

Signature
Transonic

PXL-
Series

&

PXN
Series

Precision Tubing Flowsensors

TS410 400-Series Flowmeter Module

Signature Gold Standard Ultrasonic Transit Time Flowsensors for tubing. Measures volume flow in most non-aerated liquids including saline, buffer solutions, blood, water, even diesel fuel, with high resolution and low offset. Choose *Clamp-on* or *Inline* Sensors to match your circuit requirements.

ME-PXL *Clamp-on* Flowsensors (*Sterile Tubing Flowsensors*)

- Non-contact Clamp-on Sensors do not break circuit sterility
- Preclinical and medical extracorporeal use
- Small diameter Clamp-on 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 and pre-clinical extracorporeal use by providing non-invasive measurement with high accuracy and stability. Measurements are reliable even in electromagnetically challenging medical environments.



The easy clip-on operation of the PXL flowsensors also make these sensors ideal for industrial flow measurement applications when process testing needs to be 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 tubings down to 1/8" OD.

ME-PXN *Inline* Flowsensors

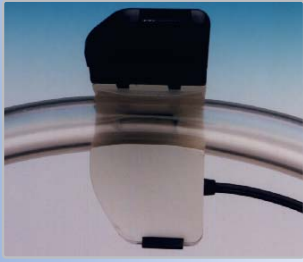
- A completely new Inline Flowsensor for a wide dynamic range
- Flexibility for tubing circuits that may vary or are still in the design phase
- Highest sensitivity for sizes for 1mm - 25mm diameter tubing

New PXN Inline Flowsensors utilize a different scheme of ultrasonic illumination that makes it possible to manufacture a flow-through sensor with a smooth, cylindrical interior. No compromises have been made in 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 it is being used. The sensors are ETO gas sterilizable. Small diameter PXN Inlines are ideal for low flow isolated heart, or perfused organ studies.



 **Transonic Systems Inc.**
The Flow Measurement Specialists

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Precision *Clamp-On* Flowsensors ME-PXL-Series for TS410 Modules

Reliable Performance for Repeated, Carefree Use in Defined Tubing Applications

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

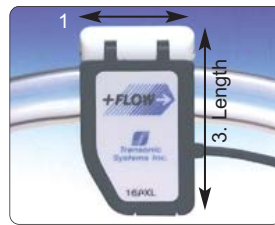
Transonic Precision PXL-Clamp-on Tubing Flowsensors clip on the outside of flexible laboratory. No physical contact is made with the fluid media. ME-PXL-Series flowsensors can be calibrated and programmed for up to 4 different fluid, temperature, tubing, flow rate combinations. Sensor size is determined by outside diameter of the tubing. Standard MEPXL sensors are sized in 1/16" increments. (Custom sizes are available for metric tubing).

3PXL

9PXL

11PXL

20PXL



PHYSICAL SPECIFICATIONS*						
SENSOR SIZE	1. DIMENSION ALONG TUBE		2. HEIGHT		3. LENGTH	
	inch	mm	inch	mm	inch	mm
Catalog #						
2PXL, 3PXL	0.82	20.8	0.67	17.0	1.25	31.6
4PXL, 5PXL	0.89	22.7	0.80	20.3	1.39	35.2
6PXL	0.96	24.3	0.88	22.3	1.54	39.1
7PXL	1.01	25.6	0.97	24.5	1.66	42.1
8PXL	1.09	27.7	0.95	24.0	1.74	41.3
9PXL	1.30	32.6	0.97	24.6	1.83	46.5
10PXL	1.24	31.6	1.06	26.9	1.99	50.5
11PXL	1.37	34.8	1.11	28.3	2.19	55.8
12PXL	1.50	38.1	1.21	30.7	2.40	60.9
14PXL	1.63	41.2	1.40	35.5	2.59	65.8
16PXL	1.85	46.9	1.54	39.3	2.95	74.9
20PXL	2.29	58.2	1.79	45.6	3.67	93.4

