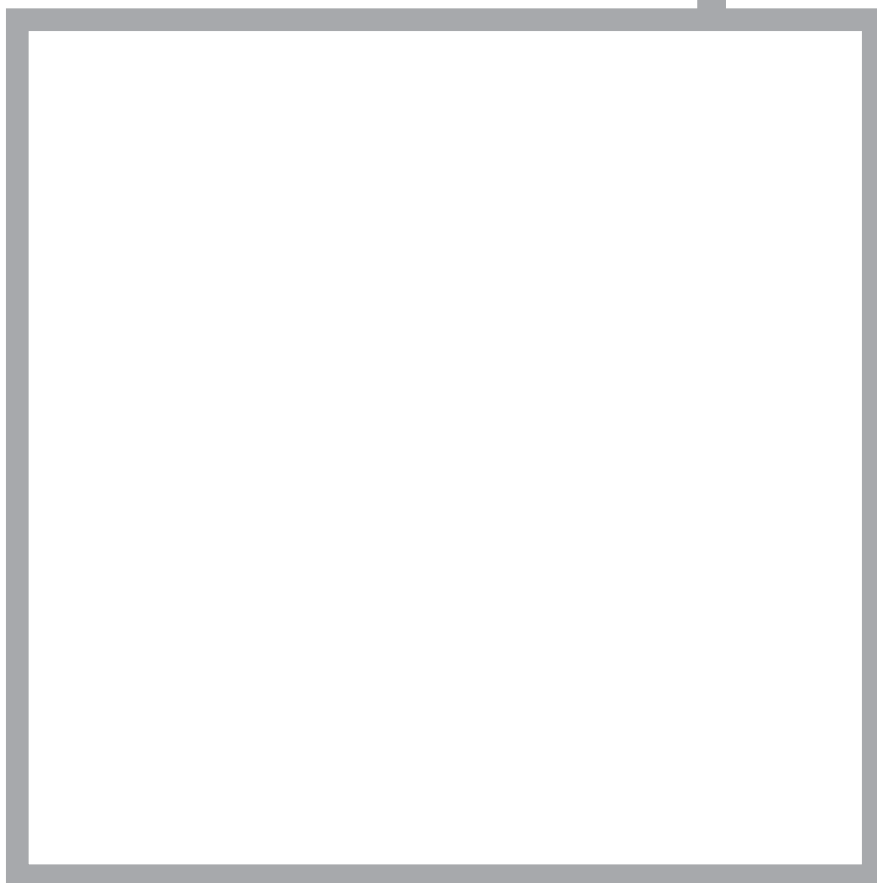


**TEMPERATURE
AND HUMIDITY
TRANSDUCER
P18 TYPE**



USER'S MANUAL



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1. APPLICATION

The P18 transducer is device 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 transducer is fixed on a wall. The programming of the transducer is possible by means of the RS-485 interface.

Applied sensor shields enable the application of the P18 transducer in various ambient conditions

2. BASIC REQUIREMENTS, OPERATIONAL SAFETY

In the security scope, the transducer meets the requirements of the EN 61010 -1 standard.

Remarks Concerning the Operator Safety:



1. General

- All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel acc. to the section 3.2. of the user's manual.
- According to this basic safety information, qualified, skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have qualifications necessary for their occupation.
- In order to avoid any damage, before switching the supply on, it is recommended to ensure that all wires were correctly connected.

When unpacking the P18 transducer, please check whether the type and version code on the data plate correspond to the order code.

3. INSTALLATION

3.1. Assembly

The P18 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.

Housing dimensions: 64 x 58 x 35 mm.

The transducer has screw connectors placed inside the transducer, which enable the connection of external wires of 1 mm² cross-section.

Overall dimensions and the fixing way are shown on the fig. 1.

