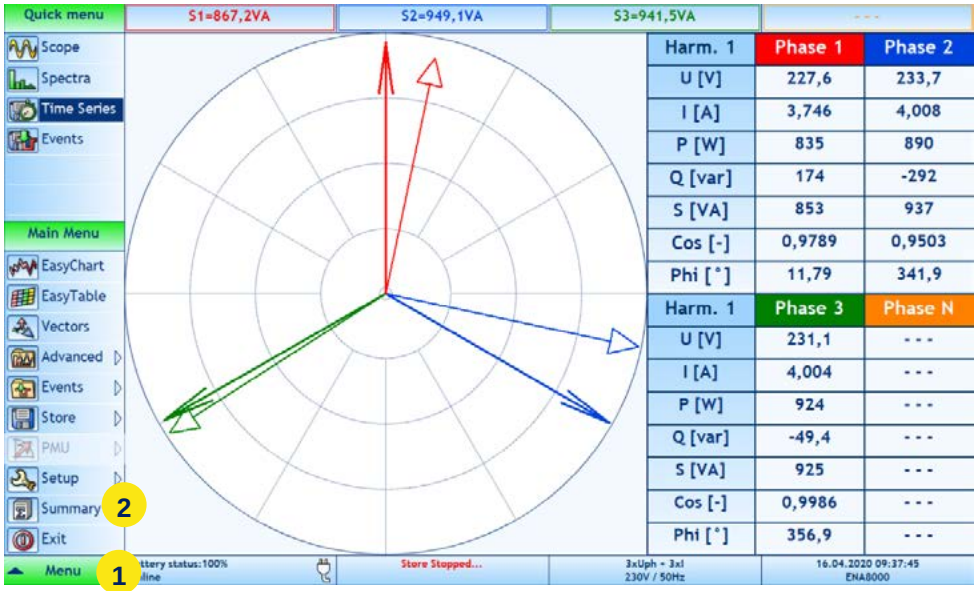
Example for the ***3U3I + 1U1I*** configuration:



4.2 Quick Start with a simple setup

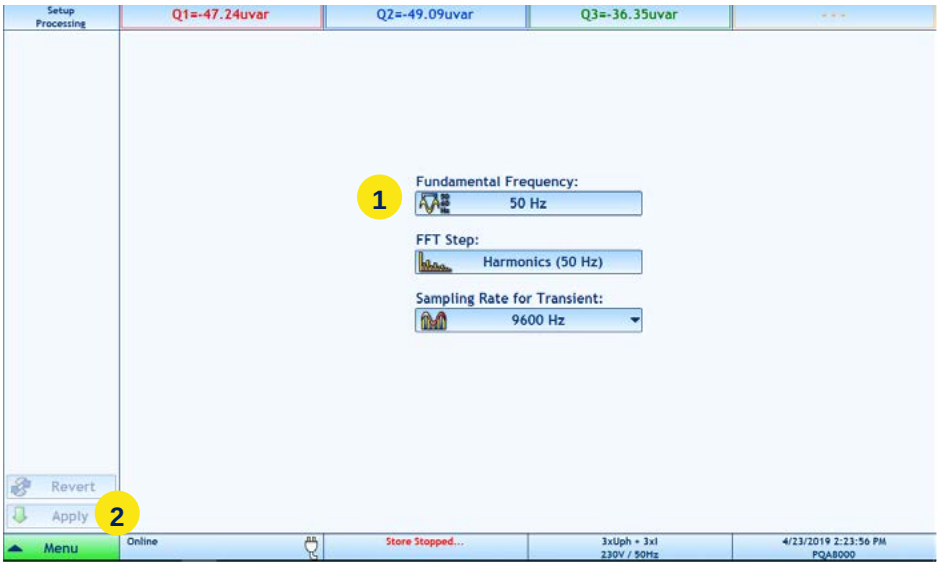
4.2.1 Fundamental Frequency Setup

The Fundamental frequency is set in the **Setup Processing panel**. You can whether navigate there via “Setup” - “Processing” or via the “Summary Panel.



The **Summary panel** shows the current setup values of the device and is the easiest way to configure the instrument for your application. It summarizes all configurations for Wiring, Frequency, Limits, User Profiles and shows the storing overview for Time series data, PQ data, Digital data, Alarms, Transients, Signaling Voltage and Disturbances. To set up a fundamental frequency, click the button of ‘Fundamental Frequency’ (1).

Select a fundamental frequency (1). After selecting the fundamental frequency, click the 'Apply' button (2).



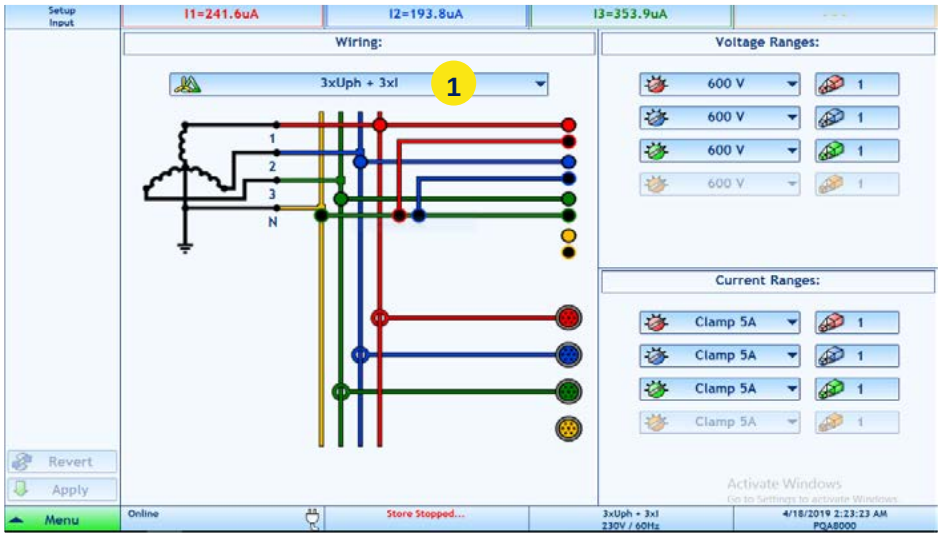
4.2.2 Basic Wiring Setup

To select a wiring type, click ‘Wiring’ button in **Summary panel** (1).

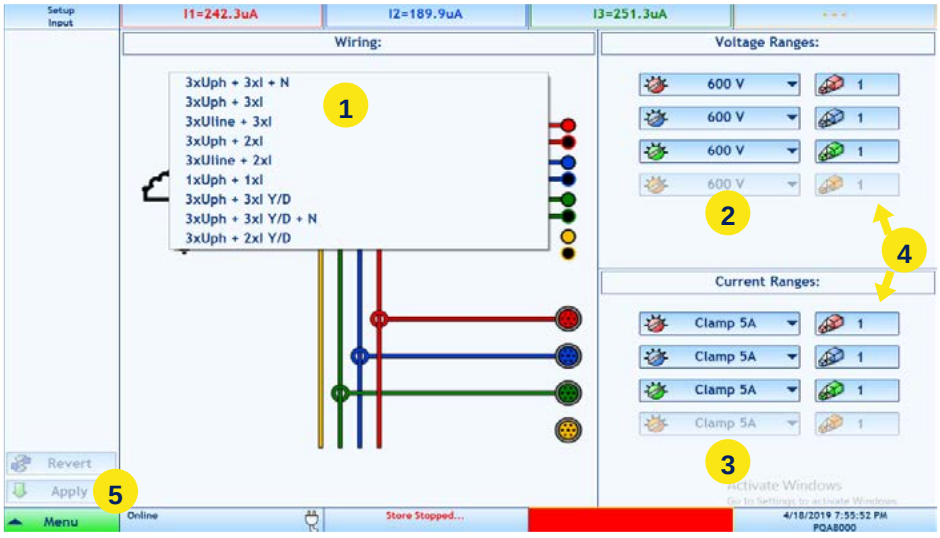
Alternative Navigation: “Setup” – “Input”

The following picture shows the ‘Setup Input’ panel for the wiring setup. The **Setup Input panel** allows changing the input wiring, input ranges, sensors and scale factors.

- By changing any of these parameters the measurement is restarted.
- If data is currently stored, the change of these settings is disabled.
- The System selection allows to setup these setting to actual system only or to all systems.

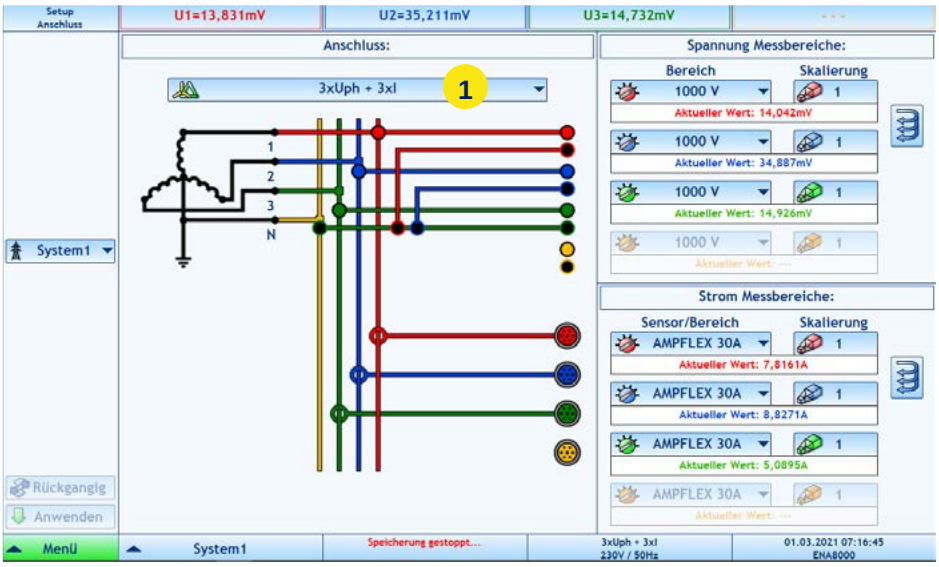


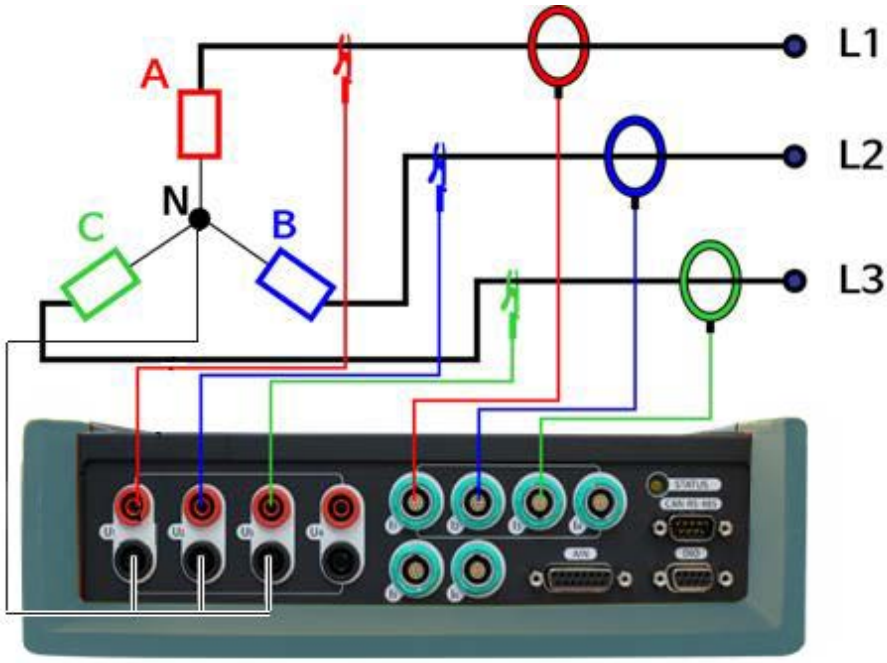
- Select a wiring type (1).
- Select a voltage input range (2).
- Select a current sensor (Clamp/Rogowski) and input range (3).
- Select a scale factor (4).
- Finally click on “Apply” button to save all changes (5)



STAR (Y) Connection

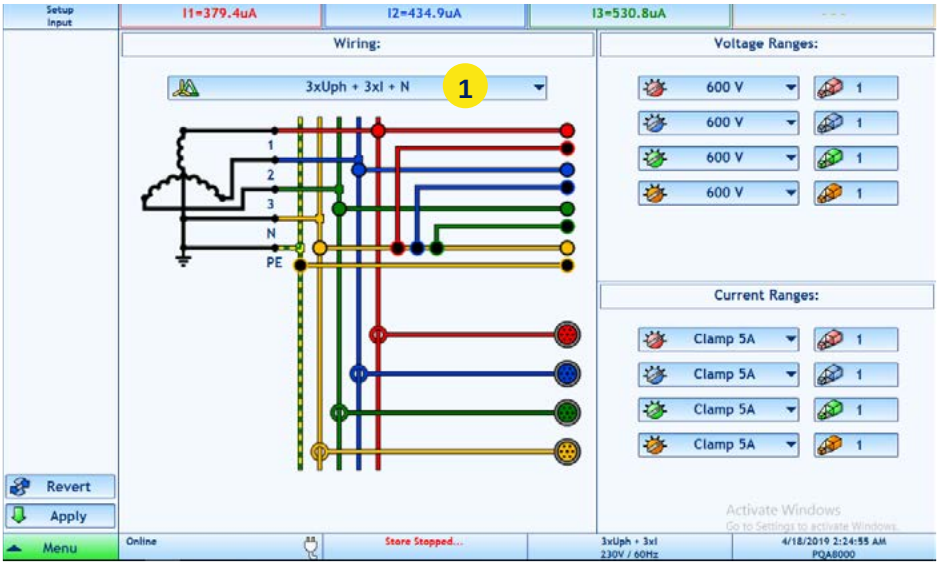
Select '3xUph + 3xI' in the wiring setup and connect the cables according to the picture below.

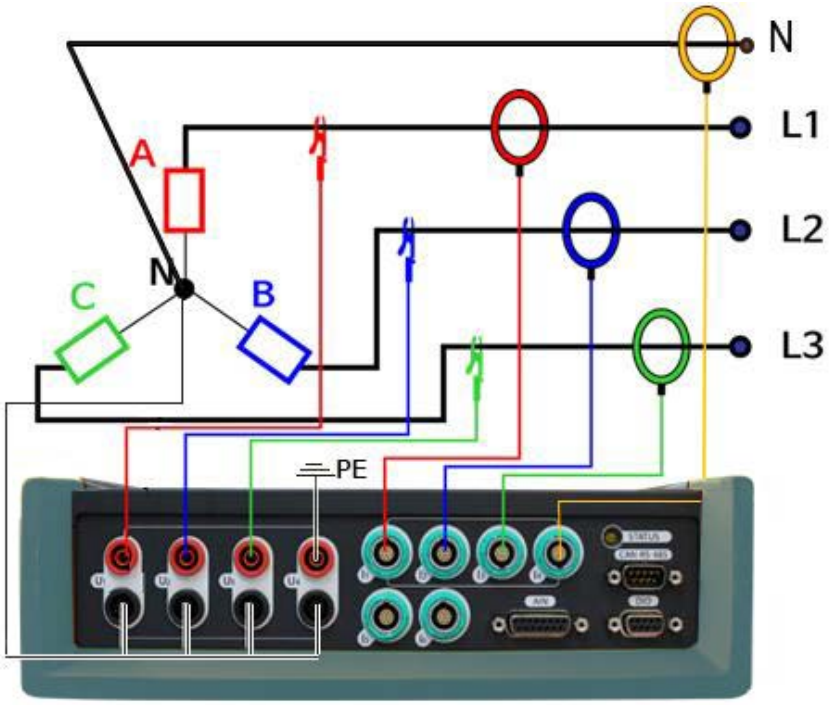




STAR (Y) + N-PE Connection

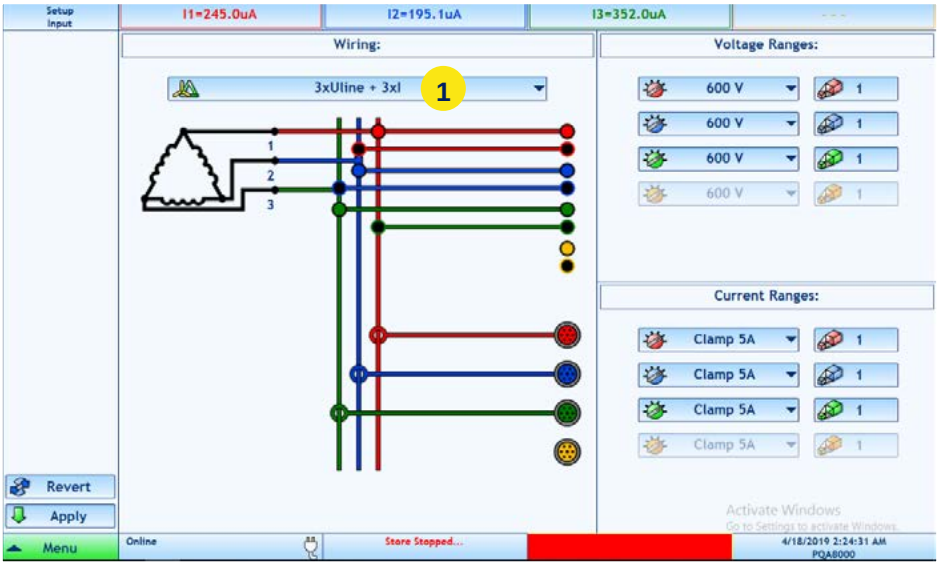
Select '3xUph + 3xI + N' in the wiring setup and connect the cables according to the picture below.

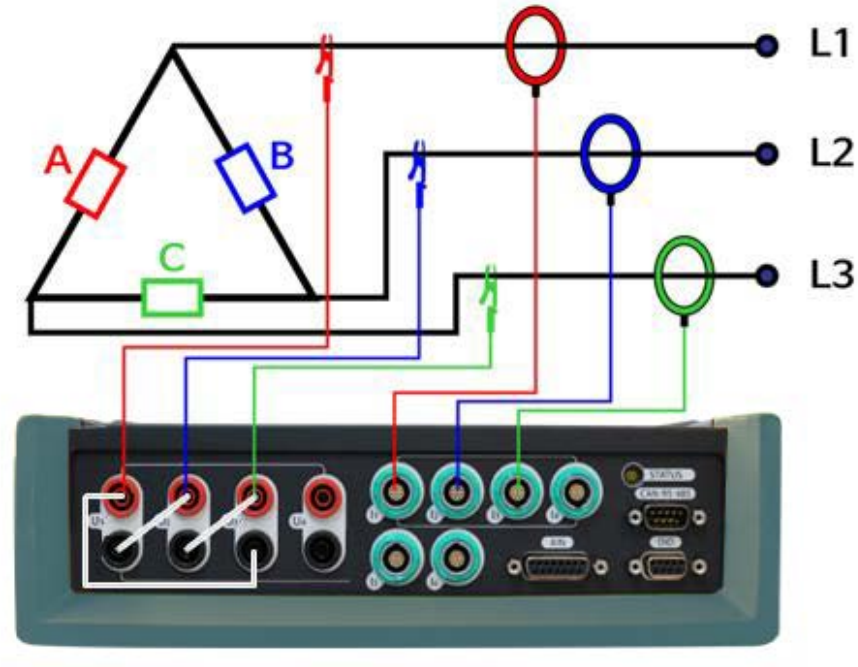




Delta Connection

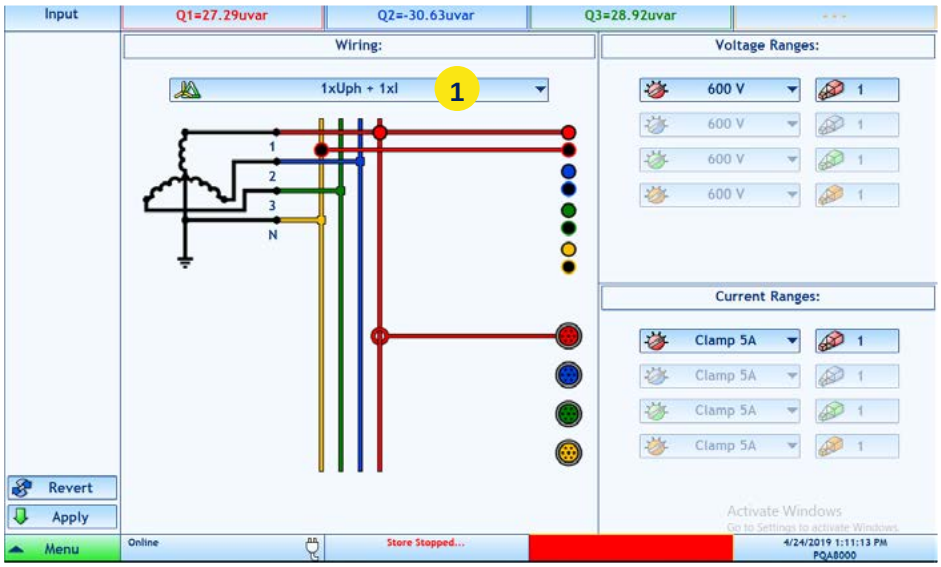
Select '3xUline + 3xI ' in the wiring setup and connect the cables like below picture.

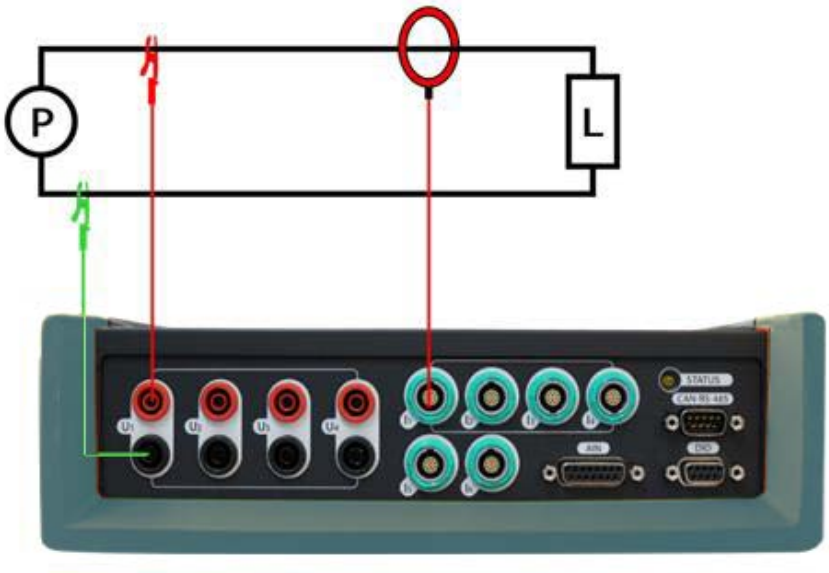




Single Phase Connection

Select ‘1xUph + 1xI' in the wiring setup and connect the cables like below picture.





