

Bartels Micropumps

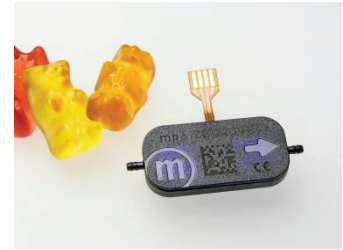
Micropumps transporting the tiniest amounts of gases or liquids can be considered the heart of microfluidics.

In many sectors they have become indispensable. Dosing lubricants, feeding sensors with sample gas or mixing starch into the steam of flat irons are only a few of the manifold tasks they can fulfill. Many further fields of application for example are located in medical technologies and analytics.

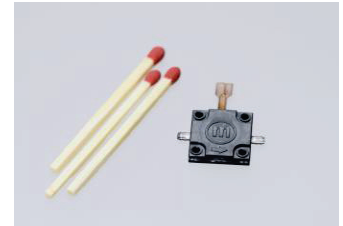
Extremely small in size and low in weight, with good particle tolerance and temperature resistance, Bartels micropumps are well prepared to be used in any of these sectors. As they are almost completely made of plastics, large quantities of these pumps can be produced at low cost and so may well be used as disposables.

The functional principle of the Bartels micropumps is based on a piezoelectric diaphragm in combination with passive check valves. A piezo ceramic mounted on a coated brass membrane is deformed when voltage is applied. By the resulting down stroke, the medium is being displaced out of the pump chamber below. The check valves on both sides of the pump chamber define the flow direction. When the voltage decreases, the corresponding piezo deformation causes an upstroke of the membrane. The medium is sucked in and the chamber is filled again. In every second, the pump can do several hundreds of such pumping cycles. The pumping performance can be influenced by adjustment of the parameters.

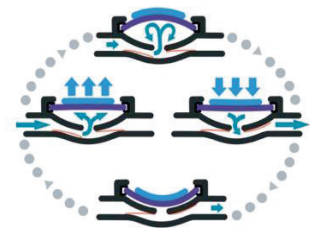
Important advantages for all users result from the radically simple pump design: Injection molded parts for housing and pump chamber, piezo actuators and passive valves constitute the key components. Thus any adaptation to specific requirements concerning flow rate or back pressure is easy to realize. This customization of micropumps with the appropriate electronic controllers is part of the services offered by Bartels microComponents. If requested, the pumps can be fully integrated into complex system designs as well.



mp6 – double actuator micropump



mp5 – smallest available plastic micropump



Functional principle.



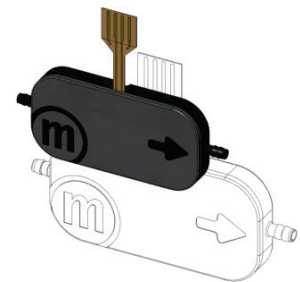
Once the perfect pump for your application has been found, you may purchase an exclusive production license for this version to include the component into your own production processes. Of course Bartels microComponents can also realize a high quality serial production for you at low cost.

mp6 Micropump

The Bartels micropump mp6 combines two piezo actuators inside a single housing. The new pump joins the established functional principle and central advantages of its parent generation mp5 with its own **specific innovative features**.

The small power pack can handle **twice the back pressure** the mp5 can cope with, has an **increased priming capability** and is of **higher bubble tolerance**, so that even gas-liquid-mixtures can be pumped without problems. Its **low power consumption** is a further advantage. In the entire pump only one material gets into contact with the medium. Now two types of materials are available. In the standard mp6 all relevant parts are made of polyphenylsulfone (PPSU) and in the mp6-pp of polypropylene (PP).

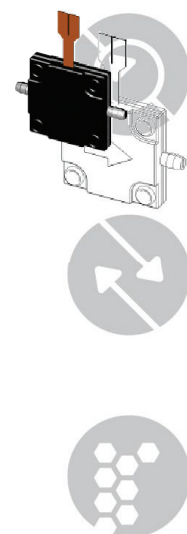
The mp6 can already be offered at low prices for large quantities due to an automated assembly. The mp6-pp is produced less automated but for larger quantities it can also be transferred into serial production.



mp5 Micropump

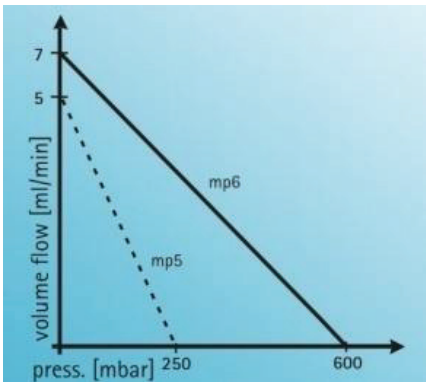
The mp5 from Bartels microComponents is the smallest and lightest micropump available. Since 2004 the mp5 has successfully shown the potential of piezo membrane pumps. Due to the limited bubble tolerance and higher price in medium quantities, it is now replaced by its successor the mp6 in many applications. If size is a challenging factor, then the mp5 is still the right choice.

Its low power consumption and tiny size makes the mp5 the perfect pump to be fully integrated into your product's design. Test the mp5 now and ask about the possibilities of a customer specific adaptation - for your individual micropump.

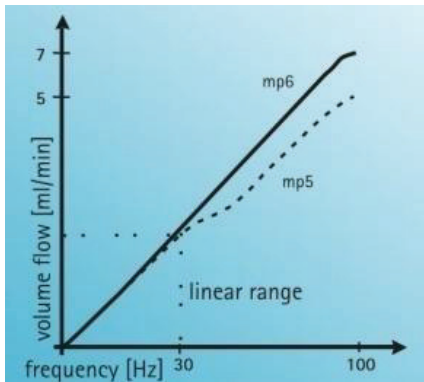


Typical characteristics of the Bartels micropumps:

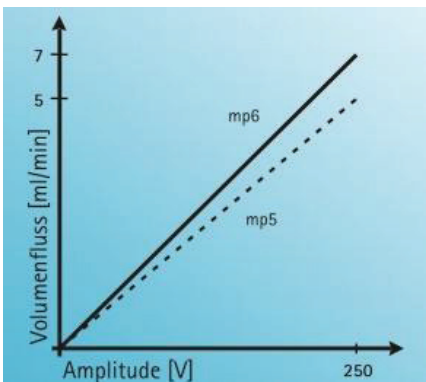
volume flow versus pressure



volume flow versus frequency



volume flow versus amplitude



Technical Data of the mp6¹

mp6	Order code: mp6
Pump type	piezoelectric diaphragm pump
Number of actuators	2
Dimensions without connectors	30 x 15 x 3.8 mm 1.1811 x 0.5906 x 0.1498 in.
Weight	2 g
Fluidic connectors	barbed tube clip, (outer diameter 1.9 mm, length 3.5 mm) ²
Electric connector	flex connector 1.25 mm pitch
Power consumption	< 200 mW
Self-priming	yes ³
Pumping media	liquids, gases, mixtures
Operating temperature	0–70°C
Life time	5000 h ⁴
IP code	IP33 ⁵
Material in contact with media	polyphenylsulfone (PPSU) ⁶
Suitable evaluation controller	mp-x, mp6-EVA and mp6-OEM
Typical values of flow and back pressure for selected media (values defined with mp-x: 250 V, SRS):	
Gases (as product mp6-air)	
max. volume flow	18 ml/min (300 Hz) ⁷
max. back pressure	100 mbar (300 Hz) ⁷
Liquids – water	
max. volume flow	7 ml/min +/- 15% (5.95 ml/min – 8.05 ml/min) ⁴
max. back pressure	600 mbar +/- 15% (510 – 690 mbar) ⁴

¹ Typical values. Values can vary under application conditions. Content is subject to changes without notice.

² Recommended tubing: 1.3 mm inner diameter.

