Software description Modbus RTU

Summary

Description of the standard software of the Modbus RTU modules:

General commands

Bit rate setting with Modbus commands

Parity and Bit rate have the same value as with the setting by the address switches.
If Parity or Baud are 0, there will be no setting or storage.
The register content is stored in the EEPROM.

Modbus Function "06 (0x06) Write Single Register"

Request

Valid Register Address 0x41 (65)
Valid Register Value 2 Bytes

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x53								Parity				Bit rate			

Bit 15-8: Magic-Number 0x53 = 83 as protection against accidental writing.
The command will be further analyzed only with this number.

Bit 7-4	1	2	3
Parity	even	odd	none

Bit 3-0	1	2	3	4	5	6	7	8
Bit rate	1200	2400	4800	9600	19200	38400	57600	115200

Response

Echo of Request

Example for a frame:

Slave address	0x12	Setting of rotary switch (18)
Function	0x06	Write Single Register
Register address Hi	0x00	
Register address Lo	0x41	Bit rate and Parity (65)
Register content Hi	0x53	Magic number
Register content Lo	0x15	Parity Even, 19200 Baud

All devices can be switched simultaneously with a Broadcast command (Slave address 0x00)
However, it is advised not to do so as this may cause problems:

- Devices from other manufacturers may have under this address a register for a different purpose that will then be operated in the wrong way.

There is no feedback from the individual devices. Consequently the control cannot immediately recognize if the command was correctly received.

It is safer to address and switch each device individually. The device will then answer with the old settings of parity and bit rate. Switching will take place afterwards. However, the answer can get lost if the bus is disturbed.

When all devices are switched; it is advised to check communication. Any function of the device providing a feedback is suitable. If a single function is to be used being independent from the process periphery then the function „Diagnostic“ sub-function „Return Query Data“ is suitable, it returns the transferred data.

If bit rate and parity setting of a device are unknown it is possible to address the device successively with all combinations of bit rate and parity until the device answers. Try the most likely combinations first. Try the lower bit rates last as they take longer.

Test of the communication system

Modbus Function “08 (0x08) Diagnostics”

Subfunction “0 (0x0000) Return Query Data”
Data Field Any
Response: Echo of Request

Subfunction “1 (0x0001) Restart Communication Option”
Data Field 0x0000 or 0xFF00
Response: Echo of Request
Action: Clears all Error Counters, Restarts node

Subfunction “4 (0x0004) Force Listen Only Mode”
Data Field 0x0000
No Response
Action: No response until Node Reset or Function Code 08
Subcode 01

Subfunction “10 (0x000A) Clear Counters”
Data Field 0x0000
Response: Echo of Request
Action: Clears all Error Counters

Subfunction “11 (0x000B) Return Bus Message Count”
Data Field 0x0000
Response: Quantity of messages that the remote device has detected on the communications system since its last restart, clear counters operation, or power-up.

Subfunction “12 (0x000C) Return Bus Communication Error Count”
Data Field 0x0000
Response: Quantity of errors encountered by the remote device since its last restart, clear counters operation, or power-up. (CRC, Length <3, Parity, Framing

Subfunction “13 (0x000D) Return Bus Exception Error Count”
Data Field 0x0000
Response: Quantity of Modbus exception responses returned by the remote device since its last restart, clear counters operation, or power-up.

Subfunction “14 (0x000E) Return Slave Message Count”
Data Field 0x0000
Response: quantity of messages addressed to the remote device, or broadcast, that the remote device has processed since its last restart, clear counters operation, or power-up.

Subfunction “15 (0x000F) Return Slave No Response Count”
Data Field 0x0000
Response: Quantity of messages addressed to the remote device for which it has returned no response (neither a normal response nor an exception response), since its last restart, clear counters operation, or power-up.

MR-DO4 / MR-DOA4

I/O commands

Modbus Function „01 (0x01) Read Coils“

Request

Valid Coil Starting Address	0 .. 7
* for MR-DOA4 Address	4 .. 7 = 0
Valid Quantity of Outputs	1 .. 8

Response

Byte Count	1
Output Status	Bit0 .. Bit7

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = Status relay 3 off
	1 = Status relay 3 on
3	0 = Status relay 4 off
	1 = Status relay 4 on
4*	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
5*	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control
6*	0 = relay 3 switched via bus
	1 = relay 3 switched via manual control
7*	0 = relay 4 switched via bus
	1 = relay 4 switched via manual control

Modbus Function “05 (0x05) Write Single Coil”

Request

Valid Output Address	0 .. 3
Valid Output Value	0x0000 or 0xFF00

Response

Echo of the request

Modbus Function “15 (0x0F) Write Multiple Coils”

Request

Valid Coil Starting Address	0 .. 3
Valid Quantity of Outputs	1 .. 4
Valid Byte Count	1
Output Value	0 or 1 in Bit0 .. Bit3

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = Status relay 3 off
	1 = Status relay 3 on
3	0 = Status relay 4 off
	1 = Status relay 4 on

Response

Function Code, Starting Address, Quantity of Outputs

Modbus Function “03 (0x03) Read Holding Registers”

Request

Valid Register Starting Address	0..1 or 66
Valid Quantity of Registers	2 or 1

Response

Function Code, Byte Count, Register Values

Values Register 0:

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = Status relay 3 off
	1 = Status relay 3 on
3	0 = Status relay 4 off
	1 = Status relay 4 on
4	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
5	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control
6	0 = relay 3 switched via bus
	1 = relay 3 switched via manual control
7	0 = relay 4 switched via bus
	1 = relay 4 switched via manual control

Values Register 1:

Bit	Information
0	0 = Initial state after Reset or communication; monitoring relay 1 off
	1 = Initial state after Reset or communication; monitoring relay 1 on
1	0 = Initial state after Reset or communication; monitoring relay 2 off
	1 = Initial state after Reset or communication; monitoring relay 2 on
2	0 = Initial state after Reset or communication; monitoring relay 3 off
	1 = Initial state after Reset or communication; monitoring relay 3 on
3	0 = Initial state after Reset or communication; monitoring relay 4 off
	1 = Initial state after Reset or communication; monitoring relay 4 on

Value Register 66:
Time constant for communication monitoring.
Register Value = 0 (0x0000) (default) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0001 to 0xFFFF => 0.01 to 655.35 seconds = 10.9 minutes

Modbus Function “06 (0x06) Write Single Register”

Request

Register Address	0 or 1 or 66
Register Value	Bits 0 – 3 according to tables or the description above

Response

Echo of the request

Modbus Function “16 (0x10) Write Multiple Registers”

Request

Valid Register Starting Address	0 or 1
Valid Quantity of Registers	2
Byte Count	2 x Quantity of registers
Registers Value	Quantity of registers x 2 Byte Bits 0 – 3 according to tables

Response

Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-DO4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-TO4

