



HOME OF SENSOR TECHNOLOGY

Description of the
RS485 MODBUS Protocol

WRF06 (RC) Modbus
WRF06 LCD (RC) Modbus

Index of Changes

| Revision | Date | Description | Autor |
|----------|------------|---|-------|
| K | 21.05.2014 | Description for BELIMO 6-way valve added (from firmware 2.10 and configuration software 2.5 or higher) | |
| L | 30.03.2016 | Description for device type AOKCO added (from firmware 2.12 and configuration software 2.7 or higher) | |
| M | 20.09.2016 | Description for device type 6WV_INV added (from firmware 2.14 and configuration software 2.8 or higher) | |
| N | 26.01.2017 | Description for device type SAUTER 6WV DN15 and DN20 added (from Firmware 2.15 and configuration software 2.9 or higher) Optional address extension | |
| O | 06.11.2017 | Type AOFV, 6WV: Correction Modbus register assignment of the analog outputs | |
| P | 20.11.2018 | Corrected LED layout | |
| Q | 06.08.2019 | Since firmware 2.17, the WRF06 can be equipped with an optional humidity sensor. Register added to measure relative humidity. | |
| R | 15.08.2019 | Description for firmware 2.18 added (Register 0x37 ... 0x3A). | |
| S | 15.02.2022 | Several corrections / Layout overhaul | JD |
| T | 25.05.2022 | Register 268/269, Section 2.7.7 / 2.7.8 | JD |

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1 WRF06-RS485-Modbus

The present document describes the serial interface of the room operating panel WRF006-RS485-MODBUS.

2 Device Description

2.1 Device types

The WRF06-RS485-Modbus could be delivered in different types.

- Devices without temperaturee controller

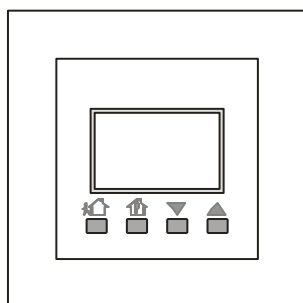
| | |
|------------|--|
| ○ Typ 2V | Output 1 (analogue): Temperature, Output 2 (analogue): Set point |
| ○ Typ 4DI | 4 Inputs (digital) |
| ○ Typ 2VPS | Output 1 (analogue): room occupancy, Output 2 (analogue): Set point |
| ○ TypeVSS | Output 1 (analogue): Set point 2, Output 2 (analogue): Set point 1 |
| ○ Type VNS | Output 1 (analogue): Temperature, Output 2 (analogue): Set point night |

- Devices with temperature controller

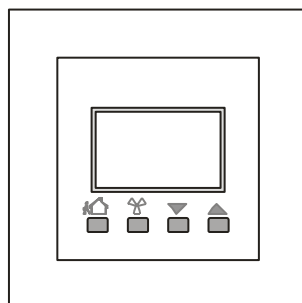
| | |
|-----------------------|--|
| ○ Typ AO2V | Output 1 (<i>analogue</i>): Heating, Output 2 (<i>analogue</i>): Cooling |
| ○ Typ DO2R | Output 1 (<i>digital</i>): Heating, Output 2 (<i>digital</i>): Cooling |
| ○ Typ DO2T | Output 1 (<i>digital</i>): Heating, Output 2 (<i>digital</i>): Cooling |
| ○ Typ OVR | Output 1 (<i>digital</i>): Heating, Output 2 (<i>analogue</i>): Cooling |
| ○ Typ OVT | Output 1 (<i>digital</i>): Heating, Output 2 (<i>analogue</i>): Cooling |
| ○ Typ AOV | Output 2 (<i>analogue</i>): Heating / Cooling, ChangeOver-Operation |
| ○ Typ AOFV | Output 1 (<i>analogue</i>): Fan stage, Output 2 (<i>analogue</i>): Heating / Cooling, ChangeOver-Operation |
| ○ Typ AOK | Output 1 (<i>analogue</i>): Heating 0-3 V Off 3-10 V 0...100% Output 2 (<i>analogue</i>): Cooling 0-3 V Off 3-10 V 0...100% (Kampmann) |
| ○ Typ AOKCO | Output 2 (<i>analogue</i>): Heating / Cooling, ChangeOver-Operation, 0-3 V Aus 3-10 V 0...100% (Kampmann) |
| ○ Typ BELIMO® 6WV | Output 1 (<i>analogue</i>): Fan Stafe, Output 2 (<i>analogue</i>): Cooling 2..4,7V / Heating 7,3..10V BELIMO® 6-way valve |
| ○ Typ BELIMO® 6WV_INV | Output 1 (<i>analogue</i>): Fan stage, Output 2 (<i>analogue</i>): Heating 2..4,7V / Cooling 7,3..10V BELIMO® 6-way valve |
| ○ Typ Sauter 6WV DN15 | Output 1 (<i>analogue</i>): fan stage, Output 2 (<i>analogue</i>): Heating / Cooling SAUTER 6-way valve nominal diameter DN15 |
| ○ Typ Sauter 6WV DN20 | Output 1 (<i>analogue</i>): fan stage, Output 2 (<i>analogue</i>): Heating / Cooling SAUTER 6-way valve nominal diameter DN20 |

2.2 Display-printing

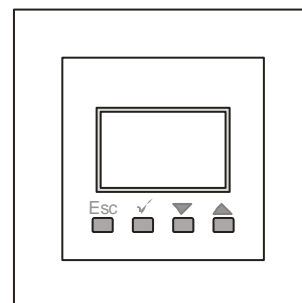
The display of WRF06-RS485-Modbus is in 3 types possible.
(additional printings are of request possible.)



Typ 1
Type 1



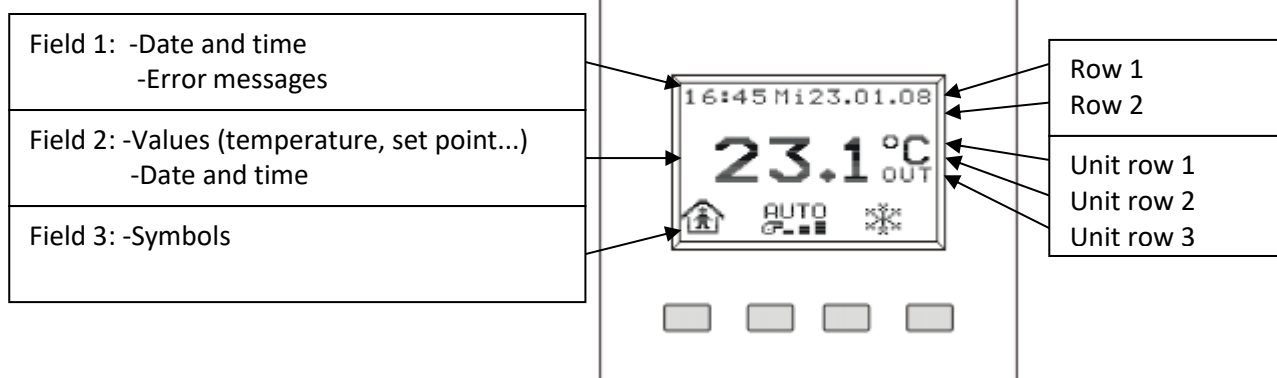
Typ 2
Type 2



Typ 3
Type 3

2.3 LCD-Display

The display is divided into 3 display areas: field 1 in the upper range, field 2 in the middle and field 3 in the bottom range.



The symbols displayed and their functions are as follows:

| | |
|--|----------------------------|
| | Setpointadjustment |
| | Error |
| | Heating |
| | Cooling |
| | Window „open“ |
| | Dewpoint detector „active“ |
| | Occupied (comfort) |
| | Unoccupied (standby) |

| | |
|--|------------------|
| | Fan off |
| | Fan stage 1 |
| | Fan stage 2 |
| | Fan stage 3 |
| | Auto Fan off |
| | Auto Fan stage 1 |
| | Auto Fan stage 2 |
| | Auto Fan stage 3 |

By means of the LCD-display different values can be displayed. As a standard, only the temperature is indicated. The values to be shown in the display can be set via the configuration 0x0000 – 0x000A. The following values can be indicated in the display:

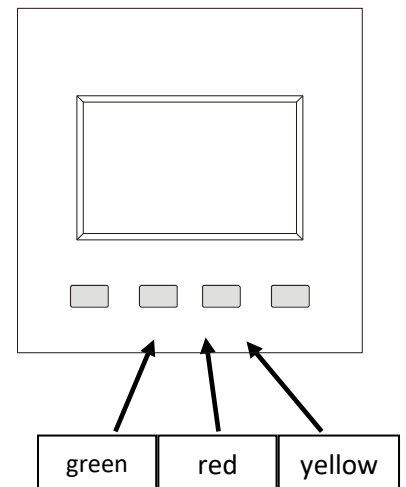
- Temperature
 - Room temperature
 - 2 field programmable text rows in field 11
- 2 Set Points
 - Unit and display are field definable
 - Set point effective and offset
 - Adjustment via operating buttons possible
 - Per value 2 field parameterize able text rows in field 1
- 4 External Measuring Values
 - Unit and display are field definable
 - e.g. for outdoor temperature, pressure, percent value etc.
 - Per value 2 field parameterize able text rows in field 1
- 4 Alarm Messages
 - 2 external values e.g. for time, pressure etc.
 - 2 set points effective and offset
 - Per message 2 field parameterize able text rows in field 1

2.4 Lower Part of Device (base plate): LED Display

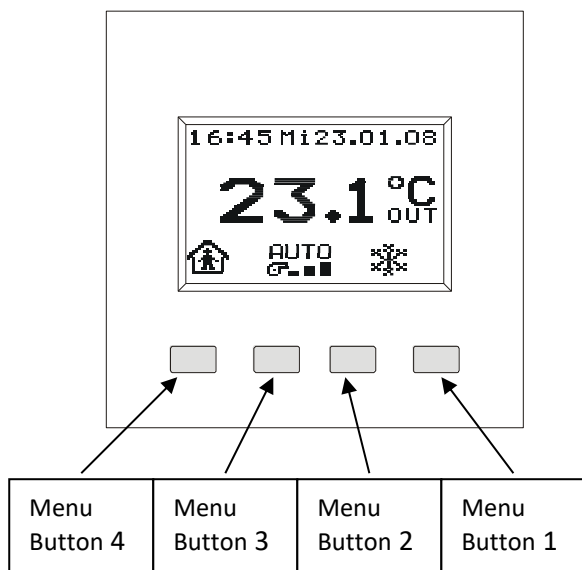
The room operating panel has 3 LEDs for the indication of different status for verifying device functions and bus communication.

