



**Badger Meter Europa GmbH**

# **ModMAG<sup>®</sup> M2000**

M-Bus interface



## **User manual**

July 2020

MID\_M2000\_BA\_MB\_02\_2007

---

|   |           |
|---|-----------|
| <b>1. Basic safety recommendation</b> .....                           | <b>3</b>  |
| <b>2. Introduction</b> .....  | <b>3</b>  |
| <b>3. Hardware</b> .....  | <b>4</b>  |
| 3.1. Electrical connection .....                                      | 4         |
| 3.2. Port settings .....  | 5         |
| <b>4. M-Bus addressing</b> .....                                      | <b>5</b>  |
| 4.1 Primary address .....   | 5         |
| 4.2 Secondary address .....   | 5         |
| 4.3 M-Bus commands .....  | 5         |
| 4.4 Setting primary address .....                                     | 6         |
| 4.5 Changing baud rate .....  | 6         |
| 4.6 Changing M-Bus response telegram .....                            | 7         |
| 4.7 Write configuration area to flash .....                           | 7         |
| 4.8 Send Modbus commands .....  | 8         |
| 4.9 M-Bus REQ_UD2 answers .....                                       | 8         |
| 4.9.1 M-Bus REQ_UD2 answer „All“ .....                                | 9         |
| 4.9.2 M-Bus REQ_UD2 answer „Instantaneous“ .....                      | 10        |
| 4.9.3 M-Bus REQ_UD2 answers “Testing” .....                           | 10        |
| 4.9.4 M-Bus REQ_UD2 answer “Calibration” .....                        | 11        |
| 4.9.5 M-Bus REQ_UD2 answer “Manufacturing” .....                      | 12        |
| <b>5. Technical data</b> .....  | <b>13</b> |
| <b>6. Return of goods for repair / Harmlessness declaration</b> ..... | <b>14</b> |

## 1. Basic safety recommendation

Please see “Basic safety recommendations” in installation and operation manual ModMAG® M2000.

## 2. Introduction

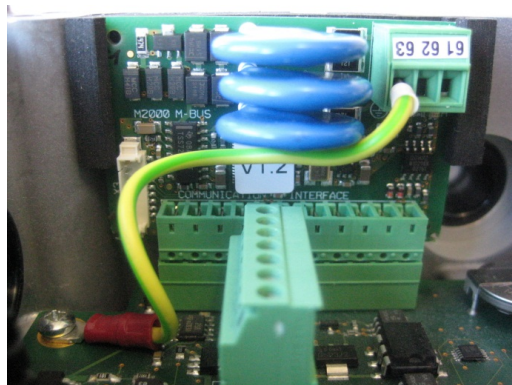
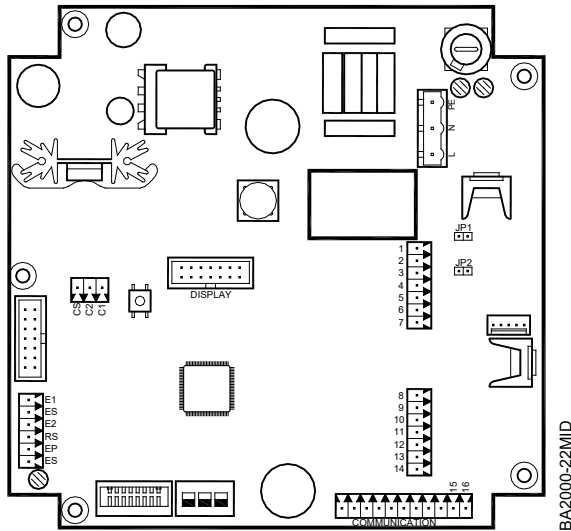
The ModMAG® M2000 M-Bus module is providing a EN13757 compatible M-Bus interface to the Badger ModMAG® M2000 flow meter with the following features:

- M-Bus primary and secondary address selection
- The primary address is saved in a non-volatile memory
- 300, 2400 and 9600 baud communication speed
- Automatic baud rate detection or manually programmable baud rate
- Standard M-Bus serial communication parameters: 8 data bits, 1 parity even bit, 1 stop bit.
- LED for M-Bus communication green: Incoming M-Bus transmission  
Red: Outgoing M-Bus transmission
  
- Five different M-Bus response telegrams with different meter values (according to EN13757-3, chapter 4.22, table 2):
  - All
  - Instantaneous values
  - Testing
  - Calibration
  - Manufacturing
  
- Meter data update from ModMAG® M2000 every second
- M-Bus wrapper command for ModBus® communication



### 3. Hardware

The additional M-Bus interface board is plugged in the communication socket (right lower corner) of the ModMAG® M2000 main board. The interface board is supported by a pad to the wall of the enclosure. A grounding strap connect the interface board terminal 63 to the nearest screw of the main board.