I/O commands

Modbus Function „01 (0x01) Read Coils“

Request

Valid Coil Starting Address	0 .. 7
Valid Quantity of Outputs	1 .. 8

Response

Byte Count	1
Output Status	Bit0 .. Bit7

Bit	Information
0	0 = Status Triac 1 off
	1 = Status Triac 1 on
1	0 = Status Triac 2 off
	1 = Status Triac 2 on
2	0 = Status Triac 3 off
	1 = Status Triac 3 on
3	0 = Status Triac 4 off
	1 = Status Triac 4 on
4*	0 = Triac 1 switched via bus
	1 = Triac 1 switched via manual control
5*	0 = Triac 2 switched via bus
	1 = Triac 2 switched via manual control
6*	0 = Triac 3 switched via bus
	1 = Triac 3 switched via manual control
7*	0 = Triac 4 switched via bus
	1 = Triac 4 switched via manual control

Modbus Function “05 (0x05) Write Single Coil”

Request

Valid Output Address	0 .. 3
Valid Output Value	0x0000 or 0xFF00

Response

Echo of the request

Modbus Function “15 (0x0F) Write Multiple Coils”

Request

Valid Coil Starting Address	0 .. 3
Valid Quantity of Outputs	1 .. 4
Valid Byte Count	1
Output Value	0 or 1 in Bit0 .. Bit3

Bit	Information
0	0 = Status Triac 1 off
	1 = Status Triac 1 on
1	0 = Status Triac 2 off
	1 = Status Triac 2 on
2	0 = Status Triac 3 off
	1 = Status Triac 3 on
3	0 = Status Triac 4 off
	1 = Status Triac 4 on

Response

Function Code, Starting Address, Quantity of Outputs

Modbus Function “03 (0x03) Read Holding Registers”

Request

Valid Register Starting Address	0..1 or 66
Valid Quantity of Registers	2 or 1

Response

Function Code, Byte Count, Register Values

Values Register 0:

Bit	Information
0	0 = Status Triac 1 off
	1 = Status Triac 1 on
1	0 = Status Triac 2 off
	1 = Status Triac 2 on
2	0 = Status Triac 3 off
	1 = Status Triac 3 on
3	0 = Status Triac 4 off
	1 = Status Triac 4 on
4*	0 = Triac 1 switched via bus
	1 = Triac 1 switched via manual control
5*	0 = Triac 2 switched via bus
	1 = Triac 2 switched via manual control
6*	0 = Triac 3 switched via bus
	1 = Triac 3 switched via manual control
7*	0 = Triac 4 switched via bus
	1 = Triac 4 switched via manual control

Values Register 1:

Bit	Information
0	0 = Initial state after Reset or communication; monitoring Triac 1 off
	1 = Initial state after Reset or communication; monitoring Triac 1 on
1	0 = Initial state after Reset or communication; monitoring Triac 2 off
	1 = Initial state after Reset or communication; monitoring Triac 2 on
2	0 = Initial state after Reset or communication; monitoring Triac 3 off
	1 = Initial state after Reset or communication; monitoring Triac 3 on
3	0 = Initial state after Reset or communication; monitoring Triac 4 off
	1 = Initial state after Reset or communication; monitoring Triac 4 on

Value Register 66:
Time constant for communication monitoring.
Register Value = 0 (0x0000) (default) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0001 to 0xFFFF => 0.01 to 655.35 seconds = 10.9 minutes

Modbus Function “06 (0x06) Write Single Register”

Request

Register Address	0 or 1 or 66
Register Value	Bits 0 – 3 according to tables or the description above

Response

Echo of the request

Modbus Function “16 (0x10) Write Multiple Registers”

Request

Valid Register Starting Address	0 or 1
Valid Quantity of Registers	2
Byte Count	2 x Quantity of registers
Registers Value	Quantity of registers x 2 Byte Bits 0 – 3 according to tables

Response

Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-TO4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-DI4 / MR-DI4-IP

Modbus Function „02 (0x02) Read Discrete Inputs“

Request

Valid Input Starting Address	0 .. 3
Valid Quantity of Inputs	1 .. 4

Response

Byte Count	1
Input Status	Bit0 .. Bit3 (Bit 4 .. 7 = 0)

Information

1= Status input closed
0= Status input open

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Input Status Bit 0..3

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-DI4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-DI10

Modbus Function „02 (0x02) Read Discrete Inputs“

Request

Valid Input Starting Address	0 .. 9
Valid Quantity of Inputs	1 .. 10

Response

Byte Count	1 or 2
Input Status	Bit0 .. Bit9

Information

1= Status input closed
0= Status input open

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Input Status Bit 0..9

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x07
Object Value	“MR-DI10”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-SI4

I/O functions

Modbus Function „02 (0x02) Read Discrete Inputs“

Request

Valid Input Starting Address	0 .. 3
Valid Quantity of Inputs	1 .. 4

Response

Byte Count	1
Input Status	Bit0 .. Bit3 (Bit 4 .. 7 = 0)

Information

1= Status input closed
0= Status input open

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	20
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Input Status Bit 0..3

Counter functions

The following functions are used to read or write the registers. The valid address ranges are indicated in brackets.

„04 (0x04) Read Input Registers“	(0-20)
„03 (0x03) Read Holding Registers“	(0-43)
“06 (0x06) Write Single Register”	(20-43)
“06 (0x06) Write Single Register”	(65)
“16 (0x10) Write Multiple Registers	(0-43)

For long data types with a length of several registers, these registers are listed directly one after the other and the one with the highest value is indicated first. This data can only be transmitted as complete set.

Input Register (Read-Only)		
Address	Name	Description
0 – 11	IZ	Pulse counter Data type uint48_t (3 registers each)
12 – 19	BZ	Calculated counter reading Data type uint32_t (2 registers each)
20	INPUT	Bits 0-3 include Discrete Input 0-3

Holding Register		
Address	Name	Description
0 – 11	IT	Copy of the pulse counter after having pressed the key Data type uint48_t (3 registers each) (EEPROM)
12 – 19	AZ	Initial counter reading Data type uint32_t (2 registers each) Factory setting 0 (EEPROM)
20 – 23	IE	Pulses per unit Data type uint16_t (1 register each) Factory setting 1 (EEPROM)
24 – 27	WI	Transformation factor for current Data type uint16_t (1 register each) Factory setting 1 (EEPROM)
28 – 31	WU	Transformation factor for voltage Data type uint16_t (1 register each) Factory setting 1 (EEPROM)
32 – 35	WP	Operating mode for calculation with transformation factor Data type uint16_t (1 register each, only Bit 0 is valid) Value range 0…1, see below Factory setting 0 (EEPROM)
36 – 39	ZS	Format of the counter digit display Data type uint16_t (1 register each) (EEPROM) High-Byte for counter digits, Value range 0…9, factory setting 7, higher values are limited to 9. Low-Byte for places after the decimal point, Value range 0…3, factory setting 1, higher values are limited to 3.
40 – 43	TA	Flag for key activation Data type uint16_t (1 register each, only Flag in Bit 0) 0: key is blocked, 1: key is operational Factory setting 1 (EEPROM)
65	BAUD	Codes for Baud rate and Parity Factory setting 19200 Baud, Even Parity (EEPROM)

Operating mode for calculation with transformation factor

In the WP register, there is a code 0…1 that determines, together with the transformation factors WI and WU, the way how they are included in calculation. WP, WI and WU depend on whether the transformers are switched by the counters, whether the counter indicates the consumption in a primary or secondary way and whether the emitted pulses correspond primarily or secondarily to the consumption.

