LUMEL

TEMPERATURE AND HUMIDITY
TRANSDUCER
P18(D)

USER'S MANUAL

CE

Contents

1. APPLICATION

The P18 and P18D transducers are the devices destined for the continuous measurement and conversion of relative humidity and ambient temperature into a digital form and into a voltage or current standard signal. The transducers are fixed on a wall. Programming of the transmitters is possible via the RS-485 interface. LPCon or eCon software designed for configuration of the transducers is available on the manufacturer's website: www.lumel.com.pl. Applied sensor shields enable the application of the transducers in various ambient conditions.
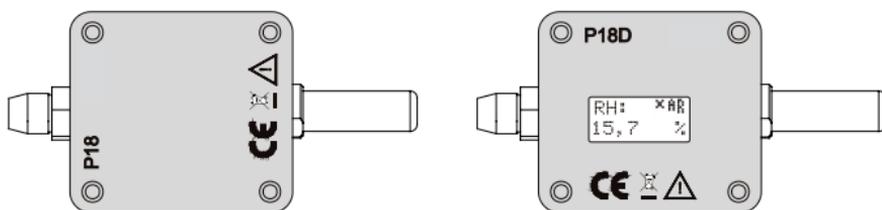
Fig. 1. Overview of the P18 and P18D transducers with the probe on the housing.
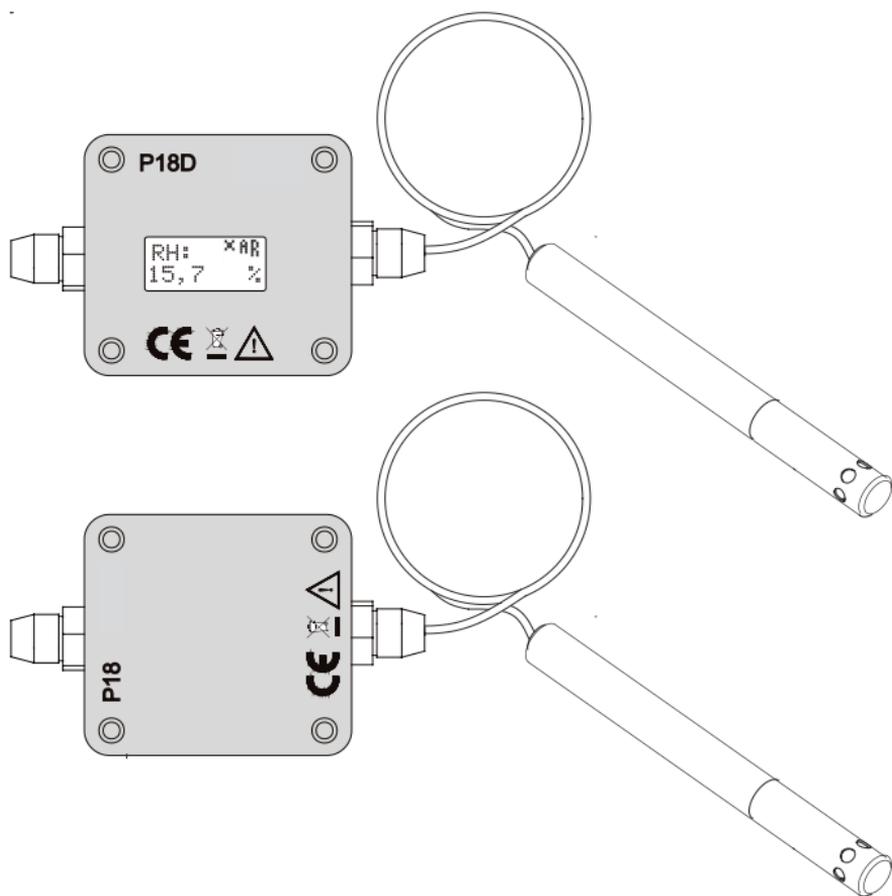
Fig. 2. Overview of the P18 and P18D transducers with the probe on the wire 0,5 m.

2. TRANSDUCER SET

‒ Transducer   1 pc

3. BASIC REQUIREMENTS, OPERATIONAL SAFETY

In terms of operational safety, the transducer meets the requirements of the EN 61010-1 standard.

Comments concerning safety

⚠

- Assembly and installation of the electrical connections should conducted only by people authorised to perform assembly of electric devices.

- Always check the connections before turning the transducer on.

- The transducer is designed to installation and usage in the industrial electromagnetic environment.

4. INSTALLATION

4.1. Assembly

The P18(D) transducer is designed to be mounted on a wall by means of a screw connection or glue without the loss of IP65 tightness. The transducer housing is made of a self-extinguishing plastics. The transducer has screw connectors placed inside the transducer, which enable the connection of external wires of 1 mm^2 cross-section.
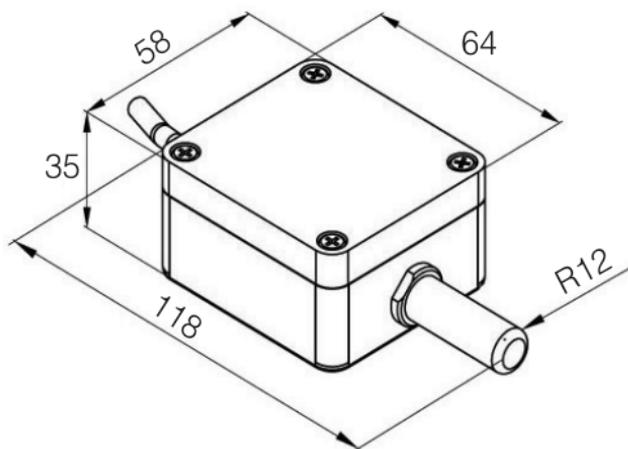
Fig. 3. Overall dimensions of the P18(D) transducer
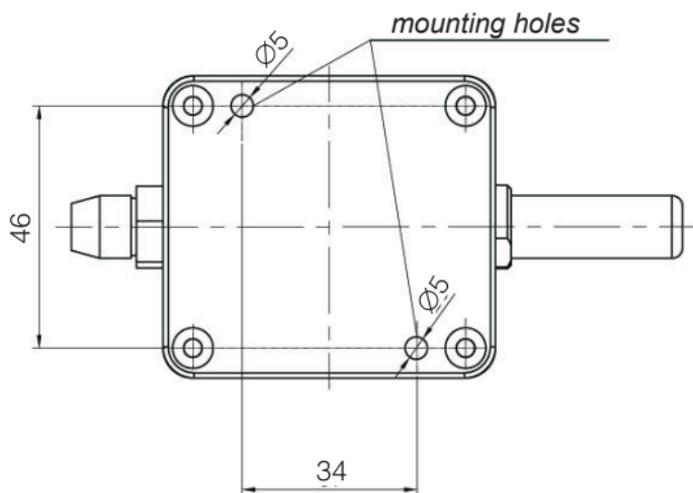
Fig. 4. Lay-out of mounting holes of the P18(D) transducer

