

Manual

MQMe Quantometers



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MQMe Quantometers



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1. Purpose of this Manual

The instruction manual is dedicated to technical staff with adequate training and technical knowledge in the sector of gas distribution industry according to the applicable technical laws and requirements. For example, staff who are educated according DVGW codes of practice G 492 and / or G 495.

2. Basic safety instructions

Requirements for the personnel

The operational staff must be qualified, instructed and authorized according the assigned functions. All service and maintenance work shall be performed exclusively by persons with proven expert knowledge, including knowledge of occupational safety and environmental protection. Protective actions have to be defined according the legal regulations.

Designated use

The MQMe Quantometer is designed for in-plant volume measurement of combustible gases of the 1., 2. and 3. gas family (natural gas, town gas, propane, butane and others), purified and dried biogas as well as other inert, non-aggressive and non-explosive gases and gas mixtures. The permissible operating pressure range reaches up to 20 bar dependent on the design of the meter, the temperature range runs from -20°C to +60°C. The manufacturer is not liable for damage caused by improper or not-designated use.

Safety at work

Wear the required personal protective equipment according to federal/national regulations.

Operational safety

The device is permitted to operate in technical faultless and fail-safe condition only. Responsible is the operator.

Product safety

This measuring device is designed, manufactured and tested according the state-of-art demands. It meets all legal requirements and complies with the EC directives.

The manufacturer confirms the device-specific EC Declaration of Conformity by fixing the CE mark to the device.

The device has left the factory in perfect condition.

Warranty could be extended only in case of proper installation and operation according to this manual.

3. Declaration

Declaration of Conformity (Annex A)

4. Use and Scope of Quantometers

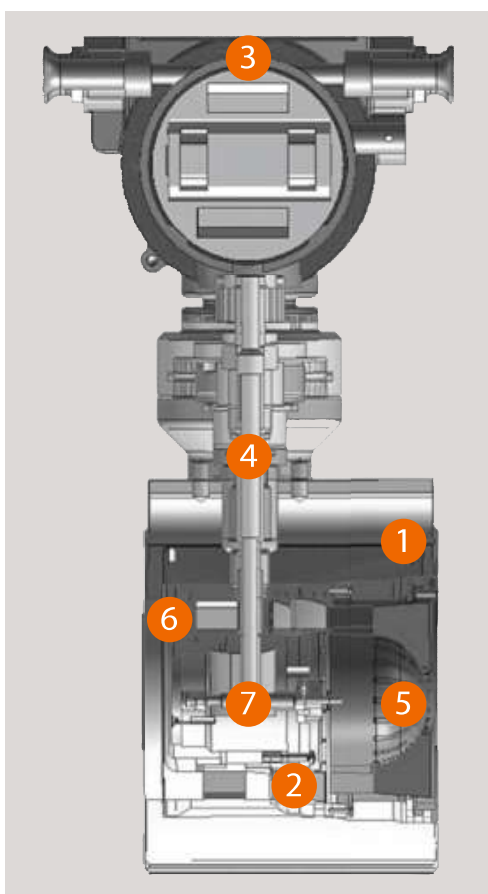
The Quantometer MQMe is designed for none fiscal or in-plant metering of natural gas and approved according the European guidelines of 2014/68/EG. The MQMe Quantometer is suitable to be installed in hazardous area of Category 2 (ATEX / IECEx Ex-Zone 1) Ex Ex ia II C T4 Ga (Annex B).

The MQMe Quantometer is suitable for the following gases:

- Natural gas, town gas, propane, butane, ethylene, air, nitrogen, noble gases
- Further gases on request.

The MQMe Quantometer cannot be used for: Oxygen, Acetylene and other aggressive gases as well as for explosive gases and gas mixtures. The meter should not be used in applications with the presence of strong pulsations. These conditions will result in an increased error and may significantly decrease the meter's lifetime.

5. Design of the MQMe Quantometer



Meter Structure

- 1 Meter housing
- 2 Turbine rotor
- 3 Electronic counter / index
- 4 Magnetoresistance sensor
- 5 Flow conditioner
- 6 Measuring unit housing
- 7 Measuring unit

Note: In case of failure or damage:
Repairs are only allowed to be done
by qualified and authorized repair centers.

Fig. 1: Sectional view of MQMe Quantometer

6. Technical Data

Meter type	MQMe Quantometer
Approval	ATEX / IECEx Ex-Zone 1; Ex ia II C T4 Ga; PED 2014/68/EU
Size	G 10 to G 1000
Nominal diameter	DN 25 (2") to DN 150 (6")
Pressure rating	PN 16 and ANSI CLASS 150
Rangeability	1:20 (exception is the DN 25 with a range of 1:10)
Temperature ranges	
• gas temperature	-20°C to +60°C
• ambient temperature	-25°C to +55°C
• storage temperature	-25°C to +55°C
Housing material	Aluminum
Max. operation pressure	20 barg
Accuracy	$Q_{\min} \leq Q < Q_{\max}$: $\pm 1.0\%$ of $Q_{\max}$

Electronic index	
Counter:	Nine-digit electronic index Meter index head
Meter index head:	Aluminum alloy
Protection class	IP 65
Battery:	Lithium battery with a calculated life time under standard conditions of 5 years
Display:	LCD Display for flow and volume under operating and standard conditions, pressure and temperature as well as the status of the battery
Keys:	4 keys
Memory:	Non-volatile 512 kB EPROM for saving the parameters and set of 1500 records
Integrated electronic volume	
correction (option):	AGA NX 19 or fixed factors
Standard conditions:	selectable, standard configuration is 273,15°K (0°C); 1013,25 mbar
Parameterization:	PC based software (HMI)

