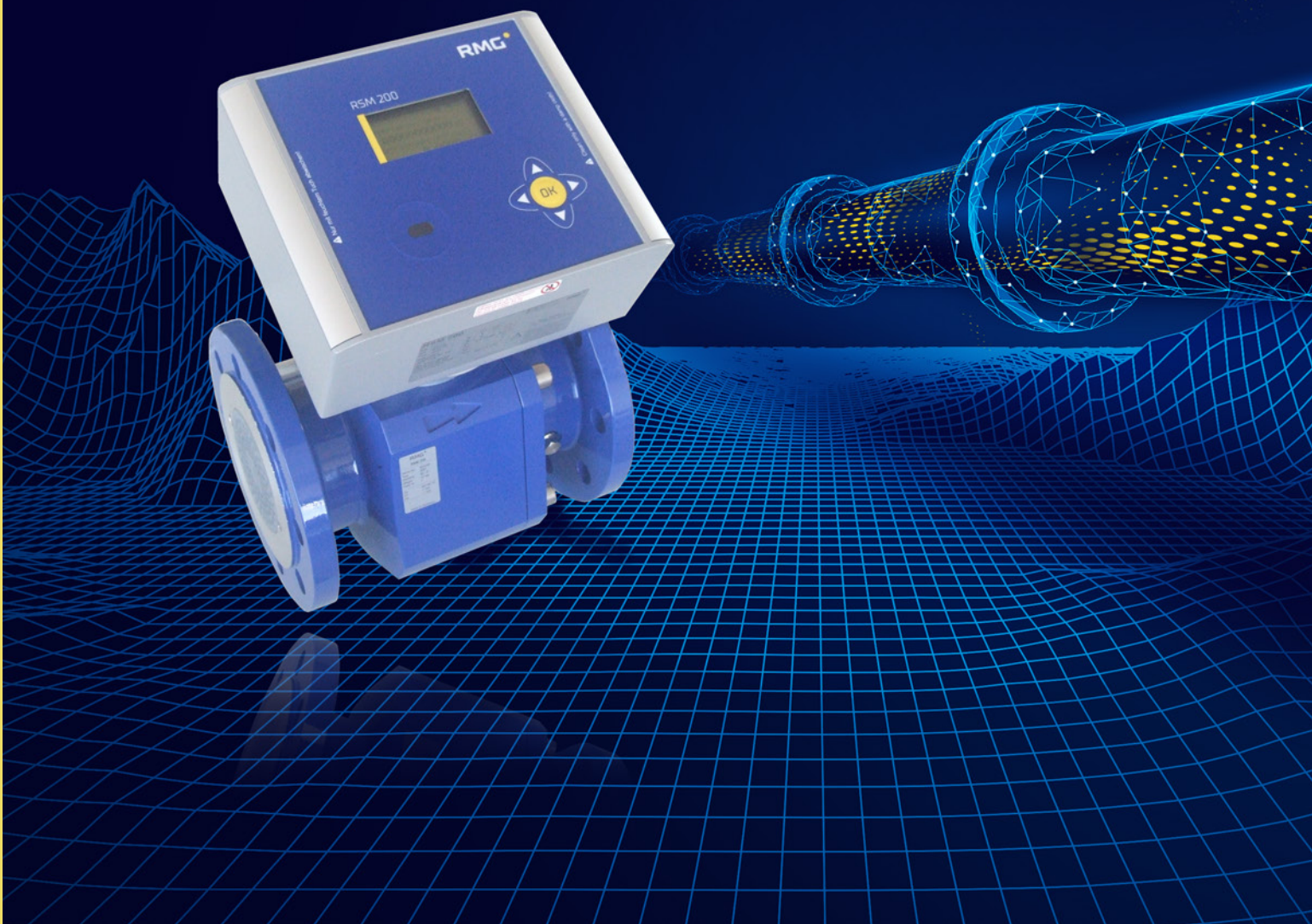
ULTRASONIC FLOW METER FOR GAS

RSM 200

Ultrasonic Flow Meter RSM 200 with the same mechanical installation as the turbine gas meter, but technically superior. Maintenance-free, battery-operated, many electronic interfaces with integrated volume corrector.