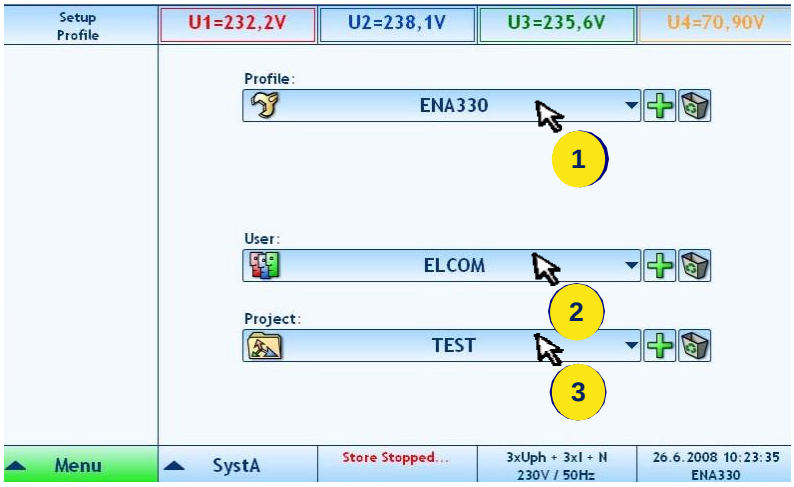
4.3 Main Menu

4.3.1 Defining user and project name

Navigation: "Setup" – "Profile"

The **Setup Profile panel** allows to change the profile of the instrument.

- PROFILE: All instrument's ***settings*** and ***setups*** are stored into a profile. The user can choose to create multiple profiles with different settings.
- USER and PROJECT: can be used for differencing the data storage. For every user/project, the measured data are stored into different folders.



1. Profile change/add/delete
2. User change/add/delete
3. Project change/add/delete

4.3.2 Setting the user language

Navigation: "Setup" – "Options"

The Setup Options panel allows changing the language.

1. Page selector
2. Available languages

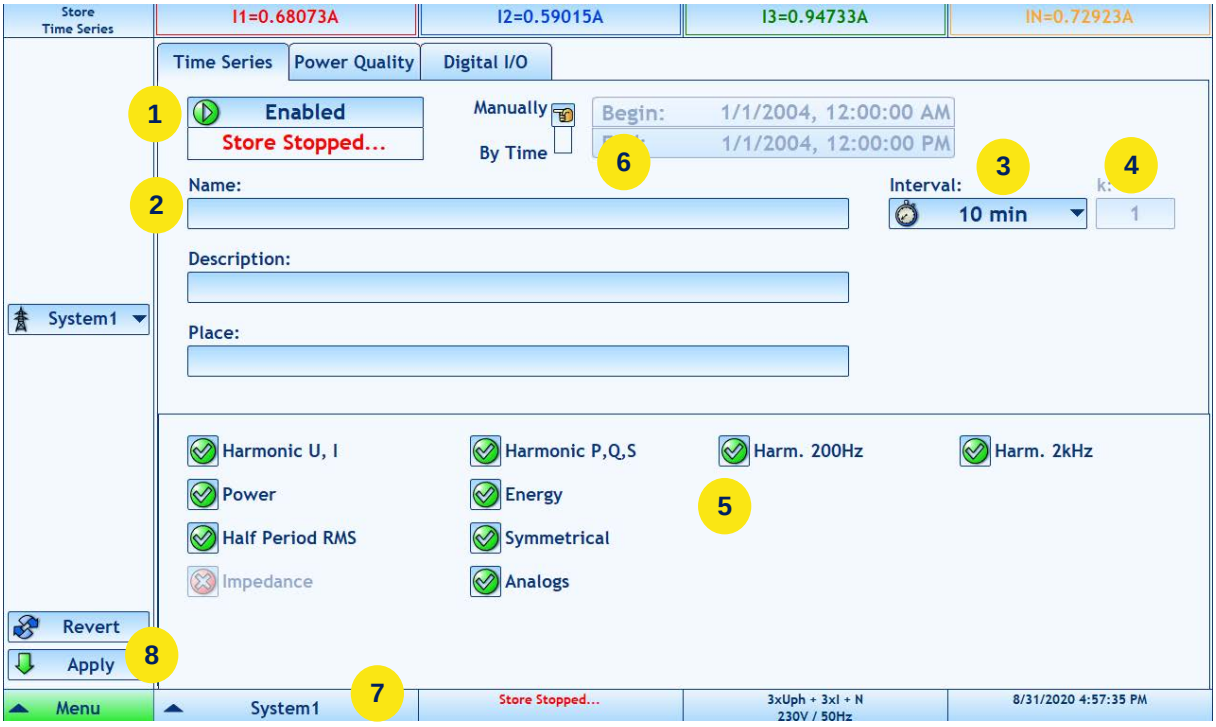
4.4 Data Storage

4.4.1 Store Data Panel

Navigation: "Store" – "Time Series"

The **Store Data panel** allows to configure the storing of calculated data. It can be set to store periodic time series data, Power Quality data and digital inputs data independently.

- Time series data: Storage rate can be set from 200ms to any averaging interval
- Power Quality: will be calculated each 10 minutes, according to international standards
- Digital Inputs: will be stored at each change of state



1. Enabled/disabled button
2. Name of measurement, Place, Description
3. Storing Interval
4. Storing interval multiplier
5. Selected values
6. Manually or automatic begin and end of storing
7. System selection (actual or all systems)
8. Apply and Revert buttons

(If storing is in progress for selected type, then only Enabled/Disabled control can be changed and applied)

How to setup storing

- Insert measurement name, description and place (2)
- Set storing interval and multiplier (3,4). Interval can be selected from 200ms up to 2 hours
- Select quantity groups that you want to store (5). Power Quality data storing and digital inputs can be configured in separated tabs.
- Select "Manually" or "By Time" condition to set up begin and end of storing (6).
- If there is the "By Time" condition activated, select the begin and end time of storing. (6). Clicking on Begin or End time area opens that calendar dialog allowing choosing begin and end time by selecting year, month, day, hour, minute and second. A left click on hour, minute or second area increases the value, while a right click decreases it.

- Enable storing (1).
- Select if changes will be applied to actual system only or to all systems (7) *supported only for multi-system instruments*
- Click Apply button to apply changes to instrument or Revert button to revert changes (8)
- To stop storing, just Disable storing (1) and Apply changes (8).

Storing Options:

- ✓ ***Harmonic U,I***
  Harmonics, THD, Interharmonics for voltage and current
- ✓ ***Harmonic P,Q,S***
  Harmonic active, reactive and apparent power
- ✓ ***Power***
  Active, apparent, reactive power, power factor, cos phi, etc.
- ✓ ***Energy***
  positive, negative, total energy
- ✓ ***Symmetrical Components***
  Zero, positive, negative sequence, unbalance factor
- ✓ ***Analog Inputs***
  Additional analoge inputs
- ✓ ***Harm.200Hz:***
  Storing of Supraharmonics (Higher Frequencies) in 200Hz bands up to 9kHz.
- ✓ ***Harmonic 2kHz:***
  Storing of Supraharmonics in 2kHz bands up to 68kHz (500kHz for PQA8000H)
- ✓ ***Half-Period RMS***
  This options stores for each defined storing interval (e.g. 200ms or 10min)
  - The maximal and minimal ½ period value for voltage and current
  - ½ period current value at ½ period voltage MIN or MAX
  - ½ period voltage at ½ period current MIN or MAX

  This option might allow detecting the source of voltage events (load or generation)

TIME SERIES
Selectable time interval (>200ms)
Data types:
POW ... P, Q, S, PF, etc.
ENE ... Energy
SYM ... Symmetrical Comp.
RMS ... ½ RMS values
FFT ... Harmonics, IH, THD
FFP ... Harmonic P, Q, S, phi
FFU ... Supraharmonics 9kHz
FFH ... Supraharmonics 500kHz

POWER QUALITY
Data type: ***PQM***
All data are automatically stored according to standards like EN50160 etc.

DIGITAL INPUTS
Data type: ***DIG***
Stored at each condition change

ALARMS
Data type: ***ALA***
Definable conditions for alarm records

TRANSIENTS
Data type: ***TRA***
Raw data record with full sampling rate
Defineable trigger conditions

SIGNALLING
Data type: ***TEL***
Telegram record of signalling voltage

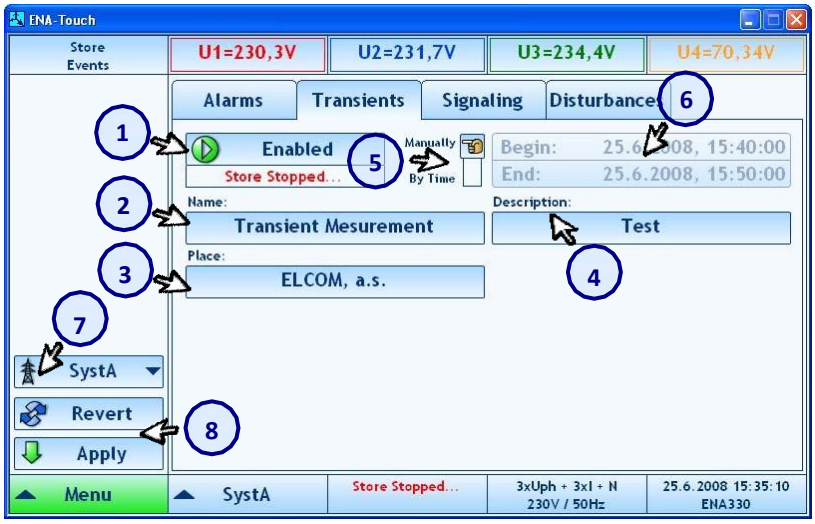
DISTURBANCES
Data type: ***DIS***
½ period values record
Defineable trigger conditions

4.4.2 Store Events/Transients Panel

Navigation: "Store" – "Events"

The **Store Events panel** allows configuring storing options for capturing events.

- The configuration for storing alarms, transients, disturbances and voltage signals can be done independently.
- EN50160 events are stored automatically, if EN50160 time series storing is enabled.
- If storing is in progress for selected event type, then only Enabled/Disabled control can be changed and applied.



1. Enabled/disabled button
2. Name of measurement
3. Place
4. Description
5. Begin- /End-/Type of storing
6. Begin and End time for storing
7. System selection (actual system or all systems)
8. Apply and Revert buttons

How to setup storing:

- Insert measurement name, description and place (2, 3, 4).
- Select "Manually" or "By Time" condition for the begin and end of storing (5).
- If there is the "By Time" condition selected, then select Begin and End time of storing. (6)
- Enable storing (1).
- Select if changes will be applied to actual system only or to all systems (7).
  supported only for multi-system instruments
- Click Apply button to apply changes to instrument or Revert button to revert changes (8).
- To stop storing just Disable storing (pointer 1) and Apply changes (8).

4.5 Measurement

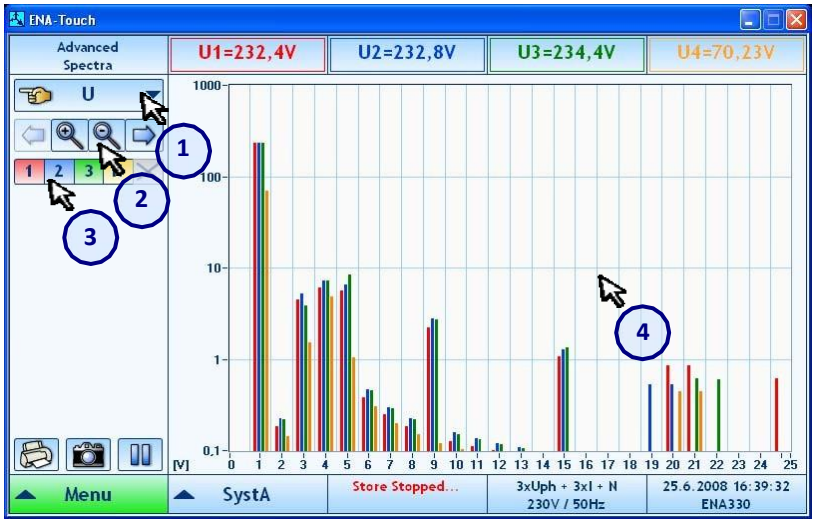
4.5.1 FFT / Spectra

Navigation: "Advanced" – "Spectra"

The **Spectra panel** displays FFT harmonic analysis either of voltage, current, active power, reactive power or apparent power.

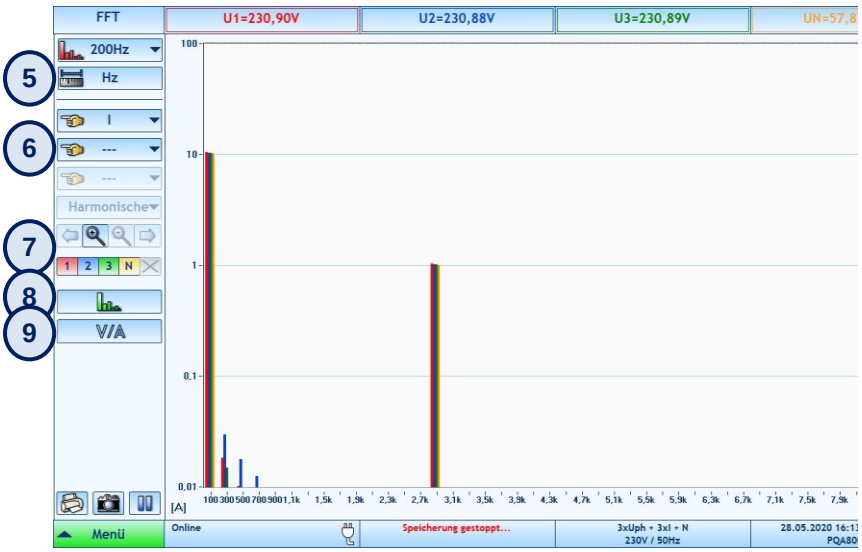
There are four different options for visualisation:

- Harmonics
- Interharmonics
- Higher Frequenciese in 200Hz bands up to 9 kHz
- Supraharmonics in 2kHz bands up to 68kHz



1. Displayed values – voltage, current, active power, reactive power or apparent power
2. Buttons for zoom or unzoom in the graph and for move through all harmonics in zoomed graph
3. Phases buttons
4. Spectra

200Hz band visualisation



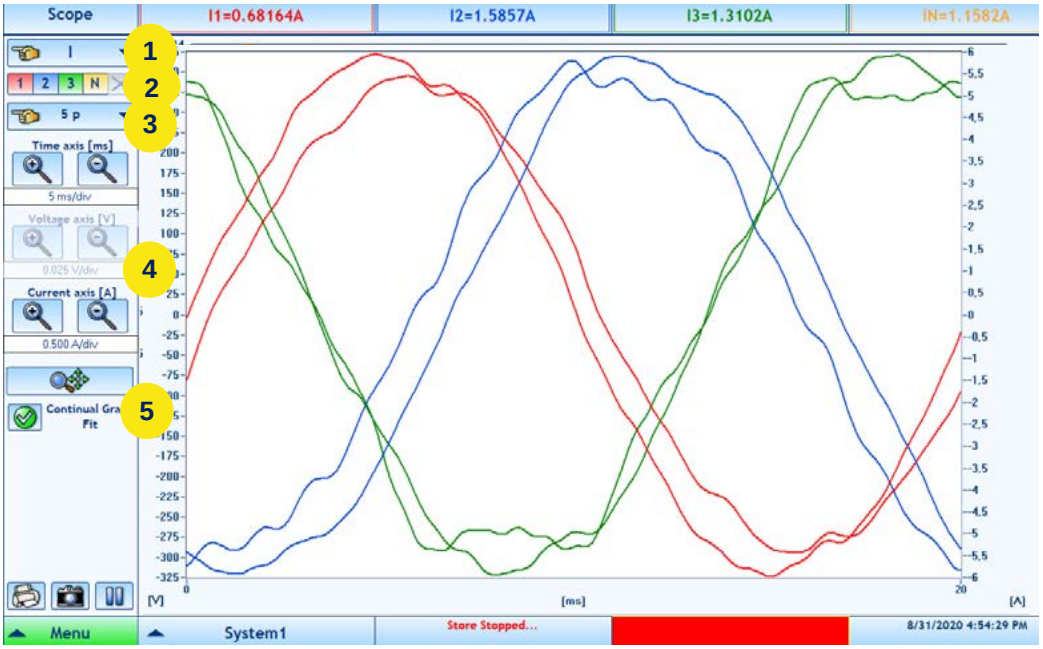
5. Selection between Harmonic order or Hertz (Hz) visualisation
6. Up to 3 charts can be shown below each other
7. Zoom and Move functions
8. Switch between table and spectra visualisation
9. Switch between % values and absolute values

4.5.2 Oscilloscope

Navigation: "Advanced" – "Scope"

The **Scope panel** displays one period of voltage and current on all phases or instant active power p(t). The Graph can be zoomed.

1) Selection of Parameters for Scope View (Voltage, Current, Instant Power)
2) Enable/Disable Phase 1-3 and Neutral
3) Selection of Number of Periods (1 period or 5 periods)
4) Zoom Functions for X and Y axis
5) Auto-Zoom: This options will always show from Min to Max value (if this option is enabled other zoom options will be disabled)

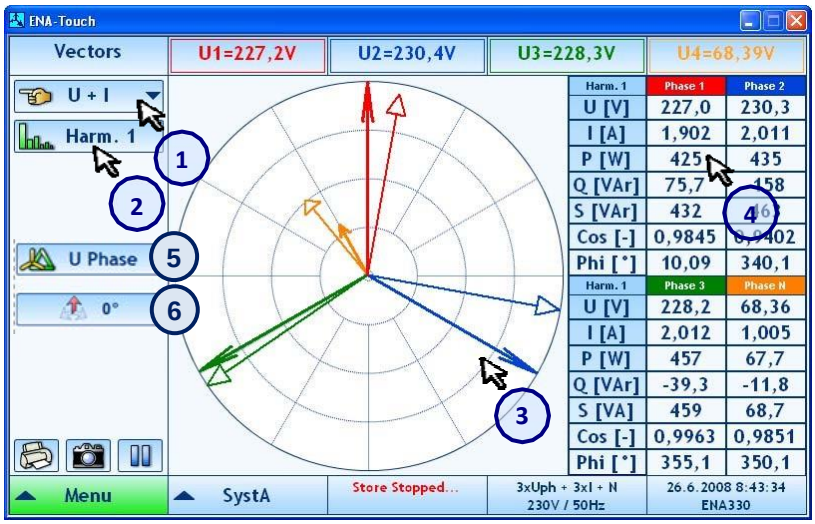


4.5.3 Vector Scope

Navigation: "Vectors"

The **Vectors panel** displays actual 3 phase vector diagram of voltage and current on the selected harmonic (frequency) and additional values of the selected harmonic.

- The vector diagram can be configured to display both voltage and current, or only one of it.
- Harmonics can be selected from the 1st up to the 50th harmonic.
- Star or delta voltage/current relation can be shown (6)
- Reference for the Phase Angle of Harmonics can be selected



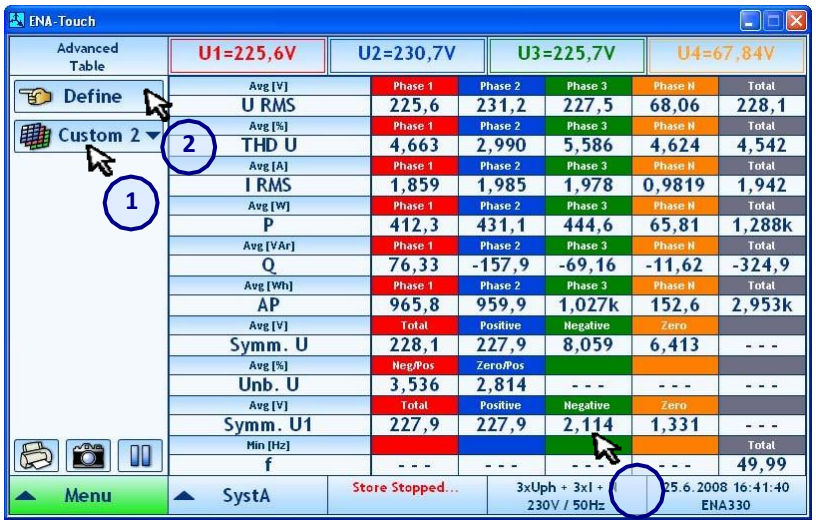
1. Displayed vectors – both or voltage only or current only
2. Selected harmonic – clicking on this button will open keyboard to insert harmonic number
3. Vector diagram
4. Additional instant values of selected harmonic
5. Selection of Delta or Star values
6. Selection of Vector Scope reference point

4.5.4 Table Panel

Navigation: "Advanced" – "Table"

The **Table panel** allows showing a wide range of measured parameters (instant values) in different table sets, or customized tables with selected quantities.

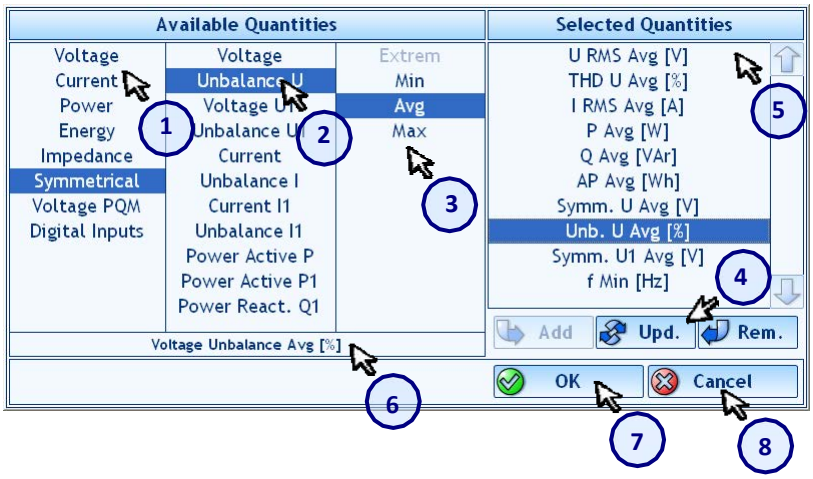
- Displayed values can be selected either from basic quantities, voltage, current, power or additional customizable tables.
- If the custom view is selected, the 'Define' button allows changing the selected quantities.