- Green LED: Operating voltage
- Yellow LED: Flashes upon receipt of a flawless telegram which was addressed to the device.
- Red LED: Flashes upon receipt of a telegram, which was addressed to another device.
- Yellow + Red LED: Flashes upon receipt of a flawless telegram.

If telegrams are sent from the Master and no LEDs are flashing at the operating unit, the communication properties must be verified.



2.5 Definition Button Numeration



The respective function of the button can be set via the register 0x0006 – 0x0009.
The following button functions are possible:

- Button pushed / not pushed e.g. for light, blinds
 - Output in output registers 257-258
 - Register 257 shows current status of buttons
 - Register 258 saves pushed buttons until readout of register
- Set Point Adjustment
 - Up to two set points can be adjusted
 - When pushing the button, the corresponding set point is indicated in the display
 - Set point 1 can only be used in the mode “room occupied”
- Adjustment of Fan Stages
 - The corresponding fan stage is automatically shown in the display
- Adjustment of Room Occupancy
 - The corresponding room occupancy is shown automatically in the display

2.6 Temperature Calibration Mode

Each temperature sensor is calibrated during production by the manufacturer. Due to the fact, that the temperature measuring with flush-mounting sensors is besides the voltage-dependent self-heating of the electronics also affected by the temperature dynamic of the wall, a recalibration might become necessary in some cases.

For the user the calibration mode offers the possibility to make a supplementary calibration via the operating buttons without needing a service engineer to make these adjustments via the RS485 bus. Also changeable is the basic set point, lower set point adjustment and upper set point, night-lowering and jump distance set point change.

| | |
|-------------------------------------|--|
| Polling of calibration mode: | Parallel actuation of the buttons T1 and T4 for a time exceeding 5s. |
| Chose parameter: | Button T3 or T4 |
| Adjust Temperature: | Button T1 for - 0,1 Button T2 for + 0,1 |

Exit Calibration Mode: No button actuation for a time exceeding 10s.

2.7 Control

2.7.1 Device Types

The control is integrated in the following devices: AO2V, OVR, OVT, DO2R, DO2T, AOV, AOFV, AOK, AOKCO2, 6WV (Belimo/Sauter).

2.7.2 Function Mode of PI-Controller

The integrated PI-controller controls the temperature (register 0x0102) of set point 1 (Register 0x0104). The control variable resulting is directly output to the outputs. The PI-controller can be adjusted by properties. The control variable of the controller is re-calculated approx. every 10 seconds. Thus, changes, such as e.g. adjustment of set point or triggering of window contact are only considered after expiration of the control time.

2.7.3 Change-Over-mode AOV, AOFV, AOKCO

The device could work for 4-pipe-systems and also for 2-pipe-systems (Change-over mode). The device types AOV, AOFV and AOKCO work with change-over mode. By using change-over mode with Holding Register „Controller mode“ (Address 0x215) could the mode of the controller be selected. **Change-over mode work on output 2!**

2.7.4 Energy Stop / Dew Point Detector

If a window contact or a dew point detector are connected to the digital inputs and the digital inputs are parameterized as the same, both are directly affecting the control.

2.7.5 Override of Controller

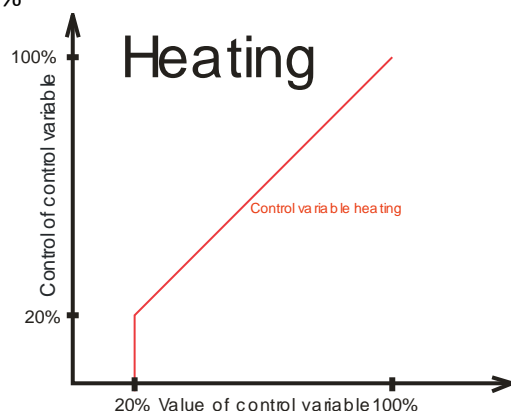
Register 534 can be used to override controller mode.

2.7.6 Minimal Control Variable

By means of the property “Use minimal control variable with control variable = 0“(Coil-Bit 28 = 0) the minimal control variable is only used, if the control variable is > 0. If Coil-Bit 28 is =1, the minimal control variable is also used if the control variable is = 0.

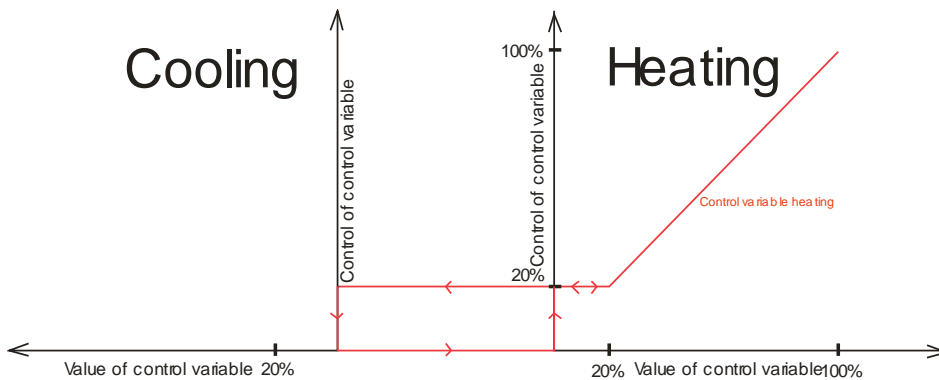
Chose mode control variable (**Register 0x001B**)

- (1) Chose mode control variable = 1
Ymin = 20%



The control variable is only sent to the output if the calculated value of the control variable is bigger than the minimal control variable.

- (2) Chose mode control variable = 0
 Ymin = 20%



The minimal control variable at the output remains unchanged until the controller changes the operating mode

2.7.7 Controller mode

During device startup the configured controller mode (register 44) and a set point

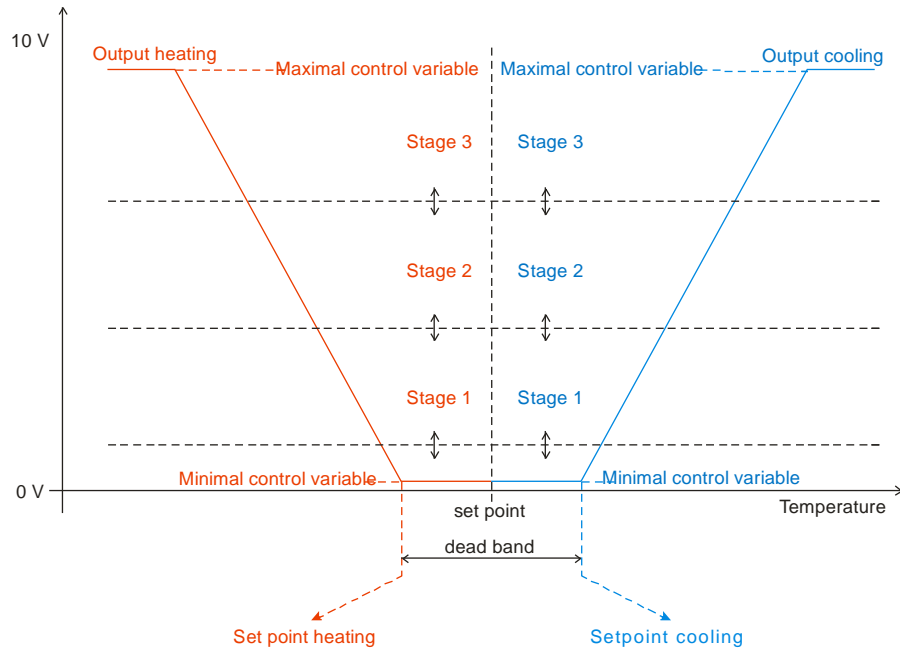
2.7.8 Display of set point

The controller uses set point 1 as control set point (Register 0x0104). After reset the controller uses the set point which was set in register 44. There are 2 possibilities for displaying the set point:

- Basic set point + adjustment
 - Heating mode: Set point = Basic set point + manual adjustment
 - Cooling mode: Set point = Basic set point + manual adjustment
- Real control variable – set point is shown which is used by the controller
 - Heating mode: Set point = Basic set point – dead band / 2 + manual adjustment
 - Cooling mode: Set point = Basic set point + dead band / 2 + manual adjustment

2.7.9 Fan speed AOFV, 6WV

The device type AOFV and 6WV can control a fan coil or a valve. The fan stages are parameterize able. The output of the fan speed is on analogue output AO1.



2.7.10 Manual mode / automatic mode

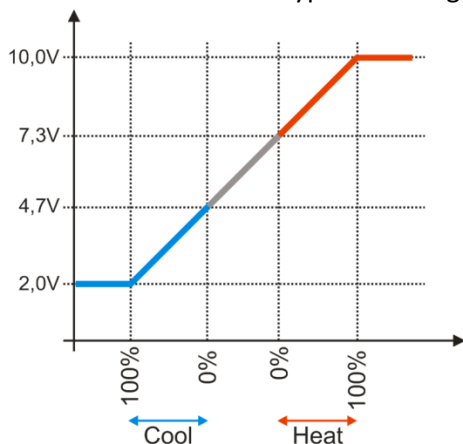
The analogue outputs could be set from a DDC via register 0x0216 and 0x0217. To remove the manual mode set register 0x0216 respectively 0x0217 to -1 / 0xFFFF.

2.7.11 Symbol fade-in/-out

Symbols Heating, Cooling and OFF can be faded-in and out. Internal controller has to be disabled. In combination with the manual mode the device can be used as a simple IO-device with.

