

Protocol Description
WRF08 BACnet MS/TP RS485

Version 1.4, 22.04.2015

1 Index of changes

Version	Date	Description
1.0	26.04.2010	1st Draft
1.1	11.08.2010	Link options of configuration software adapted
1.2	16.08.2010	Subnet mask settings
1.3	23.12.2010	Added note to deactivate other BACnet stacks
1.4	22.04.2015	Configuration software example modified

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2 Introduction

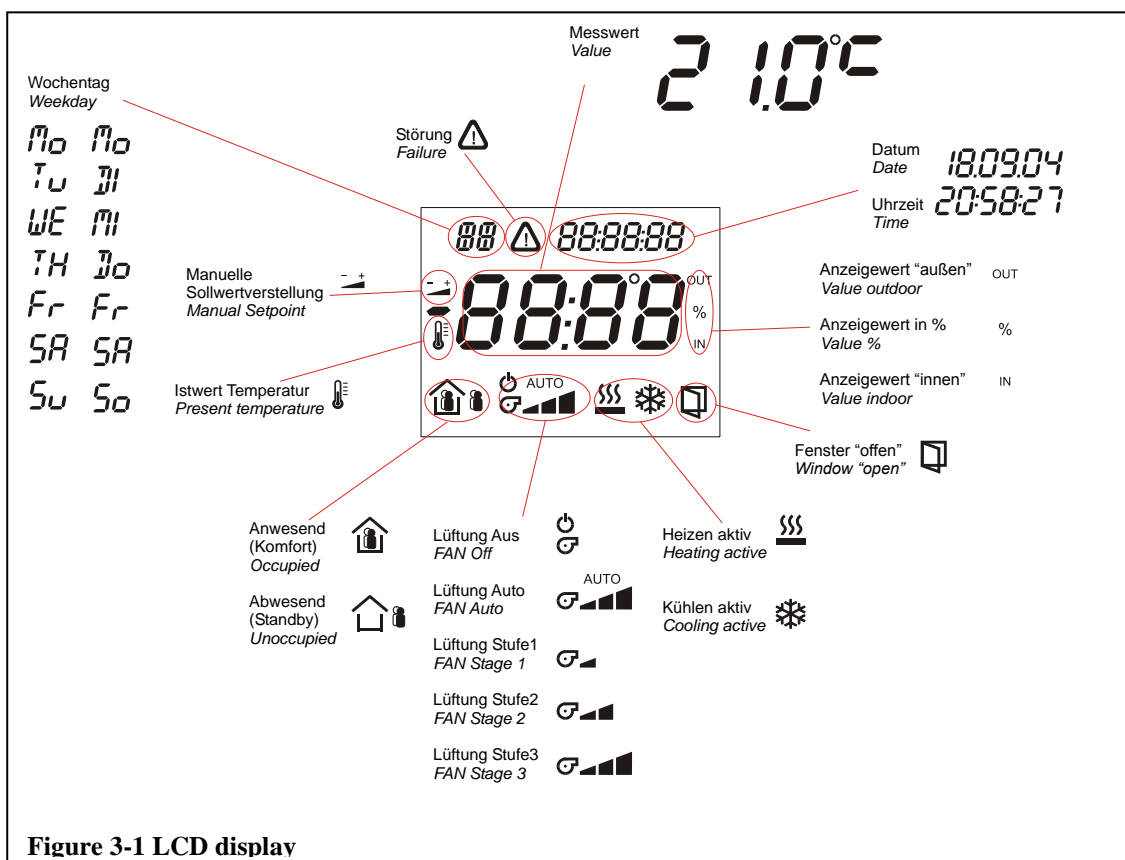
The present document describes the serial interface of the room operating panel WRF08 BACnet MS/TP-RS485.

For further information and definitions on the topic BACnet, please see www.big-eu.org.

3 Description

3.1 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 temperature is displayed. Which values shall be shown in the display can be adjusted by using the configuration software. A short description of the software can be found in chapter 7.

The following values can be indicated in the display:

- Room temperature, outdoor temperature,
- 4 external values with selectable unit
- 4 setpoints effective and offset with selectable unit
- Date, time and weekday
- symbols showing fan-coil stages, occupancy, fault, heating, cooling, window

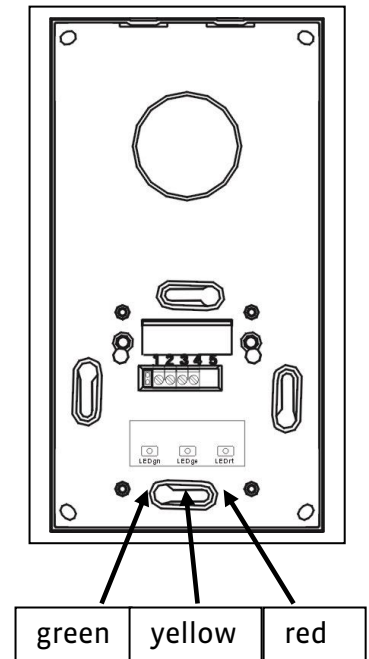
3.2 Lower part of device (base plate): LED-Display

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

UV: The **green** UV-LED is designed for the display of operation. In the standard operation, the LED is blinking in a 1s-cyclus.

RX/TX: The **yellow** RX/TX-LED is blinking for 500ms, if the device is addressed directly.

ERROR: The **red** Error-LED shows the status of the BUS communication. A constant lighting shows, that no valid communication is recognized at the BUS. A blinking LED shows, that a valid communication is recognized but that the device is not integrated in the token circulation. If the communication is valid and the participation in the token circulation is active, the LED is off.



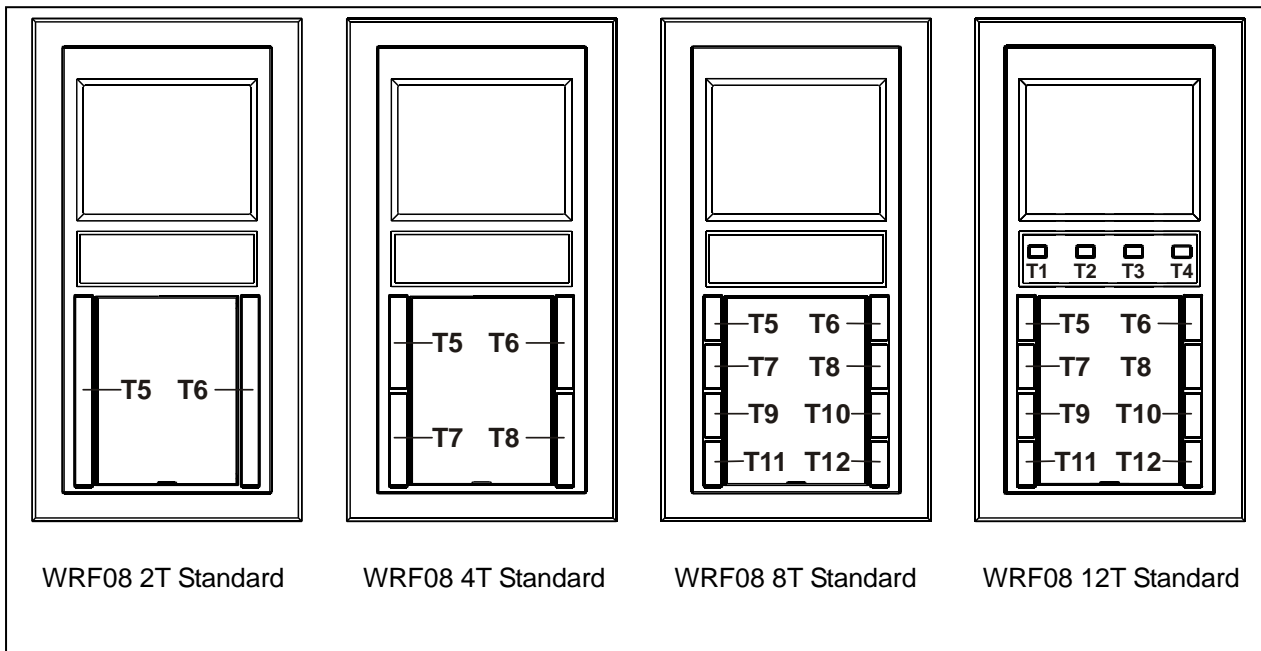
3.3 BACnet addressing

Each device in a BACnet network requires an unique device ID. The device ID is composed of the MAC address and a device ID offset. Both values can be modified in the modification menu.

