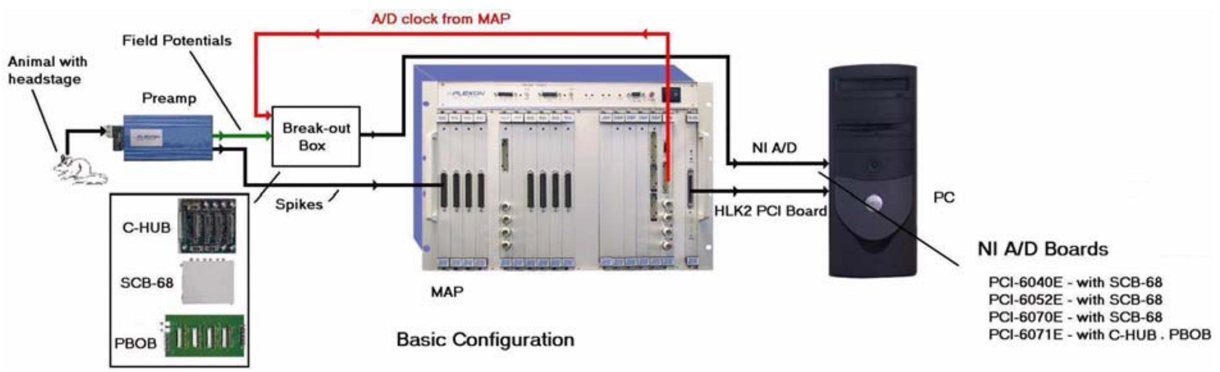
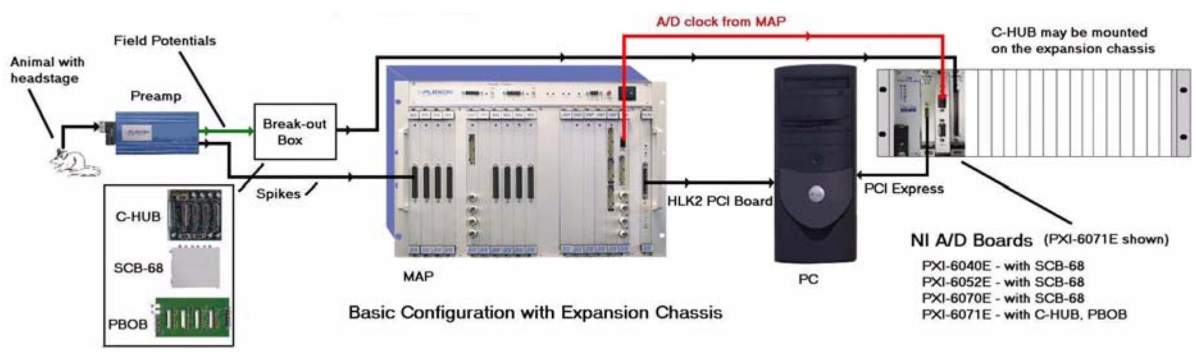
Plexon Inc

Continuous Signal Recording

Overview

Continuous analog data signals (LFP, EEG, eye coil positions, and continuous spike and wide band [spike + LFP] signals) can be recorded simultaneously with spike data from the MAP box using one or more National Instruments A/D (NIDAQ) boards in the host computer. A connection between the TIM board in the MAP box and the NIDAQ board synchronizes the recordings of the spike and analog signals. The physical configuration depends on what equipment and software are installed. For example, an SCB-68, a PBOB, or a C-HUB may be used in a basic configuration or in one of two expansion chassis (PCI/exp or PCI/exp4). There are also other configurations, such as those that include CinePlex. This means that there are a variety of possible configurations. The diagrams below show the basic configuration with and without the expansion chassis.





The MAP system software can support multiple A/D boards, though the boards in an individual system must be identical. The channels on a given board must be run at the same sampling rate, but different boards can be run at different sampling rates (e.g. at 1 kHZ for slow signals like local field potentials, and at 20 kHZ or 40 kHz for fast spike signals). The MAP software can only support a maximum of two different sampling rates across all the boards, however; a fast rate and a slow rate. Therefore, if one has three A/D boards with the first board sampling at a slow rate of 1 kHz and a second board sampling at a fast rate of 40 kHz, then the sampling rate on the third board must be set to either 1 kHz or 40 kHz.

Note: A standard MAP system without an expansion chassis cannot sample at 40 kHz.