#### 3.1. Electrical connection

| Terminal | Description |
|----------|-------------|
| 63       | Ground GND  |
| 62       | M-Bus       |
| 61       | M-Bus       |



### 3.2 Port settings

Verify or configure the ModMAG® M2000 communication port B. Access the port settings at main menu > communications > port B settings.

| Parameter             | Value         | Comments   |
|-----------------------|---------------|--|
| Port address          | 001           | Mandatory value of 001                             |
| Extended port address | 000 (Default) | Application specific. sets M-Bus address of module |
| Baud rate             | 38400         | M-Bus daughterboard auto-bauds                     |
| Data bits             | 8             | Mandatory value of 8                               |
| Parity                | EVEN          | Mandatory value of EVEN                            |
| Stop bits             | 1             | Mandatory value of 1                               |

## 4. M-Bus addressing

### 4.1 Primary address

The module may be addressed using its primary address (range: 0...250). The default (factory setting) primary address of the module is 0 (zero). The primary address can be reconfigured using the appropriate M-Bus command (see below).

### 4.2 Secondary address

The module may be addressed using the secondary address selection scheme of M-Bus. The secondary address consists of:

- PCB serial number (8 digits BCD)
- Manufacturer code (BMI, 0x09A9)
- Generation (0x01)
- Measured medium (0x07, cold water)

e.g.: 19100995,09A9,01,07

Any wildcard selection using the joker character ('F') is also possible:

19100995,FFFF,FF,FF

1910FFFF,FFFF,FF,FF

19100995,FFFF,FF,07

etc.

### 4.3 M-Bus commands

Since the device has got only two SND\_UD commands, it is not possible to send multiple commands within one M-Bus telegram.



#### 4.4 Setting primary address

The default (factory setting) primary address of the module is 0 (zero). You may program any other primary address in the range of 1 to 250 by using the standard M-Bus SND\_UD command for primary address setting:

Request (values in hex):

```
68 06 06 68 73/53 PAddr 51 01 7A NewAddr ChkS 16
```

Answer (values in hex):

```
E5
```

PAddr: Current primary address of the device

NewAddr: New primary address to program

Please note that the primary address is immediately written in the non-volatile flash memory of the module. However, since the write cycles of the flash memory are limited, the maximum number of write accesses are limited to 20 per 24 hours. If there are more write accesses within a 24 hours interval, the respective primary address is kept in RAM and will automatically be written to the flash memory in 24 hours time.

#### 4.5 Changing baud rate

By default (factory setting) the module is automatically set to detect the baud rate of the incoming M-Bus request telegram. Usually it is not necessary to change this setting. However, if it is desired to set a fixed baud rate, you may use the standard M-Bus commands to do so:

Request (values in hex):

```
68 03 03 68 73/53 PAddr B8 ChkS 16 set baud rate to 300 baud
```

```
68 03 03 68 73/53 PAddr BB ChkS 16 set baud rate to 2400 baud
```

```
68 03 03 68 73/53 PAddr BD ChkS 16 set baud rate to 9600 baud
```

```
68 03 03 68 73/53 PAddr BF ChkS 16 set baud rate to auto baud
```

Answer to all of the above requests (values in hex):

```
E5
```

The acknowledged answer is always sent with the former baud rate. After having sent the acknowledgement, the new baud rate becomes active.

Please note that the baud rate setting is not immediately written in the non-volatile flash memory of the module but only:

- On the cyclic 24 hours reset
- Or if a set primary address command has been received and executed
- Or if the command to write the configuration area to flash has been received and executed.



#### 4.6 Changing M-Bus response telegram

The module may answer a M-Bus REQ\_UD2 (request user data 2) telegram with one of five different M-Bus RSP\_UD (respond user data) telegrams, (according to EN13757-3 chapter 4.22 table 2):

- All
- Instantaneous values
- Testing
- Calibration
- Manufacturing

The telegram is selected by sending the appropriate M-Bus application reset telegram.

