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Find the *National Instruments PCI-6731* at our website: *Click HERE*

# High-Speed Voltage Output – up to 1 MS/s/Channel, up to 16 Bits, up to 32 Channels

## NI 673x, NI 671x, NI 672x

- Low-cost arbitrary waveform generation
- High-channel density
- Integrated multidevice synchronization bus
- Easy real-time control with LabVIEW Real-Time
- Digital triggering and external clocking
- Simultaneous updates
- 8 digital I/O lines (TTL/CMOS)
- Two 24-bit counter/timers
- Measurement services that simplify configuration and measurements

### Operating Systems

- Windows 2000/NT/XP
- Mac OS X
- Linux®

### Recommended Software

- LabVIEW 7.x or higher
- LabWindows™/CVI 7.x or higher
- Measurement Studio 7.x or higher
- Analog Waveform Editor

### Other Compatible Software

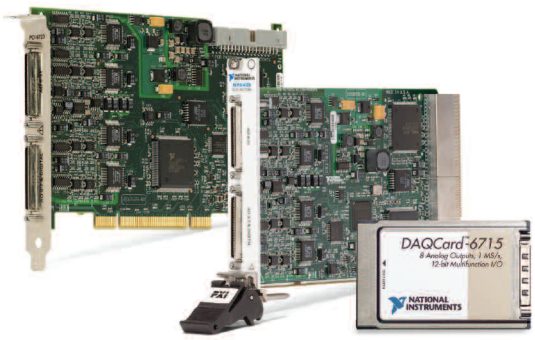
- Visual Studio .NET
- Visual Basic, C/C++, and C#

### Measurement Services Software (included)[1]

- NI-DAQmx driver
- Measurement & Automation Explorer configuration utility

[1]Mac OS X and Linux applications must use NI-DAQmx Base driver software.

*Calibration Certificate Available*




| Family | Bus | Analog Outputs | Update Rate per Channel (S/s)[1] | Output Resolution | Output Range (V) | External Voltage Reference | Digital I/O | Counter/Timers | Triggering |
|---|---|---|---|---|---|---|---|---|---|
| NI 6711 | PCI, PXI | 4 | 1 M | 12 | ±10 | ✓ | 8 | 2, 24-bit | Digital |
| NI 6713 | PCI, PXI | 8 | 740 k to 1 M | 12 | ±10 | ✓ | 8 | 2, 24-bit | Digital |
| NI 6715 | PCMCIA | 8 | 100 k to 1 M | 12 | ±10 | ✓ | 8 | 2, 24-bit | Digital |
| NI 6731 | PCI | 4 | 1 M | 16 | ±10 | ✓ | 8[2] | 2, 24-bit | Digital |
| NI 6733 | PCI, PXI | 8 | 740 k to 1 M | 16 | ±10 | ✓ | 8[2] | 2, 24-bit | Digital |
| NI 6722 | PCI, PXI | 8 | 182 to 800 k | 13 | ±10 | – | 8 | 2, 24-bit | Digital |
| NI 6723 | PCI, PXI | 32 | 45 to 800 k | 13 | ±10 | – | 8 | 2, 24-bit | Digital |

[1]Update rate can vary depending on the number of channels used; [2]Static or hardware-timed pattern generation and acquisition up to 10 MHz

*Table 1. High-Speed Voltage Output Product Selection Guide*

## Overview and Applications

National Instruments high-speed voltage output devices combine the latest in PC technologies to deliver simultaneous, multichannel updates for control and waveform output applications. Use these modules in a variety of applications, including:

- Stimulus/response
- Power supply control
- High-speed, deterministic control
- Sensor/signal simulation

## Features

The versatile NI high-speed voltage output devices commonly replace several kinds of instruments including stand-alone PID controllers, low-speed arbitrary waveform generators, and function generators.

### Waveform Generation

These devices are capable of updating at rates up to 1 MS/s, giving you the ability to generate waveforms up to 500 kHz. When using these devices, you have complete control of each data point that is updated on the output for each channel. This feature is significant because you can define not only common waveforms such as square, sine, or sawtooth but also complex waveforms. For instance, you are able to create a sine wave that is overlaid with noise in which the amplitude and noise shape are user-defined. In practice, the waveform is defined in a software buffer, within PC memory, and is streamed to the voltage output device using direct memory access (DMA) data transfers. Using DMA transfers, the amount of memory located on board the voltage output device is minimized and is swapped with inexpensive PC memory.

