

Muthard and Diamond

Side view thrombosis microfluidic device with controllable wall shear rate and transthrombus pressure gradient

Ryan W. Muthard and Scott L. Diamond*

Institute for Medicine and Engineering
Department of Chemical and Biomolecular Engineering
1024 Vagelos Research Laboratory
University of Pennsylvania
Philadelphia, PA 19104
Tel 215-573-5702
sld@seas.upenn.edu

*Corresponding Author.

Word Count: 6,163 words (8 figures); 30 references

Supplement: Figures S1-S3

Key words:

Running title:

Muthard and Diamond

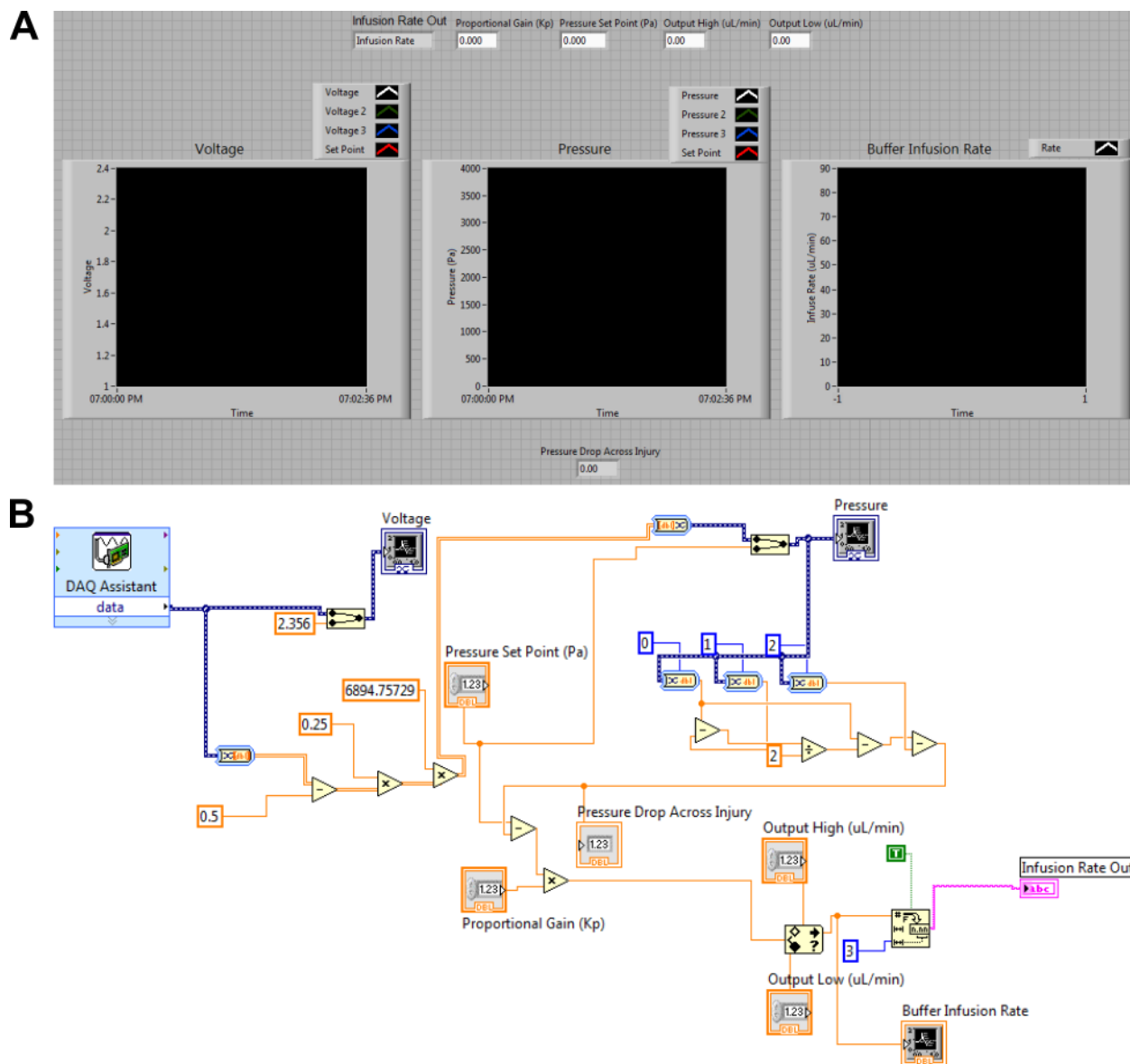


Figure S1. A LabVIEW program to measure and control microfluidic pressure gradients. A user interface was developed to monitor instantaneous pressure measurements inside of the microfluidic channel at three independent pressure sensors. The pressure transducers outputted voltage signals that were then converted into pressure. The pressures were monitored and controlled proportionally by a proportional gain constant (K_p) that produced a resulting flow rate required to maintain the pressure gradient set point. The interface continuously displayed the resulting voltage, pressure, and flow rate (A). The underlying block diagram illustrates the voltage to pressure signal conversion and the proportionate controller used to calculate the required buffer infusion flow rate (B).

