PLA33RXE

Universal power analyzer

User and service manual

version 1.0
(FW version 1.1.11 and newer)

Content

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1 Introduction

PLA33RXE is an universal measuring instrument with high accuracy class, great sampling rate 25.6 kHz (50 Hz), various input / output combinations and other features. Instrument is designed for measuring of electrical parameters in low voltage and high voltage grids for 2, 3, 4 line and TN, TT grids.

PLA33RXE can be as optionally equipped by 1GB Flash on-board memory to behave as a measured data logger with possibility of logged data download via RS485 interface.

Communication interface use Modbus RTU protocol and as an optional variant it is possible to have PLA33RXE with Profibus communication interface.

Instrument is produced in following variants:

Instrument name	PLA33RXE	C	M	D	R	A	P	Uxxx

RS485 interface

_	without RS485
C	with RS485 interface

Onboard Flash memory

_	without memory
M	1GB Flash memory

Digital I/O

_	without
D	4 x digital I/O

Relay outputs

_	without
R	3 x relay outputs
O	MOSFET outputs

Auxiliary supply voltage

U230	universal 85 ... 250 VAC/DC
U60	universal 24 ... 60 VAC/DC

PROFIBUS interface

_	without
P	PROFIBUS interface (only with variant C)

Analogue input 4 - 20mA

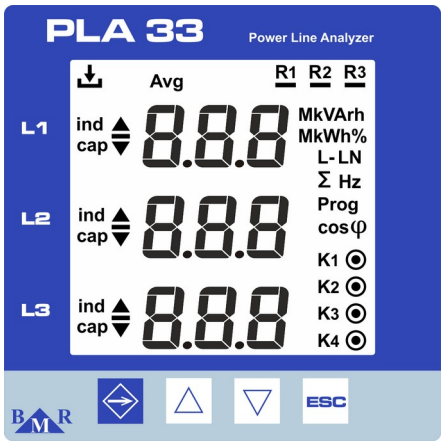
_	without
A	analogue input

2 Safety instructions

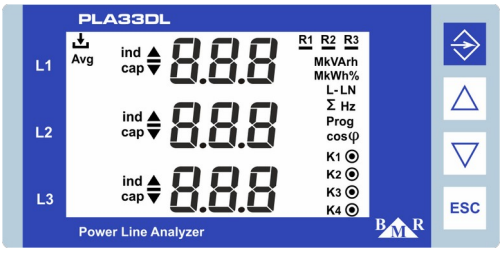
Instrument comply the standard EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use.

- Installation of the instrument can be done by qualified and authorised person only.
- Instrument should not be installed in the environment with increased humidity and close to explosive gases.
- Use the instrument in accordance instructions written in the user manual.
- Before the disconnection of CT measuring circuits assure that terminals of CT are short circuited.
- Installation and connection changes can be done without supply voltage only.
- Do not apply supply voltage, measuring voltage and current higher that allowed.

3 Front panel



Picture 1: PLA33RXE Front panel



Picture 2: PLA33RXE DL front panel

	SET ffor entering menu, confirmaion, avg, max / min values		ESC key for cancelling or return
	cursor key for moving up in menu and value increase		cursor key for moving down in menu and value decrease
	active recording into on board Flash memory	R1 R2 R3	active relay outputs
	active digital outputs	▲	symbolize maximum values
▼	symbolize minimum values	**Avg, Prog, L-L**	symbolize average values

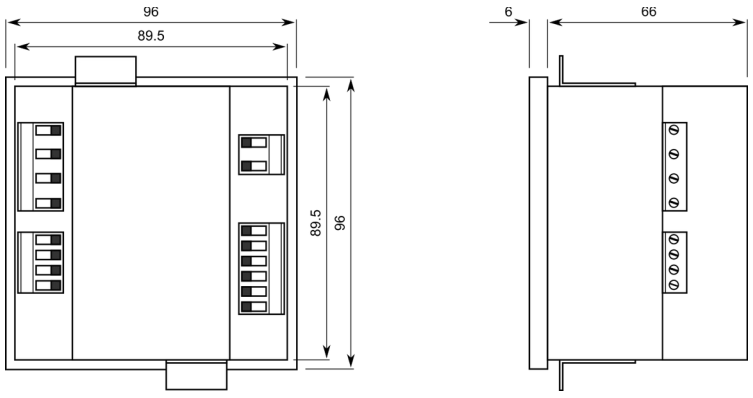
4 Measured parameters

Universal multifunction meter PLA33RXE is designed for measurement and monitoring of electrical parameters in 1 and 3 phase of LV and HV networks. Instrument architecture is based on fast microprocessor which provides high computing power to assure the device being according the norm IEC 61000-4-30.

Parameter	L1	L2	L3	L1-L2	L2-L3	L3-L1	ΣL1-L3	Max	Min	AVG	Measuring range	Displayed range	Accuracy
Phase voltage	•	•	•					•	•	•	10 ... 600 V	0 ... 1 MV	±0.2 %
Line voltage				•	•	•		•	•	•	18 ... 1000 V	0 ... 1 MV	±0.2 %
Frequency	•							•	•	•	40 ... 70 Hz	40 ... 70 Hz	10 mHz
Current	•	•	•				•	•	•	•	0.01 ... 6 A	0 ... 1 MA	±0.2 %
cosφ	•	•	•					•	•	•	0.01 L ... 0.01 C	0.01L ... 0.01C	±1 %
Power factor	•	•	•					•	•	•	0.01 L ... 0.01 C	0.01L ... 0.01C	±1 %
THDU L-N	•	•	•					•	•	•	0 ... 999 %	0 ... 999 %	±5 %
THDU L-L				•	•	•		•	•	•	0 ... 999 %	0 ... 999 %	±5 %
Under and over deviation L	•	•	•					•	•	•			
Under and over deviation L-L	•	•	•					•	•	•			
Voltage unbalance u2, u0								•	•	•			
THDI	•	•	•					•	•	•	0 ... 999 %	0 ... 999 %	±5 %
TDD	•	•	•					•	•	•	0 ... 999 %	0 ... 999 %	±5 %
Voltage harm. (up to 40th)	•	•	•								0 ... 999 %	0 ... 999 %	cl. 1
Current harm. (up to 40th)	•	•	•								0 ... 999 %	0 ... 999 %	cl. 1
Voltage, current asymmetry								•	•	•	0 ... 100 %	0 ... 100 %	0.3 %
K-factor	•	•	•										
Current unbalance i2, i0								•	•	•	0 ... 99.9 %	0 ... 99.9 %	cl. 1
Active power	•	•	•				•	•	•	•	0 ... 15.3 kW	0 ... 999 MW	±0.4 %
Reactive power	•	•	•				•	•	•	•	0 ... 15.3 kvar	0 ... 999 Mvar	±0.4 %
Apparent power	•	•	•				•	•	•	•	0 ... 15.3 kVA	0 ... 999 MVA	±0.4 %
Distortion power	•	•	•				•	•	•	•			±0.5 %
Active energy +/-	•	•	•				•				0 ... 999 GWh	0 ... 999 GVh	cl. 0.5
Reactive ind. energy +/-	•	•	•				•				0 ... 999 Gvarh	0 ... 999 Gvarh	cl. 2
Reactive cap. energy +/-	•	•	•				•				0 ... 999 Gvarh	0 ... 999 Gvarh	cl. 2
Temperature											-40 … +125°C		1°C

5 Installation

PLA33RXE is designed for wall mounting in the fixed switch boards. In order to assure well ventilation, instrument has to be installed vertically. Instrument is fixed into switchboard wall by two clips that are placed on the device at the bottom and top.



