Panametrics

Datasheet

DigitalFlow™ XGF868i

Flare gas mass flow ultrasonic flowmeter

The DigitalFlow XGF868i ultrasonic flow meter 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, and wide rangeability, the DigitalFlow XGF868i flow meter is the clear choice for flare gas applications.

PANA060DS Rev. 16

Features

- Measures velocity, volumetric and mass flow
- Independent of gas composition
- Measures instantaneous average molecular weight
- High velocity range to 120 m/s (394 ft/s)
- Accurate low flow rate measurement
- 4000 to 1 turndown ratio
- One or two path configurations
- Allows cross flow immunity in large pipes
- Minimal maintenance due to no moving parts, no holes or tubes, and tolerance to dirty or wet conditions
- No pressure drop
- Field-proven installation techniques
- Easy serviceability

Applications

The DigitalFlow XGF868i flowmeter is a complete ultrasonic flow metering system for:

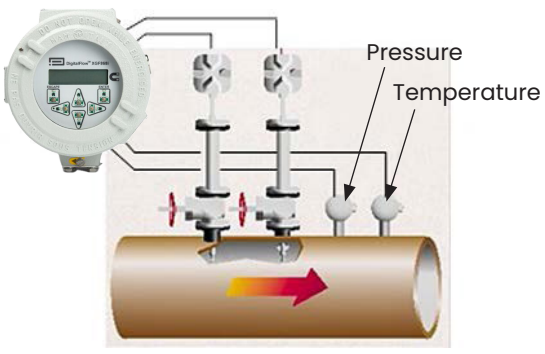
- Flare gas
- Track down or prevent losses from leakage with positive material identification
- Measures Net Heating Value (NHV) of vent gas in BTU/SCF, MJ/m3, or KJ/m3
- Account for total plant throughput of material
- Reduce cost of steam usage with proportional control
- Conserve energy by eliminating unnecessary flaring
- Comply with government regulations for pollution control
- Vent gas
- Hydrocarbon gases
- Biogases
- Digester gases

Compact housing

All of the DigitalFlow XGF868i's electronic components are housed in a compact, low cost, explosion proof/flame proof transmitter package that can be installed close to the flow measurement point. This greatly simplifies wiring of the flowmeter.

Simple installation

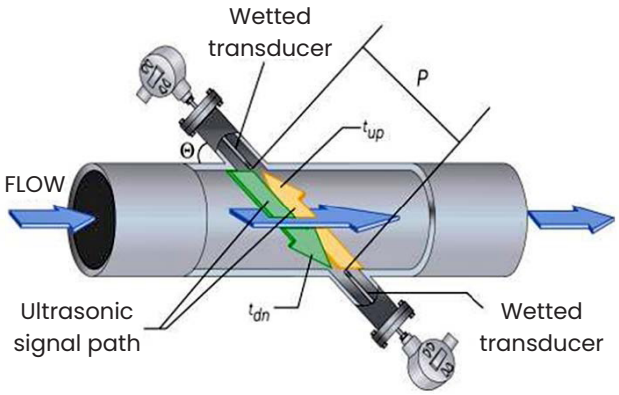
The flow meter system consists of a pair of transducers and insertion mechanism for each channel, and an XGF868i. The transducers can be installed as part of a flowcell, or directly into the pipe with a hot- or cold- tapping procedure. The DigitalFlow XGF868i meter can be located up to 1,000 ft (300 m) from the transducers.



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

Best technology for flare gas

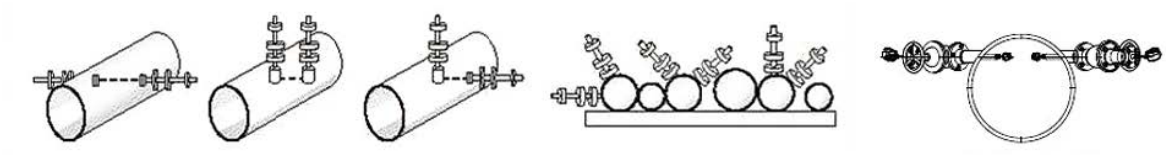
Ultrasonic flow measurement, the ideal technology for flare gas applications, is independent of gas properties, and does not interfere with the flow in any way. All metal ultrasonic transducers installed in the pipe send sound pulses upstream and downstream through the gas. From the difference in these transit times between the transducers, with and against the flow, the DigitalFlow XGF868i'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.