2.7.12 Type 6WV for BELIMO 6-Way Valve

If device type BELIMO® 6-way valve is enabled, output AO2 is used as control variable output for 6-way valve. Control variable is calculated by integrated PI controller and the output voltage is adapted according to characteristic curve of used device type. Choosing type `_INV` inverts sequences for heating and cooling.



Type: 6WV

100...0% cooling \Rightarrow 2,0...4,7V

0...100% heating \Rightarrow 7,3...10,0V

Type: 6WV_INV

heating cooling sequences inverted

Note:

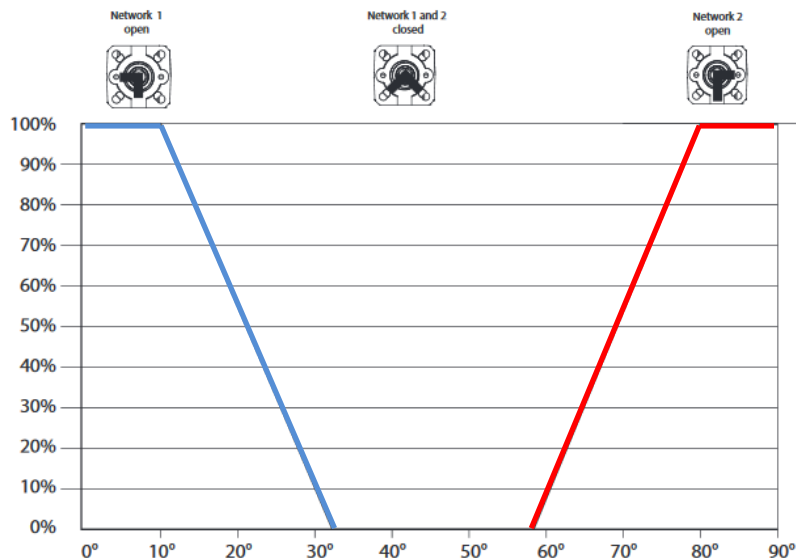
Since firmware 2.18, the voltage levels can be modified via the registers 0x37 to 0x3A.

2.7.13 Function 6WV for SAUTER 6-way valves DN15 und DN20

If device type SAUTER 6-way valves is enabled, output AO2 is used as control variable output for 6-way valve. Control variable is calculated by integrated PI controller and the output voltage is adapted according to characteristic curve of used device type. Please see SAUTER datasheet 58.001, B2KL: 6-way-ball valve with male thread, PN16). Additionally the control variable is output on AO1 adapted to settings in registers 45-50.

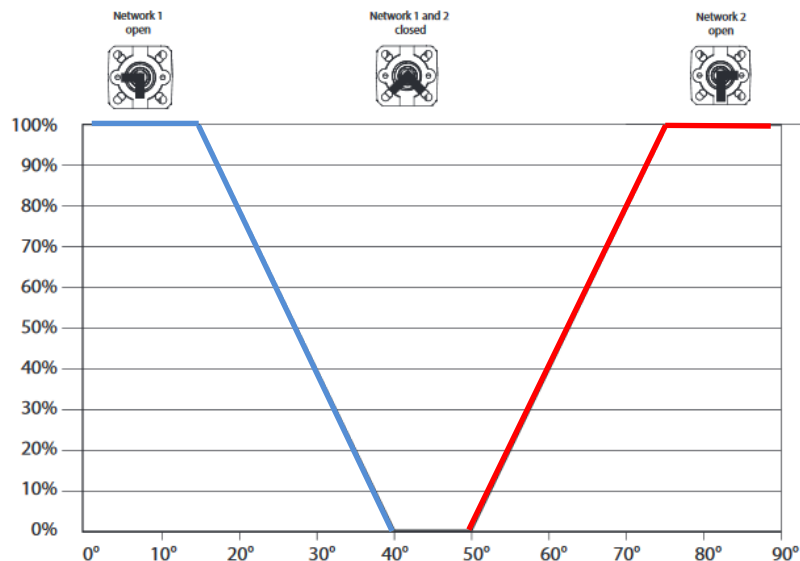
Note: The 6WV-function is only available on device type AO2V.

Circuit B2KL015F400



Picture 1 Characteristic curve of DN15 valve (extract from SAUTER datasheet 58.001e)

Circuit B2KL020F400



Picture 2 Characteristic curve of DN20 valve (extract from SAUTER datasheet 58.001e)

2.8 Communication failure monitoring

The device monitors Modbus communication. In case of a 90s communication failure the outputs are set to default values, which can be configured in registers 45 and 46.

Setting -1 (=0xFFFF) as default value, the outputs keep their last values (manual mode) respectively the controller triggers them (automatic mode).

2.9 Hardware Installation

The room operating panel can be connected by means of a twisted-pair cable (line resistance 120 Ohm). For detailed information on installation and mounting, please see the product data sheet WRF06-RS485-Modbus and the data sheet wiring_rs485_network.pdf.

2.10 RS485 Transceiver

The maximum number of bus participants without use of a repeater is preset by the RS485-transceiver. The transceiver used enables 32 devices per bus segment at maximum.

2.11 Protocol

The room operating panel WRF06-RS485-Modbus is a slave-bus participant only allowed to send to the bus on demand of the master. The protocol corresponds to the defaults of:

- MODBUS Application Protocol Specification V1.1
- MODBUS via Serial Line Specification & Implementation guide V1.0

2.12 Configuration Options

2.12.1 Device addressing

In addition to address setting via dip switch (1-32) an option for address extension (1-247) is implemented. To use extended addressing write a valid address (1-247) to register 16386 (data address 0x4001) and set dip switch to address 0! As long as an dip switch address > 0 is set, the device uses the dip switch address as network address.

To modify register 16386 (data address 0x4001) following sequence must be strictly adhered:

Set valid dip switch address (1-31). Use Modbus command 'Write multiple registers'(FC16) and write value 0x4793 to register 16385 (data address 0x4000) and the selected address to register 16386 (data address 0x4001) in one sequence. Subsequently set dip switch address to 0. Device uses the extended address setting as network address.

As long as the dip switch address is set to 0 it's not possible to modify the extended address!!!

5pole DIP switch:

- Bus address of device (1 - 31) via 5 pole DIP switch; DIP switch: 1-5 = 6pole DIP switch:

2.12.2 Interface parameters

6pole DIP switch

- Transmitting mode
 - DIP 1 off: RTU
 - DIP 1 on: ASCII
- Baud rate
 - DIP 2 off + DIP 3 off: 9600
 - DIP 2 on + DIP 3 off: 19200
 - DIP 2 off + DIP 3 on: 57600
- Parity
 - DIP 4 off + DIP 5 off: non
 - DIP 4 on + DIP 5 off: even
 - DIP 4 off + DIP 5 on: uneven
- Bus terminating resistor 120 Ohm
 - DIP 6 off
 - DIP 6 on
- The number of data bits is fixed and preset to: RTU 8 data bits and ASCII 7 data bits

As the data sheet contains a detailed description of position and meaning of the jumpers, please refer to the file „Produktblatt_wrf06_rs485.pdf“.

!! The bus address must be adjusted differently for each device

!! Transmission mode, baud rate and parity must be identical

3 WRF06-RS485-Modbus Protocol

3.1 Control Commands Supported

The following MODBUS – control commands are supported:

| Description | Function Code | |
|---------------------------|---------------|----------|
| | 01 (hex) | 1 (dez) |
| Read bits | 01 (hex) | 1 (dez) |
| | 02 (hex) | 2 (dez) |
| Read register | 03 (hex) | 3 (dez) |
| | 04 (hex) | 4 (dez) |
| Write individual bit | 05 (hex) | 5 (dez) |
| Write individual register | 06 (hex) | 6 (dez) |
| Write several bits | 0F (hex) | 15 (dez) |
| Write several registers | 10 (hex) | 16 (dez) |

Table 1

3.2 Data Administration

All data in a MODBUS-Slave are allocated to addresses. Data access (read or write) is made by the corresponding control command and the indication of the corresponding data address.

3.3 EEprom – non volatile memory

Configuration parameters are not allowed to write permanently. Device has maximum write cycles of nonvolatile memory. (dimension: <10000).

3.4 Register Definition

3.4.1 Configuration Register

| Register | Data Address | Value Range | Description |
|----------|-----------------|---|---|
| 1 R | 0x0000 | 0x0200 | Device coding, not changeable |
| 2 R | 0x0001 | 0x0012 | Firmware version, not changeable |
| 2 – 52 | 0x0002 – 0x0033 | Configuration of the operating panel, EEPROM- data – !! Don't update permanently EEprom !! | |
| 3 R/W | 0x0002 | 0x0000 | Type 2V (AO1: Temperature, AO2: set point) |
| | | 0x0001 | Type 4DI (4 digital Inputs) |
| | | 0x0002 | Type AO2V (AO1: Heating, AO2: cooling) |
| | | 0x0003 | Type DO2R (DO1: Heating, AO2: cooling) |
| | | 0x0004 | Type DO2T (DO1: Heating, AO2: cooling) |
| | | 0x0005 | Type OVR (DO1: Heating, AO2: cooling) |
| | | 0x0006 | Type OVT (DO1: Heating, AO2: cooling) |
| | | 0x0007 | Type 2VPS (AO1: occupancy, AO2: set point) |
| | | 0x0008 | Type AOV (AO2: Heating / cooling) |
| | | 0x0009 | Type AOFV (AO1: Fan speed, AO2: heating / cooling) |
| | | 0x000A | TypeVSS (AO1: set point 2, AO2: set point 1) |
| | | 0x000B | TypeVNS (AO1: temperature, AO 2: set point night temp) |
| | | 0x000C | Type AOK (AO1:heating, AO2: cooling) |
| | | 0x000D | Type Belimo® 6WV (AO1: Fan speed, AO2: heating / cooling) |
| | | 0x000E | Type AOVC02 (AO2: heating / cooling) |
| | | 0x000F | Type Belimo® 6WV (AO1: Fan speed, AO2: cooling / heating) Same as 6WV, but with swapped assignment of heating/cooling. |
| 4 R/W | 0x0003 | 0x0000-0xFFFF | Device location identification (default = 0x0000) |
| | | | |
| 5 R/W | 0x0004 | 0x0000-0x00FF | Intensity background illumination LCD, after 15s without button actuation (rest) (default = 0x000A) |
| 6 R/W | 0x0005 | 0x0000-0x00FF | Intensity background illumination LCD with button actuation (active) (default = 0x00D0) |
| 7 R/W | 0x0006 | 0x0000-0x00FF | Function button -T1 |
| 8 R/W | 0x0007 | 0x0000-0x00FF | Function button -T2 |