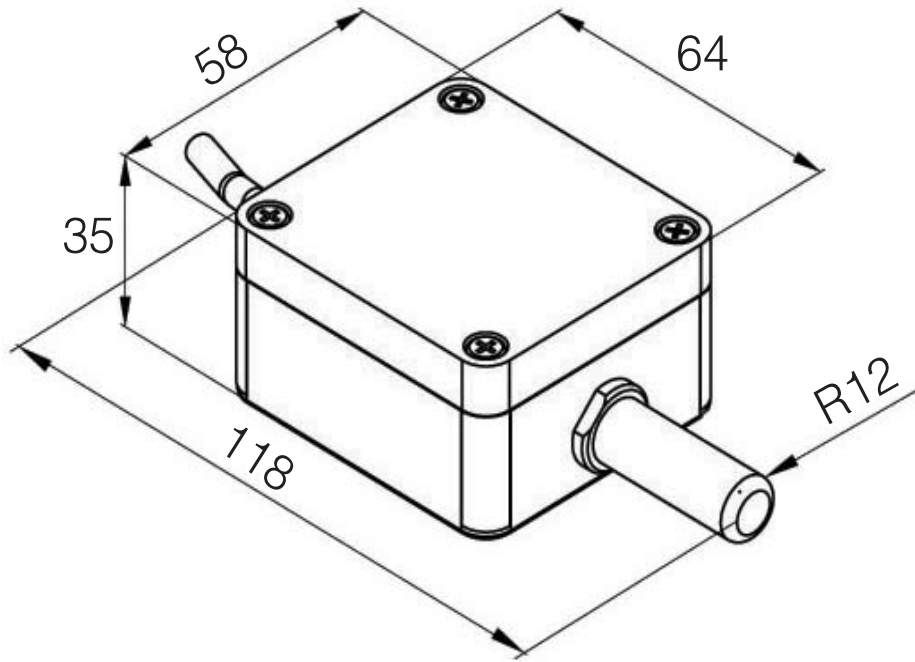


Fig.1. Overall Dimensions of the P18 Transducer

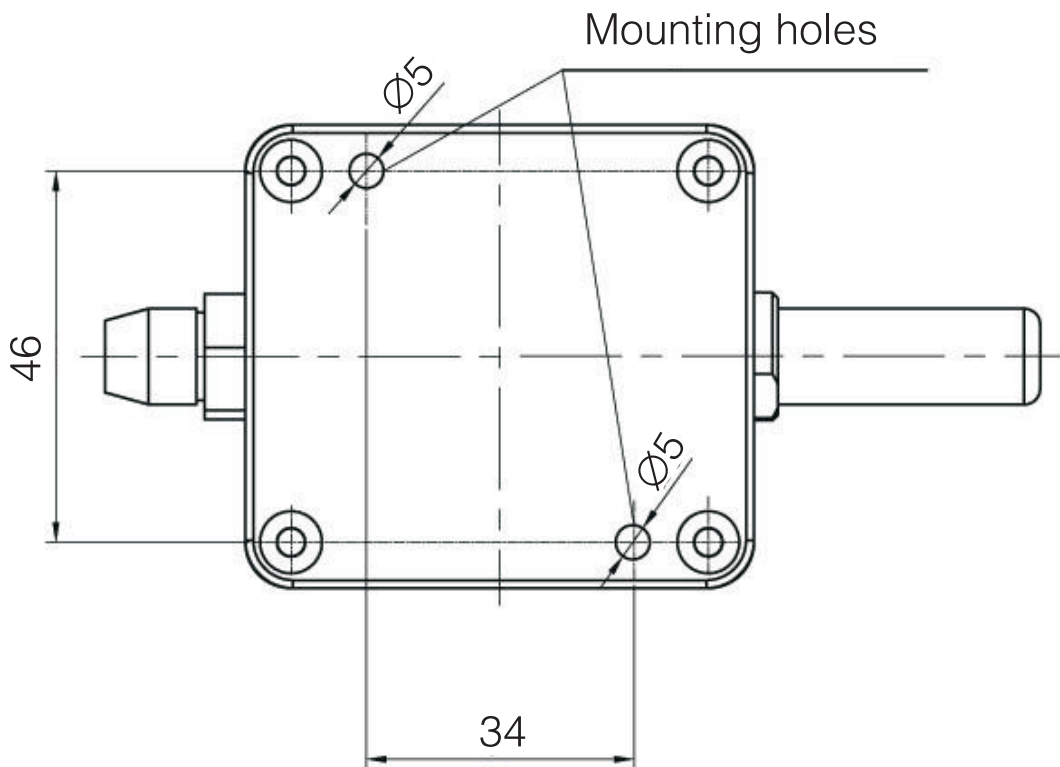


Fig.2. Lay-out of Assembly Holes of the P18 Transducer

3.2. Electrical Connections

The P18 transducer has 8 connecting terminals to which there is access after removing the cover of the transducer housing.

For electrical connections, one must use a round wire with external diameter from 3.5 mm up to 6 mm.

Before the transducer assembly, one must pass supplying wires through the packing. Twist the packing seal in order to obtain the leaktightness. If