BA01259O/09/en/02.15
No. 71298562
Firmware version
V2.00.xx

Additional instructions

Universal Data Manager ORSG35

Modbus RTU / TCP Slave

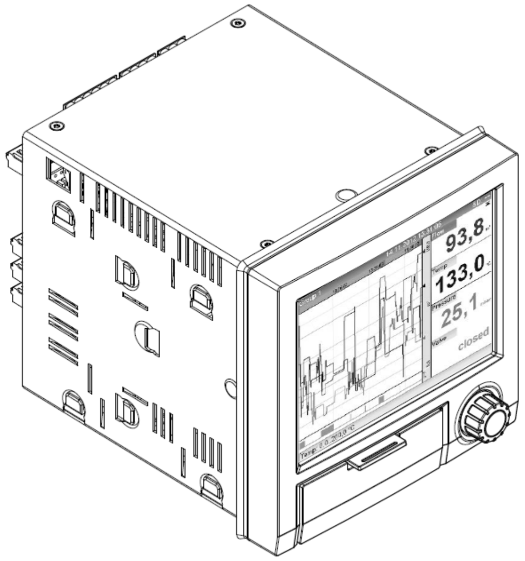


Table of contents:

1 General information

Symbols:

NOTICE **Note**
Failure to observe this sign can result in a device defect or a malfunction.

Tip
Indicates additional information.

1.1 Scope of delivery

These instructions provide an additional description of a special software option.

These additional instructions do **not** replace the corresponding operating instructions.
Detailed information can be found in the operating instructions and additional documentation.

1.2 Prerequisites

The "Modbus Slave" option must be enabled in the device. To retrofit optional functions, please follow the information in the Operating Instructions.

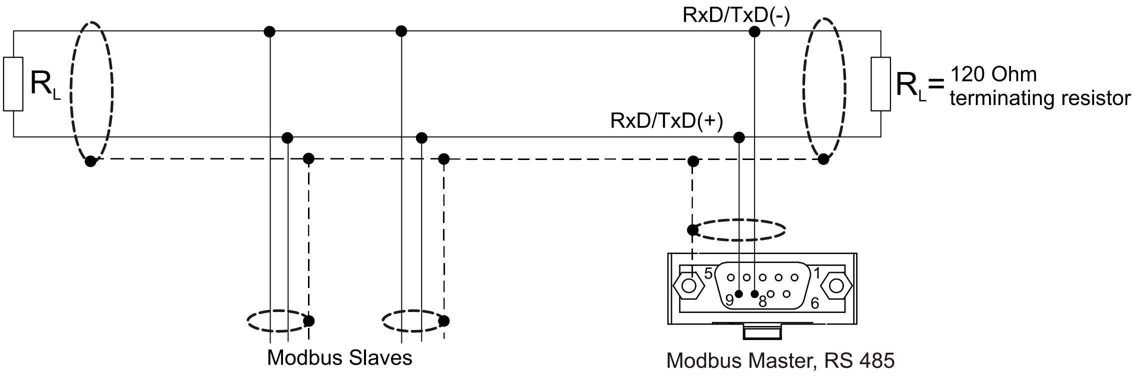
Modbus RTU via RS485 is only possible if the device has the optional RS232/RS485 interface (back of device), and only RS485 is supported. Modbus TCP is possible via the integrated Ethernet interface (back of device).

1.3 Modbus RTU connection

NOTICE **The terminal assignment does not correspond to the standard (Modbus over serial line specification and implementation guide V1.02).**

Pin	Direction	Signal	Description
Housing	-	Functional ground	Protective ground
1	-	GND	Ground (isolated)
9	Input	RxD/TxD(+)	RS-485 B wire
8	Output	RxD/TxD(-)	RS-485 A wire

Tab. 1: Pin assignment of Modbus RTU connector



1.4 Modbus TCP connection

The Modbus TCP interface is physically identical to the Ethernet interface.

1.4.1 Transfer LED

Status LED	Indicator for
Off	No communication
Flashes green	Communication

Tab. 2: Description of the function of the status LEDs for Modbus TCP

1.4.2 Link LED

Status LED	Indicator for
Off	No connection
Flashes yellow	Activity

Tab. 3: Description of the function of the link LEDs for Modbus TCP

1.5 Functional description

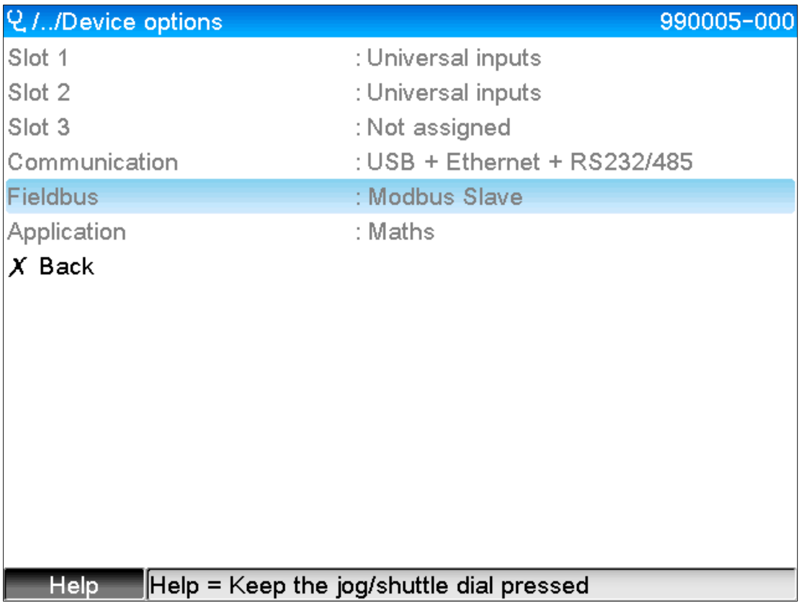
The Modbus RTU option makes it possible to connect the device to Modbus via RS485 with the functionality of a Modbus RTU slave.
Supported baud rates: 9600, 19200, 38400, 57600, 115200
Parity: None, Even, Odd

The Modbus TCP option makes it possible to connect the device to Modbus TCP with the functionality of a Modbus TCP slave. The Ethernet connection supports 10/100 Mbit, full or half duplex.

