

Protocol Description WRF06-RS485-Modbus

Version 1.1, 13.08.2008

Index of Changes

Version	Date	Description
1.0	2008-08-07	First Draft
1.1	2008-08-13	Second Draft

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1 WRF06-RS485-Modbus

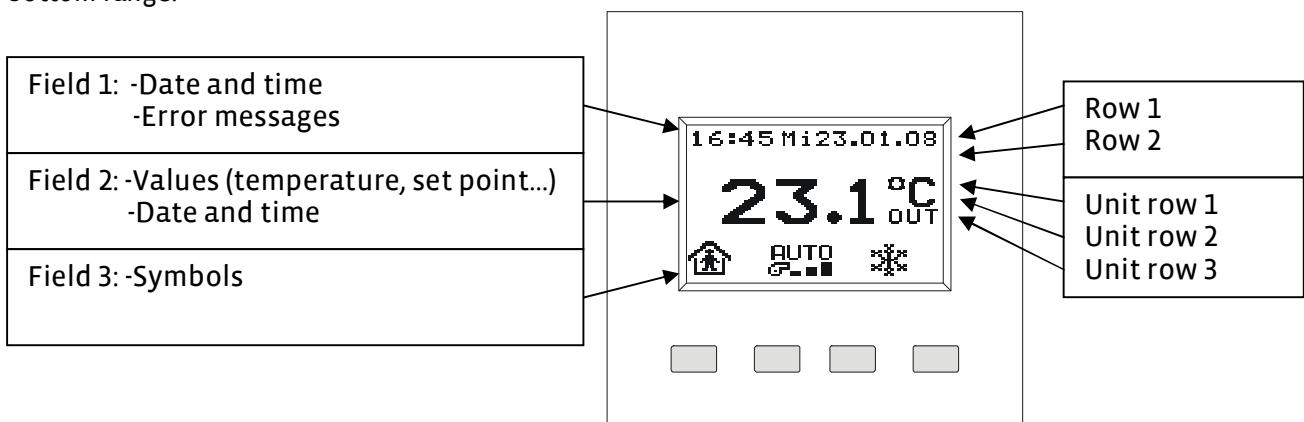
The present document describes the serial interface of the room operating panel WRF006-RS485-MODBUS. The MODBUS protocol developed by the company Modicon is an open protocol for the communication of various intelligent devices on Master-Slave base.

For further information and definitions on the topic MODBUS, please see www.modbus.org.

2 Device Description

2.1 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:

 Set point adjustment

 Error

 Heating

 Cooling

 Window "open"

 De point detector "active"

  Occupied (comfort) / Unoccupied (stand-by)

 Occupied (Extension of party time)

 Fan off

 Fan stage 1

 Fan stage 2

 Fan stage 3

 Fan off

 Fan stage 1

 Fan stage 2

 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:

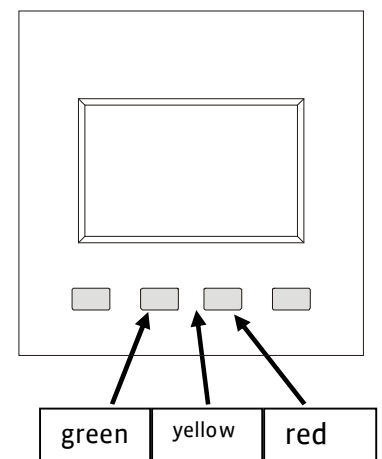
- Temperature
 - Room temperature
 - 2 field programmable text rows in field 11
- 2 Set Points
 - Unit and display are field definable
 - Set point effective and offset
 - Adjustment via operating buttons possible
 - Per value 2 field parameterizable text rows in field 1
- 4 External Measuring Values
 - Unit and display are field definable
 - e.g. for outdoor temperature, pressure, percent value etc.
 - Per value 2 field parameterizable 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 parametrizable text rows in field 1

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

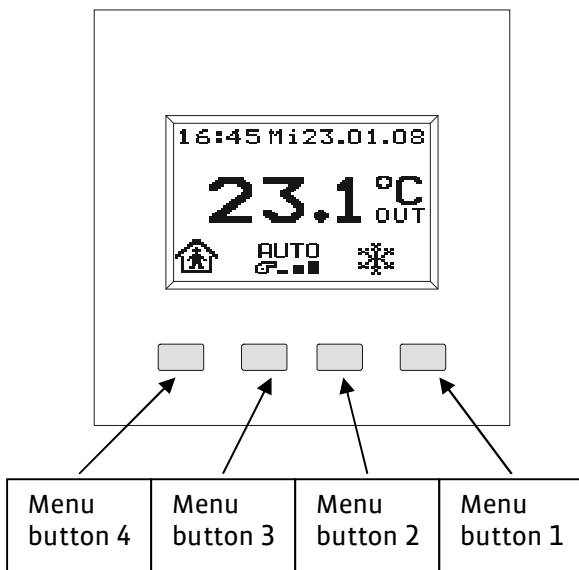
The room operating panel has 3 LEDs for the indication of different status for verifying device functions and bus communication.

