

MT-329-E

ENGLISH

## FSN SERIES FLOMETER



## INSTALLATION, OPERATING AND MAINTENANCE MANUAL

 **Pietro  
Fiorentini**®

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## Introduction

This manual provides information about the installation, operation and maintenance of the FSN series ultrasonic gas flowmeter. It contains information for correct operation and maintenance of this product. It also contains important instructions to prevent accidents and serious damage before commissioning and during operation. Furthermore, the information provided ensures trouble free and safe operation of the equipment. Before operating the product read and understand this manual. Strictly follow the safety instructions and warnings.

In the event of questions or need for additional information regarding specific matters about the FSN Series, please contact Pietro Fiorentini via e-mail or telephone.

This instruction manual is based on the latest information at the time of writing. It is provided subject to changes and updates. We reserve the right to change the configuration and/or construction of our products at any time without obligation to update previously shipped products.

The warranty provisions stipulated in our Terms and conditions are applicable to the product. Pietro Fiorentini shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or due to negligence of the purchaser;
- The equipment, or parts, have been maintained or repaired by other than an authorized representative of Pietro Fiorentini, or have been modified in any manner without prior express written permission of the manufacturer;
- Non-original parts are used;
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose;
- Use of this product with unauthorized equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

Pietro Fiorentini is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.

## 1 Contents of this manual

This manual contains several sections, covering various aspects of the FSN series flowmeter.

Chapter 1	This chapter
Chapter 2	Important instructions
Chapter 3	FSN Series product description
Chapter 4	Installation
Chapter 5	Startup and commissioning
Chapter 6	Operation
Chapter 7	Maintenance
Chapter 8	Sealing
Chapter 9	Shipping
Chapter 10	Accessories and spare parts
Appendices	

### 1.1 Conventions

The following symbol and indication conventions are used throughout this manual.



*Warning!*

A warning indicates hazards or unsafe practices that could result in severe personal injury or death



*Attention!*

The sign indicates potential hazardous or unsafe operation that could result in minor or personal injury or damage of product or property. It is also used to indicate operations or practices that could cause the product to operate in an unexpected way or provide results outside its specification.

### 1.2 Related documents

The last version of the referenced document is leading, unless otherwise specified.

[1] FSN Series Safety instructions

Author: Pietro Fiorentini  
 Document Code: MT 330-E

[2] FSN Series Flowmeter sealing locations

Author: Pietro Fiorentini  
 Document Code: MT 331-E

### 1.3 Abbreviations

The following abbreviations are used throughout the document:

ATEX	Atmosphère Explosive
CSA	Canadian Standards Association
EMC	Electromagnetic Compatibility
FM	Factory Mutual
IEC	International Electrotechnical Commission
IECEX	International Electro technical Commission certification scheme for Explosive atmospheres
IS	Intrinsic Safety
ISO	International Organization for Standardization
LCD	Liquid Crystal Display
LVD	Low Voltage Directive
OIML	Organisation Internationale de Métrologie Légale
PCBA	Printed Circuit Board Assembly
PED	Pressure Equipment Directive
SPU	Signal Processing Unit
USM	Ultrasonic Flowmeter

## 2 Important information

### 2.1 Main hazards



*Warning!*

Pressurized flammable gas flows through the Flowbody of the FSN series ultrasonic gas flowmeter. Do not remove any transducers or parts from the flowbody whilst the flowmeter is under pressure. Flammable gas can escape and parts may blow out.

### 2.2 Intended use

The FSN series ultrasonic gas flowmeter primary use is to measure the volume flow rate and gas velocity of gases in pipelines.

Optionally the FSN series can convert the volume flow at measuring conditions to base conditions as well as registering data on meter readings, diagnostics and other data.

### 2.3 Identification

Each FSN Series flowmeter has two nameplates for identification, one on the SPU and one on the flowbody. Refer to chapter 3.2.3 for detailed information about the nameplates and identification.

### 2.4 Operation in explosive atmospheres

The FSN series are suitable for use in potentially explosive atmospheres. Refer to the Safety instructions [1] (MPFM009\_Safety\_instructions) for detailed information about this.

- ATEX                      Ex ia IIC T4 Gb
- IECEx                    Ex ia IIC T4 Gb

### 2.5 Restrictions for use

The FSN series flowmeters are suitable for use in pressurized lines within the design conditions specified on the flowmeter nameplate.

### 2.6 Cleaning

Only clean the FSN series ultrasonic flowmeter with a damp cloth. Do not use solvents for cleaning.

### 2.7 User responsibility

The user should read and understand the operating instructions prior to putting the FSN series ultrasonic flowmeter in use. All safety information should be observed. In case of doubt always contact Pietro Fiorentini.

### 2.8 Additional documentation

Additional documentation is delivered with the product. This contains specific set-up data for the individual flowmeter. Depending on the configuration the following documentation is delivered with the meter.

- Certificate of conformity / EX certificates
- Safety instructions
- Material certificates
- Inspection certificate
  - Meter configuration sheet
  - Factory acceptance test

Furthermore, product information such as this manual can be downloaded from the website.

### 3 FSN Series Product description

#### 3.1 Principle of operation

The FSN Series ultrasonic gas flowmeter operate according to the transit time difference measurement

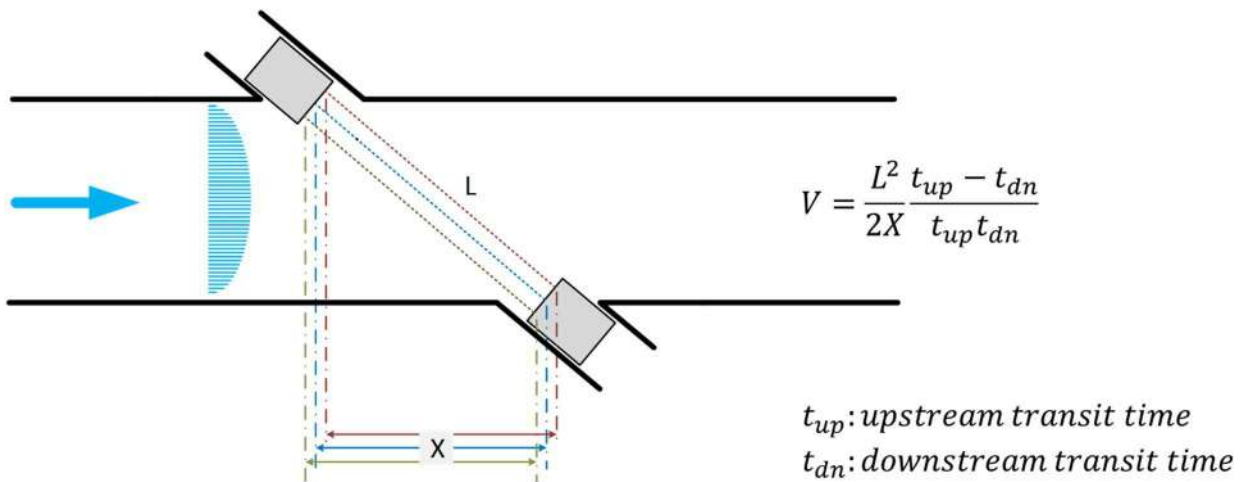


Figure 3-1 - principle of operation

Measured ultrasonic signal transit times  $t_{up}$  and  $t_{dn}$  are defined by the sound and gas velocity. Gas velocity  $V$  is proportional to the difference between the signal transit times. Changes in the sound velocity caused by pressure or temperature fluctuations do not affect the calculated gas velocity with this measurement method. The FSN series ultrasonic gas flowmeter calculates the volume flow rate based on the gas velocity and the Flowbody internal diameter.

#### 3.2 System components

The FSN series comprises of a Signal Processing Unit (SPU), Flowbody with transducers, nameplate with essential information.



Figure 3-2 - System components

### 3.2.1 Signal Processing Unit

The Signal Processing Unit (SPU) consists of a mainboard that contains all the electronic circuits for operation of the unit. In addition to the mainboard two additional boards can be placed for extra functionality such as pressure and temperature sensor interfaces and additional Input/Output interfaces.

The mainboard interfaces to the transducers and controls the complete measuring process. All interfaces except the USB service port are intrinsically safe.

### 3.2.2 Flowbody

The Flowbody is used to install the FSN series flowmeter in the pipeline. It is available in various pipe sizes, pressure ratings and flange types.

### 3.2.3 Nameplate

Nameplates and labels are fitted on the FSN Series flowmeter for identification and to provide details on the specific product as well as safety related information. Together with the safety instructions and this manual it specifies how to use the product and how it is designed and certified.

The main nameplate is fitted on the Flowbody and provides information on mechanical design conditions as well as flow related information such as meter factor and range. The meter's serial number is also provided on this nameplate.

The nameplate on the SPU provides the relevant electrical and hazardous area approval details according to ATEX or IECEx. The electronics individual serial number is provided on this nameplate. Refer to the Safety instructions for an example of this nameplate.

#### 3.2.3.1 Flowbody nameplate

The Flowbody nameplate contains information about;

- Company name and address
- Type of Ultrasonic flowmeter
- Model identification
- Flow range information
- Pressure and temperature range
- Mechanical design parameters (design code, design pressure and temperature)
- Sizing and weight
- Serial numbers
- Year-Month
- Warning: Read instruction manual before operating device

#### 3.2.3.2 SPU nameplate

The SPU nameplate contains information about;

- Company name and address
- Type of Ultrasonic flowmeter Electronics
- Hazardous area approval
- Model identification
- Serial number of the SPU
- Power requirements of the SPU
- Year of manufacture
- Substitution of components may impair intrinsic safety
- Install per drawing 6110032003



### 3.3 Interfaces

The FSN series flowmeter has several electrical interfaces. This chapter describes their function, operating parameters and intrinsic safety relevant information.



Figure 3-3 - FSN Series electrical interfaces shown with RS485 and PT option board

#### 3.3.1 Ground screw

A ground screw is provided to connect the FSN Series flowmeter to ground / earth.

#### 3.3.2 Power supply

The FSN Series flowmeter requires an external intrinsically safe power supply.

Signal	Function
PWR -	Power supply
PWR +	



**Warning!**

The power supply interfaces of the FSN Series flowmeter are reverse polarity protected up to 250mA max. Always connect via a suited intrinsically safe isolator or barrier. Refer to Control drawing 6110032003 for detailed information

**3.3.3 Frequency out**

A frequency out / pulse output is available on the mainboard (base configuration), the main purpose of this output is to provide pulses proportional to the volume flowing through the pipeline. The number of pulses per unit volume (m3 or cubic feet) is printed on the nameplate.

Signal	Function
D0_B	Frequency output -
D0_A	Frequency output +

**3.3.4 Option board terminals**

Optionally the FSN Series flowmeter can be fitted with an I/O option board, extending the functionality of the system. The option board requires a separate intrinsically safe power supply.

Signal	Function
PWR1 +	Option board power supply
PWR1 -	Option board power supply
D1_B	RS485 B
D1_A	RS485 A
D2_B	Digital output -
D2_A	Digital output +
D3_B	Digital output -
D3_A	Digital output +

**3.3.5 P/T Option Board**

In addition the FSN Series flowmeter can be fitted with an optional Pressure / temperature board, extending the functionality of the system with pressure and temperature measurement capabilities. This enables the FSN Series flowmeter to calculate base volume using PTZ conversion. A pressure and temperature sensor are then supplied by Pietro Fiorentini. Contact Pietro Fiorentini for additional information.

**3.4 Front interfaces**

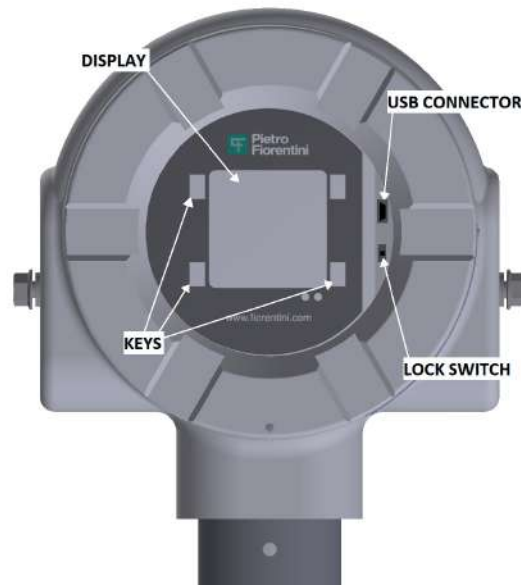


Figure 3-4 - display, keypad, USB and switch

**3.5 Display and keypad**

The front of the FSN series electronics is equipped with a graphical 128x128 dot matrix LCD graphic display. Four navigation keys are located at the corners of the display for operation of the local user interface.

**3.6 LEDs**

Two LED's are provided on the front panel. Their function is explained in detail in chapter 6.

Green LED = Power indication

Red LED = Status / Error indication

**3.7 USB Service interface and lock switch**

On the right side of the display a mini USB connector is present for connection of a laptop.



*Attention!*

This interface is not intrinsically safe and therefore powered by USB host (laptop or computer). It may be used in a safe area only or after taking suitable precautions such as gas detection. Refer to the Safety instructions [1] for further details.

The parameter lock switch is located below the USB connector and provides a way to lock all relevant parameters. This switch can be protected with a tamper proof sticker. Refer to chapter 8 (Sealing) for more details on the lock switch.

Note: the sticker shall also covers one of the display bracket screws

## 4 Installation

### 4.1 Introduction

It is very important to check the shipment of your ultrasonic flow meter equipment. By means of a visual inspection of surfaces, paint, flange sealing faces and electronics housing should be performed. In case of damage, contact Pietro Fiorentini immediately.

In addition verify all the necessary documentation is available as well:

- Safety instructions [1]
- Installation, operation and Maintenance manual (this document)

In addition to this additional documentation may be required based on project specifications. In the event documentation is missing contact Pietro Fiorentini or your local representative immediately.

### 4.2 Installation in the pipeline

The FSN series ultrasonic flowmeter is shipped in a wooden crate. To open the crate remove the top panel nails or screws and disassemble the box. Remove the transport fixtures and then move the flow meter (using the lifting lugs provided on the flow cell) to the installation site. Install the meter according to end-user's company regulations and applicable local and national requirements. To ensure optimal performance of the flowmeter, comply with the up- and downstream spool requirements specified for your particular application.



**Warning!**

To avoid possible strain, ensure your lifting equipment is suitable for the weight of the FSN series flowmeter. Always use the eyebolts provided on the flowbody and make sure to use approved lifting equipment and the equipment shows no damage or wear.

#### 4.2.1 Installation configurations

The recommended installation configurations are shown in Figure 4-1 below.

Configuration 2 with a NOVA50E type flow conditioner is approved under OIMLR137 and MID 2014/32/EU

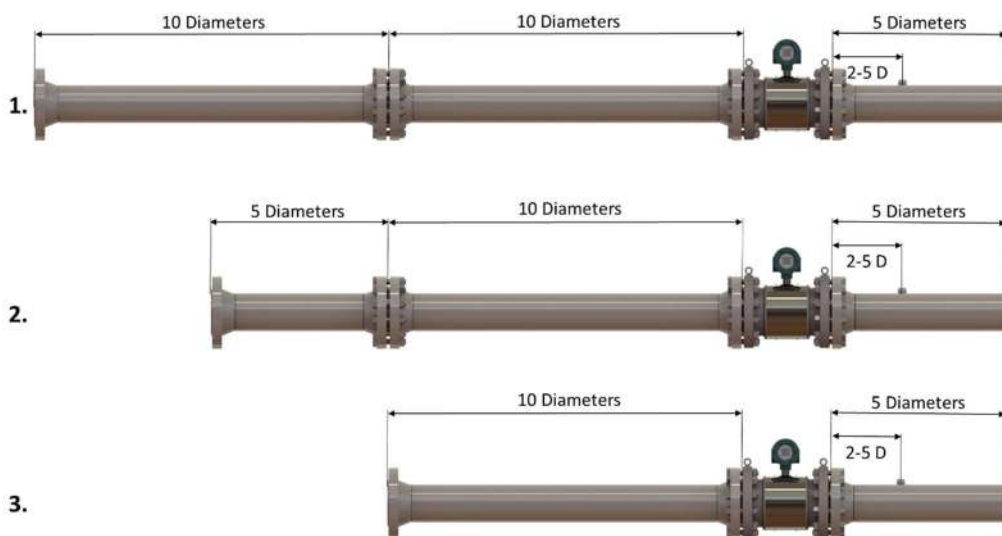


Figure 4-1 - Installation configurations

- Configuration 1. – Conservative configuration with flow conditioner
- Configuration 2. – Recommended configuration with flow conditioner
- Configuration 3. – Recommended configuration without flow conditioner

For bi-directional flow;

- The upstream piping spools and flow conditioner as applicable from configurations 1, 2 and 3 can be used on both ends of the metering package.
- Any thermowell should be positioned 3 – 5 diameters away from meter flanges.

### 4.3 Wiring of the FSN Series

This chapter provides information for correct wiring of the FSN series flowmeter. The electronics enclosure is provided with up to four cable gland entries with metric (M20x1.5) or imperial (1/2" NPT) thread. Suitable shielded cables must be used (for signal and communication cables the use of twisted pair cables is recommended) whereby the cables are protected from mechanical damaged as well as electrical interference. In addition ensure length, diameter, core are suitable for the length required in the field. As a minimum 0.75mm<sup>2</sup> core cross sectional area should be used. All terminal connections use the Phoenix contact MK3DSH series terminal blocks, suitable for wires with a core cross sectional area up to 2.5 mm<sup>2</sup>.



**Attention!**

For a reliable connection always use insulated wire end terminals compatible with the cable core cross sectional area.



**Warning!**

Refer to control drawing 6110032003 for the intrinsic safety parameters.

#### 4.3.1 Determining installed option boards

In order to determine which option boards are installed in your FSN Series flowmeter, locate the FSN Electronics model number on the nameplate of the SPU. Using the table on the control drawing (drawing 6110032003) determine which option boards are installed.

#### 4.3.2 Main board terminals

Signal	Function	Operating parameters
PWR -	Power supply	Rated input voltage 14..29VDC
PWR +		
DO_B	Frequency output -	0 .. 5kHz Passive open drain, not electrically isolated from system ground**
DO_A	Frequency output +	



**Warning!**

The power supply interfaces of the FSN Series flowmeter are reverse polarity protected up to 250mA max. Always connect via a suited intrinsically safe isolator or barrier.

Refer to Control drawing 6110032003 for detailed information

**4.3.3 Slot 1, RS485 Option board terminals (01-0020)**

Signal	Function	Operating parameters
PWR1 +	Option board power supply	Power supply for the I/O option board (14-29VDC)
PWR1 -	Option board power supply	
D1_B	RS485 B	Differential RS485 two wire communications port, galvanically isolated
D1_A	RS485 A	
D2_B	Digital output -	Passive, optically isolated open collector
D2_A	Digital output +	
D3_B	Digital output -	Passive, optically isolated open collector
D3_A	Digital output +	

**4.3.4 Slot 1 RS485 IO 4..20mA Option board terminals (01-0202)**

Signal	Function	Operating parameters
PWR1 +	Loop power supply	Power supply for the I/O option board and the 4..20mA loop.
PWR1 -	Loop power supply	
D1_B	RS485 B	Differential RS485 two wire communications port, galvanically isolated
D1_A	RS485 A	
D2_B	Digital output -	Passive, optically isolated open collector
D2_A	Digital output +	
D3_B	Digital output -	Passive, optically isolated open collector
D3_A	Digital output +	

**4.3.5 Slot 2 P/T Option board terminals (01-0022)**

Signal	Function	Operating parameters
PRESS1	Bridge +	Connections to the resistive bridge type pressure sensor (factory default = voltage mode sensor). Refer to Safety instructions for approved pressure sensors. Or contact Pietro Fiorentini for more information
PRESS2	Signal +	
PRESS3	Signal -	
PRESS4	Bridge -	
TEMP1	Supply +	Connections to the RTD sensor (factory default = 4 wire PT100). Refer to Safety instructions for approved pressure sensors. Or contact Pietro Fiorentini for more information
TEMP2	Signal +	
TEMP3	Signal -	
TEMP4	Supply -	

**4.3.6 Slot 2 4..20mA (HART) option board (01-0203)**

Signal	Function	Operating parameters
LPWR2+	Loop power supply	
LPWR2-	Loop power supply	

**4.3.7 Galvanic isolation**

In case galvanic isolation is required the use of an external isolator on frequency output D0 is required.

**5 Start-up and commissioning**

**5.1 Powering up**

After the SPU has been wired and powered up it is advisable to read out a complete list of parameters. In case of a flow calibrated meter, it is recommended to verify the parameters as found with the calibration parameters.

The parameters can be read with the Pietro Fiorentini Instrument Manager (PFIM) software tool (consult Pietro Fiorentini Instruments to obtain tool). A serial connection can be made via the USB interface.



**Warning!**

When connecting a PC or laptop in the hazardous area, ensure the rules and regulations to work with non EX equipment are met.

A flow calibrated meter should have the parameter lock switch closed and tamper proof sealing sticker in place. Make sure this is in place. Refer to chapter 8 for more details about sealing.

**5.2 Connecting to the USB Service port**

To connect to the FSN Series via the USB Service port it may be necessary to put the FSN Series flowmeter in USB Service mode. When the communication mode is set to the RS485 port, the USB Service mode enables to temporarily interface via the USB port. Refer to chapter 6.4 for details how to enable the USB service mode.



**Attention!**

When USB Service mode is enabled it will temporarily disable the RS485 option board.

When there is no activity for 60 seconds on the USB port the FSN Series resumes normal operation again

The default USB communication port settings are

Baudrate	115400
Parity	None
Databits	8
Stopbits	1
Modbus address	1

**5.3 Connecting to a flowcomputer or external device on the RS485 port**

When fitted with an option board for RS485 communications the FSN Series flowmeter can be connected to a flowcomputer or external device using the MODBUS RTU protocol.

The default communication protocol and serial port settings are provided in below

Baudrate	38400
Parity	None
Databits	8
Stopbits	1
Modbus address	1

Table 1 - Modbus communication settings

The Modbus address map can be provided on request.

The FSN Series flowmeter has a built in 120 ohm termination resistor in case the RS485 network needs to be terminated at this position. The switch shown in Figure 5-1 can be used for this



Figure 5-1 - Line termination resistor switch



**5.4 Commissioning**

When possible verify operation of the flowmeter at (near) zero flow at known gas composition. Zero flow readings and diagnostics per path should be recorded and assessed. After this zero flow check, start the gas flow and monitor per path readings and diagnostics for proper operation of the device. Ensure that the frequency signal provided by the meter match the volume flow reading on the local LCD.

