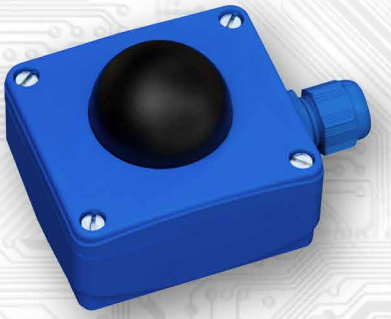
Radiation temperature sensors - RS485 communication - type P30MU

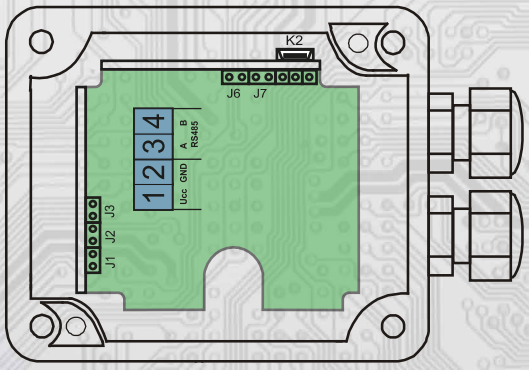


The radiation temperature sensors are designed for general-purpose application in control and regulation systems for temperature detection in larger room and halls. The radiation temperature sensor determines the effective part of active radiation respective the effectively radiant heat at the measured location. The temperature element (Pt1000) is located under the black hemisphere. The head of sensor is made of polycarbonate, cover is provided with quick-locking screws. By standard, the sensors are supplied in pass-through design with two glands. Only sensors ordered as end pieces (type P30MU/K) are equipped with a single gland. The device is configured using the USBset configuration program using the USB interface or by overwriting individual registers using RS485 Modbus RTU protocol.

Basic technical parameters

Power supply (Ucc)	10 to 30 VDC
Max. power consumption	max. 0,5W
Temperature resolution	0,1°C
Accuracy	± 0,5°C
Communication	RS485, protocol ModBus RTU, 8bit, 1 stop bit, optional parity
Baud rate	1200 ÷ 57600 Bd
Input impedance of RS485 receiver	min. 96 kΩ , typ. 150 kΩ
Max. number of sensors in the line	254
Galvanic separation RS485	no
Range of working temperature	-30 ÷ 60 °C
Range of recommended storage temp. / RH	10 ÷ 50 °C / 20 ÷ 60 %RH
Protection type	IP65
Terminal board	COB (conductors max. 1,5 mm^2)
Cable gland / Max. Ø	PG9 / 8 mm
Configuration and upgrade program	USBset; freeware; www.regmet.cz

Layout of connecting terminals and connectors (fig. 1)



K2... connector USB mini B

J1…terminal resistor 120R
J2…definition of still stand (conductor A)
J3…definition of still stand (conductor B)
J6…device configuration
J7… reset

Term. 1..... + pole (Ucc)
Term. 2..... - pole (GND)
Term. 3..... RS485 - A
Term. 4..... RS485 - B

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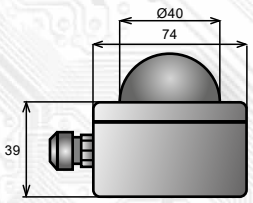
Dimensions



1.1 Properties of communication protocol:

Protocol Modbus RTU with adjustable Baud rate 1200 - 57600 Bd, 8 bits, optional parity (no parity, EVEN, ODD), 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:
1Modbus registr = 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 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.

The registers are divided in four basic memory zones:

The operational registers are situated at addresses 40001 and 40002. 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. Inthis mode the device communicates at dedicated address 255 of the Baud rate 19200 Bd. The configuration registers can be rewrittenonly using the communication protocol and under the above stated conditions. The change of setting and at the same time the registrationin 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 innormal operational mode
-Menu Active 0xB000 (45056 dek) the user has opened the manual menu
-Memory Read 0xB001 (45057dek) the device is reading from FLASH
-Memory Write 0xB002 (45058 dek) the device is register ingto FLASH

STATUS Error messages from the device to the superior system:
-CRC Error 0xBE01 (48641 dek) Application program is damaged in the FLASHmemory
-LCD Error 0xBE02 (48642 dek) Error of communication with LCD
-Sensor Error 0xBE03 (48643 dek) Error of communication with the sensor
-Memory Error 0xBE04 (48644 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

2.2 Description of operational registers:

				Modbus register [dek]
Measured temperature	-	-	-	1 - 4
-	-	-	Measured resistance	5 - 8

40001 (R) - Measured temperature:
is read by a resistance sensor that is built into the black hemispherical sensor. The value from the sensor is sent in°C in form of 16-bitnumber with sign (signed integer) multiplied by the constant10:
0x0136 = 310dek = 31,0°C.

