

LabSmith Microfluidic Application Note

Sensirion Flow Sensor Control with uProcess

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LabSmith's uProcess™ devices, such as syringe pumps, valves, sensors, and temperature control products, can all be monitored and controlled by uProcess scripting software. The software can also interface with specific third-party components such as the Sensirion® flow sensor (Model SLF3S-0600F).

This application note shows how to use uProcess components and software with a Sensirion flow sensor to develop a continuous-flow system that maintains a constant, set pressure.

Sensirion SLF3S-0600F Flow Sensor Setup

The SLF3S-0600F evaluation kit from Sensirion includes the flow sensor, USB interface, and mounting clamp. Figure 1 shows the sensor mounted on a uProcess breadboard along with the uProcess components detailed in Table 1.

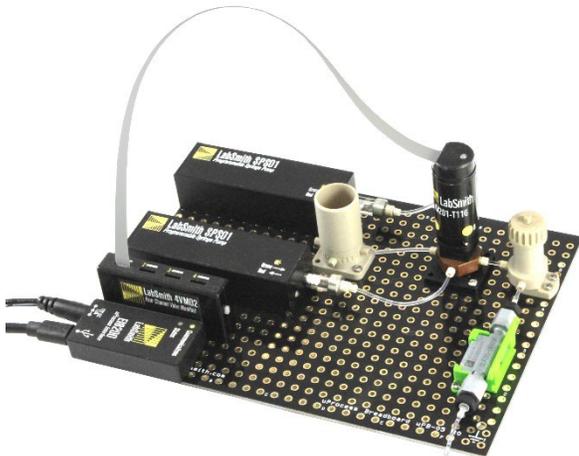


Figure 1. Application setup.

For this setup, two USB connections are required to the computer: one from the flow sensor via the SCC1-USB cable, and one from the uProcess Electronic Interface (EIB200) via a micro-USB cable to controls all uProcess devices.

uProcess Flow Sensor Software Setup

1. Connect the USB cables to the computer and connect the power cord to the EIB200.
2. Start the uProcess software.
3. Right-click on **Instruments** (Figure 2).
4. Choose **New Instrument > Sensirion SF06**.

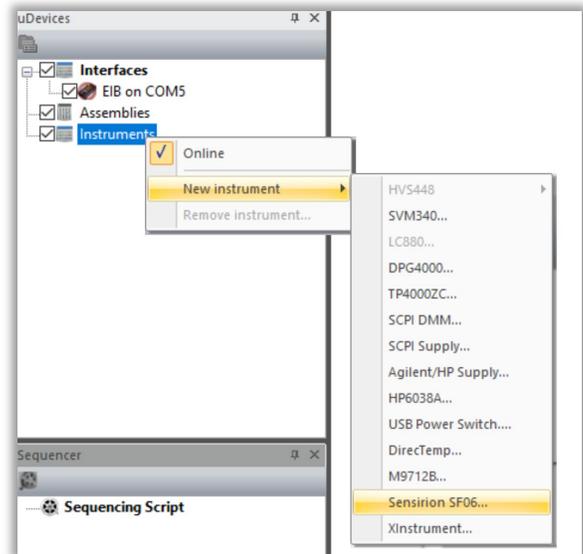


Figure 2. Adding Sensirion Flow Sensor

The uProcess software window for the sensor should look similar to Figure 3:



Figure 3. Sensirion Flow Sensor shown in uProcess software

Note: uProcess software version 2.056 or higher is required for the Sensirion Flow Sensor.