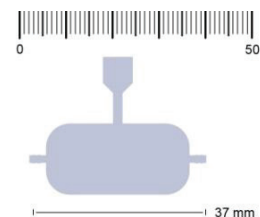
³ Conditions: Suction pressure < 10 mbar, DI water, settings mp-x: 100 Hz, 250 V, SRS, the max. volume flow will be reached after a few minutes of operation time.

⁴ Conditions: DI water, room temperature, settings mp-x: 100 Hz, 250 V, SRS

⁵ Can be changed to IP44.

⁶ The mp6 is not stable against concentrated alcoholic solutions as MeOH or EtOH.

⁷ Conditions: Gases, room temperature, mp-x: 300 Hz, 250 V, SRS

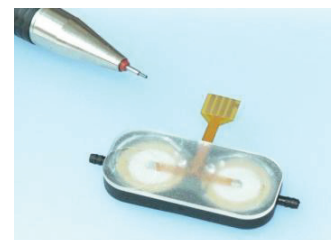
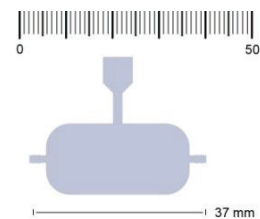


Please find more information concerning the controller and the equipment in the corresponding data sheets.



Technical Data of the mp6-pp¹

mp6-pp	Order code: mp6-pp
Pump type	piezoelectric diaphragm pump
Number of actuators	2
Dimensions without connectors	30 x 15 x 3.8 mm 1.1811 x 0.5906 x 0.1498 in.
Weight	2 g
Fluidic connectors	barbed tube clip, (outer diameter 1.9 mm, length 3.5 mm) ²
Electric connector	flex connector 1.25 mm pitch
Power consumption	< 200 mW
Self-priming	yes ³
Pumping media	liquids, gases and mixtures
Operating temperature	t.b.d.
Life time	t.b.d.
IP code	IP 33 ⁴
Material in contact with media	polypropylene (PP) ⁶
Suitable evaluation controller	mp-x, mp6-EVA and mp6-OEM
Typical values of flow and back pressure for selected media (values defined with mp-x: 250 V, SRS):	
Gases	
max. volume flow	14 ml/min +/- 15% (11.9 – 16.1 ml/min) ⁵
max. back pressure	150 mbar +/- 15% (127.5 – 172.5 mbar) ⁵
Liquids – water	
max. volume flow	5 ml/min +/- 15% (4.25 – 5.75 ml/min) ⁶
max. back pressure	650 mbar +/- 15% (552.5 mbar – 747.5 mbar) ⁶
Liquids – MeOH	
max. volume flow	6.8 ml/min ⁷
max. back pressure	550 mbar ⁷



¹ Typical values. Values can vary under application conditions. Content is subject to changes without notice.

² Recommended tubing: 1.02 mm inner diameter.

³ Conditions: Suction pressure < 10 mbar, DI water, settings mp-x: 100 Hz, 250 V, SRS, the max. volume flow will be reached after a few minutes of operation time.

⁴ Kann auf IP44 angepasst werden.

⁵ Conditions: Gases, room temperature, mp-x: 300 Hz, 250 V, SRS

⁶ Conditions: DI water, room temperature, settings mp-x: 100 Hz, 250 V, SRS

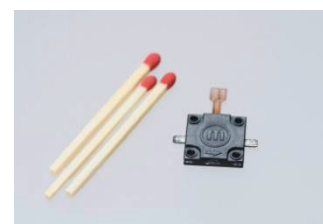
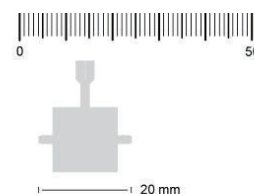
⁷ Conditions: DI water, room temperature, settings mp-x: 100 Hz, 250 V, SRS

Please find more information concerning the controller and the equipment in the corresponding data sheets.



Technical Data of the mp5¹

mp5	Order code: mp5
Pump type	piezoelectric diaphragm pump
Number of actuators	1
Dimensions without connectors	14 x 14 x 3.5 mm 0.5512 x 0.5512 x 0.1378 in.
Weight	0.8 g
Fluidic connectors	barbed tube clip, (outer diameter 2 mm, length 3 mm) ²
Electric connector	flex connector / phone jack
Power consumption	< 200 mW
Self-priming	yes ³
Pumping media	liquids or gases
Operating temperature	0 – 70°C
Life time	5000 h ⁴
IP code	IP44
Material in contact with media	polyphenylsulfone (PPSU), polyimide (PI), nitrile butadiene rubber (NBR) ⁵
Suitable evaluation controller	mp-x, mp6-EVA and mp6-OEM
Typical values of flow and back pressure for selected media (values defined with mp-x: 250 V, SRS):	
Gases	
max. volume flow	15 ml/min (300 Hz) ⁶
max. back pressure	30 mbar (300 Hz) ⁶
Liquids – water	
max. volume flow	5 ml/min (100 Hz) ⁴
max. back pressure	250 mbar (100 Hz) ⁴



¹ Typical values. Values can vary under application conditions. Content is subject to changes without notice.

² Recommended tubing: 1.3 mm inner diameter.

³ Conditions: Suction pressure < 10 mbar, DI water, settings mp-x: 100 Hz, 250 V, SRS, the max. volume flow will be reached after a few minutes of operation time.

⁴ Conditions: DI water, room temperature, settings mp-x: 100 Hz, 250 V, SRS

⁵ The mp6 is not stable against concentrated alcoholic solutions as MeOH or EtOH.

⁶ Conditions: Gases, room temperature, mp-x: 300 Hz, 250 V, SRS

Please find more information concerning the controller and the equipment in the corresponding data sheets.



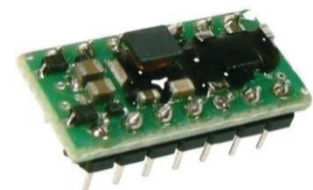
Accessories for the Bartels Micropumps

mp-x controller	Order code: mp-x
Access to the full range of driving parameters. A system for the professional evaluation of the micropumps. <i>(excl. mp6-connection cable, please order when required)</i>	
Dimensions	7.5 x 16 x 20 cm 2.983 x 6.299 x 7.874 in.
Weight	ca. 800 g
Pumping media	liquids, gases
Max. volume flow (DI-water)	mp6: 7 ml/min (SRS, 250 V, 100 Hz) mp6-pp: 5 ml/min (SRS, 250 V, 100 Hz) mp5: 5 ml/min (SRS, 250 V, 100 Hz)
Adjustable parameters	Amplitude, frequency, signal form
Amplitude range	0 – 250 V
Frequency range	0 - 300 Hz
Signal form	SRS, rectangular, sine
Power supply	mains adaptor
Current consumption	750 mA at 7.5 V
USB-Port incl. driver	one; a CD with driver software is included
connectable micropumps	mp5: 1x-2x or mp6 respectively mp6-pp: 1x



mp-x

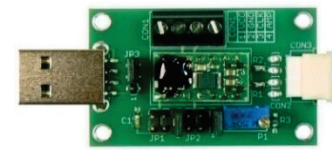
mp6-OEM controller	Order code: mp6-OEM
The OEM-controller drives the micropump at adjustable performance in a package similar to an integrated circuit. It enables integration into system electronics or on a PCB.	
Dimensions	10.5 x 20.5 x 6 mm 0.4134 x 0.8070 x 0.2362 in.
Pumping media	liquids, gases
Max. volume flow (DI-water)	4.5 ml/min
Adjustable parameters	Amplitude, frequency
Amplitude range	85 – 235 V
Frequency range	25 - 226 Hz (Frequencies up to 1000 Hz are possible; please note that the amplitude will decrease in that case. Frequencies down to 1 Hz are possible with an external clock generator.)
Signal form	similar to rectangular
Power supply	2.5 – 5.5 VDC (5 V recommended for optimized performance)
Pumping media	ca. 30 mA at 5 V
Pin arrangement	DIL 14; horizontal ~2.54 mm, vertical ~7.62 mm



