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FLUID CONTROL SYSTEMS

Mass Flow Meter (MFM) for Gases

- Direct flow measurement for nominal flow rates from 10 ml_N/min to 80 l_N/min (N_2) in MEMS technology

- High accuracy and repeatability

- Protection class IP65

- Optional field bus

Type 8702 can be combined with…

Type 8619
Multichannel program controller

Type 0330
2/2 or 3/2-way solenoid valve

Type 6013
2/2-way solenoid valve

Type 6606
2/2 or 3/2-way solenoid valve

Mass flow meters are used in process technology for the direct measurement of the mass flow of gases. In case of volumetric flow meters, it is necessary to measure the temperature and the pressure either the density, because gases change their density or rather their volume depending on the pressure.
The measurement of the mass flow, on the other hand, is independent of the pressure and the temperature.
The digital mass flow meter Type 8702 uses a sensor on silicon chip basis (see the description on page 2) located directly in the bypass channel. Due to the fact that the sensor is directly in the bypass channel a very fast response time of the MFM is reached. The actual flow is given as an analog output signal or could be read out over fieldbus communication.

Type 8702 can optionally be calibrated for two different gases, the user is able to switch between these two gases.

The materials of the parts that come into contact with the medium are selected according to customer specification so that the unit can be operated with the complete range of standard process gases. The MassFlowCommunicator software can be used for parameterisation and diagnosis.

Typical application areas are gas flow measurement in

- Test benches
- Packaging and foodstuff industry
- Environmental technology
- Pharmaceutical
- Biotechnology

Technische Daten

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Nominal flow range [1] (Q_{nom})	0.01 to 80 l_N/min[2] (ref. to N_2)	**Power consumption**	max. 2.5 W (analog communicator) to 5 W (digital communicator)
Turn-down ratio	1:50, wider span on request	**Output signal** (signal output) Max. current, volt. output Max. load, current output	0−5 V, 0−10 V, 0−20 mA or 4−20 mA 10 mA 600 Ω
Operating gas	Neutral, non-contaminated gases, others available on request		
Calibration gas	Operating gas or air with correcting function	**Digital communication** via adapter possible:	RS232, Modbus RTU (via RS interface) RS485, RS422 or USB (see accessories table on p. 3)
Max. operating pressure (Inlet pressure)	Up to max. 10 bar (145psi), depending on the orifice of the valve	**Fieldbus option**	PROFIBUS-DP, DeviceNet, CANopen (D-Sub HD15 covered with sealed plate with fieldbus MFC)
Gas temperature	-10 to +70°C (-10 to +60°C with oxygen)		
Ambient temperature	-10 to +50°C	**Type of protection** (with connected cables)	IP65
Accuracy (after 1 min warm up time)	±0.8% o.R. ±0.3% F.S. (o.R.; F.S.: of full scale)	**Dimensions [mm]** (without fitting)	See drawings on p. 7−8
Repeatability	±0.1% F.S.	**Total weight**	1000 g
Settling time ($t_{95\%}$)	<300ms	**Mounting position**	Horizontal or vertical
Materials Body Housing Seals	Stainless steel PC (Polycarbonate) FKM, EPDM (others on request)	**Light emitting diodes** (Default, other functions programmable)	Indication for Power, Communication, Limit, Error
Port connection	G 1/4", NPT 1/4" or compression fitting	**Binary inputs** (Default, other functions programmable)	Three various functions programmable
Electr. connection Additionally with fieldbus:	Socket M16, round, 8-pin and socket D-Sub HD15, 15-pin With PROFIBUS-DP: Socket M12 5-pin (for IP65) or D-Sub 9-pin With DeviceNet/CANopen: Plug M12 5-pin (for IP65) or D-Sub 9-pin	**Binary outputs** (Default, other functions programmable)	Two relay outputs 1. Limit (Q_{nom} almost reached) 2. Error (i.e. sensor fault) Load capacity: max. 60 V, 1 A, 60 VA
Operating voltage	24V DC		
Voltage tolerance	±10%		
Residual ripple	<2%		

[1] The nominal flow value is the max. flow value calibrated which can be controlled. The nominal flow range defines the range of nominal flow rates (full scale values) possible.
[2] Index N: Flow rates referred to 1.013 bar and 0° C.
Alternatively there is an Index S available which refers to 1.013 bar and 20° C.