The user can choose between Modbus TCP or Modbus RTU in the settings. It is not possible to select both at the same time.

1.6 Checking the availability of the Modbus Slave function

In the Main menu under **"Diagnostics / Device information / Device options"** or **"Setup / Advanced setup / System / Device options"** it is possible to check whether the Modbus Slave option is enabled under **Fieldbus**. Under **Communication**, it is possible to determine the hardware interface via which communication is possible:



/../Device options 990005-000

Slot 1 : Universal inputs
Slot 2 : Universal inputs
Slot 3 : Not assigned
Communication : USB + Ethernet + RS232/485
Fieldbus : Modbus Slave
Application : Maths
✗ Back

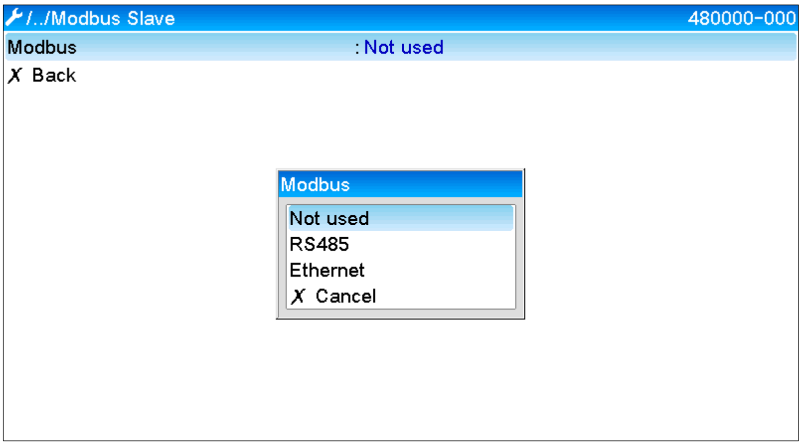
Help | Help = Keep the jog/shuttle dial pressed

Fig. 1: Checking the availability of the Modbus Slave function

2 Settings in the setup

2.1 Modbus TCP, RS485

The interface to be used for Modbus can be selected under **"Setup / Advanced setup / Communication / Modbus Slave"**:



/../Modbus Slave 480000-000

Modbus : Not used

Fig. 2: Selecting the interface for Modbus

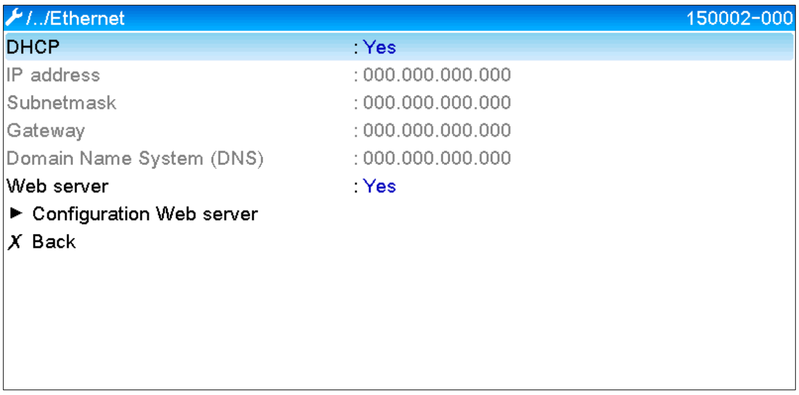
If Modbus RTU (RS485) is selected, the following parameters can be configured:

- Device address (1 to 247)
- Baud rate (9600, 19200, 38400, 57600, 115200)
- Parity (None, Even, Odd)

If Modbus TCP (Ethernet) is selected, the following parameter can be configured:

- Port TCP port (standard: 502)

If Modbus TCP is used, the settings for the Ethernet interface can be made under **"Setup / Advanced setup / Communication / Ethernet"**:



/../Ethernet 150002-000

DHCP : Yes
IP address : 000.000.000.000
Subnetmask : 000.000.000.000
Gateway : 000.000.000.000
Domain Name System (DNS) : 000.000.000.000
Web server : Yes

Fig. 3: Settings for the Ethernet interface

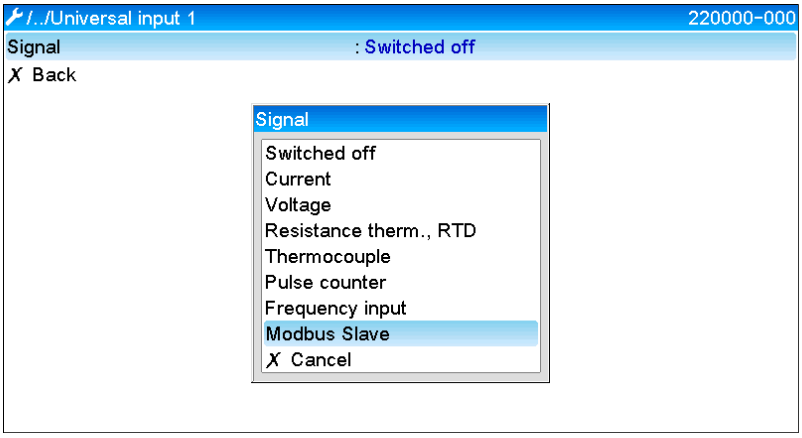
In addition, it is possible to set a timeout period under **"/Expert / Communication /Modbus Slave / Timeout"** after which the channel in question is set to "Invalid".
The timeout only refers to channels that receive a value from the Modbus Master. It does not affect channels that are only read by the Modbus Master.

