EnergoMonitor-61850EXT

Version 0.4.5

User Manual

2020

Contents

Scope

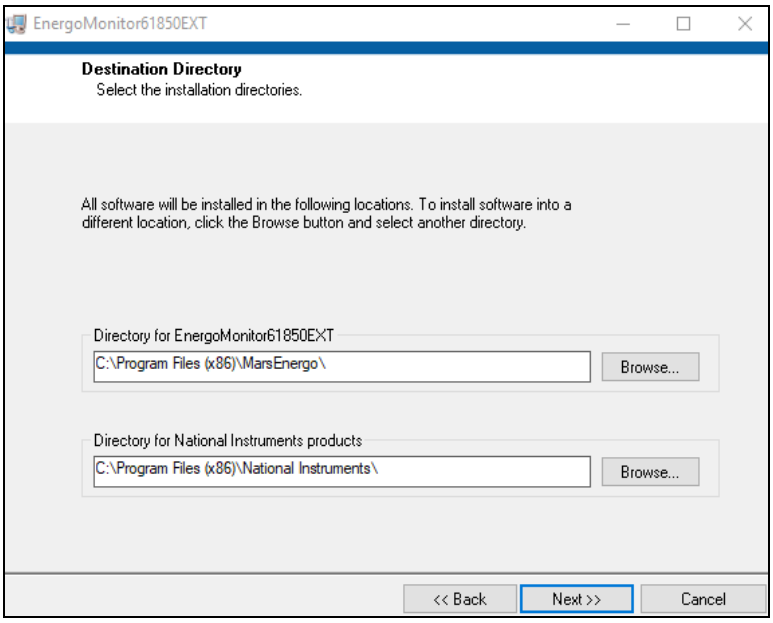
The EnergoMonitor-61850EXT program (the Program below) is a software component designed to work with the multifunctional reference meter Energomonitor-61850 (EM61850 below). The Program is used to configure EM61850 and take control of measurement results.

The Program works under Windows 7, 8, 10.

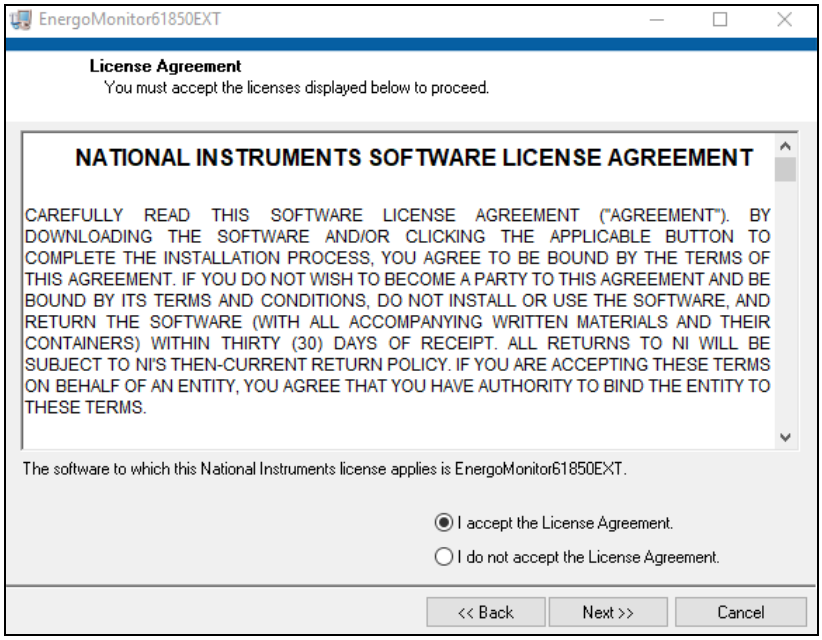
1 INSTALLATION

1.1 Run the installer **setup.exe**

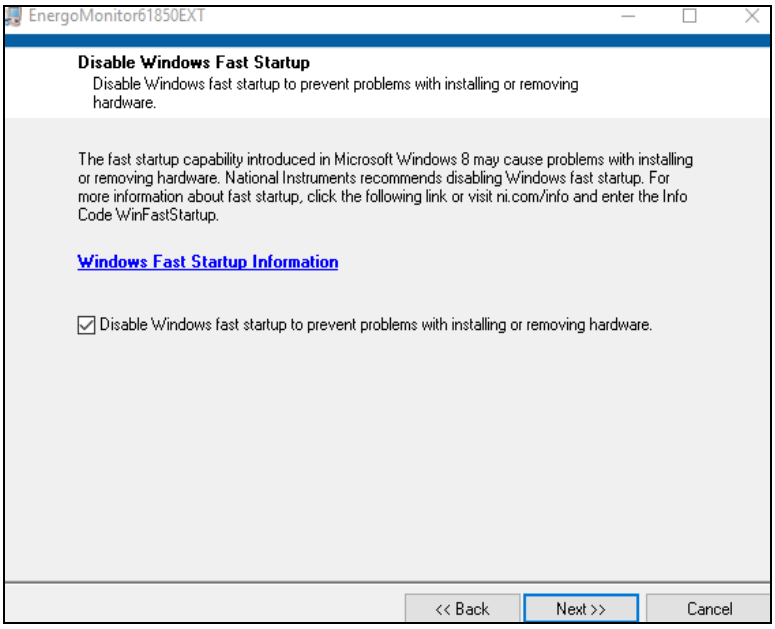
1.2 Click on **Next**



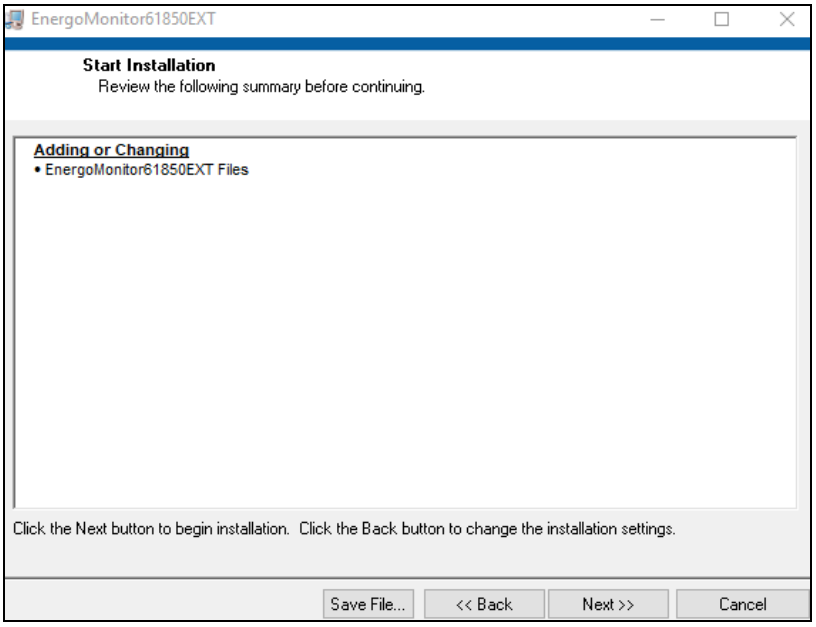
1.3 Select **I accept the License Agreement**. Click on **Next**



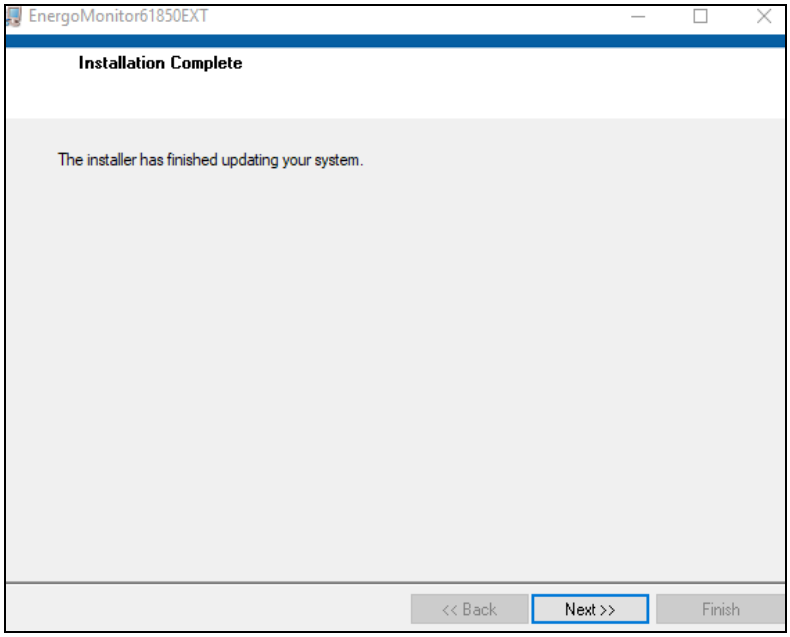
1.4 Click on **Next**



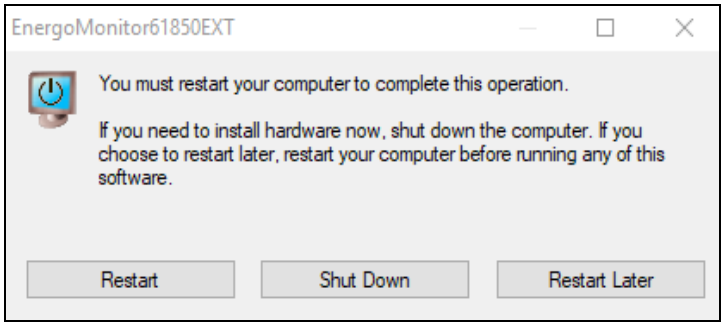
1.5 Click on **Next.** Wait for the installation to complete.



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

2.2. Launch the program EM61850EXT. In case of successful connection the indicator in the lower right corner will be displayed as shown in the figure below.
The connection can be configured in the menu Settings → Connection (see section 3.1.5).

3 OPERATING THE PROGRAM

3.1. Settings

3.1.1 ADC

3.1.1.1 Selecting measuring ranges

On the screen you can select required ranges for analogue current or voltage inputs. The ranges are activated on clicking **Apply**. When a current range is being changed, EM61850 emits 4 specific clicks. Voltage ranges are switched soundlessly.

