



# Mass Flow Meter and Controller for Gases



measuring  
•  
monitoring  
•  
analysing



- Measuring range:  
0-10 mL<sub>N</sub>/min...0-500 L<sub>N</sub>/min
- Accuracy:  
±1.5% f.s.
- p<sub>max</sub> 35 bar; t<sub>max</sub> 50 °C
- Analogue output:  
0-5 V or 4-20 mA
- Digital display
- Bypass measuring system  
laminar flow



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**Model:**  
MAS  
MFC



**Fields of application**

The KOBOLD MAS model mass flow meter makes very precise measurements of the mass flow rate of gases in different measuring ranges from 0-10 mL<sub>N</sub>/min to 0 - 500 L<sub>N</sub>/min nitrogen. The operation of the meter is based on the calorimetric principle. For indication of 98% of the actual flow, the response time is 2 s. The meter may be installed in any position.

In contrast with most volumetric flowmeters, no temperature or pressure correction is required.

This means that the MAS model is ideally suited for almost every gas flow application. Typical industrial applications are process control, laboratory measuring tasks, OEM applications, gas indication panels, leakage and filter monitoring.

The MAS is available either with analogue output only, or in addition with digital indication. The 3½-digit LCD display is infinitely rotatable through 180°. Glass-fibre-reinforced nylon or stainless steel may be used in the manufacture of wetted parts. Seal materials is FPM (Kalrez or Neoprene upon request).

The MAS model may be operated with 12-15 V<sub>DC</sub> (24 V<sub>DC</sub> optional). MAS-5100, MAS-5105, MAS-5000 or MAS-8100 are recommended as power supplies.

Typically, a 0-5 V<sub>DC</sub> (or 4-20 mA optional) analogue signal is available as output signal. This allows recording, data storage, and control functions to be implemented.

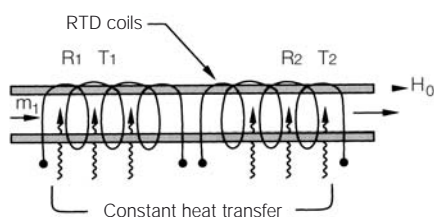
**Theory of operation**

The medium flows through the bypass measuring system. The resulting differential pressure between P1 and P2 causes a small amount of gas to flow through the overhead measuring tube. The separation ratio is constant.

Two resistance temperature detectors (RTD elements) transferring a constant amount of heat to the gas stream are mounted on the measuring tube.

Under flow conditions, the gas molecules absorb and transport the heat away. This gives rise to a temperature difference between the two detector coils, which causes a change in resistance in the detector coils, whereby R1 <> R2. The electronics converts the signal for indication. The temperature difference increases as the flow increases.

**Measuring tube design**



**Design**

**Direct indication of mass flow rate**

No temperature or pressure correction needed

**Digital display** shows the mass flow rate in mL<sub>N</sub>/min or L<sub>N</sub>/min. (other units upon request)

**Zero-point and span potentiometers** adjustable from outside

**Measuring tube**

**Laminar flow bypass** comes in 20 ranges from 0-10 mL<sub>N</sub>/min to 0-500 L/min

**Tilting indicator**

May be tilted through 180°, 9 adjustments

**Output connector**

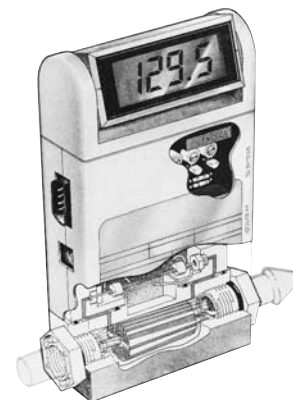
9 Pin D♣ Sub-type, Output signal 0-5 V<sub>DC</sub> or 4-20 mA optional Analogue output

**Mains plug**

Input voltage 12 V<sub>DC</sub> or 24 V<sub>DC</sub>

**Pipe unions**

possible with ¼ FNPT or ¼" Swagelok connections



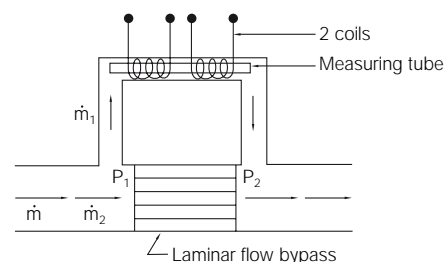
**Flow meter body**

Wetted parts either nylon or steel

**Special advantages**

- Direct mass flow measurement
- No pressure or temperature correction needed
- Large measuring range
- Negligible pressure loss
- May be fitted in any position
- High degree of repeatability
- Analogue output 0-5 V<sub>DC</sub>, Option 4-20 mA

