

Thermal Mass Flow Meter

MAK



- Measuring ranges:
0 ... 10 Nml/min,
0 ... 50 ... 0 ... 200 Nl/min,
0 ... 300 ... 0 ... 500 Nl/min
- Accuracy: $\pm 1 \dots \pm 1.5 \%$ of full scale
- p_{\max} 6 bar; t_{\max} 50 °C
- Connection:
 $\frac{1}{4} \dots \frac{1}{2}$ " compression fitting;
 $\frac{1}{4}$ " 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.

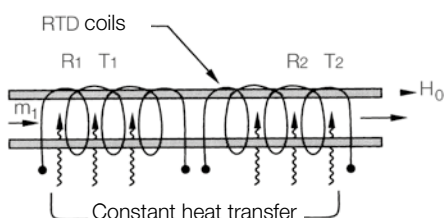
Special Advantages

- 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

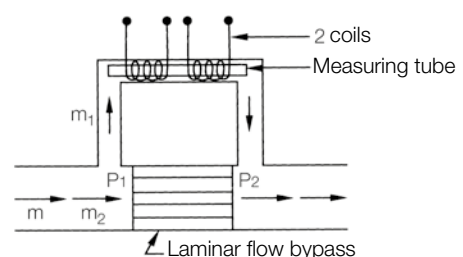
Application Examples

- Gas monitoring
- Paint lines
- Laminator systems
- Semiconductor industry
- Analysis devices
- Exhaust measurement
- Engineering
- N₂/O₂ -generators
- Boiler controls

Measuring tube design



Flow diagram



Technical Details

Field of application:

suited only for dry, oil-free gases

Housing size:

Accuracy ¹⁾:Applicable gas ²⁾:

Fitting:

Weight (without needle valve):

Weight (with needle valve):

S	M	L
±1 % ...F.S. @ 15...35 °C	±1.5 % ...F.S. @ 15...35 °C	
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⁾
Swagelok® ¼" (Standard)	Swagelok® ⅜" (Standard)	
Approx. 600g	Approx. 700g	Approx. 1000g
Approx. 800g	Approx. 1100g	Approx. 1500g

Temperature coefficient:

+/- 0.15 % full scale/°C

Pressure coefficient:

+/- 0.15 % full scale/°bar

Repeatability:

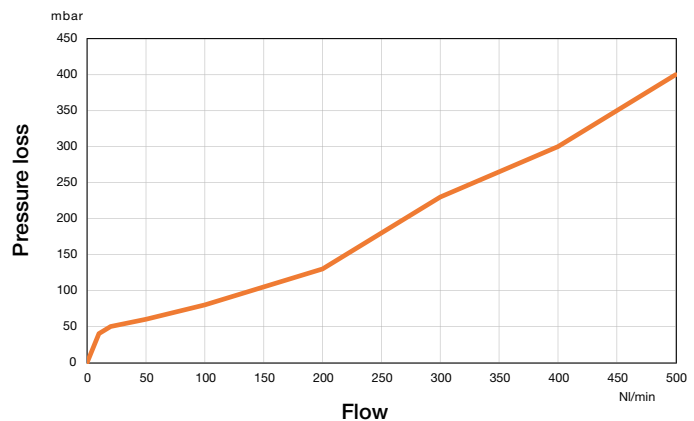
+/-0.2 % full scale

Response time:

1 s

Pressure loss

Housing size / Flow range	NI/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:

24V_{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



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 N₂.

