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DAQ

NI 651*x* User Manual

NI PCI-6510, PCI-6511, PXI-6511, PCI-6512, PXI-6512, PCI-6513, PXI-6513, PCI-6514, PXI-6514, PCI-6515, PXI-6515, PCI-6516, PCI-6517, PCI-6518, and PCI-6519 Devices

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About This Manual

This manual describes how to use the National Instruments 6510, 6511, 6512, 6513, 6514, 6515, 6516, 6517, 6518, and 6519 data acquisition (DAQ) devices with NI-DAQ 7.3 or later. If you have not already installed the DAQ device, refer to the *DAQ Getting Started Guide* for installation instructions.

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, AO <3..0>.

» — The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.

 — 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. When this symbol is marked on a product, refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for information about precautions to take.

 — When symbol is marked on a product, it denotes a warning advising you to take precautions to avoid electrical shock.

 — When symbol is marked on a product, it denotes a component that may be hot. Touching this component may result in bodily injury.

bold — Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

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

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`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.
Platform	Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.

Related Documentation

The following documents contain information that you may find helpful as you use this help file:

- *NI 651x Specifications*—This document contains specifications for the NI 6510, NI 6511, NI 6512, NI 6513, NI 6514, NI 6515, NI 6516, NI 6517, NI 6518, and NI 6519 devices. It is available for download at `ni.com/manuals`.
- *DAQ Getting Started Guide*—This guide describes how to install the NI-DAQ 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 National Instruments devices. NI-DAQmx is the software you use to communicate with and control NI DAQ devices.
- *Measurement & Automation Explorer Help for NI-DAQmx*—This help file contains information about configuring and testing DAQ devices using Measurement & Automation Explorer (MAX) for NI-DAQmx, and information about special considerations for operating systems.
- *Measurement & Automation Explorer Help for Traditional NI-DAQ (Legacy)*—This help file contains information about configuring and testing DAQ devices using Measurement & Automation Explorer (MAX) for Traditional NI-DAQ (Legacy), 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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1

NI 651*x* Fundamentals

The NI 6510 is a 30 V bank isolated data acquisition (DAQ) device for PCI chassis. The NI 6510 device features 32 digital input lines with digital filtering.

The NI 6511 is a 30 V bank isolated data acquisition (DAQ) device for PCI, PXI, or CompactPCI chassis. The NI 6511 device features 64 digital input lines with digital filtering.

The NI 6512/6513 devices are 30 V bank isolated data acquisition (DAQ) devices for PCI, PXI, or CompactPCI chassis. The NI 6512/6513 devices feature 64 unidirectional digital output lines for sourcing (6512) and sinking (6513) current, a watchdog timer, and programmable power-up states.

The NI 6514/6515 devices are 30 V bank isolated data acquisition (DAQ) devices for PCI, PXI, or CompactPCI chassis. The NI 6514/6515 devices feature 32 digital input lines and 32 digital output lines for sourcing (6514) and sinking (6515) current, a watchdog timer, digital filtering, and programmable power-up states.

The NI 6516/6517 devices are 30 V bank isolated data acquisition (DAQ) devices for PCI chassis. The NI 6516/6517 devices feature 32 unidirectional digital output lines for sourcing (6516) and sinking (6517) current, a watchdog timer, and programmable power-up states.

The NI 6518/6519 devices are 30 V bank isolated data acquisition (DAQ) devices for PCI chassis. The NI 6518/6519 devices feature 16 digital input lines and 16 digital output lines for sourcing (6518) and sinking (6519) current, a watchdog timer, digital filtering, and programmable power-up states.

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NI 651*x* Configuration

The NI 651*x* devices are completely software configurable, so it is not necessary to set jumpers for I/O configuration.

The PCI-651*x* devices are fully compliant with the *PCI Local Bus Specification, Revision 2.2*, and the PXI-6511/6512/6513/6514/6515 devices are fully compliant with the *PXI Hardware Specification, Revision 2.1*. The PCI/PXI system automatically allocates all device resources, including the base address and interrupt level. The NI 651*x* base address is mapped into PCI memory space. It is not necessary to perform configuration steps after the system powers up.

Refer to the application software documentation for configuration instructions.

After the NI 651*x* device and the software are installed, the DAQ device appears under the **Devices and Interfaces** branch of the MAX configuration tree.

If the DAQ device does not appear in MAX, use the following troubleshooting guidelines.

- Verify that you are using the correct version of NI-DAQ (NI-DAQ 7.3 or later). To download the most recent National Instruments drivers, go to `ni.com/drivers`.
- Press <F5> to refresh the MAX window, or close and re-open MAX.
- Reboot the computer.
- Power off and unplug the computer or chassis, and install the device in a different slot. Refer to the *DAQ Getting Started Guide* for installation instructions and safety guidelines.

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NI 651*x* Functional Overview

The following block diagrams illustrate the key functional components of the NI 651*x* devices.

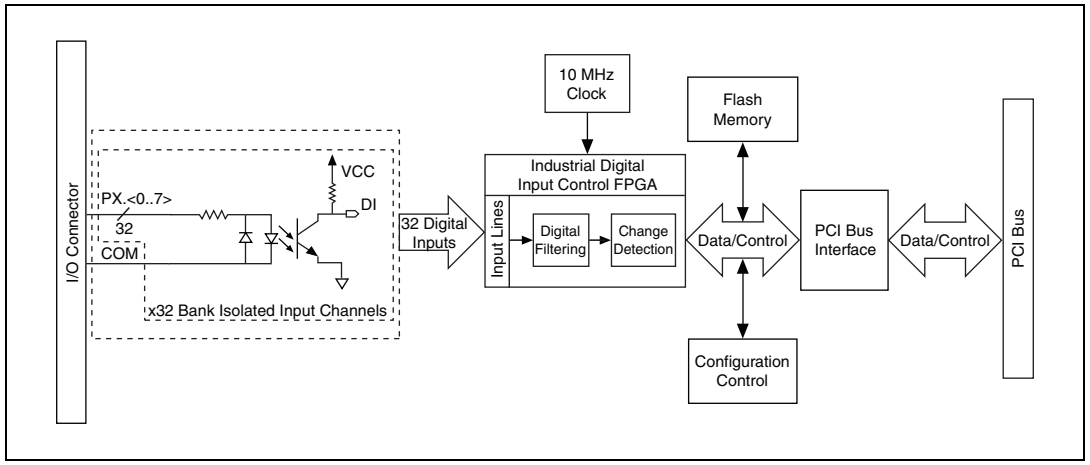


Figure 1-1. NI 6510 Block Diagram

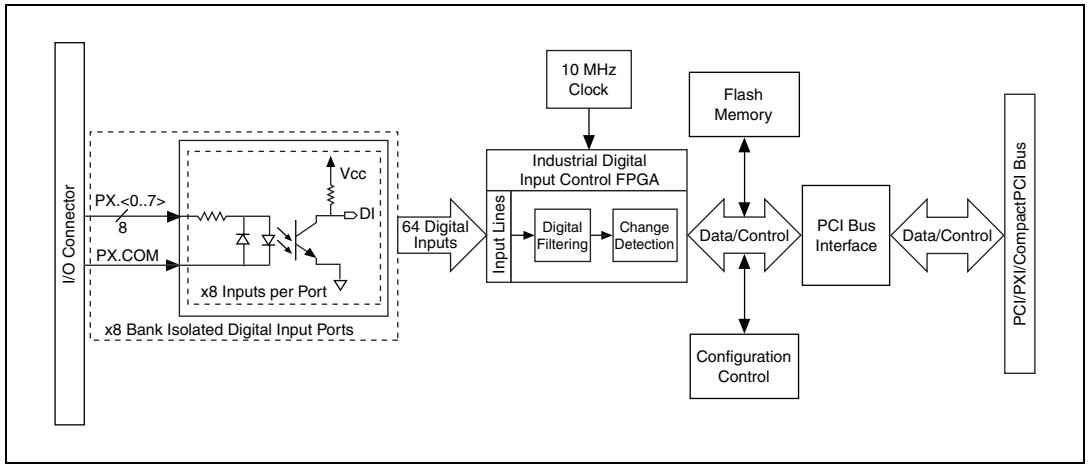


Figure 1-2. NI 6511 Block Diagram

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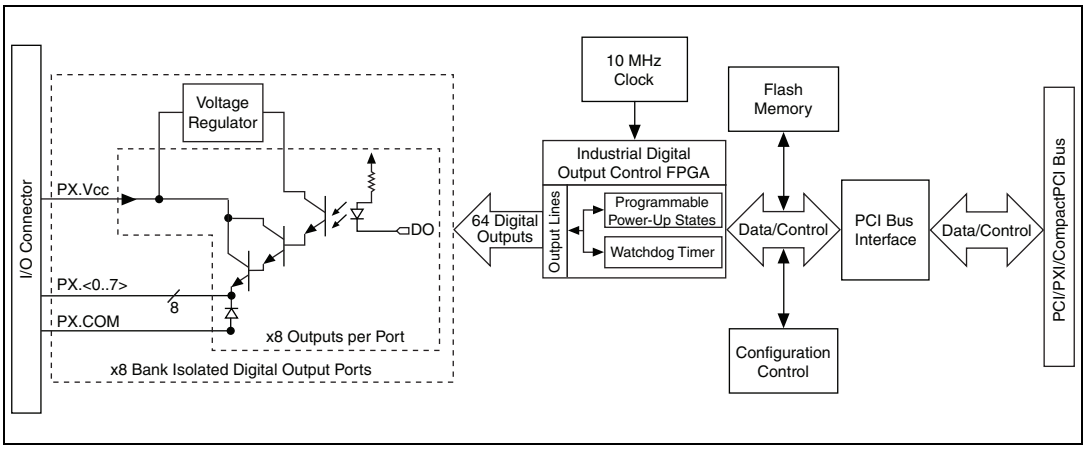


Figure 1-3. NI 6512 Block Diagram

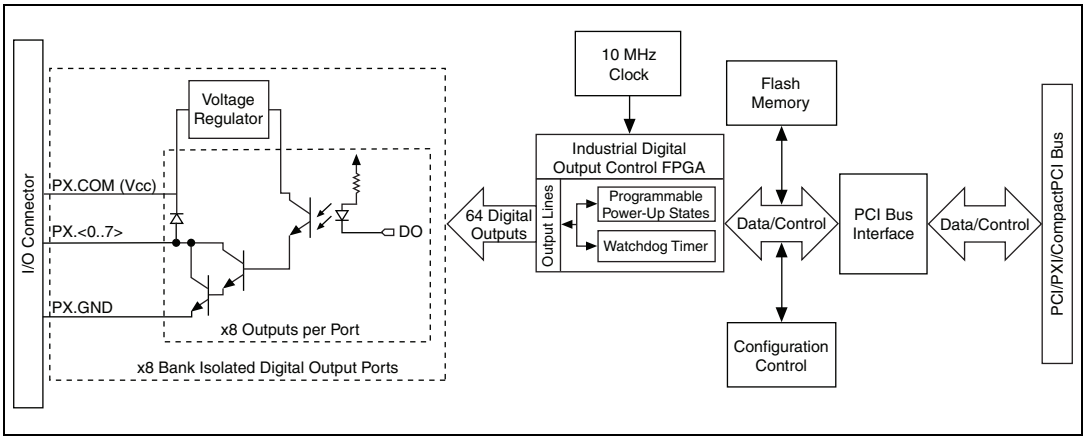


Figure 1-4. NI 6513 Block Diagram

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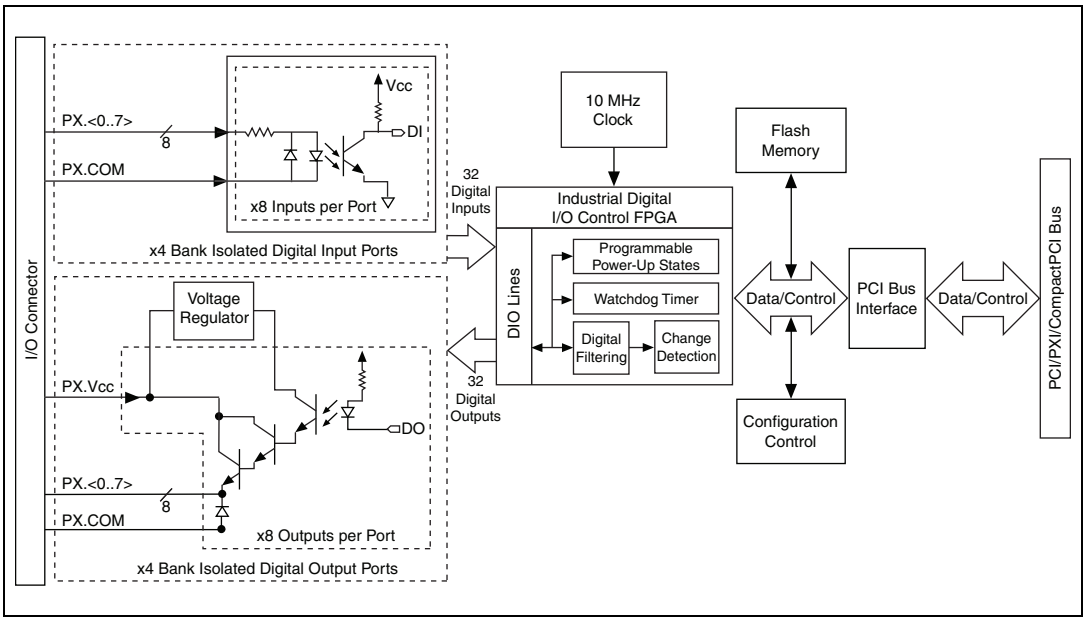


