2. Declaration of Conformity
The device was tested according to the applicable standards. Conformity was proved. 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.

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: 65 mA (AC) / 25 mA (DC)
Relative duty cycle: 100 %

Input
Resistance range: 40 Ω to 4 MΩ
Voltage input: 0 ... 10 V DC
Resolution: 1 mV
Error: Voltage input: about ±10 mV
Resistance input: < 12 kΩ = 0.1 % / > 12 kΩ = 1 %

Housing
Dimensions WxHxD: 2.0 x 2.8 x 2.6 in. (50 x 70 x 65 mm)
Weight: 104 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.

Material
Housing: Polyamide 6.6 V0
Terminal blocks: Polyamide 6.6 V0
Cover plate: Polycarbonate
Type of protection (IEC 60529): IP40
Housing: 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
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
min. 0.3 mm up to max. 2.7 mm

Temperature range
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

Display
Operating and bus activity green LED
Error indication: red LED

4. Wiring Diagram

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.
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 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 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.

If the settings differ from the settings specified in the chart the factory setting applies.
Factory setting: 19200 Bd Even

8. Jumper Positions for Voltage feeding of Active Sensors

9. Connection examples

10. Software Description
10.1 I/O Commands
„04 (0x04) Read Input Registers“
Request:
Valid Starting Address 0 .. 15
Valid Quantity of Registers 1 .. 16 (1 to 8 inputs)
Response:
Byte Count 2 x Quantity o. R.
Registers Values Quantity o. R x 2 Bytes

<table>
<thead>
<tr>
<th>Sign</th>
<th>Exponent</th>
<th>Exponent</th>
<th>Mantissa</th>
<th>Mantissa</th>
<th>Mantissa</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>0-15</td>
<td>0-15</td>
<td>0-15</td>
<td>0-15</td>
<td>0-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Register contents is stored in an EEPROM.
Modbus Functions:
• "03 (0x03) Read Holding Registers" (max. 20 at once)
• "06 (0x06) Write Single Register"
• "16 (0x10) 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 same, as for measured value

Holding Register 16-23 Configuration register (EEPROM) used to set measuring range, data type of the measured value (Float / Integer 16), unit of the measured value and the sensor characteristic
(Input 1 = Register 16)

Holding Register 24-63 Register for interpolation charts (EEPROM), alternately temperature and resistance, float in two succeeding registers.

Configuration Register 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 |
## Continuation Software Description

<table>
<thead>
<tr>
<th>Bit 15-8:</th>
<th>occupied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7:</td>
<td>0 = voltage or resistance</td>
</tr>
<tr>
<td>Bit 6-5:</td>
<td>range, defines input circuit or measuring range</td>
</tr>
<tr>
<td>Bit 7:</td>
<td>occupied</td>
</tr>
<tr>
<td>Bit 15-8:</td>
<td>occupied</td>
</tr>
</tbody>
</table>

### Mounting instruction see www.metz-connect.com

### BTR NETCOM GmbH

### RIA CONNECT GmbH

### METZ CONNECT

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### Data type of value:

- **Bit 0:** number, defines presentation of value
- **Bit 6-5:** measurement range
- **Bit 7:** sensor characteristic
- **Bit 15-8:** configuration register

### Voltage measurement:

- **Bit 0:** number, defines presentation of value
- **Bit 7:** occupied

### Configuration Register for voltage or resistance measurement:

<table>
<thead>
<tr>
<th>Bit 15-8:</th>
<th>occupied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7:</td>
<td>0 = voltage or resistance</td>
</tr>
<tr>
<td>Bit 6-5:</td>
<td>range, defines input circuit or measuring range</td>
</tr>
<tr>
<td>Bit 7:</td>
<td>occupied</td>
</tr>
<tr>
<td>Bit 15-8:</td>
<td>occupied</td>
</tr>
</tbody>
</table>

### Resistance measurement:

- **Bit 0:** number, defines presentation of value
- **Bit 7:** occupied

### Configuration 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:

<table>
<thead>
<tr>
<th>Dez</th>
<th>Hex</th>
<th>Measuring range</th>
<th>Data type</th>
<th>Unit</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0x00</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>1 V</td>
<td>10.24 V</td>
</tr>
<tr>
<td>1</td>
<td>0x07</td>
<td>Voltage 0-10 V</td>
<td>signed int</td>
<td>0.3125 mV</td>
<td>10.24 V</td>
</tr>
<tr>
<td>31-32</td>
<td>0x1F-0x20</td>
<td>Voltage/Pullup</td>
<td>float</td>
<td>1 V</td>
<td>10.24 V</td>
</tr>
<tr>
<td>64</td>
<td>0x40</td>
<td>Resistance</td>
<td>float</td>
<td>1 Ω</td>
<td>10.24 Ω</td>
</tr>
<tr>
<td>65</td>
<td>0x41</td>
<td>Resistance</td>
<td>signed int</td>
<td>0.1 Ω</td>
<td>10.24 Ω</td>
</tr>
<tr>
<td>66</td>
<td>0x42</td>
<td>Resistance</td>
<td>signed int</td>
<td>1 Ω</td>
<td>10.24 Ω</td>
</tr>
<tr>
<td>67</td>
<td>0x43</td>
<td>Resistance</td>
<td>signed int</td>
<td>10 Ω</td>
<td>10.24 Ω</td>
</tr>
<tr>
<td>68</td>
<td>0x44</td>
<td>Resistance</td>
<td>signed int</td>
<td>100 Ω</td>
<td>10.24 Ω</td>
</tr>
</tbody>
</table>

