

NETWORK PARAMETER ANALYZER **ND45PLUS**



USER MANUAL



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Table of class A parameters

Measured value	Aggregation	Measurement range			Measurement error (PN-EN-61000-4-30) ¹	Remarks
Voltage RMS						
Urms L1	3s	Un = U _{din} ³	Voltage range	Ku value ²	±0,1% U _{din}	Class A
Urms L2		230 V	23,0...345,0 V	Ku = 1		
Urms L3			...1,38 MV	Ku ≠ 1		
Uavg L123		57,7 V	5,7...86,5 V	Ku = 1		
			...280 kV	Ku ≠ 1		
		69,3 V	6,93...104 V	Ku = 1		
			...416 kV	Ku ≠ 1		
Half-wave voltage values						
Uhalf1 L1 ... Uhalf24 L1	200ms	Un = U _{din} ³	Voltage range	Ku value ²	±0,2% U _{din}	Class A
Uhalf1 L2 ... Uhalf24 L2		230 V	23,0...345,0 V	Ku = 1		
Uhalf1 L3 ... Uhalf24 L3			...1,38 MV	Ku ≠ 1		
		57,7 V	5,7...86,5 V	Ku = 1		
			...280 kV	Ku ≠ 1		
		69,3 V	6,93...104 V	Ku = 1		
...416 kV			Ku ≠ 1			
Voltage harmonics						
Har1 UL1 ... Har51 UL1	1s	0,00...100,00%			U _m ≥ 1% U _{nom} ±5% U _m U _m < 1% U _{nom} ±0,05% U _n	Class I
Har1 UL2 ... Har51 UL2						
Har1 UL2 ... Har51 UL2						
Har1 UL3 ... Har51 UL3						
Current RMS						
Irms L1	3s	In	Current range	Ki value ²	±0,1% I _n	Class A
Irms L2		5 A	0,050...7,5 A	Ki = 1		
Irms L3			...150,0 kA	Ki ≠ 1		
Iavg L123		1 A	0,010...1,5 A	Ki = 1		
			...30,0 kA	Ki ≠ 1		
Current harmonics						
Har1 IL1 ... Har51 IL1	1s	0,00...100,00%			I _m ≥ 3% I _{nom} ±5% I _m I _m < 3% I _{nom} ±0,15% I _n	Class I
Har1 IL2 ... Har51 IL2						
Har1 IL3 ... Har51 IL3						

1. Measurement error with respect to the U_{din} value according to PN-EN-61000-4-30.
2. Range Ku = 1...4000,0 and Ki = 1...20000,0.
3. U_{din} - value obtained from the declared supply voltage U_c = U_n through the transformer ratio, according to PN-EN-61000-4-30.
4. I_m, U_m – measured current and voltage values according to PN-EN-61000-4-7.
5. I_{nom}, U_{nom} – rated current and voltage values according to PN-EN-61000-4-7.
6. I_n, U_n – rated current and voltage values according to PN-EN-61000-4-30.

1 General specification

The ND45PLUS analyzer is designed to measure and analyze the parameters of three-phase, 3- or 4-wire power networks in balanced or unbalanced systems.

The set includes:

- | | |
|--|--------|
| • ND45PLUS analyzer | 1 pc. |
| • User's Manual - Quick Start | 1 pc. |
| • mounting brackets for panel installation | 4 pcs. |
| • key | 1 pc. |
| • ferrite filter STAR-TEC 74271132 | 1 pc. |
| • SD card | 1 pc. |

The following optional accessory can be ordered for the ND45PLUS analyzer:

- STR receiver for time synchronization with GPS

Note! The SD card contains:

- ND45PlusSetup and PowerArchive software,
- user's manuals in PDF format (in Polish and English).

1.1 Features of the device

- measurement and calculation of power quality parameters according to PN-EN 50160,
- intuitive operation via a touch screen and a Linux-based graphical user interface,
- color LCD TFT screen, 5,6", 640x480 pixels,
- communication interfaces: Ethernet 10/100 Base-T, RS-485,
- communication protocols: Modbus TCP/IP Slave, RS-485 Modbus Slave, IEC 60870-5-104 TCP/IP,
- all phases isolated,
- IP54 enclosure protection on the user's side,
- time zone selection, automatic daylight saving time adjustment, synchronization with a time server, GPS time synchronization when connected to an STR device,
- data archiving on an SD card,
- WWW and FTP servers,
- logs of interruptions, dips, swells, alarms and audits,
- firmware update capability,
- Polish/English language selection,
- dedicated visualization, including digital displays, analog indicators, harmonics, vector diagrams, trends and waveform records,
- measurement card sampling frequency: 20480 Hz.

Measured parameters:

Voltage measurements	Parameters measured with aggregation of 200 ms	
	RMS:	Urms L1, Urms L2, Urms L3, Uavg L123.
	Basic RMS:	Ufund L1, Ufund L2, Ufund L3, Uavg L123.
	Phase-to-phase:	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.
	Asymmetry:	Vunb.
	Half wave	Uhalf1 L1 ... Uhalf24 L1, Uhalf1 L2 ... Uhalf24 L2, Uhalf1 L3 ... Uhalf24 L3.
	Parameters measured with aggregation of 1 s	
	RMS:	Urms L1, Urms L2, Urms L3, Uavg L123.
	Basic RMS:	Ufund L1, Ufund L2, Ufund L3, Uavg L123.
	Phase-to-phase:	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.
	Asymmetry:	Vunb.
	Interharmonics:	InterHr 1 U L1 ... InterHr 51 U L1, InterHr 1 U L2 ... InterHr 51 U L2, InterHr 1 U L3 ... InterHr 51 U L3.
	Parameters measured with aggregation of 3 s	
	RMS:	Urms L1, Urms L2, Urms L3, Uavg L123.
	Basic RMS:	Ufund L1, Ufund L2, Ufund L3, Uavg L123.
	Phase-to-phase:	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.
	Asymmetry:	Vunb.
	Parameters measured with aggregation of 10 min.	
	RMS:	Urms L1, Urms L2, Urms L3, Uavg L123.
	Basic RMS:	Ufund L1, Ufund L2, Ufund L3, Uavg L123.
	Phase-to-phase:	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.
	Asymmetry:	Vunb.
	Parameters measured with aggregation of 2 hours.	
	RMS:	Urms L1, Urms L2, Urms L3, Uavg L123.
	Basic RMS:	Ufund L1, Ufund L2, Ufund L3, Uavg L123.
	Phase-to-phase:	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.
	Asymmetry:	Vunb.
	Values averaged over 15 min, 30 min or 1 hour.	
	Demand	U Demand
	Parameters with configurable averaging time: 1s, 3s, 10min, 2h	
	Harmonics:	Hr 1 U L1 ... Hr 51 U L1, Hr 1 U L2 ... Hr 51 U L2, Hr 1 U L3 ... Hr 51 U L3.
	Distortion factor:	THD U L1, THD U L2, THD U L3, THD Uavg L123.
	Distortion factor of harmonic groups:	THDS U L1, THDS U L2, THDS U L3, THDS Uavg L123.
	Distortion factor of harmonic subgroups:	THDG U L1, THDG U L2, THDG U L3, THDG Uavg L123.
	Partially weighted distortion factor:	PWHD U L1, PWHD U L2, PWHD U L3, PWHD Uavg L123.

Current measurements	Parameters measured with aggregation of 200 ms	
	RMS:	Irms L1, Irms L2, Irms L3, Iavg L123.
	Neutral:	In.
	Calculated neutral:	INC.
	Parameters measured with aggregation of 1 s	
	RMS:	Irms L1, Irms L2, Irms L3, Iavg L123.
	Neutral:	In.
	Calculated neutral:	INC.
	Interharmonics:	InterHr 1 I L1 ... InterHr 51 I L1, InterHr 1 I L2 ... InterHr 51 I L2, InterHr 1 I L3 ... InterHr 51 I L3.
	Parameters measured with aggregation of 3 s	
	RMS:	Irms L1, Irms L2, Irms L3, Iavg L123.
	Neutral:	IN.
	Calculated neutral:	INC.
	Parameters measured with aggregation of 10 min.	
	RMS:	Irms L1, Irms L2, Irms L3, Iavg L123.
	Neutral:	In.
	Calculated neutral:	INC.
	Parameters measured with aggregation of 2 hours.	
	RMS:	Irms L1, Irms L2, Irms L3, Iavg L123.
	Neutral:	In.
	Calculated neutral:	INC.
	Values averaged over 15 min, 30 min or 1 hour.	
	Demand	I Demand
	Parameters with configurable averaging time: 1s, 3s, 10min, 2h	
	Harmonics:	Hr 1 I L1 ... Hr 51 I L1, Hr 1 I L2 ... Hr 51 I L2, Hr 1 I L3 ... Hr 51 I L3.
	Distortion factor:	THD I L1, THD I L2, THD I L3, THD Iavg L123.
	Distortion factor of harmonic groups:	THDS I L1, THDS I L2, THDS I L3, THDS Iavg L123.
	Distortion factor of harmonic subgroups:	THDG I L1, THDG I L2, THDG I L3, THDG Iavg L123.
	Partially weighted distortion factor:	PWHD I L1, PWHD I L2, PWHD I L3, PWHD Iavg L123.

Power and energy measurements	Parameters measured with aggregation of 200 ms	
	Active imported energy	$\text{EnP}^+ \text{ L1, EnP}^+ \text{ L2, EnP}^+ \text{ L3, } \sum \text{EnP}^+ \text{ L123.}$
	Active exported energy	$\text{EnP}^- \text{ L1, EnP}^- \text{ L2, EnP}^- \text{ L3, } \sum \text{EnP}^- \text{ L123.}$
	Reactive inductive imported energy	$\text{EnQ}^+ \text{ } \int \text{ L1, EnQ}^+ \text{ } \int \text{ L2, EnQ}^+ \text{ } \int \text{ L3, } \sum \text{EnQ}^+ \text{ } \int \text{ L123.}$
	Reactive inductive exported energy	$\text{EnQ}^- \text{ } \int \text{ L1, EnQ}^- \text{ } \int \text{ L2, EnQ}^- \text{ } \int \text{ L3, } \sum \text{EnQ}^- \text{ } \int \text{ L123.}$
	Reactive capacitive imported energy	$\text{EnQ}^{+-} \text{ L1, EnQ}^{+-} \text{ L2, EnQ}^{+-} \text{ L3, } \sum \text{EnQ}^{+-} \text{ L123.}$
	Reactive energy (capacitive) exported	$\text{EnQ}^{-+} \text{ L1, EnQ}^{-+} \text{ L2, EnQ}^{-+} \text{ L3, } \sum \text{EnQ}^{-+} \text{ L123.}$
	Apparent energy	$\text{EnS L1, EnS L2, EnS L3, } \sum \text{EnS L123.}$
	Active power	$\text{P L1, P L2, P L3, Pavg L123, } \sum \text{P L123.}$
	Reactive power	$\text{Q L1, Q L2, Q L3, Qavg L123, } \sum \text{Q L123.}$
	Apparent power	$\text{S L1, S L2, S L3, Savg L123, } \sum \text{S L123.}$
	Parameters measured with aggregation of 1 s	
	Active power	$\text{P L1, P L2, P L3, Pavg L123, } \sum \text{P L123.}$
	Reactive power	$\text{Q L1, Q L2, Q L3, Qavg L123, } \sum \text{Q L123.}$
	Apparent power	$\text{S L1, S L2, S L3, Savg L123, } \sum \text{S L123.}$
	Parameters measured with aggregation of 3 s	
	Active power	$\text{P L1, P L2, P L3, Pavg L123, } \sum \text{P L123.}$
	Reactive power	$\text{Q L1, Q L2, Q L3, Qavg L123, } \sum \text{Q L123.}$
	Apparent power	$\text{S L1, S L2, S L3, Savg L123, } \sum \text{S L123.}$
	Parameters measured with aggregation of 10 min	
	Active power	$\text{P L1, P L2, P L3, Pavg L123, } \sum \text{P L123.}$
	Reactive power	$\text{Q L1, Q L2, Q L3, Qavg L123, } \sum \text{Q L123.}$
	Apparent power	$\text{S L1, S L2, S L3, Savg L123, } \sum \text{S L123.}$
	Parameters measured with aggregation of 2 hours	
	Active power	$\text{P L1, P L2, P L3, Pavg L123, } \sum \text{P L123.}$
	Reactive power	$\text{Q L1, Q L2, Q L3, Qavg L123, } \sum \text{Q L123.}$
	Apparent power	$\text{S L1, S L2, S L3, Savg L123, } \sum \text{S L123.}$
	Values averaged over 15 min, 30 min or 1 hour.	
	Demand	$\text{P Demand, Q Demand, S Demand.}$
	Parameters with configurable averaging time: 1s, 3s, 10min, 2h	
	Harmonic active power	$\text{Hr P 1 L1 ... Hr P 51 L1,}$ $\text{Hr P 1 L2 ... Hr P 51 L2,}$ $\text{Hr P 1 L3 ... Hr P 51 L3,}$
	Harmonic reactive power	$\text{Hr Q 1 L1 ... Hr Q 51 L1,}$ $\text{Hr Q 1 L2 ... Hr Q 51 L2,}$ $\text{Hr Q 1 L3 ... Hr Q 51 L3,}$
	Harmonic apparent power	$\text{Hr S 1 L1 ... Hr S 51 L1,}$ $\text{Hr S 1 L2 ... Hr S 51 L2,}$ $\text{Hr S 1 L3 ... Hr S 51 L3,}$

Other parameters	Parameters measured with aggregation of 200 ms	
	Power distortion factor:	dPF L1, dPF L2, dPF L3, dPFavg L123.
	Active power factor:	PF L1, PF L2, PF L3, PFavg L123.
	tgφ factor:	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.
	Angle between voltage and current:	φ L1, φ L2, φ L3, φavg L123.
	Voltage phase-to-phase angle:	∠ U L1-2, ∠ U L2-3, ∠ U L3-1.
	Parameters measured with aggregation of 1 s	
	Power distortion factor:	dPF L1, dPF L2, dPF L3, dPFavg L123.
	Active power factor:	PF L1, PF L2, PF L3, PFavg L123.
	tgφ factor:	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.
	Angle between voltage and current:	φ L1, φ L2, φ L3, φavg L123.
	Voltage phase-to-phase angle:	∠ U L1-2, ∠ U L2-3, ∠ U L3-1.
	Frequency	f
	Parameters measured with aggregation of 3 s	
	Power distortion factor:	dPF L1, dPF L2, dPF L3, dPFavg L123.
	Active power factor:	PF L1, PF L2, PF L3, PFavg L123.
	tgφ factor:	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.
	Angle between voltage and current:	φ L1, φ L2, φ L3, φavg L123.
	Voltage phase-to-phase angle:	∠ U L1-2, ∠ U L2-3, ∠ U L3-1.
	Parameters measured with aggregation of 10 s	
	Frequency	f
	Parameters measured with aggregation of 1 min	
	Flicker	Pst L1 (1 min), Pst L2 (1 min), Pst L3 (1 min)
	Parameters measured with aggregation of 10 min	
	Power distortion factor:	dPF L1, dPF L2, dPF L3, dPFavg L123.
	Active power factor:	PF L1, PF L2, PF L3, PFavg L123.
	tgφ factor:	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.
	Angle between voltage and current:	φ L1, φ L2, φ L3, φavg L123.
	Voltage phase-to-phase angle:	∠ U L1-2, ∠ U L2-3, ∠ U L3-1.
	Flicker	Pst L1, Pst L2, Pst L3
	Parameters measured with aggregation of 2 hours	
	Power distortion factor:	dPF L1, dPF L2, dPF L3, dPFavg L123.
	Active power factor:	PF L1, PF L2, PF L3, PFavg L123.
	tgφ factor:	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.
	Angle between voltage and current:	φ L1, φ L2, φ L3, φavg L123.
	Voltage phase-to-phase angle:	∠ U L1-2, ∠ U L2-3, ∠ U L3-1.
	Flicker	Plt L1, Plt L2, Plt L3
	Parameters measured with aggregation of 1 s.	
	Temp. / Resistance	T1, T2.

1.1.1 Operational safety

Caution! Removing the analyzer housing during the warranty period voids the warranty. Before removing the housing, turn off the power supply and disconnect the measurement circuits.

- Assembly and installation of the electrical connections must be carried out by suitably qualified personnel.
- Check that all connections are correct before turning on the analyzer power supply.
- The device is intended for installation and use in industrial electromagnetic environments.
- The building installation must include a switch or circuit-breaker, located near the device, easily accessible to the operator and clearly marked.

1.1.1.1 Warning and information signs

One or more of the following symbols may appear on the analyzer and in the materials supplied with it:

	Caution: refer to the description in the device user's manual.
	Protective conductor terminal.
	Warning: live equipment.
	Protection of electrostatic-sensitive devices (ESD).
	Waste electrical and electronic equipment (WEEE). Dispose of in accordance with the law.

1.1.1.2 *Operating safety*

The ND45PLUS analyzer meets the safety requirements for electrical measuring instruments for automation according to PN-EN 61010-1 and the requirements for immunity to disturbances in industrial environments according to PN-EN 61000-6-2 and PN-EN 61000-6-4.

Incorrect connection of the power supply, communication interfaces or measurement signals, or use of equipment contrary to this manual and the standards listed above, may damage the analyzer.

1.1.1.3 *Remarks concerning the analyzer installation*

In practice, various sources of interference affect the ND45PLUS analyzer continuously or as pulses through the power supply network (due to the operation of other devices), and may also be superimposed on the measured signal or the analyzer's auxiliary circuits. Strong pulse interference is particularly hazardous to device operation, as it may cause occasional incorrect measurement results or spurious alarm activation. This interference must be reduced below the analyzer's immunity threshold, primarily by installing the analyzer correctly on site.

In addition to the recommendations in the preceding sections, observe the following:

- do not supply the analyzer from networks close to devices that generate strong pulse interference in the power supply network, and do not share earthing circuits with such devices.
- signal cables must be shielded.
- route communication interface connections individually using shielded twisted-pair cables as described above.
- earth all shields at one end only, at the analyzer.
- avoid sharing an earth conductor with other devices.
- follow the general rule that cables (cable bundles) carrying different signals should be routed as far apart as possible, with any crossings at an angle of 90°.
- do not remove the analyzer housing; all repairs and changes to the device equipment must be carried out by the manufacturer.
- the protection provided for device safety may be less effective if the device is used contrary to the manufacturer's instructions and good engineering practice.
- fit the supplied STAR-TEC 74271132 ferrite filter to the power supply cable, close to the analyzer.

1.1.1.4 ESD protection precautions

The semiconductor components used in the analyzer may be damaged by electrostatic discharge (*ElectroStatic Discharge*).

To prevent this, observe the following precautions during servicing:

- disassemble instruments only in an electrostatic discharge protected area
- use conductive materials in the work area to dissipate electrostatic charges
- use only antistatic packaging to store electronic components and assemblies
- do not touch components or assemblies with your hands
- do not keep materials prone to generating electrostatic charges in the work area

2 Connection diagrams

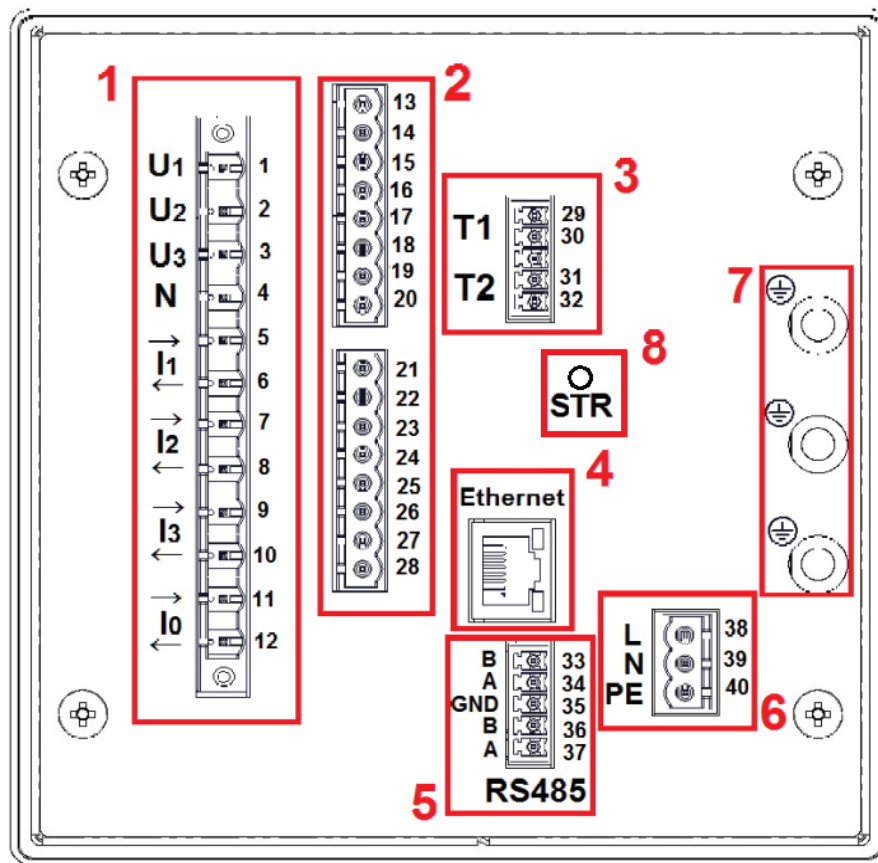


Fig. 1: Terminal board.

Item	Description
1	Electrical parameter measurement inputs.
2	Additional inputs/outputs - optional equipment depending on the ND45Plus ordering code. Relay outputs, binary inputs or analog outputs are available.
3	Temperature or resistance measurement inputs.
4	Ethernet communication interface.
5	RS 485 Modbus Slave communication interface
6	ND45Plus analyzer power supply.
7	Earthing terminals for connecting shields.
8	Connector for the STR receiver for time synchronization with GPS

2.1.1 Measurement inputs

2.1.1.1 Voltage and current

- Three-wire network. Direct measurement.

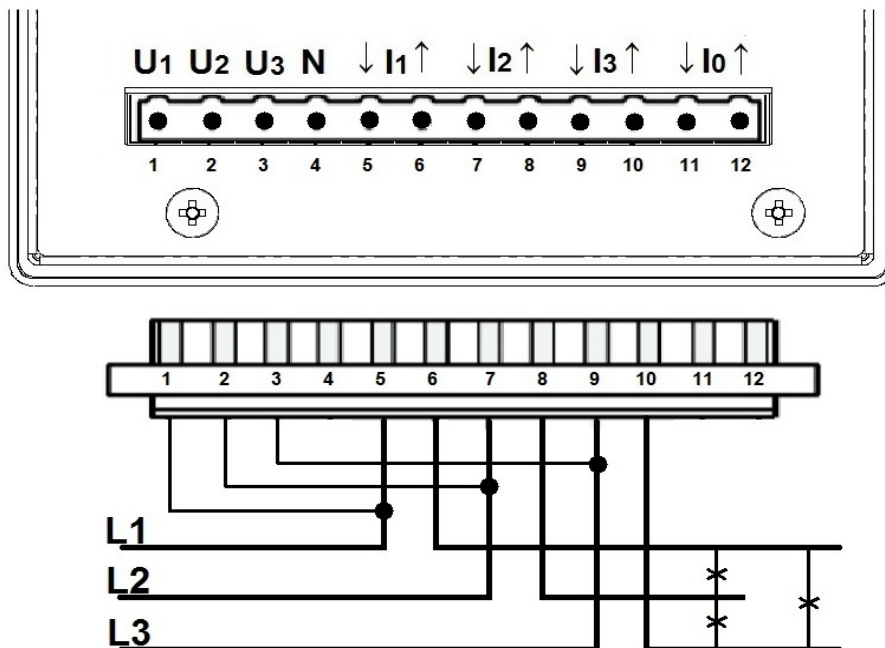


Fig. 2: Three-wire network. Direct measurement.

- Three-wire network. Semi-indirect measurement.

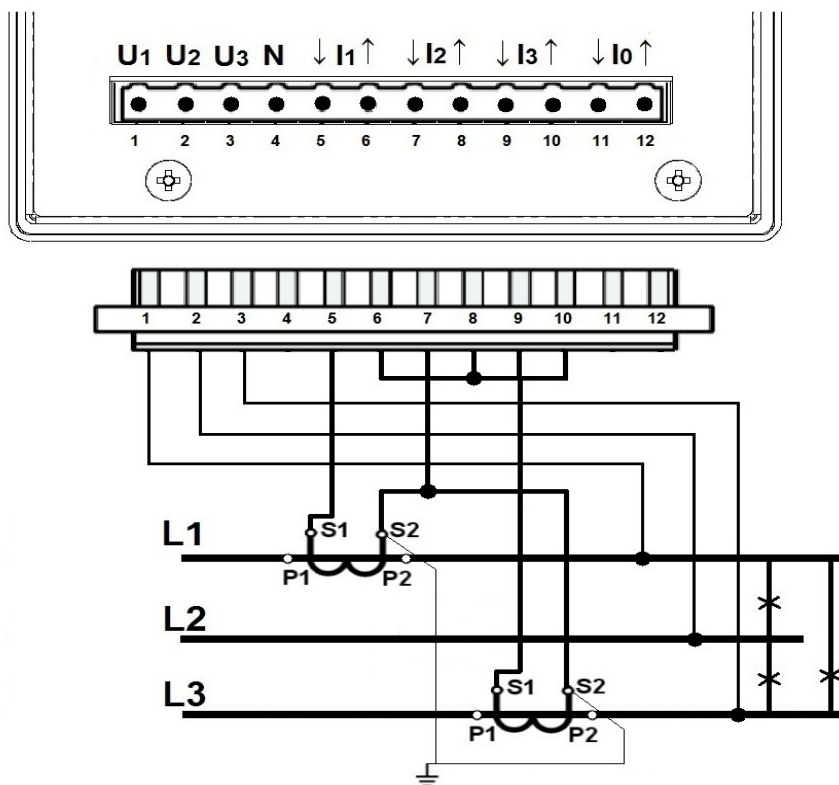


Fig. 3: Three-wire network. Semi-indirect measurement.

- Three-wire network. Indirect measurement using:
 - two current transformers,
 - two or three voltage transformers.

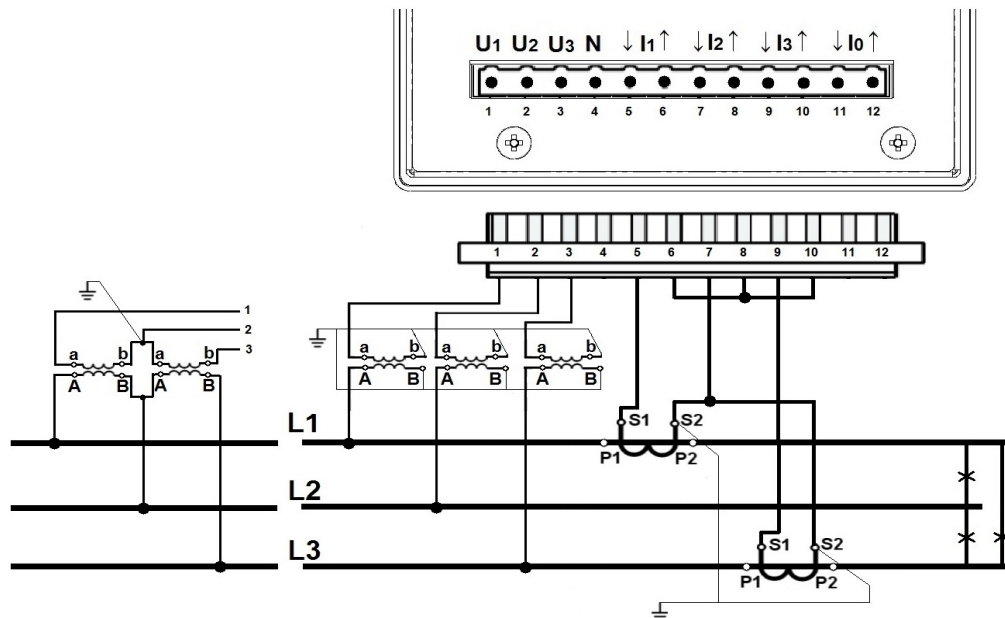


Fig. 4: Three-wire network. Indirect measurement: two current transformers, two or three voltage transformers.

- Four-wire network. Direct measurement.

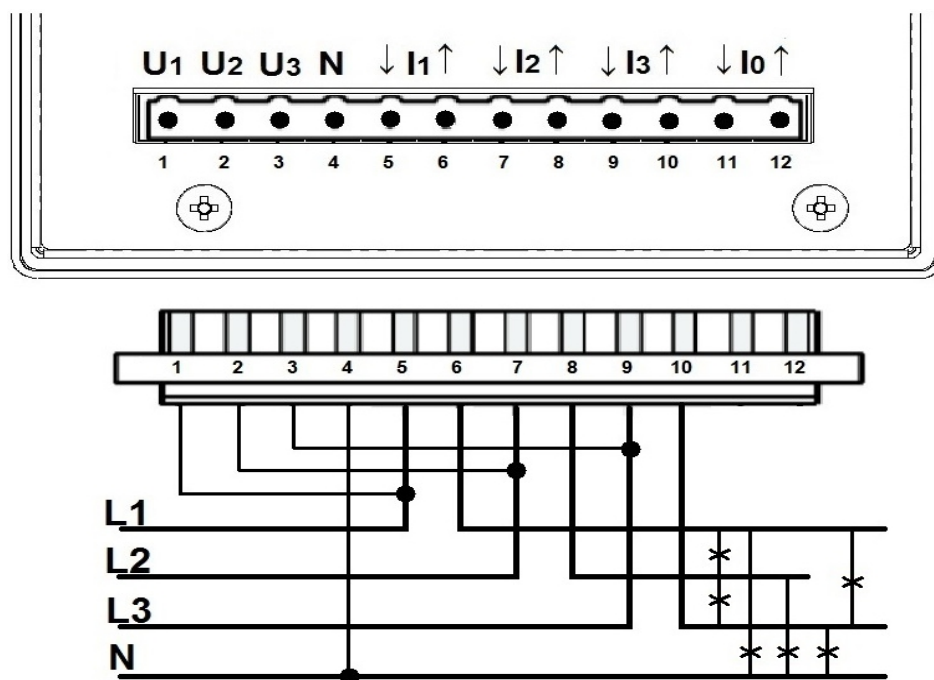


Fig. 5: Four-wire network. Direct measurement.

- Four-wire network. Semi-indirect measurement carried out with the use of three current transformers.

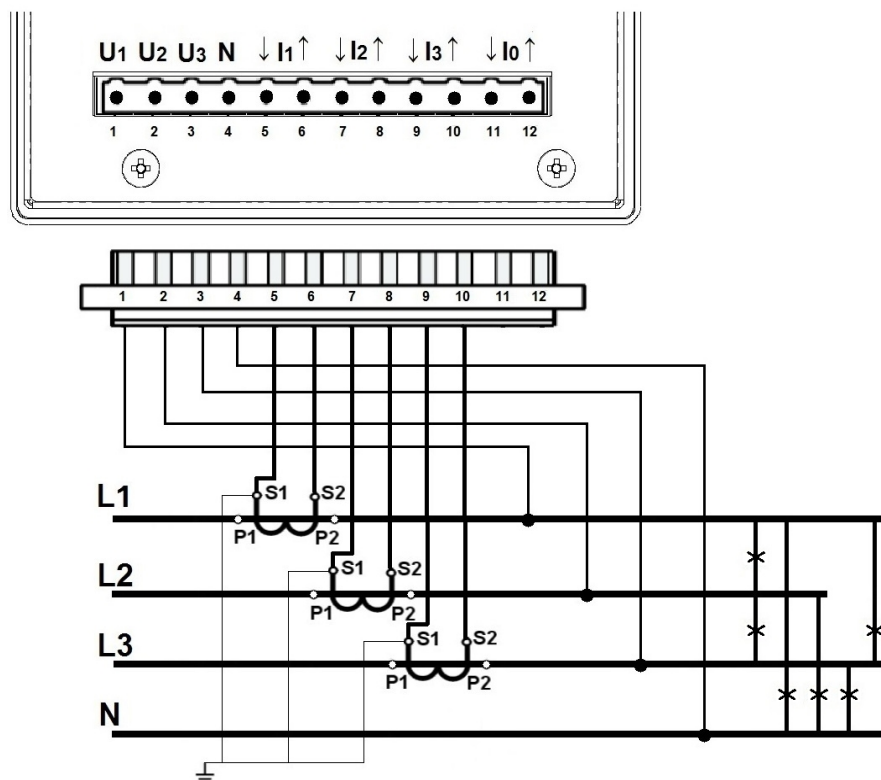


Fig. 6: Four-wire network. Semi-indirect measurement:
using three current transformers.

- Four-wire network. Semi-indirect measurement carried out with the use of four current transformers.

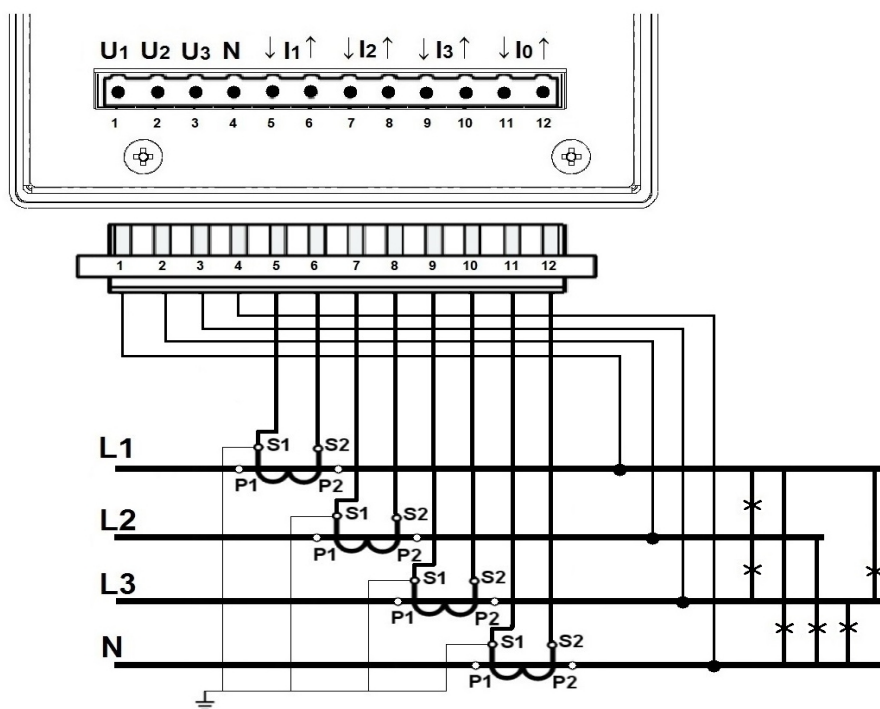


Fig. 7: Four-wire network. Semi-indirect measurement:
four current transformers.

- Four-wire network. Indirect measurement using:
 - three current transformers,
 - two or three voltage transformers.

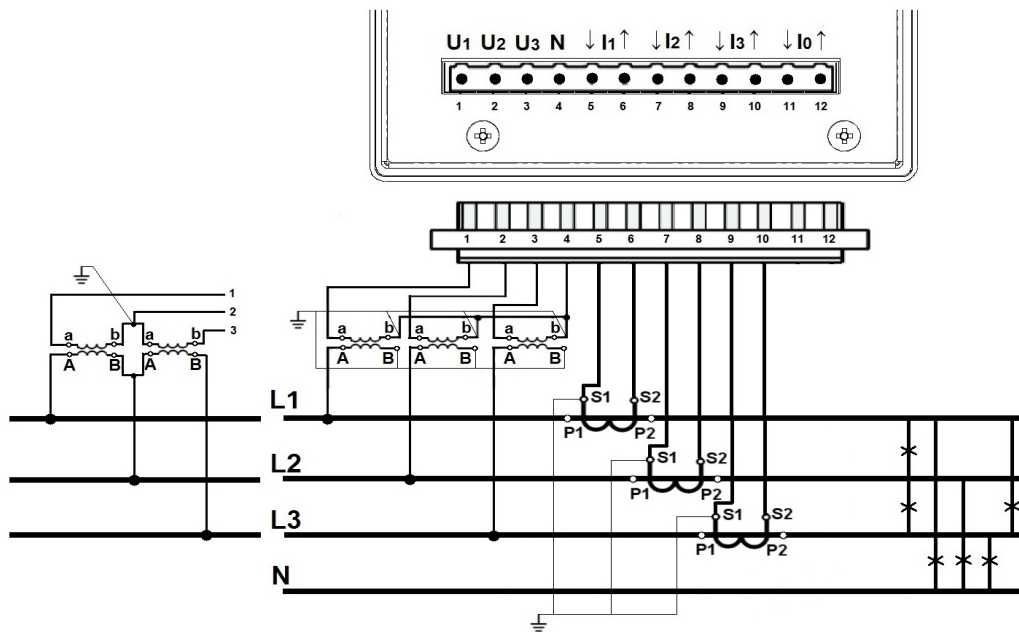


Fig. 8: Four-wire network. Indirect measurement: three current transformers, two or three voltage transformers

- Four-wire network. Indirect measurement using:
 - four current transformers,
 - two or three voltage transformers.

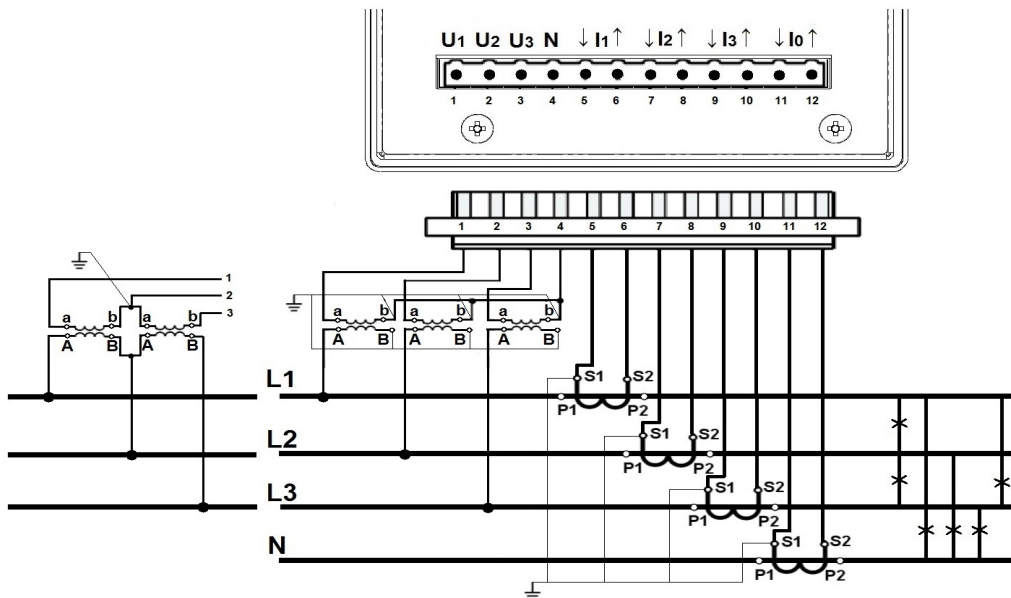


Fig. 9: Four-wire network. Indirect measurement: four current transformers, two or three voltage transformers

2.1.1.2 Temperature and resistance

Example connection of measurement inputs for temperature or resistance measurement.
For configuration details, see "Temperature and resistance".

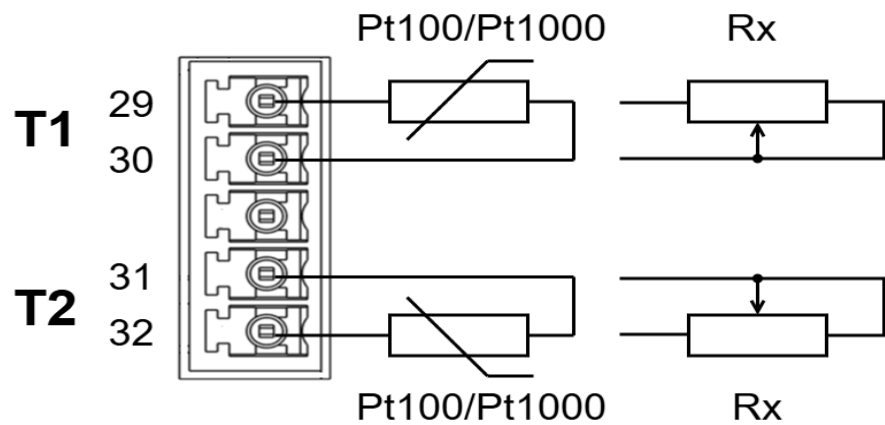
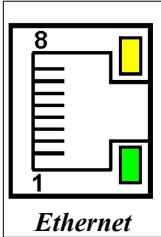
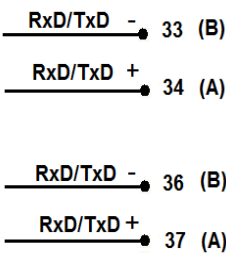


Fig. 10: Pt100/Pt1000 resistance thermometer or variable-resistance element (both options in a 2-wire connection only).

2.1.2 Communication interfaces

Ethernet socket (RJ45). Connect the analyzer to a hub or switch using a straight-through cable with 1:1 pin connections.	 Ethernet
The RS485 (Slave) interface is assigned to terminal pairs 33-34 and 36-37.	 RS485 interface

2.1.3 Card - 8 relay outputs

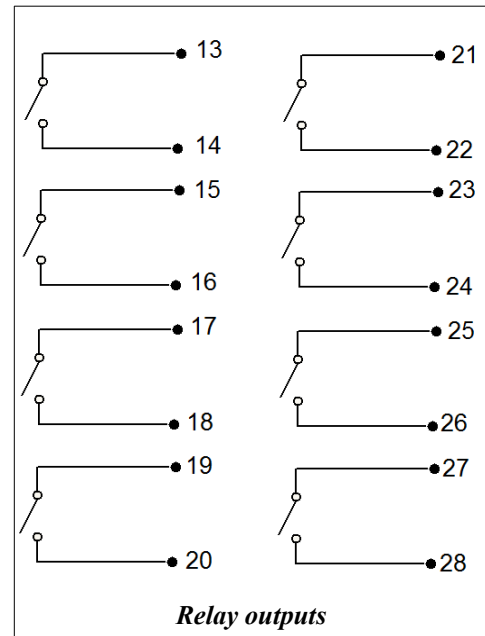
Connecting relay outputs

The relay outputs are normally open (NO).

Where:

terminals 13-14: output 1,	terminals 21-22: output 5,
terminals 15-16: output 2,	terminals 23-24: output 6,
terminals 17-18: output 3,	terminals 25-26: output 7,
terminals 19-20: output 4,	terminals 27-28: output 8.

The version with 8 relays uses the upper and lower parts of the extension card connector, terminals 13 to 28.



2.1.4 Card - 6 binary inputs, 4 relay outputs

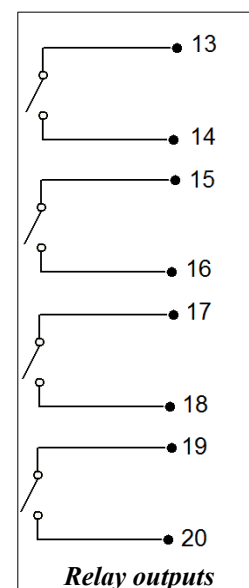
Connecting relay outputs

The relay outputs are normally open (NO).

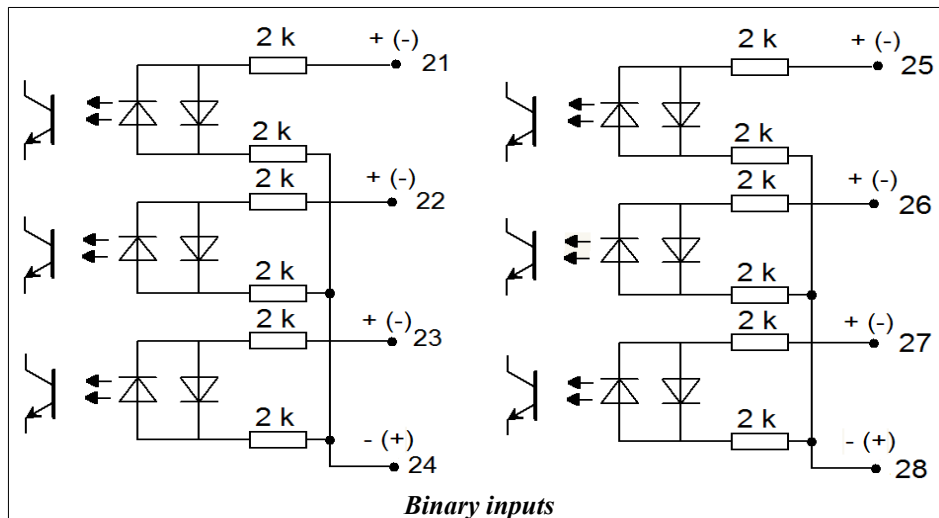
Where:

terminals 13-14: output 1,
terminals 15-16: output 2,
terminals 17-18: output 3,
terminals 19-20: output 4,

The version with 4 relays uses the upper part of the extension card connector, terminals 13 to 20.



Connecting binary inputs



Binary inputs BI 1...BI 6 are controlled by the following signals:

- 0 ... 2 V d.c – binary input inactive
- 8 ... 24 V d.c – input operating as an active binary input
- 8 ... 24 V d.c – input operating as a counting input (high level)

Where:

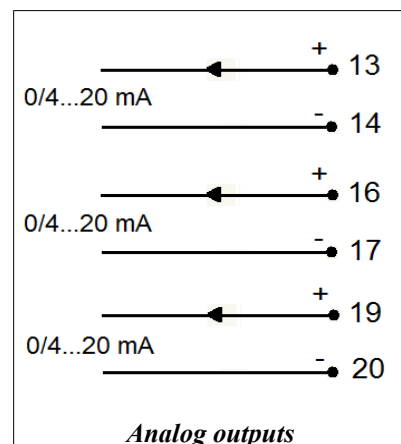
- | | |
|--|----------------------------------|
| terminal 21 : binary input BI 1, | terminal 25 : binary input BI 4, |
| terminal 22 : binary input BI 2, | terminal 26 : binary input BI 5, |
| terminal 23 : binary input BI 3, | terminal 27 : binary input BI 6. |
| terminal 24: common terminal for inputs BI 1-3 | |
| terminal 28: common terminal for inputs BI 4-6 | |

2.1.5 Card - 6 binary inputs, 3 analog outputs

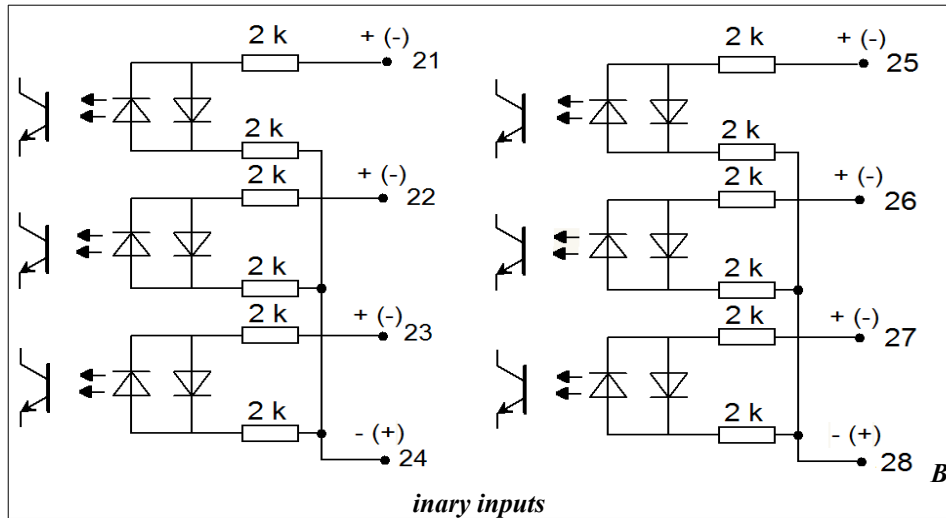
Connecting analog outputs

The version with analog outputs uses the upper part of the extension card connector and includes 3 terminal pairs:

- 13 – 14 : analog output 1 (AO1)
- 16 – 17 : analog output 2 (AO2)
- 19 – 20 : analog output 3 (AO3)



Connecting binary inputs



Binary inputs BI 1...BI 6 are controlled by the following signals:

0 ... 2 V d.c – binary input inactive

8 ... 24 V d.c – input operating as an active binary input

8 ... 24 V d.c – input operating as a counting input (high level)

Where:

terminal 21 : binary input BI 1,
terminal 22 : binary input BI 2,
terminal 23 : binary input BI 3,

terminal 25 : binary input BI 4,
terminal 26 : binary input BI 5,
terminal 27 : binary input BI 6.

terminal 24: common terminal for inputs BI 1-3

terminal 28: common terminal for inputs BI 4-6

2.1.6 Card - 4 binary inputs, 6 analog outputs

Connecting analog outputs

The version with analog outputs uses both extension card connectors and includes 6 terminal pairs:

13 – 14 : analog output 1 (AO1)

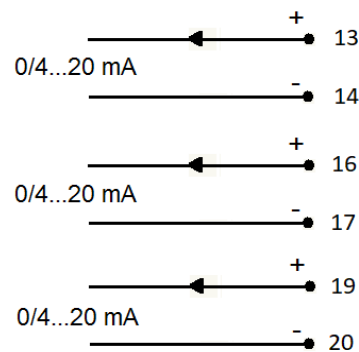
16 – 17 : analog output 2 (AO2)

19 – 20 : analog output 3 (AO3)

21 – 22 : analog output 4 (AO4)

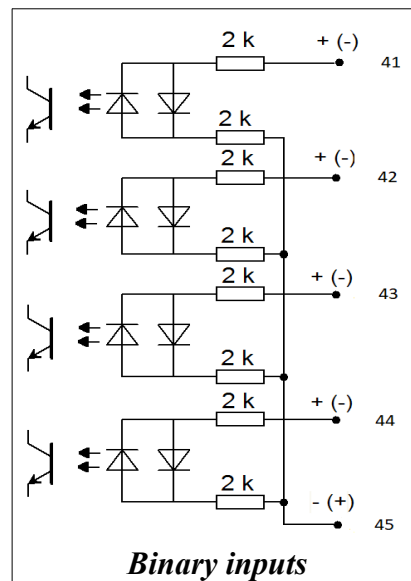
24 – 25 : analog output 5 (AO5)

27 – 28 : analog output 6 (AO6)



Analog outputs

Connecting binary inputs



Binary inputs BI 1...BI 4 are controlled by the following signals:

- 0 ... 2 V d.c – binary input inactive
- 8 ... 24 V d.c – input operating as an active binary input
- 8 ... 24 V d.c – input operating as a counting input (high level)

Where:

- terminal 41 : binary input BI 1,
- terminal 42 : binary input BI 2,
- terminal 43 : binary input BI 3,
- terminal 44 : binary input BI 4
- terminal 45: common terminal for inputs BI 1-4

2.1.7 STR receiver for time synchronization with GPS

Connect the STR receiver to the socket on the analyzer's rear panel using an adapter with a Jack 3.5mm Stereo plug. The adapter signals are shown in 1. Connect the other end of the cable to the STR receiver terminals as specified in its user's manual.

