TRANSDUCER OF POWER NETWORK

P41

USER'S MANUAL

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1. APPLICATION

The P41 transducer is a digital programmable device destined to measure and convert of 1-phase power network.

It enables for measurement and conversion of measured quantities into standarised analog current signal.

Quantities measured and calculated by the transducer:

- phase voltage .... U
- current I
- active power .... P
- reactive power .... Q
- apparent power... S
- active power factor .... Pf
- reactive power factor .... tg φ
- averaging active power (e.g.15 min.)............... P_{av}
- Tangent φ .... φ
- active and reactive energy .... Ept, Eqt,
- frequency .... f

The transducer has an archive that can store up to 9000 values of a quantity selected by a user, together with time marker. The transducer stores maximal and minimal values for all measured quantities. Additionally, it is possible to introduce external transmission of measuring transformers which will be taken into account while measuring and calculating of all measuring quantities. The update time of all available quantities does not exceed 1 second. All quantities and configuration parameters are available through the RS485 interface and USB.

The transducer output signals are galvanically isolated from input signals and the supply. Transducer housing is made of plastic. On the external side of the transducer there are screw terminal strips socket – plug to which wires of a maximal diameter - 2,5 mm^2 can be connected.

2. TRANSDUCER SET

The transducer set consists of:

–	transducer P41	1 pc
–	user's manual	1 pc
–	guarantee card	1 pc
–	CD	1 pc

3. BASIC REQUIREMENTS AND OPERATIONAL SAFETY.

In the safety service scope, the transducer meets the 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 corectness of connections to the network.
- The removal of the transducer casing during the guarantee contract period causes its cancellation.
- The transducer is destined to be installed and used in industrial electromagnetic environment conditions.
- A switch or a circuit-breaker should be located near the device, easy accessible by the operator and suitably marked.

4. INSTALLATION

4.1. Way of fixing

The P41 transducer is adapted to be mounted on a 35 mm rail acc.to EN 60715. The overall dimensions and the way of fixing are presented on the fig. 1.

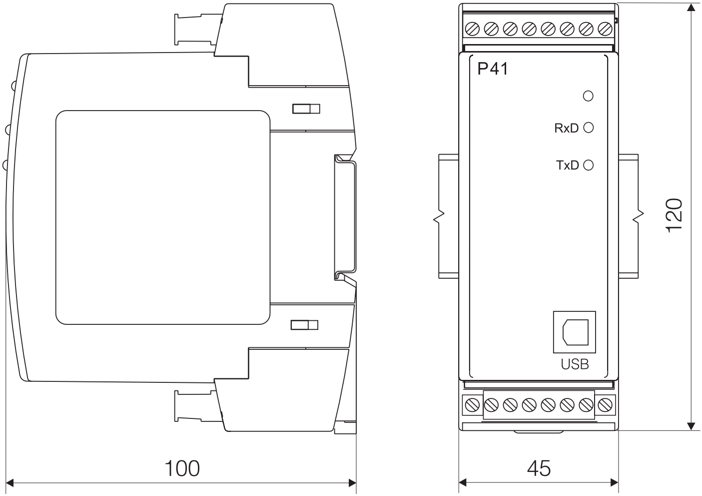
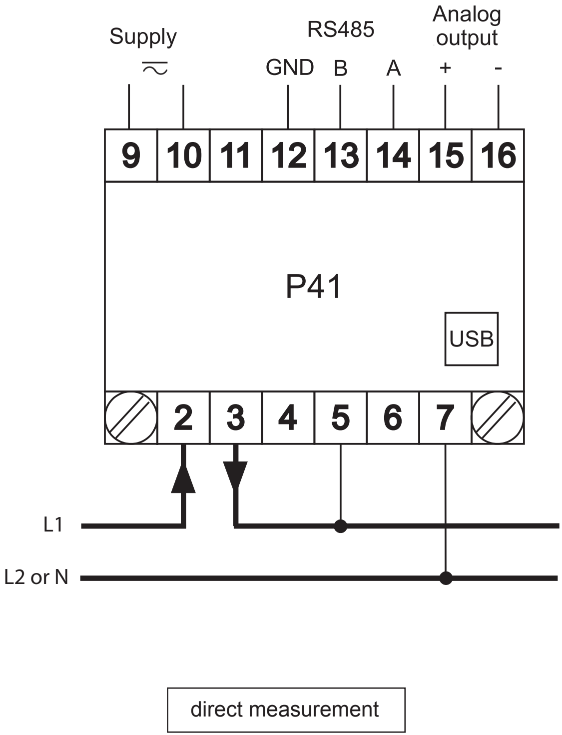


Fig. 1. Overall dimensions and the way of fixing.

4.2. External connections diagram

The transducer connection is presented on the fig. 2.