Figure 1-5. NI 6514 Block Diagram

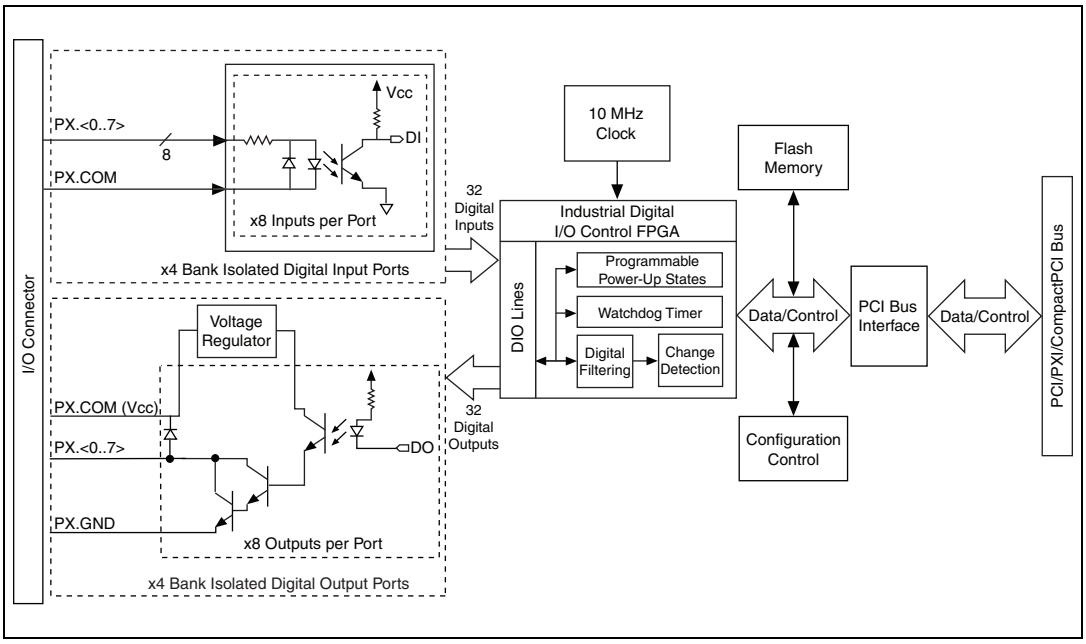


Figure 1-6. NI 6515 Block Diagram

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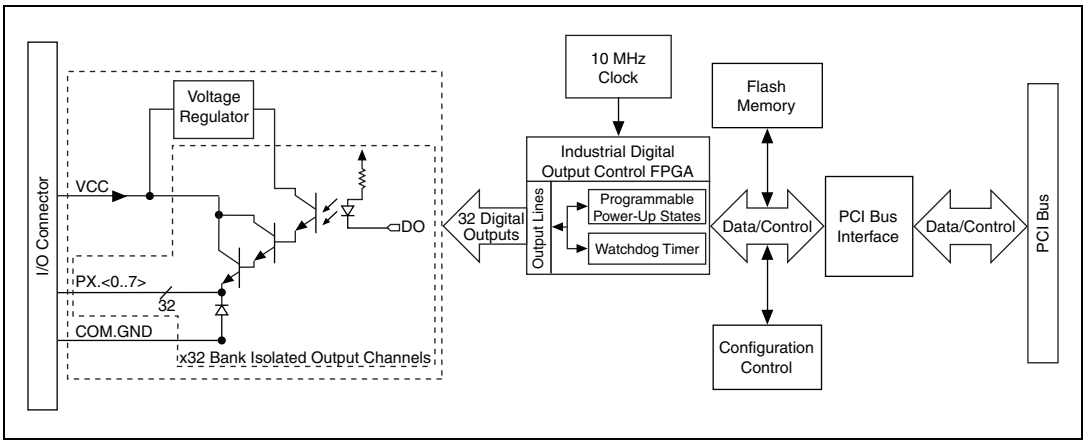


Figure 1-7. NI 6516 Block Diagram

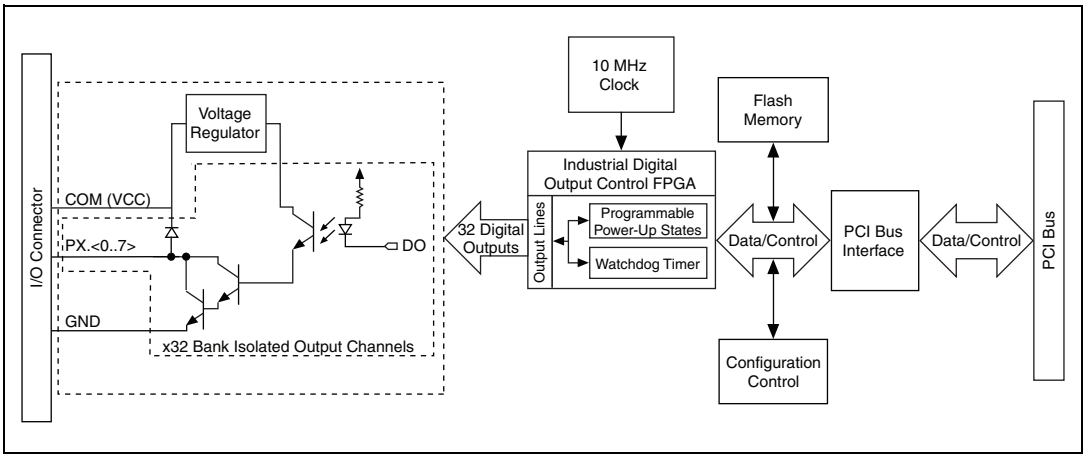


Figure 1-8. NI 6517 Block Diagram

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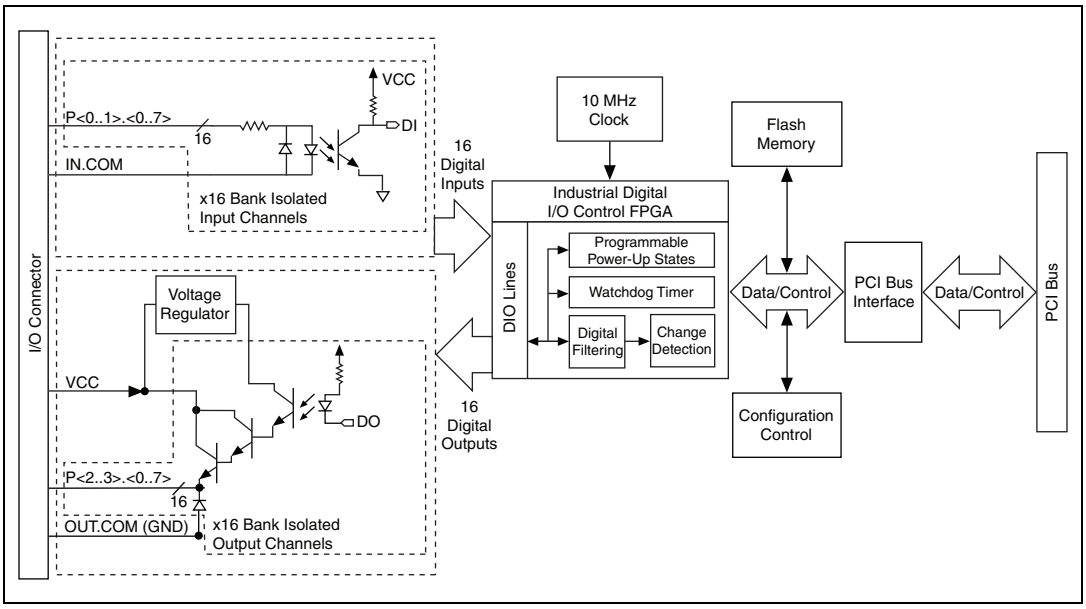


Figure 1-9. NI 6518 Block Diagram

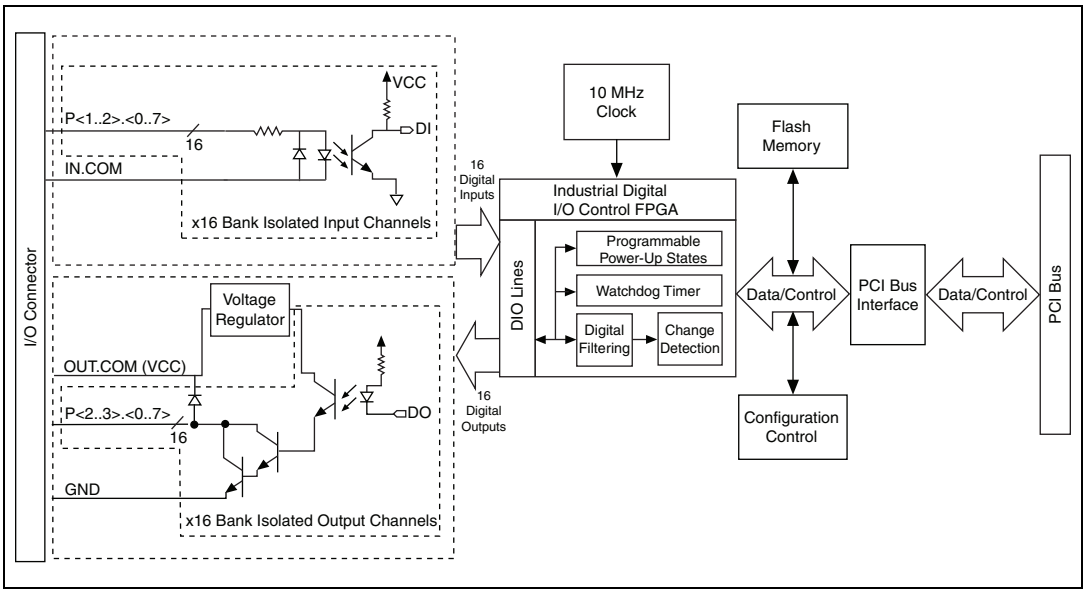


Figure 1-10. NI 6519 Block Diagram

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2

NI 651*x* Features

This chapter describes the National Instruments digital I/O features available for NI 651*x* devices. For more information on the NI industrial DIO feature set, refer to the *Complete Industrial Digital I/O and Counter/Timer Tutorial*. To access this tutorial, visit `ni.com/info` and enter the code `rdcidi`.

Digital Filtering

Use the digital filter option available on the NI 651*x* input lines to eliminate glitches on input data. When used with change detection, filtering can also reduce the number of changes to examine and process.

You can configure the digital input channels to pass through a digital filter after the photocouplers, and you can 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.

The filter operates on the inputs from the photocouplers. Photocouplers turn on faster than they turn off and pass rising edges faster than falling edges.

Table 2-1 lists the pulse widths guaranteed to be passed and blocked.

Table 2-1. NI 651*x* Digital Filter Timing Intervals

Filter Interval	Pulse Width Passed		Pulse Width Blocked	
	Low Pulse	High Pulse	Low Pulse	High Pulse
$t_{interval}$	$t_{interval}$ + 200 µs	$t_{interval}$	$t_{interval}/2$	$(t_{interval}/2)$ – 200 µs

You can enable filtering on as many input lines as is necessary for your application. All filtered lines share the same timing interval, which ranges from 200 µs to 200 ms.

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Internally, the filter uses two clocks: the sample clock and the filter clock. The sample clock has a 100 ns period. The filter clock is generated by a counter and has a period equal to one half of the specified timing interval. The input signal is sampled on each rising edge of the sample clock, which is 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 filter clock is programmable and allows you to 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.

Digital Filtering Example

Figure 2-1 shows a filter configuration with a $t_{interval}$ filter interval ($t_{interval}/2$ filter clock).

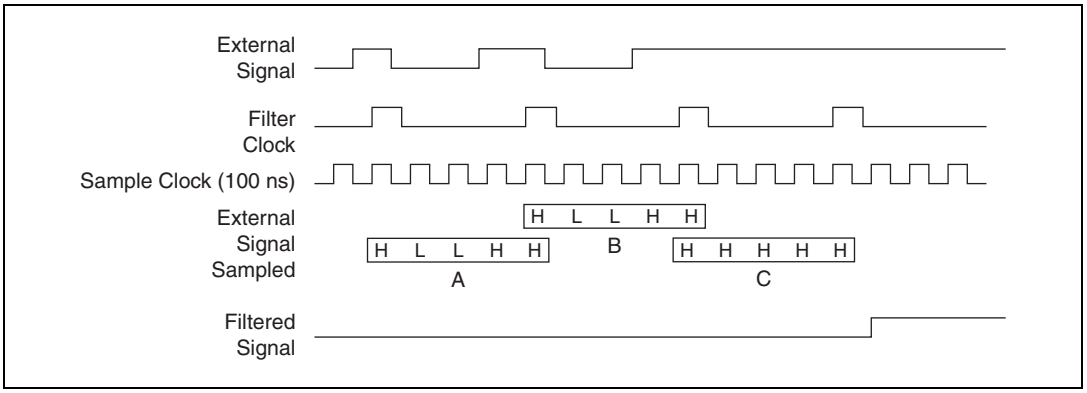


Figure 2-1. Digital Filtering Example

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. Figure 2-1 shows a rising (0 to 1) transition. The same filtering applies to falling (1 to 0) transitions.

Note NI 6512/6513/6516/6517 devices do not support digital filtering.

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Programmable Power-Up States

At power-up, the output drives on the NI 651*x* device is disabled. All output lines are user-configurable for an on or off state. User-configurable power-up states are useful for ensuring that the NI 651*x* device powers up in a known state.

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-DAQ with LabVIEW or other National Instruments application development environments (ADEs).

Note The response time of programmable power-up states is 400 ms.

Note NI 6510/6511 devices do not support programmable power-up states.

Change Detection

You can program NI 651*x* devices to send an interrupt when a change occurs on any input line.

The DIO device 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 DIO device generates an interrupt, and the NI-DAQ driver then notifies the software.

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

The DIO device sends a change detection when any one of the changes occurs, but it 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 maximum rate of change detection is determined by the software response time, which varies from system to system.

An overflow bit indicates that an additional rising or falling edge has been detected before the software could process the previous change.

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

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Change Detection Example

Table 2-2 shows a change detection example for six bits of one port.

Table 2-2. 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 DIO device detects any change in the input data so you can read the new data value.
- Bit 1 is connected to a limit sensor. The DIO device detects rising edges on the sensor, which correspond to over-limit conditions.
- Bit 0 is connected to a switch. The software can react 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 DIO device 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 DIO device 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. You cannot read the state of any lines that are configured for change detection until the change detection interrupt occurs.

Note NI 6512/6513/6516/6517 devices do not support change detection.

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Watchdog Timer

The watchdog timer is a software configurable feature used to set critical outputs to safe states in the event of a software failure, a system crash, or any other loss of communication between the application and the NI 651*x* device.

When the watchdog timer is enabled, if the NI 651*x* device does not receive a **watchdog reset** software command within the time specified for the watchdog timer, the outputs go to a user-defined safe state and remain in that state until the watchdog timer is disarmed by the application and new values are written, the NI 651*x* device is reset, or the computer is restarted. The expiration signal that indicates an expired watchdog will continue to assert until the watchdog is disarmed. After the watchdog timer expires, the NI 651*x* device ignores any writes until the watchdog timer is disarmed.