40008 (R) - Measured resistance of the temperature sensor at the ADC input:
Resistance value of the temperature sensor (Pt1000) at the ADC input. Used for control or service purposes only..
The value is sent in Ω in form of 16-bitnumber with sign (signed integer) multiplied by the constant10:
0x2BC6 = 11206dek = 1120,6Ω = 31,0°C.

2.3 Description of 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	-	-	49 - 52
-	-	-	-	53 - 76
Measured temp., 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 + parity:
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

MSB: parity

value (dek)	0	1	2
parity	none	odd	even

Example: 0x0004 = 19200Bd, without parity
0x0203 = 9600Bd, even parity

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.

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.

Content of Modbus Holding Registers

Operational registers

				Modbus register [dek]
Measured temperature	-	-	-	1 - 4
-	-	-	Measured resistance	5 - 8

Status register

Status register				29

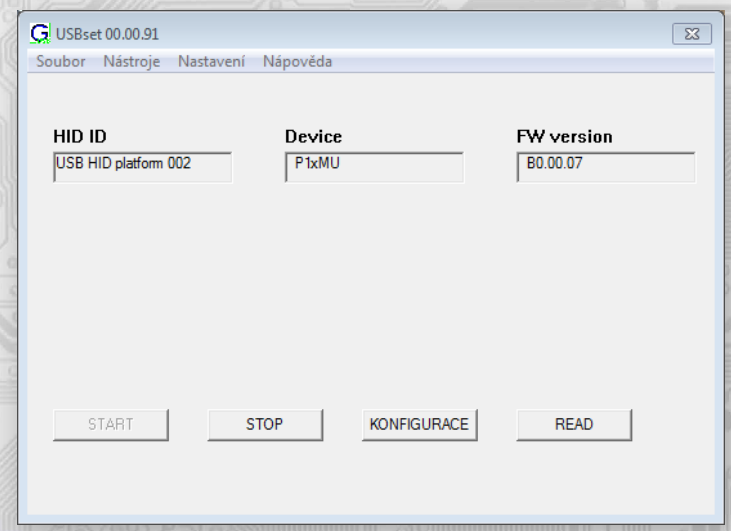
Configuration registers

The saving in FLASH is done only after writing 0xC003 (49155 dek) to 40029 – the Register Status.

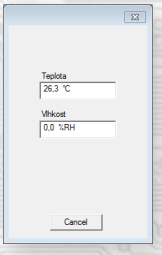
Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate + parity	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
Measured temp., Offset	-	-	-	77 – 80

3.1 Configuration of sensor using the USBset program:

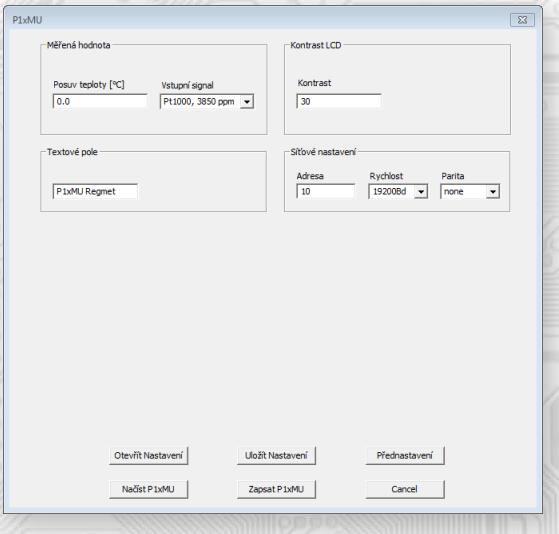
The configuration application USBset is freely available at producer´s web pages. The controlled can be configured only when the jumper J6 is inserted before the connection of supply voltage (reset).
The sensor is connected with PC using the cable of USB mini B type. With connected cable the USB communication 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 the hosting PC.



With clicking on the button “READ” a window with current input values opens



With clicking on the button “CONFIGURATION” the configuration window gets opened



With clicking on the button “Načíst P30MU" (Looad) the configuration values from the flash memory of sensor are read.

-**Shift of measured value:**
- temperature (40077): Setting of measured temperature offset.
For example, when it seems the device measures over by 1° C (for example due to the inappropriate location, own heating at often communication with loaded line...), the value – 1,0 is set and the device will display and send the temperature value lower by 1°C than the really measured value is.

-Input signal: selection of the used temperature resistance sensor, usable only for P18MU types with connectable external sensor. For other types, do not change this item! (keep Pt1000, 3850ppm).