Supported NIDAQ boards include (channel counts based on a sampling rate of 1 kHz):

- PCI-6040E [PCI-MIO-16E-4] (250 kSamples/sec, 16-channel, 12-bit resolution)
- PCI-6052E (333 kSamples/sec, 16-channel, 16-bit resolution)
- PCI-6070E [PCI-MIO-16E-1] (1.25 MSamples/sec, 16-channel, 12-bit resolution)
- PCI-6071E (1.25 MSamples/sec, 64-channel, 12-bit resolution)

Preamp filtering for neural field potential (FP) signals is typically 0.7 Hz - 300 Hz, although other filtering bandpass values can be specified. The FP signals come from the same electrodes as the spikes. Other analog signals that can be recorded through the break-out box include:

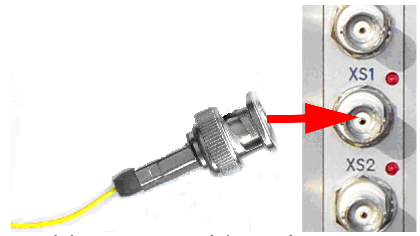
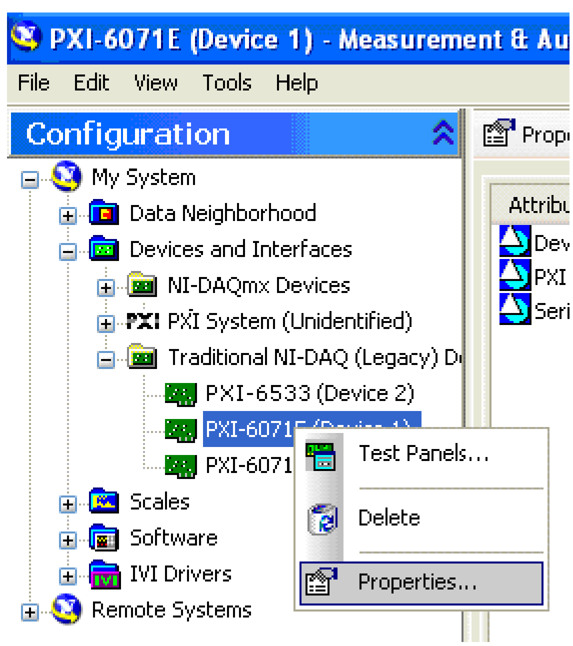
- Physiological - such as blood pressure, EKG, EMG, etc.
- Behavioral - such as eye position, arm angle, head direction, etc.

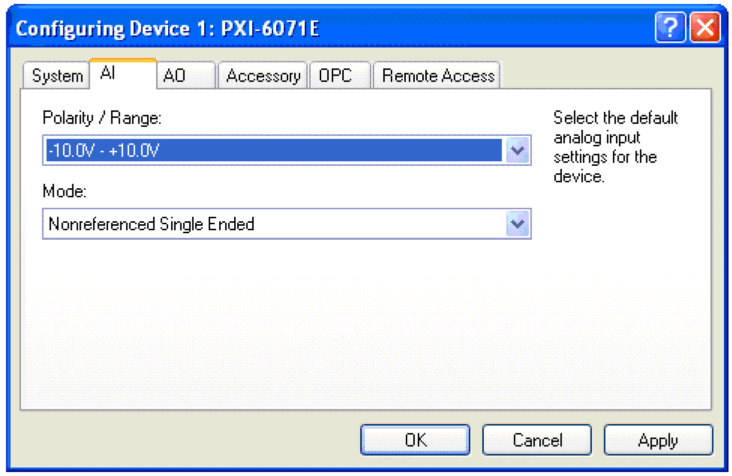
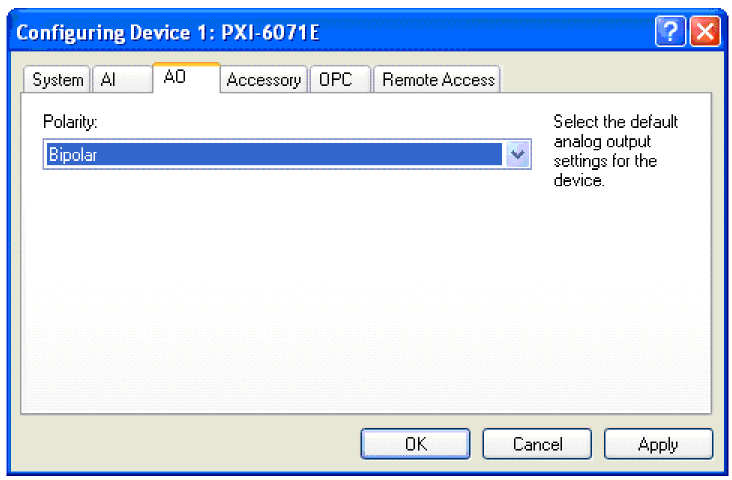
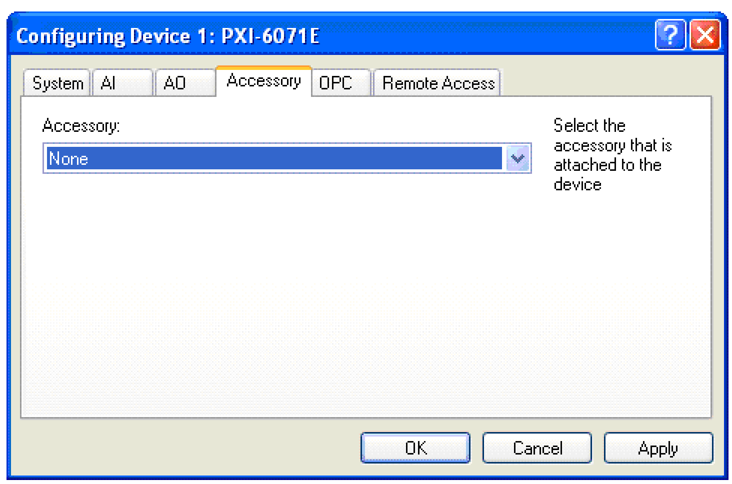
Consult the C-HUB (or PBOB) Technical Brief and the SCB-68 Data Sheet for interfacing to 64- and 16-channel NIDAQ boards, respectively.

