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Find the *Transonic Systems Inc. ME11PXL240* at our website: *Click HERE*

TSI-0007b Bioprocess Insert Flyer 9-17-08 9/17/08 1:11 PM Page 1

Non-Invasive Flow Measurement

Innovation in Bioprocess Management





Non-Invasive Flow Sensor

Monitors Tubing Degradation

- Monitors Tubing Degradation
- Delivers Dosing Pump Control Feedback
- Verifies Pump calibration

Meet Your Bioprocess Objectives

- Reduce Operating Costs
- Improve Process Performance
- Increase Product Quality

Proven Performance in GMP Manufacturing

Transonic Systems Inc.

The Flow Measurement Specialists

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Non-Invasive Flow Measurement

Innovation in Bioprocess Management

- **Maintains Aseptic Circuit**
- **Reusable Sensor Simply Clips onto Existing Tubing**
- **Accuracy ± 4%**
- **Ideal for Monitoring Pump Performance & Tubing Integrity**
- **Proven Performance in GMP Manufacturing**



Clamp-on Flowsensor Sizes

Sensor #	Tubing: Inches OD	Tubing: Inches ID x Wall	Tubing: Metric OD	Cat. # Suffix for metric tubes
ME2PXL	1/8 - 5/32	3/32 x 1/32	4 mm	- M4
ME3PXL	3/16	1/8 x 1/32	5 mm	- M5
ME4PXL	1/4	1/8 x 1/16	6 mm	- M6
ME5PXL	5/16	3/16 x 1/16	8 mm	- M8
ME6PXL	3/8	1/4 x 1/16	9 mm	- M9
ME7PXL	7/16	1/4 x 3/32	10 mm	- M10
ME8PXL	1/2	3/8 x 1/16	12 mm	- M12
ME9PXL	9/16	3/8 x 3/32	14 mm	- M14
ME10PXL	5/8	1/2 x 1/16	16 mm	- M16
ME11PXL	11/16	1/2 x 3/32	-	-
ME12PXL	3/4	1/2 x 1/8	20 mm	- M20
ME14PXL	7/8	5/8 x 1/8	23 mm	- M23
ME16PXL	1	3/4 x 1/8	25 mm	- M25
ME20PXL	1 1/4	1 x 1/8	-	-

Clamp-on Flowsensor Calibration Ranges[1]

Sensor Size mm	Low Flow (1/4 Scale)[2] Lower Linear Limit[3,4]	Low Flow (1/4 Scale)[2] Maximum Measurement Range[5]	Standard Flow (Full Scale) Lower Linear Limit[4]	Standard Flow (Full Scale) Maximum Measurement Range[5]
2PXL	50 ml/min	-250 to +250 ml/min	100 ml/min	-1 to +1 L/min
3PXL,4PXL,5PXL	100 ml/min	-500 to +500 ml/min	200 ml/min	-2 to +2 L/min
6PXL	250 ml/min	-1.25 to +1.25 L/min	500 ml/min	-5 to +5 L/min
7PXL,8PXL,9PXL	500 ml/min	-2.50 to +2.50 L/min	1 L/min	-10 to +10 L/min
10PXL,11PXL,12PXL	1 L/min	-5 to +5 L/min	2 L/min	-20 to +20 L/min
14PXL,16PXL	2.5 L/min	-12.5 to +12.5 L/min	5 L/min	-50 to +50 L/min[6]
20PXL	5 L/min	-25 to +25 L/min	10 L/min	-100 to +100 L/min[6]

[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 flowmeter in "1/4 Scale Mode."
[3] Measurements below the Lower Linear Limit may deviate from +/-4% relative accuracy specification.
[4] Custom calibration is available for average flow rates below the lower limit. This may compromise accuracy for the maximum measurement range.
[5] Any flow peaks exceeding the Max Flow Value (-5 volt to + 5 volt flowmeter range) will be clipped.
[6] Standard calibration range is up to 30 L/min; contact factory for availability of higher flow rate calibrations.

Choose Your Clamp-on Sensor

Flowmeter: TS410 400-Series Module.

Size: Sensors are scaled in 1/16 inch increments to clamp around standard outer tubing diameters.

Tubing: Flexible medical grade and laboratory tubings (PVC, silicon, polyurethane) are generally compatible for use with PXL-Sensors. A 30-60 cm tubing sample is required to calibrate the sensor.

Expected Flow Rate: PXL Sensors have two dynamic flow ranges: Standard (full scale) and Low (1/4 scale). Sensors are factory calibrated to the highest accuracy in a specified flow range. Calibration for flows below the lower limit may be requested. Specify flow range when ordering.

Fluid/Temperature Calibration: Sensors are calibrated for specific fluid densities and temperature. Specify up to four tubing, fluid, temperature and flow rate combinations when ordering. Fluid samples and MSDS information are required for custom calibration requests.