You can set the watchdog timer timeout period to specify the amount of time that must elapse before the watchdog timer expires. The counter on the watchdog timer is configurable up to $(2^{32} - 1) \times 100$ ns (approximately seven minutes) before it expires.

Note NI 6510/6511 devices do not support the watchdog timer.

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3

Digital I/O

I/O Connector

NI 6510 I/O Connector

The 37-pin D-SUB connector on the NI 6510 provides access to the digital inputs. The digital I/O available on this connector includes 32 inputs. For easy connection to the digital I/O connector, use the National Instruments SH37F-37M shielded digital I/O cable with the CB-37F connector block. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6510 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

The input lines on the NI 6510 consist of input photocouplers, which react to a voltage differential rather than only to a voltage increase. If the voltage connected to a digital input is either greater than or less than the voltage connected to COM by at least the logic threshold, the reading on the digital line will be logic high, even though in one instance the digital line has a lower voltage level than COM.

For more information, refer to the *Pin Assignments* section.

NI 6511 I/O Connector

The 100-pin high-density SCSI connector on the NI 6511 provides access to the digital inputs. The digital I/O available on this connector includes 64 inputs. For easy connection to the digital I/O connector, use the National Instruments 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. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

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Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6511 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

The input lines on the NI 6511 consist of input photocouplers, which react to a voltage differential rather than only to a voltage increase. If the voltage connected to a digital input is either greater than or less than the voltage connected to P*X*.COM by at least the logic threshold, the reading on the digital line will be logic high, even though in one instance the digital line has a lower voltage level than P*X*.COM.

For more information, refer to the *Pin Assignments* section.

NI 6512/6513 I/O Connector

The 100-pin high-density SCSI connector on the NI 6512/6513 provides access to the digital inputs and outputs. The digital I/O available on this connector includes 64 outputs. For easy connection to the digital I/O connector, use the National Instruments 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. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6512/6513 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

The output lines on the NI 6512 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to VCC, connect COM to ground, and cross a load between digital output and COM.

The output lines on the NI 6513 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to COM, connect GND to ground, and cross a load between digital output and COM.

For more information, refer to the *Pin Assignments* section.

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NI 6514/6515 I/O Connector

The 100-pin high-density SCSI connector on the NI 6514/6515 provides access to the digital inputs and outputs. The digital I/O available on this connector includes 32 inputs and 32 outputs. For easy connection to the digital I/O connector, use the National Instruments 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. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6514/6515 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

The input lines on the NI 6514/6515 consist of input photocouplers, which react to a voltage differential rather than only to a voltage increase. If the voltage connected to a digital input is either greater than or less than the voltage connected to P*X*.COM by at least the logic threshold, the reading on the digital line will be logic high, even though in one instance the digital line has a lower voltage level than P*X*.COM.

The output lines on the NI 6515 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to COM, connect GND to ground, and cross a load between digital output and COM.

For more information, refer to the *Pin Assignments* section.

NI 6516/6517 I/O Connector

The 37-pin D-SUB connector on the NI 6516/6517 provides access to the digital inputs and outputs. The digital I/O available on this connector includes 32 outputs. For easy connection to the digital I/O connector, use the National Instruments SH37F-37M shielded digital I/O cable with the CB-37F connector block. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6516/6517 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

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The output lines on the NI 6516 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to VCC, connect COM (GND) to ground, and cross a load between digital output and COM (GND).

The output lines on the NI 6517 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to COM (VCC), connect GND to ground, and cross a load between digital output and COM (VCC).

For more information, refer to the *Pin Assignments* section.

NI 6518/6519 I/O Connector

The 37-pin D-SUB connector on the NI 6518/6519 provides access to the digital inputs and outputs. The digital I/O available on this connector includes 32 inputs and 32 outputs. For easy connection to the digital I/O connector, use the National Instruments SH37F-37M shielded digital I/O cable with the CB-37F connector block. For more information on digital I/O connectivity options, refer to Chapter 5, *Cables and Accessories*.

Caution Do not make connections to the digital I/O that exceed the maximum I/O specifications. Doing so could permanently damage the NI 6518/6519 and the computer. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about maximum input ratings.

The input lines on the NI 6518/6519 consist of input photocouplers, which react to a voltage differential rather than only to a voltage increase. If the voltage connected to a digital input is either greater than or less than the voltage connected to IN.COM by at least the logic threshold, the reading on the digital line will be logic high, even though in one instance the digital line has a lower voltage level than IN.COM.

The output lines on the NI 6518/6519 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to IN.COM, connect COM (GND) to ground, and cross a load between digital output and IN.COM.

For more information, refer to the *Pin Assignments* section.

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Pin Assignments

NI 6510 Pin Assignments

Figure 3-1 shows the pin assignments for the SH37F-37M cable when connecting to the NI 6510 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.

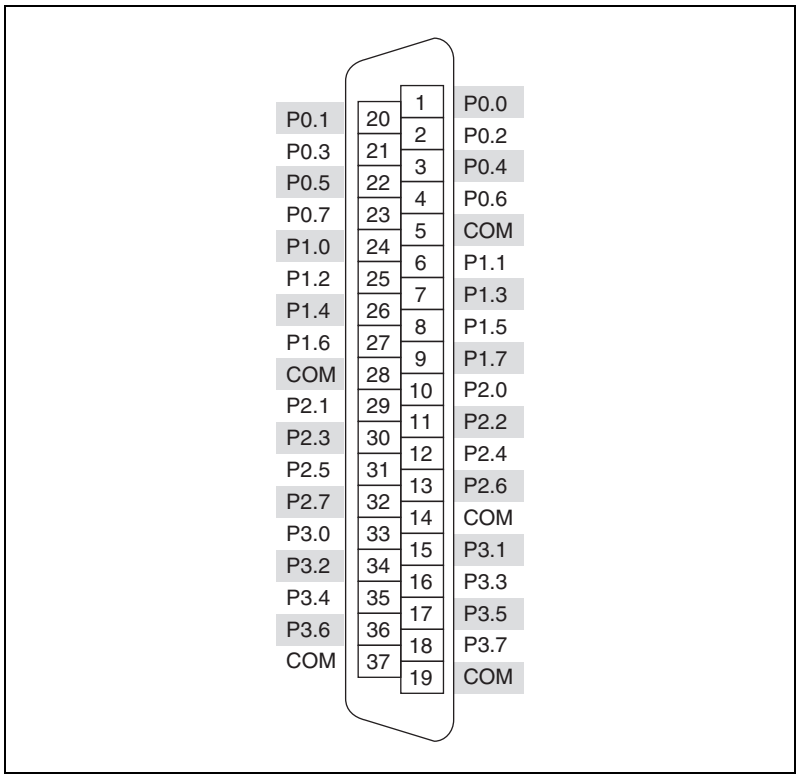


Figure 3-1. NI 6510 Pin Assignments

For more information on the NI 6510 signals, refer to the *Signal Descriptions* section.

NI 6511 SH100-100-F Pin Assignments

Figure 3-2 shows the pin assignments for the SH100-100-F cable when connecting to the NI 6511 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.

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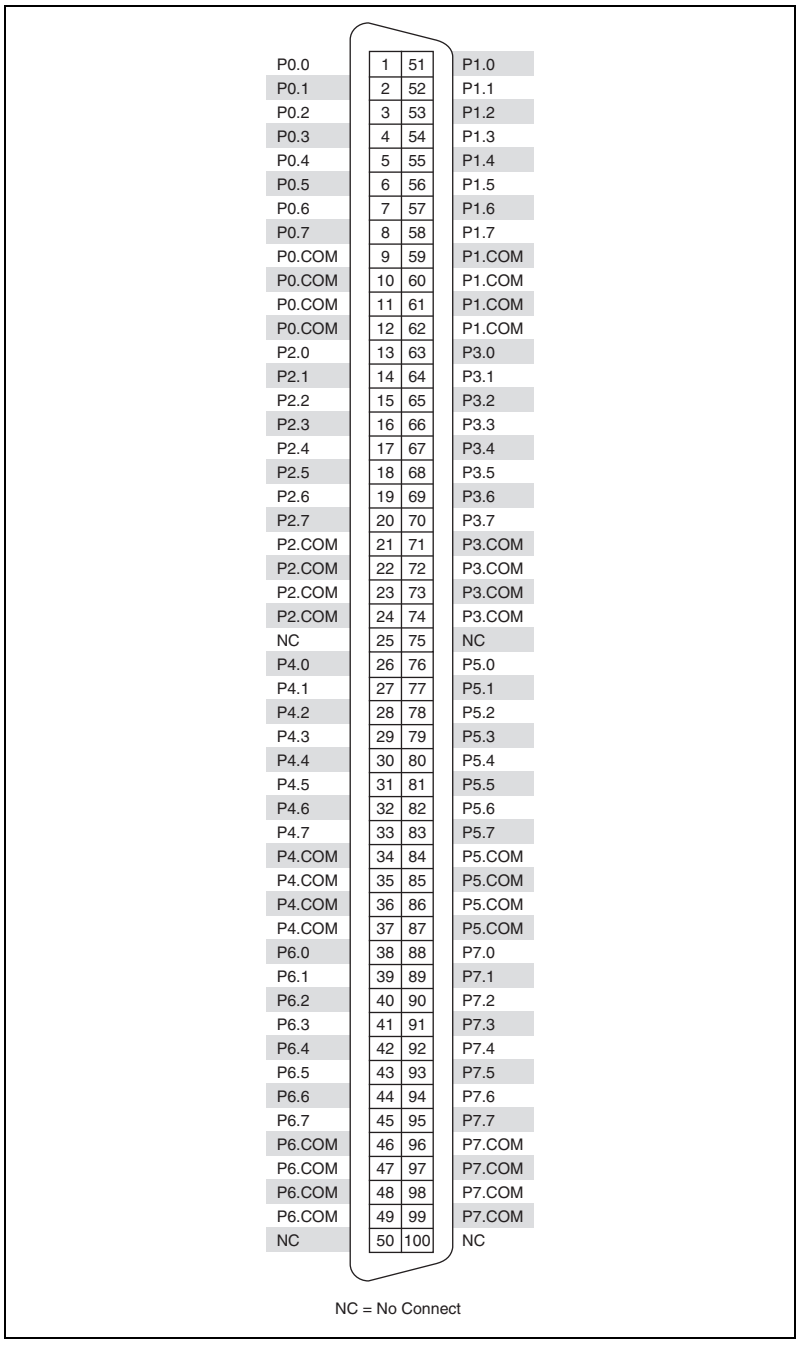


Figure 3-2. NI 6511 Pin Assignments for the SH100-100-F Cable

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For more information on the NI 6511 signals, refer to the *Signal Descriptions* section.

NI 6511 R1005050 Pin Assignments

Figure 3-3 shows the pin assignments for the R1005050 cable when connecting to the NI 6511 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.

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

NC = No Connect

Figure 3-3. NI 6511 Pin Assignments for the R1005050 Cable

For more information on the NI 6511 signals, refer to the *Signal Descriptions* section.

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NI 6512 SH100-100-F Pin Assignments

Figure 3-4 shows the pin assignments for the SH100-100-F cable when connecting to the NI 6512 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.

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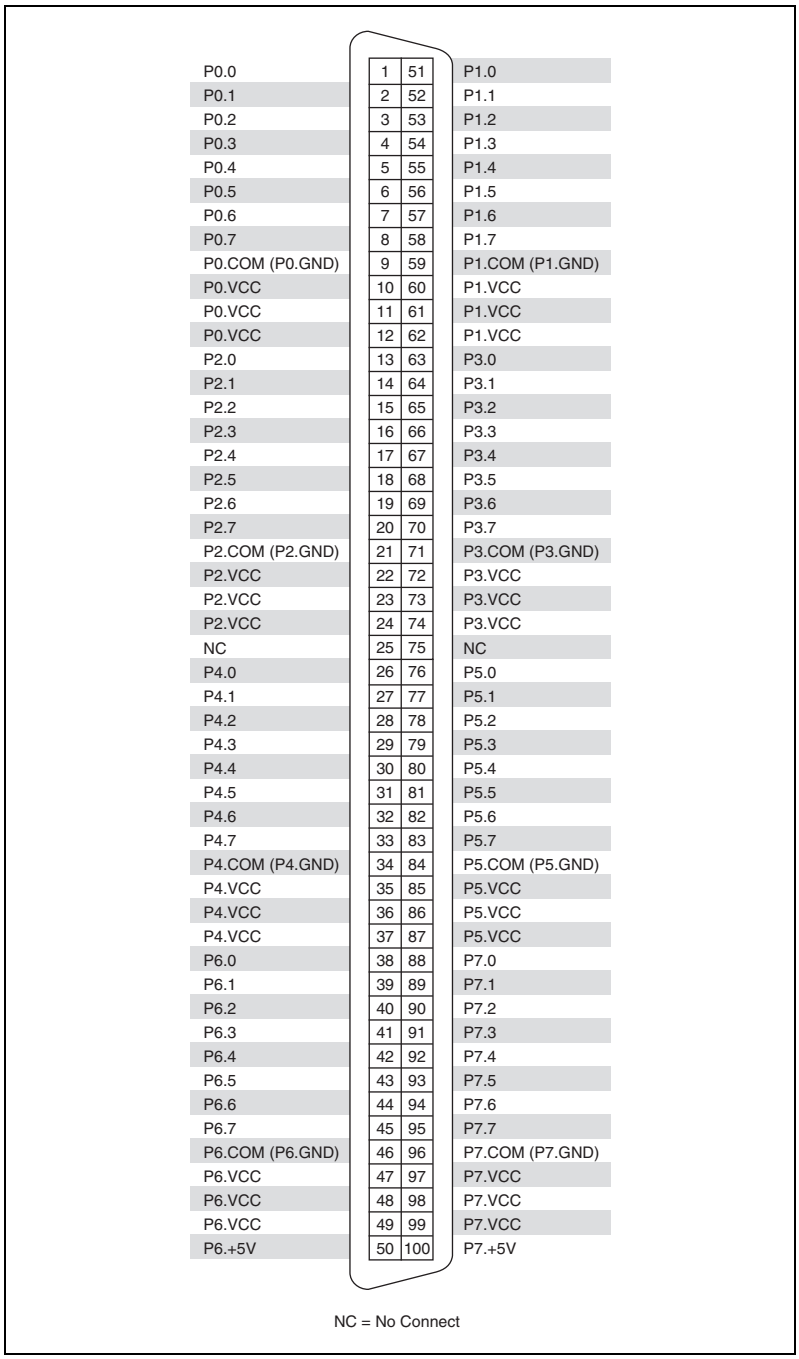


Figure 3-4. NI 6512 Pin Assignments for the SH100-100-F Cable

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For more information on the NI 6512 signals, refer to the *Signal Descriptions* section.