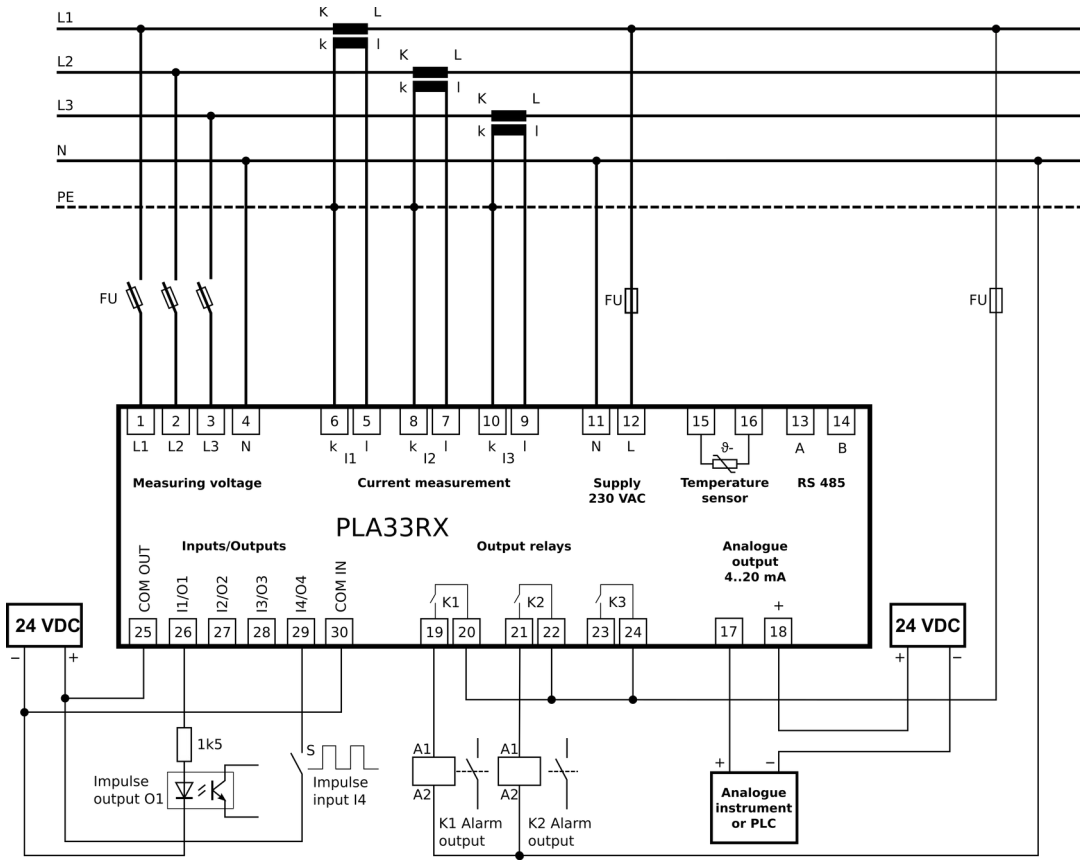
Picture 3: Dimensions of PLA33RXE

In order to assure well ventilation, instrument has to be installed vertically. There has to be empty space at least 50 mm at the top and bottom and 20 mm at the sides.

PLA33RXE DL is designed for DIN rail installation in size of 5 standard DIN.

6 Connection

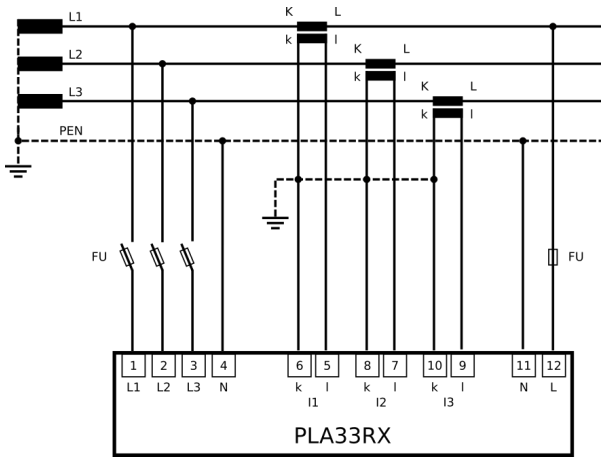
Value and type of auxiliary supply voltage has to be in accordance with rear device label. Standard auxiliary supply voltage is 85 .. 265 VAC. There is also a variant with 24 .. 65 DC/AC auxiliary supply voltage. Supply units are designed for system frequency 50Hz or 60Hz. Measuring inputs should be connected via sufficient protection like for example fuses or CB (2 – 10 A) place close to the instrument for easy maintenance. Measuring inputs of current has to be connected indirectly via measuring transformers with ration xx/5A or xx/1A.



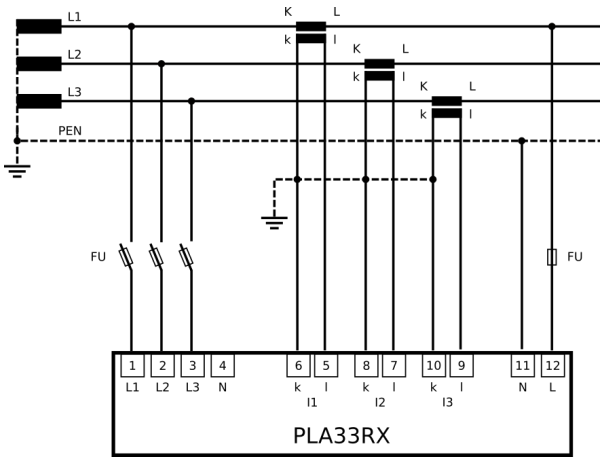
Picture 4: Device connection at TN-C network

6.1 Network type

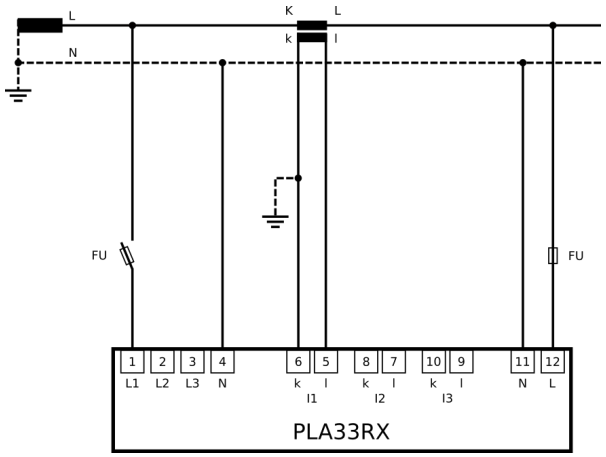
PLA33RXE is designed for various connections according to the grid type or measurement needs. Network settings defines the types network system in which the instrument is connected. In the following table are shown all possible connection variants that can be defined in the device menu.



3Un_3I *- 3-ph connection in grid TN-C-S (TN-C)*



3UL_3I *- 3-ph connection in grid TN-C-S without N*



1Un_1I *- 1-ph connection*

6.2 Voltage measuring inputs

Instrument has four voltage measuring inputs with input impedance 4 MΩ suitable for measurement according the category CATIII 600 V.

Each voltage measuring input have to be connected via circuit breaker or switch and fuse (10 A characteristic C) which are placed close to the device.

