Description of RS485 Modbus Interface

NOVOS 5 Modbus

novos

THE NEW ROOM SERIES BY THERMOKON®

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1 General

This document describes the RS485 Modbus interface for the following devices:

- NOVOS 5 RS485 Modbus
- NOVOS 5 x (LCD) RS485 Modbus

Depending on the device type and configuration level not all measuring values and configuration parameters shown in this document are available. The corresponding measured values are defined in the overview below.

	Temperature	relative humidity	absolute humdity	Enthalpy	Dew point	CO2	VOC	CO2 VOC Mix
NOVOS 5 Temp	•							
NOVOS 5 CO2 Temp	•					•		
NOVOS 5 CO2 Temp_rH	•	•	•	•	•	•		
NOVOS 5 CO2+VOC Temp	•					•	•	•
NOVOS 5 CO2+VOC Temp_rH	•	•	•	•	•	•	•	•

1.1 General Registers

General device information can be read out via the following registers.

Address	Access	Description	Remark
1025	R / u16	Sensor Setup	1= Sensor value available 0= Sensor value not available Bit 0: Humidity + Temp Bit 1: Temp Bit 2: VOC Bit 3: CO2
1034	R / u16	Hardware Version	I.e..: V 1.1 = 0x0101 Readability in hexadecimal
1035	R / u16	Firmware Version (Main/Subversion)	
1036	R / u16	Firmware Version (Revision/Build)	

1.2 Hardware Installation

The device can be connected by means of a twisted-pair cable (line resistance 120 Ohm).

Detailed information on the installation and mounting can be found in the product data sheet of the corresponding device and the data sheet wiring_rs485_network.pdf.

1.3 RS485 Transceiver

The maximal number of bus participants without the use of a repeater is default by the RS485 transceiver.

The transceiver used in the device enables 32 devices per bus segment.

1.4 Protocol

The device is a slave bus participant which is only allowed to send to the bus on request of a master. The protocol is in accordance with the defaults of:

- MODBUS Application Protocol Specification V1.1 (Link)
- MODBUS over Serial Line Specification & Implementation guide V1.0 (Link)

1.5 Configuration Options

The device can be adapted to the corresponding bus topology by means of a dip switch.

- Bus address of device (1 - 63)
- Baud rate 9600, 19200, 38400 or 57600
- Even parity (even), uneven (odd) or none (none)
- The number of stop bits is determined automatically by the device depending on the parity
    - 1 Stop bit with parity „even“ or „odd“
    - 1 or 2 stop bits with parity „none“, configurable via dip switch

2 Modbus Register Description

All following registers listed are holding registers which are addressable via the Modbus function codes 3, 6 and 16 (0x03, 0x06 und 0x10). In the column "Address" the data address of the respective register is listed. The "Access" column indicates whether the respective register is only readable (R - read only) or readable and writable (RW - read write). In addition, the data type of the respective register is specified in the "Access" column (u16 - unsigned 16 bit, s16 - signed 16 bit).

2.1 EEPROM Configuration register

Register addresses marked with a # are configuration registers (EEPROM data), which must not be written in short cycles.

2.2 Room climate

The following registers concern the basic operating functions of the NOVOS 5 x room control unit for controlling the room climate. Room occupancy and setpoint can be read out and parameterised.

Address	Access	Description	Default	Note
100	RW / u16	**Room occupancy (Toggle button)** Toggle OFF -> 0 = unoccupied Toggle-ON -> 1 = occupied	Reset value	Adjustable in Add.: 1307
# 1307	RW / u16	**Room occupancy after reset** unoccupied -> 0 occupied -> 1	1 (occupied)	
103	R / s16	**Set point (effective)** Multiplier: 10 z.B. if set point-definition absolute: 210 = 21,0 °C	Base set point	Adjustable in Add.: 1301 - Adr.: 1304
# 1301	RW / u16	**Set point-display** *(for devices with display)* absolute -> 0 relative -> 1	0 (absolute)	
# 1302	RW / s16	**Base set point** 0 – 500 *(0,0 – 50,0 °C)*	210 (21,0 °C)	
# 1303	RW / s16	**Set point adjustment range** 0 – 100 (±0,0 - ± 10,0 K)	30 (± 3,0 K)	
# 1304	RW / u16	**Set point adjustment step width** 0 – 20 (±0,0 - ± 2,0 K)	5 (± 0,5 K)	
104	R u16	**Read currently active fan stage** OFF -> 0 Stage 1 -> 1 Stage 2 -> 2 Stage 3 -> 3 Stage 4 -> 4 Stage 5 -> 5 Auto -> 6	6	Fan speed set by the user
1310	R / u16	**Availability fanstage „Auto“** not available -> 0 available -> 1	1	
1311	R / u16	**Smallest selectable fanstage** 0 -> 0 1 -> 1 2 -> 2 3 -> 3 4 -> 4 5 -> 5	0	
105	W	**Auto fan level display (if addr. 104=6)** Auto -> 6 Auto „Stage 0“ -> 7 Auto „Stage 1“ -> 8 Auto „Stage 2“ -> 9 Auto „Stage 3“ -> 10 Auto „Stage 4“ -> 11 Auto „Stage 5“ -> 12	12	If the operator has selected the Auto Fan Mode (104=6), the exact fan level can be additionally displayed with the higher-level control.

