

# Precision Tubing Flowsensors

## For Use With TS410 Flow Modules

Measure volume flow in most non-aerated liquids including saline, buffer solutions, blood, water & even diesel fuel, with high resolution and low zero offset. Choose Clamp-on or Inline to match your flow circuit requirements.

### ME-PXL Clamp-on Flowsensors

- Non-contact Clamp-on Sensors do not break circuit sterility
- Preclinical and medical flow apparatus design
- Small diameter Sensors for industrial use

Innovative transit-time technology revolutionized blood flow measurement in medical tubing applications with these Flowsensors that clip onto the outside of flexible tubing to measure the flow within. They have become the standard for OEM medical design and preclinical extracorporeal use by providing non-invasive measurement with high accuracy and stability. Measurements are reliable even in challenging electromagnetic environments.

The easy clip-on operation of the PXL Flowsensors also make these Sensors ideal for industrial flow measurement applications when process testing must quick, repeatable and applied to multiple circuits without flow interruption. Unlike large diameter industrial flow measurement devices, Transonic® provides high resolution Clamp-on Sensors for small diameter, to 1/8" OD, tubings.



### ME-PXN Inline Flowsensors

- Measure flow over a wide dynamic range
- Flexibility for tubing circuits that may vary or are still in the design phase
- Highest sensitivity Sensors for low flow applications

PXN Inline Flowsensors utilize a scheme of ultrasonic illumination that makes it possible to manufacture a flow-through Sensor with a smooth, cylindrical interior without compromising measurement accuracy. These Flowsensors offer more flexibility over Clamp-on Sensors as measurement calibration doesn't depend on the type and exact size of tubing on which they are used. Small diameter PXN Inlines are ideal for low flow isolated heart or perfused organ studies.



# ME-PXL Series Clamp-on Flowsensors

Transonic® PXL Clamp-on Tubing Flowsensors clip on the outside of flexible laboratory tubing. No physical contact is made with the fluid media. A thin smear of Vaseline® or petroleum jelly should be applied to the section of tubing where the Sensor is applied to provide a good seal between the transducers and the tube for best ultrasonic signal transmission. PXL-Series Flowsensors can be factory calibrated and programmed for up to 4 different fluid, temperature, tubing, and flow rate combinations. Sensor size is determined by the outside diameter of the tubing. Standard PXL Sensors are sized in 1/16" increments. Metric sizes are available for metric tubing.



SENSOR SIZE	PHYSICAL SPECIFICATIONS <sup>1</sup>					
	DIMENSION ALONG TUBE		DEPTH		LENGTH	
	in	mm	in	mm	in	mm
2PXL	0.8	21	0.7	17	1.3	32
3PXL	0.8	21	0.7	17	1.3	32
4PXL	0.9	23	0.8	20	1.4	35
5PXL	0.9	23	0.8	20	1.4	35
6PXL	1.0	24	0.9	23	1.5	39
7PXL	1.0	26	1.0	25	1.7	42
8PXL	1.1	28	1.0	24	1.7	44
9PXL	1.2	30	1.0	26	1.7	42
10PXL	1.3	32	1.1	27	2.0	51
11PXL	1.4	35	1.1	28	2.2	56
12PXL	1.5	38	1.2	30	2.4	61
14PXL	1.6	41	1.4	36	2.6	66
16PXL	1.9	47	1.5	39	3.0	75
20PXL	2.3	58	1.8	46	3.7	93

1. Standard cable length is 2 meters.

## APPLICATIONS

- Artificial Heart & VAD Performance
- Medical Device & Pump Engineering
- Manufacturing & Compliance Flow Testing



SENSOR SIZE	BIDIRECTIONAL FLOW OUTPUTS				SYSTEM ACCURACY SPECIFICATIONS <sup>2</sup>			ULTRASOUND FREQUENCY
	RESOLUTION <sup>1</sup>	LOW FLOW (¼ SCALE)	STANDARD FLOW SCALE	MAX FLOW (STD SCALE)	MAX ZERO OFFSET	ABSOLUTE ACCURACY	LINEARITY	
	ml/min	1V output in ml/min	1V output in ml/min	5V output in L/min	ml/min	% of reading	%	
2PXL	0.5	50	200	1	± 4.0	± 10	± 4	3.6
3PXL	1.0	100	400	2	± 8.0	± 10	± 4	3.6
4PXL	1.0	100	400	2	± 8.0	± 10	± 4	2.4
5PXL	1.0	100	400	2	± 8.0	± 10	± 4	2.4
6PXL	2.5	250	1 L	5	± 15	± 10	± 4	2.4
7PXL	5	500	2 L	10	± 30	± 10	± 4	1.8
8PXL	5	500	2 L	10	± 30	± 10	± 4	1.8
9PXL	5	500	2 L	10	± 30	± 10	± 4	1.8
10PXL	10	1 L	4 L	20	± 60	± 10	± 4	1.2
11PXL	10	1 L	4 L	20	± 60	± 10	± 4	1.2
12PXL	10	1 L	4 L	20	± 60	± 10	± 4	1.2
14PXL	25	2.5 L	10 L	50	± 150	± 10	± 4	1.2
16PXL	25	2.5 L	10 L	50	± 150	± 10	± 4	1.2
20PXL	50	5 L	20 L	100	± 300	± 10	± 4	0.9

