

Mass Flow Meter and Controller for Gases



measuring
•
monitoring
•
analysing

MAS/MFC



- Measuring range:
0-10 Nml/min ... 0-500 Nl/min
- Accuracy: $\pm 1.5\%$ f.s.
- $p_{\max}$ 35 bar; $t_{\max}$ 50 °C
- Analogue output:
0-5 V or 4-20 mA
- Digital display
- Material: Nylon®, stainless steel
- Bypass measuring system
laminar flow



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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 NmL/min to 0 - 500 NL/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_{DC} (24 V_{DC} optional). MAS-5100, MAS-5105, MAS-5000 or MAS-8100 are recommended as power supplies.

Typically, a 0-5 V_{DC} (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 $R_1 \neq R_2$. The electronics converts the signal for indication. The temperature difference increases as the flow increases.

Design

Direct indication of mass flow rate
no temperature or pressure correction needed

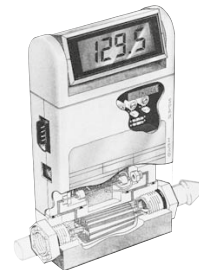
Digital display
shows the mass flow rate in NmL/min or NL/min. (other units upon request)

Tilting indicator
may be tilted through 180°, 9 adjustments

Output connector
9 Pin »D« Sub-type,
Output signal 0-5 V_{DC}
or 4-20 mA optional
analogue output

Mains plug
Input voltage
12 V_{DC} or 24 V_{DC}

Pipe unions
possible with ¼ FNPT
or ¼" Swagelok
connections



Zero-point and span potentiometers
adjustable from outside

Measuring tube

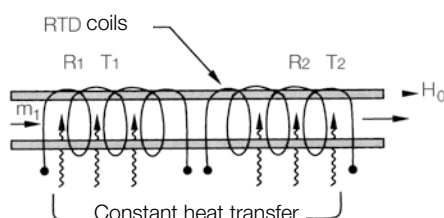
Laminar flow bypass
comes in 20 ranges from
0-10 NmL/min to 0-500
l/min

Flow meter body
Wetted parts either
Nylon® or steel

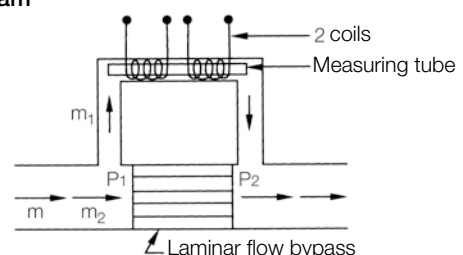
Special advantages

- 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_{DC},
option 4-20 mA

Measuring tube design



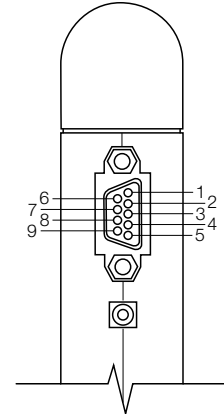
Flow diagram



Technical Data

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 Nml/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:	800 ms time constant; 6 s (typical) to within $\pm 2\%$ of final value over 25-100% of full scale
Max. medium, and ambient temperature:	50 °C
Max. operating pressure:	Nylon®: 10 bar Stainless steel: 35 bar
Installation position:	Any
Gas leak rate:	1×10^{-4} ml/s He (Nylon®) 1×10^{-7} 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 _{DC} , 24 V _{DC} optional
Output:	Linear 0-5 V _{DC} (load min. 2000 Ω) Option: 4-20 mA (load max. 500 Ω)

Connection diagram



PIN No. function

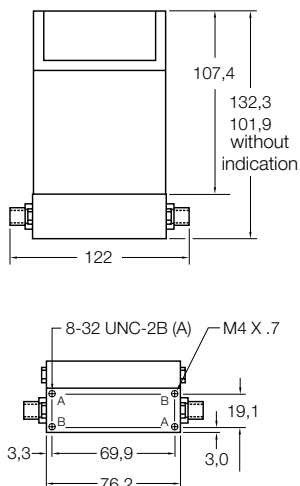
- 1 No connection
- 2 Flow rate signal ground
- 3 0-5 V_{DC} flow rate signal
- 4 + mains supply (12 or 24 V_{DC}) ^{1) 2)}
- 5 External display signal
- 6 External display ground
- 7 Mains supply ground
- 8 Analogue output 4-20 mA ground
- 9 Analogue output 4-20 mA signal

¹⁾ Devices powered with 24 V_{DC} only, when the 24 V-feature is built in, otherwise damage may be caused by overvoltage!

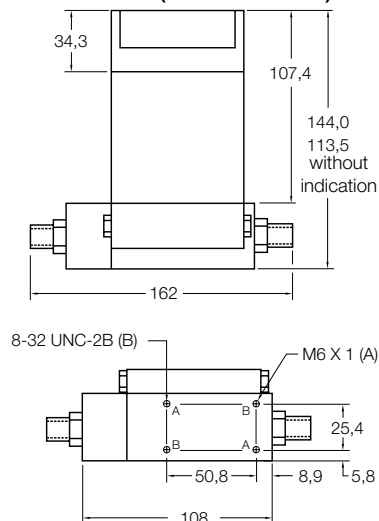
²⁾ Do not connect if the device is already supplied from the mains socket.