1. Displayed view – basic, voltage, current, power, custom 1, 2 and 3
2. Quantities selection button
3. Displayed values

Changing selected quantities in custom view

Click on 'Quantity' button, afterwards the window 'Select quantity' will open:



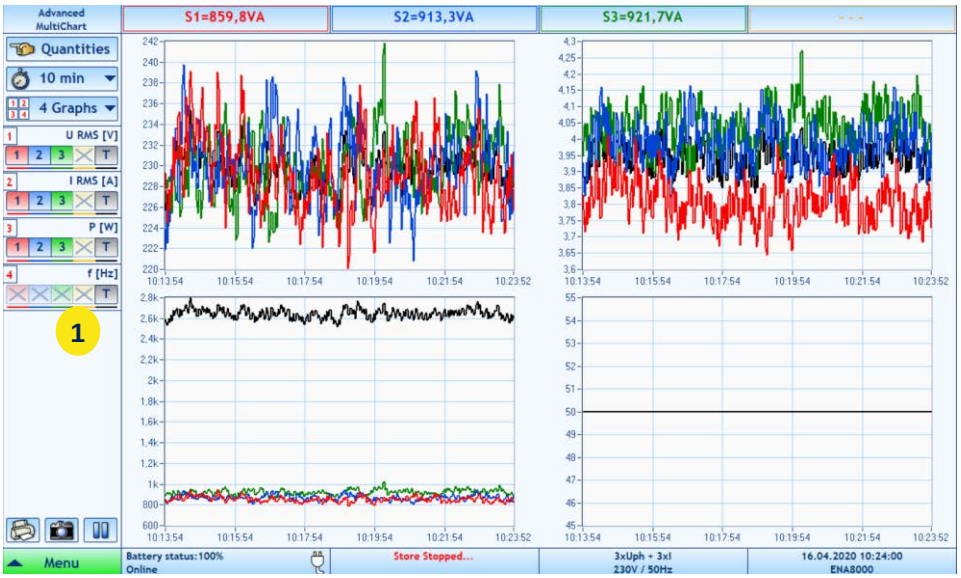
1. Select basic quantity
2. Select derived quantity
3. Select Min/Avg/Max
4. Click Add or Update button to add or change selected quantity
5. Selected quantities list
6. Name of selected quantity
7. Click OK button to apply changes
8. Click Cancel button to cancel

4.5.5 Multi-Chart

Navigation: "Advanced" – "Multichart"

Multi Chart panel allows showing up to 4 different charts. In Measurement mode the time interval can be set up to 1 hour. For further and detailed data analysis open the Report tool, which can analyze data already during measurement.

- The quantities in Multi-chart option can be defined like in the Table Panel (see 0).
- On the left side (1) you can define which phases should be shown of the individual quantities.



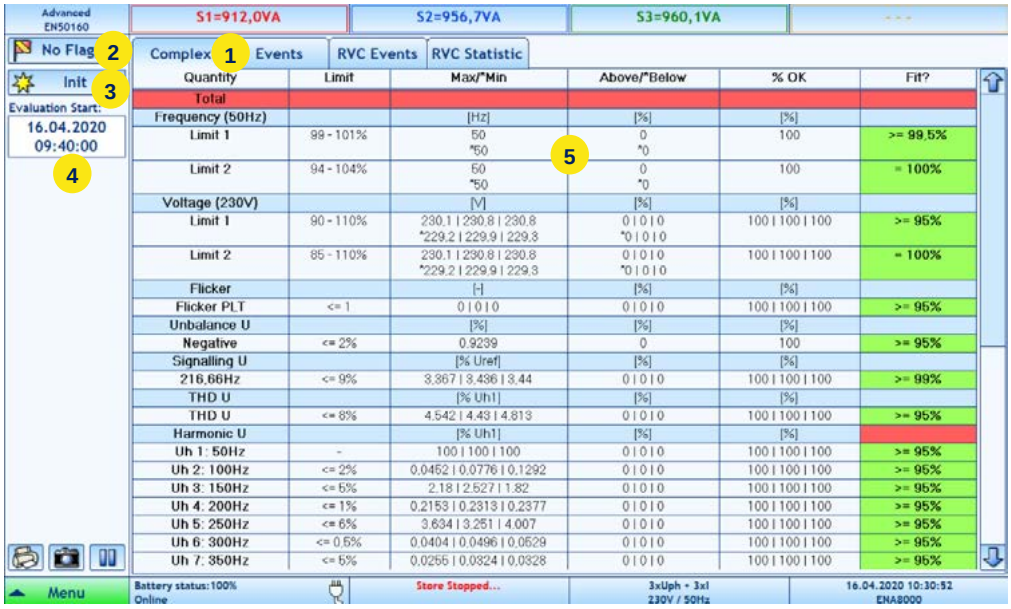
4.5.6 EN50160 Analyzer

Navigation: "Advanced" – "EN50160"

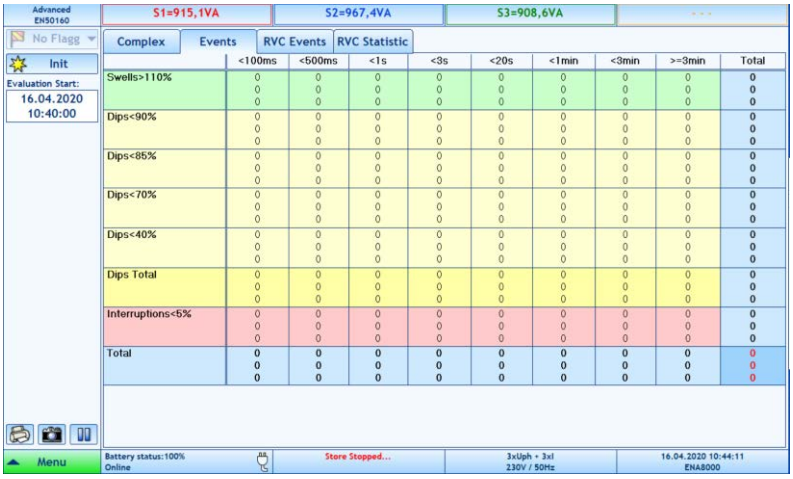
The **EN50160 panel** shows Power Quality evaluation according to EN50160 standard.

- It is possible to switch between the evaluation of all data and evaluation of not flagged data (data when no voltage event occurred).
- All quantities are measured and evaluated according to IEC 61000-4-30 class A.
- A complex overview and also more event details can be displayed. The event details include event distribution, rapid voltage changes distribution and rapid voltage changes statistics. EN50160 events itself are displayed in the events list panel.

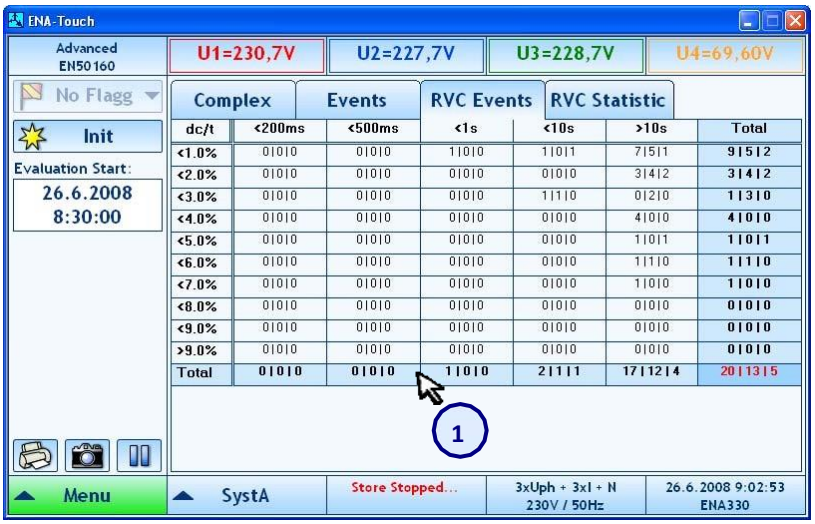
For a more detailed description of the measured parameters according to the EN50160 standard, we would like to refer to the Technical Reference Manual.



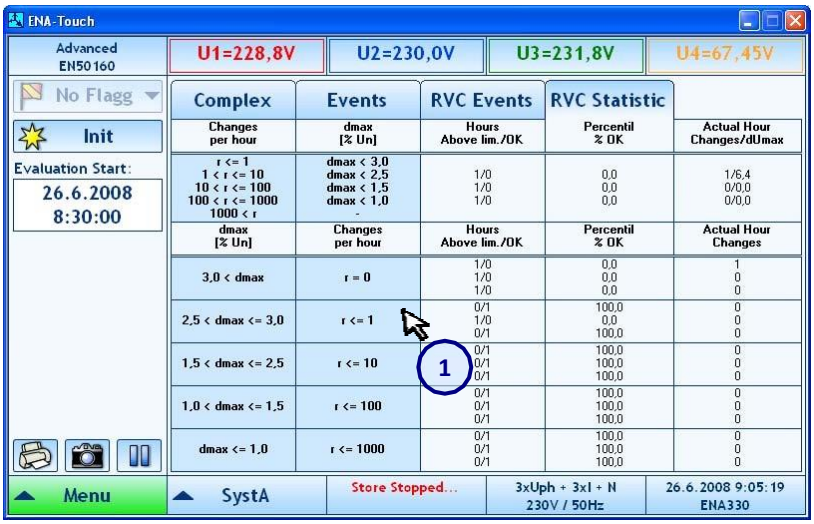
1. Selection of view type – complex, events distribution, RVC Events and RVC statistics
2. Select Flagged/Not Flagged data for evaluation
3. Initialization button
4. Start time of evaluation
5. Voltage quality information
   - Limit: Limit Values defined by selected standard (EN50160, IEC61000-2-2, etc.)
   - Max/*Min: Max and Min values of evaluation period
   - Above/*Below: Samples above or below the limits
   - % OK: Percentage within range
   - Fit?: Indication if standard is fullfiled or not



1. Table with count of voltage events distributed by length and level



1. Table with count of rapid voltage changes distributed by length and level



1. Table with rapid voltage changes statistics

4.5.7 Transient, Event and Disturbance Recorder

4.5.7.1 Event Definition

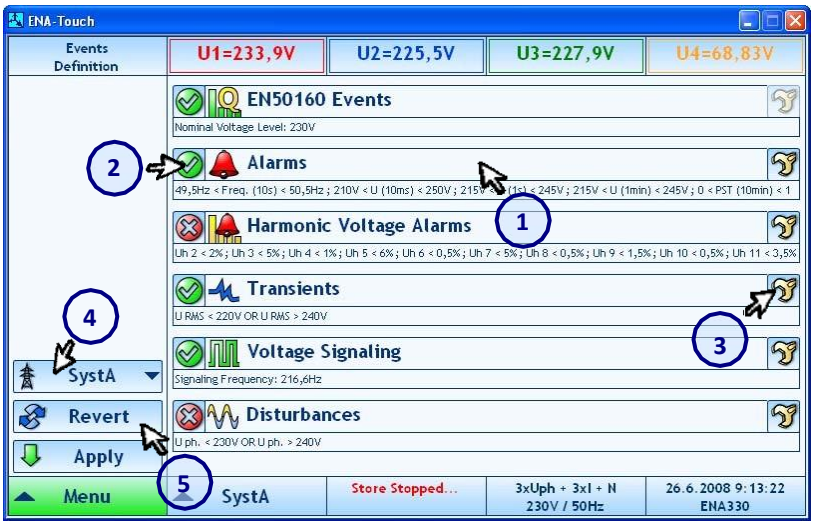
Navigation: "Events" – "Definition"

There are different types available. The following table gives an overview about event type and recording type

Type	Recording
EN50160	Event list of all EN50160 limit violations
Alarms	Event list of defined alarms
Harmonic Voltages	Event list of harmonic voltage limit violations
Transients	**Raw Data Record with full sampling rate** at limit violation
Signalling Voltage	Record of binary signal of Signalling Voltage
Disturbances	**½ Period record and Raw Data record** at limit violation

The **Events definition panel** allows to define various trigger conditions.

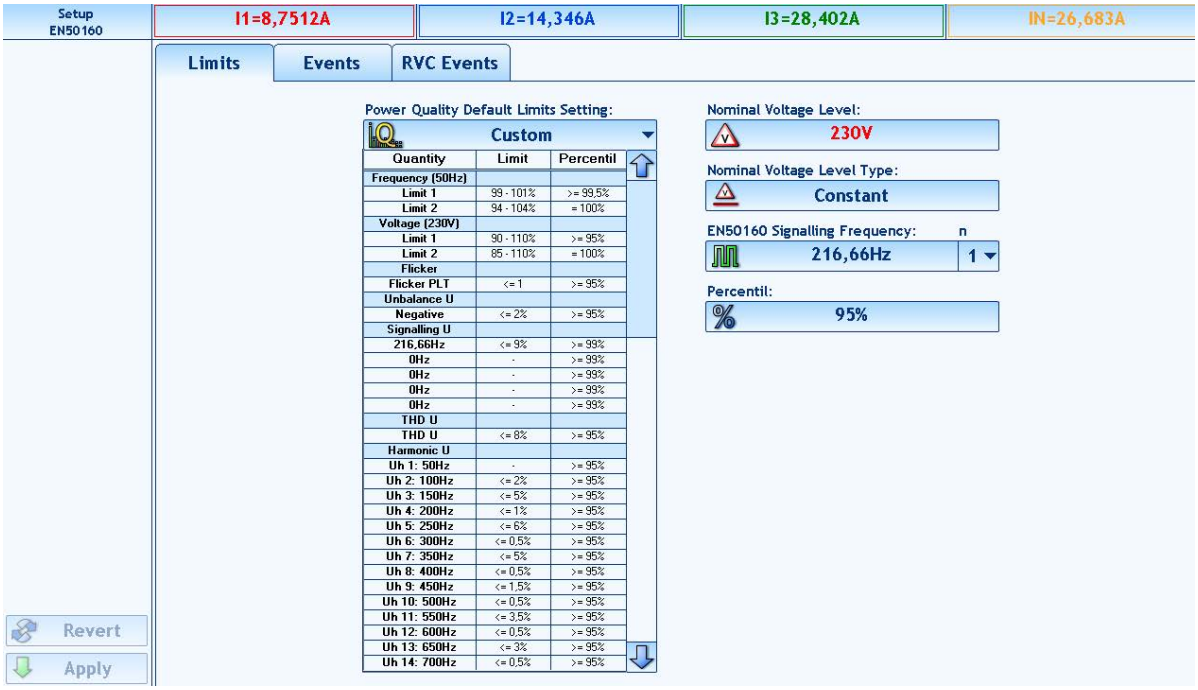
- The main screen of this panel displays a list of different event types
- Event types can be activated on the left (2) and configuring on the right. (3)
- All changes in the main panel and its sub-panels must be confirmed by Apply button. (5)



1. List of available event types
2. Event enable/disable button
3. Event configuration button
4. System selection (actual system or all systems)
5. Apply and Revert buttons

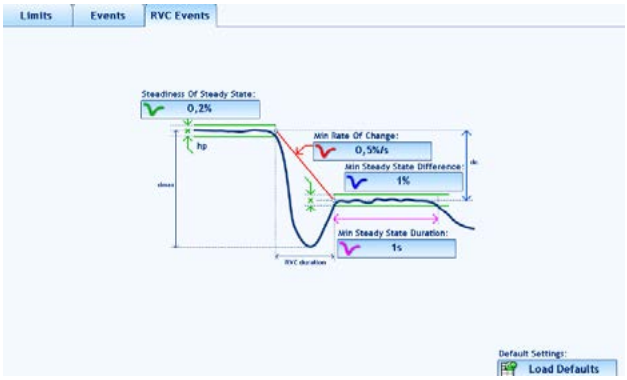
EN50160 Events

Voltage events according EN50160 can only be enabled/disabled and not configured, the configuration of EN50160 events is possible in the EN50160 setup panel. *Navigation Menu → Setup → EN50160 → Events*



For the Voltage Limits the limits for flagging the data, Swell & Dip Limit, Interruption Limit and the hysteresis can be defined.

For Rapid voltage changes the steady state, rate of change, min. steady state difference and duration can be define.

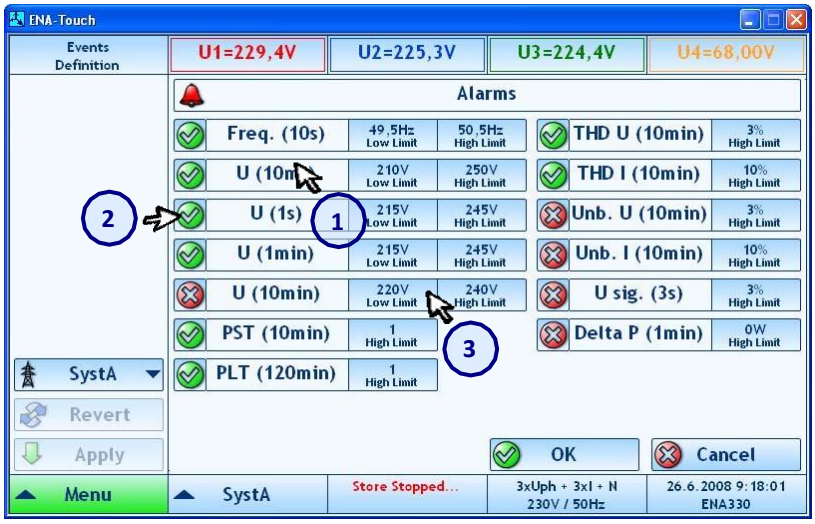


Alarms

Navigation: "Events" – "Definition" – "Alarms"

These events are generated if specific value crosses defined limits and can be logged (if

storing of alarms is enabled). Alarms can be configured for different quantities and different evaluation times according to next picture (Alarms definition sub panel):

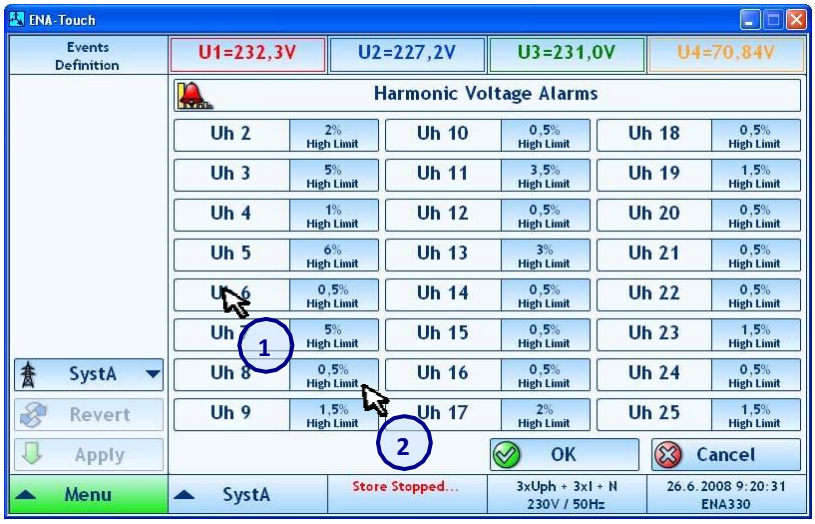


1. List of available quantities
2. Alarm enable/disable button
3. Alarm limits

Harmonic Voltage Alarms

Navigation: "Events" – "Definition" – "Harmonic Voltage Alarms"

These events are generated when a specific voltage harmonic crosses defined limits and can be logged (if storing of alarms is enabled). Alarms can be configured for different voltage harmonics (2nd to 25th). The evaluation time for all of them is 10 minutes. See next picture (Harmonic Voltage Alarms definition sub panel):



1. List of voltage harmonics
2. Voltage harmonics limits

Voltage Signaling

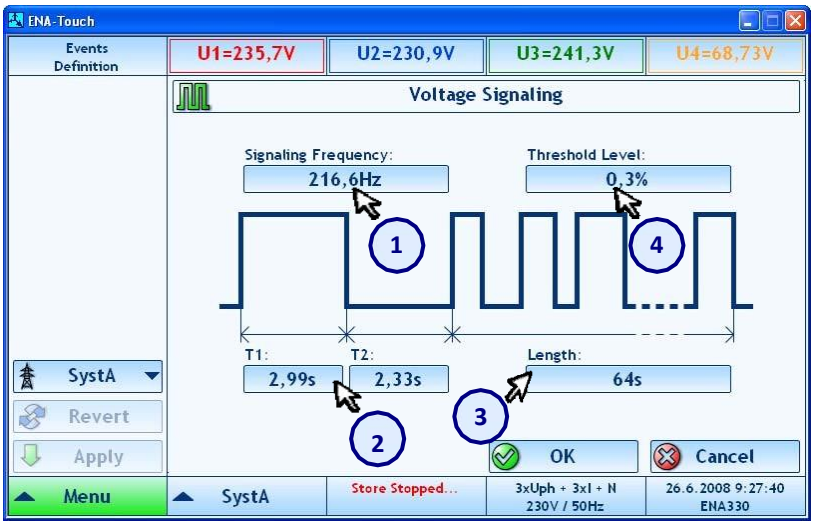
Navigation: "Events" – "Definition" – "Voltage Signalling"

Voltage Signaling is used for the remote control of specific devices by a signal superimposed on the fundamental frequency.

– These events can be measured, and if the storing is enabled, the binary signal (telegram)

which is transported by this signaling is stored.

– The definition of this event allows the setup of specific parameters of the signaling voltage, like signal frequency, start pattern and length.



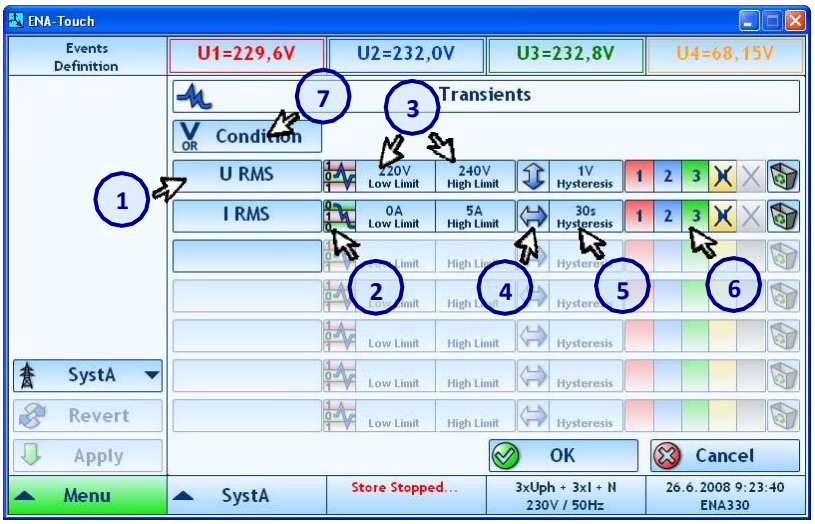
1. Signaling frequency
2. Start pattern (length of logical 1 and logical 0 on the beginning of the signal)
3. Maximum signal length
4. Threshold level

Transients

Navigation: "Events" – "Definition" – "Transients"

Transients are stored in full sampling rate (sampling rate defined in *"Setup"-"Processing").*

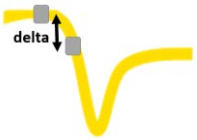
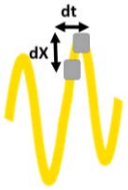
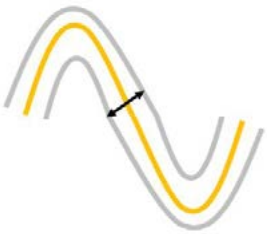
- A transient event can occur if specified conditions are met. As a condition a specific quantity, their limits, hysteresis and type of hysteresis (level or time), phases and type of window (inside limits or outside limits) can be defined.
- The number of different quantities and the logical coupling between them (logical OR or AND) can be selected.
- If the value changes, the transient event is generated (edge trigger) and transients of voltage and current are stored. Via window type (2) it can be selected if trigger should start by entering the window with selected upper and lower limit or by leaving the window.



1. Evaluated quantity
2. Window type
3. Limits
4. Hysteresis type
5. Hysteresis
6. Phases
7. Coupling between quantities

- Storage Length and Pre-Trigger time of Transient can be defined in Misc. setup panel (*Menu → Setup → Misc. → Transient*).

