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DAQ

6527 User Manual

Isolated Digital I/O Interface
for PCI, PXI™, and CompactPCI

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About This Manual

This manual describes the electrical and mechanical aspects of the 6527 devices, and contains information concerning their operation and programming.

How To Use the Manual Set

The *6527 User Manual* is one piece of the documentation set for your data acquisition system. You could have any of several types of manuals, depending on the hardware and software in your system. Use the manuals you have as follows:

- Your DAQ hardware user manuals—These manuals have detailed information about the DAQ hardware that plugs into or is connected to your computer. Use these manuals for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.
- Software documentation—Examples of software documentation you may have are the LabVIEW or Measurement Studio documentation sets and the NI-DAQ documentation. After you set up your hardware system, use either the application software or the NI-DAQ documentation to help you write your application. If you have a large and complicated system, it is worthwhile to look through the software documentation before you configure your hardware.
- Accessory installation guides or manuals—If you are using accessory products, read the terminal block and cable assembly installation guides or accessory board user manuals. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making your connections.

Conventions

The following conventions appear in this manual:

<> — Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DIG+0.<3..0>.

♦ — The ♦ symbol indicates that the text following it applies only to a specific product, a specific operating system, or a specific software version.

 — This icon denotes a note, which alerts you to important information.

 — This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

 — This icon denotes a warning, which advises you of precautions to take to avoid being electrically shocked.

italic — Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace` — Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

Related Documentation

The following documents also contain information that you may find helpful as you read this manual:

- Your computer's technical reference manual
- *PCI Local Bus Specification*, Revision 2.0
- National Instruments *PXI Specification*, Revision 1.0
- *PICMG 2.0 R2.1 CompactPCI*

1

Getting Started with Your 6527

This chapter describes the 6527 devices, lists what you need to get started, software programming choices, and optional equipment, describes custom cabling options, and explains how to unpack your board.

About the 6527 Device

Thank you for purchasing a National Instruments 6527 device. Unless otherwise noted, the text applies to all devices in the 6527 family, which includes the PCI-6527 and PXI-6527. The 6527 devices are 48-bit, parallel, isolated digital I/O interfaces for PCI bus computers and PXI or Compact PCI chassis. The 6527 devices offer 48 channels of isolated digital data acquisition. Twenty-four of the channels are optocoupler inputs and 24 are solid-state relay outputs. You can sense digital levels up to 28 VDC and switch currents of up to 120 mA. Digital filtering is available to eliminate glitches on the input lines. All input lines can also generate interrupts on rising or falling edges to notify you of changing data.

The 6527 device is a completely jumperless DAQ device for PCI buses and PXI or CompactPCI chassis and contains the National Instruments PCI MITE interface.

The 6527 devices are ideal for low-voltage isolation and switching in both industrial and laboratory environments. You can use the optically-isolated digital input lines to read the status of external digital logic at TTL and non-TTL levels. You can use the solid-state relay outputs to switch external devices, including those requiring high input currents, and to control digital logic levels at both TTL and non-TTL levels. Because of the isolated nature of the 6527 devices, you can decouple the noise and harsh ground of the computer from external signals, and vice versa.

Detailed 6527 device specifications are in Appendix A, *Specifications*.

Using PXI with CompactPCI

Using PXI-compatible products with standard CompactPCI products is an important feature provided by the *PXI Specification*, Revision 1.0. If you use a PXI-compatible plug-in device in a standard CompactPCI chassis, you will be unable to use PXI-specific functions, but you can still use the basic plug-in device functions.

The CompactPCI specification permits vendors to develop sub-buses that coexist with the basic PCI interface on the CompactPCI bus. Compatible operation is not guaranteed between CompactPCI devices with different sub-buses nor between CompactPCI devices with sub-buses and PXI. The standard implementation for CompactPCI does not include these sub-buses. Your 6527 device will work in any standard CompactPCI chassis adhering to the *PICMG 2.0 R2.1 CompactPCI* core specification.

What You Need to Get Started

To set up and use your 6527 device, you will need the following:

- ❑ One of the following devices:
  - PCI-6527
  - PXI-6527
- ❑ *6527 User Manual*
- ❑ One or more of the following software packages and documentation:
  - LabVIEW for Windows
  - Measure
  - Measurement Studio
  - NI-DAQ for PC Compatibles
- ❑ Your computer, or PXI or CompactPCI chassis and controller

Software Programming Choices

There are several options to choose from when programming your National Instruments DAQ hardware. You can use LabVIEW, LabWindows/CVI, Visual C++, or Visual Basic with the NI-DAQ driver software.

National Instruments Application Software

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition VI Library, a series of VIs for using LabVIEW with National Instruments DAQ hardware, is included with LabVIEW. The LabVIEW Data Acquisition VI Library is functionally equivalent to the NI-DAQ software.

Measurement Studio, which includes LabWindows/CVI and tools for Visual C++ and Visual Basic, features interactive graphics, user interface controls, and data acquisition through standard ANSI C functions and ActiveX controls. With Measurement Studio, you can use all of the configuration tools, resource management utilities, and interactive control utilities included with NI-DAQ.

Using LabVIEW or Measurement Studio software will greatly reduce the development time for your data acquisition and control application.

NI-DAQ Driver Software

The NI-DAQ driver software is included at no charge with all National Instruments DAQ hardware. NI-DAQ has an extensive library of functions that you can call from your application programming environment. These functions allow you to use all features of your 6527 device.

NI-DAQ addresses many of the complex issues between the computer and the DAQ hardware such as programming interrupts. NI-DAQ maintains a consistent software interface among its different versions so that you can change platforms with minimal modifications to your code. Whether you are using LabVIEW or Measurement Studio, your application uses the NI-DAQ driver software, as illustrated in Figure 1-1.

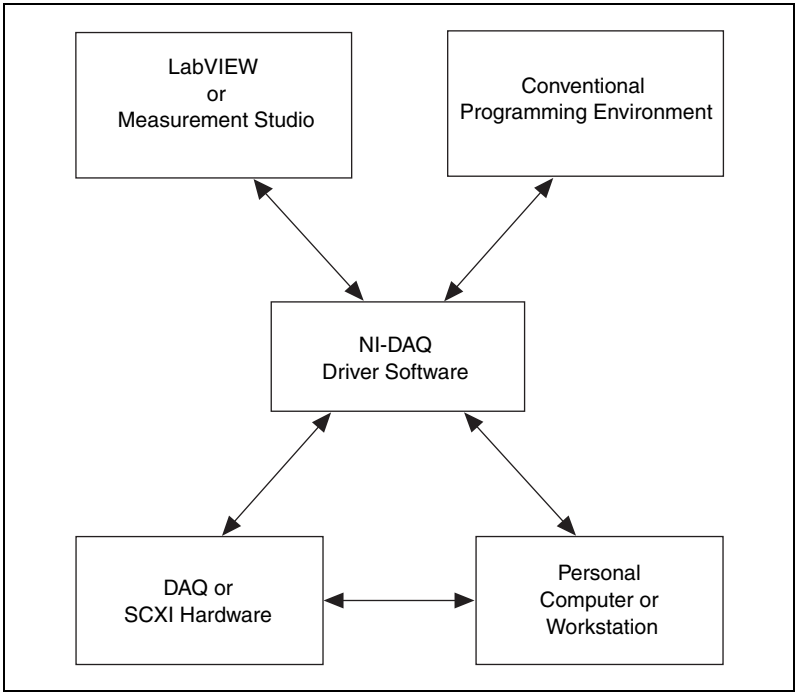


Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware

Optional Equipment

National Instruments offers a variety of accessories to use with your 6527 device, such as:

- Cables and cable assemblies, shielded and ribbon
- Connector blocks, unshielded and shielded 50- and 100-pin screw terminals

For more information about optional equipment available from National Instruments, refer to your National Instruments catalogue, or call the office nearest to you.

Custom Cabling

National Instruments offers cables and accessories for you to prototype your application or to use if you frequently change board interconnections.

If you want to develop your own cable, note that the 6527 device uses a 100-pin female cable header. AMP Corporation part number 749621-9 may be used for the mating connector. Backshells available for use on a cable with this connector include the following:

- AMP 749081-1
- AMP 749854-1

These backshells have a different thread width than the I/O connector on the 6527. A jackscrew to adapt the different thread widths is available from National Instruments; the part number is 745444-01.

Safety Information



Cautions Do *not* operate the 6527 in an explosive atmosphere or where there may be flammable gases or fumes.

Do *not* operate the 6527 in a manner not specified in the manual.

Clean the 6527 and accessories by brushing off light dust with a soft nonmetallic brush. Remove other contaminants with a stiff nonmetallic brush. The unit must be completely dry and free from contaminants before returning it to service.

Connections, including power-signal-to-ground and ground-to-power-signal, that exceed any of the maximum signal ratings for the 6527 can damage any or all of the modules in the same PXI or CompactPCI chassis, or PCI-bus computer. National Instruments is *not* liable for any damages or injuries resulting from incorrect signal connections.

All signal wiring must be properly insulated. National Instruments is *not* liable for damage to equipment or injuries caused by improper signal wiring.

The 6527 must be used in a CE-marked PXI or CompactPCI chassis, or PCI-bus computer.

Unpacking

Your 6527 device is shipped in an antistatic package to prevent electrostatic damage to the board. Electrostatic discharge can damage several components on the board. To avoid such damage in handling the board, take the following precautions:

- Ground yourself via a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of your computer chassis before removing the board from the package.
- Remove the board from the package and inspect the board for loose components or any other sign of damage.
- *Never* touch the exposed pins of connectors.



Note Notify National Instruments if the board appears damaged in any way. Do *not* install a damaged board into your computer.

2

Installing and Configuring the 6527

This chapter describes how to install and configure your 6527 device.

Installing Software

This section describes how to install your software.

Note Install your software before you install your 6527 device.

If you are using NI-DAQ, refer to your NI-DAQ release notes for specific instructions on the software installation sequence. Find the installation section for your operating system and follow the instructions given there.

If you are using LabVIEW, LabWindows/CVI, or other National Instruments application software packages, refer to the appropriate release notes for exact directions on installing your software. After you have installed your application software, refer to your NI-DAQ release notes and follow the instructions given there for your operating system and application software package.

Installing the 6527

This section describes how to install your hardware.

Note Install your software before you install your 6527 device.

The following are general installation instructions for each device. Consult your computer or chassis user manual or technical reference manual for specific instructions about installing new devices in your computer or chassis.

Note Follow the guidelines in your computer documentation for installing plug-in hardware.

- PCI-6527

  To install a PCI-6527 in any available 5 V PCI expansion slot in your computer:

  1. Turn off and unplug your computer.
  2. Remove the top cover or access port to the expansion slots.
  3. Make sure there are no lighted LEDs on your motherboard. If any are lit, wait until they go out before continuing your installation.
  4. Remove the expansion slot cover on the back panel of the computer.
  5. Ground yourself via a grounding strap or by holding a grounded object. Follow the ESD protection precautions described in the *Unpacking* section of Chapter 1, *Getting Started with Your 6527*.
  6. Insert the PCI-6527 in a 5 V PCI slot. It may be a tight fit, but do *not* force the device into place.
  7. Screw the mounting bracket of the PCI-6527 to the back panel rail of the computer.
  8. Visually verify the installation.
  9. Replace the top cover of your computer.
  10. Plug in and turn on your computer.

- PXI-6527

  To install a PXI-6527 in any available 5 V peripheral slot in your PXI or CompactPCI chassis:

  1. Turn off and unplug your PXI or CompactPCI chassis.
  2. Choose an unused PXI or CompactPCI 5 V peripheral slot.
  3. Make sure there are no lighted LEDs on your motherboard. If any are lit, wait until they go out before continuing your installation.
  4. Remove the filler panel for the peripheral slot you have chosen.
  5. Ground yourself via a grounding strap or by holding a grounded object. Follow the ESD protection precautions described in the *Unpacking* section of Chapter 1, *Getting Started with Your 6527*.
  6. Insert the PXI-6527 in the selected 5 V slot. Use the injector/ejector handle to fully inject the device into place.
  7. Screw the front panel of the PXI-6527 to the front panel mounting rails of the PXI or CompactPCI chassis.
  8. Visually verify the installation.
  9. Plug in and turn on the PXI or CompactPCI chassis.

Your 6527 is now installed. You are now ready to configure your hardware and software.

Configuring the 6527

Your 6527 device is completely software configurable, and you do not need to perform any configuration steps after the system powers up. The PCI-6527 is fully compliant with the *PCI Local Bus Specification*, Revision 2.0, and the PXI-6527 is fully compliant with the *PXI Specification*, Revision 1.0. Therefore, all board resources are automatically allocated by the PCI system, including the base address and interrupt level. The board's base address is mapped into PCI memory space.

3

Making Signal Connections

This chapter describes the pin arrangement, signal names, and signal connections on your 6527 device.

Caution Connections that exceed any of the maximum ratings of input or output signals on your 6527 device can damage the board and your computer. Pay careful attention to the maximum input ratings included with the description of each signal in this chapter. National Instruments is *not* liable for any damages resulting from signal connections that exceed these maximum ratings.

I/O Connector

The I/O connector for the 6527 device has 100 pins that you can connect to 50-pin accessories with the R1005050 cable or to 100-pin accessories with the shielded SH100100-F cable. Figure 3-1 shows the pin assignments for the 6527 I/O connector. A signal description follows the figure.