How to Order

1) Specify your Tubing OD in inches or mm
2) Identify your Tubing Type
3) Specify the Expected Flow Range (Min/Max)
4) Specify the Media and its Operating Temperature
5) Specify the Number of Flow Channels Required

Flow Measurements You Can Trust

Transonic Systems Inc is a global manufacturer of flow measurement equipment. Founded in 1983, Transonic sells its "gold standard" ultrasound transit-time flowmeters worldwide to original equipment manufacturers (OEMs), bioprocess manufacturers, clinicians and researchers.

For more information, or to arrange a product demonstration, contact:

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The Flow Measurement Specialists

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Dosing Pump Control Feedback

Application Note



In recent years those in process development for pharmaceutical or biotechnology companies have seen a revolution in the functionality of the controllers upon which they rely to manage their increasingly complex processes. It has become common for these controllers to be able to analyze multiple points of process data and implement complex feed strategies automatically for the purpose of optimizing the process. And while one might be able to vary the rate at which their pumps turn, or reverse the direction, one performance improvement has eluded a solution, the ability to ensure that the volume of media being pumped is actually that which we believe it to be. Truth be told, tubing degrades over the course of a run and that degradation often results in too little or too much media being fed into our process, sometimes with catastrophic results.

Non-Invasive Flow Solution

Today, with the introduction of the Transonic Non-Invasive Flow Measurement Solution, adjustments can be made for drift in flow over time. Pump performance can be monitored, feed strategy corrected and pump standardization implemented. With it comes the improved accuracy and increased repeatability required for reduced operating costs, increased process performance and improved product quality.

Transonic Flow Loop (Fig. 1)

The Non-Invasive Flow Measurement solution from Transonic Systems is a Flow Loop composed of two innovative components. The first is a Transit-time Ultrasound Flow Sensor. This sensor simply clamps around your existing process tubing, thus making no contact with your process media and creating no pressure drop. The measurement principle utilized by this sensor is well proven; as the media passes through the tubing the sensor directs ultrasound signals through the tubing which measure media flow both upstream and downstream. The resulting value is then indicated at the second component of this measurement loop, the Flowmeter. The Flowmeter displays real time volume flow on an integral LED display and/or transmits the measured flow value as an analog output to a bioprocess control system.

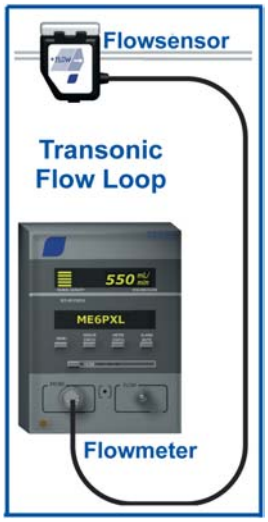


Fig. 1: Transonic Flow Loop consisting of non-invasive clamp-on Tubing Flowsensor and Flowmeter.

Standardization Introduced

In process management circles, “poor measurements mean poor control.” A Transonic Flow Loop enables optimal ± 4% accuracy and repeatability from your dosing pump(s). By allowing you to continuously monitor the flow volume from your pumps, the Transonic Non-Invasive Flow Measurement solution enables you to standardize your pumps in process and ensure optimal performance throughout the life of your run. Bioprocess understanding improves and yields may improve.

To learn more about the Transonic Non-Invasive Flow Measurement solution from Transonic Systems give us a call at (800) 353-3569 or visit us on the web at www.transonic.com/bioprocess.

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Pump Calibration

Application Note



One can walk into a process development suite at most any pharmaceutical or biotech company and still find a stopwatch and a graduated cylinder used to calibrate one of our most critical bioprocess management tools, the pump.

Even though the introduction of bioprocess control systems use software to walk you through a pump calibration, all that has been done is the classic stopwatch has been replaced with a digital timer observed by a computer and a piece of animation written in software that gives the indication of flow even though the animation never changes speed. The graduated cylinder continues to be a key component of even the most capable of bioprocess control systems software solutions to calibration. The result has been that actual flow during the process itself is not known and there has been no improvement in accuracy, no increase in repeatability and no savings in time.

Pump Calibration to Next Level

Introduction of the Non-Invasive Flow Measurement Solution from Transonic Systems takes pump calibration to the next level. Improved accuracy and increased repeatability delivers on the promise of reduced operating costs, increased process performance and improved product quality.

Flow Measurement Loop (Fig. 1)

The Transonic Non-Invasive Flow Measurement solution provides high accuracy volume flow measurements. The Transonic Flow Loop has two state-of-the-art components. The first is a Transit-time Ultrasound Flow Sensor that simply clamps around your existing process tubing. It makes no contact with your process media and creates no pressure drop.

The clamp-on Tubing Flowsensor utilizes proven transit-time ultrasound technology *(Fig. 2)*. As media passes through the tubing, the sensor detects ultrasound signals. The ultrasound signals are collected and integrated as Flow Volume by the Flowmeter module. The Flow Module displays real time flow measurement on an integral LED display and/or transmits the measured flow value as an analog output to a bioprocess control system.