Request (values in hex):

```
68 03 03 68 73/53 PAddr 50 ChkS 16 set "All" telegram
68 04 04 68 73/53 PAddr 50 00 ChkS 16 set "All" telegram
68 04 04 68 73/53 PAddr 50 50 ChkS 16 set "Instantaneous"
telegram
68 04 04 68 73/53 PAddr 50 90 ChkS 16 set "Testing" telegram
68 04 04 68 73/53 PAddr 50 A0 ChkS 16 set "Calibration" telegram
68 04 04 68 73/53 PAddr 50 B0 ChkS 16 set "Manufacturing"
telegram
```

Answer to all of the above requests (values in hex):

E5

The next (and all the following) REQ\_UD2 requests are then answered with the selected telegram.

Please note that the RSP\_UD telegram setting is not written immediately in the non-volatile flash memory of the module but only:

- On the cyclic 24 hours reset
- Or if a set primary address command has been received and executed
- Or if the command to write the configuration area to flash has been received and executed.

#### 4.7 Write configuration area to flash

The module has got a configuration area which holds settings for e.g. the baud rate option, the primary address, the selected answer telegram etc. These settings are kept in volatile RAM memory unless they are written in the non-volatile flash memory. However, since the write cycles of the non-volatile flash memory are limited, the respective RAM configuration values are only copied to the flash configuration values every 24 hours (exception: the primary address). If the user wants to save the configuration immediately in the non-volatile memory, he may execute the command below:

Request (values in hex):

```
68 06 06 68 73/53 PAddr 51 00 FE 00 ChkS 16
```

save configuration to flash

Answer (values in hex):

E5



Please note that writing to the configuration area is under any circumstances limited to 20 times per 24 hours. Even with the above mentioned command it is not possible to write more often.

#### 4.8 Send Modbus commands

Since not all of the Modbus registers of the ModMAG<sup>®</sup> M2000 are retrievable using "native" M-Bus commands, it is also possible to encapsulate "native" Modbus commands within a M-Bus command. It is then possible to use all the Modbus commands understood by the ModMAG<sup>®</sup> M2000 (0x03, 0x04, 0x06 and 0x10, register reading and writing) with a M-Bus interface too.

Request (values in hex):

```
68 LL LL 68 73/53 PAddr 51 0F [ModBus] ChkS 16
```

send ModBus<sup>®</sup> command

LL: Length byte of M-Bus telegram

[ModBus]: Modbus command without CRC

e.g.:

```
68 0A 0A 68 73/53 PAddr 51 0F 01 03 00 43 00 05 ChkS 16
```

The underlined part is the Modbus command for reading the address 0x0043 (5 registers) of the ModMAG<sup>®</sup> M2000.

Answer (values in hex):

```
68 LL LL 68 08 PAddr 72 SecAddr AccessCtr Status Signature
0F [ModBus] ChkS 16
```

e.g.:

```
68 1D 1D 68 08 00 72 95 09 10
19 A9 09 01 07 08 01 00 00 Header for M-Bus RSP_UD
0F Flag: manufacturer specific
01 03 0A 31 39 31 30 30 39 39 35 00 00 Modbus answer
ChkS 16
```

Please note however, that in case of using the encapsulated Modbus commands, the M-Bus communication timeout should be increased (e.g. from 50 ms to 400 ms), since the requested registers are directly read and the results are returned within the answer to the request.

Please note also that these commands are compatible with M-Bus physical and link layers, but not completely compatible with the application layer. Therefore, all standard M-Bus communication lines will transmit the command, however, the software on the application side must be able to understand and interpret the command.

#### 4.9 M-Bus REQ\_UD2 answers

As mentioned before, the module may answer a REQ\_UD2 data request by five different RSP\_UD answers according to its configuration:

All: Contains the volumes, flow rate, flow speed, flow direction, etc.

Instantaneous: Contains a short form of "All" with only the volumes, flow rate and flow direction (smaller telegram = faster reading)

Testing: Contains the meter diagnostic counters of the ModMAG<sup>®</sup> M2000





Calibration: Contains the meter calibration registers of the ModMAG® M2000

Manufacturing: Contains the product identification registers of the ModMAG® M2000

Please note, that the module may also answer with a "busy" telegram in case the answer telegram has been changed by the user and not all of the new data values have been received from the ModMAG® M2000 yet. In this case the REQ\_UD2 command must be repeated.