A difference must be made between the following electricity meter types:

Type 1: Directly measuring counter, display: primary, pulse: primary

Note:	Indicates the real consumption
Species:	DIN rail counter with mechanical drum-type counting mechanism, Ferraris counter
Formula type:	WP = 0
Factors:	WI = WU = 1

$$BZ = \left(\frac{IZ - IT}{IE} + AZ \right) \cdot WI \cdot WU \quad , \quad BZ = \text{counter reading} = \text{consumption}$$

Type 2: Transformer counter, display: primary, pulse: secondary

Note:	Indicates the real consumption
Species:	counter with LCD display
Formula type:	WP = 1
Factors:	WI and WU correspond to the transformers

$$BZ = \left(\frac{IZ - IT}{IE} \cdot WI \cdot WU \right) + AZ \quad , \quad BZ = \text{counter reading} = \text{consumption}$$

Type 3: Transformer counter, display: primary, pulse: primary

Note:	Indicates the real consumption
Species:	counter with LCD display, multi-function counters
Formula type:	WP = 0
Factors:	WI = WU = 1

$$BZ = \left(\frac{IZ - IT}{IE} + AZ \right) \cdot WI \cdot WU \quad , \quad BZ = \text{counter reading} = \text{consumption}$$

Type 4: Transformer counter, display: secondary, pulse: secondary

Note:	Indicates the consumption reduced by the transformation factors
Species:	DIN rail counter with mechanical drum-type counting mechanism, Ferraris counter
Formula type:	WP = 0

Consumption and display of the transformer counter are different. Both can be calculated using a different configuration (WI, WU).

Factors:	WI = WU = 1: The calculated counter reading corresponds to the display of the transformer counter.
Species:	DIN rail counter with mechanical drum-type counting mechanism, Ferraris counter.

$$BZ = \left(\frac{IZ - IT}{IE} + AZ \right) \cdot WI \cdot WU \quad , \quad BZ = \text{counter reading or consumption}$$

Start of operation

The user reads on site the initial count from the electricity meter and presses the key on the MR-SI4. After this key press, the pulse counter of register IZ is copied into register IT. Afterwards, the user configures the MR-SI4 via the Modbus using a service program. The following must be entered:

- initial counter reading from the counter
- pulses per unit,
  e.g. indication on the electricity meter 2000 pulses per kWh
- formula type for calculation with transformation factors
- factor for current transformation,
  e.g. indication on the transformer 200/5A → factor = 40
- factor for voltage conversion,
  e.g. indication on the transformer 20000/100V → factor = 200
- number of digits and places after the decimal point
- deactivate the key to protect the IT register

Details for calculation

The calculated counter reading should behave exactly as the electricity meter. This requires that there should be no overflows and rounding errors for the intermediate results. Therefore, particularly large data types are used for counting and calculation

Every 60 milliseconds, a pulse can be emitted by the electricity meter. This results in up to 1,440,000 pulses per day or about 526,000,000 pulses per year.
If the pulse counter was realized with 4 bytes, it could be count to 4,294,967,295. At highest pulse frequency, this would be enough for approx. 8.2 years.
Therefore it is provided with 6 bytes and cannot overflow.

The number of places after the decimal point is considered as an additional multiplier with a power of ten during the calculation. Furthermore, it determines the place of the decimal point in the display of BZ and AZ.
As for the electricity counter which only has a specified number of decimal places, the number of places is limited with the last step in the calculation. This is why the calculated counter reading of the MR-SI4 overflows to 0 as often as the counter reading of the electricity meter.

Calculated counter reading if WP = 0:

BZ = ((uint96_t) (IZ - IT) * WU * WI * power of ten [places after decimal point] / IE +
(uint96_t) AZ * WU * WI)
% power of ten [counter digits]

Calculated counter reading if WP = 1:

BZ = ((uint96_t) (IZ - IT) * WU * WI * power of ten [places after decimal point] / IE +
(uint96_t) AZ)
% power of ten [counter digits]

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-SI4”
Object ID	0x02
Object Length	0x04
Object Value	“V2.0”

MR-DIO4/2 / MR-DIO4/2S

I/O commands

Modbus Function „01 (0x01) Read Coils“

Request

Valid Coil Starting Address	0 .. 3
Valid Quantity of Outputs	1 .. 4

Response

Byte Count	1
Output Status	Bit0 .. Bit3 (Bit4 .. 7=0)

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
3	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control

Modbus Function „02 (0x02) Read Discrete Inputs“

Request

Valid Input Starting Address	0 .. 3
Valid Quantity of Inputs	1 .. 4

Response

Byte Count	1
Input Status	Bit0 .. Bit3 (Bit 4 .. 7 = 0)

Information

1= Status input closed
0= Status input open

Modbus Function “05 (0x05) Write Single Coil”

Request

Valid Output Address	0 .. 1
Valid Output Value	0x0000 or 0xFF00

Response

Echo of the request

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Input Status Bit 0..3

Modbus Function “15 (0x0F) Write Multiple Coils”

Request

Valid Coil Starting Address	0 .. 1
Valid Quantity of Outputs	1 .. 2
Valid Byte Count	1
Output Value	0 or 1 in Bit0 .. Bit1

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on

Response

Function Code, Starting Address, Quantity of Outputs

Modbus Function “03 (0x03) Read Holding Registers”

Request

Valid Register Starting Address 0..1 or 66
Valid Quantity of Registers 2 or 1

Response

Function Code, Byte Count, Register Values

Values Register 0:

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
3	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control

Values Register 1:

Bit	Information
0	0 = Initial state after Reset or communication; monitoring relay 1 off
	1 = Initial state after Reset or communication; monitoring relay 1 on
1	0 = Initial state after Reset or communication; monitoring relay 2 off
	1 = Initial state after Reset or communication; monitoring relay 2 on

Value Register 66:
Time constant for communication monitoring.
Register Value = 0 (0x0000) (default) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0001 to 0xFFFF => 0.01 to 655.35 seconds = 10.9 minutes

Modbus Function “06 (0x06) Write Single Register”

Request

Register Address 0 or 1 or 66
Register Value Bits 0 – 3 according to tables or the description above

Response

Echo of the request

Modbus Function “16 (0x10) Write Multiple Registers”

Request

Valid Register Starting Address	0 or 1
Valid Quantity of Registers	2
Byte Count	2 x Quantity of registers
Registers Value	Quantity of registers x 2 Byte Bits 0 – 3 according to tables

Response

Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x09
Object Value	“MR-DIO4/2”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-DIO4/2-IP

I/O commands

Modbus Function „01 (0x01) Read Coils“

Request

Valid Coil Starting Address	0 .. 3
Valid Quantity of Outputs	1 .. 4

Response

Byte Count	1
Output Status	Bit0 .. Bit3 (Bit4 .. 7=0)

