thermokon
Sensortechnik GmbH

Protocol Description
WRF08-RS485-Modbus

Version 1.13, 27.01.2012

Index of Changes

Version	Date	Desription
1.0	2006-10-30	First Draft
1.1	2007-02-28	Second Draft
1.2	2007-03-23	Third Draft
1.10	2009-09-24	Eleventh Draft
1.12	2012-01-27	Added table for max read/wite
1.13	2012-1205	Added description for Configuration Coil 31 (Firmware 1.15 or higher)

1 WRF08-RS485-Modbus

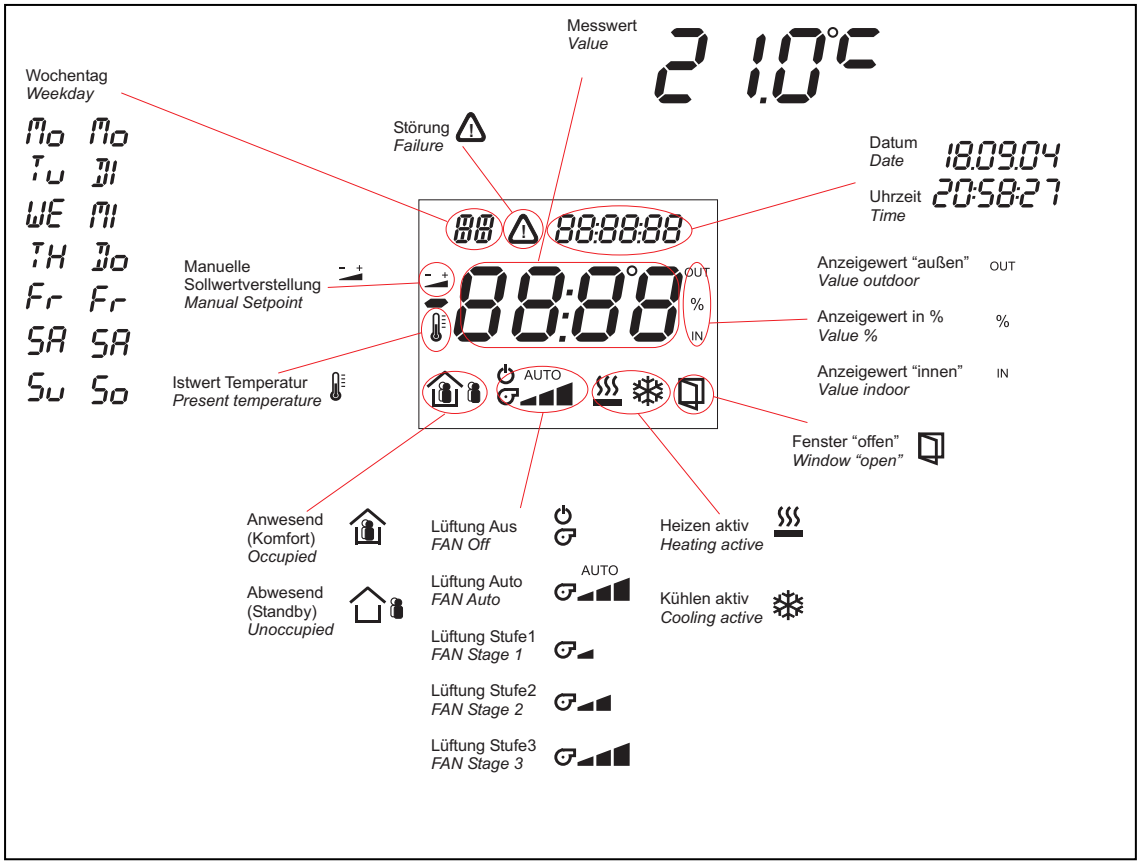
The present document describes the serial interface of the room operating panel WRF08-RS485-MODBUS. The MODBUS protocol developed by the company Modicon is an open protocol for the communication of various intelligent devcies on Master-Slave base.

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

2 Device Description

2.1 LCD-Display

The following signs can be indicated on the LCD-display:



Via the LCD display different values can be indicated. As a standard, only the temperautre is displayed. Which values shall be shown in the display can be adjusted by the configuration bits 0x0000 – 0x0013. The following values can be indicated in the display:

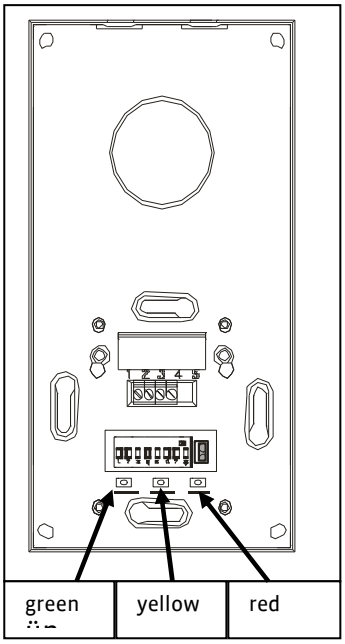
- Temperature
  - Room temperature, outdoor temperature, another 2 external temperature values
  - 2 set points effective and offset
- Percent
  - 2 external percentages e.g. for humidity
  - 2 set points effective and offset
- Value without any unit
  - 2 external value for e.g. a time, pressure etc.
  - 2 set points effective and offset