Measuring Principle
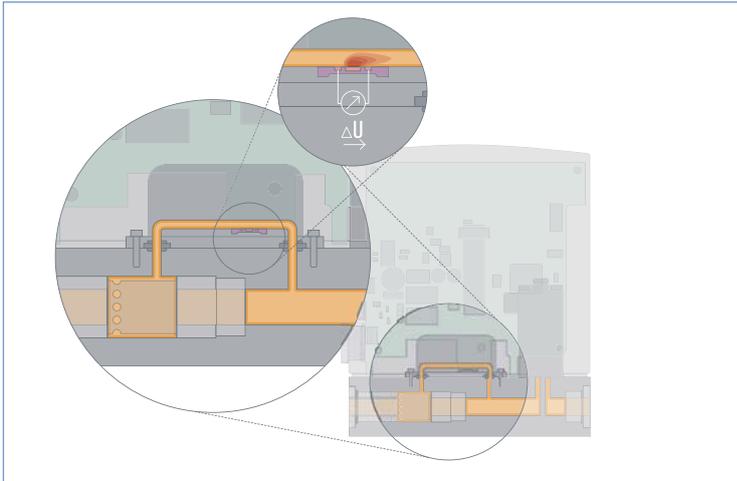
The actual flow rate is detected directly by a sensor placed in a bypass channel. This operates according to a thermal principle which has the advantage of providing the mass flow which is independent of pressure and temperature.

A small part of the total gas stream is diverted into a small, specifically designed bypassing channel which ensures laminar flow conditions.
The sensor element is a chip immersed into the wall of this flow channel. The chip, produced in MEMS technology, contains a heating resistor and two temperature sensors (thermopiles) which are arranged symmetrically upstream and downstream of the heater. The differential voltage of the thermopiles is a measure of the mass flow rate passing the flow sensor. The calibration procedure effectuates a unique assignment of the sensor signal to the total flow rate through the device.

Pressure Loss Diagram (ref. to air, with 250µm inlet filter)
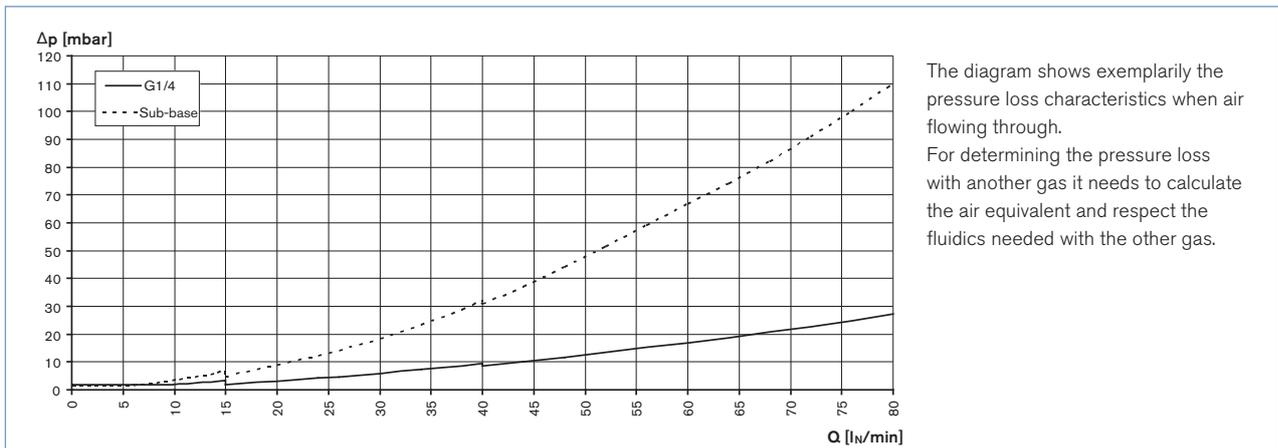
The diagram shows exemplarily the pressure loss characteristics when air flowing through.
For determining the pressure loss with another gas it needs to calculate the air equivalent and respect the fluidics needed with the other gas.

