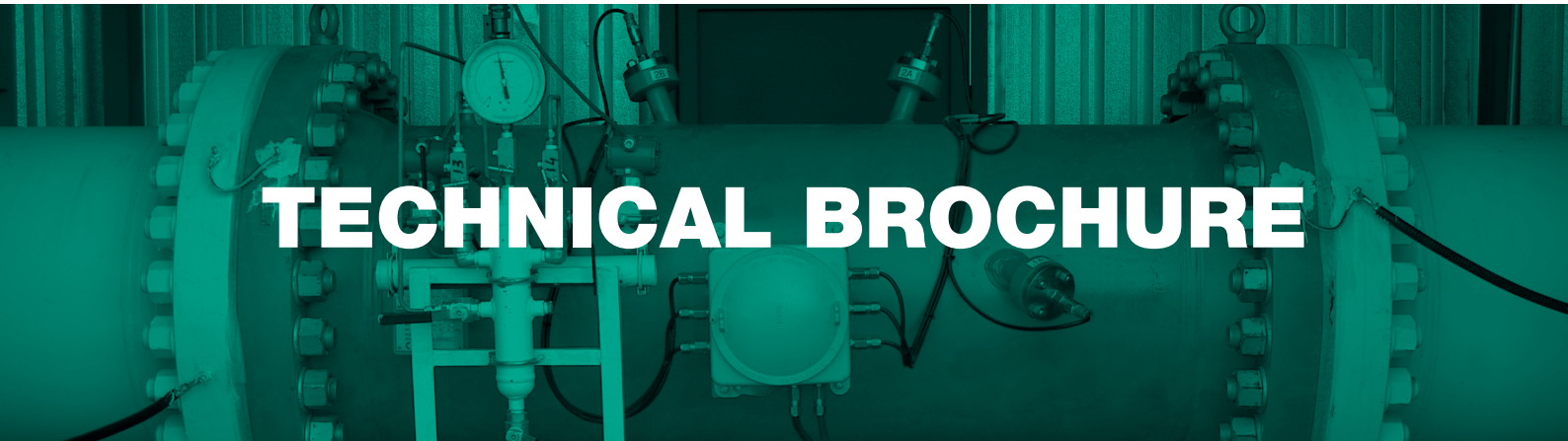
Pietro Fiorentini

FioSonic

Industrial metering



TECHNICAL BROCHURE

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Who we are

We are a Global organization specialized in designing and manufacturing technologically advanced solutions for natural gas treatment, transmission and distribution systems.
We are the ideal partner for operators in the Oil & Gas sector, with a business offer that goes across the whole natural gas chain.

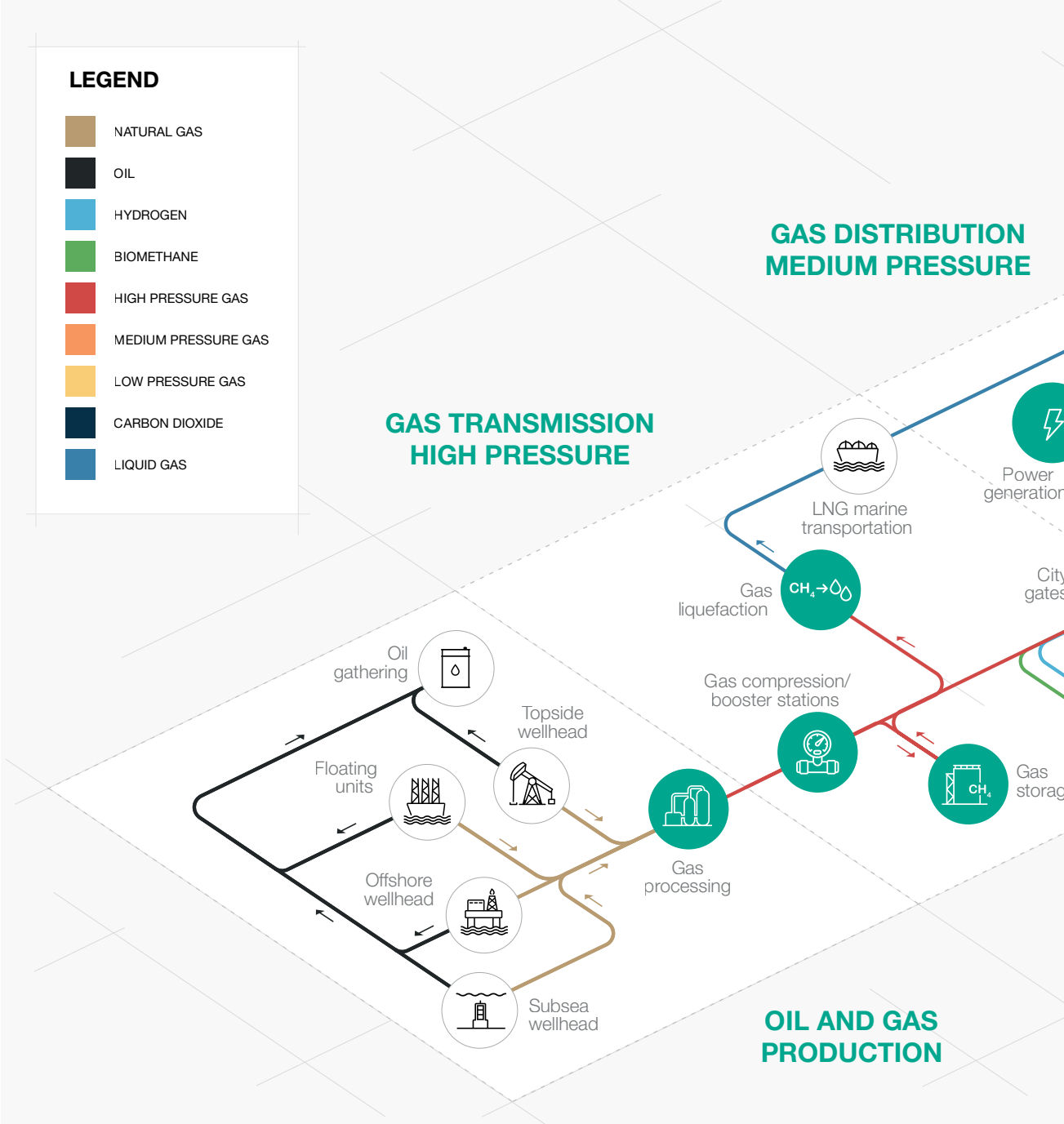
We are in constant evolution to meet our customers' highest expectations in terms of quality and reliability.