| Register | Data Address | Value Range | Description |
|----------|--------------|---------------|--|
| 9 R/W | 0x0008 | 0x0000-0x0013 | Function button -T3 0x13, Fan stage Minus without "AUTO" 0x14, Fan stage only "AUTO" 0x20, Room unoccupied 0x21, Room occupied 0x22, Room occupied / unoccupied – toggle 0x30, Control Auto / Off – toggle |
| 10 R/W | 0x0009 | 0x0000-0x0013 | Function button -T4 0x31, Control Heating 0x32, Control Cooling 0x33, Control Automatic 0x34, Control Off 0x35, Control Heat / Cool – toggle |
| 11 R/W | 0x000A | 0x00 | Fade out display weekday |
| | | 0x01 | Display weekday in English |
| | | 0x02 | Display weekday in German (default) |
| 12 R/W | 0x000B | 0x00 | Fade out display date |
| | | 0x01 | Display date in English (JJ.MM.TT) |
| | | 0x02 | Display date in German (TT.MM.JJ) (default) |
| 13 R/W | 0x000C | 0x00 | Fade out display time |
| | | 0x01 | Display time (default) |
| 14 R/W | 0x000D | 0x00 | Display time 24-hours-mode (default) |
| | | 0x01 | Display time 12-hours-mode |
| 15 R/W | 0x000E | 0x0000-0xFFFF | Updating interval of display in seconds (default = 0x0A) |
| 16 R/W | 0x000F | 0x0000-0x0C80 | Min-Response-Time signed int, (max 3100 ms) (default = 0x0A = 10 ms) |
| 17 R/W | 0x0010 | 0x0000-0x00FF | Temperature-Offset for calibration of temperature sensor signed char, e.g. 10 _{dez} = +1.0 K, -5 _{dez} = -0.5 K (default = 0x00) |
| 18 R/W | 0x0011 | 0x0000-0xFFFF | Upper adjustable range set temperature 1 (default = 0x001E) signed char, e.g. 30 _{dez} = + 3.0 K |
| 19 R/W | 0x0012 | 0x0000-0xFFFF | Lower adjustable range set temperature 1 (default = 0xFFE2) signed char, e.g. 30 _{dez} = - 3.0 K |
| 20 R/W | 0x0013 | 0x0000-0x00FF | Jumping distance with set temperature 1 (default = 0x05) signed char, e.g. 5 _{dez} = +/- 0.5 K per button actuation |
| 21 R/W | 0x0014 | 0x0000-0xFFFF | Set temperature 1 – Basic set point after reset Set temperature 1 – Basic set point after reset |
| 22 R/W | 0x0015 | 0x0000-0xFFFF | Upper adjustable range set temperature 2 (default = 0x001E) signed char, e.g. 30 _{dez} = + 3.0 K |
| 23 R/W | 0x0016 | 0x0000-0xFFFF | Lower adjustable range set temperature 2 (default = 0xFFE2) signed char, e.g. 30 _{dez} = - 3.0 K |
| 24 R/W | 0x0017 | 0x0000-0xFFFF | Jumping distance with set temperature 2 (default = 0x05) signed char, e.g. 5 _{dez} = +/- 0.5 K per button actuation |
| 25 R/W | 0x0018 | 0x0000-0xFFFF | Set temperature 2 – Basic set point after reset Set temperature 2 – Basic set point after reset |
| 26 R/W | 0x0019 | 0x0000-0x0003 | Number of fan stages (default = 0x03) |

| Register | Data Address | Value Range | Description |
|----------|--------------|---------------|--|
| 27 R/W | 0x001A | 0x0000-0x0003 | Selection digital input 1 0x00, none function 0x01, Open contact 0x02, Open dew point 0x03, Open energy hold off 0x04, Open alarm message 0x05, Open room occupancy 0x06, Open message |
| 28 R/W | 0x001B | 0x0000-0x0003 | Selection digital input 2 0x07, Open controller auto / Off 0x08, Open ctrl Heating / Cooling 0x09, Open counter rising edge 0x0A, Open count rising/falling edge 0x0B, Open impulse time 0x0C, Open Reset set temperature 1 |
| 29 R/W | 0x001C | 0x0000-0x0003 | Selection digital input 3 Only device DI4 0x10, Close contact 0x11, Close dew point 0x12, Close energy hold off 0x13, Close message 0x14, Close room occupancy 0x15, Close message |
| 30 R/W | 0x001D | 0x0000-0x0003 | Selection digital input 4 Only device DI4 0x16, Close Controller auto / Off 0x17, Close Ctrl Heating / Cooling 0x18, Close counter rising edge 0x19, Close count rising/falling edge 0x1A, Close impulse time 0x1B, Close Reset set temperature 1 |
| 31 R/W | 0x001E | 0x0000-0x0064 | Proportional range Xp (K) (default = 0x28) Heating e.g. 40 _{dez} = 4.0 K Xp = 0 deactivates controller |
| 32 R/W | 0x001F | 0x0000-0x00FF | Reset time Tn (min) (default = 0x64) Heating e.g. 100 _{dez} = 100 min |
| 33 R/W | 0x0020 | 0x0000-0x0064 | Proportional range Xp (K) (default = 0x28) Cooling e.g. 40 _{dez} = 4.0 K Xp = 0 deactivates controller |
| 34 R/W | 0x0021 | 0x0000-0x00FF | Reset time Tn (min) (default = 0x64) Cooling e.g. 100 _{dez} = 100 min |
| 35 R/W | 0x0022 | 0x0000-0x0064 | Night-lowering (unoccupied) (default = 0x28) Heating = Set point 1 – night lowering Cooling = Set point1 + night lowering e.g. 40 _{dez} = 4.0 K |
| 36 R/W | | 0x0000-0x0064 | Dead zone between heating and (default = 0x28) cooling e.g. 40 _{dez} = 4.0 K |
| 37 R/W | 0x0024 | 0x0000-0x0064 | Antifreeze (default = 0x3C) 0x00 deactivates antifreeze e.g. 60 _{dez} = 6.0 K |
| 38 R/W | 0x0025 | 0x0000-0x0064 | Maximal control variable limit (default = 0x64) Heating e.g. 100 _{dez} = 100 % |
| 39 R/W | 0x0026 | 0x0000-0x0064 | Minimal control variable limit (default = 0x00) Heating e.g. 100 _{dez} = 0 % |
| 40 R/W | 0x0027 | 0x0000-0x0064 | Maximal control variable limit (default = 0x64) Cooling e.g. 100 _{dez} = 100 % |
| 41 R/W | 0x0028 | 0x0000-0x0064 | Minimal control variable limit (default = 0x00) Cooling e.g. 100 _{dez} = 0 % |
| 42 R/W | 0x0029 | 0x0000-0x00FF | PWM-Cycle time (default = 0x0F) e.g. 15 _{dez} = 15 min |
| 43 R/W | 0x002A | 0x0000-0x00FF | Set back room occupancy to night (default = 0x00) e.g. 120 _{dez} = 120 min |

| Register | Data Address | Value Range | Description |
|----------|--------------|---------------|--|
| 44 R/W | 0x002B | 0x0000-0x0003 | Controller mode (default = 0x03) 0 – Controller off 1 – Controller heating 2 – Controller cooling 3 – Controller automatic |
| 45 R/W | 0x002C | 0x0000-0x0064 | Fan speed 1 heating (default = 0x0A) e.g. 10 _{dez} = 1 V |
| 46 R/W | 0x002D | 0x0000-0x0064 | Fan speed 2 heating (default = 0x1E) e.g. 30 _{dez} = 3 V |
| 47 R/W | 0x002E | 0x0000-0x0064 | Fan speed 3 heating (default = 0x46) e.g. 70 _{dez} = 7 V |
| 48 R/W | 0x002F | 0x0000-0x0064 | Fan speed 1 cooling (default = 0x0A) e.g. 10 _{dez} = 1 V |
| 49 R/W | 0x0030 | 0x0000-0x0064 | Fan speed 2 cooling (default = 0x1E) e.g. 30 _{dez} = 3 V |
| 50 R/W | 0x0031 | 0x0000-0x0064 | Fan speed 3 cooling (default = 0x46) e.g. 70 _{dez} = 7 V |
| 51 R/W | 0x0032 | 0x0000-0x0003 | Minimal fan speed heating (default = 0x00) e.g. 1 _{dez} = Fan speed 1 |
| 52 R/W | 0x0033 | 0x0000-0x0003 | Minimal fan speed cooling (default = 0x00) e.g. 1 _{dez} = Fan speed 1 |
| 53 R/W | 0x0034 | 0xFFFF | Type: AO2V, OVR, OVT, 6WV Analogue value 0-10V after communication failure Output1 Heating Signed int, e.g. 1000 _{dec} = 100% 0xFFFF = -1 = keep last value |
| | | 0x0000-0x0064 | Type: DO2R, DO2T Digital value after communication failure Output1 Heating* 0 - Open ≥1 - Closed 0xFFFF = -1 = keep last value |
| 54 R/W | 0x0035 | 0xFFFF | Type: AO2V, OVR, OVT, 6WV Analogue value 0-10V after communication failure Output2 Cooling Signed int, e.g. 1000 _{dec} = 100% 0xFFFF = -1 = keep last value |
| | | 0x0000-0x0064 | Type: DO2R, DO2T Digital value after communication failure Output2 Cooling* 0 - Open ≥1 - Closed 0xFFFF = -1 = keep last value |
| 55 R/W | 0x0036 | 0x0000-0xFFFF | OPTIONAL Offset for calibration of humidity sensor signed char, e.g. 10 _{dez} = +1.0 %, -5 _{dez} = -0.5 % (default = 0x00) |
| 56 R/W | 0x0037 | 0x0000-0x03E8 | Voltage level 1 (for device type 6WV and 6WV_INV only) 200 = 2,00V |
| 57 R/W | 0x0038 | 0x0000-0x03E8 | Voltage level 2 (for device type 6WV and 6WV_INV only) 470 = 4,70V |
| 58 R/W | 0x0039 | 0x0000-0x03E8 | Voltage level 3 (for device type 6WV and 6WV_INV only) 730 = 7,30V |
| 59 R/W | 0x003A | 0x0000-0x03E8 | Voltage level 4 (for device type 6WV and 6WV_INV only) 1000 = 10,00V |

