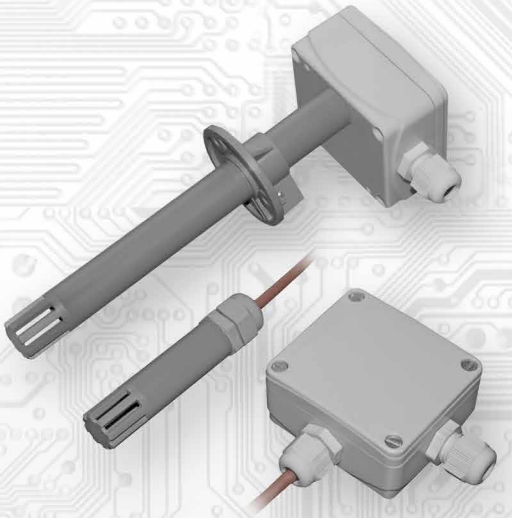
Temperature and humidity sensors with Modbus RTU communication - serie PHM



These sensors are intended for general-purpose application in control and regulation systems for the temperature and humidity measurement in airflows. The communication with superior system is led in the line RS485 by the protocol Modbus RTU and the device always operates in the "slave" mode. The common chemically non-aggressive environment suits working conditions under which the sensors require no maintenance or service. The device configuration is made with sensor connection, using the standard USB cable, to PC with Windows system using the freeware application USB_SET. By standard, the sensors are supplied in pass-through design with two glands. Only sensors ordered as end pieces (type PHM1x/K) are equipped with a single gland.
The device can also be supplied in a version with galvanic isolation of the RS485 line - versions PHM111G..., PHM12G... and PHM18G...

List of available types:

View option	without LCD	with LCD
Outside/interior	**PHM111-N**	**PHM111-D**
Duct	**PHM12N-L1**	**PHM12-D-L1**
Cable sensor	**PHM18-N**	**PHM18-D**

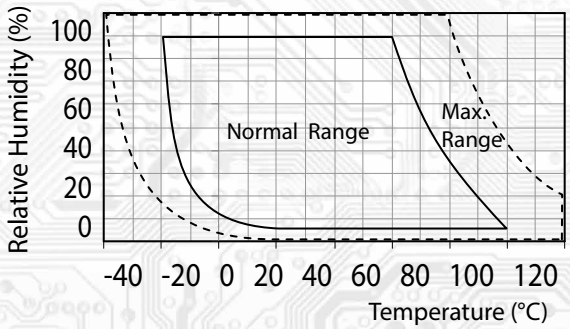
Standard length L1

180 mm
240 mm

Basic technical parameters

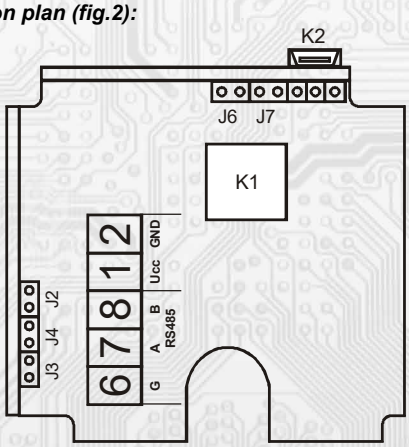
Supply voltage (Ucc)	10 ÷ 30 VDC
Power consumption	max. 0,5 W
Temperature/humidity resolution	0,1°C / 0,1%RH
Accuracy - temperature	± 0,5°C (20 ÷ 40°C), ± 1°C (0 ÷ 60°C)
Accuracy - humidity (+25°C)	± 3% (20 ÷ 80 %RH)
Communication	RS485, protocol ModBus RTU 8bits 1 stop bit, no parity
Baud rate	1200 ÷ 57600 Bd
Input impedance of the RS485 receiver	min. 96 kΩ , typ. 150 kΩ
Max. number of sensors in the line	254
Galvanic separation RS485	PHM111,12,18:no PHM111G,12G,18G: yes < 50V
Range of working temperature and humidity of sensor	max. 80°C
Range of recommended working temp. of electronics	-30 ÷ 60 °C
Range of recommended storage temp. / RH	10 ÷ 50 °C / 20 ÷ 60 %RH
Protection type - head/sensor	IP65
Terminal board	COB (wires max. 1,5 mm^2)
Cable gland	PG9 / 8 mm
Configuration program	USB_SET; freeware; www.regmet.cz
FW upgrade program	USB_BOOT; freeware; www.regmet.cz

Working conditions of the sensor SHT21 (figure 1.)



