

The PneuWave Microfluidic Pump

Fluid delivery for microfluidics demands special attention. The PneuWave is a high performance pump with flow sensing and traceability.

And it is all electric!

A New Age of Fluid Delivery Pumps

An internal compressor pressurizes a fluid vessel, resulting in the displacement of fluid from the vessel. An internal flow sensor measures the flow rate. Pressure and flow rate data are monitored by an on-board microprocessor which makes adjustments to the pressure system when needed.

Integrated Components for Each Fluid Channel

- Pressure system
- Flow sensor
- Pressure sensor
- Maximum pressure safety shutdown sequence

Communication

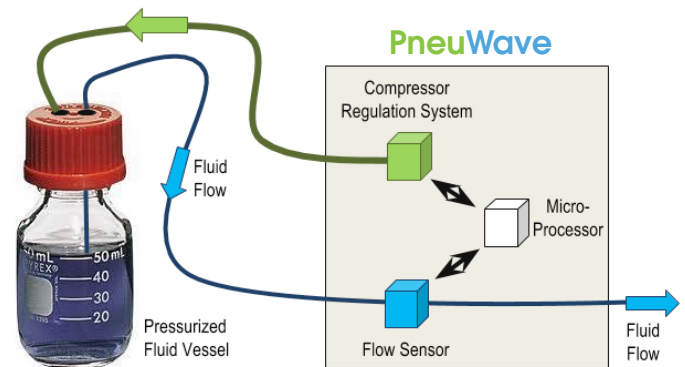
- When in Flow Rate Mode, the rate of fluid passing through the flow sensor is communicated with the microprocessor. When needed, the microprocessor commands the compressor regulation system to adjust the pressure, which adjusts the flow rate.
- When in Pressure Mode, the compressor is set to output a user-defined constant pressure or pressure profile.

Control

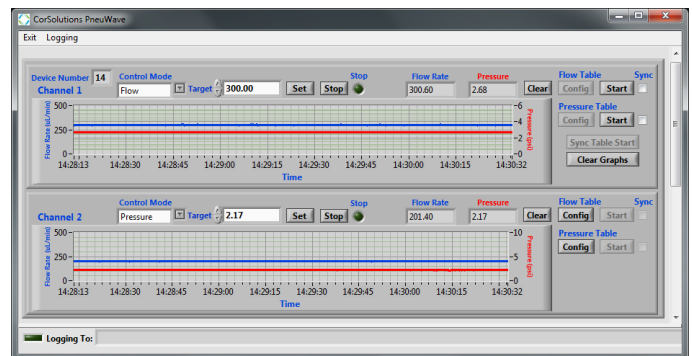
- Front Panel Display, just like a syringe pump
- PC Software - Synchronize one to eight independently controlled fluid channels. Fully programmable fluid delivery.
- LabVIEW VI
- Optional I/O module

Data Logging

- Both pressure and flow rate are logged.
- Both digital and analog outputs.



A schematic of the PneuWave pump



Screen Capture of the PneuWave Dual Channel Software. Channel 1 is in Flow Mode (top) with a flow rate set to 300 microliters per minute (in blue) and a corresponding pressure of 2.68 psi (in red). Channel 2 is in Pressure Mode (bottom) with a pressure set to 2.17 psi (in red) and a corresponding flow rate of 201 microliters per minute (in blue).

The PneuWave Microfluidic Pump

The pump pressurizes an easy-to-access fluid vessel which can range in volume from a few microliters to greater than a liter. The vessel is pressurized with a quiet, integrated, miniature pressure regulation system. Once the vessel is pressurized, fluid is displaced through the tubing. An in-line flow sensor measures the actual displacement or flow rate. When operated in flow control mode, both the flow sensor and the compressor regulation system are in continuous communication with a microprocessor. Based on the flow sensor readings, the microprocessor sends commands to the compressor regulation system, allowing for highly accurate flow control with nanoliter resolution. In this manner programmable flow profiles can be achieved. Alternatively the PneuWave pump can be operated in pressure control mode where the compressor regulation system is set at a user-defined value and any adjustments based on the flow sensor readings, are no longer made. Both flow rate and pressure are logged in flow control mode and pressure control mode.

