Energomonitor-61850EXT

Version 0.7.2

User Manual

2023

Contents

Scope

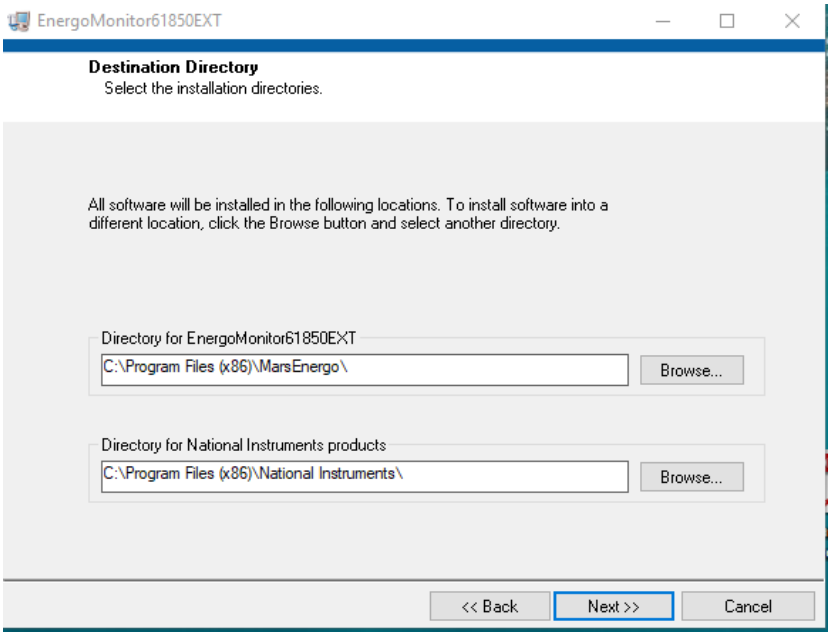
The EnergoMonitor-61850EXT program (the Program below) is a software component designed to work with multifunctional reference meters named Energomonitor 61850 (the EM61850 below). The Program is used to configure the EM61850 and take control of measurement results.

The Program works under Windows 7, 8, 10, and 11.

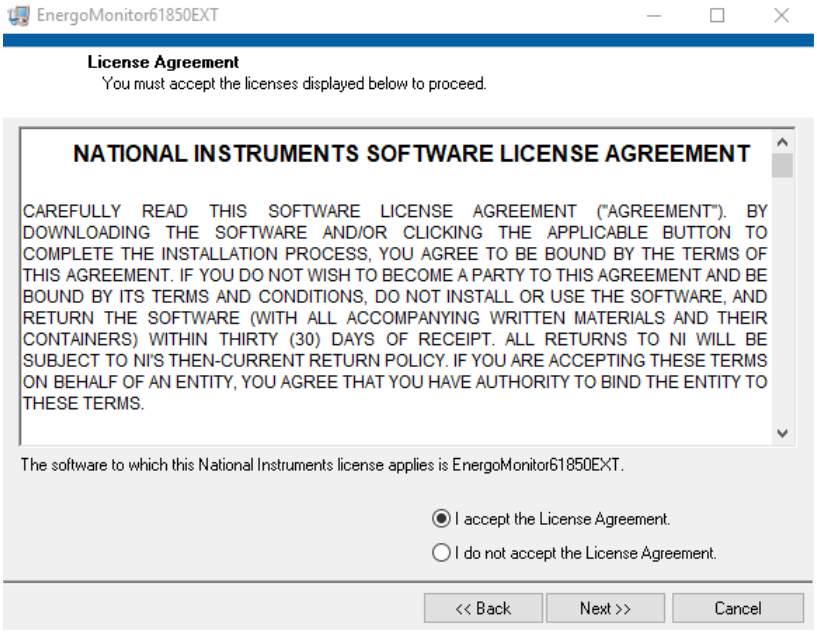
1 Installation

1.1 Run the installer **EM61850EXT_Installer.exe**

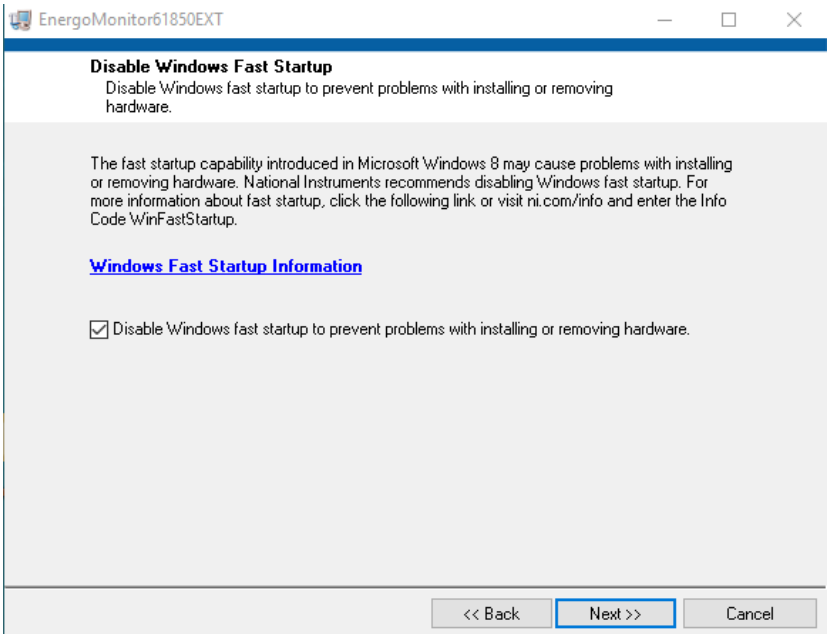
1.2 Click on **Next.**



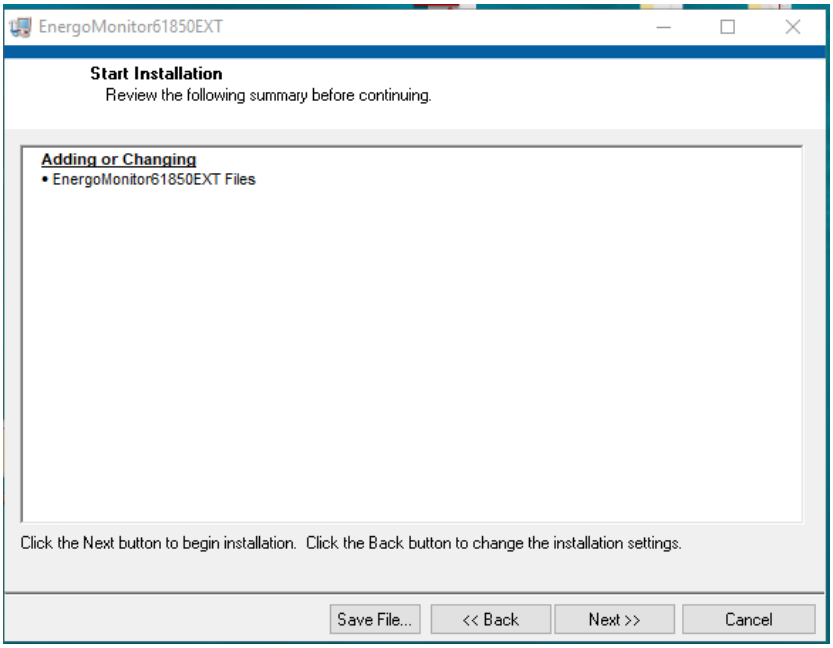
1.3 Select **I accept the License Agreement**. Click on **Next**



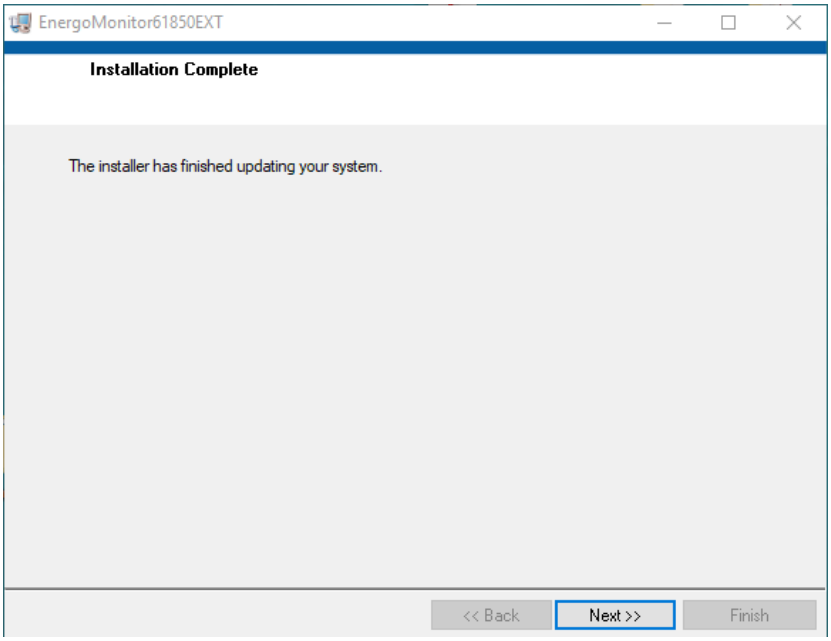
1.4 Click on **Next.**



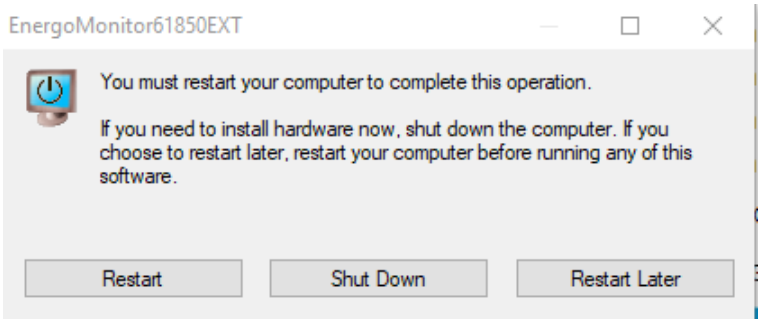
1.5 Click on **Next.** Wait for the installation to complete.



