Badger Meter Europa GmbH

ModMAG® M2000
M-Bus interface

User manual

August 2012

MID_M2000_BA_MB_02_1208

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:

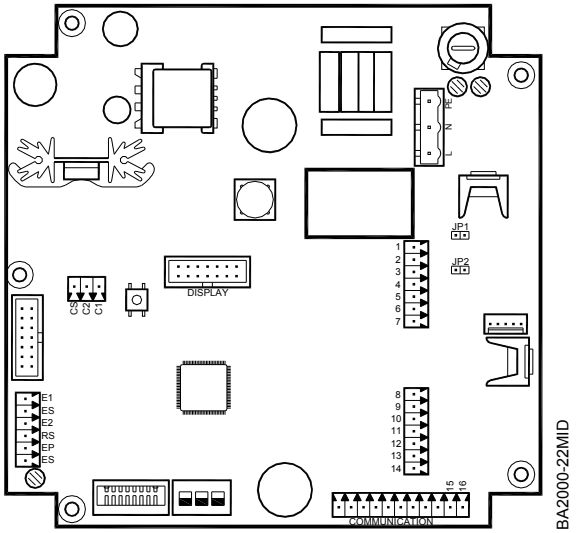
- M-Bus primary and secondary address selection
- The primary address is saved in a non-volatile memory
- 300, 2400 and 9600 baud communication speed
- Automatic baud rate detection or manually programmable baud rate
- Standard M-Bus serial communication parameters: 8 data bits, 1 parity even bit, 1 stop bit.
- LED for M-Bus communication green: Incoming M-Bus transmission
  Red: Outgoing M-Bus transmission

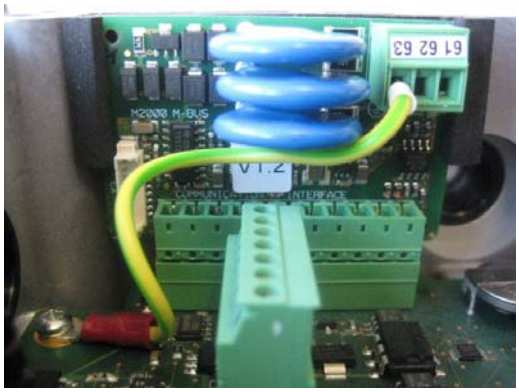
- Five different M-Bus response telegrams with different meter values (according to EN13757-3, chapter 4.22, table 2):
  - All
  - Instantaneous values
  - Testing
  - Calibration
  - Manufacturing

- 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.





4. Electrical connection

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

5. M-Bus addressing

5.1 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).

5.2 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.

5.3 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.

5.4 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.

5.5 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.

5.6 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.

5.7 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.

5.8 Send ModBus® commands

Since not all of the ModBus® registers of the ModMAG® 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® 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® 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® 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.

5.9 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® 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)

5.9.1 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^3]
1	1	0	0	REAL4	0.000000e+000	Inst.	Volume [m^3]
2	2	0	0	REAL4	1.854350e-003	Inst.	Volume [m^3]
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^3]
9	0	0	0	INT2	0	Inst.	Control signal

N°	**ModBus® register**	**Description**
0	0x00CF	T1 / T+ in m^3
1	0x00D7	T2 / T- in m^3
2	0x00D7	T3 / TN in m^3
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^3/s
7	0x00F3	Relative flow rate in %
8	0x00EB	Preset batch totalizer m^3
9	0x012D	Flow direction

5.9.2 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^3]
1	1	0	0	REAL4	0.000000e+000	Inst.	Volume [m^3]
2	2	0	0	REAL4	1.854350e-003	Inst.	Volume [m^3]
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^3
1	0x00D7	T2 / T- in m^3
2	0x00D7	T3 / TN in m^3
3	0x00E7	Flow rate in m^3/s
4	0x00E8	Flow direction

5.9.3 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

5.9.4 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 %

5.9.5 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	Daugtherboard product type
11	0x0058	Daugtherboard major version
12	0x0059	Daugtherboard minor version
13	0x011C	Security status

6. Technical data

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

Product	ModMAG® M2000 M-Bus module
Power supply	2 x +5V from M2000 internal module interface (+5 V digital, +5V field)
Current	1 mA from +5V digital 10 mA frp, +5V field
ModMAG® M2000 interface	2 wire ModBus® interface 9600, 19200, 38400 baud auto-baud detection at firmware start 8 data bits, 1 stop bit, 1 even parity bit Phoenix IMC 1.5/11-G-3.81 connector to M2000
M-Bus interface	2 wire EN13757 compatible M-Bus interface 300, 2400, 9600 baud auto-baud detection 8 data bits 1 stop bit 1 even parity bit 1 M-Bus unit load (1.5 mA) 15 mA active M-Bus current M-Bus input with reversible mains protection and protective earth clamp 3 pin clamp
Isolation	2500 V RMS isolation between M-Bus interface and ModMAG® 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

7. Return of goods for repair

Please copy, fill in and sign hereafter harmlessness declaration and enclose it for any return of goods you may send back for repair.

No repair will be performed prior to receiving the harmlessness declaration duly filled and signed.

Harmlessness declaration

To: _____

Attn. : _____

From : _____

Dept. : _____

Please note that no repair will be performed prior to receiving of this declaration duly signed by you!

Please send all parts clean from medium and inform us about possible medium wastes remaining in the part. For this purpose, please use this form. A security specification sheet of the medium must accompany this declaration in the following cases: Toxical, dangerous or objectionable media, or media belonging to any dangerous materials class. We inform you that uncleaned parts lead to additional costs. Extra clean costs will be charged to you.

Declaration

We herewith confirm that the part(s) sent for repair has/have been cleaned and is/are free of any liquid and/or solid wastes of the medium and/or cleaning medium: Any eventually remaining wastes are:

❍ harmless

❍ dangerous, toxic, etc. – Security specifications are attached

Signature of person in charge: _____

_____

Name of the person in charge in capital letters:

Date: _____

Company stamp: _____

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