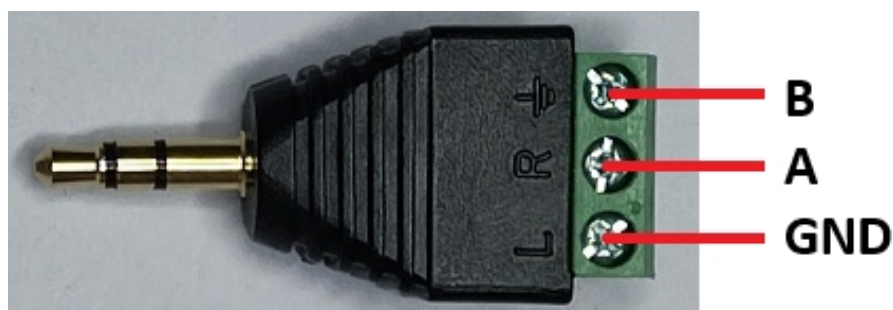
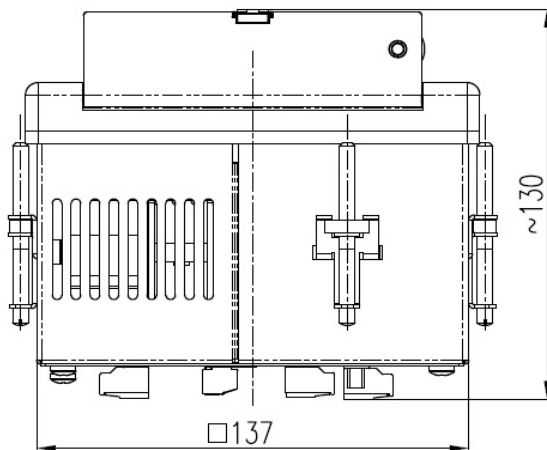


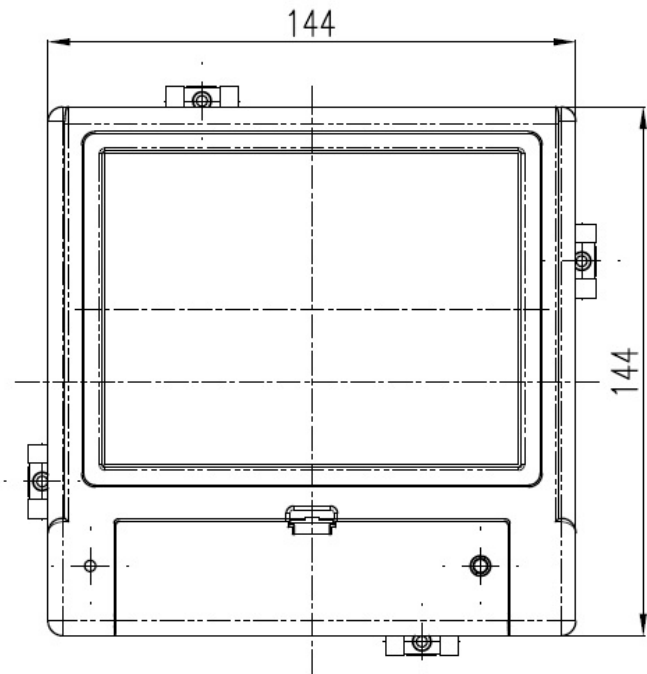
Fig. 1: Connecting the STR receiver

2.1.8 Installation

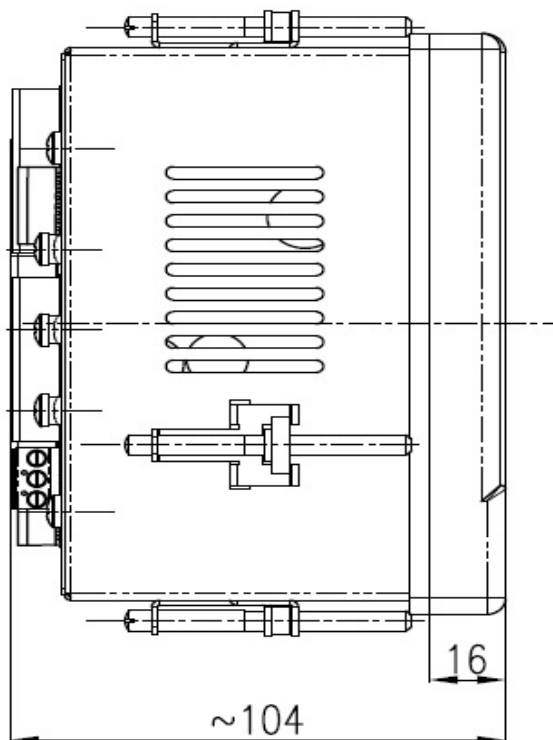
The ND45Plus analyzer is designed for panel mounting using brackets. Housing dimensions: 144 x 144 x 104 mm; mounting cut-out dimensions: 138 x 138 **mm**.



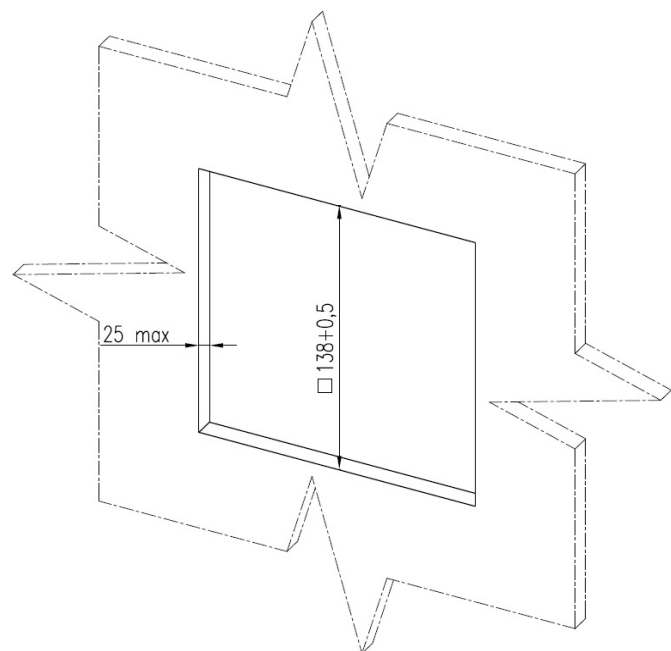
Dimensions - bottom



Dimensions - front



Dimensions - side



Dimensions – mounting cut-out

3 Operation of the device

3.1 Description of editing dialog boxes and selection lists

The main editing dialog box allows digits, letters and special characters to be entered or modified. The example shown is used to enter characters (lowercase).



Fig. 2: Dialog box – editing, lowercase

Item	Description
1	Display of the item being edited.
2	Accepts the entered value and closes the dialog box.
3	Switches the keyboard between lowercase and uppercase.
4	Switches between the letter keyboard tab and the digits and special characters keyboard tab.
5	Buttons for moving the cursor left or right in the display of the item being edited (1).
6	Deletes the single character immediately after the cursor from the display (1).
7	Closes the dialog box without saving the entered value.

Dialog box for entering characters (uppercase).

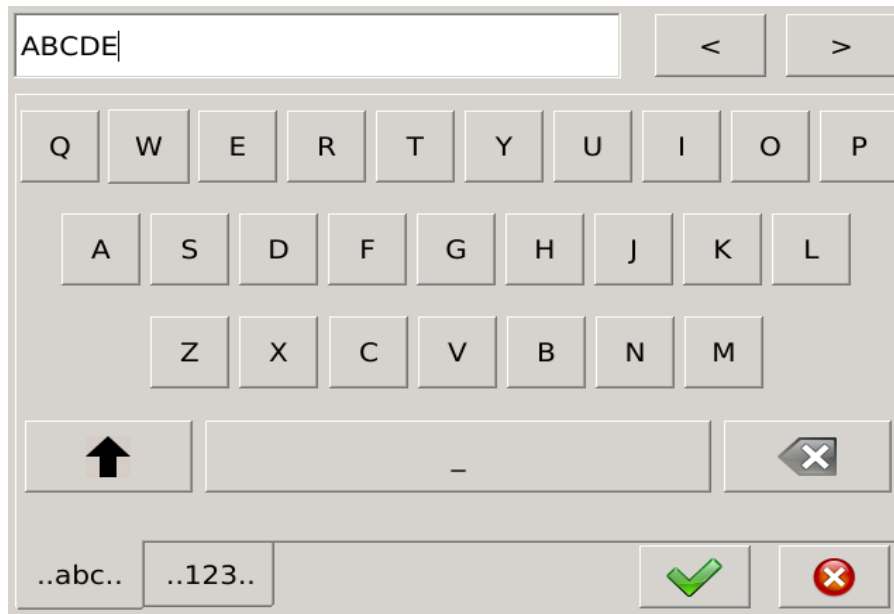


Fig. 3: Dialog box – editing, uppercase

Dialog box for entering numerical values and the available special characters.



Fig. 4: Dialog box – editing, special characters

Numerical value editor, 5 and 6. The range of values that can be saved is shown at the top. The editor allows fixed-point values (example on the left) or floating-point values (example on the right) to be entered, and the entire value display or a single digit to be cleared.

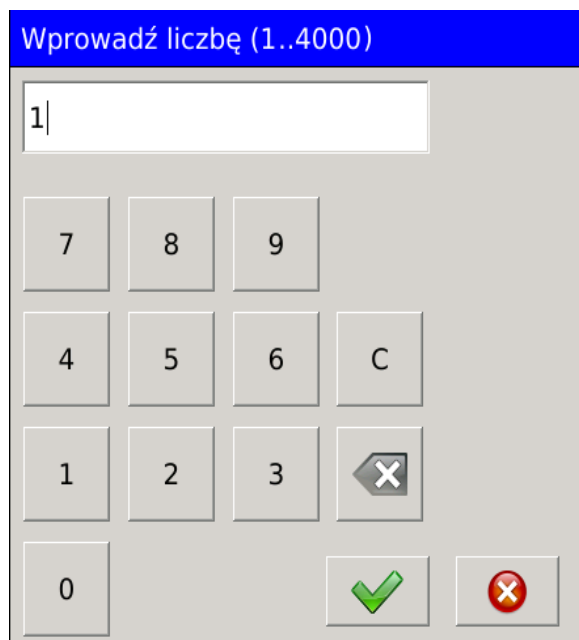


Fig. 5: Dialog box – editing, numerical values

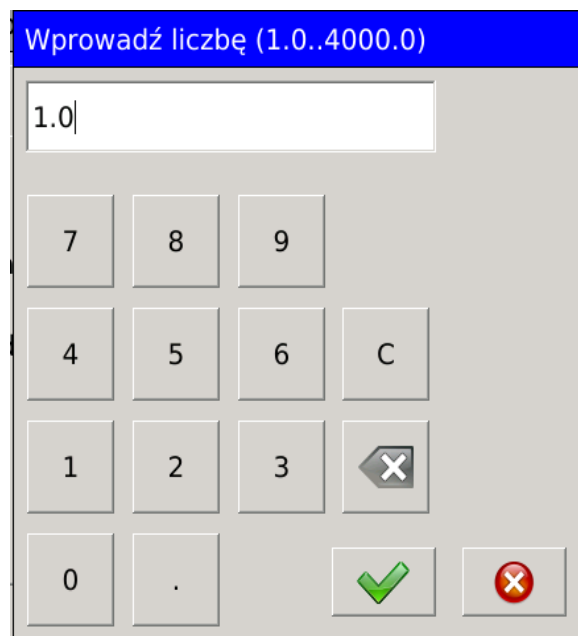


Fig. 6: Dialog box – editing, numerical values

The multiple-selection list, 7, allows more than one option to be selected. Touching an unselected item selects it. Touching a previously selected item again cancels the selection. Additional buttons allow all options in the list to be selected or deselected automatically. The selection list in 8 allows only one of the available options to be selected.

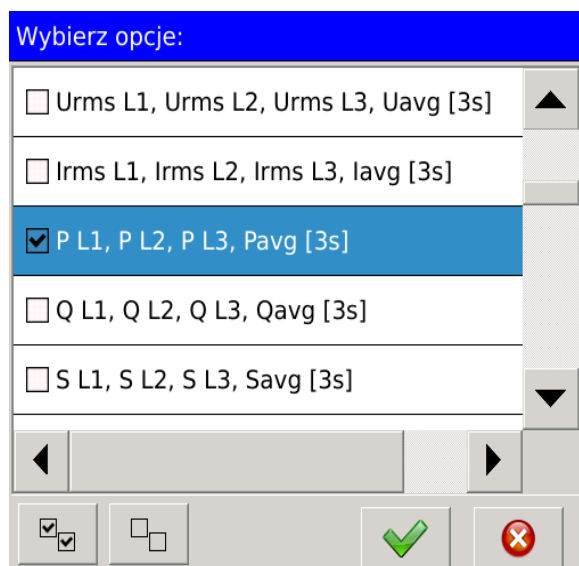


Fig. 7: Dialog box – selection, lists

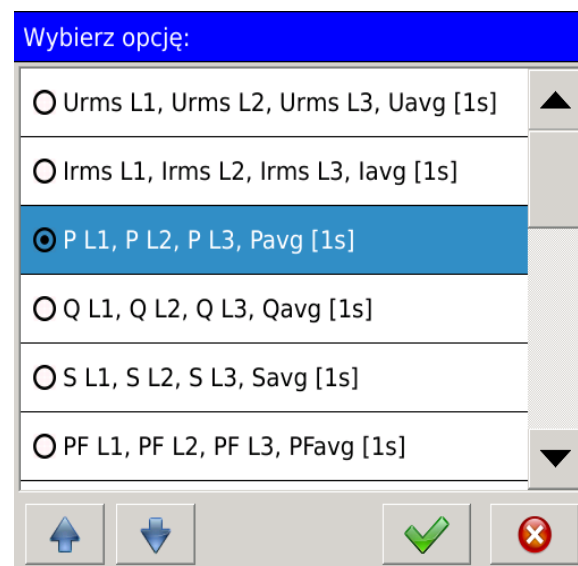


Fig. 8: Dialog box – selection, lists

3.2 Main screen

When the device starts, the main screen is displayed.

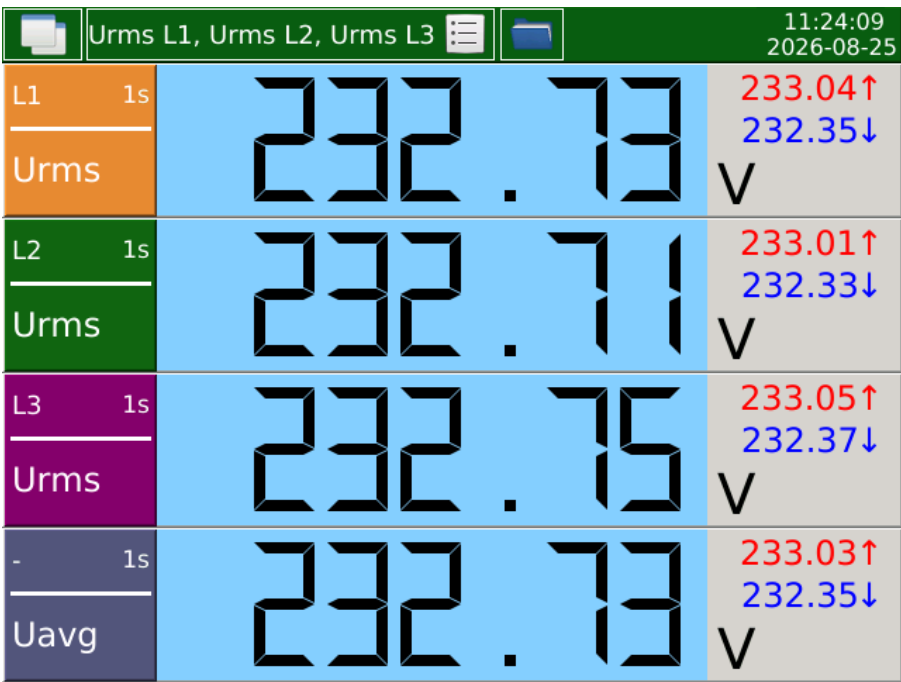


Fig. 9: Main screen

The main screen contains elements belonging to three groups. All elements can be displayed by touching the central area of the touch screen (10).

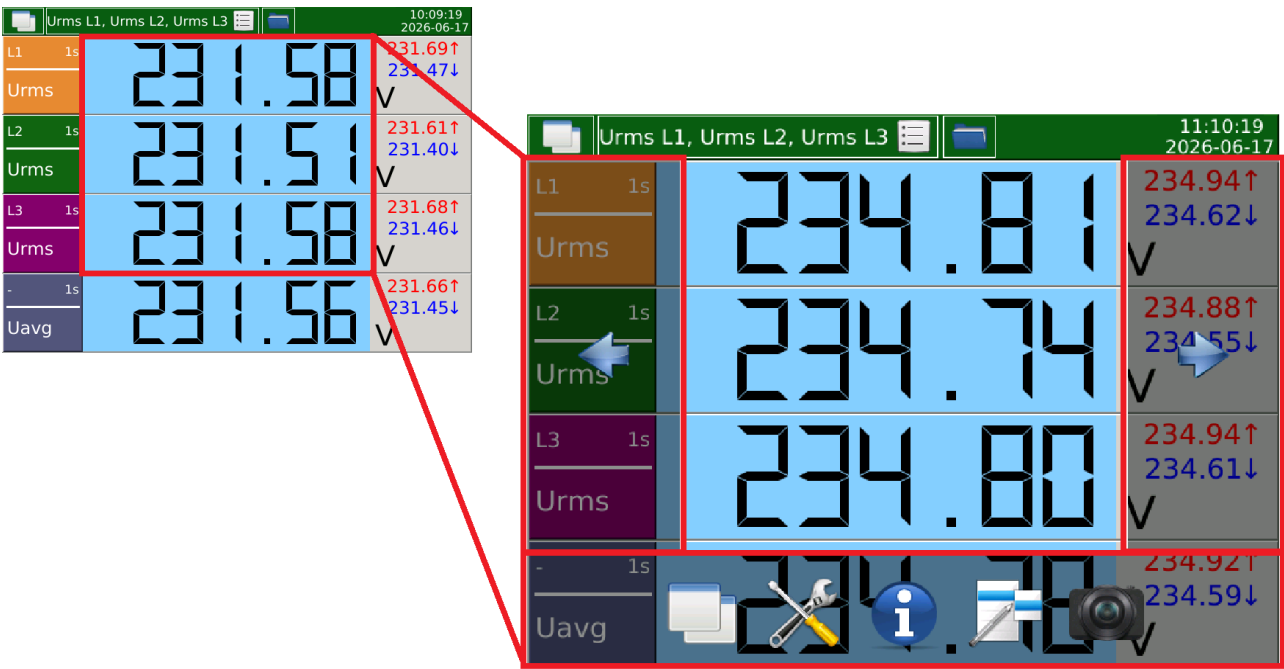


Fig. 10: Navigation – main screen

3.2.1 Navigational elements

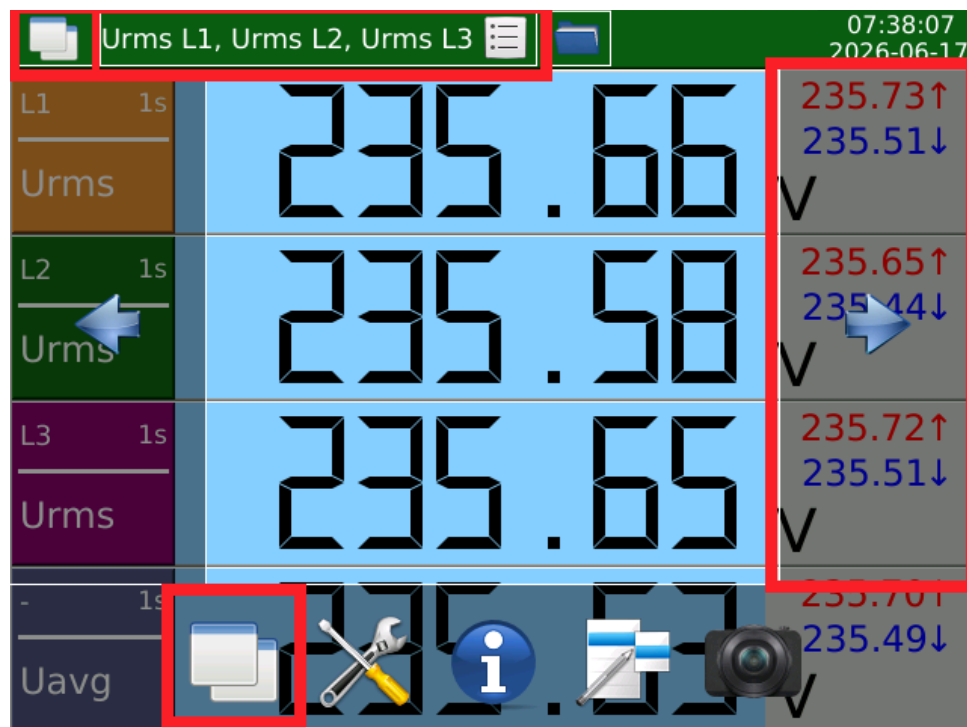


Fig. 11: Navigational elements

The first group consists of navigational elements that allow the user to switch between the available views and screens.

Navigation symbol	Description
 <i>Screens</i>	Navigation for the currently selected screen mode. Each screen and its views can be defined individually for a given configuration. Selecting the right arrow displays the next view of the screen. After the last view, selecting the right arrow returns to the first view. Navigation to the left works in the same way.
 <i>Views</i>	This button switches to the next screen. Selecting it displays the next screen available in the current configuration and its first defined view.

The navigational elements in the top bar of the main screen allow navigation through the available screens and views in any order using selection lists. (12)

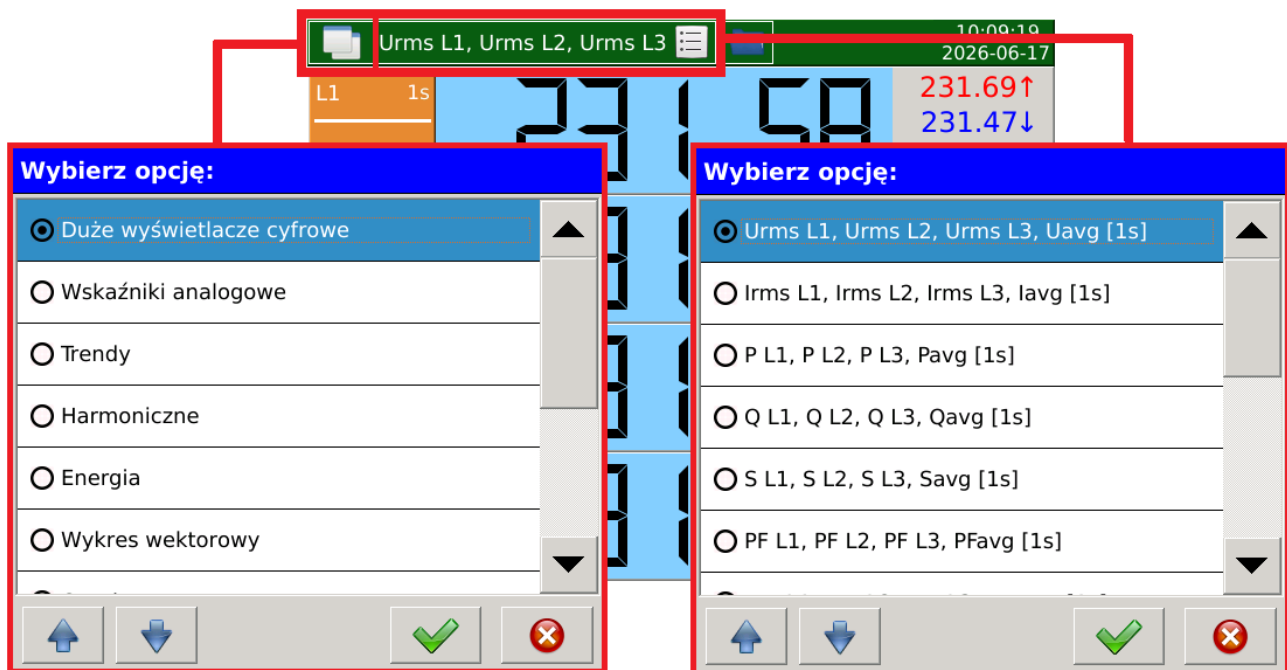


Fig. 12: Navigation – switching views and screens

3.2.2 Functional elements

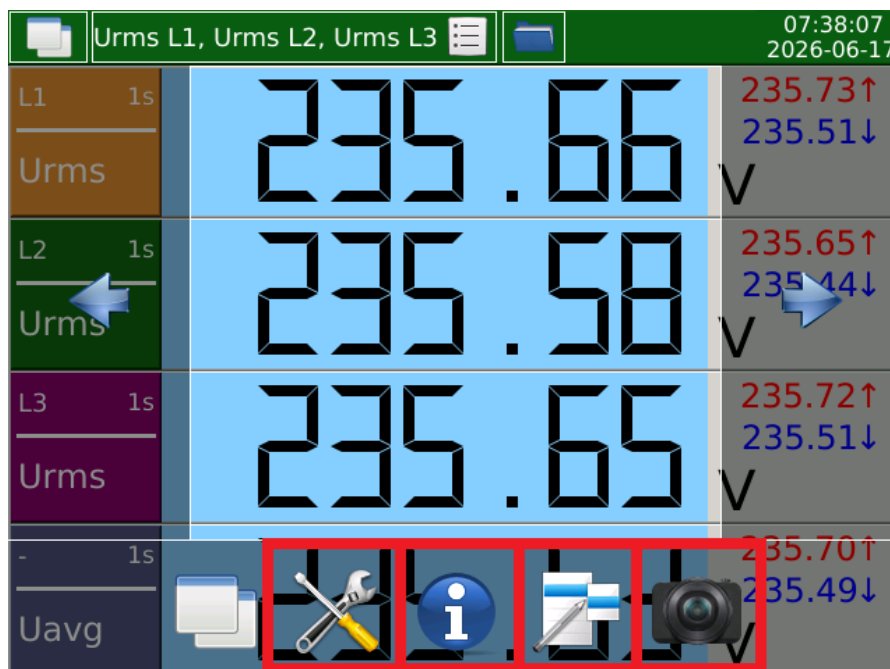


Fig. 13: Main screen - functional elements.

Function symbol	Description
 Control Panel¹	Opens the Control Panel – device configuration. Access is protected by a login window and requires a user name and password.
 System information	Opens the system information tab.
 Context menu¹	Opens the context menu for managing selected device parameters.
 Screenshot¹	Saves a screenshot to the SD card. The screenshot is saved in the format YYYY-MM-DD_hh_mm_ss.png² on the SD memory card at: <i>ND45PLUS/(numer_seryjny_urzadzenia)/Screenshots.</i>
1. You must log in before accessing these options (see "Context menu", "Control Panel",) 2. Y (year), M (month), D (day), h (hour), m (minute), s (second).	

The options available in the context menu depend on the view in which it was opened. 14 shows examples of the available options.

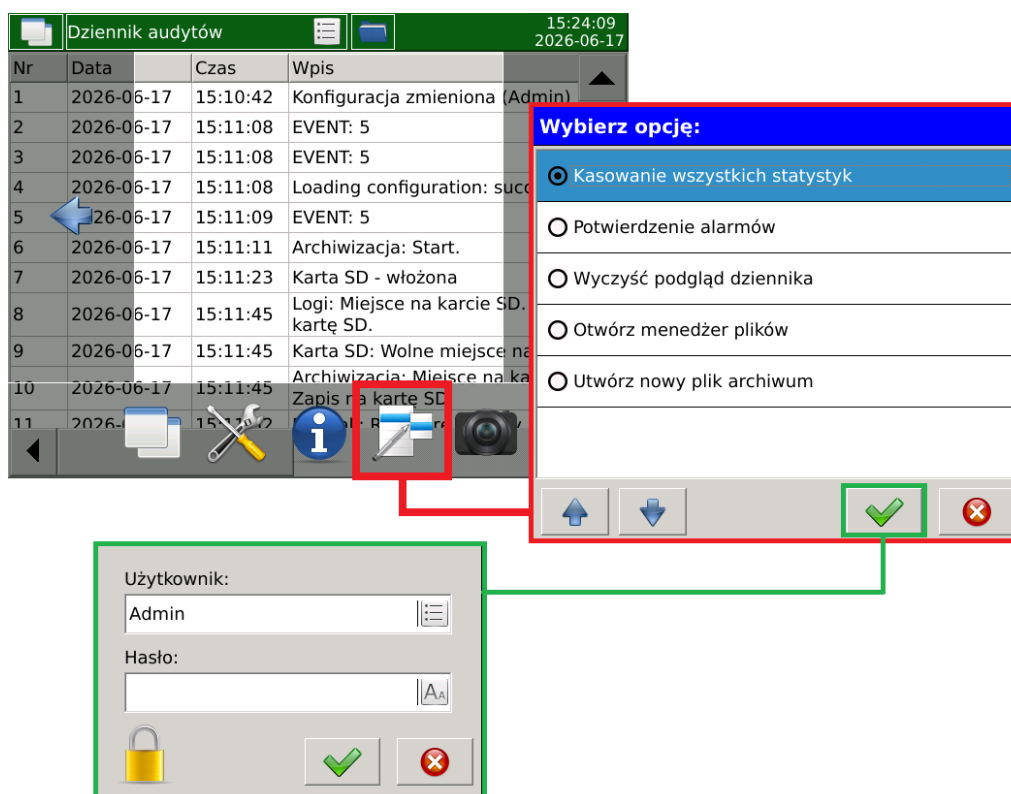


Fig. 14: Navigation – context menu

3.2.3 Information elements

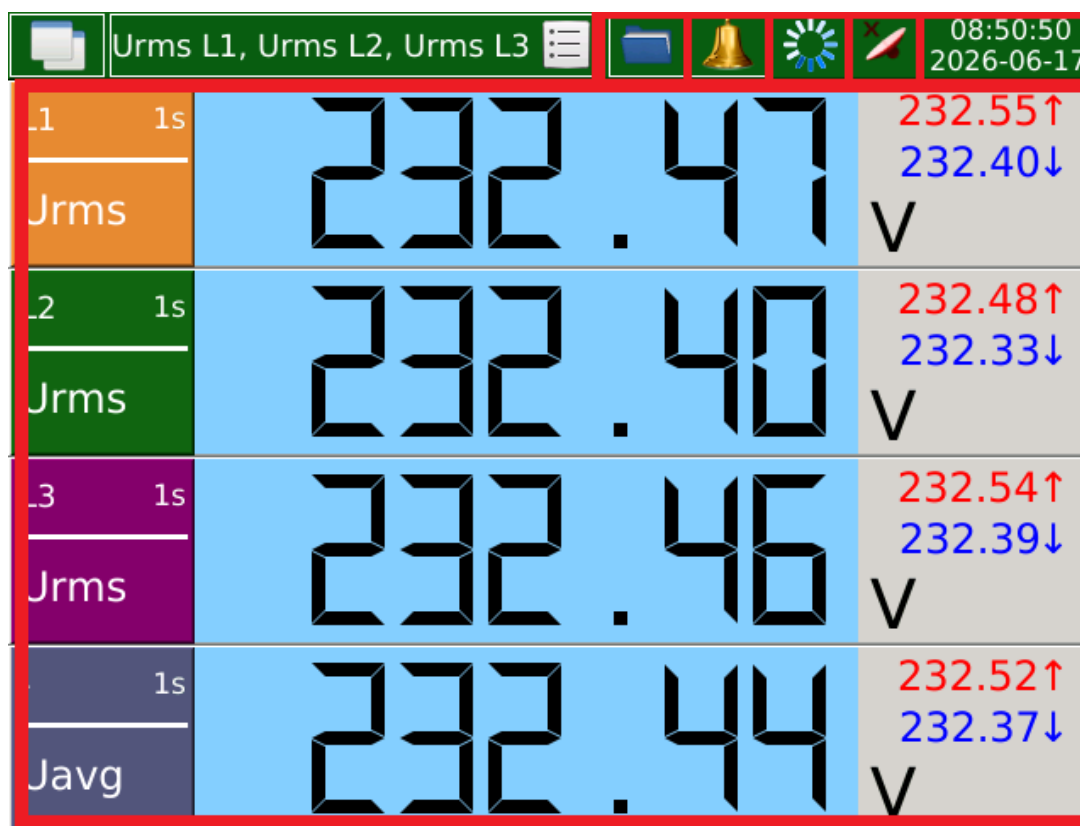
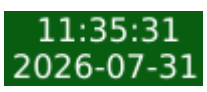


Fig. 15: Information elements

The table below describes selected information elements of the main screen and their functions.

Subject	Element symbol	Description
SD card		The SD card is correctly inserted and recognized by the device. For details, see " <i>File manager</i> "
		The SD card was removed while the device was operating.
		No SD card was detected at device startup.
Alarm		This icon appears when an alarm occurs. For details, see " <i>Alarms</i> ".
IP address		Animated icon indicating that an IP address is being obtained. For details, see " <i>Obtaining an IP address</i> ".
GPS		Communication OK.

		Communication error. For details, see " <i>Configuration of general settings</i> "
Time and date		The current time and date, displayed according to the user settings. For details, see " <i>Basic parameters</i> "

3.3 Control Panel

Access to the Control Panel is protected by a login window to prevent unauthorized changes to the device settings. Users are identified by their user name and the password assigned to it.

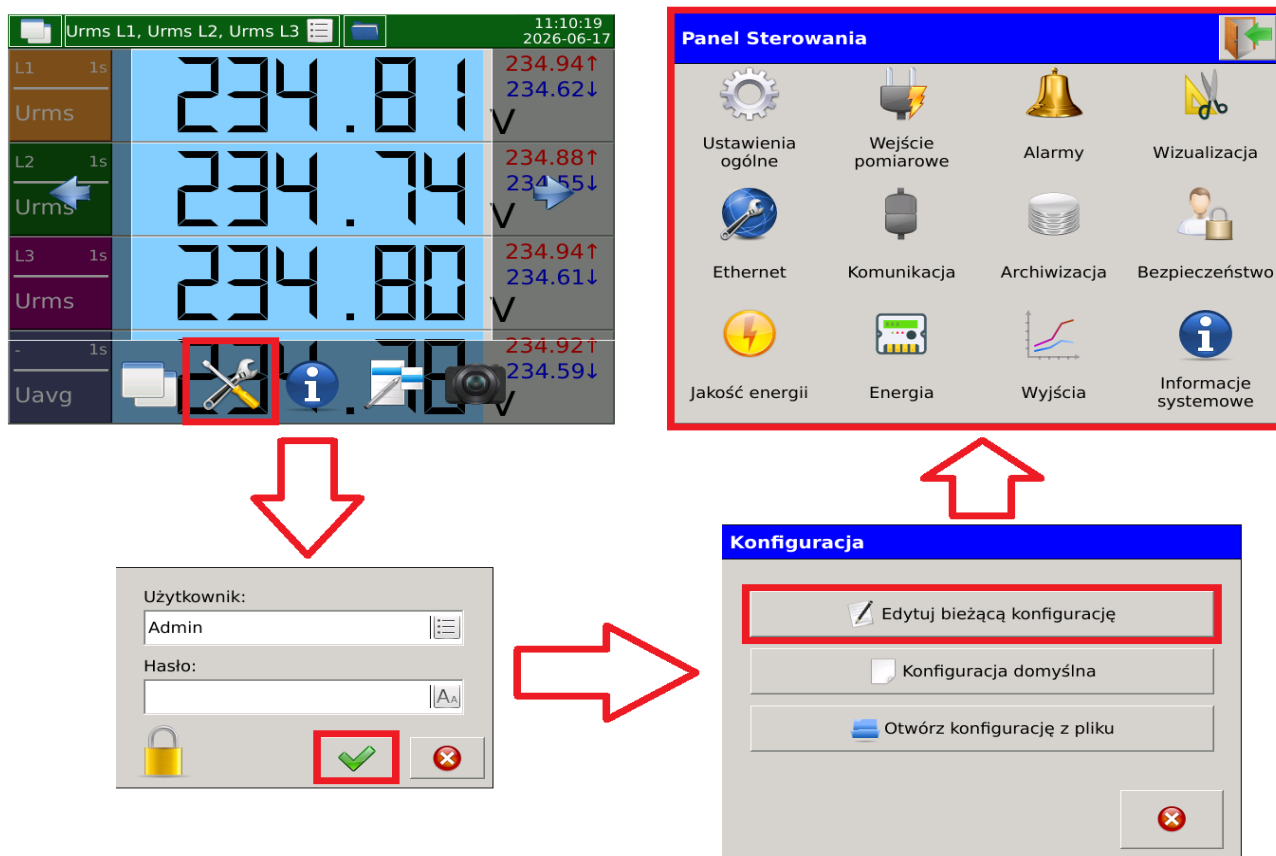


Fig. 16: Control Panel

To use the Control Panel, select one of the available settings groups. Each group allows the relevant device functions to be fully configured to meet the user's requirements.

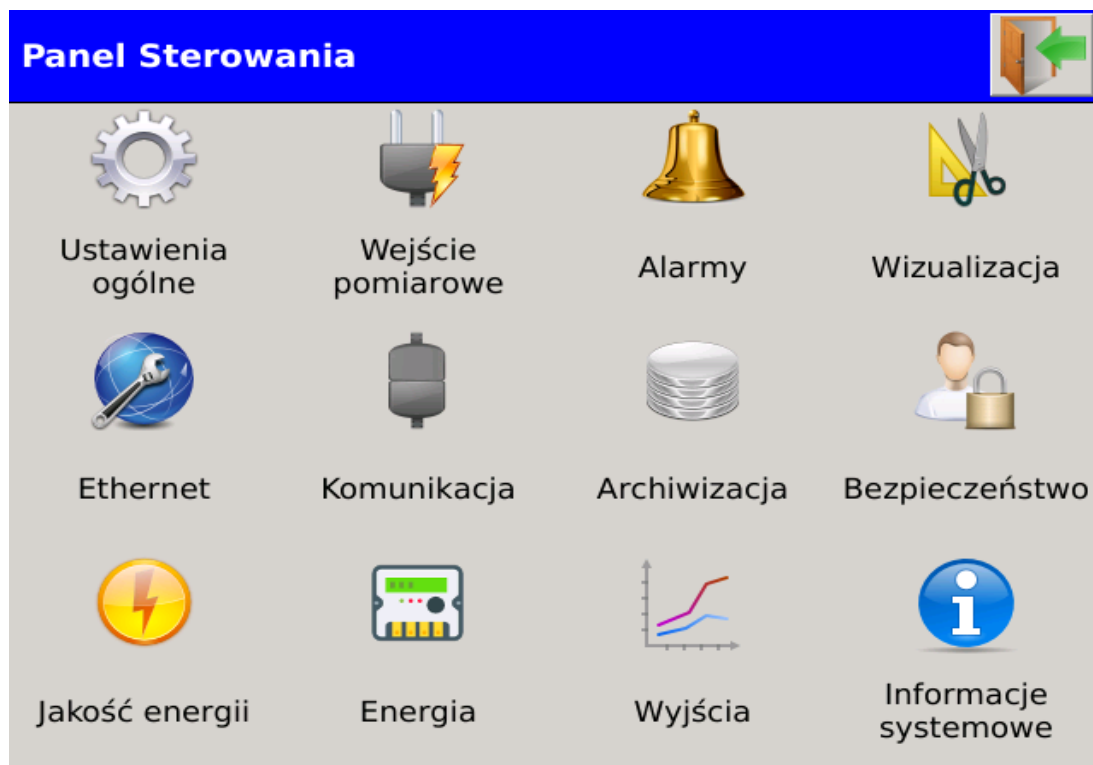


Fig. 17: Control Panel – main screen

The first tab opens by default. Other tabs are selected as shown below.

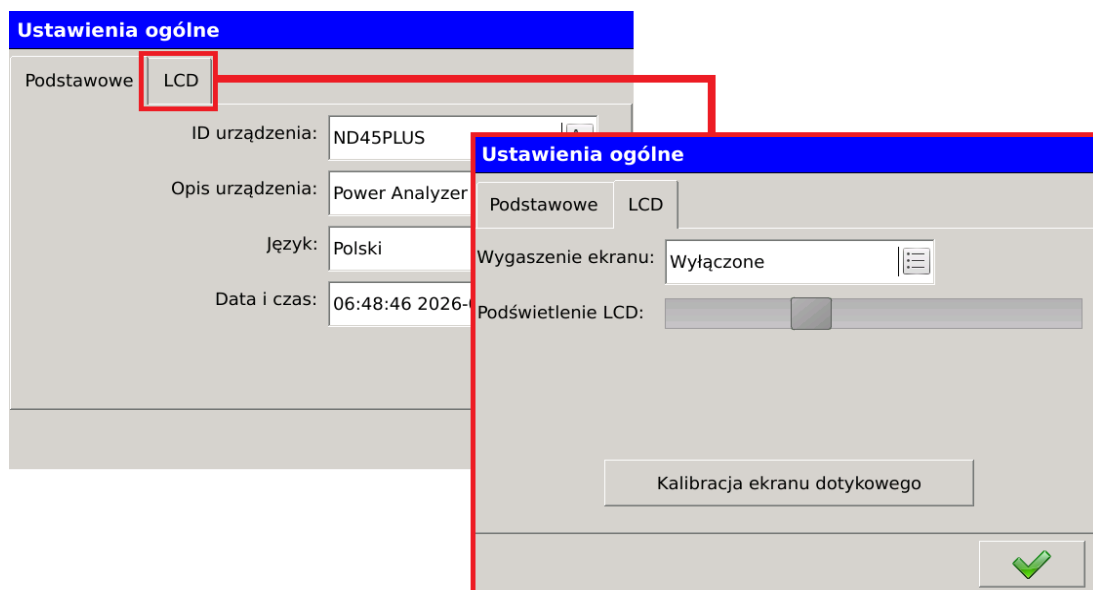


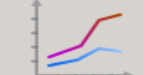
Fig. 18: Navigation – switching tabs

Some settings groups have additional navigation buttons , which allow you to switch between the parameters being configured without opening another dialog box.



The individual Control Panel settings groups are described in the table below.

Option	Description
 Ustawienia ogólne	Selection of the device name and ID. Language selection, date and time settings. Editing of LCD parameters, such as screen saving, backlight and screen calibration.
 Wejście pomiarowe	General settings for frequency, connection type, phase synchronization and averaging time. Settings for transformer ratios, current direction, temperature sensors or resistance measurement.
 Alarmy	Individual alarm settings, including the source, type and conditions for alarm activation/deactivation. Additional options provide settings for relays, confirmations, switching delays and alarm logs.
 Wizualizacja	Settings for visualization, data sets and trends. The user can enable or disable individual views, select predefined parameter sets, define custom parameter sets for presentation on the device display, and configure trends.
 Ethernet	Network connection and service settings.
 Komunikacja	Communication protocol settings. Modbus RTU/TCP, IEC 60870-5-104
 Archiwizacja	Archiving parameter settings. General archiving parameters: number of records per file, archiving time range and conditional archiving. Management of individual archiving parameters: parameter selection, interval and archiving conditions.
 Bezpieczeństwo	User permission settings. Assignment of user names, passwords and access rights.
 Jakość energii	Settings for recording voltage dips, swells and interruptions.

 Energia	Counter resetting and tariff configuration.
 Wyjścia	Configuration of analog outputs and relay operation. Available settings depend on the analyzer version.
 Informacje systemowe	General information about the system, memory, hardware and updates, and access to the service tab.

3.4 Screens and data presentation

The visualization of measurement parameters is organized in the form of views and screens. Through the configuration settings, the user can decide which views, together with their associated measurement data, are to be made available for presentation. This gives the user full control over both the amount of information presented and the content of that information.

The user can define custom measurement data sets for presentation on the recorder display in a selected view.

3.4.1 Signs and colors of measurement parameters

The example below shows a screen containing the Urms values for the individual phases and their average value. (Large digital view, 19)

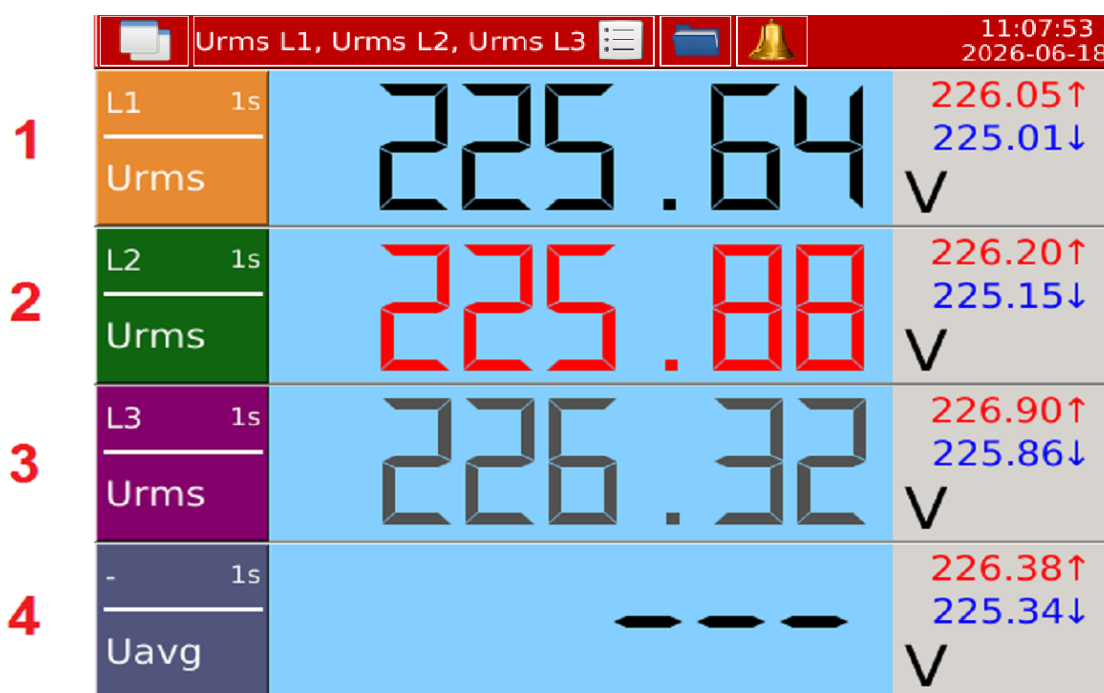


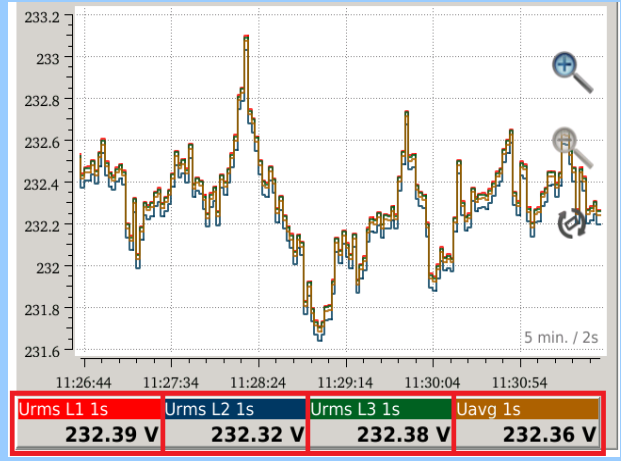
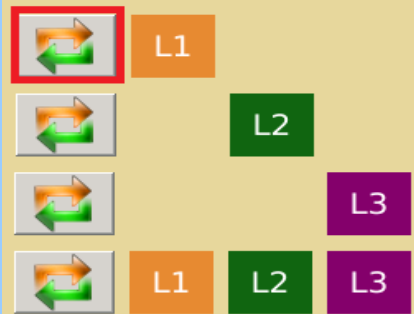
Fig. 19: Presentation of measurement data

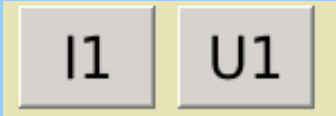
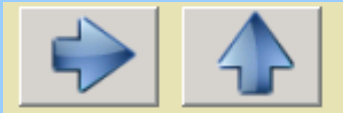
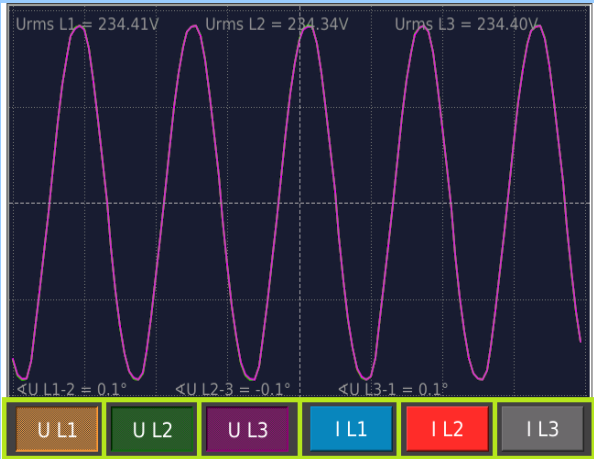
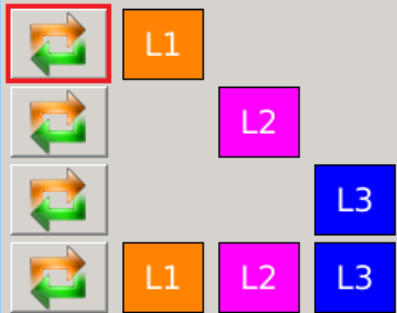
The table below provides a summary of the individual options available on the screen shown above, together with a description of its basic elements.