mp6-OEM



mp6-EVA evaluation board Order code: mp6-EVA	
The evaluation board enables the simple use of the micropump based on the mp6-OEM controller. Next to preset standard parameter (235 Vpp, 100 Hz) the mp6-EVA also allows adjusting the pump parameters flexibly, this partly by external tuning. As the supply voltage of the module can be provided via USB (no data interface), just attach it to a USB power supply and start the evaluation. Alternatively it can also be supplied by a 2.5 – 5 V voltage source.	
Dimensions	6.5 x 3 x 2 cm 2.5590 x 1.1811 x 0.7874 in.
Pumping media	liquids, gases
Max. volume flow (mp6, DI-Water)	4.5 ml/min
Adjustable parameters	Amplitude, frequency
Amplitude range	100 – 235 Vpp
Frequency range	25 – 226 Hz (Frequencies up to 1000 Hz are possible; please note that the amplitude will decrease in that case. Frequencies down to 1 Hz are possible with an external clock generator.)
Signal form	similar to rectangular
Power supply	via USB or 2.5 V – 5.5 VDC
Current consumption	ca. 30 mA at 5 V



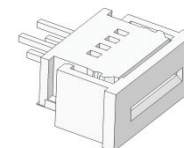
mp6-EVA

mp6-con connection cable Order code: mp6-con	
Connector for mp6/mp6-pp to mp-x	
Design and connectors	- Molex FCC 1.25 mm pitch - 85 cm (33.465 in.) cable - Binder 620 connector



mp6-con

mp6-mol connector Order code: mp6-mol	
Connector to micropump mp6/mp6-pp for custom made cabling	
Type	Molex FCC 39532045 1.25 mm pitch
packaging unit	10 pieces



mp6-mol

mp-cv check valve Order code: mp-cv	
The passive check valve eliminates the back flow of the pumping medium, when the micropump is switched off. It can be connected via tubing.	
Dimensions	21 mm x 5.5 mm (length x wrench size) 0.82677 x 0.2165 in.
Materials in contact with the pumped media	Silicone, stainless steel
Fluidic connectors	barbed tube clip, length : 5.6 mm for tubing with internal diameter: 1.3 mm
Cracking pressure	typical < 35 mbar
Max. back pressure	500 mbar
Typical leak rate	<20 µl/h for DI-water (at 500 mbar)

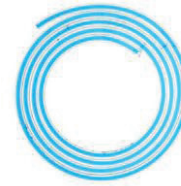


mp-cv





mp-t tubing	
Inlet/outlet compatible Tygon® tubing	
Inner diameter 1.3 mm	Order code: mp-t ID1.3
Inner diameter 1.02 mm	Order code: mp-t ID1.02



mp-t

mp-y tubing connector		Order code: mp-y
Y-connector for tubing, for the parallel use of two micropumps:		
Material	polypropylene (PP)	
for tubing inner diameters of	1.3 – 2.6 mm 0.0512 – 0.1024 in.	



mp-y



Evaluation Sets

mp5-go! Set	Order code: mp5-go!
The evaluation of the mp5 can be started directly with this set.	
It contains:	
3 micropumps mp5	
1 mp-x controller	
1 meter mp-t ID1.3 tubing	

mp6-go! Set	Order code: mp6-go!
The evaluation of the mp6 can be started directly with this set.	
It contains:	
3 micropumps mp6	
1 mp-x controller	
1 mp6-con	
1 meter mp-t ID1.3 tubing	



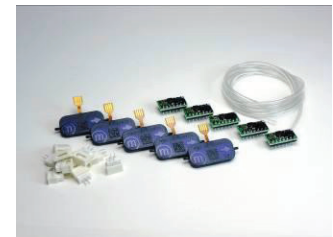
mp6-go! Set

mp6-basic Set	Order code: mp6-basic
The evaluation of the mp6 can be started directly with this set.	
It contains:	
3 micropumps mp6	
1 mp6-EVA evaluation board	
1 meter mp-t ID1.3 tubing	



mp6-basic Set

mp6-pro Set	Order code: mp6-pro
The evaluation of the mp6 can be started directly on the customer's circuit board with this set.	
It contains:	
5 micropumps mp6	
5 mp6-OEM controller	
1 packaging unit of mp6-mol	
1 meter mp-t ID1.3 tubing	



mp6-pro Set

mp6-pp-go! Set	Order code: mp6-pp-go!
The evaluation of the mp6-pp can be started with this set.	
It contains:	
3 micropumps mp6-pp	
1 mp-x controller	
1 mp6-con	
1 meter mp-t ID1.3 tubing	





The offered accessories and kits are meant to assist your evaluation process. After the feasibility of the micropump in the customer specific application has been proven, an adequate miniaturization of the controller and the equipment can be carried out.

The design of customized controllers is part of the services offered by Bartels microComponents.

Please contact us, if we can support you in choosing the suitable equipment.





Bartels Mikrotechnik Newsletter #9

One for four – Electronic evaluation board for four micropumps

Content:

- mp6-QuadEVA – a new evaluation board to control four micropumps simultaneously and to achieve higher frequencies
- Why more frequency and why more pumps when pumping gas?

mp6-QuadEVA – a new evaluation board to control four micropumps simultaneously and to achieve higher frequencies

As a developer and producer of micropumps we hear about customer applications with our products but also the requests for enhanced performance. One widespread goal of customers over a variety of different application fields is to create small mobile devices. Often a conventional pump – even if it is small for its kind – does not match the available space. Our mp6 micropumps are small, having quite powerful performance but are not always as strong as the customer wants. More performance is quite often a demand for many applications. Sure there are other pumps on the market that can create more flow and/or more pressure, but those are either larger or require much more power and most of them are more expensive.



Though you can easily drive our micropumps with the standard electronics – the lab electronic mp-x and the mp6-OEM for integration in your own circuit – both are not designed to handle more than one pump at the same time. Therefore, if you want to drive two or more pumps in a serial connection to multiply the pressure generation or in parallel connection to raise the flow rate, you will need to have the same number of electronics as you have pumps; one for one.

So, even if the small dimensions of the pumps allow having more than one pump in a mobile device, the need for increasing the amount of electronic drivers may hinder this approach to be reasonable.

Now we have developed a new electronic to address this draw-back: the mp6-QuadEVA.

This evaluation board is not based on the mp6-OEM electronic, as this can only drive one pump at full power. With its own electronic layout the mp6-QuadEVA is meant to control up to four pumps simultaneously. This new approach for controlling multiple pumps was primarily designed to power the mp6-AIR pumps and allowing serial connection for enhanced pressure generation.

Flow rate and pressure generation of mp6-AIR, mp6-pp and mp6 depend on amplitude as well as on frequency. With gases the peak value for flow rate and pressure generation is at a higher frequency (first local maximum is at ~1250 Hz) than for liquids. Our standard electronic products have a maximal frequency of 226 Hz and 300 Hz, mp6-OEM and mp-x respectively, as they were designed to cover the pumping optimum for liquids at around 100 Hz. With the new mp6-QuadEVA the maximal frequency is now raised to 800 Hz, which allows much higher flow rates and pressure levels for gases.

