Controller with digital communication with colour TFT display - CHM1CF

The controller CHM1CF is an interior device intended for sensing, and possible correction, of environment temperature, relative humidity and concentration of CO2 of air without aggressive admixtures. It is equipped with a backlit color 2.3 "TFT display.
Using the buttons or the superior system, it is possible to set the correction or required values of the measured quantities, select up to three out of 48 available modes.
The device is equipped with one universal DI and one universal DO with PWM option.
If the controller is powered by a sufficiently sized 24VDC voltage, the output DO can be used for direct control of small 24VDC thermoelectric heating valve drives (approx. 2÷3W).

The electronic system of the controller consists of two parts. The display part with controls is located at the printed circuit inside the cover and the main part with terminal boards is located in the box that is inserted in the installation box. Both parts are connected with a flat conductor and the connection can be dismounted. The CO2 sensor is located on the PCB inside the housing, the temperature and humidity sensor are located in the metal housing on the front device cover. As the sensor is open, it is necessary to protect it from impurities, enormous dust or direct water spraying!
The common chemically non-aggressive environment suits working conditions under which the sensors require no maintenance or service.
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 device configuration is made with sensor connection, using the standard USB cable, to PC with Windows system using the freeware application USB_SET.
The controller can be configured without access menu, for example for hotels, schools, etc. .
The device is available in Czech or English version. Unless otherwise ordered, the Czech version is considered the standard.

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Basic technical parameters

Supply voltage	12 ÷ 30 VDC
Power consumption/ peak <1,2s)	0,5VA / 1VA (without charged output OUT)
CO_2/temperature/humidity resolution	1ppm / 0,1°C / 0,1%RH
Range of CO_2 concentration	400 ÷ 2000ppm
Accuracy - CO_2 (range 0 ÷ 2000ppm)	±50ppm ±5% of the range
Sampling interval of concentration CO_2	30s
Recomm. calibration interval CO_2	no need to calibrate in AC mode (1)
Lifetime of sensor CO_2	>10 years
Type of used sensor T+RH	SHT40
Typ./Max. error of temp. measur.	± 0,2°C / ± 0,4°C (0 ÷ 60°C)
Typ./Max. error of RH (+25°C)	± 2 % / ± 3,5 % (10 ÷ 90 %RH)
Recomm. calibration interval T+RH	2 years
Settling time	min. 2 h (2)
Range of working T and RH	-10 ÷ 50°C / 10 ÷ 95 %RH without condensation, (3)
Range of recommended storage T / RH	10 ÷ 50 °C / 20 ÷ 60 %RH
DO (output OUT)	Aktive,type open-drain, max 300mA, max. 20kHz
Voltage level of output OUT	Hi ≈ Ucc - 0,8V, Lo ≈ 0V
DI (input WINDOW)	Active – activated by terminals connection 3,4 = 1 Passive - ≥7V = 0 ≤3V = 1
Galvanic separation of DI and DO	no
Communication	RS485, protocol ModBus RTU, 8bits, 1 stop bit, no 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 (according to EN 60529)
Type of terminal board	CPP (conductors max. 1 mm^2)

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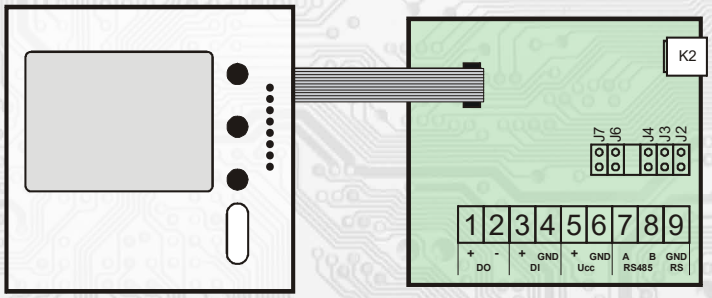
(1) The regular exposure of the CO2 sensor to a concentration of 400 ppm is the condition for the correct function of the AC mode is (regular room ventilation).
More detailed information about the used CO2 sensor, type SCD40, can be found directly on the manufacturer's website http://www.sensirion.com.

(2) Because 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 -1.0 °C. (this means that at the moment of connecting the supply voltage, the value on the line will be 1 °C lower than the actual value).

(3) The devices are intended for use in living room interiors.
The sensor RH 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.

Layout of connecting terminals and connectors (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... configuration of device
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, by external voltage of these terminals)
Terminal 4 ..... DI - GND
Terminals 5,6... supply
Terminals 7,8.. . RS485
Terminal 9..... GND
Terminal 5 (Ucc) and Terminal 1 (DO +) are galvanically connected
Terminal 6 (GND) and Terminal 4 (GND) are galvanically connected

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

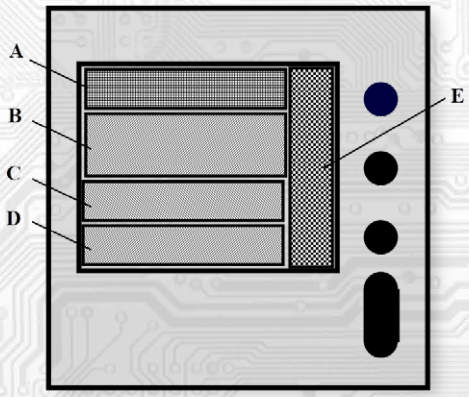
To remove condensed / splashed water or during prolonged exposure of the sensor rel. humidity >80%, the sensor can be dried with a simple command.
By writing 0xCBAC (52140 dek) to register 40029 – Status register, the heating of the sensor with a power of approx. 200mW for 1s is started. For approx. 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.

More detailed information on the conditions of long-term use of the sensor outside the normal range and the use of self-heating of the sensor are provided directly on the manufacturer's website http://www.sensirion.com

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.

1.2 *Layout of initial display:*

Following the controller switching on the display shows, for approx. 2s, the producer´s logo, and later basic information on the device and finally the initial display:



Zone A: area for displaying up to 3 symbols indicating the mode, function status or other information from the control system
Zone B: currently measured temperature
Zone C: currently measured relative humidity
Zone D: currently measured concentration of CO2
Zone E: current feature assigned to individual buttons. They change with the mode in which the controller is currently found (initial state, menu listing...) + CO2 concentration level indication

1.3 Control using the device keyboard:

By pressing the button Menu you enter a drop-down menu of the device and you can list it with buttons▲ and ▼.
Saving data into FLASH is done by pressing the button Save. When the buttons remains inactive for more than 10 seconds, it returns subsequently to the previous level up to the final leave of the menu.