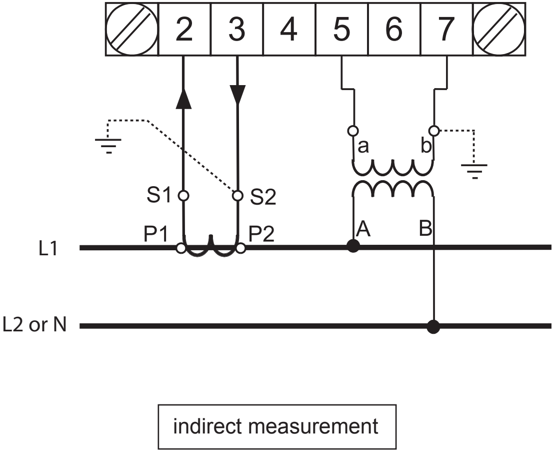


Fig. 2. Transducer connections

5. SERVICE

5.1 Description of the frontal plate

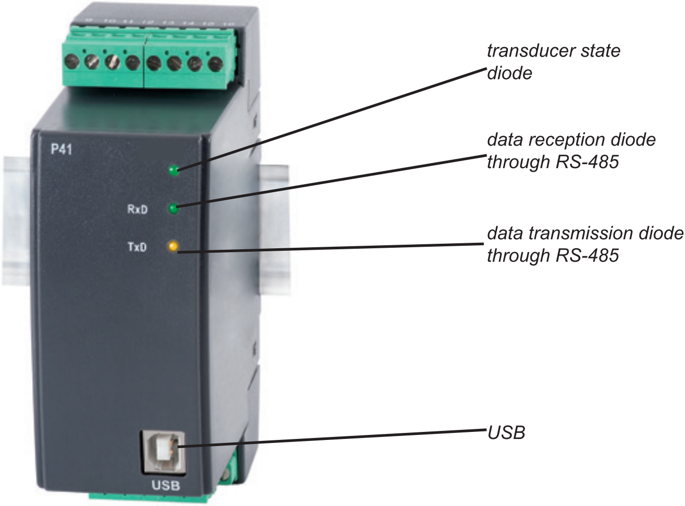


Fig. 3. The view of frontal plate

5.2 Signaling the state after switching the supply on

After switching the supply on, the state diode should light up for a moment in red, and next should light up in green. The recording confirmation in registers is signaled by a short extinction of a state diode. The incorrect work is signaled by the state diode in the way described in the chapter 7. The data reception through the RS485 interface is signaled by a pulsing of the RxD diode, and the data transmission is signaled by a pulsing of the TxD diode.

5.3 Installation of port COM drivers on a computer

Before carrying out the transducer configuration, the drivers provided on the attached CD should be installed. The P41 transducer uses the software, which is created in the system by the Universal Master Bus device – **Przetwornik / P41 Transducer** and by a virtual port Com named **Przetwornik/ P41 Transducer** attached to it. The installation of a driver in the Windows system causes adding another serial port Com to the list of ports serviced by the operational system.

After the transducer has been added to the USB port, the operational system will notify on the occurrence of a new device by displaying a message presented on the fig. 5. Found New Wizard of the Universal Serial Bus will activate automatically. The wizard's suggestions ought to be followed by selecting installation from the indicated localization and giving a tract for drivers, which can be found on an attached CD. The drivers are compatible with the following systems: Windows 2000, XP, Server 2003, Vista, Windows 7, Server 2008, Windows 8, Windows 10. At drivers installation, a message signaling the lack of drivers digital signature can occur. Ignore it and proceed with further installation.

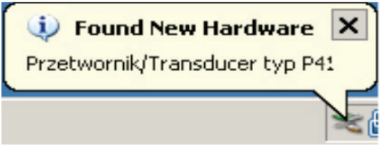


Fig. 4. Message signaling detection of a new device „Przetwornik / Transducer P41”.

After closing the wizard, the system will immediately detect another device – USB Serial Port (fig. 5). Found new hardware wizard will be restarted.

Fig. 5. System message on finding new device.

After successful installation, the system will notify on installing a new device (fig. 6). Two new devices will appear in Device Manager – ***Przetwornik/Transducer P41*** and Port COM named: ***Przetwornik/Transducer P41***, according to fig. 7.

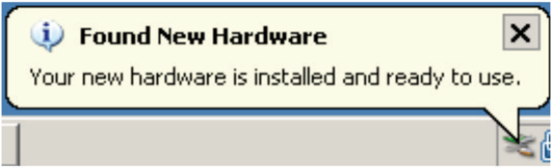


Fig. 6. System message finishing drivers installation of P41.

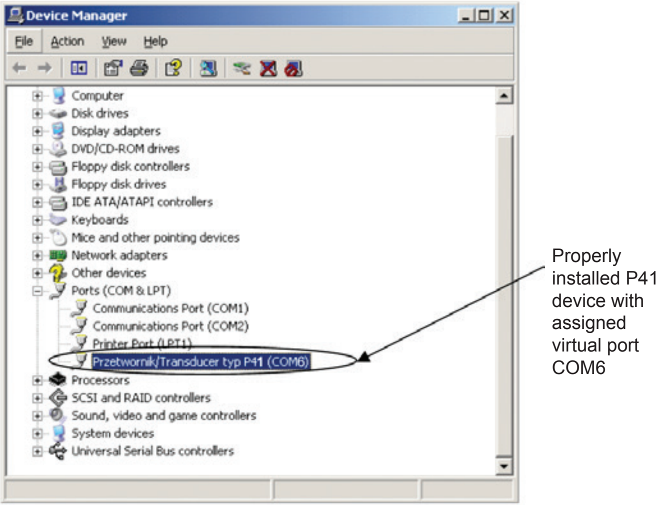


Fig. 7. Device manager window with installed P41 transducer with assigned port No. COM6

5.4 Transducer configuration using eCon

eCon program is destined for the configuration of the P41 transducer. The transducer ought to be connected to PC using a PD10 converter (if the communication will be carried out through RS485) or directly through USB.

Select ***Connection*** and configure the connection (fig. 8). For direct connections through USB: address 1, baud rate 9600kb/s, mode RTU 8N2, timeout 1000ms and the proper port COM where the driver of the P41 transducer was installed or through the RS485 interface and PD10: address, baud rate, the mode in accordance with the ones set in the transducer.

