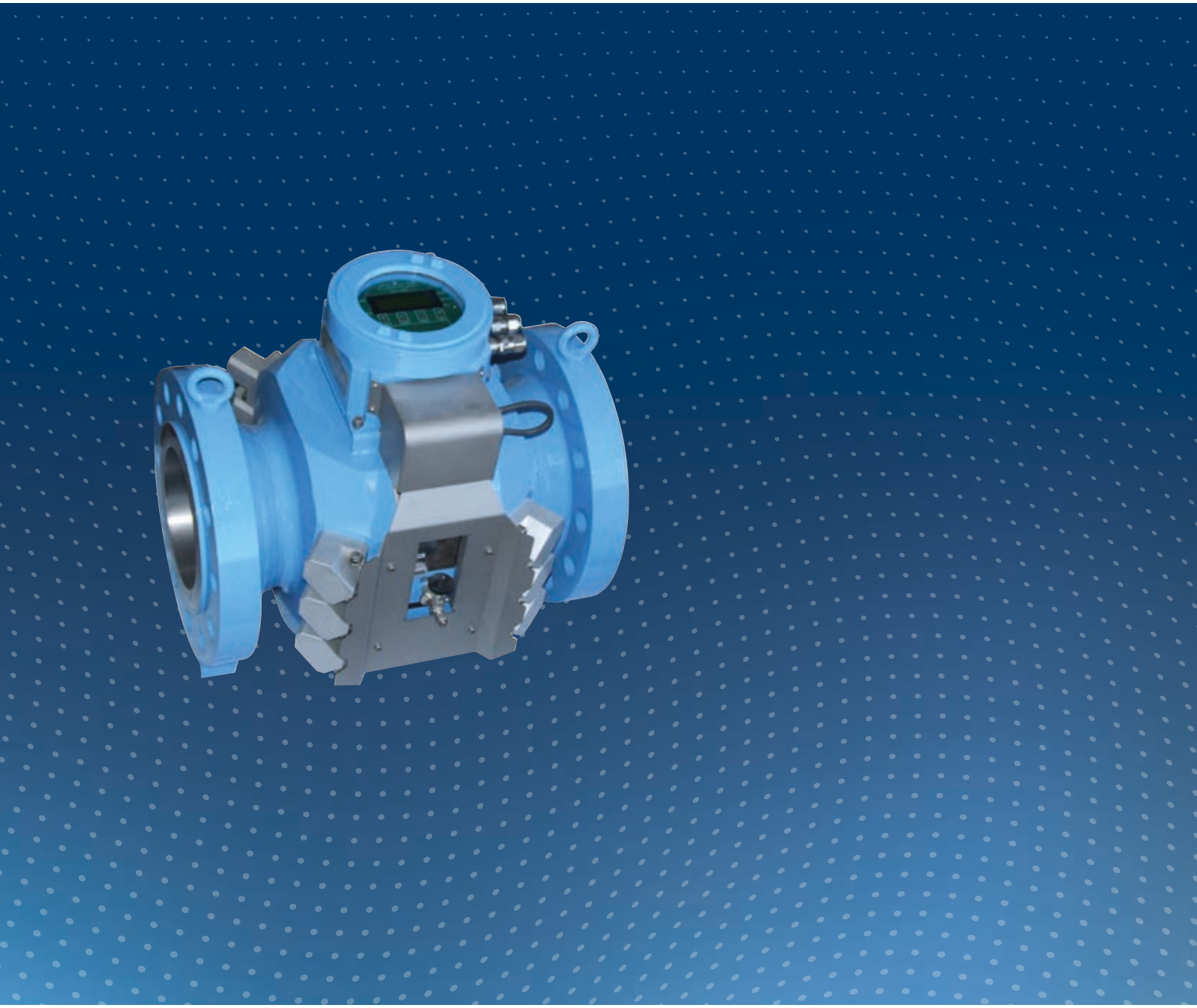
# Ultrasonic Flowmeter USZ 08



PRODUCT INFORMATION

## Reliable Measurement of Gas

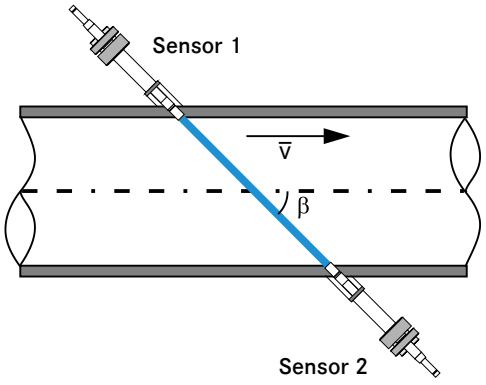
## Fields of application

The ultrasonic flowmeter is an advanced measuring system which essentially meets the requirements for accurate and stable measurements. These include:

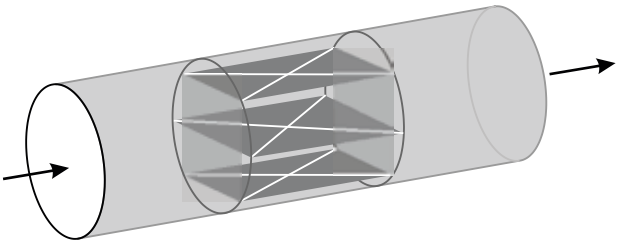
- Wide measuring ranges which allow the ultrasonic flowmeter to be used even in measuring stations where flow rates vary greatly.
- Virtually no pressure loss during operation due to the fact that no components are located within the cross section of the pipe.
- Safe against overloading since the gas meter has no sensitive components.
- Short response time due to the entirely electronic measuring method.
- High accuracy of measurement thanks to multistage correction methods.
- Bidirectional measurements, i.e. measurements in both directions with automatic detection of the flow direction and separated totalizers for both directions. Ideal for underground storage facilities where the same line can be used for storing gas and withdrawing it.

## Method of operation

The USZ 08 ultrasonic flowmeter measures the flow velocity of the gas via the transit times of ultrasonic pulses and calculates the flow rate at measurement conditions therefrom. Here use is made of the fact that ultrasonic pulses move faster in the direction of flow than in the opposite direction.




Each sensor is an emitter and a receiver at the same time. Measurements are taken alternatively in both directions, i.e. after a transit time has been measured, the emitter becomes the receiver and vice versa. In this way, the impact of the velocity of sound which depends on the gas type, pressure and temperature is eliminated.
In order to take the flow profile into account, measurements are taken using a total of 6 acoustic paths in 3 parallel planes. In each plane, there are 2 paths crossing each other.
The arrangement of paths according to Gauss-Chebyshev guarantees optimum measurements of the flow velocity even in the case of asymmetries, swirl and crossflows. In addition, these variations of the ideal flow profile can also be measured, i.e. a flow diagnosis can be made.



## Construction

The USZ 08 ultrasonic flowmeter consists of the measuring element, i.e. a case with the 12 sensors, the electronic measuring system and the ultrasonic computer.
The sensors are directly attached to the case through flanges and do not extend into the pipeline. The arrangement of the paths is symmetrical with regard to the centre of the gas meter, so that the latter can be used for both directions of flow without being modified or reprogrammed.
The electronic measuring system, which is located directly on the meter case, controls the sensors, evaluates the measuring results and calculates the flow velocity for each acoustic path. There are two variants available: A version where the electronic system on the meter case calculates the flow rate and has its own totalizers and pulse outputs, and a version with an external ultrasonic computer.
The ultrasonic computer with its corrector function in the electronics compartment is digitally connected to the electronic measuring system of the gas meter. Here the meter readings for volumes at measurement and base conditions for forward and backward flows can be found and here it is possible to read and change the measuring parameters.

