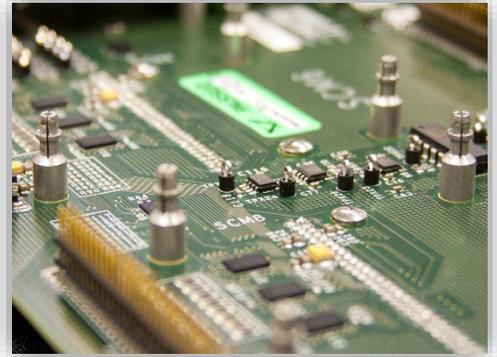


## Digital I/O Board

### What is it?

The digital I/O board is an optional card which can be added to 5900 and 6800 frames. Digital communication, unlike analog, does not sense continuous signals but inputs or outputs of one of two states: high or low, open or closed. The card used in conjunction with the frame and Bluehill software allows the operator to trigger external or internal events. It allows for 4 input and output channels to be monitored and/or triggered simultaneously.



### What is it used for?

#### Digital Outputs

Utilizing an I/O card gives the operator the ability to communicate with other devices, expanding the capabilities of a universal testing system. For example, it is required to perform certain catheter testing. Specialized I/O controlled pneumatic grips are used to properly measure the frictional forces associated with running a catheter through a tortuous path simulating an arterial pathway. The user can easily toggle each grip by setting digital output channels high or low, meaning the system can feed the catheter as a physician would in a clinical setting.