**Flow diagram**



**Technical details**

Field of application: suited only for **dry**, oil-free gases

Measuring accuracy:  $\pm 1.5\%$  f.s. (with calibrated performance characteristics, otherwise observe pressure and temperature coefficients)

Option:  $\pm 1\%$  f.s. (only to 0-100 mL<sub>N</sub>/min measuring range with stainless steel case)

Standard calibration: 1013.25 mbar abs., 0 °C  
option: to customer specification

Temperature coefficient: 0.15 % f.s. / °C

Pressure coefficient: 0.3 % f.s. / bar

Repeatability:  $\pm 0.5\%$  f.s.

Response time (within 20-100% of measuring range): 2 s until 98 % of actual flow rate is indicated

Max. medium, and ambient temperature: 50 °C

Max. operating pressure: Nylon: 10 bar  
Stainless steel: 35 bar

Installation position: any

Gas density: 1 x 10<sup>-4</sup> mL / s He (Nylon)  
1 x 10<sup>-7</sup> mL / s He (st. steel case)

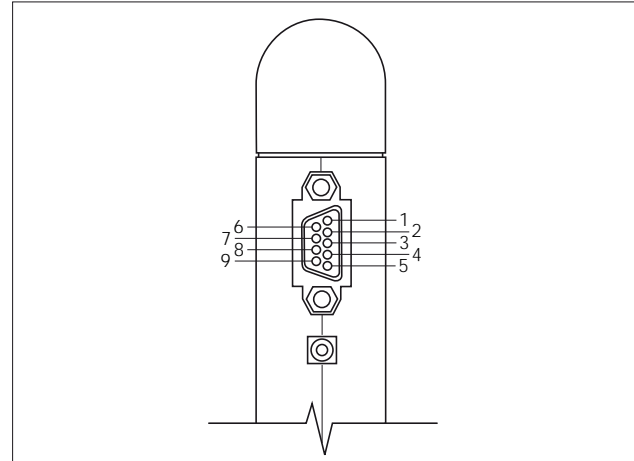
Wetted parts: 5 % either glass-fibre-reinforced nylon or stainless steel material no. 1.4401

Seals: FPM (others upon request)

Supply voltage: 12-15 V<sub>DC</sub>, 24 V<sub>DC</sub> optional

Output: Linear 0 - 5 V<sub>DC</sub> (load min. 2000 Ω)  
Option: 4 - 20 mA (load max. 500 Ω)

**Connection diagram**



**PIN No. function**

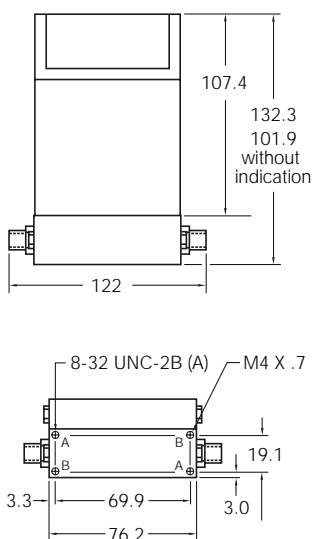
- 1 No connection
- 2 Flow rate signal ground
- 3 0 to 5 V<sub>DC</sub> flow rate signal
- 4 + mains supply (12 or 24 V<sub>DC</sub>) \*1 \*2
- 5 External display signal
- 6 External display ground
- 7 Mains supply ground
- 8 Analogue output 4 to 20 mA ground
- 9 Analogue output 4 to 20 mA signal

\*1 Devices powered with 24 V<sub>DC</sub> only, when the 24 V-feature is built in, otherwise damage may be caused by overvoltage!

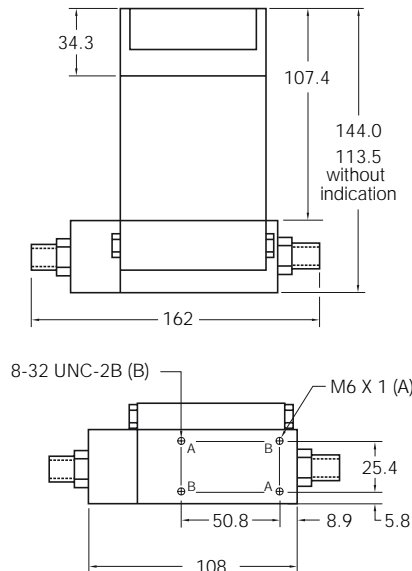
\*2 Do not connect if the device is already supplied from the mains socket.