The MAC address is the device address in the MS/TP network, the device ID is the device address in the BACnet network.

The default as supplied for the device-offset-id is 100. Device identifiers from 0 through 4194299 can be set by altering the device address or offset, after which the device is newly started and initialized.

3.4 Definition Button Numeration



The corresponding function of the button can be adjusted via the configuration software described in chapter 7.

The following button functions are possible:

- Button pressed / not pressed e.g. for light, blind
 - BACnet objekcs pushbutton_01 – pushbutton_12 (Typ BINARY_INPUT, BI1001-1012) show the current state of the buttons
- Adjustement of set point
 - Up to four set point offsets with selectable unit can be adjusted
 - When actuating the button, the corresponding set point is indicated in the display
 - The offsets can be overridden by the corresponding BACnet objects ext_setpoint_offset_x (type: Analog Value, AV1527-1530).
- Adjustement of fan stage
 - The current fan stage is automatically indicated in the display
 - The offsets can be overridden by the corresponding BACnet object ext_fan_coil_stage (type: MULTISTATE_VALUE, MV-1539).
- Adjustement of room occupancy
 - The current room occupancy is indicated in the display automatically.
 - The room occupancy can be overridden by the corresponding BACnet object ext_room_occupancy (type: BINARY_VALUE, BV-1540).

3.5 Modification menu

The following settings are possible: temperature calibration, setting the MAC address, baudrate and device-offset-ID.

Enter the modification menu:	Parallel actuation of the buttons T5, T7, T10 und T12 (8 button type) for a time exceeding 10s.
Switch to next menu:	Parallel actuation of the buttons T5, T7, T10 und T12 (8 button type) for a time exceeding 10s.
Kalibriermodus verlassen:	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.

Changed values getting valid after a warm start.

3.5.1 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.

Visualization 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

3.5.2 Setting the MAC address

Bus addresses can be set in the range of 1-127. The MAC-Adress is the device address in the MS/TP network!

Visualization MAC mode:	The button-response-LEDs T5, T7, T9 und T11 (left side) are on.
Set address:	Buttons T5 or T7 or T9 or T11 for - 1 Buttons T6 or T8 or T10 or T12 for + 1

3.5.3 Setting the baudrate

The following baudrates are supported:

- | | |
|---|--------|
| 1 | 9600 |
| 2 | 19200 |
| 3 | 38400 |
| 4 | 57600 |
| 5 | 76800 |
| 6 | 115200 |

Visualization Baud-Modus: The button-response-LEDs T6, T8, T10 und T12 (right side) are on.

Set baudrate: button T5 or T7 or T9 or T11 for the previous baudrate
button T6 or T8 or T10 or T12 for the next baudrate

In addition a bus terminating resistor 120 Ohm can be connected.

3.5.4 Setting the device-offset-ID

Setting the device-offset-ID takes place in four steps. In the first step, a change of the units is possible, afterwards a change of the hundred, then ten thousand and in the fourth step the millionth digit can be changed.

Visualization ID step 1: The button-response-LEDs T5 and T6

Visualization ID step 2: The button-response-LEDs T7 and T8

Visualization ID step 3: The button-response-LEDs T9 and T10

Visualization ID step 4: The button-response-LEDs T11 and T12

Set values: button T5 or T7 or T9 or T11 for **-1**

button T6 or T8 or T10 or T12 für **+1**

4 Hardware Installation

Devices can be connected by a twisted-pair cable (120 Ω line resistance). The maximum number of bus users (without use of a bus repeater) is defined by the RS485 transceiver.

For detailed information on installation and mounting, please see the product data sheet WRF08-RS485-Modbus and the data sheet wiring_rs485_network.pdf.

4.1 RS485 Transceiver

The maximum number of bus participants without use of a repeater is preset by the RS485-transceiver. The transceiver used allows 128 devices per bus segment at maximum.

In addition a bus terminating resistor 120 Ohm can be connected.

4.2 Protocol

The protocol used is the international standard BACnet MS/TP. This enables connection to appropriate remote terminals such as an automation station or a building services management system supporting the BACnet MS/TP protocol.

The standard defines the transmission parameters as 8N1, i.e. 8 data bits, no parity, 1 stop bit. The baud rate is freely selectable (9600, 19200, 38400, 57600, 76800, 115200), and is set in the modification menu. It is also possible to set the BACnet MAC address (bus address) of the device.

A different bus address is needed for each device!

4.2.1 BACnet Configuration Tool

BACnet MS/TP wireless receivers are always operated together with other BACnet automation stations or building services management systems such as BACnet operating workstations. All parameter settings are possible through a configuration software supplied by Thermokon.

Tools from the particular manufacturer of an automation station or building services management system are used to start up a BACnet network.

5 BACnet

5.1 BACnet Device Profile and BIBBs

The device is operating with the device profile BACnet Application Specific Controller (B-ASC).

The following BIBBs are implemented:

DS-RP-B	Data Sharing-ReadProperty-B
DS-WP-B	Data Sharing-WriteProperty-B
DS-RPM-B	Data Sharing-ReadPropertyMultiple-B
DS-COVU-B	Data Sharing-COV-Unsolicited-B
DM-DDB-B	Device Management-Dynamic Device Binding-B
DM-DOB-B	Device Management-Dynamic Object Binding-B
DM-DCC-B	Device Management-DeviceCommunicationControl-B
DM-TS-B	Device Management-TimeSynchronization-B

5.2 BACnet Objects

The room operating panel has 62 BACnet-Object. Two of these objects serve for the basic settings of the device. Five File-Objects serve for the configuration.

5.2.1 Description of objects for Basic Device Settings

Object_name	Object type / Instanz	Function
Thermokon_WRF08_BACnet	Device Object Offset-Device-ID+MAC-Adresse	The Device-Object makes the features for characterization of the device in the BACnet network available. Among others, the object list, the manufacturer and the software version is indicated. Additionally, basic settings like MAX-Master are possible.
Offset_device_id	Analogue Value 1 AV-1	This value plus the set MAC (0-127) corresponds to the device ID (writeable 0-4194200) after write, reset and new initialize.
COV-Mode	Multistate Value 1 MV-1	This setting is for COV mode. The following modes are supported: - Off - Local broadcast - Global broadcast
Configuration register file	File Object 1 FI-1	Designed for reading and writing of configuration properties by means of the configuration software.
Input registers file	File Object 2 FI-2	Designed for reading out of readable objects with the configuration software.
Holding registers file	File Object 3 FI-3	Designed for reading and writing of read- and writeable objects with the configuration software.
Configuration coils file	File Object 4 FI-4	Designed for reading and writing of the configuration bits by means of the configuration software.
Coils file	File Object 5 FI-5	Designed for reading and writing of read- and writeable binary objects with the configuration software.

