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Technical Sales
United States
(866) 531-6285
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Low-Cost Industrial Digital I/O – 5 V TTL/CMOS





Overview

NI 6509 industrial digital I/O interfaces are ideal for general-purpose data acquisition applications as well as industrial control and automated manufacturing test. With high-current drive, you can connect the digital I/O interface directly to a wide array of 5 V electronic devices, sensors, and actuators. These interfaces offer superior features and high value for industrial control and manufacturing test applications such as factory automation, embedded machine control, and production line verification. They are designed to incorporate the latest hardware technologies and provide innovative features for applications requiring ease of use, high reliability, and performance. NI 6509 interfaces take advantage of NI-DAQmx measurement services software to speed up application development with many helpful features including the DAQ Assistant, automatic code generation, and high-performance multithreaded streaming technology.

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Requirements and Compatibility

OS Information

- Windows 2000/XP
- Windows Vista x64/x86

Driver Information

- NI-DAQmx

Software Compatibility

- ANSI C/C++
- LabVIEW
- LabVIEW SignalExpress
- LabWindows/CVI
- Measurement Studio
- Visual Studio .NET

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Comparison Tables

Product	Bus	Input Lines	Output Lines	Max Range	Low Threshold	High Threshold	Output Current	Industrial Feature Set
NI 6509	USB, PCI, PCI Express, PXI	96	96	-0.5..5.5 V	0.8 V	2.0 V	±24 mA	Yes

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Application and Technology

Hardware

High-Reliability Industrial Feature Set

NI 6509 devices offer a set of high-reliability features designed to automate even the most demanding applications:

- Programmable power-up states provide safe operation when connected to pumps, valves, motors, and 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

Glitch-Free Startup with Programmable Power-Up States

With programmable power-up states, you can configure the initial NI 6509 output states in software to ensure glitch-free operations when connected to industrial actuators such as pumps, valves, motors, and relays. An NI 6509 holds these I/O states after receiving power, so your computer can boot and your software application can begin running. The programmable power-up states are glitch-free, meaning the outputs never go through an incorrect state during power up.

You can configure digital lines as high-impedance input, 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.

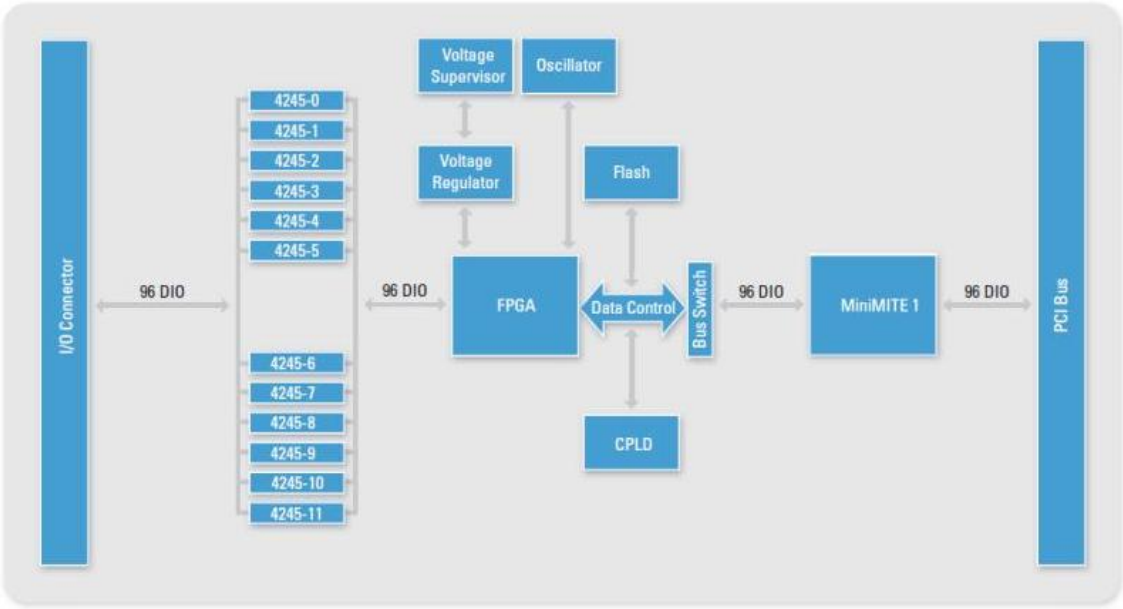


Figure 1. NI 6509 Hardware Diagram

Diagram shown is for PCI-6509 and PXI-6509 devices.

