Thermal Mass Flow Meter

MAK

Modbus

- Measuring ranges:
  0 ... 10 Nml/min,
  0 ... 50...0...200 Nl/min,
  0...300...0...500 Nl/min
- Accuracy: ±1 ... ±1.5 % of full scale
- p_{max} 6 bar; t_{max} 50 °C
- Connection:
  ¼ ... ½" compression fitting;
  ¼" NPT female
- Sensor casing: stainless steel
- Output:
  4 - 20 mA or
  0 - 5 / 1 - 5 V and Modbus
- various gases selectable
  via gas table or CF factor

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Description

The new MAK series KOBOLD digital mass flow meter has been specially developed for use in gas measurement, where excellent accuracy, high reliability, robust casing, stainless materials and maximum flexibility are important.

MAK is equipped with an indicator that employs a proven flow sensor. It has a function to indicate the integrated flow rate, in addition to the existing instantaneous flow rate indication.

A model with a flow sensor and precision needle valve in one unit is also available.

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.

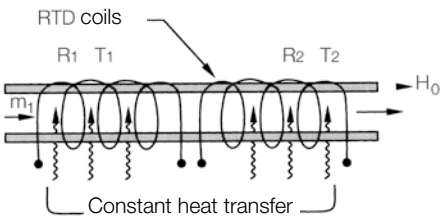
Special Advantages

- Direct mass flow measurement
- No pressure or temperature correction needed
- Large measuring range
- Negligible pressure loss
- May be fitted in any position (horizontal recommended)
- High degree of repeatability
- Analogue output 0 - 5 V_{DC}, option 4 - 20 mA
- The employment of a precision needle valve enables minute flow control and monitoring
- Flow monitoring alarm 2 points output. (2 points each for any flow rate value.)
- Instantaneous flow rate / analog output. (Voltage 0 - 5 V or 1 - 5 V or current 4 - 20 mA), integrated flow rate / pulse output installed.
- Compact and lightweight.
- The flowmeter is equipped with an indicator and can start measurement of flow rates as soon as a 24 V_{DC} power supply is connected.
- "Mass flow" enables direct reading of flow rates without a need of troublesome flow rate compensation calculation by temperature/pressure.
- 2 LED Signal lights for monitoring the instantaneous and cumulative flow rate value

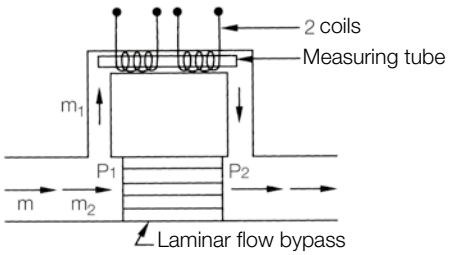
Application Examples

- Gas monitoring
- Paint lines
- Laminator systems
- Semiconductor industry
- Analysis devices
- Exhaust measurement
- Engineering
- N_2/O_2 -generators
- Boiler controls

Measuring tube design



Flow diagram



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1/07 - 2025

Technical Details

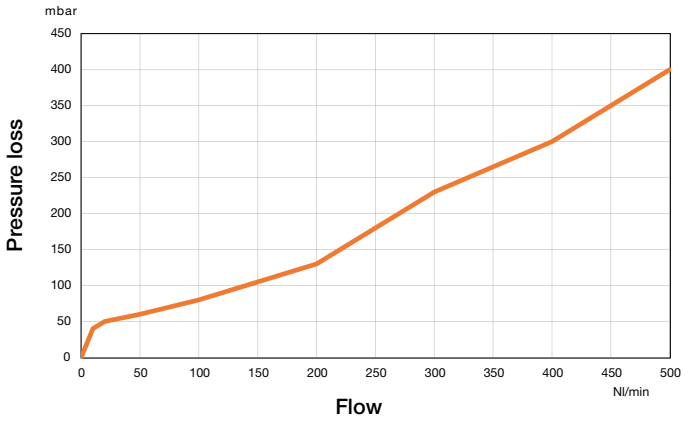
Field of application: suited only for dry, oil-free gases