Table 5-1 Description of objects for Basic Device Settings

5.2.2 Description of the read-only BACnet objects

Objekt_Name	Objekt Typ / Instanz	Funktion
pushbutton_01	BinaryInput-1001	Current state of button 1
pushbutton_02	BinaryInput-1002	Current state of button 2
pushbutton_03	BinaryInput-1003	Current state of button 3
pushbutton_04	BinaryInput-1004	Current state of button 4
pushbutton_05	BinaryInput-1005	Current state of button 5
pushbutton_06	BinaryInput-1006	Current state of button 6
pushbutton_07	BinaryInput-1007	Current state of button 7
pushbutton_08	BinaryInput-1008	Current state of button 8
pushbutton_09	BinaryInput-1009	Current state of button 9
pushbutton_10	BinaryInput-1010	Current state of button 10
pushbutton_11	BinaryInput-1011	Current state of button 11
pushbutton_12	BinaryInput-1012	Current state of button 12
room_temperature	AnalogInput-1259	Room temperature
setpoint_offset_1	AnalogInput-1260	Offset set point 1
setpoint_effective_1	AnalogInput-1261	Effective set point 1
setpoint_offset_2	AnalogInput-1262	Offset set point 2
setpoint_effective_2	AnalogInput-1263	Effective set point 2
setpoint_offset_3	AnalogInput-1264	Offset set point 3
setpoint_effective_3	AnalogInput-1265	Effective set point 3
setpoint_offset_4	AnalogInput-1266	Offset set point 4
setpoint_effective_4	AnalogInput-1267	Effective set point 4
fan_coil_stage	Multi-StateInput-1272	Fan coil stage
room_occupancy	BinaryInput-1273	Room occupancy

Table 5-2 Description of the read-only objects

5.2.3 Description of readable and writeable BACnet objects

Objekt_Name	Objekt Typ / Instanz	Bedeutung
outdoor_temperature	AnalogValue-1520	Outdoor temperature
ext_value_1	AnalogValue-1521	External value 1
ext_value_2	AnalogValue-1522	External value 2
ext_value_3	AnalogValue-1523	External value 3
ext_value_4	AnalogValue-1524	External value 4
ext_setpoint_offset_1	AnalogValue-1527	Set point 1 offset
ext_setpoint_offset_2	AnalogValue-1528	Set point 2 offset
ext_setpoint_offset_3	AnalogValue-1529	Set point 3 offset
ext_setpoint_offset_4	AnalogValue-1530	Set point 4 offset
base_setpoint_1	AnalogValue-1533	Basic set point 1
base_setpoint_2	AnalogValue-1534	Basic set point 2
base_setpoint_3	AnalogValue-1535	Basic set point 3
base_setpoint_4	AnalogValue-1536	Basic set point 4
ext_fan_coil_stage	MultiStateValue-1539	External fan coil stage
ext_room_occupancy	BinaryValue-1540	External room occupancy
led_button_12	BinaryValue-2257	LED button 12 on/off
led_button_11	BinaryValue-2258	LED button 11 on/off
led_button_10	BinaryValue-2259	LED button LED10 on/off
led_button_9	BinaryValue-2260	LED button LED9 on/off
led_button_8	BinaryValue-2261	LED button LED8 on/off
led_button_7	BinaryValue-2262	LED button LED7 on/off
led_button_6	BinaryValue-2263	LED button LED6 on/off
led_button_5	BinaryValue-2264	LED button LED5 on/off
symbol_fault	BinaryValue-2265	Symbol fault on/off
symbol_heating	BinaryValue-2266	Symbol heating on/off

Objekt_Name	Objekt Typ / Instanz	Bedeutung
symbol_cooling	BinaryValue-2267	Symbol cooling on/off
symbol_window	BinaryValue-2268	Symbol window on/off
lock_buttons	BinaryValue-2269	Deactivate Button actuation
lock_occupancy	BinaryValue 2270	Deactivate Room occupancy
lock_fan_coil	BinaryValue 2271	Deactivate Fan speed
lock_setpoint	BinaryValue 2272	Deactivate Set point

Table 5-3 Description of readable and writeable objects

5.3 Description of configuration properties

5.3.1.1 File Objekt 1 - Configuration register file

The following table lists all properties of File Object 1 . These properties can be modified using the Thermokon configuration software.

Index	Beschreibung	Value range	Default
1	Intensity background illumination LCD, after 15s without button actuation (rest)	0 – 100%	10%
2	Intensity background illumination LCD with button actuation (active)	0 – 100%	100%
3	Intensity background illumination labelling area after 15s without button actuation (rest)	0 – 100%	10%
4	Intensity background illumination labelling area with button actuation (active)	0 – 100%	100%
5	Function button -T1	without special function (default) Set point 1 + Set point 1 – Set point 2 + Set point 2 – Set point 3 + Set point 3 – Set point 4 + Set point 4 – Fan stage Plus with "AUTO" Fan stage Minus with "AUTO" Fan stage Plus without "AUTO" Fan stage Minus without "AUTO" Fan stage only "AUTO" Room unoccupied Room occupied	without special function
6	Function button -T2		without special function
7	Function button -T3		without special function
8	Function button -T4		without special function
9	Function button -T5		without special function
10	Function button -T6		without special function
11	Function button -T7		without special function
12	Function button -T8		without special function
13	Function button -T9		without special function
14	Function button -T10		without special function
15	Function button -T11		without special function
16	Function button -T12		without special function
17	Function LED -T5	without special function – (LED controllable via BI 2257) button – (LED = ON if button is pressed LED = OFF if button is not pressed)	button
18	Function LED -T6		button
19	Function LED -T7		button
20	Function LED -T8		button
21	Function LED -T9		button

Index	Beschreibung	Value range	Default
22	Function LED -T10		button
23	Function LED -T11		button
24	Function LED -T12		button
25	Display weekday	off english german	off
26	Display date	off english german	off
27	Display time	off Display time including seconds Display time without seconds	off
28	Display time mode	24h – mode 12h - mode	24h – mode
29	Updating interval of display in seconds	0 .. 255s	10s
30	Temperature-Offset for calibration of temperature sensor	-10K .. +10K	0K
31	Upper adjustable range set point 1	0 .. +100 unit depends on setting	+3
32	Lower adjustable range set temperature 1	-100 .. 0 unit depends on setting	-3
33	Step range set point 1	0 .. 100 unit depends on setting	0.5
34	Basic set point after reset – set point 1	0 .. 100 unit depends on setting	22
35	Upper adjustable range set point 2	-100 .. +100 unit depends on setting	+3
36	Lower adjustable range set point 2	-100 .. +100 unit depends on setting	-3
37	Step range set point 2	0 .. 100 unit depends on setting	0.5
38	Basic set point after reset – set point 2	0 .. 100 unit depends on setting	22
39	Upper adjustable range set point 3	-100 .. +100 unit depends on setting	+3
40	Lower adjustable range set point 3	-100 .. +100 unit depends on setting	-3

Index	Beschreibung	Value range	Default
41	Step range set point 3	0 .. 100 unit depends on setting	0.5
42	Basic set point after reset – set point 3	0 .. 100 unit depends on setting	22
43	Upper adjustable range set point 4	-100 .. +100 unit depends on setting	+3
44	Lower adjustable range set temperature 4	-100 .. +100 unit depends on setting	-3
45	Step range set point 4	0 .. 100 unit depends on setting	0.5
46	Basic set point after reset – set point 4	0 .. 100 unit depends on setting	22
47	Fan coil stages	1 – 3	3
48	Unit set point 1	temperature percent no unit	temperature
49	Unit set point 2		temperature
50	Unit set point 3		temperature
51	Unit set point 4		temperature
52	Unit value 1	temperature percent no unit	temperature
53	Unit value 2		temperature
54	Unit value 3		temperature
55	Unit value 4		temperature
56	COV-Increment temperature	0 .. 10K	0.5K
57	COV-Increment percent	0 .. 10%	1%
58	COV-Increment no unit	0 .. 10	1
59	Lock external values	0 .. 255s	5s

Table 5-4 Description of configuration properties in File Object 1

5.3.1.2 5.3.1.2 File Objekt 4 - Configuration coil file

The following table lists all properties of File Object 4. These properties can be modified using the Thermokon configuration software.