2.2 Universal channels

All the universal inputs (12) are enabled and can be used as Modbus inputs even if they are not really available as plug-in cards.

2.2.1 Data transfer: Modbus Master -> device:

Under **"Setup / Advanced setup / Inputs / Universal inputs / Universal input X"**, the **Signal** parameter is set to **Modbus Slave**:



/../Universal input 1 220000-000

Signal : Switched off

✗ Back

Fig. 4: Setting the universal input to Modbus

With this setting, a Modbus Master can write to the universal input as described in Section 2.6.1.

2.2.2 Data transfer: device -> Modbus Master:

The Modbus Master can read universal inputs 1 to 12 as described in Section 2.6.3 .

2.3 Mathematics channels

2.3.1 Data transfer: device -> Modbus Master:

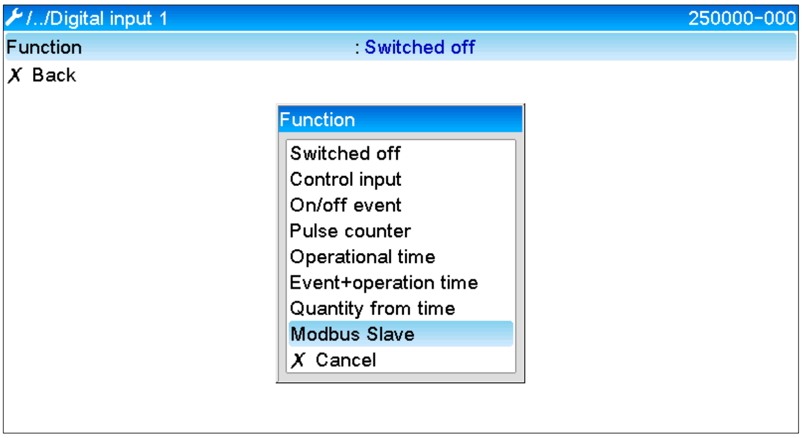
Math channels are available as an option under **/"Setup / Advanced setup / Application / Maths"**.
The results can be read by the Modbus Master (see Sections 2.6.5 and 2.6.4).

2.4 Digital channels

All the digital inputs (6) are enabled and can be used as Modbus inputs.

2.4.1 Data transfer: Modbus Master -> device:

Under **"Setup / Advanced setup / Inputs / Digital inputs / Digital input X"** the **Function** parameter is set to **Modbus Slave**:



/../Digital input 1 250000-000

Function : Switched off

Fig. 5: Setting the digital channel to Modbus

With this setting, the Modbus Master can write to the digital channel as described in Section 2.6.2.
The digital state transmitted by the Modbus Master has the same function in the device as the state of a digital channel that is actually present.

2.4.2 Data transfer: device -> Modbus Master:

Control input or on/off event
The Modbus Master can read out the digital state of the digital channel so configured (see Section 2.6.5).

Pulse counter or operational time
The Modbus Master can read out the totalizer or the total operational time of the digital channel so configured (see Section 2.6.6).

Event + operation time
The Modbus Master can read out the digital state and the totalizer of the digital channel so configured (see Section 2.6.5 and 2.6.6).

2.5 General information

Functions **03: Read Holding Register** and **16: Write Multiple Register** are supported.

The following values can be transmitted from the **Modbus Master to the device**:

- Analog values (instantaneous values)
- Digital states

The following values can be transmitted from the **device to the Modbus Master**:

- Analog values (instantaneous values)
- Integrated analog values (totalizer)
- Math channels (result: state, instantaneous value, operating time, totalizer)
- Integrated math channels (totalizer)
- Digital states
- Pulse counter (totalizer)
- Operational times
- Relay states

2.6 Addressing

The query/response examples refer to Modbus RTU via RS485.
The register addresses are all to the base 0.

2.6.1 Modbus Master -> device: instantaneous value of universal channels

The values of universal channels 1-12 must be written via **16 Write Multiple Register**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Universal 1	200	0C8	6	5200	1450	10
Universal 2	203	0CB	6	5205	1455	10
Universal 3	206	0CE	6	5210	145A	10
Universal 4	209	0D1	6	5215	145F	10
Universal 5	212	0D4	6	5220	1464	10
Universal 6	215	0D7	6	5225	1469	10
Universal 7	218	0DA	6	5230	146E	10
Universal 8	221	0DD	6	5235	1473	10
Universal 9	224	0E0	6	5240	1478	10
Universal 10	227	0E3	6	5245	147D	10
Universal 11	230	0E6	6	5250	1482	10
Universal 12	233	0E9	6	5255	1487	10

Tab. 4: Register addresses of the universal inputs

The 1st register contains the status (see Section 2.6.10.4) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Writing to universal channel 6 with the value 123.456 (32 bit float), slave address 1**

Byte	0	1	2	3	4	5
	00	80	42	F6	E9	79
		Floating point number status	Floating point number = 123.456 (32 bit float)			

Register	Value (hex)
215	00**80**
216	**42F6**
217	**E979**

Query:	Slave address	01	
	Function	10	16: Write Multiple Registers
	Register	00 D7	Register 215
	No. Registers	00 03	3 Registers
	No. Bytes	06	
	Status	00 80	
	FLP	42 F6 E9 79	123.456
	CRC	28 15	

Response:	Slave address	01	
	Function	10	16: Write Multiple Registers
	Register	00 D7	Register 271
	No. Registers	00 03	
	CRC	30 30	

The 1st register contains the status (see Section 2.6.10.4) of the floating point number (64 bit float) transmitted in the 2nd to 5th register).