Option	Description
1	A correctly measured value, containing all component measurements required for aggregation.
2	An alarm has occurred for the displayed value.
3	The value was not calculated correctly. The measurement is incomplete for this aggregation.
4	Invalid or missing value.

3.4.2 Navigation

The table below lists the navigational elements used to interact with the individual views and screens.

Navigational element	Description
Applies to all screens:	
	Navigation using the left and right arrows allows the user to switch between the views available on individual screens. The navigation arrows are displayed after the user touches the device screen.
Trends:	
	By touching the marked elements in the example trend screen, the user can add the selected parameter to the main trend presentation screen or remove that parameter from the screen.
Harmonics	
	By touching the marked element on the screen, the user can change which harmonic components are shown on the main screen. The device can generate a harmonic display for each individual phase or display a combined set of harmonic values for all three phases.
	The elements shown allow the user to increase or decrease the scale of the harmonics display. The maximum value displayed on the main screen is limited to 100%, while the minimum value is limited to 2%.

Navigational element	Description
Vector diagram:	
	Scales vector lengths to I1 or U1.
	Selects the initial axis for the first phase.
Waveform:	
	Touching the marked elements on the waveform view shown allows the user to add or remove the selected parameter from the screen.
ITIC curve:	
	Touching the marked icon changes the events displayed on the main screen. The device can display voltage disturbance events for individual phases or a combined view of all three phases.

3.4.3 Views

Each view has its own data presentation features. The following sections describe the individual view types and the elements available to the user.

3.4.3.1 Large digital view

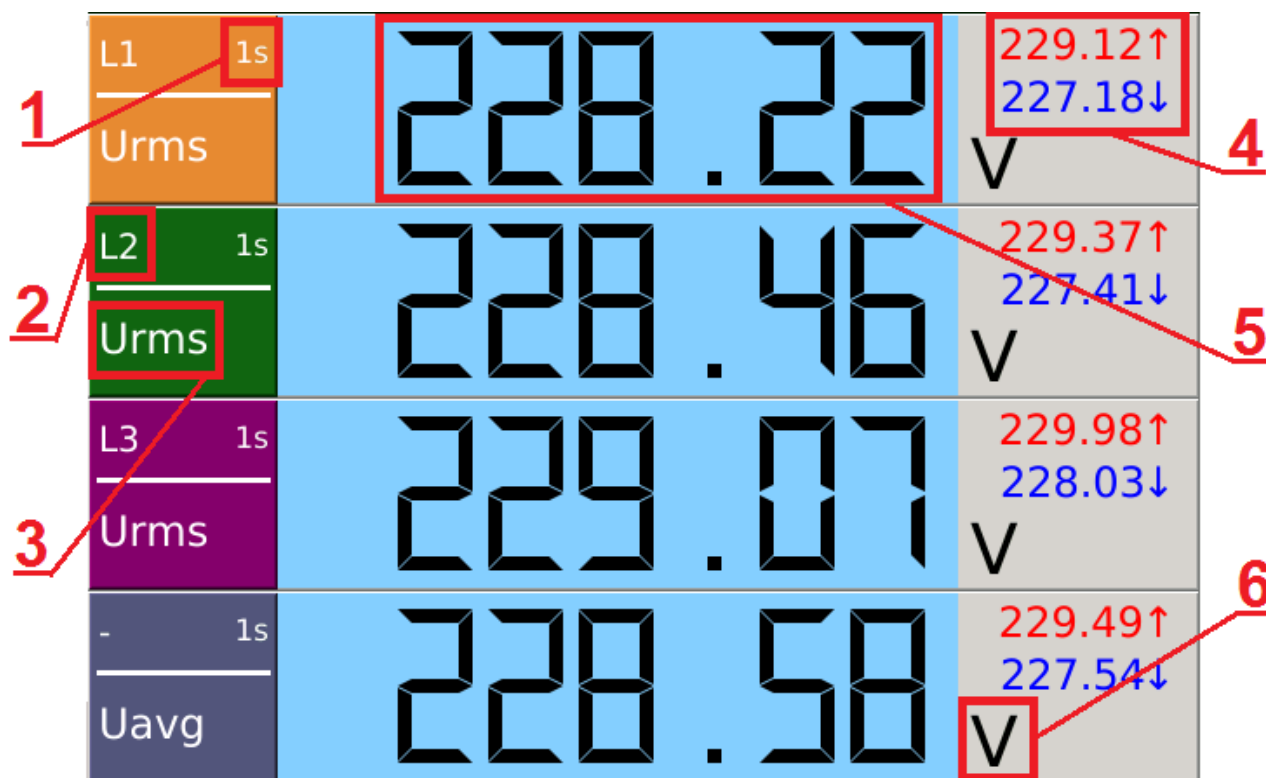


Fig. 20: Large digital view

Option	Description
1	Aggregation time of the displayed value.
2	Additional information identifying the phase associated with the displayed value.
3	Description of the displayed parameter.
4	Minimum and maximum values of the displayed parameter over the aggregation period.
5	Main measured value field.
6	Unit of the measured value.

3.4.3.2 Analog indicators

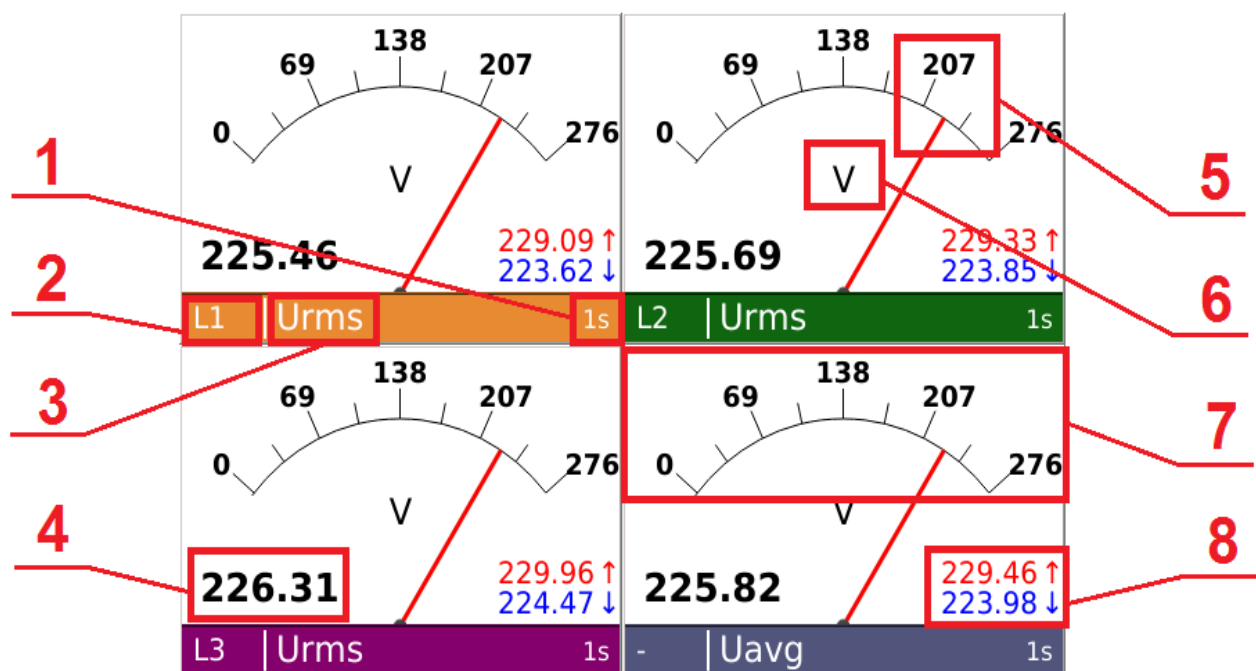


Fig. 21: Analog indicators

Option	Description
1	Aggregation time of the displayed value.
2	Additional information identifying the phase associated with the displayed value.
3	Description of the displayed parameter.
4	Measured value in digital form.
5	Analog indicator showing the measured parameter value.
6	Unit of the measured value.
7	Analog display scale for the measured value shown.
8	Minimum and maximum values of the displayed parameter over the aggregation period.

3.4.3.3 Trends

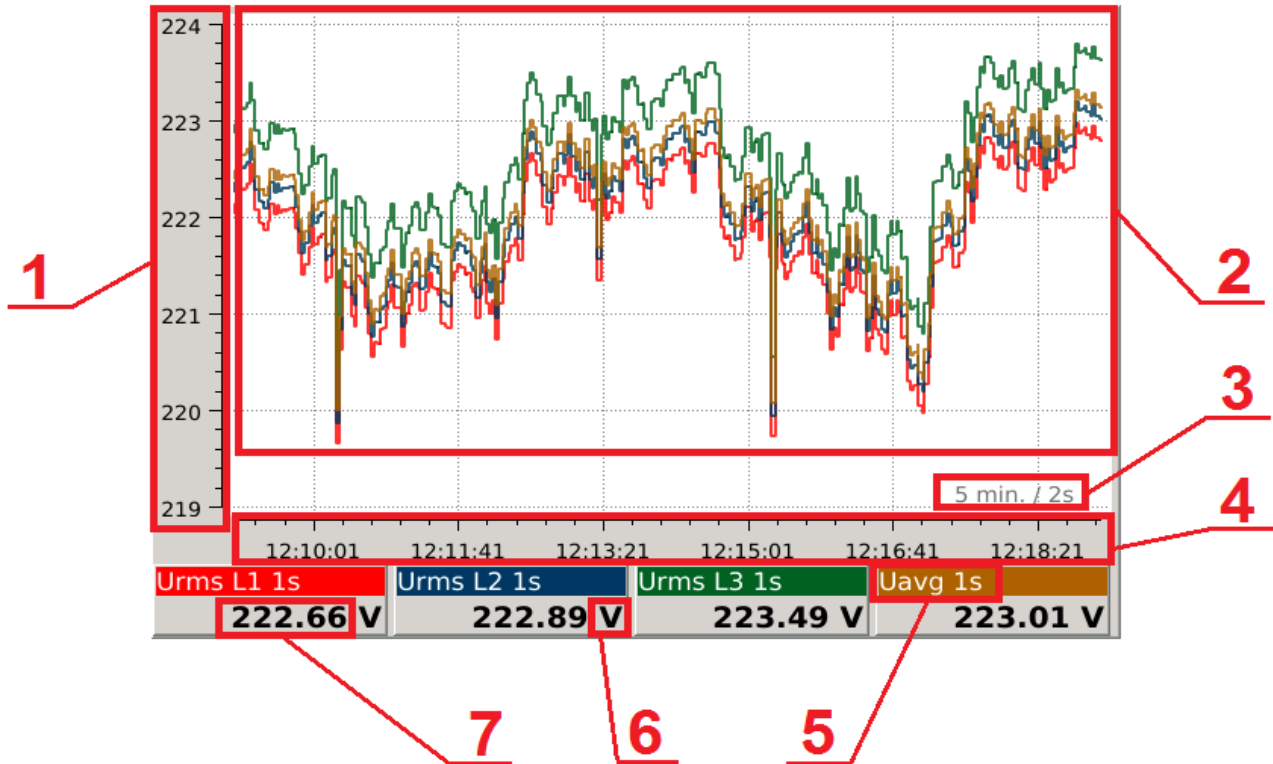


Fig. 22: Trends.

Option	Description
1	Scale showing the value range over the displayed period. The range is scaled automatically as the measured values change.
2	Main trend display window.
3	Time range of the values displayed in the trends, with the parameter update frequency. For parameters aggregated every 1 second, the displayed value is the average of two measurements.
4	Time axis, updated automatically as successive measured values are displayed on the main screen.
5	Description of the measured parameter, including its name, phase information and aggregation time.
6	Unit of the selected measured parameter
7	Measured parameter value in digital form.

3.4.3.4 Harmonics and interharmonics

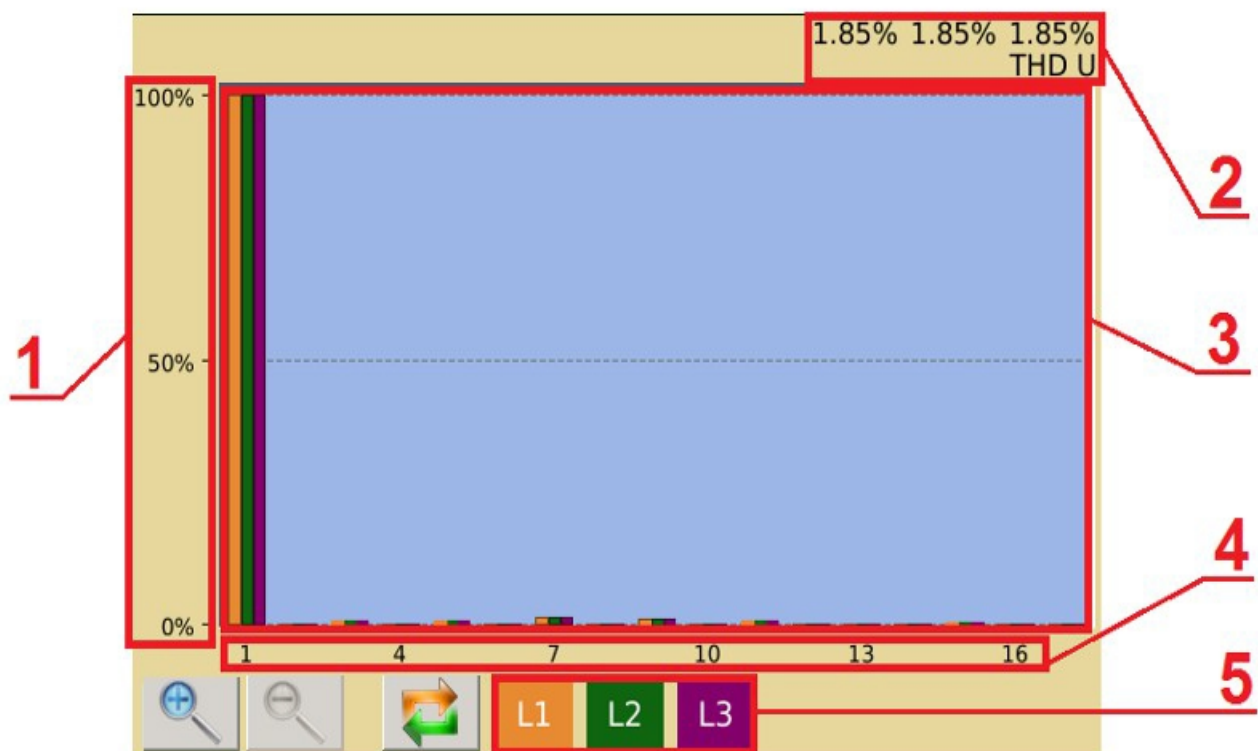


Fig. 23: Harmonics

Option	Description
1	Scale showing the value of each harmonic as a percentage.
2	Additional field showing THD values for the selected phases.
3	Main harmonic display window.
4	Numbers identifying the successive harmonics displayed.
5	Colors assigned to individual phases, matching the harmonics displayed in the main window.

The screenshot shows a user interface for displaying harmonic data. It consists of two main tables. The first table has four columns: L1 [%] (purple), L2 [%] (green), and L3 [%] (blue). The second table has five columns: Amp L1 [%] (purple), Amp L1 [V] (grey), Amp L2 [%] (green), Amp L2 [V] (grey), and an unlabeled column (blue). Red lines and numbers 1 through 6 point to specific elements: 1 points to the first column of the first table; 2 points to the header row of the first table; 3 points to the data rows of the first table; 4 points to the header row of the second table; 5 points to the data rows of the second table; and 6 points to the right side of the second table.

	L1 [%]	L2 [%]	L3 [%]
THD	3.25	3.25	3.24
THDG	3.36	3.25	3.14
THDS	---	---	---
PWHD	3.25	3.25	3.24

	Amp L1 [%]	Amp L1 [V]	Amp L2 [%]	Amp L2 [V]	An
1	100.0000	234.09	100.0000	234.18	1
2	0.0000	0.0000	0.0000	0.0000	
3	1.1354	2.6579	1.0908	2.5545	
4	0.0000	0.0000	0.0000	0.0000	
5	2.8117	6.5819	2.7698	6.4864	
6	0.0000	0.0000	0.0000	0.0000	
7	0.9487	2.2207	0.9043	2.1176	

Fig. 24: Harmonics - table

Option	Description
1	Fields describing the displayed values.
2	Phase allocation of the displayed values.
3	Values of the individual parameters
4	Phase allocation of amplitudes.
5	Description of successive harmonics displayed on the main screen.
6	Amplitude values for individual phases

Interharmonic values can be read via modbus registers (see '*Interharmonics registers*'), the WWW page and user-defined sets (see '*Configuration of visualization screens*').

3.4.3.5 Energy, tariffs, binary counters

Σ EnP+	13869.2 kWh	
L1	2486.5 kWh	
L2	5382.1 kWh	
L3	6000.6 kWh	
Σ EnP-	107844.0 kWh	
L1	8416.3 kWh	
L2	7054.1 kWh	
L3	92373.6 kWh	
Σ EnQ	291655.7 kvarh	
L1	94848.1 kvarh	
L2	121046.9 kvarh	
L3	75760.7 kvarh	

Fig. 25: Energy

Option	Description
1	Total active exported energy for the three phases. This field also identifies the energy type to which the next three parameters belong.
2	Energy values for the individual phases.
3	Displayed value of the measured energy.
4	Window showing the total measured active imported energy together with the values for the individual phases.
5	Unit assigned to the measured energy value.

B1	0 imp	1
B1 f(x)	0.000	
B2	0 imp	2
B2 f(x)	0.000	
B3	0 imp	3
B3 f(x)	0.000	
B4	0 imp	
B4 f(x)	0.000	
B5	0 imp	
B5 f(x)	0.000	
B6	0 imp	
B6 f(x)	0.000	

Fig. 26: Binary counter

Option	Description
1	The first group shows the pulse counter and the calculated value for the selected binary input.
2	The unit imp indicates the number of pulses counted.
3	Measured pulse count or calculated value for the selected binary input.

The screenshot shows a menu with the following structure:

- Header:** Taryfa **B23** zakres czasu **07:00 - 13:00**
 - 1** points to the tariff code **B23**.
 - 2** points to the time interval **07:00 - 13:00**.
- Section 1 (highlighted with a red box):**
 - 3** points to the first row of this section.
 - Σ EnP+** **00000108.7 kWh**
 - L1** 00000036.2 kWh
 - L2** 00000036.3 kWh
 - L3** 00000036.2 kWh
- Section 2:**
 - Σ EnP-** **00000000.0 kWh**
 - L1** 00000000.0 kWh
 - L2** 00000000.0 kWh
 - L3** 00000000.0 kWh
- Section 3:**
 - Σ EnQ+ }** **00000000.0 kva...**
 - L1** 00000000.0 kvarh
 - L2** 00000000.0 kvarh

5 points to the unit **kWh** in the L2 row of the Σ EnP- section.

Fig. 27: Tariffs

Option	Description
1	Description of the currently selected tariff.
2	Tariff time interval during which energy is counted.
3	Total active exported energy for the three phases. This field also identifies the energy type to which the next three parameters belong. Energy is counted for the selected tariff over the specified time interval.
4	Measured energy value for the selected counter.
5	Unit assigned to the energy counter value.

3.4.3.6 Vector diagram

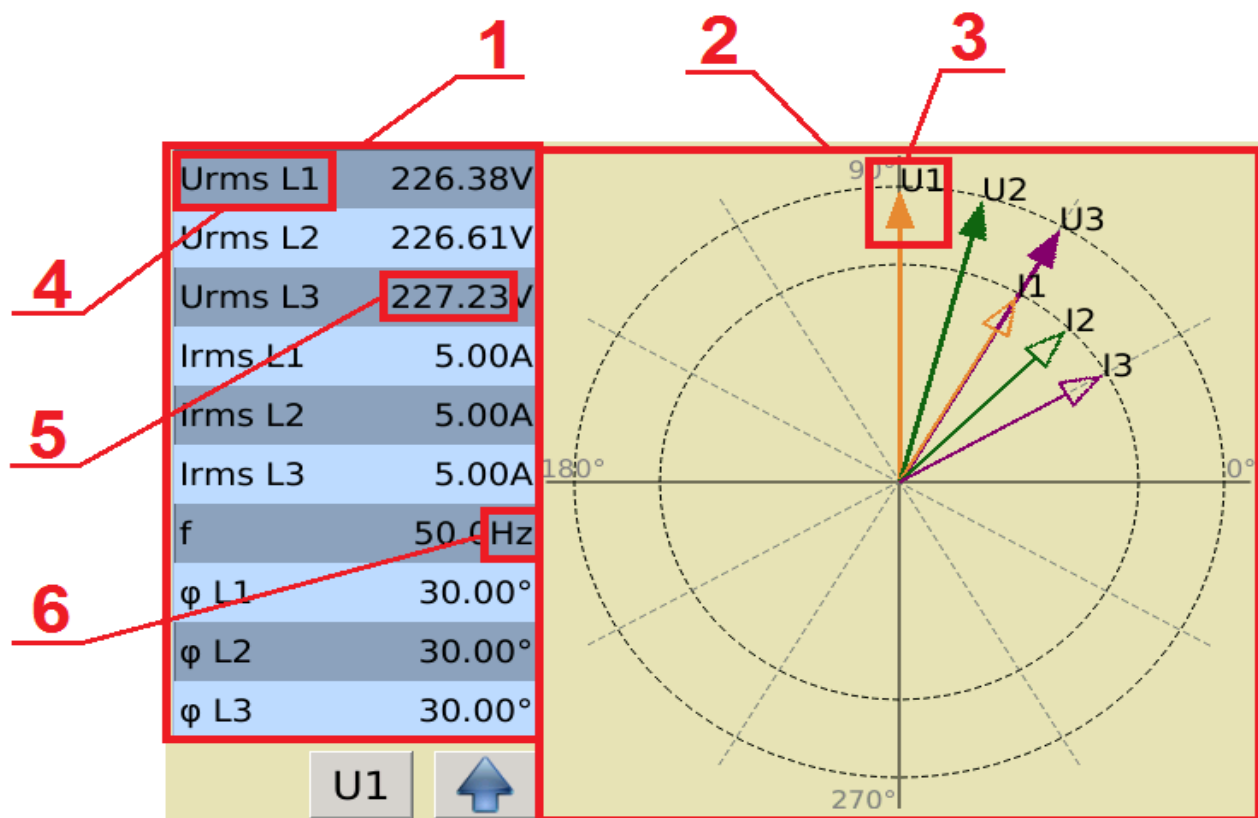


Fig. 28: Vector diagram

Option	Description
1	Table of values shown in the vector diagram.
2	Main window containing the vector diagram.
3	Measured parameter showing the angle value and a descriptive label.
4	Description of the measured parameter with additional phase information.
5	Measured parameter value in digital form.
6	Unit of the selected measured parameter.

3.4.3.7 Waveform

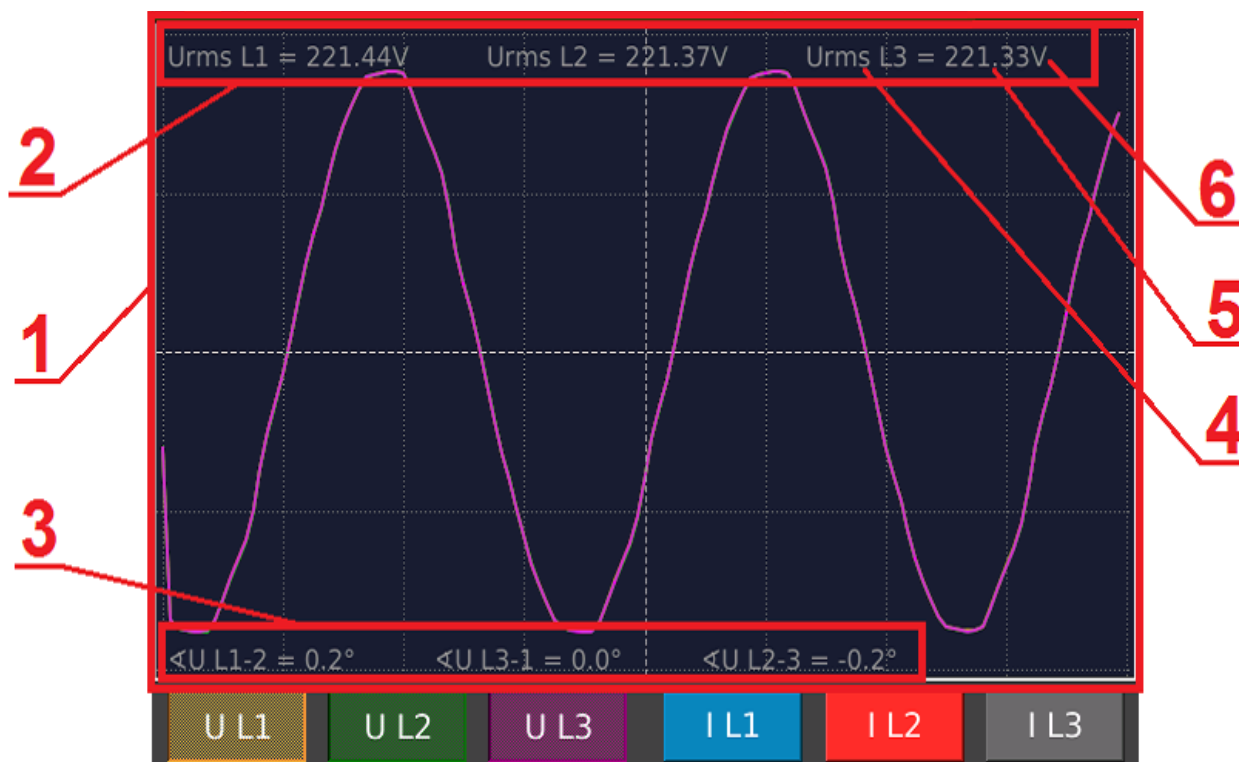


Fig. 29: Waveform

Option	Description
1	Main waveform window showing the waveform or waveforms of the selected signals .
2	Display field for 200ms values: Urms L1, Urms L2, Urms L3, Uavg, Irms L1, Irms L2, Irms L3, Iavg – depending on the selected signals.
3	Display field for 200ms values: $\angle U_{L1-2}$, $\angle U_{L3-1}$, $\angle U_{L2-3}$, ϕ_{L1} , ϕ_{L2} , ϕ_{L3} – depending on the selected signals.
4	Symbol of the displayed parameter.
5	Value of the displayed parameter.
6	Unit of the displayed parameter.

3.4.3.8 Temperature / Resistance

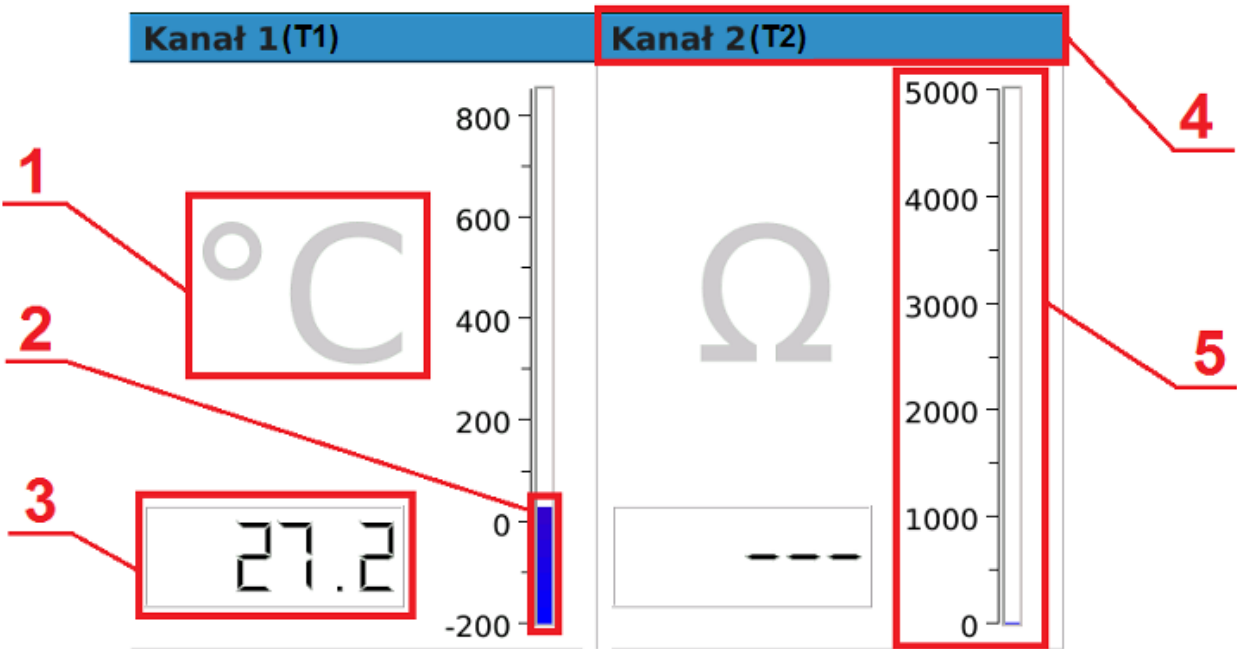


Fig. 30: Temperature/resistance

Option	Description
1	Description of the unit assigned to the field, depending on the sensor type (temperature or resistance)
2	Measured value indicator.
3	Measured value in digital form.
4	Channel description.
5	Measurement scale appropriate to the sensor type.

3.4.3.9 Binary inputs

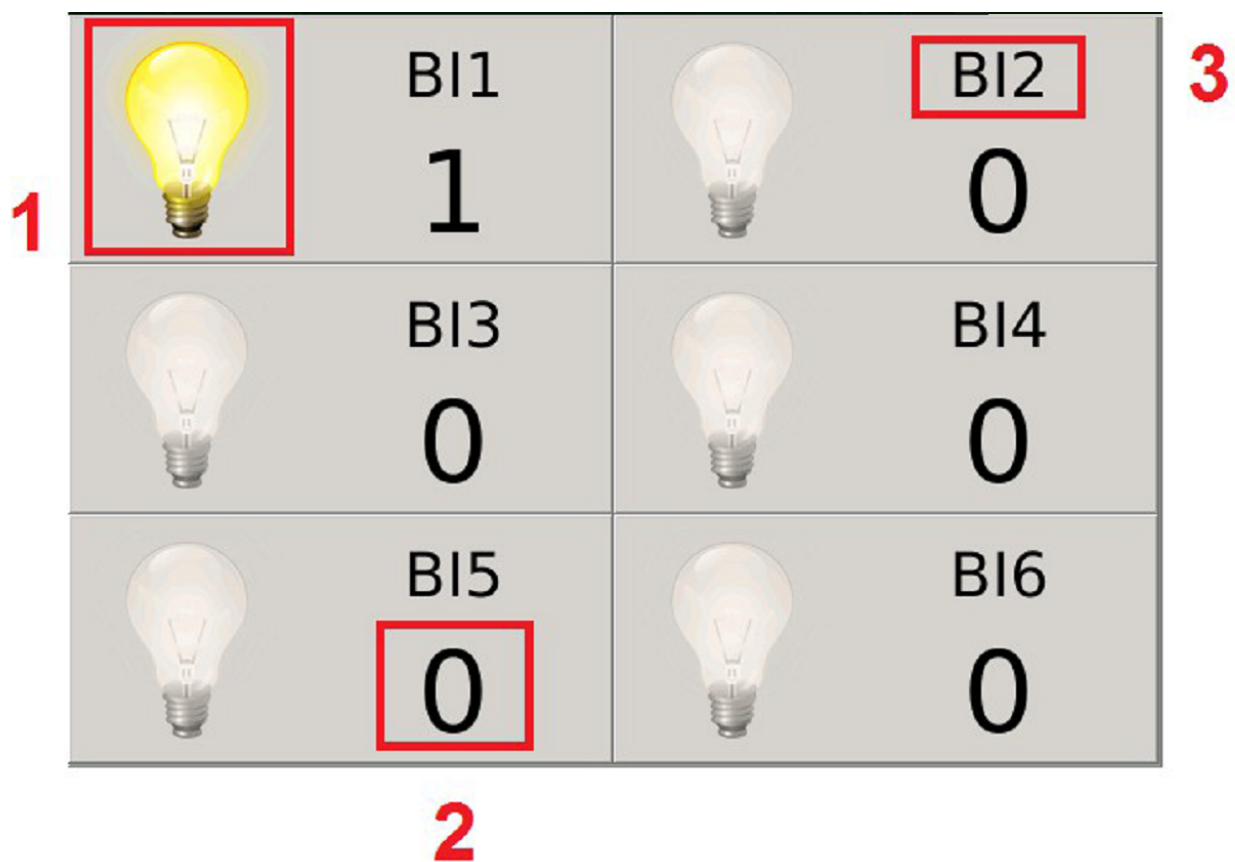


Fig. 31: Binary inputs

Option	Description
1	Binary input status display: lamp on – binary input on, lamp off – binary input off.
2	Binary input status indicator: 1 – on, 0 – off.
3	Binary input description, e.g. BI2 – binary input number 2.

3.4.3.10 Logs

Nr	Data	Czas	Wpis
4	2026-06-19	06:12:28	System uruchomiony
5	2026-06-19	06:12:28	Loading configuration: success
6	2026-06-19	06:12:29	Konfiguracja zmieniona (Admin)
7	2026-06-19	06:12:31	Archiwizacja: Start.
8	2026-06-19	06:12:42	Karta SD - włożona
9	2026-06-19	06:13:08	Logi: Miejsce na karcie SD. Zapis kartę SD.
10	2026-06-19	06:13:08	Karta SD: Wolne miejsce na karc
11	2026-06-19	06:13:08	Archiwizacja: Miejsce na karcie S Zapis na kartę SD.
12	2026-06-19	06:13:15	Firewall: Rules are already up to
13	2026-06-19	06:13:15	Firewall: active
14	2026-06-19	06:21:00	Extension Card: None

Fig. 32: Logs

Option	Description
1	Message sequence number.
2	Date of the message.
3	Time of the message
4	Message text.
5	Example log containing information about a configuration change.

A preview of the file saved on the SD card is shown below.

	A	B	C
1	2026-06-19	06:12:28	System uruchomiony
2	2026-06-19	06:12:28	Aplikacja uruchomiona
3	2026-06-19	06:12:28	Loading configuration: success
4	2026-06-19	06:12:29	Konfiguracja zmieniona (Admin)
5	2026-06-19	06:12:31	Archiwizacja: Start.
6	2026-06-19	06:12:42	Karta SD - włożona
7	2026-06-19	06:13:08	Logi: Miejsce na karcie SD. Zapis na kartę SD.
8	2026-06-19	06:13:08	Archiwizacja: Miejsce na karcie SD. Zapis na kartę SD.
9	2026-06-19	06:13:15	Firewall: Rules are already up to date.
10	2026-06-19	06:13:15	Firewall: active
11	2026-06-19	06:21:00	Extension Card: None

Fig. 33: Audit logs – file preview

Note!

Alarm logs are described in section 11 .

Dip, interruption and swell logs are described in section 6.10 .

3.4.3.11 ITIC curve

The ITIC (*Information Technology Industry Council*) curve defines the voltage disturbance magnitude and duration (drop, dip or swell) within which IT (*Information Technology*) equipment operates correctly.

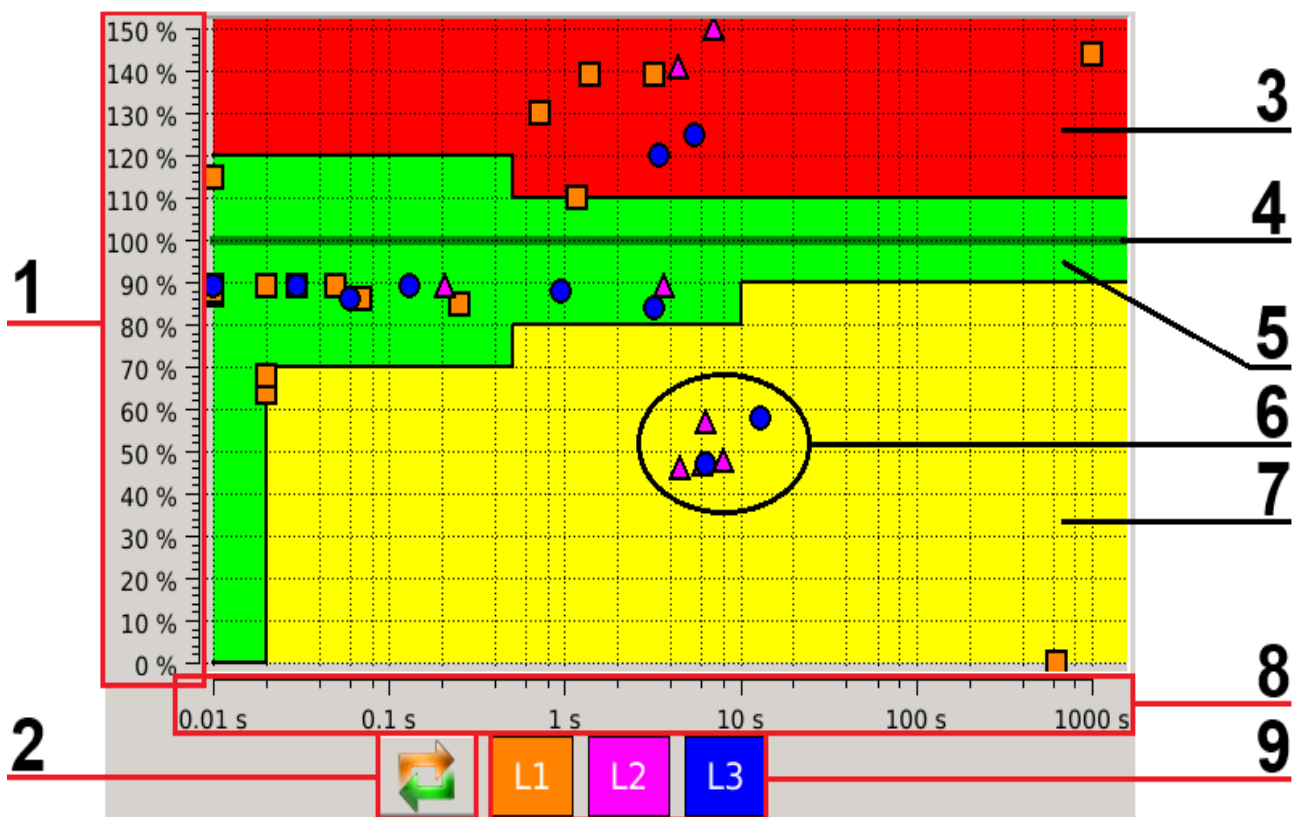


Fig. 34: ITIC curve

Option	Description
1	Axis showing the magnitude of individual voltage disturbances as a percentage.
2	Button for switching between phases and the events for a selected phase.
3	Prohibited <i>region</i> . This region covers voltage surges or swells that exceed the upper boundary of the envelope. Exposure to these conditions may damage IT equipment.
4	Nominal voltage boundary (100%).
5	<i>Steady state</i> . The steady-state range describes RMS voltage that changes very slowly or remains constant. Over time, the range narrows to +/- 10% of nominal voltage. Voltages within this range may persist indefinitely and result from normal loads and losses in the distribution system.
6	Event icons indicating a voltage disturbance for a particular phase. The icon colors match the phase colors (see option 9)

Option	Description
7	No <i>damage region</i> . Events in this region include voltage drops and interruptions below the lower boundary of the steady-state tolerance range. Normal operation of IT equipment is not generally expected under these conditions. However, they should not cause equipment damage.
8	Event duration axis in seconds (logarithmic scale).
9	Colors assigned to individual phases, matching the events displayed on the ITIC curve.

The device can display up to 20 events graphically for each phase. When further events occur, the oldest event disappears.

At startup, the device displays archived events read from the SD memory card (provided such events occurred before the power failure).

Caution! The ITIC curve function is based on the power quality range settings (see 5.10. Configuration of power quality). Changing these values beyond the default range will cause events to be displayed incorrectly or not at all.

3.5 Software update

Contact the manufacturer to obtain an update package. The package includes a file that must be copied to the SD card and extracted directly on it. Detailed, up-to-date instructions for the update procedure are always supplied with the update package.

In the Control Panel, open the System information tab, select the Update group and proceed to select the update file.

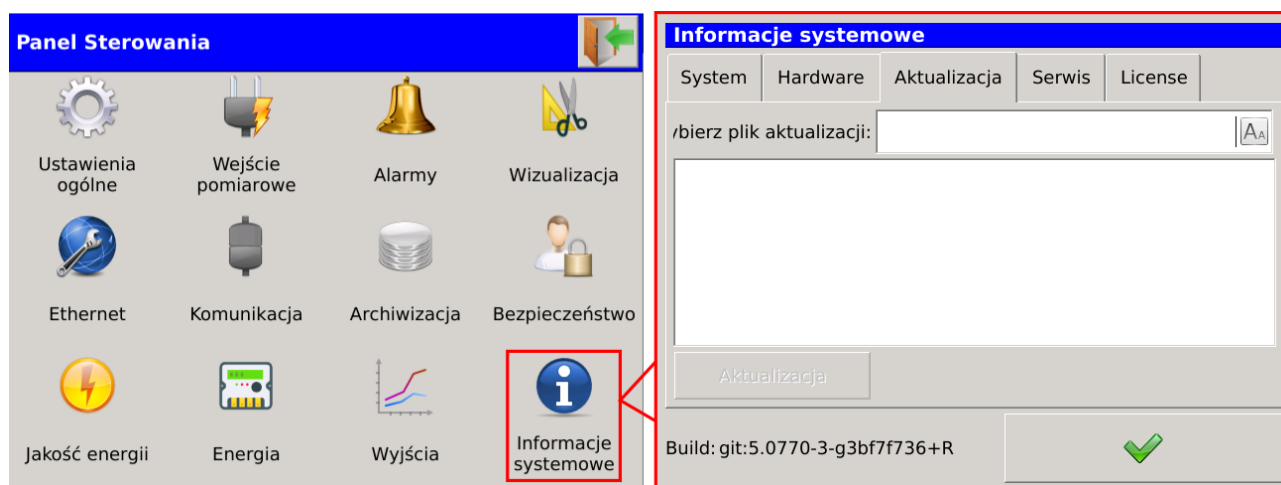


Fig. 35: Selecting the update file

Confirm your selection from the list of detected files. The next window displays information about the update. Select Update to confirm and start the process.

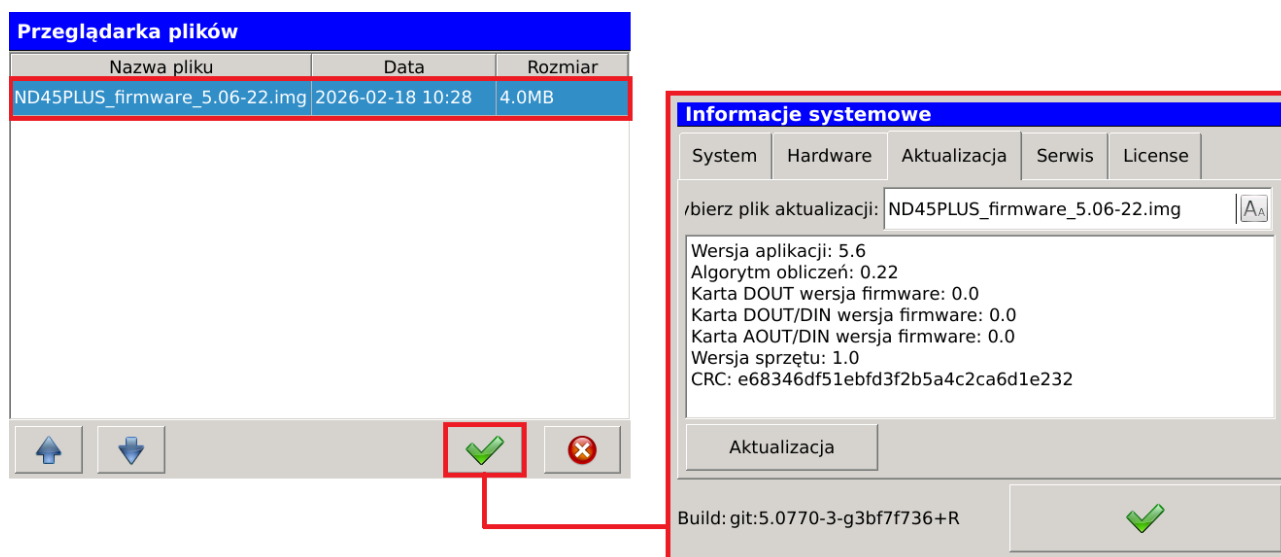


Fig. 36: Update

4 Web server management

To access the WWW server, enter the IP address assigned to the analyzer in the browser address bar.

Note! To view the device IP address, select Ethernet in the Control Panel.

The connection to the WWW page is encrypted using a self-signed certificate. Web browsers may display a corresponding warning (37).

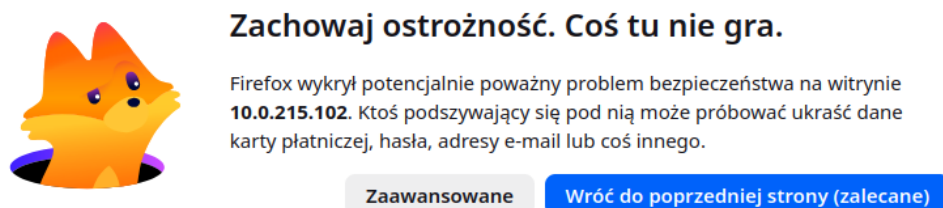


Fig. 37: WWW page – example warning about a self-signed certificate.

Ignore the message and allow the browser to proceed to the unsecured page (38).

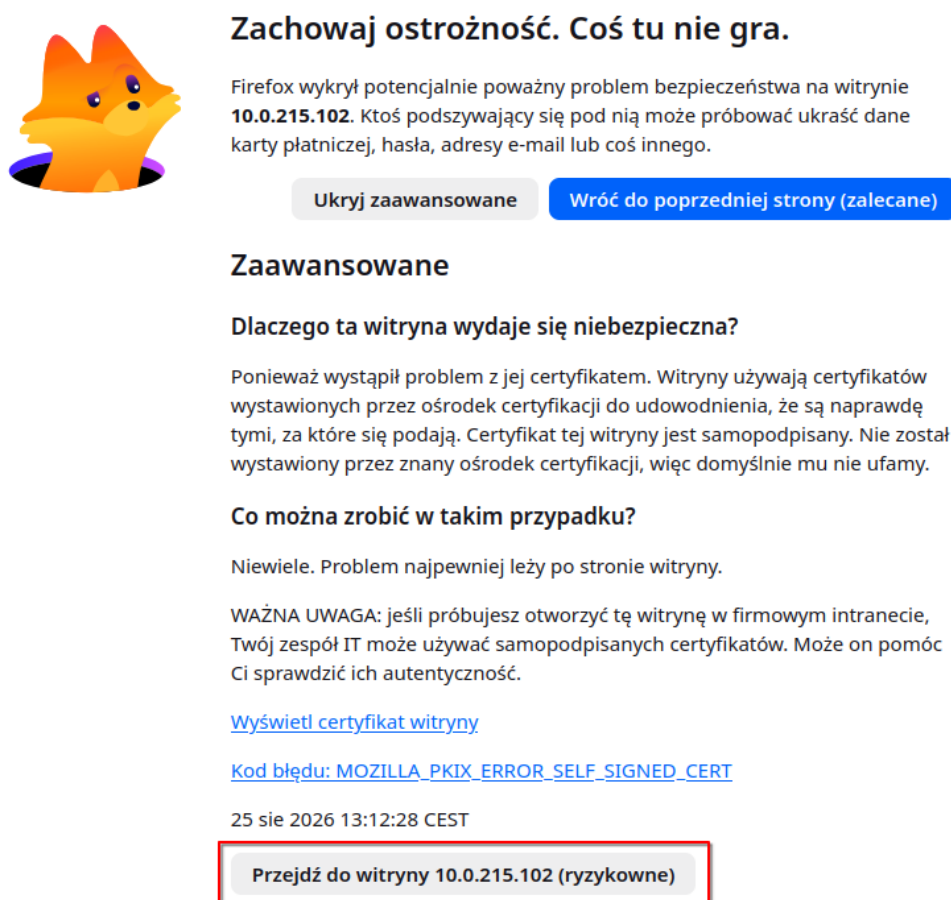


Fig. 38: WWW page - ignoring the self-signed certificate

The WWW page loads once the certificate has been accepted.