Included with the PneuWave:

- Integrated Internal Flow Sensor
- Integrated Internal Pressure Sensor
- Integrated Internal Pressure Regulation System
- Integrated Internal On-Board Microprocessor
- User-Defined Maximum Pressure Exceeded Safety Shutdown
- Option to Use External Gas Supply
- Pressure Caps for Falcon Tubes
- PC Software
- LabVIEW VI
- Front Display Control
- Ability to store multiple calibrations on-board

Options for the PneuWave:

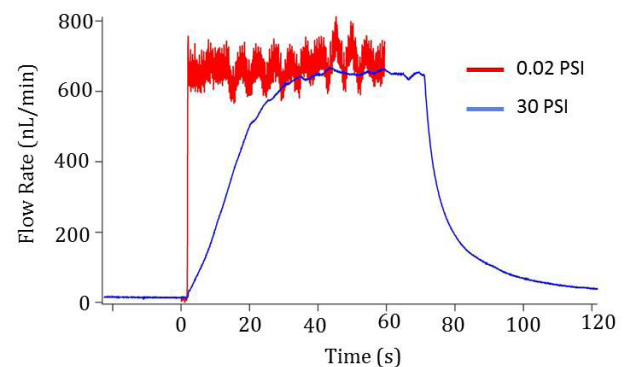
- Various Pressure Caps
- Pressure Chamber
- Tubing / Adapters / Unions
- Liquid Isolation Valve with Integrated Drive Electronics
- I/O Module for Analog Outputs, Triggering and Alarms
- Software to generate calibrations for different liquids

PneuWave Advantages

- Precise, accurate flow rate control
- Nanoliter resolution
- Pulse-free
- Superior performance to syringe pumps and traditional peristaltic pumps
- Fast response
- Accommodates from small to large pressurized fluid vessels
- Programmable fluid delivery controlled with user-friendly software
- Can be operated through either the front display or PC software (stand-alone and LabVIEW)
- Configurable with 1 to 8 channels that can be controlled independently or synchronized with a PC
- Can store multiple calibrations for accurate flow rate control of different liquids
- Can operate in either flow rate or pressure controlled mode
- Low dead-volume fluid path
- Pump contains a built-in, quiet compressor - No external compressor!
- Optional expanded I/O capability

Syringe Pumps Compromise Performance

Syringe pumps are the most widely used means of fluid delivery for microfluidics. However these pumps suffer from drawbacks that severely compromise performance and can negatively impact your microfluidic application. These drawbacks include: pulsation, slow response time, refilling of syringes is required, increased chance of air bubble introduction during syringe refill, and backpressure variations significantly effect performance.



Fluid delivery using a syringe pump is undesirable. If backpressure is increased, the pulsation is reduced, but then the response time increases.

The PneuWave Microfluidic Pump Pressure Caps

A variety of pressure caps for fluid vessels are available



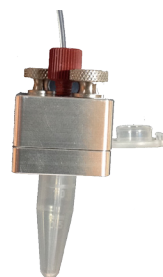
Glass Bottle Cap



Falcon Tube Cap



Nalgene Bottle Cap



Eppendorf Tube Cap



Universal Chamber

PneuWave Pump Configurations

Channel Number

- 1 Channel
- 2 Channels
- 4 Channels
- 8 Channels

Pressure Model

- Low 0-1 Bar
- High 0-4 Bar

Flow Model*

- Nano 20-7000 nL/min
- Micro 0.1-50 microL/min
- Milli 30-1000 microL/min
- Milli +5 0.2-5.0 milliL/min

*Models can operate outside the calibrated ranges provided. However flow rate measurement will be most accurate when operated within the corresponding ranges for each model.

Flow Specifications

	Nano	Micro	Milli	Milli +5
Flow Rate Range	0 - 7000 nL/min	0 - 50 µL/min	0 - 1100 µL/min	0 - 5.0 mL/min
Standard Calibrated Flow Rate Range	20 - 7000 nL/min	0.1 - 50 µL/min	10 - 1000 µL/min	0.2 - 5.0 mL/min
Accuracy below full scale (% of full scale)	0.3%	0.15%	0.2%	0.2%
Repeatability below full scale (% of full scale)	0.05%	0.01%	0.02%	0.02%
Flow Detection Response Time	40 msec			
Flow Rate Stability	Down to 0.1% CV*			
Operating Temperature	10 to 50°C			
Fluid Connector Type	UNF ¼-28Flat Bottom			
Flow Sensor Materials	Quartz Glass, PEEK™, Teflon®, Tefzel®		Borosilicate Glass, PEEK™, Teflon®, Tefzel®	
Flow Sensor Inner Diameter	150 µm	430 µm	1.0 mm	1.8 mm
Flow Sensor Internal Volume	1.5 µL	5.1 µL	< 30 µL	< 90 µL

*Relative to fluid type, tubing and system set-up

Pressure Specifications

	Low	High
Pressure Range with Internal Compressor	0-1 Bar	0-2 Bar
Pressure Range with External Pressure Source*	0-1 Bar	0-4 Bar
Response Time	down to 10 msec	

* If external pressure source is used, gas must be non-corrosive, non-explosive, dry and oil-free.