Example: Writing to universal channel 6 with the value 123.456 (64 bit float), slave address 1

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	00	80	40	5E	DD	2F	1A	9F	BE	77
		Floating point number status	Floating point number = 123.456 (64 bit float)							

Register	Value (hex)
5225	0080
5226	405E
5227	DD2F
5228	1A9F
5229	BE77

Query:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	14 69	Register 5225
No. Registers	00 05	5 Registers
No. Bytes	0A	
Status	00 80	
FLP	40 5E DD 2F 1A 9F BE 77	123.456
CRC	67 56	

Response:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	14 69	Register 5225
No. Registers	00 05	
CRC	D5 E6	

2.6.2 Modbus Master -> device: digital input state

2.6.2.1 Writing all the states simultaneously

The states of digital inputs 1-6 must be written via **16 Write Multiple Registers**.

Channel	Reg. dec.	Reg. hex.	Length, byte
Digital 1-6	1240	4D8	2

Tab. 5: Register addresses of digital inputs (Modbus Master -> device)

Example: **Setting digital input 4 to high (all others to low), slave address 1**

Byte 0 state (bit 15-8)	Byte 1 state (bit 7-0)
00000000	00001000
Always 0	Bit 3 high digital 4

Register	Value (hex)
1240	0008

Query:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	04 D8	Register 1240
No. Registers	00 01	1 Register
No. Bytes	02	
Digital status	00 08	Digital 4 to high
CRC	F0 8E	

Response:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	04 D8	Register 1240
No. Registers	00 01	
CRC	80 C2	

2.6.2.2 Writing states individually

The states of digital inputs 1-6 must be written via **16 Write Multiple Registers**.

Channel	Reg. dec.	Reg. hex.	Length, byte
Digital 1	1200	4B0	2
Digital 2	1201	4B1	2
Digital 3	1202	4B2	2
Digital 4	1203	4B3	2
Digital 5	1204	4B4	2
Digital 6	1205	4B5	2

Tab. 6: Register addresses of digital inputs (Modbus Master -> device)

Example: Setting digital input 4 to high, slave address 1

Byte 0 state (bit 15-8)	Byte 1 state (bit 7-0)
00000000	00001000
Always 0	Bit 3 high digital 4

Register	Value (hex)
1203	0001

Query:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	04 B3	Register 1203
No. Registers	00 01	1 Register
No. Bytes	02	
Digital status	00 01	Digital 4 to high
CRC	38 53	

Response:

Slave address	01	
Function	10	16: Write Multiple Registers
Register	04 B3	Register 1203
No. Registers	00 01	
CRC	F1 1E	

2.6.3 Device -> Modbus Master: universal channels (instantaneous value)

Universal inputs 1-12 are read out via **03 Read Holding Register (4x)**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Universal 1	200	0C8	6	5200	1450	10
Universal 2	203	0CB	6	5205	1455	10
Universal 3	206	0CE	6	5210	145A	10
Universal 4	209	0D1	6	5215	145F	10
Universal 5	212	0D4	6	5220	1464	10
Universal 6	215	0D7	6	5225	1469	10
Universal 7	218	0DA	6	5230	146E	10
Universal 8	221	0DD	6	5235	1473	10
Universal 9	224	0E0	6	5240	1478	10
Universal 10	227	0E3	6	5245	147D	10
Universal 11	230	0E6	6	5250	1482	10
Universal 12	233	0E9	6	5255	1487	10

Tab. 7: Register addresses of universal inputs (device -> Modbus Master)

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Reading analog 1 with the value 82.47239685 (32 bit float), slave address 1**

Byte	0	1	2	3	4	5
	00	80	42	A4	F1	DE
	Limit value violations	Floating point number status	Floating point number = 82.47239685			

Register	Value (hex)
200	0080
201	42A4
202	F1DE

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	00 C8	Register 200
	No. Registers	00 03	3 Registers
	CRC	84 35	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	06	6 Bytes
	Status	00 80	
	FLP	42 A4 F1 DE	82.47239685
	CRC	B0 F8	

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (64 bit float) transmitted in the 2nd to 5th register.

Example: **Reading universal channel 1 with the value 82.4723968506 (64 bit float), slave address 1**

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	00	80	40	54	9E	3B	C0	00	00	00
	Limit value violations	Floating point number status	Floating point number = 82.4723968506 (64 bit float)							

Register	**Value (hex)**
5200	0080
5201	4054
5202	9E3B
5203	C000
5204	0000

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	14 50	Register 5200
	No. Registers	00 05	5 Registers
	CRC	80 28	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	0A	10 Bytes
	Status	00 80	
	FLP	40 54 9E 3B C0 00 00 00	82.4723968506
	CRC	91 3E	

2.6.4 Device -> Modbus Master: math channels (result)

The results of the math channels are read out via **03 Read Holding Register (4x)**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Math 1	1500	5DC	6	6500	1964	10
Math 2	1503	5DF	6	6505	1969	10
Math 3	1506	5E2	6	6510	196E	10
Math 4	1509	5E5	6	6515	1973	10

Tab. 8: Register addresses of math channels (device -> Modbus Master)

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Reading math 1 (instantaneous value result), (32 bit float), slave address 1**

Byte	0	1	2	3	4	5
	00	80	46	40	E6	B7
	Limit value violations	Floating point number status	Floating point number = 12345.67871			

Register	Value (hex)
1500	0080
1501	4640
1502	E6B7

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	05 DC	Register 1500
	No. Registers	00 03	3 Registers
	CRC	C4 FD	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	06	6 Bytes
	Status	00 80	
	FLP	46 40 E6 B7	12345.67871
	CRC	3E 21	

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (64 bit float) transmitted in the 2nd to 5th register.

