BAKER HUGHES
a GE company

DigitalFlow™ GF868

Panametrics Flare Gas Mass Ultrasonic Flowmeter with Extended Performance Range

Applications

The DigitalFlow GF868 flowmeter is a complete ultrasonic flow metering system for:

- Flare gas
  - Track down or prevent losses from leakage with positive material identification
  - Account for total plant throughput of material
  - Reduce cost of steam usage with proportional control
  - Conserve energy by eliminating unnecessary flaring
  - Comply with government regulations for pollution control
- Vent gas
- Hydrocarbon gases
- Biogases
- Digester gases

Features

- Measures velocity, volumetric and mass flow
- Standard velocity range to 100 m/s (328 ft/s) standard
- Extended velocity range to 120 m/s (394 ft/s) *
- Measures instantaneous average molecular weight
- Measures hydrocarbon gases
- Self-calibration check assures accurate worry-free operation
- Delivers accurate flow rate, independent of gas composition
- Measures very low to very high velocity
- Field-proven installation techniques
- Built-in totalizers
- Built-in power supply for pressure and temperature transmitters
- 4000 to 1 turndown ratio
- One or two channel/path configurations

* Velocity maximum may be higher in specific installations - consult with BHGE

Flare Gas Mass Flowmeter

The DigitalFlow GF868 ultrasonic flowmeter uses the patented Correlation Transit-Time™ technique, digital signal processing, and an accurate method of calculating molecular weight. Add to these features the inherent advantages of ultrasonic flow measurement reliability with no routine maintenance, high accuracy, fast response, wide rangeability and the DigitalFlow GF868 flowmeter is the clear choice for flare gas applications.

Correlation Transit-Time Technology is Ideal for Flare Gas Flow Measurement

The Correlation Transit-Time technique has distinct advantages over other methods of flare gas flow measurement, and it is used to solve a variety of difficult problems. Typically, gas in flare stacks, headers or laterals is a mixture of components from different sources. Flow rate in flare systems may be unsteady or even bidirectional. Pulsating pressure, varying composition and temperature, harsh environment, and wide flow range further complicate the measurement. The GF868 is designed for superior performance under these conditions.

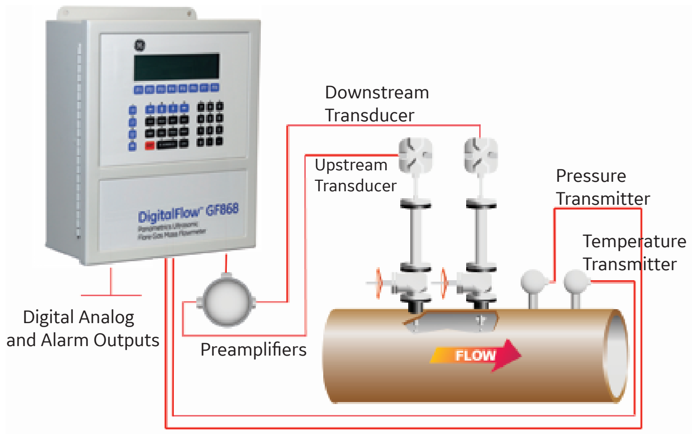
Patented Molecular Weight Measurement Method

The DigitalFlow GF868 uses a patented method for calculating the average molecular weight of hydrocarbon mixtures. This proprietary algorithm extends the range for measuring average molecular weight, while improving accuracy and compensating for nonhydrocarbon gases better than ever before possible. Higher accuracy mass flow data and more precise knowledge of flare gas composition can improve the efficiency of plant operation, enabling correct metering of steam injection at the flare tip, rapid troubleshooting of leaks into the flare stream, early detection of process control problems, and accurate plant balance.

Best Technology for Flare Gas

Ultrasonic flow measurement, the ideal technology for flare gas applications, is independent of gas properties, and does not interfere with the flow in any way. All-metal ultrasonic transducers installed in the pipe send sound pulses upstream and downstream through the gas.

