

LabSmith uProcess™

Microfluidics Automation System

- ▶ Automated fluid delivery and routing
- ▶ Innovative software for coordinated control
- ▶ Sequence-controlled pressure-driven flow
- ▶ Fast, simple automation construction



Figure 1. uProcess hardware, including: AV201 automated selector valves, SPS01 programmable syringe pumps, 4VM01 valve manifold, and IBB integrated breadboard. LabSmith's CapTite™ fluid routing components and a microfluidic chip complete this easy-to-use system for delivering micro- and nano-fluidic volumes.

Coordinated, Automated Fluid Control

LabSmith's uProcess™ system (Figure 1) is a platform comprised of hardware and software products that simplify construction and control of microfluidic systems.

Automated uDevices

uDevices connect to CapTite™ microfluidic interconnect products to make it easy to build and rebuild micro- and nano-fluidic circuits. This results in zero dead volumes and compatible, quick-to-assemble fluid interfaces, taking the hassle out of fluid routing.

SPS01 Programmable Syringe Pumps come in sizes from 5 to 100 μ l total volume, with step sizes from 8 to 100 nL. The pump body design allows syringes to be easily removed and replaced, providing a wide range of volumes with a single pump.

AV201 Automated Selector Valves provide 2-position, 3-port switching, with zero dead volumes and low swept volumes.

Programmable Automated Operation

uProcess Software (Figure 2) provides a simple interface for configuring and controlling uDevices via a laptop or PC, to simplify programming of automated processes for coordinated control of uDevices.

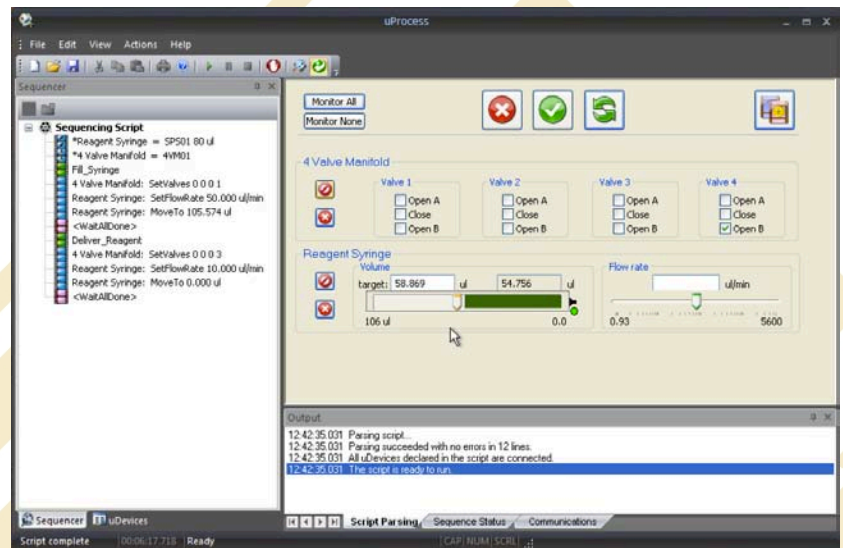


Figure 2. uProcess software provides a simple interface to control automated uDevices and create automated processes.

uDevices: SPS01 Programmable Syringe Pump



Figure 3. SPS01 Programmable Syringe Pump.

TABLE 1. SPS01 Syringe Pump Specifications

Reliable Delivery, Remarkable Size

Only 100 mm long, the SPS01 syringe pump (Figure 3) uses a fraction of the space and power required by other syringe pumps. The SPS01 delivers volumes from 5 to 100 μl , with resolution as low as 8 nl.

Low Dead Volume, Easy Cleaning

The SPS01's unique syringe glass design directly connects to 360 μm OD capillary and 1/16" OD tubing via LabSmith's CapTite connector for very low dead volumes. The Delrin® housing allows syringes to be easily removed and replaced, so a single pump can provide a wide range of volumes. All wetted surfaces can be easily removed for sterilization and autoclaving.

Coordinated Fluid Delivery

LabSmith SPS01 syringe pumps are fully programmable for coordinated fluid delivery and sequencing. An Electronic Interface Board (EIB) is required for operation; a single EIB can simultaneously control up to 10 uDevices (valves and syringe pumps), or can control many more sequentially.

Included uProcess™ software makes it easy to create programs to operate syringes and valves.

