*Last Revised: 2015-04-09 07:52:22.0*

# NI X Series Multifunction Data Acquisition


## Overview

NI X Series devices for USB, PCI Express and PXI Express are the most advanced data acquisition devices ever designed by National Instruments. They feature significant improvements in onboard timing and triggering and optimizations for use with multicore PCs. X Series devices integrate high-performance analog, digital, and counter/timer functionality onto a single device, making them well-suited for a broad range of applications, from basic data logging to control and test automation.

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## Requirements and Compatibility

### OS Information

- PharLap
- Real-Time OS
- Windows 7
- Windows 7 64-bit
- Windows Vista x64/x86
- Windows XP

### Driver Information

- NI-DAQmx

### Software Compatibility

- ANSI C/C++
- LabVIEW
- LabVIEW Real-Time Module
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- Visual Basic
- Visual Studio .NET

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## Comparison Tables

| Bus | Model Number | Analog Inputs (AI) | Max AI Sampling Rate (1-channel) | Max Total AI Throughput | Analog Outputs (AO) | Max AO Update Rate | Digital I/O Lines | Max Digital I/O Rate | Triggering |
|---|---|---|---|---|---|---|---|---|---|
| PCI Express | 6320 | 16 | 250 kS/s | 250 kS/s | 0 | - | 24 | 1 MHz | Digital |
| PCI Express | 6321 | 16 | 250 kS/s | 250 kS/s | 2 | 900 kS/s | 24 | 1 MHz | Digital |
| PCI Express | 6323 | 32 | 250 kS/s | 250 kS/s | 4 | 900 kS/s | 48 | 1 MHz | Digital |
| USB, PCI Express, PXI Express | 6341 | 16 | 500 kS/s | 500 kS/s | 2 | 900 kS/s | 24 | 1 MHz | Digital |
| USB, PCI Express | 6343 | 32 | 500 kS/s | 500 kS/s | 4 | 900 kS/s | 48 | 1 MHz | Digital |
| USB, PCI Express | 6351 | 16 | 1.25 MS/s | 1.25 MS/s | 2 | 2.86 MS/s | 24 | 10 MHz | Analog, Digital |
| USB, PCI Express | 6353 | 32 | 1.25 MS/s | 1.25 MS/s | 4 | 2.86 MS/s | 48 | 10 MHz | Analog, Digital |

| Bus | Model Number | Analog Inputs (AI) | Max AI Sampling Rate (1-channel) | Max Total AI Throughput | Analog Outputs (AO) | Max AO Update Rate | Digital I/O Lines | Max Digital I/O Rate | Triggering |
|---|---|---|---|---|---|---|---|---|---|
| USB, PCI Express, PXI Express | 6361 | 16 | 2 MS/s | 2 MS/s | 2 | 2.86 MS/s | 24 | 10 MHz | Analog, Digital |
| USB, PCI Express, PXI Express | 6363 | 32 | 2 MS/s | 2 MS/s | 4 | 2.86 MS/s | 48 | 10 MHz | Analog, Digital |
| USB, PXI Express | 6356 | 8 simultaneous | 1.25 MS/s/channel | 10 MS/s | 2 | 3.33 MS/s | 24 | 10 MHz | Analog, Digital |
| PXI Express | 6358 | 16 simultaneous | 1.25 MS/s/channel | 20 MS/s | 4 | 3.33 MS/s | 48 | 10 MHz | Analog, Digital |
| USB, PXI Express | 6366 | 8 simultaneous | 2 MS/s/channel | 16 MS/s | 2 | 3.33 MS/s | 24 | 10 MHz | Analog, Digital |
| PXI Express | 6368 | 16 simultaneous | 2 MS/s/channel | 32 MS/s | 4 | 3.33 MS/s | 48 | 10 MHz | Analog, Digital |

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## Application and Technology

### NI-STC3 Timing and Synchronization Technology

NI X Series multifunction data acquisition (DAQ) devices include the NI-STC3, an ASIC designed by NI for advanced timing, triggering, and synchronization. This technology includes the following:

- Four counter/timers with more functionality than ever before, such as the ability to create a finite pulse train with a single counter
- A 100 MHz timebase for faster triggering response and more precise generation of analog and digital sample clocks
- Independent analog and digital timing engines
- Retriggerable measurement tasks for analog I/O, digital I/O, and counter/timers

### Native PCI Express Interface

In contrast to a PCI-to-PCI Express bridge chip, which limits the bandwidth of the device to that of the PCI bus and introduces latency, PCI Express and PXI Express X Series devices use a native x1 PCI Express interface that provides up to 250 MB/s in each direction. National Instruments has also optimized this interface for low latency in single-point control applications. You can use X Series PCI Express boards in any PCI Express slot from x1 up to x16.

