BMR PLA 44

Power quality analyzer

User and service manual
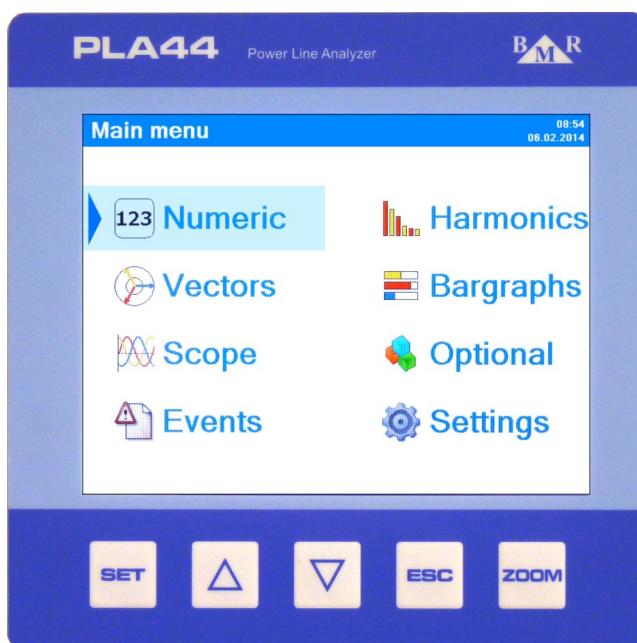
version 1.2

Content

1. Front panel

Picture 1: Front panel description

1. **SET** – key for entering the menu and parameters

2. **△** – cursor key for moving up in menu and parameter change to higher value

3. **▽** – cursor key for moving down in menu and parameter change to lower value

4. **ESC** – ESC key for canceling or return

5. **Fn** – Fn (zoom) key change function of other buttons

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

3

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

2. Device description

Power quality analyzer PLA44 is designed for measurement and monitoring of electrical parameters in 2, 3 and 4 conductor networks and in TN and TT grids. PLA44 power quality analyzer architecture is based on fast 32 bits RISC microprocessor which provides high computing power to assure the device being fully according the norm IEC 61000-4-30 class A.

Parameter	L1	L2	L3	L4	L1-2	L2-3	L3-1	ΣL1-L3	ΣL1-L4	Max	Min	AVG	Maxavg	Measuring range	Displaying range	Accuracy
Phase voltage	•	•	•	•						•	•	•	•	10 ... 600 V	1 V ... 1 MV	±0,1 %
Line voltage					•	•	•			•	•	•	•	18 ... 1000 V	0 ... 1 MV	±0,1 %
Frequency	•									•	•	•	•	40 ... 70 Hz	40 ... 70 Hz	10 mHz
Current	•	•	•	•				•	•	•		•	•	0,001 ... 8,5 A	1 mA ... 1 MA	±0,2 %
cosφ	•	•	•	•						•				0,01 L ... 0,01 C	0,01L ... 0,01C	±0,5 %
Power factor	•	•	•	•						•				0,01 L ... 0,01 C	0,01L ... 0,01C	±0,5 %
THDU L-N	•	•	•	•						•	•	•	•	0 ... 999 %	0 ... 999 %	1%
THDU L-L					•	•	•			•	•	•	•	0 ... 999 %	0 ... 999 %	1%
THDI	•	•	•	•						•	•	•	•	0 ... 999 %	0 ... 999 %	1%
Harmonics of voltage	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Group of interharmonics U	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Group of harmonics U	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Harmonics P	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Harmonics Q	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Harmonics I	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Group of interharmonics I	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Group of harmonics I	•	•	•	•										0 ... 999 %	0 ... 999 %	Class 1
Actual flicker (hidden)	•	•	•	•						•				0,4 ... 10,0 Pist	0,4 ... 10,0 Pist	Class A
Short-term flicker	•	•	•	•						•				0,4 ... 10,0 Pst	0,4 ... 10,0 Pst	Class A
Long-term flicker	•	•	•	•						•				0,4 ... 10,0 Plt	0,4 ... 10,0 Plt	Class A
Under-voltage	•	•	•	•	•	•	•			•	•	•	•	0 ... 100 %	0 ... 100 %	0,2%
Over-voltage	•	•	•	•	•	•	•			•	•	•	•	0 ... 100 %	0 ... 100 %	0,2%
Unbalance U										•	•	•	•	0 ... 100 %	0 ... 100 %	0,15%
Neutral point displacement										•	•	•	•	10 ... 600 V	0 ... 1 MV	0,2%
K-factor	•	•	•	•												
Unbalance I										•	•	•	•			0,5%
Transients	•	•	•	•												25 µs
Events	•	•	•	•												10 ms
Ripple control signal	•	•	•	•	•	•	•			•	•	•	•			
Active power	•	•	•	•				•	•	•		•	•	0 ... 15,3 kW	0 ... 9999 GW	±0,2 %
Reactive power	•	•	•	•				•	•	•		•	•	0 ... 15,3 kvar	0 ... 9999 Gvar	±0,2 %
Apparent power	•	•	•	•				•	•	•		•	•	0 ... 15,3 kVA	0 ... 9999 GVA	±0,2 %
Distortion power	•	•	•	•				•	•	•		•	•			±0,2 %
Active energy +/-	•	•	•					•						0 ... 9999 GWh	0 ... 9999 GVh	±0,2 %
Reactive ind. energy +/-	•	•	•					•						0 ... 9999 Gvarh	0 ... 9999 Gvarh	±0,2 %
Reactive cap. Energies +/-	•	•	•					•						0 ... 9999 Gvarh	0 ... 9999 Gvarh	±0,2 %
Temperature										•	•	•	•			1°C

* for ideal sinusoidal curve of voltage and current

Table 1: Measured and displayed parameters

3. Installation

PLA44 is prepared for wall mounting in the fixed switch boards. In order to assure well ventilation, the PLA44 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.