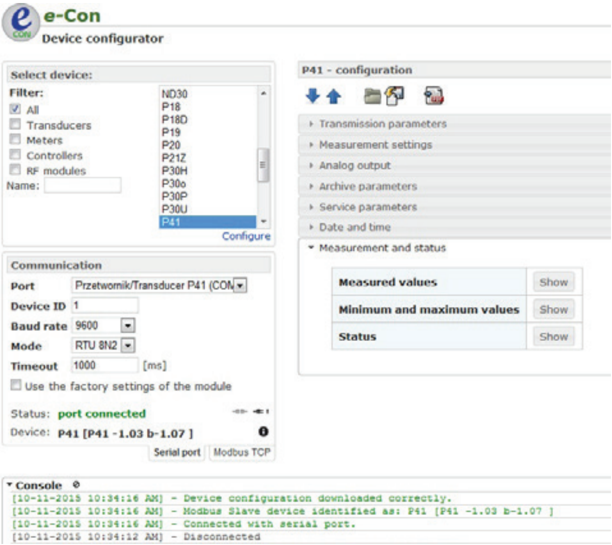


Fig. 8. Configuration of connection with the P41 transducer

After the connection has been configured, select ***Device*** → ***Transducers*** → ***P41*** from the menu and press ***Connect***. Befor changing the configuration the current configuraiton should be read and save to file for later restoration. From the eCon menu you can save the parameters to a file, read them and export the configuration to a PDF file (Figure 9).

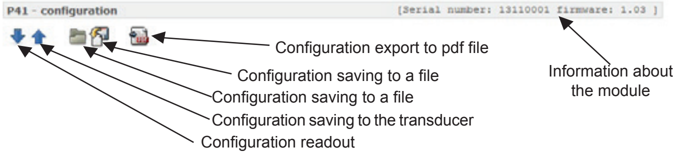


Fig. 9. Readout, saving and export of settings.

5.4.1 Setting the transmission parameters

After selecting the tab: - **transmission parameters**, the following items are available for configuration: (fig. 10):

a) address – address for the communication with the P41 transducer within the RS485 interface ranged 1…247. Value 1 is set by manufacturer,

b) baud rate – the communication speed within RS485 interface ranged (4800, 9600, 19200, 38400 bit/s). The manufacturer’s setting is on 9600,

c) transmission mode - transmission mode within RS485 interface ranged (RTU 8N2, RTU 8E1, RTU 8O1, RTU 8N1). The manufacturer’s setting is on RTU 8N2.

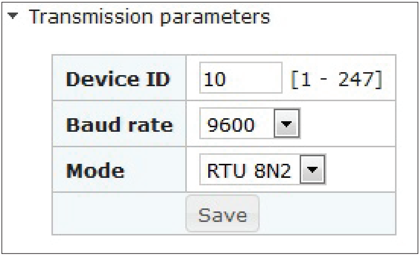


Fig. 10. The view of configuration window for transmission parameters

5.4.2 Setting the measurement parameters

After selecting the tab: - **measurement settings**, the following items are available for configuration (fig. 11):

- input synchronization: with voltage (measurement of all values) or with current (only current and frequency measurement)
- range of voltage (100 V or 400 V) and current (1 A or 5 A) input,
- transformer current ratio. The multiplier used to convert current on the primary side of transformer. It is set on 1 by the manufacturer,
- transformer voltage ratio. The multiplier used to convert voltage on the primary side of transformer. It is set on 1.0 by the manufacturer,
- the method of mean power synchronization:
  - a moving window 15 min. – average power PAV will be calculated for the last 15 minutes, updated every 15 seconds, the so called moving window,
  - the measurement synchronized with the clock every 15, 30 or 60 minutes - average power PAV will be updated every 15, 30 or 60 minutes synchronized with internal real clock (fig. 12).

  The manufacturing setting is on a walking window.
- average ordered power. Ordered power in percentage of the rated power of the transducer.
- storage of min and max values - without error values (1e20), default setting is storage without errors.
- Reactive energy calculation method: positive, negative or inductive and capacitive, default setting is inductive and capacitive.

▾ Measurement settings

Input synchronization	Voltage (measurement of all parameters)
Input voltage range	400 V
Transformer voltage ratio	1.0 [0.1 - 4000.0]
Input current range	1 A
Transformer current ratio	1 [1 - 10000]
Method of mean power synchronization	Moving window 15 min
Mean ordered power	100.0 [0.0 - 144.0 %]
Store of min. and max. values	Error free
Calculate method of reactive energy	Positive and negative
	Save

Fig. 11. View of configuration window for measurement settings

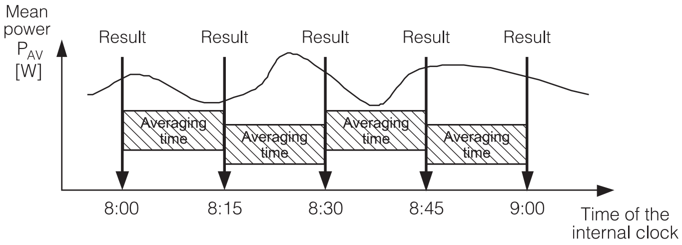


Fig. 12. Measurement of mean active power 15 minutes synchronized with the clock

5.4.3 Setting analog output parameters

After selecting the tab: - **analog output**, the following output parameters are available for configuration:

- assigning of a parameter to the analog output. The type of signal, to which an output is to react according to table 1,
- output type: 0..20 mA, 4..20 mA, -20..20 mA,
- lower value of the input range. The percentage value of a selected signal,
- upper value of the input range. The percentage value of a selected signal,
- lower value of the output range. The value of output signal in mA,
- upper value of the output range. The value of output signal in mA,
- work mode of the analog output. The following modes are available: normal, lower value, upper value.
- output value in case of input error parameter in mA.