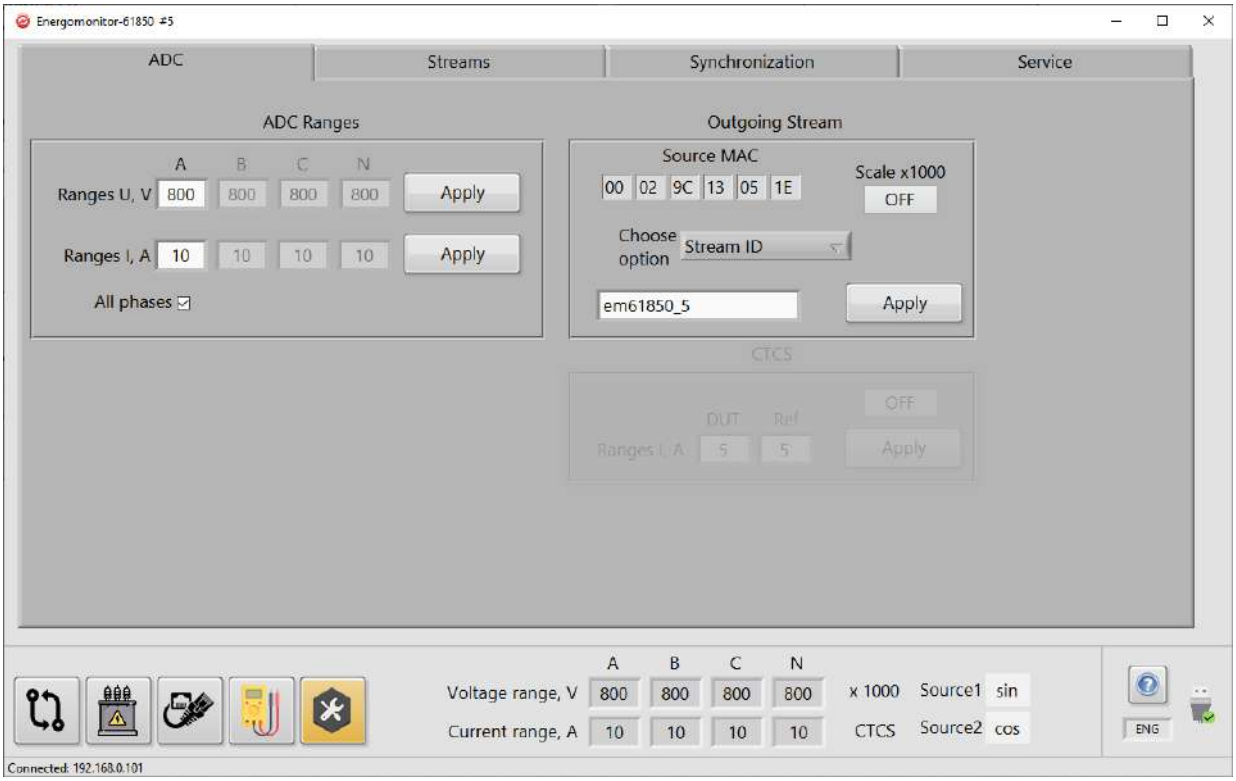
Caution!

The EM61850 controls its analogue inputs automatically:

On applying a value of current or voltage higher than 125% of a measurement range active at the moment to the input(s), the EN61850 will automatically set the corresponding range to the maximum one. The ranges with maximum ratings are as follows: 800 V for the voltage inputs, 10A for the current inputs 12A, and 100A for the current inputs 120 A.

Nevertheless, it is not recommended to apply signals over 125% of the nominal range value to the inputs, since this may damage the inputs or affect the accuracy of measurements due to the ADC overflow.

In the mode of comparison of two external streams External SV1 – External SV2 (see section 3.1.2), the automatic control of the inputs is not available



3.1.1.2 Configuring the outgoing stream

The outgoing stream, generated by the own (internal) ADC module of EM61850 according to IEC 61850-9-2, contains the digital replicas of input analogue signals: 4 input currents and 4 input voltages. The MAC address of the stream source (**ADC MAC**) is displayed as reference

information. The parameters of the stream are selected from the **Parameter** drop-down list among the following options:

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: 20, 24, 80, 96, 256, 288, 640 1280 samples per a period of the rated network frequency.

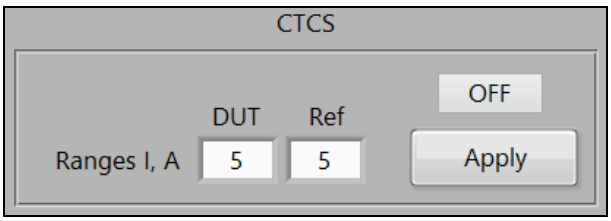
VLAN ID – is the subnetwork identifier of the stream.

APPID – is the application identifier.

Transform ratio – transformer ratio (equals 1 by default)

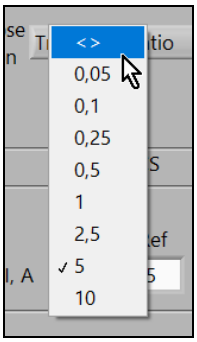
The **Scale x1000** button enables a scaling factor that may be applied to the voltage ranges 1V, 2V and current ranges 0.1A, 0.25A. When the factor is active, the **Scales x1000** indicator is displayed at the bottom of the screen. The button is activated to measure low currents and voltages. At this time, the readings RMS and RMS (1) are displayed in mV (voltage) and mA (current).

3.1.1.3 Configuring CTCS

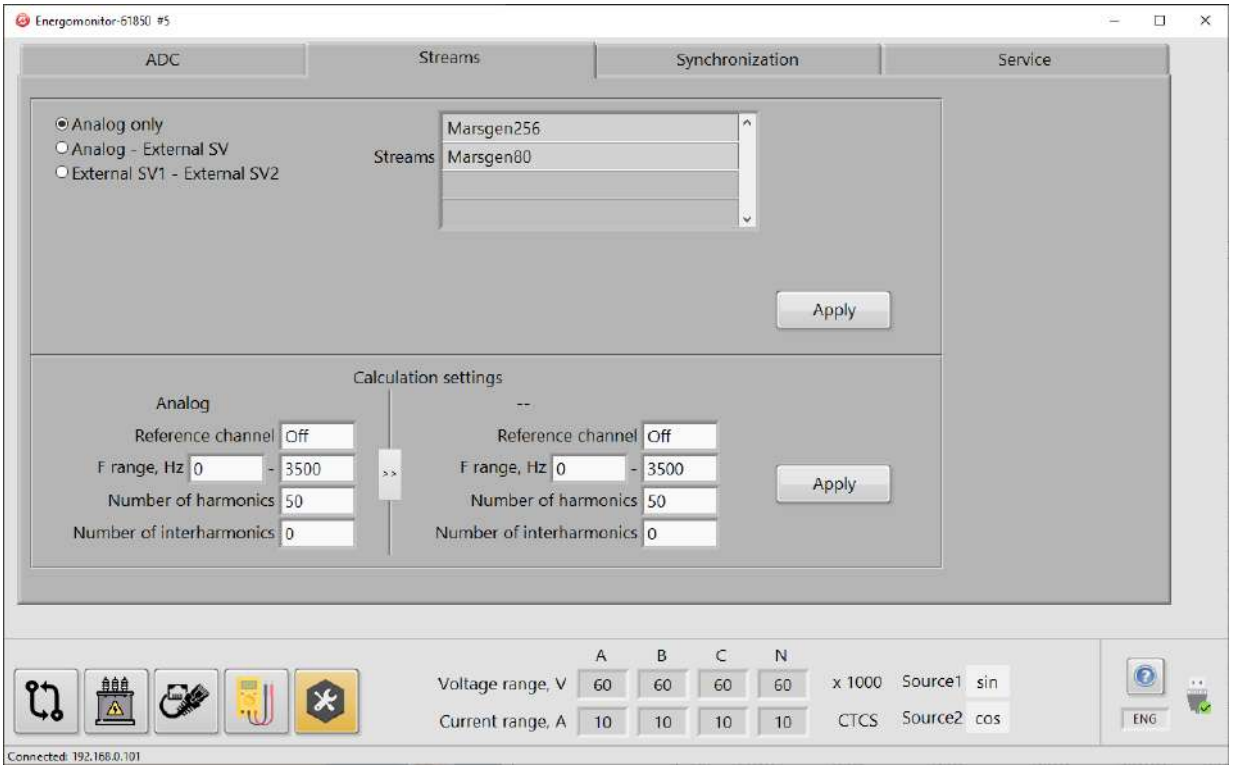


Note! This information relates to the versions operating with the instruments complete with the Current Transformer Calibration Switch (CTCS).

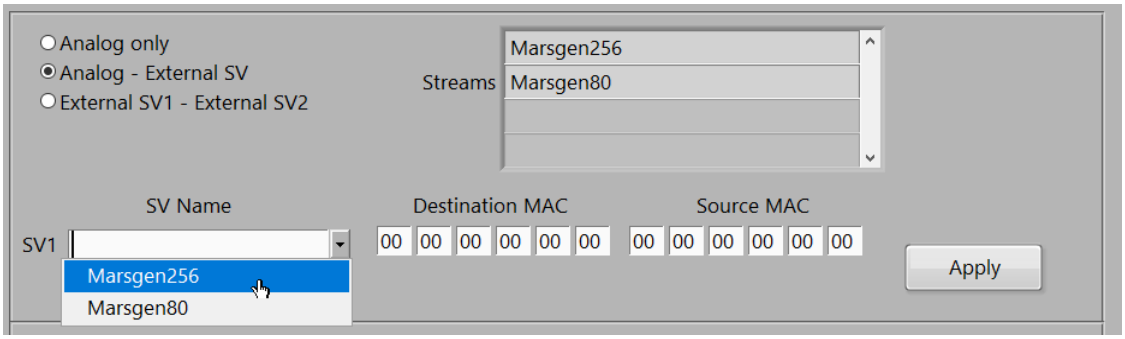
The **ON/OFF** button enables the mode of operation with the CTCS. Within an outgoing stream, the readings from the inputs of the CTCS are assigned to the phases Ib and Ic. The button **Apply** makes it possible to select one of 8 measurement ranges available: 0.05, 0.1, 0.25, 0.5, 1, 2.5, 5, 10 A. The selection of the option < > (shown in the figure below) breaks the current circuit.