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
3	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control

Modbus Function „02 (0x02) Read Discrete Inputs“

Request

Valid Input Starting Address	0 .. 3
Valid Quantity of Inputs	1 .. 4

Response

Byte Count	1
Input Status	Bit0 .. Bit3 (Bit 4 .. 7 = 0)

Information

1= Status input closed
0= Status input open

Modbus Function “05 (0x05) Write Single Coil”

Request

Valid Output Address	0 .. 1
Valid Output Value	0x0000 or 0xFF00

Response

Echo of the request

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Input Status Bit 0..3

Modbus Function “15 (0x0F) Write Multiple Coils”

Request

Valid Coil Starting Address	0 .. 1
Valid Quantity of Outputs	1 .. 2
Valid Byte Count	1
Output Value	0 or 1 in Bit0 .. Bit1

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on

Response

Function Code, Starting Address, Quantity of Outputs

Modbus Function “03 (0x03) Read Holding Registers”

Request

Valid Register Starting Address 0..1 or 66
Valid Quantity of Registers 2 or 1

Response

Function Code, Byte Count, Register Values

Values Register 0:

Bit	Information
0	0 = Status relay 1 off
	1 = Status relay 1 on
1	0 = Status relay 2 off
	1 = Status relay 2 on
2	0 = relay 1 switched via bus
	1 = relay 1 switched via manual control
3	0 = relay 2 switched via bus
	1 = relay 2 switched via manual control

Values Register 1:

Bit	Information
0	0 = Initial state after Reset or communication; monitoring relay 1 off
	1 = Initial state after Reset or communication; monitoring relay 1 on
1	0 = Initial state after Reset or communication; monitoring relay 2 off
	1 = Initial state after Reset or communication; monitoring relay 2 on

Value Register 66:
Time constant for communication monitoring.
Register Value = 0 (0x0000) (default) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0001 to 0xFFFF => 0.01 to 655.35 seconds = 10.9 minutes

Modbus Function “06 (0x06) Write Single Register”

Request

Register Address 0 or 1 or 66
Register Value Bits 0 – 3 according to tables or the description above

Response

Echo of the request

Modbus Function “16 (0x10) Write Multiple Registers”

Request

Valid Register Starting Address	0 or 1
Valid Quantity of Registers	2
Byte Count	2 x Quantity of registers
Registers Value	Quantity of registers x 2 Byte Bits 0 – 3 according to tables

Response

Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x0B
Object Value	“MR-DIO4/2IP”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-TP

I/O commands

Modbus Function “02 (0x02) Read Discrete Inputs”

Request

Valid Input Starting Address	0 .. 15
Valid Quantity of Inputs	1 .. 16

Response

Byte Count	1..2
Input Status	Bit0 .. Bit15

Information

Discrete Input 0-5:	switching status of the digital inputs, 0: OFF, 1: ON
Discrete Input 6-7:	feedback of transistor outputs, 0: OFF, 1: ON
Discrete Input 8-9:	feedback of switching status of relay 1, 0: Off, 2: level 1 (open), 3: level 2 (close)
Discrete Input 10-11:	Cause of the switching status of relay 1, for sunblind mode see table of priorities, otherwise 3: trigger switch, 0: Modbus coils
Discrete Input 12-13:	feedback of switching status of relay 2, 0: OFF, 2: level 1 (open), 3: level 2 (close)
Discrete Input 14-15:	Cause of the switching status of relay 2, for sunblind mode see table of priorities, otherwise 3: trigger switch, 0: Modbus coils

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0
Valid Quantity of Registers	1

Response

Byte Count	2
Values Register	Bit0 .. Bit15

Information

See information Discrete Input 0-15

Modbus Function “01 (0x01) Read Coils”

Request

Valid Coil Starting Address	0 .. 5
Valid Quantity of Outputs	1 .. 6

Response

Byte Count	1
Output Status	Bit0 .. Bit5

Bit	Information	
0	0 = Status digital output 1 off	
	1 = Status digital output 1 on	
1	0 = Status digital output 2 off	
	1 = Status digital output 2 on	
2-3	Status relay 1 in “switch” mode:	0: relay contact 11-14-24 open 1: relay contact 11-14-24 open 2: relay contact 11-14 closed 3: relay contact 11-24 closed
4-5	Status relay 2 in “switch” mode:	0: relay contact 31-34-44 open 1: relay contact 31-34-44 open 2: relay contact 31-34 closed 3: relay contact 31-44 closed

Modbus Function “05 (0x05) Write Single Coil”

Request

Valid Output Address	0 .. 5
Valid Output Value	0x0000 or 0xFF00

Response

Echo of request

Modbus Function “15 (0x15) Write Multiple Coils”

Request

Valid Coil Starting Address	0 .. 5
Valid Quantity of Outputs	1 .. 6
Valid Byte Count	1
Output Value	0 or 1 in Bit0 .. Bit5

Bit	Information	
0	0 = Status digital output 1 off	
	1 = Status digital output 1 on	
1	0 = Status digital output 2 off	
	1 = Status digital output 2 on	
2-3	Status relay 1 in “switch” mode:	0: relay contact 11-14-24 open 1: relay contact 11-14-24 open 2: relay contact 11-14 closed 3: relay contact 11-24 closed
4-5	Status relay 2 in “switch” mode:	0: relay contact 31-34-44 open 1: relay contact 31-34-44 open 2: relay contact 31-34 closed 3: relay contact 31-44 closed

Response

Function Code, Starting Address, Quantity of Outputs

Modbus Function “03 (0x03) Read Holding Registers”

Request

Valid Register Starting Address	0 .. 7 or 66
Valid Quantity of Registers	8 or 1

Response

Function Code, Byte Count, Register Values

Value Register 0:
Bits 0 – 5 according to the tables or the description above
Bits 6 – 15 have no function

Value Register 1:
Sunblind command (in Low-Byte)

The following registers are stored in the EEPROM.
The time constants have the unit 10 ms:

Value Register 2:
Operating mode (Low-Byte) and Flags (High-Byte)
Factory setting 1, storage in EEPROM

Value Register 3:
Bits 0-5 contain the basic setting for coils 0-5
Factory setting 0, storage in EEPROM

Value Register 4:
Time constant push-button short/long,
Unit 10 ms, factory setting 2 s, storage in EEPROM

Value Register 5:
Time constant short pulse,
Unit 10 ms, factory setting 0,5 s, storage in EEPROM

Value Register 6:
Time constant long pulse,
Unit 10 ms, factory setting 60 s, storage in EEPROM

Value Register 7:
Time constant rotating pulse (position the blades horizontally),
Unit 10 ms, factory setting 1 s, storage in EEPROM

Value Register 66
Time constant for connection monitoring
Unit 10 ms, factory setting 0 s, storage in EEPROM

Modbus Function "06 (0x06) Write Single Register"

Request

Register Address	0 - 7 or 66
Register Value	according to tables or descriptions above and below

Response
Echo of the request

Modbus Function "16 (0x10) Write Multiple Registers"

Request

Valid Register Starting Address	0 – 7
Valid Quantity of Registers	1 – 8
Byte Count	2 x Quantity of registers
Registers Value	according to tables or descriptions above and below

Response
Function Code, Register Starting Address, Quantity of Registers

Operating modes

The operating mode is selected by using the low bits of the operating mode register. The high bits contain more flags for sunblind operation (sunblind 1 / 2).
In all operating modes, a pause of 0.5 seconds of the Off status is included between level 1 and level 2 when the relay outputs are switched.