**Dimensions**

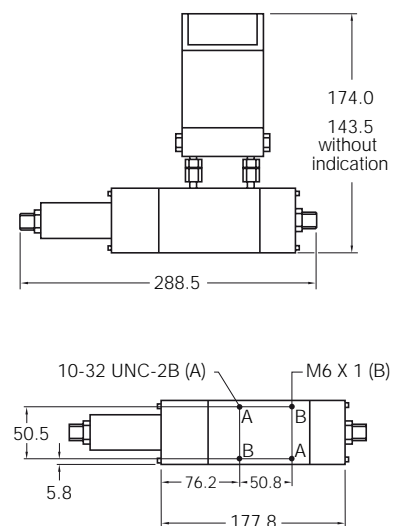
**Case L (Stainless steel and nylon)**



**Case M (Stainless steel)**



**Case H (Stainless steel)**





**Order details nylon version** (example: MAS-1002 00 V2 0)

Measuring range for N <sub>2</sub>	Max. pressure loss	Model			Connection	Voltage supply	Output
		with display	with counter	without display			
0-20 mL <sub>N</sub> /min	1 mbar	MAS-1002	MAS-1102	MAS-2002	00 = 1/4 NPT fem. C2 = Swagelok 1/4"	00 = 12 V <sub>DC</sub> V2 = 24 V <sub>DC</sub>	0 = 0-5 V <sub>DC</sub> A = 4-20 mA
0-50 mL <sub>N</sub> /min	1 mbar	MAS-1003	MAS-1103	MAS-2003			
0-100 mL <sub>N</sub> /min	1 mbar	MAS-1004	MAS-1104	MAS-2004			
0-200 mL <sub>N</sub> /min	1 mbar	MAS-1005	MAS-1105	MAS-2005			
0-500 mL <sub>N</sub> /min	1 mbar	MAS-1006	MAS-1106	MAS-2006			
0-1 L <sub>N</sub> /min	1 mbar	MAS-1007	MAS-1107	MAS-2007			
0-2 L <sub>N</sub> /min	6 mbar	MAS-1008	MAS-1108	MAS-2008			
0-5 L <sub>N</sub> /min	6 mbar	MAS-1009	MAS-1109	MAS-2009			
0-10 L <sub>N</sub> /min	6 mbar	MAS-1010	MAS-1110	MAS-2010			
0-20 L <sub>N</sub> /min	25 mbar	MAS-1011	MAS-1111	MAS-2011			
0-30 L <sub>N</sub> /min	47 mbar	MAS-1012	MAS-1112	MAS-2012			
0-40 L <sub>N</sub> /min	88 mbar	MAS-1013	MAS-1113	MAS-2013			
on customer specification		MAS-10XX	MAS-11XX	MAS-20XX			