Housing size:	S	M	L
Accuracy [1]:	±1 %...F.S. @ 15...35 °C	±1.5 %...F.S. @ 15...35 °C	
Applicable gas [2]:	N_2 (Air, H_2, He, Ar, O_2, CO_2, CH_4 / by N_2 conversion) [5]	N_2 (Air, Ar / by N_2 conversion) [5]	N_2 (Air / by N_2 conversion) [5]
Fitting:	Swagelok® ¼" (Standard)	Swagelok® ⅜" (Standard)	
Weight (without needle valve):	Approx. 600 g	Approx. 700 g	Approx. 1000 g
Weight (with needle valve):	Approx. 800 g	Approx. 1100 g	Approx. 1500 g

Temperature coefficient: +/- 0.15 % full scale / °C
Pressure coefficient: +/- 0.15 % full scale / °bar
Repeatability: +-0.2 % full scale
Response time: 1 s

Pressure loss

Housing size / Flow range	Nl/min	Pressure loss [mbar]
S10	10	40
S11	20	50
M14	50	60
M15	100	80
M17	200	130
L18	300	230
L19	400	300
L20	500	400



Temperature

Operating temperature: 5...50 °C
Storage temperature: -10...+60 °C
Operating humidity: 10...90 % RH (no condensation)
Max. operating pressure: 6 bar
Materials of parts in contact with gases: SUS316, SUS316L, PTFE, FKM (op.: NBR, CR)
Power supply: 24 V_{DC} (±10 %), max. 100 mA

Flow rate indication

Indicator: 4-digit 7-segment LED (Zero blanking)
Instantaneous flow rate indication update cycle: 25, 50, 100, 200, 500, 1000 msec (selectable)
Low cut function: indication of a value below 1 % F.S. settable to “0”
Indication range: When the low cut function is not used; indication limiter flashes at 0–10 % F.S. and at 100–125 % F.S.
Integrated flow rate indication range [3]: 8-digit indication (Max. 99,999,999, indication limiter flashing)
The units of indication are the same as the instantaneous flow rate.
Digital communication: RS485 (MODBUS RTU), ID:1...247

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Technical Details (continued))

External output

Number of outputs:	2 (Each output selected and set to instantaneous flow rate upper limit, lower limit, upper/lower limit or integrated flow rate reach. 1 point may be integrating pulse.) Inversion of outputs is possible.
Output method:	NPN open collector (Max. rating: 30 V_{DC}, 50 mA)
Integrating pulse output rate:	1 % F.S. ... 100 % F.S. / pulse, pulse width: approx. 50 ms
Alarm indication:	LED lamps (OUT1, OUT2) light up when the signal is active
Analog output [4]:	4-20 mA (max. load 250 Ω), 1-5 V or 0-5 V (min. load 10 kΩ)
Protection:	IP 40

Needle valve part

Flow adjust knob turning:	Approx. 12 turns
Materials of parts in contact with gases:	SUS303, SUS316, PTFE, FKM (op. NBR, CR)

[1] The precision is guaranteed for nitrogen gas.

[2] The full scale of the selected gas is the same as the full scale of N_2.

[3] The indication of integrated flow rates is for reference. It is held when the power is turned off.

[4] The analog output is switchable.