It is recommended to log meter readings and diagnostics using the Pietro Fiorentini Instrument Manager (TIM) software tool during startup conditions.

**6 Operation of the local user interface**

In this chapter the operation via the local user interface is explained.

**6.1 LED indicators**

The FSN Series flowmeter has two LED indicators, located underneath the LC Display, their function is described in following tables.

- Power LED - GREEN

LED status	Interval	Description
Off	--	Power off
Green, flashing	2 Sec	Power on, system running

- Status LED - RED

LED status	Interval	Description
Off	--	Status OK
Red, flashing	1 Sec	Warning
Red, flashing	0.5 Sec	Error
Red, flashing	2 Sec	Status OK, unacknowledged transient Error present



Figure 6-1 - LCD and keypad (front cover removed)

## 6.2 Keypad

The keypad has four function keys which correspond with a function shown in the corners of the LCD. Each key will have a function depending on the operating mode of the interface.

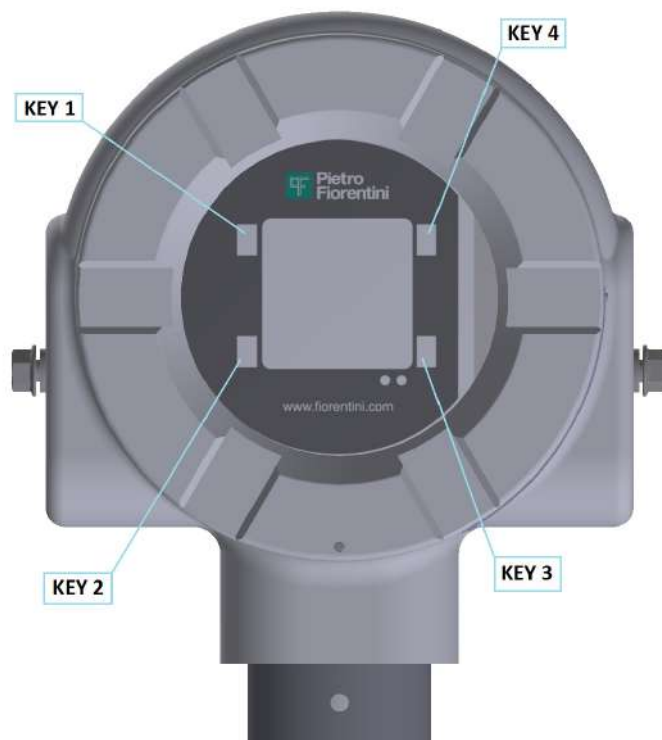


Figure 6-2 - Front view of keypad and display

### 6.3 Normal operating mode screens

During normal operation the FSN Series flowmeter provide the essential information on areas on the LCD. The following parameters can be displayed on both the upper and lower section of the LCD. Using the keys on the keypad different parameters can be selected.



The upper display is “static” - that is only the selected parameter is displayed. The parameter may be changed manually using the ◀ <left> and ▶ <right> scroll keys. The lower display will automatically scroll through the remaining parameters. The full list of parameters is shown below.

The following parameters can be viewed.

- Totalized volume forward (TotalFwd)
- Totalized volume reverse (TotalRev)
- Totalized volume forward in alarm conditions (TotalFwdAlrm)
- Totalized volume reverse in alarm conditions (TotalRevAlrm)
- Volumetric flowrate (Qline)
- Velocity of Gas (VoGCor)
- Velocity of Sound (VoSAvg)
- Meter status (MeasStatus). For a list of status codes refer to Appendix A.

#### 6.3.1 Contrast Control

The bottom two keys are used for contrast control. Use the ◻ <-contrast> and ◻ <+contrast> keys to adjust the contrast of the LCD.

**6.4 Main Menu**

Pressing the upper left key while in normal operating mode for 3 to 5 seconds will bring up the main menu of the FSN Series flowmeter.



The four function keys have now changed into **↑** <up>, **↓** <down>, **⏏** Escape <ESC> and **↵** Enter <ENT>.

Using the up and down arrow keys a menu option can be selected, pressing <ENT> will show the highlighted menu or function. To go back one step, press <ESC>. The following menu options are available

- 1. System Info
- 2. Display Test
- 3. Diagnostic Menus
- 4. Clear error
- 5. USB Service mode (unavailable in “console” mode)

**6.4.1 System Info**

The System Info Menu provides information about the FSN Meter software and hardware. After a few seconds the display will exit to the Operating Mode

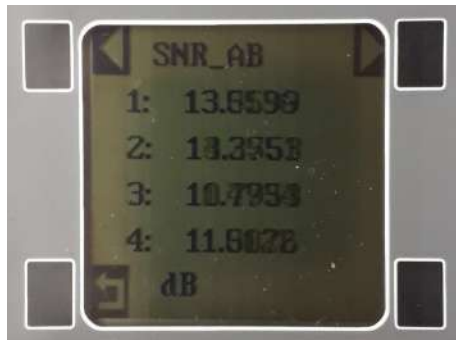


**6.4.2 Display Test**

When Display Test is highlighted and selected using the **↓** <down>, and then **↵** <ENT> a pattern will be scanned across the display to test all pixels. After the test the display will revert to the Operation Mode.

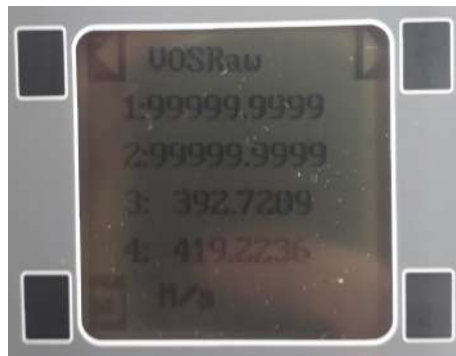
**6.4.3 Diagnostic Display**


When Diagnostic Display is highlighted and selected the following screen will be displayed




This screen shows diagnostic information for all enabled paths.


Scroll to the next diagnostic value using the  <right> scroll key.



The following diagnostic values may be displayed using the  <left> and  <right> scroll keys:

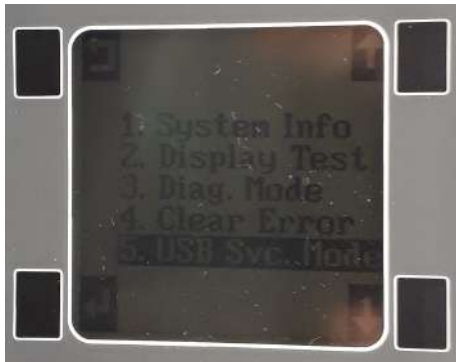
- Performance (DemodPerf)
- Velocity of Sound (VOSRaw)
- Gas Velocity (VoG)
- Gain AB (AGC AB)
- Gain BA (AGC BA)
- Signal to noise ratio AB (SNR AB)  Signal to noise ratio AB (SNR BA)
- Velocity of gas ratios (VoG ratio)
- Velocity of sound ratio (VoS ratio)
- Path Status AB (Status AB)
- Path Status BA (Status BA)

The diagnostic values and interpretation is discussed further in section 7: Maintenance.

Pressing  <ESC> will return to the normal operating display.

**6.4.4 USB Service mode**

When USB Serv. Mode is highlighted and selected using the **↓** <down>, and then **↵** <ENT> the FSN Series flowmeter will enter the USB service mode, enabling communications via the USB port. A message “USB Service Mode” will be shown on the display.



When pressing **↵** <ENT> again the FSN Series flowmeter will revert to the normal operation mode. Pietro Fiorentini Instrument Manager (PFIM) can be used to communicate via the USB port when in USB service mode.

**6.4.5 Clearing errors**

In the event an alarm or warning condition is active, the diagnostic code (refer to appendix A) is shown on the lower part of the LCD display until it is acknowledged by the user. Acknowledging alarms or warnings can be done via the main menu option 4 – Clear Alarms. If the error condition is still active the alarm or warning cannot be cleared.

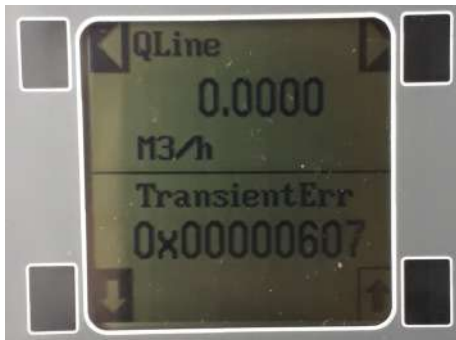


Figure 6-3 Error code to be acknowledged by user

**7 Maintenance**

The FSN Series ultrasonic flowmeter contains no moving parts. The sensors and electronics are virtually maintenance free, however periodic inspection is recommended at regular intervals. By collecting a short log file of measurement and diagnostic data at known and repeatable conditions the meter’s health status can be observed.

**7.1 Inspection of measurement and diagnostic data**

By comparing diagnostic data with previously collected data a good indication of the flowmeter’s condition can be observed. Below chapters outline the most significant diagnostic indicators. The display of diagnostic data is described in section 6.4.3 or may downloaded from the USB port or RS485 optional I/O port using a Modbus protocol. For the Modbus map or the Pietro Fiorentini Instrument Manager (PFIM) PC tool to download diagnostic and flow information contact Pietro Fiorentini Instruments.

- Performance**

This diagnostic indicates the percentage of accepted ultrasonic signals per path. The lower limit is set to 20% by default. At high flows or very turbulent flows, some rejection of ultrasonic signals may occur. The performance indicator is available for each path.
- Velocity of Sound (VoS)**

The FSN series flowmeter calculates the average velocity of sound (VoS) based on the individual measuring paths. The average VoS is simply the average of the paths. Individual VoS for each path is also provided. Under normal conditions the individual path velocities should be reading very close. When possible the theoretical velocity of sound using AGA-10 calculations based on temperature, pressure and gas composition may be compared to the measured average VoS.
- Gas Velocity (VoG)**

When possible the meter can be isolated from flowing conditions (using block valves). In this condition the meter should read less than 0.01 m/s. this is however extremely difficult to check due to natural convection inside the pipe and Flowbody as a result of slight temperature differences, causing the gas to circulate in the blocked pipe section.
- Gain (AGC AB and AGC BA)**

For each transducer the required gain in the receiver is controlled. Gain values should be in the normal operating range for all transducers. Gain values depend on gas pressure, composition and velocity, therefore gain values may differ between events.

Gain	Condition
>900	Very weak or no signal
100 - 900	Good
< 100	Very strong or saturated signal

- Signal to noise ratio (SNR AB and SNR BA)**

The SNR is calculated in dB for each received signal transducer. SNR values depend on gas pressure, composition and velocity. Below table provide information on Signal to noise ratio conditions.

SNR	Condition
>50	Very good
20 - 50	Good
10 - 20	Poor – fair
<10	Bad

- Velocity of gas ratio (VOG ratio) and profile factors**

The velocity of gas ratio is calculated between paths and provides a good indicator of the flow profile in the meter (determined by upstream piping). Profile factors are calculated from the velocity of gas ratios. Profile factors are an easy way to “understand” the flow profile in the flowmeter.
- Velocity of sound ratio (VOS ratio)**

The velocity of sound ratio is a good indicator of problems, either in the process or in the FSN Series signal detection. During normal condition the ratios should be very close to 1.0.
- Path Status (PathStatus AB and PathStatus BA)**

The Path Status diagnostic values provide a more detailed indication of the health of each path in each direction of transmission using an 8 digit number. A zero value (0x00000000) indicates that all parameters are within limits and no errors are present. The error codes are tabulated in Appendix A.

## 8 Sealing

For sealing locations refer to MT 331-E Flowmeter sealing locations.

## 9 Shipping & Storage

Use suitable means for transportation, loading and unloading of the packed FSN Series flow meter. The packing is not suitable for the use of strap belts and lifting by a crane.

If the flowmeter has been removed from its packaging, lifting and moving may only be carried out using suitable, properly fitted lifting lugs.

Take care that the meter will be installed on a vibration free location. Continuous vibration or shocks may have an adverse effect on the construction of the flow meter.

The dimensions and weight of the package depend on the type and size of the ultrasonic gas flow meter and are to be specified on the packing list.

If the FSN Series flowmeter needs to be stored for a certain period of time before installation the following storage conditions do apply:

- Never stack the (packaged) flowmeters.
- It is recommended to use a corrosion preventative coating (oil, WD40, tectyl) on all bare metal parts of the flowcell (e.g. inside, flange surfaces,...),
- Be aware to remove the corrosion preventative coating prior to putting the flowmeter in service
- Storage temperature -30 °C to 60 °C
- Storage relative humidity 5 – 95% RH, non-condensing
- Use moisture absorbing bags (silica gel) inside the SPU to protect the electronics from moisture.
- Inspect the stored flowmeter on a regular basis to ensure no condensation is present which may cause corrosion and /or damage to the electronics
- When other piping components and/or flow conditioners are provided with the meter, also apply a corrosion preventative coating to any uncoated surfaces.



### *Long term storage*

When the meter is stored for longer time. Ensure that the meter is stored in a sheltered condition with a temperature between 0°C and + 60°C. The inside of the Flowbody should be protected from corrosion using a suitable corrosion preventative coating.

## 10 Spare parts and accessories

Please contact Pietro Fiorentini for spare parts and accessories



## Appendix A: Diagnostic Codes

### Measurement Status / TransientErr

Diagnostic Status Bytes				set both AB/BA	Affects performance	WARNING	ERROR
Hex Value	Decimal Value	Enum / Short Description	Long Description				
0x00000000	0	No_error	No Error				
0x00000001	1	Warning	Measurement Warning			X	
0x00000002	2	Error	Measurement Error				X
0x00000004	4	CalSwitch_unlock	Calibration lock open			X	
0x00000008	8	System_error	Inconsistency in system parameters				X
0x00000010	16	FPGA_error	Inconsistency in FPGA parameters				X
0x00000020	32	Flash_mem_error	Error accessing internal flash memory				X
0x00000040	64	RTCBattFail	RTC clock battery failure			X	
0x00000080	128	Ispare	Not enough power			X	
0x00000100	256	Firmware_error	Firmware checksum error				X
0x00000200	512	Factory_defaults	Started from factory defaults				X
0x00000400	1024	ParamCRC_Error	Parameter checksum error				X
0x00000800	2048	Optionboard_timeout	Option board does not respond			X	
0x00001000	4096	TestMode	Meter is in test mode				X
0x00002000	8192	DigOutOverflow	LF pulse output overflow			X	
0x00004000	16384	TotalStorageInitError	Totalizer storage error - no valid flash record found on startup				X
0x00008000	32768	TotalPersistError	Totalizer persistence error - totalizer storage verification failed			X	

### Path / Transducer diagnostics

0x00000000	0	No error	No Error				
0x00000001	1	Performance_bad	Performance too low				
0x00000002	2	No_Correlation	MaxAmp and/or MinAmp below low limit		YES		
0x00000004	4	SNR_Range	Signal to noise ratio too low		YES		
0x00000008	8	Signal_overflow	Signal too large		YES		
0x00000010	16	MinMaxZoom_Range	Min and Max indices of raw signal too far away		NO		
0x00000020	32	Envelope_slope_range	Signal signature out of range		YES		
0x00000040	64	Envelope_slope_dev	% deviation filter on Signal signature		YES		
0x00000080	128	DetPoint_Range	Zero Cross out of range		YES		
0x00000100	256	ZC_DETPT_Filter	Detectionpoint corrected by ZC_DETPT_filter		NO		
0x00000200	512	DeltaT_error	ABS((DetPTCorrBA - DetPtCorrAB) - (ZeroCrossBA - ZeroCrossAB))		YES		
0x00000400	1024	DemodTransittimeAccel	Transittime acceleration too high (cycle skip)		YES		
0x00000800	2048	EnvPeakSkip	Envelope peak skip (packet)		NO		
0x00001000	4096	SPARE					
0x00002000	8192	SPARE					
0x00004000	16384	SPARE					
0x00008000	32786	SPARE					
0x00010000	65536	VOSRange	Velocity of sound out of range	YES		X	
0x00020000	131072	VOGRange	Velocity of gas out of range	YES		X	
0x00040000	262144	WetGasVOS	Wetgas filter triggered substitution based on VOS	YES		X	
0x00080000	524288	WetGasVOG	Wetgas filter triggered substitution based on VOG	YES		X	
0x00100000	1048576	Substitution	Path being substituted based on historical data	YES		X	
0x00200000	2097152	SPARE					





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**MT185-E April 2009**

MT-335-E

ENGLISH


## FSN SERIES FLOMETER





## SAFETY INSTRUCTION CARD


TECHNICAL MANUAL

## SAFETY INSTRUCTIONS CARD

	<p><i>Warning!</i></p> <p>The power supply interfaces of the FSN Series flowmeter are reverse polarity protected up to 250mA max. Always connect via a suited intrinsically safe isolator or barrier.</p> <p><b>Refer to Control drawing 6110032002 for detailed information</b></p>
---	--

	<p><i>Warning!</i></p> <p>ONLY CONNECT THE USB INTERFACE IN SAFE AREA OR ENSURE NO EXPLOSIVE ATMOSPHERE IS PRESENT.</p> <p><b>MAXIMUM VOLTAGE RATING <math>U_m = 250 \text{ VAC}</math></b></p>
---	---

	<p><i>Warning!</i></p> <p>The FSN Series requires an intrinsically safe power supply compatible with the electrical parameters stated in the control drawing 6110032002.</p>
--	--

	<p><i>Warning!</i></p> <p>Do not perform hydrotesting on the FSN Series flowmeter</p>
---	---

	<p>BEFORE INSTALLATION REMOVE RUST PREVENTATIVE COATING INSIDE SPOOLPIECE</p>
---	---

### Removing internal rust preventative

The FSN Series flowmeter meterbody is shipped with an oil type corrosion protective coating applied on the inside of the flowcell of the meter. It is recommended to remove the oil film before putting the meter in service, however the oil will evaporate over time when the meter is in service. Clean the inside wall with a cloth and solvent.

**REFER TO OTHER SIDE OF SAFETY INSTRUCTIONS CARD**

## **SAFETY INSTRUCTIONS CARD**

- Read the instruction manual before handling or operating device!
- For Storage & transportation refer to the instruction manual - Shipping and Storage:
  - Use suitable means for transportation, loading and unloading of the packed FSN Series flow meter. The packing is not suitable for the use of strap belts and lifting by a crane.
  - If the flowmeter has been removed from its packing, lifting and moving may only be carried out using suitable, properly fitted lifting lugs.
  - Take care that the meter will be installed on a vibration free location. Severe vibration or shocks may have an adverse effect on the construction of the flow meter.
- The electronics enclosure may be provided with a silica gel bag inside. Before powering up, remove the silica gel bag from the enclosure.
- Always store or transport the flowmeter with a silica gel bag inside the SPU, to absorb excessive humidity. Replace the silica gel with a fresh one before it is saturated. Check on a regular basis (e.g. monthly).
- Installation, maintenance and replacement may only be carried out by qualified personnel under safe conditions.
- Only use the FSN Series flowmeter for its intended application.
- When servicing the flowmeter a gas detector may be required!
- Ensure the FSN Series flowmeter operates within its media, pressure & temperature limits as specified on the meter's nameplate.
- It is not allowed to perform repair and maintenance activities when the FSN Series flowmeter is in operation.
- The FSN Series flowmeter operates under line pressure and is used for dangerous media.
- Removing and/or exchanging parts during operation can cause severe injury or possible death.
- In the event a transducer is required to be replaced, the flowmeter and the process line must be de-pressurized and brought to ambient temperature before servicing the meter.
- Be careful when removing transducers, process media may still be present and vent to atmosphere. This media may be poisonous, flammable or dangerous in any kind. To avoid these dangerous situations precautions need to be taken.
- Depressurize the process line before taking the meter out.
- The flowbody of the FSN Series flowmeter can be used for cold and hot media. Any contact with the flowbody may cause severe injury.
- Always use the correct tools and parts. Never use power tools to remove transducers
- Always perform a leak test after installation.
- Ensure the meter is wired and ground properly according to the wiring instructions.
- To prevent water entering the electronics enclosure, always firmly tighten the lids and tighten the set screw on the lids to avoid unintended opening of the enclosure.
- Inspect the meter for any environment and weather influence on a regular basis.

**REFER TO OTHER SIDE OF SAFETY INSTRUCTIONS CARD**



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**MT335-E July 2020**

MT-334-E

ENGLISH

# FSN SERIES FLOMETER



## FSN SERIES SERVICE MANUAL

TECHNICAL MANUAL



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## Introduction

This manual provides information for specific maintenance and service on the FSN series ultrasonic gas flowmeter. It contains guidelines for correct service and maintenance of this product. It also contains important instructions to prevent accidents and serious damage before commissioning and during operation. Before operating the product read and understand this manual. Strictly follow the safety instructions and warnings.



### *Warning!*

Service and maintenance procedures described in this manual may only be carried out by qualified service personnel.



### *Attention!*

In the event of questions or need for additional information regarding specific matters about the FSN Series, please contact Pietro Fiorentini via email or telephone.

This instruction manual is based on the latest information at the time of writing. It is provided subject to changes and updates. We reserve the right to change the configuration and/or construction of our products at any time without obligation to update previously shipped products.

The warranty provisions stipulated in our Terms and conditions are applicable to the product. Pietro Fiorentini shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or due to negligence of the purchaser;
- The equipment, or parts, have been maintained or repaired by other than an authorized representative of Pietro Fiorentini, or have been modified in any manner without prior express written permission of the manufacturer;
- Non-original parts are used;
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose;
- Use of this product with unauthorized equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

Pietro Fiorentini is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.

## 1 Contents of this manual

This manual contains several sections, covering various aspects of the FSN series flowmeter.

Chapter 1	This chapter
Chapter 2	Important instructions
Chapter 3	Product description
Chapter 4	SPU replacement
Chapter 5	Transducer replacement
Chapter 6	Accessories and spare parts
Appendices	

### 1.1 Conventions

The following symbol and indication conventions are used throughout this manual.



#### *Warning!*

A warning indicates hazards or unsafe practices that could result in severe personal injury or death.