### NI Signal Streaming

USB X Series devices include patented NI Signal Streaming, a technology that uses message-based instructions and device-side intelligence to ensure high-speed, bidirectional data transfer over USB. With USB X Series, you can concurrently transfer analog, digital, and counter data in both directions. The total device throughput over USB is PC-dependent; on some systems, up to 32 MB/s sustained transfers are possible.

#### Improved Mechanical Enclosure

USB X Series devices introduce a redesigned, extruded aluminum enclosure with an easy-access magnetic lid. This lid keeps signal wiring secured and shielded and can be opened easily when needed. The underside of the lid has a device-specific pinout label so that you can quickly determine the corresponding screw terminals for a given channel. The enclosure also includes a lockable USB port to prevent accidental removal during operation and a security slot that can be used with ordinary laptop locks to secure the device to a desk or workstation.

### Software Enhancements

PCI Express and PXI Express X Series devices are compatible with NI-DAQmx Version 9.0 or later driver software. USB X Series devices require NI-DAQmx Version 9.2 or later. More than a basic driver, NI-DAQmx includes the NI Measurement & Automation Explorer (MAX) configuration utility, the DAQ Assistant for rapid development of basic applications, and hundreds of example programs for NI LabVIEW and text-based languages. NI-DAQmx also includes LabVIEW SignalExpress LE basic data-logging software.

NI-DAQmx 9.0 introduces the ability to synchronize multiple PCI Express or PXI Express X Series devices with a single NI-DAQmx task, which previously took several tasks and manual routing of clocks and triggers. This version also introduces the fastest, easiest way to acquire measurement data to disk in the Technical Data Management Streaming (TDMS) format with the new Configure Logging VI. NI-DAQmx 9.2 introduces the ability to log acquired data to TDMS files within the DAQ Assistant Express VI.

With NI-DAQmx and intuitive LabVIEW graphical programming, you can easily develop applications that take advantage of today's multicore systems so you can perform acquisition, signal processing, and data logging on different CPU cores.

### Simultaneous Sampling X Series

Some X Series devices for USB and PXI Express offer simultaneous sampling, with the same channel counts and connectivity as multiplexed devices.

Unlike multiplexed devices that reduce sampling rates as you add more channels, you can use simultaneous sampling devices to maintain sampling rates as you expand the number of channels. Simultaneous sampling X Series devices are available with up to 16 differential channels per device, and, with PXI Express, you can sample more than 200 channels simultaneously.

Simultaneous X Series devices for USB include 32 or 64 MS onboard memory to ensure the transfer of finite acquisitions, even in the presence of heavy USB traffic.

## Applications

#### Acquisition and Visualization

X Series devices include analog, digital, and counter circuitry for the most common types of static and waveform measurements. With LabVIEW, you can easily acquire the data and view it on a variety of graphs and displays. You can use configuration-based wizards called Express VIs to take measurements and perform signal processing with minimal programming.

#### Data Logging

Whether you are validating a new hardware design, monitoring conditions on a factory floor, or recording temperature changes during a scientific experiment, you need to take measurements, visualize your data, and often log it to disk. With X Series multifunction DAQ, you can develop a user-defined measurement system by using intuitive graphical programming software and incorporating the exact visualization, analysis, and data-logging capabilities your application requires.

### Control Systems

If you need to control the temperature of a room, the speed of a motor, or the pressure of hydraulic fluids, you can use X Series DAQ hardware to connect sensors and actuators to your computer and build the control system that meets your exact application needs. The low-latency PCI Express bus improves single-point I/O performance, and with LabVIEW software and NI-DAQmx driver software, you can easily take sensor measurements, compare values to a setpoint, and update output signals. X Series devices also have four counter/timers for performing quadrature encoder measurements, pulse-width modulation, pulse train generation, frequency measurements, and much more, making them ideal for basic motor control.

Due to the inherent higher latency of USB as compared to PCI Express, National Instruments recommends that you use PCI Express or PXI Express X Series devices for applications that require single-point control or deterministic operation.

### Test Automation

X Series DAQ hardware provides analog inputs, analog outputs, hardware-timed digital I/O, and four counter/timers on a single device, making it a cost-effective option for basic device under test characterization and test automation. With NI-DAQmx software, you can easily synchronize acquisition or generation on multiple subsystems, such as an analog input and analog output channel. In addition, you can easily synchronize two or more X Series devices for further expansion by using a RTSI cable for PCI Express devices or over the PXI Express backplane for PXI Express modules. It is possible to synchronize two or more USB X Series devices by exporting sample or reference clocks from the master device to the slave device, and using external wiring.

## Compatible Accessories

PCI Express and PXI Express X Series devices use either a single or dual-stack 68-pin VHDCI female connector, depending on the number of analog and digital channels on the device. National Instruments offers several options for cables, from 0.5 to 10 m and from low-cost to high-performance with shielding. Connector blocks are available with screw terminal, BNC, or custom connector types.

For measurements requiring signal conditioning, you can use X Series with SCXI signal conditioning modules.