[5] Other Gases via CF-Factor – see instruction manual

Order Details (example: **MAK-M 30 S01 C2 4 A 0**)

Model	Material / Display	Housing size / Flow range [1)4)]	Connection	Digital output	Analog output	Option
MAK-M = Mass flowmeter	**30** = stainless steel/ with compact digital display incl. Counter	**S01** = 0 - 10 Nml/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S03** = 0 - 50 Nml/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S04** = 0 - 100 Nml/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S06** = 0 - 500 Nml/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S07** = 0 - 1 Nl/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S09** = 0 - 5 Nl/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S10** = 0 - 10 Nl/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4) **S11** = 0 - 20 Nl/min N_2 (changeable to air, H_2, He, Ar, O_2, CO_2, CH_4)	**C2** = Swagelok® ¼" **00** = ¼" NPT female **W2** = ¼" VCR female	**4** = RS485 Modbus RTU 38 400 bps [2)]	**A** = 4 - 20 mA (changeable by customer to 0 … 5 V_{DC} or 1 … 5 V_{DC})	**0** = without **N**[3)] = needle valve **R** = Cleaning oil and fat free (e.g. for oxygen) **Y** = special (to be specified in clear text)
		M14 = 0 - 50 Nl/min N_2 (changeable to air, Ar) **M15** = 0 - 100 Nl/min N_2 (changeable to air, Ar) **M17** = 0 - 200 Nl/min N_2 (changeable to air, Ar)	**C3** = Swagelok® ⅜"			
		L18 = 0 - 300 Nl/min N_2 (changeable to air) **L19** = 0 - 400 Nl/min N_2 (changeable to air) **L20** = 0 - 500 Nl/min N_2 (changeable to air)	**C3** = Swagelok® ⅜" **C4** = Swagelok® ½"			

[1)] Standard Calibration: 1013.25 mbar abs, 0 °C (changeable by customer to 20 °C, 25 °C)
[2)] changeable by customer to 9600 bps or 19 200 bps
[3)] Specify valve inlet pressure and valve outlet pressure in your P.O. for correct sizing
[4)] Other Gases via CF-Factor – see instruction manual

Suitable wall power supply 100 - 240 V_{AC} / 24 V_{DC} - 500 mA with order number: **ZUB-SNT 035L**
Suitable D-Sub connector 9P (socket) with 5 m cable length with order number **ZUB-MAK-D095**

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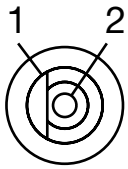
Electrical Connection

DC Jack



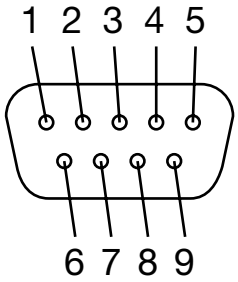
Signal table

Pin No.	Signal name	Description
1	Power supply COM	Power supply COM
2	Power supply +24 V	Power supply +24 V

Additional connector

9-pin D-sub

Pin assignment



Signal table

Pin No.	Signal name	Description
1	Power supply +24 V	Power supply +24 V
2	Power supply COM	Power supply COM
3	OUT 1	Event output 1
4	OUT 2	Event output 2
5	OUT COM	Event output COM
6	Analog output	Analog output
7	TR+	RS485 communications
8	TR-	RS485 communications
9	Analog output COM TR COM	Analog output COM RS485 communications COM

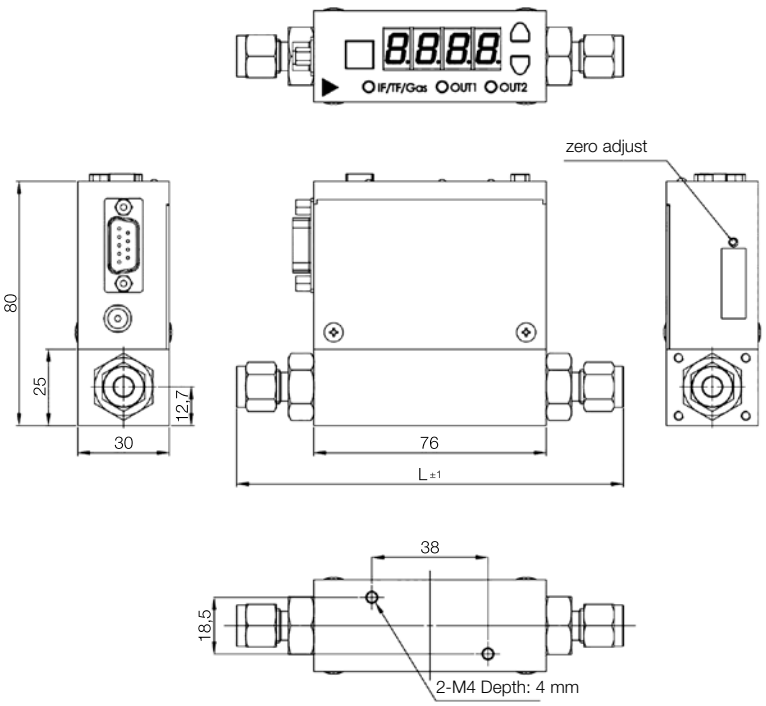
Caution: Prior to turning on the power, make sure that the product has been wired correctly. Incorrect wiring will cause damage and malfunction.