1.6 Click on **Next.**



1.7 Click on **Restart.** Your computer will be restarted.



2 Connecting EM61850 and PC

2.1. Connect your PC to the WiFi point of the EM61850.
Network name: em61850-N (where N is a serial number of the EM61850).
Password: 12345678
Besides a WiFi connection, it is also possible to make a wired connection between the EM61850 and PC. The computer is connected to the Control port of the EM61850 via a patch cord.

2.2. Launch the program EM61850EXT. In case of successful connection the EM ONLINE indicator will be displayed. The connection can be configured in the menu Settings → Connection (see section 3.1.5).

3 Operating the program

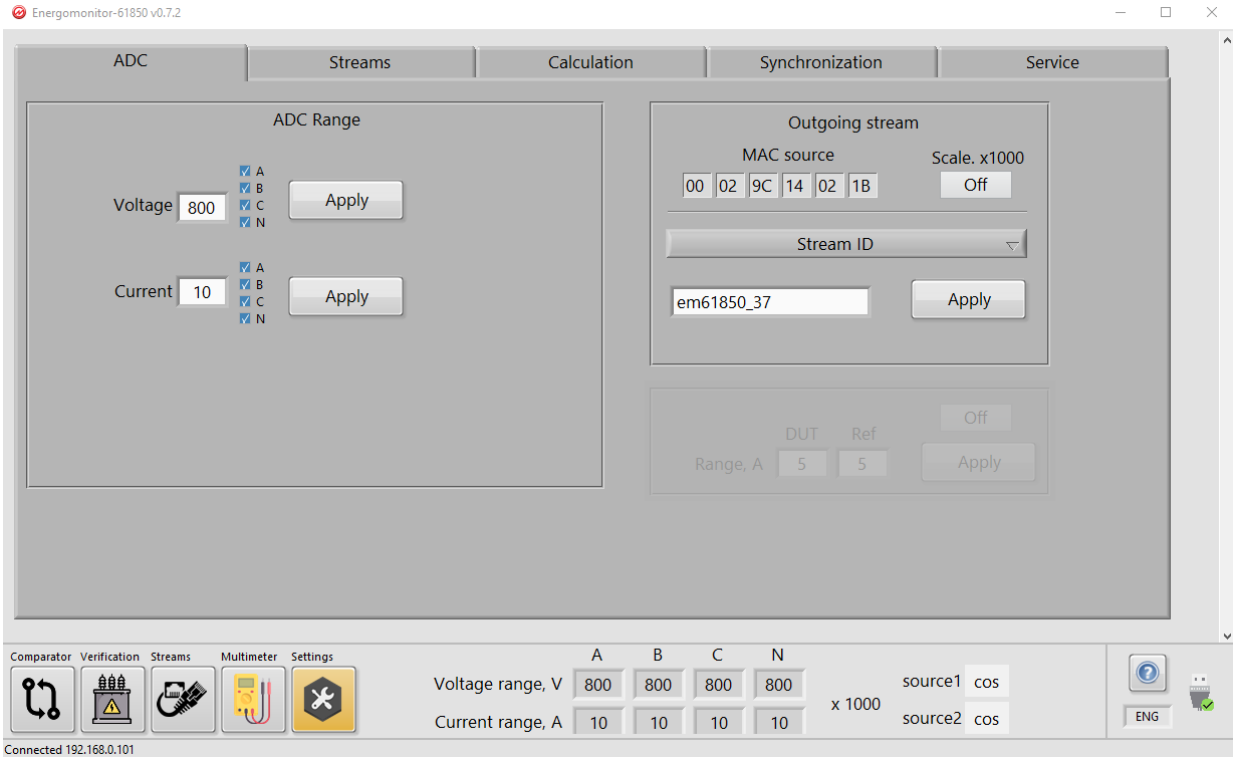
The buttons providing access to the main functions are located in the bottom line of the screen.

3.1. Settings

3.1.1 ADC

3.1.1.1 Selecting measuring ranges

Select a required range for the analogue current or voltage input and click **Apply**. When a current range is being changed, the EM61850 emits 4 specific clicks. Voltage ranges are switched soundlessly.



3.1.1.2 Configuring the outgoing stream

The outgoing stream generated by the own (internal) ADC module of the EM61850 according to IEC 61850-9-2 consists of digital replicas of input analogue signals: 4 input currents and 4 input voltages. **ADC MAC** (the MAC address of the source of the stream) is displayed as reference information. Parameters are selected from the **Parameter** drop-down list.

Stream ID is the name of the stream, it may include characters from the Roman alphabet, digits and the underscore "_" (other characters are not allowed according to the standard).

Dest MAC is the destination MAC address (MAC address of the data receiver)

F SV is the sampling rate, the admissible rates are: 24, 80, 96, 256, 288, 640 samples per a period of the rated network frequency.

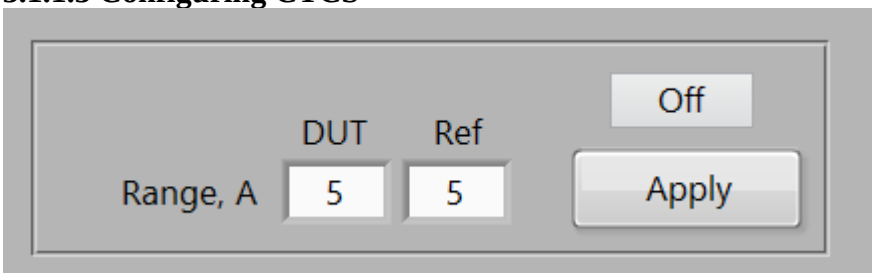
VLAN ID is the subnetwork identifier of the stream.

APPID is the application identifier.

The **Scale x1000** button enables a scaling factor that may be applied to the voltage ranges 1V, 2V and current ranges 0.1A, 0.25A. When active, the **Scales x1000** indicator is

displayed at the bottom of the screen. The button is used to measure low currents and voltages. In this case RMS and RMS (1) readings are displayed in mV (voltage) and mA (current).

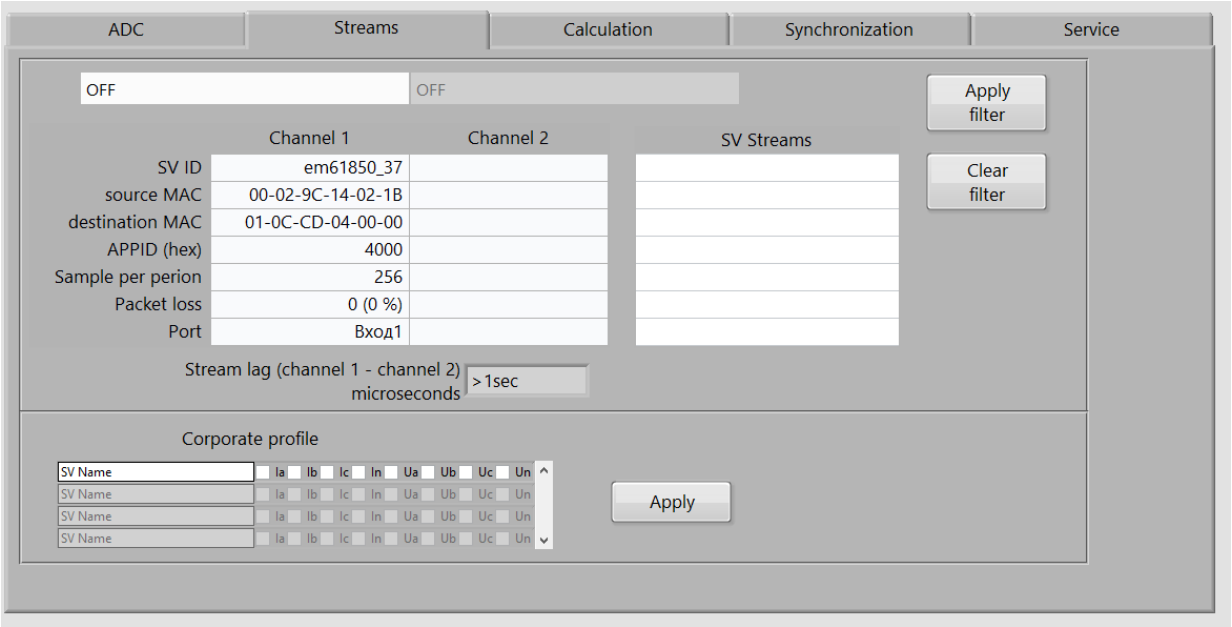
3.1.1.3 Configuring CTCS



Note! This information relates to the versions operating with the instruments complete with a Current Transformer Calibration Switch (CTCS).

The **ON/OFF** button enables CTCS. Within an outgoing stream, the readings from the inputs of CTCS are assigned to the phases Ia and Ib. The button **Apply** makes it possible to select one among the 8 ranges available: 0.05, 0.1, 0.25, 0.5, 1, 2.5, 5, 10 A.