The screenshot displays the ND45PLUS web interface. The top navigation bar includes the LUMEL logo, the device name 'ND45PLUS Power network analyzer', and a user profile 'Admin'. The main content area is divided into three sections:

- Dane pomiarowe (Measurement Data):** A table showing various electrical parameters over a 1s interval.

Nazwa	Wartość
Urms L1 1s	232.81V
Urms L2 1s	232.74V
Urms L3 1s	232.81V
Uavg 1s	232.79V
Irms L1 1s	0.0000A
Irms L2 1s	0.0000A
Irms L3 1s	0.0000A
Iavg 1s	0.0000A
Ufund L1 1s	232.77V
Ufund L2 1s	232.65V
Ufund L3 1s	232.75V
Ufavg 1s	232.73V
IN 1s	---
INC 1s	0.0000A
P L1 1s	0.0000kW
P L2 1s	0.0000kW
P L3 1s	0.0000kW
Pavg 1s	0.0000kW
ΣP 1s	0.0000kW
Q L1 1s	0.0000kvar
Q L2 1s	0.0000kvar
Q L3 1s	0.0000kvar
Qavg 1s	0.0000kvar
ΣQ 1s	0.0000kvar
- Alarmy (Alarms):** A red alert box indicating 'Alarm 1 (Urms L1 200ms = 234.334V) (> 50)' at 07:35:42, with a 'Potwierdź' (Confirm) button.
- Pliki: /ND45PLUS (Files):** A table listing configuration files.

Nazwa	Data modyfikacji	Rozmiar
25090096	2026-06-16 13:38:32	32.0 kB
Config_25090096_2026-06-17_07_06_48.ND45PLUS	2026-06-17 07:06:50	72.5 kB
Config_25090096_2026-06-17_11_54_39.ND45PLUS	2026-06-17 11:54:42	72.5 kB
Config_25090096_2026-06-17_15_08_03.ND45PLUS	2026-06-17 15:08:06	73.2 kB
- Informacje o systemie (System Information):** A table showing device details.

Nazwa urządzenia	ND45PLUS
Opis urządzenia	Power Analyzer
Numer seryjny	25090096
Wersja systemu	5.077
Zajęte miejsce na karcie SD	

Fig. 39: WWW page – general view

4.1 Navigation

Depending on the Ethernet configuration, two WWW server access modes are available. The first mode, **Authorized access**, requires login through a login window.

The screenshot shows the 'ND40 Logowanie' login window. It features a title bar with a lock icon. Below the title, there are two input fields: 'Użytkownik' (User) and 'Hasło' (Password). A blue 'Zaloguj' (Login) button is positioned at the bottom right.

Fig. 40: WWW server – login

Anonymous access redirects automatically to the WWW page with limited functionality.

The table lists the modules displayed on the WWW page.

Module	Description								
Measurement data Dane pomiarowe Wartości 1s ▾ 1s ▾ <table><tr><th>Nazwa</th><th>Wartość</th></tr><tr><td>Urms L1 1s</td><td>225.12V</td></tr><tr><td>Urms L2 1s</td><td>225.14V</td></tr><tr><td>Urms L3 1s</td><td>225.08V</td></tr></table>	Nazwa	Wartość	Urms L1 1s	225.12V	Urms L2 1s	225.14V	Urms L3 1s	225.08V	Displays current measurement results with an adjustable refresh time. Measurement sets can be configured individually (in authorized access mode only) or displayed as predefined sets. Values associated with an unconfirmed alarm also change their background color.
Nazwa	Wartość								
Urms L1 1s	225.12V								
Urms L2 1s	225.14V								
Urms L3 1s	225.08V								
Alarm module Alarmy Alarm 1 (Urms L1 200ms = 223.7V) (> 200)09:48:44 Alarm 2 (Urms L2 200ms = 223.73V) (> 210)09:48:45 ✓ Potwierdź	Displays the current alarm status. Alarms can be confirmed in authorized access mode. The module provides the alarm number, the parameter assigned to the alarm, the value that triggered the alarm, its occurrence time and the activation condition.								
File management module Pliki: /ND45PLUS									

4.2 Login / Logout

The login window is shown in section 4.1 . The login and password correspond to the access rights defined on the device under "Security" (section 6.9).

The logout option is in the upper-right corner of the browser. Click the currently logged-in user and select Logout from the drop-down list.

4.3 Reboot device

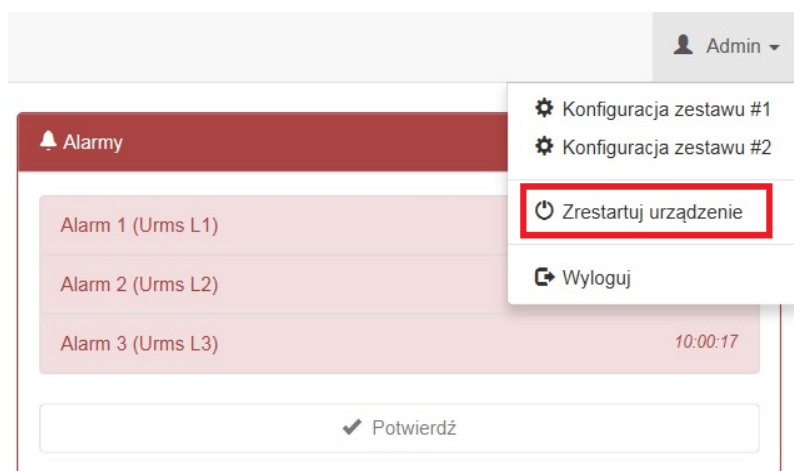


Fig. 41: WWW server – reboot

The device can be restarted remotely through the WWW page as shown below.

Click the currently logged-in user and select Reboot device **from the drop-down list**. Confirm the ND45PLUS restart in the next window.

4.4 Configuration of user measurement data sets

Measurement data sets can be defined as shown below.

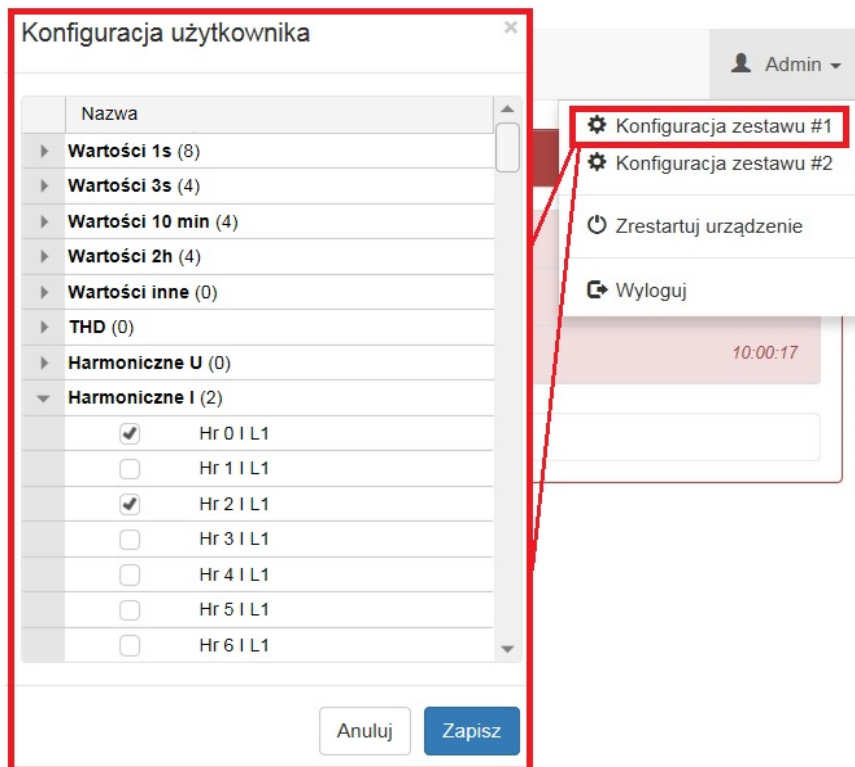


Fig. 42: WWW server – user sets

Click the currently logged-in user and select Set configuration from the **drop-down list**.

In the next window, select the data to be displayed in the measurement data window. Select a parameter group, expand its list and select or deselect the required parameters. When configuration is complete, select **Save** to save the changes or **Cancel** to close the window without making changes.

4.5 Preview of measurement data

An example page containing the Measurement data module is shown in "*Web server management*". The module itself is described in "*Navigation*".

4.6 Selection of defined sets

The example below shows how to change the measurement data by selecting a predefined data set. Select the option describing the currently displayed data set, then choose one of the available sets from the list.

Dane pomiarowe		Wartości 1s ▾	1s ▾
Nazwa	Wartość	- Wartości 1s - Wartości 3s - Wartości 10 min. - Wartości 2h - Values flicker - Wartości inne - THD - Harmoniczne U - Harmoniczne I - Interharmonics U - Interharmonics I - Liczniki energii - Wejścia binarne - Zestaw użytkownika #1 - Zestaw użytkownika #2	
Urms L1 1s	225.74V		
Urms L2 1s	225.78V		
Urms L3 1s	225.58V		
Uavg 1s	225.70V		
Irms L1 1s	0.0659A		
Irms L2 1s	0.0659A		
Irms L3 1s	0.0659A		
Iavg 1s	0.0659A		
Ufund L1 1s	225.67V		
Ufund L2 1s	225.70V		
Ufund L3 1s	225.51V		
Ufavg 1s	225.63V		
IN 1s	0.0659A		
INC 1s	0.1319A		

Fig. 43: WWW server – displayed values

4.7 Selection of user sets

The example below shows how to change the measurement data by selecting a user-defined data set. Select the option describing the currently displayed data set, then choose one of the available sets from the list.

Dane pomiarowe		Wartości 1s ▾	1s ▾
Nazwa		Wartości 1s Wartości 3s Wartości 10 min Wartości 2h Wartości inne THD Harmoniczne U Harmoniczne I Liczniki energii Zestaw użytkownika #1 Zestaw użytkownika #2	
Urms L1 1s			
Urms L2 1s			
Urms L3 1s			
Uavg 1s			
Irms L1 1s			
Irms L2 1s			
Irms L3 1s			
Iavg 1s			
IN 1s			
P L1 1s			
P L2 1s	0.00kW		
P L3 1s	0.00kW		
Pavg 1s	0.00kW		

Fig. 44: WWW server – selection of user sets

4.8 Change of measurement data refresh time

Changing the refresh time adjusts how often the measurement data displayed on the page is updated.

Dane pomiarowe		Wartości 1s ▾	1s ▾
Nazwa	Wartość	1s 5s 10s 30s STOP	
Urms L1 1s	227.44V		
Urms L2 1s	227.55V		
Urms L3 1s	228.30V		
Uavg 1s	227.76V		
Irms L1 1s	0.0000A		

Fig. 45: WWW server – changing the refresh interval

4.9 Disabling the measurement data refresh

Disabling refresh stops measurement data retrieval from the device and freezes the displayed values.



Fig. 46: WWW server – stopping measurement value refresh

4.10 Preview of alarms

An example page containing the Alarms module is shown in "Web server management". The module itself is described in section 4.1 .

4.10.1 Confirmation of alarms

The screenshot shows the 'Alarmy' (Alarms) module window. It has a red header with a bell icon and the word 'Alarmy'. Below the header, there are two alarm entries: 'Alarm 1 (Urms L1 200ms = 223.7V) (> 200)' with a timestamp of '09:48:44', and 'Alarm 2 (Urms L2 200ms = 223.73V) (> 210)' with a timestamp of '09:48:45'. At the bottom, there is a button with a checkmark and the text 'Potwierdź' (Confirm).	Alarm module window showing information about alarm occurrences.
This screenshot is identical to the previous one, showing the 'Alarmy' module window with two alarms and a 'Potwierdź' button.	Select the alarm to be confirmed and select Confirm to confirm it.
This screenshot is identical to the previous ones, showing the 'Alarmy' module window with two alarms and a 'Potwierdź' button.	Alarm module after an alarm has been confirmed: Alarm 1 (Urms L1 200ms = 223.7V) (> 200) at 09:48:44

4.11 Preview of files

An example page containing the Files module is shown in "*Web server management*". The module itself is described in section 4.1.

Example files stored on the SD card

Function	Example file
	Description
Archive	YYYY-MM-DD_hh_mm_ss.ND45PLUSArch¹
	Archive file with preview and csv export options. SQLite-compatible format.
	YYYY-MM-DD_hh_mm_ss.ND45PLUSArch.pqd
	Archive file in PQDIF format
Configuration	Config_SERNUM_YYYY-MM-DD_hh_mm_ss.ND45PLUS²
	Saved configuration file.
Alarm logs	alarm.log.csv
	Current information about alarm occurrences.
System logs	audit.log.csv
	Current system events.
Dips and interruptions	dipswell.log.csv
	Current events: dips, interruptions, swells
Dips and interruptions - measurements	dipswellsamples.log.csv
	Information including additional measurements taken before and immediately after an event.
Update	ND45PLUS_firmware_X.X.XX_XX.img³
	Update file.

1. Y (year), M (month), D (day), h (hour), m (minute), s (second).
2. SERNUM – the device's individual serial number.
3. X – sequential version numbering.

4.11.1 File list options



Fig. 47: WWW server - available file list options

Option	Description
1	Moves up one level in the directory tree.
2	Opens the selected directory.
3	Downloads the selected file.
4	Permanently deletes the selected file.
5	Sets the device configuration from a configuration file.
6	Previews the selected archive file.
7	Downloads the current device configuration.
8	Uploads any file to the current location on the device.
9	Refreshes the list of available files.

4.11.2 Preview of archive files

The archive file preview option (magnifying glass icon) allows the user to view saved files. An example excerpt from an archive file is shown below, together with a description of the display and editing tools.

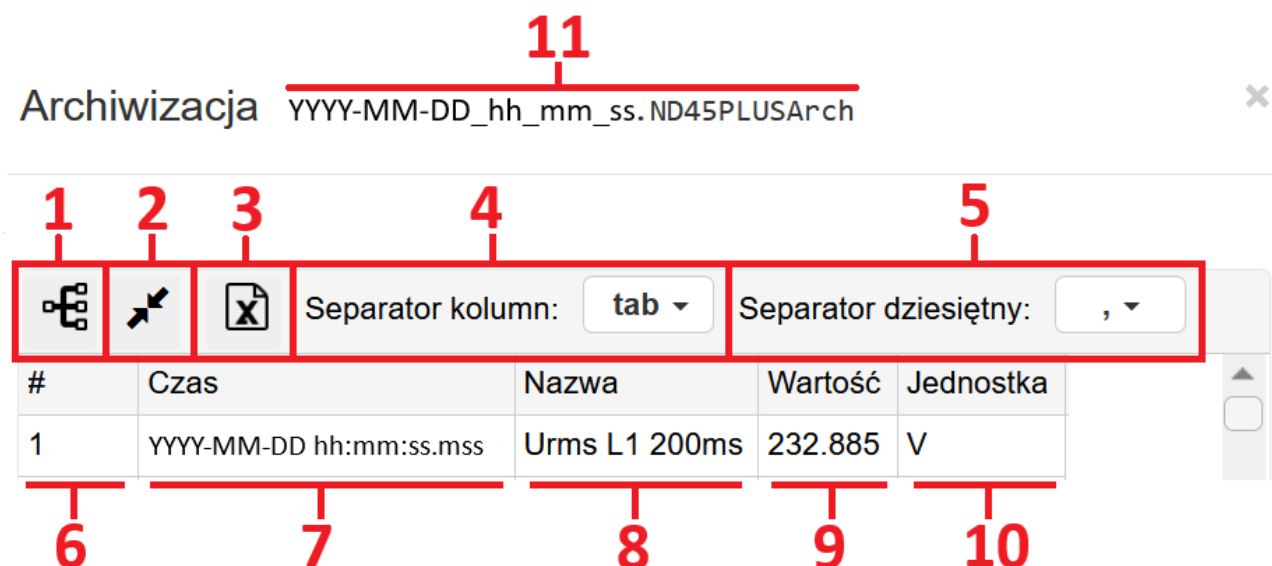


Fig. 48: WWW server – archive file properties

Option	Description
1	Option to group by archiving time.
2	Option to automatically adjust column widths.
3	Option to save the archive file in csv format.
4	Column separator selection.
5	Decimal separator selection.
6	Column with sequential archive entry numbers.
7	Column with the archiving date and time in the format YYYY-MM-DD hh:mm:ss:mss ¹
8	Column describing the archived parameter.
9	Column containing the archived value.
10	Column containing the unit of the archived value.
11	Name of the archive file being viewed, in the format YYYY-MM-DD_hh_mm_ss ¹

3. Y (year), M (month), D (day), h (hour), m (minute), s (second), mss (millisecond).

Access levels

Access levels

No.	Option	Authorized access		Anonymous access
General				
1	Login / Logout	✓		✗
2	Reboot device	✓		✗
3	Configuration of user measurement data sets.	✓		✗
Measurement data				
4	Preview of measurement data	✓		✓
5	Selection of defined sets	✓		✓
6	Selection of user sets	✓		✗
7	Change of measurement data refresh time	✓		✓
8	Disabling the measurement data refresh	✓		✓
Alarms				
9	Preview of alarms	✓		✓
10	Confirmation of alarms*	✓	✗	✗
Files				
11	Preview of files*	✓	✗	✗
12	File list refresh*	✓	✗	✗
13	Opening and closing directories*	✓	✗	✗
14	Downloading files*	✓	✗	✗
15	Deleting files*	✓	✗	✗
16	Setting configuration from a file*	✓	✗	✗
17	Preview of an archive file*	✓	✗	✗
System information				
18	Preview of system information	✓		✓

* function availability depends on user permission settings (see '*Configuration of security rules*').

5 FTP server management

Connect to the FTP server using an FTP client, such as FileZilla, and the IP address assigned to the analyzer.

The FTP connection is encrypted using a self-signed certificate. If a warning appears, accept the certificate.

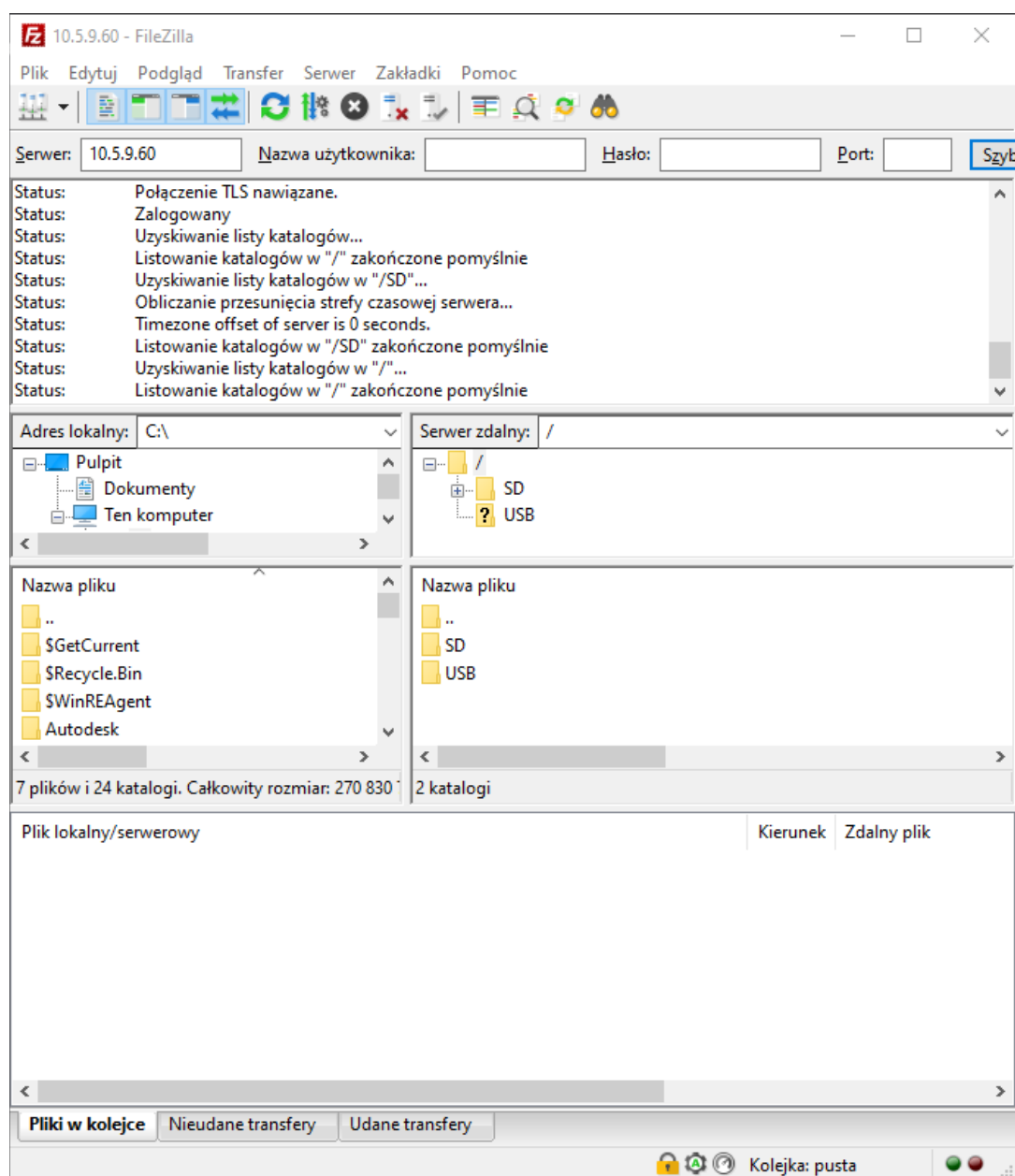


Fig. 49: FTP client. FileZilla

6 Configuration of the device parameters

6.1 Configuration management

After logging in, the user can choose one of three configuration options:

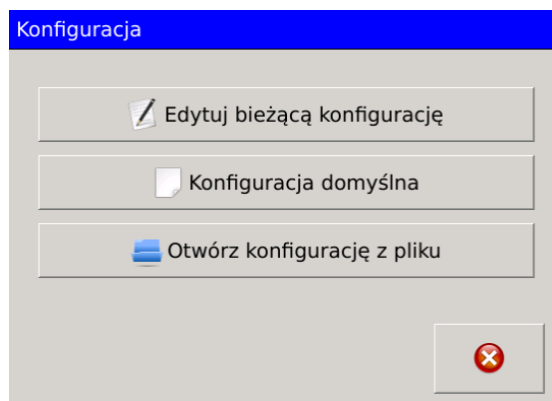


Fig. 50: Configuration

Option	Description
Edit current configuration	Opens the Control Panel.
Default configuration	Restores the device's default configuration.
Open configuration from file	Opens the file browser for selecting an available configuration file.

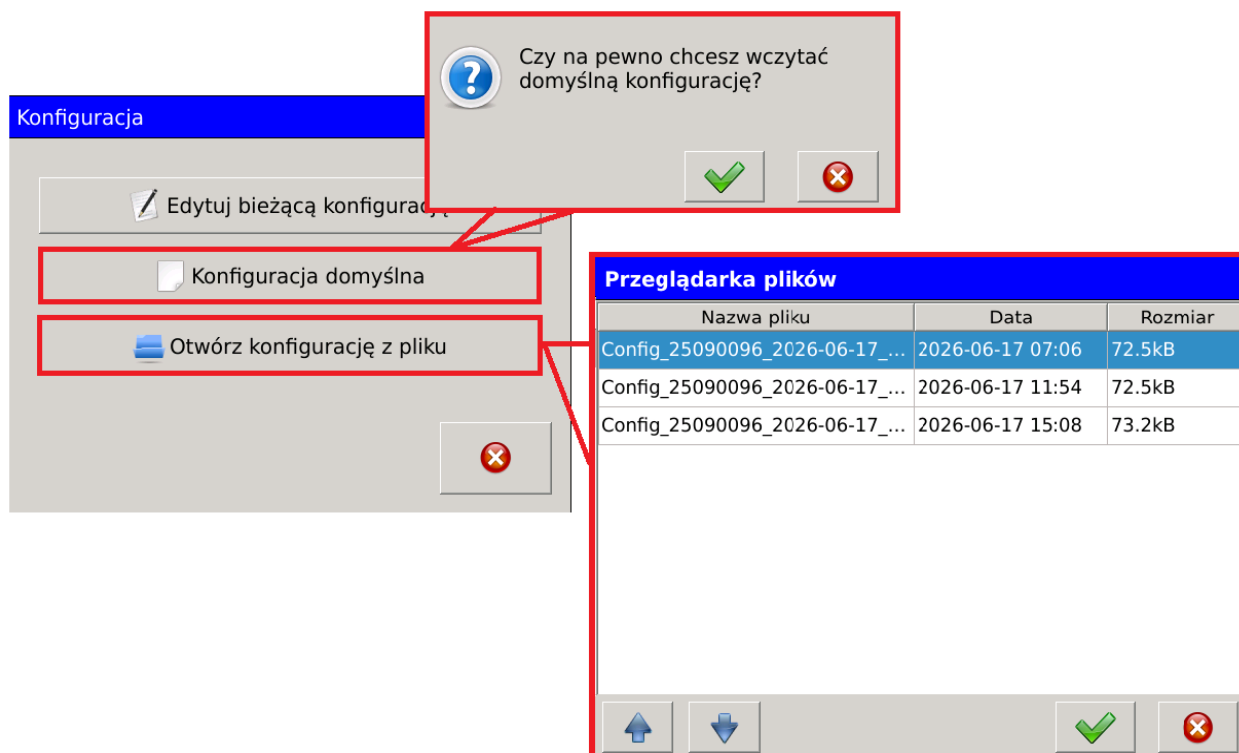


Fig. 51: Configuration – default configuration

Restoring the default configuration requires user confirmation.

The file browser shows the configuration files available to open and apply to the ND45PLUS. The file browser window contains:

Option	Description
File name	Individual name defined by the user when saving the file.
Date	Creation date of the configuration file
Size	Amount of memory occupied by the file.

Closing the Control Panel window is shown below. After the option is selected, a dialog box appears asking you to confirm that configuration editing is complete.

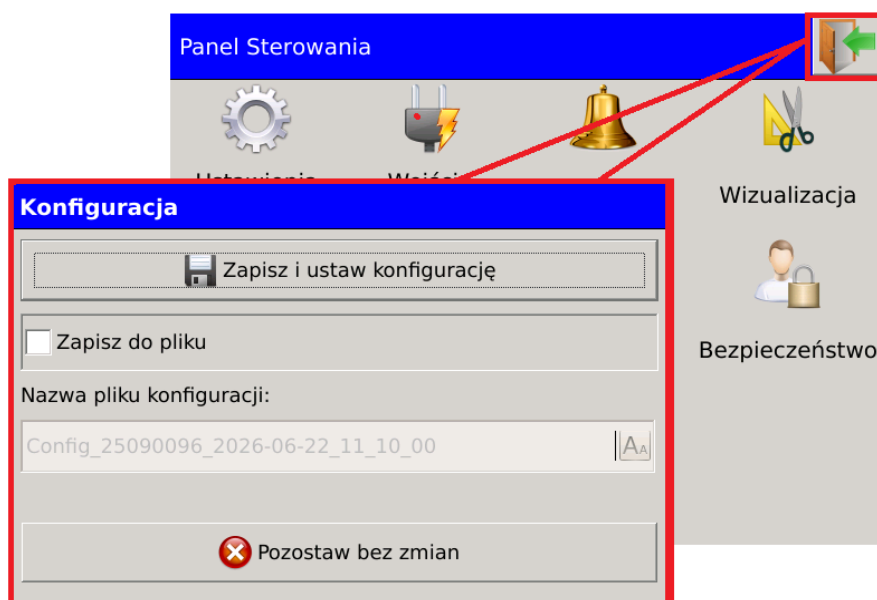


Fig. 52: Configuration – saving

To save the configuration to a file, select the option shown below. Selecting the file name field allows the user to change the file name, which by default includes a description of the saved file, the device serial number, and the date and time.

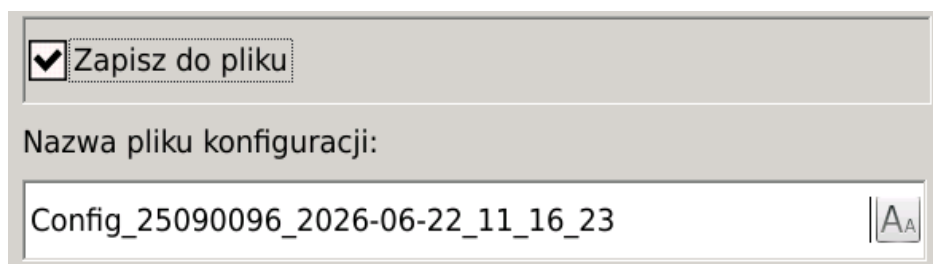


Fig. 53: Configuration – saving to a file

6.2 Configuration of general settings

6.2.1 Basic parameters

The image displays the configuration interface for the ND45PLUS device, divided into two main sections: **Ustawienia ogólne** (General Settings) and **Ustawienia czasu** (Time Settings). Red boxes highlight specific fields, and red lines connect them to enlarged views of those fields on the right.

Ustawienia ogólne (General Settings) - Tab: Podstawowe

- ID urządzenia: ND45Plus
- Opis urządzenia: Power Analyzer
- Język: Polski
- Data i czas: 11:57:24 2026-06-22
- Właściciel: Lumel
- Lokalizacja: Zielona Gora

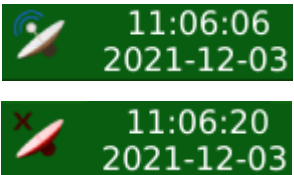
Ustawienia czasu (Time Settings)

- Data: 2026-06-22
- Czas: 11:57:18
- Strefa czasowa: Europe/Warsaw
- Serwer czasu: pool.ntp.org
- Synchronizacja z GPS: Wyłączony
- Synchronizacja z serwerem NTP: Wyłączony
- Synchronizuj (button)

Enlarged views of highlighted fields:

- Wybierz opcję:** Language selection. Options: English, **Polski** (selected).
- Wprowadź datę (rrrr-mm-dd):** Date input. Value: 2026-06-22.
- Wprowadź czas (gg-mm-ss):** Time input. Value: 12:11:35.
- Wybierz opcję:** Time zone selection. Options: **Europe/Warsaw** (selected), Indian/Antananarivo, Indian/Chagos.
- Wybierz opcję:** NTP server selection. Options: **pool.ntp.org** (selected), asia.pool.ntp.org, tempus1.gum.gov.pl.

Fig. 54: General settings - basic

Parameter		Description
Device ID		Assigned identifier. The user can change the description.
Device description		Editable device description.
Language		Selects the device operating language.
Date and time	Date	Edit field for changing the device date. Select the date component (year - month - day) to be changed and adjust it using the buttons ▲ ▼.
	Time	Time is edited in the same way as the date. Select and edit the required time components (hour – minute – second).
	Time zone	The selection list allows the user to choose any time zone.
	Time server	Selects the time server that provides reference UTC time.
	GPS synchronization	Enables communication with the STR receiver to synchronize time with the GPS system. Communication status is indicated by an icon on the main screen, next to the system time.  - communication OK - no communication
	Server synchronization	Enabling server synchronization prevents manual date and time setting. The date and time are obtained from the selected time server for the selected time zone. Disabling synchronization allows the user to set the date and time manually.
Synchronize		Forces synchronization of the application system time
Owner		Changes the device owner ¹
Location		Changes the device location ¹

1. Setting required by the PQDIF format.

6.2.2 LCD settings

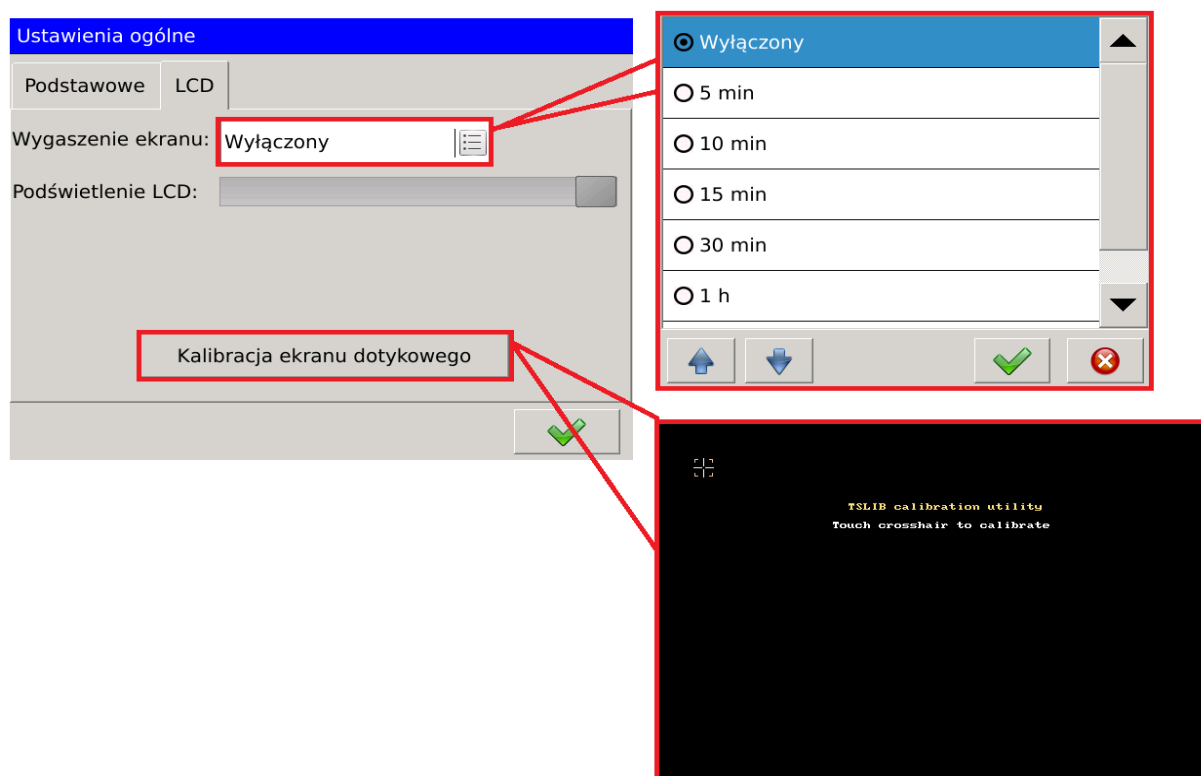


Fig. 55: General settings - LCD

Parameter	Description
Screen saver	Enables or disables the screen saver. Select from the list the time after which the device screen goes blank, or choose to leave the screen on.
LCD backlight	Adjusts the device screen brightness. Use the slider to change the backlight intensity. Moving it to the right sets the maximum value; moving it to the left reduces the screen brightness.
Calibrate touch screen	Selecting calibration opens the calibration window. During the calibration procedure, touch the points indicated on the screen. The screen is calibrated at five points, after which the device returns to the initial screen. Screen calibration cannot be interrupted. If the screen is calibrated incorrectly, repeat the procedure.

6.3 Configuration of measurement input

6.3.1 General settings

The screenshot shows the 'Wejście pomiarowe' (Measurement Input) configuration window. The 'Ogólne' (General) tab is active. The settings are as follows:

- Wartości nominalne I/U:** 5 A / 230 V (selected from a dropdown menu)
- Częstotliwość podstawowa:** 50Hz (selected from a dropdown menu)
- Typ połączenia:** 4-przewodowe wej. (3... (selected from a dropdown menu)
- Synchronizacja fazy:** U L1 (selected from a dropdown menu)
- Czas uśredniania Demand:** 15 min. (selected from a dropdown menu)

Four callout boxes provide detailed views of the dropdown menus:

- Callout 1 (Nominal I/U):** Shows options '5 A / 230 V' (selected) and '1 A / 230 V'.
- Callout 2 (Base frequency):** Shows options '50Hz' (selected) and '60Hz'.
- Callout 3 (Connection type):** Shows options '3-przewodowe wejście' and '4-przewodowe wej. (3 + przewód neutralny)' (selected).
- Callout 4 (Phase for synchronization):** Shows options 'U L1' (selected), 'U L2', 'U L3', 'I L1', 'I L2', and 'I L3'.

Callout 5 (Demand averaging time) shows options '15 min.' (selected), '30 min.', and '60 min.'.

Fig. 56: Measurement input - general

Parameter	Description
Nominal I/U	Selects the nominal current and voltage values for the device.
Base frequency	Selects the nominal frequency.
Connection type	Selects the connection type (3 or 4-wire).
Phase for synchronization	Selects the phase used for synchronization
Demand averaging time	Sets the time interval (in minutes) for averaged parameters (Demand).

If synchronization with the selected phase is lost, subsequent measurements use:
a signal frequency of 50Hz and the corresponding converter sampling frequency of 20480 Hz.

6.3.2 Voltage transformer ratio

ogólne

VT

CT

Kierunek prądu

T1

T2

Harmo.

czn

Automatyczna przekładnia:

Wyłączony

Pierwotne:

230.0 V

Wtórne:

230.0 V

Przekładnia:

1.0

ogólne

VT

CT

Kierunek prądu

T1

T2

Harmo.

czn

Automatyczna przekładnia:

Włączony

Pierwotne:

230.0 V

Wtórne:

230.0 V

Przekładnia:

1.0

Fig. 57: Measurement input – voltage transformer ratio

Parameter	Description	
Auto ratio	Enabling or disabling this option changes how the voltage transformer ratio is calculated.	
Primary	Primary voltage value.	The voltage transformer ratio is calculated by dividing the primary value by the secondary value.
Secondary	Secondary voltage value.	
Ratio	Voltage transformer ratio specified by the user.	

6.3.3 Current transformer ratio

ogólne

VT

CT

Kierunek prądu

T1

T2

Harmo.

czn

Automatyczna przekładnia:

Wyłączony

Prąd fazowy

Pierwotne:

5.0 A

Prąd neutralny

Pierwotne:

5.0 A

Wtórne:

5 A

Wtórne:

5 A

Przekładnia:

1.0

Przekładnia:

1.0

ogólne

VT

CT

Kierunek prądu

T1

T2

Harmo.

czn

Automatyczna przekładnia:

Włączony

Prąd fazowy

Pierwotne:

5.0 A

Prąd neutralny

Pierwotne:

5.0 A

Wtórne:

5 A

Wtórne:

5 A

Przekładnia:

1.0

Przekładnia:

1.0

Fig. 58: Measurement input – current transformer ratio

Parameter		Description	
Auto ratio		Enabling or disabling this option changes how the current transformer ratio is calculated.	
Phase current	Primary	Primary phase current value.	The phase current transformer ratio is calculated by dividing the primary value by the secondary value.
	Secondary	Secondary phase current value.	
	Ratio	Phase current transformer ratio specified by the user.	
Neutral current	Primary	Primary neutral current value.	The neutral current transformer ratio is calculated by dividing the primary value by the secondary value.
	Secondary	Secondary neutral current value.	
	Ratio	Neutral current transformer ratio specified by the user.	

6.3.4 Current direction

Wejście pomiarowe

Ogólne

VT

CT

Kierunek prądu

T1

T2

Harmo. czn

Odwróć kierunek prądu L1:

Wyłączony

Odwróć kierunek prądu L2:

Wyłączony

Odwróć kierunek prądu L3:

Wyłączony

Fig. 59: Measurement input – current direction

Parameter	Description
Reverse current direction L1 - L3	Fields for reversing the current direction in individual phases.

6.3.5 Temperature and resistance

The figure illustrates the configuration steps for temperature and resistance measurement in the ND45PLUS software. It shows the 'Wejście pomiarowe' (Measurement Input) window with the 'T1' tab selected. The interface includes a 'Wyłączony' (Disabled) button, a 'Włączony' (Enabled) button, and fields for 'Typ czujnika' (Sensor type), 'Offset temperatury' (Temperature offset), 'Rezystancja przewodów' (Wire resistance), and 'Zakres' (Range). The 'Wybierz opcję:' (Select option) dialog shows 'PT100' selected, and the 'Edycja zakresu' (Edit range) dialog shows the range set to 'Min: -200' and 'Maks: 850'.

Fig. 60: Measurement input – temperature/resistance

Parameter	Description
Enabled/Disabled	Enables or disables temperature or resistance measurement.
Sensor type	Selects a temperature sensor (Pt100, Pt1000) or resistance measurement.
Temperature offset	Offset value for the measured temperature.
Wire resistance	Wire resistance value for the resistance measurement.
Range	Selects the measurement range for the selected sensor type. This setting allows the user to change the standard minimum value and the standard maximum value assigned to the selected type of sensor.

6.3.6 Harmonics

Wejście pomiarowe

Współczynnik PWHD

Nr pierwszej harmoniczej: 

Nr ostatniej harmoniczej: 

Agregacja Harmonicznych i THD :

Czas uśredniania: 



Fig. 61: Measurement input – harmonics

Parameter	Description
First harmonic number	Selects the first harmonic for PWHD calculations.
Last harmonic number	Selects the last harmonic for PWHD calculations.
Averaging time	Averaging time for harmonics and THD values: 1s, 3s, 10min, 2 hours.

6.3.7 External counters.

Wejście pomiarowe

T2 Harmoniczne Zewnętrzne liczniki Obliczenia ◀ ▶

Nr. wejścia zewnętrznego: 1

Tryb wejścia: Wejście binarne

Poziom aktywności wej.: High

Czas wysokiego poziomu: 10 ms

Czas niskiego poziomu: 10 ms

Impuls na jedną f(x) jednostkę 1000

✓

Fig. 62: Measurement input – external counters

Parameter	Description
External input number	Selects the external input to be configured. After a different input is selected, the remaining configuration fields display its current settings.
Input activity mode	Selects the operating mode. Depending on the settings, only pulses or pulses together with counters can be counted.
Input activity level	Selects the level at which the input is active. Choose between Low and High.
High level time	High level time settings: 1ms, 10ms, 100ms, 1s, 100s, 60s.
Low level time	Low level time settings: 1ms, 10ms, 100ms, 1s, 100s, 60s.
Quantity per f(x) unit	Selects the counter conversion factor. Set a pulse count from 1 to 100000 that corresponds to the user-defined function f(x).

6.3.8 Calculations

Wejście pomiarowe

T2 Harmoniczne Zewnętrzne liczniki **Obliczenia**

Moce Trójkąt mocy

Wartości Podstawowe filtr dolnoprzepustowy

Kąty Trójkąt mocy

✓

Fig. 63: Calculations

- **Power** – applies to: P,Q,S, tg(phi), PF, dPF
 - **Power triangle** – power values are calculated from the power triangle
 - **Harmonics** – power values are calculated from harmonics. The device calculates the power of each individual harmonic. Additional MODBUS registers and parameter channels are available:
 - **P,Q,S channels** with aggregation of 200ms, 1s, 3s, 10min, 2h – total power of all harmonics.
 - **Hr P n Lx, Hr Q n Lx, Hr S n Lx** channels – power values for *harmonic* n and phase x. The averaging time for these parameters is set under: Measurement inputs → Harmonics → Averaging time
- **Basic values** - this setting applies to the Ufund parameter:
 - **Low-pass filter** - Ufund values after low-pass filtering
 - **First harmonic** – Ufund values from the first harmonic
- **Angles** – applies to UI angles and voltage phase-to-phase angles
 - **Power triangle** – angles from the power triangle
 - **First harmonic** – angles based on the first harmonic

6.4 Configuration of alarms

The alarm configuration window allows up to twelve alarms to be defined.

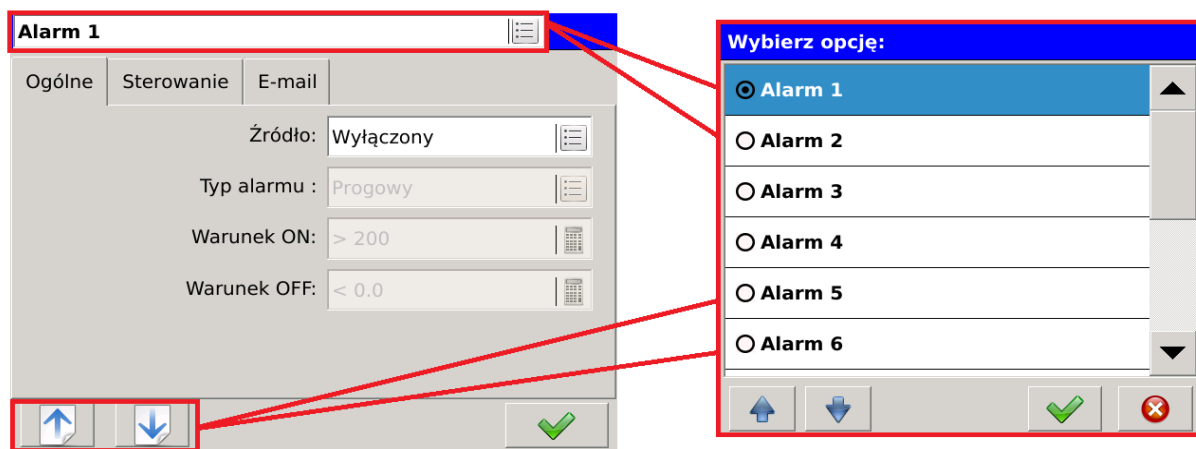


Fig. 64: Alarms – navigation

Each alarm configuration is assigned to a specific number. Navigate between alarms using the buttons or directly  through the selection list at the top of the screen.

6.4.1 General settings

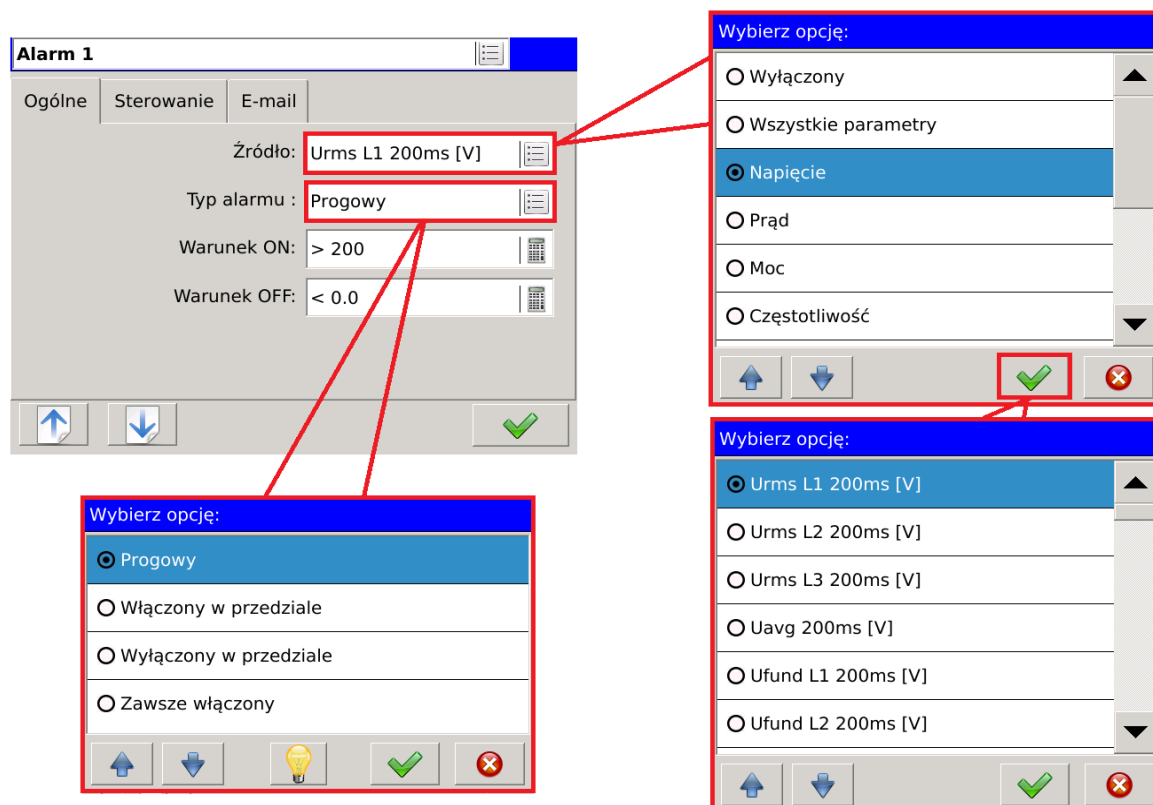


Fig. 65: Alarms – general settings

Parameter		Description
Source		Selects the alarm source. First select the parameter group, then the required parameter.
Alarm type	Threshold	The alarm is activated when Condition ON is met and deactivated when Condition OFF is met.
	Range ON	The alarm is activated when the measured value is within the specified range. A value outside the range deactivates the alarm.
	Range OFF	The alarm remains off when the measured value is within the specified range. A value outside the range activates the alarm.
	Always ON	The alarm is always on.
Condition ON		Alarm activation value.
Condition OFF		Alarm deactivation value.