Our aim is to be a step ahead of the competition, with customized technologies and an after-sale service program undertaken with the highest grade of professionalism.

Pietro Fiorentini advantages

- Localised technical support
- Experience since 1940
- We operate in over 100 countries

Area of Application



Green icon indicates the application where this product is suitable for

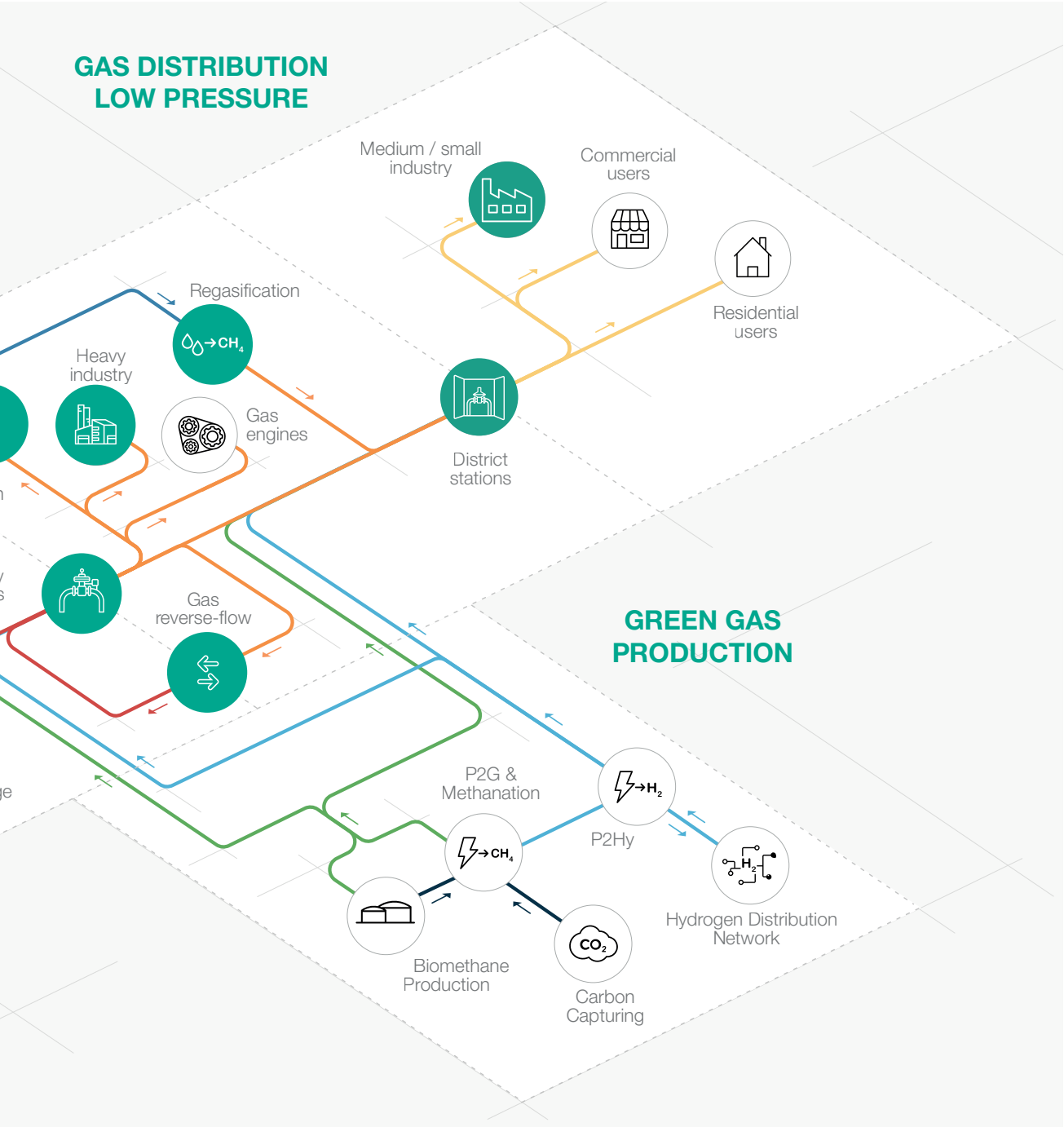


Figure 1 Area of Application Map

Introduction

FioSonic is the natural evolution of the Pietro Fiorentini know-how and experience in the gas industry.

