

Application Note 191 Automatic Control of Digital I/O Lines

Overview

This Application Note details how to automatically control the digital I/O lines of the MP160 or MP150 to trigger other devices (i.e., turn a device on and off at predetermined intervals). The MP160/150 can interface with a wide variety of devices such as pumps, valves, stimulators and switches.

The MP160/150 supports 16 digital I/O lines and 16 calculation channels, providing various options for controlling additional experimental apparatus. The digital I/O lines can be controlled manually by using the **Manual Control** function, or automatically by using an online **Control calculation** channel. By using an **Expression** calculation to create a sync signal, a timing mechanism can be set for the digital I/O lines.

Establishing a timing mechanism for the digital I/O lines in AcqKnowledge Software

In AcqKnowledge, the **Expression** preset is located in **Set Up Data Acquisition > Channels > Calculation** tab.

1. Check the “Acquire” check box for channel C0 and select **Expression** from the **Preset** pop-up menu.

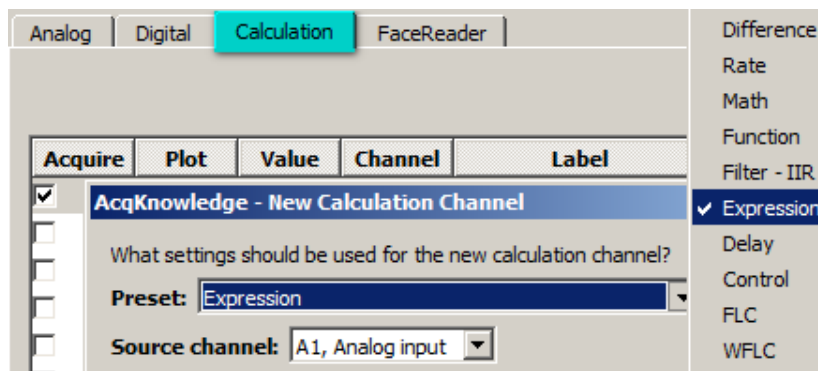


Fig. 1: Selecting a Calculation Channel Preset

2. Click **OK** and the Expression setup dialog will appear as shown below left.
3. Click the Expression Preset pop-up menu (“Preset:”) and choose “**5 Sec Cosine Waveform**” from the list (as shown below right). Alternatively, you can type **COS(2*PI*TIME/5)** into the Expression field. (Selecting “5 Sec Cosine Waveform” from the Expression Preset menu inputs this expression automatically.)

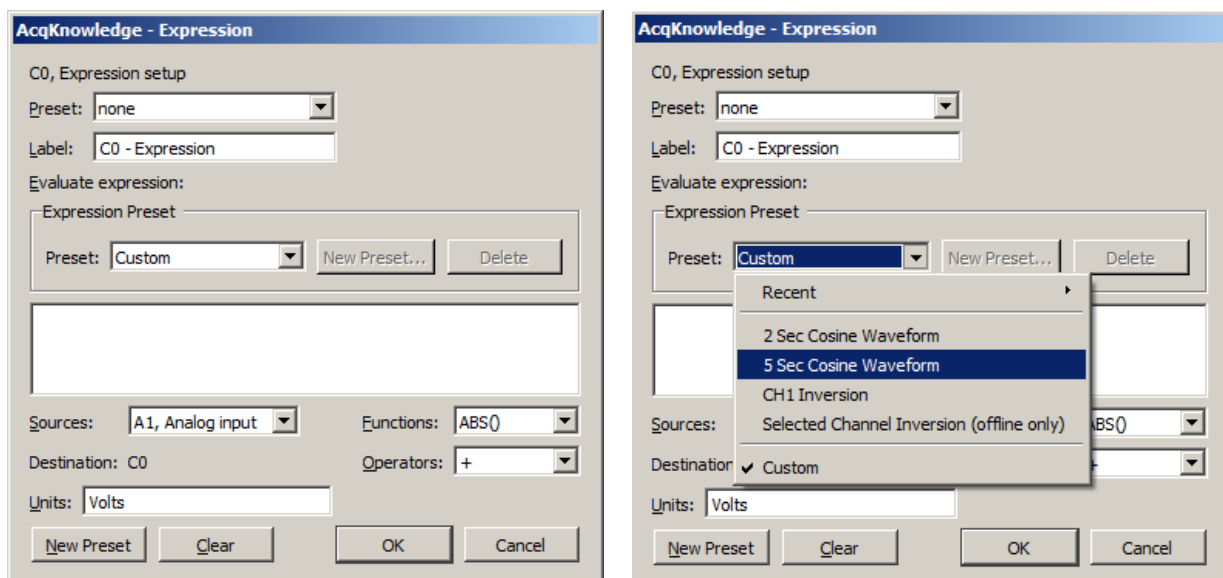


Fig. 2: Expression Calculation Setup

The final value of this expression (the divisor, in this case 5) determines the frequency of the sine wave. Adjust this value to increase or decrease the frequency of the I/O outputs. During recording, the sine wave will be displayed as a new graph channel (CH40) and can be used by the Control channel to trigger the digital I/O line.