NI 6512 R1005050 Pin Assignments

Figure 3-5 shows the pin assignments for the R1005050 cable when connecting to the NI 6512 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.

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

NC = No Connect

Figure 3-5. NI 6512 Pin Assignments for the R1005050 Cable

For more information on the NI 6512 signals, refer to the *Signal Descriptions* section.

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NI 6513 SH100-100-F Pin Assignments

Figure 3-6 shows the pin assignments for the SH100-100-F cable when connecting to the NI 6513 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.

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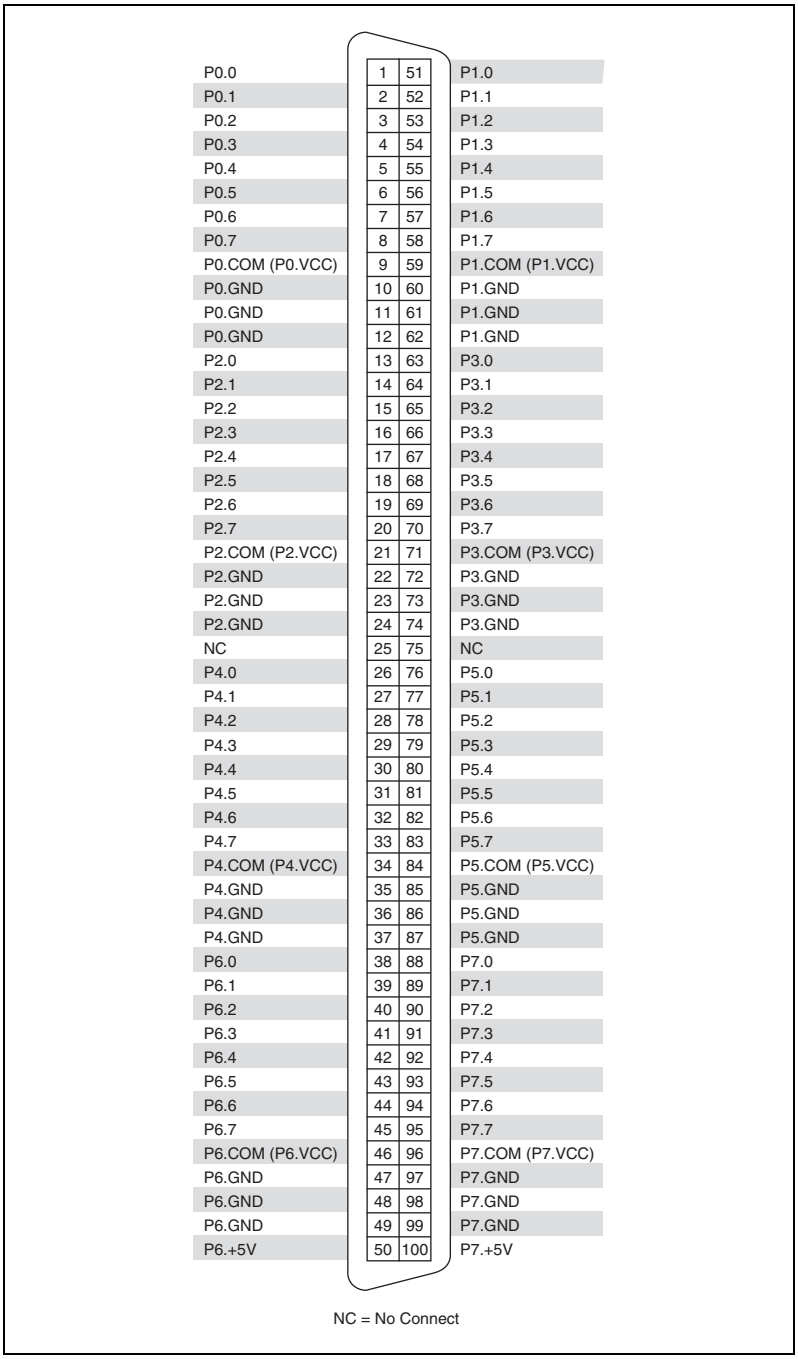


Figure 3-6. NI 6513 Pin Assignments for the SH100-100-F Cable

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For more information on the NI 6513 signals, refer to the *Signal Descriptions* section.

NI 6513 R1005050 Pin Assignments

Figure 3-7 shows the pin assignments for the R1005050 cable when connecting to the NI 6513 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.

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

NC = No Connect

Figure 3-7. NI 6513 Pin Assignments for the R1005050 Cable

For more information on the NI 6513 signals, refer to the *Signal Descriptions* section.

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NI 6514 SH100-100-F Pin Assignments

Figure 3-8 shows the pin assignments for the SH100-100-F cable when connecting to the NI 6514 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.

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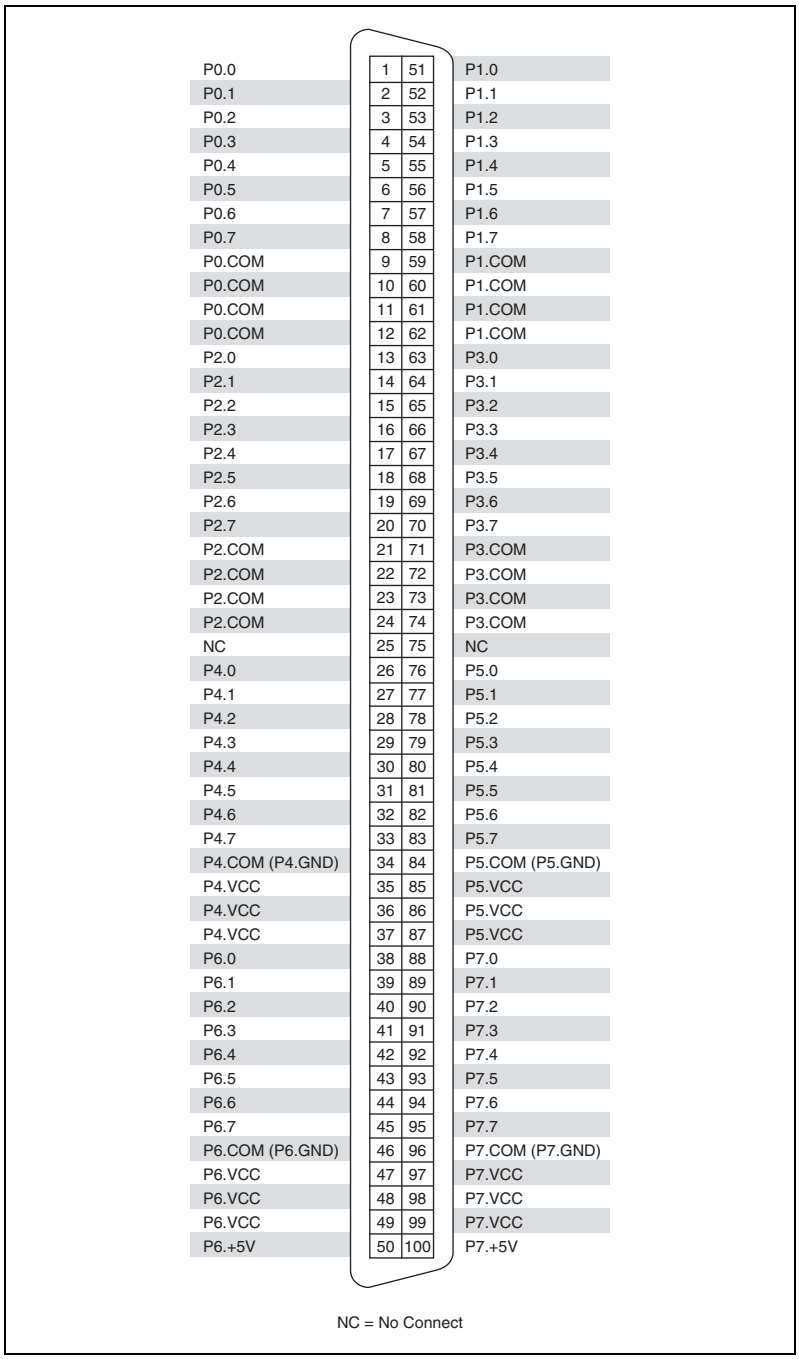


Figure 3-8. NI 6514 Pin Assignments for the SH100-100-F Cable

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For more information on the NI 6514 signals, refer to the *Signal Descriptions* section.

NI 6514 R1005050 Pin Assignments

Figure 3-9 shows the pin assignments for the R1005050 cable when connecting to the NI 6514 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.

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

NC = No Connect

Figure 3-9. NI 6514 Pin Assignments for the R1005050 Cable

For more information on the NI 6514 signals, refer to the *Signal Descriptions* section.

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NI 6515 SH100-100-F Pin Assignments

Figure 3-10 shows the pin assignments for the SH100-100-F cable when connecting to the NI 6515 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.

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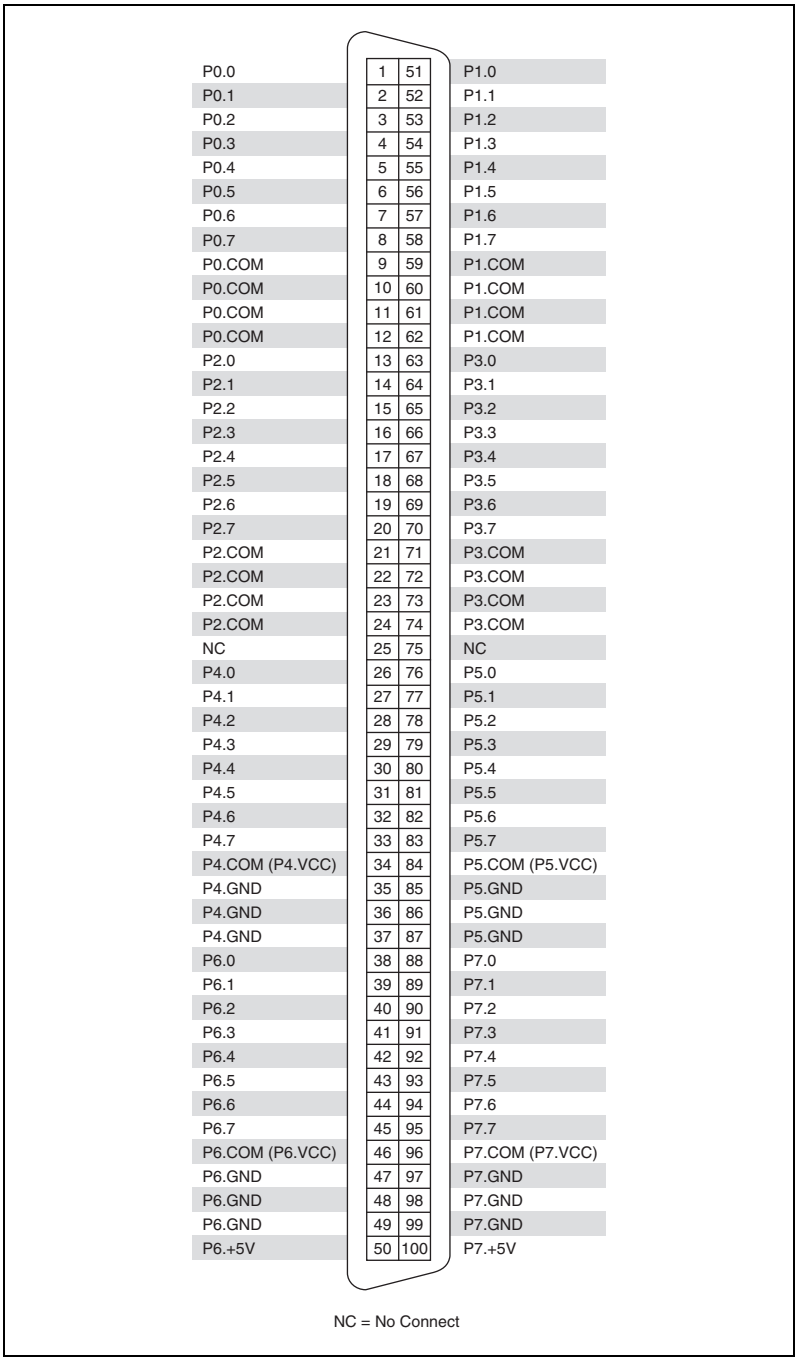


Figure 3-10. NI 6515 Pin Assignments for the SH100-100-F Cable

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For more information on the NI 6515 signals, refer to the *Signal Descriptions* section.

NI 6515 R1005050 Pin Assignments

Figure 3-11 shows the pin assignments for the R1005050 cable when connecting to the NI 6515 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.

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

NC = No Connect

Figure 3-11. NI 6515 Pin Assignments for the R1005050 Cable

For more information on the NI 6515 signals, refer to the *Signal Descriptions* section.

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NI 6516 Pin Assignments

Figure 3-12 shows the pin assignments for the SH37F-37M cable when connecting to the NI 6516 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.

