

# Coordinating Control Between uProcess and External Devices

LabSmith's uProcess series of automated valves, programmable syringe pumps, and pressure sensors allows complete control of microfluidic processes. The devices are controlled via uProcess software. LabVIEW drivers and an SDK for custom software development are also available. This application note describes how to coordinate control between uProcess devices and external devices, such as signaling an external device when the uPS pressure sensor is above a certain value, or switching a valve when an external trigger signal is activated.

## Introduction

The uProcess devices are connected to the computer through the uProcess Electronic Interface (EIB100 or EIB200). The EIB has 4 logic channels (A-D) which can be used to coordinate control among uProcess devices or with external devices.

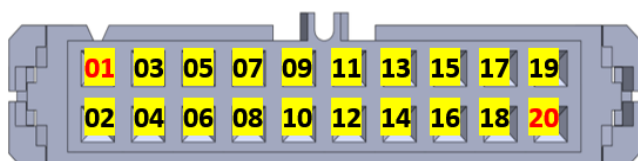
The channels A-D can be used as either inputs or outputs. The pressure sensors provide outputs, pumps and valves accept inputs. Each EIB channel has two lines, because you need to be able to issue three commands to the devices (e.g., forward, stop, backward), and you cannot do that with a single line.

The EIB channels are activated using a TTL (transistor-transistor-logic) signal. The EIB TTL signal is defined as follows:

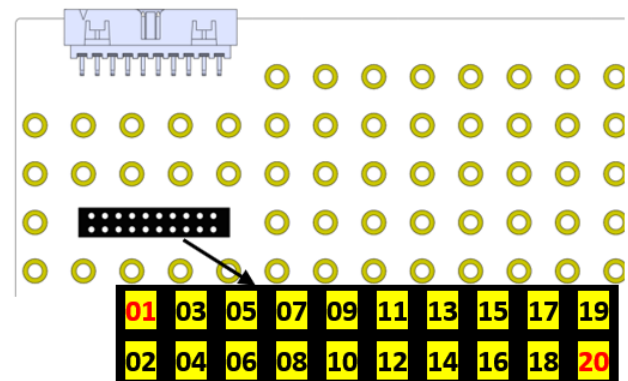
	Input or Output
TTL High	2.2-5.3 V
TTL Low	-0.3 - 0.8 V

The four channels can be accessed by adding a connector to the EIB ribbon cable (20-pin grey cable) or via one of one of the breadboard connectors.

If using the EIB ribbon cable, the pin layout is as follows:



If using a breadboard connector to access the pins, the pin layout is:



The table below shows the function of each pin.

PIN	Function
01, 20	12 V supply
03, 18	5 V supply
05, 07, 14	ground
09	sync
10	I2C Clock (SCL)
11	I2C Data (SCA)
12	reserved
16	analog ground
02	Channel A_1
04	Channel A_2
06	Channel B_1
08	Channel B_2
13	Channel C_1
15	Channel C_2
17	Channel D_1
19	Channel D_2

**CAUTION:** Pins 1 and 20 are 12 V. Take precautions not to connect to these pins to your uProcess devices, as they may damage the hardware.

The channel functions for each uDevice are described in the following sections.

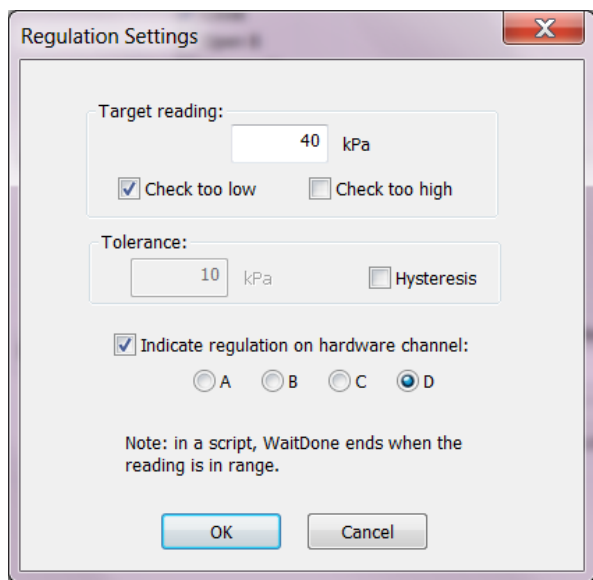



## uPS01 Pressure Sensors

The uPS01 Pressure Sensor can be used as an output to signal other devices when a pressure threshold or range has been reached. The uPS logic commands for the EIB channels are shown below.

Pressure Sensor Commands	High	Low
Channel X_1	in range	not in range
Channel X_2	overpressure	underpressure

The uProcess software is used to set the pressure regulation values. In the example below, the EIB Channel status will change when the pressure exceeds 40 kPa.