Table 1. Components used for flow sensor control

LabSmith P/N*	Description	Qty
uPB-5	uProcess breadboard	1
EIB200	Electronic Interface	1
4VM02	4-channel valve manifold	1
AV202-T116	Three-position, 4-port automated valve	1
SPS01-080-T116	Syringe pump (100 µl volume)	2
BBRES-1ML-T116	1.1 ml breadboard reservoir with cap and O-ring	1
BBRES-5ML-T116	Breadboard reservoir, 5 ml volume	1
T116-100	One-piece fitting	6
T116-101	One-piece plug	2
BB-TOOLS	Breadboard hardware and installation tools	1
TUBE116-030F	FEP capillary tubing	1m
SLF3S-0600F*	Sensirion Flow Sensor Evaluation Kit (available from mouser.com, P/N 403-SEK-SLF3S-0600F)	4
LT-115*	PEEK flangeless nut for 1/16" OD tubing (available from idex-hs.com)	2

* Non-LabSmith products

Example Flow Sensor Application

For this application two syringe pumps provide continuous flow to maintain pressure in a reservoir. While one pump is flowing, the other is filling, and vice versa. The reservoir dampens the fluctuations that can occur with stepper-motor driven syringe pumps. The Sensirion flow sensor is mounted downstream of the pressurized reservoir to monitor the flow rate, while the uProcess software uses feedback from the flow sensor to maintain the desired flow rate.

The [uProcess Quick Start Guide](#) and the [Introduction to uProcess](#) video provide helpful information for getting started with uProcess.

The uProcess software window (Figure 4) shows the control panel with the two syringe pumps, valve manifold, and Sensirion flow sensor connected.

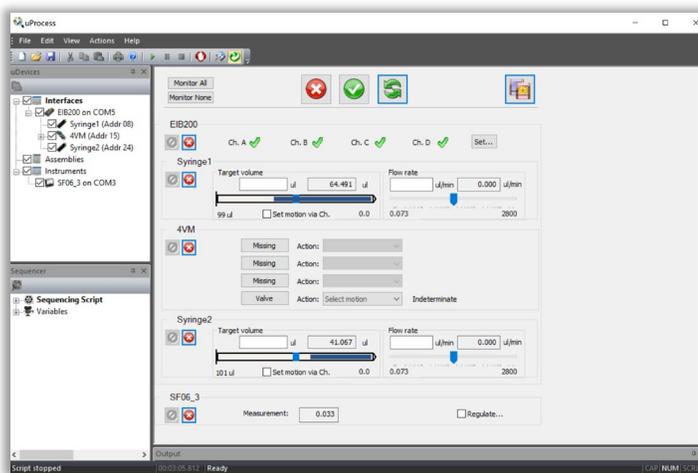


Figure 4. Component controls in uProcess

This script snippet shows the basic uProcess commands for the Sensirion sensor:

```
*SF06_3 = SF06 ; initializes the SF06 flow sensor
flow_reading = SF06_3.Reading ; reads the SF06 flow sensor
```

A complete uProcess script for regulating the flow using the Sensirion flow sensor is available at labsmith.com/applications/uProcess_Sensirion_Script.usq. In this script, while SPS01-1 pumps liquid through the flow sensor, SPS01-2 is refilling. When SPS01-1 is emptied, the valve switches such that SPS01-2 can provide uninterrupted flow. Once the flowrate is within the set range, a feedback loop is used to cycle the syringes on and off to maintain the reservoir pressure needed to maintain the set flowrate.

Direct measurement of the reservoir pressure is not necessary for this application; however, if desired, a uProcess uPS01 pressure sensor could be installed in the port on the top port of the BBRES-T116-1ML reservoir to monitor the pressure.

A snippet of the uProcess code is shown below:

```
flowrate = 50
error = .25

if (SF06_3.Reading < (flowrate-error)); if flowrate is low
{
    4VM: SetValves(0, 0, 0, 3)
    Syringe2: MoveTo ( 5.00 ul/min ) ; pressurize reservoir
    while (Syringe2.Volume > 20)
    {
        if (SF06_3.Reading >= (flowrate+error)); if flowrate is high
        {
            Syringe2: Stop(); stop syringe
            Goto EmptySyringe2
        }
    }
    Syringe2: Stop()
    Goto EmptySyringe1; continue pressurizing with Syringe1
}
```

Figure 5 shows the flow rate measured by the Sensirion flow sensor. The uProcess software was able to maintain consistent flow at the desired flow rate (50 $\mu\text{l}/\text{min}$) using the feedback loop from the flow sensor.