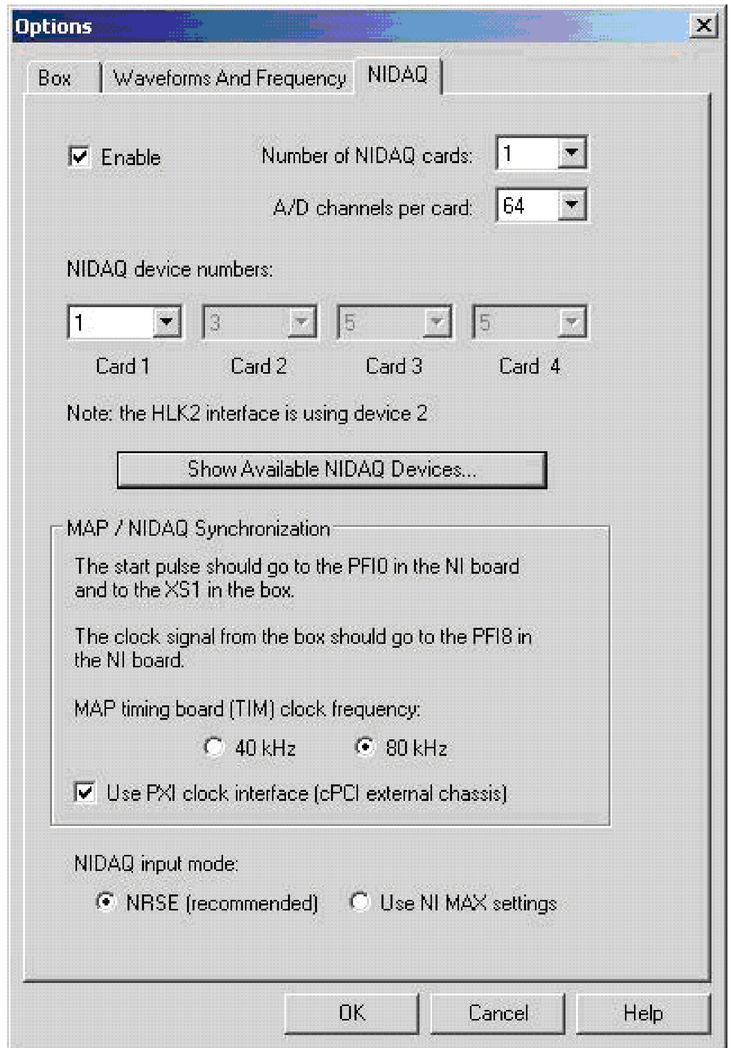
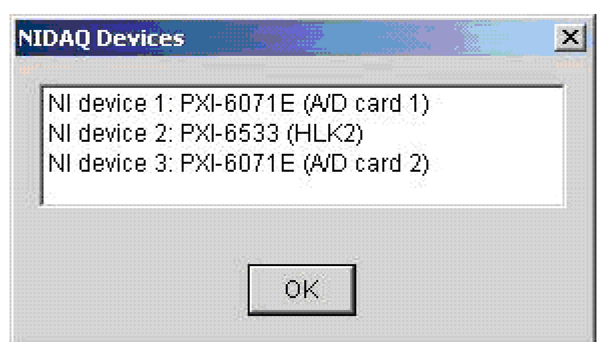
Setup of NIDAQ Boards

Follow the procedure in the table below to setup the NIDAQ boards and breakout boxes.