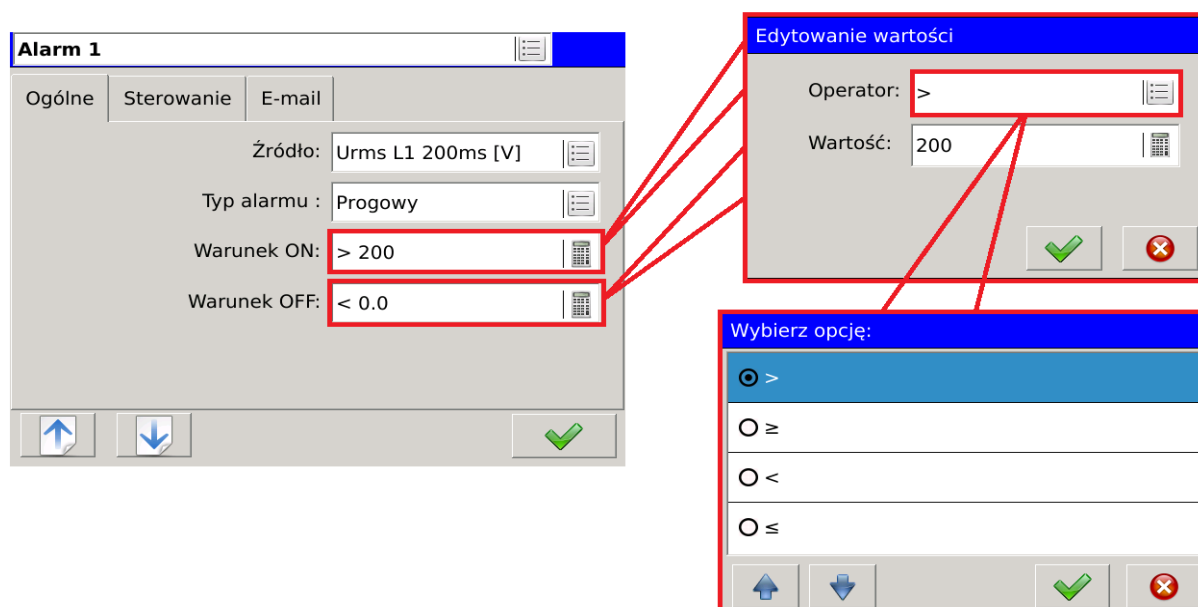


Fig. 66: Alarms – general settings, conditions

For each activation and deactivation condition, the user defines an operator and its associated value.

6.4.2 Control

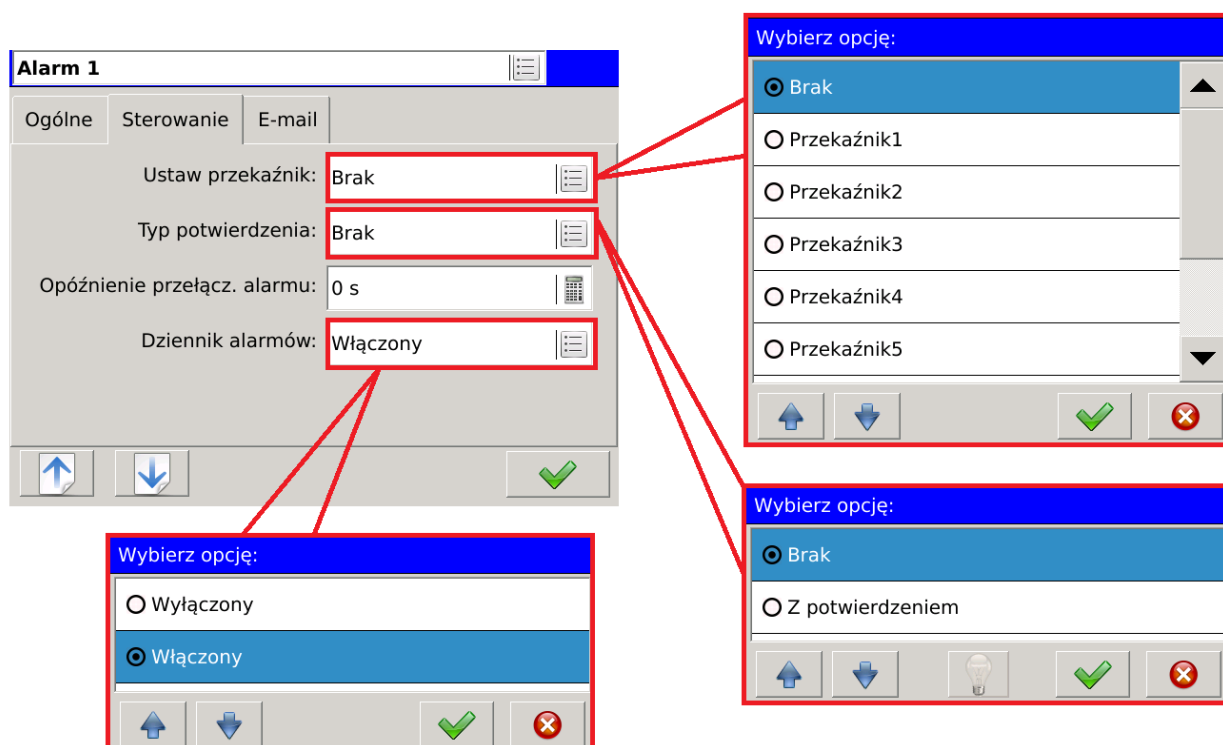


Fig. 67: Alarms – control

Parameter		Description
Set relay		Assigns a relay to the alarm output.
Confirm type	None	When the alarm is deactivated, information about its occurrence is cleared automatically.
	With confirmation	After the alarm is deactivated, information about its occurrence remains and requires confirmation.
Alarm switching delay		Delay when switching alarm states. After an event occurs, the alarm is activated or deactivated after the set delay time.
Alarm log		Enables recording of alarm-related events in the alarm log (Alarm logs).

6.4.3 E-mail

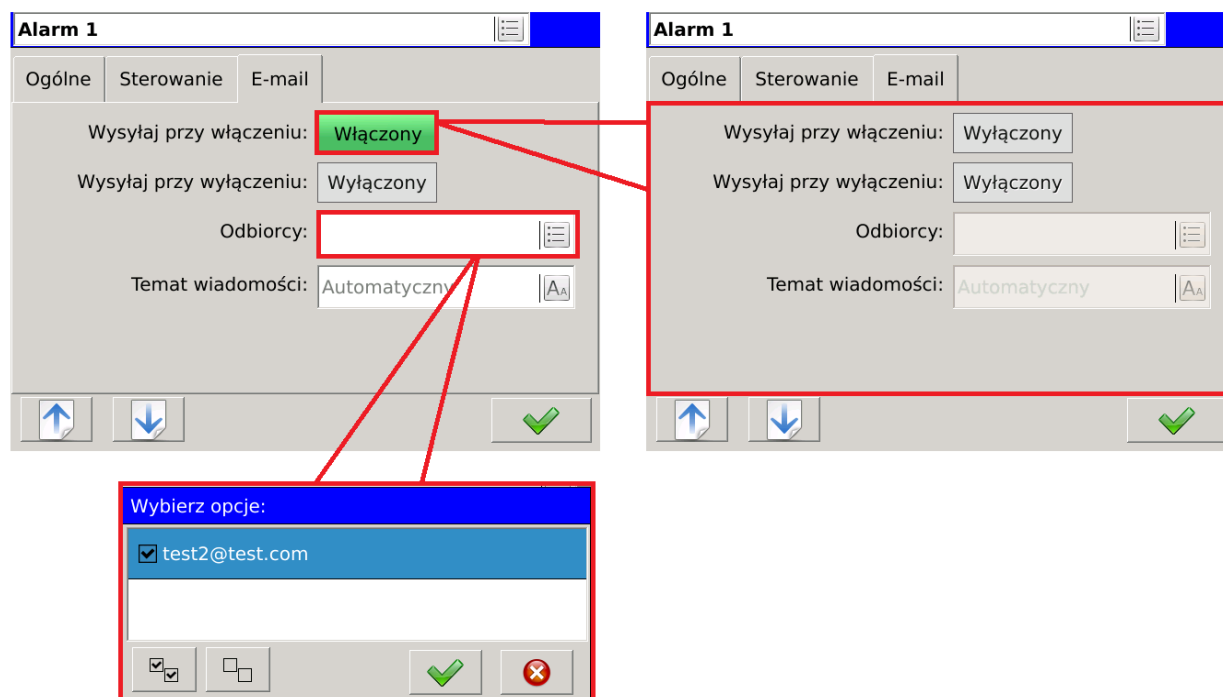


Fig. 68: Alarms – email

Parameter	Description
Send when activated	Sends an information e-mail when the alarm is activated.
Send when deactivated	Sends an information e-mail when the alarm is deactivated.
Recipients	Selection list of message recipients. Recipients are defined under Ethernet in the Control Panel .
Message subject	Edit field for the e-mail subject. The default Auto option sends a message about the alarm occurrence together with the analyzer ID and description defined under General settings .

Parameter		Description
Custom data sets	Set name	The user can define an individual name for the custom data set, or can choose to leave the name set by default unchanged. The buttons   shown here allow the user to navigate between the individual custom data sets.
	Parameters	Allows the user to select parameters for the custom data set. First, select the group to which the required parameter is assigned. To help the user, information is shown about the parameters already selected within that group. For example, the label [2] Voltage means that two parameters have been selected from the "Voltage" group. The label [-] means that no options have been selected from that group. Additional   options allow all list items to be selected or cleared quickly.

6.5.2 Trends

The editable screens in the Trends view depend on the settings under **Visualization** → **Screens** → **Trends**.

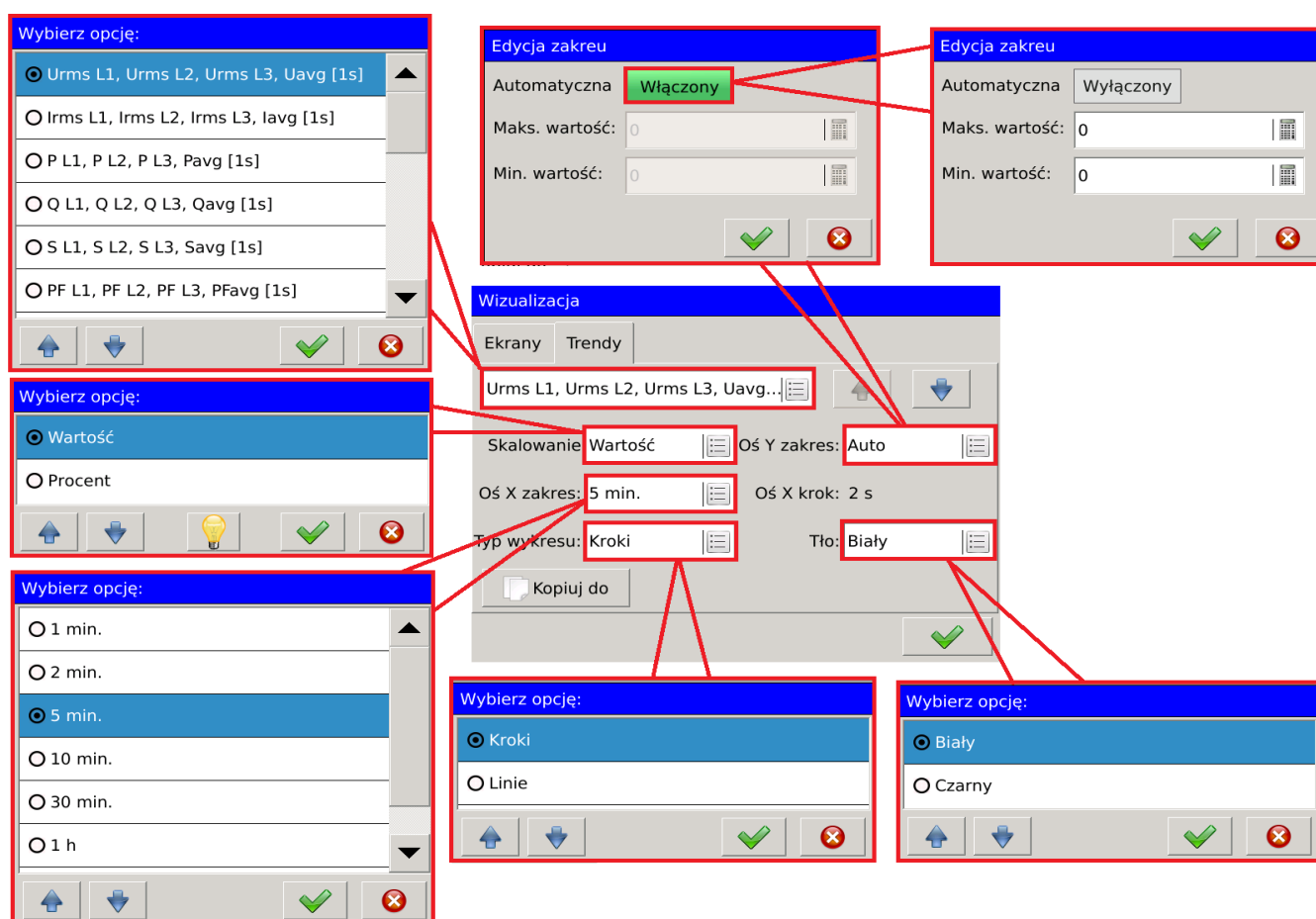


Fig. 70: Visualization – trends

Parameter		Description
Scaling	Value	Scales to the parameter values.
	Percentage	Scales as a percentage of the nominal parameter range value.
X-axis range		Time range of the data displayed on the trend screen.
Chart type		Selects how measured values are displayed. Depending on the option selected, data is shown as steps or lines.
Background		Selects the background color for trend screens.
Y-axis range	Auto	Enabling or disabling scaling determines whether the maximum and minimum values shown on the trend screen Y-axis can be edited.
	Max. value	Maximum Y-axis value for the parameter displayed on the trend screen.
	Min. value	Minimum Y-axis value for the parameter displayed on the trend screen.

6.6 Configuration of Ethernet

6.6.1 General settings

The image shows two screenshots of the 'Konfiguracja ethernetu' (Ethernet Configuration) interface. The top screenshot shows the 'Ogólne' (General) tab with DHCP set to 'Włączony' (Enabled). The bottom screenshot shows the same interface with DHCP set to 'Wyłączony' (Disabled), and a callout box showing the 'Adres IP' (IP Address) configuration screen where the IP address 10.0.17.101 is entered.

Konfiguracja ethernetu

Ogólne | Serwery | SMTP | E-mail

DHCP: **Włączony**

IP urządzenia: 10.0.17.101

Maska podsieci: 255.0.0.0

Brama domyślna: 10.10.10.200

Serwer DNS: 10.0.0.44

Adres IP

IP urządzenia: 10 . 0 . 17 . 101

Fig. 71: Ethernet – general

Parameter	Description
DHCP	Enables or disables DHCP. When enabled, the Ethernet interface automatically obtains its IP protocol parameters from external DHCP servers on the same local area network (LAN).
Device IP	Edit field for changing the IP address.
Subnet mask	Edit field for changing the subnet mask.
Default gateway	Edit field for changing the default gateway.

6.6.2 FTP and WWW server settings

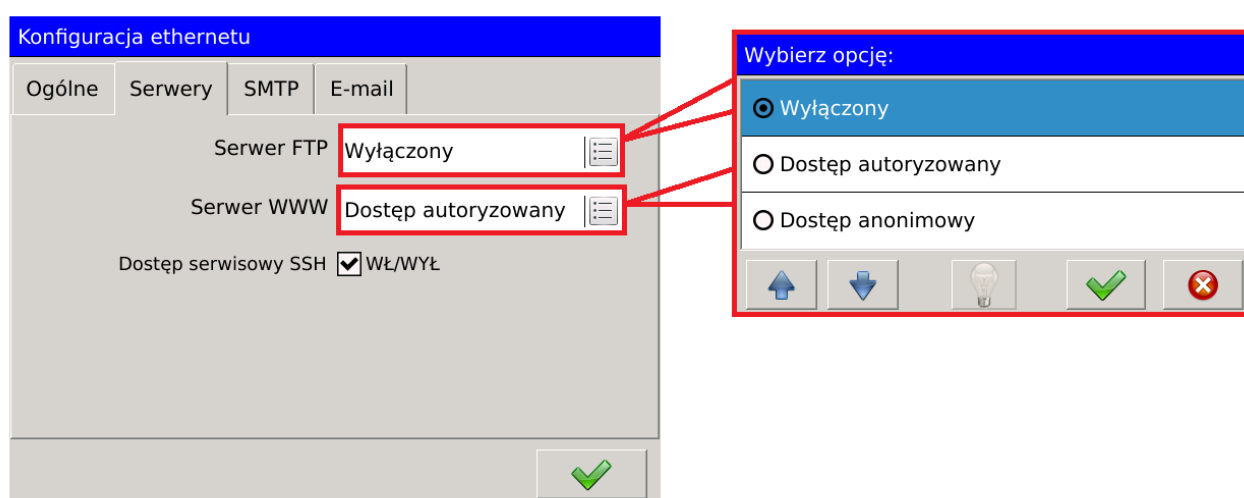


Fig. 72: Ethernet – servers

Parameter		Description
FTP server WWW server	Disabled	No access to the WWW or FTP server
	Authorized access	Access requiring authorization (login required)
	Anonymous access	Access without authorization (no login required)
SSH service access	ON/OFF	Enables/disables service access to the device via SSH

6.6.3 Mail client settings

6.6.3.1 SMTP configuration

Konfiguracja ethernetu

Ogólne Serwery SMTP E-mail

Nazwa serwera: mail.test.com

Port: 465

Zabezpieczenie połączenia: SSL / TTS

Nazwa użytkownika: user

Hasło: ●●●●

Wybierz opcję:

☐ Brak

☒ SSL / TTS

☐ STARTTLS

Up Down Confirm Cancel

Fig. 73: Ethernet – SMTP

Parameter	Description
Server name	Outgoing mail server
Port	Outgoing mail server port
Connection security	Selects the security option for outgoing mail
User name	Message sender identifier
Password	Access password

6.6.3.2 Configuration of the e-mail address list

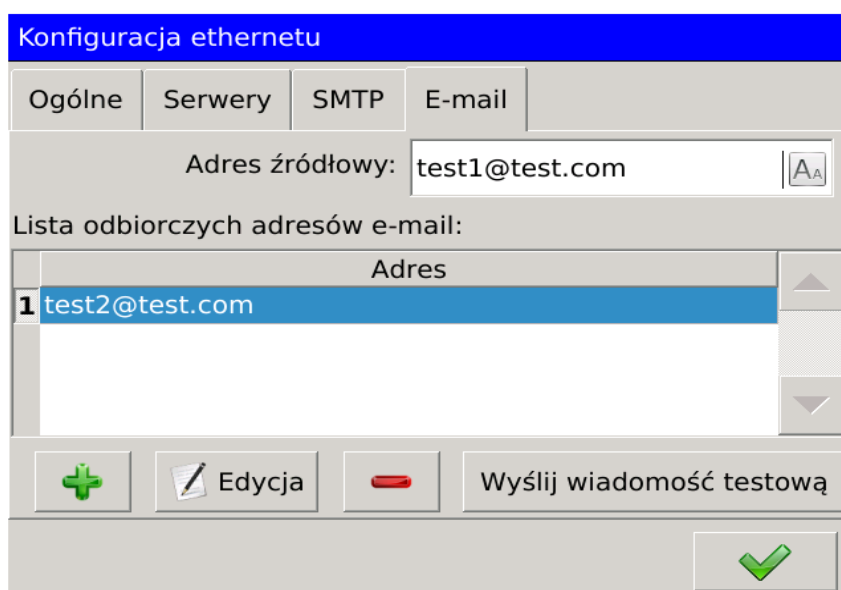


Fig. 74: Ethernet – E-mail

Parameter	Description
Source address	Outgoing mail server
Recipient e-mail address list	Editable list of recipient addresses. Up to 10 addresses can be listed.
	Adds a new recipient address to the list or removes an existing address.
Edit	Changes an existing address in the recipient list.
Send test message	Sends a test message to an address in the recipient list.

6.6.4 Obtaining an Ethernet network address

When the animated icon appears, the device is establishing an Ethernet network connection. The network is unavailable during this time. The process takes up to 3 minutes. If network problems persist, the device restarts.

The icon disappears once the connection has been established.



Fig. 75: Animated IP address acquisition icon

6.7 Communication configuration

6.7.1 Configuration of Modbus RTU

Konfiguracja komunikacji

Modbus RTU	Modbus TCP	IEC104
------------	------------	--------

Modbus slave

Tryb:

RTU 8N2

Prędkość:

115200

ID:

1

Opóźnienie odp.:

0 ms

Fig. 76: Modbus RTU slave.

Parameter	Description
Mode	Specifies the RS-485 interface transmission frame type.
Baud rate	RS-485 interface transmission speed.
ID	Device identifier in the Modbus network.
Response delay	Forces a delay in the response time.

6.7.2 Configuration of Modbus TCP

Konfiguracja komunikacji

Modbus RTU Modbus TCP IEC104

Modbus slave

TCP/IP slave: **Włączony**

ID: 1

TCP/IP port: 502

TCP KeepAlive: ☒

✓

Fig. 77: Modbus TCP slave

Parameter	Description
ID	Device identifier in the Modbus network.
TCP/IP	Enables or disables Modbus TCP/IP mode.
TCP/IP port	Modbus TCP/IP port number.
TCP KeepAlive	A mechanism that sends periodic packets to check and maintain the connection. It enables rapid detection of a lost Modbus TCP connection.

6.7.3 Configuration of IEC 60870-5-104

The device supports only one connection at a time

Selecting a large number of parameters for spontaneous and cyclic communication may delay transmission.

6.7.3.1 Configuration of IEC 60870-5-104 – General

Konfiguracja komunikacji

Modbus RTU | Modbus TCP | IEC104

Ogólne | Bezpieczeństwo | Spontaniczne | Cykliczne

IEC104: **Włączony** Adres urządzenia: 1

Port TCP: 2404 Timeout1_ACK: 15

IOA przesunięcie: 0 Timeout3_TEST: 20

Globalne zapytanie: Wybór parametrów ☐ Dodaj rejestry informacyjne

✓

Fig. 78: IEC 60870-5-104 main window

Parameter	Description
Device address	Device identifier in the IEC 60870-5-104 network
TCP port	Listening port for TCP connections
IOA offset	Address offset for all information objects
Timeout1_ACK	Maximum response waiting time. If this is exceeded, the device disconnects from the client
Timeout3_TEST	Maximum time before a test frame is sent
General query: Select parameters	Selects the parameters sent in response to a general interrogation (frame type 100 IEC104). Only global interrogation (QOI: 20) is supported.
General query: Add information registers	Includes information registers in the response to a general interrogation (frame type 100)

6.7.3.2 Configuration of IEC 60870-5-104 – Security

Konfiguracja komunikacji			
Modbus RTU	Modbus TCP	IEC104	
Ogólne	Bezpieczeństwo	Spontaniczne	Cykliczne
Filtrowanie IP klientów:		Włączony	
Klient 1:	0.0.0.0	Klient 2:	0.0.0.0
Klient 3:	0.0.0.0	Klient 4:	0.0.0.0
Klient 5:	0.0.0.0	Klient 6:	0.0.0.0
			

Fig. 79: IEC 60870-5-104 - Security

This setting enables/disables client IP address filtering for IEC104. Connection attempts from devices with IP addresses other than those configured are rejected. Filtering is performed by the device's built-in firewall.

6.7.3.3 Configuration of IEC 60870-5-104 – Spontaneous transmission

The analyzer supports spontaneous transmission of selected parameters, COT=3.

The information frame type sent is:

- M_ME_TF_1 - Measured value, short floating-point number with CP56Time2a time tag

Konfiguracja komunikacji					Konfiguracja komunikacji				
Modbus RTU		Modbus TCP		IEC104	Modbus RTU		Modbus TCP		IEC104
Ogólne	Bezpieczeństwo		Spontaniczne	Cykliczne	Ogólne	Bezpieczeństwo		Spontaniczne	Cykliczne
	Parametry	IOA	Mnożnik	Δ Zaraportowany		IOA	Mnożnik	Δ Zaraportowany	Δ Pomiar
1	Urms L2 200ms	99374	63.12345698	0.0	1	99374	63.12345698	0.0	0.0
2	Irms L3 200ms	99400	89256.22221	0.0	2	99400	89256.22221	0.0	0.0
3	P L2 200ms	99380	-0.225789	0.0	3	99380	-0.225789	0.0	0.0
Wybór parametrów					Wybór parametrów				

Fig. 80: Fig. 11: IEC 60870-5-104 - Spontaneous

Configuration:

- To select parameters, press the Select **parameters button**.
- After adding the required parameters, configure the conditions for spontaneous transmission.
- Press the relevant cell to set a condition.
- Adding new parameters discards unsaved changes.
- Press the check mark to save the changes:

Description of the settings table:

Column	Description
Parameters	Names of the selected parameters
IOA	IEC104 object address. Sum of the MODBUS register address and the IOA offset (set on the General tab)
Multiplier	Value multiplier for the selected parameter
Δ Reported	Spontaneous transmission occurs when the difference between the last transmitted value and the current measured value exceeds the set value.
Δ Measurement	Spontaneous transmission occurs when the difference between the current and previous measured values exceeds the set value.

6.7.3.4 Configuration of IEC 60870-5-104 – Cyclic transmission

The information frame type sent is:

- M_ME_NC_1 - Measured value, short floating-point number

Konfiguracja komunikacji				
Modbus RTU		Modbus TCP		IEC104
Ogólne	Bezpieczeństwo		Spontaniczne	Cykliczne
Parametry	IOA	Mnożnik	Interwał [ms]	
1 P L1 200ms	99356	1.0	500	
2 P L2 200ms	99380	1.0	500	
3 P L3 200ms	99404	1.0	500	
Wybór parametrów				
✓				

Fig. 81: IEC 60870-5-104 - Cyclic

Configuration is performed in the same way as for spontaneous transmission.

Description of the settings table:

Column	Description
Parameters	Names of the selected parameters
IOA	IEC104 object address. Sum of the MODBUS register address and the IOA offset (set on the General tab)
Multiplier	Value multiplier for the selected parameter
Interval [ms]	Cyclic transmission interval for the parameter, in milliseconds.

The supported time interval may change with future software updates.

Selecting a large number of parameters may extend cyclic communication beyond the configured time interval

6.8 Configuration of archiving

6.8.1 General settings.

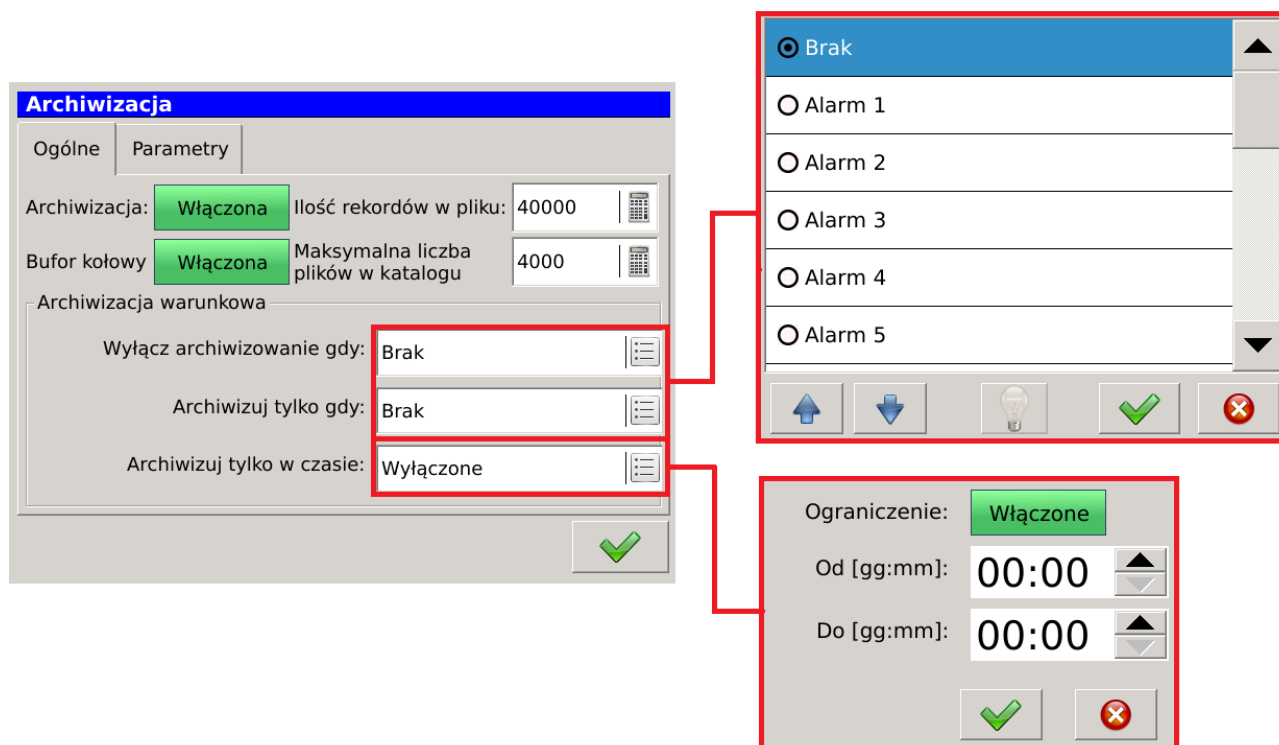


Fig. 82: Archiving - general

Option		Description
Number of records per file		Specifies the maximum number of records per file
Maximum number of files per directory		Specifies the maximum number of files per folder. When this number is exceeded, the oldest files in the current working folder are deleted until the configured limit is reached.
Circular buffer		When SD card usage exceeds 95%, the oldest folders are deleted until SD card usage falls to 80%.
Archive only when		Assigns the alarm that enables archiving (when the alarm is active).
Disable archiving when"		Assigns the alarm that disables archiving (when the alarm is active).
Archive only during	Restriction	Enabling this function activates archiving within the assigned time range.
	From [hh:mm]	Start of the specified archiving time range.
	To [hh:mm]	End of the specified archiving time range.

The table below gives the maximum values for log files.

Log file name	DESCRIPTION	Maximum number of records	Maximum number of files per folder	Maximum file size [kB]
YYYY-MM-DD_hh_mm_ss.ND45PLUSArch	Archive file with preview and csv export options. SQLite-compatible format.	4000 (default value) ²	40000 (default value) ²	-
YYYY-MM-DD_hh_mm_ss.ND45PLUSArch.pqd	Archive file in PQDIF format			-
audit.log.csv	<i>Current system events</i>			-
alarm.log.csv	<i>Current information about alarm occurrences</i>			-
dipswell.log.csv	<i>Current events: dips, interruptions, swells</i>			-
dipswellsamples.log.csv	<i>Additional information – values before the event, values at the time of the event and values after it ends.</i>	-		1024
1. Y (year), M (month), D (day), h (hour), m (minute), s (second). 2. Default values that can be overridden by the user. 3. For a detailed file description, see "Preview of files".				

Each file has a maximum record count (see table above) and/or file size. When the limit is exceeded, a new file is created and the previous file is renamed with an appended time stamp:

<file_name>.YYYY-MM-DD_hh_mm_ss.csv

Where **YYYY**(year) → year, **MM**(month) → month, **DD**(day) → day, **hh**(hour) → hour, **mm**(minute) → minute, **ss**(second) → second.

6.8.2 Parameters

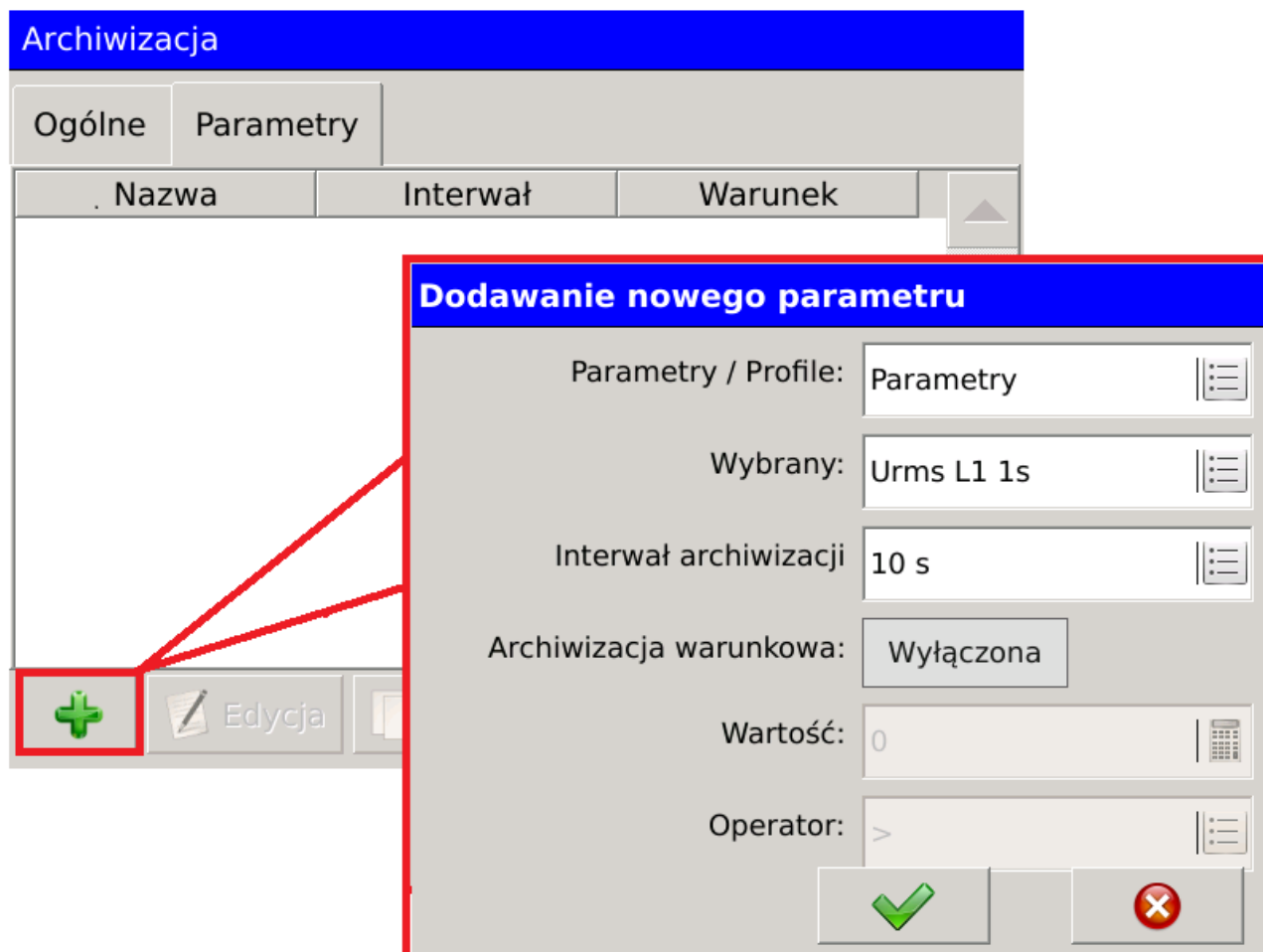


Fig. 83: Archiving - parameters

The table describes the options for adding a new parameter to be archived.

Option	Description
Parameters / Profiles	Selects the parameter or profile to be archived.
Archiving interval	Selects the archiving interval for the selected parameter.
Conditional archiving	Enables or disables conditional archiving.
Value	Value assigned to the conditional archiving operator.
Operator	Conditional archiving operator.

Note!

Always enter the **Value** parameter in standard units (Urms: V, Irms: A, etc.).

Example configuration for archiving Urms L1 voltage aggregated every second. The parameter is archived every 10 seconds. Conditional archiving is enabled, and the condition is met when $U_{rms} > 0$ V.

First select the parameter to be archived and the archiving time.

The screenshot displays the 'Dodawanie nowego parametru' (Adding new parameter) dialog box. It contains the following fields and options:

- Parametry / Profile:** A dropdown menu with 'Parametry' selected.
- Wybrany:** A dropdown menu with 'Urms L1 1s' selected.
- Interwał archiwizacji:** A dropdown menu with '10 s' selected.
- Archiwizacja warunkowa:** A green button labeled 'Włączona' (Enabled).
- Wartość:** A text input field with '0'.
- Operator:** A dropdown menu with '>' selected.

To the right of the main dialog, there are two sub-dialogs:

- Wybierz opcję:** A dialog with two radio buttons: 'Parametry' (selected) and 'Profile'.
- Wybierz parametry:** A list of parameter categories: 'Wszystkie parametry' (selected), 'Napięcie', 'Prąd', 'Moc', 'Częstotliwość', and 'Harmoniczne'.

At the bottom, there are two more lists:

- Interwały archiwizacji:** A list of time intervals: '1 min.', '5 min.', '10 min.', '30 min.', '1 h', and '2 h'.
- Lista parametrów:** A list of specific parameters: 'Urms L1 200ms' (selected), 'Urms L2 200ms', 'Urms L3 200ms', 'Uavg 200ms', 'Ufund L1 200ms', and 'Ufund L2 200ms'.

Red boxes and arrows highlight the selection process: the 'Urms L1 1s' parameter is selected in the main dialog, the 'Urms L1 200ms' parameter is selected in the list, and the '10 min.' interval is selected in the list.

Fig. 84: Archiving – new parameter

To configure conditional archiving, enable it and specify the operator that triggers archiving.

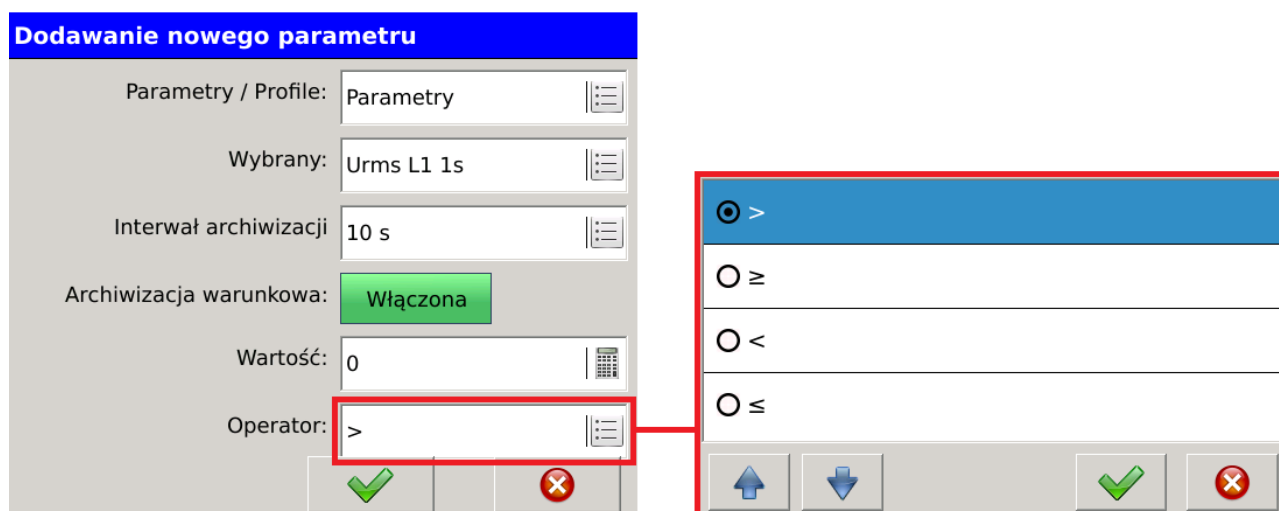


Fig. 85: Archiving – conditional

After selecting the parameter, operator and value, the condition is as follows.

Wybrany:	Operator:	Wartość:
Urms L1 1s	>	0

Fig. 86: Conditional archiving diagram

A configured parameter can be edited, or a new parameter can be created from an existing one (using the copy option).

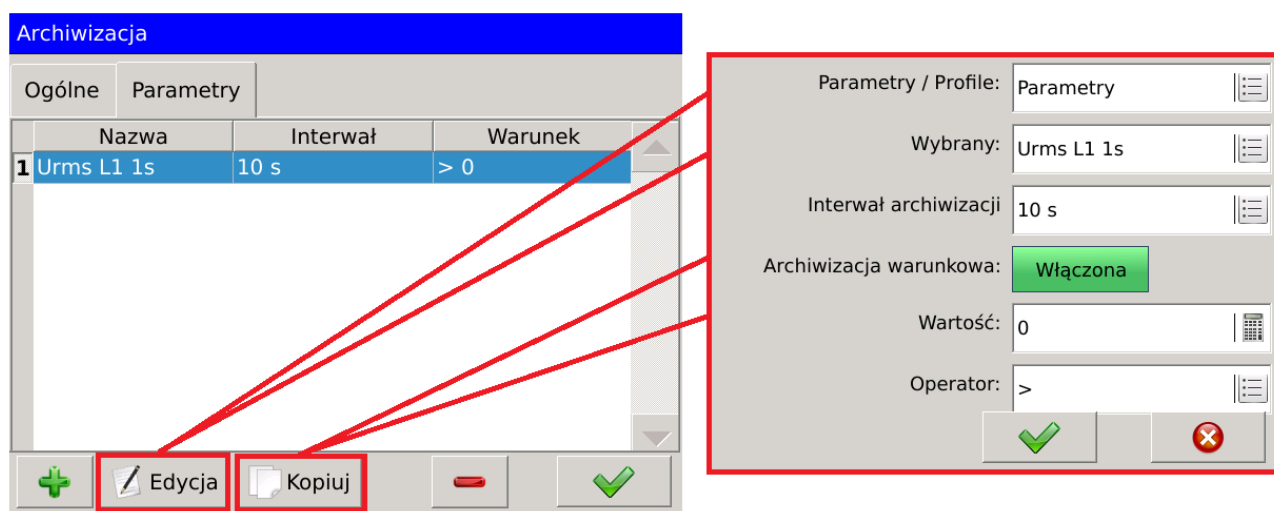


Fig. 87: Archiving – options

6.9 Configuration of security rules

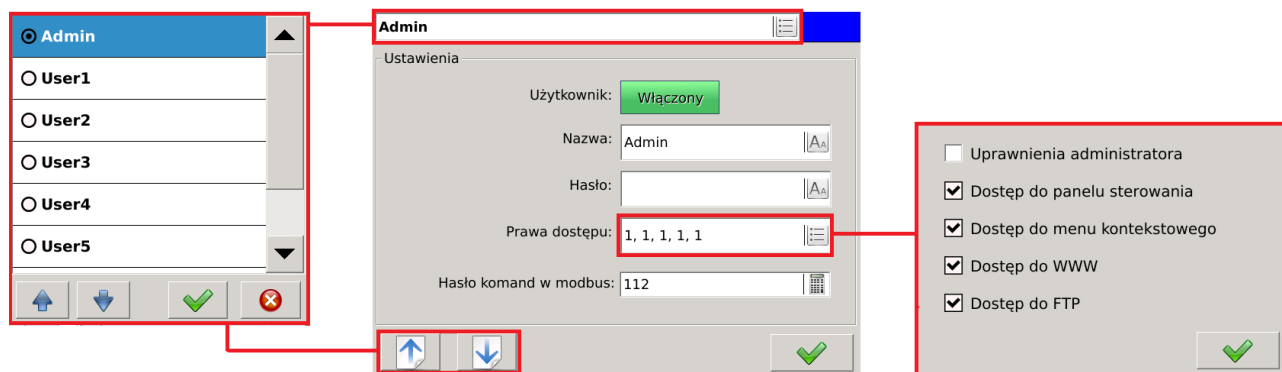


Fig. 88: Security – navigation

Navigate between users using the selection list opened by touching the field at the top of the main screen (showing Admin in the example), or using the buttons .

Parameter		Description
User		Enables or disables the user currently being edited.
Name		Editable user identifier. Eight users are defined. The default names are: Admin, User1, User2 ... User7.
Password		Sets passwords for individual users.
Access rights	Administrator rights	Full configuration and management rights.
	Control Panel access	Allows Control Panel parameters to be viewed and edited.
	Context menu access	Allows alarms to be confirmed in the context menu and also grants access to file management and alarm confirmation on the WWW page.
	WWW access	Authorized access to the WWW page.
	FTP access	Authorized access to the FTP server.
Modbus command password		Password required to perform specific actions via Modbus

6.10 Configuration of power quality

Jakość energii

Zapady

Zapady: 90.0%, 2.0%

Wzrosty: 110.0%, 2.0%

Zaniki: 1.0%, 2.0%

Zapisuj dodatkowe dane: **Włączone**

Zmienne Upn dla jakości energii: **Włączone**

Upn dla jakości energii: 230.0 V

Edytowanie wartości

Wartość progowa: 90%

Histereza: 2%

Wartości w procentach napięcia znamionowego - Urms

Edytowanie wartości

Wartość progowa: 110%

Histereza: 2%

Wartości w procentach napięcia znamionowego - Urms

Edytowanie wartości

Wartość progowa: 1%

Histereza: 2%

Wartości w procentach napięcia znamionowego - Urms

Fig. 89: Power quality - settings

Option	Description
Dips	Sets the thresholds for the selected parameter and the hysteresis value. Values are calculated relative to the rated voltage and expressed as percentages.
Swells	
Interruptions	

By default, the ND45PLUS calculates the percentage levels of individual events relative to the device's nominal value (230 V or 57,7 V). This can be changed using Upn in the power quality configuration tab.

When "Save additional data" is enabled, values before the event, at the time of the event and after it ends are saved on the SD card in the **dipswellsamples.log.csv** file.

Voltage dip – a reduction in voltage to the configured level (normally between 90% and 1% of the declared voltage), followed by a rise to the previous value. By convention, a dip lasts from 10ms to 1 minute.

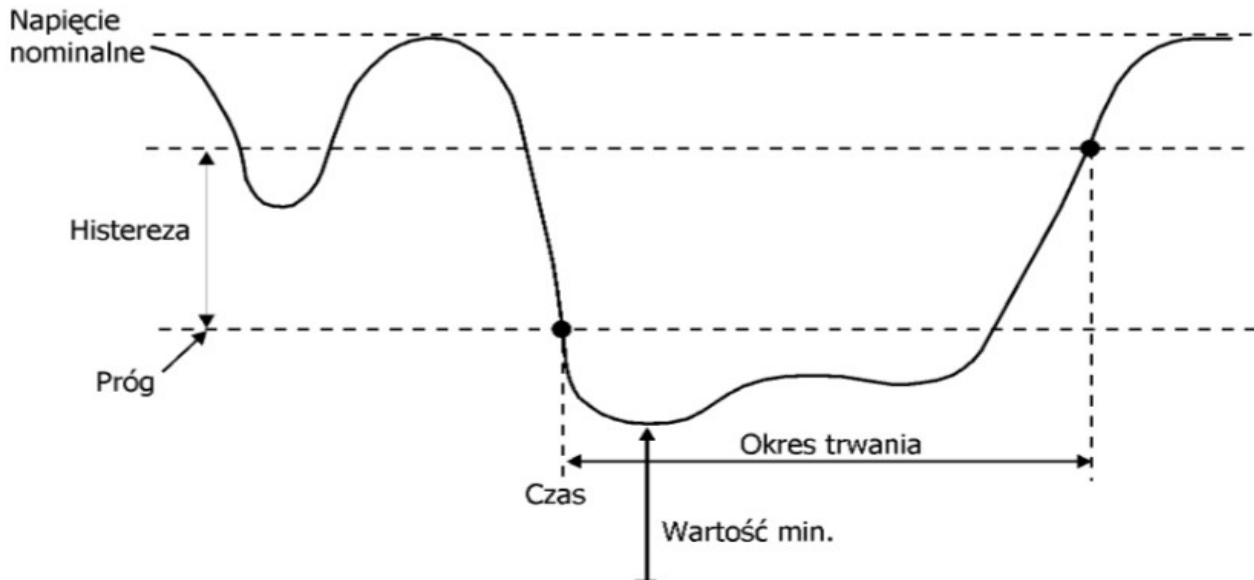


Fig. 90: Voltage dip

Voltage swell – a temporary increase in the RMS voltage beyond the tolerance range specified in the configuration (normally above 110%).

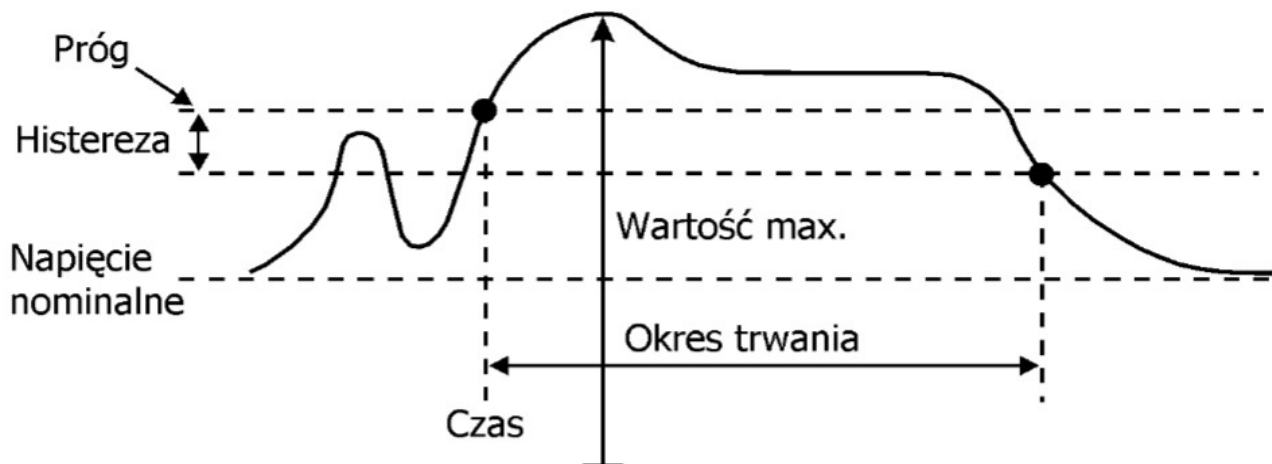


Fig. 91: Voltage swell

Voltage interruption – a condition in which the voltage is below the configured threshold (normally less than 1%).