- 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.



2.3 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

2.4 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.

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.

2.5 Control

2.5.1 Device Types

The control is integrated in the following devices: AO2V, OVR, OVT, DO2R, DO2T.

2.5.2 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.

2.5.3 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.

2.5.4 Override of Controller

By setting the symbols (window, dew point, off, heating and cooling, input register 0x0101 – 0x0105) of a building control technology, the control can be affected and overwritten directly.

2.5.5 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.

2.6 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.

2.7 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.

2.8 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

2.9 Configuration Options

By means of the DIP switch the device can be adapted to the corresponding bus topology.

5pole DIP switch:

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

Important notice for operation in the Master/Slave-System:

!! 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	
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 Register Definition

3.3.1 Configuration Register

Register	Data Address	Value Range	Description
1 R	0x0000	0x0000	Device coding, not changeable
2 R	0x0001	0x0011	Firmware version, not changeable
2 – 42	0x0002 – 0x0029		Configuration of the operating panel, EEPROM- data
3 R/W	0x0002	0x0000	Type 2V
		0x0001	Type 4DI
		0x0002	Type AO2V
		0x0003	Type DO2R
		0x0004	Type DO2T
		0x0005	Type OVR
		0x0006	Type OVT
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 0x00, without special function(default) 0x01, Set point 1 + 0x02, Set point 1 – 0x03, Set point 2 + 0x04, Set point 2 –
8 R/W	0x0007	0x0000-0x00FF	Function button -T2 0x05, Accept set point 1 0x06, Cancel set point 1 0x10, Fan stage Plus with "AUTO" 0x11, Fan Stage Minus with "AUTO" 0x12, Fan stage Plus without "AUTO" 0x13, Fan stage Minus without "AUTO"
9 R/W	0x0008	0x0000-0x0013	Function button -T3 Only device DI4 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 Only device DI4 0x31, Control Heating 0x32, Control Cooling 0x33, Control Automatic 0x34, Control Off
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)

Register	Data Address	Value Range	Description
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)
27 R/W	0x001A	0x0000-0x0003	Selection digital input 1
28 R/W	0x001B	0x0000-0x0003	Selection digital input 2
29 R/W	0x001C	0x0000-0x0003	Selection digital input 3
30 R/W	0x001D	0x0000-0x0003	Selection digital input 4
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

Register	Data Address	Value Range	Description
35 R/W	0x0022	0x0000-0x0064	Night-lowering (unoccupied) (default = 0x28) Heating = Set point 1 – night lowering Cooling = Sollwert1 + 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

3.3.2 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 – 269 R	0x0100 – 0x010C	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%
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%

3.3.3 Input register

Register	Data Address	Value Range	Description									
513 - 533	0x0200 – 0x0214	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	
				0	10 seconds			seconds				
514 R/W	0x0201	0x0000-0x003B	Minutes 0-60	B7	B6	B5	B4	B3	B2	B1	B0	
				0	10 minutes			minutes				
515 R/W	0x0202	0x0000-0x0017	Hours 0 - 23h	B7	B6	B5	B4	B3	B2	B1	B0	
				0		10 hours		hours				
516 R/W	0x0203	0x0000-0x001F	Day 1-31	B7	B6	B5	B4	B3	B2	B1	B0	
				0	0	10 day		day				
517 R/W	0x0204	0x0000-0x000C	Month 1-12	B7	B6	B5	B4	B3	B2	B1	B0	
				0	0	0	10 month		month			
518 R/W	0x0205	0x0000-0x0833	Year 2000-2099	B7	B6	B5	B4	B3	B2	B1	B0	
				10 year				year				
519 R/W	0x0206	reserve										
520 R/W	0x0207	0x0000-0xFFFF	ext. Temperature default 1				signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0001					
521 R/W	0x0208	0x0000-0xFFFF	ext. Temperature default 2				signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0002					
522 R/W	0x0209	0x0000-0xFFFF	ext. Temperature default 3				signed int, e.g. 234 _{dez} = 23.4°C fade in with Coil 0x0003					
523 R/W	0x020A	0x0000-0xFFFF	ext. Temperature default 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