You can purchase DIN-rail or panel mount kits for USB X Series devices as well as replacement power supplies and latching USB cables. See the model page for ordering information.

## Upgrading

Because X Series DAQ devices use the same NI-DAQmx driver software as NI M Series DAQ devices, upgrading is easy. In addition, PCI Express and PXI Express X Series devices use the same VHDCI connector as PCI and PXI M Series. You can reuse your code and preserve your investment in accessories. The pinouts for X Series devices are backward-compatible with M Series devices.

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## Ordering Information

For a complete list of accessories, visit the product page on ni.com.

| Products | Part Number | Recommended Accessories | Part Number |
|---|---|---|---|
| **NI PCIe-6320** | | | |
| **NI PCIe-6320**<br>Requires: 1 Cables , 1 Connector Blocks ; | 781043-01 | **Cables:** Shielded - SHC68-68-EPM Cable (2m)<br>***Also Available: [Unshielded]* | 192061-02 |
| | | **Connector Blocks:** Spring-Screw_Terminals - SCB-68A<br>***Also Available: [BNC_Terminals]* | 782536-01 |
| **NI PCIe-6321** | | | |
| **NI PCIe-6321**<br>Requires: 1 Cables , 1 Connector Blocks ; | 781044-01 | **Cables:** Shielded - SHC68-68-EPM Cable (2m)<br>***Also Available: [Unshielded]* | 192061-02 |
| | | **Connector Blocks:** Spring-Screw_Terminals - SCB-68A<br>***Also Available: [BNC_Terminals]* | 782536-01 |
| **NI PCIe-6323** | | | |
| **NI PCIe-6323**<br>Requires: 2 Cables , 2 Connector Blocks ; | 781045-01 | **Connector 0:** | |
| | | **Cables:** Shielded - SHC68-68-EPM Cable (2m)<br>***Also Available: [Unshielded]* | 192061-02 |
| | | **Connector Blocks:** Spring-Screw_Terminals - SCB-68A<br>***Also Available: [BNC_Terminals]* | 782536-01 |
| | | **Connector 1:** | |
| | | **Cables:** Shielded - SHC68-68-EPM Cable (2m)<br>***Also Available: [Unshielded]* | 192061-02 |
| | | **Connector Blocks:** Spring-Screw_Terminals - SCB-68A<br>***Also Available: [BNC_Terminals]* | 782536-01 |

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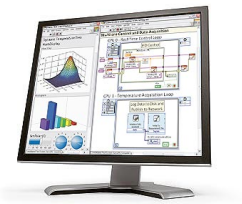
## Software Recommendations

**LabVIEW Professional Development System for Windows**

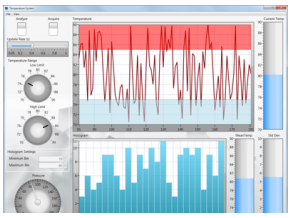


- Fully integrated graphical system design software
- Support for a wide range of measurement hardware, I/O, and buses
- Custom, event-driven user interfaces for measurement and control
- Extensive signal processing, analysis, and math functionality
- Advanced compiler to ensure high-performance execution and code optimization
- Professional software development with code quality review, unit testing, and executable creation

**SignalExpress for Windows**

- Quickly configure projects without programming
- Control over 400 PC-based and stand-alone instruments
- Log data from more than 250 data acquisition devices
- Perform basic signal processing, analysis, and file I/O
- Scale your application with automatic LabVIEW code generation
- Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

**Measurement Studio Professional Edition**



- Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
- Analysis libraries for array operations, signal generation, windowing, filters, signal processing
- Hardware integration support with native .NET data acquisition and instrument control libraries
- Automatic code generation for all NI-DAQmx data acquisition hardware
- Intelligent and efficient data-logging libraries for streaming measurement data to disk
- Support for Microsoft Visual Studio .NET 2012/2010/2008

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## Support and Services

### System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

### Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

### Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

### Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

### Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

### Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

### OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

### Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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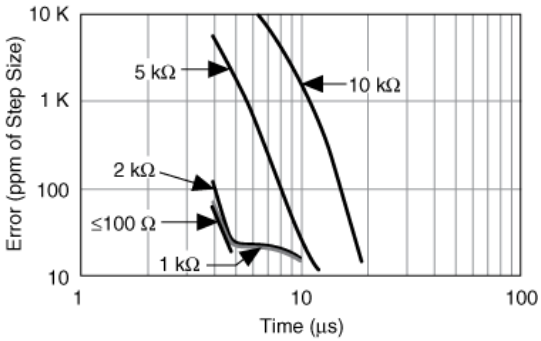
## Detailed Specifications

Specifications listed below are typical at 25 °C unless otherwise noted. Refer to the *X Series User Manual* for more information about NI PCIe-6320/6321/6323 devices.