Note

PLA33RXE is not designed for measuring of DC voltage!

PLA33RXE is not designed for usage in SELV grids!

Note

If the voltage measuring inputs are connected over the voltage measuring transformers the power of measuring transformer power must be at appropriate level. Voltage measuring inputs have 5 mW self consumption. Recommendation from measuring transformer producers is to have loaded voltage measuring transformer on 70% of maximum power for the best accuracy.

6.3 Current measuring inputs

Instrument has three current measuring inputs for indirect measurement via current measuring transformers, either ../5A or ../1A ratio. CT ratio is freely adjustable from an instrument or via PC software.

Warning

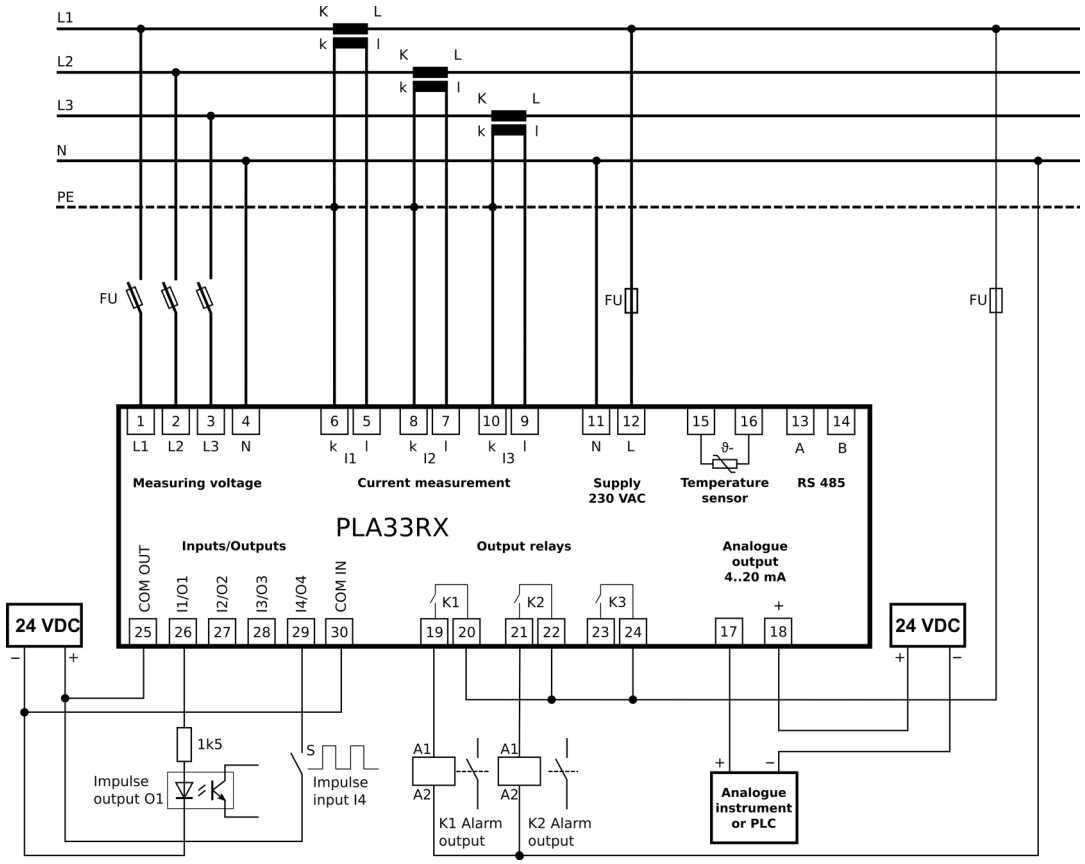
Current inputs maximum permanent capability is 10 A.

Important

Before opening the current circuit be sure that measuring terminals of current transformer are connected together.

6.4 I/O

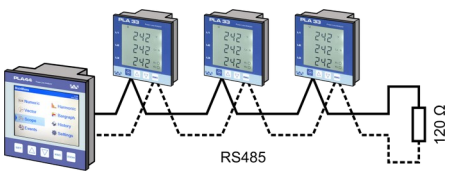
Analyser can be equipped by 4 digital I/O, 3 relay O and also analogue output 4...20mA. I/O are fully programmable via simple logic comparator or even advanced logic like a light PLC via PC SW Power Monitoring System. I/O status is possible read via Modbus protocol as well.



7 Connectivity

7.1 RS485

The PLA33RXE has built-in one RS485 interface supporting Modbus RTU protocol. Connection of the RS485 bus to the device is on the separate terminal by two wires A and B. Shielding is not required.



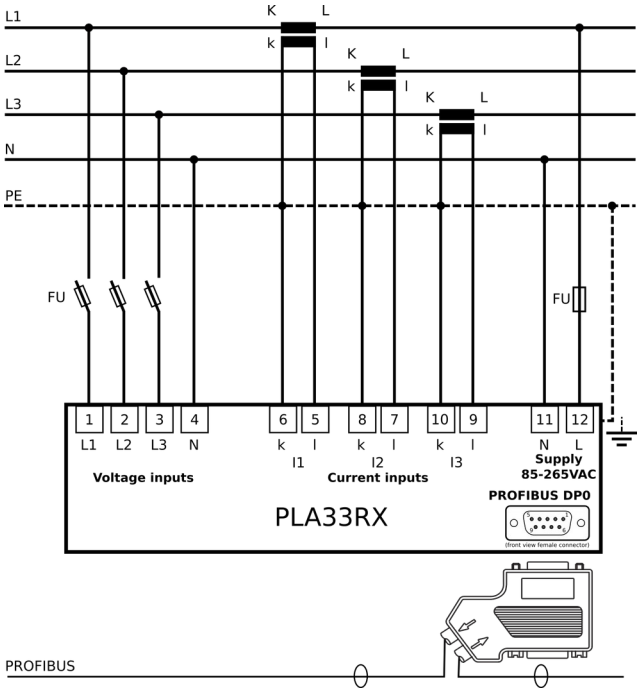
Note

PLA33RX does not have built-in termination resistor. If the instrument is at the end of the RS485 bus it should be terminated by 120 Ω resistor.

RS485 interface is fully galvanic insulated from the supply circuits and measuring circuits.

7.2 Profibus

On the request the device can be prepared in variant with interface PROFIBUS version DP0.



7.3 Ethernet

Ethernet interface of PLA33RXE offers following communication protocols: Modbus TCP, Modbus over TCP, MQTT, DHCP client and SNTP.

Note

Factory configuration of Ethernet interface

IP address: 192.168.1.233

Gateway: 192.168.1.1

Mask: 255.255.255.0

7.3.1 Modbus TCP

Industrial communication protocol Modbus TCP is by factory setting available on TCP port: 502. Table of Modbus registers is available on request.

Important

PLA33RXE has maximum allowed number of 3 opened connections.

7.3.2 Modbus RTU over TCP

Industrial communication protocol Modbus RTU over TCP is by factory setting available on TCP port: 10001. Table of Modbus registers is available on request.

Important

PLA33RXE has maximum allowed number of 3 opened connections.

7.3.3 Converter Ethernet <-> RS485

The device can be set to work as a converter between an Ethernet and RS485 interface. If the ID in the message received over the Ethernet interface matches the device ID, the analyzer returns the values of its registers. If the ID in the message received via the Ethernet interface does not match the device ID, the message is modified and sent to the RS485 interface using the Modbus RTU protocol. The device then waits for a response from the device and then modifies this response and sends it back over the Ethernet interface. The converter function is available for both protocols, both Modbus TCP and Modbus RTU over TCP.