Step	Action	Diagram/Comments
1	Run the installation program from the National Instruments CD.	This step assumes that there are no NIDAQ board(s) installed in the PC.
2	Insert the National Instruments A/D (NIDAQ) board in the 32-bit (short) PCI slot (typically white).	The NIDAQ (PXI version only) board may also be inserted into the expansion chassis, if used.
3	Connect the SCB-68, the C-HUB, or PBOB to the NIDAQ board.	SCB-68 for 16-channel NIDAQ boards PBOB for 64-channel NIDAQ boards C-HUB for 64-channel NIDAQ boards
4	Connect the rainbow ribbon cable carrying the continuous analog signals (from the field potential preamp board, or other sources) to the DB37 connector on the breakout box or BNC panel.	See specific instructions for the breakout box or panel used.

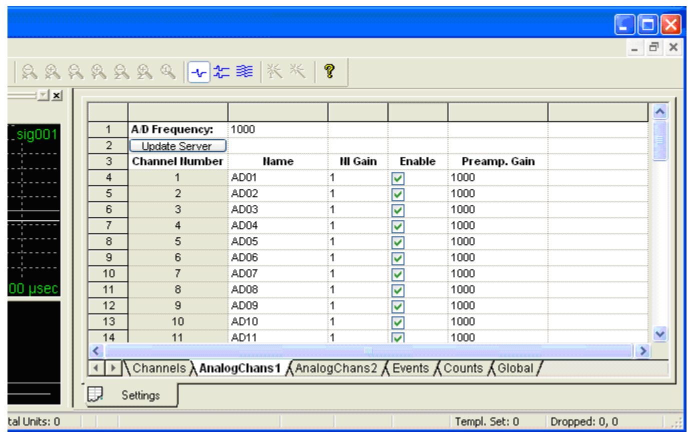
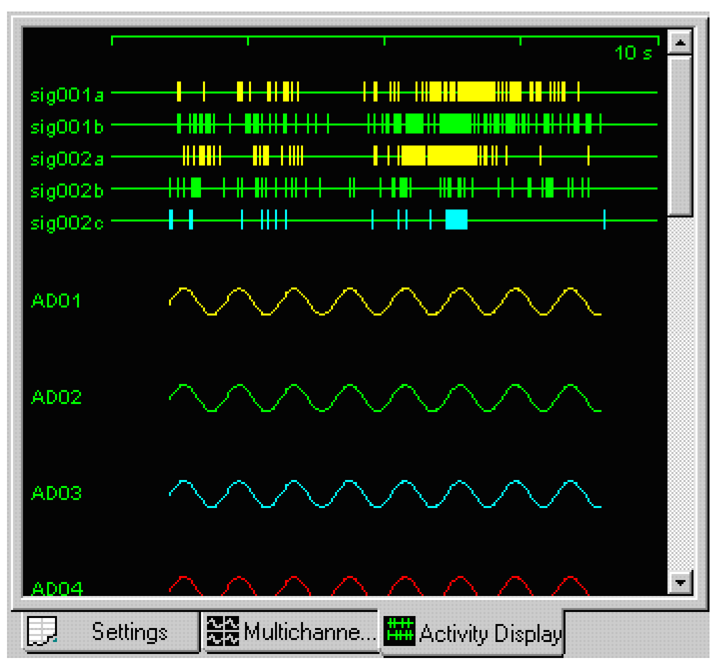
Step	Action	Diagram/Comments
5	Connect the cable from the TIM board in the MAP box to the DB9 TIM input connector on the breakout box.	If the expansion chassis is used, connect the TIM cable from the MAP box to a PXI-TIM board in the expansion chassis.
6	The diagrams at the right show the configuration of the XS1 connector on the MAP TIM board for systems shipped before 2008 and those shipped in 2008 and later.	Pre-2008 systems require the TIM cable yellow wire with BNC connector to be connected to the XS1 connector on the MAP TIM board as shown below.  Systems shipped in 2008 and later have a cap on the XS1 connector of the MAP TIM board. In case this cap is missing or needs to be replaced due to damage, refer to the diagram below. 
7	Run the **National Instruments Measurement & Automation** program. Select **Devices and Interfaces**. Right-click on the board and select **Properties**. (NOTE: The board name will depend on what is installed.)	