the packing seal is not twisted, we cannot ensure the required IP 65 leaktightness.

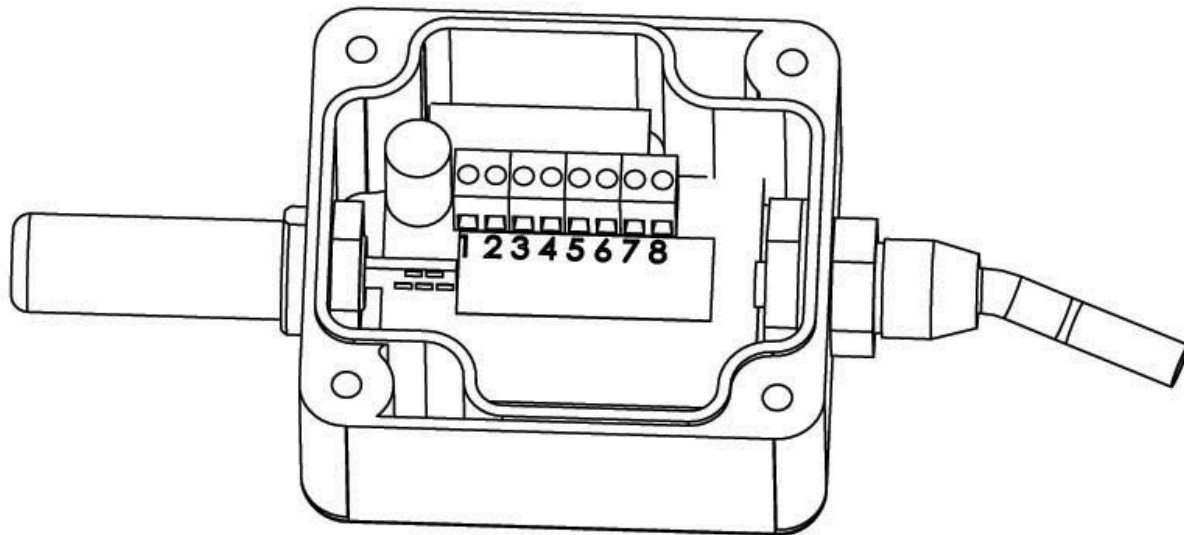


Fig.3. Marking of Terminals for the Connection of External Signals

| | |
|--|--|
| <p>Transducer without analog outputs</p> | |
| <p>Transducer with current outputs</p> | |
| <p>Transducer with voltage outputs</p> | |

One must use a spiral for the interface line connection. In case of the transducer work in an environment with high interference, one must apply shielded wires. The shield must be connected to the nearest PE point from the feeder side.