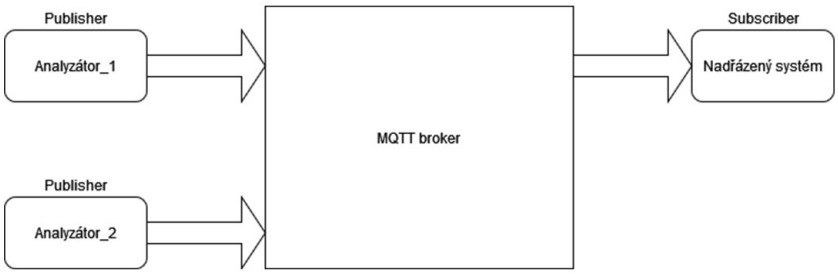
7.3.4 MQTT

MQTT is a simple protocol for communication between clients through a central intermediary (MQTT broker) that controls the flow of messages. Messages are organized into topics, where senders, so called publishers, send data to specific topics. The broker stores this data and distributes it to other devices or superior systems that are subscribers of these topics.

MQTT protocol itself does not include a specification of the format of transmitted messages, and therefore the JSON message format was chosen. This format is popular because it is widely supported in a variety of environments and programming languages, making it easy to implement devices into parent systems.

Note

Detail description of MQTT protocol and implementation procedure of PLA33RXE to supervision system is available on the request.



8 Configuration

Before usage of the PLA33RXE instrument it is necessary set several parameters essential for correct operation of the instrument in the different type of installations.

PLA33RXE device can be configured from panel screen for most of the essential parameters. Configuration menu is divided to the two sub-menus for device fundamental settings and menu for communication interfaces settings. Enter the configuration menu by pressing the button **SET** for at least 5 seconds.

For moving in the menu use cursor keys ▲ and ▼. Key ▲ is normally used for circle moving in the menu. Parameters setting is activated by pressing the key **SET**. Changing the parameter setting is done by cursor keys ▲ and ▼, confirmation of newly set parameter value by key **SET**. Key **ESC** cancels setting or move back to higher menu or back to normal operation.

Most of the device parameter and functions can be enabled and configured only by PC and software PMS.

Parameter	Description
P_1	Main configuration menu
P_2	Communication interface configuration
P_3	Information about firmware version, energy counter reset

Note

Overdrive is activated by continuous pressing of button ▲ or ▼.

8.1 P_1 General menu

In the general menu **P_1** gather fundamental settings of an instrument. Table beneath shows all available parameters with factory setting and possible setting range. In order to move in between particular parameters the cursor button ▲ is used. Editing and storing the parameter is activated by button **SET**. Modification of parameter is done by buttons ▲▼. Pressing button **ESC** returns to level back or cancel setting in case it was not saved by button **SET**.

Parameter	Description	Factory setting	Setting range
Con	measuring inputs connection type	3Un_3I	3Un_3I, 1Un_1I, 3UL_3I
Utr	primary / secondary voltage (transformer ratio of U)	230 / 230	1...750 000
Itr	primary / secondary current (transformer ratio of I)	5 / 5	1...10 000
Fr	LCD backlight	On	On, OFF, 20 … 100%, step 10%
bcl	grid nominal frequency	50 Hz	50 or 60 Hz
Y--	year setting 20__	09	09 ... 99
M--	month setting	01	01 ... 12
D--	date setting	01	01 ... 31
h--	hour setting	00	00 ... 23
M--	minute setting	00	00 ... 59
PAS	password	OFF	3 digits
rES	reset to factory setting		

8.1.1 Con – connection schema

Connection schema is selected from available schemas according to chapter 6.1.

8.1.2 Utr – voltage measuring transformer

If voltage measuring transformers are used then it is important set primary voltage and secondary voltage of used transformer. If there is no voltage transformer used then factory setting can remain.

8.1.3 Itr – current measuring transformer

Instrument is designed for indirect current measurement. For correct function it is important set primary and secondary current of used CT.

Note

Measuring input for current is sensing current in range 10 mA till 6 A. Maximum current transformer ratio is 7500 / 5 A.

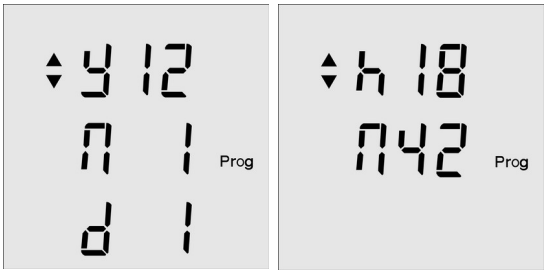
8.1.4 System frequency

PLA33RX is designed for measurement in grids with 50H z or 60 Hz system frequency. If the system is 60 Hz frequency it is important to set for correct measurement.

8.1.5 Real-time clock

Versions of PLA33RX with communication interface are equipped by internal real time clock and calendar. Setting of the time and date is available in configuration menu by editing parameters visible on the two screens.

Moving cursor on the parameter by key ▼ and pressing SET enters the setting. First screen in order is date setting (Year / Month / Day) and after pressing the key ▲ the second screen of time setting (Hour / Minute) will appear.



8.1.6 PAS – password

Device is possible to be protected against unauthorized configuration changes by three digit password. Entering the parameter PAS and activating the password setting by key **SET** opens definition of the first number of password. By key ▲ number is defined while key ▼ moves cursor to another digit. Password is confirmed by key SET. Erasing the password is possible by setting the 000.

8.1.7 rES – factory setting

In case of need it is possible return PLA33RXE back to factory setting. In the second configuration menu **P_2** there is a parameter **rES**. Activating that parameter by button **SET** device turns back tot factory setting including the real time clock.

8.2 Menu P_2

Second configuration menu related to the communication interface RS485 setting.

Parameter	Description	Factory setting	Setting range
Id	Unique identification number in RS485 network	0	0 ... 255
bd	Communication speed of RS485 interface	9.6 kBd	9.6 / 19.2 / 38.4 / 57.6 / 115 kBd
PAr	RS485 interface parity	---	--- (none), _o_ (odd), _E_ (even)
St	Stop-bit	1	1 / 2

8.2.1 Communication interface RS485

Instrument can have communication interface RS485 for connection into PC or another device.

- Id – unique number that identifies instrument in the RS485 network
- bd – communication speed between PLA33RXE and converter (PC)
- Par – communication control via parity, that is as default inactive
- St – number of stop bit

Notice

Communication configuration of the device and convert, PC or other device has to be the same on both sides.

8.3 Menu P_3

In the menu P_3 are information about firmware version, parameter FIr and hardware version - parameter VEr.