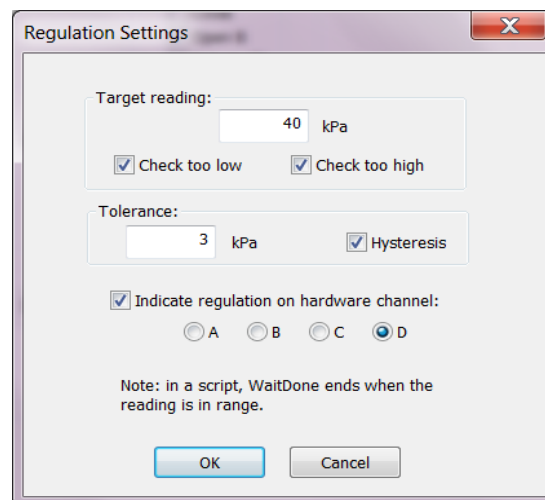


Be sure to press the **Apply Settings Now**  button after selecting the pressure setting to send the command to the EIB.

For the above case, the EIB Outputs would report as:

Channel	PIN	P < 40 kPA	P ≥ 40 kPA
D_1	17	Low	High
D_2	19	Low	High

Alternatively, the uProcess software can be used to check whether the pressure is within a specific range. For the example below, the channel is in range if the pressure is  $40 \pm 3$  kPa.



For the above case, the EIB Outputs would report as:

Channel	PIN	P < 37 kPA	37 ≤ P < 40	P ≥ 40 kPA
D_1	17	Low	High	Low
D_2	19	Low	either	High

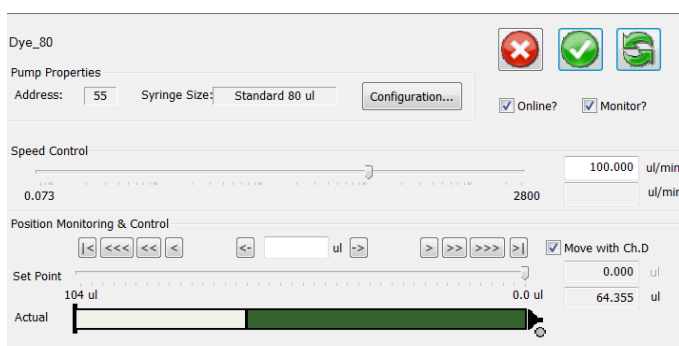


## SPS01 Syringe Pumps

The SPS01 syringe pump can take an input from the EIB channels to push or pull the syringe. The input could be from another uDevice, such as the uPS01 pressure sensor, or from an external device. The SPS01 logic commands for the EIB channels are shown below.

Channel	Setting	Pull	Stop	Push
X_1	Move	Low	High	Low
X_2	With	High	High	Low
X_1	Move	Low	High	Low
X_2	Opp.	Low	High	High



In the example below, an external signal is used to push or pull the syringe based on the input to channel D.



For the above case, the following logic commands are used to actuate the syringe.

Channel	PIN	Pull	Stop	Push
D_1	17	Low	High	Low
D_2	19	High	either	Low

The syringe will move at the set flow rate, and will continue to move until the pin logic is changed or until the syringe reaches the end of the travel.

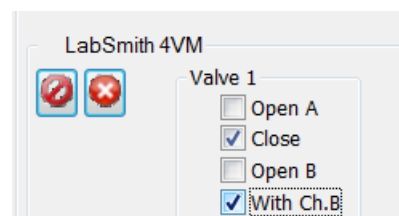
Note: When the syringe is monitoring a channel the  symbol will show. If the syringe reaches the end of travel and stops, the task is considered complete, and the  symbol will disappear. If further syringe actuations are desired the logic will need to be reset within uProcess.


## AV201 and AV202 Automated Valves

The AV201 and AV202 valves can take an input from the EIB channels to actuate the valve. The input could be from another uDevice, such as the uPS01 pressure sensor, or from an external device. The AV201/AV202 logic commands for the EIB channels are shown below.

Channel	Setting	Open to A	Close	Open to B
X_1	Move	Low	High	Low
X_2	With	High	either	Low
X_1	Move	Low	High	Low
X_2	Opp.	Low	either	High

An external signal can be used to actuate the valves. In the example below, the valve is actuated based on the input to channel B.



Again, be sure to press the **Apply Settings Now**  button to send the command to the EIB.

For the above setting, the following logic commands would actuate the valve.

Channel	PIN	Open to A	Close	Open to B
B_1	06	Low	High	Low
B_2	08	High	either	Low