Example: **Reading math 1 (instantaneous value result), (64 bit float), slave address 1**

Byte	0	1	2	3	4	5	6	7	8	9
	00	80	40	C8	1C	D6	E6	31	F8	A1
	Limit value violations	Floating point number status	Floating point number = 12345.6789 (64 bit float)							

Register	Value (hex)
6500	0080
6501	40C8
6502	1CD6
6503	E631
6504	F8A1

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	19 64	Register 6500
	No. Registers	00 05	5 Registers
	CRC	C3 4A	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	0A	10 Bytes
	Status	00 80	
	FLP	40 C8 1C D6 E6 31 F8 A1	12345.6789
	CRC	A7 FD	

Example: **Reading math 1-4 (state result), slave address 1**

The states of math channels 1-4 are read out via **03 Read Holding Register (4x)**.

Channel	**Reg. dec.**	**Reg. hex.**	**Length, byte**
Math 1-4	1800	708	2

Tab. 9: Register address of states of math channels (device -> Modbus Master)

Byte 0	Byte 1 state (bit 5-0)
00000000	00000011
Always 0	Bit 0 and 1 high Math 1 and 2

Register	**Value (hex)**
1800	0003

Query:	Slave address	01	
	Function	03	3: Read Holding Register
	Register	07 08	Register 1800
	No. Registers	00 01	1 Register
	CRC	04 BC	

Response:	Slave address	01	
	Function	03	16: Write Multiple Registers
	Number	02	2 Bytes
	States	00 03	Math 1 and 2 state high
	CRC	F8 45	

2.6.5 Device -> Modbus Master: digital channels (state)

2.6.5.1 Reading out all the states simultaneously

The states of digital inputs 1-6 are read out via **03 Read Holding Register (4x)**.

Channel	Reg. dec.	Reg. hex.	Length, byte
Digital 1-6	1240	4D8	2

Tab. 10: Register addresses of all digital inputs (device -> Modbus Master)

Example: **Reading the states of digital inputs 1-6, slave address 1**

Byte 0 state (bit 15-8)	Byte 1 state (bit 7-0)
00000000	00100100
Always 0	Bit 2 and 5 high Digital 3 and 6

Register	Value (hex)
1240	0024

Query:	Slave address	01	
	Function	03	3: Read Holding Register
	Register	04 D8	Register 1240
	No. Registers	00 01	1 Register
	CRC	05 01	
Response:	Slave address	01	
	Function	03	16: Write Multiple Registers
	Number	02	2 Bytes
	States	00 24	Digital 3 and 6 high
	CRC	B8 5F	

2.6.5.2 Reading out states individually

The states of digital inputs 1-6 are read out via **03 Read Holding Register (4x)**.

Channel	Reg. dec.	Reg. hex.	Length, byte
Digital 1	1200	4B0	2
Digital 2	1201	4B1	2
Digital 3	1202	4B2	2
Digital 4	1203	4B3	2
Digital 5	1204	4B4	2
Digital 6	1205	4B5	2

Tab. 11: Register addresses of digital inputs (device -> Modbus Master)

Example: **Reading digital input 6, slave address 1**

Byte 0	Byte 1 State bit 0
00000000	00000001
Always 0	Bit 0 high Digital 6

Register	Value (hex)
1205	0001

Query:

Slave address	01	
Function	03	3: Read Holding Register
Register	04 B5	Register 1205
No. Registers	00 01	1 Register
CRC	94DC	

Response:

Slave address	01	
Function	03	3: Read Holding Register
Number	02	2 Bytes
Digital status	00 01	Digital 6 to high
CRC	79 84	

2.6.6 Device -> Modbus Master: digital channels (totalizer)

The totalizers of digital inputs 1-6 are read out via **03 Read Holding Register (4x)**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Digital 1	1300	514	6	6300	189C	10
Digital 2	1303	517	6	6305	18A1	10
Digital 3	1306	51A	6	6310	18A6	10
Digital 4	1309	51D	6	6315	18AB	10
Digital 5	1312	520	6	6320	18B0	10
Digital 6	1315	523	6	6325	18B5	10

Tab. 12: Register addresses of digital input totalizers (device -> Modbus Master)

The 1st register (low byte) contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Reading totalizer of digital input 6 (32 bit float), slave address 1**

Byte	0	1	2	3	4	5
	00	80	40	C9	99	9A
	Limit value violations	Floating point number status	Floating point number = 65552.0			

Register	Value (hex)
1315	0080
1316	40C9
1317	999A

Query:

Slave address	01	
Function	03	3: Read Holding Register
Register	05 23	Register 1315
No. Registers	00 03	3 Registers
CRC	F4 CD	

Response:

Slave address	01	
Function	03	3: Read Holding Register
Number	06	6 Bytes
Digital status	00 80 40 C9 99 9A 6.3	
CRC	0F 6E	

The 1st register (low byte) contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (64 bit float) transmitted in the 2nd to 5th register.