Parameter	Description	Factory setting	Setting range
FIr	Firmware of device		
VEr	Hardware version of device		
CLr E_1	Reset of energy counter tariff – 1		
CLr E_2	Reset of energy counter tariff – 2		
CLr E_3	Reset of energy counter tariff – 3		
CLr E_4	Reset of energy counter tariff – 4		

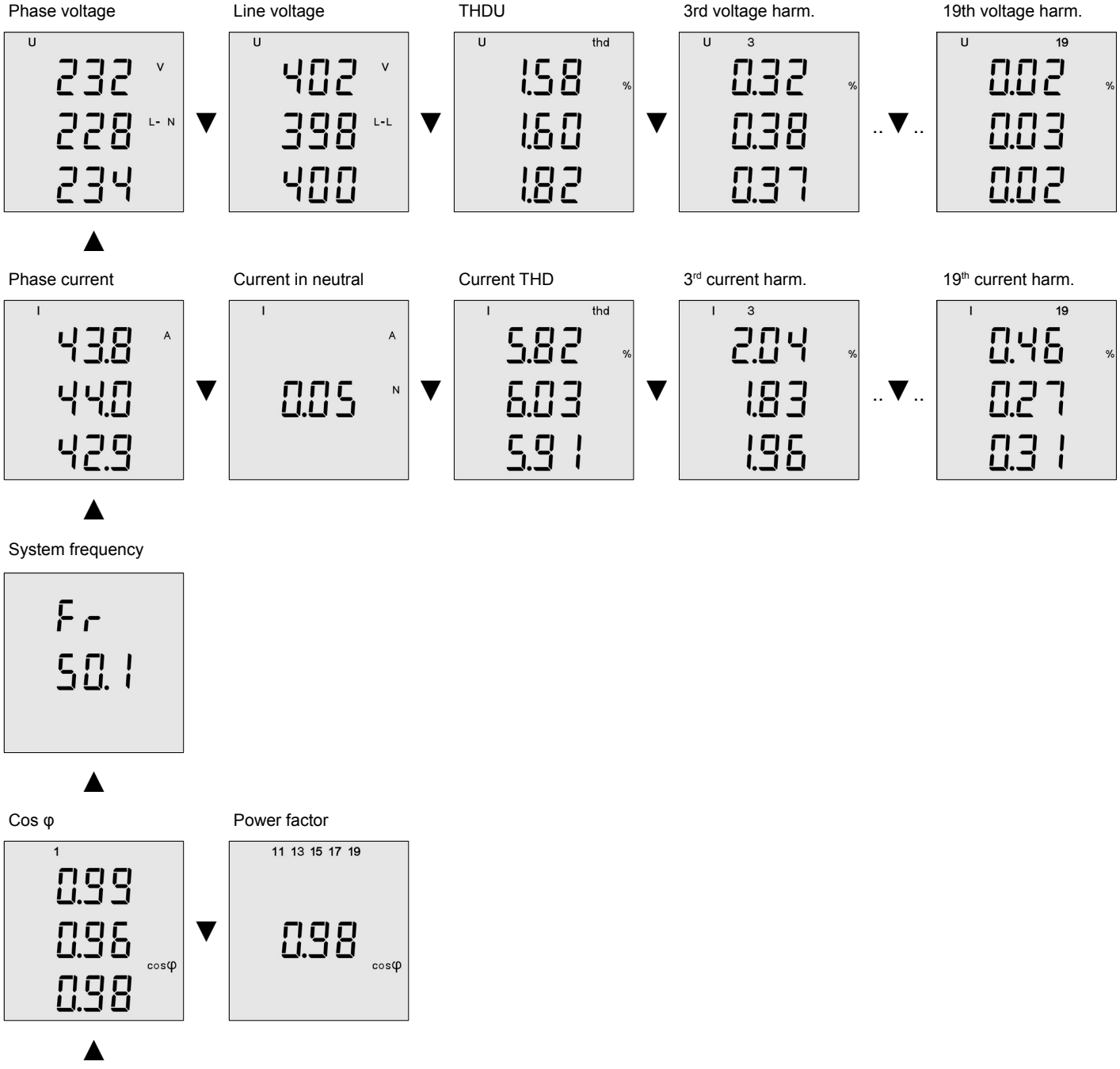
9 Monitoring mode

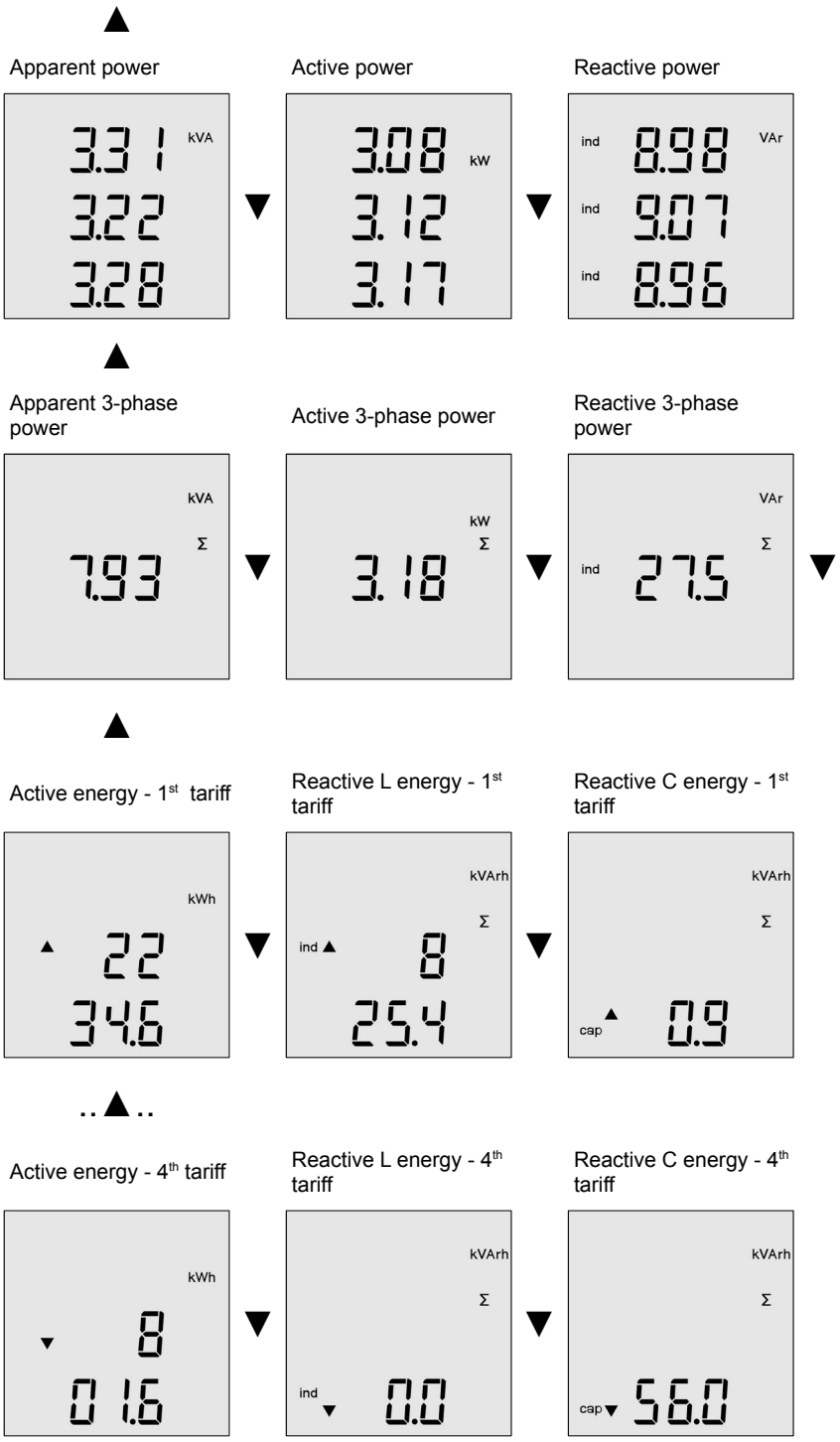
After supply voltage connection is the instrument in normal monitoring mode when measure and show electrical parameters. Measured parameters are logically sorted and displayed in the group of particular screens.