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)

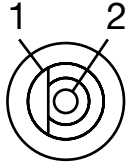
Model	Material/ Display	Housing size/ Flow range ¹⁾⁴⁾	Connection	Digital output	Analog output	Option
MAK-M = Mass flowmeter	30 = stainless steel/ with compact digital display incl. Counter	S01 = 0 - 10 Nml/min N ₂ (changeable to air, H ₂ , He, Ar, O ₂ , CO ₂ , CH ₄) S03 = 0 - 50 Nml/min N ₂ (changeable 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 NI/min N ₂ (changeable to air, H ₂ , He, Ar, O ₂ , CO ₂ , CH ₄) S09 = 0 - 5 NI/min N ₂ (changeable to air, H ₂ , He, Ar, O ₂ , CO ₂ , CH ₄) S10 = 0 - 10 NI/min N ₂ (changeable to air, H ₂ , He, Ar, O ₂ , CO ₂ , CH ₄) S11 = 0 - 20 NI/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 NI/min N ₂ (changeable to air, Ar) M15 = 0 - 100 NI/min N ₂ (changeable to air, Ar) M17 = 0 - 200 NI/min N ₂ (changeable to air, Ar) L18 = 0 - 300 NI/min N ₂ (changeable to air) L19 = 0 - 400 NI/min N ₂ (changeable to air) L20 = 0 - 500 NI/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 19200 bps³⁾ Specify valve inlet pressure and valve outlet pressure in your P.O. for correct sizing⁴⁾ Other Gases via CF-Factor – see instruction manualSuitable wall power supply 100 - 240V_{AC}/24V_{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**



Electrical Connection

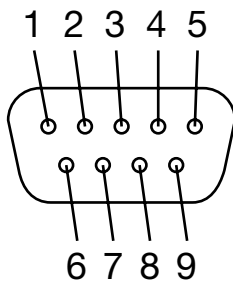
DC Jack



Additional connector

9-pin D-sub

Pin assignment



Signal table

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

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

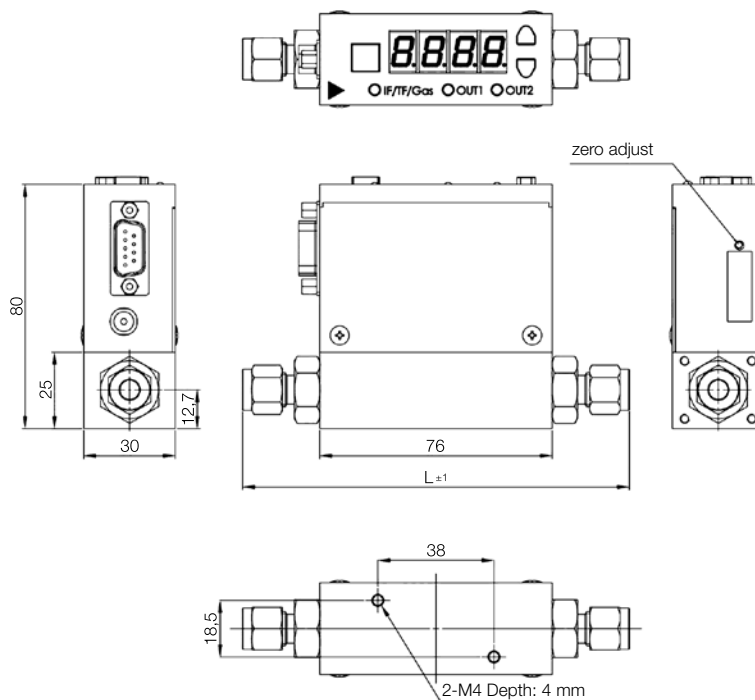
Caution: Prior to turning on the power, make sure that the product has been wired correctly. Incorrect wiring will cause damage and malfunction.

Dimensions [mm]