PERFORMANCE					
Model	Max Volume (μl)	Min Flow Rate ($\mu\text{l}/\text{min}$)	Max Flow Rate ($\mu\text{l}/\text{min}$)	Step Size (μl)	Max Pressure (psig)
-04	5	0.05	280	0.008	> 500
-08	10	0.10	560	0.017	> 500
-20	20	0.20	1100	0.033	> 500
-40	50	0.50	2800	0.083	300
-80	100	1.0	5600	0.17	200
Volume Accuracy		~ 1% (infuse direction)			
Flow Rate Accuracy		~ 1% (infuse direction)			
Service Temperature Range		50–176° F (10–80° C)			
PHYSICAL					
Dimensions	100 x 25 x 20 mm (3.9 x 1.0 x 0.79") L x W x H				
Housing Material	Delrin®				
Syringe Material	Glass with PEEK™ tip				
Plunger Material	Stainless steel with Teflon® tip				
Wet Volumes	5, 10, 20, 50, and 100 μl standard volumes				
Stroke Length	12 mm				
Syringe Glass	Interchangeable; all volumes supported with the same housing				
Tip Interface	Directly connects to 360 μm OD capillary, and 1/16" OD tubing for selected models				
Cleaning	Wetted parts can be chemically sterilized or autoclaved				

uDevices: AV201 Automated Valves



Figure 4. A CapTite™ AV201 automated valve shown with three CapTite™ one-piece fittings.

Programmable Automated Valves

LabSmith's CapTite™ AV201 automated, 2-position valves (Figure 4) deliver programmable, "L" pattern flow routing (Figure 5) in a fraction of the footprint required with most valves (Figure 6). AV201 valves operate at pressures up to 10 kpsi for use with 360 μm, 1/32" or 1/16" tubing. All models feature zero dead volume connections, nanoliter swept volumes (Table 2), rapid flow response time (Figure 7), as observed in the manual valves, low carryover, and inert, durable wetted materials. Valves include holes for breadboard mounting.

Easy Integration with Syringe Pumps via uProcess

A 4VM01 Valve Manifold is required to electronically control automated valves (one 4VM01 manifold can control up to 4 valves). An Electronic Interface Board (EIB) is also required; a single EIB can simultaneously control up to 10 uDevices (valves and syringe pumps), or can control many more sequentially.

LabSmith uProcess breadboards allow easy mechanical and electrical integration of AV201 automated valves and other uDevices. The iBB breadboard adds optical integration with the SVM340 Synchronous Video Microscope (Table 3).

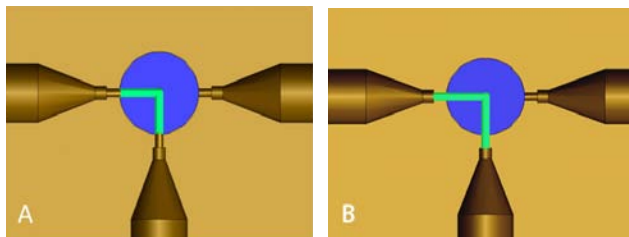


Figure 5. (A) Swept Volume, and (B) Valve Volume definitions.

TABLE 2. AV201 Automated Valve Specifications

VALVE	THROUGH HOLE DIAMETER	SWEPT VOLUME (FIG. 4A)	VALVE VOLUME (FIG. 4B)
AV201-C360	0.01" [250 μm]	130 nl	170 nl
AV201-T132	0.01" [250 μm]	130 nl	170 nl
AV201-T116	0.02" [510 μm]	520 nl	1.1 μl

4VM01 Valve Manifold is required. One manifold controls up to 4 valves.

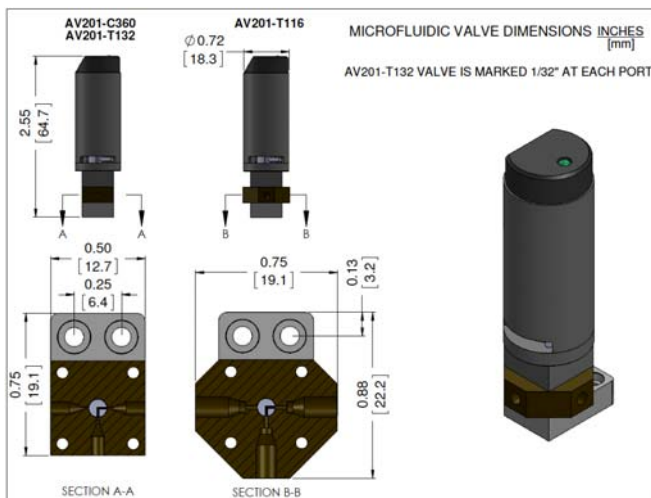


Figure 6. AV201 Valve dimensions.