The exemplary configuration of the analog output was presented in the fig. 13.

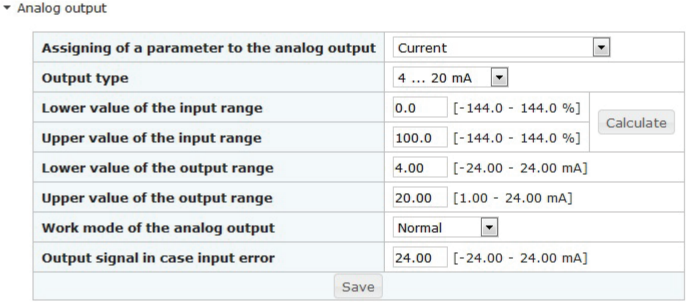


Fig. 13. The view of window for analog output configuration.

Admissible overflow on the analog output of 20% of the lower and upper value of the range. The minimum value on the analog output: -20 x 1,2 = -24 mA; the maximum value on the analog output 20 x 1,2 = 24 mA.

5.4.4 Archive parameters

After selecting the tab: - **archive parameters**, the following comments are available to carry out (fig. 14):

- selection of archive value,
- selection of archive condition,
- setting limits of archive (TL, TH).

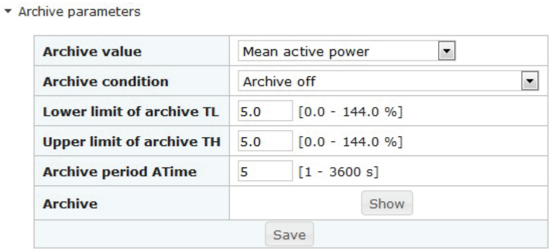


Fig. 14. The view of configuration window for archive parameters

5.4.5 Erasing of counters, extreme values and archive

After selecting the tab: - **erasing of counters, extremes and archive**, the following comments are available to carry out (fig. 15):

- restore factory parameters,
- erasing of energy - individual or all meters of active and reactive energy are erased,
- erasing of mean active power,
- erasing of min. and max. The actual measured value is prescribed to minimal and maximum value,
- erasing of archive.

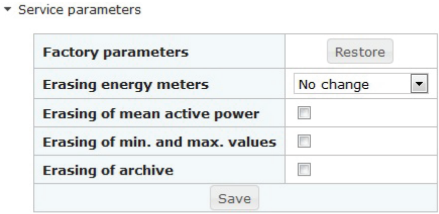


Fig. 15. The window of restoring default parameters, erasing counters, extremes and archive.

Table 1

Parameter description	Range / Value	Manufacturer's value
Transformer current ratio	1…10000	1
Transformer voltage ratio	1.0…4000.0	1
Synchronization of mean active power:	walking window 15 minute (write into archive every 15 minutes); measurement synchronized with the clock every 15, 30 or 60 minutes	walking window

The method of storing the minimal and maximal values	0.1	0 – no errors 1 - with errors (1e20, 1e20)
The method of reactive power calculation	0.1	0 – inductive and capacitive energy
Ordered power	0...144.0 %	100.00%
Quantity on the continuous output	0…11 (according to table 1)	3
Lower value of the input range in % of the nominal input range	-144.0 … 144.0 %	0.0 %
Upper value of the input range in % of the nominal input range	-144.0 … 144.0 %	100.0 %
Lower value of the output range of the output	-20.00 … 20.00 mA	4.00 mA
Upper value of the output range of the output	0.01 … 20.00 mA	20.00 mA
Manual switching on of the analog output	normal work, lower value of the output range, upper value of the output range,	normal work
Address in MODBUS network	1 … 247	1
Transmission mode:	8n2, 8e1, 8o1, 8n1	8n2
Baud rate:	4800, 9600, 19200, 38400	9600

5.4.6 Clock

After selecting the group: - **clock** it is possible to set the time and date, and synchronize it with the time on the configuring computer (fig. 16).

Fig. 16. The view of clock configuration window.

5.4.7 Measured values and status

After selecting the tab: - **measured values and status** (fig. 17) it is possible to slect the view of measured values, min and max values and statuses.

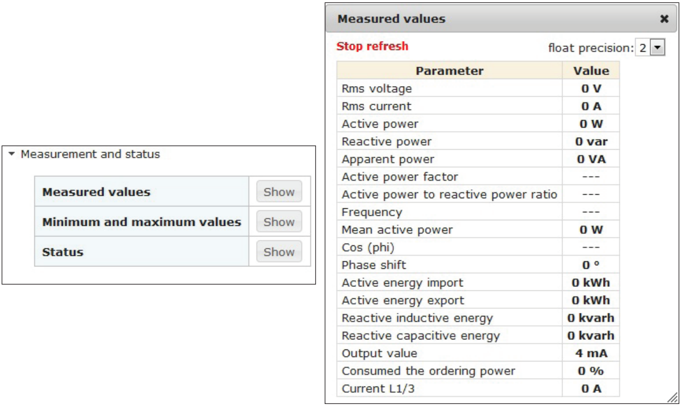


Fig. 17. The window of measured values.