#### *Attention!*

This sign indicates potential hazardous or unsafe operations that could result in minor personal injury or damage of product or property. It is also used to indicate operations or practices that could cause the product to operate in an unexpected way or provide results outside its specification.

### 1.2 Related documents

The last version of the referenced document is leading, unless otherwise specified.

#### [1] **FSN Series Safety instructions**

Author: Pietro Fiorentini

Document Code: MT-330-E FIOSONIC MT- SAFETY INSTRUCTIONS

#### [2] **FSN Series installation, operating and maintenance**

Author: Pietro Fiorentini

Document Code: MT-329-E INSTALLATION, OPERATING AND MAINTENANCE MANUAL

### 1.3 Abbreviations

The following abbreviations may be used throughout the document:

ATEX	ATmosphère Explosive
CSA	Canadian Standards Association
EMC	Electromagnetic Compatibility
FM	Factory Mutual
IEC	International Electrotechnical Commission
IECEx	International Electro technical Commission certification scheme for Explosive atmospheres
IS	Intrinsic Safety
ISO	International Organization for Standardization
LCD	Liquid Crystal Display
LVD	Low Voltage Directive
OIML	Organisation Internationale de Métrologie Légale
PCBA	Printed Circuit Board Assembly
PED	Pressure Equipment Directive
SPU	Signal Processing Unit
USM	Ultrasonic Flowmeter

## 2 Important information

### 2.1 Main hazards



#### *Warning!*

Pressurized flammable gas flows through the Flowbody of the FSN series ultrasonic gas flowmeter. Do not remove any transducers or parts from the flowbody whilst the flowmeter is under pressure. Flammable gas can escape and parts may blow out.

### 2.2 Intended use

The FSN series ultrasonic gas flowmeter primary use is to measure the volume flow rate and gas velocity of gases in pipelines.

Optionally the FSN series can convert the volume flow at measuring conditions to base conditions as well as registering data on meter readings, diagnostics and other data.

### 2.3 Identification

Each FSN Series flowmeter has two nameplates for identification, one on the SPU and one on the flowbody. Refer to the installation and operating manual for detailed information about the nameplates and identification.

### 2.4 Restrictions for use

The FSN series flowmeters are suitable for use in pressurized lines within the design conditions specified on the flowmeter nameplate.

### 2.5 Cleaning

Only clean the FSN series ultrasonic flowmeter with a damp cloth to avoid build up of static electricity. Do not use solvents for cleaning.

### 2.6 User responsibility

The user should read and understand the operating instructions prior to putting the FSN series ultrasonic flowmeter in use. All safety information should be observed. In case of doubt always contact Pietro Fiorentini.

### 3 FSN Series Product description

#### 3.1 System components

The FSN series comprises of a Signal Processing Unit (SPU), Flowbody with transducers, nameplate with essential information.



Figure 3-1 - System components

##### 3.1.1 Signal Processing Unit

The Signal Processing Unit (SPU) consists of a mainboard that contains all the electronic circuits for operation of the unit. In addition to the mainboard two additional boards can be placed for extra functionality such as pressure and temperature sensor interfaces and additional Input/Output interfaces.

The mainboard interfaces to the transducers and controls the complete measuring process. All interfaces except the USB service port are intrinsically safe.



**Warning!**

ONLY CONNECT THE USB INTERFACE IN SAFE AREA OR ENSURE NO EXPLOSIVE ATMOSPHERE IS PRESENT.  
 MAXIMUM VOLTAGE RATING  $U_m = 250 \text{ VAC}$

##### 3.1.2 Flowbody

The Flowbody is used to install the FSN series flowmeter in the pipeline. It is available in various pipe sizes, pressure ratings and flange types.

##### 3.1.3 Nameplate

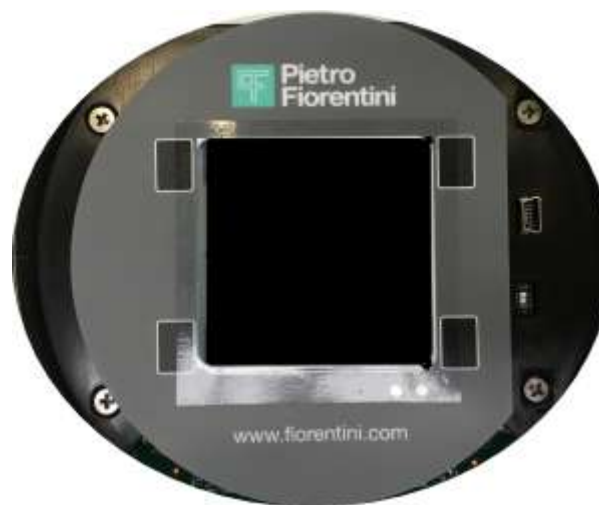
Nameplates and labels are fitted on the FSN Series flowmeter for identification and to provide details on the specific product as well as safety related information. Together with the safety instructions and this manual it specifies how to use the product and how it is designed and certified.

The main nameplate is fitted on the Flowbody and provides information on mechanical design conditions as well as flow related information such as meter factor and range. The meter's serial number is also provided on this nameplate.

The nameplate on the SPU provides the relevant electrical and hazardous area approval details according to ATEX, IECEx. The electronics individual serial number is provided on this nameplate. Refer to the Safety instructions for an example of this nameplate.

## 4 SPU replacement

This chapter describes the steps to take for replacing the Electronics assembly. This unit is a complete subassembly, there is no need to replace individual circuit boards.



### 4.1 Electrostatic Discharge (ESD) precautions





Working with electronic circuit boards requires some precautions to prevent damage to the components on the board caused by ESD. Although it is usually not possible to create a fully ESD safe working environment, a few simple precautions will usually be sufficient.

- Leave the electronic assembly in its anti-static bag until it can be fitted in the enclosure
- Do not wear or work with synthetic fabric, these are very good isolators and will be able to build up charge.
- If possible work on a grounding mat, connected to earth and work with a wrist strap. However performing repairs in the field this may not be possible. Wearing anti-static footwear will greatly help reducing the risk of building up a static charge.



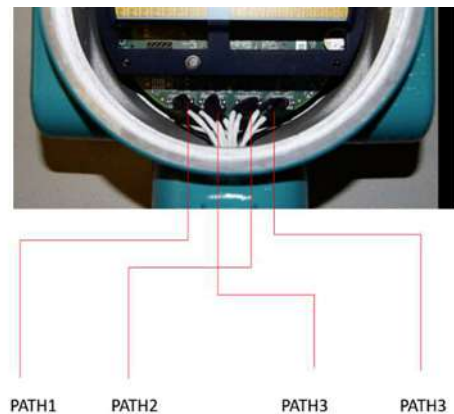
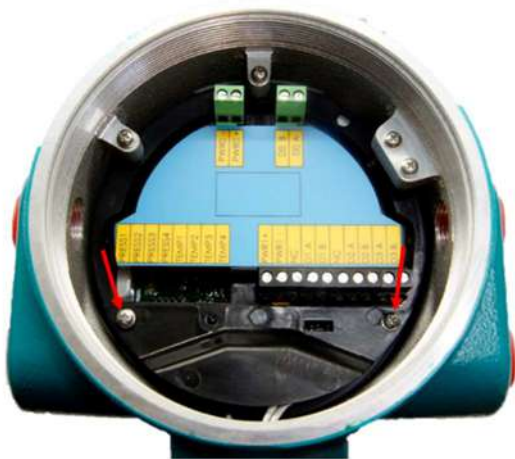
**Electrostatic discharge may cause severe damage to electronic components. This damage does not always reveal itself directly, it may cause an effect even after longer periods of time.**

**4.2 Required tools**

 <p>Flat head screwdriver</p>	 <p>Phillips head screwdriver</p>	 <p>Optional FSN-4P, Sealing wire and seals</p>	 <p>Long flatnose pliers</p>
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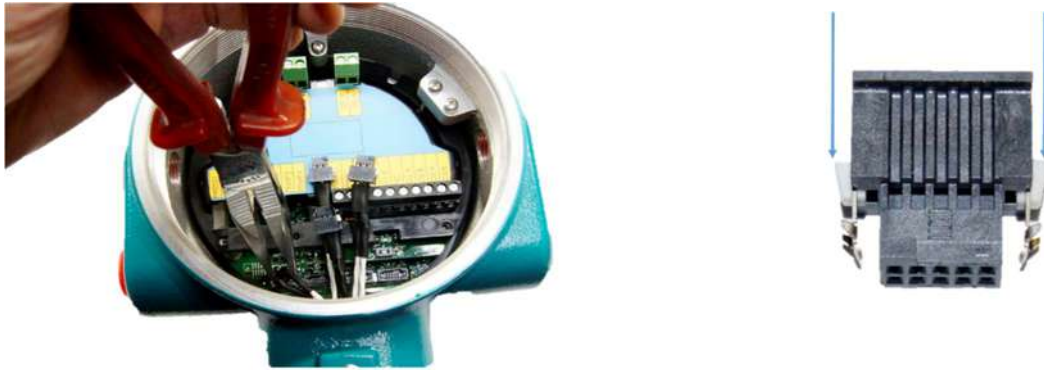
**4.3 Removing the Electronics assembly**

- a) Ensure all power to the FSN Series flowmeter is disconnected and it is safe to work on the device. Remove all field wiring from the terminal blocks. Make sure to make your wiring so it's easy to reconnect it again after the electronics have been replaced.
- b) Remove both the rear and front covers to access the electronics. The Electronics assembly comes out through the front side.
- c) Remove the wiring cover by removing the two M3 screws shown below. This now allows access to the transducer cable connectors. Note that for the FSN-4P the left screw may be a Seal screw (DIN404).

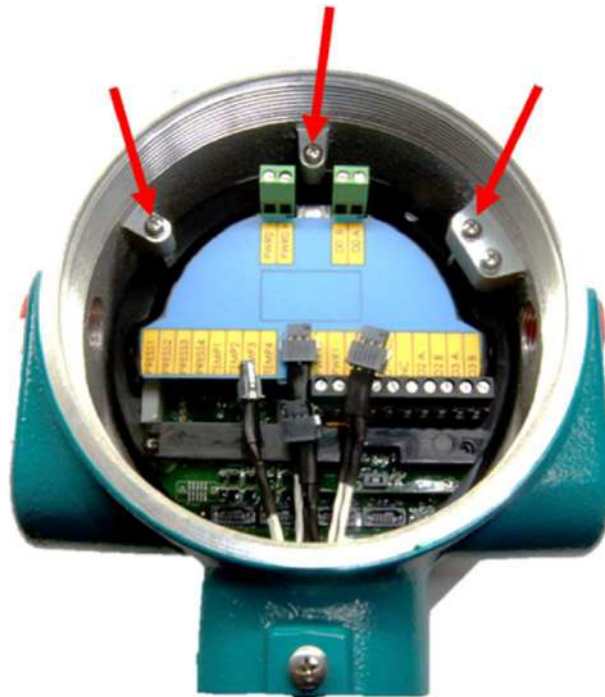




- d) Using a long flat nose plier carefully grab the Transducer cable connector latch hooks and gently pull out the connector from the Circuit board connector. Do this for all transducer cables. Make sure to mark them so they can be put back on the correct channel again after replacing the electronics assembly. The picture on the right shows the transducer connector's latch hooks, using the plier press then inward will release the connector from the Circuit board.



- e) Now unscrew the three M3 screws as shown below. Note that for the FSN-4P the left screw may be a Seal screw (DIN404)



- f) Now the electronics can be removed from the enclosure
- g) Put the replacement electronics assembly in and tighten the 3 M3 screws.  
Reconnect the transducer cables into the correct path connection. Refer to step a) for the path numbering.
- h) Re-install the transducer wiring cover
- i) Reconnect all field wiring. The FSN Series flowmeter may now be powered o again.
- j) Reprogramming may be necessary.

**5 Transducer replacement**

In the event a transducer needs to be removed for cleaning or replacement this chapter describes the steps to safely remove and re-install the transducers.

**5.1 Replacing non-retractable transducers FSN-U1 and FSN-U2**

This chapter describes the steps for removing FSN-U1 and FSN-U2 transducers that are non-retractable. This means the line needs to be de-pressurized and possibly purged with nitrogen.



**Warning!**

The transducers are not retractable under pressure and installation may only take place at atmospheric conditions and no explosive gas atmosphere may be present.

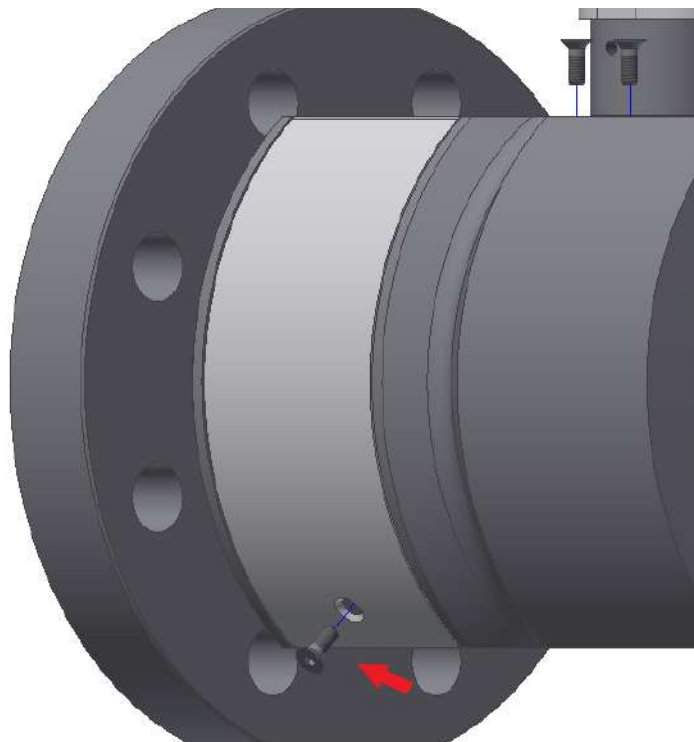
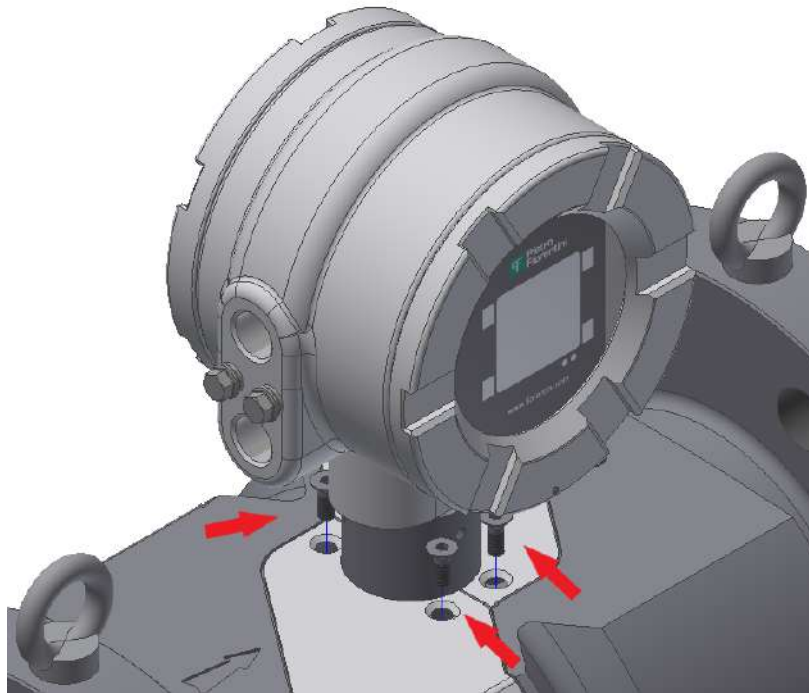
**5.1.1 Preparation**

1. Required tools and parts

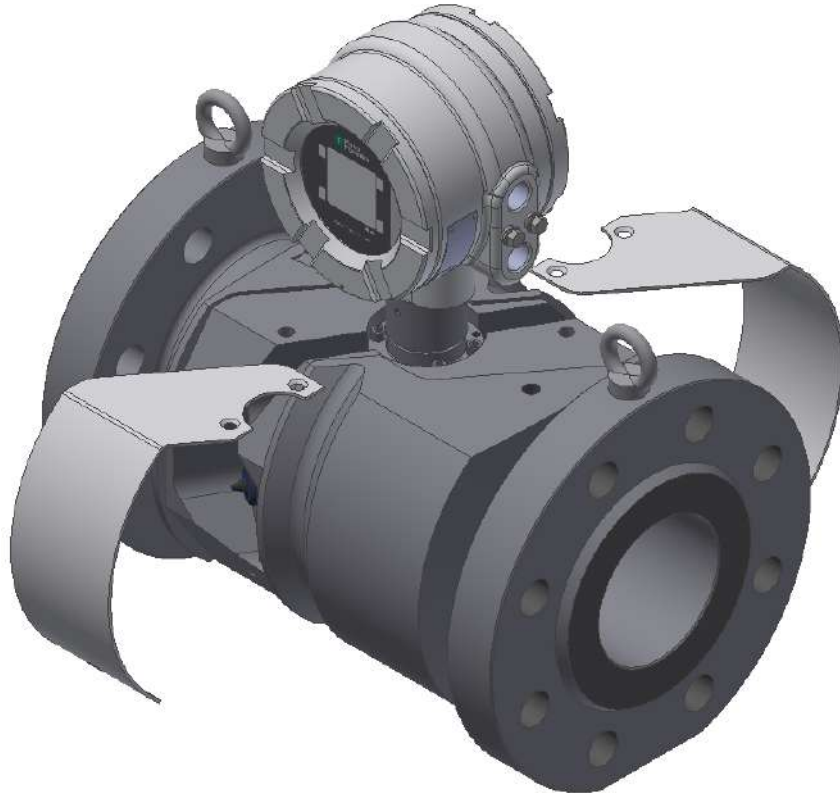
 <p>Flat head screwdriver</p>	 <p>Locknut tool Pietro Fiorentini part no. 6FS99N003</p>	 <p>Transducer O-rings in FKM</p>	 <p>Optional: Grab hooks</p>
 <p>Flat nose pliers</p>	 <p>Allen key set</p>	 <p>Molykote separator spray</p>	 <p>Brake cleaner spray</p>

**5.1.2 Removing the transducers**

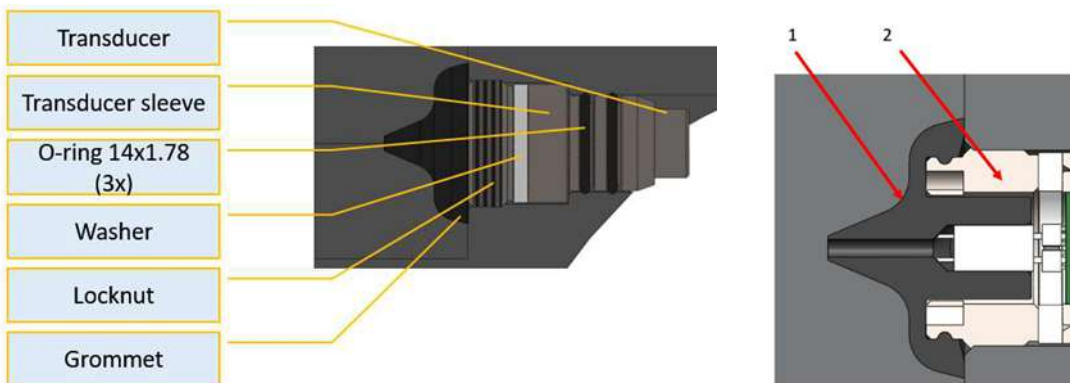
1. Ensure the gas line is depressurized and if required purged with nitrogen.
2. There is no need to disconnect the power from the FSN Series as the device is completely intrinsically safe.
3. Remove the covers by removing the screws

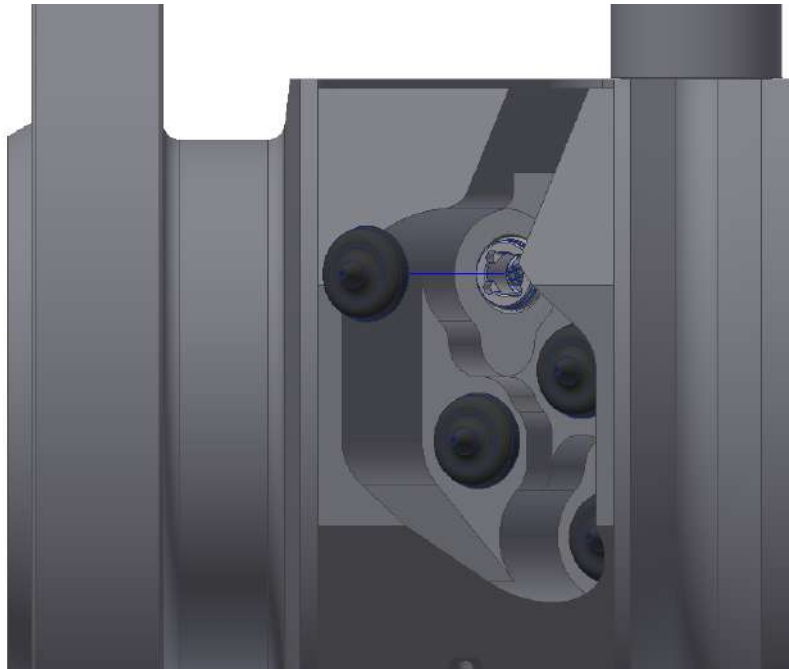


- Both covers can now be removed.



- Locate the transducers that needs service and/or replacing. In this example the upstream transducer of path 1 is being removed.
- Remove the transducer cable by lifting the rubber grommet out of the locknut. This can be done using a small flat screwdriver or a grab hook tool. Below is a section view of the grommet (1) / locknut (2) assembly.