Communication	
Pulse output:	1 LF-pulser and 1 HF-pulser; option: additionally 1 HF-pulser (at the turbine wheel)
LF-pulse generator	1 LF
Contact type	normally open
Max. voltage	15.5 V
Max. current	110 mA
Max. resistance	5.1 Ω
Max. switching frequency $f_{\max}$	10 Hz
HF-pulse generator	1 HF
Max. voltage	15.5 V
Max. current	110 mA
Max. resistance	5.1 Ω
Max. switching frequency $f_{\max}$	1000 Hz
HF-pulse generator:	1 HF (inductive sensor, acc. NAMUR specs)
Supply voltage	8.2 VDC (internal resistance of 1 k Ω)
Current consumption (sensor covered)	< 1 mA
Current consumption (sensor free)	> 2.1 mA
Max. switching frequency $f_{\max}$	1500 Hz
Analog output (option):	1 4 to 20 mA output (only with external power supply)
Serial communication:	1 RS 485 or M-Bus interface
Protocol:	Modbus RTU, M-Bus

Rangeability and pulse weighting data

DN [mm]	G-Typ	Q _{min} [m³/h]	Q _{max} [m³/h]	HF *) [imp/m³]	NF [imp/m³]
25	16	2,5	25	140000	10
25	25	4	40	140000	10
50	40	3,25	65	10400	10
50	65	5	100	10400	10
80	100	8	160	27000	1
80	160	12,5	250	27000	1
80	250	20	400	27000	1
100	160	12,5	250	13500	1
100	250	20	400	13500	1
100	400	32	650	13500	1
150	400	32	650	5400	1
150	650	50	1000	5400	1
150	1000	80	1600	5400	1

*)The absolute number of the pulses depends on the meter size and the individual meter itself. The stated values are of typical size. Exact values determined by calibration of the meter are located on the nameplate.

7. Installation

Recommendations and requirements for the installation of the MQMe Quantometer:

- Preferably, the meter should be installed horizontally, with index head upward.
- Straight inlet pipe ≥ 3 DN and outlet pipe ≥ 2 DN in the nominal pipe diameter is recommended for high accuracy.
- Ensure that the gas flow is in the same direction as shown by the arrow at the meter housing.
- Avoid heavy vibrations and pulsations in the point of measurement. Installation of a suitable compensator can effectively damp down this kind of disturbance.
- Drastic changes in the gas flow as well as strongly pulsating flow will increase the measuring error. They arise for example during frequently switching on-off of solenoid valves. The pressure impulses by opening the valve very fast may damage the ball bearings of the turbine rotor and cause failure of the Quantometer.
- Filter (small mesh size) should be installed upstream of the meter to protect it from any contamination (suspended particles $> 50 \mu\text{m}$) during start-up and operation.

- The gas should be dry. If condensate may be occurring, then the installation of a condensation trap upstream of the meter is recommended (in some filter types it is integrated). In this case choose
 - o Flow direction from top to bottom
 - o Do Not install the meter at the lowest point of the piping

Attention: The MQMe Quantometer is not suitable for Oxygen and other highly corrosive gases as well as for explosive gases and gas mixtures.

8. Mounting Position / Direction of Flow

There are two positions of installation possible for the MQMe Quantometer: Horizontal installation or vertical installation

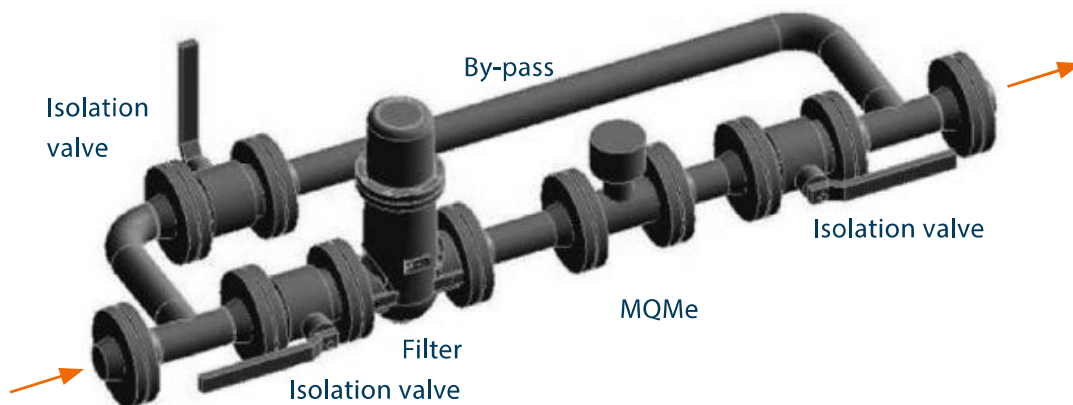


Figure 2: Typical horizontal installation of the MQMe Quantometer (recommended)