Menu – device info ↵ Information on HW and SW of the device
▼ ▲
Network information ↵ Information on current setting of the network address and Baud rate
▼ ▲
Function▲ ↵ **Inactive** Save — The central button will be without fast select option
Temperature Save — The fast select for setting required temperature will be on the middle button
Humidity Save — The fast select for setting required humidity will be on the middle button
Mode X Save — The fast select for setting the mode will be on the middle button
▼ ▲
Function▼ ↵ **Inactive** Save — The lower button will be without fast select option
Temperature Save — The fast select for setting required temperature will be on the lower button
Humidity Save — The fast select for setting required humidity will be on the lower button
Mode X Save — The fast select for setting the mode will be on the lower button
▼ ▲
Mode ↵ **Mode X** ↵ Mode X selection of mode using the relevant symbol (as per configuration)
▼ ▲
CO2 ↵ setting of required concentration CO2
▼ ▲
Humidity ↵ setting of required humidity value
▼ ▲
Temperature ↵ setting the correction or required temperature value (as per configuration)
▼ ▲
Display ↵ **Colours** — Setting of colour for individual LCD fields
Contrast — Setting of LCD contrast with inactive display (saving mode) **
Active time — Setting display active time: after this time with no button activity the display switches to the saving mode
▼ ▲
End ↵ **exit from the menu**

** In order to reduce the energy consumption of the device and thus also to negatively affect the measured values due to the device's own heating, it is recommended to set the LCD backlight to the lowest possible value when the display is inactive.

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 40040. 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
- HW key disable	0xCBAA	(52138 dek) unlocking the HW key (J6) for 1 write to the protected register

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 register [dek]
Measured temperature	Measured humidity	-	-	1 - 4
-	Measured CO2	-	-	5 - 8
Required temperature	Required humidity	-	-	9 - 12
-	Required CO2	-	-	13 - 16
Required mode 1	Required mode 2	Required mode 3	-	17 - 20
Digital input (DI)	-	-	Digital output (DO)	21 - 24
Symbol at position 1	Symbol at position 2	Symbol at position 3	-	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:
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%.

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.

40007, 40008 (R,W) - User value 1, 2:
see cap.k 4.5 (Example of displaying a temperature other than the internal sensor, eg temperature measured by an external temperature sensor)

40009 (R,W,M) – Required temperature:
or possible 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 40054 - Required temperature, upper limit at 50 will be the range of settingby keys +/-5.0°C and the value will be shown as the required temperature correction. When setting the configuration registers 40053 –Required temperature, lower limit for example at 100 and register 40054 – Required temperature, upper limit at 300 the range of setting by keys will be10 -3 0 °C and the value will be shown as the required temperature.

40010 (R,W,M) – Required value of relative humidity of air:
The limits of the range of setting by buttons are defined by configuration registers 40055 – Required humidity, lower limit and 40056 – Required humidity, upper limit.The value is in% in form of 16-bit unsigned integer.

40014 (R,W,M) – Required value of concentration CO2:
The limits of the range of setting by buttons are defined by configuration registers 40063 – Required CO2, lower limit and 40064 – Required CO2, upper limit.The value is in % in form of 16-bit unsigned integer.

40017(R,W,M) – Required mode 1:
The selection of required mode 1.The number of modes is defined by the configuration register 40086 - Mode1, counter.
The way of selection and mode indication depend also on the setting of configuration registers 40085 - Mode1, bridge and 40093+ 40108 - Mode1, symbol xx described in Chapter 2.5.The number format is 16-bit unsigned integer.
For example, when it is set: 40085 – Mode 1, Bridge = 1 dek
40086 – Mode 1, counter =2 dek
40093 – Mode 1, symbol 1= 3dek
40094– Mode 1, symbol 2 = 1dek,
with writing number 0 into reg. 40017,the first mode is selected and the symbol ☾ can be seen in the upper left corner oft he LCD.
with writing number 1 into reg. 40017 the second mode is selected and the symbol ☼ can be seen in the upper left corner of the LCD.

40018 (R,W,M) – Required mode 2:
The selection of required mode 2.
The number of modes is defined by configuration register 40088 - Mode 2, counter.
The way of selection and mode indication depend also on the setting of configuration registers 40087 - Mode 2, bridge and 40109 + 40124 - Mode 2, symbol xx described in Chapter 2.5.
The number format is 16-bit unsigned integer.

40019 (R,W,M) - Required mode 3:
The selection of required mode 3.
The number of modes is defined by the configuration register *40090 - Mode 3, counter*.
The way of selection and mode indication depend also on the setting of configuration registers *40089 - Mode 3, bridge* and *40125 + 40140 - Mode 3*, symbol xx described in Chapter 2.5.
The number format is 16-bit unsigned integer.

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 open = 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.

40025 (R,W, M) – depends on the setting of Mode x, bridge) – **Symbol at position 1**:
It defines what symbol will be displayed on LCD in zone A on the left. The symbols used are shown in Table 1.
The number format is 16-bit unsigned integer. For example, when the number 6 is set, the symbol of opened window is displayed as the information from the control system that the relevant sensor has detected the window opening.
Provided this position on LCD is occupied by linking to one of the modes (Mode x, bridge = 1), the symbol at this position cannot be changed on the line by rewriting these registers, but only by changing the mode.

40026 (R,W, M) - depends on the setting of Mode x, bridge) - **Symbol at position 2:**
It defines what symbol will be displayed in zone A, in the middle. The symbols used are shown in Table 1.
The number format is 16-bit unsigned integer.
Provided this position on LCD is occupied by linking to one of modes (Mode x, bridge = 1), the symbol at this position cannot be changed on the line by rewriting of this registers, but only by changing the mode.

40027 (R,W, M) - depends on the setting of Mode x, bridge) - **Symbol at position 3:**
It defines what symbol will be displayed in zone A, on the right. The symbols used are shown in Table 1.
The number format is 16-bit unsigned integer.
Provided this position on LCD is occupied by linking to one of modes (Mode x, bridge = 1), the symbol at this position cannot be changed on the line by rewriting of this registers, but only by changing the mode.