* Subject to modification

TUBING SENSOR	TUBING SPECIFICATIONS						ACCURACY SPECIFICATIONS							
	TUBING ID		WALL THICKNESS		TUBING OD		BIDIRECTIONAL FLOW OUTPUTS				ACCURACY ¹			ULTRA-SOUND Frequency MHz
	inches	mm	inches	mm	inches	mm	Resolution ² ml/min	Low Flow (1/4 scale) 1 volt = ml/min	Standard Flow (Full Scale) 1 volt = ml/min	Max Flow in Standard Range 5 volt = L/min	Maximum Zero Offset ml/min	Absolute Accuracy %	Relative Accuracy %	
ME 2PXL	3/32	2.4	1/32 ³	0.8 ³	1/8 - 5/32	3.1 - 4.0	0.5	50	200	1	± 4.0	± 10	± 4	3.6
3PXL	1/8	3.2	1/32 ³	0.8 ³	3/16 - 7/32	4.7 - 5.5	1	100	400	2	± 8.0	± 10	± 4	3.6
4PXL	1/8	3.2	1/16	1.6	1/4	6.4	1	100	400	2	± 8.0	± 10	± 4	2.4
5PXL	3/16	4.7	1/16	1.6	5/16	7.9	1	100	400	2	± 8.0	± 10	± 4	2.4
6PXL	1/4	6.4	1/16	1.6	3/8	9.5	2.5	250	1 L	5	± 15	± 10	± 4	2.4
7PXL	1/4	6.4	3/32	2.4	7/16	11.1	5	500	2 L	10	± 30	± 10	± 4	1.8
8PXL	3/8	9.5	1/16	1.6	1/2	12.7	5	500	2 L	10	± 30	± 10	± 4	1.8
9PXL	3/8	9.5	3/32	2.4	9/16	14.3	5	500	2 L	10	± 30	± 10	± 4	1.8
10PXL	1/2	12.7	1/16	1.6	5/8	15.9	10	1 L	4 L	20	± 60	± 10	± 4	1.2
11PXL	1/2	12.7	3/32	2.4	11/16	17.5	10	1 L	4 L	20	± 60	± 10	± 4	1.2
12PXL	1/2	12.7	1/8	3.2	3/4	19.0	10	1 L	4 L	20	± 60	± 10	± 4	1.2
14PXL	5/8	15.9	1/8	3.2	7/8	22.2	25	2.5 L	10 L	50	± 150	± 10	± 4	1.2
16PXL	3/4	19.0	1/8	3.2	1	25.4	25	2.5 L	10 L	50	± 150	± 10	± 4	1.2
20PXL	1	25.4	1/8	3.2	1 1/4	31.8	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, and temperature.

1a Absolute Accuracy is composed of zero stability, sensitivity and linearity errors. Stated values apply when flow rate is greater than 5% of maximum range and zero offset is nulled.

1b If the sensor is calibrated on-site for the tubing and liquid in use, absolute accuracy is further improved to the value listed as "Relative Accuracy."

1c 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.

2 Resolution represents the smallest detectable flow change at 0.1Hz filter (average flow output).

3 In sizes 2PXL - 3PXL ratio of tubing wall thickness to OD must not exceed 1:5 for PVC; 1:3 for silicone



1PXN

5PXN

10PXN

19PXN

25PXN

Precision *Inline* Flow sensors

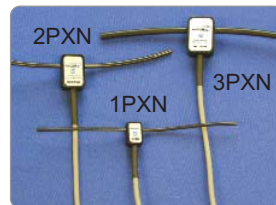
ME-PXN-Series for TS410 Modules

A Completely New Extracorporeal Inline Flow sensor with Enhanced Accuracy over a Wide Dynamic Range