FUNCTIONING AND STRUCTURE

Introduction

The gas flow meter RSM 200 (RMG Sonic Meter) is based on the innovative ultrasonic transit time difference measurement technology, which has been replacing turbine gas meters more and more for high-precision flow measurements of natural gas for several years. The RSM200 is officially approved and allows the determination of the operating and standard volume flow with a pressure and temperature measurement.

The RSM 200 determines the flow, saves it and adds up the current meter reading. The RSM 200 can transmit its values directly via various interfaces (pulse, analogue, digital). In addition, the RSM 200 offers a fully-fledged corrector including pressure and temperature measurement, so that in addition to the actual flow rate and actual volume, the standard volume flow and standard volume can also be determined. An external corrector is not required. A long-life backup battery ensures operational reliability even if an external power supply fails. Self-sufficient battery operation is possible for the calibration period, i.e. for more than 5 years.

RSM 200

RSM 200 designates an officially approved operating volume meter for gases. It is the little brother of the high-precision flow meter for pressurized natural gas with large volume flows that has been in use for a long time.

Features

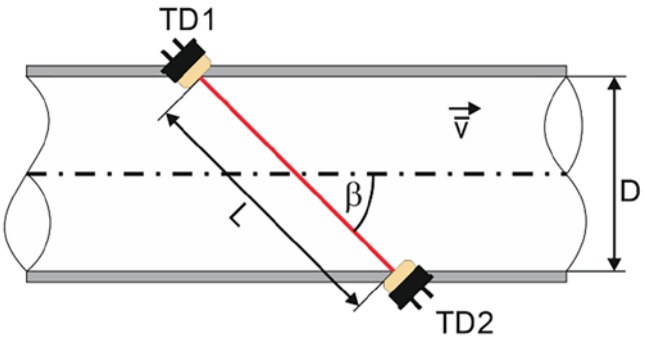
- The RSM 200 is in the PTB MID approval process
- Execution according to DIN ISO 17089
- No moving parts
- No inlet and outlet section*
- Integrated, officially approved volume corrector according to EN12405 for volume correctors
- Pressure and temperature measurement, display, output and archiving
- K number calculation according to SGERG88, AGA8 GROSS M1/M2 and AGA NX19
- The following can be displayed:
  Actual volume, standard volume, instantaneous and maximum flow.
- Terminal box:
  Pressure and temperature can be sealed separately from other electronics.
- Battery or mains operation (protected against power failure) for → calibration period, i.e. → 5 years
- Explosion protection:
  The RSM200 is intrinsically safe and can be used in zones 1 and 2
- Pulse output HF, alarm output, current output (4-20 mA, optional).
- Digital interface, serial RS 485 interface for Modbus connection
- Peak hold (Qb)
- Archive:
  Integrated fail-safe archive of parameters, events and measured values.
- RMGView^{RSM}: Supplied software for convenient parameterization and management of the device and the stored data as well as for remote diagnosis

* with minor disturbances

FEATURES

Working principle

The RSM 200 is designed for unidirectional flow measurement of dry gases with a hydrogen content of up to 10 mol%. The way the RSM 200 works is based on determining the difference in transit time of an ultrasonic pulse with and against the flow. The transducers TD1 and TD2 stand for the measurement opposite and form a measurement path with the distance L. An ultrasonic pulse covers the measurement path from sensor TD1 to transducer TD2 faster with the flow than vice versa against the flow. Physically, this is caused by the entrainment effect of the gas flow, the arrow above the v̄ indicates the flow direction.

