

## MICROFLUIDIC PUMPING

In recent years, substantial advancements have been realized in the field of microfluidics which has enabled the miniaturization of analytical instrumentation, liquid handling systems, drug delivery devices, and diagnostic platforms. It is essential that supporting technologies such as pumps and connectors undergo the same evolution to smaller, faster and more cost-effective models before the full benefits of using devices where they are most needed (in-field, at the point-of-care, etc.) can be realized.

Toward that end, SFC Fluidics is offering ePump® as the primary pumping solution to all nano- and micro-scale fluid movement and dispensing needs. In addition to advanced pumping characteristics, ePump's size is compatible with the smallest of labs-on-a-chip; for example, ePump requires only 1/36th of the space required for a standard syringe pump (see Figure 1). ePump's truly pulse-free flow at rates down to nL/min is ideal for all microfluidics applications. SFC Fluidics is confident that ePump® will become the technology of choice for microfluidic applications due to its superior pumping characteristics:

1. **Small Size:** ePump® Model 190 is ~1 inch square.
2. **Low Cost:** ePump® will be priced substantially less than competing pumps of comparable performance.
3. **Minimal Power Requirements:** ePump® requires less than 250 mW and can run off battery or solar power, which is important for implanted and portable devices.
4. **Accuracy of flow:** Smooth, controlled flow for a wide range of flow rates with standard deviation of 5% or less as measured by ultramicrobalance.
5. **Pressurization:** ePump® Model 190 is currently rated to 30 psi, which is compatible with the majority of microfluidic applications.

Higher pressures can be accommodated upon request.

6. **Long Life:** ePump® prototypes have demonstrated optimal operation (intermittent and continuous) for up to 34 months (and testing is still ongoing!).
7. **Nominal Dead Volume:** The Model 190 will be available with a self-priming cap which is designed to minimize dead volume in the pump.
8. **Customizability:** ePump® can be designed in a wide range of shapes, sizes and operating parameters. The Model 190 is optimized for use as a standalone pump in microfluidic application. The Model 220 will be optimized for use in small animal research.
9. **Compact controllers:** The controllers for ePump® are compact, customizable and amendable to wireless operation.



Figure 1: Size comparison of Model 190 ePump with a syringe pump. These two pumps have comparable operating parameters at low flow rates; however, the small footprint and low power requirements of ePump® are more compatible with POC diagnostics and other microfluidic applications.

The combination of ePump® and customizable controller ensures high performance flow control capabilities. The top graph in Figure 2 demonstrates that ePump® is capable of precision better than 1% at 2.5 µL/min in both forward and reverse directions. The bottom figure shows the ability to adjust flow rates from 250 nL/min to 1100 nL/min in a single direction. With such precise flow control, ePump® will be a driving force for significant advances in miniaturization and optimization of labs-on-a-chip.

controller and an example of ePump's® dosing performance are shown in Figure 3.

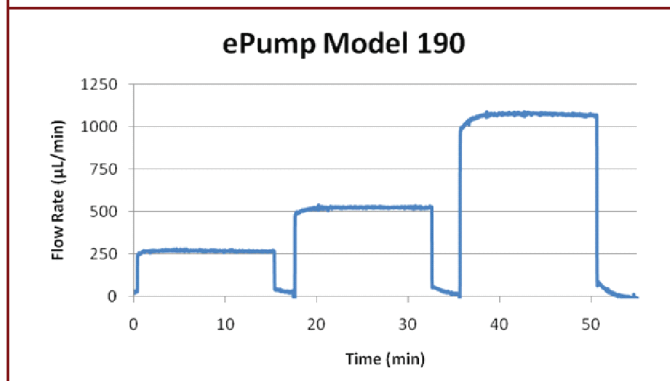
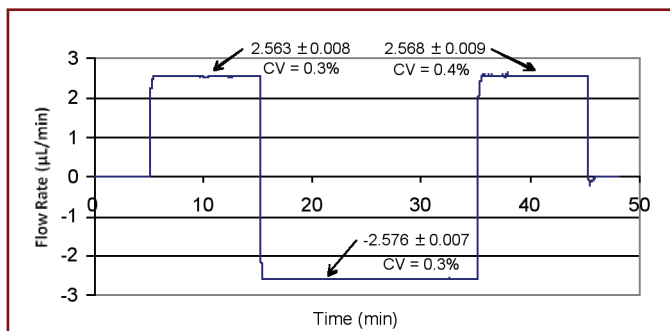


Figure 2: (Top) Typical flow profile for switching between forward and reverse flow using feedback from an external flow sensor. Note the near instantaneous change in direction and the smooth, nearly error-free maintenance of flow rates at  $\pm 2.5$  µL/min.

Figure 2: (Bottom) Demonstration of ability to carefully control and/or stop flow rate in the nL to µL range. Precise flow control is maintained by the strength of the electric signal running ePump®.

In addition to the currently available ePump® Model 190, the Model 220 will be available in the summer of 2011. The Model 220, its wireless

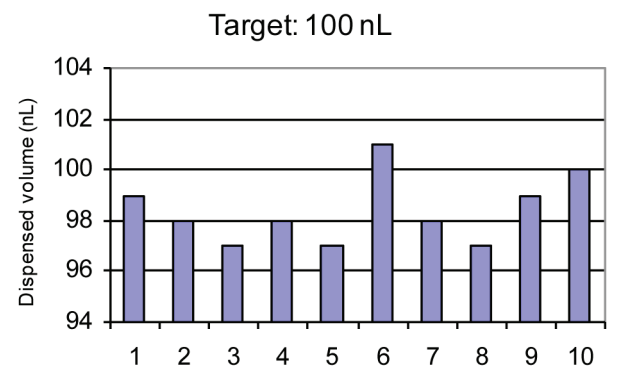
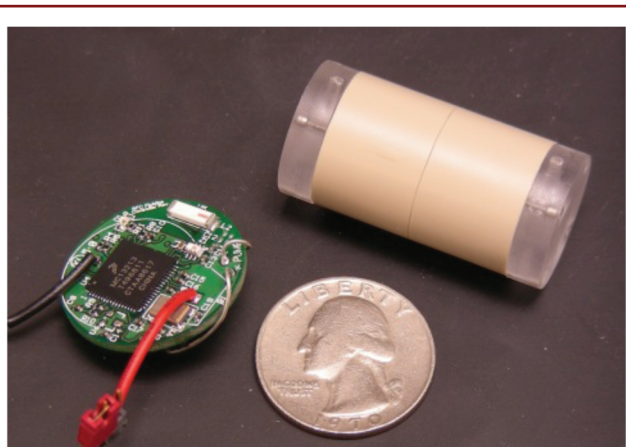


Figure 3: Photograph of the Model 220 ePump® designed for use in small animal research. The pump and controller are small enough to be carried on the back of the animal and drug delivery dosing can be controlled remotely by computer. Using ultramicrobalance, fluid dosing targeted to 100 nL varied by only  $\pm 3$  nL!

### Contact Information:

For further technical assistance and purchasing information, contact

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