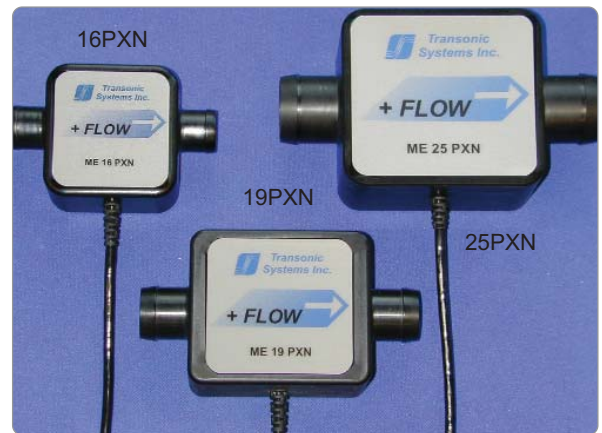
PXN Inline Flow sensors splice into laboratory tubing and measure absolute volume flow of blood and other fluids. PXN inline sensors offer the most flexibility for flow measurement in circuits where tubing requirements have not been formalized. The new four-transducer sensor design offers precision flow accuracy for < 1 ml/min to 100 liters/min steady state and pulsatile flows. Flow range sensitivity is scaled to sensor size and flow is measured consistently 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 ultem tubing ends to mate easily with flexible laboratory tubing. Miniature sizes 1PXN - 3PXN sensors are fabricated around flexible Pebax tubing which may be cut to length for insertion into small tubing circuits or perfusion apparatus. PXN-inline sensors can be calibrated and preprogrammed for up to 4 fluid, temperature, flow rate combinations for highest accuracy performance in:



- ✓ Isolated organ studies
- ✓ Flow phantoms & circulatory models
- ✓ All applications requiring maximum volume flow sensitivity



PXN Family of Inline Flow sensors



INLINE SENSOR	PHYSICAL SPECIFICATIONS						ACCURACY SPECIFICATIONS							
	TUBING ID		BARB OD ¹		DIMENSIONS ²		BIDIRECTIONAL FLOW			ACCURACY			ULTRA-SOUND Frequency MHz	
	Catalog #	inches	mm	inches	mm	Total Length w/ tube ends mm	Case Length w/out ends mm	Resolution at 10 Hz ml/min	Low Flow 1 Volt = ml/min	Standard Range 1 Volt = ml/min	Max Flow in Standard Range ml/min	Maximum Zero Offset ³ ml/min		Absolute Accuracy %
ME1PXN	3/64	1.2		Pebax	100	8.1	± 0.02	5	20	100	± 0.4	± 8	± 2	9.6
ME2PXN	1/16	1.8		Pebax	100	11.9	± 0.02	10	40	200	± 0.6	± 4	± 2	9.6
ME3PXN	3/32	2.4		Pebax	100	14	± 0.05	25	100	500	± 1	± 4	± 2	7.2
ME4PXN	1/8	3.2	0.16	4.0	24.9	15.7	± 0.1	50	200	1 L	± 2	± 4	± 2	4.8
ME5PXN	3/16	4.8	0.23	5.8	31.5	20.3	± 0.2	100	400	2 L	± 4	± 4	± 2	3.6
ME6PXN	1/4	6.4	0.3	7.6	40.6	25.9	± 0.5	250	1 L	5 L	± 10	± 4	± 2	2.4
ME10PXN	3/8	9.5	0.44	11.1	50.8	32.5	± 1	500	2 L	10 L	± 20	± 4	± 2	1.8
ME13PXN	1/2	12.7	0.58	14.7	69.1	44.7	± 2	1 L	4 L	20 L	± 40	± 4	± 2	1.2
ME16PXN	5/8	15.9	0.72	18.3	83.3	52.3	± 5	2.5 L	10 L	50 L	± 70	± 4	± 2	0.9
ME19PXN	3/4	19.1	0.86	21.9	101.1	64	± 5	2.5 L	10 L	50 L	± 100	± 4	± 2	0.9
ME25PXN	1	25.4	1.14	29.0	128	79.8	± 10	5 L	20 L	100L	± 200	± 4	± 2	0.6

¹Subject to minor modification

²Standard cable length: 1.85 meters.