With its multi path-chordal ultrasonic technology **FioSonic** provides real time diagnostics high accuracy and redundancy for custody transfer gas flow measurement.

This device is mainly used for high-pressure transmission systems, power plants, heavy industry and for medium - low pressure natural gas distribution networks up to 102 bar(g) / 1.479 psi(g) of pipeline operating pressure.

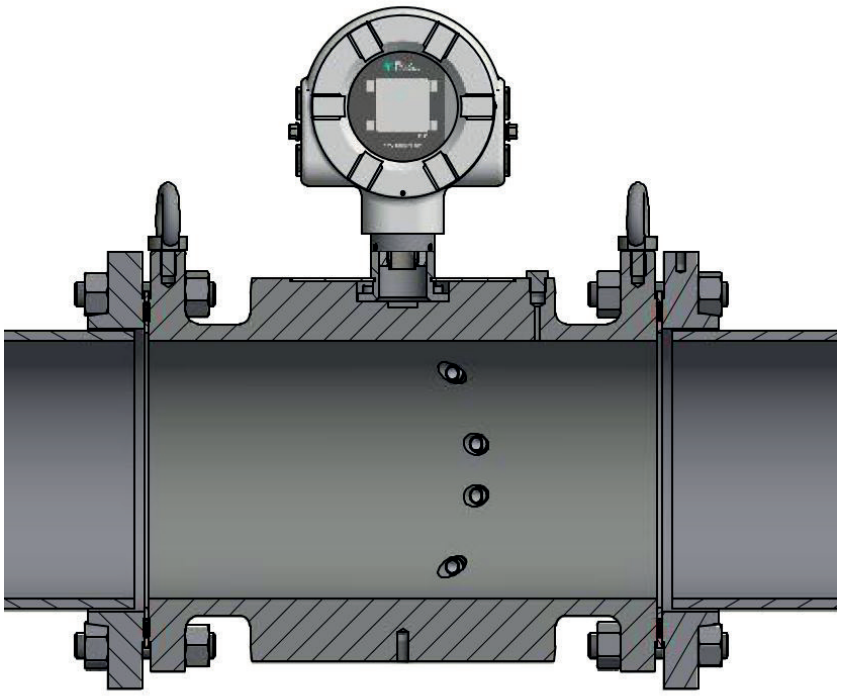


Figure 2 FioSonic - Ultrasonic Gas Flow Meter

Features

FioSonic Series standard product has four paths.
This design guarantees stable accurate flow reading over the full range of flow, pressures and gas compositions.

The BCW (Broadband Continuous Wave) signal processing allows more than one path to be interrogated simultaneously avoiding the slow response typical of first generations of ultrasonic meters.

FioSonic transducers frequency is from 100-250 kHz depending on the meter's size to guarantee the best performances..

Figure 3 FioSonic

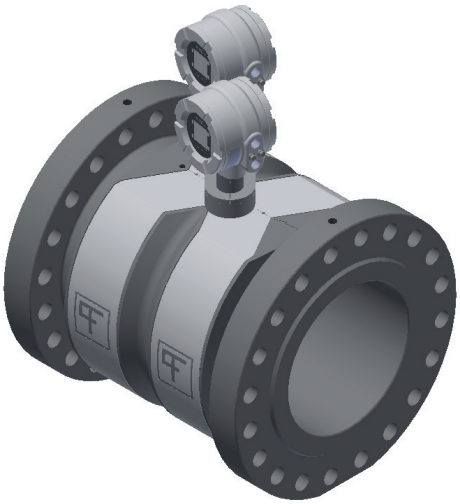


Figure 4 FioSonic BX

Natural Gas blended with Hydrogen

The **FioSonic** is suitable for use with Natural Gas with up to 30% of Hydrogen blending.

Titanium transducers

The titanium ultrasonic sensors are remarkably efficient and coupled with the BCW (Broadband Continuous Wave) processing make the meter resistant to acoustic noise such as valve noise which has been the bane of other ultrasonic meters.

The design of the ultrasonic transducers allow them to operate at the very low transmitting voltage of 3.6V compared to tens or even hundreds of volts required by other manufacturers.

All wetted surfaces are metallic to provide the best resistance against the harshest conditions.

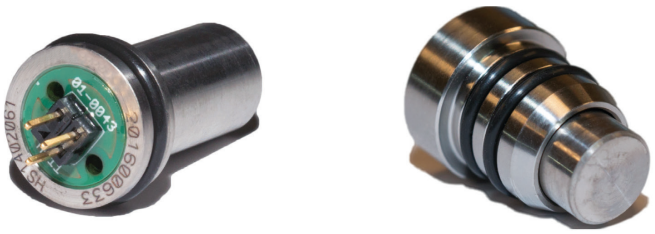


Figure 5 Ultrasonic Transducers

BCW - Broadband Continuous Wave signal processing

Most ultrasonic flow meters transmit a short burst of ultrasonic energy consisting of between one and four pulses or cycles.

A few ultrasonic meters use a short code typically much less than 100 cycles.
The **FioSonic** flow meter transmits many thousands of cycles in an almost continuous stream of encoded pulses. At the receiver the signal is decoded in real time to reconstruct the receive signal that is precise and resistant to signal noise and interferences in difficult applications.

The BCW (Broadband Continuous Wave) system allows transmission of two or more paths at the same time without interferences. Simultaneous transmission means a shorter response time and a better performance in fluctuating or pulsating flow conditions.