Operating mode 0 (Modbus Off)

The digital inputs and transistor outputs are queried and controlled by the Modbus.
The relay outputs are only controlled via the built-in trigger switches.
Function of the trigger switches: Top = level 1, center = OFF, bottom = level 2.

Operating mode 1 (Switch 0-1-2)

The digital inputs and transistor outputs are queried and controlled by the Modbus.
The relay outputs are controlled by the Modbus or by the built-in trigger switches.
Function of the trigger switches: Top = OFF, center = level 1, bottom = level 2.

Operating mode 2 (Switch 1-0-2)

The digital inputs and transistor outputs are queried and controlled by the Modbus.
The relay outputs are controlled by the Modbus or by the built-in trigger switches.
Function of the trigger switches: Top = level 1, center = OFF, bottom = level 2.

Operating mode 3 (Sunblind 1)

Unused digital inputs and transistor outputs are queried and controlled by the Modbus.
The relay outputs and digital inputs are used to control 2 sunblinds.
Used for AC/DC motors with separate coils for opening and closing.

Relay contact 11: operating voltage for motor 1
Relay contact 14: motor and limit switch 1 for opening
Relay contact 24: motor and limit switch 1 for closing
Relay contact 31: operating voltage for motor 2
Relay contact 34: motor and limit switch 2 for opening
Relay contact 44: motor and limit switch 2 for closing

Operating push-buttons and switching contacts are connected to the digital inputs.

Input 1: open sunblind 1
Input 2: close sunblind 1
Input 3: optional wind contact (NC or NO contact)
Input 4: open sunblind 2
Input 5: close sunblind 2
Input 6: optional door contact (NC or NO contact)

Operating mode 4 (Sunblind 2)
Unused digital inputs and transistor outputs are queried and controlled by the Modbus.
The relay outputs and digital inputs are used to control the sunblind.
Used for a DC motor that changes its direction of movement with polarity.

Relay contact 11: motor limit switches, open +, close −
Relay contact 14: operating voltage +
Relay contact 24: operating voltage −
Relay contact 31: motor limit switches, open −, close +
Relay contact 34: operating voltage −
Relay contact 44: operating voltage +

Operating push-buttons and switching contacts are connected to the digital inputs.

Input 1: open sunblind
Input 2: close sunblind
Input 3: optional wind contact (NC or NO contact)
Input 6: optional door contact (NC or NO contact)

Sunblind operating modes

Function of the trigger switches:
top = level 1 / opening, center = OFF, bottom = level 2 / closing.

Priorities of relay control, value is returned with relay status		
Priority	**Value**	**Description**
Highest	3	Trigger switch in the device
	2	Wind and door contact
	1	Sunblind command
Lowest	0	Inputs for operating keys

When the optional wind contact is activated, the sunblind is opened.
The activation of the wind contact has the same effect as the sunblind command 2.
When the optional door contact is activated, the sunblind is prevented from closing.

Different operation modes and time constants can be set for the operation pushbuttons.

Flags in operating mode register for sunblind mode		
Bit	**Value**	**Description**
15	0 1	No wind contact at input 3 Wind contact at input 3
14	0 1	Wind contact is NO contact Wind contact is NC contact
13	0 1	No door contact at input 6 Door contact at input 6
12	0 1	Door contact is NO contact Door contact is NC contact
10-8	0-3	Short pulse starts with key press
	0 1 2 3	Short pulse ends after the time constant „Short“ Short pulse ends after the minimum of time constant „Short“ and key press Short pulse ends after the maximum of time constant „Short“ and key press Short pulse ends with key press
	4 7	Short pulse starts at the end of key press, ends after the time constant „Short“ Pulse lasts as long as key press
	0-4 7	Long pulse starts after time constant „pushbutton“, ends after time constant „Long“ and ends earlier in case of a short key press No long pulse

Simultaneous control of both sunblinds with the sunblind command register is possible via the bus. The command sequence begins as soon as the register content is changed.

Coding of the sunblind commands	
0	Normal operation, control by operating pushbuttons possible
1	Switch off relay, lock control by operation pushbuttons (lock)
2	Long pulse for opening, then lock
3	Long pulse for closing, then lock
4	Long pulse for closing, then rotating pulse (blades horizontal), then lock

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x05
Object Value	“MR-TP”
Object ID	0x02
Object Length	0x04
Object Value	“V1.1”

MR-AO4

I/O commands

Modbus Function "03 (0x03) Read Holding Registers"

Holding Register 0-3:	output value of the outputs, Signed Integer16,
Holding Register 4-7:	basic settings of the output values

Request

Valid Register Starting Address	0..7 or 66
Valid Quantity of Registers	1..8 or 1

Response

Byte Count	2 x Quantity of Registers
Values Register 0..7	0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)

Unit = 10.24V / 215 = 1V / 3200 = 0.3125 mV

Value Register 66
Time constant for communication monitoring.
Register Value = 0 (0x0000) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0000 to 0xFFFF => 0 to 655.35 seconds = 10.9 minutes

Modbus Function "06 (0x06) Write Single Register"

Request

Valid Register Address	0..7 or 66
Valid Value Register 0..7	0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)
Valid Value Register 66	0x0000 to 0xFFFF (0 to 655.35 seconds)

Response
Echo of the request

Modbus Function "16 (0x10) Write Multiple Registers"

Request

Valid Register Starting Address	0..7
Valid Quantity of Registers	1..8
Valid Byte Count	2 x Quantity of Registers (QoR)
Valid Value Register 0..7	QoR x 0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)

Response
Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-AO4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-AOP4

I/O commands

Modbus Function „01 (0x01) Read Coils“
Modbus Function „02 (0x02) Read Discrete Inputs“
Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Starting Address	0 .. 3
Valid Quantities	1 .. 4

Response

Byte Count	1
Status Bit0 .. Bit3	1 = manual mode 0 = automatic mode

Modbus Function “03 (0x03) Read Holding Registers”

Holding Register 0-3:	output values of the outputs, Signed Integer16,
Holding Register 4-7:	basic settings of the output values

Request

Valid Register Starting Address	0..7 or 66
Valid Quantity of Registers	1..8 or 1

Response

Byte Count	2 x Quantity of Registers
Values Register 0..7	0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)

Unit = 10.24V / 215 = 1V / 3200 = 0.3125 mV

Value Register 66
Time constant for communication monitoring.
Register Value = 0 (0x0000) there is no communication monitoring, all other values are for communication monitoring with a solution of 10 ms.
0x0000 to 0xFFFF => 0 to 655.35 seconds = 10.9 minutes