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.**

2.4 Description of user registers:
It is done to FLASH after writing of 0xC002 (49154 dek) to 40029 – the Register Status

				Modbus register [dek]
	Fast select UP	Fast select DOWN	-	29 – 32
-	LCD backlight	-	LCD time	33 – 36
LCD value color	LCD symbol color	-	Bit_Field	37 – 40

40030 (R,W,M) – Fast select UP:
It defines the fast select of the middle button. The number format is 16-bit unsigned integer.
It can acquire 6 statuses:
10 dek = no fast select is chosen for the button
19 dek = the fast select of required temperature is chosen for the button, the symbol **T** is displayed at this button
20 dek = the fast select of required humidity is chosen for the button, the symbol **H** is displayed at this button
21 dek = the fast select of required mode 1 is chosen for the button, the symbol **M1** is displayed at this button
22 dek = the fast select of required mode 2 is chosen for the button, the symbol **M2** is displayed at this button
23 dek = the fast select of required mode 3 is chosen for the button, the symbol **M3** is displayed at this button

40031 (R,W,M) – Fast select DOWN:
It defines the fast select of the lower button. The number format is 16-bit unsigned integer.
It can acquire 6 statuses:
10 dek = no fast select is chosen for the button
19 dek = the fast select of required temperature is chosen for the button, the symbol **T** is displayed at this button
20 dek = the fast select of required humidity is chosen for the button, the symbol **H** is displayed at this button
21 dek = the fast select of required mode 1 is chosen for the button, the symbol **M1** is displayed at this button
22 dek = the fast select of required mode 2 is chosen for the button, the symbol **M2** is displayed at this button
23 dek = the fast select of required mode 3 is chosen for the button, the symbol **M3** is displayed at this button

40034 (R,W,M) - LCD contrast:
The setting of LCD contrast with inactive display (saving mode) ** (see the chapter 1.3).
The number format is 16-bit unsigned integer, the range of setting in the line is 0 dek ÷ 100 dek = 0 ÷ 100% on the display.

40036 (R,W,M) - LCD time:
The setting of active display time after which LCD gets switched to the saving mode in case of no action with buttons. The number format is 16-bit unsigned integer, the range of setting in the line is 5 dek ÷ 60 dek = 5 ÷ 60s on the display.

40037 (R,W,M) - LCD value colour:
The colour setting of temperature and humidity displaying. The range is 4 bits per each quantity.
bit 0 ÷ 3 = temperature
bit 4 ÷ 7 = humidity
bit 8 ÷ 11 = concentration of CO2
The available colours are shown in Table 3.

40038 (R,W,M) - LCD symbol colour:
The colour setting of symbol displaying. The range is 4 bits per each position.
bit 0 ÷ 3 = symbol on the left
bit 4 ÷ 7 = symbol in the middle
bit 8 ÷ 11 = symbol on the right
The available colours are shown in Table 3.

40040 (R,W) - Bit_Field:
The field of bit variables.
bit 0: 0 = The menu is accessible from the device keyboard.
1 = The menu is not accessible from the device keyboard (for example for hotels, schools...)
bit 1: 0 = The buttons are active immediately after the first press.
1 = The first press of any button will fully illuminate the display, only the next press will execute the given function.
bit 2: 0 = The display shows the currently measured temperature value from the sensor (reg. 40001).
1 = The display shows the value from register 40007.
bit 3: 0 = The display shows the currently measured RH value from the sensor (reg. 40002).
1 = The display shows the value from register 40008.
bit 8 ÷ 11 color of the upper line (T) according to tab. 3 if bit 2 = 1
bit 12 ÷ 15 color of the bottom line (RH) according to tab. 3 if bit 3 = 1

For example, if the request is to display the internal and external temperature alternately, the temperature value of the external sensor is sent from the RS to register 40007 and changing bit 2 to value 1 displays the temperature of the external sensor, changing bit 2 to value 0 displays the temperature of the internal sensor (from register 40001).

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	Digital output TOP	Digital output PRESC	49 – 52
Required temp. Lower limit	Required temp. Upper limit	Required humidity Lower limit	Required humidity Upper limit	53 – 56
				57- 60
		Required CO2 Lower limit	Required CO2 Upper limit	61 – 64
CO2 Lower limit	CO2 Upper limit			65 – 68
Required temp. Format	Required humidity Format			69 – 72
				73 – 76
Measured temp., Offset	Measured hum., Offset			77- 80
				81 – 84
Mode 1, Bridge	Mode 1, counter	Mode 2, Bridge	Mode 2, counter	85 – 88
Mode 3, Bridge	Mode 3, counter			89 – 92
Mode 1, symbol 1	Mode 1, symbol 2	Mode 1, symbol 3	Mode 1, symbol 4	93 – 96
Mode 1, symbol 5	Mode 1, symbol 6	Mode 1, symbol 7	Mode 1, symbol 8	97- 100
Mode 1, symbol 9	Mode 1, symbol 10	Mode 1, symbol 11	Mode 1, symbol 12	101 – 104
Mode 1, symbol 13	Mode 1, symbol 14	Mode 1, symbol 15	Mode 1, symbol 16	105 – 108
Mode 2, symbol 1	Mode 2, symbol 2	Mode 2, symbol 3	Mode 2, symbol 4	109 - 112
Mode 2, symbol 5	Mode 2, symbol 6	Mode 2, symbol 7	Mode 2, symbol 8	113 - 116
Mode 2, symbol 9	Mode 2, symbol 10	Mode 2, symbol 11	Mode 2, symbol 12	117- 120
Mode 2, symbol 13	Mode 2, symbol 14	Mode 2, symbol 15	Mode 2, symbol 16	121 - 124
Mode 3, symbol 1	Mode 3, symbol 2	Mode 3, symbol 3	Mode 3, symbol 4	125 - 128
Mode 3, symbol 5	Mode 3, symbol 6	Mode 3, symbol 7	Mode 3, symbol 8	129 - 132
Mode 3, symbol 9	Mode 3, symbol 10	Mode 3, symbol 11	Mode 3, symbol 12	133 - 136
Mode 3, symbol 13	Mode 3, symbol 14	Mode 3, symbol 15	Mode 3, symbol 16	137- 140

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.

MSB: parity

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

value (dek)	0	1	2
parity	none	odd	even

Example: 0x0004 = 19200Bd, without parity
0x0203 = 9600Bd, even 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 = 0,25μs.

40053 (R,WP) – Required temperature, lower limit:
Setting the lower limit of temperature correction setting by buttons.
The value is in form of °C in form of 16 bit number with a sign (signed integer) multiplied by the constant 10.
For example, with setting of this register at -50 and register 40054 – Required temperature, upper limit at 50 the range ofsetting by keys will be +/- 5,0°C and the value will be seen as the required temperature correction.
In case of setting of this register for example at 100 and register 40054 – Required temperature, upper limit at 300, the range of setting by keys will be 10 - 30,0 °C and the value will be seen as the required temperature.