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

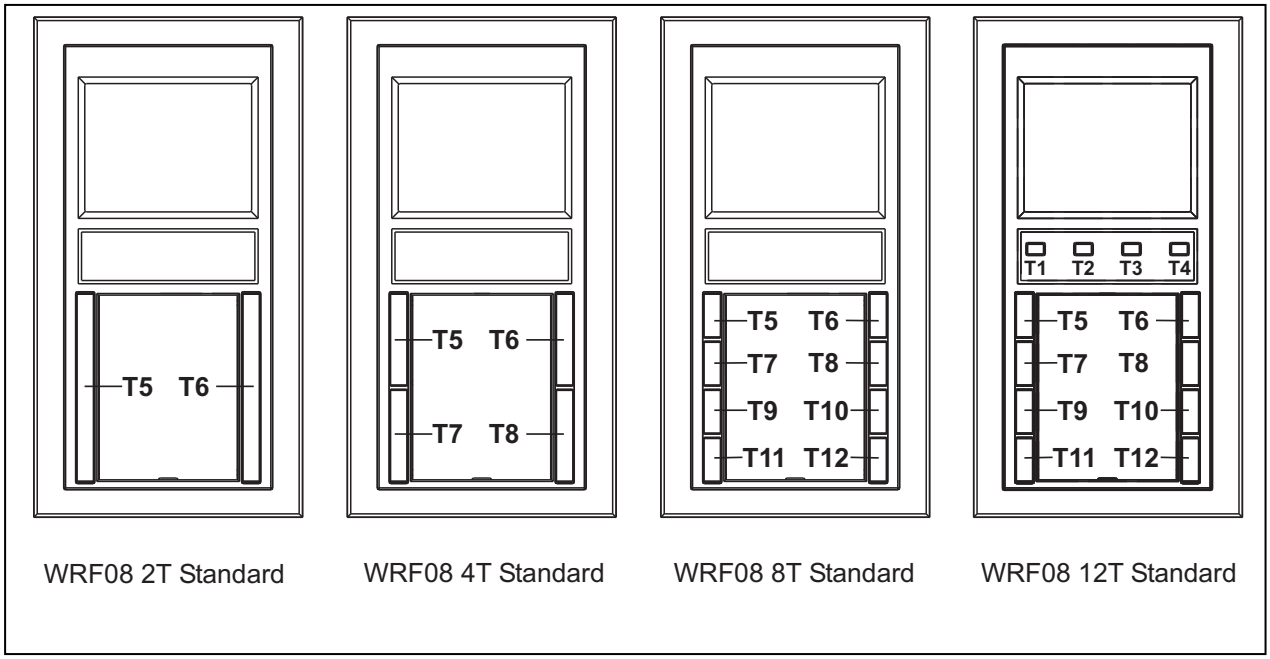
The room operating panel has 3 LEDs for the indication of different status for verifying device functions and bus communication.

- 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: Flash 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 corresponding function of the button can be adjusted via the registers 0x0008 – 0x0013 .
The following button functions are possible:

- Button pressed / not pressed e.g. for light, blind
- Output in the output registers 257-258
  - Register 257 shows the current status of the button
  - Register 258 stores the button pressed until the register is read out
- Adjustment of set point temperature
  - Up to two temperatures can be adjusted
  - When actuating the button, the corresponding set point is indicated in the

- Adjustment of percent value
  - Up to two percent values can be adjusted
  - When actuating the button, the corresponding set point is indicated in the display
- Value adjustment (independent of unit)
  - Up to two values can be adjusted independent of the unit
  - When actuating the button, the corresponding set point is indicated in the display
- Adjustment of fan stage
  - The fan stage can be overrided by the output register 539
  - The current fan stage is automatically indicated in the display
- Adjustment of room occupancy
  - The room occupancy can be overrided by the output register 540
  - The current room occupancy is indicated in the display automatically.
  -

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.

Polling of calibration mode:	Parallel actuation of the buttons **T5, T7, T10 and T12** for a time exceeding 10s.
Display in Calibration Mode:	All button-response-LEDs are on.
Adjust Temperature:	Buttons T5 or T7 or T9 or T11 for **+ 0,1** Buttons T6 or T8 or T10 or T12 for **- 0,1**
Exit Calibration Mode:	No button actuation for a time exceeding 10s.
Specific Feature WRF08 4T:	The calibration mode is polled by the buttons T5 and T8. Please make sure, that the push-button is pressed via the entire width.
Specific Feature WRF08 2T:	The calibration mode is polled by the buttons T5 and T6. Please make sure, that the push-button T5 on the upper button part is fully pressed and that the push-button T6 is fully pressed on the lower part.

2.4 Hardware Installation

The room operating panel can be connected by means of a twisted-pair cable (line resistance 120 Ohm). For detailled information on installation and mounting, please see the product data sheet WRF08-RS485-Modbus and the data sheet wiring_rs485_network.pdf.