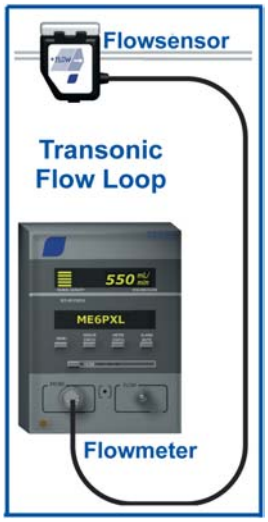


Fig. 1: Transonic Flow Loop consisting of non-invasive clamp-on Tubing Flowsensor and Flowmeter.

How It Works

After calibration is completed, simply leave the Flowsensor in place to have a real-time, continuous, independent measure of volume flow throughout the process run to augment the flow indicated by your pump RPM.

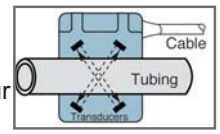


Fig. 2: Transit-time Ultrasound technology

Just as we no longer dip a piece of Litmus paper in our bioreactors to accurately measure pH or rely upon rotometers to precisely measure our gas flow, t Transonic Non-Invasive Flow Measurement Solution allows us to take the stopwatch back to the track and place the graduated cylinder back on the shelf. As with any solution a superior one ultimately comes along, and for pump calibration a superior solution is now available.

Learn More: To learn more about the Non-Invasive Flow Measurement solution from Transonic Systems give us a call at (800) 353-3569 or visit us on the web at **www.transonic.com/BioProcess.**

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Measurement of Tubing Degradation

Application Note



In recent years it has become common practice in process development suites at most any pharmaceutical or biotech company to have a sensor measuring pH, a sensor measuring Dissolved Oxygen, perhaps one for CO2 and often, at least a couple of these are redundant. Their purpose is to provide real time insight into the environment within the bioreactors and/or fermentors. However, if you want to change that environment, perhaps pump in some acid, base, or a bit of glucose, what sensor have you had to ensure that the pumps are performing at least as well as the in situ sensors? None. Instead of measuring pump performance and thereby tubing degradation, it is common practice to depend upon a collection of "Tubing Life Charts" and active observation.

Non-Invasive Flow Solution

Today, with the introduction of the Non-Invasive Flow Measurement Solution from Transonic Systems, you have the tool needed to toss out tubing life charts and re-task your time previously allocated to tubing observation. All the while you are improving process accuracy, achieving real time continuous monitoring of tubing performance and thus greatly reduce if not eliminate instances of catastrophic tubing failure.

Flow Loop (Fig. 1)

The Non-Invasive Flow Measurement solution from Transonic Systems is a measurement loop that provides high accuracy volume flow measurements. It consists of two innovative components

Flowsensor

The first is a Transit-time Ultrasound Flow Sensor. This sensor simply clamps around your existing process tubing, thus making no contact with your process media and creating no pressure drop. The measurement principle utilized by this sensor is well proven; as the media passes through the tubing the sensor directs ultrasound signals through the tubing which measure media flow both upstream and downstream.

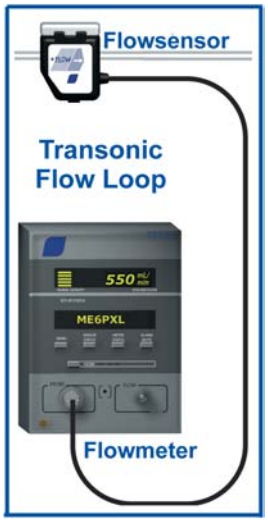


Fig. 1: Transonic Flow Loop consisting of non-invasive clamp-on Tubing Flowsensor and Flowmeter.

Flow Module

The resulting value is then indicated at the second component of this measurement loop, the Flowmeter, as Flow Volume. The Flowmeter displays the real time flow measurement on an integral LED display or transmits the measured flow value as an analog output to a bioprocess control system for utilization in continuous monitoring of tubing performance and indication of tubing degradation with unequalled volume flow signal resolution.

As the bioprocess industry continues to move toward increasingly disposable process models with increased amounts of traditional tubing, monitoring tubing degradation allows a bioprocess operator to define allowable limits of tubing performance in their SOPs, and thus reduce the risk of catastrophic tubing failure.

To learn more about the Non-Invasive Flow Measurement solution from Transonic Systems give us a call at (800) 353-3569 or visit us on the web at www.transonic.com/bioprocess.