The following table shows the different trigger types and their calculation base.

Type	Time Base
RMS (U, I) 	½ Period RMS values
Harmonic (U, I, THD, etc.)	200ms values (10/12 period-values)
P, Q, S, PF, phi 	200ms values (10/12 period-values)
Frequency	1 period value
Delta Frequency	Delta between period-values
MAX (U, I) 	Waveform (Sampled values)
Delta 	Delta between period values based on ½ period-values (sliding window)
Derivate	Voltage, Current
dX/dt (dU, dI) 	Waveform (Sampled values)
Envelope 	Envelopetrigger, absolute value (voltage) as deviation within one periode
Unbalance 	Voltage, 200ms (% value) (10/12 Periods)
Periodic Interval	Triggering after a certain time. Possible values: 1, 10, 15, 30, 60 and 120 minutes.

Detailed tabular overview of the individual trigger parameters:

Condition	Description (for 50 Hz / for 60 Hz 12 periods)
du/dt (V/s) or di/dt (A/s)	Slope/steepness between samples – max value (both hi & low) of Tw = 10 periods (200 ms)
delta U or delta I	Difference between two half-period RMS values
U peak (V) or I peak (A)	Max values for U / I of Tw = 10 periods
U rms (V) or I rms (A)	RMS value for each half-period
Uhar (V) or Ihar (A)	Specified harmonic U / I of Tw = 10 periods
THD U or THD I	THD for U / I of Tw = 10 periods
delta P	Difference in active power between two consecutives Tw = 10 periods
P	Active power of Tw = 10 periods
P1	Active power 1st harmonic of Tw = 10 periods
Q	Reactive power of Tw = 10 periods
Q1	Reactive power 1st harmonic of Tw = 10 periods
S	Apparent power of Tw = 10 periods
Unbalance (α)	Unbalance negative component of Tw = 10 periods
PF	True Power factor (incl. Harmonic content) of Tw = 10 periods
Cos φ	Displacement power factor (1st harmonic) of Tw = 10 periods
Frequency	Frequency of 1 period
delta f	Frequency difference of 1 period
Hysteresis	Trigger-dead time / Trigger-dead level
Rate of Change	For the time base t, different values can be set: t = 10 periods (as well as 1, 2, 5, 10, 20, 30, 50 or 100 periods)
du/dt or di/dt derivative	Upper and lower limits refer to +/- periods of the waveform

Further information:

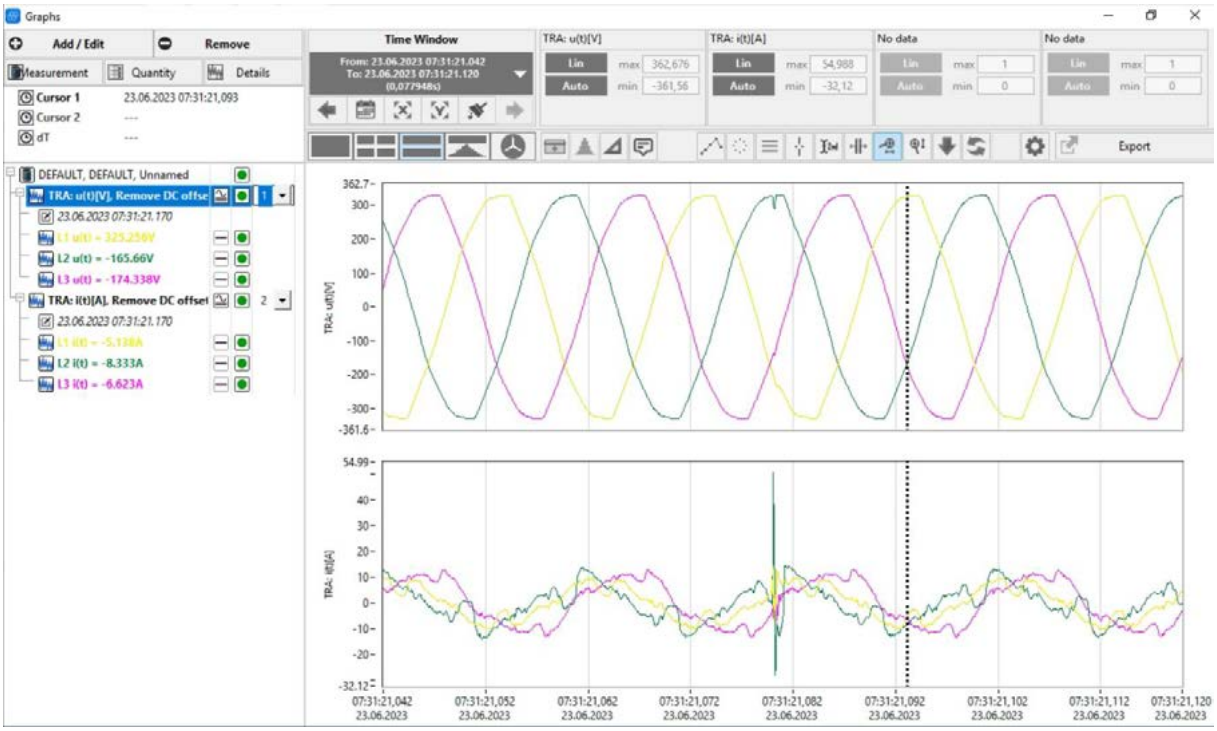
Each transient trigger can also trigger a disturbance trigger (and vice versa). If this setting is relevant to you, please contact our support.

dU/dt (and its derivative) are different for transient and disturbances recordings. Transients refer to the waveform as described in the table above. Disturbances are triggered based on consecutive ½ period values (RMS values).
Setting the correct lower and upper limits is particularly important for these triggers. For example, they should be +200 and -200V, as an upper or lower limit of 0V will inevitably result in **continuous trigger records**. This must be avoided! If you are unsure about a trigger setting, please contact our support.

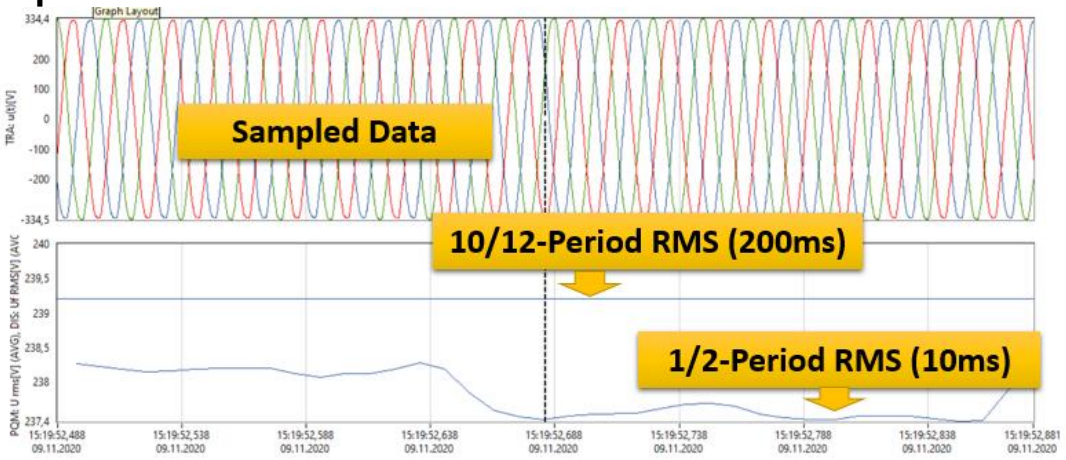
Envelope Trigger Settings Example:

The trigger setting is done in the measurement software under „Events“ → „Definition“ → „Transients“. As show in the example, 30V means a 30V envelope around the voltage signal.

In the reporting software, the recorded trigger can be displayed under „Events“.



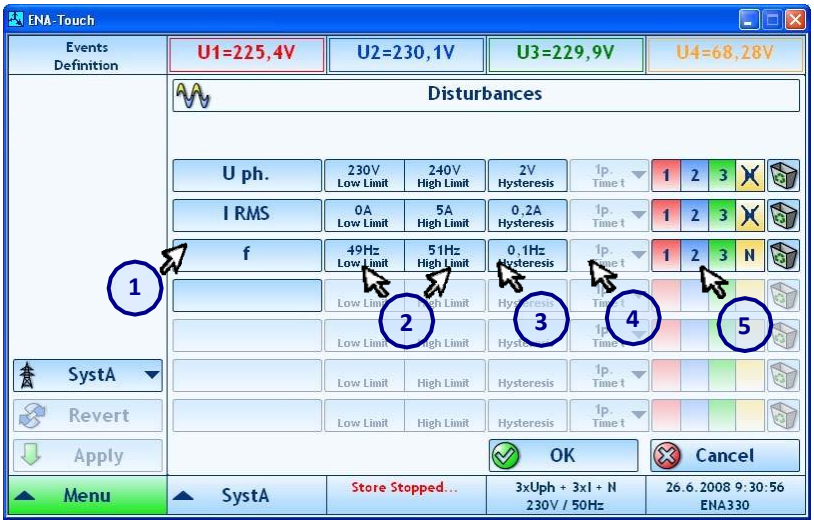
Explanation time interval



Disturbances

Navigation: "Events" – "Definition" – "Disturbances."

These events are similar to Transients. Instead of waveforms the half-period values for voltage, current, phase angle, power, power factor, etc. are stored. Each Disturbance event will also trigger an Transient event. In that way any kind of disturbance can be detected.

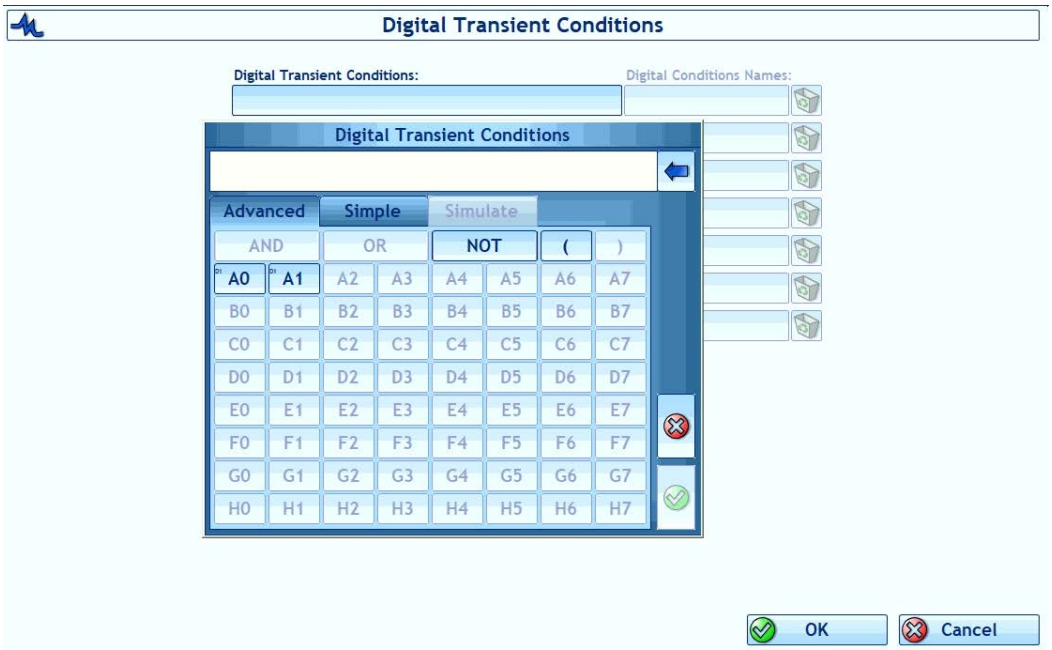


1. Evaluated quantity
2. Limits
3. Hysteresis
4. Time window for quantity rate of change (if selected)
5. Phases

- Storage Length and Pre-Trigger time of Disturbances can be defined in Misc. setup panel (*Menu* → Setup → *Misc.* → *Disturbances*).

Digital Trigger Setup

Navigation: "Events" – "Definition" – "Transients." – "Digital Tigger"

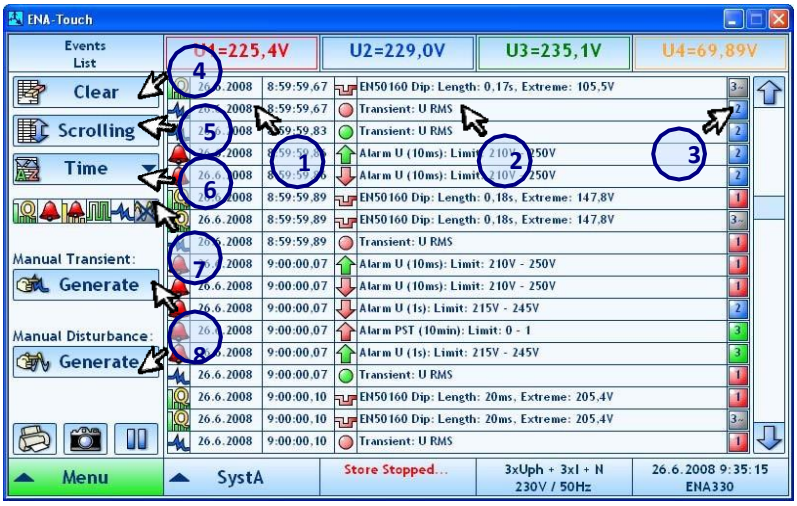


Advanced Table (can be used to check if DI is working)

U1=7,2140mV	U2=56,306mV	U3=3,4259mV	UN=35,857mV	
[-]				Total
DI A0	- - -	- - -	- - -	- - -	1,000
[-]				Total
DI A1	- - -	- - -	- - -	- - -	1,000

4.5.7.2 Event Table

Navigation: "Events" – "List"
This panel shows a list of already captured events. It displays up to the last 1000 events - no matter if they were stored or not. Event list is scrolled automatically or can be scrolled manually. The Event table can be sorted by event time, type or phase. The list can be cleared and disturbances or transients can be generated manually.



1. Event icon and date/time
2. Event description
3. Event phase
4. Clear event table button
5. Scrolling behavior button
6. Sort by button
7. Enable/disable selected event types
8. Manual triggers for transient and disturbance

4.5.8 Phase Measure Unit

Navigation: "Menu" – "PMU"

The instrument is a highest-precision Phase Measure Unit (PMU). The accurate voltage and current inputs, together with the high-precise internal GPS unit, allows measurements with highest quality. The PMU functionality requires a minimal sampling rate of 19,2kS/s.

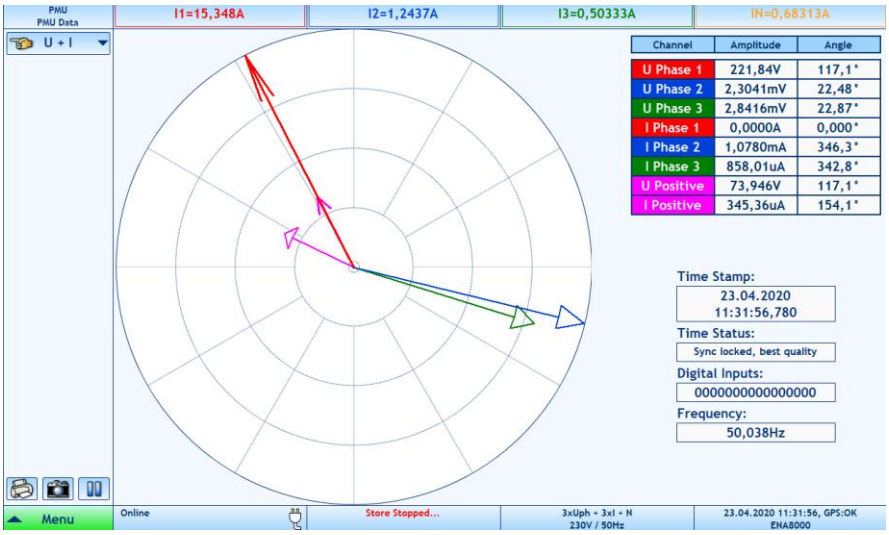
Using the PMU function doesn't store any data on the instrument. For PMU application a central software is needed, which receives the data streams of the instrument. For PMU measurements at least two PMU's needs to be installed.

For more details about principle and functionality of PMU's please refer to the Technical Reference Manual.

4.5.8.1 On-Line Phasor Daten

Navigation: "Menu" – "PMU" – "Data"

The PMU data are shown in the main panel. The Phasors are shown in the Vectorscope and the numerical table. The timestamp, status, locked or unlocked mode (with time of unlocked mode), frequency as well as digital inputs are shown on the lower right of the screen.



4.5.8.2 Configuration

Navigation: "Menu" – "PMU" – "Setup"

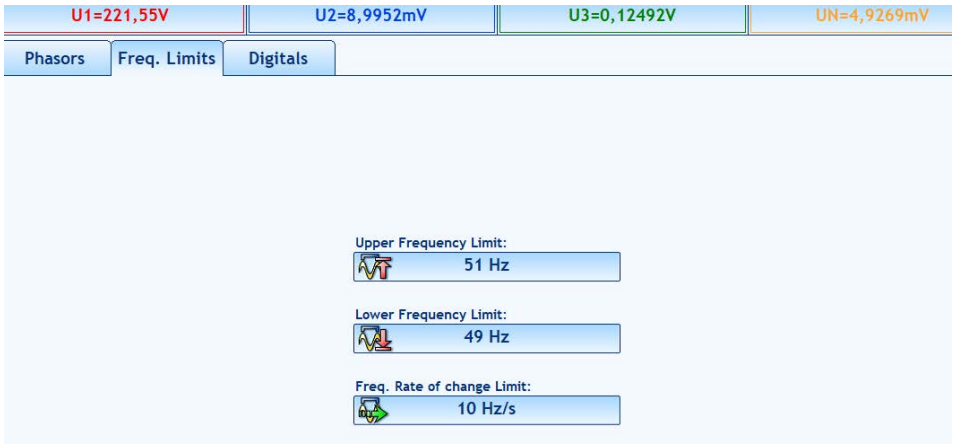
First the phasors need to be assigned to input channels of the instrument.

Reported Phasor it can be defined which quantity is being provided – for each channel – e.g. „raw" phasor, or positive, negative, zero component

Phasor name user can edit quantity name

Limits (low and high) exceeding the limit is included as an information in a „Status Word" (defined by C37.118 standard)

Frequency Limits



Similar as in phasors – exceeding the limit is included as an information in a „Status Word" – defined by C37.118 standard

4.5.8.3 Connection

Navigation: "Menu" – "PMU" – "Conn."

At general PMU settings the connection to the central PMU software (e.g. WAMS system) can be defined.

PMU ID	supposed to be unique identification number, one of the crucial parameters when connecting to PMU data stream
PMU TCP port	tcp port used to connect to PMU data stream (often 4712, but for network related reasons might be changed to another)
PMU station	supposed to be unique name of the device, this is one of the human readable parameters you can get when connected to PMU data stream, can include simple information, e.g. voltage line number and substation code
PMU header	another human-readable parameter you can get when connected to PMU data stream
Reporting Rate	sometimes called data rate, sometimes even sample rate, reporting rate is the most fitting e.g. 50Hz – data points will be transferred 50times per second,

4.5.9 Display of actual values

Actual values info bar shows actual value of phase voltages or currents or active, reactive and apparent power. Switching between displayed values is done by clicking on actual values info area.

By clicking on the top bar you can switch between the different data types.

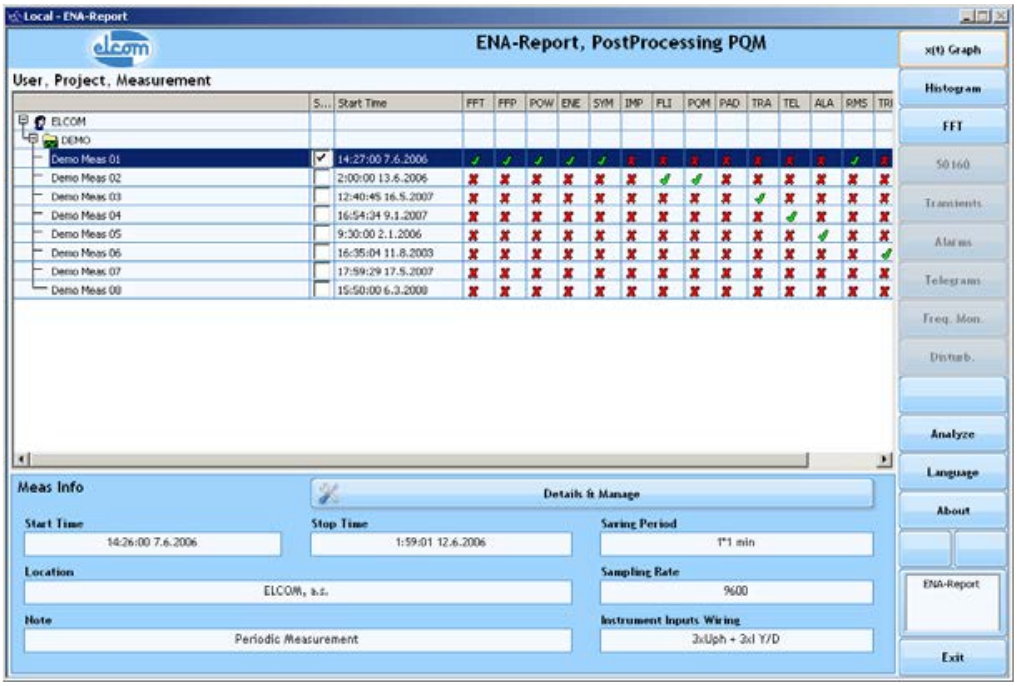
4.6 Data Analysis

In the Software Starter Screen you can select between “Report” and “Report New” tool.

- The classical “Report” tool is available on the market for more than 15 years – well known from PNA hardware products. It covers all classical functionalities. All data of PNA instruments (PNA 561, PNA571) can be opened and analyzed.
- The “Report new” tool is the latest version of a reporting tool that will cover additional functionalities compared to the Report tool. New power quality parameters like Supraharmonics will only be available in this tool, that can manage both data of old and new instruments.

Classical Report

The analysis functionalities of the classical report tool are:
Time series analysis (Graph), Histogram, FFT, EN5160 analysis, Transients, Disturbances, Alarms, Telegrams and the Frequency Monitor.



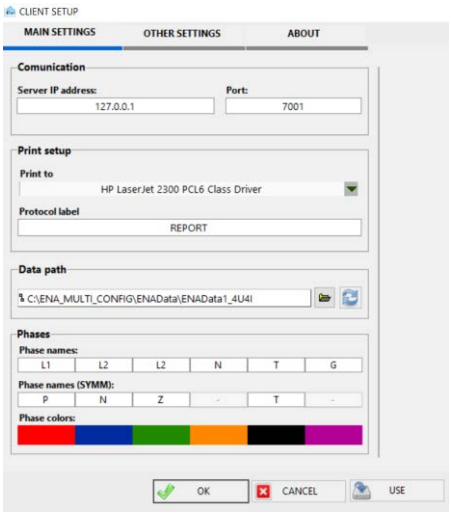
Please refer to the “REPORT Manual” for detailed instructions and information.

