

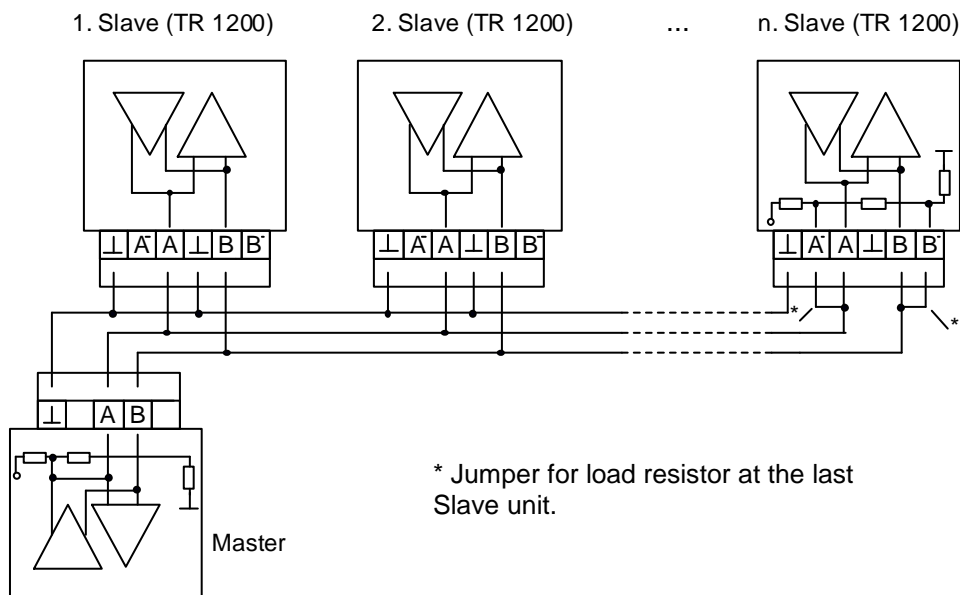
# Temperature relay TR 1200 - Appendix Modbus

## RS 485 interface with Modbus communication protocol

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### 1. Connection diagram



## 2. Important information

Please carefully read the general TR 1200 operating instructions and comply with the safety instructions.

## 3. Interface parameter

Baud rate	Data bits	Parity	Stop bit
9600, 19200	8	even, odd, none	1 (at parity none: 2)

The interface parameters are factory set to 9600 baud, 8 bits, even parity, 1 stop bit.

**The RTU mode is used.**

The TR 1200 acts in the BUS system as a slave with an adjustable address from 1 to 247.

**The TR 1200 operating instructions describe how to set the parameters.**

## 4. Telegram structure

Slave address (1 .. 247)	Function	Data	CRC-16 Checksum
1 byte	1 byte	n- bytes	2 bytes

## 5. Supported function codes

Function code	Name	Utilization
3 (03H)	Read Holding Registers	Read data from registers
16 (10H)	Write Multiple Registers	Write data into the register

### 5.1 Function code 3 (03H) - Read data from the registers

<u>Query from master</u>				
Byte no.	Meaning		1st example	2nd example
1	Slave address		0x01	0x0A
2	Function		0x03	0x03
3	Start address	Hi-byte	0x00	0x00
4		Lo-byte	0x01	0x11
5	Number of words (bytes / 2)	Hi-byte	0x00	0x00
6		Lo-byte	0x04	0x02
7	Checksum CRC-16	Lo-byte	0x15	0x95
8		Hi-byte	0xC9	0x75

<b>Reply from slave (TR 1200)</b>				
<b>Byte no.</b>	<b>Meaning</b>		<b>1st example</b>	<b>2nd example</b>
1	Slave address		0x01	0x0A
2	Function		0x03	0x03
3	Number of bytes (n) (Words x 2)		0x08	0x04
4	1st word (2 bytes)	Hi-byte	0x00	0x02
5		Lo-byte	0x32	0x5A
6	2nd word (2 bytes)	Hi-byte	0x00	0xFF
7		Lo-byte	0x3C	0xFB
8	2nd word (3 bytes)	Hi-byte	0x00	
9		Lo-byte	0x46	
10	N- words (2 bytes)	Hi-byte	0x00	
11		Lo-byte	0x50	
:	:			
:	:			
3 + (n + 1)	Checksum	Lo-byte	0x37	0x61
3 + (n + 2)	CRC-16	Hi-byte	0xF8	0x2B