2.5 RS485 Transceiver

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

2.6 Protocol

The room operating panel WRF08-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

2.7 Configuration Options

By means of a jumper and a 8-pole dip switch the device can be adapted to the respective bus topology. The following can be adjusted:

- bus address of the device (1 - 63) via 8-pole dip switch; dip switch: 1-6
- bus terminating resistor 120 Ohm
- baudrate via 8-pole dip switch 7; dip switch 7 off: 9600 or dip switch 7 on: 57600
- transmission mode RTU or ASCII via 8-pole dip switch 8; dip switch 8 off: RTU or on: ASCII
- The parity is straight line (even) and cannot be adjusted.
- The number of Data-Bits is adjusted: RTU 8 Data-Bits and ASCII 7 Data-Bits

As the data sheet contains a detailed description on position and meaning of the jumpers, please refer to the file „Produktblatt_wrf08_rs485.pdf“.

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

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

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

3 WRF08-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.

Due to limited memory resources, the maximum number of readable and writable registers and coils in a telegram is limited in dependence on the transmitting mode(ASCII/RTU).

Procedure	RTU	ASCII
Read register	16	8
Write register	8	8
Read coils	16	8
Write Coils	8	8

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**	**0x0000**	**Device coding, not changeable**	
2 R	**0x0001**	**0x0012**	**Firmware version, not changeable**	
2 – 60	**0x0002 – 0x003B**	**Configuration of the operating panel, EEPROM- data – !! Don't update permanently EEprom !!**		
3 R/W	0x0002	0x0002	WRF08 with 2 operating buttons	
		0x0004	WRF08 with 4 operating buttons	
		0x0008	WRF08 with 8 operating buttons	(default = 0x0008)
		0x000C	WRF08 with 12 operating buttons	
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	Intensity background illumination labelling area after 15s without button actuation (rest)	(default = 0x0020)
8 R/W	0x0007	0x0000-0x00FF	Intensity background illumination labelling area with button actuation (active)	(default = 0x00FF)
9 R/W	0x0008	0x0000-0x0013	Function button -T1	0x00, without spezial function(default) 0x01, Set temperature 1 + 0x02, Set temperature 1 – 0x03, Set temperature 2 + 0x04, Set temperature 2 – 0x05, Percent value 1 + 0x06, Percent value 1 – 0x07, Percent value 2 + 0x08, Percent value 2 – 0x09, Value + 0x0A, Value – 0x0B, Value + 0x0C, Value – 0x0D, Fan stage Plus with "AUTO" 0x0E, Fan Stage Minus with "AUTO" 0x0F, Fan stage Plus without "AUTO" 0x10, Fan stage Minus without "AUTO" 0x11, Fan stage only "AUTO" 0x12, Room unoccupied 0x13, Room occupied
10 R/W	0x0009	0x0000-0x0013	Function button -T2	
11 R/W	0x000A	0x0000-0x0013	Function button -T3	
12 R/W	0x000B	0x0000-0x0013	Function button -T4	
13 R/W	0x000C	0x0000-0x0013	Function button -T5	
14 R/W	0x000D	0x0000-0x0013	Function button -T6	
15 R/W	0x000E	0x0000-0x0013	Function button -T7	
16 R/W	0x000F	0x0000-0x0013	Function button -T8	
17 R/W	0x0010	0x0000-0x0013	Function button -T9	
18 R/W	0x0011	0x0000-0x0013	Function button -T10	
19 R/W	0x0012	0x0000-0x0013	Function button -T11	
20 R/W	0x0013	0x0000-0x0013	Function button-T12	

Register	Data Address	Value Range	Description	
2 – 60	**0x0002 – 0x003B**	**Configuration operating panel, EEPROM- Data – !! Don't update permanently EEprom !!**		
21 R/W	0x0014	0x00-0x01	Function LED-T5	0x00 without spezial function, LED controllable via Bit-Register 0x0100 – 0x0107 0x01, (default) LED = ON if button is pressed LED = OFF if button is not pressed
22 R/W	0x0015	0x00-0x01	Function LED -T6	
23 R/W	0x0016	0x00-0x01	Function LED -T7	
24 R/W	0x0017	0x00-0x01	Function LED -T8	
25 R/W	0x0018	0x00-0x01	Function LED -T9	
26 R/W	0x0019	0x00-0x01	Function LED -T10	
27 R/W	0x001A	0x00-0x01	Function LED -T11	
28 R/W	0x001B	0x00-0x01	Function LED -T12	
29 R/W	0x001C	0x00	Fade out display weekday	
		0x01	Display weekday in English	
		0x02	Display weekday in German (default)	
30 R/W	0x001D	0x00	Fade out display date	
		0x01	Display date in English (JJ.MM.TT)	
		0x02	Display date in German (TT.MM.JJ) (default)	
31 R/W	0x001E	0x00	Fade out display time	
		0x01	Display time including seconds	
		0x02	Display time without seconds (default)	
32 R/W	0x001F	0x00	Display time 24-hours-mode (default)	
		0x01	Display time 12-hours-mode	
33 R/W	0x0020	0x0000-0xFFFF	Updating interval of display in seconds (default = 0x0A)	
34 R/W	0x0021	0x0000-0x0C80	Min-Response-Time	signed int, (max 3100 ms) (default = 0x0A = 10 ms)
35 R/W	0x0022	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)	
36 R/W	0x0023	0x0000-0xFFFF	Upper adjustable range set temperature 1 (default = 0x001E) signed char, e.g. 30_{dez} = + 3.0 K	
37 R/W	0x0024	0x0000-0xFFFF	Lower adjustable range set temperature 1 (default = 0xFFE2) signed char, e.g. 30_{dez} = - 3.0 K	
38 R/W	0x0025	0x0000-0x00FF	Jumping distance with set temperature 1 (default = 0x05) signed char, e.g. 5_{dez} = +/- 0.5 K per button actuation	
39 R/W	0x0026	0x0000-0xFFFF	Set temperature 1 – Basic set point after reset	signed int, z.B. 220_{dez} = 22.0 °C (default = 0xDC = 22,0° C)