### Real-Time Control

You can use NI high-speed voltage output devices with the LabVIEW Real-Time Module to deliver real-time, deterministic control loop execution. Because they are compatible with LabVIEW Real-Time, common control algorithms, such as PID, are simple to implement but, more importantly, you may prototype and implement complex, cutting-edge control algorithms as well. High-performance control, on the order of eight PID loops running in excess of 20 kHz each, is possible with this combination of hardware

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and software. Each high-speed voltage output device offers multichannel simultaneous updates and hardware-timed single-point updates.

### Multidevice Synchronization

Each high-speed voltage output device offers the ability to be master or slave of a multidevice timing and triggering system. Use integration technologies such as the RTSI bus, PXI trigger bus, and PFI pins to trigger and synchronize to a wide variety of I/O types. These I/O types range from analog input, image acquisition, motion control, and high-speed digitizers to multifunction data acquisition devices. With these integration infrastructures, you can create powerful, custom test and control systems with ease.

## Measurement Services Software

National Instruments measurement services software, built around NI-DAQmx driver software, features intuitive application programming interfaces, configuration tools, I/O assistants, and other tools designed to reduce system setup, configuration, and development time. This software, part of your data acquisition purchase, includes helpful features such as:

**Automatic Code Generation** – DAQ Assistant is an interactive guide that helps you navigate through configuring, testing, and programming analog output tasks and automatically generates the necessary code for NI LabVIEW, LabWindows/CVI, or Measurement Studio.

**Cleaner Code Development** – Basic and advanced software functions have been combined into one easy-to-use yet powerful set to help you build cleaner code and move from basic to advanced applications without replacing functions.

**High-Performance Driver Engine** – NI-DAQmx delivers maximum I/O system throughput with a multithreaded driver.

**Test Panels** – With the Measurement & Automation Explorer configuration utility, you can test all of your module functionality before you begin development.

**Scaled Channels** – Easily scale your voltage data into the proper engineering units using the NI-DAQmx measurement-ready virtual channels by choosing from a list of common sensors and signals or creating your own custom scale.

**LabVIEW Integration** – All NI-DAQmx functions create the waveform data type, which carries acquired data and timing information directly into more than 400 LabVIEW built-in analysis routines for display of results in engineering units on a graph.

## NI-DAQmx Base Driver

NI-DAQmx Base (available at **ni.com/downloads**) offers Mac OS X and Linux users a programming interface similar to NI-DAQmx. It features ready-to-use LabVIEW VIs and C function features similar to those included in NI-DAQmx driver software.

| | | | |
|---|---|---|---|
| AO_GND | 34 | 68 | NC |
| NC | 33 | 67 | AO_GND |
| AO_GND | 32 | 66 | AO_GND |
| AO_GND | 31 | 65 | AO_7[1] |
| AO_6[1] | 30 | 64 | AO_GND |
| AO_GND | 29 | 63 | AO_GND |
| AO_5[1] | 28 | 62 | NC |
| AO_GND | 27 | 61 | AO_GND |
| AO_GND | 26 | 60 | AO_4 |
| AO_3 | 25 | 59 | AO_GND |
| AO_GND | 24 | 58 | AOGND |
| AO_GND | 23 | 57 | AO_2 |
| AO_0 | 22 | 56 | AO_GND |
| AO_1 | 21 | 55 | AO_GND |
| EXTREF | 20 | 54 | AO_GND |
| PO4 | 19 | 53 | D_GND |
| D_GND | 18 | 52 | DIO0 |
| PO1 | 17 | 51 | PO5 |
| PO6 | 16 | 50 | D_GND |
| D_GND | 15 | 49 | DIO2 |
| +5 V | 14 | 48 | PO7 |
| D_GND | 13 | 47 | PO3 |
| D_GND | 12 | 46 | NC |
| PFI_0 | 11 | 45 | EXTSTROBE |
| PFI_1 | 10 | 44 | D_GND |
| DBND | 9 | 43 | PFI_2 |
| +5 V | 8 | 42 | PFI_3/ CTR_1_SOURCE |
| D_GND | 7 | 41 | PFI_4/ CTR_1_GATE |
| PFI_5/AO_SAMP_CLK | 6 | 40 | CTR_1_OUT |
| PFI_6/AO_START_TRIG | 5 | 39 | D_GND |
| D_GND | 4 | 38 | PFI_7 |
| PFI_9/CTR_0_GATE | 3 | 37 | PFI_8/CTR_0_SOURCE |
| CTR_0_OUTT | 2 | 36 | D_GND |
| FREQ_OUT | 1 | 35 | D_GND |