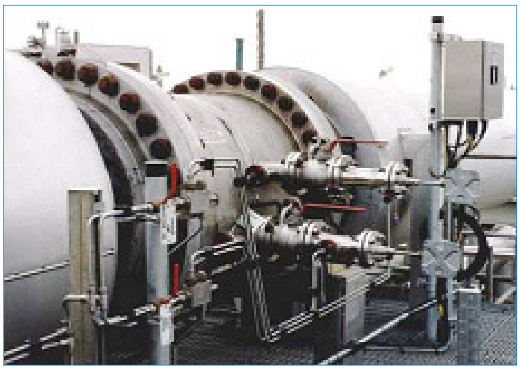
From the difference in these transit times between the transducers, with and against the flow, the DigitalFlow GF868's onboard computer uses advanced signal processing and correlation detection to calculate velocity, and volumetric and mass flow rate. Temperature and pressure inputs enable the meter to calculate standard volumetric flow. For maximum accuracy, use the two-channel version and measure along two different paths at the same location. The two-channel meter can also measure the flow in two separate pipes or at two different places on the same pipe.

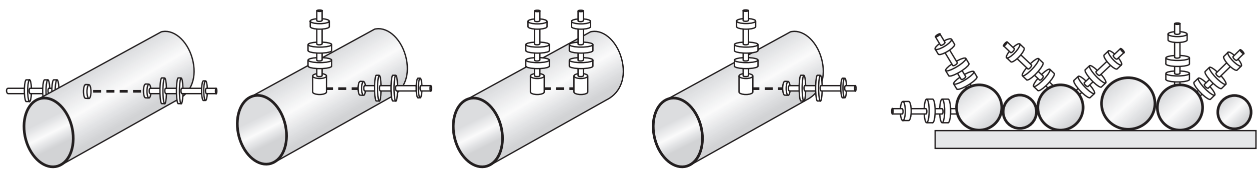


Typical meter set-up for standard volumetric or hydrocarbon mass flow

Simple Installation

The flowmeter system consists of a pair of transducers for each channel, preamplifiers, and an electronics console. The transducers can be installed as part of a flowcell, or directly into the pipe with a hot or cold-tapping procedure. The electronics console of the DigitalFlow GF868 meter can be located up to 1,000 ft (300 m) from the transducers.





Standard transducer mounting configurations

One Meter, Wide Range of Flow Conditions

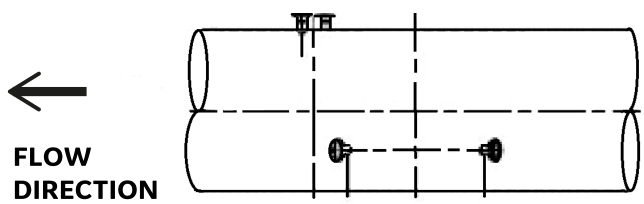
High Flow

The DigitalFlow GF868 meter achieves a new standard rangeability of 3280 to 1 and a new Extended Range rangeability of 4000 to 1. It measures velocities from 0.1 to 328 ft/s (0.03 to 100 m/s) standard in both directions, while the Extended Range version measures velocities to 394 ft/s (120 m/s) in one direction, in steady or rapidly changing flow, in pipes from 2 in to 120 in (76 mm to 3 m) in diameter. With this range of operation, one DigitalFlow GF868 flowmeter performs measurements under most of the conditions that may occur in a flare line on or offshore. The extended velocity range to 100 m/s is enabled in standard meters with no loss of accuracy.

DigitalFlow GF868 flow meter

Low Flow

For base load operation the volumetric flow in flares is often in the range 0.1 to 1 f/s (0.03 to 0.3 m/s) and the flare gas flowmeter improves the accuracy over that range, but still measures at high velocity during facility relief or upset conditions. Additional paths, longer paths, unconventional configurations and location of paths are used to achieve accurate low flow measurements. A single path or two path meter can be selected and optimized to meet both high flow and low flow measurement requirements.



