LEVIFLOW® Single Use Flowmeters & PendoTECH® LEVIFLOW Sensor Monitor
User Guide

Revision 2

www.pendotech.com

PendoTECH LEVIFLOW User Guide

Used throughout this guide:

WARNING: "WARNING" is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

Note: "Note" is used to notify the user of installation or operation information which is important but not hazard related.

	**WARNING: DANGEROUS VOLTAGE INSIDE THE CONTROL BOX. CONTROL BOX ONLY TO BE OPENED BY PENDOTECH OR AUTHORIZED REPRESENTATIVE. NO USER SERVICEABLE PARTS INSIDE.**
	**WARNING: POTENTIAL SHOCK HAZARD. UNLESS PROPERLY PANEL MOUNTED, DO NOT USE THIS PRODUCT NEAR WATER OR IF YOU ARE WET. DO NOT SUBMERGE THIS PRODUCT. USE ONLY IN A GROUNDED ELECTRICAL OUTLET. UNLESS PROPERLY PANEL MOUNTED, UNPLUG THE PRODUCT FROM THE OUTLET BEFORE CLEANING WITH ANY LIQUIDS. INSTALL SECURELY ON A STABLE SURFACE. INSTALL IN A LOCATION WHERE NO ONE CAN STEP ON OR TRIP OVER THE POWER CORD AND WHERE THE POWER CORD WILL NOT BE DAMAGED.**

WARNING: GOODS AND SOFTWARE ARE NOT DESIGNED, INTENDED OR AUTHORIZED FOR USE AS COMPONENTS IN LIFE SUPPORT OR MEDICAL DEVICES. THEY ARE NOT DESIGNED FOR ANY APPLICATION IN WHICH THE FAILURE OF THE PRODUCT COULD RESULT IN PERSONAL INJURY, DEATH OR PROPERTY DAMAGE.

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1. Overview of PendoTECH LEVIFOW Sensor Monitor

1.1. Overview

The LEVIFLOW® single-use flowmeters are for ultrasonic flow measurements in many different applications in the Biopharm Industry. Figure 1 illustrates the operating principle.
Two piezoelectric transducers, mounted in the sensor housing, generate and receive an ultrasonic wave. The wave going in direction of the flow (with-stream wave) is accelerated and the wave going against the flow direction (against-stream wave) is slowed down. The two waves are processed by the PendoTECH Leviflow® Sensor Monitor. The difference of the transit time of both waves is proportional to the velocity of the fluid. The monitor has a digital LED display for the flow reading. It also has both a 4-20mA analog output and a digital frequency output. These outputs facilitate interface of the monitor to other systems for process control and data acquisition.

System Benefits

- High precision flow measurement (1% of Reading)
- Product Line covers 1 mL/min to 80 L/min
- Gentle to sensitive fluids like CHO Cells and Proteins based on ultrasonic technology, no moving parts
- Easy integration into OEM equipment
- Gamma radiation up to 40kGy
- All wet materials of the single use (SU) flowmeters are made of biocompatible (FDA, USP-VI, BSE/TSE and Animal free) polypropylene (PP)
- Improved bubble robustness due to DSP technology

