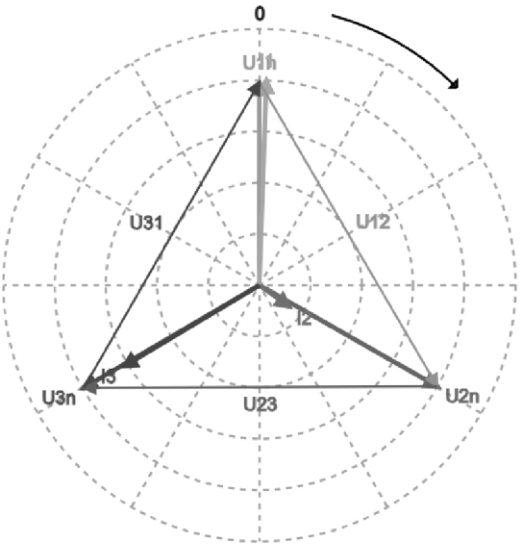
Sonel®



USER MANUAL

PQM-750
NETWORK INTERFACE

USER MANUAL

PQM-750
NETWORK INTERFACE

SONEL S.A.
Wokulskiego 11
58-100 Świdnica
Poland

Version 1.00 16.10.2024

- Due to continuous product development, the manufacturer reserves the right to make changes to functionality, features and technical parameters of the analyzers. The manufacturer provides long-term support for the product, adding new functionalities and fixing noticed errors.
- This manual describes the firmware version 1.00.

CONTENTS

1 General characteristics

The analyzer's network interface allows for:
- meter configuration,
- real-time monitoring of the meter status and measured parameters,
- browsing the list of recorded events along with waveforms and $RMS_{1/2}$ graphs,
- managing users.

The interface uses the encrypted HTTPS protocol. Unencrypted connections are not supported.

The interface is compatible with the following web browsers:
- Google Chrome: version 80 or newer,
- Mozilla Firefox: version 78 or newer,
- Microsoft Edge: version 80 or newer,
- Opera: version 80 or newer.

2 Quick start

1  Install the meter in the permanent location for the system.

2  Connect the cables to the meter inputs.

3  Turn on the meter and check its IP address.

4  Invoke the meter's network interface in your web browser.

5  Configure the meter and recording settings.

6  After entering the settings, the recorded data is deleted and recording starts automatically.

7  Recording will end:
- when the device memory is full (if linear memory model is used),
- when you enter a new measurement configuration into the device (then the previous memory content will be deleted).

3 Calling the network interface

1 Turn on the meter.

2 MAIN SCREEN ▼ NETWORK

In the meter, check the IP address. Default IP address: **192.168.75.2**.

3 Enter the meter's IP address into your web browser. If you see a warning message "Connection is not private" related to the certificate, select "Connect anyway".

4 Enter login and password. Default login: **admin**. Default password: **pqm**.

It is recommended to change this password to a stronger one after the first login, in accordance with the cybersecurity recommendations found in the main analyzer user manual.

The meter generates a self-signed TLS certificate and therefore it is not signed or confirmed by an independent certification authority. When using a web-server, all browsers will display a message regarding an unknown certificate warning about an untrusted connection (Fig. 1).

Due to the authentication scheme used by browsers, the manufacturer cannot provide certificates (for example during compilation) for use in the HTTPS protocol with browsers. This is because either the DNS name or the IP address of the device must be part of the signed certificate, both of which are ultimately determined after installation at the customer's site. Therefore, the product generate a self-signed certificate after the IP address is set. This self-signed certificate must be added to the trusted by all clients used to access the analyzer.

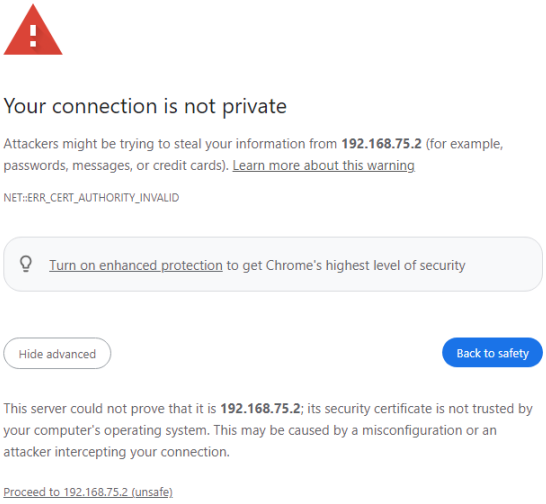


Fig. 1. Browser message about certificate error

4 Network interface

4.1 Language selection

In the upper right corner of the window, you will see an icon with the currently set interface language. Tap it to bring up the language change menu.

