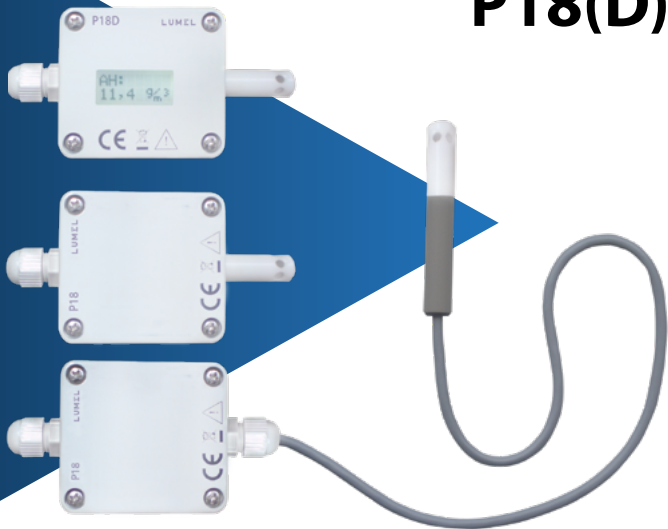


LUMEL

TEMPERATURE AND HUMIDITY TRANSDUCER **P18(D)**



USER'S MANUAL

CE

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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.

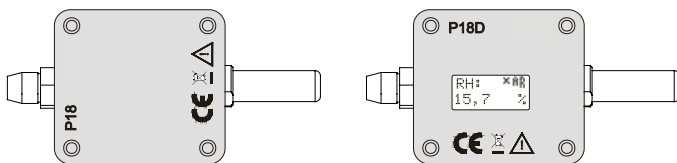


Fig. 1. Overview of the P18 and P18D transducers with the probe on the housing.

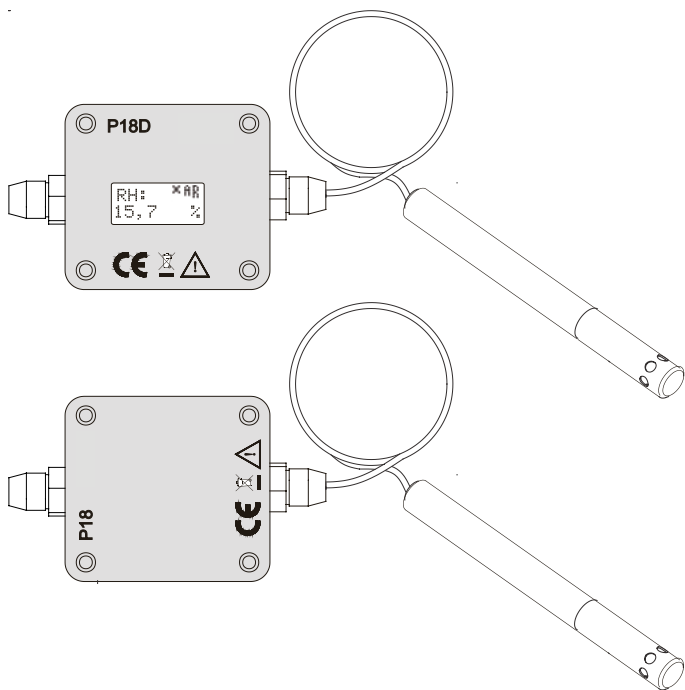


Fig. 2. Overview of the P18 and P18D transducers with the probe on the wire 0,5 m.

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 be conducted only by people authorised to perform assembly of electric devices.
- Always check the connections before turning the transducer on.
- The transducer is designed for 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 self-extinguishing plastics. The transducer has screw connectors placed inside the transducer, which enable the connection of external wires of 1 mm² cross-section.

