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USER GUIDE AND SPECIFICATIONS

PCI/PXI/PCIe-6509

This document contains information about using the PCI-6509, PXI-6509, and PCIe-6509 data acquisition devices with the NI-DAQmx driver software.

Note For information about using the USB-6509 device, refer to the *NI USB-6509 User Guide and Specifications* document.

The NI 6509 is a 96-bit, high-drive digital input/output (DIO) device. The NI 6509 features 96 TTL/CMOS-compatible digital I/O lines, 24 mA high-drive output, digital filtering, programmable power-up states, change detection, and a watchdog timer.

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Safety Information

This section contains important safety information that you must follow when installing and using National Instruments DIO devices.

Do not operate the device in a manner not specified in this document. Misuse of the DIO device can result in a hazard. You can compromise the safety protection built into the DIO device if it is damaged in any way. If the DIO device is damaged, return it to NI for repair.

Do not substitute parts or modify the DIO device except as described in this document. Use the DIO device only with the chassis, modules, accessories, and cables specified in the installation instructions. You must have all covers and filler panels installed during operation of the DIO device.

Do not operate the DIO device in an explosive atmosphere or where there may be flammable gases or fumes.

If you need to clean the DIO device, use a soft, nonmetallic brush. Make sure that the DIO device is completely dry and free from contaminants before returning it to service.

Operate the DIO device only at or below Pollution Degree 2. Pollution is foreign matter in a solid, liquid, or gaseous state that can reduce dielectric strength or surface resistivity. The following is a description of pollution degrees:

- Pollution Degree 1 means no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.
- Pollution Degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution Degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs that becomes conductive due to condensation.

You must insulate signal connections for the maximum voltage for which the DIO device is rated. Do not exceed the maximum ratings for the DIO device. Do not install wiring while the DIO device is live with electrical signals. Do not remove or add connector blocks when power

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is connected to the system. Avoid contact between your body and the connector block signal when hot swapping modules. Remove power from signal lines before connecting them to or disconnecting them from the DIO device.

Operate the DIO device at or below the *measurement category*[1] marked on the hardware label. Measurement circuits are subjected to *working voltages*[2] and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Installation categories establish standard impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of installation categories:

- Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS[3] voltage. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.
- Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar DIO devices.
- Measurement Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.
- Measurement Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) as stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in its intended operational electromagnetic environment. There is no guarantee that interference will not occur in a particular installation. To minimize the potential for the product to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

---

[1] Measurement categories, also referred to as *installation categories*, are defined in electrical safety standard IEC 61010-1.

[2] Working voltage is the highest rms value of an AC or DC voltage that can occur across any particular insulation.

[3] MAINS is defined as a hazardous live electrical supply system that powers equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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Note The following statements contain important EMC information needed before installing and using this product:

- This product is intended for use in industrial locations. As a result, this product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
- This product may become more sensitive to electromagnetic disturbances in the operational environment when test leads are attached or when connected to a test object.
- Emissions that exceed the regulatory requirements may occur when this product is connected to a test object.
- Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the hardware under the local regulatory rules.
- Operate this product only with shielded cables and accessories.

Configuration

The NI PCI/PXI/PCIe-6509 devices are fully compliant with the *PCI Local Bus Specification Revision 2.2*, the *PXI Hardware Specification Revision 2.1*, and the *PCI Express Electromechanical Specification Revision 1.1*, respectively. The PCI/PXI/PCIe system automatically allocates all device resources, including the base address and interrupt level. The device base address is mapped into PCI memory space. It is not necessary to perform configuration steps after the system powers up.

Before installing the NI 6509 device, you must install the software you plan to use with the device. Refer to the software documentation for configuration instructions.

After you install the software and the NI 6509 device, the device appears under the **Devices and Interfaces** branch of the Measurement & Automation Explorer (MAX) configuration tree.

If the NI 6509 does not appear in MAX, use the following troubleshooting guidelines:

- Verify that you are using the correct version of the NI-DAQmx driver software (version 7.1 or later for the NI PCI/PXI-6509 and version 9.2 or later for the PCIe-6509). To download the most recent National Instruments drivers, visit `ni.com/downloads`.
- Press <F5> to refresh the MAX window, or close and reopen MAX.
- Restart the computer.
- Power off and unplug the computer or chassis, and install the device in a different slot. Refer to the *DAQ Getting Started* guides for installation instructions and safety guidelines.
- **(PCI-6509 only)** You must install the PCI-6509 into a slot that provides 3.3 V. Check that the 3.3 V LED (reference designator *DS1*—located on the visible edge of the underside of the installed device) is lit. If not, check that the PC motherboard provides 3.3 V to the PCI bus.

