Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

NI 651x

- 32 or 64-bank optically isolated inputs and outputs (±30 VDC)
- High-reliability industrial feature set – isolation, programmable power-up states, digital I/O watchdogs, change detection, programmable input filters
- Low-cost solution with superior features for data acquisition, manufacturing test, and industrial control applications
- Direct connection to industrial sensors and actuators
- NI-DAQmx software for highest productivity and performance

Operating Systems
- Windows 2000/NT/XP
- LabVIEW Real-Time

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software
- C, C++
- Microsoft Visual Studio .NET 2003

Measurement Services Software (included)
- NI-DAQmx version 7.1 (or higher)

Product	Bus	Input Lines	Output Lines	Isolation	Max Range (VDC)	Low Thresh. (VDC)	High Thresh. (VDC)	Output Current (mA)[1]	Industrial Feature Set
NI 6510	PCI	32 source/sink	–	Bank	±30	±4	±11	–	3
NI 6511	PCI, PXI	64 source/sink	–	Bank	±30	±4	±11	–	3
NI 6512	PCI, PXI	–	64 source	Bank	±30	–	–	350 (75)	3
NI 6513	PCI, PXI	–	64 sink	Bank	±30	–	–	500 (120)	3
NI 6514	PCI, PXI	32 source/sink	32 source	Bank	±30	±4	±11	350 (75)	3
NI 6515	PCI, PXI	32 source/sink	32 sink	Bank	±30	±4	±11	500 (120)	3
NI 6516	PCI	–	32 source	Bank	±30	–	–	350 (75)	3
NI 6517	PCI	–	32 sink	Bank	±30	–	–	500 (120)	3
NI 6518	PCI	16 source/sink	16 source	Bank	±30	±4	±11	350 (75)	3
NI 6519	PCI	16 source/sink	16 sink	Bank	±30	±4	±11	500 (120)	3

[1]When using all lines at a 100 percent duty cycle, the maximum drive current for the NI 6512 and NI 6514 is 75 mA, and 120 mA for the NI 6513 and NI 6515. When using only one output line in each bank at a 100 percent duty cycle, the maximum drive current for the NI 6512 and 6514 is 350 mA, and 500 mA for the NI 6513 and NI 6515.

Table 1. NI 651x Selection Guide

Overview and Applications

National Instruments 651x devices are industrial 32 or 64-channel isolated digital I/O interfaces for PCI and PXI/CompactPCI systems. You can wire each input bank in a source or sink configuration. You can input and output at digital levels up to ±30 VDC with high current switching capability. NI 651x devices are ideal for general-purpose data acquisition applications, as well as industrial control and automated manufacturing test. With high current drive and isolation, you can connect the digital I/O directly to a wide array of 24 V electronic devices, sensors, and actuators.

NI 651x devices offer superior features and high value for industrial control and manufacturing test applications such as factory automation, embedded machine control, and production line verification. These devices have been designed from top to bottom to incorporate the latest hardware technologies and provide innovative features for applications requiring ease of use, high reliability, and performance. NI 651x devices take advantage of NI-DAQmx software, which includes technology to speed up application development with many helpful features including DAQ Assistant, automatic code generation, and high-performance multithreaded streaming technology.

Hardware

High-Reliability Industrial Feature Set

NI 651x devices offers a set of high-reliability features designed to automate even the most demanding applications:

- Isolation provides an extended voltage range and direct connection to industrial sensors and actuators
- Programmable power-up states provide safe operation when connected to pumps/valves/motors/relays
- Digital I/O watchdogs detect computer or application errors and ensure safe recovery
- Change detection triggers your application and returns I/O data after a digital event with minimal processor usage
- Programmable input filters eliminate glitches/spikes and remove noise

Connect Sensors Directly with Isolation

Isolation is a form of built-in signal conditioning that provides several advantages, such as an extended voltage range and direct connection to industrial sensors and actuators. Isolation also improves signal quality and protects computer circuitry. Isolation physically and electrically separates two parts of a circuit, which