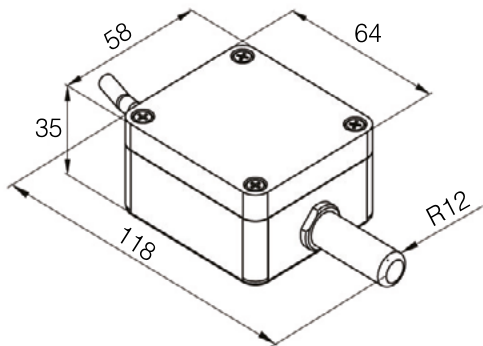


Fig. 3. Overall dimensions of the P18(D) transducer

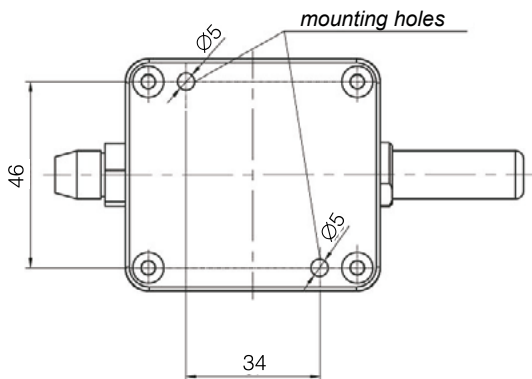


Fig. 4. Lay-out of mounting holes of the P18(D) transducer

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 multi-conductor 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.

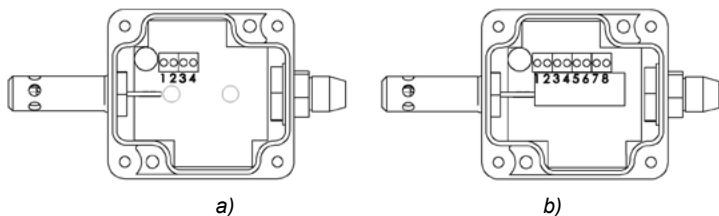


Fig. 5. Marking of the terminals for the connection of external signals of the P18(D) transducers in versions: a) without analog outputs, b) with analog outputs.

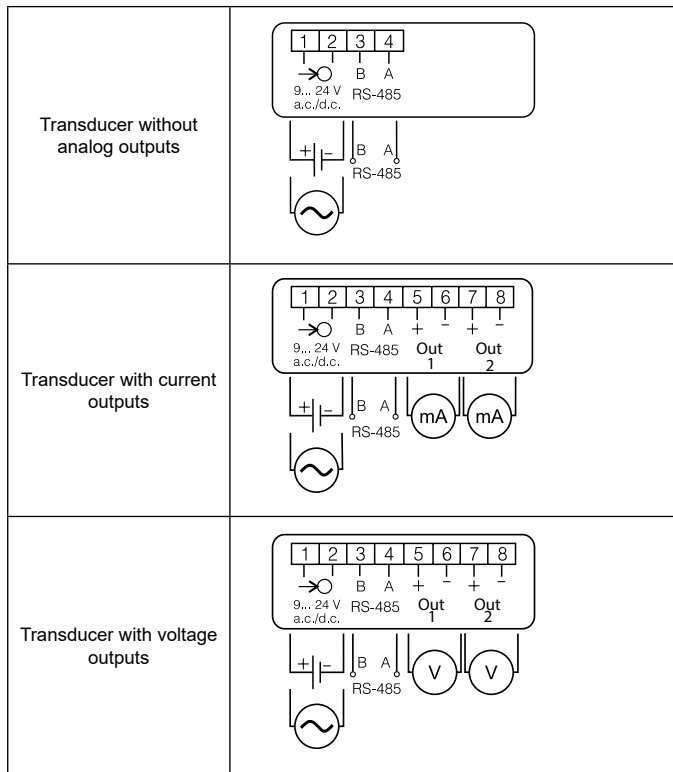


Fig. 6. Wiring diagram of the P18(D) transducer with analog outputs

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.

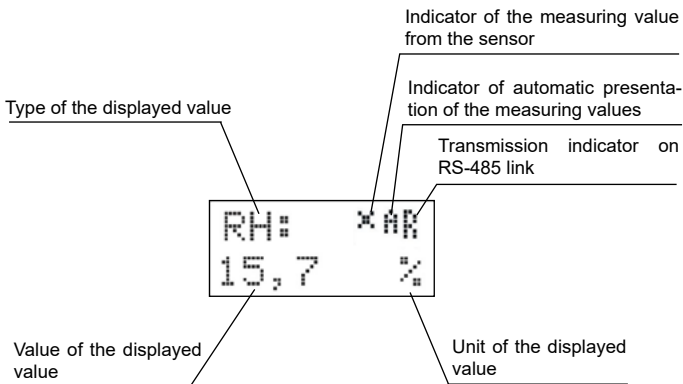


Fig. 7. Description of the P18D transducer readout field

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 |
| x | The indicator of the measuring value from the sensor |
| A | 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 |
| R | Data receiving indicator by the P18D transducer on RS-485 |
| T | 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.