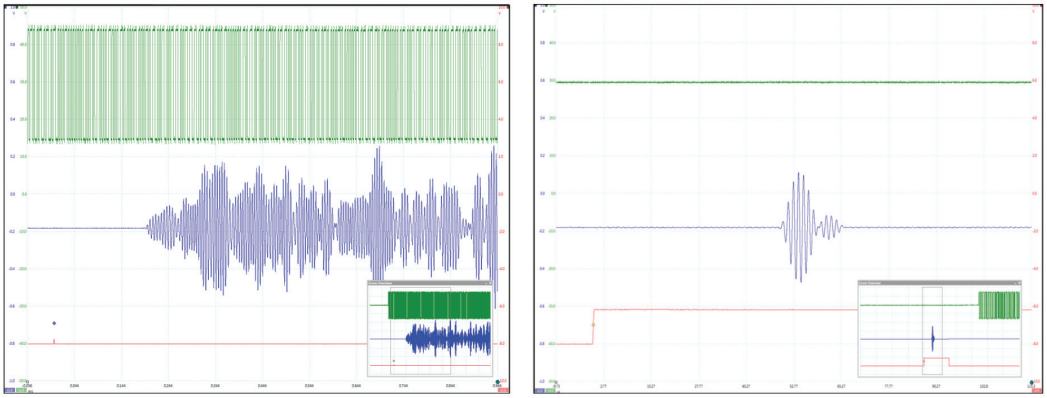


Figure 6 - Left: Encoded Transmitted Signal (green) and received signal (blue)
Right: Decoded receive signal (blue)

Simplified design

Having all on-board electronics on a single circuit board FioSonic allow an easy and fast maintenance, and at the same time is characterized by a clean and essential design.

Figure 7 On-board electronics

Additional boards

Extended I/O board

The **FioSonic** Series comes standard with the Pulse/Frequency output an USB port (for commissioning and maintenance during field operations), and a board that provides both an RS485 serial port and two isolated pulse outputs.
Optional I/O boards can instead provide a P&T imput or a 4-20 mA output.

Pressure and temperature input board

For applications requiring integrated volume conversion the FioSonic flowmeter is capable of interfacing directly with pressure and temperature sensors. The standard volume flow is calculated using the traditional volume conversion equations using fixed parameters for gas composition. This application is not for fiscal use certified.

Flow computer connectivity

FioSonic meter can be connected to all major flow computer brands available in the market either with pulses or serial line (Modbus protocol).

Environment Protections

The FioSonic Series epoxy coated aluminum alloy electronic housing rated to IP66/ NEMA 4X is designed to be used outdoor in almost any environment.

The ambient operating temperature covers the range -25°C to +55°C | -13°F to +131°F.
The ultrasonic sensors have all titanium wetted surfaces and are designed for process gas temperature from -25°C to +55°C | -13°F to +131°F.

Intrinsically Safe Design

The FioSonic has a fully Intrisically Safe design (Exia) for both transducers and electronic board components.
This design increase the safety and allow an easier maintenance process.

Diagnostic and performance monitoring

FioSonic provide extensive diagnostic information both on the graphic display screen and remotely via the FioSonic Management Software (FMS).

Flow information and diagnostics may be logged over time to show trending and enabling real time condition monitoring.

The velocity profile is a function of the upstream pipework. By calculating velocity ratios between the ultrasonic paths a good indication of the flow profile is realized. The flow meter calculates Profile and Symmetry Factors which can be used for condition monitoring of the measurement and the gas flow. In addition the FioSonic flow meter provides diagnostics for turbulence by means of the standard deviation of the instantaneous path velocity measurements.

The standard deviation provides an excellent diagnostic for turbulence fluctuations and may serve as an indicator of upstream disturbances. Additional meter diagnostics such as velocity of sound signal-to-noise ratio and signal strength are available to the user as well.

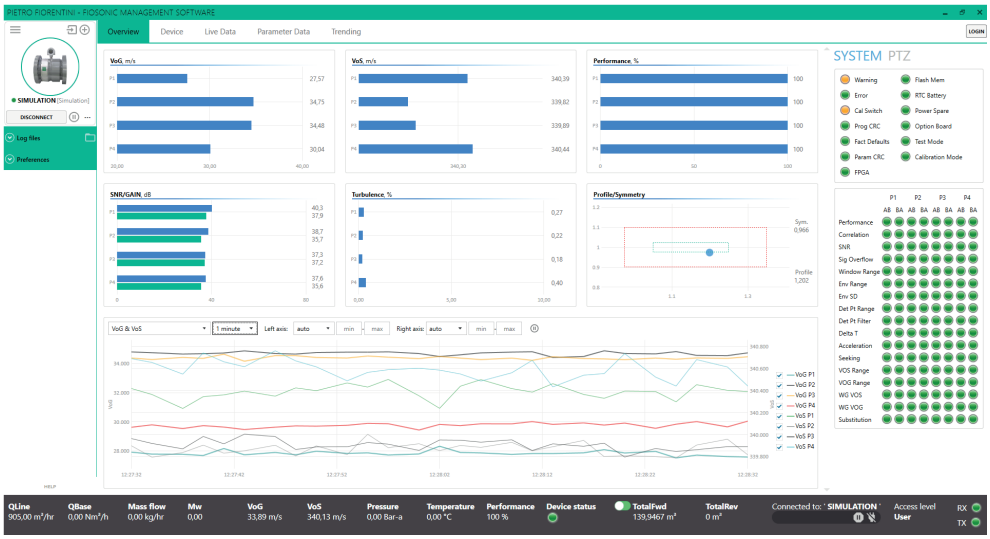


Figure 8 Diagnostic Information

FioSonic competitive advantages

- Titanium transducers for long durability
- Low voltage sensors
- No moving parts
- High rangeability
- Uni or Bi-directional Flow measurements
- BCW (Broadband Continuos Wave)
- Easy maintenance
- 30% Hydrogen blending compatible.
- Metallic wetted parts