3.1.2 Streams



When external streams are present at the EXT input of the EM61850, the names of the streams will be automatically displayed in the list **SV Streams.**

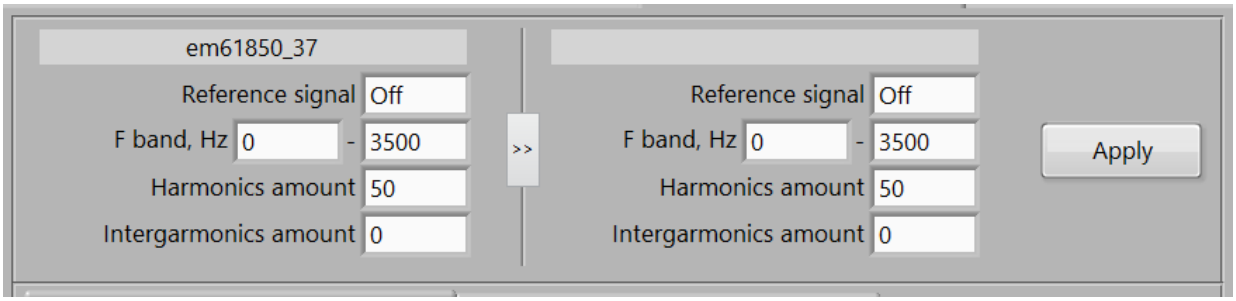
The Energomonitor-61850 simultaneously processes streams in 2 channels. By default, one of these channels is its own channel (the Analogue input) which processes its own stream. The other one can accept an external stream. Besides, these 2 channels can both accept external streams. To select an active stream, open the left drop-down list. If you need 2 external streams to be processed, open 2 drop-down lists. Select the streams and click **Apply filter**.

Note!

If even one external stream is being processed at the moment, the Program will not be able to show an actual list of streams going through the EXT port because the filter of streams is ON. To view all streams at the EXT port, click on the button **Clear filter**.

If a stream has a corporate profile, enter its name in the “Corporate profile” table and mark its active phases accordingly.

3.1.3 Calculation settings



The calculation settings (which are set to default each time the EM61850 is turned ON/OFF) influence the readings of the instrument in all tabs. The left part of the panel contains the fields where the calculation settings for an analogue signal or for an external stream selected can be made. The right part contains the calculation settings to be applied to an external stream only. In addition, such options as the number of harmonics and interharmonics are backed up in the tab Multimeter >> Harmonics.

“F band”

The “F band” option sets a range across which the search for the fundamental frequency is performed.

“Reference signal”

Selection of the frequency in a polyphase system is based on the signal in a channel configured as the reference channel. The following options are available:

- **Auto**:

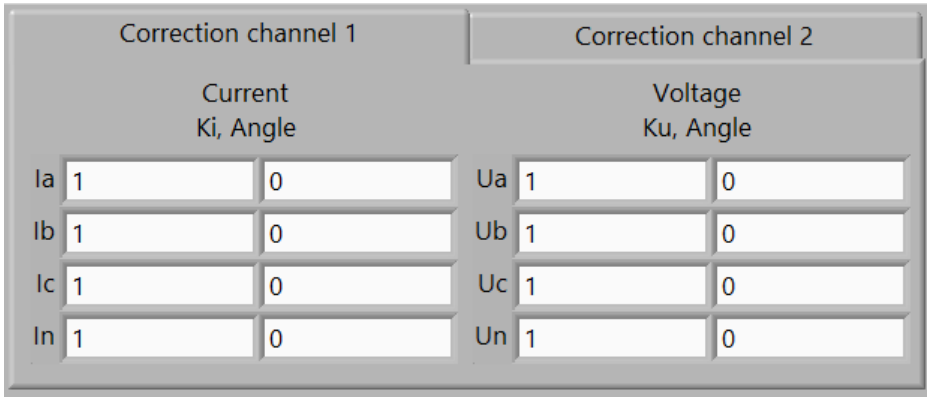
Initially channel Ua is taken as a reference channel. If an RMS value of signal in the reference channel appears to be less than 10% of the active measurement range, the first channel where an RMS value of signal exceeds the 10% threshold will be selected as the reference one automatically. The channels are scanned in the following order: Ua, Ub, Uc, Un, Ia, Ib, Ic, In. If a sufficient signal is detected in none of the channels, the search will be repeated once a second.

- **OFF** (by default):

The frequency of each channel is calculated independently of one another.

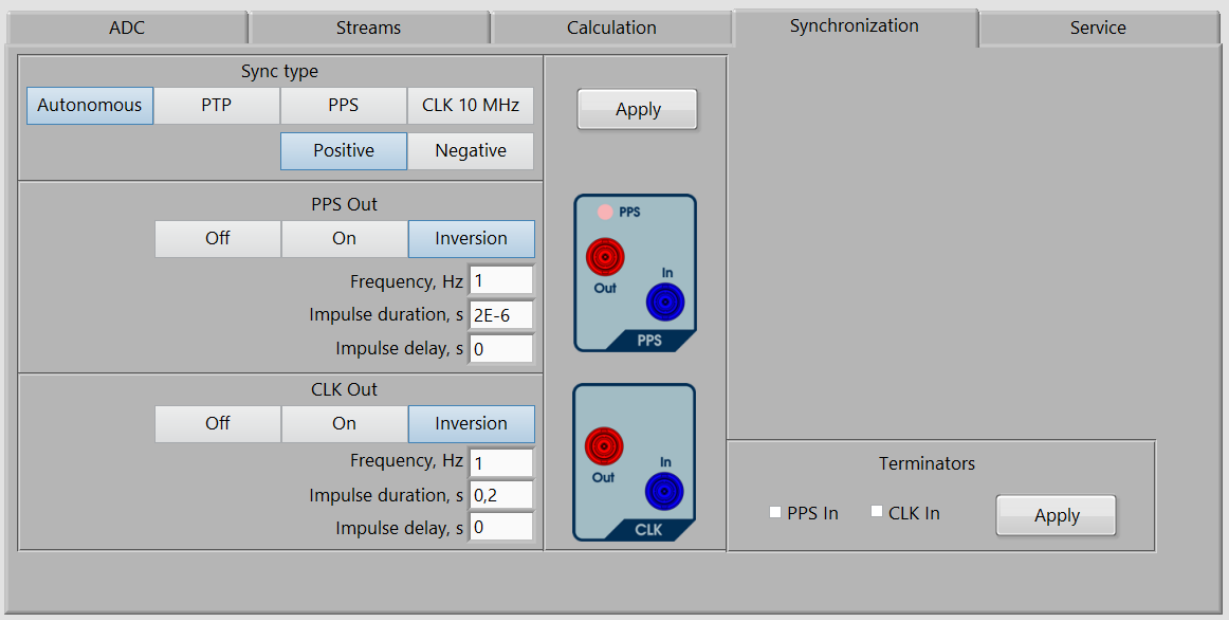
- **Ua, Ub, Uc, Un, Ia, Ib, Ic, In:**

The frequency of the selected channel is taken as the frequency of the system.



The “Correction” tabs are used to set correction factors (K_I and K_U) for RMS and RMS (1) readings of the signal in the channel along with its angle correction value (if required).

3.1.4 Synchronization



Two types of synchronization are available: internal and external.

To enable an external source of PPS (pulse per second) signal, click on the button "**PPS**".

To turn on the internal source of PPS signal, select the button "**Autonomous**".

The buttons "**PTP**" and "**CLK 10 MHz**" are reserved for future applications.

If the EM61850 is configured to compare analogue input signals with an external stream, it is critically important to set the correct type of synchronization. If the EM61850 itself operates as a synchronization unit, select the internal synchronization ("**Autonomous**").

If you want to transmit PPS synch pulses to external devices, set the "**PPS out**" function to "**On**" or "**Inversion**".

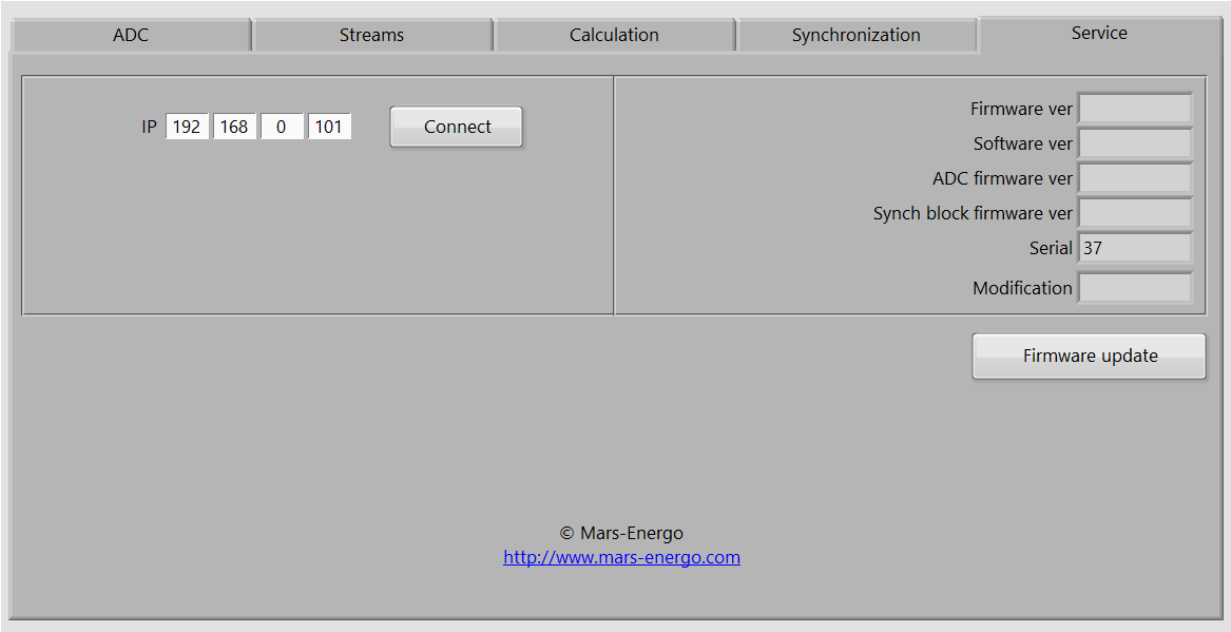
To activate the settings in the instrument, click "**Apply**".

