

TRANSDUCER OF NETWORK PARAMETERS **P43**



USER'S MANUAL



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1. APPLICATION

The P43 transducer is a programmable digital instrument destined for the measurement and parameter conversion of 3 or 4-wire three-phase power networks, in balanced and unbalanced systems.

It ensures the measurement and conversion of measured values into standard analog current signals. Relay outputs signal the overflow of selected quantities, and the pulse output can be used for the consumption monitoring of the 3-phase active energy.

Quantities measured and calculated by the transducer:

- phase voltages U_1, U_2, U_3
- phase-to-phase voltages U_{12}, U_{23}, U_{31}
- 3-phase mean voltage U
- phase-to-phase mean voltage UPP
- three-phase mean current I
- phase currents I_1, I_2, I_3
- phase active powers P_1, P_2, P_3
- phase reactive powers Q_1, Q_2, Q_3
- phase apparent powers S_1, S_2, S_3
- phase active power factors Pf_1, Pf_2, Pf_3
- reactive/active ratio of power factors $tg\varphi_1, tg\varphi_2, tg\varphi_3$
- three-phase mean power factors $Pf, tg\varphi$
- three-phase active, reactive and apparent powers ... P, Q, S
- active mean power (e.g. 15 min.) P_{av}
- voltage values THD U_1, U_2, U_3
- current values THD I_1, I_2, I_3
- phase values $\cos\varphi$ $\cos\varphi_1, \cos\varphi_2, \cos\varphi_3$
- three-phase values $\cos\varphi$ $\cos\varphi$
- phase values φ $\varphi_1, \varphi_2, \varphi_3$
- calculated current in the neutral conductor wire .. I_n
- three-phase active and reactive energy E_{pt}, E_{qt}
- frequency f
- energy consumption - power guard P_{ord}

The transducer possesses an archive, in which 9000 last mean power values, with time marker, suitably synchronized with the clock (15, 30 or 60 minutes) are stored.

Maximal and minimal values are measured for all quantities. Additionally, there is the possibility to accommodate the transducer to external measuring transducers. The transducer has a detection and signaling of incorrect phase sequence. The actualization time of all accessible quantities does not exceed 1 second. All quantities and configuration parameters are accessible through the RS-485 interface and the USB interface.

Transducer output signals are galvanically isolated from the input signals and the supply. Outside the transducer, there are socket-plug screw terminal strips, to which a conductor with maximal diameter 2,5mm² can be connected.

2. TRANSDUCER SET

The set of the P43 transducer is composed of:

- | | |
|------------------|------|
| - P43 transducer | 1 pc |
| - user's manual | 1 pc |
| - CD disc | 1 pc |

When unpacking the transducer, please check whether the type and execution code on the data plate correspond to the order.

3. BASIC REQUIREMENTS AND OPERATIONAL SAFETY

In the safety service scope, the transducer meets to requirements of the EN 61010-1 standard.



Observations Concerning the Operational Safety:

- All operations concerning transport, installation, and commissioning as well as maintenance, must be carried out by qualified, skilled personnel, and national regulations for the prevention of accidents must be observed.

- Before switching the transducer on, one must check the correctness of connections to the network.
- The removal of the transducer housing during the guarantee contract period may cause its cancellation.
- The P43 transducer is destined to be installed and used in industrial electromagnetic environment conditions.
- One must remember that in the building installation, a switch or a circuit-breaker should be installed. This switch should be located near the device, easy accessible by the operator, and suitably marked.

4. INSTALLATION

4.1. Fitting

The P43 transducer is adapted to be mounted on a 35 mm rail acc. to EN 60715. The overall drawing and the fitting way are presented on the fig.1.

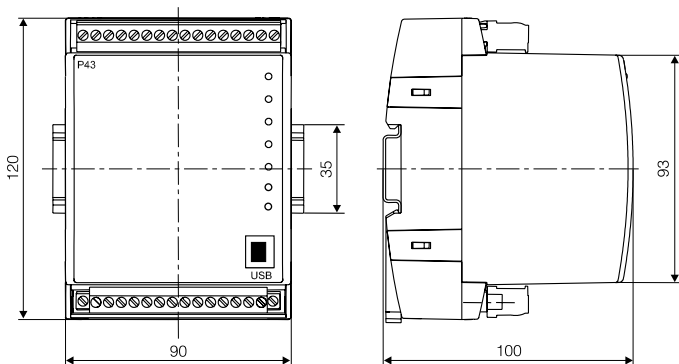


Fig.1 Overall Dimensions and Transducer Fitting Way.

4.2. External Connection Diagrams

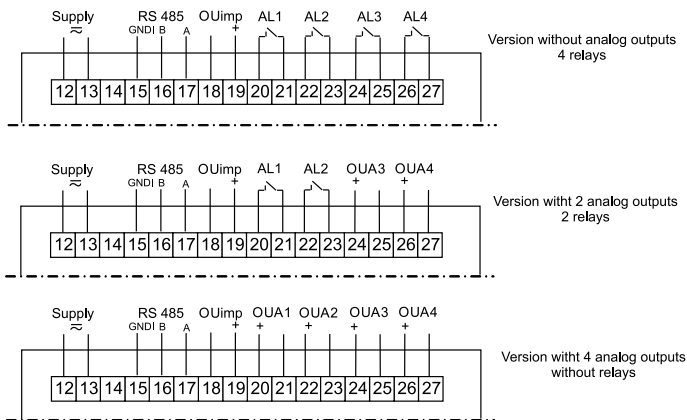
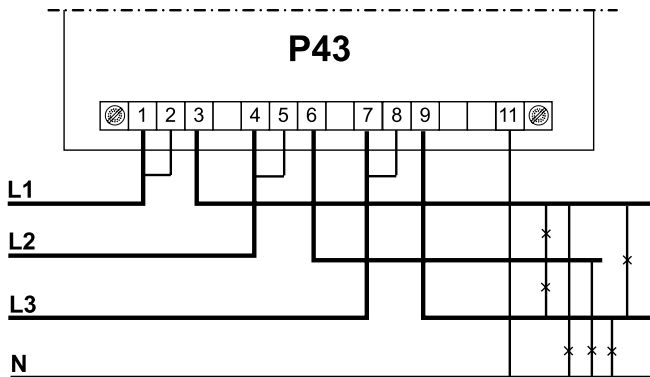
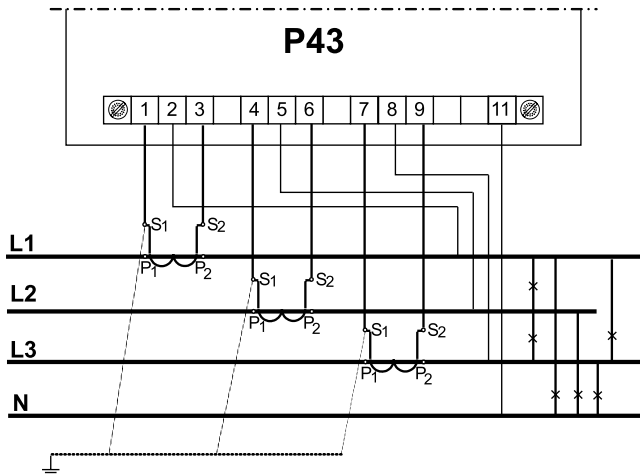


Fig. 2. Connection Diagrams of the Transducer's Upper Strip.



Direct measurement in a four-wire network.



Measurement with the use of current transformers in a four-wire network.

Indirect measurement with the use of 3 current transformers and 2 or 3 voltage transformers in a four-wire network.

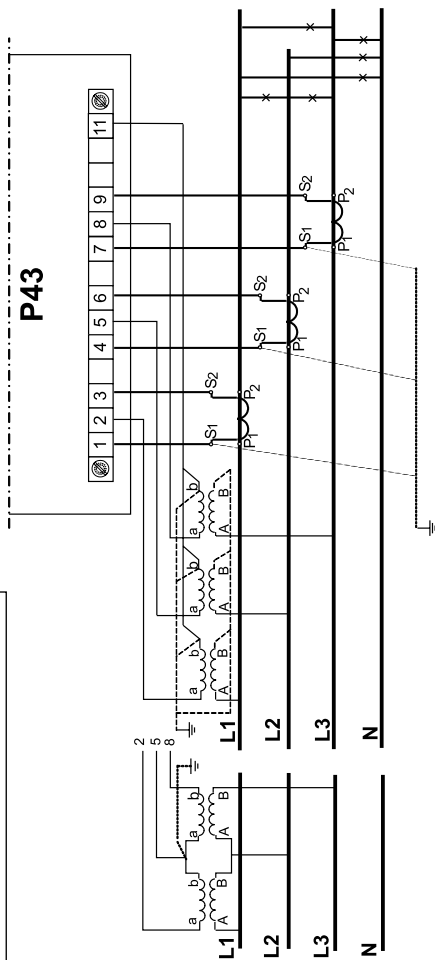
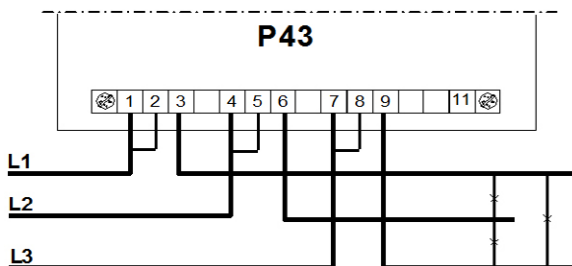
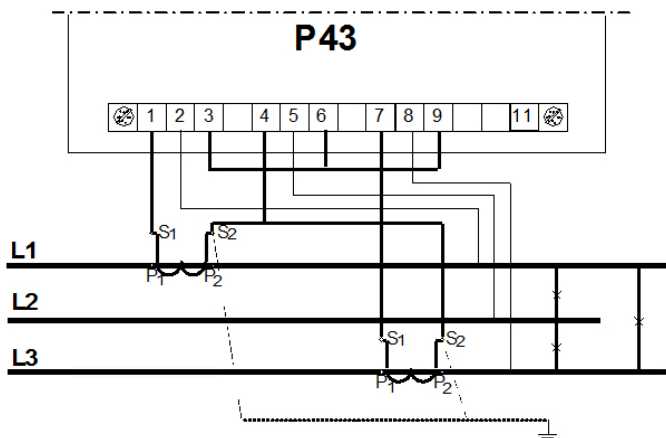


Fig. 3. Connection Diagrams of the Transducer in a Four-wire Network



Direct measurement in a three- wire network.



Semidirect measurement in a three- wire network.

