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Digital Output Module
MR-DO4
1108361321
with manual control facility

MR-DOA4
110836132101
without manual control facility

7822/899294

1. Description

The Modbus modules with 4 digital outputs are designed for local switching operations. They are suitable to operate electrical components such as motors, contactors, lamps, sun-blinds etc. We recommend to protect the relay contacts additionally by a RC-element for high inductive loads. **MR-DO4** is equipped with a manual control facility for manual switching of the relays. **MR-DOA4** has **no** manual control facility.

The outputs can be operated 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).

Continuation Description

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 METZ CONNECT 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

Protocoll	Modbus RTU
Transmission rate	1200 to 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 to 28 V AC/DC (SELV)
Current consumption	200 mA (AC) / 70 mA (DC)
Relative duty cycle	100 %

Output

Output contacts	4 x changeover contacts
Switching voltage max.	250 V AC
Continuous current max.	5 A per relay
Total current for all contacts	12 A
Switching frequency	360 switching cycles per hour

Housing

Dimensions WxHxD	1.4 x 2.8 x 2.6 in. (35 x 70 x 65 mm)
Weight	95 g
Mounting position	any
Mounting	standard rail TH35 per IEC 60715
Mounting in series without space	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.
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

Terminal blocks

|	
Supply and bus	
4 pole terminal block	max. AWG 16 (1.5 mm²) solid wire max. AWG 18 (1.0 mm²) 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 mm²) solid wire max. AWG 14 (2.5 mm²) stranded wire
Wire diameter	min. 0.3 mm up to max 2.7 mm
Protective circuitry	polarity reversal protection of operating voltage polarity reversal protection of supply and bus

Temperature range

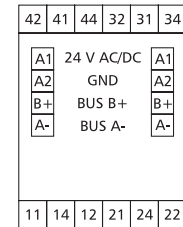|	
Operation	-5 °C to +55 °C
Storage	-20 °C to +70 °C

Display

Operating and bus activity	green LED
Error indication	red LED
Status of the outputs	yellow LED

4. Wiring Diagram

5. Connection Diagram

Members of METZ CONNECT

RIA CONNECT   **BTR** NETCOM   **MCQ** TECH
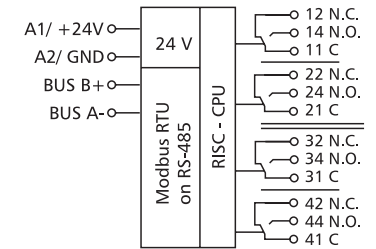
6. Mounting

| ⚠	**DANGER**
	Risk of death by electric shock! Switch off all electrical power supply before starting work on energized parts.

The device can be snapped-on to a TH35 rail. To remove the device from the rail, unblock the snap-on foot with a screwdriver.

Device connection according to wiring diagram. Strip the wires by 7 mm, put on wire end sleeves, insert them into the terminal body and fix them with an appropriate screwdriver.
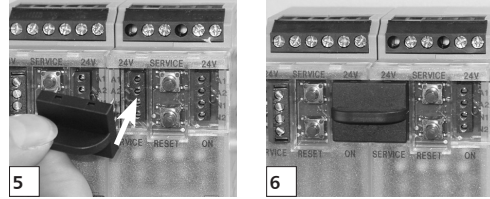
Plug in the terminal block for bus connection
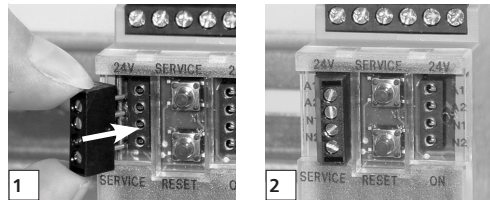
Connect the cable for bus supply
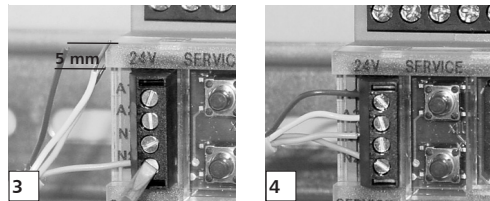
Mounting in series

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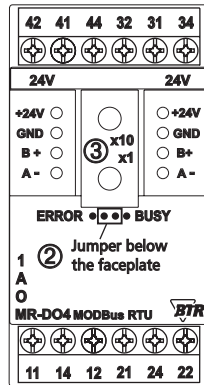
4. switch on the supply voltage of the module; it is now permanently saving the bit rate in an EEPROM;
5. switch off the supply voltage of the module;
6. remove the jumper from the header and place the front cover.

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

8. Software description

8.1 I/O commands

„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

"05 (0x05) Write Single Coil"

Request

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

Response

Echo of the request

"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 Adress, Quantity of Outputs

Continuation Software description

"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

Continuation Software description

"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

"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

8.2 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.

"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						Parität				Bitrate		

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
Parität	even	odd	none

Bit 3-0	1	2	3	4	5	6	7	8
Bitrate	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.

Continuation Software description

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.

8.3 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-DO4"
Object ID	0x02
Object Length	0x04
Object Value	"V1.0"