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

Various fittings and "L" dimension

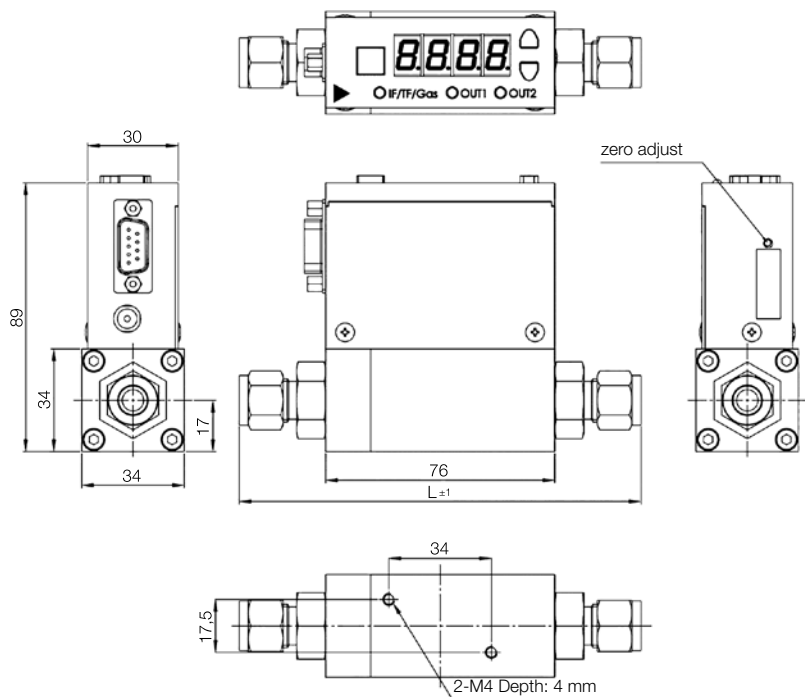
Fitting	L [mm]
1/4" NPT (f)	102.0
1/8SWL	122.8
1/4SWL	127.4
3/8SWL	130.4
1/4VCR	123.8



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

Various fittings and "L" dimension

Fitting	L [mm]
3/8SWL	130.4

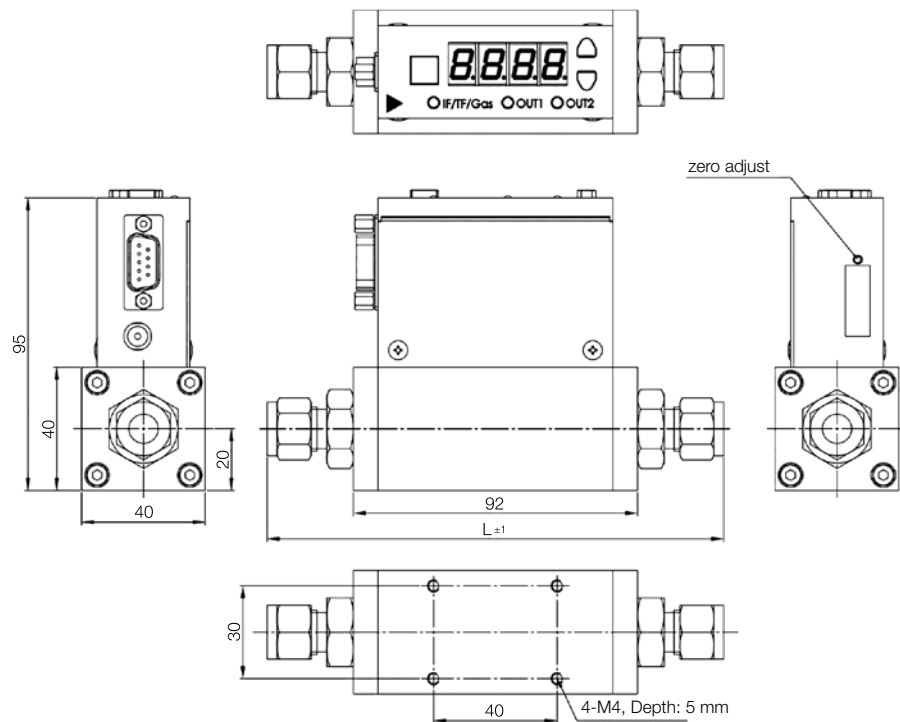


Dimensions [mm] (cont'd)

