

USM GT400 Ultrasonic Flowmeter



The multipath meter with multiple advantages

The ultrasonic meter USM GT400 from RMG delivers highest accuracy and reliability based on field proven six path technology. Designed for use in a wide range of gas custody transfer and secondary metering applications, the GT400 measures directly bulk flow rate, swirls, cross-flow and asymmetry. Its patented live precision adjustment/echo measurement reduces metering uncertainty. **Now also available with 3" diameter.**

Proven Technology. Superior Performance.



Rely on RMG

- Over 150 years of combined experience in the natural gas industry
- Global domain expertise with local support
- Broad suite of products, from single instruments to turnkey solutions
- Seamless integration with plant-wide automation and security
- Guaranteed compliance and accuracy in custody transfer



To remain competitive, today's natural gas industry is under pressure to reduce capital and operating costs, improve uptime and reduce risk. Reduction of workforce, more automation and aging workforce, with nearly half of employees skilled in control and regulatory technologies are expected to retire over the next years. Often, end users must cope with challenges such as high gas pressure or temperature, valve noise, and attenuation of signal due to contamination or the presence of liquids. This requires intelligent solutions to maintain accuracy while transferring gas between the distributor and the recipient.

Accuracy Ensured

The USM GT400 ultrasonic flowmeter from RMG provides high accuracy, reliability and long-term stability in the most demanding environments.

Proven Technology

Today, intelligent solutions are needed to measure and analyze the quality and volume of natural gas at every stage of its movement, storage and utilization. Gas industry organizations can meet this requirement with RMG's Regulating and Metering product lines, which are available individually or as complete systems for gas metering stations. RMG has more than 150 years of experience, supplying solutions to the major gas transmission companies in Europe and Asia.

Application Know-how

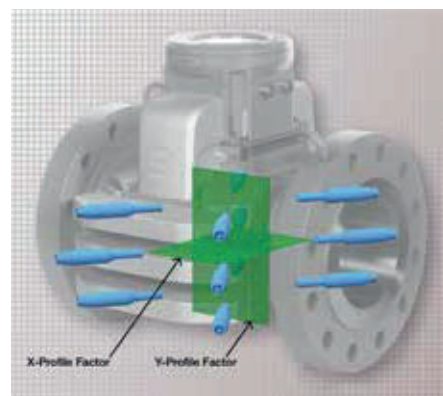
We partner closely with industrial, commercial and gas distribution customers to provide the right flow measurement solution to optimize operations at gas-fired power plants, liquefied natural gas (LNG) storage and export terminals, city gate facilities, petroleum refineries, metals and mineral processing plants, combined heat and power generation facilities, and all sites utilizing natural gas as a feedstock.

Expert Support

Our gas industry experts assist with developing standard operating procedures (SOPs) for gas metering station installations, validation routines, calibration procedures, and more. Integrated ultrasonic gas meters with control or SCADA platforms and data collection systems help you interpret meter diagnostics and troubleshoot operating problems.

Local Service

You can depend on RMG for long-term product reliability and performance, lowest total cost of ownership and installation. Global experience, locally applied.



RMG's advanced 6 Cross ("X") path technology

A Better Solution

RMG's USM GT400 is an intelligent ultrasonic flowmeter which meets today's strict requirements for accurate and stable measurements in gas industry operations. It's a multipath meter with multiple advantages: a field-proven electronics, sophisticated diagnostics, user-friendly software to monitor the health of the flow metering system and a superior six-path measuring technique. RMG's six-path technology has been proven in demanding applications across the industry for more than a decade.

Typical applications include:

- Fiscal metering
- Low-pressure custody/non-custody (atmospheric) transfer
- Allocation metering
- Check metering
- Gas transportation and distribution
- Underground gas storage (bi-directional)
- Gas-fired power plants
- Gas processing plants
- Refining and petrochemicals
- Industrial



120 kHz transducer

For natural gas processes with dry, wet, or corrosive and abrasive gases, or requiring bi-directional measurement with minimal or no pressure drop, ultrasonic devices generally offer better performance, greater reliability, and lower capital and ownership costs than mechanical metering technologies.