| **Analog Input** | |
|---|---|
| Number of channels | |
| NI 6320/6321 | 8 differential or 16 single ended |
| NI 6323 | 16 differential or 32 single ended |
| ADC resolution | 16 bits |
| DNL | No missing codes guaranteed |
| INL | Refer to the *AI Absolute Accuracy Table* |
| Sampling rate | |
| Maximum | 250 kS/s single channel, 250 kS/s multi-channel (aggregate) |
| Minimum | No minimum |
| Timing accuracy | 50 ppm of sample rate |
| Timing resolution | 10 ns |
| Input coupling | DC |
| Input range | ±10 V, ±5 V, ±1 V, ±0.2 V |
| Maximum working voltage for analog inputs (signal + common mode) | ±11 V of AI GND |
| CMRR (DC to 60 Hz) | 100 dB |
| Input impedance | |
| Device on | |
| AI+ to AI GND | >10 GΩ in parallel with 100 pF |
| AI– to AI GND | >10 GΩ in parallel with 100 pF |
| Device off | |
| AI+ to AI GND | 1200 Ω |
| AI– to AI GND | 1200 Ω |
| Input bias current | ±100 pA |
| Crosstalk (at 100 kHz) | |
| Adjacent channels | –75 dB |
| Non-adjacent channels | –90 dB |
| Small signal bandwidth (–3 dB) | 700 kHz |

| | |
|---|---|
| Input FIFO size | 4,095 samples |
| Scan list memory | 4,095 entries |
| Data transfers | DMA (scatter-gather), programmed I/O |
| Overvoltage protection (AI <0..31>, AI SENSE, AI SENSE 2) | |
| Device on | ±25 V for up to two AI pins |
| Device off | ±15 V for up to two AI pins |
| Input current during overvoltage condition | ±20 mA max/AI pin |
| **Settling Time for Multichannel Measurements** | |
| Accuracy, full scale step, all ranges | |
| ±90 ppm of step (±6 LSB) | 4 µs convert interval |
| ±30 ppm of step (±2 LSB) | 5 µs convert interval |
| ±15 ppm of step (±1 LSB) | 7 µs convert interval |
| Analog triggers | None |
| **Typical Performance Graphs** | |

Settling Error Versus Time for Different Source Impedances




## Analog Output

| | |
|---|---|
| Number of channels | |
| NI 6320 | 0 |
| NI 6321 | 2 |
| NI 6323 | 4 |
| DAC resolution | 16 bits |
| DNL | ±1 LSB |
| Monotonicity | 16 bit guaranteed |
| Maximum update rate | |
| 1 channel | 900 kS/s |
| 2 channels | 840 kS/s per channel |
| 3 channels | 775 kS/s per channel |
| 4 channels | 719 kS/s per channel |
| Timing accuracy | 50 ppm of sample rate |
| Timing resolution | 10 ns |
| Output range | ±10 V |
| Output coupling | DC |
| Output impedance | 0.2 Ω |
| Output current drive | ±5 mA |

| | |
|---|---|
| Overdrive protection | ±15 V |
| Overdrive current | 15 mA |
| Power-on state | ±20 mV |
| Power-on/off glitch | 2 V for 500 ms |
| Output FIFO size | 8,191 samples shared among channels used |
| Data transfers | DMA (scatter-gather), programmed I/O |
| AO waveform modes:<br>▪ Non-periodic waveform<br>▪ Periodic waveform regeneration mode from onboard FIFO<br>▪ Periodic waveform regeneration from host buffer including dynamic update | |
| Settling time, full scale step 15 ppm (1 LSB) | 6 µs |
| Slew rate | 15 V/µs |
| Glitch energy | |
| Magnitude | 100 mV |
| Duration | 2.6 µs |

## Calibration (AI and AO)

| | |
|---|---|
| Recommended warm-up time | 15 minutes |
| Calibration interval | 1 year |

## AI Absolute Accuracy Table

| Nominal Range | | Residual Gain Error (ppm of Reading) | Gain Tempco (ppm/°C) | Reference Tempco (ppm/°C) | Residual Offset Error (ppm of Range) | Offset Tempco (ppm of Range/°C) | INL Error (ppm of Range) | Random Noise, σ ($\mu V_{rms}$) | Absolute Accuracy at Full Scale[1] (µV) |
|---|---|---|---|---|---|---|---|---|---|
| Positive Full Scale | Negative Full Scale | | | | | | | | |
| 10 | –10 | 65 | 7.3 | 5 | 13 | 24 | 60 | 229 | 2200 |
| 5 | –5 | 72 | 7.3 | 5 | 13 | 25 | 60 | 118 | 1140 |
| 1 | –1 | 78 | 7.3 | 5 | 17 | 37 | 60 | 26 | 257 |
| 0.2 | – 0.2 | 105 | 7.3 | 5 | 27 | 93 | 60 | 12 | 69 |

### AI Absolute Accuracy Formulas

AbsoluteAccuracy = Reading · (GainError) + Range · (OffsetError) + NoiseUncertainty
GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)
OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error
NoiseUncertainty = (RandomNoise · 3) / √ 10,000, for a coverage factor of 3 σ and averaging 10,000 points.