[1] No Connect on 6711 or 6731

*Figure 1. NI 671x and NI 673x I/O Connector*



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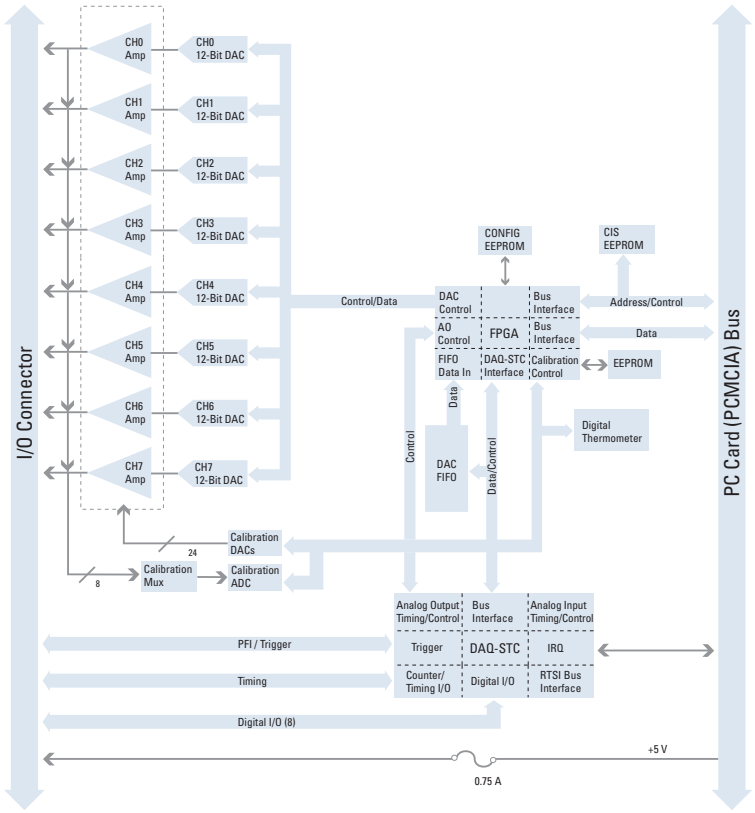