Example: **Reading totalizer of digital input 6 (64 bit float), slave address 1**

Byte	0	1	2	3	4	5	6	7	8	9
	00	80	40	19	33	33	39	80	00	00
	Limit value violations	Floating point number status	Floating point number = 6.3 (64 bit float)							

Register	Value (hex)
6325	0080
6326	4019
6327	3333
6328	3980
6329	0000

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	18 B5	Register 6325
	No. Registers	00 05	5 Registers
	CRC	92 8F	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	0A	10 Bytes
	Status	00 80	
	FLP	40 19 33 33 39 80 00 00	6.3
	CRC	C5 32	

2.6.7 Device -> Modbus Master: integrated universal channels (totalizer)

The totalizers of universal inputs 1-12 are read out via **03 Read Holding Register (4x)**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Universal1	800	320	6	5800	16A8	10
Universal2	803	323	6	5805	16AD	10
Universal3	806	326	6	5810	16B2	10
Universal4	809	329	6	5815	16B7	10
Universal5	812	32C	6	5820	16BC	10
Universal6	815	32F	6	5825	16C1	10
Universal7	818	332	6	5830	16C6	10
Universal8	821	335	6	5835	16CB	10
Universal9	824	338	6	5840	16D0	10
Universal10	827	33B	6	5845	16D5	10
Universal11	830	33E	6	5850	16DA	10
Universal12	833	341	6	5855	16DF	10

Tab. 13: Register addresses of universal input totalizers (device -> Modbus Master)

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Reading totalizer for universal channel 1 with the value 26557.48633 (32 bit float), slave address 1**

Byte	**0**	**1**	**2**	**3**	**4**	**5**
	00	**80**	**46**	**CF**	**7A**	**E6**
	Limit value violations	Floating point number status	Floating point number = 26557.48633			

Register	Value (hex)
800	00**80**
801	**46CF**
802	**7AE6**

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	03 20	Register 800
	No. Registers	00 03	3 Registers
	CRC	04 45	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	06	6 Bytes
	Status	00 80	
	FLP	46 CF 7A E6	3192.73242
	CRC	E6 FE	

The 1st register contains the status (see Section 2.6.10.4) and the limit value violations (see Section 2.6.10.3) of the floating point number (64 bit float) transmitted in the 2nd to 5th register.

Example: **Reading totalizer for universal channel 1 with the value 33174.3672951 (64 bit float), slave address 1**

Byte	0	1	2	3	4	5	6	7	8	9
	00	80	40	E0	32	CB	C0	E1	99	A9
	Limit value violations	**Floating point number status**	**Floating point number = 33174.3672951 (64 bit float)**							

Register	Value (hex)
5800	0080
5801	40E0
5802	32CB
5803	C0E1
5804	99A9

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	16 A8	Register 5800
	No. Registers	00 05	5 Registers
	CRC	00 61	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	0A	10 Bytes
	Status	00 80	
	FLP	40 E0 32 CB C0 E1 99 A9	33174.3672951
	CRC	C7 54	

2.6.8 Device -> Modbus Master: integrated math channels (totalizer)

The totalizers of the math channels are read out via **03 Read Holding Register (4x)**.
It is possible to transmit the value as a 32 bit float or 64 bit float.

Channel	Reg. dec.	Reg. hex.	Length, byte	Reg. dec.	Reg. hex.	Length, byte
Math 1	1700	6A4	6	6700	1A2C	10
Math 2	1703	6A7	6	6705	1A31	10
Math 3	1706	6AA	6	6710	1A36	10
Math 4	1709	6AD	6	6715	1A3B	10

Tab. 14: Register addresses of math channel totalizers (device -> Modbus Master)

The 1st register contains the status (see Section 2.6.10.4) of the floating point number (32 bit float) transmitted in the 2nd and 3rd register.

Example: **Reading totalizer of math 1 (32 bit float), slave address 1**

Byte	0	1	2	3	4	5
	00	80	4B	29	85	F4
		Floating point number status	Floating point number = 33174.3672951			

Register	Value (hex)
1700	0080
1701	4B29
1702	85F4

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	06 A4	Register 1700
	No. Registers	00 03	3 Registers
	CRC	44 A0	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	06	6 Bytes
	Status	00 80	
	FLP	4B 29 85 F4	33174.3672951
	CRC	85 90	

The 1st register contains the status (see Section 2.6.10.4) of the floating point number (64 bit float) transmitted in the 2nd to 5th register).

Example: **Reading totalizer of math 1 (64 bit float), slave address 1**

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	00	**80**	**41**	**68**	**5F**	**26**	**35**	**2A**	**FC**	**7E**
		Floating point number status	Floating point number = 33174.3672951 (64 bit float)							

Register	**Value (hex)**
6700	0080
6701	4168
6702	5F26
6703	352A
6704	FC7E

Query:	Slave address	01	
	Function	03	03: Read Holding Register
	Register	1A 2C	Register 6700
	No. Registers	00 05	5 Registers
	CRC	43 18	

Response:	Slave address	01	
	Function	03	03: Read Holding Register
	No. Bytes	0A	10 Bytes
	Status	00 80	
	FLP	41 68 5F 26 35 2A FC 7E	33174.3672951
	CRC	83 06	

2.6.9 Device -> Modbus Master: reading relay states

The states of the relays are read out via **03 Read Holding Register (4x)**.
Bit 0 corresponds to relay 1.