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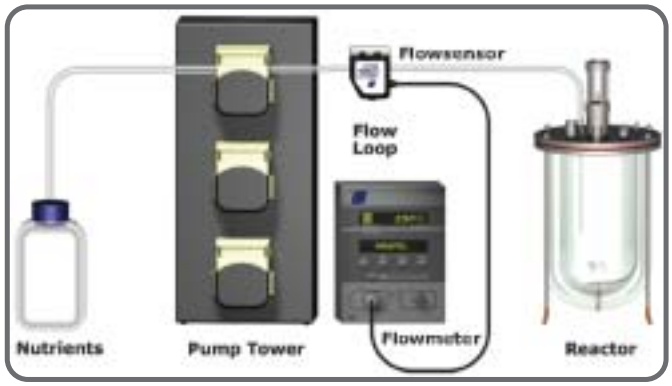
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Transonic Flow Loop

Specifications



Transonic Flow Loop integrated into Bioprocess tubing circuit.



PXL Flowsensors

- **Non-Invasive Liquid Flow Measurement**
- **Reusable Design, Simply Clamps onto Tubing**
- **Suitable for Tubing OD 1/8" (3.1mm) to 1 1/4" (31.8mm)**
- **Accuracy of better than ±4%**
- **Proven performance in GMP Manufacturing**

Specifications

Measurement Principle	Transit-time Ultrasound Volume Flow Using wide-beam illumination, four transducers pass ultrasonic signals back and forth, alternately intersecting flowing liquid in upstream and downstream directions. The transit time of the ultrasonic beam is decreased when travel ing downstream with the media flow and increased when traveling upstream against the media flow. The difference between the integrated transit times is a measure of volume flow.
Material of Construction	Plastic
Connection	2 meter Integral Cable
Fluid Types	Nutrients, Cell Culture Media, Fermentation Media, Buffer Solutions
Flow Range	20 ml/min to 100 L/min
Tubing Material	Polyurethane, Silicone, PVC
Tubing Sizes (OD)	1/8"(3.1), 3/16"(4.7), 1/4"(6.3), 5/16"(7.8), 3/8"(9.5), 7/16"(11.1), 1/2"(12.7), 9/16"(14.3), 5/8"(15.9), 11/16"(17.5), 3/4"(19.0), 7/8"(22.2), "(25.4),1?"(31.8)
Calibration	Factory Calibrated specific to application (Tubing Size, Media) Operating Temperature and Desired Flow Range
Cleaning	Mild solution of soap and warm water (<55ºC) Wiped or Flushed with ethyl alcohol to promote drying
Sterilization	ETO Gas
Dimensions	(See PXL Data Sheet)

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Transonic Flow Loop

Specifications



Flowmeter

- **Unequaled Volume Flow Signal Resolution**
- **Configurable for 1, 2 or 3 Channels**
- **Auto Recognition of Flowsensor**
- **Bright LED Display of Volume Flow & Sensor Health**
- **Dedicated Analog Outputs for Volume Flow & Ultrasonic Signal Strength**

Specifications

Measurement Principle	Transit-time Ultrasound Volume Flow Using wide-beam illumination, four transducers pass ultrasonic signals back and forth, alternately intersecting flowing liquid in upstream and downstream directions. The transit time of the ultrasonic beam is decreased when traveling downstream with the media flow and increased when traveling upstream against the media flow. The difference between the integrated transit times is a measure of volume flow.
Signal Inputs	Each Flowmeter module is capable of a single flow measurement. Multiple Flowmeter modules (1, 2 or 3) can be placed in a single console. Inputs are isolated from other signal sources and earth grounded to ensure maximum stability.
Signal Outputs	Front panel BNC Analog Output and and rear panel terminal block
Connection	10 Pin Redel (Male) Integral EPROM contains Flow Sensor Data
Auto Recognition	Flow Meter will automatically recognize the Flowsensor Size, Scale and Calibration data from EPROM in the Connector
Display	LED, 4 Digit (14 Segment); Volume Flow, Signal Strength and Errors Bar LED continuously indicates signal integrity Error Messages are in Text format and include: No Probe (No PR); No Signal (No Sig); Low Signal (Low Sig)
Material of Construction	Aluminum, 304 S.S.
Power	115/230 VAC, 50/60 HZ
Dimensions	5.125”H x 4”W x 12”D; Suitable for up to Two Channels 5.21”H x 9.25”W x 12”D; Suitable for up to Three Channels
Weight	2.2 lbs (2 channel) / 5.8 lbs (3 channel)
Mounting	Benchtop / Shelf
Certification	CE
Rating	NEMA 4

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Synchronization: Setting Up the 400-Series Modular Flowmeter

INTERNAL 400 MODULE SWITCH

Flowmeter modules have a labeled T400/T500switch on the rear panel of the module. The switch is not accessible until the module is pulled out of the console. To set the timing of the flowmeter module to be synchronized, the switch must be set to "T400" *(in the down position)* before the module is inserted into a T402 or T403 console. If the switch has been jostled or bumped out of the "T400" position during shipment, the flowmeter may exhibit considerable drift in Measure Mode and low or no signal from the Flowprobe or Flowsensor.