$$V = \frac{P^2}{2L} \frac{(t_{up} - t_{dn})}{(t_{dn} \times t_{up})}$$

$$Q_{STD} = Q_{ACT} \times \frac{P_f}{P_b} \times \frac{T_b}{T_f}$$

Q_{STD} = Standard volumetric flow rate
Q_{ACT} = Actual volumetric flow rate
P_f = Flowing pressure
P_b = Base pressure
T = Flowing temperature
T_b = Base temperature
V = Velocity
P = P ath length
L = Axial length
t_{up} = Upstream transit time
t_{dn} = Downstream transit time



Diagonal 45 | Mid-radius 90 | 90-180 Diagonal | Pipe rack | Off-diameter diagonal 45

Standard transducer mounting configurations

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 XGF868i is designed for superior performance under these conditions.

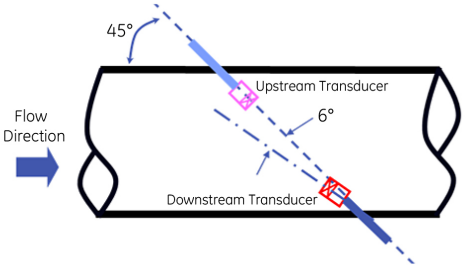
One meter, wide range of flow conditions

High flow

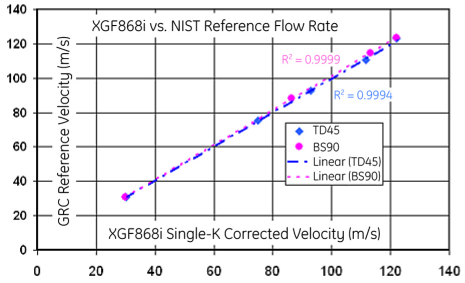
The DigitalFlow XGF868i meter achieves extended range rangeability of 4000 to 1. It measures velocities from 0.1 to 328 ft/s (0.03 to 100 m/s) standard in both directions, while the extended range version measures velocities to 394 ft/s (120 m/s) in one direction. In steady or rapidly changing flow, it measures in pipes from 4 in to 120 in (100 mm to 3 m) in diameter. With this range of operation, one DigitalFlow XGF868i flowmeter performs measurements under the conditions that occur in a flare line on or offshore.

Low flow

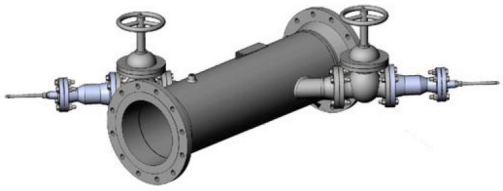
For base load operation, the volumetric flow in flares is often in the range 0.1 to 1 f/s (0.03 to 0.3 m/s) and the XGF868i flare gas flow meter improves the accuracy over that range, but still measures at high velocity during facility relief or upset conditions. A single path uses a long path to achieve accurate low flow measurements, and with the recovery angle on the downstream transducer, the extended range high flow rate is accomplished as well.



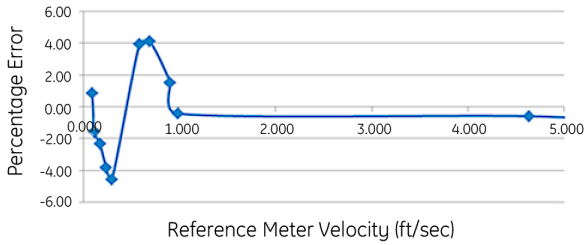
The 6 degree recovery angle on the downstream transducer provides high flow rate capability.



NIST traceable test results to over 120 m/s velocity



XGF868i with T17 transducers low flow % error



Energy measurement

Latency in measuring the energy content of a flare gas can lead to poor combustion efficiency or fuel gas waste at the flare tip. This can lead to excessive emissions, mostly harmful methane, into the atmosphere, risking increased fine associated with non-compliance and greater negative impact on the climate. The model XGF868i has an option for measuring the net heating value (NHV) of the flare gas to help operators optimize their assist flares to provide a smokeless flame and maintain a high combustion efficiency without the latency issues or the installation and maintenance costs of a separate analyzer. For increased capabilities unlocking the full potential of reduced emissions and flare control and optimization, use a GF868 or an XGF868 with flare.IQ advanced control solution.

Dual-channel model standard

For maximum accuracy, the standard two channel XGF868i can accommodate single or dual channel operation in a variety of transducer configurations.