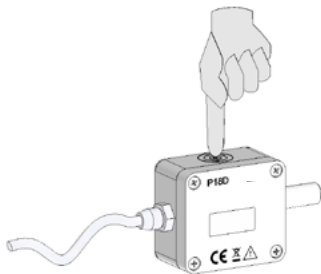


Fig. 8. Location of the P18D transducer capacitive button

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 \uparrow - 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 \downarrow - decreasing the value). If the idle time exceeds 20 seconds, the transducer will leave the menu and switch to displaying the measuring value.

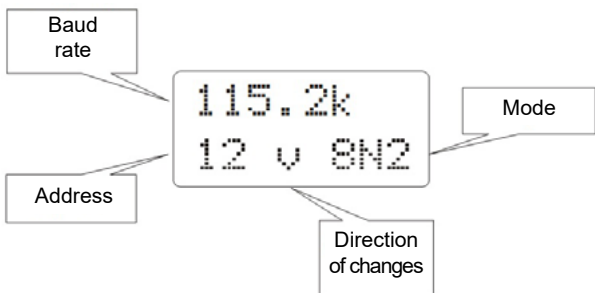


Fig. 9. The displayed information of the transmission parameters in the P18D transmitter menu

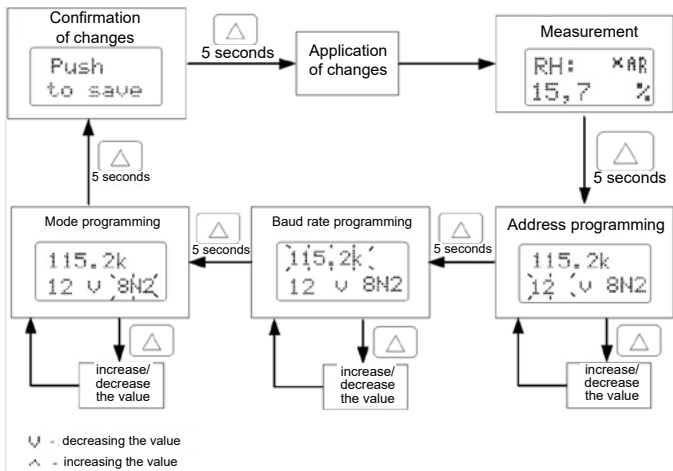


Fig. 10. Programming parameters algorithm of the P18D transducer

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.

$$DP \rightarrow \text{dew-point:} \quad DP = \frac{T_n}{\frac{m}{\log\left(P_{ws} \cdot \frac{RH}{10000 \cdot A}\right)} - 1}$$

$$DP \rightarrow \text{absolute humidity:} \quad AH = 2,1668 \cdot \frac{P_{ws} \cdot RH}{100 \cdot (T + 273,2)}$$

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.

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

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

$Y1 out$ and $Y2 out$ - expected value of the analog output

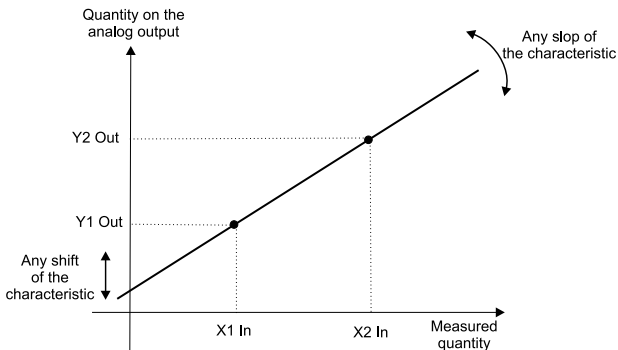


Fig. 11. Individual characteristic of analog output

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 $-12,25^{\circ}\text{C} \div 77,75^{\circ}\text{C}$ to the analog current signal in the range $4,5\text{ mA} \div 18,5\text{ mA}$.