PLA44 is fixed into switchboard wall by two clips that are placed on the device at the bottom and top.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

4

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

4. Connection

4.1. Supply voltage

Supply voltage is required to operate the PLA44. The type and level of the necessary supply voltage is written on the back label. Before applying the supply voltage, make sure that the voltage level and system frequency match the details on the label. The connection cables for the supply voltage must be connected using a fuse. Use a fuse (6A type C).

4.2. Measuring inputs

Voltage measuring inputs have to be connected via circuit breaker or switch and fuse (10 A) which are placed close to the device. Current measuring inputs have to be connected via current transformers, either ../5A or ../1A ratio.
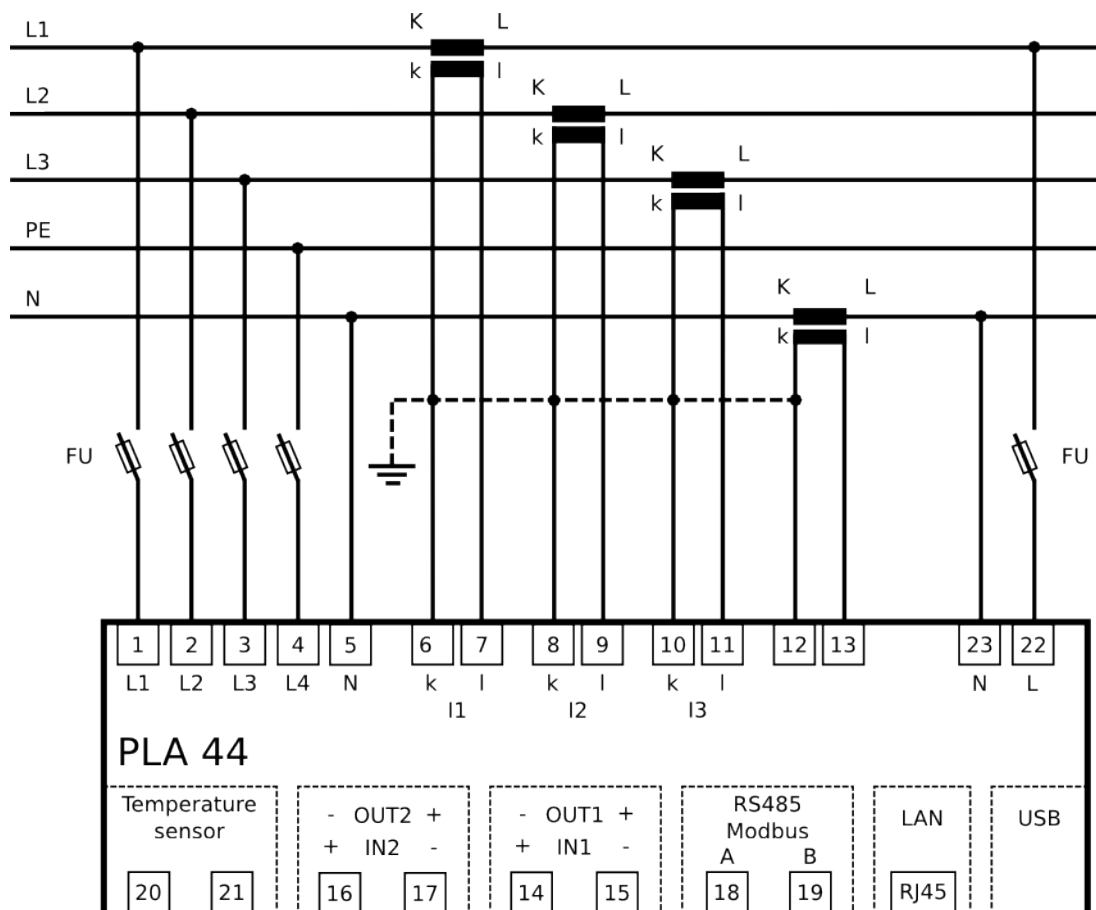
Picture 2: Full device connection at TN-C network

4.3. RS485

The PLA44 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.

PLA44 does not have built in any terminal resistor.

4.4. Ethernet

The configuration of Ethernet are defined by the network administrator and have to be set on the PLA44 correspondingly. If the network configuration is not known, the Ethernet cable should not be plugged into the device.

4.5. USB

Device has one USB interface of type B. USB interface is a standard HIT so there is no special driver needed to be installed at PC for activating the communication and data transfer.

4.6. Temperature sensor

Temperature sensor is connected directly to PLA44 inputs 20 and 21 according to the picture 2. The sensor is NTC type with resistance 10kΩ / 25°C.
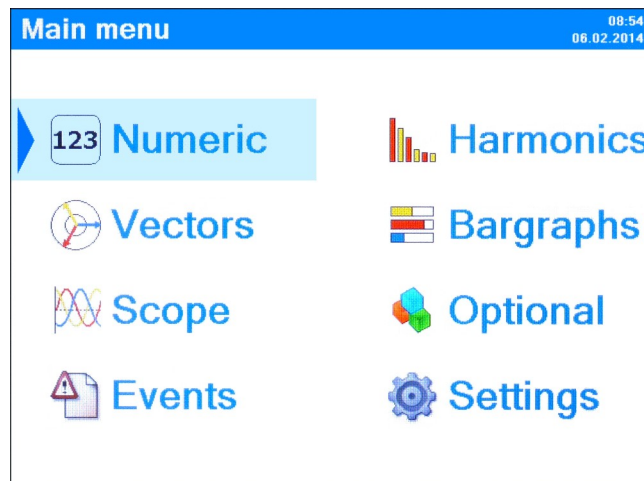
4.7. Digital inputs / outputs