Identify Leak Sources, Reduce Steam Usage and Improve Plant Material Balance

Leaks and excess steam delivery are two major causes of loss of product and energy. Reducing them immediately improves the overall efficiency in refinery and chemical plant operation. Payback for the entire DigitalFlow GF868 installation usually occurs within a matter of months. The DigitalFlow GF868 can help save millions of dollars in reduced losses.

Once the sound speed of the gas has been determined by the DigitalFlow GF868, its on-board computer uses temperature and pressure inputs in conjunction with the sound speed to calculate instantaneous average molecular weight and mass flow rate of the gas. These parameters are used to help identify sources of leaks into the flare system. Detection of even a small increase in flow rate into the flare system may indicate a leak source such as partially unseated relief valve. An accompanying change in the average molecular weight of the flare gas may be used to help locate the leak source. Quick identification and elimination of leak sources into the flare system saves significant amounts of potentially lost energy and product.

Mass flow rate may be used to perform a mass balance calculation and to control flare tip steam injection. By knowing the exact amount of gas flow and average molecular weight in the flare stack, delivery of the correct amount of steam required at the flare tip can be accurately controlled. Steam usage can be reduced while maintaining compliance with pollution control regulations.

Designed for Flare Gas Environment

The DigitalFlow GF868 flowmeter has no moving parts to clog or wear out. Its patented ultrasonic transducers are constructed of titanium or other metals that withstand the corrosive environment usually found in flare gas applications. The transducers are designed for use in hazardous locations. Wide rangeability allows measurement of flow rate from 0.1 up to 394 ft/s (0.03 to 120 m/s). In contrast to thermal flowmeters, the ultrasonic transit-time technique does not depend on the heat transfer coefficient of the flare gas and does not require regular maintenance. These and other features make the DigitalFlow GF868 unique among flare gas flowmeters.

Self-Calibration Check for Worry Free Operation

The DigitalFlow GF868 meter will perform daily heath checks using our proprietary algorithm, at the predetermined flowrates and hour chosen by operators. Depending on the self-health check result, the meter will output a PASS if the meter is working correctly or a FAIL if there is any critical failure. In the case of a problem, this will allow operators to know the status of the meter ahead of time and take actions accordingly. In addition, this will give regulatory authorities and meter operators confidence that the meter is functioning reliably and accurately.

GF868 Specifications

Electronics

Flow Measurement

Patented Correlation Transit-Time mode

Enclosures

- Standard: Epoxy-coated aluminum weatherproof Type 4X/IP66 Class I, Division 2, Groups A,B,C&D FM and CSA
- Optional: Stainless steel, fiberglass, explosion-proof, flameproof

Dimensions

- Weight 11 lb (5 kg)
- Size (h x w x d) 14.24 in x 11.4 in x 5.12 in (362 mm x 290 mm x 130 mm)

Channels

- Standard: One channel
- Optional: Two channels (for two pipes or two-path averaging)

Display

Two independent software-configurable 64 x 128 pixel backlit LCD graphic displays

Keypad

39-key tactile-feedback membrane

Power Supplies

- Standard: 100 to 130 VAC, 50/60 Hz or 200 to 240 VAC, 50/60 Hz
- Optional: 12 to 28 VDC, ±5%

Note: For DC-powered meters, Class 2 rated supplies must be used for the line power.