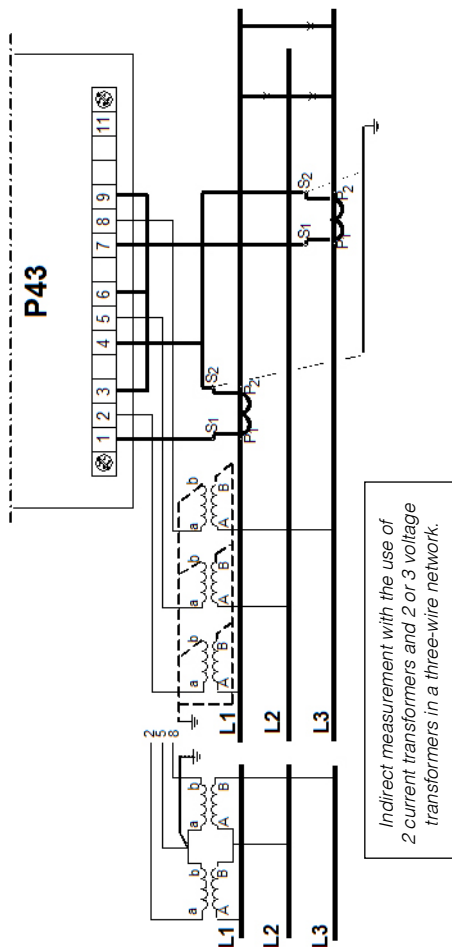


Fig. 3A. Connection Diagrams of the Transducer in a three-wire Network

naled by a pulsing of the Tx diode.

The switching of the relay 1 - 4 on causes the lighting of the AL1 - AL4 diode (fig. 4).

5.3 Installation of COM Port Controllers in the Computer

Before configuring the transducer, the driver on the CD should be installed. The P43 transducer makes use of the software, which creates in the system, a device of Universal Serial Bus – **transducer P43**, and connected to it, the virtual COM port named **transducer P43**.

The controller installation in the Windows system causes the addition of a successive serial COM port to the list of ports serviced by the operating system.

After connecting the transducer to the USB port, the operating system informs about the appearance of a new device by means of the message presented on the fig. 5.

The creator to find a new hardware of the Universal Serial Bus will be started automatically. One must act in compliance with the creator suggestions, choosing the installation from the indicated location and giving the path to controllers being in the added CD. Controllers are compatible with following systems: Windows 2000, XP, Server 2003, Vista, server 2008, (x86 and X64). When installing controllers, information about the lack of the controller digital signature can occur. One must ignore this information and carry on the installation.

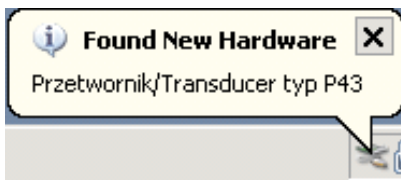


Fig. 5. Message signaling the detection of a new device "Transducer of P43 type".

After closing the creator, the system detect immediately the successive device – USB Serial Port (fig. 6.). The creator for detection a new hardware will start again.



Fig. 6. Systemic message concerning the detection of a new device

After the successful ending of the installation, the system will inform about the installation of a new device (fig. 7.). Two new devices appear in the device manager – **Transducer P43** and Port COM named: **Transducer P43**, acc. to the fig. 8.

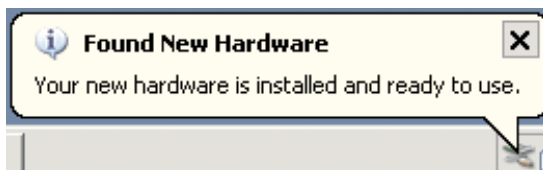


Fig. 7. Systemic message ending the installation of P43 controllers

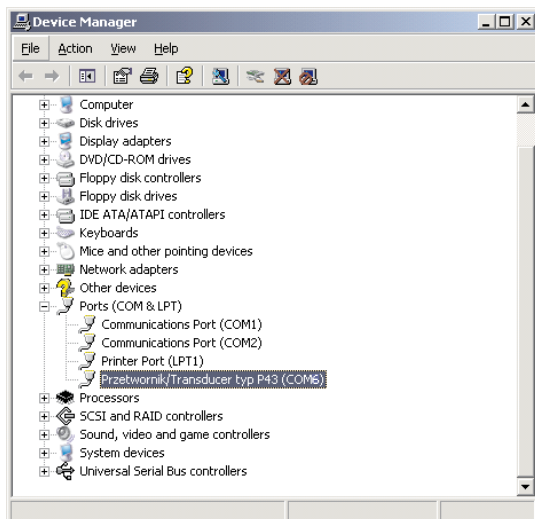


Fig. 8. View of the device manager window together with the installed P43 transducer, which the port COM6 is assigned to.

5.4 Transducer Configuration by Means of the LPCon Software

The LPCon software is destined for the configuration of the P43 transducer. One must connect the transducer to a PC computer through the PD10 converter, if the communication will be performed using RS485 interface or directly through the USB port and after choosing the **Option-> Connection configuration**, configure the connection (fig. 9.). For direct connection, through USB: address 1, baud rate 9600 kb/s, mode RTU 8N2, timeout 1000 ms and the suitable COM port under which the controller of the P43 transducer has been installed or through the RS-485 interface and the PD10 programmer: address, baud rate, and the mode acc. to the installed in the transducer.

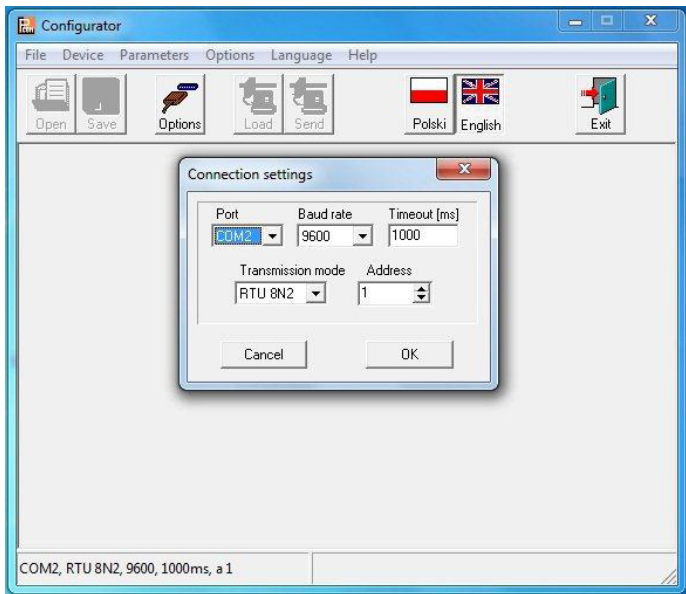


Fig. 9. Configuration of the connection with the P43 transducer

After the connection configuration, one must choose from the **Device -> Transducers -> P43v2** menu, and next click the **Readout** icon in order to read out all parameters. One can also read out parameters individually in each group, clicking the **Refresh** button. In order to change parameters, one must write the new value in the parameter window and click the **Apply** button.

5.4.1 Setting of Transmission Parameters

After choosing the group – **transmission parameters**, it is possible to configure following elements:

- address – address for the communication with the P43 transducer through the RS-485 interface from the range 1...247. The value 1 is normally set up by the manufacturer.
- baud rate – the communication rate through the RS-485 interface from the range (4800, 9600, 19200, 38400 bit/sec.) The value 9600 is set up by the manufacturer.
- transmission mode – The transmission mode through the RS485 interface from the range (RTU 8N2, RTU 8E1, RTU 8O1, RTU 8N1). The transmission mode is normally set up on RTU 8N2 by the manufacturer.

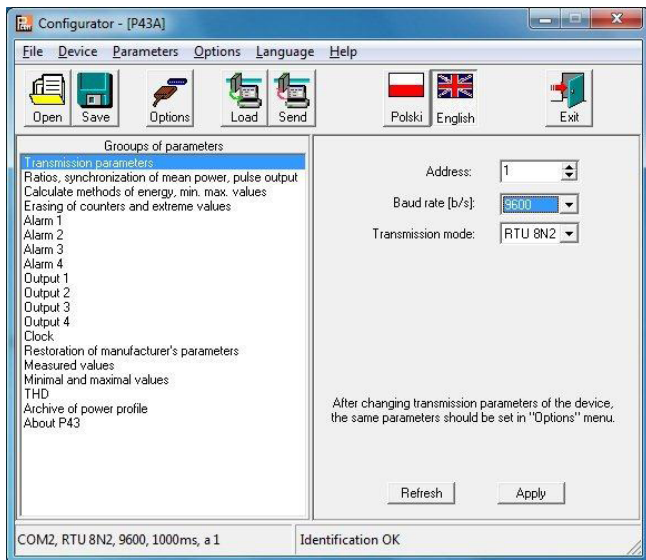


Fig. 10. View of the configuration window of transmission parameters

5.4.2 Setting of Measurement Parameters

After choosing the group: **ratios, power synchronization, time**, following elements can be configured (fig. 11.):

- a) current transformer ratio. The multiplier is used to recalculate the current in the transformer primary side. It is set up on 1 by the manufacturer.
- b) voltage transformer ratio. The multiplier is used to recalculate the voltage in the transformer primary side. It is set up on 1 by the manufacturer.
- c) way to synchronize the mean power:
 - 15 minutes' walking window – mean power PAV will be recalculated for the last 15 minutes, actualized every 15 seconds, i.e. walking window,
 - measurement synchronized with the clock every 15, 30 or 60 minutes - mean power PAV will be actualized every 15, 30 or 60 minutes synchronized with the external real clock (fig. 12).

It is set up on the walking window by the manufacturer.

Ratio of the current transformer (1...10000): 1

Ratio of the voltage transformer (0,1...4000,0): 1,0

Method of mean power synchronization: walking window 15min.

Mean ordered power (0,0...144,0 %): 0,0

Pulses quantity for pulse output: 5000

Measurement mode: 3Ph/4W

Fig. 11. View of the configuration window of measurement parameters

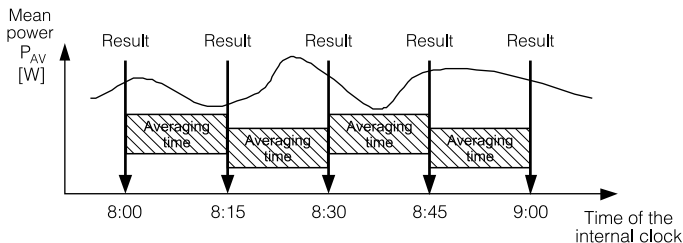


Fig. 12. Measurement of the 15 minutes' active mean power synchronized with the clock.

d) ordered power. Ordered power in percentage of rated power (see chapter 9, example 2).

e) pulse ratio for the pulse output (for active energy).

f) 3-phase measurement mode. 3- and 4-wire measurement.