4. SERVICING

After connecting wires, closing and servicing the housing, and connecting to the supply, the transducer is ready to work with manufacturer's settings (table 8).

The transducer can be programmed through the RS-485 interface.

One can program following parameters in the transducer:

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

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

The transducer is equipped of one two-colour signalling diode.

The diode pulsation means:

- pulsing in green colour – measurements carrying out correctly,
- pulsing in red colour – correct communication through the RS-485 interface.

The diode pulses only during 3 min. since the supply switching on or the change of transmission parameters, e.g. after shortening with the **ZW** jumper.

4.1. Functions of the P18 transducer

- calculation of chosen physical quantities (dew-point temperature, absolute humidity),
- conversion of measured quantities into an output signal on the base of the individual linear characteristic,
- 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.

Measured and calculated values of the P18 transducer:

- temperature

$T = \text{measured}$

- relative humidity

$RH = \text{measured}$

- dew-point

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

- absolute humidity

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

where:

T = temperature [°C]

RH = relative humidity [%]

T_d = temperature of the dew-point [°C]

P_{ws} = pressure of the saturated water vapour
(water vapour pressure) [mbar]

a = absolute humidity [g/m³]

Coefficients for the dew-point

Table 2

| T | A | m | T_n |
|-------------|----------|----------|----------------------|
| < 0 °C | 6.119866 | 7.926104 | 250.4138 |
| 0...50 °C | 6.1078 | 7.5 | 237.3 |
| 50...100 °C | 5.9987 | 7.3313 | 229.1 |

4.2. Individual Characteristic of Analog Outputs

The P18 transducer in execution with analog outputs enables the conversion of measured quantities into an output signal 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 - measured value

Y1 Out i Y2 Out - expected value on the output.