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

Various fittings and "L" dimension

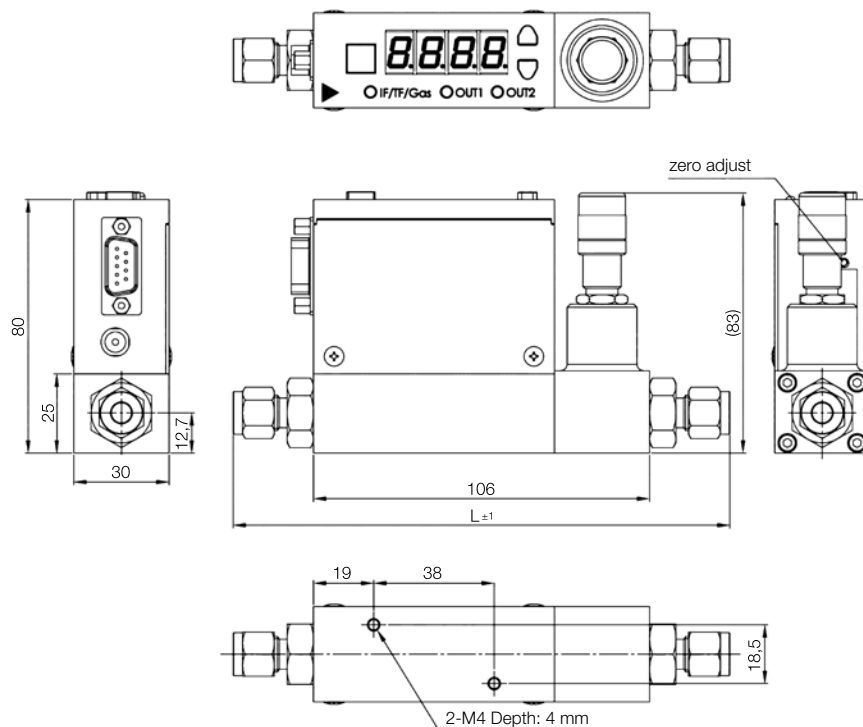
Fitting	L [mm]
3/8SWL	147.8
1/2SWL	153.5



F.S. 10 NmI/min ... F.S. 20 NI/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

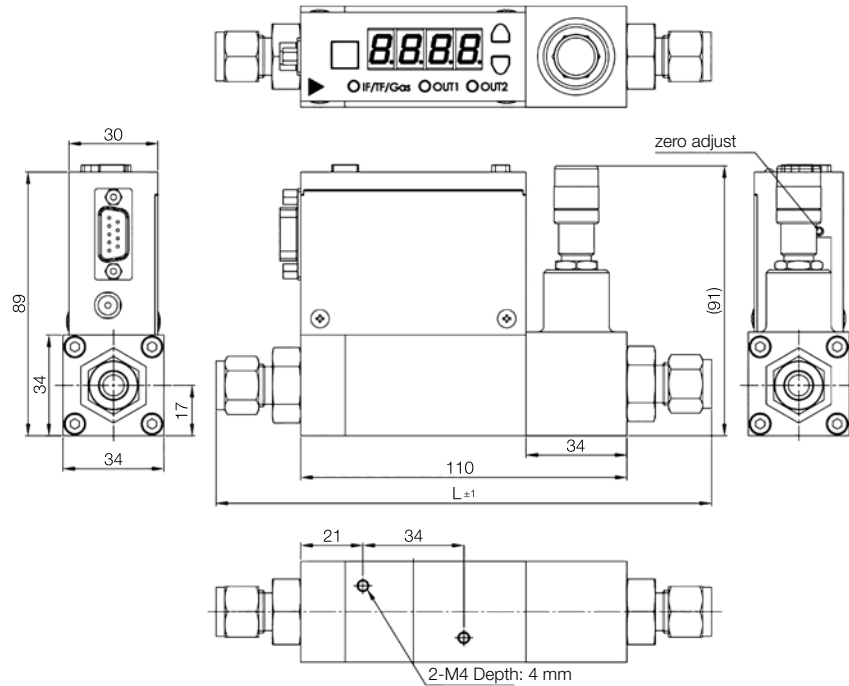


Dimensions [mm] (cont'd)

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

**Various fittings
and "L" dimension**

Fitting	L [mm]
3/8SWL	164.4



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

**Various fittings
and "L" dimension**

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