3.4.2 Output Register

| Register | Data Address | Value Range | Description |
|-------------|-----------------|--------------------------------------|---|
| 257 – 269 R | 0x0100 – 0x010C | Measuring value (data output) | |
| 257 R | 0x0100 | 0x0000-0x000F | bit0 button 1 1=pressed, 0=not pressed bit1 button 2 1=pressed, 0=not pressed bit2 button 3 1=pressed, 0=not pressed bit3 button 4 1=pressed, 0=not pressed |
| 258 R | 0x0101 | 0x0000-0x000F | It is buffered if a button was actuated since the last read out of the register. After the read out, all bits are reset to the actual value. bit0 button 1 1=pressed, 0=not pressed bit1 button 2 1=pressed, 0=not pressed bit2 button 3 1=pressed, 0=not pressed bit3 button 4 1=pressed, 0=not pressed |
| 259 R | 0x0102 | 0x0000-0xFFFF | Temperature signed int, e.g. 184 _{dez} = 18.4 °C |
| 260 R | 0x0103 | 0x0000-0xFFFF | Set temperature 1 offset signed char, e.g. -25 _{dez} = -2.5K |
| 261 R | 0x0104 | 0x0000-0xFFFF | Set temperature 1 effective signed int, e.g. 220 _{dez} = 22.0 °C Sum 0x26/0x27 + 0x104 |
| 262 R | 0x0105 | 0x0000-0xFFFF | Set temperature 2 offset signed char, e.g. -25 _{dez} = -2.5K |
| 263 R | 0x0106 | 0x0000-0xFFFF | Set temperature 2 effective signed int, e.g. 220 _{dez} = 22.0 °C Sum 0x26/0x27 + 0x104 |
| 264 R | 0x0107 | 0x0000-0x0003 0xFF00-0xFF03 | Fan stage 0 – Off 1 – Stage 1 2 – Stage 2 3 – Stage 3 0xFF00 – Auto Off 0xFF01 – Auto Stage 1 0xFF02 – Auto Stage 2 0xFF03 – Auto Stage 3 |
| 265 R | 0x0108 | 0x0000-0x0001 | Room occupancy 0 – Room unoccupied 1 – Room occupied |
| 266 R | 0x0109 | 0x0000-0x0001 | Digital input 1 0 – opened 1 – closed |
| 267 R | 0x010A | 0x0000-0x0001 | Digital input 2 0 – opened 1 – closed |

| Register | Data Address | Value Range | Description |
|--------------------|------------------------|--------------------------------------|---|
| 257 – 270 R | 0x0100 – 0x010D | Measuring value (data output) | |
| 268 R | 0x010B | 0x0000-0x03FF | 2V: Temperature unsigned int e.g. 409 = 20.0°C = 4V |
| | | 0x0000-0x0001 | DI4: Digital input 3 0 – opened 1 – closed |
| | | 0x0000-0x03FF | AO2V, DO2R, DO2T, OVR, OVT: Control variables unsigned int e.g. 511 = 50% |
| | | 0x0000-0x03FF | AOFV, 6WV: Fan speed 0...1023dec = 0...10V |
| | | 0x0000-0x03FF | 6WV: Fan speed 0...1023dec = 0...10V |
| 269 R | 0x010C | 0x0000-0x03FF | 2V: Set point unsigned int e.g. 450 = 22.0°C = 4.4V |
| | | 0x0000-0x0001 | DI4: Digital input 4 0 – opened 1 – closed |
| | | 0x0000-0x03FF | AO2V, DO2R, DO2T, OVR, OVT: Control variable cooling unsigned int e.g. 614 = 60% |
| | | 0x0000-0x03FF | AOV, AOFV: Control variable Heating / Cooling unsigned int e.g. 511 = 50% |
| | | 0x0000-0x03FF | 6WV: Control voltage for 6-way valve 0...1023dec = 0...10V |
| 270 R | 0x010D | 0x0000-0x0004 | Controller mode 0 – Controller off 1 – Controller heating 2 – Controller cooling 3 – Controller automatic heating 4 – Controller automatic cooling |
| 271 R | 0x010E | 0x0000-0xFFFF | Relative humidity OPTIONAL -1: No humidity sensor available 0...1000 = 0...100,0% |

3.4.3 Input register

| Register | Data Address | Value Range | Description | | | | | | | | | | |
|--|-----------------|-----------------------------|--------------------|---------|----|----|----|--|----|----|----|--|--|
| | | | | | | | | | | | | | |
| 513 - 536 | 0x0200 – 0x0217 | Control (ext. data default) | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Register 0x0200 – 0x0205: Updating of time If the registers are written, weekday, date and time are indicated in the display. The display format is defined by the configuration registers 0x001D – 0x0020. | | | | | | | | | | | | | |
| 513 R/W | 0x0200 | 0x0000-0x003B | Seconds 0 – 59 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | seconds | | | | | | | | | |
| 514 R/W | 0x0201 | 0x0000-0x003B | Minutes 0-60 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | minutes | | | | | | | | | |
| 515 R/W | 0x0202 | 0x0000-0x0017 | Hours 0 - 23h | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | hours | | | | | | | | | |
| 516 R/W | 0x0203 | 0x0000-0x001F | Day 1-31 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | day | | | | | | | | | |
| 517 R/W | 0x0204 | 0x0000-0x000C | Month 1-12 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | month | | | | | | | | | |
| 518 R/W | 0x0205 | 0x0000-0x0833 | Year 2000-2099 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| | | | | year | | | | | | | | | |
| 519 R/W | 0x0206 | reserve | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 520 R/W | 0x0207 | 0x0000-0xFFFF | External value 1 | | | | | signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0001 | | | | | |
| 521 R/W | 0x0208 | 0x0000-0xFFFF | External value 2 | | | | | signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0002 | | | | | |
| 522 R/W | 0x0209 | 0x0000-0xFFFF | External value 3 | | | | | signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0003 | | | | | |
| 523 R/W | 0x020A | 0x0000-0xFFFF | External value 4 | | | | | signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0004 | | | | | |
| 524 R/W | 0x020B | 0x0000-0xFFFF | Set point 1 offset | | | | | signed char, e.g. -25 _{dez} = -2.5K fade in with Coil 0x0005 | | | | | |
| 525 R/W | 0x020C | 0x0000-0xFFFF | Set point 2 offset | | | | | signed char, e.g. -25 _{dez} = -2.5K fade in with Coil 0x0007 | | | | | |
| 526 R/W | 0x020D | 0x0000-0xFFFF | Basic set point 1 | | | | | signed char, e.g. 220 _{dez} = 22 °C | | | | | |
| 527 R/W | 0x020E | 0x0000-0xFFFF | Basic set point 2 | | | | | signed char, e.g. 220 _{dez} = 22 °C | | | | | |

| Register | Data Address | Value Range | Description | |
|----------|--------------|---------------|------------------------------|--|
| 528 R/W | 0x020F | 0x0000-0xFFFF | Fan stage | signed int, 0 _{dez} = Off 1 _{dez} = Stage 1 2 _{dez} = Stage 2 3 _{dez} = Stage 3 signed int, 0xFF00 = Auto Off 0xFF01 = Auto Stage 1 0xFF02 = Auto Stage 2 0xFF03 = Auto Stage 3 |
| 529 R/W | 0x0210 | 0x0000-0x0001 | Room occupancy | 0 – Room unoccupied 1 – Room occupied |
| 530 R/W | 0x0211 | 0x0000-0x0001 | Alarm message 1 | 0 – fade out 1 – fade in |
| 531 R/W | 0x0212 | 0x0000-0x0001 | Alarm message 2 | 0 – fade out 1 – fade in |
| 532 R/W | 0x0213 | 0x0000-0x0001 | Alarm message 3 | 0 – fade out 1 – fade in |
| 533 R/W | 0x0214 | 0x0000-0x0001 | Alarm message 4 | 0 – fade out 1 – fade in |
| 534 R/W | 0x0215 | 0x0000-0x0003 | Controller mode | 0 – Controller off 1 – Controller heating 2 – Controller cooling 3 – Controller automatic heating |
| 535 R/W | 0x0216 | 0xFFFF-0x03FF | Manual set analogue output 2 | signed int, e.g. 512 _{dez} = 50 % = 5 V automatic= 0xFFFF / -1 |
| 536 R/W | 0x0217 | 0xFFFF-0x03FF | Manual set analogue output 1 | signed int, e.g. 512 _{dez} = 50 % = 5 V automatic= 0xFFFF / -1 |
| 537 R/W | 0x0218 | 0x0000-0xFFFF | Temperature (external) | signed char, e.g. 220 _{dez} = 22 °C internal Temp.: 0x7FFF/32767 |

| Data- Address | Description |
|------------------------|--|
| | |
| 0xFF00 – 0xFFFF | Range defined by the manufacturer, not allowed to be changed! |
| | |