Note For input ports, connect the higher voltage to the DIG+ pin and the lower voltage to the DIG– pin. For output ports, you can connect signals to the two pins of each line without regard to which voltage is higher. The output lines consist of solid-state relays and act as bidirectional switches.

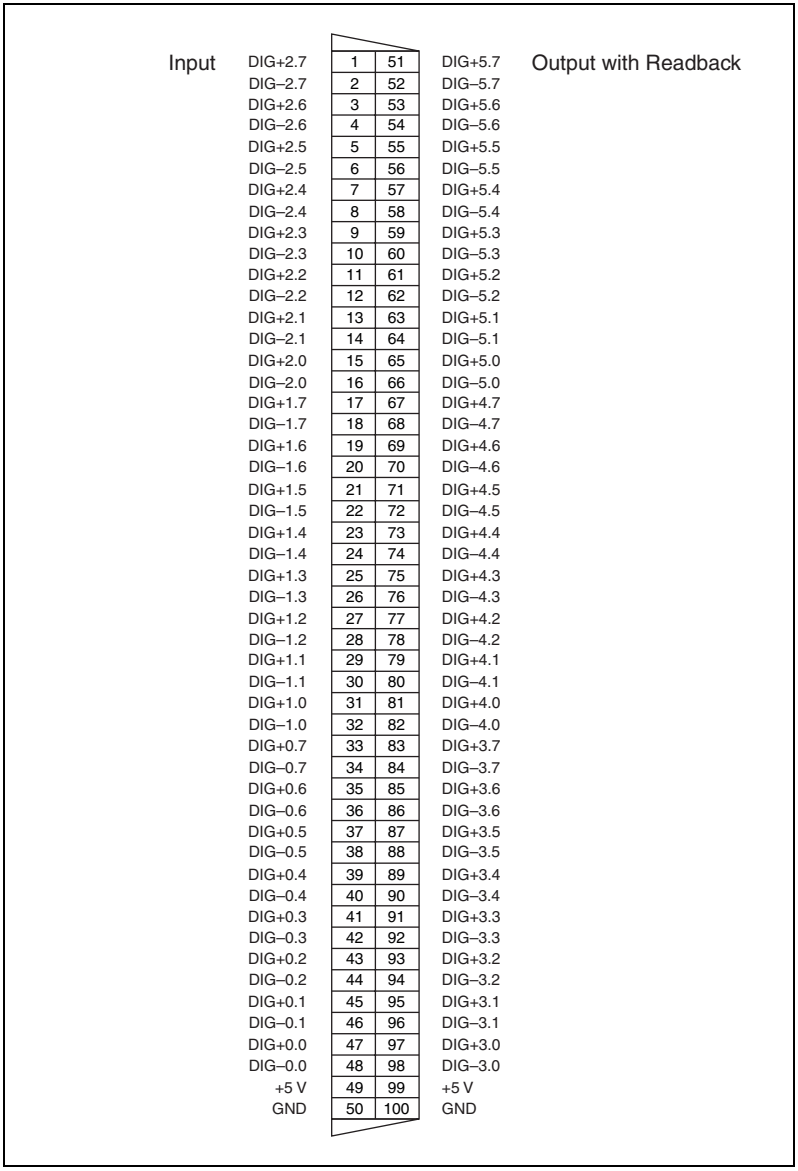


Figure 3-1. 6527 Connector Pin Assignments

Table 3-1. Port Functionality for 6527 Devices

Port	Function
0	Input
1	Input
2	Input
3	Output with readback
4	Output with readback
5	Output with readback

Cable Assembly Connectors

The optional R1005050 cable assembly you can use with the 6527 device is an assembly of two 50-pin cables and three connectors. Both cables are joined to a single connector on one end and to individual connectors on the free ends. The 100-pin connector that joins the two cables plugs into the I/O connector of the 6527 device. The other two connectors are 50-pin connectors, one of which is connected to pins 1 through 50 and the other to pins 51 through 100 of the 6527 device connector. Figure 3-2 shows the pin assignments for the 50-pin connectors on the cable assembly.

Input				Output with Readback			
DIG+2.7	1	2	DIG–2.7	DIG+5.7	51	52	DIG–5.7
DIG+2.6	3	4	DIG–2.6	DIG+5.6	53	54	DIG–5.6
DIG+2.5	5	6	DIG–2.5	DIG+5.5	55	56	DIG–5.5
DIG+2.4	7	8	DIG–2.4	DIG+5.4	57	58	DIG–5.4
DIG+2.3	9	10	DIG–2.3	DIG+5.3	59	60	DIG–5.3
DIG+2.2	11	12	DIG–2.2	DIG+5.2	61	62	DIG–5.2
DIG+2.1	13	14	DIG–2.1	DIG+5.1	63	64	DIG–5.1
DIG+2.0	15	16	DIG–2.0	DIG+5.0	65	66	DIG–5.0
DIG+1.7	17	18	DIG–1.7	DIG+4.7	67	68	DIG–4.7
DIG+1.6	19	20	DIG–1.6	DIG+4.6	69	70	DIG–4.6
DIG+1.5	21	22	DIG–1.5	DIG+4.5	71	72	DIG–4.5
DIG+1.4	23	24	DIG–1.4	DIG+4.4	73	74	DIG–4.4
DIG+1.3	25	26	DIG–1.3	DIG+4.3	75	76	DIG–4.3
DIG+1.2	27	28	DIG–1.2	DIG+4.2	77	78	DIG–4.2
DIG+1.1	29	30	DIG–1.1	DIG+4.1	79	80	DIG–4.1
DIG+1.0	31	32	DIG–1.0	DIG+4.0	81	82	DIG–4.0
DIG+0.7	33	34	DIG–0.7	DIG+3.7	83	84	DIG–3.7
DIG+0.6	35	36	DIG–0.6	DIG+3.6	85	86	DIG–3.6
DIG+0.5	37	38	DIG–0.5	DIG+3.5	87	88	DIG–3.5
DIG+0.4	39	40	DIG–0.4	DIG+3.4	89	90	DIG–3.4
DIG+0.3	41	42	DIG–0.3	DIG+3.3	91	92	DIG–3.3
DIG+0.2	43	44	DIG–0.2	DIG+3.2	93	94	DIG–3.2
DIG+0.1	45	46	DIG–0.1	DIG+3.1	95	96	DIG–3.1
DIG+0.0	47	48	DIG–0.0	DIG+3.0	97	98	DIG–3.0
+5 V	49	50	GND	+5 V	99	100	GND

