The **NTM1P, NTM2P** controllers are indoor devices designed to sense room temperature and correct temperature.
The **HTM1P, HTM2P** types also sense relative air humidity.
The set point is set by a control wheel, which is connected to the adjustment potentiometer by a shaft. The NTM2P, HTM2P devices are equipped with one green LED and one red LED, and each LED can indicate three states (off, on, flashing). The LED can be controlled by a higher-level system or one or both can be linked to a button. The NTM1P, HTM1P devices are equipped with one two-color LED (green/red), so it is possible to indicate in three colors - green, red, orange.
The device is equipped with one universal DI and one universal DO with PWM option.If the controller is powered by a sufficiently rated 24VDC voltage, the DO can be used to directly control small 24VDC thermoelectric actuators for heating valves (approx. 2÷3W). The controller electronics consist of two parts. The indicator and control part is located on a printed circuit board inside the housing, and the main part with terminal blocks is located in a box that is inserted into the installation box. Both parts are connected with a flat conductor and the connection can be dismounted. The temperature and humidity sensor are located in the metal housing on the front device cover. Since the sensor of the HTM1P type is open, it is necessary to protect it from dirt, excessive dust or direct exposure to water! 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.

Technical parameters

Supply voltage	12 ÷ 30 VDC *1
Current consumption	Max. 25 mA (without charged output OUT)
Temperature/humidity resolution	0,1°C / 0,1 %RH
Type of temp. sensor (**NTMxP**)	STS4L
Max. error of temp. measurement (**NTMxP**)	± 0,4°C / ± 0,6°C (0 ÷ 60°C)
Type of used sensor T+RH (**HTMxP**)	SHT40
Max. error of temp. measurement (**HTMxP**)	± 0,2°C / ± 0,4°C (0 ÷ 60°C)
Max. error of RH measurement (+25°C)	± 3 % (20 ÷ 80 %RH)
Range of working temperature and humidity	Max. 40°C / 0-90 %RH without condensation, see: Working conditions of sensor SHT40
Recommended calibration interval	2 years
Settling time	min. 2 h *2
Range of recommended storage temp./RH	10 ÷ 50 °C / 20 ÷ 60 %RH
DO (digital output)	Active, open - drain type, max 300mA, max. 20kHz
Voltage level of output OUT	Hi ≈ Ucc - 0,8V, Lo ≈ 0V
DI (digital input)	Active– activated by terminals connection 3,4 = 1 Pasive - ≥7V = 0 ≤3V = 1
Galvanic separation of DI and DO	no
Communication	RS485, protocol ModBus RTU, 8bits, 1 stop bit, optional parity
Max. number of sensors in the line	254 (R_{IN} ≥ 96kΩ)
Baud rate	1200 ÷ 57600 Bd
Galvanic separation RS485	no
Configuration and upgrade program	USB_SET; freeware; www.regmet.cz
Protection level	IP40 (EN 60529)
Type of terminal board	CPP (conductors max. 1 mm^2)

*1 If 24VAC supply voltage is required, an MN24 voltage converter can be ordered for the device (for placement in the KU68 installation box

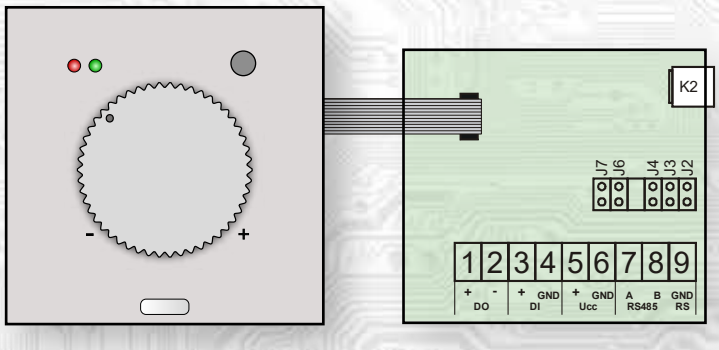
*2 See 2.5 Description of configuration registers: 40077 (R,WP) - Measured temperature, Offset:

List of types:

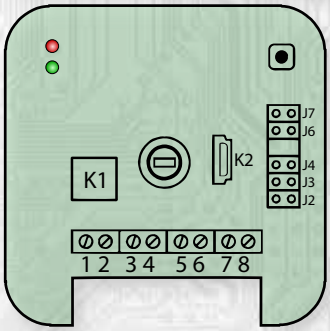
Type	Measured quantities	Number of LED
NTM2P	**temperature**	**2** (green + red)
HTM2P	**temperature + RH**	**2** (green + red)
NTM1P	**temperature**	**1** (green/red)
HTM1P	**temperature + RH**	**1** (green/red)

The controller is available in Levit and Tango versions (other designs on request).

Layout of connecting terminals and connectors (fig. 1)



K1……connector of 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 positive pole output of supply voltage for DO
Terminal 2 DO - digit. output of open – drain type
(the load is connected between terminals 1,2)
Terminal 3 DI - digit. input (it gets activated by connection
of terminals 3,4 or by external voltage of these terminals)
Terminal 4 DI - GND
Terminal 5, 6.... supply voltage
Terminal 7, 8.... RS485
Terminal 9..... GND
Positive terminal of supply (5) and positive terminal DO (1) are galvanically connected.
Negative terminal of supply (6) and negative terminal DI (4) are galvanically connected.

Operating conditions of the SHT40 sensor:

The sensor operates steadily in the recommended measuring range, which is 5 ÷ 60 °C and 20 ÷ 80% RH. Long-term exposure to high humidity, especially> 80% RH, resulting in gradually increasing deviation reading RH (+ 3% RH after 60 hours> 80% RH). After returning to the normal range, the RH will slowly return to the calibrated values.
Long-term exposure to extreme conditions can accelerate the aging of the sensor.

Long-term operation of the SHT40 sensor in conditions >80%RH:

To remove condensed / splashed water or during prolonged exposure of the sensor rel. humidity >80%, the sensor can be dried with a simple command. By writing 0xCBAC (52140 dek) to register 40029 – Status register, the heating of the sensor with a power of approx. 200mW for 1s is started. For approx. 1 min after starting the command, the sensor does not measure, the last measured values are on the line and the red heating symbol is displayed in the upper left corner of the LCD. To remove water from the sensor, it is recommended to run the command immediately after exceeding 99.9%RH. If it is not removed, the command can be repeated several times, but the delay between individual commands must be longer than that of approx. 1 min.
If the sensor is exposed for a long time >80%, it is advisable to dry the sensor periodically, e.g. once an hour.

Detailed information on conditions of long-term use of the sensor SHT40 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

1.1 Properties of communication protocol:

Protocol Modbus RTU with adjustable Baud rate 1200 - 57600 Bd, 8 bits, parity optional (no parity, odd, even), 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.

2.1 Description of registers of the device:

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 Holding registers will be mentioned in the description together with the function code field 4xxxx and the Input registers including 3xxxx. Thus the Holding register 40001 is physically sent through the busbar as register 0000 and the Input register 30001 as 0000.
Examples of communication are shown in Chapter 2.8.

1Modbus register = 2 Byte

The registers are divided in four basic memory zones:

Operational registers are situated in the zone of Holding registers at addresses 40001 to 40028. They are used for the common operational communication, registration in registers is unlimited and unprotected. The registration in FLASH will be made after recording 0xC001 (49153 dek) to 40029 – the Register Status. Provided the registration in FLASH is not done, the changes of operational registers made during the operation will not be saved for future starting.
Some operational registers enable parallel manual access from the device menu and these changes are automatically saved in FLASH.

User registers are situated in the zone of Holding registers at addresses from 40030 to 40036. They are used for preservation of user setting of the device (for example LCD contrast). The registers are accessible due to the remote zeroing of user setting (for example in hotels). The registration in registers is unlimited and unprotected. The change of setting and at the same time the registration in FLASH is done only after writing 0xC002 (49154 dek) to 40029 – the Register Status. All user registers enable the parallel manual access from the device menu and these changes are automatically saved in FLASH.