PLA44 has built-in two digital inputs/outputs which are related to several functions of device.
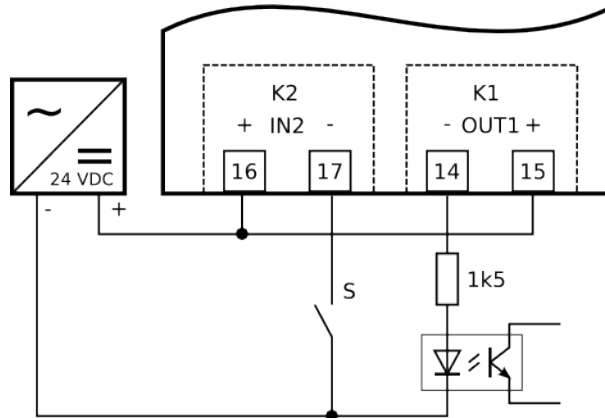
Picture 3: input / output connection

5. Operation

PLA44 allows comfort operation by easy graphic Main menu which is divided to groups of related features and functions. For the navigation in menu us the cursor buttons ▲ and ▼. To enter the selected menu or parameter press button **SET**. Returning back to previous menu or parameter level press button **ESC**.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

6

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

5.1. Numeric

Menu Numeric contains measured parameters in numeric form. Parameters are grouped to separate screens according logical order.
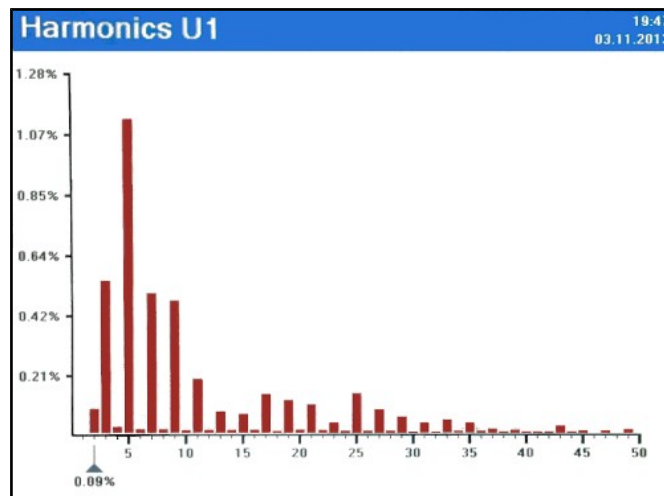

5.1.1. Flicker

Device calculates flicker according to the norm EN61000-4-15. It provides values for short-term flicker (10 minutes), long-term flicker (2 hours).

5.2. Harmonics

5.3. Vectors

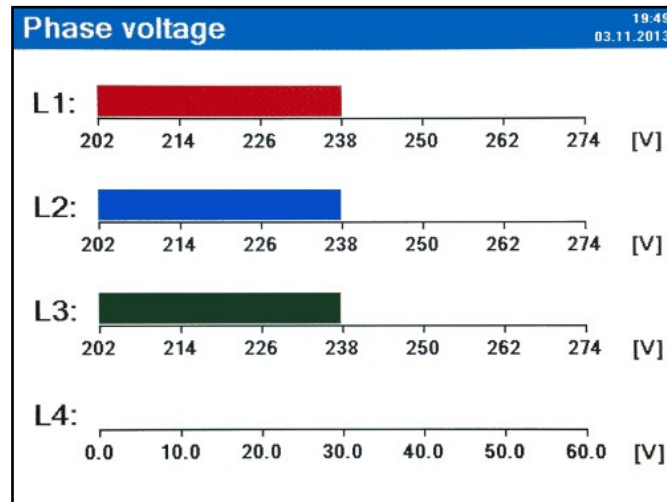## 5.4. Bar-graphs

Voltage, current and power values can be shown in bar-graph form as well. Bar graphs have synchronized automatic scale which is adjusted according to min and max displayed values to provide fast and clear comparison of measured values in all phases.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

7

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

5.5. Scope

PLA44 shows scope of measured signal for voltage and current in all four phases. It is possible to select displayed phase or phases by pressing the button **SET** and selecting the appropriate phase or phases. Escaping back from the phase selection is by pressing the button **ESC**.
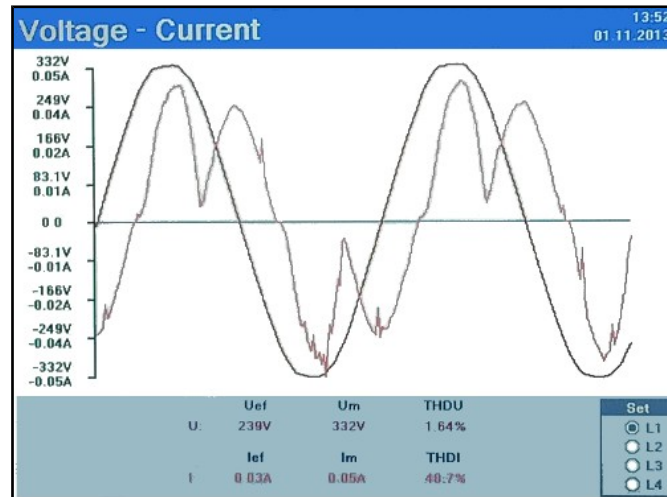
In order to show or hide curve of the phase or phases on graph press button **SET** and select the phase or phases.

5.6. Events

PLA44 captures and records voltage and current events as well as voltage transients. Detail information and signal waveform are displayed on the device screen and also web-server (if enabled).

5.6.1. List of events

Last 50 events of each type are captured in the nonvolatile memory with information about the start and end of the event and graph of the event. On the device screen the event graph can be displayed with all detail information.

There are following type of events recorded in the PLA44 memory.