Figure 3-2. Cable-Assembly Connector Pinout for the R1005050 Ribbon Cable

I/O Connector Signal Descriptions

Table 3-2. Signal Descriptions for 6527 I/O Connector Pins

Pin	Signal Name	Description
33, 35, 37, 39, 41, 43, 45, 47	DIG+0.<7..0>	Isolated input port 0, positive terminals—Take measurements at these terminals. These terminals should be positive relative to their corresponding DIG– lines. A logic high (data bit of 1) indicates input voltage and current are present.
34, 36, 38, 40, 42, 44, 46, 48	DIG–0.<7..0>	Isolated input port 0, negative terminals—Each of these terminals serves as the reference terminal from which the corresponding DIG+ line is measured. A logic high (data bit of 1) indicates input voltage and current are present.
17, 19, 21, 23, 25, 27, 29, 31	DIG+1.<7..0>	Isolated input port 1, positive terminals—Take measurements at these terminals. These terminals should be positive relative to their corresponding DIG– lines. A logic high (data bit of 1) indicates input voltage and current are present.
18, 20, 22, 24, 26, 28, 30, 32	DIG–1.<7..0>	Isolated input port 1, negative terminals—Each of these terminals serves as the reference terminal from which the corresponding DIG+ line is measured. A logic high (data bit of 1) indicates input voltage and current are present.
1, 3, 5, 7, 9, 11, 13, 15	DIG+2.<7..0>	Isolated input port 2, positive terminals—Take measurements at these terminals. These terminals should be positive relative to their corresponding DIG– lines. A logic high (data bit of 1) indicates input voltage and current are present.
2, 4, 6, 8, 10, 12, 14, 16	DIG–2.<7..0>	Isolated input port 2, negative terminals—Each of these terminals serves as the reference terminal from which the corresponding DIG+ line is measured. A logic high (data bit of 1) indicates input voltage and current are present.
49, 99	+5 V	+5 Volts—These pins are fused for up to 1 A total of +4.5 to +5.25 V from the computer power supply. *These pins are not isolated.*
50, 100	GND	Ground—These pins are connected to the computer ground reference. *These pins are not isolated.*

Table 3-2. Signal Descriptions for 6527 I/O Connector Pins (Continued)

Pin	Signal Name	Description
83, 85, 87, 89, 91, 93, 95, 97	DIG+3.<7..0>	Isolated output port 3, first terminals—Each of these is the first of two terminals of a bidirectional solid-state relay[1]. A logic low (data bit of 0) closes the relay.
84, 86, 88, 90, 92, 94, 96, 98	DIG–3.<7..0>	Isolated output port 3, second terminals—Each of these is the second of two terminals of a bidirectional solid-state relay. A logic low (data bit of 0) closes the relay.
67, 69, 71, 73, 75, 77, 79, 81	DIG+4.<7..0>	Isolated output port 4, first terminals—Each of these is the first of two terminals of a bidirectional solid-state relay. A logic low (data bit of 0) closes the relay.
68, 70, 72, 74, 76, 78, 80, 82	DIG–4.<7..0>	Isolated output port 4, second terminals—Each of these is the second of two terminals of a bidirectional solid-state relay. A logic low (data bit of 0) closes the relay.
51, 53, 55, 57, 59, 61, 63, 65	DIG+5.<7..0>	Isolated output port 5, first terminals—Each of these is the first of two terminals of a bidirectional solid-state relay. A logic low (data bit of 0) closes the relay.
52, 54, 56, 58, 60, 62, 64, 66	DIG–5.<7..0>	Isolated output port 5, second terminals—Each of these is the second of two terminals of a bidirectional solid-state relay. A logic low (data bit of 0) closes the relay.

[1] The connection is complete when the relay is closed. The connection is broken when the relay is open.

Power Connections

Four of the pins on the I/O connector are not isolated. Pin 50 and pin 100 connect to GND, the computer ground reference. Pin 49 and pin 99 of the I/O connector supply +5 V from the computer power supply via a self-resetting fuse. The fuse resets automatically within a few seconds after an overcurrent condition is removed. The +5 V pins are referenced to the GND pins and can be used to power external digital circuitry that does not require isolation.

- Power rating: 1 A at +4.5 to +5.25 V

Warning The power pins, +5 V and GND, are *not* isolated; they connect to your computer power supply. Never connect a +5 V power pin directly to GND. Never connect a +5 V or GND pin to any other voltage source; doing so can lead to injury. National Instruments is *not* liable for any damage or injury resulting from such a connection.

Isolation Voltages

The positive and negative (DIG+ and DIG–) terminals of each channel are isolated from the other input and output channels, from the +5 V and GND pins, and from the computer power supply. Isolation barriers provide isolation up to 60 VDC or 30 VAC (42 V peak) between any two terminals, except between the two terminals making up a single digital I/O channel.

Do not exceed 60 VDC or 30 VAC between any two terminals of the 6527 device, including:

- any two digital I/O (DIG+ or DIG–) lines of separate channels
- any DIG+ or DIG– line and the GND or +5 V lines
- the DIG+ line and the DIG– line of any output channel

Do not exceed 28 VDC or apply any negative or AC voltage between the DIG+ and DIG– terminals of any input channel.

Warning Do *not* exceed the isolation voltage limits. Exceeding the voltage limits can lead to injury. National Instruments is *not* liable for any damage resulting from signal connections that exceed these limits.

Optically Isolated Inputs

On a 6527 device, I/O connector pins 1 through 48, shown in Figure 3-1, represent the optically isolated input signal pins.

Input Channels

The optically-isolated inputs of a 6527 device contain a light-emitting diode (LED), a resistor for current limiting, and digital filtering and change-detection circuitry. The 6527 boards offer 24 channels of isolated digital input. Each channel has its own positive and negative terminals. Always apply the higher voltage, if any, to the positive terminal. The maximum input voltage (V_{IN}) on these channels is +28 VDC.

Caution Never apply a voltage to the positive (DIG+) terminal of any input channel that is lower than the voltage on the channel's negative (DIG–) terminal. National Instruments is *not* liable for any damage resulting from incorrect signal connection.

Sensing DC Voltages

When you apply a DC voltage of at least 2 V across the two input terminals, the 6527 device registers a logic high for that input. If no voltage is present (a voltage difference of 1 V or less), the 6527 device registers a logic low for that input. DC voltages between 1 V and 2 V are invalid and register an unreliable value. Thus, you can use the 6527 device to sense a wide range of DC signals—from TTL logic levels to DC power supply levels up to 28 V.

Signal Connection Example

Figure 3-3 shows signal connections for a supply and load connected to an isolated input. In this figure, the 6527 device is being used to sense that a load is being powered. The load is connected to the power supply by means of a switch. This power supply can be any DC voltage within the 6527 device range. When the switch is open, no current flows through the load and no voltage is applied to the load or to the 6527 device input. The digital logic of the 6527 device then registers a logic low for the channel. When the switch is closed, current flows through the LED and the 6527 device registers a logic high for the channel.