The sensor steadily works within the recommended measurement range that is 10 ÷ 80 % RH. The long-term exposition to the high humidity, namely >80% RH causes the gradually increasing reading deviation of RH (+3% RH after 60 hours >80% RH). After returning back to normal range the RH measurement gets slowly back to calibrated values. It is possible to speed up the return to calibrated values after long-term high humidity exposition by drying at 100 - 105° C at < 5% RH for 10 hours. Long-term exposition to extreme conditions can speed up the sensor aging.
Detailed information on conditions of long-term use of the sensor SHT21 under conditions out of the standard range, especially at the relative humidity >80% RH, are shown directly at the producer´s website at: http://www.sensirion.com

Connection plan (fig.2):



K1....connection sensor T+RH
K2...connector USB mini B
J2...definition of still stand (conductor A)
J3... definition of still stand (conductor B)
J4...terminal resistor 120R
J6…device configuration
J7... reset

Terminal 1.....+Ucc, positive pole
Terminal 2.....GND, negative pole
Terminal 3.....common pole GND
Terminal 4.....RS485 - A)
Terminal 5.....RS485 - B

2.1. Properties of the communication protocol

Protocol Modbus RTU with adjustable Baud rate 1200 - 57600 Bd, 8 bits, no parity, 1 stop bit, line RS485, half-duplex operation
Supported features: 03 (0x03): Read Holding Registers
04 (0x04): Read Input Registers
06 (0x06): Write Single Register
16 (0x10): Write Multiple Registers
The communication protocol description is available at www.regmet.cz, in the document named the Implementation of Modbus protocol in devices Regmet of second generation.

Description of registers of the device:

1Modbus register = 2 Byte

During the transfer the register addresses are indexed from zero, i.e. register 0x0001 is physically sent through the busbar as 0x0000... (zero based addressing).

The registers are divided in four basic memory zones:

Operational registers are situated in the zone of Holding registers at addresses 40001 to 40002. They are used for the common operational communication. To read these registers use command no. 03 "register reading" (0x03 Read Holding Registers)

The configuration registers are situated in the zone of Holding registers at addresses 40041 to 40078. They are used for configuration of the device. The registration in registers is protected and allowed under the configuration mode, i.e. when the jumper shorts out the link J6. In this mode the device communicates at dedicated address 255 of the Baud rate 19200 Bd. The configuration registers can be rewritten only using the communication protocol and under the above stated conditions.
The change of setting and at the same time the registration in FLASH is done only after writing 0xC003 (49155 dek) to 40029 – the Register Status

The information registers are situated in the zone of Input registers at addresses 30001 to 30032. They serve for unchanged preservation of device identification data.

The Status Register serves for two-way communication between the device and the superior system. The device notifies the superior system of the internal status and the superior system sends requests for performance of commands.

STATUS Information messages from the device to the superior system:
- Normal Run, 0x0000 (0 dek) the device works in normal operational mode
- Menu Active, 0xB000 (45056 dek) the user has opened the manual menu
- Memory Read, 0xB001 (45057 dek) the device is reading from FLASH
- Memory Write 0xB002 (45058 dek) the device is registering to FLASH

STATUS Error messages from the device to the superior system:
- CRC Error0xBE00 (48640 dek) Application program is damaged in the FLASH memory
- LCD Error0xBE01 (48641 dek) Error of communication with LCD
- Sensor Error 0xBE02 (48642 dek) Error of communication with the sensor
- Memory Error 0xBE03 (48643 dek) Error of communication with FLASH

STATUS Commands for the device issued from the superior system:
- Clear STATUS 0x0000 (0 dek) writes 0 to the register
- Write Area 3 0xC003 (49155 dek) it rewrites the Configuration registers to FLASH

In brackets behind the registers described, abbreviations of possible features may appear:
R Read for reading
W Write for writing
WP Write protect for protected writing
M Parallel manual access from the device menu

Description of operational registers

				Modbus registr [dek]
Measured temperature	Measured humidity	-	-	1 - 4

4001 (R) – Measured temperature
is detected with an inbuilt digital sensor that is built in the plastic stem of the sensor. The value is sent in °C in form of 16-bit number with sign (signed integer) multiplied by the constant 10:
0x00FB = 251dek = 25.1°C.

Measured relative humidity of air:
is detected with an inbuilt digital sensor that is built in the plastic stem of the sensor. The value is sent in % in form of 16-bits number with sign (signed integer) multiplied by the constant 10: 0x0164 = 356dek = 35.6%.

Description of the Status Register

				Modbus register [dek]
Status register				29

40029 (R,W) - Status Register:
It provides the superior system with information on the internal status of the device, for example the current error statuses or information that the manual setting menu is currently activated by the user. At the same time it serves as the receiving register for special commands, for example rewrite/backup of working registers to FLASH.
The number format is 16-bit unsigned integer.
See the detailed description in the Status Register in Chapter 2.1 Description of device registers.

Description of configuration registers

Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
Measured temp., Offset	Measured hum., Offset	-	-	77 – 80

40041 ÷ 40048 (R,WP) - Text
The custom text field. It is determined for the client´s identification of the device. The number format is 16-bit unsigned integer. Two ASCII signs can be in one Modbus Register

40049 (R,WP) – Network address
The network address of the sensor. The number format is 16-bit unsigned integer. It acquires the values 0 ÷ 255 dek, whereas the address 0 is reserved for the broadcast and the sensor does not respond to it, the address 255 is reserved for the controller configuration. Thus the range of available addresses is 1 ÷ 254

40050 (R,WP) – Baud rate
The Baud rate. The number format is 16-bit unsigned integer. It acquires the values 0 ÷ 6 dek.

value [dek]	0	1	2	3	4	5	6
rate [Bd]	1200	2400	4800	9600	19200	38400	57600

40077 (R,WP) – Measured temperature, Offset
Setting the measured temperature offset.
The value is in °C in form of 16 bit number with a sign (signed integer) multiplied by the constant 10.
For example, when it seems that the device shows a value 1°C higher (for example due to the inappropriate location, heating caused by frequent communication with the loaded line...), value – 10 will be set in this register and the device will display and send the temperature value decreased by 1°C than the actually measured value is.