Step	Action	Diagram/Comments
8	On the **AI** tab set: **Polarity/Range**: -10V - +10V **Mode**: Non-referenced Single Ended. NOTE: NIDAQ specifies +-10V at 1/2 gain. Therefore, the working range at 1x gain is +-5V.	
9	On the **AO** tab set: **Polarity**: Bipolar (BNC connector on breakout box - can connect to oscillo-scope)	
10	On the **Accessory** tab select the appropriate breakout box or BNC panel as the Accessory (e.g. SCB-68). If using PBOB or C-HUB, select **None** (because neither are on the dropdown list).	

Step	Action	Diagram/Comments
11	For this step open **Server** and select **View | Options**. On the **NIDAQ** tab, check the **Enable** checkbox and select the number of analog channels (16 for 16-channel NIDAQ boards 64 for 64-channel NIDAQ board). Close and restart **Server** after enabling the NIDAQ board. Note: All boards must be of the same type. Each A/D board will be displayed as a separate tab in the Analog Channels display (shown below in step 13).	
12	Ensure that the NI device numbers and boards match what is shown in the **Configuration** window of Step 7. Close **Server** when finished.	

Configuration of Continuous Signals in Sort Client

The procedure below shows how to configure the recorded signals in Sort Client.

Step	Action	Image/Comments
1	Enable Analog channels in **Sort Client**. Select individual channel boxes to enable A/D channels. Set the sampling frequency on the A/D channels (A/D Frequency). Set the desired gain on the A/D channels (NI Gain). NOTE: Normal default hardware gain for field potential channels is 1000. The value to be entered in the 'Preamp Gain' column is actually the product of the headstage gain and the preamp gain, or more generally, the total fixed gain before the signal enters the NI board. Click **Update Server.**	NOTE: When the file is opened in NEX or OFS, the amplitude of the signal at the electrode is expressed in mV. NEX and OFS use the preamp gain value to calculate what the size of the signal at the electrode was.The Preamp Gain is a combination of the gain of the headstage multiplied by the gain of the field potential board in the preamp. 
2	View analog signals in the **Sort Client Activity Display**. Select **View | Activity Display** menu option or click the **Activity Display** button on the toolbar. NOTE: Amplitude mearesurements are not provided in Sort Client. For amplitude measurements, use NEX.	

NIDAQ Multichannel Sampling Characteristics

This section provides information on the between-channel sampling offsets of National Instruments data acquisition (NIDAQ) devices and includes charts with sampling offsets for the following NIDAQ devices:

- PCI-6070E (formerly PCI-MIO-16E-1): 1.25 MS/sec, 16 channels, 12-bit resolution
- PCI-6071E: 1.25 MS/sec, 64 channels, 12-bit resolution
- PCI-6052E: 333 kS/sec, 16 channels, 16-bit resolution
- PCI-6040E (formerly PCI-MIO-16E-4): 250kS/sec, 16 channels, 12-bit resolution

Instrumentation Preamp Settling Time and Sampling Offsets

The NIDAQ devices supported by Plexon hardware use a single, very-high-speed analog-to-digital (A/D) converter, which is multiplexed (shared) by all the input channels. Within a single sample period (e.g. 25 microseconds at a 40 kHz sampling rate), the A/D converter scans all the input channels in rapid succession and sends an A/D value (sample value) to **Server** for each channel. Because of the speed at which the converter scans, under most circumstances the effect is the same as having a dedicated A/D converter per channel. Although the NIDAQ scanning introduces a small inter-channel time offset, this is less than one sample period and therefore it has little or no effect on the acquired data.

However, an instrumentation grade preamplifier (on the NIDAQ device) precedes the NIDAQ A/D converter. This preamplifier requires a finite amount of time to “settle” from a high-voltage level to a lower-voltage level, especially when the gains are very different on adjacent channels. The worst-case situation is a large-amplitude input signal on channel i with a gain of 1, followed by a very-small input signal on channel i+1 with a gain of 100; this situation requires the longest settling time between channels for the instrumentation preamp to reproduce the signal on channel i+1 accurately. The net effect is similar to a “leakage” between channels; the voltage on channel i can affect the value of channel i+1. Ideally, signal levels are similar across channels and require moderate NIDAQ gains of 1 to 10; in this case, settling time is generally not a problem.