5.4.3 Calculation methods of power, energy, minimal and maximal values

After choosing the group: **calculation methods of power, energy, minimal and maximal values**, following commands are possible to carry out:

- storing min. and max. values. Choosing of minimal and maximal values storage method: only from measuring range or also overflow error occurrence.
- reactive energy calculation method: inductive and capacitive or plus and minus.

5.4.4 Erasing of Watt-hour Meters and Extremal Values

After choosing the group: **erasing of watt-hour meters and extremal Values**, following commands are possible to carry out:

- a) erasing of watt-hour meters. All watt-hour meters of active and reactive energy are erased.
- b) erasing of active mean power.
- c) erasing of averaging power archive.
- d) erasing of min. and max. values. The currently measured value is copied out to the minimal and maximal value.

5.4.5 Setting of alarm parameters

After choosing the group: **alarm 1-4 configuration**, it is possible to configure following alarm parameters (fig. 13):

- a) assignment of the alarm output parameter – kind of signal, on which the alarm acc. to the table 1 has to react,

The set of the input quantity for alarms and analog outputs is included in the table 1. The calculation way is shown in examples in the chapter 9.

Fig. 13. View of the alarm configuration window.

Table 1

Value in registers 4015, 4023, 4031, 4039, 4047, 4055, 4063, 4072	Kind of quantity	Value for percentage calculation of alarms and output values
00	Lack of quantity /alarm or analog output switched off/	Lack
01	Voltage of phase L1	U_n [V] *
02	Current in the wire of phase L1	I_n [A] *
03	Active power of phase L1	$U_n \times I_n \times \cos(0^\circ)$ [W] *
04	Reactive power of phase L1	$U_n \times I_n \times \sin(90^\circ)$ [var] *
05	Apparent power of phase L1	$U_n \times I_n$ [VA] *

06	Coefficient of active power of phase L1	1
07	Coefficient $\text{tg}\phi$ of phase L1	1
08	Voltage of phase L2	U_n [V] *
09	Current in the wire of phase L2	I_n [A] *
10	Active power of phase L2	$U_n \times I_n \times \cos(0^\circ)$ [W] *
11	Reactive power of phase L2	$U_n \times I_n \times \sin(90^\circ)$ [var] *
12	Apparent power of phase L2	$U_n \times I_n$ [VA] *
13	Coefficient of active power of phase L2	1
14	Coefficient $\text{tg}\phi$ of phase L2	1
15	Voltage of phase 3	U_n [V] *
16	Current in the wire of phase L3	I_n [A] *
17	Active power of phase L3	$U_n \times I_n \times \cos(0^\circ)$ [W] *
18	Reactive power of phase L3	$U_n \times I_n \times \sin(90^\circ)$ [var] *
19	Apparent power of phase L3	$U_n \times I_n$ [VA] *
20	Coefficient of active power of phase L3	1
21	Coefficient $\text{tg}\phi$ of phase L3	1
22	3-phase mean voltage	U_n [V] *
23	3-phase mean current	I_n [A] *
24	3-phase active power	$3 \times U_n \times I_n \times \cos(0^\circ)$ [W] *
25	3-phase reactive power	$3 \times U_n \times I_n \times \sin(90^\circ)$ [var] *
26	3-phase reactive power	$3 \times U_n \times I_n$ [VA] *
27	Power factor of 3-phase active power	1
28	3-phase coefficient $\text{tg}\phi$	1
29	Frequency	100 [Hz]
30	Phase-to-phase voltage L1-L2	$\sqrt{3} U_n$ [V] *
31	Phase-to-phase voltage L2-L3	$\sqrt{3} U_n$ [V] *
32	Phase-to-phase voltage L3-L1	$\sqrt{3} U_n$ [V] *
33	Phase-to-phase mean voltage	$\sqrt{3} U_n$ [V] *
34	mean active power	$3 \times U_n \times I_n \times \cos(0^\circ)$ [W] *
35	used active ordered power (used energy)	100 [%]

* U_n , I_n – Rated values of transducer voltage and current

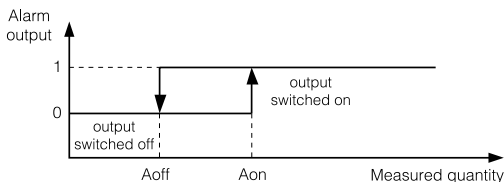
- b) kind of the alarm output operation – choose one from 10 modes n-on, n-off, on, off, h-on and h-off, A3non, A3nof, A3_on, A3_of. Working modes have been presented on the fig. 14,
- c) lower value of alarm switching – percentage value of the state change of the chosen signal,
- d) upper value of alarm switching – percentage value of the state change of the chosen signal,
- e) switching delay of the alarm. Delay time in seconds when switching the alarm state,
- f) switching off delay of the alarm. Delay time in seconds when switching off the alarm state,
- g) deadlock of alarm re-switching. Time, after which the alarm can be switched on again.

Caution! The setup of the value $A_{off} \geq A_{on}$ causes the alarm switching off.

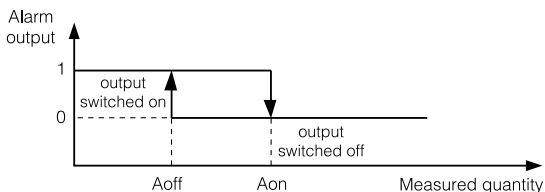
Caution! In version with analog outputs, alarms with numbers, which equal the analog outputs, control only the alarm diode on the transducer.

Exemplary configuration of alarms 1-4 is presented on the fig. 14.

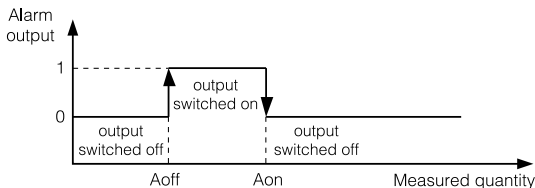
a) n-on



b) n-off



c) on



d) off

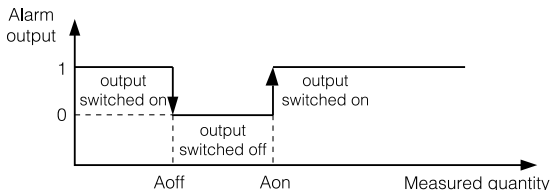


Fig. 14. Alarm types: a) n-on, b) n-off c) on d) off.

Other alarm types: h-on – always switched on; h-off – always switched off.

- A3non – when the “n-on” alarm type occurs on any of the phases
- the relay switches on . When all alarms fade away, the relay switches off.
- A3nof – when the “n-of” alarm type occurs on any of the phases
- the relay switches on . When all alarms fade away, the relay switches off.
- A3_on – when the “on” alarm type occurs on any of the phases
- the relay switches on . When all alarms fade away, the relay switches off
- A3_of – when the “off” alarm type occurs on any of the phases
- the relay switches on . When all alarms fade away, the relay switches off

In the “A3” alarm series, the alarm value must range from 0-7. They work with equal Aoff and Aon hysteresis thresholds for all of the phases.

5.4.6 Setup of analog output parameters

After choosing the group: **output 1-4**, it is possible to configure following output parameters:

- a) assignment of the parameter to the analog output. Kind of signal, on which the output has to react acc. to the table 1,
- b) lower value of the input range. Percentage value of the chosen signal,
- c) upper value of the input range. Percentage value of the chosen signal,
- d) lower value of the output range. Output signal value in mA,
- e) upper value of the output range. Output signal value in mA,
- f) working mode of the analog output. Following modes are accessible: normal work lower value, upper value. Both alarms are set up in the normal mode by the manufacturer.
- g) value on the output by false input parameter value (1e20) in mA.

An exemplary configuration of the analog output is presented on the fig.15.

The screenshot shows a configuration window for an analog output. It contains several labeled fields and a button at the bottom.

Parameter	Value
Assigning of a parameter to the analog output:	3-phase active power
Output type:	4...20 mA
Lower value of the input range [%]:	0,0
Upper value of the input range [%]:	100,0
Lower value of the output range [mA]:	4,00
Upper value of the output range [mA]:	20,00
Work mode of the analog output:	normal
Output signal in case input error [mA]:	21

Recalculate of range values

Fig. 15. View of the analog output configuration window

Admissible overflow on the analog output: 20% of the lower and upper range value.

Minimal value on the analog output: $-20 \times 1.2 = -24$ mA.

Maximal value on the analog output: $20 \times 1.2 = 24$ mA.

5.4.7 Clock

After choosing the group: **clock** it is possible to set up time and date and synchronize the clock with the time on the PC computer.

5.4.8 Restoration of Manufacturer Parameters

After choosing the group: **restoration of manufacturer parameters** it is possible to restore following manufacturers parameters set in the table 2:

Table 2

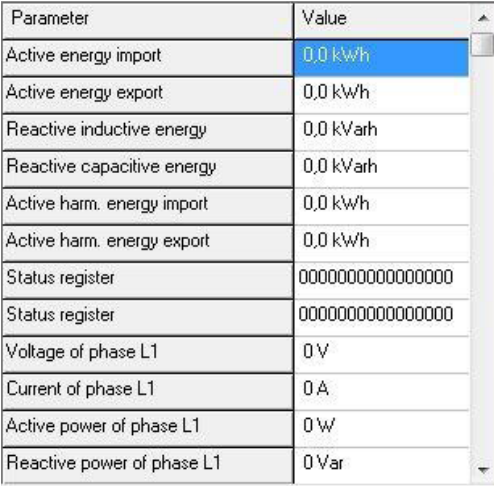
Parameter description	Range/value	Manufacturer value
Ratio of the current transformer	1...10000	1
Ratio of the voltage transformer	1...4000	1.0
Synchronization of the active mean power:	- 15 minutes' walking window (recording in the archive every 15 minutes); measurement synchronized with the clock every 15, 30 or 60 minutes	walking window
The way of min. and max. value storage	0,1	0 - without errors -1e20, 1e20
The way of passive energy calculation	0,1	0 - inductive and capacitive energy
Ordered power	0...144,0 %	100,0 %
Quantity on the alarm output No 1, 2, 3, 4	0...35 (acc. to the table 1)	24
Output type of the alarm 1, 2, 3, 4	n-on; n-off; on; off; h-on; h-off; A3non, A3nof, A3_on, A3_of	n-on

Table 2

Lower value of the alarm 1, 2, 3, 4 switching	-144.0...144.0 %	99,0 %
Upper value of the alarm 1, 2, 3, 4 switching	-144.0...144.0 %	101,0 %
Switching-on delay of the alarm 1, 2, 3, 4	0...900 seconds	0
Switching-off delay of the alarm 1, 2, 3, 4	0...900 seconds	0
Deadlock of alarm 1,2,3,4 re-switching	0...900 seconds	0
Quantity on the con- tinuous output No 1, 2, 3, 4	0...35 (acc. to the table 1)	24
Lower value of the input range in % of the rated range of the input No 1, 2, 3, 4	-144.0...144.0 %	0.0%
Upper value of the input range in % of the rated range of the input No 1, 2, 3, 4	-144.0...144.0 %	100.0%
Lower value of the out- put range of the output No 1, 2, 3, 4	-20.00...20.00 mA	0.00 mA
Upper value of the output range of the output No 1	0.01...20.00 mA	20.00 mA
Manual switching of the analog output 1, 2, 3, 4 on:	normal work, the lower value of the output range is set up, the upper value of the output range is set up.	normal work
Pulse quantity for pulse output	5000 - 20000	5000
Address in the MODBUS network	1... 247	1
Transmission mode	8n2, 8e1, 8o1, 8n1	8n2
Baud rate	4800, 9600, 19200, 38400	9600

5.4.9 Measured Values

After choosing the group: - **measured values**, all parameters measured by the transducer are displayed in the form of a list (fig. 16.).