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

3.3.4 Text Row Line 1 and Line 2

Register	Data Address		Value Range	Description										
769 – 988 R/W	0x0300 – 0x03DD		Configuration Property											
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	
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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
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	Register 939		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 temperatu re 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 temperatu re Row 2	Register 979		Register 980		...		Register 985	
				High	Low	High	Low			High	Low
				BS 1	BS 2	BS 3	BS 4			BS 13	BS 14

3.3.5 Unit Row 1, Row 2 and Row 3

Register	Data Address	Value Range	Description										
1024–1083 R/W	0x0400 – 0x043B	Configuration Properties											
BS 1-3 = ASCII letter Example for row 1, row 2: °C and row 3: out													
R 1044		R 1045		R 1046		1047		R 1048		R 1049		R 1050	
Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo
°	C							O	u	t			
0xB0	0x43	0x00	0x00	0x00	0x00	0x00	0x00	0x4F	0x75	0x74	0x00	0x00	0x00
<ul style="list-style-type: none">Input of letters and numbers in ASCII formatIf no input is made, row 1, row 2 and row 3 are not changed in the displayIf 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 1Row 3 is displayed in type size 1 (3 signs)													
1024 R/W -1033	0x0400	0x0000-0xFFFF	Unit Set Point 1	Reg 1024		Reg 1025		...		Reg 1029			
				High	Low	High	Low			High	Low		
				BS 1	BS 2	BS 3	0x00			BS3	0x00		
1034 R/W -1043	0x040A	0x0000-0xFFFF	Unit Set Point 2	Reg 1034		Reg 1035		...		Reg 1039			
				High	Low	High	Low			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		Reg 1045		...		Reg 1049			
				High	Low	High	Low			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		Reg 1055		...		Reg 1059			
				High	Low	High	Low			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		Reg 1065		...		Reg 1069			
				High	Low	High	Low			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		Reg 1075		...		Reg 1079			
				High	Low	High	Low			High	Low		
				BS 1	BS 2	BS 3	0x00			BS3	0x00		

3.4 Bit Allocation / Coil Definition

3.4.1 Configuration Bits

Bit	Data Address	Description
0x0000 – 0x0020	Configuration of Operating Panel Bit-Register, EEPROM- Data Configuration of Display Field 2	
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	
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	Reserved
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	Reserved
31 R/W	0x001E	Reserved
32 R/W	0x001F	Reserved

3.4.2 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

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

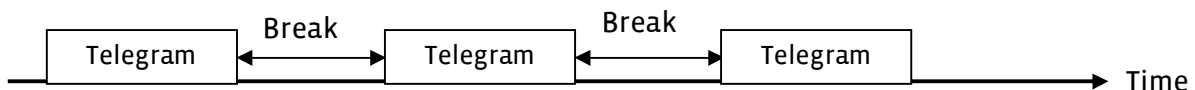
The data are sent to the bus in accordance to severely defined defaults:

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 $3,5 \times \text{word transmission time (11 bit)}$. 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 des 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 recalculates 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 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	00	06	00	02	CRC	

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

5.12 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	

5.1.2 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 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 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0	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“