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Programming Devices in Software

NI measurement devices are packaged with the NI-DAQmx driver software, an extensive library of functions and VIs you can call from your application software, such as LabVIEW or LabWindows™/CVI™, to program all the features of your NI measurement devices. NI-DAQmx provides an application programming interface (API), which is a library of VIs, functions, classes, attributes, and properties for creating applications for your device. NI-DAQmx also includes a collection of programming examples to help you get started developing an application. You can modify example code and save it in an application. You can use examples to develop a new application or add example code to an existing application. Refer to the *DAQ Getting Started* guides for more information about NI-DAQmx.

The NI PCI/PXI-6509 uses NI-DAQmx 7.1 or later, whereas the NI PCIe-6509 requires NI-DAQmx 9.2 or later.

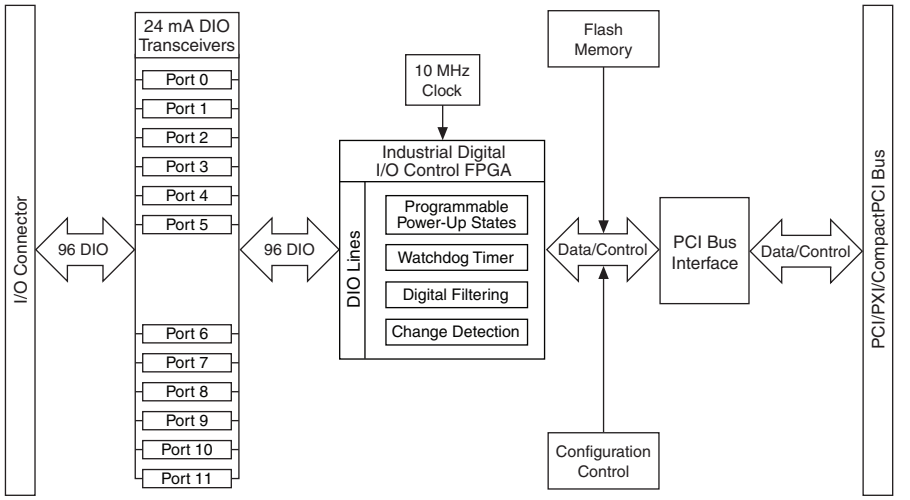
To locate examples for LabVIEW, LabWindows/CVI, Measurement Studio, Visual Basic, and ANSI C, refer to the document, *NI-DAQmx Example Locations for LabVIEW and Text-Based in Windows*, by going to `ni.com/info` and entering the Info Code `daqmxexp`.

For additional examples, refer to `ni.com/examples`.

Functional Overview

Figure 1 shows the key functional components of the NI PCI/PXI-6509.

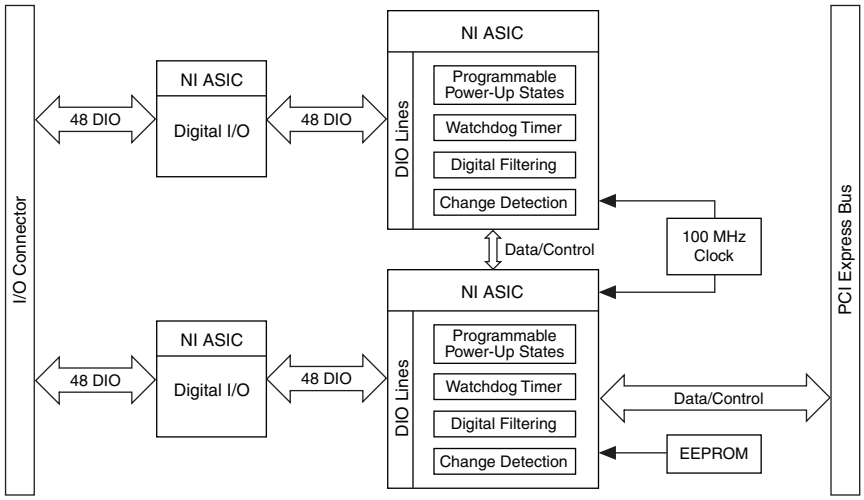
Figure 1. NI PCI/PXI-6509 Block Diagram



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Figure 2 shows the key functional components of the PCIe-6509.

