

# **TEMPERATURE AND HUMIDITY TRANSDUCER P18 TYPE**



**USER'S MANUAL**

**CE**



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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

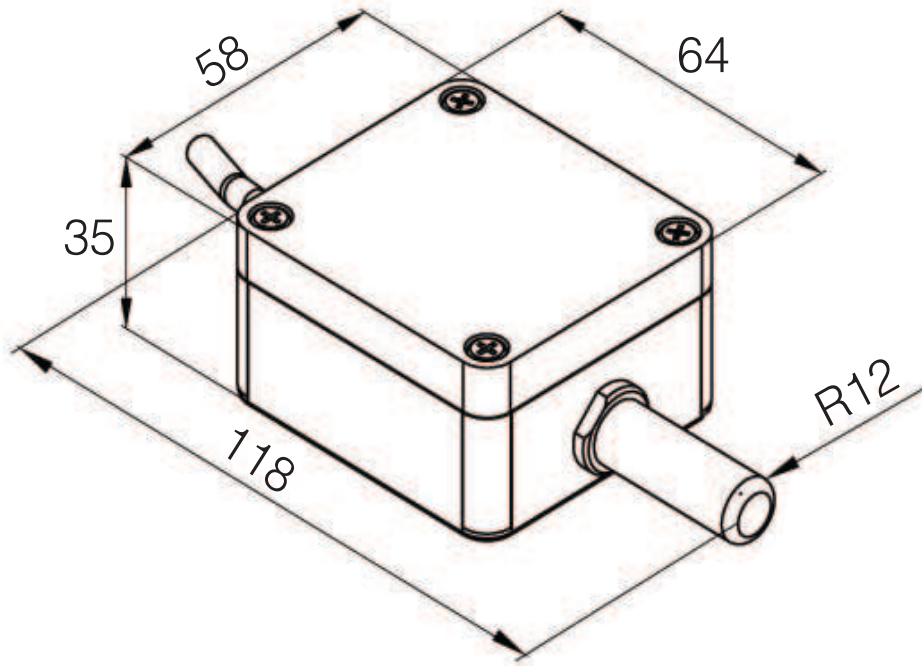
The P18 transducer is designed to be mounted on a wall by means of a screw connection or glue without the loss of IP65 tightness .

The transducer housing is made of a self-extinguishing plastics.

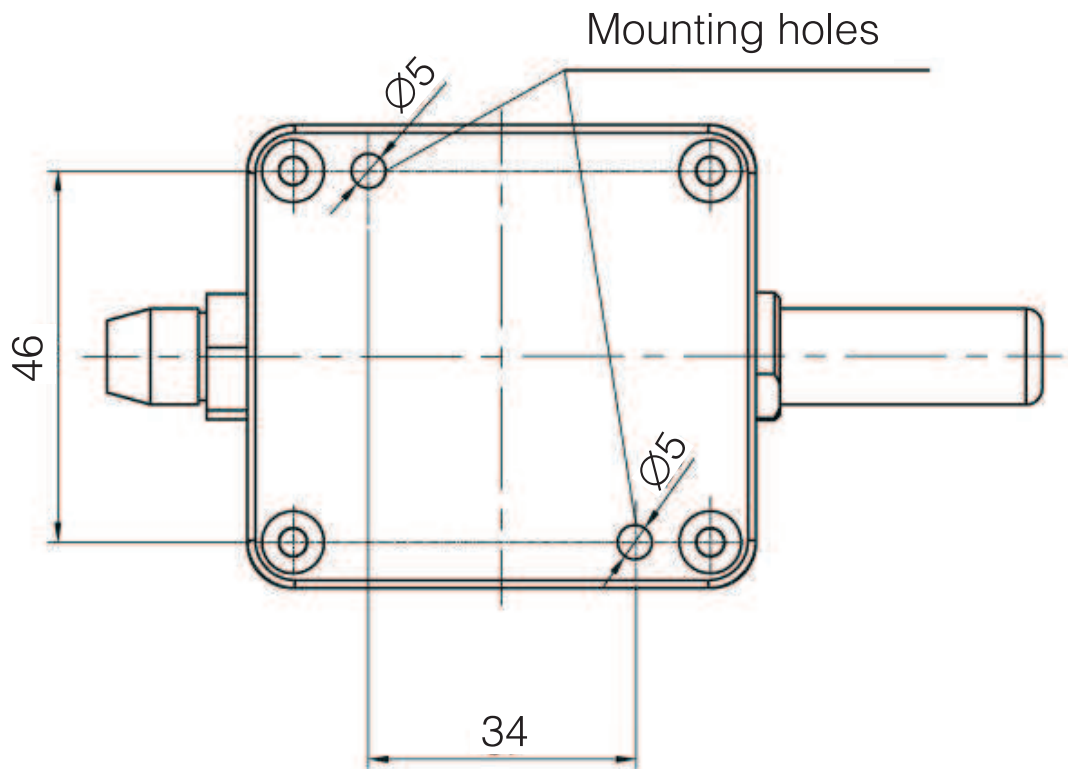
Housing dimensions: 64 x 58 x 35 mm.