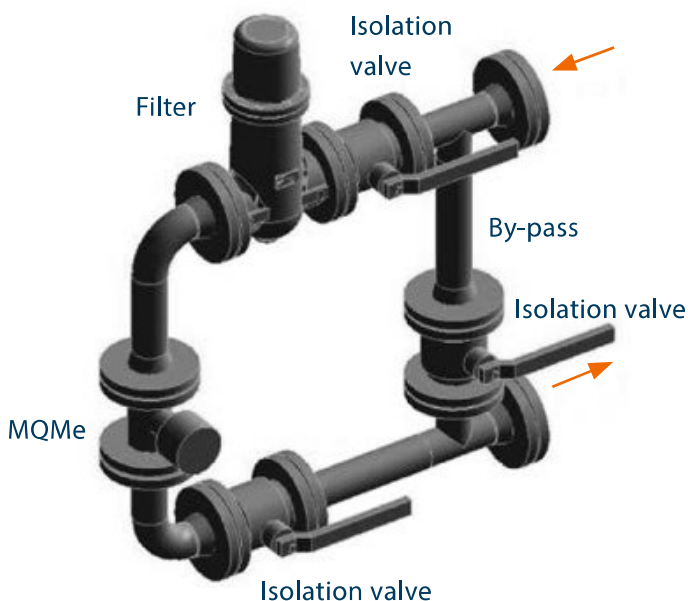


Figure 3: Typical vertical installation of the MQMe Quantometer

Notice: Ensure that the gas flow is in the same direction as shown by the arrow at the meter housing.

9. Preliminary work

Before the installation of the meter please make sure that the following steps has been observed:

1. Remove the plastic cover sheets the inlet and outlet of the meter.
2. Inspect the meter for completeness (e. g. plugs, provided oil volume) and for absence of any transport damages.
3. Clean the flange surfaces (e. g. with petroleum).
4. Check by blowing into the meter that turbine rotor rotates easily and stops smoothly.
5. Prior to the meter's installation check that no contaminations, condensate, dirt and debris are in the pipe. Especially the cleaning of elbows in vertical installations is important to prevent damage of the meter by contaminations, dirt and debris passing. A cone-shaped start-up sieve may be installed for initial operation. After 4-6 weeks it should be removed to avoid perturbations of the flow profile with resulting decrease of the accuracy.
6. Make sure that there is no intrusion of the sealing element into the pipe during installation and operation (concentric mounting).
7. Check that in addition to the meter-length there is enough installation space for the two seals between inlet and outlet flanges.
8. The meter must be installed stress-free. Therefore, in addition to point 7 observe strictly the proper alignment of the Quantometer's inlet to outlet axis with the connecting piping axis

Necessary equipment for the meter installation:

1. Suitable and certified gaskets:
 - Dimensions according DIN EN 1514-1 or DIN 2690
2. Screws according DIN ISO 4014 and ASME B 1.1
3. Nuts according DIN EN ISO 4032 and ASME B 1.1

DN [mm]	Pressure ANSI Class	Flanges according ANSI B 16.5			
		Stud bolts with continuous thread and nuts			
		Min. Operating temperature of the screws and nuts	Number of screws	Strength class screws	Strength class screws
25 Flange with threaded holes	150	- 25°C	4 x M12	ASTM A 193 Grade B7	– Grade 2H
50	150	- 25°C	4 x M16	ASTM A 193 Grade B7	ASTM A 194 Grade 2H
80	150	- 25°C	8 x M16	ASTM A 193 Grade B7	ASTM A 194 Grade 2H
100	150	- 25°C	8 x M16	ASTM A 193 Grade B7	ASTM A 194 Grade 2H
150	150	- 25°C	8 x M20	ASTM A 193 Grade B7	ASTM A 194 Grade 2H

DN [mm]	Pressure class PN	Flanges according DIN EN 1092-1			
		Min. operating temperature of the screws and nuts	Hexagon screws and nuts		
			Number of screws	Strenght class screws	Strenght class screws
25 Flange with threaded holes	16	- 10°C	4 x M12	5.6 / 8.8	–
50	16	- 10°C	4 x M16	5.6 / 8.8	5 / 8
80	16	- 10°C	8 x M16	5.6 / 8.8	5 / 8
100	16	- 10°C	8 x M16	5.6 / 8.8	5 / 8
150	16	- 10°C	8 x M20	5.6 / 8.8	5 / 8

DN [mm]	Pressure class PN	Flanges according DIN EN 1092-1			
		Min. operating temperature of the screws and nuts	Number of screws	Hexagon screws and nuts	
				screw material	screw material
25 Flange with threaded holes	16	- 40°C	4 x M12	25CrMo4	–
50	16	- 40°C	4 x M16	25CrMo4	25CrMo4
80	16	- 40°C	8 x M16	25CrMo4	25CrMo4
100	16	- 40°C	8 x M16	25CrMo4	25CrMo4
150	16	- 40°C	8 x M20	25CrMo4	25CrMo4

During Installation of the meter has to been checked:

1. The meter is mounted in the right flow direction.
2. The meter is installed gas-tight.
3. The meter is installed stress-free.
 - In horizontal pipes the meter is installed with the index head upright.
In case of vertical installations, the oil pump must be mounted in upright position (if the meter is equipped with an oil pump).
 - Connecting screws and nuts must be tightened crosswise.
 - For connecting the pressure test point please refer to chapter 15.
 - For connecting the temperature test point please refer to chapter 16.

A protective cover is recommended for outdoor installation especially when the meter is mounted together with a volume corrector.

After installation of the meter: Welding of piping and flanges nearby the Quantometer is not allowed.

10. Lubrication and Maintenance of the MQMe Quantometer

1. Quantometers with permanent lubricated ball bearings (no oil pump) are maintenance-free.
2. Quantometers with an oil pump need periodic lubrication.