Parameter	Value
Active energy import	0,0 kWh
Active energy export	0,0 kWh
Reactive inductive energy	0,0 kVarh
Reactive capacitive energy	0,0 kVarh
Active harm. energy import	0,0 kWh
Active harm. energy export	0,0 kWh
Status register	0000000000000000
Status register	0000000000000000
Voltage of phase L1	0 V
Current of phase L1	0 A
Active power of phase L1	0 W
Reactive power of phase L1	0 Var

Fig. 16. View of the window of the measured value group

5.4.10 Minimal and Maximal Values

After choosing the group: - **minimal and maximal values**, minimal and maximal values of individual parameters measured by the transducer in the form of a list are displayed (fig. 17.).

Parameter	Value
Mean minimal 3-phase voltage	229,92 V
Mean maximal 3-phase voltage	9198,44 V
Mean minimal 3-phase current	3,197 A
Mean maximal 3-phase current	319,71 A
Minimal 3-phase active power	2204,061 W
Maximal 3-phase active power	8817099 W
Minimal 3-phase reactive power	- 6,172 Var
Maximal 3-phase reactive power	1,811 Var
Minimal 3-phase apparent power	2205,419 VA
Maximal 3-phase apparent power	8822500 VA
Minimal active power factor	1

Fig. 17. View of the window of the min. and max. value group

5.4.11 Archive of power profile

After choosing the group: - **archive of power profile**, following information is available - number of archived samples; the information, from which sample to display and 15 samples with time stamp.

Archive of Mean Active Power			Sample No.
Number of samples:	575	First:	1
Reading 15 samples from No.:	100	Last:	575
Sample No.	Time	Mean Power	
100	2011-02-11 13:45	978,41 W	
101	2011-02-11 14:00	1131,59 W	
102	2011-02-11 14:15	1131,585 W	
103	2011-02-11 14:30	1131,608 W	
104	2011-02-11 14:45	1131,597 W	
105	2011-02-14 08:30	1020,544 W	
106	2011-02-14 08:45	1131,158 W	
107	2011-02-14 09:00	1131,312 W	
108	2011-02-14 09:15	1131,487 W	
109	2011-02-14 09:30	1131,634 W	

Fig. 18. View of the window of the power profile archive group

The detailed description of archive operation is described in chapter 6.

5.4.12 Information about the Device

After choosing the group – **information about the device**, following information is displayed: The device picture, serial number, program version, and a short device description (Fig. 19)



Factory No: 1101043
Firmware version: 2.43

Fig. 19. View of the window of the information about the device group

6. Archive – Power Profile

The P43 transducer is equipped with an archive allowing to store up to 1000 measurements of averaged active power. The averaged active power P_{AV} can be archived with time intervals 15, 30, 60 minutes (synchronized with the internal time clock) according to synchronization type in register 4005.

In case of work in the walking window mode, the archiving follows in full quarters of an hour, despite the fact, that the step of the walking window lasts 15 seconds and the walking window function can be activated any moment (fig. 12). Direct access to the archive is for 15 records including date, time and value located in the range of addresses 1000 - 1077.

In register 1000 is placed the position of the first (the oldest one) archived sample, and in register 1001 is the position of the last archived sample (the latest one).

In register 1002 is placed the first record of the fifteen available records located in registers 1003 - 1077. After writing the first read record (1 - 9000), the data of 15 records for read-out are updated.

Values 1e20 are in registers, in which samples are not written yet.

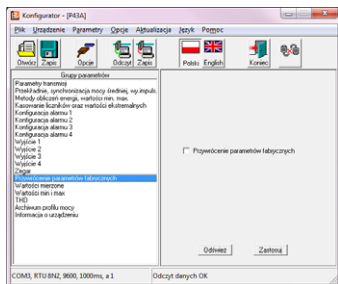
The archive is organized in a shape of a circular buffer. After writing the nine thousandth value, the next value overwrites the oldest value with the number 0, and successively the next with the number 1, etc. If the value of the register 1000 is higher than 1001, it means, that the buffer at least once was overflowed. For example value 15 in the register 1000 and 14 in register 1001 means, that there was more than nine thousand of samples and the oldest samples are from the record 15 to 9000, next from the record 1 to the latest record with the number 14.

Erasing of average power or change of the average time do not erase the archive. Automatic erasing of the archive and average power is made after current or voltage transformer ratio is changed.

7. SOFTWARE UPDATING

The P43 transducer (from the version 2.50) comes with the implemented function that allows for updating the software from a PC with LPCon software. Free LPCon program and the updating files are available on our website www.lumel.com.pl. Either RS485 port and USB port can be used to carry out the updating process.

a)



b)

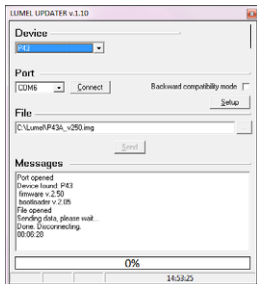


Fig. 20. The view of program window: a) LPCon, b) program updating

Note! After updating the software the manufacturer's settings for the transducer ought to be set, therefore it is advisable to store the transducer parameters before its updating using LPCon software.

After LPCon has been started, one ought to set serial port, baud rate, mode and the transducer address in Options. Then choose the P43 transducer from the menu Devices and click the icon Read in order to read all set parameters (necessary for their later restoration). After selecting from the menu Updating the option Device software updating, the Lumel Updater (LU) window opens – Fig. 20 b. Press Connect. The information window Messages contains information on the updating process. At the correctly opened port, the message Port opened displays.

Entering the updating mode in the transducer is carried out remotely by LU program (based on the settings in LPCon - adres, mode, baud rate, port Com) either through RS485 or USB. Pulsating of the transducer state diode in green signals readiness for updating, whereas the LU program displays the message Device found and the name and version of the program of the conneted device. One should press the button ... and indicate the transducer updating file. At the correctly opened file, the information File opened displays. One should press Send button. After updating being successfully completed the transducer switches to normal work, whereas the information window displays Done and the duration time of the updating. After the LU window closure, one should go to the parameters group Restoring manufacturer's settings, mark the option and press Apply button. Then press the icon Save in order to save readout initially set parameters. The up-to-date software version can also be checked via reading About P41 transducer from LPCon program.

Note! Switching the supply off during the software updating process may result in permanent damage of the transducer!

Note! If an error occurs during the upgrade, re-upgrade can be performed only by a USB port.

8. Error Codes

After connecting the transducer to the network, messages about errors can appear. Causes of errors are presented below:

- the state diode pulsates in red – lack of calibration or the non-volatile memory is damaged. One must return the transducer to the manufacturer,
- the state diode lights in red – inappropriate work parameters; one must configure the transducer again.
- the state diode pulsate alternately in red and green - error of phase connection sequence; one must interchange the connection of phase L2 with the phase L3.

9. Serial Interfaces

9.1. RS-485 Interface – Set of Parameters

- | | |
|--|---|
| ● identifier | 0xC4 (198) |
| ● transducer address | 1...247 |
| ● baud rate | 4.8, 9.6, 19.2, 38.4 kbit/s |
| ● working mode | Modbus RTU |
| ● information unit | 8N2, 8E1, 8O1, 8N1 |
| ● maximal response time | 400 ms |
| ● maximal number registers
retrieved in a single query: | - 56 registers - 4 bytes each
- 109 registers - 2 bytes each |
| ● implemented functions | 03, 04, 06, 16, 17 |
| - 03, 04 readout of registers, | |
| - 06 write of one register, | |
| - 16 write of n-registers, | |
| - 17 device identifying. | |

Manufacturer's settings: address 1, baud rate 9600, mode RTU 8N2.

9.2. USB Interface – Set of Parameters

- | | |
|---|---|
| ● identifier | 0xC6 (198) |
| ● transducer address | 1 |
| ● baud rate | 9.6 kbit/s |
| ● working mode | Modbus RTU |
| ● information unit | 8N2 |
| ● maximal response time | 400 ms |
| ● maximal number of bytes during the readout/write: | - 56 registers - 4 bytes
- 109 registers - 2 bytes |
| ● implemented functions | 03, 04, 06, 16, 17 |
| - 03, 04 readout of registers, | |
| - 06 write of one register, | |
| - 16 write of n registers, | |
| - 17 device identifying. | |

9.3. Register Map of the P43 Transducer

In the P43 transducer, data are located in 16-bit and 32-bit registers. Process variables and transducer parameters are located in the register address space in the way depending on the type of the variable value type. Bits in 16-bit register are numbered in the way depending on the variable value type. Bits in 16-bit registers are numbered from the younger to the older (b0-b15). 32-bit registers contain numbers of float type in the IEEE-745 standard. Register ranges are set in the table 3. 16-bit registers are presented in the table 4. 32-bit registers are set in tables 5 and 6. Register addresses in tables 3,4,5,6 are physical addresses.