### Temperature measurement with data type float:

| Value charts for sensors see annex: |
|---|---|---|
| 0 | 0x00 | Sensor PT100 | float | 1 °C | (50..150 °C) |
| 0 | 0x01 | Sensor PT500 | float | 1 °C | (50..150 °C) |
| 0 | 0x02 | Sensor PT1000 | float | 1 °C | (50..150 °C) |
| 0 | 0x03 | Sensor NTC-1K8 | float | 1 °C | (50..150 °C) |
| 0 | 0x04 | Sensor NTC-2K | float | 1 °C | (50..150 °C) |
| 0 | 0x05 | Sensor NTC-5K | float | 1 °C | (50..150 °C) |
| 0 | 0x06 | Sensor NTC-10K | float | 1 °C | (50..150 °C) |
| 0 | 0x07 | Sensor NTC-20K | float | 1 °C | (50..150 °C) |
| 0 | 0x08 | Sensor LM235 | float | 1 °C | (50..150 °C) |

### Temperature measurement with interpolation chart:

<table>
<thead>
<tr>
<th>Dez</th>
<th>Hex</th>
<th>Measuring range</th>
<th>Data type</th>
<th>Unit</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>0x0F</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>241</td>
<td>0x10</td>
<td>Voltage 0-10 V</td>
<td>signed int</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>242</td>
<td>0x11</td>
<td>Voltage 0-10 V</td>
<td>exponentiell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>243</td>
<td>0x12</td>
<td>Voltage 0-10 V</td>
<td>signed int</td>
<td>exponentiell</td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>0x13</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>245</td>
<td>0x14</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>exponentiell</td>
<td></td>
</tr>
<tr>
<td>246</td>
<td>0x15</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>247</td>
<td>0x16</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>exponentiell</td>
<td></td>
</tr>
<tr>
<td>248</td>
<td>0x17</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>249</td>
<td>0x18</td>
<td>Voltage 0-10 V</td>
<td>float</td>
<td>exponentiell</td>
<td></td>
</tr>
</tbody>
</table>

### Register 24-63 (0x18-0x3F) interpolation chart:

- **Register 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 16 nodes of the sensor characteristic to interpolate between:
- Example: conversion from resistance to temperature with 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 or resistance with interpolation chart
- Interpolation: sensor characteristic is approx. linear sensor characteristic is approx. exponential (for NTCs)
- Data type of value:
  - float
  - signed int

### Modbus-Funktionen

- "03 (0x03) Read Holding Registers"  
  - "16 (0x10) Write Multiple Registers"

<table>
<thead>
<tr>
<th>Node</th>
<th>Register</th>
<th>Temperature</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-24</td>
<td>2-25</td>
<td>28-29</td>
</tr>
<tr>
<td>3</td>
<td>32-33</td>
<td>34-35</td>
<td>36-37</td>
</tr>
<tr>
<td>4</td>
<td>40-41</td>
<td>42-43</td>
<td>44-45</td>
</tr>
<tr>
<td>5</td>
<td>48-49</td>
<td>50-51</td>
<td>52-53</td>
</tr>
<tr>
<td>6</td>
<td>56-57</td>
<td>58-59</td>
<td>60-61</td>
</tr>
</tbody>
</table>

The nodes (up to 10) are filled from the beginning of the chart, unit with temperature = resistance = 0, if less nodes exist.

Temperature and resistance values have to be sorted in ascending or descending order.

Data type in registers: float temperature, resistance

---

### 10.2 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 |

#### Response

| Echo of Request | 0x53 |
| Parity | Bit rate |

---

### Echo of Request

- Magic-Number 0x53 = 83 as protection against accidental writing.
- The command will be further analysed only with this number.

<table>
<thead>
<tr>
<th>Bit 7-4:</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity</td>
<td>even</td>
<td>odd</td>
<td>none</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit 3-0:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit rate</td>
<td>1200</td>
<td>2400</td>
<td>4800</td>
<td>9600</td>
<td>19200</td>
<td>38400</td>
<td>57600</td>
<td>115200</td>
</tr>
</tbody>
</table>
Continuation Software Description

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.

10.3 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 or 0xFF00
Response: Echo of Request
Action: Clears all Error Counter, 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 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.

Subfunction “12 (0x000C) Return Bus Communication 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 “13 (0x000D) Return Bus Exception Error 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 “14 (0x000E) Return Slave Message 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.

“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-AI8”
Object ID 0x02
Object Length 0x04
Object Value “V1.0”

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Distributed by RIA CONNECT GmbH and BTR NETCOM GmbH
Mounting instruction see www.metz-connect.com