Register	Data Address	Value Range	Description	
40 R/W	0x0027	0x0000-0xFFFF	Upper adjustable range set temperature 2 (default = 0x001E) signed char, e.g. 30_{dez} = + 3.0 K	
41 R/W	0x0028	0x0000-0xFFFF	Lower adjustable range set temperature 2 (default = 0xFFE2) signed char, e.g. 30_{dez} = - 3.0 K	
42 R/W	0x0029	0x0000-0xFFFF	Jumping distance with set temperature 2 (default = 0x05) signed char, e.g. 5_{dez} = +/- 0.5 K pro Tastbetätigung	
43R/W	0x002A	0x0000-0xFFFF	Set temperature 2 – Basic set point after reset	signed int, z.B. 220_{dez} = 22.0 °C (default = 0xDC = 22,0° C)
44 R/W	0x002B	0x0000-0xFFFF	Upper adjustable range set percent value 1 (default = 0x64) signed char, e.g. 100_{dez} = + 100 %	
45 R/W	0x002C	0x0000-0xFFFF	Lower adjustable range percent value 1 (default = 0x00) signed char, e.g. 0_{dez} = 0 %	
46 R/W	0x002D	0x0000-0xFFFF	Jumping distance with set percent value 1 (default = 0x0A) signed char, e.g. 10_{dez} = +/- 10 % per button actuation	
47 R/W	0x002E	0x0000-0xFFFF	Set percent value 1 – Basic set point after reset	signed int, z.B. 10_{dez} = 10 % (default = 0 %)
48 R/W	0x002F	0x0000-0xFFFF	Upper adjustable range set percent value 2 (default = 0x64) signed char, e.g. 100_{dez} = 100 %	
49 R/W	0x0030	0x0000-0xFFFF	Lower adjustable range set percent value 2 (default = 0x00) signed char, e.g. 0_{dez} = 0 %	
50 R/W	0x0031	0x0000-0xFFFF	Jumping distance with set percent value 2 (default = 0x0A) signed char, e.g. 10_{dez} = +/- 10 % per button actuation	
51 R/W	0x0032	0x0000-0xFFFF	Set percent value 2 – Basic set point after reset	signed int, e.g. 10_{dez} = 10 % (default = 0 %)
52 R/W	0x0033	0x0000-0xFFFF	Upper adjustable range set point 1 (default = 0x64) signed char, e.g. 100_{dez} = + 100	
53R/W	0x0034	0x0000-0xFFFF	Lower adjustable range set point 1 (default = 0x00) signed char, e.g. 0_{dez} = 0	
54 R/W	0x0035	0x0000-0xFFFF	Jumping distance with set point 1 (default = 0x01) signed char, e.g. 1_{dez} = +/- 1 per button actuation	
55 R/W	0x0036	0x0000-0xFFFF	Set point 1 – Basic set point after reset	signed int, e.g. 50_{dez} = 50 (default = 50)
56 R/W	0x0037	0x0000-0xFFFF	Upper adjustable range set point 2 (default = 0x64) signed char, e.g. 100_{dez} = + 100	
57 R/W	0x0038	0x0000-0xFFFF	Lower adjustable range set point 2 (default = 0x00) signed char, e.g. 0_{dez} = 0	
58 R/W	0x0039	0x0000-0xFFFF	Jumping distance with set point 2 (default = 0x01) signed char, e.g. 1_{dez} = +/- 1 per button actuation	
59 R/W	0x003A	0x0000-0xFFFF	Set point 2 – Basic set point after reset	signed int, e.g. 50_{dez} = 50 (default = 50)
60 R/W	0x003B	0x0000-0x0003	Number of fan stages (default = 0x03)	
61 R/W	0x003C	0x0000-0xFFFF	Alarm time if no RS485-connection (default = 0x001E) (If no connection alarm symbol is displayed)	