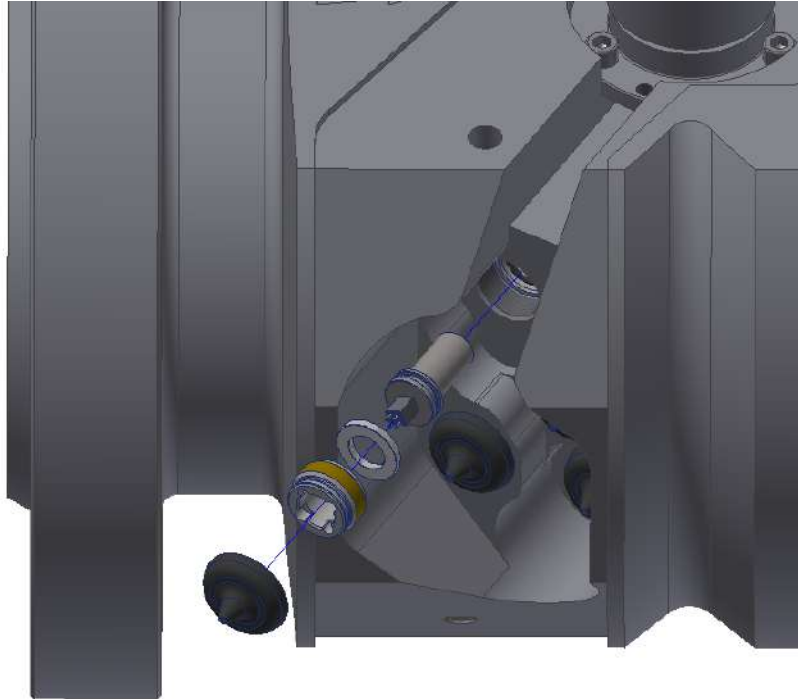




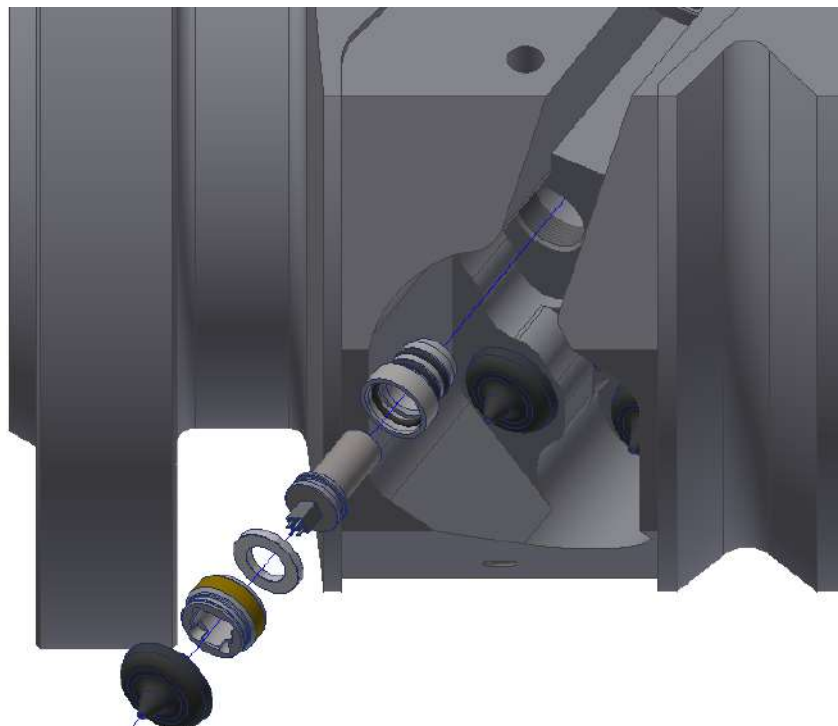
7. Now remove the locknut with the locknut tool and an allen key wrench and remove the peek washer.



8. Now using a flat nose plier grab one of the connector pins and gently pull out the transducer. Be careful not to bend the pin, pull straight along the axis of the transducer port. Below picture shows the transducer removed.



9. In case of cleaning also remove the transducer sleeve from the flowbody. Using a small hook the sleeve can be pulled out of the transducer port. Below picture shows the transducer sleeve removed from the flowbody.



10. Remove and dispose the O-rings, these need to be replaced by new ones after cleaning, or with fitting a new transducer.
11. Clean the transducer (and sleeve if also removed) with a solvent such as alcohol or brake cleaner. Do not use acetone based solvents.
12. Clean the transducer port using a cotton cloth or equivalent. Optionally use compressed air to blow out any debris from the transducer ports, in particular the M22x1.0 thread in the transducer port.



**Attention!**

Make sure there is no debris left in the transducer port as this may affect the transducer position.

**5.1.3 Inserting the transducer**

1. Now a new transducer can be placed (or the cleaned transducer placed back again).
2. Put the new O-rings on the sleeve and transducer. Make sure the O-rings are not damaged.
3. Use a little bit of silicon based O-ring lubricant spray. Molykote separator spray is the recommended lubricant to use.
4. Also spray a bit of O-ring lubricant in the transducer port to ensure the O-rings can be inserted without having to apply too much force.



**Attention!**

Do not use excessive grease on the O-rings as this will negatively influence the meter's performance.

5. Insert the transducer into the sleeve and then using a flat nose plier, grab the transducer around the black plastic connector base. Insert the transducer/sleeve assembly into the transducer port. Gently push the assembly until the sleeve is in position.



6. Insert the peek washer in the transducer port on top of the transducer and sleeve.
7. Insert the Transducer lock nut. Gently turn the locknut using the locknut tool and ensure the thread engages smoothly
8. Tighten the locknut to 4 – 5 Nm ( 2.9 - 3.7 lbf.ft ).
9. Put the connector on the transducer. The connector has 3 pins and can only be inserted one way. Be careful not to damage the pins. With the connector correctly placed on the transducer, push the rubber connector grommet firmly over the locknut.



**Attention!**

Ensure the rubber connector grommet is firmly secured over the locknut. The rubber grommet ensures a water and dust tight connection between cable and transducer.

10. Put the flowbody covers back in place and tighten the socket button head screws.

## **6 Spare parts and accessories**

Please contact Pietro Fiorentini for spare parts and accessories.





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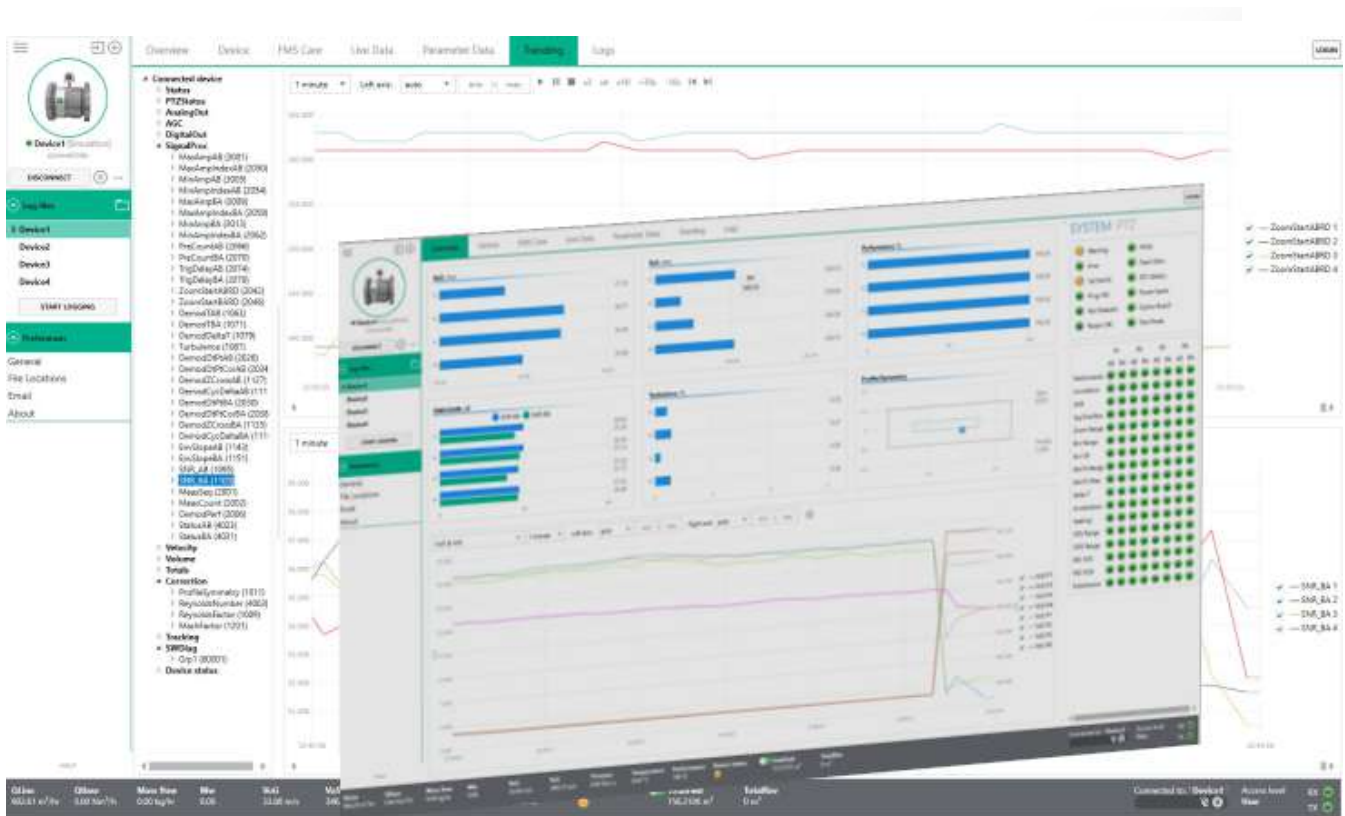
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**MT334-E July 2020**

# FSN SERIES FLOMETER



## FIOSONIC MANAGEMENT SOFTWARE

### OPERATIONS MANUAL

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## Introduction

This manual provides information for installing and performing the basic functions of Fiosonic Management Software (FMS). FMS is the Microsoft Windows based software to program, run diagnostics and troubleshoot the FSM series ultrasonic gas flowmeter. It contains guidelines for setting up a connection and perform the basic functions in FMS. Before operating the product read and understand this manual. Strictly follow the safety instructions and warnings.



### *Attention!*

In the event of questions or need for additional information regarding specific matters about the FSM Series, please refer to the Installation and operating instructions or contact Pietro Fiorentini via email or telephone.

This Quickstart is based on the latest information at the time of writing. It is provided subject to changes and updates. We reserve the right to change the configuration and/or construction of our products at any time without obligation to update previously shipped products.

The warranty provisions stipulated in our Terms and conditions are applicable to the product. Pietro Fiorentini shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or due to negligence of the purchaser;
- The equipment, or parts, have been maintained or repaired by other than an authorized representative of Pietro Fiorentini, or have been modified in any manner without prior express written permission of the manufacturer;
- Non-original parts are used;
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose;
- Use of this product with unauthorized equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

Pietro Fiorentini is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.

No license is required for Pietro Fiorentini Manager or the .Net Framework 4.0. These software programs are provided on an as-is basis. In no case will Pietro Fiorentini be liable for direct, indirect, incidental or consequential damages resulting from a defect in the software, or the unintentional or deliberate misuse of the software.


**1 Contents of this manual**


This manual contains several sections, covering various aspects of FMS.

Chapter 1	This chapter
Chapter 2	Installation
Chapter 3	General information
Chapter 4	Devices
Chapter 5	Operating FMS
Chapter 6	Trending and logs
Chapter 7	Diagnostics
Appendices	

**1.1 Conventions**

The following symbol and indication conventions are used throughout this manual

	<p><b>Warning!</b></p> <p>A warning indicates hazards or unsafe practices that could result in severe personal injury or death.</p>
---	---

	<p><b>Attention!</b></p> <p>This sign indicates potential hazardous or unsafe operations that could result in minor personal injury or damage of product or property. It is also used to indicate operations or practices that could cause the product to operate in an unexpected way or provide results outside its specification.</p>
---	--

**1.2 Related documents**

The last version of the referenced document is leading, unless otherwise specified.

**[1] FSM Series Safety instructions**

Author: Pietro Fiorentini  
 Document Code: MT-330-E - FIOSONIC MT- SAFETY INSTRUCTIONS

**[2] FSM Series installation, operating and maintenance**

Author: Pietro Fiorentini  
 Document Code: MT-329-E INSTALLATION, OPERATING AND MAINTENANCE MANUAL

**1.3 Abbreviations**

The following abbreviations may be used throughout the document:

ATEX	ATmosphère Explosive
CSA	Canadian Standards Association
EMC	Electromagnetic Compatibility
FM	Factory Mutual
IEC	International Electrotechnical Commission
IECEX	International Electro technical Commission certification scheme for Explosive atmospheres
IS	Intrinsic Safety
ISO	International Organization for Standardization
LVD	Low Voltage Directive
OIML	Organisation Internationale de Métrologie Légale
PCBA	Printed Circuit Board Assembly
SPU	Signal Processing Unit
USM	Ultrasonic Flowmeter
RTF	Rich Text Format
FMS	Fiosonic Management Software

## 2 Installation

This chapter describes the minimum system requirements and instructions for the installation of FMS.

### 2.1 Minimum system requirements

The minimum system requirements necessary to run Pietro Fiorentini Manager are:

- Windows 7 or higher with .NET framework 4.6 or higher
- Installation requires Local Administrator Rights
- Free disk space with a minimum of 500 MB
- 4GB RAM
- Screen resolution of 1366x768 or better for optimum viewing experience

### 2.2 Installing FMS

In order to be able to install FMS, the user should have administrator rights.



**Attention!**

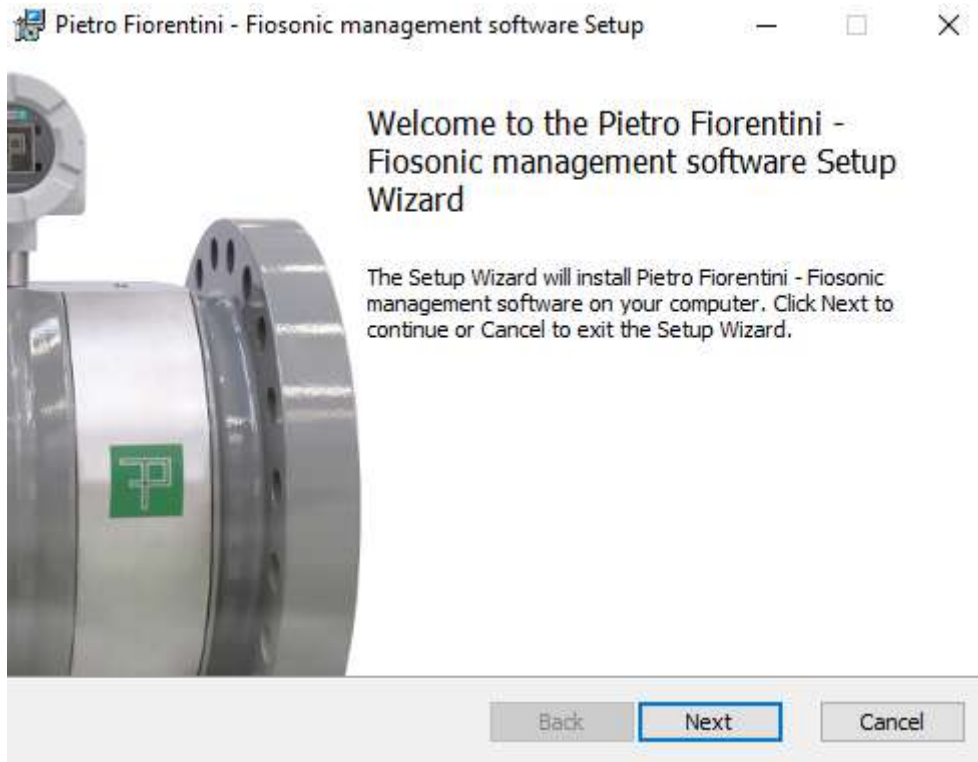
We recommend installing FMS under the account of the user that will use FMS. The user will need to have administrator rights to install FMS.

Go to the Pietro Fiorentini website download section and download the latest version of FMS. Save it to your downloads folder. When the download is complete, open the installer package and follow the steps below to complete the installation.

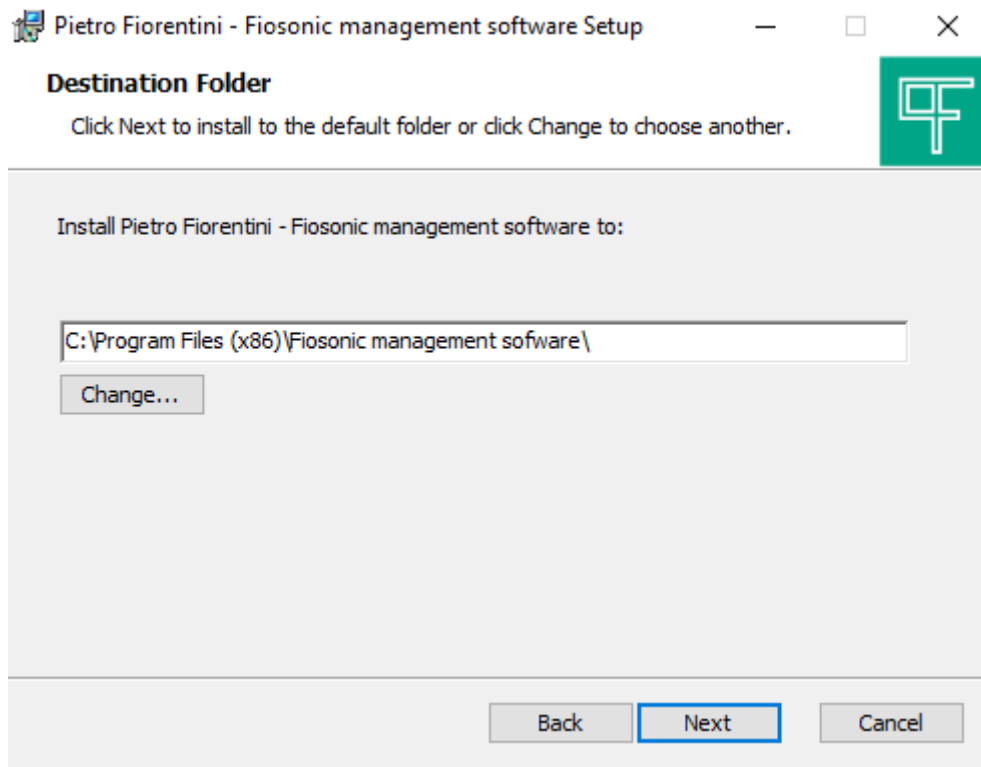
1. Run the FMSinstaller.msi Windows might give you a warning message when it doesn't recognize the app. Click <More Info> and click <Run anyway> to proceed.



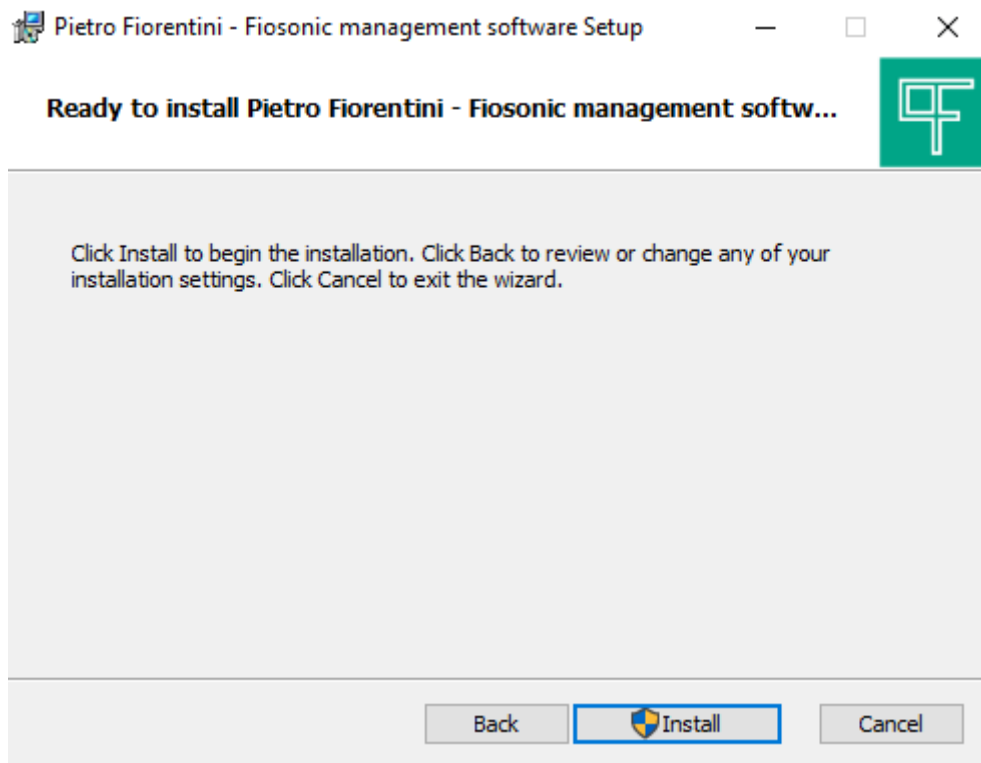
2. Click next in the following screen



3. Click next to accept the default installation folder or press <Change> to change the destination folder.



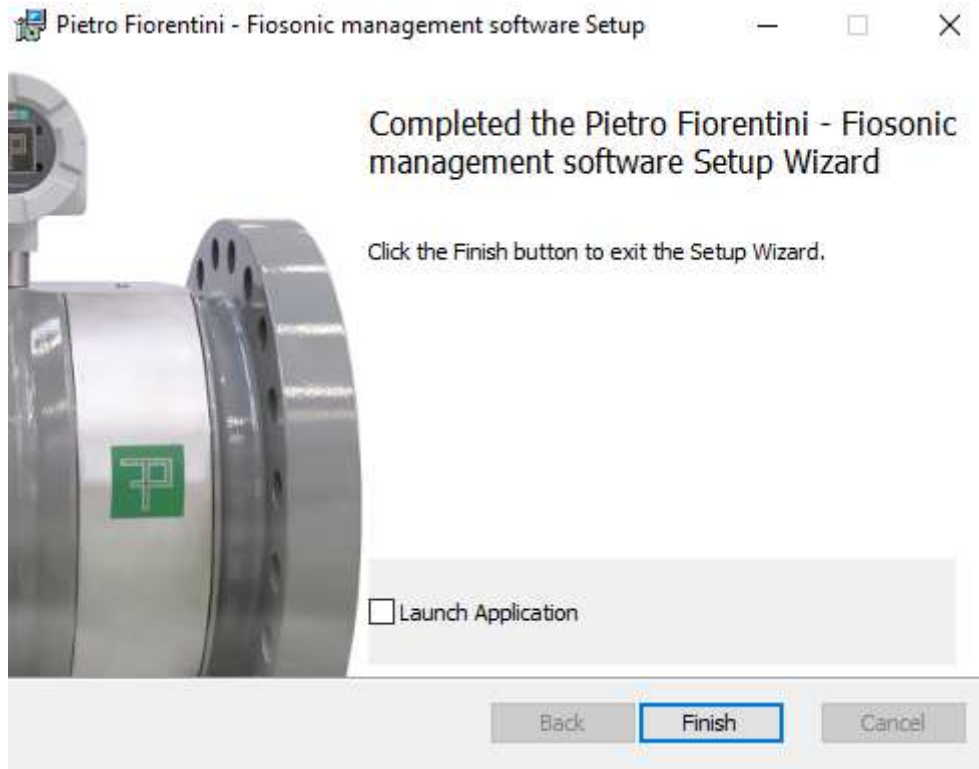
4. Click <Install> to begin the installation