Dimensions [mm]

F.S. 10 Nml/min ... F.S. 20 Nl/min

Various fittings and "L" dimension

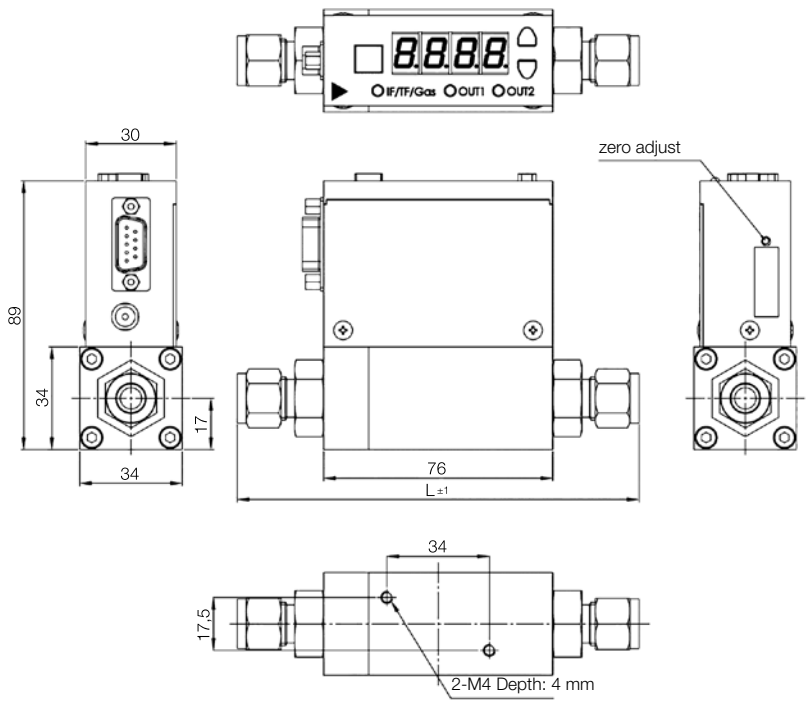
Fitting	L [mm]
¼" NPT (f)	102.0
1/8SWL	122.8
1/4SWL	127.4
3/8SWL	130.4
1/4VCR	123.8