The initial lubrication procedure is:

- a. Use only oil recommended and supplied by Metreg Technologies.
One set of oil for commissioning is delivered with the meter.
- b. Specified oil: Shell Morlina S2 BL 5 or Shell Morlina S2 BL 10
- c. Fill in the oil before commissioning the meter and after the correct installation of the meter described in chapter 7 and 8.
- d. Fill an adequate quantity of oil in the supply tank, and then horizontally pull the hand lever dependent on the size of the meter:
DN 50: 3 strokes
DN 80: 5 strokes
DN 100: 5 strokes
DN 150: 9 strokes
- e. When the lubrication procedure is finished, close the cover of the supply tank to avoid any dirt or impurities to enter the lubrication system.

- 1 Hand lever
- 2 Oil reservoir cover
- 3 Oil reservoir
- 4 One-way valve

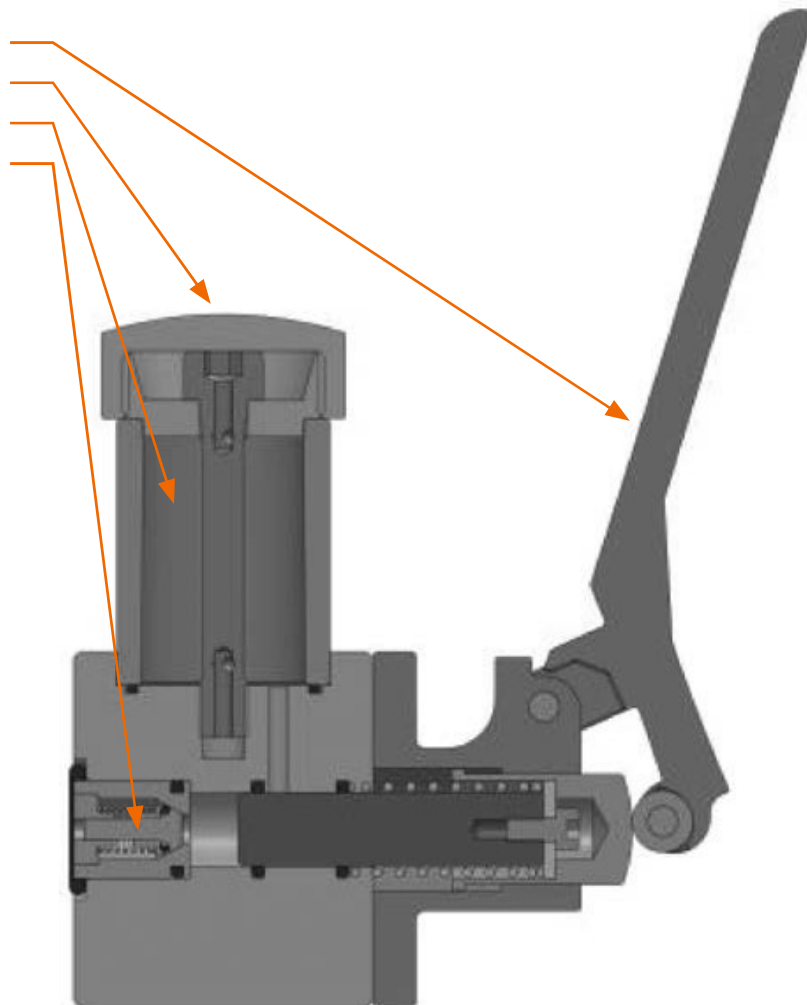


Figure 4: Sectional drawing of the oil pump

11. Maintenance of MQMe Quantometers

1. Quantometers without oil pump do not require special services.
They are maintenance-free.
2. Quantometers with an oil pump require periodically maintenance:
 - 2.1. Lubrication every 2 to 3 months if the gas is clean and filtered upstream the meter:
DN 50: 2 strokes, DN 80: 4 strokes, DN 100: 4 strokes, DN 150: 7 strokes
 - 2.2. If the gas is carrying dust and/or moisture, then the lubrication has to be done at least every month.
3. A repair of the Quantometer has only to be done by competent and authorized personnel like the Service Engineers from Metreg Technologies.

12. Commissioning of the MQMe Quantometer

The start-up procedure of the MQMe Quantometer follows the installation and leakage test of the connections:

1. Open slowly the upstream valve (fig. 2 and fig. 3)
to pressurize the pipe until operation pressure is achieved.
2. The rate of pressure increase shall not exceed 350 mbar/s.
3. At operation pressure level open the upstream valve completely.
4. Slightly open the downstream valve (fig. 2 and fig. 3).
5. At operation pressure level the downstream valve
can be opened completely.
6. Perform a leakage test on the meter at operation pressure.
7. Remove the startup sieve after 4 to 6 weeks (if installed).

13. Decommissioning procedure of the MQMe Quantometer

1. Take care of appropriate ventilation of the installation room.
2. Depressurize to atmosphere only to areas
with no active ignition sources.
3. Reduce the operating pressure slowly (e. g. < 350 mbar/s).
4. Open the bolts and nuts of the flanges only
if the pipe is completely depressurized.
5. Carefully take out the meter from the pipe connection.

14. Electronical Counter

Display

As display, a segment LCD display is used. The display is used to visualize the flow and volume under operating and standard conditions and the pressure and temperature as well as the status of the battery. The display of the total volume of gas is carried out with 4 decimal places. The counter consists of 9 points. For volume 2 decimal places are displayed. The maximum value is 9999 m³/h. If this value is exceeded, the display flashes.

Keyboard

In electrical counter 4 keys are installed:

- The reset button (RST)
- The setting button (SET)
- The increase key (INC)
- The shift key (SHT).

The user can spot the change, adjust and save the parameters via the appropriate key or key combination. This path is not particularly comfortable (the procedures for setting parameters via the four keys are in described in detail in a separate service document). The parameterization via a Windows™ based software is the preferable way. For this, the RS-485 interface of MQMe's must be connected via an RS-485 / USB converter (option) to the PC.