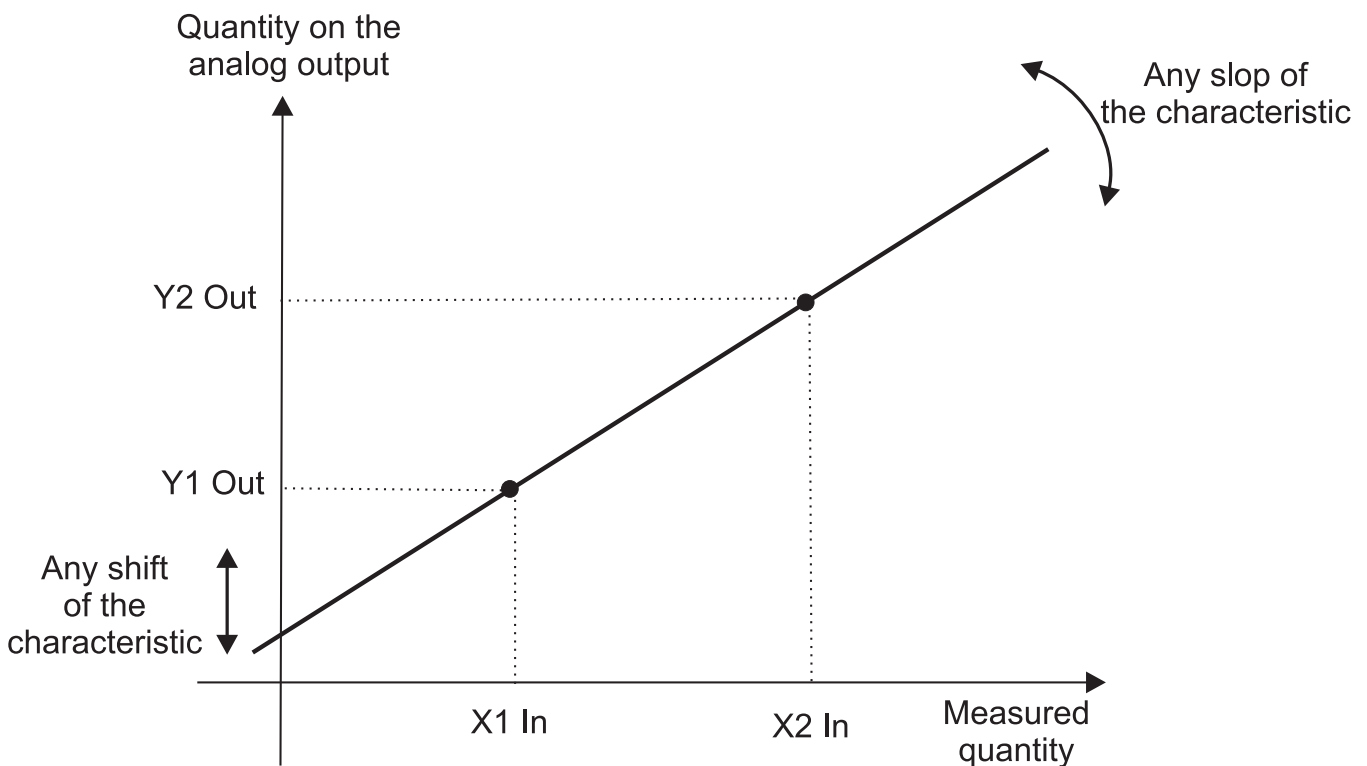


Fig.4. Individual Characteristic of Analog outputs

Value X1 In on the transducer input
=> value Yi Out on the analog output
Value X2 In on the transducer input
=> value Y2 Out on the analog output
Remaining points of the characteristic are calculated

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**. Values introduced in these registers must be integral values corresponding to set point values multiplied by the value 100.

Example 1

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

The temperature conversion in the range -12.25°C ÷ 77.75°C into the analogue current signal from the range 4.5...18.5 mA is expected.

Exemplary Configuration of the Individual First Analog Output Characteristik

Table 3

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

4.3. RS-485 Interface

4.3.1. Description of the MODBUS Protocol Implementation

The implemented protocol is in compliance with the PI-MBUS-300 Rev G Modicon Company specification. Following functions of the MODBUS have been implemented in P18 transducers:

Functions of the MODBUS Protocol Implemented in P18 Transducers

Table 4

| Code | Meaning |
|-------------|------------------------------------|
| 03 (03h) | Readout of n-registers |
| 16 (10h) | Write of n-registers |
| 17 (11h) | Identification of the slave device |

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

- transducer address 1... 247
- baud rate 4800, 9600, 19200, 38400, 57600 bit/s
- work modes RTU
- information unit 8N2, 8E1, 8O1, 8N1
- maximal response time 300 ms

The configuration of serial link parameters consists on settlement of baud rate (register *Baud rate*), device address (register *Address*) and the type information (register *Mode*).

Note:

Each transducer connected to the communication network must have: unique address, different from other devices connected to the network, the same baud rate and information unit type.

4.3.2. Register Map of the P18 Transducer

Table 5.

| Address range | Value type | Description |
|---------------|-----------------|---|
| 4000-4014 | int (16 bits) | The value is located in the 16-bit register. Registers destined to the connection parameter configuration, time of measurement and individual input characteristic are for write and readout. |
| 7000-7024 | float (32 bits) | The value is located i two successive 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500-7512. Registers are only for readout. |
| 7500-7512 | 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. |

4.3.3. Registers for Write and Readout

Configuration Registers of the P18 Transducer

Table 6.