Report New

The graphical user interface of the new Report Tool was updated and optimized. In addition a couple of new features have been implemented. Simultaneous analysis of different kind of data is a new feature, as well as enhanced analysis and data visualizations functions. Another feature is the possibility to overlay data of different measurements. The user interface is now aligned to the User Interface of the PQM SCADA solution.

4.6.1 Settings

In ***Settings screen***, general settings like Language, Phase name and colours, Printer, Data path, Export options,… can be defined.



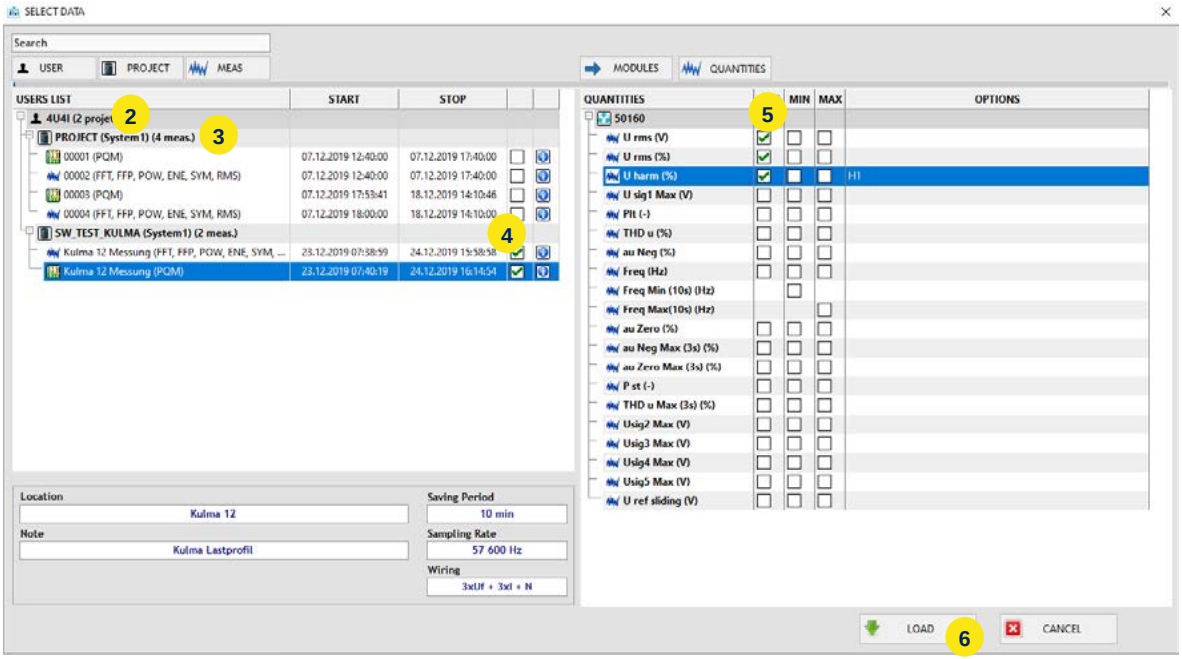
In ***Data screen***, you can select between the different Data visualization options:

- Graphs (Time series data)
- FFT (Harmonic, FFT spectra)
- Transients
- Disturbances
- EN50160
- Etc.

4.6.2 Graphs / Time Series Data

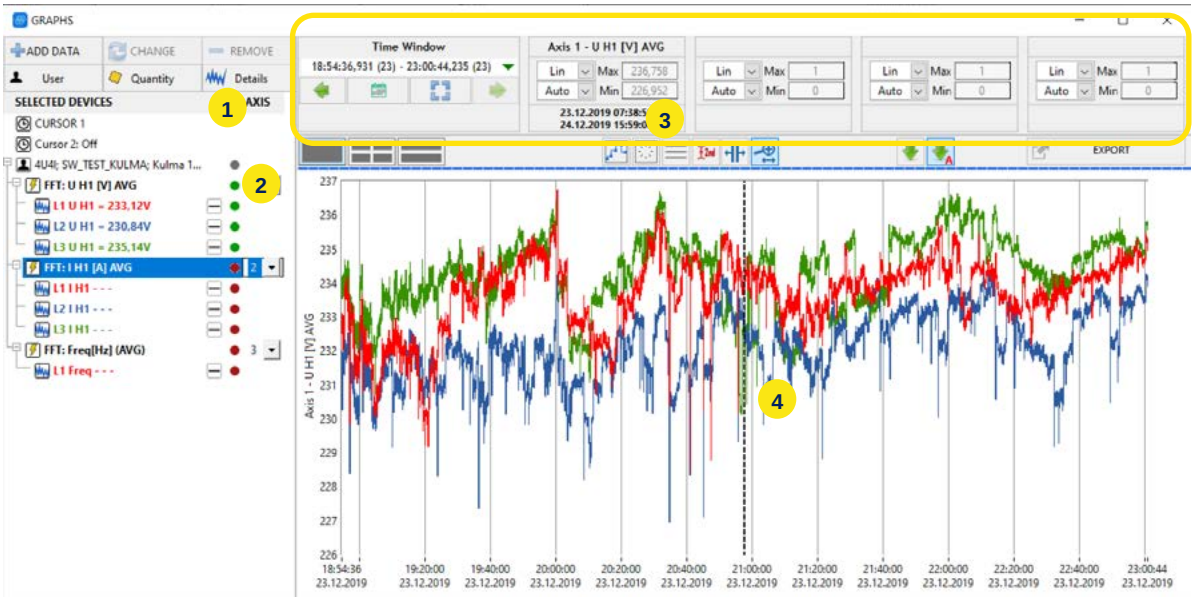
After selecting “Graphs” and pressing “Add Data” (1) button (see picture) the Channel selection menu will appear.

Then select the System (2) and project (3). The treeview will enhance and show the different measurements. Select the measurement (4) on the left side and check the quantities you want to show/analyze on the right (5). Finally press Load (6) and data will be shown.



Overview Data visualization panel

- Selected Quantities (1)
- By pressing on the green indication lamp you can enable/disable individual quantities or phases (2) for the Visualization
- Configuration of Visualization (3)
  - x-y axis (scaling, lin/log)
  - interpolation type
  - point style
  - number of charts
  - Cursors
  - Zoom In/out Function
  - Time-Interval
- Data Visualization (4)



If you want to add additional channels, just press “Add” again and select the quantities you want to add.

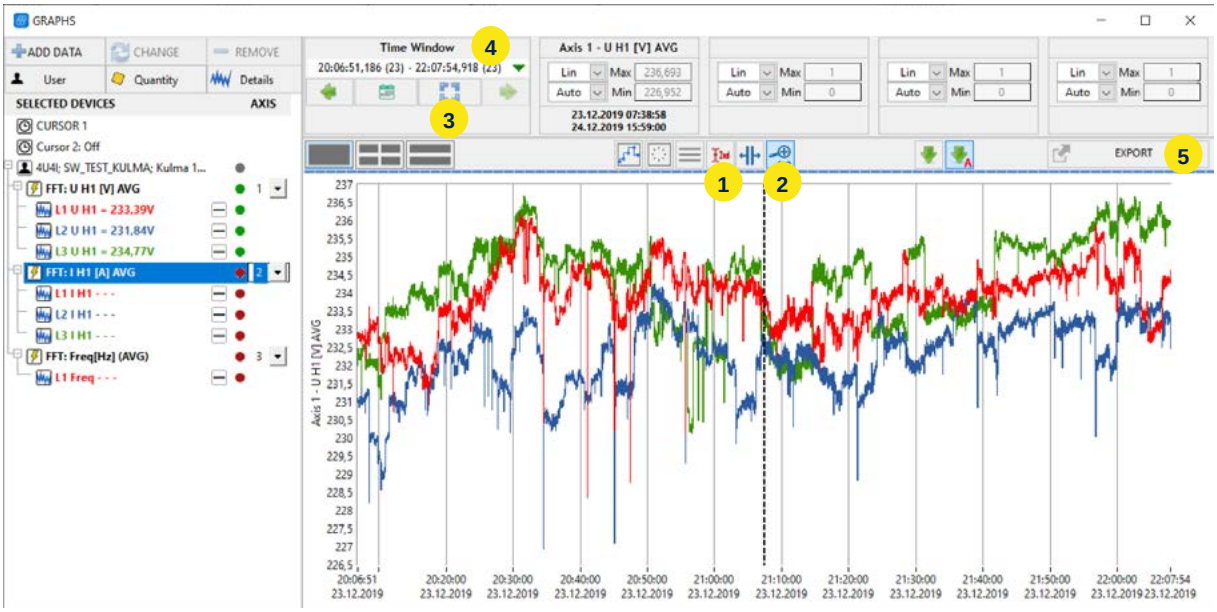
Key Feature: You can also add data of multiple data files respectively data files recorded by other instruments. In that way, you can analyse data of multiple different measurement points, which are synchronized by GPS clock, together. This allows powerful and highly synchronized data analysis.

Key Feature II: In the same Graph you can show 10-period, ½ period and Waveform data

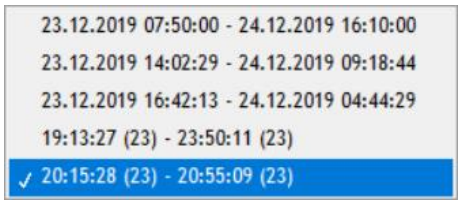
Zoom In / Out and Cursors

- A second cursor can be activate by pressing (1)
- To Zoom In activate Zoom function by pressing (2)

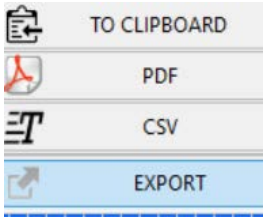
  Now Zoom function is activated. Keep the left mouse button pressed and move over the selected area you want to zoom. The data automatically will be reloaded for the selected time frame.
- To Zoom Out press (3)



- The last Zoom steps are stored at (4). So you easily can switch between different time frames.



- Data can be exported to Clipboard, PDF or CSV file by pressing (5)

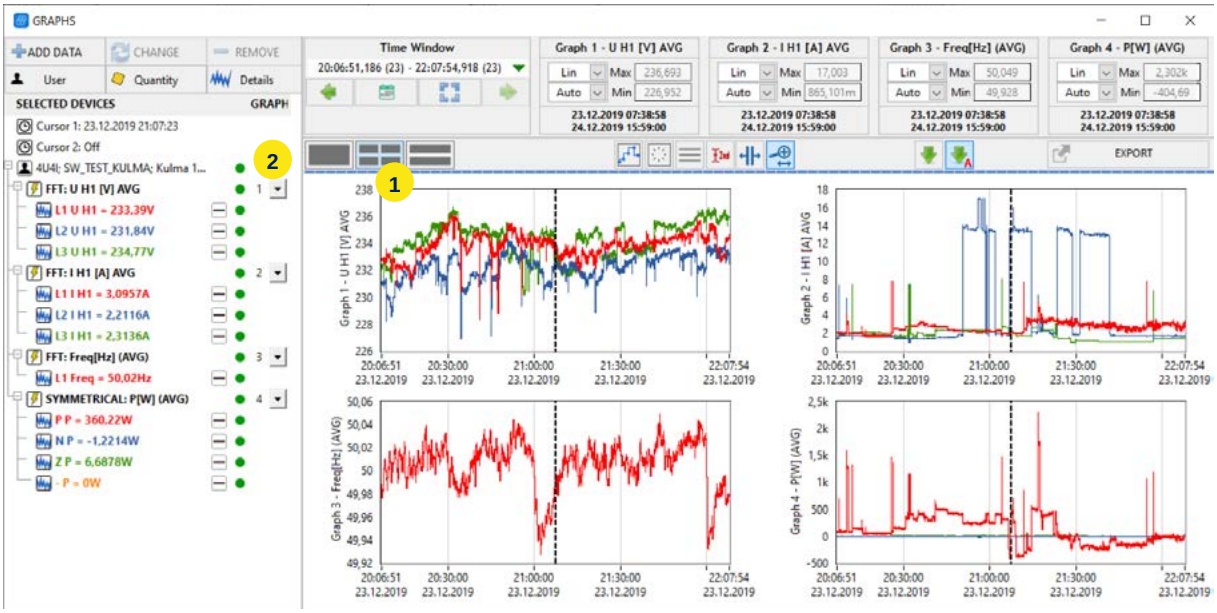


Multiple Charts

To show data in multiple charts, first select the type of multi chart visualization (1). Up to four independent charts can be defined. There are three different options available

- Single chart
- Multiple charts among each other
- Multiple charts – 2 Charts in one row (see picture)

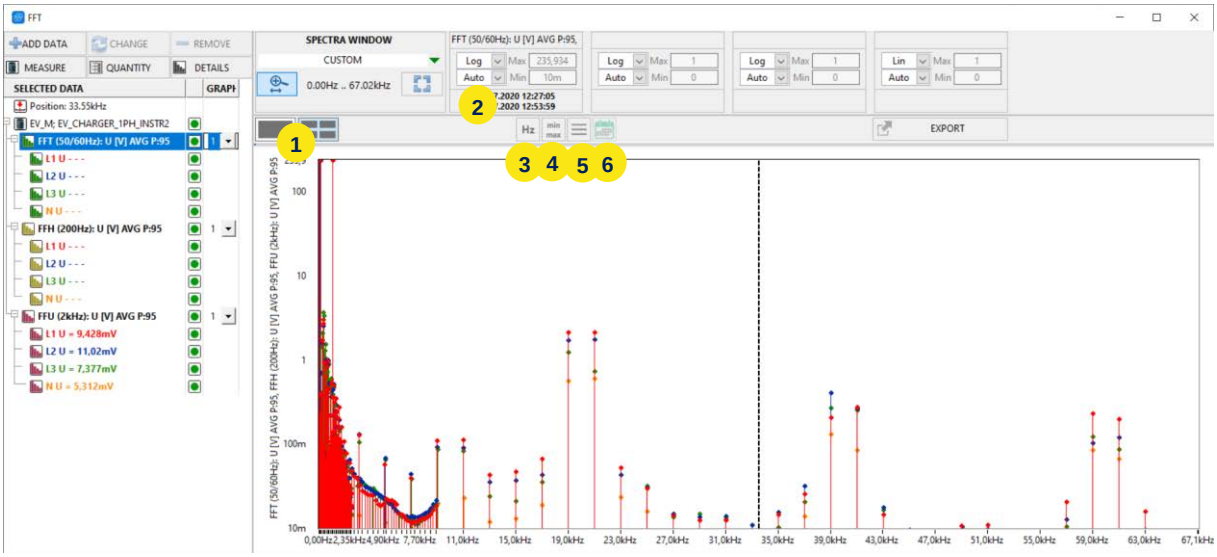
After selecting the chart type, you can assign the quantities to the individual charts via dropdown selection (2).



4.6.3 FFT Data

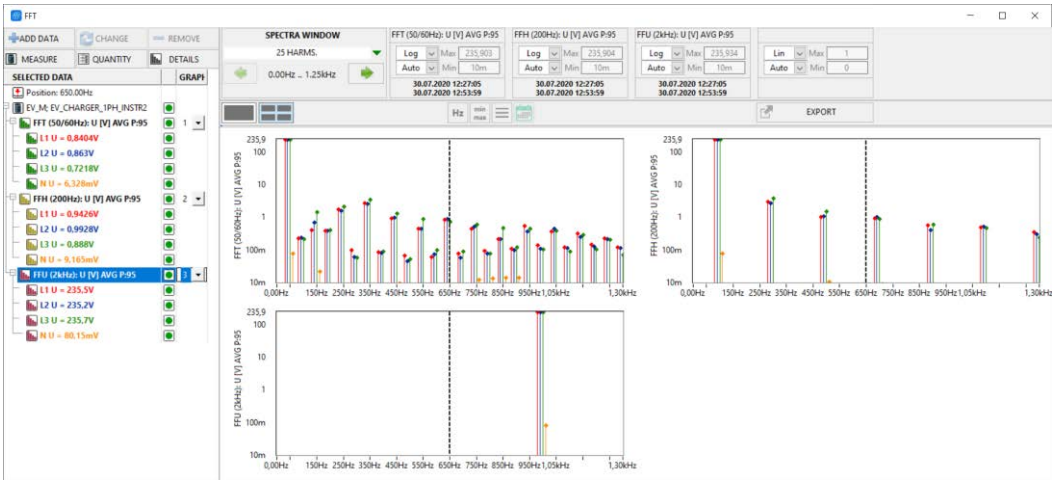
After selecting “FFT” you can add the channels in the same way as described for Graphs.

1) You can show the FFT data in multiple charts or all together in one
2) Axis scaling (linear, logarithmic, Auto, manual)
3) X-Axis in Harmonic orders or in Hertz (Hz)
4) Showing Min / Max Values
5) Horizontal lines
6) Time-Frame for additional FFT calculation



The picture above shows visualization of Harmonics (50 orders), Higher Frequencies (200Hz bands) and Supraharmonics (2kHz) of an EV charging station in one screen.

The following picture shows Harmonics, Higher Frequencies and Supraharmonics in individual tabs.

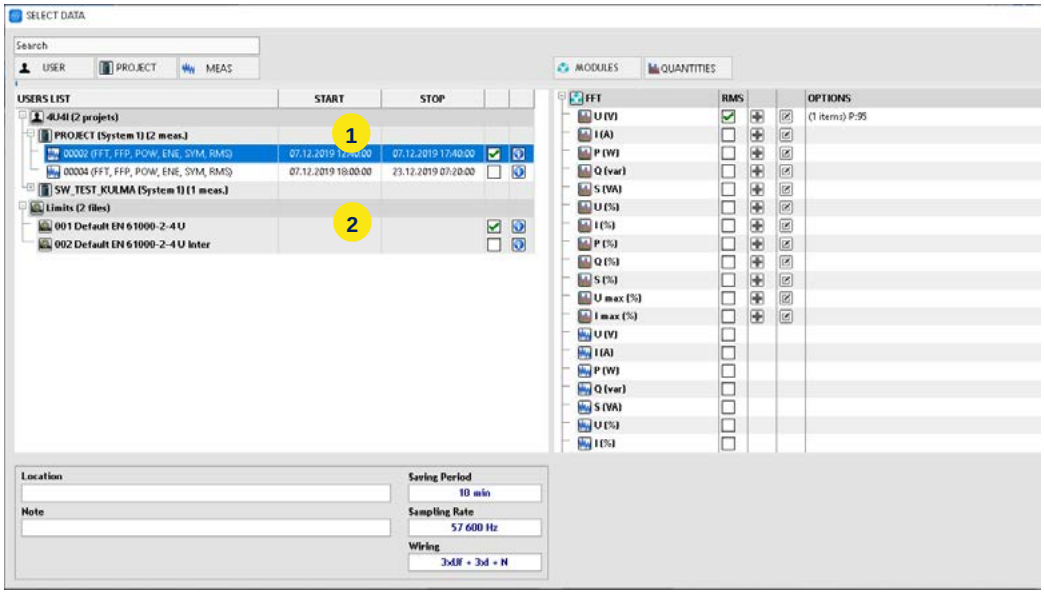


FFT Reference Curve

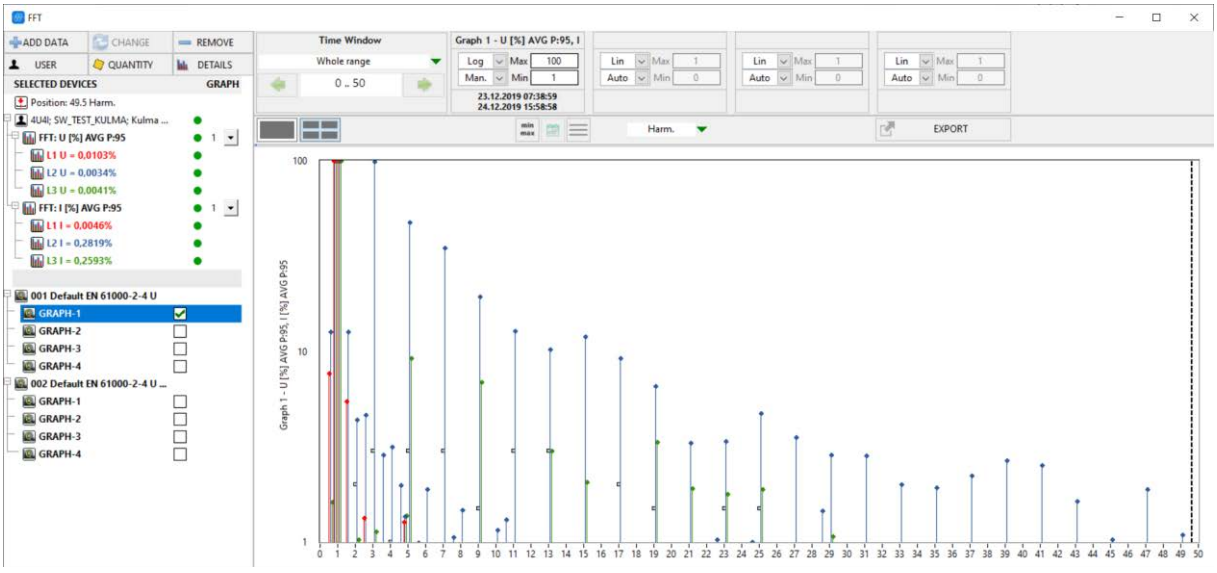
Application: Evaluation according to IEC61000-2-2, -3-3, IEEE519, etc.

For Harmonic FFT analysis it's possible to add a reference curve to the visualization screen.

When selecting the quantities (1), you can add the desired reference curve at "Limits" (2).



The limits are shown as circles in the visualization:



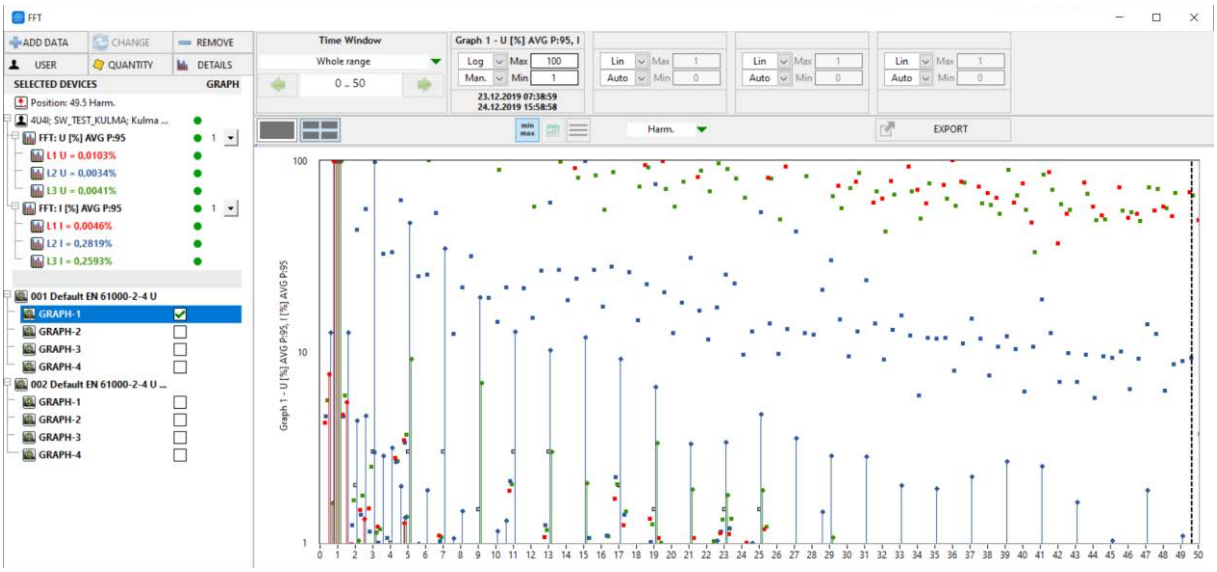
For different graphs, different limits can be selected.