Features and Functions

Over the past 20 years, ultrasonic flowmeters have been recognized as the device-of-choice to measure natural gas volume for fiscal accounting. Acceptance by gas pipeline companies has occurred due to the meter's superior precision, repeatability, capacity and rangeability, as well as its lower maintenance costs. Ultrasonic flowmeters employ robust transducers generating repeatable pulses (amplitude and frequency). They also include high-speed electronics complete with an accurate clock to detect, resolve and time transmission/reception of sonic pulses with sufficient time domain resolution. The meters' transducer and electronics configuration permits high pulse transmission rates, and transit time measurement allows rapid integration of fluid flow velocity so accurately measured values can be reported once per second.

The most important development in ultrasonic technology in recent years has been the development of multipath meters, which are designed to average axial velocity components over the cross-section of a closed pipe. Design and performance of ultrasonic flowmeters are defined in international standards e.g. ISO 17089 and AGA 9. USMs are the technology of choice for custody transfer metering and approved acc. to MID, Measurement Canada and further national approval bodies.

Proven Six-path Technology

The GT400 is designed with high stability against turbulence thanks to its direct path technology with six measuring paths on three levels. The paths are arrayed in an "X" pattern in horizontal planes: a central plane, and two geometrically similar planes. This orientation permits measurement of swirl, cross-flow and asymmetry, as well as transparent path velocity weighting per the Gauss-Chebyshev profile model for compressible fluids. It is particularly beneficial in city gate applications, where limited space for piping and installation can affect meter operation.

Field-proven Electronics

The GT400 incorporates electronics that have improved metering system uptime in installations worldwide. The electronics are used to optimize the meter's internal diagnostics; speed of sound (SoS and flow velocity calculations; signal processing; data storage; interface to flow computers, gas chromatographs and SCADA systems; and field service diagnostics tools.

Plug & Play Transducer Design

At the heart of the GT400 are its transducers, which transmit and receive sound waves or acoustic pulses. The transit time difference between pairs of transducers is the most significant aspect of meter operation. With the GT400, all path-specific measurements are handled internally by the electronics.

RMG's Exd transducer consists of piezoelectric crystals fully encapsulated in Titanium housing for resistance to contamination.

This unique design is plug & play and field-replaceable under pressure. The transducer operates at standard frequencies of 120 or 200 kHz for use in most gas metering applications. is -40°C to $+80^{\circ}\text{C}$ (-40°F to $+176^{\circ}\text{F}$) and pressure range is 1 bar to 300 bar (14,5 psi to 4351 psi). Wide measuring ranges (120:1 and above) with correspondingly high flow velocities of more than 40 m/s (131 ft/s) are also possible.

Proprietary Detection Algorithm

The GT400 utilizes numerous criteria to validate pulses without compromising high firing rates (pulses per second). One of the criteria common to many instrumentation suppliers, including RMG, is peak identification and quantization of position and amplitude in the pulse envelope. However, most companies avoid the use of comparative analysis of pulses, or "stacking," since it is a burden on signal processing in noisy and turbulent environments—resulting in either data refresh rates exceeding one second, or a reduction of evaluated samples falling below statistical acceptability.

To improve its signal process capabilities, RMG implemented additional qualitative analysis to evaluate the pulse envelope and identify ultrasonic pulses, while still maintaining high firing rates. Our proprietary, MID-approved detection algorithm is key to insensitivity to regulator noise in many installations.



RMGView^{USM} facilitates real-time performance monitoring

Advanced Noise Immunity

In a gas pipeline system, noise generated by piping configurations, valves, pressure regulators and nozzle jetting can impede the performance of some ultrasonic flowmeters. RMG addressed this problem with its proprietary MID-approved signal processing algorithm and unique Exd-rated transducer design, which work together to extend signal amplitude for a high signal-to-noise ratio (SNR) in comparison to traditional intrinsically safe transducers. Noise created at ultrasonic frequencies has marginal impact on the USM's measurements.

Precision Delay Time Adjustment

For users of ultrasonic flowmeters, the test for system delay time and adjustment described in AGA 9 (6.3) is a critical requirement. Besides the time-of-flight of the ultrasonic pulses, delay times caused by signal-processing electronics, properties of the transducers and calculation algorithms can occur within the system. These delay times must be determined by laborious measurement techniques at the factory, since they cannot be identified directly.

RMG's patented "live" Precision Adjustment/Echo Measurement capability enables the most precise adjustment of delay time and avoids the disadvantages of related testing procedures. It also preserves measurement uncertainty resulting from in-situ auto calibration of system delay (T_w) after field replacement of transducers.