The configuration registers are situated in the zone of Holding registers at addresses 40041 to 40140. 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 Error 0xBE00 (48640 dek) Application program is damaged in the FLASH memory
- LCD Error 0xBE01 (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 1 0xC001 (49153 dek) it rewrites the Operational registers to FLASH
- Write Area 2 0xC002 (49154 dek) it rewrites the User registers to FLASH
- 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

2.2 Description of operational registers:

Saving to FLASH is done just after writing 0xC001 (49153 dek) to 40029 – the Register Status.

				Modbus registr [dek]
Measured temperature	Measured humidity	-	-	1 - 4
-	-	-	-	5 - 8
Temperature correction	-	-	-	9 - 12
-	-	-	-	13 - 16
Mode (LED)	-	-	-	17 - 20
Digital input (DI)	-	-	Digital output (DO)	21 - 24
LED 1	LED 2	-	-	25 - 28

4001 (R) – Measured temperature:
is detected with an inbuilt digital sensor that is built into the front panel of the cover and connected to the circuit board through the connector via the flexible cord. The value from the sensor is displayed on OLED and at the same time it is accessible on line RS485.
It is sent in °C in form of 16-bit number with sign (signed integer) multiplied by the constant 10:
0x00FB = 251dek = 25.1°C.

40002 (R) – Measured relative humidity of air (HTMxP):
is sensed with built-in digital sensor that is built into the front panel of cover and connected to the circuit board through the connector via the flexible cord. The value from the sensor is displayed on OLED and at the same time it is accessible on line RS485.
It is sent in % in form of 16-bits number with sign (signed integer) multiplied by the constant 10: 0x0164 = 356dek = 35.6%.

40009 (R,W,M) - Temperature correction:
The limits of the range for setting by buttons are defined by configuration registers.
40053 – Required temperature, lower limit and 40054 – Required temperature, upper limit.
The value is in °C in form of 16-bits number with sign (signed integer) multiplied by the constant 10.
For example, when setting the configuration registers 40053 – Required temperature, lower limit at -50 and the register - Required temperature, upper limit at 50 will be the range of setting by keys +/- 5.0°C and the value will be shown as the required temperature correction.

40017 (R,W,M) – Mode 1 (LED 1):
Only in case of connecting the LED to the button (40085 - Mode (LED), Bridge = 1). It depends on the settings 40086 - Mode (LED), counter and 40093 to 40108 - Mode (LED), symbol, see 3.1 Configuration the sensor using the USBset program.

40021 (R) – Digital input:
It indicates the current state of DI. The number format is 16-bit unsigned integer, the range is 1 bit Lsb of register.
Active mode: terminals 3,4 disconnected = 0, Terminals 3,4 connected = 1.
Passive mode: on terminals 3,4 ≥7V = 0, on terminals 3,4 ≤3V = 1.

40024 (R,W) – Digital output:
The current value of DO. The number format is 16-bit unsigned integer.
DO can be configured into two operational modes, as the two-status digital output or the proportional digital output. It depends on the setting of configuration registers 40051 – Digital output TOP and 40052 – Digital output PRESC, described in Chapter 2.5.
The two-status DO is controlled by values, disconnected = 0, connected = Digital output TOP +1.

4**0025 (R,W, M)** - depends on the setting of Mode x, bridge) – LED 1 (green):
Only if the LED is not connected to the button (40085 - Mode (LED), Bridge = 0).

value [dek]	0	1	2
LED 1	off	flashing	on

4**0025 (R,W, M)** - depends on the setting of Mode x, bridge) – LED 1 (red):
Only if the LED is not connected to the button (40085 - Mode (LED), Bridge = 0).

value [dek]	0	1	2
LED 2	off	flashing	on

2.3 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.

2.5 Description of configuration registers:

The controller may only be configured if jumper J6 (authorisation of configuration values registration, setting of fixed address of controller 255 and setting of the Baud rate 19200 Bd) is inserted before the device is connected to power supply voltage (by the reset).