4.2. External connection diagrams

The P18(D) transducer version P18(D)-1XXX or P18(D)2XXX has 8 connecting terminals, version P18(D)-0XXX has 4 terminals (version without analog outputs). Access to the terminals is possible after removing the cover of the transducer housing. You should use a multiconductor round wire with external diameter from 3.5 mm up to 6 mm for electrical connections. Remove the display prior to connecting the wires in a screw terminal of the P18D transducer. Pass supplying wires through the packing and twist the packing seal in order to obtain the leaktightness. If the packing seal is not twisted, the required IP 65 leaktightness is not ensured. The LCD display should be put back after screwing the wires to the screw terminal of the P18D transducer.

a)   *b)*
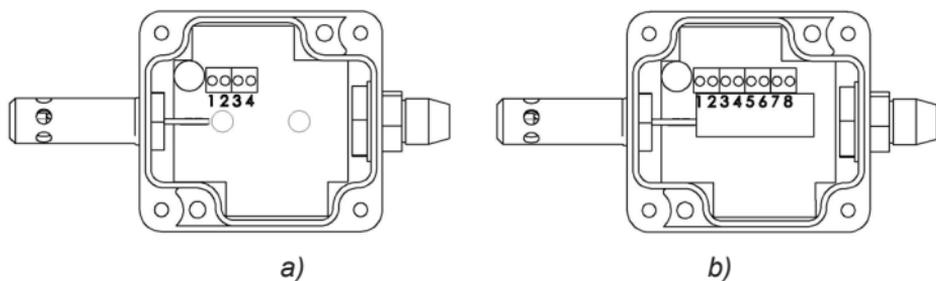
Fig. 5. Marking of the terminals for the connection of external signals of the P18(D) transducers in versions: a) without analog outputs, b) with analog outputs.

Transducer without analog outputs	
Transducer with current outputs	
Transducer with voltage outputs	
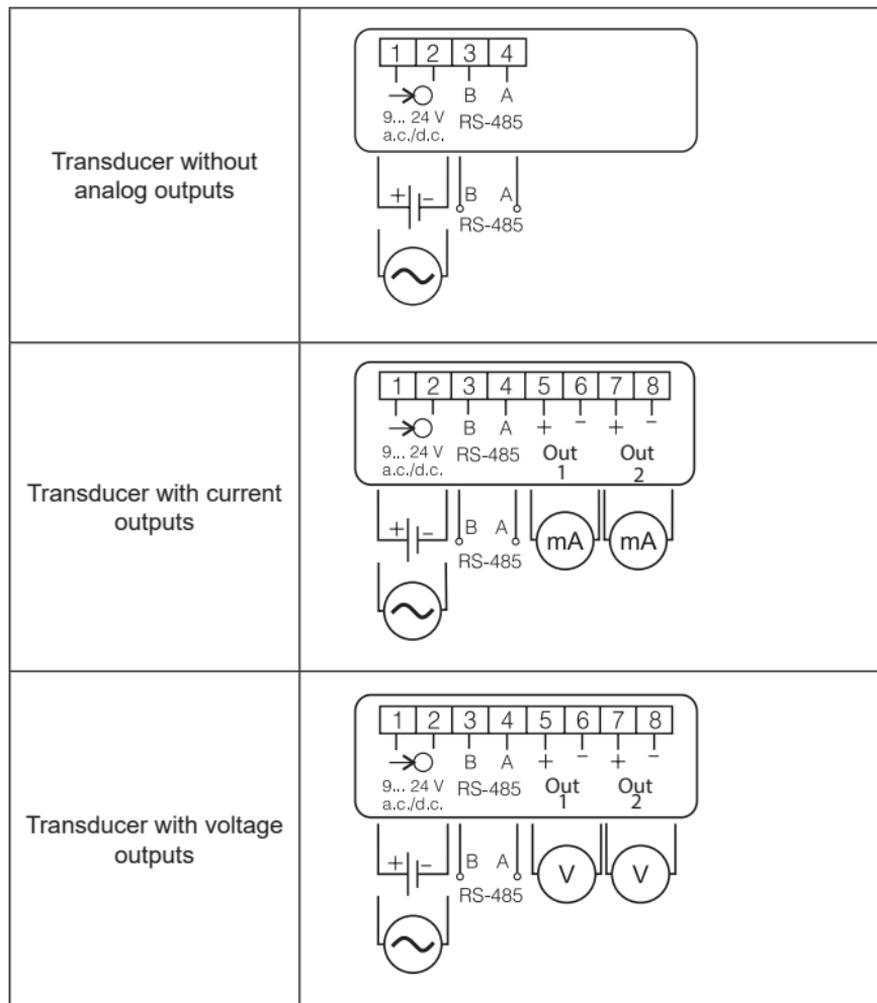
Fig. 6. Wiring diagram of the P18(D) transducer with analog outputs

Use shielded cable for supply and output signals in environments with high levels of interference. The shield must be connected to the nearest PE point from the feeder side.