The transducer has screw connectors placed inside the transducer, which enable the connection of external wires of 1 mm<sup>2</sup> cross-section.

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



*Fig.1. Overall Dimensions of the P18 Transducer*



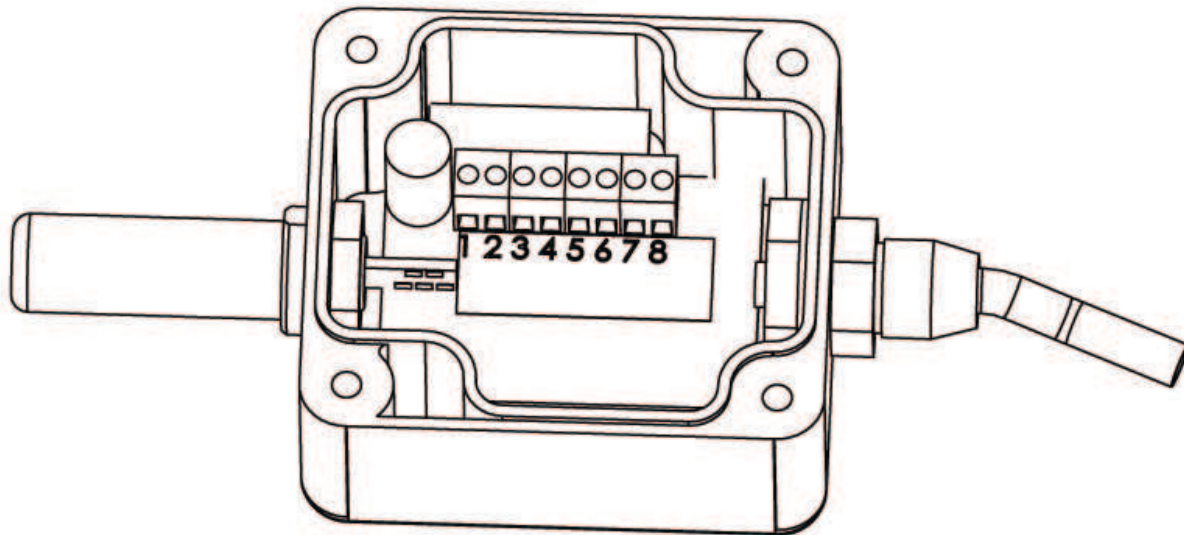
*Fig.2. Lay-out of Assembly Holes of the P18 Transducer*

### 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/m<sup>3</sup>]

*Coefficients for the dew-point*

*Table 2*

<b>T</b>	<b>A</b>	<b>m</b>	<b>T<sub>n</sub></b>
< 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