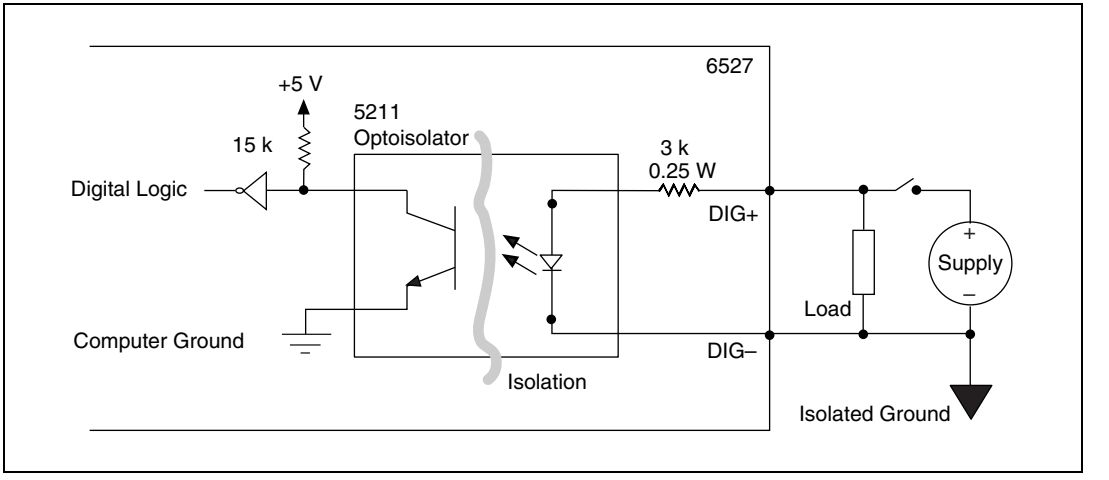


Figure 3-3. Signal Connection Example for Isolated Input

Reducing the Forward Current for High Voltages

As input voltage increases above 5 V, the input current drawn by the 6527 (forward current I_f) also rises. At 24 V, for example, current per line is found by the following equation:

$$\frac{(24V - 1.5V)}{3\ k\Omega} = 7.5\ mA$$

If you wish to reduce the current and power the 6527 draws—to reduce the impact on a circuit you are monitoring, for example—you can add another resistor in series with the 3 kΩ current-limiting resistor on the 6527, as shown in Figure 3-4.

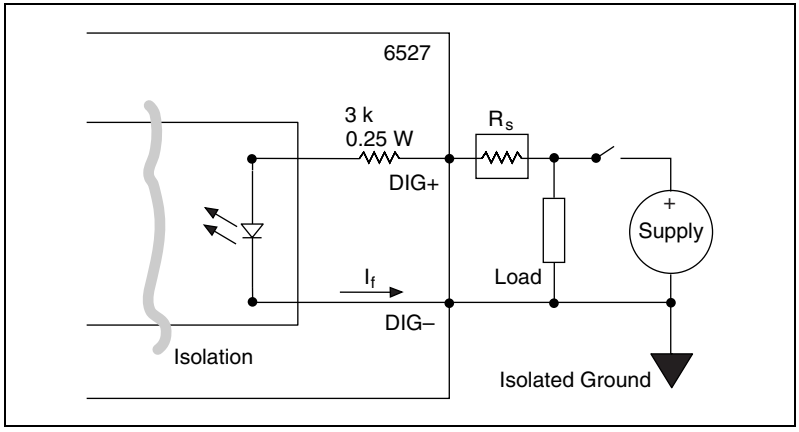


Figure 3-4. Reducing Input Current for High-Voltage Signals

It is recommended you choose a resistance value allowing at least 1 mA to flow through the LED. Assume a maximum drop across the LED of 1.5 V. For example, for 24 V inputs you could use a maximum resistance for R_s as found by the following equation:

$$\frac{(24V - 1.5V)}{1\ mA} - 3\ k\Omega = 20\ k\Omega$$

Solid-State Relay Outputs

On a 6527 device, I/O connector pins 51 through 98, shown in Figure 3-1, represent the terminals of the solid-state relays.

Output Channels

The output channels of a 6527 device are solid-state relays containing an LED and two MOSFETs connected together to form a bidirectional switch. The LH1546 is a solid-state relay. Depending on how the load is connected to the terminals, an output can either source or sink currents.

Figure 3-5 shows two signal connection examples for driving a load with these solid-state relays.

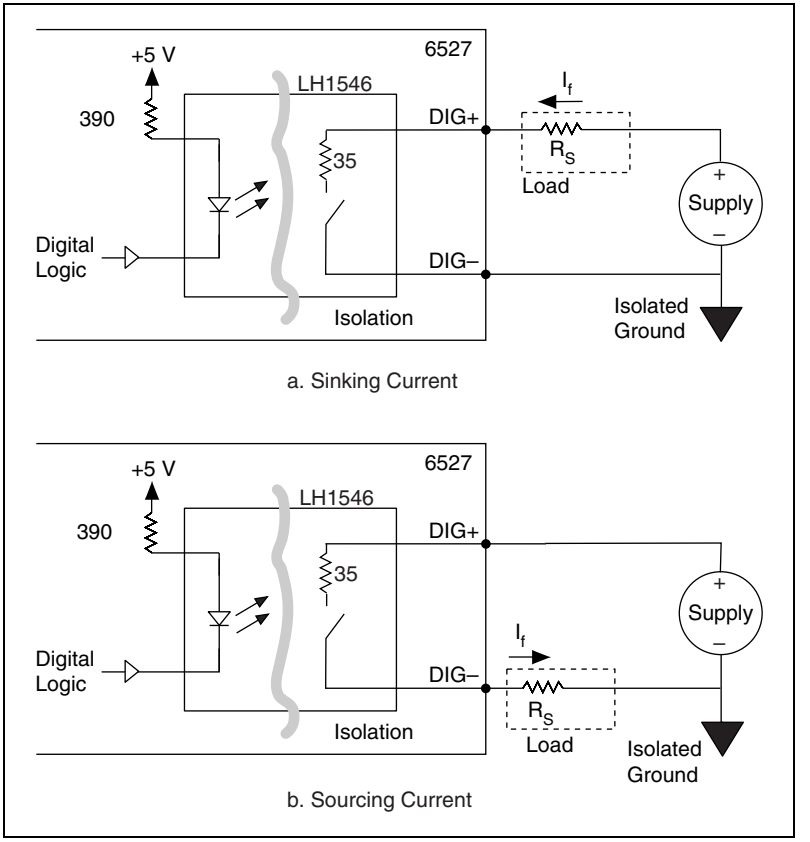


Figure 3-5. Signal Connections for Solid-State Relays

Writing a 0 (logic low) to an output bit closes the relay, and writing a 1 (logic high) opens the relay.