One other difference to the standard electronics is that the mp6-QuadEVA generates a sine driving signal only. It is not as noisy and loud as for instance a rectangular signal. The evaluation board allows controlling

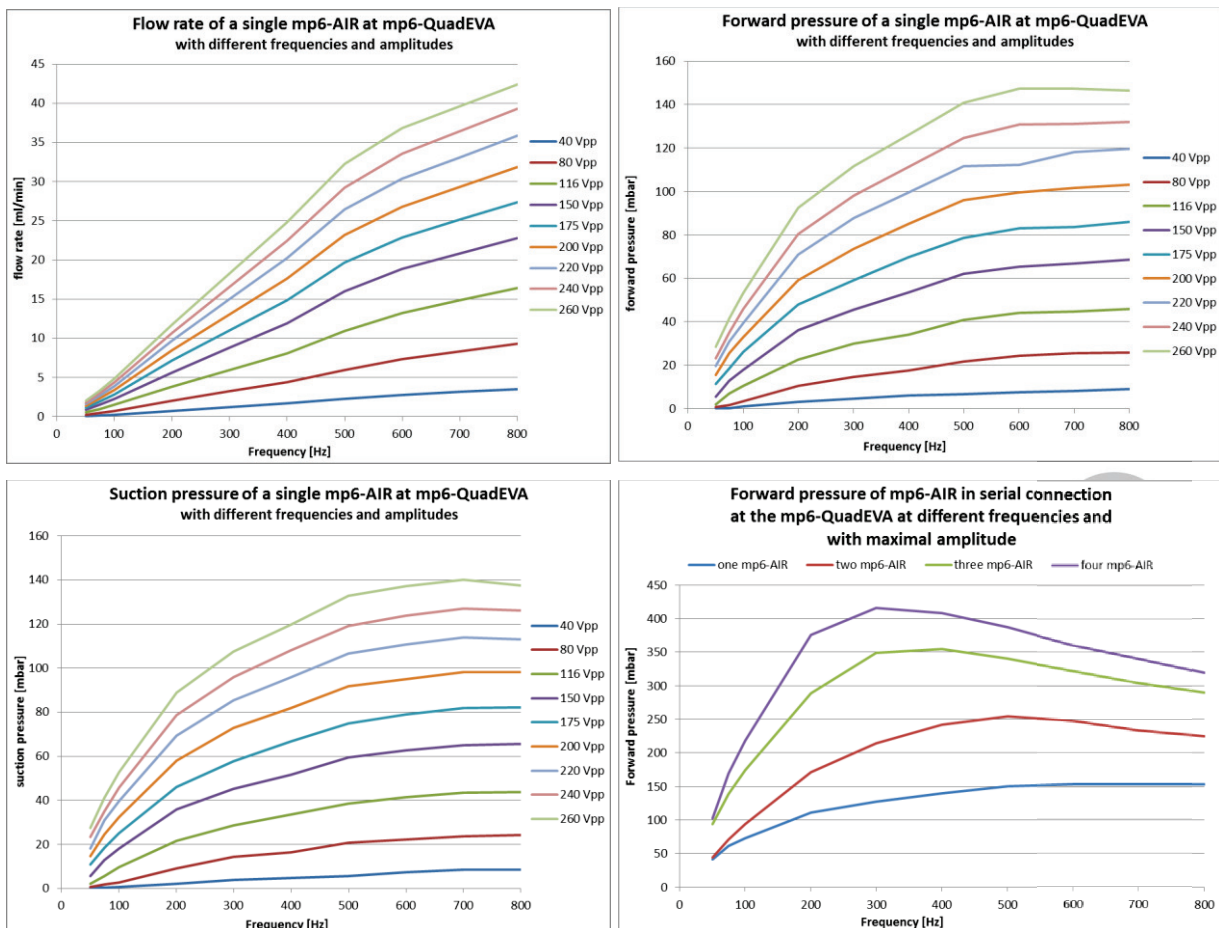


Technical data of mp6-QuadEVA	
Dimensions	80 x 60 x 16 cm 3.15 x 2.36 x 0.63 in.
Pumping media	liquids, gases
Max. volume flow (mp6-AIR, gas: air)	each single mp6-AIR: ~42 ml/min @ 260 V; 800 Hz
Adjustable parameters	Amplitude, frequency
Amplitude range	0 – 260 Vpp
Frequency range	50 – 800 Hz
Signal form	sine
Power supply	7.5 V, 1000 mA
Current consumption	avg. 220 mA, peak 280 mA ¹
¹ four connected mp6-AIR @ 260 V and 800 Hz	

amplitude and frequency either locally on board or via USB-connection. The local control is realized with rotary buttons with preset values for its positions. Each pump stage has its own on/off switch and status LED. The remote control via USB-connection can be achieved with any terminal software that is capable of sending commands to serial COM-Ports (e.g. HyperTerminal or PuTTY (www.putty.org)) but also with the software that comes together with the board. The board requires its own power supply regardless of local or remote control.

The evaluation board mp6-QuadEVA allows customers to experiment with multiple pumps for the achievability of their desired flow and pressure goals. Although gas applications are the main focus here, liquids can be pumped nevertheless.

For pumping air, the flow rate and pressure generation of a single mp6-AIR is displayed below. Additionally the forward pressure of serial connected mp6-AIR pumps is presented with the bottom right diagram. The cause for the pressure decrease of these lines is described further below.



Bartels Mikrotechnik offers the evaluation board as a set consisting of the mp6-QuadEVA board, a power supply, a mini-USB cable, four micropumps mp6-AIR together with software and USB driver.

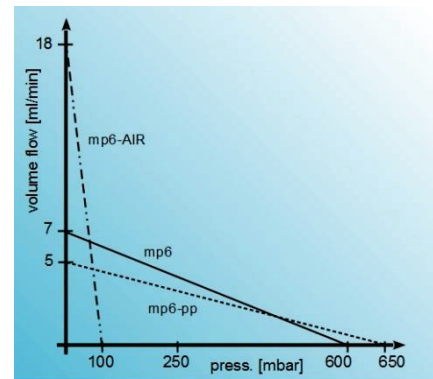
Due to the character of an evaluation board concept the design and layout of the board is not optimized for any specific application or any serial device solution. The circuit can be adapted for various applications. On request we offer such an adaptation for your customized solution. Additionally it is possible to order the schematics, part list and coding for some license fee.

Why more frequency and why more pumps when pumping gas?

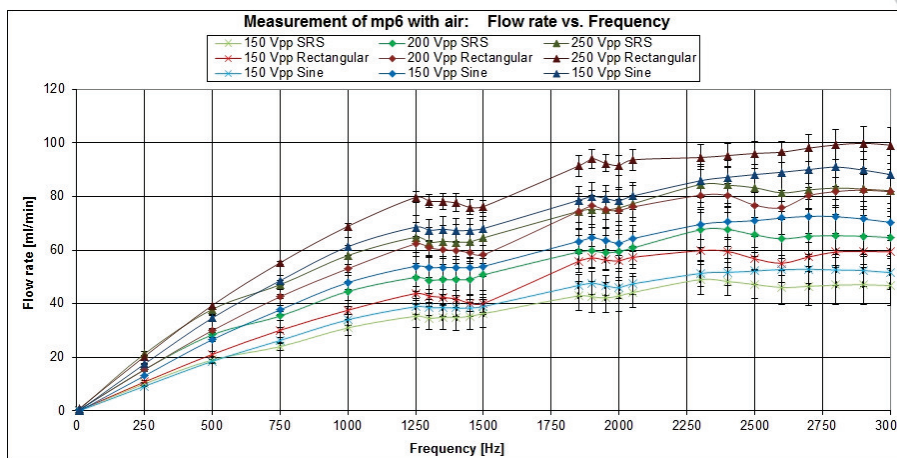
Especially for gas applications pressure levels are a key factor. The micropump mp6 was designed handling liquids, so its flow rate and pressure generation is best at a peak frequency of approximately 100 Hz (for water). With other frequencies the system "micropump mp6 with liquid inside" becomes less efficient and flow rate and pressure generation decreases.