Figure 2. PCIe-6509 Block Diagram



I/O Connector

Caution This NI product must be operated with shielded cables and accessories to ensure compliance with the Electromagnetic Compatibility (EMC) requirements defined in the *Specifications* section of this document. Do not use unshielded cables or accessories unless they are installed in a shielded enclosure with properly designed and shielded input/output ports and connected to the NI product using a shielded cable. If unshielded cables or accessories are not properly installed and shielded, the EMC specifications for the product are no longer guaranteed.

The 100-pin high-density SCSI connector on the NI 6509 provides access to 96 digital inputs and outputs. Use this connector to connect to external devices, such as solid-state relays (SSRs) and LEDs. For easy connection to the digital I/O connector, use the SH100-100-F shielded digital I/O cable with the SCB-100 connector block, or use the R1005050 ribbon cable with the CB-50 or CB-50LP connector block.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so may permanently damage the NI 6509 device and the computer. Refer to the *Signal Descriptions* and *Specifications* sections for information about the maximum I/O specifications.

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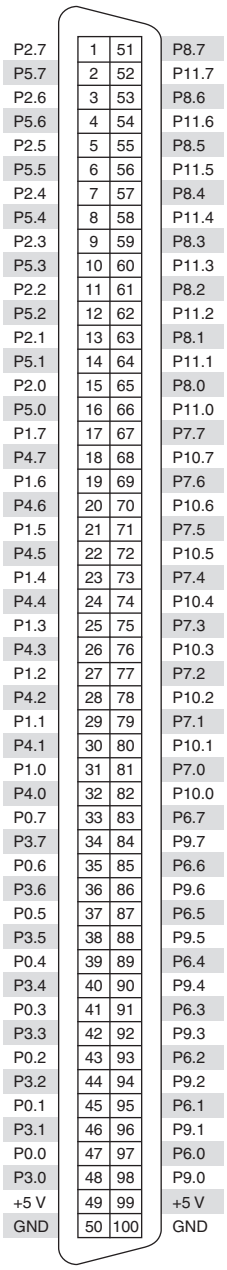
Pin Assignments

SH100-100-F Connector

Figure 3 shows the pin assignments for the SH100-100-F cable when you connect it to the NI 6509 device. The naming convention for each pin is P*X.Y*, where *X* is the port (P) number, and *Y* is the line number.

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Figure 3. SH100-100-F Connector Pinout



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

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Refer to the *Signal Descriptions* section for information about the signals available on this connector.

R1005050 Connector

Figure 4 shows the pin assignments for the R1005050 cable when you connect it to the NI 6509 device. The naming convention for each pin is P*X*.*Y*, where *X* is the port (P) number, and *Y* is the line number or name.

Figure 4. R1005050 Connector Pinout

Positions 1 through 50

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

Positions 51 through 100

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

Refer to the *Signal Descriptions* section for information about the signals available on this connector.

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Signal Descriptions

Table 1 lists the signals and descriptions for all signals available on the NI 6509 device.

Table 1. NI 6509 Signal Descriptions

Pin	Signal Name	Description	MSB	LSB
1, 3, 5, 7, 9, 11, 13, 15	P2.<7..0>	Bi-directional data lines for port 2	P2.7	P2.0
2, 4, 6, 8, 10, 12, 14, 16	P5.<7..0>	Bi-directional data lines for port 5	P5.7	P5.0
17, 19, 21, 23, 25, 27, 29, 31	P1.<7..0>	Bi-directional data lines for port 1	P1.7	P1.0
18, 20, 22, 24, 26, 28, 30, 32	P4.<7..0>	Bi-directional data lines for port 4	P4.7	P4.0
33, 35, 37, 39, 41, 43, 45, 47	P0.<7..0>	Bi-directional data lines for port 0	P0.7	P0.0
34, 36, 38, 40, 42, 44, 46, 48	P3.<7..0>	Bi-directional data lines for port 3	P3.7	P3.0
49, 99	+5 V supply	+5 volts; provides +5 V power source	—	—
50, 100	GND	Ground; connected to the computer ground signal	—	—
51, 53, 55, 57, 59, 61, 63, 65	P8.<7..0>	Bi-directional data lines for port 8	P8.7	P8.0
52, 54, 56, 58, 60, 62, 64, 66	P11.<7..0>	Bi-directional data lines for port 11	P11.7	P11.0
67, 69, 71, 73, 75, 77, 79, 81	P7.<7..0>	Bi-directional data lines for port 7	P7.7	P7.0
68, 70, 72, 74, 76, 78, 80, 82	P10.<7..0>	Bi-directional data lines for port 10	P10.7	P10.0
83, 85, 87, 89, 91, 93, 95, 97	P6.<7..0>	Bi-directional data lines for port 6	P6.7	P6.0
84, 86, 88, 90, 92, 94, 96, 98	P9.<7..0>	Bi-directional data lines for port 9	P9.7	P9.0