3.4.2 Output Register

Register	Data Address	Value Range	Description	
257 – 273 R	**0x0100 – 0x0110**	**Measuring value (data output)**		
257 R	0x0100	0x0000-0xF0FF	bit0 button 12 1=pressed, 0=not pressed bit1 button 11 1=pressed, 0=not pressed bit2 button 10 1=pressed, 0=not pressed bit3 button 9 1=pressed, 0=not pressed bit4 button 8 1=pressed, 0=not pressed bit5 button 7 1=pressed, 0=not pressed bit6 button 6 1=pressed, 0=not pressed bit7 button 5 1=pressed, 0=not pressed bit8 button 4 1=pressed, 0=not pressed bit9 button 3 1=pressed, 0=not pressed bit10 button 2 1=pressed, 0=not pressed bit11 button 1 1=pressed, 0=not pressed	
258 R	0x0101	0x0000-0xF0FF	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 12 1=pressed, 0=not pressed bit1 button 11 1=pressed, 0=not pressed bit2 button 10 1=pressed, 0=not pressed bit3 button 9 1=pressed, 0=not pressed bit4 button 8 1=pressed, 0=not pressed bit5 button 7 1=pressed, 0=not pressed bit6 button 6 1=pressed, 0=not pressed bit7 button 5 1=pressed, 0=not pressed bit8 button 4 1=pressed, 0=not pressed bit9 button 3 1=pressed, 0=not pressed bit10 button 2 1=pressed, 0=not pressed bit11 button 1 1=pressed, 0=not pressed	
259 R	0x0102	0x0000-0xFFFF	Temperatur e	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 effektive	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 effektive	signed int, e.g. 220_{dez} = 22.0 °C Sum 0x26/0x27 + 0x104
264 R	0x0107	0x0000-0xFFFF	Sollwertprozent 1 offset	signed char, e.g. 5_{dez} = 5%
265 R	0x0108	0x0000-0xFFFF	Set percent value 1 effektive	signed int, e.g. 50_{dez} = 50% Sum 0x26/0x27 + 0x104
266 R	0x0109	0x0000-0xFFFF	Set percent value 2 offset	signed char, e.g. 5_{dez} = 5%

267 R	0x010A	0x0000-0xFFFF	Set percent value 2 effektive	signed int, e.g. 50_{dez} = 50% Sum 0x26/0x27 + 0x104
268 R	0x010B	0x0000-0xFFFF	Set point 1 offset	signed char, z.B. 15_{dez} = 15
269 R	0x010C	0x0000-0xFFFF	Set point 1 effektive	signed int, e.g. 45 = 45 Sum 0x26/0x27 + 0x104
270 R	0x010D	0x0000-0xFFFF	Set point value 2 offset	signed char, e.g. 15_{dez} = 15
271 R	0x010E	0x0000-0xFFFF	Set point value 2 effektive	signed int, e.g. 45 = 45 Sum 0x26/0x27 + 0x104
272 R	0x010F	0x0000-0x0004	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
273 R	0x0110	0x0000-0x0001	Room occupancy	0 – Room unoccupied 1 – Room occupied

3.4.3 Input Register

Register	Data Address	Value Range	Description
513 - 540	**0x0200 – 0x021B**	**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	Outdoor temperature signed int, e.g. 170_{dez} = 17.0°C fade in with Coil 0x0001
521 R/W	0x0208	0x0000-0xFFFF	ext. Temperature default 1 signed int, e.g. 234_{dez} = 23.4°C fade in with Coil 0x0002
522 R/W	0x0209	0x0000-0xFFFF	ext. Temperature default 2 signed int, e.g. 234_{dez} = 23.4°C fade in with Coil 0x0003
523 R/W	0x020A	0x0000-0xFFFF	ext. Percent default 1 signed int, e.g. 85_{dez} = 85 % fade in with Coil 0x0004
524 R/W	0x020B	0x0000-0xFFFF	ext. Percent default 2 signed int, e.g. 85_{dez} = 85 % fade in with Coil 0x0005
525 R/W	0x020C	0x0000-0xFFFF	ext. Value default 1 signed int, e.g. 45_{dez} = 45 with comma: signed int, e.g. 45_{dez} = 4,5 fade in with Coil 0x0006
526 R/W	0x020D	0x0000-0xFFFF	ext. Value default 2 signed int, e.g. 45_{dez} = 45 with comma: signed int, e.g. 45_{dez} = 4,5 fade in with Coil 0x0007
527 R/W	0x020E	0x0000-0xFFFF	Set point temperature 1 offset signed char, e.g. -25_{dez} = -2.5K fade in with Coil 0x0008

Register	Data Address	Value Range	Description	
528 R/W	0x020F	0x0000-0xFFFF	Set point temperature 2 offset	signed char, e.g. -25_{dez} = -2.5K fade in with Coil 0x0009
529 R/W	0x0210	0x0000-0xFFFF	Set point percent 1 offset	signed char, e.g. 5_{dez} = 5 % fade in with Coil 0x000A
530 R/W	0x0211	0x0000-0xFFFF	Set point percent 2 offset	signed char, e.g. 5_{dez} = 5 % fade in with Coil 0x000B
531 R/W	0x0212	0x0000-0xFFFF	Set point value 1 offset	signed char, e.g. 15_{dez} = 15 fade in with Coil 0x000C
532 R/W	0x0213	0x0000-0xFFFF	Set point value 2 offset	signed char, e.g. 15_{dez} = 15 fade in with Coil 0x000D
533 R/W	0x0214	0x0000-0xFFFF	Basic set point –temperature 1	signed char, e.g. 220_{dez} = 22 °C fade in with Coil 0x000E
534 R/W	0x0215	0x0000-0xFFFF	Basic set point -temperature 2	signed char, e.g. 220_{dez} = 22 °C fade in with Coil 0x000F
535 R/W	0x0216	0x0000-0xFFFF	Basic set point –percent value 1	signed char, e.g. 50_{dez} = 50 % fade in with Coil 0x0010
536 R/W	0x0217	0x0000-0xFFFF	Basic set point percent value 2	signed char, e.g. 50_{dez} = 50 % fade in with Coil 0x0011
537 R/W	0x0218	0x0000-0xFFFF	Basic set point - value 1	signed char, e.g. 45_{dez} = 45 fade in with Coil 0x0012
538 R/W	0x0219	0x0000-0xFFFF	Basic set point -value 2	signed char, e.g. 45_{dez} = 45 fade in with Coil 0x0013
539 R/W	0x021A	0x0000-0x0004	Fan stage	signed char, 0_{dez} = Off 1_{dez} = 1. Stage 2_{dez} = 2. Stage 3_{dez} = 3. Stage signed int, 0xFF00 = Auto off 0xFF01 = Auto1. Stage 0xFF02 = Auto 2. Stage 0xFF03 = Auto 3. Stage
540 R/W	0x021B	0x0000-0x0001	Room occupancy	0 – Room unoccupied 1 – Room occupied