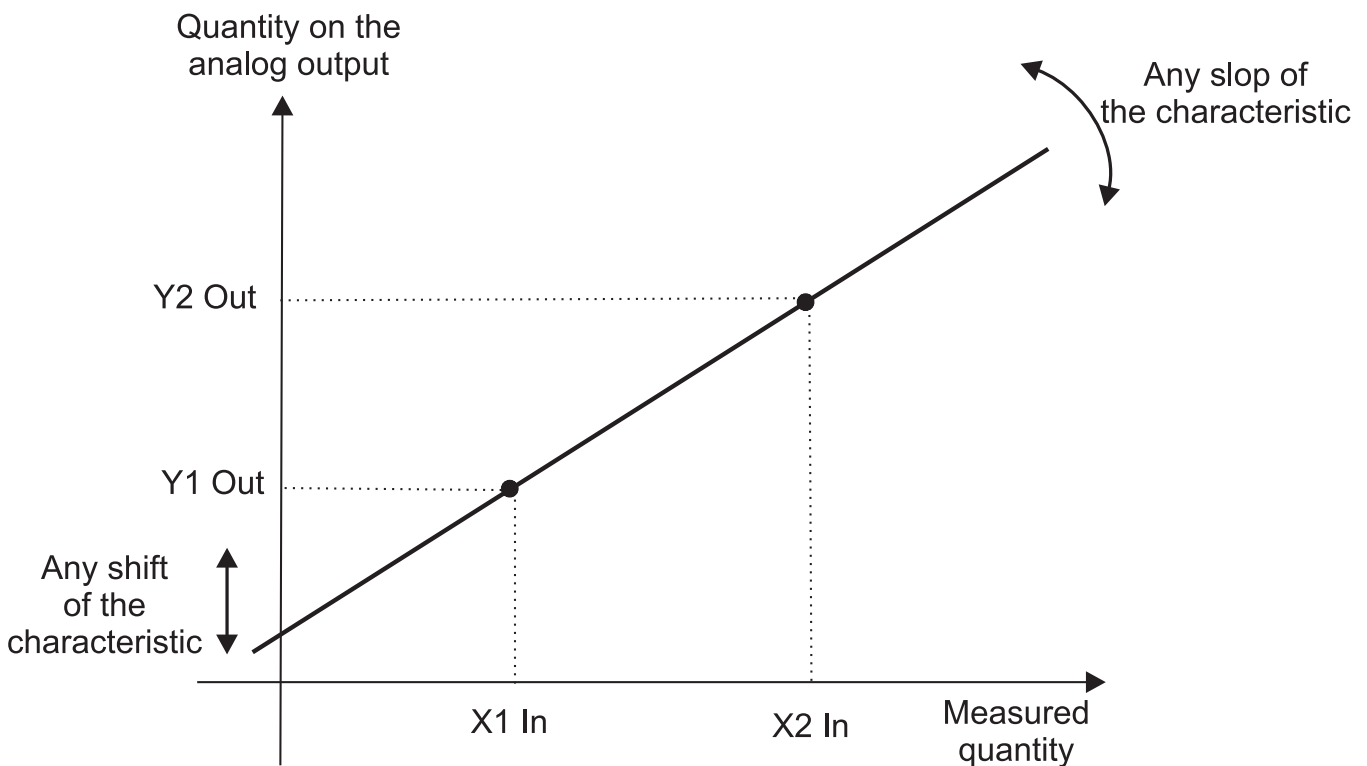
given coordinates of two points by the user, the transducer determines (from the system of equations) coefficients **a** and **b** of the individual characteristic.

$$\begin{cases} Y1Out = a \cdot X1In + b \\ Y2Out = a \cdot X2In + b \end{cases}$$

**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*

<b>Name</b>	<b>Register address</b>	<b>Value</b>
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*

<b>Code</b>	<b>Meaning</b>
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 <sup>1</sup>
4002	Baud rate	0...4	Baud rate of the RS-485 interface (bit/s) <sup>1</sup> : 0: 4800 1: 9600 2: 19200 3: 38400 4: 57600
4003	Mode	0...3	Kind of transmission through the RS-485 interface <sup>1</sup> : 0: RTU 8N1 1: RTU 8N2 2: RTU 8E1 3: RTU 8O1
4004	Change of transmission parameters	0...1	Acceptation of transmission parameter changes <sup>2</sup> : 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 <sup>2</sup> : 0: lack of operation 1: erasing
<b>Parameters of the individual characteristic of analog outputs<sup>3)</sup></b>			
4007	X1 temperature	- 5000 ....10000	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	- 5000 ....10000	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.*