Designed for flare gas environment

The DigitalFlow XGF868i flow meter 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. In contrast to other flow meter types, the ultrasonic transit-time technique does not depend on the properties of flare gas and does not require regular maintenance.

The DigitalFlow XGF868i flow meter offers a unique combination of rangeability, ease of installation, low maintenance and accuracy in a low-cost transmitter. The all-digital XGF868i creates no pressure drop; has no moving parts or parts that foul or collect debris; seldom requires maintenance; and provides reliable, drift-free operation. The flow rate can be displayed locally or transmitted to a remote system via an analog or digital communications link.

Patented molecular weight measurement method

The DigitalFlow XGF868i 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. Normally sound speed in gases depends on gamma.

$$C = \sqrt{\frac{\gamma RT}{MW}}$$

The algorithm in the meter relates sound speed of the gases to the average molecular weight of the gases, without a dependency on gamma, for hydrocarbon gases. Molecular weight, with temperature and pressure, allows the mass flow to be calculated.

$$\rho = \frac{P(MW)}{R(T)} \qquad \dot{M} = \rho VA$$

M = Mass flow
V = Actual velocity
A = Cross-sectional area
ρ = Density
P = Pressure (absolute)
T = Temperature (absolute)
R = Universal gas constant
MW = Molecular weight
Q = Volumetric flow rate
γ = Gamma: adiabatic constant
C = Speed of sound

Identify leaks, reduce steam usage, improve plant balance, and comply with emissions regulation

Higher accuracy mass flow data and more precise knowledge of flare gas composition can improve the efficiency of plant operation.

Leaks/lost product

Detection of even a small increase in flow rate into the flare system may indicate a leak source such as a 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 and aids in early detection of process control problems.

Steam injection/mass balance

Excess steam delivery can be a major cause of loss of product and energy. Reducing steam injection improves the overall efficiency in refinery and chemical plant operation. The DigitalFlow XGF868i can help save millions of dollars in reduced losses. Using the instantaneous average molecular weight and mass flow rate of the gas, delivery of the correct amount of steam required at the flare tip can be accurately controlled. Steam usage can be reduced. Mass flow rate may be used to perform a mass balance calculation and to control flare tip steam injection.

Emissions compliance

Maintaining compliance with pollution control regulations requires measurement at low flow and at high flow, and verification of meter performance. The sound speed and other diagnostics allow easy meter verification while measuring over this wide flow range.

Low operational costs

Because the DigitalFlow XGF868i installation produces no flow obstruction, the energy-robbing pressure drops and high maintenance requirements characteristic of other flow meters are eliminated. The special sealed metal transducers supplied with a DigitalFlow XGF868i system are immune to the erosion and stress caused by thermal expansion cycles.

Payback for the entire DigitalFlow XGF868i installation usually occurs within a matter of months.

Technical **Specifications**

Operation and performance

Fluid Types	Flare and vent gases
Pipe materials	All metals, fiberglass. Consult Panametrics for other materials.
Flow accuracy (velocity)	Dependent on pipe diameter, and gas species. See table below for more information

Electronics

Flow measurement	Patented correlation transit-time mode
Enclosures	• Standard: Epoxy-coated aluminum weatherproof Type 4X/ IP66 Can be configured for Class I, Division 2, Groups ABCD, NEC & CEC • Optional: Stainless steel, weatherproof Type 4X/ IP66 Can be configured for Class I, Division 2, Groups ABCD, NEC & CEC • Explosion proof Class I, Division 1, Groups BCD, NEC & CEC Ex d IIC T6 Gb, IECEx & ATEX (II 2G)
Dimensions (h x d)	Standard: Size 8.2 in x 6.6 in (208 mm x 168 mm)
Weight	10 lb (4.5 kg)
Channels	Standard: Two channels (for two-path averaging)
Display	2 line x 16 character backlit LCD display, configurable to display up to four measurement parameters in sequence
Keypad	Built-in magnetic six-button keypad for full functionality operation
Power supplies	• Standard: 100-240 VAC ±10% • Optional: 12 to 28 VDC, ±5% Note: For DC-powered meters, Class 2 rated supplies must be used for the line power.
Power consumption	20 W maximum
Operating temperature	–40°F to 140°F (–40°C to 60°C)
Storage temperature	–67F° to 167°F (–55°C to 75°C)
Standard inputs/ outputs	• Two 0/4 to 20 mA isolated outputs, 600 Ω max. load • Two 4 to 20 mA isolated inputs, 24 VDC loop power, or • One 4 to 20 mA isolated inputs, 24 VDC loop power, one direct three-wire RTD (temperature) input, –148°F to 662°F (–100°C to 350°C), 100 Ω platinum
Optional inputs/ outputs	Two frequency outputs, optically isolated, 3 A maximum, 100 VDC maximum, 1 W maximum, from DC to 10 KHz maximum
Digital interfaces	Standard: RS232 (PanaView PC software) HART®7 protocol on 4-20 mA output • Optional: Modbus® RS485 or TCP/IP • Optional: Ethernet • Optional: OPC server • Optional: Foundation Fieldbus® • Optional: Namur NE107 compliant
European compliance Complies with	• 2014/30/EU EMC - Industrial EM Environments • 2014/35/EU LVD - Equipment Class I, Pollution Degree 2,Overvoltage Category II • 2014/34/EU ATEX (optional) - II 2G • The XGF868i is intended for inclusion in large-scale fixed installations (LSFI) and are therefore outside of the scope of Directive 2011/65/EU RoHS.