The default NIDAQ hardware behavior is to scan through the channels as rapidly as possible within each sample period, which is necessary if the full bandwidth of the device is used. For example, 31 channels at 20 kHz per channel on a 1.25 megasamples/sec board like the NI 6071E results in an inter-channel scan interval of about 1613 nanoseconds. However, when less than the maximum bandwidth of the board is used, the Sort Client software automatically reduces the channel scanning rate (within each sample period) in order to maximize the amount of time available for the instrumentation preamp to settle between channels.

Note: This reduction in the scanning rate does not affect the sampling rate, only the rate at which channels are scanned within each sample period. This reduces the number of avaliable channels on the A/D board. NIDAQ never increases the inter-channel scan interval to more than one sample period, or 6 microseconds, whichever is shorter.

The following tables show the inter-channel scan intervals that Plexon software automatically selects for various combinations of channel count and digitizing rate (fast spike rate) for the NIDAQ device it supports. The values highlighted in green have sufficient settling time to enable accurate digitalization, even in the worst case described earlier. The values highlighted in yellow denote the combinations that can have reduced accuracy when there are widely differing gains set on adjacent channels. The values highlighted in red denote combinations that cannot be selected in Sort Client because they exceed the bandwidth of the NIDAQ device.

For additional information, refer to the NI PCI E Series User Manual (available on the National Instruments website), which describes the accuracy of various E series DAQ boards as a function of the inter-channel sampling offset.

Color Legend for Tables

(green)	Meets the NI worst-case settling time specification for equal gain on all channels(this range provides accurate digitization)
(yellow)	Possible problems for mixed gains(this range could cause inaccurate digitization)
(red)	Sampling rate exceeds device capacity(this range exceeds the bandwidth of the NIDAQ device)

PCI-6071E Device

The NI “worst-case” specification for this device is 1.4 microseconds.

Samp. Freq → (kHz) Ch # ↓	1	2	4	5	8	10	16	20	24	25	31.25	40	50
1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0
6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.2
7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.6	4.4	3.4	2.8
8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	5.0	4.0	3.0	2.4
9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	4.6	4.4	3.4	2.6	2.2
10	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	4.0	3.2	2.4	2.0
11	6.0	6.0	6.0	6.0	6.0	6.0	5.6	4.4	3.6	3.6	2.8	2.2	1.8
12	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.4	3.2	2.6	2.0	1.6
13	6.0	6.0	6.0	6.0	6.0	6.0	4.8	3.8	3.2	3.0	2.4	1.8	1.4
14	6.0	6.0	6.0	6.0	6.0	6.0	4.4	3.4	2.8	2.8	2.2	1.6	1.4
15	6.0	6.0	6.0	6.0	6.0	6.0	4.0	3.2	2.6	2.6	2.0	1.6	1.2
16	6.0	6.0	6.0	6.0	6.0	6.0	3.8	3.0	2.6	2.4	2.0	1.4	1.2
17	6.0	6.0	6.0	6.0	6.0	5.8	3.6	2.8	2.4	2.2	1.8	1.4	1.0
18	6.0	6.0	6.0	6.0	6.0	5.4	3.4	2.6	2.2	2.2	1.6	1.2	1.0
19	6.0	6.0	6.0	6.0	6.0	5.2	3.2	2.6	2.0	2.0	1.6	1.2	1.0
20	6.0	6.0	6.0	6.0	6.0	5.0	3.0	2.4	2.0	2.0	1.6	1.2	1.0
21	6.0	6.0	6.0	6.0	5.8	4.6	2.8	2.2	1.8	1.8	1.4	1.0	0.8
22	6.0	6.0	6.0	6.0	5.8	4.4	2.8	2.2	1.8	1.8	1.4	1.0	0.8
23	6.0	6.0	6.0	6.0	5.4	4.2	2.6	2.0	1.8	1.6	1.2	1.0	0.8
24	6.0	6.0	6.0	6.0	5.2	4.0	2.6	2.0	1.6	1.6	1.2	1.0	0.8
25	6.0	6.0	6.0	6.0	5.0	4.0	2.4	2.0	1.6	1.6	1.2	1.0	0.8
26	6.0	6.0	6.0	6.0	4.8	3.8	2.4	1.8	1.6	1.4	1.2	0.8	X
27	6.0	6.0	6.0	6.0	4.6	3.6	2.2	1.8	1.4	1.4	1.0	0.8	X
28	6.0	6.0	6.0	6.0	4.4	3.4	2.2	1.6	1.4	1.4	1.0	0.8	X
29	6.0	6.0	6.0	6.0	4.2	3.4	2.0	1.6	1.4	1.2	1.0	0.8	X
30	6.0	6.0	6.0	6.0	4.0	3.2	2.0	1.6	1.2	1.2	1.0	0.8	X
31	6.0	6.0	6.0	6.0	4.0	3.2	2.0	1.6	1.2	1.2	1.0	0.8	X
32	6.0	6.0	6.0	6.0	3.8	3.0	1.8	1.4	1.2	1.2	1.0	X	X
33	6.0	6.0	6.0	6.0	3.6	3.0	1.8	1.4	1.2	1.2	0.8	X	X
34	6.0	6.0	6.0	5.8	3.6	2.8	1.8	1.4	1.2	1.0	0.8	X	X
35	6.0	6.0	6.0	5.6	3.4	2.8	1.6	1.4	1.0	1.0	0.8	X	X
36	6.0	6.0	6.0	5.4	3.4	2.6	1.6	1.2	1.0	1.0	0.8	X	X