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

3.5 Bit Allocation / Coil - Definition

3.5.1 Configuration Bits

Bit	Data Address	Description	
0x0000 – 0x0020	Configuration of operating panel Bit-Register, EEPROM- Data – !! Don't update permanently EEprom !!		
1 R/W	0x0000	Room temperture	1 = display 0 = do not display
2 R/W	0x0001	Outdoor temperature Value of 0x0207	1 = display 0 = do not display
3 R/W	0x0002	External temperature 1 value of 0x0208	1 = display 0 = do not display
4 R/W	0x0003	External temperature 2 value of 0x0209	1 = display 0 = do not display
5 R/W	0x0004	External percent 1 Value of 0x020A	1 = display 0 = do not display
6 R/W	0x0005	External percent 2 Value of 0x020B	1 = display 0 = do not display
7 R/W	0x0006	External value 1 without unit value of 0x020C	1 = dispaly 0 = do not display
8 R/W	0x0007	External value 2 without unit value of 0x020D	1 = display 0 = do not display
9 R/W	0x0008	Set temperature 1 offset value of 0x020E	1 = display 0 = do not display
10 R/W	0x0009	Set temperature 1 effective value of 0x0214	1 = display 0 = do not display
11 R/W	0x000A	Set temperature 2 offset Value of 0x020F	1 = display 0 = do not display
12 R/W	0x000B	Set temperature 2 effective value 0x0215	1 = display 0 = do not display
13 R/W	0x000C	Set point percent 1 offset Value of 0x0210	1 = display 0 = do not display
14 R/W	0x000D	Set point percent 1 effective Value of 0x0216	1 = display 0 = do not display
15 R/W	0x000E	Set point percent 2 offset Value of 0x0211	1 = display 0 = do not display
16 R/W	0x000F	Set point percent 2 effective Value of 0x0217	1 = display 0 = do not display
17 R/W	0x0010	Set point value 1 offset Value of 0x0212	1 = display 0 = do not display
18 R/W	0x0011	Set point value 1 effective Value of 0x0218	1 = display 0 = do not display
19 R/W	0x0012	Set point value 2 offset Value of 0x0213	1 = display 0 = do not display
20 R/W	0x0013	Set point value 2 effective Value of 0x0219	1 = display 0 = do not display

Bit	Data Address	Description	
0x0000 – 0x0020	**Configuration of Bit-Register, EEPROM- Data – !! Don't update permanently EEprom !!**		
21 R/W	0x0014	Display fan speed after reset	1 = display 0 = do not display
22 R/W	0x0015	Display room occupancy after reset	1 = display 0 = do not display
23 R/W	0x0016	Activate device by button press	1 = On 0 = off
24 R/W	0x0017	Reserved	
25 R/W	0x0018	°C/°F	1 = °C 0 = °F
26 R/W	0x0019	Display temperature	1 = with tenth point 0 = without tenth point
27 R/W	0x001A	Display value without unit	1 =fade in comma* 0 = fade out comma*
28 R/W	0x001B	Display with set point adjustment Temperature	1 = Set point effective 0 = Set point offset
29 R/W	0x001C	Display with set point adjustment Percent value	1 = Set point effective 0 = Set point offset
30 R/W	0x001D	Dispaly with set point adjustment Value	1 = Set point effective 0 = Set point offset
31 R/W	0x001E	Enable compatibility mode for fan control (available on firmware 1.15 or hiher). In older versions of the firmware WRF08 (firmware older/equal 1.3) the fan control was realized by the values 0, 1, 2, 3 (stage 0 … 3) and 4 (auto). Starting with version 1.4, the setting of the stage has been added to the automatic mode. So, since 1.4 the fan control is realized by the values 0, 1, 2, 3 (stage 0 … 3) and 0xFF00, 0xFF01, 0xFF02 and 0xFF03 (auto stage 0 … 3). If the WRF08 will be integrated into an existing project, in which the fan control is realized by the values 0, 1, 2, 3 and 4, Coil 31 must be activated to ensure compatibility. For new projects, this coil remain disabled and thus made the fan control by 0, 1, 2, 3, FF00, 0xFF01, 0xFF02 and 0xFF03.	
32 R/W	0x001F	Reserved	

* As for the display "value without unit" the comma can be faded-in respectively faded-out. If a comma is faded-in, a 45_{dez} in the display means a 4,5. If the comma remains faded-out and a 45_{dez} is sent, the display indicated a 45 .