6. ARCHIVE

The direct access to the archive is destined for 15 records containing the date, time and the value of located in the range addresses 1000 – 1092. The register 1000 is the localization for the position of the first (the oldest) archived sample, whereas in 1001 is the localization of the last archived sample (the youngest). The register 1002 contains the value of the first record of the fifteen available ones located in registers 1003 – 1092. Entering the value of the first readout record (1 – 9000) causes the data updating of 15 records to readout. In the registers, to which samples have not been entered yet, there are values 1e20. The archive is arranged as a circular buffer. After the nine thousandth value has been entered, the next one overwrites the oldest one numbered 0, the next one another one with the number 1, etc. If the value of the register 1000 is greater than 1001, it means that the buffer has been overflowed. For example, the value 15 in the register 1000 and 14 in the register 1001 means that there were more than nine thousand samples and that the oldest samples are from the record 15 to 9000, then from the record 1 to the youngest record numbered 14. Erasing of mean power or changing the averaging time does not erase the archive. Automatic file deletion comes with the change of current or voltage ratio.

7 SOFTWARE UPDATING

The P41 transducer comes with the implemented function that allows for updating the software from a PC with eCon software. Free eCon 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)

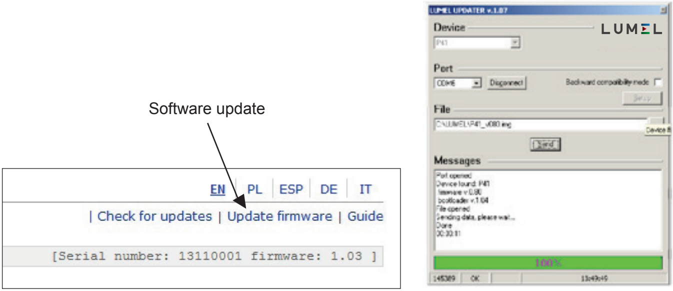


Fig. 18. The view of program window:
a) eCon, b) program updating

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 eCon software.

After eCon has been started, one ought to set serial port, baut rate, mode and the transducer address in *Options*. Then choose the P41 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. 18 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 eCon - 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 eCon program.

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

8. ERROR CODES

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

- the state diode pulsates in red – lack of calibration or the non-voliatile memory is damaged; one must return the transducer to the manufacturer
- the state diode lights in red – inapropriate work parameters; one must configure the transducer again

9. SERIAL INTERFACES

9.1 RS-485 interface – parameters

- identifier 0xAF
- transducer address 1..247
- baud rate 4.8, 9.6, 19.2, 38.4 kbit/s
- working mode Modbus RTU
- infomation unit 8N2, 8E1, 8O1, 8N1
- maximal time of reply 1000 ms
- maximal number of read out registers in one query
  – 60 registers – 4-byte,
  – 120 registers – 2-byte,
- implemented functions 03, 06, 16, 17
  – 03 readout of registers
  – 06 write of register
  – 16 write of registers
  – 17 device identification

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

9.2 USB interface – parameters

- identifier 0xAF
- transducer address 1
- baud rate 9.6 kbit/s

- working mode Modbus RTU
- infomation unit 8N2
- maximal time of reply 800 ms
- maximal number of read out registers in one query
  - 60 registers – 4-byte,
  - 120 registers – 2-byte,
- implemented functions 03, 06, 16, 17
  - 03 readout of registers
  - 06 write of register
  - 16 write of registers
  - 17 device identification

9.3 Register map of the P41 transducer

The data in the P41 transducer is located in 16 and 32-bit registers. Process variables and the transducer parameters are located in the registers address area in a way dependent on the type of the variable value. The bits in the 16-bit register are numbered from the smallest to the largest (b0-b15). The 32-bit registers contain the numbers of float type in the IEEE-745 standard. The register ranges are presented in the table 2. The 16-bit registers are presented in the table 4,5. The 32-registers are presented in the tables 6. Registers addresses in the tables 4, 5, 6 are physical addresses.

Table 2

Address range	Value type	Description
1000 – 1092	Integer (16 bits)/ Record	Archive of the avarage power profile. Table 4 contains the registers description.
4000 – 4062	Integer (16 bits)	The value located in one 16-bit register. Table 5 contains the registers description. Registers are for readout and writing.
7000 – 7118	Float (2x16 bits)	The value located in two consecutive 16-bit registers. The registers content corresponds to the 32-bit register content from the 7500 area. Registers for readout.
7500 – 7559	Float (32 bits)	The value located in one 32-bit register. Table 6 contains the registers description. Registers for readout.

Table 3

Value	Kind of type of input quantity, to which analog output is to respond
0	output swithed off
1	Voltage
2	Current
3	Active power
4	Inactive power
5	Apparent power
6	PF factor
7	tg φ
8	Frequency
9	Active average power PAV 15, 30, 60 minute
10	Current L1/3
11	Ordered power

Table 4

Registers address 16 bit	Operations	Description
1000	R	Position of the oldest archived value
1001	R	Position of the youngest archived value
1002	R/W	First available reecord – NrBL (range 1…9000)
1003	R	Year of archiving the value numbered NrBL + 0
1004	R	Month * 100 + day of archiving the value numbered NrBL + 0
1005	R	Hour * 100 + minute of archiving the value numbered NrBL + 0
1006	R	Second of archiving the value NRBL + 0