Modbus Function “06 (0x06) Write Single Register”

Request

Valid Register Address	0..7 or 66
Valid Value Register 0..7	0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)
Valid Value Register 66	0x0000 to 0xFFFF (0 to 655.35 seconds)

Response
Echo of the request

Modbus Function “16 (0x10) Write Multiple Registers”

Request

Valid Register Starting Address	0..7
Valid Quantity of Registers	1..8
Valid Byte Count	2 x Quantity of Registers (QoR)
Valid Value Register 0..7	QoR x 0x0000 to 0xFFFF (0x7FFF = 10.24 Volt)

Response

Function Code, Register Starting Address, Quantity of Registers

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x07
Object Value	“MR-AOP4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.3”

MR-AI8

I/O commands

Modbus Function "04 (0x04) Read Input Registers"

Request

Valid Starting Address	0 .. 15
Valid Quantities	1 .. 16 (1 .. 8 inputs)

Response

Byte Count	2 x Quantity o. R.
Registers Values	Quantity o. R. x 12 Bytes

Input	Register	Information
1	0-1	Measured values are supplied in 2 registers each (4 Bytes).
2	2-3	Data type in the registers can be configured. (see register 16-23)
3	4-5	float value needs 2 registers (figure 1)
4	6-7	signed in value is in the 1st register
5	8-9	signed in 0 fills the 2nd register
6	10-11	Value remains 0 until a measurement takes place
7	12-13	Data types composed from 2 registers start at an even address
8	14-15	

Figure 1

Byte1 Bit7	Byte1 Bit6..0	Byte2 Bit7	Byte2 Bit6..0	Byte3	Byte4
Sign	Exponent	Exponent	Mantissa	Mantissa	Mantissa

Configuration registers

Input circuit and measuring range, data type and value unit and the sensor characteristic for usual temperature sensors are set for the 8 inputs with the 8 configuration registers.

Modbus Function „03 (0x03) Read Holding Registers“ (max 20 at once)
Modbus Function „06 (0x06) Write Single Registers“
Modbus Function „03 (0x03) Write Multiple Registers“ (max 20 at once)

Holding Register 0-15:	Offset Register is added to the measured value in 2 succeeding registers, (Input 1 = Register 0 - 1) Float in both or Signed Integer 16 in the first one, same as for measured value
Holding Register 16-23:	Configuration register (EEPROM), used to set measuring range, data type of the measured value (Float / Integer16), unit of the measured value and sensor characteristic (input 1 = register 16)
Holding Register 24-63:	Register for interpolation charts (EEPROM), alternately temperature and resistance, Float in 2 succeeding registers each.

Configuration registers for voltage or resistance measurement

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								0	range		number				

Bit 15-8: reserved

Bit 7: 0 = voltage or resistance

Bit 6-5: range, defines input circuit or measuring range

0 0 voltage 0 to 10V

0 1 voltage 0 to 10V, Pullup 2k at 5V

1 0 resistance

1 1 reserved

Bit 4-0: Number, defines presentation of the measured value

For voltage measurement:

0 measured value with data type float, unit = 1V

1 measured value with data type signed int, unit = 10.24V/2 ^ 15=1V/3200 =0.3125mV

2-31 reserved for other presentations

For resistance measurement:

0 measured value with data type float, unit = 1 Ohm

1 measured value with data type signed int, unit = 0.1 Ohm (max. 3.2767 kOhm)

2 measured value with data type signed int, unit = 1 Ohm (max. 32.767 kOhm)

3 measured value with data type signed int, unit = 10 Ohm (max. 327.67 kOhm)

4 measured value with data type signed int, unit = 100 Ohm (max. 3276,7 kOhm)

5-31 reserved for other presentations

Configuration registers for temperature measurement

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								1	Number						Type

Bit 15-8: reserved

Bit 7: 1 = temperature with sensor characteristic

Bit 6-1: Number, is used to distinguish between sensor and characteristic

0	Sensor PT100	(-50..150°C)
1	Sensor PT500	(-50..150°C)
2	Sensor PT1000	(-50..150°C)
3	Sensor NI1000-TK5000	(-50..150°C)
4	Sensor NI1000-TK6180	(-50..150°C)
5	Sensor BALCO 500	(-50..150°C)
6	Sensor KTY81-110	(-50..150°C)
7	Sensor KTY81-210	(-50..150°C)
8	Sensor NTC-1k8	(-50..150°C)
9	Sensor NTC-5k	(-50..150°C)
10	Sensor NTC-10k	(-50..150°C)
11	Sensor NTC-20k	(-50..150°C)
12	Sensor LM235	(-40..120°C)
13-55	Reserved for other sensors	
56-61	Use of the interpolation chart see below	
62-63	Reserved	

Bit 0: Data type of the measured value

0	float,	unit 1°C
1	signed int,	unit 0.1°C

Configuration registers to use the interpolation chart

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								1	7			range		Intp	Type

Bit 15-8: reserved
Bit 7: 1 Temperature with sensor characteristic
Bit 6-4: 7 Interpolation chart
Bit 3-2: Range, defines input circuit or measuring range
0 0 Voltage 0 to 10V
0 1 Voltage 0 to 10V, Pullup 2k at 5V
1 0 Resistance
1 1 Reserved
Bit 1: Selection of interpolation
0 Sensor characteristic is nearly linear
1 Sensor characteristic is nearly exponential (for ex. NTC)
Bit 0: Data type of the measured value
0 float, unit 1°C
1 signed int, unit 0.1°C

Configurations registers are shown above in a way to display the meaning of the individual bit. For the application it is more convenient if the register contents is displayed as a whole, see the following chart.

Dez	Hex	Measuring range voltage or resistance	Data type	Unit	Maximum
0 1	0x00 0x01	voltage 0 to 10V	float signed int	1V 0.3125mV	10,24 V
32 33	0x20 0x21	voltage/pullup	float signed int	1V 0.3125mV	10,24 V
64 65 66 67 68	0x40 0x41 0x42 0x43 0x44	resistance	float signed int signed int signed int signed int	1 Ohm 0,1 Ohm 1 Ohm 10 Ohm 100 Ohm	4 MOhm 3.2767 kOhm 32.767 kOhm 327.67 kOhm 3276.7 kOhm

Temperature measurement with data type float:

Dez	Hex	Measuring range	Data type	Unit	Maximum
128	0x80	Sensor PT100	float	1°C	-50..150°C
130	0x82	Sensor PT500			-50..150°C
132	0x84	Sensor PT1000			-50..150°C
134	0x86	Sensor NI1000-TK5000			-50..150°C
136	0x88	Sensor NI1000-TK6180			-50..150°C
138	0x8A	Sensor BALCO 500			-50..150°C
140	0x8C	Sensor KTY81-110 NXP			-50..150°C
142	0x8E	Sensor KTY81-210 NXP			-50..150°C
144	0x90	Sensor NTC-1k8 Thermokon			-50..150°C
146	0x92	Sensor NTC-5k Thermokon			-50..150°C
148	0x94	Sensor NTC-10k Thermokon			-50..150°C
150	0x96	Sensor NTC-20k Thermokon			-50..150°C
152	0x98	Sensor LM235			-40..120°C