## Features

- **Suitable for operating pressures from 1 bar.**
- **Pressure stages:**
  PN 10/16 (optionally, PN 100, PN 250), ANSI 150, ANSI 300, ANSI 600 (optionally, ANSI 900, ANSI 1500).
- **Nominal diameters from DN 100 to DN 1000.**
- **High flow velocities**
  result in smaller nominal diameters of the gas meters.
- **Verification with air in conjunction with high-pressure testing**
  possible as per Technical Directive G7.
- **Suitable for use in Zone 1.**
  The meter is explosion-proof, available approvals: IECEx, ATEX (Ex d IIC T5/T6) and CSA.
- **Measurements are possible in both directions.**
  There are several totalizers available for measuring forward and backward volumes separately.
- **Proven Piezo sensor technology.**
- **One type of sensor for all pressure ranges.**
- **Robust sensors.**
  The ultrasonic sensors have a metal enclosure (titanium).
- **Long-term stability of measurements.**
- **Insensitive to soiling.**
  Since measurements are taken without sound reflection, dirt deposits on the pipe wall have no impact on the ultrasonic pulses. Furthermore, the titanium sensor surface is dirt-repellent.
- **Independent of pressure variations,**
  since the flow velocity is measured directly and no transmission of force or fluid-mechanical effects are required for measurement.
- **Easy to operate**
  through the USZ 2000 ultrasonic control computer, a device from the ERZ 2000 Flow Computer Series.
- **Design variant with totalizers on the meter case.**
  Thanks to pulse outputs, the gas meter can be connected to any gas volume corrector.
- **Almost no pressure loss.**
- **Sensor replacement without recalibration.**
- **Sensors can be replaced in pressurized condition (option).**
- **Dry calibration for special applications.**



## Approvals

The USZ 08 ultrasonic flowmeter has been approved for custody transfer gas metering with operating pressures **from pabs=1 bar** and nominal diameters up to DN 600. Verification is made in compliance with Technical Directive G7.

Available metrological approvals:
PTB, approval as per the European Measuring Instruments Directive (MID), Measurement Canada (MC).

## Installation

The USZ 08 can be installed either horizontally or vertically. An inlet pipe of 10 DN and an outlet pipe of 3 DN in length are required. When a perforated-plate flow straightener is used, this reduces the length of the inlet pipe to 5 DN. Any pipe sections with the same nominal diameter may be used as inlet or outlet pipes. The inside diameter may be smaller by a maximum of 2% or larger by a maximum of 5% than that of the gas meter.
In comparison to a turbine meter, it is possible to choose the next smaller nominal size due to the possible high flow velocities of up to 40 m/s, while the flow rate remains the same, and thus, the measuring line can be reduced in length.
Temperature transmitters for PTZ correction are installed in the outlet pipe, 1.5 to 5 DN downstream of the gas meter, in the case of bidirectional measurements at a distance of 3 to 5 DN.

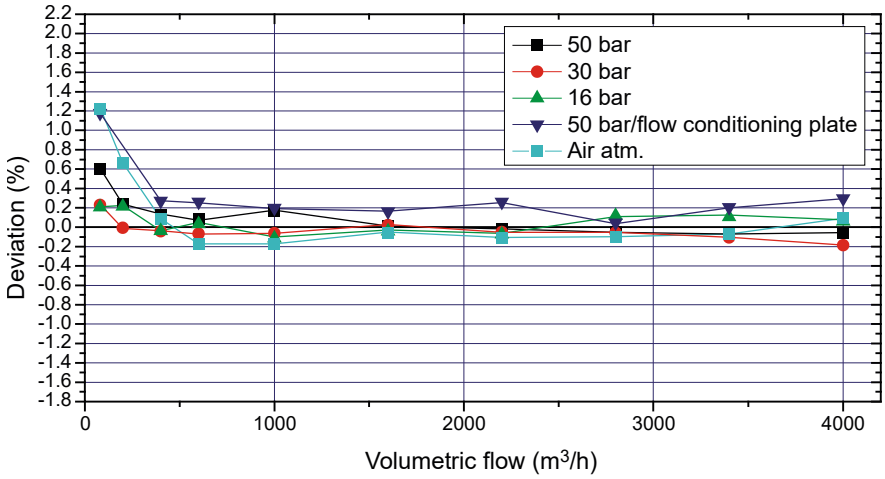
## 6-path technology

The six acoustic paths with their specific arrangement have the following decisive advantages over 3- or 4-path meters:

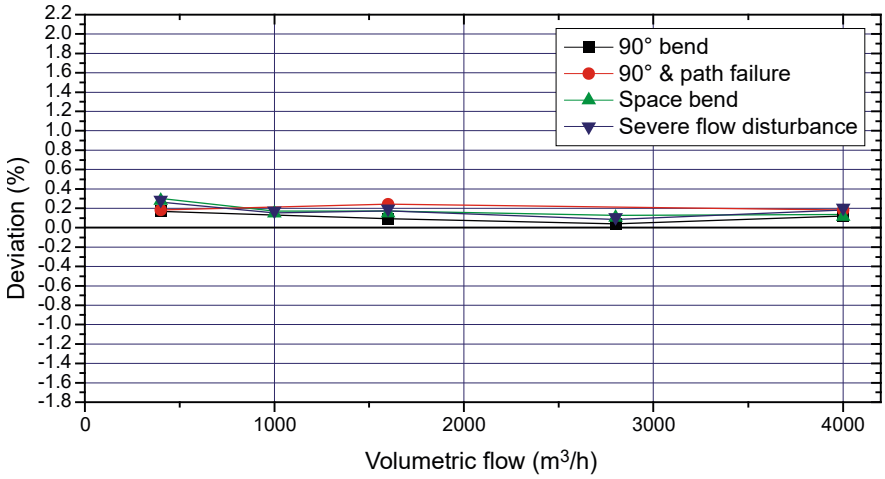
- **Insensitivity:** The path arrangement according to Gauss-Chebyshev with its crossed paths makes the gas meter largely independent of the flow profile. Thus, a high accuracy of measurement is achieved without a flow straightener even in the case of flow disturbances causing swirl, asymmetry or crossflow.
- **Redundancy:** The 6-path meter will not lose its custody transfer metering capability if any one or two of its acoustic paths fail. The failed paths will be reconstructed by means of a replacement-value function learned by the gas meter using the measuring results of all functioning paths.
- **Transferability:** The more acoustic paths a meter has, the better the results achieved on the test stand can be transferred to real on-site conditions. This was found out in studies conducted in the USA.

## Accuracy of measurement

The basic features, such as the path geometry, 6-path technology and signal amplitude, permit the gas meter to achieve a high accuracy of measurement. Additionally, two-stage error curve linearization can be made, which will even increase accuracy. The first correction uses the calibration curve from air testing, and the second correction the results from high-pressure testing. There will be no offset of the curves for various pressures.
Flow disturbance tests have shown that the error of measurement for common disturbances in gas measuring stations is within half of the error range. This is illustrated by the calibration curves below.
The measured and diagnostic values are constantly monitored and an alarm message is outputted if a fault occurs.
Thus, the USZ 08 meets the specifications of the standards for ultrasonic flowmeters, such as AGA 9 and ISO 17089.




USZ 08 ultrasonic flowmeter
6 acoustic paths
DN 200 / ANSI 600
Measurements in January 2007
without polynomial correction




USZ 08 ultrasonic flowmeter
6 acoustic paths
DN 300 / ANSI 600
Measurements in March 2006
without polynomial correction

## Sensors

Each sensor consists of a piezoelectric crystal fitted into a titanium housing. This metal is not only particularly strong but also dirt-repellent.
The sensors operate with a frequency of 120 kHz (200 kHz for DN 100 and DN 150), which makes it possible to measure flow velocities of up to 40 m/s. Thanks to a high signal amplitude and the resulting favourable signal-to-noise ratio, ultrasonic noise which may be created by gas pressure regulators at this frequency has only a minor impact on measurements.

## Ultrasonic control computer

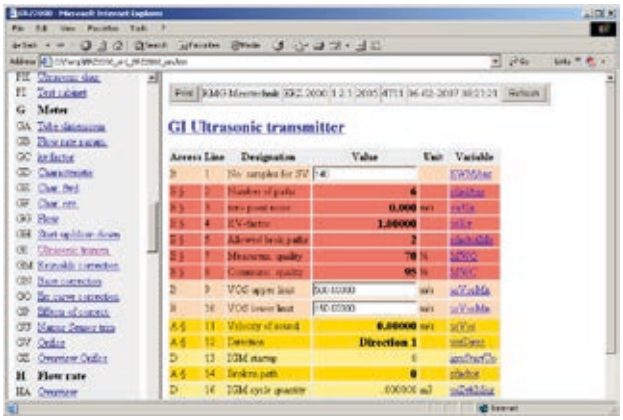
The ultrasonic flowmeter is operated through the control computer which controls measurements, calculates the flow rate and provides the meter readings. All operating parameters are stored here: The official parameters under legal control are protected by a sealable switch, whereas all the other parameters are protected by a code number.