Request (values in hex):

10 7B/5B PAddr ChkS 16 REQ\_UD2

Answer (values in hex):

68 04 04 68 08 PAddr 70 08 ChkS 16

CI = 0x70: Report of application errors

0x08: Application too busy for handling readout requests (see also, EN13757-3, chapter 8.3)

#### 4.9.1 M-Bus REQ\_UD2 answer „All“

| N° | Unit | Tariff | Storage | Data  | Value         | Funct. | VIB                         |
|----|------|--------|---------|-------|---------------|--------|-----------------------------|
| 0  | 0    | 0      | 0       | REAL4 | 1.854350e-003 | Inst.  | Volume [m <sup>3</sup> ]    |
| 1  | 1    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | Volume [m <sup>3</sup> ]    |
| 2  | 2    | 0      | 0       | REAL4 | 1.854350e-003 | Inst.  | Volume [m <sup>3</sup> ]    |
| 3  | 0    | 0      | 0       | INT2  | 0             | Err.   | No VIF                      |
| 4  | 1    | 0      | 0       | INT2  | 0             | Err.   | No VIF                      |
| 5  | 0    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | m/s                         |
| 6  | 0    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | Volume Flow [1/sec] ->*10E3 |
| 7  | 0    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | No VIF                      |
| 8  | 0    | 0      | 1       | REAL4 | 0.000000e+000 | Inst.  | Volume [m <sup>3</sup> ]    |
| 9  | 0    | 0      | 0       | INT2  | 0             | Inst.  | Control signal              |

| N° | ModBus® register | Description                           |
|----|------------------|---------------------------------------|
| 0  | 0x00CF           | T1 / T+ in m <sup>3</sup>             |
| 1  | 0x00D7           | T2 / T- in m <sup>3</sup>             |
| 2  | 0x00D7           | T3 / TN in m <sup>3</sup>             |
| 3  | 0x00E7           | T1 / T+ Rollover counter              |
| 4  | 0x00E8           | T2 / T- Rollover counter              |
| 5  | 0x00E9           | Flow velocity in m/s                  |
| 6  | 0x00ED           | Flow rate in m <sup>3</sup> /s        |
| 7  | 0x00F3           | Relative flow rate in %               |
| 8  | 0x00EB           | Preset batch totalizer m <sup>3</sup> |
| 9  | 0x012D           | Flow direction                        |



## 4.9.2 M-Bus REQ\_UD2 answer „Instantaneous“

| N° | Unit | Tariff | Storage | Data  | Value         | Funct. | VIB                         |
|----|------|--------|---------|-------|---------------|--------|-----------------------------|
| 0  | 0    | 0      | 0       | REAL4 | 1.854350e-003 | Inst.  | Volume [m <sup>3</sup> ]    |
| 1  | 1    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | Volume [m <sup>3</sup> ]    |
| 2  | 2    | 0      | 0       | REAL4 | 1.854350e-003 | Inst.  | Volume [m <sup>3</sup> ]    |
| 3  | 0    | 0      | 0       | REAL4 | 0.000000e+000 | Inst.  | Volume Flow [1/sec] ->*10E3 |
| 4  | 0    | 0      | 0       | INT2  | 0             | Inst.  | Control signal              |

| N° | ModBus® register | Description                    |
|----|------------------|--------------------------------|
| 0  | 0x00CF           | T1 / T+ in m <sup>3</sup>      |
| 1  | 0x00D7           | T2 / T- in m <sup>3</sup>      |
| 2  | 0x00D7           | T3 / TN in m <sup>3</sup>      |
| 3  | 0x00E7           | Flow rate in m <sup>3</sup> /s |
| 4  | 0x00E8           | Flow direction                 |