CLK in (Clock Signal) is an input on the panel of the EM61850 that can be used for connection of an external synchronization signal (will be active in further versions).

CLK out can be used in the same way as the **PPS out**.

The "**Terminators**" options are used to enable termination loads on the inputs "**PPS in**" or "**CLK in**", which makes it possible to eliminate beating of the PPS signal.

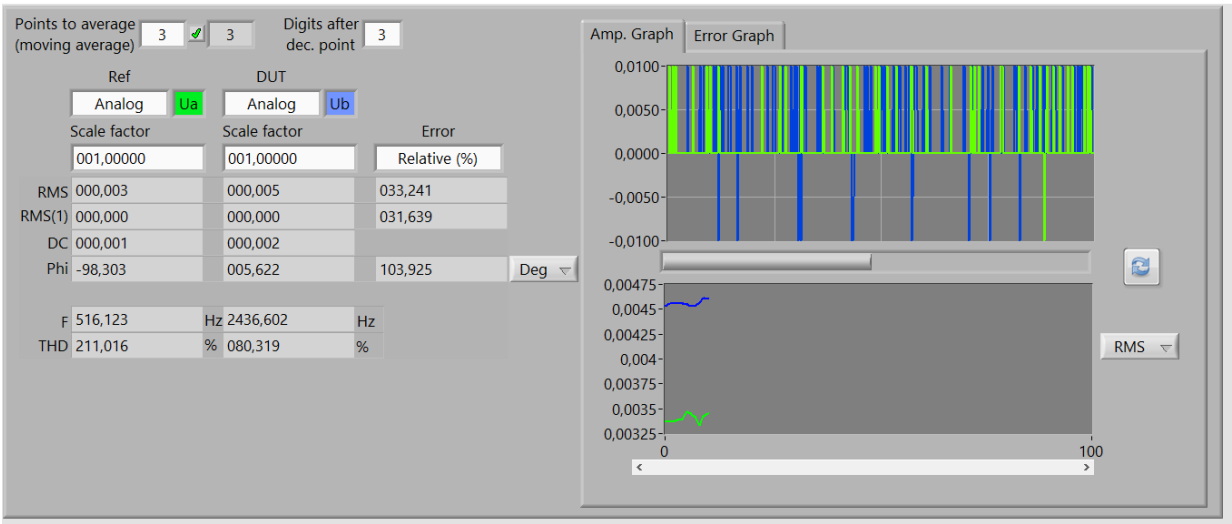
3.1.5 Service



Click "**Connect**" to activate the program on the instrument with the specified **IP** address.

Click "**Firmware update**" to update the firmware of the instrument.

3.2. Comparator



3.2.1 General information

The mode is used to compare the signals present on two phase inputs. The signals can relate to one stream or to different streams. Readings are taken once per second.

Fields:

Scale Factor – is used when the RMS and RMS (1) readings should be multiplied by a number, the number is specified in this field (equals 1 by default)

RMS – shows actual RMS values of the voltage or current signal selected in the corresponding field

RMS (1) – shows actual RMS values of the 1st harmonic of the voltage or current signal selected in the corresponding field

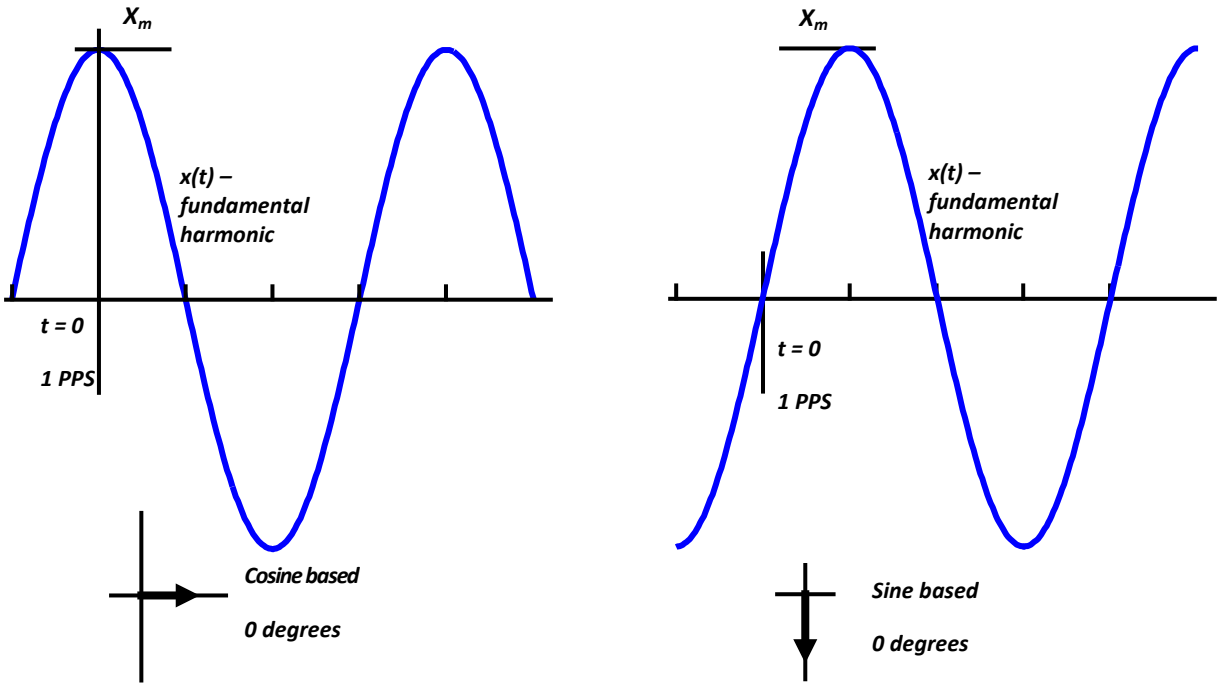
Phi – shows phase shifts with reference to PPS (measurement units are selected from the adjacent dropdown list)

Error – displays calculated values of measurement error
Relative (%) – is the relative error calculated according to the formula:
Relative_Error = (DUT – Ref) / Ref * 100
Absolute – is the error calculated as: Absolute_Error = DUT – Ref
F – shows the frequency of the 1st harmonic of the selected signal
DC – shows values of the DC component of the selected signal
THD – shows total harmonic distortion of the selected signal
Note! The errors of phase shift are always calculated according to the second formula (Absolute_Error = DUT – Ref) regardless of the error type selected in the corresponding field.

COS and **SIN** – the buttons are used to select one of the methods (cosine based or sine based) for calculation of the phase offset of a signal curve with reference to a time stamp (PPS pulse).

source1	cos
source2	cos

The methods are referred to the extreme positions of a signal curve with respect to a PPS pulse:



Cosine based: the phase offset is assumed to be zero, if a time stamp (at the moment of going from one UTC second to the next) matches the curve of the fundamental signal harmonic at its maximum
Sine based: the phase offset is assumed to be zero, if a time stamp (at the moment of going from one UTC second to the next) matches the curve of the fundamental signal harmonic when it crosses the X axis from below.

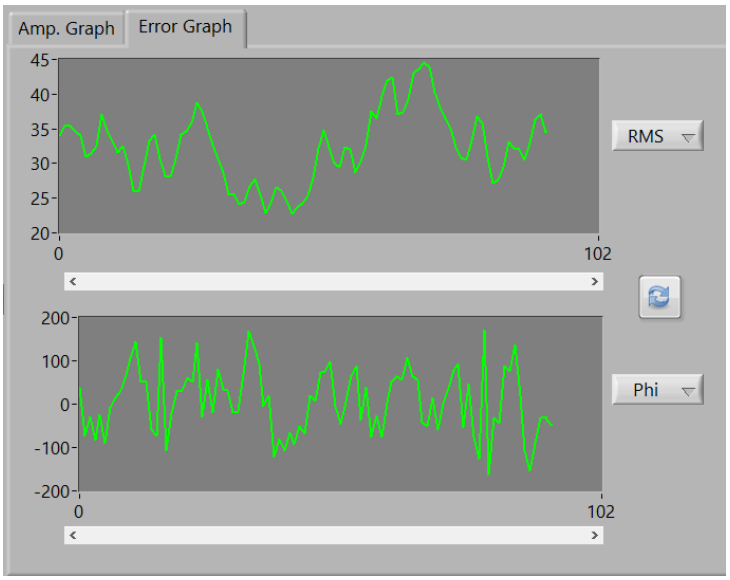
3.2.2 Amplitude graphs

A set of the amplitude curves of compared signals measured over 1 second is displayed on the upper graph panel. The horizontal axis contains fractions of a second adjustable with a