40054 (R,WP) – Required temperature, upper limit:
Setting the upper limit of temperature correction using buttons.
The value is in °C in the form of 16 bit number with a sign (signed integer) multiplied by the constant 10.

40055 (R,WP) – Required humidity, lower limit:
Setting the lower limit of required humidity using buttons.
The value is in % in the form of 16 bit unsigned integer, the range is 0 ÷ 100 dek.
For example, with setting of this register at 20 and register 40056 – Required humidity, upper limit at 80 corresponds with the range set by the device keyboard at 20 ÷ 80%.

40056 (R,WP) - Required humidity, upper limit:
Setting the upper limit of required humidity using buttons.
The value is in % in the form of 16 bit unsigned integer, the range is 0 ÷ 100 dek.

40063 (R,WP) – Required CO2, lower limit:
Setting the upper limit of required concentration CO2 using buttons.
The value is in ppm in the form of 16 bit unsigned integer, range 0 ÷ 2000 dek.

40064 (R,WP) – Required CO2, upper limit:
Setting the upper limit of required concentration CO2 using buttons.
The value is in ppm in the form of 16 bit unsigned integer, range 0 ÷ 2000 dek.

40065 (R,WP) – CO2 level indication, lower limit:
Up to this value, the CO2 level indication on the LCD will be green.
The value is in ppm in the form of 16 bit unsigned integer, range 0 ÷ 2000 dek.

40066 (R,WP) – CO2 level indication, upper limit:
From this value, the CO2 level indication on the LCD will be red. When the measured CO2 concentration values are between these limits, the "CO2 level indication“ on the LCD will light up in yellow.
The value is in ppm in the form of 16 bit unsigned integer, range 0 ÷ 2000 dek.

40069 (R,WP) – Required temperature, format:
Displaying the description of the set value and bar graph in the screen of temperature setting (from the menu).

Bit 1	Bit 0	define the displayed bar graph:
0	0	no bar graph
0	1	relative bar graph (two triangles connected by a closed angle in the middle)
1	0	absolute bar graph (increasing triangle)
1	1	constant bar graph (rectangle)

Bit.10 defines the descriptive text:
0 temperature correction
1 required temperature

Thus, when it is written to register 40069:
1 dek = description: correction, temperature, bar graph:
(for setting relative required value)
1026 dek = description: required temperature, bar graph:
(for setting absolute required value)

40070 (R,WP) – Required humidity, format:
Displaying the description of the set value and bar graph in the screen of humidity setting (from the menu).

Bit 1	Bit 0	define the displayed bar graph:
0	0	no bar graph
0	1	relative bar graph (two triangles connected by a closed angle in the middle)
1	0	absolute bar graph (increasing triangle)
1	1	constant bar graph (rectangle)

40074 (R,WP) – Required CO_2, format
Bar graph display in the settings screen CO_2

Bit.1	Bit.0	define the displayed bar graph:
0	0	no bar graph
0	1	relativní bar graf (two triangles connected by a closed angle in the middle)
1	0	absolute bar graph (increasing triangle)
1	1	constant bar graph (rectangle)

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 CO_2, Offset:
Setting the measured CO_2 offset.
The value is in ppm in form of 16 bit number with a sign (signed integer).

40085 (R,WP) - Mode 1, Bridge:
The setting of connection of mode selection by buttons with LCD. The number format is 16 bit unsigned integer.
It can acquire only 4 statuses:

0 dek = Mode 1 is not linked to any position in LCD. The mode change is possible from the superior system through the line or in the device menu, when the mode change is shown only in the line by changing the value in register 40017 – Required mode 1 and only the superior system decides whether the chosen mode will be accepted and confirmed by displaying a suitable symbol in one of the free positions by registration in register 40025 ÷ 40027 – Symbol at position x

1 dek = The change of mode by buttons is shown in the line by the change of value in register 40017 – Required mode 1 and at the same time the relevant symbol (set in registers 40093 ÷ 40108 – Mode 1, symbol xx) is displayed in LCD in zone A on the left, the numeric value of this symbol is written in register 40025 - Symbol at position 1

2 dek= The change of mode by buttons is shown in the line by the change of value in register 40017 – Required mode 1 and at the same time the relevant symbol (set in registers 40093 ÷ 40108 – Mode 1, symbol xx) is displayed in LCD in zone A in the middle, the numeric value of this symbol is written in register 40026 - Symbol at position 2

3 dek = The change of mode by buttons is shown in the line by the change of value in register 40017 – Required mode 1 and at the same time the relevant symbol (set in registers 40093 ÷ 40108 – Mode 1, symbol xx) is displayed in LCD in zone A on the right, the numeric value of this symbol is written in register 40027 - Symbol at position 3

40086 (R,WP) - Mode 1, Counter:
It sets the number of modes. The number format is 16 bit unsigned integer, the range is 0 ÷ 16 dek. For example, when number 6 is set, six modes will be switched; if 0 is set, mode 1 will not be accessible in the device menu at all.

40087 (R,WP) - Mode 2, Bridge:
It sets the interconnection of mode selection by buttons with LCD. The number format is 16 bit unsigned integer.
It can acquire only 4 statuses:

0 dek = Mode 2 is not linked to any position in LCD. The mode change is possible from the superior system through the line or in the device menu, when the mode change is shown only in the line by changing the value in register 40018 – Required mode 2 and only the superior system decides whether the chosen mode will be accepted and possible confirmed by displaying of suitable symbol in one of free positions by the registration in registers 40025 ÷ 40027 – Symbol at position x

1 dek = The change of mode by buttons is shown in the line by the change of value in register 40018 – Required mode 2 and at the same time the relevant symbol (set in registers 40109 ÷ 40124 – Mode 2, symbol xx) is displayed in LCD in zone A on the left, the numeric value of this symbol is written in register 40025 - Symbol at position 1

2 dek = The change of mode by buttons is shown in the line by the change of value in register 40018 – Required mode 2 and at the same time the relevant symbol (set in registers 40109 ÷ 40124 – Mode 2, symbol xx) is displayed in LCD in zone A in the middle, the numeric value of this symbol is written into the register 40026 - Symbol at position 2

3 dek = The change of mode by buttons is shown in the line by the change of value in register 40018 – Required mode 2 and at the same time the relevant symbol (set in registers 40109 ÷ 40124 – Mode 2, symbol xx) is displayed in LCD in zone A on the right, the numeric value of this symbol is written in register 40027 – Symbol at position 3

40088 (R,WP) - Mode 2, Counter:
It sets the number of modes. The number format is 16 bit unsigned integer, the range is 0 ÷ 16 dek. For example, when the number 6 is set, six modes will be switched; if 0 is set, mode 2 will not be accessible in the device menu at all.