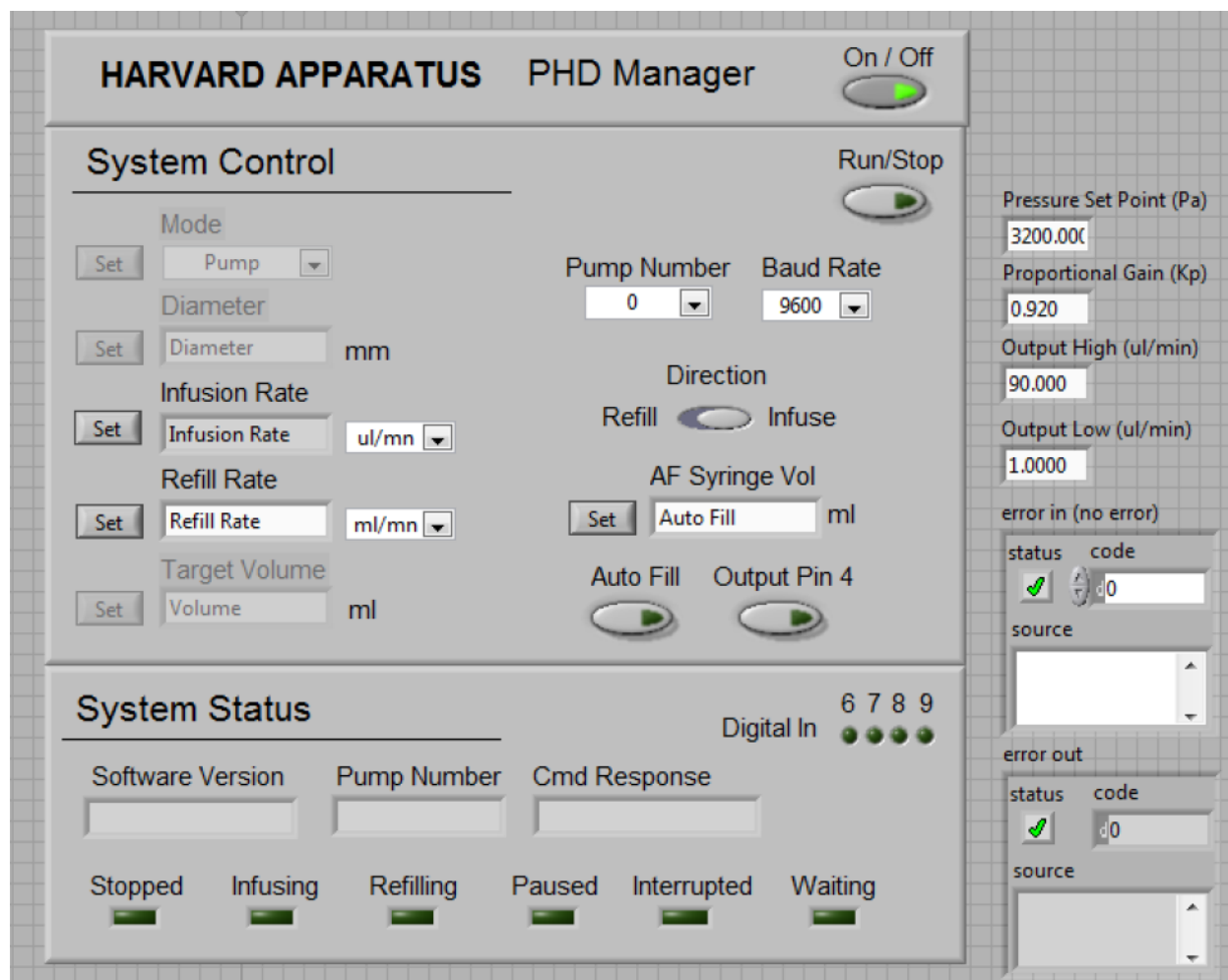
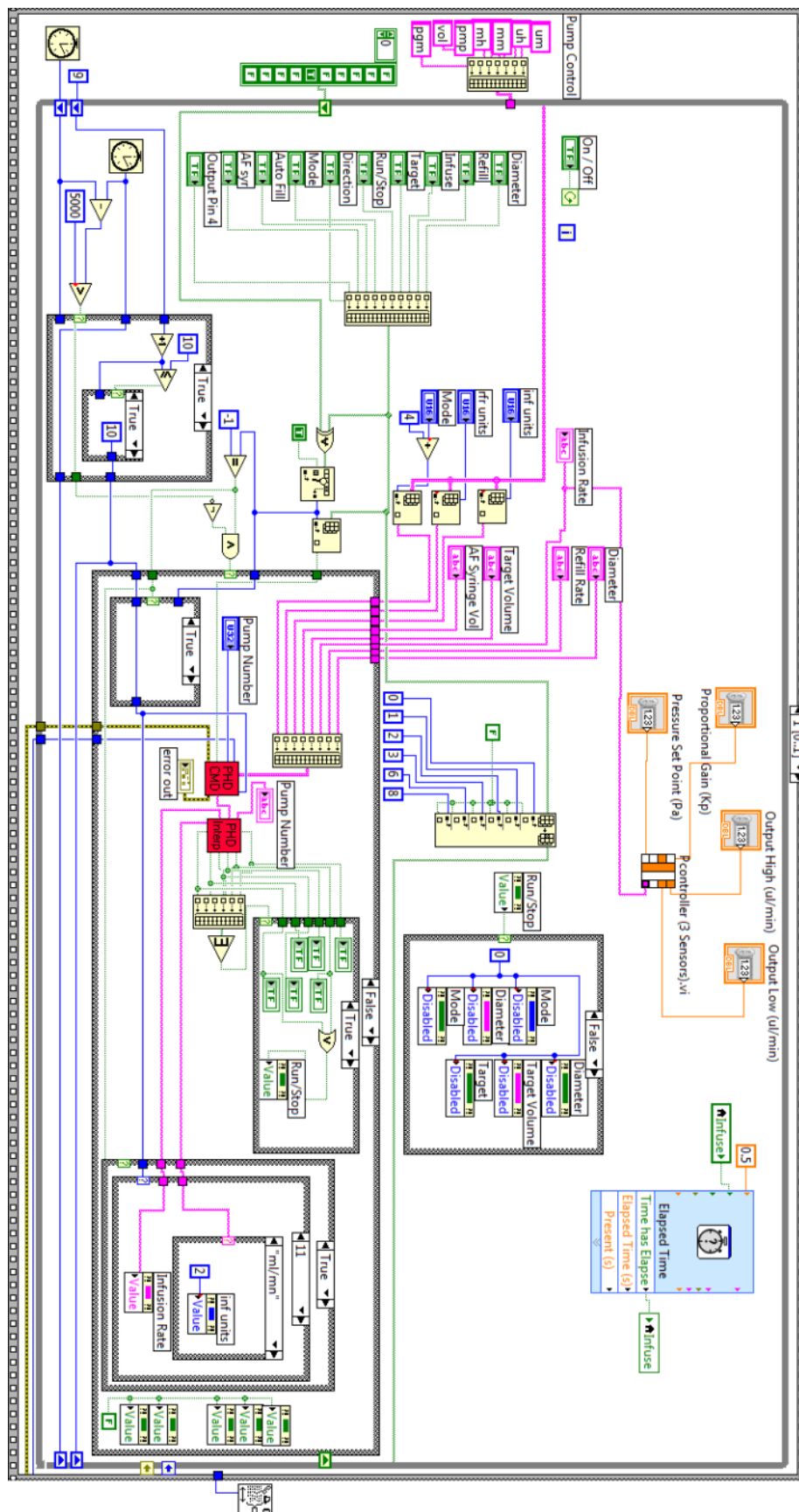


Figure S2. A customized LabVIEW interface for controlling syringe pump flow rates to maintain a pressure gradient set point. This interface directly controls a Harvard Apparatus PHD 2000 syringe pump allowing computer input of the infusion rate, refill rate, syringe diameter, pumping direction, and on/off. For the purpose of controlling microfluidic pressure gradients, the interface was supplemented with inputs for pressure set point, proportional gain, output high, and output low. Prior to imaging under flow, this interface was initiated (Run/Stop) and device pressure gradients were stabilized at the desired set point.

Muthard and Diamond



Muthard and Diamond

Figure S3. A LabVIEW block diagram utilized to control a Harvard Apparatus PHD 2000 syringe pump. This block diagram was supplemented with code to control the output infusion rate based on an externally designed proportional controller interface using instantaneous microfluidic pressure measurements. The external program measures pressure and calculates an adjusted flow rate necessary to proportionally control the pressure gradient at the desired set point. The flow rate is passed to this interface which continuously updates the pump infusion rate every 0.5 s, allowing the microfluidic pressure gradients to remain constant.