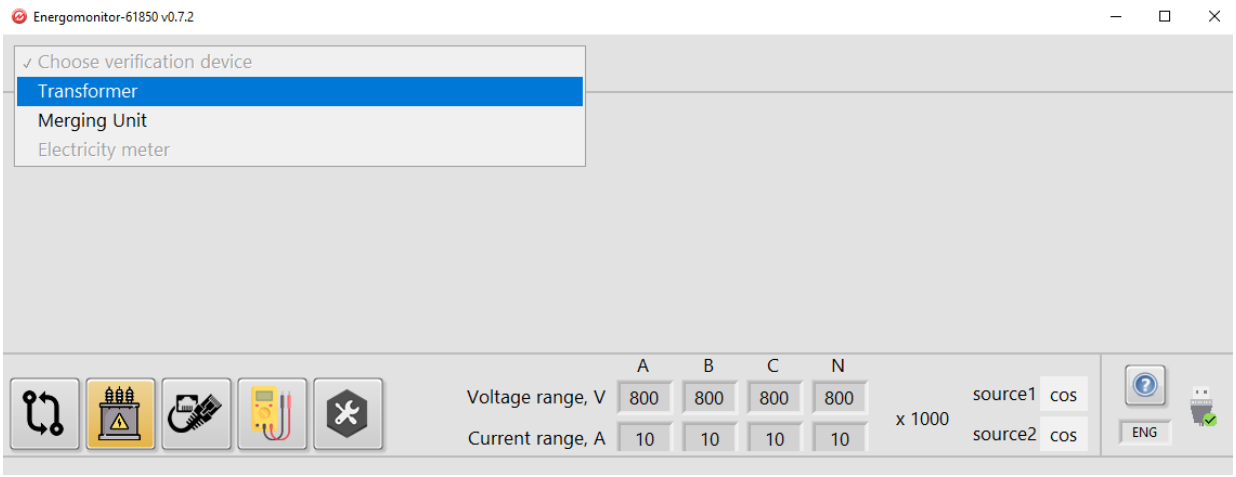
logarithmic slider. By moving the slider to the rightmost position you can view the complete 1-second plot.

The lower graph represents the curves of the parameters selected from the dropdown list (RMS, RMS (1), Phi, F, DC, and THD).

The plots representing errors located in the next tab “**Error graph**” are managed in the same way.



3.3 Verification

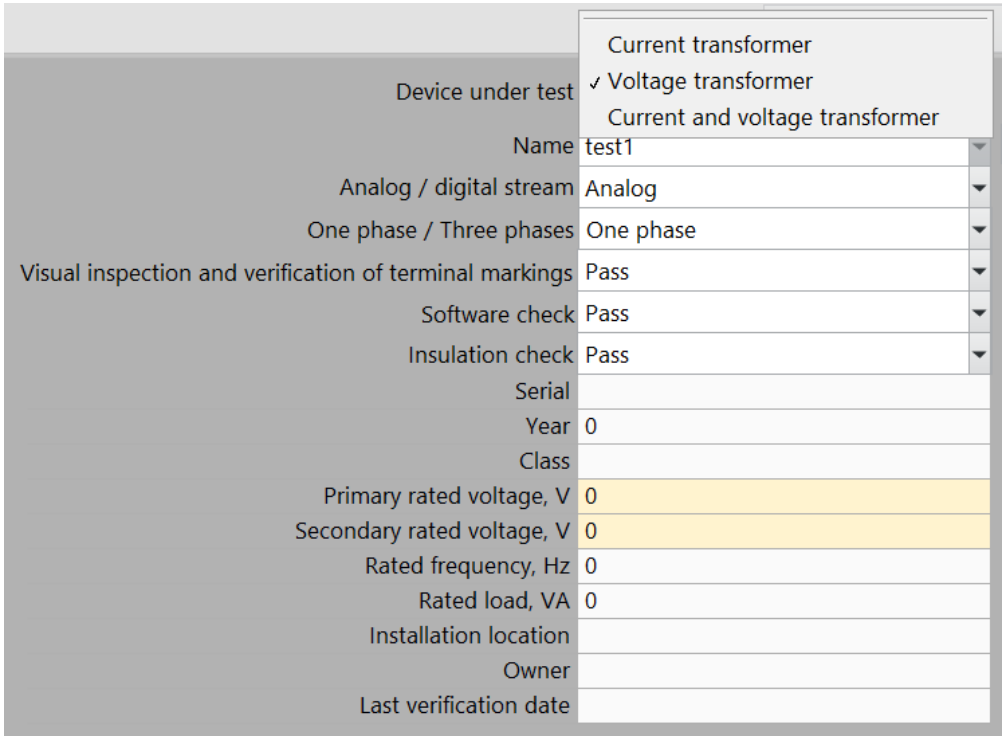


3.3.1 Verification of transformers

The procedure of accuracy testing (verification) of transformers is described in the user manual for the Energomonitor 61850.

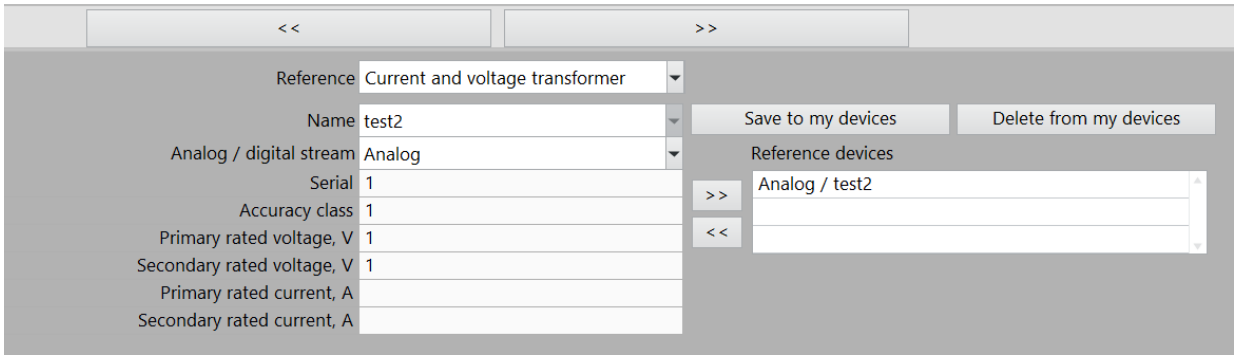
3.3.1.1 Specifying nameplate data for tested transformers

The fields for specifying nameplate data become accessible only after selecting the transformer type.



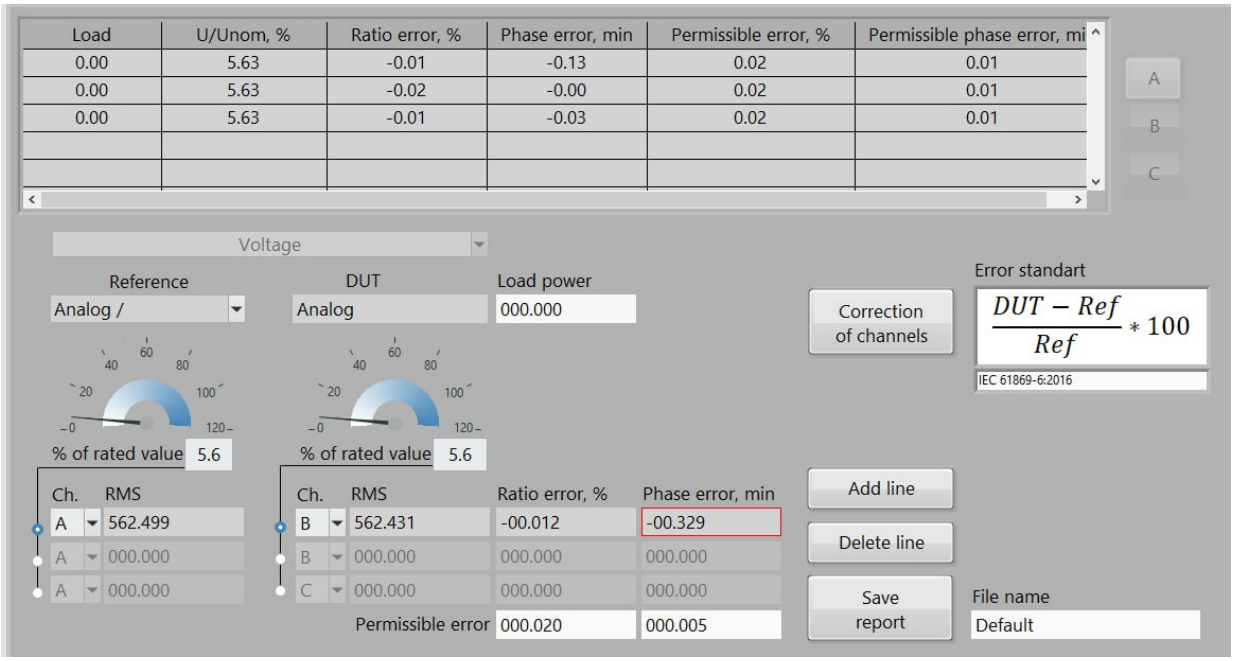
The user will be allowed to go to the next tab only after specifying the values of rated currents or voltages.