5. SERVICE

The P18D transducer is equipped with a display field 8x2 characters with illumination and one capacitive button located on the housing. The P18 transducer is not equipped with a display or a button. After connecting the wires, closing and servicing the housing, and connecting to the supply, the transducer is ready to work with manufacturer's settings (Tab. 4). The transducer can be programmed through the RS-485 interface. You can program following parameters in the transducer:

− communication parameters
− - averaging time of the measurement
− - individual characteristics of analog outputs (for executions with analog outputs).

The P18D transducers allow programming communication parameters (address, baud rate, mode) using the capacitive button.

There is the possibility to connect the transducer through another transmission media, like: ETHERNET, USB using LUMEL S.A.'s converters.

5.1. Power-on messages of the P18D transducer

After connecting the external signals and connecting to the supply, the transducer displays the type, current program version, serial number and set communication parameters (address, baud rate and operating mode).

The transmitter automatically switches to the operating mode of measurement and processing the analog output signal after approx. 5 seconds. It displays the measuring value with the unit in the bottom line of the display, the top line of the display contains information about the type of displayed quantity and the pictograms of: transmission via RS-485, the presentation mode of the measuring value, the read pointer of the measuring value of the sensor and the operating state of the internal heater.

5.2. Description of the P18D transducer readout field

The illuminated character LCD is a readout field in the transducer P18D. The illumination is turned on after switching on the supply and after the capacitive button on the housing is pressed. The illumination is automatically switched off after 30 sec. of inactivity.
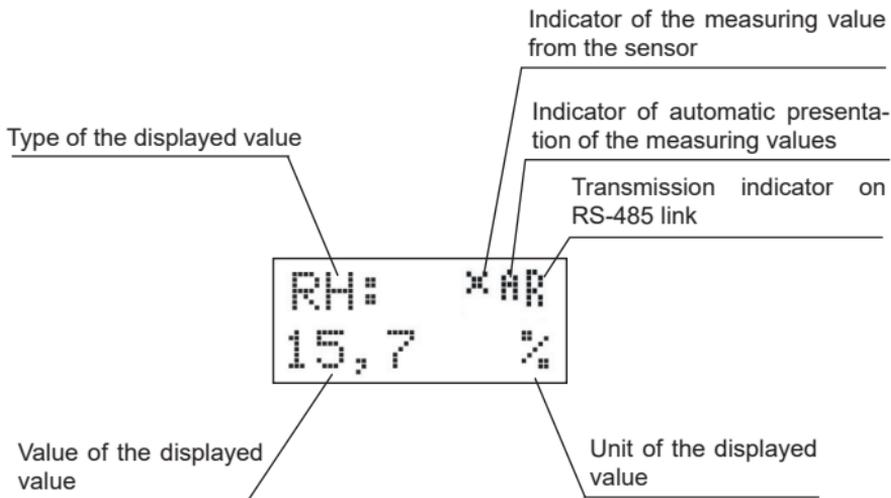
Fig. 7. Description of the P18D transducer readout field

Description of the symbols displayed by the P18D transducer is in the Table 1.

Table 1

Symbol	Meaning
T:	Type of the displayed value in the bottom line of the LCD - temperature
RH:	Type of the displayed value in the bottom line of the LCD - relative humidity

DP:	Type of the displayed value in the bottom line of the LCD - dew-point
AH:	Type of the displayed value in the bottom line of the LCD - absolute humidity
⠭	The indicator of the measuring value from the sensor
⠿	Automatic mode of measurement results presentation - a type of displayed value is automatically switched every 3 seconds in the following order: temperature → relative humidity → dew-point → absolute humidity → temperature ….
⠗	Data receiving indicator by the P18D transducer on RS-485
⠞	Data sending indicator by the P18D transducer on RS-485
h	Switching on the internal heater indicator to dry the sensor

5.3. Functions of the P18D transducer capacitive button

The P18D transducers are equipped with one capacitive button located on the housing. The location of the button shows in Fig. 8.
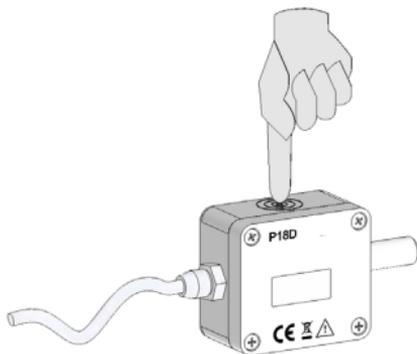
Fig. 8. Location of the P18D transducer capacitive button

Capacitive button is used to:
- switch the display illumination on
- change the presentation mode of the measurement results - holding the button for about 2 seconds switches from automatic mode to manual mode or inversely
- change the type of displayed values in the manual mode of presentation of the measurement results - pressing the button for a short time changes the displayed value.
- program communication parameters (address, baud rate, mode)