To both sink and source current with one channel requires an external resistor. You can use the solid-state relays of a 6527 device with external resistors to drive voltages at TTL or non-TTL levels, from –60 to 60 VDC or 30 VAC (42 V peak).

For isolated power, total current on all channels exceeding 1 A, or voltages other than +5 V, you can provide an external power supply. For driving non-isolated +5 V outputs totaling less than 1 A—for example, when using the 6527 as a TTL-level output device—you can use the +5 V line from the 6527 device as your voltage source only when *each* of the following conditions is true:

- Non-isolated power
- Total current is less than 1A
- Voltage level needed is +5 V

If any of the above conditions is not met, use the appropriate external power supply.

Using the +5 V line from the 6527 device allows you to use it as a TTL-level output device with non-isolated power.

Figure 3-6 shows a signal connection example for both sinking and sourcing current. The example shows a TTL-level application with a supply voltage of +5 V. The 6527 provides sink current when the relay is closed. Resistor R_L provides source current when the relay is open.

When the relay is open, little current flows through the resistor and the output voltage is close to 5 V, a logic high. When the relay is closed, current flows through the load and the output voltage is close to 0 V, a logic low. If isolation is not a concern, you can use the +5 V line from the 6527 device in place of the external +5 V supply.

Choose a value of R_L small enough to provide the source current you need but large enough to avoid reducing sink current or consuming unnecessary power. For many TTL-level applications, a value of approximately $R_L = 5\ k\Omega$ works well. To maintain 2.8 V at V_{OUT}, the source current is given by the following equation:

$$\frac{(5V - 2.8V)}{5\ k\Omega} = 440\ \mu A$$

The following equation shows the minimum sink current when V_{OUT} is 0.5 V:

$$\left(\frac{0.5V}{35\ \Omega}\right) - \frac{(5V - 0.5V)}{5\ k\Omega} = 13.4\ mA$$

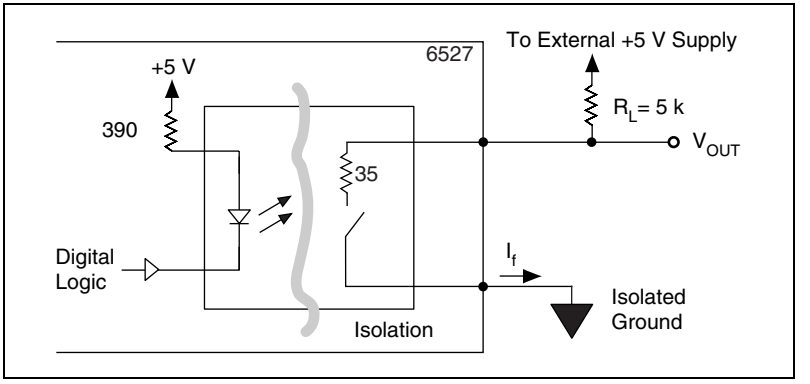


Figure 3-6. Signal Connections for Driving TTL Voltages

The maximum power ratings for the output channels on a 6527 device are as follows:

Maximum DC voltage across the terminals (V_{OUT})	60 VDC
Maximum AC voltage across the terminals (V_{OUT})	30 V_{RMS} (42 V_{Peak})
Maximum current (I_f)	120 mA[1]

[1]With all relays carrying 120 mA and all inputs driven to 28 V, the total power dissipation can approach 20 W. The maximum switching capacity in PCI and CompactPCI systems must be derated according to the ambient temperature and cooling capacity of your system to prevent the device from overheating. (The PXI chassis has built-in fans to handle 25 W per slot.)

Overcurrent Protection

The 6527 device outputs include circuitry to protect them from currents over the specified range. When excessive current flows through the relay, the relay increases resistance. Once the current level drops back under the specified range, the relays return to normal operation.

The overcurrent protection ratings for a 6527 device are as follows (typical at 25 °C):

- Overcurrent protection limit = 260 mA
- Current limit time = 1 µs at 7 V
- Duration of current above operating current (120 mA): 1 s max at 7 V

Caution Overcurrent protection is for protection against transient fault conditions only. The 6527 should not normally be operated above 120 mA. National Instruments is *not* liable for any damage resulting from signal connections that exceed 120 mA.

Power-on and Power-off Conditions

At power-up, the initial state of the digital output lines are logic high and the solid-state relays are open. The solid-state relays are also open when the computer and the 6527 device are powered off.

4

Using the 6527

This chapter contains a functional overview of the 6527 device, explains the operation of each functional unit, and describes the digital filter and change detection options.

Functional Overview

The block diagram in Figure 4-1 illustrates the key functional components of your 6527 device, which includes PCI interface circuitry, digital I/O circuitry, and optical isolation circuitry.