The parameters can be shown in different quantiles (95%, 99%, 100% … definable) at the same time.

Key Feature: IEEE519 requires different quantile calculations

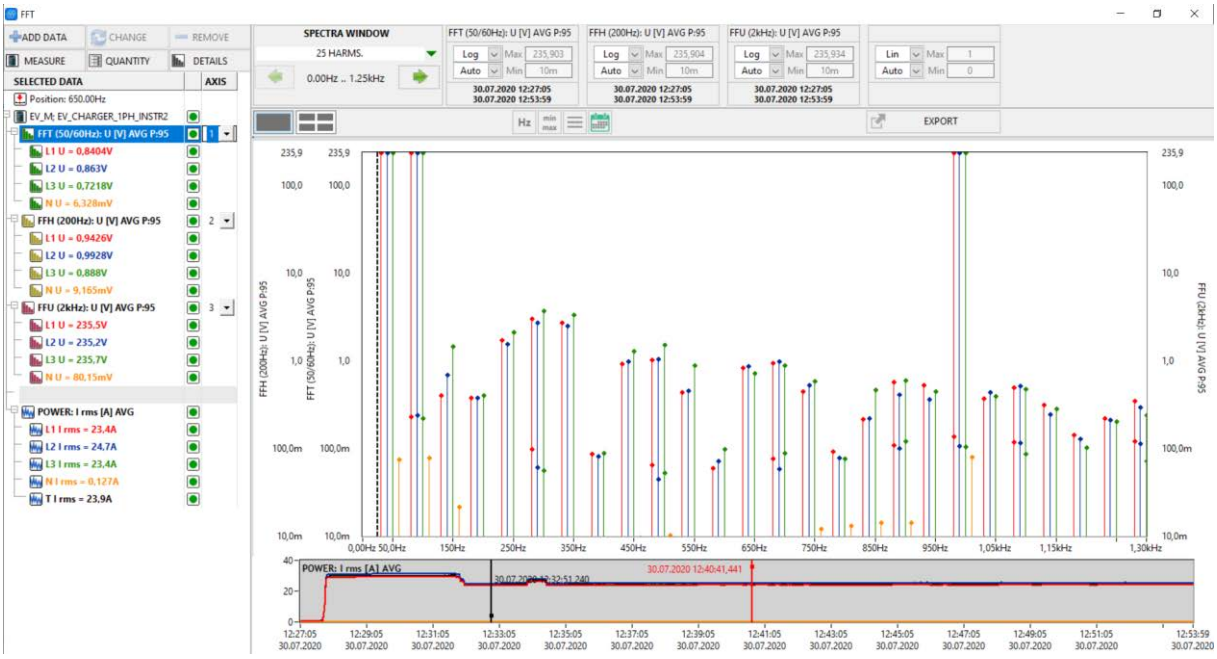
MIN / MAX values

For each harmonic the Min and Max Values can be shown in addtion. They will appear as colored rectangles:



Recorder + FFT

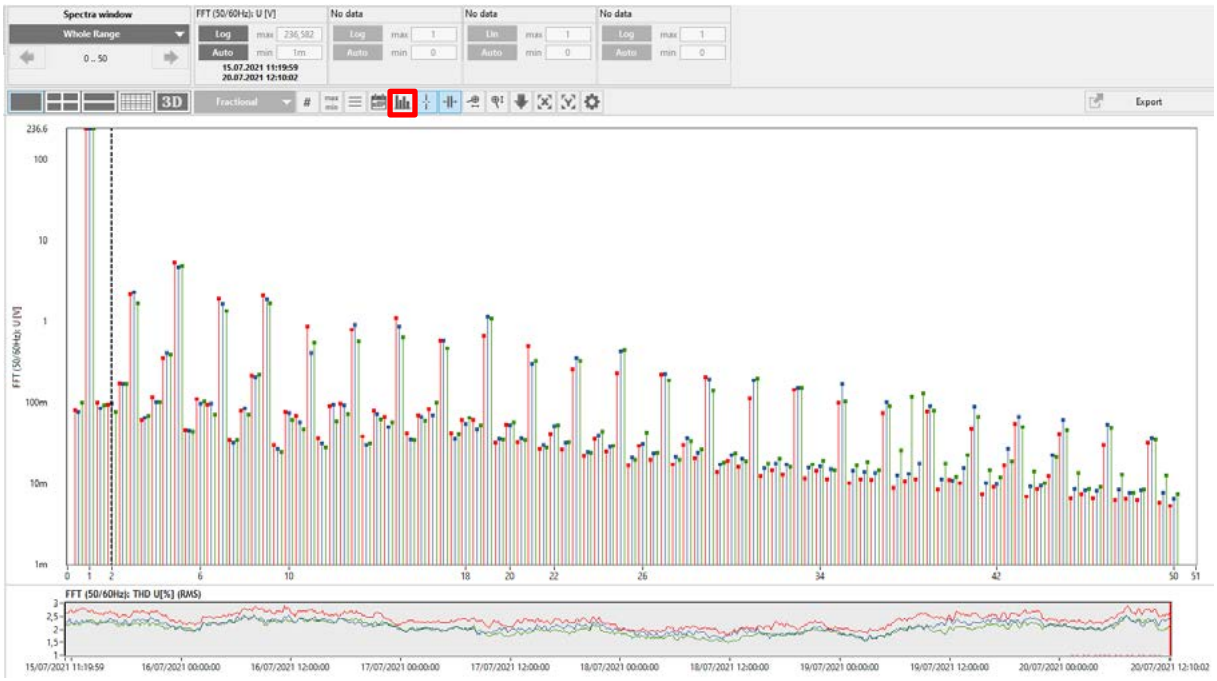
By pressing “Add data” and selection of time-series data you can add a recorder window to the FFT data.



Key Feature: Show FFT at load and no-load conditions

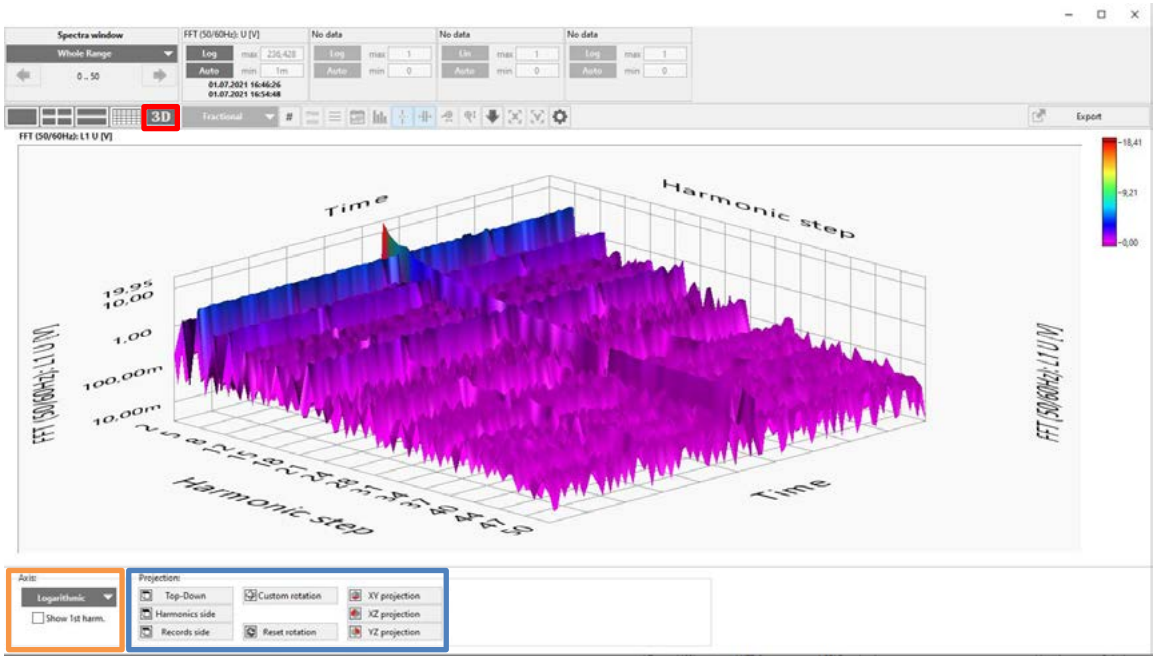
Live FFT

By choosing beside the FFT Data also a trend graph (like THD_U) the live FFT feature can be accessed. Once both are loaded the user can click on the live spectra button (marked red) and a cursor appears in the lower display. This cursor can be moved left and right to display the FFT at a certain time point.



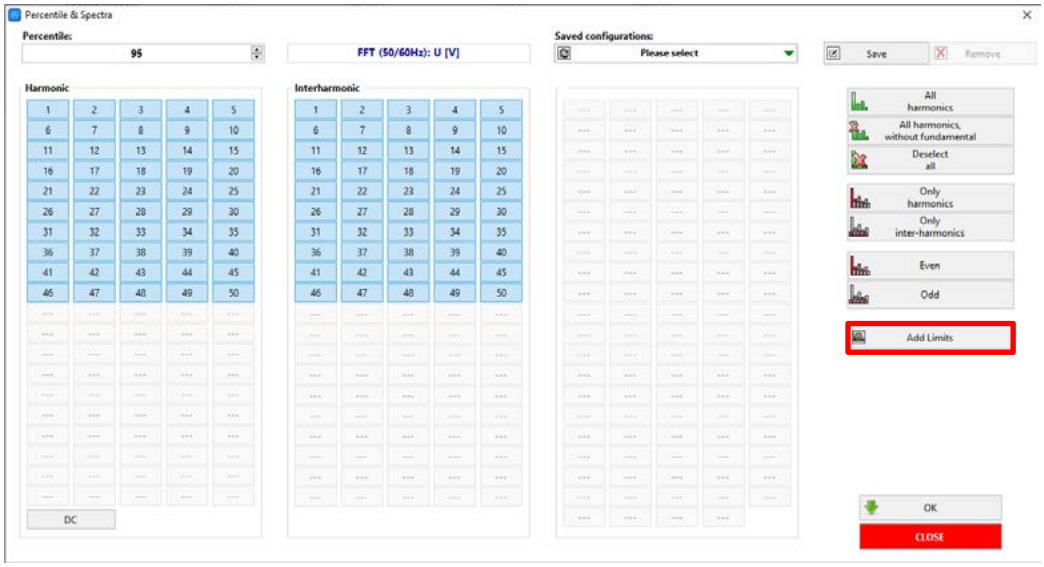
3D (Waterfall) FFT

By clicking on the red marked 3D button, the waterfall FFT can be displayed. In the blue marked area the projection of the FFT can be changed and in the blue marked area the Axis scaling can be changed from logarithmic to linear and the first harmonic (fundamental) can be removed. By clicking into the FFT window the waterfall graph can be rotated.



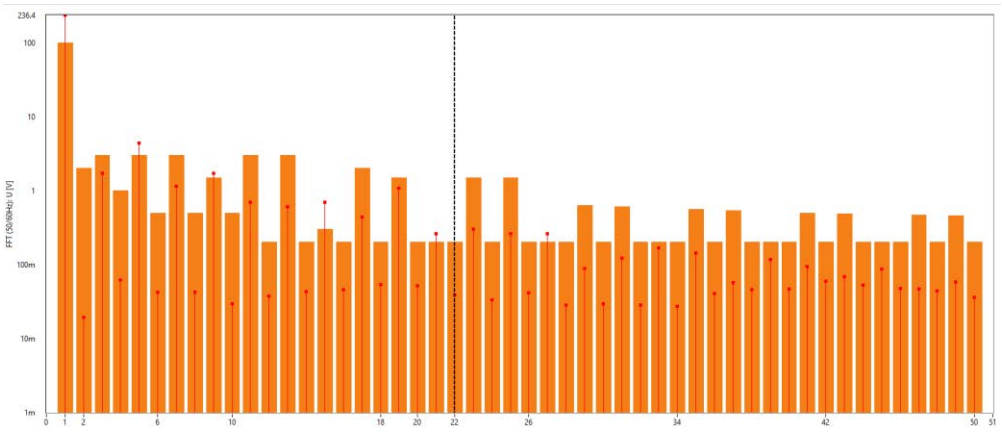
FFT Limits

When displaying FFT data limits can be added. Click on “Add Limits” (marked in red).



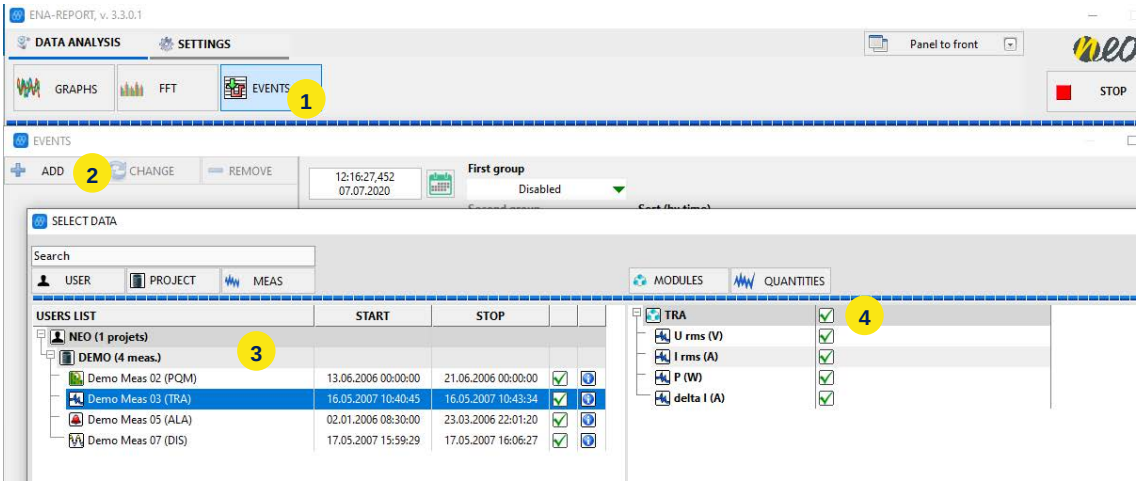
This opens the Manage PQ limits window. In the first column the names of the limit files are displayed. With the lock symbol in the next column a limit can be associated with the FFT data. The blue info icon opens a window in which the limit values are displayed. By clicking on Bars in the next column the display type can be changed to Points or Envelope. Points style changes the icon displaying the limit points and in the last column the color in which the limits are displayed can be changed.

By clicking on ok, the chosen limits are confirmed and are loaded with the FFT data.



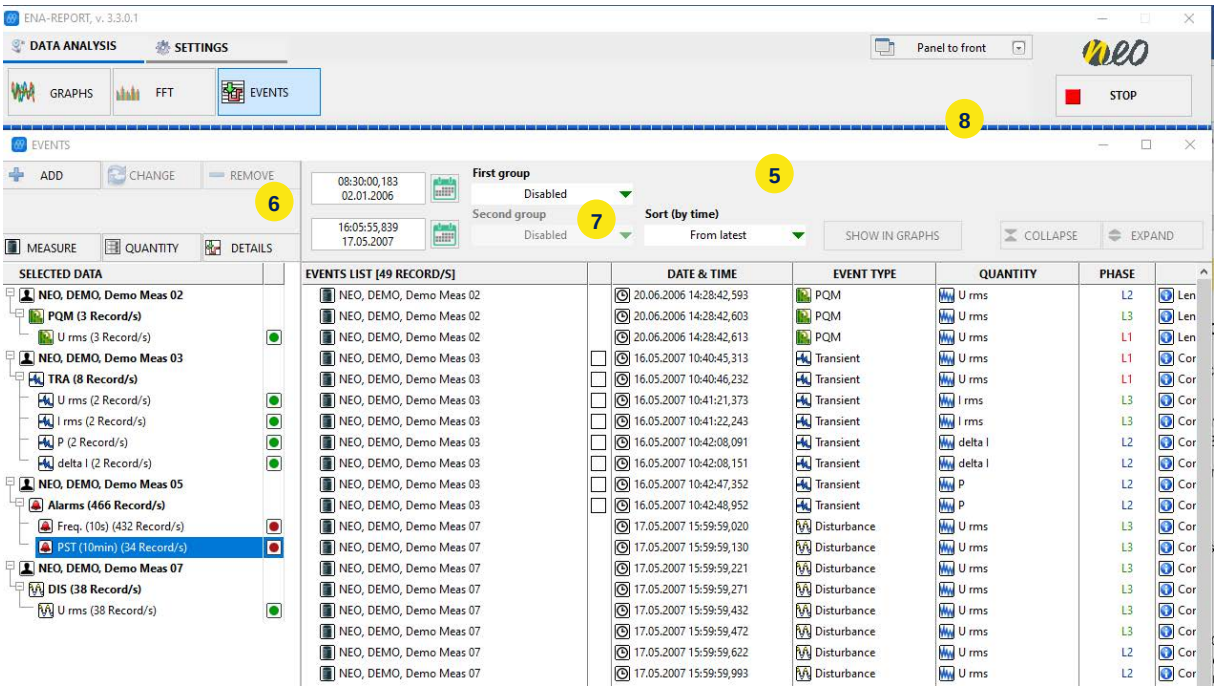
4.6.4 Events, Alarms, Transients, Disturbances

For the presentation of events, transients, alarms and deletions, the "Event Panel" is available. After clicking on Events (1), the selection of the range (2) can be selected (3). It can also be combined with all Events.

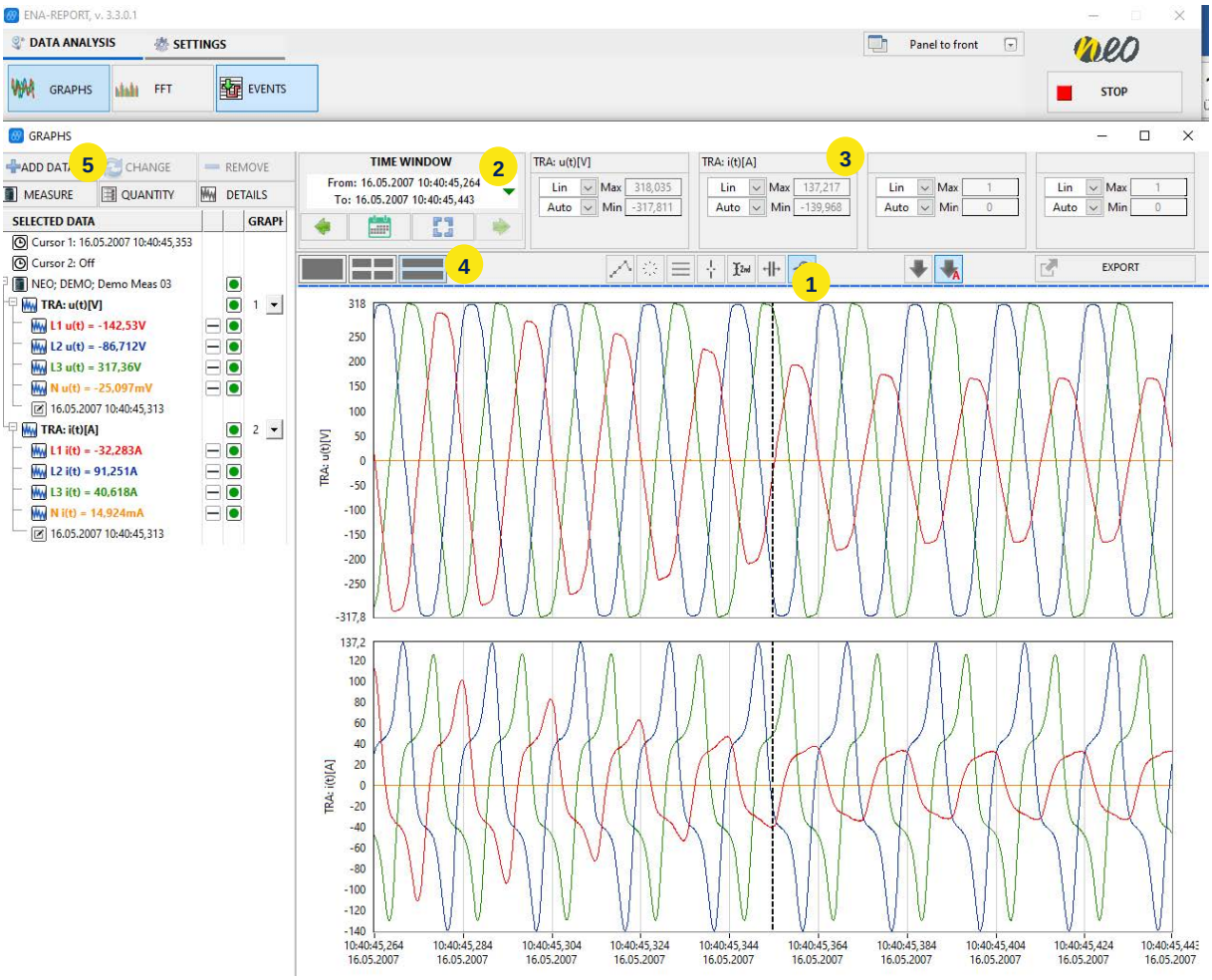


The list with all events is shown. The list can be ordered by date / time, event type, unit and phase (5). Links in the menu can also be selected / de-selected for the event type (6).

For transients, the waveform and for the disturbances of the ½ periodic values are shown(7). Also multiple Events can be shown. For a detailed view, click on "Details" (8).

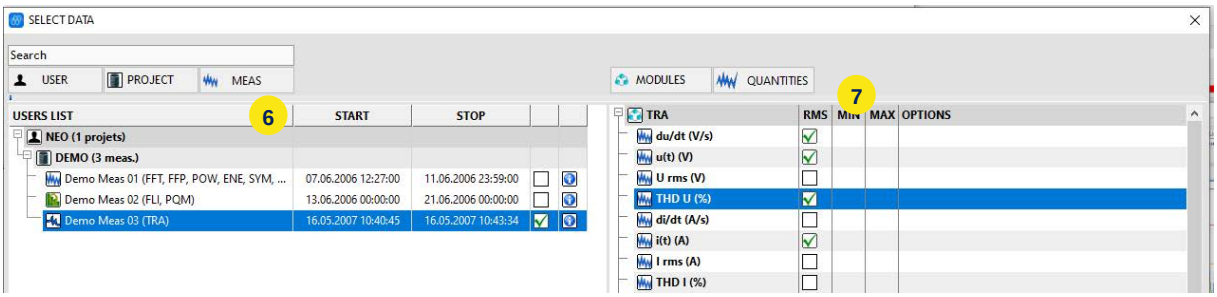


Various parameters (transients, disturbances, 10-period values) can be shown in one recorder chart.