NATIONAL INSTRUMENTS™

Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

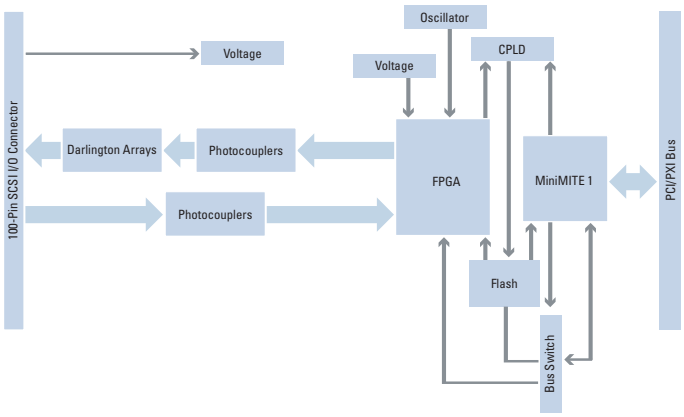


Figure 1. NI 651x Hardware Block Diagram

breaks ground loops, improves common-mode voltage and noise rejection, and permits the two parts of the circuit to be at different voltage levels. Many industrial applications require isolation to protect the electronics from transient voltage spikes and provide greater common-mode noise rejection in electrically noisy environments containing machinery and inductive loads. In bank-to-bank isolated devices, such as an NI 651x, each bank (or group) of several channels shares the same ground but is isolated from other banks.

Glitch-Free Startup with Programmable Power-Up States

With programmable power-up states, you can configure the initial output states of the digital I/O board in software to ensure glitch-free operations when connected to industrial actuators such as pumps, valves, motors, and relays. The digital I/O device holds these I/O states after receiving power, so your computer can boot and your software application can begin running. Programmable power-up states are glitch-free, meaning the outputs never go through an incorrect state during power up.

Each individual digital line can be configured as high-output or low-output. The digital I/O device stores the settings in onboard nonvolatile memory and implements the power-up states automatically after power is applied to the device.

Detect and Recover with Digital I/O Watchdogs

NI digital I/O watchdogs are an innovative technology that provides protection against a wide variety of fault conditions:

- Computer crash – total OS crash
- Application crash – software application ceases to respond
- Driver crash – device driver ceases to respond
- PCI bus failure – communications cease to respond