The ultrasonic control computer is a variant of RMG's ERZ 2000 flow computer. It has the following features:

- Integrated corrector function, alternatively for PTZ or density correction. The volume measured is transmitted either digitally or via volume pulse outputs (for wards and backwards).
- TCP/IP interface for reading out data, parameterization or servicing.
- Error curve linearization, i.e. correction of the error of measurement using the error curve obtained during high-pressure testing, is possible.
- Archives for meter readings and measured values for pressure and temperature as well as logbooks for events and parameter changes.
- Interfaces for MODBUS and DSfG bus.
- Rack-mounting case for installation in 19" subracks.
- Installation at a distance of up to 500 m from the measuring element is possible.
- 4 electrically isolated and user-programmable current outputs.

## Operation

The ultrasonic flowmeter is operated through the ultrasonic control computer, i.e. either via the keyboard or a PC connected which is even more convenient.
All configuration data and measured and calculated values are stored in an easy-to-survey table. All cells of this table can be reached by pressing arrow keys and thus they can be displayed and changed. Moreover, major variables, such as the meter reading, can be directly accessed by pressing a single key.
Thanks to the TCP/IP interface, the ultrasonic computer can be included in a network or directly connected to a PC. Then operation is performed through any internet browser. Thus, no special operating program is required.

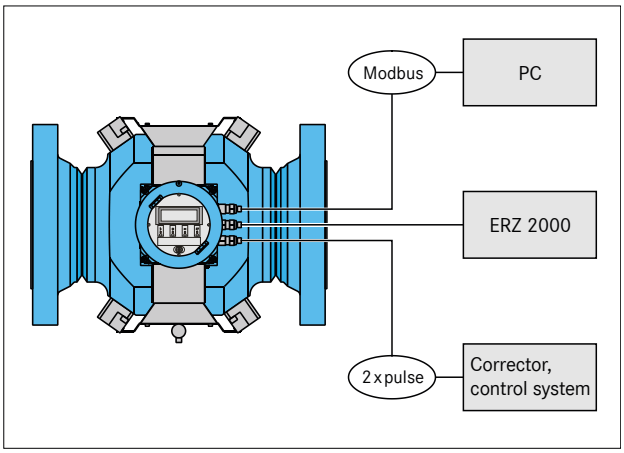


## Operating the ultrasonic flowmeter without an ultrasonic computer

The electronic ultrasonic system of the standard version has been designed to operate in conjunction with the ERZ 2000 flow computer as a flow computer. In this case, the flow computer is digitally connected to the electronic ultrasonic system and thus it can access its parameters. The ultrasonic flowmeter can optionally be operated via the RMGView diagnostic software. A Modbus interface (RS 485) is available for communi-cation with the PC. An RS 485 to USB adapter can be delivered as accessory.

By enhancing the electronic system, the USZ 08 can be operated without an ultrasonic computer. The add-on board includes a display showing the meter readings and the major measured values and parameters. The display is fitted in an explosion-proof (Ex-d) housing with a glass lid and can be operated using a magnetic pen. Two volume pulse outputs allow the USZ 08 to be connected to any appropriate gas volume corrector. Furthermore, there is a programmable current output (0/4-20 mA) available.

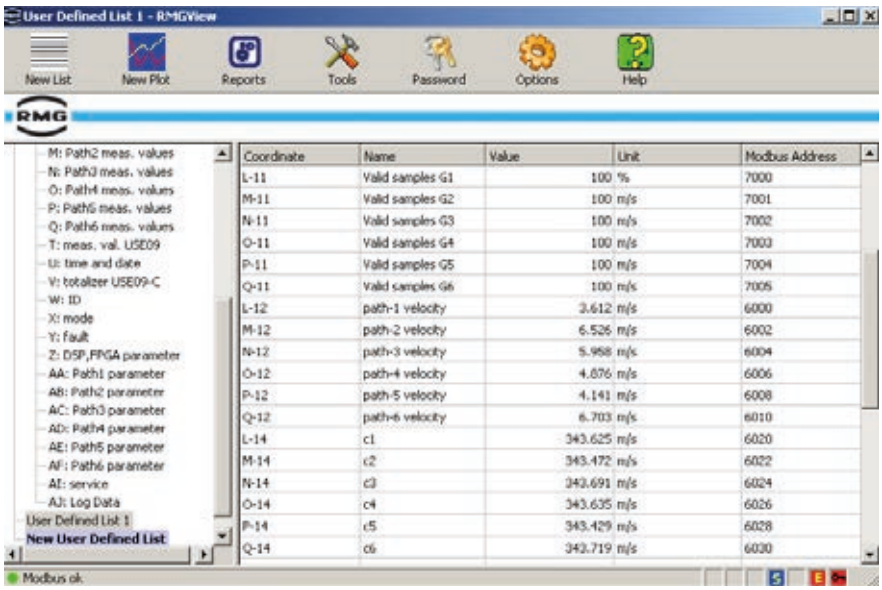
Both designs have digital outputs for alarms and warnings and, in the case of bidirectional measurements, for the direction of the gas flow.