Calibration is dependent on tubing material, wall thickness, ultrasound velocity of liquid flowing through the tube & temperature.

1. Resolution represents the smallest detectable flow change at 0.1 Hz filter (average flow output).
2. Stated system accuracy specifications apply to PXL Flowsensors with TS410 Flow Modules. (a) Absolute accuracy is comprised of zero stability, resolution and linearity effects. Stated values apply when flow rate is greater than 5% of maximum range and zero offset is nulled. (b) If the Sensor is calibrated on-site with the system Flow Module for the tubing and liquid in use, absolute accuracy may be improved to the Linearity value. (c) On-site calibration is recommended if the Sensor is routinely used to measure flows less than 5% of the maximum range to account for non-linearities associated with flow profile.

# ME-PXN Series Inline Flowsensors

PXN Inline Flowsensors splice into laboratory tubing and measure volumetric flow of blood and other fluids. They offer the most flexibility for flow measurement in circuits where tubing requirements have not been formalized. The four-transducer Sensor design offers precise and accurate flow measurement for low or high flow rates, steady state or pulsatile flows. Flow resolution is scaled to Sensor size, and flow is measured accurately across the Sensor's full dynamic range with little effect from turbulence. The Sensor's smooth round flow channel is easy to clean and does not trap air bubbles that can degrade ultrasonic performance. Sizes 4PXN - 25PXN have barbed, rigid tubing ends which mate easily with flexible laboratory tubing. Plastic clamps may be applied to the outside for added security in high pressure circuits. Miniature size 1PXN - 3PXN Sensors are fabricated around flexible tubing which may be cut to length for insertion into small tubing circuits or perfusion apparatus. The flexible tubing ends may be expanded to fit over larger tubing OD (see RL-31-tn). PXN Inline Sensors can be calibrated and pre-programmed for up to 4 fluid, temperature, and flow rate combinations.

## APPLICATIONS

- Isolated Organ Studies
- Flow Phantoms & Circulatory Models
- Volume Flow Sensitive Applications



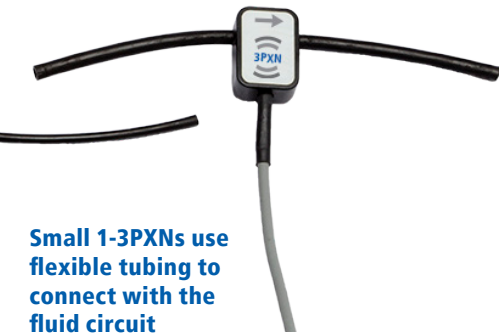
**Size 4PXN - 25PXN have barbed, rigid tubing ends**

SENSOR SIZE	TUBING SPECIFICATIONS				INLINE FLOWSENSOR CALIBRATION RANGES <sup>1</sup>			
	TUBING ID		BARB OD		LOW FLOW (1/4 SCALE) <sup>2</sup>		STANDARD FLOW (FULL SCALE)	
	in	mm	in	mm	LOWER LINEAR LIMIT <sup>3,4</sup>	MAX MEASUREMENT RANGE <sup>5</sup>	LOWER LINEAR LIMIT	MAX MEASUREMENT RANGE <sup>5</sup>
1PXN	3/64	1.2	Flexible tubing		5 ml/min	-25 to +25 ml/min	10 ml/min	-100 to +100 ml/min
2PXN	1/16	1.6			10 ml/min	-50 to +50 ml/min	20 ml/min	-200 to +200 ml/min
3PXN	3/32	2.4			25 ml/min	-125 to +125 ml/min	50 ml/min	-500 to +500 ml/min
4PXN	1/8	3.2	0.16	4.0	50 ml/min	-250 to +250 ml/min	100 ml/min	-1 to +1 L/min
5PXN	3/16	4.8	0.23	5.8	100 ml/min	-500 to +500 ml/min	200 ml/min	-2 to +2 L/min
6PXN	1/4	6.4	0.3	7.6	250 ml/min	-1.25 to +1.25 L/min	500 ml/min	-5 to +5 L/min
10PXN	3/8	9.5	0.44	11.1	500 ml/min	-2.5 to +2.5 L/min	1 L/min	-10 to +10 L/min
13PXN	1/2	12.7	0.58	14.7	1 L/min	-5 to +5 L/min	2 L/min	-20 to +20 L/min
16PXN	5/8	15.9	0.72	18.3	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min <sup>6</sup>
19PXN	3/4	19.1	0.86	21.9	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min <sup>6</sup>
25PXN	1	25.4	1.14	29.0	5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min <sup>6</sup>