| Address | Name | Range | Description |
|---|-----------------------------------|---------------------|--|
| 4000 | Identifier | 0xAA | Identifier of the P18 transducer |
| 4001 | Address | 1...247 | Device address ¹ |
| 4002 | Baud rate | 0...4 | Baud rate of the RS-485 interface (bit/s) ¹ : 0: 4800 1: 9600 2: 19200 3: 38400 4: 57600 |
| 4003 | Mode | 0...3 | Kind of transmission through the RS-485 interface ¹ : 0: RTU 8N1 1: RTU 8N2 2: RTU 8E1 3: RTU 8O1 |
| 4004 | Change of transmission parameters | 0...1 | Acceptation of transmission parameter changes ² : 0: lack of operation 1: acceptance of changes |
| 4005 | Measurement averaging time | 6...3600 | Measurement averaging time given in seconds |
| 4006 | Erasing of extremes | 0...1 | Erasing of minimal and maximal values ² : 0: lack of operation 1: erasing |
| Parameters of the individual characteristic of analog outputs³⁾ | | | |
| 4007 | X1 temperature | - 500010000 | Measured value X1 of temperature [°C x 100] |
| 4008 | Y1 temperature | 0...2000 | Output value Y1 of temperature: a. current output [mA x 100] b. voltage output [Vx100] |
| 4009 | X2 temperature | - 500010000 | Measured value X2 of temperature [°C x 100] |

| | | | |
|------|-----------------|-----------|---|
| 4010 | Y2 temperature | 0...2000 | Output value Y2 of temperature: c. current output [mA x 100] d. voltage output [Vx100] |
| 4011 | X1 humidity | 0...10000 | Measured value X1 of humidity [% x 100] |
| 4012 | Y1 humidity | 0...2000 | Output value Y1 of humidity: e. current output [mA x 100] f. voltage output [Vx100] |
| 4013 | X2 humidity | 0...10000 | Measured value X2 of humidity [% x 100] |
| 4014 | Y2 humidity | 0...2000 | Output value Y2 of humidity: g. current output [mA x 100] h. voltage output [Vx100] |
| 4017 | Status register | 0...65535 | Status register, description of bits below Bit 0 „1” transducer with current analog outputs Bit 1 „1” transducer with voltage analog outputs Bit 2 „1” the interval of averaging measurement result is expired, Bit 3,4 „0.0” steering up of 1 analog output - temperature „0.1” steering up of 1 analog output - relative humidity „1.0” steering up of 1 analog output - dew-point „1.1” steering up of 1 analog output - absolute humidity Bit 5,6 „0.1” steering up of 2 analog outputs - meaning of bits - similarly like bits 3, 4 Bit 7...Bit - 15 reserved |

- 1) The transducer begins to work with the new setting only after carrying out the confirmation (write of the value „1” in the register *Transmission parameter change*).
- 2) After carrying out the operation, the register is equal 0
- 3) In the execution without analog outputs, values of registers 4007....4014 are 0. The write to these registers does not cause any changes.

Caution!

The transducer checks as they come, values of the currently introduced parameter. In case, when the introduced value exceeds the upper or the lower change range given in the table above, the transducer does not carry out the parameter write.

4.3.4. Registers only for Readout

Register of Measured Values of the P18 Transducers

Table 7.

| Address in the area 7000...7024 | Address in the area 7500...7512 | Name | Description |
|--|--|----------------------|---------------------------------------|
| 7000 | 7500 | Identifier | Identifier of the device P18- 0xAA |
| 7002 | 7501 | Temperature T | Temperature [°C] |
| 7004 | 7502 | Relative humidity RH | Relative humidity [%] |
| 7006 | 7503 | Dew-point Td | Dew-point [°C] |
| 7008 | 7504 | Absolute humidity A | Absolute humidity [g/m ³] |
| 7010 | 7505 | Min T | Minimum temperature |
| 7012 | 7506 | Max T | Maximum temperature |
| 7014 | 7507 | Min RH | Minimum relative humidity |
| 7016 | 7508 | Max RH | Maximum relative humidity |
| 7018 | 7509 | Min Td | Minimum dew-point |
| 7020 | 7510 | Max Td | Maximum dew-point |
| 7022 | 7511 | Min a | Minimum absolute humidity |
| 7024 | 7512 | Max a | Maximum absolute humidity |