40089 (R,WP) - Mode 3, Bridge:
The setting of connection of mode selection by buttons with LCD. The number format is 16 bit unsigned integer.
It can acquire only 4 statuses:

0 dek = Mode 3 is not linked to any position in LCD. The mode change is possible from the superior system through the line or in the device menu, when the mode change is shown only in the line by changing the value in register 40019 – Required mode 3 and only the superior system decides whether the chosen mode will be accepted and confirmed by displaying a suitable symbol in one of the free positions by the registration in registers 40025 ÷ 40027 – Symbol at position x

1 dek = The change of mode by buttons is shown in the line by the change of value in register 40019 – Required mode 3 and at the same time the relevant symbol (set in registers 40125 ÷ 40140 – Mode 3, symbol xx) is displayed in LCD in zone A on the left, the numeric value of this symbol is written in register 40025 - Symbol at position 1

2 dek = The change of mode by buttons is shown in the line by the change of value in register 40019 – Required mode 3 and at the same time the relevant symbol (set in registers 40125 ÷ 40140 – Mode 3, symbol xx) is displayed in LCD in zone A in the middle, the numeric value of this symbol is written in register 40026 - Symbol at position 2

3 dek = The change of mode by buttons is shown in the line by the change of value in register 40019 – Required mode 3 and at the same time the relevant symbol (set in registers 40125 ÷ 40140 – Mode 3, symbol xx) is displayed in LCD in zone A on the right, the numeric value of this symbol is written in register 40027 - Symbol at position 3

40090 (R,WP) – Mode 3, Counter:
It sets the number of modes. The number format is 16 bit unsigned integer, the range is 0 ÷ 16 dek. For example, when number 6 is set, six modes will be switched; if 0 is set, mode 3 will not be accessible in the device menu at all.

40093 ÷ 40108 (R,WP) – Mode 1, symbol 1 ÷ 16 :
It sets the symbol of specific mode displaying. The number format is 16 bit unsigned integer. The summary of available symbols is in Table 1. If 2 is set in 40086 – Mode 1, Counter, i.e. the switching among 3 modes is set, the numbers according to Table 1 shall be set in first 3 registers 40093, 40094, 40095 so that they correspond to the required displaying.

40109 ÷ 40124 (R,WP) – Mode 1, symbol 1 ÷ 16 :
It sets the symbol of specific mode displaying. The number format is 16 bit unsigned integer. The summary of available symbols is in Table 1.

40125 ÷ 40140(R,WP) – Mode 1, symbol 1 ÷ 16:
It sets the symbol of specific mode displaying. The number format is 16 bit unsigned integer. The summary of available symbols is in Table 1.

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.

2.7 Example of mode configuration:

I need to use the mode 1 for switching of day and night mode, I need that the indication of selected mode is immediately shown on LCD upwards on the left by symbols  and  :

40085 - Mode 1, Bridge = 1 dek
40086 - Mode 1, Counter = 2 dek
40093 - Mode 1, symbol 1 = 3 dek
40094 - Mode 1, symbol 2 = 1 dek

I need to use mode 2 for switching of turns of fan coil ventilator in the range
OFF - 1 - 2 - 3 - 4 - AUTOMATIC,
I need that the indication of selected mode is immediately shown on LCD upwards in the middle by symbols

40087 - Mode 2, Bridge = 2 dek
40088 - Mode 2, Counter = 6 dek
40109 - Mode 2, symbol 1 = 33 dek
40110 - Mode 2, symbol 2 = 34 dek
40111 - Mode 2, symbol 3 = 35 dek
40112 - Mode 2, symbol 4 = 36 dek
40113 - Mode 2, symbol 5 = 37 dek
40114 - Mode 2, symbol 6 = 39 dek

I do not want to use mode 3 and I want to use the free position upwards in the right for the indication of switched heating on with the symbol  of written value 58 dek into register 40027 - Symbol at position 3:

40089 - Mode 3, Bridge = 0 dek
40090 - Mode 3, Counter = 0 dek
40125 - Mode 3, symbol 1 = 0 dek

The example of special mode setting when mode 1 is not linked to any position in LCD and at the same time it is possible to change mode 1 from the device menu.

Menu → Mode → Mode 1 → ☾ → ☼
and to send the information on this change through the line into the control system (this one decides whether to accept the change and to confirm it by indication of related symbol in some of free positions by writing in registers 40025 ÷ 40027 - Symbol at position x:

40085 - Mode 1, Bridge = 0 dek
40086 - Mode 1, Counter = 2 dek
40093 - Mode 1, symbol 1 = 3 dek
40094 - Mode 1, symbol 2 = 1 dek

2.8 Examples of communication:

Command 03 (0x03): Read Holding Registers:
Master:
02 03 00 00 00 02 Crc Crc
└ └ └ └ └ └ Number of read registers (2 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 02 92 Crc Crc
└ └ └ └ └ └ └ └ └ └ └ └ └ └ Data from 6 registers
└ └ └ Number of bytes (12)
└ └ Command (Read Holding Registers)
└ Address of device (device with address 2)

The address of initial register is 0x0001** , the number of read registers is 6. Thus: the measured temperature 0x00FF = 25,5° C, measured air relative humidity 0x0164 = 35,6% RH, neasured CO2 ...0x0292 = 658ppm

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.

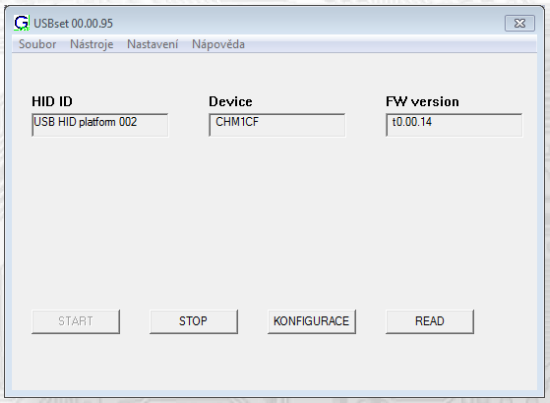
Command 06 (0x06) Write Single Register:
Master:
FF 06 00 1C C0 03 Crc Crc
└ └ └ └ └ └ Registered data (0xC003 = 49155dek)
└ └ └ └ Address of registered register (0x001D**)
└ └ Command (Write Single Register)
└ Address of device (with inserted jumper J6 - address 255)
Slave:
FF 06 00 1C C0 03 Crc Crc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