3.4.4 Text Row Line 1 and Line 2

| Register | Data Address | | Value Range | Description | | | | | | | | | |
|---|-----------------|---------------|---|--------------|------|--------------|------|-------|------|--------------|-------|-------|------|
| | | | | | | | | | | | | | |
| 769 – 988 R/W | 0x0300 – 0x03DD | | Configuration Property – !! Don't update permanently EEprom !! | | | | | | | | | | |
| BS 1-14 = ASCII letter | | | | | | | | | | | | | |
| Example for row 1: Set point 1 | | | | | | | | | | | | | |
| R 769 | | R 770 | | R 771 | | R 772 | | R 773 | | R 774 | | R 775 | |
| Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo |
| S | o | L | l | w | e | r | t | | 1 | | | | |
| 0x53 | 0x6F | 0x6C | 0x6C | 0x77 | 0x65 | 0x72 | 0x74 | 0x20 | 0x31 | 0x20 | 0x20 | 0x20 | 0x20 |
| Example for row 2: Room 1 | | | | | | | | | | | | | |
| R 779 | | R 780 | | R 781 | | R 782 | | R 783 | | R 784 | | R 785 | |
| Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo | Hi | Lo |
| R | a | u | m | | 1 | | | | | | | | |
| 0x52 | 0x61 | 0x75 | 0x6D | 0x20 | 0x31 | 0x20 | 0x20 | 0x20 | 0x20 | 0x20 | 0x20 | 0x20 | 0x20 |
| <ul style="list-style-type: none">• Input of letters and numbers in ASCII format• If no input is made, row 1 and row 2 are not changed in the display• If there is no sign in row 2 (0x00), row 1 is displayed in type size 2 (7 signs)• If row 1 and row 2 are written, up to 14 signs can be displayed in type size 1. | | | | | | | | | | | | | |
| 769 R/W -778 | 0x0300 | 0x0000-0xFFFF | Set Point 1 Row 1 | Register 769 | | Register 770 | | ... | | Register 775 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |
| 779 R/W -788 | 0x030A | 0x0000-0xFFFF | Set Point 1 Row 2 | Register 779 | | Register 780 | | ... | | Register 785 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |
| 789 R/W -798 | 0x0314 | 0x0000-0xFFFF | Set Point 2 Row 1 | Register 789 | | Register 790 | | ... | | Register 795 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |
| 799 R/W -808 | 0x031E | 0x0000-0xFFFF | Set Point 2 Row 2 | Register 799 | | Register 800 | | ... | | Register 805 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |
| 809 R/W -818 | 0x0328 | 0x0000-0xFFFF | External Measuring Value 1 Row 1 | Register 809 | | Register 800 | | ... | | Register 805 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |
| 819 R/W -828 | 0x0332 | 0x0000-0xFFFF | External Measuring value 1 Row 2 | Register 819 | | Register 820 | | ... | | Register 825 | | | |
| | | | | High | Low | High | Low | | | High | Low | | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | | |

| Register | Data Address | Value Range | Description | | | | | | | | |
|-----------------|--------------|---------------|-------------------------------------|--------------|------|--------------|------|-----|--|--------------|-------|
| 829 R/W -838 | 0x033C | 0x0000-0xFFFF | External Measuring value 2 Row 1 | Register 829 | | Register 830 | | ... | | Register 835 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 839 R/W -848 | 0x0346 | 0x0000-0xFFFF | External Measuring Value 2 Row 2 | Register 839 | | Register 840 | | ... | | Register 845 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 849 R/W -858 | 0x0350 | 0x0000-0xFFFF | External Measuring Value 3 Row 1 | Register 849 | | Register 850 | | ... | | Register 855 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 859 R/W -868 | 0x035A | 0x0000-0xFFFF | External Measuring Value 3 Row 2 | Register 859 | | Register 860 | | ... | | Register 865 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 869 R/W -878 | 0x0364 | 0x0000-0xFFFF | External Measuring Value 4 Row 1 | Register 869 | | Register 870 | | ... | | Register 875 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 879 R/W -888 | 0x036E | 0x0000-0xFFFF | External Measuring Value 4 Row 2 | Register 879 | | Register 880 | | ... | | Register 885 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 889 R/W -898 | 0x0378 | 0x0000-0xFFFF | Alarm Message 1 Row 1 | Register 889 | | Register 890 | | ... | | Register 895 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 899 R/W -908 | 0x0382 | 0x0000-0xFFFF | Alarm Message 1 Row 2 | Register 899 | | Register 900 | | ... | | Register 905 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 909 R/W -918 | 0x038C | 0x0000-0xFFFF | Alarm Message 2 Row 1 | Register 909 | | Register 910 | | ... | | Register 915 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |
| 919 R/W -928 | 0x0396 | 0x0000-0xFFFF | Alarm Message 2 Row 2 | Register 919 | | Register 920 | | ... | | Register 925 | |
| | | | | High | Low | High | Low | | | High | Low |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 |

| Register | Data Address | Value Range | Description | | | | | | | | | |
|-----------------|--------------|-------------------|----------------------------------|--------------|------|--------------|------|-----|--|--------------|-------|--|
| 929 R/W -938 | 0x03A0 | 0x0000- 0xFFFF | Alarm Message 3 Row 1 | Register 929 | | Register 930 | | ... | | Register 935 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |
| 939 R/W -948 | 0x03AA | 0x0000- 0xFFFF | Alarm Message 3 Row 2 | Register939 | | Register 940 | | ... | | Register 945 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |
| 949 R/W -958 | 0x03B4 | 0x0000- 0xFFFF | Alarm Message 4 Row 1 | Register 949 | | Register 950 | | ... | | Register 955 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |
| 959 R/W -968 | 0x03BE | 0x0000- 0xFFFF | Alarm Message 4 Row 2 | Register 959 | | Register 960 | | ... | | Register 965 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |
| 969 R/W -978 | 0x03C8 | 0x0000- 0xFFFF | Room temperature Row 1 | Register 969 | | Register 970 | | ... | | Register 975 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |
| 979 R/W -988 | 0x03D2 | 0x0000- 0xFFFF | Room temperature Row 2 | Register979 | | Register 980 | | ... | | Register 985 | | |
| | | | | High | Low | High | Low | | | High | Low | |
| | | | | BS 1 | BS 2 | BS 3 | BS 4 | | | BS 13 | BS 14 | |

3.4.5 Unit Row 1, Row 2 and Row 3

| Register | Data Address | Value Range | Description |
|--|------------------------|---------------|---|
| 1024–1083 R/W | 0x0400 – 0x043B | | Configuration Properties – !! Don't update permanently EEPROM !! |
| BS 1-3 = ASCII letter Example for row 1, row 2: °C and row 3: out | | | |
| R 1044 | R 1045 | R 1046 | 1047 |
| Hi | Lo | Hi | Lo |
| ° | C | | |
| 0xB0 | 0x43 | 0x00 | 0x00 |
| <ul style="list-style-type: none"> Input of letters and numbers in ASCII format If no input is made, row 1, row 2 and row 3 are not changed in the display If there is no sign in row 2 (0x00), row 1 is displayed in type size 2 (1 sign) If row 1 and row 2 are written, up to 3 signs per line can be displayed in type size 1 Row 3 is displayed in type size 1 (3 signs) | | | |
| 1024 R/W -1033 | 0x0400 | 0x0000-0xFFFF | Unit Set Point 1 |
| | | | Reg 1024 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |
| 1034 R/W -1043 | 0x040A | 0x0000-0xFFFF | Unit Set Point 2 |
| | | | Reg 1034 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |
| 1044 R/W -1053 | 0x0400 | 0x0000-0xFFFF | Unit External Measuring Value 1 |
| | | | Reg 1044 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |
| 1054 R/W -1053 | 0x0400 | 0x0000-0xFFFF | Unit External Measuring Value 2 |
| | | | Reg 1054 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |
| 1064 R/W -1063 | 0x0400 | 0x0000-0xFFFF | Unit External Measuring Value 3 |
| | | | Reg 1064 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |
| 1074 R/W -1083 | 0x0400 | 0x0000-0xFFFF | Unit External Measuring Value 4 |
| | | | Reg 1074 |
| | | | High |
| | | | Low |
| | | | BS 1 |
| | | | BS 2 |
| | | | BS 3 |
| | | | 0x00 |
| | | | BS3 |
| | | | 0x00 |

3.5 Bit Allocation / Coil Definition

3.5.1 Configuration Bits

| Bit | Data Address | Description |
|--|--------------|--|
| Configuration of Operating Panel Bit-Register, EEPROM- Data | | |
| 0x0000 – 0x0020 | | |
| Configuration of Display Field 2 – | | |
| !! Don't update permanently EEprom !! | | |
| 1 R/W | 0x0000 | Room temperature 1 = display 0 = do not display |
| 2 R/W | 0x0001 | External value default 1 Value of 0x0207 1 = display 0 = do not display |
| 3 R/W | 0x0002 | External value default 2 Value of 0x0208 1 = display 0 = do not display |
| 4 R/W | 0x0003 | External value default 3 Value of 0x0209 1 = display 0 = do not display |
| 5 R/W | 0x0004 | External value default 4 Value of 0x020A 1 = display 0 = do not display |
| 6 R/W | 0x0005 | Set Point 1 offset Value of 0x0103 1 = display 0 = do not display |
| 7 R/W | 0x0006 | Set Point 1 effective Value of 0x0104 1 = display 0 = do not display |
| 8 R/W | 0x0007 | Set Point 2 offset Value of 0x0105 1 = display 0 = do not display |
| 9 R/W | 0x0008 | Set Point 2 effective Value of 0x0106 1 = display 0 = do not display |
| 10 R/W | 0x0009 | Time 1 = display 0 = do not display |
| 11 R/W | 0x000A | Date 1 = display 0 = do not display |
| 12 R/W | 0x000B | Room Occupancy 1 = display 0 = do not display |
| 13 R/W | 0x000C | Fan Stage 1 = display 0 = do not display |
| 14 R/W | 0x000D | Reserved |
| 15 R/W | 0x000E | Reserved |
| 16 R/W | 0x000F | Reserved |
| 17 R/W | 0x0010 | Display Temperature 1 = with tenth digit 0 = without tenth digit |
| 18 R/W | 0x0011 | Display External Value 1 1 = with tenth digit 0 = without tenth digit |
| 19 R/W | 0x0012 | Display External Value 2 1 = with tenth digit 0 = without tenth digit |
| 20 R/W | 0x0013 | Display External Value 3 1 = with tenth digit 0 = without tenth digit |

| Bit | Data Address | Description |
|------------------------|--|--|
| 0x0000 – 0x0020 | Configuration of Operating Panel Bit-Register, EEPROM- Data – !! Don't update permanently EEprom !! | |
| | | |
| 21 R/W | 0x0014 | Display External Value 4 1 = with tenth digit 0 = without tenth digit |
| 22 R/W | 0x0015 | Display Set Point 1 1 = with tenth digit 0 = without tenth digit |
| 23 R/W | 0x0016 | Display Set Point 2 1 = with tenth digit 0 = without tenth digit |
| 24 R/W | 0x0017 | Display Set Point 1 1 = Basic set point + Offset 0 = Controls et point |
| | | |
| 25 R/W | 0x0018 | °C/°F 1 = °C 0 = °F |
| 26 R/W | 0x0019 | Display Adjustment Set Point 1 1 = Set point effective 0 = Set point offset |
| 27 R/W | 0x001A | Display Adjustment Set Point 2 1 = Set point effective 0 = Set point offset |
| 28 R/W | 0x001B | Use Minimal Control Variable with control variable > 0: = 1 Use Minimal Control Variable with control variable = 0: = 0 |
| 29 R/W | 0x001C | Room occupancy after voltage reset 1 = Room occupied 0 = Room unoccupied |
| 30 R/W | 0x001D | Activate device by 1. Button press 1 = activ 0 = not activ |
| 31 R/W | 0x001E | Save actual room occupancy 1 = Save 0 = Don't save |
| 32 R/W | 0x001F | Reserved |

