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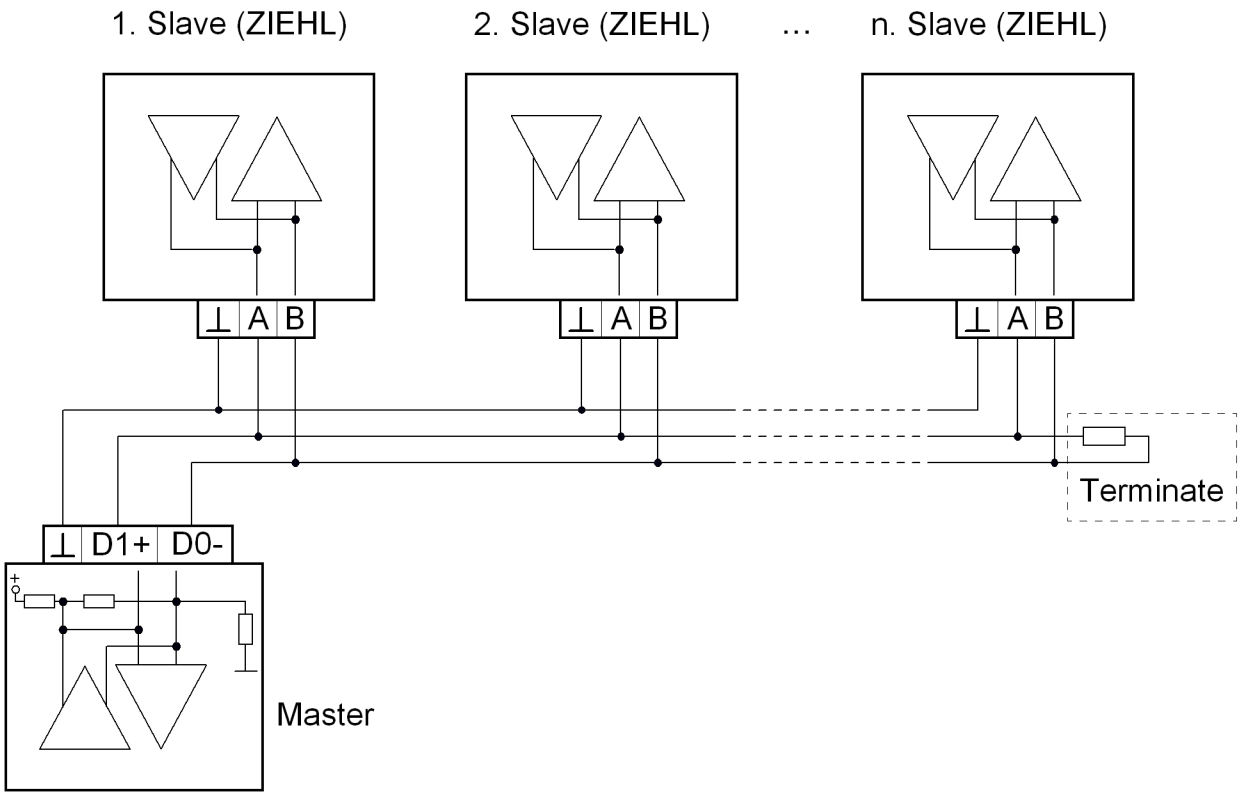
Operating Manual TR440

updated: 140408 Sc

- RS485 interface with Modbus communication protocol

Table of contents

1 Connection diagram



Connection name	Modbus	Ziehl	EIA/TIA-485
- wire	D0	B	A
+ wire	D1	A	B

2 Important information

Please carefully read the general TR440 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) ➢ from Firmware -04: adjustable

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

The RTU mode is used.
The TR440 acts in the BUS system as a slave with an adjustable address from 1 to 247.
The TR440 operating instructions describes 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

Query from master

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

Reply from slave (TR440)

Byte no.	Meaning		1st example	2nd example
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 CRC-16	Lo-byte	0x37	0x61
3 + (n + 2)		Hi-byte	0xF8	0x2B

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

Query from master				
Byte no.	**Meaning**		**1st example**	**2nd example**
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 CRC-16	Lo-byte	0x68	0xD6
7 + (n + 2)		Hi-byte	0x62	0x6C