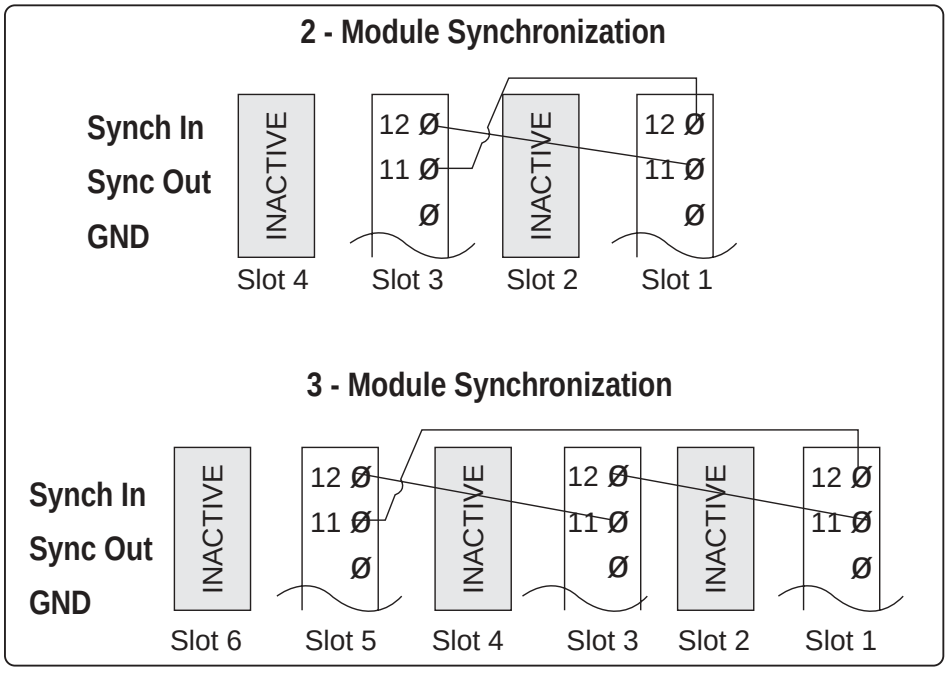
Synchronization Mode of 400-Series Flowmeter Modules is achieved via jumper cables on the console's back panel terminal blocks.

SELF-TRIGGERING: Connect Terminal block pin 11 to pin 12 via jumper "Synch In" to "Synch Out" on same terminal block

This gives the lowest flow noise and is selected when a flowmeter module runs by itself, or multiple Flowprobes on multiple modules run simultaneously with sufficient distance (20 cm) between probes. *(Flowmeter modules are shipped from the factory in this self-trigger mode unless otherwise specified.)*

SEQUENTIAL TRIGGERING: Interconnect the 2 or 3 flowmeter modules on the rear panel with jumpers between modules (pins 11 & 12) from "Synch In" and "Synch Out" as shown.

Note: Be careful to choose the active terminal connections that correspond to the installed modules (TS410 modules use the odd numbered terminal connector positions.) This wiring avoids the flow offsets that could result from ultrasonic cross-talk between adjacent probes.



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Precision *Clamp-On* Flowsensors

ME-PXL-Series for TS410 Modules

3PXL

9PXL

11PXL

20PXL

The Flowsensor for Tubing Applications

- **High Accuracy, Repeatability Reliability Volume Flow Measurements on Tubing**
- **Various size non-invasive Clamp-on Sensors for applications in Process Development, Pilot and GMP Manufacturing**
- **Measures most fluids in a dynamic flow range with high resolution.**

✔ **Tubing Degradation**

✔ **Pump Calibration/Standardization**

✔ **Dosing Feedback Control**

Transonic Precision PXL-Clamp-on Tubing Flowsensors clip on the outside of flexible tubing to measure most non-aerated liquids including nutrients, acid, base, buffer solutions, water-based and hydrocarbon-based liquids. 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 and is calibrated for tubing type and material. Standard MEPXL sensors are sized in 1/16" increments; metric custom sizes are available.