Example: **Relay 5 in active state**

Query:	Slave address	01	
	Function	03	03: Read Holding Register (4x)
	Register	0C 50	Register 3152
	No. Registers	00 01	1 Register
	CRC	87 4B	

Response:	Slave address	01	
	Function	03	03: Read holding register (4x)
	No. Bytes	02	2 Bytes
	Data	00 10	
	CRC	B9 88	

Byte 0 state (bit 15-8)	Byte 1 state (bit 7-0)
00000000	00010000
Always 0	Bit 4 high Relay 5

Register	**Value (hex)**
3152	0010

The relay state is determined from the 2 data bytes as follows:

Byte 1:
Bit 0 = Status relay 1
Bit 1 = Status relay 2
Bit 2 = Status relay 3
Bit 3 = Status relay 4
Bit 4 = Status relay 5
Bit 5 = Status relay 6

1 = Active, 0 = Inactive

2.6.10 Structure of the process values

2.6.10.1 32-bit floating point number (IEEE-754)

Octet	8	7	6	5	4	3	2	1
0	Sign	(E) 2^7	(E) 2^6					(E) 2^1
1	(E) 2^0	(M) 2^{-1}	(M) 2^{-2}					(M) 2^{-7}
2	(M) 2^{-8}							(M) 2^{-15}
3	(M) 2^{-16}							(M) 2^{-23}

Sign = 0: positive number

Sign = 1: negative number

E = exponent 8 bit, M = mantissa 23 bit

$$Zahl = -1^{VZ} \cdot \left(1 + M\right) \cdot 2^{E-127}$$

$$Zahl = -1^{VZ} \cdot \left(1 + \sum_{i=1}^{23} b_{23-i} 2^{-i}\right) \cdot 2^{E-127}$$

Example: 40 F0 00 00 h = 0100 0000 1111 0000 0000 0000 0000 0000 b

Value $= -1^0 \cdot 2^{129-127} \cdot \left(1 + 2^{-1} + 2^{-2} + 2^{-3}\right)$

$= 1 \cdot 2^2 \cdot \left(1 + 0{,}5 + 0{,}25 + 0{,}125\right)$

$= 1 \cdot 4 \cdot 1{,}875 = 7{,}5$

Byte	**0**	**1**	**2**	**3**	**4**	**5**
	00	**80**	**40**	**F0**	**00**	**00**
	Limit value violations	Floating point number status	Floating point number = 7.5			

2.6.10.2 64-bit floating point number (IEEE-754)

Octet	8	7	6	5	4	3	2	1
0	Sign	(E) 2^{10}	(E) 2^9					(E) 2^4
1	(E) 2^3	(E) 2^2	(E) 2^1	(E) 2^0	(M) 2^{-1}	(M) 2^{-2}	(M) 2^{-3}	(M) 2^{-4}
2	(M) 2^{-5}							(M) 2^{-12}
3	(M) 2^{-13}							(M) 2^{-20}
4	(M) 2^{-21}							(M) 2^{-28}
5	(M) 2^{-29}							(M) 2^{-36}
6	(M) 2^{-37}							(M) 2^{-44}
7	(M) 2^{-45}							(M) 2^{-52}

Sign = 0: positive number

Sign = 1: negative number

E = exponent 11 bit, M = mantissa 52 bit

$$Zahl = -1^{VZ} \cdot \left(1 + M\right) \cdot 2^{E-1023}$$

$$Zahl = -1^{VZ} \cdot \left(1 + \sum_{i=1}^{52} b_{52-i} 2^{-i}\right) \cdot 2^{E-1023}$$

Example: 40 1E 00 00 00 00 00 00 h

= 0 100 0000 0001 1110 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 b

Value $= -1^0 \cdot 2^{1025-1023} \cdot \left(1 + 2^{-1} + 2^{-2} + 2^{-3}\right)$

$= 1 \cdot 2^2 \cdot \left(1 + 0{,}5 + 0{,}25 + 0{,}125\right)$

$= 1 \cdot 4 \cdot 1{,}875 = 7{,}5$

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	00	**80**	**40**	**1E**	**00**	**00**	**00**	**00**	**0**	**0**

	Floating point number status	Floating point number =7.5

2.6.10.3 Limit value violations

Device -> Modbus Master

The states of the first 8 limit values that are assigned to the channel are entered here.

Bit 0: 1st assigned limit value
…
Bit 7: 8th assigned limit value

Bit x = 1: limit value violated
= 0: limit value not violated

Example:
If universal input 1 is assigned a limit value for the instantaneous value and a limit value for analysis 1, the 2 limit value states are indicated in bit 0 and bit 1 in the measured value of universal input 1 (register 200) **and** integrated universal input 1 (register 800).

Byte	0	1	2	3	4	5
	02	80	40	F0	00	00
	Limit value violations	Floating point number status	Floating point number = 7.5			

Bit 0.0 = 0: 1st assigned limit value not violated, here limit value for instantaneous value
Bit 0.1 = 1: 2nd assigned limit value violated, here limit value for integrated value

2.6.10.4 Status of the floating point number

Device -> Modbus Master

0x01	Cable open circuit
0x02	Input signal too high
0x03	Input signal too low
0x04	Invalid measured value
0x06	Error value
0x07	Sensor/input error
0x08	No value present (e.g. while measurement is initialized)
0x40	Value is uncertain (error value), no limit value violation
0x41	Value is uncertain (error value), lower limit value violation or gradient decreasing
0x42	Value is uncertain (error value), upper limit value violation or gradient increasing
0x80	Value is OK, no limit value violation
0x81	Value is OK, lower limit value violation or gradient decreasing
0x82	Value is OK, upper limit value violation or gradient increasing

Modbus Master -> Device

0x00..0x3F: value invalid
0x40..0x7F: value uncertain
0x80..0xFF: value OK

3 Overview of registers

The register addresses are all to the base 0, i.e. they correspond to the value that is transmitted in the Modbus protocol.