Type of event	Description
Interruption	Voltage interruption
DIP	Under voltage
SWELL	Over voltage
RVC	Rapid voltage changes
IMAX	Over current

On the screen of Events list it is possible filter events according to their type. Press button **Fn** (**Zoom**) to apply appropriate filter on list of events.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

8

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

By cursor buttons ▲ and ▼ move to event of your interest and pressing the button **SET** will display the event details.
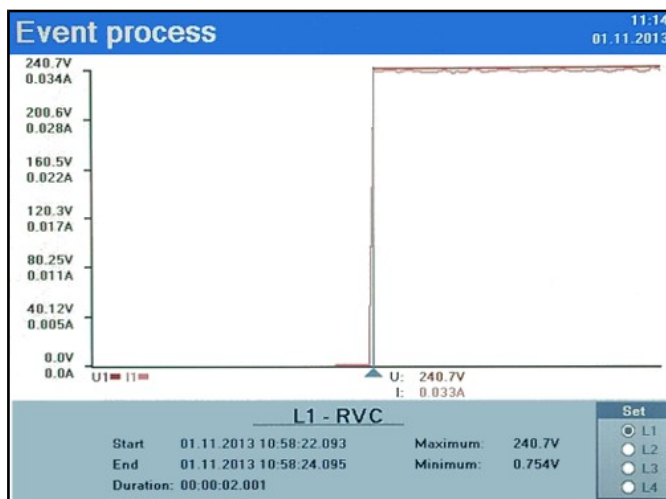
Mowing the graph left or right use the buttons ▲ and ▼. In order to select the phase or phases to be shown on graph press button **SET** and select the phase.

5.6.2. Rapid Voltage Change (RVC)

A Rapid Voltage Change (RVC) is an event characterized by a quick transition from one steady-state voltage to another. Typically, RVC events are counted for a period of one hour, or for each day.

If the change in voltage is sufficient to cross the dip threshold or the swell threshold, then the event shall not be recorded as an RVC event. It is a dip or a swell.

5.6.3. List of transients

PLA44 captures transients of voltage as short as 25 µs and keeps last 50 transients of each type in the nonvolatile memory.

Type of event	Description
Different	Transients started by differential threshold defined by zone
Absolute	Transients started by threshold absolute value defined by set value of voltage

Waveform of transient event is possible be zoomed to the detail view by pressing the button **Fn** (**Zoom**). The detailed zoom view can be moved forward and back by cursor buttons ▲ and ▼.

5.6.4. Power cuts

Power cuts of device supply voltage are recorded into the memory. Each recording is stored with date and time of power cut start and end.

Last 15 supply voltage power cuts are captured in the nonvolatile memory.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

9

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

6. Device settings

PLA44 device can be configured from panel screen for most of the essential parameters. At main screen move to parameter Setting to open device various configuration sub-menu. Some of the device parameter and functions can be enabled and configured only by PC and software PMS.

6.1. Language

Menu of PLA44 is localized to several languages. Default device language is English. Select the appropriate language from the list and confirm it. Device menu will turn immediately to the selected language.
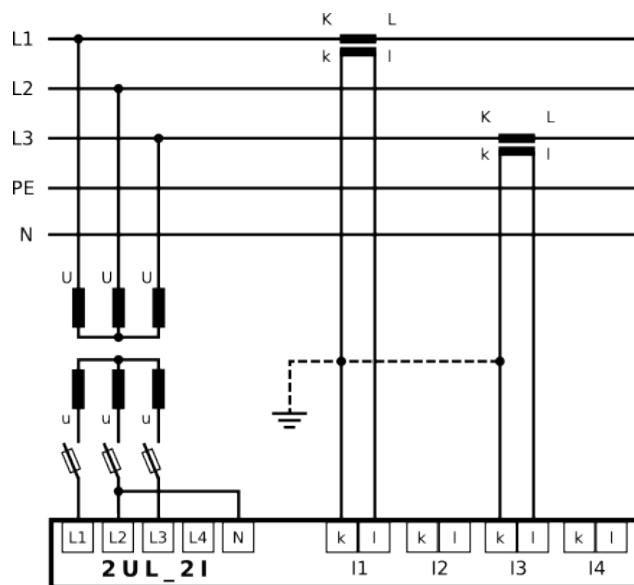
6.2. Measurement

Settings measurement gather all settings related to measuring circuits connection type, measuring transformers and type of parameters calculation.

Parameter	Description	Factory setting	Setting range
Network type	Defines the type of network and measuring circuit connection	4UN_4I	chapter 6.2.1
Frequency	Defines the nominal system frequency	50 Hz	45 ... 75 Hz
Udin	Network nominal phase voltage	230 V	1V ... 750 kV
Idin	Network nominal phase current	5 A	1A ... 750 kA
Voltage Tr	Enable the usage of measuring voltage transformer	No	No / Yes
Current Tr	Enable the usage of measuring current transformer	No	No / Yes
Utr	Primary and secondary voltage of measuring voltage transformer	230V / 230V	1 ... 750 kV
Itr	Primary and secondary current of measuring current transformer	5A / 5A	1 ... 750 kA
Flicker	Parameter of the nominal voltage and frequency for flicker calculation	230V - 50Hz	120/230V, 50/60Hz
Erase Max/Min	Deletes all saved maximums and minimums of measured parameters	No	Yes / No
Averaging	Type of averaging method	Static	Static / Sliding
Averaging period	Time for averaging period setting	5s	1 ... 3600s

6.2.1. Network type

Defines the types network system in which the PLA44 is connected. The main connection diagram of PLA44 is shown in chapter 4.2. In the following table are shown all possible connection variants that can be defined in the device menu.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