*Figure 2. NI DAQCard-6715 Hardware Block Diagram*

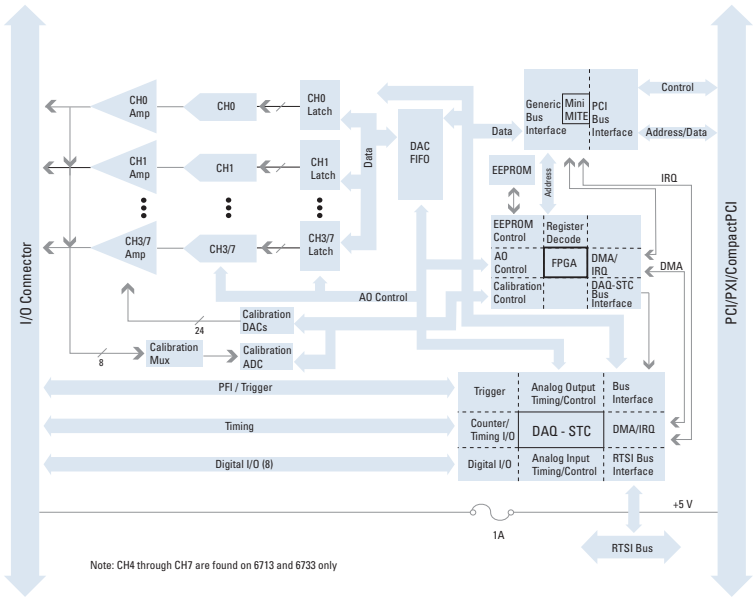



*Figure 3. NI 671x and NI 673x Hardware Block Diagram*

## High-Speed Voltage Output – up to 1 MS/s/Channel, up to 16 Bits, up to 32 Channels

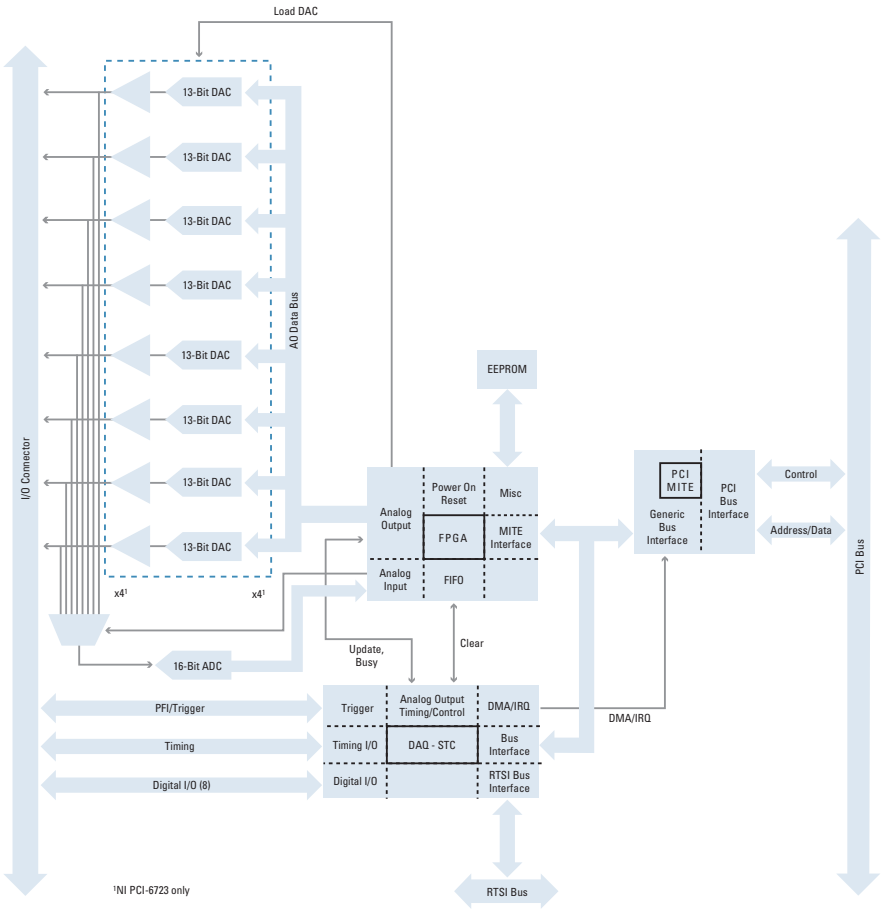



*Figure 4. NI 672x Hardware Block Diagram*

## Ordering Information

### PCI

NI PCI-6711 ..... 777740-01
NI PCI-6713 ..... 777741-01
NI PCI-6722[1] ..... 778705-01
NI PCI-6723[1] ..... 778701-01
NI PCI-6731 ..... 778511-01
NI PCI-6733 ..... 778510-01

### PXI

NI PXI-6711 ..... 777794-01
NI PXI-6713 ..... 777795-01
NI PXI-6722[1] ..... 778999-01
NI PXI-6723[1] ..... 778998-01
NI PXI-6733 ..... 778512-01

### PCMCIA

NI DAQCard-6715 ..... 778146-01

Includes data acquisition driver software.

[1]Windows only.

***For more information on extended warranty and value-added services, visit ni.com/services.***

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# Specifications – NI 671x, NI 673x

These specifications are typical at 25 °C unless otherwise stated.