Nominal Flow Range of Typical Gases
(other gases on request)

Gas	Min. Q_{nom} [I_N/min]	Max. Q_{nom} [I_N/min]
Argon	0.01	80
Helium	0.01	500
Carbon dioxide	0.02	40
Air	0.01	80
Methane	0.01	80
Oxygen	0.01	80
Nitrogen	0.01	80
Hydrogen	0.01	500

Notes regarding the selection of the unit

The decisive factors for the perfect functioning of an MFM within the application are the fluid compatibility, the normal inlet pressure and the correct choice of the fl ow meter range. The pressure drop over the MFM depends on the fl ow rate and the operating pressure.

▶ **Please use the form on page 8 for the information about your specific requirements..**

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Ordering Chart for Accessories

Article	Item No.
Connectors/Cables	
Round plug M16 8-pin (solder connection)	918 299
Round plug M16 8-pin with 5 m cable	787 733
Round plug M16 8-pin with 1 0 m cable	787 734
Plug D-Sub HD15 15-pin with 5m cable	787 735
Plug D-Sub HD15 15-pin with 10m cable	787 736
Adapters [3]	
RS232 adapter for connection to a computer, connection with an extension cable (item no. 917 039)	654 757
Extension cable for RS232 9-pin socket/plug 2 m	917 039
RS422-Adapter (RS485 compatible)	666 370
USB-Adapter (Version 1.1, USB socket type B)	670 696
USB connection cable 2 m	772 299
Adapter for manual setting of bus address	667 525
Software MassFlowCommunicator	Download unter www.buerkert.com

Accessories for Fieldbus	PROFIBUS DP (B-codiert)	DeviceNet/ CAN-open (A-codiert)
M12-Plug [4]	918 198	917 115
M12-socket (coupling) [4]	918 447	917 116
Y-junction [4]	902 098	788 643
T-junction	918 531	(auf Anfrage)
Shut-off resistor	902 553	(auf Anfrage)
GSD-Datei (PROFIBUS), EDS-Datei (DeviceNet, CANopen)	Download unter www.buerkert.com (unter Typ 8712)	

[3] The adapters serve mainly for initial operation or diagnosis. Those are not obligatory for continuous operation.

