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Description of

RS485 MODBUS interface

WRF06 AQ Modbus
FTW06 Modbus
WRF06 Temp Modbus

Revision

Revision	Date	Description	Editor
A	18.06.2018	First issue	DF
B	06.07.2018	FTW06 / cross table products added	DF
C	06.01.2020	Type WRF06 Temp added	DF

Table of Contents

1 General

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

- WRF06 AQ RS485 Modbus
- FTW06 RS485 Modbus
- WRF06 Temp 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 values are defined in the overview below.

	Temperature	relative humidity	absolute humdity	Enthalpy	Dew point	CO2	VOC	CO2 VOC Mix
WRF06 CO2						•		
WRF06 CO2 Temp	•					•		
WRF06 CO2 Temp_rH	•	•	•	•	•	•		
WRF06 CO2+VOC						•	•	•
WRF06 VOC Temp	•						•	
WRF06 CO2+VOC Temp_rH	•	•	•	•	•	•	•	•
FTW06	•	•	•	•	•			
WRF06 Temp	•							

1.1 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.

1.2 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.

1.3 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)

1.4 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 Sensor Value

Via the registers 0…7 different measuring values can be read out. Which measuring values are available in the respective devices can be inquired via the register 501 (sensor identification).

Address	Access	Description	default	Remarks
400	RW / u16	**Selection of unit systems**	1	1: SI 2: Imperial

Address	Access	Description	Resolution /Unit	
1	R / u16	**Relative humidity**	0.1	%rF
5	R / u16	**CO2**	1.0	ppm
6	R / u16	**VOC**	0.1	%
7	R / u16	**CO2 VOC Mix**	0.1	

Register 400 = 1 (unit SI)

Address	Access	Description	Resolution /Unit		
0	R / s16	**Temperature**	SI	0.1	°C
2	R / u16	**Absolute humidity**	SI	0.01	g/m³
3	R / u16	**Enthalpy**	SI	0.1	kJ/kg
4	R / s16	**Dew Point**	SI	0.1	°C

Register 400 = 2 (unit Imperial)

Address	Access	Description	Resolution /Unit		
0	R / s16	**Temperature**	Imperial	0.1	°F
2	R / u16	**Absolute humidity**	Imperial	0.01	gr/ft³
3	R / u16	**Enthalpy**	Imperial	0.1	BTU/lb
4	R / s16	**Dew Point**	Imperial	0.1	°F

2.2 Offset-/Correction Values

Via the registers 100…103 the offset/correction values for the single measuring values can be default.

Example: Offset Temperature (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	
101	RW / s16	**Offset relative humidity**	0	1.0	%rF
102	RW / s16	**Offset CO2**	0	1.0	ppm
103	RW / s16	**Offset VOC**	0	1.0	%

Register 400 = 1 (unit SI)

Address	Access	Description	Unit	default	Resolution /Unit	
100	RW / s16	**Offset Temperature**	SI	0	0.1	°C

Register 400 = 2 (unit Imperial)

Address	Access	Description	Unit	default	Resolution /Unit	
100	RW / s16	**Offset Temperature**	Imperial	0	0.1	°F

2.3 Measuring Values Upper-/Lower Limits

Via the measuring values upper-/lower limits values in a special range can be localized. The scale concerns the values in the registers 0..7.

Address	Access	Description	default	Resolution /Unit	
202	RW / u16	**Relative humidity lower limit**	0	1.0	%rH
203	RW / u16	**Relative humidity upper limit**	100	1.0	%rH
210	RW / u16	**CO2 lower limit**	0	1.0	ppm
211	RW / u16	**CO2 upper limit**	5000	1.0	
212	RW / u16	**VOC lower limit**	0	1.0	%
213	RW / u16	**VOC upper limit**	100	1.0	
214	RW / u16	**CO2 VOC Mix lower limit**	0	1.0	%
215	RW / u16	**CO2 VOC Mix upper limit**	100	1.0	

Register 400 = 1 (unit SI)

Address	Access	Description	Unit	default	Resolution /Unit	
200	RW / s16	**Temperature lower limit**	SI	0	1.0	°C
201	RW / s16	**Temperature upper limit**	SI	50	1.0	°C
204	RW / u16	**Absolute humidity lower limit**	SI	0	1.0	g/m³
205	RW / u16	**Absolute humidity upper limit**	SI	83	1.0	g/m³
206	RW / u16	**Enthalpy lower limit**	SI	0	1.0	kJ/kg
207	RW / u16	**Enthalpy upper limit**	SI	274	1.0	kJ/kg
208	RW / s16	**Dew point lower limit**	SI	-110	1.0	°C
209	RW / s16	**Dew point lower limit**	SI	50	1.0	°C

Register 400 = 2 (unit Imperial)

Address	Access	Description	Unit	default	Resolution /Unit	
200	RW / s16	**Temperature lower limit**	Imperial	32	1.0	°F
201	RW / s16	**Temperature upper limit**	Imperial	122	1.0	°F
204	RW / u16	**Absolute humidity lower limit**	Imperial	0	1.0	gr/ft³
205	RW / u16	**Absolute humidity upper limit**	Imperial	36	1.0	gr/ft³
206	RW / u16	**Enthalpy lower limit**	Imperial	0	1.0	BTU/lb
207	RW / u16	**Enthalpy upper limit**	Imperial	637	1.0	BTU/lb
208	RW / s16	**Dew point lower limit**	Imperial	-166	1.0	°F
209	RW / s16	**Dew point upper limit**	Imperial	122	1.0	°F

2.4 Sensor Configuration

Via the register 400 the requested unit system can be selected

Address	Access	Description	default	Resolution /Unit
400	RW / u16	**Selection of unit system**	1	1: SI 2: Imperial

2.5 General Registers

Via the registers 501…503 general device information can be read out and written.

Address	Access	Description	Remarks
501	R / u16	**Sensor identification**	1=sensor value available 0= sensor value not available Bit 0: Temperature Bit 1: Relative humidity Bit 2: Absolute humidity Bit 3: Enthalpy Bit 4: Dew point Bit 5: CO2 Bit 6: VOC Bit 7: CO2 VOC Mix
502	R / u16	**Hardware version main board**	Example.: V 1.1 = 0x0101 Readability in hexadecimal
503	R / u16	**Firmware version main board**	

2.6 Display Configuration

Via the registers 615 and 616 TLF parameters can be adapted

Address	Access	Description	default	Remarks
615	RW / u16	**Traffic-light threshold - TLF** Range 1→2 (green/yellow)	750 ppm	
616	RW / u16	**Traffic-light threshold - TLF** Range 2→3 (yellow/red)	1250 ppm	

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

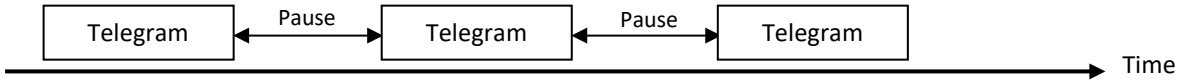
Data are sent to the bus in accordance with strictly defined defaults:

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);
}
```