Table 3

Range of addresses	Type of value	Description
1000 – 1077	Integer (16 bits) Record	Archive of the average power profile. Table 9 contains the registers description .
4000 – 4109	Integer (16 bits)	The value located in one 16-bit register. Table 3 contains the registers description. Registers are for readout and writing.
6000 – 6335	Float (2x16 bits)	Value located in two successive 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500. Sequence of bytes (1-0-3-2).
7000 – 7335	Float (2x16 bits)	Value located in two successive 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500. Sequence of bytes (3-2-1-0).
7500 – 7667	Float (32 bits)	Value located in one 32-bit register. The table 4 contains the description of registers. Registers for readout.

Table 4

Register address 16 bits	Operations	Description
1000	R	Position of the oldest archived mean power
1001	R	Position of the youngest archived mean power
1002	R/W	First available record - NrBL (range 1...9000)
1003	R	Year of archived mean power with the number NrBL + 0
1004	R	Month* 100 + archived day of mean power with the number NrBL + 0
1005	R	Hour* 100 + archived minute of mean power with the number NrBL + 0
1006	R	Archived value of mean power with the number NrBL + 0 of float type - 4 bytes in order 3-2-1-0
1007	R	
1008	R	Archived year of mean power with the number NrBL + 1
1009	R	Archived month, day of mean power with the number NrBL + 1
1010	R	Archived hour, minute of mean power with the number NrBL + 1
1011	R	Archived value of mean power with the number NrBL + 0 of float type - 4 bytes in order 3-2-1-0
1012	R	
...
1073	R	Archived year of mean power with the number NrBL + 14
1074	R	Archived month, day of mean power with the number NrBL + 14
1075	R	Archived hour, minute of mean power with the number NrBL + 14
1076	R	Archived value of mean power with the number NrBL + 0 of float type - 4 bytes in order 3-2-1-0
1077	R	

Table 5

Register address	Operations	Range	Description	By default
4000	RW	0	Reserved	0
4001	RW	0	Reserved	0
4002	RW	0	Reserved	0
4003	RW	1...10000	Current transformer ratio	1
4004	RW	1...40000	Voltage transformer ratio x 10	10
4005	RW	0...3	Synchronization of mean active power: 0 – 15 minutes' walking window (recording synchronized every 15 min with the clock.) 1 – measurement synchronized every 15 min with the clock. 2 – measurement synchronized every 30 min with the clock. 3 – measurement synchronized every 60 min with the clock.	0
4006	RW	0	Reserved	0
4007	RW	0.1	The way of minimal and maximal value recording 0 -without errors, 1 - with errors	0
4008	RW	0.1	Reserved	0
4009	RW	0...2359	The way of reactive energy calculation 0 -without errors, 1 - with errors	0
4010	RW	0...1440	Ordered power	1000
4011	RW	0..3	Erasing of energy counter: 0 - without changes, 1 - erase active energy, 2 - erase passive energy, 3 - erase all energy	0
4012	RW	0.1	Erasing of mean active power P_{AV}	0
4013	RW	0.1	Erasing of mean active power P_{AV} archive	0
4014	RW	0.1	Erasing of min. and max.	0

4015	RW	0.1...35	Alarm output 1 - quantity on the output (code acc. to table 6)	0
4016	RW	0..9	Alarm output 1 - type: 0 – n-on, 1 – n-oFF, 2 – on, 3 - oFF, 4 – h-on, 5 – h-oFF, 6 - A3non, 7 - A3nof, 8 - A3_on, 9 - A3_of	0
4017	RW	-1440...0...1440 [% _∞]	Alarm output 1 - lower alarm switching value of the rated input range	990
4018	RW	-1440...0...1440 [% _∞]	Alarm output 1 - upper alarm switching value of the rated input range	1010
4019	RW	0...900 s	Alarm output 1 - switching-on delay	0
4020	RW	0...900 s	Alarm output 1 - alarm switching-off delay (for ordered power quantity [register 4015 = 35] this parameter is excluded)	0
4021	RW	0...900 s	Alarm output 1 - deadlock of re-switching	0
4022	RW	0.1	Reserved	0
4023	RW	0.1...35	Alarm output 2 -quantity on the output (code acc.to the table 6)	24
4024	RW	0...9	Alarm output 2 - type: 0 – n-on, 1 – n-oFF, 2 – on, 3 - oFF, 4 – h-on, 5 – h-oFF, 6 - A3non, 7 - A3nof, 8 - A3_on, 9 - A3_of	3
4025	RW	-1440...0...1440 [% _∞]	Alarm output 2 - lower alarm switching value of the rated input range	990
4026	RW	-1440...0...1440 [% _∞]	Alarm output 2 - upper alarm switching value of the rated input range	1010
4027	RW	0...900 s	Alarm output 2 - alarm switching-on delay	0
4028	RW	0...900 s	Alarm output 2 - alarm switching-off delay (for ordered power quantity [register 4023 = 35] this parameter is excluded)	0
4029	RW	0...900 s	Alarm output 2 - deadlock of re-switching	0
4030	RW	0,1	Reserved	0
4031	RW	0,1...35	Alarm output 3 - quantity on the output (code acc. to table 6)	24
4032	RW	0...9	Alarm output 3 - type: 0 – n-on, 1 – n-oFF, 2 – on, 3 - oFF, 4 – h-on, 5 – h-oFF, 6 - A3non, 7 - A3nof, 8 - A3_on, 9 - A3_of	0

4033	RW	-1440...0...1440 [% _∞]	Alarm output 3 - lower alarm switching value of the rated input range	990
4034	RW	-1440...0...1440 [% _∞]	Alarm output 3 - upper alarm switching value of the rated input range	1010
4035	RW	0...900 s	Alarm output 3 - alarm switching-on delay	0
4036	RW	0...900 s	Alarm output 3 - alarm switching-off delay (for ordered power quantity [register 4023 = 35] this parameter is excluded)	0
4037	RW	0...900 s	Alarm output 3 - deadlock of re-switching	0
4038	RW	0,1	Reserved	0
4039	RW	0,1...35	Alarm output 4 - quantity on the output (code acc. to table 6)	24
4040	RW	0...9	Alarm output 4 - type: 0 – n-on, 1 – n-off, 2 – on, 3 – oFF, 4 – h-on, 5 – h-oFF, 6 – A3non, 7 – A3nof, 8 – A3_on, 9 – A3_of	0
4041	RW	-1440...0...1440 [% _∞]	Alarm output 4 - lower alarm switching value of the rated input range	990
4042	RW	-1440...0...1440 [% _∞]	Alarm output 4 - upper alarm switching value of the rated input range	1010
4043	RW	0...900 s	Alarm output 4 - alarm switching-on delay	0
4044	RW	0...900 s	Alarm output 4 - alarm switching-off delay (for ordered power quantity [register 4039 = 35] this parameter is excluded)	0
4045	RW	0...900 s	Alarm output 3 - deadlock of re-switching	0
4046	RW	0,1	Reserved	0
4047	RW	0...15258	Continuous output 1 - quantity on the output (code acc. to table 6)	24
4048	RW	0...65535	Continuous output 1 - type: 0 - (0 ...20) mA; 1 - (4...20) mA; 2 - (-20...20) mA	2
4049	RW	-1440...0...1440 [% _∞]	Continuous output 1 - lower value of the input range in [% _∞] of the rated input range	0

4050	RW	-1440...0...1440 [% _∞]	Continuous output 1 - upper value of the input range in [% _∞] of the rated input range	1000
4051	RW	-2400...0...2400 [10 μA]	Continuous output 1 - lower value of the current output range [10 μA]	0
4052	RW	1...2400 [10 μA]	Continuous output 1 - upper value of the current output range [10 μA]	2000
4053	RW	0...2	Continuous output 1 - manual switching on: 0 - normal work, 1 - value set from the register 4051, 2 - value made from the register 4052	0
4054	RW	-24...24 [mA]	Continuous output 1 - value on the output by error	24
4055	RW	0,1...35	Continuous output 2 - quantity on the output (code acc. to the tab.6)	24
4056	RW	0...2	Continuous output 2 - type: 0 - (0 ...20) mA; 1 - (4...20) mA; 2 - (-20...20) mA	2
4057	RW	-1440...0...1440 [% _∞]	Continuous output 2 - lower value of the input range in [% _∞] of the rated input range	0
4058	RW	-1440...0...1440 [% _∞]	Continuous output 2 - upper value of the input range in [% _∞] of the rated input range	1000
4059	RW	-2400...0...2400 [10 μA]	Continuous output 2 - lower value of the current output range [10 μA]	0
4060	RW	1...2400 [10 μA]	Continuous output 2 - upper value of the current output range [10 μA]	2000
4061	RW	0...2	Continuous output 1 - manual switching on: 0 - normal work, 1 - value set from the register 4059, 2 - value made from the register 4060	0
4062	RW	-24...24 [mA]	Continuous output 2 - value on the output by error	24
4063	RW	0,1...35	Continuous output 3 - quantity on the output (code acc. to the tab.6)	24
4064	RW	0...2	Continuous output 3 - type: 0 - (0 ...20) mA; 1 - (4...20) mA; 2 - (-20...20) mA	2
4065	RW	-1440...0...1440 [% _∞]	Continuous output 3 - lower value of the input range in [% _∞] of the rated input range	0

4066	RW	-1440...0...1440 [% _∞]	Continuous output 3 - upper value of the input range in [% _∞] of the rated input range	1000
4067	RW	-2400...0...2400 [10 μA]	Continuous output 3 - lower value of the current output range [10 μA]	0
4068	RW	1..2400 [10 μA]	Continuous output 3 - lower value of the current output range [10 μA]	2000
4069	RW	0...2	Continuous output 1 - manual switching on: 0 - normal work, 1- value set from the register 4067, 2 - value made from the register 4068	0
4070	RW	-24...24 [mA]	Continuous output 3 - value on the output by error	24
4071	RW	0,1...35	Continuous output 4 - quantity on the output (code acc. to the tab.6)	24
4072	RW	0...2	Continuous output 4 - type: 0 - (0 ...20) mA; 1 - (4...20) mA; 2 - (-20...20) mA	2
4073	RW	-1440...0...1440 [% _∞]	Continuous output 4 - lower value of the input range in [% _∞] of the rated input range	0
4074	RW	-1440...0...1440 [% _∞]	Continuous output 4 - upper value of the input range in [% _∞] of the rated input range	1000
4075	RW	-2400...0...2400 [10 μA]	Continuous output 4 - lower value of the current output range [10 μA]	0
4076	RW	1..2400 [10 μA]	Continuous output 4 - lower value of the current output range [10 μA]	2000
4077	RW	0...2	Continuous output 1 - manual switching on: 0 - normal work, 1- value set from the register 4075, 2 - value made from the register 4076	0
4078	RW	-24...24 [mA]	Continuous output 1 - value on the output by error	24
4079	RW	5000...20000	Pulse quantity for pulse output	5000
4080	RW	1...247	Address in the MODBUS network	1
4081	RW	0...3	Transmission mode: 0 -> 8n2, 1 -> 8e1, 2 -> 8o1, 3 -> 8n1	0
4082	RW	0...3	Baud rate: 0 -> 4800, 1 -> 9600, 2 -> 19200, 3 -> 38400	1
4083	RW	0,1	Update the change of transmission parameters	0