**Order details stainless steel version** (example: MAS-3001 C1 V2 0)

Measuring range for N <sub>2</sub>	Max. pressure loss	Case size	Model			Connection	Voltage supply	Output
			with display	with counter	without display			
0-10 mL <sub>N</sub> /min	6 mbar	L	MAS-3001	MAS-3101	MAS-4001	C1=Swagelok 1/8" C2=Swagelok 1/4" C3=Swagelok 3/8"	00 = 12 V <sub>DC</sub> V2 = 24 V <sub>DC</sub>	0 = 0-5 V <sub>DC</sub> A = 4-20 mA
0-20 mL <sub>N</sub> /min	6 mbar	L	MAS-3002	MAS-3102	MAS-4002			
0-50 mL <sub>N</sub> /min	6 mbar	L	MAS-3003	MAS-3103	MAS-4003			
0-100 mL <sub>N</sub> /min	6 mbar	L	MAS-3004	MAS-3104	MAS-4004			
0-200 mL <sub>N</sub> /min	6 mbar	L	MAS-3005	MAS-3105	MAS-4005			
0-500 mL <sub>N</sub> /min	6 mbar	L	MAS-3006	MAS-3106	MAS-4006			
0-1 L <sub>N</sub> /min	6 mbar	L	MAS-3007	MAS-3107	MAS-4007			
0-2 L <sub>N</sub> /min	6 mbar	L	MAS-3008	MAS-3108	MAS-4008			
0-5 L <sub>N</sub> /min	6 mbar	L	MAS-3009	MAS-3109	MAS-4009			
0-10 L <sub>N</sub> /min	105 mbar	L	MAS-3010	MAS-3110	MAS-4010			
0-15 L <sub>N</sub> /min	105 mbar	L	MAS-3011	MAS-3111	MAS-4011			
0-20 L <sub>N</sub> /min	40 mbar	M	MAS-3012	MAS-3112	MAS-4012			
0-30 L <sub>N</sub> /min	60 mbar	M	MAS-3013	MAS-3113	MAS-4013			
0-50 L <sub>N</sub> /min	80 mbar	M	MAS-3014	MAS-3114	MAS-4014			
0-100 L <sub>N</sub> /min	105 mbar	M	MAS-3015	MAS-3115	MAS-4015			
0-100 L <sub>N</sub> /min	6 mbar	H	MAS-3016	MAS-3116	MAS-4016	C3=Swagelok 3/8" C4=Swagelok 1/2"		
0-200 L <sub>N</sub> /min	6 mbar	H	MAS-3017	MAS-3117	MAS-4017			
0-300 L <sub>N</sub> /min	140 mbar	H	MAS-3018	MAS-3118	MAS-4018			
0-400 L <sub>N</sub> /min	140 mbar	H	MAS-3019	MAS-3119	MAS-4019			
0-500 L <sub>N</sub> /min	140 mbar	H	MAS-3020	MAS-3120	MAS-4020	C4=Swagelok 1/2"		
on customer specification		L	MAS-30LX	MAS-31LX	MAS-40LX	C1 / C2 / C3		
on customer specification		M	MAS-30MX	MAS-31MX	MAS-40MX	C2 / C3 / C4		
on customer specification		H	MAS-30HX	MAS-31HX	MAS-40HX	C3 / C4		

**Accessories: connector power supply**

Model	Input	Output
MAS-5100	230 V <sub>AC</sub>	12 V <sub>DC</sub> / 1.9 W
MAS-5105	230 V <sub>AC</sub>	24 V <sub>DC</sub> / 1.9 W
MAS-5000	110 V <sub>AC</sub>	12 V <sub>DC</sub> / 1.9 W

When placing an order, please specify detailed service conditions (type of gas, flow rate, pressure, temperature etc.).



**Fields of application**

In addition to accurately measuring the gas flow rate, it is also necessary to maintain a constant flow rate with varying inlet or outlet pressures in many processes.

Previously this has been achieved by having separate flow meter, electronic controller and valve, we can now combine these functions.

The new model MFC mass flow controller is a compact device composed of mass flow meter, controller and valve. The user is thus provided with a controlling system that maintains a constant flow rate over a wide range, independent of variations in pressure and temperature.

**Theory of operation**

The medium flows through the MAS mass flow meter, which measures the actual flow rate.

The control electronics compares the measured value with the setpoint value. When deviations occur, the control electronics outputs an altered actuating signal to the built-in proportional valve which changes the passage opening, thereby maintaining a constant flow rate.

The desired flow rate (setpoint value) may be adjusted with a built-in potentiometer or via an external 0-5 V<sub>DC</sub> (4-20 mA optional) signal.

**Technical details**

- Field of application: suited only for **dry**, oil-free gases
- Measuring accuracy: ± 1.5 % f. s. (with 10-100 % of flow rate range)
- Repeatability: ± 0.25 % f. s.
- Temperature coefficient: 0.8 % f. s. / °C
- Pressure coefficient: 0.07 % f. s. / bar
- Response time (within 20-100 % of measuring range): 1 s until 63 % of actual flow rate is indicated
- Max. medium and ambient temperature: 50 °C
- Max. medium pressure: Nylon: 10 bar
- Gas density: ambient: 1 x 10<sup>-4</sup> mL / s  
Valve: not suitable as shut-off valve
- Material: case: 10 % glass-fibre-reinforced nylon  
Swagelok: stainless steel  
seal: FPM
- Control range: 2-100 % of measuring range (valve closes below 2 % )
- Supply voltage: 24 V<sub>DC</sub>
- Output: 0-5 V<sub>DC</sub> (load min. 2000 Ω)  
4-20 mA (load max. 1000 Ω)
- Control signal: 0-5 V<sub>DC</sub> or 4-20 mA, adjustable