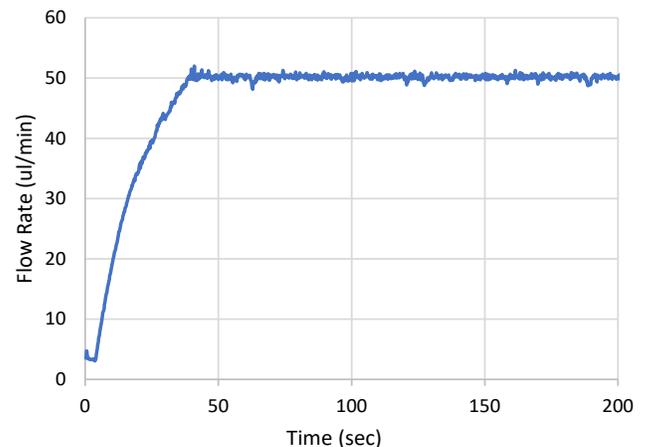


Figure 5. Regulated flowrate data

Logging Data

The uProcess software makes it easy to log data from the uProcess devices and sensor to a .csv file. To start logging data, in uProcess choose **File > Log Status/Measurements** (Figure 6).

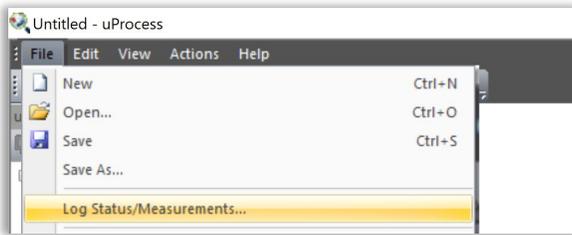


Figure 6. Logging data in uProcess

You can change the logging settings by choosing **View > Status/Meas Logging Options** (Figure 7).

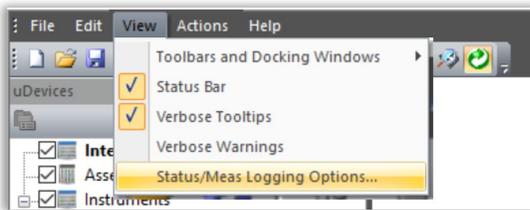


Figure 7. Changing logging settings on uProcess

In addition to logging the flowrate data shown in Figure 5, the uProcess log file also shows the syringe position, valve state, and (if used) pressure data. Figure 8 shows a plot of all of the data logged by uProcess.

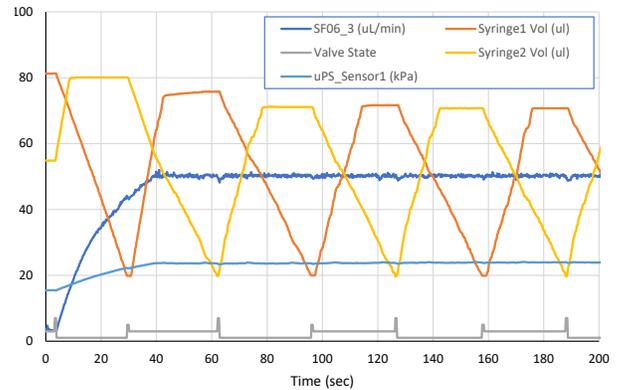


Figure 8. Data from all components in this application

Conclusion

The combination of uProcess devices and scripting software makes it easy to assemble basic circuits (such as the one shown in this example), as well as more complex circuits for microfluidics experimentation and OEM devices. The combination of reusable, reliable automation components and easy-to-learn programming makes the uProcess suite ideal for breadboarding and prototyping circuits for microfluidics and microbiology.



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