4084	RW	0...59	seconds	0
4085	RW	0...2359	Hour*100 + minutes	0
4086	RW	101...1231	Month*100 + minutes	1201
4087	RW	2009...2100	Year	2010
4088	RW	0,1	Record of standard parameters (with zero adjustment of energy, min, max and mean power)	0
4089	R	0...15258	Active input energy, two most significant bytes	0
4090	R	0...65535	Active input energy, two least significant bytes	0
4091	R	0...15258	Active output energy, two most significant bytes	0
4092	R	0...65535	Active output energy, two least significant bytes	0
4093	R	0...15258	Reactive inductive energy, two most significant bytes	0
4094	R	0...65535	Reactive inductive energy, two least significant bytes	0
4095	R	0...15258	Reactive capacitive energy, two most significant bytes	0
4096	R	0...65535	Reactive capacitive energy, two least significant bytes	0
4097	R	0	Reserved	0
4098	R	0	Reserved	0
4099	R	0	Reserved	0
4100	R	0	Reserved	0
4101	R	0... 65535	Status register 1 - description below	-
4102	R	0... 65535	Status register 2 - description below	-
4103	R	0... 65535	Serial number, two older bytes	-
4104	R	0... 65535	Serial number, two younger bytes	-
4105	R	0... 65535	Program version (x 100)	100
4106	R	0..65535	reserved	0
4107	R	0..65535	reserved	104
4108	RW	0,1	Measurement mode: 0 -3Ph4W, 1- 3Ph3W	0

In parenthesis []: resolution or unit is suitably placed.

Energies are render accessible in hundreds of Watt-hours (Var-hours) in two 16-bit registers and for this reason when recalculating values of each energy from registers, one must divide them by 10, i.e:

Active input energy = (value of register.4089 * 65536 + value of register 4090) / 10 [kWh]

Active output energy = (value of register.4091 * 65536 + value of register 4092) / 10 [kWh]

Reactive inductive energy = (value of register 4093 * 65536 + value of register 4094) / 10 [kVarh]

Reactive capacitive energy = (value of register 4095 * 65536 + value of register 4096) / 10 [kVarh]

Status register 1 (register 4101):

Bit 15 – „1” – damage of non-volatile memory

Bit 14 – „1” – lack of calibration or invalid calibration

Bit 13 – „1” – error of parameter values

Bit 12 – „1” – error of energy values

Bit 11 – „1” – error of phase sequence

Bit 10 – current range 0 – 1 A; 1 – 5 A

Bit 9 – reserved

Bit 8 – Voltage range: 0 - 57.8 V, 1 - 230 V

Bit 7 – „1” – the interval of power averaging has not elapsed

Bit 6 – „1” – bad frequency for THD measurement

Bit 5 – „1” – too low voltage to measure the frequency

Bit 4 – „1” – spent battery

Bit 3 – „1” – capacitive character ΣQ

Bit 2 – „1” – capacitive character Q3

Bit 1 – „1” – capacitive character Q2

Bit 0 – „1” – capacitive character Q1

Status register 2 (register 4102):

Bit 15 – „1” – presence of continuous output 4

Bit 14 – „1” – presence of continuous output 3

Bit 13 – „1” – presence of continuous output 2

Bit 12 – „1” – presence of continuous output 1

Bit 11 – „1” – presence of alarm output 4

Bit 10 – „1” – presence of alarm output 3

Bit 9 – „1” – presence of alarm output 2

Bit 8 – „1” – presence of alarm output 1

Bit 7 – reserved
 Bit 6 – reserved
 Bit 5 – reserved
 Bit 4 – reserved

Bit 3 – „1” – alarm output 4 switched on
 Bit 2 – „1” – alarm output 3 switched on
 Bit 1 – „1” – alarm output 2 switched on
 Bit 0 – „1” – alarm output 1 switched on

Rejestr Statusu 3 (rejestr 4109):

Bit 15-12 – „1” - zarezerwowany

Bit 11 – „1” – wystąpienia alarmu 4 typu A3xxx w fazie L3

Bit 10 – „1” – wystąpienia alarmu 4 typu A3xxx w fazie L2

Bit 9 – „1” – wystąpienia alarmu 4 typu A3xxx w fazie L1

Bit 8 – „1” – wystąpienia alarmu 3 typu A3xxx w fazie L1

Bit 7 – „1” – wystąpienia alarmu 3 typu A3xxx w fazie L2

Bit 6 – „1” – wystąpienia alarmu 3 typu A3xxx w fazie L1

Bit 5 – „1” – wystąpienia alarmu 2 typu A3xxx w fazie L3

Bit 4 – „1” – wystąpienia alarmu 2 typu A3xxx w fazie L2

Bit 3 – „1” – wystąpienia alarmu 2 typu A3xxx w fazie L1

Bit 2 – „1” – wystąpienia alarmu 1 typu A3xxx w fazie L3

Bit 1 – „1” – wystąpienia alarmu 1 typu A3xxx w fazie L2

Bit 0 – „1” – wystąpienia alarmu 1 typu A3xxx w fazie L1

Table 6

Address of 16 bit registers	Address of 32 bit registers	Operations	Description	Unit	3Ph /4W	3Ph /3W
6000/7000	7500	R	Voltage of phase L1	V	√	x
6002/7002	7501	R	Current of phase L1	A	√	√
6004/7004	7502	R	Active power of phase L1	W	√	x
6006/7006	7503	R	Reactive power of phase L1	Var	√	x
6008/7008	7504	R	Apparent power of phase L1	VA	√	x
6010/7010	7505	R	Active power factor of phase L1	-	√	x
6012/7012	7506	R	Reactive power to active power ratio of phase L1	-	√	x
6014/7014	7507	R	Voltage of phase L2	V	√	x
6016/7016	7508	R	Current of phase L2	A	√	√
6018/7018	7509	R	Active power of phase L2	W	√	x
6020/7020	7510	R	Reactive power of phase L2	Var	√	x
6022/7022	7511	R	Apparent power of phase L2	VA	√	x
6024/7024	7512	R	Active power factor of phase L2	-	√	x

6026/7026	7513	R	Reactive power to active power ratio of phase L2	-	√	x
6028/7028	7514	R	Voltage of phase L3	V	√	x
6030/7030	7515	R	Current of phase L3	A	√	√
6032/7032	7516	R	Active power of phase L3	W	√	x
6034/7034	7517	R	Reactive power of phase L3	Var	√	x
6036/7036	7518	R	Apparent power of phase L3	VA	√	x
6038/7038	7519	R	Active power factor of phase L3	-	√	x
6040/7040	7520	R	Reactive power to active power ratio of phase L3	-	√	x
6042/7042	7521	R	Mean 3-phase voltage	V	√	x
6044/7044	7522	R	Mean 3-phase current	A	√	√
6046/7046	7523	R	3-phase active power	W	√	√
6048/7048	7524	R	3-phase reactive power	Var	√	√
6050/7050	7525	R	3-phase apparent power	VA	√	√
6052/7052	7526	R	Mean active power factor	-	√	√
6054/7054	7527	R	Mean ratio of reactive power to active power	-	√	√
6056/7056	7528	R	Frequency	Hz	√	√
6058/7058	7529	R	Phase-to-phase voltage L1-L2	V	√	√
6060/7060	7530	R	Phase-to-phase voltage L2-L3	V	√	√
6062/7062	7531	R	Phase-to-phase voltage L3-L1	V	√	√
6064/7064	7532	R	Mean phase-to-phase voltage	V	√	√
6066/7066	7533	R	15, 30, 60 minutes' 3-phase act. power (P1+P2+P3)	W	√	√
6068/7068	7534	R	THD U1	%	√	x
6070/7070	7535	R	THD U2	%	√	x
6072/7072	7536	R	THD U3	%	√	x
6074/7074	7537	R	THD I1	%	√	x
6076/7076	7538	R	THD I2	%	√	x
6078/7078	7539	R	THD I3	%	√	x
6080/7080	7540	R	cosinus angle between U1 and I1	-	√	x
6082/7082	7541	R	cosinus angle between U2 and I2	-	√	x
6084/7084	7542	R	cosinus angle between U3 and I3	-	√	x

6086/7086	7543	R	mean 3-phase cosinus	-	√	√
6088/7088	7544	R	angle between U1 and I1	°	√	x
6090/7090	7545	R	angle between U2 and I2	°	√	x
6092/7092	7546	R	angle between U3 and I3	°	√	x
6094/7094	7547	R	Current in neutral lead (evaluated from vectors)	A	√	x
6096/7096	7548	R	3-phase active input energy (number of register 7549 overfills, setting to zero after exceeding 99999999.9 kWh)	100 MWh	√	√
6098/7098	7549	R	3-phase active input energy (watt-hour meter counting to 99999.9 kWh)	kWh	√	√
6100/7100	7550	R	3-phase active output energy (number of register 7551 overfills, setting to zero after exceeding 99999999.9 kWh)	100 MWh	√	√
6102/7102	7551	R	3-phase active output energy (watt-hour meter counting to 99999.9 kWh)	kWh	√	√
6104/7104	7552	R	3-phase reactive inductive energy (number of register 7553 overfills, setting to zero after exceeding 99999999.9 kVarh)	100 MVarh	√	√
6106/7106	7553	R	3-phase reactive inductive energy (watt-hour meter counting to 99999.9 kWh)	kVarh	√	√
6108/7108	7554	R	3-phase active output energy (number of register 7555 overfills, setting to zero after exceeding 99999999.9 kVarh)	100 MVarh	√	√
6110/7110	7555	R	3-phase reactive capacitive energy (watt-hour meter counting to 99999.9 kWh)	kVarh	√	√
6112/7112	7556	R	Reserved		√	√
6114/7114	7557	R	Reserved		√	√
6116/7116	7558	R	Reserved		√	√
6118/7118	7559	R	Reserved		√	√
6120/7120	7560	R	Time - seconds	sec	√	√
6122/7122	7561	R	Time - hours, minutes	-	√	√

