

Intrinsic flow controlled micropump

The micropump mp6 with its double actuator configuration exhibits the possibility of an intrinsic flow control. This offers a low cost sensing solution for applications requesting safety and accuracy under varying environmental conditions.

The micropump mp6 (figure 1) is a micro membrane pump actuated by a double configuration of piezo elements, in combination with passive valves. The two actuator stages have been combined in a single pump for the first time. Besides providing a pressure of up to 500 mbar, the double actuator principle assures self filling of the pump at startup and reliable function. Furthermore it offers the possibility of an intrinsic sensor function. As the piezo effect of the actuators used in the micropump is reversible, it can not only be used for actuation but also for sensing. To achieve both pumping and feedback for the control circuit, the pump is switched between two modi (figure 2):

Full actuation mode: Both pump stages are working as actuators, providing full performance of the pump.

Sensing mode: The first pump stage is still actuated and provides fluid pulses; the second stage is switched to sensing which provides feedback on the pump strokes of the first actuator.

As the pump is operated at a frequency in the region of 100 Hz, continuous operation between both modes does not result in a significant drop of pump performance. Still, as the piezos are not optimized for sensing purposes but effective actuation, this approach has limits in terms of accuracy and addressing very low flow rates.

Figure 3 shows the measured performance of a controlled mp6 micropump with deionized water. While the micropump exhibits the typical behavior of decreasing flow rates at increasing pressures, the flow remains almost constant while running the pump in controlled mode. The controlled-loop flow range is 0,5 – 5 ml/min with an accuracy of 10%. The flow behavior over time and accuracy for continuous flow conditions are shown in figure 4 for a flow rate of 125 ml/h.

Looking at the overall complexity, from the pump side, this solution is fully based on a proven, mass produced component. Additional effort is of course needed at the driving electronics but as the signal processing is straightforward the unit

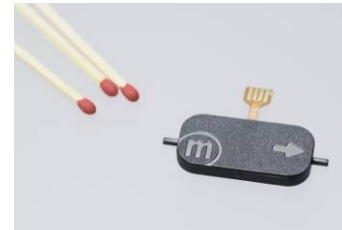


Fig. 1: Micropump mp6

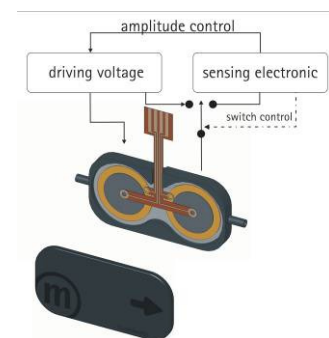


Fig. 2: Flow-sensing schematics of intrinsic sensor function



keeps its portability and capability of being driven with batteries. Especially in applications where the micropump should be used as a disposable unit while the electronics is being reused, the full potential of this solution comes into play.

About Bartels Mikrotechnik

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Bartels specializes in innovative applications of micro systems technology (MST) in the branches of classical consumer goods, mechanical engineering and medical technology. Microfluidics, microactuation and micromechanics constitute the company's technological focus. The international activities of Bartels Mikrotechnik subdivide into two business segments: Bartels microEngineering and Bartels microComponents.

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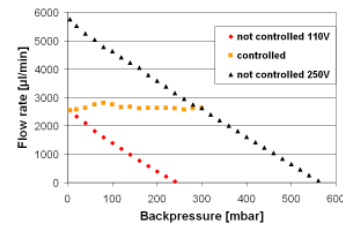


Fig. 3: First performance graph of piezo sensor controlled pump

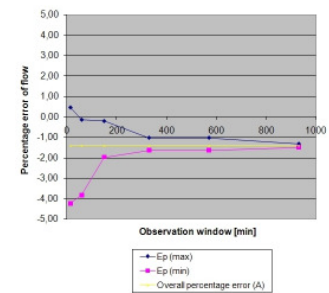


Fig. 4 Trumpet curve for 125 ml/h