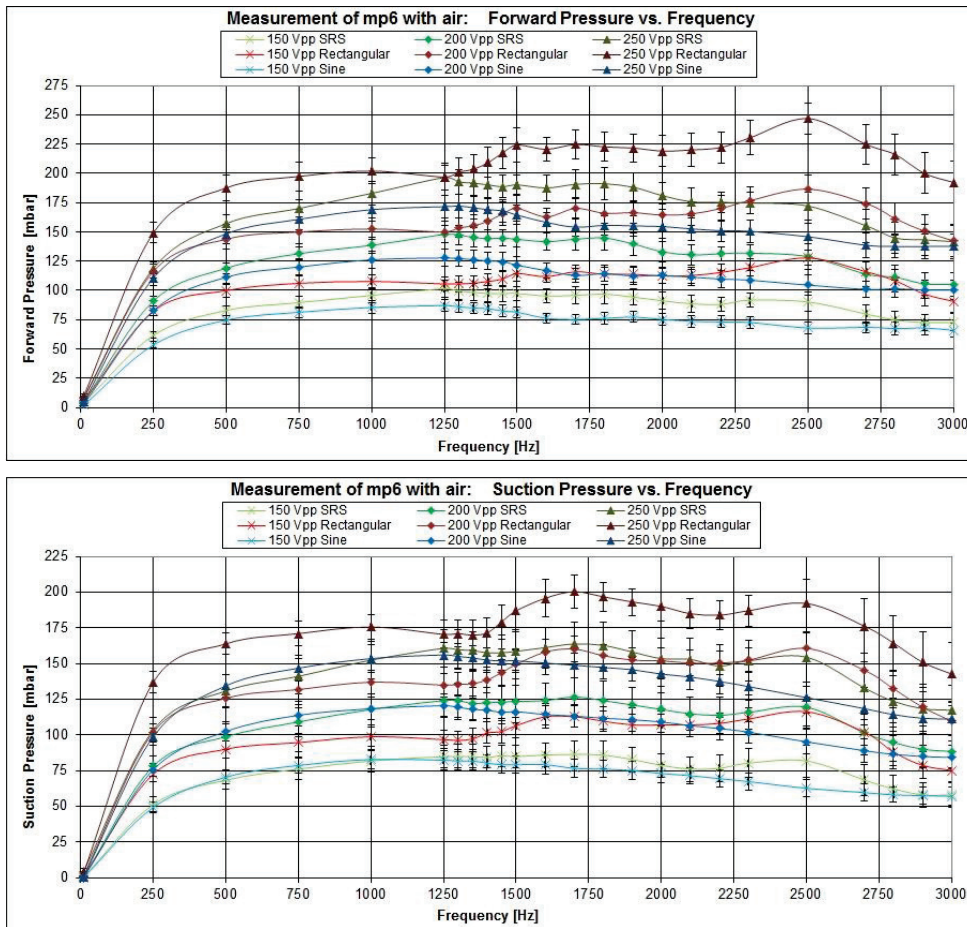
Our micropumps mp6 and mp6-pp are measured with water at 100 Hz; the mp6-AIR is measured with air at 300 Hz. The reason here is that 300 Hz is the maximal frequency of our lab electronic mp-x.

More frequency and hence more performance of mp6-AIR is only possible with specialized electronic like the mp6-QuadEVA.

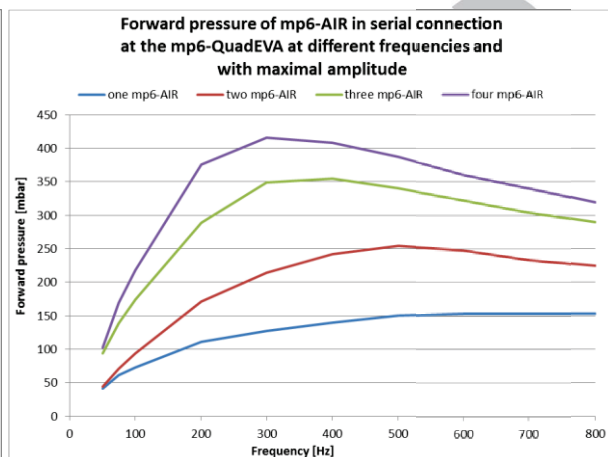
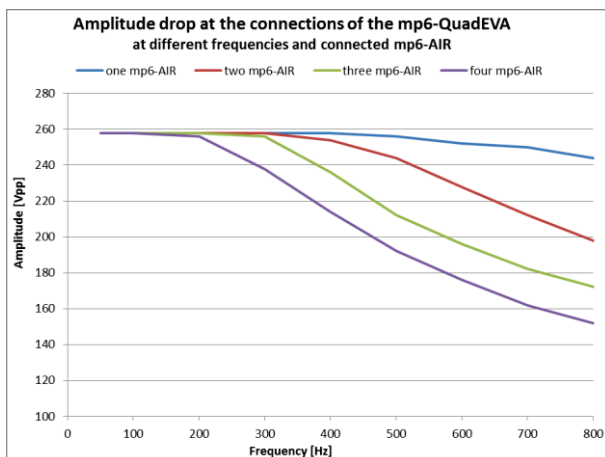


The diagrams below show flow rate and pressure generation – forward and suction pressure – and their dependency on frequency, different driving signals and amplitudes. Please note that the data is based on a waveform generator with an amplifier electronic; each data point represents the mean of five pumps.





The mp6-QuadEVA would achieve similar values, but due to an amplitude drop at higher frequencies and/or with higher load, i.e. connected pumps, the reached values are slightly lower. This amplitude behavior of the mp6-QuadEVA can be seen below (left hand picture) which is the reason for the pressure decrease mentioned above (and here with right hand picture).



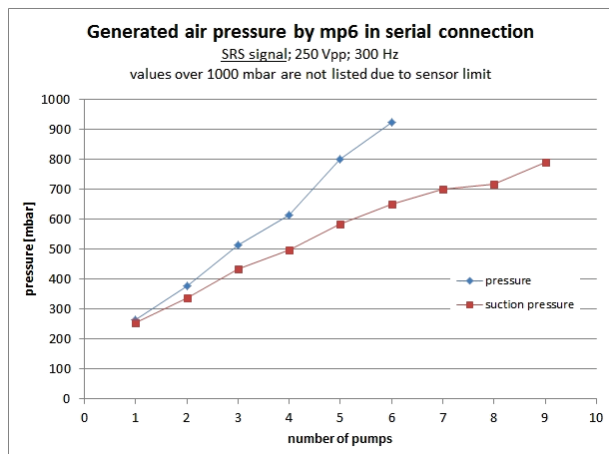
So with higher frequencies more performance is possible but it may not be enough for some applications. Additionally, higher frequencies may be too noisy and loud or the increased power demand for driving higher frequencies is not available by the power source.

Fortunately, there exists an additional solution that can be used with or without higher frequency.

As mentioned above connecting pumps in serial succession increases the pressure level, this applies to liquids and gases. If all pumps are driven with the same signal and connected in a series the pressure generation adds up. Combining pumps in that way enhances forward and suction pressure.

This method cannot be continued forever as the actuators inside the pump have to be able to move under pressure load. When certain levels are passed the actuator stroke is decreasing hence flow rate and pressure generation too. This decrease begins roughly at 600 mbar for suction pressure and around 1000 mbar for forward pressure, so that further pumps will not increase the pressure linear anymore. The difference between suction and forward pressure is caused by the mechanical tensions of the actuator when bulging inwards or outwards.

Realizing such a serial connection of pumps with the mp-x (see diagram) requires one electronic for one pump. Using the mp6-QuadEVA will simplify the electronic side.



Pressure gain with pumps in serial connection, here with one mp-x for one mp6 pumping air.

Bartels Mikrotechnik can assist with additional engineering services bringing this evaluation board technology into your specific application. We can either offer to review your existing design for optimization or by a new development.

We are looking forward to discuss your individual needs in order to provide solutions tailored to your requirements. Contact us today!