Power Consumption

20W maximum

Operating Temperature

–4°F to 131°F (–20°C to 55°C)

Storage Temperature

–67°F to 167°F (–55°C to 75°C)

Standard Inputs

Two isolated 0/4 to 20 mA inputs (121 Ohms) with integral 24 VDC power supply

Namur NE043 compliant

For required temperature and pressure inputs

Standard Outputs

- Six 4 to 20 mA outputs, software assignable
- Two outputs with 550 Ohms maximum load
- Four outputs with 1000 Ohms maximum load

Namur NE043 compliant

Optional Inputs/Outputs

There are four additional slots available for any combination of the following I/O boards:

- Analog output board with four isolated 0/4 to 20 mA outputs, 1 kOhms maximum load
- Analog input board, two types
  - With two isolated 4 to 20 mA inputs and 24V loop power
  - With two isolated, three-wire, 100 Ohms RTD inputs; span –148°F to 662°F (–100°C to 350°C);
- Totalizer/frequency output board
  - With four outputs per board, 10-kHz maximum.
  - Software-selectable functioning in two modes
    - Totalizer mode: Pulse per defined unit of parameter (e.g., 1 pulse/ft3 or 1 pulse/0.028 m3)
    - Frequency mode: frequency proportional to rate of parameter (e.g., 10 Hz = 1 ft3/h or 0.028 m3/h)
- Alarm relay board with three hermetically sealed Form C relays; 120 VAC, 28 VDC maximum, 2A maximum; DC 56W maximum, AC 60 VA

Digital Interfaces

- Standard: RS232
- Optional: RS485 (multiuser)

- Optional: HART® protocol
- Optional: Modbus® RS485 or TCP/IP
- Optional: Ethernet TCP/IP
- Optional: OPC server
- Optional: Foundation Fieldbus Namur NE107 Compliant

Site Parameter Programming

Menu-driven operator interface using keypad and "soft" function keys

Data Logging

Memory capacity (linear and/or circular type) to log more than 43,000 flow data points

Display Functions

- Graphic display shows flow in numerical or graphic format
- Displays logged data and diagnostics

European Compliance

Complies with EMC Directive 2004/108/EC, 2006/95/EC LVD (Installation Category II, Pollution Degree 2) and PED 97/23/EC for DN<25

T5/T17 Wetted Flow Ultrasonic Transducers

Temperature Ranges

Normal Temperature:	-55°C to 150°C
Low Temperature :	-220°C to 100°C
High Temperature:	-50°C to 250°C

Pressure Range

Standard: -2 psig to 1500 psig (87.6 to 10300 kPa)

Transducer Materials

- Standard: Titanium
- Optional: Monel® or Hastelloy® alloys or SS316

Process Connections

Flanged and compression fittings

Area Classifications

Explosion-proof Div. 1, Class I, Group C, D

Optional: Group B upon request

ATEX II 2 G Ex d IIC T4, T3 or T2 Gb

IECEx II 2 G Ex d IIC T4, T3 or T2

Insertion Mechanism

Standard and Extended Range

3 in (76 mm) flange mounted packing gland and valve at equal mounting angle both up and downstream

Preamplifier

Transducer mounted XAMP type of preamplifier with BNC connections; requires one preamp per transducer.

Gain

- Standard: 20 and 40
- Optional: 2 and 10 (factory selected)

Preamp Temperature Range:

-40°C to +60°C (-40°F to +140°F)

Enclosure

Explosion-proof Div. 1, Class I, Group C, D

Optional: Group B upon request

ATEX II 2 G Ex d IIC T6

IECEx II 2 G Ex d IIC T6

Transducer Cables

- Standard: (per pair of transducers)
  - One pair of coaxial cables, type RG62 A/U, preamplifier to GF868 electronics, lengths 3 m (10 ft) to 330 m (1000 ft) maximum
- Optional: flame retardant, armored cable

Additional Options

PanaView™ PC-Interface Software

The DigitalFlow GF868 communicates with a PC through a serial interface and Windows® operating systems. Features include site files, logs and other operations with a PC.

Installation Flowcells

Transducers and flowcells for specific applications are available. Consult BHGE for details.

Flare Control and Optimization

Consult BHGE for details about flare control and optimization using flare.IQ as a solution for compliance to emission regulations (such as RSR MACT 63.670) and for efficient steam control to save cost.