³ Zero offset can be eliminated by Zero Adjustment prior to measurement.

⁴ Within specified calibration range.

Ordering ME-PXN Inline Flow sensors

Catalog # ME _____ **PXN** _____ - _____ - _____
 Size Fluid/Temperature + Flow Rate Calibration Codes (up to 4)

Example: ME4PXN - BL37 SF – KR37 SF – FX37 LF is calibrated for 3 different uses:
 (Blood at 37°C at standard flow rate; Krebs at 37°C at standard flow rate;
 custom cell culture at 37°C at low flow rate)

How to Order

- Choose the sensor size that will best match the circuit ID and anticipated flow rates;
- Specify the anticipated flow range when ordering;
- Specify calibration for fluid type and temperature;
- Use the codes below to construct catalog number.
- **Contact Customer Service for any non-standard requests.**



How to Choose the Most Appropriate Inline Sensor

Flowmeter Compatibility: TS410 400-Series Flowmeter Module

Size: Sizes are scaled to insert into flexible tubing internal diameter.

(See PXN specification table for ID and barb spec.)

Tubing Diameter: The sensor that most closely matches the circuit tubing ID should be used so that perturbations in fluid dynamics are minimized. Narrowing or steps down in tubing diameter can add resistance to flow.

Expected Flow Rate: 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 PXN sensors have two dynamic flow ranges: standard (full scale) and low flow (1/4 scale) (see table at right). PXN sensors are factory calibrated for highest accuracy in the specified flow range. To meet performance specifications, indicate low or standard flow range when ordering. If no flow range is indicated, PXN flowsensors will be calibrated for the standard range. Calibration for accuracy at flows below the Lower Linear Limit may be requested and will be assessed an extra charge.

Fluid / Temperature Calibration: Inline sensors for the TS410 may be calibrated for up to 4 fluid, temperature combinations. Fluid samples and a MSDS may be required for custom calibration requests.

INFORMATION NEEDED TO CALIBRATE SENSOR

- Fluid (blood, saline, other)
- ¹To meet accuracy specifications, flowsensors should be calibrated for the flow rate range of use.
- ²Flowsensors calibrated for the low flow range should be used with the flowmeter in "1/4 Scale Mode."
- ³Measurements below the Lower Linear Limit may deviate from +/-2% linearity specification.
- ⁴Custom calibration is available for average flow rates below the lower limit. This may compromise accuracy for the maximum measurement range.
- ⁵Any flow peaks exceeding the Max Flow Value (-5 volt to + 5 volt flowmeter range) will be clipped.

INLINE FLOWSENSOR CALIBRATION RANGES ¹					
SENSOR SIZE	ID mm	LOW FLOW (1/4 SCALE) ²		STANDARD FLOW (FULL SCALE)	
		Lower Linear Limit ^{3,4}	Maximum Measurement Range ⁵	Lower Linear Limit ⁴	Maximum Measurement Range ⁵
1PXN	1.2	5 ml/min	-25 to +25 ml/min	10 ml/min	-100 to +100 ml/min
2PXN	1.8	10 ml/min	-50 to +50 ml/min	20 ml/min	-200 to +200 ml/min
3PXN	2.4	25 ml/min	-125 to +125 ml/min	50 ml/min	-500 to +500 ml/min
4PXN	3.2	50 ml/min	-250 to +250 ml/min	100 ml/min	-1 to +1 L/min
5PXN	4.8	100 ml/min	-500 to +500 ml/min	200 ml/min	-2 to +2 L/min
6PXN	6.4	250 ml/min	-1.25 to +1.25 L/min	500 ml/min	-5 to +5 L/min
10PXN	9.5	500 ml/min	-2.5 to +2.5 L/min	1 L/min	-10 to +10 L/min
13PXN	12.7	1 L/min	-5 to +5 L/min	2 L/min	-20 to +20 L/min
16PXN	15.9	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min
19PXN	19.1	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min ⁶
25PXN	25.4	5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min ⁶

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

Calibration of Inline and Clamp-on Flow sensors

All Transonic flowsensors are supplied with a Certificate of Calibration traceable to NIST standards listing and dating any calibration that was performed. Tubing flowsensors are individually custom calibrated for your use. Calibration is performed for the specified fluid at a specified temperature/flow range. Blood calibrations are performed with an analog that matches the acoustic velocity of blood and a correction for blood is applied. Calibration is valid for 1 year. Recertification can be scheduled as required for GLP studies. The customer supplies any custom tubing or fluid samples.