[1]Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

TempChangeFromLastExternalCal = 10 °C
TempChangeFromLastInternalCal = 1 °C
number_of_readings = 10,000
CoverageFactor = 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

GainError = 65 ppm + 7.3 ppm · 1 + 5 ppm · 10
GainError = 122 ppm

OffsetError = 13 ppm + 24 ppm · 1 + 60 ppm
OffsetError = 97 ppm

NoiseUncertainty = (229 µV · 3) / √ 10,000
NoiseUncertainty = 6.9 µV

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty
AbsoluteAccuracy = 2,200 µV

Accuracies listed are valid for up to one year from the device external calibration.

## AO Absolute Accuracy Table

| Nominal Range | | Residual Gain Error (ppm of Reading) | Gain Tempco (ppm/°C) | Reference Tempco (ppm/°C) | Residual Offset Error (ppm of Range) | Offset Tempco (ppm of Range/°C) | INL Error (ppm of Range) | Absolute Accuracy at Full Scale[1] (µV) |
|---|---|---|---|---|---|---|---|---|
| Positive Full Scale | Negative Full Scale | | | | | | | |
| 10 | –10 | 80 | 11.3 | 5 | 53 | 4.8 | 128 | 3,271 |

**Absolute Accuracy Formulas**

[1]Absolute Accuracy at full scale numbers is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration.

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)
GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)
OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

Accuracies listed are valid for up to one year from the device external calibration.

## Digital I/O/PFI

**Static Characteristics**

| | |
|---|---|
| Number of channels | |
| NI 6320/6321 | 24 total, 8 (P0.<0..7>) 16 (PFI <0..7>/P1, PFI <8..15>/P2) |
| NI 6323 | 48 total, 32 (P0.<0..31>) 16 (PFI <0..7>/P1, PFI <8..15>/P2) |
| Ground reference | D GND |
| Direction control | Each terminal individually programmable as input or output |
| Pull-down resistor | 50 kΩ typical, 20 kΩ minimum |
| Input voltage protection [1] | ±20 V on up to two pins |

**Waveform Characteristics (Port 0 Only)**

| | |
|---|---|
| Terminals used | |
| NI 6320/6321 | Port 0 (P0.<0..7>) |
| NI 6323 | Port 0 (P0.<0..31>) |
| Port/sample size | |
| NI 6320/6321 | Up to 8 bits |
| NI 6323 | Up to 32 bits |
| Waveform generation (DO) FIFO | 2,047 samples |
| Waveform acquisition (DI) FIFO | 255 samples |
| DO or DI Sample Clock frequency | 0 to 1 MHz, system and bus activity dependent |
| Data transfers | DMA (scatter-gather), programmed I/O |
| Digital line filter settings | 160 ns, 10.24 µs, 5.12 ms, disable |

**PFI/Port 1/Port 2 Functionality**

| | |
|---|---|
| Functionality | Static digital input, static digital output, timing input, timing output |
| Timing output sources | Many AI, AO, counter, DI, DO timing signals |
| Debounce filter settings | 90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input |

**Recommended Operation Conditions**

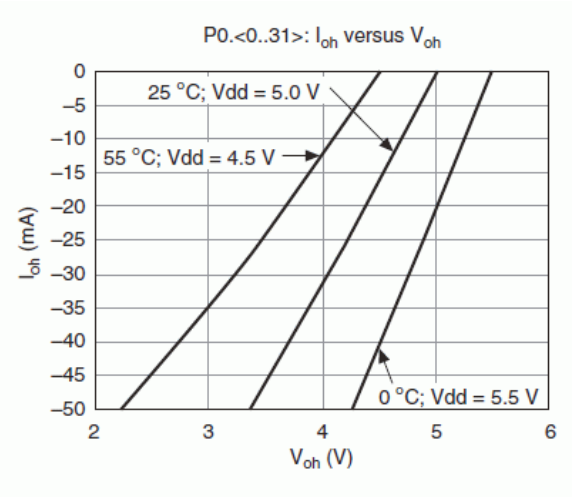
| Level | Min | Max |
|---|---|---|
| Input high voltage ($V_{IH}$) | 2.2 V | 5.25 V |
| Input low voltage ($V_{IL}$) | 0 V | 0.8 V |
| Output high current ($I_{OH}$) | | |
| P0.<0..31> | — | –24 mA |
| PFI <0..15>/P1/P2 | — | –16 mA |