TUBING SENSOR	TUBING SPECIFICATIONS						ACCURACY SPECIFICATIONS							
	TUBING ID		WALL THICKNESS		TUBING OD		BIDIRECTIONAL FLOW OUPUTS				ACCURACY[1]			ULTRA-SOUND
Catalog #	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 %	Frequency MHz
ME 2PXL	In sizes 2PXL - 4PXL ratio of tubing tubing must not exceed 1:5 for PVC; 1:3 for silicone				1/8 - 5/32	3.1 - 4.0	0.5	50	200	1	± 3.4	± 10	± 4	3.6
3PXL					3/16 - 7/32	4.7 - 5.5	1	100	400	2	± 6.6	± 10	± 4	3.6
4PXL					1/4 - 9/32	6.3 - 7.7	1	100	400	2	± 6.6	± 10	± 4	2.4 - 3.6
5PXL	3/16	4.7	1/16	1.6	5/16 - 11/32	7.8 - 8.7	1	100	400	2	± 6.6	± 10	± 4	2.4
6PXL	1/4	6.4	1/16	1.6	3/8	9.5	2.5	250	1 L	5	± 20	± 10	± 4	2.4
7PXL	1/4	6.4	3/32	2.4	7/16	11.1	5	500	2 L	10	± 40	± 10	± 4	1.8
8PXL	3/8	9.5	1/16	1.6	1/2	12.7	5	500	2 L	10	± 40	± 10	± 4	1.8
9PXL	3/8	9.5	3/32	2.4	9/16	14.3	5	500	2 L	10	± 40	± 10	± 4	1.8
10PXL	1/2	12.7	1/16	1.6	5/8	15.9	10	1 L	4 L	20	± 80	± 10	± 4	1.2
11PXL	1/2	12.7	3/32	2.4	11/16	17.5	10	1 L	4 L	20	± 80	± 10	± 4	1.2
12PXL	1/2	12.7	1/8	3.2	3/4	19.0	10	1 L	4 L	20	± 80	± 10	± 4	1.2
14PXL	5/8	15.9	1/8	3.2	7/8	22.2	25	2.5 L	10 L	50	± 200	± 10	± 4	1.2
16PXL	3/4	19.0	1/8	3.2	1	25.4	25	2.5 L	10 L	50	± 200	± 10	± 4	1.2
20PXL	1	25.4	1/8	3.2	1 1/4	31.8	50	5 L	20 L	100	± 400	± 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).

Transonic Systems Inc.
Tel 800-353-3569 www.transonic.com Fax 607- 257-7256

BP-RL21a PXL specs Rev. A 2-09

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Ordering ME-PXL-*Clamp-on* Tubing Flowsensors

Catalog # ME ___ PXL ___ ___ - ___ ___ - ___ ___ - ___ ___
Size — Fluid/Temperature + Flow Rate Calibration Codes (up to 4)

Tubing: _____

Example: ME9PXL - BL37 SF – GL323 SF – GL23 LF is calibrated for 3 different uses:
(Blood at 37ºC at Standard Flow Rate; 40% Glycerine/60%Water at Standard Flow Rate;
40% Glycerine/60%Water at Low Flow Rate) Tubing: Tygon S-50-HL

How to Order

- *Choose the sensor size that matches your tubing OD;*
- *Specify tubing type. Supply sample if your tubing is not on our standard tubing list;*
- *Specify anticipated flow range;*
- *Specify fluid and temperature for calibration;*
- *Use the codes below to construct catalog number.*

Information Needed to Calibrate Sensor

- Tubing Type
- Fluid (glucose acid, other)
- Operational temperature
- Flow ranges expected



Flowmeter Compatibility: TS410 400-Series Flowmeter Module

Size: Sensors are scaled to clamp around outer flexible tubing diameter (See spec table for OD specs.)

Tubing: 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 several standard tubing types. For other tubing types, a 30-60 cm sample is required for sensor calibration.

Sensor	Tubing (inches) ID	Wall
2 PXL	3/32	x 1/32
3 PXL	1/8	x 1/32
4 PXL	-	x -
5 PXL	3/8	x 1/16
6 PXL	1/4	x 1/16
7 PXL	1/4	x 3/32
8 PXL	3/8	x 1/16
9 PXL	3/8	x 3/32
10 PXL	1/2	x 1/16
11 PXL	1/2	x 3/32
12 PXL	1/2	x 1/8
14 PXL	5/8	x 1/8
16 PXL	3/4	x 1/8
20 PXL	1	x 1/8

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. Specify up to 4 tubing/fluid/temperature combinations for calibration. Fluid samples and MSDS information may be required for custom calibration requests (contact Customer Service). **Transonic Systems provides calibration certification tracable to NIST standards.**

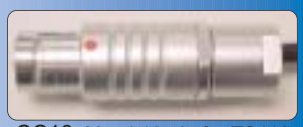
Expected Flow Rate

All PXL sensors have two dynamic flow ranges (see spec table below). Specify flow range when ordering. If no flow range is specified flowsensors will be calibrateed in the standard flow range.

