

Precision Tubing Flowsensors

For Use With TS410 Flow Modules

Measure volume flow in most non-aerated liquids including saline, buffer solutions, blood & water 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

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.

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

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

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.



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.

APPLICATIONS

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



Easy clip on application of PXL Sensor to tubing

SENSOR SIZE	PHYSICAL SPECIFICATIONS ¹					
	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.

SENSOR SIZE	BIDIRECTIONAL FLOW OUTPUTS				SYSTEM ACCURACY SPECIFICATIONS ²		ULTRASOUND FREQUENCY
	RESOLUTION ¹	LOW FLOW (¼ SCALE)	STANDARD FLOW SCALE	MAX FLOW (STD SCALE)	MAX ZERO OFFSET	ABSOLUTE ACCURACY	
	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	3.6
3PXL	1.0	100	400	2	± 8.0	± 10	3.6
4PXL	1.0	100	400	2	± 8.0	± 10	2.4
5PXL	1.0	100	400	2	± 8.0	± 10	2.4
6PXL	2.5	250	1 L	5	± 15	± 10	2.4
7PXL	5	500	2 L	10	± 30	± 10	1.8
8PXL	5	500	2 L	10	± 30	± 10	1.8
9PXL	5	500	2 L	10	± 30	± 10	1.8
10PXL	10	1 L	4 L	20	± 60	± 10	1.2
11PXL	10	1 L	4 L	20	± 60	± 10	1.2
12PXL	10	1 L	4 L	20	± 60	± 10	1.2
14PXL	25	2.5 L	10 L	50	± 150	± 10	1.2
16PXL	25	2.5 L	10 L	50	± 150	± 10	1.2
20PXL	50	5 L	20 L	100	± 300	± 10	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) 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. 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. 25PXN Flowsensors have barbed, rigid tubing ends which mate easily with flexible laboratory tubing. 25PXNB flowsensors have rigid tubing ends with no barbs. Plastic clamps may be applied to the outside for added security in high pressure circuits. 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



25PXN have barbed, rigid tubing ends

SENSOR SIZE	TUBING SPECIFICATIONS				INLINE FLOWSENSOR CALIBRATION RANGES ¹					
	TUBING ID		BARB OD		LOW FLOW (1/4 SCALE) ²		STANDARD FLOW (FULL SCALE)		ULTRA LOW FLOW ²	
	in	mm	in	mm	LOWER LINEAR LIMIT ³	MAX MEASUREMENT RANGE ⁴	LOWER LINEAR LIMIT	MAX MEASUREMENT RANGE ⁴	LOWER LINEAR LIMIT ³	MAX MEASUREMENT RANGE
25PXN	1	25.4	1.14	29.0	5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min ⁵	2 L/min	-10 to +10 L/min
25PXNB	1	25.4	No barbs		5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min ⁵	2 L/min	-10 to +10 L/min

1. To meet accuracy specifications, Flowsensors should be calibrated for the flow rate range of use.
2. Flowsensors calibrated for the Low & Ultra Low flow ranges 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. Range includes zero: any flow peaks exceeding the Max Flow Value (-5 volt to +5 volt range) will be clipped.
5. 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 ¹		PHYSICAL SPECIFICATIONS ³				ULTRASOUND FREQUENCY
	RESOLUTION	LOW FLOW (¼ SCALE)	STANDARD FLOW SCALE	MAX FLOW (STD SCALE)	MAX ZERO OFFSET ²	ABSOLUTE ACCURACY	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	MHz
25PXN	± 10	5 L	20 L	100 L	± 200	± 4	5.0	128	3.1	80	0.6
25PXNB	± 10	5 L	20 L	100 L	± 200	± 4	4.4	111	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. Standard cable length is 1.85 meters.

Catalog #: ME25PXN_____ - _____ - _____ - _____

Barbs Fluid/Temperature + Flow Rate Calibration Codes
Up to four per Flowsensor

Example: ME25PXN - BL37 SF – KR37 SF – KR37 LF, calibrated for 3 different uses:

- Blood at 37°C at standard flow rate
- Krebs at 37°C at standard flow rate
- Krebs 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 ¹
Water/Saline	H2023	H2037	H20TX
Blood	BL23	BL37	BLTX
Glycerine 40%, Water 60% (vol)	GL23	GL37	GLTX
Krebs Solution	KR23	KR37	KRTX

FLOW RANGE	CATALOG CODE
Standard Flow	SF
Low Flow	LF
Ultra Low Flow	UF

1. All custom requirements 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, 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 three dynamic flow ranges: Standard flow range (full scale), Low flow range (1/4 scale), and Ultra 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.

NOTE: Transonic may request tubing samples to confirm the proper sizing & fit for certain applications.