FLUID/TEMPERATURE	23°C	37°C	CUSTOM TEMP
WATER/SALINE	H ₂ O23	H ₂ O37	H ₂ O TX
BLOOD	BL23	BL37	BL TX
GLYCERINE 40%, WATER 60% (BY VOLUME)	GL23	GL37	GL TX
GLYCERINE CUSTOM CONC	GLX23	GLX37	GLX TX
KREBS SOLUTION	KR23	KR37	KR TX
CUSTOM FLUID	FX23	FX37	FX TX

CALIBRATION FLOW RANGE	CATALOG NUMBER CODE
STANDARD FLOW	SF
LOW FLOW	LF
CUSTOM LOWER FLOW	XF

Glycerine calibration: custom for 1PXN, 2PXN, 3PXN

X = extra charge



Measuring the Flow of Life
Taughanock Falls, NY Richard Welch, Photographer

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Use of Transonic Tubing Flowsensors

ME-PXL Clamp-on Tubing Flowsensors are applied to the outside of the tubing. A thin smear of Vaseline® or petroleum jelly should be applied to the section of tube where the sensor is applied. The Vaseline® provides a good seal between the transducers and the tube for best ultrasonic signal transmission. It also will help seat the tube in the sensor opening and allow the lid to be closed without excessive force.

ME-PXN Inline Flowsensors are applied into the ends of flexible tubing. Sizes 4PXN – 25PXN are manufactured with barbed rigid tubing ends to insert securely into the tubing circuit. For tubing circuits that are under high pressure, plastic clamps may be applied to the outside for added security to keep the tubing from popping off. Thick walled tubing that is difficult to install on the sensor tubing ends may be softened with warm water before installation.

Small ME1PXN, ME2PXN and ME3PXN have 50 mm long flexible PEBAX tubing ends. These may be cut to the appropriate length for the circuit. However, the tubing segment is not replaceable and care should be taken to retain an adequate tubing length for attachment. Metal or plastic tubing fittings may be used to mate the sensor with similar diameter tubes. Pebax tubing ends may be carefully expanded with heat application to fit over larger tubing OD (see TN# 31). Do not stretch, pull or crush the Pebax tubing.

Cleaning and Sterilization

Transonic Tubing Flowsensors may be cleaned with a solution of mild soap and warm water (<55°C) and wiped or flushed with ethyl alcohol to promote drying. The channel 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 are acceptable to use; harsh disinfectants are not. Both PXL Clamp-on and PXN Inline Tubing Sensors may be sterilized by ETO gas sterilization.

Customer Service

Contact your local distributor for quotations, proforma invoices including shipping charges, delivery times and payment terms. Transonic Systems' distributes its products through a network of knowledgeable distributors. Please feel free to contact us if you have questions or visit our website www.transonic.com for the most up-to-date product offerings, applications 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 Systems, Inc. for a period of six (6) months from their date of shipment. The warranty of Transonic Systems shall not apply to: defects caused by abuse, neglect or misuse; damage due to accident or casualty; or un-authorized alterations or repairs made by anyone other than Transonic Systems, Inc.

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. plant. Transonic will pay for the return shipping charges. No other warranty oral or written, expressed or implied. Transonic Systems is not liable for incidental or consequential damages. Warranty is valid only if equipment is purchased through Transonic Systems or a duly appointed distributor or licensed representative.

Calibration Certification & Repair Service

Transonic Systems Precision Tubing 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 Systems for recalibration if Calibration Certification is required for GLP studies.

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

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