Sensor Overview

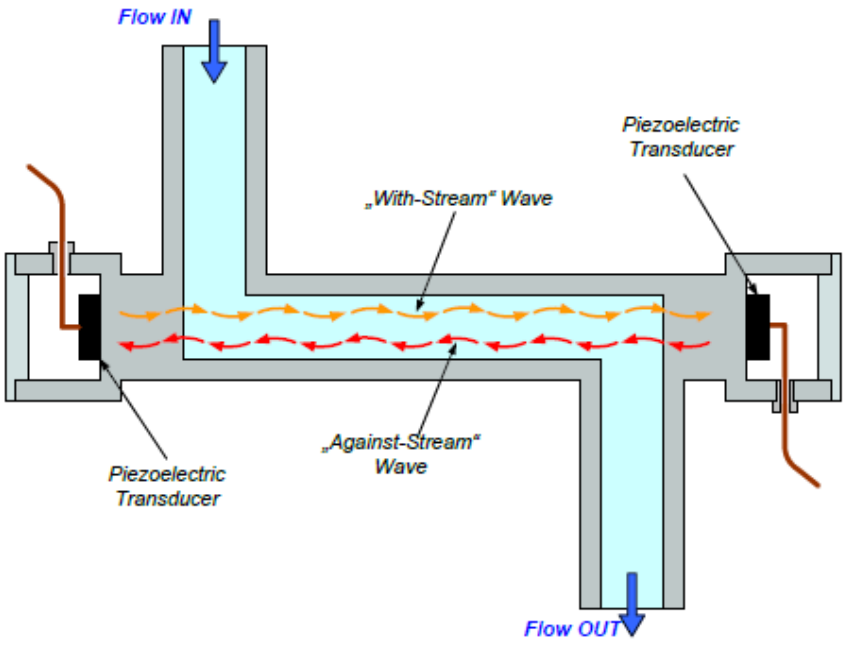


Figure 1: Operating principle of ultrasonic single-use sensor

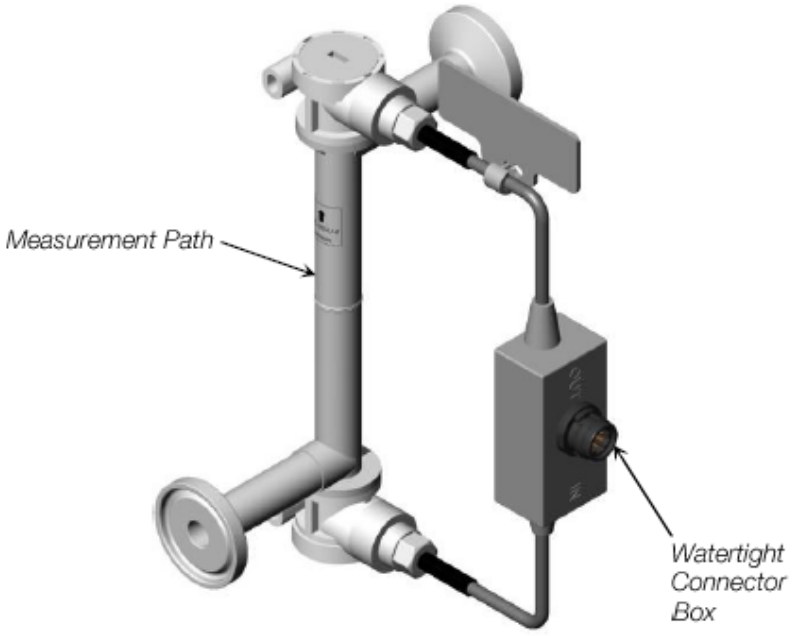


Figure 2: Single-use flowsensor

1.2. Specifications

System Component	Specifications
Enclosure	• Dimension: 5.43" x 7.48" x 1.77" (13.65 x 19.05 x .45cm) • Weight: 485g • Material: ABS Plastic
Display	• LED Display, flowrate in L/min
Environmental	• Temperature: 0–40° C (32–104° F) • Humidity: 30-85% R.H. non-condensing
Power Inlet	• M8 Male Nano, Pin 1= + Pin 3= - • 24 Volts DC • 150mA normal operation current, peak 3.8A in- rush within 210µs
Analog Output (4-20 mA)	• 4-20mA Range: 0 L/min to max flow (based on sensor size) • Sourcing/Active output • M12 5 Pin female receptacle Pin 3= + Pin 4= -
Frequency Output	• 0 L/min to max flow (max flow = 1kHz) • Open Collector • 03SU= 75,000 P/L • 06SU= 7,500 P/L • 10SU= 3000 P/L • 15SU= 1,200 P/L • 20SU= 750 P/L • M12 5 Pin female receptacle Pin 1 = + Pin 2= -

Sensor Specifications:

Sensor Type/Characteristics	FM-LFS-03SU	FM-LFS-06SU	FM-LFS-10SU	FM-LFS-15SU	FM-LFS-20SU
Flow Range [lpm] Triclamp Fitting Size Measurement Path ID in [mm]	0 – 0.8 3/8 inch (ID = 6.4 mm) 2.5	0 – 8 3/8 inch (ID = 6.4 mm) 6	0 – 20 1/2 inch (ID = 9.4 mm) 10	0 – 50 1 inch (ID = 22.2 mm)	0 – 80 1 inch (ID = 22.2 mm) 20
Accuracy of Reading Note: Repeatability < Accuracy/2	> 6 ml/min: ±1% < 6 ml/min: 0.06 ml/min	> 1.7 l/min: ±1% < 1.7 l/min: ±17 ml/min	> 4.7 l/min: ±1% < 4.7 l/min: ±47 ml/min	> 10.6 l/min: ±1% < 10.6 l/min: ±106 ml/min	>18.8 l/min: ±1 % <18.8 l/min: ±188 ml/min
Wetted Surface Area [cm2] Wetted Surface Area [ml] Weight [g]	29.5 4 42	32.2 4.8 43	53.2 12.3 61	141.2 61.7 96	173.5 95.8 125
Pressure Drop Coefficient C at 20°C ΔP = C x Q2 , Q = Flow [lpm], ΔP = Press. Drop [kPa]	16.8	0.88	0.075	0.0101	0.0035
Fluid Temperature Ambient Temperature Maximum Fluid Pressure Kinematic Viscosity Sound Speed Wet Materials Sensor Enclosure Classification Cable Jacket Material Cable Length (re-usable cable) Electrical Connectors	Normal range: 10 – 60°C (50 – 140°F) 0 – 40°C (32 – 104°F) 0 – 0.5 MPa (0 – 5 bar, 0 – 72.5 psi) 0.8 – 40 mm2/s (0.8 – 40 cSt) 1000 – 2200 m/s Polypropylene (FDA, USP VI, ADI free), Gamma robust for up to 40 kGy IP-65 (for connected sensor) PVC 9 ft/3 meter Circular type (IP-67), lock-release mounting				

System Components Supplied:

- Monitor instrument
- Interface cable to connect flow sensor to the monitor (LFI-C.1-30), 3 meters
- Integrated Frequency/analog output cable (M12 with flying leads)
- Power supply
- Flowmeter stand

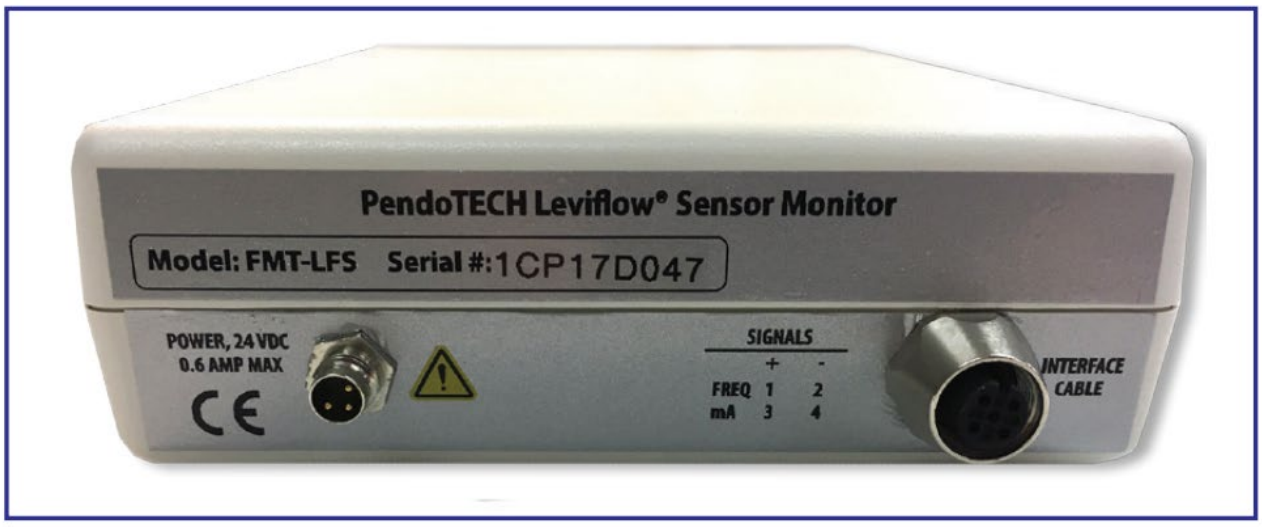
1.3. Instrument Details

1.3.1. Hardware Details

There is no power switch so the system cannot be accidentally turned off. When the wall power supply is connected to the system and plugged into a wall outlet, the system will turn ON. The sensor flow rate is show on the display screen. There is a tare button for zeroing the reading. The left side of the device has the sensor input connection (not shown). The Front and Back Panels details are as shown:

FRONT PANEL CONFIGURATION:

BACK PANEL CONFIGURATION:



Connections:

The external connections to the back panel are

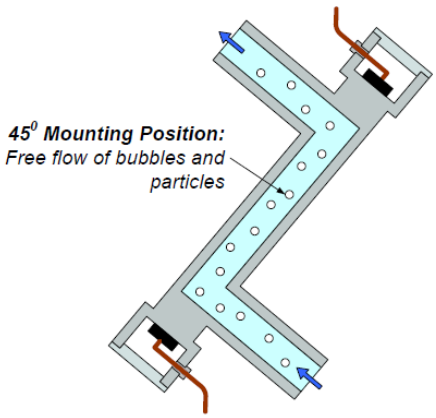
1. POWER: Power inlet receptacle (3 pin M8 male receptacle)
2. Flow Sensor Input: Input for the flow sensor (on side of monitor)
3. The 4-20mA and FREQ. Outputs: Located on a 5pin M12 Female receptacle
    a. An integral 12ft cable with flying leads is provided to facilitate output wiring. The wire colors are as follows:
        i. 1=Brown
        ii. 2=White
        iii. 3=Blue
        iv. 4=Black

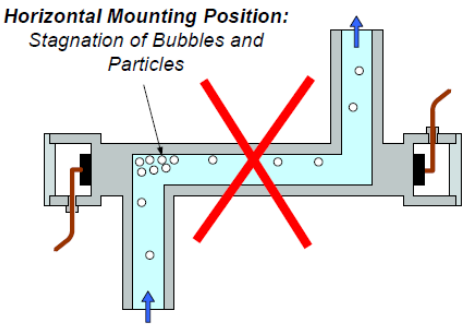
2. Instructions for use

2.1. Setup/Operation

1. The flow sensor must be mounted at a 45 degree angle, with the outlet above the inlet, as shown. PendoTECH includes a bench top stand for this purpose, but other mounting arrangements can be used. An arrow mark on the sensor indicates the flow direction.

Flow sensor stand included with monitor





2. Attach the interface cable (LFI-C.1-30) from the monitor to the sensor connector.
3. When applying power, the monitor needs about 10 seconds for a start-up procedure to be ready. For best performance, a 30 minute warm-up period is suggested.
    a. If using the device with an additional datalogging system such as a PendoTECH PressureMAT® or PendoTECH Process Control System, connect the appropriate output cable from the monitor (both power and output connections) to the datalogging device
4. After start-up a Zeroing is recommended. Assure that the sensor is completely filled with the according fluid, free of bubbles and that zero flow is realized. Then push the "ZERO" button on the monitor for about 3 seconds. During adjustment "0ADJ" appears on the converter display (about 2 seconds with blinking). The zero adjustment procedure will take about 26-60 seconds.
5. In the following cases, a re-zero is recommended
    a. 30 minutes after power-on
    b. Change of fluid properties (temperature, viscosity, density)
    c. Change of liquid chemistry
    d. Change of the flow path (upstream and downstream) geometry/circuit

2.2. Display Messages

Priority	Event	Display Digit				Status Description
		1	2	3	4	
1	Download	–	d	l	-	Firmware download running. Blinking digits.
2	Volume counter reset	C	L	E	A	Volume counter is reset
3	Zero adjustment	0	A	d	J	Zero adjustment is running (approximately 2 sec.). Blinking digits.
4	Zero adjustment error	0	–	E	r	Zero adjustment error.
5	Volume counter pulse set error	P	–	E	r	Volume counter pulse length is too big to show full scale flow on digital output.
6	Measurement error	B	–	E	r	Sensor signal error -> empty sensor, bubble, etc.. Blinking digits.
7	Warning upper limit	H				Displays upper limit warning (with flow rate display by turns). Blinking with flow rate.
	Warning lower limit		L			Displays lower limit warning (with flow rate display by turns). Blinking with flow rate.
	Exceeds vol. counter value H			H		Volume counter value exceeded preset H. Blinking with flow rate.
	Exceeds vol. counter value HH				H	Volume counter value exceeded preset HH. Blinking with flow rate.
8	Flow rate display	X.	X	X	X	Flow rate range: 0.000 ~ 9.999 L/min
		X	X.	X	X	Flow rate range:10.00 ~ 99.99 L/min
9	No sensor connected	C	–	n	o	No sensor connected to converter.
10	Calibration memory read/write	C	–	A	c	Calibration reading or write activity.
11	Calibration memory error	C	–	E	r	Calibration memory error.