## Analog Output

### Output Characteristics

Number of channels
- NI 6715/6713/6733 ..... 8 voltage outputs
- NI 6711/6731 ..... 4 voltage outputs

Resolution ..... 12 bits, 1 in 4,096 (NI 671x), 16 bits, 1 in 65,536 (NI 673x)

| | Maximum Update Rate (NI 671x/673x) | | Max Update Rate (NI 6715) | |
|---|---|---|---|---|
| Number of Channels | Using Local FIFO (kS/s)[1] | Using Host Memory (kS/s)[2] | Using Local FIFO (kS/s)[1] | Using Host Memory (kS/s)[2] |
| 1 | 1,000 | 1,000 | 1,000 | 800 |
| 2 | 1,000 | 1,000 | 850 | 400 |
| 3 | 1,000 | 1,000 | 750 | 266 |
| 4 | 1,000 | 1,000 | 650 | 200 |
| 5 | 1,000 | 1,000 | 600 | 160 |
| 6 | 952 | 1,000 | 550 | 133 |
| 7 | 833 | 869 | 510 | 114 |
| 8 | 740 | 769 | 480 | 100 |

[1]These numbers apply to continuous waveform generation, and do not change irrespective of the number of devices in the system. [2]These numbers may change when using more devices or when other CPU or bus activity is taking place.

FIFO buffer size
- NI 6713/6733 ..... 16,384 samples
- NI 6711/6715/6731 ..... 8,192 samples

Data transfers ..... DMA, interrupts, programmed I/O

DMA modes (PXI/PCI only) ..... Scatter-gather

### Voltage Output

Ranges ..... ±10.0 V, ±AO EXT REF

Output coupling ..... DC

Protection ..... Short-circuit to ground

## Digital I/O

Number of channels ..... 8 input/output

Compatibility ..... 5 V TTL/CMOS

Power-on state ..... Input (high-impedance)

Data transfers ..... Programmed I/O, DMA (NI 673x), interrupts (NI 673x)

Input buffer ..... 2048 B (NI 673x)

Output buffer ..... 2048 B (NI 673x)

Transfer rate ..... 10 Mwords/s (NI 673x)

## Timing I/O

### General-Purpose Up/Down Counter/Timers

Number of channels ..... 2

Resolution ..... 24 bits

Compatibility ..... 5 V TTL/CMOS

| Level | Minimum | Maximum |
|---|---|---|
| Input low voltage | 0 V | 0.8 V |
| Input high voltage | 2 V | 5 V |
| Output low voltage ($I_{out}$ = 5 mA) | – | 0.4 V |
| Output high voltage ($I_{out}$ = -3.5 mA) | 4.35 V | – |

Digital logic levels

Base clocks available ..... 20 MHz and 100 kHz

Data transfers ..... DMA (except DAQCard-6715), interrupts, programmed I/O

DMA modes ..... Scatter-gather

## Digital Trigger

Purpose
- Analog output ..... Start trigger, gate, clock
- General-purpose counter/timers ..... Source, gate

Source ..... (except NI 6715)
- PCI ..... RTSI <0...6>
- PXI ..... PFI <0...9>

Slope ..... Positive or negative; software-selectable

Compatibility ..... 5 V TTL/CMOS

# Specifications – NI 672x

These specifications are typical at 25 °C unless otherwise stated.

## Analog Output

### Output Characteristics

Number of channels
- NI 6722 ..... 8 voltage outputs

| | Max Update Rate (kS/s) | |
|---|---|---|
| Number of Channels | Using Local FIFO[1] | Using Host PC Memory[2] |
| 1 | 800 | 800 |
| 2 | 714 | 714 |
| 8 | 476 | 182 |
| 16 | 333 | 90.9 |
| 24 | 253 | 60 |
| 32 | 204 | 45 |

[1]These numbers apply to continuous waveform generation, which allows for the time it takes to reset the FIFO to the beginning when cycling through it. This additional time is not incurred when using host PC memory for waveform generation. The max update rate in FIFO mode does not change regardless of the number of devices in the system.

[2]These results were measured using an NI 6722/6723 device with a 550 MHz Pentium III machine. These numbers may change when using more devices or when other CPU or bus activity occurs.