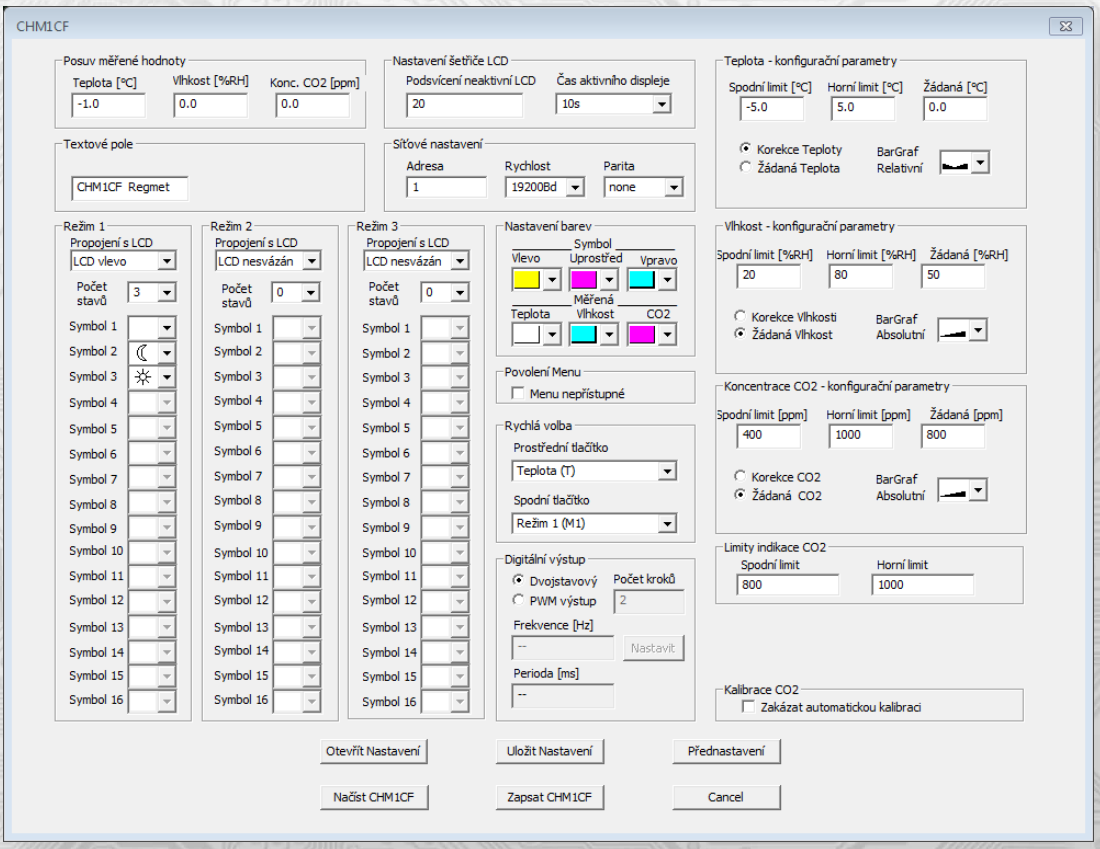
** During the transfer the addresses of registers are indexed from zero, i.e. register 0x0001 is physically sent through the bus bar as 0x0000... (zero based addressing).

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 the hosting PC.



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



With clicking on the button “Load CHM1CF" the configuration values from the flash memory of sensor are read.

3.2 Description of configuration values CHM1CF (in parenthesis the relevant register for possible setting of controller using other software then USBset is stated – see Table 2):

Correction of the measured temperature:
- 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 -2.5 (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.

- concentration CO2 (40082): Setting of measured CO2 offset.

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

Setting of LCD saver:
Inactive LCD backlight (40034): used to set the LCD backlight when the display is inactive (saving mode) in the range 0 ÷ 100% (see chap. 1.2).

Time of active display (40036): The setting of active display time, after which the LCD without activity on the touch panel switches to power sawing mode.

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.
- parite (40050):
Parity setting: none: no parity,
odd: odd parity,
even: even parity

Temperature – configuration parameters:
Lower limit (40053): setting of lower limit of setting for temperature correction by touch panel
For example, with setting of -5,0 and the upper limit of temperature correction set at 5,0 the range of setting will be +/- 5,0° C and the value will be seen as the required temperature correction.
With setting of 10,0 and the upper limit of temperature correction set at 30,0 the range of setting will be up to 10 to 30°C and the value will be seen as the required temperature.

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

Requested (40009): The required value of temperature correction. The limits of range for setting are limited Lower/Upper limit of temperature correction.

Temperature correction/Required temperature, BarGraph (40069): bargraph type setting.

Humidity – configuration parameters:
Lower limit (40055): setting of lower limit of setting of required humidity.
For example with setting 20 and the upper limit of required air humidity at 80 the range of setting from the device keyboard will be 20 ÷ 80 %.

Upper limit (40056): setting of upper limit of setting of required humidity.

Requested (40010): The required value of relative air humidity correction. The limits of the range for setting are limited by setting of lower/upper limit of required air humidity.

Correction of humidity/Required humidity, BarGraph (40070): bargraph type setting.

Concentration CO2 - configuration parameters:
Lower limit (40063): setting of lower limit of setting of required CO2
For example with setting 400 a Upper limit of required concentration CO2 to 2000 will be the setting range from the touch panel of the device 400 ÷ 2000 ppm.

Upper limit(40064): setting of upper limit of setting of required CO2

Required value (40014): Require value for CO2 concentration correction. The limits of the setting range are defined by setting the Lower/Upper limit of the required CO2 concentration.

Correction of CO2/Required CO2, BarGraph (40074): bargraph type setting: Descriptive text when setting CO2 concentration correction and bargraph type selection.

CO2 indication limits:
Lower limit (40065): Up to this value, the "CO2 level indication" on the LCD will be green.

Upper limit (40066): From this value, the "CO2 level indication" on the LCD will be red. When the measured CO2 concentration values are between these limits, the "CO2 level indication" on the LCD will light up in yellow.

CO2 calibration:
Option to turn off automatic calibration (AC mode) in case the device is placed in an environment where regular exposure of the CO2 sensor to a concentration of 400ppm is not guaranteed (regular room ventilation). If automatic calibration is disabled, it is recommended to carry out regular manual calibration with the device manufacturer.

Mode x:
Connected to LCD (40085, 40087,40089,40091): Setting of connection of mode selection on touch panel with the symbol displaying for relevant mode at the specific position in LCD.