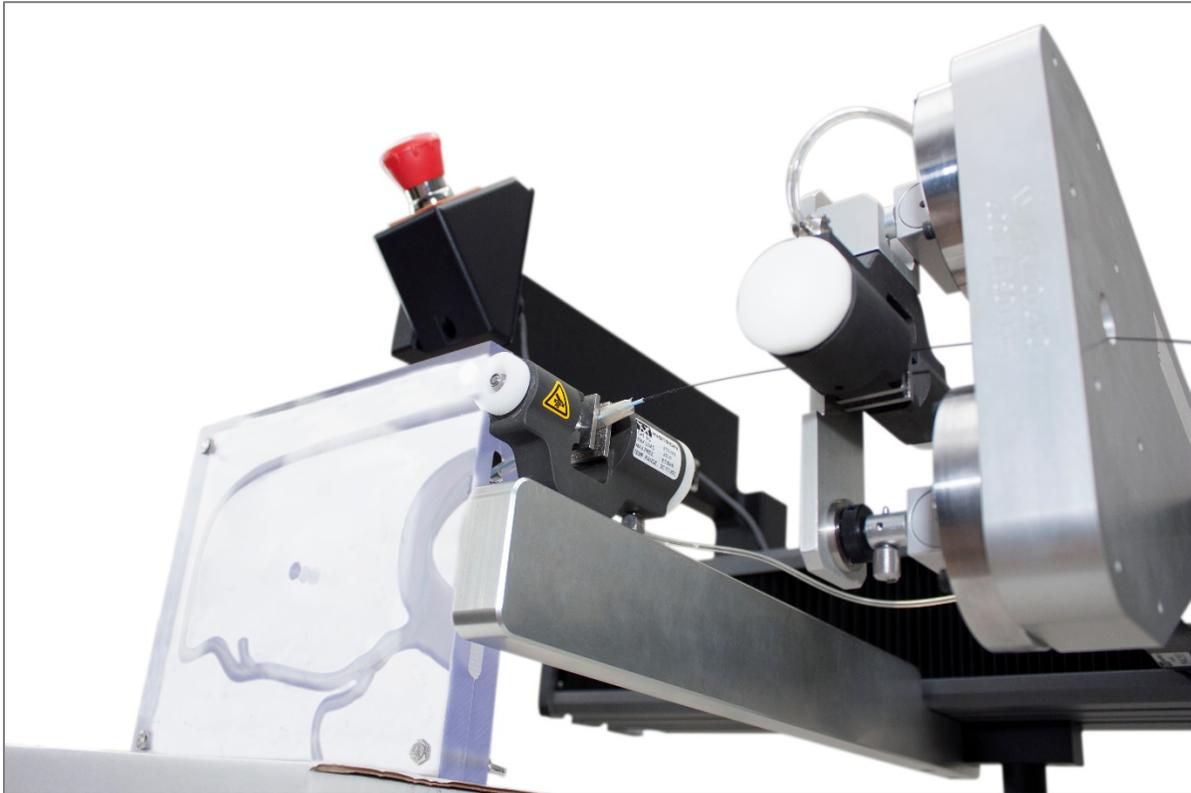


Figure 1- A Digital I/O Control Box is used in conjunction with a Tortuosity Test System

## Digital Outputs – Pulse Signals

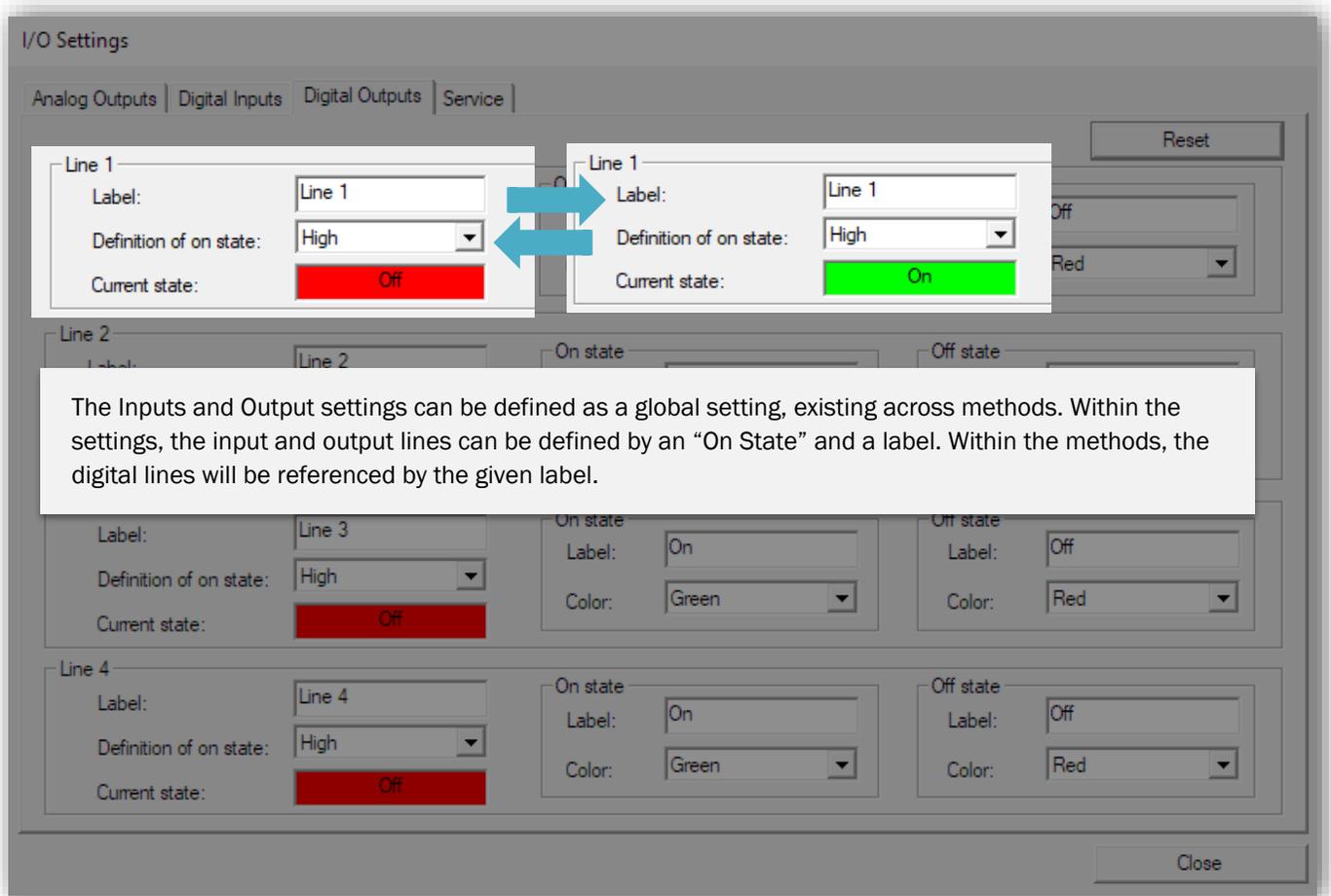
Another example is the use of digital outputs to communicate and trigger a stepper motor. For this use, a special class of digital output is used called a pulse signal. A pulse signal is unique in that it is a short burst of voltage typically from low to high. The short burst will cause the motor to move a discrete amount, defined by the motor controller. These can be used for many different applications – rotary stages can be used to test multiple locations on a component repeatably without operator influence.