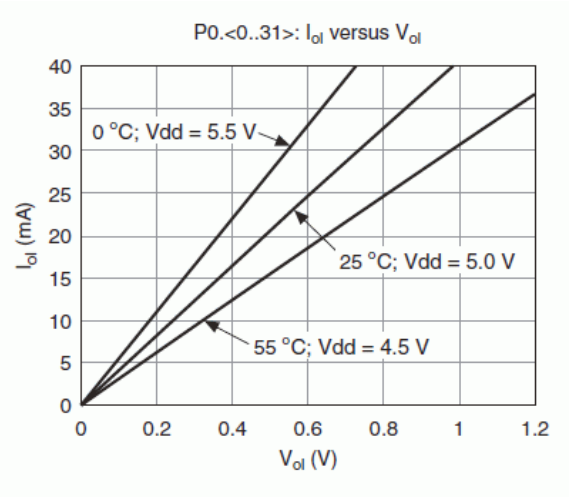
| Level | Min | Max |
|---|---|---|
| Output low current ($I_{OL}$)<br>P0.<0..31><br>PFI <0..15>/P1/P2 | <br>—<br>— | <br>24 mA<br>16 mA |

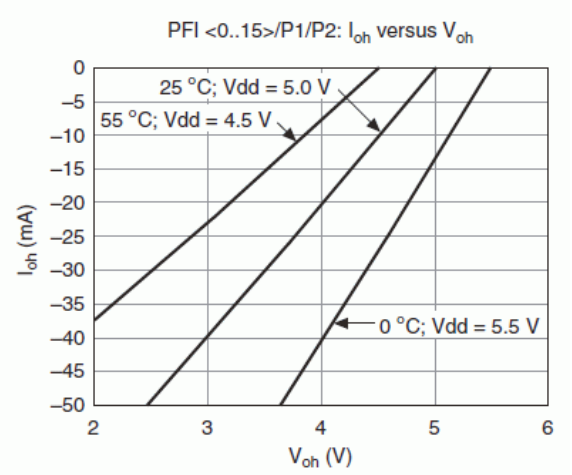
**Electrical Characteristics**

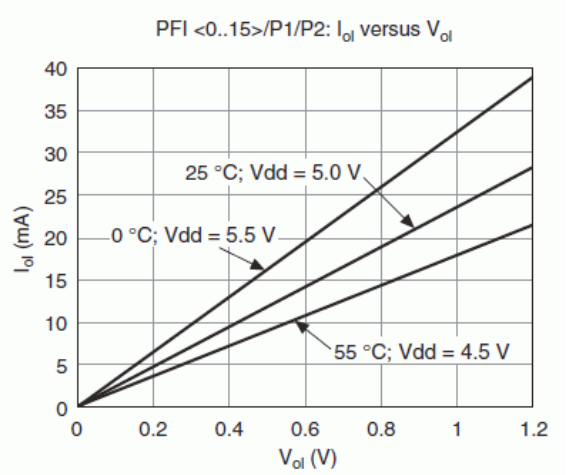
| Level | Min | Max |
|---|---|---|
| Positive-going threshold (VT+) | — | 2.2 V |
| Negative-going threshold (VT–) | 0.8 V | — |
| Delta VT hysteresis (VT+ – VT–) | 0.2 V | — |
| $I_{IL}$ input low current ($V_{in}$ = 0 V) | — | –10 µA |
| $I_{IH}$ input high current ($V_{in}$ = 5 V) | — | 250 µA |

**Digital I/O Characteristics**




## General-Purpose Counter/Timers

| | |
|---|---|
| Number of counter/timers | 4 |
| Resolution | 32 bits |
| Counter measurements | Edge counting, pulse, pulse width, semi-period, period, two-edge separation |
| Position measurements | X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding |
| Output applications | Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling |
| Internal base clocks | 100 MHz, 20 MHz, 100 kHz |

| | |
|---|---|
| External base clock frequency | 0 MHz to 25 MHz |
| Base clock accuracy | 50 ppm |
| Inputs | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock |
| Routing options for inputs | Any PFI, RTSI, many internal signals |
| FIFO | 127 samples per counter |
| Data transfers | Dedicated scatter-gather DMA controller for each counter/timer, programmed I/O |

## Frequency Generator

| | |
|---|---|
| Number of channels | 1 |
| Base clocks | 20 MHz, 10 MHz, 100 kHz |
| Divisors | 1 to 16 |
| Base clock accuracy | 50 ppm |

Output can be available on any PFI or RTSI terminal.

## Phase-Locked Loop (PLL)

| | |
|---|---|
| Number of PLLs | 1 |

**Reference clock locking frequencies**

| Reference Signal | Locking Input Frequency (MHz) |
|---|---|
| RTSI <0..7> | 10, 20 |
| PFI <0..15> | 10, 20 |

| | |
|---|---|
| Output of PLL | 100 MHz Timebase; other signals derived from 100 MHz Timebase including 20 MHz and 100 kHz Timebases |

## External Digital Triggers

| | |
|---|---|
| Source | Any PFI, RTSI |
| Polarity | Software-selectable for most signals |
| Analog input function | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase |
| Analog output function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Counter/timer functions | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock |
| Digital waveform generation (DO) function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Digital waveform acquisition (DI) function | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| **Device-To-Device Trigger Bus** | |
| Input Source | RTSI <0..7> |
| Output Destination | RTSI <0..7> |
| Output selections | 10 MHz Clock, frequency generator output, many internal signals |
| Debounce filter settings | 90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input |