When Windows asks you to confirm the installation, click <YES> to proceed with the installation



5. The following screen shows when the installation completed successfully. Press Finish to complete the installation



### 2.3 Running Pietro Fiorentini Manager

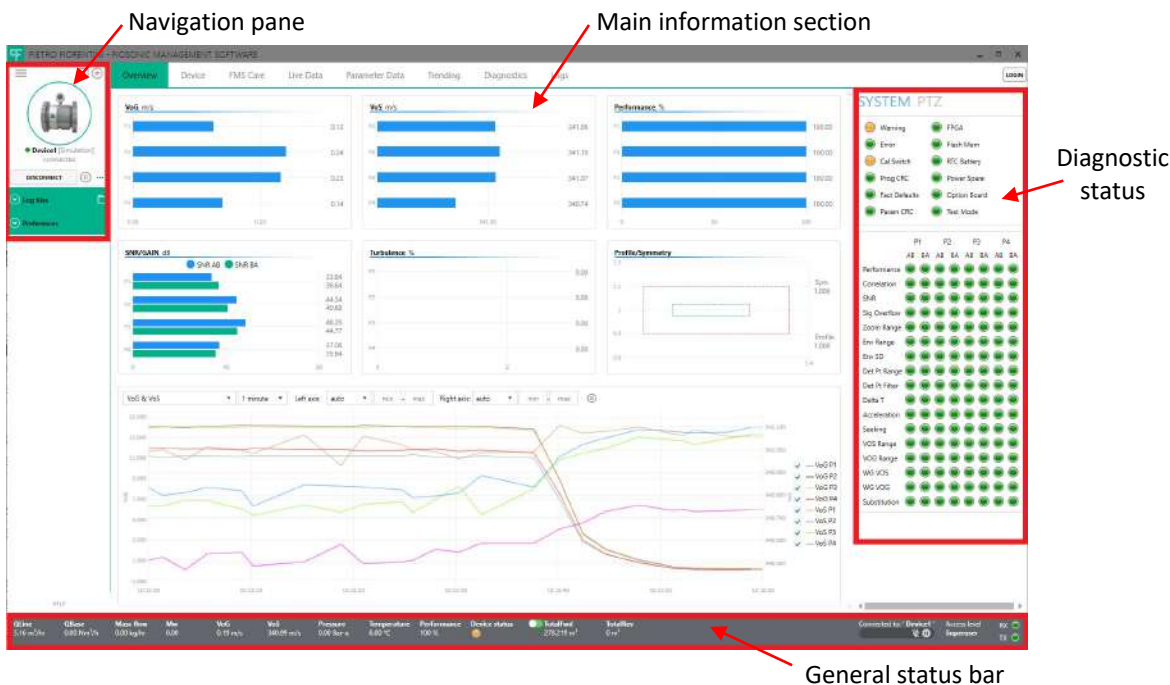
A shortcut is created in the windows start menu. Click on the windows button and search for Pietro Fiorentini Manager. For easy access its recommended to create a shortcut on the desktop or pin it to the taskbar.

**3 General information**

**3.1 User interface**

After FMS starts up the OVERVIEW screen will appear. This is the main screen for viewing live data and allows to easily observe the device status. The screen is divided in four main sections

1. Left side navigation pane  
This section of the screen contains the devices list, logfile list and preferences options
2. Main information section (middle)  
This section contains bar graphs and charts of the main diagnostics
3. Diagnostic status section (right hand side)  
This section shows real time device status information.
4. Status bar  
The status bar shows general information from the device as well as connection information



**3.2 FMS Preferences**

Preferences and general information about FMS can be accessed under Preferences in the left navigation pane.

- **GENERAL**  
Preferences and settings for device connection and properties settings can be set here
- **FILE LOCATIONS**  
Default file location folder settings can be found here
- **EMAIL**  
Default email address settings can be found here
- **FMSCare**  
Settings and preferences for FMSCare can be found here
- **ABOUT**  
Information about Pietro Fiorentini Manager

### 3.3 User levels

There are three user levels in Pietro Fiorentini Manager.

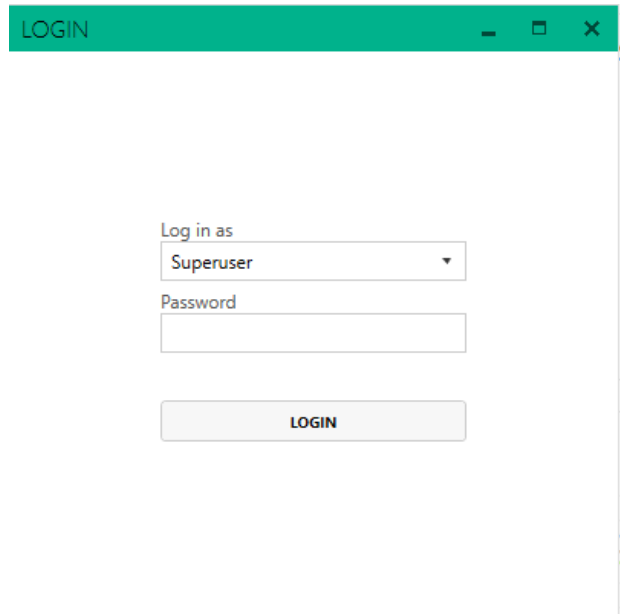
1. User – This is the entry level and requires no password.
2. Service – this is the user level for general commissioning, service and troubleshooting activities
3. Superuser – this level allows to edit all parameters of the FSM Series flowmeter



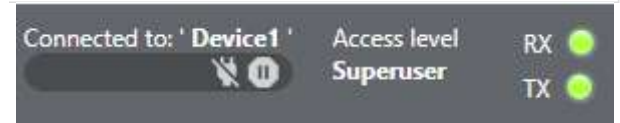
**Attention!**

Regardless of the user level, the parameter access in the FSM Series flowmeter is controlled by the calibration switch on the device. When this is closed, only parameters that do not affect the metrological performance can be changed.

Pietro Fiorentini Manager starts up at the <User> user level. No login is required for this level. To change the user level click on the <LOGIN> button in the upper right corner of the window. The login pop-up window appears. Select the desired user level, enter the password and click <LOGIN> to change to that user level.



The active user level is shown in the status bar on the right.

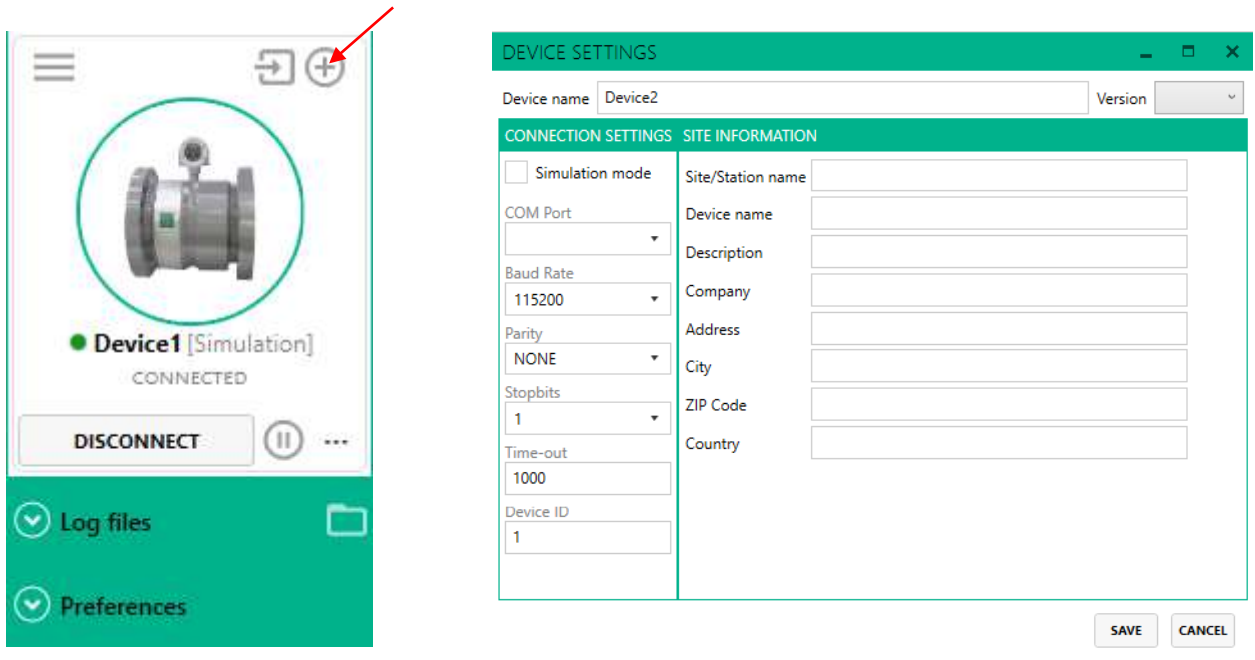


Depending on the user level several menu items or tabs are available

**4 Devices**

**4.1 Adding a device**

To add a device press the + button to bring up the device settings dialog



Enter a device name for the device you are connecting to. Configure the COM port settings. Default settings are:

- USB Port                      115200, No parity, 1 stopbit, Device ID = 1
- RS485 port                    38400, No parity, 1 stopbit, Device ID = 1

Optionally provide site information. This information is used in reports such as a parameter report.

Press SAVE to complete the process and add the device to the devices list

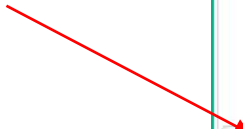


**Attention!**

All properties entered for a device and data collected with Pietro Fiorentini Manager is stored locally on the PC, not on the device itself.

### 4.2 Connecting to a device

In the devices list click on the device you want to connect to and Pietro Fiorentini Manager will initiate the connection. First it will read the parameters and then will start to read real time data.



The screenshot displays the software interface for a device. On the left, a sidebar contains a menu with 'Log files' and 'Preferences'. The main area shows a device card for 'Device1 [Simulation]' which is 'CONNECTED'. Below the device name is a 'DISCONNECT' button, a pause icon, and a three-dot menu icon. A red arrow points to the 'DISCONNECT' button. To the right, there are two charts. The top chart, 'VoG, m/s', shows four bars (P1, P2, P3, P4) with values ranging from approximately 25 to 35. The bottom chart, 'SNR/GAIN, dB', shows two series: 'SNR AB' (blue bars) and 'SNR BA' (green bars) for each of the four points (P1, P2, P3, P4), with values ranging from approximately 30 to 40.

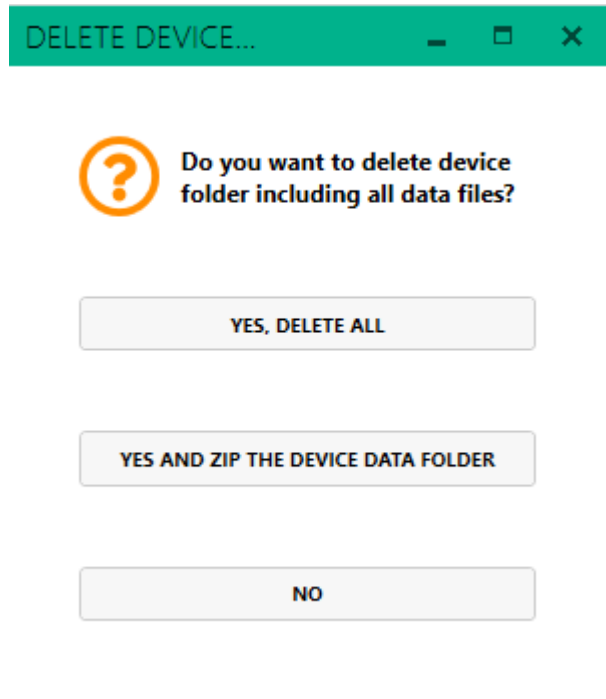
### 4.3 Changing device properties

In case certain properties or connection settings of a device need to be changed, Right-click on the device you want to change and select <PROPERTIES>

#### 4.4 Deleting a device

In the event you want to remove a device from the list, Right-click on the device you want to delete and select <DELETE>. A pop up dialog appears. Select the desired option for the delete action.

1. <YES, DELETE ALL> - This option deletes the device and all data from the PC
2. <YES AND ZIP DEVICE DATA FOLDER> - This option collects all data from the device and compresses it in a ZIP file. The device and folders will then be deleted.
3. <NO> - This cancels the operation and returns to the previous screen



#### 4.5 Disconnecting from a device

In order to disconnect from a device, click on the connected device, FMS will ask to confirm to disconnect. Any logging in progress will also end.

#### 4.6 Pausing a connection

A connection to a device can be paused. Press the pause button on the bottom status bar in order to temporarily stop polling data from the device until the pause button is pressed again.

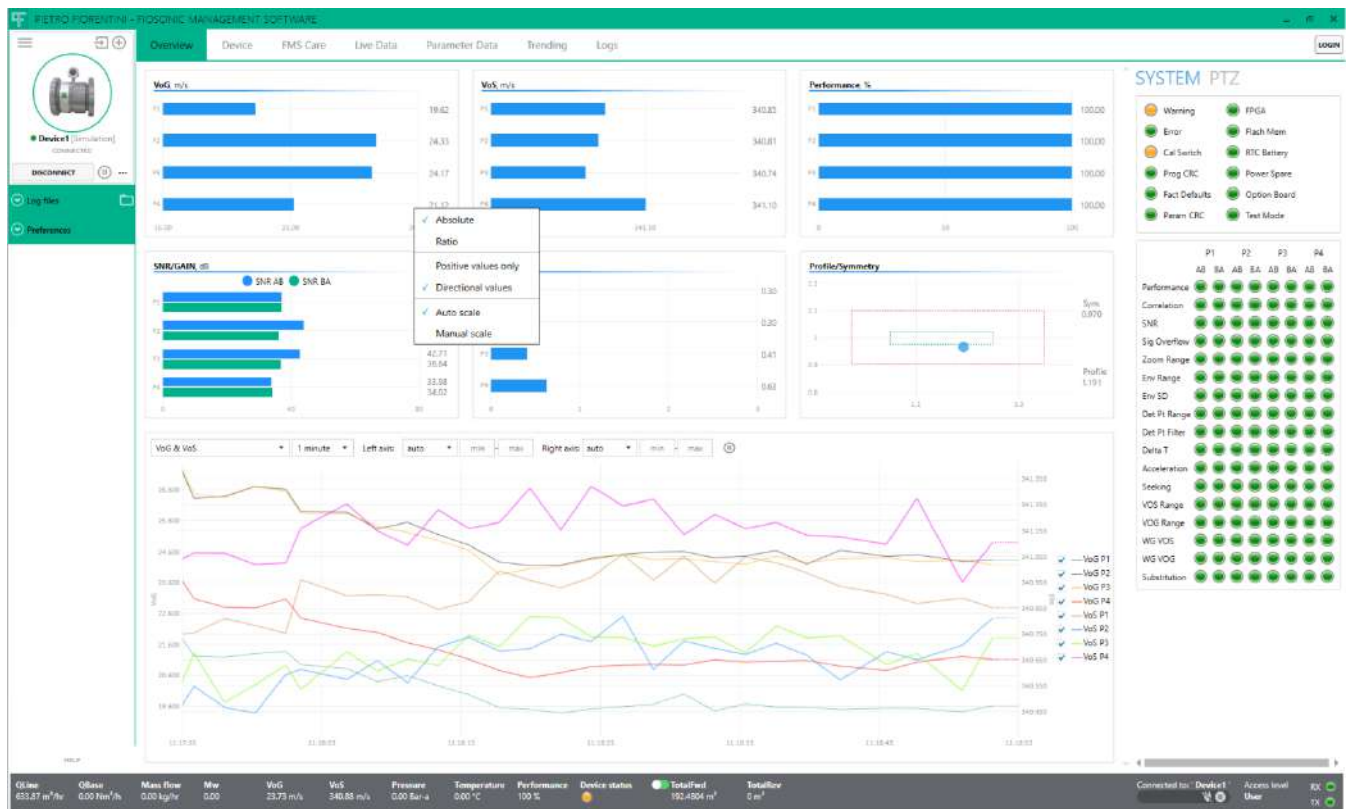


## 5 Operating FMS

### 5.1 Overview screen

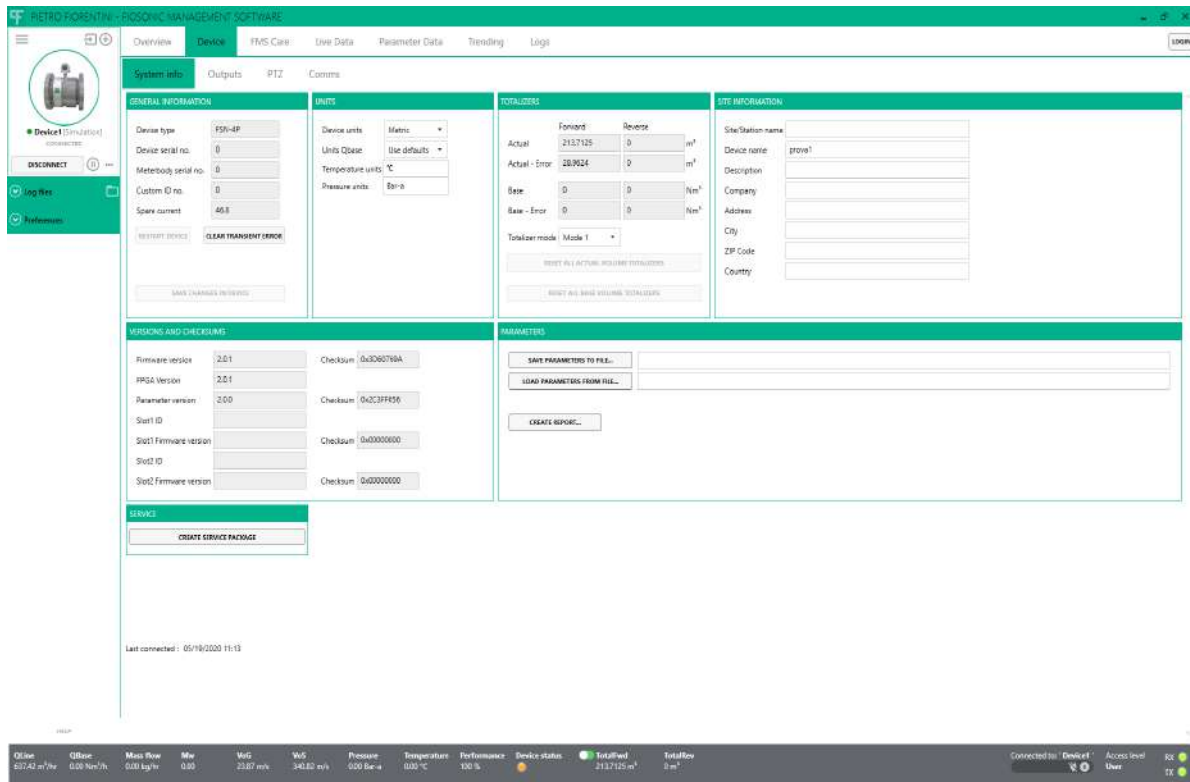
The overview screen is the default screen when starting up Pietro Fiorentini Manager. Several bar charts and a trending window are available to view diagnostic information about the operating conditions of the device and its application. Several options for each bar chart are available, such as scaling and other settings. Click on each bar chart using the right mouse button to open the options pop up menu and to adjust the graph as required.

The Trending area has several pre-configured trace sets to easily display combinations of diagnostics over time. Two Y-axes are used, one on the left and one on the right. Both are auto-scale by default. Each Y-axis can be set to a manual range if required.



## 5.2 Device information screen

The device information screen provides essential information about the device such as serial numbers, software versions and checksums. It also shows the totalizer values (volume counters).



### 5.2.1 Create Service package

For trouble shooting purposes a dedicated function is available to create a “Service package”. This feature collects data from the device and compresses it in a ZIP file. The zip file can be sent to an expert at Pietro Fiorentini or your sales representative for further analysis. The package contains a log file, parameter data and signal data.

Press the <CREATE SERVICE PACKAGE> to start collecting the data. The following screen appears, wait until FMS has completed all 5 steps. Note that this process takes several minutes to complete.



Creating service package

- 1 Collect log data
- 2 Create parameter report
- 3 Create parameter XML file
- 4 Collect signal data
- 5 Save service package

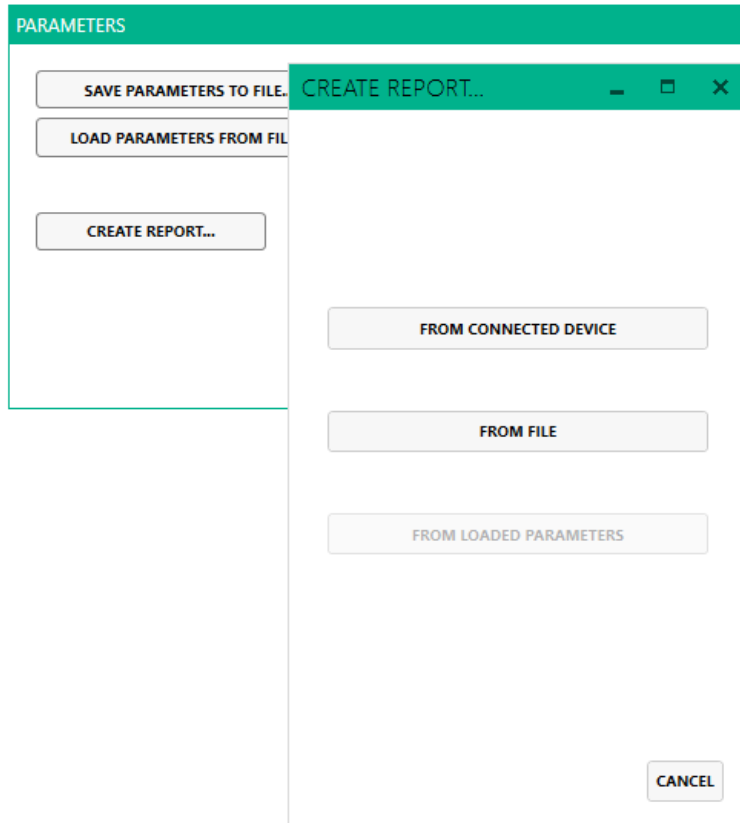
CANCEL





### 5.2.2 Creating a parameter report

To create a parameter report from a connected device or a saved parameter file of another device click <CREATE REPORT> on the METER INFORMATION tab. A pop-up dialog will appear to select from which source to create the report. Select <FROM CONNECTED DEVICE> to create a report of the connected device’s parameters.