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.

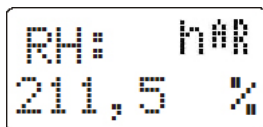


Fig. 12. Indication of the P18D transducer operation with a heater switched on

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 | Parameter 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.

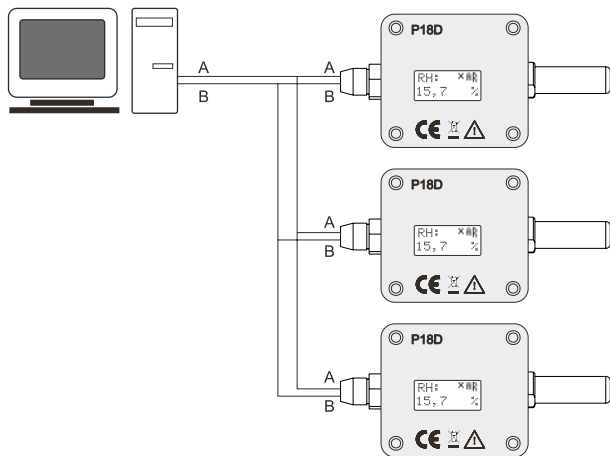


Fig. 13. Connecting the RS-485 interface.

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 | Confirmation of transmission parameters changes | | 0...1 | Value | Description |
| | | | | 0 | No change |
| | | | | 1 | Confirmation of changes |
| 4005 | Averaging time | w/r | 6...3600 | Averaging time of the measurement [s] | |
| 4006 | Erasing the extremes | w/r | 0...1 | Value | 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 | °C | Measured temperature |
| 7004 | 7502 | RH | r | % | Measured relative humidity |
| 7006 | 7503 | DP | r | °C | Calculated dew-point |
| 7008 | 7504 | AH | r | g/m ³ | Calculated absolute humidity |
| 7010 | 7505 | min T | r | °C | Min. of temperature |
| 7012 | 7506 | max T | r | °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 | °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.

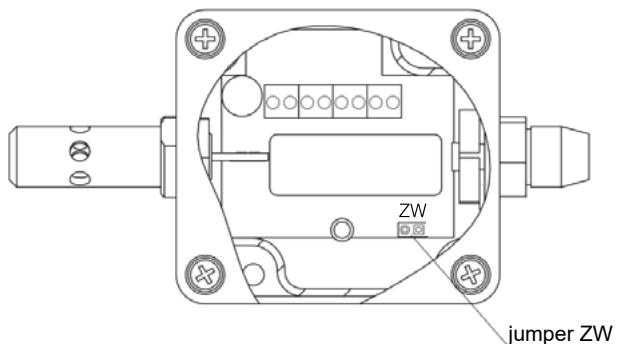


Fig. 13. Placement of the jumper setting temporary communication parameters

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 | Drawing | 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 80°C, 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 °C, response time t10/90: 14 s | Drying process in chemical applications |
| 3 | 20-015-00-00003 |  | Sintered bronze filter | Sintered bronze, pore size 60 μm | High mechanical resistance, used in high pollution and low humidity, response time t10/90: 10 s | Agriculture |

6. TECHNICAL DATA

Basic parameters:

- range of relative humidity measurement (RH) 0...100%, without condensation¹⁾
 - basic error of humidity conversioni $\pm 2\%$ of the range for RH = 10...90%
 $\pm 3\%$ for the remaining range
 - hysteresis of the humidity measurement $\pm 1\%$ RH
 - basic range of temperature measurement (T) -20...60°C²⁾
 - basic error of temperature conversion $\pm 0.5\%$ 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/m³]
dew-point temperature (Td) [°C]
 - additional errors:
 - temperature influence $\pm 25\%$ 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 k Ω

Rated operating conditions:

| | |
|--|-------------------------|
| - supply | 9...24 V a.c./d.c. |
| - power consumption | < 0.5 VA |
| - ambient temperature | - 20...23...60°C |
| - relative air humidity | < 95% ³⁾ |
| - rate of air flow | ≥ 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 × 58 × 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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