3.3.1.2 Specifying nameplate data for reference device



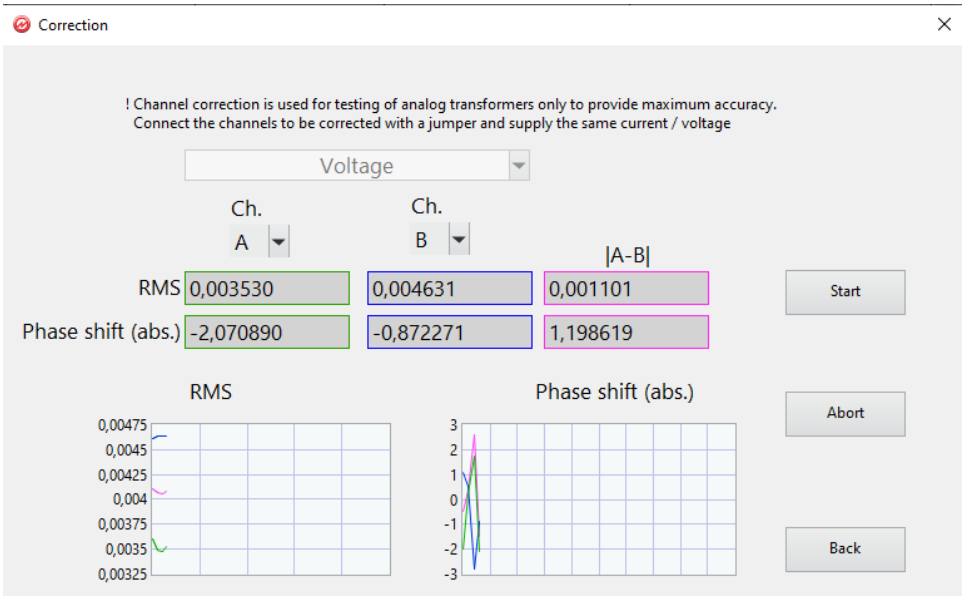
When you select a device saved earlier, its nameplate information will appear in the fields automatically.

3.3.1.3 Performing verification



The tab is used to record actual readings and results into the table in the process of verification. Test reports (rtf files) are created on this basis. Records (lines) are added to the table by clicking on the "**Add line**" button. To delete a line, highlight it with the mouse and press "Delete line". Test reports are saved on clicking the "**Save report**" button.

3.3.1.4 Correction of channels



The correction of channels is only performed prior to testing of conventional current or voltage transformers. It should be performed in 30 min (or later) after applying power to the EM61850.

Note! Prior to starting correction of channels make sure that the measurement range set in the EM61850 is no less than the rated current/voltage value of the reference transformer. Correction should be repeated each time after changing a measurement range.

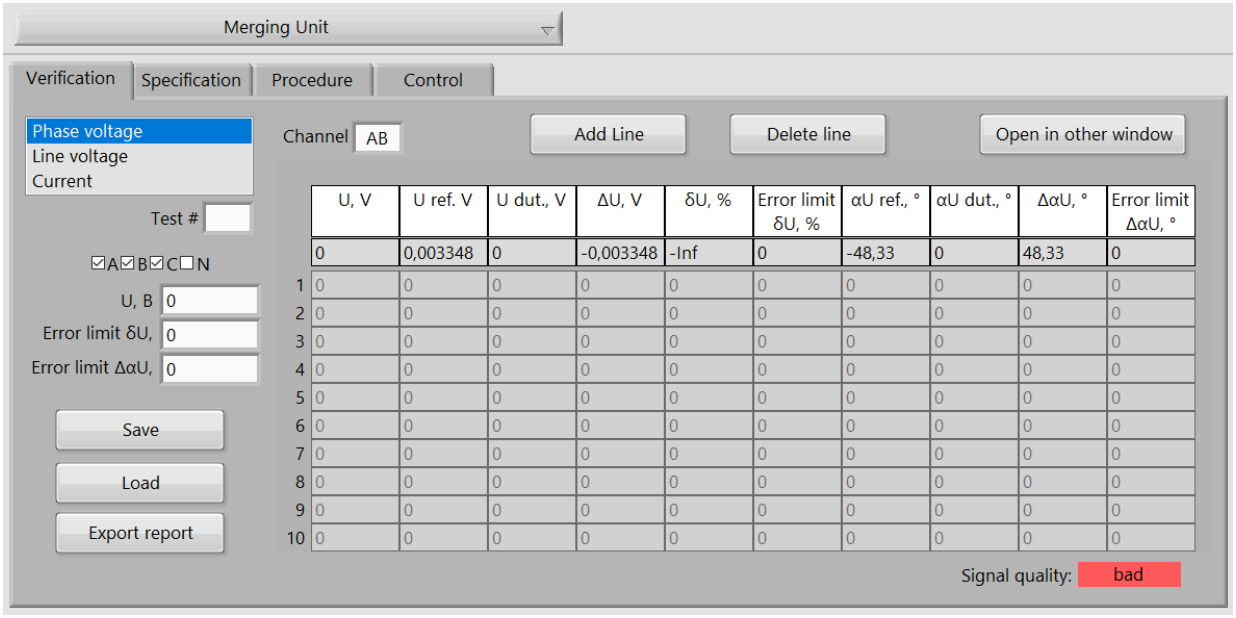
To start correction, connect the secondary of the reference transformer to the phase inputs A and B of the EM61850. Apply a voltage/current of value equal to its rated value to the reference transformer.
Click "**Start"**. At this time, the EM-61850 will carry out correction, namely it will electronically compensate both amplitude and phase shift differences between signals in channels A and B.

To obtain the highest possible measurement accuracy, it is recommended to carry out the correction of channels after a considerable (greater than 5 °C) drop in ambient temperature and each time when a measurement range is changed.

3.3.2 Verification of Merging Units

Verification of merging units is performed for phase voltages, line voltages, and phase currents in each phase.

3.3.2.1 Verification tab

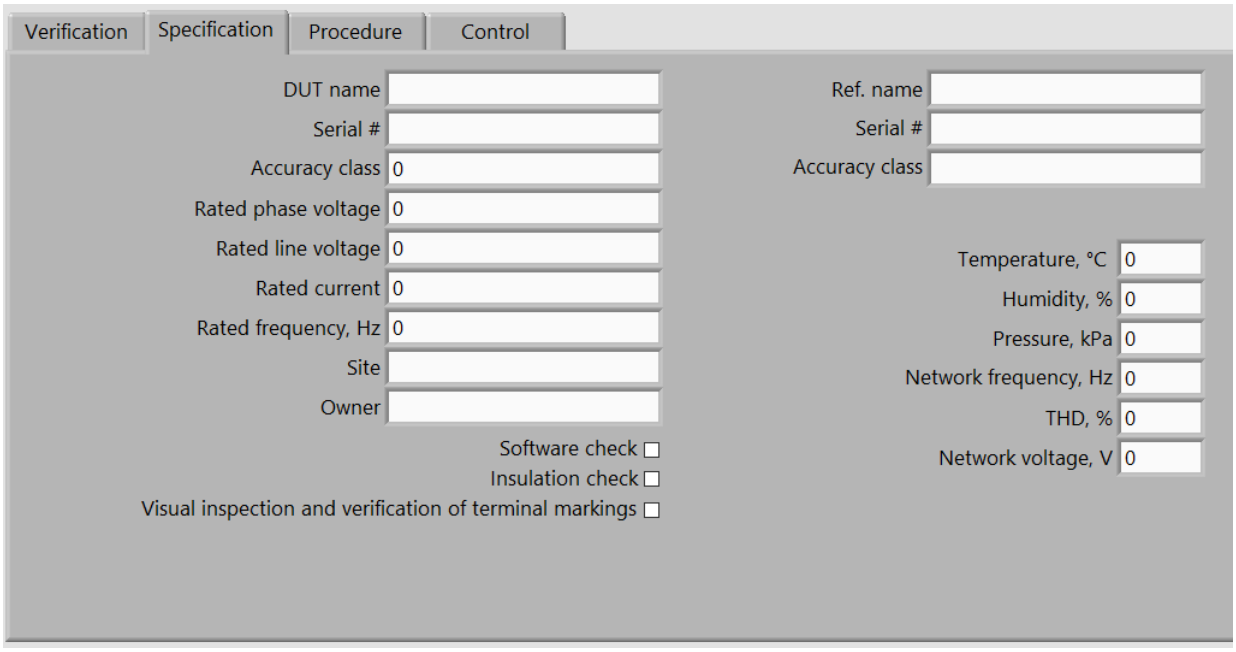


Click “**Add** line” to add a line with actual readings to the table. Please note that just the readings for the channels indicated by a check mark will be added. The “Delete line” button will delete the latest record. The “**Open in other window**” button is used to open tables for all 4 phases.

Click “**Save**” to save current records to a file. Thus, a verification procedure can be interrupted, saved to a file and then resumed with the “**Load**” button.