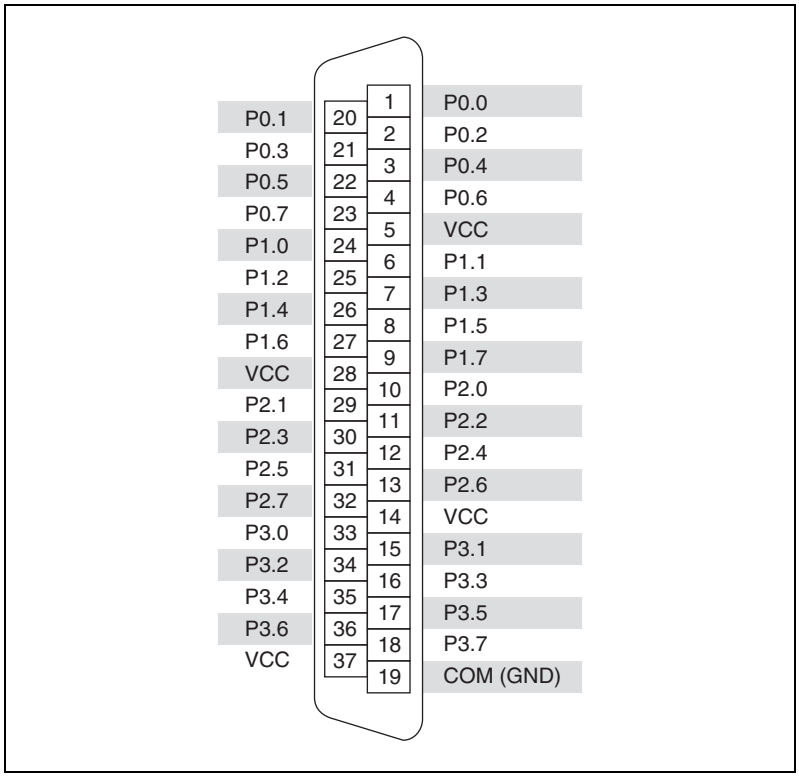


Figure 3-12. NI 6516 Pin Assignments

For more information on the NI 6516 signals, refer to the *Signal Descriptions* section.

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NI 6517 Pin Assignments

Figure 3-13 shows the pin assignments for the SH37F-37M cable when connecting to the NI 6517 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.

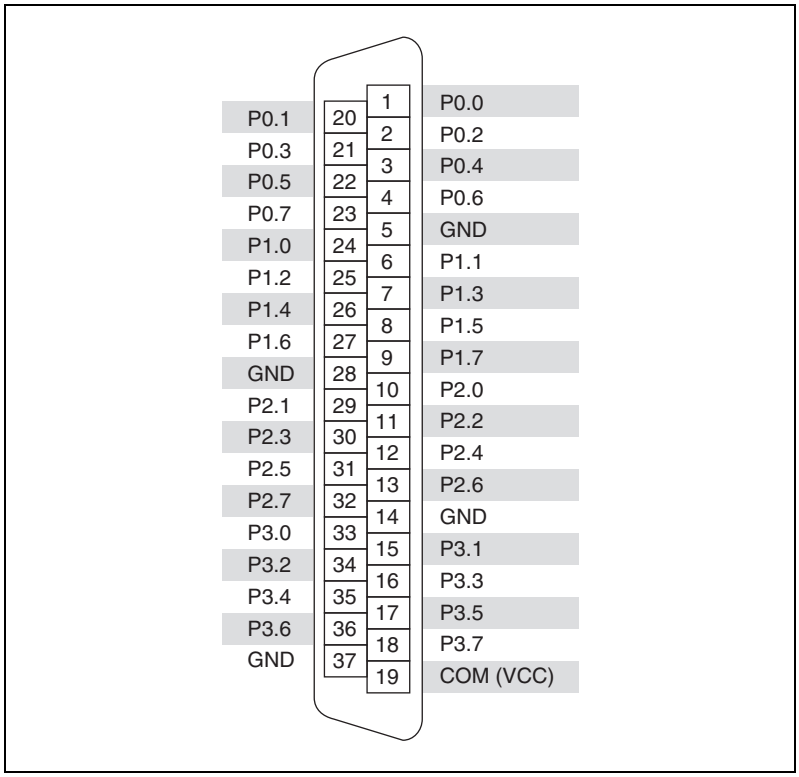


Figure 3-13. NI 6517 Pin Assignments

For more information on the NI 6517 signals, refer to the *Signal Descriptions* section.

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NI 6518 Pin Assignments

Figure 3-14 shows the pin assignments for the SH37F-37M cable when connecting to the NI 6518 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.

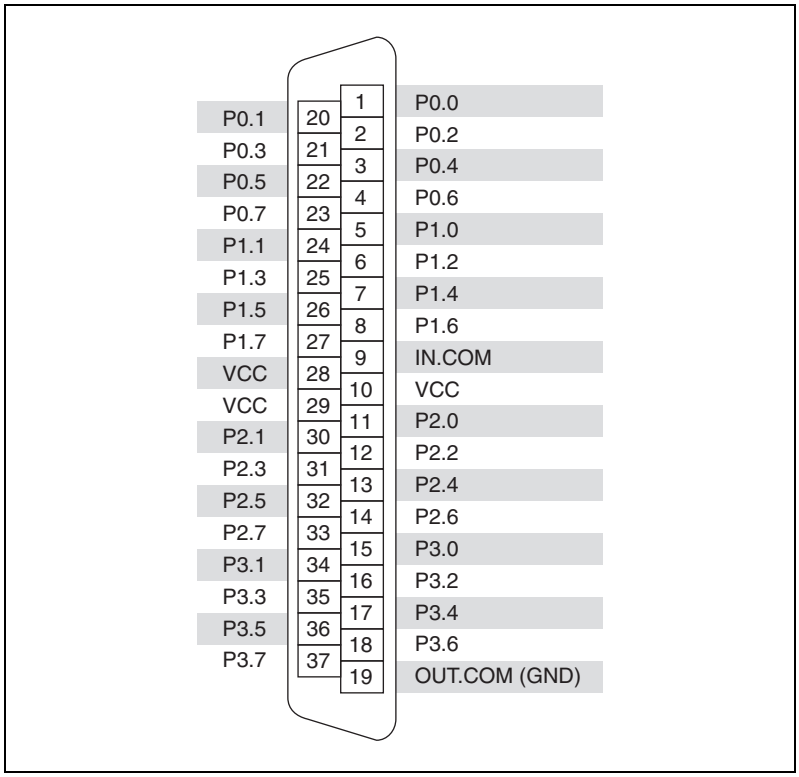


Figure 3-14. NI 6518 Pin Assignments

For more information on the NI 6518 signals, refer to the *Signal Descriptions* section.

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NI 6519 Pin Assignments

Figure 3-15 shows the pin assignments for the SH37F-37M cable when connecting to the NI 6519 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.

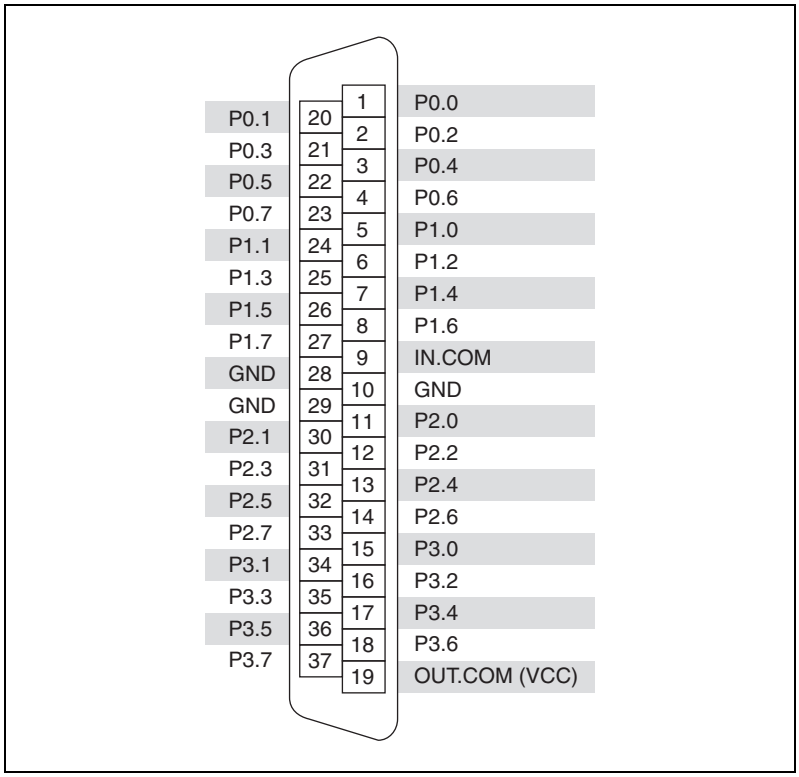


Figure 3-15. NI 6519 Pin Assignments

For more information on the NI 6519 signals, refer to the *Signal Descriptions* section.

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Signal Descriptions

NI 6510 Signal Descriptions

Table 3-1. NI 6510 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 20, 21, 22, 23	P0.<0..7>	Input	Data lines for port 0
5, 14, 19, 28, 37	COM	Input	Common lines for all ports
6, 7, 8, 9, 24, 25, 26, 27	P1.<0..7>	Input	Data lines for port 1
10, 11, 12, 29, 30, 31, 32	P2.<0..7>	Input	Data lines for port 2
15, 16, 17, 18, 33, 34, 35, 36	P3.<0..7>	Input	Data lines for port 3

NI 6511 Signal Descriptions

Table 3-2. NI 6511 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30, 31, 32, 33, 38, 39, 40, 41, 42, 43, 44, 45, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64, 65, 66, 67, 68, 69, 70, 76, 77, 78, 79, 80, 81, 82, 83, 88, 89, 90, 91, 92, 93, 94, 95	P<0..7>.<0..7>	Input	Data lines for banks 0 through 7
9, 10, 11, 12, 21, 22, 23, 24, 34, 35, 36, 37, 46, 47, 48, 49, 59, 60, 61, 62, 71, 72, 73, 74, 84, 85, 86, 87, 96, 97, 98, 99	P<0..7>.COM	Input	Common lines for banks 0 through 7
25, 50, 75, 100	NC	—	No connection

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NI 6512 Signal Descriptions

Table 3-3. NI 6512 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30, 31, 32, 33, 38, 39, 40, 41, 42, 43, 44, 45, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64, 65, 66, 67, 68, 69, 70, 76, 77, 78, 79, 80, 81, 82, 83, 88, 89, 90, 91, 92, 93, 94, 95	P<0..7>.<0..7>	Output	Data lines for banks 0 through 7
9, 21, 34, 46, 59, 71, 84, 96	P<0..7>.COM (GND)	Input	Ground for banks 0 through 7; isolated to the computer ground signal
10, 11, 12, 22, 23, 24, 35, 36, 37, 47, 48, 49, 60, 61, 62, 72, 73, 74, 85, 86, 87, 97, 98, 99	P<0..7>.VCC	Input	Power lines for banks 0 through 7
25, 75	NC	—	No connection
50, 100	P<6..7>.+5V	Output	+5 V for banks 6 and 7

NI 6513 Signal Descriptions

Table 3-4. NI 6513 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30, 31, 32, 33, 38, 39, 40, 41, 42, 43, 44, 45, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64, 65, 66, 67, 68, 69, 70, 76, 77, 78, 79, 80, 81, 82, 83, 88, 89, 90, 91, 92, 93, 94, 95	P<0..7>.<0..7>	Output	Data lines for banks 0 through 7
9, 21, 34, 46, 59, 71, 84, 96	P<0..7>.COM (VCC)	Input	Power lines for banks 0 through 7

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Table 3-4. NI 6513 Signal Descriptions (Continued)

Pin Number	Signal Name	Input or Output	Signal Description
10, 11, 12, 22, 23, 24, 35, 36, 37, 47, 48, 49, 60, 61, 62, 72, 73, 74, 85, 86, 87, 97, 98, 99	P<0..7>.GND	Input	Ground for banks 0 through 7; isolated to the computer ground signal
25, 75	NC	—	No connection
50, 100	P<6..7>.+5V	Output	+5 V for banks 6 and 7

NI 6514 Signal Descriptions

Table 3-5. NI 6514 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 5, 6, 7, 8	P0.<0..7>	Input	Data lines for bank 0
9, 10, 11, 12	P0.COM	Input	Common lines for bank 0
51, 52, 53, 54, 55, 56, 57, 58	P1.<0..7>	Input	Data lines for bank 1
59, 60, 61, 62	P1.COM	Input	Common lines for bank 1
13, 14, 15, 16, 17, 18, 19, 20	P2.<0..7>	Input	Data lines for bank 2
21, 22, 23, 24	P2.COM	Input	Common lines for bank 2
63, 64, 65, 66, 67, 68, 69, 70	P3.<0..7>	Input	Data lines for bank 3
71, 72, 73, 74	P3.COM	Input	Common lines for bank 3
25, 75	NC	—	No connection
26, 27, 28, 29, 30, 31, 32, 33	P4.<0..7>	Output	Data lines for bank 4
34	P4.COM (GND)	Input	Ground for bank 4; isolated to the computer ground signal
35, 36, 37	P4.VCC	Input	Power lines for bank 4
76, 77, 78,79, 80, 81, 82, 83	P5.<0..7>	Output	Data lines for bank 5

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Table 3-5. NI 6514 Signal Descriptions (Continued)

Pin Number	Signal Name	Input or Output	Signal Description
84	P5.COM (GND)	Input	Ground for bank 5; isolated to the computer ground signal
85, 86, 87	P5.VCC	Input	Power lines for bank 5
38, 39, 40, 41, 42, 43, 44, 45	P6.<0..7>	Output	Data lines for bank 6
46	P6.COM (GND)	Input	Ground for bank 6; isolated to the computer ground signal
47, 48, 49	P6.VCC	Input	Power lines for bank 6
50	P6.+5V	Output	+5 V for bank 6
88, 89, 90, 91, 92, 93, 94, 95	P7.<0..7>	Output	Data lines for bank 7
96	P7.COM (GND)	Input	Ground for bank 7; isolated to the computer ground signal
97, 98, 99	P7.VCC	Input	Power lines for bank 7
100	P7.+5V	Output	+5 V for bank 7

NI 6515 Signal Descriptions

Table 3-6. NI 6515 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 5, 6, 7, 8	P0.<0..7>	Input	Data lines for bank 0
9, 10, 11, 12	P0.COM	Input	Common lines for bank 0
51, 52, 53, 54, 55, 56, 57, 58	P1.<0..7>	Input	Data lines for bank 1
59, 60, 61, 62	P1.COM	Input	Common lines for bank 1
13, 14, 15, 16, 17, 18, 19, 20	P2.<0..7>	Input	Data lines for bank 2
21, 22, 23, 24	P2.COM	Input	Common lines for bank 2
63, 64, 65, 66, 67, 68, 69, 70	P3.<0..7>	Input	Data lines for bank 3

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Table 3-6. NI 6515 Signal Descriptions (Continued)

