Panametrics
a Baker Hughes business

MISURA & AUTOMAZIONE

# DigitalFlow™ XGF868i

## Flare gas mass flow ultrasonic flowmeter

### 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

## Flare gas mass flow meter

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.

## Compact housing

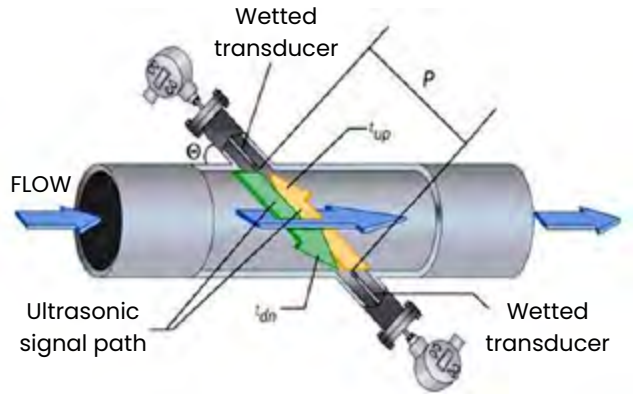
All of the DigitalFlow XGF868i's electronic components are housed in a compact, low cost, explosion proof/flame proof transmitter package that can be installed close to the flow measurement point. This greatly simplifies wiring of the flowmeter.

## 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.

## 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.

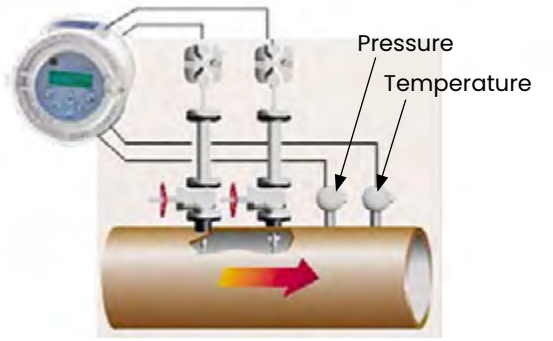


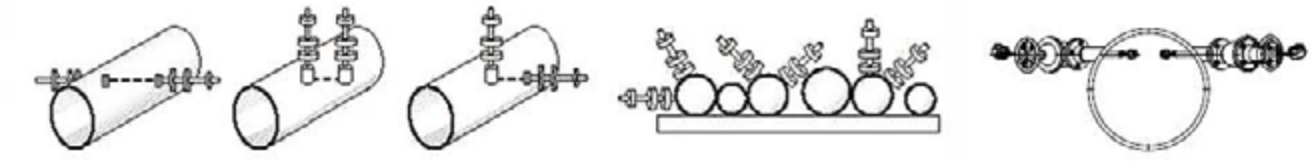

$$V = \frac{P^2}{2L} \frac{(t_{up} - t_{dn})}{(t_{dn} \times t_{up})}$$

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

$Q_{STD}$ = 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

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



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

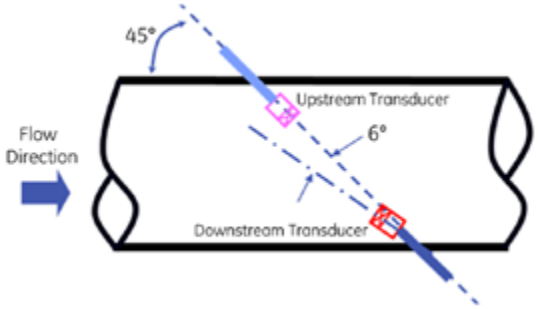
**High flow**

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.

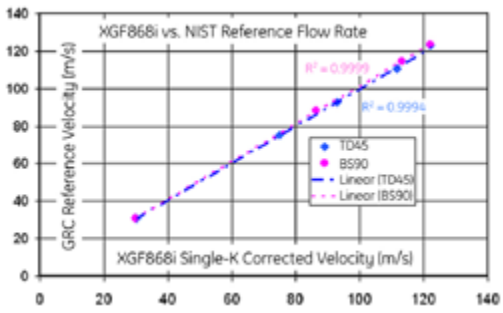
**Low flow**

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.

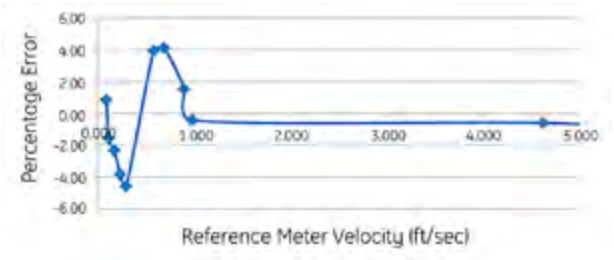



The 6 degree recovery angle on the downstream transducer provides high flow rate capability.




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.

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

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.

# XGF868i 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
  Hazardous area rating:
  Explosion-proof: Class 1, Division 1,
  Groups B, C and D
  Flameproof: ISSeP 07ATEX015
  II 2 G Ex d IIC T5 IP66
  IECEX: FM G 0011x
  II 2 G Ex d IIC T6 Gb IP66
- Optional: Stainless steel

**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**
TTwo 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**
System complies with EMC Directive 2004/108/EC, 2006/95/EC LVD (Installation Category II, Pollution Degree 2) and transducers comply with PED 97/23/EC for DN<25

## 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)

**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 T2B

## Insertion mechanism

**Standard and extended range**

- 3 in (76 mm) flange mounted packing gland and valve.
- 2 in (50 mm) might be available upon request. Consult factory for details.

## Preamplifier

Transducer mounted XAMP type of preamplifier with BNC connections, requires one preamp 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)

## 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 XGF868i electronics, lengths 3 m (10 ft) to 330 m (1000 ft) maximum
- Optional: flame retardant, armored cable

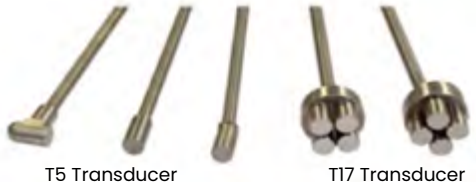
## Additional options

**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.



T5 Transducer T17 Transducer

# Flow Accuracy

| Tranducer Type | T5 Wetted Transducer | | | | T17 Wetted Tranducer | | | |
|---|---|---|---|---|---|---|---|---|
| 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 Tranducer | | | |
| 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 Tranducer | | | |
| 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 3 | | | | | | | |
| 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) | |

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 XGF868 meters. Consult factory for details.

Note 3: Assuming known N2 concentration. 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 5D downstream without CFD analysis.
5D upstream and 2D downstream with CFD analysis. Consult factory for details.

Per avere più informazioni
CONTATTACI

EP srl
41124 Modena
Via S. Faustino, 155/P

Tel. +39 059 35 76 00
www.epsas.it
ep.ma@epsas.it

Panametrics, a Baker Hughes business, provides solutions in the toughest applications and environments for moisture, oxygen, liquid and gas flow measurement.

Experts in flare management, Panametrics technology also reduces flare emissions and optimizes performance.

With a reach that extends across the globe, Panametrics' critical measurement solutions and flare emissions management are enabling customers to drive efficiency and achieve carbon reduction targets across critical industries including: Oil & Gas; Energy; Healthcare; Water and Wastewater; Chemical Processing; Food & Beverage and many others.

Join the conversation and follow us on LinkedIn
linkedin.com/company/panametricscompany

MISURA & AUTOMAZIONE

Baker Hughes

Copyright 2023 Baker Hughes Company. All rights reserved.

BHCS38684 (03/2023)

panametrics.com