## Bus Interface

| | |
|---|---|
| Form factor | x1 PCI Express, specification v1.1 compliant |
| Slot compatibility | x1, x4, x8, and x16 PCI Express slots [2] |
| DMA channels | 8, analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3 |

## Power Requirements

| | |
|---|---|
| Without disk drive power connector installed | |
| +3.3 V | 1.4 W |

| | |
|---|---|
| +12 V | 8.6 W |
| With disk drive power connector installed | |
| +3.3 V | 1.4 W |
| +12 V | 3 W |
| +5 V | 15 W |

## Current Limits

**Caution** Exceeding the current limits may cause unpredictable behavior by the device and/or PC.

| | |
|---|---|
| Without disk drive power connector installed | |
| P0/PFI/P1/P2 and +5 V terminals combined | 1 A max |
| With disk drive power connector installed | |
| +5 V terminal (connector 0) | 1 A max [3] |
| +5 V terminal (connector 1) | 1 A max [3] |
| P0/PFI/P1/P2 combined | 1 A max |

## Physical Requirements

| | |
|---|---|
| Printed circuit board dimensions | 9.9 × 16.8 cm (3.9 × 6.6 in.) (half-length) |
| Weight | |
| NI PCIe-6320/6321 | 104 g (3.6 oz) |
| NI PCIe-6323 | 114 g (4.0 oz) |
| I/O connector | |
| NI 6320/6321 | 1 68-pin VHDCI |
| NI 6323 | 2 68-pin VHDCI |
| Mating connectors | |

- 68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle), MOLEX 71430-0011
- 68-Pos Right Angle Dual Stack PCB-Mount VHDCI (Receptacle), MOLEX 74337-0016
- 68-Pos Offset IDC Cable Connector (Plug) (SHC68-*), MOLEX 71425-3001

| | |
|---|---|
| Disk drive power connector (NI PCIe-6341/6343) | Standard ATX peripheral connector (not serial ATA) |

## Maximum Working Voltage [4]

| | |
|---|---|
| Channel to earth | 11 V, Measurement Category I |

**Caution** Do *not* use for measurements within Categories II, III, or IV.

## Environmental

| | |
|---|---|
| Operating temperature | 0 to 50 °C |
| Storage temperature | –40 to 70 °C |
| Humidity | 10 to 90% RH, noncondensing |
| Maximum altitude | 2,000 m |
| Pollution Degree (indoor use only) | 2 |

## Safety Standards

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

**Note** For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

## Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

**Caution** When operating this product, use shielded cables and accessories.

**Note** For EMC declarations and certifications, refer to the *Online Product Certification* section.

## CE Compliance CE

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

To obtain product certifications and the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

## Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

## Waste Electrical and Electronic Equipment (WEEE)

**EU Customers** At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit ni.com/environment/weee.htm.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。
(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

[1] Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

[2] Some motherboards reserve the x16 slot for graphics use. For PCI Express guidelines, refer to ni.com/pciexpress.

[3] Has a self-resetting fuse that opens when current exceeds this specification.

[4] *Maximum working voltage* refers to the signal voltage plus the common-mode voltage.