The saving in FLASH is done only after writing 0xC003 (49155 dek) to 40029 – the Register 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 + parity	Digital output TOP	Digital output PRESC	49 - 52
Temparature correction Lower limit	Temparature correction Upper limit	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
Measured temp., Offset	Measured hum., Offset	-	-	77 – 80
-	-	-	-	81 – 84
Mode (LED), Brigde	Mode (LED), counter	-	-	85 – 88
-	-	-	-	89 – 92
Mode (LED),symbol 1	Mode (LED),symbol 2	Mode (LED),symbol 3	Mode (LED),symbol 4	93 – 96
Mode (LED),symbol 5	Mode (LED),symbol 6	Mode (LED),symbol 7	Mode (LED),symbol 8	97 – 100
Mode (LED),symbol 9	Mode (LED),symbol 10	Mode (LED),symbol 11	Mode (LED),symbol 12	101 – 104
Mode (LED),symbol 13	Mode (LED),symbol 14	Mode (LED),symbol 15	Mode (LED),symbol 16	105 – 108

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 + parity:
The Baud rate. The number format is 16-bit unsigned integer. It acquires the values 0 ÷ 6 dek.
Lower byte: Communication speed.

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

Upper byte: parity

value [dek]	0	1	2
parity	none	odd	even

For example:
0x0004 = 19200Bd, without parity
0x0203 = 9600Bd, odd parity

40051 (R,WP) – Digital output TOP:
It defines the number of steps for one period (PWM resolution). The number format is 16-bit unsigned integer, the range is 1 ÷ 65535 dek, the value 0 is not correct and shall not be set.
For example, if you set set 99 dek, PWM will be generated in DO (by recording in register 40024 – Digital output) in 100 steps, i.e. directly in units (%). If 255 dek is set, 8bit PWM will be generated in DO...
As for the double-status output, if value 1 is set, then DO will be controlled by recording in register 40024 – Digital output: disconnected = 0, connected = 2 dek.

40052 (R,WP) – Digital output PRESC:
The pre-divider of const. input frequency (2MHz) for the digital output. The number format is 16-bit unsigned integer.
It defines the duration of one step in the period. The basic unit is 0.5 µs and the multiplying ratio corresponds to the value of Digital output PRESC +1.
Thus, for example, for 40052 – Digital output PRESC = 1 is the basic step length multiplied by the value 2 = 1µs.
In order to define the period duration the time of one step shall be multiplied by the number of steps in the period (40051 – Digital output TOP).
For example, for 40051 – Digital output TOP = 100 and 40052 – Digital output PRESC = 199 the duration of one step is 0.5µs x (199+1) = 100µs, multiplied by the number of steps 100 = 0.01s = 100 Hz. The frequency of PWM signal is 100 Hz, i.e. the period duration of PWM signal is 10 ms.

40053 (R,WP) – Temperature correction, Lower limit:
Setting the lower limit of the temperature correction setting with the potentiometer.
The value is in the form of a 16-bit signed integer multiplied by a constant 10.
For example, when setting this register to -50 and register 40054 - Set temperature, upper limit to 50, the adjustment range with the control wheel will be +/- 5.0°C (on the line -50 ÷ 50).

40054 (R,WP) – **Temperature correction, Upper limit**:
Setting the upper limit of the temperature correction setting with a potentiometer.
The value is in the form of a 16-bit signed integer multiplied by a constant 10.

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, if after warming up the device (min. 2 hours) it seems that the device is over-measuring by 0.5°C, the value -15 is set in this register (the factory default is -10) and the device will display and transmit the actual room temperature.

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.

40085 (R,WP) - Mode 1, Bridge:
Setting the connection of the LED to the button. The number format is 16-bit unsigned integer.
It can only take on 2 states:
0 dek = No LED is linked to the button. LED indication is only possible from the master system via the line by changing the value in register 40025 – LED 1 or 40026 – LED 2.
1 dek = One or both LEDs are tied to a button.
It depends on the settings 40086 - Mode (LED), counter and 40093 to 40108 - Mode (LED), symbol, see 3.1 Configuring the sensor using the USBset program.