- Zoom (1)
- Time selection (2)
- Axis (3)
- Multi-Chart (4)

In addition, other parameters can be taken into account like derivate of voltage or current or frequency, etc. This is possible via "Add" (5) and selection of parameters at "TRA" (6 + 7)

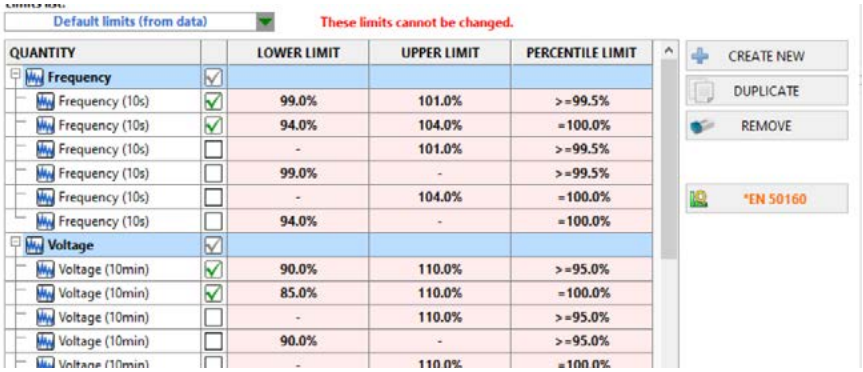


4.6.5 EN50160

This function allows the automatic evaluation according to EN50160 or other standards.

1) Select Limit and Percentile

   After selecting the datafile(s) for power quality evaluation the limit values and corresponding percentil can be selected or individually defined. Predefined templates are available for EN50160, IEC61000-2-2, IEC61000-2-4, IEEE519, FoL standards. Other templates can be added by oneself.

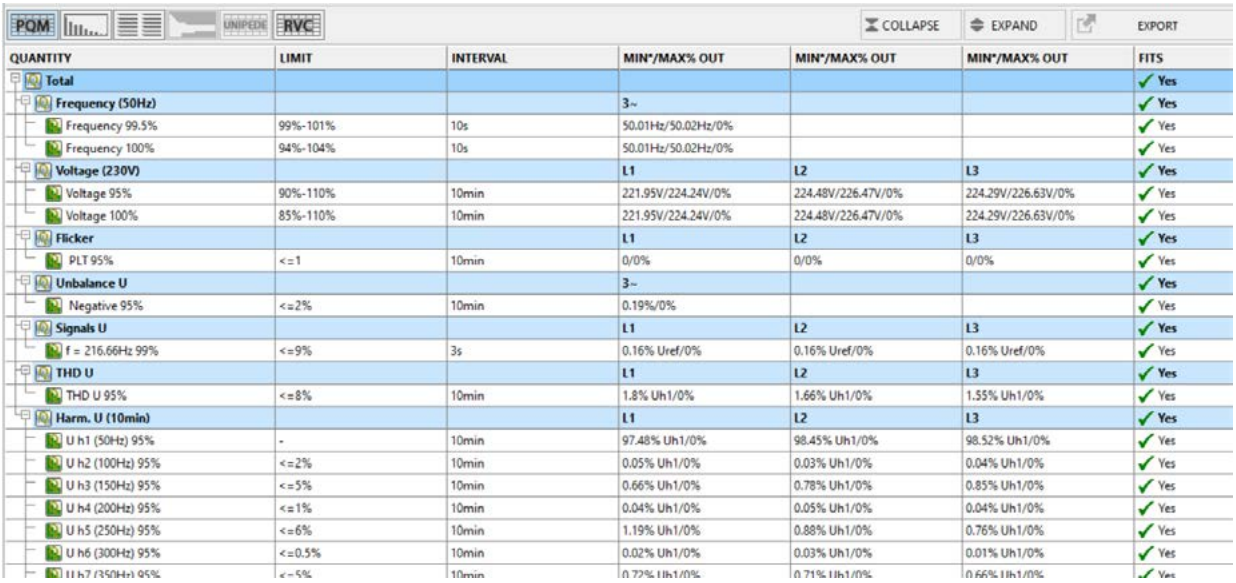


QUANTITY		LOWER LIMIT	UPPER LIMIT	PERCENTILE LIMIT
Frequency	☑			
Frequency (10s)	☑	99.0%	101.0%	>=99.5%
Frequency (10s)	☑	94.0%	104.0%	=100.0%
Frequency (10s)	☐	-	101.0%	>=99.5%
Frequency (10s)	☐	99.0%	-	>=99.5%
Frequency (10s)	☐	-	104.0%	=100.0%
Frequency (10s)	☐	94.0%	-	=100.0%
Voltage	☑			
Voltage (10min)	☑	90.0%	110.0%	>=95.0%
Voltage (10min)	☑	85.0%	110.0%	=100.0%
Voltage (10min)	☐	-	110.0%	>=95.0%
Voltage (10min)	☐	90.0%	-	>=95.0%

2) Select time-intervall *(Note: Multiple data files can be analysed together)*

3) Analysis and Report visualisations see:

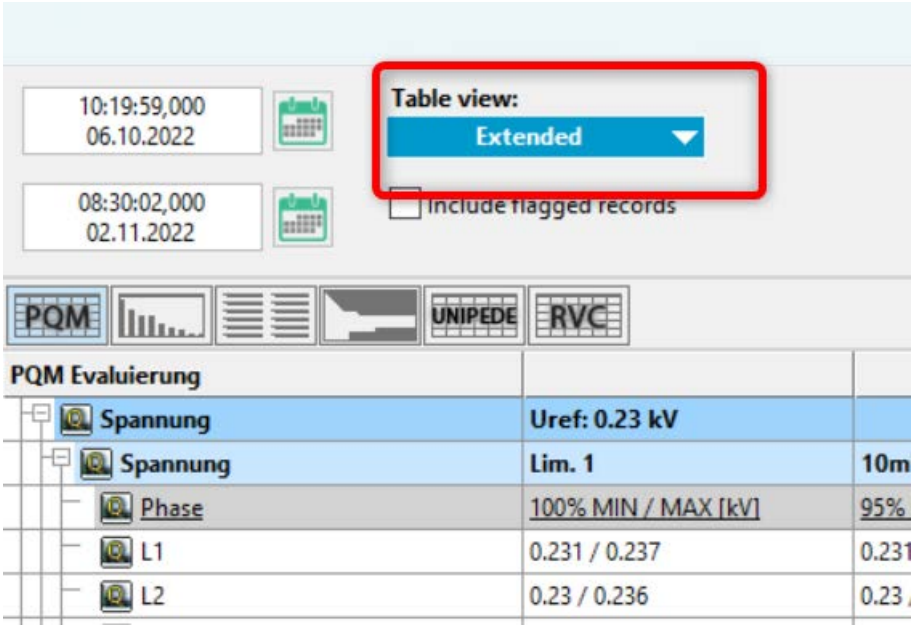
The table shows all parameters and the limits according to EN50160. The limits may also be applied to other limits (see IEC61000-2-4).



QUANTITY	LIMIT	INTERVAL	MIN*/MAX% OUT	MIN*/MAX% OUT	MIN*/MAX% OUT	FITS
Total						Yes
Frequency (50Hz)			3~			Yes
Frequency 99.5%	99%-101%	10s	50.01Hz/50.02Hz/0%			Yes
Frequency 100%	94%-104%	10s	50.01Hz/50.02Hz/0%			Yes
Voltage (230V)			L1	L2	L3	Yes
Voltage 95%	90%-110%	10min	221.95V/224.24V/0%	224.48V/226.47V/0%	224.29V/226.63V/0%	Yes
Voltage 100%	85%-110%	10min	221.95V/224.24V/0%	224.48V/226.47V/0%	224.29V/226.63V/0%	Yes
Flicker			L1	L2	L3	Yes
PLT 95%	<=1	10min	0/0%	0/0%	0/0%	Yes
Unbalance U			3~			Yes
Negative 95%	<=2%	10min	0.19%/0%			Yes
Signals U			L1	L2	L3	Yes
f = 216.66Hz 99%	<=9%	3s	0.16% Uref/0%	0.16% Uref/0%	0.16% Uref/0%	Yes
THD U			L1	L2	L3	Yes
THD U 95%	<=8%	10min	1.8% Uh1/0%	1.66% Uh1/0%	1.55% Uh1/0%	Yes
Harm. U (10min)			L1	L2	L3	Yes
U h1 (50Hz) 95%	-	10min	97.48% Uh1/0%	98.45% Uh1/0%	98.52% Uh1/0%	Yes
U h2 (100Hz) 95%	<=2%	10min	0.05% Uh1/0%	0.03% Uh1/0%	0.04% Uh1/0%	Yes
U h3 (150Hz) 95%	<=5%	10min	0.66% Uh1/0%	0.78% Uh1/0%	0.85% Uh1/0%	Yes
U h4 (200Hz) 95%	<=1%	10min	0.04% Uh1/0%	0.05% Uh1/0%	0.04% Uh1/0%	Yes
U h5 (250Hz) 95%	<=6%	10min	1.19% Uh1/0%	0.88% Uh1/0%	0.76% Uh1/0%	Yes
U h6 (300Hz) 95%	<=0.5%	10min	0.02% Uh1/0%	0.03% Uh1/0%	0.01% Uh1/0%	Yes

1) Limit: Defined limit
2) Interval: Defined time-interval for evaluation
3) MIN*/MAX/%Out: MIN*…Minimal measured value
   MAX…Maximal measured value
   %Out…Number of samples out of limit

Extended view
It is possible to change the PQM table in the extended view mode. Therefore click on „table view“ → „extended“.

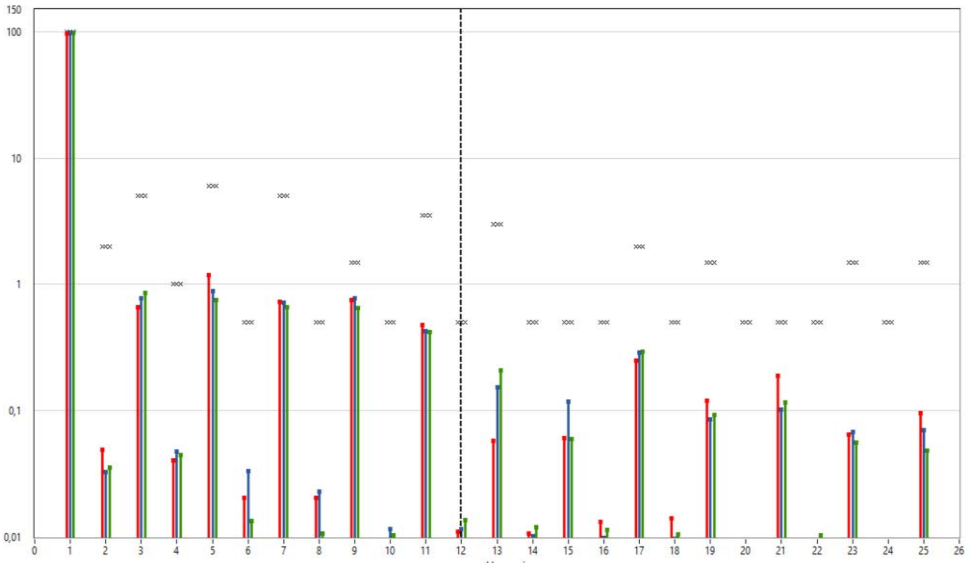


This will allow you a more detailed analysis of the measurement data.

Event list
The following table shows the Event statistics and classifications.
Depending on length and extrema of voltage events, the different events will be counted.

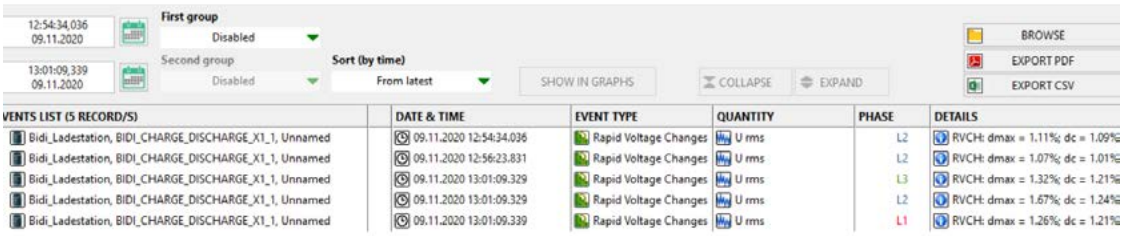
UNIPEDE	<0 - 100ms)	<100ms - 500ms)	<500ms - 1.0s)	<1.0s - 3.0s)	<3.0s - 20.0s)	<20.0s - 1min)	<1min - 3min)	>=3min	TOTAL
L2	0	0	0	0	0	0	0	0	0
L3	0	0	0	0	0	0	0	0	0
<5.0% - 40.0%)	0	0	0	0	0	0	0	0	0
L1	0	0	0	0	0	0	0	0	0
L2	0	0	0	0	0	0	0	0	0
L3	0	0	0	0	0	0	0	0	0
<0 - 5.0%)	0	0	4	0	0	4	0	8	16
L1	0	0	1	0	0	1	0	2	4
L2	0	0	1	0	0	1	0	2	4
L3	0	0	1	0	0	1	0	2	4
Interuption: <0 - 5	16	4	1	0	0	4	0	8	33
L1	2	0	1	0	0	1	0	2	6
L2	4	1	0	0	0	1	0	2	8
L3	5	2	0	0	0	1	0	2	10
Total with: <0 - 5.(	14	1	4	0	0	4	4	8	35
L1	2	0	1	0	0	1	1	2	7
L2	3	0	1	0	0	1	1	2	8
L3	4	0	1	0	0	1	1	2	9
Total without: <0 -	14	1	0	0	0	0	4	0	19
L1	2	0	0	0	0	0	1	0	3
L2	3	0	0	0	0	0	1	0	4
L3	4	0	0	0	0	0	1	0	5

Voltage Harmonics
The following FFT chart shows 95% quantil, max and limit value of the voltage harmonics.



Event list

All events are listed with phase information date and time.



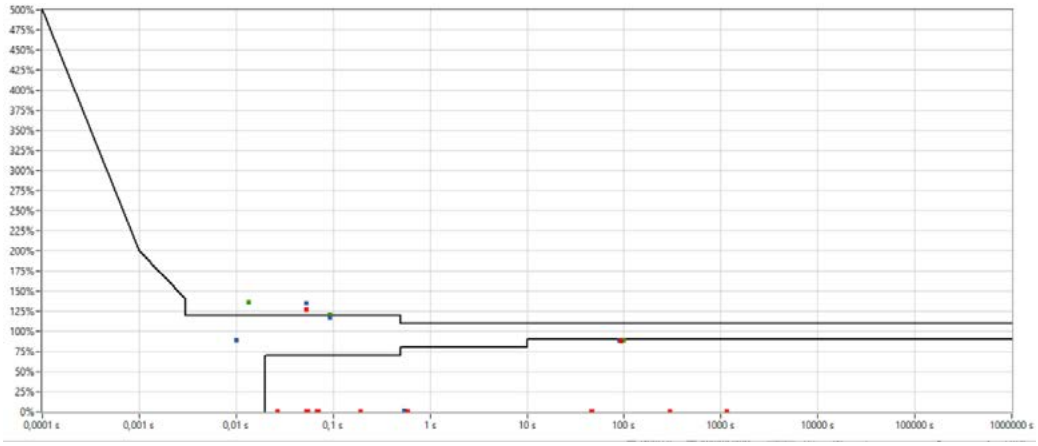
Rapid Voltage changes (RVCs)

Rapid voltage changes are by depth and changes per hour.

dmax [% Un]	CHANGES PER HOUR [r/h]	HOURS	PERCENTILE
L1		0/6	100.0
L2		0/6	100.0
L3		0/6	100.0
1,5 < dmax <= 2,5	r <= 10	Above / OK	OK
L1		0/6	100.0
L2		0/6	100.0
L3		0/6	100.0
1,0 < dmax <= 1,5	r <= 100	Above / OK	OK
L1		0/6	100.0
L2		0/6	100.0
L3		0/6	100.0
dmax <= 1,0	r <= 1000	Above / OK	OK
L1		0/6	100.0
L2		0/6	100.0
L3		0/6	100.0
Rapid Voltage Changes: Table 2			
dmax < 3,0	r <= 1		
dmax < 2,5	1 < r < 10	L1: 4/2	L1: 33.3
dmax < 1,5	10 < r < 100	L2: 4/2	L2: 33.3
dmax < 1,0	100 < r < 1000	L3: 4/2	L3: 33.3

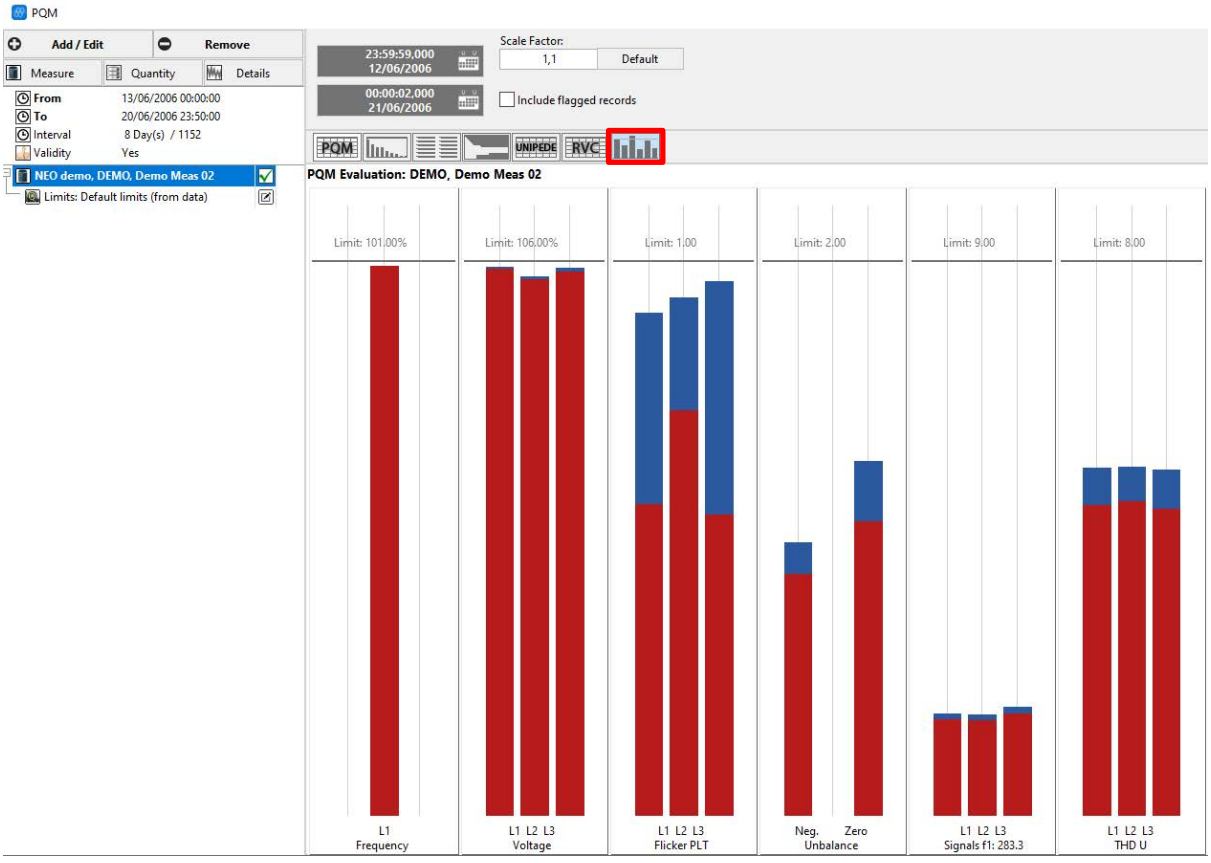
ITIC curve

The ITIC curve is an additional visualization to show and classify events. The events will be shown in different colors as points, depending on phase. Points outside the ITIC area, can affect electronic equipment.



PQM Overview

By clicking on the red marked button the PQM overview can be opened. The PQ parameter are shown in relation to their limits. If one of them is above 110% of the limit it will be cut off. To show the full extent the area above the limit can be adjusted via the Scale Factor. The minimum is at 1.1 in which case the y-Axis displays 110% of the limit.

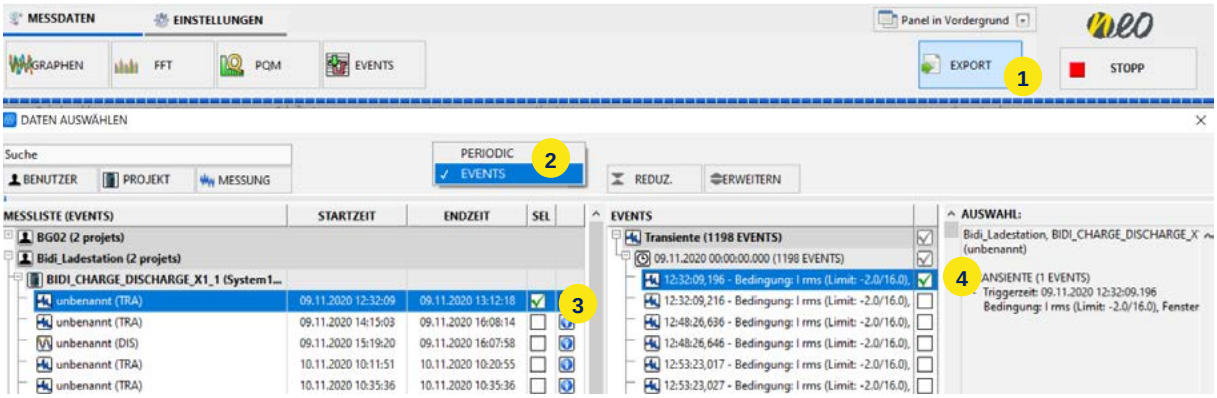


4.6.6 Data Export options

There are several options to export data.