Features

Features	Values
Flow rates	from 9 m^3/h to 43.698 m^3/h from 318 cfh to 1.543.200 cfh
Design pressure	• up to 102 bar(g) • up to 1.479 psi(g)
Ambient temperature	from -25°C to +55°C from -13° F to +131° F
Gas temperature range	from -25°C to +55°C from -13° F to +131° F
Accuracy	Class 0,5 - OIML R137-1 Class 1 - MID 2014/32/EU or OIML R137-1
Rangeability	up to 1:100
Repeatability	better than 0.1%
Index Protection	IP 66 / NEMA 4X
Environment class	M2/E2
Power supply	14 – 29 V DC
Explosion proof protection	ATEX - Ex II 1 G Ex ia IIC T4 Ga IECEx - Ex ia IIC T4 Ga CQPSUS - Class 1 Div.1 Gr. ABCD T4-T1(Ex ia IIC T4-T12 Ga)
Nominal dimensions DN	from DN80 (3”) to DN 750 (30”)
Connections	PN16 RF/RTJ flange finish according to EN1092-1 ANSI 150 – ANSI300 –ANSI 600 RF / RTJ flange finish according to ASME B16.5 (EN1759-1)

Table 1 Features

FioSonic for Custody Transfer Flow Metering: four paths for enhanced accuracy and reliability

The FioSonic model “FSN-4P” has four paths. It has been designed and certified to meet the international standards for custody transfer metering.
Available from DN80 (3”) to DN750 (30”)
The integration of the flow across the paths provides accurate measurement even with varying flow profiles caused by changes in flow velocity, gas composition and pressure or upstream pipe configuration.

Fast response is maintained by the simultaneous transmission on more than one path using BCW (Broadband Continuous Wave) processing.

The measured flow profile provides a diagnostic tool.
Should one path fail the Path Substitution Algorithm uses historical flow data to continue reliable flow measurements until the path recovers or remediation action is taken.

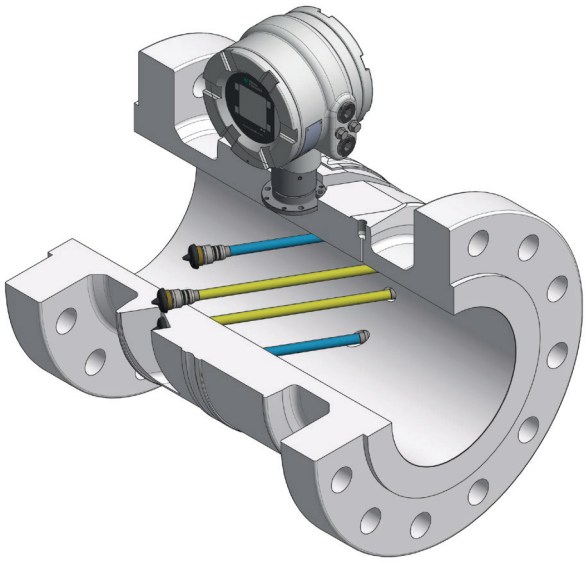


Figure 9 FioSonic-FSN-4P

FioSonic for redundant measurements applications

FioSonic BX model consists of two fully independent measurement systems (two electronic head) integrated in one single standard meter body. This solution provides a remarkable space and cost saving.
Available from DN200 (8”) to DN750 (30”)
The meter can have 2 configurations:

- FioSonic BX model “**FSN-BX-4P-4P**” where both metering systems have 4 paths each. This solution is suitable for redundant Custody Transfer metering line.
- FioSonic BX model “**FSN-BX-4P-3P**” where 1 metering systems has 4 paths and 1 has 3 paths. This solution is suitable for only 1 Custody Transfer metering line with a second electronic as check.

Each metering system works independently without any signal synchronization maintaining the full range of versatile I/O.

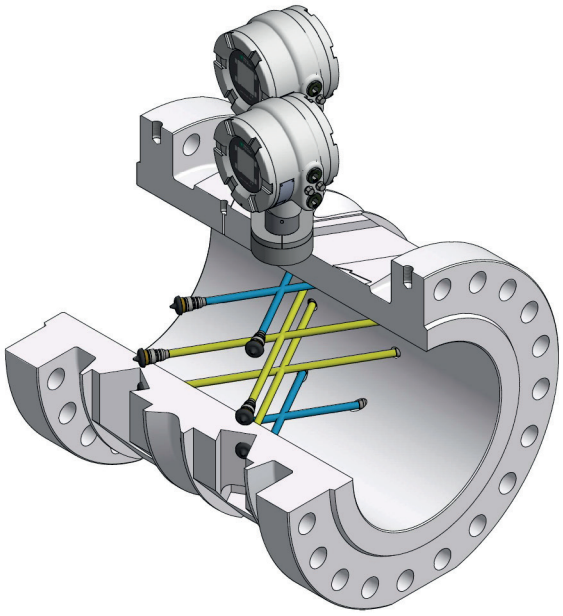


Figure 10 FioSonic-BX-4P-4P

Materials and Approvals

Part	Material
Body	Carbon steel ASTM A350 LF2 Cl.1
Electronic enclosure	Epoxy painted low copper aluminum alloy Stainless Steel 316 (on request)
Transducers	Titanium ASTM B348 Ti GR.2
Body painting	According to ISO12944-5 minimum Class C3 H (RAL9006 Grey)

Table 2 Materials

Construction Standards and Approvals

The **FioSonic** is designed to meet AGA report N.9 and ISO 17089-1 requirements.

