Micropumps for Infusion Therapy

In medical applications, such as infusion therapy, micropumps can be an attractive alternative to standard pumps due to their size, weight and low energy demand. The micropump mp6-psense with its double actuator configuration offers the possibility of an intrinsic flow control. Therefore it can fulfill higher requirements on safety and accuracy under varying conditions as the standard pump mp6. By the controlled loop function the flow can run constantly under varying conditions as pressure, viscosity or temperature changes.

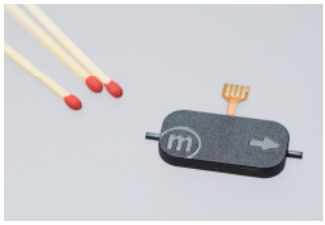

Fig. 1: Micropump mp6

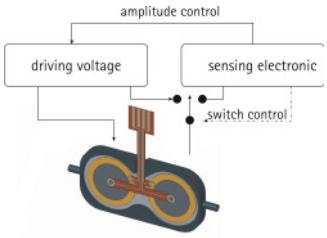

Fig. 2: Sensing routine

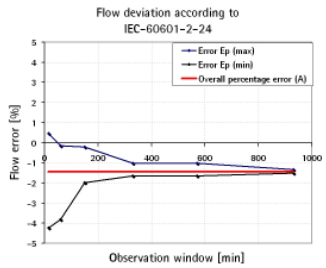

Fig. 3: Flow performance mp6

Infusion therapies like for example the continuous dosing of nutrient solution in parenteral diets have high demands on the flow accuracy. Important is the starting behavior and the stable flow during the course of infusion with a minimum of short time fluctuations. The micropump mp6-psense from Bartels Mikrotechnik with intrinsic flow control has been tested for such applications. A clear and simple picture of the general flow rate stability over time can be gained by a trumpet curve analysis. The trumpet curve shows the variations of the mean flow accuracy over specific observation periods. The variations are presented only as maximum and minimum deviations from the overall mean flow within the observation window. The flow performance of the pumps is measured over a time period of 25 hours after a 24 hour stabilizing phase or emptying of half the reservoir according to the definitions of the standard DIN EN 60601-2-24.

Since the flow controlled micropump mp6-psense has a very dynamic behavior stable flow conditions can already be achieved after 10 minutes. Therefore the stabilization phase could be considerably shortened. The trumpet curve analysis over defined time intervals then shows the maximum positive and negative errors, occurring in the time interval. Achievable flow rates of the mp6-psense are 0,5 – 5 ml/min with a flow accuracy of 10%. For a flow rate of 125 ml/h the exemplarily trumpet curve of mp6-psense is shown below. In short observation windows the error of flow is already below 5 %. With increasing intervals it decreases below 1 %. The absolute error is below 2 %.

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

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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.

Infusion therapies with flow rates below 0,5 ml/min can either be achieved by quasi-continuous pumping, for which small volumes are dosed in defined time intervals. Or a flow controlled micropump with an integrated flow sensor is used which can achieve lower flow rates with higher accuracies. The flow range of such a system is from 60 µl/min to 5 ml/min with 5 % accuracy.

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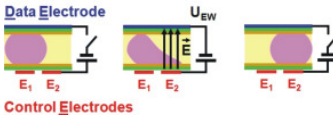
Digital Microfluidics

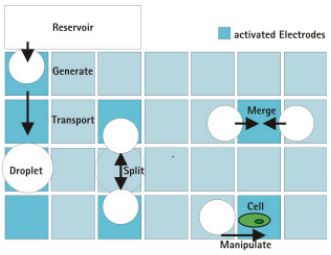
At the MD&M West (hall E, booth 812) Bartels Mikrotechnik presents digital microfluidics for flexible handling of liquids.

Lab-on-a-Chip systems are based on the reliable handling of micro to nanoliter reaction volumes and parallel sample processing. In digital microfluidics small droplets can be flexibly manipulated electrically under software control to perform even the most complex liquid handling routines. Highly complex microfluidic systems can be designed in a compact, easy to use and highly flexible manner. Valves, pumps or micro structured surfaces are not required when this unique technology is applied.

The phenomenon behind 'digital microfluidics' is electrowetting. The wetting behavior of a droplet in contact with an insulated electrode is altered when an electrical field is applied. If the electrical field is applied non-uniformly a surface energy gradient is created which can be used to manipulate – transport - a droplet. The droplet can be moved from one electrode position with frequencies up to 200 Hz. Depending on the electrode design this allows free movement of a droplet under full control. Even a number of droplets can be controlled independently or in parallel. Next to pure transportation routines merging, mixing and splitting of droplets as well as droplet generation is possible. Therefore the routines required in lab-on-a-chip operation can be realized in a flexible way. It is even possible to configure assay routines according to the requirements via programmable electrodes. The direct control of fluid handling offered by digital microfluidics is a key driver for the future development of microfluidic diagnostic systems. The company offer customer specific adaptation development of such systems in its business unit microEngineering.



Electrowetting: A droplet is moved from one position to another when voltage is applied.



Creating, transporting, cutting and merging liquid droplets by electrowetting-based actuation for digital microfluidic circuits

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About Bartels Mikrotechnik

Ever since its foundation in 1996 Bartels Mikrotechnik GmbH has been a synonym for great innovative power and microtechnological know-how.

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.

Bartels Mikrotechnik at Medical Design & Manufacturing West

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