Bartels Mikrotechnik Newsletter #9

Eins für vier – Evaluierungs-Board für vier Mikropumpen

Inhalt:

- mp6-QuadEVA – ein neues Evaluierungs-Board für die Ansteuerung von vier Mikropumpen gleichzeitig und für höhere Frequenzen
- Warum mehr Frequenz und mehr Pumpen wenn man Gase fördern will?

mp6-QuadEVA – ein neues Evaluierungs-Board für die Ansteuerung von vier Mikropumpen gleichzeitig und für höhere Frequenzen

Als Entwickler und Hersteller von Mikropumpen hören wir durch unsere Kunden von den Anwendungen in denen unsere Produkte verwendet werden aber auch von dem Bedarf nach mehr Leistungsfähigkeit. Ein weitverbreitetes Ziel der Kunden aus einer Vielzahl von Anwendungen ist es kleine mobile Geräte herstellen zu können. Oft kann eine konventionelle Pumpe – auch wenn diese klein für ihre Art ist – nicht den Anforderungen des geringen Platzbedarfs nachkommen. Unsere mp6 Mikropumpen sind klein, haben eine anständige Leistung, sind aber trotzdem nicht immer stark genug für den Kunden. Mehr Leistung ist ein sehr häufiger Bedarf für viele Anwendungen. Sicherlich existieren andere Pumpen auf dem Markt die mehr Förderrate und/oder mehr Druck erzeugen können, aber diese sind entweder größer oder benötigen mehr Energie und sind fast immer weitaus teurer.



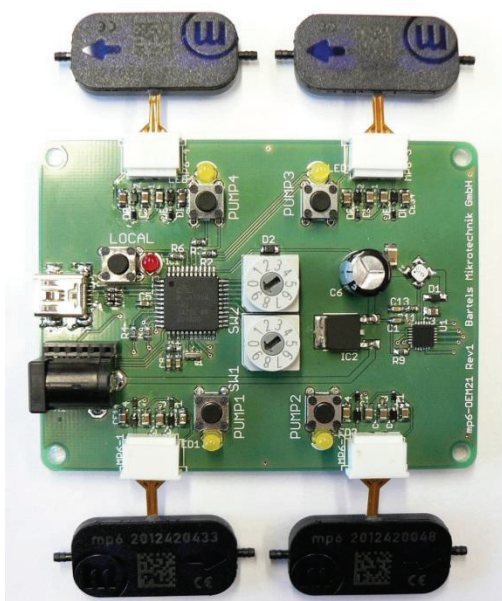
Obwohl Sie unsere Mikropumpen einfach mit den Standard Elektroniken betreiben können - Laborelektronik mp-x und die mp6-OEM für die Integration in die eigene Schaltung - sind beide nicht dafür ausgelegt mehrere Pumpen zur gleichen Zeit zu betreiben. Wenn Sie zwei oder mehr Pumpen in einer Serienschaltung zur Druckerhöhung oder einer Parallelschaltung zur Erhöhung der Förderrate nutzen wollen, benötigen Sie die gleiche Anzahl von Elektroniken wie Pumpen, eine für eine.

Auch wenn die geringen Maße der Mikropumpen es erlauben mehrere Pumpen in ein mobiles Gerät zu integrieren, die Notwendigkeit dieselbe Anzahl von Elektroniken einsetzen zu müssen kann diese Lösung unter Umständen nicht mehr sinnvoll machen.

Eine neue Elektronik wurde jetzt entwickelt diese Notwendigkeit zu brechen: das mp6-QuadEVA.

Dieses neue Evaluierungs-Board basiert nicht auf der mp6-OEM Schaltung, da diese nur eine Pumpe bei voller Leistung betreiben kann. Mit der eigenständigen Schaltungslösung kann das mp6-QuadEVA nun bis zu vier Pumpen gleichzeitig betreiben. Dieser neue Ansatz zur Ansteuerung von mehreren Pumpen wurde primär für die mp6-AIR und die Druckerhöhung mit Serienschaltung geschaffen.

Förderrate und -druck der mp6-AIR und der Standard mp6 sind abhängig von Amplitude und Frequenz des Steuersignals. Für Gase liegt der Spitzenwert für Förderrate und -druck bei einer höheren Frequenz (erstes lokales Maximum bei ~1250 Hz) als bei Flüssigkeiten. Unsere Standard Elektroniken haben eine maximale Frequenz von 226 Hz und 300 Hz, mp6-OEM bzw. mp-x, da beides für die Förderung von Flüssigkeiten beim Frequenz-Optimum von ca. 100 Hz ausgelegt wurde. Mit dem neuen mp6-QuadEVA ist die maximale Frequenz nun auf 800 Hz erhöht worden, was höhere Förderraten und -drücke für Gase erlaubt.

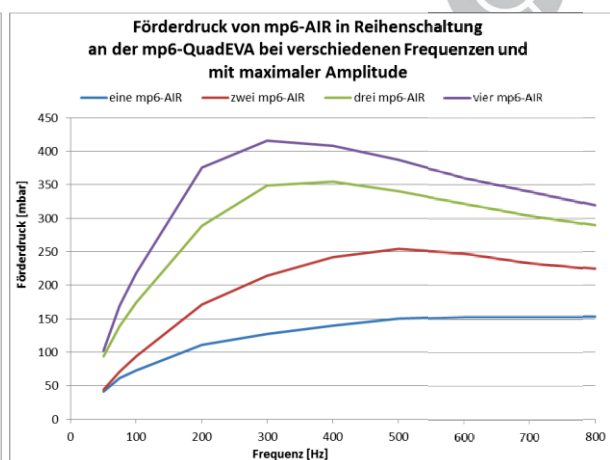
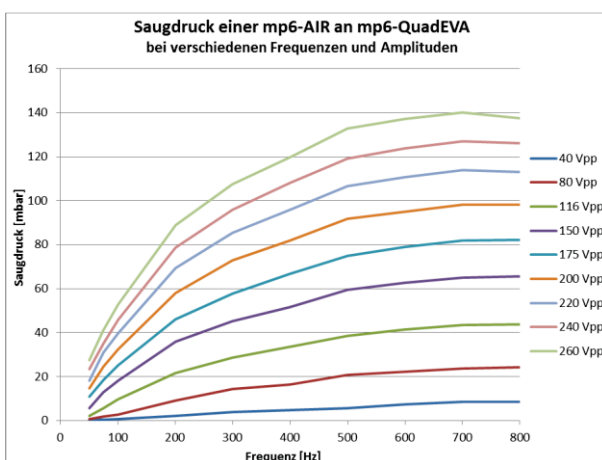
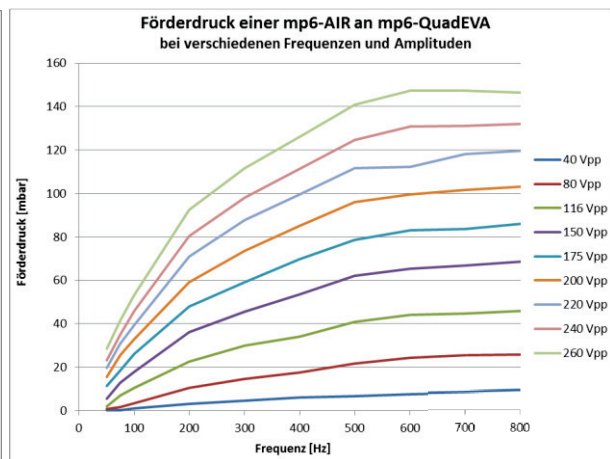
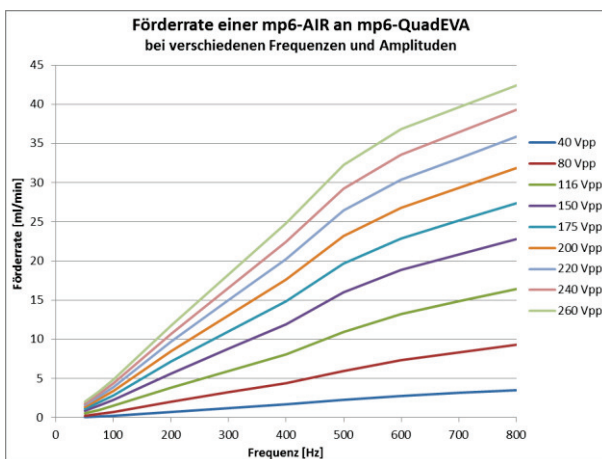