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Digital I/O

Static DIO on NI 6509 Devices

The NI 6509 device provides 96 lines of bi-directional DIO signals, P<0..11>.<0..7>. You can use each of the NI 6509 DIO lines as a static digital input (DI) or digital output (DO) line. You can use static DIO lines to monitor or control digital signals. With the PCI/PXI-6509, each DIO port can be configured as a DI or DO port. The PCIe-6509 can be configured on a line by line basis. All samples of DI lines and updates of DO lines are software-timed.

I/O Protection

Use the following guidelines to avoid electrostatic discharge (ESD) events and fault conditions such as overvoltage, undervoltage, and overcurrent:

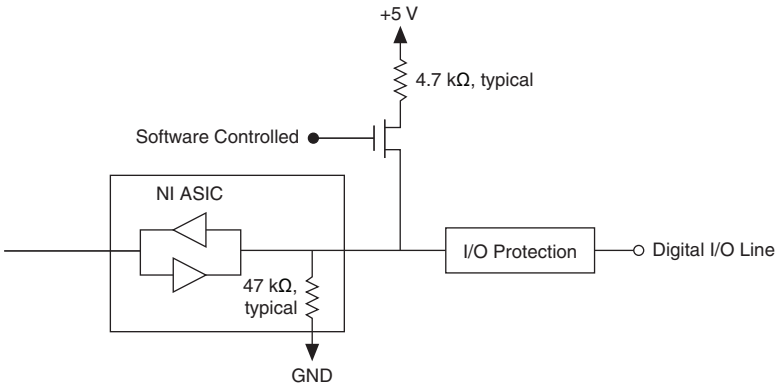
- If you configure a DIO line as an output, do not connect the line to any external signal source, ground signal, or power supply.
- If you configure a DIO line as an output, understand the current requirements of the load. Do not exceed the output limits of the DAQ device. NI has several signal conditioning solutions for digital applications that require high current drive.
- If you configure a DIO line as an input, do not drive the line with voltages outside of the normal operating range.
- Do not drive the line when the device/system is powered off. Doing so could result in unexpected behavior. Note that the PCIe-6509 Rev C (or later) has protection circuitry in place to protect against possible unexpected behavior when driving the line under power off conditions.
- Treat the DAQ device as you would treat any static sensitive device. Always properly ground yourself and the equipment when handling the DAQ device or connecting to it.

I/O Pull-Up/Pull-Down Resistors (PCIe-6509 Only)

The PCIe-6509 has user-configurable pull-up and pull-down resistors. The DIO lines on the PCIe-6509 are connected to an NI ASIC that contains a weak pull-down resistor (47 kΩ, typical), and each DIO line is connected to a software-selectable strong pull-up resistor (4.7 kΩ, typical), as Figure 5 shows.

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Figure 5. PCIe-6509 Digital I/O Circuitry



If you set the software to pull-down, the weak pull-down resistor in the NI ASIC pulls the DIO line low. If you set the software to pull-up, the strong pull-up resistor pulls the DIO line high. The pull setting takes effect regardless of the I/O direction, but the pull setting affects only the state of the DIO lines that are configured for input.

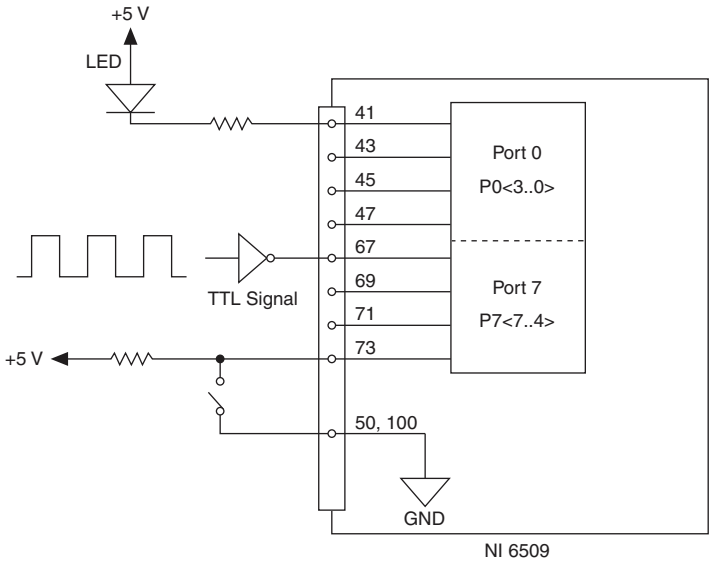
To use MAX to configure the I/O pull resistor, select the device and click the **Properties** button. Refer to the software documentation for information about how to program the pull setting using NI-DAQmx with LabVIEW or other NI application development environments (ADEs).