1007	R	Archived value numbered NrBL + 0 of float type – 4 bytes in order 3-2-1-0
1008	R	
1009	R	Year of archiving the value numbered NrBL + 1
1010	R	Month, day of archiving the value numbered NrBL + 1
1011	R	Hour, minute of archiving the value numbered NrBL + 1
1012	R	Second of archiving the value NRBL + 1
1013	R	Archived value of the value numbered NrBL + 1 float type – 4 bytes in order 3-2-1-0
1014	R	
…	…	…
1087	R	Year of archiving the value numbered NrBL + 14
1088	R	Month, day of archiving the value numbered NrBL + 14
1089	R	Hour, minute of archiving the value numbered NrBL + 14
1090	R	Second of archiving the value NRBL + 0
1091	R	Archived value of the value numbered NrBL + 14 float type – 4 bytes in order 3-2-1-0
1092	R	

Table 5

Register address	Operations	Range	Description	Default
4000	RW	0..1	Input synchronization: 0 - synchronization with voltage (measurement of all values) 1- synchronization with current (measurement of current and frequency only)	0
4001	RW	0..1	Voltage input range: 0 - range 100V 1- range 400V	1
4002	RW	0..1	Current input range 0 - range 1A 1 - Range 5A	1
4003	RW	1..40000	Voltage transformer ratio x 10	10
4004	RW	1..10000	Current transformer ratio	1
4005	RW	0..3	Synchronizing of active mean power: 0 - walking window 15 minute (entry synchro-nized with the clock every 15 minutes) 1 – measurement synchronized with the clock every 15 minutes, 2 – measurement synchronized with the clock every 30 minutes, 3 – measurement synchronized with the clock every 60 minutes,	0
4006	RW	0..11	Archived quantity / code acc.to table3 /	0

4007	RW	0..9	Archiving condition 0 – continous archiving when the value >= reg 4009 1 – continous archiving when the value < reg 4008 2 – continous archiving when the value <= reg 4009 and value >= reg4008 3 – continous archiving when the value >= reg 4009 and value <= reg4008 4 – continous archiving every 1s 5 – archiving turned off 6 – archiving every 15 minutes synchronized with RTC 7 – archiving every 30 minutes synchronized with RTC 8 – archiving every 60 minutes synchronized with RTC 9 – archiving every time set in reg 4010	5
4008	RW	0..1440	Lower archiving value	100
4009	RW	0..1440	Upper archiving value	100
4010	RW	1...3600	Archiving time	900
4011	RW	0..65535	reserved	-
4012	RW	0,1	Way to store minimal and maximal value: 0 – no errors, 1 – with errors	0
4013	RW	0,1	reserved	1
4014	RW	0,1	Way to count reactive energy: 0 – inductive and capacitive energy 1 – positive and negative energy	0
4015	RW	0..1440	Ordered power in [o/oo] of rated input range	1000
4016	RW	0…4	Erasing of watt-hour meters: 0 – no changes, 1- erase active energies, 2 – erase reactive energies, 3 – erase all energies	0
4017	RW	0,1	Erasing of active mean power PAV	0
4018	RW	0,1	Erasing archive	0

4019	RW	0,1	Erasing of min and max	0
4020	RW	0..65535	reserved	-
4021	RW	0..65535	reserved	-
4022	RW	0..65535	reserved	-
4023	RW	0..65535	reserved	-
4024	RW	0..65535	reserved	-
4025	RW	0..65535	reserved	-
4026	RW	0..65535	reserved	-
4027	RW	0..65535	reserved	-
4028	RW	0.1..11	Analog output 1 - quantity on the output / code acc. to table 3 /	3
4029	RW	0..2	Analog output 1 - type: 0 – (0...20) mA; 1 – (4…20) mA; 2 – (-20 ..20) mA	0
4030	RW	-1440..0.. 1440 [$^o/_{oo}$]	Analog output 1 - lower value of the input range in [$^o/_{oo}$] of rated input range	0
4031	RW	-1440..0.. 1440 [$^o/_{oo}$]	Analog output 1 - upper value of the input range in [$^o/_{oo}$] of rated input range	1000
4032	RW	-2400..0.. 2400 [10uA]	Analog output 1 - lower value of the current output range [10 uA]	0
4033	RW	1..2400 [10 uA]	Analog output 1 - upper value of the current output range [10 uA]	2000
4034	RW	0..2	Analog output 1 - manual switch on: 0 – normal work, 1 – value set from the register 4032, 2- value set from the register 4033	0
4035	RW	-2400… 2400 [10uA]	Analog output 1 - output value when error	2400
4036	RW	0..65535	reserved	
4037	RW	1..247	Address in MODBUS network	1
4038	RW	0..3	Transmission mode: 0->8n2, 1->8e1, 2->8o1, 3->8n1	0

4039	RW	0..3	transmission baud: 0->4800, 1->9600 2->19200, 3->38400	1
4040	RW	0,1	Update the change of transmission parameters	0
4041	RW	0..59	Seconds	0
4042	RW	0...2359	Hour *100 + Minutes	0
4043	RW	101… 1231	Month * 100 + day	1201
4044	RW	2009… 2100	Year	2010
4045	RW	0,1	Record of standard parameters (with energy reset and min, max and mean power)	0
4046	R	0..15258	Imported active energy, two smaller bytes	0
4047	R	0..65535	Imported active energy, two larger bytes	0
4048	R	0..15258	Exported active energy, two larger bytes	0
4049	R	0..65535	Exported active energy, two smaller bytes	0
4050	R	0..15258	Reactive inductive energy, two larger bytes	0
4051	R	0..65535	Reactive inductive energy, two smaller bytes	0
4052	R	0..15258	Reactive capacitive energy, two larger bytes	0
4053	R	0..65535	Reactive capacitive energy, two smaller bytes	0
4054	R	0	reserved	0
4055	R	0	reserved	0
4056	R	0	reserved	0
4057	R	0	reserved	0
4058	R	0..65535	Status Register 1 – description below	-
4059	R	0..65535	reserved	-
4060	R	0..65535	Serial number two larger bytes	-
4061	R	0..65535	Serial number two smaller bytes	-
4062	R	0..65535	Program version (* 100)	-

The brackets [ ] contain correspondingly: resolution or unit.