F.S. 50, 100, 200 Nl/min

Various fittings and "L" dimension

Fitting	L [mm]
3/8SWL	130.4



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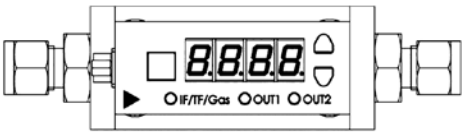
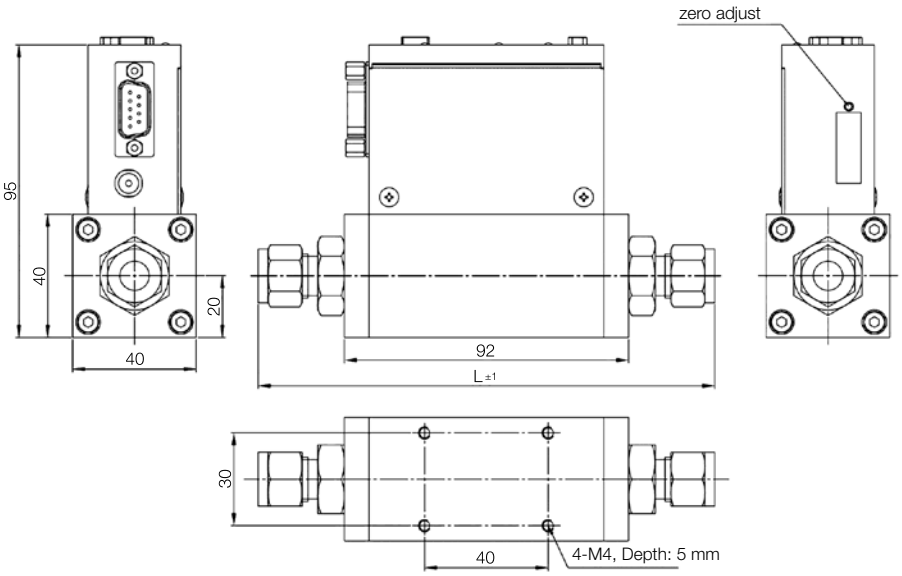
Dimensions [mm] (cont'd)