Power Supply

The power supply of MQMe's is an internal 3.6 lithium battery with a power consumption of <0.7 mW. The calculated battery life under standard conditions is 5 years' maturity. The battery charging status is displayed on the LCD display. If the battery voltage drops below 3.0V, the battery status indicator „ „ flashes. So, it indicates that the battery needs to be replaced within 30 days. The electronics of the MQMe constantly monitors the battery voltage of the internal lithium battery.

In Figure 5, the open back of the electronic counter head of the MQMe can be seen. The fixing screw at back cover of the counter must be loosened then the back cover can be removed. To replace the battery, the screws on the connection terminals must be loosen (terminals; 3.6V, GND) and then remove the battery pack and install the new one. The red wire of the battery pack must be applied to terminal „3.6 V“ and the black wire to the „GND“ terminal. From Figure 6 the block diagram of MQMe the wiring of the battery pack is shown graphically. Alternatively, the Quantometer MQMe can be used with an optional external power supply. In this case, the internal battery is not active. Wiring the external power supply is shown in figures 6 and 7.



Warning: When replacing the battery, make sure that there will be no short circuits.

Caution: The battery could only be replaced in hazardous areas if it is guaranteed that actually there is no ex zone.

Figure. 5: Back side of the electronic counter head of Quantometer MQMe

Data Storage

The electronic index of the MQMe is equipped with a 512 kB non-volatile EPROM to save 1500 records and all parameters.

Integral electronic volume corrector (Option)

The electronic index of the MQMe can optionally be equipped with an electronic volume corrector. In this case the gas flow and gas volume under standard conditions will be calculated according AGA NX-19. For these calculations, an external pressure and temperature transmitter must be installed to the MQMe. The MQMe is designed to have one external temperature and one external pressure transmitter installed to the meter. If there is no external pressure and temperature sensor is installed, fixed values for the calculations due to AGA NX-19 can be parametrized and will be used. The standard configuration from the factory is 273.15°K (0°C); 1013 mbar, unless otherwise agreed.

Pressure and Temperature Sensor

If an external pressure and temperature sensor are connected to the MQMe, the necessary wiring in Figure 6 and Figure 7 is illustrated. Communication with the external sensors is made via a serial RS485 interface. Pressure sensors with measuring ranges from 2 bara; 5 bara; 10 bara and 20 bara are supported.

Communication

The MQMe has several options to transmit the measured and calculated data to a digital control system (DCS) or SCADA. The MQMe is by standard equipped with alternatively RS 485 or M-Bus interface and one high frequency (HF) and one low frequency (LF) pulser. If an external power supply is connected to the MQMe one 4 to 20 mA – configurable signal is available. The rotation of the rotor can be scanned additionally with one external high frequency (HF) sensor as an option. The HF-sensor signal allows the determination of the actual gas flow in high-resolution and can be transmit to any digital control system (DCS) or SCADA for flow control purposes.