Energies are available in hundreds of watt-hours (var-hours) in two 16-bit registers, that is why while converting the values for the individual energies from registers they ought to be divided by 10 e.g.:

Imported active energy = (reg. value 4089 x 65536 + reg. value 4090) / 10 [kWh]

Exported active energy = (reg. value 4091 x 65536 + reg. value 4092) / 10 [kWh]

Reactive inductive energy = (reg. value 4093 x 65536 + reg. value 4094) / 10 [kVarh]

Reactive capacitive energy = (reg. value 4095 x 65536 + reg. value 4096) / 10 [kVarh]

Status Register 1:

Bit 14 - „1” - lack of calibration or calibration error
Bit 13 - „1” - parameters value error
Bit 12 - „1” - energy value error
Bit 11 - reserved
Bit 10 - reserved
Bit 9 - reserved
Bit 8 - reserved
Bit 7 - „1” - the interval of power averaging did elapsed
Bit 6 - „1” - voltage too low to measure frequency
Bit 5 - reserved
Bit 4 - reserved
Bit 3 - reserved
Bit 2 - „1” - capacity character maximum
Bit 1 - „1” - capacity character minimum
Bit 0 - „1” - capacity chracter Q

Table 6

Register address16 bit	Register address 32 bit	Operation	Description	Unit
7000	7500	R	Voltage U	V
7002	7501	R	Current I	A
7004	7502	R	Active power P	W
7006	7503	R	Reactive power Q	Var
7008	7504	R	Apparent power S	VA
7010	7505	R	Active power factor	-
7012	7506	R	Active power to reactive power ratio	-
7014	7507	R	Frequency	Hz
7016	7508	R	Mean active power PAV 15, 30, 60 minute	PAV
7018	7509	R	reserved	
7020	7510	R	reserved	
7022	7511	R	Cosine angle between U and I	-
7024	7512	R	Angle between U and I	°
7026	7513	R	Imported active energy (number of register overflow 7513, reset after exceeding 99999999.9 kWh)	100 MWh
7028	7514	R	Imported active energy (countdown counter up to 99999.9 kWh)	kWh
7030	7515	R	Exported active energy (number of register overflows 7515, reset after exceeding 99999999.9 kWh)	100 MWh
7032	7516	R	Exported active energy (countdown counter up to 99999.9 kWh)	kWh

7034	7517	R	Reactive inductive energy (number of register overflows 7517, reset after exceeding 99999999,9 kVarh)	100 Mvarh
7036	7518	R	Reactive inductive energy (countdown counter up to 99999.9 kVarh)	kvarh
7038	7519	R	Reactive capacitive energy (number of register overflows 7519, reset after exceeding 99999999.9 kVarh)	100 Mvarh
7040	7520	R	Reactive capacitive energy (countdown counter up to 99999,9 kVarh)	kvarh
7042	7521	R	reserved	-
7044	7522	R	reserved	-
7046	7523	R	reserved	-
7048	7524	R	reserved	-
7050	7525	R	Time - seconds	sek
7052	7526	R	Time – hours, minutes	-
7054	7527	R	Date – month, day	-
7056	7528	R	Date - year	-
7058	7529	R	Steering of analog output	mA
7060	7530	R	Ordered power used	%
7062	7531	R	Current / 3	A
7064	7532	R	Status 1	-
7066	7533	R	Status 2	-
7068	7534	R	Voltage min	V
7070	7535	R	Voltage max	V
7072	7536	R	Current min	A
7074	7537	R	Current max	A
7076	7538	R	Active power min	W
7078	7539	R	Active power max	W

7080	7540	R	Reactive power min	var
7082	7541	R	Reactive power max	var
7084	7542	R	Apparent power min	VA
7086	7543	R	Apparent power max	VA
7088	7544	R	Power factor (PF) min	-
7090	7545	R	Power factor (PF) max	-
7092	7546	R	Reactive power to active power ratio min	-
7094	7547	R	Reactive power to active power ratio max	-
7096	7548	R	Frequency min	Hz
7098	7549	R	Frequency max	Hz
7100	7550	R	Active mean power 15, 30, 60 minute min	W
7102	7551	R	Active mean power 15, 30, 60 minute max	W
7104	7552	R	reserved	-
7106	7553	R	reserved	-
7108	7554	R	reserved	-
7110	7555	R	reserved	-
7112	7556	R	Cosine of the angle between U and I min	-
7114	7557	R	Cosine of the angle between U and I max	-
7116	7558	R	Angle between U and I min	°
7118	7559	R	Angle between U and I max	°

In case of lower overflow the value -1e20 is entered, whereas at upper overflow or error occurence the value 1e20 is entered.

10. EXAMPLES OF P41 TRANSDUCERS PROGRAMMING

Example 1. Programming of unidirectional analog output

To program the operation of the analog output in such a way that input current values 4A correspond to the value 20 mA of the analog output, whereas input current value 0 A corresponds to the value 4 mA of the analog output.