[4] The two M12 connectors as listed above cannot be used together on the same side of the Y-junction. At least one of the two M12 connection needs to be a prefabricated cable which uses typiclly a thinner connector.
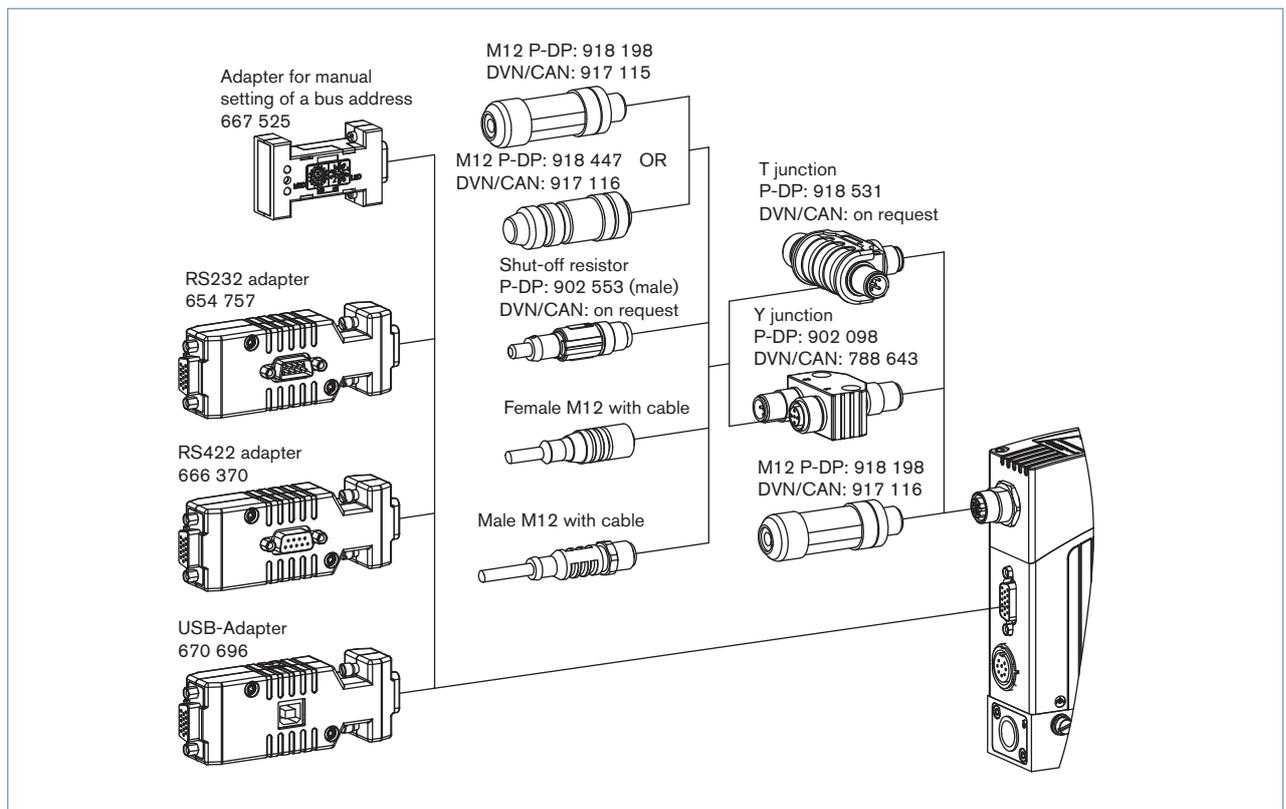
Adapter for manual setting of a bus address
667 525