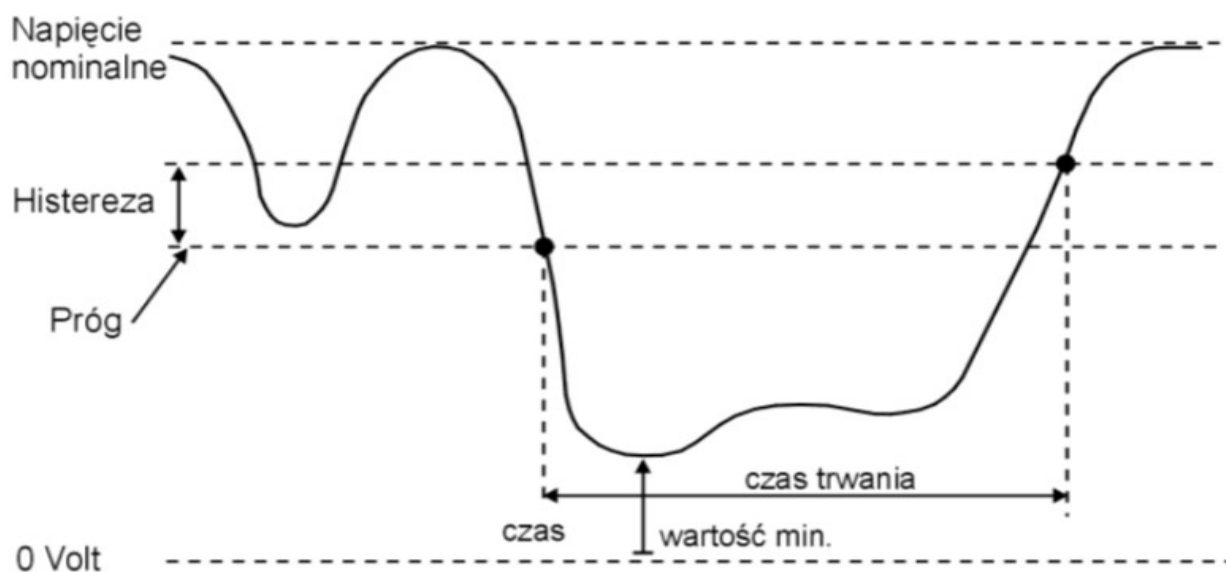


Fig. 92: Voltage interruption

Dip, swell and interruption events are recorded in the dip logs.

1	2	3	4	
	Dziennik zapadów		09:45:29 2026-06-23	
Nr	Data	Czas	Wpis	
62	2026-06-23	09:44:52.295	Zapad (U L1) L1=176.077V 00:00:00.436	
63	2026-06-23	09:44:52.844	Wzrost (U L1) Start	
64	2026-06-23	09:44:52.844	Wzrost (U L1) L1=291.940V 00:00:00.311	
65	2026-06-23	09:44:53.315	Zapad (U L1) Start	
66	2026-06-23	09:44:53.315	Zapad (U L1) L1=193.861V 00:00:00.386	
67	2026-06-23	09:44:53.814	Wzrost (U L1) Start	
68	2026-06-23	09:44:53.814	Wzrost (U L1) L1=291.377V 00:00:00.331	
69	2026-06-23	09:44:54.235	Zapad (U L1) Start	
70	2026-06-23	09:44:54.235	Zapad (U L1) L1=178.932V 00:00:02.539	

Fig. 93: Power quality - log

Option	Description
1	Number indicating the sequence of dip-related events.
2	Date of the event.
3	Time of the event.
4	Entry containing event information. The description includes the event type, half-wave voltage values for the individual phases, and duration.
5	Example voltage dip, swell and interruption events.

Dip, interruption and swell logs are saved on the SD card. The current log file is named **dipswell.log.csv**.

A preview of the file saved on the SD card is shown below.

	A	B	C
24	2026-06-23	09:44:52.295	Zapad (U L1) L1=176.077V L2=174.848V L3=175.714V czas:00:00:00.436
25	2026-06-23	09:44:52.844	Wzrost (U L1) Start
26	2026-06-23	09:44:52.844	Wzrost (U L1) L1=291.940V L2=289.789V L3=291.299V czas:00:00:00.311
27	2026-06-23	09:44:53.315	Zapad (U L1) Start
28	2026-06-23	09:44:53.315	Zapad (U L1) L1=193.861V L2=192.477V L3=193.437V czas:00:00:00.386
29	2026-06-23	09:44:53.814	Wzrost (U L1) Start
30	2026-06-23	09:44:53.814	Wzrost (U L1) L1=291.377V L2=289.347V L3=290.753V czas:00:00:00.331
31	2026-06-23	09:44:54.235	Zapad (U L1) Start
32	2026-06-23	09:44:54.235	Zapad (U L1) L1=178.932V L2=177.662V L3=178.542V czas:00:00:02.539

Fig. 94: Power quality - logs

6.11 Resetting the counters

Energy counter reset screen. Select the counters to reset from the list, then select the energy types to clear below. Press Delete to execute the command.

Fig. 95: Resetting the counters

6.12 Tariff configuration

The ND45PLUS analyzer allows the selection of one of two predefined tariffs or a user-defined tariff (96).

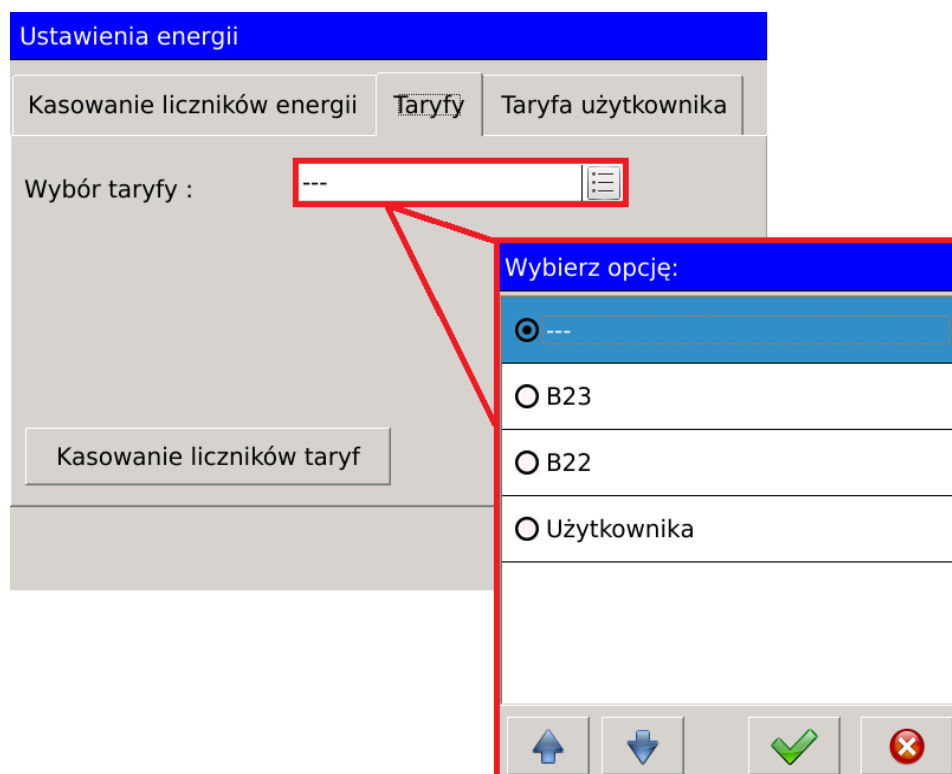


Fig. 96: Tariff selection

- Tariff B23:

Tariff	T1	T2	T3	T4
January	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00
February	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00
March	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00
April	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
May	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
June	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
July	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
August	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
September	7:00 – 13:00	19:00 – 22:00	13:00 – 19:00	22:00 – 7:00
October	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00
November	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00
December	7:00 – 13:00	16:00 – 21:00	13:00 – 16:00	21:00 – 7:00

- Tariff B22:

Tariff	T1	T2	T3	T4
January	8:00 – 11:00	16:00 – 21:00	11:00 – 16:00	21:00 – 8:00
February	8:00 – 11:00	16:00 – 21:00	11:00 – 16:00	21:00 – 8:00
March	8:00 – 11:00	18:00 – 21:00	11:00 – 18:00	21:00 – 8:00
April	8:00 – 11:00	19:00 – 22:00	11:00 – 19:00	22:00 – 8:00
May	8:00 – 11:00	20:00 – 22:00	11:00 – 20:00	22:00 – 8:00
June	8:00 – 11:00	20:00 – 22:00	11:00 – 20:00	22:00 – 8:00
July	8:00 – 11:00	20:00 – 22:00	11:00 – 20:00	22:00 – 8:00
August	8:00 – 11:00	20:00 – 22:00	11:00 – 20:00	22:00 – 8:00
September	8:00 – 11:00	19:00 – 22:00	11:00 – 19:00	22:00 – 8:00
October	8:00 – 11:00	18:00 – 21:00	11:00 – 18:00	21:00 – 8:00
November	8:00 – 11:00	16:00 – 21:00	11:00 – 16:00	21:00 – 8:00
December	8:00 – 11:00	16:00 – 21:00	11:00 – 16:00	21:00 – 8:00

- User tariff settings (97)

Ustawienia energii

Kasowanie liczników energii Taryfy Taryfa użytkownika

	T1	T2	T3	T4
Sty	---	---	---	---
Lut	---	---	---	---
Mar	---	---	---	---
Kwi	---	---	---	---
Maj	---	---	---	---
Cze	---	---	---	---
Lip	---	---	---	---
Sie	---	---	---	---
Wrz	---	---	---	---

Wprowadź czas (gg-mm-ss):

OD: 00:00

DO: 00:00

Włączone

Fig. 97: User tariffs

6.13 Configuration of outputs

Depending on the analyzer version, the options below may be available only to a limited extent. None is available in the version without additional inputs/outputs. The version with analog outputs provides only the first option (Analog outputs). The second option (Relays) is available in versions with relays (8 or 4 relay outputs).

6.13.1 Analog outputs.

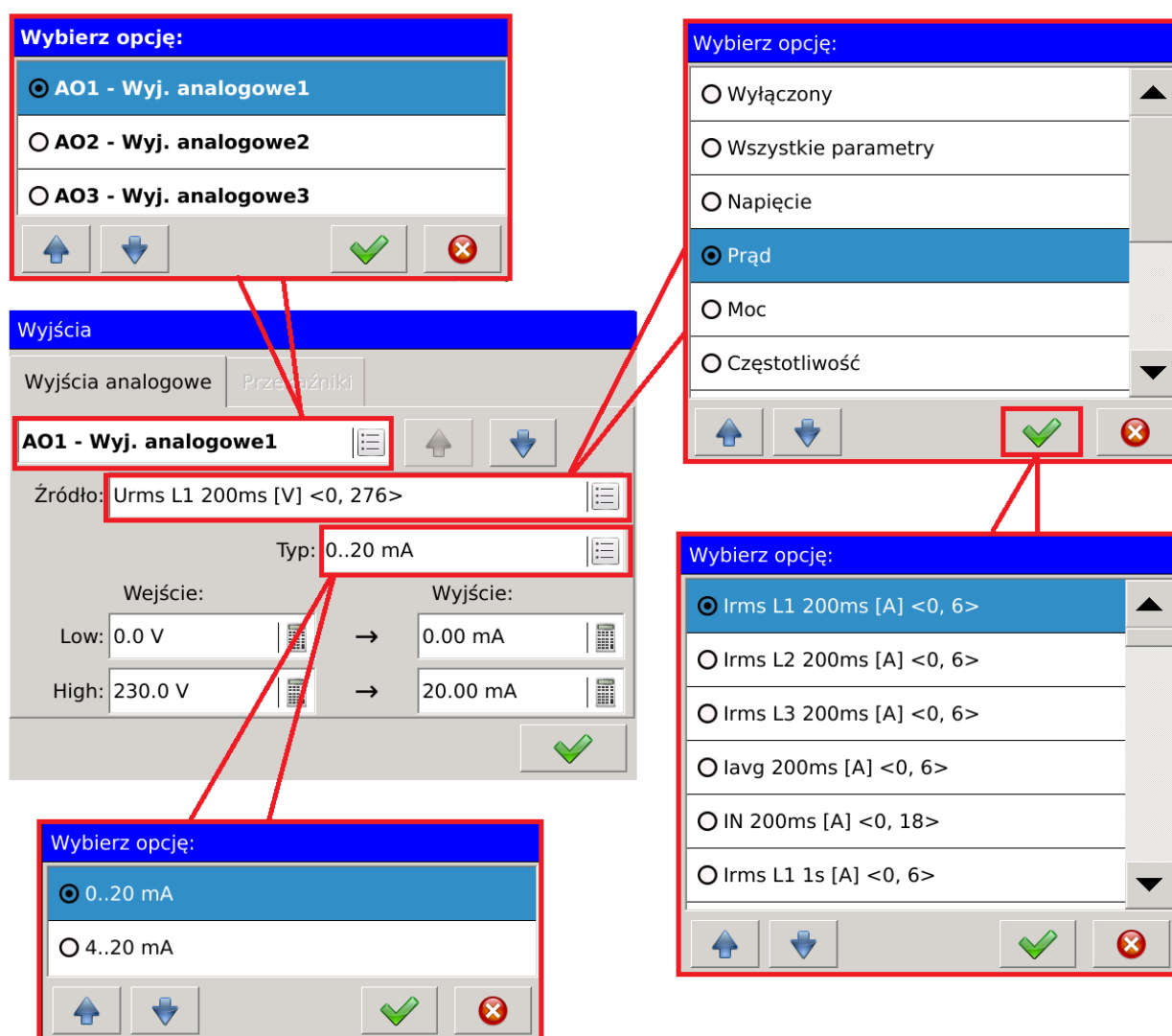


Fig. 98: Outputs - analog outputs

Option		Description
Analog output number		Selects the analog output currently being configured.
Source		Selects the input source assigned to the analog output.
Type		Selects the analog output range.
Input	Low	Lower value (of the input source).
	High	Upper value (of the input source).
Output	Low	Lower value (at the analog output).
	High	Upper value (at the analog output).

6.13.2 Relays.

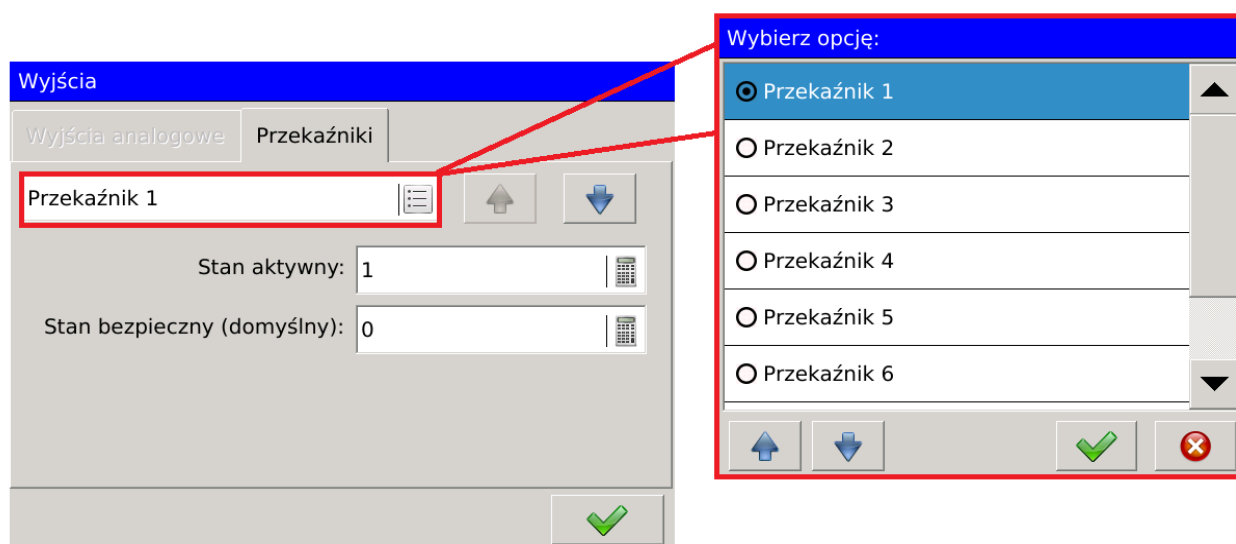


Fig. 99: Outputs - relays

Option	Description
Relay number	Selects the relay to be configured
Active state	Relay state when the alarm activation condition is met.
Safe state	Default relay state.

7 File manager

The file manager allows files on the SD card or USB host storage to be edited directly from the analyzer.

Access to file management is shown below.

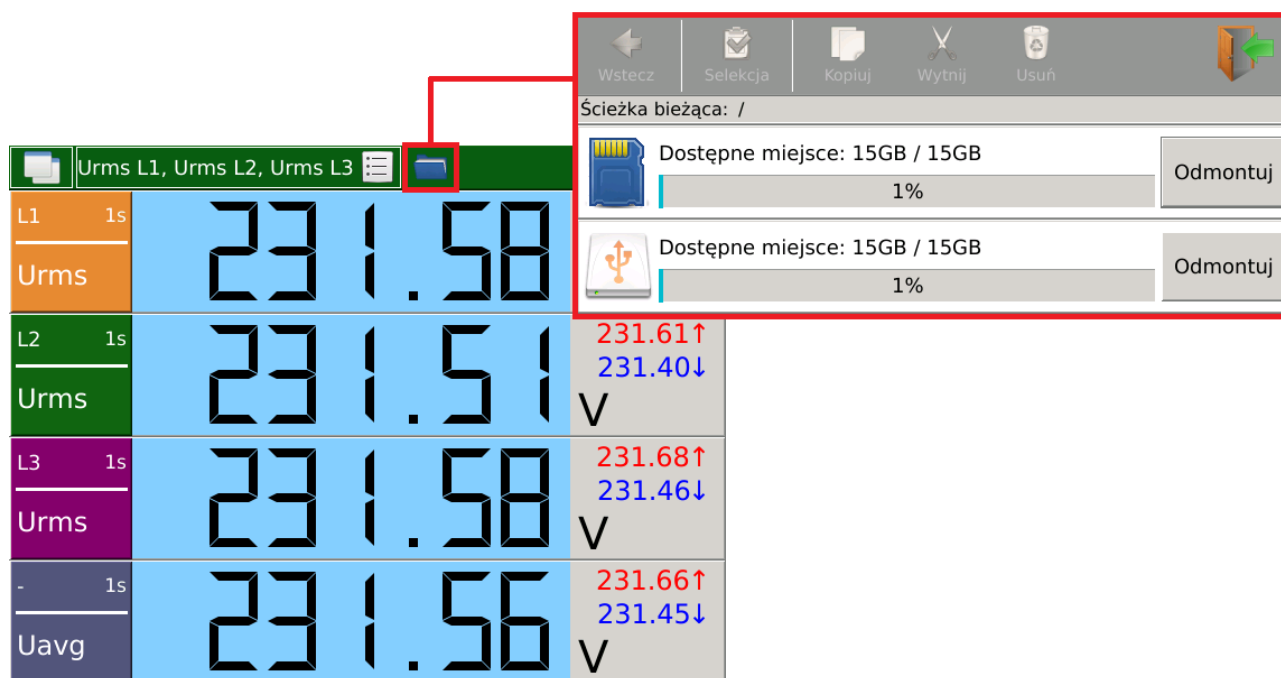


Fig. 100: File manager - navigation

- **"Unmount"** button – safely unmounts the storage device. For an SD card, files in the device's internal buffer are first saved to the card, which is then safely unmounted. After successful unmounting, the storage device is removed from the list.

Note!

Storage devices must be safely unmounted before being physically removed from the device ports.

Removing a storage device without unmounting it may damage the file system, resulting in data corruption or loss.

After selecting the SD card or USB host storage, its files can be edited. The example below shows a file selected on the SD card and the editing options available for it.

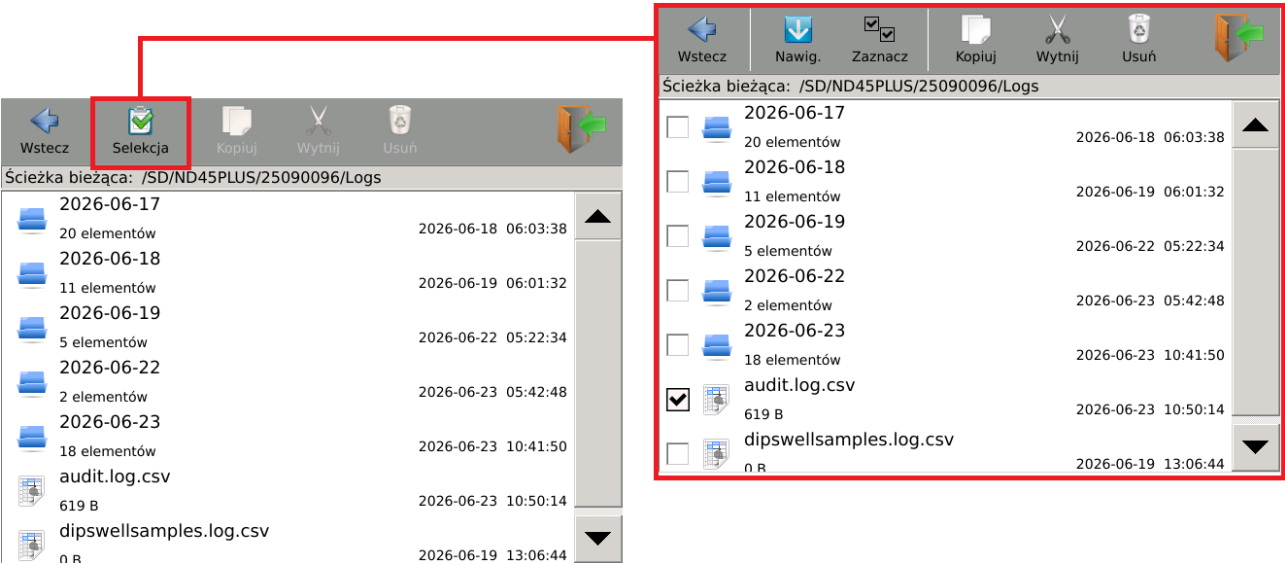


Fig. 101: File manager - file selection

Option	Description
	Copies the selected item to any chosen location on the memory card.
	Moves the selected item to any chosen location on the memory card.
	Deletes the selected item from the memory card.
	Exits the file manager.

8 Configuration of WWW

Ethernet must be configured before the server can be started. An access mode must be assigned to the WWW server option. Selecting Disabled prevents connection to the server.

Note! For details, see "*Configuration of Ethernet*".

Authorized access (fully functional WWW server) is available once access rights have been assigned to individual users.

Note! For details, see "*Configuration of security rules*".

9 Configuration of FTP

Ethernet must be configured before the server can be started. An access mode must be assigned to the FTP server option. Selecting Disabled prevents connection to the server.

Note! For details, see "*Configuration of Ethernet*".

Authorized access (fully functional FTP server) is available once access rights have been assigned to individual users. In authorized mode, the user must also have an assigned access password.

10 Data archiving

Archiving parameter configuration is described in "*Configuration of archiving*".

Analyzer screenshot showing the window for managing the parameters currently selected for archiving.

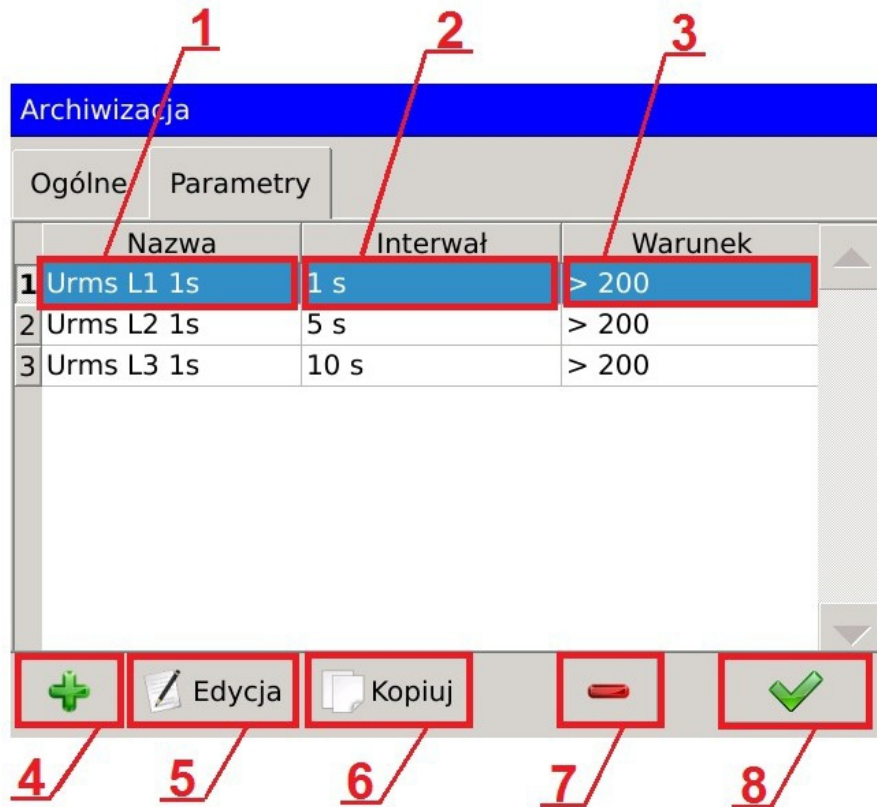


Fig. 102: Archiving - parameters

Item	Description
1	Archived parameter.
2	Archiving interval.
3	Conditional archiving: archiving condition.
4	Adds a new parameter for archiving.
5	Edits the selected archiving parameter.
6	Copies the selected parameter configuration and saves it as a new parameter for archiving.
7	Deletes the selected archived parameter.
8	Confirms the changes made.

Archive files can be downloaded via the WWW server (section 4, "*Web server management*").

After the archiving configuration is changed, for example by adding new parameters or changing archiving conditions, a new file is created with its creation time and date.

Archive files are saved in an SQLite-compatible format.

Each file contains basic information about the archived parameters:

- id - automatically assigned record identifier,
- idParameters - parameter identifier matching the number of the parameter defined under Archiving → Parameters,
- dateTime - date and time of the archived parameter occurrence,
- value - archived parameter value,
- flag - status of the archived value:
 - 0 – correct measurement
 - 1 – no measurement value
 - 128 – value averaging for the time window is not complete.

Archive files can be read using the dedicated PowerArchive application (provided by LUMEL S.A.), the WWW server (section 4.11.2 , *"Preview of archive files"*), or any application that supports an SQLite-compatible database format.

10.1.1 PQDIF

PQDIF (*Power Quality Data Interchange Format*) is a standard file format for storing and exchanging power quality data and measurement results from network analyzers.

The ND45Plus analyzer also supports cyclic archiving of user-selected network parameters in .pqd (PQDIF) format. The network parameters selected for PQDIF archiving correspond to those selected for standard archiving (see "*Data archiving*").

Archive files can be downloaded via the WWW server (see "*Web server management*").

Example PQDIF file containing archived data:

YYYY-MM-DD_hh_mm_ss.ND45PLUSArch.pqd

Where **YYY**(year) → year, **MM**(month) → month, **DD**(day) → day, **hh**(hour) → hour, **mm**(minute) → minute, **ss**(second) → second.

Files can be read using the dedicated *PowerArchive* application (available on the supplied SD card or the LUMEL S.A website), or another program that supports the PQDIF standard.

11 Alarms

Alarm configuration is described in "*Configuration of alarms*".

Event	Graphical representation	
	Description	
No alarm	 Urms L1, Urms L2, Urms L3 	
	Operating mode in which no alarm-triggering event has occurred: Green information bar	
Alarm (unconfirmed)	 Urms L1, Urms L2, Urms L3  	
	Operating mode with an active alarm: - Red information bar, - Alarm icon displayed .	
Alarm (confirmed)	 Urms L1, Urms L2, Urms L3  	
	Operating mode with an active but confirmed alarm: - Green information bar, - Alarm icon displayed .	

Select the alarm icon to display a list of currently active alarms.

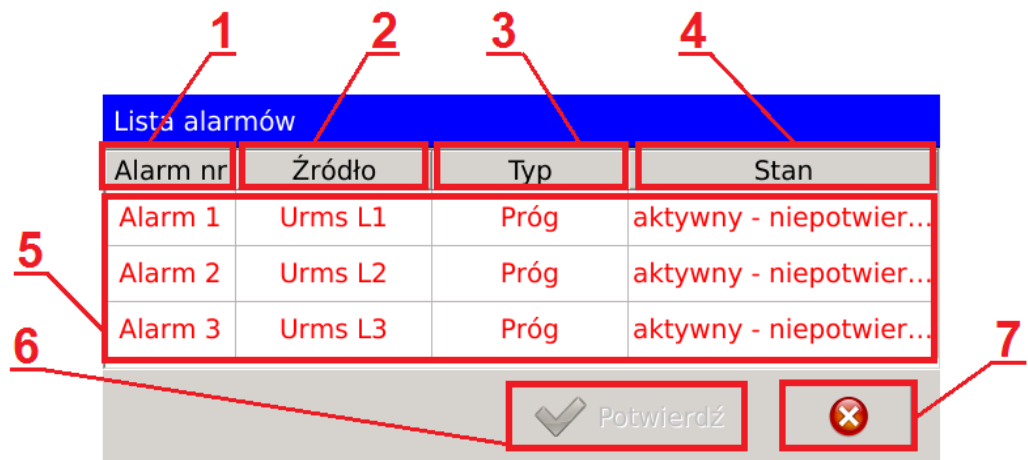


Fig. 103: Alarms - alarm list, description

Option	Description
1	Alarm number set by the user.
2	Value assigned to the alarm. The parameter value activates or deactivates the alarm.
3	Alarm type assigned to the displayed event.
4	Current alarm status.
5	Main window containing alarm occurrence information.
6	Function for confirming alarms.
7	Exits the dialog box.

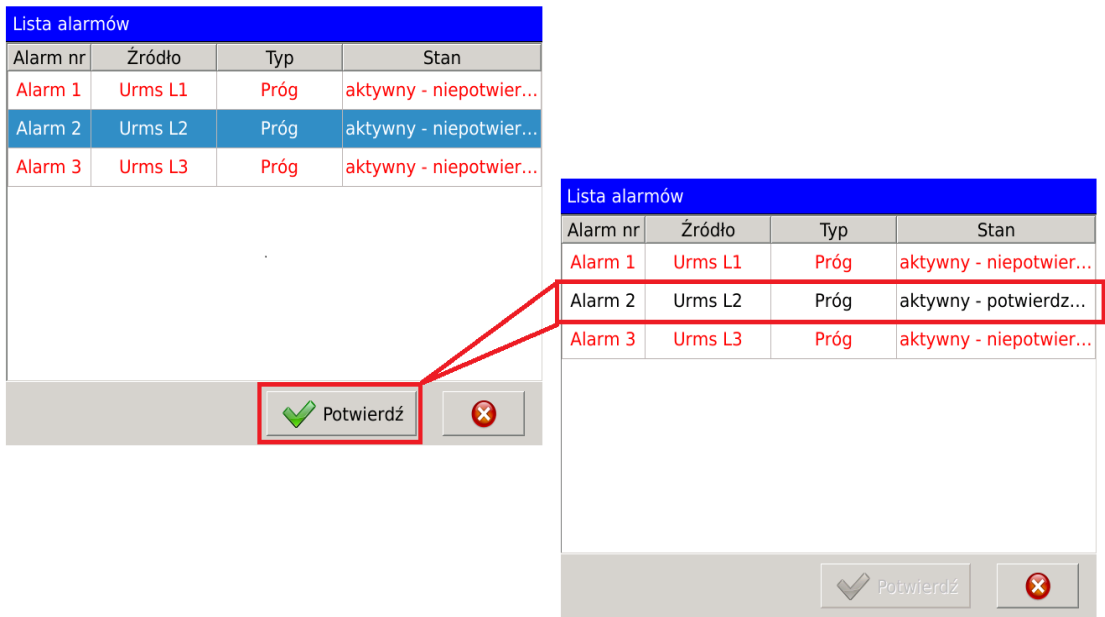


Fig. 104: Alarms - confirmation

Confirming an alarm changes how it is displayed in the alarm list. The font color and status description change.

If alarm status reporting in the alarm logs is enabled in the configuration, alarm activation and deactivation events are recorded.

Dziennik alarmów			
Nr	Data	Czas	Wpis
1	YYYY-MM-DD	hh:mm:ss	Alarm 1 - Wł. (Urms L1 200ms = 238.048V) (> 50)
2	YYYY-MM-DD	hh:mm:ss	Alarm 1 - Potwierdzone
3	YYYY-MM-DD	hh:mm:ss	Alarm 1 - Wył. (Urms L1 200ms = 0V) (< 50)
4	YYYY-MM-DD	hh:mm:ss	Alarm 1 - Wł. (Urms L1 200ms = 163.366V) (> 50)

Fig. 105: Alarms - logs

Option	Description
1	Number indicating the sequence of alarm-related events.
2	Event date in the format YYYY-MM-DD ¹
3	Event time in the format hh:mm:ss ¹
4	Entry containing event information. The description includes the alarm identifier, the event and the value that triggered it.
5	Example alarm-related events.

1. Y (year), M (month), D (day), h (hour), m (minute), s (second).

Alarm logs are managed as shown in the example below (106):

- "Clear **log preview**" **clears the** entries from the current log view. Logs saved on the SD card remain unchanged
- "Confirm alarms" opens a dialog box for confirming selected alarms after successful authentication (104)
- "Reset **all statistics**" and "Create new **archive file**" **require** confirmation of the user's access rights.

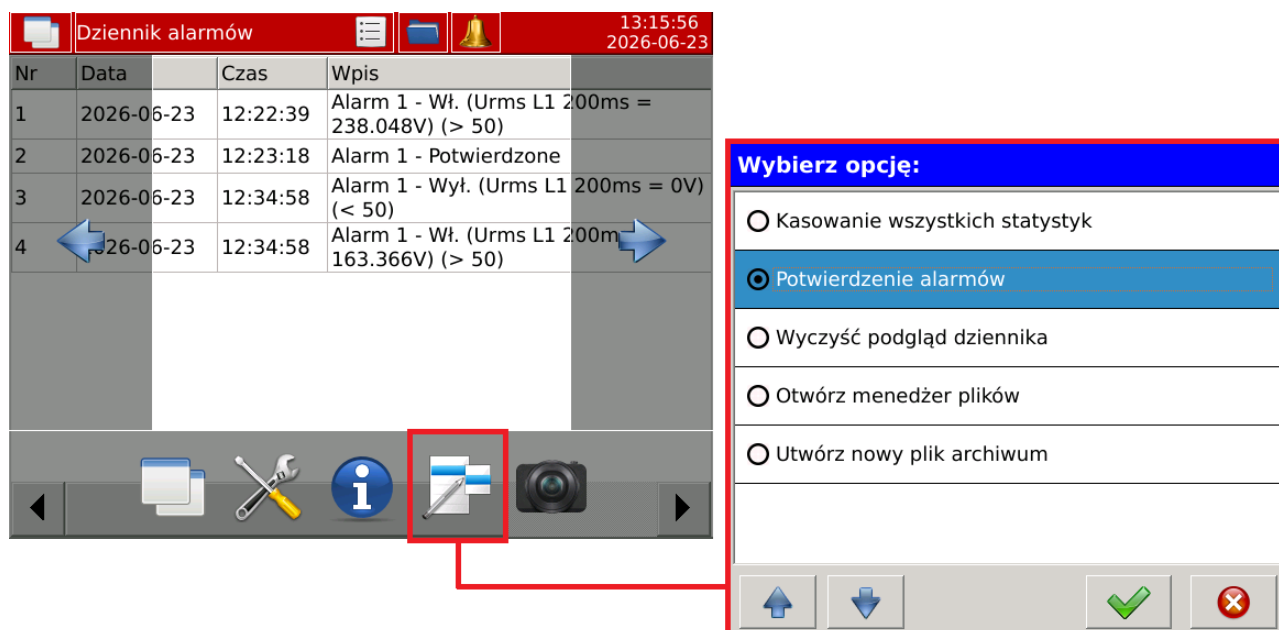


Fig. 106: Alarms - log management

Alarm logs are saved on the SD card. The current log file is named **alarm.log.csv**.

A preview of the file saved on the SD card is shown below.

	A	B	C
1	2026-06-23	12:22:39	Alarm 1 - Wł. (Urms L1 200ms = 238.048V) (> 50)
2	2026-06-23	12:23:18	Alarm 1 - Potwierdzone
3	2026-06-23	12:34:58	Alarm 1 - Wył. (Urms L1 200ms = 0V) (< 50)
4	2026-06-23	12:34:58	Alarm 1 - Wł. (Urms L1 200ms = 163.366V) (> 50)

Fig. 107: Alarms - log file entries

12 Construction

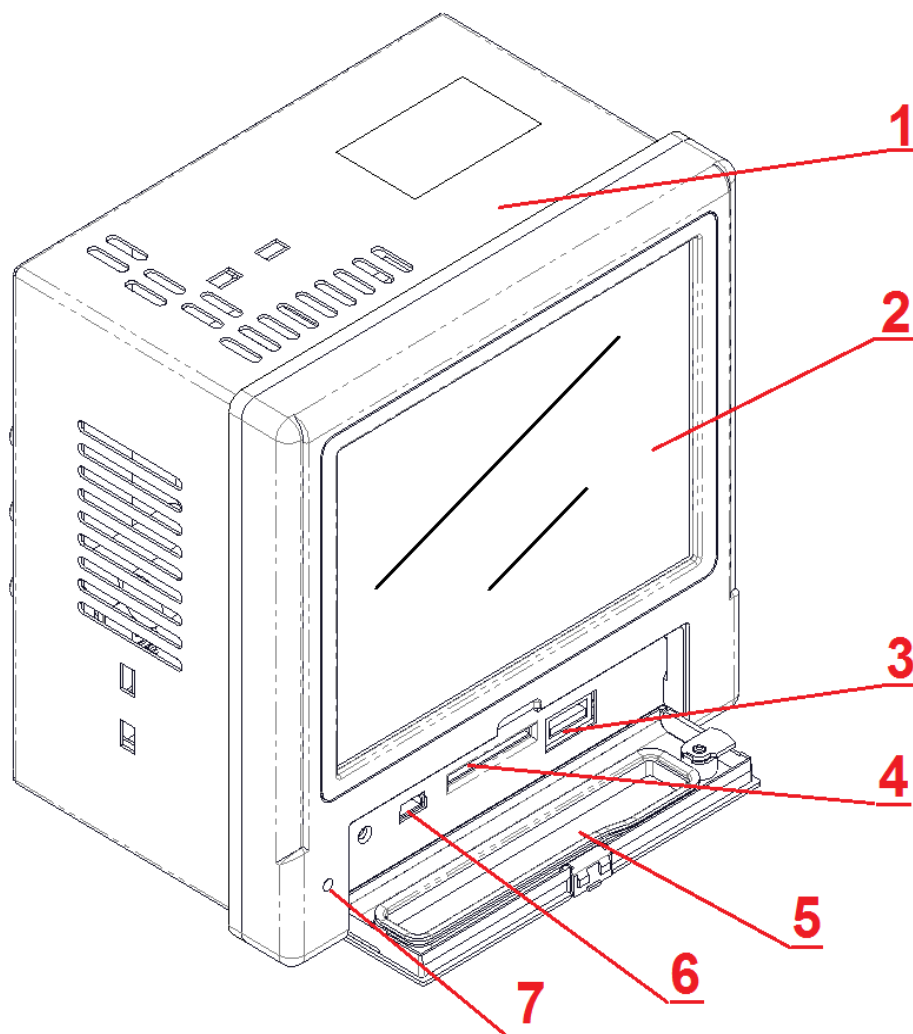


Fig. 108: ND45PLUS construction

Item	Description
1	Analyzer housing.
2	LCD touch screen.
3	USB Host.
4	SD card slot.
5	Lockable door.
6	USB Device.
7	LED indicator.

12.1 Screen

5,6-inch color LCD TFT screen, 640x480-pixel resolution, with touch panel.

12.2 RS485 interface

The ND45PLUS analyzer has an RS-485 serial interface for communication with computer systems and other devices acting as a Master. The serial interface implements the asynchronous, character-based MODBUS communication protocol. The transmission protocol defines how devices exchange information over the serial link.

The implemented protocol complies with Modicon specification PI-MBUS-300 Rev G.

Section 6.7.1 describes configuration of the MODBUS RTU protocol via the RS485 interface.

Parameter	Description
Identifier	0xD8
Meter address	Values from 1 to 247
Baud rate	1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s, 230400 bit/s.
Operating mode	Modbus RTU
Data format	8N2, 8E1, 8O1, 8N1.
Maximum response time	600 ms
Maximum number of registers read	122 registers – 2 bytes each
Implemented functions	03, 04 – read registers (shared address space)
	17 – device identification

The individual functions are described below, with examples.

Function 04 – read n registers:

Read 4 16-bit integer registers, starting at register address 00 01 of type float (2 x16 bits).

Request:

Device address	Function	Register address	Number of registers	CRC checksum
01	04	00 01	00 04	20 0B

Response

Device address	Function	Number of bytes	Register values				CRC checksum
			01	02	03	04	
01	04	08	00 0A	00 0B	00 63	00 64	DA 39

Function 03 – read n registers:

Read 4 16-bit registers, starting at register address 00 01.

Request:

Device address	Function	Register address	Number of registers	CRC checksum
01	03	00 01	00 04	15 C9

Response:

Device address	Function n	Number of bytes	Register value				CRC checksum
			01	02	03	04	
01	04	08	70 A4	41 CD	00 00	41 A2	55 CB

Function 17 – device identification:

Request:

Device address	Function	Register address
01	11	C0 2C

Response:

Device address	Function	Number of bytes	Device identifier	Device status	CRC checksum
01	11	02	D8	FF	A7 7C

12.3 Ethernet interface

The ND45PLUS network parameter analyzer has an Ethernet interface for connection to a local or global network via an RJ45 socket. The Ethernet interface supports the following network services: WWW server, FTP server and Modbus Slave TCP/IP.

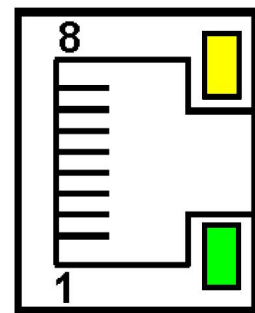
Note!

For detailed information on configuring the device interface, see section 6.6 , Configuration of Ethernet.

To access Ethernet services, connect the ND45PLUS analyzer to a TCP/IP network via the RJ45 socket on the rear of the housing.

Meaning of the LEDs in the meter's RJ45 socket:

- yellow LED -
 - on when the ND45PLUS is correctly connected to a 100 Base-T Ethernet network
 - off when the ND45PLUS is not connected to a network or is connected to a 10-Base-T network.
- green LED -
 - Tx/Rx, flashes irregularly while the meter sends and receives data; remains continuously on when no data is being transmitted



Ethernet

The following twisted-pair cable types are recommended for connecting the ND45PLUS to a network:

- U/FTP – twisted-pair cable with each pair foil-shielded,
- F/FTP – twisted-pair cable with each pair foil-shielded and an overall foil shield,
- S/FTP (formerly SFTP) – twisted-pair cable with each pair foil-shielded and an overall braided shield,
- SF/FTP (formerly S-STP) – twisted-pair cable with each pair foil-shielded and overall foil and braided shields.

Wire no.	Signal	Wire color according to standard	
		EIA/TIA 568A	EIA/TIA 568B
1	TX+	white-green	white-orange
2	TX-	green	orange
3	RX+	white-orange	white-green
4	EPWR+	blue	blue
5	EPWR+	white-blue	white-blue
6	RX-	orange	green
7	EPWR-	white-brown	white-brown
8	EPWR-	brown	brown

The minimum twisted-pair cable classification according to European standard EN 50171 is class D (category 5), for high-speed local area networks and applications using frequencies up to 100 MHz. Use category 5 STP (shielded twisted-pair) cable for the Ethernet interface with RJ-45 plugs and wire colors as listed in the table, to the following standard:

- EIA/TIA 568A at both plugs for a straight-through connection between the ND45PLUS and a network hub or switch,
- EIA/TIA 568A at the first plug and EIA/TIA 568B at the second for a crossover connection, used, for example, to connect the N100 meter directly to a computer.

12.4 USB interface

The analyzer has two USB interfaces: USB Host and USB Device.

The USB Host interface allows files to be copied between the SD card and a device connected to USB Host. USB Device serves as a service connector.

12.5 SD memory card

The standard data storage medium in the ND45PLUS analyzer is an SD card.

The SD card stores archived data (depending on configuration) and logs of alarms, audits, dips, swells and interruptions.

All archive and log files are initially saved in the analyzer's internal memory. Once writing is complete, the file is transferred to the SD card.

If no SD card is mounted while the ND45PLUS is operating, all files (both current and completed) are stored in internal memory. Once the card is mounted, all completed files are transferred from internal memory.

Note!

In the event of a power failure, retention of up to 1 MB of data saved in internal memory is guaranteed.

The SD card in the ND45PLUS can be accessed through the WWW server (section 4 , Web server management), the FTP server (section 5 , FTP server management), or the built-in file manager (section 7, File manager).

13 Technical data

13.1 Measurements

Measurement error (basic error) relative to the rated value.