Dimensions [mm]

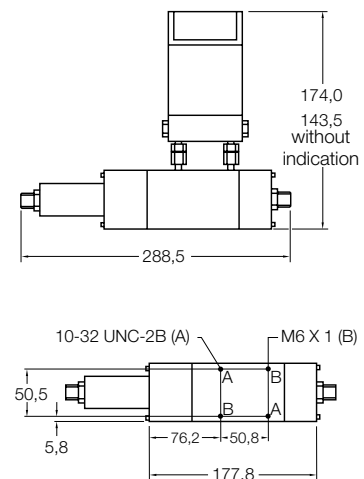
Case L (Stainless steel and Nylon®)



Case M (Stainless steel)



Case H (Stainless steel)





Mass Flow Meter Model: MAS

Order details Nylon® version (example: MAS-1002 00 V2 0)

Measuring range for N ₂	Max. pressure loss	Model			Connection	Voltage supply	Output
		with display	with counter	without display			
0-20 Nml/min	1 mbar	MAS-1002	MAS-1102	MAS-2002	00 = ¼" NPT female C2 = Swagelok ¼"	00 = 12 V _{DC} V2 = 24 V _{DC}	0 = 0-5 V _{DC} A = 4-20 mA
0-50 Nml/min	1 mbar	MAS-1003	MAS-1103	MAS-2003			
0-100 Nml/min	1 mbar	MAS-1004	MAS-1104	MAS-2004			
0-200 Nml/min	1 mbar	MAS-1005	MAS-1105	MAS-2005			
0-500 Nml/min	1 mbar	MAS-1006	MAS-1106	MAS-2006			
0-1 Nl/min	1 mbar	MAS-1007	MAS-1107	MAS-2007			
0-2 Nl/min	6 mbar	MAS-1008	MAS-1108	MAS-2008			
0-5 Nl/min	6 mbar	MAS-1009	MAS-1109	MAS-2009			
0-10 Nl/min	6 mbar	MAS-1010	MAS-1110	MAS-2010			
0-20 Nl/min	25 mbar	MAS-1011	MAS-1111	MAS-2011			
0-30 Nl/min	47 mbar	MAS-1012	MAS-1112	MAS-2012			
0-40 Nl/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 ₂	Max. pressure loss	Case size	Model			Connection	Voltage supply	Output
			with display	with counter	without display			
0-10 Nml/min	6 mbar	L	MAS-3001	MAS-3101	MAS-4001	C1= Swagelok ⅛" C2=Swagelok ¼" C3=Swagelok ⅜"	00 = 12 V _{DC} V2 = 24 V _{DC}	0 = 0-5 V _{DC} A = 4-20 mA
0-20 Nml/min	6 mbar	L	MAS-3002	MAS-3102	MAS-4002			
0-50 Nml/min	6 mbar	L	MAS-3003	MAS-3103	MAS-4003			
0-100 Nml/min	6 mbar	L	MAS-3004	MAS-3104	MAS-4004			
0-200 Nml/min	6 mbar	L	MAS-3005	MAS-3105	MAS-4005			
0-500 Nml/min	6 mbar	L	MAS-3006	MAS-3106	MAS-4006			
0-1 Nl/min	6 mbar	L	MAS-3007	MAS-3107	MAS-4007			
0-2 Nl/min	6 mbar	L	MAS-3008	MAS-3108	MAS-4008			
0-5 Nl/min	6 mbar	L	MAS-3009	MAS-3109	MAS-4009			
0-10 Nl/min	105 mbar	L	MAS-3010	MAS-3110	MAS-4010	C2=Swagelok ¼" C3=Swagelok ⅜"		
0-15 Nl/min	105 mbar	L	MAS-3011	MAS-3111	MAS-4011	C2=Swagelok ¼" C3=Swagelok ⅜"		
0-20 Nl/min	40 mbar	M	MAS-3012	MAS-3112	MAS-4012	C2=Swagelok ¼" C3=Swagelok ⅜" C4=Swagelok ½"		
0-30 Nl/min	60 mbar	M	MAS-3013	MAS-3113	MAS-4013	C2=Swagelok ¼" C3=Swagelok ⅜" C4=Swagelok ½"		
0-50 Nl/min	80 mbar	M	MAS-3014	MAS-3114	MAS-4014	C2=Swagelok ¼" C3=Swagelok ⅜" C4=Swagelok ½"		
0-100 Nl/min	105 mbar	M	MAS-3015	MAS-3115	MAS-4015	C3=Swagelok ⅜" C4=Swagelok ½"		
0-100 Nl/min	6 mbar	H	MAS-3016	MAS-3116	MAS-4016	C3=Swagelok ⅜" C4=Swagelok ½"		
0-200 Nl/min	6 mbar	H	MAS-3017	MAS-3117	MAS-4017	C3=Swagelok ⅜" C4=Swagelok ½"		
0-300 Nl/min	140 mbar	H	MAS-3018	MAS-3118	MAS-4018	C3=Swagelok ⅜" C4=Swagelok ½"		
0-400 Nl/min	140 mbar	H	MAS-3019	MAS-3119	MAS-4019	C3=Swagelok ⅜" C4=Swagelok ½"		
0-500 Nl/min	140 mbar	H	MAS-3020	MAS-3120	MAS-4020	C3=Swagelok ⅜" C4=Swagelok ½"		
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		