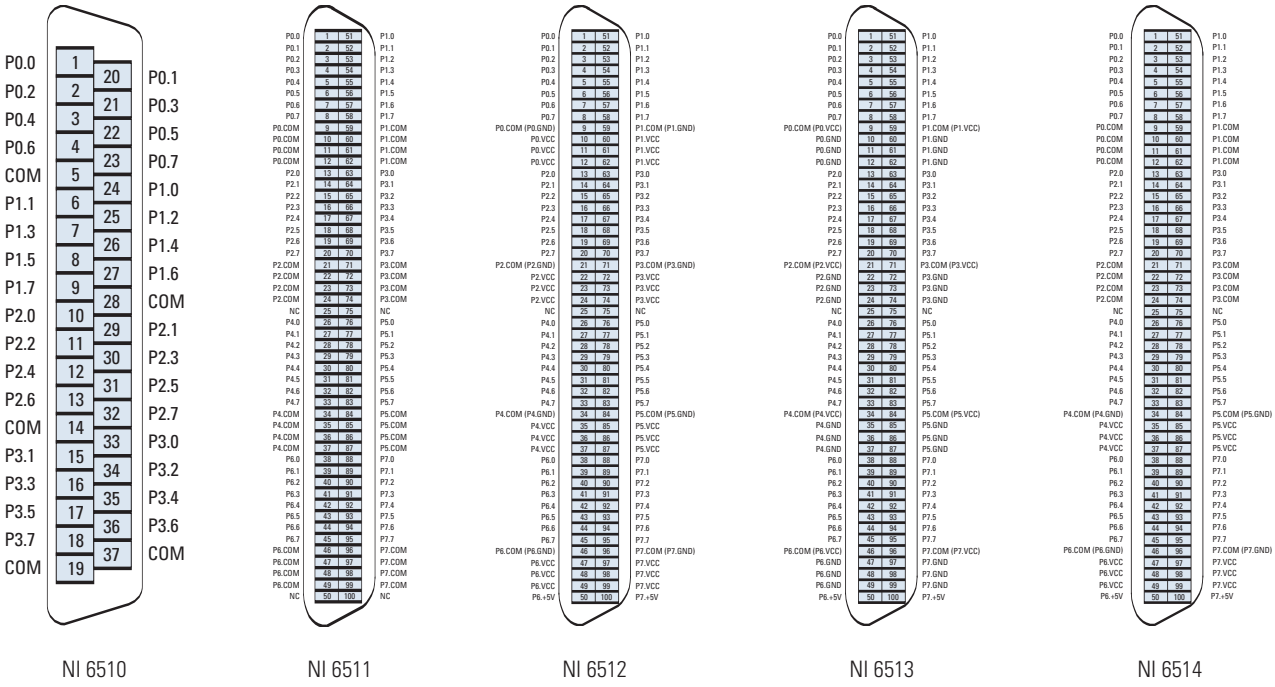


Figure 2. NI 6510, NI 6511, NI 6512, NI 6513, and NI 6514 Connectors

Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

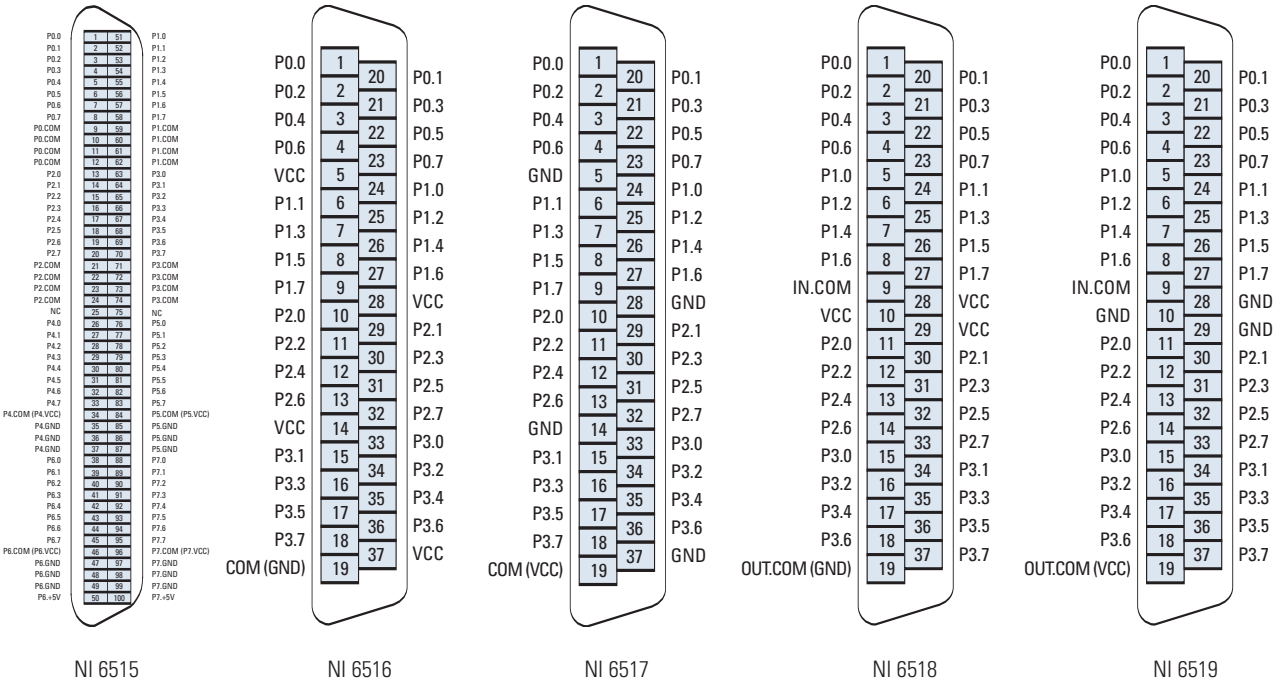


Figure 3. NI 6515, NI 6516, NI 6517, NI 6518, and NI 6519 SCSI I/O Connectors

With watchdogs, the digital outputs go to a safe recovery state when a fault condition is detected and the watchdog timer expires. Watchdogs are important whenever the device is connected to actuators such as pumps, valves, motors, and relays. The digital I/O device monitors the software application, and if the application fails to respond within the time limit, the device automatically sets the output lines to a user-defined safe state. The device remains in the watchdog state until the watchdog timer is disarmed by the application and new I/O values are written, the NI 651x is reset, or the computer is restarted.