6124/7124	7562	R	Date - month, day	-	√	√
6126/7126	7563	R	Date - year	-	√	√
6128/7128	7564	R	Setting up the analog output 1	mA	√	√
6130/7130	7565	R	Setting up the analog output 2	mA	√	√
6132/7132	7566	R	Setting up the analog output 3	mA	√	√
6134/7134	7567	R	Setting up the analog output 4	mA	√	√
6136/7136	7568	R	Energy consumption in percentages in "power guard" mode	%	√	√
6138/7138	7569	R	Status 3	-	√	√
6140/7140	7570	R	Status 1	-	√	√
6142/7142	7571	R	Status 2	-	√	√
6144/7144	7572	R	Voltage L1 min	V	√	x
6146/7146	7573	R	Voltage L1 max	V	√	x
6148/7148	7574	R	Voltage L2 min	V	√	x
6150/7150	7575	R	Voltage L2 max	V	√	x
6152/7152	7576	R	Voltage L3 min	V	√	x
6154/7154	7577	R	Voltage L3 max	V	√	x
6156/7156	7578	R	Current L1 min	A	√	√
6158/7158	7579	R	Current L1 max	A	√	√
6160/7160	7580	R	Current L2 min	A	√	√
6162/7162	7581	R	Current L2 max	A	√	√
6164/7164	7582	R	Current L3 min	A	√	√
6166/7166	7583	R	Current L3 max	A	√	√
6168/7168	7584	R	Active power L1 min	W	√	x
6170/7170	7585	R	Active power L1 max	W	√	x
6172/7172	7586	R	Active power L2 min	W	√	x
6174/7174	7587	R	Active power L2 max	W	√	x
6176/7176	7588	R	Active power L3 min	W	√	x
6178/7178	7589	R	Active power L3 max	W	√	x
6180/7180	7590	R	Reactive power L1 min	var	√	x
6182/7182	7591	R	Reactive power L1 max	var	√	x
6184/7184	7592	R	Reactive power L2 min	var	√	x
6186/7186	7593	R	Reactive power L2 max	var	√	x
6188/7188	7594	R	Reactive power L3 min	var	√	x

6190/7190	7595	R	Reactive power L3 max	var	√	x
6192/7192	7596	R	Apparent power L1 min	VA	√	x
6192/7194	7697	R	Apparent power L1 max	VA	√	x
6196/7196	7698	R	Apparent power L2 min	VA	√	x
6198/7198	7699	R	Apparent power L2 max	VA	√	x
6200/7200	7600	R	Apparent power L3 min	VA	√	x
6202/7202	7601	R	Apparent power L3 max	VA	√	x
6204/7204	7602	R	Power factor (PF) L1 min	-	√	x
6206/7206	7603	R	Power factor (PF) L1 max	-	√	x
6208/7208	7604	R	Power factor (PF) L2 min	-	√	x
6210/7210	7605	R	Power factor (PF) L2 max	-	√	x
6212/7212	7606	R	Power factor (PF) L3 min	-	√	x
6214/7214	7607	R	Power factor (PF) L3 max	-	√	x
6216/7216	7608	R	Reactive and active power ratio L1 min	-	√	x
6218/7218	7609	R	Reactive and active power ratio L1 max	-	√	x
6220/7220	7610	R	Reactive and active power ratio L2 min	-	√	x
6222/7222	7611	R	Reactive and active power ratio L2 max	-	√	x
6224/7224	7612	R	Reactive and active power ratio L3 min	-	√	x
6226/7226	7613	R	Reactive and active power ratio L3 max	-	√	x
6228/7228	7614	R	Phase to phase voltage L_{1-2} min	V	√	√
6230/7230	7615	R	Phase to phase voltage L_{1-2} max	V	√	√
6232/7232	7616	R	Phase to phase voltage L_{2-3} min	V	√	√
6234/7234	7617	R	Phase to phase voltage L_{2-3} max	V	√	√
6236/7236	7618	R	Phase to phase voltage L_{3-1} min	V	√	√
6238/7238	7619	R	Phase to phase voltage L_{3-1} max	V	√	√
6240/7240	7620	R	3-phase mean voltage min	V	√	√
6242/7242	7621	R	3-phase mean voltage max	V	√	√
6244/7244	7622	R	3-phase mean current min	A	√	√
6246/7246	7623	R	3-phase mean current max	A	√	√
6248/7248	7624	R	3-phase active power min	W	√	√
6250/7250	7625	R	3-phase active power max	W	√	√
6252/7252	7626	R	3-phase reactive power min	var	√	√
6254/7254	7627	R	3-phase reactive power max	var	√	√

6256/7256	7628	R	3-phase apparent power min	VA	√	√
6258/7258	7629	R	3-phase apparent power max	VA	√	√
6260/7260	7630	R	Power factor (PF) min	-	√	√
6262/7262	7631	R	Power factor (PF) max	-	√	√
6264/7264	7632	R	min 3-phase mean reactive and active power ratio	-	√	√
6266/7266	7633	R	max 3-phase mean reactive and active power ratio	-	√	√
6268/7268	7634	R	Frequency min	Hz	√	√
6270/7270	7635	R	Frequency max	Hz	√	√
6272/7272	7636	R	Phase to phase mean volatge min	V	√	√
6274/7274	7637	R	Phase to phase mean volatge max	V	√	√
6276/7276	7638	R	15,30,60 minutes 3-phase active power min	W	√	√
6278/7278	7639	R	15,30,60 minutes 3-phase active power max	W	√	√
6280/7280	7640	R	THD U1 min	%	√	x
6282/7282	7641	R	THD U1 max	%	√	x
6284/7284	7642	R	THD U2 min	%	√	x
6286/7286	7643	R	THD U2 max	%	√	x
6288/7288	7644	R	THD U3 min	%	√	x
6290/7290	7645	R	THD U3 max	%	√	x
6292/7292	7646	R	THD I1 min	%	√	x
6294/7294	7647	R	THD I1 max	%	√	x
6296/7296	7648	R	THD I2 min	%	√	x
6298/7298	7649	R	THD I2 max	%	√	x
6300/7300	7650	R	THD I3 min	%	√	x
6302/7302	7651	R	THD I3 max	%	√	x
6304/7304	7652	R	Cosine angle between U1 and I1 min	-	√	x
6306/7306	7653	R	Cosine angle between U1 and I1 max	-	√	x
6308/7308	7654	R	Cosine angle between U2 and I2 min	-	√	x
6310/7310	7655	R	Cosine angle between U2 and I2 max	-	√	x
6312/7312	7656	R	Cosine angle between U3 and I3 min	-	√	x
6314/7314	7657	R	Cosine angle between U3 and I3 max	-	√	x
6316/7316	7658	R	Mean 3-phase cosine min	-	√	√
6318/7318	7659	R	Mean 3-phase cosine max	-	√	√
6320/7320	7660	R	Angle between U1 and I1 min	°	√	x
6322/7322	7661	R	Angle between U1 and I1 max	°	√	x

6324/7324	7662	R	Angle between U2 and I2 min	°	√	x
6326/7326	7663	R	Angle between U2 and I2 max	°	√	x
6328/7328	7664	R	Angle between U3 and I3 min	°	√	x
6330/7330	7665	R	Angle between U3 and I3 max	°	√	x
6332/7332	7666	R	Current in neutral lead min	A	√	x
6334/7334	7667	R	Current in neutral lead max	A	√	x

In case of a lower overflow, the value $-1e20$ is written in, however in case of an upper overflow or if an error occurs, the value $1e20$ is written in.

10. Examples of P43 Transducer Programming

Example 1 – Programming an Alarm 1 with Hysteresis

Program the operation of the alarm 1 in such a way, that at the value 250 V of the phase 1 voltage, the alarm will be switched on, however switched off at the value 210 V.

For the rated $U_n = 230$ V execution, one must set up values from the table 7.

Table 7

Register	Value	Meaning
4015	1	1 – voltage of phase 1 (U1)
4016	0	0 – n-on mode
4017	913	913 – 91.3% (percentage value with one place after the decimal point multiplied by 10) of the rated voltage of phase 1 – alarm switched off, (210 V/230 V) x 1000 = 913
4018	1087	1087 – 108.7 % (percentage value with one place after the decimal point multiplied by 10) of the rated voltage of phase 1 – alarm switched on, (250 V/230 V) x 1000 = 1087
4019	0	0 – 0 second delay in the alarm switching
4020	0	0 – 0 second delay in the alarm switching off
4021	0	0 – 0 second deadlock for the alarm re-switching

Example 2 – Configuring alarm of ordered power exceeding

Set the alarm of the earlier warning of ordered power exceeding possibility on 90% level by 15-minutes (900 sec.) calculation. Current transformer 2500 : 5 A, voltage $U_n=230$ V. Temporary maximal power consumption 1.5 MW.

Calculate:

3-phase rated active power of the transducer P43: $P = 3 \times 230 \text{ V} \times 2500 \text{ A} (500 \times 5 \text{ A}) = 1.725 \text{ MW} (500 \times 3450 \text{ W})$ i.e. 100%

Ordered power and rated power ratio = $1 \text{ MW} / 1.725 \approx 57.97\%$ of the transducers rated value (register **4010**).

Hysteresis of alarm work: alarm switching for **90%** of ordered power (register **4018**), switching off for example: by 1% lower - 89% (register **4017**)

Work optimization of power limit function (alarm switch on delay):

delay time of the alarm $t_o = 10\% \cdot [1 \text{ MW} \cdot 900 \text{ s} / 1.5 \text{ MW}] = 60 \text{ s}$ (register **4019**).

Figure 20 presents how to take advantage of the parameter showing used ordered power to activate alarm. The alarm delay is switched off (set to 0 sec.) - register 4019.

In the example for the remaining 10% of ordered power under maximal power consumption the devices could work yet 60 seconds without exposing the consumer to penalties. If the delay was set to 60 seconds the alarm would not be activated (register 4019).