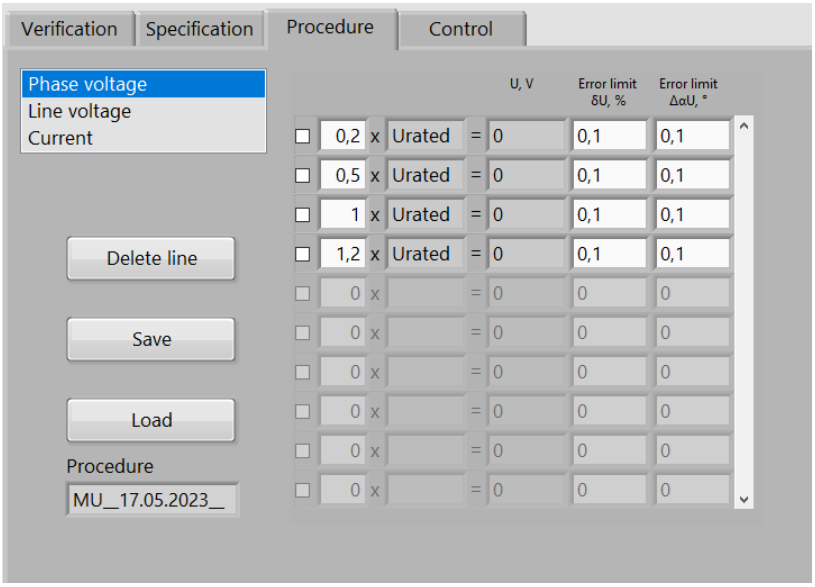
Click “**Export report**” to generate a test report (pdf file).

3.3.2.2 Specification

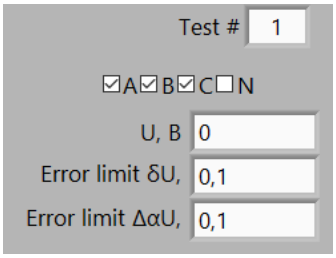


The “Specification” tab contains fields where the nameplate data for the tested device, reference device and test conditions are specified.

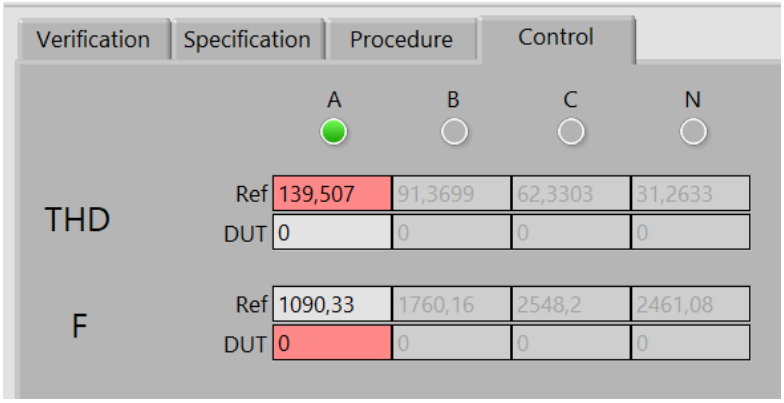
3.3.2.3 Procedure



The tab is optional, and its fields can remain empty. However, with these fields the user can specify a verification procedure as a set of test points, save it to a file with the "**Save**" button and then activate it at any time with the "**Load**" button, if necessary. Then, if specified, these test points are displayed in the Verification tab as pop-up tips for signals to be applied to the tested device.

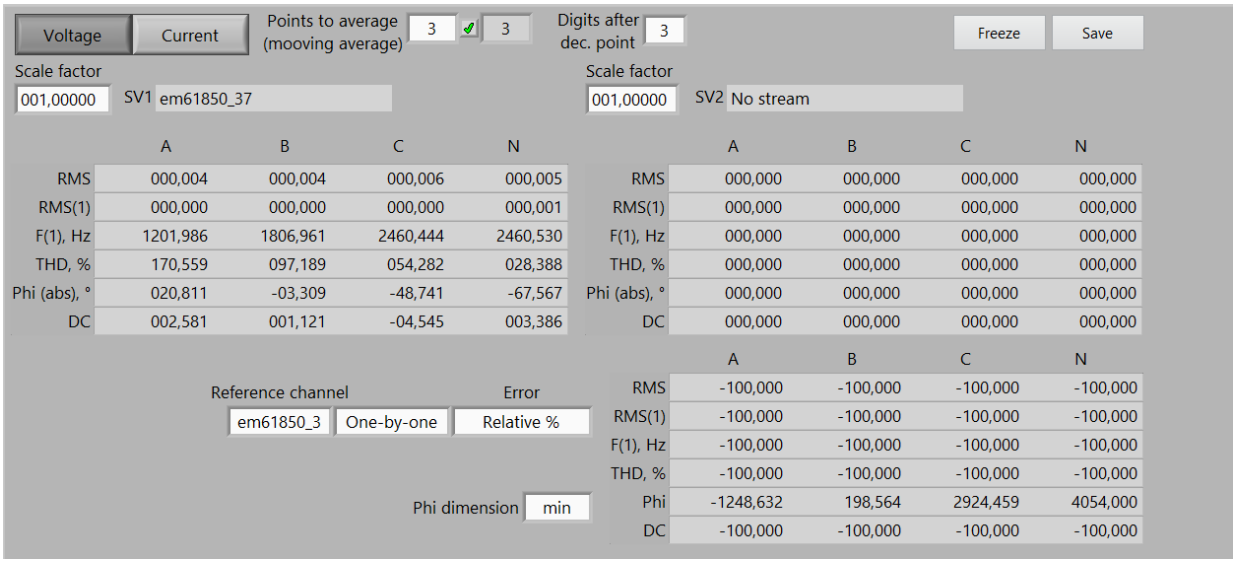


3.3.2.4 Control



The Control menu is used to keep watch on signal quality by monitoring such parameters as total harmonic distortion (THD) and the difference in frequencies of the tested and reference merging units (F). The parameters are highlighted, if their values fall outside the permissible range. Verification is useless and cannot be performed if THD is more than 5% and F is more than 0.001 Hz. Please note that the quality is checked just for the channels marked in the verification tab.

3.4 Streams



This is a two-channel verification mode that makes it possible to compare 2 streams across all voltage or current phases. The streams to be compared are configured in the same way as described for the Comparator tab.

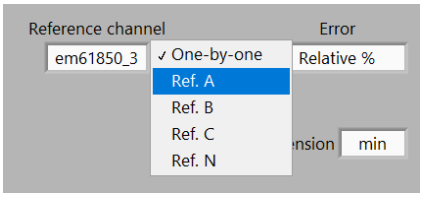
Fields:

Scale factors (these fields are adjacent to those with the names of streams) – set the multipliers to be applied to the RMS and RMS (1) readings of the corresponding streams.

Reference channel – this drop-down list is used to select one of the streams as a reference stream. The adjacent list is used to select one of the phases as a reference phase.

The **One-by-one** option means that each phase signal from one stream will be compared with the corresponding phase signal from another stream.

The **Error** field makes it possible to select the type of error: absolute or relative.



Note! Phase shifts of an external and internal stream can only be compared if the sources of these streams are synchronized. If 2 external streams are compared, the synchronization mode of the EM61850 is of no importance (see section 3.1.3).

3.5 Multimeter

3.5.1 U, I

em61850_37 | Points to average (moving average) 3 | 3

U, I | P, Q, S | Phasors | Harmonics | Oscilloscope

	Voltage A	Voltage B	Voltage C	Voltage N	Current A	Current B	Current C	Current N
RMS, V, A	000,004	000,004	000,006	000,005	000,000	000,000	000,000	000,000
RMS(1), V, A	000,000	000,000	000,000	000,001	000,000	000,000	000,000	000,000
DC, V, A	002,677	001,248	-04,797	003,753	-00,130	-00,120	-00,158	-00,098
Phi(abs), grad	-78,439	-13,270	022,204	008,142	-27,474	-71,603	-29,781	-04,383
F, Hz	425,063	2203,664	2459,840	2459,887	1883,354	803,392	2450,245	2180,975
THD, %	212,776	086,821	063,746	031,648	097,238	177,165	104,173	076,493

Digits after dec. point 3

Symmetry components

U1	000,12133	I1	000,00085
U2	000,11433	I2	000,00113
U0	000,02159	I0	000,00093
K2	094,22622	K2	133,14624
K0	030,81455	K0	109,61524

Fields:
RMS – RMS values of voltage/current
RMS (1) – RMS values of the 1st harmonic of voltage/current
DC – DC components of voltages and currents per each phase
Phi (abs) – absolute angles (between a voltage/current signal and PPS per each phase)
F – frequency
THD – Total harmonic distortion
Symmetrical components:
U1(I1) – positive sequence components
U2(I2) – negative sequence component
U0 (I0) – zero sequence component
K2 – negative sequence ratio
K0 – zero sequence ratio