M12 P-DP: 918 198
DVN/CAN: 917 115

M12 P-DP: 918 447   OR
DVN/CAN: 917 116

T junction
P-DP: 918 531
DVN/CAN: on request

RS232 adapter
654 757

Shut-off resistor
P-DP: 902 553 (male)
DVN/CAN: on request

Y junction
P-DP: 902 098
DVN/CAN: 788 643

Female M12 with cable

RS422 adapter
666 370

M12 P-DP: 918 198
DVN/CAN: 917 116

Male M12 with cable

USB-Adapter
670 696
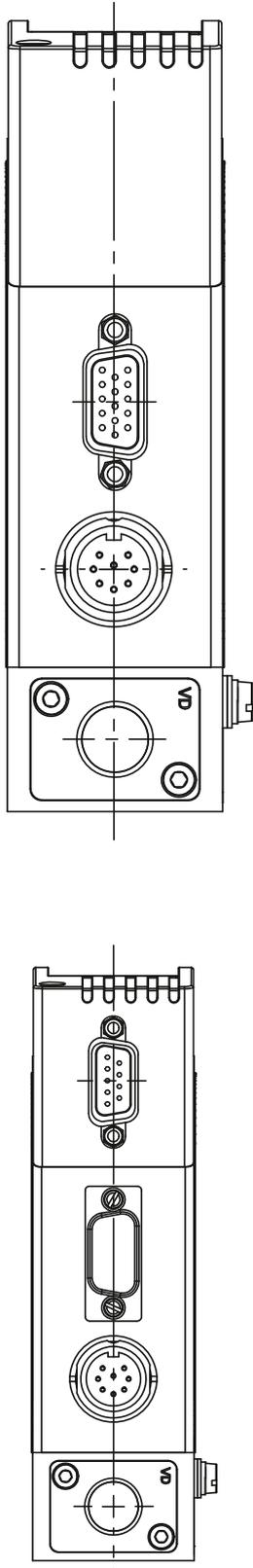
Pin Assignment
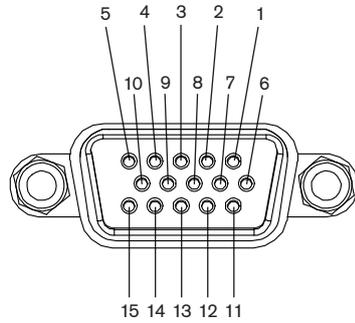
Socket D-Sub HD15	Pin	Assignment	
		Analogue Control	Bus control
	1	N.C.	N.C. [5]
	2	N.C.	N.C.
	3	Actual value output +	N.C.
	4	Binary input 2	
	5	12V-Output (only for internal company use)	
	6	RS232 TxD (direct connection to computer)	
	7	Binary input 1	
	8	GND (for binary inputs)	
	9	only company internal use (do not connect!)	
	10	12V-Output (only for internal company use)	
	11	12V-Output (only for internal company use)	
	12	Binary input 3	
	13	Actual value output GND	N.C.
	14	RS232 RxD direct connection to computer)	
	15	DGND (for RS232-interface)	

[5] N.C.: not connected (not used)
Note:
– Optional Pin 1 and 2 with bus version as transmitter input possible
– The cable length for RS232/ flow value signal is limited to 30 meters.
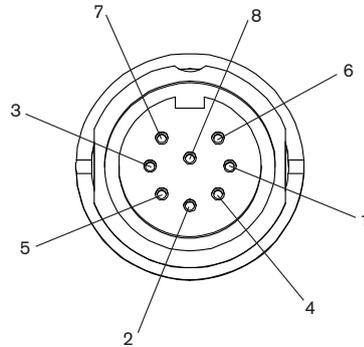
Socket M16, round, 8-pin	Pin	Assignment
	1	24V-Supply +
	2	Relay 1 – reference contact
	3	Relay 2 – reference contact
	4	Relay 1 – normally closed contact
	5	Relay 1 – normally open contact
	6	24V-Supply GND
	7	Relay 2 – normally open contact
	8	Relay 2 – normally closed contact

Socket D-Sub 9-pin (only with fieldbus version)	Pin	Assignment	
		PROFIBUS DP	DeviceNet/ CANopen
	1	Shield	Shield
	2	N.C.	CAN-L data line
	3	RxD/TxD - P (B-line)	GND
	4	RTS (control signal for repeater)	N.C.
	5	GND	N.C.
	6	VDD (only for termination resistor)	N.C.
	7	N.C.	CAN-H data line
	8	RxD/TxD - N (A-line)	N.C.
	9	N.C.	N.C.
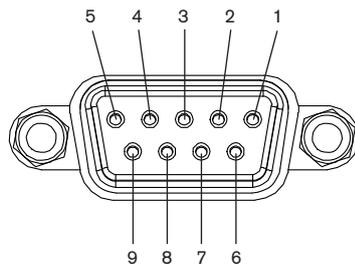
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Pin Assignment *(continued)*
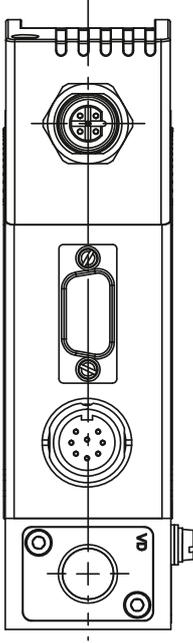
PROFIBUS DP – socket B-coded M12 (DPV1 max. 12 Mbaud)	Pin	Assignment
	1	VDD (only for termination resistor)
	2	RxD/TxD – N (A-line)
	3	DGND
	4	RxD/TxD – P (B-line)
	5	N.C.