3.1.2 Streams



Selecting a stream:



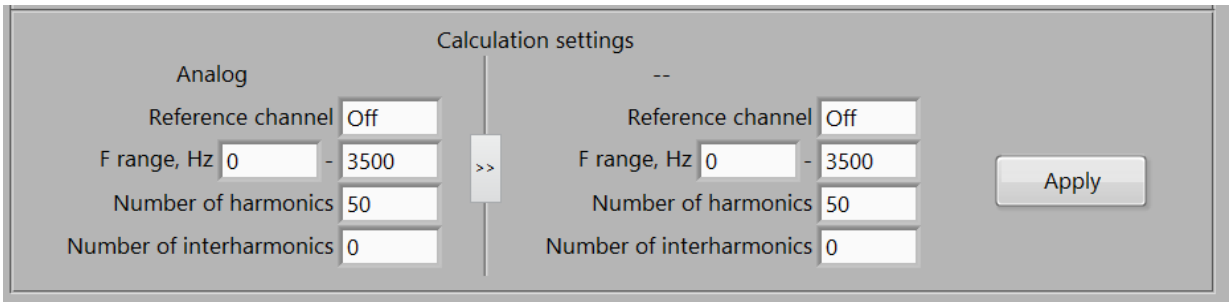
When external streams are connected to the EXT input, the names of the streams will be automatically displayed in the **Streams** list.

When the **Analog only** option is selected, the mode of accepting external streams is disabled, and the comparison of streams is not available

Selection of the **Analog – External SV** option enables the mode of comparison of an analog signal and an external stream (analogue – digital comparison). At this time, the corresponding field, where a required external stream may be selected, becomes accessible.

Selection of the **External SV1 – External SV2** option enables the mode of comparison of 2 external streams (digital – digital).

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 analog signal or for a digital stream selected can be made. The right part represents the calculation settings for an external stream only. In addition, such options as the number of harmonics and interharmoncs are backed up in the tab Multimeter >> Harmonics.

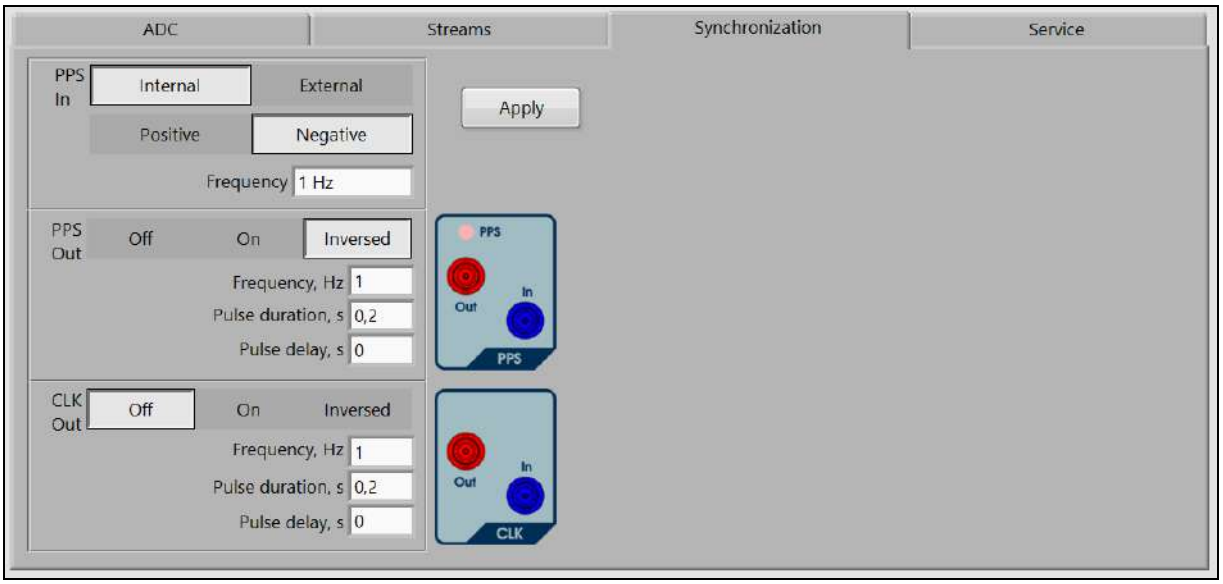
The **Frequency range** (**F range**) option sets a range across which the search for the fundamental frequency is performed. Calculation of frequency in a polyphase system is based on a signal in a channel configured as the reference channel. The corresponding **Reference channel** field contains the following options:

- **Auto:** The channel Ua is taken as the reference. If the RMS signal value in the reference channel appears to be less than 10% of an active measurement range, the first channel where the RMS signal value exceeds the 10% threshold will be selected as the reference 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.

- Selection among: **Ua, Ub, Uc, Un, Ia, Ib, Ic, In**. The frequency of the selected channel is taken for the frequency of the system.

3.1.3 Synchronization



There are 2 modes of synchronization: internal (with an internal quartz generator) and external.

To use an external source of PPS (pulse per second) signal, choose the **External** button among the **PPS $_{In}$** options.

To enable the internal source of PPS signal, select the **Internal** option.

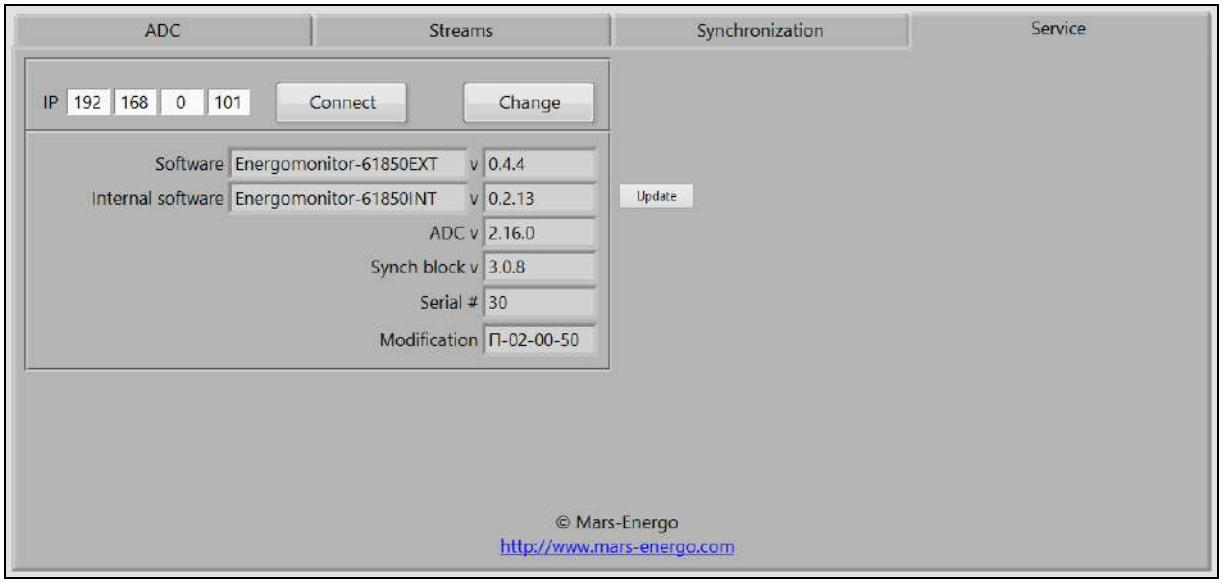
To transmit PPS signal from the EM61850 to external devices, among the **PPS $_{Out}$** options choose **On** or **Inversed**.

Click on **Apply** to send the settings to the instrument.

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

The **CLK out** panel serves in the same way as **PPS out**.

3.1.4 Service



This tab contains the information about actual firmware versions.

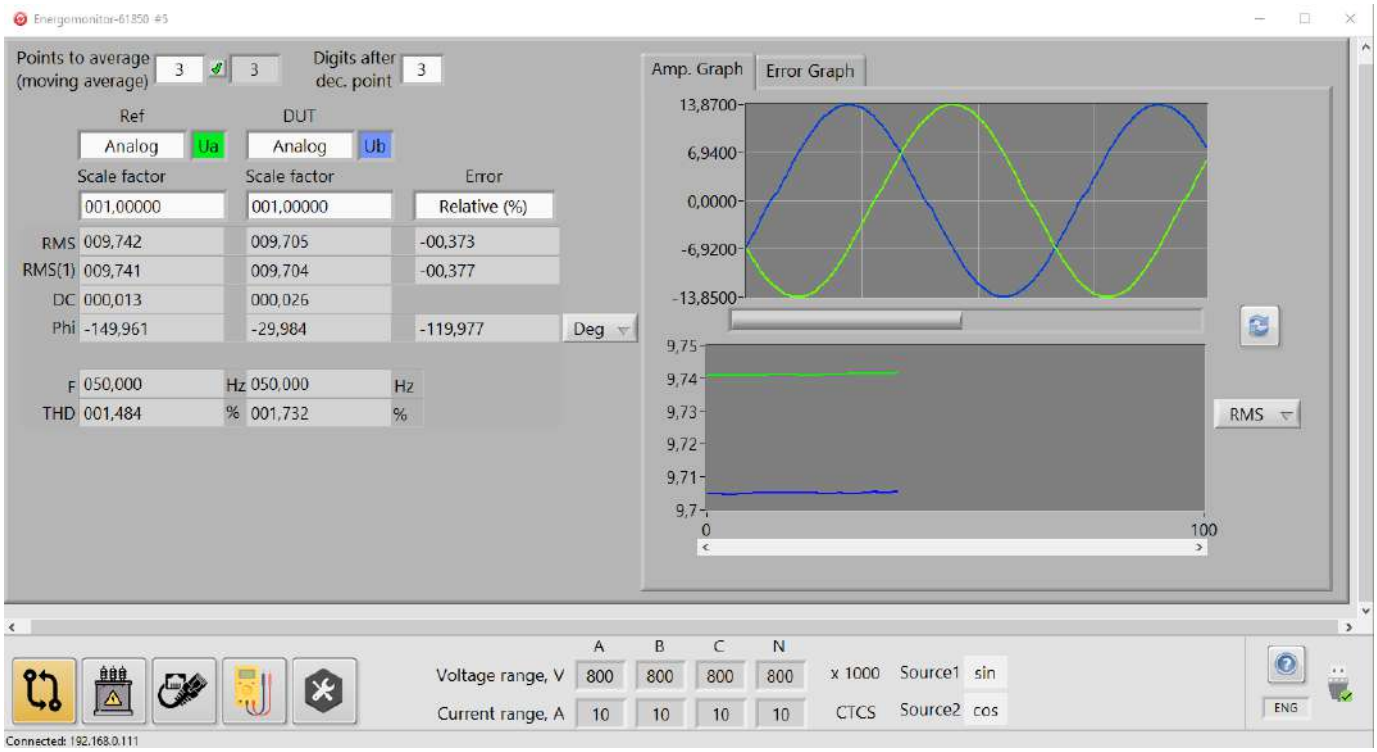
The **Connect** button is used to connect the EM61850 with the specified IP address to the Program.