Contrast: unused

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

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

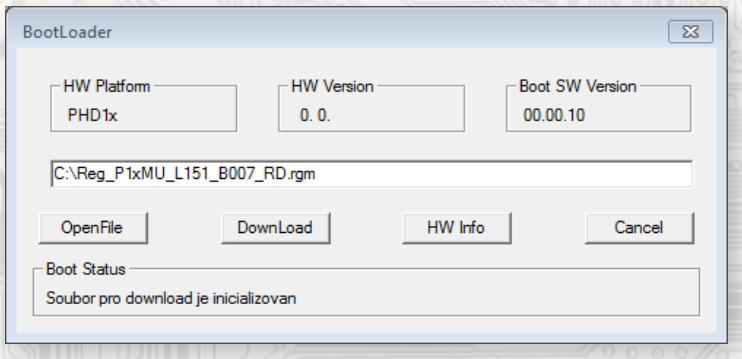
- baud rate (40050): selection of Baud rate in the range 1200 ÷ 57600 Bd for the operation of sensor in the serial line.

- parity (40050): Parity selection
none: without parity
odd: odd parity
even: even parity

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"
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

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.

4.1 Examples of communication:

Command 03 (0x03): Read Holding Registers:

Master: 02 03 00 04 00 01 Crc Crc
- 02 — Address of device (device with address 2)
- 03 — Command (Read Holding Registers)
- 00 04 — Address of initially read register (0x0005**)
- 00 01 — Number of read registers (1 registers)

Slave: 02 03 06 00 FF Crc Crc
- 02 — Address of device (device with address 2)
- 03 — Command (Read Holding Registers)
- 06 — Number of bytes (2)
- 00 FF — Data from register (0x00FF)

The address of initial register is 0x0005** which is the address of measured temperature register. Thus: the measured temperature 0x00FF = 25,5° C.
** 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).

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 10 00 30 00 02 Crc Crc

- Number of registered registers (2)
- Address of first registered register (0x0031**)
- Command (Write Multiple Registers)
- 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:

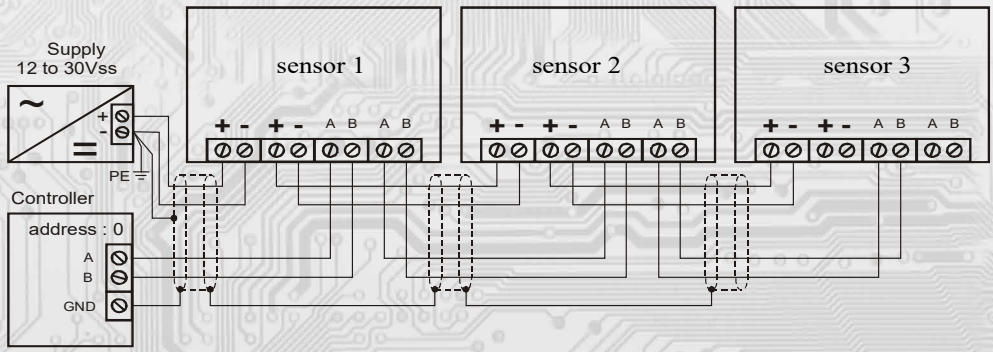
FF 06 00 1C C0 03 Crc Crc

- 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 orswitchedoff.

** During the transfer the addresses of registers are indexed from zero, i.e. register 0x0001 is physically sent through the bus bar as0x0000... (zero based addressing).

Example of wiring the sensors in the system



The electrical connection of the wires is made on the terminal block (Fig. 1), which is accessible after loosening the quick-release screws by pressing them and turning them 90° and then removing the head cap.

The electrical connection of the wires is made on the terminal board, which is on the main board in the base with a wire with a cross-section of max. 1 mm2 according to Fig. 1 and 2. The signal terminals A and B on the controller are connected to the same terminals on the control system. The use of jumpers J2 to J4 follows the general principles for RS485 communication. One 12 to 30 Vdc power source can be used to power the device, and the power supply voltage is connected to the controller terminals marked Ucc and GND. It is recommended to connect the controllers to each other with a suitable shielded cable with twisted wires (dual twisted pair), in which data signals and power will be conducted. The cable shield is connected to the terminal marked GND_RS and in the switchboard it is connected to the lowest potential (PE terminal, see Fig. 2). We recommend cables with shielded twisted pairs with a core cross-section of 0.35 ÷ 0.8 mm2 with an impedance close to 120 Ω, e.g. STP CAT5 and higher.

The holes for mounting on a wall or other surface are accessible after removing the box lid.