DeviceNet/ CANopen – Plug A-coded M12	Pin	Assignment
	1	Shield
	2	N.C. [6]
	3	DGND
	4	CAN_H
	5	CAN_L

[6] Optional configuration with 24V DC possible for power supply via fieldbus connector. With this no power supply connection on round M16 plug needed.

Dimensions [mm]
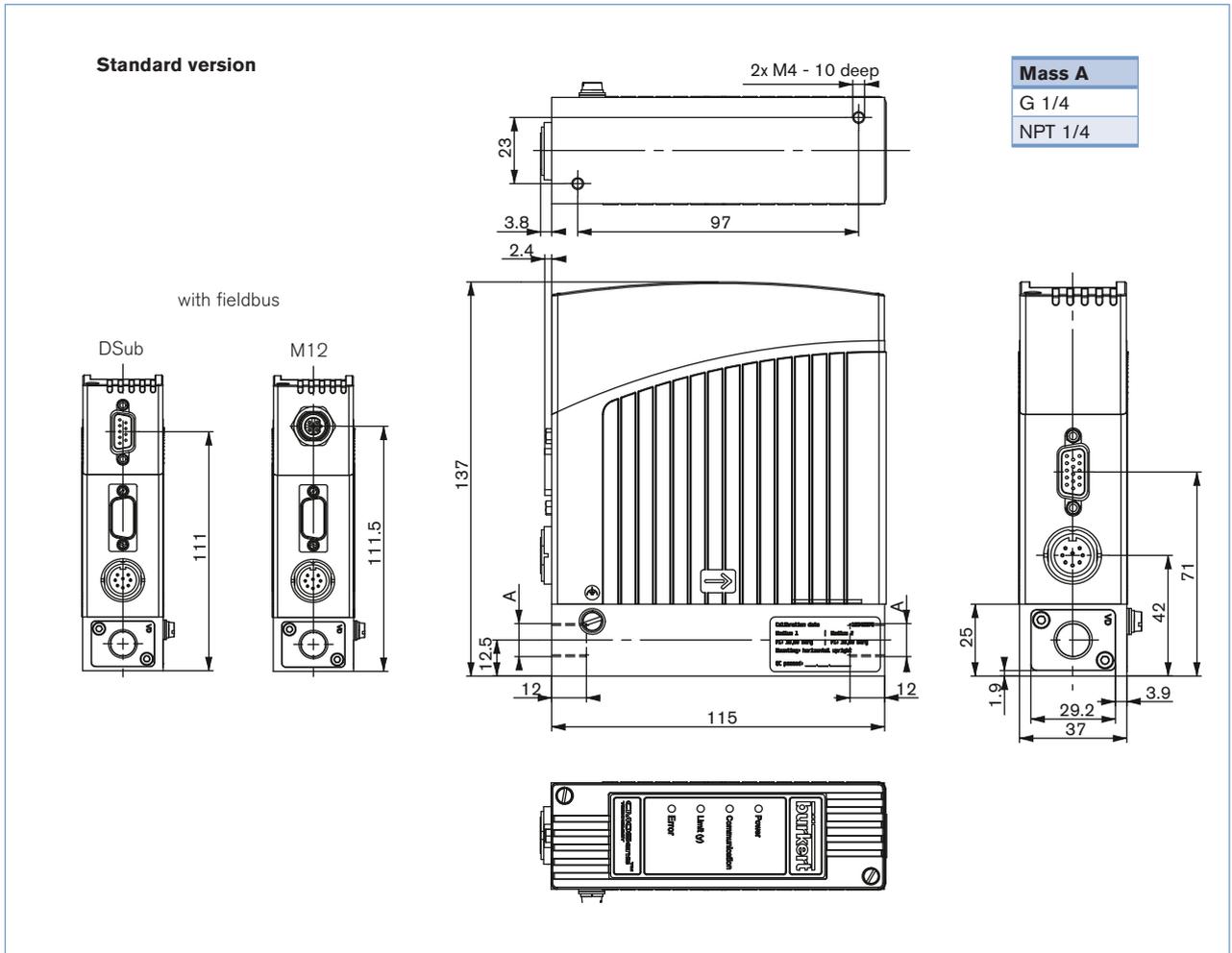
Standard version

2x M4 - 10 deep

Mass A
G 1/4
NPT 1/4

23

3.8

97

2.4

with fieldbus

DSub   M12

111

111.5

137

A   A

12.5

12   12

115

71

42

25

1.9

29.2   3.9

37

Dimensions [mm] *(continued)*

Flange version

with fieldbus

DSub   M12

4x ∅ 4.5

2x ∅ 8.8
2x ∅ 6

44.5

44.5

52

0 4 10 32   66.5 83 92 111 115

2.4

111

113.8

137.15

71

42

25

3.8

0

.10

M4

44.5

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MFC/MFM-applications - Request for quotation

▶ **Please complete and send to your nearest Bürkert sales centre**

Company		Contact person	
Customer No		Department	
Address		Tel./Fax	
Postcode/Town		E-mail	

☐ MFC-Application   ☐ MFM-Application   [ ] **Quantity**   [ ] **Required delivery date**

Medium data

Type of gas (or gas proportion in mixtures)	[ ]		
Density	[ ]	kg/m^3 [7]	
Gas temperature [°C or °F]	[ ]	°C [ ]	°F
Moisture content	[ ]	g/m^3	
Abrasive components/solid particles	☐ no	☐ yes, as follows: [ ]	

Fluidic data

Flow range Q_{nom}   [ ] Min.   [ ] Max.