Technische Daten mp6-QuadEVA	
Dimensionen	80 x 60 x 16 cm 3.15 x 2.36 x 0.63 in.
Pumpmedien	Flüssigkeiten, Gase
Max. Förderrate (mp6-AIR, Luft)	je mp6-AIR: ~42 ml/min @ 260 V; 800 Hz
Variable Parameter	Amplitude, Frequenz
Amplitudenbereich	0 - 260 Vpp
Frequenzbereich	50 - 800 Hz
Signalform	Sinus
Stromversorgung	7.5 V, 1000 mA
Stromverbrauch	ca. 220 mA, Spitze 280 mA ¹
¹ vier angeschlossene mp6-AIR @ 260 V und 800 Hz	

Ein weiterer Unterschied zu den Standard Elektronikern ist, dass nur ein Sinus-Signal zur Ansteuerung erzeugt wird. Es ist weniger laut als beispielsweise ein Rechteck-Signal. Das Evaluierungs-Board ermöglicht die Einstellung von Amplitude und Frequenz direkt lokal auf dem Board oder per USB-Verbindung. Auf dem Evaluierungs-Board können Einstellungen mit Drehschaltern abgerufen werden. Jeder Anschlussstelle hat ihren eigenen An/Aus-Schalter und eine Status-LED. Die Steuerung mittels USB-Verbindung kann beliebiger Terminal-Software realisiert werden, die Befehle an die seriellen COM-Schnittstellen schicken kann (z.B. HyperTerminal oder PuTTY (www.putty.org)), oder mit der mitgelieferten Software. Eine eigene Stromversorgung ist für beide Steuerungsarten notwendig.

Das Evaluierungs-Board mp6-QuadEVA ermöglicht dem Kunden mit mehreren Pumpen gleichzeitig zu experimentieren, um die Erreichbarkeit der gewünschten Förderrate und -druck zu prüfen. Obwohl der Anwendungsfokus hier bei den Gasen liegt, können auch Flüssigkeiten gepumpt werden.

Für Luft zeigen die unten stehenden Diagramme Förderraten und -drücke einer einzelnen mp6-AIR. Zusätzlich ist mit dem Diagramm unten rechts der Förderdruck der Reihenschaltung von mp6-AIR dargestellt. Der Grund für den Druckabfall dieser Kurven wird weiter unten beschrieben.



Bartels Mikrotechnik bietet das Evaluierungs-Board als Set an, bestehend aus mp6-QuadEVA, einem Netzteil für die Stromversorgung, einem Mini-USB Kabel, vier Mikropumpen mp6-AIR sowie Software und Treiber.

Als Evaluierungs-Board sind weder Design noch Layout für spezielle Anwendungen oder die Serienfertigung optimiert. Die Schaltung kann für verschiedene Anwendungen adaptiert werden. Somit bieten wir auf Anfrage eine solche Anpassung für Ihre kundenspezifische Anwendung an. Zusätzlich ist es auch möglich Schaltpläne, Stückliste und Quellcode als Lizenz zu erwerben.

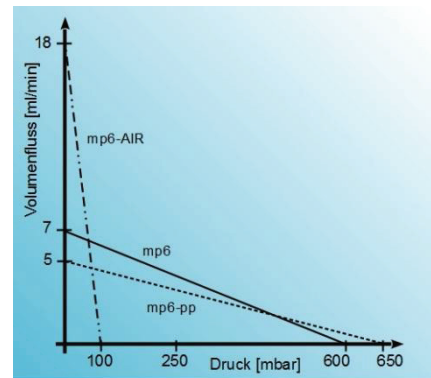
Warum mehr Frequenz und mehr Pumpen wenn man Gase fördern will?

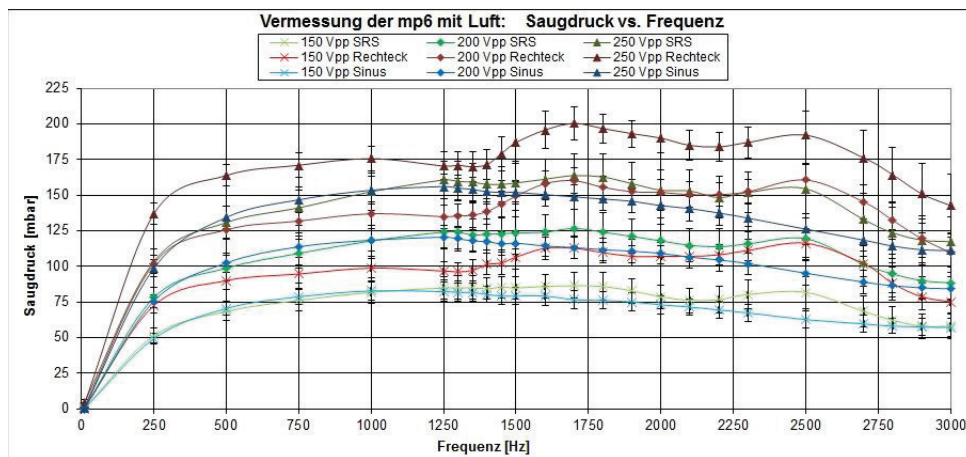
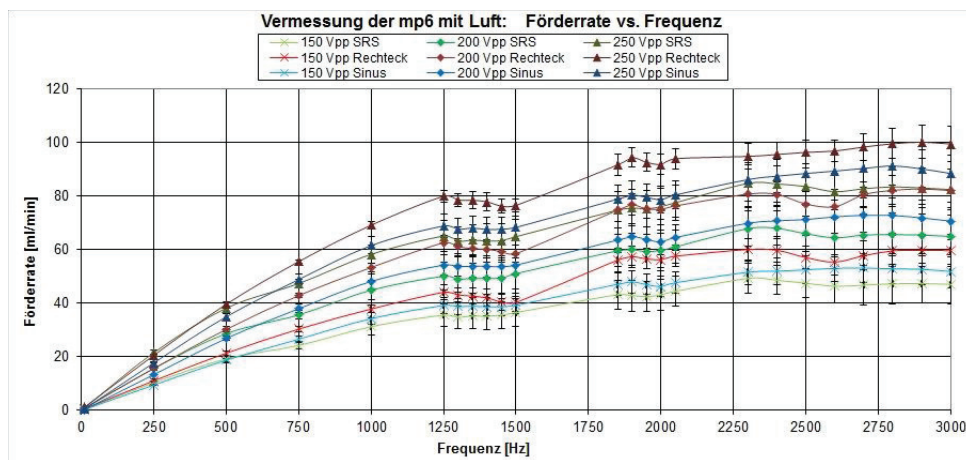
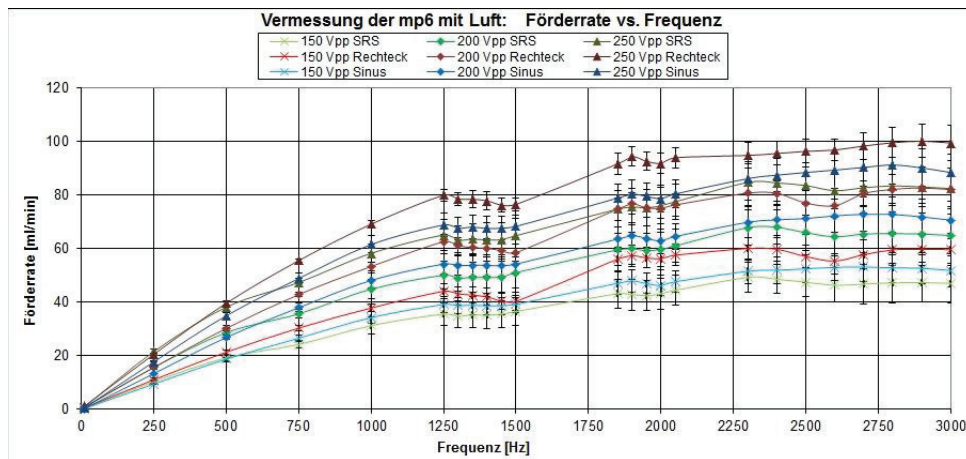
Insbesondere für Anwendungen mit Gasen ist der Druck stets ein Schlüsselement. Die Mikropumpe mp6 wurde für Flüssigkeiten entwickelt, so sind Förderrate und Druckerzeugung am höchsten bei einer Frequenz von ca. 100 Hz (für Wasser). Mit anderen Frequenzen wird das Systems „Mikropumpe mp6 mit Flüssigkeit“ ineffizient und Förderrate und Druckerzeugung nehmen ab.