The **Change** button will be functional in future program versions.

The **Change** button is added to make it possible to change an active IP address of the EM61850 to a new one (if the IP address has been changed, to apply a new one, it is necessary to turn the power of the EM61850 off and turn it on again).

The **Update** button downloads a new firmware version.

3.2. Comparator



3.2.1 General information

The mode is used to compare signals on two phase inputs. The signals may relate to one stream or to different streams.

Measurements are performed once per second.

Meanings of the fields:

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

RMS – shows the RMS value of a voltage or current signal selected in the corresponding field

RMS(1) – shows the RMS value of the first harmonic of this signal

DC – shows the DC component value of this signal

Phi – displays the phase shift (measurement units are selected in the field below)

Error – displays the calculated values of measurement error (relative or absolute)

Relative (%) is the error calculated according to the formula:

Relative_Error = (Ref - DUT) / DUT * 100

Absolute is the error calculated according to the formula:

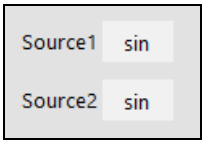
Absolute_Error = DUT – Ref

Note! The values of phase shift error are always calculated according to the second (**absolute error** calculation) formula.

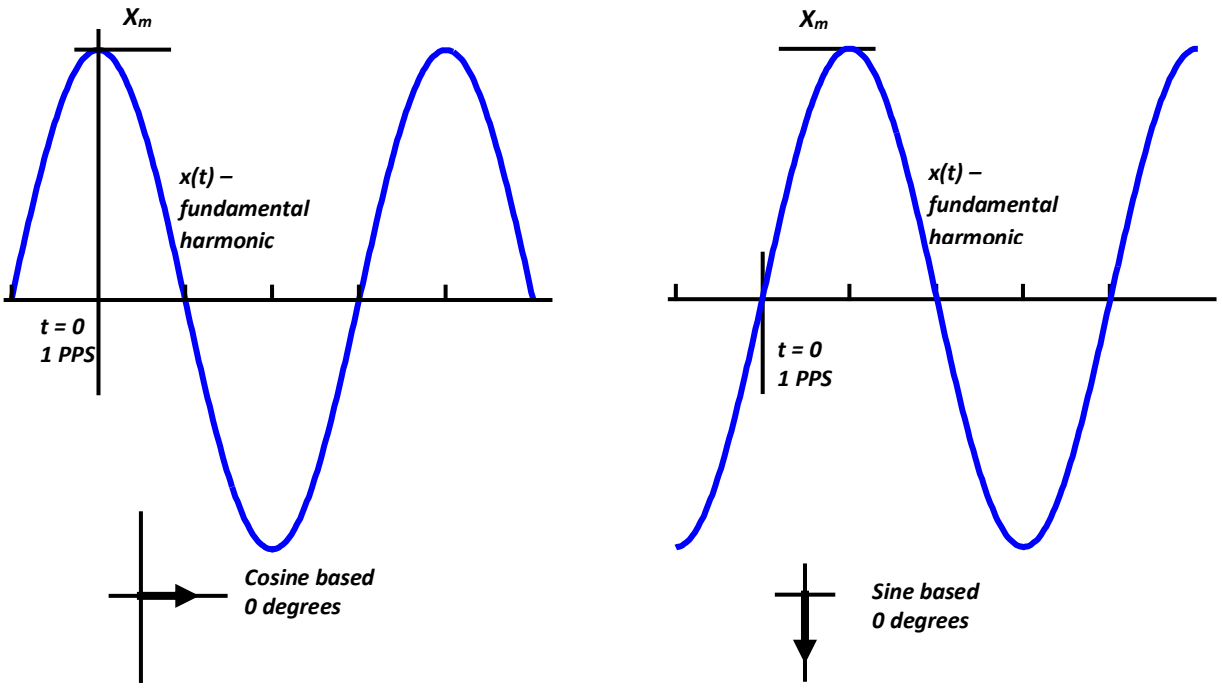
F – shows the frequency of the first harmonic of the corresponding signal

THD – shows its total harmonic distortion

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



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 second to the next) matches the curve of the fundamental signal harmonic at its maximum.

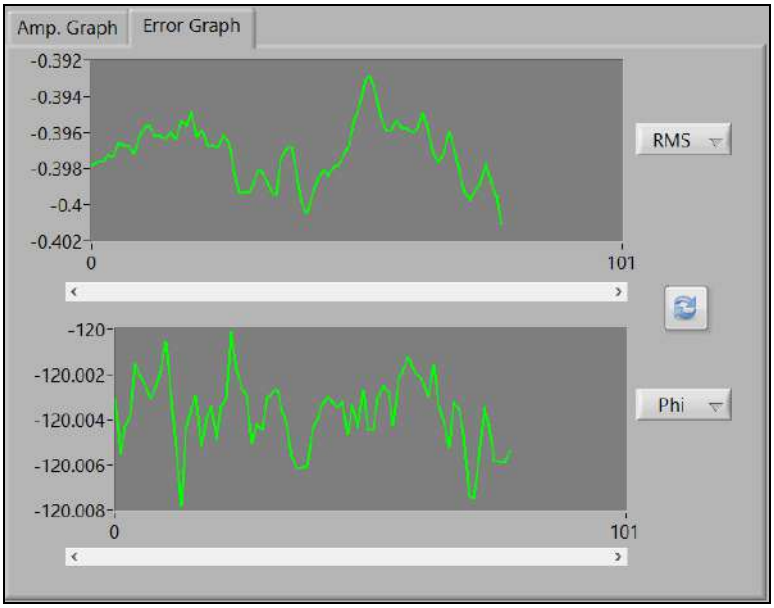
Sine based: the phase offset is assumed to be zero, if a time stamp (at the moment of going from one second to the next) matches the curve of the fundamental signal harmonic when it crosses the X axis from below.

3.2.2 Amplitude graphs

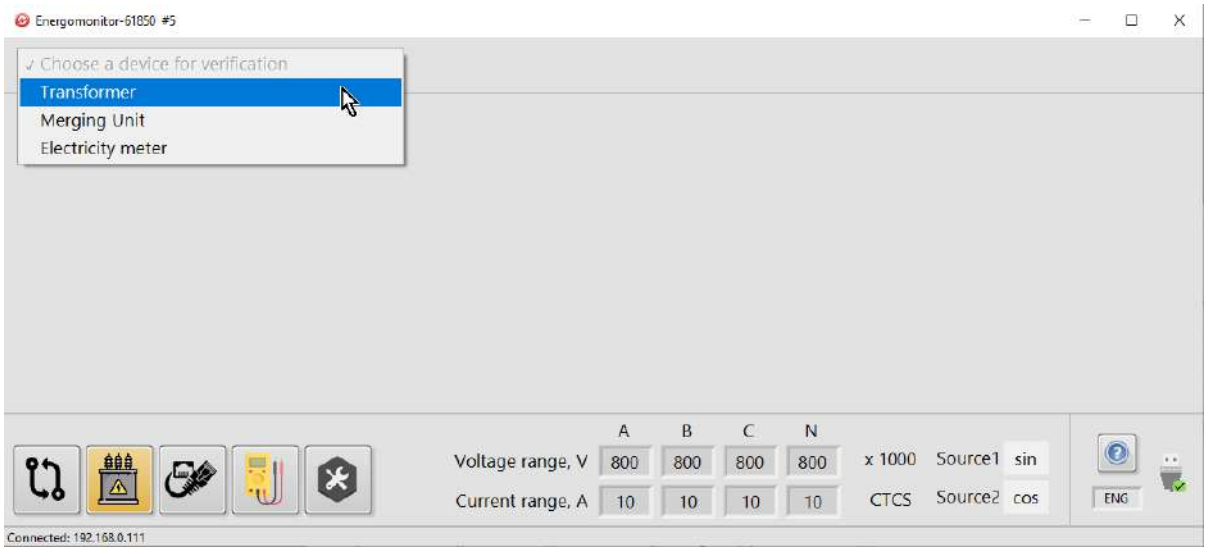
A set of the amplitude curves of compared signals measured over 1 second is displayed on the upper graph panel. The horizontal axis contains fractions of a second adjusted with a slider **Scale**. By moving the slider to the rightmost position you can view the complete 1-second graph.

The lower graph panel represents the curves of the parameters selected from the drop-down list (RMS, RMS(1), Phi, F, DC, THD).

The error graphs located in the next tab are managed in the same way.