5.4. Programming parameters menu of the P18D transducer

Enter the programming menu by pressing and holding the capacitive button for approx. 5 sec. When entering the menu a first time, changes direction marker is set to ⬝⬝⬝ - increasing the value; next entry in the menu will cause the cyclic switching of the direction of changes (2 input in the menu will set the marker at ∨ – decreasing the value). If the idle time exceeds 20 seconds, the transducer will leave the menu and switch to displaying the measuring value.
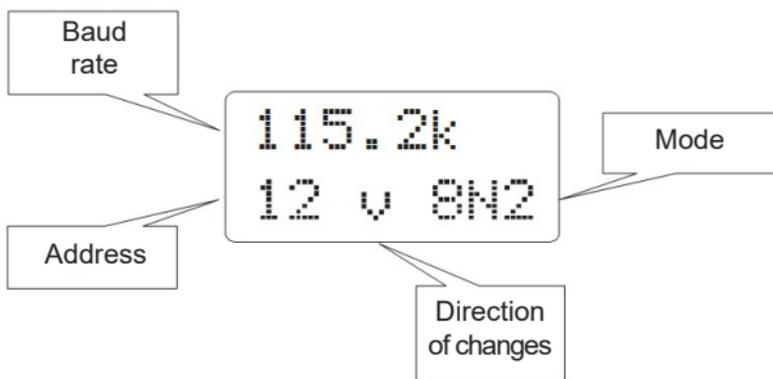
Fig. 9. The displayed information of the transmission parameters in the P18D transmitter menu
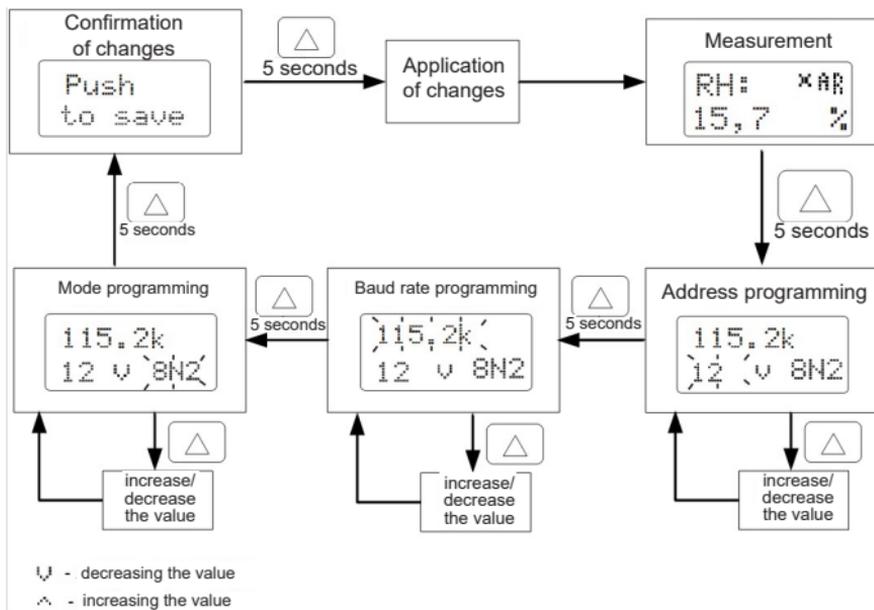
Fig. 10. Programming parameters algorithm of the P18D transducer

5.5. Functions of the P18(D) transducer

The P18(D) transducer carries out the functions:
- measurement of the ambient temperature and relative humidity
- calculation of chosen physical quantities (dew-point temperature, absolute humidity, wet bulb temperature)
- conversion of measured values into an output signal on the base of the individual linear characteristic (2 configurable analog outputs - optional)
- memory storage of maximal and minimal values for each of the measured and calculated value
- programming of the measurement averaging time
- RS-485 interface servicing in the MODBUS protocol, in RTU mode.
- Displaying measuring and calculated values (only P18D)

5.5.1. Calculated values

Based on the measurement of a temperature and relative humidity, the P18D transducer calculates dew-point and absolute humidity of the following dependencies.

DP → dwe-point:

$$DP = \frac{T_n}{\dfrac{m}{log\left(P_{ws} \cdot \dfrac{RH}{10000 \cdot A}\right)} - 1}$$

DP → absolute humidity:

$$AH = 2,1668 \cdot \frac{P_{ws} \cdot RH}{100 \cdot (T + 273,2)}$$

where:

T → measured temperature [°C]

RH → measured relative humidity [%]

DP → dew-point temperature [°C]

P_{ws} → saturated water vapor pressure (water vapor pressure) [mbar]

AH → absolute humidity [g/m³]

Table 2

The factors used to calculate the dew-point			
T [°C]	A	m	T_n
< 0	6.119866	7.926104	250.4138
0...50	6.1078	7.5	237.3
50...100	5.9987	7.3313	229.1

5.5.2. Selection of controlling values for analog outputs

The P18(D) transducers in versions P18(D)-1XX, P18(D)--2XX, P18(D)-4XX, P18(D)-5XX are equipped with two programmable analog outputs (voltage or current). By default, the first analog output is set for a presentation of the ambient temperature and the second analog output is controlled by the value of the relative humidity. The analog outputs can respond to any of the measuring or calculated values

(T, RH, DP, AH, wet bulb temperature). The value controlling the analog outputs is defined by the registers, respectively 4015 for the first output and 4016 for the second analog output (Tab. 14).

5.5.3. Individual characteristic of analog outputs

The P18(D) transducers in the version with analog outputs enable the conversion of measured values into an output signal based on the strength of individual linear characteristic of analog outputs. On the base of given coordinates of two points by the user, the transducer determines (from the system of equations) coefficients a and b of the individual characteristic.

$$\begin{cases} Y1out = a \cdot X1in + b \\ Y2out = a \cdot X2in + b \end{cases}$$

where:

$X1\ in$ and $X2\ in$ - displayed value,

$Y1\ out$ and $Y2\ out$ - oexpected value of the analog output
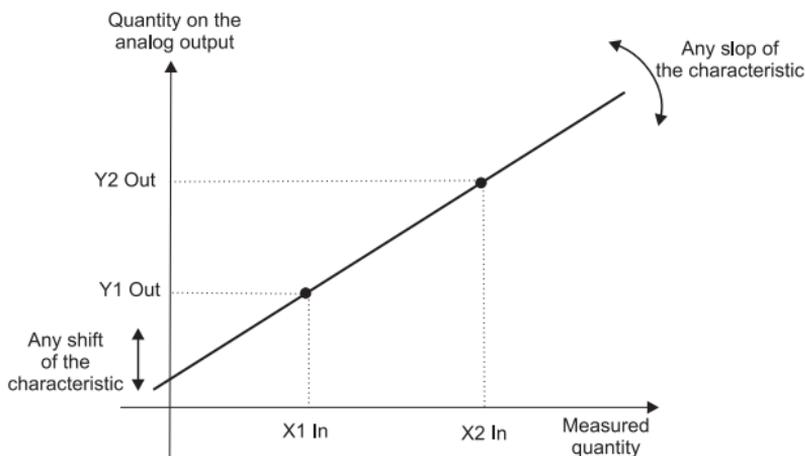
Fig. 11. Individual characteristic of analog output

The configuration of the individual characteristic of analog outputs amounts to the introduction of suitable values X1, X2, Y1, Y2 in corresponding registers to them from the range 4007 – 4014 Tab. 3. The values introduced in these registers must be integral values corresponding to the set point values multiplied by the value 100.

Example 1

Configuration of the individual characteristic of the first analog current output (temperature):

Expected processing temperature in the range -12,25°C ÷ 77,75 °C to the analog current signal in the range 4,5 mA ÷ 18,5 mA.

Table 3

Name	Register address	Value
X1 temperature	4007	-1225
Y1 current	4008	450
X2 temperature	4009	7775
Y2 current	4010	1850

Caution:

The analog outputs are not isolated from the supply, the RS-485 interface and each other, the analog current outputs don't have a common potential (low potential terminals can not be connected together), analog voltage outputs have a common low potential (low potential terminals can be connected together).

5.5.4. Support of a sensor heater

The sensors used in the P18(D) transducers are equipped with internal heating elements to allow faster release of water molecules from the sensor being flooded or working a long time in highly humid environments. Switching the heater on is possible by writing the appropriate value to the register 4021 (see Tab. 14). Status of the heater is available in the status register (register 4017) at the bit position 11 (if the bit 11 of the register 4017 is set to „1" - this means that the heater is switched on).

Caution:

The transducer with a heating element switched on does not measure the proper ambient temperature and humidity! (the temperature measured by the sensor increases and the humidity decreases). The value 200 is added to the measuring values (temperature, relative humidity) when using the transducer with the heater switched on in order to avoid distortions of a measurement in the measurement systems!

The P18D transducers working with a heating element switched on display a flashing symbol h.
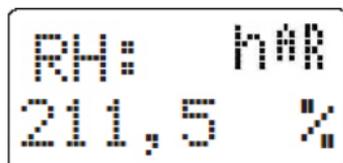
Fig. 12. Indication of the P18D transducer operation
with a heater switched on

5.5.5. Default settings

The Table 4 shows the standard settings of the P18D transducer. The settings can be restored via the RS-485 interface after writing the value „1" to the registry 4020.

Table 4

Parameter description	Para-meter address	Standard value		
		P18D-0XX, P18D-3XX	P18D-1XX, P18D-4XX	P18D-2XX, P18D-5XX
Address	4001	1		
Baud rate	4002	9600		
Mode	4003	RTU 8N2		
Averaging time	4005	30 [s]		
X1 of the 1st analog output	4007	0	-2000	-2000
Y1 of the 1st analog output	4008	0	400	0
X2 of the 1st analog output	4009	0	6000	6000
Y2 of the 1st analog output	4010	0	2000	1000
X1 of the 2nd analog output	4011	0	0	0
Y1 of the 2nd analog output	4012	0	400	0
X2 of the 2nd analog output	4013	0	10000	10000
Y2 of the 2nd analog output	4014	0	2000	1000

Value controlling the first analog output.	4015	0	0	0
Value controlling the second analog output.	4016	1	1	1
Custom configuration	4019	8	8	8

6. RS-485 INTERFACE

The P18(D) programmable digital transducers have a serial link RS-485 for communication in the computer systems and with other devices that serve as a Master. Asynchronous character MODBUS communication protocol has been implemented in a serial link. The transmission protocol describes how to exchange information between devices via a serial link.

Caution:

For the transmitter versions without analog outputs (P18 (D) -0XX and P18 (D) -3XX), the RS-485 interface is galvanically isolated from the supply - 1 kV separation.

For the transmitter versions with analog outputs, the RS-485 interface is not isolated from the supply or from the analog outputs.

6.1. Connection of the serial interface

Standard RS-485 allows a direct connection up to 32 devices on a single serial link to a length of 1200 m (at baud rate 9600 b/s). It is necessary to use additional intermediate-separation circuits for connecting higher number of the devices, for example PD51 manufactured by LUMEL S.A.

Output of the interface line is shown in Fig. 6. It is required to connect the lines A and B in parallel with their equivalents in other devices to obtain the correct transmission. The connection must use a shielded wire. The cable shield should be connected to the protective terminal in close proximity to the transmitter (connect a shield to the protective terminal at one point only).

RS-485 interface card or the converter is required for a connection to a PC, for example PD10. The method of connecting devices is shown in Fig. 13.
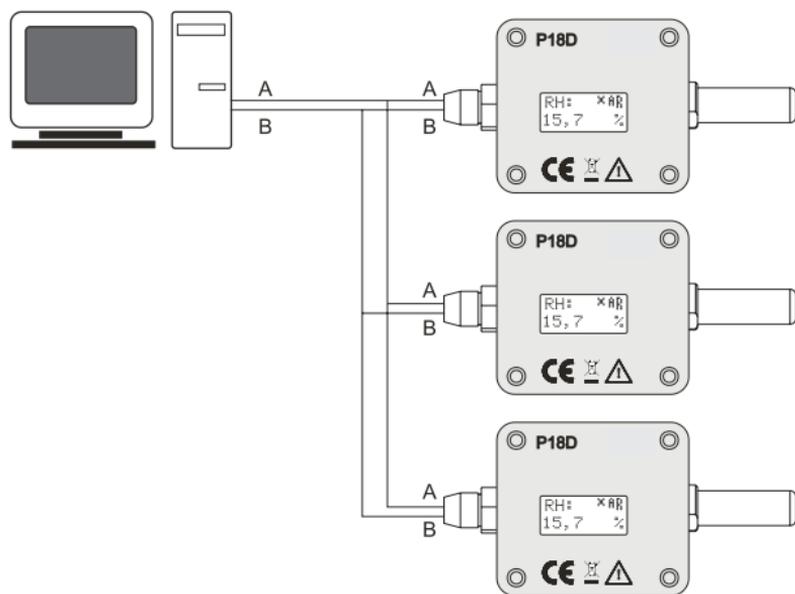
Fig. 13. Connecting the RS-485 interface.

