



- Modbus RTU communication over RS485 line
- long-term stability of measurement CO2 - NDIR sensor
- direct wall mounting

These sensors are designed for measurement CO2 concentration, relative humidity and temperature in interior. They are intended for the direct mounting on the wall. The communication with superior system is led in the line RS485 by the protocol Modbus RTU.

The actual CO2 concentration sensor and T+RH sensor are located below front cover.

Basic technical parameters

Supply voltage (Ucc)	10 to 30 VDC
Power consumption/ peak <200ms)	0,5VA / 4VA
CO2/temperature/humidity resolution	1ppm / 0,1°C / 0,1%RH
Accuracy - CO2 (range 0 - 2000ppm)	±30ppm ±3% of the range
Sampling interval for the measurement of CO2 concentration	3s
type of sensor T+RH	SHT31
Accuracy - temperature	± 0,5°C (20 ÷ 40°C), ± 1°C (0 ÷ 60°C)
Time of stabilization	min. 2 hours
Accuracy - humidity (+25°C)	± 3% (20 ÷ 80 %RH)
Communication	RS485, protocol ModBus RTU, 8bits, 1 stop bit, without parity
Baud rate	1200 ÷ 57600 Bd
Input impedance of the RS485 receiver	min. 96 kΩ , typ. 150 kΩ
Max. number of sensors on the line	254
Galvanic separation RS485	yes, < 50V
Range of working temperature and humidity ²	-10 ÷ 60°C/ 0 ÷ 95 %RH without condensation
Recommended calibration interval RH	2 years
Range of recommended storage temp. / RH	10 ÷ 50 °C / 20 ÷ 60 %RH
Protection type	IP40
Terminal board	CPP (wires max. 1 mm ²)
Configuration and FW upgrade	USBset; freeware; www.regmet.cz

1. Since the device has some own power consumption (especially the CO2 measurement module) and the temperature sensor is part of it, the measured temperature is affected by the energy emitted by the device.

After installation of the sensor and tempering for min. 2h, the measured and actual temperature difference stabilizes at a constant value. For types with temperature measurement, the offset is preset to -2.0 ° C. (this means that at the moment of connecting the supply voltage, the value on the line will be 2 ° C lower than the actual value).

2. The devices are intended for use in the interior of living rooms.

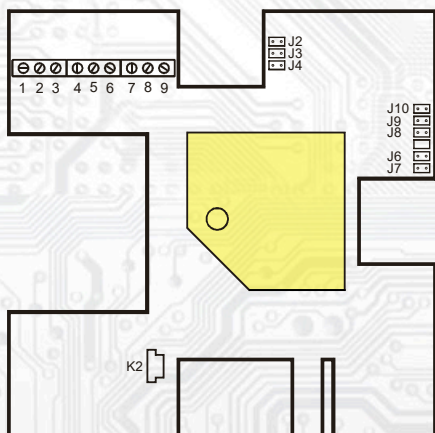
The sensor operates steadily in the recommended measuring range, which is 5 ÷ 60 ° C and 20 ÷ 80% RH. Long-term exposure to high humidity, especially > 80% RH, resulting in gradually increasing deviation reading RH (+ 3% RH after 60 hours > 80% RH). After returning to the normal range, the RH will slowly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

Long-term exposure to extreme conditions can accelerate the aging of the sensor.

Detailed information on conditions of long-term use of the sensor SHT31 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.1):



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

J8.....manual recalibration (MCDL)

J9.....automatic calibration (ACDL)

J10...LED (Optical signaling of increased CO2 concentration)

