

# Analog Output Module MR-AO4

1108351302

7162/899293



## 1. Description

The Modbus module with 4 analog outputs is designed for local switching operations. It is suitable as variable encoder, for example ventilation or mixing valves, valve positions etc. The outputs can be adjusted via a Modbus-Master. Setting of the slave address, bit rate and parity is done with the two address switches (x1 / x10) on the front. Possible settings are addresses 00 to 99 and bit rates 1200, 2400, 4800, 9600, 19200, 38400, 57600 und 115200 Bd.

The device does not participate in bus communication if the address is 00 (reserved for broadcast commands).

Communication with the master can be monitored with a watchdog timer. If master or communication fail the outputs are switched to their basic state (secure state) and the red LED is lighting. The timer restarts with each valid message addressed to the device. When defining the time constant it is necessary to take account of the baud rate, the number of slaves on the bus and the length of the messages per slave.

## 2. Declaration of Conformity

The device was tested according to the applicable standards. Conformity was proofed. The declaration of conformity is available at the manufacturer BTR NETCOM GmbH.

## Notes Regarding Device Description

These instructions include indications for use and mounting of the device. In case of questions that cannot be answered with these instructions please consult supplier or manufacturer.

The indicated installation directions or rules are applicable to the Federal Republic of Germany. If the device is used in other countries it applies to the equipment installer or the user to meet the national directions.

## Safety Instructions

Keep the applicable directions for industrial safety and prevention of accidents as well as the VDE rules.

Technicians and/or installers are informed that they have to electrically discharge themselves as prescribed before installation or maintenance of the devices.

Only qualified personnel shall do mounting and installation work with the devices, see section "qualified personnel".

The information of these instructions have to be read and understood by every person using this device.

## Symbols

Warning of dangerous electrical voltage

## Danger



means that non-observance may cause risk of life, grievous bodily harm or heavy material damage.

## Qualified Personnel

Qualified personnel in the sense of these instructions are persons who are well versed in the use and installation of such devices and whose professional qualification meets the requirements of their work.

This includes for example:

- Qualification to connect the device according to the VDE specifications and the local regulations and a qualification to put this device into operation, to power it down or to activate it by respecting the internal directions.
- Knowledge of safety rules.
- Knowledge about application and use of the device within the equipment system etc.

## 3. Technical Data

### Modbus Interface

Protocol: Modbus RTU  
Transmission rate: 1200 ... 115200 Bd (factory setting 19200 Bd Even)  
Cabling: RS485 two wire bus with voltage equalizing cable in bus / line topology

### Supply

Operating voltage range: 20 ... 28 V AC/DC (SELV)  
Current consumption: 50 mA (AC) / 20 mA (DC)  
Relative duty cycle: 100 %

### Output

Output voltage: 4 x 0 ... 10 V DC  
Output current: 5 mA at 10 V DC  
Resolution: 0.625 mV / Digit  
Error: 100 mV

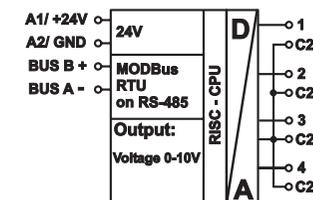
### Housing

Dimensions WxHxD: 1.4 x 2.8 x 2.6 in. (35 x 70 x 65 mm)  
Weight: 72 g  
Mounting position: any  
Mounting: standard rail TH35 per IEC 60715  
Mounting in series: the maximum quantity of modules connected in line is limited to 15 or to a maximum power consumption of 2 Amps (AC or DC) per connection to the power supply. For any similar block of additional modules a separate connection to the power supply is mandatory.

## Continuation Technical Data

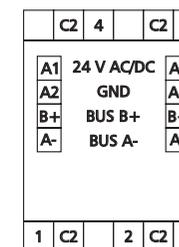
Material	
Housing	Polyamide 6.6 V0
Terminal blocks	Polyamide 6.6 V0
Cover plate	Polycarbonate
Type of protection (IEC 60529)	
Housing	IP40
Terminal blocks	IP20
<b>Terminal blocks</b>	
Supply and bus	
4 pole terminal block	max. AWG 16 (1,5 mm <sup>2</sup> ) solid wire max. AWG 18 (1,0 mm <sup>2</sup> ) stranded wire
Wire diameter	min. 0.3 mm up to max. 1.4 mm (terminal block and jumper plug are included to each packing unit)
Module connection	
Input/Output	max. AWG 12 (4,0 mm <sup>2</sup> ) solid wire max. AWG 14 (2,5 mm <sup>2</sup> ) stranded wire
Wire diameter	min. 0.3 mm up to max 2.7 mm
<b>Temperature range</b>	
Operation	-5 °C ... +55 °C
Storage	-20 °C ... +70 °C
Protective circuitry	polarity reversal protection of operating voltage polarity reversal protection of supply and bus
<b>Display</b>	
Operating and bus activity	green LED
Error indication	red LED