Next, a window will open with a preview of the report. Select SAVE AS. to save the report as an .RTF file. This file can be opened in Microsoft Word. Click <CANCEL> to cancel the operation.

**Site Identification**

Site / Station name:

Device Name:

Description:

Company:

Address:

City, Zip Code:

Country:

---

**Device Identification**

Device type: <input type="text" value="FSN-4P"/>	System units: <input type="text" value="Metric"/>
Device Serial: <input type="text" value="0"/>	Flowbody serial: <input type="text" value="0"/>
Custom ID no.: <input type="text" value="0"/>	Meterfactor DD: <input type="text" value="9000"/>
Firmware version: <input type="text" value="2.0.1"/>	Totalizer mode: <input type="text" value="Mode 1"/>
Parameter version: <input type="text" value="2.0.0"/>	Checksum: <input type="text" value="0x3D50769A"/>
FPGA version: <input type="text" value="2.0.1"/>	Checksum: <input type="text" value="0x2C3FF856"/>
Slot 1 ID: <input type="text"/>	Checksum: <input type="text" value="0x00000000"/>
Slot 1 FW version: <input type="text"/>	Checksum: <input type="text" value="0x00000000"/>
Slot 2 ID: <input type="text"/>	Checksum: <input type="text" value="0x00000000"/>
Slot 2 FW version: <input type="text"/>	Checksum: <input type="text" value="0x00000000"/>

---

**Flowbody Parameters**

Flowcell type:       Inside diameter:  [m]

	Path 1	Path 2	Path 3	Path 4	
Path length	0.30436	0.45085	0.45085	0.30436	[m]
Axial length	0.18246	0.27028	0.27028	0.18246	[m]
Tw	30	30	30	30	[µsecs]
Path type	2	1	1	2	

---

**Limits**

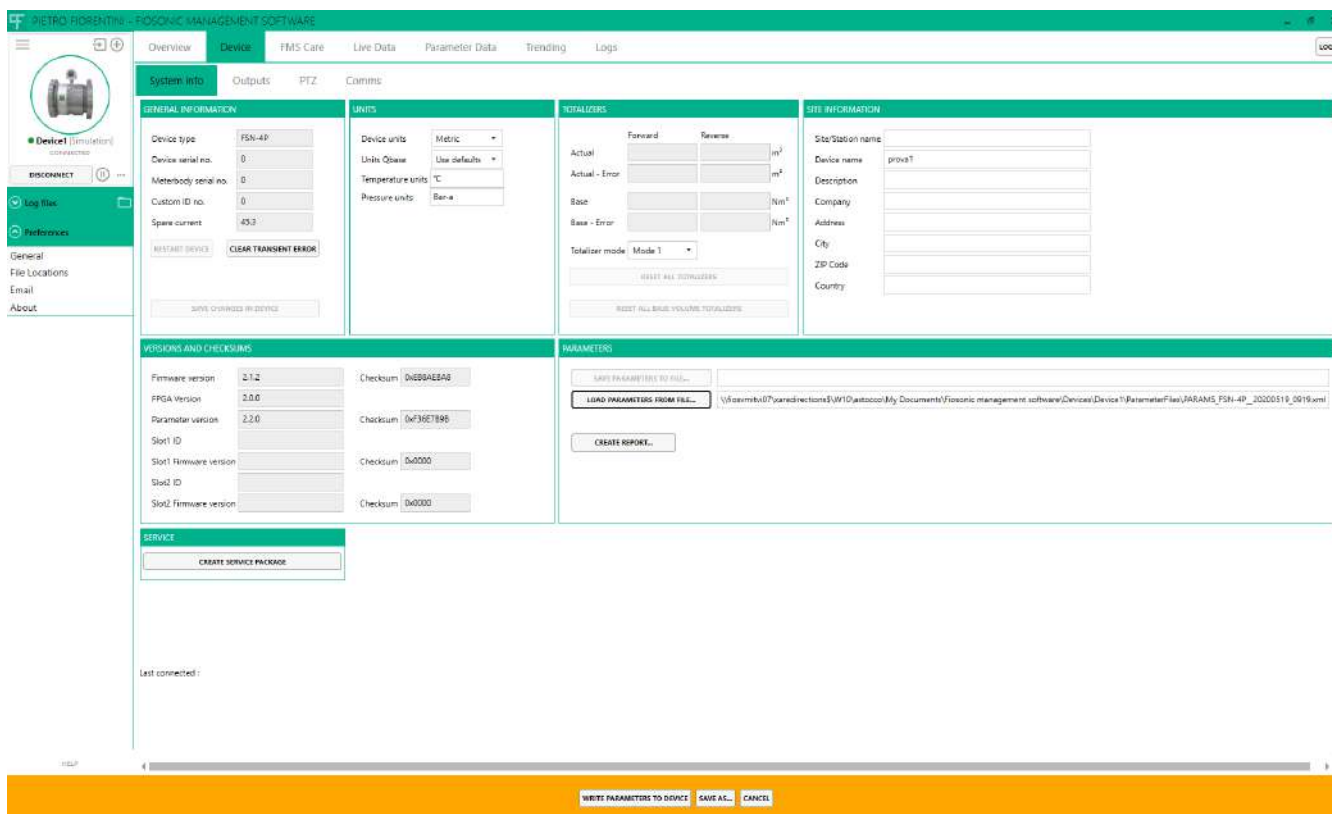
Vog low limit: <input type="text" value="-40"/> [m/s]	Vog high limit: <input type="text" value="40"/> [m/s]
Vps low limit: <input type="text" value="300"/> [m/s]	Vps high limit: <input type="text" value="500"/> [m/s]
Zero cutoff: <input type="text" value="0"/> [m/s]	


### 5.2.3 Saving a parameter set to file

The parameters of the device can be written to an XML file by pressing <SAVE PARAMETERS.> on the DEVICE INFORMATION tab. This file can be used later to easily write the same parameters to a device again.

### 5.2.4 Writing a parameter set to a device

In case a device needs to be reprogrammed with a previously saved parameter set (for example after swapping out electronics) the parameters can be written to the device by pressing <LOAD PARAMETERS...>. An “open file” dialog window will open to browse to the desired XML parameter file. After opening, an orange popup message will appear on the bottom status bar to select the required operation. Select <WRITE PARAMETERS TO DEVICE> to write the parameter set to the device.





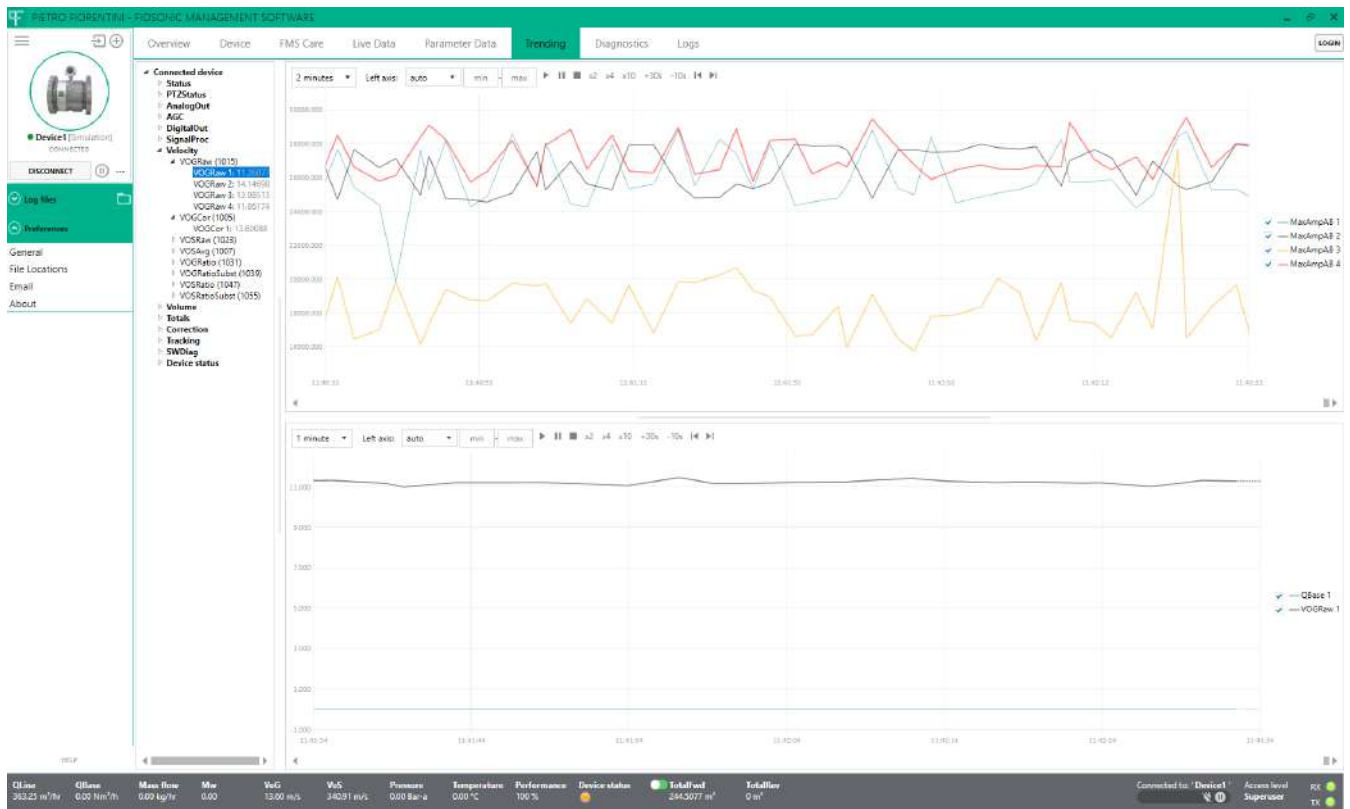
**Attention!**

FMS checks if the parameter file version is compatible with the device parameter version before writing to the device. In case the versions are incompatible it is not possible to write the parameters. Consult Pietro Fiorentini for assistance

## 6 Trending and logs

### 6.1 Trending live data

When connected to a device, using the Trending tab it is possible to display any result parameter over time. The parameters can be selected by the “drag and drop” principle. Drag a parameter from the parameter tree left of the chart areas and drop it in the chart area to plot the values. Up to 8 parameters (traces) can be trended at the same time. Traces can also be removed again from the trend area. Right click on the trace name in the legend to the right of the trend, a pop up dialog will appear to select the desired option.



### 6.2 Logs

Logging data on the PC can be started at any time when connected to a device. Press the <START LOGGING> button on the left navigation pane. A dialog window will pop up to provide a file name. Logs are saved in CSV (Comma Separated Values) format. Log files can be easily imported in a spreadsheet editor for further analysis if required.

### 6.3 Playback of logs

FMS can open and play back previously created log files. Log files can be selected from the left hand navigation pane in the Logs tree, or when the log file is not present in the tree list, opened using the “Open log file” button as shown to the right.

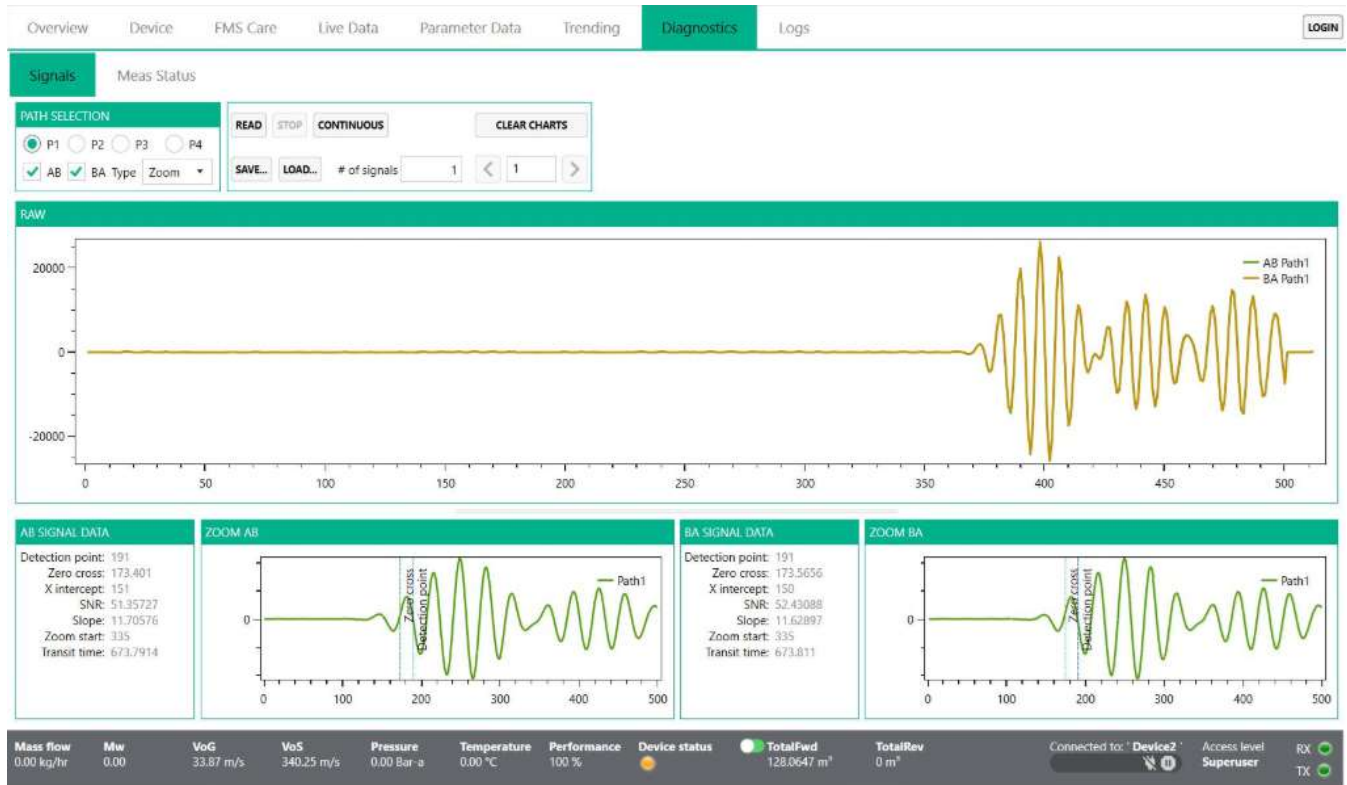
The trend windows work exactly the same as the live trend tab. Furthermore additional controls can be used such as fast forward, faster playback. These buttons are available in the trend window.



Mass flow	Mw	VoG	VoS	Pressure	Temperature	Performance	Device status	TotalFwd	TotalRev	Editing offline: Device2	Access level	RX	TX
0.00 kg/hr	0.00	0.00 m/s	0.00 m/s	0.00 Bar-a	0.00 °C	0 %		0 m³	0 m³	User			

## 7 Diagnostics

When logged in under Service or Super user level the diagnostics tab is available. This tab allows to view the received signals of the transducers. Signals can be viewed directly from the connected device. Previously saved signal sets can also be loaded in FMS for further analysis when offline from the device.



### 7.1 Reading signals from device

To read signals select the Path to read in the <CHANNEL SELECTION> area. Enter the number of signals to read (FMS can store several signals in one file, this may be useful for observing dynamic behaviour of the signal). Default number of signals is one. Press <READ> to read the signals, this takes several seconds, when completed the signals appear on the chart areas.

- RAW Signal                      This chart area shows the raw signal (BCW processed)
- ZOOM AB                        This chart area shows a zoom in of the AB direction (signal travelled downstream)
- ZOOM BA                        This chart area shows a zoom in of the BA direction (signal travelled upstream)

To save the signal to a file, press <SAVE>. In case signals are already loaded from the device a pop up dialog appears to select to load new signals or save the signals that were already loaded.

To load a signal from file, press <LOAD> and select the file to load. The signals will appear in the chart areas.



#### Attention!

Instead of saving separate signals it is recommended to use the <CREATE SERVICE PACKAGE> feature. Using this feature a complete set of data is collected including a short logfile, signal file and parameter data.





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**MT333-E April 2020**

MT-332-E

ENGLISH

# FSN SERIES FLOMETER



## FIELD WIRING GUIDE

TECHNICAL MANUAL



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**Introduction**

This document provides a guide to the field wiring of the FSN Series Ultrasonic Gas Flowmeters in hazardous areas where explosion safety regulations apply. All field wiring in the FSN Series meters is Intrinsically Safe (IS). This means that the energy to the terminals must be limited by the use of suitable zener barriers, isolators or other means. In this document we will recommend certain barriers, isolators and supplies that are suitable. This is however not an exhaustive list. In addition intrinsic safety sets certain limits on parameters (inductance and capacitance) of the user wiring. This is rarely of concern unless very long wiring runs are used, but the user must ensure that the wiring used is within these maxima.

For the electrical parameters required for intrinsic safety refer to the ATEX/IECEx Control Drawing 6110032002 and chapter 4 of the document Safety Instructions FSN Series Flowmeter.

In addition to the requirements and recommendations of this document national and local wiring regulations should be observed.

Refer also to the document Safety Instructions FSN Series Flowmeter prior to installation of the field wiring. The Safety Instructions FSN Series Flowmeter document provides essential safety information for the installation and operation of the FSN series ultrasonic gas flowmeter. It contains information for correct installation of this product. It also contains important instructions to prevent accidents and serious damage during installation, commissioning and operation. Before installing the product read and understand this document. Strictly follow the safety instructions and warnings.


**1 Contents of this document**


This manual contains several sections, covering various aspects for proper installation and operation of the FSN series flowmeter.


Chapter 1	This chapter
Chapter 2	FSN Series Field Wiring
Chapter 3	Power Wiring Recommendations
Chapter 4	I/O Wiring Recommendation

**1.1 Conventions**

The following symbol and indication conventions are used throughout this manual.

	<p><i>Warning!</i></p> <p>A warning indicates hazards or unsafe practices that could result in severe personal injury or death.</p>
---	---

	<p><i>Attention!</i></p> <p>This sign indicates potential hazardous or unsafe operations that could result in minor personal injury or damage of product or property. It is also used to indicate operations or practices that could cause the product to operate in an unexpected way or provide results that are outside the specification limits</p>
--	---

	<p><i>Specific information for explosion safety</i></p> <p>This sign is used where specific important information is given in order to comply with explosion safety regulations</p>
---	---

**1.2 Related documents**

The last version of the referenced document is leading, unless otherwise specified.

**[1] FSN Series Safety instructions**

*Author*                      Pietro Fiorentini S.p.A.  
*Document Code:*    MT 330-E

**[2] FSN Series installation, operating and maintenance manual**

*Author*                      Pietro Fiorentini S.p.A.  
*Document Code:*    MT 329-E

### 1.3 Abbreviations

The following abbreviations may be used throughout the document:

ATEX	ATmosphère Explosive
CSA	Canadian Standards Association
EMC	Electromagnetic Compatibility
FM	Factory Mutual
IEC	International Electrotechnical Commission
IECEX	International Electro technical Commission certification scheme for Explosive atmospheres
IS	Intrinsic Safety
ISO	International Organization for Standardization
LVD	Low Voltage Directive
OIML	Organisation Internationale de Métrologie Légale
PCBA	Printed Circuit Board Assembly
SPU	Signal Processing Unit
USM	Ultrasonic Flowmeter

## 2 FSN Series Field Wiring Compartment

Remove the back cover of the FSN flowmeter to access the field wiring terminals. The wiring compartment is shown in Figure 2.1. Main Board terminal blocks will be supplied on all units. The Option Board terminal blocks will depend on the options provided. The wiring compartment is provided with four M20 or ½" NPT size cable gland entries.

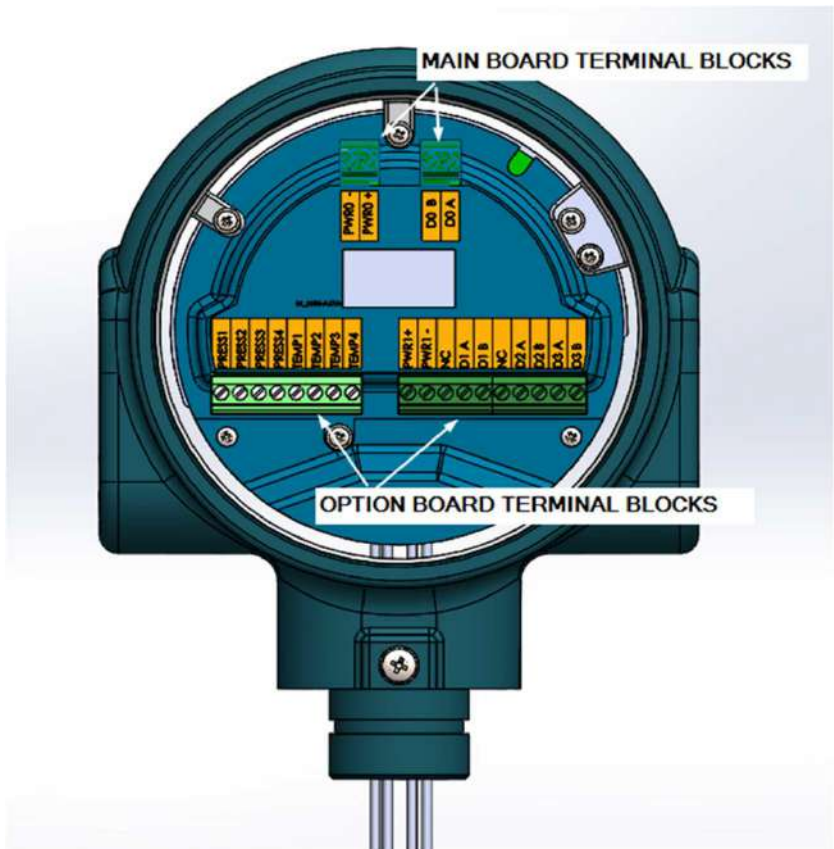




Figure 2.1: FSN Series wiring compartment.