Terminal 1.....+Ucc, positive pole

Terminal 2.....GND, negative pole

Terminal 3.....+Ucc, positive pole

Terminal 4.....GND, negative pole

Terminal 5.....RS485 -A

Terminal 6.....RS485 -B

Terminal 7 ...RS485 -A

Terminal 8.....RS485 -B

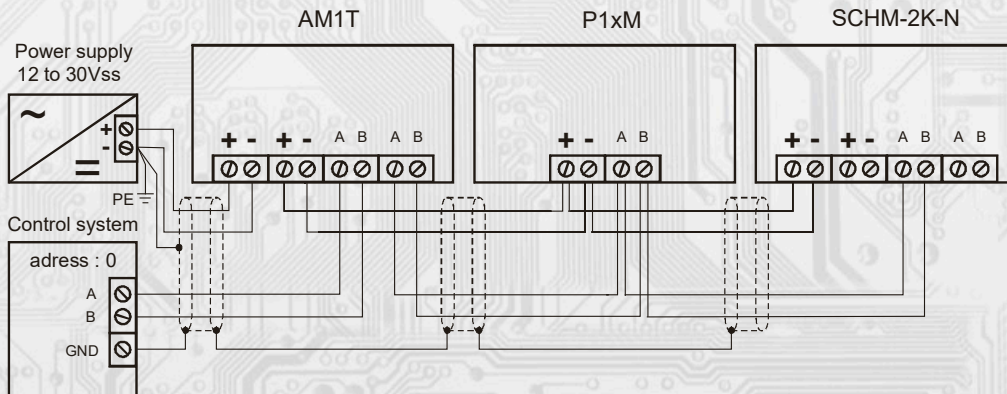
Terminal 9.....RS485 - common pole (shielding)

List of available types:

CO2 range	CO2 = 0 ÷ 2000ppm	CO2 = 0 ÷ 5000ppm	CO2 = 0 ÷ 10000ppm
Measured quantities			
CO2 + temperature + RH	SCHM - 2K	SCHM - 5K	SCHM - 10K
CO2 only	SCNM - 2K	SCNM - 5K	SCNM - 10K

Note: For standard habitable space is the best range measurement of CO2 in the range 0 to 2000ppm

Example of wiring the sensors in the system:



1.1 Properties of 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**.

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:

Operational registers are situated at addresses 40001, 40002 and 40006. 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 40082. 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 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 registr [dek]
Measured temperature	Measured humidity	-	-	1 - 4
-	Measured CO2	-	-	5 - 8

4001 (R) – Measured temperature

is detected with an inbuilt digital 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.

4002 (R) – Measured relative humidity of air:

is detected with an inbuilt digital 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%.

4006 (R) – Measured CO2 concentration:

is detected with an a module that is embedded under the cover. The value is sent in ppm in form of 16-bits number with sign (signed integer): 0x0237 = 567dek = 567ppm.

2.3. Description of the Status Register:

				Modbus registr [dek]
Status registr				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.

2.4 Description of configuration registers:

Saving into EEPROM is done **after writing 0xC003 (49155 dec) to 40029 - 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	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 - 60
-	-	-	-	61 - 64
-	-	-	-	65 - 68
-	-	-	-	69 - 72
-	-	-	-	73 - 76
Measured temp., Offset	Measured hum., Offset	-	-	77 - 80
-	Measured CO2, Offset	-	-	81 - 84

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.

40082 (R,WP) - Measured CO2, Offset

Setting the measured CO2 offset.

The value is in ppm in form of 16 bit number with a sign (signed integer).

2.5 Description of information registers:

HW_Platform_1	HW_Platform_2	HW_Platform_3	HW_Platform_4	Modbus registr [dek]
HW_Platform_5	HW_Platform_6	HW_Platform_7	HW_Platform_8	1 - 4
HW_Version_1	HW_Version_2	HW_Version_3	HW_Version_4	5 - 8
FW_Boot_Version_1	FW_Boot_Version_2	FW_Boot_Version_3	FW_Boot_Version_4	9 - 12
ID_Device_1	ID_Device_2	ID_Device_3	ID_Device_4	13 - 16
ID_Device_5	ID_Device_6	ID_Device_7	ID_Device_8	17 - 20
FW_Applic_Version_1	FW_Applic_Version_2	FW_Applic_Version_3	FW_Applic_Version_4	21 - 24
0x0000	0x0000	0x0000	0x0000	25 - 28
				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 (tab. 2):

Operational registers:

Measured temperature	Measured humidity	-	-	Modbus registr [dek]
-	Measured CO2	-	-	1 - 4
				5 - 8

Status registr:

Status register				29
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Description of configuration registers