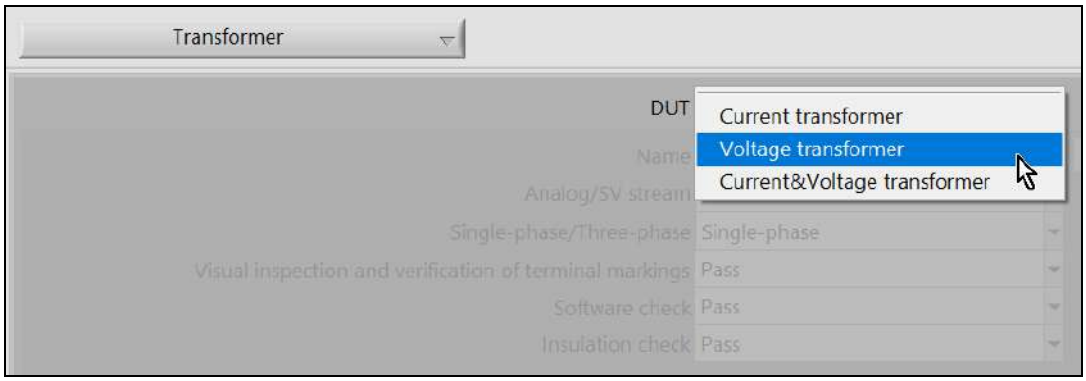
3.3 Verification



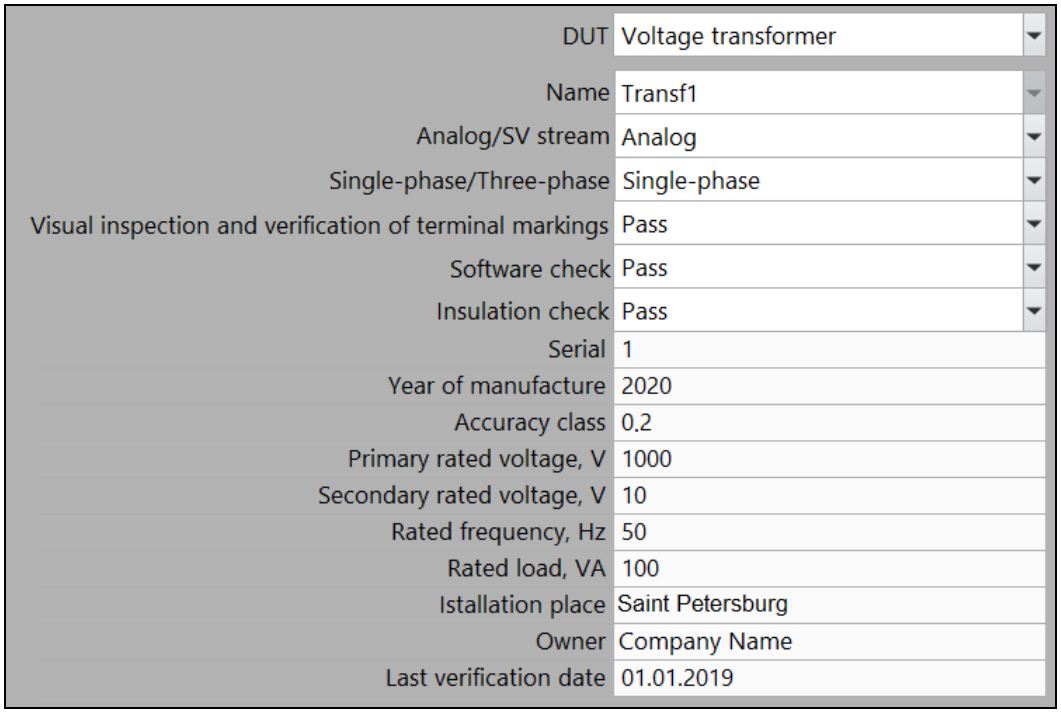
3.3.1 Verification of transformers

Full description for the accuracy testing (verification) of transformers is provided in the user manual for the Energomonitor 61850 (MC3.055.501 UM).

3.3.1.1 Specification tab for the transformer under test

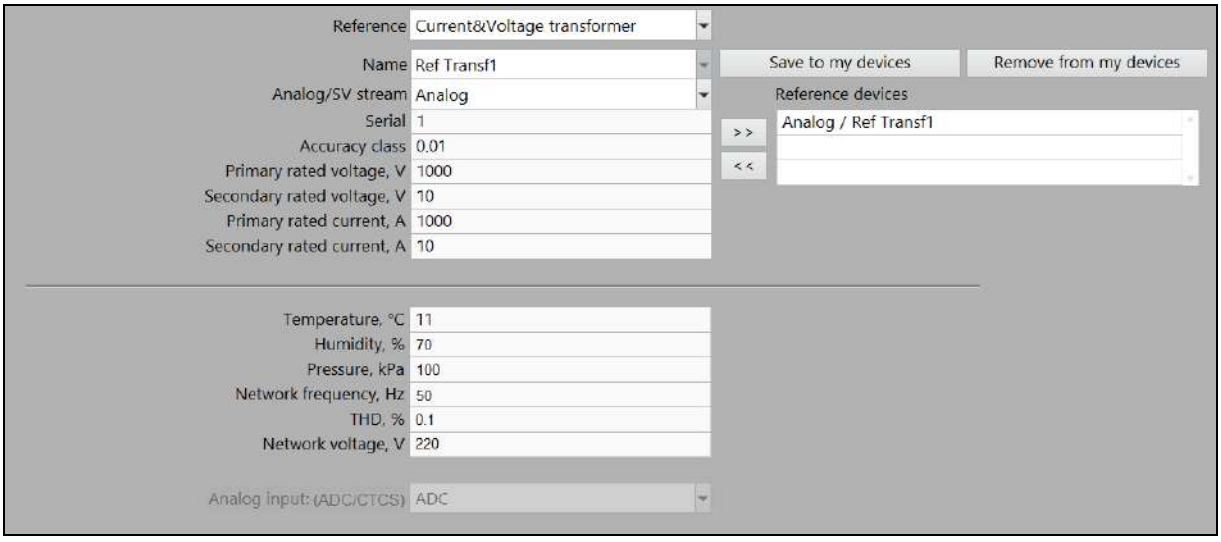


The fields for entering the details of the transformer under test (DUT) become accessible only if a transformer type has been selected.



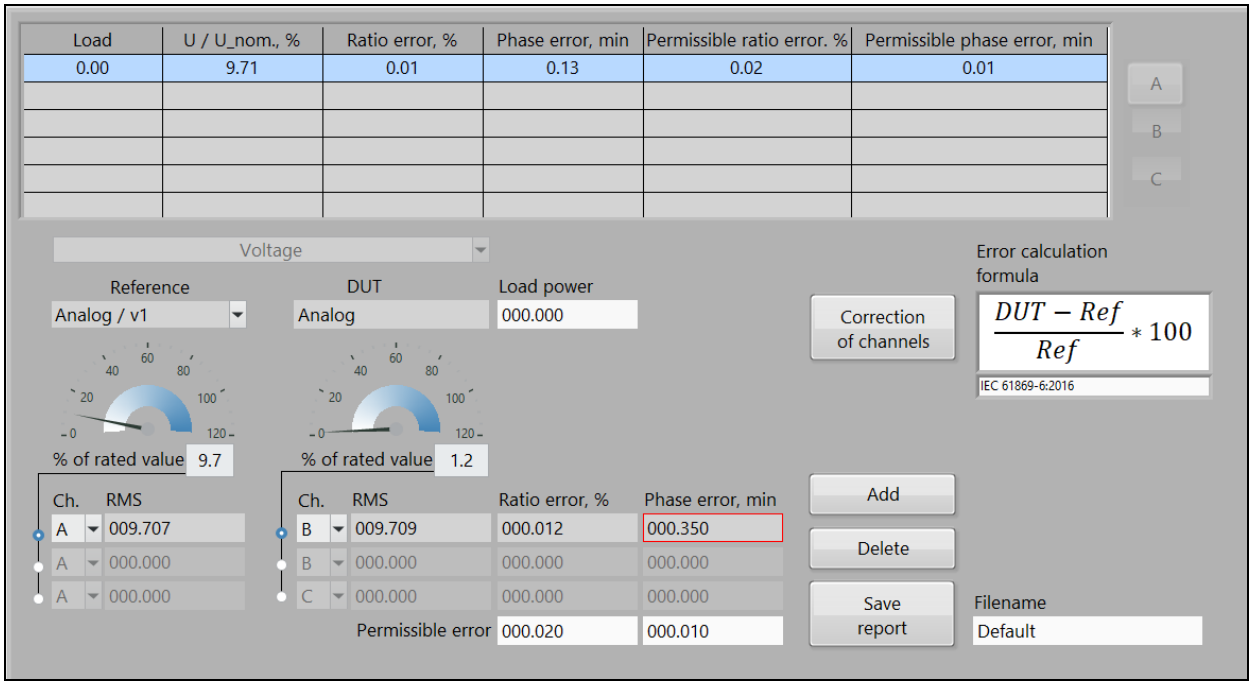
Note! The other tabs in the window are inaccessible if the fields **Primary rated voltage** (or **Primary rated current**) and **Secondary rated voltage** (or **Secondary rated current**) are not filled.

3.3.1.2 Specification tab for the reference transformer



If you have been selected a device saved earlier, its data will appear in the fields automatically.

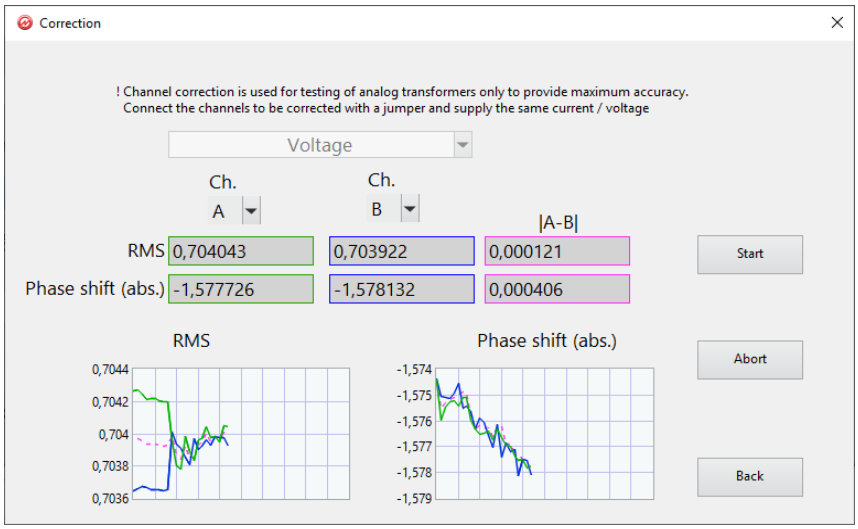
3.3.1.3 Performing verification



The tab is used to record measurement results in the table on the basis of which the test report is created (in the form of an rtf file). To add an actual reading to the table, press the **Add** button. To delete a record from the table, highlight it with the mouse and press the **Remove** button. To create a test report, press **Save**.