## 4.9.3 M-Bus REQ\_UD2 answers “Testing”

| N° | Unit | Tariff | Storage | Data | Value         | Funct. | VIB                  |
|----|------|--------|---------|------|---------------|--------|----------------------|
| 0  | 0    | 0      | 0       | INT2 | 40            | Inst.  | Commulation counter  |
| 1  | 0    | 0      | 1       | INT2 | 41            | Inst.  | Commulation counter  |
| 2  | 0    | 0      | 2       | INT2 | 0             | Inst.  | Commulation counter  |
| 3  | 0    | 0      | 3       | INT2 | 0             | Inst.  | Commulation counter  |
| 4  | 0    | 0      | 4       | INT2 | 0             | Inst.  | Commulation counter  |
| 5  | 0    | 0      | 5       | INT2 | 0             | Inst.  | Commulation counter  |
| 6  | 0    | 0      | 6       | INT2 | 0             | Inst.  | Commulation counter  |
| 7  | 0    | 0      | 7       | INT2 | 1             | Inst.  | Commulation counter  |
| 8  | 0    | 0      | 8       | INT2 | 2             | Inst.  | Commulation counter  |
| 9  | 0    | 0      | 9       | INT2 | 16            | Inst.  | Commulation counter  |
| 10 | 0    | 0      | 10      | INT2 | 20            | Inst.  | Commulation counter  |
| 11 | 0    | 0      | 11      | INT2 | 0             | Inst.  | Commulation counter  |
| 12 | 0    | 0      | 12      | INT2 | 0             | Inst.  | Commulation counter  |
| 13 | 0    | 0      | 13      | INT2 | 1             | Inst.  | Commulation counter  |
| 14 | 0    | 0      | 0       |      | 2.083367e-038 | Err    | Storage interval [s] |

| N° | ModBus® register | Description                |
|----|------------------|----------------------------|
| 0  | 0x00F5           | Power up counter           |
| 1  | 0x00F6           | Detector error counter     |
| 2  | 0x00F7           | Empty pipe counter         |
| 3  | 0x00F8           | Full scale counter         |
| 4  | 0x00F9           | Totalizer overflow counter |
| 5  | 0x00FC           | Pulse sync counter         |
| 6  | 0x00FD           | ADC interrupt counter      |
| 7  | 0x00FE           | ADC range counter          |
| 8  | 0x00FF           | WDT resets counter         |
| 9  | 0x0100           | WDT location               |



|    |        |                                 |
|----|--------|---------------------------------|
| 10 | 0x0101 | System error #                  |
| 11 | 0x0109 | Action request overflows        |
| 12 | 0x010A | Measurement overflows           |
| 13 | 0x0154 | Remote resets                   |
| 14 | 0x0107 | Power loss totalizer in seconds |

#### 4.9.4 M-Bus REQ\_UD2 answer "Calibration"

| N° | Unit | Tariff | Storage | Data  | Value         | Funct. | VIB          |
|----|------|--------|---------|-------|---------------|--------|--------------|
| 0  | 0    | 0      | 0       | INT2  | 9             | Inst.  | mm           |
| 1  | 0    | 0      | 1       | INT2  | 50            | Inst.  | mm           |
| 2  | 0    | 0      | 2       | REAL4 | 0.000000e+000 | Inst.  | No VIF       |
| 3  | 0    | 0      | 3       | REAL4 | 0.000000e+000 | Inst.  | No VIF       |
| 4  | 0    | 0      | 2       | REAL4 | 0.000000e+000 | Inst.  | m/s          |
| 5  | 0    | 0      | 3       | REAL4 | 0.000000e+000 | Inst.  | m/s          |
| 6  | 0    | 0      | 4       | REAL4 | 7.692835e+008 | Inst.  | No VIF       |
| 7  | 0    | 0      | 5       | REAL4 | 1.000000e+000 | Inst.  | No VIF       |
| 8  | 0    | 0      | 0       | REAL4 | 2.003202e-001 | Inst.  | Current [mA] |
| 9  | 0    | 0      | 1       | REAL4 | 2.000000e-001 | Inst.  | Current [mA] |
| 10 | 0    | 0      | 0       | INT2  | 0             | Inst.  | Hs           |
| 11 | 0    | 0      | 1       | INT2  | 2             | Inst.  | Hs           |
| 12 | 0    | 0      | 6       | REAL4 | 0.000000e+000 | Inst.  | No VIF       |

| N° | ModBus® register | Description                      |
|----|------------------|----------------------------------|
| 0  | 0x006F           | Detector diameter in mm          |
| 1  | 0x0070           | Detector diameter other in mm    |
| 2  | 0x0071           | Detector factor                  |
| 3  | 0x0073           | [FACTORY] Detector factor        |
| 4  | 0x0075           | Detector offset in m/s           |
| 5  | 0x0077           | [FACTORY] Detector offset in m/s |
| 6  | 0x0079           | Amplifier factor                 |
| 7  | 0x007B           | [FACTORY] Amplifier factor       |
| 8  | 0x007D           | Detector current in mA           |
| 9  | 0x007F           | [FACTORY] Detector current in mA |
| 10 | 0x0081           | Power line frequency in Hz       |
| 11 | 0x0082           | Excitation frequency in Hz       |
| 12 | 0x010B           | Scale factor in %                |