40086 (R,WP) – Mode (LED), Counter:
Specifies the number of functional states of the LED indicator button. The number format is 16-bit unsigned integer, range 0 ÷ 16 dec.
For more information, see 3.1 Configuring the sensor using the USBset program.

40093 ÷ 40108 (R,WP) – Mode (LED), symbol 1 ÷ 16:
Specifies the type of LED indication. The number format is 16-bit unsigned integer.

Overview of usable symbols (table 1):

Hex	dek	
0	0	LED 1 ON, LED 2 OFF
1	1	LED 1 ON, LED 2 OFF
2	2	LED 1 OFF, LED 2 ON
3	3	LED 1 ON, LED 2 ON
4	4	LED 1 flashing, LED 2 OFF
5	5	LED 1 OFF, LED 2 flashing
6	6	LED 1 flashing, LED 2 flashing
7	7	LED 1 OFF, LED 2 Modbus
8	8	LED 1 ON, LED 2 Modbus
9	9	LED 1 flashing, LED 2 Modbus
A	10	LED 1 Modbus, LED 2 OFF
B	11	LED 1 Modbus, LED 2 ON
C	12	LED 1 Modbus, LED 2 flashing

Example 1:
If 1 is selected in 40085 – Mode (LED), Bridge and 2 is selected in 40086 – Mode (LED), Counter, the button switches between 2 states.
If the number 7 is entered in reg. 40093 and the number 8 in reg. 40094, the button will switch between the off and on LED 1 (green), LED 2 (red) can be controlled via the line by writing to reg. 40026 LED 2 (red).

Example 2:
If 1 is selected in 40085 – Mode (LED), Bridge and 40086 – Mode (LED), Counter, the button switches between 4 states. If the number 0 is entered in reg. 40093, the number 1 in reg. 40094, the number 2 in reg. 40095 and the number 3 in reg. 40096, the button will switch:
LED1 off, LED2 off - LED1 on, LED2 off - LED1 off, LED2 on - LED1 on, LED2 on.
If one two-color LED (green/red) is ordered, the button will switch:
off – green – red – orange.

2.6 Description of information registers:

				Modbus register [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_Vers._1	FW_Boot_Vers._2	FW_Boot_Vers._3	FW_Boot_Vers._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_Vers._1	FW_Applic_Vers._2	FW_Applic_Vers._3	FW_Applic_Vers._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.

2.8 Examples of communication:

Command 03 (0x03): Read Holding Registers:
Master:

```
02 03 00 00 00 09 Crc Crc
 |  |  |  |  └ └ Number of read registers ( 9 registers)
 |  |  └ └ Address of initially read register ( 0x0001** )
 |  └ Command (Read Holding Registers)
 └ Address of device (device with address 2)
```

Slave:

```
02 03 04 00 FF 01 64 00 00 00 00 00 00 00 00 00 00 00 00 0A Crc Crc
 |  |  |  └ └ └ └ └ └ └ └ └ └ └ └ └ └ └ └ └ └ Data from registers
 |  |  └ Number of bytes ( 4 )
 |  └ Command (Read Holding Registers )
 └ Address of device (device with address 2)
```

The address of initial register is 0x0001** which is the address of measured temperature register, the number of read registers is 2. Thus: the measured temperature 0x00FF = 25,5° C, measured air relative humidity 0x0164 = 35,6% RH. correction of temperature 0x000A = +1°C.