Fluid/Temperature	23ºC	37ºC	Custom Temp specify
Water/Saline	$H_2$023	$H_2$037	$H_2$0TX
Glucose	GLU23	GLU37	GLUX
Acid	ACD23	ACD37	ACDTX
Base	BSE23	BSE37	BSETX
Custom Fluid	FX23	FX37	FXTX

X designates custom calibration for extra charge

Connector



CC16: Metal 16-pin for TS410 Standard Cable Length on sensors: 2 meters

TS410 Extension Cable

CC16-S-CC16: Standard 1 meter length
CC16-X-CC16: Custom length available)

Clamp-on Flowsensor Calibration Ranges[1]

Sensor Size mm	Low Flow (1/4 Scale)[2] Lower Linear Limit[3,4]	Low Flow (1/4 Scale)[2] Maximum Measurement Range[5]	Standard Flow (Full Scale) Lower Linear Limit[4]	Standard Flow (Full Scale) Maximum Measurement Range[5]
2PXL	50 ml/mm	-250 to +250 ml/mm	100 ml/mm	-1 to +1 L/mm
2PXL,4PXL,5PXL	100 ml/mm	-500 to +500 ml/mm	200 ml/mm	-2 to +2 L/mm
6PXL	250 ml/mm	-1.25 to +1.25 L/mm	500 ml/mm	-5 to +5 L/mm
7PXL,8PXL,9PXL	500 ml/mm	-2.50 to +2.50 L/mm	1 L/mm	-10 to +10 L/mm
10PXL,11PXL,12PXL	1 L/mm	-5 to +5 L/mm	2 L/mm	-20 to +20 L/mm
14PXL,16PXL	2.5 L/mm	-12.5 to +12.5 L/mm	5 L/mm	-50 to +50 L/mm
20PXL	5 L/mm	-25 to +25 L/mm	10 L/mm	-100 to +100 L/mm

[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 flowmeter in "1/4 Scale Mode."
[3]Measurements below the Lower Linear Limit may deviate from +/-4% relative accuracy specification.
[4]Custom calibration is available for average flow rates below the lower limit. This may compromise accuracy for the maximum measurement range.
[5]Any flow peaks exceeding the Max Flow Value (-5 volt to + 5 volt flowmeter range) will be clipped.

Physical Specifications*

Sensor Size	1. Dimension Along Tube		2. Height		3. Length	
Catalog #	inch	mm	inch	mm	inch	mm
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

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BP-RL21a PXL specs Rev. A 2-09

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Quick Reference Guide

USING THE TRANSONIC CLAMP-ON FLOWSENSOR ON TUBING

(Refer to the Bioprocess Flow Loop Manual and second side for explicit directions and explanations.)

❑ Step1: TS410 FLOWMETER TESTS

1) Verify that the console's rear panel synchronization terminals are properly connected *(see console synchronization instructions, page 6 of the manual.)*
2) Connect console power cord to grounded power receptacle.
3) Turn on power switch on back panel of console: TS410 Tubing Flowmeter Module Digital Display will scroll TSI ✓ and display "NO.PR." The LCD will read "TS410 Flowmeter."
4) Connect a tubing Flowsensor to the front panel mounted self-aligning 16-pin connector.
5) Check Flowmeter's Operational Modes (Measure, Status, Program) with the sensor clamped on tubing and fluid flowing through the tubing *(see pages 15-18 of the manual)*.

❑ Step2: SELECT SENSOR

Confirm that the clamp-on sensor has been factory calibrated for the conditions (fluid, temperature, tubing) on which it is being used by pressing the **SENSOR STATUS** button. The LCD will scroll to display the fluid type and temperature for which the active sensor is calibrated.

❑ Step3: SELECT SITE FOR APPLICATION OF FLOW SENSOR

Select a location well below the highest elevation of the tubing *(where bubbles might lodge)*.

❑ Step4: PREPARE TUBING

Apply a layer of petroleum jelly, or silicone grease over the tubing surface selected to hold the sensor to enable ultrasonic transmission between tube and sensor.

❑ Step5: APPLY TUBING FLOWSENSOR

Open the Flowsensor's hinged lid, insert **lubricated** tubing into the sensing cavity, and close the lid. Fit should be tight, with the full tubing cross section contacting all inner surfaces of the sensing window.

❑ Step6: CHECK SIGNAL QUALITY

Check that 3-5 signal quality bars (at least 3) are illuminated. Low signal quality may indicate that an air or gas bubble is lodged in the tube. Since gas bubbles block ultrasonic transmission, tilt the tubing and Flowsensor vertically before operating the flowmeter to **flush** any bubbles from the sensing window.

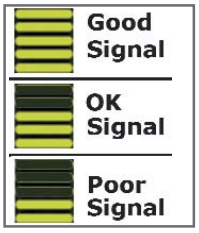


Fig. 1: Signal quality indicator bars (TS410 Flowmeter).

❑ Step7: MEASURE FLOW

Once the tubing is filled with liquid, flow is displayed on the LED in mL/min or L/min.

❑ Step8: CLEANING THE FLOWSENSOR

After a sensor has been used, it may be cleaned by wiping with a solution of soap and water (60°C, 140°F) followed by a ethyl alcohol rinse to promote drying.