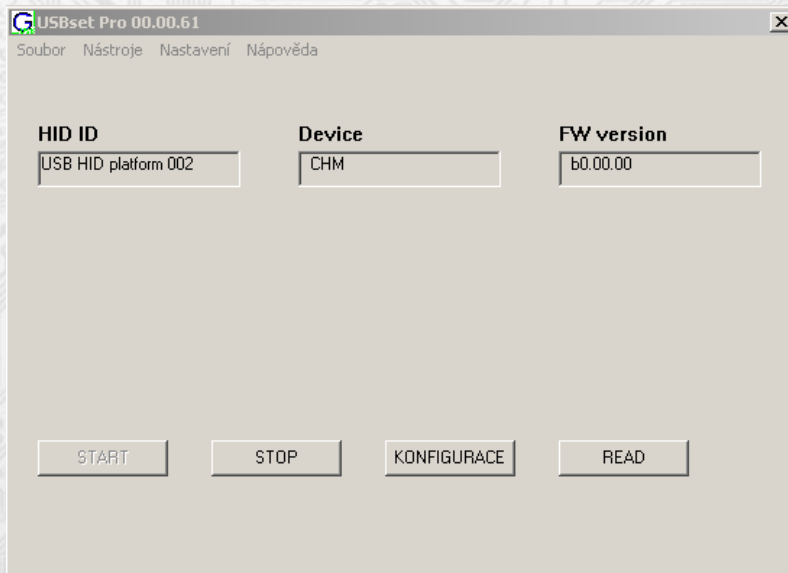
Saving into EEPROM is done after writing 0xC003 (49155 dec) to 40029 - Register Status !!!

Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 - 60
-	-	-	-	61 - 64
-	-	-	-	65 - 68
-	-	-	-	69 - 72
-	-	-	-	73 - 76
Measured temp., Offset	Measured hum., Offset	-	-	77 - 80
-	Measured Co2 concentration., Offset	-	-	81 - 84

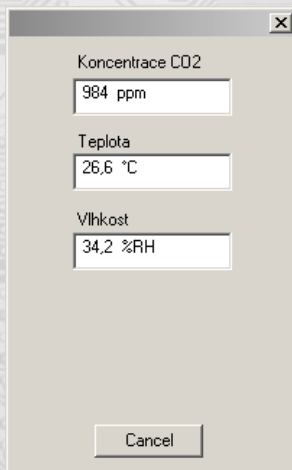
3.1. SW configuration of sensor using the USBset program:

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 "READ" button opens the window with the current input values.



With clicking on the button "KONFIGURACE" the configuration window gets opened.

With clicking on the button "READ" the configuration values from the ash memory of sensor are read.

Shift of measured value (T, RH, CO2)

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.

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

Address...selection of network address in the range 1 ÷ 254 for the operation of sensor in the serial line

Baud rate...selection of Baud rate in the range 1200 ÷ 57600 Bd for the operation of sensor in the serial line

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

Variation of the application part FW:

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

The function of the automatic calibration (ACDL) and the manual recalibration (MCDL):

The CO2 sensor contains optical elements, which "age" during operations and the sensor loses its accuracy. In normal living rooms, where occasional complete air exchange of the room is assumed, ageing is compensated by setting the ACDL mode, which is the automatic calibration function. This function is activated by a permanent short-circuit of the J7 connector, when the first automatic calibration takes place after 3 days and then after every week.

In areas, where it is not possible to use the automatic calibration function, it is advisable to occasionally use the manual recalibration function. This is done by placing sensors with a connected voltage supply into the ventilated area, preferably into an outdoor environment (CO2 content = approx. 400ppm) for at least 30 minutes. Then, the J8 connector is short-circuited for 10 minutes. After 10 minutes, the connector is disconnected and the sensor works with modified values. The sensor must be placed in a ventilated area for the duration of the recalibration.

The instrument is supplied calibrated from the manufacturer without any set mode. It is up to the user to choose how the calibration will take place. The majority of the users use the optimal automatic calibration function (ACDL), thereby connected to J9.

Optical signalization increased concentration of CO2

Closing the J10 connector (LED) activates the function signaling increased CO2 concentration. If this function is active, once CO2 concentration exceeds 1000ppm, the red LED at the top part of the cover lights up and turns off once the CO2 concentration drops below 800ppm.