A microfluidic control system consisting of micropump/valves with a re-usable pneumatic actuator and a disposable polymer lab-on-a-slide is presented. The lab-on-a-slide was fabricated using low cost methods, such as injection moulding of TOPAS® cyclic olefin copolymer (COC) slide, lamination of different layers of polymer, and ultrasonic welding of TOPAS® lid to the slide. The re-usable pneumatic actuator not only simplifies the design of the lab-on-a-slide and reduces the fabrication cost, but also reduces the possibility of cross contamination during replacement of the disposable lab-on-a-slide. The experiment results show the micropump is capable of providing a wide range of flow rate (20–300 μL/min), and microvalves provides a reliable fluidic control in the different parts of the system.