Unsere Mikropumpe mp6 und mp6-pp werden mit Wasser bei 100 Hz vermessen, die mp6-AIR mit Luft bei 300 Hz. Der Grund für 300 Hz ist, dass es die maximale Frequenz der Laborelektronik mp-x ist.

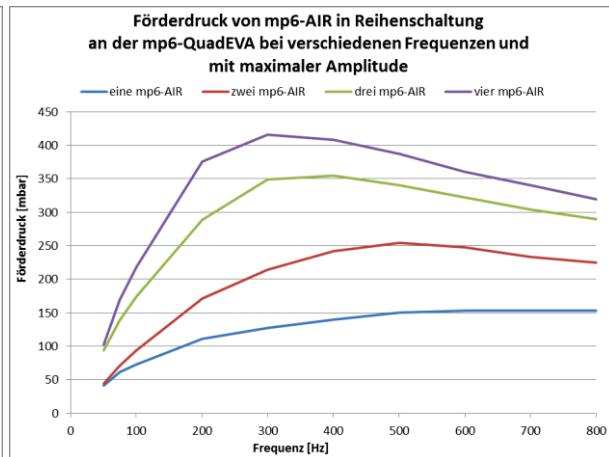
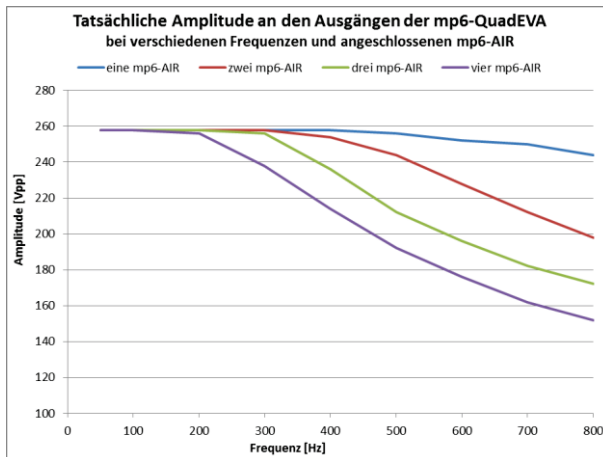
Höhere Frequenzen und somit mehr Leistung der mp6-AIR ist nur mit spezialisierter Elektronik wie jetzt mit der mp6-QuadEVA möglich.

Die unten dargestellten Diagramme zeigen Förderrate und Druckerzeugung – Förderdruck und Saugdruck – mit der Abhängigkeit von Frequenz, verschiedenen Steuersignalen und Amplituden. Bitte beachten Sie, dass diese Daten mit einem Funktionsgenerator und nachgeschalteten Verstärker erzeugt wurden. Jeder Datenpunkt repräsentiert den Mittelwert aus fünf Pumpen.



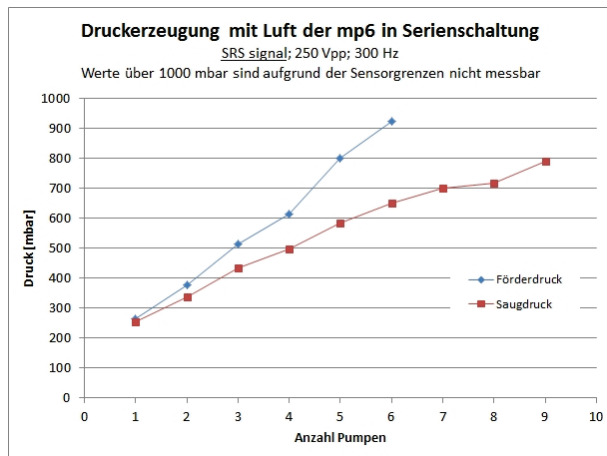


Das mp6-QuadEVA würde ähnliche Werte erreichen, allerdings verringert sich die Amplitude bei hohen Frequenzen und/oder hoher Last, d.h. angeschlossene Pumpen, so dass die Werte etwas niedriger ausfallen. Diese Verringerung der Amplitude am mp6-QuadEVA ist unten dargestellt (linkes Bild) und ist demnach der Grund für den weiter oben erwähnten Druckabfall (und auch hier im rechten Bild).



Zwar ist nun mit höherer Frequenz mehr Leistung möglich, trotzdem kann es immer noch nicht genug für gewisse Anwendungen sein. Des Weiteren können die höheren Frequenzen auch zu laut sein, oder der höhere Energiebedarf, um die hohen Frequenzen zu erzeugen, ist mit der Energiequelle nicht zu decken. Glücklicherweise existiert hier eine weitere Lösung die sowohl mit als auch ohne die hohen Frequenzen genutzt werden kann.

Wie bereits oben erwähnt kann der Druck mit der seriellen Verschaltung der Pumpen erhöht werden, dies gilt für Wasser als auch für Luft. Wenn alle so verschalteten Pumpen mit dem gleichen Signal betrieben werden, addiert sich der erzeugte Druck. Saug- und Förderdruck können so erhöht werden.



Anstieg der Druckerzeugung für Luft mit Pumpen in Serienschaltung, hier mit einer mp-x für eine mp6.

Diese Methode kann nicht unendlich fortgesetzt werden, da die Aktuatoren in den Pumpen sich mit der Druckbelastung noch bewegen müssen. Ab einer gewissen Druckbelastung verringert sich der umgesetzte Hub der Aktuatoren, und somit

Förderrate und Druckerzeugung. Diese Grenze ist bei ca. 600 mbar für den Saugdruck und bei ca. 1000 mbar beim Förderdruck erreicht, so dass der weitere Druck-Anstieg mit weiteren Pumpen nicht mehr linear erfolgt. Der Unterschied zwischen Saug- und Förderdruck liegt hier in den mechanischen Spannungen des Aktuators beim Ein- und Ausbeulen.

Um eine solche serielle Kette von Pumpen mit der mp-x zu erhalten wird für jede Pumpe eine mp-x benötigt. Die Nutzung des mp6-QuadEVA vereinfacht die elektronische Seite.



Bartels-Mikrotechnik unterstützt Sie bei der Umsetzung dieser Evaluierungs-Board Technologie in Ihre kundenspezifische Anwendung. Wir bieten sowohl die technische Überprüfung und Optimierung Ihrer eigenen Lösung als auch Neu-Entwicklungen an.

Wir freuen uns Ihren individuellen Bedarf zu diskutieren, um Ihnen die passende Lösung für Ihre Randbedingungen liefern können. Kontaktieren Sie uns noch heute!