4. Type “Sine 5” into the Expression “Label:” field and click OK. Expression channel setup is complete.

Control Channel Setup

Like the Expression preset, the **Control** preset is also located in **Set Up Data Acquisition > Channels > Calculation** tab.

1. Check the “Acquire” box for channel C1 and select **Control** from the Preset pop-up menu.
2. Select “C0, Sine 5” from the Control Preset “Source channel:” list and click OK.

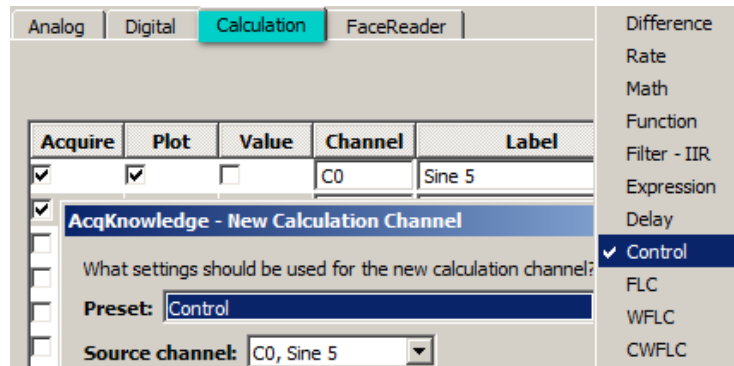


Fig. 3: Control Calculation Setup

3. After clicking OK, the following Control Setup options will appear:

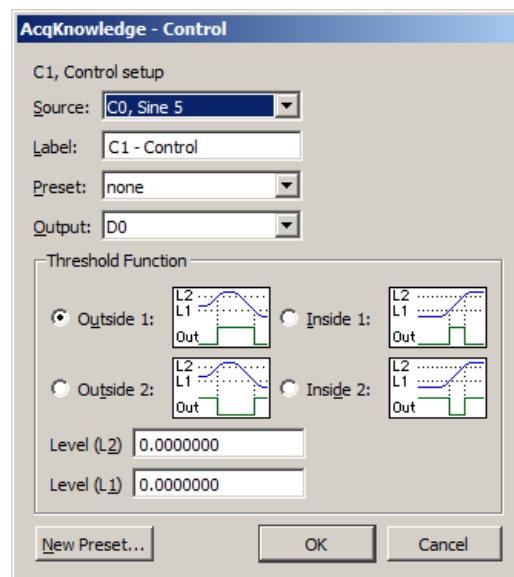


Fig. 4: Control Setup Dialog

The Control Setup dialog provides four threshold control options:

- Above (Outside 1)
- Below (Outside 2)
- Within a range (Inside 1)
- Outside a range (Inside 2)

The Control channel **Source** is the previously created Expression sine wave and the **Output** is the digital I/O line that will trigger the device.

During recording, the Control channel will monitor the incoming sine wave and will output a 5 V TTL pulse through the appropriate digital I/O line when it crosses a user-defined threshold.

In the following example, the default Threshold option was used and the Levels set to **L1** = 0.3 V and **L2** = 0.5 V. Under these settings, the Control channel will trigger high (0 to +5 V) when the sine wave crosses the first threshold of +0.5 V. The digital output will remain high (+5 V) until the signal crosses the second threshold of +0.3 V, whereupon it will drop back to low (-5 V to 0).

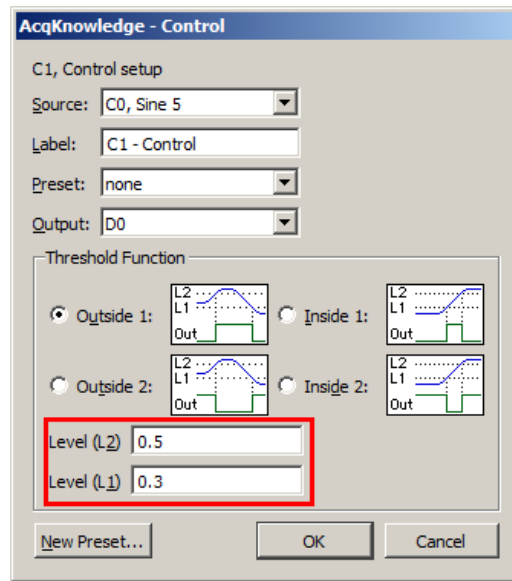


Fig. 5: Control Setup with Thresholds set

Hardware Example Setup

MP160 (or MP150) with HLT100C High Level Transducer Module and STP100C Isolated Digital Interface

Connect a cable to your device from the BNC connector labeled "1" on the front of the STP100C. (The STP100C is used to safely isolate digital input and output lines to and from the MP System.)