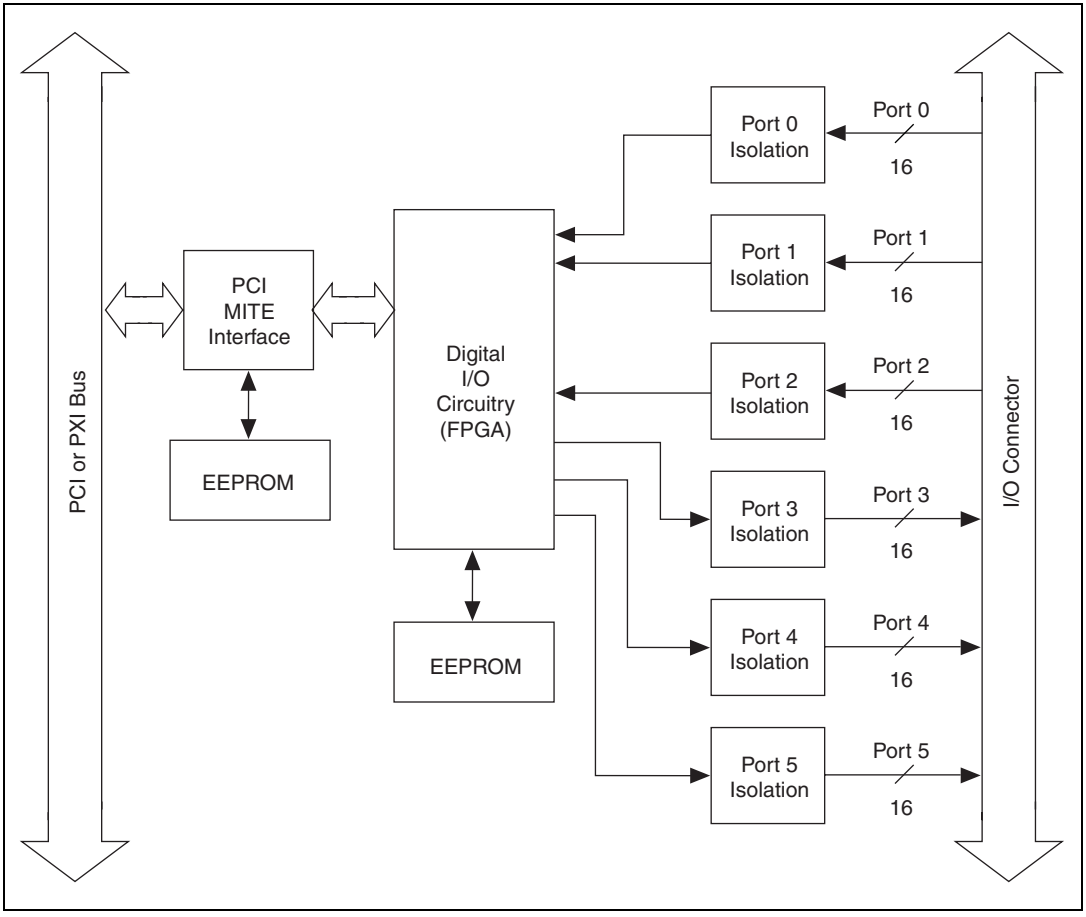


Figure 4-1. 6527 Block Diagram

PCI Interface Circuitry

Your 6527 board uses the PCI MITE ASIC, designed by National Instruments specifically for data acquisition, to communicate with the PCI bus. The PCI MITE is fully compliant with *PCI Local Bus Specification 2.0*.

Digital I/O Circuitry

You can use your 6527 board as follows:

- Output ports
  - Write
  - Read back
- Input ports
  - Read
  - Apply digital filtering (software programmable)
  - Change detection on selected lines (software programmable)

Table 3-1, *Port Functionality for 6527 Devices*, contains a summary of port functions.

Optical Isolation Circuitry

The 5211 optocouplers optically isolate the digital input ports of a 6527 device. Each optocoupler provides optical isolation for one channel of input.

Infineon LH1546 solid-state relays provide isolation on the output. One solid-state relay is used for isolation at each channel of output.

For diagrams of the complete input and output circuitry, see Chapter 3, *Making Signal Connections*.

Digital Filtering

You can eliminate glitches on input data by using the digital filter option that is available on all the input lines. When used with change notification, filtering can also reduce the number of changes for you to examine and process.

You can configure any of the digital input channels from the optocouplers to pass through a digital filter. You can also control the timing interval that the filter uses. The filter blocks pulses shorter than half of the specified timing interval, treating them as glitches. The filter passes pulses 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.

The filter operates on the inputs from the optocouplers. The optocouplers turn on faster than they turn off, passing rising edges faster than falling edges. The optocouplers can therefore add up to 100 µs to a high pulse or subtract up to 100 µs from a low pulse (a 100 µs change is typical at I_f = 5 mA, RL = 100 Ω). As a result, the pulse widths guaranteed to be passed and blocked are those shown in Table 4-1.

Table 4-1. Digital Filter Characteristics

Filter Interval	Pulse Width Passed		Pulse Width Blocked	
	Low Pulse	High Pulse	Low Pulse	High Pulse
$t_{interval}$	$t_{interval}$ + 100 µs	$t_{interval}$ – 100 µs	($t_{interval}$ /2) + 100 µs	($t_{interval}$ /2) – 100 µs

You can enable filtering on as many input lines as you wish. All filtered lines share the same timing interval. The interval ranges from 1 ms to 100 ms.

Internally, the filter uses two clocks. The first, a sample clock, has a 100 ns period. The second, a filter clock, is generated by a counter and has a period equal to one half your specified timing interval. The input signal from the optocoupler is sampled on each rising edge of the sample clock—every 100 ns. However, a change in the input signal is recognized only if it maintains its new state for at least two consecutive rising edges of the filter clock.

The two clocks serve different functions. The filter clock, which is programmable, lets you control how long a pulse must last to be recognized. The sample clock provides a fast sample rate to ensure that input pulses remain constant between filter clocks.

Figure 4-2 shows a filter configuration with an 800 ns filter interval (400 ns filter clock). While 800 ns is not a valid filter interval, we use this number in this example to illustrate how the filter works.

In periods A and B, the filter blocks the glitches because the external signal does not remain steadily high from one filter clock to the next. In period C, the filter passes the transition because the external signal does remain 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. Figure 4-2 shows a rising (0-to-1) transition; the same filtering applies to falling (1-to-0) transitions.

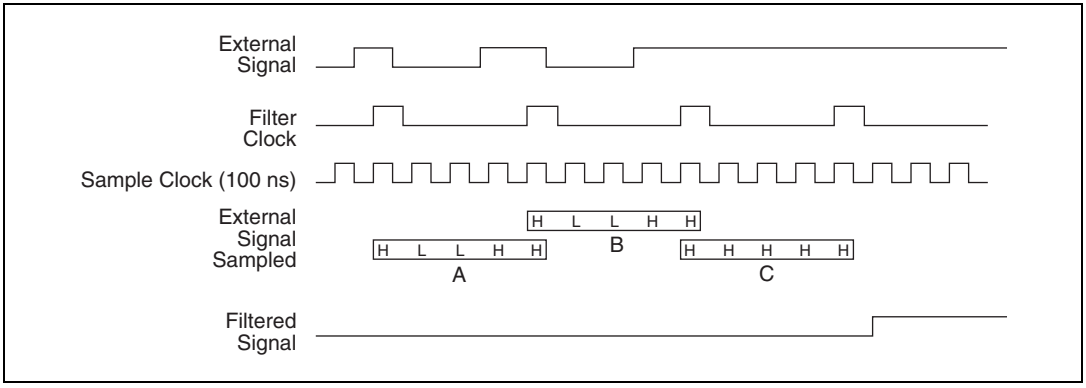


Figure 4-2. Digital Filter Timing

Change Notification

You can program the 6527 to notify you of changes on input lines. Change notification can reduce the number of reads your software must perform to monitor inputs. Instead of reading the inputs continuously, your software reacts only to transitions.

You can monitor changes on selected input lines or on all lines. You can monitor for rising edges (0-to-1), falling edges (1-to-0), or both. When an input change occurs matching your criteria, the 6527 generates an interrupt. The NI-DAQ driver can then notify your software using a DAQ event or a LabVIEW occurrence. See your software documentation for information about support for event notification in your software environment.

The 6527 notifies you when any one of the changes you are monitoring occurs; the 6527 does not report which line changed or whether the line rose or fell. After a change, you can read the input lines to determine the current line states.

Note The maximum rate of change notification is therefore limited by software response time and varies from system to system.