Temperature measurement with data type signed int (register number is by 1 larger than above):

Dez	Hex	Measuring range	Data type	Unit	Maximum
129	0x80	Sensor PT100	signed int	0.1°C	-50..150°C
131	0x82	Sensor PT500			-50..150°C
133	0x84	Sensor PT1000			-50..150°C
135	0x86	Sensor NI1000-TK5000			-50..150°C
137	0x88	Sensor NI1000-TK6180			-50..150°C
139	0x8A	Sensor BALCO 500			-50..150°C
141	0x8C	Sensor KTY81-110 NXP			-50..150°C
143	0x8E	Sensor KTY81-210 NXP			-50..150°C
145	0x90	Sensor NTC-1k8 Thermokon			-50..150°C
147	0x92	Sensor NTC-5k Thermokon			-50..150°C
149	0x94	Sensor NTC-10k Thermokon			-50..150°C
151	0x96	Sensor NTC-20k Thermokon			-50..150°C
153	0x98	Sensor LM235			-40..120°C

Measurement with interpolation chart:

Dez	Hex	Measuring range	Data type	Interpolation
240	0xF0	Voltage 0 to 10V	float	linear
241	0xF1		signed int	linear
242	0xF2		float	exponential
243	0xF3		signed int	exponential
244	0xF4	Voltage/Pullup	float	linear
245	0xF5		signed int	linear
246	0xF6		float	exponential
247	0xF7		signed int	exponential
248	0xF8	Resistance	float	linear
249	0xF9		signed int	linear
250	0xFA		float	exponential
251	0xFB		signed int	exponential

Registers 24-63 (0x18-0x3F) interpolation chart

This chart can be used to convert and linearize values for sensors without a characteristic already defined in the device. The chart contains up to 10 nodes of the sensor characteristic to interpolate between.

Example: transformation from resistance to temperature for temperature sensors.

Register contents is stored in the EEPROM.

The description refers to temperature sensors. Other sensors than temperature sensors (e.g. humidity) are also possible and it is also possible to measure voltage instead of resistance.

These properties can be set in the configuration register:

Measuring range	voltage voltage, pullup 2k at 5 V (for ex. for LM235) resistance (normal case with temperature sensors)
Interpolation	sensor characteristic is nearly linear sensor characteristic is nearly exponential (for NTCs)
Data type of measuring range	float (unit 1 °C) signed int (unit 0.1 °C)

Node	Registers	Registers
	Temperature	Resistance
1	24-25	26-27
2	28-29	30-31
3	32-33	34-35
4	36-37	38-39
5	40-41	42-43
6	44-45	46-47
7	48-49	50-51
8	52-53	54-55
9	56-57	58-59
10	60-61	62-63

The nodes are filled beginning at the top of the chart, with a maximum of 10, and end with temperature = resistance = 0, if there are less nodes. Temperature and resistance values have to be in ascending or descending order.
Data type in the registers: float temperature, float resistance.

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-AI8”
Object ID	0x02
Object Length	0x04
Object Value	“V1.4”

MR-CI4

I/O commands

Modbus Function “04 (0x04) Read Input Registers”

Request

Valid Register Starting Address	0 .. 3
Valid Quantity of Registers	1 .. 4

Response

Byte Count	2 x Quantity o.R.
Input Registers Values	2 x Quantity o.R.

Information

Measured values of the inputs 1-4, Signed Integer16,
Value range:
0x0000 .. 0x7FFF (32767) = 0 .. 10.24 V
0x0000 .. 0x7FFF (32767) = 0 .. 20.48 mA
0x0000 .. 0x7FFF (32767) = 4 .. 20.38 mA

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x06
Object Value	“MR-CI4”
Object ID	0x02
Object Length	0x04
Object Value	“V1.2”

MR-AIO4/2-IP

I/O commands

Modbus Function "04 (0x04) Read Input Registers"

Request

Valid Starting Address	0 .. 7
Valid Quantities	1 .. 8 (1 .. 4 inputs)

Response

Byte Count	2 x Quantity o. R.
Registers Values	Quantity o. R. x 12 Bytes

Input	Registers	Information
1	0-1	The measured values are supplied in2 registers each (4 Bytes). Data type in the registers can be configured. (see registers 16-19) float value needs 2 registers (figure 1) signed in value is in the 1st register signed in 0 fills the 2nd register Value remains 0 until a measurement takes place Data types composed from 2 registers start at the even address
2	2-3	
3	4-5	
4	6-7	

Figure 1

Byte1 Bit7	Byte1 Bit6..0	Byte2 Bit7	Byte2 Bit6..0	Byte3	Byte4
Sign	Exponent	Exponent	Mantissa	Mantissa	Mantissa

Configuration registers

These 4 configuration registers are used for the setting of input circuit and measuring range, data type and unit of the measured value and the sensor characteristic for usual temperature sensors for each of the 4 inputs.

The register content is stored at the EEPROM.

Modbus Function „03 (0x03) Read Holding Registers“ (max 20 at once)
Modbus Function „06 (0x06) Write Single Registers“
Modbus Function „03 (0x03) Write Multiple Registers“ (max 20 at once)

Holding Register 0-7:	Offset register, is added to the measured value in 2 succeeding registers each, (input 1 = register 0-1) Float in both or Signed Integer16 in the first same as for measured value
Holding Register 8-15:	Freely usable register
Holding Register 16-19:	Configuration register, is used to set measuring range, data type of the measured value (Float / Integer16), unit of the measured value and sensor characteristic (input 1 = register 16)
Holding Register 20-21:	Output registers, output values of the outputs, Signed Integer16, Value range: 0 = 0 V .. 32767 = 10.24 V
Holding Register 22-23:	Basic settings of the output values, Signed Integer16, factory setting 0
Holding Register 24-63:	Interpolation chart registers, alternately temperature and resistance, Float in 2 succeeding registers each.
Holding Register 66:	Time constant for connection monitoring factory setting 0

Configuration registers for voltage or resistance measuring

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								0	Range		Number				

Bit 15-8: reserved
Bit 7: 0 = voltage or resistance range,
Bit 6-5: defines input circuit or measuring range
0 0 voltage 0 to 10V
0 1 voltage 0 to 10V, pullup 2k at 5 V
1 0 resistance
1 1 reserved
Bit 4-0: Number, defines the presentation of the measured value

For voltage measurement:
0 measured value with data type float, unit = 1V
1 measured value with data type signed int, unit = 10.24V/2^15=1V/3200 =0.3125mV
2-31 reserved for other presentations

For resistance measurement:
0 measured value with data type float, unit = 1 Ohm
1 measured value with data type signed int, unit = 0,1 Ohm (max. 3.2767 kOhm)
2 measured value with data type signed int, unit = 1 Ohm (max. 32.767 kOhm)
3 measured value with data type signed int, unit = 10 Ohm (max. 327.67 kOhm)
4 measured value with data type signed int, unit = 100 Ohm (max. 3276.7 kOhm)
5-31 reserved for other presentations