Option 1: Export in Main tab

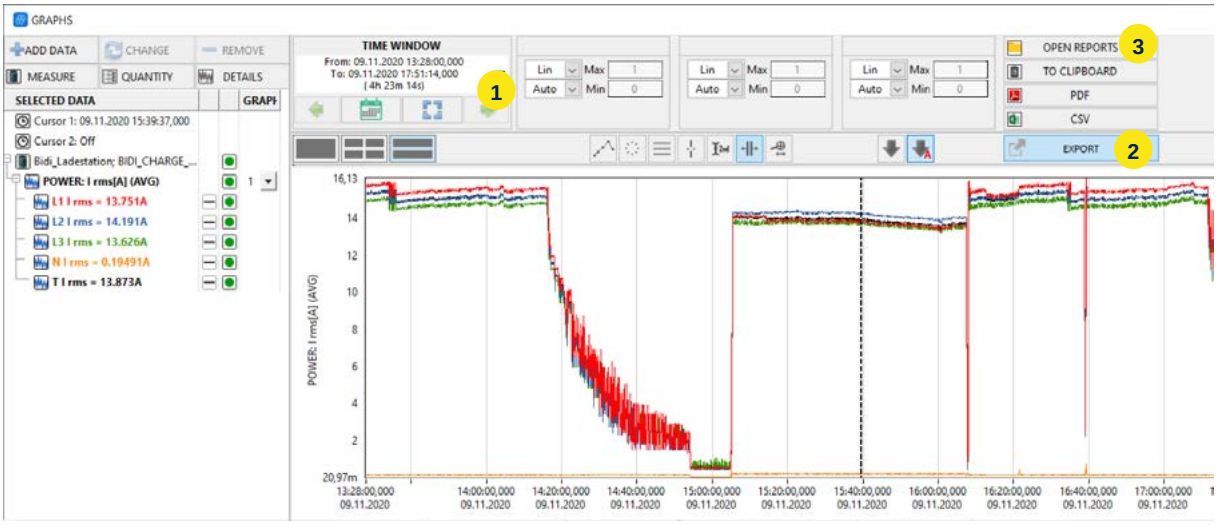
This option allows to export data of one or multiple datafiles together with full storage rate for time series data respective full sampling rate for Transients.



1) Start “Export function”
2) Select between Periodic (Time-Series) or Events (Raw Data for Transients)
3) Select data file
4) Select transient respective parameters to export and time-range

Option 2: Export in visualization (chart, FFT, Event, …)

Note: this option will only export averaged data for the shown time-frame. It will not export data in storage or sampling rate.



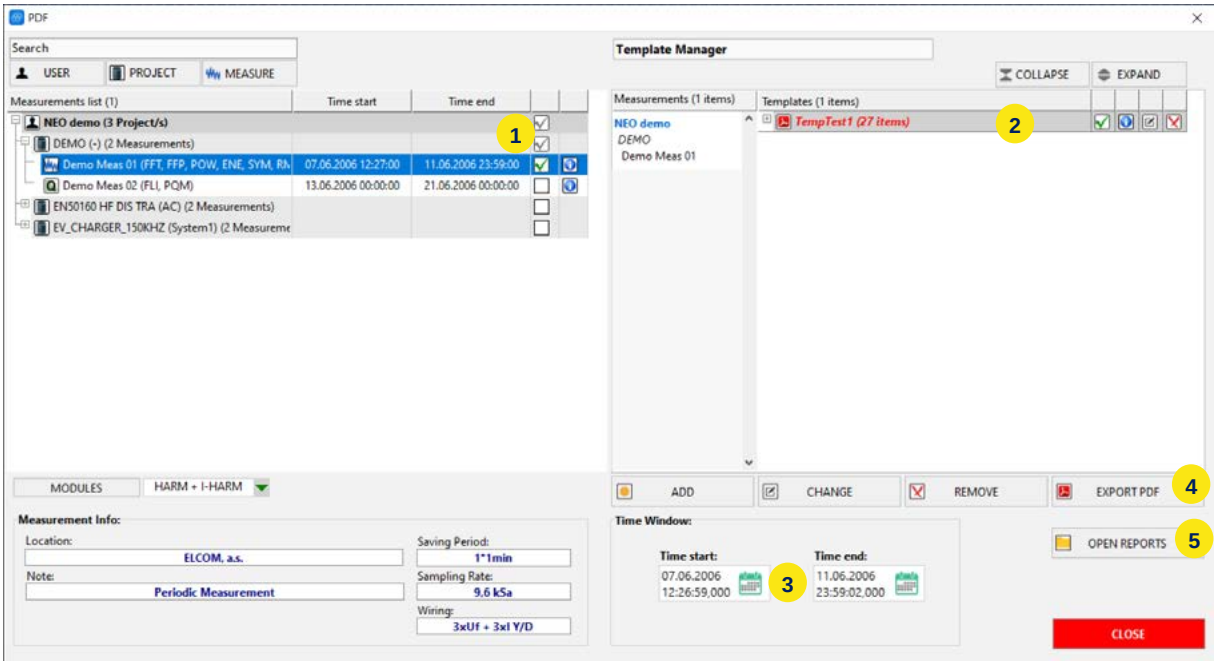
1) Select time-frame or use Zoom-function to define time-frame for export
2) Press “Export” and select one of the export options
   CSV / PDF / CLIPBOARD
3) Click on “Open Reports” to open the directory where the exported data are stored

4.6.7 Automatic Report Generator

This function allows creating automatic reports with customizable templates. Any kind of stored parameter can be displayed in various visualisations like XY-Chart, FFT-Chart, Transient View etc.

4.6.7.1 How to generate a report

After opening report function via click on “PDF” the report generator screen will appear.



1) Select one or more data files
2) Select one templates
3) Define time-frame
4) Press “Export PDF”

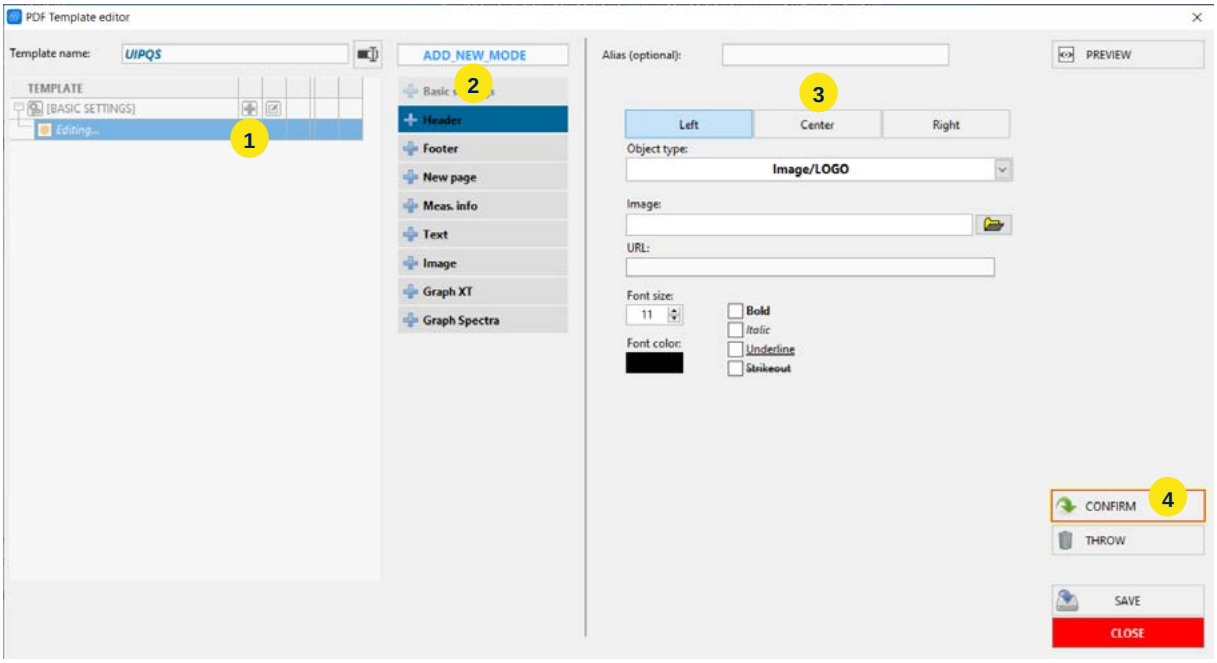
   Afterwards the report will be generated. A popup window will ask for having the report in ***one merged file*** or ***individual files*** for the different data files and data types.
5) The reports are stored in the folder defined at settings and can be opened by pressing (5).

4.6.7.2 How to create a new template

After opening the report generator panel (PDF), you can add, change or remove templates:

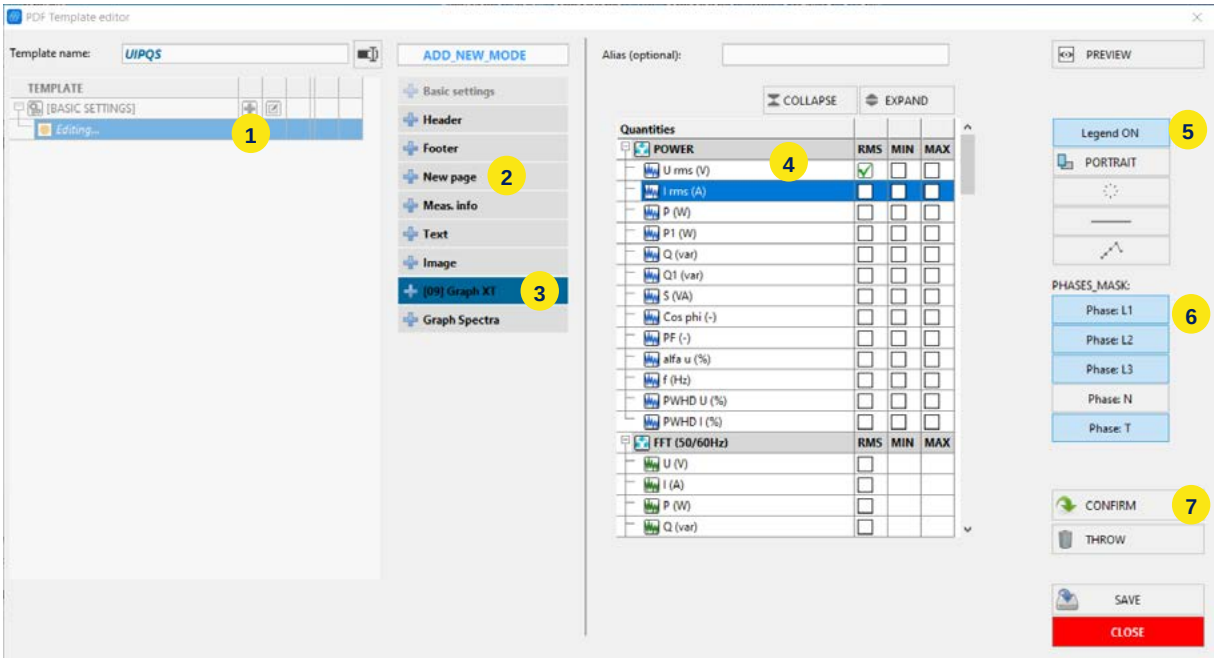
After adding a new template via “Add” you can define a name for the template in the popup window:

The idea of creating templates follows a modular block system.



1) First add a new “block” by pressing “+”
2) Select one of the visualization, design and text options
3) Select the quantities or configure the visualization
4) Confirm the setup for the “block”
5) Start again with (1)

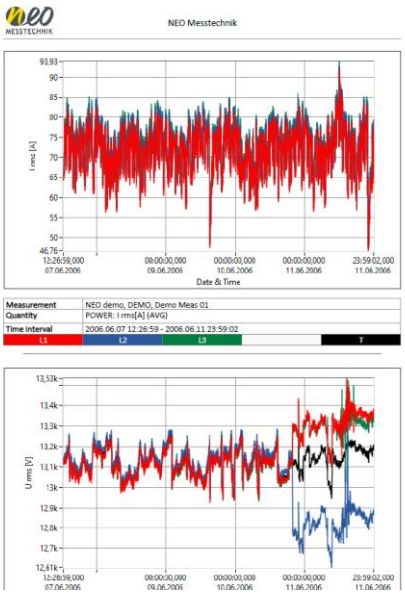
Example: Adding a XY-Chart for voltage and current on one page



1) Add new block
2) Select block for new page and press confirm (7)
3) Add new block (1) and select Graph XT
4) Select Voltage Urms
5) Select page style, legend off/on and line style
6) Phase selection
7) Confirm
8) Save

➔ Repeat the whole procedure and select in the next step Current I rms.

After selecting a datafile and the new template you can generate your report

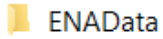


4.6.8 Data Analysis on PC / Copy data of instrument

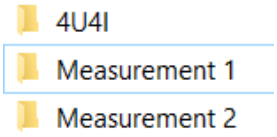
All data can be analyzed on your personal computer. There are two options to copy the data:

Option 1: Copy data folder to your PC
For this option only the report tool needs to be installed on your PC.

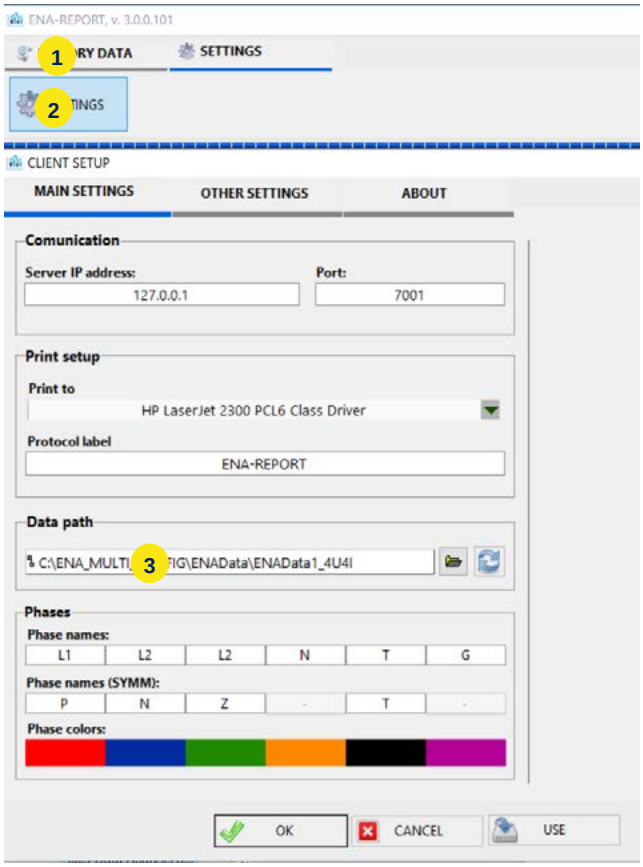
1) Copy whether the data folder, where all measurements are stored, of your instrument,



or the folder of the measurement to your PC



2) The easiest way is to copy the folder to the exact same path of the installation folder. If you use another directory, you need to adjust the data path (3) in the settings of report tool, see screenshot:



Option 2: Remote data transfer via Measure mode
For this option the full software (Measure and Report tool) needs to be installed on your PC and the measurement instruments needs to be in the same network (LAN). This option is especially helpful, if you have multiple instruments connected in the same network. You easily can transfer data to your personal computer of multiple devices and can check live values, storage space and other parameters. How to setup this option is described in the software manual.

5 Further Manuals and Links

There are a couple of additional manuals and information available for our products.
All information can be found on our webpage in the download section.

www.camillebauer.com

- **Technical Reference Manual**
  Describes the basics of power and power quality calculations with all formulas and calculations.
- **Accessories Manual**
  Shows technical data of all sensors. For all current sensors detailed technical information are found as well as accuracy specifications for different applications and use-cases.
- **Measurement Software Manual**
  Detailed information for the measurement software with all functionalities described.
- **Classical Report Tool Manual**
  Detailed information for the classical report tool, detailed description to all analysis and data visualization functionalities.
- **Quick Start Manual**
  This quick start manual is available online and as PDF.

6 Technical Data and Specifications

6.1 PQA8000H

ANALOG				HV	LV	
Channel	Voltage			4	-	
	Current			-	6 (LEMO)	5(LEMO)
	Analog Input			-	2(DSUB15)	3 (DSUB15)
Input Range	Voltage			±1600Vp ±800Vp	-	
	Current	Clamp		-	±10Vp MAX	
		Rogowski		-		
	Analog Input			-	±10Vp MAX	
DC Accuracy				±0.05%FS	±0.05%FS	
Gain	Voltage			1	-	
	Current	Clamp		-	1,2,5,10 x 1,2,5,10 / 1,5	
		Rogowski		-		
		Integrator@50Hz		-	1,10	
		Direct Current		-	-	
	Analog Input			-	1,2,5,10	
Gain Linearity				-	20ppm (MAX)	
Gain Drift Range				-	20ppm/K (MAX)	
Offset Drift				6mV/K (MAX)	26uV/K (MAX)	
Input Resistance				10Mohm	10Mohm	
ADC	Type			SAR		
	Data rate			1Msps(MAX)		
Filter Bandwidth	-3dB BW	Analog		510kHz 4th Order Butterworth		
		Digital (FIR)		241kHz@1Msps 160kHz@600ksps 121kHz@500ksps 70kHz@144ksps 68kHz@140ksps 11.5kHz@24ksps 9.6kHz@20ksps,140ksps 3.1kHz@12ksps,6ksps 2.6kHz@10ksps,5ksps	
	-0.1dB BW	Analog		160kHz 4th Order Butterworth		
		Digital (FIR)		220kHz@1Msps 153kHz@500ksps 110kHz@600ksp 68kHz@144ksps 66kHz@140ksps 11kHz@24ksps 9.2kHz@20ksps,140ksps 3kHz@12ksps,6ksps	

				2.5kHz@10ksps,5ksps	
Measuring BandWidth	-3dB			510 kHz	
	-0.1dB			160kHz	
Typical SNR				90dB	
Typical CMRR				85dB	
Current Sensor Power				-	±15V(1.3A),12V(1A),3.3V(1A)
Sensor TEDS	Current			-	1 TEDS for All CH
	Analog Input			-	1 TEDS for All CH
Isolation Type				CH-CH	Sensor Isolation
Isolation Voltage				6kVp	Sensor Isolation

6.2 PQA8000

ANALOG				HV	LV	
Channel	Voltage			4	-	
	Current			-	6 (LEMO)	5(LEMO)
	Analog Input			-	2(DSUB15)	3 (DSUB15)
Input Range	Voltage			Nom. ±500Vrms (±1,600Vp MAX)	-	
	Current	Clamp		-	±10Vp MAX	
		Rogowski		-	±2Vp MAX	
	Analog Input			-	±10Vp MAX	
DC Accuracy				±0.05%FS	±0.05%FS	
Gain	Voltage			1	-	
	Current	Clamp		-	1,2,5,10	
		Rogowski		-	1,10,100,1000	
		Integrator@50Hz		-	1,10	
		Direct Current		-	-	
	Analog Input			-	1,2,5,10	
Gain Linearity				-	10ppm (MAX)	
Gain Drift Range				-	10ppm/K (MAX)	
Offset Drift				6mV/K (MAX)	9uV/K (MAX)	
Input Resistance				10Mohm	10Mohm	
ADC	Type			Delta-Sigma		
	Oversampling Frequency			9MHz(Typ.)		
	Data rate			144ksps(MAX)		
Filter Bandwidth	-3dB BW	Analog		630kHz 4th Order Butterworth		
		Digital (FIR)	No FIR filter	68kHz@140ksps		
			One FIR 700 order	9.6kHz@20ksps,140ksps		
			Two FIR 700 order	3.1kHz@12ksps,6ksps		
			Two FIR 700 order	2.6kHz@10ksps,5ksps		
		Analog		320kHz 4th Order Butterworth		

	-0.1dB BW	Digital (FIR)	No FIR filter	66kHz@140ksps
			One FIR 700 order	9.2kHz@20ksps,140ksps
			Two FIR 700 order	3kHz@12ksps,6ksps
			Two FIR 700 order	2.5kHz@10ksps,5ksps
Measuring BandWidth	-3dB			68kHz
	-0.1dB			66kHz
Typical SNR				95dB
Typical CMRR				90dB
Current Sensor Power				- ±15V(1.3A),9V(1A),3.3V(1A)
Sensor TEDS	Current			- 1 TEDS / CH
	Analog Input			- 1 TEDS for All CH
Isolation Type				CH-CH Sensor Isolation
Isolation Voltage				6kVp Sensor Isolation

6.3 Digital Inputs

Digital Input	Channel	2	
	Isolation Type	CH-GND 3kVp Isolation	
	Schematic	Buffer Input, 1MΩ Input Impedance	
	Positive Trigger Voltage	Adjustable 0~50V (CH1~2)	
	Negative Trigger Voltage	Adjustable 0~50V (CH1~2)	
	Trigger Resolution	12mV	
	EXT Power for DI	12V, Not Isolated	
Digital Output	Channel	2	
	Isolation Type	CH-CH	
	Schematic	Photo MOS Dry contact, 25Ω Output Impedance	
	Load Voltage	350V MAX	
	Load Current	0.3A MAX	
	Load Power	300mW MAX	
CAN	CH	1	
	Isolation Type	CH-GND	
	Termination Resistor	None, 100Ω Selectable	
RS485	CH	1	
	Isolation Type	CH-GND	
	Termination Resistor	120Ω	
	Schematic	5V, 1.2k Pullup Pulldown Resistor	
GPS		Possible	
Measurement Category @<Pollution Degree 2		CATIII 1000Vrms, CATIV 600Vrms	
Surge		±4000V	±4000V
Burst		±4000V	±4000V

6.4 Environment and Mechanical

Processor		Intel®ATOM™
Storage		SSD 256GB x2 (MAX)
Display		10.1 inch TFT
PC interface		3x USB, 1x Ethernet, 1x HDMI, WiFi
Power supply		90~250VAC / 47~63Hz
UPS (Interruption)		2hours (Typ.), Battery Gauge LED
Power consumption		Typ. 40W
Weight		4.1Kg
Size (width x length x height)		298 x 225 x 95 mm
Temperature range	Operating	0°C ~ +60°C
	Storing	-20°C ~ +80°C

6.5 Scope of Delivery

Besides the instrument, the following additional components are provided as seen below.

(Touch pencil)

(PQA8000)

(Power cable)

(Bag)

6.6 Accessories

Please check the Camille Bauer webpage (www.camillebauer.com) to see all available accessories for the instrument.

7 Maintenance and Care

Regular calibration

The Instrument must be calibrated at regular intervals as determined by the accuracy requirements of the application. For most applications a one-year cycle is appropriate. Accuracy specifications are only guaranteed if adjustments are made at regular calibration intervals. Accuracy specifications are not guaranteed unless a one-year calibration cycle is followed. Calibration cycles beyond 2 years are not recommended for any application. Regardless of which calibration cycle you choose, it is always a good to perform a complete readjustment at each calibration cycle. This keeps the instrument within specification for the next calibration cycle and provides the best stability in the long run. Before your instrument is delivered, it is calibrated. Detailed calibration reports can be requested.

Revision History

20.03.2020	Version 1	Initial Version of Manual
02.04.2020	Version 1.1	Adding Report New chapter
14.05.2020	Version 1.2	Adding PMU functionality
07.07.2020	Version 1.3.	Events, Alarms, Disturbance, EN50160
13.08.2020	Version 1.4	Picture Connection
31.08.2020	Version 1.5	Measure and Analysis updates
11.01.2021	Version 1.6.	EN50160, PQM, Events, Multisystems, Export
22.02.2021	Version 1.7	PQA8000H
30.04.2021	Version 1.8	Events description
12.08.2021	Version 1.9.	Report Generator
16.12.2022	Version 1.9.1.	Envelopetrigger, PQM Table extended view
23.03.2023	Version 1.9.2.	PQM Overview, Live FFT, 3D FFT and FFT Limits
19.06.2023	Version 1.9.3.	Digital Input Configuration Description added
30.06.2023	Version 1.9.4.	Trigger description expanded. Table /example added

Contact

When you are working with our products we want to provide you with the greatest possible benefits. If you need any support, we are her to assist you.

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