<b>Address in the area 7000...7024</b>	<b>Address in the area 7500...7512</b>	<b>Name</b>	<b>Description</b>
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 <sup>3</sup> ]
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

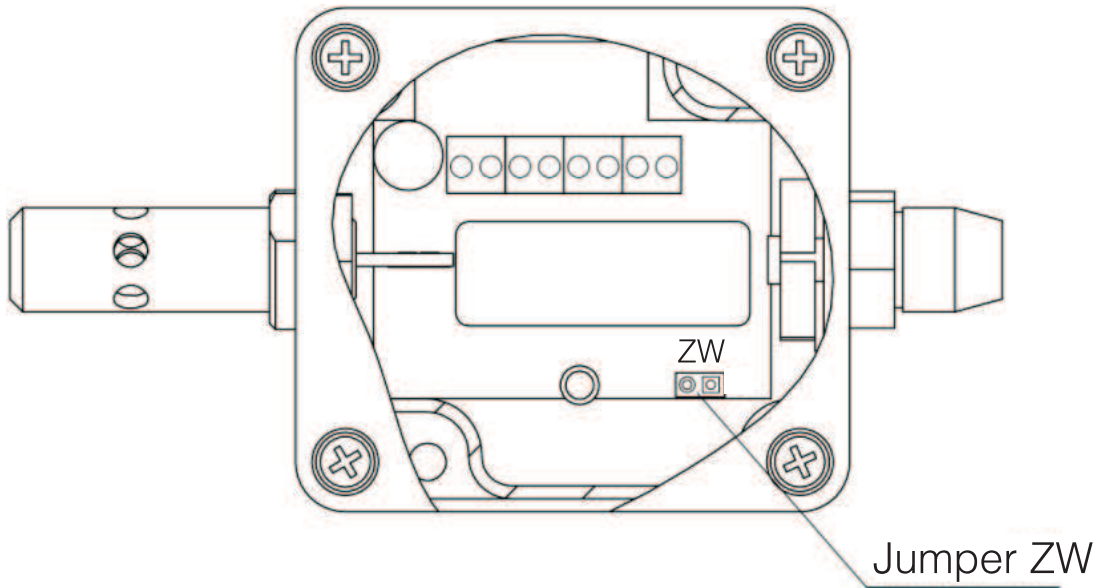
Parameter description	Standard value		
	Version without analog outputs	Version with the current output	Version with the voltage output
Address	1	1	1
Baud rate	9600	9600	9600
Mode	RTU 8N1	RTU 8N1	RTU 8N1
Measuring time	30 [s]	30 [s]	30 [s]
X1 temperature	0	-2000 [°C x 100]	-2000 [°C x 100]
Y1 temperature	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.*





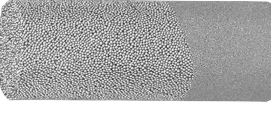
**Fig. 5. Placement of the Jumper Setting Temporary Communication Parameters.**

## 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 condensation<sup>4)</sup>
- 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°C<sup>5)</sup>
- basic error of temperature conversion calculated quantities  $\pm 0.5\%$  of the range  
absolute humidity (a) [g/m<sup>3</sup>]  
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  $\Omega$
- maximal load resistance of the voltage output 1 k $\Omega$

### 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% <sup>6)</sup>
- rate of air flow	≥ 0.5 m/sec <sup>7)</sup>
- 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

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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
<b>Analog outputs:</b>			
without analog outputs	0		
current output 4...20 mA	1		
voltage output 0...10 V	2		
<b>Version:</b>			
standard		00	
non standard setting		NS	
custom-made*		XX	
<b>Acceptance tests:</b>			
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.**

P18-07B 18.07.2011