If readings in the fields **Ratio error, %** and **Phase error, min** exceed their permissible threshold values, the fields are highlighted in red.

3.3.1.4 Correction of channels



The procedure of channel correction should be performed before testing (verification) of analog current or voltage transformers to provide considerably better comparison accuracy.

The correction of channels mode is applicable to testing of conventional transformers only. Correction should be made in 30 min (or later) after applying power to the EM61850.

Note! Prior to starting the Correction mode make sure that the measurement range set in the EM-61850 is no less than the nominal value of the secondary of the reference transformer. Correction should be repeated each time after changing any measurement range.

To start correction, apply voltage/current to the primary of the reference transformer (that equals its primary rated value) and apply the voltage/current from the secondary of the reference transformer to the both voltage/current channels A and B of the EM61850.

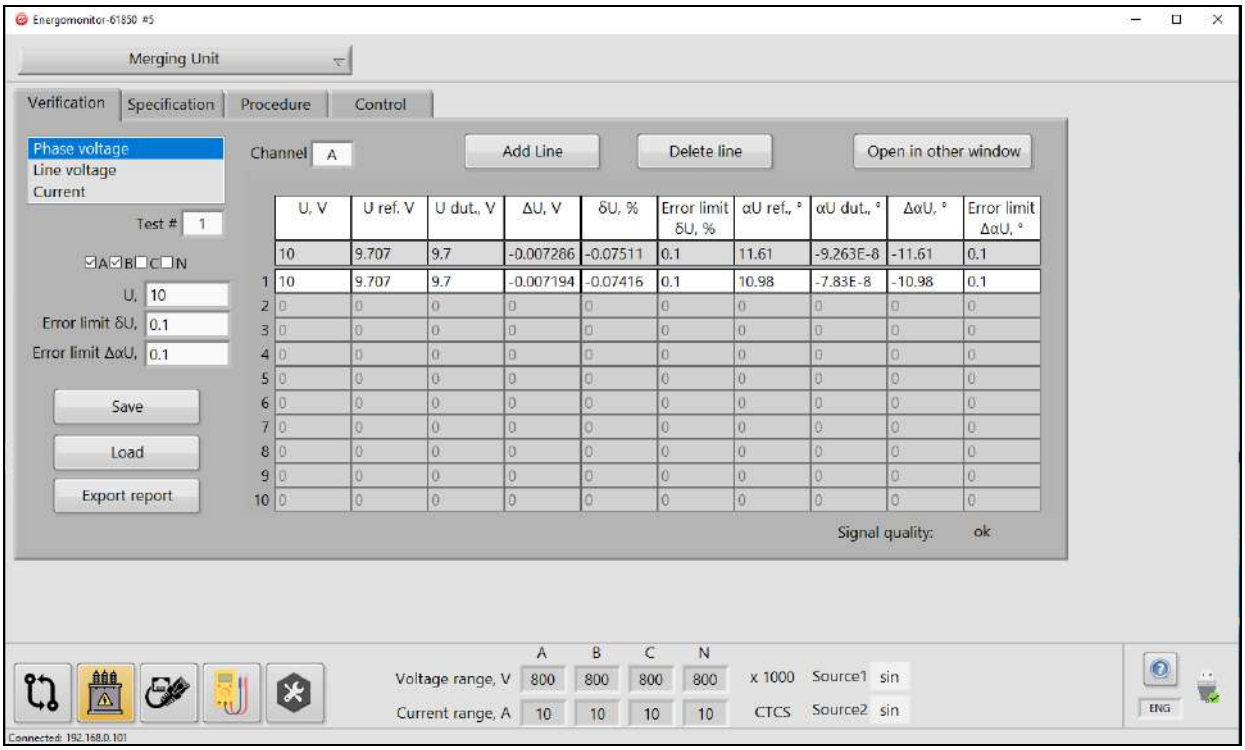
Click on the Start button. At this time, the EM-61850 will carry out correction, namely it will electronically compensate both amplitude and phase shift differences between signals in channels A and B.

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 after each measurement range change.

3.3.2 Verification of Merging Units

The Merging Unit menu allows the user to perform verification over all channels (phase voltages, line voltages and current).

3.3.2.1 Verification



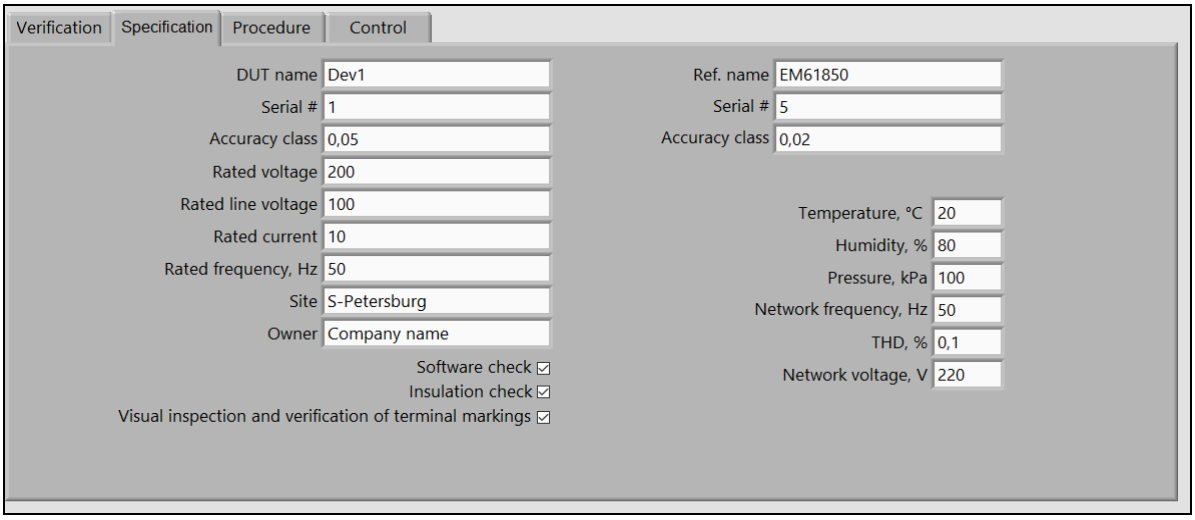
The **Add line** button adds an actual measurement (made for the channel selected in the top-left fields) to the table of measurements. The **Delete line** button deletes the latest record.

The **Open in other window** button allows the user to open the tables of measurements for all channels.

The **Save** button saves current test results to a file. Thus a verification procedure can be interrupted and then resumed by pressing the **Load** button.

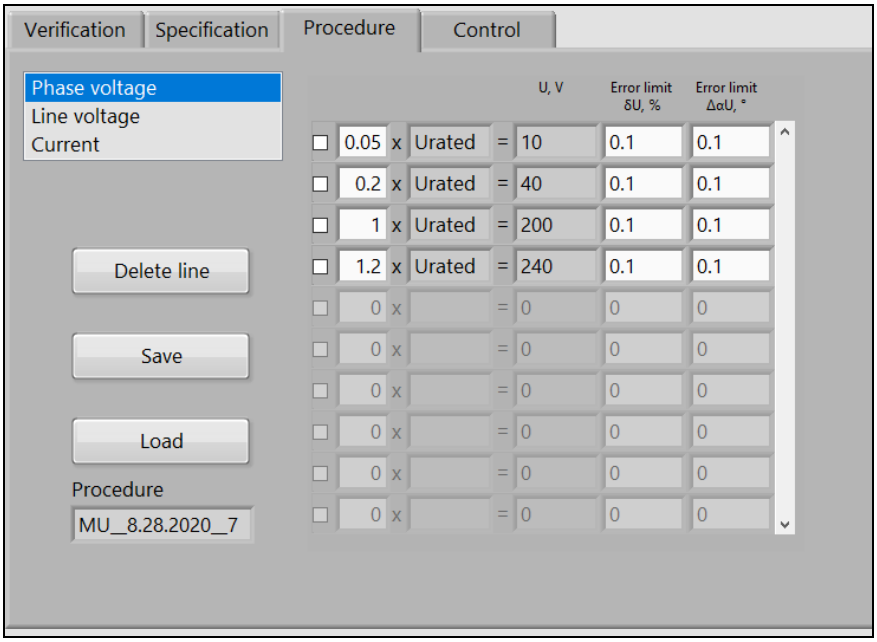
The **Export report** button is used to create a test report (in the form of an rtf file).

3.3.2.2 Specification

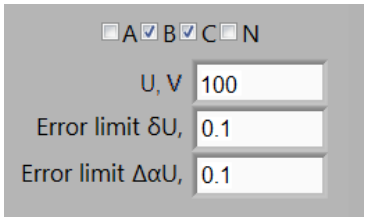


The **Specification** tab contains the fields where the data for the device under test, reference device and test conditions are specified.

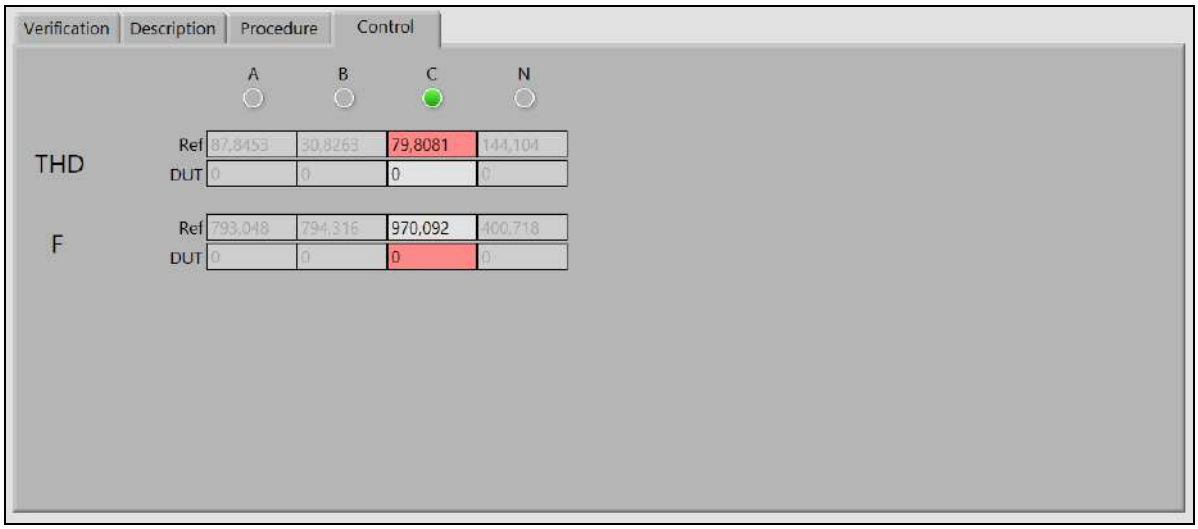
3.3.2.3 Procedure



The tab contains the fields where 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). The tab is optional, and the fields can remain empty. However, if specified, the test points are used in the Verification tab as pop-up tips for signals to be applied to the device under test.