Signal Connections

Figure 6 shows an example of signal connections for three typical digital I/O applications. Port 0 is configured for digital output, and port 7 is configured for digital input.

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Figure 6. NI 6509 Signal Connections



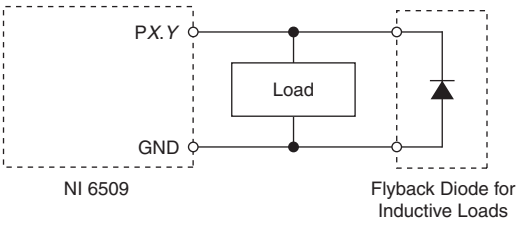
Digital output applications include sending TTL signals and driving external devices such as the LED shown in the figure. Digital input applications include receiving TTL signals and sensing external device states such as the state of the switch in the figure.

Protecting Inductive Loads

When inductive loads are connected to output lines, a large counter-electromotive force may occur at switching time because of the energy stored in the inductive load. These flyback voltages can damage the outputs and/or the power supply.

To limit these flyback voltages at the inductive load, install a flyback diode across the inductive load. For best results, mount the flyback diode within 18 inches of the load. Figure 7 shows an example of using an external flyback diode to protect inductive loads.

Figure 7. Limiting Flyback Voltages at the Inductive Load



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Sinking and Sourcing Examples

The following sections provide examples of driving a relay with no more than 24 mA, driving a relay with more than 24 mA, and driving a solid-state relay (SSR).

Driving a Relay ≤ 24 mA

Figures 8 and 9 show examples of connecting the NI 6509 to a relay that does not require more than 24 mA of current.

Figure 8. NI 6509 Sinking Connection Example, ≤ 24 mA

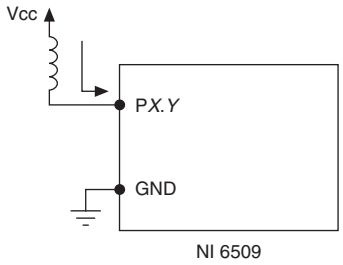
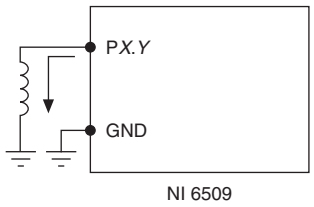


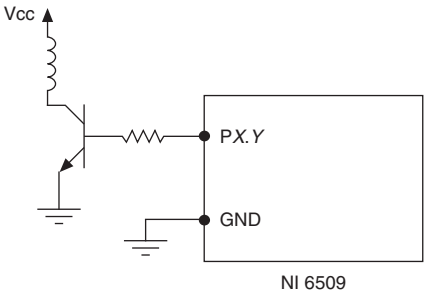
Figure 9. NI 6509 Sourcing Connection Example, ≤ 24 mA



Driving a Relay > 24 mA

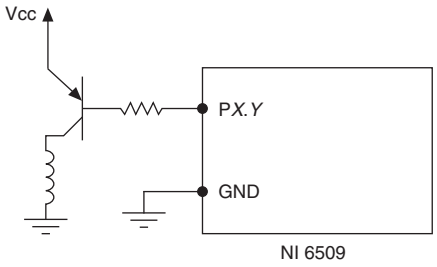
Figures 10 and 11 are examples of connecting the NI 6509 to a relay that requires more than 24 mA of current. These examples use an additional transistor circuit.

Figure 10. NI 6509 Sinking Connection Example, > 24 mA



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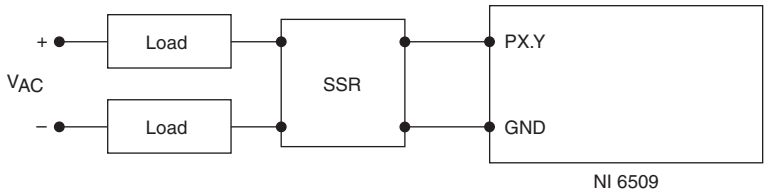
Figure 11. NI 6509 Sourcing Connection Example, > 24 mA



Driving an SSR

Figure 12 shows an example of connecting the NI 6509 to an SSR.