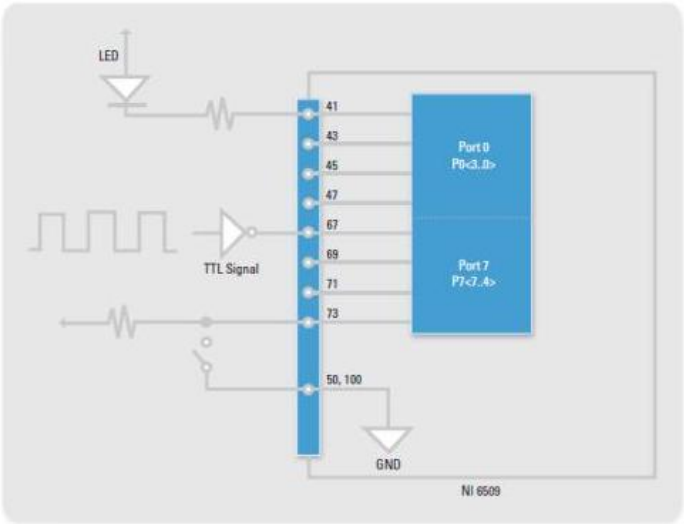


Figure 2. Signal Connections

Software-Configurable Pull-Up/Pull-Down Resistors (NI PCIe-6509 only)

The NI PCIe-6509 includes an option in software to program whether the digital inputs have a value of high or low when not connected externally. You accomplish this using resistors that either pull up the line to +5 V or pull down the line to ground. You can configure this in NI Measurement & Automation Explorer (MAX) or programmatically via the NI-DAQmx driver.

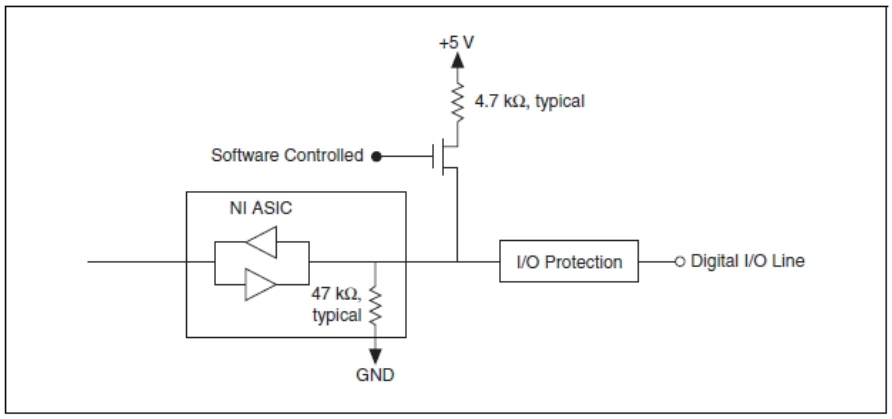


Figure 3. NI PCIe-6509 Digital I/O Circuitry

Detect and Recover with Digital I/O Watchdogs

NI digital I/O watchdogs provide 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

With watchdogs, the digital outputs go to a safe state when a fault condition is detected and the watchdog timer expires for safe recovery. 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 it fails to respond within the time limit, 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, an NI 6509 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. Using change detection, you can monitor for 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 6509 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 independently 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, as well as provide debouncing for digital switches and relays. This 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 is blocked by the digital I/O device, preventing invalid readings and false triggers for change detection events.

Software

NI-DAQmx Software Technology

NI-DAQmx software, included free with an NI 6509, is available for download from **ni.com/downloads**. With NI-DAQmx 7.1 or later, you can use your NI digital I/O device in LabVIEW, ANSI C, Microsoft Visual C++, and the Microsoft .NET languages C# and Visual Basic .NET.

With NI-DAQmx technology, you have access to the full functionality and state-of-the-art hardware technology of your NI 6509 digital I/O devices. It speeds up your development with many features such as automatic code generation to make configuration and programming easy. NI 6509 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 the DAQ Assistant to guide you to fast, accurate measurements with no programming
- Use automatic code generation to create your application in LabVIEW, ANSI 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 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 NI 6509 devices connects to 100-pin ribbon cable or shielded cables. For low-cost unshielded connectivity, use the R1005050 ribbon cable with two CB-50LP or CB-50 connector blocks (a CB-100 kit). For shielded connectivity, use the SH100-100-F shielded digital I/O cable with the SCB-100 connector block. You can individually program each 8-bit port on an NI 6509 to be input or output. The maximum input logic high and output logic high voltages assume a V_{cc} supply voltage of 5 V. The absolute maximum voltage rating is -0.5 to +5.5 V with respect to GND. Pins 49 and 99 on the I/O connector supply +5 V from the computer power supply through a self-resetting fuse.