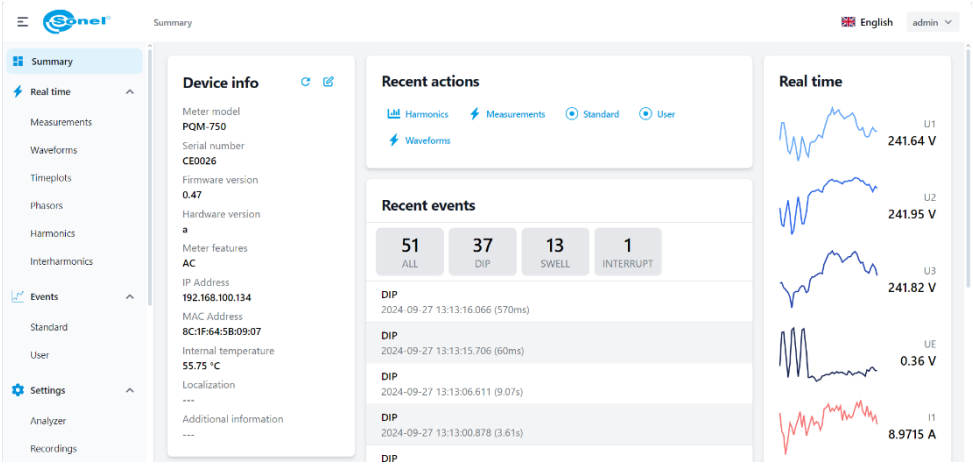
4.2 Menu icons

General			
	Unfold menu	admin	▪ Network interface version ▪ User logout
	Refresh		Edit
/	Active option	/	Nonactive option
	Reset password		Delete
Measurements			
	Show / hide columns		Show hint
U1 /	Parameter is displayed	U1 /	Parameter is not displayed
	Next screen		Previous screen
	Export data to file		

4.3 Summary

Here you will find a brief status of the device and the basic measured parameters.

- **RECENT ACTIONS** – the last few places you visited in the interface.
- **RECENT EVENTS** – list of the last few recorded events.
- **REAL TIME** – preview of the few mains parameters currently measured by the analyzer.
- **DEVICE INFO** – information identifying the meter. Some can be edited.
- **RECORDING INFO** – recording status.

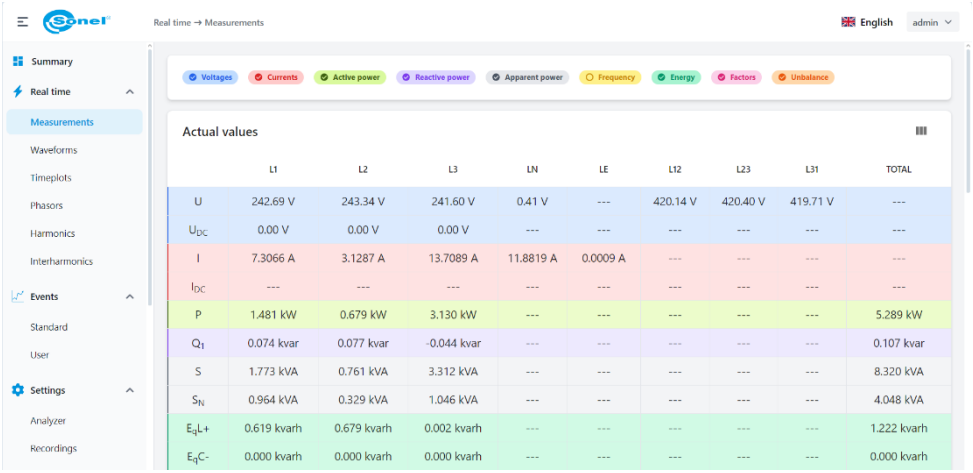


4.4 Real time

This section displays the current parameters of the measured network. Depending on the tab, they are displayed graphically on a chart and/or in tabular form (tabs **ALL** / **CHART** / **TABLE**).

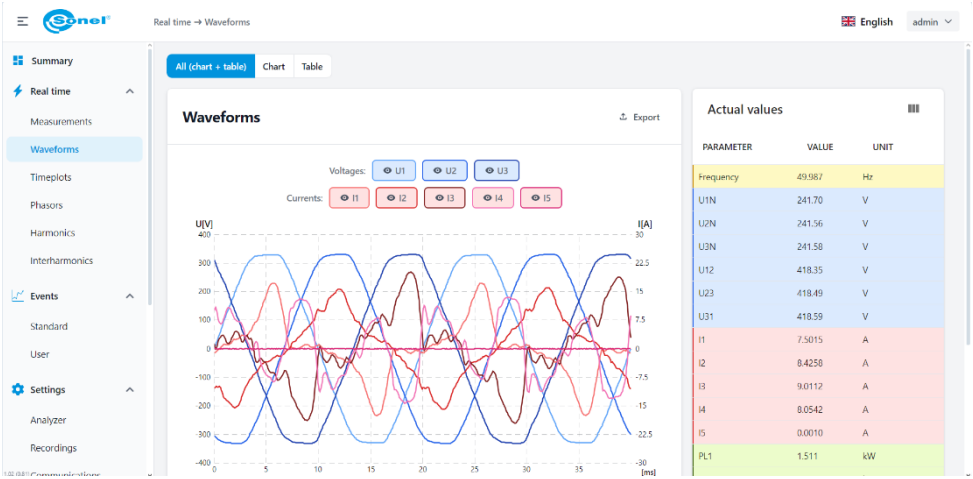
4.4.1 Measurements

Here you will find the table with measured values.



4.4.2 Waveforms

Here you'll find voltage and current waveforms (oscillograms).