$$K2 = \frac{U2(I2)}{U1(I1)}$$

$$K0 = \frac{U0(I0)}{U1(I1)}$$

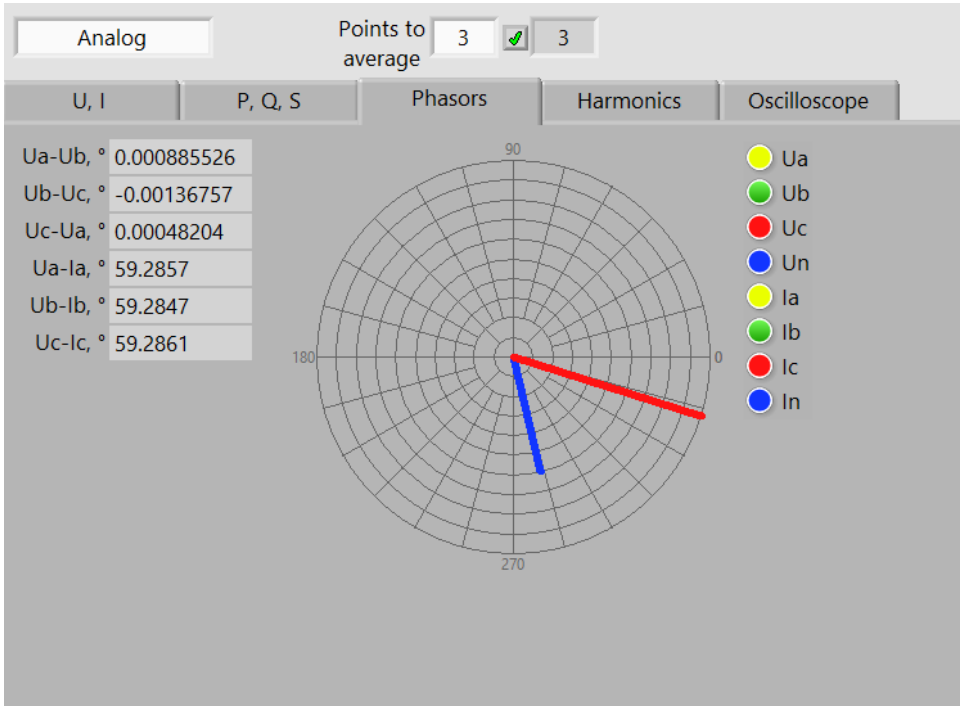
3.5.2 P, Q, S

U, I | P, Q, S | Phasors | Harmonics | Oscilloscope

	A	B	C	N	Sum
U, V	56.9994	56.9996	56.9996	56.9994	
I, A	5.00004	4.99996	5.00004	5.00004	
P, W	142.501	142.499	142.498		427.498
Q, Var	246.816	246.813	246.819		740.448
S, VA	284.999	284.996	285.001		854.996
PF	0.500004	0.500003	0.499993		0.5
P(1), W	142.501	142.499	142.498		427.498
Q(1), Var	246.816	246.813	246.819		740.448
S(1), VA	284.999	284.996	285.001		854.996
cos(phi)1	0.500004	0.500003	0.499993		
sin(phi)1	0.866023	0.866024	0.86603		
U^I, °	59.99972	59.99981	60.00047		
Bd type	0.5L	0.5L	0.5L	0.5L	

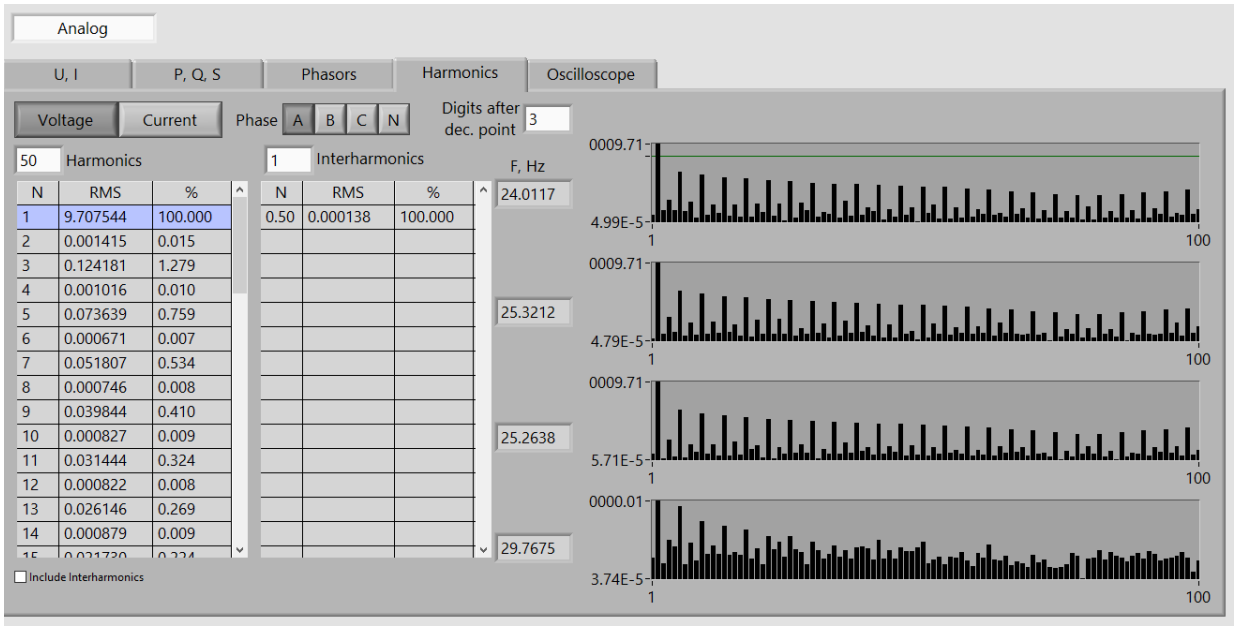
Fields:
U, V – RMS values of voltage
I, A – RMS values of current
P, W – active power
Q, Var – reactive power
S, VA – apparent power
PF – power factor
P(1), W – active power of the 1st harmonic
Q (1), Var – reactive power of the 1st harmonic
S (1), VA – apparent power of the 1st harmonic
Cos(phi)1 – cosine of the angle between the 1st harmonics of voltage and current
Sin(phi)1 – sine of the angle between the 1st harmonics of voltage and current
U^I – angle between the 1st harmonics of voltage and current per each phase
Bd type – type of burden
Sum – the fields relate to the corresponding parameters of a three-phase system (ABC)

3.5.3 Phasors



The tab "**Phasors**" displays numeric values of phase shifts among signals in the channels. The vector diagram shows phasors (angles with respect to PPS).

3.5.4 Harmonics



The buttons **Current/Voltage** allows you to select between current and voltage readings.

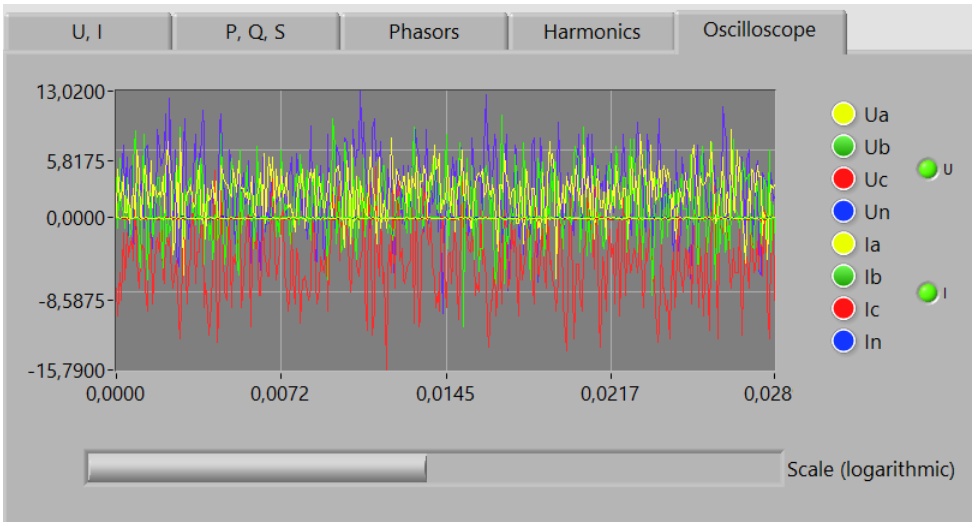
The **Phase** buttons are used to select a phase to be displayed.

The **Harmonics** field is used to specify a number of harmonics to be measured.

The **Interharmonics** field provides the same for interharmonics.

Four amplitude graphs related to phases A, B, C, and N are displayed on the right. Harmonic or interharmonic numbers are displayed along the horizontal axis. The vertical axis corresponds to magnitudes.

3.5.5 Oscilloscope



In the **Oscilloscope** mode, the waveforms on the selected channels (based on the measurements over the latest second) are displayed. At the leftmost position of the logarithmic scaling slider the amplitudes within 0 to 0.001 s are plotted. By moving the slider to the rightmost position you can view the complete 1-second curves.

APPENDIX 1

VERIFICATION REPORT

Type: analogue voltage transformer
Name:
Accuracy class: 0.1
Serial No: 1
Rated primary voltage: 1000 V
Rated secondary voltage: 5 V
Rated frequency: 50 Hz
Site: Saint Petersburg
Owner: Company
Last verification date, time: 01.01.2021

Reference means of verification:

	Reference standard:	Comparator:
Name	Reference 1	Energomonitor-61850
Serial No	1	1
Accuracy class	0.01	0.02

Conditions during verification:
Temperature 20 °C, Humidity 70 %
Atmospheric pressure 100 kPa
Network frequency 50 Hz, network
THD 0.1, %, network voltage 220 V

1) Visual inspection and verification of terminal markings: pass
pass, fail

2) Software check: pass
pass, fail

3) Insulation check: pass
pass, fail

4) Accuracy test results:

U/Un, %	S, VA	DUT error	
		δ_f, %	$\Delta\delta$, min
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Summary result _____
pass, fail

Verification performed by _____ _____ 18.08.2022
Signature Name and surname Date

INSTALLING EM-61850EXT ON ANOTHER COMPUTER

When installing the program on another PC, some aspects that need to be considered are as follows:

a) EM-61850 has no DHCP server, thus, to provide connection between the EM-61850 and a client computer, it is necessary to set up a static IP address of LAN or WLAN of the client.

For example:

	WLAN	LAN
IP address	192.168.0.11	192.168.0.10
Subnet mask	255.255.255.0	255.255.255.0

b) EM-61850 uses the following IP addresses:

WLAN	LAN
192.168.0.111 (for connection)	192.168.101 (for connection) 192.168.0.2 (in-service) 192.168.0.3 (in service)