10

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

4UN_4I

3UN_3I

1UN_1I

3UN_2I

PE-N_IN

2UL_2I
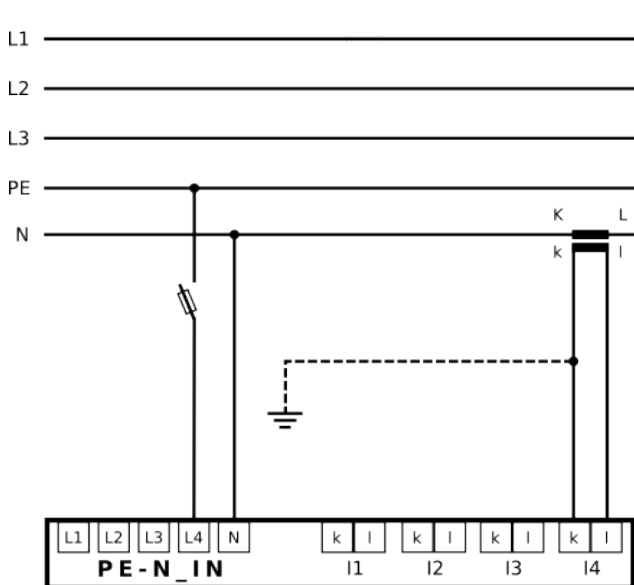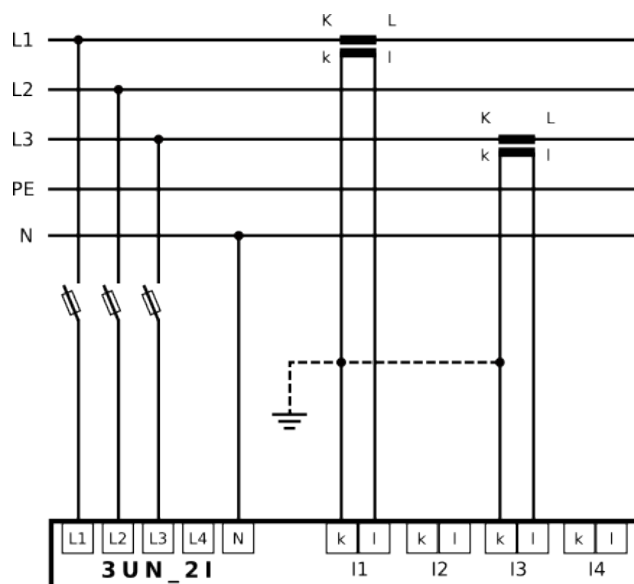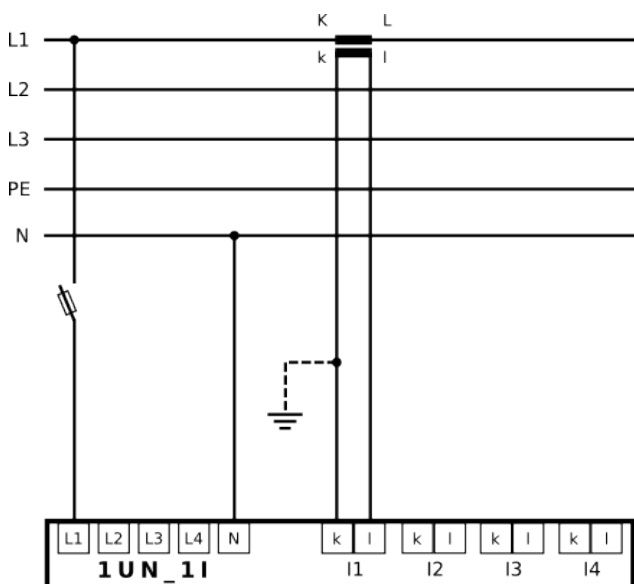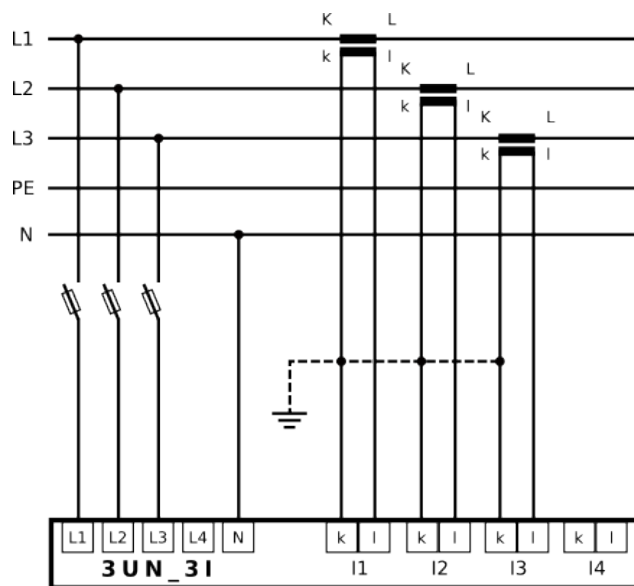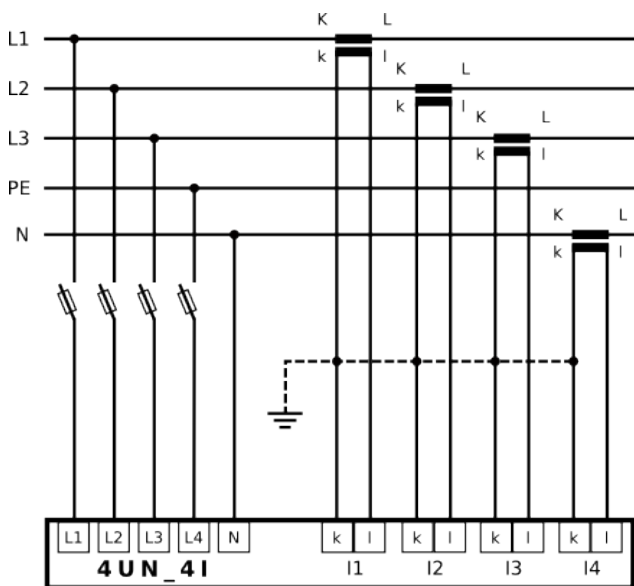
6.3. Analyser

Settings related to the device itself such as display parameters, colors, time, password protection and reset of all settings.