Intelligent Diagnostic Technique

One of the key advantages of ultrasonic flowmeters over all other flow measurement technologies is the availability of diagnostic information beyond just delivering pulses or signals proportional to the gas volume.

RMG offers the WindowsTM-based RMGView^{USM} parameterization and diagnostics software as an interface to robust condition monitoring capabilities. This application is easy to use and all data is displayed systematically in clearly arranged tables. It is also possible to combine selected measured values and parameters in user-defined tables.

First, RMGView^{USM} monitors the health of the GT400 and warns if there are any pending problems.

Monitoring the health of the GT400: The parameterization and diagnostics software RMGView^{USM}. It is easy to use thanks to intuitive user interface.

Secondly, it monitors the gas process and alerts when there are any upset conditions e.g. pipeline contamination, blockages or liquids in the gas stream. Thirdly, the software monitors calculated metering uncertainties and provides alarm notification.

Intuitive User Interface

Supplied with the GT400, RMGView^{USM} allows direct access to the electronic measuring system via a PC to read out all parameters; change parameters (if the calibration switch is enabled); represent measured values graphically; and create test certificates and data sheets, and output them as PDF files. The software facilitates real-time performance monitoring of all diagnostic parameters e.g.:

- Monitoring of AGC levels
- Indication of flow profile
- Monitoring of turbulence (profile factor)
- Comparison of the SoS of each path
- Identification of signal quality
- Comparison of SoS (per AGA 10) to estimated velocity of sound from the composition of natural gas and measured velocity of sound from the ultrasonic meter
- Monitoring the swirl angle



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Thanks to the GT400, your business can realize significant benefits affecting your bottom line. These improvements are key to increased productivity – and profitability – in an increasingly competitive marketplace.

Benefits to Your Business

The GT400 provides improved overall performance thanks to:

- Rugged, non-intrusive design
- Bi-directional measurement
- Real-time system measurement
- Direct path design
- Six-cross acoustic paths
- Direct “cross flow” measurement
- Dynamic 3-D flow profile modeling
- Extended diagnostic functions
- Precise flow profile identification
- Enhanced swirl and asymmetry measurement
- Best-in-class Exd transducer
- Superior noise suppression
- No moving parts or pressure drop
- Wide turndown ratio (>120:1)
- Low-to-high-pressure operation (0-300 barg, 0-4351 psig)
- Extended flow range (0.15-40 m/s , 0.5-131 ft/s)
- Excellent repeatability and measurement certainty

Lower CAPEX

With the GT400, users can reduce the cost of implementing an advanced gas metering system. This is partly due to the ability to employ smaller size meters with higher flow velocity, greater rangeability and extended turndown. The USM's crossed path arrangement also enables high-accuracy measurement without the need for long inlet piping. A single ultrasonic meter can often replace dual turbine meter runs in low- and high-flow applications. In addition, the USM's improved signal conditioning capabilities help do away with expensive noise reduction infrastructure.

Reduced OPEX

The GT400 is our recommended answer to driving down maintenance and repair costs at gas metering sites. It is a non-mechanical device with no moving parts. The meter's operation is not directly impacted by contamination on the pipe wall, and the inclusion of high-reliability transducers – proven in service since 1999 – minimize the need to send technicians to the field.

Improved Uptime

Natural gas facilities can avoid unplanned shutdowns and loss of production with ultrasonic technology. The flowmeter's rugged transducer features two-path redundancy (MID-approved) for greater reliability in extreme situations. Its Titanium sensor surface is also contaminant-repellant, so personnel no longer have to shut down processes to allow for cleaning. Plus, the unit's plug & play design shortens the time required to exchange sensors.

Reduced Risk

RMG's knowledgeable subject matter experts work with customers on all aspects of product and application planning for ultrasonic flowmeter installations. We recognize the critical importance of service and support delivery throughout the entire project lifecycle. Our authorized field technicians can assist with start-up, commissioning and field service.



A Trusted Partner

RMG is one of the few manufacturers that provide metering and regulating solutions for the worldwide natural gas market. With personnel working in key industry locations, including unmatched local technical support, RMG is your single-source partner for the gas value chain. From detailed engineering, to project execution and training for operators and field technicians, you can trust RMG to help make your project more successful – and your operation more profitable.