Table 4-2 shows a change notification example for six bits of one port. 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 6527 detects any change in the input data so you can read the new data value.

- Bit 1 is connected to a limit sensor; the 6527 detects rising edges on the sensor, which correspond to over-limit conditions.
- Bit 0 is connected to a switch. Your software can react to any switch closure, represented by a falling edge. If the switch closure is noisy, you should also enable digital filtering for at least this line.

In this example, the 6527 reports rising edges only on bit 1, falling edges only on bit 0, and rising and falling edges on bits 7, 6, 5, and 4. The 6527 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.

Table 4-2. Change Notification 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

If you anticipate noisy or rapidly changing input lines, use digital filtering with change notification to reduce the changes to a manageable number; excessive notifications can hurt system performance. For example, if you want to limit the rate of notifications and interrupts to a maximum of one change per line every 10 ms, set a filter interval of 10 ms. This causes glitches and all other transitions that occur for less than 10 ms to be ignored.

A

Specifications

This appendix lists the specifications for the 6527 devices. These specifications are typical at 25 °C unless otherwise noted.

Digital I/O

PCI/PXI-6527 ..... 24 optically-isolated digital input channels and 24 solid-state relay output channels

Isolated Inputs

Number of input channels ..... 24, each with its own ground reference isolated from other channels

Max input voltage ..... 28 VDC

Digital logic levels

Level	Min	Max
Input low voltage	0 VDC	1 VDC
Input high voltage	2 VDC	28 VDC

Input current

5 V inputs ..... 1.5 mA/channel max

24 V inputs ..... 8 mA/channel max

Isolation ..... 60 VDC channel-to-channel and from computer ground and V_{CC}

Relay Outputs

Number of channels ..... 24, each with two terminals that are isolated from other channels

Relay type ..... Normally open form A solid-state relays

Max switching voltage

AC.....30 V_{RMS} (42 V peak)

DC.....60 VDC

Max switching capacity .....120 mA[1]

Common-mode isolation .....60 VDC
30 V_{RMS} (42 V peak)
(channel-to-channel and
channel-to-computer)

On resistance.....35 Ω max; 25 Ω typ

Output capacitance .....55 pF at 1 V

Off leakage current (max).....200 nA

Relay set time (max).....3.0 ms

Relay reset time (max).....3.0 ms

Power-on state .....Relays open

Overcurrent protection on outputs, typical at 25 °C, V_{relay} = 7 V

Current limit .....260 mA
Shutdown time.....1 µs
Overcurrent duration (max).....1 s

Power Requirement

+5 VDC (±5%) .....500 mA max

Power available at I/O connector.....+4.5 to +5.25 VDC, fused at 1 A

[1] With all relays carrying 120 mA and all inputs driven to 28 V, the total power dissipation can approach 20 W. The maximum switching capacity in PCI and CompactPCI systems must be derated according to the ambient temperature and cooling capacity of your system to prevent the device from overheating. (The PXI chassis has built-in fans to handle 25 W per slot.)

Physical

Dimensions (not including connectors)

PCI-6527 ..... 17.5 × 10.7 cm (6.9 × 4.2 in.)

PXI-6527 ..... 16 × 10 cm (6.3 × 3.9 in.)

I/O connector ..... 100-pin keyed female cable connector

Environment

Operating temperature ..... 0 to 50 °C

Storage temperature ..... –20 to 70 °C

Relative humidity ..... 10% to 90% noncondensing

Functional shock (PXI-6527) ..... MIL-T-28800 E Class 3 (per Section 4.5.5.4.1); half-sine shock pulse, 11 ms duration, 30 g peak, 30 shocks per face

Operational random vibration (PXI-6527) ..... 5 to 500 Hz, 0.31 g_{rms}, 3 axes

Nonoperational random vibration (PXI-6527) ..... 5 to 500 Hz, 2.5 g_{rms}, 3 axes

Note Non-operational random vibration profiles were developed in accordance with MIL-T-28800E and MIL-STD-810E Method 514. Test levels exceed those recommended in MIL-STD-810E for Category 1 (Basic Transportation, Figures 514.4-1 through 514.4-3).

Safety

Designed in accordance with IEC/EN 61010-1, UL 3111-1, and CAN/CSA C22.2 No. 1010.1 for electrical measuring and test equipment.

Maximum altitude ..... 2000 m

Pollution degree 2

Overvoltage category ..... CAT I

Indoor use only

B

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of `ni.com`

NI Developer Zone

The NI Developer Zone at `ni.com/zone` is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

Customer Education

National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of `ni.com` for online course schedules, syllabi, training centers, and class registration.

System Integration

If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of `ni.com`

Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of `ni.com`. Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

Glossary

Prefix	Meanings	Value
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}

Numbers/Symbols

°	degrees
–	negative of, or minus
Ω	ohms
/	per
%	percent
±	plus or minus
+	positive of, or plus
+5 V	+5 Volts signal

A

A	amperes
AC	alternating current
ANSI	American National Standards Institute
ASIC	Application-Specific Integrated Circuit—a proprietary semiconductor component designed and manufactured to perform a set of specific functions

C

C	Celsius
CAT I	installation category (overvoltage category) I—equipment for which measures are taken to limit transient overvoltages to an appropriate low level. Examples include signal-level, telecommunications, and electronic equipment with transient overvoltages smaller than local-level mains supplies.
cm	centimeters
CompactPCI	refers to the core specification defined by the PCI Industrial Computer Manufacturer's Group (PICMG)

D

DAQ	data acquisition—a system that uses the personal computer to collect, measure, and generate electrical signals
DC	direct current
DIG+	positive data terminal
DIG–	negative data terminal

G

GND	ground reference

H

Hz	hertz

I

I/O	input/output
in.	inches
isolation	signal conditioning to break ground loops and reject high common-mode voltages to protect equipment and users and to ensure accurate measurements

L

LED	light-emitting diode

M

m	meters
max	maximum
MOSFET	metal-oxide semiconductor field-effect transistor

O

optical isolation	the technique of using an optocoupler to transfer data without electrical continuity, to eliminate high-potential differences and transients
optocoupler	a device that transfers electrical signals by utilizing light waves to provide coupling with electrical isolation between input and output

P

PCI	Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA.
port	a digital port, consisting of four or eight lines of digital input and/or output
PXI	PCI eXtensions for Instrumentation—an open specification that builds on the CompactPCI specification by adding instrumentation-specific features

S

s	seconds

T

TTL	transistor-transistor logic, or 5 V digital voltage levels originally used with transistor-transistor logic

V

V	volts
V_{cc}	supply voltage; for example, the voltage a computer supplies to its plug-in devices
VDC	volts direct current
VI	virtual instrument—a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic standalone instrument
V_{IN}	input voltage

W

W	watts

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