Catalog #: ME ____ PXL ____ - ____ - ____ - ____ - ____

Size	Suffix if Metric OD	Fluid/Temperature + Flow Rate Calibration Codes Up to four per Flowsensor
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Tubing: Specify type and size (ID x wall x OD)

Example: ME6PXL – BL37 SF – H2023 LF is for 3/8" OD tubing, calibrated for 2 uses:

- Blood at 37° C at Standard Flow Rates on Tygon ND 100-65 (1/4" ID x 1/16" wall)
- Water at 23° C at Low Flow Rates on Tygon E-3603 (1/4" ID x 1/16" wall)



ME-PXL Clamp-on Flowsensor Parameters

SENSOR SIZE	CLAMP-ON FLOWSENSOR CALIBRATION RANGES ¹					
	LOW FLOW (¼ SCALE) ²		STANDARD FLOW (FULL SCALE)		ULTRA LOW FLOW ²	
	LOWER LINEAR LIMIT ³	MAX MEASUREMENT RANGE ⁴	LOWER LINEAR LIMIT	MAX MEASUREMENT RANGE ⁴	LOWER LINEAR LIMIT	MAX MEASUREMENT RANGE ⁴
2PXL	50 ml/min	-250 to +250 ml/min	100 ml/min	-1 to +1 L/min	20 ml/min	-200 to +200 ml/min
3PXL, 4PXL, 5PXL	100 ml/min	-500 to +500 ml/min	200 ml/min	-2 to +2 L/min	40 ml/min	-400 to +400 ml/min
6PXL	250 ml/min	-1.25 to +1.25 L/min	500 ml/min	-5 to +5 L/min	100 ml/min	-1 to +1 L/min
7PXL, 8PXL, 9PXL	500 ml/min	-2.5 to +2.5 L/min	1 L/min	-10 to +10 L/min	200 ml/min	-2 to +2 L/min
10PXL, 11PXL, 12PXL	1 L/min	-5 to +5 L/min	2 L/min	-20 to +20 L/min	400 ml/min	-4 to +4 L/min
14PXL, 16PXL	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min ⁵	1 L/min	-10 to +10 L/min
20PXL	5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min ⁵	2 L/min	-20 to +20 L/min

1. To meet accuracy specifications, Flowsensors should be calibrated for the flow rate range of use.
2. Flowsensors calibrated for the Low & Ultra Low flow ranges 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. Range includes zero: any flow peaks exceeding the Max Flow Value (-5 volt to +5 volt range) will be clipped.
5. Standard calibration range is up to 30 L/min; contact factory for availability of higher flow rate calibrations.

STANDARD CONNECTOR TYPES

- CC16: Metal 16-pin; 25PXN & all PXLs

TS410 EXTENSION CABLES

PXNs come with a standard cable length of 1.85 meter.
PXLs come with a 2 meter cable. Extension cables are available.

- CC16-S-CC16: Standard 1 meter
- CC16-X-CC16: Specified custom length; up to 5 meter standard

FLUID / TEMPERATURE CALIBRATION

Since fluid density and temperature alter the transit time of the ultrasound signal and affect the acoustic properties of the tubing, we calibrate the Sensor specifically for these parameters. Operational fluid temperature should be within $\pm 2^{\circ}\text{C}$ of the specified calibration temperature. Specify up to 4 tubing, fluid, temperature, & flow rate combinations for calibration.

CALIBRATION CERTIFICATES

Sensors are supplied with a certificate of calibration for specified use. Yearly recertification is recommended.

CLAMP-ON FLOWSENSOR TUBING SPECIFICATIONS				
FRACTIONAL (1/16 INCH INCREMENTS)				
SENSOR SIZE	TUBING ID	WALL THICKNESS	TUBING OD	STOCK TUBING ²
2PXL	3/32	1/32 ¹	5/32	A, B
3PXL	1/8	1/32 ¹	3/16	A
4PXL	1/8	1/16	1/4	A, B
5PXL	3/16	1/16	5/16	A
6PXL	1/4	1/16	3/8	A, B
7PXL	1/4	3/32	7/16	A, B
8PXL	3/8 5/16	1/16 3/32	1/2	A, B N/A
9PXL	3/8	3/32	9/16	A, B
10PXL	1/2	1/16	5/8	A, B
11PXL	1/2	3/32	11/16	A, B
12PXL	1/2	1/8	3/4	A, B
14PXL	5/8 11/16	1/8 3/32	7/8	A B
16PXL	3/4	1/8	1	A
20PXL	1	1/8	1 1/4	A

1. In sizes 2-3PXL ratio of tubing wall thickness to OD must not exceed 1:5 for PVC; 1:3 for silicone
2. A= Tygon E-3603, B= Tygon ND 100-65

CLEANING

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.

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 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).



Transonic Systems Inc. is a global manufacturer of innovative biomedical flow measurement equipment. Founded in 1983, Transonic sells state-of-the-art, transit-time ultrasound devices for surgical, hemodialysis, perfusion, ECMO, and medical device testing applications, and for incorporation into leading edge medical devices.

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