6.2. Description of the MODBUS protocol implementation

The implemented protocol is compliant with the PI-MBUS-300 Rev G specification of Modicon.

Set of parameters of the P18D transducer serial link in the MODBUS protocol:

- Transducer address 1..247.
- Baud rate: 4800, 9600, 19200, 38400, 57600, 115200 [b/s].
- Operating mode: RTU frame format: 8N2, 8E1, 8O1, 8N1.
- Maximum response time: 500 ms

Configuration of the serial link parameters consists of determining the baud rate, the device address and the format of the transmission mode - protocol.

Caution: Each transmitter connected to the communication network must:

- have a unique address, different from the addresses of other devices connected to the network.
- Identical baud rate and type of a transmission mode

6.3 Description of the functions used

Following functions of the MODBUS protocol have been implemented in P18D transducers:

- 03 (03h) – readout of registers group,
- 04 (04h) – readout of input registers group,
- 06 (06h) – single register writing,
- 16 (10h) – registers group writing,
- 17 (11h) – slave device identification.

Readout of n-registers (code 03h)

Example 1. Readout of 2 registers, starting with the register address 1D4Dh (7501) float (32-bit), (register values 25.68, 20.25.)

Request:

Table 5

Device address	Function	Register address		Number of registers		CRC check-sum
		B1	B0	B1	B0	
01h	03h	1Dh	4Dh	00h	02h	5270h

Response:

Table 6

Device address	Function	Number of bytes	Value from the register 1DB0 (7501)				Value from the register 1DB1 (7502)				CRC check-sum
			B3	B2	B1	B0	B3	B2	B1	B0	
01h	03h	08h	41h	CDh	70h	A4h	41h	A2h	00h	00h	83D0h

Single register writing (code 06h)

Example 2. Writing the value 78h (120) to the register FA1h (4001)

Request:

Table 7

Device address	Function	Register address		Register value		CRC checksum
		B1	B0	B1	B0	
01h	06h	0Fh	A1h	00h	78h	DB1Eh

Response:

Table 8

Device address	Function	Register address		Register value		CRC checksum
		B1	B0	B1	B0	
01h	06h	0Fh	A1h	00h	78h	DB1Eh

Writing n-registers (code 10h)

Example 3. Writing the value 78h (120) and the value 4h (4) to the registers FA1h, FA2h (4001, 4002)

Request:

Table 9

Device address	Function	Register address		Number of registers		Number of bytes	Register value 4001		Register value 4002		CRC checksum
							B1	B0	B1	B0	
01h	10h	0Fh	A1h	00h	78h	04h	00h	78h	00	04	F831h

Response:

Table 10

Device address	Function	Register address		Number of registers		CRC checksum
		B1	B0	B1	B0	
01h	10h	0Fh	A1h	00h	02h	133Eh

Device identification report (code 11h)

Example 4. Device identification

Request:

Table 11

Device address	Function	Checksum
01h	11h	C02Ch

Response:

Table 12

Device address	Function	Number of bytes	Identifier P18D	Device status	The field depending on the device software version (e.g. 0.70)	CRC checksum
01h	11h	0Eh	CCh	FFh	50h 31h 38h 44h 76h 2Eh 30h 2Eh 30h 34h 20h 00h	B154h

6.4 Map of the registers

In the P18D transducer, data are placed in 16 and 32-bit registers. Process variables and transducer parameters are placed in the address area of registers in a way depended on the variable value type. Bits in 16-bit registers are numbered from the youngest to the oldest (b0 … b15). The 32-bit registers (4 bytes) contain numbers of float type in IEEE-754 standard. Bytes sequence: B3 B2 B1 B0 – the oldest byte is transmitted as the first.

A following map is the map of P18(D) transducers registers.

Caution:
All listed addresses are physical addresses. Some computer programs use logic addressing, then the addresses should be increased by 1.

Table 13

Address range	Value type	Description
4000-4022	integer (16 bits)	The value is located in the 16-bit register.
6000-6030	float (32 bits)	Value set in the two following 16-bit registers. These registers contain the same data as 32-bit registers from 7500-7515 range. Readout registers. Bytes sequence (B1,B0,B3,B2)
7000-7030	float (32 bits)	Value set in the two following 16-bit registers. These registers contain the same data as 32-bit registers from 7500-7515 range. Readout registers. Bytes sequence (B3,B2,B1,B0)
7500-7515	float (32 bits)	The value is located in the 32-bit register. Registers contain measured and calculated data by the transducer. Registers are only for readout.