The screw terminals will accept wire size from 24 AWG to 10 AWG (0.2mm<sup>2</sup> to 6mm<sup>2</sup>)



**Warning!**

Refer to the document Safety Instructions FSN Series Flowmeter prior to installation of the field wiring.

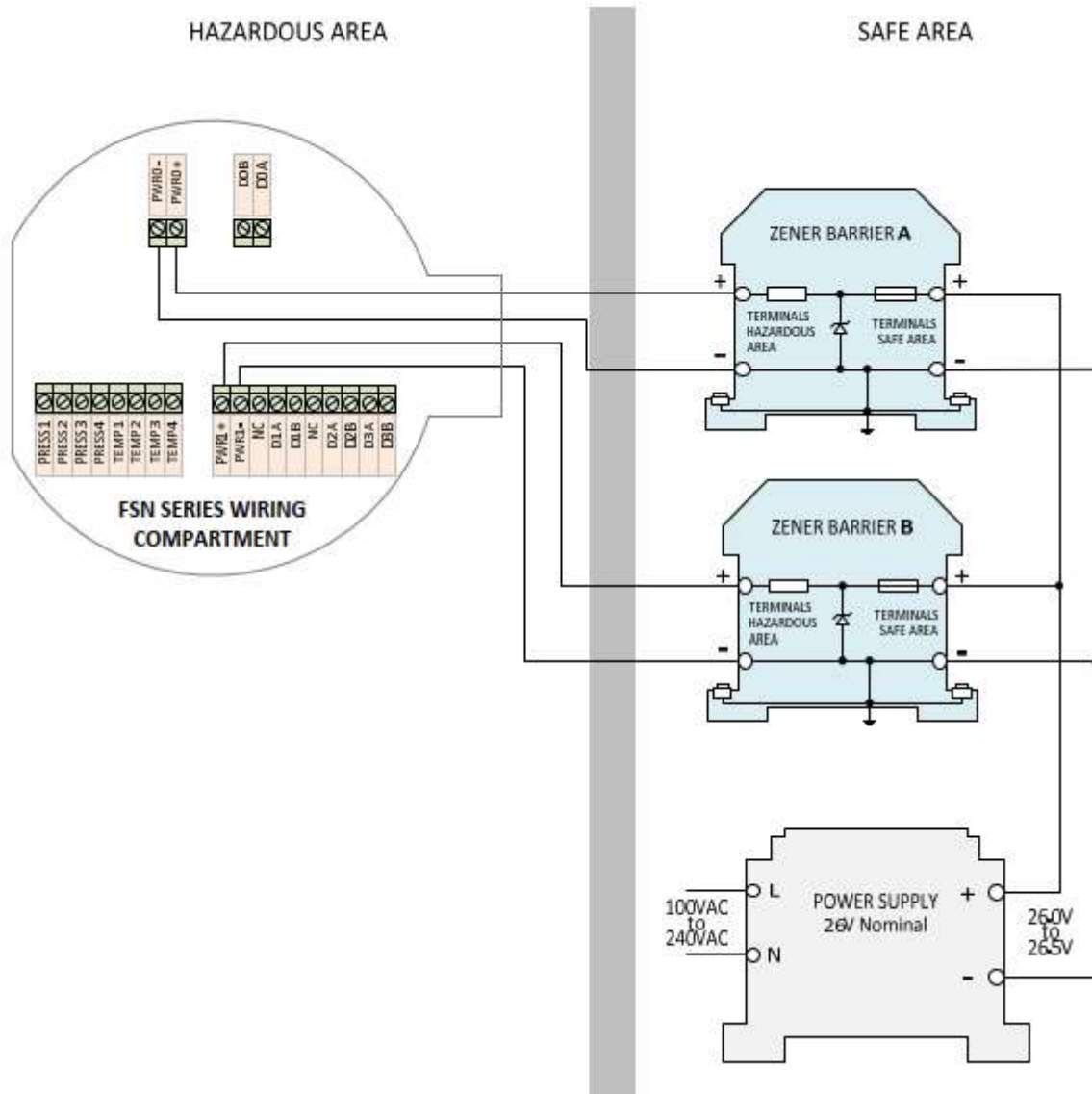


**Specific information for explosion safety**

The recommended zener barriers, power supplies or isolators are for guidance only. It is the responsibility of the installer to ensure that the zener barriers, power supplies or isolators meet the local explosion safety requirements.

## 3 Power Wiring Recommendations

If the FSN Series Flowmeter is installed in a hazardous area suitable safety barriers must be used between the supply voltages and the FSN flowmeter. The wiring diagram for the FSN Flowmeter main power to PWR0+ and PWR0- terminals is shown in Figure 3.1. Zener Barrier A, in the safe area, limits the energy to terminal PWR0+ and PWR0- to safe levels. If an Option Board is included a separate zener barrier (Zener Barrier B) is required for the power connections the Option Board power terminals PWR1+ and PWR1 – as shown in Figure 3.1. Alternatively dual zener barrier may be used for both the main and option supplies.



**Figure 3.1: FSN Series Power Wiring**

The power supplies of the FSN Series flowmeters are isolated, so it is not required to use an isolated supply.

Recommended zener barriers and power supplies are shown in Table 3-1 and Table 3-2.

<b>RECOMMENDED ZENER BARRIERS</b>		
<b>MANUFACTURER</b>	<b>DESCRIPTION</b>	<b>PART NUMBER</b>
<b>Single Channel</b>		
Stahl	Safety Barriers for Positive Polarity, 268 Ohm Max	9001/01-252-100-141
Allen-Bradley	Zener Barrier, 1-Ch, 327 Ohm Max	937ZH-DPBN-1
Pepperl+Fuchs	Zener Barrier, 1-Ch, 327 Ohm Max	Z728
Turck	Zener Barrier, 1-Ch, 333 Ohm Max	MZB28P
MTL (Cooper)	Zener Barrier, 1-Ch, 333 Ohm Max	MTL7728+
<b>Dual Channel</b>		
Allen-Bradley	Zener Barrier, 2-Ch, 327 Ohm Max	937ZH-DPBN-2
Pepperl+Fuchs	Zener Barrier, 2-Ch, 327 Ohm Max	Z779
Turck	Zener Barrier, 2-Ch, 333 Ohm Max	MZB79P

**Table 3-1: Recommended Zener Barriers**

<b>RECOMMENDED POWER SUPPLIES</b>		
<b>MANUFACTURER</b>	<b>DESCRIPTION</b>	<b>PART NUMBER</b>
TRACO Power	TBL Series, 15W, 24V-28V	TBL 015-124
TDK-Lambda	DRB Series, 15W, 24V-28V	DRB15-24-1
TDK-Lambda	DPP15 Series, 15W, 22.5V-28.5V	DRB15-24-1
Schneider Electric	15W, 24V nom, 22.2V - 28.8V adjustable	ABL8MEM24006

**Table 3-2: Recommended Power Supplies**

**4 I/O Wiring Recommendations**

**4.1 Standard (Main Board) Frequency/Pulse Output (terminals D0A and D0B)**

The standard Frequency Output on terminals D0A and D0B is an open collector type and is not galvanically isolated from the system ground. An isolating repeater or isolated frequency converter is therefore recommended, to meet both the isolation and safety requirements

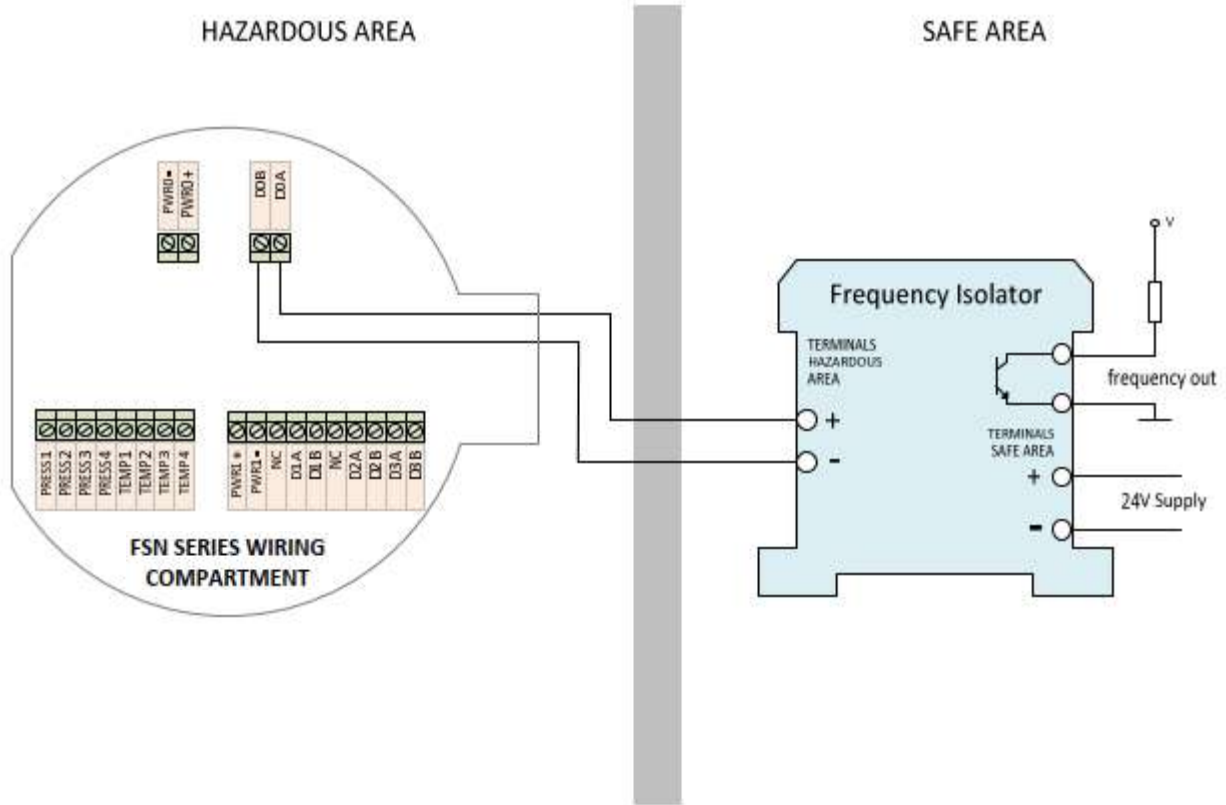


Figure 4.1: Frequency Output wiring

Where the frequency isolator provides a choice of input types select one suitable for open collector or dry contact input.

RECOMMENDED FREQUENCY ISOLATORS		
MANUFACTURER	DESCRIPTION	PART NUMBER
<b>Single Channel</b>		
GM International	Frequency-Pulse Isolating Repeater	D1035S
Turck	Isolating switching amplifier	IM1-12EX-T
Allen-Bradley	Switch Amplifier, Transistor Output with Splitter	937TH-DISTS-DC1
<b>Dual Channel</b>		
Turck	Isolating switching amplifier	IM1-22EX-T
Allen-Bradley	Switch Amplifier Transistor Output	937TH-DISAT-DC2

Table 4-1: Recommended Frequency Isolators



**4.2 I/O Option Board RS485 Communication Port (terminals D1A and D1B)**

The RS485 port on the I/O Option Board is isolated so an isolating barrier is not necessarily required. However most industrial barriers also provide isolation. A switch on the FSN Series flowmeter allows the user to add a 120Ω terminating resistor if required. Refer to the FSN Series installation, operating and maintenance manual for details.

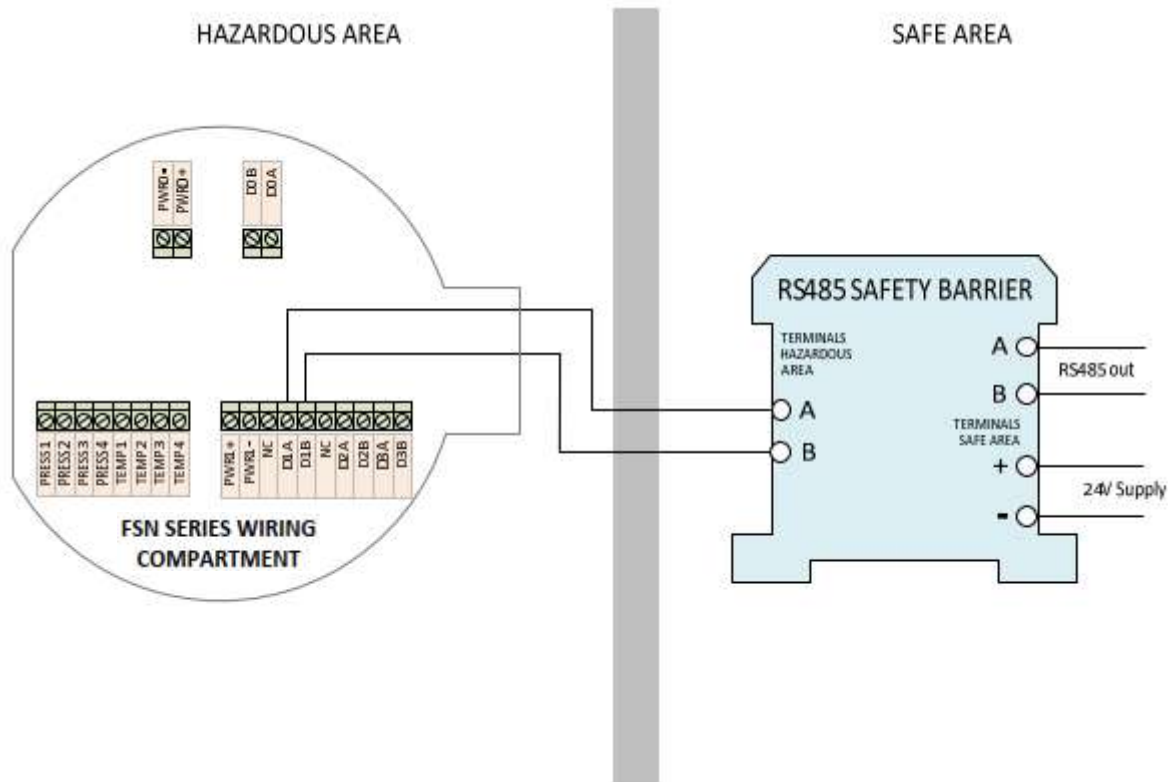


Figure 4-2: RS485 Port wiring

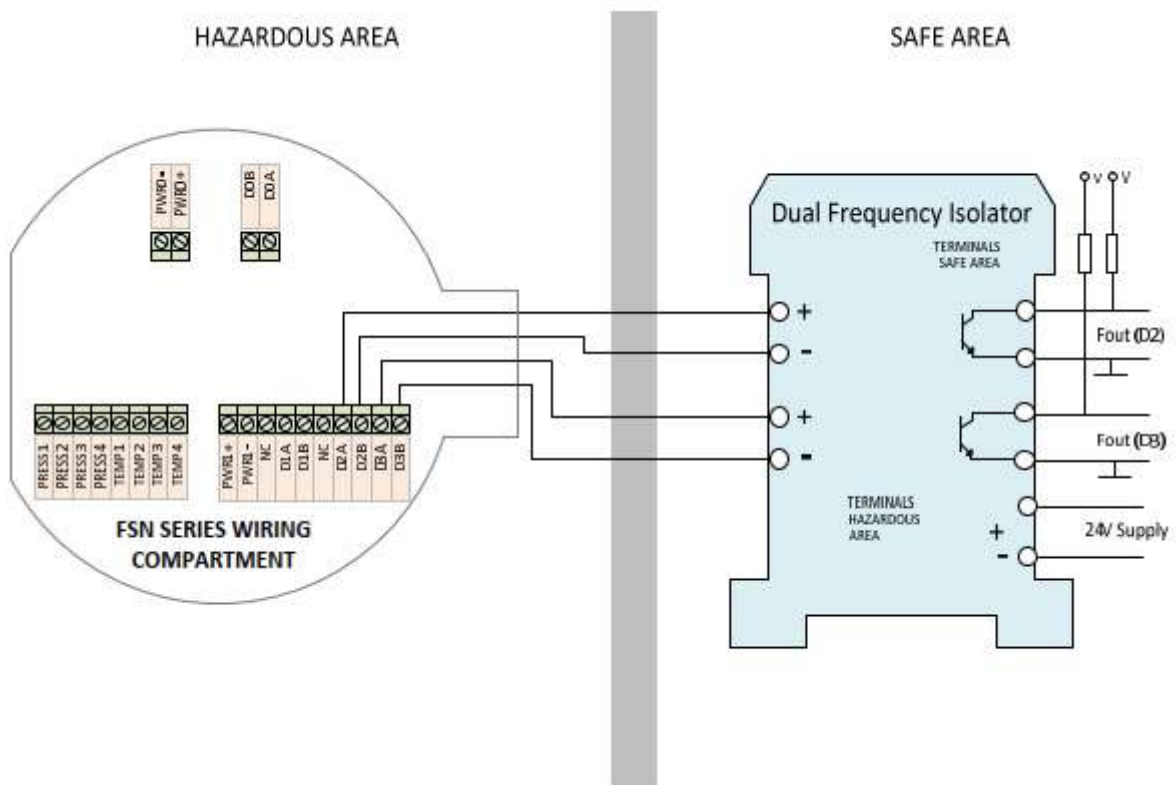
Recommended RS485 barriers are shown in Table 4-2.

RECOMMENDED RS485 BARRIERS		
MANUFACTURER	DESCRIPTION	PART NUMBER
<b>Single Channel</b>		
GM International	RS422 / RS485 Isolating Repeater	D1061S
R. Stahl	Fieldbus Isolating Repeater (suitable for zone 1)	9185/11-35-10s

Table 4-2: Recommended RS485 Barriers

**4.3 I/O Option Board Isolated Frequency/Pulse Outputs (terminals D2A and D2B/D3A and D3B)**

There are two optically isolated frequency, pulse or status outputs provided on the I/O Option Board. The outputs are open collector type. As these outputs are isolated, isolating barriers are not strictly necessary. However, many industrial barriers are isolating including the ones recommended below, and these may of course be used



**Figure 4.3: Isolated Frequency/Pulse Outputs wiring**

Recommended frequency barriers/isolators are shown in Table 4-3. The wiring in Figure 4.3 shows a dual barrier, of course two single barriers may be used.

RECOMMENDED FREQUENCY BARRIERS/ISOLATORS		
MANUFACTURER	DESCRIPTION	PART NUMBER
<b>Single Channel</b>		
GM International	Frequency-Pulse Isolating Repeater	D1035S
Turck	Isolating switching amplifier	IM1-12EX-T
Allen-Bradley	Switch Amplifier, Transistor Output with Splitter	937TH-DISTS-DC1
<b>Dual Channel</b>		
Turck	Isolating switching amplifier	IM1-22EX-T
Allen-Bradley	Switch Amplifier Transistor Output	937TH-DISAT-DC2

**Table 4-3: Recommended Frequency Barriers/Isolators**





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**MT332-E June 2020**

MT-331-E

ENGLISH

# FSN SERIES FLOMETER



## SEALING

TECHNICAL MANUAL

**Version History**

Version	Date	Description	Author	Checked	Approved
A	29/06/2020	Initial release	AS	LC	

**Version Description**

The following sections were added to (A), modified (M), or deleted from (D) the previous version.

Section	Change (A/M/D)	Description

**Open Issues**

The following table details any outstanding issues relating to this document.

Issue type	Issue description	Action

Table of contents

1 Introduction ..... 2

1.1 Document Purpose ..... 2

2 Sealing..... 2

2.1 Sealing of Flowbody ..... 2

2.2 Sealing of electronic components..... 2

## 1 Introduction

### 1.1 Document Purpose

This document describes the sealing locations of the UIM Series flowmeter for use in legal metrology applications

## 2 Sealing

In case the UIM Series flowmeter is used in a custody transfer (fiscal) application, the meter's legally relevant components are protected against tampering and/or unauthorized altering, manipulation or exchange.

### 2.1 Sealing of Flowbody

The Flowbody and access to the transducers is sealed by means of a seal wire through the cover bolts/hexscrews as shown in Figure 2-1. Tampering with the seal will invalidate the calibration



Figure 2-1: Meter body seal

### 2.2 Sealing of electronic components

The electronics assembly and cover to the transducer connectors is sealed by means of a seal wire as shown in Figure 2-2.



**Figure 2-2: Electronic assembly and transducer connector cover seal**

**Sealing of software**

Sealing of software is provided by means of a “calibration lock” switch behind the front cover, right of the LCD. When the lock switch is in LOCK position the firmware does not allow any legally relevant parameter to be changed. It also does not allow any firmware to be upgraded over any of the interfaces.

Note that the “ON” position of the switch is the **UNLOCKED** position for failsafe operation.

The lock switch is sealed with a tamper proof sticker, which also covers one screw of the display bracket to prevent removal of the bracket.





Figure 2-3: Calibration Lock Switch



Figure 2-4: Calibration Lock Switch and Display Cover Seal





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**MT331-E June 2020**

MT-330-E

ENGLISH

## FSN SERIES FLOMETER



## SAFETY INSTRUCTIONS

TECHNICAL MANUAL

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## Introduction

This document provides essential safety information for the installation, of the FSN series ultrasonic gas flowmeter. It contains information for correct installation of this product. It also contains important instructions to prevent accidents and serious damage during installation, commissioning and operation. Before installing the product read and understand this document. Strictly follow the safety instructions and warnings.

In the event of questions or need for additional information regarding specific matters about the FSN Series, please contact Pietro Fiorentini S.P.A. via email or telephone.

These safety instructions are based on the latest information at the time of writing. It is provided subject to changes and updates. We reserve the right to change the configuration and/or construction of our products at any time without obligation to update previously shipped products.

The warranty provisions stipulated in our Terms and Conditions are applicable to the product. The manufacturer shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or by necessity in whole or part by catastrophe, or the fault or negligence of the purchaser;
- The equipment, or parts, have been maintained or repaired by other than an authorized representative of the manufacturer, or have been modified in any manner without prior express written permission of the manufacturer;
- Non-original parts are used;
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose;
- Use of this product with unauthorized equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

Pietro Fiorentini S.P.A. is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.