Register	Value	Format	Access
200	Universal 1	Status + 32 Bit Float	R/W
203	Universal 2	Status + 32 Bit Float	R/W
206	Universal 3	Status + 32 Bit Float	R/W
209	Universal 4	Status + 32 Bit Float	R/W
212	Universal 5	Status + 32 Bit Float	R/W
215	Universal 6	Status + 32 Bit Float	R/W
218	Universal 7	Status + 32 Bit Float	R/W
221	Universal 8	Status + 32 Bit Float	R/W
224	Universal 9	Status + 32 Bit Float	R/W
227	Universal 10	Status + 32 Bit Float	R/W
230	Universal 11	Status + 32 Bit Float	R/W
233	Universal 12	Status + 32 Bit Float	R/W
800	Universal 1 totalizer	Status + 32 Bit Float	R
803	Universal 2 totalizer	Status + 32 Bit Float	R
806	Universal 3 totalizer	Status + 32 Bit Float	R
809	Universal 4 totalizer	Status + 32 Bit Float	R
812	Universal 5 totalizer	Status + 32 Bit Float	R
815	Universal 6 totalizer	Status + 32 Bit Float	R
818	Universal 7 totalizer	Status + 32 Bit Float	R
821	Universal 8 totalizer	Status + 32 Bit Float	R
824	Universal 9 totalizer	Status + 32 Bit Float	R
827	Universal 10 totalizer	Status + 32 Bit Float	R
830	Universal 11 totalizer	Status + 32 Bit Float	R
833	Universal 12 totalizer	Status + 32 Bit Float	R
1200	Digital 1 state	2 Byte	R/W
1201	Digital 2 state	2 Byte	R/W
1202	Digital 3 state	2 Byte	R/W
1203	Digital 4 state	2 Byte	R/W
1204	Digital 5 state	2 Byte	R/W
1205	Digital 6 state	2 Byte	R/W
1240	Digital 1-6 states	2 Byte	R/W
1300	Digital 1 totalizer	Status + 32 Bit Float	R
1303	Digital 2 totalizer	Status + 32 Bit Float	R
1306	Digital 3 totalizer	Status + 32 Bit Float	R
1309	Digital 4 totalizer	Status + 32 Bit Float	R
1312	Digital 5 totalizer	Status + 32 Bit Float	R
1315	Digital 6 totalizer	Status + 32 Bit Float	R
1500	Math 1	Status + 32 Bit Float	R
1503	Math 2	Status + 32 Bit Float	R
1506	Math 3	Status + 32 Bit Float	R
1509	Math 4	Status + 32 Bit Float	R
1700	Math 1 totalizer	Status + 32 Bit Float	R
1703	Math 2 totalizer	Status + 32 Bit Float	R
1706	Math 3 totalizer	Status + 32 Bit Float	R
1709	Math 4 totalizer	Status + 32 Bit Float	R
1800	Math 1-4 states	2 Byte	R
3152	Relay states	2 Byte	R
5200	Universal 1	Status + 64 Bit Float	R/W
5205	Universal 2	Status + 64 Bit Float	R/W
5210	Universal 3	Status + 64 Bit Float	R/W
5215	Universal 4	Status + 64 Bit Float	R/W
5220	Universal 5	Status + 64 Bit Float	R/W
5225	Universal 6	Status + 64 Bit Float	R/W
5230	Universal 7	Status + 64 Bit Float	R/W
5235	Universal 8	Status + 64 Bit Float	R/W
5240	Universal 9	Status + 64 Bit Float	R/W
5245	Universal 10	Status + 64 Bit Float	R/W
5250	Universal 11	Status + 64 Bit Float	R/W
5255	Universal 12	Status + 64 Bit Float	R/W
5800	Universal 1 totalizer	Status + 64 Bit Float	R

5805	Universal 2 totalizer	Status + 64 Bit Float	R
5810	Universal 3 totalizer	Status + 64 Bit Float	R
5815	Universal 4 totalizer	Status + 64 Bit Float	R
5820	Universal 5 totalizer	Status + 64 Bit Float	R
5825	Universal 6 totalizer	Status + 64 Bit Float	R
5830	Universal 7 totalizer	Status + 64 Bit Float	R
5835	Universal 8 totalizer	Status + 64 Bit Float	R
5840	Universal 9 totalizer	Status + 64 Bit Float	R
5845	Universal 10 totalizer	Status + 64 Bit Float	R
5850	Universal 11 totalizer	Status + 64 Bit Float	R
5855	Universal 12 totalizer	Status + 64 Bit Float	R
6300	Digital 1 totalizer	Status + 64 Bit Float	R
6305	Digital 2 totalizer	Status + 64 Bit Float	R
6310	Digital 3 totalizer	Status + 64 Bit Float	R
6315	Digital 4 totalizer	Status + 64 Bit Float	R
6320	Digital 5 totalizer	Status + 64 Bit Float	R
6325	Digital 6 totalizer	Status + 64 Bit Float	R
6700	Math 1 totalizer	Status + 64 Bit Float	R
6705	Math 2 totalizer	Status + 64 Bit Float	R
6710	Math 3 totalizer	Status + 64 Bit Float	R
6715	Math 4 totalizer	Status + 64 Bit Float	R

4 Troubleshooting

4.1 Troubleshooting for Modbus TCP

- Is the Ethernet connection between the device and master OK?
- Does the IP address sent by the master match the address configured on the device?
- Do the port configured on the master and the port configured on the device match?

4.2 Troubleshooting for Modbus RTU

- Do the device and master have the same baud rate and parity?
- Is the interface correctly wired?
- Does the device address sent by the master match the configured address of the device?
- Do all the slaves on the Modbus have different device addresses?

5 List of abbreviations/glossary of terms

Modbus Master: All instruments such as a PLC, PC plug-in cards etc. that perform a Modbus Master function.

6 Index