AGA9 ISO17089-1

The product is certified according to European Directives 2014/68/EU (PED) as well as 2014/32/EU (MID), 2014/34/EU (ATEX), - International Organization of Legal Metrology OIML R137 – 1 - International Electrotechnical Commision IECEx – QPS Evaluation Service (Canada – USA) cQPSus.

PED MID ATEX OIML R137-1 IECEx cQPSus

Working pressure sizing chart

To choose the suitable working pressure range for each FiuoSonic size, it is mandatory to refer to the green cells in the Table 3. The models in the red cells are not usable.

Pressure range Bar (a)	DN80 3”	DN100 4”	DN150 6”	DN200 8”	DN250 10”	DN300 12”
from 1 to 2 bar (a)						
from 2 to 4 bar (a)						
from 4 to 8 bar (a)						
from 8 to -> bar (a)						

Pressure range Bar (a)	DN350 14”	DN400 16”	DN450 18”	DN500 20”	DN600 24”	DN750 30”
from 1 to 2 bar (a)						
from 2 to 4 bar (a)						
from 4 to 8 bar (a)						
from 8 to -> bar (a)						

Table 3 Working pressure sizing chart

Capacity table

Custody Transfer measurement Class 0,5 with OIML R137-1 certification

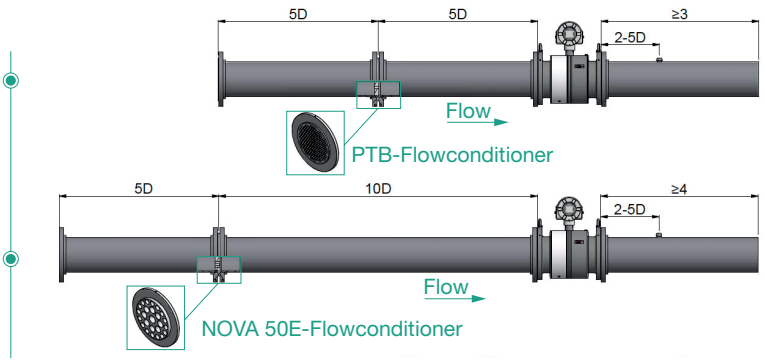
Class 0.5 OIML R-137 FioSonic 4P Capacity table [pipe configuration 1 or 2]

Nominal size		Pipe schedule	Capacity						
			Qmin		Qt		Q max		Turndown
Inches	DN	SCH	m3/h	cfh	m3/h	cfh	m3/h	cfh	1:X
3"	80	STD	9	318	60	2.119	601	21.224	66
4"	100	STD	15	530	99	3.496	991	34.996	66
6"	150	STD	27	954	201	7.094	2.014	71.124	75
8"	200	STD	35	1.236	348	12.284	3.485	123.072	100
10"	250	STD	55	1.942	549	19.384	5.494	194.000	100
12"	300	STD	78	2.755	779	27.494	7.798	275.400	100
14"	350	STD	95	3.356	951	33.566	9.518	335.810	100
16"	400	STD	123	4.344	1.231	43.469	12.313	434.614	100
18"	450	STD	163	5.752	1.626	57.414	16.265	574.393	100
20"	500	STD	194	6.852	1.936	68.361	19.366	684.900	100
24"	600	STD	296	10.441	2.863	101.001	28.634	1.011.192	97
30"	750	STD	468	16.511	4.369	154.289	43.698	1.543.174	93

Table 4 Capacity and rangeability table

1 **PTB** flow conditioner piping configuration

2 **NOVA 50E** flow conditioner piping configuration



Custody Transfer measurement Class 1 with MID 2014/32/EU or OIML R137-1 certification

Class 1 OIML R-137 and MID class 1 FioSonic 4P Capacity table [pipe configuration 1 - 2 - 3]