Figure 12. NI 6509 SSR Connection Example



Power Connections

+5 V Power Available at I/O Connector

Pins 49 and 99 supply +5 V power to the I/O connector. The I/O connector power has a fuse for overcurrent protection. This fuse is not customer replaceable. If the fuse is blown, return the device to NI for repair.

Caution Do *not* connect the +5 V power pin directly to ground or to any other voltage source on any other device. Doing so may permanently damage the NI 6509 device and the computer.

Disk Drive Power Connector (PCIe-6509 Only)

The disk drive power connector is a four-pin hard drive connector on the PCIe-6509 that, when connected, increases the current the device can supply on the +5 V terminal.

Note The disk drive power has a fuse for overcurrent protection. This fuse is not customer replaceable. If the fuse is blown, the fuse LED (reference designator *DS1*—located on the visible edge of the underside of the installed device) is lit. In this case, return the device to NI for repair.

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When to Use the Disk Drive Power Connector

You can install the disk drive power connector if you want to increase the power supply on the +5 V terminal. However, it is not necessary to install the disk drive power connector for most applications.

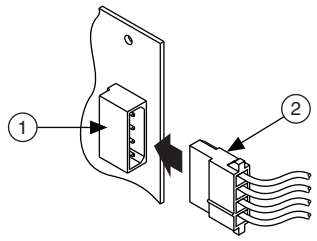
Refer to the *Specifications* section for more information about the power requirements and power limits of the PCIe-6509.

Disk Drive Power Connector Installation

Before installing the disk drive power connector, you must install and set up the PCIe-6509 as described in the *DAQ Getting Started* guides. Complete the following steps to install the disk drive power connector:

1. Power off and unplug the computer.
2. Remove the computer cover.
3. Attach the PC disk drive power connector to the disk drive power connector on the PCIe-6509, as Figure 13 shows.

Figure 13. Connecting to the Disk Drive Power Connector



1 Device Disk Drive Power Connector 2 PC Disk Drive Power Connector

Note The power available on the disk drive power connectors in a computer can vary. For example, consider using a disk drive power connector that is not in the same power chain as the hard drive.

4. Replace the computer cover, and plug in and power on the computer.

Industrial DIO Features

The NI 6509 features digital filtering, programmable power-up states, change detection, and a watchdog timer.

Digital Filtering

You can use the digital filtering option available on the NI 6509 to eliminate glitches on input data. When used with change detection, digital filtering can also reduce the number of changes to examine and process.

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You can configure the digital input lines to pass through a digital filter and control the timing interval the filter uses. The filter blocks pulses that are shorter than half of the specified timing interval and passes pulses that are longer than the specified interval. Intermediate-length pulses—pulses longer than half of the interval but less than the interval—may or may not pass the filter.

Table 2 lists the pulse widths that the NI 6509 is certain to pass and block.

Table 2. NI 6509 Digital Filtering

Filter Interval	Pulse Width Passed		Pulse Width Blocked	
	Low Pulse	High Pulse	Low Pulse	High Pulse
$t_{interval}$	$t_{interval}$	$t_{interval}$	$t_{interval}/2$	$t_{interval}/2$

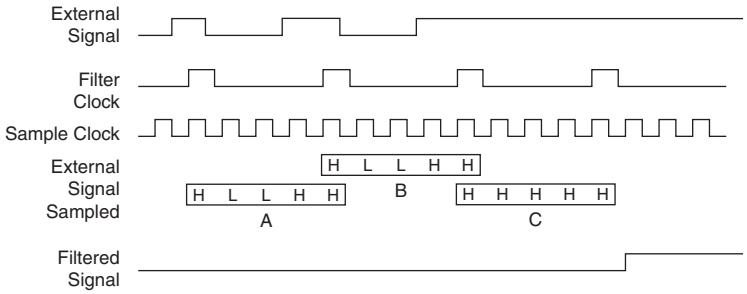
You can enable digital filtering on as many input lines as necessary for your application. All filtered lines share the same timing interval, which ranges from 400 ns to 200 ms on the NI PCI/PXI-6509. The PCIe-6509 supports only three timing intervals: 160 ns, 10.24 µs, and 5.12 ms.