Pin Number	Signal Name	Input or Output	Signal Description
71, 72, 73, 74	P3.COM	Input	Common lines for bank 3
25, 75	NC	—	No connection
26, 27, 28, 29, 30, 31, 32, 33	P4.<0..7>	Output	Data lines for bank 4
34	P4.COM (VCC)	Input	Power line for bank 4
35, 36, 37	P4.GND	Input	Ground for bank 4; isolated to the computer ground signal
76, 77, 78,79, 80, 81, 82, 83	P5.<0..7>	Output	Data lines for bank 5
84	P5.COM (VCC)	Input	Power line for bank 5
85, 86, 87	P5.GND	Input	Ground for bank 5; isolated to the computer ground signal
38, 39, 40, 41, 42, 43, 44, 45	P6.<0..7>	Output	Data lines for bank 6
46	P6.COM (VCC)	Input	Power line for bank 6
47, 48, 49	P6.GND	Input	Ground for bank 6; isolated to the computer ground signal
50	P6.+5V	Output	+5 V for bank 6
88, 89, 90, 91, 92, 93, 94, 95	P7.<0..7>	Output	Data lines for bank 7
96	P7.COM (VCC)	Input	Power line for bank 7
97, 98, 99	P7.GND	Input	Ground for bank 7; isolated to the computer ground signal
100	P7.+5V	Output	+5 V for bank 7

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NI 6516 Signal Descriptions

Table 3-7. NI 6516 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 20, 21, 22, 23	P0.<0..7>	Output	Data lines for port 0
6, 7, 8, 9, 24, 25, 26, 27	P1.<0..7>	Output	Data lines for port 1
10, 11, 12, 13, 29, 30, 31, 32	P2.<0..7>	Output	Data lines for port 2
15, 16, 17, 18, 33, 34, 35, 36	P3.<0..7>	Output	Data lines for port 3
5, 14, 28, 37	VCC	Input	Power lines for all ports
19	COM (GND)	Input	Common line for all ports

NI 6517 Signal Descriptions

Table 3-8. NI 6517 Signal Descriptions

Pin Number	Signal Name	Input or Output	Signal Description
1, 2, 3, 4, 20, 21, 22, 23	P0.<0..7>	Output	Data lines for port 0
6, 7, 8, 9, 24, 25, 26, 27	P1.<0..7>	Output	Data lines for port 1
10, 11, 12, 13, 29, 30, 31, 32	P2.<0..7>	Output	Data lines for port 2
15, 16, 17, 18, 33, 34, 35, 36	P3.<0..7>	Output	Data lines for port 3
19	COM (VCC)	Input	Power line for all ports
5, 14, 28, 37	GND	Input	Ground for all ports

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NI 6518 Signal Descriptions

Table 3-9. NI 6518 Signal Descriptions

Pin Number	Signal Name	Input or Output*	Signal Description
1, 2, 3, 4, 20, 21, 22, 23	P0.<0..7>	Input	Data lines for port 0
5, 6, 7, 8, 24, 25, 26, 27	P1.<0..7>	Input	Data lines for port 1
11, 12, 13, 14, 30, 31, 32, 33	P2.<0..7>	Output	Data lines for port 2
15, 16, 17, 18, 34, 35, 36, 37	P3.<0..7>	Output	Data lines for port 3
9	IN.COM	Input	Common line for all input channels
10, 28, 29	VCC	Input	Power lines for all ports
19	OUT.COM (GND)	Input	Ground for all output channels
* The NI 6518 inputs are isolated from the outputs.			

NI 6519 Signal Descriptions

Table 3-10. NI 6519 Signal Descriptions

Pin Number	Signal Name	Input or Output*	Signal Description
1, 2, 3, 4, 20, 21, 22, 23	P0.<0..7>	Input	Data lines for port 0
5, 6, 7, 8, 24, 25, 26, 27	P1.<0..7>	Input	Data lines for port 1
11, 12, 13, 14, 30, 31, 32, 33	P2.<0..7>	Output	Data lines for port 2
15, 16, 17, 18, 34, 35, 36, 37	P3.<0..7>	Output	Data lines for port 3
9	IN.COM	Input	Common line for all input channels
10, 28, 29	GND	Input	Ground for all ports
19	OUT.COM (VCC)	Input	Power line for all output channels
* The NI 6519 inputs are isolated from the outputs.			

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4

Power Connections

Isolation

NI 6510

The NI 6510 has 32 channels that consist of four eight-line ports. All channels belong to one isolated bank and use the same common. The NI 6510 digital inputs are isolated from the computer power supply. Isolated photocouplers provide isolation.

NI 6511

The inputs in each bank of the NI 6511 device are isolated from the inputs in other banks, from P*X*.COM pins in other banks, and from the computer power supply. All lines in the same input bank use the same common. Isolated photocouplers provide isolation.

NI 6512/6513

The outputs in each bank of the NI 6512/6513 device are isolated from the outputs in other banks, from the +5 V and P*X*.GND pins in other banks, and from the computer power supply. All lines in the same output bank use the same common power and ground. Isolated photocouplers provide isolation.

NI 6514/6515

The inputs and outputs in each bank of the NI 6514/6515 are isolated from the inputs and outputs in other banks, from the +5 V and P*X*.GND pins in other banks, and from the computer power supply. All lines in the same input or output bank use the same common power and ground. Isolated photocouplers provide isolation.

NI 6516/6517

The NI 6516/6517 has 32 channels that consist of four eight-line ports. All channels belong to one isolated bank and use the same common. The NI 6516/6517 digital outputs are isolated from the computer power supply. Isolated photocouplers provide isolation.

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NI 6518/6519

The NI 6518/6519 has 32 channels that consist of four eight-line ports. Ports 0 and 1 (inputs) belong to the same bank, and Ports 2 and 3 (outputs) belong to the same bank, and inputs are isolated from outputs. Each bank shares the same common. The NI 6518/6519 digital inputs and outputs are isolated from the computer power supply and from one another. Isolated photocouplers provide isolation.

Optically Isolated Inputs (NI 6510/6511/6514/6515/6518/6519)

The input lines provide 32 lines of optically isolated digital input on the NI 6510/6514/6515 device, 64 lines of optically isolated digital input on the NI 6511 device, and 16 lines of optically isolated digital input on the NI 6518/6519 device. These inputs contain an AC input photocoupler and a resistor for current limiting. The maximum input voltage (V_{IN}) on these lines is 30 VDC.

Sensing DC Voltages

(NI 6510/6511/6514/6515/6518/6519 Only) These devices can sense DC signals from 11 V to DC power supply levels up to 30 V.

Applying a DC voltage of at least 11 V across the two input terminals registers a logic high for that input. If no voltage is present (a voltage of 4 V or less), the device registers a logic low for that input. DC voltages between 4 V and 11 V are invalid and register an unreliable value.

Input Signal Connection Example

(NI 6510/6511/6514/6515/6518/6519 Only) The following figures show signal connections for a supply connected to an isolated input on these devices. The power supply can be any DC voltage within the device range. Refer to the *NI 651x Specifications*, available at `ni.com/manuals`, for information about voltage ranges.

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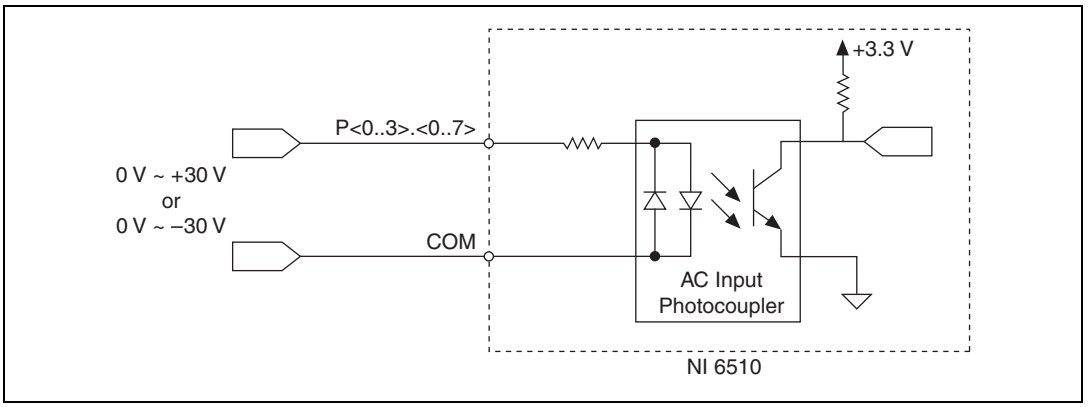


Figure 4-1. NI 6510 Signal Connection Example

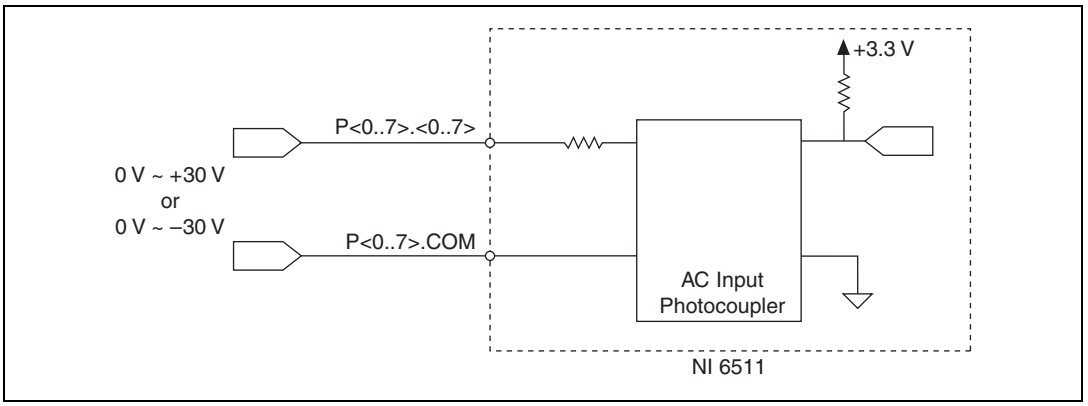


Figure 4-2. NI 6511 Input Signal Connection Example

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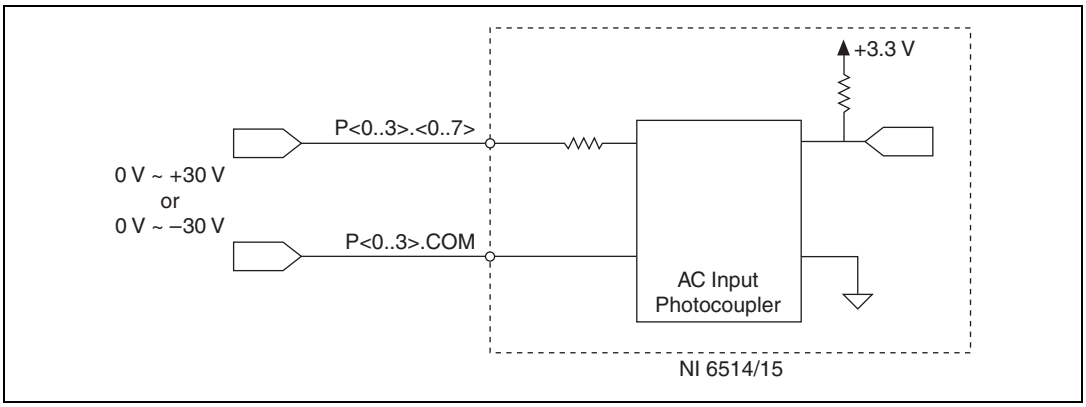


Figure 4-3. NI 6514/6515 Input Signal Connection Example

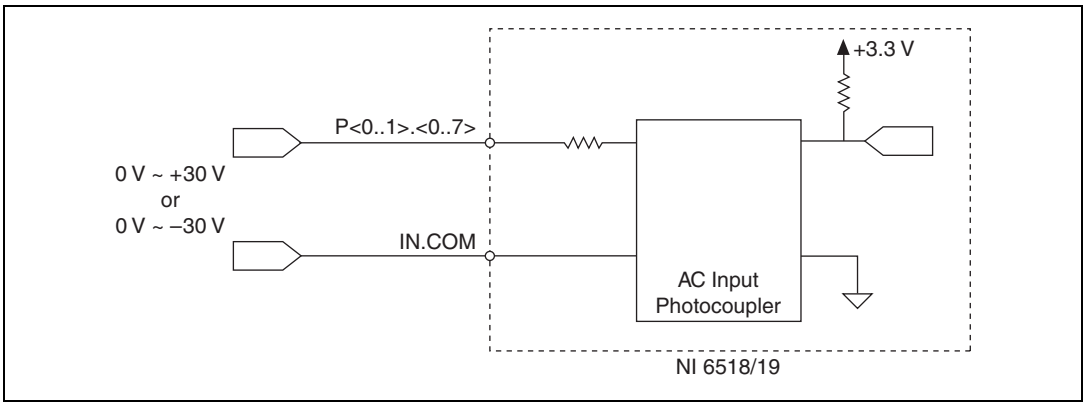


Figure 4-4. NI 6518/6519 Input Signal Connection Example

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Optically Isolated Outputs with Darlington Arrays (NI 6512/6513/6514/6515/6516/6517/6518/6519)

The outputs on the NI 6512/6513/6514/6515/6516/6517/6518/6519 device are optically isolated photocouplers with Darlington arrays. You can configure the outputs as follows:

- Writing a 1 (logic high) to an output line switches on one channel of the Darlington array and allows current to pass through the output line.
- Writing a 0 (logic low) to an output line switches off one channel of the Darlington array and prohibits current from passing through the output line.
- **(NI 6512/6513/6514/6515 Only)** To supply +5 V of isolated power, use an external power supply over +8 V on Bank 6 and Bank 7.

Note The maximum external voltage on these lines is 30 VDC.

Caution Do *not* reverse the external voltage polarity or exceed the maximum output specifications. Doing so could permanently damage the NI 6512/6513/6514/6515/6516/6517/6518/6519 device and the power supply if it is not protected.

Power-On and Power-Off Conditions

(NI 6512/6513/6514/6515/6516/6517/6518/6519 Only) At power-on and power-off, the Darlington arrays on these devices switch off.

Output Signal Connection Example (Sourcing Current)

The following figures show examples of driving a load with the photocouplers and Darlington arrays (sourcing current).