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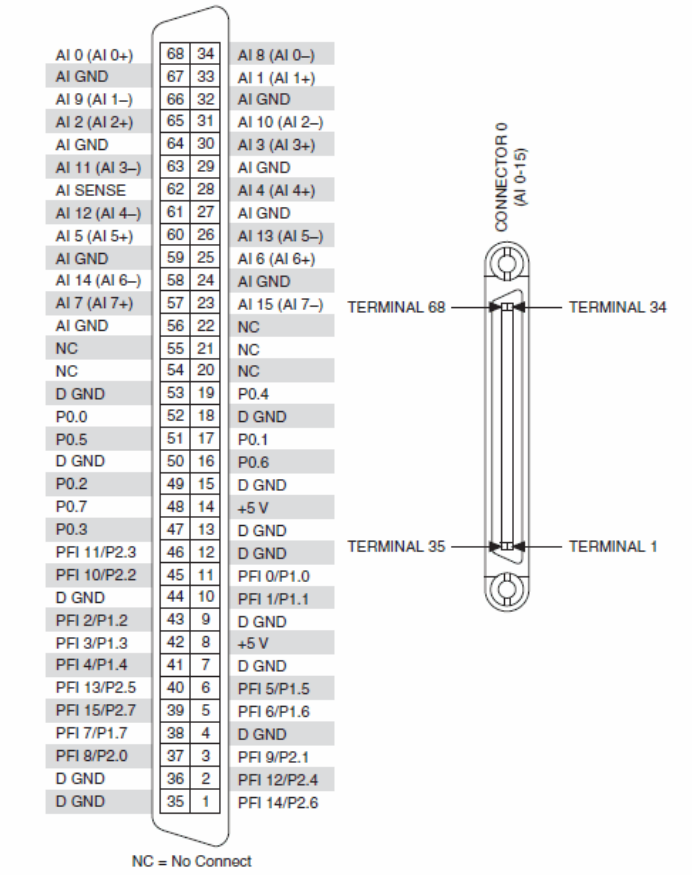
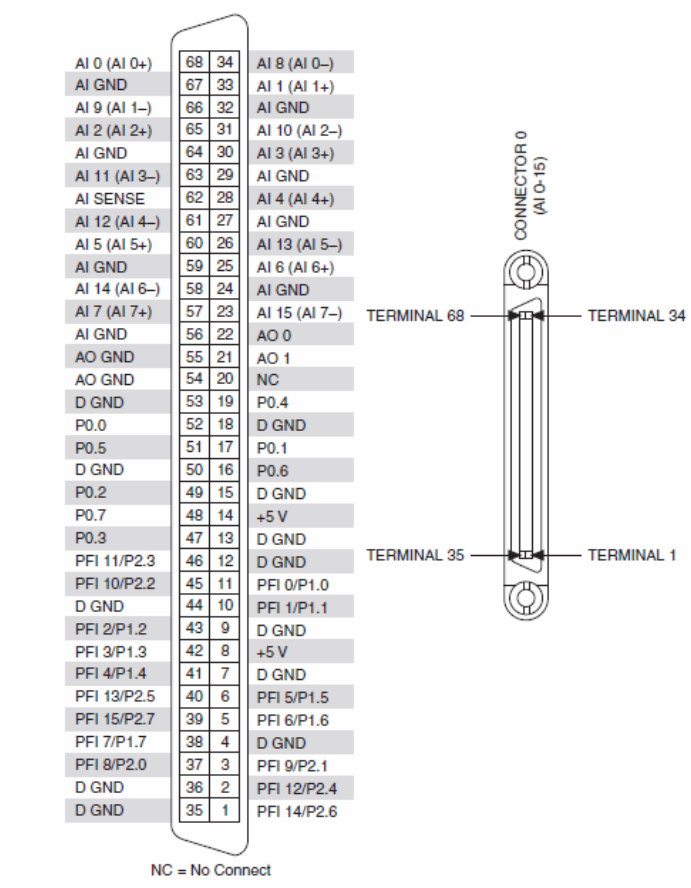
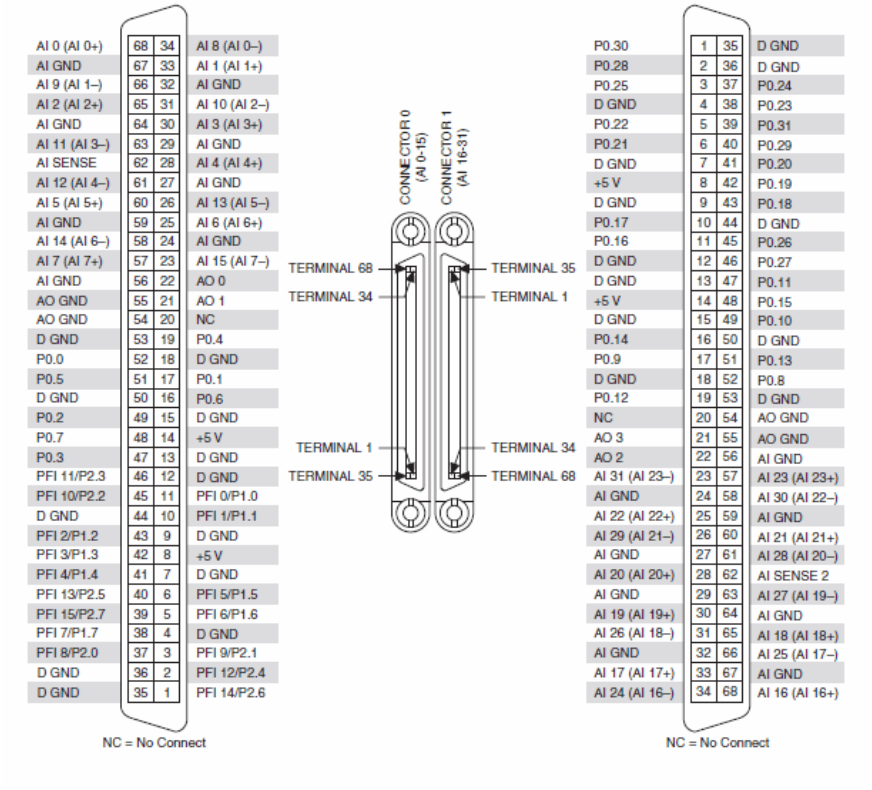
**Pinouts/Front Panel Connections**




PCIe-6320 pinout




PCIe-6321 pinout




PCIe-6323 pinout

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