9.1 Monitoring screens

Meaning of each screen is easily identified by usage of standard ISO symbols and value parameters. Every displayed parameter value is shown with its variable.

From any of screens press of button **ESC** returns to the first screen displaying phase voltage.





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9.2 Max, Min and AVG values

For some of measured parameters the max and min values are stored. For displaying the maxim of measured value press shortly button **SET**. Max values are introduced by symbol ▲ before displayed value. Second press of button **SET** will show min value. Min values are introduced by symbol ▼ before displayed value. Third press of button **SET** shows average value of measured parameter introduced by ▲▼.

9.3 Optical signalization of inputs/outputs status

Digital inputs and outputs can be in four operating states. Signalization is mutual for all digital I/O and it is described in the table beneath.

Parameter	Description	Active	Inactive
In	input	K1◉	K1○
Out	output	K1◉	K1○
PuL	Pulse output	K1◉ pulse	K1○
AL	Alarm output	K1◉ flashing	

Relay outputs statuses are signalized by underline beneath the relay symbols **R1**, **R2**, **R3** in the upper right corner of display.

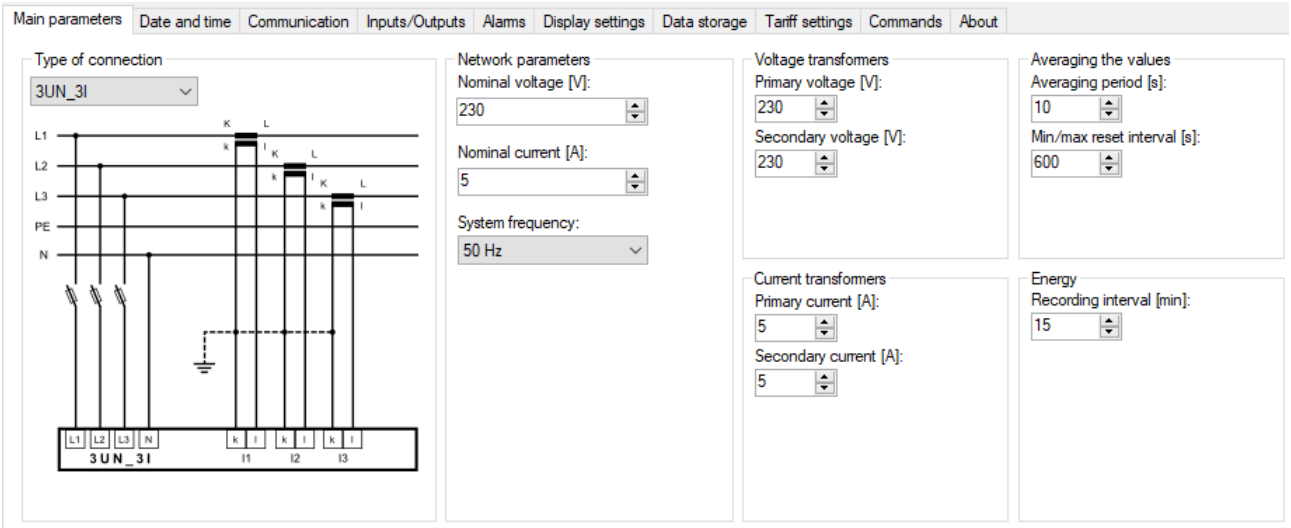
10 Power monitor software

PLA33RX allows fundamental configuration via keys on the the device. Full configuration is available via Power Monitoring Software only.

10.1 Device configuration

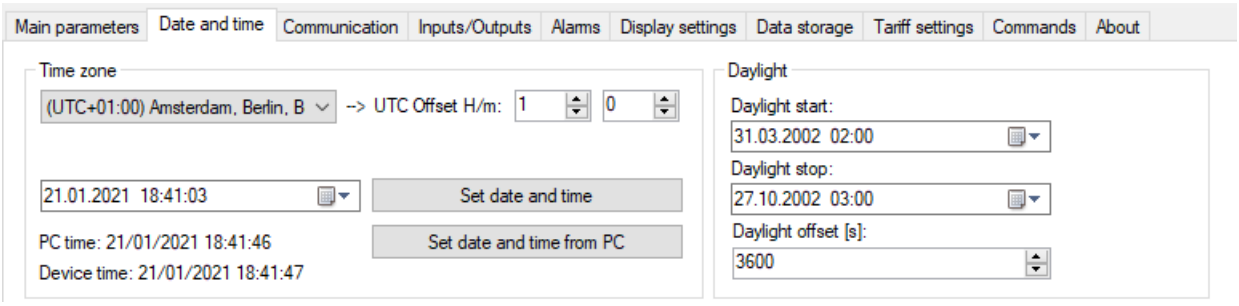
In the device configuration it is possible set following configuration:

- Type of instrument connection to the grid
- Nominal voltage, nominal current, system frequency
- Voltage and current measuring transformers ratio
- Averaging period of measured values and energy counter load profile interval.



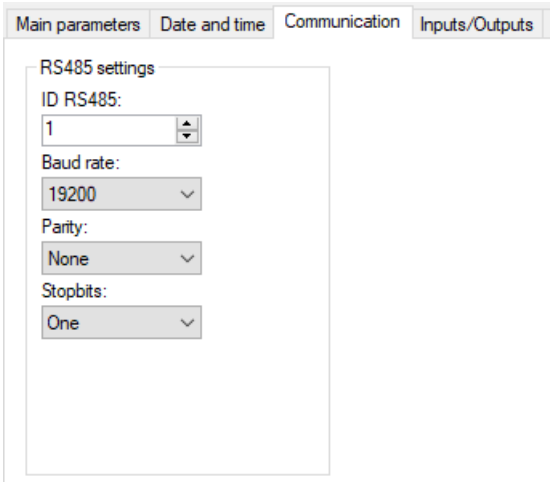
10.2 Date and time

PLA33RX real time internal clock can be either set on the instrument or via software manually or synchronized with PC time.



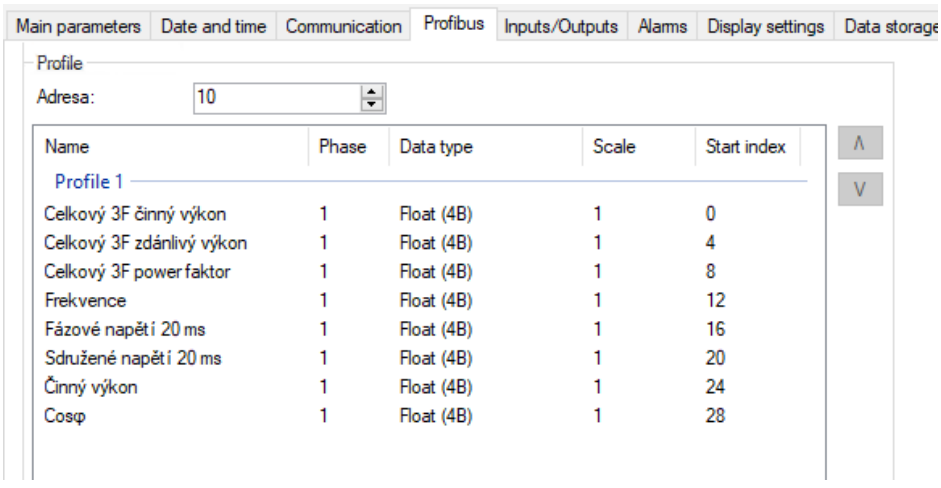
10.3 RS485 interface

Device is equipped by communication interface RS485 with Modbus RTU protocol and all related parameters can be set via PMS SW too. Nevertheless it is recommended to set parameters manually on device to avoid possible ost communication after parameter changes.