Reply from slave (TR440)				
Byte no.	**Meaning**		**1st example**	**2nd example**
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 (n) (bytes x 2)	Hi-byte	0x00	0x02
6		Lo-byte	0x04	0x02
7	Checksum CRC-16	Lo-byte	0x70	0x40
8		Hi-byte	0x0B	0x16

5.3 Modbus register tables

Register of function code 3 (03H) - Read data from the registers					Affects program no.			
Adr.	Data type	Description / Value range			1	2	3	4
0000	Signed Int	Prog. no.	1 .. 4		x	x	x	x
0001	Signed Int	Unit	0=[°C], 1=[°F]		x	x	x	x
0002	Signed Int	Sensor 1	-2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0003	Signed Int	Sensor 2	-2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0004	Signed Int	Sensor 3	-2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0005	Signed Int	Sensor 4	-2=nc, -1=3L, 0 .. 999=2L (line res.)			x	x	x
0006	Signed Int	Alarm 1:	Alarm value	-199 .. 999	FAN	FAN	FAN	COR
0007	Signed Int	Alarm 1:	Hysteresis	0 .. 99	x	x	x	x
0008	Signed Int	Alarm 1:	Alarm delay on	0 .. 999	x	x	x	x
0009	Signed Int	Alarm 1:	Alarm delay off	0 .. 999	x	x	x	x
000A	Signed Int	Alarm 1:	-1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
000B	Signed Int	Alarm 2:	Alarm value	-199 .. 999	ALR	ALR	ALR	ALR
000C	Signed Int	Alarm 2:	Hysteresis	0 .. 99	x	x	x	x
000D	Signed Int	Alarm 2:	Alarm delay on	0 .. 999	x	x	x	x
000E	Signed Int	Alarm 2:	Alarm delay off	0 .. 999	x	x	x	x
000F	Signed Int	Alarm 2:	-1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
0010	Signed Int	Alarm 2:	Core	-199 .. 999		x		
0011	Signed Int	Alarm 3:	Alarm value	-199 .. 999	TRP	TRP	TRP	TRP
0012	Signed Int	Alarm 3:	Hysteresis	0 .. 99	x	x	x	x
0013	Signed Int	Alarm 3:	Alarm delay on	0 .. 999	x	x	x	x
0014	Signed Int	Alarm 3:	Alarm delay off	0 .. 999	x	x	x	x
0015	Signed Int	Alarm 3:	-1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
0016	Signed Int	Alarm 3:	Core	-199 .. 999		x		
0017	Signed Int	Alarm 4:	Alarm value	-199 .. 999	ERR	ERR	COR	ERR
0018	Signed Int	Alarm 4:	Hysteresis	0 .. 99			x	
0019	Signed Int	Alarm 4:	Alarm delay on	0 .. 999			x	
001A	Signed Int	Alarm 4:	Alarm delay off	0 .. 999			x	
001B	Signed Int	Alarm 4:	-1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
001C	Signed Int	Test K1:	Cycle [h] (0 = off)	0 .. 999	x	x	x	x
001D	Signed Int	Test K1:	Duration [h]	0 .. 999	x	x	x	x
001E	Signed Int	Sensor 1:	Min. value	-199 .. 999 32748=Not assigned 32766=Interrupt 32767= Short circuit				
001F	Signed Int	Sensor 2:	Min. value					
0020	Signed Int	Sensor 3:	Min. value					
0021	Signed Int	Sensor 4:	Min. value					
0022	Signed Int	Sensor 1-4:	Min value					
0023	Signed Int	Sensor 1:	Max. value					
0024	Signed Int	Sensor 2:	Max. value					
0025	Signed Int	Sensor 3:	Max. value					
0026	Signed Int	Sensor 4:	Max. value					
0027	Signed Int	Sensor 1-4:	Max value					
0028	Signed Int	Sensor 1:	Measurement					
0029	Signed Int	Sensor 2:	Measurement					
002A	Signed Int	Sensor 3:	Measurement					
002B	Signed Int	Sensor 4:	Measurement					
002C	Signed Int	Error - Sensor 1		0=No error 1=Short circuit, 2=Interruption				
002D	Signed Int	Error - Sensor 2						
002E	Signed Int	Error - Sensor 3						
002F	Signed Int	Error - Sensor 4						
0030	Signed Int	Error - Device		0=No error				
0031	Signed Int	Alarm 1		0=Off, 1=Delay Alarm, 2=On, 3=Delay Alarm off, 4=Locked				
0032	Signed Int	Alarm 2						
0033	Signed Int	Alarm 3						
0034	Signed Int	Alarm 4						
0035	Signed Int	Relay K1		0=Off, 1=On				
0036	Signed Int	Relay K2						
0037	Signed Int	Relay K3						