## 4.9.5 M-Bus REQ\_UD2 answer "Manufacturing"

| N° | Unit | Tariff | Storage | Data | Value             | Funct. | VIB                |
|----|------|--------|---------|------|-------------------|--------|--------------------|
| 0  | 0    | 0      | 0       | INT2 | 1                 | Inst.  | Model / Version    |
| 1  | 0    | 0      | 0       | Var. | M2000             | Inst.  | Model / Version    |
| 2  | 0    | 0      | 1       | Var. | M2000 TMS320F2811 | Inst.  | Model / Version    |
| 3  | 0    | 0      | 0       | Var. | N-Series v1.09    | Inst.  | Software version # |
| 4  | 0    | 0      | 0       | Var. | Sep 1 2010        | Inst.  | No VIF             |
| 5  | 0    | 0      | 1       | Var. | 09:32:43          | Inst.  | No VIF             |
| 6  | 0    | 0      | 2       | Var. | BEFF              | Inst.  | No VIF             |
| 7  | 0    | 0      | 3       | Var. | D8D5              | Inst.  | No VIF             |
| 8  | 0    | 0      | 0       | Var. | v1.001            | Inst.  | Hardware version # |
| 9  | 0    | 0      | 0       | Var. | v1.09             | Inst.  | Firmware version # |
| 10 | 1    | 0      | 0       | INT2 | 3                 | Inst.  | Model / version    |
| 11 | 1    | 0      | 0       | INT2 | 1                 | Inst.  | Firmware version # |
| 12 | 1    | 0      | 1       | INT2 | 0                 | Inst.  | Firmware version # |
| 13 | 0    | 0      | 0       | INT2 | 258               | Inst.  | Password           |

| N° | ModBus® register | Description                 |
|----|------------------|-----------------------------|
| 0  | 0x0000           | Product code                |
| 1  | 0x0001           | Product name                |
| 2  | 0x0009           | Firmware name               |
| 3  | 0x0019           | Application version         |
| 4  | 0x0023           | Compile date [MMM:DD:YYYY]  |
| 5  | 0x0033           | Compile time [HH:MM:SS]     |
| 6  | 0x0048           | OTP boot checksum           |
| 7  | 0x004B           | Flash OS checksum           |
| 8  | 0x004E           | Boot version                |
| 9  | 0x0053           | OS version                  |
| 10 | 0x0057           | Daughterboard product type  |
| 11 | 0x0058           | Daughterboard major version |
| 12 | 0x0059           | Daughterboard minor version |
| 13 | 0x011C           | Security status             |



## 5. Technical data

The ModMAG<sup>®</sup> M-Bus module is providing a EN13757 compatible M-Bus interface to the Badger ModMAG<sup>®</sup> M2000 flow meter

|                                     |   |
|-------------------------------------|---|
| Product                             | ModMAG <sup>®</sup> M2000 M-Bus module  |
| Power supply                        | 2 x +5V from M2000 internal module interface<br>(+5 V digital, +5V field)   |
| Current                             | 1 mA from +5V digital<br>10 mA frp, +5V field   |
| ModMAG <sup>®</sup> M2000 interface | 2 wire ModBus <sup>®</sup> interface<br>9600, 19200, 38400 baud auto-baud detection at firmware start<br>8 data bits,<br>1 stop bit,<br>1 even parity bit<br>Phoenix IMC 1.5/11-G-3.81 connector to M2000   |
| M-Bus interface                     | 2 wire EN13757 compatible M-Bus interface<br>300, 2400, 9600 baud auto-baud detection<br>8 data bits<br>1 stop bit<br>1 even parity bit<br>1 M-Bus unit load (1.5 mA)<br>15 mA active M-Bus current<br>M-Bus input with reversible mains protection and protective earth clamp<br>3 pin clamp |
| Isolation                           | 2500 V RMS isolation between M-Bus interface and ModMAG <sup>®</sup> M2000  |
| Module size                         | 54 x 37 mm, maximum height 27 mm  |
| Operating temperature               | -20 °C ... +60 °C (-4 °F ... +140 °F)   |
| Storage temperature                 | -40 °C ... +70 °C (-40 °F ... +160 °F)  |
| Humidity                            | 90 %  |
| Product life time                   | > 10 years  |