Flow Accuracy

T5 Transducer　　　　T17 Transducer

Transducer Type	T5 Wetted Transducer				T17 Wetted Transducer			
Number of Paths	One Path		Two Paths		One Path		Two Paths	
Flow Measurement Range								
Standard Range	-328 to 328 ft/s (-100 to 100 m/s) - bidirectional							
Extended Range	.1 to 394 ft/s (0.03 to 120 m/s) - non-bidirectional							
Applicable Pipe Sizes								
Diagonal 45	3 in to 14 in (50 to 350 mm) OD				14 in to 120 in (350 to 3000 mm) OD			
Bias 90	Note 1 & 2				Not Applicable			
Design Velocity Accuracy from 1 to 394 ft/s (0.3 to 120 m/s) - see notes below								
Transducer Type	**T5 Wetted Transducer**				**T17 Wetted Transducer**			
Number of Paths	One Path		Two Paths		One Path		Two Paths	
	1 ft/s (0.3 m/s)	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**
Pipe Dia. </= 6 in. (150mm)	+-2.5%	+-2.0%	+-2.0%	+-1.5%	NA	NA	NA	NA
Pipe Dia. >/= 6 in (150mm)	+-2.0%	+-2.0%	+-1.5%	+-1.5%	+-2.0%	+-2.0	+-1.5%	+-1.5%
Calibrated Velocity Accuracy from 1 to 394 ft/s (0.3 to 120 m/s) — see notes below								
Transducer Type	**T5 Wetted Transducer**				**T17 Wetted Transducer**			
Number of Paths	One Path		Two Paths		One Path		Two Paths	
	1 ft/s (0.3 m/s)	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**	**1 ft/s (0.3 m/s)**	**>3 ft/s (1 m/s)**
Dia. </= 6 in. (150mm)	+-1.5%	+-1.0%	+-1.0%	+-0.75%	NA	NA	NA	NA
Pipe Dia. >/= 6 in (150mm)	+-1.0%	+-1.0%	+-0.75%	+-0.75%	+-1.0%	+-1.0%	+-0.75%	+-0.75%
Mass Flow Accuracy								
2 to 120 kg	+-4.0%		+-3.1%		+-2.7%		+-2.3%	
Molecular Weight Accuracy								
2 to 120 kg/kmole	+-1.8% to +-2%							
Flow Velocity Sensitivity from .1 to 1 ft/s (0.03 to .3 m/s)								
Pipe Dia. = 10 in. (250mm)	±0.12 in/s(±0.004 m/s)		±0.08 in/s(±0.003 m/s)		NA		NA	
Pipe Dia. = 14 in. (250mm)	±0.12 in/s(±0.004 m/s)		±0.08 in/s(±0.003 m/s)		±0.08 in/s(±0.003 m/s)		±0.06 in/s(±0.002 m/s)	
Pipe Dia. >/= 20 in. (500mm)	±0.12 in/s(±0.004 m/s)		±0.08 in/s(±0.003 m/s)		±0.06 in/s(±0.002 m/s)		±0.04 in/s(±0.0015 m/s)	

Note 1: Accuracy and sensitivity are dependent on pipe diameter, molecular weight and temperature. All accuracy specs assume molecular weights greater than 24 kg/kmole and temperatures less than 100 °F (38 °C)

Note 2: All accuracy specs assume a fully developed flow profile. This typically requires 20D upstream and 5D downstream. Desired accuracy can also be achieved with shorter straight runs as little as 5D upstream and 2D downstream through correction factors from Computational Fluid Dynamics (CFD) analysis loaded to GF868 meters. Consult factory for details.

Repeatability

±0.5% at 1 to 394 ft/s (30 cm/s to 120 m/s). Consult factory for details.

General Installation Straight Run Requirement

20D upstream and 5-10D downstream without CFD analysis.
5D upstream and 2D downstream with CFD analysis. Csonsult factory for details.

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