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

Accessories: Connector power supply

Model	Input	Output
MAS-5100	230 V _{AC}	12 V _{DC} /1.9 W
MAS-5105	230 V _{AC}	24 V _{DC} /1.9 W
MAS-5000	110 V _{AC}	12 V _{DC} /1.9 W

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_{DC} (4-20 mA optional) signal.

Technical Data

Field of application: Suited only for dry, oil-free gases
Measuring accuracy: $\pm 1.5\%$ f.s.
(with 10-100% of flow rate range)

Repeatability: $\pm 0.25\%$ 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 10⁻⁴ 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_{DC}

Output: 0-5 V_{DC} (load min. 2000 Ω)
4-20 mA (load max. 1000 Ω)

Control signal: 0-5 V_{DC} or 4-20 mA, adjustable

Order details Nylon® version (example: MFC-5101 00 00)

Measuring range for N ₂	Min. required diff. pressure	Model		Connection	Output
		with display	without display		
0-10 Nml/min	0.35 bar	MFC-5101	MFC-5202	00 = 1/4" NPT female C1 = Swagelok 1/8" C2 = Swagelok 1/4" K1 = 6 mm compression fitting	00 = 0-5 V _{DC} V4 = 4-20 mA
0-20 Nml/min	0.35 bar	MFC-5102	MFC-5203		
0-50 Nml/min	0.35 bar	MFC-5103	MFC-5204		
0-100 Nml/min	0.35 bar	MFC-5104	MFC-5205		
0-200 Nml/min	0.35 bar	MFC-5105	MFC-5206		
0-500 Nml/min	0.35 bar	MFC-5106	MFC-5207		
0-1 Nl/min	0.55 bar	MFC-5107	MFC-5208		
0-12 Nl/min	0.55 bar	MFC-5108	MFC-5209		
0-5 Nl/min	1.00 bar	MFC-5109	MFC-5210		
0-10 Nl/min	1.38 bar	MFC-5110	MFC-5211		
0-20 Nl/min	1.38 bar	MFC-5111	MFC-5212		
0-30 Nl/min	1.38 bar	MFC-5112	MFC-5201		
0-40 Nl/min	1.38 bar	MFC-5113	MFC-5213		
0-50 Nl/min	1.38 bar	MFC-5114	MFC-5214		
on customer specification		MFC-51xx	MFC-52xx		

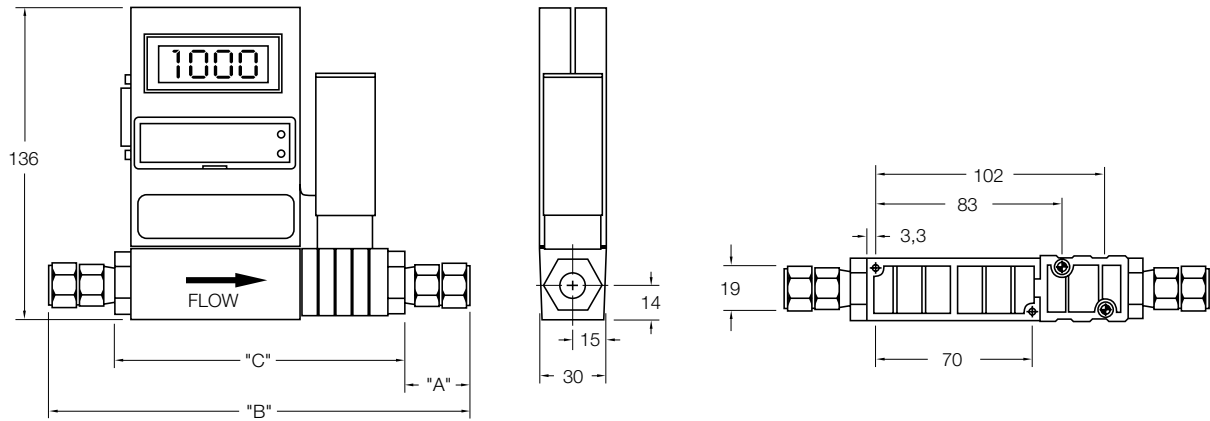
When placing an order, please specify detailed service conditions (type of gas, flow rate, pressure, temperature etc.).

Accessories: Connector power supply

Model	Input	Output
ZUB-SNT035L	100-240 V _{AC}	24 V _{DC} / 500 mA



Dimensions [mm]



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