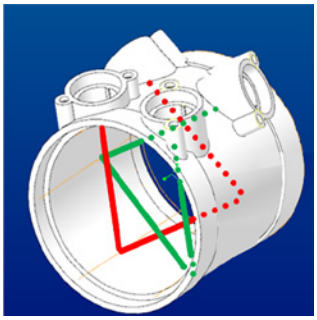


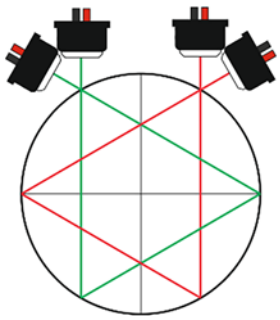
The propagation times of the ultrasonic pulse are determined with the ultrasonic electronics. With tTD12 (running times from TD1 to TD2) and tTD21 (running times from TD2 to TD1) the average speed v̄ along the measuring path can be determined.

$$\bar{v} = \frac{L}{2 \cdot cos\beta} \cdot \left(\frac{1}{t_{TD12}} - \frac{1}{t_{TD21}} \right)$$

All parameters that depend on the gas are omitted.

The interior of the RSM 200 consists of 3 sections, an inlet for conditioning the flow, a measuring cell and an outlet with an integrated temperature sensor. The inlet with the integrated rectifiers was optimized with CFD support to ensure the desired accuracy.





Inside the RSM 200 is the measuring cell with the ultrasonic sensors. In order to determine the velocity averaged over the pipe cross-section, the measuring path is implemented as a 2-fold reflecting Gaussian integration. A second measurement path covers further cross-sectional areas and also records a swirl flow reverse influence on the measurement signal. In total, the influence of a swirl flow is compensated.

As already described above, the measurement path arrangement determines the mean velocity in the pipe. The volume flow results from the average of the two velocities along the respective measuring paths multiplied by the pipe cross-section A:

$$Q_{Betrieb} = \frac{\overline{v_1} + \overline{v_2}}{2} \cdot A$$

MEASURING RANGES, PRESSURE LOSS

Measuring ranges

Nominal size mm / inch	Flow rate				Gas velocity in pipeline [1]			
	Q_{max} [m³/h]	Q_t [m³/h]	Q_{min} [m³/h]	Q_{bug} [2] [m³/h]	v (Q_{max}) [m/s]	v ($Q_{t,min}$) [m/s]	v (Q_{min}) [m/s]	v (Q_{bug}) [m/s]
50 / 2"	160	16	1,0	0,25	22,64	2,26	0,14	0,035
80 / 3"	400	40	2,5	0,63	22,10	2,21	0,14	0,035
100 / 4"	650	65	3,2	1,25	22,99	2,30	0,11	0,028
150 / 6"	1600	160	8,0	2,00	25,15	2,52	0,13	0,033
200 / 8"	2500	250	13,0	3,25	22,10	2,21	0,11	0,028

[1] To simplify things, the inner diameter Di of the incoming pipe was equated with the value of the nominal values; that means Di (DN50 /2") = 50 mm = 0.05 m, etc.

[2] The recommended setting for the cut-off flow was selected here (Q_{bug} = 0.25 x Q_{bug})

Note: The specified measuring ranges apply to operating pressures of up to 4 bar (g) and when calibrating with air at atmospheric pressure. At operating pressures > 4 bar (g), a high-pressure test is required according to the approval (as is also the case for other gas meters). The currently available high-pressure test benches (as of June 2023) are not approved for the entire measuring range of the RSM 200 in the small nominal sizes (DN 50 to DN 100). Therefore, the meters can only be calibrated with a Qmin of 3m³/h in natural gas or 5 m³/h in high-pressure air.

Pressure loss

The pressure loss is smaller than with a comparable turbine. The pressure loss Δp [mbar] is calculated using the following formula:

$$\Delta p_B = Z_p \cdot \rho_B \cdot \left(\frac{Q_B^2}{DN^4} \right)$$

with:

Δp_B = Pressure loss at actual conditions (pB, QB) in mbar
Z_p = Pressure drop coefficient
ρ_B = Operating density in kg/m³
Q_B = Operating volume flow in m³/h
DN = Nominal diameter of meter in mm

The pressure loss coefficient Zp for turbines is typically around 5000, while the RSM 200 has a value of less/approx. 3000.