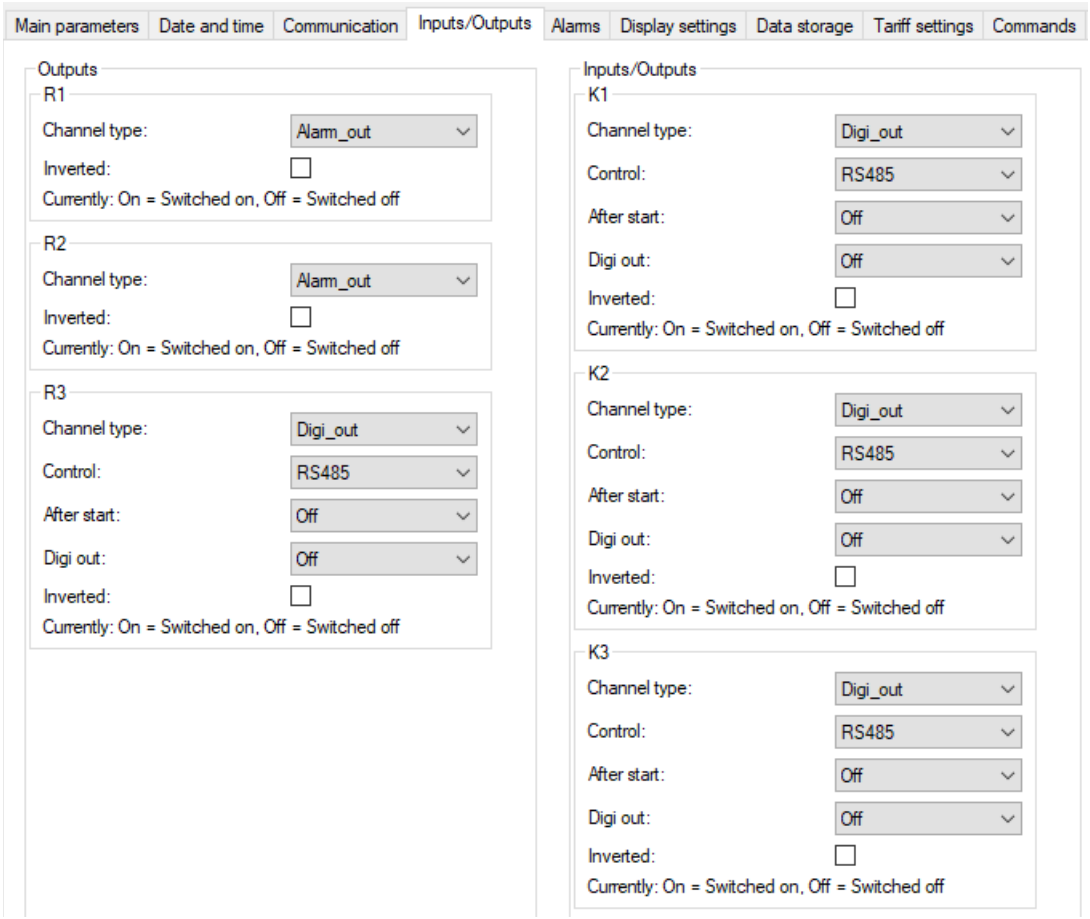
10.4 Profibus

Special variant of PLA33RXCP with Profibus interface adds new cart that allows definition of Profibus address mapping.



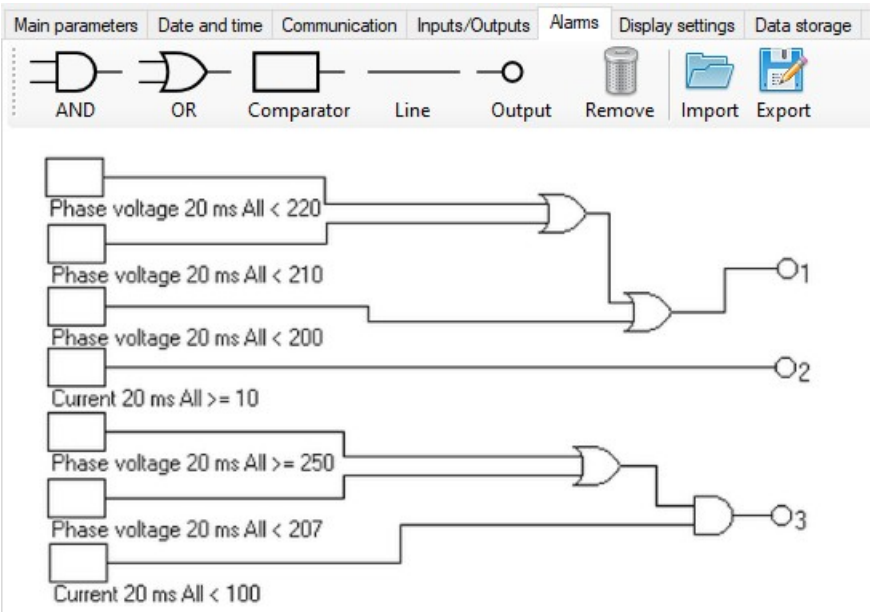
10.5 Inputs / outputs, alarms

Instrument can be according to the variant (CDR, CMDR, CDRA, CMDRA) equipped by 4 digital fully programmable inputs / outputs, 3 relay outputs 3A/250VAC. PLA33RX can also have analogue output 4 – 20 mA.



Inputs / outputs can be controlled by simple logic comparators or it is possible define advanced rules. Function of inputs / outputs is defined in graphical tool under Power Monitoring SW at instrument configuration as light PLC.

Thanks to this programmable light PLC can be defined functionality like for example current monitoring relay or more complex three level protection for photo-voltaic power plants.