Parameter	Description	Factory settings	Settings range
Display refresh	Speed of display refreshing. The optimal setting is 5 cycles.		
Brightness	Brightness of display for operation while buttons are touched		
Standby brightness	Defines level of brightness when device is not pressed at any button		
Standby time	Time delay after that device turns to standby level of display brightness.		
Password	Four digit password for access to device settings menu		
Date and time	Device internal clock configuration sub-menu	►	
Colors	Colors template of particular voltages and currents of phases for graphs		
Reset	Reset device to the factory settings		

6.3.1. Date and time

Sets manually internal clock. PLA44 corrects internal clock according to NTP servers while it is connected to Internet. NTP time synchronization has always priority above the manual clock settings. Clock synchronization by NTP is fully automatic and there is no need to set anything.

The selection of closest NTP server is adjustable in software PMS. For the finding the closest NTP server refer to the following link http://support.ntp.org/bin/view/Servers/StratumOneTimeServers.

Parameter	Description	Factory settings	Settings range
Device time	Date and UTC time in format for date YYYY.MM.DD and HH:MM for time.		
UTC time offset	Time offset of the local time against to UTC. Offset is set in seconds.		
Daylight start	Beginning of the summer time season		
Daylight stop	End of the summertime season		
Daylight offset	Time shift for summertime season		

6.3.2. Reset

Reset device to the factory settings. All settings including communication interface configuration will be erase and set to the factory settings.

6.4. Communication

6.4.1. Ethernet

Menu of settings related to Ethernet interface.

Parameter	Description	Factory setting	Setting range
Ethernet	Enable or disable Ethernet interface	Yes	Yes / No
IP	PLA44 IP address in the local network	192.168.001.201	
Mask	Mask of the Ethernet network	255.255.255.0	
Gateway	IP address of PC or router used as a gateway to parent network	192.168.001.001	
IP - public	Public IP address of router	192.168.001.001	
Web server	Web-server settings advance menu	►	
Modbus TCP	Modbus TCP settings advance menu	►	
FTP server	FTP server settings advance menu	►	

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic
12
Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

6.4.1.1 Web server

Menu of settings related to web server of PLA44.

Parameter	Description	Factory setting	Setting range
Web server	Enable or disable web server	Yes	Yes/No
Web port	Port on which the web-server is accessible	80	0 ... 3850
Web name	User name for access to PLA44 device web-server	admin	
Web password	Password for access to PLA44 device web-server	1234	

Defines the. For standard access by any browser by setting only IP address without port value, it should be set on 80.

6.4.1.2 Modbus TCP

Parameter	Description	Factory setting	Setting range
Modbus TCP	Enable or disable Modbus TCP feature	Yes	Yes / No
Modbus TCP - port	Defines the port on which the Modbus TCP is accessible	80	

6.4.1.3 FTP server

Parameter	Description	Factory setting	Setting range
FTP server	Reference voltage level type	Yes	Yes / No
FTP port	Port of the FTP service	21	
FTP name	User name for access to FTP server of PLA44 device	admin	
FTP password	Password for access to FTP server of PLA44 device	1234	

6.4.2. RS485

Settings related to RS485 interface with Modbus RTU protocol support.

Parameter	Description	Factory setting	Setting range
ID	Unique identification number in RS485 network	0	0 ... 255
Transfer rate	Communication speed of RS485 interface is adjustable in speed	9,6 kBd	9,6 kBd ... 115 kBd
Parity	RS485 interface parity	odd	odd / even
Stop bit	RS485 interface stop-bit	1	1 / 2

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

13

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

6.4.3. Connection of PLA44 to LAN with NAT server

If there is request for remote access (from Internet) to PLA44, which is place in the local network behind the router with active NAT server, the following parameters configuration to be defined on the router.
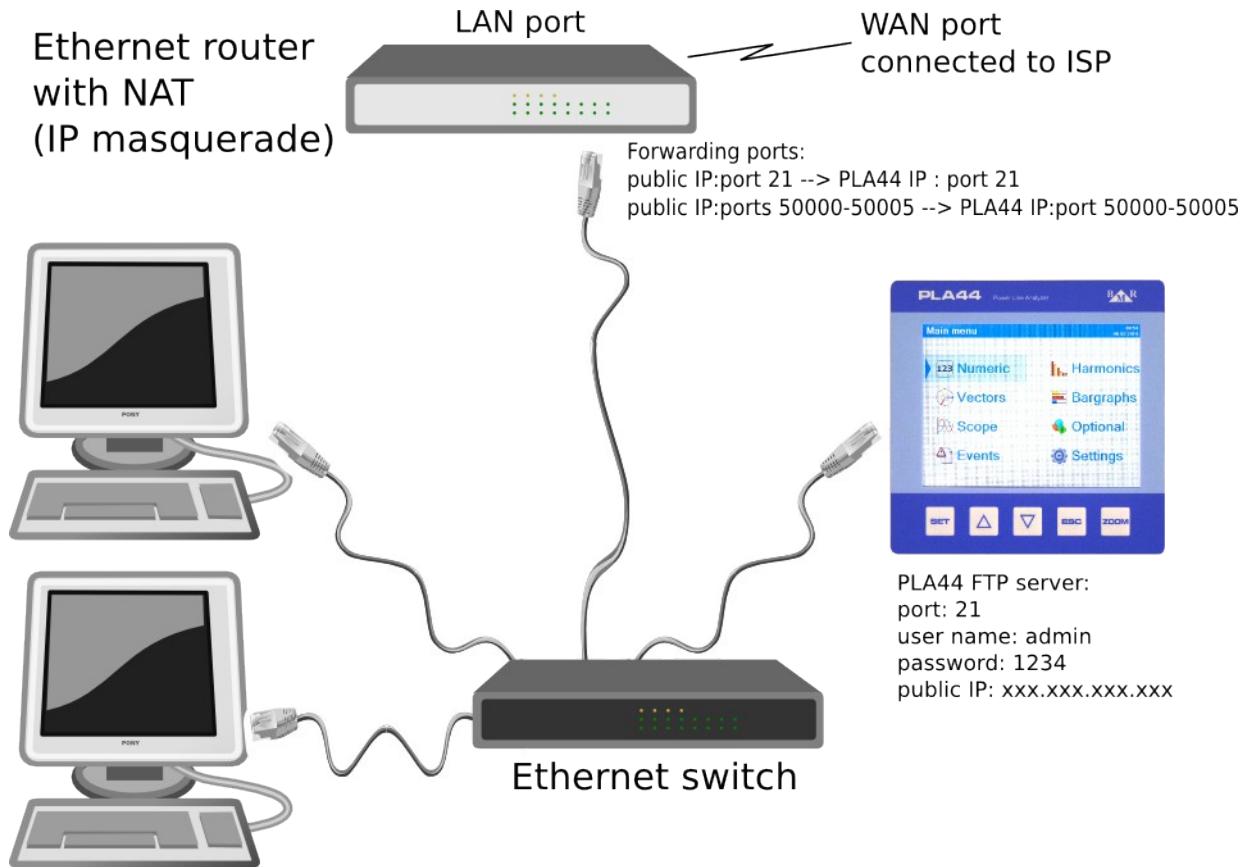
For access to web server of PLA44 there has to be created port forwarding (virtual server):