Approvals

EU type examination according to

- Pressure Equipment Directive PED 2014/68/EU according to certificate
- Explosion protection directive ATEX 2014/34/EU according to certificate
  Identification: II 2 G Ex ia IIC T4 Gb
- EMC Directive 2014/30/EU according to the test report
- The RSM 200 is in the PTB MID approval process

TECHNICAL DATA

Technical Data

Explosion protection	II 2G Ex ia IIC T4 Gb
Protection degree	IP 65
Ambient temperature	-40 °C – +80 °C
Temperature range	-25 °C – +60 °C
Temperature sensor	temperature sensor EDT 87
Pressure range	0 bar (g) – 20 bar (g)
Pressure sensor	digital pressure sensor EDT 96
Power supply	Standard Lithium batteries 3.6 V (life cycle > 5 years, calibration period) or external power supply
Output	4 x Digital output: 1 x DO or serial encoder protocol 1 x DO or inverted DO 1 2 x DO: Pulse, status, alarm 1 x Analog output 4 - 20 mA (only with external power supply), galvanically isolated
Interfaces	RS 485 (Modbus protocol) / Infrared serial encoder protocol

Measurement accuracy

The RSM 200 passed the pre-fault measurements according to OIML R137-1&2, Class 1 with light and severe pre-fault.

Gas types

The device may be operated with the following types of gas; Safe operation is guaranteed with the specified types of gas:

- Class 1 gases
- Class 2 gases
- Class 3 gases

The components of the gases must be within the concentration limits according to EN 437:2009 for test gases. The gas to be measured must not form any condensates in the working range of the RSM 200 (flow rate, pressure and temperature range) and must be free of corrosive and aggressive components, liquids and solids.

The RSM 200 can be used in hydrogen-containing natural gas. There are no safety concerns in this regard. The RSM 200 is suitable for use in natural gases with a maximum hydrogen content of 10 mol% in accordance with the TR-G19 applicable in Germany, with the accuracies specified above.

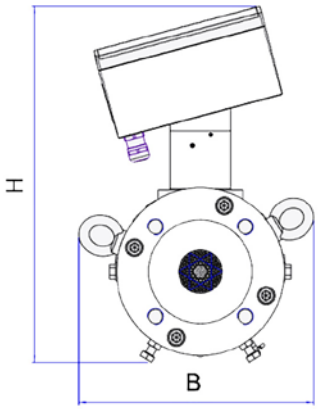
Materials

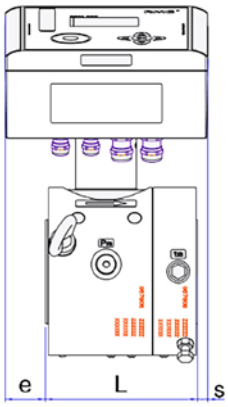
Designation	Material
Body	Aluminum or Fine-grained steel (P355QH1)
Flow straightener	Epoxy (3D print)
Measuring cell	Aluminum
Counter header	Aluminum

DIMENSIONS, MOUNTING OPTION

Dimensions

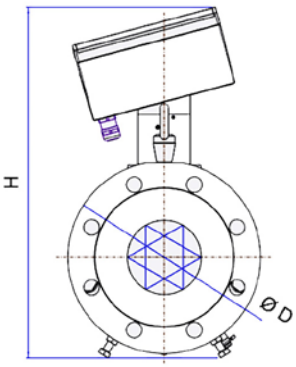
DN 50

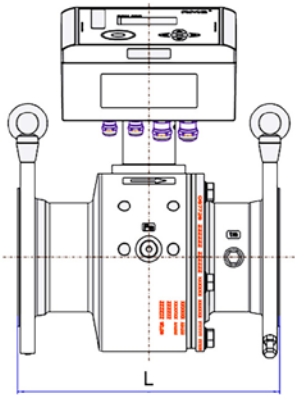




Nominal diameter		Dimensions [mm]					Weight
mm	inch	L	B	H	e	s	kg
50	2"	150	231	351	40	10	26