4.4. Standard Parameters

Standard Parameters of the P18 Transducer

Table 8

| Parameter description | Standard value | | |
|-----------------------|--------------------------------|---------------------------------|---------------------------------|
| | Version without analog outputs | Version with the current output | Version with the voltage output |
| Address | 1 | 1 | 1 |
| Baud rate | 9600 | 9600 | 9600 |
| Mode | RTU 8N1 | RTU 8N1 | RTU 8N1 |
| Measuring time | 30 [s] | 30 [s] | 30 [s] |
| X1 temperature | 0 | -2000 [°C x 100] | -2000 [°C x 100] |
| Y1 temperature | 0 | 400 [mA x 100] | 0 [V x 100] |
| X2 temperature | 0 | 6000 [°C x 100] | 6000 [°C x 100] |
| Y2 temperature | 0 | 2000 [mA x 100] | 1000 [V x 100] |
| X1 humidity | 0 | 0 [°C x 100] | 0 [% x 100] |
| Y1 humidity | 0 | 400 [mA x 100] | 0 [V x 100] |
| X2 humidity | 0 | 10000 [°C x 100] | 10000 [% x 100] |
| Y2 humidity | 0 | 2000 [mA x 100] | 1000 [V x 100] |

In case when standard communication parameters have been changed and the new configuration has been lost, one can set temporary on the transducer plate communication parameters by means of the jumper marked with the symbol ZW:

- transducer address 247
- baud rate 9600kb/s
- mode RTU 8N1

Above-mentionned parameters are current till the moment of the jumper removal.

After removing the jumper, the transducer returns to previous settings or to settings changed during the operation with the jumper.

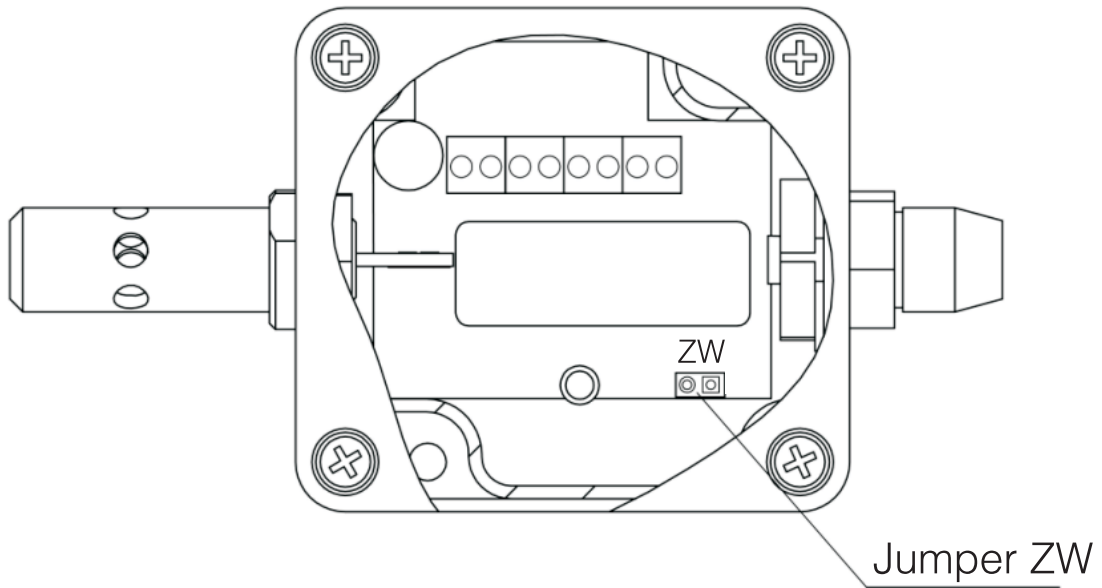





Fig. 5. Placement of the Jumper Setting Temporary Communication Parameters.