E.g. when "LCD symbol x" is entered, the mode change with the buttons is reflected on the line by changing the value in the given register and at the same time the corresponding symbol (set below) is displayed on the LCD.
When "LCD not bound" is entered, the mode will not be bound to the position on the LCD. Changing the mode is only possible from the superior system via the line or via the device menu, when the mode change is only reflected on the line by changing the value in the given register and the superior system only decides whether it accepts the selected mode and, if necessary, confirms it by displaying the appropriate symbol on the LCD.

Number of statuses (40086, 40088,40090): Setting of number of modes that will be available for switching. For example with setting of the number 6, it will be possible to switch among six modes, with setting of 0, the mode will not be available in the device menu at all.

Symbol x (40093÷40140): It sets the symbol of specific mode displaying.
For example, if we wish to use this mode for switching between the day and night mode, then we choose in “Symbol 1” the noon as the night mode symbol, and the symbol of sun in the “Symbol 2”.

Colour setting (40037, 40038):
The required colour is separately chosen for every position in LCD, it can be set by buttons in the device menu.

Enable Menu:
Menu inaccessible (40040): Check to make the menu inaccessible, e.g. for hotels, schools...

Fast select:
Middle button (40030): Defines a quick dial for the given button.

Bottom button (40031): Defines a quick dial for the given button.

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.

After 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.

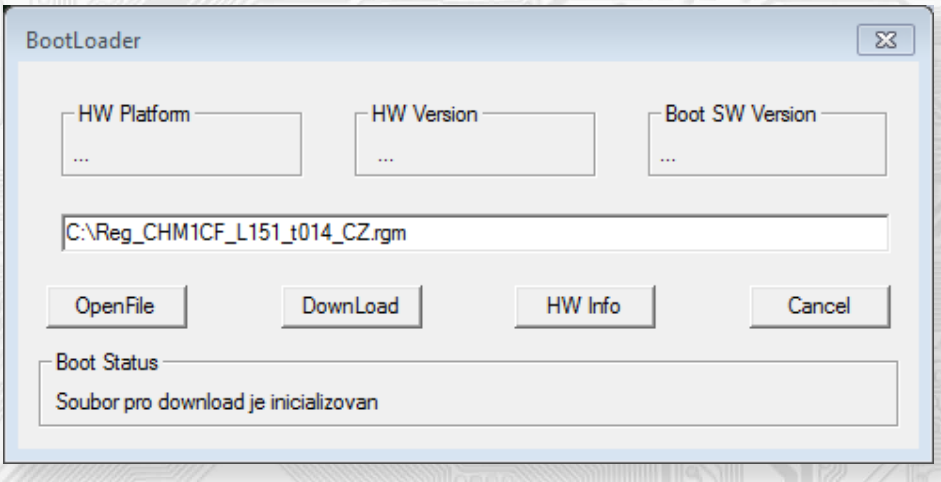
After setting of required values and quantities the new configuration values are saved in the flash memory of the device by clicking on the button „ Write CHM1CF“.
The writing into the flash memory is conditioned by insertion of jumper J6 (authorisation for configuration values recording) before the 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.

Table of symbols (tab. 1):

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109
110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129
130	131	132	133	134	135	136	137	138	139
140	141	142	143	144	145	146	147	148	149
150	151	152	153	154	155	156	157	158	159

Content of Modbus Holding Registers (tab. 2):

Operational registers:

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

				Modbus register [dek]
Measured temperature	Measured humidity	-	-	1 - 4
-	Measured CO2	-	-	5 - 8
Required temperature	Required humidity	-	-	9 - 12
-	Required CO2	-	-	13 - 16
Required mode 1	Required mode 2	Required mode 3	-	17 - 20
Digital input (DI)	-	-	Digital output (DO)	21 - 24
Symbol at position 1	Symbol at position 2	Symbol at position 3	-	25 - 28

Status register:

Status register				29

Users registers :

Saving to FLASH is done just after writting 0xC002 (49154 dek) do *40029 - Status register*.

	-	-	-	29 – 32
-	-	LCD backlight day	LCD backlight time	33 – 36
LCD value color	LCD symbol color	LCD backlight night	Bit_Field	37 – 40

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	Digital output TOP	Digital output PRESC	49 - 52
Required temp. Lower limit	Required temp. Upper limit	Required humidity Lower limit	Required humidity Upper limit	53 - 56
LCD backlight night limit	LCD backlight day limit	-	-	57 – 60
-	-	Required CO2 Lower limit	Required CO2 Upper limit	61 – 64
CO2 Lower limit	CO2 Upper limit			65 – 68
Required temp., Format	Required RH, Format	-	-	69 – 72
-	Required CO2, Format	-	-	73 – 76
Measured temp, Offset	Measured RH , Offset	-	-	77 – 80
-	Measured CO2, Offset	-	-	81 – 84
Mode 1, Brigde	Mode 1, counter	Mode 2, Brigde	Mode 2, counter	85 – 88
Mode 3, Brigde	Mode 3, counter	Mode 4, Brigde	Mode 4, counter	89 – 92
Mode 1, symbol 1	Mode 1, symbol 2	Mode 1, symbol 3	Mode 1, symbol 4	93 – 96
Mode 1, symbol 5	Mode 1, symbol 6	Mode 1, symbol 7	Mode 1, symbol 8	97 – 100
Mode 1, symbol 9	Mode 1, symbol 10	Mode 1, symbol 11	Mode 1, symbol 12	101 – 104
Mode 1, symbol 13	Mode 1, symbol 14	Mode 1, symbol 15	Mode 1, symbol 16	105 – 108
Mode 2, symbol 1	Mode 2, symbol 2	Mode 2, symbol 3	Mode 2, symbol 4	109 – 112
Mode 2, symbol 5	Mode 2, symbol 6	Mode 2, symbol 7	Mode 2, symbol 8	113 – 116
Mode 2, symbol 9	Mode 2, symbol 10	Mode 2, symbol 11	Mode 2, symbol 12	117 – 120
Mode 2, symbol 13	Mode 2, symbol 14	Mode 2, symbol 15	Mode 2, symbol 16	121 – 124
Mode 3, symbol 1	Mode 3, symbol 2	Mode 3, symbol 3	Mode 3, symbol 4	125 – 128
Mode 3, symbol 5	Mode 3, symbol 6	Mode 3, symbol 7	Mode 3, symbol 8	129 – 132
Mode 3, symbol 9	Mode 3, symbol 10	Mode 3, symbol 11	Mode 3, symbol 12	133 – 136
Mode 3, symbol 13	Mode 3, symbol 14	Mode 3, symbol 15	Mode 3, symbol 16	137 – 140