**1. Contents of this document**


This manual contains several sections, covering various aspects for proper installation and operation of the FSN series flowmeter.


- Chapter 1 This chapter
- Chapter 2 Installation
- Chapter 3 Safety instructions
- Chapter 4 Electrical parameters
- Chapter 5 Control drawings

**1.1 Conventions**

The following symbol and indication conventions are used throughout this manual.

	<p><i>Warning !</i>                  A warning indicates hazards or unsafe practices that could result in severe personal injury or death.</p>
--	--

	<p><i>Attention !</i>                  This sign indicates potential hazardous or unsafe operations that could result in minor personal injury or damage of product or property. It is also used to indicate operations or practices that could cause the product to operate in an unexpected way or provide results that are outside the specification limits</p>
---	--

	<p><i>Specific information for explosion safety</i>                  This sign is used where specific important information is given in order to comply with explosion safety regulations</p>
---	---

**1.2 Abbreviations**

The following abbreviations are used throughout the document:

ATEX	Atmosphère Explosive
CSA	Canadian Standards Association
EMC	Electromagnetic Compatibility
FM	Factory Mutual
IEC	International Electrotechnical Commission
IECEX	International Electro technical Commission certification scheme for Explosive atmospheres
IS	Intrinsic Safety
ISO	International Organization for Standardization
LVD	Low Voltage Directive
OIML	Organisation Internationale de Métrologie Légale
PCBA	Printed Circuit Board Assembly
SPU	Signal Processing Unit
USM	Ultrasonic Flowmeter

**2. Important information**

**2.1 Main hazards**



*Warning !*

Natural gas flows through the meterbody of the FSN series ultrasonic gas flowmeter. Do not remove any transducers or parts from the meterbody whilst the flowmeter is under pressure. potentially explosive gas can escape and parts can blow out.

**2.2 Intended use**

The FSN series ultrasonic gas flowmeter primary use is to measure the volume flow rate and gas velocity of gases in pipelines.



### 2.3 Identification

The Ultrasonic flowmeter is available with approval for use in hazardous area according to ATEX or IECEx. Always refer to the actual label information on your flowmeter for the specific approval of your flowmeter and this manual for correct use.

Each SPU label comprises:

- Our company name and address
- Type of Ultrasonic flowmeter
- Hazardous area approval
- Model identification of the SPU
- Serial number of the SPU
- Power requirements of the SPU
- Year-Month
- Warning: Read instruction manual before operating device
- Reference to Control drawing (INSTALL PER DRAWING 6110032002)

### 2.4 Safety instructions for the operator



These safety instructions are applicable for the FSN Series ultrasonic flowmeter installations in hazardous areas.

The FSN series flowmeter is suitable for use in pressurized lines within the design conditions specified on the flowmeter nameplate.

Do not install, operate or maintain this flowmeter without reading, understanding and following the operating instructions, otherwise injury or damage may result. Read and understand these operating instructions carefully before the installation of the equipment and keep them for future reference.

Observe all warnings, notes and instructions as marked on the packaging of the equipment and detailed in the operating instructions.

**WARNING - EXPLOSION HAZARD**, do not change or alter any components of the flowmeter. Unauthorized changes or substitutions of components may impair the explosion safety of the equipment.

**WARNING - EXPLOSION HAZARD**, the ultrasonic transducers are made out of titanium and contain piezo electric devices. The ignition hazard due to physical impact or friction shall be excluded by adequate provisions. The process piping and flowbody are considered adequate provision.

The special conditions of use as described in the EC type examination certificate must be followed. In addition, all given electrical specifications must be met.

The electrical installation must be in accordance with applicable national standards (equivalent to IEC 364) in addition to the requirements for installation in hazardous areas according to EN/IEC 60079-14 "Electrical installations in hazardous locations" or equivalent national standards.

Installation, operation, service and maintenance of the equipment must only be performed by authorised and trained personnel with the necessary knowledge and qualifications in explosion safety.

If the product does not operate normally, please refer to the service and troubleshooting instructions, or contact Pietro Fiorentini S.P.A. for help.

To prevent water entering the Electronics enclosure, firmly tighten the covers when closing. Make sure the O-rings on the covers are correctly fitted and in good condition.

Take care that no dirt / particles are present on the thread or O-rings before closing the covers

## 2.5 Operation in explosive atmospheres

The FSN series Flowmeter is suitable for use in potentially explosive atmospheres. It is designed to be installed in explosion proof areas classified as Gases, vapours and mists, Zone 0. The equipment protection level (EPL) is Ga.

- ATEX / IECEx Ex II 1 G Ex ia IIC T4 Ga

## 2.6 Legislative requirements

### CE Marking

The flowmeter is designed to meet the safety requirements in accordance with sound engineering practice. It has been tested and has left the factory in a condition in which it is safe to operate. The equipment is in conformity with the statutory requirements of the EC directive and complies with applicable regulations and standards for electrical safety EN 61010, hazardous area equipment 94/9 EC (ATEX100a) and electromagnetic compatibility EN 61326. A CE Declaration of Conformity has been issued, a copy is available on the website or will be provided on request.

### WEEE Directive

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) aims to minimize the impact of electrical and electronic goods on the environment by increasing re-use and recycling and by reducing the amount of WEEE going to landfill. It seeks to achieve this by making producers responsible for financing the collection, treatment, and recovery of waste electrical equipment, and by obliging distributors to allow consumers to return their waste equipment free of charge.

Pietro Fiorentini S.P.A. offers its customers the possibility of returning unused and obsolete equipment for correct disposal and recycling. The Dustbin Symbol indicates that when the last user wishes to discard this product, it must be sent to appropriate facilities for recovery and recycling. By not discarding this product along with other household-type waste, the volume of waste sent to incinerators or landfills will be reduced and natural resources will be conserved. Please contact Pietro Fiorentini S.P.A. for more information



### RoHS Directive

All products manufactured by Pietro Fiorentini S.P.A. are compliant with the relevant aspects of the RoHS Directive

## 2.7 Interconnection of the FSN Series Flowmeter

Refer to Drawing 6110032002 (Control drawing ATEX/IECEx) for electrical parameters

### 2.7.1 Interconnection to Pressure and Temperature sensors

The FSN Series Flowmeters, when fitted with the P/T Option Board is designed to operate with bridge type pressure sensors and platinum RTD temperature sensors.

Approved pressure sensors are given in the table below. These sensors consist of resistive sensing elements only and do not have any active conditioning or amplification circuit. The surface area also exceeds 20mm<sup>2</sup> by a large margin.

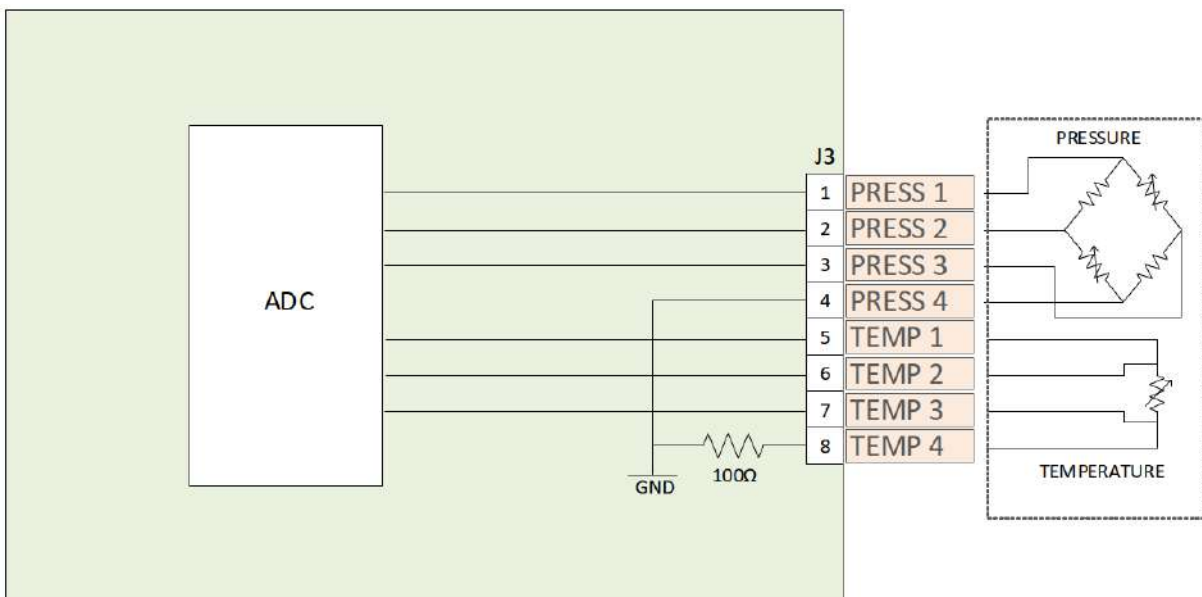
Series	Manufacturer	Approved Part Numbers	Comment
--------	--------------	-----------------------	---------


US300	Measurement Specialties	US32x-00000x-xxxxx	x - do not care
Pi600	Applied Measurements Ltd	Pi607 Pi610	
Passive Transmitter TM	STS Sensors	any (passive)	
Series 11	Keller AG	any (passive)	
Series 6	Keller AG	any (passive)	
<u>110S</u>	<u>BCM Sensor</u>	<u>Any (passive)</u>	

Table 2-1: Approved Pressure Sensors

Suitable temperature sensors include 100Ω, 5000Ω and 1000Ω platinum RTDs in two, three or four wire configurations. The RTDs must be mounted in a metal sheath of a minimum 3mm diameter and 10mm length, giving a surface area exceeding 100mm<sup>2</sup>. All temperature sensors meeting these requirements are approved to be used with the FSN Series Flowmeter.


Below figure shows the interconnection details to the passive pressure and temperature sensors.





**Warning !**  
 ONLY INTERCONNECT APPROVED PRESSURE AND TEMPERATURE SENSORS.  
 MAXIMUM CABLE LENGTH TO THE SENSORS MAY NOT EXCEED 2 meters (6.7 ft)

The local USB port can be used to connect non intrinsically safe devices (such as a laptop) to the FSN Series flowmeter. The FSN Series flowmeter's USB circuit has built-in protection to safely connect non intrinsic safe equipment with  $U_m = 250 \text{ VAC}$ .

	<p><b>Warning !</b>                  ONLY CONNECT THE USB INTERFACE IN SAFE AREA OR ENSURE NO EXPLOSIVE ATMOSPHERE IS PRESENT.                  MAXIMUM VOLTAGE RATING <math>U_m = 250 \text{ VAC}</math></p>
---	---

**2.8 Cleaning**

Only clean the FSN series ultrasonic flowmeter with a damp cloth. Do not use solvents for cleaning.

**2.9 Installation, operation and maintenance**

More detailed information about installation, operation and maintenance of your FSN Series flowmeter can be found in document MT 329-E (installation, operating and maintenance manual).

**2.10 Additional documentation**

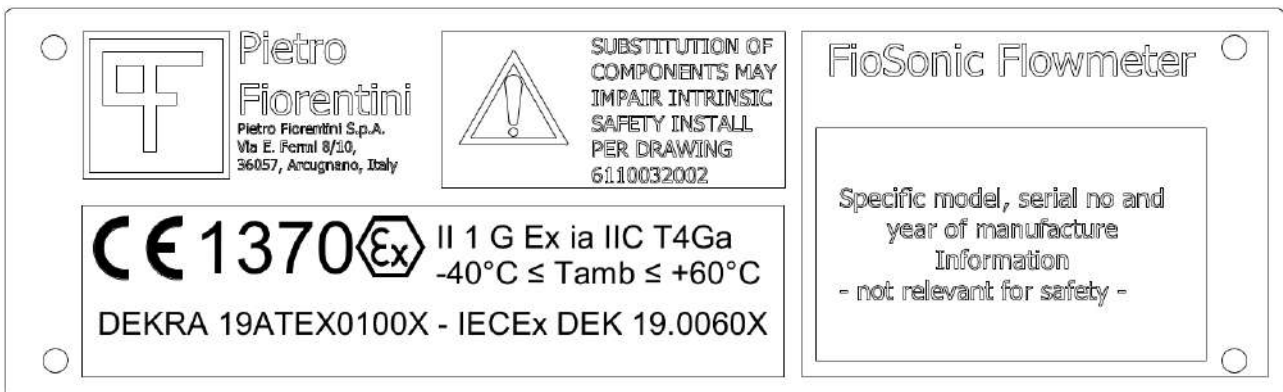
Additional documentation is delivered with the product. This contains specific set-up data for the individual flowmeter. Depending on the configuration the following documentation is delivered with the meter.

- Certificate of conformity / EX certificates
- Material certificates
- Meter configuration sheet
- Factory acceptance test report

Furthermore, product information such as this manual can be downloaded from the website

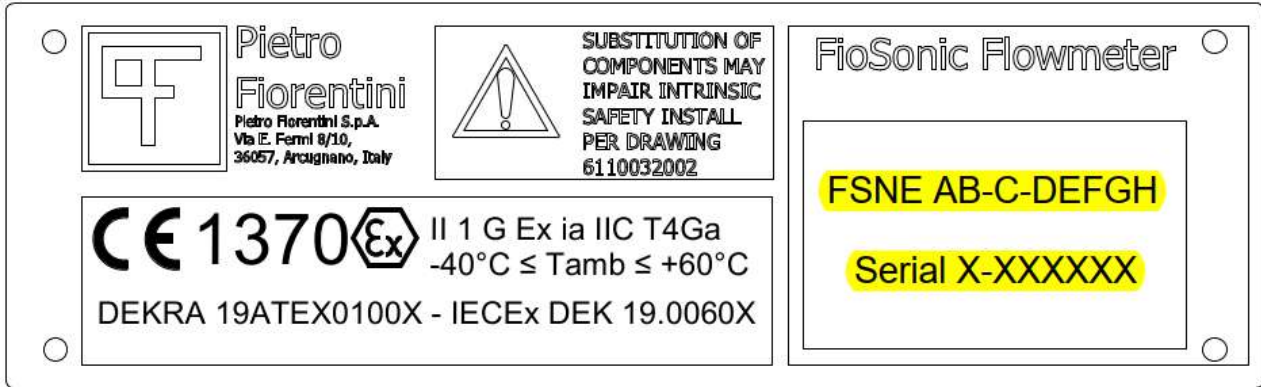
**2.11 Marking**

The SPU has a permanently affixed stainless steel label with relevant explosion safety information engraved, examples are shown below.



**3. Installation and wiring**

The FSN Series flowmeter can be equipped with a variety of option boards. Make sure to identify which option board is installed in your specific flowmeter. The option boards can be identified by the electronics assembly part number label on the SPU permanently affixed stainless steel label – refer to below figure for an example.



FSN Electronics assembly model number	
FSNE-AB-C-DEFGH	
A	x Number of paths (1 to 4)
B	x Application type
C	x Meter size
D - SLOT 1	0 Not installed 1 RS485 Option board (01-0020) 2 RS485 IO 4..20mA option board (01-0202)
E - SLOT 2	0 Not installed 1 P/T option board (01-0022) 2 4..20mA HART option board (01-0203)
F - LCD	0 Not installed 1 Installed
G	1 M20 cable gland entries 2 1/2" NPT cable gland entries
H	x options

### 3.1 Wiring

User connections are available in the back compartment of the SPU. The transducers and optional pressure and temperature sensors are already factory connected when applicable. For detailed interconnecting instructions and electrical parameters also refer to Control Drawing 6110032002.

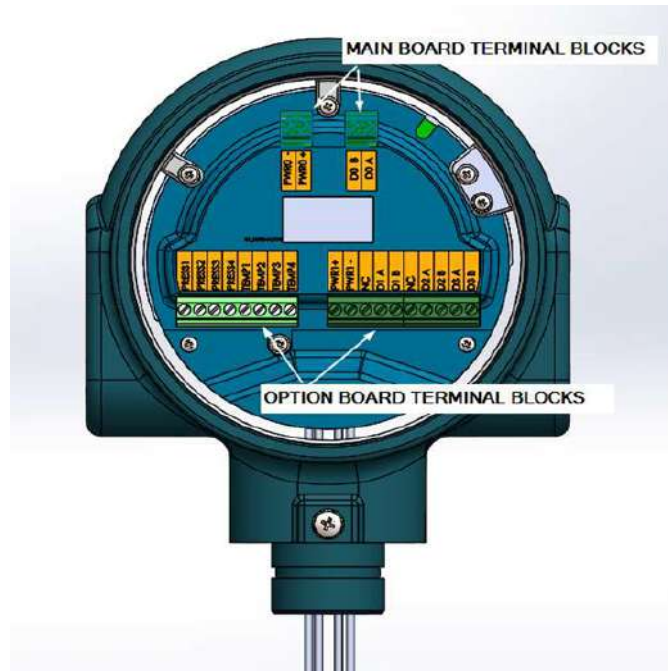


Figure 3-1 - User connections shown with PT option board (left) and IO option board (right)

The electronics enclosure is provided with four M20 or 1/2” NPT size cable gland entries available to the user

Select and install the glands according to all applicable requirements, like those stated in:

- National and local regulations;
- The FSN Series flowmeter documentation and on the SPU label
- The control drawing
- The specifications of the user wiring

It is recommended to use suitable armoured shielded cable to provide protection against mechanical damage and electrical interference.

Important: Only use cables with suitable, capacitance, inductance, resistance, diameter, cores and length compliant with the Electrical parameters of the flowmeter.

If your FSN series flowmeter is FM approved (refer to the SPU label), the following special remarks are also applicable:

- Installations shall comply with the relevant requirements of the latest edition of the National Electrical Code (ANSI/NFPA 70). Installations shall comply with the latest edition the manufacturer’s instruction manual.
- For intrinsically safe installation in the United States of America, electrical equipment connected to the Associated Apparatus shall not use or generate more than 250 volts rms.
- For guidance on United States of America installations, see ANSI/ISA-RP12.06.01, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
- Tampering and replacement with non-factory components may adversely affect the safe use of the System.
- Read and understand the instruction manual before operating the device.
- Each cable gland or blind plug fitted in the enclosure must comply with the NEMA or IP class and the temperatures indicated on the SPU (e.g. by using a suitable IP washer).
- During transport and storage the electronics enclosure may contain a bag of silica gel to absorb excessive humidity. Remove the bags before powering the SPU



**Warning !**

The FSN Series requires an intrinsically safe power supply compatible with the electrical parameters stated in chapter 4.

**4. Electrical Parameters**

<b>01-0018 (TIP005) Mainboard</b>	
PWR-, PWR+	<p>Main board Power supply                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_i = 29V</math>  <math>P_i = 670\text{ mW}</math>  <math>I_i = 100\text{ mA}</math>  <math>L_i = 0.3\text{ mH}</math>  <math>C_i = 0.03\text{ }\mu F</math> </p>
<b>Frequency output</b>	
D0_A, D0_B	<p>Frequency / pulse output                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_i = 29V</math>  <math>P_i = 670\text{ mW}</math>  <math>I_i = 100\text{ mA}</math>  <math>L_i = 0.15\text{ mH}</math>  <math>C_i = 0.03\text{ }\mu F</math> </p>
<b>01-0020 (TIP007) RS485 Option board parameters</b>	
Power PWR1+, PWR1-	<p>External power to the I/O option board                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_i = 28V</math>  <math>P_i = 670\text{ mW}</math>  <math>I_i = 100\text{ mA}</math>  <math>L_i = 0.3\text{ mH}</math>  <math>C_i = 0.03\text{ }\mu F</math> </p>
<b>RS485 port</b> D1_A, D1_B	<p>Differential RS485 two wire communications port                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_o = 4.12V</math>                      <math>U_i = 4.2V</math>  <math>P_o = 670\text{ mW}</math>                      <math>P_i = 250mW</math>  <math>I_o = 150mA</math>                      <math>I_i = 250mA</math>  <math>C_i = 20\mu F</math>  <math>L_i = \text{negligible}</math> </p>
<b>Digital output</b> D2_A, D2_B	<p>Passive optically isolated open collector output                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_i = 15V</math>  <math>P_i = 250\text{ mW}</math>  <math>I_i = 100mA</math>  <math>C_i = 0.03\mu F</math>  <math>L_i = 0.02mH</math> </p>
<b>Digital output</b> D3_A, D3_B	<p>Passive optically isolated open collector output                      In type of protection intrinsic safety, with the following maximum values:</p> <p> <math>U_i = 15V</math>  <math>P_i = 250\text{ mW}</math>  <math>I_i = 100mA</math>  <math>C_i = 0.03\mu F</math>  <math>L_i = 0.02mH</math> </p>

**01-0202 (TIP010) RS485 IO 4..20mA Option board parameters**

<b>Power / 4..20mA Loop</b> PWR1+, PWR1-	4..20mA Loop / Option board supply In type of protection intrinsic safety, with the following maximum values: $U_i = 29V$ $P_i = 670 \text{ mW}$ $I_i = 100mA$ $L_i = 0.3mH$ $C_i = 0.03\mu F$
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<b>RS485 port</b> D1_A, D1_B	Differential RS485 two wire communications port In type of protection intrinsic safety, with the following maximum values: $U_o = 4.12V$ $U_i = 4.2V$ $P_o = 670 \text{ mW}$ $P_i = 250mW$ $I_o = 150mA$ $I_i = 250mA$ $C_i = 20\mu F$ $L_i = \text{negligible}$
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<b>Digital output</b> D2_A, D2_B	Passive optically isolated open collector output In type of protection intrinsic safety, with the following maximum values: $U_i = 15.5V$ $P_i = 250 \text{ mW}$ $I_i = 100mA$ $C_i = 0.03\mu F$ $L_i = 0.02mH$
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<b>Digital output</b> D3_A, D3_B	Passive optically isolated open collector output In type of protection intrinsic safety, with the following maximum values: $U_i = 15.5V$ $P_i = 250 \text{ mW}$ $I_i = 100mA$ $C_i = 0.03\mu F$ $L_i = 0.02mH$
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**01-0203 (TIP011) 4..20mA HART Option board parameters**

<b>Loop Power / 4..20mA</b> LPWR2+, LPWR2-	4..20mA Loop power In type of protection intrinsic safety, with the following maximum values: $U_i = 29V$ $P_i = 670 \text{ mW}$ $I_i = 100mA$ $L_i = 0.3mH$ $C_i = 0.03\mu F$
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**5. EControl drawings**

Refer to the following control drawings

- ATEX / IECEx Drawing 6110032002 Control Drawing ATEX/IECEX







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