3.3.2.4 Control

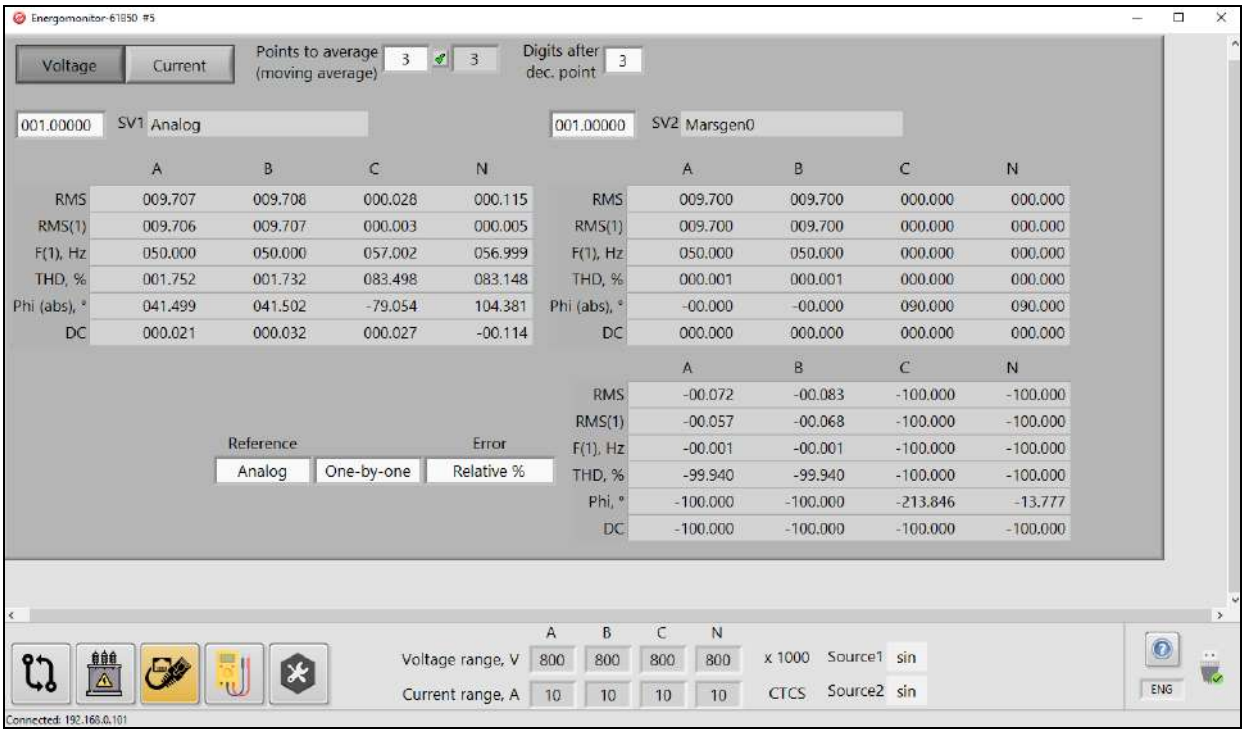


The Control menu is used to keep watch on the signal quality by monitoring such parameters as total harmonic distortion (THD) and the difference in frequencies of the merging unit under test and the reference one (F). The parameters are highlighted, if their values fall outside the permissible range. 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.

3.3.3 Verification of electrical energy meters

The function will be available in future versions.

3.4 Streams



The Streams mode makes it possible to compare 2 streams across all voltage or current phases. The streams are configures in the same way as described for the Comparator tab.

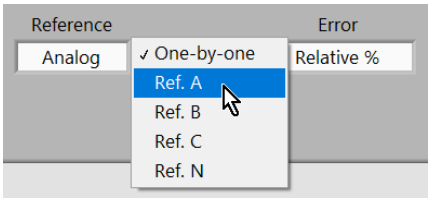
Fields:

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

Reference – this drop-down list makes it possible 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.

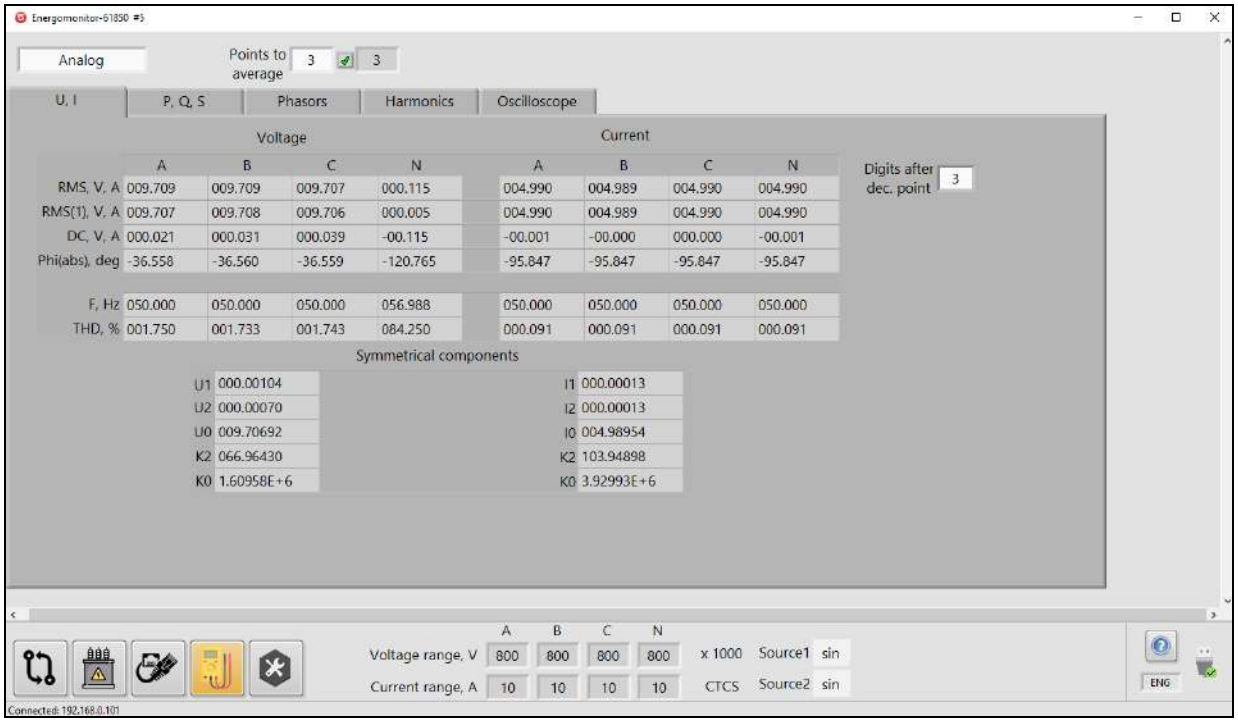
The **Error** field is used to select the error type (absolute or relative).



Note! The phase shifts of an internal and external stream can only be compared if the sources of these streams are synchronized. In the case of comparison of two external streams, the synchronization mode of EM61850 is of no importance (see section 3.1.3).

3.5 Multimeter

3.5.1 U, I



Fields:

RMS – RMS values of voltage/current

RMS (1) – RMS values of the 1st harmonics of voltage / current

Phi, deg – absolute angles (between voltage/current and PPS per each phase)

F – frequency

DC – DC components of voltages and currents per each phase

THD – Total harmonic distortion

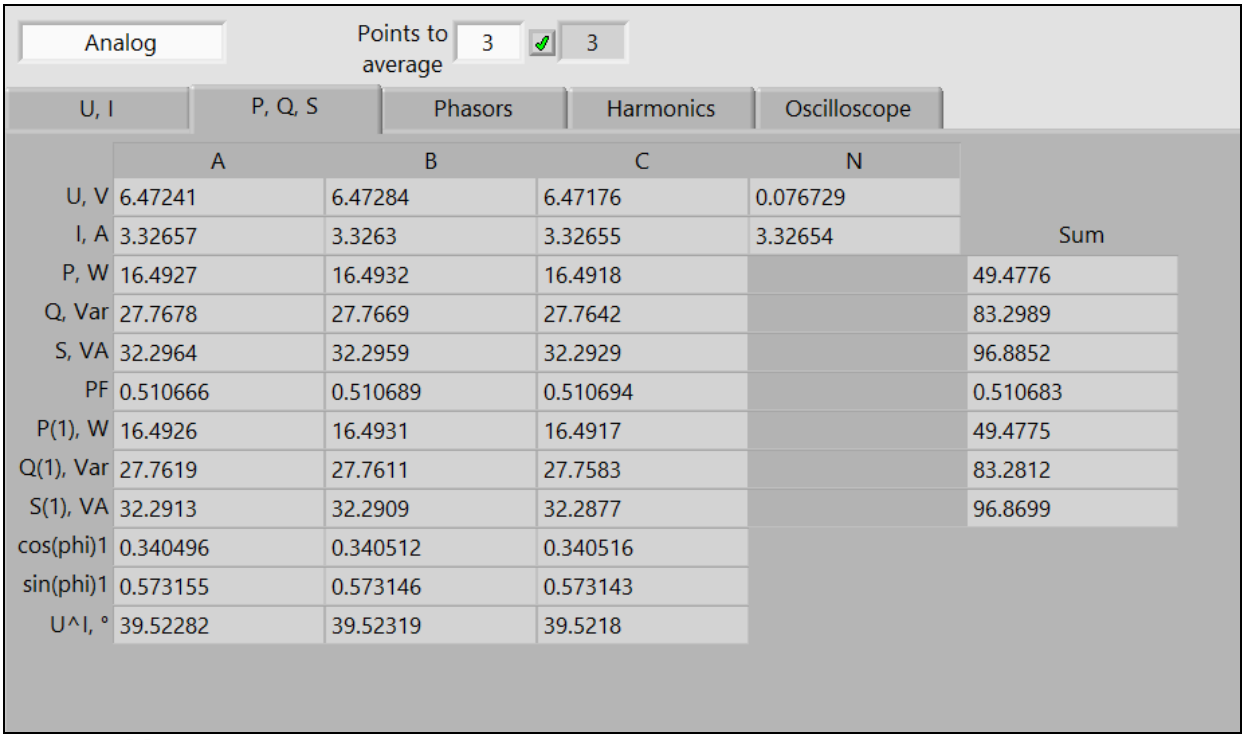
Symmetrical components:

U1(I1) – positive sequence component
U2(I2) – negative sequence component
U0 (I0) – zero sequence component
K2 – negative sequence ratio
K0 – zero sequence ratio

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

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

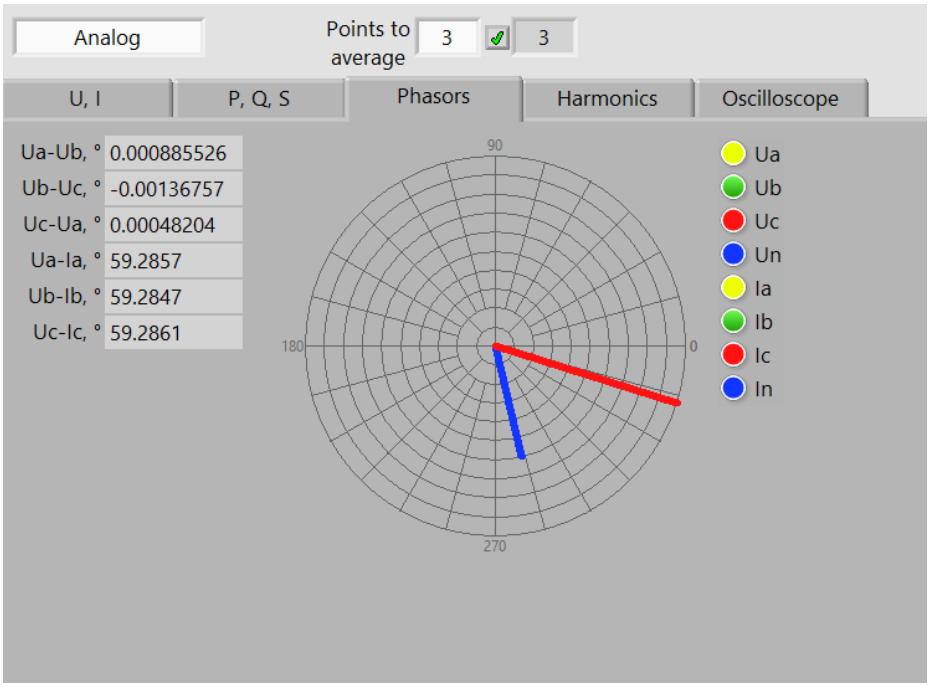
3.5.2 P, Q, S



	A	B	C	N	
U, V	6.47241	6.47284	6.47176	0.076729	
I, A	3.32657	3.3263	3.32655	3.32654	Sum
P, W	16.4927	16.4932	16.4918		49.4776
Q, Var	27.7678	27.7669	27.7642		83.2989
S, VA	32.2964	32.2959	32.2929		96.8852
PF	0.510666	0.510689	0.510694		0.510683
P(1), W	16.4926	16.4931	16.4917		49.4775
Q(1), Var	27.7619	27.7611	27.7583		83.2812
S(1), VA	32.2913	32.2909	32.2877		96.8699
cos(phi)1	0.340496	0.340512	0.340516		
sin(phi)1	0.573155	0.573146	0.573143		
U^I, °	39.52282	39.52319	39.5218		

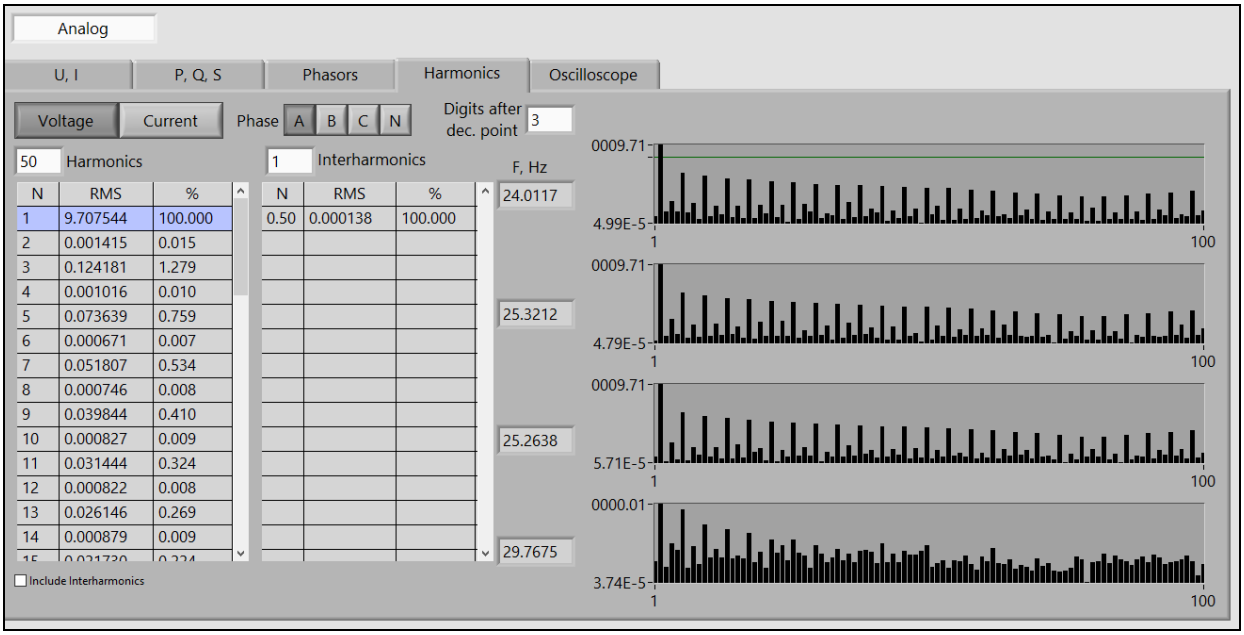
Fields:
U, V – RMS values of voltage
I, A – RMS values of current
P, W – active power
Q, Var – reactive power
S, VA – apparent power
PF – power factor
P(1), W – active power of the first harmonic
Q (1), Var – reactive power of the first harmonic
S (1), VA – apparent power of the first harmonic
Cos(phi)1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

3.5.3 Phasors



The tab 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.

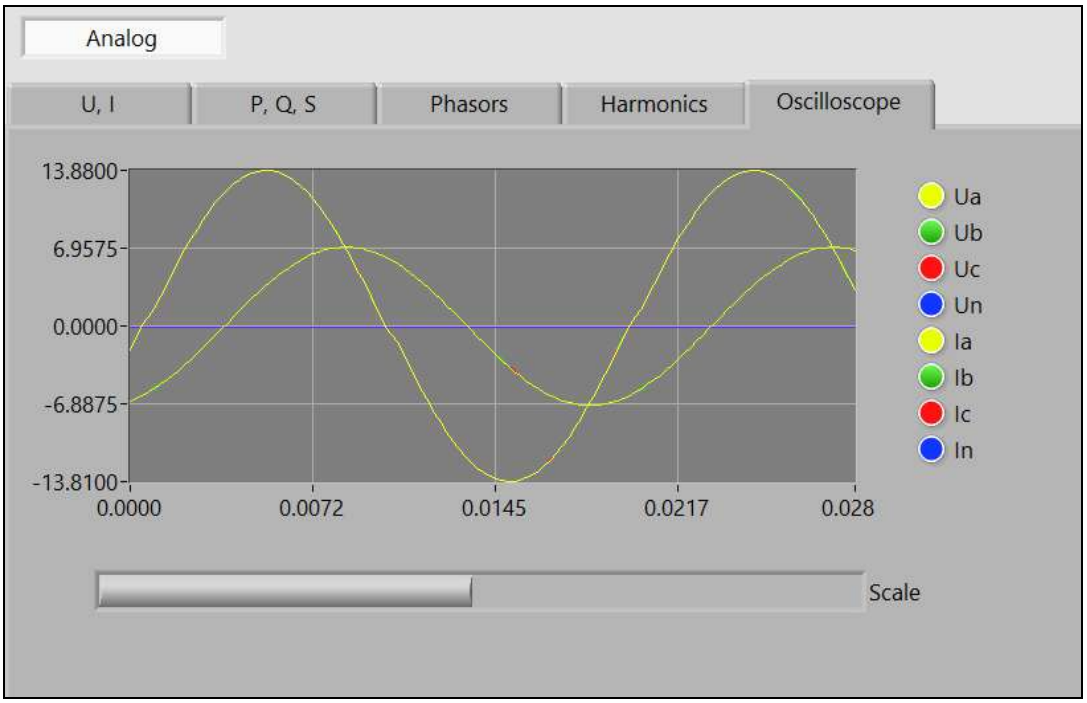
The **Phase** buttons are used to select a phase to be displayed.

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**
Serial No:
Rated primary voltage: **0**, V
Rated secondary voltage: **0,** V
Rated frequency: **0**, Hz
Site:
Owner:
Last verification date, time:

Reference means of verification:

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

Conditions during verification:
Temperature **0** °C, Humidity **0**, %
Atmospheric pressure **0**, kPa
Network frequency **0**, Hz, network THD **0**, %, network voltage **0**, 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 _____ _____ **18.08.2020**
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)