Index	Beschreibung	Wertebereich	Grund-einstellung
1	Display room temperature (internal sensor)	on/off	on
2	Display outdoor temperature (present value from AV-1520)	on/off	off
3	Display external value 1 (present value from AV-1521)	on/off	off
4	Display external value 2 (present value from AV-1522)	on/off	off
5	Display external value 3 (present value from AV-1523)	on/off	off
6	Display external value 4 (present value from AV-1524)	on/off	off
7	Display set point 1 offset	on/off	off
8	Display set point 1 effective	on/off	off
9	Display set point 2 offset	on/off	off
10	Display set point 2 effective	on/off	off
11	Display set point 3 offset	on/off	off
12	Display set point 3 effective	on/off	off
13	Display set point 4 offset	on/off	off
14	Display set point 4 effective	on/off	off
15	Display fan coil stage after reset	on/off	on
16	Display room occupancy after reset	on/off	on
17	Activate device by button press	on/off	off
18	Unit temperature	°C / °F The selection is valid for all objects which have temperature units (set points, external values, room temperature, outdoor temperature) !	°C
19	Display temperature	fade in/fade out tenth point	fade in tenth point
20	Display value without unit	fade in/fade out Komma	fade in comma
21	Display with set point 1 adjustment	offset/effective	offset
22	Display with set point 2 adjustment	offset/effective	offset

Index	Beschreibung	Wertebereich	Grund-einstellung
23	Display with set point 3 adjustment	offset/effective	offset
24	Display with set point 3 adjustment	offset/effective	offset

Table 5-5 Description of configuration properties in File Object 4

5.3.2 BACnet Device Object

5.3.2.1 Device object -> MAX-Master property

This property can be written between 0 and 127 and defines up to which address further users are polled on the bus. It is an MS/TP-specific property.

5.3.2.2 Device object-> Object identifier

Each device in a BACnet network requires a unique device ID. The device offers two ways of altering the ID. The device ID is composed of the MAC address, produced by the address DIP switch, and a device ID offset, written by a BACnet object. The default as supplied for this object is 100, the default MAC address is 127 arising a device id of 227. Device identifiers from 0 through 4194299 can be set by altering the MAC address or offset, after which the device is newly started and initialized.

5.3.2.3 Device object-> object name, description

These two properties are writeable, with a maximum text length of 64 characters. The object name property must also be unique within a BACnet network.

6 Function Description

6.1.1 COV-Treating

The functionality can be selected with the multistate value object (MV-1). Writing the present value property (1-3) selects the COV mode. The following settings can be made:

Index	Name	Description
1	no cov	COV-Service is deactivated. Values can only be read using the ReadProperty-service.
2	local cov	COV-Service is activated. Values are sent as a local broadcast message (only MS/TP network).
3	global cov	COV-Service is activated. Values are sent as a global broadcast message (global BACnet network).

Table 6-1 Setting the COV-service

Configuration		
Index	Name	Beschreibung
<i>File Object 1</i> <i>Index 57</i>	COV-Increment temperature	If a temperature value changes by the adjusted value COV-Increment temperature, the new temperature value is transmitted as a COV-service
<i>File Object 1</i> <i>Index 58</i>	COV-Increment percent	If a percent value changes by the adjusted value COV-Increment percent, the new percent value is transmitted as a COV-service.
<i>File Object 1</i> <i>Index 59</i>	COV-Increment no unit	If a no unit value changes by the adjusted value COV-Increment no unit, the new no unit value is transmitted as a COV-service.

Table 6-2 COV-service parameters

6.1.2 Display

By means of the following configuration properties the indication of the display can be changed. It is possible to adjust different brightness values for the LCD display and the label area. Furthermore, the interval for the toggling of the display in the LCD can be changed.

Configuration		
Index	Name	Description
<i>File Object 1</i> <i>Index 1</i>	Intensity background illumination LCD, after 15s without button actuation (rest)	If no button is pushed for 15s, the device falls back in the sleeping mode. Values between 0 (OFF) and 100% can be adjusted.
<i>File Object 1</i> <i>Index 2</i>	Intensity background illumination LCD with button actuation (active)	Upon button actuation the device is back in the active mode. Values between 0 (OFF) and 100% can be adjusted.
<i>File Object 1</i> <i>Index 3</i>	Intensity background illumination labelling area after 15s without button actuation (rest)	If no button is pushed for 15s, the device falls back in the sleeping mode. Values between 0 (OFF) and 100% can be adjusted.
<i>File Object 1</i> <i>Index 4</i>	Intensity background illumination labelling area with button actuation (active)	Upon actuation of a button, the device is back in the active mode. Values between 0 (OFF) and 100% can be adjusted.
<i>File Object 1</i> <i>Index 29</i>	Updating interval of display in seconds	Interval for the toggling of the display to the next value in seconds to be displayed.

Table 6-3 Display parameters

6.1.3 Buttons and LED

The WRF08_BACnet is available in the types 2T, 4T, 8T and 12T. Every button can be field programmed. Buttons T5-T12 have an additional LED. The function of the LED is also be field programmable.

Output		
Type	Name	Description
<i>Binary Input Object</i> 1001 - 1012	pushbutton_xx	Current button state

Table 6-4 Objects for status message of buttons

Input		
Type	Name	Description
<i>Binary Value Object</i> 2258 - 2264	led_button_xx	Control of LED by a higher-level system.
<i>Binary Value Object</i> 2269	lock_buttons	Via this object the buttons to which no special function is assigned, are locked.

Table 6-5 Objects for control of LED

Configuration		
Index	Name	Description
<i>File Object 1</i> Index 5-16	Function button Tx	Here the configuration of the corresponding button function is made.
<i>File Object 1</i> Index 17-24	Function LED Txx	Optionally, the LEDs can be coupled to the button or set via the network.

Table 6-6 Button configuration properties

6.1.4 Set Points

Up to 4 set points can be indicated in the display as effective or offset values. The unit can be adjusted individually for each set point. A change of the set point is feasible via the buttons or the network. As output values the effective set point and the adjusted offset are made available.

Output		
Type	Name	Description
<i>Analog Input Object</i> 1260, 1262, 1264, 1266	setpoint_offset_x	Current set point offset. Can be changed by the user by means of button actuation or via the input object ext_setpoint_offset_x. After a manual set point adjustment, the input object ext_setpoint_offset_x can be deactivated for a selectable time (see locking of parameter external default). Thus, it can be prevented, that the user inputs are directly overwritten by network updates.
<i>Analog Input Object</i> 1261, 1263, 1265, 1267	setpoint_effective_x	The effective set point is calculated of the set point offset and the basic set point.

Table 6-7 Set point output objects

Input		
Type	Name	Description
<i>Analog Value Object</i> 1527-1530	ext_setpoint_offset_x	External default of offset by a higher-level system.
<i>Analog ValueObject</i> 1533-1536	base_setpoint_x	External default of a basic set point by a higher-level system. As long as no valid value is received in this object, the value of the configuration property basic set point after reset is valid.
<i>Binary Value Object</i> 2272	lock_setpoint	Locks the buttons of the set point adjustment.

Table 6-8 Set point input objects

Configuration		
Index	Name	Description
<i>File Object 1</i> <i>Index 31, 35, 39, 43</i>	Upper adjustable range	Threshold value for upper range of set point offset adjustment by means of the buttons.
<i>File Object 1</i> <i>Index 32, 36, 40, 44</i>	Lower adjustable range	Threshold value for lower range of set point offset adjustment by means of the buttons.
<i>File Object 1</i> <i>Index 33,37,41,45</i>	Step range	Determines the step range of the manual set point adjustment by means of the buttons.
<i>File Object 1</i> <i>Index 34, 38, 42, 46</i>	Basic set point after reset	After a restart of the device, the value adjusted here is used as a basic set point. This value remains valid as long as another value is received by the input object <code>base_setpoint_x</code> .
<i>File Object 1</i> <i>Index 48, 49, 50, 51</i>	Unit	For every set point the unit can be freely selected. For selection <i>temperature</i> , <i>percent</i> and <i>no unit</i> are available. Display of temperature is depending on the property <i>unit temperature</i> . (see File-Objekt4, Index 18)
<i>File Object 4</i> <i>Index 7, 9, 11, 13</i>	Display offset value	Here it can be selected if the offset value shall be displayed.
<i>File Object 4</i> <i>Index 8, 10, 12, 14</i>	Display effective value	Here it can be selected if the effective value shall be displayed.
<i>File Object 4</i> <i>Index 21, 22, 23, 24</i>	Display with adjust-ment	Selection of set point display upon change of button. It is possible to display the effective set point or the set point offset.

Table 6-9 Set point configuration parameters

6.1.5 External Values

Up to four external values (defaults of a higher-level station) can be displayed. The unit of each value can be freely chosen.

Input		
Type	Name	Description
<i>AnalogValue</i> 1521 - 1524	ext_value_1-4	External default for external values for indication in the display.