Table 7

Register	Value	Meaning
4028	2	2 - current
4029	1	analog output 1 - type: 1 – (4…20) mA
4030	0	0 – 0,0 % (percentage value with one decimal place multiplied by 10) lower value of rated three-phase mean current, (0 A / 5 A) x 1000 = 0
4031	800	800 – 80,0 % (percentage value with one decimal place multiplied by 10) upper value of rated current, (4 A / 5A) x 1000 = 800
4032	400	400 – 4,00 mA (value in mA with two decimal places multiplied by 100) lower value of current output, (4.00 mA x 100) = 400
4033	2000	2000 – 20,00 mA (value in mA with two decimal places multiplied by 1000) upper value of current output, (20.00 mA x 100) = 2000
4034	0	0 – normal mode of an analog output
4035	2400	24 – 24 mA on a continuous output when error (-1e20 or 1e20)

Example 2. Programming of bidirectional analog output

To program the operation of the analog output in such a way, that at the power value 4 A x 230 V x cos (180°) = -2760 W on the output was the value -20 mA, whwreas for the power value 4 A x 230 V x cos (0°) = 2760 W was the value 20 mA.

Table 8

Regi-ster	Value	Meaning
4028	3	3 - current
4029	2	analog output 1 - type: 1 – (4…20) mA
4030	-800	-100 – 100,0 % (percentage value with one decimal place multiplied by 10) lower value of rated power, (4 A x 230 V x cos(180°) /5 A x 230 V) x 1000 = - 800)
4031	800	1000 – 100,0 % (percentage value with one decimal place multiplied by 10) upper value of three-phase rated power, (4 A x 230 V x cos(0°) /5 A x 230 V) x 1000 = 800
4032	-2000	-2000 – -20,00 mA (value in mA with two decimal places multiplied by 100) lower value of current output, (-20.00 mA x 100) = -2000
4033	2000	2000 – 20,00 mA (value in mA with two decimal places multiplied by 100) upper value of current output, (20.00 mA x 100) = 2000
4034	0	0 – normal mode of an analog output 1
4035	24	24 – 24 mA on continuous output 1 when error (-1e20 or 1e20)

11. TECHNICAL DATA

Measuring ranges and admissible basic errors (table 9)

Table 9

Measured quantity	Measuring range	Basic error
Current 1 A ~ 5 A ~	0.005...1.200 A~ 0.025...6.000 A~	±0.2%
Voltage L-N 100 V~ 400 V~	1...120.0 V~ 4...480 V~	±0.2%
Frequency	45.0...66.0...100 Hz	±0.2%
Active power	-2.88 kW ..1.40 W .. 2.88 kW	±0.5%
Reactive power	-2.88 kvar ..1.40 var .. 2.88 kvar	±0.5%
Apparent power	1,40 VA .. 2,88 kVA	±0.5%
PF factor	-1...0...1	±0.5%
Tangent φ_i	-1.2...0...1.2	±1%
φ	0 .. 359	±1%
Active energy	0 ... 9 999 999.9 kWh	±0.5%
Reactive energy	0 ... 9 999 999.9 kvarh	±0.5%

Standard conversion time: 1.2 s

Maximal conversion time: 2.2 s

Power consumption:

- in supply circuit ≤ 3 VA
- in voltage circuit ≤ 0.05 VA
- in current circuit ≤ 0.05 VA

Analog output

programmable output:
current (max. range) -24..0..+24 mA
termination resistance
of current output R_{load}: 0..250 Ω
voltage: 15 V

Serial interfaces	**RS485**: 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; tryb 8N2; baud rate 9.6 kbit/s, max. USB cable lenght ≤ 3m transmission protocol: modbus RTU response time: 1000 ms
Ratio of the Voltage transformer Ku	0.1 .. 4000.0
Ratio of the Current transformer Ki	1 .. 10000

Protection degree ensured by the housing:

for the housing	IP 40
for terminals	IP 10

Weight	0.2 kg
Dimensions	40 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..300 V d.c. 20..40 V a.c. 40..400 Hz; 20..60 V d.c.
- input signal	0 .. 0.005..1.2 In; 0.01..1.2 Un for current and voltage 0 .. 0.005..1.2 In; 0..0.01..1.2 Un for power factors Pfi ,tφi frequency <u>45..66</u>..100 Hz sinusoidal (THD ≤ 8%)
- power factor	-1 .. 0 .. 1
- analog output	-24 .. -20 .. 0 .. +20..24 mA
- ambient temperature	-10 .. 23 .. +55 °C
- storage temperature	- 30 .. +70 °C
- humidity	< 95% (condensation inadmissible)

- admissible peak factor:	
- current intensity	2
- voltage	2
- external magnetic field	0..40 ..400 A/m
- short duration overload (5 s)	
voltage input	2 Un (max.1000 V)
current input	10 In
- work position	any
- warm-up time	5 min.

Additional errors:
in % of a basic error

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

Standards fulfilled by the transducer
Electrical measuring transducers for converting electrical quantities of alternating current into analog or digital signals EN 60688

Kompatybilność elektromagnetyczna:

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

Safety requirements:
according to EN 61010-1

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

12. ORDERING CODE

Table 9

P43 -	X	XX	X	X
Supply:				
85..253 V a.c. 40..400 Hz; 90..300 V d.c.	1			
20..40 V a.c. 40..400 Hz; 20..60 V d.c.	2			
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

* after agreeing with the manufacturer

EXAMPLES OF ORDERS:

The code P41-100E0 means the transducer with supplay voltage 85..253 V a.c.; 90..300 V d.c. Standard version, user's manual in English, without extra quality requirements.

LUMEL
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P41-09A