Preview of values on the waveform graph:

- A frame with a preview of the instantaneous value of voltages and currents is displayed next to the cursor at the location indicated by a thin vertical line with dots.

4.4.3 Timeplots

Here you will find time charts of voltage and current RMS values, powers and frequency.

View types:

- **COMBINED** – all parameters are presented on one chart.
- **SEPARATED** – each parameter is presented on a separate chart.

Chart navigation:

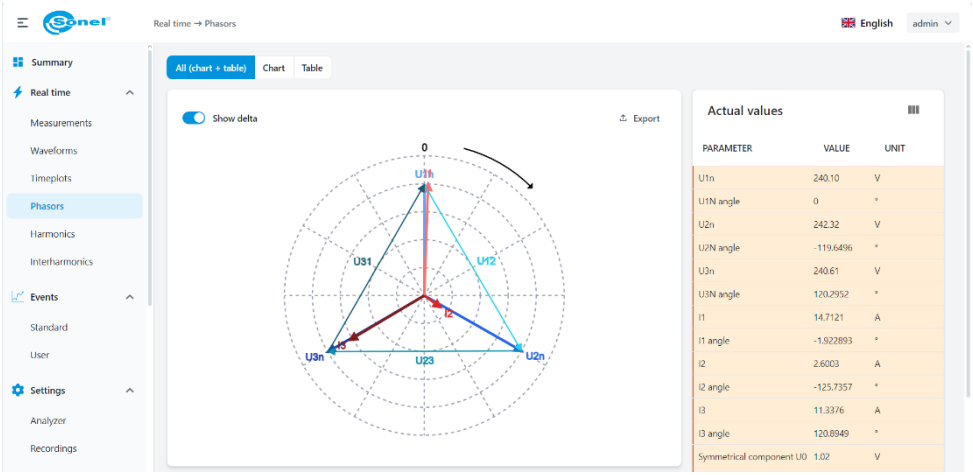
- **Zoom in / zoom out** – hover over the graph and roll the mouse wheel up/down.
- **Move** – grab the graph with the cursor and move it left/right.

Preview of values on the waveform graph:

- A frame with a preview of the parameter's values is displayed next to the cursor at the location indicated by a thin vertical line with dots.

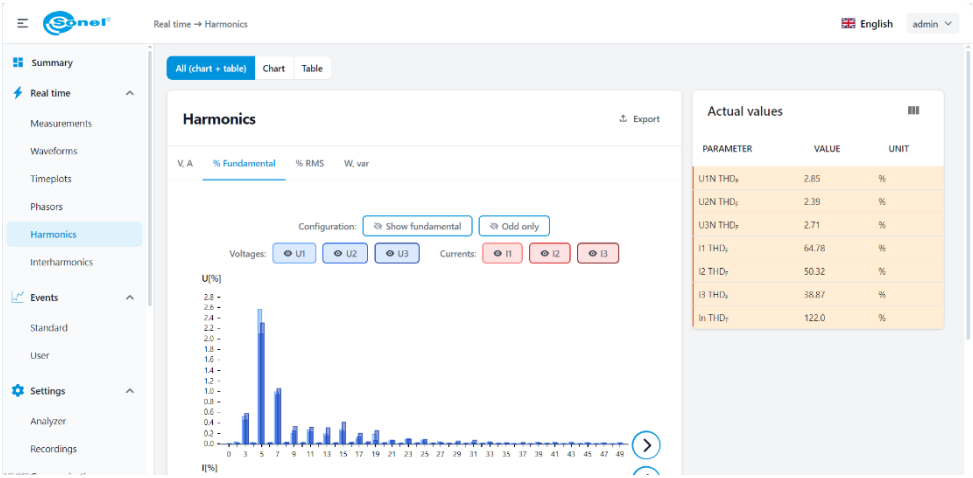
4.4.4 Phasors

This screen displays a phasor diagram, which shows the vectors of the voltage and current fundamental components. It can be used to quickly verify the correctness of the analyzer connection to the measured network. The table on the right contains the numerical values of the vectors and the unbalance coefficients.



4.4.5 Harmonics

Here you can see the harmonic values of voltages and currents. You can view the bars up to the 249th order. The table on the right displays the values of the total harmonic distortion factors THD-F.



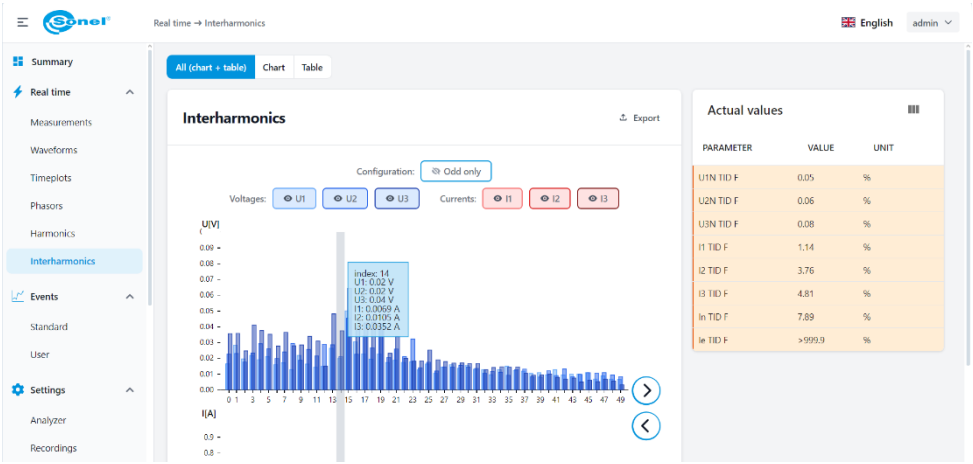
View types:

- **V, A** – harmonic values of voltages and currents given in absolute units (volts, amps).
- **% FUNDAMENTAL** – harmonic values of voltages and currents given in percentages of the fundamental component.
- **% RMS** – harmonic values of voltages and currents given in percentage of the RMS value.
- **W, VAR** – harmonic power values given in absolute units (watts, vars).

When you move the cursor over a harmonic bar, a frame is displayed with the numerical values of the harmonic magnitudes of the indicated order.

4.4.6 Interharmonics

Here you will find the values of interharmonics in voltage and current and the total interharmonic distortion factors TID-F.



When you move the cursor over a interharmonic bar, a frame is displayed with the numerical values of the interharmonic magnitudes of the indicated order.

4.5 Events

This section displays events recorded by the analyzer in tabular form. This screen is divided into tabs: **STANDARD EVENTS** and **USER EVENTS**. The latest events are displayed at the top of the table. It is possible to filter the view by event type and channel/phase.

The following columns are displayed in the table:

- **ID** – the event number. The counters are independent for standard and user events.
- **TYPE** – specifies the type of event, e.g. dip, swell, exceeding the maximum current value etc.
- **SOURCE** – this column specifies the channel/phase in which the event occurred.
- **FLAGS** – indicate which flags occurred during the event, e.g. lack of time synchronization, event designation flag according to the IEC 61000-4-30 standard, etc.
- **START** – indicates the date and time of the beginning of the event.
- **END** – indicates the date and time of the end of the event.
- **DURATION OF THE EVENT** – the difference between the end and the beginning of the event.
- **EXTREME** – the extreme value of the parameter that occurred during the event, e.g. residual voltage for a dip.
- **AVERAGE** – the average value of the parameter during the event.
- **THRESHOLD** – the threshold for triggering the event that was set in the configuration.
- **ACTIONS**: depending on the event, one of the following actions is available for it:

  – event preview on oscillogram

  – event preview on $RMS_{1/2}$ chart

  PQDIF – export event to .PQDIF file

Waveform and $RMS_{1/2}$ graphs are available only for selected types of events. Waveform and $RMS_{1/2}$ graph preview is limited in the interface in terms of time window length to 500 ms for waveforms and 3 seconds for $RMS_{1/2}$. The file exported to PQDIF format does not have this limitation.

Events are added to the table immediately after the event ends. However, the availability of waveform and $RMS_{1/2}$ graphs may be delayed to a maximum of several minutes after the event ends.

4.5.1 Standard events

Here you will find a list of all events recorded for the currently set norm (**sec. 4.6.8**) that were detected during the recording.

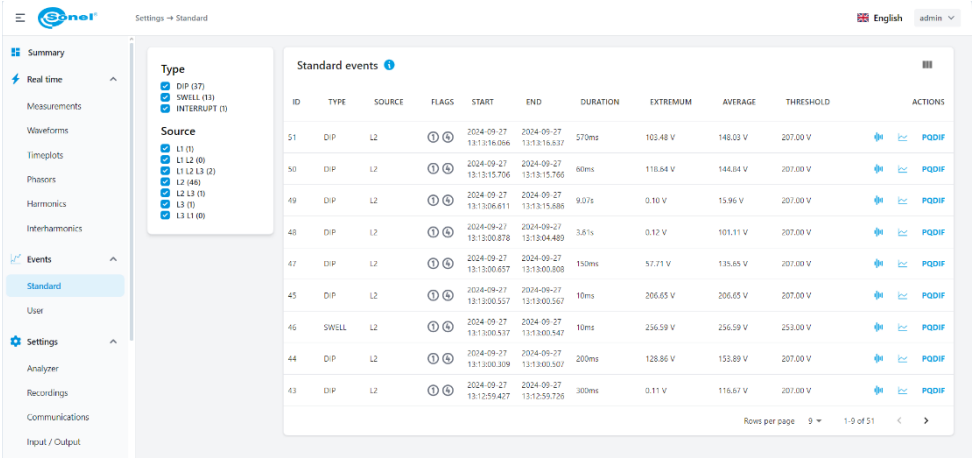


Fig. 2. “Standard events” screen

4.5.2 User events

Here you will find a list of all events enabled by the user (**sec. 4.6.8**) that were detected during recording.