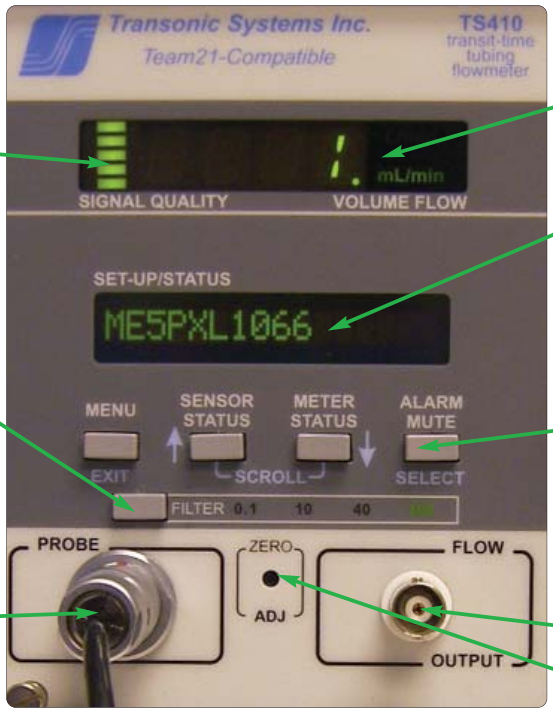
The Clamp-on Tubing Flowsensor can be damaged by saline immersion or wet storage.

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Quick Reference Guide



Signal Quality Indicator

Selectable Filters
0.1 Hz
10 Hz
40 Hz
160 Hz

Sensor connection or extension cable connector

LED Display
mean volume flow in L/min or ml/min

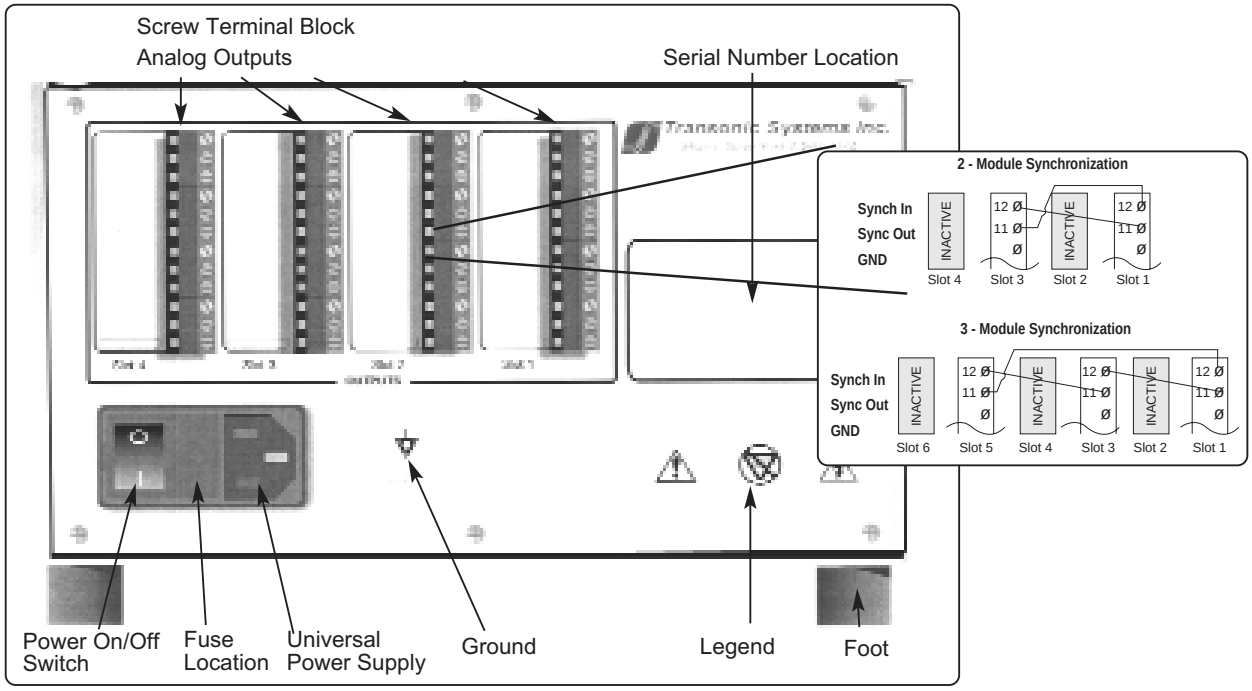
LCD Display
SET-UP/STATUS:
displays set-up menu and program messages for flowmeter and sensor settings

Push-button Controls
SENSOR STATUS: reads sensor eprom; selected fluid/temp, calibration gain.
METER STATUS: LCD displays current flowmeter settings
•invert flow "ON or OFF"
•1/4 scale "ON or OFF"
•Active Alarms "ON or OFF"
ALARM MUTE
•Alarm Audio "ON or OFF"
PROGRAM NAVIGATION FOR SET-UP

BNC Flow Output Signal

Zero Offset Adjustment
Recessed "one press" button adjusts flowmeter to read zero when flow is stopped.

REAR PANEL T402 CONSOLE



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