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks							
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S						
Voltage													
RMS	Urms L1, Urms L2, Urms L3, Uavg L123.	200 ms 1 s 3 s 10 min 2 hours.			±0,2% U _{din} ¹⁾		Class B						
			Un = U _{din} ³	Voltage range	Ku ²	±0,2% U _{din} ¹⁾		Class B					
			230 V	23,0...345,0 V	= 1	±0,1% U _{din}		±0,2% U _{din}	Class A ¹⁾	Class S			
				...1,38 MV	≠ 1								
			57,7 V	5,7...86,5 V	= 1	±0,1% U _{din}		±0,2% U _{din}	Class A ¹⁾	Class S			
				...280 kV	≠ 1								
			69,3 V	6,93...104 V	= 1	±0,1% U _{din}		±0,2% U _{din}	Class A ¹⁾	Class S			
				...416 kV	≠ 1								
						±0,1% U _{din}		±0,2% U _{din}		Class A ¹⁾		Class S	
			Basic RMS	Ufund L1, Ufund L2, Ufund L3, Ufavg L123.	200 ms 1 s 3 s 10 min 2 hours.	Un = U _{din} ³	Voltage range	Ku ²	±0,2% U _{din} ¹⁾				
230 V	23,0...345,0 V	= 1											
	...1,38 MV	≠ 1											
57,7 V	5,7...86,5 V	= 1											
	...280 kV	≠ 1											
69,3 V	6,93...104 V	= 1											
	...416 kV	≠ 1											

Measured value			Measurement range			Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks	
	Symbol	Aggr.				Class A/S	Class S	Class A/S	Class S
Phase-to-phase	Umf L1-2, Umf L2-3, Umf L3-1, Umf avg L123.	200 ms 1 s 3 s 10 min 2 hours.	Unm f	Voltage range	Ku ²	±0,5% Unmf			
			230 V	40,0...600,0 V	= 1				
				...2,4 MV	≠ 1				
			100 V	10,0...120,0 V	= 1				
				...480 kV	≠ 1				
			120 V	12,0...180,0 V	= 1				
				...720 kV	≠ 1				
Asymmetry	Vunb.	200 ms 1 s 3 s 10 min 2 hours.	0,00...100,00%			±0,3%			
Half wave	Uhalf1 L1 ... Uhalf24 L1, Uhalf1 L2 ... Uhalf24 L2, Uhalf1 L3 ... Uhalf24 L3.	200 ms	Un = Udin ₃	Voltage range	Ku ²	±0,2% Udin ¹⁾	±1% Udin ¹⁾	Class A	Class S
			230 V	23,0...345,0 V	= 1				
				...1,38 MV	≠ 1				
			57,7 V	5,7...86,5 V	= 1				
				...280 kV	≠ 1				
			69,3 V	6,93...104 V	= 1				
				...416 kV	≠ 1				
Harmonics	Hr 1 U L1 ... Hr 51 U L1, Hr 1 U L2 ... Hr 51 U L2, Hr1 U L3 ... Hr 51 U L3.	1 s 3 s 10 min 2 h	0,00...100,00%			U _m ≥ 1% U _{nom} ±5% U _m U _m < 1% U _{nom} ±0,05% U _{nom}		Class I	
Interharmonics	InterHr 1 U L1 ... InterHr 51 U L1, InterHr 1 U L2 ... InterHr 51 U L2, InterHr 1 U L3 ... InterHr 51 U L3.	1 s	0,00...100,00%			±5% ⁷			
Distortion factor	THD U L1, THD U L2, THD U L3, THD Uavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%			±5% ⁷			

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks			
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S		
Distortion factor of harmonic groups	THDS U L1, THDS U L2, THDS U L3, THDS Uavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%	±5%					
Distortion factor of harmonic subgroups	THDG U L1, THDG U L2, THDG U L3, THDG Uavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%	±5%					
Partially weighted distortion factor	PWHD U L1, PWHD U L2, PWHD U L3, PWHD Uavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%	±5%					
Demand	U Demand	15 min 30 min 1 hour	Un = U _{din} 3	Voltage range	Ku ²	±0,1% U _{din}			
			230 V	23,0...345,0 V	= 1				
				...1,38 MV	≠ 1				
			57,7 V	5,7...86,5 V	= 1				
				...280 kV	≠ 1				
			69,3 V	6,93...104 V	= 1				
				...416 kV	≠ 1				
Current									
RMS	Irms L1, Irms L2, Irms L3, Iavg L123.	200 ms 1 s 3 s 10 min 2 hours.				±0,2% In		Class B	
			In	Current range	Ki ²	±0,2% In		Class B	
			5 A	0,05...7,5 A	= 1	±0,1% In	±0,2% In	Class A ¹⁾	Class S
				...150 kA	≠ 1				
			1 A	0,01...1,5 A	= 1	±0,1% In	±0,2% In	Class A ¹⁾	Class S
				...30 kA	≠ 1				
						±0,1% In	±0,2% In	Class A ¹⁾	Class S
Neutral	IN	200 ms 1 s 3 s 10 min 2 hours.	In	Current range	Ki ²	±0,5% In		Class S	
			5 A	0,05...7,5 A	= 1				
				...150 kA	≠ 1				
			1 A	0,01...1,5 A	= 1				
				...90 kA	≠ 1				

Measured value			Measurement range			Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks	
	Symbol	Aggr.				Class A/S	Class S	Class A/S	Class S
Neutral (calculated)	INC	200 ms 1 s 3 s 10 min 2 hours.	In	Current range	Ki ²	±0,2% In			
			5 A	0,15...22,5 A	= 1				
				...450 kA	≠ 1				
			1 A	0,03...4,5 A	= 1				
				...450 kA	≠ 1				
Harmonics	Har1 IL1 ... Har51 IL1, Har1 IL2 ... Har51 IL2, Har1 IL3 ... Har51 IL3.	1 s 3 s 10 min 2 h	0,00...100,00%			I _m ≥ 3% I _{nom} ±5% I _m I _m < 3% I _{nom} ±0,15% I _{nom}		Class I	
Interharmonics	InterHr 1 I L1 ... InterHr 51 I L1, InterHr 1 I L2 ... InterHr 51 I L2, InterHr 1 I L3 ... InterHr 51 I L3.	1 s	0,00...100,00%			±5% ⁷			
Distortion factor	THD I L1, THD I L2, THD I L3, THD Iavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%			±5% ⁷			
Distortion factor of harmonic groups	THDS I L1, THDS I L2, THDS I L3, THDS Iavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%			±5% ⁷			
Distortion factor of harmonic subgroups	THDG I L1, THDG I L2, THDG I L3, THDG Iavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%			±5% ⁷			
Partially weighted distortion factor	PWHD I L1, PWHD I L2, PWHD I L3, PWHD Iavg L123.	1 s 3 s 10 min 2 h	0,00...200,00%			±5% ⁷			
Demand	I Demand	15 min 30 min 1 hour	In	Current range	Ki ²	±0,2% In			
			5 A	0,05...7,5 A	= 1				
				...150 kA	≠ 1				
			1 A	0,01...1,5 A	= 1				
				...150 kA	≠ 1				

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks	
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S
Power and energy							
Active imported energy	EnP + L1, EnP + L2, EnP + L3, ΣEnP + L123.	-	L1, L2, L3 : 0...3e+3 Gwh L123: 0...9e+3 Gwh	±0,5% ⁷			
Active exported energy	EnP - L1, EnP - L2, EnP - L3, ΣEnP - L123.	-	L1, L2, L3 : 0...3e+3 Gwh L123: 0...9e+3 Gwh	±0,5% ⁷			
Reactive inductive imported energy	EnQ + ∑ L1, EnQ + ∑ L2, EnQ + ∑ L3, ΣEnQ + ∑ L123.	-	L1, L2, L3 : 0...3e+3 GVarh L123: 0...9e+3 GVarh	±0,5% ⁷			
Reactive inductive exported energy	EnQ - ∑ L1, EnQ - ∑ L2, EnQ - ∑ L3, ΣEnQ - ∑ L123.	-	L1, L2, L3 : 0...3e+3 GVarh L123: 0...9e+3 GVarh	±0,5% ⁷			
Reactive capacitive imported energy	EnQ + ∓L1, EnQ + ∓L2, EnQ + ∓L3, ΣEnQ + ∓L123.	-	L1, L2, L3 : 0...3e+3 GVarh L123: 0...9e+3 GVarh	±0,5% ⁷			
Reactive capacitive exported energy	EnQ - ∓L1, EnQ - ∓L2, EnQ - ∓L3, ΣEnQ - ∓L123.	-	L1, L2, L3 : 0...3e+3 GVarh L123: 0...9e+3 GVarh	±0,5% ⁷			
Apparent energy	EnS L1, EnS L2, EnS L3, ΣEnS L123.	-	L1, L2, L3 : 0...3e+3 GVarh L123: 0...9e+3 GVarh	±0,5% ⁷			
Active power	P L1, P L2, P L3, Pavg L123, ΣP L123.	200 ms 1 s 3 s 10 min 2 hours	In = 5A, Un =230V: -2587,5...2587,5W (Ki=1,Ku=1) In = 1A, Un =230V: -517,3...517,3W (Ki=1,Ku=1) In = 5A, Un =57,7V: -525...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: -105...105 W (Ki=1,Ku=1)	±0,5% ⁷			

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks	
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S
Reactive power	Q L1, Q L2, Q L3, Qavg L123, ΣQ L123.	200 ms 1 s 3 s 10 min 2 hours	In = 5A, Un=230V: -2587,5...2587,5W (Ki=1,Ku=1) In = 1A, Un=230V: -517,3...517,3W (Ki=1,Ku=1) In = 5A, Un =57,7V: -525...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: -105...105 W (Ki=1,Ku=1)	±0,5% ⁷			
Apparent power	S L1, S L2, S L3, Savg L123, ΣS L123.	200 ms 1 s 3 s 10 min 2 hours	In = 5A, Un=230V: 1,5...2587,5VA (Ki=1,Ku=1) In = 1A, Un=230V: 0,23...517,5VA (Ki=1,Ku=1) In = 5A, Un =57,7V: 0,285...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: 0,057...105 W (Ki=1,Ku=1)	±0,5% ⁷			
Active power of a harmonic	Hr P 1 L1 ... Hr P 51 L1, Hr P 1 L2 ... Hr P 51 L2, Hr P 1 L3 ... Hr P 51 L3.	1 s 3 s 10 min 2 h		0,2 ⁸ 1% ⁹			
Reactive power of a harmonic	Hr Q 1 L1 ... Hr Q 51 L1, Hr Q 1 L2 ... Hr Q 51 L2, Hr Q 1 L3 ... Hr Q 51 L3.	1 s 3 s 10 min 2 h		1 ⁸			
Apparent power of a harmonic	Hr S 1 L1 ... Hr S 51 L1, Hr S 1 L2 ... Hr S 51 L2, Hr S 1 L3 ... Hr S 51 L3.	1 s 3 s 10 min 2 h		0,2 ⁸			

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks	
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S
Demand	P Demand,	15 min 30 min 1 hour	In = 5A, Un=230V: -2587,5...2587,5W (Ki=1,Ku=1) In = 1A, Un=230V: -517,3...517,3W (Ki=1,Ku=1) In = 5A, Un =57,7V: -525...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: -105...105 W (Ki=1,Ku=1)	±0,5% ⁷			
	Q Demand,	15 min 30 min 1 hour	In = 5A, Un=230V: -2587,5...2587,5W (Ki=1,Ku=1) In = 1A, Un=230V: -517,3...517,3W (Ki=1,Ku=1) In = 5A, Un =57,7V: -525...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: -105...105 W (Ki=1,Ku=1)	±0,5% ⁷			
	S Demand.	15 min 30 min 1 hour	In = 5A, Un=230V: 1,5...2587,5VA (Ki=1,Ku=1) In = 1A, Un=230V: 0,23...517,5VA (Ki=1,Ku=1) In = 5A, Un =57,7V: 0,285...525W (Ki=1,Ku=1) In = 1A, Un =57,7V: 0,057...105 W (Ki=1,Ku=1)	±0,5% ⁷			
Other							
Frequency	f	1 s 10 s	For 50Hz 42,5 ... 57,5Hz For 60Hz 51 ... 69Hz	±0,05Hz		Class S	
				±0,05Hz		Class S	

Measured value			Measurement range	Measurement error (PN-EN-61000-4-3) ¹ (PN-EN IEC 61557-12) ⁸ (PN-EN 61000-4-7) ⁹		Remarks																			
	Symbol	Aggr.		Class A/S	Class S	Class A/S	Class S																		
Flicker	Pst (U L1, U L2, U L3). Plt (U L1, U L2, U L3).	1 min 10 min 2 hours	0,2...10,00	±0,5% ⁷																					
Power distortion factor	dPF L1, dPF L2, dPF L3, dPFavg L123.	200 ms 1 s 3 s 10 min 2 hours	0...1	±0,5% ⁷																					
Active power factor	PF L1, PF L2, PF L3, PFavg L123.	200 ms 1 s 3 s 10 min 2 hours	-1...1	±0,5% ⁷																					
tgφ factor	tgφ L1, tgφ L2, tgφ L3, tgφavg L123.	200 ms 1 s 3 s 10 min 2 hours	-10...10	±1% ⁷																					
Angle between voltage and current	φ L1, φ L2, φ L3, φavg L123.	200 ms 1 s 3 s 10 min 2 hours	-180°...180°	±0,5% ⁷																					
Voltage phase-to-phase angle	✕ U L1-2, ✕ U L2-3, ✕ U L3-1.	200 ms 1 s 3 s 10 min 2 hours	<table><tr><td>Unm f</td><td>Voltage range</td><td>K u²</td></tr><tr><td rowspan="2">400 V</td><td>40,0...600,0 V</td><td>= 1</td></tr><tr><td>...2,39 MV</td><td>≠ 1</td></tr><tr><td rowspan="2">100 V</td><td>10,0...120,0 V</td><td>= 1</td></tr><tr><td>...480 kV</td><td>≠ 1</td></tr><tr><td rowspan="2">120 V</td><td>12,0...180,0 V</td><td>= 1</td></tr><tr><td>...720 kV</td><td>≠ 1</td></tr></table>	Unm f	Voltage range	K u ²	400 V	40,0...600,0 V	= 1	...2,39 MV	≠ 1	100 V	10,0...120,0 V	= 1	...480 kV	≠ 1	120 V	12,0...180,0 V	= 1	...720 kV	≠ 1	±0,5% ⁷			
Unm f	Voltage range	K u ²																							
400 V	40,0...600,0 V	= 1																							
	...2,39 MV	≠ 1																							
100 V	10,0...120,0 V	= 1																							
	...480 kV	≠ 1																							
120 V	12,0...180,0 V	= 1																							
	...720 kV	≠ 1																							
Temperature / Resistance	T1, T2	1s	Pt100: -200...850° Pt1000: -200...850° Resistance: 0...5000Ω	0,2% ⁷																					

13.2 Extension cards

The availability of additional inputs/outputs depends on the analyzer ordering code.

13.2.1 3 isolated analog outputs

Type:	3 galvanically isolated current outputs
Output signal:	0/4...20 mA
Output measurement error:	$\pm 0,2$ % of the measurement range
Load resistance:	$\leq 500 \Omega$
Response time:	200 ms

13.2.2 6 isolated analog outputs

Type:	6 galvanically isolated current outputs
Output signal:	0/4...20 mA
Output measurement error:	$\pm 0,2$ % of the measurement range
Load resistance:	$\leq 500 \Omega$
Response time:	200 ms

13.2.3 Binary inputs

Type:	2 groups of 3 binary inputs with a common ground
Control signal:	0...2/8...24 V d.c.
Switching frequency:	up to 50 Hz input voltage range +8...24 V d.c.

13.2.4 Alarm outputs

Type:	8 or 4 programmable electromagnetic relays, normally open (NO)
Contact voltage / load current:	≤ 250 V a.c. / 1,5 A
	≤ 30 V d.c. / 1 A
Response time:	200 ms + hysteresis time

13.3 Reference conditions and rated operating conditions

Storage conditions (temperature and humidity)	Temperature: -20...50°C (-4...122°F) Humidity: below 75% RH (non-condensing)
Operating conditions (temperature and humidity)	Temperature: 0...50°C (32...122°F) Humidity: below 75% RH (non-condensing)

Power supply	85...253 V a.c. (40...400Hz), 90...300 V d.c.
	24 V d.c. ($\pm 10\%$)
Maximum power consumption in the circuit	power supply $\leq 20\text{VA}$ voltage $\leq 0,2\text{ VA}$ current $\leq 0,2\text{ VA}$
Permissible crest factor	Current measurement: 2 Voltage measurement: 2
Dust and water protection	IP54 – front side IP20 – terminal side

13.4 Operating safety according to PN-EN 61010-1, basic insulation

Installation category	III
Pollution degree	2
Insulation voltage to earth	RS485: 500V a.c./d.c. Ethernet : 250V ac / 500V d.c. Temperature measurement input: 500V a.c./d.c. Voltage input: 2140 V a.c./d.c. Power supply and relay output circuits: 2140 V a.c./d.c. Analog outputs: 500V a.c./d.c.
Maximum operating voltage to earth	Power supply and relay output circuits: 300 V Measurement input: 500 V RS485, Ethernet, relay output, analog output and binary input circuits: 50 V
Altitude above sea level	< 2000 m

13.5 Electromagnetic compatibility

Electromagnetic emissions	compliant with EN 61000-6-4
Interference immunity	compliant with EN 61000-6-2

13.6 Assembly

Dimensions	144 Width $\times$ 144 Height $\times$ 90 Depth mm (5.669" Width $\times$ 5.669" Height $\times$ 3,897" Depth)
Mounting cut-out dimensions	138 ^{-0,5} Width $\times$ 138 ^{-0,5} Height mm (5.433 ^{-0,02} " Width $\times$ 5.433 ^{-0,02} " Height)
Weight	1,6 kg (5.44 oz.)

13.7 Conformity with standards

EN 61010	Operating safety
EN 61000-6-4	Electromagnetic compatibility
EN 61000-6-2	
EN 50160	Measurement and calculation of parameters
EN 61000-4-30	
EN 61000-4-7	
EN 61557	

13.8 Tables of registers

The ND45PLUS analyzer stores data in 16- and 32-bit registers. Bits in 16-bit registers are numbered from least to most significant (b0 ... b15). The 32-bit registers (4 bytes, 2 x 16 bits) contain float values with byte order B4 B3 B2 B1.

Note! All listed addresses are physical addresses. Some computer programs use logical addressing; in these cases, increase the addresses by 1.

The ND45PLUS register map is shown below.

Address range	Register type	Description
0000 - 0019	Integer (16 bits)	Information and status registers.
0050 - 0170	Float (2 x 16 bits)	Parameters measured with aggregation of 200 ms.
0200 - 0320		Parameters measured with aggregation of 1 s.
0350 - 0470		Parameters measured with aggregation of 3 s.
0500 - 0620		Parameters measured with aggregation of 10 min.
0650 - 0770		Parameters measured with aggregation of 2 h.
0800 - 0808		Parameters averaged in time (Demand).
0818 - 0826		Frequency, temperature/resistance.
0828 - 0844		Flicker
0852 - 0862		Statuses of binary inputs.
0900 - 1010		Energy meters.
1050 - 1112		THD, THDG, THDS, PWHD factors.
1150 - 1760		Harmonics.
1762 - 2372		Interharmonics
2380 - 2522		Half-wave voltages.
2580 - 2799	Integer (16 bits)	Dips, interruptions, swells.
2800 - 2822	Float (2 x 16 bits)	Pulse counters.
2850 - 3296		Tariffs.
3298 - 3406	Unsigned integer (2x16)	Energy meters – KWh, one decimal place
3408 - 3516		Energy meters – KWh, no decimal places

13.8.1 Information and status registers.

Register	Parameter	3Ph / 4W	3Ph / 3W
0000	Device identifier	✓	✓
0001	Main program version	✓	✓
0002	Measurement card program version	✓	✓

Register	Parameter	3Ph / 4W	3Ph / 3W
0003	Status 1	✓	✓
0004	Status 2	✓	✓
0005	Status 3	✓	✓
0006	Time: seconds	✓	✓
0007	Time: hours and minutes (hour *100 + minutes)	✓	✓
0008	Date: month and day (month * 100 + day)	✓	✓
0009	Date: year	✓	✓
0010	Serial number	✓	✓
0011	Serial number	✓	✓
0012	Password confirming execution of the CMD command	✓	✓
0013	Number assigned to the CMD command	✓	✓
0014	Device hardware version	✓	✓
0015	Fifth and fourth bytes (B5.B4) of the meter MAC address, format B5:B4:B3:B2:B1:B0 25651 (0x6433 = 64:33)	✓	✓
0016	Third and second bytes (B3.B2) of the meter MAC address, format B5:B4:B3:B2:B1:B0 56090 (0xDB1A = DB:1A)	✓	✓
0017	First and zeroth bytes (B1.B0) of the meter MAC address, format B5:B4:B3:B2:B1:B0 27051 (0x69AB = 69:AB)	✓	✓
0018	Third and second bytes (B3.B2) of the meter IP address, IPv4 address format: B3.B2.B1.B0 49320 (0xC0A8 = 192.168)	✓	✓
0019	First and zeroth bytes (B1.B0) of the meter IP address, IPv4 address format: B3.B2.B1.B0 356 (0x0164 = 1.100)	✓	✓

13.8.2 CMD commands

Executing a command requires the correct security password to be set in register 12.

Command	Description
Resetting energy counters	
1	Active imported energy L1
2	Active imported energy L2
3	Active imported energy L3
4	Active imported energy L123
5	Active exported energy L1
6	Active exported energy L2
7	Active exported energy L3
8	Active exported energy L123
9	Active exported and imported energy L123
11	Reactive inductive imported energy L1

Command	Description
12	Reactive inductive imported energy L2
13	Reactive inductive imported energy L3
14	Reactive inductive imported energy L123
15	Reactive inductive exported energy L1
16	Reactive inductive exported energy L2
17	Reactive inductive exported energy L3
18	Reactive inductive exported energy L123
19	Reactive inductive imported and exported energy L123
21	Reactive capacitive imported energy L1
22	Reactive capacitive imported energy L2
23	Reactive capacitive imported energy L3
24	Reactive capacitive imported energy L123
25	Reactive capacitive exported energy L1
26	Reactive capacitive exported energy L2
27	Reactive capacitive exported energy L3
28	Reactive capacitive exported energy L123
29	Reactive capacitive imported and exported energy L123
31	Apparent energy L1
32	Apparent energy L2
33	Apparent energy L3
34	Apparent energy L123
39	Resetting all counters

13.8.3 Status registers

Status 1

Bit no.	Description
0	No synchronization
1	Phase connection sequence error
2	Measurement card queue overflow
3	Calibration parameter error

Status 2

Bit no.	Description
0	Lower overrun UL1
1	Upper overrun UL1
2	Lower overrun UL2

3	Upper overrun UL2
4	Lower overrun UL3
5	Upper overrun UL3

Status 3

Bit no.	Description
0	Lower overrun IL1
1	Upper overrun IL1
2	Lower overrun IL2
3	Upper overrun IL2
4	Lower overrun IL3
5	Upper overrun IL3

13.8.4 Parameters measured with aggregation of 200 ms

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0050	Voltage RMS	L1	Urms	L1	V	✓	✗
0052	Current RMS		Irms		A	✓	✓
0054	Basic voltage value		Ufund		V	✓	✗
0056	Active power		P		W	✓	✗
0058	Reactive power		Q		var	✓	✗
0060	Apparent power		S		VA	✓	✗
0062	Power distortion factor		dPF		-	✓	✗
0064	Active power factor		PF		-	✓	✗
0066	tgφ factor		tgφ		-	✓	✗
0068	Reserved						
0070	Angle between voltage and current	L1	φ	L1	rad	✓	✗
0072	Angle between voltage and current		φ		°	✓	✗
0074	Voltage RMS	L2	Urms	L2	V	✓	✗
0076	Current RMS		Irms		A	✓	✓
0078	Basic voltage value		Ufund		V	✓	✗
0080	Active power		P		W	✓	✗
0082	Reactive power		Q		var	✓	✗
0084	Apparent power		S		VA	✓	✗
0086	Power distortion factor		dPF		-	✓	✗
0088	Active power factor		PF		-	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0090	tgφ factor		tgφ		-	✓	✗
0092	Reserved						
0094	Angle between voltage and current	L2	φ	L2	rad	✓	✗
0096			φ		°	✓	✗
0098	Voltage RMS	L3	Urms	L3	V	✓	✗
0100	Current RMS		Irms		A	✓	✓
0102	Basic voltage value		Ufund		V	✓	✗
0104	Active power		P		W	✓	✗
0106	Reactive power		Q		var	✓	✗
0108	Apparent power		S		VA	✓	✗
0110	Power distortion factor		dPF		-	✓	✗
0112	Active power factor		PF		-	✓	✗
0114	tgφ factor		tgφ		-	✓	✗
0116	Reserved						
0118	Angle between voltage and current	L3	φ	L3	rad	✓	✗
0120			φ		°	✓	✗
0122	Average voltage	L123	Uavg	L123	V	✓	✗
0124	Average current		I avg		A	✓	✗
0126	Average basic voltage		Ufavg		V	✓	✗
0128	Total active power		ΣP		W	✓	✓
0130	Total reactive power		ΣQ		var	✓	✓
0132	Total apparent power		ΣS		VA	✓	✓
0134	Average power distortion factor		dPFavg		-	✓	✗
0136	Average active power factor		PFavg		-	✓	✓
0138	Average tgφ factor	tgφavg	-	✓	✗		
0140	Phase-to-phase voltage L1-2		Umf L1-2		V	✓	✓
0142	Phase-to-phase voltage L2-3		Umf L2-3		V	✓	✓
0144	Phase-to-phase voltage L3-1		Umf L3-1		V	✓	✓
0146	Average phase-to-phase voltage	L123	Umf avg	L123	V	✓	✓
0148	Average active power		Pavg		W	✓	✗
0150	Average reactive power		Qavg		var	✓	✗
0152	Average apparent power		Savg		VA	✓	✗
0154	Neutral current		IN		A	✓	✗
0156	Calculated neutral current		INC		A	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0158	Average angle between voltage and current.	L123	φ avg	L123	rad	✓	✗
0160			φ avg		°	✓	✗
0162	Voltage phase-to-phase angle L1-2		$\angle$ U L1-2		°	✓	✓
0164	Voltage phase-to-phase angle L2-3		$\angle$ U L2-3		°	✓	✓
0166	Voltage phase-to-phase angle L3-1		$\angle$ U L3-1		°	✓	✓
0168	Average phase-to-phase angle L123		$\angle$ U avg L123		°	✓	✓
0170	Voltage asymmetry		Vunb		%	✓	✓

13.8.5 Parameters measured with aggregation of 1 s

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0200	Voltage RMS	L1	Urms	L1	V	✓	✗
0202	Current RMS		Irms		A	✓	✓
0204	Basic voltage value		Ufund		V	✓	✗
0206	Active power		P		W	✓	✗
0208	Reactive power		Q		var	✓	✗
0210	Apparent power		S		VA	✓	✗
0212	Power distortion factor		dPF		-	✓	✗
0214	Active power factor		PF		-	✓	✗
0216	tgφ factor		tgφ		-	✓	✗
0218	Reserved						
0220	Angle between voltage and current	L1	φ	L1	rad	✓	✗
0222			φ		°	✓	✗
0224	Voltage RMS	L2	Urms	L2	V	✓	✗
0226	Current RMS		Irms		A	✓	✓
0228	Basic voltage value		Ufund		V	✓	✗
0230	Active power		P		W	✓	✗
0232	Reactive power		Q		var	✓	✗
0234	Apparent power		S		VA	✓	✗
0236	Power distortion factor		dPF		-	✓	✗
0238	Active power factor		PF		-	✓	✗
0240	tgφ factor		tgφ		-	✓	✗
0242	Reserved						
0244	Angle between voltage and current	L2	φ	L2	rad	✓	✗
0246			φ		°	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0248	Voltage RMS	L3	Urms	L3	V	✓	✗
0250	Current RMS		Irms		A	✓	✓
0252	Basic voltage value		Ufund		V	✓	✗
0254	Active power		P		W	✓	✗
0256	Reactive power		Q		var	✓	✗
0258	Apparent power		S		VA	✓	✗
0260	Power distortion factor		dPF		-	✓	✗
0262	Active power factor		PF		-	✓	✗
0264	tgφ factor		tgφ		-	✓	✗
0266	Reserved						
0268	Angle between voltage and current	L3	φ	L3	rad	✓	✗
0270			φ		°	✓	✗
0272	Average voltage	L123	Uavg	L123	V	✓	✗
0274	Average current		I avg		A	✓	✓
0276	Average basic voltage		Ufavg		V	✓	✗
0278	Total active power		ΣP		W	✓	✗
0280	Total reactive power		ΣQ		var	✓	✗
0282	Total apparent power		ΣS		VA	✓	✗
0284	Average power distortion factor		dPFavg		-	✓	✗
0286	Average active power factor		PFavg		-	✓	✗
0288	Average tgφ factor		tgφavg		-	✓	✗
0290	Phase-to-phase voltage L1-2	Umf L1-2			V	✓	✓
0292	Phase-to-phase voltage L2-3	Umf L2-3			V	✓	✓
0294	Phase-to-phase voltage L3-1	Umf L3-1			V	✓	✓
0296	Average phase-to-phase voltage	L123	Umf avg	L123	V	✓	✓
0298	Average active power		Pavg		W	✓	✗
0300	Average reactive power		Qavg		var	✓	✗
0302	Average apparent power		Savg		VA	✓	✗
0304	Neutral current	IN			A	✓	✗
0306	Calculated neutral current	INC			A	✓	✗
0308	Average angle between voltage and current	L123	φ avg	L123	rad	✓	✗
0310			φ avg		°	✓	✗
0312	Voltage phase-to-phase angle L1-2	∠ U L1-2			°	✓	✓

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0314	Voltage phase-to-phase angle L2-3	$\angle U_{L2-3}$	$^\circ$	✓	✓
0316	Voltage phase-to-phase angle L3-1	$\angle U_{L3-1}$	$^\circ$	✓	✓
0318	Average phase-to-phase angle L123	$\angle U_{avg L123}$	$^\circ$	✓	✓
0320	Voltage asymmetry	Vunb	%	✓	✓

13.8.6 Parameters measured with aggregation of 3 s

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0350	Voltage RMS	Urms	V	✓	✗
0352	Current RMS	Irms	A	✓	✓
0354	Basic voltage value	Ufund	V	✓	✗
0356	Active power	P	W	✓	✗
0358	Reactive power	Q	var	✓	✗
0360	Apparent power	S	VA	✓	✗
0362	Power distortion factor	dPF	-	✓	✗
0364	Active power factor	PF	-	✓	✗
0366	tgφ factor	tgφ	-	✓	✗
0368	Reserved				
0370	Angle between voltage and current	φ	rad	✓	✗
0372		φ	$^\circ$	✓	✗
0374	Voltage RMS	Urms	V	✓	✗
0376	Current RMS	Irms	A	✓	✓
0378	Basic voltage value	Ufund	V	✓	✗
0380	Active power	P	W	✓	✗
0382	Reactive power	Q	var	✓	✗
0384	Apparent power	S	VA	✓	✗
0386	Power distortion factor	dPF	-	✓	✗
0388	Active power factor	PF	-	✓	✗
0390	tgφ factor	tgφ	-	✓	✗
0392	Reserved				
0394	Angle between voltage and current	φ	rad	✓	✗
0396		φ	$^\circ$	✓	✗
0398	Voltage RMS	Urms	V	✓	✗
0400	Current RMS	Irms	A	✓	✓
0402	Basic voltage value	Ufund	V	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0404	Active power	L3	P	L3	W	✓	✗
0406	Reactive power		Q		var	✓	✗
0408	Apparent power		S		VA	✓	✗
0410	Power distortion factor		dPF		-	✓	✗
0412	Active power factor		PF		-	✓	✗
0414	tgφ factor		tgφ		-	✓	✗
0416	Reserved						
0418	Angle between voltage and current	L3	φ	L3	rad	✓	✗
0420			φ		°	✓	✗
0422	Average voltage	L123	Uavg	L123	V	✓	✗
0424	Average current		I avg		A	✓	✓
0426	Average basic voltage		Ufavg		V	✓	✗
0428	Total active power		ΣP		W	✓	✗
0430	Total reactive power		ΣQ		var	✓	✗
0432	Total apparent power		ΣS		VA	✓	✗
0434	Average power distortion factor		dPFavg		-	✓	✗
0436	Average active power factor		PFavg		-	✓	✗
0438	Average tgφ factor		tgφavg		-	✓	✗
0440	Phase-to-phase voltage L1-2		Umf L1-2		V	✓	✓
0442	Phase-to-phase voltage L2-3		Umf L2-3		V	✓	✓
0444	Phase-to-phase voltage L3-1		Umf L3-1		V	✓	✓
0446	Average phase-to-phase voltage	L123	Umf avg	L123	V	✓	✓
0448	Average active power		Pavg		W	✓	✗
0450	Average reactive power		Qavg		var	✓	✗
0452	Average apparent power		Savg		VA	✓	✗
0454	Neutral current		IN		A	✓	✗
0456	Calculated neutral current		INC		A	✓	✗
0458	Average angle between voltage and current	L123	φ avg	L123	rad	✓	✗
0460			φ avg		°	✓	✗
0462	Voltage phase-to-phase angle L1-2		✗ U L1-2		°	✓	✓
0464	Voltage phase-to-phase angle L2-3		✗ U L2-3		°	✓	✓
0466	Voltage phase-to-phase angle L3-1		✗ U L3-1		°	✓	✓
0468	Average phase-to-phase angle L123		✗ U avg L123		°	✓	✓
0470	Voltage asymmetry		Vunb		%	✓	✓

13.8.7 Parameters measured with aggregation of 10 min

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0500	Voltage RMS	Urms	V	✓	✗
0502	Current RMS	Irms	A	✓	✓
0504	Basic voltage value	Ufund	V	✓	✗
0506	Active power	P	W	✓	✗
0508	Reactive power	Q	var	✓	✗
0510	Apparent power	S	VA	✓	✗
0512	Power distortion factor	dPF	-	✓	✗
0514	Active power factor	PF	-	✓	✗
0516	tgφ factor	tgφ	-	✓	✗
0518	Reserved				
0520	Angle between voltage	φ	rad	✓	✗
0522	and current	φ	°	✓	✗
0524	Voltage RMS	Urms	V	✓	✗
0526	Current RMS	Irms	A	✓	✓
0528	Basic voltage value	Ufund	V	✓	✗
0530	Active power	P	W	✓	✗
0532	Reactive power	Q	var	✓	✗
0534	Apparent power	S	VA	✓	✗
0536	Power distortion factor	dPF	-	✓	✗
0538	Active power factor	PF	-	✓	✗
0540	tgφ factor	tgφ	-	✓	✗
0542	Reserved				
0544	Angle between voltage	φ	rad	✓	✗
0546	and current	φ	°	✓	✗
0548	Voltage RMS	Urms	V	✓	✗
0550	Current RMS	Irms	A	✓	✓
0552	Basic voltage value	Ufund	V	✓	✗
0554	Active power	P	W	✓	✗
0556	Reactive power	Q	var	✓	✗
0558	Apparent power	S	VA	✓	✗
0560	Power distortion factor	dPF	-	✓	✗
0562	Active power factor	PF	-	✓	✗
0564	tgφ factor	tgφ	-	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0566	Reserved						
0568	Angle between voltage and current	L3	φ	L3	rad	✓	✗
0570			φ		°	✓	✗
0572	Average voltage	L123	Uavg	L123	V	✓	✗
0574	Average current		I avg		A	✓	✓
0576	Average basic voltage		Ufavg		V	✓	✗
0578	Total active power		ΣP		W	✓	✗
0580	Total reactive power		ΣQ		var	✓	✗
0582	Total apparent power		ΣS		VA	✓	✗
0584	Average power distortion factor		dPFavg		-	✓	✗
0586	Average active power factor		PFavg		-	✓	✗
0588	Average tg φ factor		tg φ avg		-	✓	✗
0590	Phase-to-phase voltage L1-2		Umf L1-2		V	✓	✓
0592	Phase-to-phase voltage L2-3		Umf L2-3		V	✓	✓
0594	Phase-to-phase voltage L3-1		Umf L3-1		V	✓	✓
0596	Average phase-to-phase voltage	L123	Umf avg	L123	V	✓	✓
0598	Average active power		Pavg		W	✓	✗
0600	Average reactive power		Qavg		var	✓	✗
0602	Average apparent power		Savg		VA	✓	✗
0604	Neutral current		IN		A	✓	✗
0606	Calculated neutral current		INC		A	✓	✗
0608	Average angle between voltage and current	L123	φ avg	L123	rad	✓	✗
0610			φ avg		°	✓	✗
0612	Voltage phase-to-phase angle L1-2		$\nless U$ L1-2		°	✓	✓
0614	Voltage phase-to-phase angle L2-3		$\nless U$ L2-3		°	✓	✓
0616	Voltage phase-to-phase angle L3-1		$\nless U$ L3-1		°	✓	✓
0618	Average phase-to-phase angle L123		$\nless U$ avg L123		°	✓	✓
0620	Voltage asymmetry		Vunb		%	✓	✓

13.8.8 Parameters measured with aggregation of 2 h

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0650	Voltage RMS	L1	Urms	L1	V	✓	✗
0652	Current RMS		Irms		A	✓	✓
0654	Basic voltage value		Ufund		V	✓	✗
0656	Active power		P		W	✓	✗
0658	Reactive power		Q		var	✓	✗
0660	Apparent power		S		VA	✓	✗
0662	Power distortion factor		dPF		-	✓	✗
0664	Active power factor		PF		-	✓	✗
0666	tgφ factor		tgφ		-	✓	✗
0668	Reserved						
0670	Angle between voltage and current	L1	φ	L1	rad	✓	✗
0672			φ		°	✓	✗
0674	Voltage RMS	L2	Urms	L2	V	✓	✗
0676	Current RMS		Irms		A	✓	✓
0678	Basic voltage value		Ufund		V	✓	✗
0680	Active power		P		W	✓	✗
0682	Reactive power		Q		var	✓	✗
0684	Apparent power		S		VA	✓	✗
0686	Power distortion factor		dPF		-	✓	✗
0688	Active power factor		PF		-	✓	✗
0690	tgφ factor		tgφ		-	✓	✗
0692	Reserved						
0694	Angle between voltage and current	L2	φ	L2	rad	✓	✗
0696			φ		°	✓	✗
0698	Voltage RMS	L3	Urms	L3	V	✓	✗
0700	Current RMS		Irms		A	✓	✗
0702	Basic voltage value		Ufund		V	✓	✗
0704	Active power		P		W	✓	✗
0706	Reactive power		Q		var	✓	✗
0708	Apparent power		S		VA	✓	✗
0710	Power distortion factor		dPF		-	✓	✗
0712	Active power factor		PF		-	✓	✗
0714	tgφ factor		tgφ		-	✓	✗

Register	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
0716	Reserved						
0718	Angle between voltage and current	L3	φ	L3	rad	✓	✗
0720			φ		°	✓	✗
0722	Average voltage	L123	Uavg	L123	V	✓	✗
0724	Average current		I avg		A	✓	✓
0726	Average basic voltage		Ufavg		V	✓	✗
0728	Total active power		ΣP		W	✓	✗
0730	Total reactive power		ΣQ		var	✓	✗
0732	Total apparent power		ΣS		VA	✓	✗
0734	Average power distortion factor		dPF		-	✓	✗
0736	Average active power factor		PFavg		-	✓	✗
0738	Average tgφ factor		tgφavg		-	✓	✗
0740	Phase-to-phase voltage L1-2		Umf L1-2		V	✓	✓
0742	Phase-to-phase voltage L2-3		Umf L2-3		V	✓	✓
0744	Phase-to-phase voltage L3-1		Umf L3-1		V	✓	✓
0746	Average phase-to-phase voltage	L123	Umf avg	L123	V	✓	✓
0748	Average active power		Pavg		W	✓	✗
0750	Average reactive power		Qavg		var	✓	✗
0752	Average apparent power		Savg		VA	✓	✗
0754	Neutral current		IN		A	✓	✗
0756	Calculated neutral current		INC		A	✓	✗
0758	Average angle between voltage and current	L123	φ avg	L123	rad	✓	✗
0760			φ avg		°	✓	✗
0762	Voltage phase-to-phase angle L1-2		∠ U L1-2		°	✓	✓
0764	Voltage phase-to-phase angle L2-3		∠ U L2-3		°	✓	✓
0766	Voltage phase-to-phase angle L3-1		∠ U L3-1		°	✓	✓
0768	Average phase-to-phase angle L123		∠ U avg L123		°	✓	✓
0770	Voltage asymmetry		Vunb		%	✓	✓

13.8.9 Parameters averaged in time (Demand)

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0800	Averaged active power (Demand)	P Demand	W	✓	✓
0802	Averaged reactive power (Demand)	Q Demand	var	✓	✓
0804	Averaged apparent power (Demand)	S Demand	VA	✓	✓
0806	Averaged voltage (Demand)	U Demand	V	✓	✓
0808	Averaged current (Demand)	I Demand	A	✓	✓

13.8.10 Frequency, temperature/resistance

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0818	Frequency with 1 s aggregation	f 1s	Hz	✓	✓
0820	Frequency with 10 s aggregation	f 10s	Hz	✓	✓
0822	Temperature/resistance in the first channel	T1	°C / Ω	✓	✓
0824	Temperature/resistance in the second channel	T2	°C / Ω	✓	✓
0826	Analog card temperature	-	°C	✓	✓

13.8.11 Flicker

Register	Parameter		Symbol	Unit	3Ph / 4W	3Ph / 3W
0828	1-minute Flicker value	L1	Pst 1min	-	✓	✓
0830		L2		-	✓	✓
0832		L3		-	✓	✓
0834	10-minute Flicker value	L1	Pst 10min	-	✓	✓
0836		L2		-	✓	✓
0838		L3		-	✓	✓
0840	2-hour Flicker value	L1	Plt 2H	-	✓	✓
0842		L2		-	✓	✓
0844		L3		-	✓	✓

13.8.12 Statuses of binary inputs

Register	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0852	Binary input no. 1	BI 1	-	✓	✓
0854	Binary input no. 2	BI 2	-	✓	✓
0856	Binary input no. 3	BI 3	-	✓	✓
0858	Binary input no. 4	BI 4	-	✓	✓
0860	Binary input no. 5	BI 5	-	✓	✓
0862	Binary input no. 6	BI 6	-	✓	✓

13.8.13 Energy meters

13.8.13.1 Floating-point values (Float (2 x 16 bits))

Register	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0900	Active imported energy	L1	EnP+	MWh	✓	✓
0902	Active imported energy		EnP+	kWh	✓	✓
0904	Active imported energy	L2	EnP+	MWh	✓	✓
0906	Active imported energy		EnP+	kWh	✓	✓
0908	Active imported energy	L3	EnP+	MWh	✓	✓
0910	Active imported energy		EnP+	kWh	✓	✓
0912	Sum of active imported energy	L123	ΣEnP+	MWh	✓	✓
0914	Sum of active imported energy		ΣEnP+	kWh	✓	✓
0916	Active exported energy	L1	EnP-	MWh	✓	✓
0918	Active exported energy		EnP-	kWh	✓	✓
0920	Active exported energy	L2	EnP-	MWh	✓	✓
0922	Active exported energy		EnP-	kWh	✓	✓
0924	Active exported energy	L3	EnP-	MWh	✓	✓
0926	Active exported energy		EnP-	kWh	✓	✓
0928	Sum of active exported energy	L123	ΣEnP-	MWh	✓	✓
0930	Sum of active exported energy		ΣEnP-	kWh	✓	✓
0932	Reactive inductive imported energy	L1	EnQ+ }	Mvarh	✓	✓
0934	Reactive inductive imported energy		EnQ+ }	kvarh	✓	✓
0936	Reactive inductive imported energy	L2	EnQ+ }	Mvarh	✓	✓
0938	Reactive inductive imported energy		EnQ+ }	kvarh	✓	✓
0940	Reactive inductive imported energy	L3	EnQ+ }	Mvarh	✓	✓

Register	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0942	Reactive inductive imported energy		$\text{EnQ}^+ \}$	kvarh	✓	✓
0944	Total value of reactive inductive imported energy	L123	$\Sigma \text{EnQ}^+ \}$	Mvarh	✓	✓
0946	Total value of reactive inductive imported energy		$\Sigma \text{EnQ}^+ \}$	kvarh	✓	✓
0948	Reactive inductive exported energy	L1	$\text{EnQ}^- \}$	Mkvarh	✓	✓
0950	Reactive inductive exported energy		$\text{EnQ}^- \}$	kvarh	✓	✓
0952	Reactive inductive exported energy	L2	$\text{EnQ}^- \}$	Mvarh	✓	✓
0954	Reactive inductive exported energy		$\text{EnQ}^- \}$	kvarh	✓	✓
0956	Reactive inductive exported energy	L3	$\text{EnQ}^- \}$	Mvarh	✓	✓
0958	Reactive inductive exported energy		$\text{EnQ}^- \}$	kvarh	✓	✓
0960	Total value of reactive inductive exported energy	L123	$\Sigma \text{EnQ}^- \}$	Mvarh	✓	✓
0962	Total value of reactive inductive exported energy		$\Sigma \text{EnQ}^- \}$	kvarh	✓	✓
0964	Reactive capacitive imported energy	L1	$\text{EnQ}^+ \text{--}$	Mvarh	✓	✓
0966	Reactive capacitive imported energy		$\text{EnQ}^+ \text{--}$	kvarh	✓	✓
0968	Reactive capacitive imported energy	L2	$\text{EnQ}^+ \text{--}$	Mvarh	✓	✓
0970	Reactive capacitive imported energy		$\text{EnQ}^+ \text{--}$	kvarh	✓	✓
0972	Reactive capacitive imported energy	L3	$\text{EnQ}^+ \text{--}$	Mvarh	✓	✓
0974	Reactive capacitive imported energy		$\text{EnQ}^+ \text{--}$	kvarh	✓	✓
0976	Total value of reactive capacitive imported energy	L123	$\Sigma \text{EnQ}^+ \text{--}$	Mvarh	✓	✓
0978	Total value of reactive capacitive imported energy		$\Sigma \text{EnQ}^+ \text{--}$	kvarh	✓	✓
0980	Reactive capacitive exported energy	L1	$\text{EnQ}^- \text{--}$	Mkvarh	✓	✓
0982	Reactive capacitive exported energy		$\text{EnQ}^- \text{--}$	kvarh	✓	✓
0984	Reactive capacitive exported energy	L2	$\text{EnQ}^- \text{--}$	Mvarh	✓	✓
0986	Reactive capacitive exported energy		$\text{EnQ}^- \text{--}$	kvarh	✓	✓
0988	Reactive capacitive exported energy	L3	$\text{EnQ}^- \text{--}$	Mvarh	✓	✓
0990	Reactive capacitive exported energy		$\text{EnQ}^- \text{--}$	kvarh	✓	✓
0992	Total value of reactive capacitive exported energy	L123	$\Sigma \text{EnQ}^- \text{--}$	Mvarh	✓	✓
0994	Total value of reactive capacitive exported energy		$\Sigma \text{EnQ}^- \text{--}$	kvarh	✓	✓

Register	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
0996	Apparent energy	L1	EnS	MVAh	✓	✓
0998	Apparent energy		EnS	kVAh	✓	✓
1000	Apparent energy	L2	EnS	MVAh	✓	✓
1002	Apparent energy		EnS	kVAh	✓	✓
1004	Apparent energy	L3	EnS	MVAh	✓	✓
1006	Apparent energy		EnS	kVAh	✓	✓
1008	Sum of apparent energy	L123	ΣEnS	MVAh	✓	✓
1010	Sum of apparent energy		ΣEnS	kVAh	✓	✓

Conversion of energy counters available in registers, for example EnP+ L1:

EnP+ L1 = ((Value of register 0900 x 1000) + value of register 0902) [kWh]

The other energy values are converted in the same way.

13.8.13.2 Unsigned integer values (2 x 16 bits) – with one decimal place

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3298	Active imported energy	L1	EnP+	kWh	✓	✓
3302	Active imported energy	L2	EnP+	kWh	✓	✓
3306	Active imported energy	L3	EnP+	kWh	✓	✓
3310	Sum of active imported energy	L123	ΣEnP+	kWh	✓	✓
3314	Active exported energy	L1	EnP-	kWh	✓	✓
3318	Active exported energy	L2	EnP-	kWh	✓	✓
3322	Active exported energy	L3	EnP-	kWh	✓	✓
3326	Sum of active exported energy	L123	ΣEnP-	kWh	✓	✓
3330	Reactive inductive imported energy	L1	EnQ+ } }	kvarh	✓	✓
3334	Reactive inductive imported energy	L2	EnQ+ } }	kvarh	✓	✓
3338	Reactive inductive imported energy	L3	EnQ+ } }	kvarh	✓	✓
3342	Total value of reactive inductive imported energy	L123	ΣEnQ+ } }	kvarh	✓	✓
3346	Reactive inductive exported energy	L1	EnQ- } }	kkvarh	✓	✓
3350	Reactive inductive exported energy	L2	EnQ- } }	kvarh	✓	✓
3354	Reactive inductive exported energy	L3	EnQ- } }	kvarh	✓	✓
3358	Total value of reactive inductive exported energy	L123	ΣEnQ- } }	kvarh	✓	✓
3362	Reactive capacitive imported energy	L1	EnQ+ - -	kvarh	✓	✓
3366	Reactive capacitive imported energy	L2	EnQ+ - -	kvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3370	Reactive capacitive imported energy	L3	EnQ+ $\text{--}\text{ }$	kvarh	✓	✓
3374	Total value of reactive capacitive imported energy	L123	Σ EnQ+ $\text{--}\text{ }$	kvarh	✓	✓
3378	Reactive capacitive exported energy	L1	EnQ- $\text{--}\text{ }$	kvarh	✓	✓
3382	Reactive capacitive exported energy	L2	EnQ- $\text{--}\text{ }$	kvarh	✓	✓
3386	Reactive capacitive exported energy	L3	EnQ- $\text{--}\text{ }$	kvarh	✓	✓
3390	Total value of reactive capacitive exported energy	L123	Σ EnQ- $\text{--}\text{ }$	kvarh	✓	✓
3394	Apparent energy	L1	EnS	kVAh	✓	✓
3398	Apparent energy	L2	EnS	kVAh	✓	✓
3402	Apparent energy	L3	EnS	kVAh	✓	✓
3406	Sum of apparent energy	L123	Σ EnS	kVAh	✓	✓

13.8.13.3 Unsigned integer values (2 x 16 bits) – with no decimal places

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3408	Active imported energy	L1	EnP+	kWh	✓	✓
3412	Active imported energy	L2	EnP+	kWh	✓	✓
3416	Active imported energy	L3	EnP+	kWh	✓	✓
3420	Sum of active imported energy	L123	Σ EnP+	kWh	✓	✓
3424	Active exported energy	L1	EnP-	kWh	✓	✓
3428	Active exported energy	L2	EnP-	kWh	✓	✓
3432	Active exported energy	L3	EnP-	kWh	✓	✓
3436	Sum of active exported energy	L123	Σ EnP-	kWh	✓	✓
3440	Reactive inductive imported energy	L1	EnQ+ ~	kvarh	✓	✓
3444	Reactive inductive imported energy	L2	EnQ+ ~	kvarh	✓	✓
3448	Reactive inductive imported energy	L3	EnQ+ ~	kvarh	✓	✓
3452	Total value of reactive inductive imported energy	L123	Σ EnQ+ ~	kvarh	✓	✓
3456	Reactive inductive exported energy	L1	EnQ- ~	kkvarh	✓	✓
3460	Reactive inductive exported energy	L2	EnQ- ~	kvarh	✓	✓
3464	Reactive inductive exported energy	L3	EnQ- ~	kvarh	✓	✓
3468	Total value of reactive inductive exported energy	L123	Σ EnQ- ~	kvarh	✓	✓
3472	Reactive capacitive imported energy	L1	EnQ+ $\text{--}\text{ }$	kvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3476	Reactive capacitive imported energy	L2	EnQ+ - -	kvarh	✓	✓
3480	Reactive capacitive imported energy	L3	EnQ+ - -	kvarh	✓	✓
3484	Total value of reactive capacitive imported energy	L123	ΣEnQ+ - -	kvarh	✓	✓
3488	Reactive capacitive exported energy	L1	EnQ- - -	kvarh	✓	✓
3492	Reactive capacitive exported energy	L2	EnQ- - -	kvarh	✓	✓
3496	Reactive capacitive exported energy	L3	EnQ- - -	kvarh	✓	✓
3500	Total value of reactive capacitive exported energy	L123	ΣEnQ- - -	kvarh	✓	✓
3504	Apparent energy	L1	EnS	kVAh	✓	✓
3508	Apparent energy	L2	EnS	kVAh	✓	✓
3512	Apparent energy	L3	EnS	kVAh	✓	✓
3516	Sum of apparent energy	L123	ΣEnS	kVAh	✓	✓

13.8.14 THD, THDS, THDG and PWHG registers

Reg.	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
1050	Voltage THD factor L1	THD U L1	%	✓	✗
1052	Voltage THD factor L2	THD U L2	%	✓	✗
1054	Voltage THD factor L3	THD U L3	%	✓	✗
1056	Average voltage THD L123	THD Uavg L123	%	✓	✗
1058	Current THD factor L1	THD I L1	%	✓	✓
1060	Current THD factor L2	THD I L2	%	✓	✓
1062	Current THD factor L3	THD I L3	%	✓	✓
1064	Average current THD L123	THD Iavg L123	%	✓	✓
1066	Voltage THDS factor L1	THDS U L1	%	✓	✗
1068	Voltage THDS factor L2	THDS U L2	%	✓	✗
1070	Voltage THDS factor L3	THDS U L3	%	✓	✗
1072	Average voltage THDS L123	THDS Uavg L123	%	✓	✗
1074	Current THDS factor L1	THDS I L1	%	✓	✓
1076	Current THDS factor L2	THDS I L2	%	✓	✓
1078	Current THDS factor L3	THDS I L3	%	✓	✓
1080	Average current THDS L123	THDS Iavg L123	%	✓	✓

Reg.	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
1082	Voltage THDG factor L1	THDG U L1	%	✓	✗
1084	Voltage THDG factor L2	THDG U L2	%	✓	✗
1086	Voltage THDG factor L3	THDG U L3	%	✓	✗
1088	Average voltage THDG L123	THDG Uavg L123	%	✓	✗
1090	Current THDG factor L1	THDG I L1	%	✓	✓
1092	Current THDG factor L2	THDG I L2	%	✓	✓
1094	Current THDG factor L3	THDG I L3	%	✓	✓
1096	Average current THDG L123	THDG Iavg L123	%	✓	✓
1098	Voltage PWHD factor L1	PWHD U L1	%	✓	✗
1100	Voltage PWHD factor L2	PWHD U L2	%	✓	✗
1102	Voltage PWHD factor L3	PWHD U L3	%	✓	✗
1104	Average voltage PWHD L123	PWHD Uavg L123	%	✓	✗
1106	Current PWHD factor L1	PWHD I L1	%	✓	✓
1108	Current PWHD factor L2	PWHD I L2	%	✓	✓
1110	Current PWHD factor L3	PWHD I L3	%	✓	✓
1112	Average current PWHD L123	PWHD Iavg L123	%	✓	✓

13.8.15 Harmonics registers

13.8.15.1 Harmonics registers - Amplitudes

Relative value

Reg.	Parameter	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
1150	Harmonic no. 1	Har1	%	✓	✗
1152	Harmonic no. 2	Har2	%	✓	✗
1154	Harmonic no. 3	Har3	%	✓	✗
...	...				
1246	Harmonic no. 49	Har49	%	✓	✗
1248	Harmonic no. 50	Har50	%	✓	✗
1250	Harmonic no. 51	Har51	%	✓	✗
1252	Harmonic no. 1	Hr1	%	✓	✗
1254	Harmonic no. 2	Hr2	%	✓	✗
1256	Harmonic no. 3	Hr3	%	✓	✗
..	...				