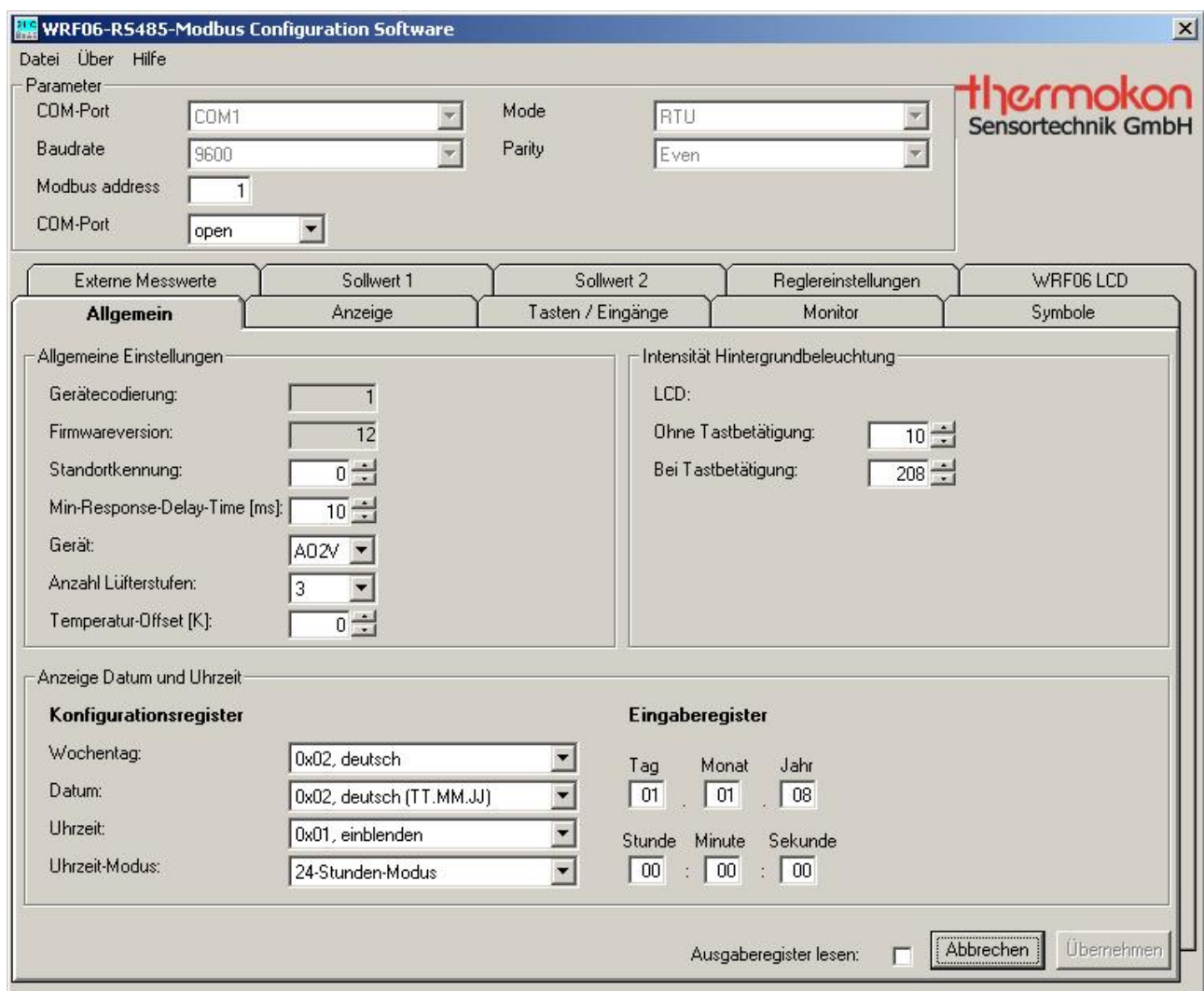
Operating systems supported: Windows9x; WindowsNT; WindowsMe; Windows2000;
 WindowsXP; WindowsServer

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 3.3.

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.



WRF06-RS485-Modbus Configuration Software

Datei Über Hilfe

Parameter

COM-Port: COM1 Mode: RTU

Baudrate: 9600 Parity: Even

Modbus address: 1

COM-Port: open

thermokon
Sensortechnik GmbH

Externe Messwerte Sollwert 1 Sollwert 2 Reglereinstellungen WRF06 LCD

Allgemein Anzeige Tasten / Eingänge Monitor Symbole

Allgemeine Einstellungen

Gerätecodierung: 1

Firmwareversion: 12

Standortkennung: 0

Min-Response-Delay-Time [ms]: 10

Gerät: A02V

Anzahl Lüfterstufen: 3

Temperatur-Offset [K]: 0

Intensität Hintergrundbeleuchtung

LCD:

Ohne Tastbetätigung: 10

Bei Tastbetätigung: 208

Anzeige Datum und Uhrzeit

Konfigurationsregister

Wochentag: 0x02, deutsch

Datum: 0x02, deutsch (TT.MM.JJ)

Uhrzeit: 0x01, einblenden

Uhrzeit-Modus: 24-Stunden-Modus

Eingaberegister

Tag: 01 Monat: 01 Jahr: 08

Stunde: 00 Minute: 00 Sekunde: 00

Ausgaberegister lesen: ☐

Abbrechen Übernehmen

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