☐ l_N/min [7]   ☐ l_S/min (slpm) [8]
☐ m_N^3/h [7]   ☐ kg/h
☐ cm_N^3/min [7]   ☐ cm_S^3/min (sccm) [8]
☐ l_N/h [7]   ☐ l_S/h [8]

Inlet pressure at Q_{nom} [9] p_1 = [ ] bar(g) ■
Outlet pressure at Q_{nom} p_2 = [ ] bar(g) ■
Max. inlet pressure P_{1max}   [ ] bar(g) ■

MFC/MFM port connection   ☐ without screw-in fitting
   ☐ 1/4" G-thread (DIN ISO 228/1)
   ☐ 1/4" NPT-thread (ANSI B1.2)
   ☐ with screw-in fitting (acc. to specification for pipeline)
      [ ] mm Pipeline (external Ø)
      [ ] inch Pipeline (external Ø)
   ☐ Flange version

Installation   ☐ horizontal
   ☐ vertical, flow upwards   ☐ vertical, flow downwards

Ambient temperature   [ ] °C

Material data

Body	☐ Aluminium	☐ Stainless steel
Housing	☐ Plastic	☐ Metal (not with type 8712/8702 and not with fieldbus)
Seal	☐ FKM	☐ EPDM

Electrical data

Signals for set point   with standard signal   with fieldbus
and actual value

Setpoint	actual value		
☐ 0-5 V	☐ 0-5 V	☐ PROFIBUS DP	☐ M12
☐ 0-10 V	☐ 0-10 V	☐ DeviceNet	☐ D-Sub
☐ 0-20 mA	☐ 0-20 mA	☐ CANopen	(only for type 8712/8702)
☐ 4-20 mA	☐ 4-20 mA		

■ Please quote all pressure values as overpressures with respect to atmospheric pressure bar(ü)
7) at: 1,013 bar(a) and 0°C   8) at: 1.013 bar (a) and 20°C   9) matches with calibration pressure

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