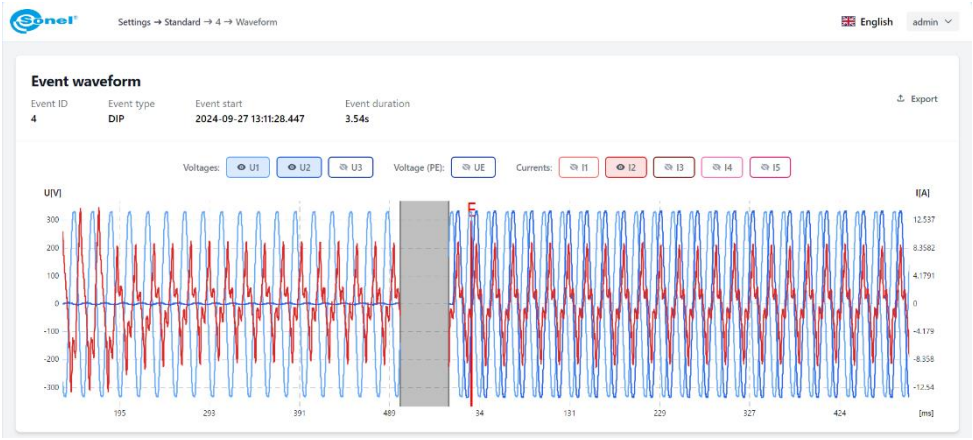


Fig. 3. Sample event – waveform plot

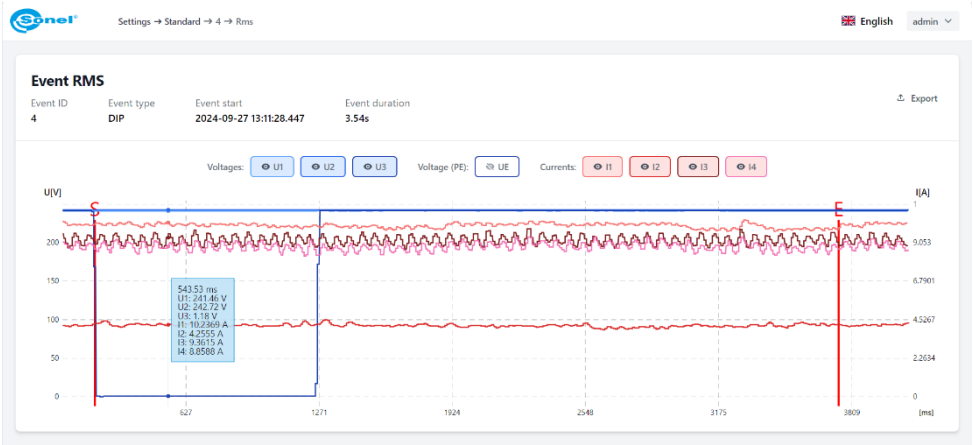


Fig. 4. Sample event – $RMS_{1/2}$ plot

4.6 Settings

- After making changes to the settings, click **SAVE**. The changes made will be marked in a different color. The top bar will display additional buttons **SAVE CHANGES** and **DISCARD** with the caption **PENDING CONFIGURATION** (Fig. 5).
- After making all the changes on one or more tabs, click **SAVE CHANGES**. To discard the changes made, click **DISCARD**.
- After clicking **SAVE CHANGES** a window will be displayed with a list of all the changes made (the current setting and the new setting). Pressing **SAVE AND RESTART** saves the new settings in the analyzer, deletes all data from the memory card and starts a new recording (Fig. 6).

Some options will become editable in future versions of the analyzer firmware.

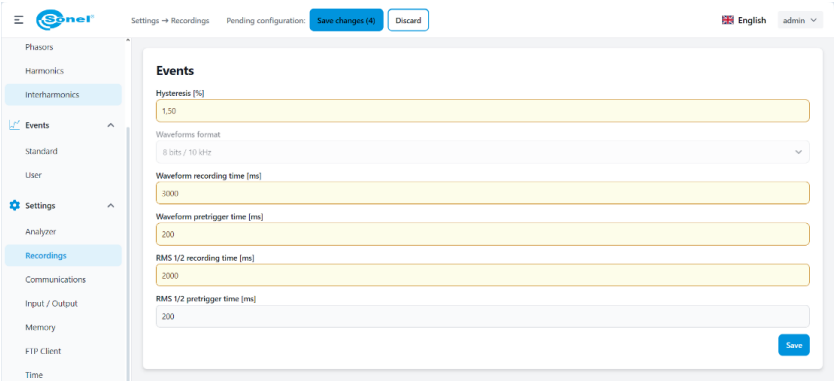


Fig. 5. Entering changes in settings

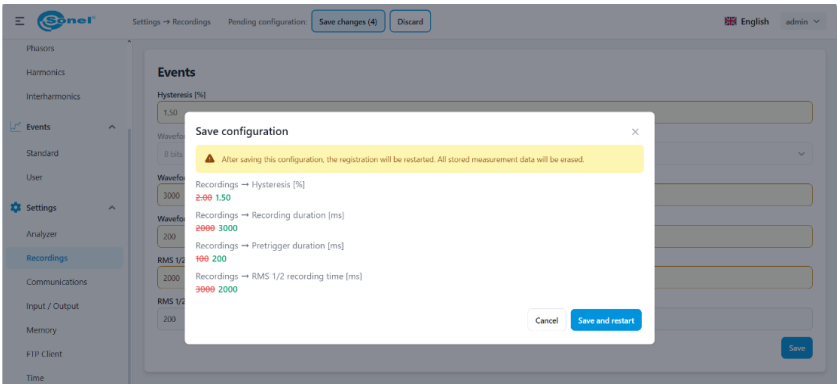


Fig. 6. List of changes made to settings and confirmation of changes

4.6.1 Analyzer

Available settings:

- **MAINS SYSTEM**.
- **CURRENT I4** – enable current measurement in channel four / neutral (I_N – N wire).
- **CURRENT I5** – enable current measurement in channel five / grounding (leakage current I_E).
- **NOMINAL FREQUENCY** – nominal frequency of the mains.
- **NOMINAL VOLTAGE** – nominal voltage of the mains. In the case of working with voltage transducers, this is the voltage of the primary side of the transducer.
- **U_{NE} VOLTAGE** – enable voltage measurement between the N wire of the mains and the ground potential.
- **VOLTAGE TRANSDUCER RATIO** – input voltage multiplier: ratio of the voltages of the primary and secondary sides of the transducer.
- **CURRENT I1/I2/I3 TRANSDUCER RATIO** – input current multiplier of channels I1, I2, I3: ratio of the currents of the primary and secondary sides of the transducer.
- **CURRENT I4 TRANSDUCER RATIO** – input current multiplier of channel I4 (I_N).
- **CURRENT I5 TRANSDUCER RATIO** – input current multiplier of channel I5 (I_E).
- **PHASE ROTATION** – selection of phase rotation direction in the tested network.

4.6.2 Recordings

Available settings:

- **HYSTERESIS [%]** – percentage value used for event detection. Higher values allow you to limit the number of detected events if the parameter value oscillates around the threshold.
- **WAVEFORMS FORMAT** – specifies the format of waveforms saved on the memory card.
- **WAVEFORM RECORDING TIME [MS]** – recording time of instantaneous voltage and current waveforms accompanying the detection of events that have the option of enabling waveform recording.
- **WAVEFORM PRETRIGGER TIME [MS]** – specifies what part of the entire recorded waveform will be the fragment preceding the trigger moment (the beginning or end of the event). This time cannot be longer than the waveform recording time.
- **$RMS_{1/2}$ RECORDING TIME [MS]** – recording time of $RMS_{1/2}$ voltage and current effective values, accompanying the detection of events that have the ability to enable recording of this type of waveform.
- **$RMS_{1/2}$ PRETRIGGER TIME [MS]** – determines what part of the entire recorded waveform will be the fragment preceding the moment of triggering (the beginning or end of the event). This time cannot be longer than the $RMS_{1/2}$ recording time.

4.6.3 Communication

Here, settings are available for communication protocols: **RS-485**, **Modbus TCP**, **Modbus RTU**, **IEC 61850**.

RS-485

Available settings:

- Setting the protocol for RS-485-1 port.
- Setting the protocol for RS-485-2 port.

Modbus TCP

Available settings:

- **PORT** – TCP port on which communication takes place (default is 502).
- **WORD ORDER** – specifies the ordering of 16-bit words in larger fields, such as 32-bit floating-point numbers FLOAT32 or fixed-point numbers INT32 and UINT32 (Little endian by default).

For detailed information on the Modbus TCP protocol, please refer to a dedicated Modbus protocol user manual.

Modbus RTU

Available settings:

- **SLAVE ADDRESS** – address of the meter on the Modbus bus (default is 2).
- **BAUDRATE** (from 57600 to 921600 bytes/s, default 115200).
- **WORD ORDER** – specifies the ordering of 16-bit words in larger fields, such as 32-bit floating-point numbers FLOAT32 or fixed-point numbers INT32 and UINT32 (Little Endian by default).
- **PARITY** (None/Even/Odd. Default: Even).

For detailed information on the Modbus RTU protocol, please refer to a dedicated Modbus protocol user manual.

IEC 61850

Here configuration options for the IEC 61850 protocol are available. The **ENABLE** switch allows you to enable or disable the protocol.

- The IEC 61850 standard requires a static IP address for the analyzer. When DHCP (automatic IP address acquisition) is enabled in the network configuration, enabling the IEC 61850 protocol is impossible. To unlock this option, the analyzer must be set to static IP address mode. This is only possible using the meter's touchscreen.
- Enabling DHCP in the meter when the IEC 61850 protocol is active will automatically disable the IEC 61850 protocol.

The IEC 61850 configuration panel allows you to:

- enable or disable protocol support,
- set the IED (Intelligent Electrical Device) name that will be assigned to the meter in the IEC 61850 network,
- set the dead bands for parameters that will determine the changes required in these parameters for which the analyzer will send configured reports to the master device.
- generate and download an .ICD (IED Capability Description) file that describes the capabilities of the device and its data model. The ICD file also contains the current IP address of the analyzer. The ICD file is then loaded into the master system for initial configuration of the analyzer.

For each parameter for which dead band can be set, the interface provides two fields:
- reference for the dead band (Dead band ref),
- dead band (Dead band) [%].

The reference is given in units of a given parameter – e.g. for voltage it is volts – and it is usually equal to the maximum or nominal value of the parameter.