Other Connectivity Options and High-Voltage Signal Conditioning

Visit **ni.com/dataacquisition** to learn more about connectivity solutions, including high-voltage signal conditioning and isolation and electromechanical relay devices.

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Ordering Information

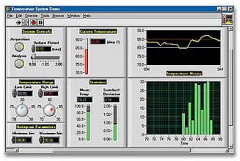
For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI PCI-6509			
NI PCI-6509 Requires: 1 Cables , 1 Connector Blocks	778792-01	**Cables:** Shielded - SH100-100-F Cable (2m) ***Also Available: Unshielded*	185095-02
		Connector Blocks: Spring-Screw_Terminals - SCB-100	776990-01
NI PXIe-6548- 1 Mb/ch			
NI PXI-6509 Requires: 1 Cable , 1 Connector Block	778858-01	**Cable:** Shielded - SH100-100-F Cable (2m) ***Also Available: Unshielded*	185095-02
		Connector Block: Spring-Screw_Terminals - SCB-100	776990-01

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Software Recommendations

LabVIEW Professional Development System for Windows



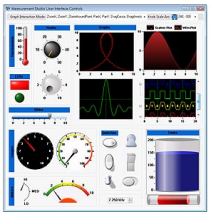
- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

NI LabWindows™/CVI for Windows



- Real-time advanced 2D graphs and charts
- Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
- Analysis tools for array manipulation, signal processing statistics, and curve fitting
- Simplified cross-platform communication with network variables
- Measurement Studio .NET tools (included in LabWindows/CVI Full only)
- The mark LabWindows is used under a license from Microsoft Corporation.

NI Measurement Studio Enterprise Edition



- Support for Microsoft Visual Studio .NET 2010/2008/2005
- Customizable Windows Forms and Web Forms controls for test and measurement user interface design
- Hardware integration support with data acquisition and instrument control libraries
- Automatic code generation with data acquisition, instrument control, and parameter assistants
- LabWindows™/CVI ANSI C development environment
- Advanced analysis and cross-platform communication libraries

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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. NI offers a number of calibration services to help maintain the ongoing accuracy of your measurement hardware. These services allow you to be completely confident in your measurements, and help you maintain compliance to standards like ISO 9001, ANSI/NCSL Z540-1 and ISO/IEC 17025. 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 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

This section lists the specifications for the NI 6509. These specifications are typical at 25 °C, unless otherwise noted.

Power Requirements	
Current draw from bus during no-load condition	
NI PCI/PXI-6509	375 mA on +3.3 VDC, typical; 250 mA on +5 VDC, typical
NI PCIe-6509	550 mA on +3.3 VDC, typical
+5 V power available at I/O connector (pins 49 and 99)	+4.0 V to +5.25 V; 1A, maximum

Note The voltage at the I/O connector depends on the amount of current drawn from the NI 6509.

Digital I/O	
Number of channels	96 I/O
Compatibility	
NI PCI/PXI-6509	TTL/CMOS, single-ended GND referenced
NI PCIe-6509	TTL Schmitt Trigger/CMOS, single-ended GND referenced
Power-on state	
NI PCI/PXI-6509	Input high-Z (default), output 1 or 0

NI PCIe-6509	Input pulled up or down (software-selectable), output 1 or 0
Data transfers	Interrupts, programmed I/O
I/O connector	100-pin female 0.050 series SCSI
Pull resistor (NI PCIe-6509 only)	
Pull-up resistor	4.7 kΩ, typical
Pull-down resistor	47 kΩ, typical
Input voltage protection (NI PCIe-6509 only)	±20 V on up to two pins, maximum

Digital Logic Levels (NI PCI/PXI-6509)

Input Signals

The maximum input logic high and output logic high voltages assume a Vcc supply voltage of 5.0 V. Given a Vcc supply voltage of 5.0 V, the absolute maximum voltage rating for each I/O line is –0.5 V to 5.5 V with respect to GND.

Level	Min	Max
Input voltage (V_{in})	0 V	Vcc
Input logic high voltage (V_{IH})	2 V	—
Input logic low voltage (V_{IL})	—	0.8 V

Output Signals (Vcc = 5 V)

Level	Min	Max
High-level output current (I_{OH})	—	–24 mA
Low-level output current (I_{OL})	—	24 mA
Output voltage (V_{out})	0 V	Vcc
Output high voltage (V_{OH}), at –24 mA	3.7 V	—
Output low voltage (V_{OL}), at 24 mA	—	0.55 V

The total current sinking/sourcing from one port cannot exceed 100 mA.