Technical Specification

| Technical Data | |
|---|--|
| Gases | Pipeline Quality Natural Gas, Air |
| Measurements | Volume Flow, Totalized Volume, Velocity of Gas, Speed of Sound, Swirl |
| Sizes | DN 80-600 / 3", 4", 6", 8", 10", 12", 16", 20", 24" (ANSI 600); Consult RMG for sizes > 24". |
| Path Configuration | 6 Direct Cross ("X") Path; 3 Planes |
| Measurement uncertainty (from Q_1 to Q_{max}) Dry calibration with Nitrogen acc. AGA 9 HP-flow calibration. Full measuring range (Q_1 to Q_{max}). | +/-0.5% +/-0.1% |
| Repeatability | +/- 0.1% |
| Operating Pressure Range | 1 bar (14.5 psi)..... 300 bar (4351psi) |
| Flanges | up to ANSI600; Consult RMG for higher design pressure |
| Ambient Temperature | -40°C (-40°F) to +55°C (131°F) |
| Gas Temperature Range | -40°C (-40°F) to +80°C (176°F) |
| Operating Relative Humidity | up to 95% condensing |
| Measuring Interval | Typically 32 measurements/sec |
| Power supply | 24 V/DC +/- 10% |
| Power requirement | Typically 7 W |
| Hazardous Area Approvals | ATEX: Ex II 2G Ex de IIB + H2 T6; IECEx: Ex de IIB + H2 T6 Gb CSA, FM: Class I, Div 1, Groups B, C, D T6 |
| Metrology Approvals | MID, PTB, Measurement Canada |
| Conformities | AGA 9, ISO 17089, OIML 137-2012 |
| Electrical Safety | EMV, Environmental |
| Analog output | 0/4-20 mA (galvanically isolated, programmable, load resistor: max. 400 Ohm, $U_{max} = 16$ V) |
| Frequency outputs | 2 HF-outputs with $f_{max} = 5$ kHz, Namur or Open Collector |
| Digital I/O | 2 X Programmable |
| Analog input for P&T | Galvanically isolated two-wire 4-20 mA p-transmitter or a 4-wire PT100 |
| Interfaces RS 485-0 RS 485-1 RS 485-2 | Service port with MODBUS-Protocol; RMGView ^{USM} (max. cable length: 500m / 1640ft); Ethernet via external module Serial connection to RMG's ERZ 2000-NG Flow Computer MODBUS-protocol for interfacing with Third-Party Flow Computers, SCADA; Ethernet via external module |
| Transducer Frequency | 120 kHz/200 kHz for Sizes ≥ 8 " (DN 200) 200 kHz for Sizes ≤ 6 " (DN 150) |
| RMGView^{USM} Diagnostics Software | Visualization, flow data, diagnostics, configuration, parameter changes, export/import of parameters and data |
| Protection | IP66 |
| Meter Body Material | Casted Steel; CS ASME A352 gr LCC |
| Material Electronics Housing | Aluminum cast |
| Color/Finish | Blue (RAL 5012) and metallic silver (RAL 9006) |
| Installation outside | With weather protection cover and sun roof |
| Remarks | Consult RMG for special requirements |

Technical Specification

High pressure > 4 bar/58 psi

| Measuring Range | Q _{min} | | Q _{min extended} | | Q _{max} | | Q _{min} | | Q _{min extended} | | Q _{max} | |
|-----------------|------------------|------|---------------------------|-------------------|------------------|---------|------------------|-------------------|---------------------------|-------------------|------------------|-------------------|
| | ft/s | ACFH | ft/s | ACFH | ft/s | ACFH | m/s | m ³ /h | m/s | m ³ /h | m/s | m ³ /h |
| DN 80/3" | 1.07 | 177 | 0.54 ¹⁾ | 89 ¹⁾ | 128.24 | 21186 | 0.33 | 5 | 0.17 ¹⁾ | 2,5 ¹⁾ | 39.1 | 600 ²⁾ |
| DN 100/4" | 0.98 | 283 | 0.49 ¹⁾ | 142 ¹⁾ | 122.82 | 35315 | 0.30 | 8 | 0.15 ¹⁾ | 4 ¹⁾ | 37.4 | 1000 |
| DN 150/6" | 1.08 | 706 | 0.54 ¹⁾ | 353 ¹⁾ | 129.93 | 84755 | 0.33 | 20 | 0.17 ¹⁾ | 10 ¹⁾ | 39.6 | 2400 |
| DN 200/8" | 0.99 | 1130 | 0.50 | 565 | 129.89 | 148322 | 0.30 | 32 | 0.15 | 16 | 39.6 | 4200 |
| DN 250/10" | 0.98 | 1766 | 0.49 | 883 | 129.91 | 233077 | 0.30 | 50 | 0.15 | 25 | 39.6 | 6600 |
| DN 300/12" | 0.97 | 2472 | 0.49 | 1236 | 130.78 | 331958 | 0.30 | 70 | 0.15 | 35 | 39.9 | 9400 |
| DN 400/16" | 1.05 | 4238 | 0.53 | 2119 | 131.73 | 529720 | 0.32 | 120 | 0.16 | 60 | 40.2 | 15000 |
| DN 500/20" | 1.01 | 6357 | 0.51 | 3179 | 131.37 | 829895 | 0.31 | 180 | 0.16 | 90 | 40.0 | 23500 |
| DN 600/24" | 1.01 | 9182 | 0.51 | 4591 | 131.52 | 1200699 | 0.31 | 260 | 0.16 | 130 | 40.1 | 34000 |