Command 16 (0x10) Write Multiple Registers:
Master:

```
FF 10 00 30 00 02 04 00 02 00 03 Crc Crc
 |  |  |  |  |  |  |  |  |  └ └ Registered data 2. Regist. reg. (0x0003)
 |  |  |  |  |  |  |  └ └ Registered data 1. Regist. reg. (0x0002)
 |  |  |  |  |  |  └ Number of bytes (4)
 |  |  |  |  └ └ Number of registered registers (2)
 |  |  └ └ Address of first registered register (0x0031**)
 |  └ Command (Write Multiple Registers)
 └ Address of device (with inserted jumper J6 - address 255)
```

Slave:

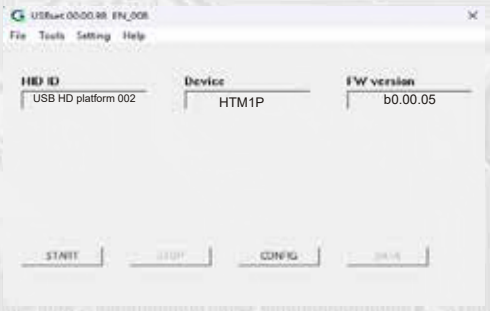
```
FF 06 00 1C C0 03 Crc Crc
 |  |  |  |  └ └ Registered data (0xC003 = 49155dek)
 |  |  |  └ └ Address of registered register (0x001D**)
 |  |  └ Command (Write Single Register)
 └ Address of device (with inserted jumper J6 - address 255)
```

With writing of the value 2dek in register 0x0031* (40049 – Network address) the network communication address 2 is set and with the writing of the value 3dek in register 0x0032** (40050 – Baud rate) the Baud rate 9 600 Bd is set.

Command 06 (0x06) Write Single Register:
Master:
FF 06 00 1C C0 03 Crc Crc
└ └ Registered data (0xC003 = 49155dek)
└ └ Address of registered register (0x001D**)
└ Command (Write Single Register)
└ Address of device (with inserted jumper J6 - address 255)
Slave:
FF 06 00 1C C0 03 Crc Crc
└ └ Registered data (0xC003 = 49155dek)
└ └ Address of registered register (0x001D**)
└ Command (Write Single Register)
└ Address of device (with inserted jumper J6 - address 255)

By writing the value 49155dek in register 0x001D** (40029 - Status Register), the configuration registers are saved in the flash memory of the device. If, for example, the communication address and rate pursuant to the previous example are changed through the network, then after this registration in the Status Register this change will be valid even after the device is reset or switched off.
** During the transfer the addresses of registers are indexed from zero, i.e. register 0x0001 is physically sent through the bus bar as 0x0000... (zero based addressing).

3.1 Configuration of sensor using the USBset program:
The configuration application USBset is freely available at producer´s web pages. The controlled can be configured only when the jumper J6 is inserted before the connection of supply voltage (reset). The sensor is connected with PC using the cable of USB mini B type. With connected cable the USB communication has the priority over the line RS485.
After the launching of USBset program, the basic window is opened and the connected sensor is automatically connected with



With clicking on the button “CONFIG” the configuration window gets opened.

With clicking on the button "**Read HTM1P**" the configuration values from the flash memory of sensor are read.

Description of configuration values (in parenthesis the relevant register for possible setting of controller using other software then USBset is stated – see Table 2):

Shift of measured values:
- temperature (40077): Setting of measured temperature offset.
Since the device has its own energy consumption and the temperature sensor is part of it, the measured energy temperature is affected radiated from the device. After installation of the device and tempering for min. 2h, the difference between the measured and the actual temperature stabilizes at a constant value and it is possible to compensate for this difference by setting the measured temperature shift. The factory default offset is -1.0 ° C, but it depends on the specific design, wall material, location, line load ...For example, if after tempering the device (min. 2h) it seems that the device is measuring by 0.5 ° C, the value is set to -1.5 (from the factory it is already preset -1.0) and the device will display and transmit the actual room temperature.

- humidity (40078): Setting of measured humidity offset.

Text field (40041 ÷ 40048): intended for the client´s identification of the controller (title, location...).