The dead band is always given in percentages, and the permitted range is **0…100**. It specifies the percentage of the reference value, exceeding which will trigger sending a report to the master system. For example: setting the reference phase voltage to 230 V and 5% for dead band will cause sending a report to the master system each time the subsequent measured values of the rms voltage differ from each other by more than 11.5 V.

It is advised to avoid setting the dead bands to zero. Such a situation leads to sending reports in a continuous manner, with every change in the parameter value.

List of parameters for which dead bands can be defined:
- Phase voltages
- Phase to phase voltages
- N-earth voltage U_{NE}
- Phase currents
- Neutral current I_4 (I_N)
- Earth current I_5 (I_E)
- Total active power P
- Total reactive power Q
- Total apparent power S
- Phase active powers P
- Phase reactive powers Q
- Phase apparent powers S
- Frequency
- Voltage harmonics
- Current harmonics
- Voltage interharmonics
- Current interharmonics
- Voltage THD
- Current THD
- Voltage TID
- Current TID
- Symmetrical component U1
- Symmetrical component U2
- Symmetrical component U0
- Symmetrical component I1
- Symmetrical component I2
- Symmetrical component I0
- Unbalance for voltage and current
- Flicker P_{ST}
- Flicker P_{LT}
- Emissions in the 2-9 kHz band
- U_{max} in the 2-9 kHz band
- Emissions in the 9-150 kHz band
- U_{max} in the 9-150 kHz band
- Battery voltage

4.6.4 Input / Output

Available settings for:

- digital inputs,
- relays (digital outputs).

Digital inputs

Here for the desired input you can enable the detection of state change events – check box **ENABLE EVENTS LOGGING**. After activating the event, you can set the active level: low or high. Each change of the input state to active will result in the event being recorded.

Relays

In the relays section you can configure the operation of the analyzer's digital relay outputs. Available settings:

- **ACTIVE TIME [MS]** – duration of the active pulse after detecting a defined event. This time can be configured in the range from 10 ms to 1 second.
- **HOLD-OFF TIME [MS]** – dead time after generating the pulse, during which the relay will not react to any subsequent events. This time can be configured in the range from 0 (no hold-off time) to 10 seconds.
- **ACTION** – indicates whether the pulse is to be implemented by closing or opening the relay contacts.
  - The **O→C→O** action means that when there are no events, the contacts are in the open state (the relay does not have a powered coil), during excitation the contacts close, then return to the rest position.
  - The **C→O→C** action has reversed logic – in the absence of an event, the relay is closed all the time (coil energized), during the pulse the contacts open (relay coil de-energized), and then the contacts return to the closed position.

Relays are associated with events in the configuration panel of individual parameters in the **SETTINGS→MEASUREMENTS→USER** section.

4.6.5 Memory

Here you can adjust the meter's memory structure and the way it is organized.

- **User data** – space for data recorded according to user guidelines. Minimum setting: 5%.
- **Normative data** – space for data recorded according to standard guidelines. Minimum setting: 5%.
- **Energy counters data** – space for energy counters data, not subject to user editing. Set to 1%.

Data memory model:

- **CIRCULAR** – when the memory space is full during recording, the oldest data will be overwritten with the newest data.
- **LINEAR** – when the memory space is full during recording, the recording will end.

4.6.6 FTP Client

In this section you can activate the FTP client, which will connect to a remote FTP server at a specified time of day and transfer the data recorded the previous day in PQDIF format. The types of data transferred are given in the main analyzer manual.

Available settings:

- **ENABLE** – activates and deactivates the FTP client.
- **LOGIN** – user name on the remote FTP server.
- **PASSWORD** – user password on the remote FTP server.
- **SERVER IP ADDRESS** – FTP server IP address.
- **SERVER PORT** – TCP port on which the remote FTP server is operating.
- **OPERATING MODE** – Active/Passive. Specifies the mode in which the FTP server is operating. The choice of mode may be important in networks secured by firewalls. The choice of mode should be consulted with the FTP server administrator.
- **ENCRYPTION** – No/Yes. Allows the use of unencrypted data transfer (FTP) or encrypted data transfer mode (FTPS).
- **DESTINATION DIRECTORY** – specifies the path on the remote server where files will be uploaded.
- **TEST CONNECTION** – clicking this button performs a connection test between the analyzer and the remote FTP server. During this test, a test file is sent. Success of this test indicates that the connection has been configured correctly.
- **AUTOMATIC UPLOAD TIME** – specifies the time from midnight UTC after which the analyzer will start sending files to the remote FTP server. Possible settings are from UTC 01:00 (one hour after midnight UTC) to UTC 12:00, with a step of one hour. The analyzer makes multiple attempts to upload files in case of temporary connection problems.

4.6.7 Time

Here you can change the meter time settings. The upper part displays the current meter time and the local time determined based on the time on the local computer where the browser is running. Available options:

- **TIME SYNCHRONIZATION**:
  - **AUTO (GPS, IRIG-B, NTP)** – the analyzer selects the best available time source and automatically switches between them.
  - **RTC ONLY** – the analyzer switches to the local real-time clock. GPS, IRIG-B, NTP sources are ignored. After switching to this mode, the option to change the time in the analyzer becomes available and the NTP service is automatically disabled.
- **TIMEZONE** – the offset of the analyzer's local time indicated on the analyzer screen relative to UTC. The setting does not affect the data recorded on the memory card – the data is always marked with UTC time.
- **DAYLIGHT SAVING TIME** – adds one hour to the local time.
- **NTP ENABLE** – allows you to enable or disable time synchronization using the NTP protocol.
- **NTP SERVER NO. X** – allows you to enter the DNS names or IP addresses of four NTP servers.