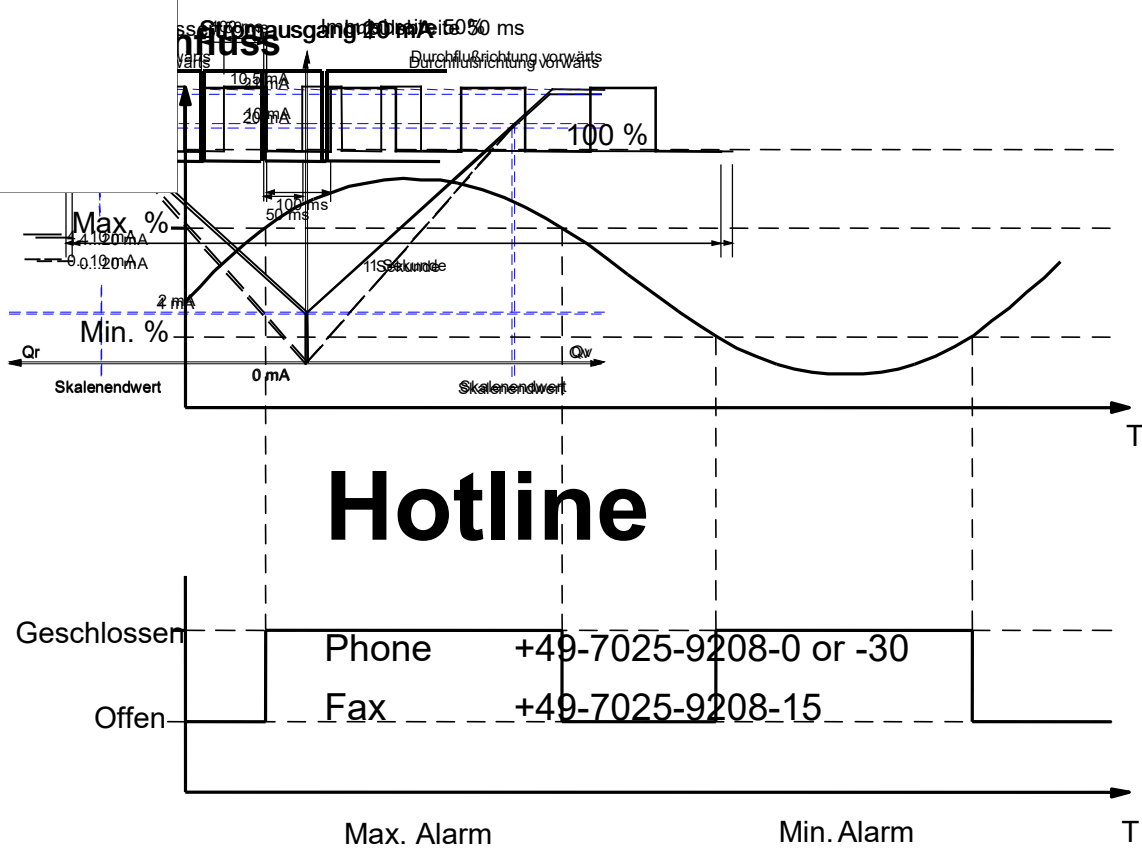


**6. Return of goods for repair / Harmlessness declaration**

Please refer to our claims return form/harmlessness declaration under [www.badgermeter.de/service/return of goods](http://www.badgermeter.de/service/return_of_goods).







**Badger Meter Europa GmbH**  
 Subsidiary of Badger Meter, Inc., USA

Nürtinger Strasse 76  
 72639 Neuffen (Germany)  
 E-mail: [badger@badgermeter.de](mailto:badger@badgermeter.de)  
[www.badgermeter.de](http://www.badgermeter.de)