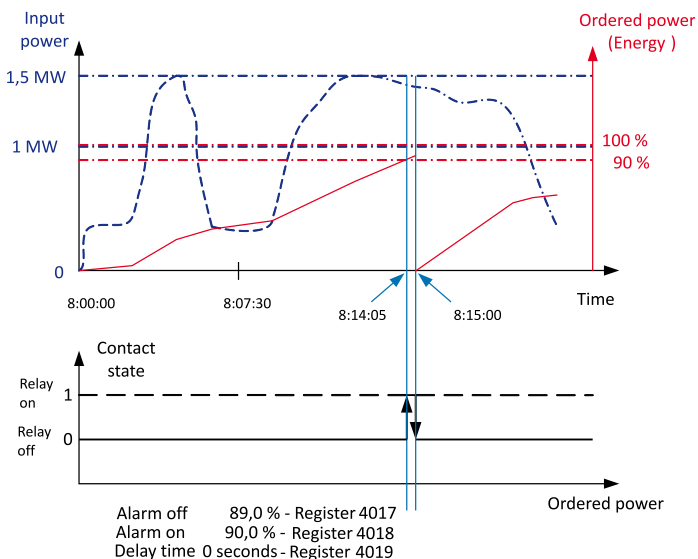


Fig. 20. Measurement of used ordered power, 15-minutes averaging time, synchronization with the clock, alarm set to 90%.

Table 8

Register	Value	Meaning
4010	579	579 – 57.9 % (percentage value with one place after the decimal point multiplied by 10) percentage value of ordered power in relation to the rated power
4015	35	35 – alarm set to the percentage of used active power
4016	0	0 – n-on mode
4017	890	890 – 89.0% (percentage value with one place after the decimal point multiplied by 10) alarm switch off; for the alarm to work the value in the register 4017 should be lower than in the register 4018 (hysteresis), for example: by 1%
4018	900	900 – 90.0% mA (percentage value with one place after the decimal point multiplied by 10) percentage of ordered power - alarm switch on
4019	0 or 60	0 – 0 seconds of alarm switch on delay (without optimization), 60 with optimization
4020	0	0 – 0 seconds of alarm switch off delay
4021	0	0 – 0 seconds of blockade for alarm re-switching

Example 3 – Programming a Unidirectional Continuous Output 1

Configure the continuous output 1 to have the value 20 mA, when 3-phase average current is 4 A, and to have the value 4 mA when the current is 0 A.

For the rated current $I_n = 5$ A, one must set values according to the table 9:

Table 9

Register	Value	Meaning
4048	23	23 – mean 3-phase current (I)
4049	0	0 – 0.0% (percentage value with one place after the decimal point multiplied by 10) the lower value of the rated mean 3-phase current, (0 A/5 A) x 1000 = 0
4050	800	800 – 80.0 % (percentage value with one place after the decimal point multiplied by 10) the upper value of the rated mean 3-phase current, (4 A/5 A) x 1000 = 800

4051	400	400 – 4.00 mA (value in mA with two places after the decimal point multiplied by 100) lower value of the output current (4,00 mA x 100) = 400
4052	2000	2000 – 20.00 mA (value in mA with two places after the decimal point multiplied by 100) upper value of the output current. (20.00 mA x 100) = 2000
4053	0	0 – normal mode of the continuous output 1
4054	24	24 – 24 mA on continuous output 1 if the error (-1e20 or 1e20)

Example 4 – Programming a Bidirectional Continuous Output 1

Configure the continuous output 1 to have the value -20 mA, when the three-phase power value $3 \times 4 \text{ A} \times 230 \text{ V} \times \cos(180^\circ) = -2760 \text{ W}$, and to have the value 20 mA when the three-phase power value is $3 \times 4 \text{ A} \times 230 \text{ V} \times \cos(0^\circ) = 2760 \text{ W}$.

For the rated execution $3 \times 5 \text{ A} / 230 \text{ V}$, one must set values according to the table 10

Table 10

Register	Value	Meaning
4048	24	24 – mean 3-phase current (I)
4049	-800	-1000 – -100.0% (percentage value with one place after the decimal point multiplied by 10) the lower value of the rated mean 3-phase current, $3 \times 4 \text{ A} \times 230 \text{ V} \times \cos(180^\circ) / 3 \times 5 \text{ A} \times 230 \text{ V} \times 1000 = -800$
4050	800	1000 – 100.0 % (percentage value with one place after the decimal point multiplied by 10) the upper value of the rated mean 3-phase current, $3 \times 4 \text{ A} \times 230 \text{ V} \times \cos(0^\circ) / 3 \times 5 \text{ A} \times 230 \text{ V} \times 1000 = 800$
4051	-2000	-2000 – -20.00 mA (value in mA with two places after the decimal point multiplied by 100) lower value of the output current (-20.00 mA x 100) = -2000
4052	2000	2000 – 20.00 mA (value in mA with two places after the decimal point multiplied by 100) upper value of the output current (20.00 mA x 100) = 2000
4053	0	0 – normal mode of the continuous output 1
4053	24	24 – 24 mA on continuous output 1 if the error (-1e20 or 1e20)

11. TECHNICAL DATA

Measuring Ranges and Admissible Basic Errors

Table 11

Measured quantity	Measuring range	L1	L2	L3	Σ	Basic error
Current 1 A ~ 5 A~	0.002 ... 1.2 A~ 0.01 ... 6 A~	●	●	●		±0.2%
Voltage L-N 57.7 V~ 230 V~	2.80 ... 70.0 V~ 10.0 ... 276 V~	●	●	●		±0.2%
Voltage L-L 100 V~ 400 V~	5 ... 120 V~ 20 ... 480 V~	●	●	●		±0.5%
Frequency	47.0...63.0 Hz	●	●	●		±0.2%
Active power	-1.65 kW...1.4 W...1.65 kW	●	●	●	●	±0.5%
Reactive power	-1.65 kvar...1.4 var...1.65 kvar	●	●	●	●	±0.5%
Apparent power	1.4 VA...1.65 kVA	●	●	●	●	±0.5%
PF factor	-1...0...1	●	●	●	●	±0.5%
Tangens ϕ	-1.2...0...1.2	●	●	●	●	±1%
Cosinus ϕ	-1...1	●	●	●	●	±1%
Angle between U and I	-180°... 180°	●	●	●		±0.5%
Input active energy	0...99 999 999.9 kWh				●	±0.5%
Developed active energy	0...99 999 999.9 kvarh				●	±0.5%
Reactive inductive energy	0...99 999 999.9 kWh				●	±0.5%
Reactive capacitive energy	0...99 999 999.9 kvarh				●	±0.5%
THD in the range 10...120% U _I ; 48...52 Hz; 58.62 Hz	0...100%	●	●	●	●	±5%

Caution! For correct current measurement, the presence of voltage with the value higher than 0.05 U_n is required at least on one phase.

Power Consumption:

- in supply circuit ≤ 10 VA
- in voltage circuit ≤ 0.05 VA
- in current circuit ≤ 0.05 VA

Analog Outputs:	0, 2 or 4 programmable outputs: -20...0...+20 mA, R_{load} : 0..250 Ω basic error 0,2% output response time < 2 s
Relay Outputs:	0, 2 or 4 relays, voltageless NO contacts load capacity 0.5 A/250 V a.c.
Serial Interface:	RS-485: address 1...247; mode: 8N2, 8E1, 8O1, 8N1; baud rate: 4.8, 9.6, 19.2, 38.4 kbit/s, USB: 1.1 / 2.0, address 1; mode 8N2; baud rate 9.6 kbit/s,
Transmission Protocol:	Modbus RTU
Response time:	500 ms
Energy Pulse Output:	output of OC type, passive acc. to EN 62053-31
Pulse Constant of OC Type Output:	5000 -20000 imp./kWh, independently on settings ratios Ku, Ki
Ratio of the Voltage Transformer Ku:	0.1... 4000.0
Ratio of the Current Transformer Ki:	1... 10000
Protection Degree:	
- for the housing	IP 40
- from terminals (rear side)	IP 10
Weight:	0.3 kg
Dimensions:	90 x 120 x 100 mm
Fixing Way:	on a 35 mm DIN rail
Reference and Rated Operating Conditions:	
- supply voltage	85...253 V a.c. 40...400 Hz;

	90...320 V d.c. or 20...40 V a.c. 40...400 Hz; 20...60 V d.c.
- input signal	0... <u>0.002...1.2</u> I_n ; 0... <u>0.05...1.2</u> U_n for current, voltage 0... <u>0.002...1.2</u> I_n ; 0... <u>0.1...1.2</u> U_n for power factors P_{fi} , φ_i frequency 47...63 Hz sinusoidal (THD $\leq 8\%$)
- power factor	<u>-1...0...1</u>
- analog outputs	-24...-20...0...+20...24 mA
- ambient temperature	-10... <u>23</u> ...+55°C
- storage temperature	-30...+70°C
- relative humidity	25...95% (inadmissible condensation)
- admissible peak factor:	
- current	2
- voltage	2
- external magnetic field	<u>0.40</u> ...400 A/m
- short duration overload 5 sec.	
- voltage inputs	2 U_n (max. 1000 V)
- current inputs	10 I_n
- work position	any
- preheating time	5 min.

Additional errors:

in percentage of the basic error:

- from frequency of input signals	< 50%
- from ambient temperature changes	< 50%/10°C
- for THD > 8%	< 100%

Standards Fulfilled by the Meter

Electromagnetic Compatibility:

● noise immunity	acc. to EN 61000-6-2
● noise emission	acc. to EN 61000-6-4

Safety Requirements:

According to EN 61010-1 standard

- isolation between circuits basic
- installation category III,
- pollution level 2,
- maximal phase-to-earth voltage
 - for supply and measurement circuit 300 V
 - for other circuits 50 V
- altitude above sea level < 2000 m,

12. ORDERING CODES

P43 -	X	X	X	X	XX	X	X
Current input In:							
1 A (X/1)	1						
5 A (X/5)	2						
Voltage input (phase/phase-to-phase) Un:							
3 x 57.7/100 V	1						
3 x 230/400 V	2						
Supply voltage:							
85..253 V a.c., 90..300 V d.c.	1						
20..40 V a.c., 20..60 V d.c.	2						
Output type:							
without analog outputs, 4 relays	1						
2 analog outputs, 2 relays	2						
4 analog outputs, without relays	3						
Version:							
standard					00		
custom-made*					XX		
Language:							
Polish						P	
English						E	
other						X	
Acceptance tests:							
without extra quality requirements							0
with an extra quality inspection certificate							1
acc. to customer's requirements*							X

* the version code will be established by the manufacturer

Example of Order:

When ordering please respect successive code numbers.

The code: **P43 - 2 2 1 3 00 E 0** means:

- P43** – transducer of network parameters of P43 type
- 2** – current input I_n : 5 A (x/5),
- 2** – input voltage (phase/phase-to-phase) $U_n = 3 \times 230/400$ V,
- 1** – supply voltage: 85...253 V a.c.; 90..320 V d.c.
- 3** – output type: 4 analog outputs, without relays
- 00** – standard version,
- E** – language: english
- 0** – execution without extra quality requirements.