Table 6-10 External value objects

Configuration		
Index	Name	Description
<i>File Object 1</i> Index 52-55	Unit	Free selectable between <i>temperature</i> , <i>percent</i> and <i>no unit</i>
<i>File Object 4</i> Index 3-6	Display	The display can be switch on/off for every external value.

Table 6-11 External value parameters

6.1.6 Room Occupancy

Room occupancy can be changed by a higher-level BMS as well as locally via the buttons. The current status is determined by the value updated latestly as both types have equal rights. An exception is the possibility to lock the external default. See chapter 6.1.10! Local change of room occupancy can be locked by the BMS.

Output		
Type	Name	Description
Binary Input 1273	room_occupancy	Outputs the current status of room occupancy.

Table 6-12 Room occupancy output objects

Input		
Type	Name	Description
Binary Value 1540	ext_room_occupancy	External default of room occupancy by a higher-level system. After a local adjustment of the room occupancy the input object ext_room_occupancy can be deactivated for a selectable time (see property lock external default). Thus, it can be prevented that user input is directly overwritten by network updates.
Binary Value 2270	lock_occupancy	Locks the button for room occupancy.

Table 6-13 Room occupancy input objects

Configuration		
Index	Name	Description
File Object 1 Index 5-16	Function button Tx	Here any button can be assigned to the room occupancy. The allocations „room occupied“ and „room unoccupied“ are feasible.
File Object 4 Index 16	Display room occupancy after reset	After the boot up of the device, the room occupancy is faded in automatically. If the setting is deactivated, the occupancy is faded in as soon as it has changed, regardless whether locally changed or by an update via the network.

Table 6-14 Room occupancy properties

6.1.7 Fan coil

The fan stage can be changed by a higher-level system or locally via a button.

Up to 3 fan stages are feasible. It can be distinguished between manual or automatic mode.

Output		
Type	Name	Description
<i>MultiStateInput</i> 1272	fan_coil_stage	Indicates the current status of the fan stages.

Table 6-15 Fan coil output objects

Input		
Type	Name	Description
<i>Binary Value</i> 1539	ext_fan_coil_stage	External default of the fan stage by a higher-level system. After a local setting of the fan stages the input object ext_fan_coil_stage can be deactivated for a selectable (see Property lock external default). Thus, it can be prevented that the user input is directly overwritten by a network update.
<i>Binary Value</i> 2270	lock_fan_coil	Locks the buttons of the fan stages.

Table 6-16 Fan coil input objects

Configuration		
Index	Name	Description
<i>File Object 1</i> <i>Index 5-16</i>	Function Taste Tx	Here any button can be assigned to the change of a fan stage. Possibilities for this setting can be found in the description of the button functions.
<i>File Object 4</i> <i>Index 16</i>	Display fan coil after reset	After the boot up of the device, the fan stage is faded in automatically. If the setting is deactivated, the fan stage is faded in as soon as it has changed, regardless whether locally or by an update via the network.

Table 6-17 Fan coil parameters

6.1.8 Date and Time

For setting of time and date, the TimeSynchronization Service is used. This service is designed for Synchronization of the time within the same time zones. In the Device Object, time and date of a device can be inquired via the features localDate and localTime. For the indication in the display, note that time and date are only faded in, if the device received a valid time or a valid date via the TimeSynchronization Service.

Configuration		
<i>File Object1</i> <i>Index 25</i>	Display weekday	Fading in of weekday. If the weekday shall be faded in, it can be selected between German and English display.
<i>File Object1</i> <i>Index 26</i>	Display date	Fading in of date. If the date shall be faded in, it can be selected between German and English display
<i>File Object1</i> <i>Index 27</i>	Display time	Fading in of time. If the time shall be faded in, it can be selected between display with and without seconds.
<i>File Object1</i> <i>Index 28</i>	Display time mode	The time can be displayed in 12h or 24h mode.

Table 6-18 Date and time properties

6.1.9 Symbols

In the display the symbols failure, heating, cooling and window can be indicated.

Input:		
Type	Name	Description
BinaryValue 2265	symbol_fault	The symbol „failure“ can be faded in and out via a higher-level system.
BinaryValue 2266	symbol_heating	The symbol „heating active“ can be faded in and out via a higher-level system.
BinaryValue 2267	symbol_cooling	The symbol „cooling active“ can be faded in and out via a higher-level system.
BinaryValue 2268	symbol_window	The symbol „window open“ can be faded in and out via a higher-level system.

Table 6-19 Symbols

6.1.10 Lock External Values

Changes made by the user for set points, room occupancy or fan stages via the buttons are decoupling the corresponding BACnet input objects from the internal calculations. After expiration of the adjusted time, the input objects are released again. Thus, it is guaranteed, that the user inputs are not directly overwritten by via the network. The values can be synchronized via the network.

Configuration		
<i>Index 59</i>	Lock external values	<p>The locking becomes active upon changes of the room occupancy, fan stages and set points.</p> <p>If the room occupancy is changed by the user, the object ext_room_occupancy (BinaryValue-1540) is decoupled.</p> <p>If the fan stage is changed by the user, the object ext_fan_coil_stage (MultiStateValue-1539) is decoupled.</p> <p>If a set point is changed by the used, the corresponding object ext_setpoint_offset_x (AnalogValue-1527-1530) is decoupled.</p>

Table 6-20 Lock external values

7.3 Configuration of WRF08-BACnet

7.3.1 Start

After having started the software, the following starting window is shown.

A screenshot of a Windows-style dialog box titled "Choose a device". It has a blue title bar with a close button. The dialog is divided into two main sections. The top section contains two text input fields labeled "User name" and "Password", followed by "Login" and "Cancel" buttons. The bottom section is labeled "Please choose the device type:" and contains a dropdown menu with "WRF08_BACnet" selected, and an "Ok" button at the bottom.

Figure 7-2 Login

For the start, no user name and no password must be mentioned. In the user management, a new user should be created afterwards. As soon as a new user is created, the fields for user name and password must be filled in, accordingly. A registration without valid inputs in these fields is no longer possible, thus.

A screenshot of a Windows-style dialog box titled "Choose a device". It has a blue title bar with a close button. The dialog is divided into two main sections. The top section contains two text input fields labeled "User name" and "Password", followed by "Login" and "Cancel" buttons. The bottom section is labeled "Please choose the device type:" and contains a dropdown menu with "WRF08_BACnet" selected, and an "Ok" button at the bottom.

Figure 7-3 Select a device

After successful registration, the field for device selection is released. When confirming the selection with OK, the main window is entered.

7.3.2 Main window

The main window is divided in the following areas:

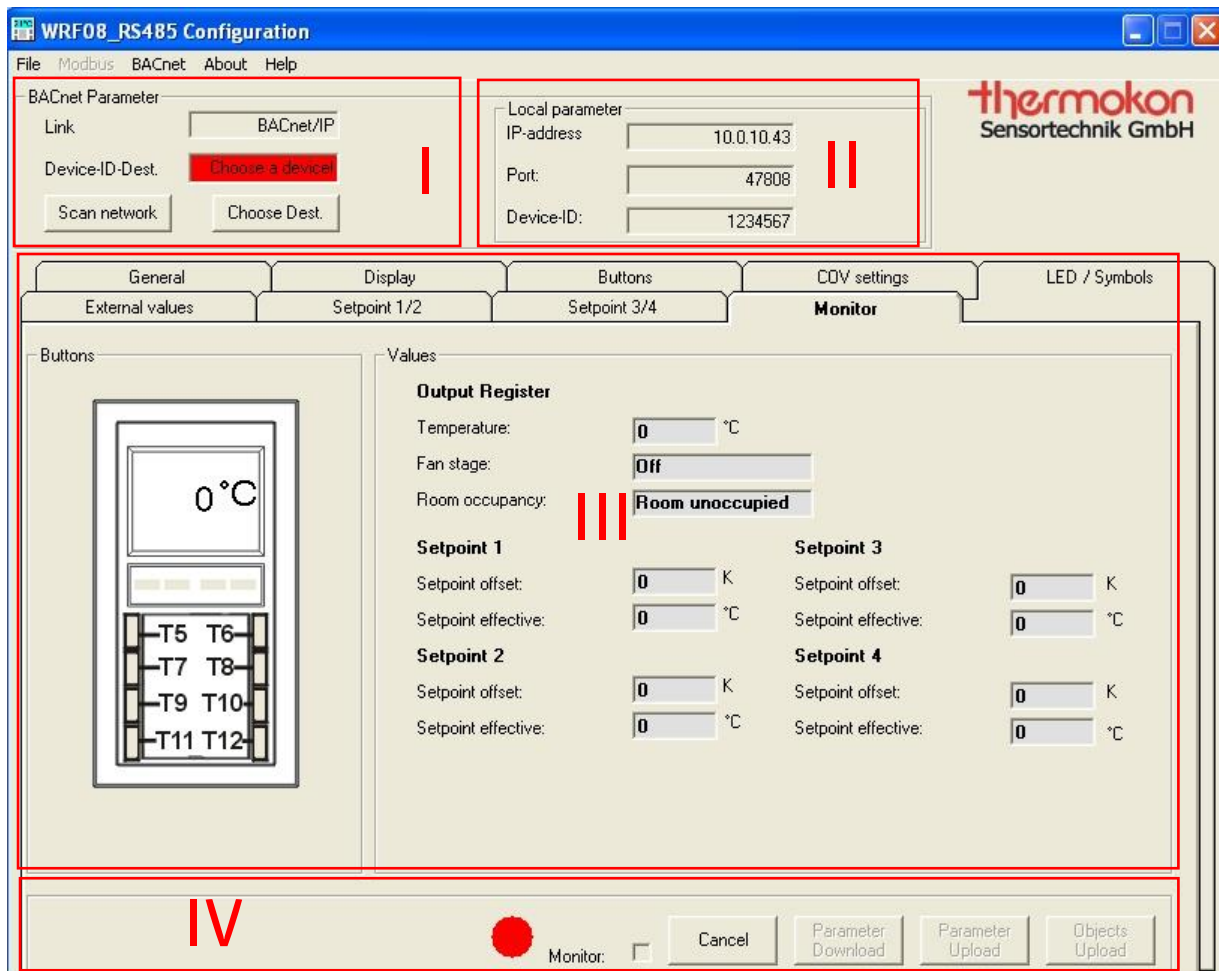


Figure 7-4 Main window

I. Network scan and Destination

The BACnet network is scanned for WRF08 devices. Afterwards, the device that shall be configured is selected from the list. The link shows if the search for the devices in the IP network or in another local MS/TP network shall be carried out. Therefore, the PC/Laptop must be included in the RS485 line via an interface converter.

Local properties

The BACnet properties are indicated, which were executed in the menu BACnet-> settings of user. The display of the properties is depending on link set by the user.

Device configuration

Here all properties for the configuration of the WRF08 can be set. Moreover, the device can be tested in the monitor operation or monitored.

Action bar

The user has the option to supervise, read out or to write the device (monitor).

7.3.3 Menu

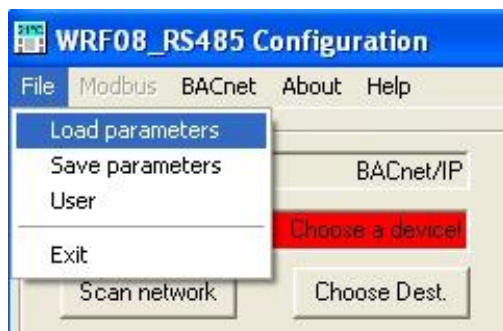


Figure 7-5 Menu: File

Load parameters:

Save parameters:

User:

Configuration saved before are loaded.

The current configuration is saved in a text file.

Opens a menu for user management.

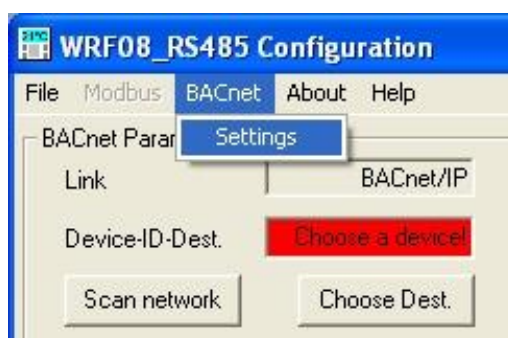


Figure 7-6 Menu BACnet

Settings:

Setting of properties for access to the BACnet network.

7.3.3.1 User management



Figure 7-7 User management window

After selection of the menu point, the window shown above is opened. In the upper part of the window the entered users are listed. In the lower part users can be created and deleted, accordingly.



Figure 7-8 Create a new user

For creating a new user, you must be registered as administrator. The user name of the new user as well as a password must be entered. It is also possible to create users without administrator rights. In this case, the users only have read access to the WRF08.

7.3.3.2 BACnet network properties

In the window BACnet network properties all properties for control of the access to the BACnet network can be made.

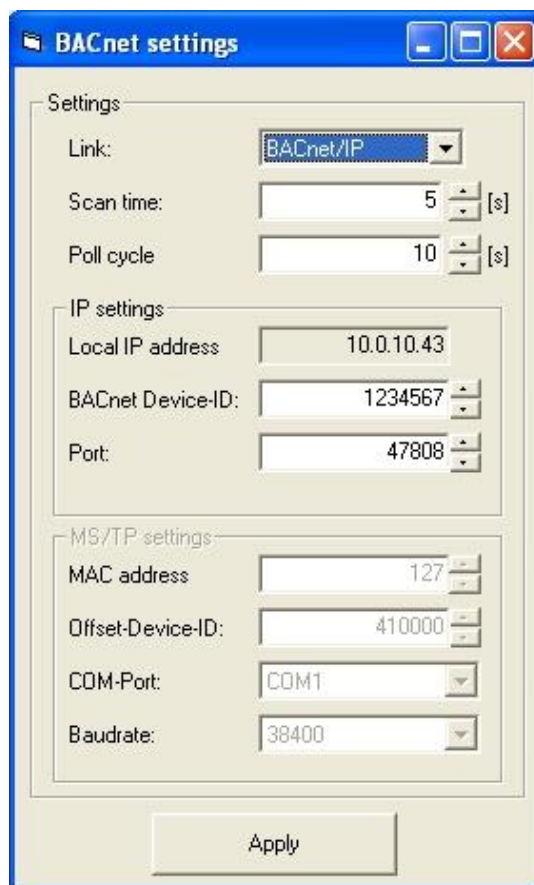


Figure 7-9 BACnet network properties

Settings:

Link:	Selection between the access via BACnet/IP or BACnet MS/TP. Actually only the IP-Link is available!
Scan Time:	Determines how long a tool waits for response from the BACnet network during the network scan.
Poll Cycle:	Determines the cycle time in which the device is queried if the monitor function is activated.

IP settings:

Local IP address:	Local IP-address of the computer. It cannot be changed!
BACnet Device-ID:	Setting of the device-ID with which the configuration tool shall be shown in the network.
Port:	The Port by which the access to the network is made.

MS/TP settings:

Not implemented

7.3.4 Network Scan and Destination Selection

Before a device in the network is accessed or before a device can be selected from the list, the network must be scanned for devices.

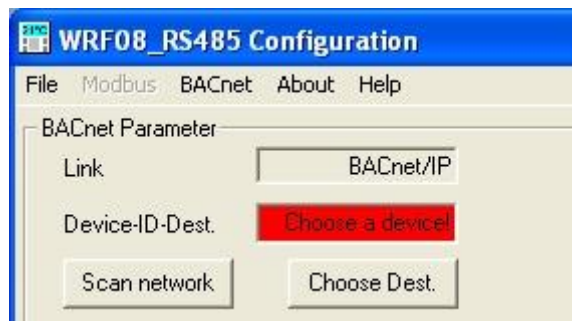


Figure 7-10 Network scan and destination

After „Scan network“ is selected, a new window is shown. Here it can be adjusted in which address range devices shall be searched.