## 4. Wiring Diagram



A2 = C2 = GND

## 5. Connection Diagram



## 6. Mounting

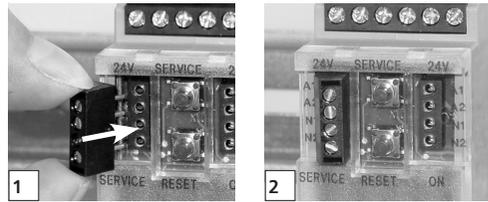
### Power down the equipment

Mount the module on standard rail (TH35 per IEC 60715 in junction boxes and/or on distribution panels).

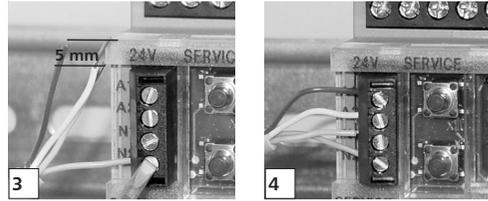
### Installation

Electric installation and device termination shall be done by qualified persons only, by respecting all applicable specifications and regulations.

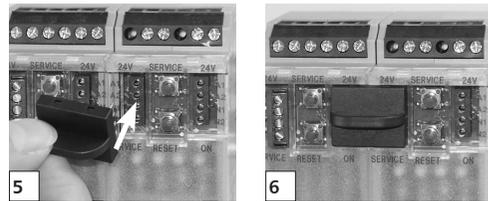
Plug in the terminal block for bus connection



1 Connect the cable for bus supply



3 Mounting in series



The module can be aligned without interspace. Use the jumper plug to connect bus and supply voltage when the modules are mounted in series.

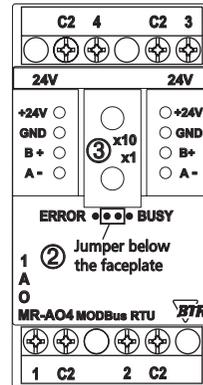
The maximum quantity of modules connected in line is limited to 15 or to a maximum power consumption of 2 Amps (AC or DC) per connection to the power supply. For any similar block of additional modules a separate connection to the power supply is mandatory.

## 7. Bit rate and Parity setting

The bit rate and parity can be set in the programming mode when a jumper is plugged behind the front cover of the module. This jumper is removed in normal mode. A connection to the bus is not required during bit rate setting.

The bit rate of the modules can be set in the following way:

1. remove the front cover of the module;
2. plug a jumper to the two middle pins of the 4 pole header between the red and green LED (2);
3. set the desired parity and bit rate with the address switches (3) in accordance to the chart below.



4. switch on the supply voltage of the module; it is now permanently saving the bit rate in an EEPROM;
5. switch off the supply voltage of the module;
6. remove the jumper from the header and place the front cover.

Switch x10	1	2	3					
Parity	even	odd	none					
Switch x1	1	2	3	4	5	6	7	8
Bitrate (Bit/s)	1200	2400	4800	9600	19200	38400	57600	115200

If the settings differ from the settings specified in the chart the factory setting applies.

Factory setting: 19200 Bd Even

## 9. Software description

### 9.1 I/O Commands

#### "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 )

Einheit = 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

#### "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

#### "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

### 9.2 Bit rate setting with Modbus command

Parity and bit rate have the same value as when setting them by address switch.

If Parity or Bit has the value 0, no setting or storage is carried out.

The register content is stored in the EEPROM.

## Continuation Software description

### "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 analysed 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 contents Hi 0x53 Magic-Number  
Register contents 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 can 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 only 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.

## Continuation Software description

### 9.3 General Commands

#### "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 oder 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.

## Continuation Software description

### "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 0x03  
Object Value "BTR"  
Object ID 0x01  
Object Length 0x06  
Object Value "MR-AO4"  
Object ID 0x02  
Object Length 0x04  
Object Value "V1.0"