Internally, the digital filter uses two clocks: a sample clock and a filter clock. The filter clock is generated by a counter and has a period equal to one half of the specified timing interval. The NI 6509 samples the input signal on each rising edge of the sample clock, but the NI 6509 recognizes a change in the input signal only if the input signal maintains its new state for at least two consecutive rising edges of the filter clock. The filter clock is programmable and allows you to control how long a pulse must last to be recognized by the NI 6509.

Digital Filtering Example

Figure 14 shows an example of digital filtering.

Figure 14. Digital Filtering Example



In periods A and B, the filter blocks the glitches because the external signal does not remain steadily high from one rising edge of the filter clock to the next. In period C, the filter passes the transition because the external signal remains steadily high. Depending on when the transition occurs, the filter may require up to two filter clocks—one full filter interval—to pass a transition.

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The figure shows a rising (0 to 1) transition. The same filtering applies to falling (1 to 0) transitions.

Programmable Power-Up States

You can program the DIO lines on the NI 6509 to power up at a predefined state: input, high output, or low output. Programmable power-up states ensure that the NI 6509 powers up in a known state.

Note On the PCIe-6509, the DIO lines can be pulled high or low. For more information, refer to the *I/O Pull-Up/Pull-Down Resistors (PCIe-6509 Only)* section.

The typical response time of programmable power-up states is 400 ms for the PCI/PXI-6509 and 500 ms for the PCIe-6509.

To use MAX (recommended) to program the power-up states, select the device and click the **Properties** button. Refer to the software documentation for information about how to program the power-up states using NI-DAQmx with LabVIEW or other NI application development environments (ADEs).

Change Detection

You can program the NI 6509 to send an interrupt when a change occurs on any input line. The NI 6509 can monitor changes on selected input lines or on all input lines. It can monitor for rising edges (0 to 1), falling edges (1 to 0), or both.

When an input change occurs, the NI 6509 generates an interrupt and notifies the software. However, the NI 6509 does not report which line changed or if the line was rising or falling. After a change, you can read the input lines to determine the current line states. The rate of change detection is determined by the software response time, which varies from system to system.

Note Excessive change detections may affect system performance. Use digital filtering to minimize the effects of noisy input lines.

An overflow bit indicates that the NI 6509 detects an additional rising or falling edge before the software processes the previous change.

Refer to the software documentation for information about how to set up and implement the change detection feature.

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Change Detection Example

Table 3 shows a change detection example for six bits of one port.

Table 3. Change Detection Example

	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Changes to detect	↕	↕	↕	↕	—	—	↑	↓
Enable rising-edge detection	yes	yes	yes	yes	no	no	yes	no
Enable falling-edge detection	yes	yes	yes	yes	no	no	no	yes

This example assumes the following line connections:

- Bits 7, 6, 5, and 4 are connected to data lines from a four-bit TTL output device. The NI 6509 detects any change in the input data so you can read the new data value.
- Bit 1 is connected to a limit sensor. The NI 6509 detects rising edges on the sensor, which correspond to over-limit conditions.
- Bit 0 is connected to a switch. The NI 6509 reacts to any switch closure, which is represented by a falling edge. If the switch closure is noisy, enable digital filtering for this line.

In this example, the NI 6509 reports rising edges on only bit 1, falling edges on only bit 0, and rising and falling edges on bits 7, 6, 5, and 4. The NI 6509 reports no changes for bits 3 and 2. After receiving notification of a change, you can read the port to determine the current values of all eight lines. However, you cannot read the lines that are configured for change detection until a change detection interrupt occurs.

Watchdog Timer

The watchdog timer is a software-configurable feature that sets critical output lines to predefined safe states in the event of a software failure, a system crash, or any other loss of communication between the application and the NI 6509.

After you enable the watchdog timer, if the NI 6509 does not receive a **watchdog reset** software command within the time specified for the watchdog timer, the output lines enter a user-defined safe state and remain in that state until one of the following events occurs:

- The application disarms the watchdog timer and writes new values to the output lines.
- The NI 6509 is reset.
- The computer is restarted.

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The signal indicating an expired watchdog asserts continuously until the application disarms the watchdog timer. After the watchdog timer expires, the NI 6509 ignores any writes until the application disarms the watchdog timer.

Note On the PCIe-6509, ports that are set to tristate cannot enter safe states of output when the computer enters a fault condition.