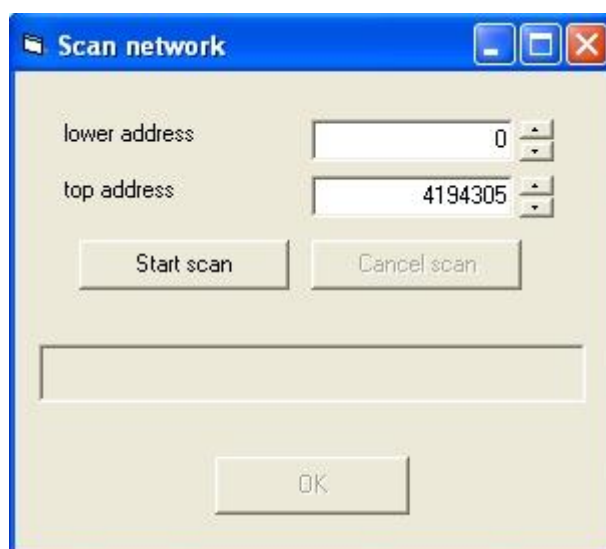


Figure 7-11 Network scan window

If the scan was ended successfully, the desired device can be selected from the list. For opening the list, „Choose Dest“ must be confirmed in the main window.

The device list appears.

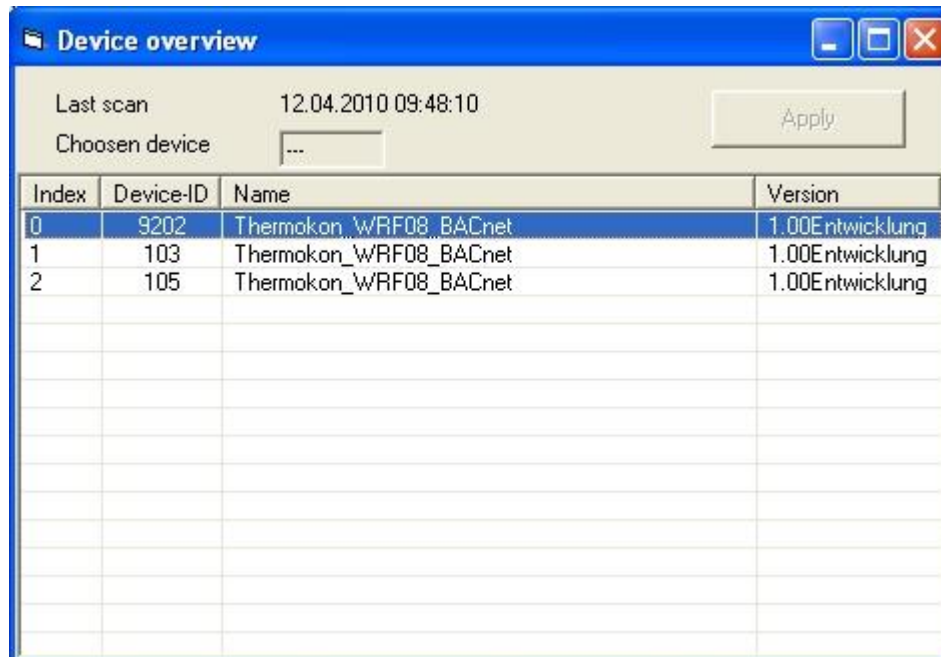


Figure 7-12 Device list

For selection of the device the entry must be marked and the window must closed with *Apply* . In the main window the selected address appears in the field *Device-ID Dest*.

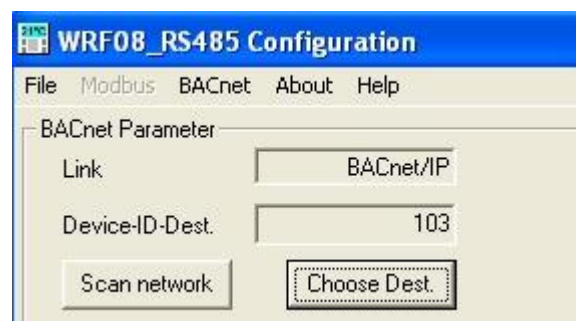
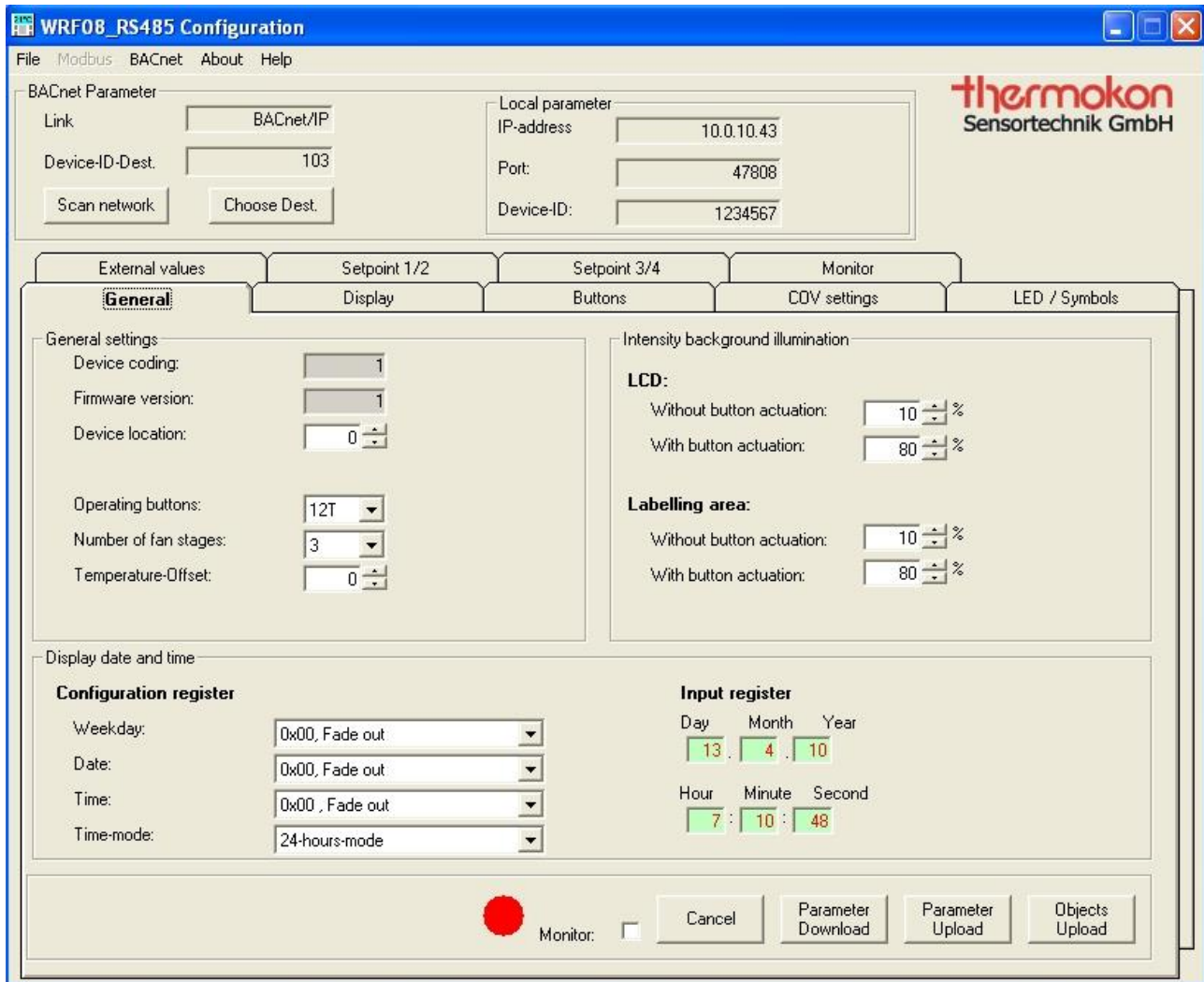


Figure 7-13 Display of the selected destination

7.3.5 Device Configuration

Under the different register cards access to all properties of the device is available. It is distinguished between configuration properties (values saved in the EEPROM) and the objects. The objects are writeable BACnet objects. The fields of these objects are green. Furthermore, the BACnet type and the instance is mentioned for these objects.