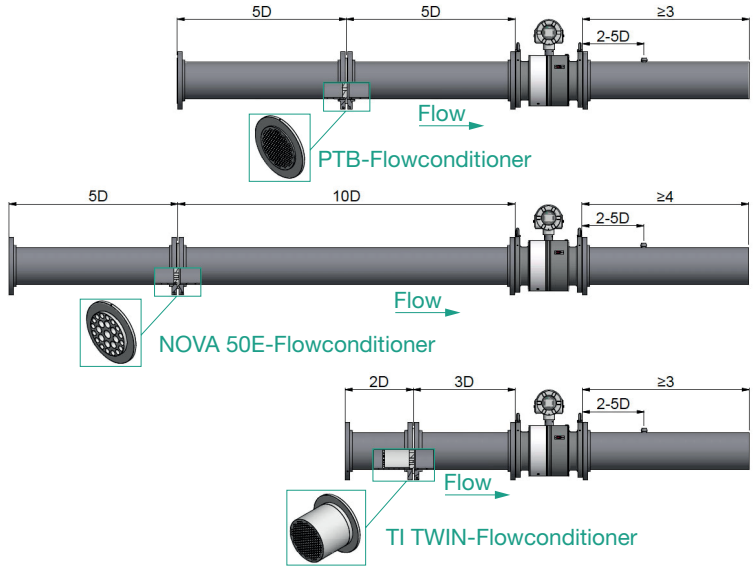
Nominal size		Pipe schedule	Capacity						
			Qmin		Qt		Q max		Turndown
Inches	DN	SCH	m3/h	cfh	m3/h	cfh	m3/h	cfh	1:X
3"	80	STD	9	318	60	2.119	601	21.224	66
4"	100	STD	15	530	99	3.496	991	34.996	66
6"	150	STD	27	954	201	7.094	2.014	71.124	75
8"	200	STD	35	1.236	348	12.284	3.485	123.072	100
10"	250	STD	55	1.942	549	19.384	5.494	194.000	100
12"	300	STD	78	2.755	779	27.494	7.798	275.400	100
14"	350	STD	95	3.356	951	33.566	9.518	335.810	100
16"	400	STD	123	4.344	1.231	43.469	12.313	434.614	100
18"	450	STD	163	5.752	1.626	57.414	16.265	574.393	100
20"	500	STD	194	6.852	1.936	68.361	19.366	684.900	100
24"	600	STD	296	10.441	2.863	101.001	28.634	1.011.192	97
30"	750	STD	468	16.511	4.369	154.289	43.698	1.543.174	93

Table 5 Capacity and rangeability table

1 **PTB** flow conditioner piping configuration

2 **NOVA 50E** flow conditioner piping configuration

3 **TI TWIN** flow conditioner piping configuration



Flow Conditioner

FioSonic flow conditioner is selected according to target accuracy, piping configuration constrains and certification required between the below 3 models .
It is mandatory for Custody Transfer and No Custody Transfer measurements.

To choose the suitable type of flow conditioner for each FioSonic size, it's mandatory to use the models in the green cells of the following table 6.
The models in the red cells are not usable.

Flow Conditioner	Straight pipe	DN80 3"	DN100 4"	DN150 6"	DN200 8"	DN250 10"	DN300 12"
NOVA 50E	10DN						
PTB	5DN						
TI-TWIN	3DN						

Flow Conditio-ner	Straight pipe	DN350 14"	DN400 16"	DN450 18"	DN500 20"	DN600 24"	DN750 30"
Nova 50E	10DN						
PTB	5DN						
TI-TWIN	3DN						

Table 6 Flow Conditioner table

Figure 11 FioSonic flow conditioner

Flow Conditioner Pipes Configuration

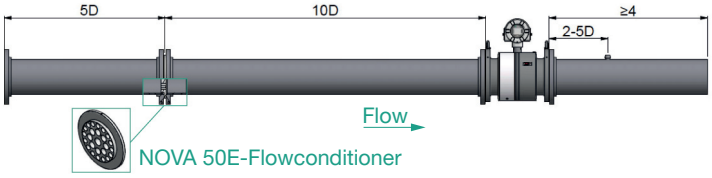
FioSonic flow conditioner installation require the inlet/outlet pipes configuration (spool) indicated in the figure 12.

NOVA 50E Flow conditioner pipes configuration

Suitable for FioSonic from DN80 (3”) up to DN750 (30”) and certified:

- OIML R137-1 Class 0,5 or Class 1
- MID 2014/32/EU Class 1

Require as minimum lengths:
Upstream piping: 5D+NOVA50E+10D
Between flow conditioner and meter: 10D (fixed length)
Downstream piping: ≤ 4D

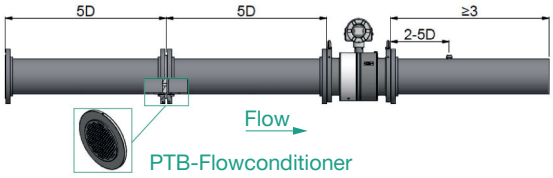


PTB Flow conditioner pipes configuration

Suitable for FioSonic from DN80 (3”) up to DN200 (8”) and certified:

- OIML R137-1 Class 0,5 or Class 1
- MID 2014/32/EU Class 1

Require as minimum lengths:
Upstream piping: 5D+PTB+5D
Between flow conditioner and meter: 5D (fixed length)
Downstream piping: ≤ 3D



TI-TWIN Flow conditioner pipes configuration

Suitable for FioSonic from DN80 (3”) up to DN150 (6”) and certified:

- OIML R137-1 Class 1
- MID 2014/32/EU Class 1

Require as minimum lengths:
Upstream piping: 2D+TI-TWIN+3D
Between flow conditioner and meter: 3D (fixed length)
Downstream piping: ≤ 3D

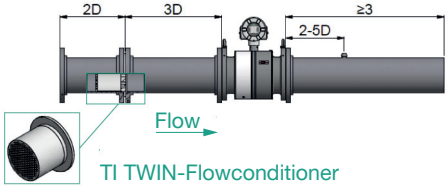


Figure 12 FioSonic flow conditioner pipes configuration

Accessories

For the electronic:

- Passive output board 4-20 mA (HART)
- P&T Pressure and Temperature sensors imput board (not for Fiscal use)
- Electronic housing in Stainless Steel SS316

For the meter:

- Electrical power supply panel
- Flow Conditioner
- Spool pipes kit
- Safety barriers / isolating repeater
- Temperature and pressure sensors