1. To meet accuracy specifications, Flowsensors should be calibrated for the flow rate range of use.
2. Flowsensors calibrated for the low flow range should be used with the Flow Module in "1/4 Scale Mode."
3. Measurements below the Lower Linear Limit may deviate from the stated accuracy specification.
4. Custom calibration is available for average flow rates below the lower limit. This may compromise accuracy for the max measurement range.
5. Range includes zero: any flow peaks exceeding the Max Flow Value (-5 volt to +5 volt range) will be clipped.
6. Standard calibration range is up to 30 L/min; contact factory for availability of higher flow rate calibrations.

SENSOR SIZE	BIDIRECTIONAL FLOW OUTPUTS				SYSTEM ACCURACY SPECIFICATIONS <sup>1</sup>			PHYSICAL SPECIFICATIONS <sup>4</sup>				ULTRASOUND FREQUENCY
	RESOLUTION	LOW FLOW (1/4 SCALE)	STANDARD FLOW SCALE	MAX FLOW (STD SCALE)	MAX ZERO OFFSET <sup>2</sup>	ABSOLUTE ACCURACY	LINEARITY <sup>3</sup>	TOTAL LENGTH W/ TUBE ENDS		CASE LENGTH W/O TUBE ENDS		
	at 10 Hz in ml/min	1V output in ml/min	1V output in ml/min	5V output in L/min	ml/min	% of reading	%	in	mm	in	mm	
1PXN	± 0.02	5	20	100	± 0.4	± 8	± 2	3.9	100	0.3	8	9.6
2PXN	± 0.02	10	40	200	± 0.6	± 4	± 2	3.9	100	0.5	12	9.6
3PXN	± 0.05	25	100	500	± 1	± 4	± 2	3.9	100	0.6	14	7.2
4PXN	± 0.1	50	200	1 L	± 2	± 4	± 2	1.0	25	0.6	16	4.8
5PXN	± 0.2	100	400	2 L	± 4	± 4	± 2	1.2	32	0.8	20	3.6
6PXN	± 0.5	250	1 L	5 L	± 10	± 4	± 2	1.6	41	1.0	26	2.4
10PXN	± 1	500	2 L	10 L	± 20	± 4	± 2	2.0	51	1.3	33	1.8
13PXN	± 2	1 L	4 L	20 L	± 40	± 4	± 2	2.7	69	1.8	45	1.2
16PXN	± 5	2.5 L	10 L	50 L	± 70	± 4	± 2	3.3	83	2.1	52	0.9
19PXN	± 5	2.5 L	10 L	50 L	± 100	± 4	± 2	4.0	101	2.5	64	0.9
25PXN	± 10	5 L	20 L	100 L	± 200	± 4	± 2	5.0	128	3.1	80	0.6

1. Stated system accuracy specifications apply to PXN Flowsensors with TS410 Flow Modules
2. Zero offset can be eliminated by Zero Adjustment prior to measurement
3. Within specified calibration range.
4. Standard cable length is 1.85 meters.



Small 1-3PXNs use flexible tubing to connect with the fluid circuit

Catalog #: ME \_\_\_\_\_ PXN \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_  
 Size Fluid/Temperature + Flow Rate Calibration Codes  
 Up to four per Flowsensor

Example: ME4PXN - BL37 SF – KR37 SF – FX37 LF, calibrated for 3 different uses:

- Blood at 37°C at standard flow rate
- Krebs at 37°C at standard flow rate
- Custom fluid at 37°C at low flow rate

## How to Order a Flowsensor

1. ME- indicates compatibility with TS410 Flow Modules.
2. Determine if a PXN Inline or PXL Clamp-on Flowsensor is better for your application.
  - a. If PXN Inline, choose the Sensor size that will best match the circuit ID and anticipated flow rates.
  - b. If PXL Clamp-on, choose the Sensor size that matches your tubing OD. Then specify tubing type. Supply a 60 cm length sample if your tubing is not on our stock tubing list.
3. Specify the following information for either Flowsensor type:
  - a. Anticipated flow range (average and peak)
  - b. Fluid and temperature for calibration
4. Use the code tables (right) to construct the catalog number.
5. Contact Customer Service for any non-standard requests.