2.3 LED status display

The following registers relate to the NOVOS room operating units 3 x with LED (button). The LED can be switched on/off directly using the values 0 or 1, or switched on/off when the button is pressed. It is thus possible to make the LED flash during operation or to change the colour. After restarting the device, the registers must be written again, because the values are not stored. **If no LCD Display is installed and the TLF function is active (see Display configuration), the functions in registers 426 and 427 are not applicable.**

Address	Access	Description	Default	Description
426	RW / u16	**LED illumination (button) ON / OFF** 0 = not active 1 = active 2 = Room occupancy- / button state	0 (not active)	
# 427	RW / u16	**LED illumination (button) color** 1 = white 2 = black* 3 = red 4 = green 5 = blue 6 = yellow 7 = magenta 8 = turquoise	4 (green)	

* black = no color / LED off

2.4 Sensor Value

The unit system required can be selected via register 1100. Please note that when changing the unit system, the measured value upper/lower limits are not adjusted.

Address	Access	Description	Default	Remark
# 1100	RW / u16	**Selection of units System** 1: SI 2: Imperial	1	-

The various measured values can be read out via registers 500...507.

Address	Access	Description	Resolution / Unit	
501	R / s16	**Relative Humidity**	0.1	%
505	R / s16	**CO2**	1.0	ppm
506	R / s16	**VOC**	1.0	Index
507	R / s16	**CO2 VOC Mix**	0.1	%

Register 1100 = 1 (Einheit SI)

Address	Access	Description	Resolution / Unit SI		
500	R / s16	**Temperature**	SI	0.1	°C
502	R / s16	**Absolute humidity**	SI	0.1	g/m³
503	R / s16	**Enthalpy**	SI	0.1	kJ/kg
504	R / s16	**Dew point**	SI	0.1	°C

Register 1100 = 2 (Einheit Imperial)

Address	Access	Description	Resolution / Unit IMP		
500	R / s16	**Temperature**	Imperial	0.1	°F
502	R / s16	**Absolute humidity**	Imperial	0.1	gr/ft³
503	R / s16	**Enthalpy**	Imperial	0.1	BTU/lb
504	R / s16	**Dew point**	Imperial	0.1	°F

2.5 Digital input

The status of a potential-free contact can be read out via the digital input of the device.

Address	Access	Description
514	R / u16	**Status digital contact** Contact open -> 0 Contact closed -> 1

2.6 Offset/correction values

These registers can be used to specify offset/correction values for the individual measured values.

Example Offset Temperatur (Register 100):
Offset +1 °C (+1 °F) = 10_{10} ($0000'0000'0000'1010_2$) = 00 $0a_{16}$
Offset -1 °C (-1 °F) = -10_{10} ($1111'1111'1111'0110_2$) = ff $f6_{16}$

Address	Access	Description	Default	Resolution / Unit	
# 2111	RW / s16	**Offset relative humidity**	0	0.1	%
# 2511	RW / s16	**Offset CO2**	0	1.0	ppm
# 2611	RW / s16	**Offset VOC**	0	1.0	Index

Register 400 = 1 (Einheit SI)

Address	Access	Description	Unit	Default	Resolution / Unit SI	
# 2011	RW / s16	**Offset Temperature**	SI	0	0.1	°C

Register 400 = 2 (Einheit Imperial)

Address	Access	Description	Unit	Default	Resolution / Unit IMP	
# 2011	RW / s16	**Offset Temperature**	Imperial	0	0.1	°F

2.7 Measured value upper/lower limits

The measured value upper/lower limits can be used to limit the values within a certain range.

