## Nonlinear pressure-flow relationships for passive microfluidic valves

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## **Supplemental Information**

The figure below illustrates the fabrication process. (1) Disconnected microchannels are etched into a Borofloat glass slide (Schott) using conventional lithography techniques. The remaining layers are then stripped from the glass surface. (2) A narrow strip of AZ4210 photoresist approximately 4 µm thick is then patterned over the weir, again using conventional lithography. (3) Access holes are drilled into the bottom of the slide, and port fittings are attached. A PDMS sheet is then plasma bonded to the top, over the photoresist covering the weir. The photoresist over the weir is then removed by flushing the channel with methanol, thus freeing a narrow channel over the weir that is nominally closed (at zero upstream/ pressure/flow). (4) The finished device is capped with a glass slide with a rectangular hole that is clamped to prevent deformation of the film over the inlet and exit channels. The window in the slide permits the film to deflect upwards and allow flow over the weir. It also allows inlet and outlet pressures (just in front of the weir and just after) to be estimated by measuring the film deformation at those locations.

In all experiments, the channels were 60  $\mu$ m deep, 1.1 mm wide and the inlet-to-outlet distance was fixed at 16 mm. Consequently, the distance from the leading and trailing edges of the diode to the inlet and outlet connections decreased as diode length increased. The film was 280  $\mu$ m thick in all cases. Three diode widths were studied: 0.2, 0.5 and 1 mm. Thus, the diodes involved a width constriction of 5.5-1, 2.2-1 and 1.1-1, as well as the vertical constriction controlled by deformation of the film. Such constrictions were chosen to ensure that the pressure drop through the diode was larger than that of the channels: otherwise, the pressure in the diode is dominated by the fluidic resistance of the downstream channel. For each case, the length of the diode (weir) was fixed to be ten times the width of the diode (i.e. the lengths were 2 mm, 5 mm and 10 mm).

The experiments consisted of injecting a prescribed flow rate with a syringe pump connected to the inlet channel, and measuring the steady-state deflection. The deflection was measured using extrinsic Fabry-Perot interferometry (EFPI) (FiberPro 2, Luna Innovations) [1]. In this approach, a fiber optic is aligned

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over the planar position where the deflection is to be measured using a micro-positioning stage: at each location, the stage is used to find the location of the maximum reflected signal, which corresponds to the location of maximum film deflection. The forward flow rate was increased stepwise, and the steady-state deflection at various locations recorded: after a maximum of 480  $\mu$ L/min, the flow-rate was decreased in a stepwise fashion, with accompanying deflection measurements at each step. This cycle was repeated three times. Within experimental error, the measurements with decreasing flow rate agreed with those with increasing flow rate: the exception was the narrowest diode, which exhibited slightly larger deflections when the flow rate was stepped down.



## References

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