**Order details nylon version (example: MFC-5101 00 00)**

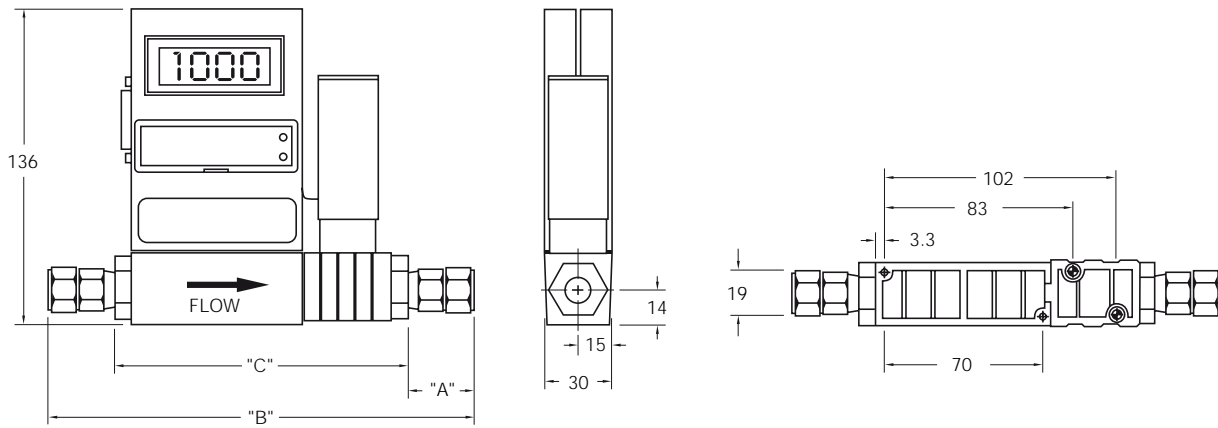
Measuring range for N <sub>2</sub>	Min. required diff. pressure	Model		Connection	Output
		with display	without display		
0-10 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5101</b>	<b>MFC-5201</b>	<b>00</b> = ¼ NPT fem. <b>C1</b> = Swagelok ⅛" <b>C2</b> = Swagelok ¼" <b>K1</b> = 6 mm compression fitting	<b>00</b> = 0-5 V <sub>DC</sub> <b>V4</b> = 4-20 mA
0-20 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5102</b>	<b>MFC-5202</b>		
0-50 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5103</b>	<b>MFC-5203</b>		
0-100 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5104</b>	<b>MFC-5204</b>		
0-200 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5105</b>	<b>MFC-5205</b>		
0-500 mL <sub>N</sub> /min	0.35 bar	<b>MFC-5106</b>	<b>MFC-5206</b>		
0-1 L <sub>N</sub> /min	0.55 bar	<b>MFC-5107</b>	<b>MFC-5207</b>		
0-2 L <sub>N</sub> /min	0.55 bar	<b>MFC-5108</b>	<b>MFC-5208</b>		
0-5 L <sub>N</sub> /min	0.55 bar	<b>MFC-5109</b>	<b>MFC-5209</b>		
0-10 L <sub>N</sub> /min	1.00 bar	<b>MFC-5110</b>	<b>MFC-5210</b>		
0-20 L <sub>N</sub> /min	1.38 bar	<b>MFC-5111</b>	<b>MFC-5211</b>		
0-30 L <sub>N</sub> /min	1.38 bar	<b>MFC-5112</b>	<b>MFC-5212</b>		
0-40 L <sub>N</sub> /min	1.38 bar	<b>MFC-5113</b>	<b>MFC-5213</b>		
0-50 L <sub>N</sub> /min	1.38 bar	<b>MFC-5114</b>	<b>MFC-5214</b>		
on customer specification		<b>MFC-51xx</b>	<b>MFC-52xx</b>		

**Accessories: connector power supply**

Model	Input	Output
<b>MAS-8100</b>	230 V <sub>AC</sub>	24 V <sub>DC</sub> / 6 W

When placing an order, please specify detailed service conditions (type of gas, flow rate, pressure, temperature etc.).

Dimensions (mm)



Connection	"A"	"B"	"C"
1/8" Swagelok	29	186	128
1/4" Swagelok	28	184	128
1/4 NPT	-	-	128