CALIBRATION CODES			
FLUID	TEMPERATURE		
	23°C	37°C	CUSTOM <sup>2</sup>
Water/Saline	H2023	H2037	H20TX
Blood	BL23	BL37	BLTX
Glycerine 40%, Water 60% (vol) <sup>1</sup>	GL23	GL37	GLTX
Custom Glycerine <sup>2</sup>	GLX23	GLX37	GLXTX
Krebs Solution	KR23	KR37	KRTX
Custom Fluid <sup>2</sup>	FX23	FX37	FXTX

FLOW RANGE	CATALOG CODE
Standard Flow	SF
Low Flow	LF
Custom Flow <sup>2</sup>	XF

1. Glycerine calibration is custom for 1PXN-3PXN
2. All custom requirements (X) incur an extra charge

## Considerations for Choosing the Most Appropriate Flowsensor

### FLOW MODULE COMPATIBILITY

TS410 Tubing Flow Module

### SENSOR SIZE

PXN Inline Flowsensors are sized to fit the internal diameter of the flexible tubing in your circuit. PXL Clamp-on Flowsensors clamp around the outer diameter of flexible tubing. Use the tubing specification tables to determine the best Sensor size for your tubing requirements.

### TUBING DIAMETER FOR PXN INLINES

The PXN Sensor that most closely matches the circuit tubing ID should be used so that perturbations in fluid dynamics are minimized. Reducing the tubing diameter can add resistance to flow.

### TUBING REQUIREMENTS FOR PXL CLAMP-ONS

Transmitting the ultrasound signal through the tubing wall requires a snug, compressive fit, so the Sensor size is dependent on the tubing of the circuit. Medical grade and laboratory tubings (PVC, silicone, polyurethane) are

generally compatible for use with PXL Sensors. Rigid PVC and acrylic (Lucite) are not. We stock common PVC tubing types. For other tubing types or metric sizes, a 60 cm sample is required for Sensor calibration.

### EXPECTED FLOW RATES

Transonic® Flowsensor sizes are scaled to achieve the highest resolution in flow measurement. The smaller the Sensor, the higher the sensitivity to low volume flows and the lower the offset at zero flow (see specifications table). All PXL and PXN Sensors have two dynamic flow ranges: standard flow range (full scale) and low flow range (1/4 scale). Sensors are factory calibrated for the highest accuracy in the specified flow range. To meet performance specifications, indicate low or standard flow when ordering. If no flow range is indicated, Sensors will be calibrated in the standard flow range. Calibration for flows below the lower linear limit may be requested and will incur an extra charge.





## CLEANING & STERILIZATION

Transonic® Tubing Flowsensors may be cleaned with a solution of mild soap and warm water (<55°C). The inside of PXN Flowsensors may be cleaned with a soft brush. Care should be taken to avoid scratching the inside surface of the tube. Common mild cleaning agents such as gluteraldehyde and OPA are acceptable to use; harsh disinfectants are not. Do not use alcohol to clean small 1 - 3PXN Sensors. Both PXL Clamp-on and PXN Inline Tubing Sensors may be sterilized by EtO gas.

## CUSTOMER SERVICE

Contact your local distributor or sales representative for quotations, shipping information and payment terms. Please feel free to contact us if you have questions or visit our website [www.transonic.com](http://www.transonic.com) for the most up-to-date product offerings, application and technical support, and reference materials.

## LIMITED WARRANTY

Transonic Systems Inc.® warrants that Tubing Flowsensors are free from defects which are the result of faulty material or workmanship by Transonic® for a period of six (6) months from their date of shipment. The warranty of Transonic® shall not apply to: defects caused by abuse, neglect or misuse; damage due to accident or casualty; or unauthorized alterations or repairs made by anyone other than Transonic®.

Transonic Systems Inc.® will, at no charge to the user, either repair or replace a defective Flowsensor during its warranty period. The Buyer pays shipping charges to Transonic Systems Inc.® and Transonic® will pay for return shipping charges. There is no other warranty oral or written, expressed or implied. Transonic® is not liable for incidental or consequential damages. Warranty is valid only if equipment is purchased through Transonic® or a duly appointed distributor or licensed representative.

## CALIBRATION CERTIFICATION & REPAIR SERVICE

Transonic® Flowsensors are precalibrated at the factory with equipment that has been calibrated traceable to the standards of National Institute of Standards and Technology and to Transonic Systems Inc.® equipment performance standards. At purchase, Flowsensors are issued a Certificate of Calibration valid for one year. Sensors may be returned to Transonic® for recalibration if Calibration Certification is required for GLP studies.

Transonic® will also perform repairs on Flowsensors which have been damaged or cut. Contact Transonic® or your local distributor for a RMA # (Return Materials Authorization).