40078 (R,WP) – Measured humidity, Offset
Setting the measured humidity offset.
The value is in % in form of 16 bit number with a sign (signed integer) multiplied by the constant 10.

Description of information registers

				Modbus registr [dek]
HW_Platform_1	HW_Platform_2	HW_Platform_3	HW_Platform_4	1 - 4
HW_Platform_5	HW_Platform_6	HW_Platform_7	HW_Platform_8	5 - 8
HW_Version_1	HW_Version_2	HW_Version_3	HW_Version_4	9 - 12
FW_Boot_Version_1	FW_Boot_Version_2	FW_Boot_Version_3	FW_Boot_Version_4	13 - 16
ID_Device_1	ID_Device_2	ID_Device_3	ID_Device_4	17 – 20
ID_Device_5	ID_Device_6	ID_Device_7	ID_Device_8	21 – 24
FW_Applic_Version_1	FW_Applic_Version_2	FW_Applic_Version_3	FW_Applic_Version_4	25 – 28
0x0000	0x0000	0x0000	0x0000	29 – 32

Information on HW and SW of the device, commands 04 (Read Input Registers) are counted at the addresses 30001 to 30032 (including the function code field 3xxxx, i.e. register 30001 is sent through the bus bar as register 0000).
The number format is 16 bit unsigned integer. One Modbus register contains two ASCII signs.

Content Modbus Holding Registers (fig. 2):

Operational registers:

				Modbus registr [dek]
Měřená teplota	Měřená vlhkost	-	-	1 - 4

Status registers:

Status registr				29

Configuration registers:
Saving into the EEPROM is done only after writing 0xC003 (49155 dec) to 40021 - Registry status.

Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
Measured temp., Offset	Measured hum., Offset	-	-	77 – 80

Variation of the application part FW:

The FW upgrade description is available at www.regmet.com in a document titled Device Regmet II. generation.

Assembly and connection

The wires are connected to a terminal strip (Fig. 2), which can be accessed by removing the screws and head cap). The signal terminals A and B on the sensors are connected to the serial line as per the rules for connection of devices in RS485 serial lines. The use of A, B, ZAK. jumpers is subject to general rules for communication through RS485 lines (note: at end points of the RS485 line, it is necessary to connect a terminating resistor through the ZAK. jumper). The sensors are supplied from a single 12 to 30 VAC power supply, while the supply voltage is connected to the terminals marked by + and GND. It is recommended to interconnect the devices using a multi-core shielded cable, which hosts data as well as power supply wires. The cable shield must be interconnected between individual segments of the line and only connected to the lowest potential (PE terminal) in the switchboard. When you are done, install the cap by mounting all the four screws.

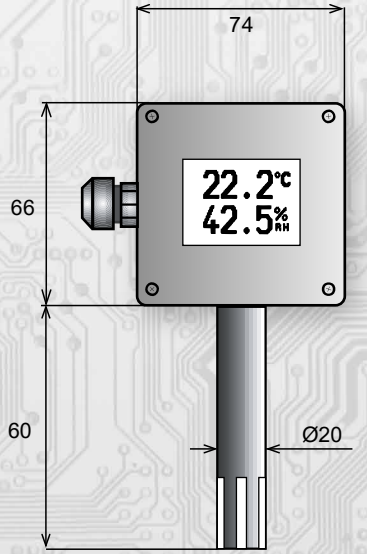
Method of ordering

State the quantity of pieces and the sensor type in the order .
An example of an order: 5 pieces sensor PHM12D-180

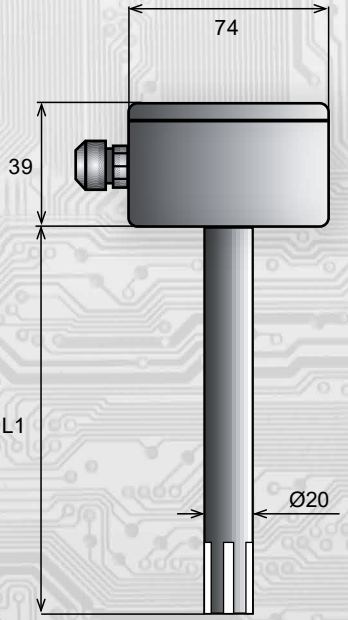
- Stem length
- D...with LCD
  N...without LCD
- Type (Duct)

Dimensions and accessories

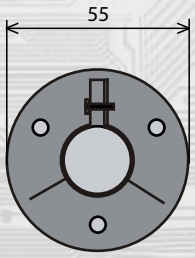
PHM111-D



PHM12-x-xx



Center holder for PHM12-x-xx



3 holes Ø 4,5 mm