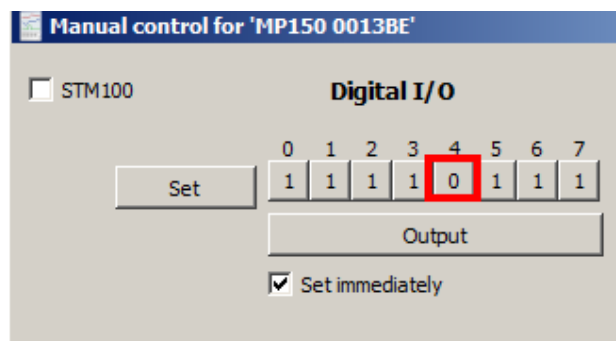
To make the connection to your own device, one of these BIOPAC adapters may be useful:

- BSLCBL6: BNC male to Output 3.5 mm mono phone socket
- CBL 102 BNC male to 3.5 mm mono phone plug
- CBL125: BNC male to BNC male
- CBL207: BNC male to 2 x 1.5 mm Touchproof pins

Setting the Digital I/O Channels in AcqKnowledge

Before sending signals through the STP100C, Digital Output Channels D0-D3 must be enabled in AcqKnowledge software. To do this:

1. Choose the MP160 (or MP150) menu > Manual Control.
2. Click the "Input" button to toggle it to "Output."
3. Check the "Set immediately" box.
4. Click Digital I/O button 4 to toggle to "0" as shown in the example below and close the Manual Control window.



Recording and Display Controls

Having set the sync signal, the Control channel output, and connected the device(s), data recording can begin.

AcqKnowledge will display both the sine wave and the Control channel output signal, as shown below. If desired, these signals can be hidden by unchecking the “Plot” option in the “Set Up Data Acquisition > Channels” setup, or the channels can be hidden in the graph view by Alt+clicking the desired channel button.

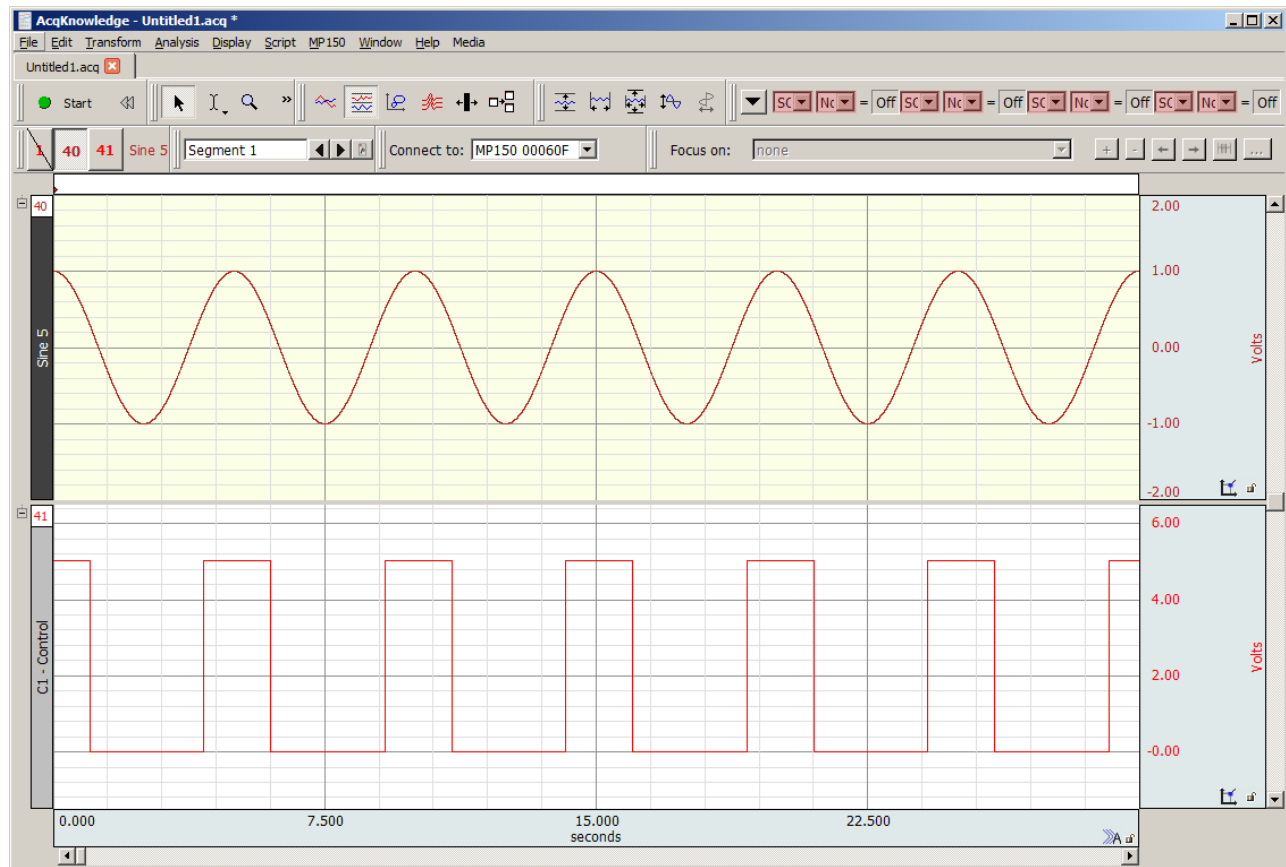


Fig. 6: Graph with Sine Wave and Control Output Signal