

# Application Note

## Micropumps in Small Fuel Cells

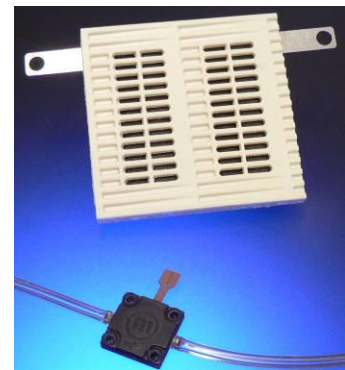
The continuing downsizing of fuel cells leads to the demand for smaller peripheral components at low cost and with low energy consumption. As the power generation in portable devices will not be higher than 5 to 100 W, the overall efficiency is strongly dependent on the power consumption of the external components.

One essential group of external components for direct methanol fuel cells (DMFC) are pumps. In DMFC-systems, they fulfill two important tasks: One pump injects pure methanol into the cell, where the fluid is diluted with water. A second pump is required to continuously circulate this mixture through the system. Therefore miniaturized fluid transport is the key to efficient and reliable performance of portable fuel cell systems. The requirements that pumps have to meet in these systems are defined by the flow characteristics of the respective fuel cells and thus vary from case to case.

Based on piezo membrane technology, Bartels Mikrotechnik produces micropumps that due to their design's scalability can cover different sets of flow rate and feed pressure as well as material properties. These small devices with very low power consumption offer customized performance based on a well proven pump principle. The main standard product, the mp5, is available in evaluation kits with different controllers. Being the smallest polymer based micropump cost effectively produced in series, the mp5 provides flow control in small dimensions.

For increased priming capabilities and higher outlet pressures over 600 mbar, two pumps can be connected in series. This new pump generation, the mp6, will feature a double actuator inside a single housing.

As small DMFC stacks cannot generate high supply voltages, the mp5 and mp6 are particularly suitable to feed such systems. Due to special driving circuits the pumps operate with a supply voltage as



Micropump mp5 and DMFC (FWB / Fraunhofer ISE)



mp6 – the new double actuator micropump



low as 0.9 V. To increase the cell efficiency, the pumps are being driven in an alternating mode tailored to the fuel cells' inner volume and characteristics. Such customized driving electronics can be developed for all of Bartels Mikrotechnik's customers in order to cope with the requirements of every individual application.

To raise the level of integration, the polymer pump housing can be designed as a part of the fuel cell stack or the methanol reservoir. By this the height of the pump can be reduced even below the 3.5 mm of the standard product.

If a flow rate or methanol concentration sensors would be integrated, the pump can be enabled to work as a closed-loop system, automatically adjusting the fuel cell performance to different driving conditions.

General Specifications	mp5*	mp6*
type	piezoelectric diaphragm pump	
pump medium	liquids or gases	liquids, gases and mixtures
outer dimensions (without fluidic connectors)	14 x 14 x 3.5 mm <sup>3</sup>	30 x 15 x 3.8 mm <sup>3</sup>
fluidic connectors	tube clips, 2 mm outer diameter	tube clips, 1.6 mm outer diameter
operating temperature	0 - 70 °C	
life time	> 5000 h <sup>2</sup>	
materials in contact with media	PPSU/PI/NBR	PPSU
max. flow, water <sup>1</sup>	5 ml/min (100 Hz)	6 ml/min (100 Hz)
max. pressure, water <sup>1</sup>	250 mbar (100Hz)	550 mbar (100 Hz)
max. flow, air <sup>1</sup>	15 ml/min (300 Hz)	On request.
max. pressure, air <sup>1</sup>	30 mbar (300 Hz)	On request.

\* Typical values. Values can vary under application conditions. Content is subject to changes without notice.

<sup>1</sup> Values taken with electronic controller mp-x set to 250 V amplitude, SRS signal

<sup>2</sup> Conditions: DI water, room temperature, settings mp-x: 100 Hz, 250 V, SRS.



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Videotutorials and other answers can be found on our Blog

<http://blog.bartels-mikrotechnik.de>

or on our YouTube Channel

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