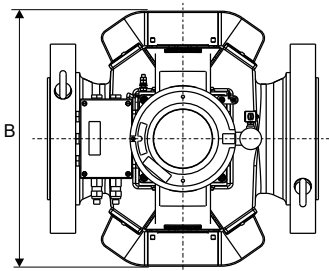
¹⁾ In preparation

²⁾ with extended measuring range: Q_{max} = 650 m³/h

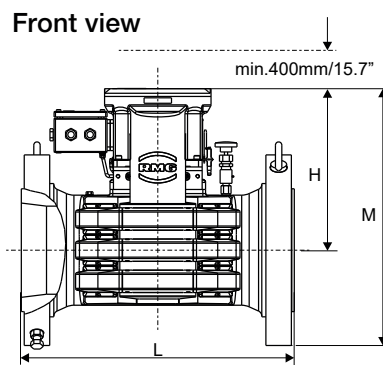
| Meter Dimensions ³⁾ | Diameter | Pressure Class | Length | | Height (H/M) | | Width (B) | | Weight (ca.) | |
|--------------------------------|------------|----------------|--------|------|--------------|-----------|-----------|------|--------------|-------|
| | | | (mm) | (in) | (mm/in) | (mm/in) | (mm) | (in) | (kg) | (lbs) |
| | DN 80/3" | ANSI 600 | 240 | 9 | 328/12.9 | 435/17,1 | 418 | 16 | 75 | 165 |
| | DN 100/4" | ANSI 600 | 300 | 12 | 330/13.0 | 470/18,4 | 430 | 17 | 100 | 220 |
| | DN 150/6" | ANSI 600 | 450 | 18 | 340/13.4 | 520/20.4 | 470 | 19 | 160 | 353 |
| | DN 200/8" | ANSI 600 | 600 | 24 | 360/14.2 | 570/22.4 | 530 | 21 | 300 | 662 |
| | DN 250/10" | ANSI 600 | 750 | 30 | 380/15.0 | 635/25.0 | 650 | 26 | 450 | 992 |
| | DN 300/12" | ANSI 600 | 900 | 35 | 395/15.6 | 675/26.6 | 700 | 28 | 550 | 1213 |
| | DN 400/16" | ANSI 600 | 1200 | 47 | 500/19.7 | 845/33.2 | 750 | 30 | 950 | 2094 |
| | DN 500/20" | ANSI 600 | 1500 | 59 | 550/21.7 | 960/37.7 | 900 | 35 | 1500 | 3307 |
| | DN 600/24" | ANSI 600 | 1200 | 47 | 550/21.7 | 1020/41.0 | 1000 | 39 | 1550 | 3417 |

³⁾ Consult RMG for sizes >DN600/24"

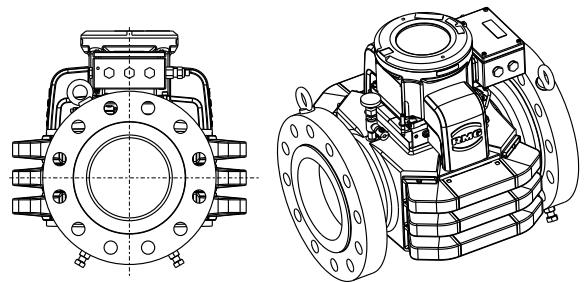
Top view



Front view



Side view



Technical data is subject to change without notice.

For More Information

To learn more about products and solutions from RMG, visit www.rmg.com or contact your account manager.

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