Samp. Freq → (kHz) Ch # ↓	1	2	4	5	8	10	16	20	24	25	31.25	40	50
37	6.0	6.0	6.0	5.4	3.2	2.6	1.6	1.2	1.0	1.0	0.8	X	X
38	6.0	6.0	6.0	5.2	3.2	2.6	1.6	1.2	1.0	1.0	0.8	X	X
39	6.0	6.0	6.0	5.0	3.2	2.4	1.6	1.2	1.0	1.0	0.8	X	X
40	6.0	6.0	6.0	5.0	3.0	2.4	1.4	1.2	1.0	1.0	0.8	X	X
41	6.0	6.0	6.0	4.8	3.0	2.4	1.4	1.2	1.0	0.8	X	X	X
42	6.0	6.0	5.8	4.6	2.8	2.2	1.4	1.0	0.8	1.0	X	X	X
43	6.0	6.0	5.8	4.6	2.8	2.2	1.4	1.0	0.8	1.0	X	X	X
44	6.0	6.0	5.6	4.4	2.8	2.2	1.2	1.0	0.8	1.0	X	X	X
45	6.0	6.0	5.4	4.4	2.6	2.2	1.2	1.0	0.8	1.0	X	X	X
46	6.0	6.0	5.4	4.2	2.6	2.0	1.2	1.0	0.8	1.0	X	X	X
47	6.0	6.0	5.2	4.2	2.6	2.0	1.2	1.0	0.8	1.0	X	X	X
48	6.0	6.0	5.2	4.0	2.6	2.0	1.2	1.0	0.8	1.0	X	X	X
49	6.0	6.0	5.0	4.0	2.4	2.0	1.2	1.0	0.8	1.0	X	X	X
50	6.0	6.0	5.0	4.0	2.4	2.0	1.2	1.0	0.8	1.0	X	X	X
51	6.0	6.0	4.8	3.8	2.4	1.8	1.2	0.8	0.8	X	X	X	X
52	6.0	6.0	4.8	3.8	2.4	1.8	1.2	0.8	0.8	X	X	X	X
53	6.0	6.0	4.6	3.6	2.2	1.8	1.0	0.8	X	X	X	X	X
54	6.0	6.0	4.6	3.6	2.2	1.8	1.0	0.8	X	X	X	X	X
55	6.0	6.0	4.4	3.6	2.2	1.8	1.0	0.8	X	X	X	X	X
56	6.0	6.0	4.4	3.4	2.2	1.8	1.0	0.8	X	X	X	X	X
57	6.0	6.0	4.2	3.4	2.0	1.6	1.0	0.8	X	X	X	X	X
58	6.0	6.0	4.2	3.4	2.0	1.6	1.0	0.8	X	X	X	X	X
59	6.0	6.0	4.2	3.2	2.0	1.6	1.0	0.8	X	X	X	X	X
60	6.0	6.0	4.0	3.2	2.0	1.6	1.0	0.8	X	X	X	X	X
61	6.0	6.0	4.0	3.2	2.0	1.6	1.0	0.8	X	X	X	X	X
62	6.0	6.0	4.0	3.2	2.0	1.6	1.0	0.8	X	X	X	X	X
63	6.0	6.0	3.8	3.0	1.8	1.4	0.8	X	X	X	X	X	X
64	6.0	6.0	3.8	3.0	1.8	1.4	0.8	X	X	X	X	X	X

PCI-6070E (PCI-MIO-16E-1) Device

The NI “worst-case” specification for this device is 1.5 microseconds.