Configuration properties and objects are written to the device via different selection buttons. The button „Property Download“ lists all properties plus the objects of the device.



The screenshot shows the 'WRF08_RS485 Configuration' window with the 'General' tab selected. The window is divided into several sections:

- BACnet Parameter:** Includes fields for Link (BACnet/IP), Device-ID-Dest (103), and buttons for 'Scan network' and 'Choose Dest.'.
- Local parameter:** Includes fields for IP-address (10.0.10.43), Port (47808), and Device-ID (1234567).
- Navigation tabs:** External values, Setpoint 1/2, Setpoint 3/4, Monitor, Display, Buttons, COV settings, and LED / Symbols.
- General settings:**
 - Device coding: 1
 - Firmware version: 1
 - Device location: 0
 - Operating buttons: 12T
 - Number of fan stages: 3
 - Temperature-Offset: 0
- Intensity background illumination:**
 - LCD:** Without button actuation: 10%, With button actuation: 80%
 - Labelling area:** Without button actuation: 10%, With button actuation: 80%
- Display date and time:**
 - Configuration register:** Weekday (0x00, Fade out), Date (0x00, Fade out), Time (0x00, Fade out), Time-mode (24-hours-mode).
 - Input register:** Day (13), Month (4), Year (10), Hour (7), Minute (10), Second (48).
- Bottom controls:** A red circular indicator, a 'Monitor' checkbox, and buttons for 'Cancel', 'Parameter Download', 'Parameter Upload', and 'Objects Upload'.

Figure 7-14 Main window

In the registration card the device can be configured as requested. Changed fields are shown in red colour. User without administrator rights only have read access!

In the lower border , all options for access to the device are available. The fields are only activated if a device was selected.



Figure 7-15 Action bar

- Cancel: Cancels all changes in the fields made by the use.
- Parameter download: Download all parameter and objects from device
- Parameter upload: Upload configuration parameters to device
- Objects upload: Upload objects to device
- Monitor: Polls the objects of the device in cyclical periods.

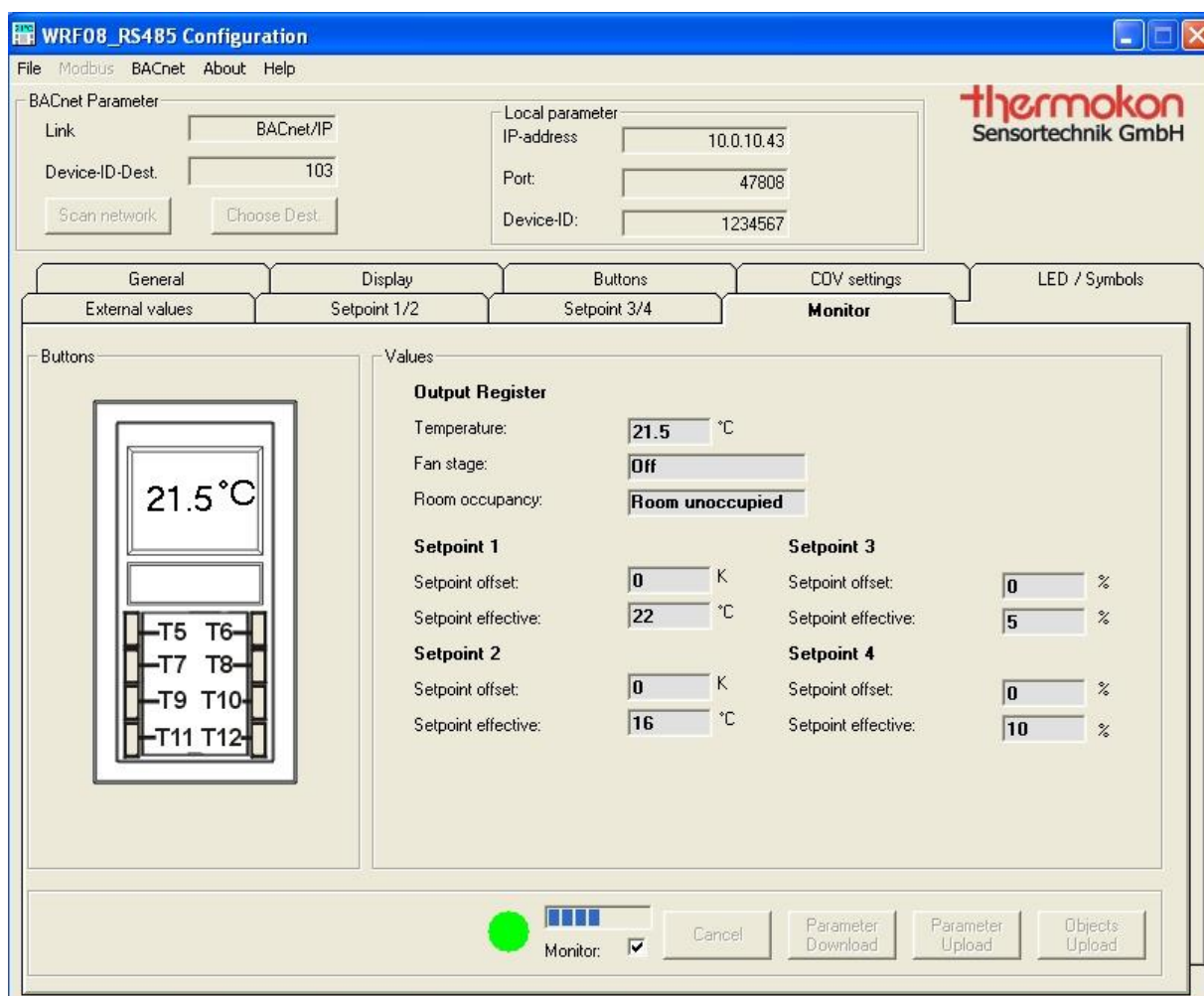


Figure 7-16 Device monitoring

8 PICS

BACnet Protocol Implementation Conformance Statement

Vendor Name: "Thermokon Sensortechnik"
 Product Name: "WRF08-BACnet"
 Product Model Number: "1.0"

Product Description: "Multi-function Room Operating Panel with interface BACnet MS/TP RS485, for temperature detection and integrated operation of HVAC, lighting and blinds for single room control."

BIBBs Supported:

Supported BIBBS	BIBB Name
DS-RP-B	Data Sharing-Read Property-B
DS-RPM-B	Data Sharing-Read Property Multiple-B
DS-WP-B	Data Sharing-Write Property-B
DS-COVU-B	Data Sharing-COV Unsolicited-B
DM-DDB-B	Device Management – Dynamic Device Binding – B
DM-DOB-B	Device Management – Dynamic Object Binding – B
DM-DCC-B	Device Management – Device Communication Control – B
DM-TS-B	Device Management – Time Synchronization - B

BACnet Standard Application Services Supported:

ReadProperty
 ReadPropertyMultiple
 WriteProperty
 DeviceCommunicationControl
 I-Am
 I-Have
 UnconfirmedCOVNotification
 Time Synchronization

Standard Object Types Supported:

Object-Type	Dynamically Creatable Deleteable	Optional Properties supported	Writable Properties	Property Range Restrictions
Analog Input	<input type="checkbox"/>	COV_Increment Description		
Analog Value	<input type="checkbox"/>	COV_Increment Description	Present_Value	
Binary Input	<input type="checkbox"/>	Description Inactive_Text Active_Text		
Binary Value	<input type="checkbox"/>	Description Inactive_Text Active_Text	Present_Value	
Device	<input type="checkbox"/>	Description Max-Info-Frames Max-Master Location localTime localDate	Object name Description Max_Master Location	
Multi-state Input	<input type="checkbox"/>	Description State Text		
Multi-state Value	<input type="checkbox"/>	Description State_Text	Present_Value	

Data Link Layer Option:

MS/TP master. Baud rate(s): [9600,19200,38400,57600,76800,115200]

Device Address Binding:

Is static device binding supported?

Yes ☐No ☒

Character Sets Supported:

ANSI X3.4

Special Functionality:

Maximum APDU size in octets: 480

9 Annex

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