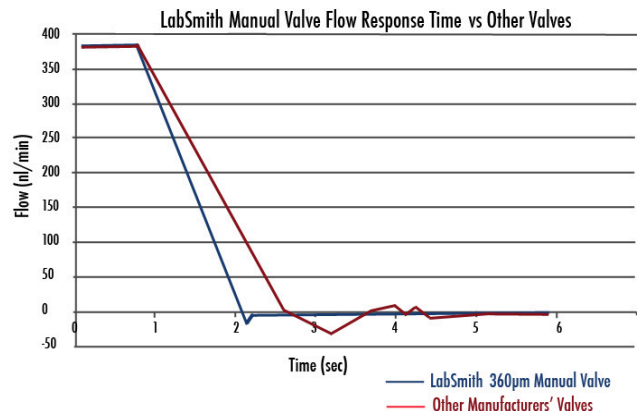


Figure 7. Manual valve flow response-time performance.

uProcess Required and Optional Hardware

Figure 8 shows the components of a typical uProcess setup:

- A. Electronic Interface Board (EIB) is required to control SPS01 syringe pumps or AV201 Valves.
- B. uPB or iBB breadboard (uPB-05 shown) is optional, for simplified component mounting.
- C. SPS01 Programmable Syringe Pump.
- D. 4VM01 Valve Manifold is required to control AV201 automated valves. One 4VM01 can control up to 4 valves.
- E. AV201 Automated Valve.
- F. CapTite™ microfluidic routing components complete the fluid circuit. Shown here are a Breadboard Reservoir, one-piece fittings and capillary.

TABLE 3. uProcess Required and Optional Equipment

AUTOMATED CONTROL AND SEQUENCING	
uProcess™ software included	
LabVIEW™ drivers included	
Software Developers' Kit (C, C++) included	
ELECTRONIC INTERFACE BOARD (REQUIRED)	
Device Connections	Controls up to 60 uDevices (syringes, automated valves, etc.)
Interface	RS-232; optional USB adaptor sold separately
Power	12 volt, 1 amp external power supply included
OPTIONAL HARDWARE	
uPB-05 Breadboard	185 x 133 mm (7.3 x 5.2") breadboard with connections for 5 syringes; ¼" hole spacing for connecting LabSmith CapTite™ microfluidic connector products
uPB-08 Breadboard	25.4 x 22.9 cm (10 x 9") breadboard with connections for 8 syringes; ¼" hole spacing for connecting LabSmith CapTite™ microfluidic connector products
iBB Breadboard	25.4 x 22.9 cm (10 x 9") breadboard with connections for up to 8 syringe pumps; ¼" hole spacing; 2.5 x 7.6 cm (1 x 3") cutout for viewing microsystems on LabSmith SVM340 Synchronous Video Microscope; hardware for mounting to SVM340 is included.

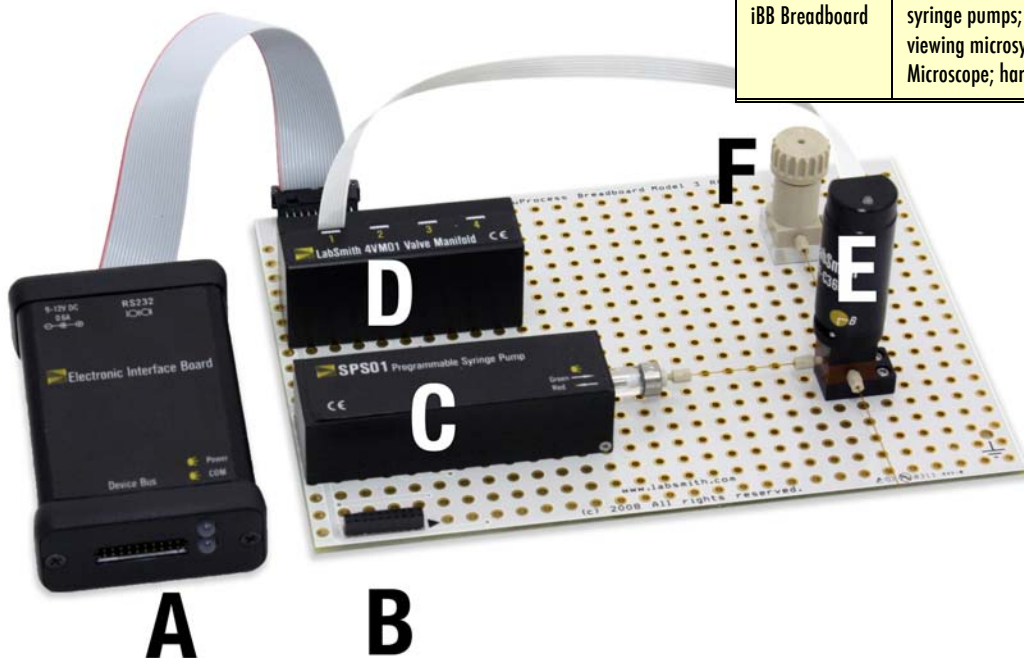


Figure 8. Components of a typical uProcess automated fluid routing setup.

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