With a load, use the following equation to determine the power consumption on a 5 V rail. In the equation, *j* is the number of channels you are using to source current.

$$250\ \text{mA} + \sum_{i=1}^{j} (\text{current sourced on channel } i)$$

Digital Logic Levels (NI PCIe-6509)

Input Signals

Level	Min	Max
Input voltage (V_{in})	0 V	5 V
Positive-going threshold (VT+)	—	2.2 V
Negative-going threshold (VT−)	0.8 V	—
Delta VT hysteresis (VT+ − VT−)	0.2 V	—
Input high current (I_{IH}) (V_{in} = 5 V, resistors set to pull-up)	—	260 µA
Input high current (I_{IH}) (V_{in} = 5 V, resistors set to pull-down)	—	260 µA
Input low current (I_{IL}) (V_{in} = 0 V, resistors set to pull-up)	—	–1250 µA
Input low current (I_{IL}) (V_{in} = 0 V, resistors set to pull-down)	—	−20 µA

Output Signals

Level	Min	Max
High-level output current (I_{OH})	—	–24 mA
Low-level output current (I_{OL})	—	24 mA
Output voltage (V_{out})	0 V	5.5 V
Output high voltage (V_{OH}), at –24 mA	3.4 V	—
Output low voltage (V_{OL}), at 24 mA	—	0.78 V

The total current sinking/sourcing from one port cannot exceed 100 mA.

Without the disk drive power connector installed, the +5 V supply and the DIO lines share the same power source. In this case, use the following equation to determine the current available at the +5 V terminal. In the equation, I_{DIO} is the total current sourced on all DIO lines.

$I_{+5V} = 1.2\ A - I_{DIO}$

With the disk drive power connector installed, the current at the +5 V terminal is supplied by an external power source. In this case, the current at the +5 V terminal can be up to 1 A.

Physical Characteristics

Dimensions (without connectors)	
NI PCI-6509	12.4 cm × 9.7 cm (4.9 in. × 3.8 in.)
NI PXI-6509	16.0 cm × 10.0 cm (6.3 in. × 3.9 in.)
NI PCIe-6509	14.2 cm × 10.4 cm (5.6 in. × 4.1 in.)
Weight	
NI PCI-6509	70.9 g (2.5 oz)
NI PXI-6509	172.9 g (6.1 oz)
NI PCIe-6509	95.7 g (3.4 oz)

Environmental

The NI 6509 device is intended for indoor use only.

Operating Environment	
Ambient temperature range	0 °C to 55 °C (tested in accordance with IEC-60068-2-1 and IEC-60068-2-2)
Relative humidity range	10% to 90%, noncondensing (tested in accordance with IEC-60068-2-56)
Altitude	2,000 m (at 25 °C ambient temperature)
Storage Environment	
Ambient temperature range	–20 °C to 70 °C (tested in accordance with IEC-60068-2-1 and IEC-60068-2-2)
Relative humidity range	5% to 95%, noncondensing (tested in accordance with IEC-60068-2-56)
Shock and Vibration (NI PXI-6509 Only)	
Operational shock	30 g peak, half-sine, 11 ms pulse (tested in accordance with IEC-60068-2-27; test profile developed in accordance with MIL-PRF-28800F)
Random vibration	
5 Hz to 500 Hz, 0.3 g_{rms}	Operating
5 Hz to 500 Hz, 2.4 g_{rms}	Nonoperating

Random vibration is tested in accordance with IEC-60068-2-64. The nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3. Random vibration is tested in accordance with IEC-60068-2-64. The nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.

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.

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Electromagnetic Compatibility

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

- EN 61326-1 (IEC 61326-1): 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

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

Note For EMC compliance, operate this device only with the SH100-100-F shielded cable.

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 module 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)

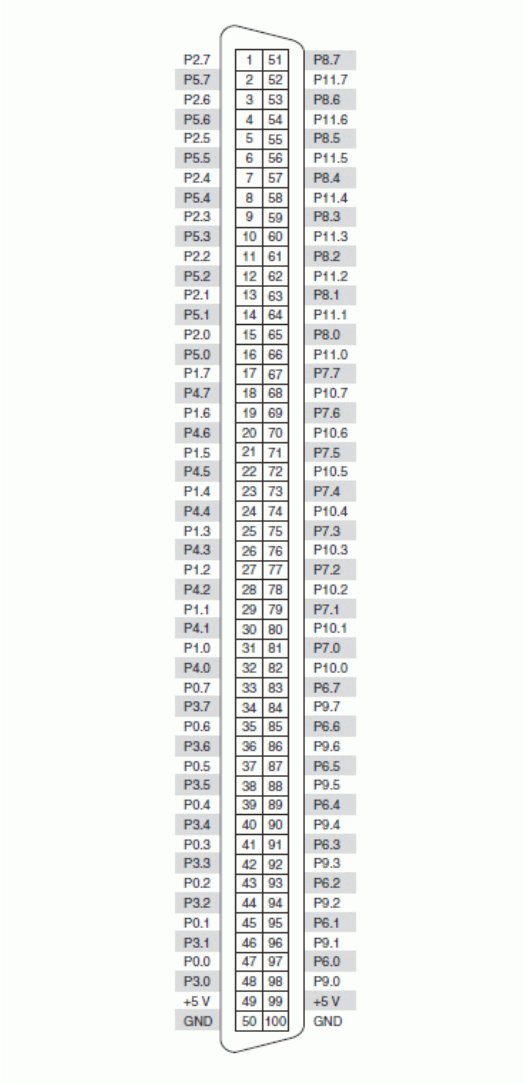
EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit ni.com/environment/weee.htm.