- router public IP address `xxx.xxx.xxx.xxx:port 80` --> IP address of PLA44 `xxx.xxx.xxx.xxx:port 80`

For access to FTP server of PLA44 (needed for PMS software) there has to be created port forwarding (virtual server):

- router public IP address `xxx.xxx.xxx.xxx:port 21` --> IP of PLA44 `xxx.xxx.xxx.xxx:port 21`

- router public IP address `xxx.xxx.xxx.xxx:port 50000...50005` --> IP of PLA44 `xxx.xxx.xxx.xxx:port 50000...50005`

Notice

Number of port of 80, 21 is possible change on router. Range of ports 50000 ... 50005 is fixed and it is not possible to change it.

On the PLA44 device it is necessary set following parameters in:

- IP - public
- FTP: 21 (factory value)
- user name: admin (factory value)
- password: 1234 (factory value)

Notice

For communication with FTP server of PLA44 within local network is IP-public parameter set on the same as IP of the device. For communication with FTP server of PLA44 from the internet is the IP-public parameter set on public IP obtained from Internet provider.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

14

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

6.5. Events setting

Events captured by PLA44 are fully adjustable by the parameters described in the list beneath.

Parameter		Description	Factory setting	Setting range
Reference		Reference voltage level type	Udin	Udin / Sliding
Pre Samples		Number of recorded half periods Urms1/2 (10ms = 1) before event	10	0 ... 4000
Post Samples		Number of recorded half periods Urms1/2 (10ms = 1) after event	150	0 ... 4000
Over-voltage	▶	Threshold	110%	100 ... 500%
		Hysteresis	5%	1 ... 20%
Under-voltage	▶	Threshold	90%	1 ... 100%
		Hysteresis	5%	1 ... 20%
Interruption	▶	Threshold	5%	1 ... 100%
		Hysteresis	2%	1 ... 20%
Over-current	▶	Threshold	110%	100 ... 500%
		Hysteresis	5%	1 ... 20%