F.S. 300, 400, 500 Nl/min

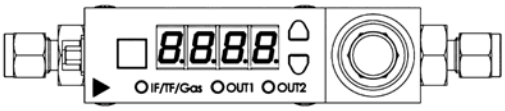


Various fittings and "L" dimension

Fitting	L [mm]
3/8SWL	147.8
1/2SWL	153.5

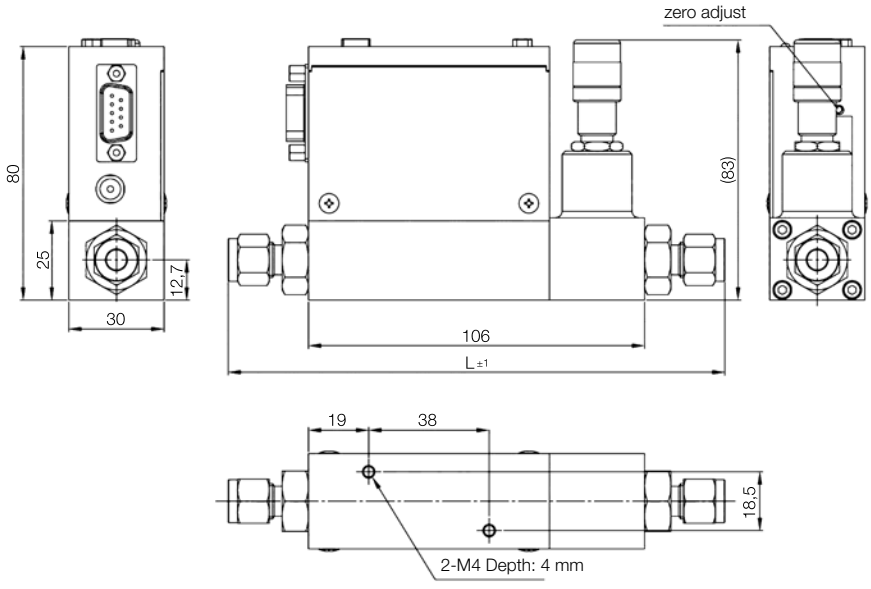


F.S. 10 Nml/min ... F.S. 20 Nl/min with needle valve



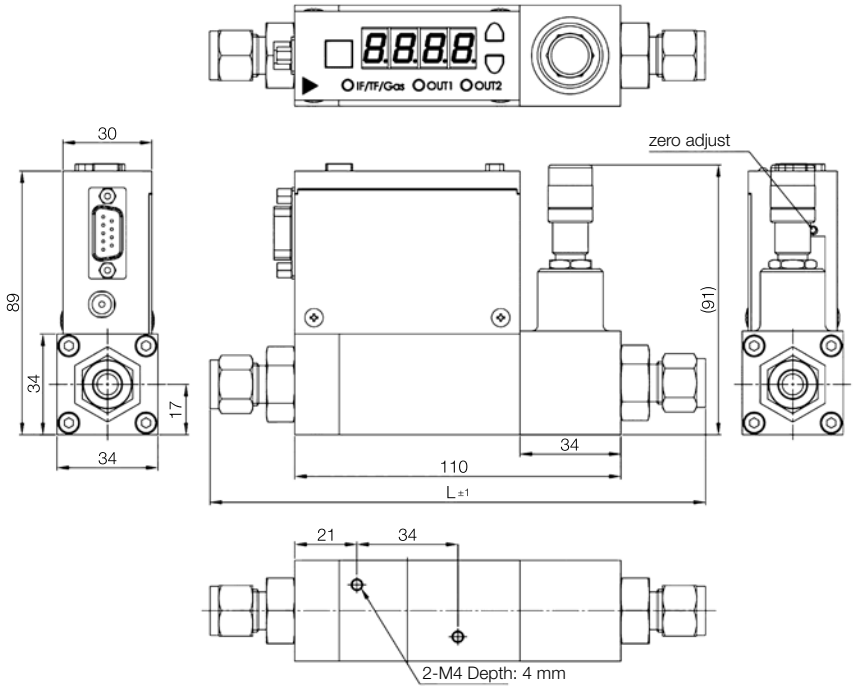
Various fittings and "L" dimension

Fitting	L [mm]
¼" NPT (f)	132.0
1/8SWL	152.8
1/4SWL	157.4
3/8SWL	160.4
1/4VCR	153.8



Dimensions [mm] (cont'd)

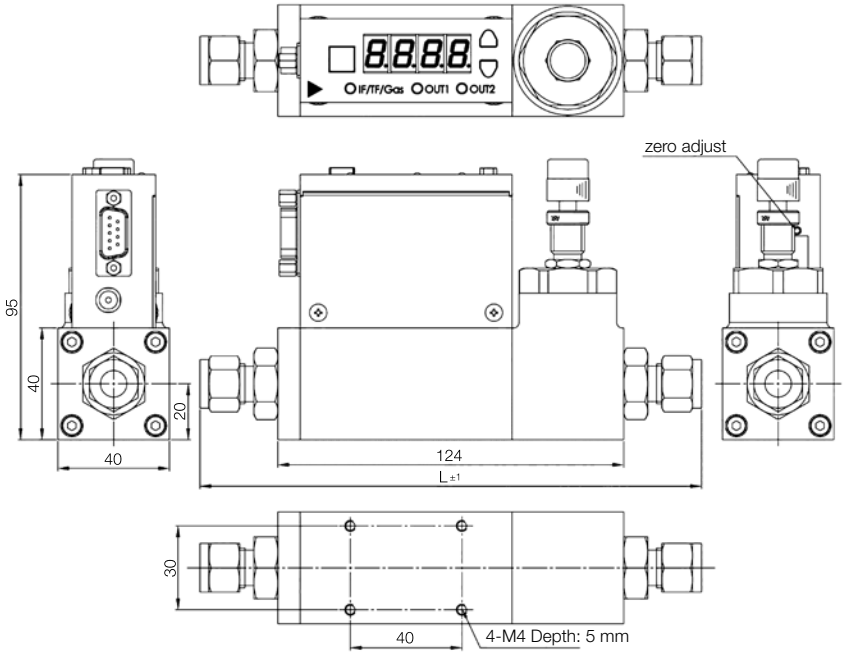
F.S. 50, 100, 200 Nl/min with needle valve



Various fittings and "L" dimension

Fitting	L [mm]
3/8SWL	164.4

F.S. 300, 400, 500 Nl/min with needle valve



Various fittings and "L" dimension

Fitting	L [mm]
3/8SWL	179.8
1/2SWL	185.5

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