Potentiometer – configuration parameters:
ower limit (40053): setting of lower limit of setting for temperature correction by potentiometer.
For example, with setting of -5,0 and the upper limit of temperature correction set at 5,0 the range of setting by potentiometer will be +/- 5,0° C (in the line -50 ÷ 50)

Upper limit (40054): setting of upper limit of setting for temperature correction by potentiometer

Network setting:
- address (40049): selection of network address in the range 1 ÷ 254 for the operation of sensor in the serial line.

- rate (40050): selection of Baud rate in the range 1200 ÷ 57600 Bd for the operation of sensor in the serial line.

- parity(40050):
none
odd
even

Digital output:
Two-state: The digital output will acquire only two states, on and off.

PWM output: PWM signal with resolution set in the field "Number of steps" and with the frequency set in the field "Frequency" will be generated in the digital output.

Number of steps (40051): The number of steps for 1 period. Setting of PWM resolution. The range of setting from 3 to 65536.

Frequency (40052): Setting of PWM signal frequency. The range of setting depends on setting of number of steps for 1 period, as the maximum allowed frequency of PWM is 20 kHz.

PAfter setting of number of steps and PWM frequency it is necessary to click on the button Set (next to the Frequency). The maximum closest real value of frequency will be displayed in the window Frequency.

Period: The period of PWM signal calculated from the set PWM frequency.

Switch 1:
Connection with LED:

No: The button is not connected to any LED, pressing it will have no effect, the LED can only be controlled via the line by writing to register 40025 LED 1 (green) or register 40026 LED 2 (red).

Yes: The button is connected to one or both LEDs, the function depends on the state settings.

Number of states: If Connection with LED: Yes is selected, the number of functional states of the button is selected.

State 1 ÷ 16: The type of LED indication is entered.

Example 1:
If Connection with LED: Yes and Number of states: 2 are selected, the button is set to switch between 2 states.
If State 1: LED 1 off, LED 2 Modbus and State 2: LED 1 on, LED 2 Modbus are entered, the button will switch between off and on LED 1 (green).
LED 2 (red) can be controlled via the line by writing to register 40026 LED 2 (red).

Example 2:
If Connection with LED: Yes and Number of states: 4 are selected, the button is set to switch between 4 states.
If State 1: LED 1 off, LED 2 off, State 2: LED 1 on, LED 2 off, State 3: LED 1 off, LED 2 on, and State 4: LED 1 on, LED 2 on, the button will switch:
LED1 off, LED2 off - LED1 on, LED2 off - LED1 off, LED2 on - LED1 on, LED2 on.
If one bi-color LED (green/red) is ordered, the button will switch:
off – green – red – orange.

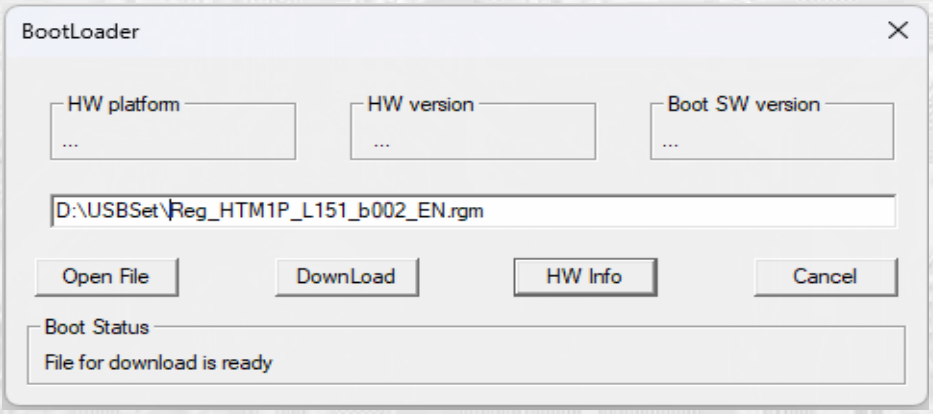
After setting of required values and quantities the new configuration values are saved in the flash memory of the device by clicking on the button **"Write HTM1P".**
The writing into the flash memory is conditioned by insertion of jumper J6 (authorisation for configuration values recording) before the clicking on the button **"Write".**
By clicking on the button "Cancel" the configuration windows gets closed.