2.3. Inspection and Maintenance

The PendoTECH *LEVIFLOW*® ultrasonic flowmeters do not require special maintenance since there are no moving parts that can be subjected to wear and tear. However, the following periodical checks are recommended to ensure smooth and reliable operation:

1. Check for excessive mechanical stress onto the flow sensor body for example caused by bended piping.
2. Inspect for loosen connections caused by excessive pipe vibrations.
3. Inspect the sensor visually for any deposits, excessive bubbles or foreign materials in the measuring tube.

APPENDIX A: PRODUCT WARRANTY

PENDOTECH LIMITED WARRANTY

LIMITED WARRANTY: Subject to the limitations contained in LIMITATION OF REMEDY AND LIABILITY and except as otherwise expressly provided herein, PendoTECH LLC ("Seller") warrants that the Software will execute the programming instructions provided by Seller, and that the products, systems and goods ("Goods") manufactured by Seller will be free from defects in materials or workmanship under normal use and service until the expiration of twenty-four (24) months from the date of shipment by Seller. Expendable items are warranted to be free from defects in material and workmanship under normal use and service for a period of ninety (90) days from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If, within thirty (30) days after Buyer's discovery of any warranty defects during the applicable warranty period, Buyer notifies Seller thereof in writing, Seller shall, at its option and as Buyer's sole and exclusive remedy hereunder, promptly correct any errors that are found by Seller to exist in the Software, or repair or replace F.O.B. point of manufacture, that portion of the Goods or Software found by Seller to be defective. All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Failure by Buyer to give such written notice of defects within the applicable time period shall be deemed an absolute and unconditional waiver of Buyer's claim for such defects. Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. All warranties, either express or implied, extend to BUYER only. All descriptions, representations and/or other information concerning Goods on the PendoTECH website and/or contained in PendoTECH's advertisements, brochures, promotional material, or statements made by employees or sales representatives of PendoTECH are solely for general informational purposes only and are not binding upon PendoTECH. No employee or sales representative of PendoTECH shall have any authority to establish, expand or otherwise modify PendoTECH's warranty associated with the sale of Goods. SELLER shall not be liable to BUYER in any manner with respect to Goods sold. SELLER MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY TYPE, EXPRESS OR IMPLIED, AND EXPRESSLY DISCLAIMS AND EXCLUDES ANY REPRESENTATION OR WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, NON-INFRINGEMENT OR WARRANTY ARISING FROM USAGE OF TRADE, COURSE OF DEALING OR PERFORMANCE. PendoTECH, LLC makes no warranty or representation regarding whether or not a customer's end use of any PendoTECH product, system or good infringes the valid intellectual property rights of others.

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Rev. 0

APPENDIX B: EC Declaration of Conformity

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Certificate of Conformance

European Community Low Voltage Directive 2014/35/EU
Certificate Number 1787

Certificate Issued to:
PendoTECH
174 Nassau Street, Suite 256
Princeton, NJ 08542
USA

Manufacturing Location:
PendoTECH
174 Nassau Street, Suite 256
Princeton, NJ 08542
USA

This certificate is only issued for the products described and listed in Ergonomics, Inc. Report Number R-0735-000.

Product tested:
The unit tested was PendoTECH LEVIFLOW® Sensor Monitor, Serial Number Prototype. External power supply was manufactured by Cincon Electronics Co. LTD Power adaptor, model TR15RA240.

Issued by:
Ergonomics, Inc.
324 Second Street Pike
Southampton, PA 18966
USA

David L. George
Director

Applicable Standard:

EN 61010-1:2010 - Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General Requirements.

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