6.5 Registers for writing and readout

Table 14

The value is located in the 16-bit registers	Name	Write (w) / readout (r)	Range	Description	
4000	Identifier	w/r	170	P18 device identifier	
			204	P18D device identifier	
4001	Address	w/r	1...247	Device address	
4002	RS-485 baud rate		0...5	Value	Description
				0	4800 bit/s
				1	9600 bit/s
				2	19200 bit/s
				3	38400 bit/s
				4	57600 bit/s
				5	115200 bit/s
4003	RS-485 transmission mode		0...3	Value	Description
				0	RTU 8N1
				1	RTU 8N2
				2	RTU 8E1
				3	RTU 8O1

4004	Confir-mation of trans-mission parameters changes		0...1	Va-lue	Description
				0	No change
				1	Confirmation of changes
4005	Averaging time	w/r	6...3600	Averaging time of the mea-surement [s]	
4006	Erasing the extre-mes	w/r	0...1	Va-lue	Description
				0	No change
				1	Erasing the min. and max. values
4007	X1 of output 1	w/r	-32768 ...32767	Individual characteristic of analog outputs	Value controlling output 1 - point X1[x100]
4008	Y1 of output 1	w/r	-32768 ...32767		Expected value of output 1 for point X1
4009	X2 of output 1	w/r	-32768 ...32767		Value controlling output 1 - point X2 [x100]
4010	Y2 of output 1	w/r	-32768 ...32767		Expected value of output 1 for point X2
4011	X1 of output 2	w/r	-32768 ...32767		Value controlling output 2 - point X1 [x100]
4012	Y1 of output 2	w/r	-32768 ...32767		Expected value of output 2 for point X1
4013	X2 of output 2	w/r	-32768 ...32767		Value controlling output 2 - point X2 [x100]
4014	Y2 of output 2	w/r	-32768 ...32767		Expected value of output 2 for point X2

4015	Value controlling 1 analog output.	w/r	0...3	Value	Description
				0	Temperature
				1	Relative humidity
				2	Dew-point
				3	Absolute humidity
				4	Wet bulb temperature
4016	Value controlling 2 analog output.	w/r	0...3	Value	Description
				0	Temperature
				1	Relative humidity
				2	Dew-point
				3	Absolute humidity
				4	Wet bulb temperature

4017	Status	w/r	-32768 ...32767	Transducer status. Shows the current state of the transducer and the hardware configuration. Successive bits represent the event. Bit set to 1 indicates that the event took place.	
				Bit15	Restart of the supply, writing the value -32768 (8000h) will clear the status bit
				Bit14	Error of the calibration parameters
				Bit13	Error of the transmitter settings - enter the new settings

				Bit12	not used			
				Bit11	Indicator of switching the heater on			
				Bit10	Indicator of erasing the extremes, writing the value 1024 (400h) erases the status bit			
				Bit9	Temporary communication parameters are set (shorten jumper „ZW")			
				Bit8	LCD display error			
				Bit7	Error reading the value from the sensor			
				Bit5, 6	Value controlling 2 analog output			
					00	01	10	11
					temperature	relative humidity	dew-point	absolute humidity
				Bit3, 4	Value controlling 1 analog output			
					00	01	10	11
					temperature	relative humidity	dew-point	absolute humidity

				Bit2	results averaging interval has ended
				Bit1	The transducer is equipped with the analog outputs - voltage.
				Bit0	The transducer is equipped with the analog outputs - current.
4018	Software version	o	1...999	Software version x100	

6.6 Registers for readout

Table 15

Value set in the two following 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500.	The value is located in the 32-bit registers	Name	Write (w)/ readout (r)	Unit	Quantity name
7000	7500	ID	r	-	P18(D) device identifier
7002	7501	T	r	^{o}C	Measured temperature
7004	7502	RH	r	%	Measured relative humidity
7006	7503	DP	r	^{o}C	Calculated dew-point
7008	7504	AH	r	g/m^3	Calculated absolute humidity
7010	7505	min T	r	^{o}C	Min. of temperature
7012	7506	max T	r	^{o}C	Max. of temperature
7014	7507	min RH	r	%	Min. of relative humidity
7016	7508	max RH	r	%	Max. of relative humidity
7018	7509	min DP	r	^{o}C	Min. of dew-point

7020	7510	max DP	r	°C	Max. of dew-point
7022	7511	min AH	r	g/m^3	Min. of absolute humidity
7024	7512	max AH	r	g/m^3	Max. of absolute humidity
7026	7513		r	°C	Wet bulb temperature
7028	7514		r	kPa	Water vapor pressure

Table 16 shows the registers of measuring values of the P18D transducer working in the registers 7000 and 7500 compatibility mode with the P14W transducer

Table 16

Value set in the two following 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500.	The value is located in the 32-bit registers	Name	Write (w) /readout (r)	Unit	Quantity name
7000	7500	ID	o	-	P18(D) device identifier

7002	7501	T	o	°C	Measured temperature
7004	7502	DP	o	°C	Calculated dew-point
7006	7503	-	-	-	
7008	7504	RH	o	%	Measured relative humidity
7010	7505	AH	o	g/m^3	Calculated absolute humidity
7012	7506	-	-	-	
7014	7507	-	-	-	
7016	7508	-	-	-	
7018	7509	min T		°C	Min. of temperature
7020	7510	max T		°C	Max. of temperature
7022	7511	min DP		°C	Min. of dew-point
7024	7512	max DP		°C	Max. of dew-point
7026	7513	-	-	-	
7028	7514	-	-	-	
7030	7515	min RH	o	%	Min. of relative humidity
7032	7516	max RH	o	%	Max. of relative humidity
7034	7517	min AH	o	g/m^3	Min. of absolute humidity
7036	7518	max AH	o	g/m^3	Max. of absolute humidity

6.7 Emergency restoration of default parameters

If the communication parameters have been changed and the new configuration is lost, you can use the jumper marked „ZW" on the transmitter's board to set the temporary communication parameters:

- address   247
- baud rate   9600 kb/s
- mode   RTU 8N2

You can connect to the transmitter after setting the temporary parameters and adjust them or restore the defaults settings. After removing the jumper, the transducer returns to previous settings or to settings changed during the operation with the jumper.
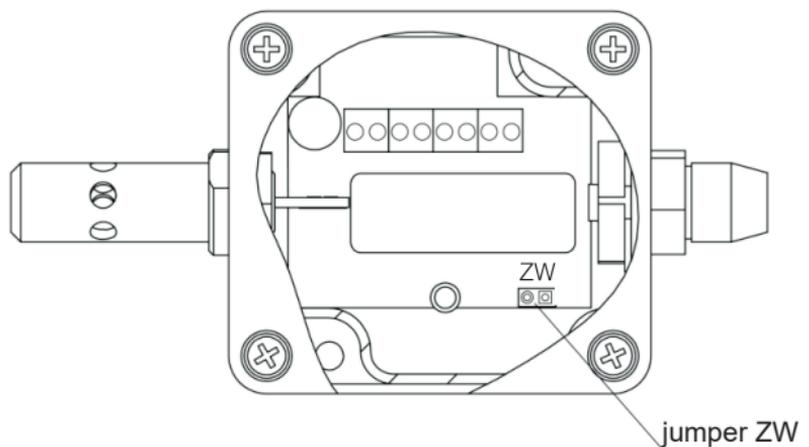

jumper ZW

Fig. 13. Placement of the jumper setting temporary communication parameters

7. ERROR CODES

The error messages could be displayed on the transducer P18D display during operation. The table below lists the error codes which are possible to be displayed and their reasons as well as the recommended user responses. Information about the existing errors is also available in the P18(D) transducers status register - register 4017.

Table 17

Message	bit no. reg. Status (reg. 4017)	Description
Error Sensor	7	Sensor failure - transmitter should be returned to a service
Error Calibr.	14	Loss of calibration parameters - loss of efficiency of the analog outputs, measurements are correct - returning a transmitter to a service should be considered
Error Param. XX	13	Loss of transmitter settings - XX - number of a parameter (register number 40XX) configured incorrectly - correct value should be written to the register 40XX or default settings restored

8. ACCESSORIES

As a standard, the P18(D) transducer is equipped with a shield of the sensor, destined only for indoors applications. It is recommended to use additional shields of the sensor (interchangeable) for outdoors or indoors applications exposed to the possibility of water vapor condensation, depending of the transducer working conditions.

Table 18

Item	Order code	Dra-wing	Name	Design	Features	Typical applications
1	20-015-00-00011		Membrane filter	PCV housing, PTFE membrane with a laminated film, pore size: 1 µm	Average effect of filtration, maximal temperature: up to 80oC, response time t10/90: 15 s	Building automation, for use in the rooms with small pollution
2	20-015-00-00007		PTFE filter	Sintered PTFE, pore size 50 µm	High chemical resistance, maximal temperature: up to 180 ^{o}C, response time t10/90:14 s	Drying process in chemical applications

6. TECHNICAL DATA

Basic parameters:

- range of relative humidity
  measurement (RH)   0...100%, without condensation[1]

- basic error of humidity
  conversioni   ± 2% of the range for RH = 10...90%
                                 ± 3% for the remaining range

- hysteresis of the humidity
  measurement   ± 1% RH

- basic range of temperature
  measurement (T)   -20...60°C[2]

- basic error of temperature
  conversion   ± 0.5% of the range*

* for the versions with analog outputs P18(D)-1, P18(D)-2, P18(D)-4 or P18(D)-5,
 a basic error of temperature conversion may increase by 0.2°C

- calculated values   absolute humidity (a) [g/m^3]
                                 dew-point temperature (Td) [°C]

- additional errors:
  - temperature influence   ± 25% of the basic error /10°C

RS-485 digital output:

- transmission protocol   MODBUS
- baud rate   4800, 9600,19200,38400,
                                 57600 bit/s
- mode   RTU: 8N2, 8E1, 8O1, 8N1
- max. response time   300 ms

Analog outputs:

- current   4...20 mA
- voltage   0...10 V
- max. load resistance
  of the current output   100 Ω
- min. load resistance
of the voltage output   1 kΩ

Rated operating conditions:

- supply	<u>9...24</u> V a.c./d.c.
- power consumption	< 0.5 VA
- ambient temperature	- 20...<u>23</u>...60°C
- relative air humidity	< 95% [3)]
- rate of air flow	$\geq$ 0,5 m/s [4)]
- preheating time	15 minutes
- protection grade ensured	
by the housing	IP 65
- fixing	on a wall
- weight	125 g
- dimensions	$(35 \times 58 \times 118)$ mm

- working position:
  - in applications non-exposed to a direct contact with water: any
  - in applications exposed to a direct contact with water:
    with the sensor chamber directed towards the ground

Electromagnetic compatibility:

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

Safety requirements acc. to EN 61010-1

- installation category	III
- pollution grade	2
- phase-to-earth operating voltage	50 V
- altitude above sea level	< 2000 m

[1)] In case of condensation of water vapor on the sensor surface, the measurement error may exceed the basic error till a moment of drying up the sensor structure

[2)] The absolute temperature measurement range is –30...85°C but the measurement class is not guaranteed beyond the basic range

[3)] Admissible condensation of water vapor when using additional sensor shields, see Tab. 9)

[4)] For air flow < 0.5 ms, the temperature and humidity measurement error may increase by 100%.

7. ORDERING CODE

Table 10

Code	Description
P18 000M0	Temperature and humidity transducer P18 without analog outputs; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements
P18 100M0	Temperature and humidity transducer P18 2x analog output 4-20mA; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements
P18 200M0	Temperature and humidity transducer P18 2x analog output 2x 0-10V; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements
P18D 000M0	Temperature and humidity transducer P18D with LCD display, without analog outputs; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements
P18D 100M0	Temperature and humidity transducer P18D with LCD display, 2x analog output 4-20mA; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements
P18D 200M0	Temperature and humidity transducer P18D with LCD display, 2x analog output 0-10V; sensor on the housing; documentation and descriptions in Polish and English version, without any extra requirements

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