0038	Signed Int	Relay K4	
0039	Signed Int	Test K1: Expired time in [Minutes]	
003A	Signed Int	Test K1: Expired time in [Seconds]	
003B	Signed Int	Software version	

Parameters

Measurements

Register of function code 16 (10H) - Write data in registers				Affects program no.			
Adr.	Data type	Description / Value range		1	2	3	4
0000	Signed Int	Prog. no. 1 .. 4		x	x	x	x
0001	Signed Int	Unit 0=[°C], 1=[°F]		x	x	x	x
0002	Signed Int	Sensor 1 -2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0003	Signed Int	Sensor 2 -2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0004	Signed Int	Sensor 3 -2=nc, -1=3L, 0 .. 999=2L (line res.)		x	x	x	x
0005	Signed Int	Sensor 4 -2=nc, -1=3L, 0 .. 999=2L (line res.)			x	x	x
0006	Signed Int	Alarm 1: Alarm value	-199 .. 999	FAN	FAN	FAN	COR
0007	Signed Int	Alarm 1: Hysteresis	0 .. 99	x	x	x	x
0008	Signed Int	Alarm 1: Alarm delay on	0 .. 999	x	x	x	x
0009	Signed Int	Alarm 1: Alarm delay off	0 .. 999	x	x	x	x
000A	Signed Int	Alarm 1: -1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
000B	Signed Int	Alarm 2: Alarm value	-199 .. 999	ALR	ALR	ALR	ALR
000C	Signed Int	Alarm 2: Hysteresis	0 .. 99	x	x	x	x
000D	Signed Int	Alarm 2: Alarm delay on	0 .. 999	x	x	x	x
000E	Signed Int	Alarm 2: Alarm delay off	0 .. 999	x	x	x	x
000F	Signed Int	Alarm 2: -1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked			x	x	x
0010	Signed Int	Alarm 2: Core	-199 .. 999		x		
0011	Signed Int	Alarm 3: Alarm value	-199 .. 999	TRP	TRP	TRP	TRP
0012	Signed Int	Alarm 3: Hysteresis	0 .. 99	x	x	x	x
0013	Signed Int	Alarm 3: Alarm delay on	0 .. 999	x	x	x	x
0014	Signed Int	Alarm 3: Alarm delay off	0 .. 999	x	x	x	x
0015	Signed Int	Alarm 3: -1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
0016	Signed Int	Alarm 3: Core	-199 .. 999		x		
0017	Signed Int	Alarm 4: Alarm value	-199 .. 999	ERR	ERR	COR	ERR
0018	Signed Int	Alarm 4: Hysteresis	0 .. 99			x	
0019	Signed Int	Alarm 4: Alarm delay on	0 .. 999			x	
001A	Signed Int	Alarm 4: Alarm delay off	0 .. 999			x	
001B	Signed Int	Alarm 4: -1=Quiescent-, -2=Operating current, -3=Quiescent-, -4=Operating current locked		x	x	x	x
001C	Signed Int	Test K1: Cycle [h] (0 = off)	0 .. 999	x	x	x	x
001D	Signed Int	Test K1: Duration [h]	0 .. 999	x	x	x	x
001E	Signed Int	Sensor 1: Min. value	write 1 = Reset value				
001F	Signed Int	Sensor 2: Min. value	write 1 = Reset value				
0020	Signed Int	Sensor 3: Min. value	write 1 = Reset value				
0021	Signed Int	Sensor 4: Min. value	write 1 = Reset value				
0022	Signed Int	Sensor 1-4:Min value	write 1 = Reset value				
0023	Signed Int	Sensor 1: Max. value	write 1 = Reset value				
0024	Signed Int	Sensor 2: Max. value	write 1 = Reset value				
0025	Signed Int	Sensor 3: Max. value	write 1 = Reset value				
0026	Signed Int	Sensor 4: Max. value	write 1 = Reset value				
0027	Signed Int	Sensor 1-4:Max value	write 1 = Reset value				
0028	Signed Int	RESET locked alarm (write 1)					

6 Error messages

The telegram sent from the master is checked by the slave (TR440).
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**