After USB cable disconnection the jumper J6 is pulled out and the device is ready for operation.

"Save setting" – it saves the configuration set in the configuration window as the file with suffix .rgc.
"Open setting" – it sets the values in the configuration window according to the chosen file.

3.2 Variation of the application part FW:

After the USBset program launching click on the Tools – BootLoader and the windows gets opened:

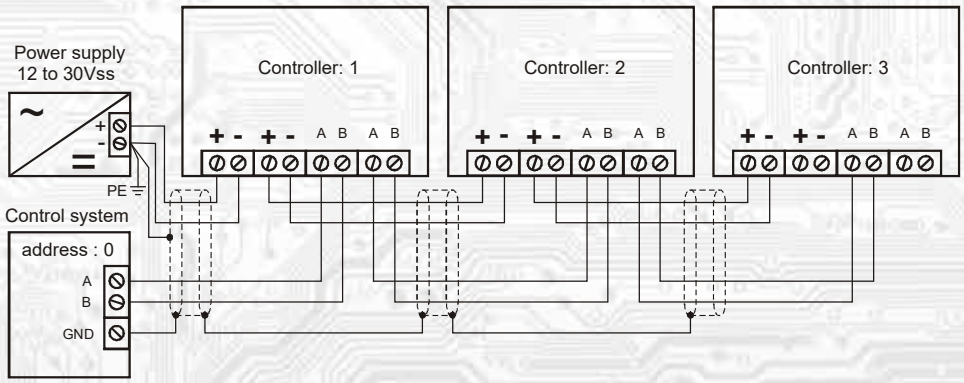


The work with application is conditioned by insertion of the jumper J6 (authorisation for configuration values recording).
Using the button "OpenFile" the new application FW is chosen and using the button "Download" the FW variation gets started, being automatically controlled by PC and the device.
For the maximum simplicity and safety every device has unambiguous identification of HW platform. This designation describes HW topology and also defines what application FW can be sued for the specific type of HW. This information can be read through the button "HW info".
The application FW are distributed in data format ".reg ". In case of application variation the information on HW platform and HW version are always read after the connection of PC with the device. At the same time, the HW platforms descriptors and HW versions from the file ".reg " are read. Provided HW platform and HW version are not compatible, the FW variation cannot be done.
Provided the communication failure occurs during the application FW variation, for example due to the supply voltage drop, the application SW will not be functional. In such case the automatic launching of "bootload" process as well as the automatic reading of HW info will not work. The Bootloader in the device gets always activated after the reset, thus it is necessary to reset manually. Using the RESET jumper or the simple disconnection and subsequent connection of supply voltage.
Provided the automatic sequence of FW variation launching is damaged:
- switch off the device or connect the jumper at RESET pins
- launch the bootload process using the button "DownLoad"
- switch on the supply voltage or release the RESET jumper
- delay between the activation of button "DownLoad" and the switching on or by the RESET shall be shorter than 2s

After the USB cable disconnection the jumper J6 is pulled out and the device reset is performed using the short shorting of RST jumper (J7).

The integrity check of content of memories:
The bootloader as well as the application are protected by control total sums. Provided the data integrity is broken, the content of FLASH memory MCU is damaged and the damaged program will not be launched.

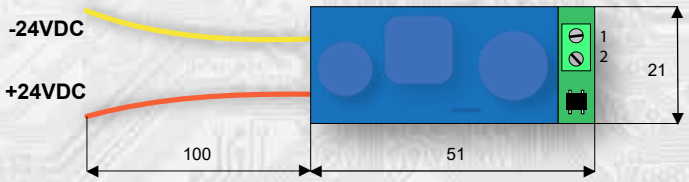
Example of connection of controllers in the system



Using the conterollers in 24VAC systems

Using the MN24 converter, these devices can also be used in 24VAC measurement and control systems.
The converter can be placed in a deeper flush-mounted box, e.g. KU68.

Dimensions



Terminals 1, 2 :
input voltage 24VAC