- NI 6723 ..... 32 voltage outputs

Resolution ..... 13 bits, 1 in 8,192

Max update rate

FIFO buffer size ..... 2,048 samples

Data transfers ..... DMA, interrupts, programmed I/O

DMA modes ..... Scatter gather

### Voltage Output

Ranges ..... ±10 V

Output coupling ..... DC

Protection ..... Short-circuit to ground

## Digital I/O

Number of channels ..... 8 input/output

Compatibility ..... TTL/CMOS

Power-on state ..... Input (high-impedance)

Data transfers ..... Programmed I/O

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## Timing I/O

Number of channels
- Up/down counter/timers ..... 2
- Frequency scaler ..... 1

Resolution
- Up/down counter/timers ..... 24 bits
- Frequency scaler ..... 4 bits

Compatibility ..... 5 V TTL/CMOS

Digital logic levels

| Level | Min | Max |
|---|---|---|
| Input low voltage | 0.0 V | 0.8 V |
| Input high voltage | 2.0 V | 5.0 V |
| Output low voltage ($I_{out}$ = 5 mA) | – | 0.4 V |
| Output high voltage ($I_{out}$ = -3.5 mA) | 4.35 V | – |

Data transfers
- Up/down counter/timers ..... DMA (scatter-gather), interrupts, programmed I/O
- Frequency scaler ..... Programmed I/O

## Digital Trigger

Purpose
- Analog output ..... Start trigger, gate, clock
- Counter/timers ..... Source, gate

Source ..... PFI <0...9>

Compatibility ..... 5 V TTL

Response ..... Rising or falling edge

*For more detailed specifications, please refer to the product manual.*

# High-Speed Voltage Output Cables and Accessories

## Recommended Configurations

- Shielded options for minimal noise interference
- Direct connectivity options such as BNC
- Low-cost options for OEM
- Front-mount terminal block for PXI
- Custom connectivity with the CA-1000

| Model | Shielding | Connect to … | Cable | Accessory |
|---|---|---|---|---|
| NI 673x, NI 671x | Shielded | BNC | SH68-68-EP | BNC-2110 |
| | Shielded | Screw terminals | SH68-68-EP | SCB-68 or TBX-68 |
| | Shielded | Screw terminals | – | TB-2705 (PXI) |
| | Shielded | Custom | SH68-68-EP | CA-1000 |
| | Unshielded | Screw terminals | R6868 | CB-68LP or CB-68LPR |
| NI 6723 | Shielded | BNC | 2 SH68-C68-S | BNC-2110 and BNC-2115 |
| | Shielded | Screw terminals | 2 SH68-C68-S | 2 SCB-68 or TBX-68 |
| | Shielded | Custom | 2 SH68-C68-S | 2 CA-1000 |
| NI 6722 | Shielded | BNC | SH68-C68-S | BNC-2110 |
| | Shielded | Screw terminals | SH68-C68-S | SCB-68 |
| | Shielded | Custom | SH68-C68-S | CA-1000 |
| | Unshielded | Screw terminals | RC68-68 | CB-68LP or CB-68LPR |
| DAQCard-6715 | Shielded | BNC | SHC68-68-EPM | BNC-2110 |
| | Shielded | Screw terminals | SHC68-68-EPM | SCB-68 |
| | Shielded | Custom | SHC68-68-EPM | CA-1000 |
| | Unshielded | Screw terminals | RC68-68 | CB-68LP or CB-68LPR |

## I/O Connector Blocks

**BNC-2110** – Shielded I/O connector block with signal-labeled BNC connectors for easy connectivity of your analog output (AO), digital I/O (DIO), and counter/timer signals.

BNC-2110 ..... 777643-01

Dimensions – 20.3 by 11.2 by 5.5 cm (8.0 by 4.4 by 2.2 in.)

**BNC-2115** – Shielded I/O connector block with signal-labeled BNC connectors for easy connectivity of your extended analog output on NI 6723 devices.

BNC-2115 ..... 777807-01

Dimensions – 20.3 by 11.2 by 5.5 cm (8.0 by 4.4 by 2.2 in.)

**SCB-68** – Shielded I/O connector blocks giving you rugged, very low-noise signal termination. The SCB-68 also houses silk-screened component locations for easy addition of simple signal conditioning circuitry for your AO channels.

SCB-68 ..... 776844-01

Dimensions – 19.5 by 15.2 by 4.5 cm (7.7 by 6.0 by 1.8 in.)

**CA-1000** – Configurable enclosure that gives you user-defined connectivity and flexibility through customized panelettes.