Memory for capturing the samples of RMS curve is fixed on the maximum of 4000 samples. Definition of number Pre and Post samples is limited by this maximum samples memory space.
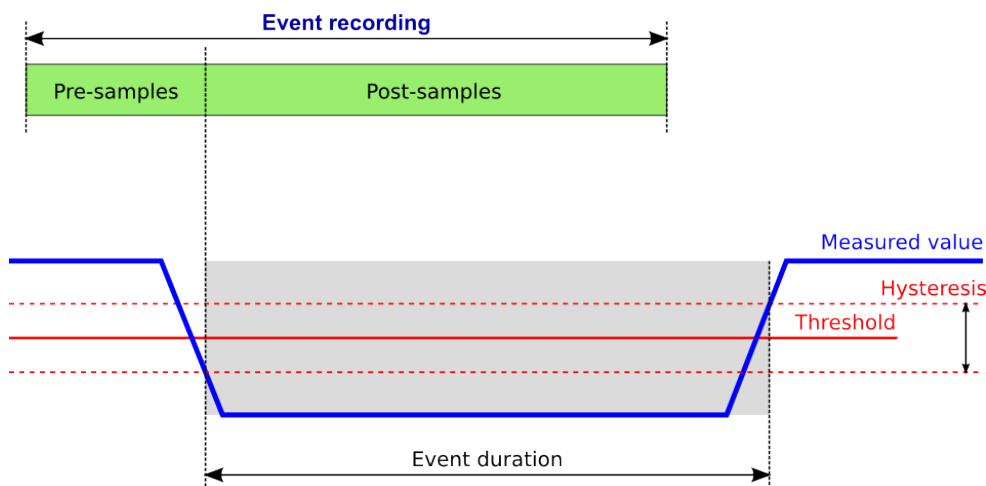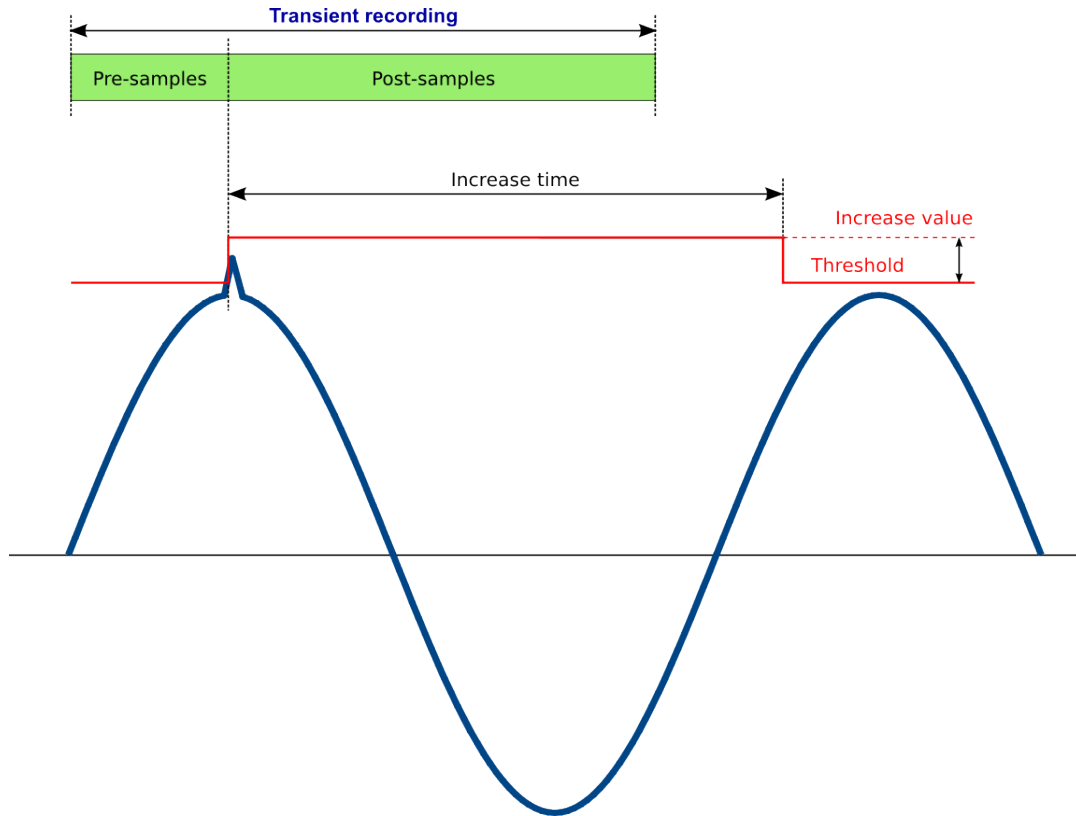

6.6. Transients setting

Transient setting is defined by several parameters listed in table beneath.

Parameter		Description	Factory setting	Setting range
Pre Samples		Number of recorded samples before the transient start	768	0 ... 8000
Post Samples		Number of recorded samples after the transient start	768	0 ... 8000
Delay time		Time delay before next transient recording after transient start	5s	1 ... 20 s
Increase value		Increment value for transient insensitivity after recording start	10V	1 ... 750000 V
Difference	▶	Difference activation	No	YES / NO
		Threshold difference setting	20%	1 ... 100%
Absolute	▶	Absolute activation	NO	YES / NO
		Threshold absolute setting	110%	100 ... 500%

Memory for capturing the transients amplitude is fixed on the maximum of 8000 samples. Definition of number Pre and Post samples is limited by this maximum samples memory space.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

15

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

6.7. RVC and Ripple control

The RVC threshold (or thresholds) and the RVC hysteresis are both set by the user according to the use.

Mains signaling voltage, called "ripple control signal" in certain applications, is a burst of signals, often applied at a non-harmonic frequency, that remotely control industrial equipment, revenue meters, and other devices.

Parameter	Description	Factory setting	Setting range
RVC threshold	The RVC threshold is a percentage of Udin	3,3%	1 ... 100%
RVC hysteresis	The RVC hysteresis is a smaller percentage of Udin	1%	1 ... 20%
Ripple -control	Adjustable by PMS	50 Hz	50 Hz ... 3 kHz

According to the norm the ideal settings is RVC threshold on 3.5% of Udin and hysteresis on 1% of Udin.

6.8. Information

Information about the vendor and device firmware version.

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

16

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com

7. Technical features

Parameter	Value
Supply voltage	230 VAC, 50/60 Hz (+10%,-15%)
Power consumption	<5 VA
Voltage measuring range L - N	10 ... 600 VAC
Voltage measuring range L - L	18 ... 1000 VAC
Current measuring range	0,001 ... 8,5 A
Frequency measuring range	40 ... 70 Hz
Clock accuracy	< 1 s per day
Number of output / input	2
Output type	NPN transistor free potential optical insulated
Maximum voltage for output usage	24 VDC
Maximum output load capability	100 mA
Input type	optical insulated free potential
Maximum input voltage	24 VDC
Maximum input consumption	10 mA
Voltage transformer ratio	1 ... 750 000
Current transformer ratio	1 ... 750 000
Supply voltage power cuts memory	15 events
Sampling rate	40 kHz
Events trigger	10 ms
Data memory for measured parameters	1 GB
Display type and size	VGA TFT 5,6"
Temperature input	NTC sensor 10kΩ / 25°C
Communication port	RS485 (optional) / Modbus RTU / 9,6; 19,2; 38,4 ... 115 kBd
Ethernet	RJ45 / 10/100 Mbit
USB	Type B
Temperature limit	-25°C ... +70°C
Front panel	144 x 144 mm
Panel cutout	136,5 x 136,5 mm
Site depth	75 mm
Weight	1350 g
Protection degree	IP20 rear cover / IP54 front panel
Related standards	IEC 61000-4-30 class A, IEC 61000-4-7, IEC 61000-4-15, IEC61557-12

BMR *trading*
Horní lán 17
779 00 Olomouc
Czech Republic

17

Tel: +420 778 066 566
export@bmr-trading.com
www.bmr-trading.com