Configuration registers for temperature measurement

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								1	Number						Type

Bit 15-8: reserved

Bit 7: 1 = temperature with sensor characteristic

Bit 6-1: Number, is used to distinguish sensor and measuring range

0	Sensor PT100	(-50..150°C)
1	Sensor PT500	(-50..150°C)
2	Sensor PT1000	(-50..150°C)
3	Sensor NI1000-TK5000	(-50..150°C)
4	Sensor NI1000-TK6180	(-50..150°C)
5	Sensor BALCO 500	(-50..150°C)
6	Sensor KTY81-110	(-50..150°C)
7	Sensor KTY81-210	(-50..150°C)
8	Sensor NTC-1k8	(-50..150°C)
9	Sensor NTC-5k	(-50..150°C)
10	Sensor NTC-10k	(-50..150°C)
11	Sensor NTC-20k	(-50..150°C)
12	Sensor LM235	(-40..120°C)
13-55	reserved for other sensors	
56-61	use of the interpolation chart see below	
62-63	reserved	

Bit 0: Data type of the measuring range

0	float,	Unit 1°C
1	signed int,	Unit 0.1°C

Configuration registers to use the interpolation chart

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								1	7			Range		Intp	Type

Bit 15-8: reserved
Bit 7: 1 temperature with sensor characteristic
Bit 6-4: 7 interpolation chart
Bit 3-2: Range, defines input circuit or measuring range
0 0 voltage 0 to 10V
0 1 voltage 0 to 10V, pullup 2k at 5 V
1 0 resistance
1 1 reserved
Bit 1: Selection of interpolation
0 sensor characteristic is nearly linear
1 sensor characteristic is nearly exponential (for ex. NTC)
Bit 0: Data type of the measured value
0 float, unit 1°C
1 signed int, unit 0.1°C

Configurations registers are shown above in a way to display the meaning of the individual bit. For the application it is more convenient if the register contents is displayed as a whole, see the following chart

Dez	Hex	Measuring range Voltage or resistance:	Data type	Unit	Maximum
0 1	0x00 0x01	Voltage 0 to 10V	float signed int	1 V 0.3125 mV	10.24 V
32 33	0x20 0x21	Voltage/Pullup	float signed int	1 V 0.3125 mV	10.24 V
64 65 66 67 68	0x40 0x41 0x42 0x43 0x44	Resistance	float signed int signed int signed int signed int	1 Ohm 0.1 Ohm 1 Ohm 10 Ohm 100 Ohm	4 MOhm 3.2767 kOhm 32.767 kOhm 327.67 kOhm 3276.7 kOhm

Temperature measurement with data type float:

Dez	Hex	Measuring range	Data type	Unit	Maximum
128	0x80	Sensor PT100	float	1°C	-50..150°C
130	0x82	Sensor PT500			-50..150°C
132	0x84	Sensor PT1000			-50..150°C
134	0x86	Sensor NI1000-TK5000			-50..150°C
136	0x88	Sensor NI1000-TK6180			-50..150°C
138	0x8A	Sensor BALCO 500			-50..150°C
140	0x8C	Sensor KTY81-110 NXP			-50..150°C
142	0x8E	Sensor KTY81-210 NXP			-50..150°C
144	0x90	Sensor NTC-1k8 Thermokon			-50..150°C
146	0x92	Sensor NTC-5k Thermokon			-50..150°C
148	0x94	Sensor NTC-10k Thermokon			-50..150°C
150	0x96	Sensor NTC-20k Thermokon			-50..150°C
152	0x98	Sensor LM235			-40..120°C

Temperature measurement with data type signed int (register number is by 1 larger then above):

Dez	Hex	Measuring range	Data type	Unit	Maximum
129	0x80	Sensor PT100	signed int	0.1°C	-50..150°C
131	0x82	Sensor PT500			-50..150°C
133	0x84	Sensor PT1000			-50..150°C
135	0x86	Sensor NI1000-TK5000			-50..150°C
137	0x88	Sensor NI1000-TK6180			-50..150°C
139	0x8A	Sensor BALCO 500			-50..150°C
141	0x8C	Sensor KTY81-110 NXP			-50..150°C
143	0x8E	Sensor KTY81-210 NXP			-50..150°C
145	0x90	Sensor NTC-1k8 Thermokon			-50..150°C
147	0x92	Sensor NTC-5k Thermokon			-50..150°C
149	0x94	Sensor NTC-10k Thermokon			-50..150°C
151	0x96	Sensor NTC-20k Thermokon			-50..150°C
153	0x98	Sensor LM235			-40..120°C

Measurement with interpolation chart:

Dez	Hex	Measuring range	Data type	Interpolation
240	0xF0	Voltage 0 to 10V	float	linear
241	0xF1		signed int	linear
242	0xF2		float	exponential
243	0xF3		signed int	exponential
244	0xF4	Voltage/Pullup	float	linear
245	0xF5		signed int	linear
246	0xF6		float	exponential
247	0xF7		signed int	exponential
248	0xF8	Resistance	float	linear
249	0xF9		signed int	linear
250	0xFA		float	exponential
251	0xFB		signed int	exponential

Registers 24-63 (0x18-0x3F) interpolation chart

This chart can be used to convert and linearize values for sensors without a characteristic already defined in the device. The chart contains up to 10 nodes of the sensor characteristic to interpolate between.
Example: transformation from resistance to temperature for temperature sensors.

Register contents is stored in the EEPROM.

The description refers to temperature sensors. Other sensors than temperature sensors (e.g. humidity) are also possible and it is also possible to measure voltage instead of resistance.

These properties can be set in the configuration register:

Measuring range	voltage
	voltage, pullup 2k at 5 V (for ex. for LM235)
	resistance (normal case with temperature sensors)
Interpolation	sensor characteristic is nearly linear
	sensor characteristic is nearly exponential (for NTCs)
Data type of measuring range	float (unit 1 °C)
	signed int (unit 0.1 °C)

Node	Register	Register
	Temperature	Resistance
1	24-25	26-27
2	28-29	30-31
3	32-33	34-35
4	36-37	38-39
5	40-41	42-43
6	44-45	46-47
7	48-49	50-51
8	52-53	54-55
9	56-57	58-59
10	60-61	62-63

The nodes are filled beginning at the top of the chart, with a maximum of 10, and end with temperature = resistance = 0, if there are less nodes. Temperature and resistance values have to be in ascending or descending order.
Data type in the registers: float temperature, float resistance.

Modbus Function “08 (0x08) Diagnostics”

Subfunction “43 /14 (0x2B / 0x0E) Read Device Identification”

Request

Read Device ID code:	0x01
Object ID	0x00

Response

Device ID code	0x01
Conformity level	0x01
More follows	0x00
Next object ID	0x00
Number of objects	0x03
Object ID	0x00
Object Length	0x11
Object Value	“METZ CONNECT GmbH”
Object ID	0x01
Object Length	0x09
Object Value	“MR-AIO4/2”
Object ID	0x02
Object Length	0x04
Object Value	“V1.0”