Weights and Dimensions

FioSonic

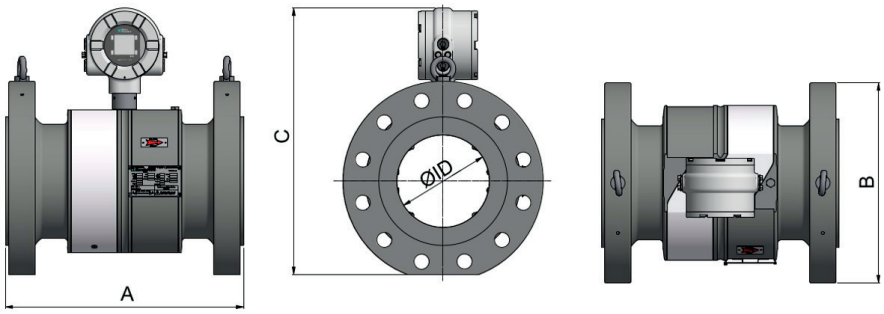


Figure 13 FioSonic dimensions

Below table shows the minimum standard FioSonic dimensions.
Different dimensions can be customized according to Customer's need.

Nominal size table

ØID Nominal Size inches | [DN]	Rating [ANSI] | PN	**A-Length** [mm] | inches	**B-Width** [mm] | inches	**C-Height** [mm] | inches	**Weight** [Kg] | lbs
3" | DN80	ANSI 150 | PN 16	350 | 13.78	210 | 8.27	430 | 16.93	55 | 121
	ANSI 300	350 | 13.78	210 | 8.27	430 | 16.93	60 | 132
	ANSI 600	350 | 13.78	210 | 8.27	430 | 16.93	65 | 143
4" | DN100	ANSI 150 | PN 16	400 | 15.75	275 | 10.83	500 | 16.69	70 | 154
	ANSI 300	400 | 15.75	275 | 10.83	500 | 16.69	80 | 176
	ANSI 600	400 | 15.75	275 | 10.83	500 | 16.69	90 | 198
6" | DN150	ANSI 150 | PN 16	400 | 15.75	355 | 13.98	570 | 22.44	88 | 194
	ANSI 300	400 | 15.75	355 | 13.98	570 | 22.44	106 | 234
	ANSI 600	400 | 15.75	355 | 13.98	570 | 22.44	130 | 287

Table 7 Weights and dimensions table

NOMINAL SIZE TABLE					
ØID Nominal Size inches | [DN]	Rating [ANSI] | PN	**A-Length** [mm] | inches	**B-Width** [mm] | inches	**C-Height** [mm] | inches	**Weight** [Kg] | lbs
8" | DN200	ANSI 150 | PN 16	500 | 19.69	420 | 16.54	620 | 24.41	130 | 287
	ANSI 300	500 | 19.69	420 | 16.54	620 | 24.41	160 | 353
	ANSI 600	500 | 19.69	420 | 16.54	620 | 24.41	195 | 430
10" / DN250	ANSI 150 | PN 16	550 | 21.65	510 | 20.08	690 | 27.17	184 | 406
	ANSI 300	550 | 21.65	510 | 20.08	690 | 27.17	220 | 485
	ANSI 600	550 | 21.65	510 | 20.08	690 | 27.17	295 | 650
12" | DN300	ANSI 150 | PN 16	600 | 23.62	560 | 22.05	750 | 29.53	245 | 540
	ANSI 300	600 | 23.62	560 | 22.05	750 | 29.53	305 | 672
	ANSI 600	600 | 23.62	560 | 22.05	750 | 29.53	393 | 866
14" | DN350	ANSI 150 | PN 16	650 | 25.59	605 | 23.82	780 | 30.71	505 | 1113
	ANSI 300	650 | 25.59	605 | 23.82	780 | 30.71	565 | 1246
	ANSI 600	650 | 25.59	605 | 23.82	780 | 30.71	615 | 1356
16" | DN400	ANSI 150 | PN 16	700 | 27.56	690 | 27.17	860 | 33.86	640 | 1411
	ANSI 300	700 | 27.56	690 | 27.17	860 | 33.86	715 | 1576
	ANSI 600	700 | 27.56	690 | 27.17	860 | 33.86	805 | 1775
18" | DN450	ANSI 150 | PN 16	900 | 35.43	745 | 29.33	950 | 37.40	760 | 1676
	ANSI 300	900 | 35.43	745 | 29.33	950 | 37.40	875 | 1929
	ANSI 600	900 | 35.43	745 | 29.33	950 | 37.40	1035 | 2282
20" | DN500	ANSI 150 | PN 16	1000 | 39.37	815 | 32.09	1000 | 39.37	950 | 2094
	ANSI 300	1000 | 39.37	815 | 32.09	1000 | 39.37	1085 | 2392
	ANSI 600	1000 | 39.37	815 | 32.09	1000 | 39.37	1315 | 2899
24" | DN600	ANSI 150 | PN 16	1100 | 43.31	940 | 37.01	1050 | 41.34	1280 | 2822
	ANSI 300	1100 | 43.31	940 | 37.01	1050 | 41.34	1500 | 3307
	ANSI 600	1100 | 43.31	940 | 37.01	1050 | 41.34	1800 | 3968
30" | DN750	ANSI 150 | PN 16	1300 | 51.18	1130 | 44.49	1270 | 50.00	2450 | 5401
	ANSI 300	1300 | 51.18	1130 | 44.49	1270 | 50.00	2790 | 6151
	ANSI 600	1300 | 51.18	1130 | 44.49	1270 | 50.00	3220 | 7099

Table 8 Weights and dimensions table

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