Address	Access	Description	Default	Resolution / Unit
# 2112	RW / s16	Relative humidity lower limit	0	0.1 %
# 2113	RW / s16	Relative humidity upper limit	1000	0.1
# 2512	RW / s16	CO2 lower limit	0	1.0 ppm
# 2513	RW / s16	CO2 upper limit	2000	1.0
# 2612	RW / s16	VOC lower limit	0	1.0 Index
# 2613	RW / s16	VOC upper limit	500	1.0
# 2712	RW / s16	CO2 VOC lower limit	0	0.1 %
# 2713	RW / s16	CO2 VOC upper limit	1000	0.1

Register 1100 = 1 (SI)

Address	Access	Description	Unit	Default	Resolution / Unit
# 2012	RW / s16	Temperature lower limit	SI	0	0.1 °C
# 2013	RW / s16	Temperature upper limit	SI	500	0.1
# 2212	RW / s16	Absolute humidity lower limit	SI	0	0.1 g/m³
# 2213	RW / s16	Absolute humidity upper limit	SI	500	0.1
# 2312	RW / s16	Enthalpy lower limit	SI	0	0.1 kJ/kg
# 2313	RW / s16	Enthalpy upper limit	SI	850	0.1
# 2412	RW / s16	Dew point lower limit	SI	0	0.1 °C
# 2413	RW / s16	Dew point upper limit	SI	500	0.1

Register 1100 = 2 (Imperial)

Address	Access	Description	Unit	Default	Resolution / Unit
# 2012	RW / s16	Temperature lower limit	Imperial		0.1 °F
# 2013	RW / s16	Temperature upper limit	Imperial		0.1
# 2212	RW / s16	Absolute humidity lower limit	Imperial		0.1 gr/ft³
# 2213	RW / s16	Absolute humidity upper limit	Imperial		0.1
# 2312	RW / s16	Enthalpy lower limit	Imperial		0.1 BTU/lb
# 2313	RW / s16	Enthalpy upper limit	Imperial		0.1
# 2412	RW / s16	Dew point lower limit	Imperial		0.1 °F
# 2413	RW / s16	Dew point upper limit	Imperial		0.1

2.8 Display Configuration

During a user interaction, the LCD backlight is dimmed to a higher value. After a predefined time (default 120 seconds) the display brightness is dimmed down in standby or switched off completely. **The default factory settings for the LCD backlight (user interaction and standby) are 100%.**

If several measured variables are available, they can be shown in parallel or alternately (fix, every 5 seconds) on the display.

Address	Access	Description	Default	Remark
# 1200	RW / u16	**LCD backlight during user interaction** 0 – 100 (0 – 100%)	100 (100%)	-
# 1201	RW /u16	**LCD backlight standby (no user interaction)** 0 – 100 (0 – 100%)	100 (100%)	-
# 1202	RW / u16	**Time after which the display switches to standby after a user interaction** 1..120 seconds (0 disables the function)	120 (120 seconds)	-
# 1206	RW / u16	**Measured values are shown alternately or parallel on the display** parallel -> 1 alternating ->2	1 (parallel)	-

The RBG backlight of the display can be used as a colored status indicator (TLF) for any available measured variable. Threshold values for changing the display color are defined.

If no LCD display is installed, the LED button (if installed) is used. The TLF function can only be activated on devices without LCD, if the LED lighting is inactive (addr.:426=0). Only one measured variable can be defined for TLF display at a time.

Sensor data blocks for TLF

Measuring value	Address range	Unit
Temperature	2015 ff. (2015-2024)	°C
Relative humidity	2115 ff. (2115-2124)	%
Absolute humidity	2215 ff. (2215-2224)	g / m³
Enthalpy	2315 ff. (2315-2324)	KJ / KG
Dew point	2415 ff. (2415-2424)	°C
CO2	2515 ff. (2515-2524)	ppm
VOC	2615 ff. (2615-2624)	Index
CO2 / VOC MIX	2715 ff. (2715-2724)	%

Sensor data blocks for display configuration

Up to 4 Sensor values can be shown in the display.

Measuring value	Address	Default
Temperature	2014	1
Relative Humidity	2114	1
Absolute Humidity	2214	0
Enthalpy	2314	0
Dew Point	2414	0
CO2	2514	1
VOC	2614	1
CO2 / VOC MIX	2714	0

Address	Access	Description	Default	Remark
# 2014	RW / u16	**Display Sensor value (YES / NO)**	1	0 = No | 1 = Yes
# 2015	RW / u16	**TLF Temperature ON / OFF**	0	0 = off | 1 = TLF on
# 2016	RW / u16	**Range 1 colour** **Colour definition for the first range.** *Range 1 begins with the lower measuring range limit and ends with threshold value 1-2.* 1 = white 2 = black* 3 = red 4 = green 5 = blue 6 = yellow 7 = magenta 8 = turquoise	3	
# 2017	RW / u16	**Range 2 colour** **Colour definition for the second area.** *Range 2 starts with threshold 1-2 and ends with threshold 2-3.* *See Range 1*	6	