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.)

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Pinouts/Front Panel Connections



P2.7	1	51	P8.7
P5.7	2	52	P11.7
P2.6	3	53	P8.6
P5.6	4	54	P11.6
P2.5	5	55	P8.5
P5.5	6	56	P11.5
P2.4	7	57	P8.4
P5.4	8	58	P11.4
P2.3	9	59	P8.3
P5.3	10	60	P11.3
P2.2	11	61	P8.2
P5.2	12	62	P11.2
P2.1	13	63	P8.1
P5.1	14	64	P11.1
P2.0	15	65	P8.0
P5.0	16	66	P11.0
P1.7	17	67	P7.7
P4.7	18	68	P10.7
P1.6	19	69	P7.6
P4.6	20	70	P10.6
P1.5	21	71	P7.5
P4.5	22	72	P10.5
P1.4	23	73	P7.4
P4.4	24	74	P10.4
P1.3	25	75	P7.3
P4.3	26	76	P10.3
P1.2	27	77	P7.2
P4.2	28	78	P10.2
P1.1	29	79	P7.1
P4.1	30	80	P10.1
P1.0	31	81	P7.0
P4.0	32	82	P10.0
P0.7	33	83	P6.7
P3.7	34	84	P9.7
P0.6	35	85	P6.6
P3.6	36	86	P9.6
P0.5	37	87	P6.5
P3.5	38	88	P9.5
P0.4	39	89	P6.4
P3.4	40	90	P9.4
P0.3	41	91	P6.3
P3.3	42	92	P9.3
P0.2	43	93	P6.2
P3.2	44	94	P9.2
P0.1	45	95	P6.1
P3.1	46	96	P9.1
P0.0	47	97	P6.0
P3.0	48	98	P9.0
+5 V	49	99	+5 V
GND	50	100	GND

SH100-100-F Connector Pinout

Positions 1 through 50				Positions 51 through 100			
P2.7	1	2	P5.7	P8.7	1	2	P11.7
P2.6	3	4	P5.6	P8.6	3	4	P11.6
P2.5	5	6	P5.5	P8.5	5	6	P11.5
P2.4	7	8	P5.4	P8.4	7	8	P11.4
P2.3	9	10	P5.3	P8.3	9	10	P11.3
P2.2	11	12	P5.2	P8.2	11	12	P11.2
P2.1	13	14	P5.1	P8.1	13	14	P11.1
P2.0	15	16	P5.0	P8.0	15	16	P11.0
P1.7	17	18	P4.7	P7.7	17	18	P10.7
P1.6	19	20	P4.6	P7.6	19	20	P10.6
P1.5	21	22	P4.5	P7.5	21	22	P10.5
P1.4	23	24	P4.4	P7.4	23	24	P10.4
P1.3	25	26	P4.3	P7.3	25	26	P10.3
P1.2	27	28	P4.2	P7.2	27	28	P10.2
P1.1	29	30	P4.1	P7.1	29	30	P10.1
P1.0	31	32	P4.0	P7.0	31	32	P10.0
P0.7	33	34	P3.7	P6.7	33	34	P9.7
P0.6	35	36	P3.6	P6.6	35	36	P9.6
P0.5	37	38	P3.5	P6.5	37	38	P9.5
P0.4	39	40	P3.4	P6.4	39	40	P9.4
P0.3	41	42	P3.3	P6.3	41	42	P9.3
P0.2	43	44	P3.2	P6.2	43	44	P9.2
P0.1	45	46	P3.1	P6.1	45	46	P9.1
P0.0	47	48	P3.0	P6.0	47	48	P9.0
+5 V	49	50	GND	+5 V	49	50	GND

R1005050 Connector Pinout

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