5. ACCESSORIES

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

Table 9

Sensor protection shields

| Item | Order code | Design | Name | Construction | Features | Typical application |
|------|--------------|---|--------------------------------|---|---|---|
| 1 | 0874-490-016 |  | Membrane filter | Casing made of PCV Membrane of teflon. laminated by a film Pore size: 1 µm | Mean filtration effect. Maximal temp.: up to 80°C Response time: t10/90:15 s | Building automation. In rooms with low pollution |
| 2 | 0874-490-015 |  | Filter made of teflon | Sintered teflon Pore size: 50 µm | High chemical resistance Maximal temp.: up to 180 °C Response time: t10/90:14 s | Drying process in chemical applications |
| 3 | 0874-490-014 |  | Filter made of sintered bronze | Sintered bronze Pore size: 60 µm | High mechanical resistance. To co-operate with high pollution. Applied at small air humidity Response time: t10/90:10 s | Agricultural applications |

6. TECHNICAL DATA

Basic parameters:

- range of relative humidity measurement (RH) 0...100%, without condensation⁴⁾
- basic error of humidity conversion $\pm 2\%$ 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 - 20...60°C⁵⁾
- basic error of temperature conversion calculated quantities $\pm 0.5\%$ of the range
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
- maximal response time 300 ms

Analog outputs:

- current 4...20 mA
- voltage 0...10 V
- maximal load resistance of the current output 100 Ω
- maximal load resistance of the voltage output 1 k Ω

Rated operating conditions:

| | |
|--|--|
| - supply | 9...24 V a.c./d.c. |
| - consumption | < 0.5 VA |
| - ambient temperature | - 20... <u>23</u> ...85°C |
| - relative air humidity | < 95% ⁶⁾ |
| - rate of air flow | ≥ 0.5 m/sec ⁷⁾ |
| - pre-heating time | 15 minutes |
| - protection degree 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 |

Security requirements acc. to EN 61010 -1:

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

4) In case of condensation of water vapour on the sensor surface, the error measurement does not exceed the basic error till the moment of drying up the sensor structure.

5) The absolute temperature measurement range is -30...85°C, but beyond the basic range, the measurement class is not guaranteed.

6) Admissible condensation of water vapour when using additional sensor shields, (see table 8).

7) For the air flow < 0.5 m/s, the temperature and humidity measurement error can grow of 100%.

7. ORDERING CODES

Ordering Codes of P18 Transducer Versions

Table 10

| P18 - | X | XX | X |
|--|---|----|---|
| Analog outputs: | | | |
| without analog outputs | 0 | | |
| current output 4...20 mA | 1 | | |
| voltage output 0...10 V | 2 | | |
| Version: | | | |
| standard | | 00 | |
| non standard setting | | NS | |
| custom-made* | | XX | |
| Acceptance tests: | | | |
| without extra quality requirements | | | 8 |
| with an extra quality inspection certificate | | | 7 |
| according to customer's request * | | | X |

* After agreeing with the manufacturer.

Example of Order:

The code: **P18-1- 00- 8** means

P18 - Humidity and temperature transducer.

1 - current output: 4...20 mA

00 - standard version

8 - without additional quality inspection certificate.

In case of need, one must order additionally the sensor protection shield acc. to the table 9., e.g. the shield coded: **0874-490-014** means a filter made of sintered bronze.

8. MAINTENANCE AND GUARANTEE

The P18 transducer does not require any periodical maintenance.
In case of some incorrect operations:

1. In the period of 12 months from the date of purchase:

One should take the transducer down from the installation and return it to the Manufacturer Quality Control Dept.

If the unit has been used in compliance with the instructions, the Manufacturer guarantees to repair it free of charge.

2. After the guarantee period:

One should turn over the transducer to repair it in a certified service workshop.

The disassembling of the housing causes the cancellation of the granted guarantee.

Our policy is one of continuous improvement and we reserve the right to make changes in design and specifications of any products as engineering advances or necessity requires and revise the above specifications without notice.