3.5.2 Input Bits

| Bit | Data Address | Description |
|------------------------|---|---|
| 0x0100 – 0x010F | Input Value of Operating Panel Bit-Register Override of Controller | |
| 257 R/W | 0x0100 | Symbol Failure 1 = ON, 0 = OFF |
| 258 R/W | 0x 0101 | Symbol Heating - Controller Heating Mode 1 = ON, 0 = OFF |
| 259 R/W | 0x0 102 | Symbol Cooling - Controller Cooling Mode 1 = ON, 0 = OFF |
| 260 R/W | 0x0 103 | Symbol Window - Energy Stop 1 = ON, 0 = OFF |
| 261 R/W | 0x0 104 | Symbol Dew Point - Dew Point Alarm 1 = ON, 0 = OFF |
| 262 R/W | 0x 0105 | Symbol Off - Controller off 1 = ON, 0 = OFF |
| 263 R/W | 0x 0106 | Without Function |
| 264 R/W | 0x 0107 | Without Function |
| 265 R/W | 0x 0108 | Without Function |
| 266 R/W | 0x 0109 | Without Function |
| 267 R/W | 0x0 10A | Without Function |
| 268 R/W | 0x0 10B | Without Function |
| 269 R/W | 0x0 10C | Without Function |
| 270R/W | 0x 010D | Without Function |
| 271 R/W | 0x 010E | Without Function |
| 272 R/W | 0x 010F | Without Function |

3.5.3 Extended address range

| Register | Data Address | Value Range | Description |
|------------------------------------|------------------------|----------------------|-------------------|
| 16385 – 16386 R/W | 0x4000 – 0x4001 | | |
| 16385 R/W | 0x4000 | 0x4793 | Access protection |
| 16386 R/W | 0x4001 | 1-247 _{dez} | Extended address |

To modify extended address strictly adhere to sequence as described in chapter 2.12.1!

4 Data Transmission

4.1 Master/Slave Protocol

One master and one or more slaves are connected to the serial bus. The communication between master and slave is exclusively controlled by the master. The slaves are only allowed to send if they have been addressed by the master before. Slaves are only sending back to the master, never to another slave.

4.2 Data Frame

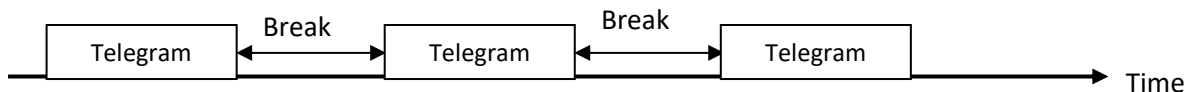
The data are sent to the bus in accordance to severely defined defaults:

| | | | |
|---------|-----------------|------|----------|
| Address | Control Command | Data | Checksum |
|---------|-----------------|------|----------|

In general, a MODBUS telegram starts with the address of the slave, followed by a control command (e.g. read register) and the data. By means of the checksum at the telegram end, the bus participants can recognize transmission errors.

4.3 Transmission Mode RTU

In the transmission mode RTU telegrams are separated by means of transmission breaks.



The period of the transmission breaks for separating telegrams is depending on the adjusted baud rate and amounts to $3,5 \cdot \text{word transmission time (11 bit)}$. With 9600 baud at least 4 ms must pass by and with 57600 at least 1 ms. must pass by between two telegrams.

4.3.1 Telegram Layout

| | | | | |
|-------------------|---------------------------|----------------------|----------|----------|
| Address 1 Byte | Command Control 1 Byte | Data 0 - 100 byte | Checksum | |
| | | | CRC Low | CRC High |

4.3.2 Calculation of CRC-Checksum

The CRC checksum (Cyclical Redundancy Check) is calculated by the sender out of all bytes transmitted and is attached to the message.

The receiver re-calculates the CRC checksum and compares it with the checksum received. If the values do not correspond, a transmission error is assumed and the data received are rejected.

The least significant byte of the 16 bit checksum is set to the penultimate location and the most significant byte is set at last location.

Calculation of checksum (Programming example in C):

```
crc = 0xFFFF; // CRC-Check, Initialisation
for(i = 0; i < Telegram length-2; i++)
    crc = crc_calc(crc, Telegram data[i]);

crc_low = crc & 0x00FF; // Low-Byte
crc_high = (crc & 0xFF00) >> 8; // High-Byte

// Function definition CRC calculation
unsigned int crc_calc(unsigned int crc_temp, unsigned int data)
{
    unsigned int Index_CC=0; // Loop counter
    unsigned int LSB=0; // Help variable

    // Exclusive-Or der 8Bit-Char with the lower 8Bit of CRC
    crc_temp = ((crc_temp ^ data) | 0xFF00) & (crc_temp | 0x00FF);

    for(Index_CC = 0; Index_CC < 8; Index_CC++)
    {
        LSB = (crc_temp & 0x0001);
        crc_temp >>= 1;
        if(LSB)
            crc_temp = crc_temp ^ 0xA001; // calculation polynomial für CRC16
    }

    return(crc_temp);
}
```

4.4 Transmission Mode ASCII

The ASCII transmission mode does not make that high demands on the computer speed of the bus participants. The telegrams are not separated by break times, but by ASCII control characters.

4.4.1 Telegram Layout

The ASCII control character „:“ always identifies the beginning of a telegram. The ASCII control characters „CR“ and „LF“ identify the end of a telegram. The telegram data are output hexa-decimal in the ASCII format:

e.g.: 197dez (1Byte) = C5hex (1 Byte) = C (1 Byte) 5 (1 Byte) ASCII

As one data byte is displayed by 2 ASCII characters, the number of data bytes to be transmitted is doubled compared with the RTU mode.

| Start 1 char | Address 2 char | Control command 2 char | Data 0 - 2 x 100 char | Checksum LRC 2 char | End 2 char |
|-----------------|-------------------|---------------------------|--------------------------|------------------------|---------------|
| : | | | | | CR LF |

4.4.2 Calculation of LRC-Checksum

The LRC checksum (Longitudinal Redundancy Check) is calculated by the sender out of all bytes transmitted (without „:“, „CR“, „LF“) and pasted in the message of „CR,“ and „LF“. The receiver re-calculates the LRC checksum and compares it with the checksum received. If the values do not correspond, a transmission error is assumed and the data received are rejected.

The most significant ASCII character of the 8 bit checksum is sent in the telegram before the least significant ASCII character.

Calculation of checksum (programming example in C):

```
lrc = 0;
for(i = 1; i < Telegram length -4; i++)
    lrc = lrc + Telegram data [i];
```

```
lrc = 0xFF - lrc;
lrc = lrc + 1;
```

5 Examples: Telegrams

5.1 Register

The operating unit has different registers for the configuration, for the display of values and for the input values.

5.1.1 Parameterization of Operating Unit

The operating unit can be parameterized by the configuration registers 3-42 and the control commands „Write Register“(10hex or 06hex).

Example: button 1 and button 2 for set point adjustment of temperature 1.

Master - Telegram in Transmission Mode RTU:

| Device | command | Start address | | Number of Register | | Number of Bytes | Data Register 08 | | Data Register 09 | | Check Sum | |
|--------|---------|---------------|--------|--------------------|--------|-----------------|------------------|--------|------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | | H Byte | L Byte | H Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 00 | 06 | 00 | 02 | 04 | 00 | 01 | 00 | 02 | CRC | |

Slave – Response Telegram in Transmisson Mode RTU:

| Device | command | Start address | | Number of Register | | Check Sum | |
|--------|---------|---------------|--------|--------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 00 | 06 | 00 | 02 | CRC | |

If button 1 or 2 is pushed, the set point for temperature is changed.

5.1.2 Read-Out of Output Register

Button status and values are stored in the output registers. After a reset the basic set points are taken over from the configuration registers for the corresponding set points.

| Master - Telegram in Modus RTU | | Slave – Response Telegram in Modus RTU | |
|--------------------------------|-------------|---|-------------|
| Description | Value (Hex) | Description | Value (Hex) |
| Slave address | 02 | Slave Address | 02 |
| Command | 03 | Command | 03 |
| Start address High | 01 | Number of Bytes | 14 |
| Start address Low | 00 | Register value High (0100) | 00 |
| Number of Registers High | 00 | Register value Low (0100) Button 1-4 | 08 |
| Number of Registers Low | 04 | Register value High (0101) | 01 |
| Check sum Low | CRC | Register value Low (0101) Button 1-4 | 23 |
| Check sum High | | Register value High (0102) Temperature | 00 |
| | | Register value Low (0102) Temperature | DC |
| | | Register value High (0103) Set point offset | FF |
| | | Register value Low (0103) Temperature 1 | E7 |
| | | Check sum Low | CRC |
| | | Check sum High | |

5.1.3 Setting of Input Registers

By means of the input registers different values can be overwritten in the operating unit.