## 5.2 Function code 16 (10H) - Write data in register

<b>Query from master</b>				
<b>Byte no.</b>	<b>Meaning</b>		<b>1st example</b>	<b>2nd example</b>
1	Slave address		0x01	0x0A
2	Function		0x10	0x10
3	Start address	Hi-byte	0x00	0x00
4		Lo-byte	0x07	0x10
5	Number of words (bytes / 2)	Hi-byte	0x00	0x00
6		Lo-byte	0x04	0x02
7	Number of bytes (n)		0x08	0x04
8	1st register	Hi-byte	0x00	0x00
9		Lo-byte	0x5A	0x00
10	2nd register	Hi-byte	0xFF	0x00
11		Lo-byte	0xFB	0x64
12	3rd register	Hi-byte	0x00	
13		Lo-byte	0x0A	
14	4th register	Hi-byte	0x00	
15		Lo-byte	0x14	
:	:			
:	:			
7 + (n + 1)	Checksum	Hi-byte	0x68	0xD6
7 + (n + 2)	CRC-16	Lo-byte	0x62	0x6C

<b>Reply from slave (TR 1200)</b>				
<b>Byte no.</b>	<b>Meaning</b>		<b>1st example</b>	<b>2nd example</b>
1	Slave address		0x01	0x0A
2	Function		0x10	0x10
3	Start address	Hi-byte	0x00	0x00
		Lo-byte	0x07	0x10

4	Number of words (n) (bytes x 2)	Hi-byte	0x00	0x02
5		Lo-byte	0x04	0x02
6	Checksum CRC-16	Lo-byte	0x70	0x40
7		Hi-byte	0x0B	0x16

### 5.3 Modbus register tables

Register of function code 3 (03H) - Read data from the registers			
Register address		Date type	Description
Decimal	Hex		
1	0001	Signed Int	Temperature of Sensor 1
2	0002	Signed Int	Temperature of Sensor 2
3	0003	Signed Int	Temperature of Sensor 3
4	0004	Signed Int	Temperature of Sensor 4
5	0005	Signed Int	Temperature of Sensor 5
6	0006	Signed Int	Temperature of Sensor 6
7	0007	Signed Int	Temperature of Sensor 7
8	0008	Signed Int	Temperature of Sensor 8
9	0009	Signed Int	Temperature of Sensor 9
10	000A	Signed Int	Temperature of Sensor 10
11	000B	Signed Int	Temperature of Sensor 11
12	000C	Signed Int	Temperature of Sensor 12
13	000D	Signed Int	Temperature Max Sensor
14	000E	Signed Int	Max- value Sensor 1
15	000F	Signed Int	Max- value Sensor 2
16	0010	Signed Int	Max- value Sensor 3
17	0011	Signed Int	Max- value Sensor 4
18	0012	Signed Int	Max- value Sensor 5
19	0013	Signed Int	Max- value Sensor 6
20	0014	Signed Int	Max- value Sensor 7
21	0015	Signed Int	Max- value Sensor 8
22	0016	Signed Int	Max- value Sensor 9
23	0017	Signed Int	Max- value Sensor 10
24	0018	Signed Int	Max- value Sensor 11
25	0019	Signed Int	Max- value Sensor 12
26	001A	Signed Int	Max- value Max Sensor
27	001B	Signed Int	Min- value Sensor 1
28	001C	Signed Int	Min- value Sensor 2
29	001D	Signed Int	Min- value Sensor 3
30	001E	Signed Int	Min- value Sensor 4
31	001F	Signed Int	Min- value Sensor 5
32	0020	Signed Int	Min- value Sensor 6
33	0021	Signed Int	Min- value Sensor 7
34	0022	Signed Int	Min- value Sensor 8
35	0023	Signed Int	Min- value Sensor 9
36	0024	Signed Int	Min- value Sensor 10
37	0025	Signed Int	Min- value Sensor 11
38	0026	Signed Int	Min- value Sensor 12
39	0027	Signed Int	Min- value Max Sensor
40	0028	Signed Int	Internal error
41	0029	Signed Int	Relay status (0= released, 1= picked up)
42	002A	Signed Int	Type of Sensor 1 (-2= nc, -1= 3-L, 0...999= 2-L)
43	002B	Signed Int	Type of Sensor 2 (-2= nc, -1= 3-L, 0...999= 2-L)
44	002C	Signed Int	Type of Sensor 3 (-2= nc, -1= 3-L, 0...999= 2-L)
45	002D	Signed Int	Type of Sensor 4 (-2= nc, -1= 3-L, 0...999= 2-L)
46	002E	Signed Int	Type of Sensor 5 (-2= nc, -1= 3-L, 0...999= 2-L)
47	002F	Signed Int	Type of Sensor 6 (-2= nc, -1= 3-L, 0...999= 2-L)
48	0030	Signed Int	Type of Sensor 7 (-2= nc, -1= 3-L, 0...999= 2-L)
49	0031	Signed Int	Type of Sensor 8 (-2= nc, -1= 3-L, 0...999= 2-L)
50	0032	Signed Int	Type of Sensor 9 (-2= nc, -1= 3-L, 0...999= 2-L)