T5MAX wetted flow ultrasonic transducers

Temperature range	Normal Temperature (NT): -55°C to 150°C
Pressure range	Standard: -2 psig to 1500 psig (87.6 to 10300 kPa)
Transducer Material	• Standard: Titanium • Hastelloy® alloys or SS316 • (Monel® Consult factory)
Process connections	Flanged and compression fittings
Hazardous Area Classifications	Explosive-proof Class I, Division 1, CD Optional: Group B upon request Ex d IIC T4.T3 or T2 Gb, IECEx & ATEX (II 2G) An integrated XAMP preamplifier may be installed in the certified assembly.

T5/T17 wetted ultrasonic flow transducers

Temperature range	• Normal Temperature (NT): -55°C to 150°C • Low Temperature (LT): -220°C to 100°C • High Temperature (HT): -50°C to 250°C Extremely High Temperature (XT): -180°C to 300°C
Pressure range	Standard: -2 psig to 1500 psig (87.6 to 10300 kPa)
Transducer Material	• Transducer Materials • Standard: Titanium • Optional: Monel® or Hastelloy® alloys or SS316
Process connections	Flanged and compression fittings
Hazardous Area Classifications	Explosion proof Class 1, Division 1, Group C, D Optional: Group B upon request ATEX II 2 G Ex db IIC T6...T2 Gb IP66 IECEx Ex db IIC T6...T2 Gb IP66

Insertion mechanism

Standard and extended range	2 in (50 mm) and 3 in (76mm) flange mounted packing gland and valve.

Preamplifier

In-line XAMP preamplifier with BNC connections; one per transducer.

Gain	• Standard: 20 and 40 • Optional: 2, 10 (factory selected)
Preamp temperature range	-40°C to +60°C (-40°F to +140°F)

Location

Installation of the XAMP in the transducer assembly is covered by the transducer's hazardous area certification, subject to the above temperature limits.
Alternately, the XAMP may be installed separate from the transducer – remote mounted – with the following rating.
Explosion-proof Class I, Division 1, CD or BCD
Ex d IIC T6 Gb, IECEx & ATEX (II 2G)

Transducer cables

- Standard: (per pair of transducers)
- One pair of coaxial cables, type RG62 A/U, preamplifier to XGF868i 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 XGF868i 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 Panametrics for details.

Flow Accuracy

Tranducer Type	T5/T5MAX wetted transducer				T17/T5MAX 180 Degree Head (see note 1)			
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 2 and 3							
Transducer Type	T5 Wetted Transducer				T17/T5MAX 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 3 and 4							
Transducer Type	T5 Wetted Transducer				T17/T5MAX 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)	+-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%							
	Net Heating Value (NHV) Accuracy - refer to note 4							
Typical accuracy	2% - 5%							
	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)	

Notes:
1. T17 available in NT/HT/LT/XT; T5MAX only available in NT. T5 and T5MAX are available in both Bias 90 and 180 configuration while T17 is only available in 180 configuration.
2. 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)
3. 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 XGF868 meters. Consult factory for details.
4. Assuming known N2 concentration. Consult factory for details.


T5 Transducer


T17 Transducer

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 5D downstream without CFD analysis.
5D upstream and 2D downstream with CFD analysis. Consult factory for details.

PANA060DS_R16 (09/2025)