Table of colours (Table 3):

Color	Hex	dek
Red	0	0
Green	1	1
Blue	2	2
Yellow	3	3
Magenta	4	4
White	5	5
Cyan	6	6
Dark Green	7	7
Light Blue	8	8
Light Brown	9	9
Orange	A	10
White	B	11
White	C	12
White	D	13
White	E	14
White	F	15

3.3 Protection of overriding configuration registers via the RS485 line with a common communication address without using HW key:

1) Enter 0xCBAA into register 40029 – register status, which deactivates the protection of overriding configuration registers HW.
2) One (function 06) or more registers (function 16) are overridden with a new value, which is saved into the RAM. Once the new value is entered, the protection of overriding configuration registers HW is automatically re-activated and another entry into the protected registers is no longer possible.
3) Enter 0xCBAA into register40029 – register status, which again deactivates the protection of overriding configuration registers HW .
4) Enter 0xC003 into register40029 – register status, which saves the value into the RAM and overwrites it into the FLASH memory device.
Once the new value is entered, the protection of overriding configuration registers HW is automatically re-activated.

3.4 An example of setting the offset of the measured temperature via the RS485 line with a common communication address without using HW key:

Since the device has some kind of its own energy consumption (dependent upon setting the LCD contrast, the load bearing of the line...) and the temperature sensor is part of the controller, the measured temperature is affected by the energy emitted by the device. Once the controller is installed and tempering occurs for at least 1 hour, the difference between the measured and the actual temperatures stabilizes at a constant value and it is possible to compensate this difference by adjusting the measured temperature shift. This can be done via the USB interface programme, USBset (chapter 3.1) or via the RS485 interface by a Modbus command (chapter 2.5). The disadvantage is the necessity to disassemble the device due to the necessity to insert the HW key (jumper J6). This HW protection may be avoided for one entry (chapter 3.3) and it is possible to set the offset without disassembly.
For example, if we find out that the device measures by 2.0°C in a stable status:
1) Enter 0xCBAA into register40029 – register status, which deactivates the protection of overriding configuration registers HW.
2) Function 06 into register40077 – Measured temperature, Offset enters a value of 0xFFEC. The change is seen immediately by displaying the correct value. However, after resetting the device, this change would be lost. Therefore, it is necessary to enter the correction into the flash memory.
3) Enter 0xCBAA into register40029 – register status, which again deactivates the protection of overriding configuration registers HW.
4) Enter 0xC003 into register40029 – register status, which saves the value into the RAM and overrides it into the FLASH memory device and the set offset of the measured temperature remains valid even after resetting the device

3.5 An example of mode change over RS485 line

1) Using funkction 06 is written required value to register 40017 - Required mode 1, 40018- Required mode 2, 40019 -Required mode 3, 40020 -Required mode 4.
   The change is seen immediately on display, it is still necessary to write it into the flash:
2) Enter 0xC001 (49153 dek) into register 40029 - register status, which saves the value in the RAM and overrides in to the Flash memory devices.

The condition is the appropriately chosen parameters of the registers 40085 ÷ 400140.

The same procedure applies to changing registers 40009 - Required temperature, 40010 - Required humidity, 40014 - Required CO2 and 40025 - 27 - Symbol at position 1 ÷ *3*

3.6 Example of displaying a symbol in a different color than the one set in reg. 40038 (LCD symbol color) or in USBset: Setting colors - symbol

For example, in the middle position (reg. 40026) there is a requirement to display the battery charging symbol (95 - see table 1) in red or green depending on the current state.

The lower byte of reg. 40026 determines the displayed symbol (battery charge = 95)
The upper byte of reg. 40026 carries information about the color of the symbol:
If the MSB of the upper byte = 0, then the color from reg. 40038 (LCD symbol color) or from USBset is used for the given symbol: Color settings - symbol
If the MSB of the upper byte = 1 (mask 0x80), then the lower 7 bits of the upper byte are the color code according to table 3.

Assuming that in register 40038 bit 4 ÷ 7 = 0 (red, according to table 3),
with the writing of the value 0x005F (95 dek) (battery charging, according to Table 1) to register 40026 in the middle position, the red symbol of battery charging will be displayed.
By writing the value 0x815F (33119 dek), a green battery charging symbol will appear in the middle position.

In this way, it is possible to display any symbol in any color, e.g. writing the value 0x865F will display the cyan battery charging symbol in the middle position.

Reg. 40029:
0xCBAA = 52138 dek unsigned, -13398 dek signed (deactivation of HW override of configuration registers)
0xCBAB = 52139 dek unsigned, -13397 dek signed (activation of display)
0xC003 = 49155 dek unsigned, -16381 dek signed (writting configuration registers into the FLASH)
0xC002 = 49154 dek unsigned, -16382 dek signed (writting user registers into the FLASH)
0xC001 = 49153 dek unsigned, - 16383 dek signed (writting operational registers into the FLASH)

3.7 Example of displaying a different temperature than from an internal sensor, e.g. temperature measured by an external temperature sensor together with by changing the color of the displayed external temperature.

1) In the register 40007 – User value 1, the temperature value measured by the external sensor is written in the form of a 16-bit number with a sign (signed integer) multiplied by the const. 10, eg 25.1°C = 0x00FB = 251dec.
2) reg. 40040 determines whether the value from int. sensors or the value from reg. 40007, in that case also the color. Thus, if the value of reg. 40040 is in the form 0xKLMN (16-bit hexadecimal, i.e. 4 characters), then "N" is the Bit_ eld as described in chap. 2.4, bit 2 of the lower byte of register 40040 determines whether the value from int. sensor or value from register 40007.
   "M" is unused
   "L" is the color of the upper line (temperature) according to tab. 3
   "K" is the color of the middle row (RH) according to tab. 3

By writing 0x104, the value from register 40007 will be displayed in green (25.1°C green) on the top line.
By changing bit 2 from value 1 to value 0, the value from register 40001 (Measured temperature) will be shown on the display again in the original color selected in register 40037.

A similar procedure applies to displaying another rel value. humidity than from the internal sensor:

1) In register 40008 – User value 2, the RH value measured by the external sensor is written in the form of a 16-bit number with a sign (signed integer) multiplied by the const. 10, eg 35.6% = 0x0164 = 356dec.
2) Writing 0x2008 to register 40040 will display the value from register 40008 in blue (35.6% blue) on the middle line. By changing bit 3 from value 1 to value 0, the value from register 40002 (Measured humidity) will be shown on the display again in the original color selected in register 40037.

Example of connection of controllers in the system