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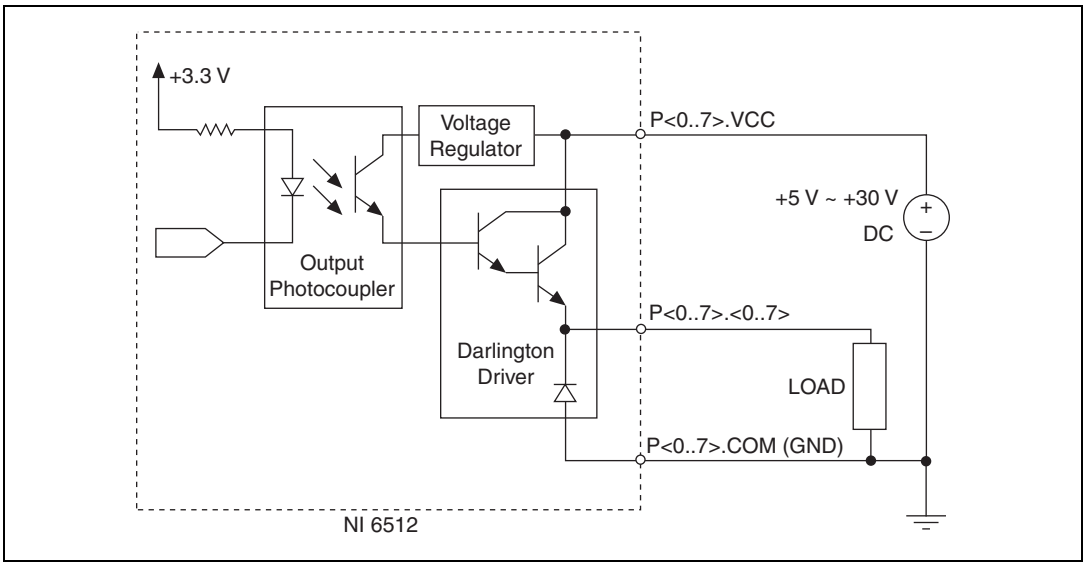


Figure 4-5. NI 6512 Output Signal Connection Example

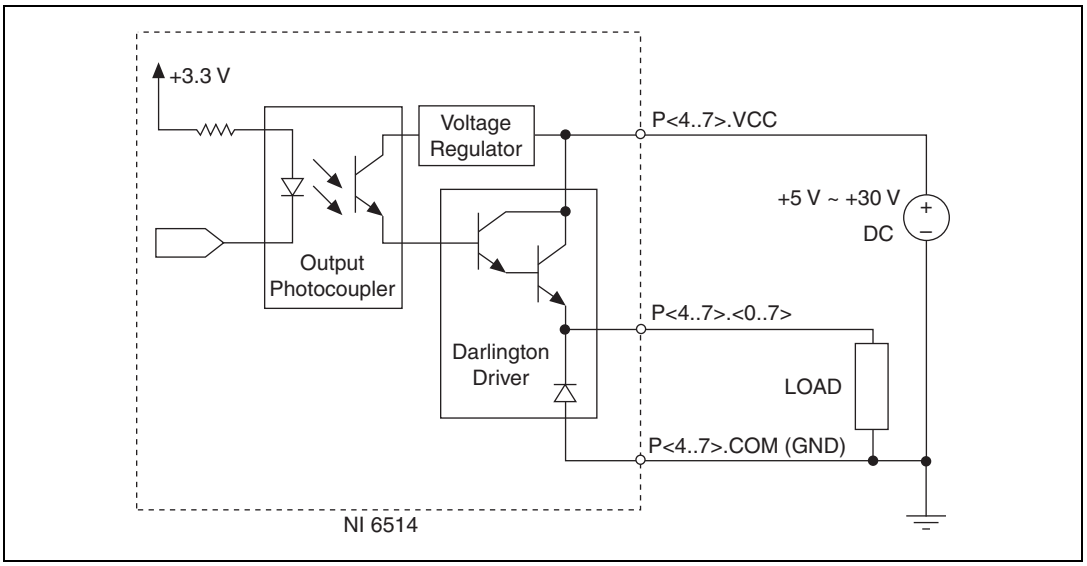


Figure 4-6. NI 6514 Output Signal Connection Example

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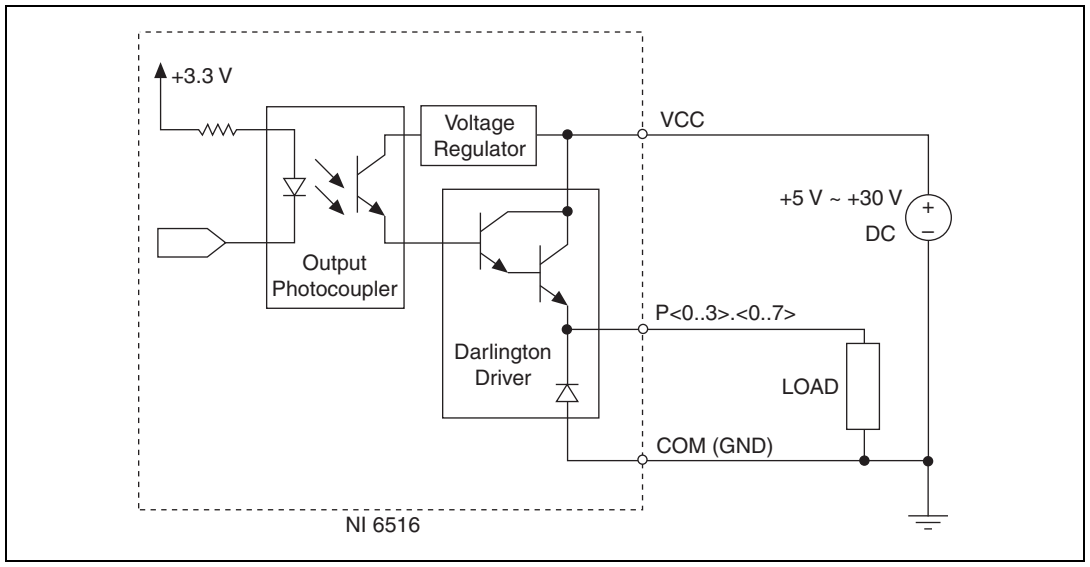


Figure 4-7. NI 6516 Output Signal Connection Example

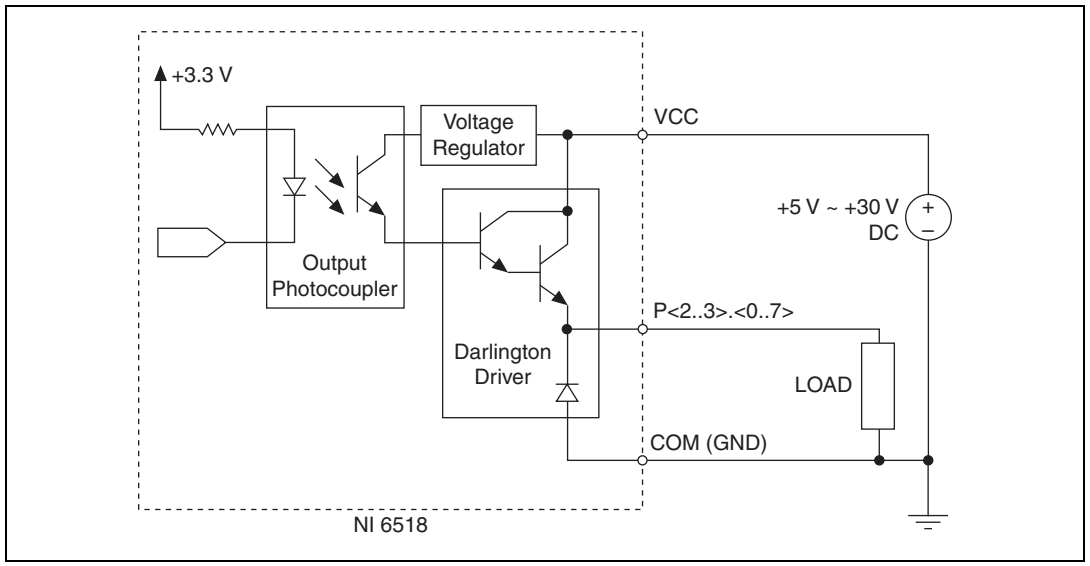


Figure 4-8. NI 6518 Output Signal Connection Example

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Distributing Current (NI 6516/6518 Only)

In applications that drive many high-current loads, a large amount of current must be returned on the VCC pins. When connecting the NI 6516/6518 to multiple loads, physically connect to all VCC pins on the device, as shown in Figure 4-9 and Figure 4-10. Connecting to all VCC pins distributes the current evenly among the VCC pins and lowers the amount of current driven on any single cable wire and on the accessory terminals.

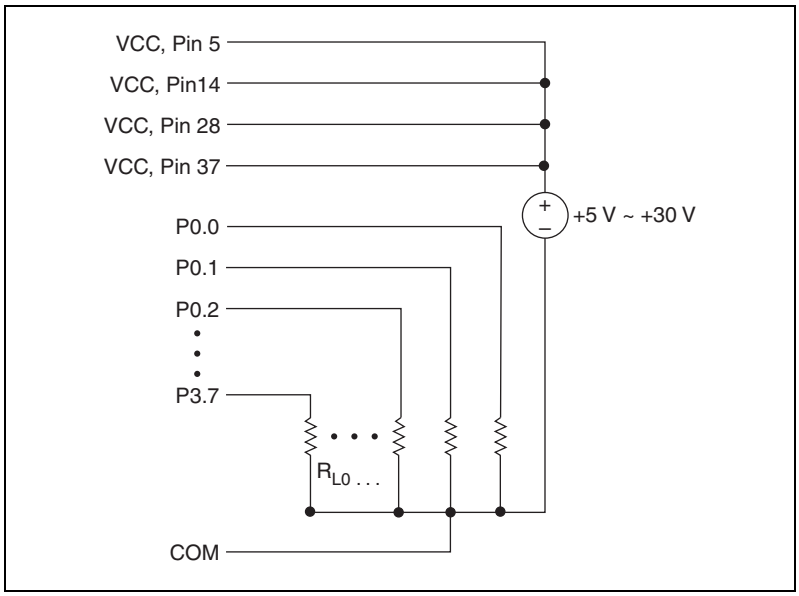


Figure 4-9. NI 6516 GND Connection Example

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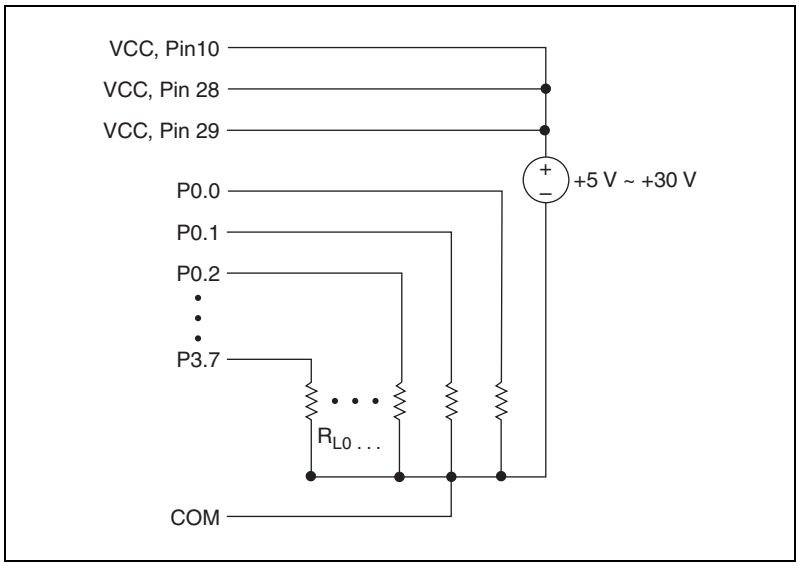


Figure 4-10. NI 6518 GND Connection Example

Refer to the *NI SH37F-37M Cable* section of Chapter 5, *Cables and Accessories*, for more information.

Output Signal Connection Example (Sinking Current)

The following figures show examples of driving a load with the photocouplers and Darlington arrays (sinking current).

Caution Make sure that **P<0..7>.COM (VCC)** is connected to the positive pole of the power supply and that **P<0..7>.GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6513 device and the power supply if it is not protected.

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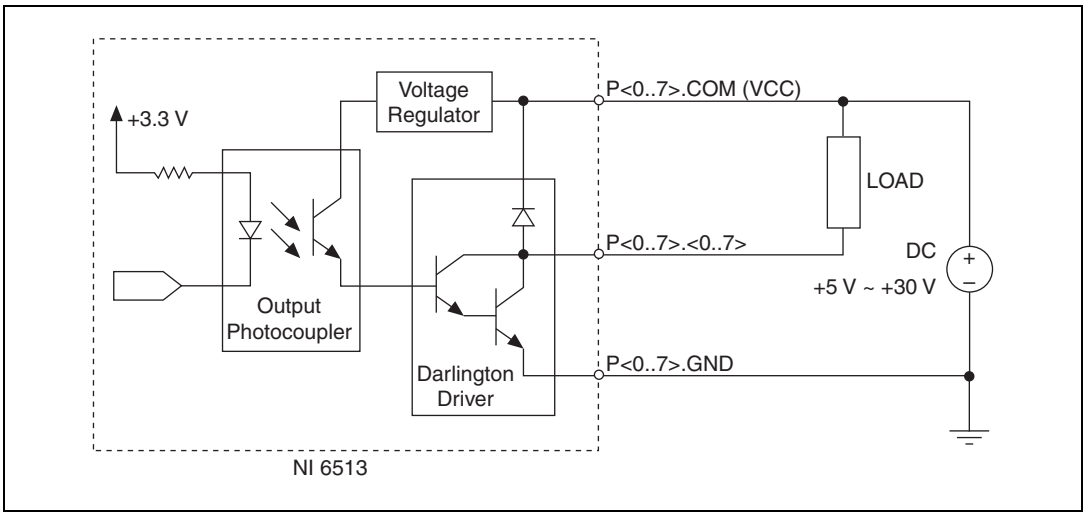


Figure 4-11. NI 6513 Output Signal Connection Example

Caution Make sure that **P<4..7>.COM (VCC)** is connected to the positive pole of the power supply and that **P<4..7>.GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6515 device and the power supply if it is not protected.