Trigger Your Application with Change Detection

With change detection, you can automatically trigger your software application to perform a digital read operation upon a digital change of state. A digital change of state is defined as the rising edge (0 to 1 transition), or falling edge (1 to 0 transition) on one or more digital lines. With change detection, you can monitor digital events with minimal processor usage. No polling is necessary because the digital I/O device generates an interrupt to automatically wake up your application.

Using NI-DAQmx software technology, an NI 651x notifies the software application when the event is detected, causing the application to automatically perform a read operation. To minimize the effects of noisy input lines, you can use programmable input filters in combination with change detection to eliminate spurious change detection events caused by noise or glitches. NI-DAQmx also includes multithreaded streaming technology so digital change detection events can occur independent of other data acquisition activities such as analog input or output events.

Eliminate Noise with Programmable Input Filters

Programmable input filters remove noise, glitches, and spikes on inputs, and also provide debouncing for digital switches and relays. This feature is important for applications in noisy industrial environments to prevent false readings caused by noise. You can configure the programmable input filter for each digital line by setting the filter time in seconds. Any digital noise, glitch, or spike that is shorter than half of the specified filter time will be blocked by the digital I/O device, preventing invalid readings and false triggers for change detection events.

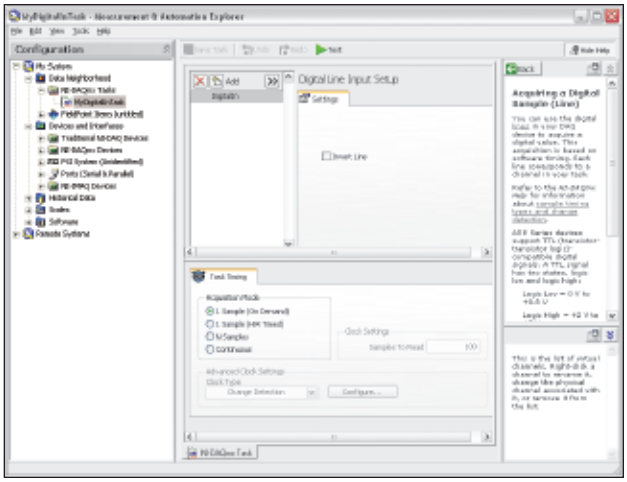


Figure 4. Write Your Application with No Programming Using NI DAQ Assistant

Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

NI-DAQmx Software Technology

NI 651x devices require NI-DAQmx measurement services software version 7.1 or higher (7.2 for NI 6511, NI 6512, and NI 6513; 7.3 for NI 6510, NI 6516, NI 6517, NI 6518, and NI 6519). NI-DAQmx software, included FREE with the purchase of a NI 651x device, is available for download from **ni.com/downloads**. With NI-DAQmx, you can program your NI digital I/O device in LabVIEW, ANSI C, Microsoft Visual C++, and the Microsoft .NET languages C# and Visual Basic .NET. You can access the full functionality and state-of-the-art hardware technology of your NI 651x devices. NI-DAQmx technology speeds up your development with many features such as automatic code generation to make configuration and programming easy. NI 651x devices take full advantage of key NI-DAQmx software technologies such as multithreaded streaming technology for dramatic improvements in I/O performance and ease of use.

- Use DAQ Assistant to guide you to fast, accurate measurements with no programming
- Use automatic code generation to create your application in LabVIEW, C, Visual Basic .NET, or C#
- Take advantage of multithreaded streaming technology for 1,000X performance improvements
- Use automatic timing, triggering, and synchronization technology to make advanced applications easy
- Visit **ni.com** for more than 3,000 FREE software downloads to jump-start your project
- Use the NI-DAQmx functions for jumper-free software configuration of all digital I/O features without hardware switches/jumpers
- Develop your application with easy and open programming in LabVIEW, ANSI C, Microsoft Visual C++, C#, and Visual Basic .NET

Digital I/O Connector

The 100-pin high-density SCSI connector on each NI 6511/12/13/14/15 connects to 100-pin ribbon cables or shielded cables. For low-cost unshielded connectivity, use the R1005050 ribbon cable with two CB-50LP or CB-50 connector blocks (CB-100 kit). For shielded connectivity, use the SH100-100-F shielded digital I/O cable with the SCB-100 connector block.