3.5.2 Input Bits

Bit	Data Address	Description	
0x0100 – 0x010F	**Input values for the operating panel Bit-Register**		
257 R/W	0x0100	LED-button 12	1 = ON, 0 = OFF
258 R/W	0x 0101	LED-button 11	1 = ON, 0 = OFF
259 R/W	0x0 102	LED-button 10	1 = ON 0 = OFF
260 R/W	0x0 103	LED-button 9	1 = ON 0 = OFF
261 R/W	0x0 104	LED-button 8	1 = ON, 0 = OFF
262 R/W	0x 0105	LED-button 7	1 = ON 0 = OFF
263 R/W	0x 0106	LED-button 6	1 = ON, 0 = OFF
264 R/W	0x 0107	LED-button 5	1 = ON 0 = OFF
265 R/W	0x 0108	Symbol fault	1 = ON, 0 = OFF
266 R/W	0x 0109	Symbol heating	1 = ON, 0 = OFF
267 R/W	0x0 10A	Symbol cooling	1 = ON 0 = OFF
268 R/W	0x0 10B	Symbol window	1 = ON 0 = OFF
269 R/W	0x0 10C	Deactivate Button actuation	1 = ON 0 = OFF
270R/W	0x 010D	Deactivate Room occupancy	1 = ON 0 = OFF
271 R/W	0x 010E	Deactivate Fan speed	1 = ON 0 = OFF
272 R/W	0x 010F	Deactivate Set point	1 = ON 0 = OFF

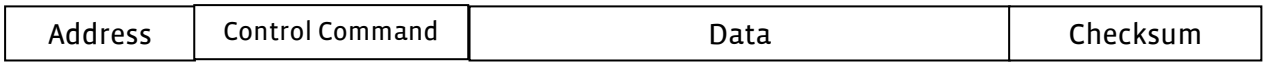
4 Data Transmission

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 only send back to the master, never to another slave.

4.2 Data Frame

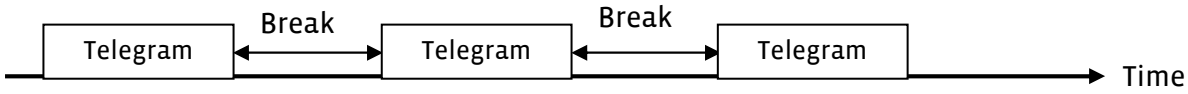
The datas are sent to the bus in accordance to severely defined defaults:



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.

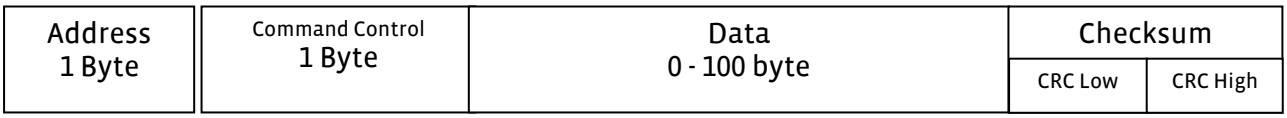
4.3 Transmission Mode RTU

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 * 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



4.3.2 Calculation of CRC-Checksum

The CRC checksum (Cyclicyal 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 large 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, Initialisierung
for(i = 0; i < Telegrammlänge-2; i++)
        crc = crc_calc(crc, Telegrammdaten[i]);

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

// Funktionsdefinition CRC Berechnen
unsigned int    crc_calc(unsigned int   crc_temp, unsigned int data)
{
        unsigned int    Index_CC=0;             // Schleifenzähler
        unsigned int    LSB=0;                  // Hilfsvariable

        // Exclusive-Oder des 8Bit-Char mit den unteren 8Bit von 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 polynominal 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 calcualted 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 significat ASCII character of the 8 bit large 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 < Telegrammlänge -4; i++)
        lrc = lrc + Telegrammdaten [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 3-60 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	08	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	08	00	02	CRC	

If button 1 or 2 is pressed, the set point for temperature a 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 Telegrame in Modus RTU**		
Description	Value (Hex)	Description		Value (Hex)
Slave address	02	Slave Adresse		02
Command	03	Command		03
Start address High	01	Number of Bytes		14
Start address Low	00	Register value High (0100)	Tasten 1-4	00
Number of Registers High	00	Register value Low (0100)	Tasten 5-12	08
Number of Registers Low	04	Register value High (0101)	Tasten 1-4	01
Check sum Low	CRC	Register value Low (0101)	Tasten 5-12	23
Check sum High		Register valueHigh (0102)	Temperatur	00
		Register value Low (0102)	Temperatur	DC
		Register value High (0103)	Sollwert offset	FF
		Register value Low (0103)	Temperatur 1	E7
		Check sum Low		CRC
		Check sum High		

5.1.2 Setting of Input Registers

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

Example: Setting of time: 14:23:47

Master - Telegram in the transmission mode TU:

Device	Command	Start address		Number of l Register		Number ofl 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: 23.01.2006

Master - Telegram in transmission mode RTU:

Device	Command	Start address		Number of Register		Number of Bytes	Data Register 516		Data Register 517		Datea 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	06	CRC	

Slave – Respones 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 commandl „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 – Respone 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“ (01_{hex} or 02_{hex}) one or more bits can be read out.