## RMGView diagnostic software

The RMGView software supplied together with the ultrasonic flowmeter allows the electronic measuring system to be directly accessed with a PC. Using the program, it is possible to:
- read out all parameters;
- change parameters (if the calibration switch is enabled);
- represent measured values graphically;
- create test certificates and data sheets and output them as PDF files.

The software is easy to use and all the data is displayed systematically in clearly arranged tables. It is also possible to combine selected measured values and parameters in user-defined tables.




### Representation of parameters

Similar to the ultrasonic computer, the USE 09 electronic ultrasonic system has a parameter table.
It is possible to combine selected parameters in a user-defined table.
All quantities measured can also be represented graphically. It is possible to select and display the relevant measured quantities. Graphics and measured values can also be exported.

## Measuring ranges and dimensions

| DN mm (in) | Measuring range $m^3/h$ | | Inside diameter mm | Dimensions mm | | | Max. weight [1] kg |
|---|---|---|---|---|---|---|---|
| | $Q_{min}$ | $Q_{max}$ | | Length | Width | Height [2] | |
| 100 ( 4”) | 13 | 1000 | 102 | 300 | 400 | 330 | 90 |
| 150 ( 6”) | 20 | 2500 | 150 | 450 | 410 | 350 | 140 |
| 200 ( 8”) | 40 | 4000 | 202 | 600 | 530 | 360 | 260 |
| 250 (10”) | 65 | 6500 | 255 | 750 | 590 | 390 | 400 |
| 300 (12”) | 80 | 10000 | 303 | 900 | 640 | 420 | 530 |
| 400 (16”) | 130 | 16000 | 378 | 1200 | 710 | 450 | 885 |
| 500 (20”) | 200 | 25000 | 476 | 1500 | 820 | 530 | 1465 |
| 600 (24”) | 320 | 40000 | 570 | 1200 | 940 | 510 | 1500 |
| 700 (28”) | 400 | 55000 | 682[3] | 1200 | 980 | 560 | 1730 |
| 800 (32”) | 600 | 70000 | 787[3] | 1500 | 1100 | 620 | 2100 |
| 900 (36”) | 750 | 90000 | 889[3] | 1500 | 1250 | 680 | 2530 |
| 1000 (40”) | 900 | 110000 | 990[3] | 1500 | 1350 | 740 | 2950 |

[1] For ANSI 600 pressure stage [2] Measured from centre line of pipe [3] Special designs, data can change

| Technical data | | |
|---|---|---|
| **Uncertainty:** | | < ± 0.25% of the value measured (from 10% to 100% of $Q_{max}$)<br>< ± 0.15% with high pressure calibration |
| **Reproducibility:** | | ≤ 0.1% |
| **Ultrasonic frequency:** | | 120 kHz/ 200 kHz |
| **Measuring interval:** | | 1 update / s |
| **Flow velocity:** | | 0.3 to 40 m/s (each direction) |
| **Gas temperature range:** | | -20° to +55°C (optional -40°C to +55°C) |
| **Power supply:** | | 24 V/DC |
| **Power requirement:** | | Measuring element: < 15 W, computer: 35 W |
| **Measured-value transmission (ERZ 2000):** | | - DZU-interface (RS 485)<br>- 2 pulse outputs<br>- current outputs (user-programmable, 0/4-20 mA, electrically isolated) |
| **Explosion protection** | ATEX<br>IECEx<br>CSA | II2 G Ex de IIC T5/T6 / BVS 07 ATEX E 003 (sensor), BVS 07 ATEX E 035 (electr.)<br>II2 G Ex de IIC T5/T6 / IECEx 10.0001 (sensor), IECEx 09.0034 (electronics)<br>Class 225802, 225882 / Cert. 2156089 |
| **Protection class:** | | IP 65 |

**For More Information**

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

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