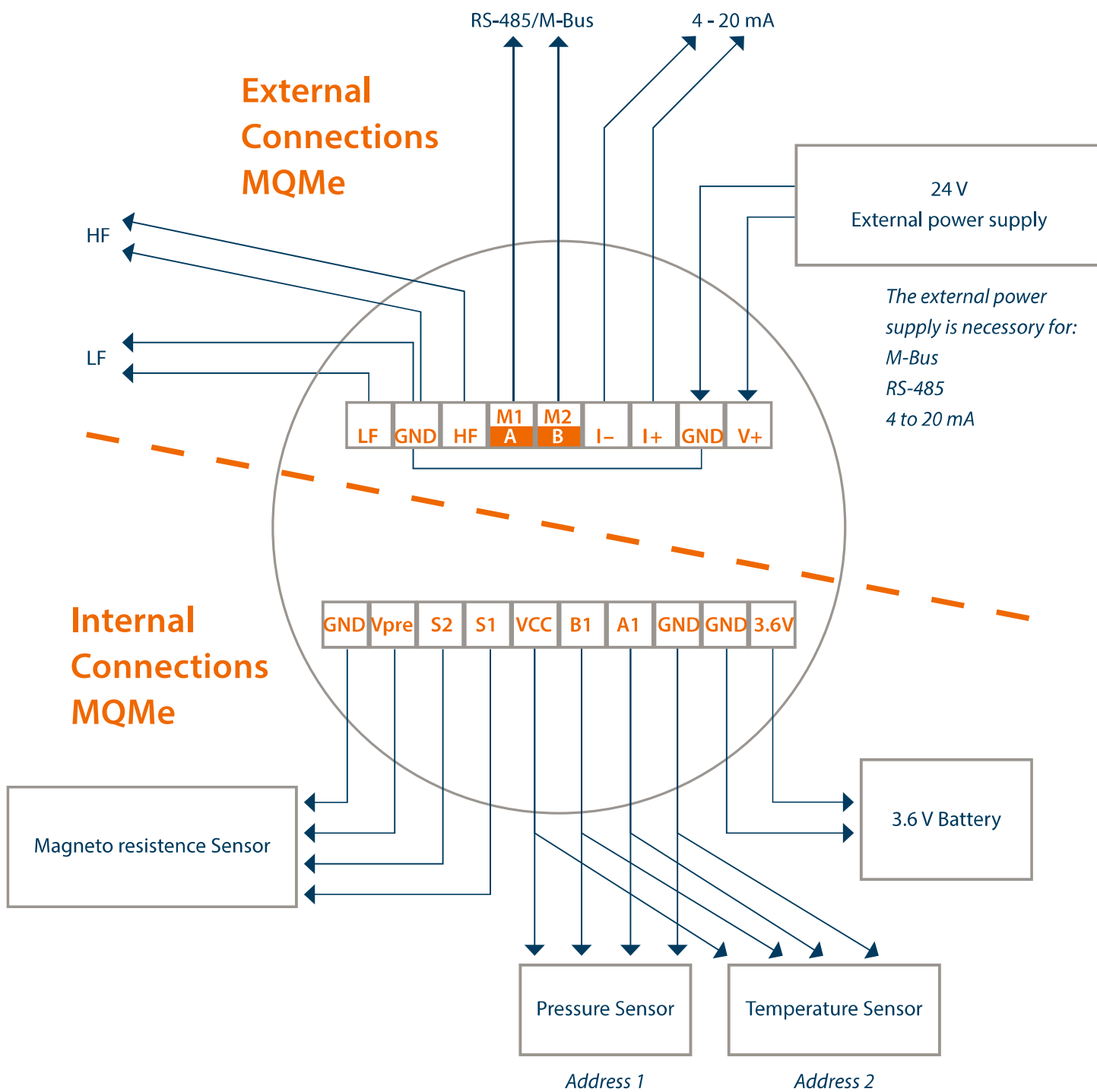


Figure. 6: Wiring diagram for the flow sensor, pressure and temperature sensor, as well as for the battery pack

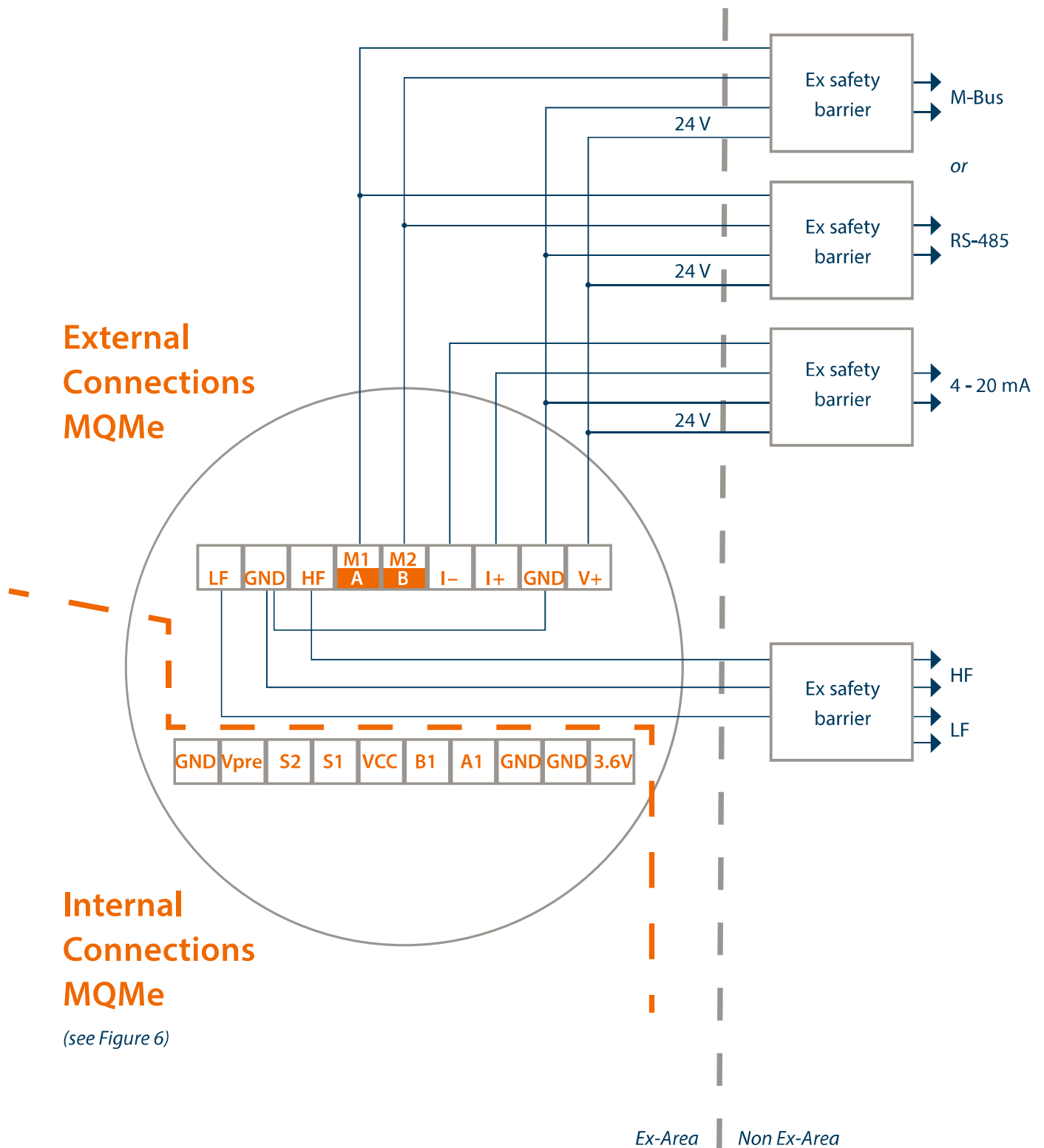


Figure. 7: Electrical connections on the back of the electronic counter head

Pulse Generators

A low frequency (LF) pulse and high frequency (HF) pulse generator are integrated by default in the standard version of Quantometer MQMe. The LF pulse is required for the volume flow determination. The function of the HF pulser is the determination of the actual gas flow in high resolution. As an option, additionally one high frequency (HF) pulse generator can be installed onto the meter. The HF-pulser follows NAMUR specification and is typically connected to the input of flow computers or appropriately equipped volume correctors. For the connection use shielded cable only. The blades of the turbine rotor are scanned by the high-frequency sensor. Each blade passing the HF-sensor creates a pulse.

