Description of RS485 Modbus Interface

NOVOS 3 Modbus

novos

THE NEW ROOM SERIES BY THERMOKON®

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Revision

Revision	Date	Description	Editor
A	18.06.2018	First issue	DF
B	31.01.2020	Addition of the registers RBG NOVOS 3	DF
C	18.06.2020	Corrections and additions	DF
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Table of Contents

1 General

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

- NOVOS 3 RS485 Modbus
- NOVOS 3 x 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 3 Temp	•							
NOVOS 3 CO2 Temp	•					•		
NOVOS 3 CO2 Temp_rH	•	•	•	•	•	•		
NOVOS 3 CO2+VOC Temp	•					•	•	•
NOVOS 3 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: Feuchte + Temp Bit 1: Temp Bit 2: VOC Bit 3: CO2
1034	R / u16	**Hardware Version**	Bsp.: 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). Register addresses marked with a # are configuration registers (EEPROM data), which must not be written in short cycles.

2.1 Room climate

The following registers concern the room operating units NOVOS 3 x. Room occupancy and setpoint can be read out and configured.

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	RW / 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-definition** 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)	

2.2 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 the TLF function is active, the functions in registers 426 and 427 are not applicable (see chapter 2.7).

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

2.3 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	Note
# 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	%
507	R / s16	**CO2 VOC Mix**	0.1	

Register 1100 = 1 (Einheit SI)

Address	Access	Description	Resolution / Unit		
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		
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

2.4 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

2.5 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	0.1	%

Register 400 = 1 (Einheit SI)

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

Register 400 = 2 (Einheit Imperial)

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

2.6 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	0.1 %
# 2613	RW / s16	VOC upper limit	1000	0.1
# 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

2.7 Display Configuration TLF

The LED can be used as a coloured status indicator for any available measured variable. For this purpose, threshold values for changing the display color are defined. The TLF function can only be activated 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)	%
CO2 / VOC MIX	2715 ff. (2715-2724)	%

Address	Access	Description	Default	Remark
# 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.* 0 = transparent 1 = white 2 = black 3 = red 4 = green 5 = blue 6 = yellow 7 = magenta 8 = turquoise 9 = orange	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	
# 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)*		

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

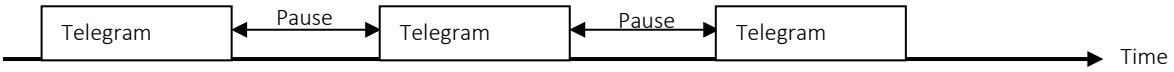
Data are sent to the bus in accordance with strictly defined defaults:

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);
}
```