* black = no color / LED off

# 2018	RW / u16	**Range 3 colour** **Colour definition for the third range.** *Range 3 starts with threshold 2-3 and ends with threshold 3-4.* *See Range 1*	4
# 2019	RW / u16	**Range 4 colour** **Colour definition for the fourth range.** *Range 4 starts with threshold value 3-4 and ends with threshold value 4-5.* *See Range 1*	6
# 2020	RW / u16	**Range 5 colour** **Colour definition for the fifth range.** *Range 5 begins with the threshold value 4-5 and ends with the upper range limit.* *See Range 1*	3
# 2021	RW / u16	**Threshold value between range 1 and range 2** *Absolute value (within measuring range limits)*	
# 2022	RW / u16	**Threshold value between range 2 and range 3** *Absolute value (within measuring range limits)*	
# 2023	RW / u16	**Threshold value between range 3 and range 4** *Absolute value (within measuring range limits)*	
# 2024	RW / u16	**Threshold value between range 4 and range 5** *Absolute value (within measuring range limits)*	

2.8.1 Icons (Coils)

Address	Access	Description	Default	Remark
16	RW	**Show Dew point (Icon)**	0	inactive = 0 | active = 1
17	RW	**Show Window open(Icon)**	0	inactive = 0 | active = 1
18	RW	**Show Calibration due (Icon)**	0	inactive = 0 | active = 1
19	RW	**Show Communication error Bus (Icon)**	0	inactive = 0 | active = 1
20	RW	**Show USB-Communication mode (Icon)**	0	inactive = 0 | active = 1
21	RW	**Show ECO (Icon)**	0	inactive = 0 | active = 1
22	RW	**Show Modus Heating (Icon)**	0	inactive = 0 | active = 1
23	RW	**Show Modus Cooling (Icon)**	0	inactive = 0 | active = 1
24	RW	**Show PIR active (Icon)**	0	inactive = 0 | active = 1
25	RW	**Show presence detection (Icon)**	0	inactive = 0 | active = 1
26	RW	**Show Warning (Icon)**	0	inactive = 0 | active = 1
27	RW	**Show Maintenance due(Icon)**	0	inactive = 0 | active = 1

3 Modbus Protocol

http://www.modbus.org/

3.1 Supported Control Commands

The following MODBUS control commands are supported by the device:

Description	Function Code	
Read Holding Register	03 (hex)	3 (dec)
Write Single Register	06 (hex)	6 (dec)
Write Multiple Register	10 (hex)	16 (dec)

3.2 Data Transmission

3.2.1 Master/Slave Protocol

One Master and one or several Slaves are connected to the serial bus. The communication between Master and Slave is solely controlled by the Master. Slaves are only allowed to send if they were called by the Master before. Slaves are only sending to a Master, never to another Slave.

3.2.2 Data Frame

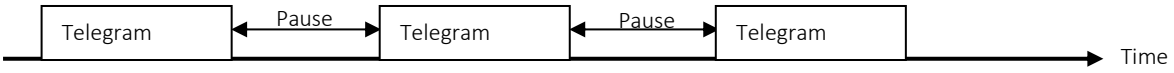
Data are sent to the bus in accordance with strictly defined defaults:

Address	Control Command	Data	Checksum

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

3.2.3 Transmission Mode RTU

In the transmission mode RTU telegrams are separated by transmission pauses.



The period of the transmission pauses for separation of telegrams is depending on the set baud rate and amounts to 3,5 * Word-Transmission Time (11 Bit). With 9600 Baud at least 4 ms and with 19200 at least 2ms must pass by between two telegrams.

3.2.3.1 Telegram Structure

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

3.2.3.2 Calculation of CRC-Checksum

The CRC checksum (Cyclicyal Redundancy Check) is calculated by the sender by means of all bytes transmitted and is attached to the message. Then, the receiver calculates the CRC checksum again and compares the same with checksum received. If the values are not matching, a transmission error must be assumed and the data received are rejected. The low-order byte of the 16 bit checksum is sent in the telegram next to the last position and the high-order byte at the last position.

Calculation of Checksum (programming example in C):

```
crc = 0xFFFF;                                   // CRC-Check, Init
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

// Calculate CRC
unsigned int crc_calc(unsigned int crc_temp, unsigned int data)
{
        unsigned int    Index_CC=0;
        unsigned int    LSB=0;
        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 for CRC16
        }
        return(crc_temp);
}
```