4.6.8 Measurements

Available settings for:

- standard,
- user.

STANDARD – available settings:

- **ENABLE** – enabling recording for compliance with the EN 50160 standard (always active).
- **LOGGING ACCORDING TO** – selection of the standard variant according to which compliance reports will be generated.
- **LOG WAVEFORMS AND RMS$_{1/2}$** – enabling/disabling the recording of waveform graphs and RMS$_{1/2}$ plots for normative events.

USER – available settings:

- **ENABLE** – Enabling/disabling user recording (default status: disabled),
- **AVERAGING PERIOD** – selection of the user logging averaging time (from 200 ms to 30 minutes),
- **LOG WAVEFORMS AND RMS$_{1/2}$** – enabling/disabling the recording of waveform graphs and RMS$_{1/2}$ plots for user events for which it is possible to enable these graphs,
- **VOLTAGE**,
- **CURRENT**,
- **POWER**,
- **ENERGY**,
- **HARMONICS**,
- **ADDITIONAL**.

Click the item to expand the detailed settings. Tab. 1 presents available options. In the case of parameters for which events can be enabled along with relay triggering, their configuration consists of two steps:

- selecting trigger phases / channels: L1 / L2 / L3 / N / E / TOTAL (any combination can be enabled),
- selecting the Action, i.e. indicating the relays: Relay No. 1 / Relay No. 2 or both.

Tab. 1. Available options for user recording

Parameter	Values recorded				Event detection	Relays triggering	Waveforms and $RMS_{1/2}$
	min.	average	max.	inst.			
RMS voltage	✓	✓	✓		Swell	✓	✓
					Dip	✓	
					Interruption	✓	
U_{NE} voltage					✓	✓	
Waveshape variation					✓	✓	
Phase jump					✓	✓	
DC voltage	✓	✓	✓				
Frequency	✓	✓	✓		✓	✓	
Voltage Crest Factor	✓	✓	✓				
Voltage unbalance and symmetrical components	✓	✓	✓		✓		
Flicker P_{ST}		✓			✓	✓	
Flicker P_{LT}		✓			✓	✓	
RMS current	✓	✓	✓		✓	✓	✓
Current Crest Factor	✓	✓	✓				
Current unbalance and symmetrical components	✓	✓	✓				
Active power P	✓	✓	✓		✓		
Active power P+	✓	✓	✓		✓	✓	
Active power P-	✓	✓	✓		✓	✓	
Fundamental active power P1	✓	✓	✓				
Fundamental reactive power Q1	✓	✓	✓		✓	✓	
Apparent power S	✓	✓	✓		✓	✓	
Fundamental apparent power S1	✓	✓	✓				
Distortion power S_N/Q_B	✓	✓	✓				
Active energy E_P				✓	✓		
4-quadrant reactive energy E_Q				✓	✓		
Apparent energy				✓			
Voltage THD-F	✓	✓	✓		✓	✓	
Voltage THD-R	✓	✓	✓				
Voltage TID-F	✓	✓	✓				
Voltage TID-R	✓	✓	✓				
Voltage harmonics amplitudes	✓	✓	✓				
Voltage interharmonics amplitudes	✓	✓	✓				
Current THD-F	✓	✓	✓		✓	✓	
Current THD-R	✓	✓	✓				
Current TID-F	✓	✓	✓				
Current TID-R	✓	✓	✓				
Current harmonics amplitudes	✓	✓	✓				
Current interharmonics amplitudes	✓	✓	✓				
Harmonics active power	✓	✓	✓				
Harmonics reactive power	✓	✓	✓				
Angles between voltage and current harmonics	✓	✓	✓				
K-Factor	✓	✓	✓				
Mains signalling U_{R1}		✓	✓				
Mains signalling U_{R2}		✓	✓				
2…9 kHz band measurement	✓	✓	✓				
8…150 kHz band measurement	✓	✓	✓				
Phasor charts				✓			

4.6.9 Export / Import

Here you can export the current PQM-750 analyzer configuration to a file or import a configuration created in another PQM-750 analyzer.

4.6.10 Firmware upgrade

Here you can update the analyzer firmware. Load the update file and follow the instructions on the screen. The update process will stop the ongoing recording and continue it after update is finished.

4.6.11 Password

Here you can change the password of the currently logged user.

4.7 Users

This menu allows you to:

- add new users with limited access,
- reset user passwords,
- delete users.

5 Manufacturer

The manufacturer of the device and provider of guarantee and post-guarantee services:

SONEL S.A.
Wokulskiego 11
58-100 Świdnica
Poland
tel. +48 74 884 10 53 (Customer Service)
e-mail: customerservice@sonel.com
web page: www.sonel.com

NOTE!

Service repairs must be performed only by the manufacturer.

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58-100 Świdnica
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www.sonel.com