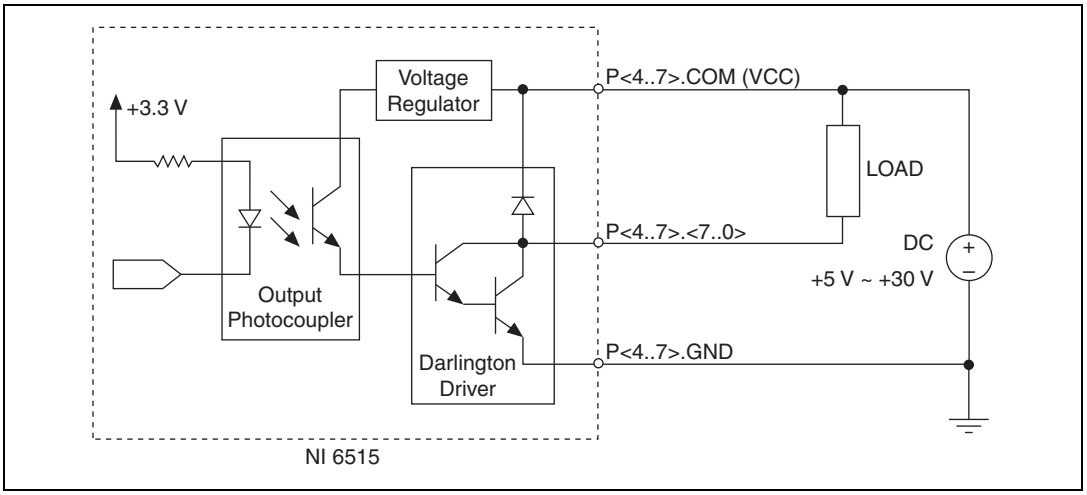


Figure 4-12. NI 6515 Output Signal Connection Example

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Caution Make sure that **COM (VCC)** is connected to the positive pole of the power supply and that **GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6517 device and the power supply if it is not protected.

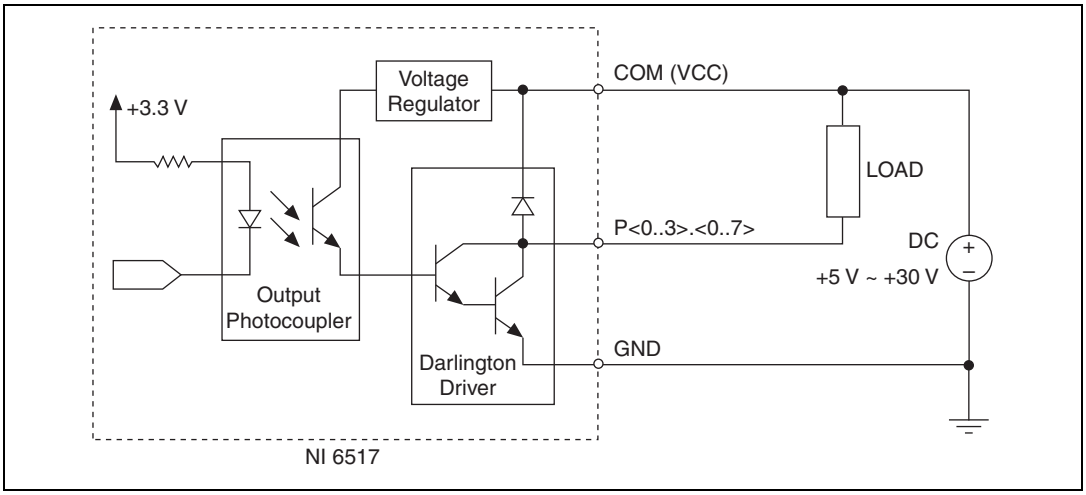


Figure 4-13. NI 6517 Output Signal Connection Example

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Caution Make sure that **OUT.COM (VCC)** is connected to the positive pole of the power supply and that **GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6519 device and the power supply if it is not protected.

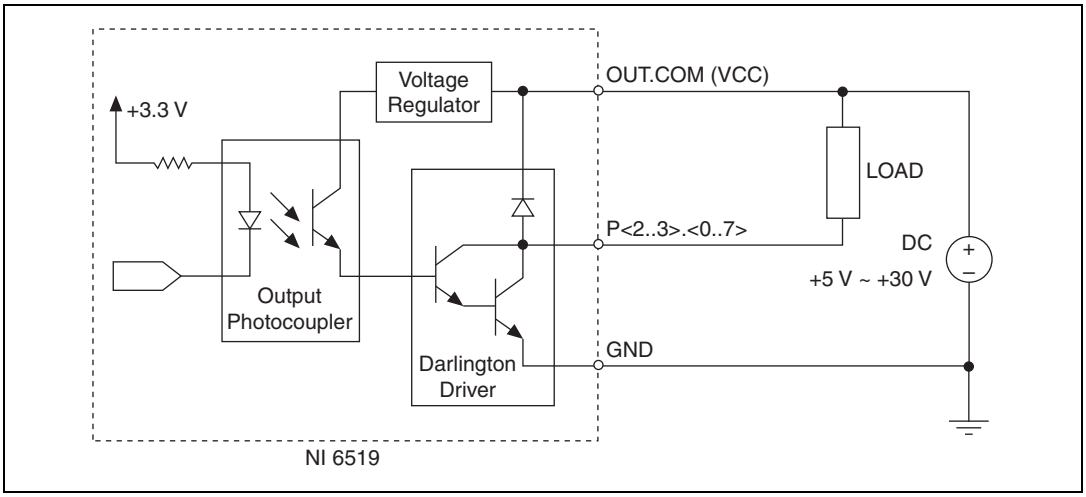


Figure 4-14. NI 6519 Output Signal Connection Example

Distributing Current (NI 6517/6519 Only)

In applications that drive many high-current loads, a large amount of current must be returned on the GND pins. When connecting the NI 6517/6519 to multiple loads, physically connect to all GND pins on the device, as shown in Figure 4-15 and Figure 4-16. Connecting to all GND pins distributes the current evenly among the GND pins and lowers the amount of current driven on any single cable wire and on the accessory terminals.

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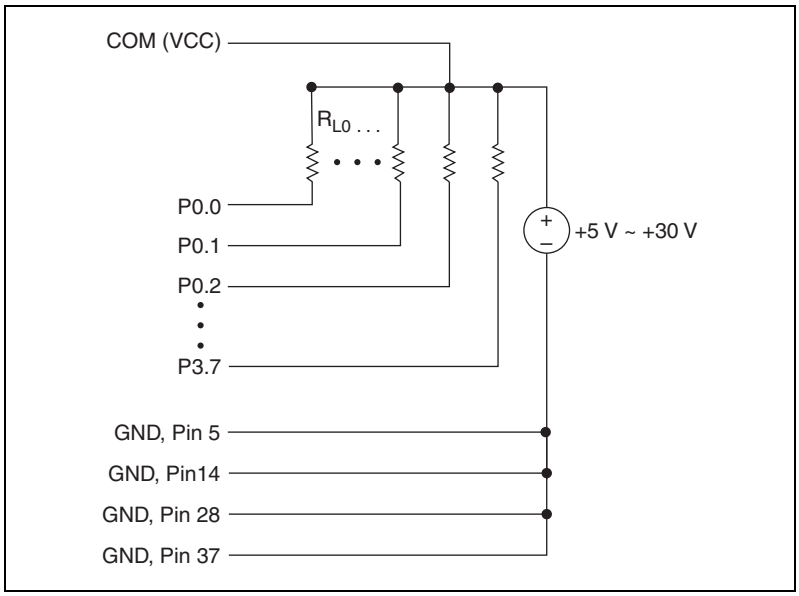


Figure 4-15. NI 6517 GND Connection Example

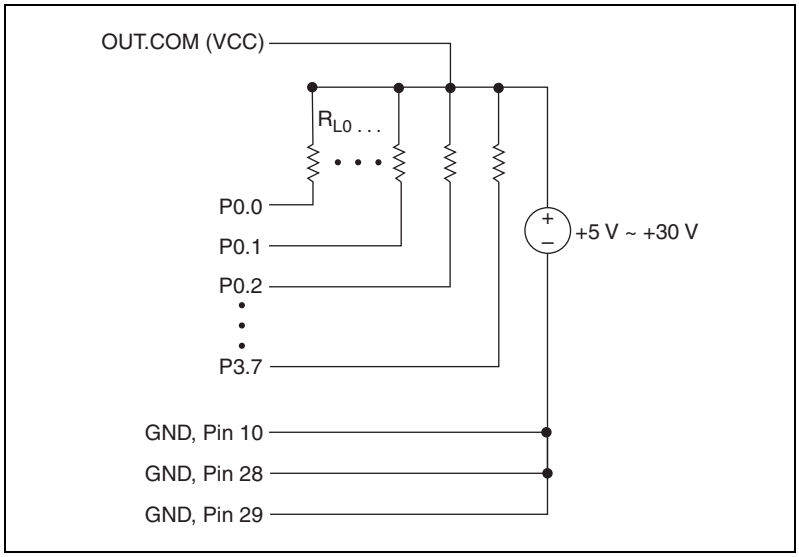


Figure 4-16. NI 6519 GND Connection Example

Refer to the *NI SH37F-37M Cable* section of Chapter 5, *Cables and Accessories*, for more information.

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5

Cables and Accessories

National Instruments offers the following products for use with NI 651*x* devices.

Accessories for 37-Pin Devices

National Instruments offers the following connectivity options for use with 37-pin safety low voltage (≤60 VDC/42.4 Vpk/30 Vrms) NI 6510/6516/6517/6518/6519 devices.

Choose from the following screw terminal connectivity options:

- CB-37F Connector Block—part number 778672-01 (vertical) and 778673-01 (horizontal)
- CB-37F-LP Unshielded, I/O Connector Block with 37-Pin D-SUB—part number 779353-01

  With one of the following cabling options:

  – SH37F-37M Shielded Cable—part number 778621-01 (1 m) and 778621-02 (2 m)

  – SH37F-P-4 37-Pin Female-to-Pigtails Shielded I/O Cable—part number 778620-04 (4 m)

  – R37F-37M-1 37-Pin Female-to-Male Ribbon I/O Cable—part number 779195-01 (1 m)

You may also choose from the following custom connectivity options:

- SH37F-P-4 37-Pin Female-to-Pigtails Shielded I/O Cable—part number 778620-04 (4 m)
- TB-37F-37CP 37-Pin Crimp & Poke Terminals, Shell with Strain Relief—part number 779185-01
- TB-37F-37SC 37-Pin Solder Cup Terminals, Shell with Strain Relief—part number 779184-01

For more information about optional equipment available from National Instruments, refer to the National Instruments catalog or visit the National Instruments Web site at `ni.com`.

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NI SH37F-37M Cable

The NI SH37F-37M cable is a 37-pin shielded cable that provides direct connection to 37-pin 651*x* devices. This cable uses 26 AWG wire that has a maximum current rating of 1.2 A per line. Some devices that can be physically connected to this cable have current ratings that exceed this limitation. The NI SH37F-37M cable is not intended for use with hazardous voltages (greater than 60 VDC, 42.4 V peak, or 30 Vrms).

Ensure that the DIO device does not exceed the maximum current rating by evenly distributing the current among the VCC pins on the NI 6516 and NI 6518 devices, or among the GND pins on the NI 6517 and NI 6519 devices. For more information, refer to the *Distributing Current (NI 6516/6518 Only)* section and *Distributing Current (NI 6517/6519 Only)* section of Chapter 4, *Power Connections*.

For quick connection to the I/O connector, use the National Instruments CB-37F terminal block with the NI SH37F-37M cable.

Accessories for 100-Pin Devices

National Instruments offers the following products for use with NI 6511/6512/6513/6514/6515 devices.

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

For more information about optional equipment available from National Instruments, refer to the National Instruments catalog or visit the National Instruments Web site at `ni.com`.

SH100-100-F Cable

The SH100-100-F cable is a 100-pin shielded cable that provides direct connection to 100-pin devices. For quick connection to the I/O connector, use the National Instruments SCB-100 terminal block with the SH100-100-F cable.

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R1005050 Ribbon Cable

The 100-pin R1005050 ribbon cable splits into two 50-pin cables for direct connection to one or two 50-pin accessories. The 100-pin connector that joins the two cables plugs into the I/O connector on the DIO device.

For quick connection to the I/O connector, use the CB-50 or CB-50LP terminal blocks with the R1005050 cable.

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  - **Self-Help Technical Resources**—For answers and solutions, visit `ni.com/support` for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on. Registered users also receive access to the NI Discussion Forums at `ni.com/forums`. NI Applications Engineers make sure every question submitted online receives an answer.
  - **Standard Service Program Membership**—This program entitles members to direct access to NI Applications Engineers via phone and email for one-to-one technical support as well as exclusive access to on demand training modules via the Services Resource Center. NI offers complementary membership for a full year after purchase, after which you may renew to continue your benefits.

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- **Training and Certification**—Visit `ni.com/training` for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit `ni.com/alliance`.

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- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

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Glossary

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

A

A	amperes
ASIC	Application Specific Integrated Circuit

C

C	Celsius

D

DI	digital input
DMA	direct memory access—A method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.
DO	digital output

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F

Form A relay	a single-pole single-throw (SPST) relay with a default state of normally open
Form C relay	a single-pole double-throw (SPDT) relay that breaks the connection with one throw before making contact with the other (break-before-make)

G

GND	ground signal

H

hex	hexadecimal

I

inductive load	A reactive load in which the inductive reactance exceeds the capacitive reactance and therefore carries a lagging current with respect to the voltage across the terminals.

L

latching	the ability to keep a relay contact in its current state if power is removed
logic	A sequence of functions made up of circuits designed to perform an operation.
LSB	least significant bit

M

MSB	most significant bit

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N

non-latching relay	A type of electromechanical relay that has an initial position of normally closed (NC). This position is maintained by the force of a spring or permanent magnet while no current flows. The normally open (NO) contact is maintained by the force of a magnetic field while current flows through the coil. When the current stops, the relay reverts back to its initial NC position.

P

PCI	Peripheral Component Interconnect—A high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and workstations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.
port	A digital port, consisting of four or eight lines of digital input and/or output.

S

S	samples
s	seconds
SCSI	Small Computer System Interface. Interface for communication between devices.
signal conditioning	The manipulation of signals to prepare them for digitizing.

T

TTL	transistor-transistor logic

V

VCC	Supply voltage; for example, the voltage a computer supplies to its plug-in devices.
VDC	volts direct current

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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.
VI	input voltage

W

W	watts

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