

TechNote

How to combine multiple pumps to increase flow or pressure performance

In general the flow and pressure performance of the micropump mp6 is limited to a maximum performance which is:

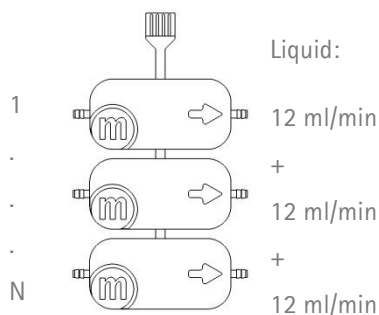
Gas: 12 ml/min (300 Hz) and 100 mbar (300 Hz)

Water: 6 ml/min (100 Hz) and 500 mbar (100 Hz)

(values defined with mp-x: 250 V; SRS)

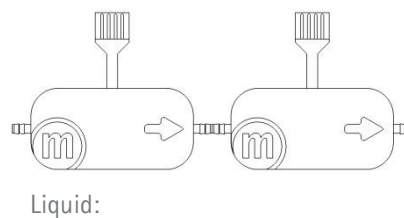
Applications requiring higher performance parameters can in general be accessed by combining multiple pumps together. The effects achievable are similar to how resistors behave in circuitry when connected in series or parallel. So summing it up in short, depending on the fluidic connection the flow or pressure performance is adding up.

Increase of volume performance



$$\text{Flow} = N * 12 \text{ ml/min}$$

Increase of pressure performance



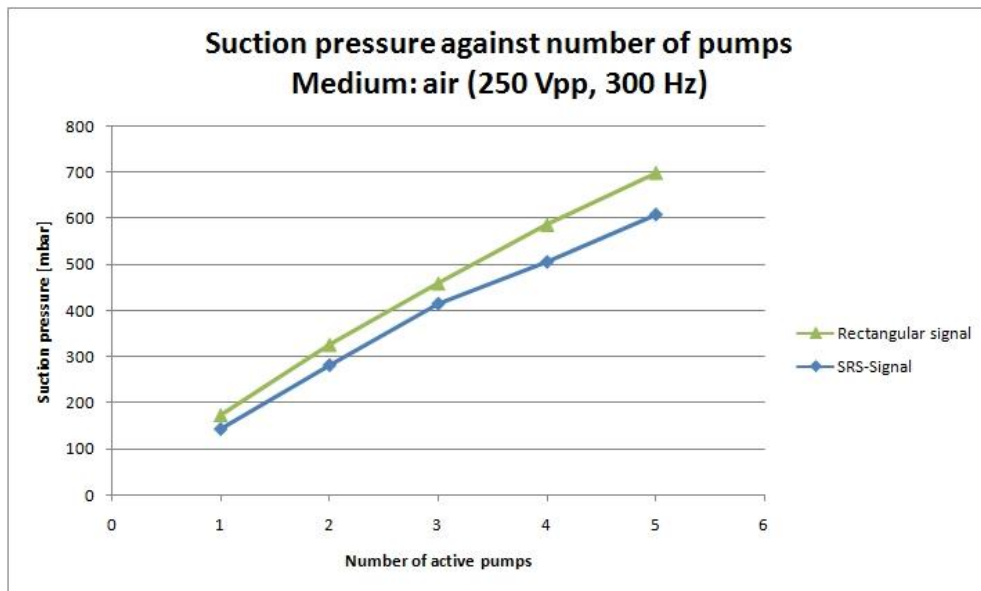
$$900 \text{ mbar} + 900 \text{ mbar}^*$$

*tested: 2 bar (total pressure capability is in customers responsibility)

For aqueous applications this means, by combining pumps in parallel the flow rate can be increased by approximately 7 ml/min for each pump added. This effect decreases with every pump by a small friction. As the flow rate increases the pressure remains stable. The overall pressure is equivalent to the pressure performance of an individual pump regardless the amount of pumps added. Y-connectors for connection of pumps in parallel through tubing are offered as standard accessory in the pump catalogue.

And by driving pumps in series the pressure performance roughly increases by 600 mbar for every pump added. This effect lowers for additional pumps. Combinations with more than 3 pumps are not advised. Combining several micropumps in series has no impact on the flow rate as the later pumps can only transport the output of the first pump.

For vacuum applications, the same behavior is also observed concerning the suction pressure of the pump, as shown below:



In general it should be noted that the values refer to the performance at optimal driving parameters of the mp6 standard pump. For performance improvement through multiple pumps, please keep in mind the diameter of the tubing suitable for the desired flow, otherwise the advantages gained through multiple pumps are lost to the flow friction of the tubes. Additionally the tubing connectors for stacking pumps in series should be as short as possible to reduce performance loss.

For applications requiring even higher flow or pressure performance the piezo micropump can also be customized. Due to the simple design, pumps can be scaled in terms of flow rate and pressure performance (suction and back pressure). The flow scales approximately by the power of two over the piezo diameter. Improvement of the compression rate can be achieved by redesign of the overall fluidic design and the pump chamber. Due to required development time and costs this approach is advisable for quantities above 10k pieces per year.