Example: Setting of time: 14:23:47

Master - Telegram in the transmission mode TU:

| Device | Command | Start address | | Number of I Register | | Number of Bytes | Data Register 513 | | Data Register 514 | | Data Register 515 | | Check Sum | |
|--------|---------|---------------|--------|----------------------|--------|-----------------|-------------------|--------|-------------------|--------|-------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | | H Byte | L Byte | H Byte | H Byte | L Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 02 | 00 | 00 | 03 | 06 | 00 | 47 | 00 | 23 | 00 | 14 | CRC | |

Slave – Response Telegram in transmission mode RTU:

| Device | Command | Start Address | | Number of Register | | Check Sum | |
|--------|---------|---------------|--------|--------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 02 | 00 | 00 | 03 | CRC | |

Example: Setting of date: 23.01.2008

Master - Telegram in transmission mode RTU:

| Device | Command | Start address | | Number of Register | | Number of Bytes | Data Register 516 | | Data Register 517 | | Data Register 518 | | Check Sum | |
|--------|---------|---------------|--------|--------------------|--------|-----------------|-------------------|--------|-------------------|--------|-------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | | H Byte | L Byte | H Byte | H Byte | L Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 02 | 03 | 00 | 03 | 06 | 00 | 23 | 00 | 01 | 00 | 08 | CRC | |

Slave – Response Telegram in transmission mode RTU:

| Device | Command | Start address | | Number of Register | | Check Sum | |
|--------|---------|---------------|--------|--------------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | L CRC | H CRC |
| 02 | 10 | 02 | 03 | 00 | 03 | CRC | |

5.2 Coil / Bit Allocation

The operating unit has different configuration bits for the setting of the display value in the display. By means of the input bits different symbols and LEDs of the operating unit can be controlled.

5.2.1 Configuration Bits

By means of the control command „Write Bit(s)“ (0Fhex or 05hex) a configuration bit (or more) can be written with the value „1“ or „0“.

Example: Display outdoor temperature

Master - Telegram in transmission mode RTU:

| Slave Address | Command | Start address | | Number of Bits | | Number of Bytes | Data | Check Sum | |
|---------------|---------|---------------|--------|----------------|--------|-----------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | | H Byte | L CRC | H CRC |
| 02 | 0F | 00 | 01 | 00 | 01 | 01 | 01 | CRC | |

Slave – Response Telegram in transmission mode RTU:

| Slave Address | Command | Start address | | Number of Bits | | Check Sum | |
|---------------|---------|---------------|--------|----------------|--------|-----------|-------|
| | | H Byte | L Byte | H Byte | L Byte | L CRC | H CRC |
| 02 | 0F | 00 | 01 | 00 | 01 | CRC | |

5.2.2 Read Out of Bits

By means of the control command „Read bits“(01hex or 02hex) one or more bits can be read out.

Example: Read out indicated symbols (Data address = 00000hex 00001hex)

| Master - Telegram in mode RTU | | Slave –Response telegram in mode RTU | |
|-------------------------------|-------------|--------------------------------------|-------------|
| Description | Value (Hex) | Description | Value (Hex) |
| Device | 02 | Device | 02 |
| Command | 01 | Command | 01 |
| Start address High | 00 | Number of Bytes | 01 |
| Start address Low | 00 | Bit value 0,0,0,0,0,0,Bit1,Bit0 | 03 |
| Number of Bits High | 00 | Check Sum Low | CRC |
| Number of Bits Low | 02 | Check Sum High | |
| Check Sum Low | CRC | | |
| Check Sum High | | | |

6 Configuration Software

By means of a RS485-interface (e.g. RS232-RS485-level converter e.g. ADAM-4520) it is possible to access to the Modbus by the configuration software. The configuration software is not obligatory necessary for the installation of the WRF06-RS485 Modbus. It is possible to use any programme producing Modbus telegrams which is suitable to set registers.

7 Software Installation

For the installation of the configuration software, the setup files „WRF06_Modbus_ Config_Setup.exe “must be started. Please note that you must have administrator rights for the installation. During the installation, please follow the screen instructions.

After a successful operation, the configuration software can be started via the
“Starting Menu/Programs/Thermokon“

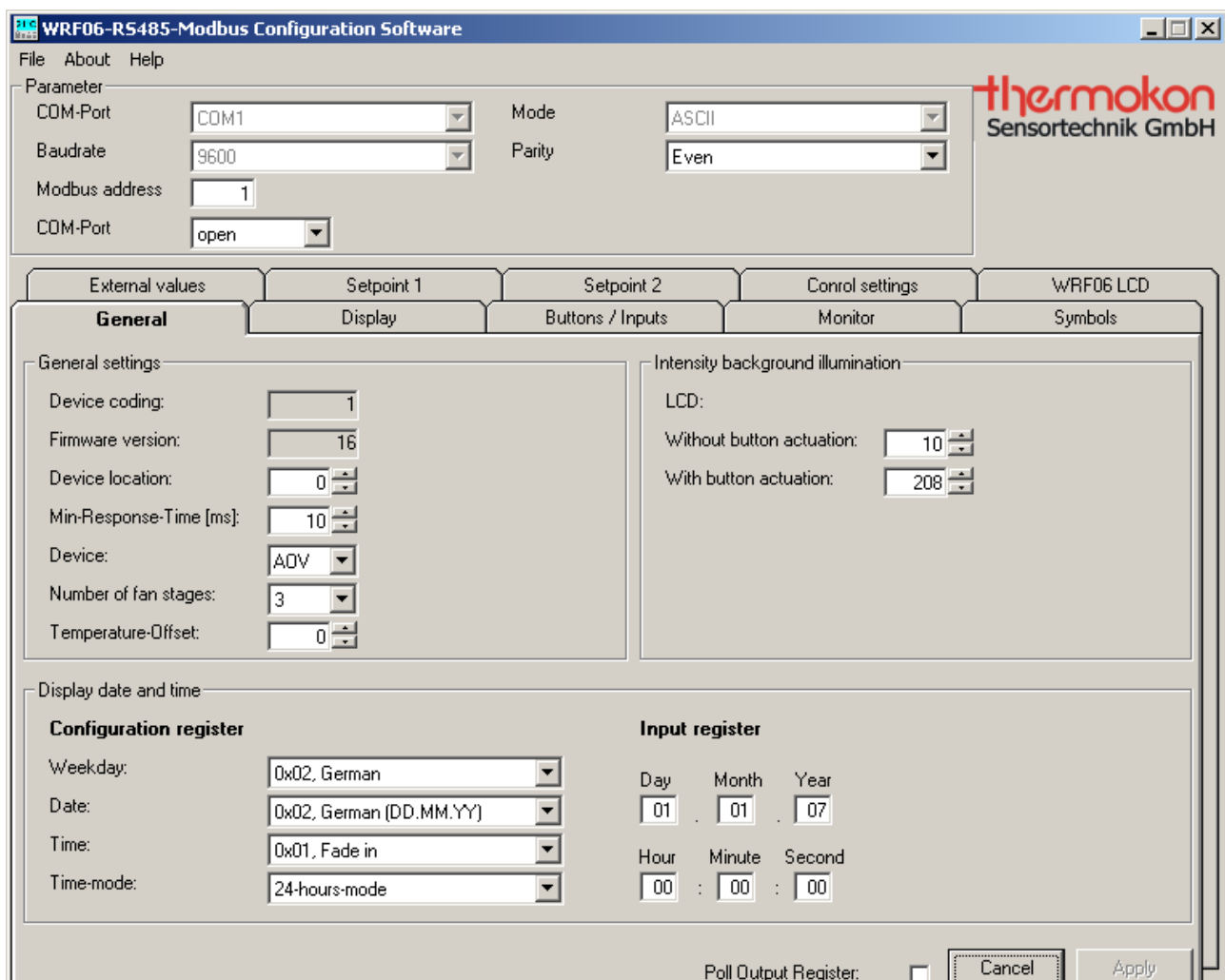
Operating systems supported: Windows9x; WindowsNT; WindowsMe; Windows2000; WindowsXP;
WindowsServer

8 Configuration of WRF06-RS485-Modbus

8.1 Software Configuration

By means of the configuration software the configuration registers can be clearly adjusted. Output registers of the WRF06 can be read out and input registers can be set. The load of the individual registers is described in chapter 0.

Via the menu points "File" and "Saving of Parameter" respectively "Loading of Parameter", the configuration registers can be stored in a text file and can be reloaded into the WRF06-RS485-Modbus.



Picture 8-1: Configuration Software

8.2 Parameter-Frame

The Modbus can be accessed via the configuration software by means of a COM-Port. In the "Parameter"-Frame hardware settings can be made. They must be in conformity with the Modbus receiver, in order to produce a connection.

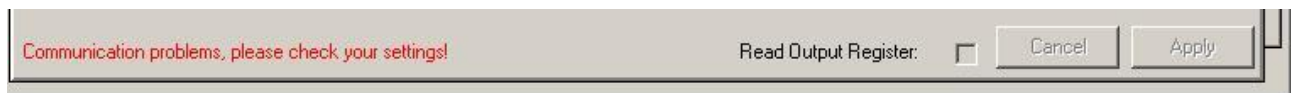
The following options can be selected:

- COM-Port
- Baud rate 9600 , 19200, 57600
- Parity none, even, odd
- Modus for setting of transmission ASCII or RTU
- Modbus address (1-31)

In the field "Modbus address" the address of the WRF06-RS485 Modbus that shall be configured is entered (value between 1 and 31).

Via the selection menu behind "COM-Port" the port can be opened "open" and closed "close".

If the connection failed, the same is shown by an error message.



Picture 8-2: Communication Problems

8.3 Register

The configuration registers can be set in the different riders. Furthermore, the output registers can be read and the input registers can be set.

Changes are sent to the WRF06-RS485 Modbus after having pressed the button "take over". By actuating the button "Cancel" the registers of the WRF06-RS485-Modbus are read out again.

By activating the hook "read output register" all output registers are read out cyclically.



Picture 8-3: Data