Samp. Freq → (kHz) Ch # ↓	1	2	4	5	8	10	16	20	24	25	31.25	40	50
1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0
6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.2
7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.6	4.4	3.4	2.8
8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	5.0	4.0	3.0	2.4
9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	4.6	4.4	3.4	2.6	2.2
10	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	4.0	3.2	2.4	2.0
11	6.0	6.0	6.0	6.0	6.0	6.0	5.6	4.4	3.6	3.6	2.8	2.2	1.8
12	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.4	3.2	2.6	2.0	1.6
13	6.0	6.0	6.0	6.0	6.0	6.0	4.8	3.8	3.2	3.0	2.4	1.8	1.4
14	6.0	6.0	6.0	6.0	6.0	6.0	4.4	3.4	2.8	2.8	2.2	1.6	1.4
15	6.0	6.0	6.0	6.0	6.0	6.0	4.0	3.2	2.6	2.6	2.0	1.6	1.2
16	6.0	6.0	6.0	6.0	6.0	6.0	3.8	3.0	2.6	2.4	2.0	1.4	1.2

PCI-6052E Device

The NI "worst-case" specification for this device is 4.0 microseconds.

Samp. Freq → (kHz) Ch # ↓	1	2	4	5	8	10	16	20	24	25	31.25	40	50
1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0
6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.2
7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.6	4.4	3.4	2.8
8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	5.0	4.0	3.0	2.4
9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	4.6	4.4	3.4	2.6	2.2
10	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	4.0	3.2	2.4	2.0
11	6.0	6.0	6.0	6.0	6.0	6.0	5.6	4.4	3.6	3.6	2.8	2.2	1.8
12	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.4	3.2	2.6	2.0	1.6
13	6.0	6.0	6.0	6.0	6.0	6.0	4.8	3.8	3.2	3.0	2.4	1.8	1.4
14	6.0	6.0	6.0	6.0	6.0	6.0	4.4	3.4	2.8	2.8	2.2	1.6	1.4
15	6.0	6.0	6.0	6.0	6.0	6.0	4.0	3.2	2.6	2.6	2.0	1.6	1.2
16	6.0	6.0	6.0	6.0	6.0	6.0	3.8	3.0	2.6	2.4	2.0	1.4	1.2

PCI-6040E (PCI-MIO-16E-4) Device

The NI “worst-case” specification for this device is 4.0 microseconds.

Samp. Freq → (kHz) Ch # ↓	1	2	4	5	8	10	16	20	24	25	31.25	40	50
1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0
6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.2
7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.6	4.4	3.4	2.8
8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.2	5.0	4.0	3.0	2.4
9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	4.6	4.4	3.4	2.6	2.2
10	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	4.0	3.2	2.4	2.0
11	6.0	6.0	6.0	6.0	6.0	6.0	5.6	4.4	3.6	3.6	2.8	2.2	1.8
12	6.0	6.0	6.0	6.0	6.0	6.0	5.2	4.0	3.4	3.2	2.6	2.0	1.6
13	6.0	6.0	6.0	6.0	6.0	6.0	4.8	3.8	3.2	3.0	2.4	1.8	1.4
14	6.0	6.0	6.0	6.0	6.0	6.0	4.4	3.4	2.8	2.8	2.2	1.6	1.4
15	6.0	6.0	6.0	6.0	6.0	6.0	4.0	3.2	2.6	2.6	2.0	1.6	1.2
16	6.0	6.0	6.0	6.0	6.0	6.0	3.8	3.0	2.6	2.4	2.0	1.4	1.2

Signal Mapping Between C-HUB and NI PCI-6071E

The table below shows the signal mapping between the C-HUB and the NI PCI-6071E A/D board. See the NI PCI E-series User Manual (NI 320945D-01) on the National Instruments website for more information about each signal.

C-HUB to PCI-6071E Signal Mapping

Plexon Signal Name	National Instruments Signal Name
AD01	ACH0
AD02	ACH1
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AD64	ACH63
AISENSE	AISENSE
AISENSE2	AISENSE2
AIGND	AIGND
DO1	DIO0
DO2	DIO1
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DO8	DIO7
DGND*	DGND*
CTR1 (Line 2)**	GPCTR1
A/D Clock	PFI8/GPCTR0_Source
A/D Start	PFI0_TRIG1
CPX Clock	GPCTR0_OUT
AO1	DAC0_OUT
AO2	DAC1OUT
AOGND*	AOGND*

* The NI signals DGND and AOGND are shorted together on the C-HUB.

**CTR1 is called “Line 2” in the PlexDO utility.