You can set the watchdog timer timeout period to specify the amount of time that elapses before the watchdog timer expires. The counter on the watchdog timer is configurable up to $(2^{32} - 1) \times 100$ ns (about seven minutes) on the PCI/PXI-6509 and $(2^{32} - 1) \times 32$ ns (about two minutes) on the PCIe-6509 before the watchdog timer expires.

Accessories

Caution This NI product must be operated with shielded cables and accessories to ensure compliance with the Electromagnetic Compatibility (EMC) requirements defined in the *Specifications* section of this document. Do not use unshielded cables or accessories unless they are installed in a shielded enclosure with properly designed and shielded input/output ports and connected to the NI product using a shielded cable. If unshielded cables or accessories are not properly installed and shielded, the EMC specifications for the product are no longer guaranteed.

NI offers the following products for use with the NI 6509.

Cable (Part Number)	Accessory (Part Number)
SH100-100-F shielded cable (185095-*xx*)	SCB-100 connector block (776990-01)
R1005050 ribbon cable (182762-*xx*)	CB-50 connector block, DIN-rail mount (776164-90)
	CB-50LP connector block, panel mount (777101-01)

For more information about optional equipment available from NI, visit `ni.com`.

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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
PCIe-6509	550 mA on +3.3 VDC, typical; 20 mA on +12 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	
PCI/PXI-6509	TTL/CMOS, single-ended GND referenced
PCIe-6509	TTL Schmitt Trigger/CMOS, single-ended GND referenced
Power-on state	
PCI/PXI-6509	Input high-Z (default), output 1 or 0
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 (PCIe-6509 only)	
Pull-up resistor	4.7 kΩ, typical
Pull-down resistor	47 kΩ, typical
Input voltage protection (PCIe-6509 only)	±20 V on up to two pins, maximum

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Digital Logic Levels (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	Minimum	Maximum
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	Minimum	Maximum
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 (PCIe-6509)

Input Signals

Level	Minimum	Maximum
Input voltage (V_{in})	0 V	5 V
Positive-going threshold (VT+)	—	2.2 V

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Level	Minimum	Maximum
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	Minimum	Maximum
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.

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Physical Characteristics

Dimensions (without connectors)	
PCI-6509	12.4 cm × 9.7 cm (4.9 in. × 3.8 in.)
PXI-6509	16.0 cm × 10.0 cm (6.3 in. × 3.9 in.)
PCIe-6509	14.2 cm × 10.4 cm (5.6 in. × 4.1 in.)
Weight	
PCI-6509	70.9 g (2.5 oz)
PXI-6509	172.9 g (6.1 oz)
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
Relative humidity range	10% to 90%, noncondensing
Altitude	2,000 m (at 25 °C ambient temperature)

Storage Environment

Ambient temperature range	–20 °C to 70 °C
Relative humidity range	5% to 95%, noncondensing

Shock and Vibration (PXI-6509 Only)

Operational shock	30 g peak, half-sine, 11 ms pulse
Random vibration	
5 Hz to 500 Hz, 0.3 grms	Operating
5 Hz to 500 Hz, 2.4 grms	Nonoperating

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Safety

This product meets 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 61326-1 (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-003: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

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

Environmental Standards

The NI 6509 meets the requirements of the following environmental standards for electrical equipment.

- IEC-60069-2-1 - Cold
- IEC-60068-2-2 - Dry Heat
- IEC-60068-2-78 - Damp Heat (steady-state)
- IEC-60068-2-64 - Random Operating vibration (PXI-6509 Only)
- IEC-60068-2-27 - Operating shock (PXI-6509 Only)
- MIL-PRF-28800F - Operating shock (PXI-6509 Only)
    - Random vibration for nonoperating Class 3.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

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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 to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* 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 and Electronic Equipment, visit ni.com/environment/weee.

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Where to Go Next

The following documents contain information that you may find helpful as you use this user guide:

- *DAQ Getting Started* guides—These guides describe how to install the NI-DAQmx driver software, the DAQ device, and how to confirm that the device is operating properly.
- *NI-DAQmx Help*—This help file contains information about using NI-DAQmx to program NI devices. NI-DAQmx is the software you use to communicate with and control National Instruments DAQ devices.
- *Measurement & Automation Explorer Help for NI-DAQmx*—This help file contains information about configuring and testing DAQ devices using MAX for NI-DAQmx, and information about special considerations for operating systems.
- *DAQ Assistant Help*—This help file contains information about creating and configuring channels, tasks, and scales using the DAQ Assistant.



Note You can download these documents from ni.com/manuals.

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