51	0033	Signed Int	Type of Sensor 10 (-2= nc, -1= 3-L, 0...999= 2-L)
52	0034	Signed Int	Type of Sensor 11 (-2= nc, -1= 3-L, 0...999= 2-L)
53	0035	Signed Int	Type of Sensor 12 (-2= nc, -1= 3-L, 0...999= 2-L)
54	0036	Signed Int	Relay function (-2= operating-current mode, -1= closed current mode)
55	0037		Software version

### Register of function code 16 (10H) – Write data in registers

Register address		Date type	Description
Decimal	Hex		
1	0001	Signed Int	Type of Sensor 1 (-2= nc, -1= 3-L, 0...999= 2-L)
2	0002	Signed Int	Type of Sensor 2 (-2= nc, -1= 3-L, 0...999= 2-L)
3	0003	Signed Int	Type of Sensor 3 (-2= nc, -1= 3-L, 0...999= 2-L)
4	0004	Signed Int	Type of Sensor 4 (-2= nc, -1= 3-L, 0...999= 2-L)
5	0005	Signed Int	Type of Sensor 5 (-2= nc, -1= 3-L, 0...999= 2-L)
6	0006	Signed Int	Type of Sensor 6 (-2= nc, -1= 3-L, 0...999= 2-L)
7	0007	Signed Int	Type of Sensor 7 (-2= nc, -1= 3-L, 0...999= 2-L)
8	0008	Signed Int	Type of Sensor 8 (-2= nc, -1= 3-L, 0...999= 2-L)
9	0009	Signed Int	Type of Sensor 9 (-2= nc, -1= 3-L, 0...999= 2-L)
10	000A	Signed Int	Type of Sensor 10 (-2= nc, -1= 3-L, 0...999= 2-L)
11	000B	Signed Int	Type of Sensor 11 (-2= nc, -1= 3-L, 0...999= 2-L)
12	000C	Signed Int	Type of Sensor 12 (-2= nc, -1= 3-L, 0...999= 2-L)
13	000D	Signed Int	Relay function (-2= operating-current mode, -1= closed current mode))

## 6. Error messages

The telegram sent from the master is checked by the slave (TR 1200). During a malfunction, an error message is generated and sent back to the master. While doing so, the 7th bit is set in function byte to "1".

### Error telegram:

Byte no.	Meaning		1st example	2nd example
1	Slave address		0x01	0x0A
2	Function		0x81	0x90
3	Error code		0x02	0x03
4	Checksum CRC-16	Lo-byte	0xC1	0x7D
5		Hi-byte	0x91	0xC3

### The following error codes are possible:

- 1 (01H) Invalid function
- 2 (02H) Invalid start address
- 3 (03H) Invalid data value
- 4 (04H) Slave device error

### Error not detected by slave (telegram will be rejected):

- False checksum CRC-16
- Unknown slave address

## 7. CRC-16 checksum

The checksum is attached to each Modbus telegram and is used to detect transmission errors. It is 2 bytes long and is calculated from all bytes in a telegram. During this, first the lo-byte and then the hi-byte are transmitted.

Please refer to the original Modbus documentation for more details, which can be found at <http://www.modbus.org>