## Digital Inputs

Digital Input are generally used to trigger the testing machine to either initiate or terminate a test or test sequence. Most commonly, digital inputs can be programmed on sensors to change states when falling out of a set range. This can be useful when using temperature or pressure sensors, ending the test if the required test conditions are not met. If external recording devices are being used, a digital input can be utilized to start the test, ensuring the data capture is synced.

## How do I set them up?

Digital Inputs and Outputs can be easily configured and utilized within Bluehill Universal. The inputs are set up in the system settings by clicking the I/O icon.



The screenshot shows the 'I/O Settings' dialog box with tabs for 'Analog Outputs', 'Digital Inputs', 'Digital Outputs', and 'Service'. The 'Digital Inputs' tab is active. It displays settings for four digital lines. Line 1 is highlighted with a white box, and two blue arrows point between two instances of its settings, one showing 'Off' and the other 'On'. A text box explains that these settings are global. Line 3 and Line 4 are also visible, each with 'On state' and 'Off state' sub-sections.

I/O Settings

Analog Outputs | Digital Inputs | Digital Outputs | Service

Line 1

Label: Line 1

Definition of on state: High

Current state: Off

Line 1

Label: Line 1

Definition of on state: High

Current state: On

Line 2

Label: Line 2

On state

Off state

Line 3

Label: Line 3

Definition of on state: High

Current state: Off

On state

Label: On

Color: Green

Off state

Label: Off

Color: Red

Line 4

Label: Line 4

Definition of on state: High

Current state: Off

On state

Label: On

Color: Green

Off state

Label: Off

Color: Red

Reset

Close

The Inputs and Output settings can be defined as a global setting, existing across methods. Within the settings, the input and output lines can be defined by an “On State” and a label. Within the methods, the digital lines will be referenced by the given label.

In any method, the digital output lines can be programmed at the beginning or end of the test within the test control tab. By toggling “set digital output lines”, each line appears with a drop box consisting of three options.

1. **Set:** Moves the output line to On
2. **Clear:** Moves the output line to Off
3. **Retain:** Keeps the output line at its current state

### Actions

Set digital output lines

Line 1:	Set
Line 2:	Set
Line 3:	Set
Line 4:	Retain

By utilizing TestProfiler, an operator can create complex test sequences triggering external devices without any coding required. Within a TestProfiler step, digital inputs can be set as events and digital outputs can be set as actions.

### Event setup: Digital input event

Type: Digital input event

Description: Digital input event

Digital input line: Line 1

Trigger condition: On

The digital input event requires a trigger condition which can be one of the following:

- On
- Off
- On to Off
- Off to On

If the condition is On/Off, the preexisting state will trigger the event as opposed to On to Off/Off to On which requires a change of state.

### Action setup: Set a digital output

Type: Set a digital output

Description: Set a digital output

Digital output line: Line 2

Action: Off

Single pulse

The digital output action can either set the line to a high or low state. The single pulse can also be toggled for sending an individual burst rather than permanently changing the state.