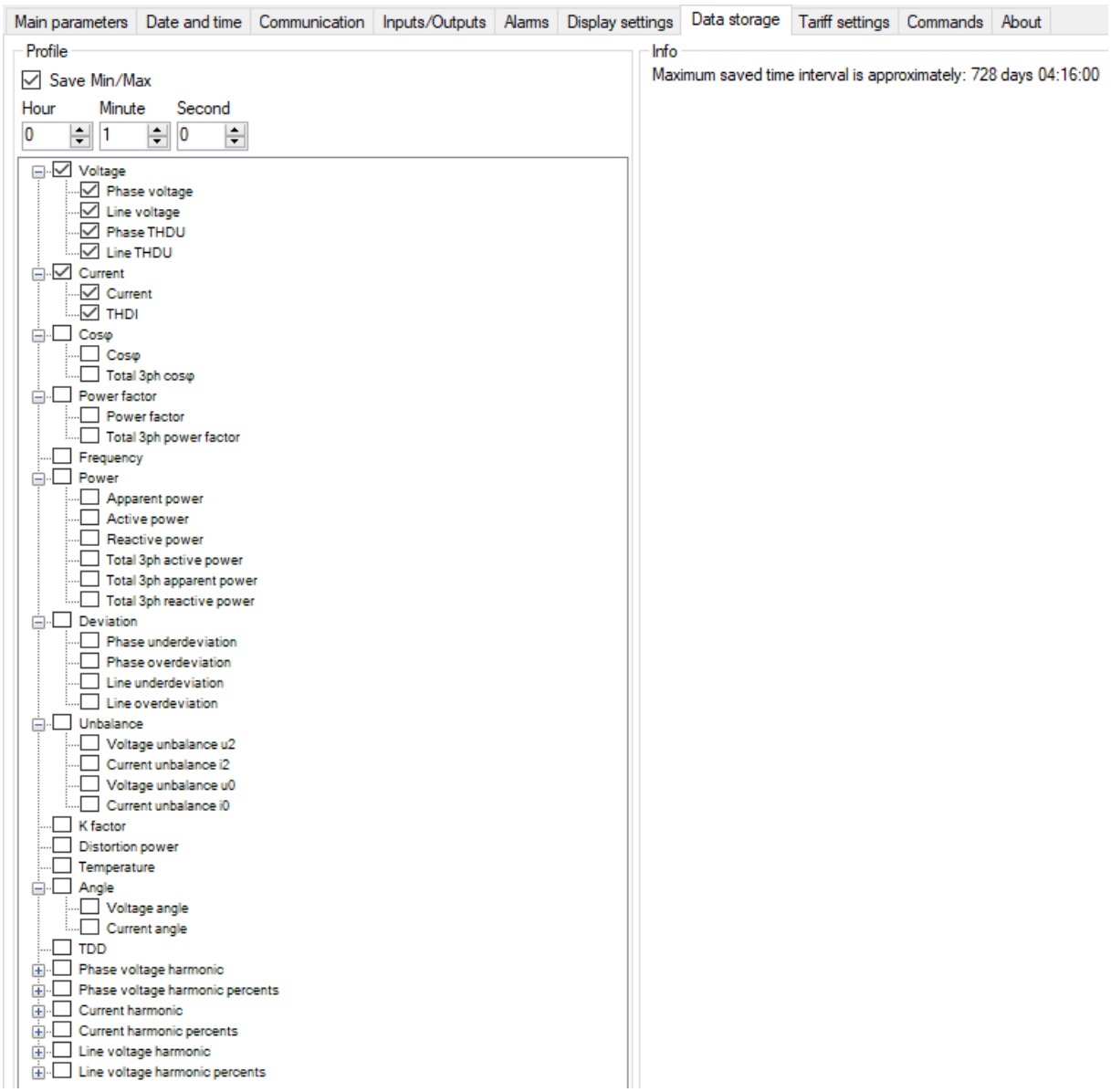


10.6 Logging of measured parameters into SQL

Power Monitoring Software allows log selected measured parameters from PLA33RX into SQL database. Among average value of selected parameter it is also possible record min and max values of the defined averaging period.

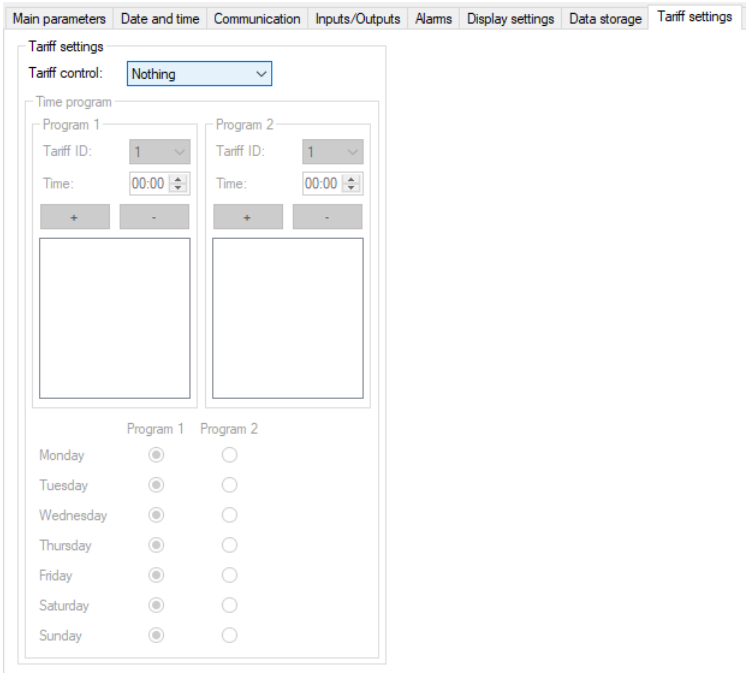
Averaging period for the Average value is defined in the Main parameters by Averaging period. Time window length of resetting of min and max values is defined at the same place.

It is possible read also min and max values of measured parameters. Define the interval window of min and max value wisely with consideration of SQL database file size.



10.7 Tariff setting

Instrument energy counters are using four tariffs that can be operated either by signal on I/O input or according to the time program.

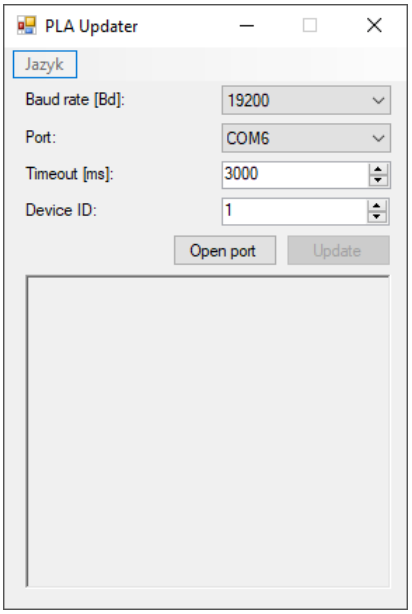


10.8 Modbus registers

Complete description of Modbus registers and implementation of PLA33RX into any software is available on the request on export@bmr-trading.com.

10.9 Firmware update

Instrument has a possibility of being updated by new releases of firmware. New firmware including installer are presented on manufacturer web-pages.



11 Technical features

Parameter		Values
Supply voltage for variants	PLA33RX U230 PLA33RX U60	85 ... 250 V AC/DC 24 ... 60 V AC/DC
System frequency		50 Hz or 60 Hz
Current measuring range		0.01 ... 8 A (max permanent current 10 A)
Voltage measuring range L - N		0 ... 600 VAC
Power consumption		1.5 VA
Sampling frequency 50/60Hz		25.60 kHz / 30.72 kHz
Number of inputs / outputs		3 x relay outputs, 4 x digital I/O, 1 x 4 … 20 mA
Type of digital outputs		open collector, optically-isolated (S0)
Max voltage of digital output		24 VDC
Max current load of digital output		100 mA
Type of input		optically-isolated
Max voltage of digital input		24 VDC
Max input consumption		10 mA
Max pulse output frequency		10 Hz
Impulse length		50 ms
Impulse weight		1 ... 50 Wh (VArh)
Relay output max power		3A / 250 VAC
Primary voltage measuring transformer ratio		1 ... 750000
Primary current measuring transformer ratio		1 ... 10000
Maximum number of registered auxiliary supply power cuts		20
Data memory for measured parameters recording (optional)		1 GB
Ethernet interface		RJ45
Communication port		RS485 insulated
Communication protocol		MODBUS RTU, PROFIBUS
Communication speed		9.6 / 19.2 / 38.4 / 57.6 / 115 kBd
Over-voltage class		600V CAT III
Pollution degree		2
Panel cut-out dimensions		92 x 92 mm
Site depth		90 mm
Dimensions		96 x 96 x 73 mm refer to picture 2
Weight		350g / 350g DL version
Protection degree		IP20 rear panel / IP54 front panel
Related standards: EN 61010-1, EN 62586-1, EN 61000-6-2, EN 61000-6-3		