CA-1000 ..... 777664-01

Dimensions – 30.7 by 25.4 by 4.3 cm (12.1 by 10 by 1.7 in.)

**TBX-68** – 68 screw terminals for easy connection of field signals to 68-pin DAQ devices. It includes one 68-pin male connector for direct connection to 68-pin cables. The TBX-68 is mounted in a protective plastic base with hardware for mounting on a standard DIN rail.

TBX-68 ..... 777141-01

Dimensions – 12.50 by 10.74 cm (4.92 by 4.23 in.)

**CB-68LP, CB-68LPR** – 68 screw terminals for easy connection of field signals to AO devices. They include one 68-pin male connector for direct connection to 68-pin cables. The connector blocks include standoffs for use on a desktop or for mounting in a custom panel. The CB-68LP has a vertical mounted 68-pin connector. The CB-68LPR has a right-angle mounted connector and can also be used with the CA-1000.

CB-68LP ..... 777145-01

Dimensions – 14.35 by 10.74 cm (5.65 by 4.23 in.)

Dimensions – 7.62 by 16.19 cm (3.00 by 6.36 in.)

**TB-2705** – 68-pin screw-terminal block for PXI-671x and PXI-673x modules. Latches to the front of your PXI module with locking screws and provides strain relief as well as easy access to your analog, digital,



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trigger, and counter/timer signals through screw terminals. Does not work with NI 6703 or NI 6704 devices.

TB-2705 .....778241-01

Dimensions – 8.43 by 10.41 by 2.03 cm (3.32 by 4.1 by 0.8 in.)

## Synchronization Cables

**RTSI Bus Cables** – Used to connect timing and synchronization signals among measurement, vision, motion, and CAN boards for PCI. For systems with long and short boards, use the extended RTSI cable.

2 boards .....776249-02
3 boards .....776249-03
4 boards .....776249-04
5 boards .....776249-05
Extended, 5 boards .....777562-05

## Shielded I/O Cables

**SH68-68-EP** – Shielded 68-conductor cable terminated with two 68-pin female 0.050 series D-type connectors, featuring individually shielded analog twisted pairs for reduced crosstalk with high-speed devices. This cable works with all NI 671x and NI 673x devices.

1 m .....184749-01

**SHC68-68-EP** – Shielded cable for connecting and latching the NI DAQCard-6715, NI 6722, and NI 6723 to standard 68-pin accessories. Latching screws secure the shielded connector to the device itself for stability. Use this cable for a DAQCard located in the bottom PCMCIA slot of a laptop.

0.5 m .....186838-0R5
1 m .....186838-01

**SHC68U-68-EP** – Identical to the SHC68-68-EP, except that the DAQCard connector is inverted so you can use two latching DAQCard devices in adjacent slots. Use this cable with a DAQCard inserted in the upper PCMCIA slot of a laptop.

0.5 m .....187406-0R5
1 m .....187406-01

**SH68-C68-S** – Shielded cable for connecting and latching NI 672x devices to standard 68-pin accessories.

2 m .....186381-02

## Ribbon I/O Cables

**R6868** – 68-conductor flat ribbon cable terminated with two 68-pin connectors. Use this cable to connect the NI 670x, NI 671x, and NI 673x devices to low-cost 68-pin accessories.

1 m .....182482-01

**RC68-68** – 68-conductor flat ribbon cable terminated with one VHDCI 68-pin connector and one 68-pin SCSI II connector. Use this cable to connect the NI 6722 devices and DAQCard-6715 with standard 68-pin accessories.

1 m .....187252-01



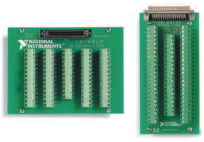
*BNC-2110*



*SCB-68*



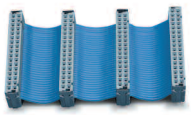
*CA-1000*



*CB-68LP I/O and CB-68LPR*



*TB-2705*



*RTSI Bus Cable*



*SH68-68-EP Shielded Cable*



*SHC68-68-EP*



*R6868 Ribbon Cable*



*RC68-68 Ribbon Cable*



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## Hardware Services

### NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with **ni.com/pxiadvisor**.

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351432A-01 2006-7838-301-101-D

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