The 37-pin D-Sub connector on NI 6510/16/17/18/19 connects to 37-pin accessories including the SH37F-37M-1 shielded digital I/O cable wih the CB-37F-37S-H DIN-rail-mountable connector block.

Ordering Information

PCI

NI PCI-6510 779081-01
NI PCI-6511 778966-01
NI PCI-6512 778968-01
NI PCI-6513 778970-01
NI PCI-6514 778836-01
NI PCI-6515 778835-01
NI PCI-6516 779082-01
NI PCI-6517 779083-01
NI PCI-6518 779084-01
NI PCI-6519 779085-01

PXI

NI PXI-6511 778967-01
NI PXI-6512 778969-01
NI PXI-6513 778971-01
NI PXI-6514 778965-01
NI PXI-6515 778964-01

Includes NI-DAQmx 7.1 or higher (7.2 for NI 6511, NI 6512, NI 6513).

Recommended Configurations

Family	Accessory	Cable
NI 651x	SCB-100 (776990-01) CB-100 kit (777812-01)	SH100-100-F (185095-02) R1005050 included in kit
NI 6510	CB-37F-37S-H (778673-01)	SH37F-37M-1 (778621-01)
NI 6511	Bundle (778972-01)	Cable and connector blocks included
NI 6512	Bundle (778973-01)	Cable and connector blocks included
NI 6513	Bundle (778974-01)	Cable and connector blocks included
NI 6514	Bundle (778939-01)	Cable and connector blocks included
NI 6515	Bundle (778938-01)	Cable and connector blocks included
NI 6516	CB-37F-37S-H (778673-01)	SH37F-37M-1 (778621-01)
NI 6517	CB-37F-37S-H (778673-01)	SH37F-37M-1 (778621-01)
NI 6518	CB-37F-37S-H (778673-01)	SH37F-37M-1 (778621-01)
NI 6519	CB-37F-37S-H (778673-01)	SH37F-37M-1 (778621-01)

BUY NOW!

For complete product specifications, pricing, and accessory information, call (800) 813 3693 (U.S. only) or go to **ni.com/daq**.

Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

Specifications

These specifications are typical at 25 °C, unless otherwise noted.

Digital I/O

Number of channels ..... 32 or 64, optically isolated
Power-on state ..... 0 (open), default; user-programmable to 0 or 1
Data transfers ..... Interrupts, programmed I/O
I/O connector ..... 100-pin keyed female SCSI connector or 37-pin female D-Sub connector

Isolated Inputs

Number of input lines ..... 0, 16, 32, or 64 bidirectional, each bank with its own ground reference isolated from other banks
Bank isolated inputs ..... 8, 16, or 32 lines per bank
Maximum input voltage ..... 30 VDC

Level	Min	Max
Input logic low-voltage (VIL)	0 VDC	±4 VDC
Input logic high-voltage (VIH)	±11 VDC	±30 VDC

Input current
- 11 V inputs ..... 4.5 mA/line, maximum
- 30 V inputs ..... 12.5 mA/line, maximum

Propagation delay ..... 30 µs, typical

Isolated Outputs

Number of lines ..... 0, 16, 32, or 64, each bank with its own ground reference isolated from other banks
Bank isolated outputs ..... 8, 16, or 32 lines per bank
Maximum switching voltage ..... 30 VDC
Maximum switching capacity
- NI 6512, NI 6514, NI 6516, NI 6518 ..... 350 mA (75 mA)
- NI 6513, NI 6515, NI 6517, NI 6519 ..... 500 mA (120 mA)

Pin 50/Pin 100 (at +5 V) ..... 200 mA, maximum (only on 100-pin devices)
Propagation delay ..... 10 µs, typical

Power Requirements

+5 VDC (±5%) ..... 150 mA
+3.3 VDC (±5%) ..... 300 mA, typical; 500 mA, maximum
Power available at I/O connector ..... +3.75 to +5.25 VDC

Note: The power at the I/O connector is derived from the output V_{cc} (user provided). If V_{cc} is greater than 10 VDC, then the the output voltage is 5 VDC (±5%).