DN 80 – DN 200



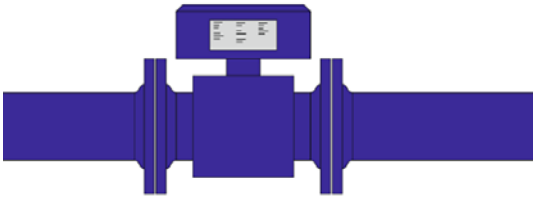


Nominal diameter		Dimensions [mm]			Weight
mm	Zoll	L	D	H	kg
80	3"	240	200	383	37
100	4"	300	220	402	46
150	6"	450	285	464	89
200	8"	600	340	512	150

Electronis housing: 200 mm x 180 mm x 100 mm

Mounting option

The RSM 200 can be supplied with DIN and ANSI flange connections. In principle, the measuring device can be installed in any position for dry, clean gases. In order to reduce the influence of condensate deposits (which should not occur in dry gas), a horizontal installation position is preferable.



Rotate display

The RSM 200's display faces the viewer and is slightly tilted forwards and downwards; this allows rainwater to run off and improves readability. The orientation of the display can be easily changed and thus adapted to the direction of flow. With this change, the device loses neither its calibration nor its parameterization.

ARCHIVES, OPERATING SOFTWARE

Archives

Parameter changes, flow rate, meter readings, pressure, temperature and events are stored in the archives. The storage depth is (see table on the right):

The measurement period can be set to 15, 30 or 60 minutes.

Event archive	200 entries
Parameter archive (calibrated)	300 entries
Parameter archive (not custody transfer)	300 entries
Monthly archive	25 entries
Daily archive	100 entries
Period archive	8800 entries

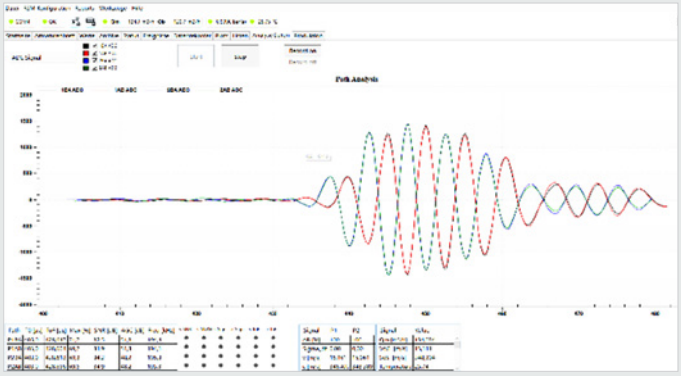
Operating software RMGView[RSM]

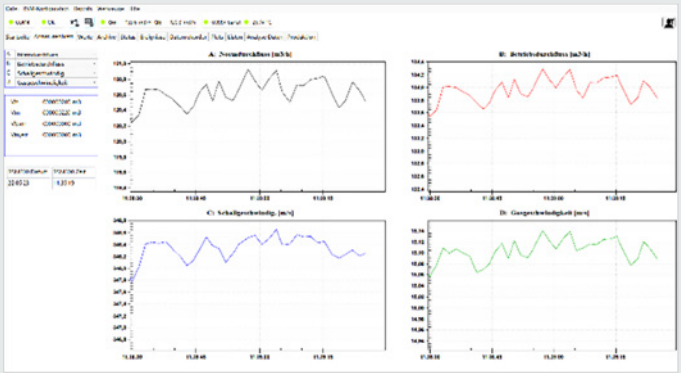
The supplied software RMGView[RSM] enables direct access to the measuring electronics with a PC. The most important functions are:

- Reading of all parameters
- Changing parameters (when the calibration switch is open)
- Graphic display of measured values
- Creation of test certificates and data sheets and their issue in pdf format
- Reading out the archives
- Export of parameters and archive data in Excel-readable format

Operation is easy, all values are displayed systematically in graphic form or in clear tables. It is also possible to compile selected measured values and parameters in user-defined tables.

Screenshots (examples):





RMG
ONE STEP AHEAD

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To learn more about RMG's advanced gas solutions, contact your RMG account manager or visit **www. rmg.com**

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