The connection of the HF pulser (option: scanning the turbine wheel, only with external power supply, the signal cannot be connected on the electronics of the MQMe):

- 1 HF-pulser for the volume flow rate measurement
 - o Yellow (-)
 - o White (+)

Warning: All pulse generators are intrinsically safe. If the meter is installed in hazardous area it must be connected to external devices like electronic volume correctors (EVC's) only via intrinsically safe circuits.

RS485 Modbus and M-BUS Communication

The communication with the MQMe via RS-485 Modbus or M-bus is possible. When ordering, please specify which of the two communication channels to be used, as the configuration of the interface in the factory before delivery of the Quantometer happens. The baud rate is 2400 and supports the MODBUS RTU protocol. In Figure 6 and 7, the wiring is illustrated by means of M-Bus and RS 485 interface.

4-20mA Output Signal

The Quantometer MQMe has a configurable standard two-wire 4 to 20 mA signal. Through the 4 to 20 mA signal the actual flow under operating conditions or standard conditions will be transmitted. At 4 mA, the flow rate is 0, and at 20 mA, a corresponding maximum value can be set. The maximum deviation is: $\pm 0.5\%$ FS. Figure 6 and 7 illustrates the wiring of the analog 4 to 20 mA signal.

Parameter setting

The parameterization is via a PC-based software (metregSync) via the RS-485 interface possible. The metregSync software is available for download on the Metreg Technologies website to disposal. A commercially available PC does not have an RS 485 interface. For the communication of the MQMe with a PC is a so-called interface converter from RS-485 to USB is required. Figure 8 shows the cabling of the MQMe via the interface converter with a standard commercial PC. The interface converter is available as an optional accessory from Metreg Technologies.

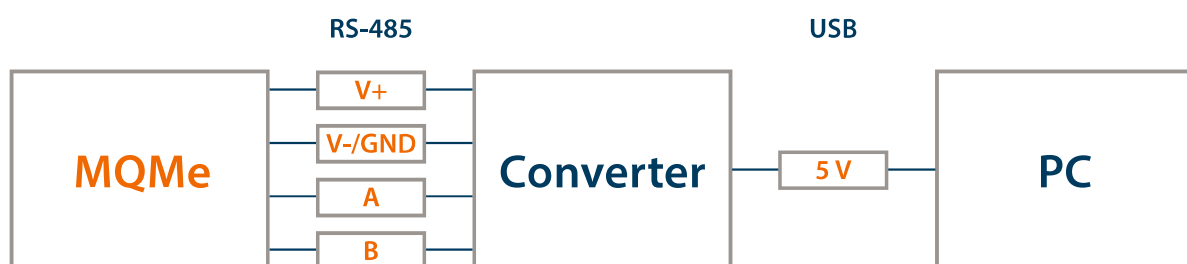


Figure 8: Connection diagram for the RS 485 interface of the MQMe via the Metreg interface converter to a commercial PC

15. Pressure Measuring Point

There is a pressure test point within the MQMe Quantometer as shown in figure 9. The pressure tap is marked with “p_m”. The pressure test point is designed for a connection of steel tubing with a diameter of 6 mm. The steel tubing should be according DIN EN 10305-1. The pipe connection or fitting should be in accordance to DIN 2353. It may only be used seamless drawn stainless steel tubes according to DIN EN 10216-5:2014-03. Pipes not made of stainless steel or made out of non-metallic materials are not allowed.

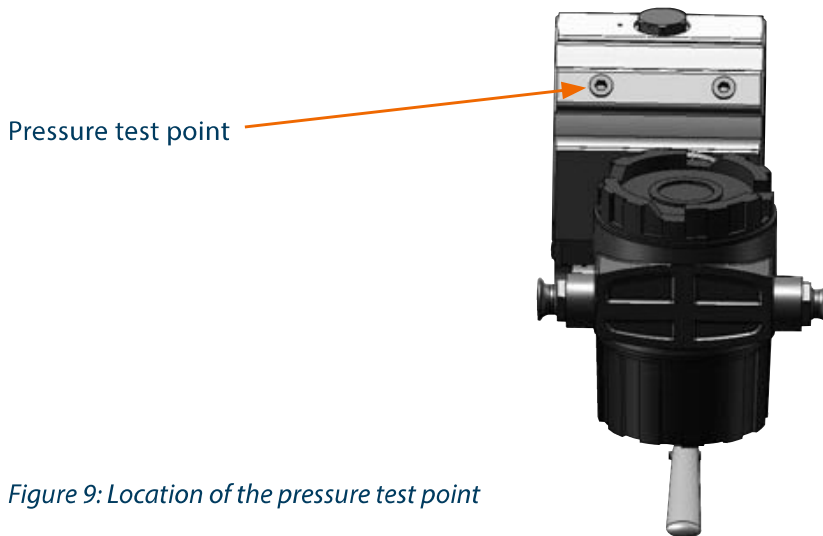


Figure 9: Location of the pressure test point

16. Temperature Measuring Point

There is one temperature test point as shown in figure 10. The temperature tap is marked with “tm”. The temperature tap is locked with a screw (G 1/4”). In case of using the temperature tap remove the plug screw and replace it by a temperature pocket with an integral thread of G 1/4”. The temperature pocket is designed for a temperature sensor with a diameter of 6 mm.