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

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	Bitwerte 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 WRF08-RS485 Modbus. It is possible to use any program producing Modbus telegrams and which is suitable to set registers.

7 Software Installation

For the installation of the configuration software, the setup file „ WRF08_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“

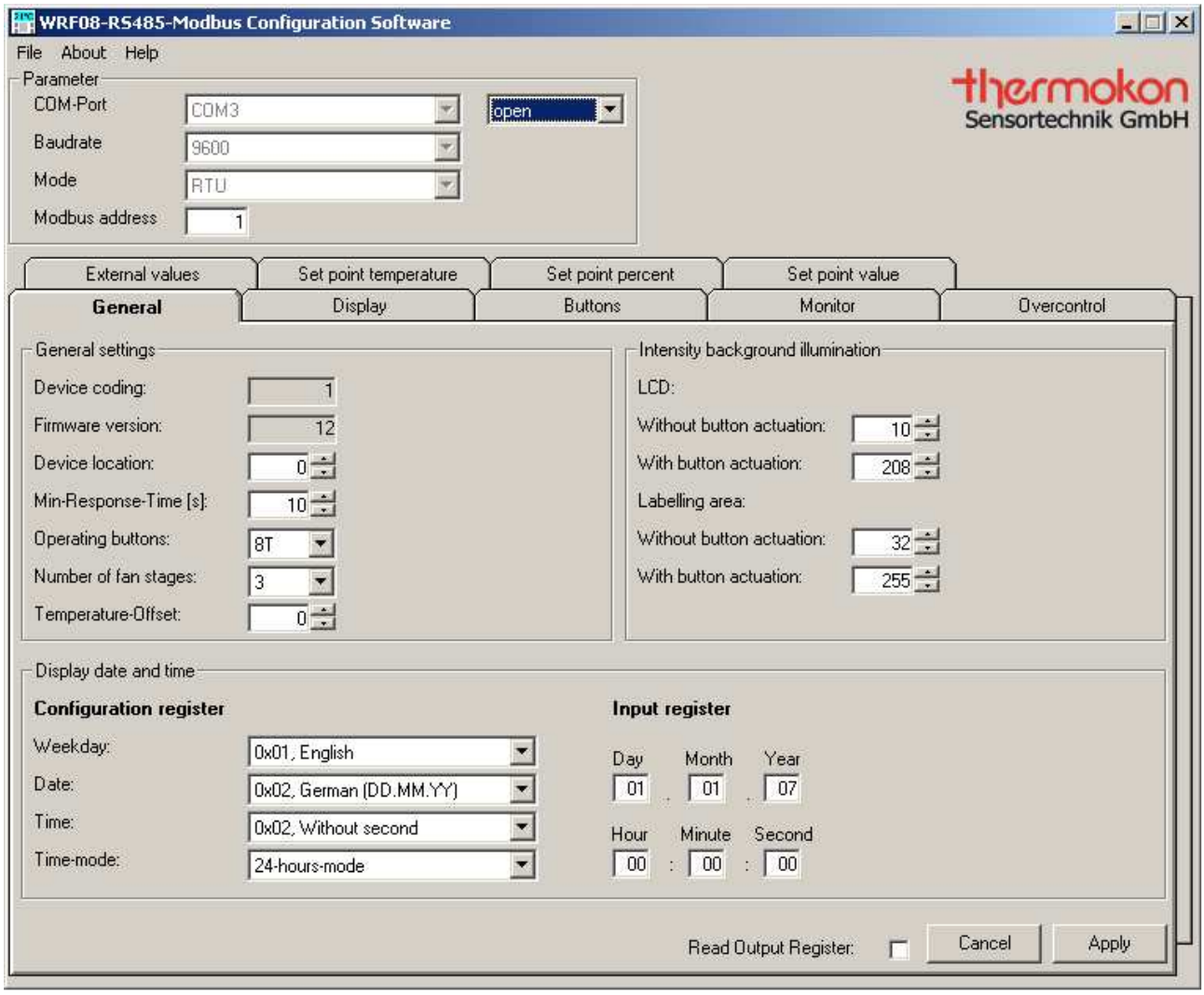
Operating systems supported: Windows9x; WindowsNT; WindowsMe; Windows2000; WindowsXP; WindowsServer

8 Configuration of WRF08-RS485-Modbus

8.1 Software configuration

By means of the configuration software the configuration registers can be clearly adjusted. Output registers of the WRF08 can be read out and input registers can be set. The load of the individual registers is described in chapter 3.4.

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 WRF08-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 comformity with the Modbus receiver, in order to produce a connection.

The following options can be selected:

- COM-Port
- Baud rate 9600 , 57600
- Parity even
- Modus for setting of transmission ASCII or RTU
- Modbus address (1-63)

In the field "Modbus address" the address of the WRF08-RS485 Modbus that shall be configured is entered (value between 1 and 63).

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

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

Changes are sent to the WRF08-RS485 Modbus after having pressed the button "take over". By actuating the button "Cancel" the registers of the WRF08-RS485-Modbus are read out again.

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

Picture 8-3: Data