Physical

Dimensions
- PCI ..... 14.1 by 11.4 cm (5.54 by 4.47 in.)
- PXI ..... 10.0 by 16 cm (3.9 by 6.3 in.)

Environment

Operating temperature ..... 0 to 55 °C
The following table lists the derated current values (100% duty cycle):

Ambient Temperature	NI 6512, 6514 6516, 6518 All Lines	NI 6512, 6514, 6516, 6518 One Line per Port	NI 6513, 6515, 6517, 6519 All Lines	NI 6513, 6515, 6517, 6519 One Line per Port
Up to 25 °C	75 mA	350 mA	125 mA	475 mA
Up to 35 °C	65 mA	350 mA	125 mA	425 mA
Up to 45 °C	55 mA	350 mA	115 mA	375 mA
Up to 55 °C	50 mA	300 mA	100 mA	325 mA

Storage temperature ..... -20 to 70 °C
Relative humidity ..... 10 to 90% noncondensing
Maximum altitude ..... 2,000 m
Note: The NI 651x devices are intended for indoor use only.

Safety

The NI 651x devices meet the requirements of the following standards for safety and electrical equipment for measurement, control and laboratory use:
- IEC 61010-1, EN 61010-1
- UL 3111-1, UL 61010B-1
- CAN/CSA C22.2 No. 1010.1

Note: For UL and other safety certifications, refer to the product label, or visit **ni.com/hardref.nsf** *and search by model number or product line, and click the appropriate link in the Certifications column.*

Electromagnetic Compatibility

Emissions ..... EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz
Immunity ..... EN 61326:1997 + A2: 2001, Table 1
EMC/EMI ..... CE, C-Tick, and FCC Part 15 (Class A) Compliant

Note: For EMC compliance, you must operate this device with shielded cabling.

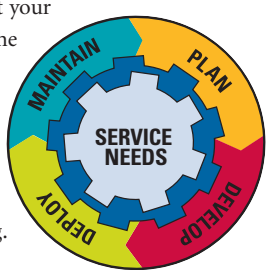
CE Compliance CE

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:
- Low-Voltage Directive (safety) 73/23/EEC
- Electromagnetic Compatibility Directive (EMC) 89/336/EEC

Note: Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit **ni.com/hardref.nsf** *and search by model number or product line, and click the appropriate link in the Certifications column.*

NI Services and Support

NI has the services and support to meet your needs around the globe and through the application life cycle – from planning and development through deployment and ongoing maintenance. We offer services and service levels to meet customer requirements in research, design, validation, and manufacturing. Visit ni.com/services.



Training and Certification

NI training is the fastest, most certain route to productivity with our products. NI training can shorten your learning curve, save development time, and reduce maintenance costs over the application life cycle. We schedule instructor-led courses in cities worldwide, or we can hold a course at your facility. We also offer a professional certification program that identifies individuals who have high levels of skill and knowledge on using NI products. Visit ni.com/training.

Professional Services

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide NI Alliance Partner Program of more than 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

NATIONAL INSTRUMENTS™
Certified Alliance Partner

OEM Support

We offer design-in consulting and product integration assistance if you want to use our products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Local Sales and Technical Support

In offices worldwide, our staff is local to the country, giving you access to engineers who speak your language. NI delivers industry-leading technical support through online knowledge bases, our applications engineers, and access to 14,000 measurement and automation professionals within NI Developer Exchange forums. Find immediate answers to your questions at ni.com/support.

We also offer service programs that provide automatic upgrades to your application development environment and higher levels of technical support. Visit ni.com/ssp.

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.

Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit ni.com/calibration.

Repair and Extended Warranty

NI provides complete repair services for our products. Express repair and advance replacement services are also available. We offer extended warranties to help you meet project life-cycle requirements. Visit ni.com/services.

NATIONAL INSTRUMENTS™

ni.com • (800) 813 3693
National Instruments • info@ni.com

2005_5201_301_101_D