Notice: : If the temperature tap of the Quantometer is not used the temperature measurement point should be located 1-3 DN downstream of the meter.

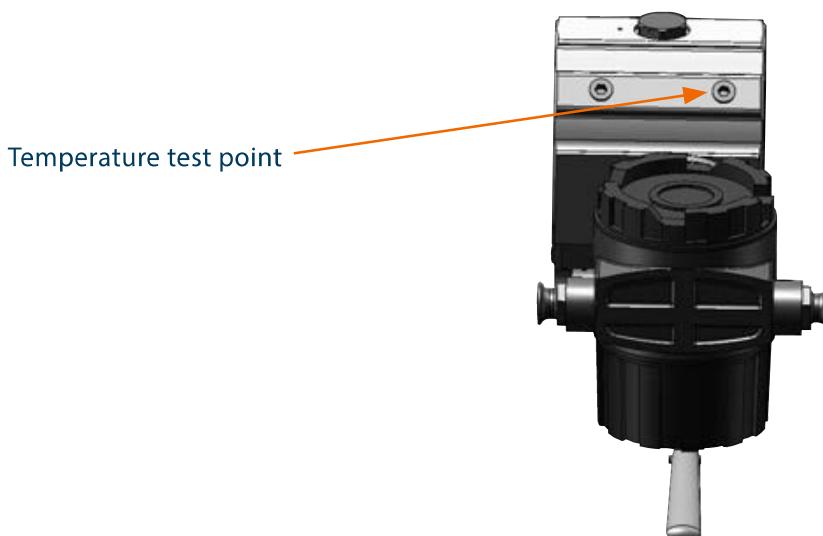


Figure 10: Location of the temperature test point

17. Cleaning

For cleaning the meter from dust and dirt please do not use any solvents. It is suitable to use a damp cloth only for that purpose.

18. Transport and Storage

The Quantometer and accessories shall be stored in the original packaging. Secure the measuring device from rotating or slipping. Be careful during loading and transportation to or from the measuring point.

Some requirements for transportation and storage of the meter are:

- The meter is on both flanges covered with a protection cover
- For transportation the oil pump (if installed) is not filled with oil
- Prevent from rain and moisture
- Prevent from mechanical vibrations or impacts
- Unpack and check:
 - the packing list to account for all items received
 - Inspect each item for damage

19. Annex A

CE Declaration of Conformity



Produkt
Product
Produit

Typ, Ausführung
Type, Model
Marquage de produit

EU-Konformitätserklärung
EU-Declaration of Conformity
Declaration UE de conformité

Elektronisches Quantometer
Electronical Quantometer - Turbine Gas Flow Meters
Quantomètres électronique - Compteurs de gaz

MQMe

Fabrik Nr.:
Fabrikation-no.:
Numéro de série:



Metreg Technologies GmbH

Tränkeweg 9
15517 Fürstenwalde

Richtlinie Directive Directive	PED
Produktkennzeichnung Product marking Marquage de produit	ohne/without/sans - DN25 CE - DN50 CE0035 - DN80-DN150
EU-Richtlinien EC-Directives Directives européenne	2014/68/EU
Normen Standards Normes	OIML 137-1&2 DIN EN 12261
EU-Baumusterprüfung EC Type-Examination Décision d'approbation européenne	HpiVS/P1001-103-Q-04
Überwachungsverfahren Surveillance Procedure Methode à garder	2014/68/EU Annex III Modul H
Überwachungsinstanz des Systems Surveyor of the System Auditeur de la système	Notified Body 0035 TÜV Rheinland

Wir erklären als Hersteller:

Die entsprechend gekennzeichneten Produkte sind nach den aufgeführten Richtlinien und Normen hergestellt. Sie stimmen mit den geprüften Baumustern überein. Die Herstellung unterliegt dem genannten Überwachungsverfahren. Durch den Zusammenbau der Produktkomponenten werden keine zusätzlichen Zündquellen erzeugt.

We declare as manufacturer:

Products labelled accordingly are manufactured according to the listed directives and standards. They correspond to the type approval samples. The production is subject to the stated surveillance procedures. No additional ignition sources are being created by assembly of the product's components.

Déclaration du fabricant:

Les produits désignés en conséquence ont été fabriqués conformément aux exigences des Directives et Normes citées. Ils conformes au type éprouvé. La fabrication ets soumise au Procédé de surveillance indiqué. L'assemblage des composants du produit ne génère aucune source d'allumage supplémentaire.

Unterzeichnet für und im Namen von: Metreg Technologies GmbH

Signed for and on behalf of:

Signé pour et au nom de:

Ulf Lehmann
Qualitätssicherung und Prüfstelle

Fürstenwalde, 01.12.2016

Dr. Achim Zajc
Geschäftsführer Technik, Marketing & Sales

The HF pulse generator direct to the turbine wheel has its own ATEX approval and has the following markings:

HF-Impulser	Proximity switch specs. acc. NAMUR	PTB 01 ATEX 2191 ⬡Ex⬢ II 1G Ex ia IIC T6 Ga Ta: -20...70° C ⬡Ex⬢ II 1G Ex ia IIC T5 Ga Ta: -20...80° C ⬡Ex⬢ II 1D Ex ia IIIC T90° C Da Ta: -20...70° C ⬡Ex⬢ II 1D Ex ia IIIC T100° C Da Ta: -20...80° C
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