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
1348	Harmonic no. 49	U L2	Hr49	U L2	%	✓	✗
1350	Harmonic no. 50		Hr50		%	✓	✗
1352	Harmonic no. 51		Hr51		%	✓	✗
1354	Harmonic no. 1	U L3	Hr1	U L3	%	✓	✗
1356	Harmonic no. 2		Hr2		%	✓	✗
1358	Harmonic no. 3		Hr3		%	✓	✗
..	...						
1450	Harmonic no. 49	U L3	Hr49	U L3	%	✓	✗
1452	Harmonic no. 50		Hr50		%	✓	✗
1454	Harmonic no. 51		Hr51		%	✓	✗
1456	Harmonic no. 1	I L1	Har1	I L1	%	✓	✗
1458	Harmonic no. 2		Har2		%	✓	✗
1460	Harmonic no. 3		Har3		%	✓	✗
..	...						
1552	Harmonic no. 49	I L1	Har49	I L1	%	✓	✗
1554	Harmonic no. 50		Har50		%	✓	✗
1556	Harmonic no. 51		Har51		%	✓	✗
1558	Harmonic no. 1	I L2	Har1	I L2	%	✓	✗
1560	Harmonic no. 2		Har2		%	✓	✗
1562	Harmonic no. 3		Har3		%	✓	✗
..	...						
1654	Harmonic no. 49	I L2	Har49	I L2	%	✓	✗
1656	Harmonic no. 50		Har50		%	✓	✗
1658	Harmonic no. 51		Har51		%	✓	✗
1660	Harmonic no. 1	I L3	Har1	I L3	%	✓	✗
1662	Harmonic no. 2		Har2		%	✓	✗
1664	Harmonic no. 3		Har3		%	✓	✗
..	...						
1756	Harmonic no. 49	I L3	Har49	I L3	%	✓	✗
1758	Harmonic no. 50		Har50		%	✓	✗
1760	Harmonic no. 51		Har51		%	✓	✗

Absolute value

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
5000	Harmonic no. 1	U L1	Har1	U L1	V	✓	✗
5002	Harmonic no. 2		Har2		V	✓	✗
5004	Harmonic no. 3		Har3		V	✓	✗
...	...						
5096	Harmonic no. 49	U L1	Har49	U L1	V	✓	✗
5098	Harmonic no. 50		Har50		V	✓	✗
5100	Harmonic no. 51		Har51		V	✓	✗
5102	Harmonic no. 1	U L2	Hr1	U L2	V	✓	✗
5104	Harmonic no. 2		Hr2		V	✓	✗
5108	Harmonic no. 3		Hr3		V	✓	✗
..	...						
5198	Harmonic no. 49	U L2	Hr49	U L2	V	✓	✗
5200	Harmonic no. 50		Hr50		V	✓	✗
5202	Harmonic no. 51		Hr51		V	✓	✗
5204	Harmonic no. 1	U L3	Hr1	U L3	V	✓	✗
5208	Harmonic no. 2		Hr2		V	✓	✗
5210	Harmonic no. 3		Hr3		V	✓	✗
..	...						
5300	Harmonic no. 49	U L3	Hr49	U L3	V	✓	✗
5302	Harmonic no. 50		Hr50		V	✓	✗
5304	Harmonic no. 51		Hr51		V	✓	✗
5306	Harmonic no. 1	I L1	Har1	I L1	A	✓	✗
5308	Harmonic no. 2		Har2		A	✓	✗
5310	Harmonic no. 3		Har3		A	✓	✗
..	...						
5402	Harmonic no. 49	I L1	Har49	I L1	A	✓	✗
5404	Harmonic no. 50		Har50		A	✓	✗
5406	Harmonic no. 51		Har51		A	✓	✗
5408	Harmonic no. 1	I L2	Har1	I L2	A	✓	✗
5410	Harmonic no. 2		Har2		A	✓	✗
5412	Harmonic no. 3		Har3		A	✓	✗

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
..	...						
5504	Harmonic no. 49	I L2	Har49	I L2	A	✓	✗
5506	Harmonic no. 50		Har50		A	✓	✗
5508	Harmonic no. 51		Har51		A	✓	✗
5510	Harmonic no. 1	I L3	Har1	I L3	A	✓	✗
5512	Harmonic no. 2		Har2		A	✓	✗
5514	Harmonic no. 3		Har3		A	✓	✗
..	...						
5606	Harmonic no. 49	I L3	Har49	I L3	A	✓	✗
5608	Harmonic no. 50		Har50		A	✓	✗
5610	Harmonic no. 51		Har51		A	✓	✗

13.8.15.2 Harmonics registers – UI phase shift [rad]

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
5612	Harmonic no. 1	PHI UI L1	Hr1	PHI UI L1	rad	✓	✗
...	...						
5712	Harmonic no. 51	PHI UI L1	Hr51	PHI UI L1	rad	✓	✗
5714	Harmonic no. 1	PHI UI L2	Hr1	PHI UI L2	rad	✓	✗
..	...						
5814	Harmonic no. 51	PHI UI L2	Hr51	PHI UI L2	rad	✓	✗
5816	Harmonic no. 1	PHI UI L3	Hr1	PHI UI L3	rad	✓	✗
..	...						
5916	Harmonic no. 51	PHI UI L3	Hr51	PHI UI L3	rad	✓	✗

13.8.15.3 Harmonics registers – UI phase shift [deg]

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
5918	Harmonic no. 1	PHI UI L1	Hr1	PHI UI L1	°	✓	✗
...	...						
6018	Harmonic no. 51	PHI UI L1	Hr51	PHI UI L1	°	✓	✗
6020	Harmonic no. 1	PHI UI L2	Hr1	PHI UI L2	°	✓	✗
..	...						
6120	Harmonic no. 51	PHI UI L2	Hr51	PHI UI L2	°	✓	✗

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
6122	Harmonic no. 1	PHI UI L3	Hr1	PHI UI L3	°	✓	✗
..	...						
6222	Harmonic no. 51	PHI UI L3	Hr51	PHI UI L3	°	✓	✗

13.8.15.4 Harmonics registers - Active power

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
6224	Harmonic no. 1	Hr P L1	Hr1	Hr P L1	W	✓	✗
...	...						
6324	Harmonic no. 51	Hr P L1	Hr51	Hr P L1	W	✓	✗
6326	Harmonic no. 1	Hr P L2	Hr1	Hr P L2	W	✓	✗
..	...						
6426	Harmonic no. 51	Hr P L2	Hr51	Hr P L2	W	✓	✗
6428	Harmonic no. 1	Hr P L3	Hr1	Hr P L3	W	✓	✗
..	...						
6528	Harmonic no. 51	Hr P L3	Hr51	Hr P L3	W	✓	✗

13.8.15.5 Harmonics registers - Apparent power

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
6530	Harmonic no. 1	Hr S L1	Hr1	Hr S L1	VA	✓	✗
...	...						
6630	Harmonic no. 51	Hr S L1	Hr51	Hr S L1	VA	✓	✗
6632	Harmonic no. 1	Hr S L2	Hr1	Hr S L2	VA	✓	✗
..	...						
6732	Harmonic no. 51	Hr S L2	Hr51	Hr S L2	VA	✓	✗
6734	Harmonic no. 1	Hr S L3	Hr1	Hr S L3	VA	✓	✗
..	...						
6834	Harmonic no. 51	Hr S L3	Hr51	Hr S L3	VA	✓	✗

13.8.15.6 Harmonics registers - Reactive power

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
6836	Harmonic no. 1	Hr Q L1	Hr1	Hr Q L1	var	✓	✗
...	...						

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
6936	Harmonic no. 51	Hr Q L1	Hr51	Hr Q L1	var	✓	✗
6938	Harmonic no. 1	Hr Q L2	Hr1	Hr Q L2	var	✓	✗
..	...						
7038	Harmonic no. 51	Hr Q L2	Hr51	Hr Q L2	var	✓	✗
7040	Harmonic no. 1	Hr Q L3	Hr1	Hr Q L3	var	✓	✗
..	...						
7140	Harmonic no. 51	Hr Q L3	Hr51	Hr Q L3	var	✓	✗

13.8.16 Interharmonics registers

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
1762	Interharmonic no. 1	U L1	IHar1	U L1	%	✓	✗
1764	Interharmonic no. 2		IHar2		%	✓	✗
1766	Interharmonic no. 3		IHar3		%	✓	✗
...	...						
1858	Interharmonic no. 49	U L1	IHar49	U L1	%	✓	✗
1860	Interharmonic no. 50		IHar50		%	✓	✗
1862	Interharmonic no. 51		IHar51		%	✓	✗
1864	Interharmonic no. 1	U L2	IHr1	U L2	%	✓	✗
1866	Interharmonic no. 2		IHr2		%	✓	✗
1868	Interharmonic no. 3		IHr3		%	✓	✗
..	...						
1960	Interharmonic no. 49	U L2	IHr49	U L2	%	✓	✗
1962	Interharmonic no. 50		IHr50		%	✓	✗
1964	Interharmonic no. 51		IHr51		%	✓	✗
1966	Interharmonic no. 1	U L3	IHr1	U L3	%	✓	✗
1968	Interharmonic no. 2		IHr2		%	✓	✗
1970	Interharmonic no. 3		IHr3		%	✓	✗
..	...						
2062	Interharmonic no. 49	U L3	IHr49	U L3	%	✓	✗
2064	Interharmonic no. 50		IHr50		%	✓	✗
2066	Interharmonic no. 51		IHr51		%	✓	✗
2068	Interharmonic no. 1	I L1	IHar1	I L1	%	✓	✗
2070	Interharmonic no. 2		IHar2		%	✓	✗

Reg.	Parameter		Symbol		Unit	3Ph/ 4W	3Ph/ 3W
2072	Interharmonic no. 3		IHar3		%	✓	✗
..	...						
2164	Interharmonic no. 49	I L1	IHar49	I L1	%	✓	✗
2166	Interharmonic no. 50		IHar50		%	✓	✗
2168	Interharmonic no. 51		IHar51		%	✓	✗
2170	Interharmonic no. 1	I L2	IHar1	I L2	%	✓	✗
2172	Interharmonic no. 2		IHar2		%	✓	✗
2174	Interharmonic no. 3		IHar3		%	✓	✗
..	...						
1654	Interharmonic no. 49	I L2	IHar49	I L2	%	✓	✗
1656	Interharmonic no. 50		IHar50		%	✓	✗
2270	Interharmonic no. 51		IHar51		%	✓	✗
2272	Interharmonic no. 1	I L3	IHar1	I L3	%	✓	✗
2274	Interharmonic no. 2		IHar2		%	✓	✗
2276	Interharmonic no. 3		IHar3		%	✓	✗
..	...						
2368	Interharmonic no. 49	I L3	IHar49	I L3	%	✓	✗
2370	Interharmonic no. 50		IHar50		%	✓	✗
2372	Interharmonic no. 51		IHar51		%	✓	✗

13.8.17 Voltage half-wave registers

Reg.	Parameter		50 Hz	60 Hz	Symbol		Unit	3Ph/ 4W	3Ph/ 3W
2380	Half-wave value no. 1	U L1	✓	✓	Uhalf1	U L1	V	✓	✗
2382	Half-wave value no. 2		✓	✓	Uhalf2		V	✓	✗
2384	Half-wave value no. 3		✓	✓	Uhalf3		V	✓	✗
...	...								
2420	Half-wave value no. 21	U L1	✗	✓	Uhalf21	U L1	V	✓	✗
2422	Half-wave value no. 22		✗	✓	Uhalf22		V	✓	✗
2424	Half-wave value no. 23		✗	✓	Uhalf23		V	✓	✗
2426	Half-wave value no. 24		✗	✓	Uhalf24		V	✓	✗
2428	Half-wave value no. 1	U L2	✓	✓	Uhalf1	U L2	V	✓	✗
2430	Half-wave value no. 2		✓	✓	Uhalf2		V	✓	✗
2432	Half-wave value no. 3		✓	✓	Uhalf3		V	✓	✗

Reg.	Parameter	50 Hz	60 Hz	Symbol	Unit	3Ph/4W	3Ph/3W
..	...						
2468	Half-wave value no. 21	×	✓	Uhalf21	V	✓	×
2470	Half-wave value no. 22	×	✓	Uhalf22	V	✓	×
2472	Half-wave value no. 23	×	✓	Uhalf23	V	✓	×
2474	Half-wave value no. 24	×	✓	Uhalf24	V	✓	×
2476	Half-wave value no. 1	✓	✓	Uhalf1	V	✓	×
2478	Half-wave value no. 2	✓	✓	Uhalf2	V	✓	×
2480	Half-wave value no. 3	✓	✓	Uhalf3	V	✓	×
..	...						
2516	Half-wave value no. 21	×	✓	Uhalf21	V	✓	×
2518	Half-wave value no. 22	×	✓	Uhalf22	V	✓	×
2520	Half-wave value no. 23	×	✓	Uhalf23	V	✓	×
2522	Half-wave value no. 24	×	✓	Uhalf24	V	✓	×

13.8.18 Dip/interruption/swell registers

Reg.	Parameter	50 Hz	60 Hz	Symbol	Unit	3Ph/4W	3Ph/3W
2579	Event flag “1” - any event has occurred; writing “0” clears the flag	✓	✓	-	-	✓	×
Start of event							
2580	Event type: “1” – <i>dip</i> , “2” – <i>swell</i> , “3” – <i>interrupt</i>	✓	✓	-	-	✓	×
2581	Event phase no.	✓	✓	-	-	✓	×
2582	Hour	✓	✓	-	-	✓	×
2583	Minute	✓	✓	-	-	✓	×
2584	Second	✓	✓	-	-	✓	×
2585	Millisecond	✓	✓	-	-	✓	×
2586	Year	✓	✓	-	-	✓	×
2587	Month	✓	✓	-	-	✓	×
2588	Day	✓	✓	-	-	✓	×
2589	Event type	✓	✓	-	-	✓	×
2590	Event phase no.	✓	✓	-	-	✓	×

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2591	Hour		✓	✓	-	-	✓	✗
2592	Minute		✓	✓	-	-	✓	✗
2593	Second		✓	✓	-	-	✓	✗
2594	Millisecond		✓	✓	-	-	✓	✗
2595	Year		✓	✓	-	-	✓	✗
2596	Month		✓	✓	-	-	✓	✗
2597	Day		✓	✓	-	-	✓	✗
2598	Event type	Event 3	✓	✓	-	-	✓	✗
2599	Event phase no.		✓	✓	-	-	✓	✗
2600	Hour		✓	✓	-	-	✓	✗
2601	Minute		✓	✓	-	-	✓	✗
2602	Second		✓	✓	-	-	✓	✗
2603	Millisecond		✓	✓	-	-	✓	✗
2604	Year		✓	✓	-	-	✓	✗
2605	Month		✓	✓	-	-	✓	✗
2606	Day		✓	✓	-	-	✓	✗
2607	Event type	Event 4	✓	✓	-	-	✓	✗
2608	Event phase no.		✓	✓	-	-	✓	✗
2609	Hour		✓	✓	-	-	✓	✗
2610	Minute		✓	✓	-	-	✓	✗
2611	Second		✓	✓	-	-	✓	✗
2612	Millisecond		✓	✓	-	-	✓	✗
2613	Year		✓	✓	-	-	✓	✗
2614	Month		✓	✓	-	-	✓	✗
2615	Day		✓	✓	-	-	✓	✗
2616	Event type	Event 5	✓	✓	-	-	✓	✗
2617	Event phase no.		✓	✓	-	-	✓	✗
2618	Hour		✓	✓	-	-	✓	✗
2619	Minute		✓	✓	-	-	✓	✗
2620	Second		✓	✓	-	-	✓	✗
2621	Millisecond		✓	✓	-	-	✓	✗
2622	Year		✓	✓	-	-	✓	✗
2623	Month		✓	✓	-	-	✓	✗
2624	Day		✓	✓	-	-	✓	✗

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2625	Event type	Event 6	✓	✓	-	-	✓	✗
2626	Event phase no.		✓	✓	-	-	✓	✗
2627	Hour		✓	✓	-	-	✓	✗
2628	Minute		✓	✓	-	-	✓	✗
2629	Second		✓	✓	-	-	✓	✗
2630	Millisecond		✓	✓	-	-	✓	✗
2631	Year		✓	✓	-	-	✓	✗
2632	Month		✓	✓	-	-	✓	✗
2633	Day		✓	✓	-	-	✓	✗
2634	Event type	Event 7	✓	✓	-	-	✓	✗
2635	Event phase no.		✓	✓	-	-	✓	✗
2636	Hour		✓	✓	-	-	✓	✗
2637	Minute		✓	✓	-	-	✓	✗
2638	Second		✓	✓	-	-	✓	✗
2639	Millisecond		✓	✓	-	-	✓	✗
2640	Year		✓	✓	-	-	✓	✗
2641	Month		✓	✓	-	-	✓	✗
2642	Day		✓	✓	-	-	✓	✗
2643	Event type	Event 8	✓	✓	-	-	✓	✗
2644	Event phase no.		✓	✓	-	-	✓	✗
2645	Hour		✓	✓	-	-	✓	✗
2646	Minute		✓	✓	-	-	✓	✗
2647	Second		✓	✓	-	-	✓	✗
2648	Millisecond		✓	✓	-	-	✓	✗
2659	Year		✓	✓	-	-	✓	✗
2660	Month		✓	✓	-	-	✓	✗
2661	Day		✓	✓	-	-	✓	✗
2662	Event type	Event 9	✓	✓	-	-	✓	✗
2663	Event phase no.		✓	✓	-	-	✓	✗
2664	Hour		✓	✓	-	-	✓	✗
2665	Minute		✓	✓	-	-	✓	✗
2666	Second		✓	✓	-	-	✓	✗
2667	Millisecond		✓	✓	-	-	✓	✗
2668	Year		✓	✓	-	-	✓	✗

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2669	Month		✓	✓	-	-	✓	✗
2670	Day		✓	✓	-	-	✓	✗
2671	Event type	Event 10	✓	✓	-	-	✓	✗
2672	Event phase no.		✓	✓	-	-	✓	✗
2673	Hour		✓	✓	-	-	✓	✗
2674	Minute		✓	✓	-	-	✓	✗
2675	Second		✓	✓	-	-	✓	✗
2676	Millisecond		✓	✓	-	-	✓	✗
2677	Year		✓	✓	-	-	✓	✗
2678	Month		✓	✓	-	-	✓	✗
2679	Day		✓	✓	-	-	✓	✗
End of event								
2680	Event type	Event 1	✓	✓	-	-	✓	✗
2681	Event phase no.		✓	✓	-	-	✓	✗
2682	L1 integer part		✓	✓	-	-	✓	✗
2683	L1 fractional part		✓	✓	-	-	✓	✗
2684	L2 integer part		✓	✓	-	-	✓	✗
2685	L2 fractional part		✓	✓	-	-	✓	✗
2686	L3 integer part		✓	✓	-	-	✓	✗
2687	L3 fractional part		✓	✓	-	-	✓	✗
2688	Duration (hours)		✓	✓	-	-	✓	✗
2689	Duration (minutes)		✓	✓	-	-	✓	✗
2690	Duration (seconds)		✓	✓	-	-	✓	✗
2691	Duration (milliseconds)		✓	✓	-	-	✓	✗
2692	Event type	Event 2	✓	✓	-	-	✓	✗
2693	Event phase no.		✓	✓	-	-	✓	✗
2694	L1 integer part		✓	✓	-	-	✓	✗
2695	L1 fractional part		✓	✓	-	-	✓	✗
2696	L2 integer part		✓	✓	-	-	✓	✗
2697	L2 fractional part		✓	✓	-	-	✓	✗
2698	L3 integer part		✓	✓	-	-	✓	✗
2699	L3 fractional part		✓	✓	-	-	✓	✗
2700	Duration (hours)		✓	✓	-	-	✓	✗
2701	Duration (minutes)		✓	✓	-	-	✓	✗

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2702	Duration (seconds)		✓	✓	-	-	✓	✗
2703	Duration (milliseconds)		✓	✓	-	-	✓	✗
2704	Event type	Event 3	✓	✓	-	-	✓	✗
2705	Event phase no.		✓	✓	-	-	✓	✗
2706	L1 integer part		✓	✓	-	-	✓	✗
2707	L1 fractional part		✓	✓	-	-	✓	✗
2708	L2 integer part		✓	✓	-	-	✓	✗
2709	L2 fractional part		✓	✓	-	-	✓	✗
2710	L3 integer part		✓	✓	-	-	✓	✗
2711	L3 fractional part		✓	✓	-	-	✓	✗
2712	Duration (hours)		✓	✓	-	-	✓	✗
2713	Duration (minutes)		✓	✓	-	-	✓	✗
2714	Duration (seconds)		✓	✓	-	-	✓	✗
2715	Duration (milliseconds)		✓	✓	-	-	✓	✗
2716	Event type	Event 4	✓	✓	-	-	✓	✗
2717	Event phase no.		✓	✓	-	-	✓	✗
2718	L1 integer part		✓	✓	-	-	✓	✗
2719	L1 fractional part		✓	✓	-	-	✓	✗
2720	L2 integer part		✓	✓	-	-	✓	✗
2721	L2 fractional part		✓	✓	-	-	✓	✗
2722	L3 integer part		✓	✓	-	-	✓	✗
2723	L3 fractional part		✓	✓	-	-	✓	✗
2724	Duration (hours)		✓	✓	-	-	✓	✗
2725	Duration (minutes)		✓	✓	-	-	✓	✗
2726	Duration (seconds)		✓	✓	-	-	✓	✗
2727	Duration (milliseconds)		✓	✓	-	-	✓	✗
2728	Event type	Event 5	✓	✓	-	-	✓	✗
2729	Event phase no.		✓	✓	-	-	✓	✗
2730	L1 integer part		✓	✓	-	-	✓	✗
2731	L1 fractional part		✓	✓	-	-	✓	✗
2732	L2 integer part		✓	✓	-	-	✓	✗
2733	L2 fractional part		✓	✓	-	-	✓	✗
2734	L3 integer part		✓	✓	-	-	✓	✗
2735	L3 fractional part		✓	✓	-	-	✓	✗

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2736	Duration (hours)		✓	✓	-	-	✓	✗
2737	Duration (minutes)		✓	✓	-	-	✓	✗
2738	Duration (seconds)		✓	✓	-	-	✓	✗
2739	Duration (milliseconds)		✓	✓	-	-	✓	✗
2740	Event type	Event 6	✓	✓	-	-	✓	✗
2741	Event phase no.		✓	✓	-	-	✓	✗
2742	L1 integer part		✓	✓	-	-	✓	✗
2743	L1 fractional part		✓	✓	-	-	✓	✗
2744	L2 integer part		✓	✓	-	-	✓	✗
2745	L2 fractional part		✓	✓	-	-	✓	✗
2746	L3 integer part		✓	✓	-	-	✓	✗
2747	L3 fractional part		✓	✓	-	-	✓	✗
2748	Duration (hours)		✓	✓	-	-	✓	✗
2749	Duration (minutes)		✓	✓	-	-	✓	✗
2750	Duration (seconds)	Event 7	✓	✓	-	-	✓	✗
2751	Duration (milliseconds)		✓	✓	-	-	✓	✗
2752	Event type		✓	✓	-	-	✓	✗
2753	Event phase no.		✓	✓	-	-	✓	✗
2754	L1 integer part		✓	✓	-	-	✓	✗
2755	L1 fractional part		✓	✓	-	-	✓	✗
2756	L2 integer part		✓	✓	-	-	✓	✗
2757	L2 fractional part		✓	✓	-	-	✓	✗
2758	L3 integer part		✓	✓	-	-	✓	✗
2759	L3 fractional part		✓	✓	-	-	✓	✗
2760	Duration (hours)	Event 8	✓	✓	-	-	✓	✗
2761	Duration (minutes)		✓	✓	-	-	✓	✗
2762	Duration (seconds)		✓	✓	-	-	✓	✗
2763	Duration (milliseconds)		✓	✓	-	-	✓	✗
2764	Event type		✓	✓	-	-	✓	✗
2765	Event phase no.		✓	✓	-	-	✓	✗
2766	L1 integer part		✓	✓	-	-	✓	✗
2767	L1 fractional part		✓	✓	-	-	✓	✗
2768	L2 integer part		✓	✓	-	-	✓	✗
2769	L2 fractional part		✓	✓	-	-	✓	✗

Reg.	Parameter		50 Hz	60 Hz	Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2770	L3 integer part		✓	✓	-	-	✓	✗
2771	L3 fractional part		✓	✓	-	-	✓	✗
2772	Duration (hours)		✓	✓	-	-	✓	✗
2773	Duration (minutes)		✓	✓	-	-	✓	✗
2774	Duration (seconds)		✓	✓	-	-	✓	✗
2775	Duration (milliseconds)		✓	✓	-	-	✓	✗
2776	Event type	Event 9	✓	✓	-	-	✓	✗
2777	Event phase no.		✓	✓	-	-	✓	✗
2778	L1 integer part		✓	✓	-	-	✓	✗
2779	L1 fractional part		✓	✓	-	-	✓	✗
2780	L2 integer part		✓	✓	-	-	✓	✗
2781	L2 fractional part		✓	✓	-	-	✓	✗
2782	L3 integer part		✓	✓	-	-	✓	✗
2783	L3 fractional part		✓	✓	-	-	✓	✗
2784	Duration (hours)		✓	✓	-	-	✓	✗
2785	Duration (minutes)		✓	✓	-	-	✓	✗
2786	Duration (seconds)		✓	✓	-	-	✓	✗
2787	Duration (milliseconds)		✓	✓	-	-	✓	✗
2788	Event type	Event 10	✓	✓	-	-	✓	✗
2789	Event phase no.		✓	✓	-	-	✓	✗
2790	L1 integer part		✓	✓	-	-	✓	✗
2791	L1 fractional part		✓	✓	-	-	✓	✗
2792	L2 integer part		✓	✓	-	-	✓	✗
2793	L2 fractional part		✓	✓	-	-	✓	✗
2794	L3 integer part		✓	✓	-	-	✓	✗
2795	L3 fractional part		✓	✓	-	-	✓	✗
2796	Duration (hours)		✓	✓	-	-	✓	✗
2797	Duration (minutes)		✓	✓	-	-	✓	✗
2798	Duration (seconds)		✓	✓	-	-	✓	✗
2799	Duration (milliseconds)		✓	✓	-	-	✓	✗

13.8.19 Binary input pulse counters and energy counters from the external card

Reg.	Parameter	50 Hz	60 Hz	Symbol	Unit	3Ph/4W	3Ph/3W
2800	Output 1 pulse counter	✓	✓	-	imp	✓	✓
2802	Output 2 pulse counter	✓	✓	-	imp	✓	✓
2804	Output 3 pulse counter	✓	✓	-	imp	✓	✓
2806	Output 4 pulse counter	✓	✓	-	imp	✓	✓
2808	Output 5 pulse counter	✓	✓	-	imp	✓	✓
2810	Output 6 pulse counter	✓	✓	-	imp	✓	✓
2812	Output 1 energy counter	✓	✓	-	kWh	✓	✓
2814	Output 2 energy counter	✓	✓	-	kWh	✓	✓
2816	Output 3 energy counter	✓	✓	-	kWh	✓	✓
2818	Output 4 energy counter	✓	✓	-	kWh	✓	✓
2820	Output 5 energy counter	✓	✓	-	kWh	✓	✓
2822	Output 6 energy counter	✓	✓	-	kWh	✓	✓

13.8.20 Tariffs

Reg.	Parameter		Symbol	Unit	3Ph/4W	3Ph/3W
Tariff 1						
2850	Active imported energy	L1	EnP+	MWh	✓	✓
2852	Active imported energy	L1	EnP+	kWh	✓	✓
2854	Active imported energy	L2	EnP+	MWh	✓	✓
2856	Active imported energy	L2	EnP+	kWh	✓	✓
2858	Active imported energy	L3	EnP+	MWh	✓	✓
2860	Active imported energy	L3	EnP+	kWh	✓	✓
2862	Sum of active imported energy	L123	ΣEnP+	MWh	✓	✓
2864	Sum of active imported energy	L123	ΣEnP+	kWh	✓	✓
2866	Active exported energy	L1	EnP-	MWh	✓	✓
2868	Active exported energy	L1	EnP-	kWh	✓	✓
2870	Active exported energy	L2	EnP-	MWh	✓	✓
2872	Active exported energy	L2	EnP-	kWh	✓	✓
2874	Active exported energy	L3	EnP-	MWh	✓	✓
2876	Active exported energy	L3	EnP-	kWh	✓	✓
2878	Sum of active exported energy	L123	ΣEnP-	MWh	✓	✓
2880	Sum of active exported energy	L123	ΣEnP-	kWh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2882	Reactive inductive imported energy	L1	$\text{EnQ}^+ \}$	Mvarh	✓	✓
2884	Reactive inductive imported energy	L1	$\text{EnQ}^+ \}$	kvarh	✓	✓
2886	Reactive inductive imported energy	L2	$\text{EnQ}^+ \}$	Mvarh	✓	✓
2888	Reactive inductive imported energy	L2	$\text{EnQ}^+ \}$	kvarh	✓	✓
2890	Reactive inductive imported energy	L3	$\text{EnQ}^+ \}$	Mvarh	✓	✓
2892	Reactive inductive imported energy	L3	$\text{EnQ}^+ \}$	kvarh	✓	✓
2894	Total reactive inductive imported energy	L123	$\Sigma \text{EnQ}^+ \}$	Mvarh	✓	✓
2896	Total reactive inductive imported energy	L123	$\Sigma \text{EnQ}^+ \}$	kvarh	✓	✓
2898	Reactive capacitive exported energy	L1	$\text{EnQ}^- \}$	Mvarh	✓	✓
2900	Reactive capacitive exported energy	L1	$\text{EnQ}^- \}$	kvarh	✓	✓
2902	Reactive capacitive exported energy	L2	$\text{EnQ}^- \}$	Mvarh	✓	✓
2904	Reactive capacitive exported energy	L2	$\text{EnQ}^- \}$	kvarh	✓	✓
2906	Reactive capacitive exported energy	L3	$\text{EnQ}^- \}$	Mvarh	✓	✓
2908	Reactive capacitive exported energy	L3	$\text{EnQ}^- \}$	kvarh	✓	✓
2910	Total reactive capacitive exported energy	L123	$\Sigma \text{EnQ}^- \}$	Mvarh	✓	✓
2912	Total reactive capacitive exported energy	L123	$\Sigma \text{EnQ}^- \}$	kvarh	✓	✓
2914	Reactive inductive imported energy	L1	$\text{EnQ}^+ \dashv$	Mvarh	✓	✓
2916	Reactive inductive imported energy	L1	$\text{EnQ}^+ \dashv$	kvarh	✓	✓
2918	Reactive inductive imported energy	L2	$\text{EnQ}^+ \dashv$	Mvarh	✓	✓
2920	Reactive inductive imported energy	L2	$\text{EnQ}^+ \dashv$	kvarh	✓	✓
2922	Reactive inductive imported energy	L3	$\text{EnQ}^+ \dashv$	Mvarh	✓	✓
2924	Reactive inductive imported energy	L3	$\text{EnQ}^+ \dashv$	kvarh	✓	✓
2926	Total reactive inductive imported energy	L123	$\Sigma \text{EnQ}^+ \dashv$	Mvarh	✓	✓
2928	Total reactive inductive imported energy	L123	$\Sigma \text{EnQ}^+ \dashv$	kvarh	✓	✓
2930	Reactive capacitive exported energy	L1	$\text{EnQ}^- \dashv$	Mvarh	✓	✓
2932	Reactive capacitive exported energy	L1	$\text{EnQ}^- \dashv$	kvarh	✓	✓
2934	Reactive capacitive exported energy	L2	$\text{EnQ}^- \dashv$	Mvarh	✓	✓
2936	Reactive capacitive exported energy	L2	$\text{EnQ}^- \dashv$	kvarh	✓	✓
2938	Reactive capacitive exported energy	L3	$\text{EnQ}^- \dashv$	Mvarh	✓	✓
2940	Reactive capacitive exported energy	L3	$\text{EnQ}^- \dashv$	kvarh	✓	✓
2942	Total reactive capacitive exported energy	L123	$\Sigma \text{EnQ}^- \dashv$	Mvarh	✓	✓
2944	Total reactive capacitive exported energy	L123	$\Sigma \text{EnQ}^- \dashv$	kvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
2946	Apparent energy	L1	EnS	MVAh	✓	✓
2948	Apparent energy	L1	EnS	kVAh	✓	✓
2950	Apparent energy	L2	EnS	MVAh	✓	✓
2952	Apparent energy	L2	EnS	kVAh	✓	✓
2954	Apparent energy	L3	EnS	MVAh	✓	✓
2956	Apparent energy	L3	EnS	kVAh	✓	✓
2958	Sum of apparent energy	L123	Σ EnS	MVAh	✓	✓
2960	Sum of apparent energy	L123	Σ EnS	kVAh	✓	✓
Tariff 2						
2962	Active imported energy	L1	EnP+	MWh	✓	✓
2966	Active imported energy	L1	EnP+	kWh	✓	✓
2966	Active imported energy	L2	EnP+	MWh	✓	✓
2968	Active imported energy	L2	EnP+	kWh	✓	✓
2970	Active imported energy	L3	EnP+	MWh	✓	✓
2972	Active imported energy	L3	EnP+	kWh	✓	✓
2974	Sum of active imported energy	L123	Σ EnP+	MWh	✓	✓
2976	Sum of active imported energy	L123	Σ EnP+	kWh	✓	✓
2978	Active exported energy	L1	EnP-	MWh	✓	✓
2980	Active exported energy	L1	EnP-	kWh	✓	✓
2982	Active exported energy	L2	EnP-	MWh	✓	✓
2984	Active exported energy	L2	EnP-	kWh	✓	✓
2986	Active exported energy	L3	EnP-	MWh	✓	✓
2988	Active exported energy	L3	EnP-	kWh	✓	✓
2990	Sum of active exported energy	L123	Σ EnP-	MWh	✓	✓
2992	Sum of active exported energy	L123	Σ EnP-	kWh	✓	✓
2994	Reactive inductive imported energy	L1	EnQ+ } }	Mvarh	✓	✓
2996	Reactive inductive imported energy	L1	EnQ+ } }	kvarh	✓	✓
2998	Reactive inductive imported energy	L2	EnQ+ } }	Mvarh	✓	✓
3000	Reactive inductive imported energy	L2	EnQ+ } }	kvarh	✓	✓
3002	Reactive inductive imported energy	L3	EnQ+ } }	Mvarh	✓	✓
3004	Reactive inductive imported energy	L3	EnQ+ } }	kvarh	✓	✓
3006	Total reactive inductive imported energy	L123	Σ EnQ+ } }	Mvarh	✓	✓
3008	Total reactive inductive imported energy	L123	Σ EnQ+ } }	kvarh	✓	✓
3010	Reactive capacitive exported energy	L1	EnQ- } }	Mvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3012	Reactive capacitive exported energy	L1	EnQ- $\int$	kvarh	✓	✓
3014	Reactive capacitive exported energy	L2	EnQ- $\int$	Mvarh	✓	✓
3016	Reactive capacitive exported energy	L2	EnQ- $\int$	kvarh	✓	✓
3018	Reactive capacitive exported energy	L3	EnQ- $\int$	Mvarh	✓	✓
3020	Reactive capacitive exported energy	L3	EnQ- $\int$	kvarh	✓	✓
3022	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	Mvarh	✓	✓
3024	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	kvarh	✓	✓
3026	Reactive inductive imported energy	L1	EnQ+ $\int$	Mvarh	✓	✓
3028	Reactive inductive imported energy	L1	EnQ+ $\int$	kvarh	✓	✓
3030	Reactive inductive imported energy	L2	EnQ+ $\int$	Mvarh	✓	✓
3032	Reactive inductive imported energy	L2	EnQ+ $\int$	kvarh	✓	✓
3034	Reactive inductive imported energy	L3	EnQ+ $\int$	Mvarh	✓	✓
3036	Reactive inductive imported energy	L3	EnQ+ $\int$	kvarh	✓	✓
3038	Total reactive inductive imported energy	L123	Σ EnQ+ $\int$	Mvarh	✓	✓
3040	Total reactive inductive imported energy	L123	Σ EnQ+ $\int$	kvarh	✓	✓
3042	Reactive capacitive exported energy	L1	EnQ- $\int$	Mvarh	✓	✓
3044	Reactive capacitive exported energy	L1	EnQ- $\int$	kvarh	✓	✓
3046	Reactive capacitive exported energy	L2	EnQ- $\int$	Mvarh	✓	✓
3048	Reactive capacitive exported energy	L2	EnQ- $\int$	kvarh	✓	✓
3050	Reactive capacitive exported energy	L3	EnQ- $\int$	Mvarh	✓	✓
3052	Reactive capacitive exported energy	L3	EnQ- $\int$	kvarh	✓	✓
3054	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	Mvarh	✓	✓
3056	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	kvarh	✓	✓
3058	Apparent energy	L1	EnS	MVAh	✓	✓
3060	Apparent energy	L1	EnS	kVAh	✓	✓
3062	Apparent energy	L2	EnS	MVAh	✓	✓
3064	Apparent energy	L2	EnS	kVAh	✓	✓
3066	Apparent energy	L3	EnS	MVAh	✓	✓
3068	Apparent energy	L3	EnS	kVAh	✓	✓
3070	Sum of apparent energy	L123	Σ EnS	MVAh	✓	✓
3072	Sum of apparent energy	L123	Σ EnS	kVAh	✓	✓
Tariff 3						
3074	Active imported energy	L1	EnP+	MWh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3076	Active imported energy	L1	EnP+	kWh	✓	✓
3078	Active imported energy	L2	EnP+	MWh	✓	✓
3080	Active imported energy	L2	EnP+	kWh	✓	✓
3082	Active imported energy	L3	EnP+	MWh	✓	✓
3084	Active imported energy	L3	EnP+	kWh	✓	✓
3086	Sum of active imported energy	L123	Σ EnP+	MWh	✓	✓
3088	Sum of active imported energy	L123	Σ EnP+	kWh	✓	✓
3090	Active exported energy	L1	EnP-	MWh	✓	✓
3092	Active exported energy	L1	EnP-	kWh	✓	✓
3094	Active exported energy	L2	EnP-	MWh	✓	✓
3096	Active exported energy	L2	EnP-	kWh	✓	✓
3098	Active exported energy	L3	EnP-	MWh	✓	✓
3100	Active exported energy	L3	EnP-	kWh	✓	✓
3102	Sum of active exported energy	L123	Σ EnP-	MWh	✓	✓
3104	Sum of active exported energy	L123	Σ EnP-	kWh	✓	✓
3106	Reactive inductive imported energy	L1	EnQ+ $\int$	Mvarh	✓	✓
3108	Reactive inductive imported energy	L1	EnQ+ $\int$	kvarh	✓	✓
3110	Reactive inductive imported energy	L2	EnQ+ $\int$	Mvarh	✓	✓
3112	Reactive inductive imported energy	L2	EnQ+ $\int$	kvarh	✓	✓
3114	Reactive inductive imported energy	L3	EnQ+ $\int$	Mvarh	✓	✓
3116	Reactive inductive imported energy	L3	EnQ+ $\int$	kvarh	✓	✓
3118	Total reactive inductive imported energy	L123	Σ EnQ+ $\int$	Mvarh	✓	✓
3120	Total reactive inductive imported energy	L123	Σ EnQ+ $\int$	kvarh	✓	✓
3122	Reactive capacitive exported energy	L1	EnQ- $\int$	Mvarh	✓	✓
3124	Reactive capacitive exported energy	L1	EnQ- $\int$	kvarh	✓	✓
3126	Reactive capacitive exported energy	L2	EnQ- $\int$	Mvarh	✓	✓
3128	Reactive capacitive exported energy	L2	EnQ- $\int$	kvarh	✓	✓
3130	Reactive capacitive exported energy	L3	EnQ- $\int$	Mvarh	✓	✓
3132	Reactive capacitive exported energy	L3	EnQ- $\int$	kvarh	✓	✓
3134	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	Mvarh	✓	✓
3136	Total reactive capacitive exported energy	L123	Σ EnQ- $\int$	kvarh	✓	✓
3138	Reactive inductive imported energy	L1	EnQ+ $\dashv$	Mvarh	✓	✓
3140	Reactive inductive imported energy	L1	EnQ+ $\dashv$	kvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3142	Reactive inductive imported energy	L2	EnQ+ - -	Mvarh	✓	✓
3144	Reactive inductive imported energy	L2	EnQ+ - -	kvarh	✓	✓
3146	Reactive inductive imported energy	L3	EnQ+ - -	Mvarh	✓	✓
3148	Reactive inductive imported energy	L3	EnQ+ - -	kvarh	✓	✓
3150	Total reactive inductive imported energy	L123	Σ EnQ+ - -	Mvarh	✓	✓
3152	Total reactive inductive imported energy	L123	Σ EnQ+ - -	kvarh	✓	✓
3154	Reactive capacitive exported energy	L1	EnQ- - -	Mvarh	✓	✓
3156	Reactive capacitive exported energy	L1	EnQ- - -	kvarh	✓	✓
3158	Reactive capacitive exported energy	L2	EnQ- - -	Mvarh	✓	✓
3160	Reactive capacitive exported energy	L2	EnQ- - -	kvarh	✓	✓
3162	Reactive capacitive exported energy	L3	EnQ- - -	Mvarh	✓	✓
3164	Reactive capacitive exported energy	L3	EnQ- - -	kvarh	✓	✓
3166	Total reactive capacitive exported energy	L123	Σ EnQ- - -	Mvarh	✓	✓
3168	Total reactive capacitive exported energy	L123	Σ EnQ- - -	kvarh	✓	✓
3170	Apparent energy	L1	EnS	MVAh	✓	✓
3172	Apparent energy	L1	EnS	kVAh	✓	✓
3174	Apparent energy	L2	EnS	MVAh	✓	✓
3176	Apparent energy	L2	EnS	kVAh	✓	✓
3178	Apparent energy	L3	EnS	MVAh	✓	✓
3180	Apparent energy	L3	EnS	kVAh	✓	✓
3182	Sum of apparent energy	L123	Σ EnS	MVAh	✓	✓
3184	Sum of apparent energy	L123	Σ EnS	kVAh	✓	✓
Tariff 4						
3186	Active imported energy	L1	EnP+	MWh	✓	✓
3188	Active imported energy	L1	EnP+	kWh	✓	✓
3190	Active imported energy	L2	EnP+	MWh	✓	✓
3192	Active imported energy	L2	EnP+	kWh	✓	✓
3194	Active imported energy	L3	EnP+	MWh	✓	✓
3196	Active imported energy	L3	EnP+	kWh	✓	✓
3198	Sum of active imported energy	L123	Σ EnP+	MWh	✓	✓
3200	Sum of active imported energy	L123	Σ EnP+	kWh	✓	✓
3202	Active exported energy	L1	EnP-	MWh	✓	✓
3204	Active exported energy	L1	EnP-	kWh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3206	Active exported energy	L2	EnP-	MWh	✓	✓
3208	Active exported energy	L2	EnP-	kWh	✓	✓
3210	Active exported energy	L3	EnP-	MWh	✓	✓
3212	Active exported energy	L3	EnP-	kWh	✓	✓
3214	Sum of active exported energy	L123	Σ EnP-	MWh	✓	✓
3216	Sum of active exported energy	L123	Σ EnP-	kWh	✓	✓
3218	Reactive inductive imported energy	L1	EnQ+ } }	Mvarh	✓	✓
3220	Reactive inductive imported energy	L1	EnQ+ } }	kvarh	✓	✓
3222	Reactive inductive imported energy	L2	EnQ+ } }	Mvarh	✓	✓
3224	Reactive inductive imported energy	L2	EnQ+ } }	kvarh	✓	✓
3226	Reactive inductive imported energy	L3	EnQ+ } }	Mvarh	✓	✓
3228	Reactive inductive imported energy	L3	EnQ+ } }	kvarh	✓	✓
3230	Total reactive inductive imported energy	L123	Σ EnQ+ } }	Mvarh	✓	✓
3232	Total reactive inductive imported energy	L123	Σ EnQ+ } }	kvarh	✓	✓
3234	Reactive capacitive exported energy	L1	EnQ- } }	Mvarh	✓	✓
3236	Reactive capacitive exported energy	L1	EnQ- } }	kvarh	✓	✓
3238	Reactive capacitive exported energy	L2	EnQ- } }	Mvarh	✓	✓
3240	Reactive capacitive exported energy	L2	EnQ- } }	kvarh	✓	✓
3242	Reactive capacitive exported energy	L3	EnQ- } }	Mvarh	✓	✓
3244	Reactive capacitive exported energy	L3	EnQ- } }	kvarh	✓	✓
3246	Total reactive capacitive exported energy	L123	Σ EnQ- } }	Mvarh	✓	✓
3248	Total reactive capacitive exported energy	L123	Σ EnQ- } }	kvarh	✓	✓
3250	Reactive inductive imported energy	L1	EnQ+ - -	Mvarh	✓	✓
3252	Reactive inductive imported energy	L1	EnQ+ - -	kvarh	✓	✓
3254	Reactive inductive imported energy	L2	EnQ+ - -	Mvarh	✓	✓
3256	Reactive inductive imported energy	L2	EnQ+ - -	kvarh	✓	✓
3258	Reactive inductive imported energy	L3	EnQ+ - -	Mvarh	✓	✓
3260	Reactive inductive imported energy	L3	EnQ+ - -	kvarh	✓	✓
3262	Total reactive inductive imported energy	L123	Σ EnQ+ - -	Mvarh	✓	✓
3264	Total reactive inductive imported energy	L123	Σ EnQ+ - -	kvarh	✓	✓
3266	Reactive capacitive exported energy	L1	EnQ- - -	Mvarh	✓	✓
3268	Reactive capacitive exported energy	L1	EnQ- - -	kvarh	✓	✓
3270	Reactive capacitive exported energy	L2	EnQ- - -	Mvarh	✓	✓

Reg.	Parameter		Symbol	Unit	3Ph/ 4W	3Ph/ 3W
3272	Reactive capacitive exported energy	L2	EnQ- - -	kvarh	✓	✓
3274	Reactive capacitive exported energy	L3	EnQ- - -	Mvarh	✓	✓
3276	Reactive capacitive exported energy	L3	EnQ- - -	kvarh	✓	✓
3278	Total reactive capacitive exported energy	L123	ΣEnQ- - -	Mvarh	✓	✓
3280	Total reactive capacitive exported energy	L123	ΣEnQ- - -	kvarh	✓	✓
3282	Apparent energy	L1	EnS	MVAh	✓	✓
3284	Apparent energy	L1	EnS	kVAh	✓	✓
3286	Apparent energy	L2	EnS	MVAh	✓	✓
3288	Apparent energy	L2	EnS	kVAh	✓	✓
3290	Apparent energy	L3	EnS	MVAh	✓	✓
3292	Apparent energy	L3	EnS	kVAh	✓	✓
3294	Sum of apparent energy	L123	ΣEnS	MVAh	✓	✓
3296	Sum of apparent energy	L123	ΣEnS	kVAh	✓	✓

Conversion of tariff energy counters available in registers, for example EnP+ L1:

EnP+ L1 = ((Value of register 2850 x 1000) + value of register 2852) [kWh]

The other energy values are converted in the same way.

14 Ordering codes

ND45PLUS network parameters analyzer	X	X	X	X	X	XX	X
Input voltage (phase/phase-to-phase) Un:							
3 x 57,7 V / 100 V	1						
3 x 230,0 / 400 V	2						
3 x 69,3/120 V	3						
Inputs/Outputs							
None	0						
8 relay outputs	1						
6 binary inputs, 4 relay outputs	2						
6 binary inputs, 3 outputs 0/4-20 mA	3						
4 binary inputs, 6 outputs 0/4-20 mA	4						
Power supply							
85...253 V a.c., 90...300 V d.c.		1					
24 V d.c. ($\pm 10\%$)		2					
Measurement class							
class S			0				
class A/S			1				
Language version:							
Polish - English					M		
Version:							
standard						00	
special*						XX	
Acceptance tests:							
no additional requirements							0
with a quality inspection certificate							1
with a calibration certificate							2
as agreed with the customer*							X

*Only by prior agreement with the manufacturer

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